METROPOLITAN MUNICIPALITY OF ISTANBUL
PLANNING AND CONSTRUCTION DIRECTORIAT
GEOTECHNICAL AND EARTHQUAKE INVESTIGATION DEPARTMENT

EARTHQUAKE MASTER PLAN FOR ISTANBUL

BOĞAZİÇİ UNIVERSITY
ISTANBUL TECHNICAL UNIVERSITY
MIDDLE EAST TECHNICAL UNIVERSITY
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TABLE OF CONTENTS

EXECUTIVE SUMMARY: WORK PACKAGES

The Earthquake Master Plan for Istanbul has been motivated by a request by the Metropolitan Municipality (IMM) to a consortium involving four leading Turkish universities. The specialist staff have been confronted not only with the issues that will need to be resolved when Istanbul, the most populous metropolis in the country that doubles also as the leading financial and industrial conurbation, is struck by a large-magnitude earthquake that appears to be very likely but also with legal, administrative and organizational countermeasures that must be put into effect before the actual event occurs. This commitment was fulfilled under two teams consisting of METU+ITU and BU+YTU.

The main guiding principle has been the self-evident fact that while no natural disaster can be prevented from happening, the incorporation of well-formulated planning and technical counter-measures will mitigate damages and losses significantly. This has been continually emphasized during the bi-monthly progress meetings that were organized during the course of the work. It is not possible or feasible to eliminate all losses. There will always exist a residual component for damages and physical losses. What this implies for the Metropolitan Municipality is that an emergency plan must be drawn up. The corresponding parts of the Final Report contain the building stones for this plan as they have been defined by the METU+ITU group. The way in which issues have been identified and solutions offered in this part of the Final Report are likely to be different from their counter-parts in the report submitted by the other team. This is not unnatural because a comprehensive master plan is related in a complex way to legal, administrative, financial and social maters. Solutions in such contexts are not necessarily unique as in technical matters, and can reflect a multitude of syntheses leading to some different set of recommendations. This should not be interpreted as a development leading to complications, but as a conclusion offering a range of strategies for adoption. The realization of the Master Plan can not be accomplished only within the province of the local government machinery, but requires support and close cooperation of the parliament and the executive branch of government. When matters move to such planes, it must be admitted that a different set of dynamics may enter the process shaping the final product, so a range of options for the alternative approaches will then serve as an advantage

The emergencies engendered by earthquakes always occur suddenly without prior notice. This report assumes as its basis the supposed occurrence of Scenario A Earthquake as it has been described in a preceding study conducted for IMM under JICA auspices. When earthquakes are involved it is not possible to forecast precisely the range of natural consequences that will then be realized. A scenario earthquake should be viewed only as a planning tool. If the earthquake should one day actually occur, and an account is taken at some later day of its effects it will be found that often an order of magnitude difference will exist between predictions and reality. This must be accepted as inevitable.

Emergency planning for natural disasters is a relatively recent development. The descriptive title given to these documents may be designated as Disaster Plan, Emergency Action Plan, Emergency Response Plan, Emergency Preparedness Plan, Emergency Recovery Plan or Emergency Contingency Plan. Each of these reflects the particular needs and traditions of the corresponding agencies that have defined them. This report also refers to these equivalent designations. Regardless of its title most emergency plans (and this Master Plan) contain the following principal components.

- Ensuring that vital urban functions are carried on without interruption by the existing organization following the emergence of the phenomenon for which the plan has been prepared,
- It is a basic given that planning activities and services are the most effective way of curbing losses at metropolitan scale. Therefore the basic administrative structure for performing these tasks must be established. Powers of the local government may not overcome all of the obstacles so ways of effective cooperation with the central government must be probed.
- Empowering designated agencies and persons to perform their duties at designated places and times,
- A hierarchical organization must be designed so that powers and responsibilities are fulfilled completely and without administrative overlapping.
- It is of primary importance that the safety of life and property should be preserved during the earthquake emergency
- Rules and guidelines must be established on how the Metropolitan Municipality and cooperating agencies will utilize physical resources such as manpower, equipment, facilities, supplies during the initial response and recovery phases.
- The Master Plan requires legal revisions and additional financial resources before it can be realized. A critical assessment of the administrative and technical resources at disposal of the local government must be made, and appropriate changes in these formulated.
- A wide-scope and ambitious plan must have popular support and involvement. A public training and awareness program must be initiated, and the citizens must be informed about the hardships that must be endured so that the plan becomes a reality.

For reasons listed above the Master Plan must be a transparent document readily accessible for the public. It should be crafted in a flexible way that will prove to be convenient to revise it as requirements arise later. The report we have prepared is of this nature.

As in much of the rest of the country, many citizens of Istanbul live in multi-unit apartment buildings that are managed in accordance with the articles of Law No. 634. The ownership is thus diffused even in buildings with a single structural system. The report emphasizes that the load-carrying framework for many of these buildings falls below the capacities that will be required if the scenario earthquake should occur.

The legislation that deals with urban settlements regulates construction activities, and disaster legislation in Turkey is oriented toward post-disaster situations. The huge potential risk represented by the sub-standard building stock can not be eliminated with the legal tools currently in existence. Assuming that it would be possible to rank buildings on the basis of how deficient they are in terms of their earthquake capacity (not an easy task to accomplish) it still requires a complex package containing technical, administrative, legal and financial issues that must be resolved before these buildings are no longer a life-threat for their occupants. We have described a system for transfer of development rights in urban conversion zones along with financial and human resources that would minimize the complaints of the impacted citizenry. Our report deals with this particular aspect in detail, proposing a number of alternative solutions. Successful accomplishment of these steps will depend on the close cooperation of the legislative and executive branches of government. But more importantly, there must be a popular conviction that whatever hardship are engendered, these burdens are equitably borne by all stake-holders, and that it is all eventually for the common good. The system contained in the Final Report effectively creates an Istanbul Model that contains a risk management system for urban planning. Achievement of the objectives dictates that a number of well-defined project packages should be executed as follow-up work. The terms of reference for the project packages have also been appended for action. In this sense, the Final Report is an Action Plan as well.

The Istanbul Earthquake Master Plan is comprised of three fundamental actions in its approach. The first is a Contingency Plan that must be prepared for the entire urban area that ensures coordination among different sectors. The Contingency Plan is the principal document that outlines the instruments for managing risks (avoidance, mitigation, or sharing) that all systems and sectors in the jurisdictional area of the city face from earthquakes (and other hazards). The tasks in this coverage are risk analysis studies, contingency standards and appropriate risk management methods. Commitment of the affected sectors is obtained before supervision of implementation is guaranteed by responsible parties.

The second item is a local action plan that contains sub-project activities or implementation packages in high-risk areas so that comprehensive urban transformation actions can be initiated.

The third component is a bundle of Research and Activity Programs that will facilitate sustaining or completing of the first two sets of actions

The third component is a bundle of Research and Activity Programs that will facilitate sustaining or completing of the first two sets of actions. Its parts are:

- The popular and political support for the Master Plan will be facilitated through close cooperation with NGOs, the media, and the economic sector. Relations with each of these parties must be enhanced so that local government and central administration support can be received.
- Each project work package contains a particular risk management item that must be implemented. For purposes of ensuring implementation each project package must have a clearly identified stake holder party, or a legally responsible partner. In turn this calls for suitable administrative restructuring and procedures.
- The process of ensuring resource creation and domestic or international financial support for the Contingency Plan and the Action Plan must be initiated without delay.
- A separate but parallel road map must be elaborated immediately because new legal instruments should be formulated to overcome legislative or procedural obstacles, enforcement incapacity, lack of standards or penalties if the Master Plan is to be realized.
- A wide range of technical research activities should be undertaken to support the project packages for the Contingency Plan and the Action Plan. These will gather information, create new data bases or operate existing ones.

As the summary above describes the Istanbul Earthquake Master Plan is truly the name of an ambitious risk management plan with few global precedents. It is of relevance to all sectors of the social structure in the city. The realization of a plan is often far more challenging that preparing it. The two research teams that collaborated in preparing the Final Report hope that the issues they have recognized and identified in it, and the solution they submit will prove to be beneficial for the citizens and government of Istanbul.

1 INTRODUCTION

The scope of Earthquake Master Plan for Istanbul comprised of works to be done in the following areas;

a) Assessment of current situation
b) Seismic assessment and rehabilitation of existing buildings
c) Urban planning issues
d) Legal issues
e) Financial issues
f) Educational issues
g) Social issues
h) Risk and disaster management issues

and, aimed at planning of the activities in these fields, preparation of implementation programs, and identification of the responsibilities and responsible authorities for earthquake disaster mitigation works to be carried out in Istanbul.

Taking into account the high seismic risk of Istanbul and findings of the preceding study for Istanbul Metropolitan Municipality (IMM) under Japanese International Cooperation Agency (JICA) auspices, preparation of a master plan for Istanbul which will include the assessment of existing building stock, infrastructure, urban and public facilities in the light of available geological and geotechnical data, the determination of short, medium and long term measures and strategies for earthquake preparedness of Istanbul, the identification of legal, technical, financial and social responsibilities, including implementation plans at selected pilot project areas was requested by IMM.

An important aspect to be covered by the Master Plan is decided to be the assessment of seismic vulnerability of existing building stock in Istanbul, the development of seismic retrofitting methods and the determination of technical, social, administrative, legal and financial measures to be taken in order to be able to implement such methods. In the Master Plan the works to be done in these fields are examined and the recommendations about the measures to be taken are given.

Earthquake disaster mitigation efforts for Istanbul should be multi-disciplinary and have a broad vision. These efforts will be pioneering examples of Urban Development Projects and Local Transformation Programs, or total “Action Planning” for Turkey. The four universities which took part in the project have set up several working groups consisting of expert faculty members, and approached the project with such a perspective and studied in detail the works to be done for earthquake preparedness of Istanbul.

The apparently unavoidable possibility of the occurrence of a major earthquake that will affect Istanbul, necessitates the determination of existing conditions with respect to pre and after earthquake disaster preparation and management methods to be employed. The expected effects of an earthquake on physical and social environments have to be assessed quantitatively. The works done in this aspect are complied in the “Current Situation” chapter. The available seismic data and risk assessment reports comprised the basis for the seismic risk assessment for Istanbul. Both deterministic and probabilistic approaches are employed in seismic risk assessment studies. The available information about buildings, urban infrastructure (transportation, natural gas, water, electricity, and telecommunication networks) and industrial facilities are evaluated with respect to seismic performance and social losses.

The main goal in assessment of seismic safety of building type structures in Istanbul is to predict the probability of earthquake damage on an individual building basis and especially to determine the probability of building damage that will cause human casualties and the areal distribution of such buildings.

The seismic assessment of buildings is proposed to be done in three stages. The first stage inspection/evaluation works are also referred as “street survey” and correspond to preliminary assessment. The goal of these works is to make a preliminary grading of all buildings in Istanbul with respect to their seismic performance, and therefore to collect limited data on buildings by visual inspection from outside which can be processed in a rational manner for seismic assessment. This will enable to set priorities for second stage assessment at both individual building basis and regional basis.

In the second stage assessment, starting with the high priority buildings and regions, more detailed investigation/evaluation works will be executed for seismic assessment of buildings. The goal of these works will be to make reliable performance evaluations which will enable to reach final decisions on as many as possible number of buildings and leave as few as possible number of buildings for third stage detailed assessment.

The third stage investigation/evaluation works will comprise especially high rise residential and office buildings and public buildings, and will be carried out by registered expert engineering firms in accordance with specified methods and performance criteria and will include detailed engineering analysis.

For the first and second stage assessment more than one method of investigation/evaluation based on alternative approaches are recommended. The validity and suitability for use of these methods are proposed to be checked at a pilot study area, and compare the results with each other and those of more sophisticated methods known to yield more reliable results.

Several methods are proposed for seismic strengthening of buildings. These methods are compiled under “simplified strengthening” and “comprehensive strengthening” headings. The simplified strengthening methods are proposed to be applied on a larger number of buildings.

Three faculty members from the Master Plan project team have been invited by the Ministry of Construction and Settlements to participate in the works to add the principles and provisions related to seismic strengthening of buildings to the Turkish Earthquake Code.

The comprehensive approach to earthquake mitigation in Istanbul would be preparation of a CONTINGENCY PLAN based on the definition and elimination of risk sectors in all fields related the city and social life, and implementation of ACTION PLANS at regions of high priority which are indicated as high risk areas in the contingency plan.

There are several risks generated from the natural conditions as well as building and land use practices. These risks are needed to be defined within a limited number of sectors. Their interaction and damage potentials are to be analyzed, and methods and measures are to be developed to reduce their risk levels. For each sector, RISK MANAGEMENT techniques and methods should be developed and the operational duties of responsible agencies should be clearly defined. For each risk sector, certain legal and administrative arrangements, and implementation methods for reduction or elimination of risks are to be developed.

A narrow and single disciplinary approach to the problem, with conventional urban planning concepts and tools will be insufficient and invalid. Conceiving that measures within ordinary administrative and legal structure will be sufficient would be underestimating the dimensions of the situation.

Within the scope of urban planning studies a Strategic Plan for Disaster Mitigation in Istanbul (SPDMI) has been developed. This plan's secondary goal will be the improvement of natural and urban environmental quality, and this also supports the main goal of diminishing the destructive effects of a possible major earthquake. For this purpose SPDMI is prepared in such a way that it will serve as a road map for IMM in taking measures against the earthquake problem.

SPDMI focuses on the following points

- Conceptualization of strategic planning
- The problems and potentials of Istanbul Metropolitan Area
- A road map including strategies, planning instruments, and priorities at various levels
- Institutional and legal considerations

The problems in Istanbul concerning the earthquake risk range from the poor quality or depreciation of buildings from an engineering point of view to the poor urban environment generated by social, economic and physical deterioration as well as uncontrolled urban growth and an inflexible planning system which remains incompatible with the dynamics of the city. In this context, alternative implementations vary respectively on a palette of solutions including reinforcement, reconstruction of individual buildings, preservation of historical urban fabric, regeneration of urban areas, creating new settlements or alternative urban centers within a regional perspective, etc. The approach to the disaster (earthquake) problem must be holistic in nature, i.e. comprising economic, political, social and cultural visions, and strategic in application, i.e. flexible and relying on the effective participation of various actors. To this end, it is attempted to aforementioned tools within a broad planning framework.

Earthquake risk mitigation works are closely linked with the legal structure at every stage. All efforts towards the risk mitigation will be implemental only as far as they are described in the legal framework. With this respect, first the problem areas in the Turkish legal system are identified. Especially the laws concerning planning and building rules are examined taking into account the new law proposal, and recommendation are produced for additional clauses for risk mitigation. The study of legal issues have focused on problems encountered in Istanbul, identification of the problems, the solution of such problems and the recommendations about changes in the existing laws and new laws needed to implement the proposed solutions. In addition to discrepancies and problems in legal structure, a fundamental problem is recognized to be the deficiency in enforcement of the laws, and recommendations are developed to enhance enforcement including effective inspection and participation concepts.

An important aspect of the Master Plan was the determination national and international financial resources needed for all pre-and post-earthquake work on mitigation and risk management, and also to design a financial model for a properly coordinated allocation of resources. Given the fact that the currently available resources for this purpose are very limited, the first step need to be the identification of the areas of need and estimation of the total demand for financing. The following summary of list of work seems to require financing;

Pre-Earthquake:

1. Studies on earthquake vulnerability and security
2. Technical investigation and strengthening (or re-location) of public structures (hospitals, schools, key government buildings, infrastructure, bridges, dams, etc.)
3. Technical investigation and strengthening (or re-location) of private buildings (residential, commercial and industrial buildings)

4. Other related works mentioned in the Master Plan.

Post Earthquake:

1. 1-Provision of shelter, food, medical and social services to people
2. 2-Technical investigation, repair and reconstruction of public and private buildings and structures.

First of all it should be recognized that the more successful the pre-earthquake plans and their implementations are, the lower will be the financial burden after the earthquake. Moreover, the allocation of funds before an earthquake occurs is certainly needed for humane reasons, and also technically easier. This fact is fully considered in the development of the financial model. The basic principles of the financial model is made to be compatible with the current social and economic facts of the the city of Istanbul and also of the country.

The organizational structure expected to carry out the pre- and post-disaster management activities has been critically evaluated and suggestions for improvement are investigated. For this purpose, the current legal structure and organizations are evaluated, distribution of authority among the central and local government bodies is analyzed, responsibility and coordination mechanisms are identified, and the problems and insufficiencies in the system have been determined. In addition, disaster management models that are operational in other countries are analyzed and parts of these models that can be adopted to the Turkish system have been integrated into the proposed model. Furthermore, the model included the findings of in-depth interviews with administrators and individuals involved in disaster–related organizations and a field survey that were conducted with citizens in two neighborhood areas.

Earthquake information infrastructure studies have been carried out under five main headings: 1) Standards ,2)data layers; 3) Software, hardware and network infrastructure, 4)data collection and updating, and 5) reliability of data and computer systems.

Developing and adhering to standards is of utmost importance in the design of information systems. Large systems such as urban information system or a disaster information system necessitate the coordination and information sharing of many institutions. In many cases, a distributed information system formed by different databases may be appropriate. In order for this work without problems, it is essential that standards be used, developed and adhered to.

The data layers that should be present in a disaster information system are discussed under the heading “functional classification”.

“Software, hardware and network infrastructure” alternatives on geographical information systems, database systems, server hardware, and network infrastructure of a disaster management system are presented and some recommendations are made.

Procedural and technological suggestions on the management of the data over time and updating of data are presented in the section of “data collection and updating”.

The reliability of data and computer systems are discussed, information about reliable hardware and software, and backup procedures are presented.

For earthquake disaster mitigation and preparedness public education and awareness campaigns and community organizations are very important. In Turkey, education of public disaster preparedness and disaster mitigation has been under the responsibility of the central government (department of civil defense, department of education). Local governments and non-governmental organizations are not given to play a sufficient role in these issues.

Education about earthquake risk is offered in primary and high schools, but there is no systematic education program for general public.

Development of standards for public education and community organizations, reaching the public at large, active participation of public, training the trainers and production of training materials are the important issues.

Within the scope of educational and social studies for earthquake disaster mitigation, the works to be done to increase public awareness and preparedness to improve response and rehabilitation abilities, and thus increase the capacity of local communities to overcome effects of disasters are evaluated and suggestions are made.

Risk and Disaster Management model proposed in the Master Paln does not only consider the post-earthquake response actions to mitigate the negative effects of the disaster, but it also considers the planning phase to manage the activities effectively. The proposed model is prepared to cover four stages of disaster management (risk mitigation preparation and planning, response and recovery)

Response dominated emergency management model is focused on four main actions:

- Coordination
- Incident Command System
- Resource Management
- Training

The emergency management model incorporating the above components and the training requirements are presented.

2 CURRENT SITUATION

2.1 Current Situation

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Following the losses suffered during the two major earthquakes that struck Turkey in 1999, there has been a broad recognition among governmental, non-governmental and academic organizations of the need for extensive response planning based on detailed risk analyses of likely seismic hazards in Istanbul.

In recent decades rapid and uncontrolled urbanization, faulty land-use planning and construction, inadequate infrastructure and services, and environmental degradation caused the increase of earthquake disaster risks in Istanbul. The other important source of the increased risk in Istanbul is the unprecedented increase of the probability of occurrence of a large earthquake (which stands at about 65% during the coming 30 years). The inevitability of the occurrence of such a large earthquake in Istanbul makes it imperative that certain preparedness and emergency procedures be contrived in the event of and prior to an earthquake disaster. The seismic risk will be best portrayed by the quantification of the earthquake effects on the physical and social environment.

Basic data needed for the quantification of the earthquake risk in Istanbul are generally gathered by the following institutions

- Istanbul Governorate
- Istanbul Metropolitan Municipality
- Local Municipalities of Istanbul
- State Statistical Institute
- Mineral Research and Exploration Institute
- State Planning Organization
- Ministry of Public Works and Settlement – General Directorate of Disaster Affairs, General Directorate of Highways-Directorate of 17th Division
- Ministry of Energy and Natural Resources – General Directorate of State Water Works, General Directorate of Electricity Transmission
- Ministry of Transportation - General Directorate of Turkish Telecommunication
- Ministry of Industry and Commerce
- Boğaziçi University – Kandilli Observatory and Earthquake Research Institute
- TUBITAK – Marmara Research Center
- Turkish Navy – Department of Navigation, Hydrography and Oceanography

The building count conducted by the State Statistical Institute in year 2000 is the most comprehensive study about the building stock in Istanbul. Within the context of the JICA – IMM project some pilot studies have been conducted for verification purposes. Digital imagery has been obtained from helicopter flights on predefined routes over Istanbul realized with the cooperation of Boğaziçi University and Istanbul Metropolitan Municipality. This video imagery has been partially geocoded and used for the verification of the building distribution data. Data obtained from the institutions cited above and from private companies, specific studies and satellite imagery have been combined and rigorously used in the following projects and studies:

- The Study on a Disaster Prevention / Mitigation Basic Plan in Istanbul including Seismic Microzonation in the Republic of Turkey – Japan International Cooperation Agency and Istanbul Metropolitan Municipality (JICA – IMM)
- Earthquake Risk Assessment for Istanbul Metropolitan Area – Boğaziçi University (supported by the American Red Cross) (BU – ARC)
- Earthquake Risk Assessment for Industrial Facilities in Istanbul – Boğaziçi University (supported by Munich-Re Group)
- Turkish Improvement of Natural Hazard Insurance and Disaster Funding Strategy (TEFER) Project – Turkish Treasury (supported by the World Bank and conducted by Cordis-Willis with the assistance of CAR and Boğaziçi University)

Studies of JICA – IMM and BU – ARC are used for the preparation of the information on the earthquake risk in Istanbul. In the light of this information, regions with different risk levels can be identified and priorities can be assigned for earthquake mitigation purposes. It should be noted that the JICA – IMM study assessed physical and social risks in mahalle level, whereas in the ARC-BU study, these risks are assessed in a 0.005° x 0.005° (400 x 600 m) grid level. For final considerations and evaluations, the grids used by the BU – ARC study will be adopted. To correlate the results of the BU – ARC and JICA – IMM studies, the grid based database of the BU – ARC study has been converted to the mahalle level. In districts such as Eminönü, Beyoğlu and Fatih where there are some mahalles smaller than the grid area, some mahalles from the JICA – IMM study have not been found in the BU – ARC study. Nevertheless, population and building count-based correlation coefficients between both studies have been found as 90% and 80% respectively.

Computation of earthquake casualties is essentially based on the year 2000 census of the State Statistical Institute.

To complete the image on the current situation of Istanbul, data related with the lifelines (highways, networks of natural gas, water, electricity and telecommunication) and the industrial facilities are compiled and their earthquake performances are evaluated.

The following considerations are needed in the evaluation of the earthquake risk in a metropolitan area:

- Earthquake ground motion (Intensity and spectral accelerations at T=0.2 sec and 1.0 sec)
- Problems related with soil conditions (liquefaction and landslide potential)
- Bulding damage (heavy damage and total collapse)
- Casualties
- Financial losses due to building damage
- Needs for emergency sheltering
- Road blockage (in terms of emergency and rescue activities)
- Fire, explosion and hazardous material release

The priorities of the risk carrying regions can be determined by way of weight assignment to the above elements.

2.1.1 Earthquake Ground Motion

Both in BU – ARC and JICA – IMM studies, earthquake risk assessment in Istanbul are based on the scenario earthquake governed deterministic methodology. As all the physical outcomes of the scenario earthquake are concurrent in time, this kind of assessment is well suited for the computation of total losses as well as for the planning of emergency and rescue activities, medical services and settlement issues. It should be noted that both ground motion and loss estimations based on deterministic assessments are mean values. In other words the reality has a 50% probability of being both below and above those levels.

On the other hand, in the comparison of ground motions (or the probable losses that would result from the ground motions) in various regions (or geographic cells) probabilistic methods would yield more realistic results. Theoretically probabilistic approaches comprise the results of an infinite number of scenario earthquakes. Therefore within the context of a structural rehabilitation program for Istanbul, the probabilistic assessment of ground motions for short return periods would be beneficial.

Probabilistic Earthquake Hazard Assessment

Earthquake occurrences on the North Anatolian Fault being usually characteristic and well documented in history, a time dependent model can be reasonably used for the probabilistic assessment of the seismic hazard in Istanbul. Based on recent findings, a fault segmentation model has been developed for the Marmara region. Large magnitude (characteristic) earthquakes of the Marmara region have been assigned to the segments of the model and the characteristic earthquake magnitude, the return period of that earthquake and the time elapsed since the last characteristic event have been computed for each segment (Erdik et al., 2003). In time-dependent models, the probability of earthquake occurrence increases with the elapsed time since the last major (or characteristic) earthquake on the segment. While the segments of these faults generally rupture with characteristic magnitude earthquakes, they can also rupture in cascades producing larger magnitudes. The August 17, 1999 Kocaeli earthquake is an example of multi-segment rupture involving 4 segments. Therefore the possibility of multi-segment events has also been considered in the study. The Cascade assumption increases the Maximum Magnitude but reduces the rate of occurrence of the more moderate events. The probabilistic results based on cascade models provided about the same earthquake hazard levels obtained from non-cascading models. The probabilistic model used in the study assumes that characteristic earthquakes occur on well-defined faults (e.g. the Main Marmara Fault). Smaller magnitude events on the other hand are treated as the background seismicity and their effect has been computed following a spatial smoothing process. As for the attenuation relationships, modeling of the epistemic uncertainties and soil amplification effects, references and methodologies used in the BU – ARC study, have been faithfully adopted.

Site-dependent probabilistic peak ground accelerations (PGA) having 20 and 50% probabilities of exceedance in 50 years are presented in Figure 2.1.1 and Figure 2.1.2 respectively. These probabilities of exceedance correspond to mean return periods of 140 and 70 years. Site dependent PGA have been computed as 40% of the site-dependent spectral accelerations at T = 0.2 sec.

Deterministic Earthquake Hazard Assessment

In this section, the results of both BU – ARC and JICA – IMM studies are presented. The BU – ARC study assumed that, based on the segmentation model developed, the scenario earthquake would occur on the unruptured segments of the Main Marmara Fault producing an Mw = 7.5 event. The same seismo-tectonic structure is used in the JICA – IMM study and the scenario earthquake model A is equivalent the one used in the BU – ARC study. Compilation and interpretation of topographic, geologic and geotechnical data and the selection of the appropriate attenuation and site response models constitute the remaining main inputs of the earthquake hazard assessment. The distribution of the site dependent deterministic peak ground and spectral accelerations at T=0.2 sec and 1.0 sec are presented in Figure 2.1.3, Figure 2.1.4 and Figure 2.1.5. Figure 2.1.6 illustrates the intensity distribution resulting from the scenario earthquake. The deterministic spectral acceleration distribution for 0.2 sec and 1.0 sec periods obtained in the JICA – IMM study are presented in Figure 2.1.7 and Figure 2.1.8.

Ground motions vary as a function both fault distance and soil conditions. The similarity between Figure 2.1.2 and Figure 2.1.3 demonstrates that the occurrence of the M=7.5 scenario earthquake used in the assessment of the seismic risk Istanbul is highly probable in the next 70 years. Actually, based on the stress transfer theory, Parson et al. (2000) estimate a 60% probability of having a destructive earthquake in the next 30 years (corresponding to a return period of 50 years).

Following the transfer of the ground motion values to the 0.005 x 0.005° geocells, the spectral accelerations obtained for 20 and 50% probabilities of exceedance and from the deterministic studies have been normalized with respect to their mean value. The distribution of these relative amplifications has been presented in Figure 2.1.9 through Figure 2.1.11 in order to provide a spatial comparison tool for the relative seismic hazard in Istanbul.

2.1.2 Problems Related with Soil Conditions

Information on the geotechnical structure and the related problems in Istanbul have been evaluated in the JICA – IMM project based on the existing and recently conducted bore logs, PS logging and microtremor measurements. Data from 17th Division of the Turkish State Highways and private firms have been used in the ARC –BU project. Locations with high potential of liquefaction and slope instability are determined based on both the BU – ARC and JICA – IMM studies.

The surface geology map with a scale of 1/50,000 prepared by Istanbul Metropolitan Municipality has been used in the ARC –BU study. Geotechnical data have been obtained from 17th Division of the Turkish State Highways, bore-holes provided by ZETAŞ (Geotechnical and Foundation Investigations Co.) and other geotechnical firms and array microtremor measurements conducted for the JICA – IMM project by both the University of Tokio (Prof. Kudo) and Kandilli Observatory and Earthquake Research Institute, Department of Geophysics. Based on this information, the geologic formations in Istanbul have been classified according to the NEHRP (1997) site classification provisions. The classification has also been crosschecked with the PS logging measurements conducted by ITU (Prof. Atilla Ansal) for the JICA – IMM project. The site classification map developed as a part of the BU – ARC project is presented in Figure 2.1.12. The F Class soils shown on the map can be defined as the soil group carrying relatively the highest risk and require site-specific evaluations. The following soil types can be classified as F. Class.

- Soils vulnerable to potential or collapse under seismic loading such as liquefiable soils quick and highly sensitive clays, collapsible weakly cemented soils
- Peat and/or highly organic clays with thickness H>3 m of peat and/or highly organic clay
- Very high plasticity clays (H>8 m with PI>75)
- Very thick soft/medium stiff clays (H>36 m)

The JICA – IMM study utilized the geological map of Istanbul prepared by Oktay and Eren (1994) and numerous site investigation reports and geophysical studies, besides 48 boreholes and PS loggings at 39 locations and array microtremor measurements. Boreholes and geophysical studies have been mostly concentrated in liquefaction prone areas. NEHRP (1997) soil classification has been used in the JICA – IMM project, but the D class soils have been further subdivided into the following 5 groups:

- D1: 300-360 m/s
- D2: 250-300 m/s
- D3: 220-250 m/s
- D4: 200-220 m/s
- D5: 180-200 m/s

The mean shear wave velocities have also been provided for each geological unit. The soil classification map provided in the JICA – IMM study is presented in Figure 2.1.13.

Except the classification of the Trakya formation in the European site of Istanbul, the soil classification maps provided by both the BU – ARC and JICA – IMM studies are in good agreement.

The BU - ARC study used the Youd and Perkins (1978) methodology to evaluate the liquefaction potential in Istanbul. In this methodology the opportunity for ground failure in a given area is defined as the function of the seismicity of the area and the rate of occurrences of earthquake ground motion of sufficient intensity to produce ground failure in susceptible materials. The susceptibility on the other hand is defined a function of the geological materials in the area and relative likelihood that these materials would undergo liquefaction and ground failure during strong seismic shaking. Soil deposition and age are the factors used in the liquefaction susceptibility classification. Fault distance on the other hand is not taken into consideration. The liquefaction susceptibility map is presented in Figure 2.1.14, where the soils are grouped as having low, medium and high susceptibility. The liquefaction potential map presented in Figure 2.1.15 is obtained by the combination of the opportunity and susceptibility maps. On this map it can easily be observed that location having the same susceptibility may have different liquefaction potential levels depending on the fault distance and earthquake magnitude. For instance both Uskumruköy and Alibeyköy have the same susceptibility but show a great difference in the liquefaction potential.

Within the context of the JICA – IMM study, the locations of the artificial landfills and Quaternary soils are identified and liquefaction analysis is conducted for typical soil profiles of the formations in these regions. Soil models are built up on a grid of 500 x 500m, and based on geotechnical and earthquake information, liquefaction analysis is conducted using F_L (Japanese Design Specification of Highway Bridges, 1986) and P_L (Iwasaki, 1982) methods. The liquefaction potential map is presented in Figure 2.1.16.

2.1.3 Building Damage

Heavy damage and total collapse constitute the most critical building damage classes. Within the context of the BU – ARC study, building damages are computed based on both intensity and spectral displacements. For the computations base don spectral displacements HAZUS99 methodology is used. However, for various building types, the story drift amounts are modified to obtain damage grades compatibles with those defined in EMS-98. Brief descriptions of the structural damage levels suggested for reinforced concrete buildings are provided below:

- Slight damage: Fine shear cracks are formed in some columns and beams, near and inside the column-beam joints and in shear walls.
- Medium damage: Cracks are formed in most of columns and beams
- Heavy damage: Heavy damage occurs in columns and beams, most of them reach the yield capacity level, large cracks form, spilling of the concrete cover and buckling of the longitudinal reinforcements are seen. Diagonal shear cracks are formed in non-ductile frame members and shear walls (this level corresponds to damage level 3 of EMS-98).
- Very heavy damage (total collapse): Total failure of some or all of the structural members. Partial or total collapse of the building due to large deformations (this level corresponds to damage level 4 and 5 of EMS-98).

The JICA – IMM project defines the building damages as Heavy, Medium and Partial for all building types. Heavy damage comprises collapse or heavy structural damage and corresponds to damage level 4 and 5 of EMS-98. Medium and partial damages correspond to EMS-98 levels of 3 and 2 respectively.

The “medium damage” definition of the JICA – IMM study corresponds to the “heavy damage” level of the BU – ARC study, whereas “heavy damage” in the JICA – IMM study corresponds to “very heavy damage” in the BU – ARC study.

The grid-based distributions of the total numbers and ratios of the collapsed buildings obtained in the BU – ARC study by using spectral displacement based vulnerability relationships are presented in Figure 2.1.17 and Figure 2.1.18 respectively.

The grid-based distributions of the total numbers and ratios of the heavily damaged buildings obtained in the BU – ARC study by using spectral displacement based vulnerability relationships are presented in Figure 2.1.19 and Figure 2.1.20 respectively.

The distributions of the total numbers and ratios of the heavily damaged buildings in the sub-district level obtained in the JICA – IMM study are presented in Figure 2.1.21 and Figure 2.1.22 respectively.

2.1.4 Casualties

The main source of information in the computation of the casualties in the BU – ARC study is the year 2000 census of the State Statistical Institute. The year 2000 population information obtained in the district level has been converted to the sub-district level using the number of households per sub-district from the building inventory data of the State Statistical Institute. The population information thus obtained corresponds to the nighttime population in the sub-district level. The daytime populations are computed using the Master Transportation Plan of Istanbul prepared by Istanbul Technical University for the Istanbul Metropolitan Municipality. Based on this report, the population transfer between the districts during working hours is computed and these amounts are added (or subtracted) to the nighttime population values.

HAZUS99 methodology has been used in the computation of the casualties. This methodology establishes a direct relationship between the structural damage and the number of casualties, giving casualty rates for each injury severity level and for each damage level of various structural types. The rates do not show a significant difference for various reinforced concrete structural types, but they are higher for masonry structures. The rates have been revised with the help of existing data on Turkish earthquakes. Number of daytime and nighttime death and injuries are computed by multiplying those rates with the daytime and nighttime population per building for each damage level.

Within the context of the JICA – IMM study an empirical relationship has been established between the number of deaths and injuries and the number of heavily damaged housing units in past earthquakes of Turkey. In the report it is stated that the relationship depended greatly on the damage due to the Izmit earthquake and accordingly, the estimated damage is applicable for a nighttime event.

The grid-based distributions of the total numbers and ratios of daytime deaths obtained in the BU – ARC study are presented in Figure 2.1.23 and Figure 2.1.24 respectively. The corresponding nighttime distributions are presented in Figure 2.1.25 and Figure 2.1.26.

The distributions of the total numbers and ratios of the deaths in the sub-district level obtained in the JICA – IMM study are presented in Figure 2.1.27 and Figure 2.1.28 respectively.

2.1.5 Financial Losses due to Building Damage

The monetary equivalents of the physical building damages resulting from the scenario earthquake of the BU – ARC study are presented in Figure 2.1.29.

2.1.6 Needs for Emergency Sheltering

The total number of uninhabitable residential units is the key parameter in the estimation of the shelter needs. Extensively and completely damaged buildings were considered as uninhabitable and the corresponding dwelling units were calculated for low, medium and high-rise buildings with corresponding dwelling units. In order to exclude the commercial buildings, the total number of dwelling units was adjusted by the corresponding DIE values.

The grid distributions of the number and ratio of shelter needs resulting from the scenario earthquake in the BU – ARC study are presented in Figure 2.1.30 and Figure 2.1.31.

2.1.7 Road Blockage

Based on the JICA – IMM study, areas that are supposed to be isolated by road blockage as a consequence of the scenario earthquake are shown in Figure 2.1.32.

2.1.8 Fire, Explosion and Hazardous Material Release

Secondary risks following an earthquake are fire, hazardous material release, explosion and partial flooding. For the identification of the risk carrying areas, timber framed structures, pump stations, natural gas distribution and dams that, if damaged in an earthquake, may threaten residential areas, are important considerations.

2.1.9 Preliminary Research For Lifeline Facilities Of Istanbul Metropolitan Area

Lifelines can simply be defined as the structures that are needed for maintaining human activities and city life. Lifelines usually convey food, energy, fuel and communication from the point of manufacture to the point of use. Generally speaking, the lifelines that are prone to earthquake risk can be listed as follows.

- Highway, Railway and Subway Bridges and Viaduct Tunnels
- Highway, Railway and Subway Routes
- Airports
- Harbors and Docks
- Gas and Petroleum Stations
- Power Stations (Electricity)

- Dams
- Natural Gas, Sanitary Water, Wastewater-Sewage Systems
- Manufacturing or Storage Facilities of Dangerous Materials

2.1.10 Highway Bridges and Viaducts

The main information source for the bridges and viaducts within the boundaries of Istanbul Metropolitan area was the General Directorate of Highways - 17th Division and Istanbul Metropolitan Municipality. In the following studies, the data obtained from above institutions and from other specific studies were evaluated and used for the computation of the earthquake risks.

- The Study on a Disaster Prevention / Mitigation Basic Plan in Istanbul including Seismic Microzonation in the Republic of Turkey – Japan International Cooperation Agency and Istanbul Metropolitan Municipality (JICA – IMM)
- Earthquake Risk Assessment for Istanbul Metropolitan Area – Boğaziçi University (supported by the American Red Cross) (BU – ARC)

Besides these extensive studies, in two Master of Science Theses (Zülfikar, 1995 and Duman, 1997), carried out between the years 1995-1997 at Kandilli Observatory and Earthquake Research Institute, Department of Earthquake Engineering, 123 viaducts and bridges (except the suspension bridges) on E5 (01) and TEM (02) and secondary roads, have been evaluated in terms of their earthquake performance. The data belonging to these viaducts and bridges were provided by the Directorate of 17th Division of Highways and all were transferred into GIS. Detailed data and research on the Bosporus and Fatih Sultan Mehmet suspension bridges can be obtained from the graduate theses (Apaydın, 2002 and Koşar, 2003)which are kept in the Department of Earthquake Engineering, KOERI.

It is also possible to reach the data and risk assessment details of the highway bridges and viaducts in the JICA – IMM study. The information used in the JICA – IMM study was also provided by the General Directorate of Highways-17th Division and Istanbul Metropolitan Municipality. (Figure 2.1.33)

Totally, there exists 123 bridges/viaducts, within the boundaries of the 17th Division of Highways, 45 of them belong to Highway 01, 51 to Highway 02, and 27 to link roads. The structural and geometrical details pertaining to the above mentioned bridges and viaducts are given in Table 2.1.1 through Table 2.1.8. The bridges and viaducts with known geographic coordinates, are given in Figure 2.1.34 in GIS format. Main viaducts and bridge intersections are summarized below.

Viaducts on Highway 01

V-408 Ortakoy Viaduct 411 M Prestressed-Simple Supported

V-409 Ortakoy Viaduct 362 M Prestressed-Simple Supported

V-411 Besiktas Viaduct 272 M Prestressed-Simple Supported (The Highest H=43 M)

V-302 Mecidiyekoy Viaduct 861 M Pre-stressed-Simple Supported (The Longest)

Viaducts on Highway 02

V7 Mahmutbey Viaduct 399.8 M Prestressed-Simple Supported

V7A Gaziosmanpasa Viaduct 120 M Prestressed-Simple Supported

V6 Aksemsettin Viaduct 604 M Prestressed-Single Span

V5 Hasdal Viaduct 324 M Prestressed-Single Span

V1 Sadabat II Viaduct 400 M Prestressed-Simple Supported

LMV1 Levent Viaduct 363.6 M Prestressed-Simple Supported

M3V1 Molla Gurani Viaduct 498 M Prestressed-Simple Supported

Viaducts on Hasdal-Okmeydanı Secondary Highway

V2A Gedikahmetpasa Viaduct 240 M Prestressed-Simple Supported

V2 Nurtepe Viaduct 400 M Prestressed-Simple Supported

V3 Sadabat I Viaduct 788 M Prestressed-Single Span

V4 Okmeydanı Viaduct 161.5 M Prestressed-Simple Supported

Bridge Intersections

Mahmutbey, Metris, Kumburgaz, Hasdal, Askeriakademi, Buyukdere-Levent, Levent, Umraniye, Anadolu, Kozyatağı

The bridges and viaducts that are already being or planned to be retrofitted by the Directorate of 17th Division of Highways can be seen in Table 2.1.9 through Table 2.1.12. The above mentioned retrofit plan has also been put into GIS format.

Earthquake evaluation of bridges and viaducts generally involves a three-step study. The first step is "Preliminary Assessment and Priority Listing", the second is "Detailed Evaluation and Elimination" and the final step is "Determination of Applicable Repair/Retrofit Methodology". Three methods are widely used around the world for Preliminary Assessment and Priority Listing. These are ATC 6-2 (2), CALTRANS (5) and Kawashima Methods. For the application of these methods, the information on earthquake risk at the location of the bridge, importance of the bridge, local site soil conditions and the structural system are needed. Factors assigned to each of the above information, are expressed as a score, and by the aid of an algorithm, a total score is obtained. The algorithms for obtaining the total score are "alternative choice" (worst of two or more factors), "simple addition" or "addition after multiplication". In ATC 6-2 Method, both alternative choice and simple addition methods were used. In CALTRANS (1990) Method, "addition" method is used with weighted factors. In CALTRANS (1993), the seismicity factor, has been changed to "addition after multiplication". The Kawashima Method on the other hand is totally different. Here, rather than combining various factors, a more realistic approach is adopted, by using statistical data gathered from past bridge damages observed in 105 earthquakes.

Two Master of Science Theses (Zülfikar, 1995 and Duman, 1997) that were carried out between the years 1995-1997 at Kandilli Observatory and Earthquake Research Institute (KOERI), Department of Earthquake Engineering were used for the Preliminary Earthquake Performance Evaluation of the Istanbul Highway Bridges and Viaducts. In these thesis studies, preliminary earthquake risks of the bridges and viaducts on highways 01, 02 and on secondary roadways are assessed by the scoring method of ATC 6-2.

The information needed for the preliminary assessment in ATC 6-2 are: Vulnerability, Seismicity and Bridge Importance.

Vulnerability is a function of the type of bearing, skew angle of the superstructure, minimum support length, height of the middle bents, height of the abutments, seating at the abutments due to landfill.

Seismicity is a function of earthquake intensity, geology and geotechnical surrounding.

Importance of the Bridge is based on the daily average of the traffic, the physical size of the bridge, population around the area of bridge usage, the role of the bridge for transportation to the important structures (hospitals etc.)

Each of the above information is assessed with a score of 1 to 10. Each score is then multiplied by 3.33 and added.

The scores assessed by the ATC 6-2 methodology for the viaducts and bridges of Istanbul are given in Table 2.1.13 through Table 2.1.17. A bridge with a score of 100 is the first bridge to be assessed in the second step, namely detailed evaluation. The bridges and viaducts shown with the peak ground velocity maps in Figure 2.1.36 are at high risk, the bridges and viaducts shown with the peak ground velocity maps in Figure 2.1.37 are at lower risk.

JICA – IMM study contains the preliminary earthquake performance assessment results of 480 bridges obtained by the Katayama procedure. In JICA – IMM study, it is stated that the Katayama Method is practical and easy to use for the assessment of bridges or viaducts, when only limited information is available on the structure or shape of the bridge. Information can be based on visual inspections and assessment is based on scoring.

On the other hand, deck fall, which is most damaging in earthquakes, can be determined reliably. The 10 parameters, which can cause deck fall, are as follows:

Soil type / Probability of liquefaction / Type of deck beam / Support type / Height of pier and abutments / Minimum seat length of deck beam / Expected intensity of the earthquake at the site (JMA Intensity Scale) / Type of foundation / Structural Material of pier and abutments

For each parameter, a score varying between 0.5 and 6.3 is assigned. Faulting effects and slope stability are not included in these parameters. At the end of the scoring, if the total score is 30 or more, then the deck has a high probability to fall, if it is between 26 and 30, then the deck failure (fall down) is of medium probability and if it is 25 and below, it is classified as low probability. According to this, the bridges and viaducts shown in Figure 2.1.38 are at high risk, the ones in Figure 2.1.39 are at medium risk, and finally the ones in Figure 2.1.40 are at low risk. Out of the 480 bridges, assessed using the Katayama method considered in the report, 21 bridges have a high probability of damage due to deck fall, 4 bridges are found to have a medium probability. For numerous bridges, total score is stated to be approximately 10.

2.1.11 Natural Gas System

Structural information and data sources used for the preliminary earthquake performance evaluations of the natural gas system in the Istanbul Metropolitan Area (Pumping Stations, Distribution Station and Pipeline) are covered in this section.

All of the data used in the JICA – IMM project were gathered from IGDAS in digital format and was transferred to GIS format (Figure 2.1.41). In the report, probable damage locations to pipelines and service boxes are presented. Different damage estimate methods were examined and amongst them, the methodology developed by the Tokyo Metropolitan Disaster Plan (1997) was used. This methodology uses the peak ground velocity as the hazard parameter. Little damage is expected to occur on the natural gas pipelines. The reason for this is that the pipelines are fairly new and are made of earthquake resistant polyurethane material (Table 2.1.19).

Only the main pipelines are assessed in the ARC-BU project. The structural information used has been gathered from IGDAS and was transferred to GIS. There are 662 km of natural gas pipelines, 396 pumping stations and 360 distribution stations in the Istanbul Metropolitan Area (Figure 2.1.42). For the preliminary assessment of the natural gas system, methodologies of ATC 25 and ATC 13 are used.

In addition to that, for the estimation the pipeline damages the peak ground velocity based methodology of HAZUS-1999 is used. Figure 2.1.43 shows the natural gas pipelines on the peak ground velocity map obtained form the scenario earthquake for the Istanbul Metropolitan area. The pipe performances associated with the peak ground velocity are presented in Table 2.1.18. If the pipes in the assessments were manufactured from ductile materials, 88x %80 = 70 leakage and 88x %20 = 17 breaking damages are determined to occur. These assessments are for the main pipelines. The secondary pipelines are made of plastic based materials and there is a small chance of damage on these pipes except the building entrances.

2.1.12 Sanitary and Wastewater Systems

Structural information and data used for preliminary earthquake performance evaluations of the sanitary water and wastewater systems in the Istanbul Metropolitan Area (Pumping Stations, Reservoirs and Pipelines) are elaborated below.

Data on the sanitary water and wastewater systems of Istanbul Metropolitan area used in the JICA – IMM study are obtained from ISKI (Figure 2.1.44 and Figure 2.1.45). Different methodologies are considered for the evaluation of the sanitary water system. The method developed by the Japanese Waterworks Union (1998) where the damage is a function of the peak ground velocity (PGV) is used. About 1400 damage points are expected for scenario earthquake A and 1600 damage points are expected for scenario earthquake C (Table 2.1.20). The damage is mostly concentrated on the European side of Istanbul. The greatest damage is expected at Fatih and Güngören. In order to determine the damage to the wastewater system, the damage function used for the sanitary water is used with updated coefficients. For earthquake A approximately 1200 points and for earthquake C, approximately 1300 points of pipeline damage are expected (Table 2.1.21).

ISKI has kindly provided the data used in the BU – ARC project. The sanitary water system in Istanbul consists of 683 km of pipeline, 25 pumping stations and 14 reservoirs. The wastewater system on the other hand is formed of 1265 km of pipeline, 87 pumping stations and 100 reservoirs (Figure 2.1.46) and (Figure 2.1.47). For the assessment of earthquake performance of sanitary and wastewater systems, ATC 25 and ATC 13 methods are used. For the estimation of earthquake damage to pipelines, peak ground velocity method of HAZUS-1999 is used. In Figure 2.1.48 and Figure 2.1.49 the Istanbul Metropolitan sanitary and wastewater systems are shown on the peak ground velocity maps. In Table 2.1.22, the pipe performances of the sanitary water system are shown with respect to PGV. The upper limit of pipeline damage is obtained when all the pipes are considered as brittle. In that case, 465 x %80 = 372 leakage damages and 465x %20 = 93 breaking damages are estimated to take place. In Table 2.1.23, the wastewater performances with respect to PGV are provided. Again if all pipelines are assumed to be of brittle material, 322 x %80 = 258 leakage damages and 322 x %20 = 64 breaking damages are estimated to occur as the upper limit of the damage.

Besides this general evaluation, based on the ISKI database, a graduate thesis (Uğurlu, 2002) conducted at Boğaziçi University Kandilli Observatory and Earthquake Research Institute (KOERI), Department of Earthquake Engineering has evaluated a total of 1265 km pipelines, 87 pumping stations, 4 storage reservoirs, 115 terminal reservoirs, 12 water treatment plants and 13 water bents belonging to the sanitary water system, and 682 km of pipelines, 25 pumping stations, 14 water treatment facilities and 14 wastewater bents belonging to the wastewater system. ATC-25 ATC-13 and HAZUS-1999 methods are used for the earthquake performance assessment of the sanitary and wastewater systems, under exposure to the scenario earthquake. For earthquake damage estimates, only ground motion and liquefaction potential are considered. Faulting effect on the other hand is not taken into account. For the sanitary water system, the highest pipeline damage is expected at Kucukcekmece with 123 breaks, heavy damage is expected in the pumping stations at Adalar, In almost all districts water bents will undergo slight damage, the highest water treatment plant damage is expected as medium damage at Tasoluk and Beykoz, the reservoirs at Kucukcekmece will be damaged. Bakirkoy, Kucukcekmece, Sariyer, Adalar, Beykoz, Maltepe, Pendik ve Sultanbeyli terminal reservoirs are expected to experience medium damage. For the wastewater systems; 216 breaks are estimated to occur on the main pipelines at Bakirkoy, the tunnels at Pendik and Tuzla are expected to experience medium damage, Adalar, Zeytinburnu and Kartal pumping stations are expected experience heavy damage. Avcılar, Bakırkoy, Beykoz and Tuzla water treatment stations are expected to experience heavy damage. Sanitary water lines are expected to have a total of 1191 breaks; wastewater systems are expected to have a total of 1959 breaks.

2.1.13 Electric Power Transmission System

A preliminary earthquake performance assessment concerning the Electric Power Transmission System in Istanbul Metropolitan Area (operating stations, centrals and power transmission lines) has been conducted in the BU – ARC study. Data for this study were obtained from TEDAS and transferred to GIS by way of digitization. The system consists of of 51 operating stations, 12 stations under construction, 2 operating central units, 284 km of 380 KW transmission lines, 399 km of 34.5 KW transmission lines and 380 km of 154 KW transmission lines (Figure 2.1.50). ATC-25 and ATC-13 methods were used for preliminary assessment of Electric Power Transmission Systems. The components (operating stations, centrals and power transmission lines) of the system were indicated on the intensity distribution map resulting from the scenario earthquake (Figure 2.1.51). The 380 KW electric power distribution centers are shown on the intensity distribution map in Figure 2.1.52. In Table 2.1.24, the distribution of the units forming the Electric Power Transmission System is given in terms of intensity ranges.

The units forming the Electric Power Transmission System in Istanbul Metropolitan Area are similar to the units damaged in 1967 Adapazarı, 1992 Erzincan and 1999 Kocaeli earthquakes, in terms of structural features. In California, for non-upgraded electrical transmission stations, ATC-25 assigns 16, 26, 42 and 70 percent damage ratios, for earthquake intensities of VII, VIII, IX and X respectively. The corresponding percentages for the distribution substations are 8, 13, 25, and 52 percent.

The JICA – IMM study stated that data on the high voltage transmission lines were obtained from TEDAS and transferred to GIS format (Figure 2.1.53). However, data on the medium and low voltage transmission lines in analog format. The report argues that according to the literature survey conducted in the study, at transmission lines and transmission towers damages are rare. However, at underground transmission lines, more damages are faced. For on the ground transmission lines, damage functions, available in Japan, USA and the other countries, were used. For underground transmission lines, the damage function given in HAZUS-99 was used. Based on the observations from past earthquakes, it is assumed that power transmission lines with high voltage are not likely to receive any damage. 800 km of transmission lines are expected to be damaged as the result of the scenario earthquake Model

A, and 1100 km of transmission lines are expected to be damaged as the result of the scenario earthquake Model C. The highest damage is expected in Zeytinburnu, Güngören and Bahçelievler.

2.1.14 Telecommunication System

Within the context of the BU – ARC study, data provided by Türk-Telekom (The general Directorate of Turkish Telecommunications) were transferred to GIS and a database of the administration buildings and switch stations, including their structural types and number of stories was formed. 139 administrative and telephone exchange buildings were thus identified for Istanbul (Figure 2.1.54).

For the preliminary risk assessment of the telecommunication system, ATC-25 and ATC-13 methods were used. The quantity of telephone exchange buildings in each intensity range was determined by overlaying the system with a scenario earthquake intensity distribution map (Figure 2.1.55). Table 2.1.25 shows distribution of telecommunication system in terms of earthquake intensity ranges.

The units of telecommunication systems in Istanbul Metropolitan Area are the same as units, which have suffered from the 1967 Adapazarı, 1992 Erzincan and 1999 Kocaeli earthquakes, in terms of structural features. As a rough guess we can state that about 40% of the telephone exchange buildings (approximately 5) will be heavily damaged intensity IX regions.

In the project of JICA – IMM, a database about telecommunication systems in Istanbul Metropolitan Area was prepared in GIS format. The database includes information such as the location of telephone exchange buildings, structure type and project year (Figure 2.1.56).

2.1.15 Schools and Hospitals in Istanbul

Information on the existing hospital and school stock in Istanbul has been gathered from the 1/1000 scale maps provided by the Turkish Telecommunication Association (Türk Telekom). Section 2.1.18 contains information on how these maps have been screened for various facilities in Istanbul as part of the BU – ARC Study.

The distribution of the schools and hospitals on the intensity map resulting from the scenario earthquake are presented in Figure 2.1.57 and Figure 2.1.58 respectively.

Table 2.1.1. Structural and geometrical data about the bridges and viaducts in Istanbul

Name	Longitude	Latitude	Type	Project Year	Superstructure Type	Length (m)	Span	Width (m)	Expansion Joint	Skew Angle	Pier Type	Abutment Type
M3V1			Viaduct	1988	Post-Tension	498.80	9	40.00	2	0.0	Box	Box
V3	28.96	41.07	Viaduct	1988	Post-Tension	788.80	14	26.00	2	0.0	Wall	Box
V302	29.00	41.07	Viaduct	1974	Post-Tension	861.00	29	31.00	3	0.0	Column	Column
V5	28.93	41.10	Viaduct	1988	Post-Tension	324.00	12	40.00	2	0.0	Wall	Box
V6	28.92	41.10	Viaduct	1988	Post-Tension	599.75	12	40.00	2	0.0	Box	Box
V7	28.85	41.07	Viaduct	1989	Prestress	399.80	10	33.00	2	0.0	Column	Column
V408	29.03	41.05	Viaduct	1973	Prestress	411.00	9	44.00	3	0.0	Box	Box
V409	29.03	41.05	Viaduct	1973	Prestress	362.00	8	30.80	3	0.0	Box	Box
V1	28.98	41.10	Viaduct	1988	Prestress	402.00	10	36.00	3	0.0	Wall	Column
V411	29.02	41.06	Viaduct	1973	Prestress	272.00	6	27.50	2	0.0	Box	Box
B1	28.84	41.06	Viaduct	1989	Prestress	68.90	2	11.00	0	54.0	Wall	Wall
LMV1	29.03	41.09	Viaduct	1989	Prestress	363.60	9	40.00	2	0.0	Column	Column
KMU3	29.10	40.98	Viaduct	1990	Prestress	18.50	1	11.00	0	0.0	Wall	
V4			Viaduct	1989	Prestress	161.50	4	22.00	0	0.0	Wall	Column
VMO1	29.09	41.09	Viaduct	1990	Prestress	49.00	2	18.00	0	0.0	Wall	Wall
V2	28.96	41.08	Viaduct	1988	Prestress	402.00	10	22.00	3	0.0	Wall	Column
V2A	28.96	41.09	Viaduct	1989	Prestress	242.00	6	11.00	2	0.0		Column
BLU1	29.01	41.08	Viaduct	1988	Prestress	40.20	1	7.00	2	30.0	Wall	
K1	29.08	41.02	Viaduct	1993	Prestress	207.50	8	14.00	2	3.0		Column
NMU4	29.12	41.00	Viaduct	1990	Prestress	114.00	1	7.00	2	0.0	Wall	
RMO1	29.12	41.03	Viaduct	1990	Prestress	67.10	2	21.00	0	28.0	Wall	Wall
RMO2	29.12	41.03	Viaduct	1990	Prestress	52.00	2	14.00	0	9.0	Wall	Wall
V7A	28.90	41.09	Viaduct	1989	Prestress	120.00	3	40.00	2	0.0	Column	Column
B16	28.97	41.10	Viaduct	1988	Prestress	47.00	2	8.00	0	11.0	Wall	Wall

Table 2.1.2. Structural and geometrical data about the bridges and viaducts in Istanbul

Name	Longitude	Latitude	Type	Pier Height (m)	Abutment Height (m)	Supported Length (cm)	Support Type	Foundation Type	Soil Type	Score
M3V1			Viaduct	7.10	70.00	80.00	Elastomeric	Shallow	A,B,C	90
V3	28.96	41.07	Viaduct	6.00	26.00	40.00	Elastomeric	R.C Piled	E	87
V302	29.00	41.07	Viaduct	9.40	13.11	60.00	Elastomeric	Shallow	B	87
V5	28.93	41.10	Viaduct	9.30	24.60	35.00	Elastomeric	Shallow	B	87
V6	28.92	41.10	Viaduct	6.00	29.50	60.00	Elastomeric	Shallow	B	87
V7	28.85	41.07	Viaduct	10.50	37.50	50.00	Elastomeric	R.C Piled	B	87
V408	29.03	41.05	Viaduct	7.00	38.55	60.00	Elastomeric	Shallow	B	80
V409	29.03	41.05	Viaduct	10.50	26.00	60.00	Elastomeric	Shallow	B	77
V1	28.98	41.10	Viaduct	2.00	35.00	200.00	Elastomeric	R.C Piled	B,E	73
V411	29.02	41.06	Viaduct	9.00	38.18	60.00	Elastomeric	Shallow	B	73
B1	28.84	41.06	Viaduct	9.00	8.00	80.00	Elastomeric	Shallow	D	72
LMV1	29.03	41.09	Viaduct	7.50	26.00	80.00	Elastomeric	Shallow	B	70
KMU3	29.10	40.98	Viaduct	9.00	0.00	60.00	Elastomeric	Shallow	D	69
V4			Viaduct	19.00	21.00	200.00	Elastomeric	Shallow	B	68
VMO1	29.09	41.09	Viaduct	10.00	9.00	60.00	Elastomeric	Shallow	A,B,C,D	68
V2	28.96	41.08	Viaduct	15.00	40.00	200.00	Elastomeric	Shallow	B	65
V2A	28.96	41.09	Viaduct	15.00	32.00	200.00	Elastomeric	Shallow	B	65
BLU1	29.01	41.08	Viaduct	9.50	0.00	70.00	Elastomeric	Shallow	B	63
K1	29.08	41.02	Viaduct	6.50	11.00	80.00	Elastomeric	Shallow		63
NMU4	29.12	41.00	Viaduct	10.00	0.00	80.00	Elastomeric	Shallow	A,B,D	63
RMO1	29.12	41.03	Viaduct	11.00	8.00	100.00	Elastomeric	Shallow	A,B,D	63
RMO2	29.12	41.03	Viaduct	9.00	8.40	100.00	Elastomeric	Shallow	A,B,D	63
V7A	28.90	41.09	Viaduct	4.50	23.67	60.00	Elastomeric	Shallow	B	63
B16	28.97	41.10	Viaduct	10.00	9.20	80.00	Elastomeric	Shallow	B	62

Table 2.1.3. Structural and geometrical data about the bridges and viaducts in Istanbul

Name	Longitude	Latitude	Type	Project Year	Superstructure Type	Length (m)	Span	Width (m)
K521	29.03	40.99	Underpass	1975	Post-Tension	82.00	4	20.00
K407	29.02	41.06	Underpass	1972	Reinforced	35.50	1	13.80
M5U1	29.10	40.99	Underpass	1990	Prestress	74.20	4	21.00
K205	28.98	41.07	Underpass	1974	Post-Tension	67.50	4	17.60
K104	28.92	41.03	Underpass	1974	Post-Tension	69.20	4	17.80
K300	28.99	41.07	Underpass	1974	Post-Tension	49.00	2	15.00
KMU4			Underpass	1990	Prestress	18.50	1	11.00
B15	28.97	41.10	Underpass	1990	Prestress	54.95	4	15.40
K511	29.06	41.00	Underpass	1971	Reinforced	26.40	1	15.25
UMU5	29.10	41.03	Underpass	1993	Reinforced	33.21	1	13.40
K412	29.01	41.05	Underpass	1972	Reinforced	37.50	1	12.50
K513	29.05	40.99	Underpass	1974	Reinforced	28.00	1	11.00
K518	29.03	40.99	Underpass	1972	Post-Tension	51.10	3	25.00
M2U2	29.05	41.09	Underpass	1989	Prestress	41.00	1	14.00
M302	29.08	41.09	Underpass	1989	Prestress	41.00	1	14.00
M5U2			Underpass	1990	Prestress	47.40	1	7.00
NMU2			Underpass	1990	Reinforced	119.95	7	16.10
NMU3			Underpass	1990	Prestress	47.80	1	7.40
B5	28.88	41.09	Underpass	1988	Prestress	43.80	1	11.50
M1U1			Underpass	1988	Prestress	47.60	1	7.00
M1U2			Underpass	1988	Prestress	42.60	1	7.00
B17			Underpass	1988	Prestress	39.90	1	4.00
B3B	28.87	41.08	Underpass	1988	Prestress	38.20	2	12.00
B3C	28.87	41.08	Underpass	1987	Prestress	45.00	1	11.50
K201	28.95	41.05	Underpass	1972	Reinforced	39.50	1	17.30
K208	28.97	41.06	Underpass	1973	Reinforced	40.03	1	12.00
K211	28.97	41.06	Underpass	1972	Reinforced	34.50	1	12.50
K502	29.05	41.03	Underpass	1971	Reinforced	40.00	1	11.00
K504	29.05	41.02	Underpass	1971	Reinforced	43.80	1	11.80
K501	29.04	41.04	Underpass	1974	Reinforced	39.20	2	14.50
K203	28.96	41.06	Underpass	1972	Post-Tension	63.52	4	19.00
K210	28.97	41.06	Underpass	1972	Reinforced	34.10	1	12.70
NMU1	29.12	41.00	Underpass	1990	Prestress	99.99	7	19.40
RMU1	29.12	41.03	Underpass	1990	Prestress	31.50	1	17.00
RMU3			Underpass	1991	Reinforced	34.94	2	14.80
U208A	29.13	41.00	Underpass	1990	Prestress	55.00	2	27.65
UMU8	29.11	41.03	Underpass	1993	Reinforced	38.92	2	23.40
K509	29.06	41.00	Underpass	1972	Post-Tension	80.40	2	13.50
K301	28.99	41.07	Underpass	1972	Reinforced	35.00	1	16.00
UMU7	29.11	41.03	Underpass	1993	Reinforced	51.56	1	13.40
K304	29.02	41.08	Underpass	1974	Reinforced	28.80	1	14.36
K401	29.01	41.07	Underpass	1972	Reinforced	48.00	1	12.00
K405	29.01	41.07	Underpass	1972	Reinforced	33.60	1	17.30
UMU3A	29.08	41.03	Underpass	1993	Reinforced	23.40	2	0.00
RMU4			Underpass	1991	Prestress	38.94	3	15.20
B9	28.95	41.10	Underpass	1988	Reinforced Arc	99.99	1	12.00

Table 2.1.4. Structural and geometrical data about the bridges and viaducts in Istanbul

Name	Type	Expansion Joint	Skew Angle	Pier Type	Abutment Type	Pier Height (m)
K521	Underpass	0	54.0	Wall	Wall	5.00
K407	Underpass	0	24.3	Wall		9.88
M5U1	Underpass	0	0.0		Wall	11.50
K205	Underpass	2	0.0	Wall	Wall	8.50
K104	Underpass	2	29.0		Wall	7.50
K300	Underpass	1	50.0	Wall	Wall	9.00
KMU4	Underpass	0	0.0	Wall		9.00
B15	Underpass	0	0.0	Wall		7.45
K511	Underpass	0	19.8	Wall		9.83
UMU5	Underpass	0	19.0	Wall		9.30
K412	Underpass	0	29.7	Wall		7.51
K513	Underpass	0	11.7	Wall		8.35
K518	Underpass	0	12.6	Column	Wall	5.17
M2U2	Underpass	2	47.0	Wall		8.50
M302	Underpass	2	47.0	Wall		8.50
M5U2	Underpass	0	14.0	Wall		8.50
NMU2	Underpass	0	3.0			
NMU3	Underpass	2	43.0	Wall		10.00
B5	Underpass	0	14.0	Wall		8.00
M1U1	Underpass	2	47.0	Wall		12.00
M1U2	Underpass	2	47.0	Wall		8.50
B17	Underpass	2	9.0	Wall		11.50
B3B	Underpass	0	35.0	Wall	Wall	10.00
B3C	Underpass	0	0.0	Wall		8.00
K201	Underpass	0	25.2	Wall		9.77
K208	Underpass	0	0.0	Wall		7.50
K211	Underpass	0	0.0	Wall		7.68
K502	Underpass	0	27.0	Wall		8.10
K504	Underpass	0	27.0	Wall		8.35
K501	Underpass	2	22.0	Wall		11.00
K203	Underpass	0	18.0	Wall	Wall	2.50
K210	Underpass	0	10.8	Wall		8.35
NMU1	Underpass	2	0.0	Wall		8.80
RMU1	Underpass	0	4.0	Wall		7.25
RMU3	Underpass	0	0.0	Wall	Wall	4.50
U208A	Underpass	0	0.0	Wall	Wall	8.00
UMU8	Underpass	0	20.0	Wall	Wall	8.30
K509	Underpass	2	15.0	Wall	Wall	9.50
K301	Underpass	0	9.9	Wall		8.00
UMU7	Underpass	0	0.0	Wall		8.23
K304	Underpass	0	4.5	Wall		9.28
K401	Underpass	0	0.0	Wall		8.40
K405	Underpass	0	5.4	Wall		8.14
UMU3A	Underpass	0	0.0	Wall	Wall	7.50
RMU4	Underpass	0	0.0	Wall	Wall	4.50
B9	Underpass	0	31.0			0.00

Table 2.1.5. Structural and geometrical data about the bridges and viaducts in Istanbul

Name	Type	Abutment Height (m)	Supported Length (cm)	Support Type	Foundation Type	Soil Type	Score
K521	Underpass	4.00	47.00	Elastomeric	Shallow	E	90
K407	Underpass	0.00	0.00		Shallow	E	77
M5U1	Underpass	12.00	60.00	Elastomeric	Shallow	E	71
K205	Underpass	8.00	60.00	Elastomeric	R.C Piled	D	70
K104	Underpass	3.50	70.00	Elastomeric	R.C Piled	C	69
K300	Underpass	9.00	90.00	Elastomeric	R.C Piled	D	68
KMU4	Underpass		60.00	Elastomeric	Shallow	D	68
B15	Underpass	0.00	80.00	Elastomeric	Shallow	D	67
K511	Underpass	0.00	0.00		Shallow	E	67
UMU5	Underpass	0.00	0.00		Shallow	D	67
K412	Underpass	0.00	0.00		Shallow	B	63
K513	Underpass	0.00	0.00		Shallow	E	63
K518	Underpass	6.92	87.00	Elastomeric	Shallow	E	63
M2U2	Underpass	0.00	70.00	Elastomeric	Shallow	B	63
M302	Underpass	0.00	70.00	Elastomeric	Shallow	B	63
M5U2	Underpass		75.00	Elastomeric	Shallow	A,B	63
NMU2	Underpass				Shallow	E	63
NMU3	Underpass		80.00	Elastomeric	Shallow	A,B	63
B5	Underpass	0.00	60.00	Elastomeric	Shallow	B	62
M1U1	Underpass		70.00	Elastomeric	Shallow	B	62
M1U2	Underpass		70.00	Elastomeric	Shallow	B	62
B17	Underpass		80.00	Elastomeric	Shallow	B	61
B3B	Underpass	10.00	60.00	Elastomeric	Shallow	B	61
B3C	Underpass	0.00	60.00	Elastomeric	Shallow	B	60
K201	Underpass	0.00	0.00		Shallow	B	60
K208	Underpass	0.00	0.00		Shallow	D	60
K211	Underpass	0.00	0.00		Shallow	D	60
K502	Underpass	0.00	0.00		Shallow	A,B,C	60
K504	Underpass	0.00	0.00		Shallow	A,B,C	60
K501	Underpass	11.00	90.00	Elastomeric	R.C Piled	B	58
K203	Underpass	7.33	30.00	Elastomeric	Shallow	B	57
K210	Underpass	0.00	0.00		Shallow	B	57
NMU1	Underpass	0.00	75.00	Elastomeric	Shallow	A,B,C	57
RMU1	Underpass	0.00	80.00	Elastomeric	Shallow	A,B,D	57
RMU3	Underpass	6.00	60.00		Shallow	D	57
U208A	Underpass	7.00	80.00	Elastomeric	Shallow	A,B,C	57
UMU8	Underpass	8.30	0.00		Shallow	A,B,D	57
K509	Underpass	2.00	60.00	Elastomeric	R.C Piled	B	55
K301	Underpass	0.00	0.00		Shallow	B	53
UMU7	Underpass	0.00	0.00		R.C Piled	A,B,D	53
K304	Underpass	0.00	0.00		Shallow	B	50
K401	Underpass	0.00	0.00		Shallow	B	50
K405	Underpass	0.00	0.00		Shallow	B	50
UMU3A	Underpass	7.50	0.00		Shallow	B	50
RMU4	Underpass	7.85	80.00	Elastomeric	Shallow	A,B,D	47
B9	Underpass	0.00	0.00		Shallow	B	43

Table 2.1.6. Structural and geometrical data about the bridges and viaducts in Istanbul

Name	Longitude	Latitude	Type	Project Year	Superstructure	Length (m)	Span	Width (m)
KMV1	29.10	40.98	Overpass	1990	Steel	409.61	11	14.00
K510	29.06	41.00	Overpass	1972	Post-Tension	67.80	4	8.90
K515	29.04	40.99	Overpass	1972	Post-Tension	68.40	4	14.00
K517	29.04	40.99	Overpass	1972	Post-Tension	53.00	4	12.90
K512	29.05	40.99	Overpass	1972	Post-Tension	68.40	4	7.50
NMO1	29.11	41.00	Overpass	1990	Prestress	51.10	2	21.00
B11	28.96	41.10	Overpass	1988	Prestress	65.70	2	9.00
B12	28.97	41.10	Overpass	1988	Prestress	65.70	2	9.00
B13	28.99	41.10	Overpass	1988	Prestress	46.80	2	13.00
K101	28.91	41.02	Overpass	1973	Post-Tension	125.50	4	9.00
B21			Overpass	1989	Prestress	150.00	6	19.00
K102	28.92	41.03	Overpass	1973	Post-Tension	72.00	4	7.00
KMO1	29.09	40.98	Overpass	1990	Prestress	69.40	4	21.00
BF2	29.01	41.10	Overpass	1989	Prestress	246.52	8	13.20
BRO	29.01	41.10	Overpass	1989	Prestress	42.00	2	11.70
K103	28.92	41.03	Overpass	1973	Post-Tension	60.10	4	8.90
K106	28.93	41.03	Overpass	1973	Post-Tension	60.10	4	8.90
K204	28.97	41.06	Overpass	1972	Post-Tension	35.00	2	10.00
B14			Overpass	1988	Prestress	46.80	2	13.00
BF1	29.01	41.08	Overpass	1989	Prestress	304.89	9	12.70
RMO3			Overpass	1991	Prestress	32.86	2	14.80
M301	29.08	41.09	Overpass	1990	Prestress	111.00	2	11.00
ICO			Overpass	1989	Prestress	64.60	2	7.00
M101	29.03	41.09	Overpass	1988	Prestress	70.00	2	7.00
M401	29.11	41.07	Overpass	1990	Prestress	48.50	2	4.00
M501	29.12	41.02	Overpass	1991	Prestress	80.00	4	14.00
B19			Overpass	1989	Prestress	67.00	2	8.00
K4A	28.81	41.07	Overpass	1993	Prestress	92.35	1	22.00
M102	29.02	41.10	Overpass	1988	Prestress	70.00	2	7.00
M302			Overpass	1990	Prestress	49.10	2	11.00
M402	29.12	41.05	Overpass	1990	Prestress	49.60	2	4.00
B10	28.96	41.10	Overpass	1989	Prestress	78.90	3	12.00
B3	28.87	41.08	Overpass	1989	Prestress	103.10	3	9.00
B6	28.89	41.09	Overpass	1989	Prestress	45.60	2	9.00
L102			Overpass	1988	Prestress	40.00	1	7.00
B2	28.86	41.07	Overpass	1989	Prestress	40.50	2	9.00
K2	29.09	41.03	Overpass	1993	Prestress	103.30	1	28.20
OWO			Overpass	1990	Prestress	99.16	3	10.10
UMO5	29.08	41.03	Overpass	1993	Prestress	51.50	1	15.10
K503	29.05	41.02	Overpass	1971	Post-Tension	80.90	4	7.10
K202	28.95	41.05	Overpass	1972	Post-Tension	72.70	4	10.90
K206	28.98	41.07	Overpass	1972	Post-Tension	67.50	4	10.00
K505	29.06	41.02	Overpass	1971	Post-Tension	69.40	4	7.00
K212	28.96	41.06	Overpass	1972	Post-Tension	58.60	4	7.50
K402	29.01	41.07	Overpass	1972	Post-Tension	75.60	4	16.60
K404	29.01	41.07	Overpass	1972	Post-Tension	81.40	4	9.50
K207	28.96	41.06	Overpass	1972	Post-Tension	69.80	4	7.90
K410	29.02	41.06	Overpass	1972	Reinforced	34.80	2	7.00
O207			Overpass	1989	Prestress	52.64	2	18.90
UMO7	29.10	41.03	Overpass	1993	Prestress	51.50	1	12.10
UMO6	29.09	41.03	Overpass	1993	Prestress	51.50	1	12.10
K303	29.00	41.07	Overpass	1974	Post-Tension	73.90	3	6.60
K305	29.02	41.07	Overpass	1974	Post-Tension	159.60	5	8.00
K414	29.01	41.06	Overpass	1972	Reinforced	69.20	3	7.00

Table 2.1.7. Structural and geometrical data about the bridges and viaducts in Istanbul

Name	Type	Expansion joint	Skew Angle	Pier Type	Abutment Type	Pier Height (m)
KMV1	Overpass	3	0	Wall	Wall	1.50
K510	Overpass	2	0	Wall	Wall	7.00
K515	Overpass	0	9	Wall	Wall	9.50
K517	Overpass	0	4	Column	Wall	8.50
K512	Overpass	0	12	Wall	Wall	7.00
NMO1	Overpass	0	22	Wall	Wall	12.00
B11	Overpass	0	54	Wall	Wall	13.00
B12	Overpass	0	54	Wall	Wall	12.00
B13	Overpass	0	17	Wall	Wall	16.00
K101	Overpass	2	0		Wall	4.00
B21	Overpass	3	11		Column	12.00
K102	Overpass	1	8	Wall	Wall	9.00
KMO1	Overpass	0	23	Wall	Wall	11.00
BF2	Overpass	4	0	Piled	Piled	1.85
BRO	Overpass	2	0	Wall	Wall	11.00
K103	Overpass	2	10	Wall	Wall	8.00
K106	Overpass	2	10	Wall	Wall	8.00
K204	Overpass	2	0	Wall	Wall	7.90
B14	Overpass	0	17	Wall	Wall	16.00
BF1	Overpass	4	0	Piled	Piled	1.85
RMO3	Overpass	2	14	Wall	Wall	7.90
M301	Overpass	0	0	Wall	Wall	5.00
ICO	Overpass	2	40	Wall	Wall	14.00
M101	Overpass	0	0	Wall	Wall	12.00
M401	Overpass	0	0	Wall	Wall	12.50
M501	Overpass	0	14	Wall	Wall	2.00
B19	Overpass	0	45	Wall	Wall	11.00
K3	Overpass	2	36	Wall	Wall	9.00
M102	Overpass	2	23	Wall	Wall	20.00
M302	Overpass	0	0	Wall	Wall	5.00
M402	Overpass	0	0	Wall	Wall	8.50
B10	Overpass	0	26	Wall	Wall	12.00
B3	Overpass	0	23		Wall	1.00
B6	Overpass	0	9	Wall	Wall	12.00
L102	Overpass	2		Wall		8.20
B2	Overpass	0	14	Wall	Wall	10.50
K2	Overpass	2	3	Wall	Wall	9.00
OWO	Overpass	0	9	Wall	Wall	3.40
UMO5	Overpass	2	36	Wall	Wall	5.60
K503	Overpass	0	15	Wall	Wall	8.50
K202	Overpass	2	27	Wall	Wall	10.50
K206	Overpass	0	9	Wall	Wall	8.80
K505	Overpass	0	0	Wall	Wall	8.50
K212	Overpass	0	9	Wall	Wall	8.50
K402	Overpass	2	3	Wall	Wall	9.50
K404	Overpass	2	2	Wall	Wall	7.00
K207	Overpass	0	5	Wall	Wall	8.20
K410	Overpass	0	27	Wall	Wall	13.80
O207	Overpass	2	0	Wall	Wall	9.00
UMO7	Overpass	2	28	Wall	Wall	6.00
UMO6	Overpass	2	18	Wall	Wall	5.60
K303	Overpass	2	0	Wall	Column	4.50
K305	Overpass	0	0	Wall	Column	3.00
K414	Overpass	2	9	Wall	Wall	12.00

Table 2.1.8. Structural and geometrical data about the bridges and viaducts in Istanbul

Name	Type	Abutment Height (m)	Supported Length (m)	Support Type	Foundation Type	Soil Type	Score
KMV1	Overpass	6.00	20.00	Elastomeric	Shallow	D	83
K510	Overpass	1.00	90.00	Elastomeric	Piled	B	79
K515	Overpass	4.50	90.00	Elastomeric	Shallow	E	79
K517	Overpass	8.50	90.00	Elastomeric	Shallow	E	79
K512	Overpass	8.00	50.00	Elastomeric	Shallow	E	78
NMO1	Overpass	11.00	100.00	Elastomeric	Shallow	E	76
B11	Overpass	11.00	100.00	Elastomeric	Shallow	D	74
B12	Overpass	10.00	100.00	Elastomeric	Shallow	D	74
B13	Overpass	11.50	60.00	Elastomeric	Shallow	D	73
K101	Overpass	3.00	80.00	Elastomeric	Piled	C	72
B21	Overpass	11.00	120.00	Elastomeric	Piled	D	71
K102	Overpass	2.50	80.00	Elastomeric	Shallow	C	71
KMO1	Overpass	11.00	80.00	Elastomeric	Shallow	D	71
BF2	Overpass	5.50	50.00	Elastomeric	Shallow	D	70
BRO	Overpass	8.00	60.00	Elastomeric	Shallow	D	68
K103	Overpass	3.00	80.00	Elastomeric	Piled	C	68
K106	Overpass	3.00	80.00	Elastomeric	Piled	C	68
K204	Overpass	8.20	80.00	Elastomeric	Shallow	B	68
B14	Overpass	12.00	60.00	Elastomeric	Shallow	E	67
BF1	Overpass	6.50	50.00	Elastomeric	Shallow	B	67
RMO3	Overpass	7.70	50.00	Elastomeric	Shallow	A,B,D	67
M301	Overpass	12.00	50.00	Elastomeric	Shallow	B,C	65
ICO	Overpass	12.00	80.00	Elastomeric	Shallow	B	64
M101	Overpass	11.00	60.00	Elastomeric	Shallow	B	64
M401	Overpass	11.50	60.00	Elastomeric	Shallow	D	64
M501	Overpass	8.40	80.00	Elastomeric	Shallow	A,B	64
B19	Overpass	9.00	80.00	Elastomeric	Shallow	B	63
K3	Overpass	8.40	30.00	Elastomeric	Shallow	D	63
M102	Overpass	14.00	60.00	Elastomeric	Shallow	B	63
M302	Overpass	12.00	50.00	Elastomeric	Shallow	B	63
M402	Overpass	7.70	50.00	Elastomeric	Shallow	A,B	63
B10	Overpass	10.00	100.00	Elastomeric	Shallow	B	62
B3	Overpass	11.00	180.00	Elastomeric	Piled	B	62
B6	Overpass	12.00	60.00	Elastomeric	Shallow	B	62
L102	Overpass		60.00	Elastomeric	Shallow	B	62
B2	Overpass	9.00	40.00	Elastomeric	Shallow	B	60
K2	Overpass	10.60	35.00	Elastomeric	Shallow	A,B,D	60
OWO	Overpass	9.00	50.00	Elastomeric	Shallow	A,B,D	60
UMO5	Overpass	8.00	45.00	Elastomeric	Shallow	A,B,D	60
K503	Overpass	2.50	80.00	Elastomeric	Shallow	C	59
K202	Overpass	4.50	80.00	Elastomeric	Shallow	B	58
K206	Overpass	4.00	80.00	Elastomeric	Shallow	B	58
K505	Overpass	2.70	60.00	Elastomeric	Shallow	C	58
K212	Overpass	6.00	60.00	Elastomeric	Shallow	B	55
K402	Overpass	2.00	80.00	Elastomeric	Shallow	B	55
K404	Overpass	3.50	70.00	Elastomeric	Shallow	B	55
K207	Overpass	3.10	80.00	Elastomeric	Shallow	B	54
K410	Overpass	2.00	12.00	Elastomeric	Shallow	B	54
O207	Overpass	8.70	50.00	Elastomeric	Shallow	A,B,D	53
UMO7	Overpass	8.60	45.00	Elastomeric	Shallow	B	53
UMO6	Overpass	7.60	45.00	Elastomeric	Shallow	B	50
K303	Overpass	4.50	70.00	Elastomeric	Shallow	B	49
K305	Overpass	5.00	75.00	Elastomeric	Shallow	B	49
K414	Overpass	2.00	50.00	Elastomeric	Shallow	B	49

Table 2.1.9. Bridges and viaducts to be retrofitted (Directorate of 17th Division of Highways)

Name	Longitude	Latitude	Type	Project Yrs	Length (m)	Width (m)	Pier Type	Abutment Height (m)	Supported Length (cm)
SEFAKOY	28.81	41.01	Overpass	1986	52.60	9.00	Shallow	6.80	65.00
OSMANIYE	28.90	41.01	Overpass	1984	72.50	15.30	Column	7.18	45.00
YENIBOSNA	28.84	40.99	Overpass	1986	154.00	21.00	Shallow	6.65	154.00
SAGMALCILAR	28.90	41.04	Viaduct	1983	522.10	31.00	Shallow	27.22	64.00
B3	28.87	41.08	Overpass	1989	103.10	9.00	Piled	11.00	180.00
K4A	28.81	41.07	Overpass	1990	40.00	13.47	Shallow	10.65	50.80
K3	28.81	41.07	Underpass	1990	52.00	38.30	Piled	9.38	48.00
V302	29.00	41.07	Viaduct	1974	861.00	31.00	Shallow	13.11	60.00
V7A	28.90	41.09	Viaduct	1989	120.00	40.00	Shallow	23.90	105.00
V7	28.85	41.07	Viaduct	1989	399.80	33.00	Shallow	37.53	90.00
M5U1	29.10	40.99	Underpass	1990	74.20	21.00	Shallow	12.00	60.00
NMO1	29.11	41.00	Overpass	1990	51.10	21.00	Shallow	11.00	100.00
K305	29.02	41.07	Overpass	1974	159.60	8.00	Shallow	5.00	75.00
V1	28.98	41.10	Viaduct	1988	402.00	36.00	Shallow	35.00	200.00
V2A	28.96	41.09	Viaduct	1989	240.00	26.00	Shallow	33.86	95.00
V2	28.96	41.08	Viaduct	1988	400.00	26.00	Shallow	40.82	115.00
OKMEYDANI	28.96	41.06	Viaduct	1989	160.00	26.00	Shallow	18.42	95.00
B3B	28.87	41.08	Underpass	1988	38.20	12.00	Shallow	10.00	60.00
KMO1	29.09	40.98	Overpass	1990	69.40	21.00	Shallow	11.00	80.00
LMV1	29.03	41.09	Viaduct	1989	363.60	40.00	Shallow	26.00	80.00
RMO1	29.12	41.03	Viaduct	1990	67.10	21.00	Shallow	8.00	100.00
BOGAZICI BRIDGE	29.04	41.05	Suspension	1973	1560	33.40	Steel		
FATIH SULTAN MEHMET BRIDGE	29.06	41.09	Suspension	1989	1510	39.40	Steel		
OLD HALIC BRIDGE	28.94	41.04	Overpass		976	31.20	Shear Wall		60.00
V408	29.03	41.05	Viaduct	1973	411	44.00	Box	38.55	60.00
V409	29.03	41.05	Viaduct	1973	362	30.80	Box	26.00	
NEW HALIC WEST SIDE	28.94	41.04							
NEW HALIC EAST SIDE	28.94	41.04							
OLD HALIC APPROACH VIADUCT	28.94	41.04							
NEW HALIC APPROACH VIADUCT -A	28.94	41.04	Viaduct		822	11.00			
NEW HALIC APPROACH VIADUCT -B	28.94	41.04	Viaduct		822	11.00	Shear Wall		

Table 2.1.10. Bridges and viaducts to be retrofitted (Directorate of 17th Division of Highways)

Name	Type	Support Type	Foundation Type	Soil Type	Target Ground Acceleration	Design Ground Acceleration	Seismic Performance
SEFAKOY	Overpass	Elastomeric	Shallow	Z3	0.4	0.05	D
OSMANIYE	Overpass	Elastomeric	Shallow	Z2	0.4	0.04	D
YENIBOSNA	Overpass	Elastomeric	Shallow	Z2	0.4	0.04	D
SAGMALCILAR	Viaduct	Elastomeric	Shallow	Z3	0.3	0.05	D
B3	Overpass	Elastomeric	Pile	Z3	0.3	0.17	D
K4A	Overpass	Elastomeric	Shallow	Z1	0.4	0.17	D
K3	Underpass	Elastomeric	Piled	Z1	0.4	0.17	D
V302	Viaduct	Elastomeric	Shallow	Z2	0.3	0.05	D
V7A	Viaduct	Elastomeric	Shallow	Z2	0.3	0.17	D
V7	Viaduct	Elastomeric	Shallow	Z2	0.3	0.17	D
M5U1	Underpass	Elastomeric	Shallow	Z2	0.3	0.17	D
NMO1	Overpass	Elastomeric	Shallow	Z2	0.3	0.17	D
K305	Overpass	Elastomeric	Shallow	Z2	0.3	0.05	D
V1	Viaduct	Elastomeric	Piled	Z3	0.2	0.17	C
V2A	Viaduct	Elastomeric	Shallow	Z1	0.3	0.17	D
V2	Viaduct	Elastomeric	Shallow	Z1	0.3	0.17	D
OKMEYDANI	Viaduct	Elastomeric	Shallow	Z1	0.3	0.17	D
B3B	Underpass	Elastomeric	Shallow	Z1	0.3	0.17	D
KMO1	Overpass	Elastomeric	Shallow	Z1	0.3	0.17	D
LMV1	Viaduct	Elastomeric	Shallow	Z1	0.2	0.17	C
RMO1	Viaduct	Elastomeric	Shallow	Z1	0.2	0.17	C
BOGAZICI BRIDGE	Suspension	Steel Roll					
FATIH SULTAN MEHMET BRIDGE	Suspension	Elastomeric	Shallow				
OLD HALIC BRIDGE	Overpass	Elastomeric	Shallow				
V408	Viaduct		Shallow	B			
V409	Viaduct			B			
NEW HALIC WEST SIDE							
NEW HALIC EAST SIDE		Elastomeric					
OLD HALIC APPROACH VIADUCT		Elastomeric	Shallow Piled				
NEW HALIC APPROACH VIADUCT -A	Viaduct		Shallow Piled				
NEW HALIC APPROACH VIADUCT -B	Viaduct						

Table 2.1.11. Bridges and viaducts to be retrofitted (Directorate of 17th Division of Highways)

Name	Type	Abutment	Plastic Hinge	Confinement	Abutment Suscept.	Pier Suscept.	Liquefaction
SEFAKOY	Overpass	0.5x4	Yes	No	0	5	10
OSMANIYE	Overpass	6.85x1	Yes	No	10	5	10
YENIBOSNA	Overpass	1x5.58	Yes	No	10	5	10
SAGMALCILAR	Viaduct	1.25x2.50	Yes	No	7	5	10
B3	Overpass	1x16.24	Yes	No	5	5	10
K4A	Overpass	1x14.81	Yes	No	5	5	10
K3	Underpass	1x38.6	Yes	No	5	5	10
V302	Viaduct	1.20x1.50	Yes	Yes	7	0	10
V7A	Viaduct	7x3	Yes	No	0	0	10
V7	Viaduct	3x4.5	Yes	No	5	5	10
M5U1	Underpass	1x19.92	Yes	No	5	5	10
NMO1	Overpass	1x19.85	Yes	No	5	5	10
K305	Overpass	1.5	Yes	No	0	0	10
V1	Viaduct	7x3	Yes	No	5	0	10
V2A	Viaduct	3x3.5	Yes	No	0	5	10
V2	Viaduct	3x3.5	Yes	No	0	5	10
OKMEYDANI	Viaduct	3x3.5	Yes	No	0	5	10
B3B	Underpass	1x28.35	Yes	No	0	5	10
KMO1	Overpass	1x32.85	Yes	No	5	5	10
LMV1	Viaduct	3	Yes	No	0	0	7
RMO1	Viaduct	1x10.53	Yes	No	5	0	7
BOGAZICI BRIDGE	Suspension						
FATIH SULTAN MEHMET BRIDGE	Suspension						
OLD HALIC BRIDGE	Overpass						
V408	Viaduct						
V409	Viaduct						
NEW HALIC WEST SIDE							
NEW HALIC EAST SIDE							
OLD HALIC APPROACH VIADUCT							
NEW HALIC APPROACH VIADUCT -A	Viaduct						
NEW HALIC APPROACH VIADUCT -B	Viaduct						

Table 2.1.12. Bridges and viaducts to be retrofitted (Directorate of 17th Division of Highways)

Name	Type	Total Score	Seismic Score	Seismic Range
SEFAKOY	Overpass	10	7.50	75.00
OSMANIYE	Overpass	10	6.00	60.00
YENIBOSNA	Overpass	10	6.00	60.00
SAGMALCILAR	Viaduct	10	5.63	56.25
B3	Overpass	10	5.63	56.25
K4A	Overpass	10	5.00	50.00
K3	Underpass	10	5.00	50.00
V302	Viaduct	10	4.50	45.00
V7A	Viaduct	10	4.50	45.00
V7	Viaduct	10	4.50	45.00
M5U1	Underpass	10	4.50	45.00
NMO1	Overpass	10	4.50	45.00
K305	Overpass	10	4.50	45.00
V1	Viaduct	10	3.75	37.50
V2A	Viaduct	10	3.75	37.50
V2	Viaduct	10	3.75	37.50
OKMEYDANI	Viaduct	10	3.75	37.50
B3B	Underpass	10	3.75	37.50
KMO1	Overpass	10	3.75	37.50
LMV1	Viaduct	7	2.50	17.50
RMO1	Viaduct	7	2.50	17.50
BOGAZICI BRIDGE	Suspension			
FATIH SULTAN MEHMET BRIDGE	Suspension			
OLD HALIC BRIDGE	Overpass			
V408	Viaduct			
V409	Viaduct			
NEW HALIC WEST SIDE				
NEW HALIC EAST SIDE				
OLD HALIC APPROACH VIADUCT				
NEW HALIC APPROACH VIADUCT -A	Viaduct			
NEW HALIC APPROACH VIADUCT -B	Viaduct			

Table 2.1.13. Scores for the viaducts and bridges of Istanbul assessed with ATC 6-2

Name	Longitude	Latitude	Type	Support	Abutment	Pier	Liquefaction	Seismicity	Importance of Structure	Total Score
M3V1			Viaduct	10	6	2	0	7	10	90
V6	28.92	41.10	Viaduct	10	0	2	0	6	10	87
V5	28.93	41.10	Viaduct	10	0	2	0	6	10	87
V7	28.85	41.07	Viaduct	10	0	2	0	6	10	87
V3	28.96	41.07	Viaduct	10	0	1	5	8	8	87
V302	29.00	41.07	Viaduct	10	2	2	0	6	10	87
V408	29.03	41.05	Viaduct	8	0	2	0	6	10	80
V409	29.03	41.05	Viaduct	7	0	2	0	6	10	77
V1	28.98	41.10	Viaduct	5	0	0	5	8	9	73
V411	29.02	41.06	Viaduct	6	0	2	0	6	10	73
B1	28.84	41.06	Viaduct	5	3	5	7	7	8	72
LMV1	29.03	41.09	Viaduct	5	0	2	0	6	10	70
KMU3	29.10	40.98	Viaduct	5	3	5	3	8	8	69
V4			Viaduct	5	0	0	0	6	9	68
VMO1	29.09	41.09	Viaduct	5	0	0	3	7	8	68
V2A	28.96	41.09	Viaduct	5	0	0	0	6	9	65
V2	28.96	41.08	Viaduct	5	0	0	0	6	9	65
V7A	28.90	41.09	Viaduct	3	0	0	0	6	10	63
K1	29.08	41.02	Viaduct	5	0	0	0	6	8	63
NMU4	29.12	41.00	Viaduct	5	0	0	5	6	8	63
RMO1	29.12	41.03	Viaduct	5	0	0	5	6	8	63
RMO2	29.12	41.03	Viaduct	5	0	0	5	6	8	63
BLU1	29.01	41.08	Viaduct	5	0	0	0	6	10	63
B16	28.97	41.10	Viaduct	5	0	0	0	6	8	62

Table 2.1.14. Scores for the viaducts and bridges of Istanbul assessed with ATC 6-2

Name	Longitude	Latitude	Type	Support	Abutment	Pier	Liquefaction	Seismicity	Importance	Total Score
K521	29.03	40.99	Underpass	2	5	5	10	10	7.00	90
K407	29.02	41.06	Underpass	0	0	5	5	10	8.00	77
M5U1	29.10	40.99	Underpass	5	3	5	5	8	8.33	71
K205	28.98	41.07	Underpass	2	2	5	5	7	9.00	70
K104	28.92	41.03	Underpass	3	0	0	5	7	8.67	69
K300	28.99	41.07	Underpass	0	2	5	5	7	8.33	68
KMU4			Underpass	5	3	5	5	8	7.33	68
B15	28.97	41.10	Underpass	0	4	2	4	8	8.00	67
K511	29.06	41.00	Underpass	0	0	3	2	10	7.00	67
UMU5	29.10	41.03	Underpass	0	0	2	5	8	7.00	67
K412	29.01	41.05	Underpass	0	1	5	0	6	8.00	63
K513	29.05	40.99	Underpass	0	1	2	2	10	7.00	63
K518	29.03	40.99	Underpass	0	2	0	2	10	7.00	63
M2U2	29.05	41.09	Underpass	5	0	0	0	6	8.00	63
M302	29.08	41.09	Underpass	5	0	0	3	6	8.00	63
M5U2			Underpass	5	0	0	5	6	8.00	63
NMU2			Underpass	0	0	0	2	7	7.00	63
NMU3			Underpass	5	0	0	5	6	8.00	63
B5	28.88	41.09	Underpass	5	0	0	0	6	7.67	62
M1U1			Underpass	5	0	0	0	6	7.67	62
M1U2			Underpass	5	0	0	0	6	7.67	62
B17			Underpass	5	0	0	0	6	7.33	61
B3B	28.87	41.08	Underpass	5	0	0	0	6	7.33	61
B3C	28.87	41.08	Underpass	5	0	0	0	6	7.00	60
K201	28.95	41.05	Underpass	0	0	5	0	6	7.00	60
K208	28.97	41.06	Underpass	0	0	2	2	8	8.00	60
K211	28.97	41.06	Underpass	0	0	2	2	8	8.00	60
K502	29.05	41.03	Underpass	0	1	5	0	6	7.00	60
K504	29.05	41.02	Underpass	0	0	5	0	6	7.00	60
K501	29.04	41.04	Underpass	3	0	0	3	6	8.33	58
K203	28.96	41.06	Underpass	4	0	0	0	6	7.00	57
K210	28.97	41.06	Underpass	0	0	2	0	7	8.00	57
NMU1	29.12	41.00	Underpass	0	3	2	0	7	7.00	57
RMU1	29.12	41.03	Underpass	0	3	2	0	7	7.00	57

Table 2.1.15. Scores for the viaducts and bridges of Istanbul assessed with ATC 6-2

Name	Longitude	Latitude	Type	Support	Abutment	Pier	Liquefaction	Seismicity	Importance	Total Score
RMU3			Underpass	0	3	0	0	7	7.00	57
U208A	29.13	41.00	Underpass	0	4	2	0	7	6.00	57
UMU8	29.11	41.03	Underpass	0	0	3	0	7	7.00	57
K509	29.06	41.00	Underpass	2	0	0	0	6	9.00	55
K301	28.99	41.07	Underpass	0	0	2	0	6	8.00	53
UMU7	29.11	41.03	Underpass	0	0	2	0	7	7.00	53
K304	29.02	41.08	Underpass	0	0	2	0	6	7.00	50
K401	29.01	41.07	Underpass	0	0	2	0	6	7.00	50
K405	29.01	41.07	Underpass	0	0	2	0	6	7.00	50
UMU3A	29.08	41.03	Underpass	0	0	2	0	6	7.00	50
RMU4			Underpass	0	0	1	0	7	6.00	47
B9	28.95	41.10	Underpass	0	0	0	0	6	7.00	43

Table 2.1.16. Scores for the viaducts and bridges of Istanbul assessed with ATC 6-2

Name	Longitude	Latitude	Type	Support	Abutment	Pier	Liquefaction	Seismicity	Importance	Total Score
KMV1	29.10	40.98	Overpass	10	2	0	0	8	7.00	83
K510	29.06	41.00	Overpass	0	0	0	0	6	8.67	79
K515	29.04	40.99	Overpass	0	2	0	5	10	8.67	79
K517	29.04	40.99	Overpass	0	2	5	5	10	8.67	79
K512	29.05	40.99	Overpass	2	2	5	5	10	8.33	78
NMO1	29.11	41.00	Overpass	5	3	5	7	8	8.00	76
B11	28.96	41.10	Overpass	5	3	5	7	7	8.33	74
B12	28.97	41.10	Overpass	5	3	5	7	7	8.33	74
B13	28.99	41.10	Overpass	5	3	5	5	8	8.88	73
K101	28.91	41.02	Overpass	2	0	0	5	8	8.67	72
B21			Overpass	5	3	5	5	8	8.00	71
K102	28.92	41.03	Overpass	2	0	0	5	8	8.33	71
KMO1	29.09	40.98	Overpass	5	3	5	5	8	8.33	71
BF2	29.01	41.10	Overpass	5	0	0	0	8	8.00	70
BRO	29.01	41.10	Overpass	5	3	5	5	7	8.33	68
K103	28.92	41.03	Overpass	0	0	0	5	7	8.33	68
K106	28.93	41.03	Overpass	2	0	0	5	7	8.33	68
K204	28.97	41.06	Overpass	0	2	5	0	7	8.33	68
B14			Overpass	5	3	5	5	7	8.00	67
BF1	29.01	41.08	Overpass	6	2	0	0	6	8.00	67
RMO3			Overpass	6	0	2	0	7	7.00	67
M301	29.08	41.09	Overpass	5	0	0	3	6	8.67	65
ICO			Overpass	5	0	0	0	6	8.00	64
M101	29.03	41.09	Overpass	5	0	0	0	6	8.33	64
M401	29.11	41.07	Overpass	5	0	0	5	6	8.33	64
M501	29.12	41.02	Overpass	5	0	0	5	6	8.33	64
B19			Overpass	5	0	0	0	6	8.00	63
K4A	28.81	41.07	Overpass	5	4	5	5	8	6.00	63
M102	29.02	41.10	Overpass	5	0	0	0	6	8.00	63
M402	29.12	41.05	Overpass	5	0	0	5	6	8.00	63
B10	28.96	41.10	Overpass	5	0	0	0	6	8.33	62
B3	28.87	41.08	Overpass	5	0	0	0	6	7.67	62

Table 2.1.17. Scores for the viaducts and bridges of Istanbul assessed with ATC 6-2

Name	Longitude	Latitude	Type	Support	Abutment	Pier	Liquefaction	Seismicity	Importance	Total Score
B6	28.89	41.09	Overpass	5	0	0	0	6	7.67	62
L102			Overpass	5	0	0	0	6	7.67	62
B2	28.86	41.07	Overpass	5	0	0	0	6	7.00	60
K2	29.09	41.03	Overpass	5	3	2	0	7	6.00	60
OWO			Overpass	5	0	0	0	7	6.00	60
UMO5	29.08	41.03	Overpass	2	4	5	0	7	6.00	60
K503	29.05	41.02	Overpass	2	0	0	3	6	8.67	59
K202	28.95	41.05	Overpass	3	0	0	0	6	8.33	58
K206	28.98	41.07	Overpass	2	2	0	0	7	8.33	58
K505	29.06	41.02	Overpass	2	0	0	3	6	8.33	58
K212	28.96	41.06	Overpass	2	0	0	0	6	8.67	55
K402	29.01	41.07	Overpass	2	0	0	0	6	8.67	55
K404	29.01	41.07	Overpass	2	0	0	0	6	8.67	55
K207	28.96	41.06	Overpass	2	0	0	0	6	8.33	54
K410	29.02	41.06	Overpass	2	0	0	0	6	8.33	54
O207			Overpass	0	3	2	0	7	6.00	53
UMO7	29.10	41.03	Overpass	2	0	4	0	6	6.00	53
UMO6	29.09	41.03	Overpass	2	0	3	0	6	6.00	50
K303	29.00	41.07	Overpass	0	0	0	0	6	8.67	49
K305	29.02	41.07	Overpass	0	0	0	0	6	8.67	49
K414	29.01	41.06	Overpass	0	0	0	0	6	8.67	49

Table 2.1.18. Performance of the natural gas pipe lines associated with the peak ground velocity (BU – ARC)

Peak Ground Velocity (cm/sn)	Pipeline Length (km)	Repair Rate (re/km) (Ductile Material)	Total Amount of Repairs along the Pipeline (Ductile Material)
10 - 20	61	0.01	1
20 - 30	171	0.04	7
30 - 50	414	0.12	50
50 - 70	56	0.3	17
70 - 90	23	0.57	13
Total	725	1.04	88

Table 2.1.19. The expected damage of natural gas pipelines resulting from the scenario earthquake. (JICA – IMM)

ID	District Name	Pipeline Length (km)	Damage Score			
			Model A		Model C	
2	Avcılar	119	1,254	29%	1,426	33%
3	Bahçelievler	240	2,457	22%	2,866	25%
4	Bakırköy	194	2,208	28%	2,490	31%
5	Bağcılar	171	679	14%	807	17%
7	Beyoğlu	101	449	12%	510	14%
8	Beşiktaş	217	551	6%	656	7%
10	Bayrampaşa	163	1,981	17%	2,246	19%
12	Eminönü	39	90	18%	100	20%
13	Eyüp	86	456	14%	498	16%
14	Fatih	214	3,620	24%	4,033	26%
15	Güngören	150	1,374	19%	1,653	23%
16	Gaziosmanpaşa	182	544	7%	631	8%
17	Kadıköy	462	1,532	9%	1,868	10%
18	Kartal	295	1,145	14%	1,272	16%
19	Kağıthane	111	114	6%	133	7%
20	Küçükçekmece	252	1,811	22%	2,023	24%
21	Maltepe	251	944	12%	1,096	14%
22	Pendik	186	649	16%	725	18%
23	Sarıyer	171	130	2%	151	2%
26	Şişli	173	466	6%	574	7%
28	Tuzla	5	26	18%	28	19%
29	Ümraniye	207	275	4%	330	5%
30	Üsküdar	520	1,121	5%	1,325	6%
32	Zeytinburnu	88	620	29%	700	33%
902	Esenler	75	491	14%	589	16%
Total		4,670	24,985	14%	28,729	16%

Table 2.1.20. The expected damage of sanitary water pipelines resulting from the scenario earthquake (JICA – IMM)

ID	District Name	Pipeline Length (km)	Damage Scores	
			Model A	Model C
1	Adalar	59	20	21
2	Avcılar	187	65	66
3	Bahçelievler	321	107	115
4	Bakırköy	207	98	97
5	Bağcılar	391	87	98
6	Beykoz	189	16	21
7	Beyoğlu	220	46	54
8	Beşiktaş	234	24	31
10	Bayrampaşa	207	48	55
12	Eminönü	126	37	41
13	Eyüp	262	60	69
14	Fatih	321	110	122
15	Güngören	169	64	70
16	Gaziosmanpaşa	372	23	30
17	Kadıköy	527	71	85
18	Kartal	394	62	71
19	Kağıthane	264	21	27
20	Küçükçekmece	523	130	142
21	Maltepe	352	48	56
22	Pendik	432	59	69
23	Sarıyer	276	13	19
26	Şişli	247	15	21
28	Tuzla	138	29	32
29	Ümraniye	293	14	19
30	Üsküdar	471	32	42
32	Zeytinburnu	180	66	70
902	Esenler	205	31	36
Total		7,568	1,395	1,577

Table 2.1.21. The expected damage of waste water pipelines resulting from the scenario earthquake (JICA – IMM)

ID	District Name	Pipeline Length (km)	Damage Scores	
			Model A	Model C
2	Avcılar	229	85	85
3	Bahçelievler	422	152	162
4	Bakırköy	183	93	91
5	Bağcılar	474	121	136
6	Beykoz	318	20	28
7	Beyoğlu	271	48	57
8	Beşiktaş	286	28	36
10	Bayrampaşa	Insufficient Data		
12	Eminönü			
13	Eyüp			
14	Fatih			
15	Güngören			
16	Gaziosmanpaşa			
17	Kadıköy	613	87	103
18	Kartal	398	71	81
19	Kağıthane	289	57	70
20	Küçükçekmece	525	152	165
21	Maltepe	402	63	73
22	Pendik	245	44	51
23	Sarıyer	307	12	18
26	Şişli	261	17	23
28	Tuzla	145	44	47
29	Ümraniye	343	21	28
30	Üsküdar	463	36	46
32	Zeytinburnu	Insufficient Data		
902	Esenler			
Total		6,174	1,152	1,299

Table 2.1.22. The Performance of sanitary water pipe lines with the peak ground velocity

Peak Ground Velocity (cm/sn)	Pipeline (km)	Repair Rate (re/km) (Brittle Material)	Repair Rate (re/km) (Ductile Material)	Total Amount of Repairs along the Pipeline (Brittle Material)	Total Amount of Repairs along the Pipeline (Ductile Material)
10 - 20	182	0.04	0.01	7	2
20 - 30	354	0.14	0.04	49	14
30 - 50	578	0.4	0.12	231	69
50 - 70	120	1	0.3	120	36
70 - 90	31	1.9	0.57	58	18
Total	1265	3.48	1.04	465	139

Table 2.1.23. The performance of the wastewater pipelines with the peak ground velocity

Peak Ground Velocity (cm/sn)	Pipeline Length	Repair Rate (re/km) (Brittle Material)	Repair Rate (re/km) (Ductile Material)	Total Amount of Repairs along the Pipeline (Brittle Material)	Total Amount of Repairs along the Pipeline (Ductile Material))
10 - 20	89	0.04	0.01	3	1
20 - 30	212	0.14	0.04	28	8
30 - 50	206	0.4	0.12	82	25
50 - 70	146	1	0.3	146	44
70 - 90	33	1.9	0.57	63	19
Total	683	3.48	1.04	322	97

Table 2.1.24. Distribution of the various components of the electric power transmission system on intensity regions

Intensity	VI	VII	VIII	IX	Total
Operating Stations	5	17	23	16	61
Stations under construction	1	4	5	2	12
Operating Centrals	0	0	0	2	2
Transmission Line - (380 KV) Length (km)	37	190	57	0	284
Transmission Line - (154 KV) Length (km)	6	130	145	99	380
Transmission Line - (34.5 KV) Length (km)	62	158	137	42	399

Table 2.1.25. Distribution of telephone exchange buildings on intensity regions

Intensity	VI (MMI)	VII(MMI)	VIII(MMI)	IX(MMI)	Total
Telephone Exchange	1	89	28	21	139

Development of the Industry in Istanbul

Istanbul is believed to be one of the oldest continuously occupied metropolises in the world. In recent decades it has experienced unprecedented growth. Between years 1950 and 2000 the population has increased at least nine-fold from about one million to nine million. Today, Istanbul houses one-eighth of the total population and one half of the industrial potential of Turkey. According to Tümertekin (1997) 40% of the industrial facilities in Turkey are located in the city and 30% of the population working in the industry lives in Istanbul. Figure 2.1.59 illustrates the growth of the city starting from the Byzantine era and extending until 1994.

The industry in Istanbul started to grow considerably in the 1950's. Although industrial areas were marked and planned in the land-use plans prepared for the city, mainly lack of control and authority hindered those plans to be fully followed. There are industrial areas, which have been surrounded by residential buildings with the growth of Istanbul in time and thus were left within city limits, such as Topkapı, Şişli, Ayazağa, Bomonti, Güneşli, Maltepe and Ümraniye.

On the Asian side the majority of industrial facilities are located in Maltepe. The new investments are mainly in areas towards Izmit starting in Tuzla to the east of Maltepe. They are positioned along the two highways connecting Istanbul with Ankara. On the European side the industry is generally to the north of the E-5 highway. Topkapı, Zeytinburnu, Bayrampaşa, Rami, Halkalı, Sefaköy, Güngören, Avcılar are examples which have grown as industrial areas within the last 30 years (Figure 2.1.60). The industrial areas and their relations with other functions in Istanbul have been presented in Figure 2.1.61. The figure is a compilation from Istanbul Master Plan "Nazım Planı" (1995). Recently localities in neighbor cities have become areas, where industrial investments from Istanbul have been focused, such as Çorlu, Çerkezköy and Lüleburgaz on the European side and Gebze on the Asian side. A location map for Istanbul is presented in Figure 2.1.62.

Industrial Elements at Risk

Industrial facilities consist of buildings, their contents, pipelines, storage areas and/or tanks, silos, chimneys, cranes, conveyor systems, etc. From the design engineer's point of view, an industrial facility has three major components; building structures (1) office buildings, production buildings, storage areas, (2) non-building structures (cranes, tanks, silos, chimneys, towers etc.), (3) nonstructural elements (architectural, mechanical, electrical).

Buildings

Prefabricated structures exist widely in the industrial facility stock in Turkey. All building constructions should comply with the Turkish Earthquake Resistant Design Code. Many industrial facilities are designed by international teams, thus their design may conform with international codes (such as UBC, EuroCode, IBC2000) as well. For buildings to be retrofitted for improved earthquake performance there does not exist any official code in Turkey. In isolated instances FEMA273 or FEMA356-Prestandarts have been used in such cases.

Non-Building Structures

Non-building structures are tanks, vessels, pressurized spheres, silos, chimneys, stacks, trussed towers, cooling towers, inverted pendulum type of structures, signs and billboards, bins and hoppers and storage racks supported at grade. Among those, elevated liquid tanks, pressurized tanks, bunkers, silos, chimneys, cooling towers, inverted pendulum type structures and storage racks are classified as non-building structures by the Turkish earthquake resistant design code, the dynamic analysis of which can be performed based on the guidelines presented in the code. Comprehensive codes are missing for the retrofit of these structures.

Nonstructural Elements

Certain nonstructural elements such as exterior cladding, partition walls etc. and mechanical and electrical components such as heating and air conditioning systems, elevators etc., are considered as architectural components. In United States, the most widely used design requirements for non-structural components are the UBC 1997 and IBC 2000.

Nonstructural elements are covered in Section 6.11 of the Turkish Earthquake Resistant Design Code (1998). The code distinguishes between the treatment of the architectural elements and the mechanical and electrical components. The architectural components such as exterior cladding, partition walls etc are designed for earthquake forces computed by the multiplication of the weight of the element with the spectral acceleration factor calculated by multiplying the seismic zone coefficient with the importance of the building.

For the mechanical and electrical components the design forces are obtained by multiplying the weight of the component, effective ground acceleration parameter, building importance factor and the height factor, which varies between 1 and 2. The code states that the equipment will be considered in the overall dynamic analysis of the building if its weight exceeds 0.2 x the weight of the floor it is installed in. Fire suppression systems, emergency power equipment and heating systems, as well as all equipment connected to infill walls, are to be designed for two times the forces found by the procedure explained above. For industrial structures, if the floor acceleration spectra are available, they can be used instead of the procedure described above. The Turkish Earthquake Design Code does not take into account local soil factor, near-fault effects, the ductility of the element, and component dynamic amplification in the design of nonstructural components and their connection.

2.1.16 Inventory of Industrial Facilities

Industrial facilities in Istanbul can be classified into two groups as small to medium sized facilities and large-scale facilities.

Small to Medium Size Industrial Facilities

The inventory of small to medium size facilities is based on Turk-Telekom and Istanbul Municipality data. The inventory of large-scale facilities relies on data from local municipalities, special reconnaissance surveys and questionnaires covered in the following chapter.

Turk Telekom Data

The maps of Turkish Telecommunication Association (Turk-Telekom) have been an invaluable source of information for the compilation of data regarding various facility stocks in Istanbul. The maps (usually of 1/1000 scale) were on raster image format for the European side and on paper format for the Asian side of Istanbul. For some dense areas 1/500 maps were also available. All the maps have been visually screened by a group of students and engineers and data have been compiled for small to medium size industrial facilities. The categorized sectors are given in the following table.

Table 2.1.26. Description of Industrial Sectors

SECTOR No.	DESCRIPTION
Sector 1	Mining, Construction, Ceramics, Glass
Sector 2	Commercial Facilities, Food and Beverage
Sector 3	Textile, Leather
Sector 4	Wood products and furniture, Agriculture
Sector 5	Chemical and Petroleum Products
Sector 6	Iron- steel and the other metals
Sector 7	Machinery and automotive
Sector 8	Transportation and telecommunication

A total of 1060 maps for the European side and 1573 maps for the Asian side of the city of Istanbul have been screened. The resolution of the maps allowed for a reliable data compilation. Table 2.1.27 gives the distribution of the sectors regarding the districts of Istanbul.

Table 2.1.27. District-based distribution of small to medium size industrial facilities

DISTRICT	Sect.1	Sect.2	Sect.3	Sect.4	Sect.5	Sect.6	Sect.7	Sect.8
Avcilar	77	58	94	44	47	26	26	3
Bagcilar	156	118	137	55	51	44	44	25
Bahcelievler	62	53	112	31	43	39	31	28
Bakirkoy	67	25	16	17	17	11	11	1
Bayrampasa	18	3	8	1	2	3	3	0
Besiktas	31	7	2	0	7	1	1	3
Beykoz	31	35	8	14	10	5	3	0
Beyoglu	115	26	10	9	16	18	11	11
Eminonu	1	0	5	0	0	1	1	1
Esenler	18	11	9	2	1	4	4	3
Eyup	22	25	15	3	12	12	9	0
Fatih	1	5	4	2	4	1	0	1
Gaziosmanpasa	102	182	24	21	75	26	17	0
Gungoren	95	2	27	2	8	7	3	0

Kadikoy	23	53	10	21	10	6	23	2
Kagithane	38	18	21	8	36	17	21	1
Kartal	50	117	49	47	68	62	101	3
Kucukcekmece	122	66	87	47	53	44	52	10
Maltepe	18	41	7	17	23	14	27	2
Pendik	32	53	10	16	53	33	39	6
Sariyer	21	32	3	2	10	3	13	3
Sisli	104	39	30	15	44	8	24	10
Sultanbeyli	5	19	4	10	3	4	3	2
Tuzla	18	22	20	8	23	9	17	11
Umraniye	37	89	24	27	38	55	42	3
Uskudar	22	66	11	22	9	3	11	1
Zeytinburnu	10	7	13	2	7	3	6	2

Municipality Data (1:1,000 GIS Maps)

Another source of information for the compilation of the industrial facility database has been obtained from the Metropolitan Municipality of Istanbul. GIS maps of 1:1,000 scales, gathered from aerial photographs reveal the locations of factories in the city. These locations are illustrated in Figure 2.1.63.

These maps are provided Figure 2.1.65 through Figure 2.1.72 respectively for industrial facilities in sectors 1 to sector 8 obtained on the basis of the Turk-Telekom maps. The pie charts of the distribution of these sectors overlaid on the intensity map are provided in Figure 2.1.73.

Large Size Industrial Facilities and Industrial Parks

This section is related with the identification of industrial inventory and sectoral occupancy of large size industrial facilities. The term, "large size industrial facility", corresponds to a single large size individual facility, or to an industrial park encompassing a multitude of industrial facilities in all sizes, in and around Istanbul in regions exposed to high earthquake hazard. The risk associated with these facilities need to be analyzed separately due to their economical and/or hazardous importance. The earthquake risk estimation of these facilities can also be related to the observed earthquake performance of industrial facilities during the past earthquakes.

The survey given here is by no means complete. The localities of these essential industrial facilities/complexes were identified and several approaches have been used for their survey. The data provided through, (1) Helicopter flights, were used to identify the building and non building structural components, of the industrial facilities, and (2) Personal contacts, trade unions and municipalities, were gathered and complied together to yield the industrial information in terms of sectoral occupancy and land use.

Water front structures

Turkey has several ports and berthing facilities; the ports are classified into three groups: governmental, municipal and private ports. The first group, general-purpose governmental ports, is operated by State Economic Enterprises; the Turkish State Railways (TCDD) ports, all of which are connected with the railway network; the Turkish Maritime Organization (TDI) ports. These two State Economic Enterprises are under the control of the Ministry of Transport, but they are acting as independent enterprises. The second group is municipal ports, which are managed by the municipalities. These ports are comparatively small and are general limited to a small volume of coastal traffic serving the local needs of provincial towns. The third group is made up of private ports. These ports are mostly confined to the particular needs of industrial plant but allowed to be used by third parties too.

Liquid storage tanks, power generation units, cranes, winches, waste water treatment plants, crude oil, and pressurized LNG storage tanks are the most important components of the water front structures in the regions of Dilovası, Tuzla, Ambarlı and Marmara Ereglisi.

Industrial Parks

There exists a number of industrial parks in Gebze and vicinity, İkitelli, Hadımköy and Çerkezköy and vicinity.

Large Size Industrial Facilities

The localities of these essential industrial facilities/complexes were identified and several approaches have been used for their survey. There exist chemical, petrochemical, steel mills, metal forming, cement and other large size facilities in Gebze, Darıca, Bayramoglu, Silivri and Buyuk Cekmece regions.

Helicopter Surveys

Two flights were organized. Both of them have started and terminated in Çamlıca. The routes of these flights are represented by the red and blue colored lines in Figure 2.1.74**.** Since the industrial facilities are concentrated in some specific locations, the organization of this chapter is based on the information of critical facilities at selected localities, numbered from, A1 to A4 on the Asian side and, E1 to E6 on the European side, (Figure 2.1.74). These industrial concentrations correspond to the following localities.

These industrial concentrations correspond to the following localities given in Figure 2.1.74.

- A1: Dilovası and vicinity
  Ports (1), Hazardous (1) , Large size (1)
- A2: Gebze and vicinity
  Industrial Parks (1) , Large size (2)
- A3: Tuzla and vicinity
  Ports (2)+Industrial Parks (2)
- A4: Haydarpaşa and Moda
  Ports (3)

and,

- E1: Ambarlı and vicinity
  Ports (4) – Hazardous (2)
- E2: Marmara Ereğlisi and vicinity
  Ports (5) – Hazardous (3)
- E3: Çerkezköy –Çorlu and vicinity
  Industrial Parks (3)
- E4: Hadımköy and vicinity (Industrial Parks (4)
- E5: İkitelli and vicinity
  Industrial Parks (5)

The sectoral distribution at these industrial concentrations vary from, petro chemical, chemical, metal, transportation, textile, leather, machinery to steel mills.

- Dilovası (A1): Port structures, storage tanks, chimneys, power generation.
- Gebze (A2): Storage tanks, power generation, steel mills.
- Tuzla- coastal line (A3): Port structures, cranes.
- Tuzla- (North) (A2): Waste water treatment plant – and industrial parks building structures.
- Haydarpaşa Custom A(4): Port structures and cranes.
- Ambarlı Petro Chemical (E1): Port structures, hazardous structures and cranes.
- Marmara Ereğlisi (E2): LNG storage tanks and port structures.
- Çerkezköy and Çorlu (E3): Textile industry and industrial parks.

Çatalca, Hadimköy and İkitelli (E4 and E5) –

Earthquake Intensity Zonation of Industrial Facilities

The locations of the large size industrial parks, where helicopter and, other surveys have been carried out, are indicated in Figure 2.1.75 on the intensity distribution map. Enlarged detail of this figure is provided in Figure 2.1.76. Owing to their proximity to the Main Marmara Fault, special attention will be paid to the water front structures in Dilovası (A1), Tuzla (A3) and Kaynarca (A3), on the Asian side, and Ambarlı (E1) and Marmara Ereğlisi (E2) on the European side. Both due to its close distance to the fault and the high concentration of industrial facilities, the Tuzla, Gebze and Dilovası region is considered to carry the highest risk. The numbers of industrial facilities for each sector located in different intensity zones are given in Table 2.1.28.

Table 2.1.28. Numbers of Industrial Sectors in Each Intensity Zone

INTENSITY ZONE	Sect.1	Sect.2	Sect.3	Sect.4	Sect.5	Sect.6	Sect.7	Sect.8
VI – VII	188	357	70	72	159	87	81	11
VII – VIII	393	339	148	113	184	147	196	43
VIII – IX	656	490	517	204	296	202	259	69
IX	160	113	110	72	75	47	48	17

Total number of industrial facilities in each intensity zone is given in Table 2.1.29 at below.

Table 2.1.29. Numbers of small to medium size industrial facilities from municipality data in each intensity zone

Intensity Zone	VI – VII	VII – VIII	VIII – IX	IX
Industrial Facilities	294	1044	1874	234

2.1.17 Vulnerabilities of Typical Facilities and Components

ATC-13 presents a very good example in the compilation of losses to a very wide variety of structures and systems and in presenting associated loss functions in terms of intensity. In ATC 13, the buildings are classified in two ways, 1) engineering classification based on the building size, structural system and type, 2) social function, a classification based on the economic function of the building. The engineering classification has buildings, pipelines, chimneys, storage tanks, cranes, conveyor systems, on- and offshore towers, waterfront structures and equipment. The matrices are valid for facilities with standard construction. Nonstandard construction is classified as construction more susceptible to earthquake damage. Such buildings can be treated by shifting the P_{DSI} one or two intensities down. ATC-13 suggests the shift of the P_{DSI} by two intensities down for nonstandard construction where a lack of earthquake resistant design has been observed or is to be expected.

The industrial classes are part of the social function classification used in ATC-13. They encompass activities such as heavy and/or light fabrication and assembly, food and drugs processing, metal and minerals processing, high technology, construction and petroleum. Loss of function/restoration time relationships are provided for each of the industrial classes. Equipment classes are the residential, office, electrical, mechanical, high technology equipment, laboratories and vehicles.

Vulnerability functions for direct damage and economic losses for a series of lifelines can be found in ATC-25 in terms of intensity. ATC-25 covers highways, railroads, airports, ports and harbors, electric power transmission systems; gas and liquid fuel transmission pipelines, emergency broadcast facilities, hospitals and water supply systems, as well as components comprising these systems. For each of these lifelines vulnerability functions are developed (1) to define direct losses in terms of repair costs expressed as a fraction of total replacement cost of the facility as a function of ground motion given in intensities and (2) restoration curves to estimate the time required to restore damaged facilities to their pre-earthquake state. The curves provided in ATC-25 are based on regression analysis of real damage data from ATC-13 enhanced largely by expert opinion. To describe the approach taken in ATC-25 to produce system vulnerabilities, several cases are summarized from ATC-25 below:

Ports/Cargo Handling Equipment
Warehouse buildings, office buildings, waterfront structures, aprons, scales, tanks, cranes, silos, pipelines, and railroad terminals.

Pore water pressure build-up and excessive pressures lead to deformation of walls and backfill material, liquefaction and associated damages, submarine sliding and associated deformations on the ports. Damages due to shaking are due to loss of bearing and lateral spreading. All the damage types have been observed at the ports and shore structures in the Izmit bay, during the 1999 Kocaeli earthquake.

Fossil Fuel Power Plants:
Power plants fueled either by coal or oil, medium-rise steel braced frame structures are classified in this group. Damage types are as follows: overstressed connections and buckled braces in steel structures, pounding of turbine pedestals against the surrounding floor of the generation building and damage of the turbine generators, sway of boilers causing damage to the support structure, expansion guides and internal tubes of the boiler, water and fuel tanks may have buckled walls, ruptured attached piping, stretched anchor bolts or collapse, piping may be damaged due to due to differential movement or pounding with unanchored equipment, coal conveyors may get misaligned and severely damaged, unstrained batteries and other equipment may fall off their supports, damage in many cases other equipment nearby, transformers may slide and topple.

Hydroelectric Power Plants:
Dams (earthfill, rockfill or concrete) and associated equipment such as water-driven turbines, control house and equipment, substation with transformers, switching equipment. Generally good performance has been observed in past earthquakes, fill dams can experience failures, unless unanchored the equipment performs well, unanchored instruments, batteries,

equipment, may slide and topple leading to substantial damage, consequent damages may occur to piping, substation equipment, especially ceramics may be very vulnerable.

Terminal Reservoirs/Tanks:
Underground, on-ground or elevated storage tanks or impounding reservoirs, underground reservoirs are typically reinforced or prestressed concrete with concrete or wood roofs; on-ground storage tanks are anchored or unanchored tanks supported at ground level, they are steel, reinforced or prestressed concrete or wood; elevated tanks are supported by single or multiple columns, have a cylindrical or elliptical shape are mostly braced.

Underground tanks receive damage at the columns supporting the roof structure, cracking of walls, sloshing damage to roofs may be observed; in case of liquefaction empty tanks may float upward; steel on-ground tanks may be damaged due to the failure of welding between the base and the walls, buckling of tank wall, rupture of attached piping due to sliding or rocking of the tank, implosion of the tank due to rapid loss of contents, differential settlement, bolt and rivet failures, failure of connections between shell and roof, total collapse may be observed; concrete tanks may be damaged due to failure of columns supporting the roof, cracking, sliding may occur at construction joints; elevated tanks fail due to inadequate bracing, column buckling, anchorage failure may occur.

Treatment plants:
Complex facilities including a number of reinforced concrete buildings, underground or on-ground reinforced concrete tank structures and basins. Components include trickling filters, clarifiers, chlorine tanks, re-circulation and wastewater pumping stations, chlorine storage and handling, tanks and pipelines, wastewater is conveyed in concrete channels; mechanical, electrical and control equipment and piping in buildings.

Soil failure is observed frequently, since they are usually on flat and low-lying ground, differential settlement, pipe failures, generic building damage, damage to unanchored equipment, crack or collapse of basin walls may be observed.

Refineries
Complex facilities with many different types of buildings, equipment, and structures; tank storage consists of unanchored vertical storage tanks supported on ground, horizontal pressurized storage tanks supported on steel or concrete plinths, spherical tanks supported on legs; steel stacks anchored to concrete foundations, extensive runs of ground and elevated piping, pumps, heat exchangers, furnaces, motors, generators, transformers, switchgear, motor control centers, control equipment, cooling towers, refueling stations, administrative buildings, wharf loading facilities. Fire is the primary concern for refineries (TUPRAS refinery case after the Kocaeli earthquake), loss of contents of any tanks lead to fire, toxic release, air emissions are dangerous, large cylindrical steel tanks can suffer wall buckling, bottom rupture, wall-to-bottom weld failure, roof damage, differential settlement, pipe failure. Piping systems can be damaged, mechanical equipment with inadequate anchorage may slide or topple, buildings can experience generic structural damage, and stacks or columns may be damaged at the anchor bolts.

Air Transportation System:
Air transportation systems consist of terminals, and runways and taxiways. Air transportation terminals include terminal buildings, control towers and hangars. Generally control towers are reinforced concrete shear-wall buildings, whereas hangars are typically steel structures. The main terminal building can be either RC or steel. Equipment at air terminals is control, gate and x-ray equipment and standard electrical and mechanical equipment to be found in any commercial facility. Fuel tanks and underground pipelines are used for airplane refueling.

Expected damage includes generic building damage and equipment damage, ranging from broken windows, cracks in walls and frames to partial and total collapse. Unanchored and improperly anchored equipment may slide and topple causing damage to attached piping as well. Gate equipment may become misaligned and inoperable. Fuel tanks and pipes can rupture or be damaged. Tank damage may range from wall buckling, settlement, ruptured piping to loss of contents and even collapse leading to fires and explosions. Airports in low-lying areas, alluvial plains in most cases, may suffer damage due to flooding or tsunamis as well. Runway damage depends on the strength of the underlying soil. They can be damaged due to liquefaction and compaction. Damage includes misalignment, uplift, cracking or buckling of pavement.

Two national airports exist in Istanbul to serve international and domestic lines: Atatürk International Airport on the European side and Sabiha Gokcen International Airport on the Asian Side. In addition there are military airports and smaller size civil airports which serve smaller private or commercial aircrafts, and also serve for educational purposes such as Hazerfan airport to the immediate north of the Büyükcekmece Lake and Samandira airport on the Asian side.

Transmission Lines:
Transmission lines can be underground or on-ground. Towers are usually steel supported by concrete footings, which may or may not be on piles. Most transmission lines are ac. For dc long-distance lines there are converter stations at each end of the line. Transmission towers are more susceptible to secondary damage due to landslides, rock falls, and liquefaction and other ground failures, which also hold for underground lines. Conductors supported by towers can slap against each other and burn down.

Transmission Substations:
Transmission substations in the electrical system receive power at high voltages and step it down to lower voltages for distribution. They consist of one or more control buildings, steel towers, conductors, ground wires, underground cables and extensive electrical equipment including banks of circuit breakers, switches, wave traps, buses, capacitors, voltage regulators and massive transformers.

Control buildings may experience generic building damage ranging from dropped suspended ceilings and cracks in walls to partial and total collapse. Un- or improperly damaged anchored control equipment may slide or topple, experiencing damage and damaging nearby piping, equipment etc. Steel towers are usually damaged only due to soil failures. Porcelain bushings, insulators, and lightning arresters are brittle and vulnerable to shaking and are damaged frequently. Transformers are large, heavy pieces of equipment that are frequently un- or inadequately anchored. They can shift, tear the attached conduit, break bushings, damage radiators and spill oil. Transmission substations are to be found in many large-scale industrial facilities.

Tanks
In general most tanks are unanchored cylindrical tanks resting directly on ground. They can be of welded, bolted or riveted steel. Foundations may consist of sand or gravel or a concrete ring wall supporting the shell.

Damage mechanisms include failure of welding between base plate and wall, buckling of tank wall (elephant foot), rupture of attached rigid piping due to sliding or rocking of the tank, implosion of the tank resulting from rapid loss of contents and associated negative internal pressure, differential settlement, anchorage failure or tearing of tank wall, failure of roof-to-shell connection or damage to roof seals for floating roofs (and loss of oil), failure of shell at bolts or rivets because of tensile hoop stresses and total collapse. Torsional rotations of floating roofs may damage attachments such as guides, ladders etc.

Theoretically it is always possible to use the damage data provided in ATC-13 and the approach used in ATC-25 to derive vulnerability relationships for the industry classes used in our analysis, assuming that the design and construction quality of industrial systems do not change significantly from country to country.

Vulnerabilities for Human Losses

Casualty Vulnerabilities Due to Building Damage

The earthquake casualties for total deaths can be expressed by the following general equation (Spence and Coburn, 1997):

$K = K_s + K' + K_2$

where K_s is the fatalities due to structural damage, K' is fatalities due to non-structural damage and K_2 arises from follow-on hazards, such as fire, landslide etc.

The above equation can also be used to express all levels of injury severity, such that:

$K_i = K_{si} + K'_i + K_{2i}$

where K_i is the i^{th} level of severity as defined in Table 2.1.30.

Table 2.1.30. Injury severity description as given by HAZUS99

Injury severity	**Injury description**
Severity 1	Injuries requiring basic medical aid without requiring hospitalization
Severity 2	Injuries requiring a greater degree of medical care and hospitalization, but not expected to progress into a life threatening status
Severity 3	Injuries that pose an immediate life threatening condition if not treated adequately and expeditiously. The majority of these injuries result because of structural collapse and subsequent collapse or impairment of the occupants.
Severity 4	Instantaneously killed or mortally injured

Casualty rates for R/C structures in Turkey are given in Table 2.1.31.

Table 2.1.31. Casualty rates for Reinforced Concrete Structures

Injury Severity	Casualty Rates for R/C structures (%)			
	Low Damage	Medium Damage	Heavy Damage	Very Heavy Damage
Severity 1	0.05	0.2	1	10-50
Severity 2	0.005	0.02	0.5	8-15
Severity 3	0	0	0.01	4-10
Severity 4	0	0	0.01	4-10

The percentages given in the tables above should be multiplied by the number of people in the building at the time of earthquake.

It should be noted that the casualties in industrial facilities will be controlled not necessarily by collapsed buildings, but rather by collateral hazards such as fire, explosion and chemical substance releases. As such, the assessment of the casualties will be highly facility-specific and no general assessment of casualty ratios can or should be assessed.

Expected General Losses and Conclusions
Total industrial buildings located in Istanbul mean damage ratios ar given in Table 2.1.32.

Table 2.1.32. Mean Damage Ratios for Buildings in Industrial Facilities

EMS-98 I or MMI	VII	VIII	IX
Mean Damage Ratio	3%	8%	20%

It should be noted that these loss ratios are associated large variations depending on the physical properties of the industrial facility and the possibility of consequential hazard related losses. The following average losses can be predicted in reference to the factual loss information. “Equipment and Machinery” and “Stock” losses, MMI IX intensity zones for each industrial sector, originally defined by Table 2.1.33.

Table 2.1.33. Mean Loss Ratios for ”Equipment and Machinery” and “Stock” for MMI IX

Sector No	Description	Equipment and Machinery Loss	Stock Loss
1	Mining, Construction, Ceramics, Glass Min	10%	10%
2	Commercial Facilities, Food and Beverage	10%	10%
3	Textile, Leather	10%	30%
4	Wood products and furniture, Agriculture	10%	10%
5	Chemical and Petroleum Products	30%	35%
6	Iron- steel and the other metals	2%	2%
7	Machinery and automotive	2%	2%
8	Transportation and telecommunication	10%	2%

Although very limited empirical data exists at intensity level VIII for losses at industrial facilities, “Equipment and Machinery” and “Stock” losses would be realized at about 1/3 to 1/4 of the average losses associated with intensity level IX.

In Table 2.1.34, the percentage of industrial facilities in intensity zones IX and VIII are about respectively 7%-12% and 40%-60%. By considering this distribution with the mean damage ratios for buildings given in Table 2.1.32, the overall loss for all industrial buildings in Istanbul and immediate vicinity can be estimated to be between %6 and %8 as the result of the scenario earthquake. The approximate overall losses for all sectors will be about 2.5% for Equipment-Machinery and about 3% for Stocks.

Table 2.1.34. Total Losses for ”Equipment and Machinery” and “Stock” in Intensity Regions

Sector No	Description	Equipment and Machinery Loss		Stock Loss	
		IX	VIII	IX	VIII
1	Mining, Construction, Ceramics, Glass Min	0.011	0.013	0.011	0.013
2	Commercial Facilities, Food and Beverage	0.009	0.011	0.009	0.011
3	Textile, Leather	0.013	0.017	0.039	0.050
4	Wood products and furniture, Agriculture	0.016	0.012	0.016	0.012
5	Chemical and Petroleum Products	0.033	0.035	0.033	0.035
6	Iron- steel and the other metals	0.002	0.002	0.002	0.002
7	Machinery and automotive	0.002	0.002	0.002	0.002
8	Transportation and telecommunication	0.012	0.014	0.002	0.003

In intensity IX zones the empirical data from Turkey indicates that the business interruption losses, expressed as a ratio of annual turnover, varies between 5%-10% for almost all industrial sectors. In intensity VIII regions the Business Interruption losses varies between 2-3% for almost all sectors. For both intensity regions, anomalous exceptions exist for “Chemical”, “Textile” and “Automotive” sectors where the business interruption losses have reached 50%, 30% and 15% respectively. These figures indicate that the average business interruption loss for all industrial sectors in Istanbul will vary between 2% and 3% in relation to their total annual turnover. These loss ratios can be converted to monetary losses if the value of the portfolio is known.

It should be noted that these loss figures are obtained just to provide an indication of the order of losses to be experienced by the industrial facilities in Istanbul after the occurrence of the scenario earthquake. They are based on gross assumptions and across the table generalizations.

It can be said in general that the earthquake damage observed in Turkey are not really different from industrial damage observed in worldwide earthquakes. Large storage tanks, pipelines, transmission lines and precision machinery seem to be particularly susceptible to damage through earthquakes. Due to the high relative value of contents, their vulnerability and dependence on structural performance are key to assessing loss potential especially for Heavy Manufacturing Facilities. Port and Harbor facilities are particularly susceptible to submarine landslide or ground settlement due to liquefaction that may occur during earthquakes. In addition, all processes that involve a substantial risk of explosion, for example processes in the petrochemical industry and processes involving molten metal, should be examined particularly.

The greatest risk from an earthquake is that to life safety. Building code requirements in most counties, including Turkey, are set with the intent of protecting the life of the occupants. The building is allowed to experience damage but without any collapse thereby allowing for the safe evacuation of occupants with minimum risk of casualties. However, in large earthquakes, the damage to the industrial buildings and other structures may cause costly to repairs to the machinery and equipment they house and may also lead to consequential damages such as fire and chemical spills. Since most of the revenue generated by industrial facilities is related to the products and services they provide, rather than the physical assets of the company, any significant interruption to the production of these goods and services because of this damage will also have an adverse affect on the business. The risk of business interruption is an important economic reason for controlling the damage from and following earthquakes. As such, the design (or seismic retrofit) of industrial facilities should preferably be based on performance-based methodologies with the intent on controlling the structural and non-structural damage.

Large earthquakes have an ability to find holes in the technology and weak points in the structural design and equipment. To detect these weak spots in a given industrial facility mandates a through investigation of the vulnerability to earthquakes and particularly its expected performance under exposure to the Marmara Earthquake. A first order assessment can be conducted by using the hazard and vulnerability information contained in this report. However, it should be noted that, the vulnerability relationships are essentially intended for a large number of inventories. For individual elements at risk the vulnerabilities encompass large uncertainties. For a rigorous assessment of the performance engage professionals and have your facility inspected by an earthquake engineer. The next steps should be the development, prioritization and implementation of strengthening measures for buildings, storage tanks, silos, stacks, electrical equipment and other critical components of the facility.

Inspection of the facility for entities or equipment that can move, fall, topple or spill during an earthquake is an important task. Appropriate measures needs to be taken to secure them and to have incompatible chemicals stored separately. Installation of fire protection systems and earthquake early warning/alarm systems to automatically shutoff critical processes in the facility is an important measure to avoid fire, explosion and/or damages during strong earthquakes.

Preparation of a contingency plan to be followed in the event of earthquake is essential in order to minimize damage and restore operations as soon as possible. Among other issues that relate to the continued operation, the contingency plan should encompass: Restoration of the supply of power if the normal supply systems are not functioning; Supply of raw materials if the suppliers are affected; Repair and/or replacement of damaged equipment and machinery in a timely manner.

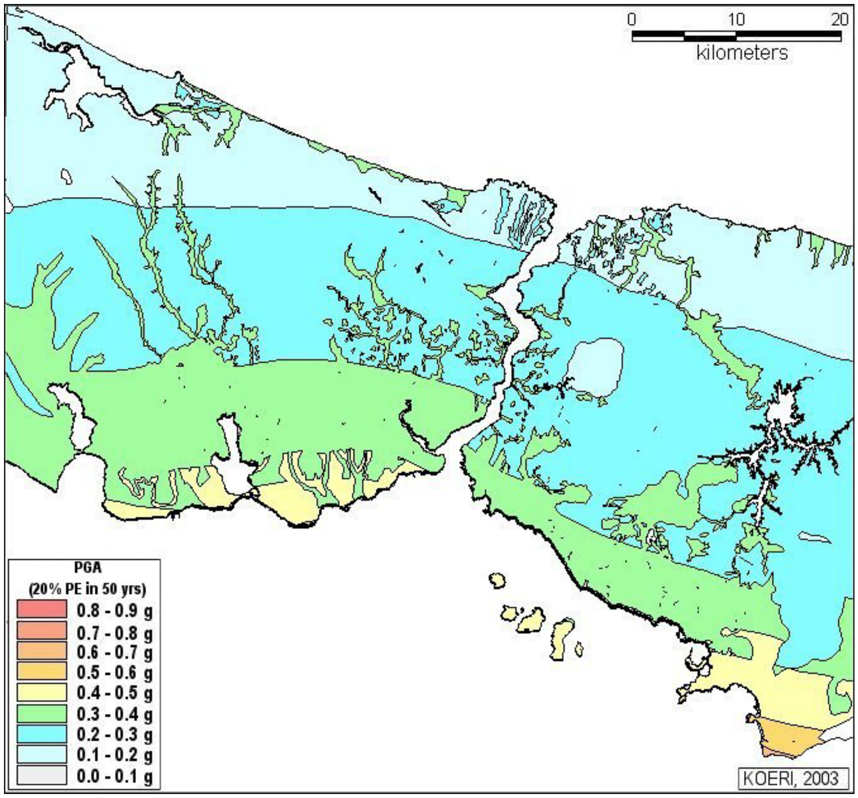

Figure 2.1.1. Site dependent peak ground accelerations with 20% probability of exceedance in 50 years.

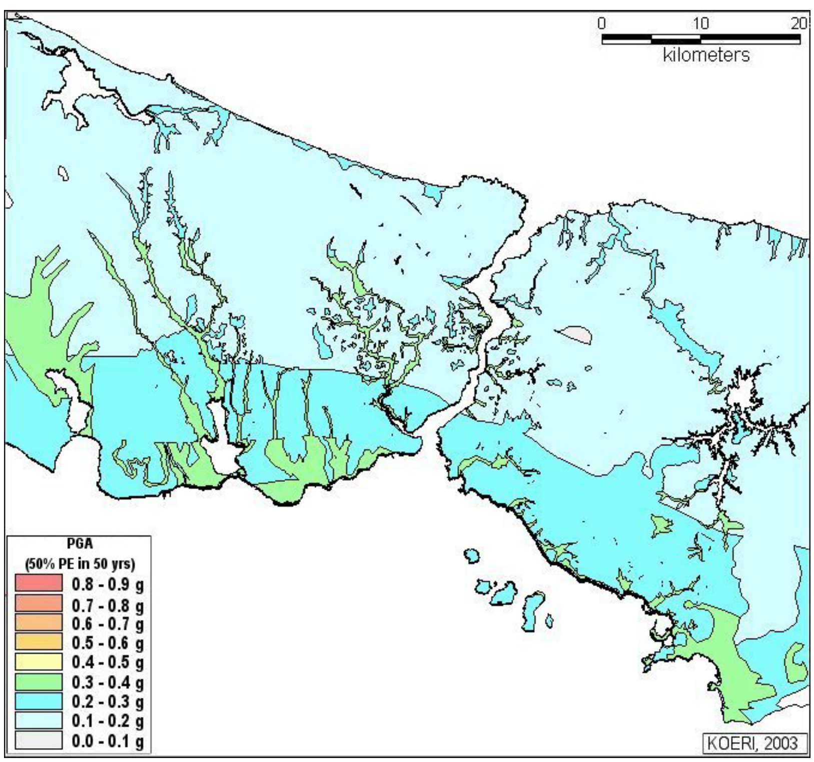

Figure 2.1.2. Site dependent peak ground accelerations with 50% probability of exceedance in 50 years.

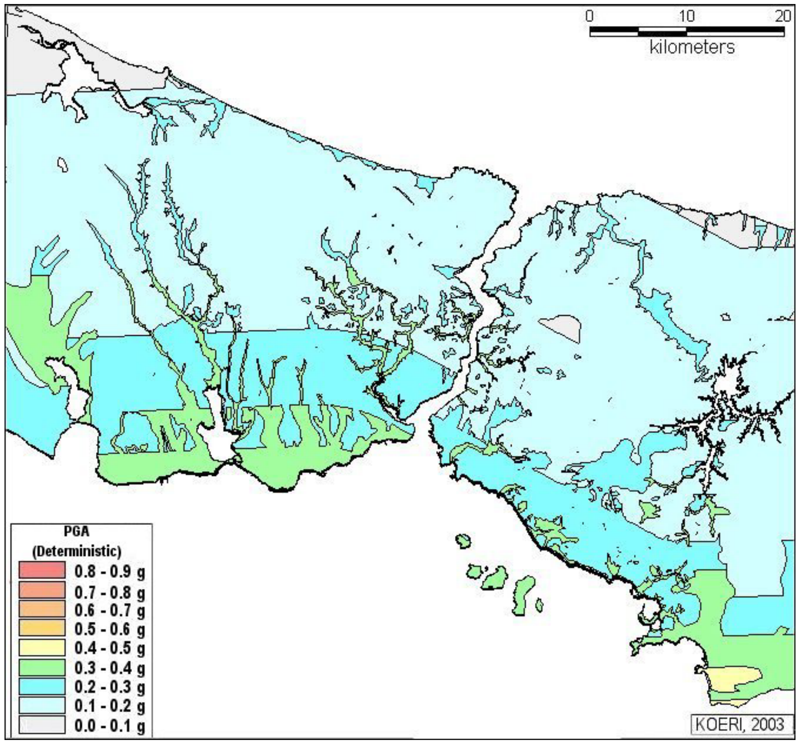

Figure 2.1.3. Site dependent deterministic peak ground accelerations

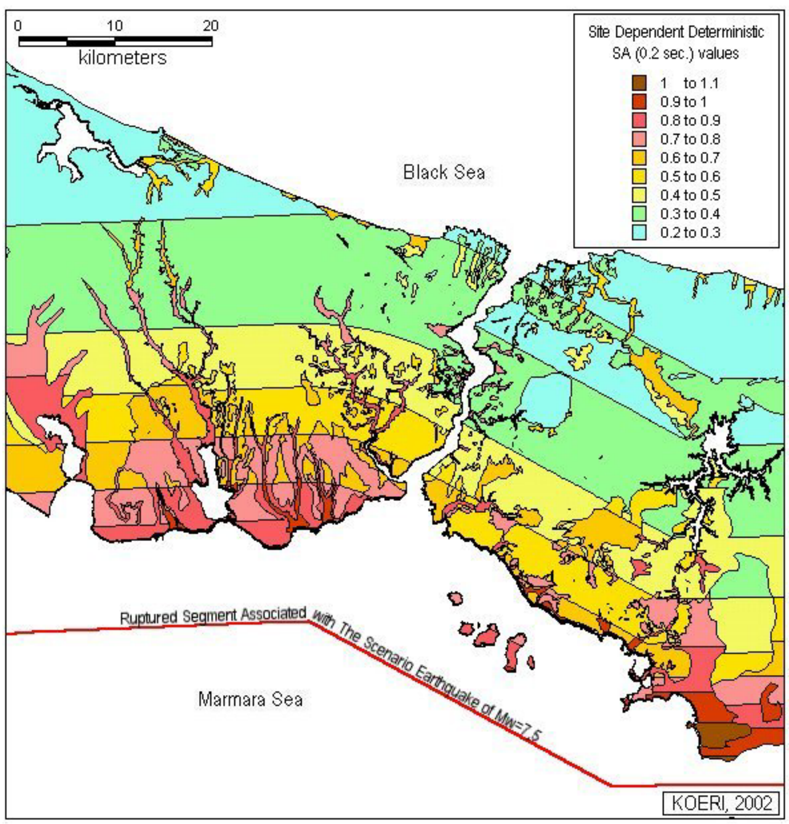

Figure 2.1.4. Site dependent deterministic spectral accelerations for T=0.2 sec.

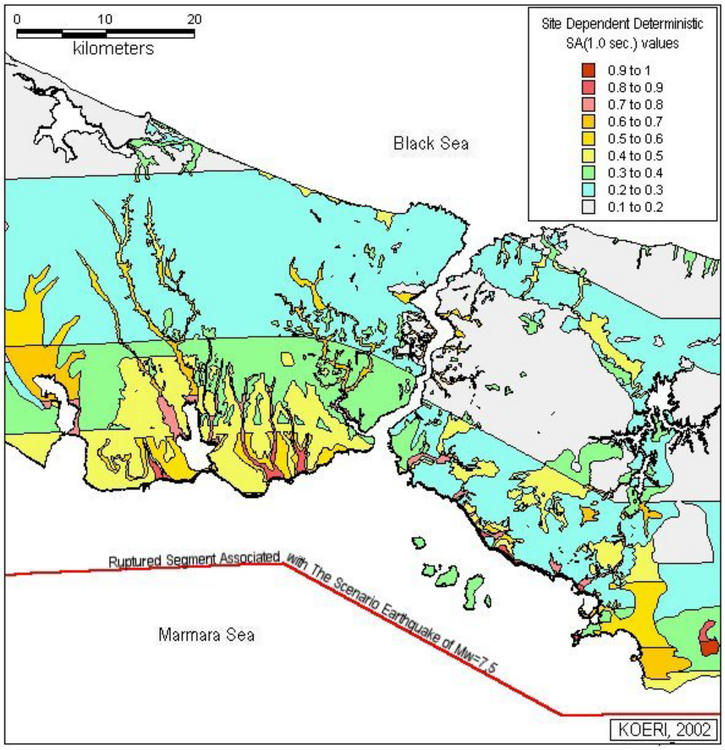

Figure 2.1.5. Site dependent deterministic spectral accelerations for T=1.0 sec.

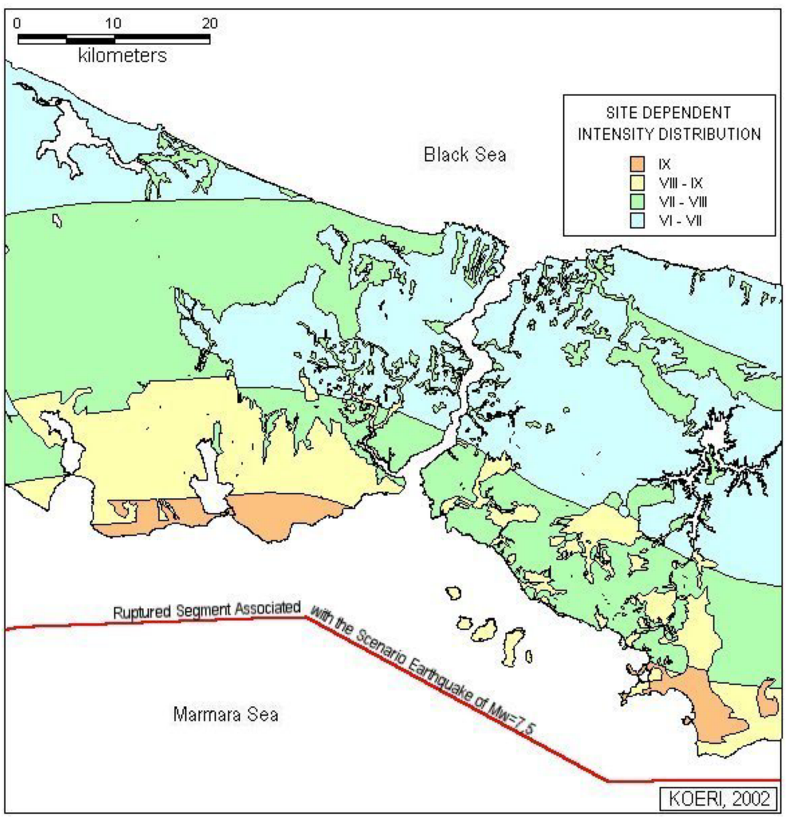

Figure 2.1.6. Site dependent deterministic intensity distribution.

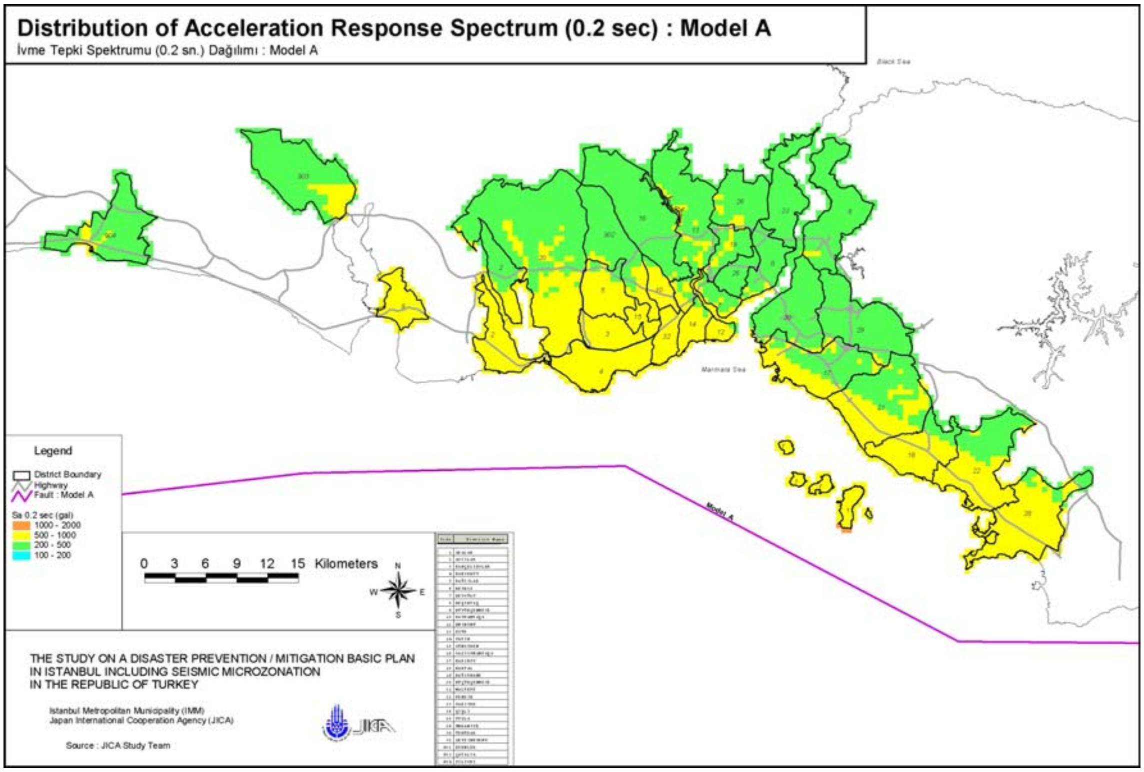

Figure 2.1.7. Distribution of acceleration response spectrum (0.2 sec): Model A (JICA – IMM study).

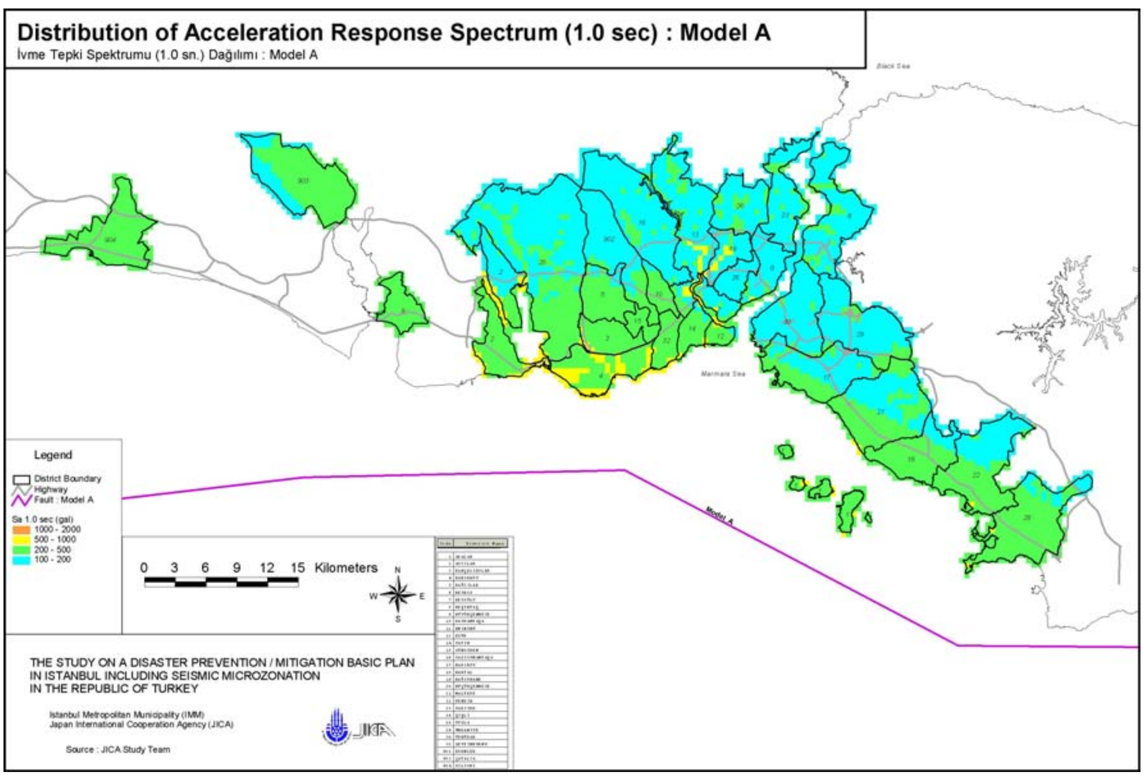

Figure 2.1.8. Distribution of acceleration response spectrum (1.0 sec): Model A (JICA – IMM study).

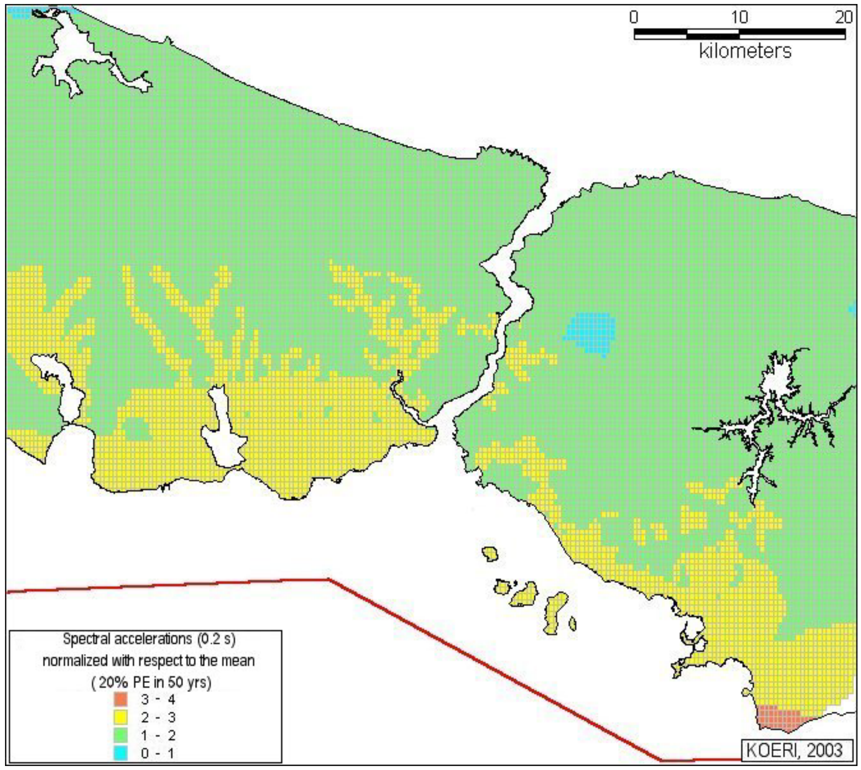

Figure 2.1.9. Distribution of the spectral accelerations (T=0.2 sec) with 20% probability of exceedence in 50 years, normalized with respect to the mean.

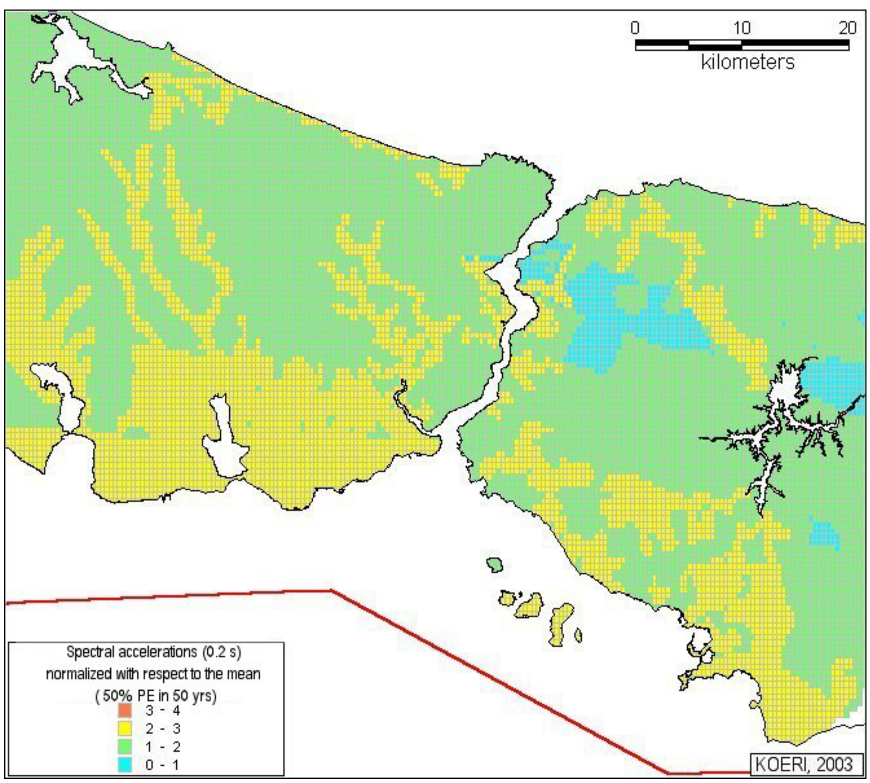

Figure 2.1.10. Distribution of the spectral accelerations (T=0.2 sec) with 50% probability of exceedance in 50 years, normalized with respect to the mean.

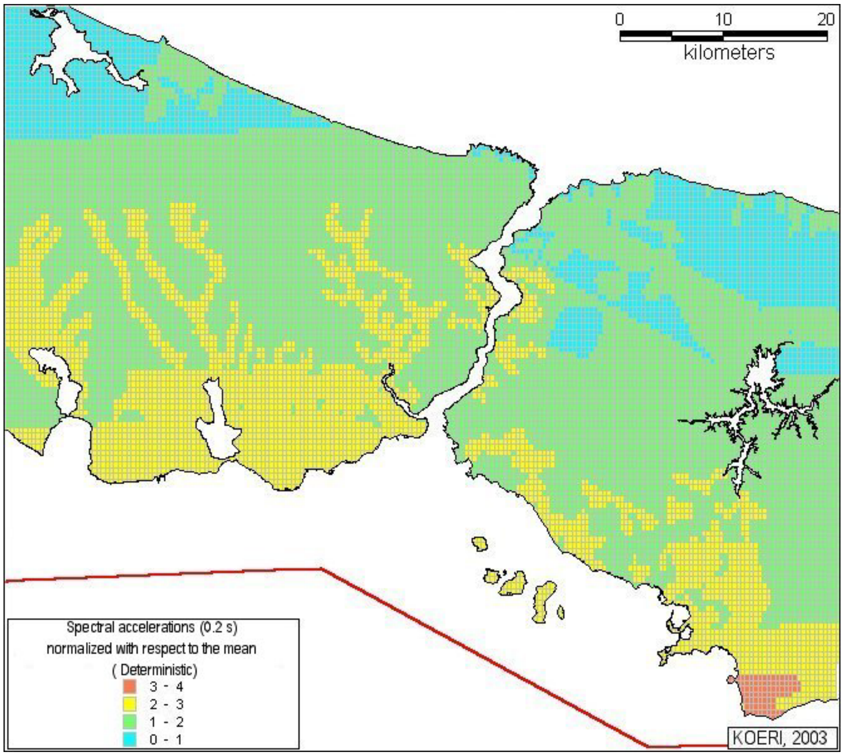

Figure 2.1.11. Distribution of the deterministic spectral accelerations (T=0.2 sec) normalized with respect to the mean.

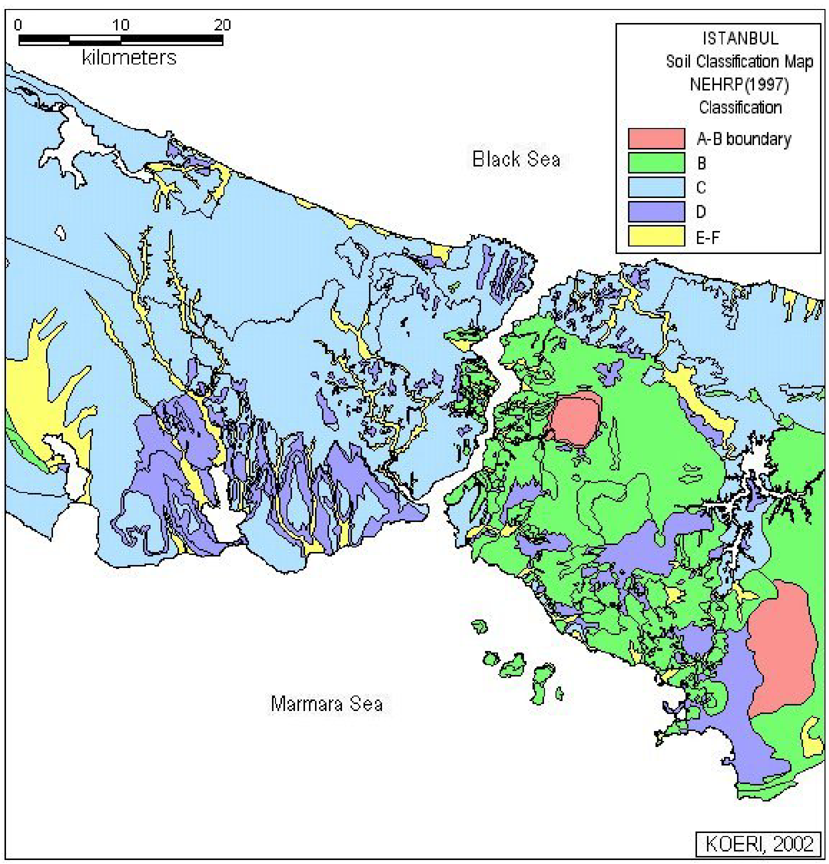

Figure 2.1.12. Soil Classification map of Istanbul (BU – ARC study)

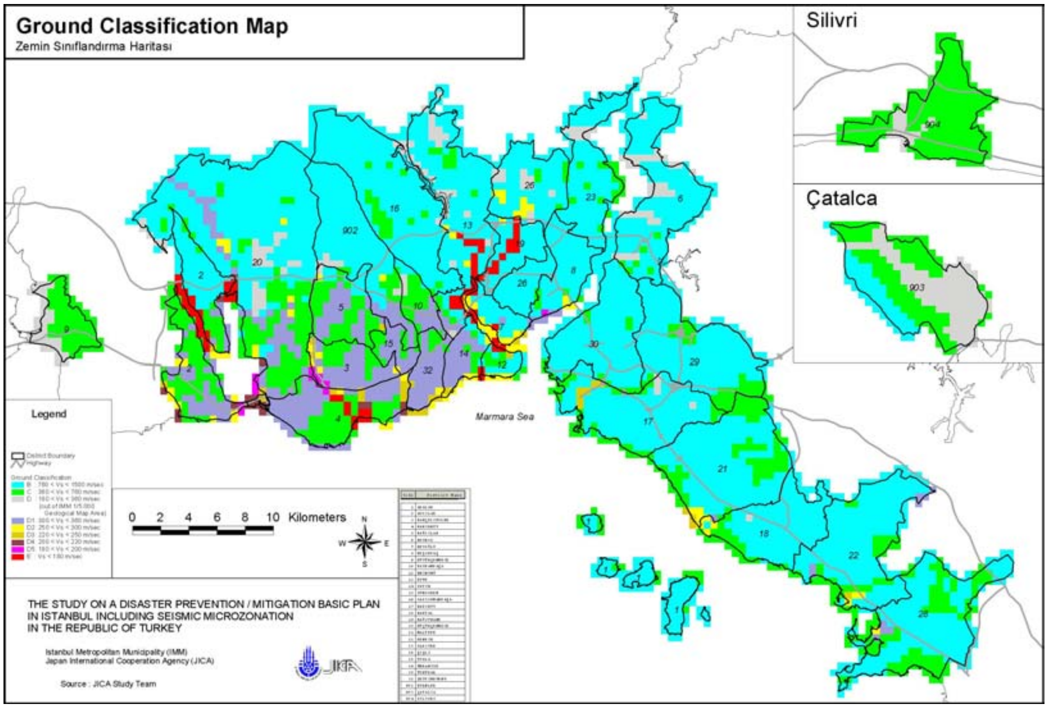

Figure 2.1.13. Soil Classification map of Istanbul (JICA – IMM study)

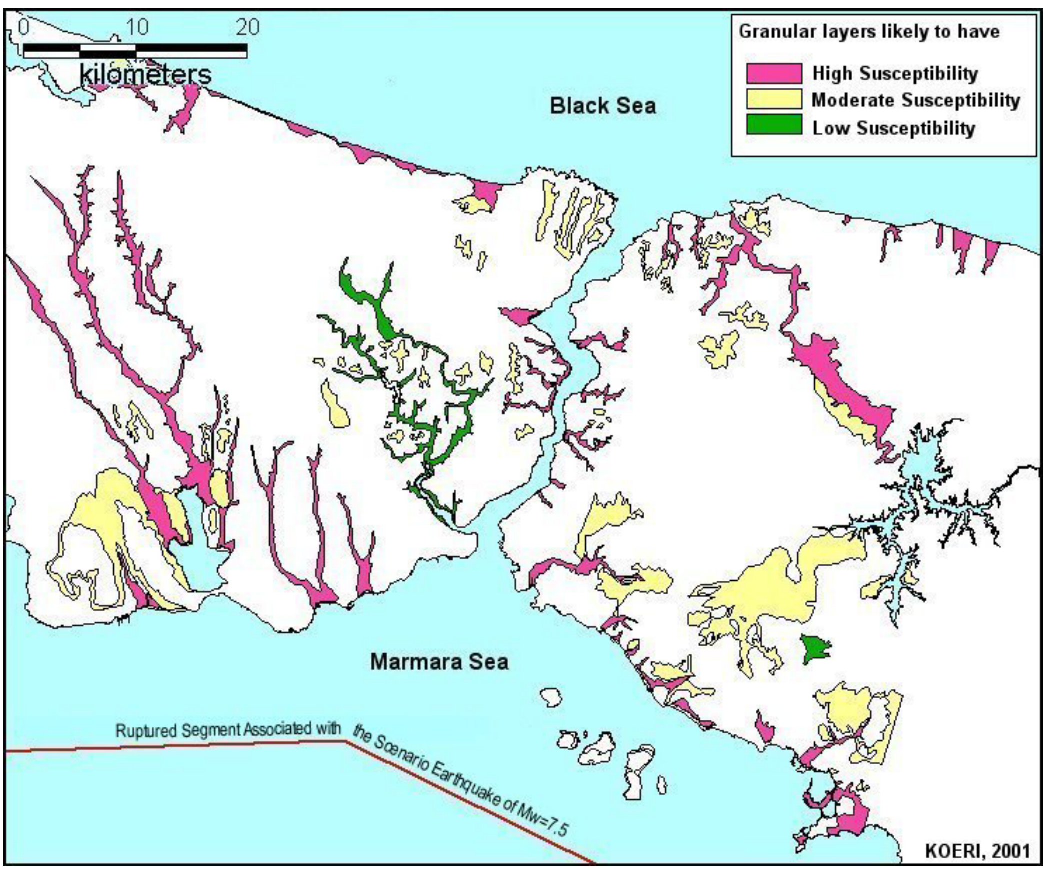

Figure 2.1.14. Liquefaction susceptibility map (BU – ARC study)

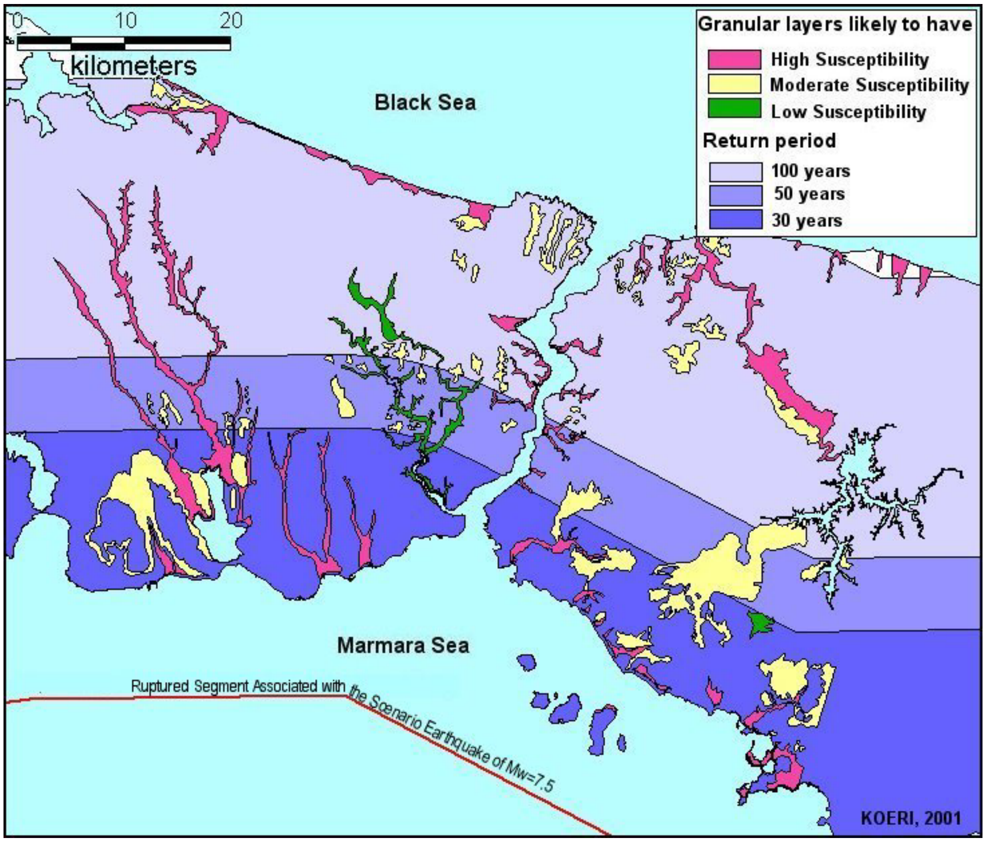

Figure 2.1.15. Liquefaction potential map (BU – ARC study)

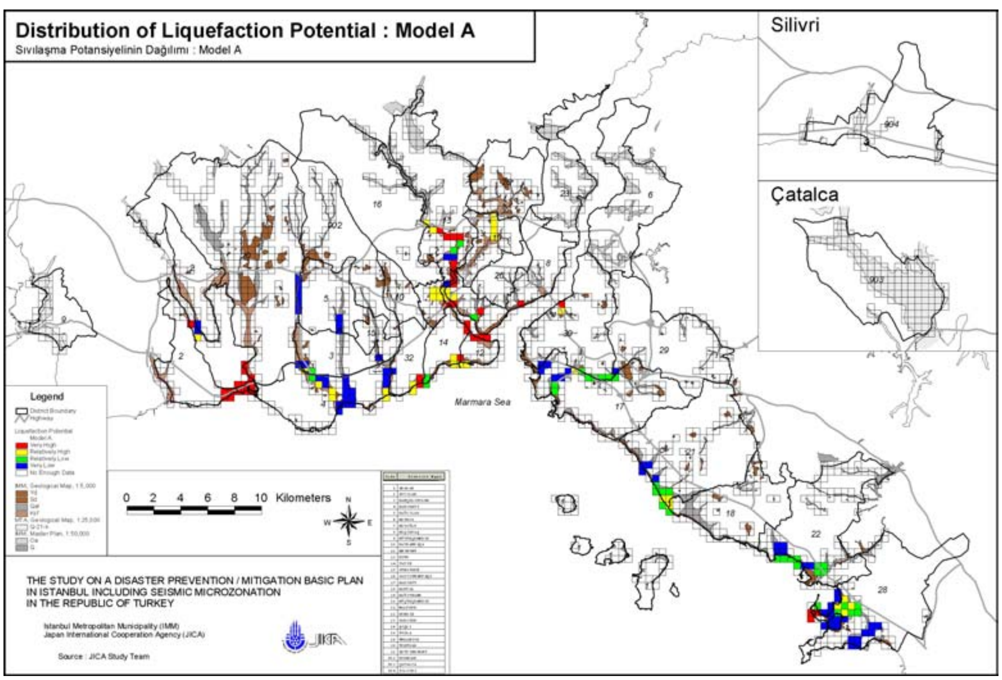

Figure 2.1.16. Liquefaction potential map (JICA – IMM study)

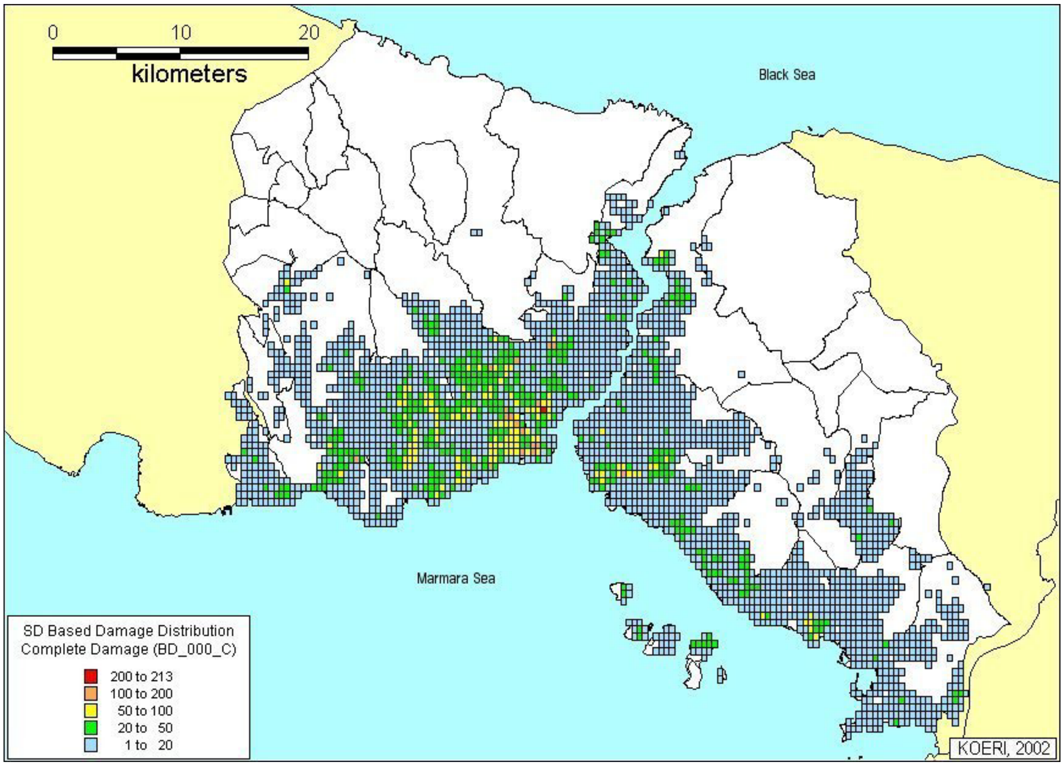

Figure 2.1.17. Distribution of the collapsed buildings (based on the scenario earthquake and spectral displacement based vulnerability curves, BU – ARC study)

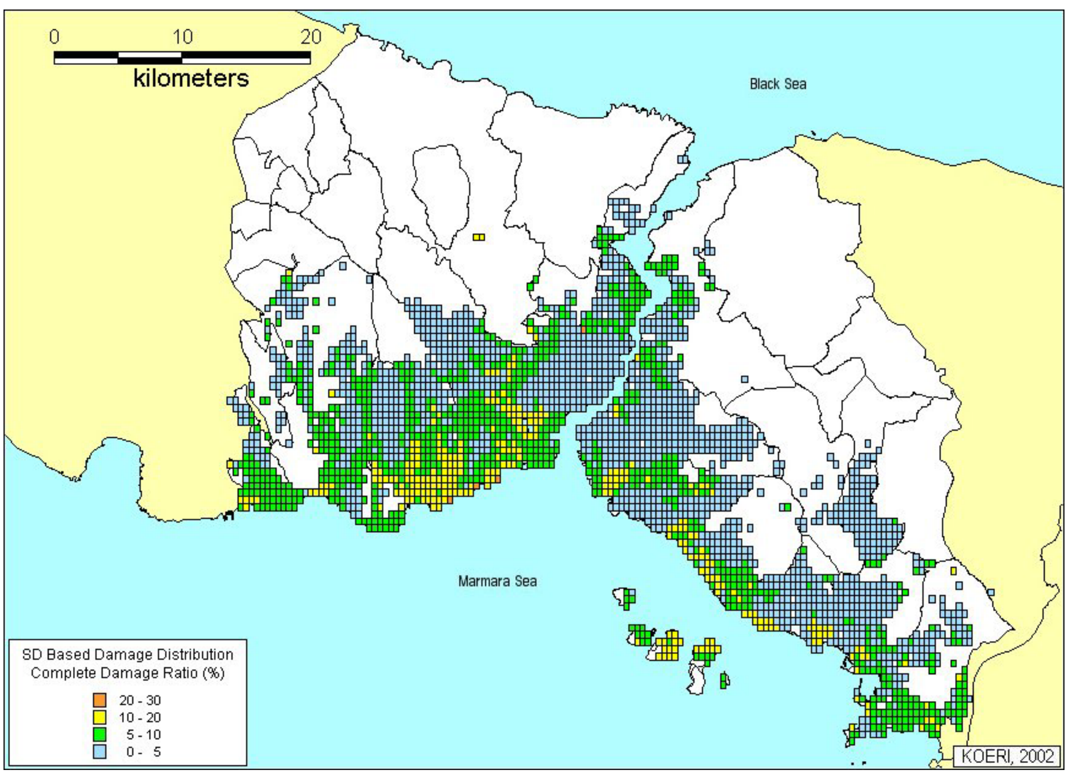

Figure 2.1.18. Ratio of the collapsed buildings to the total number of buildings (based on the scenario earthquake and spectral displacement based vulnerability curves, BU – ARC study)

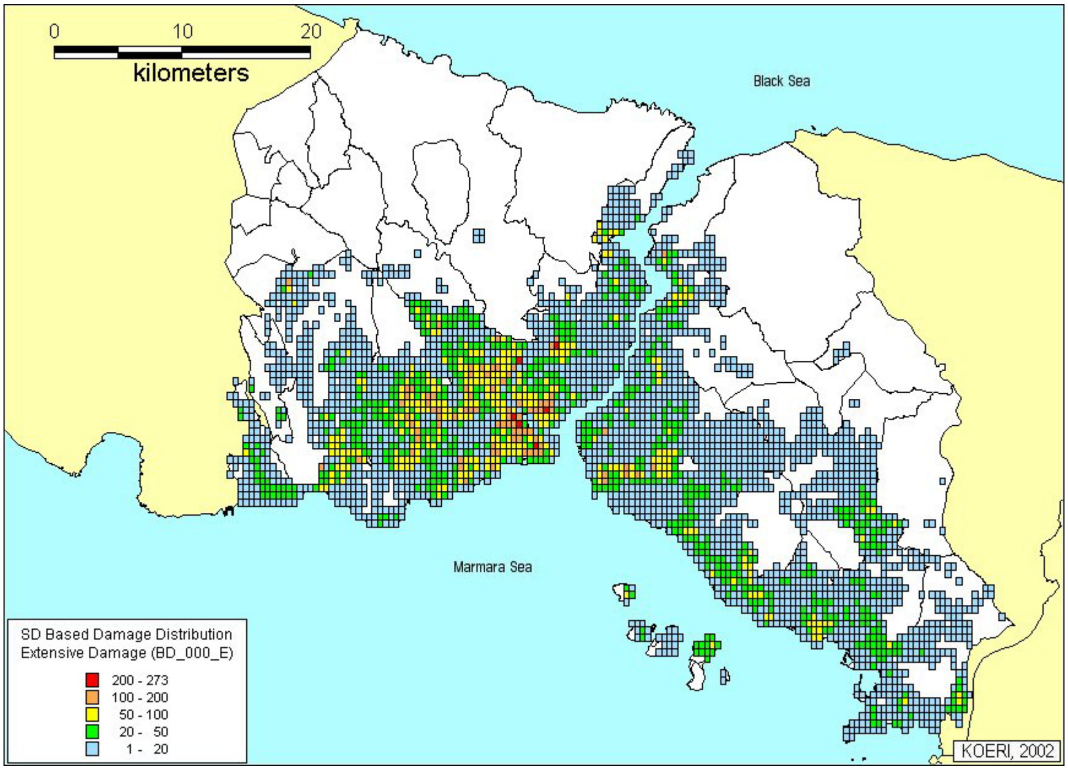

Figure 2.1.19. Distribution of the heavily damaged buildings (based on the scenario earthquake and spectral displacement based vulnerability curves, BU – ARC study)

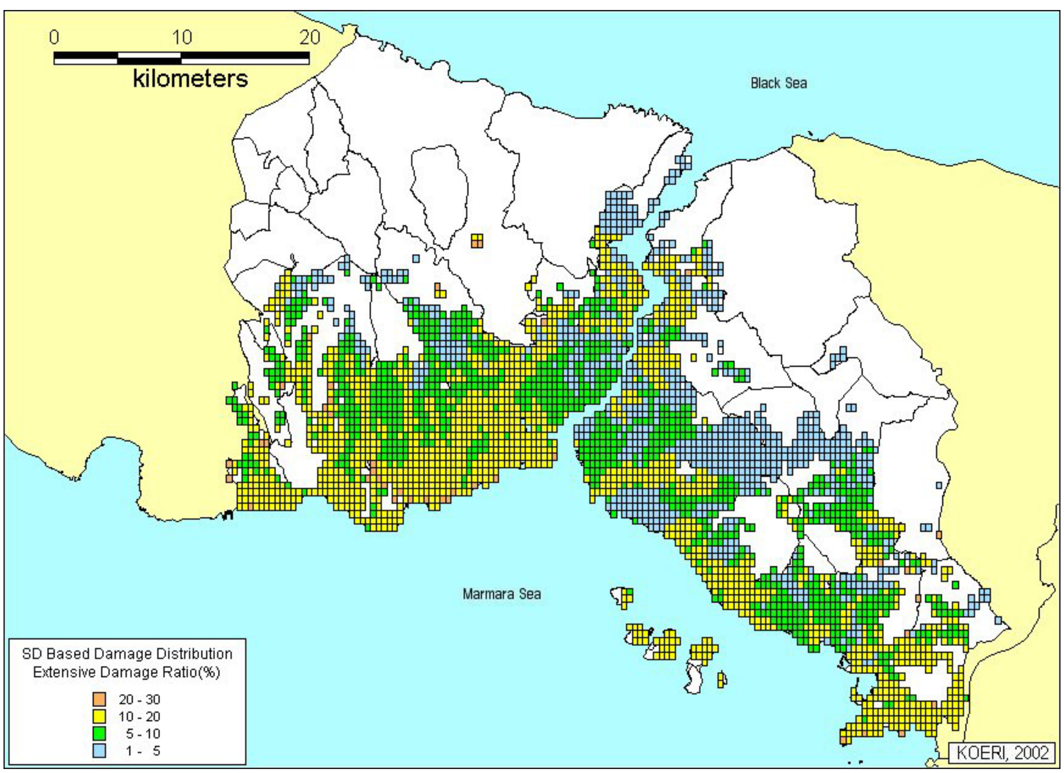

Figure 2.1.20. Ratio of the heavily damaged buildings to the total number of buildings (based on the scenario earthquake and spectral displacement based vulnerability curves, BU – ARC study)

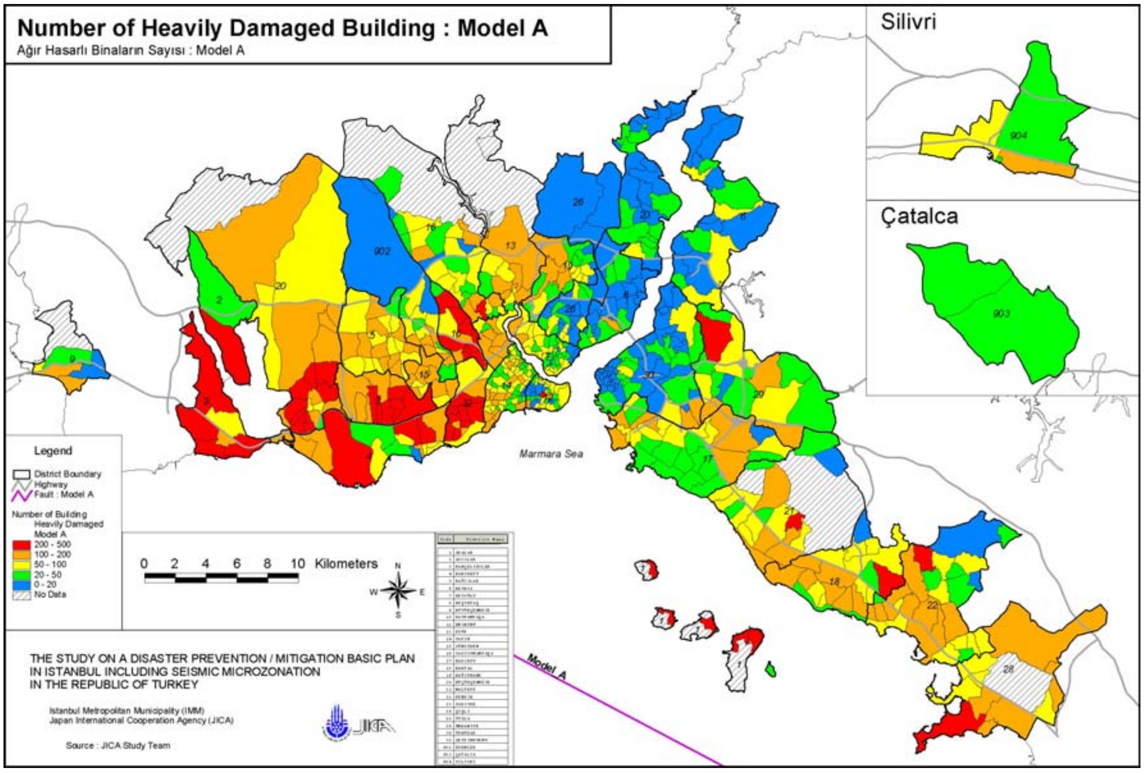

Figure 2.1.21. Numbers of heavily damaged buildings (based on scenario earthquake model A, JICA – IMM study)

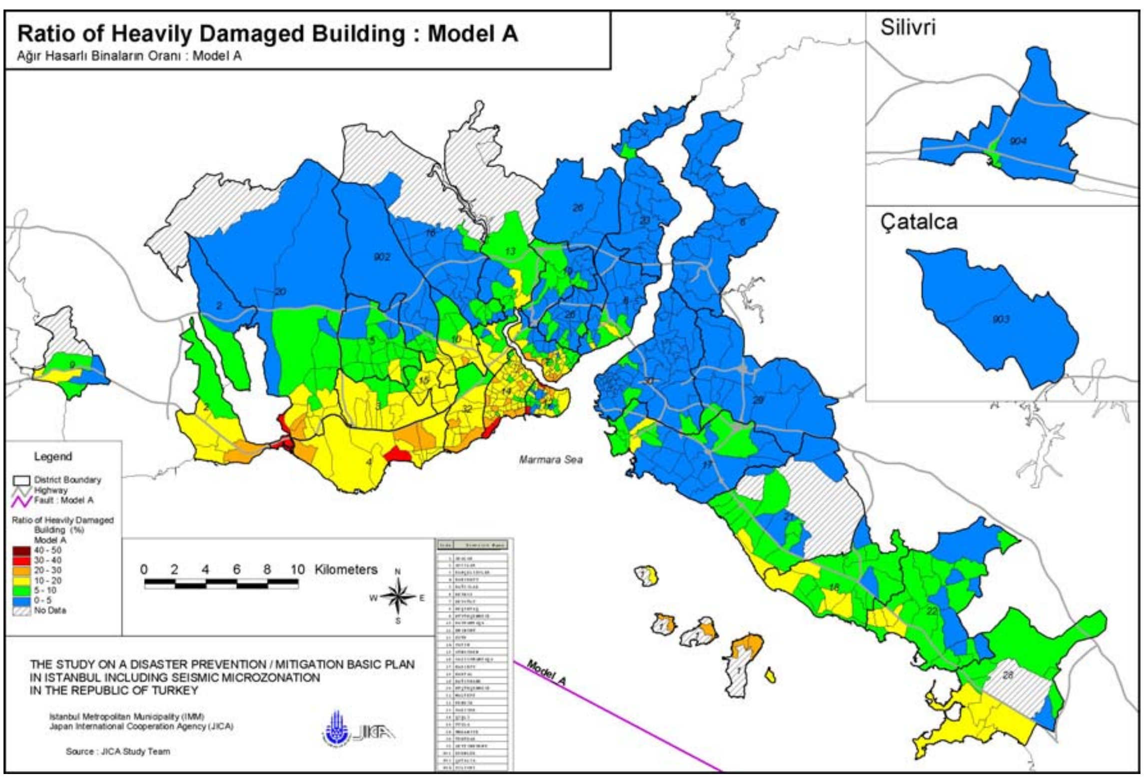

Figure 2.1.22. Ratio of heavily damaged buildings (based on scenario earthquake model A, JICA – IMM study)

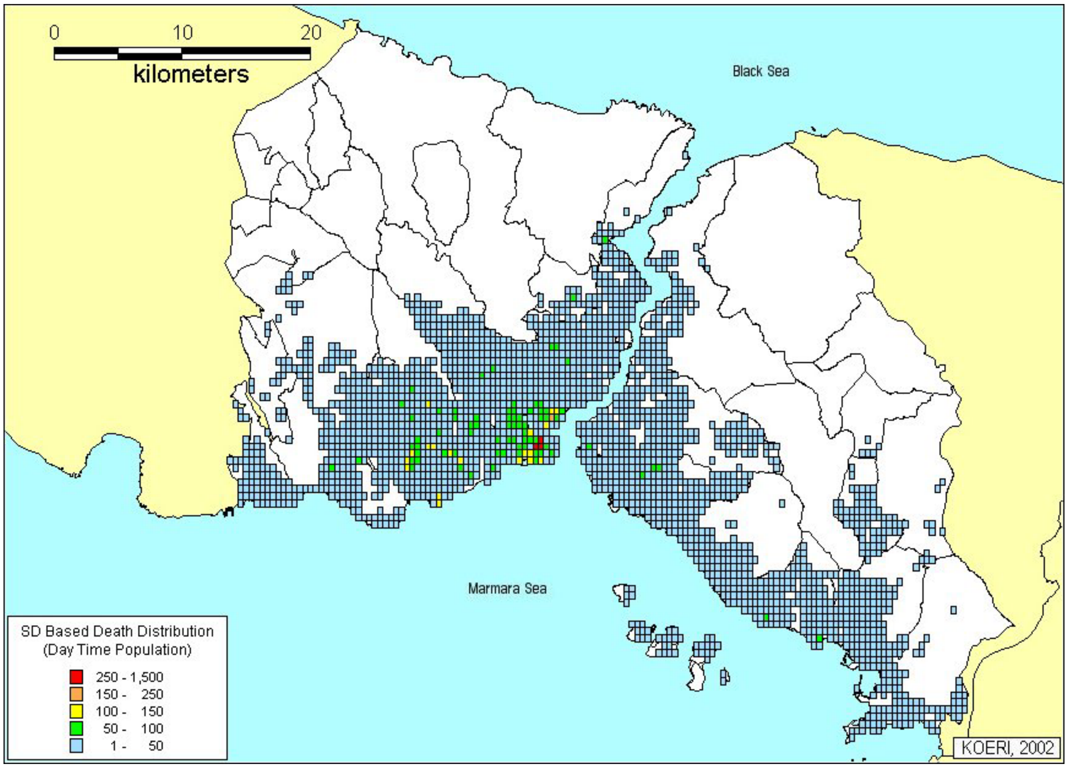

Figure 2.1.23. Distribution of the day-time deaths (based on the scenario earthquake and spectral displacement based vulnerability curves, BU – ARC study)

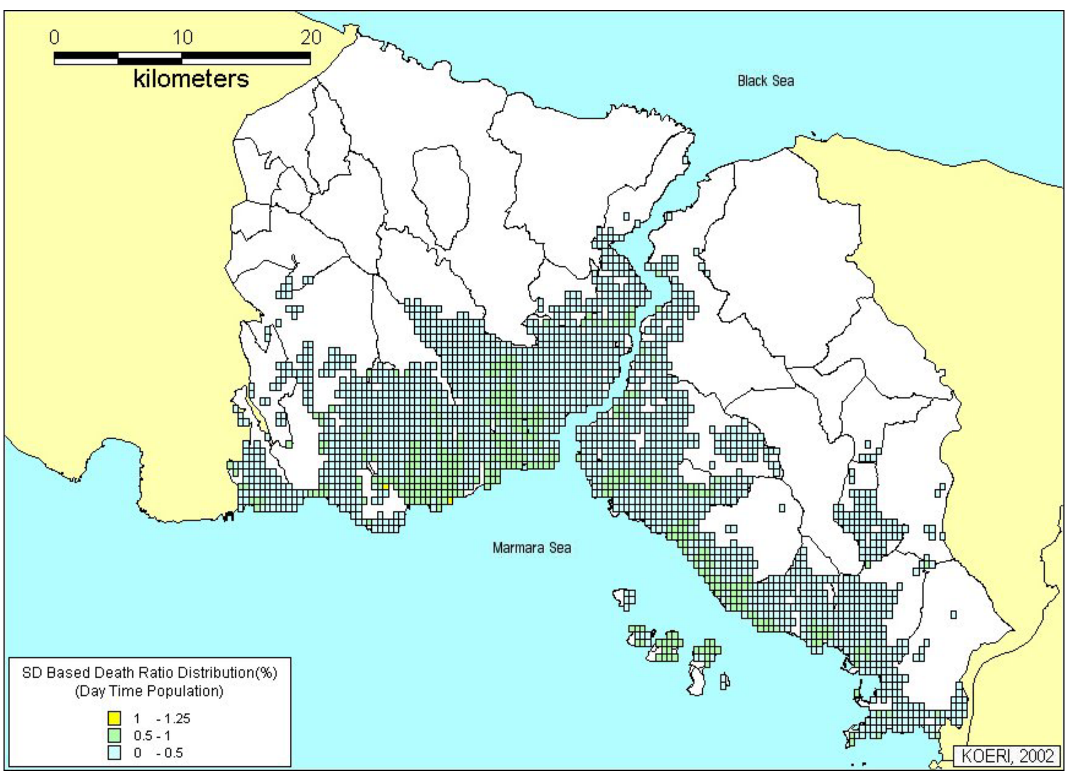

Figure 2.1.24. Ratio of the day-time deaths to the total day-time population (based on the scenario earthquake and spectral displacement based vulnerability curves, BU – ARC study)

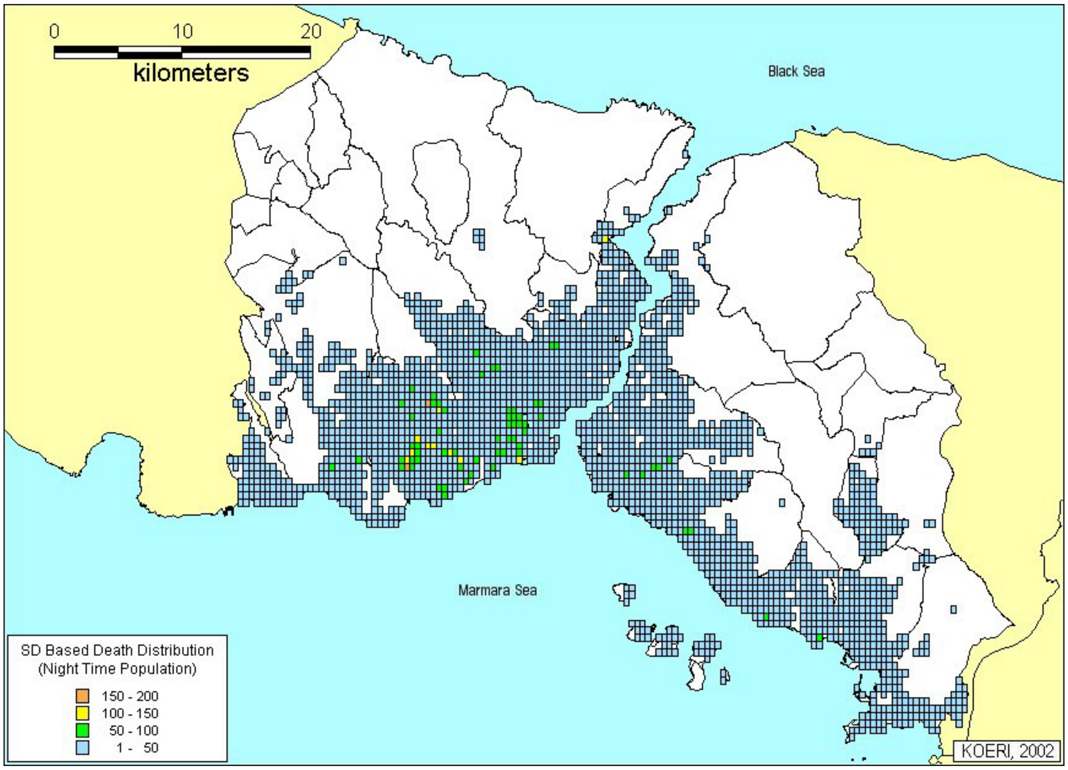

Figure 2.1.25. Distribution of the night-time deaths (based on the scenario earthquake and spectral displacement based vulnerability curves, BU – ARC study)

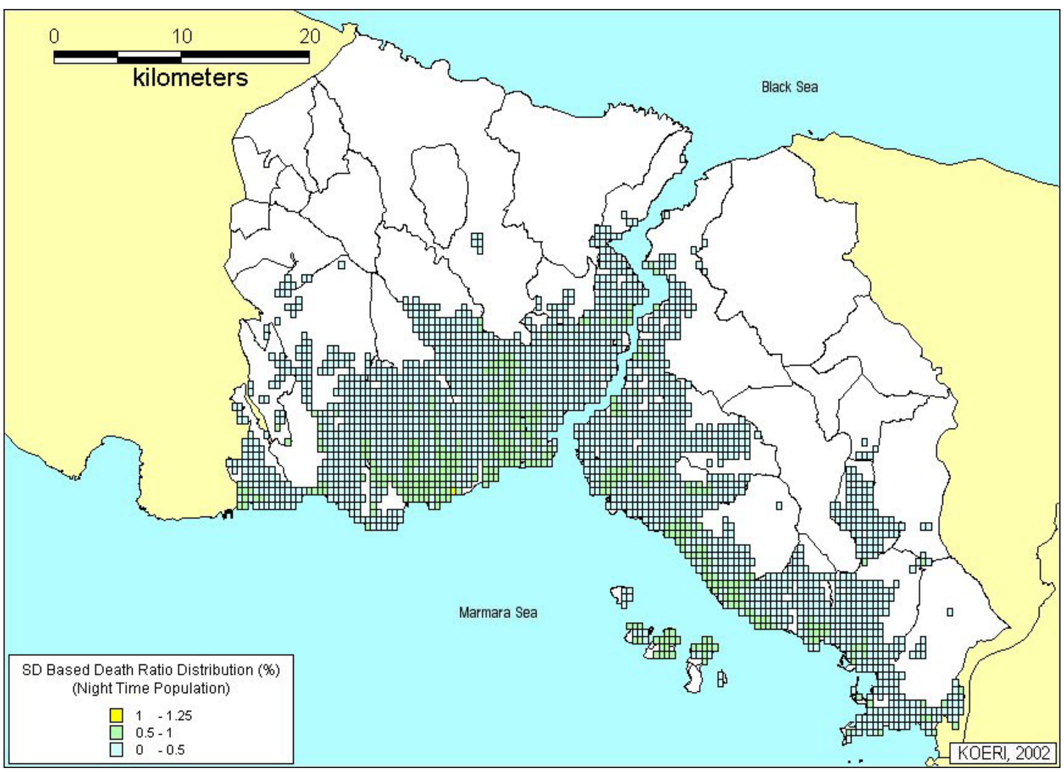

Figure 2.1.26. Ratio of the night-time deaths to the total night-time population (based on the scenario earthquake and spectral displacement based vulnerability curves, BU – ARC study)

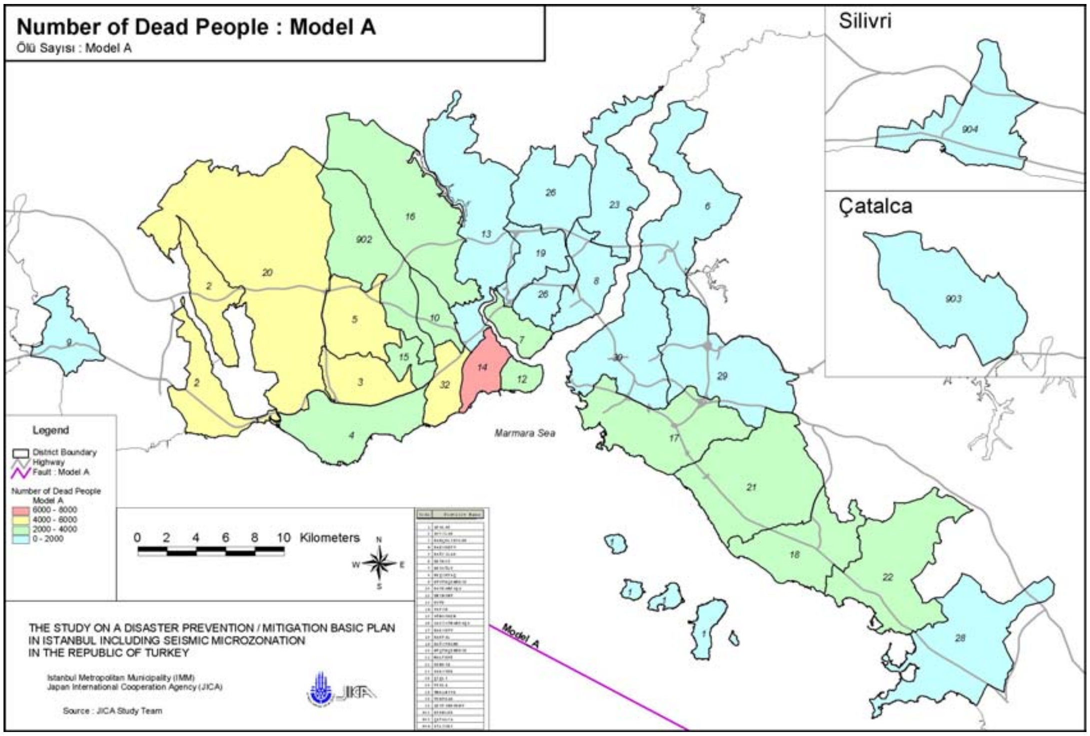

Figure 2.1.27. Number of dead people (Model A; JICA – IMM study)

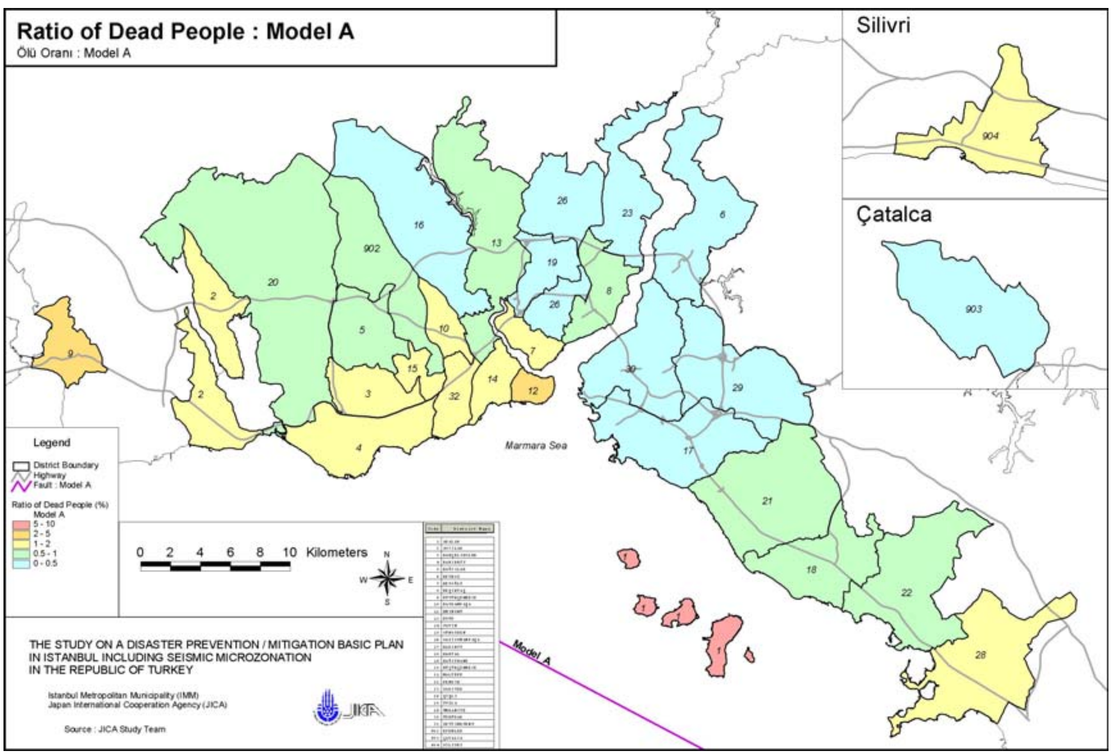

Figure 2.1.28. Ratio of dead people (Model A; JICA – IMM study)

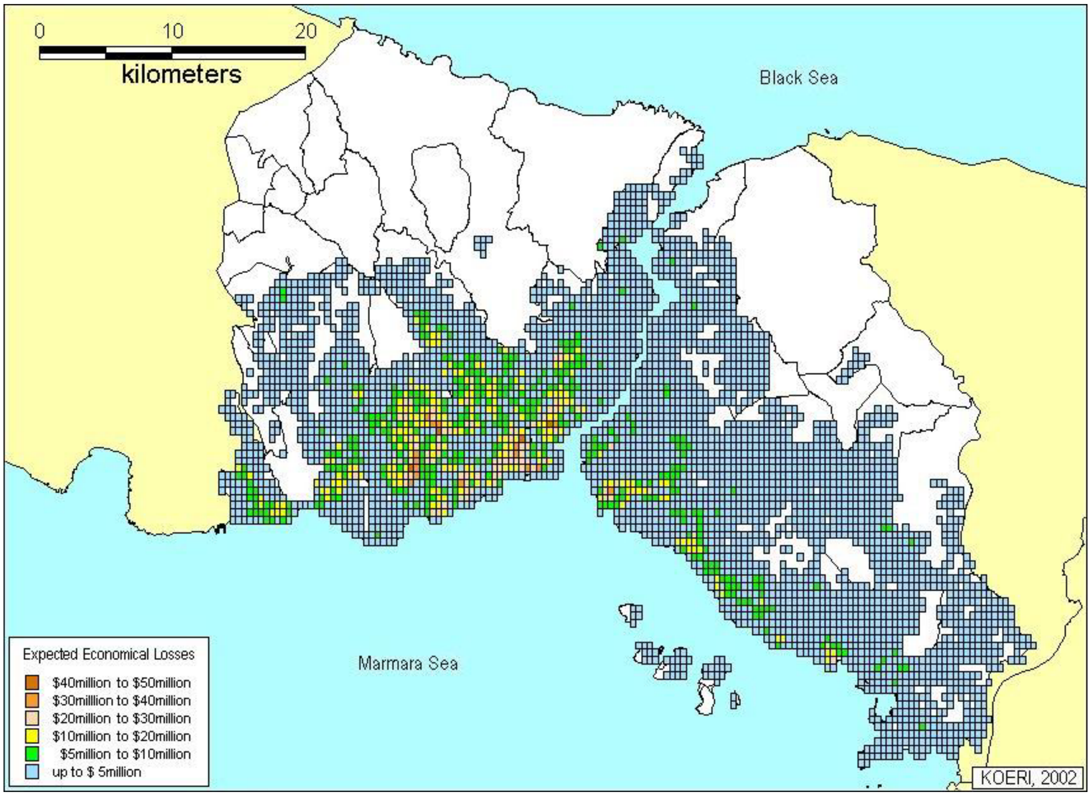

Figure 2.1.29. Distribution of Direct Financial Losses due to Building Damage (BU – ARC study)

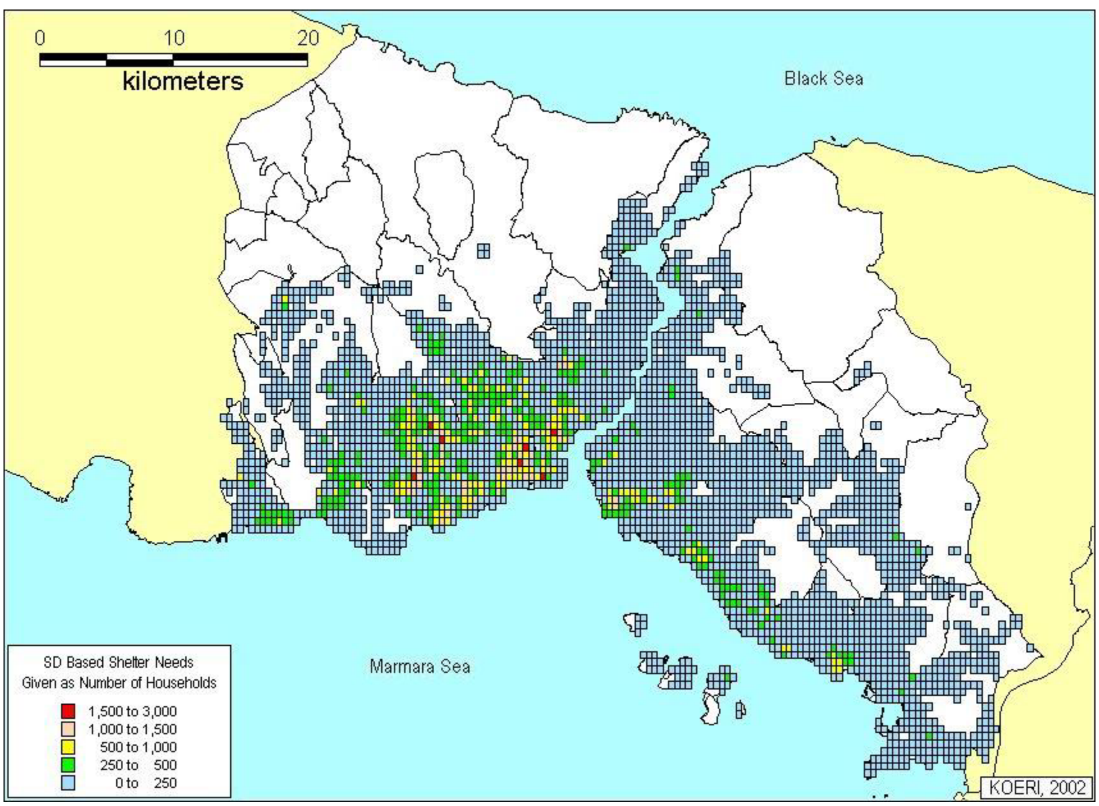

Figure 2.1.30. Distribution for Families in Need of Emergency Sheltering (BU – ARC study)

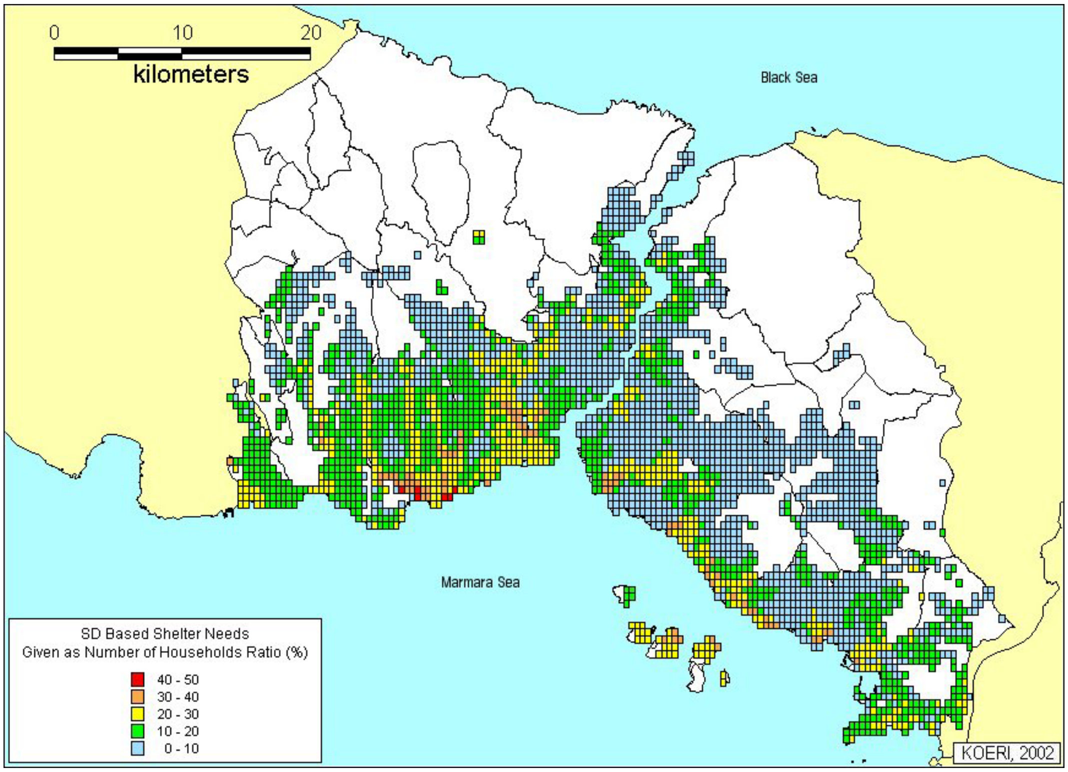

Figure 2.1.31. Ratio of shelter needing households to total number of dwelling units(BU – ARC study)

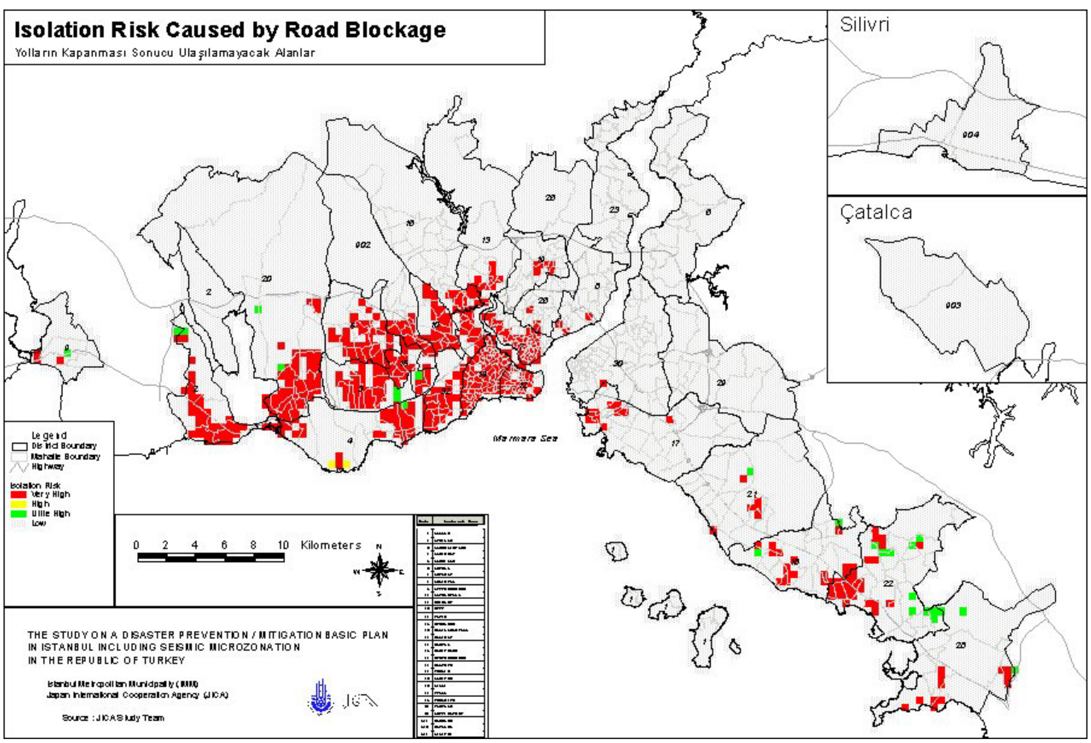

Figure 2.1.32. Isolation risk due to road blockage (JICA – IMM study)

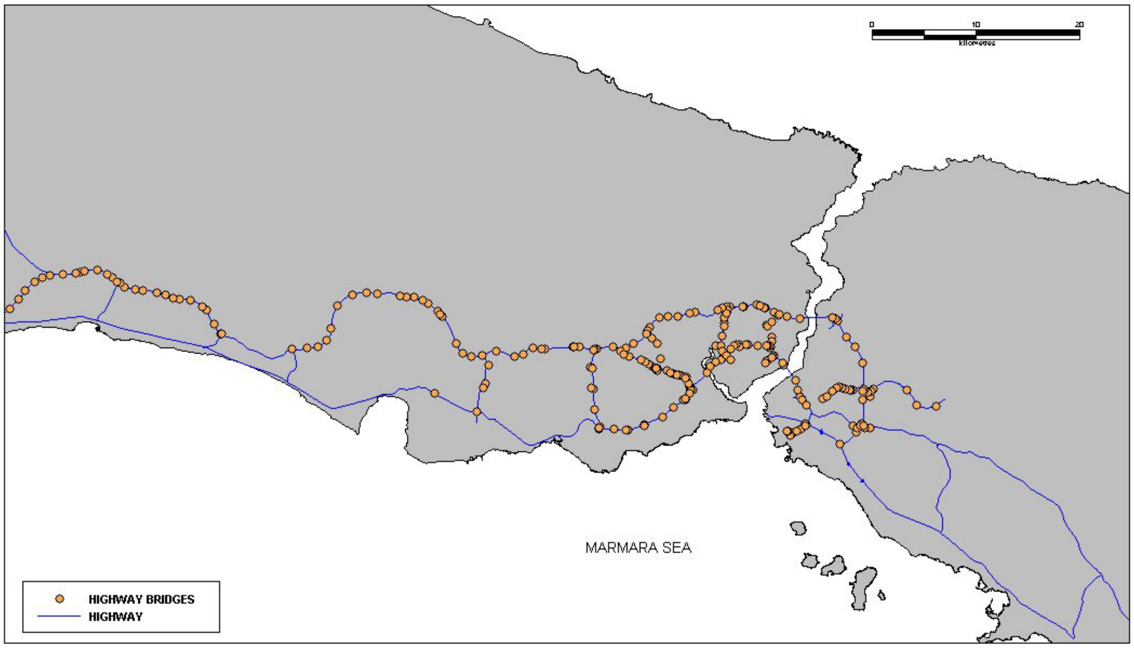

Figure 2.1.33. The highway bridges and viaducts (JICA – IMM)

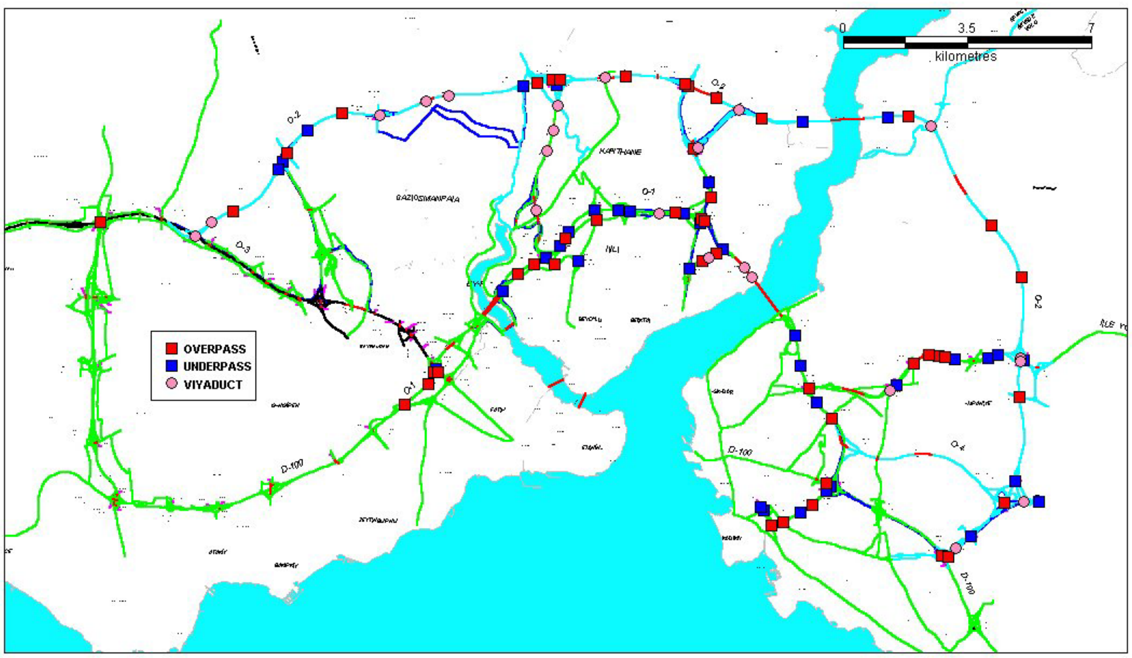

Figure 2.1.34. The Istanbul Highway Bridge and Viaducts evaluated the earthquake performance based on the ATC 6-2 (BU – KOERI)

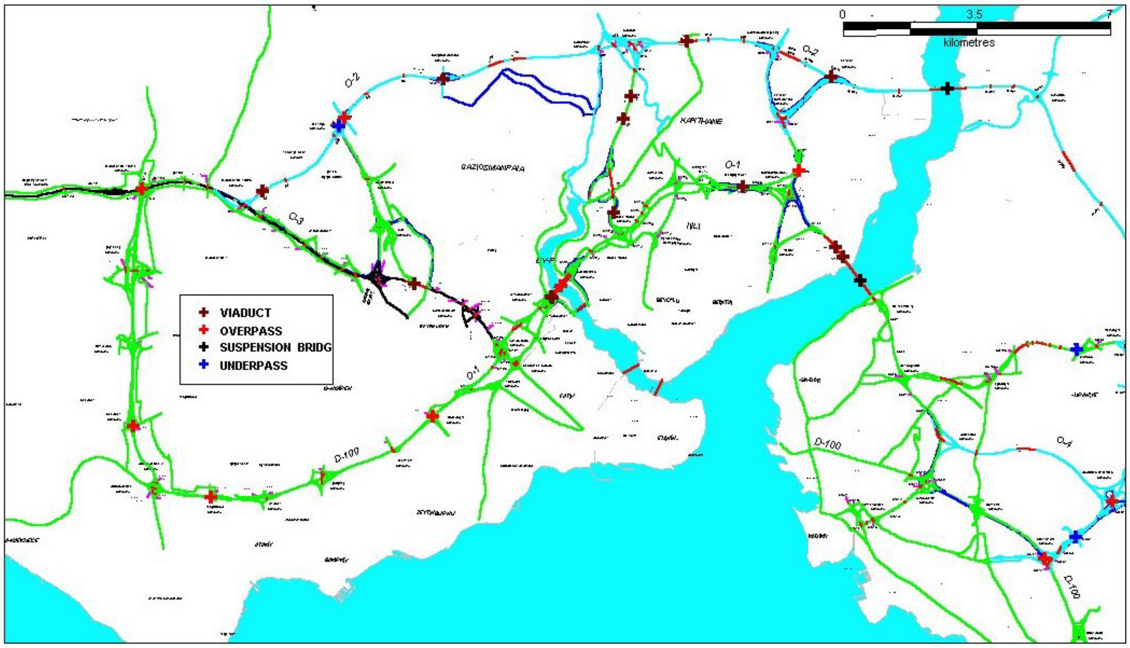

Figure 2.1.35. The bridges and viaducts suggested to be retrofitted by Directorate of 17th Division of Highways

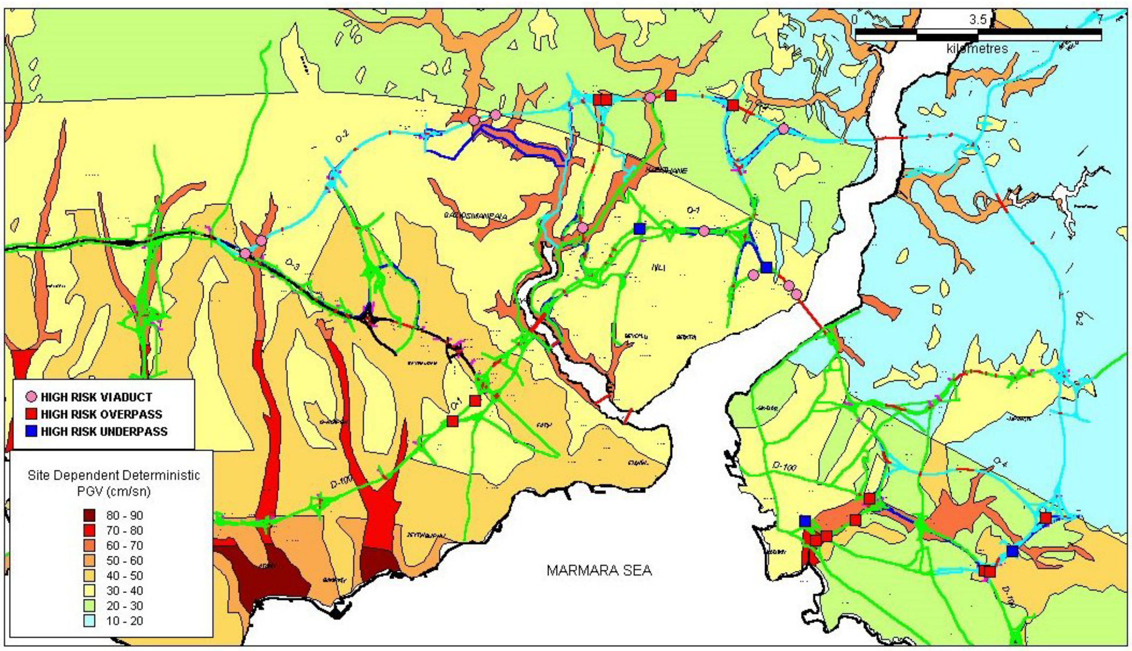

Figure 2.1.36. Distribution of the “high risk” bridges and viaducts based on the ATC6-2 method, overlaid with the peak ground velocity map resulting from the scenario earthquake (BU - KOERI)

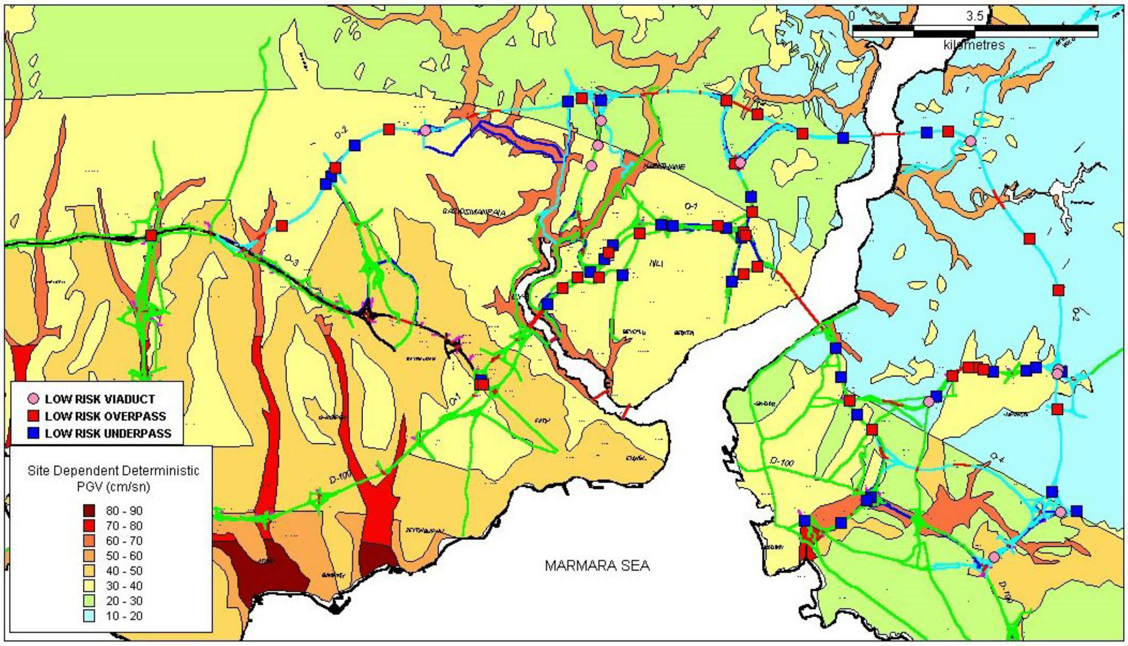

Figure 2.1.37. Distribution of the "low risk" bridges and viaducts based on the ATC6-2 method, overlaid with the peak ground velocity map resulting from the scenario earthquake (BU - KOERI)

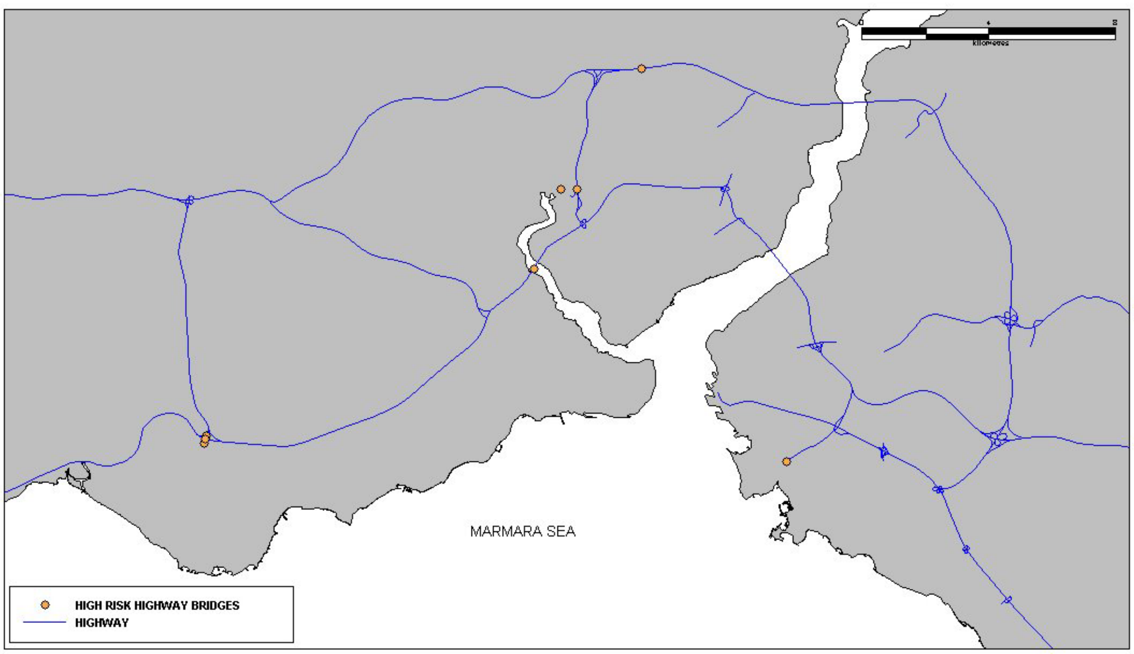

Figure 2.1.38. Distribution of the "high risk" bridges and viaducts based on the Katayama method (JICA – IMM)

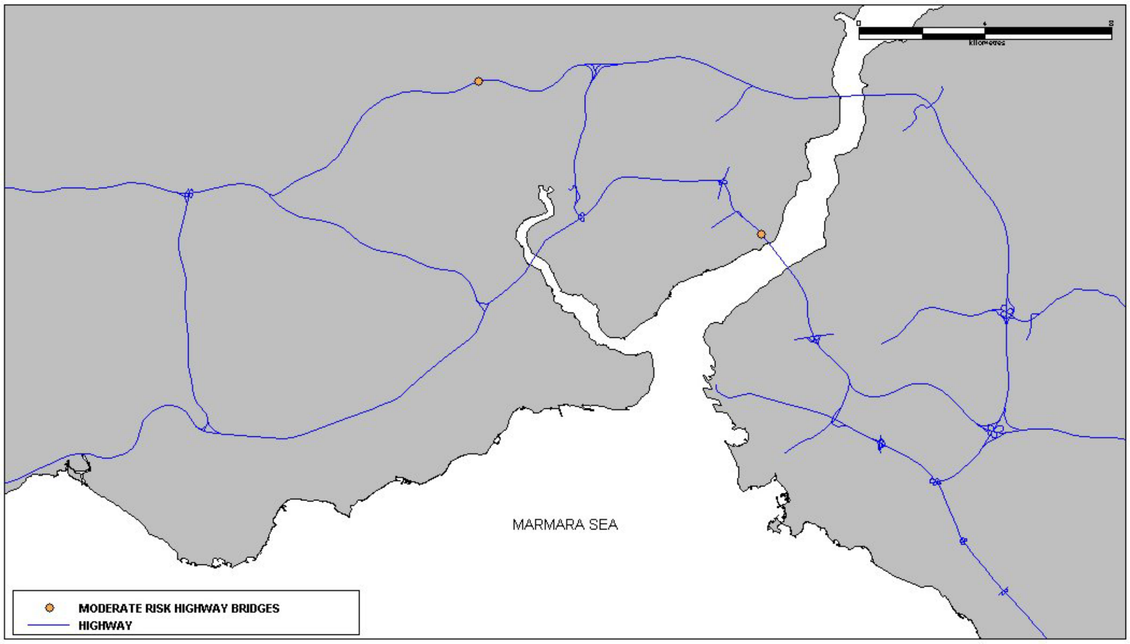

Figure 2.1.39. Distribution of the "moderate risk" bridges and viaducts based on the Katayama method (JICA – IMM)

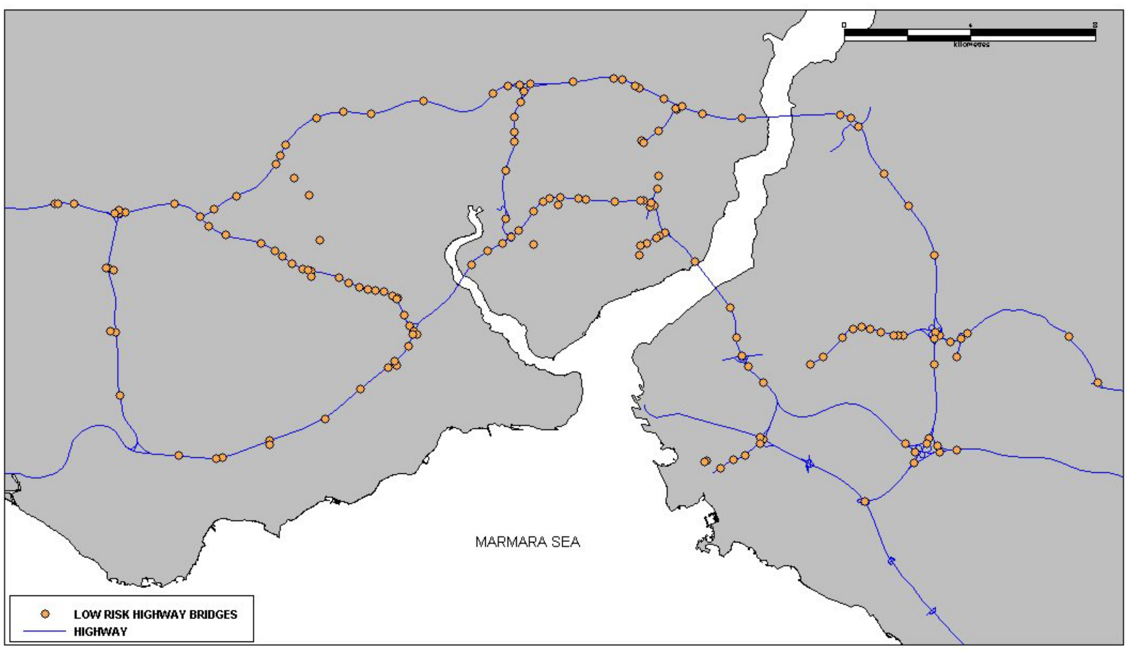

Figure 2.1.40. Distribution of the "low risk" bridges and viaducts based on the Katayama method (JICA – IMM)

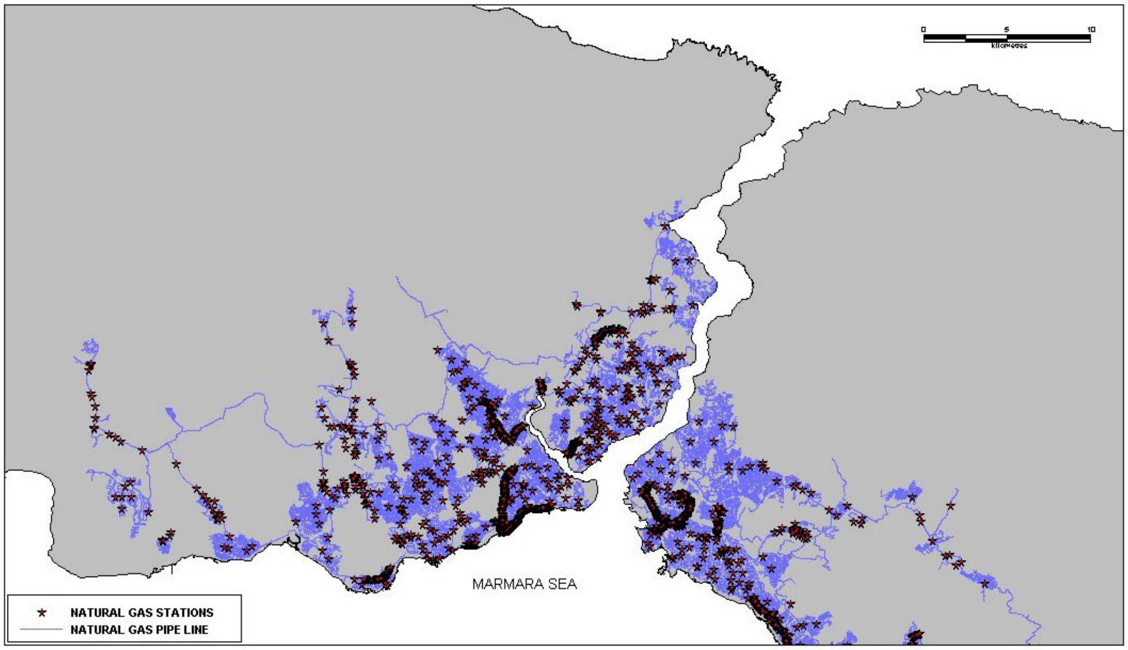

Figure 2.1.41. Distribution of the natural gas system in the Istanbul Metropolitan Area (JICA – IMM)

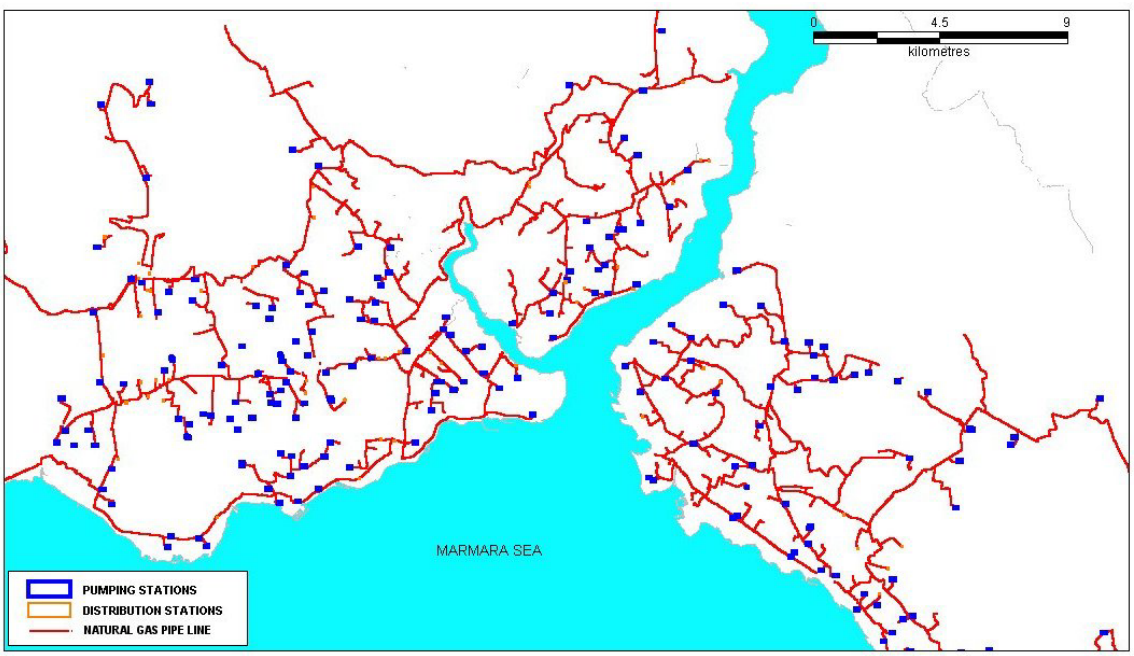

Figure 2.1.42. Distribution of the natural gas system in the Istanbul Metropolitan Area ((BU - KOERI)

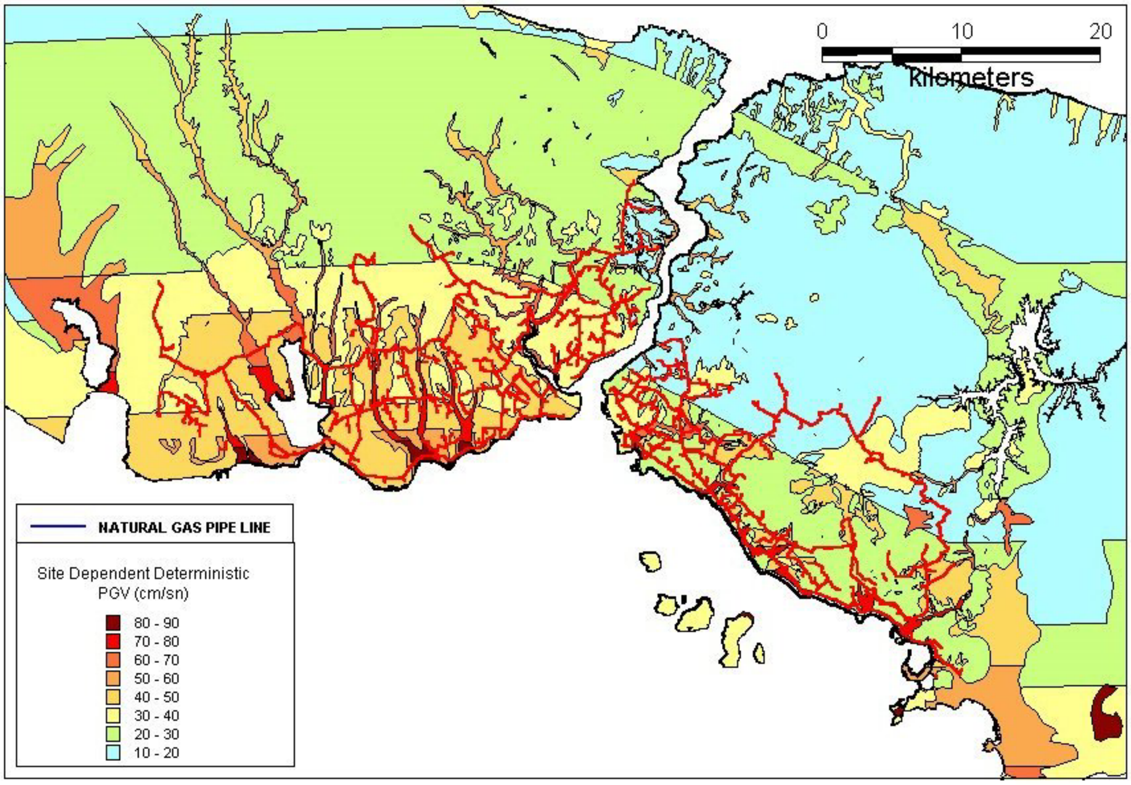

Figure 2.1.43. Distribution of the natural gas pipe lines overlaid with the peak ground velocity resulting from the scenario earthquake (BU - KOERI)

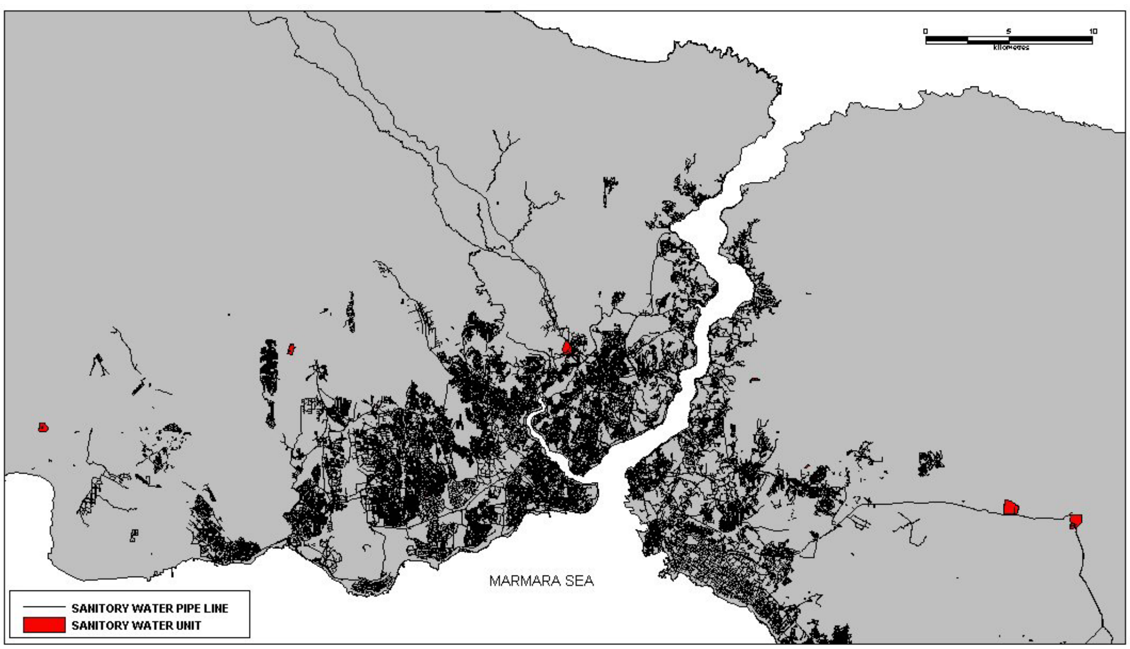

Figure 2.1.44. Distribution of the" sanitary water" pipe lines in the Istanbul Metropolitan Area (JICA – IMM)

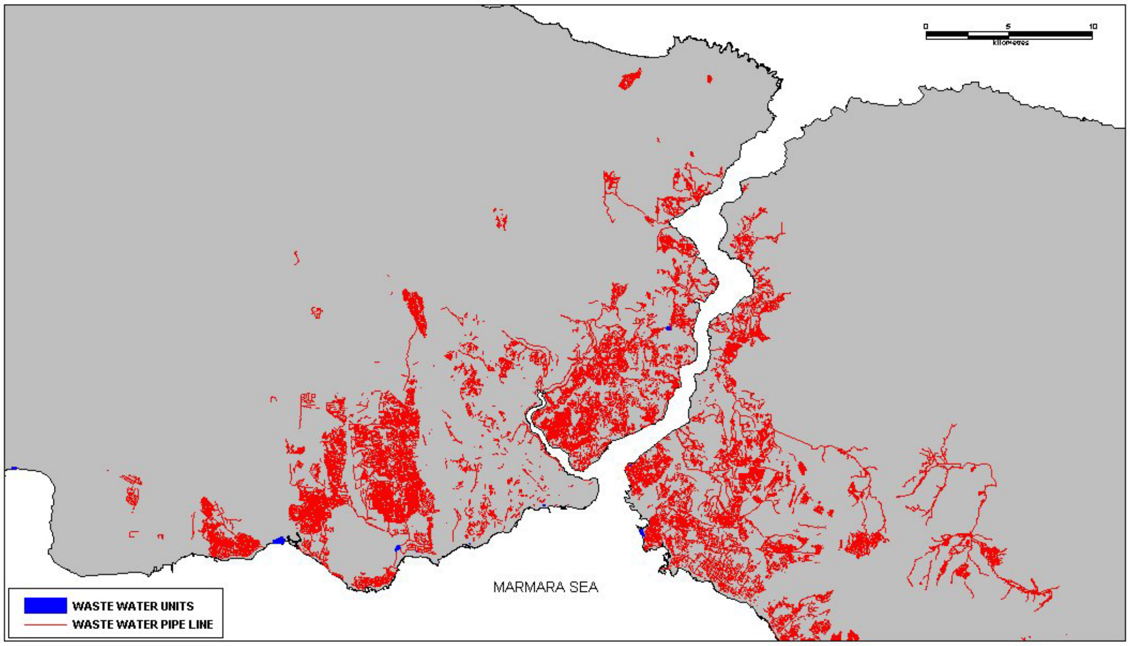

Figure 2.1.45. Distribution of the “waste water” pipe lines in the Istanbul Metropolitan Area (JICA – IMM)

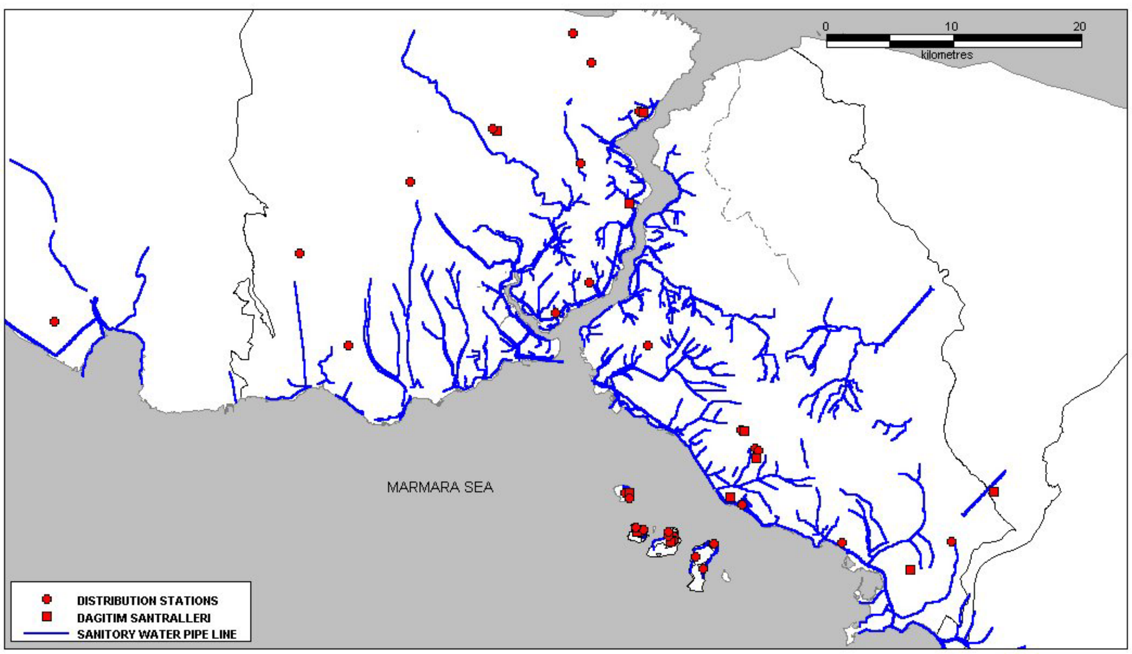

Figure 2.1.46. Distribution of the” sanitary water” pipe lines in the Istanbul Metropolitan Area ((BU - KOERI)

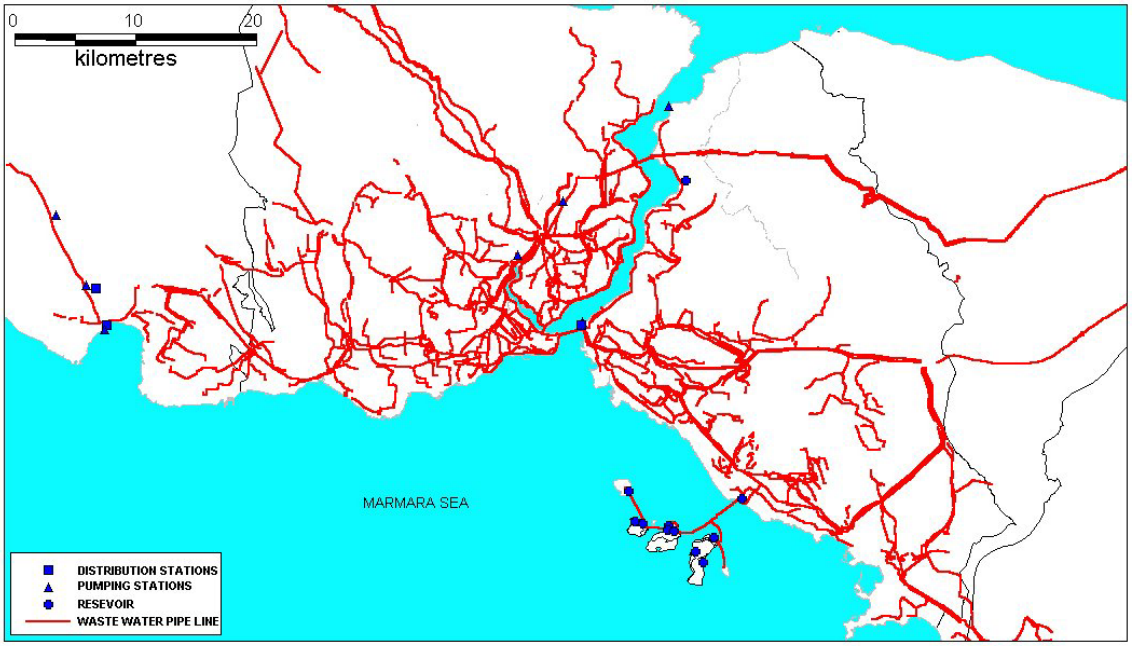

Figure 2.1.47. Distribution of the" waste water" pipe lines in the Istanbul Metropolitan Area ((BU - KOERI)

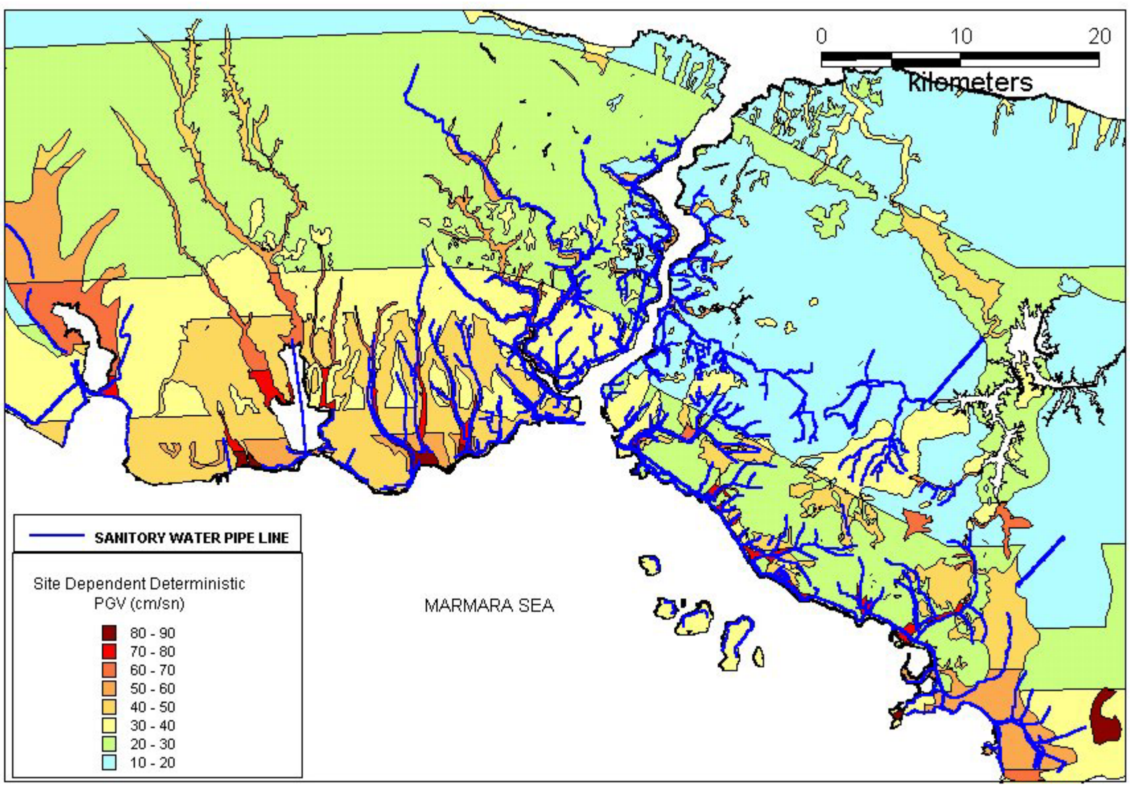

Figure 2.1.48. Distribution of the "sanitary water" pipe lines overlaid with the peak ground velocity resulting from the scenario earthquake (BU - KOERI)

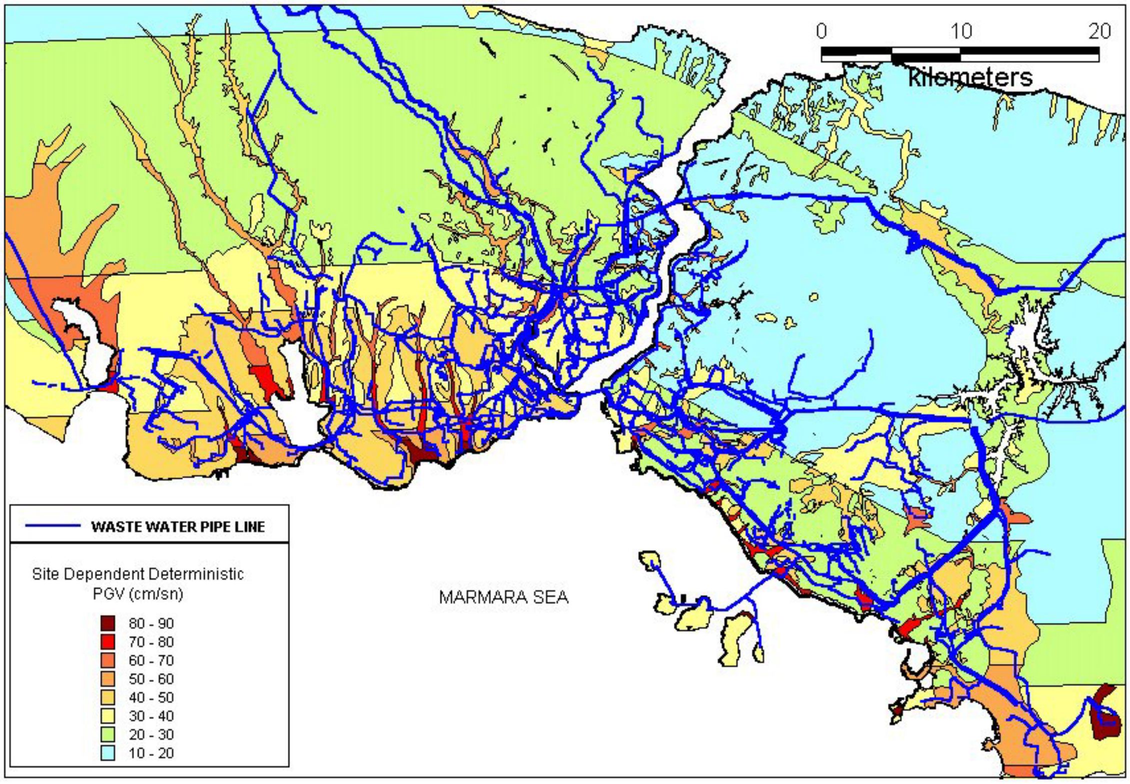

Figure 2.1.49. Distribution of the "waste water" pipe lines overlaid with the peak ground velocity resulting from the scenario earthquake (BU - KOERI)

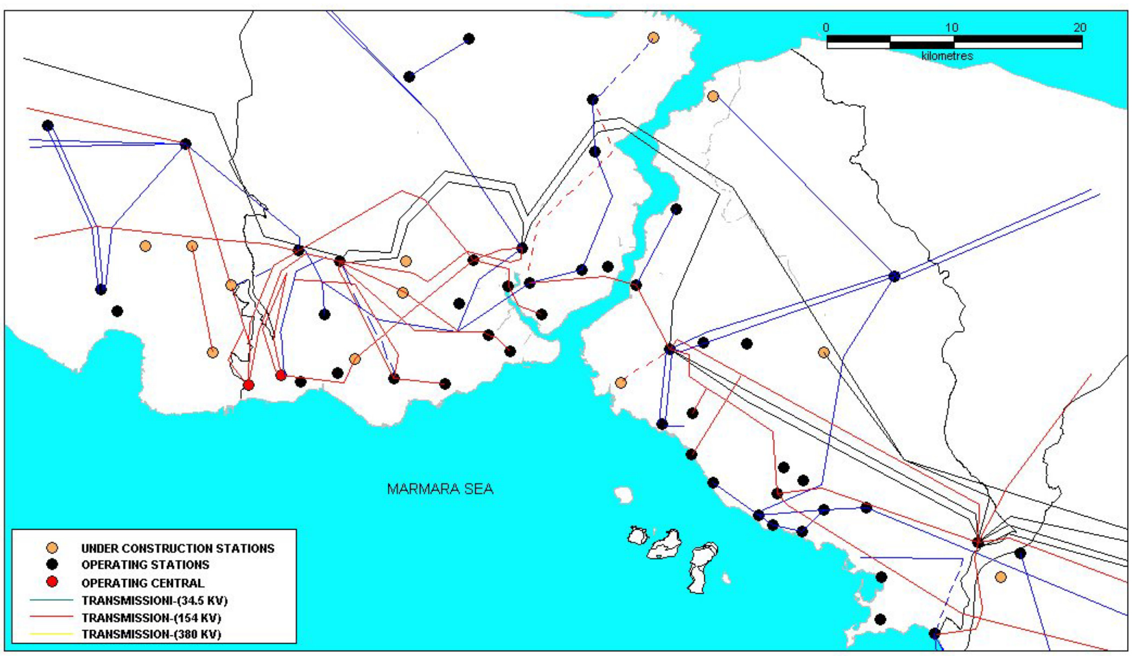

Figure 2.1.50. Distribution of the electric power transmission system in the Istanbul Metropolitan Area ((BU - KOERI)

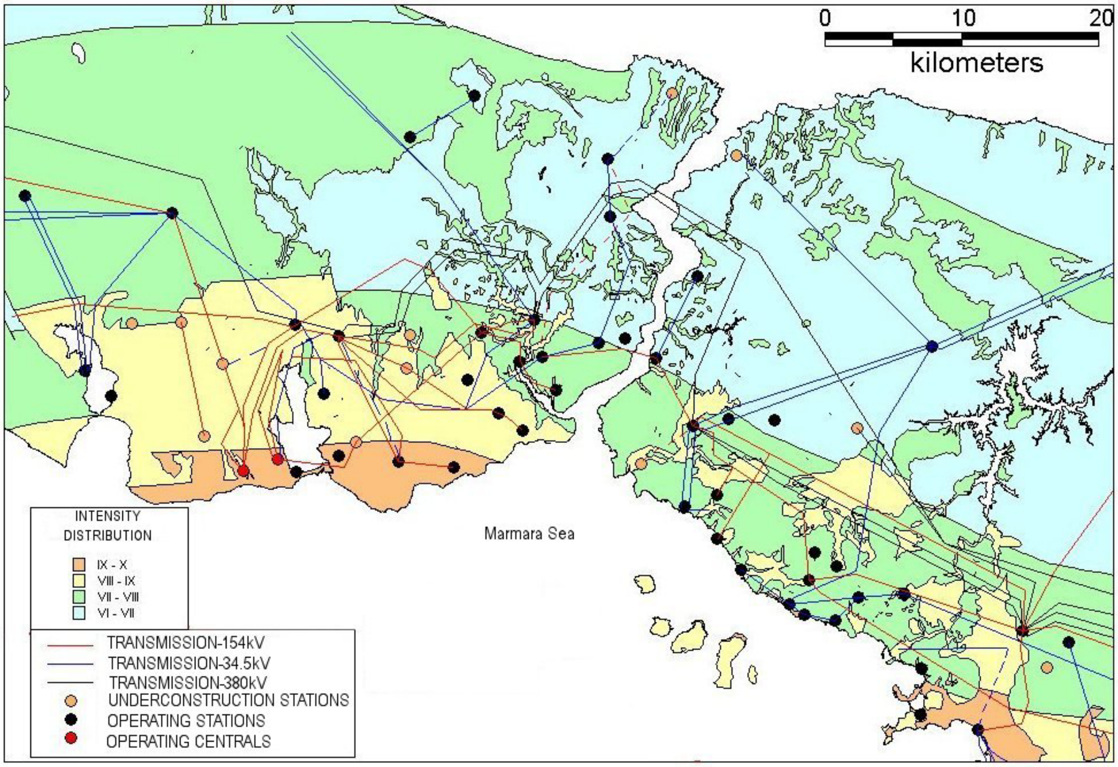

Figure 2.1.51. Distribution of the electric power transmission system overlaid with the intensity, resulting from the scenario earthquake in the Istanbul Metropolitan Area (BU - KOERI)

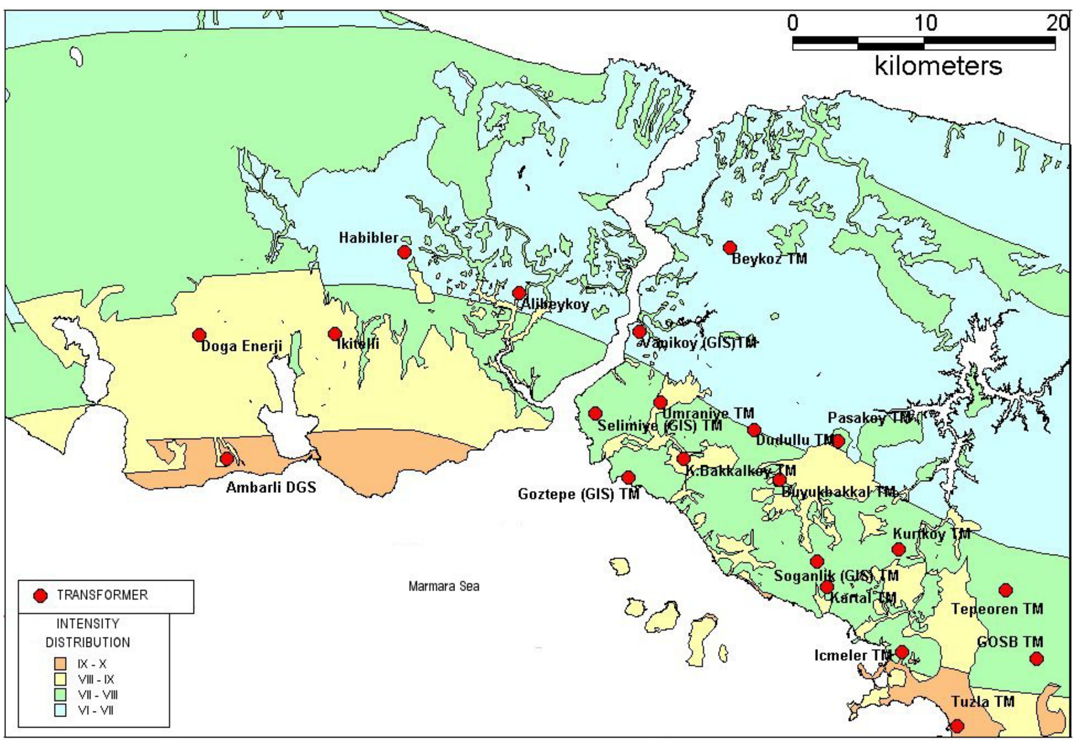

Figure 2.1.52. Distribution of the electric power transmission system with 380 Kv. overlaid with the intensity map, resulting from the scenario earthquake in the Istanbul Metropolitan Area (BU - KOERI)

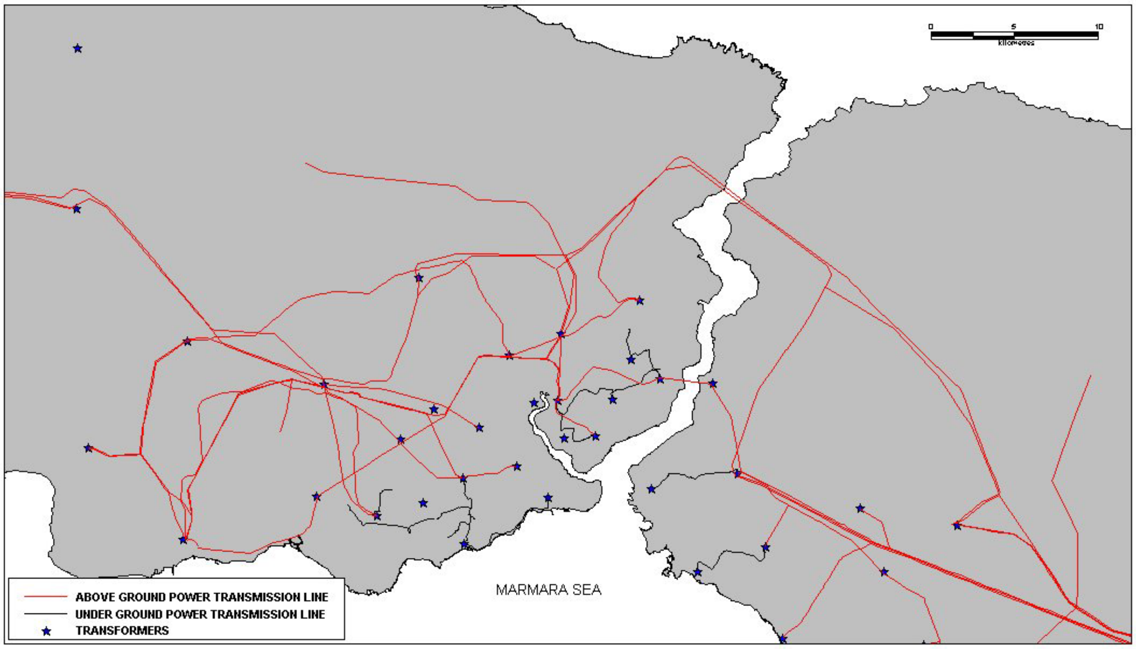

Figure 2.1.53. Distribution of the electric power transmission system in the Istanbul Metropolitan Area (JICA – IMM)

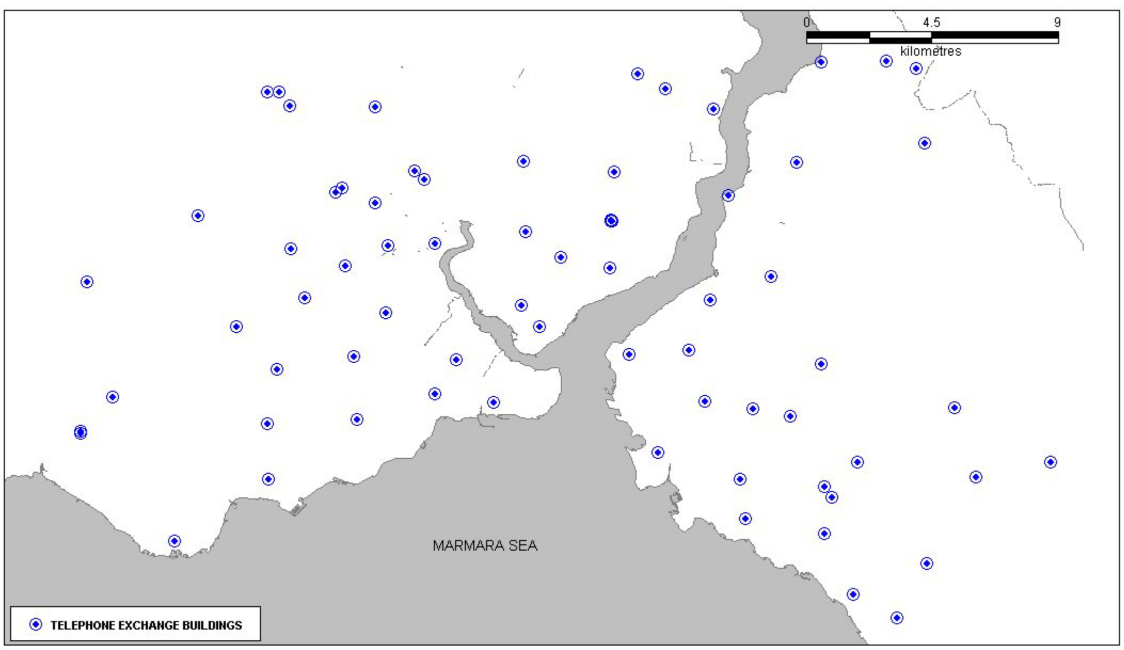

Figure 2.1.54. Distribution of the telephone exchange buildings in the Istanbul Metropolitan Area

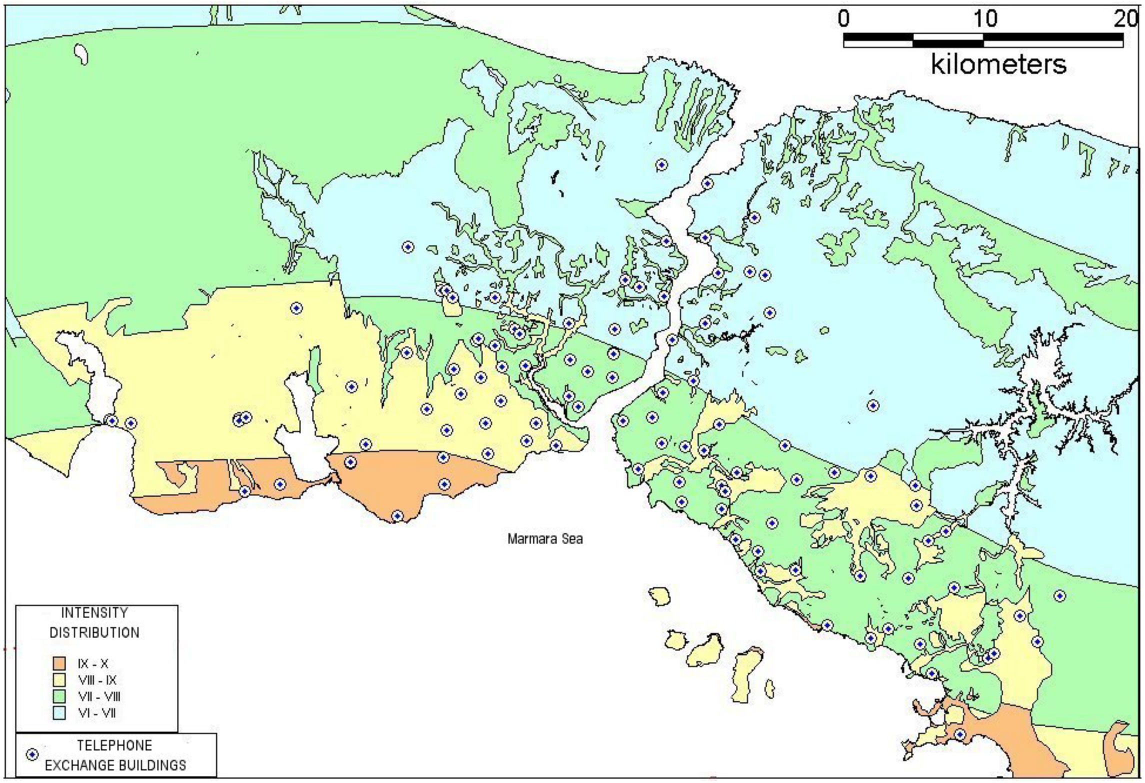

Figure 2.1.55. Distribution of the telephone exchange buildings overlaid with the intensity map, resulting from the scenario earthquake in the Istanbul Metropolitan Area (BU - KOERI)

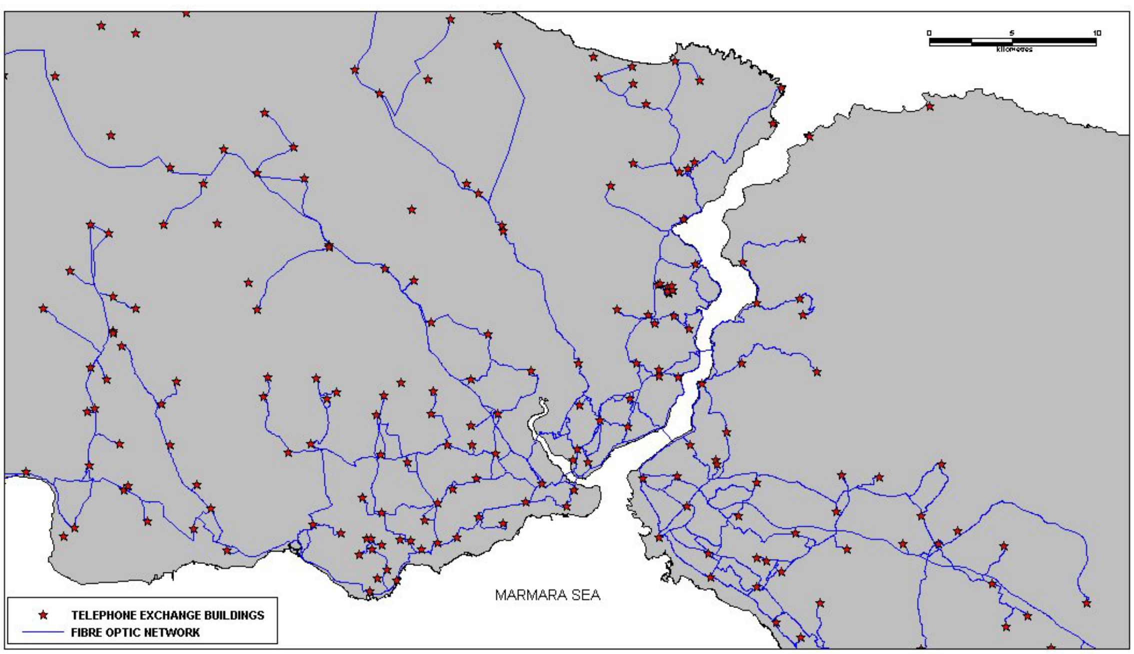

Figure 2.1.56. Distribution of the telecommunication system in Istanbul Metropolitan Area (JICA – IMM)

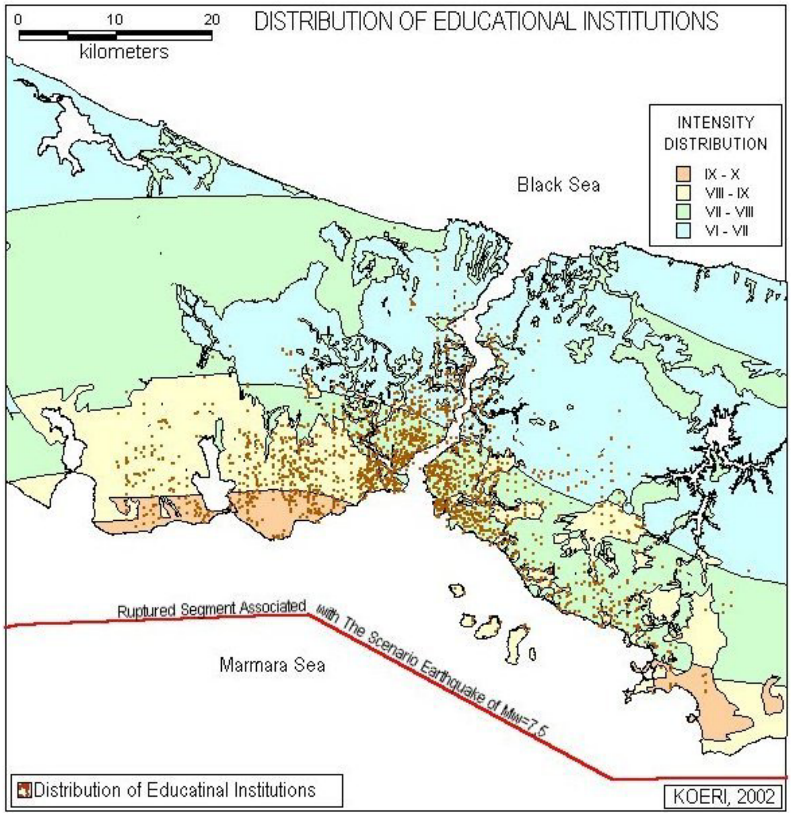

Figure 2.1.57. The distribution of educational institutions overlain with the intensity map

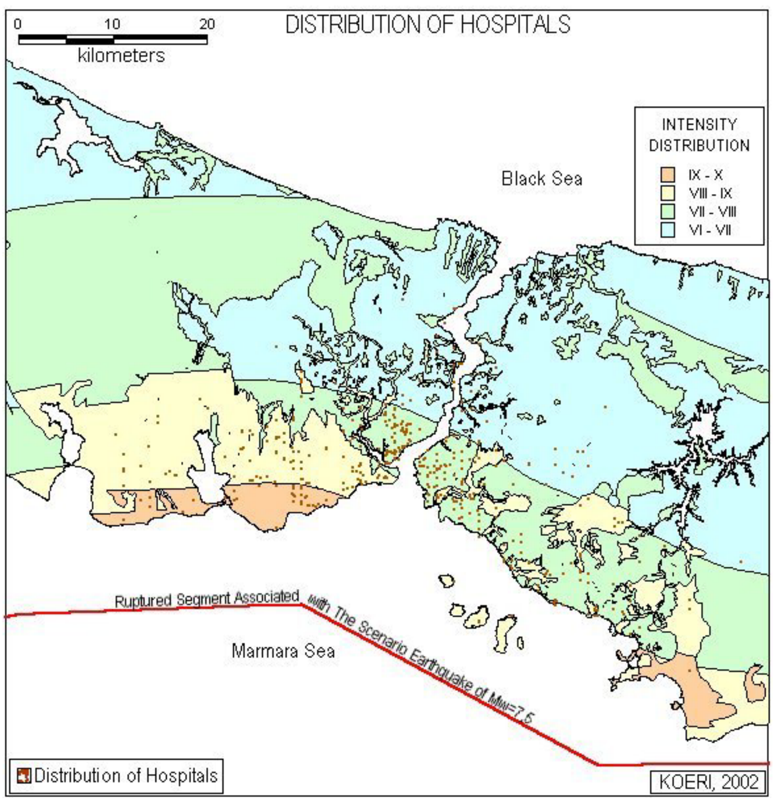

Figure 2.1.58. The distribution of hospitals overlain with the intensity map

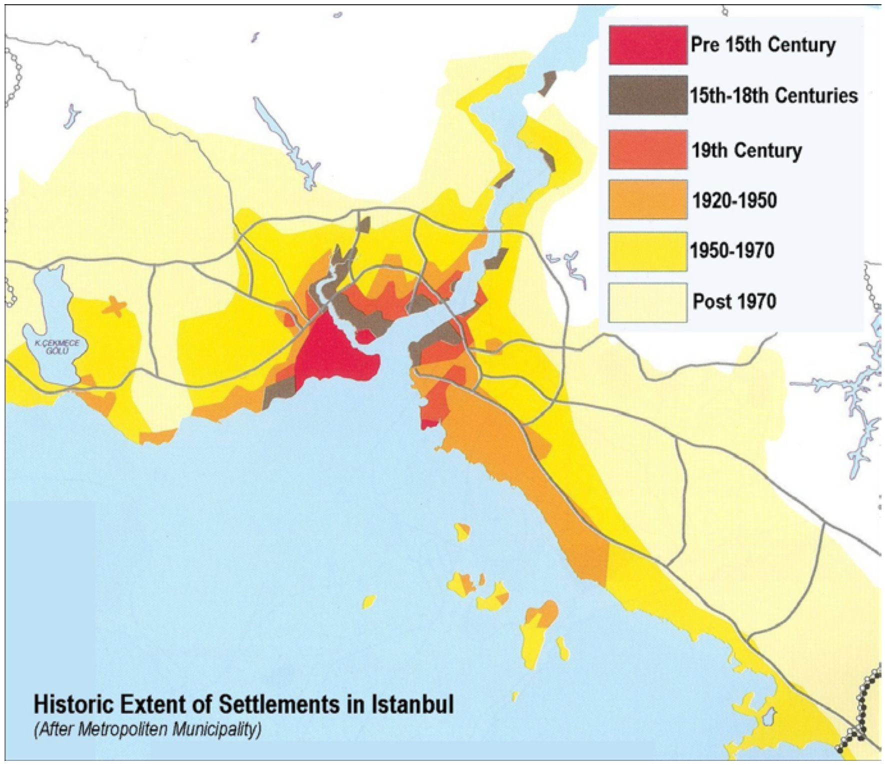

Figure 2.1.59. Historic growth of the city of Istanbul

Figure 2.1.60. Location map

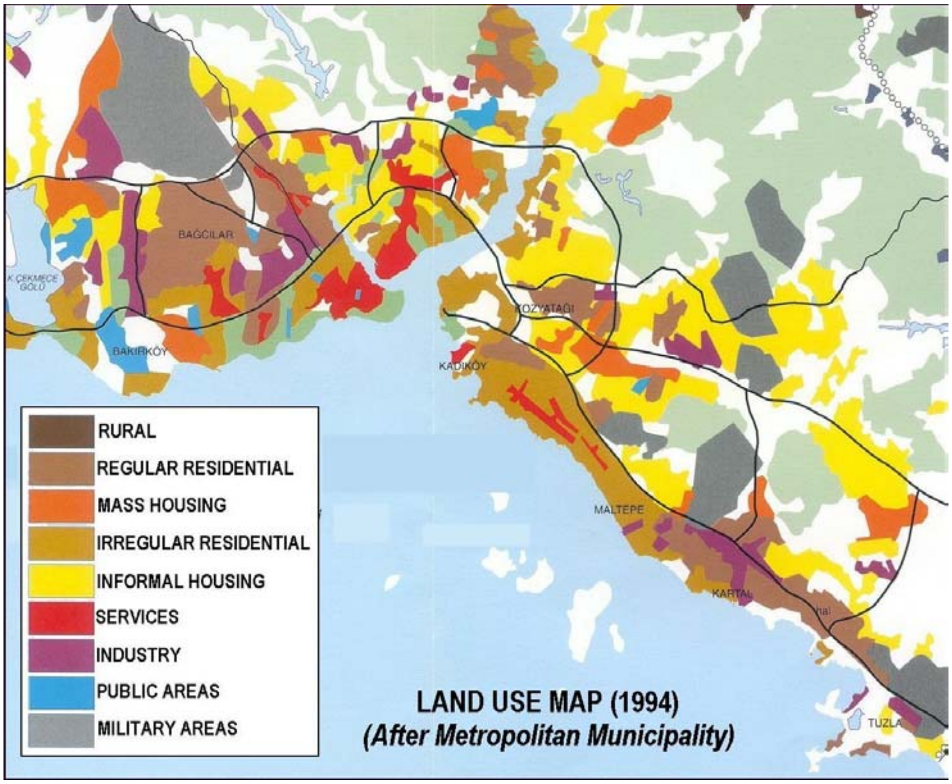

Figure 2.1.61. Land use map of Istanbul in 1994

Figure 2.1.62. Location map including neighboring provinces components of industrial facilities

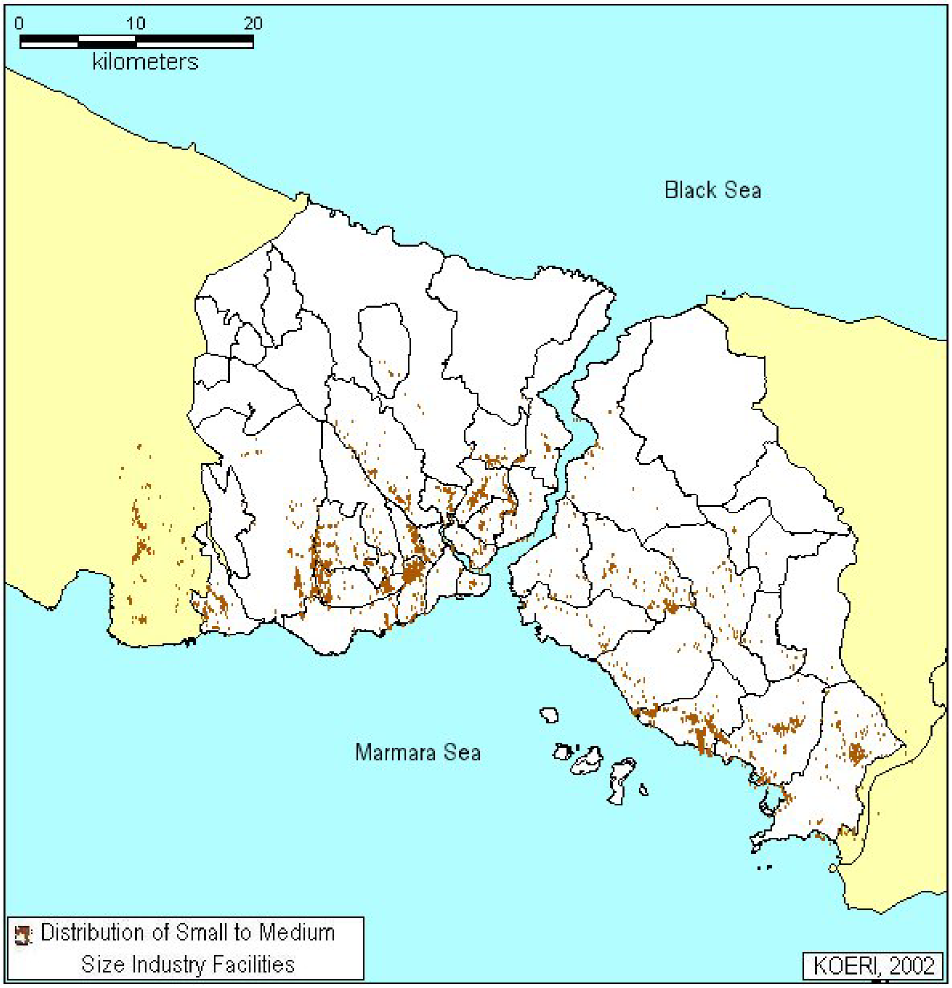

Figure 2.1.63. The distribution of small to medium size industry facilities overlain with the district map (from Municipality data)

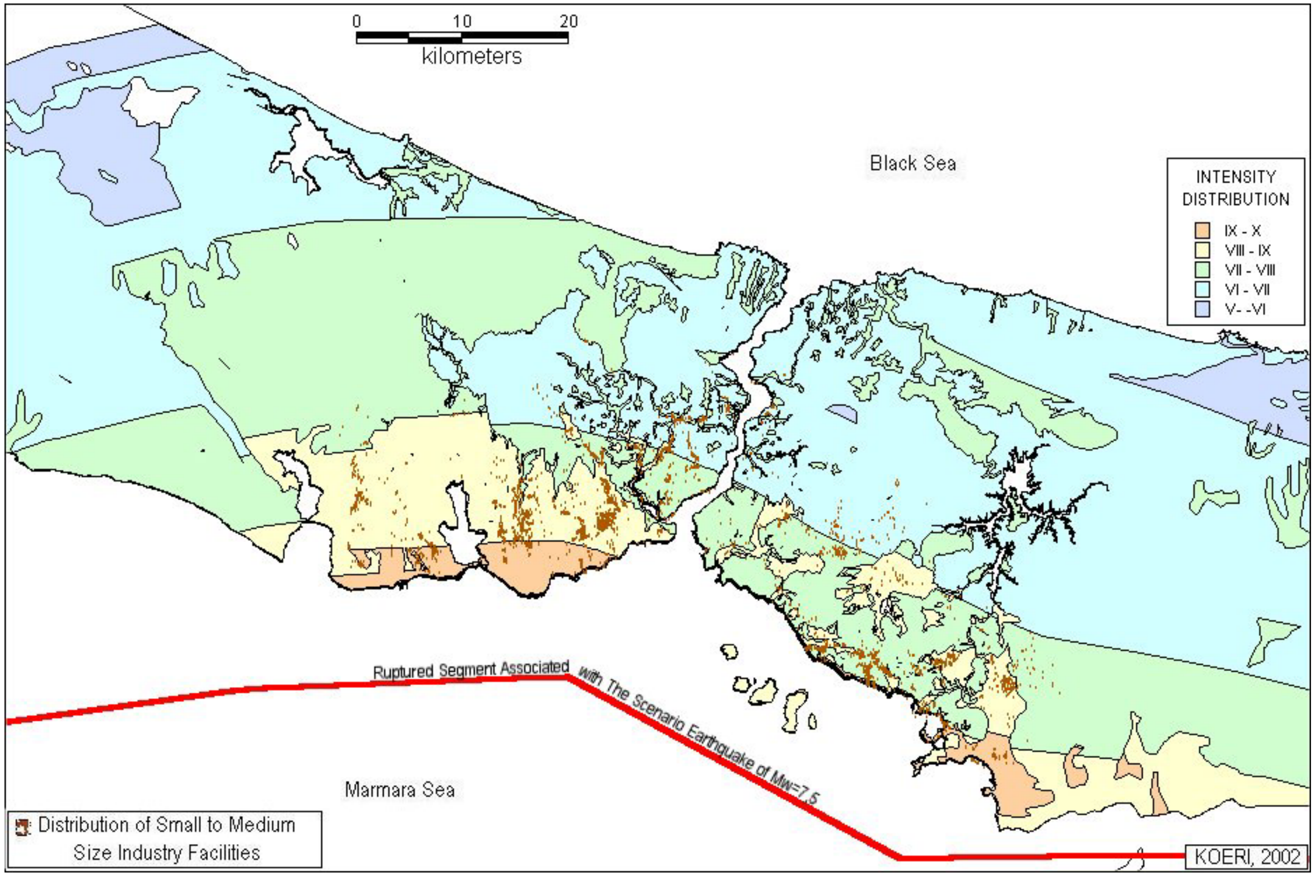

Figure 2.1.64. Distribution of Small to Medium Size Industry Facilities overlain with the intensity map

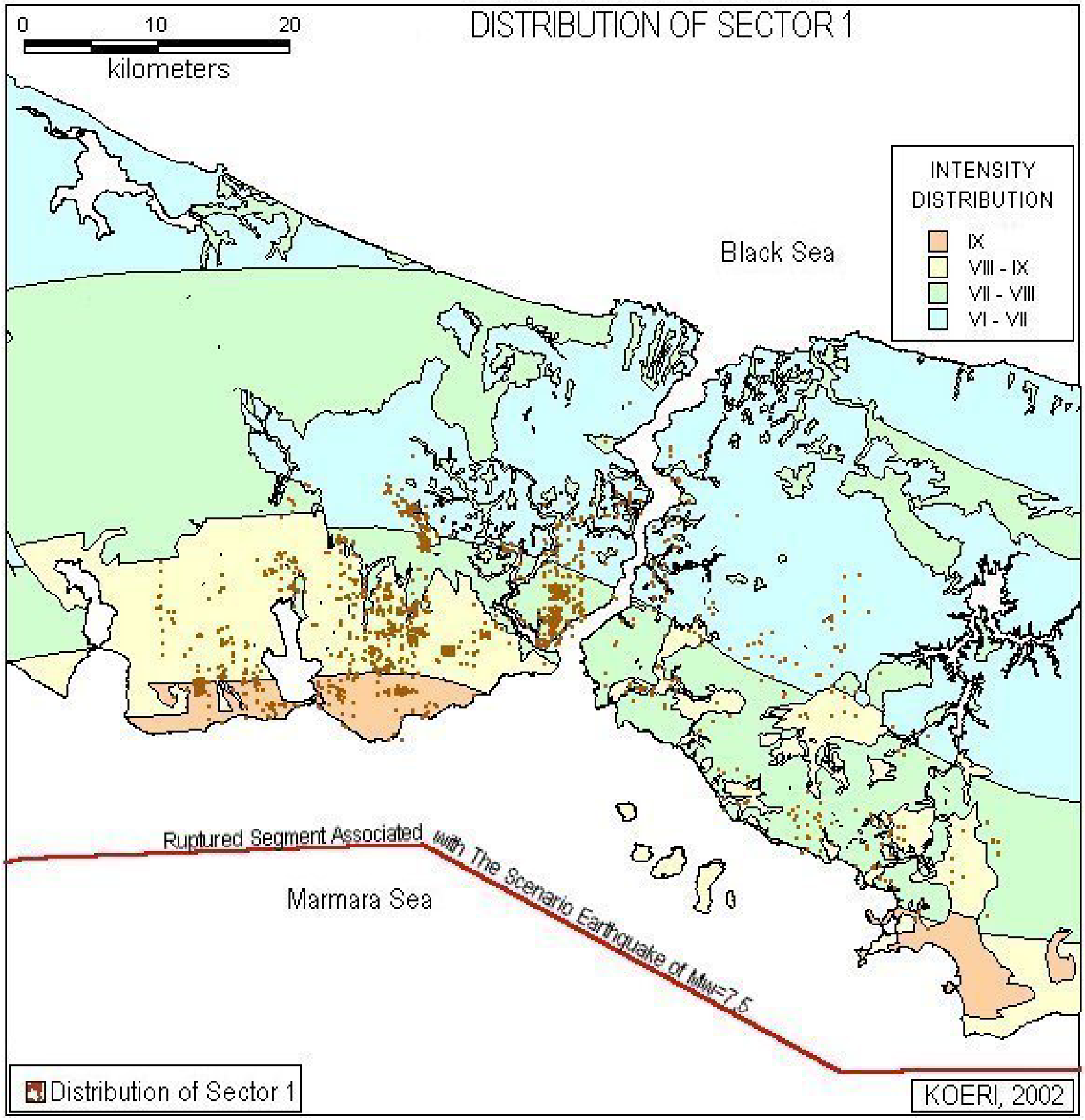

Figure 2.1.65. Distribution of Sector 1 overlain with the intensity map

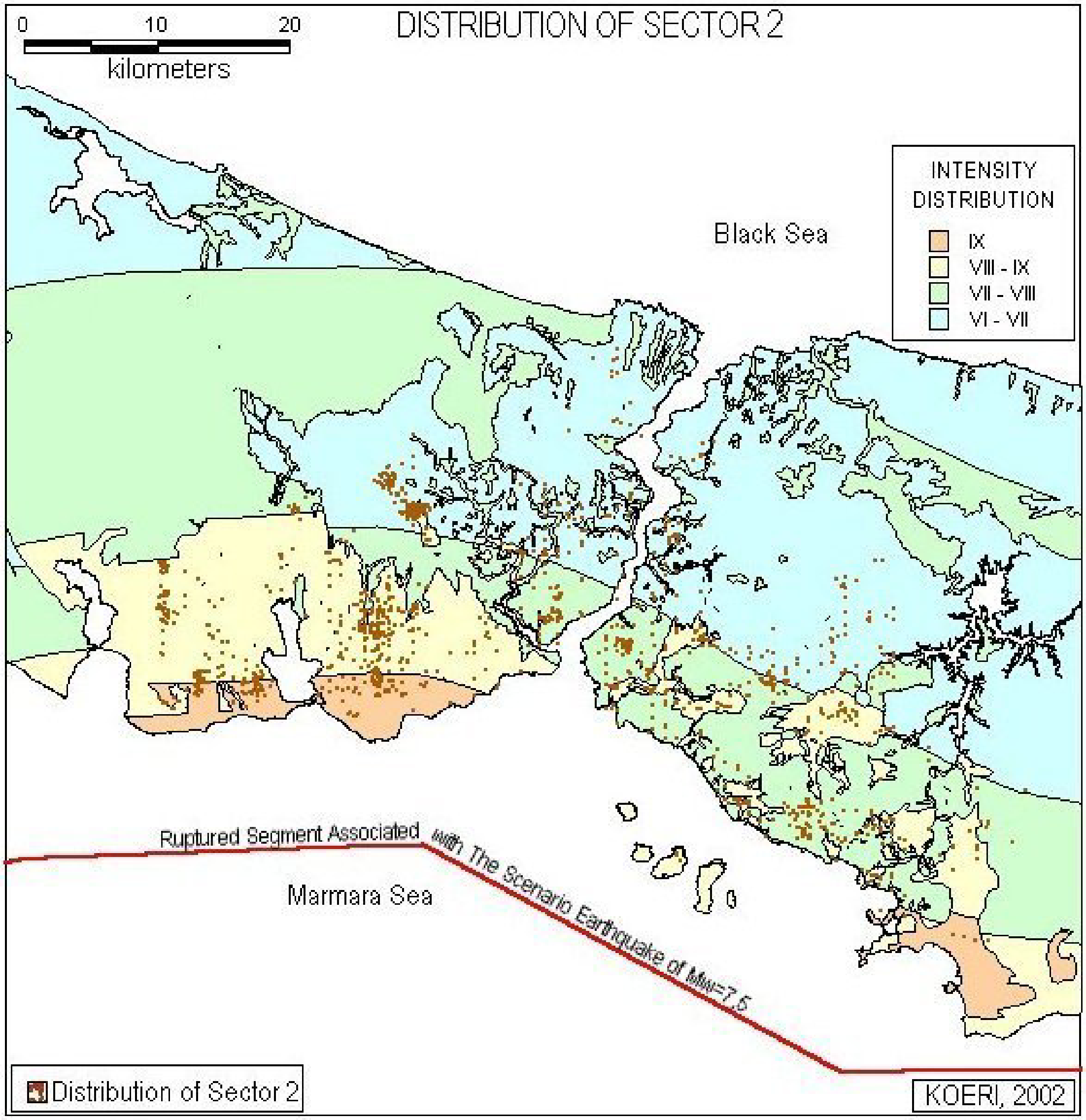

Figure 2.1.66. Distribution of Sector 2 overlain with the intensity map

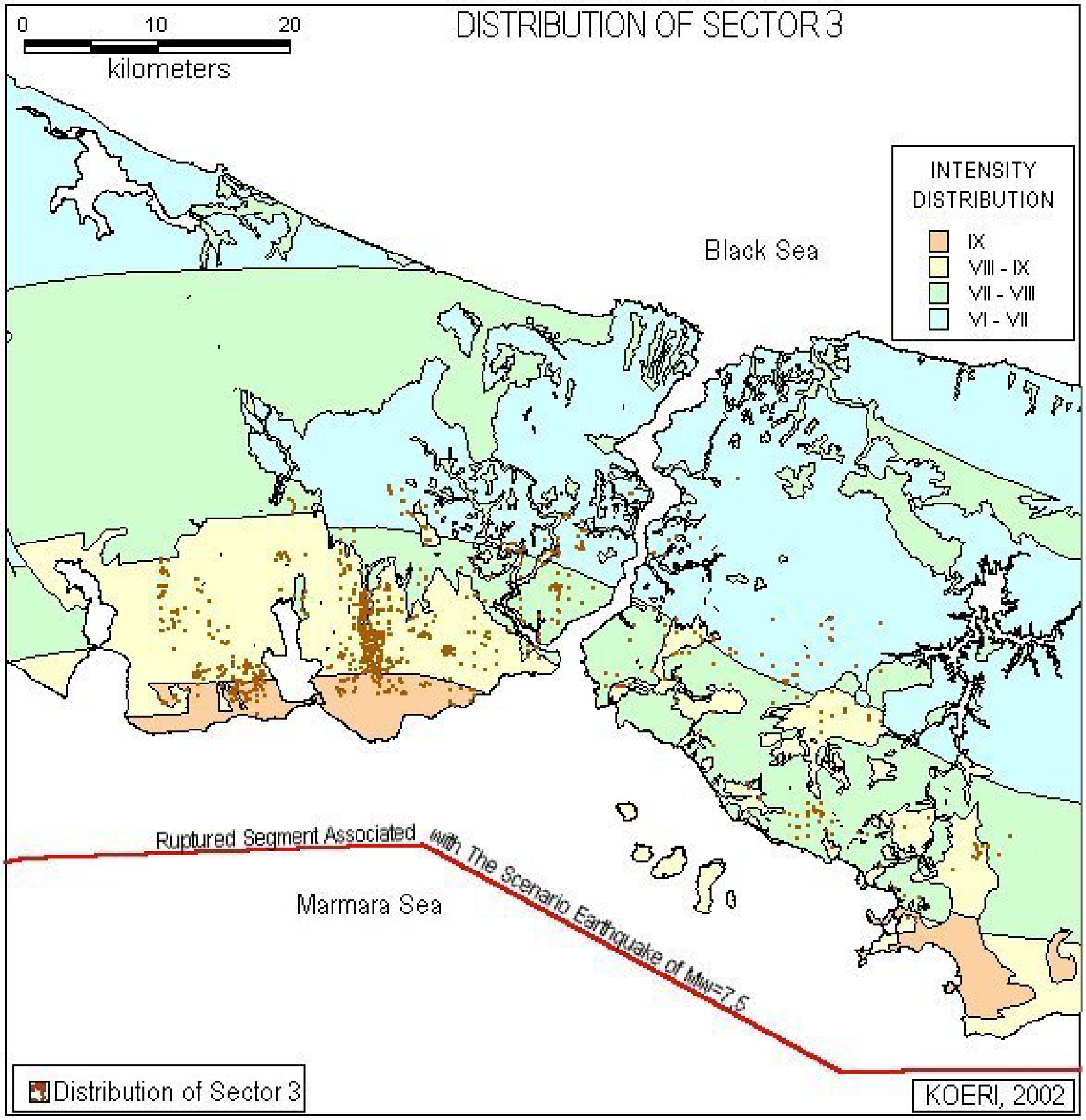

Figure 2.1.67. Distribution of Sector 3 overlain with the intensity map

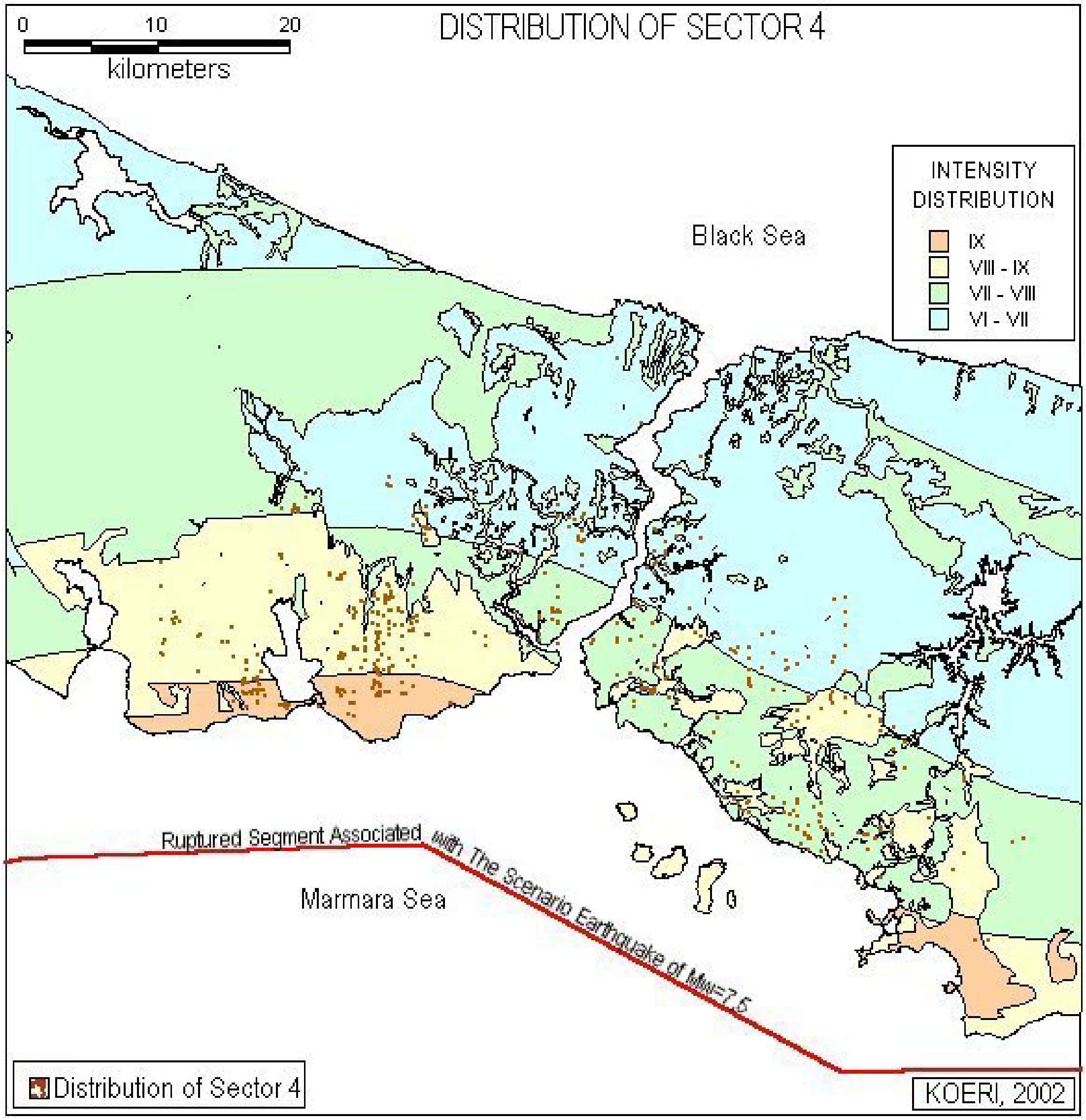

Figure 2.1.68. Distribution of Sector 4 overlain with the intensity map

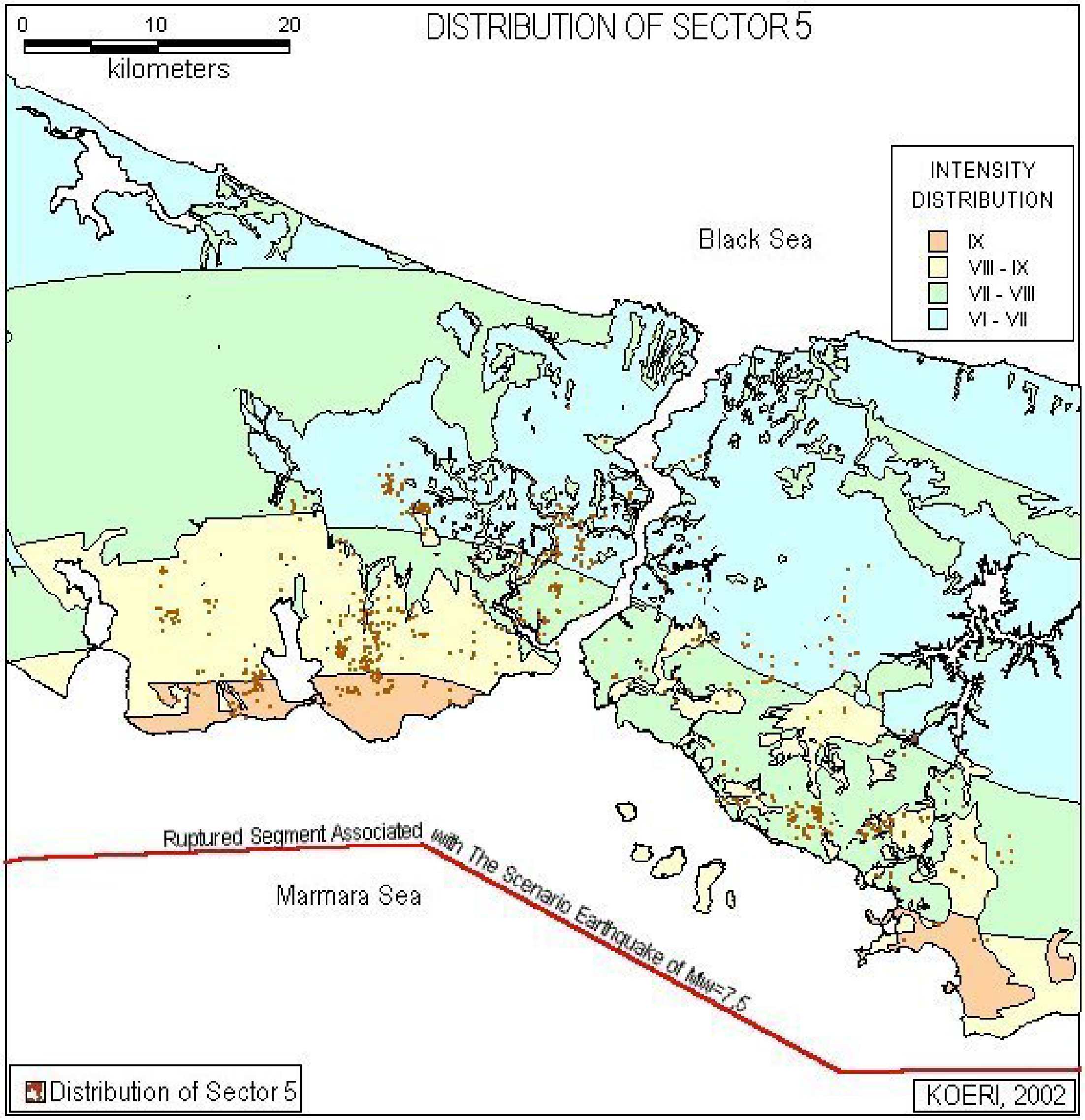

Figure 2.1.69. Distribution of Sector 5 overlain with the intensity map

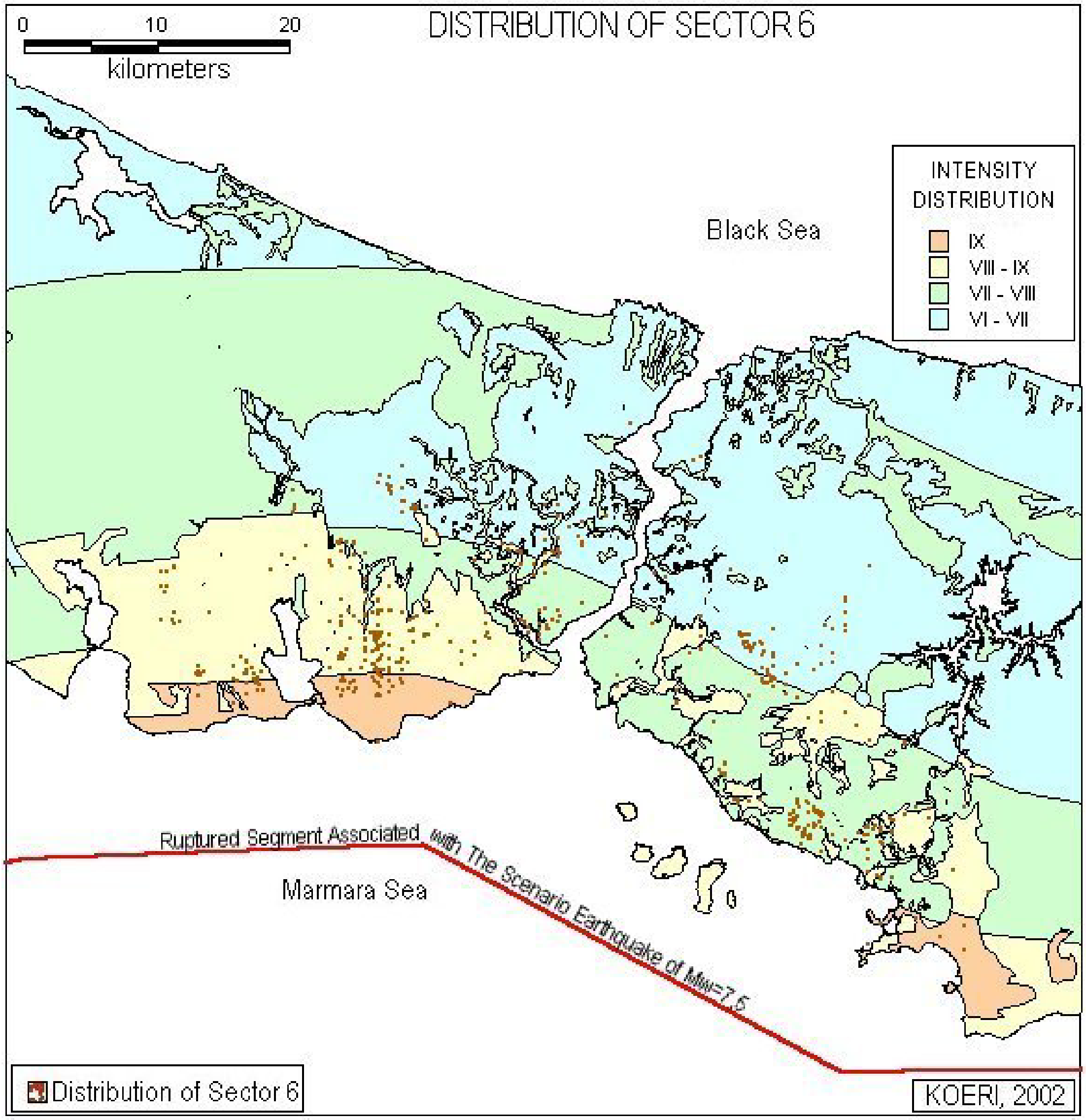

Figure 2.1.70. Distribution of Sector 6 overlain with the intensity map

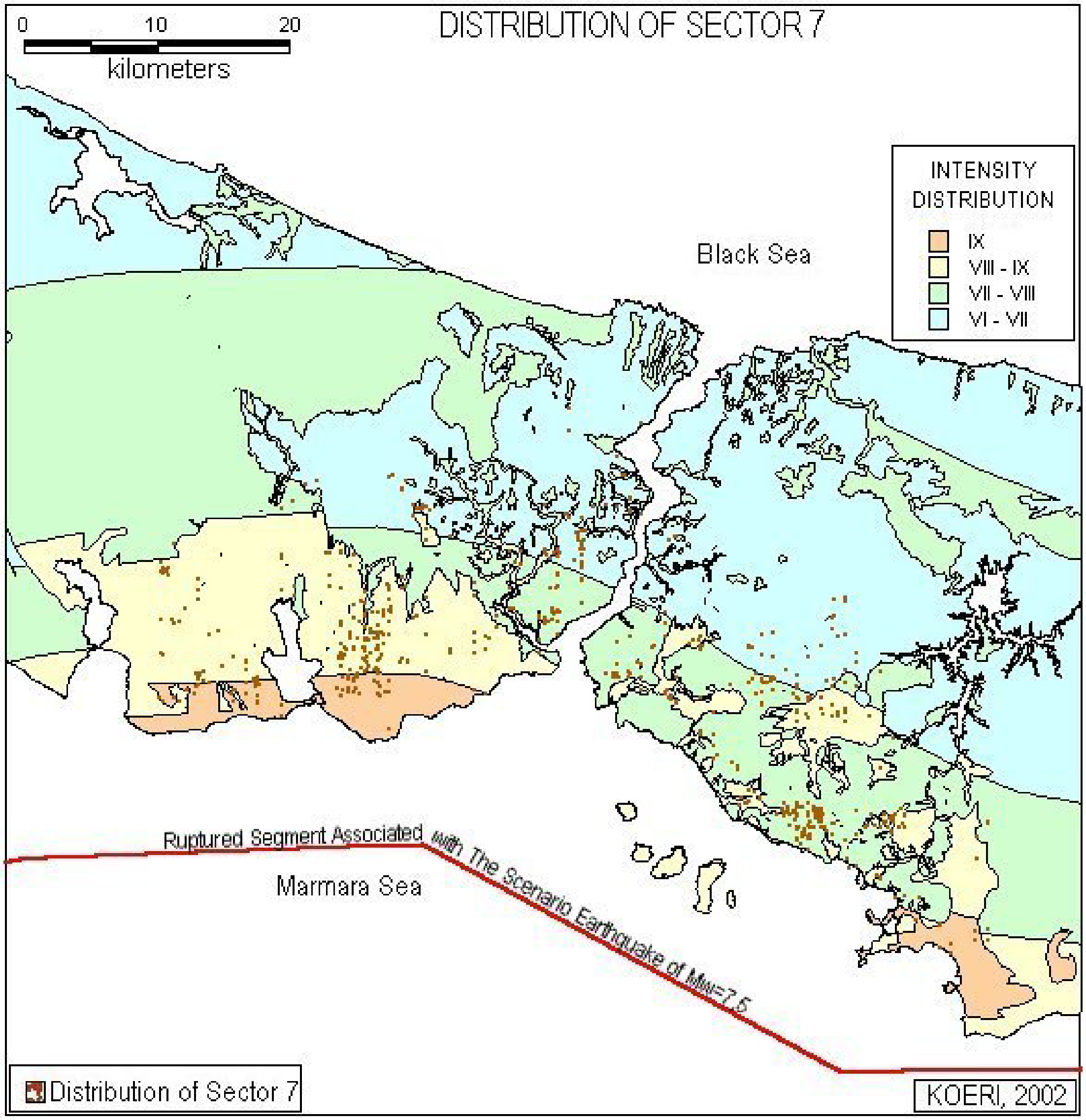

Figure 2.1.71. Distribution of Sector 7 overlain with the intensity map

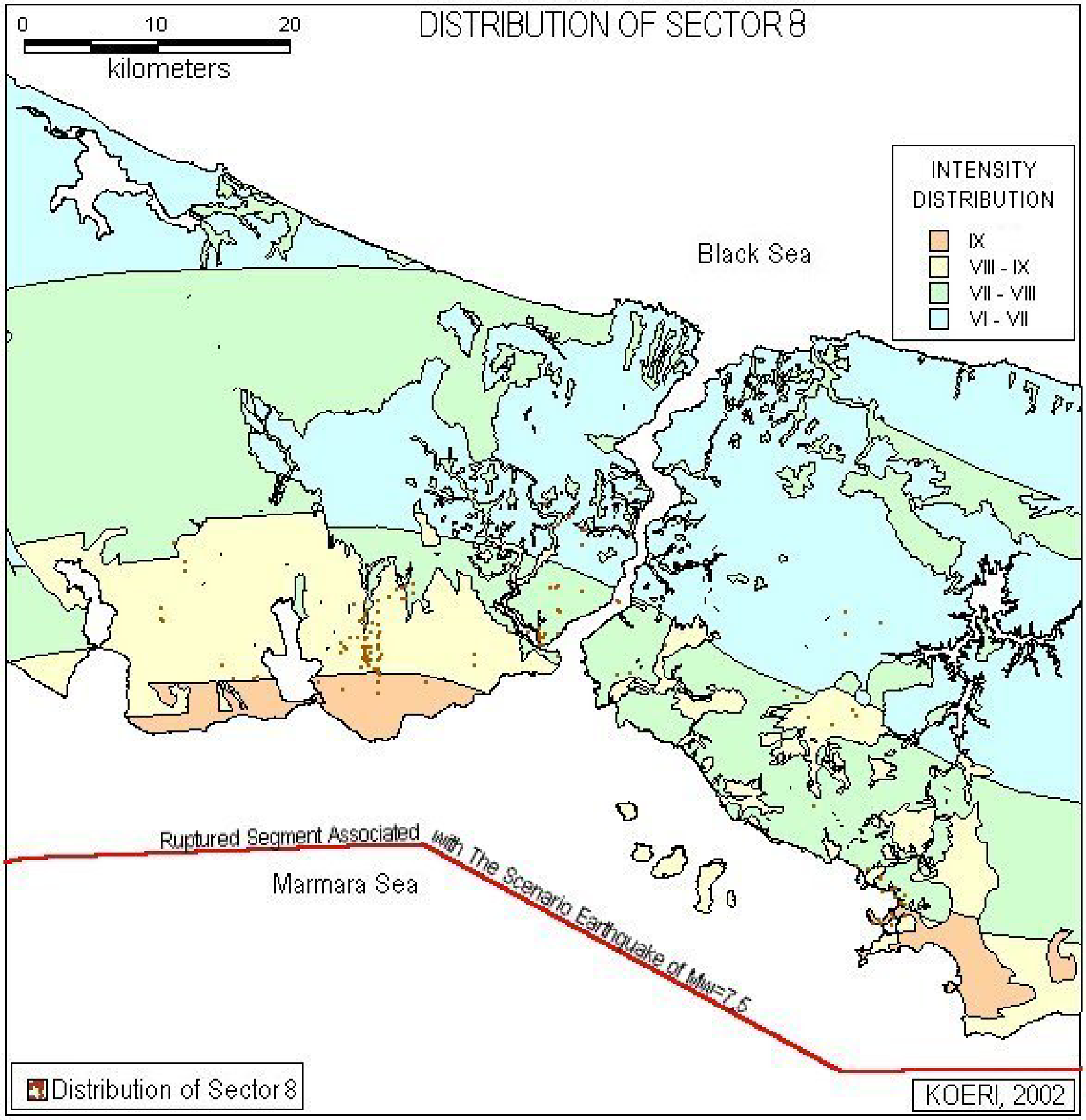

Figure 2.1.72. Distribution of Sector 8 overlain with the intensity map

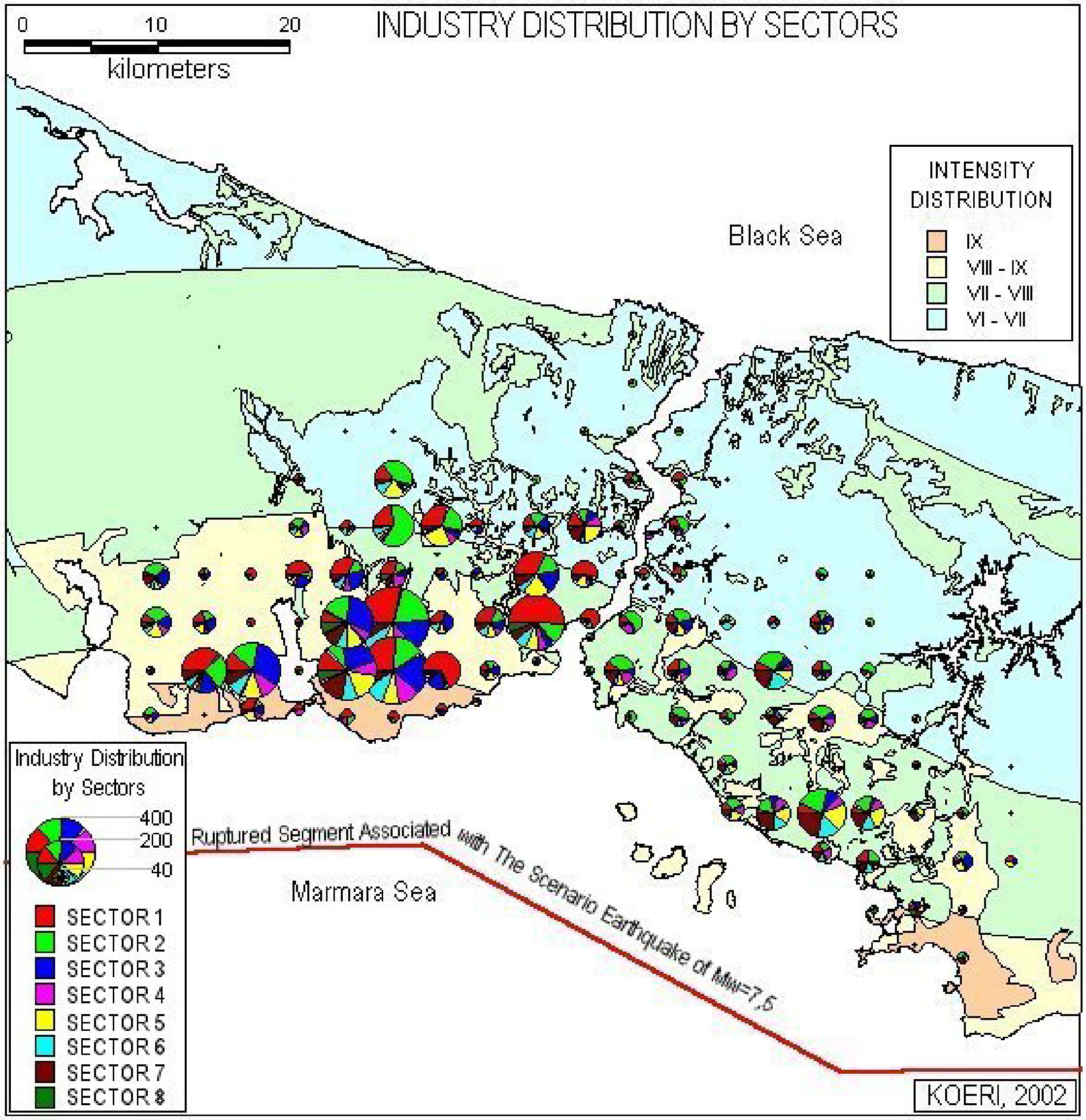

Figure 2.1.73. The general distribution of small to medium size industrial facilities with respect to total (8) sectors

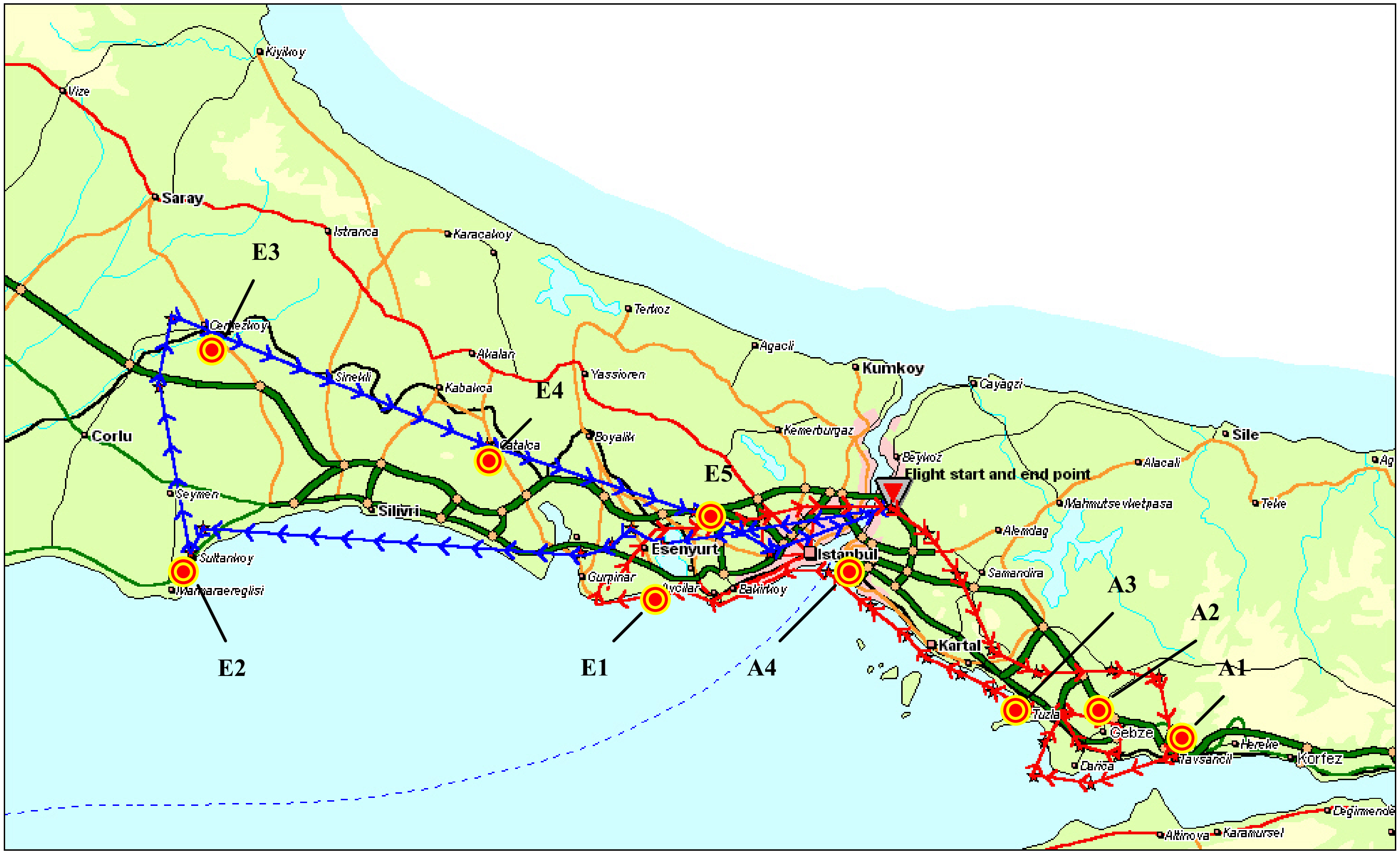

Figure 2.1.74. The route of helicopter flights and the large-scale industrial facilities

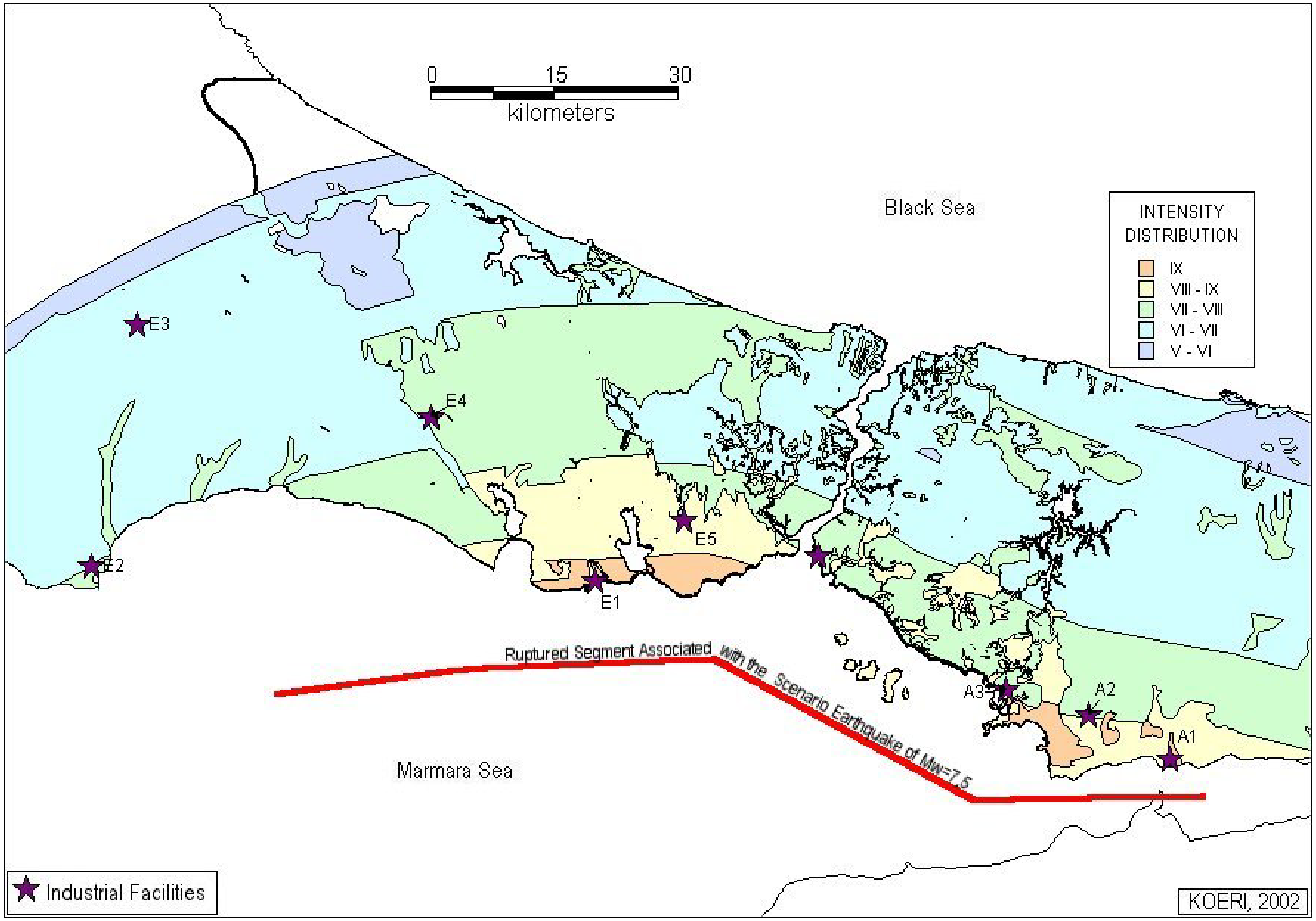

Figure 2.1.75. The distribution of large size industrial facilities and industrial parks on intensity map

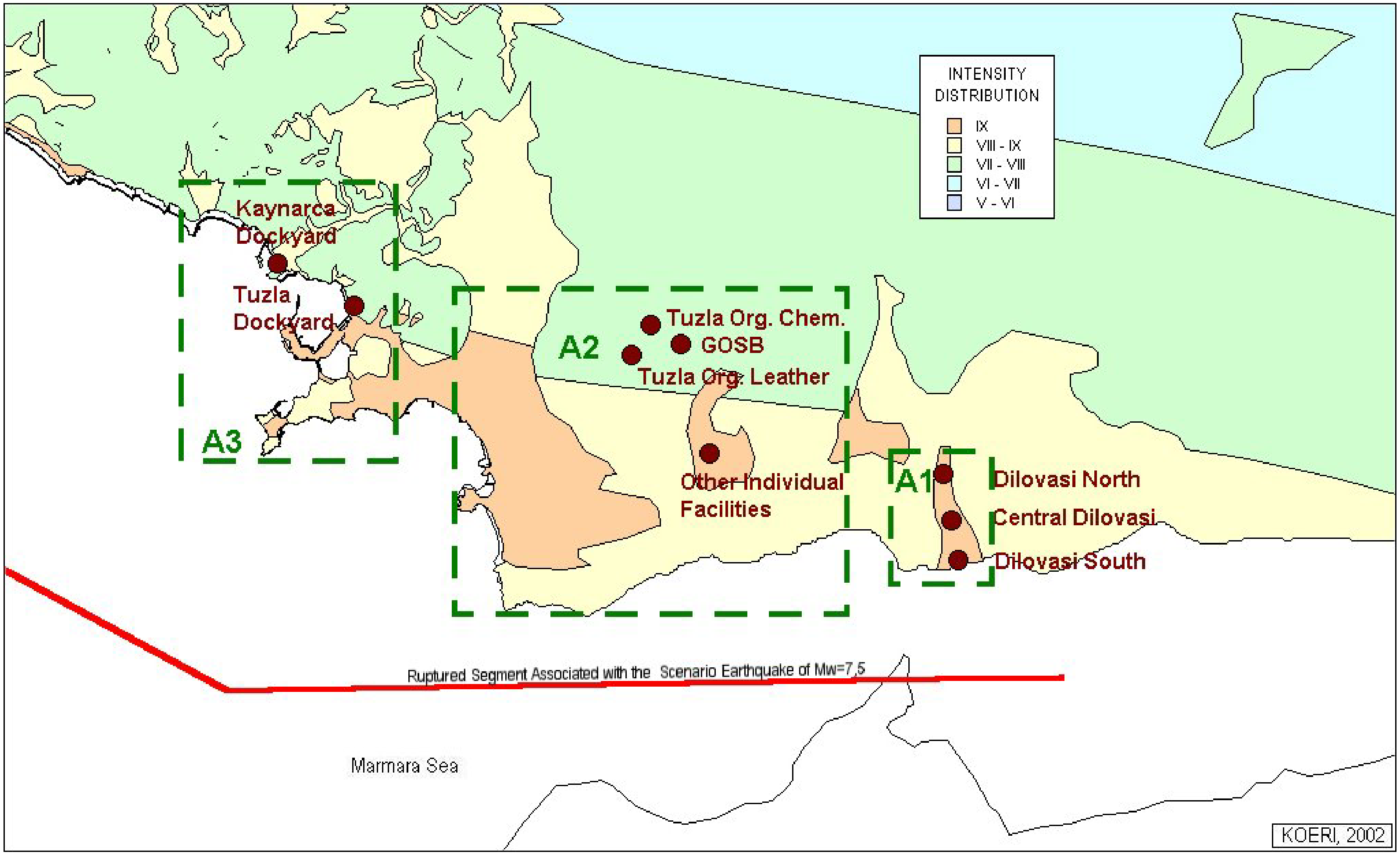

Figure 2.1.76. The distribution of large size industrial facilities and industrial parks on intensity map at Tuzla, Gebze and Dilovası

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3 SEISMIC ASSESSMENT AND REHABILITATION OF EXISTING BUILDINGS

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3.1 Seismic Assessment of Existing Buildings

3.1.1 Introduction

Seismic evaluation of existing buildings and strengthening of those, which do not have acceptable seismic safety, form the core of the Master Plan. As it is well known, there are various evaluation and strengthening methods available. The accuracy of the results of any method used in the Master Plan increases, as the method becomes more detailed. But, it is not reasonable to use a detailed method in the Master Plan for two reasons. First one is the number of the buildings. It is known that the evaluation and the investigation of the existing buildings have been carried out only for a limited number of buildings. Probably, it is the first time; this kind of investigations will be done for ten thousands of buildings. The second reason, why any detailed evaluation and strengthening method can not be applied in the present situation, is that a large number of the buildings in Istanbul does not have received any civil engineering service and they do not have any civil engineering drawings of the structural system. When simple errors are done in the design of the structural system and in the construction of the buildings, then the use of any detailed method in evaluation and strengthening is not appropriate. For these reasons, multistage building evaluation and strengthening procedures are developed and presented in the Master Plan. As the stage of the procedure increases, the procedure becomes more detailed.

In the evaluation of the seismic safety of buildings, three stages are adopted. In the first stage assessment procedure, the buildings are arranged according to the simple parameters, which are effective on their seismic safety. The second stage assessment is in fact a simplified evaluation method. At this stage, a documentation of the buildings according to their seismic risk level will be done. Having done this listing, it is be possible to identify the buildings having definite seismic structural safely and also the buildings having no seismic safely at all. The third assessment stage will be applied to the socially essential buildings of limited number only. It will be also applied to the buildings for which the second stage yields any uncertainty. Furthermore, upon the request of the owner, the stage can be applied for any building by considering various safely levels.

Similar to the assessment procedures, the strengthening procedures are considered in two stages depending on the extent of their detail. The first one is called the simplified procedure and its application is expected to be very wide. The second one, the comprehensive strengthening, will be applied to the socially essential buildings and to any building upon the request of its owner.

The procedures are developed by the numerous experts in the earthquake engineering and they are discussed in the broad range meetings, before this presented final version is

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accepted. However, these procedures are not applied on the buildings having that large number. For this reason, more than one procedure for assessment and strengthening at each stage are given in the Master Plan. Furthermore, only some of the given procedures have theoretical background only, whereas the parameters used in these procedures are given within numerical interval only, without specifying a definite value for them. Additionally, some of the procedures are derived from the theoretical back grounds which are very close to each other. Consequently, they resemble to each other in certain degree. For obtaining the reliable results, these procedures are supposed to apply in a certain geographical pilot region, their result should be compare with each other and with the results of the more comprehensible and detailed methods. In this way, it will be useful to calibrate them within a certain part of the city and obtain more reliable further results.

3.1.2 Assessment of Available Information

Scenario A described in the JICA-IMM report foresees that 7 percent of all buildings in Istanbul (51 000 buildings) will either collapse or suffer major damage, causing some 73 000 deaths. These figures are based on the average neighborhood distribution of the building stock in the city and assessment of its structural characteristics. One the primary goals of the Master Plan work we have pursued is to locate the weakest 5-10 percent of the existing buildings that have the highest probability of collapse. The multistage building assessment system that has been developed will play a key role in determining the eventual success of the Master Plan. Duration, cost and manpower requirements of the multistage assessment procedure will play a central role in defining the implementation of the Master Plan.

3.1.3 Scope of the Building Assessment

It is possible to classify most buildings in Turkey, and those in Istanbul, as follows on the basis of occupancy, material type and structural framing:

a) Reinforced concrete buildings with 1-7 stories
b) Masonry buildings with 1-5 stories
c) Buildings with 8 or more stories (residential blocks or business centers)
d) Schools, hospitals and fire stations (essential buildings)
e) Other public buildings
f) Simple industrial buildings (small business industrial campuses, 1-2 story reinforced concrete or prefabricated structures or steel-frame buildings
g) Industrial facilities (factories)
h) Strategic buildings
i) Hazardous buildings (storage facilities, etc.)
j) Bridges and viaducts
k) Timber frame buildings
l) Infrastructure network facilities
m) Historic/cultural heritage buildings

The JICA-IMM report states that of all buildings in Istanbul those under item (a) constitute 73 percent of the total, and those under (b) account for 23 percent. It is likely that buildings of type (e) conform to either (a) or (b). The implication of this observation is that if a building assessment procedure covering these two groups can be developed then 96 percent of the building stock will have been addressed. We do not consider the inclusion of types (g)-(m) under the same assessment system would be appropriate. Industrial facilities or hazardous buildings are often special types of structures. It is also likely that strategic buildings are not readily accessible, and that they would require permission from the Ministry of Defense or the General Staff Command. Bridges or viaducts must be handled under a separate undertaking, and to our knowledge other responsible agencies are in the process of implementing such work. Timber framed buildings are not numerous in Istanbul. They are usually quite resistant against collapsing and causing deaths. Buildings classified under the heading of historic or cultural heritage must be investigated within a separate study. The multi-stage assessment techniques and tools developed for groups (a) and (b) may be applied to (c)-(f) with small modifications. Table 3.1 is a summary of which assessment stage will be applied to which building type.

Table 3.1. Building Assessment Levels for Building Types

Building Type	Street Survey	Preliminary Assessment	Detailed Assessment
(a)	X	X	X
(b)	X	X	
(c)			X
(d)			X
(e)		X	X
(f)		X	X

The group of buildings under heading (c) are likely to be engineered structures for which design projects are available. The street survey or preliminary assessment tools developed for buildings in groups (a) or (b) may not be directly applicable for them. Therefore, the straightforward application of the Detailed Assessment procedures to these buildings may be appropriate. Essential buildings such as schools, hospitals or fire stations should have a superior earthquake performance than ordinary buildings. These buildings should continue to function in the post-event phase of the expected scenario earthquake. Therefore for group (d) the Detailed Assessment procedure should be applied directly.

The remaining public buildings are probably more extended than ordinary residential buildings, so their assessment should preferably start at the Preliminary Assessment Stage. Simple industrial buildings require a different approach also. When identical simple industrial buildings are assessed, it is likely that systematic refinements for the Preliminary Assessment procedures will be achieved for them.

3.1.4 Multistage Building Assessment Procedure

Introduction

In their First and Second Progress Reports submitted to IMM all research groups had indicated that they were in agreement with the multistage building assessment procedure, and that they were developing suitable tools for its implementation. Even though this may be accepted as fact, it is unavoidable that among the parties conducting the consultancy work, there will exist differences of approach. The consequence of this is that in this and future report developments, there will be more than one method applicable for each stage. This is in fact in agreement with the nature of our commitment. As in medical science a diagnosis can be based on a series of successive analyses, or on a number of alternative analyses for the same stage. Each approach will have its own set of merits. Before generalizing the proposed techniques to the rest of Istanbul, it will prove to be useful to calibrate them within a pilot study for a particular area of the city. Some of the procedures are more heavily dependent on field work, but incrementally more reliable estimates can only be achieved by following these alternative paths.

Starting with the Final Report, a unification of the terms used by the two university teams should be done. What the BU-YTU group has called the "Preliminary Assessment

Stage" is designated by the ITU-METU group as "Street Survey Stage." It is advisable that this should be called "FIRST STAGE ASSESSMENT." Both groups have defined a stage where access to the building is required. We will designate this stage as "SECOND STAGE ASSESSMENT". The stage at which detailed computational assessment procedures will be implemented is to be called the "THIRD STAGE ASSESSMENT." Each of these stages will require the implementation of specific work packages to fulfill the need of the work stage.

First Stage Assessment

Method I: (for 1-7 story reinforced concrete buildings) --- METU

Structural parameters that have to be observed during the field surveys, their effects on building seisic risk, and the value given to each parameter by the observer are explained below.

<u>Number of Stories:</u>

Field observations after the 1999 Kocaeli and Düzce earthquakes revealed that there is a very significant correlation between the number of stories and the severity of building damage. If all buildings were conforming to modern seismic design codes, then such a distribution would not occur, and a uniform distribution of damage would be expected. However if the majority of buildings in the earthquake stricken region lack this basic property, then the increasing number of stories increase seismic forces linearly whereas the seismic resistances do not follow in adequate proportions. Accordingly, damage increases almost linearly with the number of stories. After the two earthquakes in 1999, damage distribution for all 9685 buildings in Düzce is obtained with respect to the number of stories. As the number of stories increase, the ratio of undamaged and lightly damaged buildings decrease steadily whereas the ratio of moderately and severely damaged buildings increase in an opposite trend. This is a clear indication that the number of stories is a very significant, perhaps the most dominant parameter in determining the seismic vulnerability of typical multistorey concrete buildings in Turkey.

<u>Soft Story:</u> No (0); Yes(1)

Soft story usually exists in a building when the ground story has less stiffness and strength compared to the upper stories. This situation mostly arises in buildings located along the side of a main street. The ground stories, which have level access from the street, are employed as a street side store or a commercial space whereas residences occupy the upper stories. These upper stories benefit from the additional stiffness and strength provided by many partition walls, but the commercial space at the bottom is mostly left open between the frame members for customer circulation. Besides, the ground stories may have taller clearances and a different axis system causing irregularity. The compound effect of all these negative features from the earthquake engineering perspective is identified as a soft story. Many buildings with soft stories were observed to collapse due to a pancaked soft story in the past earthquakes all over the world.

<u>Heavy Overhangs:</u> No (0); Yes (1)

Heavy balconies and overhanging floors in multistory reinforced concrete buildings shift the mass center upwards; accordingly increase seismic lateral forces and overturning moments during earthquakes. Buildings having balconies with large overhanging cantilever spans enclosed with heavy concrete parapets sustained heavier damages during the recent earthquakes in Turkey compared to regular buildings in elevation. Since this building feature can easily be observed during a walk-down survey, it is included in the parameter set.

Apparent Building Quality: Good (0); Moderate (1); Poor (2)

The material and workmanship quality, and the care given to its maintenance reflect the apparent quality of a building. A well-trained observer can classify a buildings apparent quality roughly as good, moderate or poor. A close relationship had been observed between the apparent quality and the experienced damage during the recent earthquakes in Turkey. A building with poor apparent quality can be expected to possess weak material strengths and inadequate detailing.

Short Columns: No (0); Yes (1)

Semi-infilled frames, band windows at the semi-buried basements or mid-story beams around stairway shafts lead to the formation of short columns in concrete buildings. These captive columns usually sustain heavy damage during strong earthquakes since they are not originally designed to receive the high shear forces relevant to their shortened lengths. Short columns can be identified from outside because they usually form along the exterior axes.

Pounding Effect: No (0); Yes (1)

When there is no sufficient clearance between adjacent buildings, they pound each other during an earthquake as a result of different vibration periods and consequent non-synchronized vibration amplitudes. Uneven floor levels aggravate the effect of pounding. Buildings subjected to pounding receive heavier damages at the higher stories.

Topographic Effects: No (0); Yes (1)

Topographic amplification is another factor that may increase the ground motion intensity on top of hills. Besides, buildings located on steep slopes (steeper than 30 degrees) usually have stopped foundations, which are incapable of distributing the ground distortions evenly to structural members above. Therefore these two factors must be taken into account in seismic risk assessment. Both factors can be observed easily during a street survey.

Local Soil Conditions:

Site amplification is one of the major factors that increase the intensity of ground motions. Although it is difficult to obtain precise data during a street survey, an expert observer can be able to classify the local soils as stiff or soft. In urban environments, geotechnical data provided by local authorities is a reliable source for classifying the local soil conditions.

The intensity of ground motion under a building during an earthquake predominantly depends on the distance of the building to the causative fault, and the local soil conditions. Mapping of seismic hazard at micro scale considers both variables. Seismic hazard, or ground motion intensity is mapped in terms of PGA and PGV in the JICA report. PGV usually reflects the effect of soil conditions very well during a large magnitude earthquake (Wald et al., 1999). The correlation of PGV and shear wave velocities of local soils can easily be observed from the associated maps given in the JICA report (Figures 3.1 and 3.2). Accordingly, PGV is selected to represent the ground motion intensity in this study.

The PGV map in the JICA report has contour increments of 20 cm/s2. The intensity zones in Istanbul are expressed accordingly, in terms of the associated PGV ranges.

Zone I : $60<PGV<80$ cm/s^2

Zone II : $40<PGV<60$ cm/s^2

Zone III : $20<PGV<40$ cm/s^2

The superiority of PGV over PGA can be best observed at the Prince Islands, which are bedrock outcrops. They are in PGV zone II. However if PGA were employed, they would be in zone I due to their proximity to the Marmara fault. It is well documented that the Prince Islands were not severely affected from the strong historical earthquakes.

The differences in ground motion intensities at three PGV zones are reflected in the initial scores given in Tables 3.2 and 3.3, according to a study conducted by Akkar and Sucuoglu (2003).

Building Seismic Performance

Once the vulnerability parameters of a building are obtained from walk-down surveys and its location is determined, the seismic performance score is calculated by using Table 3.2. In this table, an initial score is given first with respect to the number of stories and the intensity zone. Then, the initial score is reduced for every vulnerability parameter that is observed or calculated. A general equation for calculating the seismic performance score (PS) can be formulated as follows.

PS = (Initial Score) - ∑(Vulnerability parameter) × (Vulnerability Score)

The weight of each building vulnerability parameter is evaluated by statistical procedures, based on the Düzce database. Statistical analysis is conducted by the program package SPSS Version 11, using the "*Multivariable Stepwise Linear Regression Analysis*" procedure. The results are then smoothed, and the weights of the parameters for which there was no available data (soft story, pounding, topography) are assigned by using engineering judgment

Table 3.2. Initial and Vulnerability Scores for Concrete Buildings

Story #	Zone I 60<PGV<80	Zone II 40<PGV<60	Zone III 20<PGV<40		Heavy Overhang	Apparent Quality	Short Column	Pounding	Topographic Effects
1, 2	90	125	160	0	-5	-5	-5	0	0
3	90	125	160	-10	-10	-10	-5	-2	0
4	80	100	130	-15	-10	-10	-5	-3	-2
5	80	90	115	-15	-15	-15	-5	-3	-2
6, 7	70	80	95	-20	-15	-15	-5	-3	-2

Vulnerability Parameters

Soft story : No (0); Yes (1)
Heavy overhangs : No (0); Yes (1)
Apparent quality : Good (0); Moderate (1); Poor (2)
Short columns : No (0); Yes (1)
Pounding effect : No (0); Yes (1)
Topography effect : No (0); Yes (1)

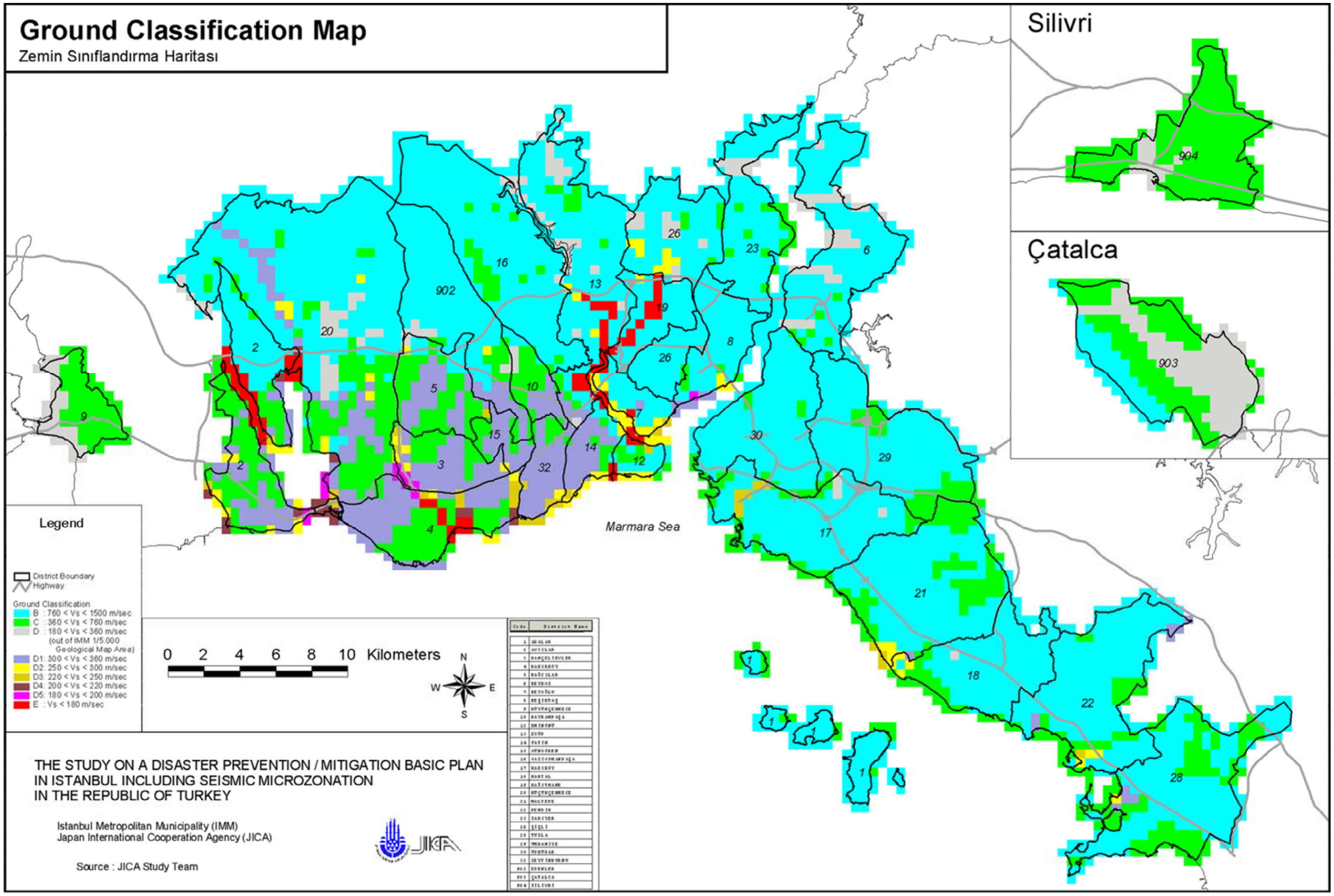


Figure 3.1. Geotechnical Classification Map (JICA Report)

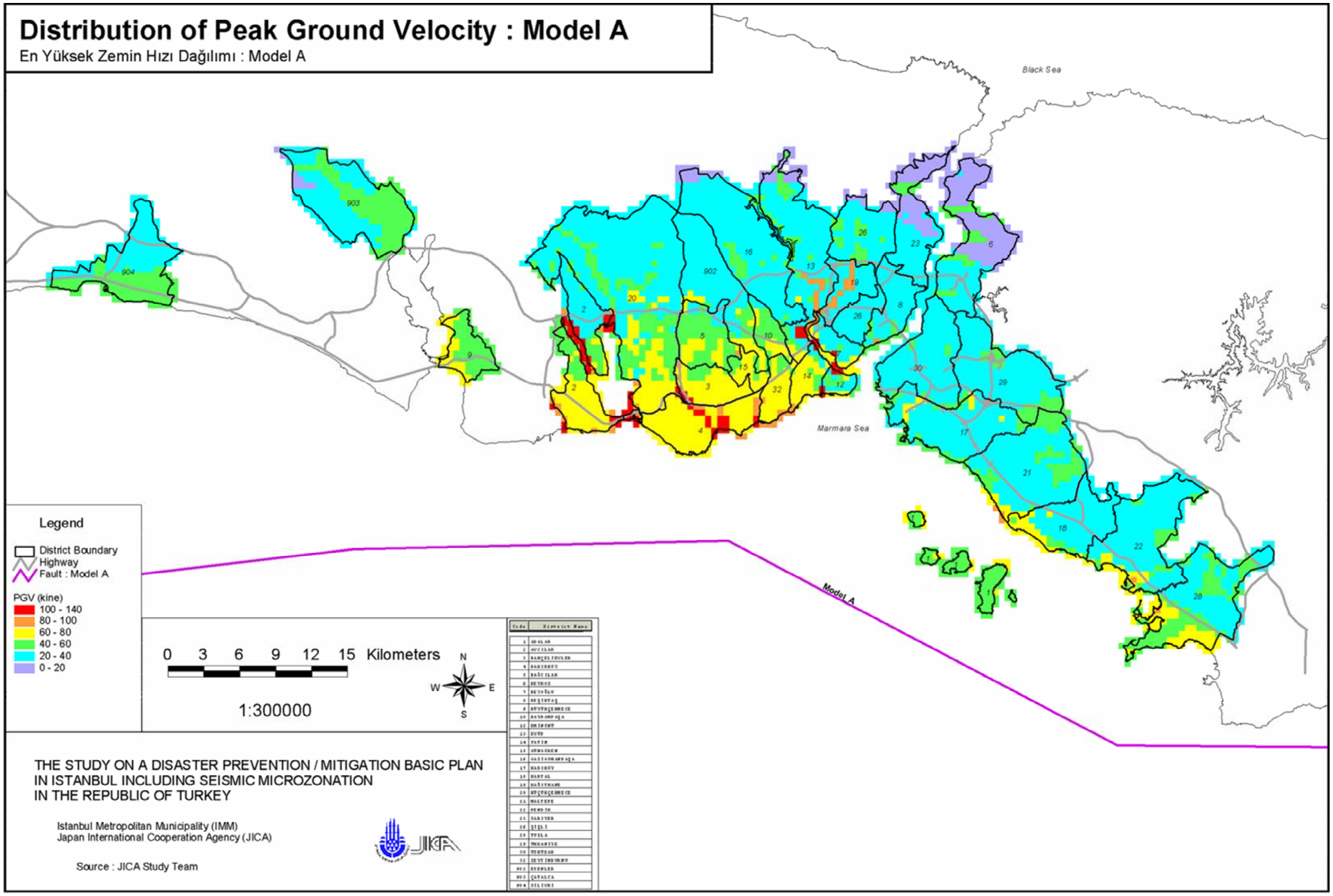


Figure 3.2. Peak Ground Velocity Distribution Map (JICA Report)

Method II: (1-5 story masonry buildings) ---- METU

The parameters that have to be observed, and the values to be assigned during the walk-down surveys are given below. They are based on the observations after the 1992 Erzincan and 1995 Dinar earthquakes, where many masonry buildings were damaged.

Number of Stories

In recent Turkish seismic codes, (1975 and 1998), masonry buildings are limited to 2 and 3 stories in seismic zones 1 and 2, respectively. Based on past experience, it can be expected that masonry buildings having more than 3 stories carry significantly higher risk compared to the lower ones.

Apparent Building Quality **:** Good (0); Moderate (1); Poor (2)

The correlation between apparent building quality and seismic damage risk is expected to be similar to that for concrete buildings.

Wall Opening Ratio: Small (0), Moderate (1), Large (2)

The wall with largest openings is probably the front facade wall. The ratio of openings to wall area is classified as small, moderate or large. If the ratio of the total length of openings to the total length of wall is less than 1/3, it is small, if it is between 1/3 and 2/3 it is moderate, if more, it is large. These ratios can be selected by visual proportioning.

Orientation of Wall Openings: Regular (0), Less Regular (1), Irregular (2)

If openings in the walls of multistory buildings are aligned, this is a regularity. If not, it increases the damage risk. When the openings are completely misaligned, it is defined as an an irregularity.

Pounding Effect**:** No (0); Yes (1)

When there is no sufficient clearance between adjacent buildings, they pound each other during an earthquake as a result of different vibration periods and consequent non-synchronized vibration amplitudes. Uneven floor levels aggravate the effect of pounding. Buildings subjected to pounding receive heavier damages at the higher stories.

Local Soil Conditions**:**

The classification given for the concrete buildings above are also valid for the masonry buildings.

Building Seismic Performance

Once the vulnerability parameters of a building are obtained from walk-down surveys and its location is determined, the seismic performance score is calculated by using Table 3.3. In this table, an initial score is given first with respect to the number of stories and the intensity zone. Then, the initial score is reduced for every vulnerability parameter that is observed or calculated. A general equation for calculating the seismic performance score (PS) can be formulated as follows.

PS = (Initial Score) - ∑(Vulnerability parameter) x (Vulnerability Score)

Table 3.3. Initial and Vulnerability Scores for Masonry Buildings

Number of Stories	Zone I PGV>60	Zone II 40<PGV<60	Zone III PGV<40	Apparent Quality	Wall Openings	Opening Orientation	Pounding Effect
1,2	100	130	150	-10	-5	-2	0
3	85	110	125	-10	-5	-5	-3
4	70	90	110	-10	-5	-5	-5
5	50	60	70	-10	-5	-5	-5

Vulnerability Parameters

Wall openings: Small (0); Moderate (1); Large (2)

Opening orientation : Regular (0); Less regular (1); Irregular (2)

Apparent quality : Good (0); Moderate (1); Poor (2)

Pounding effect : No (0); Yes (1)

The values given in Tables 3.2 ve 3.3 are preliminary figures and they have to be calibrated during pilot field studies.

Method III --- (BU – YTU)

The following information is envisaged to be compiled in a standard data sheet in the building inventory study, which is also called “sidewalk survey”:

- Address and coordinate of the building (GPS data)
- An electronic photograph of the building
- Approximate plan area of the building
- Number of stories of the building (excluding basement, including penthouse if any)
- Apparent construction quality of the building (Good – fair – bad)
- Pounding susceptibility of the building (existing or not)
- If pounding susceptibility exists, observe whether
  - (a) the building is at the corner
  - (b) R/C floor levels are different or not
- Structural system of the building (Reinforced concrete, masonry or wood)
- In R/C buildings, observe whether
  - (a) weak story exists
  - (b) short columns exists in the façade
  - (c) façade columns rest on cantilevers at the ground floor level
- In masonry or wood buildings, observe whether
  - (a) the order of openings in the perimeter walls is little, moderate or excessive
  - (b) the openings in the perimeter walls are regular or not

Preliminary assessment study

As a result of the preliminary assessment study based on inventory information to be compiled, it is aimed that the numbers and distributions of buildings with the highest risk of loss of life can be reasonably estimated.

In this regard, the analytical loss estimations realized through JICA project developed for the Greater Municipality of Istanbul and the project carried out by KOERI of Boğaziçi University for the American Red Cross have utilized building inventory data compiled by the State Statistics Institute. These estimations are expected to be refined on the basis of the more reliable data to be obtained from the building inventory study. Such a preliminary assessment study will cover the entire building stock in Istanbul.

Seismic hazard levels and performance criteria

It is imperative that the "seismic actions" to be considered in the seismic safety assessments of buildings be defined in the preliminary evaluation stage and they are to be used consistently in all subsequent stages and the final retrofit studies. It needs to be emphasized that the seismic actions to be considered in both seismic assessment and retrofit stages should not be determined in accordance with the current seismic design code and associated seismic hazard map. In any case, "seismic hazard levels" to be considered in assessment and retrofit should be compatible with the "building performance levels".

In this respect it is envisaged that the mean "deterministic" seismic hazard map developed by KOERI within the framework of the Redcross Project and the "probabilistic" seismic hazard map with a 10% probability of exceedance in 50 years be used to satisfy the "life safety" and "collapse prevention" performance criteria, respectively.

Estimation of earthquake displacement demand

Utilizing "*spectral accelerations*" specified in deterministic and probabilistic seismic hazard maps for small cell-regions and the associated "spectral displacements", it is possible to estimate the seismic demand in terms of roof displacement of each type of the classified buildings. In those maps, short period spectral acceleration SS and one-second spectral acceleration S1 are specified according to NEHRP definition on the basis of small cell-regions. Utilizing those data, standard "elastic" acceleration spectrum with 5% damping can be defined through the formulae given in FEMA 302 and FEMA 356:

$$S_{ae} = (1 + 1.5\, T / T_o)\, S_S / 2.5 \quad (T < T_o) \qquad (3.1a)$$

$$S_{ae} = S_S \quad (T_o \le T \le T_S) \qquad (3.1b)$$

$$S_{ae} = S_1 / T \quad (T > T_S) \qquad (3.1c)$$

in which $T_S = S_1 / S_S$ ve $T_o = 0.2\, T_S$.

The elastic displacement spectrum can be defined in terms of the above-defined elastic acceleration spectrum as

$$S_{de} = (T/2\pi)^2\, S_{ae} \qquad (3.2)$$

where the the effective fundamental period of the building, T, can be estimated by considering the nonlinear deformations in reinforced concrete buildings as

$$T = 0.15\, n \qquad (3.3a)$$

and in masonry buildings as

$$T = 0.075\, n \qquad (3.3b)$$

where n represents the number of stories of the building excluding basement(s).

On the other hand inelastic (nonlinear) displacement spectrum can be defined through the approximate relationship given below:

$$S_{di} = C_d\, S_{de} \qquad (3.4)$$

where Cd coefficient refers to an empirical factor, which depends on the number of stories (n) of the building excluding basement and given the approximate nature of the preliminary assessment study, it is deemed to replace all three coefficients given in FEMA 356, namely C1, C2 and C3, as similat to FEMA 310 approach.

Table 3.4. Cd coefficients

N	1	2	3	≥4
C_d	1.5	1.3	1.1	1.0

The above-defined inelastic (nonlinear) spectral displacement can be related to the nonlinear roof displacement of the building. Assuming that the seismic behavior of the building is governed by the fundamental vibration mode, the "*roof displacement demand*" can be obtained by the following relationship:

$$u_n = \phi_n\, \Gamma\, S_{di} \qquad (3.5)$$

where un represents the roof displacement, ϕn refers to the fundamental mode shape amplitude at the roof and Γ denotes participation factor of the fundamental mode. Assuming that the mode shape is linear in 5-6 story buildings and taking story masses equal, the roof displacement demand can be simply expressed as

$$u_n = [3n \,/\, (2n + 1)]\, S_{di} \qquad (3.6)$$

Assuming the average story height as 3 m, the "*building drift ratio demand*", (D_d), which is defined as the roof displacement divided by the total building height, (H_n), is obtained as

$$D_d = u_n \,/\, H_n = S_{di} \,/\, (2n + 1) \qquad (3.7)$$

where S_{di} is in meters.

Estimation of displacement capacities of buildings

The "*seismic demands*" estimated for deterministic and probabilistic earthquake as defined above in terms of roof displacements will be compared with the below-defined roof displacement "*capacities*" for each building type according to "*life safety*" and "*collapse prevention*" performance criteria:

$$D_c = D_{co}\, C_c \qquad (3.8)$$

where D_c represents "*building drift ratio capacity*", D_{co} refers to "*basic drift ratio capacity*" defined in Table 3.5 and C_c denotes the "*capacity reduction factor*" defined according to building inventory data.

Table 3.5. Basic drift ratio capacities (Dco)

Building Type	*Life safety Performance criterion*	*Collapse prevention Performance criterion*
R/C	0.008	0.014
Masonry	0.006	0.014

The values given in this table are only estimates. However possible errors in the first stage assessment are not very important, since the aim of this stage is to achieve a preliminary prioritization to be considered in the second stage assessment studies.

The capacity reduction factor (C_c) is defined by multiplying the following factors:

1. 1.0, 0.9 and 0.8 respectively for the apparent qualities "good", "fair" and "bad".

- In pounding susceptible buildings, 1.0 for those in the middle, 0.9 for those at the corner.
- In pounding susceptible buildings, 1.0 if the floor levels are the same, 0.9 if not.
- 0.8 for R/C buildings with weak stories, 1.0 for those without.
- 0.8 for R/C buildings with short columns, 1.0 for those without.
- 0.8 for R/C buildings where façade columns rest on cantilevers at the ground floor level, 1.0 otherwise
- In masonry buildings 1.0, 0.9 and 0.8 respectively for the order of wall opening ratio "*little*", "*moderate*" and "*excessive*".
- In masonry buildings, 0.9 where wall openings are irregular, 1.0 where regular.
- In masonry buildings, 0.8 where number stories exceeds two, 1.0 otherwise.

<u>Ordering of buildings for seismic risk</u>

It is important to re-emphasize that in the first stage assessment it is not intended to reach a conclusion for buildings, such as a sufficient seismic safety is available for certain buildings and that no action is required for retrofit of those buildings. Similarly, it is not relevant to state that certain buildings are not earthquake safe and that they are to be demolished or need retrofit.

The objective of the first stage assessment studies is to make a rational "*preliminary prioritization*" for buildings in terms of their seismic performance according to the above mentioned "*capacity-demand*" comparisons. Thus "*priorities*" for the forthcoming second stage assessment can be defined on individual building as well as on regional bases.

In fact it is expected that there will be a considerable number of buildings that would satisfy the performance criteria in low hazard zones of the city. Those buildings will be classified as as buildings with the lowest priority.

The ratio of the above-defined roof displacement capacity to roof displacement demand will be the basis of prioritization:

$$\text{Capacity/Demand Ratio} = D_c / D_d$$

This ratio will be determined separately for both life safety and collapse prevention performance criteria.

The above-described assessment studies will be realized in a acentralized manner through a special software to be developed based on electronically compiled inventory data.

In cases where the majority of the buildings in certain regions are estimated inferior in terms of their seismic performance, priorities for the development of "urban renewal" projects would be established.

Second Stage Assessment

Method I: (for 1-7 story reinforced concrete buildings) --- METU

Up to date procedures on the vulnerability assessment of building structures have primarily focused on the structural system, capacity, layout and response parameters. These parameters would provide realistic estimates of the expected performance when the built structural system reflects the prescribed structural and architectural features. In general, the construction practice in Turkey is far beyond reflecting designed structural system. For this reason, statistical analysis based on the observed damage and significant building attributes would provide reliable and accurate results for regional assessments. In this context, discriminant analysis technique was used to develop a preliminary evaluation methodology for assessing seismic vulnerability of existing low- to mid-rise reinforced concrete buildings. The main objective is to identify the buildings that are highly vulnerable to damage, that is the seismic performance is inadequate to survive a strong earthquake. Hence, the damage scores obtained from the derived discriminant functions are used to classify existing buildings as "safe", "unsafe" and "intermediate". The discriminant functions are generated based on the basic damage inducing parameters, namely number of stories (n), minimum normalized lateral stiffness index (mnlstfi), minimum normalized lateral strength index (mnlsi), normalized redundancy score (nrs), soft story index (ssi) and overhang ratio (or).

Definition of the discriminating parameters and the procedure to be followed are introduced below.

Definition of Parameters

Considering the characteristics of the damaged structures and the huge size of the existing building stock, the following parameters were chosen as the basic estimation parameters of the proposed method:

- number of stories (n),
- minimum normalized lateral stiffness index (mnlstfi),
- minimum normalized lateral strength index (mnlsi),
- normalized redundancy score (nrs),
- soft story index (ssi),
- overhang ratio (or).

These parameters are briefly defined in the following paragraphs.

a) Number of stories (N): This is the total number of individual floor systems above the ground level.

b) Minimum normalized lateral stiffness index (MNLSTFI): This index is the indication of the lateral rigidity of the ground story, which is usually the most critical story. If the story height, boundary conditions of the individual columns and the properties of the materials used are kept constant, this index would also represent the stiffness of the ground story. This index is calculated by considering the columns and the structural walls at the ground story. While doing this, all vertical reinforced concrete members with "maximum cross-sectional dimension / minimum cross-sectional dimension ratio" less then 7 are considered as columns. All other reinforced concrete structural members are considered as structural walls. The MNLSTFI parameter shall be computed based on the following relationship:

$$\text{mnlstfi} = \min(I_{nx}, I_{ny}) \tag{3.9}$$

I_{nx} and I_{ny} values in Eq.(3.9) are to be calculated by using Eq.(3.10).

$$I_{nx} = \frac{\sum (I_{col})_x + \sum (I_{sw})_x}{\sum A_f} \times 1000$$
$$I_{ny} = \frac{\sum (I_{col})_y + \sum (I_{sw})_y}{\sum A_f} \times 1000 \tag{3.10}$$

Here:

$\Sigma(I_{col})_x$ and $\Sigma(I_{col})_y$: summation of the moment of inertias of all columns about their centroidal x and y axes, respectively.

$\Sigma(I_{sw})_x$ and $\Sigma(I_{sw})_y$: summation of the moment of inertias of all structural walls about their centroidal x and y axes, respectively.

I_{nx} and I_{ny}: total normalized moment of inertia of all members about x and y axes, respectively.

ΣA_f: total story area above ground level.

c) Minimum normalized lateral strength index (MNLSI): The minimum normalized lateral strength index is the indication of the base shear capacity of the critical story. In the calculation of this index, in addition to the existing columns and structural walls, the presences of unreinforced masonry filler walls are also considered. While doing this, unreinforced masonry filler walls are assumed to carry 10 percent of the shear force that can be carried by a structural wall having the same cross-sectional area [8, 11, 12]. As in MNLSTFI calculation, the vertical reinforced members with a cross-sectional aspect ratio of 7 or more are classified as structural walls. The MNLSI parameter shall be calculated by using the following equation:

$$\text{mnlsi} = \min(A_{nx}, A_{ny}) \tag{3.11}$$

Here:

$$A_{nx} = \frac{\sum (A_{col})_x + \sum (A_{sw})_x + 0.1\sum (A_{mw})_x}{\sum A_f} \times 1000$$
$$A_{ny} = \frac{\sum (A_{col})_y + \sum (A_{sw})_y + 0.1\sum (A_{mw})_y}{\sum A_f} \times 1000 \tag{3.12}$$

For each column with a cross-sectional area denoted by A_{col}:

$$(A_{col})_x = k_x \cdot A_{col}$$
$$(A_{col})_y = k_y \cdot A_{col} \tag{3.13}$$

Here:

k_x=1/2 for square and circular columns;

k_x=2/3 for rectangular columns with $b_x > b_y$;

k_x=1/3 for rectangular columns with $b_x < b_y$; and

k_y=1-k_x.

For each shear wall with cross-sectional area denoted by A_{sw}:

$$(A_{sw})_x = k_x \cdot A_{sw}$$
$$(A_{sw})_y = k_y \cdot A_{sw} \tag{3.14}$$

Here;

k_x=1 for structural walls in the direction of x-axis;

k_x=0 for structural walls in the direction of y-axis; and

k_y =1-k_x.

For each unreinforced masonry filler wall with no window or door opening and having a cross-sectional area denoted by A_{mw}:

$$(A_{mw})_x = k_x \cdot A_{mw}$$
$$(A_{mw})_y = k_y \cdot A_{mw} \tag{3.15}$$

Here;

k_x=1.0 for masonry walls in the direction of x-axis;

k_x=0 for masonry walls in the direction of y-axis; and

k_y=1-k_x.

d) Normalized redundancy score **(NRS)**: Redundancy is the indication of the degree of the continuity of multiple frame lines to distribute lateral forces throughout the structural system. The normalized redundancy ratio (NRR) of a frame structure is calculated by using the following expression:

$$\text{nrr} = \frac{A_{tr}(nf_x - 1)(nf_y - 1)}{A_{gf}} \tag{3.16}$$

Here;

A_{tr}: the tributary area for a typical column. A_{tr} shall be taken as 25 m^2 if nf_x and nf_y are both greater than and equal to 3. In all other cases, A_{tr} shall be taken as 12.5 m^2.

nf_x, nf_y: number of continuous frame lines in the critical story (usually the ground story) in x and y directions, respectively.

A_{gf}: the area of the ground story, i.e. the footprint area of the building.

Depending on the value of NRR computed from Eq. (3.16), the following discrete values are assigned to the normalized redundancy score (NRS):

NRS = 1 for $0 < NRR \leq 0.5$

NRS = 2 for $0.5 < NRR \leq 1.0$

NRS = 3 for $1.0 < NRR$

e) Soft story index **(SSI)**: On the ground story, there are usually fewer partition walls than in the upper stories. This situation is one of the main reasons for soft story formations. Since the effects of masonry walls are included in the calculation of MNLSI, soft story index is defined as the ratio of the height of first story (i.e. the ground story), H_1, to the height of the second story, H_2.

$$ssi = \frac{H_1}{H_2} \quad (3.17)$$

f) Overhang ratio **(OR)**: In a typical floor plan, the area beyond the outermost frame lines on all sides is defined as the overhang area. The summation of the overhang area of each story, $A_{overhang}$, divided by the area of the ground story, A_{gf}, is defined as the overhang ratio.

$$or = \frac{A_{çıkma}}{A_{gf}} \quad (3.18)$$

<u>Performance Classification</u>

The damage index or the damage score corresponding to the life safety performance classification (DILS) shall be computed from the discriminant function given in Eq. (3.19).

$$DI_{LS}=0.620n-0.246mnlstfi-0.182mnlsi-0.699nrs+3.269ssi+2.728or-4.905 \quad (3.19)$$

In the case of immediate occupancy performance classification (IOPC), the discriminant function, where DI_{IO} is the damage score corresponding to IOPC, based on these variables is:

$$DI_{IO}=0.808n-0.334mnlstfi-0.107mnlsi-0.687nrs+0.508ssi+3.884or-2.868 \quad (3.20)$$

In the proposed classification methodology, buildings are evaluated according to both performance levels, by using Eqs. (3.19) and (3.20), and the final decisions for the damage state of the buildings are achieved by considering the results of the two performance levels simultaneously. The steps to be followed are:

1. Calculate DILS and DIIO scores of the building by using Eq. (3.19) and Eq. (3.18), respectively.
2. Determine the cutoff values for each performance classification by using the relationships given in Eq. (3.21). In these relationships n is the number of stories of the building and the CM values are adjustment factors, which introduces the spatial variation of the ground motion in the evaluation process. These values shall be taken from Table 3.6. The location of the building relative to the fault and the soil properties of the site shall be taken from the JICA Report.

$$CV_{LS} = CM \times (-0.090 \cdot n^3 + 1.498 \cdot n^2 - 7.518 \cdot n + 11.885)$$
$$CV_{IO} = CM \times (-0.085 \cdot n^3 + 1.416 \cdot n^2 - 6.951 \cdot n + 9.979) \quad (3.21)$$

Table 3.6. Variation of CM Values vith Soil Type and Distance to Fault

JICA Soil Classification	Shear Wave Velocity (m/s)	Distance to Fault (km)				
		0-4	5-8	9-15	16-25	>26
B	>760	0.778	0.824	0.928	1.128	1.538
C	360-760	0.864	1.000	1.240	1.642	2.414
D	180-360	0.970	1.180	1.530	2.099	3.177
E	<180	1.082	1.360	1.810	2.534	3.900

By comparing the CV values with associated DI value calculate performance grouping of the building for LSPC and IOPC as follows:

$DI_{LS} > CV_{LS}$ ise PG_{LS}=1

$DI_{LS} < CV_{LS}$ ise PG_{LS}=0

$DI_{IO} > CV_{LS}$ ise PG_{IO}=1

$DI_{IO} < CV_{LS}$ ise PG_{IO}=0

By examining the performance groupings of the building for LSPC and IOPC, make a decision on the probable expected performance level of the building. In this process following reasoning shall be adopted.

PG_{LS}	PG_{IO}	Decision
0	0	Building is SAFE (None or Light Damage)
1	1	Building is UNSAFE (Severe Damage or Collapse)
1	0	Building is in the INTERMEDIATE ZONE.
0	1	Building is in the INTERMEDIATE ZONE.

With this procedure it is possible to classify the buildings in three groups. These groups are named as SAFE, UNSAFE and INTERMEDIATE. Although a major portion of the buildings in the INTERMEDIATE group is expected to experience moderate damage, this group encompasses buildings with all degrees of damage, which can not be identified at the level of desired accuracy, i.e. the correct classification rate in each group should be at least 70 % and, the maximum classification error related to damage states leading to life loss should be 5 % at the most. It is therefore strongly sugessted that further detailed analyses should be performed on these buildings before reaching a final decision about their expected performance levels.

Sample Application

To see the extent and relativity of the expected damage or the layout of the risk within Istanbul an exercise was undertaken, in which, all buildings in Düzce database were assumed to portray buildings all over Istanbul. In other words, a uniform exposure that is identical to the compiled database for Düzce, is assigned to all districts of Istanbul. The earthquake scenario "Model A" and shear wave velocity estimates of JICA study were employed to model the fault and to classify the sites. The modified cutoff values were applied and all buildings were identified as "safe", "unsafe" or "intermediate" in all districts of Istanbul. It should be pointed out that "safe" buildings represent the structures that would experience none or light damage states, "unsafe" buildings include those that are expected to suffer severe damage or would collapse, and "intermediate" buildings might encompass buildings with all degrees of damage, which can not be clearly identified.

The results obtained are presented in Figures 3.3 and 3.4 in the form of the ratio of the classified buildings to the total number of buildings. The visual plots indicate some spotty areas, which reflect the local soil profile. The effect of distance to source is clearly observed. The range of safe buildings varies from 38% to 60% depending on the site class. Unsafe buildings constitute 1-40 % and buildings identified as intermediate, which represent buildings that could not be clearly classified as safe or unsafe, have a share of 21-39%. Of the indeterminate buildings, around 50% were moderately damaged, 38% had light or no damage and 10% were severely damaged in Düzce.

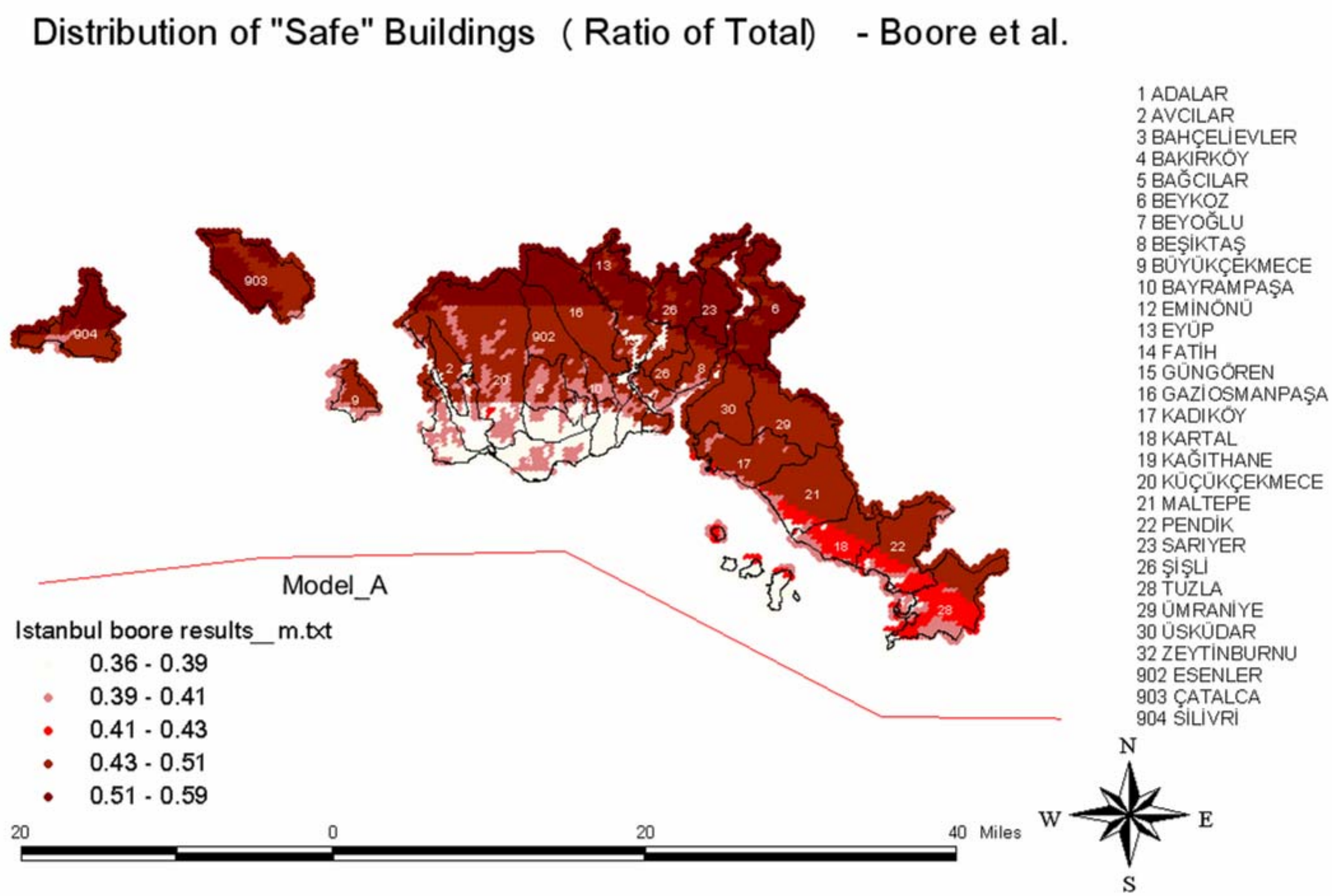


Figure 3.3. Distribution of SAFE Buildings

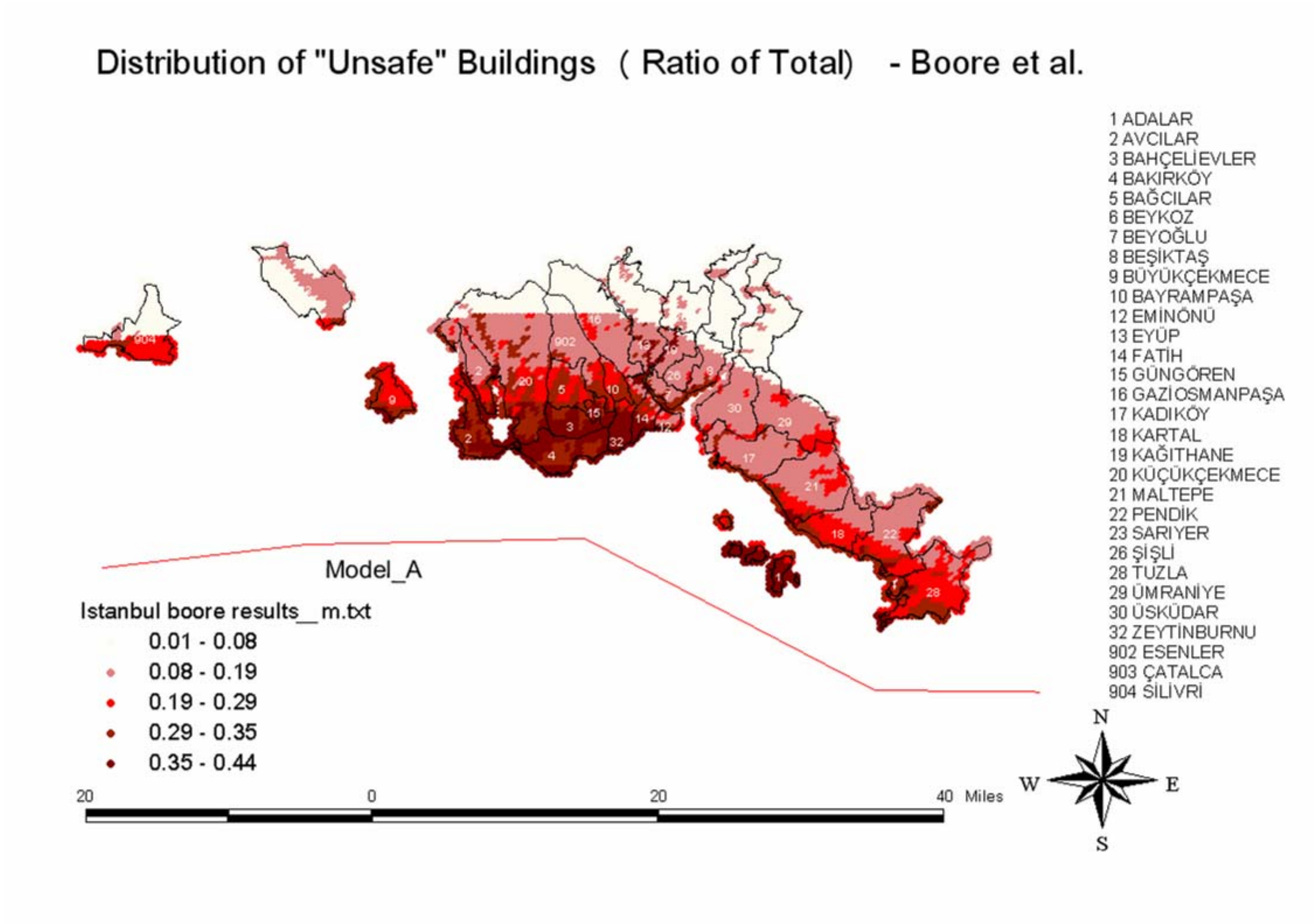


Figure 3.4. Distribution of UNSAFE BUILDINGS

Method II: (Quick Assessment Method) ---- ITU

Most of the existing low rise reinforced concrete buildings consist of moment resistant frames. Since they have practically no shear walls, they are very flexible if the contribution of partitioning walls is not considered in the lateral stiffness of the structure. For this type of buildings a simplified force based quick assessment method, which can easily be computerized so that the effect of possible small changes in selected structural parameters can be altered to have an idea on the final decisions, can be proposed if the following assumptions are made.

Assumptions

It has been assumed that;

A. regional seismicity and local soil conditions are known, local or metropolitan municipalities or governments made this information available,

B. at least the size of columns and their orientations in the selected critical stories where the investigation will be focused, is known,

C. the expected structural damage on beams can not be as important as column damages,

D. columns have more or less similar ductilities hence their capacities can be sum up,

E. if it is not experimentally available, concrete compressive strength can be taken as fcd $\cong$ 10 $\mp$ 2,8 MPa

F. if they are not visually checked, the amount of longitudinal reinforcement bar is 1% of gross cross section of columns,

G. tributarial area of columns can be used to define the column axial forces which will be base to the determination of column capacities,

H. total weight of the structure can be estimated by examining the type of slabs and beams,

I. fundamental period of building can either be determined easily or measured,

J. the relative storey drift in the critical storey can approximately be calculated.

Methodology

The proposed assessment method for low rise reinforced concrete buildings with moment resistant frames is presented in the flow chart given in Figure 3.5.(a) Since it is most of the cases, it has been assumed that there exist no drawings or the building has been altered in its lifetime.

Parametric Justification of the Proposed Method

Using these mathematical models a parametric study for four representative planar frames shown schematically in Figure 3.5.(b) have been properly designed satisfying all code requirements valid in the year of design. The observations gathered on damaged buildings and during the earlier works of rehabilitation have been utilized to define the hypothetical structures has been conducted changing the orientations of columns as it is shown in Figure 3.5.(c), reducing the concrete quality and/or main reinforcement ratio in columns, etc. It has been assumed that the realistically presumed vertical loads are going to be constant during the whole course of lateral load increments in push-over analyses, [1], [2]. In all these analyses material coefficients for steel and concrete has been taken as unity.

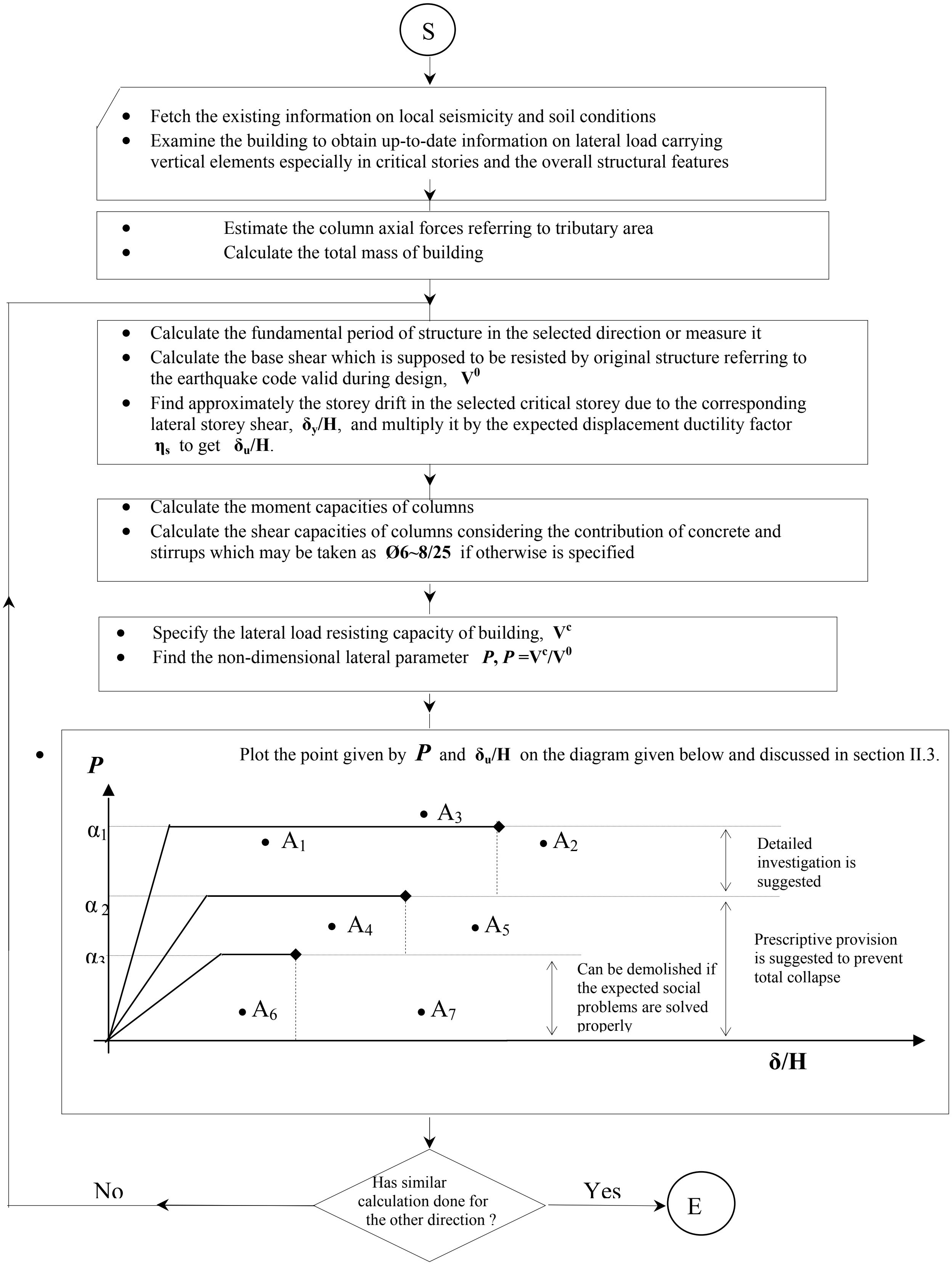
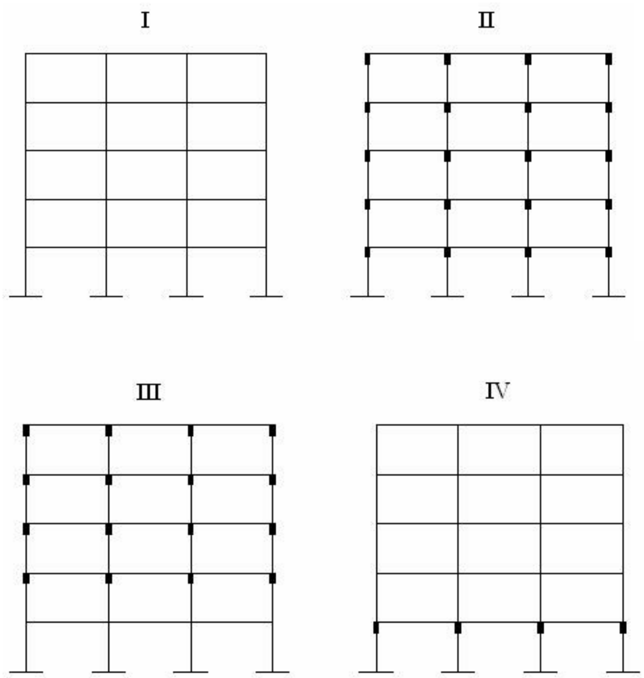


Figure 3.5.(a) Flow chart of the proposed assessment method



I-All beams are shallow flat beams, h<b;
II-All beams are regular beams, h>b;

III- Only in the first floor beams are flat;
IV-Only in the first floor beams are regular beams

Figure 3.5.(b) Representative Four Frames

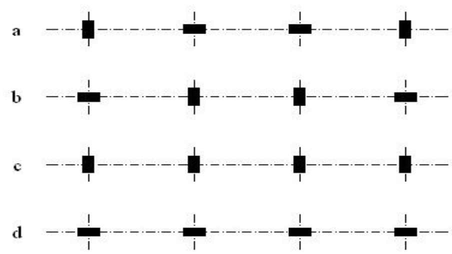
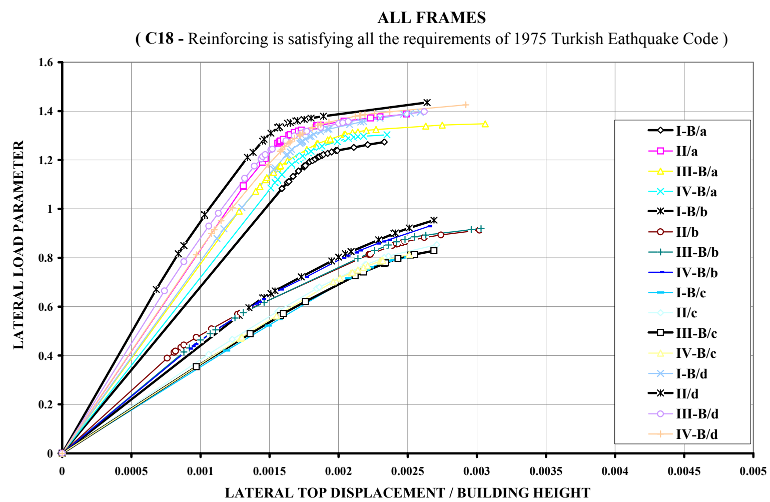


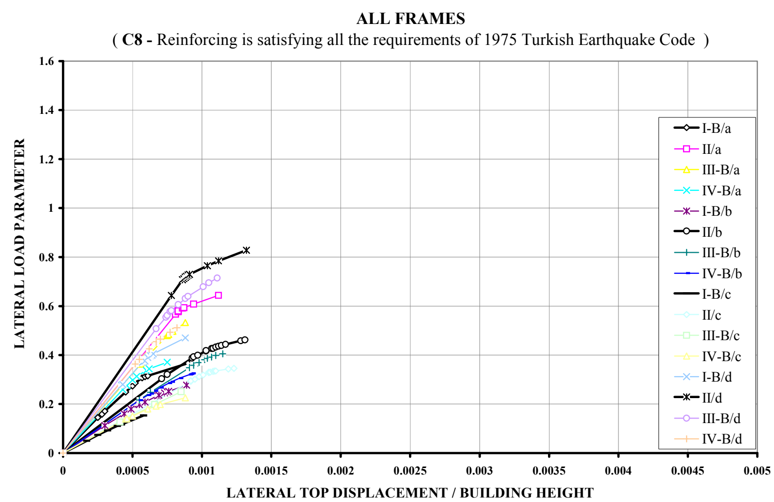
Figure 3.5.(c) Possible Column Orientations

Some of the details of representative frames are submitted in Appendix A. The *P- δ/H* curves achieved at the end of the pushover analyses are presented in Figure 3.5.(d), (e) and (f). As it is expected *P-δ/H* curves corresponds to perfect design are not scattered to much, and they are above 1 because of the material coefficients, which have been taken as unity and over strength of the sections, Figure 3.5.(d). As soon as concrete quality drops down keeping everything same, which may corresponds not only to real deficiency of concrete compressive strength but to a certain extent of relatively smaller cross-sections also, the lateral load parameters decrease drastically.

If the longitudinal reinforcement ratios of columns are decreased 20% to represent several other deficiencies observed in the field widely, such as corrosion or lack of sufficient longitudinal reinforcement together with the loss of concrete compressive strength, which represents more or less the worst case, can be encountered in the field, the lowest lateral load parameter is obtained as it is expected, see Figure 6. One should note that the structural detailing has no important effect on the results and they do not cause serious scattering. On the other hand the change in the orientation of the columns which is another deficiency encountered in the field may cause substantial decrement in lateral load capacity of building but no serious scattering in *P- δ/H* curves, see Figure 6. The other important observation one can easily made when looking at Figures 4 to 6 is, the displacement ductility exposed by the frames designed properly. Although the failure loads which are closer to ultimate loads the displacements correspond to those loads are drastically different from each other. In other words it is strongly probable that the representative structures will reach to failure loads always prior to the ultimate loads. And they will have lower ductility ratios than the expected value 4. The similar results can be extracted from the bench of *P- δ/H* curves obtained for the models with lower concrete compressive strength and/or longitudinal reinforcement ratios in columns, see Figure 5 and 6. And in these two cases the exposed overall displacement ductilities are even much more smaller than the expected ductility 4 for non-ductile frames. These results inevitably depend on the definition of failure loads which should be discussed before the final results are used in practice.

Looking at the expected structural behaviors of the low rise reinforced concrete buildings shown in Figures 3.5.(d), (e) and (f) roughly it can be concluded that α_1, α_2 and α_3 given in flow chart can respectively be taken as 1, 0.6 and 0.4 and several sensitivity analyses better be carried out if the lateral load capacities calculated in first trial are closer to these values 15% and then depending on the final output the decisions should be made.





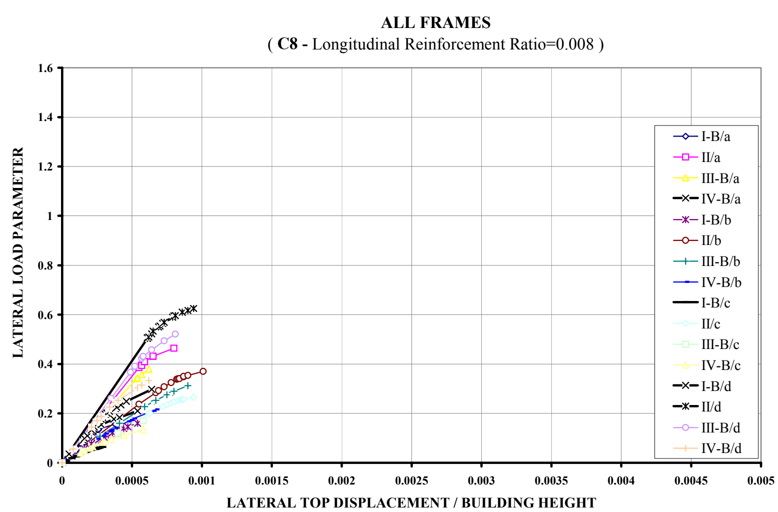
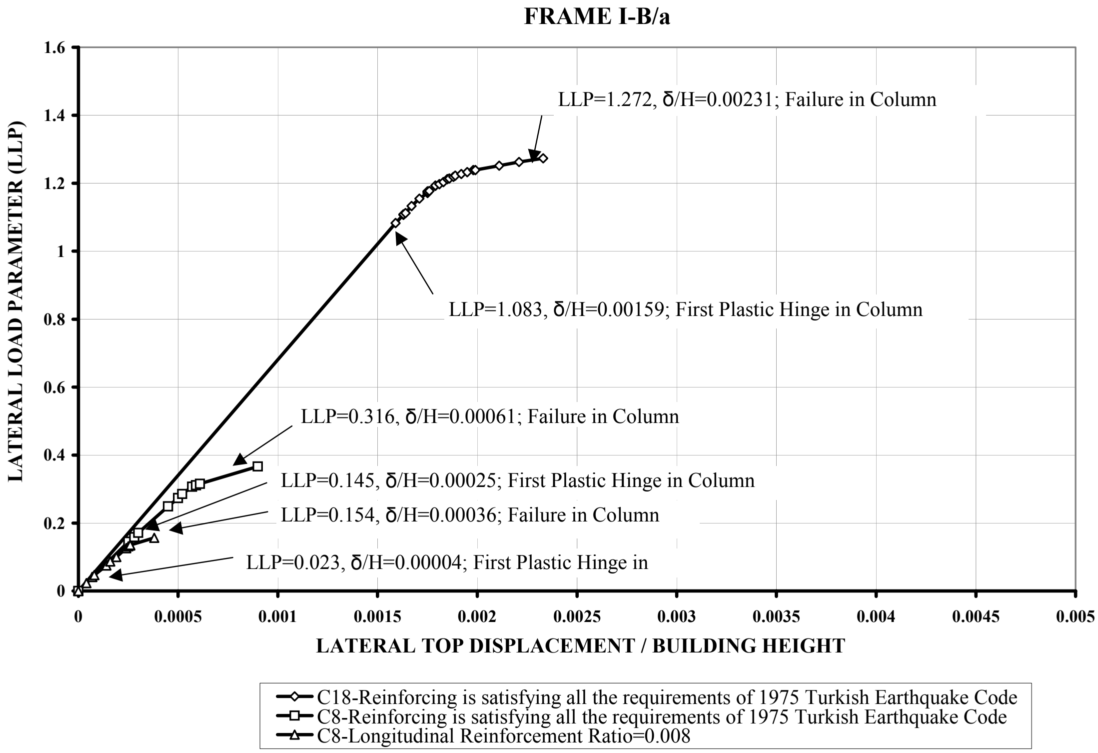


Figure 3.5.(d) The *P*- *δ/H* curves



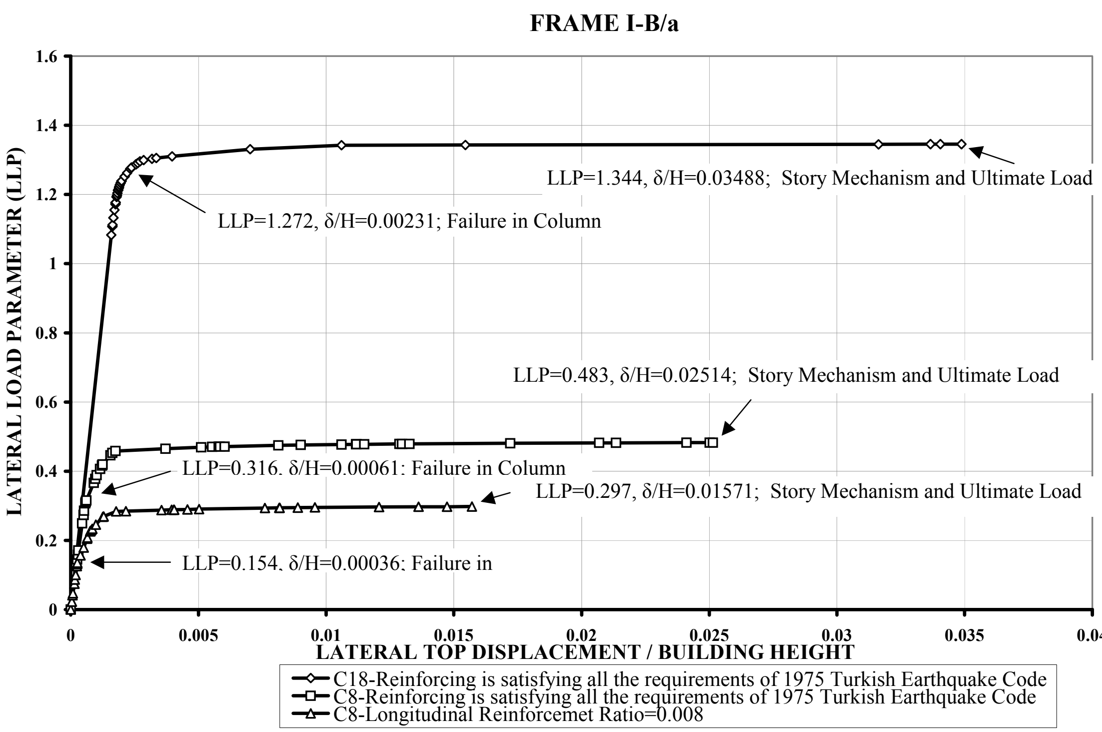
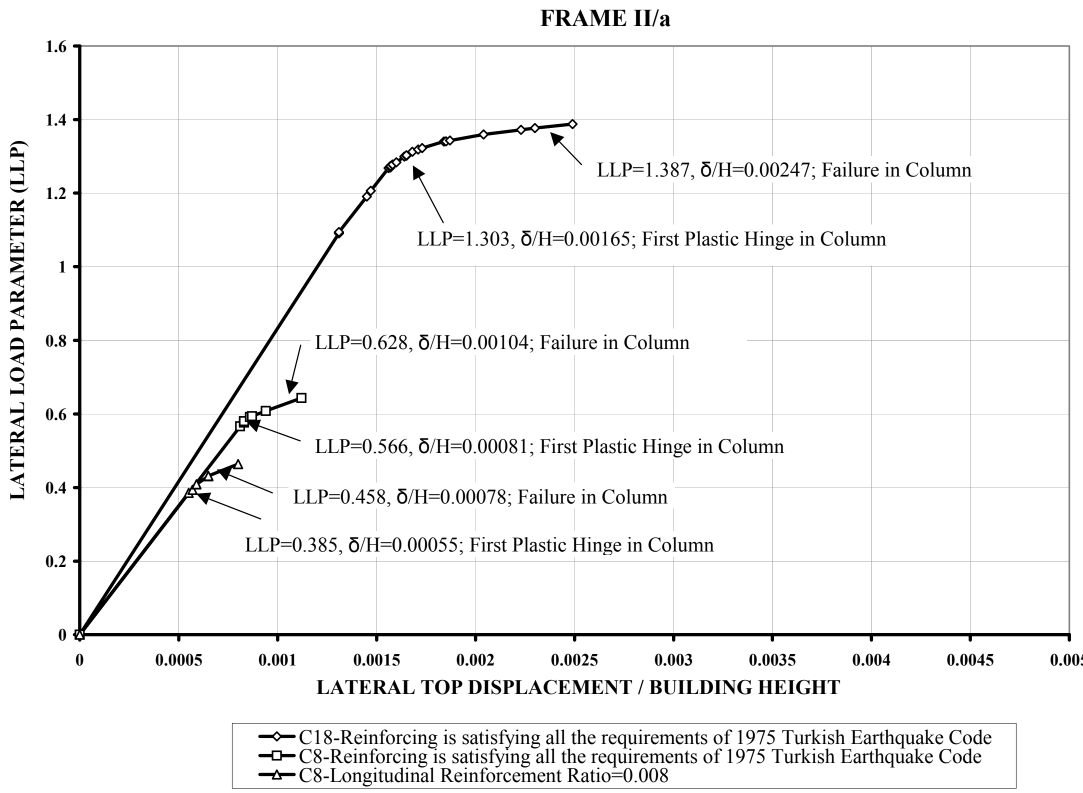


Figure 3.5.(e) Structural behaviors of the low rise reinforced concrete buildings



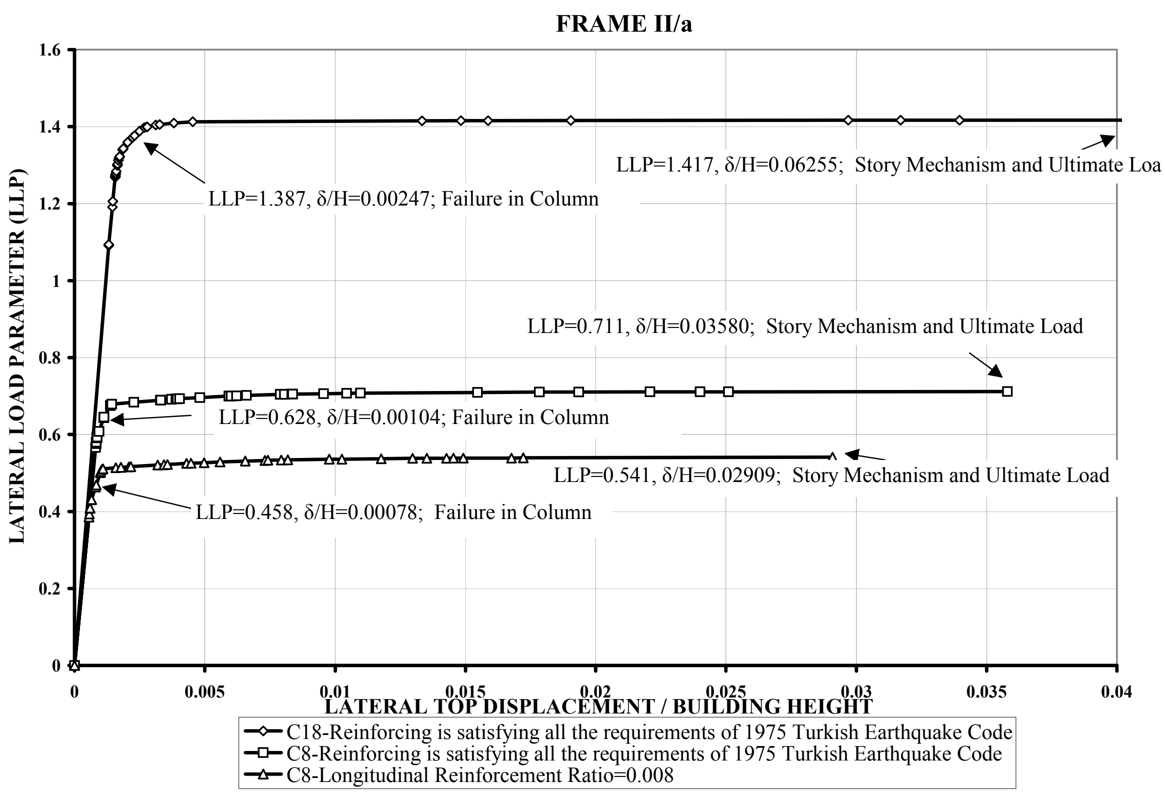


Figure 3.5.(f) Structural behaviors of the low rise reinforced concrete buildings

Method III: (Seismic Safety Screening Method)--- ITU

When the huge existing stock of buildings in Istanbul is considered, it is clear that it is practically impossible to carry out detailed structural analysis for all of the buildings. Therefore, it is inevitable to use simplified techniques, which can predict the seismic safety of the existing buildings in relatively shorter time. The expected outcome from such an analysis should not be the exact determination about which buildings are safe, which are not. The outcome should be the determination of the buildings, which need further detailed analysis, by spending minimum time.

Seismic Safety Screening Method (SSSM), is an adaptation of the Japanese Seismic Index Method Method considering Turkish Earthquake Resistant Design Code 1998 and applications of the method to a number of buildings damaged during 1992 Erzincan, 1998 Adana-Ceyhan and 1999 Marmara and Düzce Earthquakes. This rapid seismic safety evaluation method can be applied for structures having a story number 6 or less with reinforced concrete frame, shear wall or dual frame-shear wall structural systems. The calibration of several coefficients proposed in this method will further be done considering the studies carried out in various pilot areas like Zeytinburnu.

Although the original method consists of two stages with higher reliability in Stage Two, since the subject is rapid seismic safety assesment, only the first stage is focused herein this study. First step of investigation involves the examination of the structural system, age and physical conditions of the building. After this examination the performance index I can be determined. Comparing this performance index I, with the adequate reference index I_D the seismic safety of the building can be estimated. This comparison should be repeated for all critical stories and for two principal directions. If for any of the comparison cases $I<I_D$ then it is concluded that the behavior of the structure is indeterminate.

Reference index I_D can be calculated by Eq. (3.22).

$$I_D = P_o * B * Z * U \qquad (3.22)$$

In this equation B is zone factor, which has to be considered as 1.0 for the areas that are identified as first degree of earthquake zone by Turkish Earthquake Resistant Design Code 1998 and other areas of high seismic risk. In other areas B can be reduced according to the seismicity of the region. However, in any case B should be considered as greater than 0.5. Z ground coefficient is related with the local ground conditions. Z coefficient can get values between 0.8 and 1.0, with lower values for better ground conditions. U usage coefficient is related with the importance and usage of the building. It should be decided considering the importance of the structure and the extent of possible effects of damage after earthquakes. Since the buildings, which need to be in service after earthquakes like hospitals, schools, fire stations, etc. are out of the scope of this method, it is convenient to use U as 1.0. However if seen necessary, U can be increased up to 1.50. P_o basic reference index can be considered as 1.0 for this first stage analysis. The studies carried out for this coefficient will be presented in the next report.

Performance index, I, can be calculated by using Eq. (3.23).

$$I = P * D * K \qquad (3.23)$$

In this equation P is the basic structural performance index, D is a coefficient determined according to the physical properties and geometry of the structure and K is a coeffiicent that represents the aging effects on the structure. If the irregularities in plan or elevation as introduced in the Turkish Earthquake Resistant Design Code 1998 are not present, D may be considered as 1.0, othervise it may be reduced upto 0.70.

The values of K are defined by the Japan Building Disaster Prevention Association (1990) considering the deformations of the structure, the cracks present on the columns or shear walls, the cracks on the plaster or finishing, age of the building and whether the building experienced fire or not. Its value can change between 1.00 and 0.80.

During calculation of P index, the vertical structural members are examined in three distinct groups as columns, short columns and shear walls. The calculation of P Index differs according to the presence or absence of short columns in the structure. If there is no short column in the structure than P index is calculated by Eq. (3.24), otherwise by Eq. (3.25). In these equations n is the number of stories excluding the ground floor, i is the story which is dealt with, C_W is the coefficient related with the strength of shear walls, C_C is the coefficient related with the strength of columns, C_{SC} is the coefficient related with the strength of short columns, R_W is the coefficient related with the ductility of the shear walls, R_{SC} is the coefficient related with the ductility of the short columns. a_1, a_2 and a_3 are the compatibility coefficients.

$$P = (n+1/n+i) * (C_w + a_1 C_c) * R_w \quad (3.24)$$

$$P = (n+1/n+i) * (C_{sc} + a_2 C_w + a_3 C_c) * R_{sc} \quad (3.25)$$

After necessary inventory data is collected and necessary coding and classification is completed for all buildings, for application of SSSM, buildings will be examined from inside. The structural systems of the buildings will be drawn and member dimensions will be recorded on the drawings. If it is possible to obtain architectural or structural design drawings of the buildings, the compatibility of the application and design drawings will be checked and if there is, alterations will be noted. The parameters needed for the application of SSSM are given in Table 3.15.

Method IV --- (BU – YTU)

In second stage evaluation/assessment, more detailed studies will be carried out compared to the first stage with priorities given to the most vulnerable buildings determined at the first stage or to the regions where such buildings are concentrated.

Structural system layout drawings

The first task at this stage is the preparation of structural system layout drawings of the buildings to be evaluated an assessed. The objective is to determine the cross section dimensions and coordinates of the structural system elements (columns, structural walls, beams) and infill walls. Since layout drawings of tens or even hundreds of thousands of buildings would be needed in practice, it would have to be sufficed with the information related to the ground story only or at most those of the ground story and the first story. These structural system data are intended to be compiled in an electronic environment (as in the first stage inventory data) to provide input data for a standard drafting software. During collecting the structural system data, the first stage inventory data will also be checked, fixed and completed, if necessary.

Assessment method

There is no doubt that from technical viewpoint the second evaluation/assessment stage is the most critical stage of Istanbul Earthquake Master Plan. The biggest problem at this stage is necessity of reaching conclusive decisions on as much as large number of buildings (tens, even hundreds of thousands) in spite of the limited content of the collected data due to logistic reasons. As mentioned above, as much as small number of buildings (few thousands) should be left to the third evaluation/assessment stage, which will be carried out by consultant firms on individual building basis. Otherwise performing an evaluation/assessment study is practically impossible.

Clearly stated, a technical prescription for such a huge problem of decision making is not readily available. Although seismic evaluation methods are available for individual buildings, it is impossible to apply those methods to tens, even hundreds of thousands of buildings. Therefore it should be admitted that the sheer number of buildings to be evaluated will govern the evaluation method to be proposed.

At this reporting stage, the essential points of a "displacement-based performance evaluation method" are presented, which is developed for R/C frame buildings of up to six stories excluding basement, a building typology that constitutes more than 90% of the total building stock in Istanbul.

Determination of modal capacity

The proposed procedure is basically based on an approximate but a consistent nonlinear "*pushover analysis*", which is carried out essentially utilizing the structural system data pertaining to ground story only.

Under the reasonable assumptions outlined below, nonlinear pushover analysis can be carried out with single-mode "*Incremental Response Spectrum Analysis (IRSA)*" procedure [1,2]. In this procedure the "*modal capacity diagram*" (as called "*capacity spectrum*" in ATC-40) is obtained directly, without necessarily plotting the conventional "*pushover curve*". A special formulation of IRSA procedure based on ground story data only is given in Appendix B.

The assumptions made for the pushover analysis are summarized below:

1. It is assumed that the displacement profile as well as the mode fundamental mode shape of the structural system is linear (inverted triangle) at all pushover steps.
2. It is assumed that plastic hinges would develop only at the column ends. This assumption is on the safe side in terms of estimating the seismic demand and it is consistent with the observed earthquake behavior of buildings in Turkey.
3. The behavior of the plastic hinges will be assumed as elasto-plastic. The plastic hinge length will be taken equal to the effective height of the section.
4. It is assumed that the column reinforcing bars are placed at the corners an reinforcement ratio is in the order of 0.8% – 1%.
5. Concrete compressive strength of columns will be taken as average 12 Mpa.
6. The concrete model in columns will be considered as the classical unconfined concrete model (Hognestad model with maximum compressive strain of 0.004). The compressive strain corresponding to the maximum stress (strength) of the concrete will be taken as 0.002.
7. "Linearized yield lines" will be utilized to account for the effects of axial forces in the formation plastic hinges. For the initial step of the pushover analysis, axial forces will be calculated according to tributary areas with a uniform gravity load of 10 kN/m2 per story. The increments or decrements in axial forces during pushover analysis will be calculated in an approximate manner from the variations in the base overturning moment.

8. At each step of pushover analysis, the relationship between the ground story displacement and the base shear will be calculated approximately by the Muto Method. The major reason for using this method is that the structural system data of the ground story only is sufficient for the analysis of displacements and section forces of that story. In this analysis, effective section stiffnesses of columns and first floor beams will be taken as halves the gross section stiffnesses. The effects of infill walls will be neglected. However, in columns where short-column effects are developed due to infill walls, those effects will be taken into account by considering reduced column heights.

Estimation of modal seismic demand

As in the first assessment/evaluation stage, it is also envisaged in the second stage evaluation studies that the mean "deterministic" seismic hazard map developed by KOERI within the framework of the Red Cross Project and the "*probabilistic*" seismic hazard map with a 10% probability of exceedance in 50 years be used to satisfy the "life safety" and "collapse prevention" performance criteria, respectively.

Utilizing the "local" spectral information obtained from above-mentioned seismic hazard maps and the modal capacity diagrams defined earlier, the "*seismic demand associated with the modal displacement*" will be calculated. First, the capacity diagram is to be converted to a bilinear diagram. The slope of the initial line represents the square of the free vibration frequency, from which the "*effective*" natural period is obtained. For the sake simplicity, the slope of the initial line may be taken equal to the slope of the capacity diagram in the first pushover step, i.e., $(\omega^{(1)})^2$ (See Appendix B, Eq. B9a). In this case, the conversion to a bilinear diagram is not required and the effective first natural period is calculated as $T = 2\pi / \omega^{(1)}$.

To calculate the maximum modal displacement, use will be made of C_1 and C_2 coefficients defined in FEMA 356:

$$S_{di} = C_1 \, C_2 \, S_{de} \qquad (3.26)$$

where S_{di} and S_{de} represent, as defined earlier, the nonlinear and linear spectral displacements, respectively.

C_1 coefficient represents the ratio of the inelastic spectral displacement to spectral displacement of the corresponding linear system. This coefficient is defined as

$$C_1 = [(1 + (R_y - 1)\, T_S / T)] / R_y \qquad (T \leq T_S) \qquad (3.27a)$$

$$C_1 = 1 \qquad (T > T_S) \qquad (3.27b)$$

where T represents the above-defined effective natural period (which is also equal to the period of the corresponding linear system), T_S is *characteristic period* of the FEMA elastic response spectrum at the transition from the constant pseudo-acceleration region to the constant pseudo-velocity region and R_y refers to the *strength reduction factor* defined in Appendix D.

On the other hand C_1 coefficient in Eq. (3.26) represents an empirical factor approximating the deteriorations in the hysteretic behavior. This factor is given in Table 3.7 in terms of number of stories.

Table 3.7. C_2 coefficient

N	1	2	3	4	5	6
C_2	1.3	1.2	1.1	1.0	1.0	1.0

For the special case of C_1 = 1 (equal displacement rule) ve C_2 = 1, the estimation of the modal displacement demand according to FEMA 356 is explained in Appendix D.

The "*plastic rotation demands*" of the plastic hinges and the "*shear demands*" of the columns will be calculated using the modal displacement demand described above (See Appendix C).

Plastic deformation and shear capacities

In order to estimate the "*plastic hinge rotation capacities*", use will be made of moment-curvature analysis basen on the above-defined unconfined concrete model, in which axial force demands in columns will also be considered. The curvatures corresponding to a compressive concrete strain of 0.002 will be considered as the upper limit for the life safety performance level. Similarly, curvatures corresponding to a compressive concrete strain of 0.004 will be considered as the upper limit for the collapse prevention performance level

In the estimation of "*shear capacities*" of columns, use will be made of M.J.N. Priestley's three-parameter shear model, in which the effect of the bending ductility demand on the shear strength of columns can be taken into account along with the column axial force demands.

Performance evaluation

Any column may be deemed to fail when the plastic rotation demand or the shear demand exceeds the column's capacity corresponding to the collapse prevention performance level. However even if the plastic rotation capacity is exceeded, it is well possible that the core region of the column cross section can sustain the gravity loading (provided that it is not failed in shear) when the concrete strains are below the crushing strains.

On the other hand, the failure of a single column would not necessarily lead to the collapse of the building. It has been observed that columns can still stand when axial shortening occurs due to conctrete crushing and even reinforcement bars buckle. In such cases, the beam hinging and or Vierendeel action may save the building from collapse. As a practical suggestion, it may be proposed that the building will be deemed collapsed when two columns with the maximum axial force demands fail in bending or such a failure occurs in one of the corner columns of the building.

Practical examples

In order to implement the practical application of the above-described method, a special computer software called IRSAMONO is developed. 3, 4, 5 and 6 story reinforced concrete residential buildings with typical floor plans are analyzed with the software to identify the prevailing failure mechanisms (beam mechanism or column mechanism) and some of the preliminary results (which may not be sufficient for calibration) are presented in Appendix E. In the pratical examples, commonly used story plans with double flats are considered (see Figures E1 and E2 for ground floor and above-ground floors, respectively). The real dimensions of columns and beams are considered, however intentional changes are made in structural arrangements to obtain extreme configurations with "*strong columns-weak beams*" in x-x direction and "*strong beams-weak columns*" in y-y direction.

It is known that the majority of the buildings in this country collapse with "*column mechanism*". It is most likely that the majority of buildings to be evaluated in Istanbul has this kind of structural systems. However it could be case that a small number buildings may fail with "*beam mechanism*". In order to test the sensitivity of the proposed method, four sample structures with "*strong columns-weak beams*" are included in the examples.

Apart from the effect of failure mechanism, sample buildings are varied in terms of the changes in story plans at the ground floor and upper floors. In the first set of examples the ground floor plans are assumed to be same at all floors (indicated with AKP in figures and tables), while in the other set they are taken different as they are in reality (indicated with FKP in figures and tables). Results are given in Appendix E where the proposed method is marked with IRSA(ÖY) and the reference inelastic solution is indicated with SAP 2000.

As expected, the solutions with the proposed method compares well with the reference solutions in building failing with "*column mechanism*" (solutions in y-y direction, Figure 5 a,b,c,d). Results are summarized in Table 3.8.

Table 3.8		$100S_{ae}/g$		$100S_{ay}/g$		R		S_{du} (mm)		S_{dy} (mm)		μ	
Bldg No	Fail. mode	SAP 2000	IRSA (ÖY)	SAP 2000	IRSA (ÖY)	SAP 2000	IRSA (ÖY)	SAP 2000	IRSA (ÖY)	SAP 2000	IRSA (ÖY)	SAP 2000	IRSA (ÖY)
1	Column mech.	48	46	11	9.5	4.4	4.8	72	78	22	18.5	3.3	4.5
2		38	38	8	7.5	4.7	5.1	97	98	30	24	4.0	4.1
3		30	33	6.2	6.2	4.8	5.3	128	121	32	29	4.0	4.2
4		23.5	26	4.9	5.5	4.8	4.7	159	142	47	40	3.4	3.6
5	Beam mech.	72	95	26	23	2.8	4.1	48	38	17	9	2.8	4.2
6		54	73	19	20	2.8	3.7	64	49	20	14	3.2	3.5
7		45	60	15	18	3	3.3	76	59	26	18	2.9	3.3
8		36	51	11	16	3.3	3.2	95	71	29	23	3.3	3.1

It is clear that the results obtained from a limited number of sample solutions are insufficient, even though they are indicative of the success or failure of the proposed method, which should be thoroughly tested and calibrated in a pilot study with respect to nonlinear solution methods.

Method V : (for 1-7 story reinforced concrete buildings) – METU

It is possible to calculate the base shear capacity of a building approximately, from the ground story structural system information. Further calculation of building period from the number of stories yields lateral displacement and elastic strength demand under a given ground excitation. The obtained results can be evaluated both from a displacement and a force based performance assessment. The steps for calculating the base shear capacity are explained below.

Axial forces from gravity:

Column axial forces can be calculated by using the tributary areas and unit weights. (Frame slabs: 10 kN/m2 , Joist slabs: 12 kN/m2)

Moment capacities of beam ends:

- T-sections are considered in calculating positive moments.
- Minimum reinforcement proposed in TS-500 is employed.

Column axial forces when the beams reach their flexural capacity

Shear forces in beams are calculated when the ends reach flexural capacity in biaxial bending.

- The directions of earthquake forces are taken into account in calculating beam shears.
- The directions of beam shear forces are taken into account in calculating column axial forces.

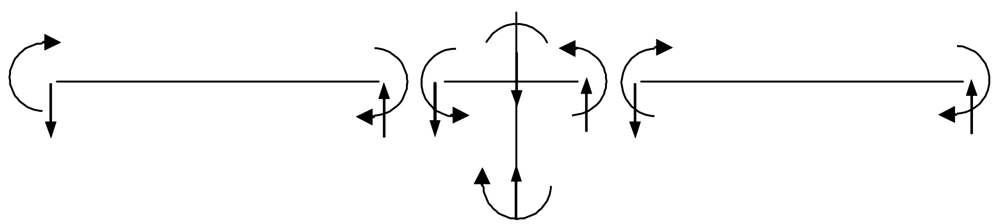


Figure 3.6. Directions of moments and shears when seismic forces act in the right direction

Column total axial forces

- Axial forces from gravity (Ng) and lateral seismic forces (Neq) are added.

Column moment capacities

- Minimum reinforcement ratio recommended in TS-500 can be employed (0.008-0.010).

Beam-Column capacity ratios (BCCR)

$$BCCR = \frac{\sum Beam\ Moment\ Capacity}{\sum Column\ Moment\ Capacity} \tag{3.28}$$

If BCCR is less than one, beams yield before columns. Otherwise columns yield first, hence beams do not reach their flexural capacities. Then beam moments are updated (Eq. 3.29).

$$M_{solkiris} = \frac{\sum M_{kkol} * (I/L)_{sol}}{((I/L)_{sol} + (I/L)_{sag})} \quad ; \quad M_{sagkiris} = \frac{\sum M_{kkol} * (I/L)_{sag}}{((I/L)_{sol} + (I/L)_{sag})} \tag{3.29}$$

In Eq. (30), $M_{solkiriş}$ is the beam left end moment connecting to the right of connection, $M_{sağkiriş}$ is the right end moment. $\sum M_{kkol}$ is the total moment capacity of columns, $(I/L)_{sol}$ and $(I/L)_{sağ}$ are the inertia to length ratios at left and right, respectively. If BCCR's are larger than one in all ground story columns, then a soft story collapse mechanism is very likely.

<u>Base shear capacity in soft story mechanism</u>
The procedure is very simple as outlined in Fig. 3.7.

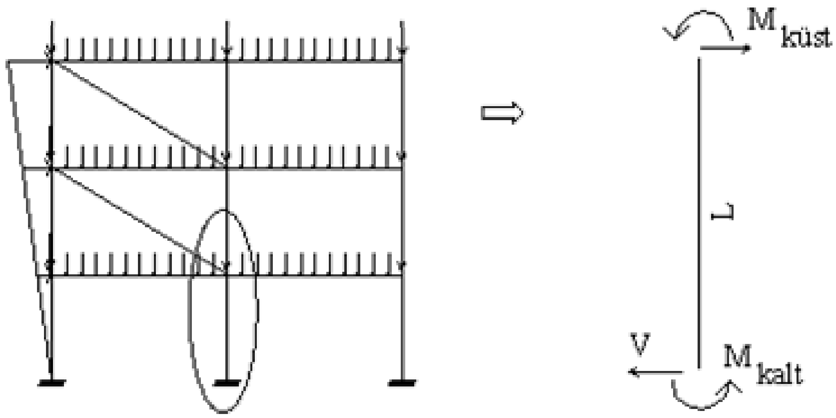


Figure 3.7. Calculation of base shear capacity from column end moment capacities

$$V_t = \sum_i \left(\frac{M_{kust} + M_{kalt}}{L}\right)_i \tag{3.30}$$

In Eq. 3.30;

V_t	: Base shear capacity
$M_{küst}$	: Moment capacity at the top end of a column
M_{kalt}	: Moment capacity at the bottom end of a column
L	: Length of column i

Base shear capacity in mixed mechanism

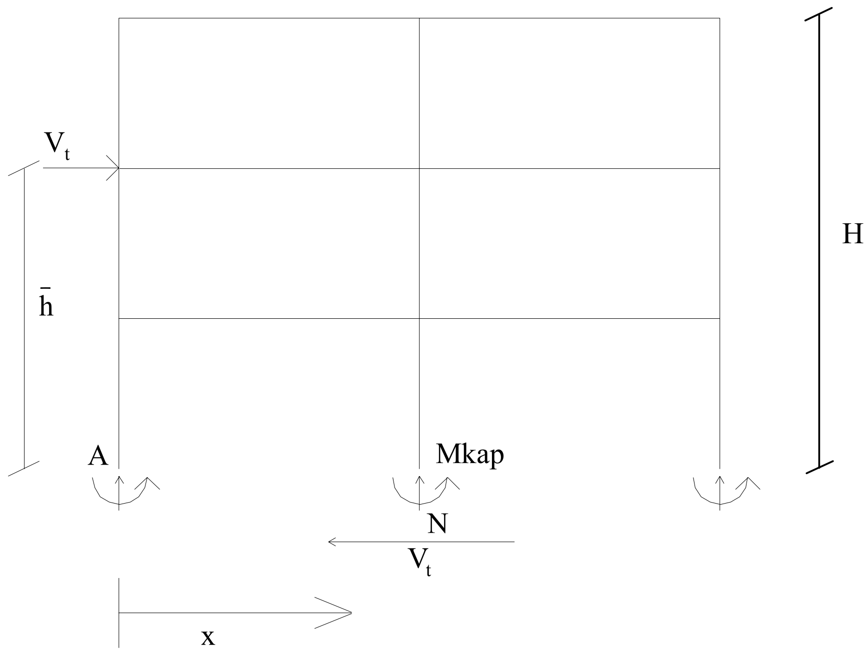


Figure 3.8. Calculation of base shear capacity from global equilibrium

Base shear capacity V_t can be calculated from global equilibrium as shown in Fig. 3.8. Moment equilibrium of forces about point A yields Eq. 3.31.

$$M_{dev} = \sum N_i \cdot x_i + \sum Mk_i \tag{3.31}$$

Here,

N_i : axial force in column i undr lateral x_i : i kolonundaki eksenel kuvvetin moment kolu
Mk_i : capacity of column i under total axial
M_{dev} : overturning moment about A

Base shear capacity is obtained by dividing M_{dev} by the effective height $\bar{h}$. In the first mode, $\bar{h}$ is approximately 0.7H (Fig. 3.8).

Evaluation procedure

Building performance can be evaluated either by employing displacement, or force based criteria. In calculating building periods, 0.15n may be assumed for soft story buildings and 0.12n for masonry infilled frames (n : number of stories). Displacement and force based acceptance criteria are given in Tables 3.9 and 3.10, respectively.

Table 3.9. Displacement based acceptance criteria

Failure mechanism	δ_t / H	Performance limit state
Soft story mechnism	0.005 0.010	Life safety Collapse prevention
Mixed mechanism	0.008 0.015	Life safety Collapse prevention

Table 3.10. Force based assessment criteria

Failure mechanism	Force reduction factor $R = V_{el} / V_t$	Performance limit state
Soft story mechnism	2 4	Life safety Collapse prevention
Mixed mechanism	4 8	Life safety Collapse prevention

Method VI (for 1-5 masonry buildings and mixed systems) – METU

Shear response of bearing walls govern the seismic behavior of masonry buildings. Unreinforced masonry walls exhibit fragile behavior when they reach their shear capacity. Resistance of walls degrade quickly after the formation of diagonal shear cracks. Accordingly, a linear elastic and force based evaluation procedure is appropriate for unreinforced masonry buildings.

Required data

A ground story plan indicating the orientation of bearing walls has to be prepared at site. Wall dimensions and openings have to be accurately noted. The type of masonry units and mortar can be identified by removing the wall paste at few locations. Slab and foundation type are also important information. All of these properties are considered in Table 3.11.

Calculation of wall stresses

The base shear forces V_{bx} and V_{by} are first calculated in both directions. Force calculations are in line with the 1998 seismic code, with S=2.5 and R=2.5. The only required data in this calculation is the building weight, which may be based on a unit floor weight of 10 kN/m^2 . The forces V_{bx} and V_{by} are then distributed to the ground story walls. Shear rigidity of a wall is

$$k_i = \frac{A_i G}{H} \tag{3.32}$$

Here A is the wall area, H is the story height, and G is the shear modulus. If H and G are the same for all walls, they can be normalized to 1.0. The centers of rigidity of walls are calculated from the geometric center of the slab.

$$x_o = \frac{\sum_i x_i \, k_{yi}}{\sum_i k_{yi}} \tag{3.33.a}$$

$$y_o = \frac{\sum_i y_i \, k_{xi}}{\sum_i k_{xi}} \tag{3.33.b}$$

Here, x_i, is the distance of the wall in y direction from the geometric center, and k_{yi} is its rigitity. Similar definitions are also valid for y_i in the other direction. The torsional inertia of walls are calculated in both directions from Eq. (3.34).

$$I_{xo} = \sum_i (y_i^2 \, k_{xi}) - y_o^2 \sum_i k_{xi} \tag{3.34.a}$$

$$I_{yo} = \sum_i (x_i^2 \, k_{yi}) - x_o^2 \sum_i k_{yi} \tag{3.34.b}$$

Polar moment of inertia is the sum of I_{xo} and I_{yo}.

$$J_o = I_{xo} + I_{yo} \tag{3.35}$$

The coordinates x_o ve y_o, calculated from Eq. (3.33) are also the eccentricities. The resulting torsional moments are,

$$M_x = y_o \cdot V_{bx} \tag{3.36a}$$

$$M_y = x_o \cdot V_{by} \tag{3.36.b}$$

They influence the shear distribution in walls. The shear forces acting on walls in both directions are calculated from

$$V_{xi} = \frac{k_{xi}}{\sum_i k_{xi}} \cdot V_{bx} + \frac{M_x}{J_o} y_i \, k_{xi} \tag{3.37.a}$$

$$V_{yi} = \frac{k_{yi}}{\sum_i k_{yi}} \cdot V_{by} + \frac{M_y}{J_o} x_i \, k_{yi} \tag{3.37.b}$$

Accordingly, shear stresses in each wall can be calculated.

$$\tau_i = \frac{V_i}{A_i} \tag{3.38}$$

Shear resistance of walls

Shera resistance of masonry walls are governed by the diagonal tensile failure state. Vertical stresses influence shear strength. These vertical stresses are assumed constant here , calculated for a typical 3 story building. Shear strength of walls are recommended in Table 3.11, which conform with Eurocode 6.

Table 3.1.1 Shear strength of masonry walls

Wall type	Shear strength (MPa)
Harman Brick	0.25
Hollow brick (no corner ties)	0.15
Hollow brick (with corner ties)	0.25
Concrete block	0.10

Evaluation

Shear stress τ_i, calculated for each wall is divided to its associated τ_d for calculating the shear resistance factor.

$$KDF_i = \frac{\tau_i}{\tau_d} \tag{3.39}$$

Then a weighted shear resistance factor is calculated for the entire building.

$$AKDF = \frac{\sum_i (KDF_i \text{ x } A_i)}{\sum_i A_i} \tag{3.40}$$

Depending on the AKDF value, a decision is made on the building resistance level.

AKDF<1 : No damage limit state
1<AKDF<2 : Life safety limit state
AKDF>2 : Collapse limit state

A Structural analysis program is not required for implementing this procedure. It can be programmed on a spread sheet.

Third Stage Assessment

Method I - (ITU)

The analytical and experimental research on predicting the real behavior of building structures under gravity and earthquake loads have been conducted extensively during the last decades and the research results have been incorporated into new codes and standards. These developments enable structural engineers to design earthquake resistant buildings. Furthermore, due to the developments in construction technology, the production of high quality construction material and lessons learned from the past earthquakes, building structures can be constructed in accordance with the original design and general engineering principles.

As it is well known, the earthquake resistant design and construction of new buildings is not sufficient to prevent or to reduce the possible life and property losses in future earthquakes. Therefore, starting from high-risk earthquake zones, the seismic capacity of existing buildings should be evaluated and buildings without sufficient capacity should be strengthened.

In our country, a standard for the seismic evaluation of existing buildings has not been developed yet. Besides, the 1998 Turkish Seismic Code, which is applicable to seismic design of new buildings, cannot be directly applied to existing buildings. Therefore, procedures and guidelines are needed to evaluate the seismic capacity of existing buildings, which were designed and constructed in accordance with past codes, standards and practices, most of them are considered inadequate today. The new procedures and guidelines, after being calibrated through the pilot applications, shall be incorporated into a new code for seismic assessment and rehabilitation.

The following paragraphs present the basic principles of the methodology recommended for the detailed seismic evaluation (third phase evaluation) of existing buildings in Istanbul.

Investigations on existing building and data collection

The necessary information required for the mathematical modeling and seismic evaluation of the structural system is obtained by collecting related documents, their evaluation and performing site investigations.

The sources of data to be used in the seismic evaluation of an existing building are listed below.

a) Structural calculations and drawings, architectural and mechanical drawings. The structural analysis and design calculations are vital for the evaluation of the structural system. Because, by examining these calculations, the gravity loads and earthquake effects considered in the design, the mathematical modeling of the structural system, the design assumptions and idealizations, the analysis and design methods can be determined.

b) Standards and codes used for the original design of the building's structural system.

c) Geotechnical report of the building site.

d) Reports of material testing that may have been performed during construction.

e) Documentation of the as-built conditions recorded during construction as they vary from the original construction documents. In some cases the application of the original structural project may not be possible or a decision to alter the structural design may be unavoidable due to necessities that could arise during construction. Records that document these changes enable the assessment of the as-built condition of the structure.

f) Records of changes to the structural and non-structural components of the building. Even in the case where the building is constructed in accordance with the structural design documents, some changes or strengthening could have been made to remedy any damages. Knowledge of such changes to the structural system that can directly or indirectly influence the structural behavior are essential for the true representation of the actual building behavior in the structural system analytical model.

In many cases, where the drawings and other documents may not be available or may be incomplete, the information necessary for seismic evaluation can be obtained by field investigation. Even if the construction documents contain sufficient information, site investigation should be done to verify the accuracy of the documents.

Field investigation of existing conditions consists of the following steps:

a) geotechnical investigation of the building site (characteristics of foundation soil, seismicity of the region etc.)

b) material testing (selection of testing methods and number of tests to be performed on the existing building, correlation between different types of tests, evaluation of test results)

c) field investigations on the existing structural system (preparation of schematic as-built drawings of the structural system)

d) determination of actual reinforcing steel ratio through the non-destructive and destructive tests and comparison of existing reinforcing steel ratio with the design values when drawings are available.

e) investigation on the structural system (structural parameters that effect the analysis model, properties to be considered in the seismic evaluation: irregularities in plan and elevation, interaction between adjacent buildings, factors effecting the system ductility ratio, short columns, divergence from the original geometry due to construction imperfections, poor connection detailing etc.)

f) examination of the nonstructural elements (the positions, dimensions, material quality and workmanship of nonstructural walls and wall panels, positions and dimensions of wall openings etc.). This information may be useful for structural modeling and seismic evaluation of an existing building.

g) observation of damages caused by improper construction or by earthquakes, environmental effects and similar reasons (structural cracks in concrete, corrosion of reinforcement , concrete damages due to chemical effects etc.)

Recommended detailed evaluation method

The design principles set forth in 1998 Turkish Seismic Code will be reviewed for seismic assessment of existing reinforced concrete buildings in Istanbul, as outlined in the following sections.

Basic Principles of the Method

The proposed method for the seismic evaluation of existing reinforced concrete buildings is essentially a force based method which depends on linear analysis. In other words, under the gravity and earthquake loads, the building structure is analyzed according to the linear theory and the seismic evaluation of building is based on strength criteria.

However, by the use of the proposed method,

a) internal forces redistribution is also accomplished

b) plastic hinge rotations and elastic-plastic displacements caused by internal forces redistribution can be approximately calculated and compared with the limiting values, to determine the building performance level

system ductility ratio, that is defined as the ratio of total elastic-plastic deformations to linear-elastic deformations, is determined and the seismic reduction factor used in the structural analysis calculations is checked for the calculated ductility ratio. The analysis calculations are revised for the actual ductility ratio, when necessary.

<u>Determination of the earthquake level to be considered for the seismic analysis of existing structural system</u>

The following basic principles should be considered for the determination of equivalent earthquake forces or elastic response spectra to be taken into account for the analysis of existing structural system.

a) Turkish Seismic Zone Map will not be used for the prediction of seismic loads; instead, results of micro-zonation studies conducted JICA-IBB for Istanbul will be utilized.

b) Based on the age of the building and therefore the decrease of seismic risk probability for the remaining life, the seismic loads or the response spectra may be reduced by a factor. (A reduction factor of 0.75 is suggested in FEMA 310, for the detailed evaluation phase). The expected building performance level should also be considered when determining this reduction factor.

<u>Basic principles of the method used for seismic analysis of existing structural system</u>

a) The static lateral force procedure can be used for buildings not more than seven stories in height, and without any irregularities, described in the 1998 Turkish Seismic Code. However, the nonlinear behavior may be approximated by the redistribution of internal forces and by the global capacity check of lateral load resisting elements.

b) The dynamic lateral force procedure (method of modal superposition) shall be used for buildings that are taller than seven stories and/or having irregularities. The non-linear behavior can be approximated as noted above.

c) The redistribution of internal forces between lateral load resisting elements (columns and shear walls) may be accomplished by utilizing the *capacity tables*, arranged as explained in the following.

   c1) In general, the capacity tables are prepared for each story, for each perpendicular direction and for two extreme eccentricity conditions of lateral earthquake loads.

   c2) Capacity tables should be prepared for columns and shear walls, separately. The effect of beam capacities on the column and shear wall capacities shall be evaluated by means of the beam-to-column (beam-to-shear wall) capacity ratios.

   c3) The transfer of the part of internal forces acting on weak structural elements is done by *redistribution*. During this operation, the equilibrium equations should be satisfied and the plastic deformations caused by the redistribution of internal forces should be considered as explained in the following. Another method of internal force redistribution is to repeat the structural analysis by changing the member flexural rigidities, properly. This method is especially beneficial, for the internal force redistribution between columns and shear walls.

d) The plastic hinge rotations developed during the redistribution of bending moments can be approximately calculated through the *virtual work theorem*. Then, the seismic performance level of the building is determined by comparing these plastic rotations with the corresponding plastic rotation capacities. The plastic rotation capacities may be taken from FEMA 356 (*Pre-standard and Commentary for the Seismic Rehabilitation of Buildings*).

e) The total elastic-plastic displacements of the structural system are calculated depending on the revised internal force diagrams and plastic hinge rotations. Then the *system ductility ratio* is determined as the ratio of these displacements to the linear-elastic displacements. Later, the seismic reduction factor, used in the structural analysis calculations is checked for the calculated ductility ratio. The analysis calculations may be revised for the actual ductility ratio, when necessary.

<u>Use of structural analysis results for the selection of seismic strengthening method</u>

The results of the seismic analysis may be used in selecting the seismic strengthening method and taking the necessary strengthening measures. This approach is explained in the following.

A. In case where the seismic safety of the building is well below the required value, the strength, rigidity and the stability is improved by adding lateral load resisting members to the existing structure.

B. In structural systems with limited ductility, the excessive plastic hinge rotations may result in poor system performance and in some cases the performance level may be lower than the collapse prevention performance level. In this case the collapse safety of the existing building can be improved by increasing the plastic hinge rotation capacities. This could be achieved by local strengthening measures such as enhancing the confinement of concrete.

C. Some local mechanisms (for example beam or panel mechanism) that are developed due to design and construction errors may result in structural collapse. In such cases, the building performance can be improved by local strengthening.

D. Another reason for the structural collapse is large amount of displacements and relative displacements developed in the building structure. If collapse occurs due to large lateral displacements, the lateral rigidity of the whole structure is increased. For this purpose, new lateral load carrying elements e.g. shear-walls are added to the structural system. Local strengthening methods may be applied for structures with higher relative displacements.

Method II (for 1-7 story concrete buildings) – METU

The proposed procedure is based on a 14-step force-based assessment method (Günay and Sucuoğlu, 2003; Sucuoğlu, 2003). Design drawings as well as reinforcement detailing are required in the application. The steps of the procedure are shown schematically in Figure 3.10. An important feature of the procedure is conducting linear elastic analysis only once (Step 3). Each step of the proposed procedure is explained below.

<u>Modelling (Step 1)</u>

2D modeling was used in this study in order to be able to compare the results with the static pushover analysis. In general, proposed procedure is applicable to 3D modeling as well. For all sample buildings, beams and columns were modeled as prismatic, massless line elements.

Shear walls were modeled by column elements having the cross sectional properties equal to the shear walls, connected to infinitely rigid beams at story levels. Foundations were considered infinitely rigid. Considering that concrete would crack under seismic action, cracked section stiffness was employed according to FEMA-356 [2000] recommendations. Masonry infill walls were modeled as diagonal axial force carrying struts with finite stiffness in compression, and no stiffness in tension. Only the struts that would be under compressive force according to the direction of the lateral force were modeled, since the stiffness contribution of the struts would be doubled otherwise. For 2D modeling, the planar frames were connected to each other by rigid links to consider diaphragm rigidity. Elastic and static pushover analyses were performed with the nonlinear analysis software DRAIN-2DX [2]. Elasto-plastic force-deformation relations were used in pushover analyses.

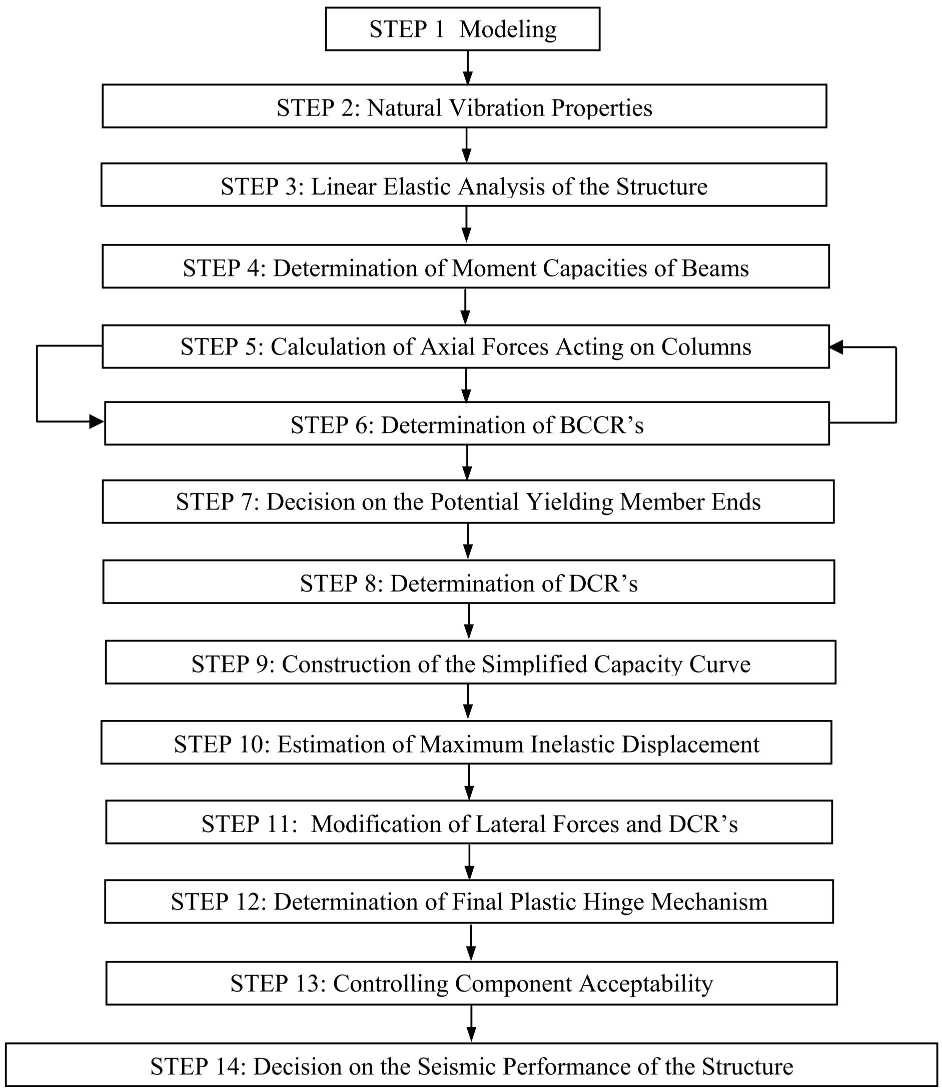


Figure 3.9. Steps of the proposed assessment procedure

Linear Elastic Analysis of the Structure (Step 3)

Linear elastic analysis of a structure is conducted under the maximum lateral force that will be sustained by the structure under a ground motion excitation (considering that the structure will remain elastic). Lateral force vector was determined in proportion to the story masses and the first mode shape of the building.

Moment Capacities of Beams (Step 4)

Mean strength values obtained from site inspection were used for the calculation of capacities, since the proposed procedure is an assessment procedure. Moment capacities can be calculated by using the rectangular stress distribution as the compressive stress block (Ersoy, 1997), since it gives results in agreement with more sophisticated concrete models when confinement is not effective, which is the case for most of the existing concrete structures in Turkey.

Calculation of Axial Forces on Columns (Step 5) and Determination of BCCR's (Step 6)

Axial forces are calculated with a limit state analysis from the maximum shear forces that can be transmitted from the beams. First, all the beam-ends are accepted to yield in flexure, in agreement with the direction of the lateral force. The beam end shear forces are calculated by considering the free body diagrams of the beams (Figure 3.11). Axial force on a column is calculated by using vertical equilibrium, from the free body diagram of the considered column axis (Figure 3.11). The gravity forces transmitted by the transverse beams connecting to the considered plane frame, column weights and vertical components of the strut forces should be considered in the calculation of the axial forces. In Figure 3.11, Q represents the sum of column weights and the forces transmitted from the transverse beams, and SF represents the vertical components of the strut forces.

After calculation of the axial forces on the columns, moment capacities can be calculated by using the interaction diagrams of the columns. Then Beam-to-Column Capacity Ratios (BCCR) are calculated for all joints as the ratio of MB to MC, where MB is the total moment capacity of the beam ends connecting to the joint and MC is the total moment capacity of the column ends connecting to the joint. If BCCR for a joint is greater than 1.0, the moments at the beam ends will be bounded by the total moment capacity of the column ends. In this case, the beam end moments are modified as MC*ELM/ELMT, where ELM is the moment at the considered beam end calculated with elastic analysis under lateral forces and ELMT is the total moment at the beam ends connecting to the joint calculated with the same analysis. After the modification, if the calculated moments are greater than the capacities, capacities should be used. If BCCR for a joint is smaller than 1.0, moments at the beam ends become the capacities. Using the modified beam end moments, beam end shear forces and column axial forces are updated using the free body diagrams in Figure 3.11, column moment capacities are recalculated by using the interaction diagrams of the columns with the updated axial forces, and BCCR values are recalculated finally.

This iterative procedure can be continued until the axial forces calculated at an iteration step are the same with the axial forces at the previous step, but the results after one step are usually sufficient.

Decision on the Potential Yielding Member Ends (Step 7)

If BCCR for a joint is greater than 1.05, column ends are considered as the potential yielding locations, if BCCR is smaller than 0.95, beam ends are considered as the potential yielding locations, and if BCCR is between 0.95 and 1.05, all member ends connecting to the joint are considered to have yielding potential.

Determination of DCR's (Step 8)

With the determined values of demands and capacities, demand-to-capacity ratios at all member ends are determined as the ratios of demands obtained from linear elastic analysis to the capacities.

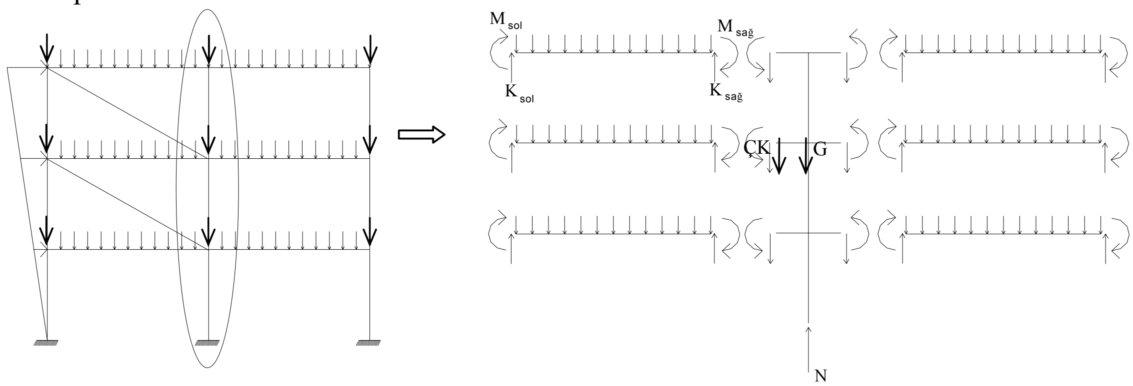


Figure 3.10. Calculation of the beam end shear forces and axial forces on the columns

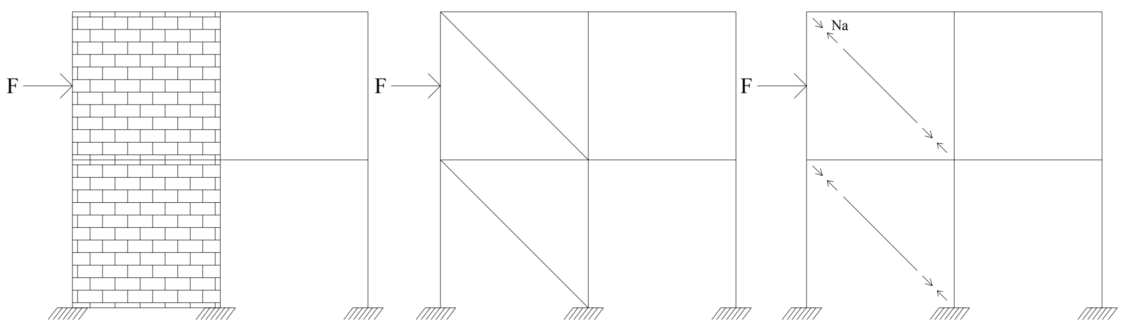


Figure 3.11. Calculation of axial forces on the columns

Construction of the Simplified Capacity Curve (Step 9)

The global capacity curve can be simplified as a bilinear curve, with two parameters, namely the base shear capacity V_y, and the initial stiffness k_0, in the case of elastoplastic behavior (Figure 3.12).

A structure's base shear capacity is controlled by the capacities of individual elements of the structure. In this study two different methods are proposed in order to estimate the base shear capacity. In both methods, axial forces calculated from the maximum shear forces that can be transmitted from the beams are used. In addition, all the ground story column bases are considered to yield. In the first method, base shear capacity is calculated using the global equilibrium of the structure (Figure 3.13). In the second method, base shear capacity is calculated as the sum of ground story column shear forces (Figure 3.14). The shear force of a ground story column is calculated as ($Mtop_i$+$Mbot_i$) / L_i; where $Mbot_i$ is equal to the moment capacity of the i'th column, $Mtop_i$ is equal to the moment capacity of the i'th column if BCCR for joint J (Figure 5) is larger than 1.0. If BCCR is less than 1.0, $Mtop_i$ is equal to MB*ELM/ELMT where MB is equal to McapL+McapR (Figure 5), ELM is the moment at the top column end calculated from linear elastic analysis under lateral forces, and ELMT is the total moment at the column ends connecting to the joint calculated from the same analysis.

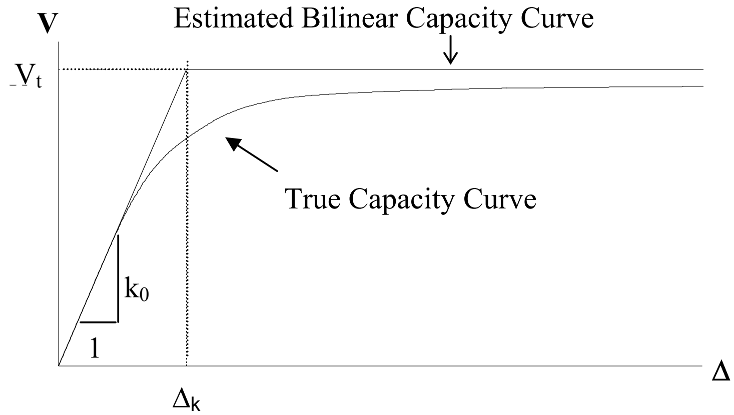


Figure 3.12. Global capacity curve and simplification to a bilinear form

Initial stiffness can be calculated by dividing the lateral force by the top story displacement in linear elastic analysis.

Estimation of Maximum Inelastic Displacement (Step 10)

The coefficient method in FEMA-356 (2000) is used for the calculation of maximum inelastic displacement in this study. In the coefficient method, the maximum inelastic displacement demand of a nonlinear MDOF system is estimated as the maximum displacement of an elastic SDOF system, multiplied by a series of modification coefficients.

Modification of Lateral Forces and DCR's (Step 11)

In the proposed procedure, inelastic behavior of a structure is estimated from linear elastic analysis at equal global displacement. The magnitude of the lateral force used in Step 3 is modified so that the displacement of the control node (top story node) obtained from linear elastic analysis is equal to estimated maximum inelastic displacement calculated in Step 10 (Figure 3.15). The modification factor is equal to δin / δel. This factor is equivalent to C1.C2.C3 in the FEMA coefficient method. DCR values calculated in Step 8 are also multiplied with the modification factor.

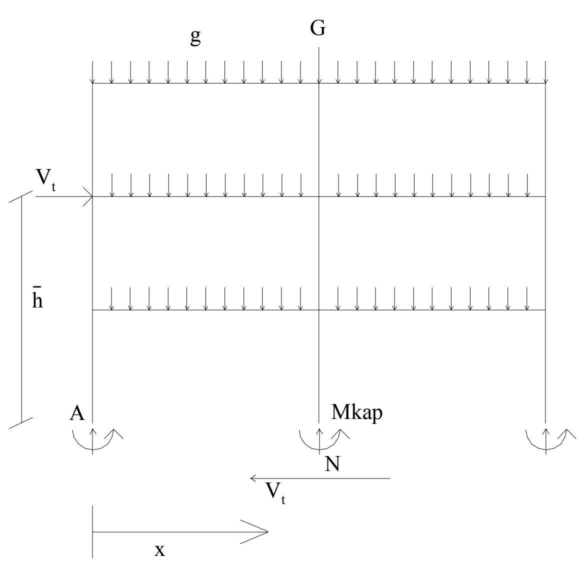


Figure 3.13 Calculation of base shear capacity using the global equilibrium of the structure

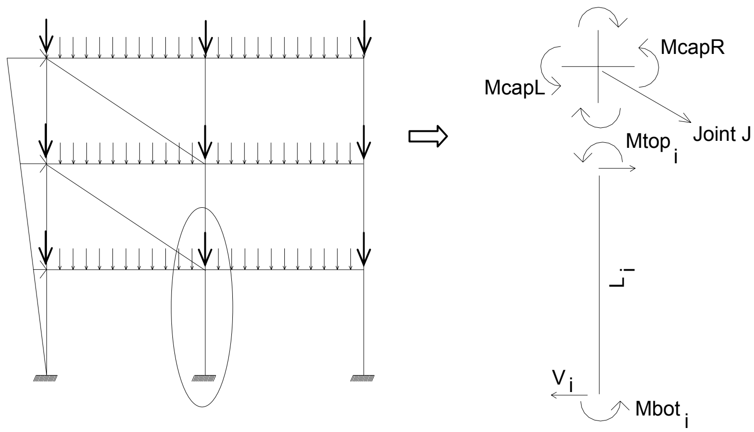


Figure 3.14. Calculation of base shear capacity as the sum of the ground story column shear forces

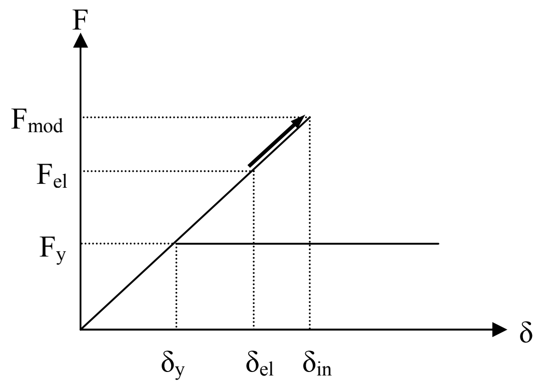


Figure 3.15 Modification of lateral force

<u>Determination of Final Plastic Hinge Mechanism (Step 12)</u>

The final plastic hinge mechanism is determined by using DCR values of the potential yielding member ends. If DCR value at a potential yielding member end is greater than one, the member end is considered to yield, else the member end is considered not to yield. Also, ground story column bases are considered as yielding member ends if their DCR's exceed one.

<u>Component Acceptability (Step 13)</u>

In the proposed procedure, flexural deformations are controlled for the acceptability of beams and columns. Acceptability was controlled by two different ways in this study. In the first one, plastic rotations at the member ends were estimated and controlled with the acceptable deformation limits recommended in FEMA-356 (2000). In the second one, Demand-to-Capacity Ratios (DCR's) were used directly for controlling acceptance.

Plastic rotations were estimated by using three different approaches. In the first two approaches, plastic rotations were calculated by using equal energy and equal displacement assumptions for the elastic and elasto-plastic moment chord rotation relations of member ends (Figure 3.16). The definition of chord rotation is shown in Figure 3.17.

For structures that displayed mixed inelastic mechanisms, DCR's were directly used for controlling acceptance. DCR values were plotted against plastic rotations obtained from pushover analysis for all the potential yielding member ends from the case study buildings that displayed mixed inelastic mechanisms, and DCR limits corresponding to the plastic rotation limits of FEMA-356 (2000) were decided on by using the distribution of data. The proposed DCR limits are shown in Table 3.12.

Table 3.12 Acceptable DCR limits proposed for non-conforming R/C members

Beams		Columns	
$V/(b_w.d.\sqrt{fc})$ (1)	DCR Limit	$N/(A_g.fc)$ (2)	DCR Limit
≤ 0.25 (3)	6	≤ 0.1 (3)	3
≥ 0.50	3.5	≥ 0.4	1

(1) V : Shear force (N), b_w : section width (mm),
d : section depth (mm), fc : concrete compressive strength (MPa)
(2) N : Axial force, A_g : Gross area of column
(3) Linear interpolation is used for the intermediate values

Decision on the Seismic Performance of the Structure (Step 14)

According to the obtained results, decision is made on the global seismic performance of the structure, depending on the distribution of plastic hinges, and the magnitude of the estimated plastic rotations at yielding member ends.

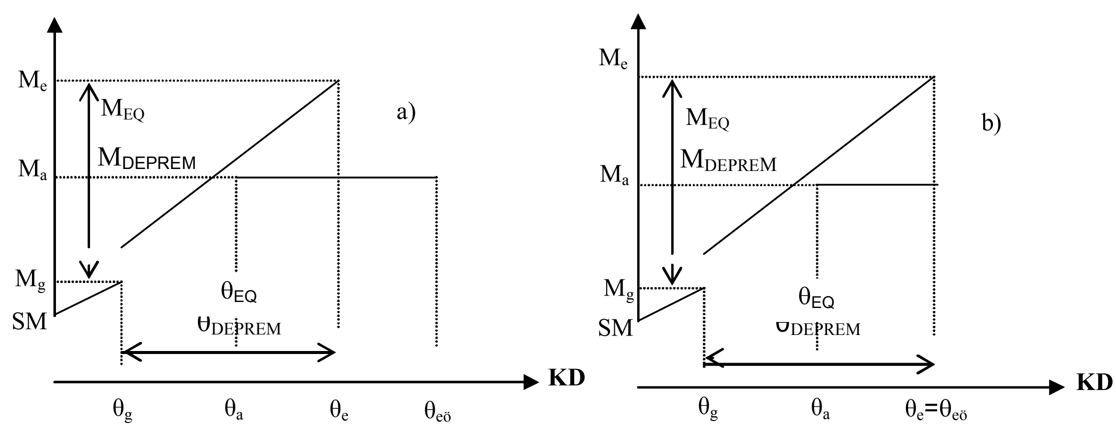


Figure 3.16. Moment vs chord rotation relations for elastic and elasto-plastic behaviors assuming; a) equal energy assumption, b) equal displacement assumption

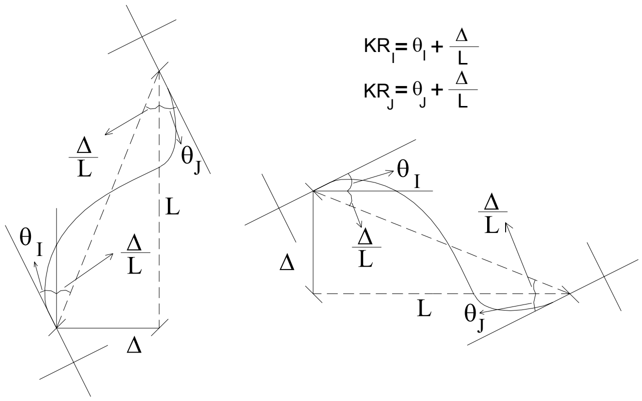


Figure 3.17. Chord rotation definition

Controlling the Possibility of Shear Failure

The proposed assessment procedure can be applied if shear failure does not occur in any of the members or joints of the structure. Therefore, the possibility of shear failure should be controlled. Shear failure possibility for the frame members can be controlled by calculating the shear force corresponding to the end moment capacities, and comparing it with the shear capacity for each member end. BCCR values should be taken into account in finding the shear force corresponding to moment capacities. Capacities should not be used if the member ends don't yield in accordance with BCCR values, instead the moments distributed from the yielding member ends (as explained in Sections 2.5 and 2.8) should be used. In the calculation of shear capacities, the decrease in the contribution of concrete to shear capacity with increasing curvature ductility should be taken into account (Park, 1998). The critical stress values for interior and exterior joints proposed by Priestley (1997) can be used for controlling the shear failure of beam-column joints.

Method III – BU - YTU

The buildings to be considered in the third stage detailed evaluation/assessment are the residential and office buildings with more than six stories (excluding basement) and the important buildings, such as schools, hospitals, government buildings, etc. Considering the priorities set out in the second stage assessment, it is proposed that a "*detailed performance evaluation based on displacement demands and capacities*" be carried out and in addition internal force capacities of non-ductile elements should be checked in those buildings, which are expected to have a minor share in entire building stock in Istanbul.

In order that such an evaluation can be made properly it would be necessary to acquire the design drawings of buildings as well as the structural system layout drawings to be compiled in-situ. In addition, structural material investigations and, if it is deemed necessary, soil investigations could be considered.

The above-mentioned seismic hazard maps and seismic performance criteria will also be considered at this stage. However "*operational*" performance criterion will be applicable to "*important buildings*" under an earthquake with a 10% probability of exceedance in 50 years.

Since the "*detailed performance evaluation based on displacement demands and capacities*" is a modern and rather a new procedure, currently it is applied by practising engineers in Turkey in a very limited manner. On the other hand, it is verty well known that the "force (strength) – based" evaluation approach based on current seismic codes is not realistic and generally yields very conservative results. It should be borne in mind that the evaluation/retrofit campaign envisaged to be realized in Istanbul will be an extremely important engineering event worldwide. It is expected that sufficient number of engineering groups can be trained through an intensive training campaign with appropriate organizational schemes and relatively small number of buildings left to the detailed assessment stage can be evaluated by those new and modern methods. It is worth to add that those methods can be equally applied to the retrofit design stage and thus technical and economical feasibility of retrofit campaign can be achieved.

On the other hand, Part 3 of the newly drafted Eurocode 8 [3,4], which is devoted to seismic assessment and retrofit of structures, may be considered as a valuable source for the new section to be added to the Turkish seismic design code and it may be directly exploited for the applications in Istanbul. The draft code is essentially based on "*performance evaluation based on displacement demands and capacities*" and it allows the use of the linear analysis which is familiar to the engineers along with the more advanced nonlinear pushover analysis. Linear analysis is performed according to unreduced seismic loads and seismic demands associated with displacements and deformations are based on the "*equal displacement rule*". Nonlinear deformations capacities are given in terms of regression relationships obtained from a vast number of test results. Eurocode 8 – Part 3 also includes analysis and designh guidelines for the retrofit of structures.

3.1.5. Estimation of durations and man months in multi-stage assessment

First Stage Assessment

The forms shown in Table 3.13 shall be completed for each building in 15 minutes. This requires a total of 900 man-months for all buildings in Istanbul.

When the risk grades obtained from the first tier assessment through walk-down surveys, and marked on a (1/1000) scale map, the distribution of buildings with high risk can be obtained

Table 3.13 First-Stage Assessment Forms

FORM 1: STREET DATA

Street name	
District	
Province	
GIS coordinate 1	North : East:
GIS coordinate 2	North: East:
PGV Zone	I □ II □ III □
Note: GIS coordinates are recorded at the two ends of a street.	

FORM 2 : GENERAL BUILDING DATA

Door No:	Concrete □	Masonry □	Mixed □

FORM 3 is for concrete, FORM 4 is for masonry and mixed buildings.

FORM 3 : CONCRETE BUILDING DATA

Number of stories (Basement included)	
Soft story	No □ Yes □
Heavy overhangs	No □ Yes □
Apparent quality	Good □ Moderate □ Poor □
Short columns	No □ Yes □
Pounding effect	No □ Yes □
Topography effect	No □ Yes □

FORM 4: MASONRY AND MIXED BUILDING DATA

Number of stories (Basement included)	
Apparent quality	Good □ Moderate □ Poor □
Wall opening ratio	Slight □ Moderate □ Significant □
Wall opening orientation	Regular □ Less regular □ Irregular □
Pounding effect	No □ Yes □

Second Stage Assessment

Second tier assessment requires longer time than the first. Priority should be given to the districts with high expected losses in the JICA-IBB loss estimation scenario. It is appropriate to start from districts with heavy damage ratio > % 10, and life loss ratio > % 1. Completion of forms in Tables 3.14 requires 1-2 hours for each building with a team of 3 technical persons.

Table 3.14. Second Stage Assessment Forms

GENERAL INFORMATION

Building Reference No.		**Investigation Date**	**: / / 2003**
Address Information			
Construction Date	**/ /**	**Date of Design**	**: / /**
Building GPS Coordinates			
Memberfs of the Investigation Team			

Photo 1

Photo 2

y

x

Plan View

Building Information

Story	Number of Repetition	Floor Height (m)	Floor Area (m^2)	Remarks			
Basement							
Ground							
Mezzanine							
Normal Story							
Penthouse							
Is there any increase in story numbers due to change of municipal construction regulations?				Yes		No	

Location	Detached		Appending corner building		Appending on both sides in a row of housing	
	Building on a slopping terrain?		Yes		No	
	Slope		$\geq 30^o$		$< 30^o$	

Does seismic dilatation with neighboring buildings exist?	Yes		Yok		NA	

Does floor height difference between adjacent neighboring buildings exist	No		Yes		NA	

Irregularities		
	Exist	Does not exist
Irregularities in plan		
Irregularites in the elevation		
Floor discontinuity		
Non-parallel frame lines		
Soft story		
Discontinuity in vertical elements		

Properties of the Structural System

Type of the Structural System:	**RC Frame**	
	RC Wall-Frame System	
	Mixed (RC+Masonry)	
	Masonry	

For RC Buildings		
Infil Wall Material	**Hollow clay tiles**	
	Solid clay tiles	
	Concrete briquettes	
	Kiln-fired bricks	
	AAC	
	Others (please specify) -	

Mixed/Masonry Buildings		
Structural Wall Material	**Hollow clay tiles**	
	Solid clay tiles	
	Concrete briquettes	
	Kiln-fired tiles	
	AAC	
	Stone	
	Others (please specify) -	

Bodrum Perdesi Malzemesi:	**Stone masonry (pointed or rubble)**	
	RC wall	
	Kiln-fired or solid clay tiles	
	Concrete briquettes	
	Others (please specify) -	

Floor System	**Two-way slab with beams**	
	Hollow joist slab system	
	Joist slab	
	Flat slab	
	Others (please specify) -	

Reinforcement *						
Grade	**S220 (St I)**		**S420 (St III)**		**S500 (St IV)**	
Type	**Plane:**				**Deformed:**	
Any sign of corrosion?		**Yes:**			**No:**	
Any sign of longitudinal cracks in exterior columns or beams?		**Yes:**			**No:**	

- If it can be determined.

Structural System Information

(1) Any stores in the ground floor?	Yes:		No:	
(2) Any story height difference b/w the ground story and the first story?	Yes:		No:	
(3) Is there any difference in the number of stories as tey apper from the front and rear facades of the building?	Yes:		No:	
(4) In case the answer to Question 3 is negative, please answer:				
Apparent number of stories as seen from the front façade				
Apparent number of stories as seen from the front façade				
(5) Is there any short columns?	Yes:		No:	
(6) Binanin kirişlerinin yüksekliği kolonlarin genişliğinden fazla mi? (Belirlemek mümkün değilse boş birakiniz).	Yes:		No:	
If there are any other thing that must be mentioned, please specify.				

OVERALL WORKMANSHIP EVALUATION

		Yes/Good	No/Bad
Apparent quality of the building is:			
Material Quality	Concrete		
	Infill		
	Structural wall		
Beams and columns meet at joint without any significan offset, i.e. confined beam-column joints.			
Are there significant change b/w the architectural plans of the successive floors?			
Are there any damage in RC structural elements, i.e. cracks, excessive deformation, etc.			
Others, please specify.			

3.1.6. Education program for the assessment

Table 3.15. Education program for the persons participating in the assessment of buildings

Subject	Duration (hour)	Content
Reinforced concrete structural systems and safety of structural system	3	Types of foundations, soil groups, local soil classes, effect of the soil conditions on seismic safety of a building, methods for identification of concrete quality of existing buildings, corrosion and corrosion damage levels, safety of reinforced concrete structural systems, bond and anchorage between steel and concrete, reinforced concrete structural systems, stiffness, strength and ductility, general behavior of structural systems under seismic load, classification of structural systems, structural systems of moment resisting frames, of shear walls and frames, regular and irregular structural systems, elements of reinforced concrete structures, slabs, beams, columns, shear walls, footings, masonry structures, structural damages, cracks in structural elements and their evaluations.
Procedures for assessment of seismic safety of reinforced concrete structures and the first stage assessment	3+3	Identification of structural system in a building, three-stage assessment procedures, first, second and third stage assessments procedures, principles of the first stage assessment procedure, structural parameters to be observed during field surveys and their importance for the seismic safety of the structural system, indexing and scoring of structural systems, short column, soft and weak story, heavy overhangs, pounding effect, structural characteristics of infill walls and their effects on the lateral load capacity of structural systems, evaluation of concrete cracks and their effect on the loading capacity of reinforced concrete elements.
Second stage assessment procedure for evaluation of seismic safety of reinforced concrete buildings	3+3	Structural elements and systems of buildings, second stage assessment procedure, structural parameters to be determined during field surveys and their importance for the seismic safety of the structural system.
Field application	3+3	Identification of the structural parameters of the first and second stage assessment procedures in field.
Field application	3+3	Electronically data collection of the structural parameters of the first and second stage assessment procedures in field.
Test exam	3	

The training program could be organized by chamber of civil engineering and/or universities. Expected participant will be civil engineers or architects. Participants who could pass the test will have the certificate of achievement.

3.2 Seismic Strengthening of Buildings

3.2.1 Principles of strengthening

As much as possible simple, quick and cheap strengthening methods come in question. Provided that these strengthening methods are economic, they will be applied to buildings which have seismic risk in terms of collapse or heavy damages. The target of the strengthening of buildings is to prevent the total collapse of the structural system and consequently to provide live safety under the scenario earthquake. This targer does not include any type of prevention of structural damages. The classification to be considered in building strengthening is given in Table 3.16.

Table 3.16. Classification of the building strengthening

<table>
<tr><td rowspan="2">Types of buildings</td><td colspan="2">Reinforced concrete and masonry low-rise buildings
(Number of story in between 1-7)</td><td rowspan="2">High-rise reinforced concrete and masonry buildings
(Number of story higher than 7)</td><td rowspan="2">Steel buildings</td></tr>
<tr><td>Buildings with limited number of stories
(Reinforced concrete 1-3, masonry 1-3)</td><td>Moderately high buildings
(Reinforced concrete 4-7, masonry 4-7)</td></tr>
<tr><td>Residential buildings</td><td>Simplified strengthening</td><td>Simplified or comprehensible strengthening</td><td>Comprehensible strengthening</td><td>Comprehensible strengthening</td></tr>
<tr><td>Socially essential buildings</td><td colspan="4">Compressive strengthening</td></tr>
</table>

3.2.2 Simplified strengthening method

It is most probable that a very good part of buildings in Istanbul does not have any civil engineering document related to their structural system and they are non-engineered; build by private homeowners and other non-professional builders. Furthermore, even if they have some design documents or drawings; these documents often do not conform to the existing situation. For these reason, it is unrealistic to adopt a strengthening method or procedure which requires lengthy and sophisticated calculations. Often it is very difficult to include some local weaknesses of structural elements even in a comprehensive evaluations; such as inadequate anchorage length of reinforcements in columns and beams; poor reinforcement detailing in beam-columns joints or voids in these joints; small eccentricities of column axes in elevation. It is unrealistic to carry out a sophisticated non-linear analysis, and expect useful and acceptable results. As it is the case in the seismic evaluation of existing buildings, the simplified strengthening method is defined as a simple strengthening intervention which can be designed and implemented easily without requiring any sophisticated calculations. Identification of the ductility and strength of the existing infill walls as well as their improvement in structural systems of frame type are one of the main strengthening works in this method.

Limit states to be considered in the strengthening method

Expected seismic forces to be carried by the structural system and performance level expected to be displayed by the building consist of the limit states for determining the extent of the strengthening work. The seismic effect can be adopted from the Seismic Code by using a suitable reduction factor, such as 75%. It obvious that different values can be assumed provided that more realistic studies are available. However, it is important to note that the level of the seismic effect considered in the strengthening should be definitely higher that the level adopted in the assessment procedure. This requirement will provide a certain safety margin between the building which has acceptable minimum level of safety found in the assessment procedure and the building which is strengthened by considering the minimum level of the limit states. The following explanations are related to the limit stresses to be considered in the strength evaluation of infill walls and in the performance levels expected from the building.

Lateral load capacity of infill walls

Infill walls are parts of the structural load carrying system in masonry buildings and they resist vertical and lateral loads. However, this type of participation also comes into being in reinforced concrete structures at a certain level. The load carrying capacity of infill walls depends on their material, thickness, material of mortar, and workmanship. In the codes which specify the design of the new reinforced concrete structures, this extra capacity is not taken into account. However, in the seismic evaluation of existing buildings it is almost inevitable to include any additional capacity of the structural system, otherwise most of the existing structures appears to be unsafe against to seismic events. In this respect it is of prime importance to determine the contribution of infill walls to the seismic capacity of the structural system. The tests carried out in the structural and earthquake laboratories of the Technical University of Istanbul and that of the Middle East Technical University have yielded the existence of such load carrying capacity.

Use of infill walls as strengthening elements is recommended especially in low-rise buildings. It requires a limited extent of strengthening intervention and it transfers the seismic forces by distributing them and lowering their intensity, before they reach to the footings. For this reason, often no strengthening work is required in foundations. As it is well known, strengthening of foundations is one of the prime problems in the classical strengthening work. Infill walls between columns and beams are subjected to normal and shearing stresses. As seismic effect increases, the shearing stress gets larger. The shearing stress capacity of the wall rises with the increase in the normal stress up to a certain level. However, the level of the normal stress in the infill walls of reinforced concrete structures is low, since the infill walls are added after the construction of the frame system. For this reason it is reasonable to assume that the shearing stress capacity of an infill wall is independent from the normal stress. In this case, it is important to include quantitatively; material, thickness, material of mortar and workmanship of infill walls in the evaluation of its load carrying capacity. Various qualitative and quantitative applications of these parameters complicate evaluation of their participation. This difficulty partly can be overcome by adopting a table giving values corresponding to the most widespread applications.

It is important to find an equivalent shear area for walls having various quality and mortar configuration to compare them with each other. Here a reference infill wall is adopted as the infill wall of 20cm thickness, consisting of solid masonry units, grouted vertical and horizontal by lime mortar. It is assumed that all other types of walls can be converted to it regarding to the effective shear area. The adjusting coefficients are given in Table 3.17, 3.18 and 3.19 for obtaining the corresponding equivalent shear area. Table 3.17, 3.18 and 3.19 give the adjusting coefficients to include the effect of material of wall, thickness, material of mortar and workmanship, respectively. For example; when a infill wall 10cm thickness, with masonry units having horizontal voids and medium quality of workmanship is in question, the total adjusting coefficient for effective shear area is obtained by using the values of the tables 0.4×0.8×0.8×0.8 = 0.20. It means that the cross section of such infill wall will be multiplied by 0.20 to convert it to the cross section of the wall of 20cm thickness having solid masonry units and horizontal and vertical mortar. These coefficients are adopted under the results of the past experiences and they can be modified, when more accurate and realistic results are obtained as a result of numerical or experimental studies.

Table 3.17. Adjusting coefficient depending on the material of the existing infill wall for converting its area to that of the reference infill wall of 20cm thickness, consisting of solid blocks, grouted vertical and horizontal by mortar

Material of the infill wall			
Solid masonry brick units	Masonry brick units having vertical voids	Masonry brick units having horizontal voids	Masonry concrete units having voids and low cement ratio
1.0	0.6	0.4	0.3

Table 3.18. Adjusting coefficient depending on the thickness, mortar quality and workmanship of the existing infill wall for converting its area to that of the reference infill wall of 20cm thickness, consisting of solid blocks, grouted vertical and horizontal by mortar

Thickness		Quality of mortar			Workmanship		
10cm	20cm	Poor	Medium	Good	Poor	Medium	Good
0.8	1.0	0.5	0.8	1.0	0.5	0.8	1.0

Table 3.19. Adjusting coefficient depending on the type of mortar of the existing infill wall for converting its area to that of the reference infill wall of 20cm thickness, consisting of solid blocks, grouted vertical and horizontal by mortar

Lime mortar		Cement mortar	
Horizontal mortar only	Horizontal and vertical mortar	Horizontal mortar only	Horizontal and vertical mortar
0.7	1.0	1.5	2.0

Table 3.20. Adjusting coefficient for columns and concrete walls for converting its area to that of the reference infill wall of 20cm thickness, consisting of solid blocks, grouted vertical and horizontal by mortar

Concrete column			Concrete wall		
Quality of concrete			Quality of concrete		
Poor	Medium	Good	Poor	Medium	Good
3.0	5.0	6.0	3.0	5.0	6.0

Table 3.21. Adjusting coefficient for concrete layer on infill walls for converting their areas to that of the reference infill wall of 20cm thickness, consisting of solid blocks, grouted vertical and horizontal by mortar

Application of steel and concrete		Connection of the applied layer to columns			Connection of the applied layer to beams		
On one surfaces of the wall	On two surfaces of the wall	No connection	Medium connection	Good connection	No connection	Medium connection	Good connection
4.0	5.0	0.5	0.7	1.0	0.5	0.7	1.0

The lateral load capacity of infill walls can be increased by improving the quality of masonry units, mortar and workmanship. It can be done by tearing down the wall and constructing it with care. In this case, the adjusting coefficients conforming to the new wall have to be used. Furthermore, by application of the web steel reinforcement (Q106 or higher) and concrete (C20 and higher; approximately 5cm thickness) on the surfaces of infill walls, their lateral load capacity and ductility can be increased dramatically. The behavior of the improved infill walls will not be the same as that of the original wall. However, this behavior is also show similarities to that of the plain wall and the shear force capacity can be determined accordingly.

It is once more worth to mention that this type of capacity evaluation is only acceptable for low-rise buildings. The assumptions used above for quick and approximate seismic capacity evaluation may yield incorrect results for high-rise buildings where bending is more pronounced that the shearing effects. Table 3.20 gives the adjusting coefficients for concrete columns and walls for converting their cross sectional areas to that of the reference infill wall of 20cm thickness, consisting of solid blocks, grouted vertically and horizontally. Similar coefficients for concrete layer on infill walls are given in Table 3.21.

The adjusting coefficients of infill walls to be used in the loading combination G+Q+E are given above. The possible discussion related to the accuracy level of the method will be summarized as follows:

a) Analysis is carried out by considering forces and stresses, deformations and displacements are out of control: It is assumed that in the strengthening structural system the forces and stresses are the governing parameters, since the system becomes more rigid through the strengthening. Consequently, it is not expected that the deformation and displacement will be decisive parameters in the lateral capacity of the structural system.
b) Analysis bases on the shearing stresses without considering normal stresses due to the gravitational vertical load and to the seismic bending moment: It is assumed that buildings are low-rise i.e., they have very limited number of stories and the infill walls do not show any irregularities in elevations.

c) Analysis does not consider the properties of the infill walls having various configuration in elevation and in plan: The infill walls which do not display any irregularity and which are continuous in elevation are taken into account. Furthermore they are included in the analysis, when they do not have any openings and when they are continuous in between slab and ceiling.

The reference infill wall is adopted as a infill wall of 20cm thickness, consisting of solid bricks, grouted vertical and horizontal by lime mortar. The maximum allowable shearing stress of the reference wall under the load combination G+Q+E should be determined as a result of suitable tests (as an acceptable interval 0.15MPa and 0.40MPa can be given)

Further simplified strengthening interventions and methods

Following simplified strengthening intervention and methods can be used alone or together with the above strengthening method.

Increase the quantity of the structural load carrying walls

The lateral load capacity of masonry buildings can be increased by adding more walls. This procedure can be applied in low-rise reinforced concrete buildings as well and it is widely preferred, because it requires a limited extent of strengthening intervention, but no strengthening work in foundations. By using the principles, a design control can be done whether an acceptable seismic safety is provided.

Increase the quality of the structural load carrying walls

When building has enough number of infill wall and when no additional wall can be accepted, their lateral load capacity can be increased by improving the quality of infill walls. The walls can be taken apart and they can be constructed with care. As it is mentioned above, another solution is application of the web steel reinforcement and concrete on the surfaces of infill walls. This strengthening work is to be applied in masonry and reinforced concrete building of low-rise.

Adding precast panels to openings of structural frames

Filling the frame opening between beams and columns by using precast panels will increase the lateral load capacity of the structural system. Here it is important to provide integration of the elements of the frame with the newly added panel elements.

Construction of surrounding wall in the basement floor of the building

Construction of surrounding reinforced concrete wall is a very practical strengthening intervention for proving additional lateral load capacity. The surrounding wall within the openings of the frame can be constructed by using masonry units as well. In this way theoretically the number of the story of the building which is effective on the seismic load will be decreased by one. This is probably the most simple and practical strengthening work, when the building has a basement floor.

Decreasing the number of building story

This can be implemented, provided that their is no legal difficulty. The corresponding decision must be done after careful consideration of the existing situation. It should be remembered that it is an intervention which is very difficult to accept by the owner of the building.

Demolishing heavy balconies and overhangs

Abolishing of heavy balconies, parapets and overhanging floors is a strengthening work which can bee done easily.

Removing irregularities in the structural system

By adding new walls and removing the existing ones, continuity of the walls in elevation can ensured and irregularity can be removed. Especially in the ground floors of buildings which often are used for commercial purposes, the presence of the infill walls does not wanted and usually they are less than those of the upper floors. Additionally, the story height of the ground floor is often large. In order to remove this irregularity, some of the masonry and concrete walls of the basement can be continued or some of the columns can be jacketed in the ground floor.

Application FRP on the infill walls

By applying FRP on the surfaces of infill walls, their lateral capacity can be increased greatly without interrupting the activities in the building. This application is very quick and clean, it can be economical as well depending on the function of the building.

3.2.3 Comprehensive Strengthening

The strengthening of an existing building may be thought as increasing of its earthquake performance or decreasing of its present risk to a acceptable level. By applying the comprehensive strengthening, the structural system is updated to satisfy provisions of the seismic code. In this way all the strengthening provisions can be satisfied for the existing buildings, but it is not possible to satisfy exactly all the details given in the new earthquake code. However, an appropriate design can be done to increase of the earthquake performance of a building to a desired level. The most important subject of the strengthening is to ensure the displacement and force compatibility of the existing system and the newly added elements.

Scope

The comprehensive strengthening is applied to the structures, which do not have satisfactory seismic safety. This is determined after a detailed investigation and the comprehensive strengthening is applied when the simplified strengthening is not suitable.

Determination of the earthquake effect level applied to the structure

Same as the earthquake effects of the third stage assessment.

The strengthening steps to be followed

a) To increase the lateral strength and rigidity of the building:
   - o Adding the shear-walls (walls joining the columns from one side or two sides, external walls),
   - o Adding the steel frames with diagonals (axial or eccentric frames).

b) To increase the ductility of the structural system:
   - o Jacketing of columns (jacketing by steel plates, use of FRP),
   - o Column strengthening (steel or concrete jacketing of columns),
   - o Reduction of local rigidity (for example opening the peripheral of the short columns, removing some of the walls).

c) To decrease the earthquake effects (to decrease the demand):
   - o Base isolation: In this way the period and the effective damping is decreased (this method can be applied generally to the monuments and the prestige buildings),
   - o Placement of the energy damping systems: In this way the earthquake effects are damped and the displacement demand of the structure is decreased.

- Decreasing the number of stories: In this way the mass and loads will be decreased.

Each of the techniques explained above may be used for improving of the seismic safety of structural systems, a few of these techniques can be used together as well.

The analysis procedures to be used

Here the procedures, which base on the force and displacement methods, and are used in the detailed investigation is appropriate. After the mathematical model of the structure is established and analyzed with the newly added elements, the compatibility of the first and the final model obtained as a result of the analysis should be shown. The well known methods may be used in the investigations. Also the adaptation between the existing structure and the newly added elements should be provided.

3.2.4 Education program for the persons controlling the strengthening of buildings

Table 3.22. Education program for the persons controlling the strengthening of buildings

Subject	Duration (hour)	Content
Geotechnical and foundation engineering in structural and earthquake engineering	3	General geotechnical properties of soils, index and mass properties of soil, specific limits of soils, classification of soils, stresses in soil, effective stress concept, soil stresses due to surface stresses, compaction of soils, consolidations and settlement, shear strength of soils, types of foundations, surface foundations, soil with and without cohesion, soil amplification of seismic waves, soil groups, local soil classes, effect of soil conditions on the seismic safety of a building.
Production of concrete, quality control, and strengthening materials	2	Material selection, their quality controlling, expected main properties of concrete, methods for identification of concrete quality of existing building, steel profiles, epoxy, high strength fiber materials.
Reinforced concrete structural elements and systems	2	Classification of structural systems, structural systems of moment resisting frames, of shear walls and frames, structural system ductility, regular and irregular structural systems.
Design of reinforced concrete structural elements	2	Safety of reinforced concrete structural systems, load coefficients, structural behavior of concrete and steel, material coefficients, bond and anchorage between steel and concrete, design according to the strength method, bending, bending with axial force, shearing force, modeling of structural systems.
Principles of earthquake engineering	2	Seismic behavior of buildings, limit states, stiffness, strength and ductility, global seismic behavior of a building, structural irregularities, seismic analysis of structural system, equivalent earthquake load.
Earthquake resistant design	2	Capacity concept in the design of reinforced

of reinforced concrete structures		concrete structures, elements of reinforced concrete structures, slabs, beams, columns, shear walls, footings, detailing of reinforcement.
Assessment procedures for evaluation of seismic safety of reinforced concrete buildings	2	Identification of structural system in a building, three-stage assessment procedures, first, second and third stage assessment procedures, field applications.
Simplified strengthening of reinforced concrete buildings	3+3	Principles of simplified strengthening method, interaction between structural system and infill walls, structural improvement of the infill walls, their participation to the lateral load capacity, applications.
Comprehensive strengthening of reinforced concrete buildings	3+3	Principle of the comprehensive strengthening of reinforced concrete structures, structural system, seismic behavior, strengthening methods, applications.
Seismic behavior and strengthening of masonry buildings	3+3	Application of the simplified strengthening method on masonry buildings, load bearing walls, continuity of walls, participation of the walls in the lateral load capacity, improvement of infill walls, applications.
Production and controlling of repair and strengthening works	3+3	Engineering services for repair and strengthening work, analysis of production cost of repair and strengthening, applications.
Test exam	3	

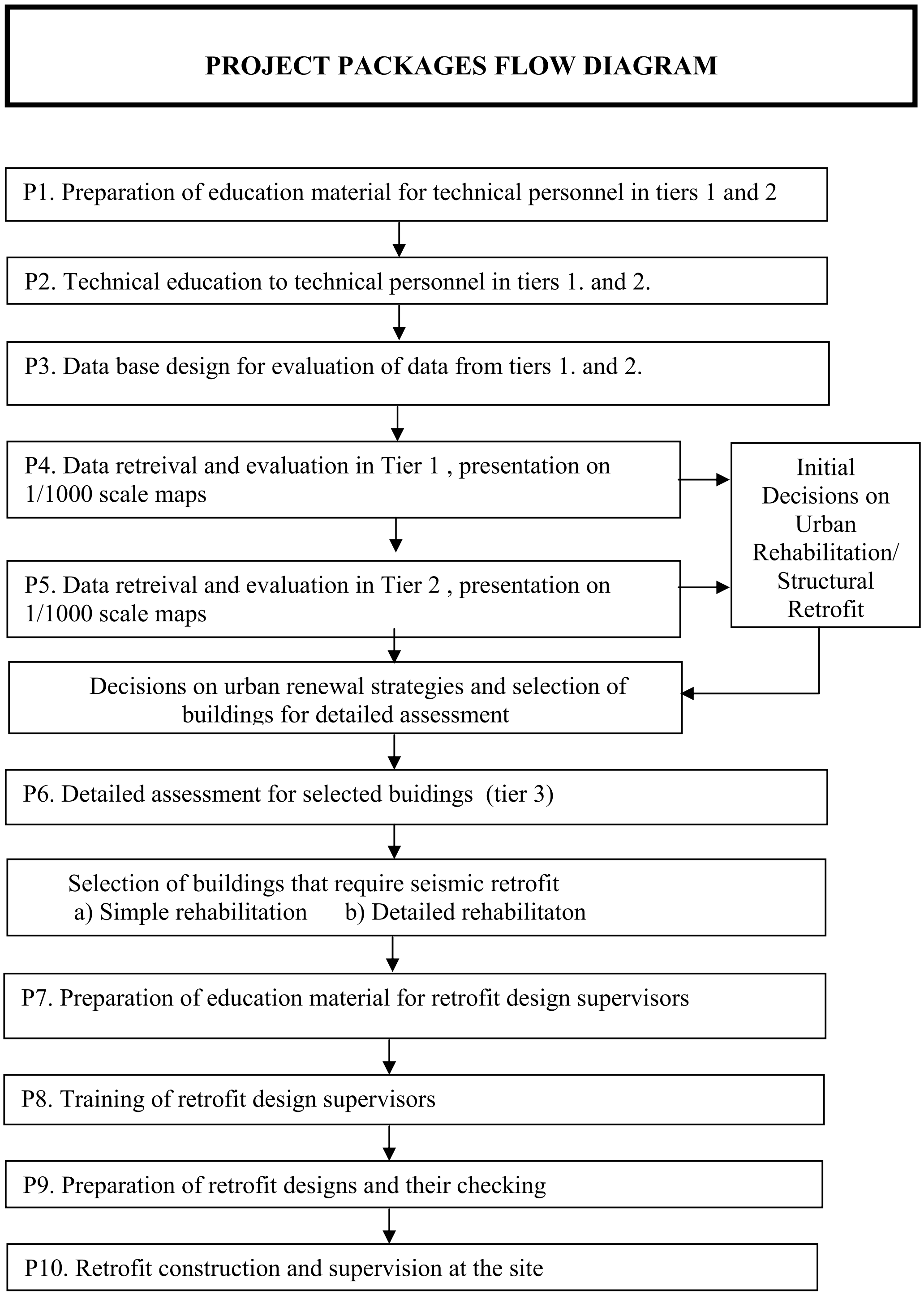
The training program could be organized by chamber of civil engineering and/or universities. Expected participant are civil engineers. Participants who could pass the test will have the certificate of achievement.

3.3 Project Packages For Building Assessment/Retrofit Works

The multi-stage assessment and retrofit procedures proposed in the Masterplan must be iplemented in an integrated fashion. The works in this scope are arranged as project packages, and presented in the form of a flow diagram. The flow diagram is given in Table 3.23.

Each package is a different task with its associated terms of reference. In contracting these tasks, their terms of reference must be defined in detail.

Table 3.23. Flow Diagram - Project Packages for Building Assessment /Retrofit Works



Multi-Stage Assessment
Stage 1.: Walk-down survey
Stage 2.: Investigations in the building, at ground story
Stage 3.: Detailed assessment, evaluation, structural modelling and analysis

3.4 Code, Standart and Principles

3.4.1 Principles of repair and strengthening

Principles of Repair and Strengthening of Reinforced Concrete and Masonry Buildings

The principles given here are valid for RC and masonry buildings with or without having structural damage and having insufficient seismic structural safety.

Before strengthening of buildings a geotechnical investigation of the site should be carried out and a report should be prepared. This report should include the grade and the class of the soil with the allowable soil stress. In the same report the total failure and the liquefaction risk of the foundation soil also should be explained.

Repair and strengthening of RC Buildings

Repair of RC Buildings

The goal of the repair of structural system is to bring it to a safety level which the system has before damages took place, therefore the analysis of the structural system is not required. The process of repairing generally includes to remove the reinforcement corrosion and to fix the cross sectional damage of structural elements. In this way, firstly loose parts at the surroundings of the reinforcement are removed. The reinforcement should be cleaned preferably by blasting with sand without chlorine or with a hard brush. If it is required, reinforcement should be added. This region should be watered slightly, later a latex based mix (cement + polymer + a corrosion stopper additive) is to be applied to the surface with a brush. Then a fixing mortar, having no shrinkage property, is sprayed immediately and all the cavities are filled. Then the surface is flatten and finally an acrylic based surface protector is applied to the surface. All the main provisions required for load transfer given for the strengthening in the following are also valid for the repairing.

Strengthening of RC buildings

a) Decision of the strengthening

After the investigation related to the existing situation of the building is investigated carefully, the strengthening level should be designated. These include:
checking the present state of buildings with its original drawings, preparation of the structural scheme of the building, if it is required, identifying quality of structural material and conducting a geotechnical investigation.

Possible damage should be checked and documented (if it is present) and the seismic analysis of the structural system should be checked. In this way, the edge and corner columns of the building and the number of load carrying frames in two directions are to be investigated by given special care. The medium level damage according to the specifications of the Ministry of Public Works and Settlement Government of Republic of Turkey or an important deficiency in the load transfer may be sufficient for making strengthening decision. Especially, if the quality of concrete is under an unacceptable value or the story number of the building is more than that given in its project of the structural system, the strengthening decision can be made without further investigation.

In checking of the seismic effects and the reinforcements and dimensions of the structural elements according to the Seismic Code (1998), the seismic loads may be reduced depending on the engineer's judgment. Maximum value of this reduction may be taken as %25 provided that these seismic effects are not less than the original project values. However, if there are some uncertainties in the carrying or transferring of the loads in the existing system, the capacity values of the system may be reduced by a coefficient of 0,85.

In the cross sectional checks the redistribution of the moments in the supports and spans of the beams and the interaction of the columns may be taken into account depending on the configuration and ductility level of the structural system. In these analyses the equilibrium condition should be ensured. In this check the structural behavior factor R may be selected between the values given for the systems with high and normal ductility levels. The selection the value given for the high level ductility means all the conditions specified in the seismic code are satisfied, which is not the case for the existing buildings. An evaluation report related to the strengthening principles used is written for each building.

The decision for taking down the building can be taken in the following cases: a) If the cost of the strengthening is larger than %40 of the cost of new building, b) If the economical life of the building is completed, c) If the structural system have a heavy damage level according to the measure of the Ministry of Public Works and Settlement Government of Republic of Turkey, except the historical or prestige buildings

b) Detail of Strengthening and Minimum Provisions

The strengthening of a building may be realized by adding new structural walls, jacketing of columns, strengthening of beams and foundations. In the residential buildings which have three or less stories excluding the basement floor jacketing of the column can be accepted as a sufficient strengthening provided that the structural system sufficient seismic safety. In the buildings which have four or more stories it is generally appropriate to add structural walls. The cross sectional area of the structural walls should be determined through the analysis. In this analysis the new structural walls should resist at least 70% of the total overturning moment obtained by using the Seismic Code in each direction. The newly added structural walls should have the high ductility level. The structural behavior factor is to be selected between the values given for the systems with the high and the normal ductility levels in the strengthened buildings (this value may be selected between 5 and 6). In this selection; the regularity of the structural system, the position of the added structural walls, the concrete quality, the situation of the stirrups in the columns and beams of the building should be taken into account.

It is sufficient for the existing columns to carry the vertical loads safely only. The axial load capacity may be taken as given in TS500 ($N_{rmax}= 0.6\ f_{ck}\ A_c$). The columns having insufficient cross sectional area should be strengthened by jacketing with reinforced concrete or steel material in the required stories. Similarly, the columns which have locally heavy damage also should be jacketed. The symmetry should be maintained in the jacketing process. The thickness of jacketing should not be less than 120mm and the reinforcement is placed minimum 1% of the jacketing area. For ensuring the workability of concrete the lateral reinforcement should be placed only perimeter of the cross section, when the thickness of jacketing less than 150mm. In the case of the thickness of jacketing is greater than 150mm, the reinforcement is required at the two sides of the section. The reinforcement required for the load transfer, especially the corner bars, should be continued between the stories and the jacketing should be built from the required story down to the foundation and the anchorage of the jacketing reinforcement should be done to the foundation.

In the checks of cross sections, the design compressive strength of concrete may be obtained by using a material safety factor less than that given in the code.

The new structural walls should be placed in the existing frames joining the existing columns at least one of them. If the concrete strength is sufficient the load transfer between column and the structural wall can be satisfied by providing anchorage reinforcements. The column reinforcement may be included to the boundary reinforcement of the wall. If it is not the case, a jacketing should be provided for columns.

The required reinforcement continuity should be provided by an appropriate arrangement. The continuity of the web reinforcement should be satisfied by the steel anchorages to columns and the beams. This reinforcement can be taken as Φ16/300mm and should passes through in the beams and columns or their anchorages should be ensured. The minimum reinforcement in the web of the structural walls can be taken as Φ10/200mm in two sides and in the two directions. In the wall boundary zones minimum transverse reinforcement is recommend as Φ10/100mm along the critical wall height, otherwise Φ10/200mm.

In the strengthened buildings, the existing column and beam cross sections, the columns and beams should be strengthened, except in the following conditions are not satisfied:

$A_{s,req} < (1.20\sim1.33)\ A_{s,present}$ (column reinforcement is known)

$A_{s,req} < (0.0012\sim0.015)\ A_{s,present}$ (column reinforcement is not known)

$A_{s,req} < (1.00\sim1.25)\ A_{s,present}$ (beam reinforcement is known)

$A_{s,req} < (0.0015\sim0.020)\ A_{s,present}$ (beam reinforcement is not known)

where A_c is the gross cross sectional area, A_s is the total longitudinal reinforcement of the cross section or the sum of the span and support reinforcements of the beam. The difference of the elasticity modules of the existing and the newly added elements should be taken into account in the analysis.

In the residential buildings with six or less stories the cross sectional area and the placement of the structural walls may be approximately proportioned, if the structural drawings are present, the lateral load carrying system is regular, the concrete quality is good and the reinforcement arrangement is satisfactorily. In this case two structural walls in each direction should be placed in plan symmetrically without constituting any torsion effect and these walls should be placed along the height of the building. In the structural analysis the mean value of the story may be taken as 12 kN/m^2 and the approximate period relations given in specifications may be used. The existing structure is assumed to have the normal ductility level. Also any check of the structural system members should not be required except for the damaged and critic elements. The newly added walls may be placed instead of existing infill walls or may be contiguous one or two sided to the existing infill walls.

c) Transfer of Forces

The continuity of the reinforcements of structural wall boundary zones and the that of main reinforcements of the jacketed columns between the stories should be absolutely satisfied. The load transfer between present and newly added elements should be also maintained. For this purpose the following methods may be used:

- Using of special material to ensure integration between the existing and the new concrete,
- Joining the reinforcements of the existing and the newly added elements by means lap splices, welding and another methods,
- To cut thread in existing concrete or to ensure rough surfaces in transfer of shear forces between existing and new elements, to place of the anchorage reinforcements.

The development length of the bars to the frame elements should be minimum 15Φ and the hole diameter for the bar will be 4mm greater than bar diameter. The anchorage bars between the frame and the wall should have a minimum length of 35Φ within the structural walls and the spacing of these bars should be between 250 and 400mm. The anchorage bars in columns may be a slope approximately of 10^0 to prevent overflow of the epoxy. Before the driving of bolts, the holes should be cleaned by cylindrical wire brush and dusts and loose pieces should be removed by vacuum.

In the case of the jacketing of columns, roughing of the surfaces an addition of bonding bars to transfer the shear forces may not be used. In concreting the structural walls or jacketing sections, the top of these elements should be placed special mortar with no-shrinkage at the distance of 50~100mm lower edge of the beams.

If the existing foundations are insufficient, they should be enlarged and the load transfer between the old and new parts should be ensured by using the anchorage bars with sufficient diameter and spacing. The reliable transfer of the forces of newly added structural walls to the soil should be proven. Also the transfer of forces between structural wall and the foundation will be ensured by the anchorage reinforcement. Anchorage length in the existing foundation should be 20Φ and these bars should be lengthen into the structural wall with a minimum length of 60Φ.

The Analogous Strengthening for the Masonry Buildings

In the residential buildings when the number of stories equal to four or less, the strengthening may be realized by adding the reinforcement and concrete layers to the existing masonry walls. The decision of strengthening method will depend on cost comparison. All the structural safety checks should be made according to the specifications of masonry buildings.

Repair and strengthening of masonry buildings

Repair of masonry buildings

The goal of repairing of the load carrying walls is to provide a safety level to the system which has before the damage situation. Therefore, the analysis of the structural system is not required. The walls which damages are less than the given in the following paragraphs will be repaired and the walls with heavy damages should be renovated.

Strengthening of the masonry buildings

a) Decision of the strengthening

The existing layout and quality of the load carrying walls should be determined. If there is, a damage level, level of width of cracks in the load carrying walls and the tilting of walls from vertical plane exists, the situation should be documented. If the wall arrangement is satisfactory, the seismic loads given in the Seismic Code may be reduced maximum 25%. The value of this reduction depends on the wall material, the mortar quality and the arrangement of the load carrying walls. On the contrary, if there are some uncertainties in the load carrying system of the existing building system, the capacity values of the system may be reduced by a coefficient of 0.85.

The cracks in the main walls, of width between 2 to 25mm indicate to medium damage level and the building should be strengthened. If the crack width is greater than 25mm or the permanent story drift ratio (the separation of wall plane from vertical one) is greater than 1/100, the wall is heavy damaged and should be renovated.

b) The strengthening methods

In this analysis the existing shear stress in walls to compare with the allowable material values. The building will be strengthened to resist the seismic force given in Seismic Code. The strengthening can be done by adding of an amount of wall areas to the existing walls in each direction to resist the seismic forces and to ensure interaction between the existing and the new walls. These walls may be reinforced concrete or brick. In the case of the seismic forces which is resist by RC walls with mat reinforcements, the structural behavior factor may be increased 50%.

In the buildings strengthened by addition of RC elements, the story drift limits and the other constructive limitations may not be taken into account.

The strengthening of masonry buildings may be summarized by the following ways: a) Story reduction, b) Renovation of walls, c) Increasing the wall thickness and decreasing the wall openings, d) Shotcreting of walls from one or two sides after adding a web steel. (the thickness of concrete cover may be taken from 50 to 70mm). The anchorage of reinforcement should be ensured to the foundation and to the lintel beams. e) Adding RC walls to one or two sides of the existing walls.

The limit values of the shear stresses may be assumed as given in the following, if there are not more reliable values:
for the sun-dried brick and concrete block walls… $\tau_u = 50$ kN/m^2
for the stone and brick walls …………………… $\tau_u = 200$ kN/m^2
for the concrete basement walls ………………… $\tau_u = 750$ kN/m^2
and the ratio of elasticity modules is assumed to be $E_{concrete\ wall} / E_{brick\ or\ stone\ wall} = 5$.

A group of the members of IBB Master Plan Committee is preparing a new chapter called " Evaluation and Strengthening of Existing Buildings" to as an appendix into the Specification for Structures to be Built in Disaster Areas-1998 for the Ministry of Public Works and Settlement Government of Republic of Turkey.

3.5 Determination of the Legal Difficulties to be Arisen During Evaluation and Strengthening Works.

3.5.1 Determination of the legal difficulties to be arisen during evaluation work

For the public benefit, legal infrastructure must be built up as soon as possible without wasting any time for the practice of the evaluation. Entering inside of the buildings, essential parameters, which are necessaries, must be collected on second and third evaluations stages.

According to the decisions to be made by the apartment's owners having nominal majority or holding major shares of the land, one or both of them of the evaluation stages could be applied. In the apartment ownership Law number 634, article 35 mentions that building's administrator is authorized for the maintenances and repairs in the buildings. But for the expensive works other than the works, which are imperatives and urgent to prevent any future damage and loss in case of delay (like roof repairs.), the common decisions of the apartments owners are obligatory. Article 42 mentions that any owner of any apartment can not make any change in the common places of the building by his own decision alone, any innovation and supplement aiming to arrange the common places of the building to make them much more comfortable, simples and useful can be done according to the common decisions of the apartments owners having nominal majority or holding major shares of the land, expenses of the mentioned works to be paid by the apartments' owners which are using these changes and payment to be proportional to their utilization percentages, article 43 mentions that the owners which are not utilizing these changes have no obligation to share any expenses which are very expensive and luxes and such expenses to paid by the owners who decided it to be done, article 21 mentions that the insurance of the main building can be decided in general assembly of the apartments' owners, article 20 mentions that apartments owners have to share insurance premium of the main building, expenses for the maintenances and repairs of the common places proportional to their land shares. An article must be adjudged and to be added to the apartment ownership law, which would state that, apartments' owners, must share strengthening works expenses, being proportional to their land shares, in case of lack of the earthquake safety become definite for the building.

3.5.2 Determination of the legal difficulties to be arisen during strengthening work

For the social benefit, below mentioned points to be considered while actual reconstruction plans and regulations are re-examined, ameliorated and prepared for practicing about the buildings which was decided to be reinforced or to be demolished according to city development plans.

- Demolishing and safe rebuilt of the buildings, which are at the end of their economic life, and which is designated, as not safe in case of earthquake must be encouraged. For this purpose:
  - A larger building area possibilities
  - Additional building stages possibilities,
  - Suitable borrowing possibilities and such like ways can be followed.

Unification desires for a same purpose of the land owners forming the parts of a parcel of land, to build up much more profitable and higher buildings must be encouraged.

- For the repair and strengthening of the building having console, extension in the base and approach by periphery must be authorized.
- Ground floors which are left as unoccupied and empty must be authorized to be enclosed with purpose of economical source for strengthening works of the building.
- In case of availability to be another economical source of strengthening works construction of additional stages must be authorized.
- In case of proved danger in the buildings, which are unsafe by earthquake, demolishing of the enough stages by expropriation or by purchase of the other apartment owner must be authorized.
- For the buildings, which are, nor enough safe in case of earthquake, "Building apt to collapse" application can be applied.
- In the article 39 of the construction and city development law number 3194 there are some points related to the dangerous buildings apt to collapse. According to this article, the owners to be notified about the situation of their buildings for the partly of entirely dangerous buildings apt to collapse determinated by the governor of the province or by the municipality, in case of absence of the owners residents of these buildings to be notified about the situation, if there is no possibility to reach the residents of the building either, official notifying minute to be hung on the building as accepted as to be notified to the owners of the building and this situation to be stated by a minute written together with the muhtar (the elected head of a village or of o neighborhood within a town or city.); after the notification if the danger wouldn't be lifted up by repair or by destruction made up by the owner(s) such works to be effected by the municipality or by the governor of the city and the expenses to be collected from the owner(s) of the building with %20 additional charges; in case of poverty of the owner(s) the expenses to be recovered from the budget of the municipality and governorship; if the situation of the danger necessitate evacuation of the building and its environment the evacuation to be effected without any judicial decree. In construction and city development law it is remarkable that there is not any sentence about the existing buildings. It is a big deficiency for our country situated on earthquake strap that we have not any sentence in our law mentioning preventive measures to be taken for the existing buildings after the earth-quakes of Erzincan 1992, Dinar 1995, Adana-Ceyhan 1998 and finally Marmara 1999. But at least we can use this article of law for the amelioration and/or destruction of the unsafe buildings against earthquakes.

- The minority votes mustn't be block of the majority votes desire the strengthening of the administration assembly of the building.
- In the written decree essential 2001/776 and numbered as 2001/935 of the 18th Department of Justice of the Supreme Court related to a trial pursued at the 6th Civil Justice Court of Kadiköy, it is mentioned that; " For the measures to be taken about the safety and soundness of the building, if there is not any possibility to come to an agreement between the apartment owners, the court investigating the building in its place must determine the resistance and soundness of the building by competent consultative authorities and if the building would be found unsound, a report mentioning the measures to be taken to make the building resistant and sound and mentioning the works to be done for this purpose must be written. Instead to decide according to these results received by the court, to decide to refuse the trial mentioning that the problem should be solved between the members of the owners assembly of the building who can not find a solution to this disagreement is not found fair and true by us".

Relating to the problems mentioned in the items numbered 3.5.1 and 3.5.2, under the Istanbul Main Municipality Master Plan, working together with "Planning Teams Group", suggestions of amendments for the Construction and City Development Law and Apartment Ownership law are prepared and presented under the relevant chapter of the Master Plan.

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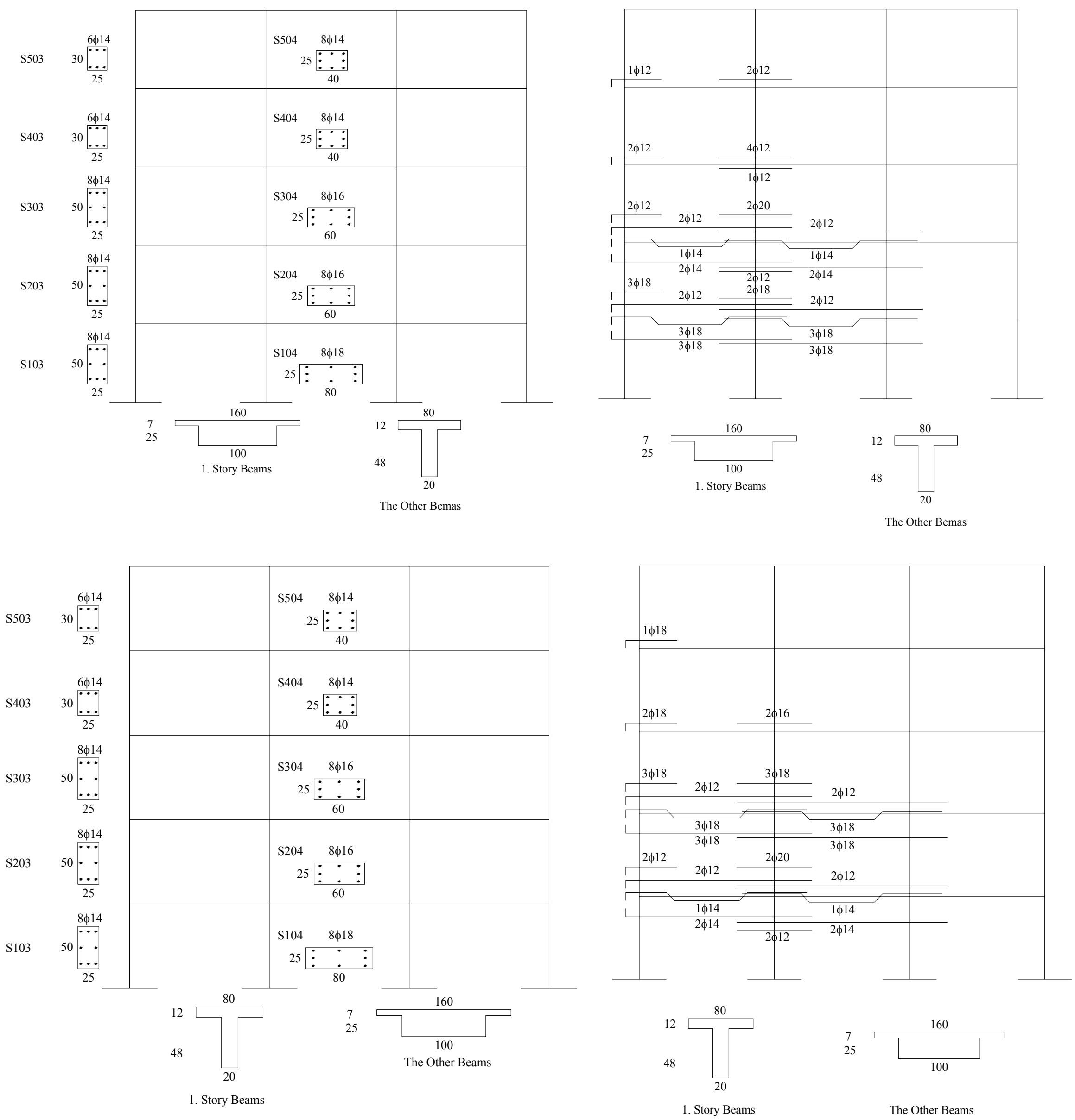
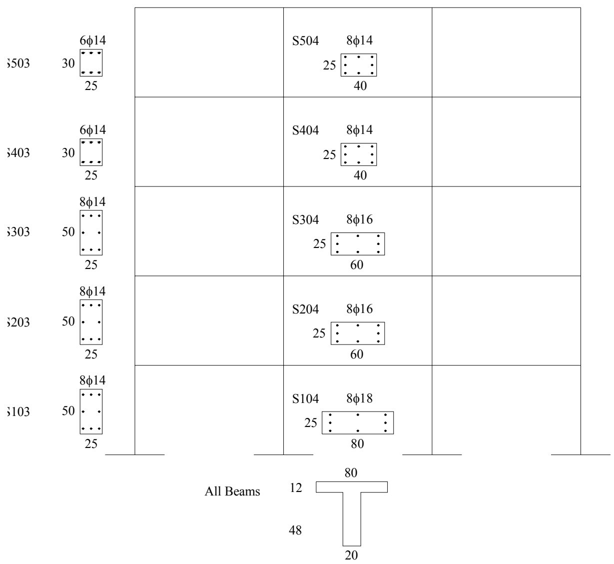
3.6 Appendix A

Some of the details of representative frames

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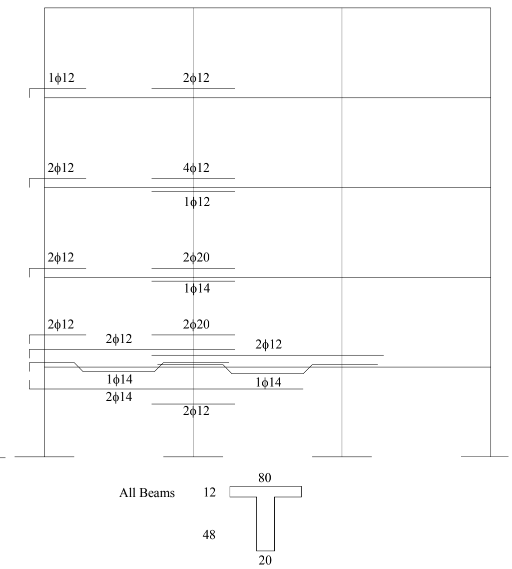
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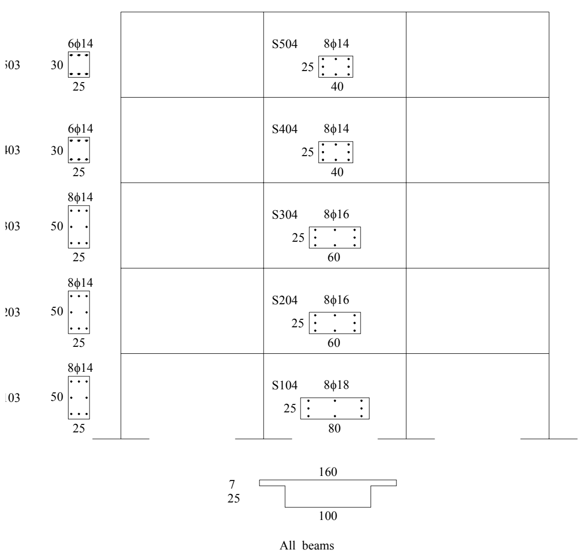
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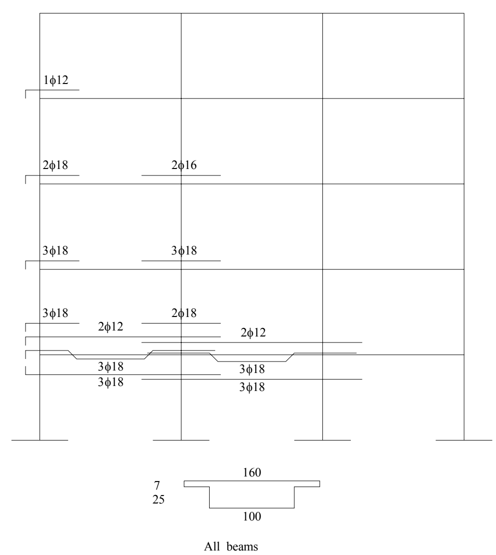
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All beams

3.7 Appendix B

IMPLEMENTATION OF SINGLE-MODE PUSHOVER ANALYSIS BY IRSA PROCEDURE

The displacement increment at the first floor, ($u_1^{(i)}$, at the (i)'th pushover step can be expressed as

$$\Delta u_1^{(i)} = \phi_1 \, \Gamma \, \Delta d^{\,(i)} \qquad \text{(B1)}$$

where ($d^{(i)}$ represents the modal displacement increment, ($_1$ is the first mode shape amplitude at the first floor and (denotes the participation factor of the first mode, which is expressed as

$$\Gamma = \mathrm{L} / \Sigma(m_k \, \phi_k^2) \qquad ; \qquad \mathrm{L} = \Sigma(m_k \, \phi_k) \qquad \text{(B2a)}$$

where m_k represents the k'th story mass. For the special case of equal story masses and heights, it can be expressed for an n story building as

$$\Gamma = 3 / (2n + 1) \qquad \text{(B2b)}$$

The first floor displacement increment at the (i)'th pushover step can be approximately calculated by the *Muto Method* as follows:

$$\Delta u_1^{(i)} = \Delta V^{(i)} / \Sigma D^{(i)} \qquad \text{(B3)}$$

where ($V^{(i)}$ represents the base shear at the (i)'th pushover step and ($D^{(i)}$ is the sum of $D^{(i)}$ coefficients by Muto Method for the first story columns at the same pushover step (See Appendix C).

From Eq. (B1) and Eq. (B3), the following expression can be written for the modal displacement:

$$\Delta d^{\,(i)} = (\Delta V^{(i)} / \Sigma D^{(i)}) / (\phi_1 \, \Gamma) \qquad \text{(B4)}$$

On the other hand, equivalent seismic load increment, ($f_k^{(i)}$, of k'th floor at (i)'th pushover step and their sum, the base shear increment, ($V^{(i)}$, can be expressed as

$$\Delta f_k^{(i)} = m_k \, \phi_k \, \Gamma \, \Delta a^{(i)} \qquad \text{(B5)}$$

$$\Delta V^{(i)} = \Sigma \, \Delta f_k^{(i)} = M_{eff} \, \Delta a^{(i)} \qquad \text{(B6)}$$

where ($a^{(i)}$ represents the *modal pseudo-acceleration* and M_{eff} is the effective participating mass in the first mode.

$$M_{eff} = \Gamma \mathrm{L} \qquad \text{(B7a)}$$

For the special case of equal story masses and heights, it can be written for an n story building as

$$M_{eff} = (3/2) \, M_t \, (n + 1) / (2n + 1) \qquad \text{(B7b)}$$

in which M_t represents the total building mass. From Eq. B6 and Eq. A7, modal pseudo-acceleration can be expressed as

$$\Delta a^{(i)} = \Delta V^{(i)} / (\Gamma \mathrm{L}) \qquad \text{(B8)}$$

By definition, the ratio of the modal pseudo-acceleration increment and the modal displacement increment, in other words the instantaneous slope of the capacity diagram is equal to natural frequency squared of the system with all previous plastic hinges considered [2,3]. Thus, from Eq. B4 and Eq. B5,

$$(\omega^{(i)})^2 = \Delta a^{(i)} / \Delta d^{\,(i)} = (\phi_1 / \mathrm{L}) \, \Sigma D^{(i)} \qquad \text{(B9a)}$$

For the special case of equal story masses and heights, it can be written for an n story building as

$$(\omega^{(i)})^2 = [2 / (n + 1)] \, (\Sigma D^{(i)} / M_t) \qquad \text{(B9b)}$$

In order to calculate the modal displacement increments during the formation of plastic hinges in the system, Eq. B1 can be written in the following form:

$$\Delta u_1^{(i)} = \underline{u}_1^{(i)} \, \Delta d^{\,(i)} \qquad \text{(B10a)}$$

$$\underline{u}_1^{(i)} = \phi_1 \, \Gamma \qquad \text{(B10b)}$$

For the special case of equal story masses and heights, $\underline{u}_1^{(i)}$ can be expressed for an n story building as

$$\underline{u}_1^{(i)} = 3 / (2n + 1) \qquad \text{(B10c)}$$

Column shears and bending moments as well as rotations of the previously developed plastic hinges can be calculated by the Muto Method (See Appendix C). At the end of the (i)'th pushover step, any response quantity, $\underline{r}^{\,(i)}$, can be written as

$$r^{(i)} = r^{(i-1)} + \underline{r}^{(i)} \, \Delta d^{\,(i)} \qquad \text{(B11)}$$

When this expression is specialized for the bending moments of the potential plastic hinges and then equated to plastic moments, then ($d^{(i)}$ can be calculated [2,3]. Note that column axial forces have to be considered in this calculation.

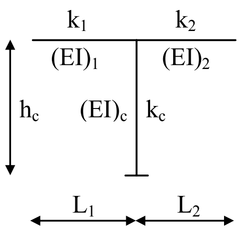
At the end of the (i)'th pushover step, modal displacement and modal pseudo-acceleration increments, i.e., the coordinates of the modal capacity diagram is obtained as

$$d^{\,(i)} = d^{\,(i-1)} + \Delta d^{\,(i)} \qquad \text{(B12a)}$$

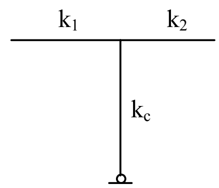
$$a^{(i)} = a^{(i-1)} + \Delta a^{(i)} = a^{(i-1)} + (\omega^{(i)})^2 \, \Delta d^{\,(i)} \qquad \text{(B12b)}$$

3.8 Appendix C

IMPLEMENTATION OF MUTO METHOD



$k_1 = (EI)_1 / L_1$
$k_2 = (EI)_2 / L_2$
$k_c = (EI)_c / h_c$



$k_b = (k_1 + k_2) / k_c$

$a = (0.5 + k_b) / (2 + k_b)$

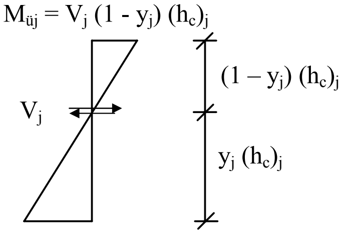
$a = 0.5\, k_b / (1 + 2\, k_b)$

$$D_j = a_j\, [12\, (EI)_c / h_c^3]_j$$

$$V_j = (D_j / \Sigma D)\, V_b$$

<u>Plastic hinge rotations:</u>
Hinge at bottom only: $\Delta\theta_p = -\,(1 + 2a)\, \Delta u_1 / h_c$
Hinges at both bottom and top: $\Delta\theta_p = -\,\Delta u_1 / h_c$

$M_{üj} = V_j\, (1 - y_j)\, (h_c)_j$



$M_{aj} = V_j\, y_j\, (h_c)_j$

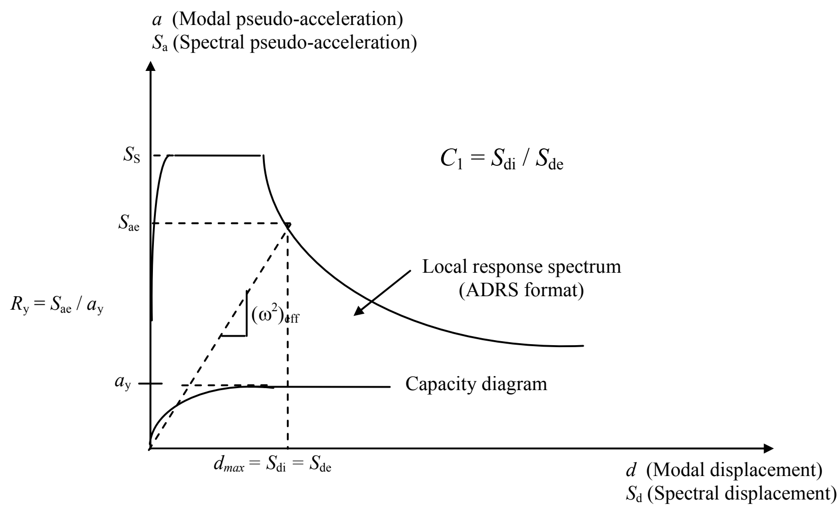
(y) coefficients for the first story columns

n	k_b											
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	2.0	≥3.0
1	0.80	0.75	0.70	0.65	0.65	0.60	0.60	0.60	0.60	0.55	0.55	0.55
2	1.00	0.85	0.75	0.70	0.70	0.65	0.65	0.65	0.60	0.60	0.55	0.55
3	1.15	0.90	0.80	0.75	0.75	0.70	0.70	0.65	0.65	0.65	0.60	0.55
4	1.20	0.95	0.85	0.80	0.75	0.70	0.70	0.70	0.65	0.65	0.55	0.55
5	1.30	1.00	0.85	0.80	0.75	0.70	0.70	0.65	0.65	0.65	0.60	0.55
6	1.30	1.00	0.85	0.80	0.75	0.70	0.70	0.65	0.65	0.65	0.60	0.55

3.9 Appendix D

For the special case of $C_1 = 1$ (equal displacement rule) and $C_2 = 1$:

Estimation of modal displacement demand according to FEMA 356



3.10 Appendix E

EXAMPLES OF SINGLE-MODE PUSHOVER ANALYSIS

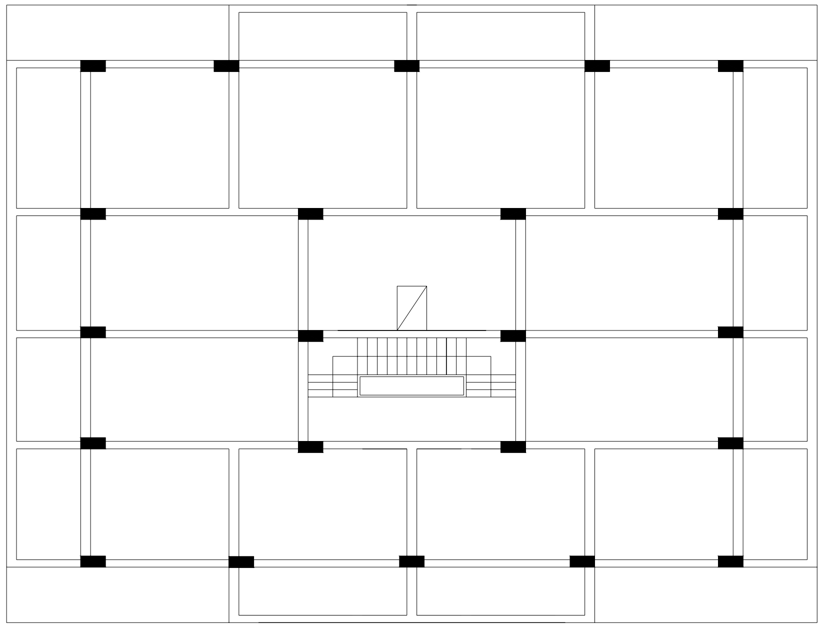


Figure E1. First floor formwork plan of the sample building
(strong column-weak beam arrangement is purposely made in x-x direction)

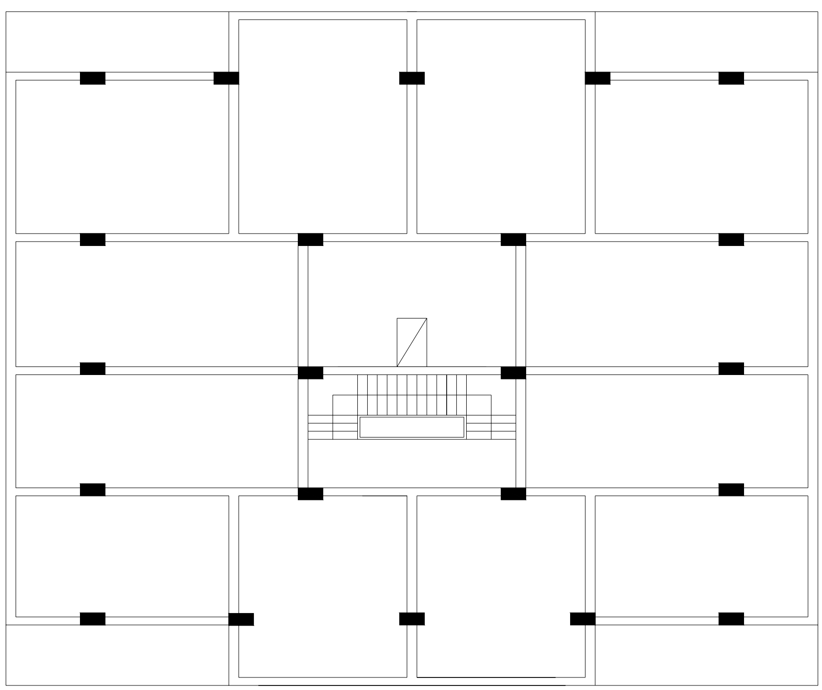


Figure E2. Above ground regular formwork plan of the sample building

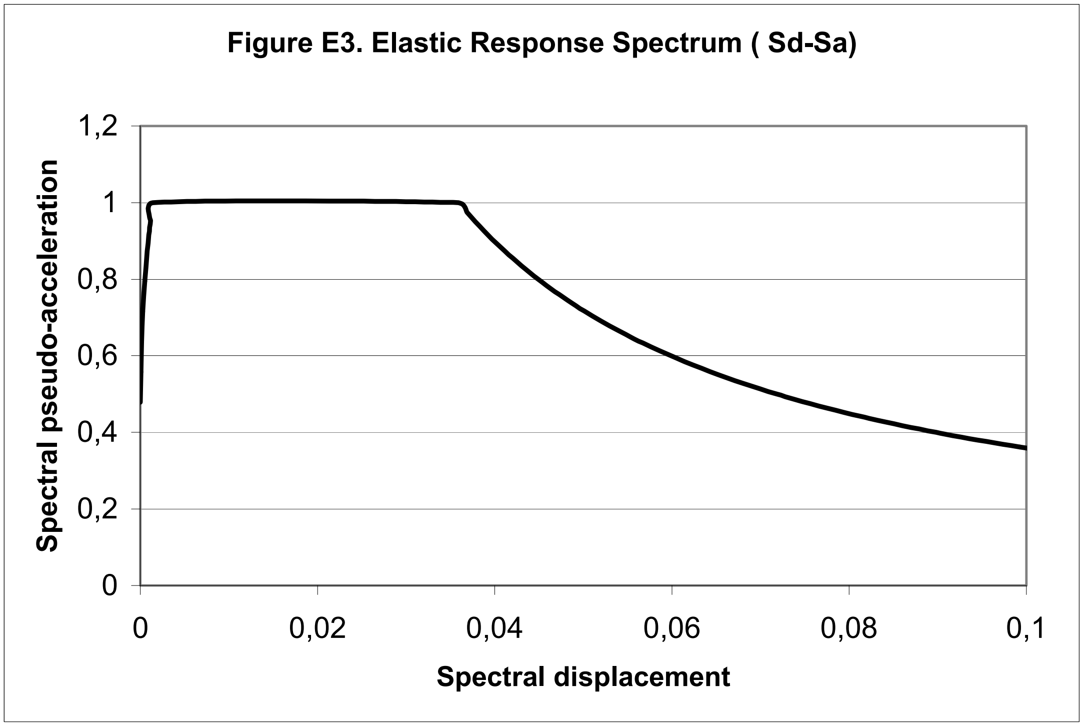


Figure E3. Elastic Response Spectrum (Sd-Sa)
Spectral pseudo-acceleration
1,2
1
0,8
0,6
0,4
0,2
0
0
0,02
0,04
0,06
0,08
0,1
Spectral displacement

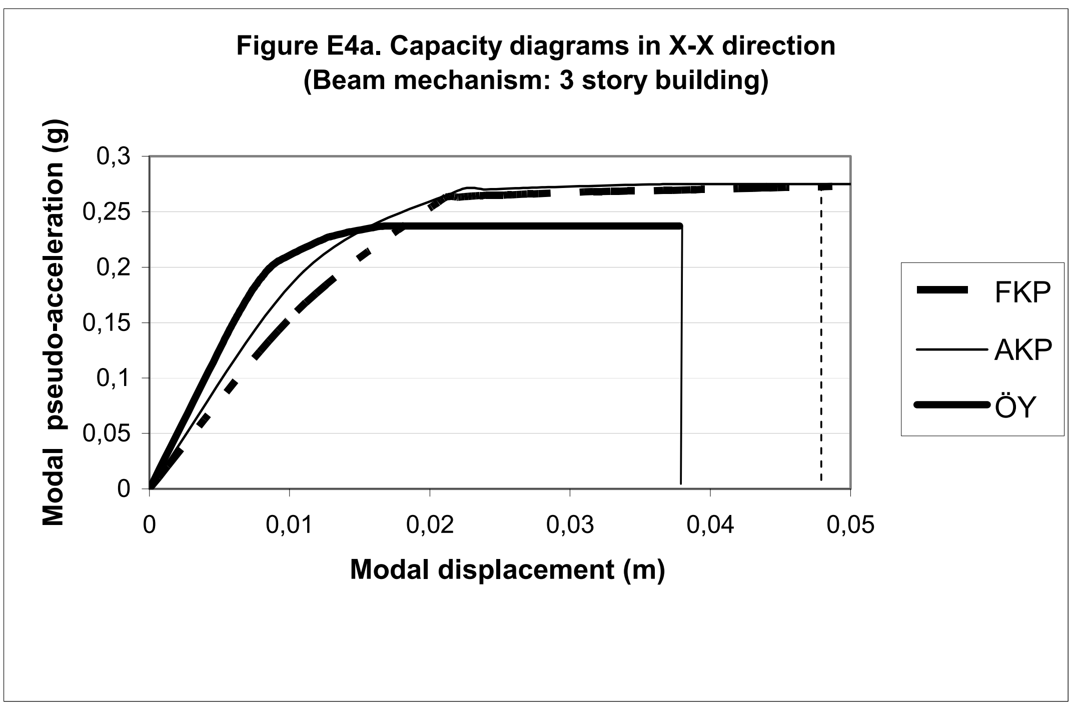


Figure E4a. Capacity diagrams in X-X direction
(Beam mechanism: 3 story building)
Modal pseudo-acceleration (g)
0,3
0,25
0,2
0,15
0,1
0,05
0
0
0,01
0,02
0,03
0,04
0,05
Modal displacement (m)
FKP
AKP
ÖY

Figure E4b. Capacity diagrams in X-X direction (Beam mechanism: 4 story building)

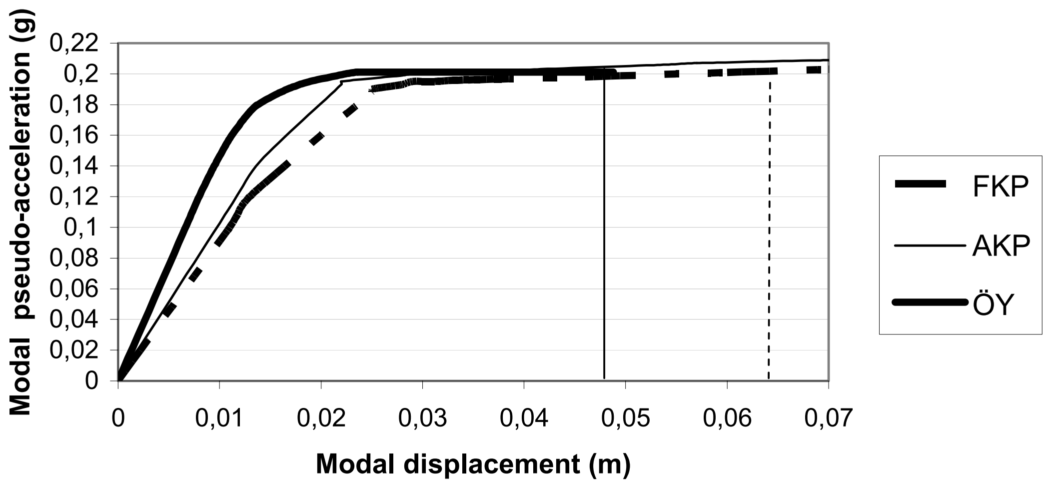


Figure E4c. Capacity diagrams in X-X direction (Beam mechanism: 5 story building)

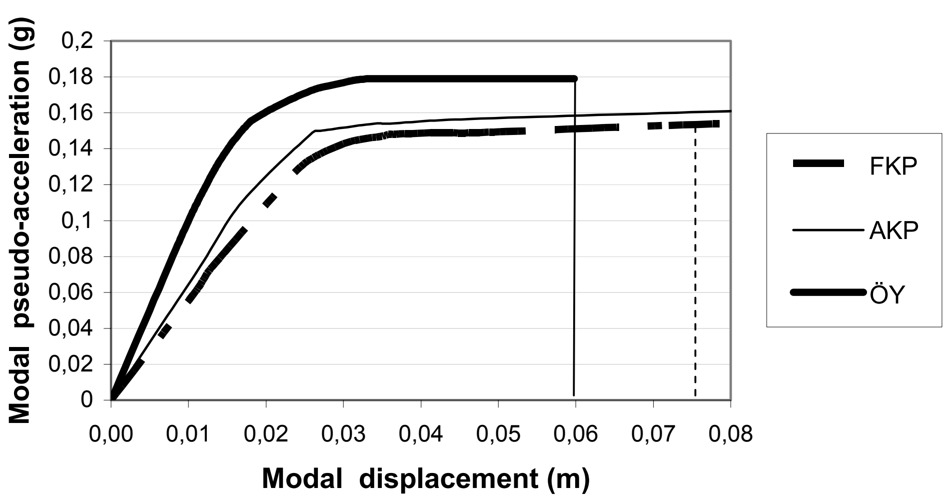


Figure E4d. Capacity diagrams in X-X direction
(Beam mechanism: 6 storey building)

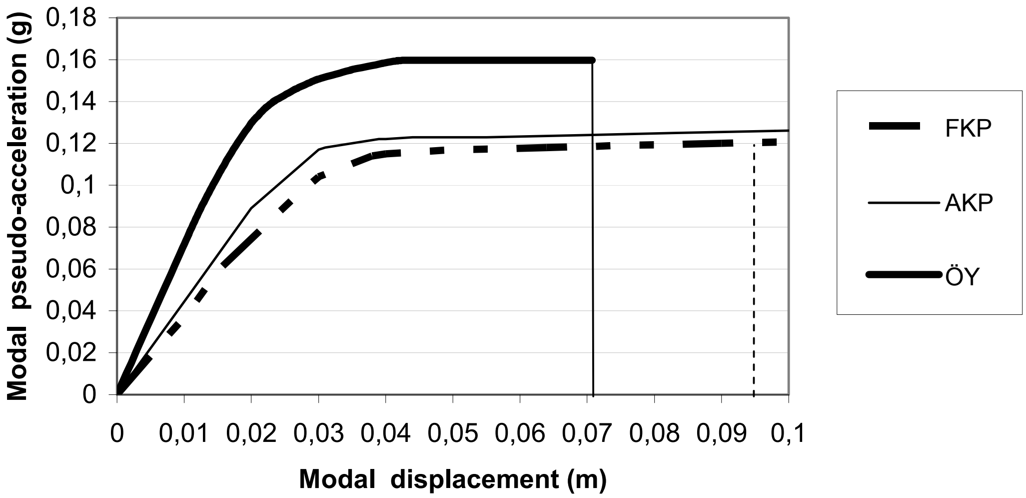


Figure E5a. Capacity diagrams in Y-Y direciton
(Column mechanism: 3 storey building)

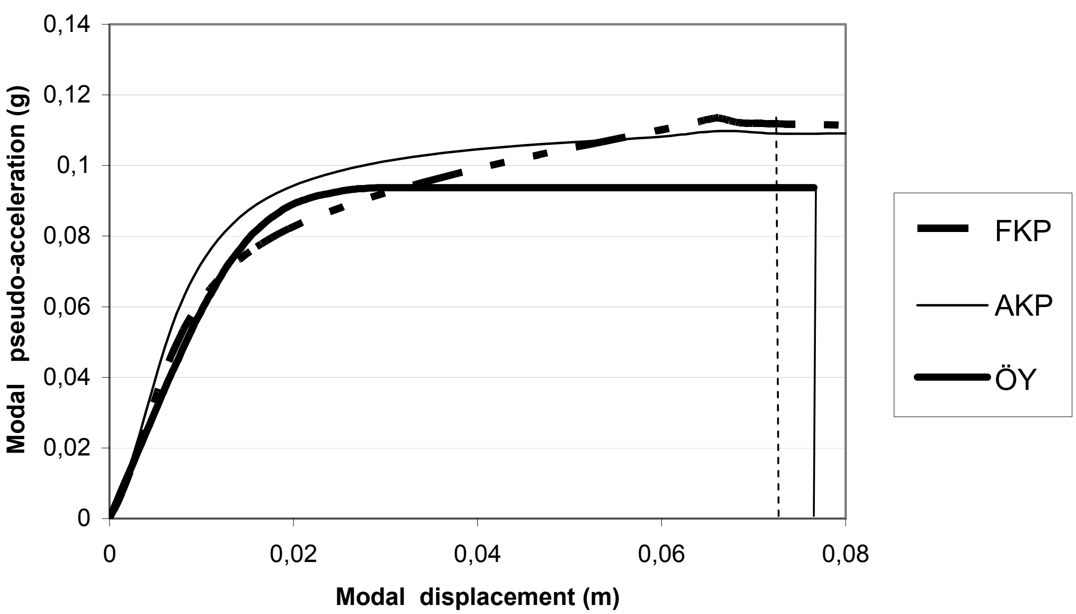


Figure E5b. Capacity diagrams in Y-Y direction (Coloumn mechanism: 4 storey building)

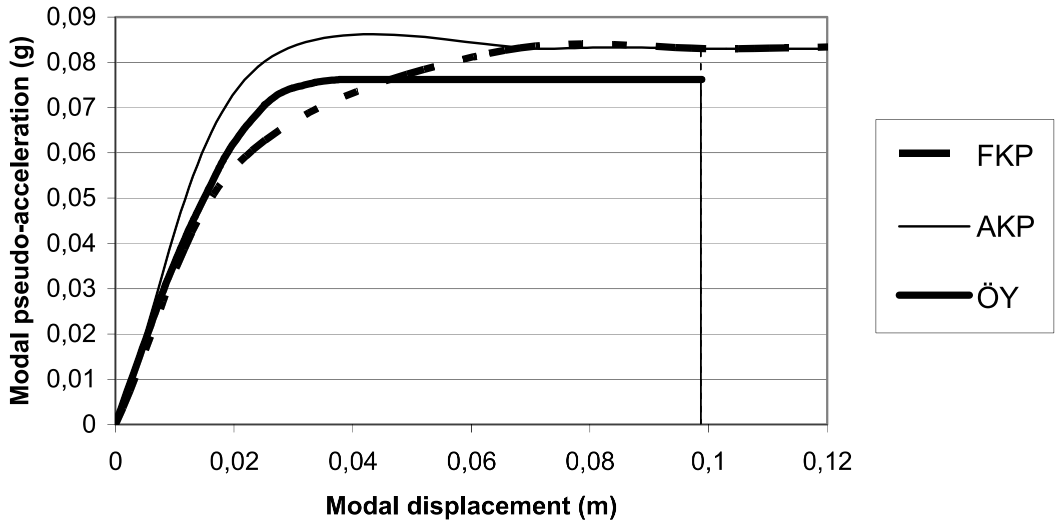
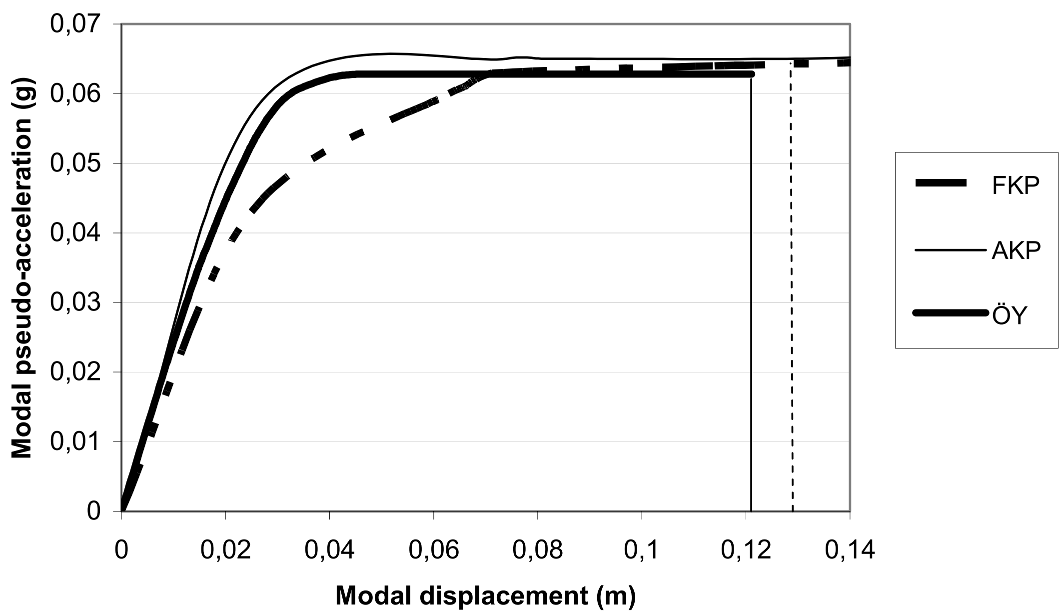


Figure E5c. Capacity diagrams in Y-Y direciton (Column mechanism: 5 storey building)



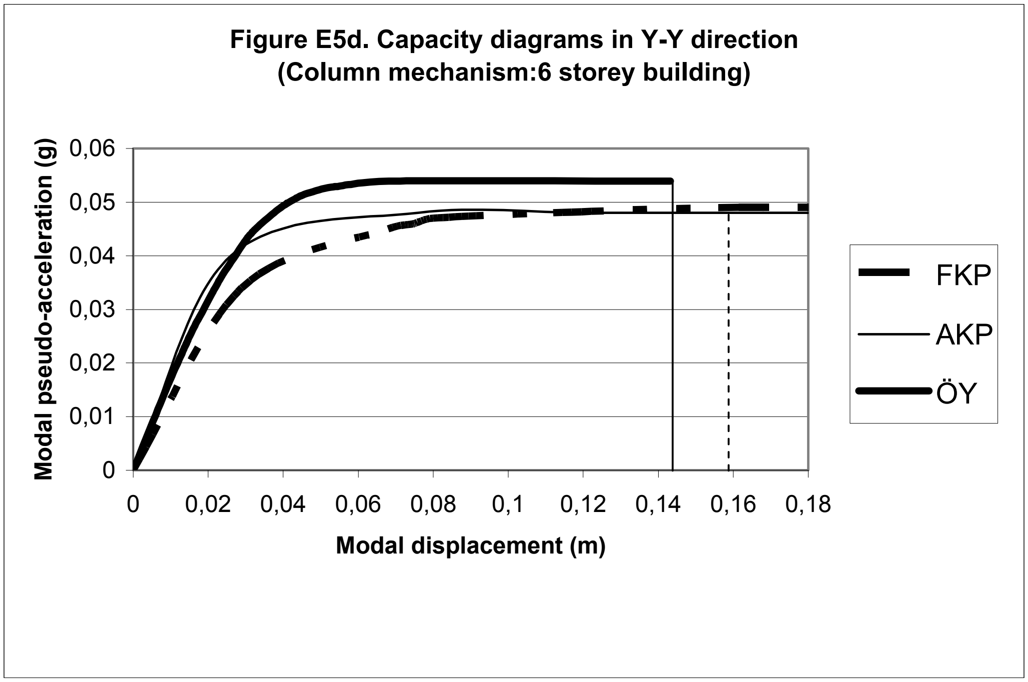


Figure E5d. Capacity diagrams in Y-Y direction
(Column mechanism:6 storey building)
Modal pseudo-acceleration (g)
0,06
0,05
0,04
0,03
0,02
0,01
0
0
0,02
0,04
0,06
0,08
0,1
0,12
0,14
0,16
0,18
Modal displacement (m)
FKP
AKP
ÖY

4 URBAN PLANNING, LEGAL ISSUES, ADMINISTRATION, FINANCE

4.1 Urban Planning-

Prof Dr. Ayşenur Ökten, Prof. Dr.Fazıl Sağlam, Doç.Dr. Betül Şengezer, Doç.Dr. İclal Dinçer, Doç. Dr. Gül Batuk, Doç.Dr. Hülya Demir, Öğr. Gör. Dr. Ercan Koç, Öğr. Gör. Dr. Ayfer Gül, Dr.Yiğit Evren, Arş.Gör. Ebru Seçkin, Arş. Gör. Tuba İnal Çekiç, Arş Gör. Ozan Emem.

Advisor:Prof Dr. Rıfkı Arslan

Executor:Betül Şengezer

STRATEGIC PLAN FOR DISASTER MITIGATION IN ISTANBUL (SPDMI)*
A Summary of the Planning and Legal Issues Raised by the Working Groups for Urban Planning (BU-YTU)

* The connotation SPDMI in this section is used to designate the contribution of the Working Groups for Urban Planning and Law (BU-YTU).

4.1.1 Introduction

The primary goal of SPDMI is to diminish the hazardous effects of a possible earthquake in Istanbul, which is supported by a secondary goal of improving the quality of the natural and urban environment. For this purpose, the BU-YTU group has prepared this SPDMI in the form of a strategic plan to serve as a road map for the municipality in tackling the earthquake problem.

<u>The SPDMI focuses on following points:</u>

- Our conceptualization of strategic planning
  - The problems and potentials of the Istanbul Metropolitan Area, in general
  - A roadmap including strategies, planning instruments, and priorities at various levels
  - Some institutional and legal considerations

The problems in Istanbul concerning the earthquake risk range from the poor quality or depreciation of the buildings, from an engineering point of view, to the poor urban environment generated by social, economic and physical deterioration as well as uncontrolled urban growth and an inflexible planning system which remains incompatible with the dynamics of the city. In this context, alternative implementations vary respectively on a palette of solutions including reinforcement, reconstruction of individual buildings, preservation of historical urban fabric, regeneration of urban areas, creating new settlements or alternative urban centers within a regional perspective, etc.

The approach to the disaster (earthquake) problem must be holistic in nature, i.e. comprising economic, political, social and cultural visions, and strategic in application, i.e. flexible and relying on the effective participation of various actors. To this end, the BU-YTU group attempted to construct an approach that incorporates the aforementioned tools within a broad planning framework.

4.1.2 The Problems and Potentials of the Istanbul Metropolitan Area

The Istanbul Metropolitan Area is characterized by a unique topography where the forest area in the north, numerous small valleys and water basins in and around the city serve as natural ventilation corridors and reservoirs. There is an uncontrolled urban growth on the periphery of the metropolitan area which threatens these vital resources of the urban life. Furthermore, it increases the hazard risk of a possible earthquake because of illegal constructions, industries which are unfriendly to the environment, and high-income residential enclaves areas which may create heavy water pollution in case of a damage.

Inside the metropolitan area, problems may be classified with respect to various criteria such as the initial development characteristics, urban functions, and population densities. The initial development characteristics are determined by the legal status of the development process as planned or unplanned. Mass housing areas and historical areas such as Eminönü and Fatih in the Historical Peninsula, which are planned areas, are treated as special cases. The unplanned areas, on the other hand, are classified as upgraded and not upgraded areas. Each classification, whether planned or unplanned, is arranged with respect to the urban functions such as residential, non-residential, and mixed use. Each classification is further divided into three density classes as 0-299, 300-599, 600+ (persons Per Ha). The combination of these criteria is shown below.

PLANNED											UNPLANNED								
Residential			**Non-residential**			**Mixed use**			**Special case: Mass housing areas**	**Special case: Historical areas (Eminönü, Fatih etc.)**	**Upgraded Areas** / **Not Upgraded**								
											Residential			**Non-residential**			Mixed use		
0-299	300-599	600+	0-299	300-599	600+	0-299	300-599	600+			0-299	300-599	600+	0-299	300-599	600+	0-299	300-599	600+

As a result of the analysis in accordance with the above classification, the following problems and potentials are diagnosed:

Problems (Associated with Initial Characteristics):

- In Istanbul, 80% of the buildings are resided without permission. Thus, it is highly probable that even in planned areas, a certain percentage of the buildings have undergone minor or major changes without necessary legal documentation. Such legal deviancies will probably create further legal problems in case of a necessary reinforcement application.
- Structures built before 1975 are usually assumed to have depreciated to the extend that they are in a higher risk group in comparison to those built after 1975, from an engineering point of view. However, this assumption deserves a re-consideration because the construction techniques, materials used, and the small number of stories contributes positively to their resistance to earthquakes.
- In mass housing areas, the constructions by the Real Estate Bank and the municipality led companies can be considered relatively less risky in terms of construction standards; yet, they may be rated highly risky as far as the negligence of the ground formation in location decisions of some cases is concerned.
- In residential areas built up through construction co-operations, the low technical quality of the buildings is a frequently encountered problem.
- The major problem in previously unplanned and currently illegal areas is the very poor quality of constructions. These areas accommodate the lowest income groups and, consequently, lack the chances of going through radical reinforcement applications which may be expected to be necessary.
- Furthermore, during any application in unplanned areas local government would have to deal with an excess number of residents due to extremely small size of the building lots and properties.
- These unplanned areas which are still growing illegally have problems similar to those in the upgraded areas apart from the fact that the residents have no legal entitlement to land whatsoever. Consequently, any action on the part of the local government must be

evaluated against the dilemma between the legal status and socio-economic problems of these residents.

Problems (Associated with Urban Functions):

- The historic CBD is in the highest risk group due to the deterioration of its historic building stock. Yet, these buildings accommodate a very active part of the metropolitan economy.
- Although the CBD on Taksim-Mecidiyeköy axis belongs to a lower risk group with respect to construction safety, it creates the highest risk for the entire city in terms of probable economic loss due to an earthquake.
- The CBD on Büyükdere axis is assessed as of highest safety in engineering terms. However, it deserves special attention and precautions in regard of disruptions of power supply etc in case of an earthquake.
- Some establishments are located in mid of dense inhabitation. Others are situated close to the natural resources of the metropolis. Therefore, industrial land use deserves special attention in issues like pollution and fire possibilities which may cause further environmental damage in chain reaction. In the SPDMI industrial areas are classified as follows:
    - Category-1: Industrial areas located at the city centre. These areas are designated to remain as industrial areas in the latest Master Plan for the Metropolitan Area of Istanbul (MPI)[5].
    - Category-2: Industrial areas located at the city centre which are planned (in MPI) to undergo a functional change.
    - Category-3: Industrial areas beyond the planning boundary of the MPI.
- Industrial areas in the first two categories are mostly developed between 1950 and 1980. The establishments in these areas have outdated technologies and new locational requirements. The changing production conditions as well as land prices in the area create a problem of survival for them.
- In spite of the regeneration prospects in these areas, micro developments lacking an overall strategy as well as action plans reduce the possibility of creating liveable urban environments.
- Establishments in category 3 are located on the metropolitan periphery. They are built by the permission issued by local municipalities which are independent of Istanbul Metropolitan Municipality (IMM)[6]. Most of these industries are new, export oriented, flourishing businesses. Therefore, their contribution to the local economy is creating an agglomeration effect on other industries and households which are mostly encroaching on land in water basins, near forests and along the rivers. This tendency may augment the post-disaster hazards.

Potentials (Associated with Initial Characteristics):

- In planned areas, the average housing area Per person is above $25m^{2.}$ This fact can be used as a possibility to develop a self-financing project based on the exchange of endangered dwellings against smaller ones in technically safer areas.
- In application, the economic structure of the residents in such areas can allow them to spare money for repairing if such projects are supported with low-interest credits.

[5] MPI = İNP (Master Plan for the Metropolitan Area of Istanbul)
[6] IMM = İBB (Istanbul Bigcity Municipality)

- The population in planned areas is assumed to be relatively well educated. This may be an advantage in explaining the necessity of advantages of urban redevelopment operations to the public and having their long-term co-operation.
- Some unplanned areas are situated on the best spots of the metropolis in terms of natural environment or accessibility. From this viewpoint, the location rent of these areas can be used as a financial instrument for urban redevelopment.
- Low building density in unplanned areas presents opportunities for vast transformations.

Potentials (Associated with Urban Functions):

- The Historic CBD (Spanning from the Historic Peninsula to Galata and the Golden Horn) is of utmost importance for Istanbul's vision of becoming a global city. The distinguishing and authentic features of this area can be converted into planing advantages.
- The part of the CBD on the Taksim-Mecidiyeköy and Büyükdere axis generates the highest value-added in Turkey; Kadıköy-Bakırköy-Üsküdar, on the other hand, are important trade centers serving their hinterlands. The economic powers of these locations can financially smooth the planning operations against earthquake hazards.
- Establishments in old industrial areas, many of which have lost their locational advantages, have the tendency to shift to new industrial locations thereby yielding from the functional transformation (from industry to services) at the original site.

4.1.3 The Road Map

The SPDMI suggests **a threefold roadmap** to treat these problems and potentials, which consists of macro-level strategies [A], mezzo-level strategies [B], and micro-level implementations [C]. Macro-level strategies are shaped in the national strategic plan, regional plans, in the SPDMI, and the metropolitan master plan. These strategies are elaborated for urban redevelopment or project areas at mezzo level [B]. Micro-level decisions are implemented through the designation of urban redevelopment ignition areas [CA], local redevelopment areas [CB], and land readjustment areas [CC][7].

Macro-Level Strategies [A]

A new planning level should be introduced into the planning system of Turkey; namely, a ***National Strategic Plan* (NSP)**[8] to indicate the spatial basics of social and economic development. The NSP should be developed by the State Planning Organization (SPO).

The identity of Istanbul must be defined in a **regional plan** which should not be optional as it is now, but obligatory. For this purpose, SPO must establish regional offices and empower them to prepare regional plans. SPO offices must prepare these plans in collaboration with regional actors including the provincial administrations, local governments, professional chambers, universities and other related institutions.

Regional Growth Model For Istanbul : A Framework With Some Propositions

The functional area of Istanbul stretches East-West within a 200-km belt running between the Black Sea in the North and the Marmara Sea in the South. This area comprises not only the territory of the IMM, but also the remaining provincial territory encroaching even upon neighboring provinces. This fact requires a special regional plan for the "metropolitan region" of Istanbul. Any local plan in Istanbul, whether or not prepared specifically for hazard abatement, should be developed in accordance with the overall strategies set at regional scale, within a model. At this level, the model is designed to focus on:

[7] The capital letters in brackets refer to the corresponding parts in the roadmap diagram given in Appendix 1.
[8] NSP = UMSP (National Strategic Plan)

- Preserving forests and water basins within a specifically designed preservation model
- Removing existing structures from naturally vulnerable as well as from topographically and/or geologically inappropriate areas.
- Counterbalancing the growth on the Eastern part with developments on the Western part, in the form of new industrial areas, techno-parks, research and development centres and universities, which are combined with compact settlements that have various urban functions.
- Evacuation of high-risk areas within the city or reducing their density. This process is expected to serve the regeneration of these areas with a multiplier effect. This strategy must be carried out by using the sparsely built up areas on the periphery as reserve land for the deployment of the population in high-risk, high-density inner-city areas. Such a procedure would increase public resources as well as total urban land stock. It is also necessary to revise the prevailing implementation plans and population estimates in the light of the suggested developments and to have a realistic approach to the housing market.
- Transportation planning is an indispensable element of this model, and it is to be based on the following:
    - The "fast train" line to be built and to connect Turkey to Europe.
    - An improved railway line between Silivri (West) and Gebze (East) that is combined with a tube beneath the Bosporus.
    - The highways E-5 and TEM as the primary image axes of Istanbul.

The Master Plan

The master plan for the metropolitan area of Istanbul and the SPDMI are the next steps of macro-level strategies. These two plans work together and use the maps showing the physical, cultural, and natural thresholds, which are produced by specialized institutions. Having identified the risk thresholds, the SPDMI indicates the priorities for planning operations. Drawing on these priorities, on the other hand, the master plan determines urban zones as well as project areas. In this plan, following priority areas are driven from the analysis of the existing data base:

- Areas of highest priority
    - Historic areas: The Historical Peninsula and Galata
    - The earliest upgraded areas
- Areas of secondary priority
    - Planned areas
    - Mass housing areas
    - Upgraded areas – initial status illegal
- Areas of tertiary priority
    - Planned areas
    - Mass housing areas

The Method of Determining the Priority Areas

Two data bases have been used for this SPDMI; namely, the hazard probability data prepared by JICA and a data base produced by the BU-KOERI to monitor the post-disaster essentials. Three techniques have been employed:

- Technique 1: A location quotient has been calculated for the rate of buildings expected to be heavily damaged (BEHD) in each district.

- Technique 2: The JICA data showing the density of the BEHD in each ward has further been analysed and reproduced in the form of standard units of hectares.
- Technique 3: The data obtained by the above method for each hectare has been multiplied by building density and population density of its unit for achieving a more realistic picture of the areas which will experience greatest loss of lives and economic value due to a possible earthquake in Istanbul respectively.

In addition to this, topology and land use information were considered as other parameters in the last two methods.

A re-mapping of the metropolis according to the aforementioned method gives the opportunity to assess local risks for smaller urban units and, furthermore, to produce a detailed hierarchy of priority areas in tackling the earthquake problem. Ranking the urban areas with respect to risk assessment and other urbanistic parameters provides the municipality with more realistic and feasible strategies for creating **disaster resistant areas**.

Mezzo-Level Strategies [B]

The strategies at the macro level are elaborated for urban redevelopment or project areas at mezzo level. The mezzo-level strategies are developed/produced in four successive steps. First of all, a research is to be done in selected strategy areas in order to diagnose local dynamics. The planning unit (PU)[9] and the planning and urban redevelopment unit (URDU)[10] of the Istanbul Metropolitan Municipality (IMM) are to organize surveys, meetings, and in-depth interviews with interest groups and industries, in co-operation with the "land development administration" (LDA)[11] and local municipalities. On the second step, tentative strategic plans are produced by the IMM and officially declared for further discussion. The third step consists of the joint work done by the local municipalities, interest groups, the non-governmental organizations (NGO) and the community based organizations (CBO). The tentative strategies are discussed thoroughly and sent back to the IMM with amendments, objections and alternatives produced as a result of negotiations at local level. The final step consists of the production of the final strategic master plan for the area as an official document.

Micro-Level Implementations [C]

At this level, development, redevelopment, rejuvenation, regeneration or implementation plans are produced depending on the characteristics of each area and the planned strategies at macro and mezzo levels. Three types of implementation are proposed by the authors of this SPDMI:

- Urban redevelopment ignition areas
- Local redevelopment areas
- Land readjustment areas

Urban redevelopment ignition areas (URDI)[12] are those areas which bare a strong potential and enthusiasm for redevelopment and for initiating radical changes at metropolitan scale. Urban redevelopment in these areas should be promoted by the metropolitan authority with a comprehensive planning approach and should be compatible with the philosophy of the upper-level plans, i.e. regional plans and the MPI.

Through out the planning process of this implementation type, the key issues are the identification of the major urban activity to be promoted, the exact boundaries of the URDI and land use principles. The actors involved are the IMM, local municipalities, LDA, and the association for urban renewal and investments (URIA)[13]. Consequently, this first step of

[9] PU = Directorate of City Planning
[10] URDU = Directorate of Settlement
[11] LDA = AGI (Land Development Agency)
[12] See **CA** on the road map for the URDI = Urban redevelopment ignition areas
[13] AURI: Association for Urban Renewal And Investments

commencing urban redevelopment here requires appropriate financial projects. At the second and third steps the programme of the project is constructed and announced to receive offers. The offers are evaluated with the participation of interest groups at the fourth step. Mediation and negotiation between the land owners and the investors take place at the final step.

Local redevelopment areas (LRDA)[14] are areas where the scale of redevelopment is expected to produce good results at local level. These areas may be lacking active redevelopment dynamics; but redevelopment may be promoted here with rational, effective planning strategies.

At the first three steps, the process begins with determining the exact size and location of LRDA, continues with the public announcement of the project and the preparation of the necessary data base for it. At the fourth step three different processes must be carried out simultaneously:

- Organization and co-ordination work are carried out to realize community based planning (CBP) and to provide the contribution of the CBOs.
- Education about planning; training for participation in planning; informing the interest groups about the project.
- Gathering detailed information about the LRDA.

Preparation of alternative local redevelopment projects and establishment of the relevant financial model constitute the fifth and sixth steps, respectively. After the mediation and negotiation processes at step seven, the plan for the LRDA is approved and implemented (Step 8).

Land readjustment areas (LRAA)[15] are areas which have fewer problems and lower risk as far as urban facilities and the quality of the structures are concerned. The main goal here is to increase the quality of urban environment and to create better post-disaster conditions. Land readjustment can be carried out with participation, as different from the classical implementation plans of today, only if it is applied to a small area where community activities are feasible. Thus it is vital that the LRAA is limited to a ward and that the territory of each ward is revised from this point of view (Step 1). Similar to the process in the LRDA, tentative, alternative plans are prepared by local municipalities (Step 2) and discussed with the participation of the NGOs, CBOs, individuals, private investors, and public institutions (Step 3). Mediation and negotiation processes leading to the revision of the tentative plans include public meetings and ombudsman activities, which take place at the fourth step. All activities for the LRAA, including the plan approval at the last step, are co-ordinated by local municipalities.

4.1.4 Propositions

In the light of the above mentioned framework, the SPDMI working group developed various propositions concerning some problem areas:

Planned Areas

- In planned areas, on the whole, reinforcement and micro-renovations are recommended as major means of risk abatement because the urban tissue is comparatively unproblematic.
- In planned areas with high economic potentials, regeneration, i.e. a change in urban functions, building densities and tissue characteristics, may be preferable (advantageous) if ground characteristics allow it. Such a planning intervention may contribute to the earthquake effect mitigation as well as improve the urban quality in general.
- If a category-1 industrial area is diagnosed as a high-risk area, the main challenge for the SPDMI is to decide whether it should be subject to urban transformation or risk mitigation without any functional change.

[14] See **CB** on the road map for the LRDA = Local redevelopment areas
[15] See **CC** on the road map for the LRAA = Land readjustment areas

- For category-2 industrial areas, earthquake risk mitigation can be implemented in the form of urban transformation, i.e. a change in functions as well as in urban tissue, because the pre-set decisions by the MPI foresee a change in urban functions where urban tissue deserves further discussion.
- Before any planning decision is made for industrial areas, a through industrial analysis of the area is necessary. The main focus should be on issues like commuting patterns, inter-firm relations, the level of vertical disintegration, the degree of agglomeration economies and relational assets.
- Commercial activities and other services (business activities) of different scales are distributed to various locations within the metropolis. The CBD includes the Historical Peninsula-Galata, Beyoğlu-Taksim-Şişli, Levent-Maslak on the European side, Kadıköy on the Asian side, each of which has a different characteristic and a different problem in relation to earthquake:
  - In areas of high risk and vital functions, e.g. the Historical Peninsula, an approach comprising reinforcement and preservation is recommended.
  - In relatively lower-risk CBD areas, e.g. Şişli and Kadıköy, reinforcement and rehabilitation can be employed in combination.
  - In the newly developed part of the CBD with high-rise buildings and low risk, special precautions can be implemented in order to ease post-earthquake operations.
- In mass housing areas, depending on the specific features of each area, different intervention methods can be employed:
  - In areas where the building density is low, a re-planning for the purpose of earthquake abatement may be necessary. The neighborhood may be subject to a design package including erecting new buildings on spare land, evacuating excessively old buildings, i.e. dating back to the 1960s, reinforcing of others.
  - A special priority should be given to those areas which were heavily damaged at the earthquake 1999, partly abandoned thereafter and, consequently, depreciated in economic value. Rehabilitation and/or renovation should be considered as primary means for those areas.

Unplanned Areas

For the upgraded areas, projects of reinforcement and/or renewal including evacuation, transformation, rehabilitation and reinforcement, are the priority tools. The earthquake abatement procedures in those areas should be identified as short term and long term projects, separately:

- Short term projects are three-staged reinforcement projects in which the first two stages are the prerequisites to the third:
  - Controlling and establishing a CIS data base for construction and dwelling permissions.
  - Execution of the earthquake risk assessment procedures.
  - Execution of the reinforcement process itself.
- Long-term projects are urban renewal projects with creative solutions supported by appropriate financial models, with an insight into local dynamics. Renewal projects comprise the following:
- Construction of a new institutional model which serves to the purposes of bringing various actors together such as, property owners, professionals, local authority, contractor, financial institutions.
- Providing the grounds for mediation;

- Organizing fair redistribution of the post-planning gains.

For the areas which retain their illegal status, basic strategies should be worked out by re-evaluating (analyzing) their locations in terms of topographic and geologic criteria, with respect to green areas, preservation zones and any other planning consideration.

  - If any threat to these elements of a sustainable city is identified, then new locations for development should be sought.
  - If the location(s) is/are appropriate, then renewal and regeneration strategies should be considered.

- Action plans in these areas require an effective co-ordination between the local municipality and the metropolitan municipality of Istanbul.
- In cases where the project involves more than one municipality, be it for land development or exchange opportunities, a co-operation between concerned local municipalities is a must.
- Any project in these areas must be designed as a social project as well as engineering and planning project, because their population is mostly of lower education and income groups. In this context, projects must include solution alternatives like cheap credit, rental housing.

A ROAD MAP FOR THE STRATEGIC PLAN FOR DISASTER MITIGATION IN ISTANBUL (SPDMI)

STEPS		TOOLS	SCALE	INSTITUTIONS-	LEGAL
A	MACRO-LEVEL STRATEGIES				
AA	IDENTIFICATION OF MACRO STRATEGIES AND PRIORITIES				
*	The overall strategies for Istanbul at national and regional scales are defined.	Five-year Development Plans NSP[16]		Prepared by: SPO[17] Contribution: All ministries; professional chambers	The Constitution (Article166-B) SPO Act The Town Development Code
**	The regional strategies are defined.	REGIONAL PLAN	1/200.00 0	Prepared by: Regional office of the SPO Contribution: Local municipalities; local institutions; universities; professional chambers	Draft Municipal Act Town Development Code
1	Physical, cultural, and natural thresholds are identified.	Related Maps[18]	1/50.000 1/25.000	Provincial administration; IMM[19]; GDMRE[20]; GDWW[21]; GDDAERD[22]; Environment Commission and Cultural Heritage	The Constitution (Article 166-B) Draft Town Development Code
2	The risk thresholds with respect to a possible earthquake are specified.	SPDMI[23]	1/50.000	IMM, Regional Disaster Commission-	Draft Town Development Code
3	Various proposals for the economic and social development of the region are prepared and presented to the regional office of the SPO			Local municipalities Metropolitan Council	Draft Town Development Code

[16] NSP: National Strategic Plan
[17] SPO: State Planning Organisation
[18] Related Maps: Standard topographic and cadastral maps; geological map; Newly proposed: reigonal seismic hazard map; regional flood hazard map; combined disaster hazard maps; Cultural and Enviromantal Protected araeas.
[19]IMM: Istanbul Metropolitan Municipality
[20] GDMRE:General Directorate of Mineral Research and Exploration
[21] GDWW:General Directorate of Water Works
[22] GDDAERD:General Directorate of Disaster Affairs Earthquake Research Department
[23] SPDMI: Strategic Plan For Disaster Mitigation In Istanbul

4	The major urban functions and their locations are defined. A growth model for the metropolis is prepared. Metropolitan strategies are established.	The priorities for planning operations are identified.	MPI	SPDMI	1/50.000	IMM Regional Disaster Commission	
5	The planning decisions of SPDMI are combined with those of the MPI.		MPI				
6	The MPI decisions are finalized.						
AB[24]	ESTABLISHING THE INFRASTRUCTURE OF INFORMATION						
1	A standardized database network through GIS, which covers a wide range of information, such as land use, building specifications,		GIS			Directorate of Reconstruction, Directorate of Photogrammetry, Directorate of Data Processing	Draft Town Development Code
2	An analysis for building safety with respect to the priorities set at step AA4 is conducted.		Technic al analysis	Micro-zoning maps	Various	IMM, Directorate of Earth & Earthquake Research, Regional Disaster Commission; Ministry of Public Works and Settlements	

B	**<u>MEZZO-LEVEL STRATEGIES</u>**				
1	A research in selected strategy areas in order to diagnose local dynamics is done.	Questionnaires, meetings, and in depth interviews.		IMM City Planning Dept.,Urban Redevelopment Unit Local Municipalities and LDA[25]	
2	Tentative strategic plans are produced by the IMM and officially declaration for further discussion[26].		1/50.000 1/25.000	IMM City Planning Dept., Urban Redevelopment Unit; Local Municipalities	

[24] The steps AB and AA are realised simultaneously
[25] LDA: Land Development Agency
[26] Areas which bare a strong potential and enthusiasm for redevelopment and for initiating radical changes at metropolitan scale

3	Tentative strategies are discussed thoroughly and sent back to the IMM with amendments, objections and alternatives produced as a result of negotiations at local level.	Meetings for mediation.	1/50.000 1/25.000	IMM City Planning Dept., Urban Redevelopment Unit, Local Municipality Interest groups: various representatives from the region, NGOs, CBOs; Public and Private institutions	
4	The production of the final strategic master plan for the area as an official document.	MPI	1/50.000 1/25.000	IMM	

C	**MİCRO-LEVEL IMPLEMENTATIONS**					
CA	**URBAN REDEVELOPMENT IGNITION AREAS (URDI)**					
1	The major urban activity to be promoted, the exact boundaries of the URDI, and land use principles are identified.	Appropriate financial projects for each URDI are prepered.	Redevelopment Plan	1/5.000 1/1.000 1/500	IMM Urban Redevelopment Unit Local Municipality LDA AURI[27]	Draft Town Development Code
2	The programme of the project is constructed.				Local Municipality	
3	The project is announced to receive offers.		Awards (contracts) or competition[28]			
4	The offers are evaluated with the participation of interest groups		Public meetings			
5	Mediation and negotiation between the land owners and the investors		Public meetings for co-ordination and mediation.			

[27] AURI: Association for Urban Renewal And Investments
[28] Offers must include an application model and must be supported with a social transformation model

<table>
<tr><td>CB</td><td colspan="7">LOCAL REDEVELOPMENT AREAS (LRDA)[29]</td></tr>
<tr><td>1</td><td colspan="3">The exact size and location of LRDA is determined.</td><td rowspan="2"></td><td>1/1.000
1/500</td><td rowspan="8">Participatory agents:
Local Municipality “Unit for CBP”
CBO – Ward Council
NGOs

Coordinated by:
Local Municipality
AURI
A representative from IMM</td><td rowspan="8"></td></tr>
<tr><td>2</td><td colspan="3">The project is announced to the public</td><td rowspan="2"></td></tr>
<tr><td>3</td><td colspan="3">The necessary data base is prepared for the project.</td><td>Questionnaires[30]</td></tr>
<tr><td>4</td><td>Organization and co-ordination work are carried out to realize CBP[31] and to provide the contribution of the CBOs[32].</td><td>Education about planning; training for participation in planning; informing the interest groups about the project.</td><td>Gathering detailed information about the LRDA.</td><td>Public meetings
Seminars ; conferences
Questionnaires; in-depth interviews; announcements through printed and audio-visual materials.</td><td></td></tr>
<tr><td>5</td><td colspan="3">Preparation of alternative local redevelopment projects</td><td rowspan="4"></td><td rowspan="4"></td></tr>
<tr><td>6</td><td colspan="3">Establishment of the relevant financial model</td></tr>
<tr><td>7</td><td colspan="3">Mediation and negotiation processes</td></tr>
<tr><td>8</td><td colspan="3">The plan for the LRDA is approved and implemented.</td></tr>
<tr><td>CC</td><td colspan="7">LOCAL READJUSTMENT AREAS (LRAA)[33]</td></tr>
<tr><td>1</td><td colspan="3">The exact size and location of LRAA is determined.</td><td></td><td>1/1.000</td><td>IMM local and neighboring municipalities; Head man of ward unit, NGOs, CBOs</td><td>Draft Municipal Act and Draft Town Development Code</td></tr>
<tr><td>2</td><td colspan="3">Tentative, alternative plans are prepared</td><td>Development plans</td><td>1/1.000</td><td>Local and neighboring municipalities</td><td></td></tr>
</table>

[29] Areas where the scale of redevelopment is expected to produce good results at local level
[30] Questionnaires must be designed to diagose the local dynamics e.g. the attitude of the residents towards a possible redevelopment project in that area
[31] CBP = Community Based Planning
[32] CBO= Community Based Organisation
[33] Areas which have fewer problems and lower risk as far as urban facilities and the quality of the structures are concerned

3	Tentative, alternative plans are discussed with the participation of the NGOs, CBOs, individuals, private investors, and public institutions		Tentative Plans; announcements through printed and audio-visual materials; public meetings		Coordinated by: Local and neighboring municipalities Participatory agents: NGOs, CBOs, public institutions, private sector representatives, individuals	Draft Town Development Code
4	Mediation and negotiation processes	Revision of the tentative plans	Meetings		Local municipality Ombudsman and/or RCPC[34]	Draft Municipal Act and Draft Town Development Code
5	The plan for the LRAA is approved and implemented.		Development plans	1/1.000	Local municipality and IMM	

[34] RCPC= The Regional Commision for Plan Control

4.2 Institutional and Legal Considerations

This part of the SPDMI report focuses on the legal issues. The SPDMI working group (BU-YTU) identified first, the problem areas in the Turkish legal system which may create obstacles in the way of SPDMI's application and second, in order to minimize these problems, it produced some suggestions on various issues in the constitution, as well as in the laws concerning building, urban development, urbanization, and local administration. A brief summary of these are given below.

4.2.1 Problems Associated with Institutional Responsibilities

1. The institutional organization for disaster management and planning in Turkey has a chaotic nature, namely the duties and responsibilities of some of the institutions often create confusions.
2. Unlike the central government, local governments are not given any real responsibility with respect to disaster management.
3. Due to the inconsistency in macro level policies and standards, the central government fails to provide efficient assistance to local governments in tackling disasters.
4. The legal system does not incorporate plans and programs for disaster mitigation which in fact can be used as means to support effective community participation.
5. The draft laws and their bylaws related to planning and development have contradictory articles.

4.2.2 Problems Associated with Planning

1. The preparations of regional plans are optional, thereby creating areas developing without macro level plans.
2. The coverage, scale and definition of some plans contradict with each other in different laws.
3. Particularly in metropolitan areas, some of the institutions established by the central government are empowered to prepare their individual local plans for areas relevant for their specialties. As a result overlapping and contradictory plans for the same location occur.
4. In the context of risk assessment and risk mitigation, the planning system, in general, often fails to reflect the real dynamics of the cities in Turkey.
5. The existing legal framework does not incorporate effective compensation mechanisms which specifically pay regard to the public interest by redistributing of the post-planning gains.
6. The legal framework of planning lacks some of the instruments for risk mitigation and associated financial models.
7. Amnesties for illegal constructions encourage the development of illegal, poor quality and disaster unresistant areas, particularly in the fast growing cities in Turkey

4.2.3 Problems Associated with the Built Environment

1. The bureaucratic obstacles and long frustrating procedures for the constructing usually encourage the illegal development.
2. An efficient control mechanism for construction safety has not yet been introduced into the legal framework since the earthquake in 1999.

4.2.4 Recommendations

1. Following amendments are to be made in the constitution in order to tackle the problems associated with institutional responsibilities:
   - The duties and responsibilities of some of the institutions are to be reorganised.

- o Two institutional bodies are to be empowered to make the control mechanism work independently, ie. The Regional Commission for Plan Control (ombudsman).

2. The planning hierarchy and relevant institutional relationships are shown in Figure 4.2.1. According to this, the most radical and significant change is making the preparation of regional plans obligatory.
3. Local authorities, including metropolitan municipalities and regional seismic commissions, are to be empowered to assess disaster risks and prepare strategic plans and programs, and co-ordinate a wide range of local activities in disaster management.
4. In this context, the overall system is reorganized at regional scale allowing effective community participation.
5. The issues concerning the preparation of various maps and other related documentation for disaster management are to be identified in the legal framework and summarized in Figure 4.2.1.
6. The financial models and their instruments proposed by the planning and finance working groups ie. Real Estate Investment Fund, Earthquake Mitigation Fund and Association for Urban Renewal and Investment (AURI), are all to be specified within the legal system.
7. Various applications of 'exchange of property rights' are proposed as alternative compensation mechanisms in planning operations.
8. The draft law concerning the control of constructions is largely accepted by the working group with some additional articles.

4.2.5 Conclusion

The SPDMI must be perceived as a combination of strategies. These strategies allow the municipality to create a number of solutions at different scales, ranging from reinforcement of individual buildings to redevelopment of urban areas. The disaster mitigation in each area in the metropolis will be achieved with instruments specifically chosen for that location. However, these solutions will fail to contribute to the sustainability of the metropolis, as a whole, unless the disaster mitigation operations remain on the main line of thought pursued by the SPDMI.

The municipality's approach must be holistic in deciding upon the priorities, but flexible in implementing the strategies. In order to keep the holistic nature, the municipality must first develop macro level strategies in reference to regional and national priorities. Then, it must develop mezzo-level strategies with the co-operation of various national, regional and metropolitan institutions, and local municipalities.

At micro-level, the success of the SPDMI depends on internalizing a new planning conceptualization by local governments since strategic planning is based on new concepts such as flexible planning and community based planning. These concepts can be realized with new institutional mechanisms, new administrative perspectives, and participatory attitude on the part of the citizens. The presumption is that every "urban project" is to be carried out with highest possible community support and participation. Therefore, the suggestions in the SPDMI include new institutional arrangements like the regional branches of the SPO, the land development administration (LDA), the association for urban renewal and investment, and ombudsmanship.

Institutional reorganization is, naturally, accompanied by legal arrangements. For that reason, the SPDMI includes suggestions on various issues in the constitution, as well as in the laws concerning building, urban development, urbanization, and local administration. Institutional reorganization should also include financial institutions, because the feasibility of the SPDMI depends on the employment of an appropriate financial model which can attract a wide range of actors.[35] Participation, on the other hand, has some pre-requisites, such as the

[35] See the SPDMI report for more about the proposed financial model.

training of the municipality personnel, good information flow, continuous education of the public on urban and planning matters. For that purpose, the IMM and local municipalities are strongly advised to carry out educational programs as an integral part of the planning procedure, as indicated in the Road Map [CB4]. These programs are fundamental for risk assessment as well as urban redevelopment or land readjustment projects.

Table 4.2.1. Suggested Planning Hierarchy, Preparing and Assigning Agencies

	TYPE OF PLAN	PREPARED BY:	PARTICIPATING INSTITUTIONS	APPROVED BY :	CONTROLLED BY :
Physical Strategic Plans	National Strategic Plan (NSP)	SPO	Ministries Representative of NGO and professional chambers	Council of Ministers	
	Regional Plan (RP)	Regional Offices of SPO	Related agencies and offices, Representative of NGO and professional chambers and Universities Representatives from various commissions (Regional Disaster, Environment and Cultural Heritage Conservation Commission) Regional Council Sub-Regional Council City Council	Regional Council	SPO
	Sub Region Development Plan(SRDP)	Regional Offices of SPO		Council of Sub-Region	Regional Commission Plan Control
	Metropolitan Plan	Metropolitan Municipality (MM)		Metropolitan Municipality	Commission of Plan Control
Local Development Plan	City Development Plan (CSP)	Local Municipality	Related agencies and offices, City Council, professional chambers, Ward Council, Representative of NGO, CBO and University	Metropolitan Municipality Council Pre-Approval:(MMC) Final-Approval: (MMC)	Commission of Plan Control
	City Implementation Plan (CADP)	Local Municipality	Related agencies and offices, Ward Council, professional chambers of profession, Representative of NGO, CBO and University, Representative of MM Planning Unit	Council of Municipality Pre-Approval: Council of Local Municipality Final-Approval: (MMC)	Commission of Plan Control
	Action Plan (EP)	The planning unit of Local Municipality	Related agencies and offices, Ward Council, professional chambers, Representative of NGO, CBO and University, Representative of MM Planning Unit and other related groups	Council of Municipality Pre-Approval: Council of Local Municipality Final-Approval: (MMC)	Commission of Plan Control
	Lot Plan (LP)	Local Municipality		Committee of Local Municipality	Commission of Photogrammetry-Lot Plan Control
	City Implementation Program CIP	Local Municipality			Public Hearing

Table 4.2.2. Draft Photogrammetry Maps and Responsible Institutions

Type of Map	Responsible Unit	Responsible unit for control
Standard Topographical Cadastral Map (STCM)	Municipality and Governor of Province	Commission of Photogrammetry-Lot Plan Control)
Geologic Map (GM) 1/25000-1/100000	General Directorate of Mineral Research and Exploration (GDMRE)	Regional Disaster Commission
Regional Seismic Hazard Map (RSHM) 1/10000 - 1/25000	GDMRE + Big City Municipality	Regional Disaster Commission, Metropolitan Municipality Disaster Commission
Regional Flood Hazard Map1/10000 - 1/25000 (RFHM)	Regional Office of General Directorate of Water Works Local Administration	Regional Disaster Commission
Disaster Hazard Maps1/10000 - 1/25000 (ATH)	General Directorate of Disaster Affairs Earthquake Research Department	
Micro-Zoning Map (MZM) 1/5000 – 1/1000	Municipality and Governor of Province	Related chamber of professions Regional Disaster Commission
Disaster Risk Map (DRM)	Local Municipality	Regional Disaster Commission
Report of structural risks	Local Municipality	
Strategic Plan For Disaster Mitigation (SPDM)	Disaster Commission of Related Municipality	Regional Disaster Commission
Combined Disaster Hazard Maps (CDHM)	Regional Planning Offices	Regional Disaster Commission
Detail Analysis of soil condition for lots		

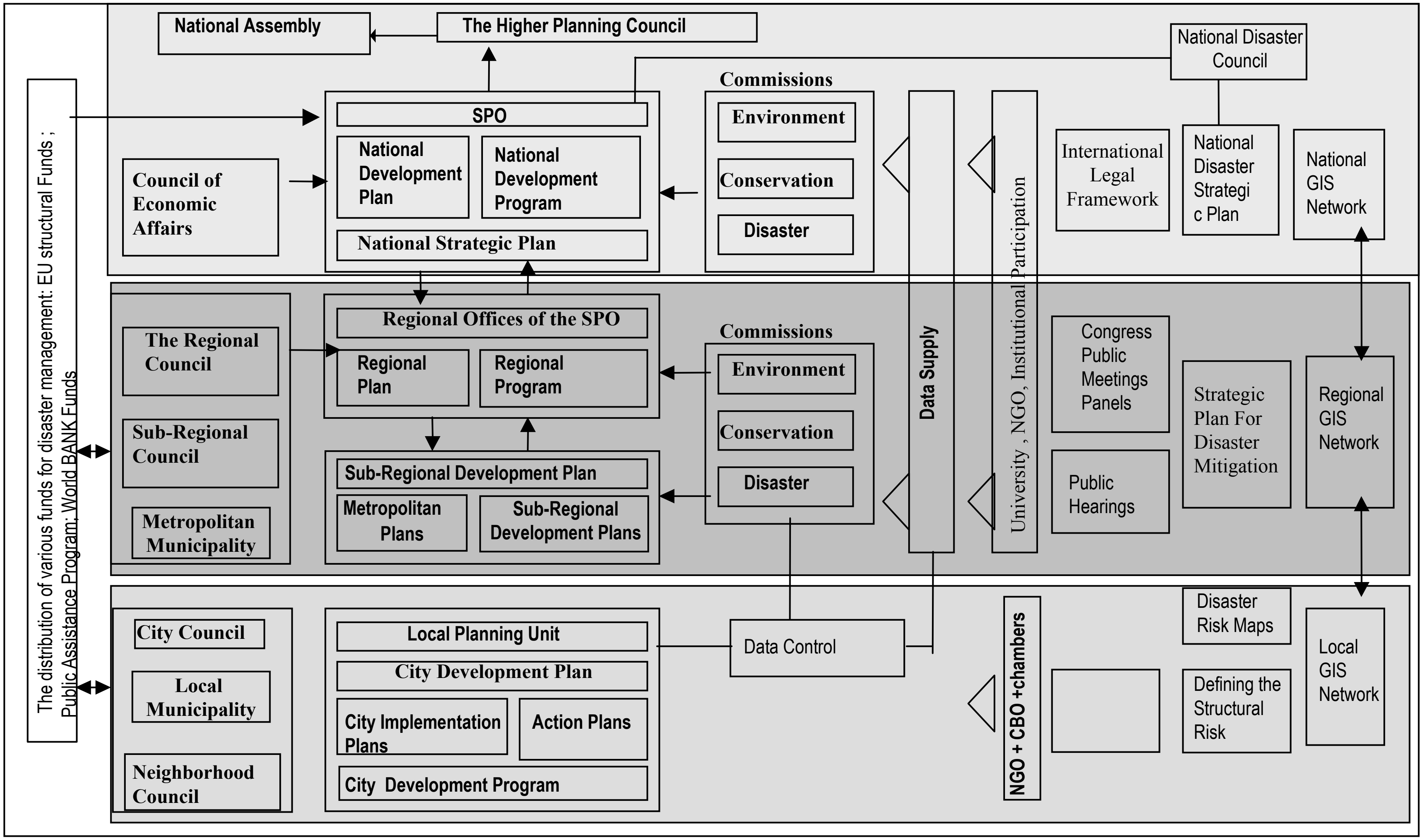


Figure 4.2.1. Legal Framework of Planning System and Risk Mitigation

4.3 Structural Design in the Pre-And Post- Stages of an Earthquake: An Evaluation of The Current Administrative Structure

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SUMMARY AND CONCLUSION

The main objective of this chapter is to formulate a Turkish disaster management model that includes all parties that are involved in pre- and post- disaster management activities. For this purpose, the current legal structure and organizations are evaluated, distribution of authority among the central and local government bodies is analyzed, responsibility and coordination mechanisms are identified, and the problems and inefficiencies in the system have been determined. In addition, disaster management models that are operational in other countries are analyzed and parts of these models that can be adaptable to the Turkish system have been integrated into the proposed model. Furthermore, the model included the findings of in-depth interviews with administrators and individuals involved in disaster-related organizations and a field survey that were conducted with citizens in two neighborhood areas.

An evaluation of the current legal structure and practices in Turkey can be summarized as:

- Turkish disaster management system concentrates mainly on the response stage, with less emphasis on preparedness and mitigation activities.
- The involvement of central government in disaster management has led to complex and complicated system, which makes coordination, planning, leading, and organizing difficult and problematic, and definition of roles remain ambiguous. Observations after the 1999 Marmara Earthquake has reached similar conclusions, where central government bodies were evaluated as slow and ineffective in most response activities.
- The current system provides a passive role to the local governments, military units, NGOs, professional chambers, *muhtar*s (neighborhood administrators), and citizens. These groups are only supposed to provide the services they are asked to conduct and they have no proactive role in planning, mitigation, and decision-making bodies.
- The gaps and problems in the legal structure have been filled with some organizations that are founded to improve the effectiveness of the system; Governorship Disaster Management Center (AYM) and Metropolitan Municipality Disaster Coordination Center (AKOM) are the two major organizations that are established after the 1999 Marmara Earthquake to coordinate disaster-related activities and fill the gaps in the legal structure and find solutions to the problems in practice.
- There is a need to transform the system into a simple and straightforward model, clarify the roles, and emphasize planning, leadership, and controlling functions in order for the organizational structure to work in an effective manner.

An analysis of disaster management models in other countries show that the models are transformed from complex and complicated systems to more simple structures after the country faces a major disaster. In the process of simplifying the system, there is a trend towards a significant reduction in the number of ministries associated with disaster management, an inclination to set up a simple coordination mechanism and to put the administration of natural disasters and man – made disasters under the same structural umbrella. Another characteristic of other country models is that at the top level, allocation of technical and physical resources and coordination of different agencies are achieved by a high-level council. At the provincial level, the Governor and/or the Mayor carry the responsibility for disaster management. In addition, the military forces, NGOs, local organizations, institutions with technical and health-related

resources and expertise, and community based organizations take part in disaster management systems in an active way.

In order to develop an effective disaster management model that eliminates the current existing problems, a new system with a long-term and short-term focus is proposed, which incorporates the above-mentioned organizational principles. In the long-run, a significant reduction in the number of involved ministries should be made and responsibility for disaster management needs to be in the hands of one ministry. Furthermore, it is suggested that management of natural and man – made disasters should be organized under the umbrella of one ministry. In the short-run, the proposed model can be analyzed at the central, provincial, and neighborhood levels. At the central level, the proposed responsible bodies for disaster management are: *Undersecretary of Disaster Management,* who directly reports to the *Prime-Minister, Central Disaster Preparedness and Response Council*, and *Disaster Higher Control Center*, which will operate as the crisis and emergency center after a major disaster. *Disaster Bureau* will carry out the communication, filing, reporting, and office affairs of the *Central Disaster Preparedness and Response Council.*

At the provincial level, it is proposed that *Provincial Disaster Preparedness and Response Council* will be responsible for disaster management and coordination of all disaster-related functions. The highest body for decision-making of the *Provincial Disaster Preparedness and Response Council* will be the *Provincial Higher Board,* which includes the *Governor,* who is the leader of the board and the *Mayor of the Larger Metropolitan Area* and the *Garrison Commander.* A *Vice-governor, an Assistant General Secretary of the Metropolitan Municipality* and a top level *Garrison Officer* form the *Provincial Executive Body,* which is responsible for execution of the decisions taken by the *Provincial Higher Board* and to ensure coordination among disaster-related activities. *Provincial Disaster Preparedness and Response Council* will be responsible from managing all disaster-related functions in the areas of security and public order, transportation, health services, public training/ public relations, humanitarian aid, fires/ secondary disasters/search and rescue, public works/engineering, settlements planning, and communication/technical infrastructure. *Provincial Disaster Management Directorate* will be responsible from communication, reporting, filing, and other office affairs of the *Provincial Disaster Preparedness and Response Council. Provincial Advisory Council* will operate as an advisory body the *Provincial Disaster Preparedness and Response Council* and will include the representatives of major NGOs, professional chambers, chambers of industry and commerce, some district mayors, military forces, universities, and TUBITAK (The Scientific and Technical Research Council of Turkey). It is proposed that *Provincial Disaster Control Center* becomes operational after a major disaster and serves as the emergency and crisis center in the province.

The new proposed model stresses the importance of neighborhood organizations in disaster management and suggests that legal and structural arrangements be made for this purpose. At the neighborhood level, *muhtar*s (elected neighborhood administrators) should play an active role and be the leader of *Neighborhood Disaster Council* and *Neighborhood Disaster Volunteers,* which will serve as the basis of neighborhood organizations. In order to ensure effective leadership and involvement of *muhtar*s in disaster management, physical and financial resources need to be activated. *Muhtar*s can operate as information node in the neighborhood and act as a bridge between the public and central and local government units. Furthermore, there is a need to integrate the activities of community-based organizations and the *Civil Defense* organization in order to achieve effective disaster management at the local level.

4.3.1 Objectives

Effectiveness of disaster management systems strongly depends on the deployment of resources and division of tasks, the set of formal tasks assigned to individuals and departments, the formal reporting relationships, including lines of authority, decision responsibility, and the design of systems to achieve effective coordination of involved parties. Preparedness, mitigation, response, and recovery stages of disaster management incorporates a wide array of constituents, including central and local government bodies, non-governmental organizations (NGOs), chambers of professions, private and public organizations, community-based organizations (CBOs), and the citizens. The main objective of this chapter is to create an organizational structure for disaster management in Turkey that will provide guidance to division of labor into specific departments and jobs, formal lines of authority, and mechanisms for coordinating activities of a wide-array of constituents regarding all stages of disaster management. For this purpose, the following steps are taken:

3. Laws, regulations and the legal framework are analyzed in order to formulate the current organizational structure and design of disaster management, with a particular emphasis on the authority and responsibility of central and local government bodies and the other involved parties.

- The current organization structure is evaluated in terms of possible sources of inefficiencies, duplication of effort, waste of resources and time.
- The current practices in disaster management are assessed and a comparison of the formal legal structure with the ongoing practices is made.
- Organization structure and models of disaster management in other countries is analyzed.
- Major functions of an effective disaster management system are formulated.
- Roles and functions regarding preparedness, mitigation, response, and recovery stages of disaster management are identified.
- Units and organizations that are responsible for disaster management and implementation are identified.
- A structural design that incorporates central and local government units, public and private organizations, NGOs and CBOs is formulated.
- A framework for planning, coordination, motivation, leadership, and controlling functions is proposed in order to enhance the effective running of the organization structure.

Method:

The major characteristics of the methodology that is employed in deriving the organization structure can be summarized as:

1. The related legal framework, including the laws, by-laws, and formal procedures are reviewed in order to identify the current organizational structure of disaster management in pre- and post-stages:
    E. Law no.7269 on “Precautions and Aid Regarding All Types of Disasters that Impacts the Community,” dated 1959.
    F. Organization Structure and Planning of Disaster-Related Responses By-Law.
    G. Organizational Structure and Duties of Ministry of Public Works and Settlements Ordinance.
    H. Building Inspection Ordinance.
    I. Law no. 7126 on “Civil Defense,” dated 1958.
    J. Prime-Ministry Crisis Management Center By-Law.
    K. Ordinance no.600 on “Changing the Prime-Ministry Organization Structure.”

- Academic work and reports about disaster management structures and models in other countries are reviewed.
- Academic work and reports about disaster management are analyzed in order to identify the functions and activities regarding preparedness, mitigation, response, and recovery stages.

- In-depth interviews were conducted with representatives of central and local government bodies, professional chambers, NGOs, and private and public organizations, and; a field survey was applied to 172 citizens.

A Framework for Management Functions to Enhance the Effective Running of the Organization Structure

Observations and academic research conducted in the aftermath of the 1999 Marmara Earthquake point to a significant gap between the formal organization structure and the many governmental bodies, the media, and various institutions declared the necessity of improving the formal organization structure. On the other hand, organization structure cannot be treated as an independent management function that is sufficient for the effective execution of disaster management. An effective disaster management system should include the following management functions in an integrated and interrelated way:

1. Decision Making and Planning
    a. Goal setting, deciding on the acceptable standards and objectives
    b. Deciding on the alternatives means and paths to reach the goals
    c. Planning the activities
- Organizing
    a. Clarifying roles and responsibilities
    b. Deciding on the hierarchical structure
    c. Describing the main components of the communication and feedback system
    d. Simplifying the language
    e. Deciding on the human resources needs
    f. Achieving coordination
- Leadership
    a. Setting the main principles of teamwork.
    b. Motivating employees and constituents
    c. Effective conflict management
- Controlling
    a. Comparing actual performance with the goals and standards
    b. Determining the causes of deviation from goals and standards
    c. Taking corrective action
    d. Setting new goals and objectives

Decision Making and Planning

In order to improve the effectiveness of disaster management systems, managers responsible from different functions need to formulate the objectives and goals that are related with their functions and units. These objectives should involve both a short-term and a long-term perspective, with a focus on the problems that need to be solved and opportunities that lie ahead.

After deciding on the short-term and long-term objectives, managers in all departments need to formulate the alternative paths to reaching these goals. Alternatives should clarify the needed physical and human resources in reaching the goals. Managers can make use of decision-making tools like “brainstorming” or “Delphi-technique” in determining the alternative means. These decisions should not be made with only the contribution of central governmental bodies and technical experts, but should also involve the participation of local government units, NGOs, professional chambers, the military and the related citizens.

Generating alternatives should be followed by evaluating the alternatives based on various criteria that include technical and financial feasibility. Finally, managers should decide on the activities that will be executed and decide on a beginning and ending date for the activities.

Organizing

Organizing and effective deployment of resources is an essential aspect of effective management, which involves determining the roles and responsibilities, grouping the related tasks, and formulating the hierarchical structure. Main dimensions of an organizational structure include the number flayers in a hierarchy, departments and units, distribution of authority, description of the needed human resources, and the communication flow.

According to the current legal framework in Turkey, the central government bodies are the main units responsible for disaster management. In this chapter, we will propose a change in the current framework and plan for a "hybrid" structure where the organization structure will involve the local government, NGOs, other public and private institutions and the CBOs in addition to the central government units. In this hybrid model, the central government will assume the role of leadership and providing the legal structure, and yet it will encompass a decentralized approach by including all related parties in the system.

The hybrid model will simultaneously carry centralized and decentralized elements. Centralized elements are indispensable characteristics needed in times of emergency and allow for coordination and fast decision-making, while decentralization permits flexibility and adaptation to local conditions.

Leadership

Leadership function becomes an important variable in hybrid structures for motivating and increasing commitment of a great number of constituents. Strong leadership is needed to receive the participation and active involvement of parties whose main responsibility is in areas other than disaster management. Strong leadership is needed to initiate and get the continuous support of NGOs, CBOs, and other public and private organizations in pre- and post- stages of disaster management. A study conducted in the Istanbul Batıköy neighborhood showed that neighborhood dwellers did not perceive disaster management to be within the responsibility domain of citizens and NGOs (Iseri-Say, Inelmen, Kabasakal and Akarun, 2002). On the other hand, they thought that central and local government bodies carried the main responsibility for disaster management activities. This study points out to the fact that leadership function is essential to get the commitment and involvement of citizens and to persuade them to assume responsibility in both pre- and post- disaster activities. The same study highlights the importance of "*muhtar*" (elected neighborhood administrator) in achieving participation of neighborhood dwellers. The proposed model in this chapter will incorporate *muhtar* as a significant party in neighborhood organizations.

Controlling

The controlling function of management would include monitoring the performance of all related parties and responsible units and comparing their actual performance with the objectives and standards that are set. Controlling is a necessary activity for individuals and parties to direct their energies towards the set objectives and standards. If managers find a significant gap between actual performance and objectives, they should investigate the reasons for the gap, and take corrective action.

4.3.2 Current Legal and Administrative Structure of Disaster Management

Legal Structure

Law no.7269 on "Precautions and Aid Regarding All Types of Disasters that Impacts the Community"

The most comprehensive and operative of the current Turkish legal system is the Law no. 7269, which prescribes all precautions and aid following all types of disasters. After the foundation of the Turkish Republic, a number of disaster related laws, which turned out to be disaster specific, were issued. With the arising need of a single comprehensive law that would encompass all disasters and their impacts, the Law on *Precautions and Aid Regarding All Types of Disasters that Impacts the Community* was prepared and became effective from 1959 onwards. Although a number of its articles was amended due to changing needs or with the inclusion of temporary clauses in the subsequent years, the Law is still in effect. The main rationale of the Law is to entail all precautions and aid after earthquakes, wild fires, flooding, avalanche, etc. that could turn out to have disastrous effect on both public and private buildings, and could have large impact on community life.

Deployment of resources for earthquake preparedness and post-earthquake management of humanitarian aid is based on the effect of tremors being highly damaging and have large-scale influence on the general community life or the eminent possibility of a future disaster having the same potential. However blandly, the Law sets down the ground for earthquake preparedness and determines the constituents at this stage. Pre- and post-disaster responsibilities and courses of actions are broadly defined with this Law. The main objective of instituting such a double-sided structure has been the anticipation of such a system would minimize the state's duties and involved costs in the recovery stage, if the state fulfills the duties of leadership, education of the public and, maybe more importantly, auditing functions. However, when considered in its entirety, the Law largely focuses on the post-disaster stage instead of preparedness. A large share of the articles is devoted to rather reactive disaster management strategies, such as assessment of damage, valuation, allocation of the humanitarian aid, establishment of these activities related committees, retrofitting or demolishing of the damaged buildings after the disaster, foundation and finance of funds that would be used to cover the costs, etc.

Disaster preparedness as an issue is taken up only in a handful of articles that are mostly related to the directives on dissemination of disaster related information to the general public. The directives could be as comprehensive as mandatory relocation of a whole neighborhood because of eminent danger with the Council of Minister's decision. Other directives include development of programs and plans with the goal of protection of citizens' life and national wealth, designing education programs and publicizing information in coordination with ministries and other institutions, foundation of institutes under the Ministry of Public Works and Settlements with the intention of creation knowledge on disaster related issues. It could be argued that an analytical approach is adopted in the preparation of the Law, and creation of scientific knowledge in regard to dissemination of disaster related knowledge was uphold and the responsibility was given to the Ministry of Public Works and Settlements. Although the Ministry is designated as the main responsible party for both pre- and post-disaster planning and coordination, for all of these stages a reactive management style is stipulated. For example, the Disaster Coordination Council gets activated only after a large-scale disaster. The Council is led by the undersecretary of Public Works and Settlements and consists of undersecretaries of Ministries of Defense, Foreign Affairs, Internal Affairs, Economy and Customs, Education, Health, Agriculture, Forests and Village Affairs, Work Life and Social Security, Industry and Trade, and Infrastructure with the Director of Turkish Red Crescent and a representative from the Headquarters of Turkish Armed Forces. The responsibility of this Council is described as achieving a strong coordination and assuring an effective network of assistance with the Prime Ministry and between Ministries. The plans that are prepared by the Council would be send to the Ministry of Public Works and Settlements and the implementation would be carried out by the Ministry.

In case of a calamity or eminent danger of such an event, the Ministry of Public Works and Settlements is the only accountable body to declare this event as a disaster officially. Following the official declaration of the Ministry, the Governor of the province, where the disaster took place, legally assumes extraordinary entitlements as the person in charge. In other words, the assessment of danger is carried out at the country scale, whereas the emergency management is performed at the province scale. As stated by Sengezer and Kansu (2001), the connection between the central and local levels and through which processes this relationship would be operationalized is not very well defined. Moreover, the discrepancy between the responsibility and the command appears to be one of the most important problems of disaster management in Turkey.

Organization Structure and Planning of Disaster-Related Responses By-Law

Establishment of the disaster response administrative structure in Turkey is done according to the By-law of Organization Structure and Planning of Disaster-Related Responses, which was put into effect in 1988 (Figure 4.3.1). This By-law aims to achieve successful implementation of planning, organizing and coordination of emergency response and search and rescue activities of the governmental bodies. At the province scale, the By-law gives extraordinary entitlements to the province governor and districts' authorities, and defines the nature of the relationships and assistance between the Ministries and their local organizations, other central governmental bodies, troops of Armed Forces and the Turkish Red Crescent's emergency response activities. The preparation of the disaster plans and constant updating of these, is given special importance to in the By-law. Keeping in mind that disaster planning has emerged as a field of expertise and up-dating of the disaster plans should be carried out by specialized personnel, it could be suggested that professional advice should be sought, as in the case of other country examples (Sengezer & Kansu, 2001).

The By-law defining the constitution of the Provincial Rescue and Aid Committee, its authority and responsibilities, in planning of the response activities mainly seeks to coordinate and mobilize the public organizations' resources at the provincial level. Nevertheless, in case the situation calls for it the neighboring province governorships and Armed Forces and resources could also be mobilized, according to the By-law.

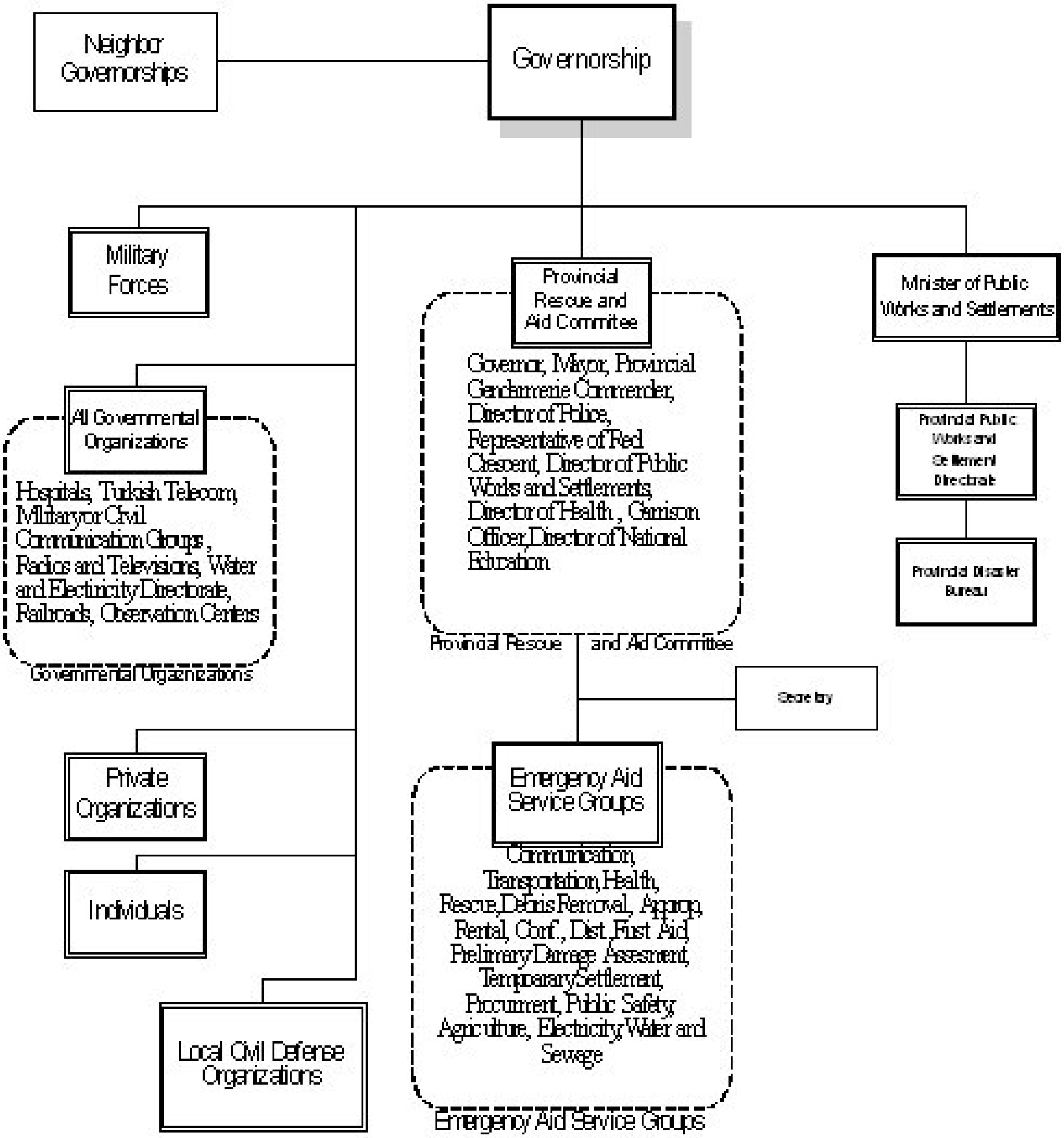


Figure 4.3.1. Existing Disaster Response Organizational Structure

Organizational Structure and Duties of the Ministry of Public Works and Settlements Ordinance
The ordinance defines the disaster related duties of the Ministry, which has very important responsibilities regarding earthquake and other disasters. Articles (g) and (m) which refer to earthquake and disasters and articles (k), (o), (p) which refer to outcomes of disasters make this Ministry a central unit in the whole administrative structure. Among the duties of the Ministry are planning for the pre and post disaster measures and aid, implementing them, cooperation with related ministries and institutions, re-planning settlements, implementing these and controlling them, and implementing all the duties given to it by law. It has been given an important place in decision-making processes about disasters regarding planning, implementing, controlling and resource allocation. "Cooperation" with various organizations for carrying out its duties is also one of the ministry's duties.

Also additional article 5 of law number 7269 states that this ministry will organize to deal with, execute and conclude disaster related services, and the organization at the center, region and local levels will be decided by the ministry.

The ministry's organization statements give a detailed distribution of duties within " major service units". The Directorate of Construction deals with permanent settlement issues. Articles (f) and (g) define duties especially related to earthquake and disasters. Permanent settlement issues for disasters can be said to cover both pre and post disaster issues. Unlike the other two directorates, the Directorate of Disasters is given duties that are related solely to disasters. It is responsible for pre-disaster construction planning, precautions and post-disaster emergency response.

Articles (b) and (c) which define the duties of the Directorate of Technical Research and Implementation in disasters are concerned with earthquakes. The duties have been defined with an earthquake focus and these duties are mostly related to the pre-disaster functions.

General Directorate of Highways works under the authority of this ministry and as part of its local organization structure. This directorate is crucial in the planning and maintenance for alternative transportation and emergency aid logistics services during pre and post-disaster situations.

The duties defined for this ministry encompass the technical issues in disaster functions. However the representation of this ministry in various committees of the administrative system (e.g. Central Disasters Coordination Board/Undersecretary-head; Provincial Rescue and Aid Committee/Director; District Rescue and Aid Committee/Representative of the Directorate) and the content of the functions it deals with place this ministry in a very strong and important position for pre and post- disaster functions. Thus it becomes important to ensure cooperation and coordination and to deal with disaster related issues separately.

Construction Inspection Ordinance

With this ordinance the responsibility of building inspections has been given to private building inspection organizations in pilot regions of Adana, Ankara, Antalya, Aydin, Balikesir, Bolu, Bursa, Canakkale, Denizli, Duzce, Eskisehir, Gaziantep, Hatay, Istanbul, Izmir, Kocaeli, Sakarya, Tekirdag and Yalova. According to the ordinance, the private building inspection organizations are responsible for controlling that the construction process is in line with building codes and permissions, that the materials and the construction are in line with the planning, technical regulations and standards, and also for certifying the results of these inspections and processes.

Building Inspection Service Agreement is signed between the owner of the building and the private building inspection organization. Building Inspection Committee in the Ministry of Public Works and Settlements is given the duty of controlling that the parties follow this agreement, giving operating permissions to building inspection organizations, and keeping registration and records of these organizations. The committee has the right to uphold or cancel the operating permissions of building inspection organizations which do not follow the signed agreement.

Law number 7126 on "Civil Defense"

This law defines the duties of the Civil Defense Organization, which are minimizing loss of life and property during natural disasters and fires, protection and rescue, protection, repair and renovation of crucial public and private organizations, and getting support from the civil public for defense.

According to article 2, areas that are prone to natural disasters (sensitive areas) are determined and announced by the Directorate of Disasters within the Ministry of Public Works and Settlements. The Directorate of Civil Defense is established within the Ministry of Internal Affairs in order to organize civil defense in such sensitive areas, to train, manage and control the civil defense, to plan and implement the calls of obligation for service, and to ensure cooperation and aid between these sensitive areas.

The central civil defense organization consists of the General Directorate of Civil Defense, College of Civil Defense, mobile groups, and warning and alarm centers. The organization at the local levels consists of civil defense directorates, administration, and civil defense local groups (provincial and town civil defense organizations, protection guides, public and private organizations' civil defense groups).

According to this law, provincial governors and town/district governors are responsible for organizing the civil defense units, securing the necessary equipment, for its logistics, administration and control, and for implementing the civil defense requirements in their respective disaster prone areas. The provincial and town governors arrange cooperation and reciprocal aid for civil defense purposes between public and private organizations in disaster prone areas. The highest public administrative authority in the area cooperates with the Garrison Commander or the highest military authority in the area for planning of civil defense services and reciprocal aid. Municipalities in disaster prone areas have the obligation of implementing Civil Defense requests and are responsible to the public administrative authority in the area. Citizens and all organizations have the obligation of implementing civil defense requests, attend training and practice sessions when they are called.

If the public administrative authority requires, the civil defense organizations in the area of natural disasters and big fires have to participate in the rescue and aid functions carried out within the frameworks of law number 4373 (protection against floods) and law number 4623 (measure to be taken before and after earthquakes).

Article 17 defines "protection guides" for leading the public and ensuring coordination between central and local civil defense units. It is necessary to investigate the extent to which this concept is implemented in the administrative structure and to ensure its implementation in order to make use of the current regulatory arrangements.

Prime-Ministry Crisis Management Center By-Law

The organization, constitution, working, assignments and responsibilities of the Prime-Ministry Crisis Management Center (PMCMC) are defined with a By-law that aspires the smooth functioning of the operations during the emergency situation. These operations include all activities related to containment, control and suspending of the crisis situation.

The Crisis Coordination Board, which works as part of PMCMC, carries the function of planning and deciding on the activities that would be part of crisis situation management. The Crisis Appraisal and Execution Board, on the other hand, carry out the implementation stage of the Crisis Coordination Board's decisions. Information dissemination on disaster related events and public relations are functions that are fulfilled by the PMCMC secretariat.

Ordinance no.600 on "Changing the Prime-Ministry Organization Structure"
Another organization under the Prime Ministry is *the Turkish Emergency Management Directorate* (TAY) was founded to take action for avoiding emergencies through planning the countermeasures in public organizations, preparation of short and long term plans, institution and assessment of data banks that will hold disaster related critical information. In addition to these duties, TAY also fulfills the function of establishment of centers for emergency in public organizations and coordination of efforts of these centers.

4.3.3 Responsible Organizations for Disaster Management

An often-expressed opinion about the most basic problem of Turkish disaster management system is the existence of a number of different organizations, which are given -often overlapping- duties related to disaster preparedness and coordination activities by the current legal system. A comprehensive but not exhaustive list of the organizations that are given various responsibilities in preparedness, response and recovery stages are as follows:

- Natural Disasters Coordination Board
- Central Disasters Coordination Board
- Crisis Coordination Board
- Crisis Appraisal and Execution Board
- Prime Ministry Extraordinary Condition Coordination Board
- Undersecretariat of Disaster Coordination
- Turkish Emergency Management Directorate (TAY)
- Directorate of Technical Research and Development in the Ministry of Public Works and Settlements
- Directorate of Disaster Affairs
- Directorate of Civil Defense
- National Earthquake Council
- Natural Disasters Insurance Foundation
- Provincial and District Emergency Response Organization
- Provincial Disaster Bureau
- Emergency Response Teams
- Provincial and District Crisis Centers
- Civil Defense Search and Rescue Teams
- Municipalities
- Fire brigade organization
- Turkish Red Crescent
- NGOs and other civil society organizations

With its current status of several institutions and organizations being partly or wholly responsible for disaster management, it is highly unlikely to achieve the desired level of effectiveness and coordination. Redundancies should be decreased and a less complicated organizational model should replace the current system. An administrative model titled "Model for Turkey", taking the above points into consideration, was developed.

4.3.4 The New Administrative Arrangement in Istanbul

Following the 1999 Marmara Earthquake, to overcome the legal difficulties that hindered smooth functioning of disaster related activities, two new organizations were established in Istanbul:

Governorship Disaster Management Center (AYM) and Metropolitan Municipality Disaster Coordination Center (AKOM).

Governorship Disaster Management Center (AYM)
With the directive of the Head of State, AYM was founded under the Istanbul Governorship, with the main objective of achieving a higher level of coordination in disaster management. AYM contains such bodies of an execution center, a scientific consultation board (SCB), an administrative board and a management center. In year 2000, the SCB has announced an earthquake preparedness and mitigation plan. As it is the case in the SCB's plan, majority of the AYM's current duties are mainly directed towards pre-disaster stage.

Establishment of district AYMs, which will report to the district authority, is in progress. The constitution of D-AYMs requires municipality major of each district to work with district authority. In addition to the monthly management meetings organized by the Governorship, the D-AYMs meet each week on a continuous basis with a Vice-Governor to discuss technical issues. The meeting agenda and made decisions are also send to AKOM (a representative of AKOM is present at the weekly meetings).

Although the Governorship is given extraordinary entitlements for the disaster response and coordination of the activities, because of limited financial and technical resources, the Governorship is bound to ask for assistance from central government, military and other provinces. The Governorship has signed memorandum of understandings with other provinces for assistance.

Metropolitan Municipality Disaster Coordination Center (AKOM)
In year 2000, Istanbul Metropolitan Municipality (IMM) launched a center for the purposes of establishing an internal communication channel and assuring coordination between the organizations within the IMM. This center was set up with the Mayor's directive and Municipalities Council's approval. The constituents of AKOM are Fire Brigade Organization, Municipalities' health related departments, ISKI and IGDAS. IMM's General Secretary is the natural head of AKOM, whereas the Supervisor of the Fire Brigade is the vice-head.

AKOM do not have an organic link with the District Municipalities or D-AYMs. In terms of organization both IMM and AKOM report to the Governorship on a monthly basis. Weekly AYM meeting results and decisions send to AKOM without delay. At the post-disaster stage, AKOM is given the duty of following the orders of the Governorship. Some major public organizations like ISKI and IGDAS are constituents of AKOM. These organizations also take part in AYM meetings for the information sharing purposes. In case of a disaster, these organizations' heads are directly responsible to the Governor, whereas their deputies attend AKOM meetings.

In contrast to the Governorship, the IMM do not have yet signed memorandum of understanding with other province municipalities.

4.3.5 Administrative Structure in the "Making"

In this section, the problems that occur due to the current legal structure in real life disaster management cases were taken up. The disaster management experience after large and medium sized earthquakes in Turkey showed large discrepancy between the management that is foreseen by the legal framework and the actual management. For instance, Ozerdem and Barakat (2000) report a large number of such observations and suggestions. At the response stage, the activities and personnel of the Directorate of Civil Defense were found to be inadequate. The national search and rescue teams and international assistance organizations largely filled this void. Moreover, the Turkish Armed Forces troops' response activities were highly regarded. This discrepancy points to the possibility of the current administrative structure not being capable to deal with large-scale disasters. For example, in general both central and local authorities were unsuccessful in regard to assessment of buildings in terms of earthquake safety. It was suggested that **private civil engineering firms** should be given the function of earthquake safety auditing of buildings. As of July 2001, the Construction Inspection Ordinance gave both responsibilities and duties to such firms.

A study conducted in Golcuk at the aftermath of 1999 Marmara Earthquake (Alp, Kabasakal & Sirman, 1999) concluded that both central and local administrative bodies were deemed to be rather slow and ineffective in dealing with the disaster. The same study points to the civil initiatives' significant role in search and rescue, and humanitarian help, as well as military troops. In the administrative vacuum, some natural leaders among the citizens emerged and became highly influential in the coordination of response and recovery activities. The same period saw extensive media coverage on arguments related to the Turkish Red Crescent being rather ineffective, and as a result the Red Crescent supervisor had to resign. To sum up, the administrative vacuum left behind by the 1999 Marmara Earthquake was filled by national and international organizations including civil initiatives and the Turkish Armed Forces.

In another study (Barbarosoglu, Fisek, Kabasakal, Iseri, Inelmen & Aydogdu, 2001), which was conducted after a medium sized earthquake in Osmaniye, the workings of the administrative structure were investigated. The results of this study showed that there were differences between the nature of the response activities in the city center and the rural areas. In the rural areas, the Gendarmerie troops and Red Crescent have been active in organizing and delivering the humanitarian help, whereas in the city center the Municipality and a civil society organization have been active in coordination of the efforts. As prescribed by the by-laws of disaster management, the Osmaniye Governorship activated the Crisis Management Center and coordinated activities of involved parties. Again, the central administrative structure was deemed to be slow in delivering relief after the disaster.

These studies that were conducted right after the earthquakes did provide important insights for the actual disaster management in Turkey. In accordance with these findings, a new administrative model for disaster management was prepared and **municipalities, civil society organizations** and **the Turkish Armed Forces** given active role in both preparation and response stages. Moreover, current regulations need to be significantly revised to give way to the **international organization** for being part of disaster preparation and response. Although the Law no 7269 prescribes some tax immunities and tariff exemptions, the experience of 1999 Earthquake showed that there is still room for large improvements in that regard. In the present study, under the light of earlier investigations' results and observations, suggestions for an effective administrative organization are developed.

4.3.6 Conclusions

The Law no 7269 on "Precautions and Aid Regarding All Types of Disasters that Impacts the Community", Law no. 7126 on "Civil Defense", Organization Structure and Planning of Disaster-Related Responses By-Law, Ministry of Public Works and Settlements' Duties and Organization By-law, Prime-Ministry Crisis Management Center By-Law, Building Inspection Ordinance, Ordinance no.600 on "Changing the Prime-Ministry Organization Structure" establish the legal structure of the current disaster management system in Turkey.

An assessment of the current legal structure is provided below:

1. The chief legal frame of disaster management is Law no. 7269 which is mainly directed toward post disaster organization of humanitarian help, assessment of the damage and finance, although there are some articles that are devoted to duties and responsibilities related to preparedness.

- The Law no 7269 holds that the Ministry of Public Works and Settlements has the authority and responsibity for the coordination of disaster preparedness activities of the central governmental organizations. Additionally, Directorate of Civil Defense under the Ministry of

Internal Affairs and Turkish Emergency Management Directorate (TAY), which was found after the 1999 Earthquake, are responsible for coordination, planning and organization. This tripartite structure, which also includes a number of other side organizations held responsible, constitute a highly complicated and confusing arrangement where the roles in the disaster management is highly obscure.

- In addition to this tripartite structure, there are a number of other boards that are activated after a disaster, such as Prime Ministry Crisis Management Center and Central Disasters Coordination Board. These boards further complicate the situation in case of disasters.
- At the provincial level, from a legal perspective the central administrative bodies are the ones that are in charge. Following a disaster the appointed Governor and the district authorities are given extraordinary entitlements for the purposes of management of response activities at the province scale. The current legal regulations do not specify administrative role for municipalities, NGOs, professional organizations, muhtars and citizens, but holds them responsible for carrying out the duties assigned by the central authority. Moreover, these parties are also not given any discretion neither for planning, nor for mitigation stages.
- Due to the complicated and difficult to implement nature of the laws and by-laws related to disaster management, especially after the 1999 Earthquake the central governmental organs appeared to be inadequate to deal with large-scale disasters.
- With the perception of weakness of disaster preparedness measures, to remedy this weakness under Istanbul Governorship AYM and under Istanbul Metropolitan Municipality AKOM organizations have been instituted.
- As the result of an assessment of the current disaster management system, there appears a need for a less complicated, new administrative structure. To assure the successful implementation of the new system, independent planning, leadership and assessment functions must be incorporated in this framework.

4.3.7 Models in Other Countries

Disaster management practices in Turkey were examined from a critical perspective and accordingly, in order to develop a new model on the basis of these evaluations, models of disaster management in other countries were taken into consideration. For this study, mainly Europe, America, Far East and Pacific-based models were investigated (Council of Europe Report, 1999; Farazmand, 2001; Istanbul Technical University Crisis Management Report, 2002; Sengezer & Kansu, 2001). In particular, Germany, United States of America, Australia, Austria, Belgium, Denmark, France, Finland, South Korea, Hong Kong, Holland, Spain, United Kingdom, Ireland, Italy, Japan, Canada, Luxemburg, Portugal, and Greece were considered.

When structural and administrative characteristics of the above listed countries are examined, it is seen that there are significant differences besides noteworthy similarities. While some of these countries adopted centralized governance systems (e.g. France, Japan), some of them are governed through federal structure (e.g. USA, Germany, Australia, Canada).

On the other hand, when the development of disaster management models in these countries are investigated, while complex administrative structures are observed in prior phases, it is observed that after being exposed to serious disasters, there is a tendency towards simplification of these administrative structures and turning them into effective ones where coordination can be achieved easily. South Korea and Japan are two countries experiencing such kind of developments. After the 1995 Kobe Earthquake, Japan reduced the number of 22 ministries and institutions related to disaster management to half and transformed the structure into a more efficient one through a smaller structure. In USA, where dealing with disasters were responsibilities of several institutions until 1970s, all these functions were gathered into FEMA (Federal Emergency Management Agency) after this date. Especially after 11th September, FEMA is also under a new centralization process with many more units and organizations under the name of Homeland Security[3].

As seen in Homeland Security model, natural and man-made disasters are treated together and gathered under the same configuration. The proposed Homeland Security model can be seen in Figure 4.3.2 This tendency in USA is also experienced in several other countries that were exposed to serious disasters. In the case of South Korea, after the large-scale disaster that occurred in Sampoong Store, disaster management by-law was constituted in 1995 and accordingly, natural and man-made disasters have been evaluated together since then. The South Korean model can be seen in Figure 4.3.3 (Kim & Lee, 2001).

In addition, disaster management model of France, a European country that has a similar governance structure with Turkey, is provided in Figure 4.3.4 (Council of Europe Report, 1999) and disaster management model of Japan, a country which was exposed to several large-scale disasters and has highly developed disaster management practices is provided in Figure 4.3.5 (Sengezer & Kansu, 2001).

[3] http://www.dhs.gov

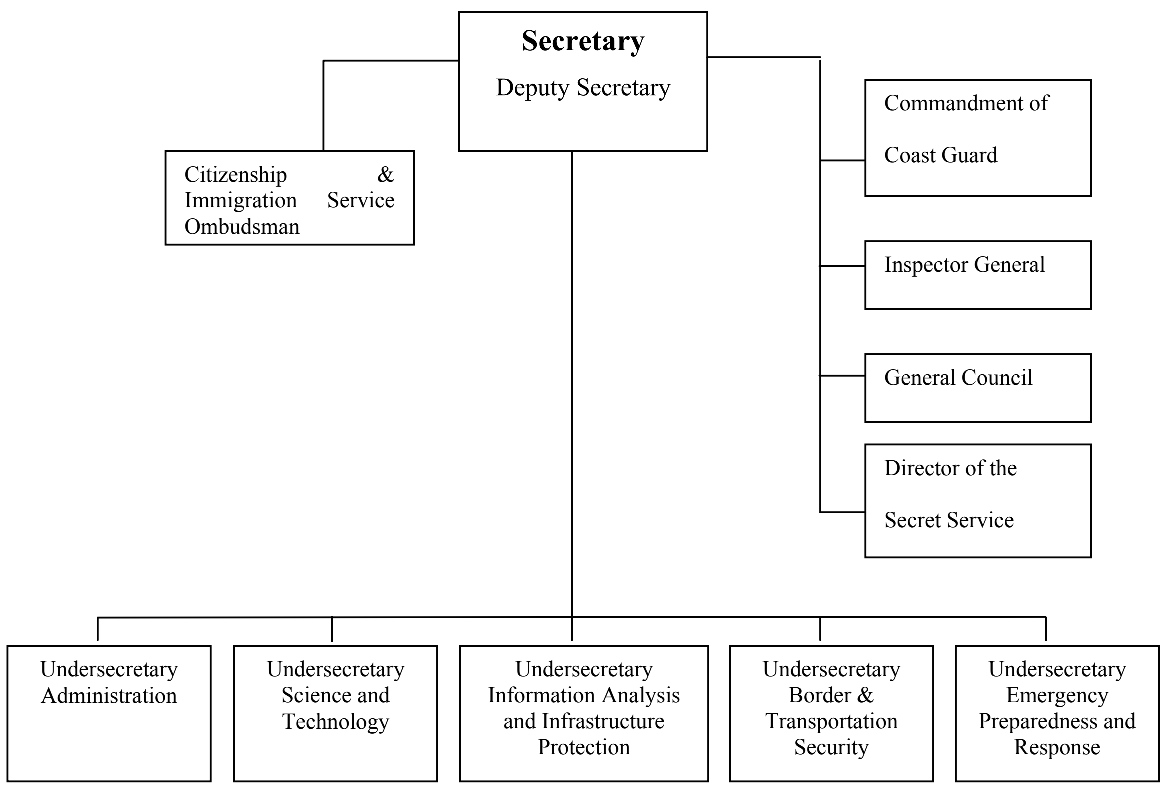


Figure 4.3.2. Homeland Security Model

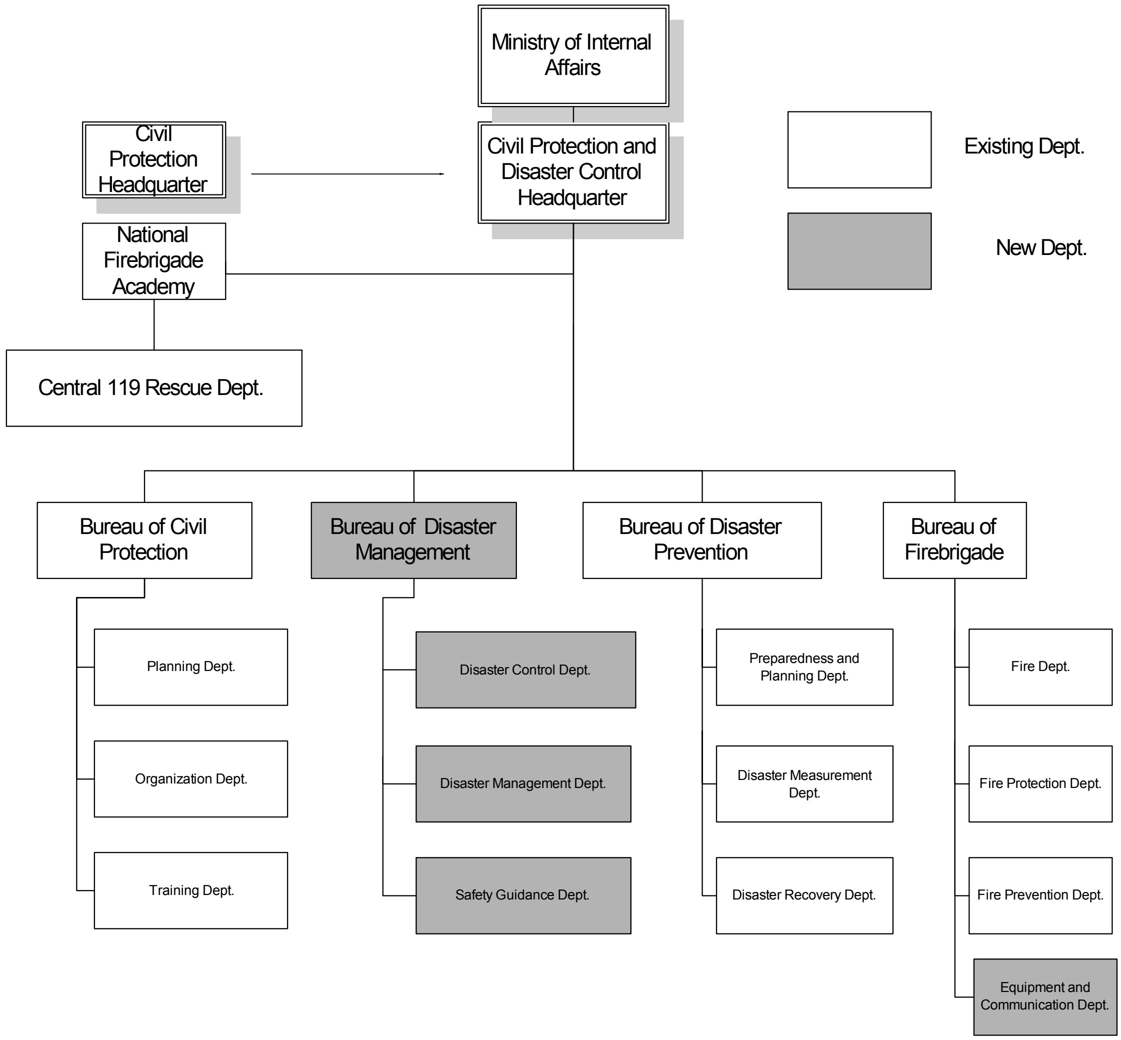


Figure 4.3.3. Korea Civil Protection Model

DISASTER RELIEF IN FRANCE

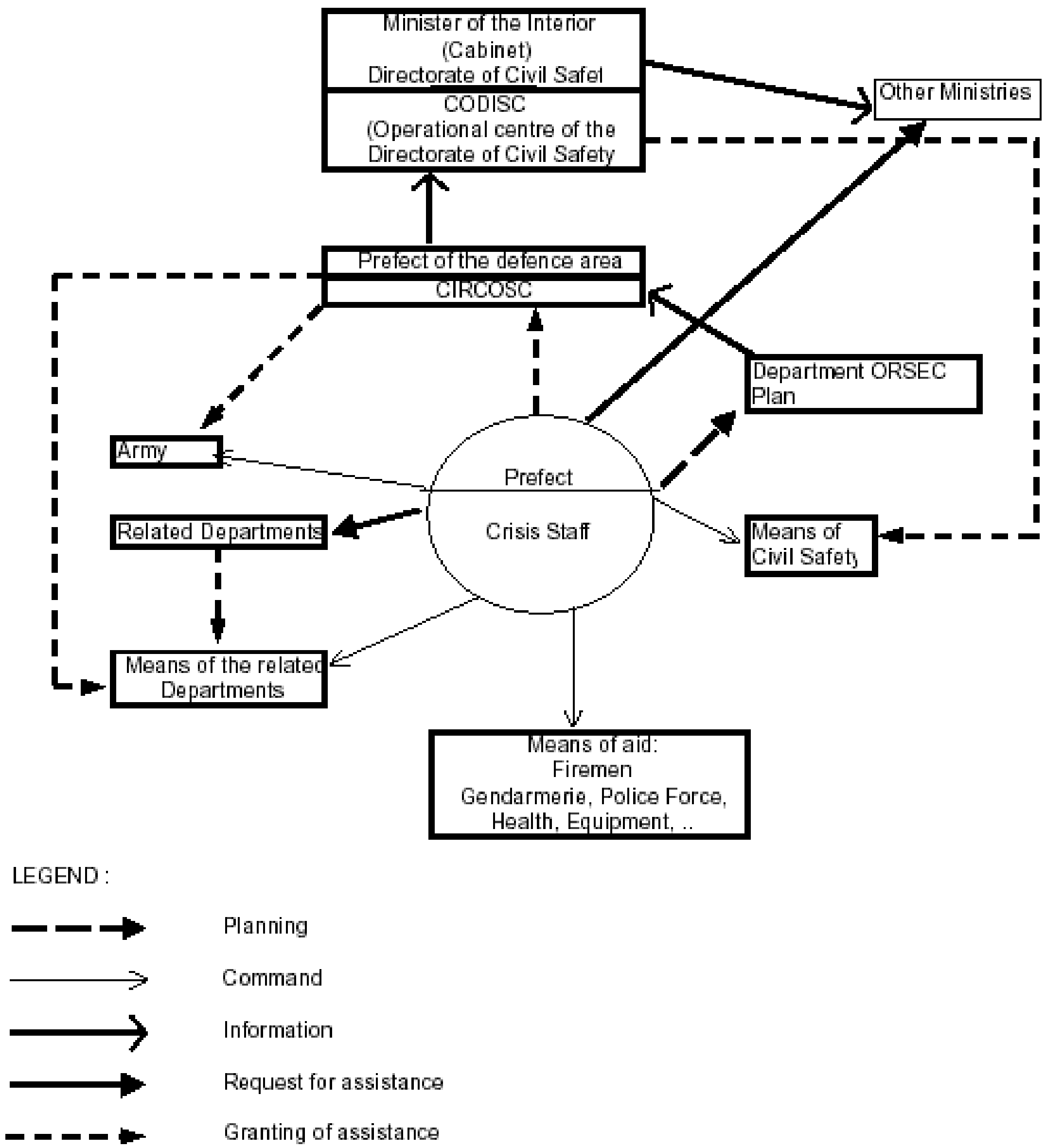


Figure 4.3.4. Disaster Relief in France

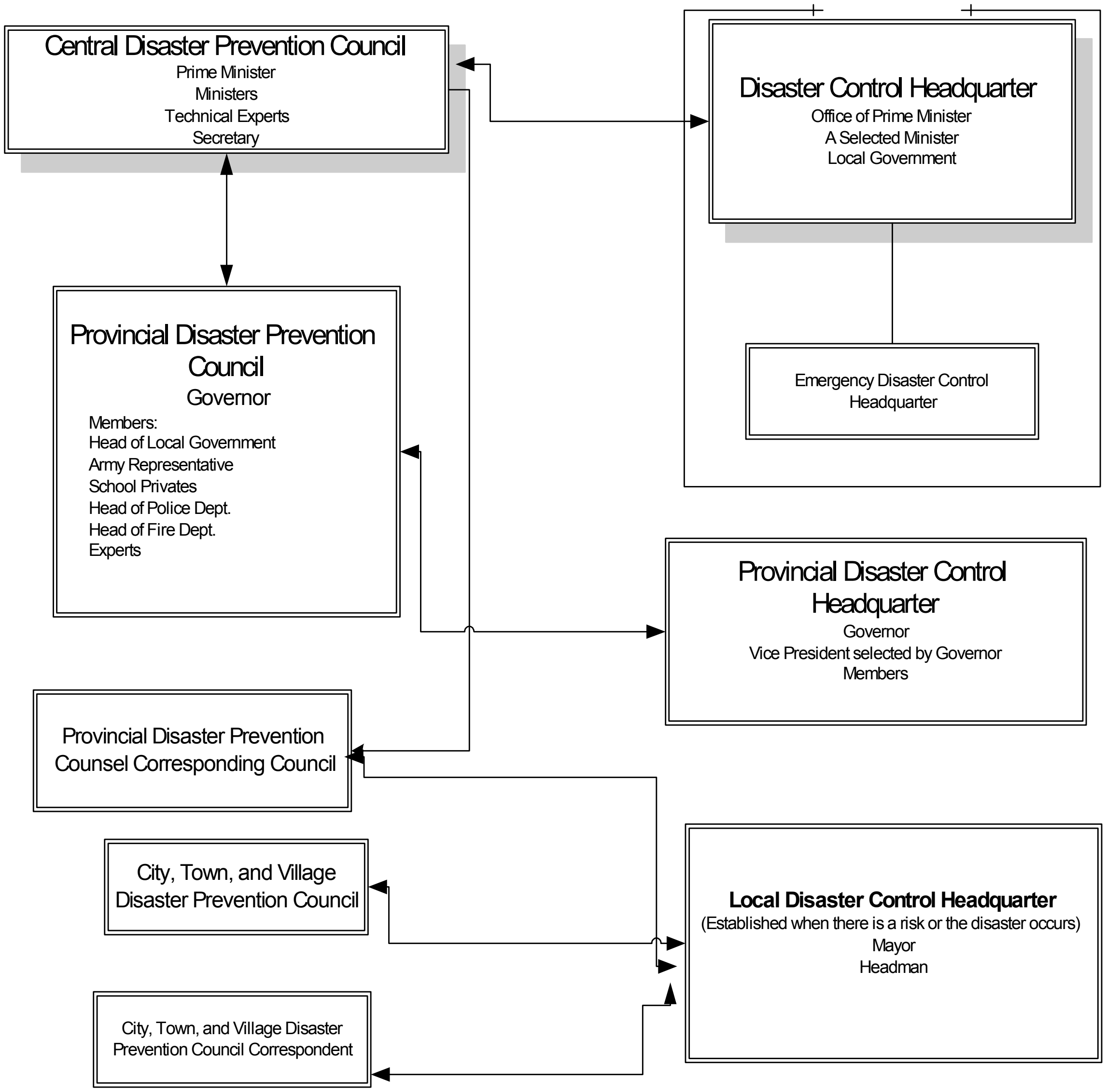


Figure 4.3.5. Disaster Management in Japan

4.3.8 Organizational Structure of the Higher Board Responsible for Disaster Management

As disaster management requires technical skills, resources, and coordination among several organizations, it becomes inevitable for the central government to have a role in disaster management as an effective and high authority. In the country examples that have been investigated, it is also observed that government plays a major role in providing advanced technology and required resources, and achieving coordination through a higher board. The structure of this board appears in several different ways:

1. Supra-Ministry Independent Board (e.g. USA and Australia)
- Board within Cabinet or Prime Ministry (e.g. Japan)
- Board within National Defense Ministry (e.g. Canada)
- Board within Ministry of Internal Affairs (e.g. Belgium and South Korea)

Regional Structuring

In most of the countries examined, it is observed that there are regional boards acting in relation to a higher board responsible for disaster management. For example, in Sweden, Regional Management Boards were established in relation to Swedish Rescue Services which provides higher coordination. These boards coordinate the activities of Municipality Rescue Services in their regions. In a similar manner, in Greece, 13 regions were formed under the Ministry of Internal Affairs Civil Defense General Secretariat and in addition, these regions were divided into 54 provinces.

Provincial Structuring

When organizational structure at the provincial level is examined, it is observed that while in some countries the Governor is the sole responsible person (e.g. Japan), in several ones the Mayor bears this responsibility (e.g. Holland), and in other countries responsibility is shared through a cooperation between the Governor and the Mayor (e.g. Italy and Portugal). While one reason for such different applications is the differences in the size of residential areas and settlements, the other reason is whether the country has a central or a federal general administrative system.

In general, there are Provincial Disaster Prevention Boards responsible to the Governor or the Mayor. Besides, it is also possible to come across Provincial Disaster Control Centers that are established after serious disasters.

In some countries (for example Japan) there are efforts to become organized in lower levels of the government system in settlements like city-town-village. These organizations work mainly under the governance of the Mayor.

Other Factors

In the models of most of the countries, the armed forces are an active member in the administrative system (e.g. Portugal, Greece, and France). Besides, non-governmental and community-based organizations, institutions specialized in health and technical issues, and citizens also take place in administrative model (e.g. Portugal and Greece).

4.3.9 Model for Turkey

The current disaster management model in Turkey represents a structure mainly devoted to response activities taking place after disasters. In the proposed model, besides response activities, mitigation and planning activities including pre-disaster stages are also emphasized. After determining general principles for this purpose, by considering pre- and post-disaster stages, authorities that will manage mitigation, preparedness, response, and recovery activities and take related decisions will be designated at country, province, and district levels.

Principles of the Administrative Structure

In Turkey's current situation, there is an administrative gap about the bodies responsible for carrying out the required activities for preparedness and mitigation purposes in case of a possible disaster. Although laws, to a certain extent, determine the authority and responsibility for the activities needed to be carried out after disasters, it is not currently available for pre-disaster activities. The present administrative structure focuses mainly on organizing and coordinating post-earthquake activities.

In addition to administrative gaps, present structure is complex and leads to possible inefficiencies. As a result of numerous boards responsible for achieving coordination, a system has developed, which is incomprehensible, where decision making takes a long time and duplications give rise to inefficiencies. While authorities at higher levels of the hierarchical system should be responsible for coordination among units that should work in cooperation, this responsibility was given to authorities at the same hierarchical level. The proposed model was developed by considering several principles that would remove all these problems. The proposed model and the related boards will be discussed in detail in following sections (see Figure 4.3.6, 4.3.7, and 4.3.8). These principles are summarized below.

Integration of Pre- and Post-Disaster Activities

Besides responsibilities of pre- and post-disaster activities, the execution should also be carried out by the same authorities. Based on this principle, the existing gap about the responsible authorities of pre-disaster activities was filled in the proposed model.

Handling Planning and Controlling Together

Authorities that have clearly defined responsibilities are expected to make short, medium, and long-term plans regarding their responsibility areas. At the governmental level, Disasters Undersecretary and Central Disaster Preparedness and Response Council under the presidence of the Prime Minister, and at the provincial level the Provincial Higher Board (see Figure 4.3.6) will be responsible for making these plans in coordination with each other.

Besides, it is required to control in short, medium, and long terms whether the authorities' plans are implemented or not. In other words, inspection is needed for performance checks. Authorities that are responsible for achieving coordination of plans should also carry out the controlling function.

Hybrid Structure

Inside a hybrid structure, "centralization" and "participation" of local governments, non-governmental and all other concerned organizations in decision making processes should be achieved simultaneously.

Centralization

As decisions will be related to a large-scale disaster and have strategic importance, it is inevitable to have "centralization" and gather authority in one body. Centralization is needed in order to achieve coordination among related units and have faster decision making.

Participation of Related Units to Decision-Making Processes

On the other hand, due to high levels of complexity, uncertainty, and need for information about local conditions, it is necessary to include local government, the military, non-governmental organizations and all other related organizations in the decision making processes. Central administration is responsible for activating the participation of all these organizations and achieving coordination and cooperation among them.

Lean and Easy-to-understand Structure

The proposed structure is "lean". The numbers of coordination boards are reduced to a minimum. Coordination is achieved through a hierarchical system.

Organizing at Different Levels

It covers organizing at several levels namely, central, provincial, and neighborhood level, and determines responsible organizations/institutions for each level.

In the proposed model, organizing at the country-wide and provincial-wide regional levels were not considered. It was believed that inclusion of these types of organizing would bring more complexity and were not appropriate for the Turkish administrative system. However, although additional bureaucratic levels of organizing are not formed, planning for cooperation and reciprocal assistance by the neighboring provincial Governors is inevitable. Collaboration is required under the presidency of the Undersecretary responsible for disasters heading the Central Disaster Preparedness and Response Council in order to activate this cooperation without any problem. Additionally, although the European and Asian sides of Istanbul were considered as unified in administrative terms, coordination of activities that will be held on both sides should be planned effectively. This coordination planning process should be carried out at the Provincial Higher Board level.

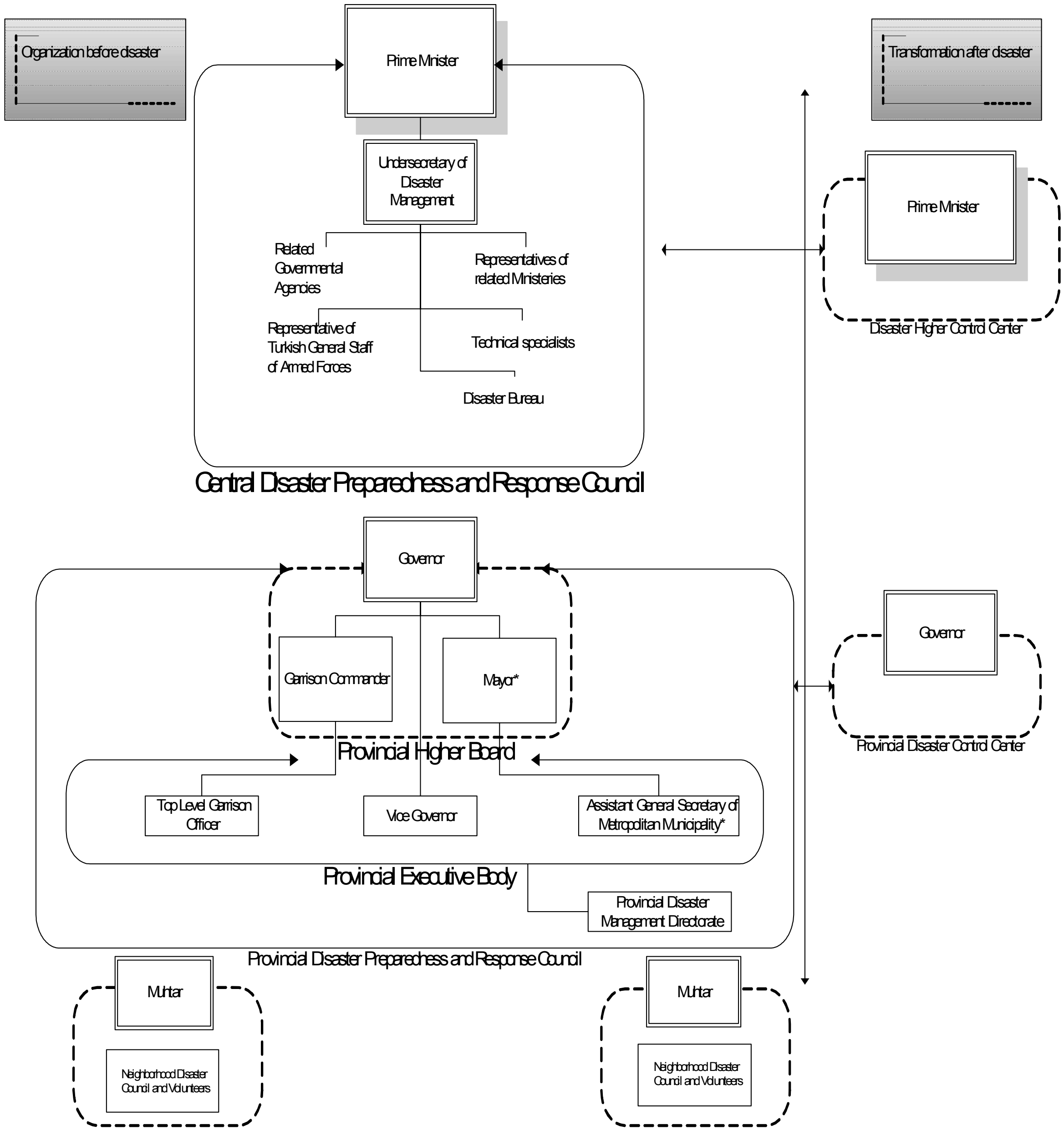
Participation of Volunteers and Designation of Principles

Considering the magnitude of a probable earthquake, it is clearly seen that it is impossible for government officials to deal with all possible secondary disasters and carry out all search-rescue activities. For this reason, it is proposed that **volunteer** participation be planned both at district and neighborhood levels by the Fire Brigade in dealing with secondary disasters and by the Directorate of Civil Defense in its search-rescue activities. However, necessary rules and regulations about volunteers' participation and responsibilities need to be prepared and defined based on mutual understanding. At this point, problems of the notion of "civil defense obligation" should be considered, and this process should be examined on the basis of volunteer participation.

In addition to dealing with secondary disasters and search-rescue activities, it is important to achieve volunteer participation of neighborhood residents and the public during the stages of preparedness, mitigation, response and recovery. In order to attribute an active role to **neighborhood administrators** at the neighborhood level, some principles were determined and these are discussed in further sections.

The Proposed Model

Turkey National Disasters Coordination Board, Central Coordination Board of Disasters, Crisis Coordination Board, Crisis Evaluation and Monitoring Board, Prime Ministry Extraordinary circumstances Coordination Board, First Undersecretary of Disasters Coordination, Turkish Emergency Management in Turkey (TAY), National Earthquake Council, General Directorate of Technical Research and Application of Ministry of Public Works and Settlements, General Directorate of Disaster Management, General Directorate of Civil Defense of Ministry of Internal Affairs are among the organizations and institutions that serve as example for the fundamental problem of disaster management system in Turkey, namely, multiple authority. In order to solve the above-mentioned problem and achieve cooperation, two different propositions were developed to be implemented in short-and long-term.



*In provinces where there are not metropolitan municipalities, the central district mayor and vice mayor assume these roles

Figure 4.3.6. Model for Turkey

<u>Model to be Implemented in Long-Term</u>

As seen in models of countries like USA and South Korea, following extensive disasters, there is a tendency to evaluate and bring together both natural and man-made disasters under the same structure. For example in USA, Homeland Security was established after September 11th. Emergency preparedness and response, information monitoring and border security are among the functions of this organization and effectiveness and coordination are achieved through centralization.

In the model proposed for implementation in Turkey in the long-term, a decrease in the number of ministries related with functions of disaster management is advised. Thus, by solving the coordination problem among units gathered under different ministries, it is aimed at achieving a more effective cooperation. As an example of this tendency, the *Ministry of Disaster and Civil Security* is proposed to be established, centralizing the main responsibilities, functions and authorities under a single ministry. In the case of establishing such a ministry, its functions and responsibilities, support relationships from other ministries and cooperation among each should be clarified by legislation. It is also proposed to combine the management of natural disasters and man-made disasters under same administrative structure. In case of deciding to establish a new ministry, various alternative organizational structures may be considered.

<u>Model to Be Implemented in Short-Term</u>

While the proposed short-term model intends to maintain the current laws, public system and structuring without any large-scale changes, it offers a more efficient organizational structure that overcomes present problems and achieves more effective coordination. In this proposed short-term model, new structures are planned at both central, provincial and neighborhood levels.

In the development phase of this model, other country models were investigated for evaluating whether regional and sub-provincial structures would be appropriate for Turkey. First impressions and expert opinions suggest that regional structuring, as seen in some countries (e.g. Sweden), that will organize response of neighborhood provinces will not be appropriate for the Turkish administrative public system. It is widely accepted that regional structuring will cause further problems of cooperation, timely-response, and management due to additional hierarchical levels. However, at the provincial level, coordination of preparedness and response systems at European and Asian sides of Istanbul seem to be a critical issue.

Structure at the Center

In this model, the Prime Minister is the head of *Central Disaster Preparedness and Response Council* and on behalf of the Prime Minister; the execution is carried out by the Undersecretary responsible for disasters. The Council is made up of heads or representatives from related ministries, General Staff of Armed Forces and several organizations, technical experts, besides the Prime Minister and/or Undersecretary. Furthermore, it is proposed that this higher council should include the *Disaster Bureau,* which will undertake the secretariat function and be responsible from the coordination function and ensure communication among responsible ministries and organizations (Figure 4.3.7).

As investigated in models of other countries, the structuring of the higher council to be established under Prime Minister is one of the existing alternatives. This model is also applied in countries like Japan and Greece that are exposed to large-scale natural disasters and also have similar cultural characteristics. The aim of the Central Disaster Preparedness and Response Council in the proposed model is to achieve coordination among units in different ministries that are directly related to disasters, and directorates responsible for carrying out these functions. Another responsibility of this board is coordination among other public organizations and institutions related to disaster management. Current applications in Turkey show that there are problems of coordination and that too many organizations have been established with the same aim (Canpolat, 2003). In the proposed model, this complex organizational structure will be simplified and transformed into a more effective one.

The aim of the *Central Disaster Preparedness and Response Council* is to develop a national policy and macro plans for disaster prevention. This council is chaired by the *Prime-minister* and includes the related ministers and head of the following formal and semi-formal institutions:

- Ministry of Public Works and Settlement
- Ministry of Internal Affairs
- Ministry of Finance
- Ministry of Health and Social Aid
- Ministry of National Education
- Ministry of Tourism and Culture
- Turkish Armed Forces
- Turkish Red Crescent
- Kandilli Observatory and Earthquake Research Institute
- TÜBİTAK (The Scientific and Technical Research Council of Turkey)
- General Directorate of Turkish State Meteorological Services
- Turkish Telecom Company
- TRT (Turkish Radio and Television Institute)
- TOBB (Turkish Union of Chambers)
- Technical experts
- Disaster Bureau (a new organization for TAY)

It is proposed that the *Disaster Bureau* will carry out the communication of the decisions to the related organizations, ensure coordination among them, and conduct the reporting functions of the *Central Disaster Preparedness and Response Council.* The currently functioning *General Directorate of Turkish Emergency Management* (TAY) may be designated as the *Disaster Bureau*, with a larger group of personnel. It is suggested that in addition to the core personnel, personnel from related ministries and institutions work in the *Disaster Bureau* as a second job in order to enhance coordination among the separate institutions.

Disaster Higher Control Center

After serious disasters, Disaster Higher Control Center is activates in order to take decisions and give necessary orders concerning humanitarian aid, search and rescue, transportation, communication, health services, secondary disasters, debris removal, damage assessment and all related functions within the scope of response activities and starts to work within the framework of Central Disaster Preparedness and Recovery Council members and plans. This center is equipped with extraordinary authority and acts as a crisis command center.

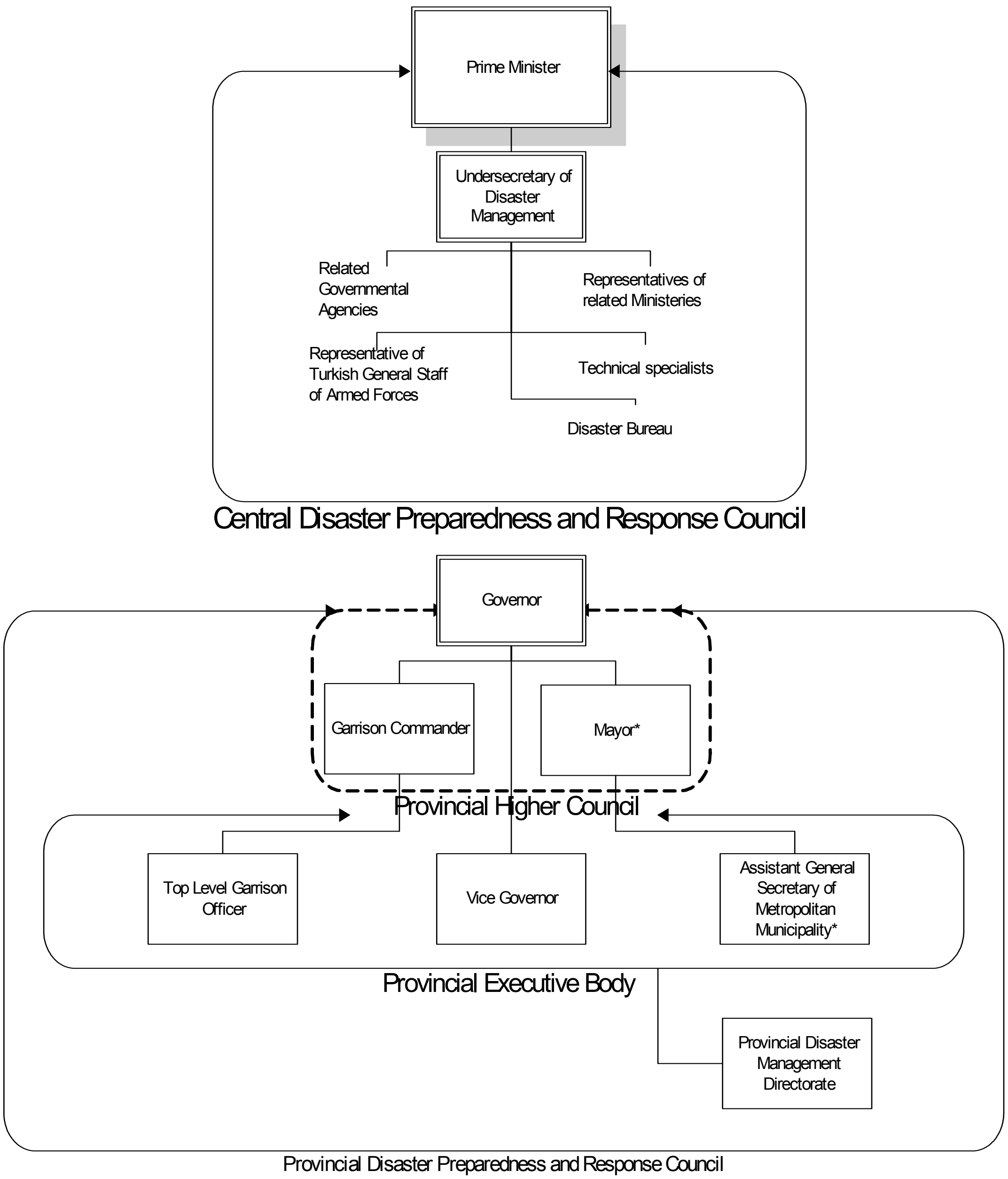
Organizational Structure at the Province Level

Provincial Disaster Preparedness and Response Council

In the proposed model, the *Provincial Disaster Preparedness and Response Council* is the agency that is responsible for all disaster management activities. The top authority of the council is the *Provincial Higher Board,* which is the highest body for decision making in disaster related functions and activities in the province. The *Governor* of the province is the leader of the *Provincial Higher Board*, where the *Mayor of the Larger Metropolitan Area* and the *Garrison Commander* are the members who together share the responsibility of disaster management in the province. The reason for forming this board is to ensure coordination among the disaster-related activities of the governorship, municipality, and the military, and to share the responsibility and authority in disaster management with the bodies that have the related resources and know-how. A *Vice-governor, an Assistant General Secretary of the Metropolitan Municipality* and *Garrison Commander* constitute the *Provincial Executive Body,* which is responsible for execution of the decisions taken by the *Provincial Higher Board* and to achieve coordination in the implementation of disaster-related activities.

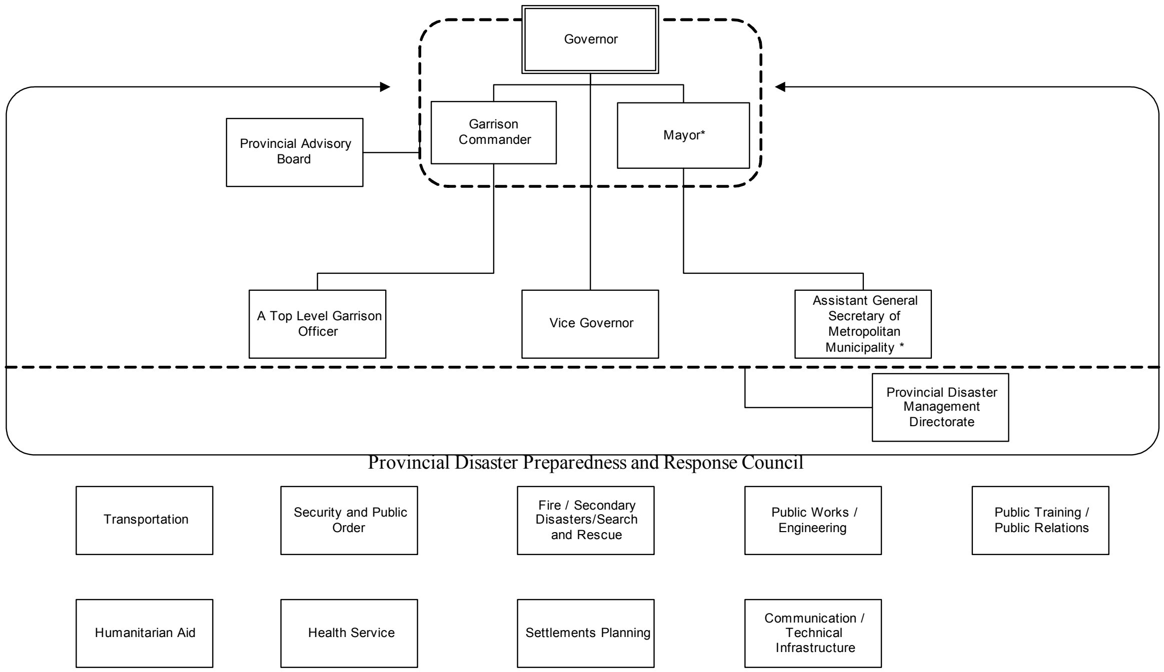
Given that only 15 provinces in Turkey have a metropolitan municipality status, in other provinces, the Central District Mayor would take on the role of the Mayor of the Larger Metropolitan Area, while the Vice-Mayor would take on the role of the Assistant General Secretary of the Metropolitan Municipality in the *Provincial Disaster Preparedness and Response Council.*

Although the involvement of municipalities in disaster management mainly concerns the activities of the metropolitan municipalities or the central district municipalities, there are some issues that require the involvement of district municipalities. There needs to be a legal framework to ensure coordination among the decisions taken by the *Provincial Disaster Preparedness and Response Council* and the district municipalities so that the district municipalities comply by the decisions and plans developed by the *Provincial Disaster Preparedness and Response Council* and work in a coordinated manner.



*In provinces where there are not metropolitan municipalities, the central district mayor and vice mayor assume these roles

Figure 4.3.7. Disaster Management Model of Turkey



*In provinces where there are not metropolitan municipalities, the central district mayor and vice mayor assume these roles

Figure 4.3.8 Organizational Structure at Province Level

The disaster-related functions that fall within the domain of the Provincial Disaster Preparedness and Response Council are:

- Security and Public Order
- Transportation
- Health Services
- Public Training/ Public Relations
- Humanitarian Aid
- Fires/ Secondary Disasters/Search and Rescue
- Public Works/Engineering
- Settlements Planning
- Communication/Technical Infrastructure

These disaster-related functions are formed by a re-categorization of more than 20 sub-activities and functions that are derived by reviewing various sources and reports. Institutions and units that should be responsible for carrying out different activities are identified and the bodies that will achieve coordination among different parties are determined. The *Provincial Executive Body* will be responsible for ensuring coordination among different institutions and units within the functions. The *Provincial Executive Body* will bring together the provincial heads of institutions related to each function with the purpose of developing plans and effective implementation in a coordinated manner. The *Provincial Disaster Preparedness and Response Council* will be accountable for coordinating the activities of parties involved across all functions. After major disasters, the responsibility for coordination of all activities will be passed to the *Provincial Disaster Control Center.*

In this model the *Provincial Disaster Directorate* will be responsible for the executing effective implementation of the decisions taken by the *Provincial Disaster Preparedness and Response Council* by carrying out the communication of the decisions to the related institutions, reporting, filing, and writing out the plans. The currently functioning *Governorship Disaster Management Directorate* can take on the role of the suggested *Provincial Disaster Directorate,* with an enlarged body of human resources and restructuring. In addition to the core personnel of the *Governorship Disaster Management Directorate, the Provincial Disaster Directorate* needs to include personnel from the metropolitan municipality and other related institutions as their second job, with the purpose of enhancing coordination among the organizations.

Parties Responsible for Implementation of Disaster-Related Functions:

- Security and Public Order
  - Directorate of Provincial Police, Gendarmerie Garrison Commandership, Provincial Disaster Directorate (Governorship Disaster Management Directorate)
- Transportation
  - Metropolitan Municipality Transportation Planning Directorate, Metropolitan Municipality Infrastructure Coordination Directorate, Metropolitan Municipality Traffic Directorate, General Directorate of Highways, Governmental Airports Enterprise (DHMI), Turkish Governmental Railways (TCDD), Turkish Maritime Enterprises (TDI), Istanbul Fast Ferry (IDO), Provincial Disaster Directorate (Governorship Disaster Management Directorate)
- Health Services
  - Directorate of Provincial Health and Social Aid, Directorate of Provincial Civil Defense, Directorate of Provincial Work and Social Security, Turkish Red Crescent, Metropolitan Municipality Search and Rescue Organization, Metropolitan Municipality Directorate of Health Protection, Provincial Disaster Directorate (Governorship Disaster Management Directorate)
- Public Training/Public Relations
  - Governorship Disaster Management Center (AYM), Metropolitan Municipality Disaster Coordination Center (AKOM), Directorate of Provincial National Education, Turkish Radio and Television Institution (TRT), Other radio and television stations, Chamber of Architects and Engineers (TMMO), NGOs, Neighborhood Organizations, Provincial Disaster Directorate (Governorship Disaster Management Directorate)
- Humanitarian Aid
  - Governorship, Directorate of Provincial Public Works and Settlements, Directorate of Provincial Health and Social Aid, Turkish Red Crescent, Metropolitan Municipality Directorate of Cemeteries, Provincial Directorate of Population and Citizenship, Social Services and Children Protection Institute, Provincial Disaster Directorate (Governorship Disaster Management Directorate)
- Fires/Secondary Disasters/Search and Rescue
  - Turkish Armed Forces, Directorate of Provincial Civil Defense, Fire Brigade, Metropolitan Municipality Directorate of Flammable and Chemical Materials Warehouse, NGOs, Neighborhood Organizations, Public and Private Ambulance Services, Provincial Disaster Directorate (Governorship Disaster Management Directorate)
- Public Works and Engineering
  - Provincial Directorate of Public Works and Settlements, Metropolitan Municipality Directorate of Public Works, Metropolitan Municipality Directorate of Soil and Earthquake Inspection, District Municipalities, Private Building Inspection Firms, Chamber of Architects and Engineers, Chamber of Civil Engineers, TÜBİTAK (The Scientific and Technical Research Council of Turkey), Provincial Disaster Directorate (Governorship Disaster Management Directorate)

- Settlements Planning
    - Provincial Directorate of Public Works and Settlements, Metropolitan Municipality Directorate of Soil and Earthquake Inspection, Metropolitan Municipality Directorate of Settlements, Private Building Inspection Firms, Governorship Disaster Management Directorate, Ministry of Rural Affairs, Natural Disasters Insurance Institute, Provincial Directorate of Tourism and Culture, Institute of Monuments, Directorate of National Trust, Chamber of Architects and Engineers, Local Assessment Unit for Settlements Planning, Provincial Disaster Directorate (Governorship Disaster Management Directorate)
- Communication/Technical Infrastructure
    - Governorship Disaster Management Directorate, Turkish Telecommunication Company, General Directorate of Radio and Wireless Communication, Private GSM Firms, Provincial Directorate of Energy and Natural Resources, Regional Directorate of State Hydraulic Works (DSI), Istanbul Water Company (ISKI), Istanbul Gas Company (IGDAS), Turkish Electric Distribution Company (TEDAS), Bogazici Electric Distribution Company (BEDAS), Representative of Turkish Radio Amateurs Association, Kandilli Observatory and Earthquake Research Institute, Provincial Disaster Directorate (Governorship Disaster Management Directorate)

Security and Public Order, Transportation, Health Services, Public Training/ Public Relations, Humanitarian Aid, Fires/ Secondary Disasters/Search and Rescue, Public Works/Engineering, Settlements Planning, and Communication/Technical Infrastructure functions related to disaster management involve different organizations and thus the issue of coordination among these parties in preparedness and mitigation deserves a special focus. Following are some of the issues that emerged in interviews with the participants in this regard:

- The Provincial Security Directorate needs to develop plans in cooperation with the Gendarmerie Garrison District Commandership for ensuring security and safety against possible rebellions, anarchy, looting and vandalism that can occur after a major earthquake.
- Article 19 of the Floor Ownership Code requires a consensus among all owners for strengthening and retrofitting damaged or risky buildings. This article needs to be changed from requiring consensus to "majority vote" for strengthening and retrofitting of buildings.
- The various parties responsible for transportation needs to take precautions and make plans in a coordinated manner against a possible collapse of main arteries and viaducts, and plan for alternative maritime routes, railways, and airways.
- The related governmental bodies need to cooperate with private health organizations and Turkish Red Crescent in planning for needed health personnel, medicine, blood types, and other material, allocating the stocks among different locations, and designing a system which will circulate the stocked medicine and blood so that they would be used before their expiry date.
- Observations after the 1999 Marmara Earthquake showed that there were delays and bureaucratic problems in receiving international search and rescue teams and humanitarian aid. Revisions in legal framework and including a representative from the *Customs Directorate* in the *Provincial Disaster Control Center* are needed to increase the efficiency of the system.
- In order to activate participation of NGOs and CBOs in disaster management activities, the governmental bodies that are directly responsible for disaster management should not only provide information, but rather should play an active role in motivating and achieving their commitment. The media needs to be used vigorously as a tool of information sharing as well as motivating active involvement.

- In order to be able to effectively cope with fires/secondary disasters/search and rescue activities, NGOs and CBOs need to be actively involved in planning at neighborhood level and volunteers need to be encouraged and trained for these functions. There is a need to increase the number of water hydrants and establish local fire brigade stations in neighborhoods, particularly in those districts with transportation difficulties.
- Efforts geared towards preparing for a possible major earthquake should consider strengthening the communication, electricity, water, and gas infrastructure and plan for alternative resources and communication channels. These plans should be made at both provincial and neighborhood levels, where the neighborhood residents should be included in these decisions and alternative plans.
- In order to achieve effective implementation of disaster related plans, the Provincial Disaster Preparedness and Response Council should play an active role and be held accountable for ensuring coordination among different constituents and bodies, activate participation and commitment of citizens, NGOs, and private organizations, and monitor the activities of these bodies and control whether the responsible parties have reached the objectives that are defined in the plans.

Provincial Disaster Control Center

After a major disaster strikes a province in a way that impacts the society in a dramatic way, *Provincial Disaster Control Center* becomes operational in order to respond to the disaster in terms of humanitarian aid, search and rescue, effective transportation and communication, health services, fighting with secondary disasters and fires, removing debris, determining the extent of damage, and all necessary activities. *Provincial Disaster Control Center* operates on the plans and principles that are determined by the *Provincial Disaster Preparedness and Response Council* and is managed by the members of this council. The *Governor* is the head of the *Provincial Disaster Control Center,* which has extraordinary powers and functions as the crisis management center in the province.

Provincial Advisory Board

Provincial Advisory Board functions as a body that formulates recommendations to the *Provincial Higher Board* of the *Provincial Disaster Preparedness and Response Council.* This advisory body includes representatives of major related NGOs, professional chambers, chambers of industry and commerce, military, some district municipalities (maximum of four), universities, and TÜBİTAK (The Scientific and Technical Research Council of Turkey). *Provincial Advisory Board* provides technical and expert opinion on preparedness and mitigation activities of the province and acts as a bridge among various constituents of society. The board regularly meets every 6 months or upon the call of the *Provincial Higher Board* when needed.

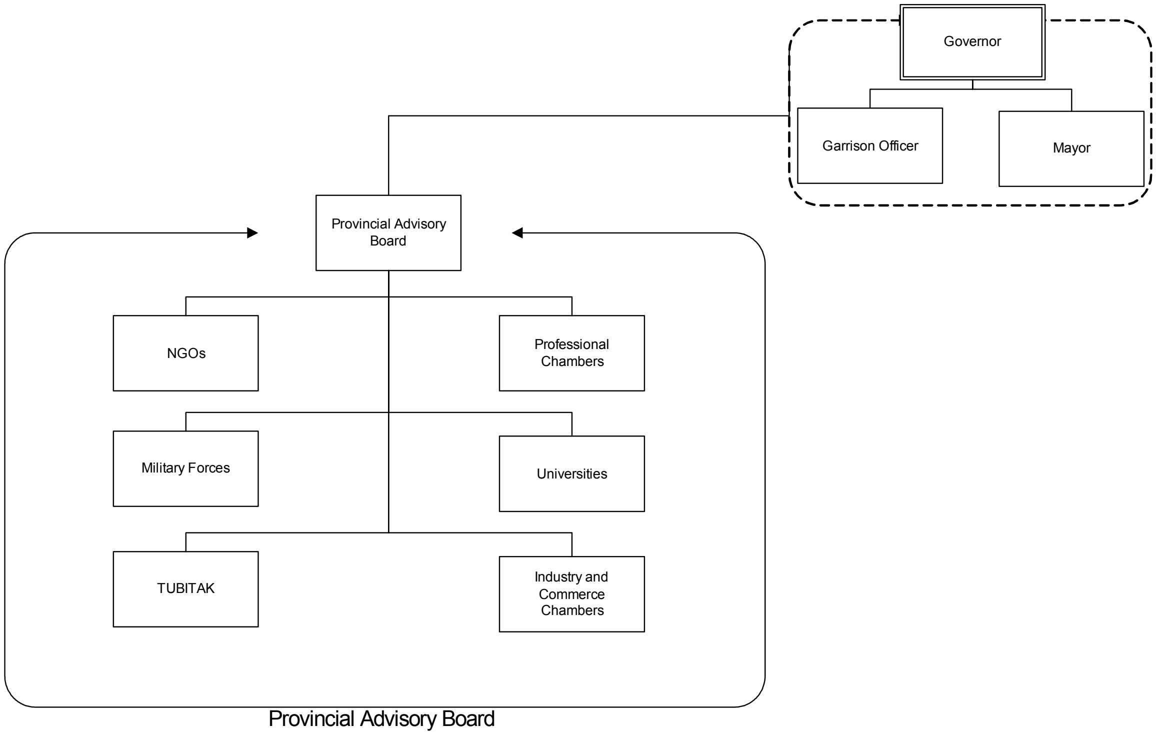


Figure 4.3.9. Provincial Advisory Board

Organization in Neighborhood Level

Importance of Neighborhood Organization in Disaster Management:

For micro level, the importance of organizing neighborhood residents for disaster mitigation, preparedness and response mentioned in several studies (e.g. Inelmen, Iseri Say, Kabasakal & Akarun, 2003; Okten, Sengezer & Hokelek, 2002). As in case of the effective city management, the participation of the public in management is important for an effective crisis management. Since the Ottoman Empire, the neighborhoods have played a significant role for the residents in terms of providing a common socioeconomic, cultural, and ethnic environment that provides the belongingness among the citizens. Most of the time, the citizens tend to identify themselves in terms of the neighborhood where they live and this situation still exists even though the city population increased due to domestic immigrations after 1950s. On one hand, the newcomers distort the existing socioeconomic context of the neighborhoods, but on the other hand, they commonly prefer to settle near their relatives or fellow citizens that strengthen the relations among residents. Due to these facts, the neighborhoods are the smallest units of potential organization that provide strong bases for effective disaster preparedness, mitigation, and response.

Findings of recent studies (e.g., Iseri Say, et. al, 2002) indicate that the *muhtar* (neighborhood administrator) plays a significant role in the participation of residents in disaster preparedness and mitigation processes. The importance of the *muhtar* and the neighborhood school teacher as significant parties in neighborhood disaster preparedness and mitigation activities in addition to women, 12 – 17 age young, local shop owners and retired people, is mentioned by the previous researchers (Okten, et. al., 2002). In Gayrettepe and Batikoy neighborhoods, it is observed that the *muhtars* can perform important roles as the elected officer in disaster preparedness and mitigation activities. (Inelmen et. al., 2003; Iseri Say et. al., 2002). Neighborhood Crisis Management Project (MAY) still continued in several neighborhoods of Istanbul including Gayrettepe, Yıldız, Ideal Tepe, Gokturk town, Kemerkoy and Kemerburgaz, Mimarsinan and Mithat Pasa. The vision of the MAY project is to start disaster preparation in neighborhood level, in other words, its aim is to prepare the neighborhood residents in their houses, workplaces and schools for disasters. [1]

Another project for organization in neighborhood level is the Neighborhood Disaster Support Project that is approved by the Kocaeli Governorship and permitted by Ministry of Internal Affairs and applied since 2001. In addition to Kocaeli Governorship, there are several institutions and organizations such as, Provincial Civil Defense Directorate, the Directorate of Fire Department of Metropolitan Municipality of Izmit, University of Kocaeli, City Council of Izmit and The Swiss Agency for Development and Cooperation (SDC). There are two important groups: Neighborhood Disaster Volunteers and Neighborhood Disaster Council. Each Neighborhood Disaster Volunteers group consists of 50 people that have 30 hours of education about mitigation, preparedness and response operations. Moreover, these volunteers are equipped with necessary relief and first aid tools in order to response immediately after the disaster occurs. After the professional rescue teams arrive, the volunteers leave the rescue operations and help the professionals. In each neighborhood where the project applied, there exits a Neighborhood Disaster Council of seven members including the *muhtar* as the president.

As seen in the example of Neighborhood Disaster Support Project, the support of central government agencies, universities, domestic and foreign NGOs supports their efforts at the neighborhood level. A similar example would be the Istanbul Disaster Preparedness Training Project (IAHEP) carried out by Bogazici University Kandilli Observatory Center and Earthquake Research Institute that provides disaster preparedness training coordinating with several NGOs and local organizations. IAHEP is funded by United States Agency for International Development, Office of Foreign Disaster Assistance (USAID/OFDA). This example represents the importance of coordination and information exchange among several units and the contributions of these efforts at neighborhood level.

Problems of Community Based Organizations:

Even though the importance of CBOs in disaster preparedness stage is known, there are several problems in participation of residents in these organizations. Recent studies (Inelmen, et. al., 2003; Iseri Say, et. al., 2002), in two neighborhoods of Istanbul, Gayrettepe and Mimarsinan – Batikoy, suggest that these problems can be analyzed in legal and behavioral dimensions. From the sampling of 171 people, it is observed only 3 (1.8%) people participate in a volunteer organization for disaster preparedness. This observation indicates that although the citizens are afraid of the earthquake, the majority of them are reluctant to participate in any organization for disaster preparedness. 52.5% of the respondents indicated that the city would suffer from large-scale of damage. On the other hand, majority of them (68.3%) indicate that their houses would have no or low-level damage. Only 7% of the respondents indicated that they expect very heavy damage or collapse. The discrepancy between the perception of respondents about the magnitude of a potential earthquake that is expected in the city of Istanbul and for their own houses represents the individuals' passive attitude of participating in CBOs for disaster preparedness and mitigation

The analysis of the reasons for not joining disaster-related organizations revealed three main clusters. First group includes reasons of not being invited, expecting invitation to join, and not knowing aims of those organizations. In this situation, it is recommended that the participation of individuals in these organizations need to be facilitated in legal and public context. Second group consists of having no time, being busy and occupied by other things. Third cluster points to the fact that individuals think they do not have relevant skills to join these organizations. Therefore, the individual or organization that communicates with the residents should explain to them that by necessary training the skills of individuals can be enhanced and they become capable of carrying operations in disaster preparedness, mitigation, response and recovery stages.

When respondents were asked about their capabilities in the disaster preparedness, mitigation, response and response stages, most of them viewed central government and local government as the major actors that are responsible for such stages. Residents felt responsible for operations especially in the response stage, the search and rescue operation, and first aid, etc., and they also perceive the local organizations are responsible at this stage. It can be seen that perception of low levels of responsibility for themselves and local organizations during preparedness and mitigation stages tends to affect levels of participation in such organizations.

Findings from Gayrettepe and Mimarsinan-Batikoy neighborhood represent for increasing participation of residents in disaster-related organizations. When respondents were asked about is asked residents the perceived benefits of joining such organizations, they ranked spiritual solace, increased safety of self and family, access information, priority access to resources as important benefits. As findings show, it is important to convince the citizens about the emotional and physical benefits of participating in disaster – related organizations.

Policy Implications For Increasing The Local Level Involvement

- **Increasing the Effectiveness of Neighborhood Administrators**

In the disaster laws, *muhtars* are not given any role in neither pre nor post disaster activities. Given the research finding that the neighborhood administrator is perceived as among the most responsible parties in disaster mitigation and preparedness, the central government should incorporate them in their efforts to initiate local level involvement. Neighborhood administrators can act as the information node for the local community due to their access to different types of information like the infrastructure, the types of buildings, the inhabitants particular skills and their sentiments, other institutions such as hospitals, factories, etc. and their links to local government. Provided the fact that neighborhood administrators, CBOs and NGOs are indispensable in disaster preparedness and response, regulatory arrangement that will allow them both to generate and provide financial, physical, and human resources should be institutionalized. For example, neighborhood administrators, CBOs, and NGOs may be supported by a percentage of real estate tax fund or environment cleaning tax fund collected by the municipalities. In order that the above suggestions could be put into practice a new legal framework, which will provide legitimate status to *muhtarships,* should be developed.

- **Promotion and Information for Increasing the Civil Involvement**

Community members' awareness about the possible risk and damage to their private sphere needs to be communicated realistically by credible sources. In order to make the CBOs and NGOs more familiar to the citizens, activities that would attract the public attention are needed with the coordination of governorship, municipalities and neighborhood administrators. Moreover, the objectives and activities of NGOs and CBOs by effective promotion methods should be communicated to the public. Also the mass media should offer space and time to the CBOs and NGOs to communicate their activities to the general public.

- **Community Based Organizations and the Local Government**

CBOs and the local governmental organizations should be connected to each other in order to carry effective disaster mitigation and response policies; therefore, they should recognize each other, and join their efforts in disaster mitigation and response to implement successful Civil Defense organization would play a leading role of cooperating the efforts of CBOs and the government.

- **Neighborhood Disaster Volunteers and Neighborhood Disaster Council**

In order to define the volunteer activity at neighborhood level, a legal frame with responsibilities should be completed. It should also allow neighborhood administrators to be president of Neighborhood Disaster Council and Neighborhood Disaster Volunteers. Besides the fact that it increases the residents' consciousness, legalization would also increase the local involvement.

4.3.10 Conclusion

The main objective of this chapter is to formulate a Turkish disaster management model that includes all parties that are involved in pre- and post- disaster management activities. For this purpose, the current legal structure and organizations are evaluated, distribution of authority among the central and local government bodies is analyzed, responsibility and coordination mechanisms are identified, and the problems and inefficiencies in the system have been determined. In addition, disaster management models that are operational in other countries are analyzed and parts of these models that can be adaptable to the Turkish system have been integrated into the proposed model. Furthermore, the model included the findings of in-depth interviews with administrators and individuals involved in disaster-related organizations and a field survey that were conducted with citizens in two neighborhood areas.

An evaluation of the current legal structure and practices in Turkey can be summarized as:

- Turkish disaster management system concentrates mainly on the response stage, with less emphasis on preparedness and mitigation activities.
- The involvement of central government in disaster management has led to complex and complicated system, which makes coordination, planning, leading, and organizing difficult and problematic, and definition of roles remain ambiguous. Observations after the 1999 Marmara Earthquake has reached similar conclusions, where central government bodies were evaluated as slow and ineffective in most response activities.
- The current system provides a passive role to the local governments, military units, NGOs, professional chambers, *muhtar*s (neighborhood administrators), and citizens. These groups are only supposed to provide the services they are asked to conduct and they have no proactive role in planning, mitigation, and decision-making bodies.
- The gaps and problems in the legal structure have been filled with some organizations that are founded to improve the effectiveness of the system; Governorship Disaster Management Center (AYM) and Metropolitan Municipality Disaster Coordination Center (AKOM) are the two major organizations that are established after the 1999 Marmara Earthquake to coordinate disaster-related activities and fill the gaps in the legal structure and find solutions to the problems in practice.
- There is a need to transform the system into a simple and straightforward model, clarify the roles, and emphasize planning, leadership, and controlling functions in order for the organizational structure to work in an effective manner.

An analysis of disaster management models in other countries show that the models are transformed from complex and complicated systems to more simple structures after the country faces a major disaster. In the process of simplifying the system, there is a trend towards a significant reduction in the number of ministries associated with disaster management, an inclination to set up a simple coordination mechanism and to put the administration of natural disasters and man – made disasters under the same structural umbrella. Another characteristic of other country models is that at the top level, allocation of technical and physical resources and coordination of different agencies are achieved by a high-level council. At the provincial level, the Governor and/or the Mayor carry the responsibility for disaster management. In addition, the military forces, NGOs, local organizations, institutions with technical and health-related resources and expertise, and community based organizations take part in disaster management systems in an active way.

The main principles of the disaster management model that is proposed for Turkey include:

- An integration of pre- and post-disaster functions and activities
- A simultaneous application of planning and controlling approaches for management of disaster-related functions and units.
- A hybrid organizational structure

- Centralization
- Participation of all constituents in the decision making process
- A simple and easy-to-understand structure
- An organizational structure at different levels
- Involvement of volunteers

In order to develop an effective disaster management model that eliminates the current existing problems, a new system with a long-term and short-term focus is proposed, which incorporates the above-mentioned organizational principles. In the long-run, a significant reduction in the number of involved ministries should be made and responsibility for disaster management needs to be in the hands of one ministry. Furthermore, it is suggested that management of natural and man – made disasters should be organized under the umbrella of one ministry. In the short-run, the proposed model can be analyzed at the central, provincial, and neighborhood levels. At the central level, the proposed responsible bodies for disaster management are: *Undersecretary of Disaster Management,* who directly reports to the *Prime-Minister, Central Disaster Preparedness and Response Council*, and *Disaster Higher Control Center*, which will operate as the crisis and emergency center after a major disaster. *Disaster Bureau* will carry out the communication, filing, reporting, and office affairs of the *Central Disaster Preparedness and Response Council.*

At the provincial level, it is proposed that *Provincial Disaster Preparedness and Response Council* will be responsible for disaster management and coordination of all disaster-related functions. The highest body for decision-making of the *Provincial Disaster Preparedness and Response Council* will be the *Provincial Higher Board,* which includes the *Governor,* who is the leader of the board and the *Mayor of the Larger Metropolitan Area* and the *Garrison Commander.* A *Vice-governor, an Assistant General Secretary of the Metropolitan Municipality* and a top level *Garrison Officer* form the *Provincial Executive Body,* which is responsible for execution of the decisions taken by the *Provincial Higher Board* and to ensure coordination among disaster-related activities. *Provincial Disaster Preparedness and Response Council* will be responsible from managing all disaster-related functions in the areas of security and public order, transportation, health services, public training/ public relations, humanitarian aid, fires/ secondary disasters/search and rescue, public works/engineering, settlements planning, and communication/technical infrastructure. *Provincial Disaster Management Directorate* will be responsible from communication, reporting, filing, and other office affairs of the *Provincial Disaster Preparedness and Response Council. Provincial Advisory Council* will operate as an advisory body the *Provincial Disaster Preparedness and Response Council* and will include the representatives of major NGOs, professional chambers, chambers of industry and commerce, some district mayors, military forces, universities, and TUBITAK (The Scientific and Technical Research Council of Turkey). It is proposed that *Provincial Disaster Control Center* becomes operational after a major disaster and serves as the emergency and crisis center in the province.

The new proposed model stresses the importance of neighborhood organizations in disaster management and suggests that legal and structural arrangements be made for this purpose. At the neighborhood level, *muhtar*s (elected neighborhood administrators) should play an active role and be the leader of *Neighborhood Disaster Council* and *Neighborhood Disaster Volunteers,* which will serve as the basis of neighborhood organizations. In order to ensure effective leadership and involvement of *muhtar*s in disaster management, physical and financial resources need to be activated. *Muhtar*s can operate as information node in the neighborhood and act as a bridge between the public and central and local government units. Furthermore, there is a need to integrate the activities of community-based organizations and the *Civil Defense* organization in order to achieve effective disaster management at the local level.

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4.4 Financial Model

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4.4.1 Purpose

The purpose of this study is to determine the national and international financial resources needed for all the pre- and post-earthquake work on mitigation and risk management, and also to design a financial model for a properly coordinated allocation of resources. Given the fact that the currently available resources for this purpose are very limited, the first step should be to identify the areas of need and to estimate the total demand for financing. The following summary list of work would seem to require financing:

Pre-Earthquake:

1. Studies on earthquake vulnerability and security

- Technical investigation and strengthening (or re-location) of public buildings (hospitals, schools, key government buildings, infrastructure, bridges, dams, etc.)
- Technical investigation and strengthening (or re-location) of private buildings (residential, commercial and industrial buildings)
- Other related studies mentioned in this report

Post-Earthquake:

1. Provision of shelter, food, medical and social services to people

- Technical investigation, repair and reconstruction of public and private buildings

First of all, it should be recognized that the more successful the pre-earthquake plans and their implementations are, the lower will be the financial burden after the earthquake. Moreover, the estimation of the costs of an earthquake before it occurs is not only more important but also technically easier. This fact is fully considered in the financial model.

4.4.2 Basic Principles

The basic principles of the financial model should be compatible with the current social and economic facts of the city of Istanbul and also of the whole country:

- As Istanbul is the most important city of our country, the financial implications of a possible earthquake in Istanbul constitute a potential problem not only for the city but also for the country as a whole.
- Since buildings occupied by people of lower income levels that are in general physically riskier in an earthquake, the distributions of income and earthquake-related financial needs do not match. Consequently, any sensible preparation for a potential earthquake can only be possible through a mechanism based mutual benefit/cost sharing and collective effort by all segments of the population.
- Under the limitations imposed by the country’s current economic conditions, the necessary resources cannot be obtained in a sustainable way through plain borrowing and mere legal regulation. Thus, self-productive and smart financial models should be put in place in order to assure the participation of national and international financial markets.

4.4.3 General Approach

Defining every single type of work suggested in this Master Plan as a “task”, any defined task then belongs to one of the following classes:

1. A "specific task" is one which has a clear description, predictable capital requirement, and needs one-time financing only (for example, a technical investigation and strengthening project for a specific public building, a specific scientific study, etc.).

- A "permanent task" is one which needs continuous financing and for which the final capital requirement is partially or totally unpredictable at the outset (for example, a project to strengthen and re-locate private residential buildings in the city, a project to develop new earthquake – resistant housing sites, etc.).

Specific tasks and permanent tasks should be considered separately as follows:

1. Standard "project credits" for specific tasks can be obtained easily. Below are some national and international credit sources:
    - A. International sources
        - i European Development Bank
        - ii European Investment Bank
        - iii Related European Union funds
        - iv Islamic Development Bank
        - v United Nations Development Program
        - vi World Bank funds
        - vii Other multilateral development banks and institutions
        - viii Bilateral development banks and institutions
    - B. National sources
        - i. Municipality sources
        - ii. Treasury sources
        - iii. Private sector sources via temporary or permanent partnerships

- Although it may sometimes be possible to find project credit for some parts of some permanent tasks, permanent tasks can be financed in a sustainable way only through long-term and large-scope financial models that rely on the market mechanism.

For specific tasks, when equity capital and new budgetary sources such as extra real estate taxes are insufficient, domestic and/or foreign project credit may be found. The terms and conditions of such credit should be carefully evaluated, payback estimates should be developed, and their overall economic feasibility should be assessed. More importantly, their relation and interaction with the financial model for permanent tasks must be clearly understood.

The necessary financing for permanent tasks also can be generated from three sources:

1. Sources mentioned above for specific tasks and other similar sources

- Appropriations from current municipalities' budgets, central government budget, and also new budgetary sources designated for selected permanent tasks.
- Securitization of the huge pool of non-productive and non-liquid assets in and around the city, which is claimed here to be the most effective and efficient mechanism to generate the needed financing for permanent tasks.

Securitization is the main idea in this study and, for the problem at hand, it can be used in two related areas:

- o **Securitization of Risk**: Disasters such as earthquakes that have taken place during the last couple of decades have demonstrated huge financial risks faced by investors and, in particular, insurers of natural and man-made disasters. To cope with these risks, insurers and re-insurers have engineered certain financial instruments such as CATastrophe bonds to securitize and sell these risks in financial markets. This mechanism can be used for two purposes in the Turkish context:

- Insurance companies selling disaster insurance and their reinsurers can prepare more realistic earthquake insurance plans and thus collect larger funds. The use of such funds for the tasks in the Master Plan will not only help partially finance these tasks but also provide a consequent decrease in the ultimate risk faced by the city.
- The city of Istanbul can herself issue debt instruments similar to CAT bonds. These types of bonds offer higher yields than average (to attract investor interest) but, in case of a catastrophe, the principal is totally or partially dropped. This scheme is consistent with both the need to generate funds to prepare towards an earthquake and also the need to reduce financial risk imposed by an earthquake on the city.

This model is explained in detail under the topic of "**Earthquake Preparation Fund**."

- **Securitization of Non-liquid Assets:** This involves the allocation of idle (unutilized) city – and state – owned land to private developers to produce safe residential sites. This is best done via organizing like a real estate investment trust (REIT) as defined in the Capital Markets Law. As REITs can design and sell in international markets continued securitization packages to obtain necessary financing to cover development and construction costs, this scheme can produce huge quantities of safe and affordable houses without much regulatory changes and the problems of standard credit financing. This model is explained in detail under the topic of "Land Development Agency".

4.4.4 Earthquake Preparation Fund (EPF)

In order to provide the conceptual basis of an EPF, it is proper first to explain how risks are securitized through the issuance of catastrophe bonds. However, it should be emphasized that, in this study, the term "catastrophe bond" refers to a model with a much wider scope and purpose than the standard definition of CAT bond as applied in the U.S. and some other countries.

In most applications in various countries, standard catastrophe bonds are used solely for management of financial risks associated with disasters covered by insurance. Insurance and reinsurance companies securitize high claim risk that they may face in presence of a catastrophe by designing catastrophe bonds and selling them in financial markets. There are two main features that distinguish catastrophe bonds from other bonds:

a They pay a higher rate of return compared to other bonds with similar maturities. For example, in the U.S., this premium is usually around 4%. The reason of this premium is related to the second feature mentioned below.

b In case of a predefined catastrophe, the principal due to the bondholder is reduced, either in part or completely. The amount to be reduced depends on the scale of the disaster, its economic damage, and the timing of the event. (For example, there can be a conditional model where, if the magnitude of the earthquake and the damage it causes are above a certain cutoff value and if the earthquake occurs before the maturity of the bond, then the principle is not paid back at all. If the damage is less than the cutoff, only a portion of the principal is dropped.) As the uncertainty about the principal means extra risk for the investor, these bonds should yield higher rates of interest as compensation.

For an insurance company, the logic of the model is very clear. As an example, assume that the catastrophe exposure of an insurance company is 100 lira in claims payable. To manage this risk, suppose that

- A CAT bond with a 100 lira face value and 5 – year maturity is issued and the interest on this bonds is X lira / year which is higher than current comparable bond yield,
- The catastrophe insurance premium is P lira / year
- Insurance company invests these funds at the average market rate

Possible scenarios after an earthquake leading to the revocation of principal payment are as follows:

- o If the risk is not managed: Total premium proceeds over the 5-year period will be 5P. If an earthquake does not occur, the balance in the insurance pool will be 5P at the end of 5 years. If an earthquake does occur N years from now, then the total net cost will be 5N - 100, which is the undesirable outcome.
- o If the risk is managed with catastrophe bonds: Total proceeds will be insurance premiums plus net amounts collected from the bond issue. This makes 5P + 100 - 5X liras. If an earthquake does not occur, at the end of 5 years, the balance will amount to 5P - 5X, which can be less or more than zero depending on the choice of the insurance premium and the catastrophe bond interest premium. If an earthquake occurs before 5 years, as the principal on the debt will drop and the net cost will be controlled within the limit of 5P - 5X + 100 - 100 = 5P - 5X.

As can be seen from this example, the insurance company is able to transfer its catastrophe exposure to investors, who are willing to assume this risk, via a catastrophe bond. Taking this simple example as a starting point, the concept of a catastrophe bond can be expanded to a model to prepare Istanbul for an expected earthquake. To this end, our priorities and aims should be set as follows:

- We have to minimize social and economic costs of an earthquake, just like an insurance company that wants to decrease its catastrophe exposure.
- The only way to minimize the costs of an earthquake is to prepare for it, just like the probable principal reduction in the catastrophe bond issued by the insurance company.
- Preparation for an earthquake requires money and this money needed for preparation is much less than the cost of earthquake without proper prudential measures. Therefore, even a little sum of money raised today is very precious. This fact rationalizes higher returns offered in catastrophe bonds, just like the high interest the insurance company is willing to pay for catastrophe bonds.

These points suggest that the catastrophe bond model is conceptually appropriate for earthquake preparation. For this purpose, under the lead of the Greater Municipality of Istanbul, an Earthquake Preparation Fund should be established primarily to sell earthquake insurance and also issue catastrophe bonds. To be more effective, EPF should be organized as a consortium or a partnership of private insurance companies and financial institutions. The Fund should stay strictly within its defined scope and not diverge into other activities. Most importantly, the function of this fund should not be only selling insurance like the Turkish Natural Disaster Insurance Corporation ("DASK") but also generating funds for earthquake mitigation. Briefly:

1. Equipped with the valuable experiences from similar applications in Japan, USA, and other places, the EPF should develop a sound and realistic insurance philosophy. Insurance premiums should be calculated by a pricing model that properly incorporates all probable risks. Engineering data to be gathered with the implementation of this Master Plan will be very useful in this calculation.
2. The Fund should issue bonds, which not only inspires from standard catastrophe bond models but also takes into account the unique conditions of Istanbul, and sell them in both domestic and foreign financial markets. These bonds should have minimum maturities of 3 years and offer interest rates that truly and fairly reflect the involved risks. There should be a new issue every year such that the principal on maturing bonds should be paid from the proceeds of new issues. Details of this process will be explained below.

- A big portion of the available funds in the insurance premium pool and proceeds from bond issues less current interest payments due on outstanding bonds may be used for earthquake preparation expenditures. (This should not be interpreted as one-sided spending only. The

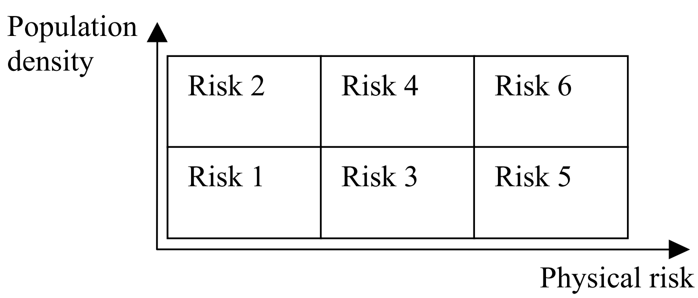
Fund can also act like a creditor for other companies in the process.) Under this scheme, the only short position of the Fund at any point in time will the principal of the latest bond issue, whose cost may be shared with other governmental bodies that are also responsible for earthquake mitigation.

Managing the Fund with sound financial policies is actually the easy part. The more difficult and more important part is the application of correct and realistic procedures in calculating insurance premiums and catastrophe bond parameters.

Istanbul Economic Risk Profile

A realistic premium and bond pricing model requires an underlying database, which may be called "the Istanbul Economic Risk Profile". Relevant properties of this model are described below:

- Prediction of the stochastic processes modeling probable Istanbul earthquake and selection of the best empirical model from past data. These type of processes are commonly used in applications of earthquake engineering and some empirical models for Istanbul has already been developed by scientists preparing this Master Plan.
- Number of households, home ownership and income distribution. Depending on this information, households will be classified into two groups: (1) rich and (2) poor.
- Information on structural vulnerability of houses, soil characteristics, and probable damage distribution of a scenario earthquake will be used to classify households into three physical risk categories: (1) high risk, (2) medium risk, and (3) low risk.
- Density distribution of the population as (1) high density and (2) low density.



The 6 different risk groups shown in the diagram are further classified as (1) rich and (2) poor, resulting in a total of 12 risk groups. Each household is then associated with a risk class and the collection of these data will constitute the Istanbul Economic Risk Profile. In application, this type of classification can be made in a more detailed fashion but basic principles would remain the same.

Scope of Implementation

Envisioned process of preparing for an earthquake and suggested financial models are based on the following observations:

1. After an earthquake, the economic losses and damages that are not covered by insurance companies and other private sources are under the social responsibility of the government. The distribution of these losses can be classified as:
   - o Infrastructure and public buildings (communication, energy, transportation, administrative buildings, schools, hospitals, historical buildings, etc.)
   - o Private houses and businesses classified by the Istanbul Economic Risk Profile as
     i. Partially insured or totally uninsured; poor or rich
     ii. Insured

The government is expected to cover the losses listed in (a) and the buildings occupied by poor households in (b.i). (Although it is desired to have all of the buildings, rich and poor alike, under insurance coverage, it is realized that this is almost impossible.)

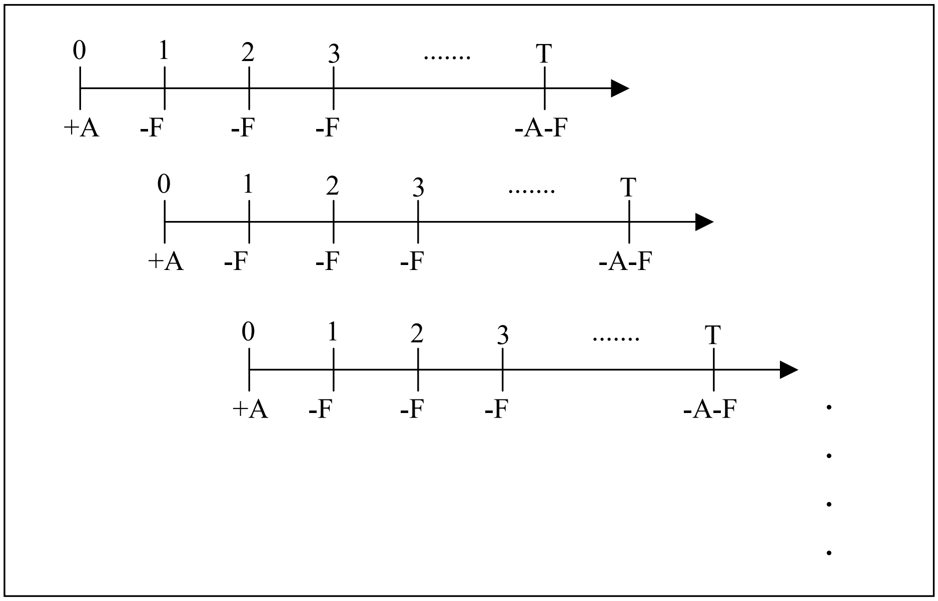
- Apart from the social dimension of a disaster and the public responsibility of the government, there is also a huge potential financial risk faced by local and central governmental bodies in case of a destructive earthquake. The only way to minimize this risk is building into the earthquake preparation process a "smart risk transfer model". Risk transfer or reduction depends on two interrelated facts:
  a. Financial cost of the losses mentioned in 1 will be huge if caught under no systematic preparation.
  b. Minimizing this exposure is possible with two complementary precautionary measures:
     i. Generating financial resources now with CAT-bond type instruments whose principal payments are reduced in case of an earthquake
     ii. Using these resources for earthquake preparation

This model is not only consistent with our country's realities but also its overall cost is considerably less than other alternative models such as straight borrowing. To demonstrate this fact, a simple mathematical formulation of the model is presented below.

For a simple mathematical presentation of a catastrophe bond suitable for Istanbul, let us define following parameters and variables:

- $Z(t)$ is the economic cost of an earthquake, which occurs on an unknown future date $\tilde{t}$. A properly defined "damage index" may be used to estimate the size and time behavior of this cost. This index would be calculated using a probabilistic process based on earthquake engineering data. Similar indexes have been published in the USA and Japan. The maximum value this index can have (e.g., in case of an earthquake in the Marmara Sea with a magnitude of Mw = 7.6) is denoted by $Z_{\max}$.
- $Y(0)$ is the investment that should be done for the preparations to decrease that $Z_{\max}$ to an acceptable level. It is obvious that $Z_{\max} >> Y(0)$ and let $Z_{\max} = M \times Y$ for sum large M. In other words, a relatively small investment today may help reduce the huge loss that may be faced in the future.
- A is the principal value and F is the yearly interest payment of T-year catastrophe bond to be issued every year for N consecutive years. For ease of presentation, we assume that the bond will be issued at par. If, without any loss of generality, we ignore the time value of money and that interest rates may change in time, the total interest cost of such a model will be $(T \times N) \times F$ and it will span a time period of $N + T$ years. The bond parameters may be chosen such that $A - TF > 0$. As a result, $(A - TF)$ liras will be available for earthquake investment every year a bond is issued.

The cash flows related to the described bond model are shown below.



The number of years the model will be carried is initially determined by solving the following equation for N:

$$N(A - TF) = Y = Z_{max} / M$$

The principal the bondholders will actually receive depends on whether an earthquake occurs and also the size of the damage caused by the earthquake. Let Z_{min} be the prespecified minimum damage and A_{min} be the prespecified minimum principal due. (A_{min} may be also specified as zero.)

If t denotes the time at which an earthquake happens in the future, there are two probable damage levels and bond principal payments:

[I] If $Z(t) \leq Z_{min}$, then the principal payment per bond will be A liras, summing to tA liras in t bonds.

[II] If $Z(t) > Z_{min}$, the sum of the principal payments on t bonds will be a conditional figure given by $\min\{tA_{min}, tA - (Z(t) - Z_{min})$ liras.

If an earthquake does not take place during initial T years (that is, $t > T$), there are two probable dates for a future earthquake: (1) $t < T + N$, the earthquake occurs before preparations are completed, or (2) $t > T + N$, preparations are completed before the disaster occurs. It is reasonable to assume that each date has a positive probability of occurring.

The whole scenario of the bond model is summarized as:

- If the earthquake does not happen before the preparations are finished $t > T + N$, total financing cost will be $(TN)F$ liras. This is the most desirable result that can be attained.
- If the earthquake occurs before the preparations are completed, $t < T + N$, and total economic damage is below the prespecified minimum value, $Z(t) < Z_{min}$, the total cost of financing will be $(Tt)F$ liras. In this case, mitigation spending would possibly continue and final total cost will again be $(TN)F$.
- If the earthquake occurs before the preparations are completed, $t < T + N$, but the total economic damage is above the prespecified minimum value, $Z(t) > Z_{min}$, then the total cost of financing will be

$$(TN)F - (\underbrace{(T-1)A - \min\{tA_{\min}, tA - (Z(t) - Z_{\min})\}}_{\text{net principal reduction}}) < (TN)F$$

This is the result of a devastating earthquake. In such an eventuality, since a portion of the outstanding bond principals will be not be paid, the economic burden on the government would be decreased. In other words, the basic economic aim of this model, which is reducing the risk, is will be achieved.

Each of the results outlined above has a positive probability of occurring. This shows that expected cost of financing is less the nominal cost. Stated differently, the probability that the actual cost will be lower than the nominal cost is greater then zero:

E(financing cost) < T x N x F

Prob{financing cost < T x N x F} > 0

This result is significant in that it makes it possible to structure CAT bonds to yield a higher return than the comparable market return. This may be accomplished via a high coupon rate or a lower issue price, either of which makes the bond more attractive for investors.

The pricing of the bond outlined above is a financial mathematical problem that indeed has a practical solution. The damage variable $Z(\tilde{t})$ may be modeled as a stochastic process in accordance with the seismic / geophysical conditions of Istanbul and the Istanbul Economic Risk Profile. Then, the bond (or the series of bonds) can be considered as a portfolio of options and its value can be calculated. The exact pricing should rely on related parameter values estimated through the Master Plan.

A final important point is the fact that there is no statistical relation between natural events like earthquakes and financial prices. The zero correlation between the risk of partial principal loss in cat bonds and returns on other market securities makes cat bonds very useful in risk management and portfolio optimization. This feature would enhance the marketability of these bonds.

In conclusion, the bond model detailed above to securitize earthquake risk is a convenient and low–cost model in financing earthquake mitigation task. One should note that such a task should be conducted at any event to minimize future costs of an earthquake.

4.4.5 Land Development Agency

In this section, two topics will be introduced; (i) how Istanbul's real estate sources can be better utilized with the securitization of non-liquid assets (ii) how to build a model through which resources can be created in a sustainable fashion in restructuring areas which can be hardest hit in an earthquake. The model is primarily dependent on the following observations:

1. Istanbul is rich in real estate where value is not fully realized.

- Local residential buildings, which were constructed in accordance with old regulations, should be urgently rehabilitated and a significant portion might have to be demolished and rebuilt.
- "Development of land" function to create new residential and commercial areas has not been properly fulfilled. Currently, there is a plenty of potentially valuable land in Istanbul belonging to either central government or local administration. However, such invaluable pieces of land could not have been adequately treated under current legal and market conditions.

- Real estate rent, which exists in abundance, cannot be distributed fairly and legally between the public sector (central government and local administration) and the private sector.
- Devastating effects of a probable Istanbul earthquake require combining efforts of all involved parties. Such large coalition and cooperation, which are non-existent, should be initiated.

Land Development Function

Central government and local administration should combine their resources to develop areas ready for construction. To this end, a new institution by the name of Land Development Agency should be established. The mission of this establishment should be to offer market-friendly solutions that are sensitive to environmental and legal aspects. In a collective solutions seeking mechanism this institution would channel funds created through better utilizing land portfolios into those who could be adversely affected in high-risk areas.

In principle, such an agency can be administered by selected representatives of Greater Municipality of Istanbul, TOKİ (Mass Housing Administration), National Estate and Land Office. Chambers of Engineers/Architects and other related non-governmental organizations and city planners, should function in the capacity of advisors and consultants. Related governmental bodies, municipalities and NGOs will provide all the support required for the administrative work. To achieve good working relationship, protocols between different agents should be clearly defined, including the scope and degrees of cooperation and coordination. The management of such a newly developed institution should be vested with the authority of devising and amending the city plan, if necessary. Such a task should be carried out in accordance with a mutually agreed strategic plan. All other working relationships within the government and private sector should be thoroughly described at the outset. In this respect, all necessary legal and regulatory changes should be completed.

This new establishment will prepare the strategic plan for land development, considering the Istanbul's earthquake risk, residential densities, environmental factors (including water basins and forest areas) and infrastructure constraints. All the newly defined tasks should be carried out in accordance with the principles and guidelines of the city plan and be supported by new legal and regulatory amendments.

The pre-requisite for a successful implementation of the strategic plan is that less-resistant buildings in high-risk areas should be evicted without any delay. This is only possible when eviction order can be legally instituted. Such an amendment should be promptly made. Eviction decisions should be based on a technical risk assessment, which should be carried out by technically competent and autonomous body. This body should also consider historical, environmental consequences of its eviction decisions. Such a socially daunting task should not be left solely to the political authority and all related governmental agencies should be adequately represented in this body. Control and supervision of the proposed body can be vested into the Land Development Agency.

Legal and administrative aspects of the working principles of the proposed Agency should be clearly set at the beginning. Ultimately, this Agency should function in a fair, impartial and equitable setting.

Financial Model

In accordance with the Strategic Plan developed, a Real Estate Investment Trust (REIT) can be established. Such an investment vehicle, which is widely used mechanism in developed countries in securitizing real estates, is legally possible within the context of Turkish Capital Markets Board rules and regulations.

One should note that it is still possible for the Greater Municipality of Istanbul to start its own REIT. However, the likelihood of success for large-scale projects is limited in scope and magnitude. As suggested previously, if the municipality can combine its efforts with other related institutions (public and private alike), the success and the impact will be significant. All the related institutions can participate in the establishment of such a REIT in cash and in kind. It is also possible that some designated industrial and trade zones can take a part in this strategic alliance. Some of the likely benefits of such a strategic alliance are as follows:

- There will be no unnecessary disputes and conflicts with the public sector.
- Land portfolios in the hands of the public sector can be better utilized.
- There will be no unfair competition with current REITs.
- Technical expertise and marketing experience of the private sector can be better shared.
- Such an alliance makes it easier to find funding for large-scale projects..

REIT, which is recommended to be under the control and supervision of Land Development Agency, is expected to conduct a well-defined program in the following ways:

- **Providing Pre-Funding:** REIT whose initial capital (in cash and in kind) will be in line with the proposed strategic alliance will sell shares in domestic and especially international stock markets. Municipalities can partially use Preparation for Earthquake Fund for this purpose. To increase the marketability of newly issued shares, the REIT should offer attractive projects.
- **Primary Bidding Period:** For all the sites and areas that are developed according to the guidelines and principles of the Strategic Plan, a tender process will be instituted. Pre-qualification for this process will be sought. At the end of the tender, an agreement will be signed with the winner of the bid as to how much of the proceeds will be in the form of cash and in-kind. Cash proceeds will be gathered in a pool that can be used to finance initial project expenditures.
- **House Exchanges:** Houses in high risky areas are to be exchanged with new houses. Such new houses will be equipped with better social facilities including swimming pools, parking lots, parks etc. Differences in values of new and old housing will be reflected in the form of shares of REIT, being offered to occupants of old housing, thus making them partners to the newly established REIT. It should be noted that house exchanges mechanism, including timing of relocation and valuation should be clearly defined from the outset.
- **Providing Temporary Funding:** Provisions of domestic and foreign resources for rental payments and other types of monetary support to all affected people including tenants and estate owners should be established. For this purpose, given a well-defined budgetary plan, funds from Preparation for Earthquake Fund and various credit resources are to be utilized.
- **Secondary Bidding Period: New tender will be held for the areas where evictions have taken place. New buildings in these high-risk areas will have to comply with stricter construction requirements. In addition, earthquake insurance policies will be made mandatory at every level of a construction. It is suggested that designated insurance companies are allowed to conduct inspections at construction sites.**

An Example:

The above described mechanism is, in fact, a mechanism of securitization of non-liquid assets. For illustrative purposes, a simple version of the model is presented below:

- Suppose the REIT has decided to auction 2,000,000 square meters of land from its own portfolio, out of which 500,000 square meters has been set aside for municipality services.

A tender for the remaining 1,500,000 square meters has been held. Furthermore, suppose that 2:1 ratio of allowable construction area applies, thus construction area goes up to 3,000,000 square meters. Under the assumptions of 40 % of allowable construction area goes to the REIT and 250,000 square meters has been set aside for commercial and business purposes, 21,150 apartments can be built, each being 130 square meters. Thus, the share that goes to the REIT is 8,460 apartments and 100,000 square meters of commercial and business area.

- Upon completion of the project, 8,460 families can move out from old buildings into new ones. To keep our example simple, suppose that there are no value differences between new and old houses. Again for simplicity, suppose 6,000 new houses, rather than 8,460, could be built. Note that the land of evicted houses can still be utilized for new settlements. Under the assumptions of 130 square meters per apartment, each valued at $60,000 on average, and 40 % of share, the REIT can collect a revenue of $144 million. The 100,000 square meters of commercial area that still belongs to the REIT can generate a fund of $50 million, assuming that 1 square meter has a value of $500 on the average. As a whole, the REIT can collect a fund of $194 million.
- Assuming home buyers seek borrowing up to 75% of total cost of a house (i.e., 25% equity, 75% borrowing) for a 130 square meters house, valued at 60,000, the REIT can offer $45,000 of credit for up to 4,300 buyers.

In the above example, under a set of assumptions, we have shown that new funding can be generated through auctioning of the combined portfolio of land already owned or obtained after the eviction. Note that further financing is still possible through securitization. Securitization example is given below:

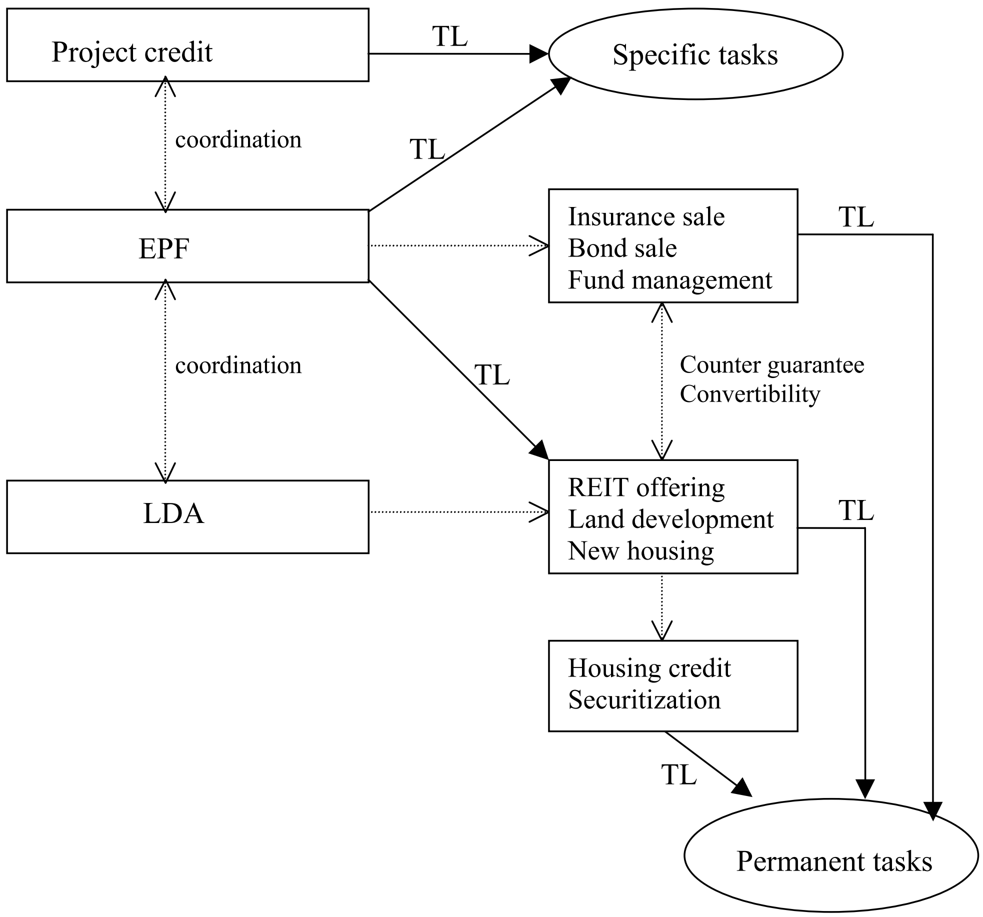
- Assuming loans can be extended for 15 years at an annual interest rate of 8%, $194 million of available funds can generate monthly payments of 22.6 million. If we securitize these future payments, almost $218 million of proceeds can be raised, assuming 6 percent of coupon rate and maturity of 15 years. It is also possible to issue a lower coupon rate instrument as long as the Treasury provides loan guarantees. At any event, with the securitization scheme up to this stage, a pool of loans for additional 4,800 houses can be made possible.

To sum up, starting with 2,000,000 square meters of land, we could manage to exchange 8,460 houses, while extending long-term credit for up to 9,100 new houses.

If the scope of such a scheme gets wider, given the potential of Istanbul, much can be accomplished in a relatively shorter period of time.

4.4.6 Schematic Financial Model

Below is the schematic expression of the harmony and synergy of the models mentioned in details above:



4.5 The Earthquake Mitigation Plan for Istanbul (EMPI)

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4.5.1 Overview

The project assigned by the Istanbul Metropolitan Municipality (IMM) to four universities by tendering procedures, aims to develop a Road-Map to be followed by the IMM and all bodies and individuals involved in the city, as well as the central authorities. Prepared by experts of four universities, the implementation of the plan should be possible upon its presentation to wider audiences and the public, and its collective evaluation. It could then be legitimately followed by the authorities and activate a majority in the city.

EMPI is a comprehensive coordination of mitigation measures to be implemented in the face of the impending earthquake in Istanbul, developing a special approach to the problem. It essentially draws the framework for a series of Social Contracts indicating to the operations necessary, and the responsibilities of all administrative units, private bodies, and the ordinary citizens.

4.5.2 The Purposes, Scope and Principles of EMPI

- EMPI is an integrated plan to synchronize all physical, financial, legal, organizational measures with the aim of developing risk management methods according to the causal structures and spatial distributions of hazards and risks; Reducing risks in existing urban environment and avoiding vulnerabilities in the formation of new developments;
- EMPI is envisaged as a framework for social contracts to be drawn between IMM, the Governorate, local municipalities, uncorporate municipalities, institutions, enterprises, NGOs, local community administrations, and individual citizens with the aim of determining the active role of the parties involved, and facilitating their participation and contributions;
- The over-all purpose of EMPI is to enhance safety and total quality of life in the city by:
    - Reducing infrastructural deficiencies
    - Gradually eliminating the unauthorized stock
    - Integration of City Management Processes
    - Protection of the natural and historical assets
    - Reclaiming urban quality and identity
    - Participation of the local communities in the management of the city
    - Comprehensive Rehabilitation of high risk areas
    - Retrofitting or removal of buildings according to the local revision plans

EMPI is not

- An operation confined to the ‘retrofitting’ of some buildings in the metropolitan area; Rather, the urban environment is considered in its totality, with its life-lines, emergency facilities, land uses and management processes.
- A “development plan” describing simply some future physical state, employing the devices of physical rearrangements; Rather, EMPI has to generate tools to monitor organizational tendencies and processes.
- An exercise in strict confines of existing ‘legal and administrative constraints’; Rather, proposals are made for the development of new methods and tools of enforcement, and the revision of existing legal frameworks.

- A ‘one-shot’ undertaking; Rather, sustainable mechanisms and institutions for a safer and more robust city and resilient communities are introduced.
- An excuse to allow further expansion of the city with new waves of pillage over the forests and water basins; Rather, it is a comprehensive methodology for upgrading the existing built-up areas in safety and quality, and protecting the natural assets.

4.5.3 EMPI Terminology

RISK SECTORS: are relatively exclusive sets of causal relations focused on specific urban risks or vulnerabilities.

CONTINGENCY PLAN: the overall plan to coordinate all documents related to risk sectors, to identify risk management measures, the actors, supervision methods, and the protocols to be drawn between responsible bodies, specifying their lines of action.

EMERGENCY FACILITIES: Public or private propety and facilities designated to provide emergency rescue and care services.

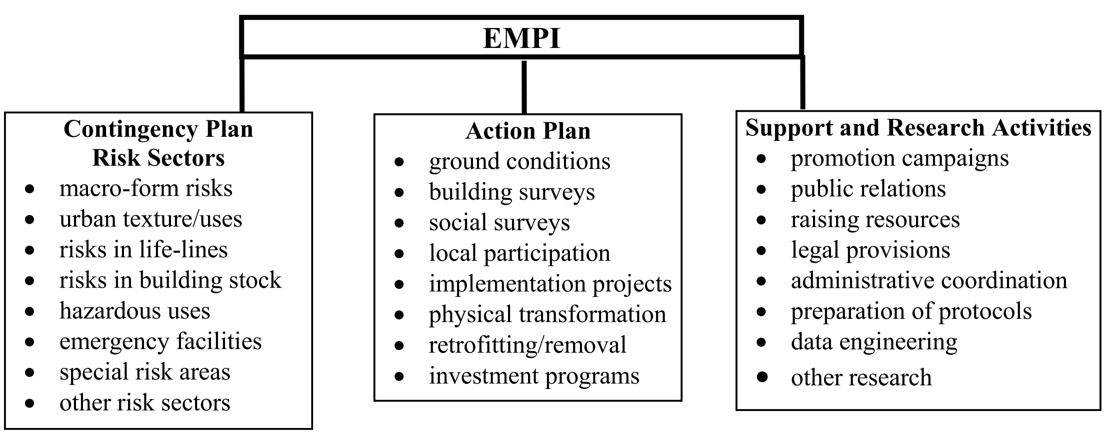
REHABILITATION AREAS: High risk areas to be comprehensively managed (in terms of resident cooperation, improvements in building stock and infrastructure) for the reduction of risks by various measures (physical rearrangements, lowering densities, retrofitting, removals, etc.) and sustainable community regeneration.

ACTION PLANNING: methods of immediate intervention in rehabilitation areas to coordinate property owners and inhabitants, to allow public and private partnerships, with special public powers to synchronize resources and physical development.

PROJECT PACKAGES: work to be independently fulfilled by third parties as part of the EMPI, subject to tender agreements.

4.5.4 EMPI Components

It is possible to envisage EMPI in terms of three components as described in the following chart. The Contingency Plan refers to analyses and risk management activities for the total metropolitan area. Whereas Action Plan refers to local comprehensive rehabilitation projects that cover physical transformation and community regeneration programs. Some of the Support and Research Activities have been accomplished during the EMPI preparation stage, others will have to take place at the implementation stage.



4.5.5 Implementation of EMPI

Various activities will have to be followed in line with the recommendations advanced in EMPI:

- Information Dissemination and Promotion Campaigns
- Formation of Action Platforms with Private Sector and NGOs

- Administrative Cooperation and Coordination Protocols
- Cooperation of Related Parties in Risk Sectors thorough Protocols
- Tendering of Project Packages described in the Contingency Plan
- Initiation of Pilot Action Plans
- Formulation of Legal and Administrative Changes Required and Monitoring
- Procurement of Resources for Implementation
- Public Relations and Information Engineering

4.5.6 Risk Sectors of the Contingency Plan

Abbreviations: IMM: Istanbul Metropolitan Municipality; MPWS: Ministry of Public Works and Settlement; SPO: State Planning Organization; SIS: State Institute of Statistics; SHAT: State Highways Administration of Turkey; SAWW: State Administration of Water Works; NGO: Non Governmental Organizations; ICI: Istanbul Chamber of Industry; ICT: Istanbul Chamber of Trade; UCAET: Union of Chambers of Architects and Engineers of Turkey; CAT: Chamber of Architects of Turkey; CET: Chamber of Engineers of Turkey; LCA: Local Community Administrations (as proposed by EMPI)

Macro-form Risks

Scope: Risks involved in the structure of main access system and compatibility with urban settlement area sizes, densities and configurations, natural boundaries to expansion, water basins, long-term development tendencies, attraction points and investments of metropolitan scale, all investigated in relation to micro-zones;

Problems: High density building in hazardous locations, unauthorized developments, developments in forest and water-catchment zones, uncontrollable urban growth;

Risk Management: Micro-zoning, density reduction and intensification areas, protection zones, designation of action planning zones, and marginal areas for new urban development; tools of property exchange, transfer of development rights, and differential property taxation;

Responsible Bodies: IMM, municipalities, MPWS, SPO, Governorate;

Proposals: A follow-up Committee formed by the representatives of responsible bodies, universities, professional chambers, NGOs, ICI, ICT; An Evaluation Symposium will be organized by this Committee every year; Recommended changes in the Development Law and the Property Taxation Law.

Risks in Urban Texture

Scope: Independent of the building safety, determination of Risks in the differential formation of urban fabric comprising plots, building coverage and density, access roads and car-parking, ownership pattern, and other environmental properties;

Problems: Great disparities of risk between various types of urban pattern, and unauthorized changes in due course are observed;

Risk Management: Differentiation of urban texture zones in development plans, and long-term physical policies for redevelopment, collective or singular buildings; differentiated property taxation and obligatory insurance enforcements;

Responsible Bodies: IMM and municipalities, LCAs;

Proposals: Formation of an inter-municipality working committee, functioning with improved powers of municipalities in development, supervision of construction, differential property taxation, municipal assessment in the determination of obligatory insurance; Legal changes in Municipalities (1580), Development (3194), Property Taxation (1319) Laws, and modifications in the Obligatory Earthquake Insurance Draft Law.

Risks Related to Incompatible Uses

Scope: Analysis of Risks arising from adverse affects of incompatible urban uses in neighbouring areas, buildings or within a building in the event of an earthquake;

Problems: Difficulty of land-use and building occupations control; Change of use taking place without permission;

Risk Management: Finer land-use zoning and explicit designation of uses to be avoided in development plans; Obligatory renewal of use permissions on a periodical basis; Formation of municipal data-base of uses combining district administrators' (*mukhtars*') information and municipal permissions; Standards for mixed-use, conditions for neighbouring housing-office, housing-manufacture uses; Promotion of local auto-control of uses;

Responsible Bodies: IMM, municipalities, ICI, ICT, UCAET, LCAs, other NGOs;

Proposals: Formation of municipal working committees with necessary data-base for the surveillance of local uses; Committee public reporting of problems every six months; provisions in Municipality (1580), Development (3194), and Flat Ownership (634) Laws.

Risks of Productivity Loss

Scope: Investigation of seismic sensivity of industrial enterprises and Risks of productivity losses in the industrial establishments, in the case of earthquakes, based on their size, location, building and facilities robustness, technology employed, materials processed, and dependencies on infrastructures, access, input-output relations, etc.;

Problems: Many industrial enterprises are extremely vulnerable in terms of location and building quality; Resilience of the city is largely dependent on the sustainability of the productive potential of the city in many direct and indirect ways;

Risk Management: Carrying out essential research on vulnerability classes of the industry; Building a data-base and developing methods of mitigation; Promoting local and sectoral cooperation between industries; Provision of credits for different types of mitigation; Imposition of obligatory insurance; Compulsory early warning systems; Training for emergency; Information dissemination;

Responsible Bodies: IMM, ICI, ICT, Ministry of Industry, Universities, Business Associations, UCAET, and other related NGOs;

Proposals: A 'Safe Industry' Committee to be established by the representatives of responsible bodies, with information and inspection teams, facilitating the special mitigation measures each enterprise has to take; Supervision functions of the Committee; Enabling with provision of information, and credits for retrofitting and other safety measures; Building up a technical information pool, with standards and regulations of safety;

Risks in Special Areas

Scope: The seashore, infill areas, dams and down-stream basins, river beds and other areas subject to liquefaction and landslide are areas that require detailed and special analyses of risks;

Problems: Often super-impositions of risks are observed in such areas; large populations and significant urban assets are at stake;

Risk Management: Designation of special risk areas in the urban plans; Salvation plan preparation tasks and priority of vacating emergency facilities and other infrastructure and public services; Special powers of enforcement; Constraints in land-use; Removal of night-population; Retrofitting of life-lines; Requirement of special geophysical investigation from private property owners;

Responsible Bodies: IMM, municipalities, Governorate, SAWW, UCAET, and NGOs, Ministry for Culture and Tourism, 'Protection Committees of Natural and Cultural Assets'; Sea-faring Enterprises, The Navy;

Proposals: IMM-municipalities special commissions to prepare implementation plans; Vacated areas to be designated as open and green areas only; Priority implementations, rapid compulsory purchase, special fund allocations, exchange of property, transfer of development rights; Special supervision of the areas; Revisions in Development (3194) and Greater Municipalities (3030) Laws, and Law 4650.

Open Space Scarcity Risks

Scope: If open areas (green, car-park, sports-fields, etc.) are not of sufficient size, not in proximity to residential districts, and are not appropriate for the emergency requirements, than scarcities prevail and so do Deficiency Risks; The distribution of available and appropriate open areas is investigated in relation to densities and pattern of built up areas;

Problems: High density residential districts are deprived of open spaces; Over-fragmented nature of open spaces and green areas; No specially designated and designed space for emergencies; Low level of maintenance and control;

Risk Management: Increasing the ratio of open spaces by combining existing ones; Reduction of densities in high risk areas; Vacating land to create continuous strips of open space between major land-uses; Avoiding development and removing existing buildings in river beds, potential land-slide and liquefaction areas; Facilitating local community use and control; Provision of bands of open spaces along major roads, regional car-parks, and heliports;

Responsible Bodies: IMM, municipalities, NGOs, LCAs;

Proposals: Preparation of local 'Open Spaces Implementation Plan' by special task groups of IMM and municipality planners and representatives of LCAs and NGOs in view of a 'Macro Open Spaces Policy'; Ordinary and emergency uses of each plot of open space will be determined by the implementation plan; Designation of open spaces to LCAs; Provisions in rapid compulsory purchase Law (4650), Changes for exchange of property and transfer of development rights in Development Law (3194), Special regulation by IMM on the standards and procedures of urban open spaces provision (3030), Changes in Flat Ownership Law (634) for LCAs.

Risks Related to Hazardous Materials

Scope: Urban uses that process, store, and distribute combustible, explosive, poisonous and pollutant materials are sources of further risks, the location, environment and routes of which should be separately investigated;

Problems: Unauthorized and ignorant operators; Ineffective regulatory devices and standards; Disregard of the need for contingencies, waste management and responsibilities; No supervisory system; Uncontrolled spatial spread and levels of concentration;

Risk Management: Survey and determination of enterprises that deal with hazardous materials, development of a comprehensive data base; Classification of enterprises according to the potential risk contained, and their spatial distributions; Developing a unified permit system, periodical inspections and warnings to neighboring uses;

Responsible Bodies: IMM, Governorate, Ministry of Energy, LCAs, environmentalist NGOs.

Proposals: IMM-Governorate protocol for comprehensive control over the Province; Instituting a permits and inspection system in line with EU standards and procedural constraints; Access to the spatial data-bank and transparencies in management and information; Proficiency requirements in the sector; Lists of hazardous materials as used by international organizations;

Enterprises processing and/or distributing hazardous materials to share insurance costs of neighboring uses; Obligation of warning the neighbors by the enterprise dealing with hazardous material; Preparation of a special regulation by IMM (3030); Obligatory earthquake insurance of the enterprise; Changes necessary in Property Taxation (1319), and Environment (2872) Laws.

Vulnerabilities of Historical and Cultural Heritage

Scope: Buildings of historical and cultural significance demand special analysis of structural and other forms of risks; A priorities list of the registered stock need to take into consideration the ground conditions, historical and architectural significance of the building and its environs, the other forms of vulnerabilities the building or complex may have in the face of earthquake;

Problems: Surveys and registers are not comprehensive; Inventories and spatial information are incomplete; Scarcity of resources and experts; Unique buildings have very indeterminacies in terms of design, structure and materials;

Risk Management: Generating a priorities program taking into consideration the micro-zonation findings and ground conditions; Accomplishment of special surveys of priority buildings; Fund raising campaigns for implementation and detailed surveys;

Responsible Bodies: IMM, Ministry of Culture and Tourism, Protection Committees, universities, enterprises in the tourism and culture sector, foundations, municipalities, Governorate and NGOs, UCAET, media enterprises;

Proposals: Constituting a campaign commission with the representatives of responsible bodies based on the protocol made between responsible bodies for the joint effort; Preparation of a long-term campaign program with phases and assignments to each party; each school, touristic hotel, restaurant, etc. in the campaign will work for the promotion of their locally assigned specific heritage; Fund raising in national and international art, culture, and tourism activities; Assigning special buildings to international promoting institutions; Channeling part of archaeological expenditures and expertise to Istanbul; Organizing conferences on the issue; Preparation of a regulation in the framework of Law of Protection of Cultural and Natural Heritage (2863), and Law of Promotion of Tourism (2634)

Risks in Lifelines

Scope: Analysis of life-lines in terms of structure of networks, routes, service area, volume of flow, construction and materials, with reference to microzonation and ground conditions; The access network; Vulnerable points and congestion risks;

Problems: Incremental growth of networks; Fragmented nature of authority and information; Network design mistakes and bottlenecks; No contingency measures;

Risk Management: Determination of weak-spots in the systems and retrofitting; Introducing redundancy in the systems; Redesign of networks and rerouting, considering the priority positions of Emergency Facilities, and service areas; Determination of allowable risk category areas; Improvements in construction performance and quality of materials; Over-all supervision;

Responsible Bodies: IMM, municipalities, infrastructural services enterprises, LCAs, NGOs;

Proposals: Development of an integrated data-base; Formation of a Risk management team with representatives from municipalities and the Governorate; Preparation of a regulation concerning design and risk management in infrastructural systems by IMM (3030).

Risks in Building Stock

Scope: Evaluation of private and public buildings in their design and constructional performance; Classification of stock and assessment of retrofit feasibilities;

Problems: Great volume of unauthorized buildings; Little information on the state of building stock, and extensive structural changes; Deficiencies in public buildings and emergency facilities; Many special cases as in the case of historic buildings;

Risk Management: Determination of building robustness in relation to surveys and microzonation information; Determination of retrofitting methods feasible for the different categories of buildings; Determination of comprehensive rehabilitation and action planning areas with respect to the concentration of deficient buildings;

Responsible Bodies: IMM, municipalities and the Governorate; LCAs; NGOs;

Proposals: Surveying by visual inspection and scanning of the total stock of around a million buildings in stages and three phases; Building up a detailed spatial data-base for the building stock for multiple purposes; Developing retrofitting models for standard cases; Facilitating decisions for retrofitting with modifications in Flat Ownership Law (634); Changes in Development Law (3194) in special high risk zoning and enforcement capacities for comprehensive rehabilitation;

Risks Related to Emergency Facilities

Scope: Hospitals, schools/ dormitories, communications centers, fire-stations, police-quarters, major commercial centers and storage facilities, banks, and other public and private buildings that are expected to provide emergency services after the earthquake are investigated for their satisfactory functioning; Their malfunctioning imply further risks for the city;

Problems: Structural risks of the emergency facilities are beyond tolerable limits; Facility management is not geared to emergency conditions; Locational and spatial risks are high; Disregard of an integrated planning approach prevails;

Risk Management: Structural safety of emergency facilities as part of an integrated emergency plan is a first step; A second aspect is the intra-risk management within each facility; Thirdly, inter-facility management has to be reviewed as part of the integrated emergency city-plan; Fourthly, safety of location and spatial distribution of facilities with respect to predicted emergency service demand has to be evaluated, complementarities and substitutive nature of facilities verified;

Responsible Bodies: Governorate, IMM, municipalities, Ministry of Education, Ministry of the Interior; Ministry of Health, SHAT, infrastructure managing corporate enterprises; private enterprises, NGOs, media enterprises;

Proposals: A joint 'Emergency Risks Committee' of Governorate and the IMM to develop a comprehensive plan of mitigation measures for emergency; The 'Emergency Facility' status should provide priorities as in services and special infrastructural support, and special pecuniary and non-pecuniary benefits or exemptions as of tax or insurance costs; Emergency Facility status could be granted to public, or if necessary to private buildings; Production of emergency facilities system map of the city and its dissemination to citizens; Preparation of a special regulation by the IMM, specifying mitigation standards and prerogatives of the municipalities in Law 3030; other prerogatives to be provided in Property Taxation (1319); Changes in Disasters Law (7269), Law of Municipalities (1580), empowering the joint Committee; provisions necessary also in the National Health, Education, and Civil Defense Laws.

External Risks

Scope: These cover all possible forms of deliberate or macro accidental events or actions that would nullify the mitigation measures taken against the earthquake, or make emergency activities less effective, or inflict damages; The risks that could materialize as losses in the face of unfavorable weather conditions, or acts of sabotage or terrorism; Investigation of factors to give rise to reactionary spontaneous movements of social unrest or actions to disrupt public order;

Problems: Difficulties in prediction;

Risk Management: Security units, Governorate and the IMM regular commission meetings; Assessment of global and regional security conditions, technological advances; Worst possible scenario studies;

Responsible Bodies: Governorate, IMM, Police, Ministry of the Interior, Secret Service, Gendarmerie, General Directory of Meteorology;

Proposals: Formation of an 'Alert Group' with the representatives of responsible bodies, periodically meeting on worst possible scenario; Public awareness raising programs; Provisions to be included in the Disasters Law (7269).

Risks of Incapacitated Management

Scope: Investigation of risks due to incapacities of the city administrations in risk management and emergency circumstances;

Problems: Hierarchic and bureaucratic structure of administrations to defy lateral interactions; Absence of expert personnel, facilities, and equipment deficiencies of the administrations; Missing cooperative work habits, sharing of information and infrastructure;

Risk Management: Introduction of expertise of risk management to the city administrations; Reconsideration of administrative structure and prerogatives of branches;

Responsible Bodies: IMM Disaster Center (AKOM), Governorate Disasters Center, General Directory of Emergency Management of Turkey;

Proposals: Formation of IMM special task unit for risk management; Inter-operability of personnel, equipment, data-bases and information; Drawing of a protocol for cooperation with the Governorate and municipalities; Training of IMM personnel for risk management, and use of consultants; Administrative redundancy creation for the emergency circumstances; Capacity building for employing volunteer groups, and challenging work against time; Provisions in the Disasters Law (7269), the Municipalities Law (1580), and in Local Administrations Draft Law.

Risks in Urban Environment

- Population Density
- Means of Access and Removals (roads, car parks, traffic)
- Environmental Impacts of Building Collapse
- Site and Building Features
- Microzonation properties of location

Risks in Infrastructure

- Risks in existing road system and accessibility
- Emergency use of the road system and infrastructures
- Emergency facilities and the Road System
- Routing, networking and nodes in infrastructures

Scenario-Based Risks

- Urban Systems Performance: (Search and rescue services, Emergency access and storage facilities, Accommodation and daily support provisions)
- Adequacy of Emergency Facilities: (Location and capacities, Vulnerabilities of damages, Access, alternatives in service capacities)
- Emergency Management Capacities of Administrations: (Emergency equipment / vehicles availability, Trained personnel, Communications means, Capacity of instant decision making and action, Capacities to coordinate voluntary labor and resources)

4.5.7 Local Action Planning and Rehabilitation Programs

- Designation of High Risk Areas
- Local Surveys (Physical, Social, Natural Conditions)
- Evaluations and Rehabilitation Planning
- Project Development and Organizational Measures
- Project and Resources Management
- Implementation (infrastructures, retrofitting, redevelopment, removals, etc.)

4.5.8 Procurement of Resources

Private property owners / Saving capacities

Institutional Resources

- Extending the Obligatory EQ Insurance Pool
- Allocation of resources for mitigation
- Public Resources: Budget allocations, Local Authority allocations

New Methods of Procurement

- tourism / culture / sports / recrecreational sector contributions
- transit traffic
- large-scale project development
- External Resources
- Funding by International Inst.
- European resources (Dev. Bank, etc.)
- Donations / Credits by countries

4.5.9 Project Packages of the Istanbul Contingency Plan

Risks Related To Urban Physical Properties (SP1)

- SP1.A. Macroform Risk Analyses and Management
- SP1.B. Risks Related to Urban Physical Texture Properties and Mitigation
- SP1.C. Risks Related to Incompatible Urban Uses and Risk Management

Methods for Building Structural System Analyses and Retrofitting (SP2)

- SP2.A. Preparation of Training Materials for Technical Personnel to Carry Out I. and II. Phase Assessments
- SP2.B. Training of Personnel to Carry Out I. and II. Phase Assessments
- SP2.C. I. and II. Phase Data-Base Design, Data Processing and Evaluation
- SP2.D. Preparation of Training Materials for Engineers to Carry Out Retrofitting Supervision
- SP2.E. Training of Engineers to Carry Out Retrofitting Supervision

Riks in Life-Lines (SP3)

- SP3.A. Risks in the Macro Level Transportation Network and Mitigation Methods
- SP3.B. Risks in the Macro Level Infrastructure Networks

Risks of Loss of Productive Capacities (SP4)

- SP4.A. Analyses of Types, Causes, and Impacts of Loss Distributions in Industry
- SP4.B. Local and Sectoral Cooperation for Mitigation of the Industrial Units

- SP4.C. Training of Industrial Managers for Mitigation in Production Processes
- SP4.D. Training of Labor for Workplace Mitigation
- SP4.E. Material Incentives Opportunities and Needs for Mitigation
- SP4.F. Training and Support of Labor for Residential Safety

Risks in Historical Environments and Heritage, and Risk Management (SP5)

- SP5.A. Design and Management of a Campaign for the Preparation of the Istanbul World Cultural and Historical Heritage to Earthquakes
- SP5.B. Improvement of the Spatial and Digital Data-Base of Cultural Heritage in Istanbul
- SP5.C. Risk Assessments in the
- SP5.D. Design and Management of the 'Istanbul Heritage Repossession Campaign' of Elementary and other Schools Activities Component
- SP5.E. Design and Management of the programs concerning the tourism sector of the 'Istanbul Heritage Re-possession Campaign' with local assignments of specific heritage to hotels, restaurants, etc. participating in the campaign

Management of Special Risk Areas (SP6-8)

Dams and Downstream Basins

- SP6.A. Design Examination of the Existing Dams for the Probable EQ
- SP6.B. Developing Dam Damages and Flooding Scenario, Feasibility and CBA of Alternative Courses of Action
- SP6.C. Risk Management and Planning in Downstream Basins
- SP6.D. Investigation of Viaducts in Downstream Basins
- SP6.E. Improvement of river-beds in Downstream Basins
- SP6.F. Enforcement of Land-use Constraints and Transfers in Downstream Basins
- SP6.G. Removal of Emergency Facilities and Public Buildings in Downstream Basins

Seashore Strips

- SP7.A. Probable Subsurface Landslide Areas
- SP7.B. Determination of Tsunami Impact Areas
- SP7.C. Protection of Vessels and Passengers at Sea
- SP7.D. Safety of Public Buildings and Emergency Facilities at Seashore
- SP7.E. Infill areas at Seashore Landslide, Liquefaction and Flooding Area
- SP8.A. Planning and Long-Term Measures in Areas Subject to Landslide, Liquefaction and Flooding
- SP8.B. Liquefaction in Riverbeds and Development of Green Belts

Risks of Hazardous Uses (SP9)

- SP9.A. Identification and Management of Risks Related to the Distribution of Hazardous Materials
- SP9.B. Risks in Petrol and LPG Stations and Access Roads

Emergency Facilities (SP10)

- SP10.A. Identification and Management of Risks in Emergency Facilities Related to Structural Capacities
- SP10.B. Identification and Minimization of Risks Related to the Management of Emergency Facilities

- SP10.C. Identification and Management of Risks in Emergency Facilities Related to Location

Open Spaces (SP11)

- SP11.A. Development of Urban Open Spaces System
- SP11.B. Identification of Principles for the Design and Development of EQ Parks
- SP11.C. Design and Implementation of Continuous Open Space Bands along Circulation, Infrastructure and Buffer Zones

Promotion of Istanbul Earthquake Master Plan (SP12)

- SP12.A. Determination of Activities, and Preparation of Dissemination Materials
- SP12.B. Conduct of Campaigns
- SP12.C. Evaluation of Campaign Results
- SP12.D. Preparation of a Program and Related Material for International Campaigns
- SP12.E. Formation and Conduct of Municipal Follow-Up Committee for Risk Management

4.5.10 Istanbul Local Action Plan Project Packages

Preparation and Implementation of Local Action Plans (EP1)

- EP1.A. Method of Action Plan Preparation: Organization, Tasks, and Operations
- EP1.B. Survey of Natural and Ground Conditions
- EP1.C. Surveys of Infrastructure Systems and Data-Base Design
- EP1.D. Social Survey Data Collection
- EP1.E. Principles of Action Plan Implementation and Procedures

5 EARTHQUAKE INFORMATION INFRASTRUCTURE

5.1 Information Infrastructure

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In this final report on the information infrastructure, previous studies within the scope of the first three reports have been unified under appropriate headings, incomplete aspects have been completed, and a new section on reliability in computer systems has been added.

This report consists of five main sections:

1. Standards
2. Data layers
3. Software, hardware and network infrastructure
4. Data collection and updating
5. Reliability of data and computer systems.

We begin the report with a section on standards to stress the importance we attribute to developing and adhering to standards. Large systems such as an urban information system or a disaster information system necessitate the coordination and information sharing of many institutions. In many cases, a distributed information system formed by different databases may be appropriate. In order for this to work without problems, it is essential that standards be used, developed and adhered to. There are many standards that apply to an earthquake information system. The foremost among these is the TABİS standard that has been developed for earthquake information systems within Turkey. This standard should be used as a basis. In addition to this, there are several data file formats and exchange standards, each applying to a specific application software. In this report, we give information relating to those and the international organizations that govern these standards. Lastly, standard development studies relating to data structure of disaster information systems have been outlined. An ISO committee is currently working on this issue; however, a final standard has not emerged. In this report, a proposal for this named KIWI+ is described in some detail.

In the second section, under the subheading “functional classification”, we discuss data layers that should be present in a disaster information system. We follow this by a discussion of the Zeytinburnu pilot study developed by the Municipality of Istanbul, and propose some modifications, which makes the system compatible with the disaster management database design described in the next subsection. We present detailed designs on disaster management, building reinforcement and analysis databases.

In the third section, “software, hardware and network infrastructure”, alternatives on geographical information systems, database systems, server hardware and network infrastructure of a disaster management system have been presented and some proposals have been made.

The fourth section is on data collection and updating. In this section, both procedural and technological suggestions on the management of the data over time and updating of data have been presented.

Lastly, in the fifth section, the reliability of data and computer systems has been discussed. Information about reliable hardware and software and backup procedures have been presented.

5.1.1 Standards

Turkish Earthquake Information Standard: TABIS

TABİS is a standard that has been developed for earthquake information ststems within Turkey. This standard should be used as a basis in this project. Detailed information about TABIS has been given in the report of the ITU group, which has developed the standard.

File Formats and Data Exchange Standards

All institutions have the responsibility of maintaining geographical information under their control. Nevertheless each institution may need other institutions data for their daily or future operations. In these situations it is an important matter how to exchange geographical information between institutions.

Data exchange is needed to be done via some protocols and standards in order to minimize the effort and time costs. Even under circumstances where different geographical information systems are used, the data exchange should be done perfectly with minimum time and process requirements.
Data exchange standards are carried out by many international public and private organizations. The following international bodies shown in Table 5.1.1 have been involved in their preparation.

Table 5.1.1. Data exchange standards

ISO/IEC JTC1	ISO/IEC Joint Technical Committee on Information Technology
ISO/IEC 204	ISO Technical Committee for Transport Information and Control Systems (TICS)
ISO/IEC TC211	ISO Technical Committee for Geographic information and Geomatics
CEN TC278	European standardization organization for road transport and traffic telematics
CEOS	The Committee on Earth Observation Satellites
CERCO	Comité Européen des Responsables de la Cartographie Officielle
CSIRO	Commonwealth Scientific & Industrial Research Organization
DGIWG	Digital Geographic Information Working Group
EuroGeographics	European Mapping Agencies
EUROGI	European Umbrella Organization for Geographic Information
IAU	International Astronomical Union
ICA	International Cartographic Association
IGS	International GPS Service for Geodynamics
IHO	International Hydrographic Organization
ISCGM	International Steering Committee for Global Mapping
OGC	Open GIS Consortium

As seen in the Table 5.1.1, standards are tried to be developed by many institutions. Much commercial geographic information system software in the market is developed to be suitable with these standards. However, this commercial software is differentiated from each other by the data format used. Commercial software vendors keep their data structures confidential which make data exchange between systems difficult.

To overcome the problems related with different file formats, each commercial software vendor prepares modules to convert their file formats to others. This method demands each software company develop software modules for converting their file format to file formats of all other software vendors. But in most cases keeping the file format confidential and existence of restrictions for the usage of file format makes this method ineffective (Figure 5.1.1)

In Figure 5.1.1, it is illustrated how the data exchange strategy takes place between four different file formats of different software vendors. Even for four different file formats, the number of data conversion programs is six. For six different formats, this would lead to 16 different conversion modules. It can be easily perceived that the number of software modules for the purpose conversion increases exponentially with the number of file formats.

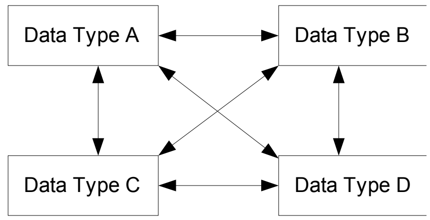


Figure 5.1.1. Conversion between different file formats

These kinds of obstacles are avoided by software companies using common data exchange protocols between geographical information systems. For this purpose, each company develops software modules to convert their own file format to common data exchange format (Figure 5.1.2). With this motivation GML (Geography Markup Language) was developed as a common data exchange format. This language comprises protocols and standards for data exchange between different platforms.

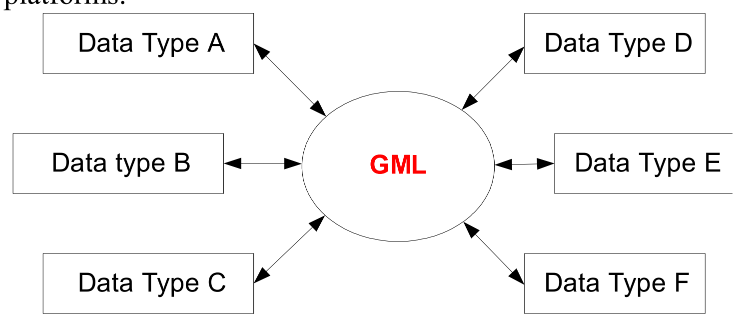


Figure 5.1.2. Usage of common data exchange format

There are certain characteristics that a common data exchange language must have. These are:

- Data structure must be free to use for all companies
- Must be easy to understand and use
- Do not include properties that may restrict the possible requirement in future
- It must be improved continuously by international consortiums

GML is a XML format which is designed to transfer and store spatial and attribute data of geographical entities. The most important design criteria for GML are making it easier to transfer and store the spatial data over internet. Considering that the environment of future geographic information systems will be internet, geographic information are intended to be stored in a compact form.

GML is both platform and vendor independent which makes it very suitable for sharing data over local and wide area networks. Both plain and compressed XML files can be served by streaming so users do not have to wait for the whole file to be transferred to open it. This property improves the usability of the language over networks dramatically.

Usage of GML would enable the concept of spatial network. By this way all institutions that have GIS information will be able to distribute all their data over network using GML easily. GML will facilitate institutions to integrate their geographical information with other geographical information data sources and make it easy to distribute their own data to other systems. This distribution operation will even be possible between geographical information systems developed by different companies. So it is not mandatory to use the same software with other institutions any more as each institution may use the software that is most appropriate to the institutions work environment. After the data exchange between institutions is established, each institution's cost will decline and service quality will be increased.

OpenGIS consortium has also defined software called "Web Feature Server" (WFS) that serves GML services. Most companies working on geographical information systems have WFS applications. These products usually support each company's data format separately. Another map serving method is "Web Map Server" (WMS). This product process the maps as images and sends attribute data of entities to the clients using predefined GML data structure.

Spatial Temporal Data Structure: KIWI+

Data exchange formats defined above is valid for spatial geographical information systems and there is no de facto standard for spatial-temporal geographic information systems. KIWI+ format is a data format that is proposed to international organizations as a standard for spatial-temporal systems which is an open file format. KIWI+ is an improved version of KIWI format which is a data format proposed in ISO/TC204/WG3.2 for car navigation systems. KIWI+ combines KIWI data format and temporal management of entities in one data format.

This data structure includes vector elements (VE) for shaping graphic data and connector elements (CE) that are used to relate entities formed by vector elements to attribute data. Both vector and connector elements comprise time information and relations between these two elements are calculated at run time dynamically.

Temporal factor that both vector and connector elements have the following four components:

- SS: the point when the object starts to exist (starting building construction)
- SE: the time when the existence of the object is established. (finishing building construction)
- ES: the point when the object starts to disintegrate (starting demolition of building)
- EE: the point when the object ceases to exist. (finishing demolition of building)

All these components may not be needed for all entities. For some entities SE and EE are enough for proper use.

To access topographic information for a specific time, these components are used in the following steps:

- Finding vector and connector elements that are valid for the specified time point.
- Building relations between these elements at run time dynamically
- Finding vector area that the point of query resides.
- Finding connector element that is related with this vector area using topographic relations and fetching the result. (Figure 5.1.3)

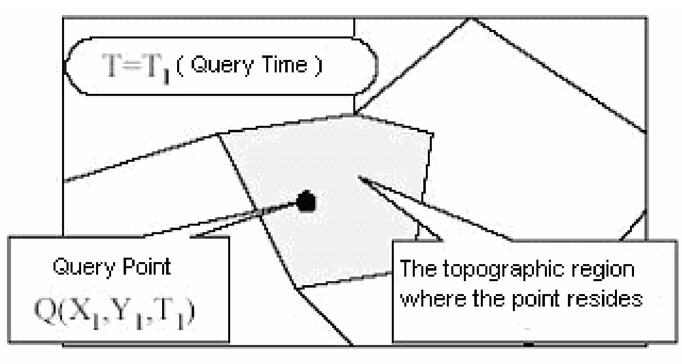


Figure 5.1.3. Spatial-Temporal query

A Vector element in KIWI+ comprises latitude, longitude, altitude, and temporal information. To define any polygon, the system may use one or more vector elements. At run time all vector elements for current time and space are processed to establish topographic shapes. Figure 5.1.4 illustrates how two polygons are produced by processing vector elements. The spatial relations between vector elements are established in real-time which produce two distinct polygons.

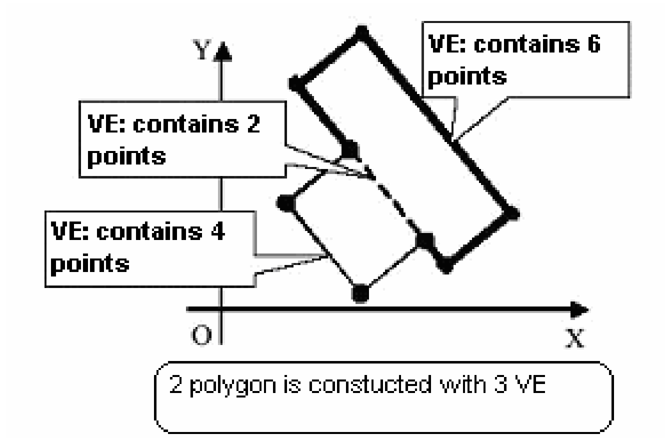


Figure 5.1.4. Vector elements

The purposes of connector elements are to connect attribute information to the topographic shapes obtained via vector elements. A connector element mainly comprise spatial information like longitude, latitude and altitude data, and temporal information as well as attribute information such as the display information and grouping information of the entity that this element is related.

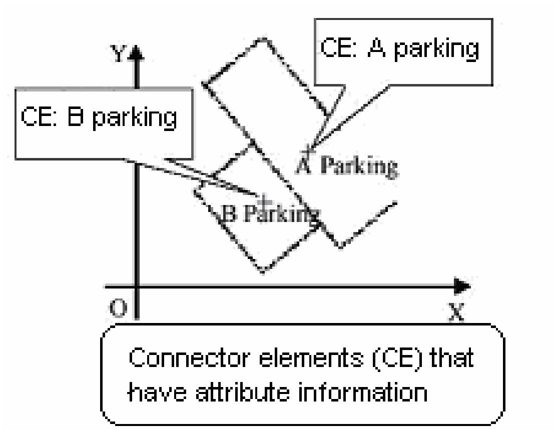


Figure 5.1.5. Connector element

As shown in Figure 5.1.5, there are two connector elements that reside in two polygons obtained from vector elements. There is no explicit relation defined between the polygons and connector elements. This means that, there are no common fields connecting vector element records to connector element records. At run time each polygon (point, line or even may be a body) is checked whether there is a connector element in it or not. If there is one in polygon, then the attribute information is found.

If we make an examination of KIWI+ considering information system design criteria mentioned in chapter 5.1.3, following results may be concluded:

- GIS projects are long term projects where the spatial information changes over time. Through time changes occurs and GIS should be able to reflect these changes and should be able to answer queries regarding to past. Being a spatial-temporal information system, KIWI+ cover all possible requirements that are needed for a temporal GIS and can be used in long term projects as an efficient database structure.

- KIWI+ data structure is an open data structure which can also be used as a data exchange standard and geographic data can be transferred to other systems without any extra overheads.

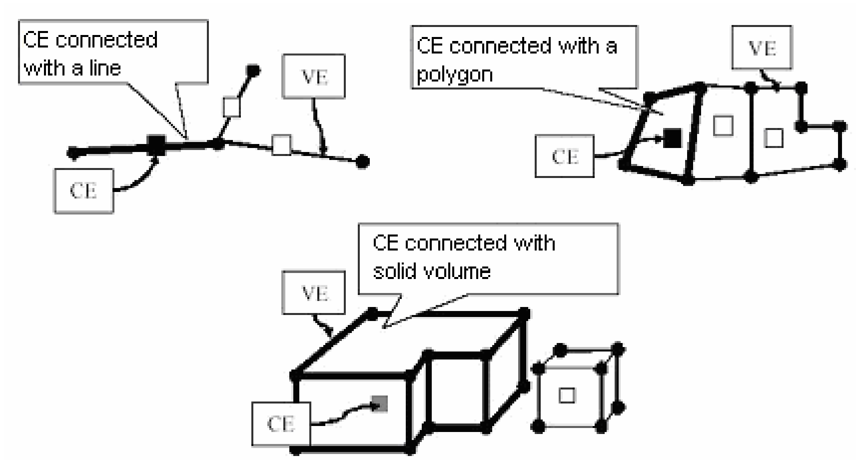


Figure 5.1.6. CE-VE relationships

Metadata

Metadata roughly means data about the data and it has become a very important concept in many disciplines. Metadata is a record about the data that can represent the original source, and when needed can replace the data for some tasks. Nowadays, metadata is used in different contexts by many different users as librarians, desktop publishers, designers and database administrators, where the data exists. In computer society, the term is inevitably used for data warehousing applications and GIS based information systems where very large data is processed. The main reason for its use lies in the fact that metadata facilitates the categorization and the query processes for large data.

Departments such as İETT, İSKİ, İGDAŞ in Istanbul Municipality are producing large amount of data in their usual work, and this data would not be used only by these departments, but also by AKOM and other disaster related people who are performing complex queries and analysis on that. Currentness of such a system would be crucial, and institutions should store data very carefully. Otherwise, there would be a junk of data in the warehouse. The proposed method for this storage is to use metadata with the catalogs. When included, a metadata tag shows log information like when data is produced, by whom, on which purpose, etc. and additionally the classification information of the data.

We should also notice one other significant use of metadata when we are dealing with technological constraints. Usually GIS based systems store data in binary form which are not easy to index for searching purposes. However, metadata can be stored in any suitable form, which is usually in text form, so that instead of indexing whole binary data, only metadata which is considerably small is indexed. Below metadata entry form of Federal Geographic Data Committee is presented.

FGDC Metadata Entry Form

This form produces a set of metadata elements whose output meets the minimum data collection requirements of the Content Standards for Digital Geospatial Metadata.

Identity of this entry (for future update):

Originator: Publication date (YYYYMMDD):

Title of data set:

Edition: *Presentation Form:* map

Publication place: Publisher:

Online linkage (URL):

Abstract:

Purpose:

Supplemental Information:

Beginning date: (YYYYMMDD): Ending date: (YYYYMMDD): present

Currentness reference: ground condition Progress: Complete

Intended data set maintenance and update frequency: Annually

West bounding coordinate (-DDD.XXX):

East bounding coordinate (-DDD.XXX):

North bounding coordinate (DD.XXX):

South bounding coordinate (DD.XXX):

Theme keywords: Reference:

Place keywords: *Reference:*

Limits on data accessibility:

Limits on use of data:

Browse graphic URL:

Browse graphic caption:

Browse graphic file type: Graphics Interchange Format

Spatial data type: Point

Distribution organization:

Distribution contact position/person:

Address type: mailing and physical address

Address:

City:

State or province: Postal code: Country:

Phone: *Fax:* *E-mail:*

Dataet name as known by Distributor:

Liability held by distributor:

Date of last metadata entry or update (YYYYMMDD): 2003080

Post Metadata Entry | Clear Form

Most of the GIS companies are integrating tools for creating and editing metadata with their GIS products. For instance ESRI has its own tool for creating metadata in ArcMap series product. On the other hand, the process of entering metadata can be combined with the process of data creation by setting metadata standards such as the one of FGDC, so that metadata is produced automatically. It would be a better way to use tool that is compatible with the GIS software which is in use by the institution.

Metadata can be stored in different formats. The most widely used standard for metadata is XML format. As a matter of fact, most of the metadata tools use that format in their software. XML is stored as a text file in the memory, but it is designed to store all the description of the data. Therefore it is suited perfectly to the task of metadata storage.

5.1.2 Data Layers

Functional Classification

Functional classification deals with usage purpose of data. In this stage, data is classified according to the functions of data for earthquake related studies, independent of its creation or store purposes.

This classification is made using only data's functional and logical relations and a variety of sources have been used for this purpose. As a result natural system, infrastructure system, transportation system, and buildings are grouped and illustrated in Table.

Table 5.1.2. Classification of data

MAIN CLASSES	SUB CLASSES	DESCRIPTIONS
BUILDINGS	• Construction Date • Type • # Of Floors	Buildings are classified into 24 classes. Building inventory database is given in Figure 5.1.6
REINFORCEMENT	• Technical Inspection Data • Damage Assessment Data • Reinforcement Data	Building inspection and restoration data will be stored in the database. The database schemas are given in Figure 5.1.7 and Figure 5.1.8.

TRANSPORTATION	Highway Transportation Network
	• Motorway (T.C.K.)
	• State Highway
	• Provincial Road
	• Secondary Provincial roads
	• Bridges
	• Tunnels
	• Viaducts
	• Passageways
	
	Railway Transportation System
	• Tracks
	• Stations
	• Bridges
	• Tunnels
	• Facilities
	• Railway Mass Transit System
	    • Suburban lines
	    • Subway
	    • Light Subway
	    • Tramway
	    • Fast Tramway
	    • Tunnel
	
	Maritime Transportation System
	• Harbors and Passenger Facilities
	• Warehouse
	• Crane and Cargo Facilities
	• Fuel and Maintenance Facilities
	• Maritime Transportation System
	    • Urban Lines (T.D.İ.)
	    • Ferry Lines
	    • Sea Buses (İ.D.O.)
	    • Private Sea Taxis
	    • Harbor and Passenger Facilities
		Transportation information can be under the responsibility of T.C.K., Great City Municipality or district municipalities. Transportation network is represented in database using administrative classification.
		
		According to the maintenance and administrative purposes, railway network is classified to different classes.
		
		T.D.İ. and İ.D.O. are two institutions responsible for maritime transit network.

Table 5.1.3. Classification of data (cont.)

MAIN CLASSES	SUB CLASSES	DESCRIPTIONS
	Air Transportation System • Control Tower • Air Fields • Helicopter Landing Fields • Terminal Buildings • Fuel Facilities • Maintenance and Hangar Facilities • Parking Facilities	In addition to Atatürk Airfield and air fields of D.H.M.İ. helicopter landing fields are also classified.
	Public Bus Transportation System • İ.E.T.T. Bus Lines • Private Bus Lines • Minibus Tracks • Bus Stations • Transfer Centers	Mass transit system data can also be used for analysis.
INFRASTRUCTURE	Fresh Water System • Pipelines • Chlorination Facilities • Water Basis • Pumping Stations • Water Storage Tanks • Cisterns	All fresh water networks from source to houses will reside in this module.
	Waste Water System • Canals • Collectors • Treatment Facilities • Pumping and Discharge Facilities	Waste water system also needed to be included to the system.
	Garbage System • Storage Areas • Treatment Stations	
	Electrification System • Lines • Induction centers • Transformers	Electric distribution components of T.E.D.A.Ş. and B.E.D.A.Ş. are given here.
	Natural gas System • Pipelines • Storage and Distribution Stations	Natural gas distribution network is given here.

	Telecommunication System
	• Public Switch Network
	   • Cable Network
	   • Distribution Centers
	   • PBX
	   • Radio-Link Stations
	• Mobile Telephone System
	   • Base Stations
	   • Base Station cable network
	• Television Stations
	• Radio Stations
		Communication system which will be vital in any emergency situation is classified.

Table 5.1.4. Classification of data (cont.)

MAIN CLASSES	SUB CLASSES	DESCRIPTIONS
SOCIAL SERVICES	Health Service Institutions Disaster Management Centers Police Stations Fire Department Schools Dormitories Guest houses Courthouses Religious Buildings Administrative Buildings	All administrative institutions in Istanbul will be grouped here.
STRATEGIC FACILITIES	Dams and Levies Military Facilities Shipyards Petro-chemical Facilities Fuel Storage and Distribution Facilities Factories and Industrial Facilities	Facilities that may cause additional damage after an earthquake are classified here.
COMMERCE CENTERS	Marketplaces Shopping Centers Warehouses	These are required for damage/loss analysis.
TOURISM AND RECREATION CENTERS	Historical Buildings Museums Sports Facilities Historical Bazaars Convention Centers Cultural Facilities, Concert Halls Hotels	These are required for damage/loss analysis.
NATURAL STATE	Topographical Maps Geological Maps Geotechnical Data • Ground Classification • Liquefaction • Slope Stabilities Earthquake data • Tectonic Movements • Seismic Data • Historical Earthquakes • Strong Ground Motion	Natural state maps and studies related with physical states are grouped here.
SOCIO-ECONOMIC	Demographic Density Demographic Composition	Demographic data are classified here
ANALYSIS	Analysis Results • Earthquake Scenarios • Direct Damages • Indirect Damages • Direct Economic Losses • Indirect Economic Losses Damage Functions Restoration Functions Damage Computation Functions	Previous study results and function parameters are stored here.

Table 5.1.5. Classification of data (cont.)

BASE CLASSES	SUB CLASSES	DESCRIPTIONS
AREAS	Commercial & Industrial Areas Tourism Areas Sports Areas Urban Recreation Areas • Nature Parks • Provincial Parks • Fair & Festival Areas • Street Parks • Zoos • Sports Areas • Olympic Areas • University Areas Forests Protected Areas Areas with Construction Limits • Geologically Risky Areas • Water Basis Protection Areas Bosphorus Region Historical Forests Historical Recreation Areas Military Zones	After an earthquake most of the areas will be used to serve people. Planning may be needed before a disaster for the best response.
ZONING AND CONSTRUCTION PLANS		
EMERGENCY RESPONSE	Materials Inventory Personnel Vehicles Planning	Emergency related information like vehicle, personnel or materials will be stored in this group.
TRAINING PROJECTS	• Research & Development Projects • Training Programs • Drills	Trainings and drills carried out by all institutions will reside here.
CONTACT INFORMATION	Officials Address Information	All officials information (names, addresses) will be stored in database
LAWS AND REGULATIONS	• Disaster Related Laws & Regulations • Construction Related Laws • Building Inspection Laws • Laws related to Apartments, Public Housing, Cooperatives, and Gecekondu(Shanties) • Municipality Laws • All Other Regulations	All laws and regulations prepared will be stored here and will be queried easily.

Current Status Database

The databases developed for city information System and Zeytinburnu prototype information system prepared by Istanbul Municipality Information Center are studied and following conclusions are made:

- Most of the data layers that would be required for pre-earthquake and post-earthquake phases are completed.
- Creating the tables in a relational model is neglected however this can be achieved easily.
- No integrity between tables which are used for the same purpose. Tables, which store the same kind of information, all have different structures. These data may be united in some standard table structure easily.

Zeytinburnu prototype information system database, tables do not have integrity between each other. Tables like "İlçe Kurtarma ve Yardım Komitesi", "İlçe Acil Yardım Hizmet grup Başkan ve Yardımcıları", "İlçe Afet Yönetim Merkezi Personeli", and "Kaymakamlık Birimleri İrtibat Bilgileri" all store the same kind of contact information, however they do not have the same table structure. Some tables have missing attributes. But there should be a standard for contact information as for anyone, the contact information is identical. For example;

- Name
- Surname
- Work Phone
- Home Phone
- Cell Phone
- Address
- Fax
- Email

can be stored in one table and standard procedures can be defined for information input (Figure 5.1.41).

Contact information table can be related with other tables using *IrtibatId* attribute. With this method not only the tables mentioned above, but also all possible tables that may need contact information can be related with this table and therefore queries can be made easier.

Contact information table can also have additional attributes like the firm the person is working or function in case of a disaster. These attributes can be defined in another table and related to Contact table using "GörevID" attribute.

Storing personnel data in hospital table makes it more difficult to make changes in the table. For example head doctor's attributes like name, surname, work phone and cell phone are stored in hospital table. But the contact information attributes defined for contact information table are not all defined for this table. There is a contradiction here:

- Contact information table have too detailed structure
- Hospital head doctor contact information is missing.

Furthermore, personnel, bed and material numbers are some other attributes of hospital table. It would be more appropriate to store these kind of data related with institution table so that queries can be standardized.

Developed database structure stores all standard institutional data in ***Kurumlar*** table. All buildings of institutions in the city are related with ***Kurumlar*** table using ***KurumBina*** table. Geographic coordinates and shapes are stored in ***Binalar*** table so that all spatial data are stored in standardized form. Institution types that are related with institutions (Directorates, Security institutions, Educational institutions, etc.) are related to ***Binalar*** table via ***Kurumlar*** table and each institution's layer data can obtained at run-time.

All attributes that are peculiar to institutions are stored in corresponding institution tables. For example:

- Educational Institutions : Dormitory capacity, dining hall capacity
- Security Institutions : Jail capacity

To store all these kinds of attributes in a common institution table would cause design problems as to store all 14 kinds of institution attributes in one table would result with lots of null values in the table and low system performance.

The same method is used to define tables related with areas. All common attributes related to areas are stored in ***Alanlar*** table and each area layer is related to this table via *AlanID* attribute. Address information attributes like *İlçeID* and *MahalleID* are just references to ***İlçeler*** and ***Mahalleler*** tables respectively. This method prevents possible spelling errors that may cause problems for query operations and remove redundancy.

Database structure for emergency is obtained by relating ***Alanlar*** and ***Kurumlar*** tables with ***PlanAtama*** table. Areas and institutions in the database design are just abstract structures. The only difference between an area and an institution is that institutions are related with inventory tables as they may have personnel, materials and vehicles. Additionally spatial information for institutions is stored in buildings table whereas the spatial information of areas is stored in ***Alanlar*** table.

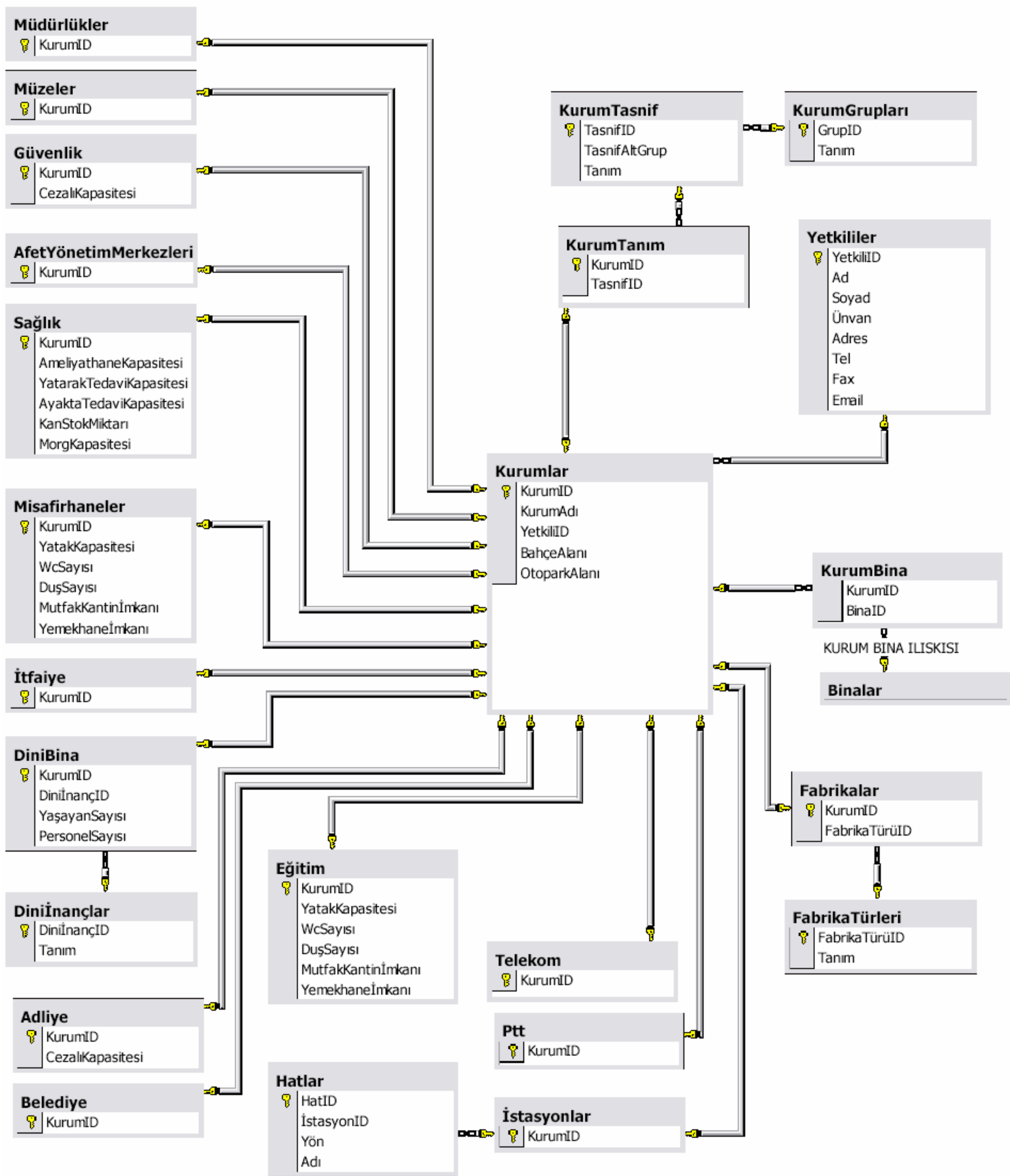


Figure 5.1.7. Proposed institution database

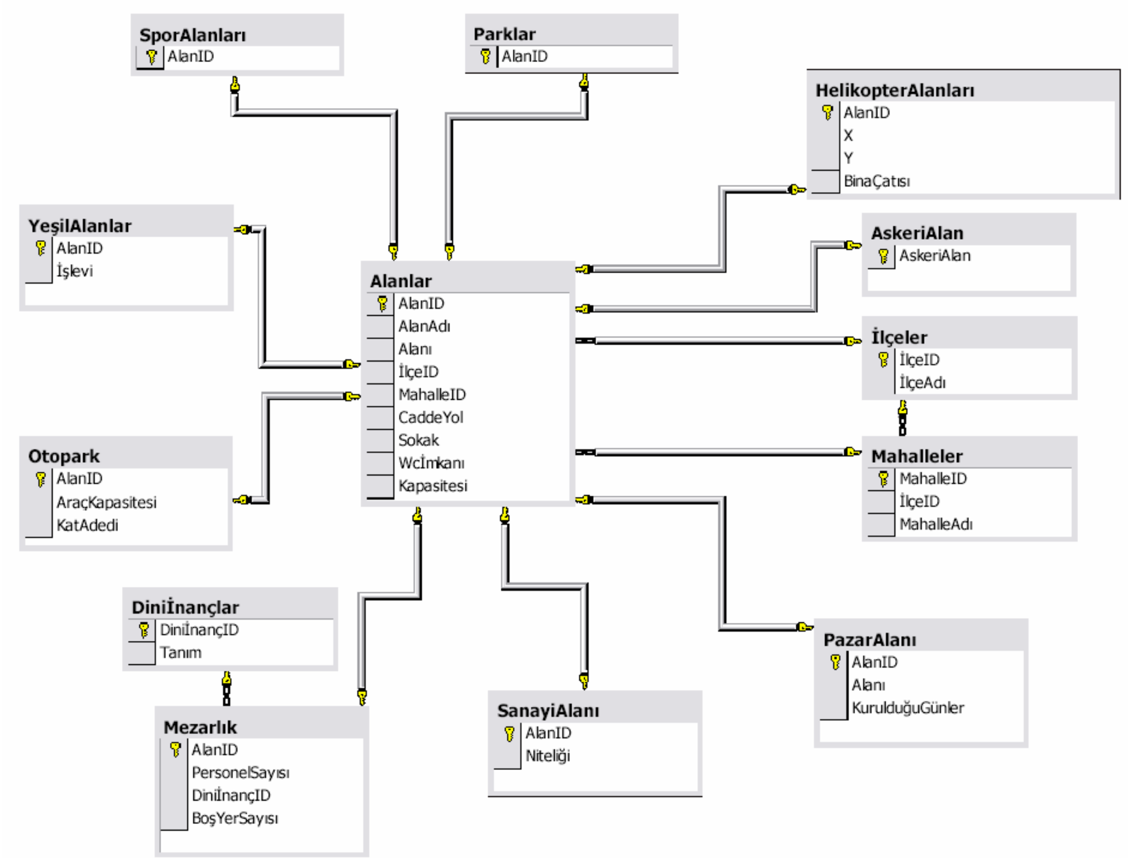


Figure 5.1.8. Proposed area database

The table designs for institution and area databases are given in Table 5.1.6.

Table 5.1.6. Institution and Area database table structures

TABLE NAME	DATABASE FIELDS			
Alanlar	Field Name	Type	Size	Description
	AlanID	int	4	Area identifier
	AlanAdı	varchar	50	Area name
	Alanı	int	4	Area (m^2)
	İlçeID	int	4	District id
	MahalleID	int	4	Mahalle id
	CaddeYol	varchar	50	Main Road
	Sokak	varchar	50	Street
	WcİmkanıI	int	4	WC capacity
	Kapasitesi	int	4	Capacity(m^2)
YeşilAlanlar	Field Name	Type	Size	Description
	AlanID	int	4	Area identifier
	İşlevi	char	10	Usage purpose
Otopark	Field Name	Type	Size	Description
	AlanID	int	4	Area identifier
	AraçKapasitesi	int	4	Car park capacity
	KatAdedi	int	4	# of Car Park floors
Mezarlık	Field Name	Type	Size	Description
	AlanID	int	4	Area identifier
	PersonelSayısı	int	4	# of Personnel
	Diniİnançİd	int	4	Religion identifier
	BoşYerSayısı	int	4	Free space in cemetery
Diniİnançlar	Field Name	Type	Size	Description
	DiniİnançID	int	4	Religion identifier
	Tanım	varchar	50	Description/Name
SanayiAlanı	Field Name	Type	Size	Description
	AlanID	int	4	Area identifier
	Niteliği	varchar	20	Type of industrial area
PazarAlanı	Field Name	Type	Size	Description
	AlanID	int	4	Area identifier
	Alanı	int	4	area of bazaar (m^2)
	KurulduğuGünler	varchar	50	Days of bazaar

AskeriAlan	Field Name	Type	Size	Description
	AlanID	int	4	Area identifier

HelikopterAlanları	Field Name	Type	Size	Description
	AlanID	int	4	Area identifier
	X	int	4	X coordinate
	Y	int	4	Y coordinate
	BinaÇatısı	bit	1	lWhether on roof or not

Parklar	Field Name	Type	Size	Description
	AlanID	int	4	Area identifier

SporAlanları	Field Name	Type	Size	Description
	AlanID	int	4	Area identifier

Müdürlükler	Field Name	Type	Size	Description
	KurumID	int	4	institution identifier

Müzeler	Field Name	Type	Size	Description
	KurumID	int	4	institution identifier

Güvenlik	Field Name	Type	Size	Description
	KurumID	int	4	institution identifier
	CezalıKapasitesi	int	4	Jail capacity

AfetYönetimMerkezleri	Field Name	Type	Size	Description
	KurumID	int	4	institution identifier

Sağlık	Field Name	Type	Size	Description
	KurumID	int	4	institution identifier
	AmeliyathaneKapasitesi	int	4	Operating room
	YatarakTedaviKapasitesi	int	4	Capacity of treatment on bed
	AyaktaTedaviKapasitesi	int	4	Capacity of treatment on foot
	KanStokMiktarı	int	4	Blood capacity in the hospital
	MorgKapasitesi	int	4	Öorgue capacity in the hospital

Misafirhaneler	Field Name	Type	Size	Description
	KurumID	int	4	institution identifier
	YatakKapasitesi	int	4	Capacity of guest house
	WcSayısı	int	4	# of WC
	DuşSayısı	int	4	# of showers
	MutfakKantinİmkanı	int	4	Capacity of canteen/kitchen
	Yemekhaneİmkanı	int	4	Dining hall capacity

İtfaiye	Field Name	Type	Size	Description
	KurumID	int	4	institution identifier

DiniBina	Field Name	Type	Size	Description
	KurumID	int	4	institution identifier
	Diniİnançl D	int	4	Religion id
	YaşayanSayısı	int	4	# of people living in it
	PersonelSayısı	int	4	# of people working

Adliye	Field Name	Type	Size	Description
	KurumID	int	4	institution identifier
	CezalıKapasitesi	int	4	Jail capacity

Belediye	Field Name	Type	Size	Description
	KurumID	int	4	institution identifier

Eğitim	Field Name	Type	Size	Description
	KurumID	int	4	institution identifier
	YatakKapasitesi	int	4	Dormitory Capacity
	WcSayısı	int	4	# of WC
	DuşSayısı	int	4	# of Shower
	MutfakKantinİnkanı	int	4	Capacity of kitchen/canteen
	Yemekhaneİmkanı	int	4	Dining hall capacity

Fabrikalar	Field Name	Type	Size	Description
	KurumID	int	4	institution identifier
	FabrikaTürüID	int	4	Factory type id

FabrikaTürleri	Field Name	Type	Size	Description
	FabrikaTürüID	int	4	Factory type id
	Tanım	varchar	50	Tactory type description

Telekom	Field Name	Type	Size	Description
	KurumID	int	4	institution identifier

Ptt	Field Name	Type	Size	Description
	KurumID	int	4	institution identifier

İstasyonlar	Field Name	Type	Size	Description
	KurumID	int	4	institution identifier

Hatlar	Field Name	Type	Size	Description
	HatID	int	4	Track identifier
	İstasyonID	int	4	Station id
	Yön	varchar	50	Direction
	Adı	varchar	50	Track name

Kurumlar	Field Name	Type	Size	Description
	KurumID	int	4	institution identifier
	KurumAdı	int	4	Institution name
	YetkiliID	int	4	Official name for communication
	BahçeAlanı	int	4	institution park area
	OtoparkAlanı	int	4	Car park area

Yetkililer	Field Name	Type	Size	Description
	YetkiliID	int	4	Official identifier
	Ad	varchar	30	Name
	Soyad	varchar	30	Surname
	Ünvan	varchar	30	Occupation
	Adres	varchar	100	Address
	Tel	varchar	20	Telephone
	Fax	varchar	20	Fax
	Email	varchar	50	Email

KurumTanım	Field Name	Type	Size	Description
	KurumID	int	4	institution identifier
	TasnifID	int	4	Institution classification code

KurumTasnif	Field Name	Type	Size	Description
	TasnifID	int	4	Institution classification id
	TasnifAltGrup	int	4	Sub class of institution
	Tanım	varchar	50	Classification description

KurumGrupları	Field Name	Type	Size	Description
	GrupID	int	4	Institution group identifier
	TasnifAltGrup	int	4	Sub class of institution
	Tanım	varchar	50	Classification description

KurumBina	Field Name	Type	Size	Description
	KurumID	int	4	institution identifier
	BinaID	int	4	Building identifier

Disaster Management Database

For an effective and on time action, the decision makers need accurate and current data. For success of Emergency Response Plans, a stable and complete disaster information system is a prerequisite. The users of the system on the other hand, have different backgrounds and produce, store and update their data inventory in different formats. For this reason, the disaster management related data should be extracted and organized in a standard way. An important point to be considered is the unity of data, data format. Each data with its data format should be determined to force the distributed operators along the city for right and exact data entrance. Obtaining all personnel, vehicle, and material inventory data of institutions and making planning assignment to institutions and areas would improve an efficient information system for disaster management. Preventing possible data input errors and redundancy is a critical database design criteria.

The database designs made taking these points into account have already been given in Figure 5.1.7 and Figure 5.1.8.

Emergency Response Database

Listing inventory of resources provides easy reach to resources on hand. To supply the decision maker the correct data on time and facilitate decision making the following groups of data is decided to store in database:

- Inventory of Material: The material information of institutions is stored with respective quantities. The aim is to see the materials that any institution has on hand and appoint them for effective usage and direct the operations carried out with this materials.
- **Personnel**: The various types of personnel belonging to any institution are stored with type and quantity. This method makes appointment and management of emergency response actions easier.
- **Inventory of Vehicle**: The vehicles are stored according to class and quantity related with institutions. The main objective are to appoint these vehicles to places, where necessary, and manage the activities after the disaster effectively.
- **Planning**: Planning is determination of necessary equipment, vehicle and personnel for an institution, region or function and appointing them as a planning entry to any institution or area seeking the resource.

We may follow two possible methods to build this information. First method is to enter all data from a central point. So, data entrance can easily be controlled. Other method is uses the concept distributed data entrance. In this method each institution enters its own data to the central information system via internet. When the amount of data and the frequency update operations are considered, the second method is more efficient as the vice versa would require huge amounts of time and human resources. Also it is easier for each institution to make its own inventory and planning updates in a distributed environment.

Emergency response database structure is illustrated in Figure 5.1.9. As can be seen in Figure 5.1.9 information about materials, vehicles and personnel are stored in different related tables. The way that inventory data is stored improves the performance and scaling ability, give the system developers in application phase and most importantly it provides a unity within data and makes querying easier. The advantages of the database structure defined above are:

- Data repetition will be prevented
- Data will take up less space and system performance will increase
- Scaling increases
- System complexity decreases

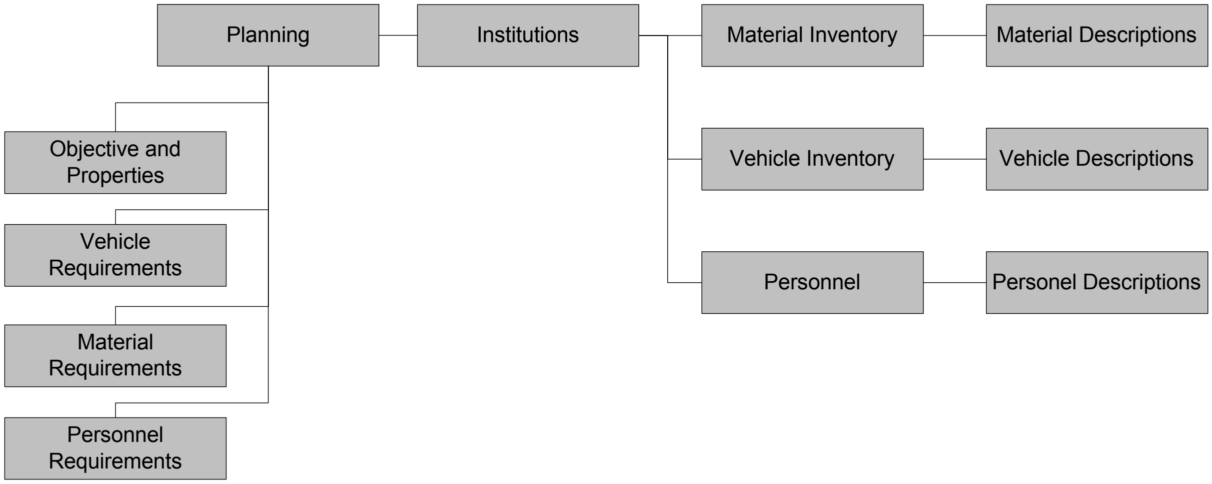


Figure 5.1.9. Institution-Planning relations

Each entry in materials table connects the material type defined in materials definition table and its quantity with the institution to which the material belonging. If it is considered that institutions have many common materials, existence of materials definition in materials table causes unnecessary repetition. For this respect, definitions of materials are stored in another table and only the record number defining the type of the material is stored in materials table. ” Definition of Material” is classified according to type of usage criteria. The classes of materials are as follows:

- Building Materials
- Medical Materials
- Firefighting Materials

The vehicle inventory of each organization is stored with the aid of items given in vehicles list. ”Vehicles” table relates itself with “Institutions” table by declaring the quantity using “Definition of Vehicles” table. Like each entry in “Definition of Materials”, “Definition of Vehicles” table has also classification. This classification is:

- Automobiles
- Sea Vehicles
- Heavy Machines
- Fire Brigade Vehicles
- Medical Services
- Mass transportation Vehicles
- Cargo Vehicles

The type and quantity of personnel working in any organization is very important to plan and to appoint before and after the disaster respectively. With the same argument the personnel is stored related with institution concept.

Planning

Planning is a table that contains necessary equipment, vehicle and personnel determined for an institution, region or function. The planning may be appointing a material, area or institution as a planning entry. The places where a planning activity or item may be appointed:

- Schools
- Dormitories
- Sport Halls
- Parks

- Sport Areas

Vehicle, material and personnel inventories for planning are structured in the same way as institution personnel and inventory information (Figure 5.1.10). The difference is that the inventory records are related with "Planlama" table instead of "Kurumlar" table.

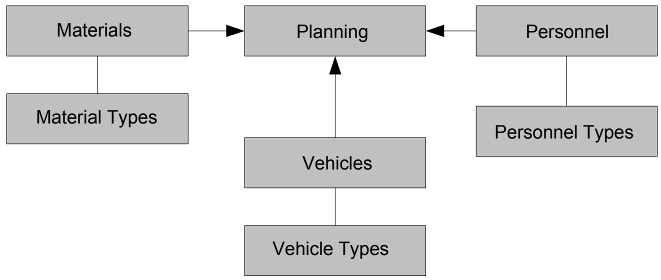


Figure 5.1.10. Planning database and relations (I)

The planning objective must also be stored. For this reason usage purpose and requirements for this purpose are also related with planning table. This is illustrated in Figure 5.1.11.

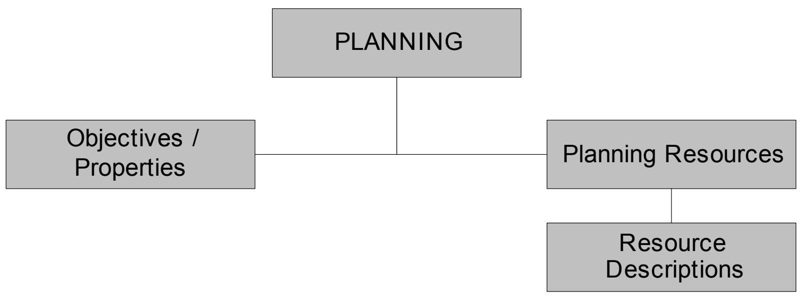


Figure 5.1.11. Planning database and relations (II)

Database Structure

Database defined in logical terms, are stored as tables related with each other. The structure of these logistic and planning tables and relations between these are given in Figure 5.1.12.

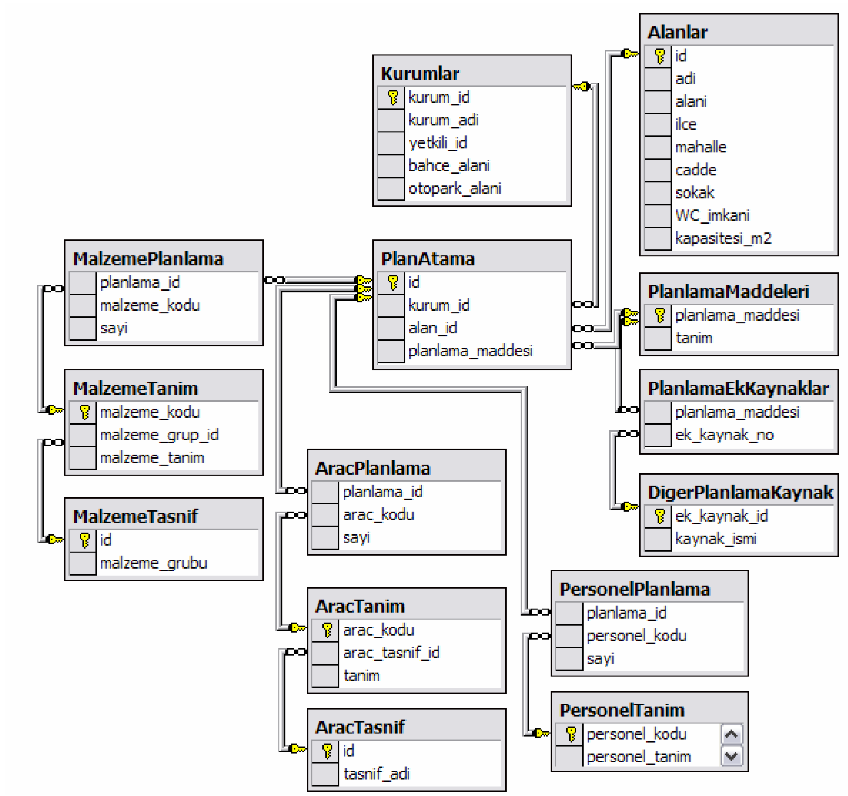


Figure 5.1.12. Planning database

Schema seen in Figure 5.1.12 includes planning model that we need for disaster management system. As seen in Table 5.1.2, data can be hierarchically classified according to their functions. Thus relations are obtained via this classification. For example buildings layer will be in close relation with reinforcement database. In this relation, the classes obtained using construction date, number of floors, and building type will be critical in reinforcement projects.

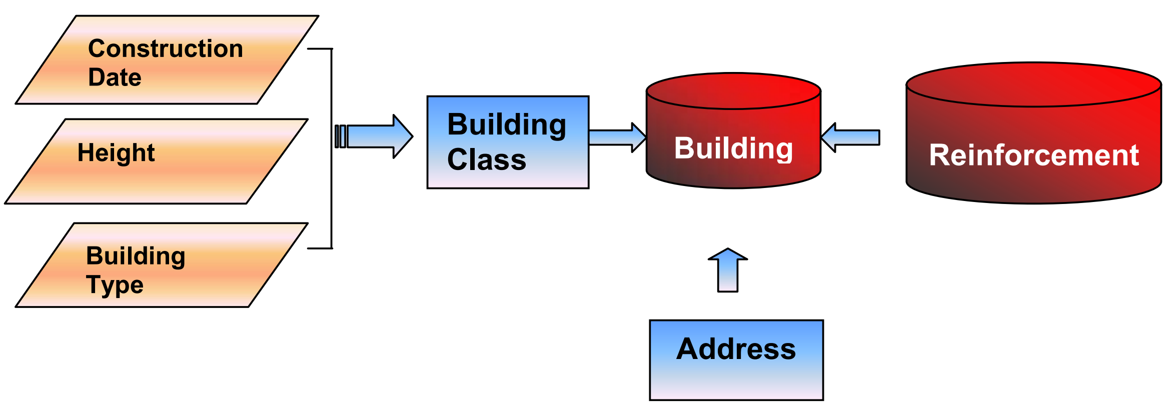


Figure 5.1.13. Building database logical relations

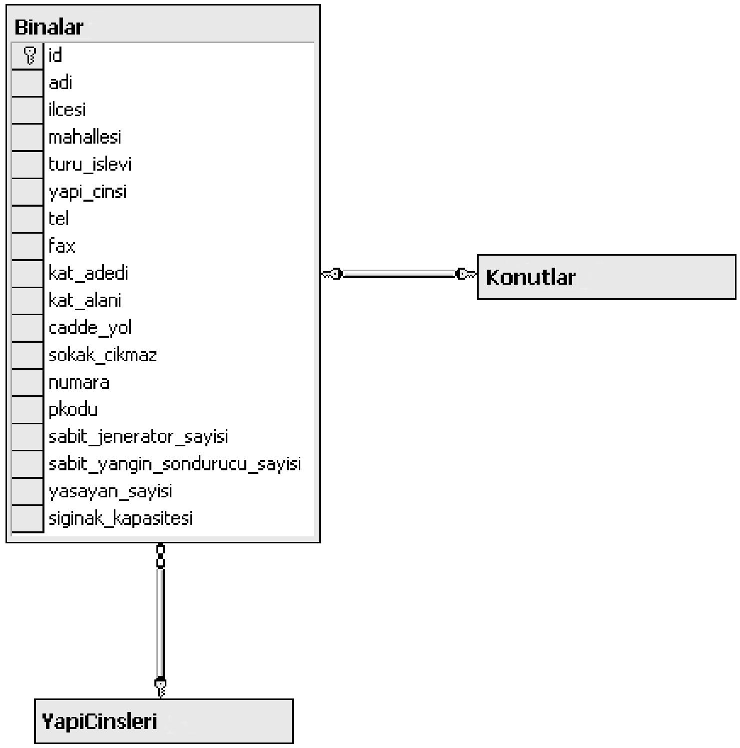


Figure 5.1.14. Building database in table form

As the information system will be based on geographical information system such a representation is possible. Structural classification is made by extracting such relations.

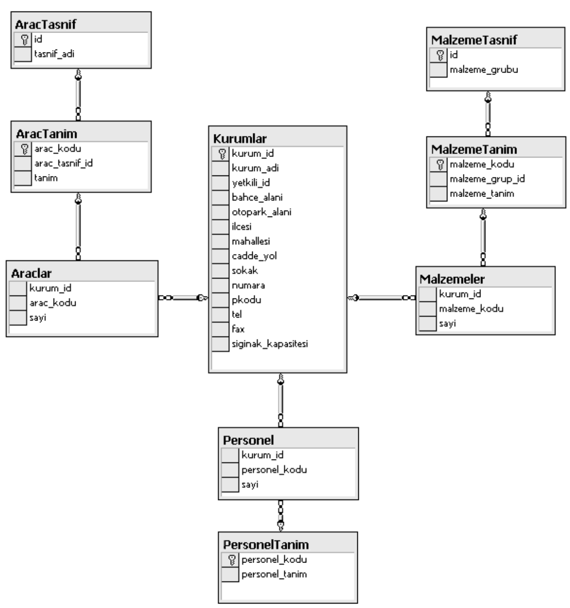


Figure 5.1.15. Institution-Inventory database

The tables that are mentioned in this chapter are given in Table 5.1.7.

Table 5.1.7. Institution and Inventory database table structures

TABLE NAME	DATABASE FIELDS			
Kurumlar	**Field Name**	**Type**	**Size**	**Description**
	kurum_id	int	4	Institution identifier
	kurum_adi	varchar	50	Institution name
	yetkili_id	int	4	Official responsible for institution
	bahce_alani	int	4	Institution park area
	otopark_alani	int	4	Institution car park area
Araclar	**Field Name**	**Type**	**Size**	**Description**
	kurum_id	int	4	Institution identifier
	arac_kodu	int	4	Vehicle identifier
	sayi	int	4	# of vehicles
AracTanim	**Field Name**	**Type**	**Size**	**Description**
	arac_kodu	int	4	Vehicle identifier
	arac_tasnif_id	int	4	Vehicle category identifier
	tanim	varchar	50	Vehicle description
AracTasnif	**Field Name**	**Type**	**Size**	**Description**
	id	int	4	Vehicle category identifier
	tasnif_adi	varchar	50	Vehicle category Description
Personel	**Field Name**	**Type**	**Size**	**Description**
	kurum_id	int	4	Institution identifier
	personel_kodu	int	4	Personnel type identifier
	sayi	int	4	# of personnel
PersonelTanim	**Field Name**	**Type**	**Size**	**Description**
	personel_kodu	int	4	Personnel type identifier
	personel_tanim	varchar	50	Personnel type description
Malzemeler	**Field Name**	**Type**	**Size**	**Description**
	kurum_id	int	4	Institution identifier
	malzeme_kodu	int	4	Material type identifier
	sayi	int	4	#of materials
Malzeme Tanim	**Field Name**	**Type**	**Size**	**Description**
	malzeme_kodu	int	4	Material type identifier
	malzeme_grup_id	int	4	Material category identifier
	malzeme_tanim	varchar	50	Material description
MalzemeTasnif	**Field Name**	**Type**	**Size**	**Description**
	id	int	4	Material category identifier
	malzeme_grubu	varchar	50	Material category description

TABLE NAME	DATABASE FIELDS			
Alanlar	**Field Name**	**Type**	**Size**	**Description**
	id	int	4	Area identifier
	adi	varchar	50	Name of the area
	alani	int	4	aurface area in m^2
	ilce	int	4	District identifier
	mahalle	int	4	Mahalle identifier
	cadde	varchar	50	Main road
	sokak	varchar	50	Street
	WC_imkani	int	4	# of WC
	kapasitesi_m2	int	4	Capacity (m^2)
PlanAtama	**Field Name**	**Type**	**Size**	**Description**
	id	İnt	4	Planning identifier
	kurum_id	Varchar	50	Institution id of the this planning
	alan_id	İnt	4	Area id of this planning
	planlama_maddesi	İnt	4	Planning objective identifier if there is any
MalzemePlanlama	**Field Name**	**Type**	**Size**	**Description**
	planlama_id	int	4	Planning identifier
	malzeme_kodu	int	4	Material identifier
	sayi	int	4	# of materials
AracPlanlama	**Field Name**	**Type**	**Size**	**Description**
	planlama_id	int	4	Planning identifier
	arac_kodu	int	4	Vehicle identifier
	sayi	int	4	# of vehicles
PersonelPlanlama	**Field Name**	**Type**	**Size**	**Description**
	planlama_id	int	4	Planning identifier
	personel_kodu	int	4	Personnel identifier
	sayi	int	4	# of personnel
PlanlamaMaddeleri	**Field Name**	**Type**	**Size**	**Description**
	planlama_maddesi	İnt	4	Planning objective identifier
	tanim	Varchar	50	Planning objective description
PlanlamaEkKaynaklar	**Field Name**	**Type**	**Size**	**Description**
	planlama_maddesi	int	4	Planning identifier
	ek_kaynak_no	int	4	Resource identifier
Diger Planlama Kaynaklari	**Field Name**	**Type**	**Size**	**Description**
	ek_kaynak_id	int	4	Resource identifier
	kaynak_ismi	varchar	50	Resource description

Building Evaluation Database

In this chapter, table designs of building inspection, damage inspection and reinforcement tables are defined. The data that would be required for earthquake analysis are also taken into consideration through design phase.

Building inspection database will be used to store all information that will be gathered during earthquake safety examination process of the city. Information gathered here will be used for analyzes of singular building damage estimation, and casualty estimation. Inspection process will be carried out in three distinct phases, and different techniques and applications will be used to calculate earthquake performances of buildings for each phase of the inspection.

According to the analysis results gained after the inspection process, it will be decided how to evaluate the buildings. If the building is considered for reinforcement according to the earthquake performance score, reinforcement data for the building will also be stored in the database. For this purpose reinforcement database is design to store reinforcement related data for the entire city.

Building Inventory

Building inventory database stores building related data of all buildings in Istanbul including earthquake performance score. This information can be obtained using current building inventory or obtained from first phase building inspection.

Building inventory will store the following data:

- Address and coordinates (GPS)
- Usage purpose or function
- Number of floors and area of building
- Usage of first floor
- Day and night population

To store address information compact and non-redundant, district and mahalle attributes will be referenced to other tables. ***Mahalleler*** *and* ***İlçeler*** tables are created for this purpose and holds district and mahalle names respectively. Instead of keeping district and mahalle names in ***Binalar*** table, *İlçeID* and *MahalleID* attributes are used which are just ID numbers corresponding to names of districts and mahalles in tables ***Mahalleler*** and ***İlçeler.***

Building data would be grouped using construction date, building type and height. A total of 24 classes are obtained by cross matching these subclasses. These classes are stored in ***BinaTipleri*** table. Buildings are classified using references to *BinaTipiID* field in ***Binalar*** table. Building inventory database schema is illustrated in Figure 5.1.16.

Building Inspection Database

Building inspection database holds the data obtained from building examination process. Building examination took place in three phases. Although there are some data that are common for all three inspection phases (Date, Officials), most of them are peculiar to different phases of inspection process. Studies showed that following attributes are required for examination and analysis process.

- Prior Inspection (1. Phase)
  - Building photo
  - Building main carrier system
  - Whether outer columns fits to base
  - Existence of outer floors
  - Construction date of the building or its parts
  - Whether the building had engineering service

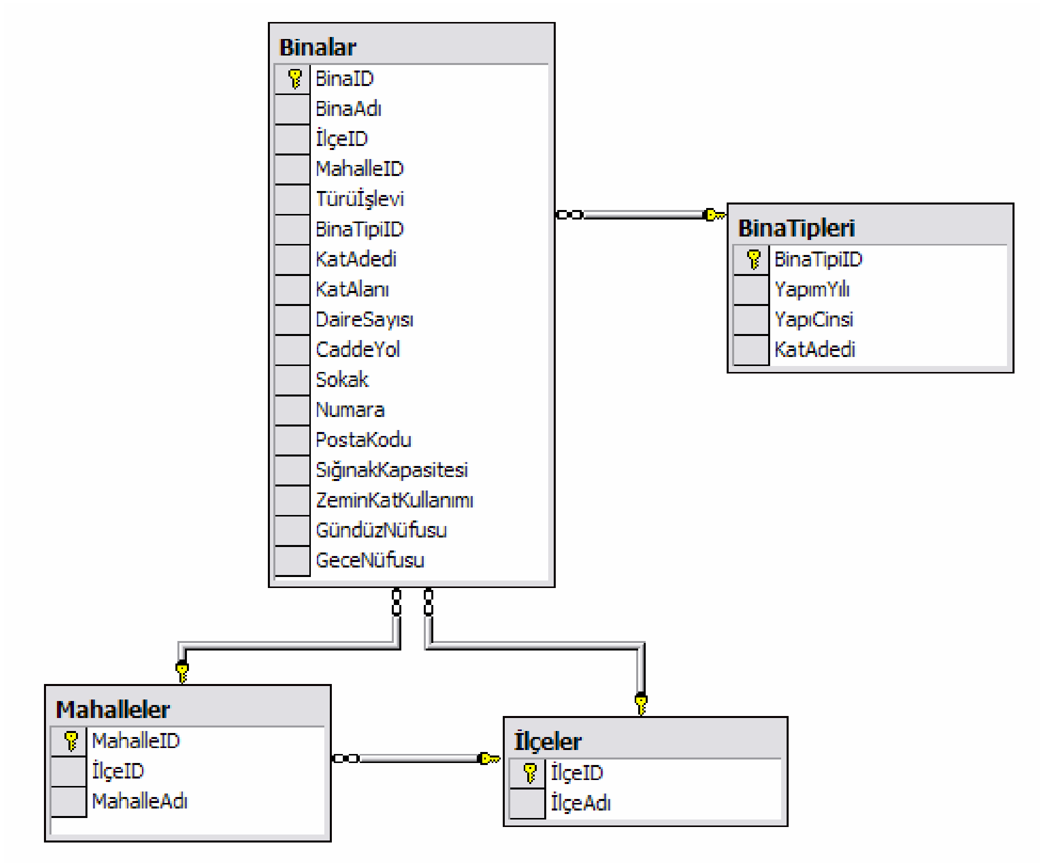


Figure 5.1.16. Building inventory database

- Building regularity (adjacent or separated)
- Floor difference for adjacent buildings
- If the building is at corner for adjacent buildings
- The width of road where the building resides
- Existence of soft floor
- Existence of heavy balconies
- Existence of short columns
- Building quality (observed)
- Wall types
- Wall emptiness percentage
- Wall emptiness regularity

- Intermediate Inspection (2. Phase)
  - Carrier system plan
  - Continuity of horizontal components
  - Building base area
  - Building floor area
  - Irregularity of vertical components
  - Soft floor properties
  - Observed material quality
  - Corrosion effect
  - Additional floors if there are any

- Detailed Inspection (3. Phase)
  - Detailed material data
  - Plan of the building
  - Analysis results

Information about the officials who make the inspection is stored in "Görevliler" table. This table is used to keep information about the people who makes the inspection so that it would be possible to access data about the investigators of a particular building. Some of attributes are:

- Name, Surname
- Telephone
- Institution

And new attributes can be added according to the requirements which are related with officials. The tables and relations between these for building inspection are illustrated in Figure 5.1.17.

"Carrier system plan" is the main component of second phase inspection. This carrier system plan will be used to store building elements' dimensions and position on a digital medium and analysis will be carried out using these digital plans. It is possible for the officials making the building inspection, to use palm computers to create these carrier system plans on a digital medium easily. These analyzes that will be made using these digital data would be more useful than raw building element data which do not comprise location knowledge. An example program developed for this purpose is given in chapter 5.1.4.

Building Reinforcement Database

In the case of giving reinforcement decision for any examined building, it would be necessary to store reinforcement related data in the database. Reinforcement database is created with this purpose in mind and holds information about reinforcement projects.

Güçlendirme table holds data about reinforcement projects. Related to **Binalar** table using *BinaID* field, and related to **Firmalar** table via *FirmaID* field. Reinforcement related data are:

- Start and end dates of the project
- Cost
- Report related to reinforcement project

Furthermore the methods that are used during reinforcement projects will be stored in ***GüçlendirmeTipleri*** table. These methods will be related to ***Güçlendirme*** table using GüçlendirmeÇalışmaları table (Figure 5.1.18). With this relation it is possible to find out what kinds of methods are used for each kind of building type and which methods are more usable and efficient for each kind type of building.

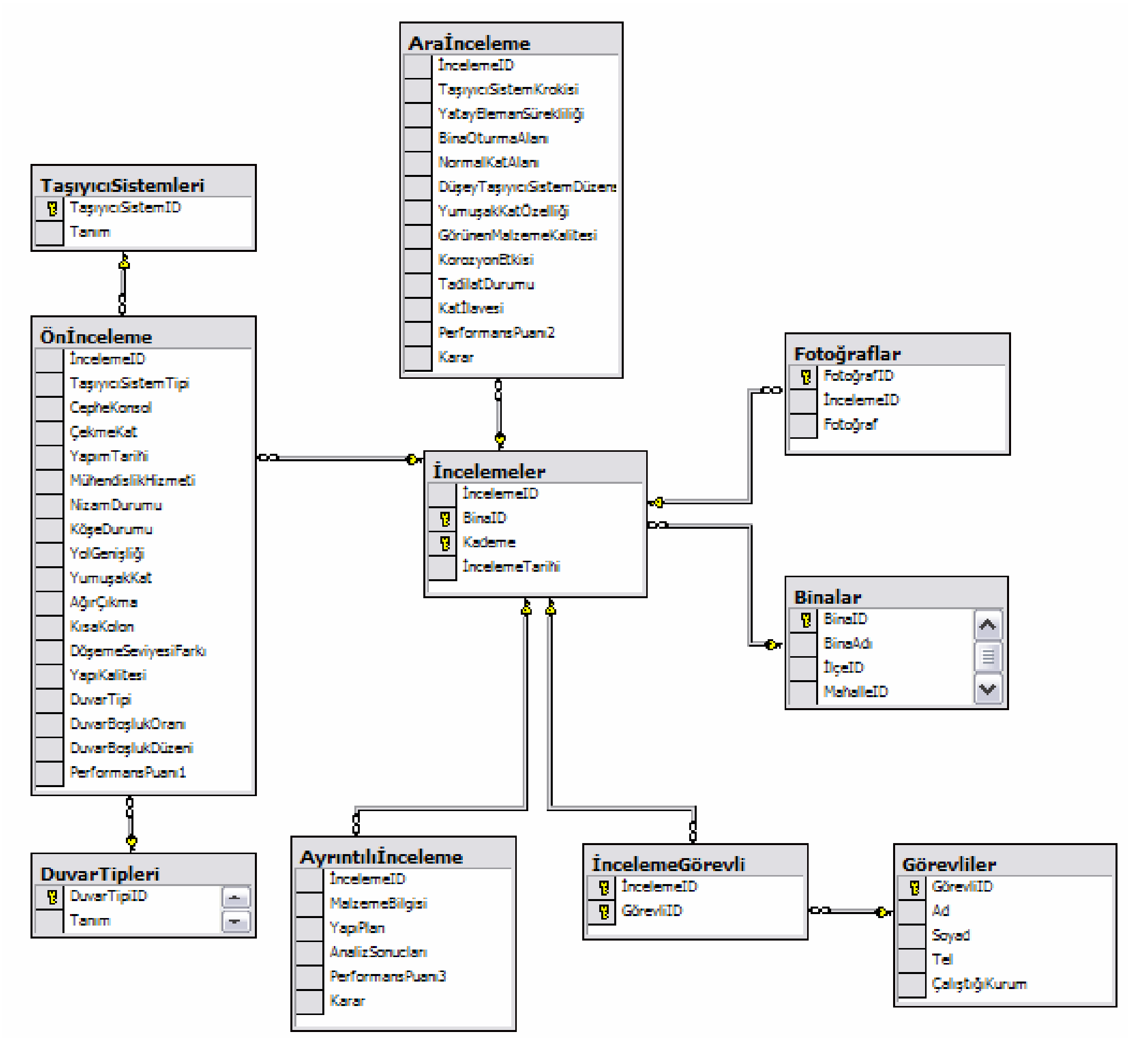


Figure 5.1.17. Building inspection database

GüçlendirmeTipleri table will store reinforcement types and these types may vary according to building type and existing technologies. Following list is an example of reinforcement types for ***GüçlendirmeTipleri*** table.

- Reinforcement of carrier walls
- Converting filling walls to carrier walls
- Adding reinforced concrete walls
- Converting filling walls to prefabricated components
- Removing floors
- Removing heavy balcony
- ...

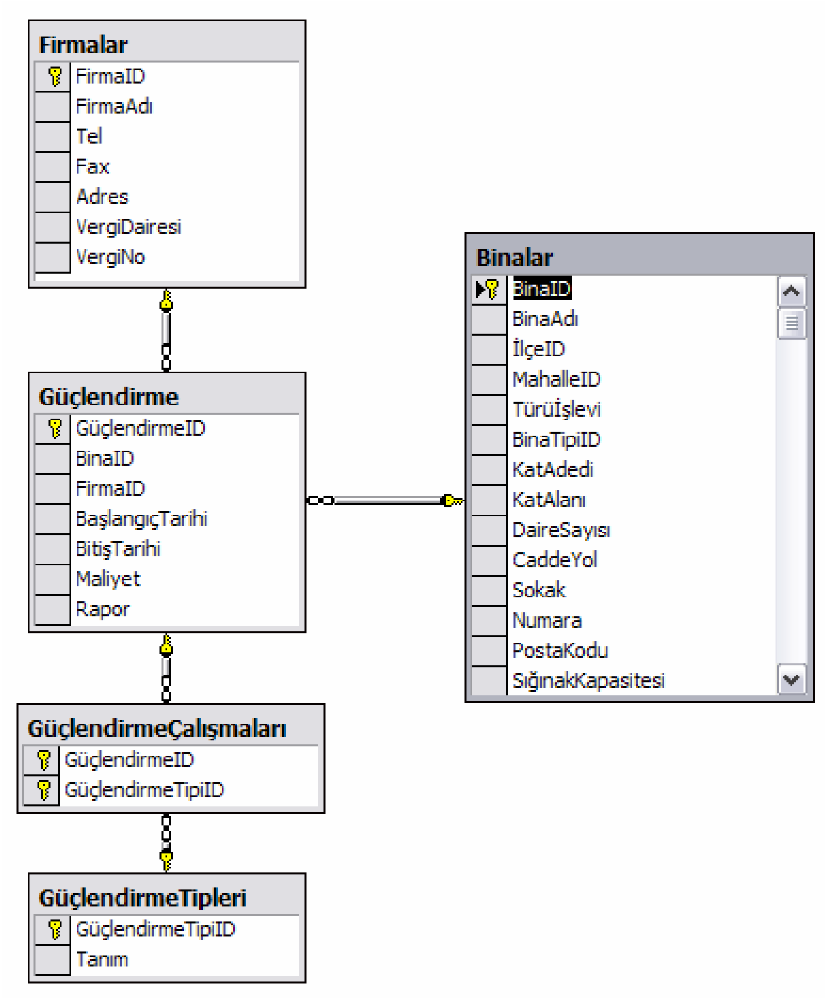


Figure 5.1.18. Building reinforcement database

Damage Inspection Database

The database design for damage inspection process after an earthquake is given at Figure 5.1.19. Damage inspection stores data like damage reports, the data about officials prepared the reports, damage types that are observed for each building and final decision given for the buildings.

HasarTespit table is related with **Binalar** table via *BinaID* field. Following items of data will be stored in **HasarTespit** table:

- Date of inspection
- Report prepared after inspection
- Performance score calculated after the examination
- Decision given for the building according to performance score

HasarTipleri table is created to classify possible damage types so that analyzes can be made according damage types. After the inspection procedure, observed damage types for buildings will be related with HasarTespit table so that analyzes will be possible for what kind of damages happen for particular building types.

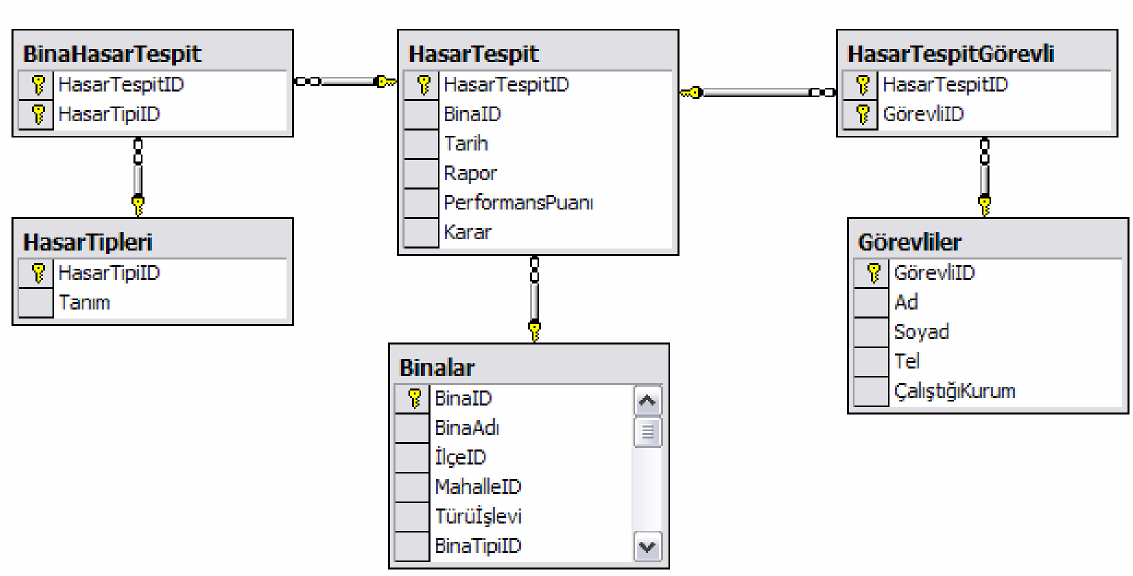


Figure 5.1.19. Damage inspection database

Table 5.1.8. Tables for building inspection, reinforcement and damage databases

TABLE NAME	DATABASE FIELDS			
Araİnceleme	Field Name	Type	Size	Description
	İncelemeID	int	4	Inspection identifier
	TaşıyıcıSistemKrokisi	image	16	Carrier system plan
	YatakElemanSürekliliği	real	4	Continuity of horizontal components
	BinaOturmaAlanı	int	4	Building base area
	NormalKatAlanı	int	4	Building floor area
	DüşeyTaşıyıcıSistemDüzensizlikleri	real	4	Irregularity of vertical components
	YumuşakKatÖzelliği	smallint	2	Soft floor properties (yes/no) (1/0)
	GörünenMalzemeKalitesi	smallint	2	Observed material quality (0,1,2)
	KorozyonEtkisi	real	4	Corrosion effect
	TadilatDurumu	smallint	2	Restoration status
	Katİlavesi	smallint	2	Additional floors if there are any
	PerformansPuanı2	real	4	Performance score
	Karar	char	1	Final performance decision

Ayrıntılıİnceleme	Field Name	Type	Size	Description
	İncelemeID	int	4	Inspection identifier
	MalzemeBilgisi	varchar	100	Detailed material data
	YapıPlan	image	16	Plan of the building
	AnalizSonuçları	varchar	50	Analysis results
	PerformansPuanı3	real	4	Performance score
	Karar	char	1	Final performance decision

BinaHasarTespit	Field Name	Type	Size	Description
	HasarTespitID	int	4	Damage inspection identifier
	HasarTipiID	int	4	Damage type identifier

Binalar	Field Name	Type	Size	Description
	BinaID	int	4	Building identifier
	BinaAdı	varchar	50	Building name
	İlçeID	int	4	District identifier
	MahalleID	int	4	Mahalle identifier
	Türüİşlevi	varchar	100	Building usage type
	BinaTipiID	int	4	Building classification identifier
	KatAdedi	int	4	# of floors
	KatAlanı	int	4	Buildings floor area
	DaireSayısı	int	4	# of flat in the building

	CaddeYol	varchar	50	Road name
	Sokak	varchar	50	Street
	Numara	varchar	50	Building address no
	PostaKodu	char	5	Zip code
	SığınakKapasitesi	int	4	Shelter capacity
	ZeminKatKullanımı	char	1	Base floor usage type
	GündüzNüfusu	smallint	2	Day population
	GeceNüfusu	smallint	2	Night population

BinaTipleri	Field Name	Type	Size	Description
	DuvarTipiID	int	4	Building type identifier
	Tanım	varchar	50	Building type description

DuvarTipleri	Field Name	Type	Size	Description
	BinaTipiID	int	4	Building type identifier
	YapımYılı	int	4	Construction data
	YapıCinsi	int	4	Building type
	KatAdedi	int	4	# of floors

Firmalar	Field Name	Type	Size	Description
	FirmaID	int	4	Company identifier
	FirmaAdı	varchar	100	Company name
	Tel	varchar	50	Telephone number
	Fax	varchar	50	Fax
	Adres	varchar	100	Address
	VergiDairesi	varchar	50	Tax dapartment
	VergiNo	varchar	20	Tax number

Fotoğraflar	Field Name	Type	Size	Description
	FotoğrafID	int	4	Photograph identifier
	İncelemeID	int	4	inspection identifier
	Fotoğraf	image	16	Binary photo data

Görevliler	Field Name	Type	Size	Description
	GörevliID	int	4	Official identifier
	Ad	varchar	30	Name
	Soyad	varchar	30	Surname
	Tel	varchar	20	Phone number
	ÇalıştığıKurum	varchar	50	Official's occupation

Güçlendirme	Field Name	Type	Size	Description
	GüçlendirmeID	int	4	Reinforcement identifier
	BinaID	int	4	Building identifier

	FirmaID	int	4	Company identifier
	BaşlangıçTarihi	date	8	Start data
	BitişTarihi	date	8	End data
	Maliyet	money	8	Cost
	Rapor	text	16	Project report

GüçlendirmeTipleri	Field Name	Type	Size	Description
	GüçlendirmeTipiID	int	4	Reinforcement type identifier
	Tanım	varchar	200	Description

GüçlendirmeÇalışmaları	Field Name	Type	Size	Description
	GüçlendirmeID	int	4	Reinforcement project identifier
	GüçlendirmeTypeiID	int	4	Used reinforcement type identifier

HasarTespit	Field Name	Type	Size	Description
	HasarTespitID	int	4	Damage inspection identifier
	BinaID	int	4	Building identifier
	Tarih	date	8	Date
	Rapor	text	16	Inspection report
	PerformansPuanı	real	4	Performance score
	Karar	char	2	Given decision

HasarTespitGörevli	Field Name	Type	Size	Description
	HasarTespitID	int	4	Damage inspection identifier
	GörevliID	int	4	Official identifier

HasarTipleri	Field Name	Type	Size	Description
	HasarTipiID	int	4	Damage type identifier
	Tanım	varchar	200	Damage type description

Mahalleler	Field Name	Type	Size	Description
	MahalleID	int	4	Mahalle identifier
	İlçeID	int	4	District identifier
	MahalleAdı	varchar	30	Name of the mahalle

Önİnceleme	Field Name	Type	Size	Description
	İncelemeID	int	4	Inspection identifier
	TaşıyıcıSistemTipi	smallint	2	Main carrier system type
	CepheKonsol	smallint	2	Whether outer columns fit to base
	ÇekmeKat	smallint	2	Existence of outer floors
	YapımTarihi	date	8	Building construction date
	MühendislikHizmeti	smallint	2	Whether the building had engineering service

	Field Name	Type	Size	Description
	NizamDurumu	smallint	2	Building regularity
	KöşeDurumu	smallint	2	Floor differences for adjacent buildings
	YolGenişliği	int	4	Width of the road
	YumuşakKat	smallint	2	Existence of soft floors
	AğırÇıkma	smallint	2	Existence of heavy balconies
	KısaKolon	smallint	2	Existence of short columns
	DöşemeSeviyesiFarkı	smallint	2	Döşeme seviyesi farkı var/yok (0/1)
	YapıKalitesi	smallint	2	Observed structure quality
	DuvarTipi	int	4	Wall type identifier
	DuvarBoşlukOranı	smallint	2	Wall emptiness percentage
	DuvarBoşlukDüzeni	smallint	2	Wall emptiness regularity
	PerformansPuanı1	real	4	Performance score
	Karar	char	1	Decision

İlçeler	Field Name	Type	Size	Description
	İlçeID	int	4	District identifier
	İlçeAdı	varchar	30	District name

İncelemeGörevli	Field Name	Type	Size	Description
	İncelemeID	int	4	Inspection identifier
	GörevliID	int	4	Official identifier

İncelemeler	Field Name	Type	Size	Description
	İncelemeID	int	4	Inspection identifier
	BinaID	int	4	Building id
	Kademe	smallint	2	Phase of the inspection
	İncelemeTarihi	date	8	inspection date

Analysis Database

Analysis database is planned to keep data and results of analyses related to earthquake research. The main categories can be listed as:

- Survey results about the physical state
- Earthquake scenarios and analysis results

Survey results about the physical state

The analysis database will keep raw data, some of which is the results of geological surveys. The data will be kept chronologically, with information about the institution which obtained the data. The data can be classified as:

- Geological formation maps
- Ground classification maps

This data is obtained as a result of subjective interpretations derived from geological surveys. Therefore, different analyses and interpretations may lead to different maps. The database will keep all available data to enable researchers to access all related data.

Geological formation maps

Table 5.1.9 shows 36 different geological classes that were included for Istanbul in the JICA study.Geological maps with scale of 1:50.000'lik following this classification, 1:5.000 scale maps prepared by the Istanbul Municiplaity Groung Analysis Directorate (Büyükşehir Belediyesi Zemin İnceleme Müdürlüğü) and 1:25.000 scale maps prepared by MTA are available and will be provided in the database.

Other geological classification studies will yield similar maps which will be included inthe database. A classification table such as the one in Figure 5.1.20 will be prepared and the related tables will be kept in the *geolojik_siniflandirmalar* table.

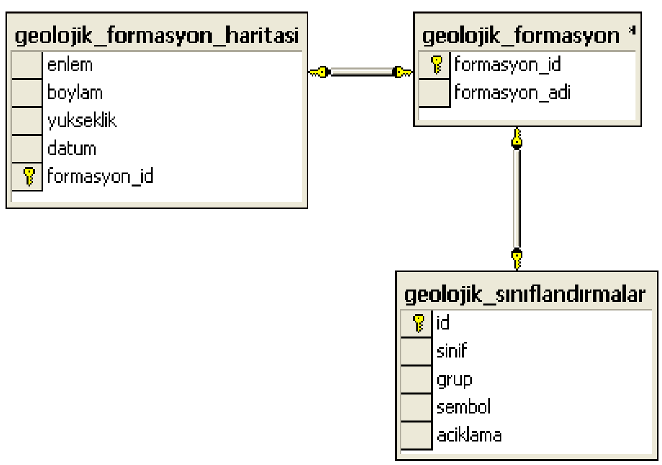


Figure 5.1.20. Geological formation database

Table 5.1.9. Geological formations for istanbul

GRUP	FORMASYON	SEMBOL
	Dolgu	Yd
	Alüvyon	Qa
	Kuşdili	Kşf
	Alüvyon Yelpazeleri	Q (Suf)
Halkalı	Bakırköy	Baf
	Güngören	Gnf
	Çukurçeşme	Çf
	Çamurluhan	Çmf
Terkos	Karaburun/Gürpınar	Kbf/Güf
Çatalca	Ceylan	Cef
	Soğucak	Sf
	Hamamdere	Haf
Darıca	Şemsettin/Sarıyer	Şf/Saf
	Kutluca	Ktf
	Hereke Pudingi	Hpf
Gebze	Tepecik	Tef
	Hereke	Hf
	Erikli	Ef
	Kapaklı	Kaf
	Kocatarla	Kof
Istanbul	Trakya	Trf
	Baltalimanı	Blf
	Tuzla	Tf
	Kartal	Kf
	Dolayoba	Df
	Gözdağ	Gf
	Aydos	Af
	Kurtköy	Kuf

Soil Classification Map

Istanbul Municipality Ground and Earthquake Research Directorate (Büyükşehir Belediyesi, Zemin ve Deprem Araştırma Müdürlüğü) has prepared the 1:5000 scale Geotechnical Reports, yielding the soil types in Table 5.1.10.

Table 5.1.10. Ground classification

Geoteknik Zemin Sınıflandırma	
YU	Suitable for settlement
AJ	Detailed geotechnical study required
SA	Not suitable for settlement
ÖA	Construction prohibited without precaution
YÖUA	Stability study required
AJE	Detailed geotechnical study required
YUOA	Planning can be done for special purpose construction

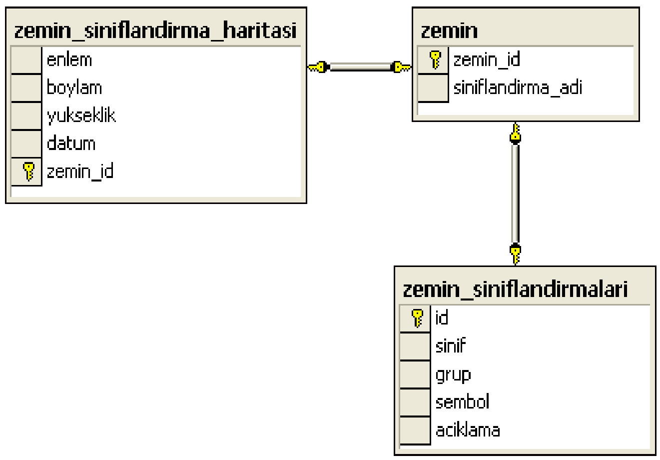


Figure 5.1.21. Ground classification database

Yıldız Technical University, together with Ground and Earthquake Research Directorate, will prepare a computer based analysis of all survey results called the "Istanbul İçin Zemin Çekirdek Sistemi", and is continuing bore haole surveys.

Earthquake scenarios and predictions database

Results of earthquake analyses will take place in the second part of the analysis database. It is planned to provide both the outputs of such anlyses as well as the inputs in the database. This way, different studies suuch as JICA or BÜ-ARC will be available to all researchers as well as institutions such as AKOM or the State Disaster Management Center. In the future, the system may be integrated with a HAZUS-like simulation and analysis program so that the users can run their scenarios and create new data.

We first outline the principle steps involved in running an earthquake scenario to explain how the database design is carried out. In running the earthquake scenario, there are many steps and intermediate outputs are stored in tables. The output of a stage serves as input to the next stage. All theseintermediate outputs are accessible in individual tables.

Scenario Models

The data for earthquake scenarios is kept in scenario model tables. Historical earthquakes may also be kept here because historical data is important from the point of view of testing present models. A historical earthquake can be simulated on the system as a scenario and resulting effects may be compared with factual data.

The design for the earthquake scenario database is simple as seen in Figure 5.1.22.

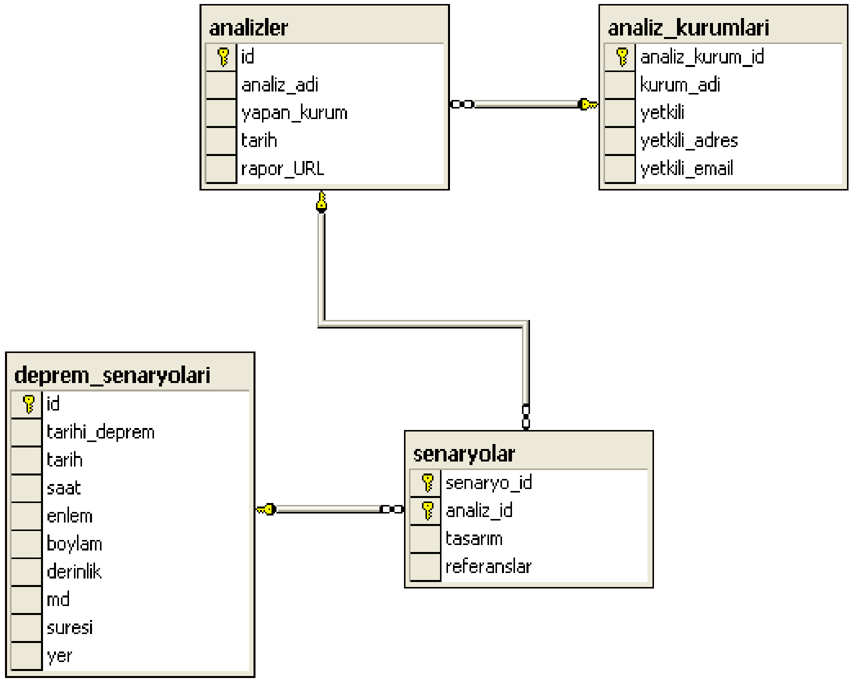


Figure 5.1.22. Earthquake scenario database

Ground Motion Analysis

Although different methods exist for ground motion analyses, we describe here a generally accepted model, given in the JICA study. The flowchart of this approach is seen in the Figure below.

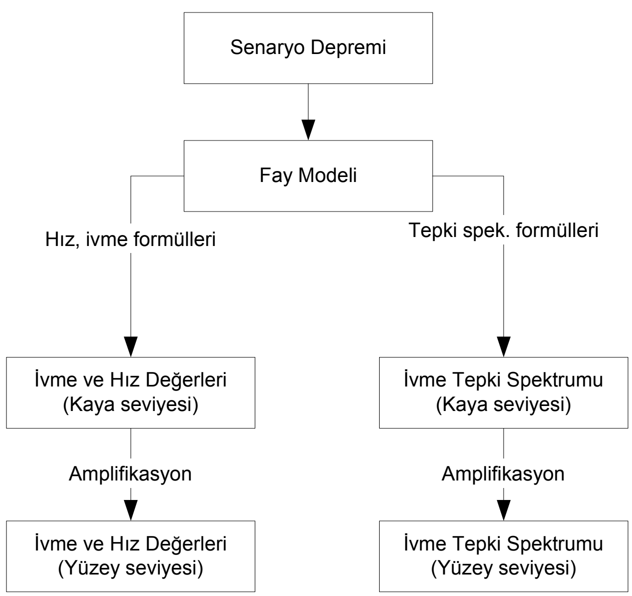


Figure 5.1.23. Flowchart of ground motion analyses

The approach is very general. An earthquake scenario is created either based on a historical earthquake or from scratch. A fault model is created next. The peak ground acceleration (PGA), Peak Ground Velocity – (PGV) and Response Spectrum These values are used in later analyses. The corresponding database design can be observed in Figure 5.1.24.

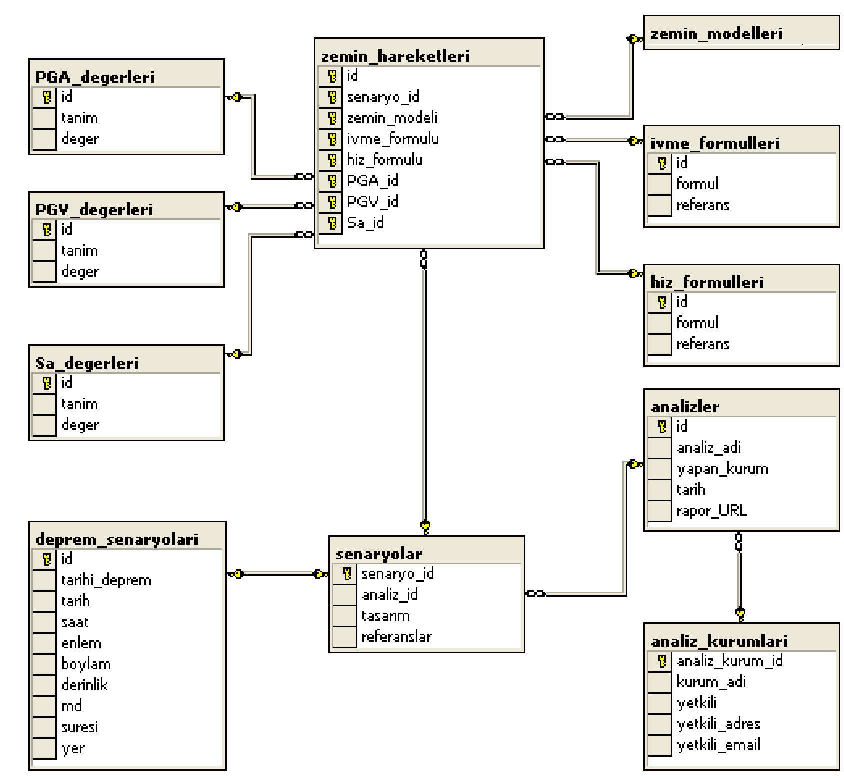


Figure 5.1.24. Ground motion analysis database

Liquefaction Potential Analysis

Under certain conditions, layers that are below the ground water level lose their resistance and behave as liquids instead of solids. This is called liquefaction. Soils which have low clay content such as sand, gravel, or even silt have a larger liquefaction potential. Liquefaction alone does not cause damage. However, it can cause large displacements, and hence, collapse of the foundations. It can also cause damage in the infrastructure such as fresh and wastewater and natural gas pipes. In addition, liquefaction causes landslides.

Although it is possible to predict risky areas for liquefaction, it is not possible to say whether liquefaction will occur in an earthquake. High risk areas for liquefaction may be determined by considering ground water level, soil type, and density. A possible algorithm for determining liquefaction potential is given in Figure 5.1.25.

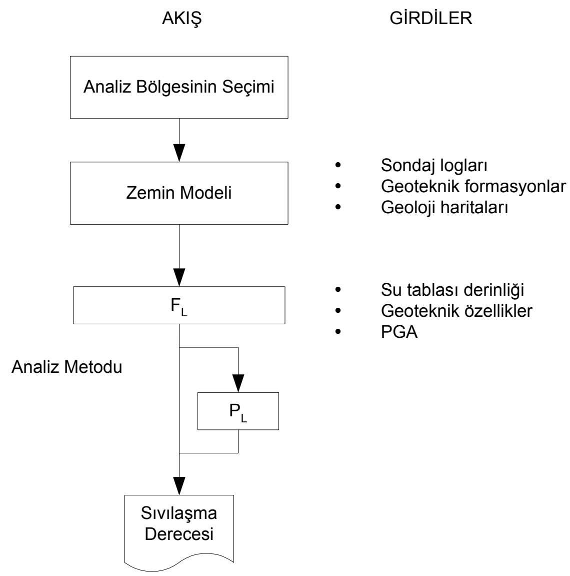


Figure 5.1.25. Flowchart for determining liquefaction potential

As observed in Figure 5.1.25, first, an alaysis area is selected and data is collected. The ground model and PGA values calculated as a result of previous analyses are other inputs. FL and PL methods are used as in the JICA study; however, the database design is independent of the specific method used.

The liquefaction analysis tables are as given in Figure 5.1.26.

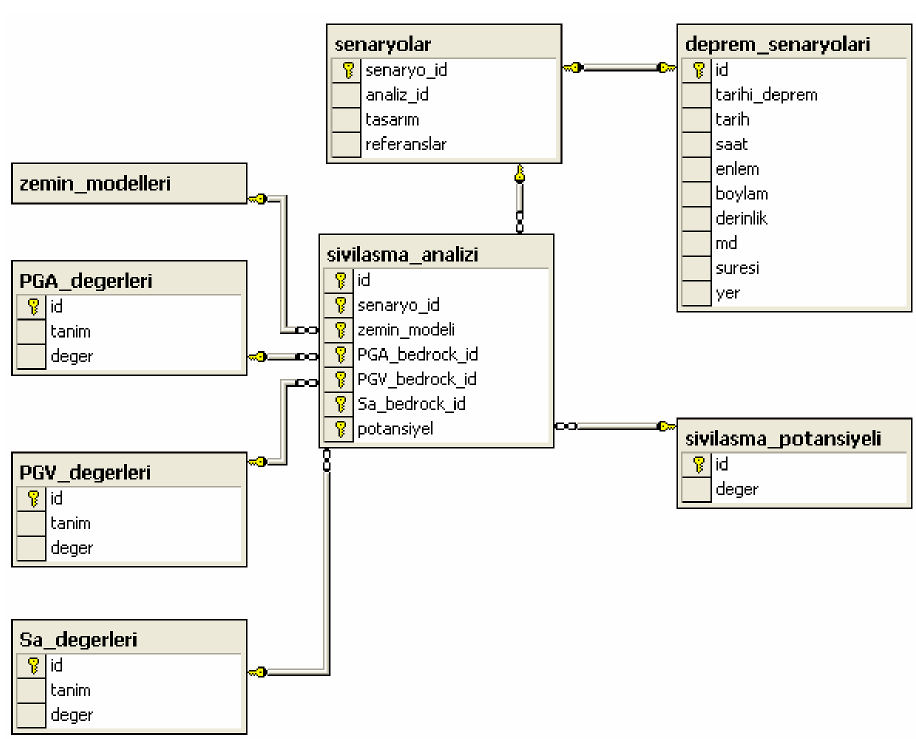


Figure 5.1.26. Liquefaction analysis database

Slope Stability Risk Analysis

The inputs for the slope stability risk anlysis are, slope and ground classification values for the area of interest. The flowchart for the slope stability analysis is given in the figure below.

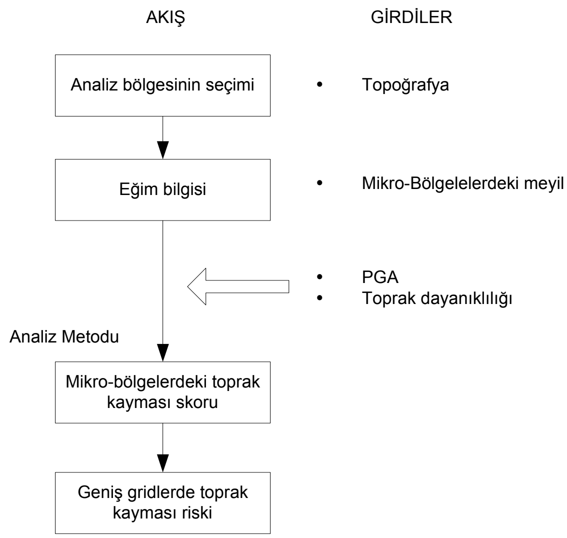


Figure 5.1.27. Slope stability analysis

The flowchart in Figure 5.1.27 is based on the microzonation. First, the area of analysis is selected. Then, the slope gradient angle is calculated in each microzone. This value is used as the slope for that area. The PGA values and ground stability are other inputs to the algorithm. Slope stability in larger zones is claculated from slope stability of microzones. The database design is independent of the actual methods used and can be seen in Figure 5.1.28.

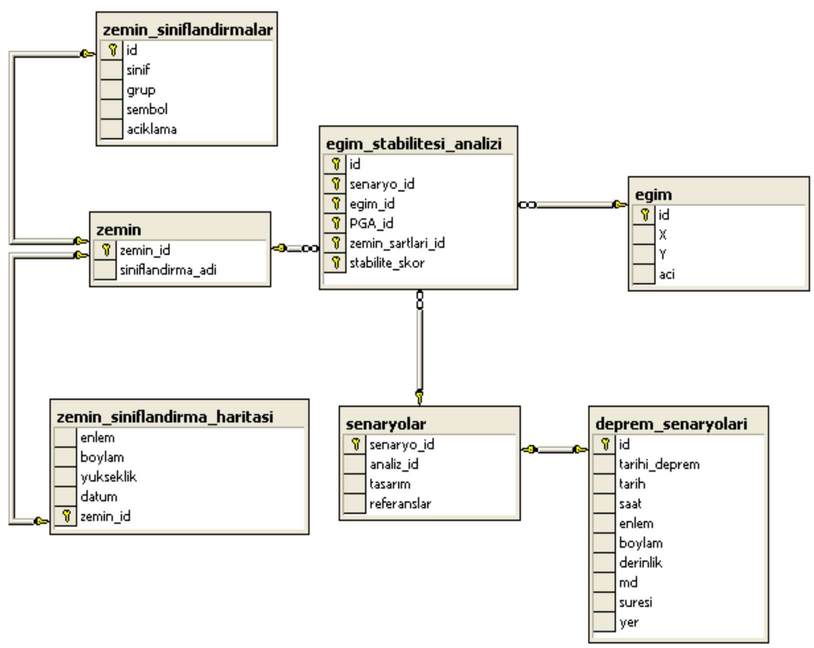


Figure 5.1.28. Slope stability analysis database

Results

From the point of view of decision makers, the most important aspect of earthquake analyses are the results. These results generally take the form of loss or damage estimates. The scenario lets decision makers test the decision processes and make capacitiy analyses before the actual earthquake.

We can categorize the results in the analysis earthquake into two groups: Financial damage and causalties.

Financial damage

Financial damage can simply be thought to stem from building collapses. Therefore, we should concentrate on buildings. The displacement due to the earthquake is an input for this stage. The building displacement response depends on the ground level Sa and the building model. The fragility function determines the damage suffered by a building. This analysis is carried out over microzones, zones and the whole of Istanbul. The database design is seen in Figure 5.1.29.

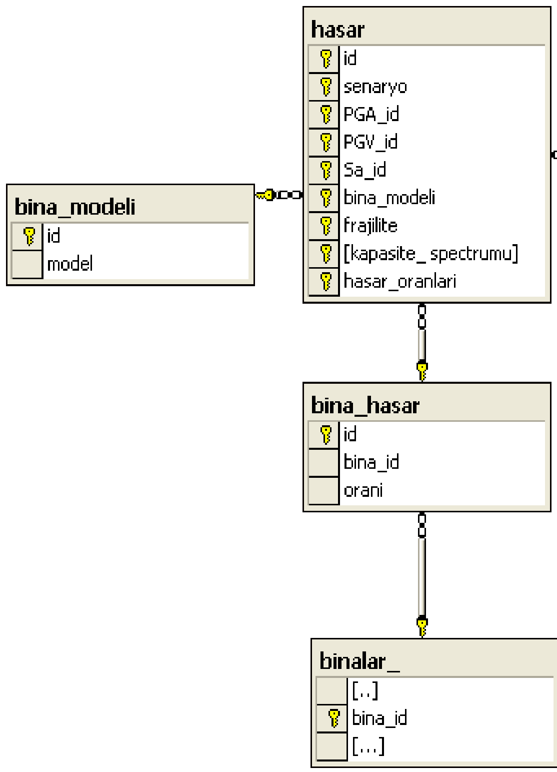


Figure 5.1.29. Building damage analysis database

Causalties

A large majority of causalties are due to building collapses. Therefore, one needs a statistic for the number of people inside a building that is in question. One needs estimate functions for proportion of injured and lost. The database design proposed is below:

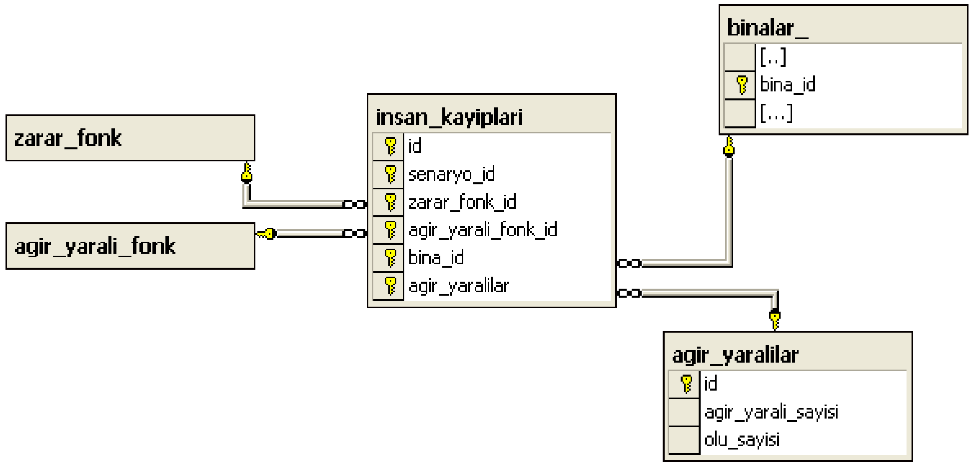


Figure 5.1.30. Casualty analysis database

5.1.3 Software, hardware and network infrastructure

GIS Technologies

Geographical Information Systems (GIS) are digital information systems that enable the analysis and display of entities and events that can be related to a spatial location on the earth surface. The data entities in a GIS system include all spatially referenced objects and all events and other non-spatial data related to these spatial objects.

The history of GIS technologies goes back to the 1960's. Since then, there have been many improvements in technology and new methodologies have emerged. A fundamental classification is between object based and record based data models. In record based models, spatial data are represented as points (map coordinates), polylines (A sequence of points with start and end coordinates), or polygons (an area enclosed by a closed polyline), depending on the nature of the data. The relationship of these data entities can only be defined topologically, in terms of spatial coordinates. In the database, these geometrical elements are related to features that represent the physical entity they relate to. For example, the features of a road may be its length, type, number of lanes, etc. In the GIS, the database is generally organized in terms of layers that represent different features. The relationship between different layers is usually based on relational keys. For example, the parcel number acts as a key that relates different records that deal with the same parcel. Record-based spatial data models also use hierarchical and network type relationship models.

Spatial data is complex both in terms of the nature of the entities that form the data and in terms of relationship between different data entities. The need for a better way of representing these relationships has led to the emergence of object based models. In these models, the "entity" concept has emerged as the central modeling element. Each entity is defined in terms of its features and its relationships with other entities. The geometry of an entity is embedded into the entity as a definitive feature, whereas in record-based models, the spatial component is a separate layer on its own. For example, in this model, a highway may have spatial features such as beginning and end, length, etc, and non-spatial features such as number of lanes and current status. In addition, the relationship of this highway with other highways may be represented on an object basis.

Historically, while the first GIS systems that emerged in the 60's used hierarchical, record based models, key-based relational models became more widespread in later years. In the 90's, the use of object based data models and network models became popular. In the last years, there was a return to traditional models with spatio-temporal models, which present an improved methodology that enables very fast operation. In this model, data is related not only with spatial coordinates but with the time frame in which it is valid. The relationship between different data entities is through spatial location of entities rather than a specific key. This model, although similar to the oldest model, provides a very flexible and modular design methodology and is successful in distributed database systems in which each system possesses a different model.

Geographical Information System Design

The information system designed within the scope of this project should use the present information systems and data as much as possible and be able to meet long term needs. From this point of view, the design criteria are:

- GIS components and compatibility issues
- Flexibility and the ability to meet long-term needs

GIS Selection Criteria

Since 1950's, large investments have been made for the installation of geographical information systems. Many projects have suffered from lack of information and coordination, and wrong predictions about future needs. As a result, incomplete projects and systems that have become outdated have led to the waste of resources.

At the time of installation, hardware and software costs become the determining factor. However, considering the life of both hardware and software, over the long term, the most critical factor becomes data. Figure 5.1.31 shows the components of a GIS and approximate lifetime of these components.

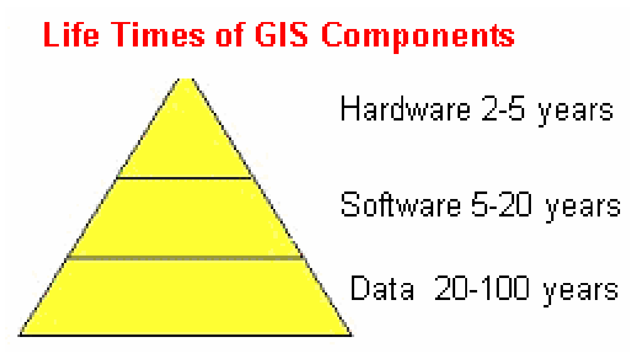


Figure 5.1.31. Lifetime of GIS elements

As seen in Figure 5.1.31, the longest lasting component of a GIS system is the data that is processed by the system.

The rapid change in technology has doubled the speeds of computers every 2-3 years, resulting in a drastic change in computer architectures every 3-5 years. From this point of view, the hardware of the system to be designed will change every 3-5 years to meet increasing data volume and speed requirements.

Even though at a slower pace, a similar change will take place on the software side. As a result of new technologies and changing user trends, new software development methodologies emerge every 5-10 years, necessitating software upgrades. For example, with the emergence and widespread use of the Internet, new GIS software support data supply over the Internet.

Software usually has a life-cycle of 5-20 years. At the end of this period, the software has to be completely upgraded in order to make it compatible with new hardware and technologies. This change is generally in the form of an upgrade to a new version of the software, making the transition smoother.

The longest lasting component is a GIS is data. It is also the hardest to upgrade; therefore, it is the factor which determines the life of a system. This is not intuitive since users see the servers that the system runs on and the software they see as an interface. However, the software is useful only if it is able to process correct data. For example, if the data structure is not designed to reflect the change of an object in time, the software is not able to get this information or it is very expensive and slow to extract this information.

The data that is mentioned here should not be confused with the database. Data structure refers to the form and attributes of a specific geographical object. The form and features of a data structure is the main factor in the kind of analyses, query types, and performance of the software. Databases, on the other hand, are software which store data in a form that enables fast access in a complete system framework including security and reliability issues.

Considering that the hardware components are standard parts of a GIS, there remain two main factors to be considered:

- The software and its functionalities
- The data structure and database

It is essential to examine these two factors in terms of both present and future needs. We want to stress the factors effecting the selection of these components both in the short term and in the long term.

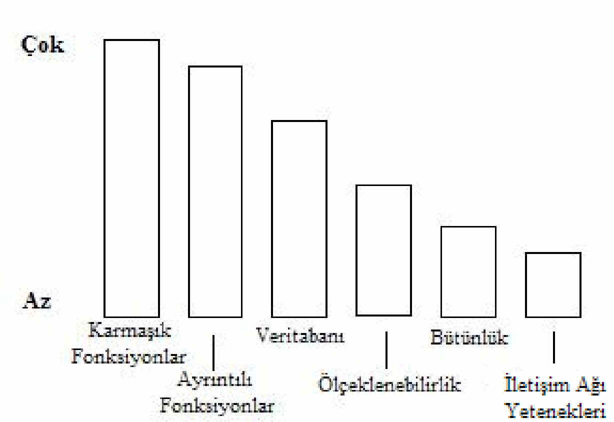


Figure 5.1.32. Pre-project stage selection criteria

Selection criteria in designing a system can be listed as:

- Complex functions: These are functions that depend on visual form.
- Detailed functions: Functions for data analysis and processing
- Database: How and where the data is kept; which database technology is used.
- Scalability: The degree of expandability of the system.
- Compatibility: Is the system compatible with other GIS systems
- Network capabilities: Communication and network devices and protocols supported

Figure 5.1.32, Figure 5.1.33 and Figure 5.1.34 show how the expected functionalities of a GIS system change over time from the time of installation, in the short range, and over the long range. At the time of installation, the most important factor seems to be the detailed functions for data query and analysis (Figure 5.1.32). However, as the system becomes operational, needs change with the increase in the amount of data. Issues such as database and scalability gain importance as visual functions become less important. (Figure 5.1.33). In the long run, the needs and expectations of users change completely: Increasing amount of data and issues such as the need for data exchange make compatibility and scalability more central. (Figure 5.1.34). In the light of the change of the importance of different factors over time, the main selection criteria in system design should be the database, data structure, scalability and compatibility.

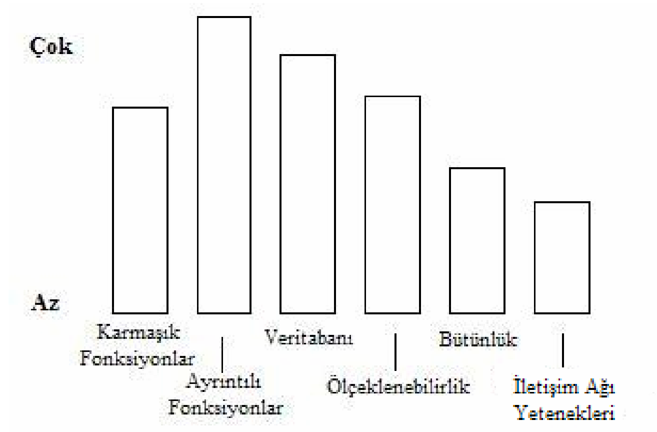


Figure 5.1.33. Selection criteria in the short run

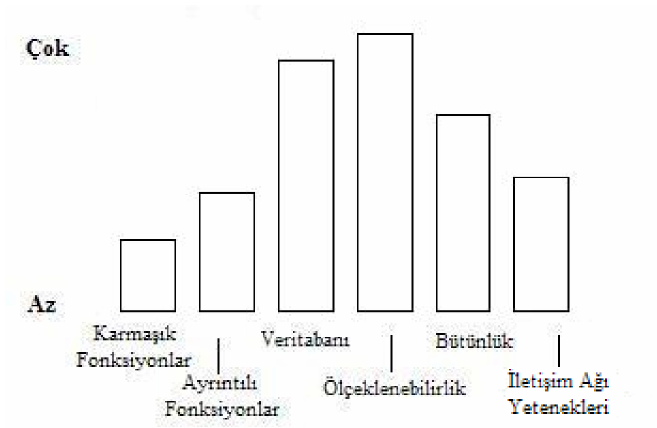


Figure 5.1.34. Selection criteria in the long run

GIS Needs of the Future

As a result of improvements in technology, information systems become more vital and access to data more essential. Spatial data becomes an essential part of needed information. From this point of view, the information system designed for this project should not focus solely on the supply of coordinating earthquake related activities, but be designed as part of a larger urban information system.

Future needs for such an urban information system will be:

- The use of remote sensing in GIS software
- The distributed operation capability over the internet
- The ability to support mobile devices such as cellular phones and PDAs, in which GPS is a standard component.
- The ability to reflect change in GIS data.

Remote sensing enables the detection of changes in geography or urban areas as soon as changes occur using satellite or aerial images. This enables the tracking of changes in the urban environment such as illegal construction, changes in forest areas or in water basins. Furthermore, such a system can detect changes after an earthquake: it can determine damaged areas and enable the direction of resources in the relief effort. Research in this field is ongoing. The ability to incorporate and use remote sensing data within a GIS enables the speedy processing of large volumes of data and increases the capabilities of a GIS system.

Another important issue is the compatible operation of different GIS systems installed by different organizations. Presently, all data transfers are made via CD-ROMs. The time and personnel effort necessary for this transfer and the data structure changes needed to make the data structures compatible has a very large cost. The ability to automatically access and use data in other GIS systems, within the framework of access rights is an important design requirement.

The increasing use of portable wireless communication devices enables cheaper and faster access to data over the internet. In the near future, the need to perform queries on such devices will become widespread; and municipalities will try to answer this need. Therefore, the structure of the urban information system should enable access using wireless communication devices.

One of the most important requirements for an organization such as the municipality is to be able to plan future needs. In order to do this, one should be able to track the change of data over time. This can be achieved in two ways:

- The comparison of backups of the database at regular intervals
- The ability to inherently perform queries in which time is the main attribute.

The first method is not applicable in practice, considering that the snapshots of a database of 10 GB will add up to unmanageable sizes. For examples, even with monthly backups, the size will increase to 120 GB yearly, adding up to 600 GB in 5 years. Even then, only monthly changes will be tracked, and many important changes will be missed. With daily backups, the size will increase to 300 GB in one month, adding up to 3600 GB at the end of the year. Even though daily backups suffice to track changes, dealing with such huge volumes of data will make the system very slow.

The second method requires the data structure to directly support time0based tracking. In the data structure proposed for this, the time period in which the geographical object exists is a property of the object, and the system can form the geographical data at any given time dynamically. Due to the central importance of this property, a data structure that supports spatio-temporal operations and a standard that supports this structure, called KIWI+, has been described in detail in this report.

Databases

One of the main components of the information system of earthquake master plan will be database systems. Working with geographic information demands high amounts of data to be transferred between server and clients. Furthermore relational queries and spatial analyzes at server site requires high amounts of process power to run in real time. Besides access right to information systems of each institution needs to be well defined and database servers must support such security policies in order to keep information consistent. These policies may be carried out by a coordinator institution. The list below shortly describes popular database management systems in use today.

MySQL

MySQL is an open source database management system that was first developed for Linux operating system. It gained its popularity with the help of server side web programming language PHP, and now it has a large user community and still keeps growing. As a result of its popularity, today it is available on many different platforms which make it more attractive. Most of the web applications online today use MySQL for their database related activities as it doesn't request any license fee.

MySQL has not yet implemented some of the commands and structures of SQL92 which is a standard for database query language SQL. The most important of these is the lack of sub-selection structure. Although MySQL can process "SELECT" queries very fast, it is not as successful for "UPDATE" queries. MySQL can handle connection request to the database server from clients very quickly which makes it attractive for web applications where you may need to open too many database connections to the web server.

MySQL has not been used for large enterprise applications. The main reason for not using this database for large applications is the lack of "Stored Procedures", "Triggers", ACID property, load balancing and clustering operations.

PostgreSQL

PostgreSQL is an open source, free to use database management system. It is not ported to many platforms as MySQL. For example it can work on windows platform using a Cygwin emulator which limits the performance of the database system.

It was developed fully compliant with SQL92 standard and includes some additional language properties like object oriented functions. PostgreSQL attracts many users by supporting sub selections, "Stored Procedures", "Triggers", and ACID property. These properties give it advantage over MySQL on serious applications.

MSSQL

MSSQL is a commercial database management system that is developed by Microsoft Corporation. It can be used for medium and large enterprise applications successfully. I can only run on operating systems developed by Microsoft Corporation like Windows 2000, Windows NT. It supports "Transaction Locking", "Stored Procedures", "Trigger", "Load Balancing", and "Clustering".

Oracle

Oracle is a well known database management system that is used for mission critical applications. High license costs make it usable only for medium and large scale applications. Spatial databases developed to be used only for spatial information systems have outstanding performance over others as it uses special indexing mechanisms to access and process spatial data. "Transaction Locking", "Stored procedures", "Trigger", "Load Balancing" and "Clustering" are all supported by oracle database management systems.

IBM DB2

Developed by IBM Corporation that is used only in large-scale enterprise applications. It can run on many platforms (Windows, UNIX family), and have special indexing mechanisms to store and access spatial data. It supports "Transaction Locking", "Stored Procedures", "Trigger", "Load Balancing" and "Clustering" properties.

Hardware

Information system users are not in just one location. Both data producer and users work on different sites. For this reason it is inevitable to design the system as a distributed information system. Such a system's most important component is network structure. Detailed communication structure to connect each institution units to other units and institutions are given below.

The hardware component of database servers must be chosen carefully to avoid possible bottlenecks in them. UNIX mainframes or personal computers designed to have server specifications can be selected for hardware component of database systems.

For such a server, following components are important to consider:

- Processor: Processor comparisons can be made according to the family (for example: Pentium 4, Itanium) or clock frequency (for example 1.8 GHz, 2.4 GHz). The comparison of CPU speeds from different architectures (for example: Intel, Sun) can not be done as the performance can vary too much between different architectures with same CPU clock rates. Instead of this approach, standards are developed to find out real performance values of computers. MIPS, Mflops, Whetstones, Dhrystones, TPC are examples of these standards. Systems are tested with these performance measurement standards and the results are announced to public community by independent organizations.
- Memory: As well as the main memory capacities, cache memory capacities and secondary storage device capacities are also important components of the system.
- Graphic System: Graphic components of the systems are graphic cards and output units known as monitors. High performance graphic cards and 21" monitors at least are mandatory for a GIS system. State of the art graphic cards have special graphic processors and large

amounts of memory known as frame buffer. These graphic processors make it possible to render 3D scenes in real time. As most of the GIS software in use today support 3D features, the graphic subsystem must have high performance 3D graphic processor.

- System Architecture: Defines how central processing unit, memory, graphic card, and I/O units are connected to each other. System architecture is also important as much as the processor speeds. As described above, system performance test standards measure both the system architecture and processor power.

The hardware chosen for disaster information system should have additional properties like fault tolerance. There are many methods to make the systems fault tolerant depending on hardware, software and network components. These methods are written comprehensively in chapter 5.1.5.

Telecommunication in Disaster Management

In this chapter, we will review different telecommunication technologies that are ready and available for disaster management purposes. The review includes actual technologies and processes as well as future approaches proposed for disaster telecommunication.

According to the International Telecommunication Union (ITU), the prevention and alleviation of human suffering caused by disasters is one of the most important uses of communication technology today. During times of disaster, clear communication into and out of affected areas is essential to any relief effort. As technology progresses, the limits on what can be done to insure communication links between disaster areas and the outside world decrease. Unfortunately, the doors opened by new technologies are often expensive. Without giving a cost analysis of these technologies, we will present in the following paragraphs different telecommunication infrastructure instances.

Related Works

The last decade has seen a number of conferences dealing with disaster related communication issues on a global scale. The 1990 UNDRO Conference on Disaster Communications aimed to facilitate the exchange of emergency telecommunications information between nations. The Tampere Conference on Disaster Communications in 1991 formed the first comprehensive document on the title subject. The 1994 Buenos Aires Resolution on Disaster Communications, though not legally binding, urged signatories to facilitate the rapid deployment of telecommunication during times of disaster. Following these conferences, in 1998 Tampere Convention was published.

Regardless of the widespread acknowledgement that the effective use of telecommunications resources is crucial for disaster prevention and relief, the transborder use of telecommunications required in humanitarian relief operations is all too often restricted in certain countries. This not only prevents the mobilization of the most appropriate form of assistance, but also dramatically reduces the effective work of rescue teams. For many different reasons, actual national regulations are prohibiting the import and export of telecommunications equipment, the use of telecommunications equipment or radio frequency spectrum and the transit of telecommunications resources into, out of, and through the territory of a third country. The effort to remove such barriers has been hampered by the lack of an international legal instrument to override such restrictions during times of emergency. A diplomatic conference held in June of 1998 considered the first international convention on the use of telecommunications is disaster relief operations. Drafted in Tampere, Finland, the signatories agreed to wave certain legal restrictions on the importation and use of various types of telecommunication equipment once a country asks for and agrees to receive international aid during a disaster. The Tampere Convention will remain open for signature by other governments at the office of the United Nations in New York until June 21, 2003. Turkey has not yet signed the Tampere Convention.

Technological Tools

During times of disaster, the existing telecommunications network is often vulnerable. When a network fails, relief workers must rely on alternative methods of communication.

Cellular Technology

In Turkey and many other countries, cellular services cover most or many of the metropolitan areas. Cellular technology is mobile, portable, and transportable, giving it a major advantage for emergency communications. Cellular provides both air-links and access to the phone network. However if the phone network is not functional or blocked, cellular systems will not help. When disasters occur, it is highly likely that the cellular traffic will be heavy. This overuse will usually result in high blockage rates. Reserving emergency links can provide a partial solution to the blockage issue. Coverage is also a major concern because many areas (especially rural areas) do not have cellular coverage.

Cellular systems which are commonly used in mobile telephony present an excellent solution for disaster situations. Systems called temporary cell systems consist of a base antenna installed on top of a motor vehicle and are outfitted with equipment to set up a temporary cell in any desired area. During normal operation, these temporary cells are set up near crowded events such as football stadiums, concerts, etc. During a time of disaster, a temporary cell can provide coverage in a 5 km2 region. The American FEMA organization owns several of these devices. The temporary cells set up in a disaster area can use any native technology. It can communicate with the existing telephone infrastructure using a satellite or microwave link using antennas installed on the vehicle.


Figure 5.1.35. Temporary mobile communication vehicles used by FEMA

High Frequency (HF) Radio

HF radio works in the 3-30 MHz range as a means of communication over long distances. An HF signal transmitted from the earth travels through the ionosphere before being "bent" back down toward the ground. HF radios are portable devices which usually operate around 125 Watts RF power. In situations where the land based network is destroyed, HF Radio is a good candidate for emergency communications at a minimum cost.

The National Communication System (NCS), the National Telecommunication Information Administration (NTIA) and the Institute for Telecommunication Science (ITS) have developed standards for ALE HF Radio and provide guidelines for emergency preparedness. The disadvantage of HF radio is that the link through ionosphere is subject to sudden and unpredictable short-term disturbance caused by sun spots, electric activities of the atmosphere or just ordinary bad weather. Broadcast radio may also interfere with the HF radio signal because the working frequencies are not far apart. Capacity for HF is moderate to low also because it works using a single side band transmission mode. Interoperability with other communication media (cellular, satellite and PSN) also remains a problem.

Satellite Systems

Satellite systems have been used for disaster and emergency communications and by the media for news reporting from areas where communication would otherwise be difficult or impossible. In addition, systems are available for temporary or fixed operation in areas beyond the reach of normal communications. Thus far, satellite systems are regarded as the near ideal communication method for use during disasters. Communication satellites often referred to as COMSATS; include Geostationary (GEO) and Low Earth Orbit (LEO) models.

GEO (Geostationary Earth Orbit) Satellites

GEO satellites have been the communication method used in disasters for quite sometime. One of the most practical satellite systems for use for disaster relief is the International Mobile Satellite Organization's system (INMARSAT). Inmarsat systems use GEO satellites to communicate with land-based terminals. A GEO satellite circles the Earth 24 hours per day, 22,300 miles above a point on the surface. The fact that GEO's orbit 22,300 miles above the equator make GEO satellites appear stationary over a fixed point on the surface of Earth. Consequently, they are better suited to broadcast applications than satellites in other orbits because their coverage patterns do not move. During disaster, GEO's are a practical way to substitute for other types of communication.

There are several Inmarsat systems involved in global mobile satellite communications. In the first generation, INMARSAT defined five standards: standard A (1982), standard B (1993), standard C (1991), standard M (1992/1993) and aeronautical standard (1992). All these standards provide different service worldwide, including voice, facsimile, and data. Inmarsat A and B are mostly used in maritime shipping, while Inmarsat C is provides service to small crafts, fishing boats, and land mobiles. The standard aeronautical service is a bit different from others because it serves only commercial and private aircraft. The weight of Inmarsat terminals range between 25 kg in standard A to the lightest one in standard C, at about 5 kg.15 Although Inmarsat is good for maritime and aeronautical purposes; they are not good choices during disasters where the portability and terminal size are paramount. Costs related to owning and operating Inmarsat equipment often makes its use prohibitive for smaller relief agencies. Future communication systems will require very small, light user terminals, similar to the ones now used in the cellular systems.

LEO (LOW EARTH ORBIT) Satellites

LEOs may prove an ideal solution for disaster telecommunications in the near future. The problem of normal mobile phone systems is that they require a base station. During disasters, some of the base stations may be damaged, thus shutting down communications in the area. For GEOs, the size of the terminal makes transporting equipment in and out of the disaster areas problematic. LEO systems can solve both of these problems. LEOs circle the Earth only a few hundred of miles above its surface. There are two types of LEOs, little and big. Little LEO system is used for non-voice, two-way messaging and positioning with low-cost transceivers. The drawback of this type of LEO system is that the satellites operate in the spectrum below 1 GHz, which is heavily used worldwide. It is unlikely to find such spectrums available on a global basis. In addition, the fact that little LEOs can not carry voice traffic limits the communication modes available during a disaster. Unlike little LEO systems, big LEO systems can carry voice, data, facsimile, and radio determination satellite services (RDSS). Currently, there are several types of big LEO systems introduced into the market. This paper will explore three types of big LEO Global Mobile Personal Communications Satellite (GMPCS) systems: Iridium, Globalstar, and ICO.

Iridium

Iridium was introduced by Motorola for global coverage and a variety of services, including voice (full-duplex, 2.4Kbps), data (2400 baud), facsimile (2,400 baud), and paging. Each Iridium satellite has three antennas, which project 48 spot beams onto the Earth, to form 48 cells at the footprint of each satellite. The satellites of this system have complete information transference by utilization of inter-satellite links, which make the system a network in the sky. Iridium does not need the terrestrial systems to carry the traffic. The traffic travels directly from the user to the satellite using L-band frequencies and travels from satellite to satellite by using inter-satellite links in the Ka-band until the traffic reaches its destination. With this type of the architecture, Iridium can be used in situations where the terrestrial systems are damaged by a disaster.

However, Iridium system has recently withdrawn due to financial difficulties. Nowadays, it is been funded and operated by investors, and it is in service with limited capabilities.

Globalstar

The Globalstar system is a LEO satellite-based mobile communication system the plans to launch service by the end of 1999. Unlike the Iridium, Globalstar uses the bent-pipe approach to route long-distance calls. In this architecture, each satellite establishes a moving footprint that is inconstant communication with a gateway. The individual ground users establish a traffic link to the satellite via a spot beam within the footprint. All such communications must go up and down between the satellite and the gateway. Importantly, for all users in another satellite footprint, terrestrial lines must be used to complete the circuit. This system's reliance on terrestrial lines makes it vulnerable during disasters. For example, an earthquake might destroy terrestrial lines, thus shutting down the Globalstar system. The main advantage anticipated from this system will be its lower cost because of the combination of access methods used.

ICO

ICO, a Medium Earth Orbit (MEO) constellation with 10 satellites, plans to offer global service in 2000. This system will route calls from terrestrial networks through its ICONet, comprised of 12 Earth stations or satellite access nodes (SANs) and the terrestrial links between them. These SANs will select a satellite through which to deliver calls to and from the mobile terminals. Although ICO depends on the terrestrial networks and bent-pipe architecture to some extent, it does not mean that the system will necessarily suffer during disaster; the 12 SANs on Earth are positioned to provide redundancy in case one of them goes down.

Ad Hoc Networks

Ad hoc networks can be defined as access points which can communicate with each other in a wireless environment. They do not require any existing network infrastructure by design. Each node in such a network behaves as a router and transmits each packet it receives to the other network nodes. In that sense, the network topology is not static.

The need for a network that can operate under any condition has led to the development of Ad Hoc networks. Support for mobile equipment is crucial in that sense. Ad Hoc networks should survive in any condition. Hence, they don't rely on existing communication infrastructure. They provide a rapidly deployable self-organizing network structure.

Ad Hoc networks provide distinct advantages in applications which require high reliability such as military and disaster management or wherever rapid connection facilities between people attending a meeting are desired.

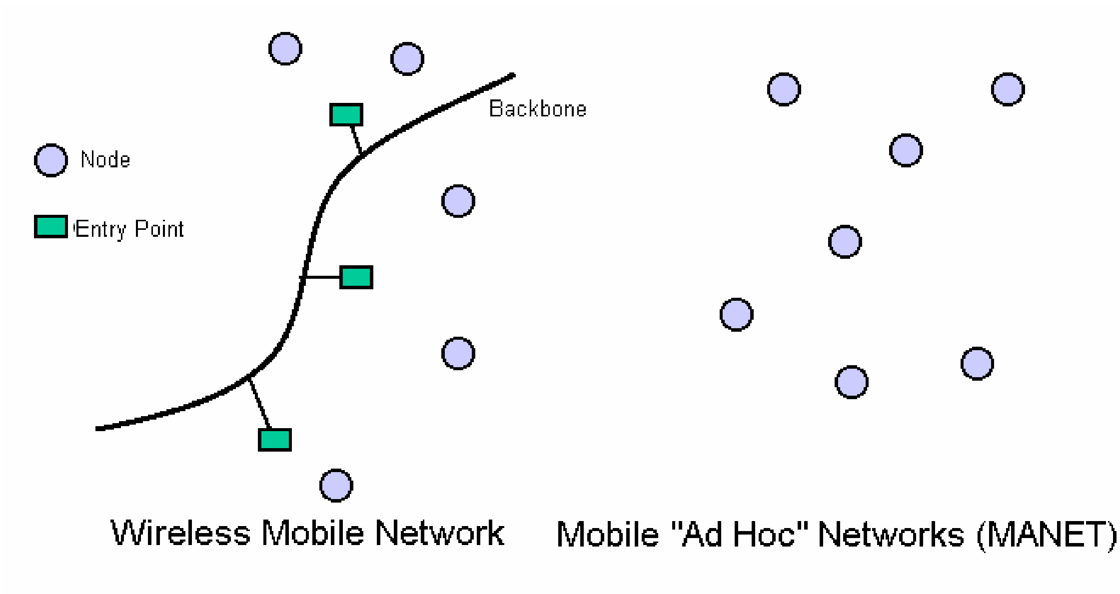


Figure 5.1.36. Mobile Networks and Mobile "Ad Hoc" Networks

The characteristics of these special networks can be listed as:

- Dynamic topology
- Heterogeneity
- Bandwidth-constrained variable-capacity links
- Limited physical security
- Nodes with limited battery life and storage capabilities

Currently, issues such as routing protocols, administration of clusters, quality of service (QoS) and media access are active research issues. Routing in mobile Ad Hoc networks differs from routing in other types of networks because both end stations and routing elements are mobile. In this respect, error rates can increase drastically as mobility increases. Therefore, regular performance measurement criteria do not suffice and new techniques to measure effectives are needed.

At present, ad hoc network technologies include Bluetooth, Bluetooth2, Infrared, IEEE 1394, CAN, IEEE 802.11 type cellular technologies.

Considering the strong possibility that fixed computers and computer networks will be out of service at a time of disaster, ad hoc networks emerge as a fast and inexpensive solution for communication needs over short distances. At the time of disaster, mobile devices may form their own local area network and meet data transfer needs using one of the above mentioned (Bluetooth, IEEE802.11 ...) technologies. For example, Bluetooth technology can reach speeds of 1 Mbit/s in over a network where stations are at distances of about 10 meters. If IE802.11 is used\ speeds of 1-2 Mbit/s can be met at an area of about 150 meter radius. The low power consumption of Bluetooth technology is a distinct advantage in mobile applications. At present, Bluetooth is the technology of choice for communication of devices in the same room, IEEE 802.11 technology is used to serve different devices in the same building or campus. For example, IEEE 802.11 technology is used to provide Internet access to passengers in Ataturk International Airport.

Multi-Layer Systems

Multi-layer systems are a solution that increases reliability against communication failures during times of disaster. In this model, more than one type of communication mode is used in a redundant structure. For example, microwave, GSM and satellite links may be used at the same time. In this system, end stations that are close (less than 150 meters) can connect at a very high speed (11

Mbits/s) using Microwave technology. As distance increases, GSM may take over to provide a connection. Satellite connection may be used over longer distances. This architecture provides reliable communication in a multilayer model.

Communication links with other disaster management centers

Communication between involved organizations is one of the most critical issues in disaster management. The effect of communication failures on relief operations will be drastic. In addition to disaster relief operations, communication is vital also during the mitigation phase, where the collecting, updating and sharing of information is a vital task. A reliable communication network between disaster-related organizations is therefore, a vital issue. The main organizations that are involved in disaster planning and relief within Istanbul are Disaster Management Center (AYM) ve Disaster Coordination Center (AKOM). A model for a communication network between these organizations is given in Figure 5.1.37.

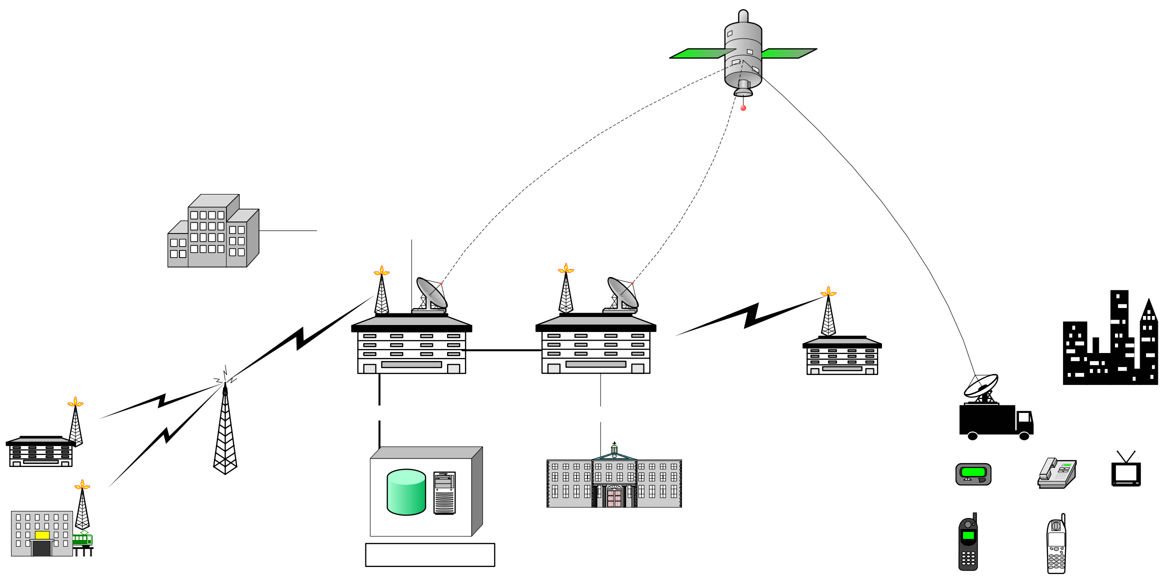


Figure 5.1.37. Telecommunication Infrastructure

Disaster Communication Radio Band

The 5. WGET (Workgroup on Emergency Telecommunications) Congress held on 20-21 May 1997 has allocated narrowband communication bands for International humanitarian support efforts. These frequency allocations have been updated in the 8th WGET Congress held June 7-8 1999.

Table 5.1.11. Disaster communication radio band

Within the spectrum allocated to land-mobile service in the VHF range:			
	Primary Channel (A):	Alternative Channel (B):	Alternative Channel (C):
Simplex:	163.100 MHz	163.025 MHz	163.175 MHz
Duplex:	Repeater transmits on 163.100 MHz Repeater receives on 158.100	Repeater transmits on 163.025 MHz Repeater receives on 158.025 MHz	Repeater transmits on 163.175 MHz Repeater receives on 158.175 MHz

Within the spectrum allocated to land-mobile service in the UHF range:			
	Primary Channel (A):	Alternative Channel (B):	Alternative Channel (C):
Simplex:	463.100 MHz	463.025 MHz	463.175 MHz
Duplex:	Repeater transmits on 463.100 MHz Repeater receives on 458.100	Repeater transmits on 463.025 MHz Repeater receives on 458.025 MHz	Repeater transmits on 463.175 MHz Repeater receives on 458.175 MHz

5.1.4 Data collection and updating

Procedural

The first stage of any data collection effort is the definition of data. This topic has been presented in some detail in the previous sections. The procedures for data collection and updating are related to the management of this process.

Which unit of the organization will administer the collection of data? In many organizations, this is automatically assumed to be the responsibility of the computer services department, since data resides in their computers. In general, this is not the right approach. In order to assign this responsibility, one has to think of the situation before automation: Which department kept the records, on paper format? There is no reason for this assignment of responsibility to change: Computer services department is responsible from the installation and maintenance of the automation and database software; but the administration of the data collection task belongs to the respective department.

In many cases, data collection may be a joint responsibility of many organizational units. In that case, an interdepartmental commission decides on the distribution of responsibility, and the principles of data sharing, use, and access rights. Participation of a representative from the computer services department makes the application easier.

Data updating, is the long-term version of data collection. Indeed, data is not a static entity that, once collected, resides forever on a computer, but dynamic piece of information that is updated at certain intervals. In this respect, during data definition, updating periods should be set and the information system should be designed accordingly. Considering the data in our area of interest, we see different modes of updating:

- Static data: This is data that does not change regularly and needs to be updated only exceptionally. For example, data in topographic maps can be assumed to be of this type. In exceptional cases, this data may change; necessitating an updating mechanism. However, this is done on request, rather than periodically.
- Data with long updating periods: Many data items fall into this category. For example, demographic data is collected every five years, by census. Therefore, the updating period is five years. Similarly, data such as the borders of administrative units, etc. Does not change very often and needs to be updated only occasionally. Therefore, as in static data, this type of data may be updated directly on the database, making separate updating software unnecessary. However, the administrative procedures for the updating of this data should be planned.
- Data with short updating periods: Data with an updating period of one year or shorter falls into this category. For example, the personnel, inventory, or similar data need to be updated at intervals of one year or shorter. Since the majority of data in the information system falls into

this category and the updating periods are short, appropriate mechanisms for efficient and reliable update should be developed: Automation of updating is essential for this category.

- Data with very short updating periods: Data with updating periods of one day or shorter falls into this category. Some of this data may be the output of some on-line measurement device, or aggregate data of some real time system. For example, the magnitudes and locations of significantly large earthquakes may automatically be entered into a database. For such applications, interfaces that automatically summarize and prepare data and enter it into the database without human intervention are most appropriate.

The human factor, while a major source of error in routine operations, brings flexibility and intelligence when used appropriately. The basic principle should be to automate all routine operations, provide simple controls to detect operator errors, and provide human intervention in the form of administrator control and approval. An important principle is the protection of mechanism in the pre-automation stage. For example, if a certain data item is collected by an employee and needs administrator approval before reporting and filing, the same procedure should be followed after automation: When the employee enters the data into a form in his computer, the system should send a message for administrator approval. The administrator should approve it in his own terminal, prompting the system to proceed with reporting and filing of the data item.

Automation in data collection and update

Updating over the Internet

The entry of all data from a central office is a difficult and time consuming operation. Often, parts of the data are changed, but this change is not reflected to the central database. This may cause incorrect operation due to imperfect data and have grave consequences during disaster operations.

The data belonging to different organizations that will be used within the context of a disaster management system can be categorized as:

- Buildings and land data: all data relating to these
- Material information: type and quantity
- Personnel information: Type, number and communication information
- Vehicle information: number, type and location

Although this data changes with short periods of time, the entry of the current values of the data into the disaster management database system often takes years, necessitating concentrated effort by dedicated teams of people. We propose the distributed entry of data by organizations that generate the data, using a data entry system over the Internet. A central authority should administer the healthy and secure operation of the system by distributing access rights, passwords, and by entering data that relates to spatial coordinates.

Two alternatives can be foreseen for the operation of the system:

- The data changes may be reflected to the central system whenever they change in the local database.
- The data changes may be entered by authorized personnel by connecting to the disaster management system web page.

The first alternative provides the fastest method for reflecting the current data. However, this necessitates the development and installation of software modules in the computer systems of both parties. This is often not feasible.

The second alternative lets the authorized employees of different organizations that provide data to enter the changes in data through the web at regular intervals of say, 15 days. In this system, when users access the data entry system over the web, they can select their data via a geographical information system GUI. They enter their usernames and passwords and are able to update the information related to their organization. Figure 5.1.38 - Figure 5.1.39show the data entry screens of a software that has been developed for this purpose.

Under both alternatives, the user access rights should be set carefully. Data should be updated only by the organization that provides it, and user access rights for authorized personnel from the organization should be appropriately set in accordance with both security and confidentiality rules.

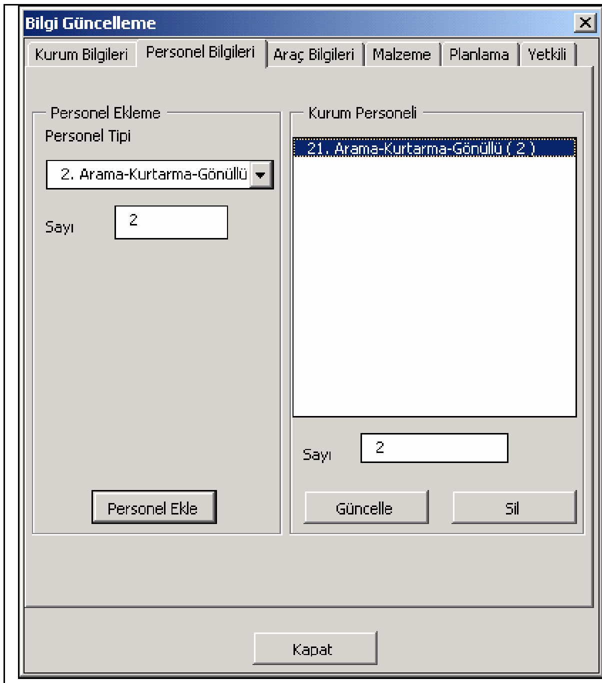


Figure 5.1.38. Personnel data update

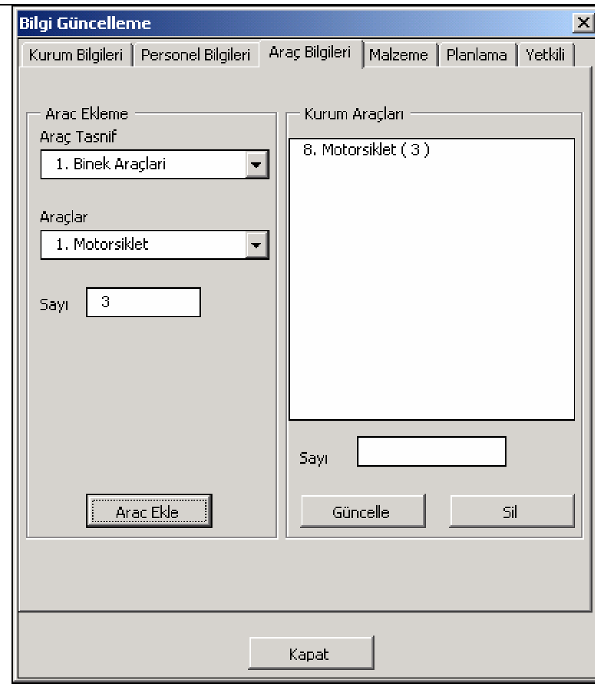


Figure 5.1.39. Vehicle data update

Although the first system has distinct advantages in terms of both speed and reliability, it does not seem feasible due to the large number of different systems and organizations involved. Therefore, the second system should be selected and implemented promptly. The development of software modules for the second alternative can be implemented swiftly and the costs will be low because the software will be installed at a central location only. The personnel that will be using the system may be trained in the beginning phase and the system may become operational in only months after the deployment of the project.

Data Collection and Updating Using Mobile Devices

The majority of data in an Urban Information system is collected by observation in the field. The most common procedure for this is for the observer to enter this data into a paper form, which, is processed by an operator later and entered into a computer. This is both time consuming and the re-entry of data causes errors. A better solution is the entry of data directly into the database via a mobile device. This device may be in communication with the central database system through mobile links or may collect the data throughout the day and relay this information when inserted into a cradle in connection with a desktop.

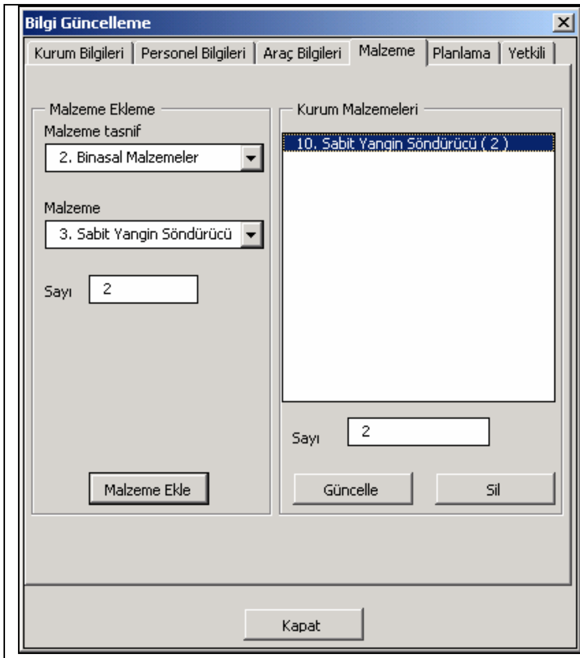


Figure 5.1.40. Materials information update

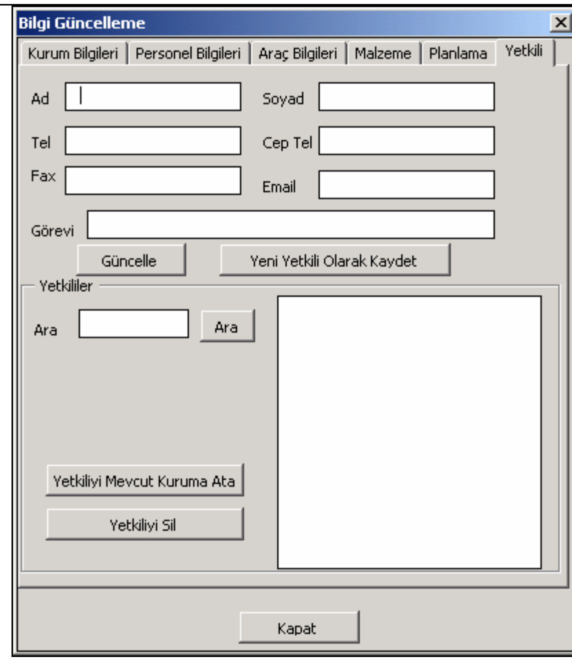


Figure 5.1.41. Personnel information update

We propose the use of such a mobile information collection system in the building evaluations part of this project. In building evaluation, it is proposed that all residential buildings be evaluated by experts, in stages. In the first stage of this detailed building evaluation process, information about the building will be collected from the street level. In later stages, experts will enter the buildings to collect more detailed structural information and prepare plans. It is foreseen that this later stage will be one of the most costly and time-consuming steps of this project. We therefore propose that street teams be outfitted with mobile devices with special software for data collection.

The prices of mobile handheld devices that may be used for this purpose have dropped to under 100 US dollars. The benefit of the use of such devices will offset the direct cost.

The functions of such a mobile device will be:

- Convenient user interface for data entry
- Access, copying and editing functionalities for previously entered data
- Graphical user interface for drawing plans showing the structural elements of the building
- Software for converting such plans to common CAD formats, such as DXF.
- Synchronization software to transfer the collected data to a desktop computer.

Prototype software that has the above functionalities and runs on a Pocket PC has been developed for this project. The software has been developed in the .NET CompactFrameWork. The code is compatible with smartphone type mobile phones and personal digital assistants (PDAs). The cost of simple PDAs has dropped to under 100 US dollars.

The operation of the software can be followed in the user screens. Figure 5.1.42 shows the first user screen. In this form, the user assigns a new filename, enters his name and the building data. The user may click on the building tab and enter building information such as type, number of floors, dimensions and a subjective quality index.

Figure 5.1.42. Main screen

Figure 5.1.43. Building tab

After entry of the building data, the user clicks on the Bina2 tab to enter information such as corner/non corner, connected/ disconnected, etc. (Figure 5.1.44). This goes on with the Bina3 and Bina4 tabs. (Figure 5.1.45 and Figure 5.1.46). Lastly, the user may enter freeform text by clicking on the Notes tab (Figure 5.1.47).

After the entry of all text data, in the last evaluation stage, an expert enters the building to draw a simplified plan of the building showing all load bearing structural elements. By clicking on the plans tab, a new plan may be created or previously entered plans may be edited. Since the base-level and first floor plans may be different for a building, the entry of two different plans has been foreseen.

Since the screens of handheld devices are rather small, it is planned to use the whole graphic screen to show the plan. (Figure 5.1.48). In this screen, the coordinates of the clicked location can be seen on the lower right-hand corner. A mesh background has been used to ease plan drawing. In this screen, columns, beams, and load bearing walls may be shown. The dimensions of load bearing elements are entered via a different screen. (Figure 5.1.49)

Figure 5.1.44. Bina 2 screen

Figure 5.1.45. Bina 3 screen

Figure 5.1.46. Bina 4 secreen

Figure 5.1.47. Notes Screen

Figure 5.1.48. Plan screen

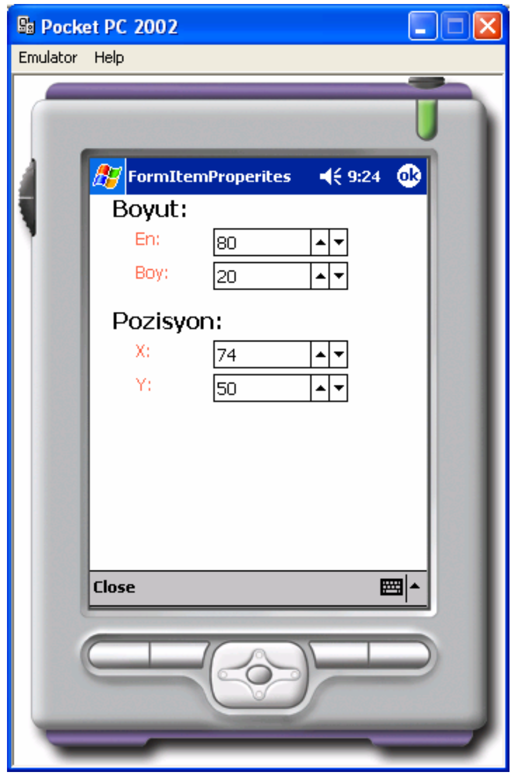


Figure 5.1.49. Structural element dimension entry screen

Versioning and Spatial-Temporal Representation

When the geographic information is updated, it is a problem how to deal with out-dates information. There are two possible methods that can be used to deal with this. These are:

- Spatial-Temporal information system
- Versioning

Spatial-Temporal Geographic Information system

Spatial-Temporal geographic information systems define any object on earth by its coordinates on earth together with the time slice in which object exists. In this sense the following data are used define an object in space-time dimensions:

- Latitude,
- Longitude,
- Altitude,
- Time

Geographic information systems are the core component of any Information Systems related with city, and usually are long term projects. The following criteria are critical for such kind of long term projects:

- The data structure used for system should be a open-data structure;
- The system should have data structure that is suitable with spatial-temporal systems;
- System software should be preferable developed by local companies

Geographic information changes very rapidly over time. The main weakness of current geographic information systems is the lack of update operations not taking place in time which results working with misleading data. In order to use the system effectively, data must be updated all the time. However geographic information differs from other kinds of data: usually previous geographic data are also important. For example current forest borders can be compared with forest borders of 3 years ago and the changes in forest areas can be discovered so the afforestation studies can be made more effectively. In this situation, the data must be added to the system instead of updating old data. For this purpose temporal information can be used to manage geographic data.

As its name sounds spatial-temporal information systems can work with both spatial and temporal data. Such a system can be thought as a spatial information system that has special methods to manage temporal data. This system should meet the following requirement:

- Data structure should be compact, removing unnecessary properties and redundancies
- Data structure must be simple and easy to understand;
- System should be able to work with uncertain time information;
- System should be able to work with maps of different time slices;
- Two maps belonging to different times should be able compared visually;
- System should show changes between two time points.

Conventional geographic information systems based on the concept of storing maps on digital platforms. The main purpose of these systems were taking print outs of maps from computers. The rapid development of information technologies has changed the requirements of geographic information systems. Complex spatial analysis became a standard operation in these systems. This requirement needs the computer to store a realistic representation of the world. But this realistic representation can only be handled by integrating the time factor into the model. For this purpose the following two methods may be used:

- Comparing the backups of databases taken at different time points
- Data structure stores the time data for each object of the database

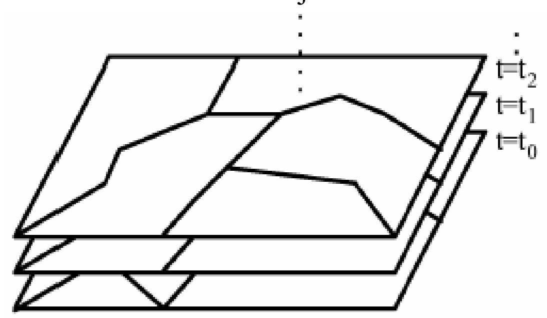


Figure 5.1.50. Databases at different time points

As mentioned before, first method uses the concept of taking backups of data sets at different times, and making analyzes by comparing these backup sets. (Figure 5.1.50). In this strategy time data is obtained using the backup dates. Existing commercial GIS software use this approach.

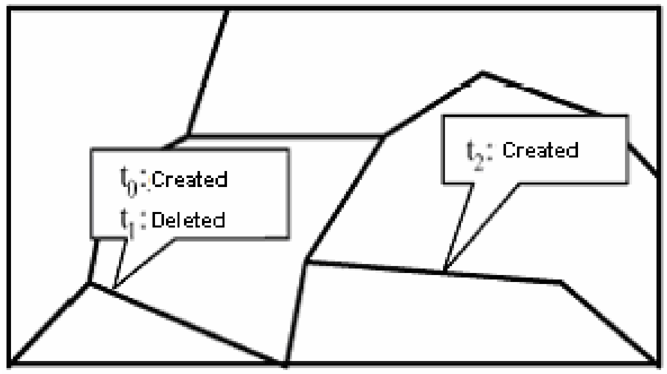


Figure 5.1.51. Each object has time component

Second method approach the problem by assigning a time attribute to each geographic entity. (Figure 5.1.51). In this model there are no explicit topographic relations between data sets. Because conventional geographic information systems uses two-dimensional coordinates to relate data sets and this model can not be extended to include time data to build topographic relations. For this reason topographic relations should be defined using implicit ways. System builds the topographic relations in real time as it is needed.

Versioning

Time dependent changes are represented by creating new versions of changing object. Taking backups of the whole database for each change would lead to insurmountable storing requirements and logical problems. Relational databases offer some solutions to these problems: changes can be represented by creating new versions of tables, tuples or attributes. This operation is called versioning.

Relational tables that have temporal data can be considered as a three dimensional data cubes. In this cube third dimension represents time. As new versions of tables are created, the data cube expands in time axis in full. If the expansion in time dimension is made on tuple basis, then there will be lots of missing parts for most of the tuples. Because the system will not create new tuples for unchanged entities. If the expansion is attribute based, then the data cube would become sparse.

Selection of the expansion method is a decision given between storage efficiency and complexity. Creation of new versions of tables for each attribute change creates storage problems as a result of high amounts of redundancy. For the other case, the first normalization criteria of relational database would be violated as more than one value would be stored in any attribute and these results w

The main problem of table based versioning is the redundancy as a result creating new versions of tables when the changes occur not just in one time. This kind of inefficiency creates insurmountable amounts of data as any GIS system has already huge amounts of data.

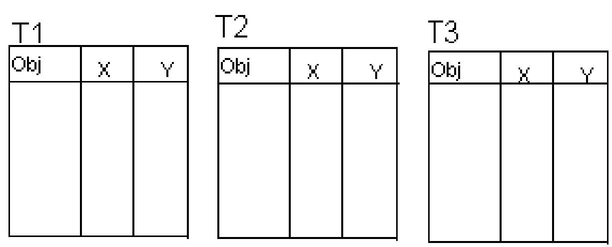


Figure 5.1.52. Table based versioning

In tuple based versioning, each tuple is stored with its time data. New records are added to the system by inserting these records to the tables. Tuples are deleted by altering time attribute of the tuple. Update operation takes place by first deleting the existing tuple by altering time attribute and then inserting the updated version of tuple as a new tuple with valid time attribute. In such a system, queried are made using time attribute in the query. But apparently, the system response time of the system increases as the number of tuples in a table increases.

	Obj	X	Y
T1			
T2			
T3			

Figure 5.1.53. Tuple based versioning

Another tuple based versioning method uses "history chaining". Any changed tuple (delete, update) is stored in the main table while history data is hold in a different table. Any object's old information can be found by following history chains in the history table.

Attribute based versioning uses variable length columns and complex data structures that hold time data. In this method each records attribute data is hold using time-value couple. Ant attribute can hold more than one time-value couple.

Obj	X			Y		
	T1	T2	T3	T1	T2	T3

Figure 5.1.54. Attribute based versioning

5.1.5 Data and Computer Systems Reliability

Introduction

Reliability of disaster management information system refers to its availability when requested. In such a vital system data should be available when we need. In spite of this, many different factors may prevent this accessibility: hardware failures, software errors are major ones. According to a recent research data loss can be classified as follows (Figure 5.1.55):

- Hardware failures (% 44)
- Human errors (%32)
- Software errors (%14)
- Virus (%7)
- Natural disasters(% 3)

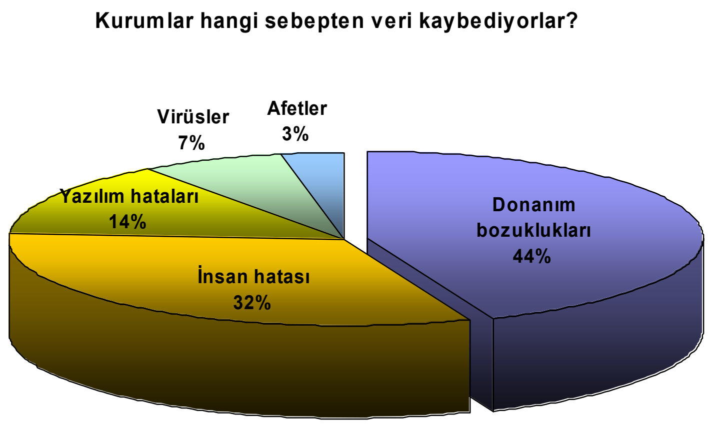


Figure 5.1.55. Classification of data loss

We remark that %32 of data loss is caused by human errors. Combined with the %7 of data loss caused by computer viruses, these two groups of errors are prevented by accurate anti-virus software and efficient education of computer users. Hence, we can deal with these problems by one way or another.

We need to use fault tolerant systems in order to prevent remaining errors or failures. Information systems for disasters and earthquakes work necessarily on extraordinary, unusual cases by definition. Therefore, they need to continue operating whether power corruption, strong shakes, high heat or flood happens. We need to consider these extraordinary conditions while designing such a system.

Since it is virtually impossible (at a reasonable implementation cost at least) to design and implement a completely fault-free system, measures have to be provided which allow the system to detect and tolerate these faults dynamically during normal operation. There are four different means by which dependability in a computer system can be achieved:

- fault prevention (how to prevent fault occurrence by construction),
- fault tolerance (how to provide service when faults are present),
- fault removal (how to minimize the presence of faults), and
- fault forecasting (how to estimate the creation and manifestation of faults)

As it is not possible to prevent, stop or foreseen earthquakes, information system should be designed as fault tolerant. We will briefly review basic concepts on how to design such a fault tolerant system in the following paragraphs.

Basic Concepts and Definitions

The trustworthiness of a system such that reliance can justifiably be placed on the service it provides would have several main attributes:

- *Availability* - the extent to which a system has a readiness for usage.
- *Reliability* - the extent to which system continuously provides its service.
- *Security* - the extent to which a system prevents unauthorized access and/or handling of information.

A system, which no longer delivers a service that complies with the specification of the system, is said to suffer from a system *failure*. An *error* is a system state, which is liable to lead to a subsequent failure. The adjudged or hypothesized cause of an error is a *fault*. (Figure 5.1.56).

Error recovery is the main attempt to substitute the erroneous system state with one which is error-free. This recovery can be done using either *backward recovery* or *forward recovery*. Backward recovery means that the system is brought back to an error-free state recorded in a *recovery point* - a "snapshot" of the system state - prior to the erroneous state. Forward recovery means the transformation of the erroneous state consists of finding a new state from which the system can operate In order to ensure that faults can be tolerated, a fault tolerant system is assumed to support some level of redundancy. This redundancy consists of additional components and algorithms attached to the system and it is categorized as *hardware redundancy (space), software redundancy (information)* and *time redundancy (repetition)*. The following sections highlight the techniques that use these concepts.

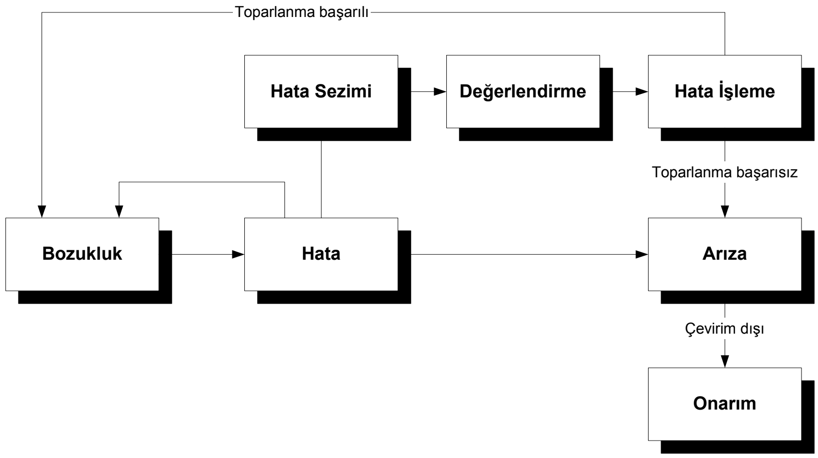


Figure 5.1.56. the process of faults, errors and failures in a system

Hardware Fault Tolerance

To have computer systems with acceptable level of reliability, computers should be able to survive in faulty, unexpected conditions. Such fault tolerant systems were first developed for mission-critical application areas like manufacturing, and aerospace. With the introduction of computers into all stages of our daily life, it is critical to make all these computers more reliable than ever. Because any malfunction in these systems can stop our daily life. As requirements for such systems grow up and computers become more complex, the request for highly reliable and available computer systems arises.

Development of reliable computer systems had begun in 1950s as a result of high failure rates of vacuum tubes. With the development of transistors, the reliability of computer components has been highly improved and the researches in this area now focused on performance and functionality.

Any fault tolerant system should have the following features:

- Masking: Fault tolerant system should be able to mask or dynamically fix any faulty system operations. Any unmaskable failures must be able to manage by another fault tolerant mechanism (software).
- Detection: Computer system should be able to distinguish fault operations from normal operations. For complex hardware devices this not an easy task, and smart techniques should be developed to find fault operations.
- Containment: To reduce complexity of such systems, failures must be handled by modules where the failures occur. This can be achieved by self-checking modules such as each module checks its output and affirm the correctness of it.
- Diagnosis: Maintenance costs of complex computer systems increase rapidly. Maintenance operations can be simplified by finding out the source of failure quickly.
- Maintenance and Configuration: Faulty system can be put into service by replacing the failed module or distributing work load of the failed module to the others.

- System Recovery: The process of returning back to online mode. If the error can not be fixed dynamically, other techniques can be used. The most widely used method is turning back to a previously saved point.

The main principle of fault tolerant systems is using additional redundant components which can overcome failures. In most cases redundancy is achieved by adding extra hardware, software and data to the system's minimal requirements.

Copying methods define the effects of malfunctioning modules and use of the hardware replacements. These methods are classified as static, dynamic and hybrid methods. In static copying, a number of different copies for each working unit are presented to the system and a voting unit compares the results of the outputs of these copies. The cost of including a hardware copy might be expensive; however static copying techniques are very powerful in finding and patching failures.

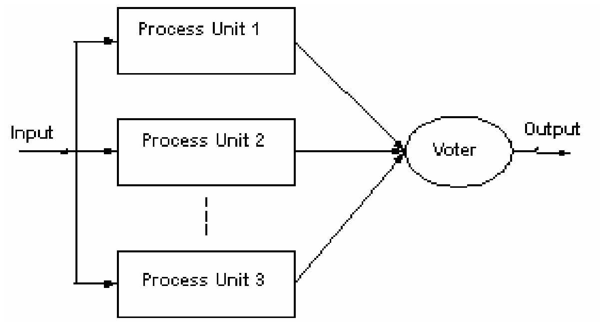


Figure 5.1.57. Static replication

In dynamic copying technique, the replicates of the working units are installed independently. These additional working units don't need to work on regular operation. But whenever a failure in the main units is detected, replicate of the working unit is selected to work instead of the main unit.

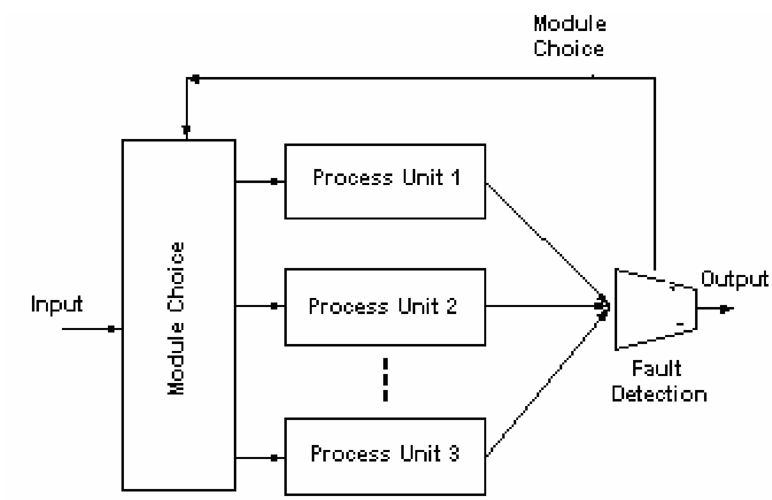


Figure 5.1.58. Dynamic Replication

Hybrid systems are formed with the combination of both static and dynamic techniques. Systems based on hybrid copying techniques are characterized as the best replicated systems with the least complexity that deal with the hardware failures.

Redundant working units are inevitable for pre-and-post disaster issues since uninterrupted working conditions are desired. We can consider the redundant system in three levels:

3. Storage redundancy (RAID5 Array)
4. Server redundancy
5. Clustering

The basic approach in storage redundancy is the use of two RAID 5 disk arrays instead of single RAID 5 array in each server. In that kind of system whether a failure occurs in one or more hard disks of the primary RAID array, a secondary RAID 5 array will be available and the system would not interrupt. The system should be supported with separate uninterruptible power supplies and cooling devices for each of the RAID arrays. The schema of such a system is shown in the following figure (Figure 5.1.59).

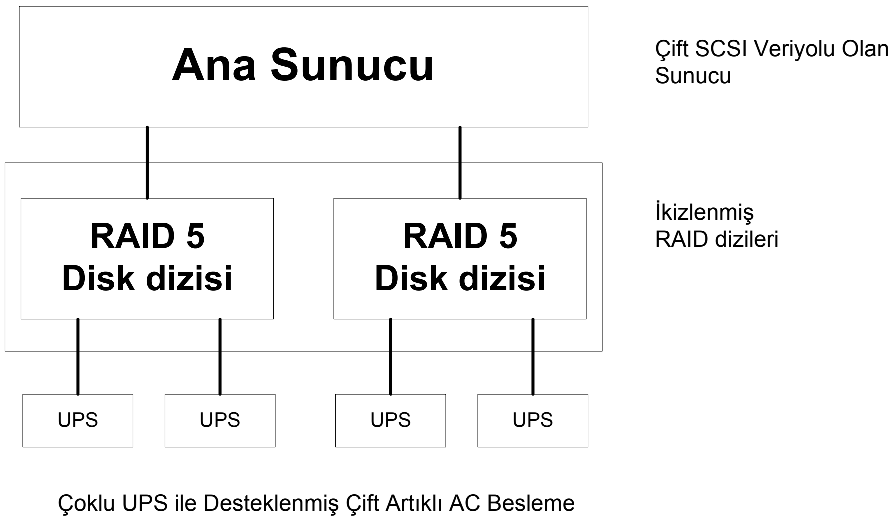


Figure 5.1.59. Storage redundancy

Server redundancy is formed by attaching more than one server to all of the RAID 5 disk arrays. In this system redundant servers can be let suspended in normal conditions and wait for the first server to fail. Each redundant server has also a separate bus to reach disk arrays therefore whether a failure on data bus of server occurs, it would not affect the system availability.

Sharing data between multiple servers enables network managers to distribute workloads onto multiple servers without the need to arbitrarily decide how to split up the data. When combined with RAID 5 storage, redundant servers share the total jobs and new jobs are transmitted to the server which has the minimum number of jobs. This architecture maximizes the utility of all installed components, and promotes ease of access to shared data.

Software Fault Tolerance

The designers of Disaster Management Information System should consider carefully that the highest need for the system will occur in case of a disaster, therefore, besides its hardware components, all other simple to complicated software included in the information system should be tolerant to all types of faults. In that sense, basic software tolerance techniques are presented in this section

Recovery Block - RB

The system has one hardware channel, i.e. no redundancy in the hardware; has redundant in software - it uses multiple diverse modules performing the same task; and is also redundant in time, since the multiple modules are executed sequentially in the event of errors. Horning describes a Recovery block as being a "firewall in time".

The basic elements of a recovery block are primary module, which performs the desired operation, alternate modules, which perform the same desired operation as does the primary module in a different way; and one acceptance test which is executed on exit from the primary and alternate modules to confirm that the results produced are acceptable. In order for the recovery block to be able to provide any degree of fault tolerance and continued service in the event of module failure, there must be at least one alternate module. All alternate modules should deliberately be different from the primary module, and also from each other, i.e. software diversity is employed. If all the modules would be the same, or even just similar, not much would be gained since they would all fail in the same way when working on the same input data. The modules of the recovery block may themselves incorporate inner recovery blocks, i.e. the recovery block scheme can be nested. The acceptance test yields a binary decision as to whether or not the results produced by a module are acceptable. In addition, the recovery block scheme requires a recovery cache, i.e. a structure which provides functionality for storing essential information of the current system state in so called recovery points or checkpoints - snapshots of the system state.

Upon entry into a recovery block a checkpoint is established. This checkpoint is stored in the recovery cache, and contains all relevant data describing the current state of the system as seen from the recovery block. When the checkpoint has been stored the primary module is executed. After its execution, the produced results are submitted to the acceptance test. If the results are considered satisfactory by the test, the recovery block is terminated and the results are passed as the output of the recovery block.

Should the results not be accepted, a recovery procedure is started. This procedure will restore the system state to that which is described by the checkpoint established at block entry and is stored in the recovery cache. This form of recovery is called backward recovery or rollback recovery in that it pro-vides all modules, primary and alternates, with exactly the same experience of the system state when their respective executions start, i.e. the time can be said to be turned back. When the recovery is complete the first alternate module is executed, and on exit the results are again submitted to the acceptance test. If the test is successful the recovery block terminates, otherwise the system state is again recovered in the same manner as before and the second alternate module is executed. Once again the results will be checked by the acceptance test. This chain of events will continue until

- a module produces results which pass the acceptance test or
- All modules have failed and an error is raised to the environment.

Since the recovery block scheme uses a recovery cache and backward error recovery, it introduces physical and temporal overhead. The overhead in space is mainly due to the extra space needed to store the code of alternate modules and the acceptance test, and the space needed for the recovery cache. The overhead in execution time is mainly dependent on the time required to evaluate (execute) the acceptance test and on the implementation of the recovery cache. However it is considered as suitable approach in the sense of reliability.

N-Version Programming (NVP)

The concept of using multiple computations in order to detect and correct failures has been known for a long time. In modern times, the usage of multiple versions of a software module in order to tolerate faults has been in use since the 1960's, and the generalization of the multiple computation method is called N-version programming (NVP). In N-version programming approach, N functionally equivalent programs from the same initial specification are generated. These N versions would run on several hardware channels producing results which are subject to some decision mechanism, usually a voter. If a majority of the N versions agree on the result, this result will be used as the output. If no majority agreement can be obtained, the system fails. In a sense, the NVP approach can be said to be the software equivalent of the N-modular redundancy for hardware where several hardware channels are used to mask hardware failures.

The basic elements of the N-version programming approach are the initial specification, the specification of the functionality which is desired by the software. N software versions - software modules which all are independently generated from the initial specification; and a decision mechanism a mechanism which decides what the final result of the computations will be using the results from the N versions as input.

The purpose of N-version programming is to provide either fault-tolerance or fault-detection with respect to software faults. The scheme aims at tolerating or detecting these faults by trying to minimize the probability of similar errors at decision points. This shall be achieved by independent generation of multiple functionally equivalent versions from the same initial specification.

The scheme may also be able to tolerate faults in the hardware. The errors produced by faults in components may sometimes not be distinguishable from those created by software faults. Hence, many hardware faults can be treated as though they were software faults with regard to their effect on software execution. Of course, recovery has to be quite different for hardware faults compared to software faults.

Data Diversity

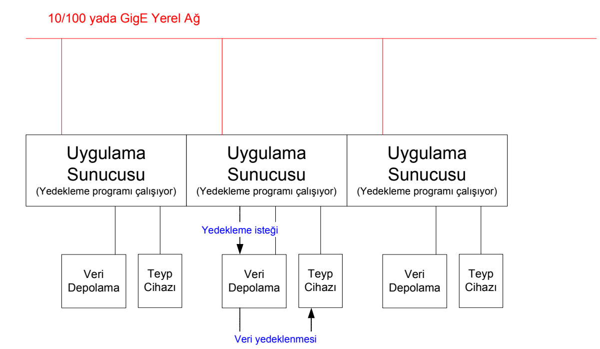
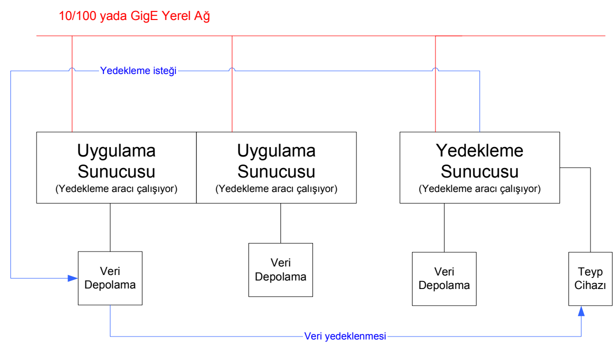
The fault tolerance schemes discussed so far in this report all make use of design diversity. They depend on the development of several diverse software modules delivering the same service. One other approach considers the use of diversity in the data space instead. This consideration is supported by the observation that programs usually fail for special cases in the input space, i.e. under a particular set of obscure values in the input data. This set of input data, for which the software fails, is called the "failure domain" of the software. A minor perturbation of the data, i.e. moving the input data out of the failure domain, might be sufficient to let the software execute without failing. This perturbation or re-expression of the input data is made deliberately and with total control. A re-expression of input data generates logically equivalent data sets. There are two approaches to using data diversity: the *retry block* and *N-copy programming*. These are respectively the rough equivalents of recovery blocks and N-version programming for design diversity. Empirical data shows that the Retry Blocks and the N-copy programming systems are roughly equally successful in tolerating faults.

Backup Techniques

In the previous sections we have defined several design issues concerning fault tolerance, but whether these issues are addressed or not, a totally protected large-scale information system requires industrial solutions. Backup tools are the most important ones. For all systems included in the information system, backup procedures should be defined as well. Each institution considered as a part of the disaster information system would define its own backup procedures and the whole scheme should be compatible with the backup strategy which is described a priori by IT managers. Below, we describe three actual backup techniques and solutions.

As the diagram shows, a locally attached storage system requires that the storage devices be managed individually at each server. Backup typically must be done locally at each server, resulting in high hardware and software costs since a backup device and a license for backup software is required per server and extremely high management costs, due to the large amount of time and personnel needed to complete the backup process. However, this type of backup is used frequently especially for its simplicity.

Alternatively, it is possible to deploy a single, central backup server, and with the helper agent at each server, the data is backed up to this central backup server over the LAN. Nevertheless, the LAN traffic is increased significantly, to the point that backup can only be done during "quiet" or off-peak hours. Disaster information system tends to be in operation 24x7; it is difficult to decide on quiet moments for backup.

<table>
<tr><th>Backup Strategy</th><th>Structure</th></tr>
<tr><td>Traditional Backup -
Direct Attached Storage (DAS)</td><td>
</td></tr>
<tr><td>Networked Backups and Network Attached Storage (NAS)</td><td>
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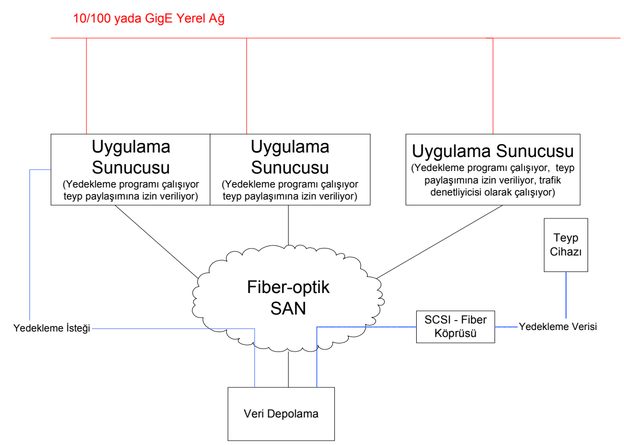
<tr><td>Storage Area Network (SAN)</td><td>
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Network Attached Storage (NAS) is based on the same principle that network-attached printers did. As printers became more intelligent, it became viable to embed the network interface and printer management software directly inside the printer. These network-attached printers could now be plugged directly onto the corporate network, and today users can easily find and connect to them by a “printer share.” Similarly, as storage appliances became more intelligent, NAS became viable as a “network-attached” storage appliance. A NAS box is essentially a storage device with a built-in network interface, network operating system, and storage allocation software. A NAS box can be plugged directly onto the corporate LAN, making it accessible with one or multiple “file shares.” Users and groups are assigned read/write privileges and space quota. As the number of users grows, and as free space becomes low, additional NAS boxes can be plugged in. However, although NAS makes some progress in simplifying the provisioning of the storage to clients, it does not address the problem of backup. You still have to run the backup from a central backup server which causes traffic on the LAN, or perform backup in unconventional ways, which inevitably lead to increases in management overhead. Another crucial problem with NAS is speed. An application running on a client that accesses storage on the NAS box has to go down the entire seven layers of the networking protocol, across the LAN wire, up the seven layers, get the data, and back. This is the reason why, despite the easier space management, NAS cannot be used in data-intensive server applications. Some high-performance database systems actually do raw I/O directly using SCSI commands to avoid the inefficiency of the OS file system. Since the NAS access is via the network redirector through the OS file system, no raw I/O is possible. In short, NAS is ideal for "sharing" files by general users and for some non-data-intensive application servers. For data-intensive servers, a SAN (Storage Area Network) seems to be a more accurate solution. As the diagram above illustrates, although the storage devices are detached from the server and centralized in the Storage Farm, a high-speed path connects the storage back to the server. The SCSI protocol is preserved, making the server believe that a SCSI host adaptor is still available, with SCSI storage devices attached.

Since 1992, Fiber Channel (FC) has emerged as the de-facto standard for implementing a SAN. The main reason for that is the viable Gigabit-speed transport. In addition to raw bit rate, FC protocol was designed to be highly efficient for storage traffic that is characterized as "large block transfer." FC can efficiently move megabytes of data in a single transaction, thereby reducing CPU utilization.

Case-study: SIAC

SIAC – Securities Industry Automation Corporation is the company that sets up, maintains and runs the computer systems of both the New York Stock Exchange and American Stock Exchange. After September 11th, the computer systems of SIAC were able to function without interruption, at a time when the life of the whole city was disrupted. This success is partly due to the redundant natre of the computer system: The strategic planners of SIAC found the relaibility of the system in the Manhattan site insufficient and planned for more redundaancy to be added to the system at a geographically close, yet separate location in Brooklyn. They argued that the river between the two sites would efficiently prevent large disasters such as fires to spread from one to the other. Their prediction turned out to be correct and the New York Stock Exchange was able to continue functioning the next day after the disaster without any data losses.

Figure 5.1.60. SIAC-New York Stock market

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5.2 Earthquake Information Infrastructure

Nuran Zeren Gülersoy, Doğan Uçar, Handan Türkoğlu, Muhammed Şahin, M. Zeki Coşkun

5.2.1 Introduction

Turkey often comes accross especially earhtquakes as well as other natural (such as flood, fire, landslide) and man-made disasters. These disasters cause people and economic losses in different degrees. The losses due to the disasters increase as the degrees of initialization and population density increase in the disaster area. The losses can be classified as follows:

- Social and cultural losses (life losses and damage of social & cultural environment).
- Damage of environement (damage of nature, spread of matters changing the ecological balance).
- Property losses (damage of agricultural products, building collapses, damage of industrial units, partially or completely)
- All the losses stated above have appeared in the last serious disasters in Turkey, on 17Th August 1999..
- The studies of establishment of information infrastructure of the ISDEBIS to be formed from the Istanbul Eqarthquake Master Plan should be carried out with a multi-discipliner group. There are several reasons to do so, which are itemised as follows:
- The degrees of losess increase depending on the population and housing density. The probability for an earthquake turning into catastrophe increases parallel to the degrees of industrialization.
- The information infrastructure which can be used for risk assessment of a probable Istanbul earthquake is not sufficient as in other parts of the country. Appropriate mechanisms devoted to the problems have also not been developed. In this concept, different suggestions and projects have been made by foreign foundations and organisations without detailed, serious and comprehensive studies.
- Similarly, we cannot perform a robust analysis yet on how the earthquake results or scenarios affect the economic and the social lifes of the community due to the lack of standards of information infrastructure.
- In an earthquake case, there is also no tool for obtaining integrated information that guides the related units or organisations.
- It is not enough to have data before, during and after an earthquake. The important issue is how these data are used in a master plan concept. In order to make a proper analysis, specialists in different disciplines, managers responsible for different duties and specialists in the response stage need standard comprehensive data. The data should be delivered to these people in time in a proper standard and in a good quality and concept when needed. The proposed information system should have spatial characteristics as the earthquake occurs in natura.
- The spatial information system proposed under the Earthquake Master Plan for Istanbul project is called as Istanbul Earthquake Information System (ISDEBIS : IStanbul DEprem BIlgi Sistemi). ISDEBIS can be used by the following units and organisations. Fig 1 shows the city administration units or departments that will use the proposed information system. These are
- Disaster protection and rescue units
- Administration units (governorships, districts, municipalities and other sub units)
- Service sectors (banks, insurance companies, construction companies)

- Research foundations
- NGOs (non-governmental organisations)
- Other state foundations and NGOs responsible for mitigation, response and recovery.

It is vital to develop standards of a Geographical Information System (GIS) - based information and management system which will operate using the Remote Sensing System (RSS), the Global Positioning System (GPS) and other data collection techniques for especially Istanbul and of course Turkey. GIS will be used for emergency planning and administration, disaster management and damage estimation, and as a decision support system for central and local authorities (ministries and local administrative units) at other times. The data catalog developed by ITU and METU is based on modeling of data requirements.

ISDEBIS will bring with it a standard for an information and management system that will involve the coordination of efforts between Istanbul Metropolitan units and foundations, as well. Thus, a regional, an environmental and a managerial spatial information system has been developed.

The system formed for Istanbul in this concept will supply up-to-data, current and standard data (information) to the users. The system prevents the information confusion as well. It helps on sharing information, perfoming a good coordination between data, and using the data in a good manner for planning and management.

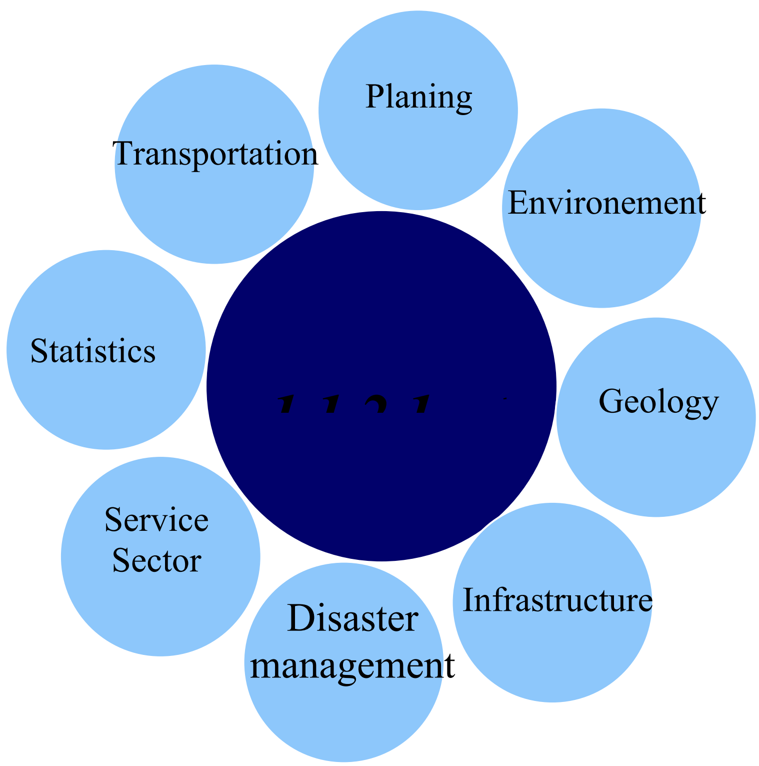

Figure 5.2.1. Some units using ISDEBİS

The concept, “standard” used in ISDEBİS has more than one meaning in GIS as following:

1. The standards regarding the spatial reference or the standards related to the modeling of the spatial. The concept, “spatial” contains urban and rural zones. This topic can be understood better when examined the data catalog.
2. Similarly, modeling of data with spatial & non-spatial reference related to the multi direction management of the earthquakes.
3. Principles related to the institutional modeling for maintenance of the system.

4. Examining of existing data for integrating into the system on the base of their location, unit, concept, format and up-to-data.
5. Software standards which will be used during and after the establishment of the system.
6. Hardware which will be used during and after the establishment of the system.
7. Data collection standards of meta data with different characteristics (geometric, attribute and meta) for different scales (eg. the geometric data are integrated into the system by digitising the analog maps the scale of the map is required).
8. Rules determining the integration of the data obtained from different sources.
9. Data exchange standards
10. Standards related to the Cartographic products (maps) which will be produced by geometric data infrastructure with medium and large scales.
11. Standards related to the data presentation (eg. cartographic or word documents)
12. Standards related to obtaining and marketing of the data
13. Meta data standards.

GIS components are as following, when conspired on the base of governorship and municipality:

- Staff (personnel)
- Hardware
- Software
- Data exchange standards
- Data collection and update standards
- Meta data standards
- General data standards (modeling of spatial in the sense of geometric, semantik and topologic).

The following standards and reports have been examined when preparing the above components of ISDEBIS:

- ISO: International Standard Organization
    - Technical Committee Reports
    - Committee Draft Report
    - Working Draft Report
    - Draft International Standard Report
    - Final International Standard Report
- USGS: United States Geological Survey
- FGDC: Federal Geodetic Data Committee
- ATKIS: National Topographic Cartographic Information System
- National Information System Report, Prime Ministry, 2000, Ankara.
- Istanbul Metropolitan Municipality – County Information System, Feasibility Study Final Report
- Istanbul, Bursa, Sakarya Information Systems Projects and many others.
- The studies for GIS standards have been carried out by international organisations for many years. The main studies are as following:
- ISO/TC 211 Geographic Information Systems /Geomatics standards (ISO → International Organization for Standardization)

- CEN/TC 287 Geographic Information System Standards (CEN → Comité Européen de Normalisation)
- CEN/TC 278 Highway transportation standards (CEN → Comité Européen de Normalisation)
- Other international studies, eg. OpenGIS(OGC→Open GIS Consortium)

CERN/TC 287 technical research group has stopped their GIS standardisation studies. The reason is that all the studies related to GIS standards have been carried out by international organisations for some years. ISO and OGC standards are used in Turkey. ISDEBIS also uses the related standards of ISO. For instance, ISO/TC 211 standards are used for expression of meta data related an object. TSE (Turkish Standardisation Institute) represents ISO in Turkey, which publicities all the standardisation studies related to spatial data.

Some important topics related to ISDEBIS are summarised below.

5.2.2 Data Exchange Standards

The data exchange format defined for GIS needs is a prior condition for information exchange. There is no any common national exchange format to exchange data between different countries. Each country, in general, has uses their own standards.

The exchange of spatial data between the partners requires a joint agreement and shared information channels. In this respect, the system should be clearly defined, modelled and systematic. Some of the Data Exchange Standards used by different countries are as following:

Table 5.2.1. Data Exchange Standards

USA	STDS (Spatial Data Transfer Standart)
UK	NTF(National Transfer Format)
GERMANY	EDBS(Einheitliche Datenbank- Schnittstelle)
CERCO(Comitée Européen des Responsables de la Cartographie	ISO 8211
NATO	ISO 8211 ve DIGEST (Digital Geographic Information Exchange Standard)
DEMETER	GDF-EF(Geographic Data File Exchange Format) ve NTF)
CANADA	SAIF(Spatial Archieve and Interchange Format)

As seen in this table, there are several exchange standards used for national basis. On the other hand, there are also several software developed to exchange data from one GIS system into another (eg CITRA software of the CISS company). These systems should be monitored continuously and updated by specialists.

In this concept, ISO 8211 data exchange standards which are used by ISO TC 211 will become important in the future. Furthermore, GML (Geographic Markup Language) aims at solving problems of data exchange between geographic information systems in especially internet environment. GML will be delivered as a third version on the base of XML (Extensible Markup Language) by OpenGIS Consortium.

The appropriateness of XML[36] based exchange possibilities developed by the Large Scale Map Production Draft of Turkey should be seriously examined when ISDEBIS is designed. It

[36] XML : Extensible Markup Language (standards designed by W3C group)

should be noted that XML is not a data exchange format, it is a language tool (interoperability) that can be used for exchange of web based data produced by different systems.

5.2.3 Data Model & Data Standards Problems

In Turkey, to data, there is no any foundation who satisfies the users in serving spatial topographic data, which can be used for modeling the spatial objects with a medium scale, in a digital form on the base of basis topographic information system. In this respect, only the General Command Of Mapping in Turkey has carried out systematic studies for many years. However, there are still problems. Each group or foundation or organisation works on their own and collects data as they need without any coordination between them. For instance, there are different county information systems or GIS based on disaster management systems established by different municipalities and governorships. They have no common standards. Each software company uses their own standards. Of course this is not their fault. So, there is a huge waste of source. On the other hand, the government should supply spatial data responding the needs which change by time related to transportation, law, economic, land planning and management.

Resolution Concept In Geographic Information Systems

The fundamental spatial components of a GIS to be formed for a special aim are the topographic objects. The basic geometry defining the spatial of topographic objects has planimetric characteristics. As the geodesy and photogrammetry engineers are familiar, the fundamental topographic objects have one of the three spatial references on the base of criteria to be used in modeling the spatial: Point, Draw and Area. The geometric data forming the spatial reference of GIS are the geometric model for the basic topograhic objects. The determination of structure of geometric model is the determination of system accuracy, resolution, geometric spatial references, hierarchic order between data and which quantitative and qualitative criteria will be used for the basic topographic objects which will take place in the system, or not. The definition of the basic topographic objects, which do not take place in the system with certain criteria (planimetric size in the first place) is a kind of object generalisation in a analog map production.

We should remember the intellectual processes during the data recording and calling stages. As these processes are involved in computers, the concept, "artifical intelligence" will become importance for GIS in the future. Without it, we may not control or manage the huge amount of GIS data, which are increasing day by day.

We, now, give an example on how the determination of system features is carried out in a data model concept. The word "mansion (Konak in Turkish)" animates a series of events in our memory. In a GIS establishment, there are certain restrictions with respect to the modeling of "spatial" and objects. All the rules regarding the modeling and processes are called "data model". A mansion has an area as planimetric. If the area is not greater or smaller than a certain value the object can then be called as "mansion". Otherwise, we would talk about an apartment or a building of a different class. This mansion has a spatial and a height. It has an address and a possessor. It has also water, electric, canal, etc connections. It is so easy to model all these data in GIS. Certain rules should be defined and the system should be controlled continuously. Otherwise, we may come across "a data mass" which can not controlled and managed for any purpose.

The spatial data model developed for ISDEBİS should have at least the following four characteristics:

- The model should reflect geometric, topologic and tematic features of the data.
- The model should be very simple, but it should be appropriate to express the object structures.
- Its features and options should be easily applicable, but should also be reliable.
- The system should be applicable for spatial efforts of other disciplines. The ISDEBİS will be economically an acceptable investment.

There are ofcourse some contradictions between the features of the model. However, it is always impossible to remove all the contradictions completely in practice because all the abjects cannot be modelled as required. The main principle is the expression of maximum number of comprehensive events with minimum number of functions (Lego method: Structure stones which can be combined to make a complete system and can be divided).

Maps and the related GISs are accepted as models of the related spatial in cartography. The models have important functions in problem definitions. The reasons of model definition in problem analysis and decision making stage are as follows:

- Instead of working with a real object, it is more productive to work with a model which includes data focusing on a problem solution.
- A real object is generally very complex to copy.
- Unnecessary complexity is not appropriate for solution of a problem.
- It is easy to operate the model
- The production cost is low.
- It is less sensitive against production errors
- It has productive contributions on education

The modeling of the spatial according to the topographic elements is performed from general to detail. There is a hierarchic order in this modeling. In this concept, different spatial modeling examples have been carried out for specific needs in the world.

As the aims become different, the modeling of the parts of spatial and their features changes. This situation is very similar to role of scale differences in an analog map design. The fundamental maps and the products obtained by cartographic generalisation make no difference.

There are similarities between the examples of spatial modeling developed for the same purposes. However, there are also differences between the models. There are two projects performed in Turkey regarding these studies: Large scale map production codes and Fundamental Spatial Object Catalog of the TABİS (Turkey Disaster Information System). The base scale for modeling spatial is 1:1000 for the Large scale maps. Whereas it is 1:5000 and 1:25000 for TABİS. The ISDEBIS has been developed for high resolution applications (1:1000). A data catalog of ISDEBIS has been prepared which is harmonised with TABİS Object Catalog. This catalog with 400 pages is attached to this document.

Today, the system must use the standards of the OpenGIS Consortium (OGC-Open GIS Consortium). In this way, it is easy to reach the system data online. The results obtained here by using the standards of International Standardisation Foundations (Technical Committee 211, ISO[37]/TC 211) should be very carefully used. To obtain analog products in standard different scales from ISDEBIS, cartographic generalised mechanisms tested their qualities by specialist cartographers are required. In this concept, the projects carried out in the concept of "model generalisation" in the world should be studied. As known, the model generalisation is an approach of producing a spatial information system with lower spatial resolution from a GIS with a high spatial resolution. For instance, we need to specify and identify very clearly which products with low resolutions can be obtained from an information system prepared for spatial fundamental topographic objects with resolutions of 1:1 000 and 1: 5 000 or 1: 10 000.

- Digital Spatial Model (SMM) and
- Digital Earthquake Model (SADM).

In both the digital models, spatial is obtained by dividing its elements one by one based on the object (features). The process here is the atomisation of the spatial based on database modeling.

[37] ISO: International Organization for Standardization

The atomised data related to both the digital models are prepared as data catalog. The name of this catalog is the ISDEBİS Data Catalog (ISDEBİS-VK).

ISDEBİS-VK has two fundamental components, SMM (Digital Spatial Model) and SMDM (Digital Spatial Earthquake Model)

A. .Fundamental Topographic Features (Entities♣) Catalog (ISDEBIS-TOK)

B. Catalog for Other Specialty Features Regarding Earthquake Master Plan (ISDEBİS-DUK)

ISDEBIS-TOK includes modelling of concrete objects which characterise the geometry of topography of the related region. Therefore, This part of ISDEBIS-VK is called “Fundamental Topographic Features”.

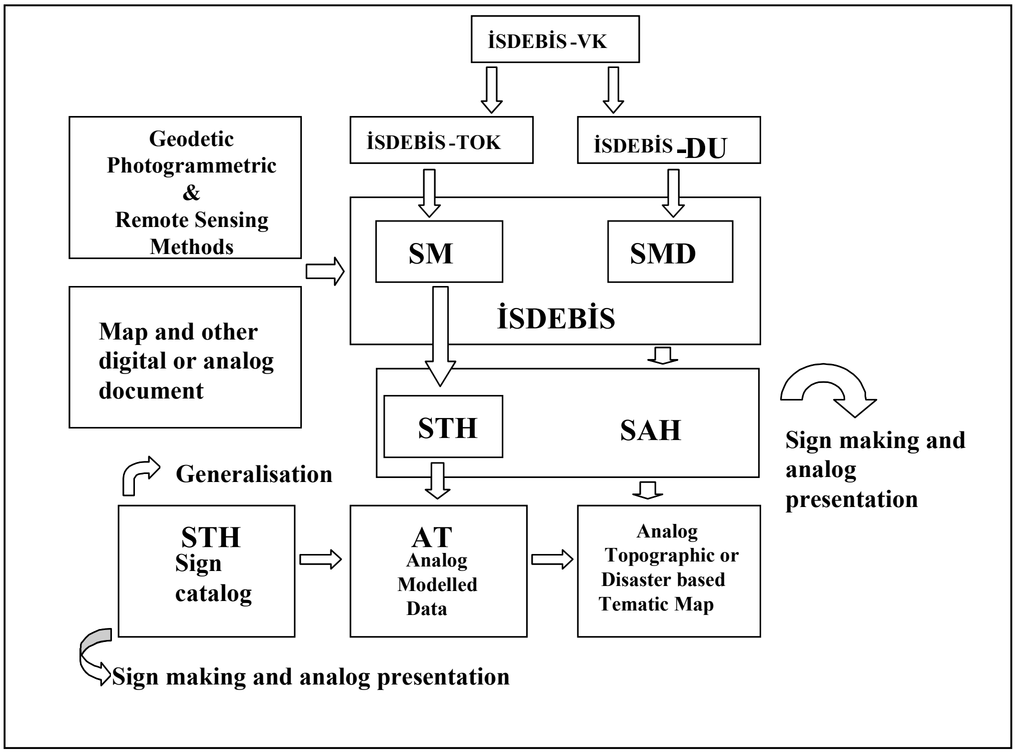

Figure 5.2.2: Modeling approach of spatial of ISDEBİS-TOK

ISDEBİS-TOK has a definite data standard feature for state and private sectors who would like establish spatial information systems for their needs in Turkey. The object models, object definitions, attribute definitions, data type of each attribute and attribute values stated so far show the concent of a topographic map. There is no doubt that the data catalog and the data model derived under ISDEBIS are very powerful.

So, a GIS established suitable to the ISDEBİS-TOK model will be formed in the city or in a region, and the other multi-purpose GIS can use this system immediately. The ISDEBİS-TOK will cover the gaps in spatial modeling in Turkey. On the other hand, these standards can solve the problems of the organisations and state departments who would like to establish their own information systems with different data collected with different standards. So, the homogeneous relation will be established between the systems (geometric, semantic, accuracy, up-to-data, consistency).

The mentioned feature of the ISDEBİS-TOK shows the spatial modeling approach of ISDEBİS-TOK of all the foundations. It is designed by taking into account of scales of 1:1 000

♣ The concepts of entity**, object** and **features** have the same meaning in ISDEBİS.

and1:25 000 of the ISDEBIS-VK modeling. Figure 5.2.2 shows the expression of the ISDEBİS Data Model with UML(Unified Modeling Language).

Consequently, the stated cartographic criterion should be taken into account in the evaluation of ISDEBIS-TOK. Therefore, the modeling of topography based on geometric objects should be evaluated by taking into account the object generalisation.

Examples From Isdebis Data Catalogs

The attached document shows the conceptual arrangement of the data needed by planners, specialists and managers in different stages of the Master Plan. The Master Plan needs reliable data to obtain the proposed benefit systematically. The reports I and II show how many classes these data have. Earthquake is a natural event. The entities affected by earthquakes have spatial references. Therefore, the required data regarding the entities in the earthquake master plan can have spatial references and can be designed, arranged and established as a GIS. ISDEBIS reflects all of the objectives stated above.

The information systems in banking, insurance and population or the information systems in GIS work with the atomised data. A hierarchic approach is used to model a spatial in ISDEBIS. In this approach, the features are divided into two fundamental concepts :

A. Fundamental Topographic Features (Entities)

B. Other Specialty Features Regarding Earthquake Master Plan

The spatial objects in the group A are again divided into 8 sub-groups. In the decomposition in this stage, the spatial objects have not taken into account to be managed in the relational database.

The codes of these groups have two elements. The first element is A which is a single digit code of the upper group. The second elements starts with A and ends with H.

Each of the 8 sub-groups is also divided into second sub-groups. The first two elements of the codes of the second degree sub-groups is similar to the two elements of the upper-group. The third element starts with 1 and increases depending on the number of groups anticipated to be in the group.

In a hierarchic order, I, II and III degree object groups have no concrete elements. These are only defined for design of conceptual data of ISDEBİS.

The object classes with concrete elements are located under III degree groups. The codes of the object classes have five characters except for the points. The first three characters come from the third degree group. The last two characters starts with 01 and increase depending on the number of the objects.

The bold italic terms in the feature class define the related class (attribute data with no plannimetric-geometric characters). The information given by coding in the form of an integer data structure under the attribute data are the values which the related attribute may have. For instance, a "Structure Order" attribute data of a concrete object belonging to "A.A.1.02 Hosuing Area" object class may have values of "101 Decomposed", "102 Block" or "103 Comprehensive".

All the concepts and sub classes under upper classes, which have been explained in A. Fundamental Topographic Features and B. Other Specialty Features Regarding Earthquake Master Plan, have been worked out very carefully by the scientists in different disciplines. Therefore, the ISDEBİS Data Catalog is the first standard production in Turkey. The project group has really carried out a great job by preparing this standard catalog. The information regarding the data collection suitable to the this data catalog and the information regarding the other standards used for the establishment of the ISDEBIS are explained in the related sections of this project.

Data Cardinal Degree For Attributes

The cardinal degree of an attribute shows the digital status of attribute values appointing into the object class. The presentation of “cardinal” located in this column is explained as follows:

- 1:1 The related attribute should be appointed to the related object and the appointment can be a single value. For instance, the “DRM Status” of A.1.14 Industrial Areas object class can be expressed as “Working” or “111 Out of service, closed”
- 1:? The related attribute should be appointed to the related object and the appointment can have either a single value or more. For instance, the “SRV Services” of “B.C.1.01 Hospital” object class can be expressed as “102 Child surgeon”, “105 Eye illness”, “103 General Surgeon”.
- 0:1 The related attribute may be appointed to the related object, or not. For instance, this kind of cardinal is valid for the “GEC Population in the building at night” attribute value of “A.A.4.01 Building” object class.
- 0:? The related attribute may not be appointed to the related object or appointed with more than one value. For instance, this kind of cardinal is valid for the “DPG Earthquake resistance” attribute value of “B.C.1.01 Hospital” object class.

Object Groups In Isdebis

As explained above, the fundamental object areas are divided into object groups. The object groups and codes for each fundamental object area are explained as follows.

The object classes located under the object groups, attribute data related to the object classes and other details are presented in the ISDEBİS Data Catalog attached to this document.

A. Fundamental Topographic Features (Entities)

A.A.Settlement Area

A.B.Administrative Regions

A.C.Transportation Structures and Infrastructure

A.D. River and Lake

A.E. Plant Cover

A.F.Geodetic Reference Points

A.G.Topography

A.H.Cadastral Status

B. Other Specialty Features Regarding Earthquake Master Plan

B.A.Geology

B.B.Risky Regions

B.C.Emergency Personnel

B.D.Historical and Cultural Areas

B.G.Plans

B.H.Public Foundations

B.K.Dangerous Material Establishments

C. .Other

C.A.Other

Here, object classes which have no spatial references are modelled. In the ISDEBİS concept, there is only C.A.1.01 Address object class at this stage. The ISDEBİS Object Catalog has been submitted to the related administrative unit with PDF format.

Apart from the the data catalog developed for ISDEBİS, the fundamental studies which are required for strategic planning have also been presented. These are the basic outlines:

- Strategic planning
- Status analysis and definition of the requests
- Model definition for application
- Determination of Hardware and software features and system selection
- Analysis of methods for transferring data and data sources into system

6 EDUCATIONAL AND SOCIAL ISSUES

6.1 Educational and Social Studies For Mitigation Against Earthquakes

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6.1.1 Evaluation of the Current Situation

The Current Situation

The area of interest of the education group is the state of preparedness of the Istanbul public and what has been done and can be done about this state. The current situation can be summarized as a pervasive state of unpreparedness. However this does not mean that nothing has been done. Below the educational efforts that have been or are currently being undertaken are summarized, and further a report is made on a study demonstrating the public's views on preparedness.

Educational Activities.

Work done by Bogazici University (B.U) Kandilli Observatory and Earthquake Research Institute.

Prof. Ahmet Mete Işıkara ran the first projects on "Ddeveloping local capacity for disaster prevention and preparation". In this connection the "Basic disaster awareness education" has been given in Istanbul and a number of other cities. Similarly M. Petal has also conducted a series of projects, involving training trainers to disseminate information. A master's thesis conducted in the B.U. Psychology department has evaluated these projects and positive results were found (Aydoğdu, 2002).

Work done by Istanbul Technical University.

These activities aim to disseminate information about disaster preparedness by training trainers. The ITU group will give a detailed presentation.

Work done by Middle East Technical University.

These activities, which aim to increase disaster preparedness, do not include the city of Istanbul. These activities are explained by the METU group.

Work done by the Municipality:

Work within the borders of the city of Istanbul, is being done by the Municipality of Istanbul and other local municipalities.

Work done by Non Governmental Organizations:

Within the borders of Istanbul, various non-governmental organizations and neighborhood organizations have carried out education and preparation activities in limited ways. Information and evaluation related to these organizations are going to be given later.

Research Activities

Psychosocial research related to earthquakes in Turkey can be roughly categorized into two groups. The first group includes research exploring post-earthquake psychological reactions and none of them is about Istanbul (e.g. Karancı and Akşit, 1998; Başoğlu et al., 2002). The second group consists of sociological research, which explores post-earthquake community reactions and other phenomena at a macro-sociological level (e.g.. Kasapoğlu and Ecevit, 2001).

The only study, which elaborates the post/pre-earthquake reactions and other phenomena in Istanbul, from psychological, local administration, emergencey management engineering, and other perspectives, is the research carried out by the Center for Disaster Management (CENDIM) of Boğaziçi University. None of the other studies stated above are specifically Istanbul based and again none of them elaborates the pre-disaster expectations, reactions and attitudes of the public. Therefore, although they present useful information, they lack the necessary data to inform the preparations to be completed in the future.

The Research on the Expectations of the Public About Earthquakes

As far as we know the only study observing the cognitions, emotions and mitigation behaviors of the people of Istanbul concerning the coming earthquake, is summarized below. The aim of the Psychosocial Module of the project named "Integrated Decision Support System for Disaster Management in Turkey" completed by B.U. CENDIM was to observe the reactions, level of knowledge, expectations, mitigation activities related to earthquakes and felt readiness of a sample drawn from different parts of of Istanbul.

A sample of 254 participants, were selected from five different districts of Istanbul, varying in socio-economic status, soil conditions and construction qualities. Avcılar (n=54), Fatih (n=50) and Erenköy (n= 50) have poor soil conditions while Beşiktaş (n=50) and Beykoz (n=50) have relatively better soil conditions. In terms of quality of constructions, Avcılar is the district with highest risk. For the socio-economic status, Erenköy and Beşiktaş are seen as more advantaged regions. A structured interview survey consisting of 124 items, and prepared for this project was used in the study. The reports coming out of this study are presented in the references (Fişek et al., 2001a-b; 2002 a-b; 2003; Özkarar et al., 2002; Yeniçeri et al., 2002). The final report of the research is being translated into Turkish. The results of the research are briefly summarized below:

1. The participants of all the five regions have realistic perceptions about the soil conditions of their districts and about the quality of their constructions (e.g. Beykoz percieved to be secure, Avcılar not)
2. The perceived risk of a probable future earthquake is high and not influenced by demographic factors like income, education or district.
3. Compared to level of education, the level of income has a higher impact on mitigation. The strongest predictor of preparation-mitigation and felt readiness against earthquakes is the level of income.
4. The level of post-traumatic stress experienced after the 17th August earthquake does not increase the perceived risk of future earthquakes.
5. Women experience higher levels of post-traumatic stress, and therefore report feeling less ready against the coming earthquake.
6. However, neither perceived risk, nor actual level of risk lead to mitigation behaviors.
7. Similarly, positive attitudes towards mitigation do not necessarily lead to either mitigation behaviors or felt readiness.

Interestingly the results of the present study are parallel to the results of other studies completed in Turkey or abroad (e.g.. Hurnen and McClure, 1997). This situation is called "rational preparation, irrational reaction" by some researchers (Farley, 1998). That is; stated attitudes and intentions are not consistent with behaviors. Nevertheless, the first condition for earthquake mitigation is the actualization of intentions. Therefore, an education campaign must aim to find ways of filling the gap between intention and action.

Conclusion

The educational efforts underway so far are valuable and have reached a large number of people. However, their effectiveness in leading to concrete mitigation behaviors has not been evaluated. The only evaluation study we know of has been mentioned before. Although the outcomes are positive for the trained trainers, what the public educated by those trainers had done is not evaluated in that study.

The educational work done so far focus solely on "what and how to do". Information on earthquakes is presented, non-structural mitigation is demonstrated, what to do during a earthquake is shown and a trial is made. This focus is certainly important. However, clearly another focus is required; which is to find the mechanisms to get the public to take action.

Given these conclusions, an education campaign must take the following issues into consideration. Despite perceiving high risk and avowing positive attitudes towards mitigation, people do not act unless they see the feasibility of the proposed mitigation activities. Thus, an active education campaign must show the importance and utility of prevention not only with words, but also with demonstrated gains. Further, attitudes hindering action must be addressed, and encouragement rather than scare tactics must be emphasized.

As a result, two facts must be emphasized in an active education campaign: Teaching what to do before and during the earthquake, and facilitating the development of psychological mechanisms that will lead to preventive behavior. The principles underlying an active education campaign are stated below.

6.1.2 Basic Principles and Requirements.

Principles Underlying Disaster Readiness Education for the Public.

Below is a list of principles that we think are essential for a comprehensive approach to public education, with a specific focus on earthquake readiness (Fişek et al, 2003). It is especially important to be cognizant of these principles when the goal is to promote public ownership of disaster readiness.

1. **Trustworthiness and Reliability.** The relevant literature is clear that trust in authorities is a must for the public to engage in mitigation or preparedness (e.g. Weinstein, 1989). Even experts cannot convince people to engage in expensive efforts if they are not trusted (Sjöberg, 2000). Trust also involves trust that the authorities will do their share, thus it is a matter of "a public trust". The scientific controversies as well as the administrative statements made to the media after the 1999 earthquakes have left a residue of distrust in the minds of the public (Fişek et al, 2003). Therefore any declarations made have to be very carefully considered regarding trustworthiness (Kunreuther, Slovic and McGrawer, 2002; Rohrmann, 2000; Slovic, 2002). Information has to be scientifically sound, the limits of knowledge have to be acknowledged, and statements have to be concrete, to the point and understandable by the public.
2. **Addressing cognition, emotion, attitude and expectation as a unity.** It is clear that disasters such as earthquakes are not experienced only as cognitive phenomena by people (Hurnen and McClure, 1997; Johnson, 2002). The most frequent reaction to earthquakes is cited as "fear and panic" (Fişek et al, 2003; Karancı and Rüstemli, 1995). Non-logical reactions such as denial (Hurnen and McClure, 1997) are especially evident when the ability to control events is weakened (Fetherstonhaugh, 1997 cited in Slovic, 2002; Weber, 1997 cited in Slovic, 2002). Similarly avowals of positive attitudes towards preparedness do not necessarily translate to actual behaviors (Farley, 1998; Fişek et al, 2002; Weinstein, 1989).
3. **Transforming the meaning of an earthquake from a disaster to be awaited in helpless fear to a natural event that can be coped with.** As long as earthquakes are seen as unavoidable disasters, a "learned helplessness" syndrome is created which may lead the public into apathy, while a coping expectation is more likely to lead to preventive action (Fişek et al, 2003). Earthquakes cannot be prevented but damage can (Hurnen and McClure, 1997). A coping stance can be fostered by appropriate information on what can lead to damage and how it can be prevented. The emphasis should be on how to withstand damage rather than what leads to damage. Such information can be buttressed by "success stories" (Scawthorn, 2002) of buildings that do survive.
4. **Creating a self-efficacy/can do approach.** In line with the above principle, educational efforts should be geared toward creating a self-efficacy expectation in addition to information dissemination. The factors involved in the decision to take preventive action are as follows: the level of danger, the risk of damage, possible preventive actions, the knowledge needed, the resources needed, and finally personal factors (Rohrmann, 2000). The important personal factor here is a belief in one's ability to cope, an internal locus of control, which increases the probability of preventive action (Rohrmann, 2000). An important consequence of internal

control is a sense of responsibility for what happens to one. Both these factors are necessary for preparation and mitigation, which can be further strengthened by a belief in the usefulness and cost effectiveness of such action (Weinstein, 2000).

5. **Helping people see disaster readiness as a human right.** Disaster readiness is seen primarily as a security issue, with an emphasis on reducing hazards. However disaster readiness should now be a human right (Weinstein, 1989). Expectations of "a paternalistic administration protecting the public" should change to "a service oriented administration respecting the rights of the public". This right is firstly a right to know (Rohrmann, 2000). Correct, realistic information presented with a respectful consideration of the public's characteristics has a better chance of being effective. The development of an awareness of rights as a citizen can lead to an awareness of responsibilities, which is precisely what is needed to take action. This combination of rights and responsibilities paves the way to the next principle.
6. **Creating an ethic of mutuality between the public and the administration.** Disaster readiness has to be a total process involving individuals, families, neighborhoods and cities. Thus the public, the administration, volunteer organizations, and experts have to be open to an ongoing cooperation. Expecting each side to do their share without coordination will not lead to total success; reciprocal information sharing and cooperation are musts. The first step has to come from the administration, in telling the public what is being done and planned, what kind of public cooperation is needed, etc. Such an open attitude will lead to more trust and willingness to join in the efforts (Ermolieva et al, 2002).
7. **Respect for the Values and Judgments of the Public.** Research shows that the public makes relatively realistic evaluations of earthquake risks, preventive actions and their own situation (Fişek et al, 2002; Karancı and Rüstemli, 1995). Yet it is clear that taking action is not easy, a number of hindrances get in the way. Therefore it is important to address the doubts, hesitations and questions, and present information and support that will facilitate action. An approach that shows respect to the public's position and cultural characteristics will help develop "internalization" of the need to engage in preventive action (Akşit and Karanci, 1999; Hurnen and McClure, 1997; Pennings et al, 2002; Sjöberg, 2000).

   It is important to consider areas where cultural characteristics come to the fore in preparing educational programs. One very important characteristic is reciprocity between the nuclear and extended family in this culture. Protection of the extended family from hazard comes before protection of the neighbors or other groups (Fişek et al, 2003). This value should be respected and utilized functionally. The attitudes prevailing in the social environment are also important and should be mobilized as a social support/cooperation/incentive mechanism (Fişek et al, 2003; Hurnen and McClure, 1997; Sakallı, 2000). Fatalism, another characteristic, prevents action when coping seems difficult, and needs to be addressed with understanding and evidence of the possibility of successful coping.
8. **Evaluating the Program and its Effectiveness.** Disaster readiness education should not be a one-time phenomenon. In order for preventive action to be developed, internalized, and sustained, education and a self-efficacy awareness have to be continuously fostered. Any continuous endeavor should be assessed as to its effectiveness, and modified according to need, so that it becomes an ongoing and self-renewing program. An essential requisite of such a program is evaluation (Rohrmann, 2000). To do this an evaluation method has to be developed, including means of assessment, criteria of success, target audience etc.

Steps Needed to Implement the Basic Principles and Requirements

The implementation of the above principles rests on some requirements to be kept in mind in the preparation of programs. As long as these requirements are followed, the program's connection to the principles and fit with the primary goals can be evaluated at each step. These requirements are listed below:

1. The content of the education program has to be decided on, such as what topics will be stressed and what actions will be asked of the public. Details need to be worked out in addition to the main thrust.

   With these details in mind, priorities have to be set. We can envision the responsibilities of the administration and expectations of the public as a set of concentric circles as follows:
   ...Personal preparedness (e.g. learning what to do before and during an earthquake)
   ...family planning (e.g. creating a family disaster plan)
   ...preparation indoors (e.g. nonstructural mitigation)
   ...preparation outdoors (e.g. structural evaluation)
   ...community preparation (e.g. taking responsibility for the neighborhood)
   ...ownership of the city (e.g. monitoring public efforts in cooperation with the local administration).
   For example, if the priorities point to structural mitigation, the steps will be different from priorities about family planning.
2. Resources have to be identified. Once educational priorities are set, the resources needed should be decided on. These can be financial, material, information, experts, and other personnel. What resources are currently available, what will be developed, and what new resources need to be sought should be ascertained. This requirement is naturally very important and demands inter institutional cooperation.
3. The target population needs to be decided on. Istanbul is a complex mega city, and the educational program and the method of dissemination has to be appropriate to the target group. For example, identifying and training key individuals in each neighborhood and training the widest spectrum of individuals require very different methods.
4. Finally the appropriate channel of information dissemination has to be decided on. What kind of education with what kind of methods through what kind of channel has to be decided. The criterion of "most appropriateness" must be the fit with the principles outlined earlier. Beyond that, choice of content, the state of the resources, the characteristics of the target population, time constraints, administrative and political preferences will also play a role in the communication channel chosen.

Once some decisions are made based on the above requirements, program development or choosing an extant program can proceed. The requirements regarding the two main educational models present are given below.

The Requirements for Applied Public Education.

The steps required to actualize the principles stated before play an important role in the preparation of face-to-face applied public education. These steps are listed below:

1. **In this step public preparedness is seen as a series of widening circles**. Applied education handles the first four circles, starting with the innermost, individual and family preparations. The fifth and sixth circles arise as a result of public education and involve organization at the neighborhood or other levels. Applied education should follow these principles: a. Giving concrete and reliable information; b. explaining what needs to be done before and during an earthquake, along with the rationale; c. Reinforcing this information with exercises.

   A variety of applied education programs have been and are being used in the country, done by universities, state institutions, local authorities, and NGO's. The administration should check these programs and choose one or a few more or less standard applications. Different programs are not inherently problematic; they can complement each other and reach different sectors. However the content taught has to be scientifically sound and the same. For example, the same message should be given on what to do at the time of an earthquake. A team of experts should evaluate the different programs.

2. **The identification of financial resources for education has to be done in coordination with the groups already providing education**. Cooperation with the Military, National Guard Directorate (Sivil Savunma) , Ministry of Education etc. can be sought. Similarly educational materials also need to be dealt with in a cooperative manner. Another important resource is the trainers and those who will train them. Cooperation with groups such as KOERI can be sought.
3. **Target populations should also be thought of as different circles.** The widest circle comprises the people. Considering the children, adults, men, women, families in this circle, it has to be decided how and where which group can be best dealt with. For example, the best way to reach children is through schools, but a public education center is best for women. Cooperation with different institutions will be a requirement. A narrower circle comprises the trainers. These can be people accountable to the public, such as teachers, firemen, nurses etc. However it is crucial that they be volunteers and that they are provided financial incentives. It has been found that success is difficult without these requirements (Aydoğdu, 2002). They have to be trained in educational technology in addition to content. A trainer who cannot communicate what he/she knows is not useful.

   Another circle involves opinion makers, primarily written and visual media representatives. Preparedness education as well as disaster communication training should be given to media representatives in cooperation with their organizations. The last circle involves community organization, which goes beyond education into disaster management. Cooperation with volunteer communities can be a start. Contact with NGO's currently active in such efforts is very useful. Neighborhood earthquake plans can be made similar to family earthquake plans. Search and rescue, first aid training, etc. can be considered in this context.

All the above activities involve face-to-face applications. However the materials prepared (such as booklets, brochures, videos, etc) can be distributed during earthquake awareness weeks. It is important to make multiple uses of all materials prepared.

The Requirements for a Visual Media Campaign for Widespread Public Education

<u>Rationale.</u>

Neither psychological nor behavioral preparation is something that can be done on an individual basis by the majority. Guidance, information, equipping, in short, education is necessary. It is true that the best owned and lasting education is face-to-face education. However such education demands volunteer attendance. Involuntary learning will not lead to lasting benefit.

This leads to an important question: how to motivate large groups, get them to seek volunteer training? The most likely answer is to institute a widespread public education campaign. It is known that danger and risk are not accepted solely on the basis of being informed (Rohrmann, 2000). What is needed is to develop a social dialogue and an ethic of cooperation. This demands reaching large groups of people

1. It would be very useful to start such a campaign along with face-to-face education, covering much the same topics. Such a wide spectrum of topics can best be handled by the visual media (Boehm, 1997). A visual media campaign can reach a wide array of people. There have been earthquake programs earlier on the media, but the way images have been presented have only served to scare people, the disagreements among experts have created mistrust, the suggestions were ignored. In short the public has attained a "psychophysical desensitisation" (Fetherstonhaugh, 1997, cited in Slovic, 2002). However it is still true that everywhere in the world the public is best informed about earthquakes through the visual media. (Fişek et al, 2002, Boehm, 1997). Then the goal should be to use this important communication channel in the most effective manner. The best route to effective use is to abide by the principles presented earlier. Beginning with reliability, addressing the whole psychology of the individual, creating an awareness of capability etc. types of principles can aid a campaign in creating a "can do and should do" psychology. The aim is not to scare but to provide the

information that will lead to a sense of ability. As was stated before, research shows that "information dissemination alone" does not lead to the desired behavioral change. Educational approaches that address cognition, emotion, attitude and expectation as a unity and emphasize capability are more successful. Up till now earthquakes have been presented as disasters to be avoided. What needs to be stressed in this campaign is that earthquakes are natural events that can be coped with. Among the topics dealt with are what Istanbul is actually facing, what the officials are doing, what individuals need to do, along with the reasons and the relevant resources.

Basic principles of education and the requirements of a visual media campaign.

The planning for all educational programs has to be based on sound theoretical principles. Therefore cooperation between the authorities and social scientists is important (Rohrmann, 1999). The principles cited earlier provide such a foundation. The requirements below show that these principles are musts based on sound scientific information.

1. The topics to be covered need to be decided. While deciding what topics to address for the public, the authorities have to consider their own priorities too. For example do they want to focus on individual or group preparedness or risk mitigation? The widespread campaign visualized here aims at as wide a spectrum of topics as possible. The topics listed below rely on the principles of informing, inspiring trust, creating a capability awareness etc. and create a whole including the contributions of the public, government authorities and experts. The goal is more effective action. Such a campaign would have the following headings:]

   ...What our city is facing.
   ...What our city is doing.
   ...What the community/public can do:
   ...How to go about it.
   ...Success stories.
   ...Incentives.
   ...Monitoring/control.
   ...Why do it?

   The topics above and other topics will be detailed later.

2. Listing the resources needed and available for use in such a campaign, financial, material, personnel or otherwise. Some resources may be already available, some may need to be developed, and some may require a search. Clearly the issue of resources is very important and requires coordination between relevant institutions.
3. Identifying the target audience. Mega cities like Istanbul harbor complex and highly varied constituencies. Thus it is necessary to evaluate who will comprise the target audience for which kind of educational program, and choose a method accordingly. For example, locating key persons in each neighborhood and training them for leadership requires a very different approach from reaching a wide and varied audience.

4. Identifying the possible channels of communication, which could be multiple. It has to be decided which kind of education can best be provided by which method and which channel of communication. The measure of appropriateness of a particular channel has to be based on the principles outlined earlier; the most appropriate channel for a particular target group will be the one that meets those criteria. Beyond that, availability of resources, time constraints, audience characteristics, and political priorities will also play a role in the choice of channel.

Conclusion

Each module in such a program should be planned as part of a comprehensive effort, and needed personnel and equipment should be evaluated. Detailed explication of the proposal follows. Is obvious that such a program requires a variety of expert contributions. Suggestions will be made for the principles of institutional cooperation. Further an organization model appropriate for preparation by the public hand in hand with the administration within an ethic of mutual support should be instituted. Research shows that cooperation between the public and the administration is a must for such efforts to succeed.

In short applied public education and widespread public education and consciousness raising should be thought of as parts completing each other and should be implemented as such.

6.1.3 Program Outlines

Detailed Outlınes for the Proposed Programs

In this section we will present detailed, concrete educational models, and outline proposals, based on thoughts developed earlier, in the following order:

1. applied public education program
2. training of trainers program
3. widespread public education program via visual media
4. education program for media representatives
5. model outline for community/locality based organization for preparedness
6. information on existing organized NGO/community organizations
7. suggestions for publications on earthquake related educational material for the public.

Program Outline for Applied Public Education Training on Preparedness

Public Education on earthquake preparedness allows the public's acceptance of as well as participation in large-scale projects to create an earthquake-resistant city and its inhabitants. It is of utmost importance for the public to recognize the steps they have to take in preparedness and mitigation in order for the macro-level planning to succeed. Awareness of how their efforts will dovetail with those of such large-scale plans is essential.

One of the common aims of Public Education Trainings is to increase the knowledge base and awareness levels in terms of damage risk reduction and mitigation tasks pertaining to preparedness for the next earthquake. Another aim is to help change the public's attitudes and behaviors related to earthquakes to more constructive ones.

Any public education training program has to be prepared taking into consideration the local culture and structures in order to convey the appropriate message in the appropriate medium. Public education that is tailored to the characteristics of the local community is more likely to succeed in getting the participants to accept the training's goals and aim for fulfilling its targets.

The draft for public education on earthquake preparedness presented below is the final outcome of analyzing the existing local (METU- Karancı, Akşit, Anafarta and Özdemir, 2001; BU KOERI IAHEP) and international training programs and focusing on the commonalities as well as the topics that need to be addressed in such a training program. The suggested public education training is a draft, thus further detailed version will be available upon realization of the project.

<u>Topics that will be covered in the Public Education Trainings</u>

Note: Time will be allocated for the participants' questions at the end of each topic presentation.

Section 1: What is an earthquake and what is the probable earthquake scenario for Istanbul?

- What is an earthquake?
- What kinds of damage and loss are likely to occur in earthquakes? The answers to these 2 questions are delivered briefly by the trainer after the goals of the training is introducted to the participants.
- What is in store for Istanbul and what needs to be done? (Specific information about the topics that will be discussed in this section is available in Section 1 of this report). The trainer will relay information about risks of earthquakes and factors increasing damage and loss in a language that will be accessible for the general public using earthquake-resistant buildings from the 1999 Marmara earthquake as examples. The necessary integrative function of risk

reduction and perparedness programs from macro level (municipality, disaster management units, etc.) to micro level (individual household) is stressed.

- What do the participants want to gain from this training?

  Discussion among the participants is facilitated by the trainer.

Section 2: Steps that need to be taken before the earthquake (from macro to micro level)

- Introduction of the elements that highten hazard risks (structural and non-structural, fire, first aid capacity, damage to transportation, electric, water and natural gas lines)

Each item will be introduced one at a time by the trainer. Use of examples of buildings or energy lines that withstood the previous major earthquakes is important. Also, the trainer will discuss the properties of such earthquake resistant buildings to clarify the presentation. The trainer answers participants' questions.

Non-structural elements:

- Demonstrating how to locate hazard inducing items during and after an earthquake inside buildings and showing how necessary precautions can be taken
- Preparing a Family Emergency Plan (regarding meeting place, out of area contact person, family earthquake drills)
- Preparing Emergency kits and list of necessary items (fire extinguisher, etc.)
- Shutting off the utilities (gas, electricity, water)

This section is enriched by using visual materials or live examples. The trainer answers participants' questions.

Fire-fighting:

- Learning how to use fire extinguishers (every participant will learn how to use one appropriately by practicing on a fire extinguisher)
- Detailed explanation of how to respond in small and big fires
- Description of how to recognize fires or potentials for fires and clear description of what should not be done in such situations

This section will be demostrated by the trainer and supplemented with visual materials.

First Aid Capacity:

- Most basic first-aid information will be given - the aim is to get the participants to acknowledge that they will need to take care of the people around them and themselves during the first 72 hours after the earthquake and encourage them to take first-aid training.

This section can be short, the aim is more on building awareness of the importance of first-aid training.

Structural Elements: what comprises earthquake-resistant buildings?
What does the structural assessment of buildings entail and who is eligible to conduct such an assessment?
What are the steps of strenthening the buildings against the earthquake (retrofitting)?
Who can carry out these steps? (Specific information about the topics that will be discussed in this section is available in Sections 4 and 5 of this report)
When is retrofitting meaningful and when is it not enough to reduce risk of significant damage or loss?
How involved will the municipalities/state institutions be in these tasks and what kind of a partnership will they form with the public? (Specific information about the topics that will be discussed in this section is available in Section 6 of this report)
What kinds of financial opportunities exist for retrofitting? (Specific information about the topics that will be discussed in this section is available in Section 7 of this report)
What can you do?

It is important to explain these topics in a clear and simple fashion using relevant visual materials. Questions will be answered by the trainer.

Section 3: What to do during the earthquake?

- What to do and what not to do when inside a building (e.g. home, workplace, supermarket, shopping mall, etc.)
- What to do and what not to do when outside a building or on the road
- What to do and what not to do when driving your car
- What to do and what not to do when trying to help people in need such as children, elderly or handicapped
- How to cope with psychological and behavioral factors such as fear and anxiety

This section will be explained by the trainer and is planned so that the participants get to practice what they learn. Questions will be answered by the trainer.

Section 4: What to do after the earthquake?

- Information regarding evacuating the building – dangerous behaviors
- What to do during the aftershocks
- Information regarding communication and transportation options
- Psychological and behavioral elements – coping with shock, fear, and grief
- How you can help your family and children cope with their reactions
- How you can conduct light search and rescue and first aid – what to pay attention to, where to get more training

The trainer will introduce these topics with the aid of visual materials where appropriate and will implement a practice session with some of the skills training sections. Questions will be answered by the trainer.

Section 5: General post-training evaluation:

The evaluation session will start by having the participants discuss the following questions: addressing what the participants learned from the training, what kinds of support they need to implement what they have learned, what hinderance they can run into and how they can deal with such situations.

It is also imperative that the participants discuss how they can influence others around them and what they can do to start implementing preparedness steps in their neighborhood. Their thoughts about how to organize a Neighborhood Disaster Committee and team building around disaster planning in their neighboorhood are asked. Discussion of the participants' suggestions is facilitated by the trainer. If necessary, the trainer introduces some pertinent suggestions to the discussion.

The participants also discuss how much of their expectations regarding the training is delivered. Feedback about the training is solicited.

The trainer reviews the disaster preparedness model that outlines the partnership between macro and micro projects presented earlier in the training.

The participants are left with the following suggestions at the end of the evaluation session: setting goals for taking the necessary preparedness steps and that the training team is available to offer support and help when necessary. They are also informed that they will be contacted in the future to get a sense of the impact of the training on them.

Lastly, the participants are asked to fill out an evaluation of the training.

The materials and topics presented in this training will be supplemented with a take-home booklet that discusses each of the topics in a clear and easy to follow format.

The training can be delivered based on the needs of the participants, either as a one-day training or 3 2-hour sessions spread over a few days or weeks. If the training will be divided into separate modules, then the first module would include section 1 and the first part of section 2, the second module would include the rest of section 2 and section 3, and the third module would include sections 4 and 5.

The information about training for the trainers will be introduced in the next section of this report. Pedagogic and methodological issues will be discussed in that section.

Program Outline for Traınıng of Traıners

As a first step of education, it is planned for experts in public education to train a small group of people, who will then become supervisors in later work. In the second step, the supervisors are supposed to train the trainers, and also hold monitoring and feedback meetings once the large-scale education programs ensue. Thus the training of trainers is a multiphase program, which goes from the most expert group to others in ever widening circles.

i. Who can be a supervisor?

This is the group who will train a large number of people and thus constitute the second circle after the initial key experts. Possible groups who can supply potential supervisors are as follows:

- Those who have been trained by the Kandilli Observatory Earthquake Research Institute,
- The Istanbul Technical University-FEMA group
- Members of the Turkish Psychological Association
- Red Crescent personnel
- Relevant personnel from the armed forces
- Relevant personnel from the municipality

ii. Who can be a trainer?

The trainers comprise the last circle of those who are to train the public. Voluntary participation and the availability of incentives for participating are seen as requirements for reaching the success aimed at. Volunteers can be recruited from groups such as the following:

1. NGO's and self referred individuals (teachers preferred)
2. Civil defense personnel (sivil savunma)
3. Volunteers from hospital personnel

iii. Structuring the Program.

Small group meetings (20-25 participants)
Duration: A total of 16 hours.

iv. Content of the Program

The content consists of the applied public education program and educational technologies to be taught, that are added on.

Module One: (in group discussion format)

the importance of public education and participation reinforcing approaches that can reduce resistance in participants

Module Two: theoretical information and demonstrations, and "how these topics should be taught":

What is an earthquake? What is a natural disaster?
What is the reality of a future Istanbul earthquake?
What should be done before an earthquake?

Nonstructural mitigation (demonstrated)
First response (demonstrated)
Coping with fires (demonstrated)
Structural mitigation

What should be done during an earthquake?

In a building (duck, cover and hold etc.)
Outside a building
In a car
What to do for those who need help (e.g. elderly, handicapped, children)
Handling of psychological and behavioral manifestations

What should be done after an earthquake?

Module Three: (in group discussion format)

Heightening motivation for the trainers

Questions and discussion on educational technology and pedagogy

Motivation reducing possibilities

Discussion of ways to cope with difficulties (e.g. support groups among trainers, regular meetings with supervisors)

v. Closing:

Certificates

Filling out the training evaluation forms

Distributing the educational paraphernalia kit

Distributing the evaluation forms for the training that they will be giving

vi. Follow up Meeting:

Meeting with the supervisors after the first training event, to be repeated from time to time

Program Outline for a Visual Media Campaign on Public Education to Reduce Earthquake Risk

i. Aim.

To help the public acquire an informed ownership of the earthquake risk reduction process, to educate about risk reduction, to facilitate organization at the community level. To provide information, warning, guidance and incentives in order for the public to mobilize for these aims, in an accessible format and venue.

ii. Method.

A TV documentary series is suggested which consists of about a dozen weekly modules presentable in sequence or independently, oriented toward the above aims. The number of weeks depends on the degree of detail desired in the final product. Each module should not be more than 45 minutes to accommodate attention span. These issues will be clarified in the details of each module below.

The modules will be geared to the following goals:

...to arouse curiosity, elicit questions
...to provide understandable answers to possible questions
...to make use of experts who can strengthen the preparedness messages
...to clearly explain what needs to be done and how
...to provide information, incentives, and reinforcements for maximum ownership of the suggestions by the public

iii. Content.

The modules explain the risk of earthquakes and what needs to be done to reduce this risk in a sequential logic. The basic topics are these:

1. The Istanbul earthquake awaited by the public: expectations, attitudes, behaviors
2. Explanation of the realistic situation and expectations
3. What can be done: presentation of detailed concrete suggestions
4. Presentation of incentives and reinforcements.
5. The reinforcement of the necessity and feasibility of preparation.

In all these steps an effort will be made to address and reduce to a minimum the public's negative attitudes and reservations, thereby developing a kind of psychological inoculation on the topic of earthquakes. The sequence below presents the topics and presentation suggestions for each module.

iv. Module Implementers.

The preparation and presentation of the modules will make use of expert contributions in addition to the detailed contents of the previously described education program packets. Consistency of content and approach in all public education formats is a must for success. Once the program is decided on, the relevant experts can be consulted, the presentation techniques can be set, and the content can be prepared. In order to provide an overall consistency, it would be helpful to have a general coordinating team.

v. Modules.

Module I: The public's view of the earthquake and announcing the series.

Below is an outline of a scenario suggestion for an initial module. The aim in offering a scenario is to provide a feeling for the overall format and atmosphere of the program. The public's view is represented by actual participant comments taken from a qualitative study conducted on behalf of the Center for Disaster Management of Boğaziçi University (CENDIM). These comments can be presented as an interview or as individual statements by different individuals.

Questions and sample responses:

Q. 1. What comes to your mind when a possible future earthquake in Istanbul is mentioned?

"Once again helplessness, once again fear. There is nothing to be done. Fasten this and that, we'll run out if God wills it, if not we'll stay inside. Hope God will not show us this, if He does, that it will be without damage. İ mean so that our pain and loss will be less."

"I think of Istanbul... they say there will be no Istanbul left. İ feel that way inside too."

"There is nothing to do except to accept one's fate."

Q. 2. Are you doing anything to prepare for a possible earthquake?

"We haven't done anything. We had, we had prepared our earthquake bags, then we got too upset and then we stopped."

"For a while, we had prepared milk and biscuits. But you cannot prepare that everyday. Living with that fear everyday makes one even more depressed. İ only think about being brave in one's soul."

"At home? İ mean, İ don't think İ can do anything at home, what could an earthquake precaution be?"

Q. 3. What stops you from preparing for an earthquake?

"Nerves, fear, İ mean remembering. We are living it anyway, and then to live seeing it everyday, take the bag and put it there. İt is more upsetting."

"For 10 days, 15 days you do it, you do it all the time. But it renews the fear and you end up feeling more fear."

"For example what kind of preparation, there aren't many precautions İ can take in the house, in the building. What can İ do?"

Q. 4. What would motivate you to prepare?

"To not be hungry, to not be left naked, for that moment İ mean, because during the earthquake, people were left helpless, they were left naked. They were uncovered, in order not to be left like that we were preparing. But as we saw the things and we got depressed, we said whatever God shows us will be. But you do dress more properly for bed."

"İ thought of my son's diapers, of his food. İ mean to combat his helplessness if left without food. But if we are to feel pain, and that is what happened to the others, then if are to live through it, we are to live through it. İ am no different from the others."

Q. 5. Under what circumstances would you consider undergoing economic hardship to strengthen your home?

"If it had been cheap, we would have thought about it, since it was expensive we didn't think about it. And a lot of people like us, maybe everyone in Turkey. Because it is too expensive."

"I don't believe that it is a very necessary thing."

"If they made an announcement on TV that it would be greater than 7, then we would call an engineer and have it looked at."

Q. 6. If there were an Educational Campaign to build awareness among the public, how would you like it to be, what would you like to see, to hear? What would you not like to see?

"You don't know where a person will be at that moment. If I am at the market at that moment, then I will not know where to hide. Only if you are in your home, then sit agains your refrigerator or something, but that is very indefinite because İ think that a person will act on instinct. But still İ think education should contain first aid."

"Everyone in a family should learn this, because if the man is hurt, then if a woman doesn't know what to do, she can't do it. İ mean in a family everyone except the child, for example except those younger than 7, who won't understand, everyone should go."

"What is important is that when the pubic is being warned, the scientists should not use their own opinions but use scientific analysis to aid the public, they should not create these kinds of panic. Because even if a person is given an education, in this kind of a situation there is nothing to do. But of course warnings are very useful. Those are done too. For example stand in the entryway, under the weight carrying. beams. But if the hour of death has come, then death won't stop due to beams, nothing will stop it."

Q. 7. What kind of a campaign would convince you to start taking steps to protect yourself?

" Well till now I have never thought about myself and I don't plan to. Should I take my children, should I take my mother, that is how I always think."

"The warrior spirit in me is enough anyway, I mean I can do anything to protect myself, and if everyone does that then there is no problem. ... But at a time like that when the hour of death comes, no matter how many decisions you have made before, if a person can not escape, he can not escape."

"What is important is not to protect myself but for the people as a whole to be protected."

Analysis

The host of the program analyzes the above-mentioned quotes, and the meanings of the comments are discussed. In sum the reality of the public is that they are scared, do not sustain their efforts, tend to ignore possibilities and are locked into "that moment." This being locked into the moment stops us from considering a gathering of resources beforehand. This locked/blocked state is shown as one reality, a future earthquake is shown as a second reality, and finally a third reality is shown, that it is possible to build one's resources for protection in the face of an earthquake. An encouraging, informative and warning presentation is made on this topic. Taking into account the question of how this locked state will be overthrown and the reality of an earthquake will be faced, and how there will be a warming up to the idea of preparing rather than trying to forget, the Istanbul Master Plan Presentation will be presented as follows:

"The Municipality has an offer: Together let us forge a new reality: let us take the responsibility of taking precautions for an earthquake, let us be informed, let us be educated and let us get organized and be resistant individuals, families, neighborhoods and let us be an Istanbul that is resistant to earthquakes.

How does this happen? The Municipality has prepared a Master Plan, which will be delivered to you by person X. in the following episodes of this program, we will talk about what resources you can build to prepare for an earthquake. In today's program we will talk about the topics that will be broached during the coming episodes."

If, as suggested in the following modules, it is possible to come to an agreement with a pilot family, that family will be introduced to the viewers during this first module.

NOTE: The suggestions made in this part have been developed in light of the research (Fişek, Müderissoğlu, Yeniçeri & Özkarar, 2003) done for the Center for Disaster Management (CENDIM) of Boğaziçi University.

Module II: information about earthquakes.

Topic 1. What awaits Istanbul?

1. What is an earthquake?
2. Brief explanation of Istanbul's seismic qualities.
3. Map of soil conditions and brief information
4. Calculation of Risk= soil conditions + the quality of the building + the epicenter and strength of the earthquake. Specific regions could be given as examples on this topic.
5. Clarifications to make sure that the information does not inspire too much fear. Emphasis on the fact that in every situation there are steps that can be taken to lessen the damage, in some cases they are simple, in others much more radical. These will be told sequentially, according to what the administration will have to do and what the people would have to do.
6. Where to go for information: The name, address and phone numbers of easily accessible sources are given. For example, AKOM or the Kandilli Website. What is the situation in your region and whom can you ask? Information such as the earthquake web page of the Municipality, which neighborhoods have which NGO's and how can they be reached is given.

Those responsible for the module: Kandilli seismology and earthquake engineering teams and appropriate departments in the Municipality.

NOTE: As stated before, the educational technology of this and all other modules, its presentation and the psychological effects will all be analyzed by a professional team of psychologists. It would be useful for this team to be in charge of the overall coordination.

Module III: What is our municipality doing?

1. An overview of the planning and organization- organization for disaster management, who is responsible for what, preparations for before, during and after an earthquake
2. Cooperation and coordination with central authorities and other relevant institutions (e.g. Red Crescent, the Military etc.)
3. Mitigation activities- especially public sector buildings, roads, bridges etc. (to be explained with examples)
4. Work on utility networks (electricity, natural gas, water etc.)
5. Sources of financing, projections for the future. This should be explained without going into detail but with enough substance to indicate concrete support
6. Where to apply for further information, how to reach the relevant municipal authority

Module implementers: relevant Municipal sections

Module IV: What can you do?

Introduction

This is the module that needs the most detail, so a general introduction needs to be made and then the details need to be handled in separate modules. Thus this is the topic that may increase the final number of modules.

Preparation for people

1. educating and preparing oneself, preparation for before-during and after the earthquake
2. family planning
3. helping others
4. collecting supplies

Preparation for places

1. for the home- non structural mitigation
2. for the building- structural mitigation, evaluation, strengthening, moving
3. ownership of the community- activities before, during, after an earthquake

All these topics need to be spelled out in sequence, details will be based on the applied public education program, there will be a joint language and handling with that program. All suggestions will be demonstrated with concrete examples, using real life examples wherever possible. In all the coverage will include what to do-haw to do- where the resources are (information, supplies, financing etc.)

Detailed explanation

The topics below can be seen as separate modules depending on time and content constraints, but all need to be touched on.

Preparation for people: individual, family, and community.

1. education for the moment of the earthquake- e.g. when to duck and cover, when to go outside, what to keep by the bedside etc., preparation for the elderly, children, handicapped, animals.
2. emergency plan- family meeting place, telephones, learning how to shut off utilities, important documents, earthquake bag etc.
3. learning first aid, light search and rescue (teaching resources in detail)
4. family decision making as to what to do
5. apartment living- cooperation with neighbors, apartment meeting
6. duties of the flat owner, of the renter for information: the Municipality, Kandilli web site, NGO's, and education resources

The possibility of incentive campaigns should be evaluated

Module implementers: Education resources, NGO's.

Suggestion: Finding a volunteer family (e.g. in the pilot area) and demonstrating each step with that family, as they prepare, presenting a concrete example each week based on that family's preparations.

Module V: Preparation for Places-1: Structural mitigation against damage.

1. What to do: actions such as fastening equipment etc.will be demonstrated with examples, possibly in the home of the volunteer family, as well as examples from different contexts.
2. How to do it- step-by-step demonstration and showing where to get the supplies without inadvertent advertising.

   Module implementers: education resources, NGO's, municipal experts

Again possibilities of incentive campaigns should be evaluated. For example, a certificate for those homes deemed ready by a given date, a placard for the building etc. Those who want to participate can get in touch with the assigned municipal office; show their preparation to get certified.

Module VI: Preparation for Places-2: Structural mitigation against damage.

Focusing on soil conditions, some version of the description below will be explained.

1. good soil = rocky surfaces etc.

   good building = built after 1975, has certain stated features, etc.
2. bad soil = has risk of liquefaction, on riverbanks etc.

   good building = what has been done to compensate for the soil conditions
3. good soil

   bad building = what is missing
4. bad soil

   bad building

Examples of each should be given, the positive examples can be any building, but the poor examples should preferably be anonymous buildings, possibly a public sector building that has been condemned. What can happen if mitigation is and is not done should be explained, with examples.

Explanation of what needs to be done to evaluate the building: the evaluation phase is detailed, using the a-b-c-d schema and describing what needs to be done in each case.

The issue of expense has to be dealt with. Some sort of public- municipal cooperation scheme may be a possibility, based on the report of the resource experts.

The kind of experts and firms responsible for evaluation and mitigation should be described, "how to choose your expert" should be discussed, any financial resources and relocation alternatives should be explained.

Example of incentive- certification of buildings as "earthquake resistant building". In case of community wide efforts, there can be an "earthquake resistant community" certificate. Interviews on successful examples can be done.

Module implementers: Kandilli earthquake engineering department, relevant municipal experts, association of architects and engineers, legal advisors etc.

Decision locus for mitigation is with individuals for single dwellings, but it is with a group for apartments. Support can be offered for decision-making, financial support alternatives, insurance etc.

Module VII: Success stories

This can either be a separate module or be inserted into relevant modules. The issue is to raise awareness of feasibility through the use of concrete examples such as photographs, visits, and excerpts. Questions could be asked as to how a building was left standing and why the damage was minor. One could also use before and after photographs of buildings that have been retrofitted and photographs of good and bad construction. For example a public sector building that will be abandoned.

Module implementers: the previous group.

The rationale for the module: To see positive examples of things that have been learned up to this point. To give a sense of "so it can be done."

Module VIII: To take ownerships of the neighborhood, of the city.

This module consists of suggestions, information and encouragement that will lead to a greater awareness among the neighborhood's inhabitants. Successful examples are shown. The importance of organization on a community basis is emphasized.

- Get to know your environment: What is in the area surrounding you, a gpvernment building, a green space, utility stations etc. The reason is that you must know the places from which you can possibly receive aid or harm. Where can you obtain this information?
- Question the leadership: What is being done for my environment? Relevant phone numbers are given.
- Question yourself: What am İ doing for my environment? Where can İ apply for information, where could İ volunteer and what can İ learn?
- Be organized: selections from existing examples are shown, NGO's, success stories, the possibility of certificates for successful neighborhoods are discussed. For what: For disaster management, meaning active readiness for the time preceding the earthquake, during it and afterwards.
- How can you get organized? The names, phone numbers and addresses of those willing to be consultants.

Every one of these bullet points is shown with examples and there are interviews with those who have already begun the questioning process and taken action, as well as with NGO's and neighborhood groups.

A necessary point for neighborhood organization: we are not living in a vacuum. We cannot be responsible only for ourselves. The negative externalities theorem shows this: that someone else's neglect may harm you as well.

Example: Your airline takes very strict security measures during baggage control but another airline does not. If there is a bomb in the transit baggage that comes from that airline, you are not protected.

Example: if your building is strong but the one that is attached or leaning on your building is unsound then you are at risk as well. İf that building falls down then your building could suffer harm as well.

In conclusion, we are all responsible for each other; we must have an ideal that emphasizes communal support and communal protection.

The principle: A citizen's awareness and human rights, the right to know.

At this point, it would be helpful to use statements such as these that mention responsibility and find examples from the qualitative study. For example: "What is important is not to protect myself but that people as a whole are protected."

Module IX: Why earthquake preparation?

Protect yourself and your family- protect your near environment- protect your city—be aware, be active, be capable, be self-sufficient, be a leader. A "you can do it" message must be given.

Here once again examples could be taken from the initial conversations, such as the responsibility towards elders and children. The examples of hesitation from the initial conversations are repeated and the question is asked, are we really that helpless. An attitude must be developed that says: Our families, our homes, our routines are the results of years worth of effort, are we truly going to fall victim to pessimism when there are ways of saving all this?

How can we believe that we can do it?

1. By acting on one suggestion, however small,
2. By discussing this with our close ones,

3. By calling the consultation units for more information and more analysis,
4. By meeting as the inhabitants of the same apartment and coming to an agreement,
5. By joining the educational efforts.

The above-mentioned bullet points are considered one by one. The real importance of this module will be its help towards a psychological vaccination.

Individual preparation, and that of a family are a must, however they are not enough. Why?

1. Every member of a family may not be in the house at the time of an earthquake.
2. Damage and weakness in a nearby dwelling may affect your home as well.
3. Damage within the city will affect your daily lives.
4. The notion of "protection through interdependence", which comes from being dependent on each other is important. The behavior of other people will affect your life; therefore we must strive for mutual agreement.

Once again every point is considered separately.

Conclusion: the preparation must be as widespread as possible; everyone must be stronger and safer. In conclusion let us develop a mutual support ethic = support within the apartment, the neighborhood, the area, and the city and with the authority.

In general: With an attitude like "if others are not preparing, then I will not either" we are running a greater risk of collapsing together. An approach like "if I prepare, then others will as well" will lead to widening success. Let us develop an agreement or culture of safety, beginning with our neighborhood, with our apartment.

The rationale: We need cooperation, kindness and monitoring to develop trust. Let us monitor ourselves, our neighborhood and the leadership of our city, and make sure that we are informed.

Note: Encouragement is necessary in every aspect possible.

Program Outline for Training of Media Representatives and The Role of The Media.

A public's right to know about the risks and danger that remain following a disaster, what needs to be done in the face of these risks and their right to know what kind of precautions the officials are taking or will take in this matter can be counted among the most basic of human rights.

The use of the media is an appropriate method for the building of awareness and informing of the public on a topic like a natural disaster that concerns the general population. It is also an appropriate way of dispensing information on how the public must act in the face of possible risks. However, the media's informing of the public must not happen only when disasters occur. The goal must be to be able to reach the public with information as to what they must do at the time of the disaster, well before the disaster occurs.

It is important to guarantee that the news programs in the media about earthquakes must be directed towards the public and must be simple. The news and interpretations must not be sensationalized, exaggerated or dramatized.

Following large earthquakes, it has been the role of the media to relate the damages that the earthquakes have caused, as well as the problems and needs of the given area. At times when communication has been cut off, it has again been the role of the media to communicate the situation to the national and international public. This is a very valuable service that the media offers. But the understanding that a sensation must be created and a difference from other media must be sought, that came in the aftermath, damaged this positive image and led the public to experience great stress, fear and panic.

From the events that followed, it is clear that there is a discrepancy between the public's notion of a news media and the media's notion of news reporting. İn this case, the level of trust that the public has for the media is steadily decreasing.

It is certain that members of the media will play an important role in the presentation of the Istanbul Earthquake Master Plan to the public, in the general preparation, informing and awareness building of the public. In order to make use of the media's active role in informing the public and to ensure that news about earthquakes are delivered in a truthful and simple way, the necessity for the media representatives to undergo training is clear.

The education of media representatives must be developed in two ways. First of all, members of the media organizations who are determined as volunteers must undergo the public training that is mentioned in the initial section. It is only with this method that the media representatives can report in a balanced manner on what is happening, what the situation in Istanbul is and what precautions can be taken. The second step is to ensure that the information that reaches the public is based on scientific facts, far from sensationalism and has an ethical approach that induces safety and calm. Here are some examples of topics that could be emphasized (Friedman, 2002):

1. When speaking of the damage, it is important to avoid using words such as "little", "very", and "heavy" that have no specific meaning and opt for words that depend more on the factual findings.
2. When making a risk evaluation, it is important to deliver information clearly and from trustworthy sources because the subject is confusing in itself.
3. It is also important to note that a difference of opinion between scientists is not necessarily artificial but originates from the use of different models.
4. News programs about the disaster should avoid emphasizing only the negative.

Program Outline for Neıghborhood/Communıty Organısatıon

Rationale:

Organization at the local level is a very important step in the network of disaster management. After the 1999 earthquakes in Turkey, numerous civic initiatives flourished, which started to create the local organizations especially in the most affected areas. The structure of these organizations varied, some being more successful than others especially in terms of sustainability. An appropriate model of civic organization which takes into consideration the conditions of Turkey is likely to emerge in time. In this section, examples of existing models will be presented. Examples of neighborhood organizations that have been built according to the local culture and structure are mentioned below.

SDC is currently heading a Neighborhood Disaster Support Project in İzmit which aims at building awareness in the local community regarding the risks and possible mitigation and preparedness steps and increasing local response capacities within the neighborhoods for the critical first few hours after the disaster through offering trainings and necessary equipment.

Within this project, approximately 50 Neighborhood Disaster Volunteers (NDV) are trained for each neighborhood to offer the first response immediately after the disaster and are provided with the necessary equipment.

The Neighborhood Disaster Council (NDC) consist of people who have different positions and knowledge regarding disaster preparedness and response.

- Leader - neighborhood administrator (muhtar)
- Coordinator of the volunteers
- Coordinator of logistics
- Coordinator for damage assessment
- Members of the NDC who work on increasing the preparedness and first response capacities in their neighborhoods

Members of the Neighborhood Disaster Council are selected from the group of volunteers who have received the Neighborhood Disaster Volunteers Training based on the match between their characteristics and the requirements for the positions.

Another example of local organization is the project mentioned in the first report which is coordinated by IULA-EMME called "Preventing disasters and developing local capacities for preparedness" in Adapazarı. For the Neighborhood Disaster Education program, groups of up to 30 volunteers under the leadership of the neighborhood administrator (muhtar) in every neighborhood are trained. "ABCD Basic Disaster Awareness, First-Aid, Light Search and Rescue and Fire Fighting Skills" trainings are given to the volunteers led by the neighborhood administrator (muhtar).

Neighborhood Organizations and their disaster preparedness activities in Istanbul

The information regarding existing neighborhood organizations and their disaster preparedness activities is presented at the end of the report in Appendix 2.

Lessons learned from the 1999 Kocaeli and Düzce earthquakes regarding the importance of neighborhood organizations (IBB-JICA)

The 1999 Kocaeli and Düzce earthquakes have shown that local and central institutions along with the public were unprepared for disasters of such magnitudes. Lessons drawn from the experience of these disasters point to the necessity of having effective local units such as Neighborhood Disaster Councils for disaster preparedness as well as first response after the disaster (JICA report, 2002). The incidents shown below and the related lessons learnt are directly related to significance of neighborhood organization.

Incidents:	Necessary neighborhood planning:
For the first few days the search and rescue activities were carried out by people in the neighboorhood. Help from outside came many days later.	**Search and rescue** committee
It was very difficult to find out if people were under the rubble in neighborhoods where people did not know their neighbors.	**Communication** committee
It was very difficult for out of the area search and rescue teams to conduct their activities without a local guide.	**Communication** and **coordination** committees
Lack of adequate knowledge regarding first-aid created significant problems	**First-Aid** committee
The help and materials sent to affected areas were not adequately coordinated.	**Out of area aid coordination** committee
Shelters (camps) that did not have adequate infrastructure had problems.	**Shelter and food** committee
Logistical support such as heavy machinery and supply of power was inadequate. Lack of adequate lighting slowed down search activities at night.	**Resource** committee
Due to lack of a sign system for already searched buildings, more that one team searched some of the buildings.	**Search and rescue** committee

The above mentioned activities at the local level are important milestones for macro level risk reduction and disaster management. Information about the steps in organizing neighborhood disaster councils that form partnerships with numerous disaster related organizations will be discussed next.

iv. Elements for organizing a healthy neighborhood disaster council.

In general, most of the NGO's working in this area have focused on and built expertise in search and rescue activities. Despite the significant financial struggles these NGO's face, they continue to survive. Neighborhood Disaster Councils which consist of volunteers living in the neighborhood can be effective in taking the steps necessary for damage risk reduction and disaster management by:

1. increasing awareness regarding retrofitting options
2. encouraging completion of household preparedness steps
3. organizing neighborhood wide preparedness activities and building self-sufficiency of the neighborhood for the aftermath of the disaster

v. Aim:

The Neighborhood Disaster Council (NDC) has 2 main goals to structure the activities around:

1. Increasıng awareness in the community regarding disaster preparedness and organizing necessary damage risk reduction activities
2. Creating a self-sufficient neighborhood which can take care of its needs in the first 72 hours (or one week) after the disaster

vi. Necessary steps for damage risk reduction and response activities:

1. Activities geared towards the completion of preparedness tasks for individual households
2. Creation of committees that will become responsible for intervention after the disaster:
   a Communication Committee: Acts as a bridge between the Neighborhood Disaster Council and the inhabitants of the neighborhood before the disaster. The committee is responsible for annoucing the work undertaken by the council as well as the necessary preparedness tasks that need to be completed by individual households, increasing awareness in the public of disaster preparedness issues, answering questions. Also aims to improve neighborhood relations by creating opportunities to get neighbors to meet each other (example: creating buddy system for household preparation activities among neighbors). Works on necessary communication resourses for use during the disasters. The committee is also responsible for coordinating communication between outside of area help teams and distribution of information. Partnership with local administration is another area of responsibility.
   b Damage Assessment Committee: The main responsibilities include scanning the neighborhood immediately after the disaster for damaged buildings and marking those buildings on neighborhood maps which will be passed on to the search and rescue committee or teams. Partnership with local administration is another area of responsibility.
   c First-Aid Committee: The committee either provides the first-aid training to interested inhabitants of the neighborhood or coordinates such trainings to become available by building partnerships with related agencies in the larger community. Also aims to provide immediate first-aid services after disasters. Partnership with local administration is another area of responsibility.
   d Light Search and Rescue Committee: Members of the committee obtain necessary training to perform competent search and rescue activities after the disaster. At the time of response to the disaster, they receive information from the damage assessment committee to respond to priority areas first. In order to maintain communication with out of area rescue teams, uses a preapproved signaling system regarding the search activities conducted in the neighborhood (i.e. signs to denote whether the building was searched, etc.). Partnership with local administration is another area of responsibility.
   e Security Committee: The committee is responsible for taking care of possible mayhem after the disaster and maintaining the security of the neighborhood (example: taking measures to stop looting of buildings). Having a rotational system in place that will work on maintaining the security of damaged buildings may make it easier for inhabitants of such buildings to leave their homes and go to more secure shelters. Forming partnerships with local administration as well as the local security units is another area of responsibility.
   f Shelter and Food Committee: The committee works on finding appropriate shelter space and equipment as well as food for inhabitants of the neighborhood in the aftermath of the disaster. With the approval of the local administration, available space for building tents is identified and food for the first few days to sustain the neighborhood is secured. Partnership with local administration is another area of responsibility.
   g Resource Committee: The committee prepares a list of available resources in the neighborhood and undertakes the necessary work to make their use available after the disaster. Builds partnerships with the necessary agencies for the appropriate use

of these supplies. Partnership with local administration is another area of responsibility.

h Out of area Aid Coordination Committee: The committee works to organize the appropriate distribution of out of area aid sent to the neighborhood. Partnership with local administration is another area of responsibility.

i General Coordination Committee: The committee coordinates the pre-disaster and post-disaster activities that need to be conducted by the different committees. Partnership with local administration is another area of responsibility.

3. Preparing the Neighborhood Disaster Plan:

a Neighborhood Disaster Plan informs who will carry which responsibilities during and after the disaster and how the concurrent activities will be coordinated in a specific neighborhood. This plan includes all of the activities that need to be started (Search and rescue, first-aid, shelter, communication etc.) after the disaster.

b Disaster Response Directory (DRD) that contains all of the necessary information and resources and how to reach them. The Directory has to be gıven to all of the responsible parties in printed form.

Priority information that should be part of the DRD:

5. Neighborhood Disaster Plan
6. Communication information for all the parties involved in the NDC and its committees along with their areas of responsibility
7. Maps of the neighborhood
8. Priority information regarding inhabitants of the neighborhood (how to reach those who have first-aid training)
9. List of necessary equipment and user's guides
10. Communication information regarding disaster related agencies within and outside of the neighborhood

Given that disaster preparedness activities depend upon serious team work, the leader has to have the capacity to coordinate the activities of the committees, be responsible for task distribution, follow –up and forming multiple partnerships with different agencies.

It is very important to maintain the continuity of disaster preparedness activities in a sustainable entity. As new people will join the neighborhood with time, it is important to inform the newcomers of the preparedness activities within the neighborhood as well as increase their awareness regarding household disaster preparedness tasks.

vii. Steps in creating the organization:

1. **Identifying the core group**: A preliminary meeting with the key players in the neighborhood (such as public administrator (muhtar), religious leader (imam), pharmacists, doctor, school administration, firefighters, etc.) should be arranged by the Municipality. These key players should be asked whether they would be willing or interested in becoming part of the organizing force for forming the NDC. Other significant groups that may be interested in performing disaster activities can be identified (such as youth and women) and can be sought out in gathering places to ask them for partnership in forming the NDC. The core group group consisting of 7-9 people can come together with the support of the Municipality and anouncements can be put out to reach the potential volunteers in the neighborhood who may be interested in working for the committees within the NDC. Consultations regarding team-building issues should be provided to the core group. Team building consultation can be provided by the integrated efforts of three sources:

a Municipality – The municipality will be able to offer numerous resources and information essential for the NDC
b Consultant from a successful NGO – A consultant can share experience in working for such an entity as well as share best practices
c Social scientist consultant from the universities

The core group needs to consist of people who can get along and work well with each other. The members will have to hold numerous meetings before the neighborhood is invited to a general meeting. Some of the main tasks they have to do are: identifying the borders of the neighborhood, investigating the resources available in the neighborhood, preparing the necessary documemnts and handouts for the first meeting, identifying the topics for the communities and writing clear job descriptions for the volunteers.

2. **Setting the borders of the neighborhood:** It is important to select the area of the neighborhood the NDC will be responsible for at the outset. The selected area should not be bigger than what one or two volunteers can manage to scan immediately after the disaster in order to prepare the damage assessment report. This is very important both for the planning and coordination purposes. It is also imperative to pay attention to the internal structure of the neighborhood while considering the borders of the neighborhood.
3. **Investigation of the available resources within the neighborhood:** Before a general announcement is made to the public for their voluntary participation in the committees, the members of the core group have to do extensive research to find out about all kinds of resources available in the neighborhood (specialists, trainers, training materials, local resources, etc.), make a list of the, find out potential agencies they can form partnerships with (i.e. Turkish Red Crescent – staff can give first-aid training, Fire Station – can receive fire-fighting skills training). Also, reaching out to the larger community resources such as, local administrations (municipalities, other NGO's) as well as central administration agencies (governer's office, Civic Defense office, military and TRAC) involved in disaster planning to find out how NDC can be part of the larger disaster plans in the region. It ıs imperative to make good use of available resources when planning an organization, thus saving time and manpower.
4. **Preparing a work plan for the necessary activities, deliniating job descriptions and timetables:** Before inviting the volunteers into the NDC, a well defined workplan and clear job descriptions have to be prepared. It will be easier to recruit volunteers for well-defined jobs within the committees.
5. **Invitations for the general meeting at the neighborhood:** Announcements to the first general meeting have to be well thought of and planned for it to succeed. The first meeting will introduce the planned disaster preparedness and response activities for the neighborhood. The purpose of the meeting has to be very clear on the annoucements, which should be posted in frequently visited local places such as (coffee houses, sports clubs etc.)
6. **First General Meeting:** The meeting has to take place in a location and time easily attended by the public. The members of the core group will be responsible for making the announcements in the neighborhood with flyers that define the purpose for the meeting very clearly. The meeting has to be well structured and should communiate to its audience all the necessary information, what is planned for the neighborhood, descriptions of the committes and job descriptions for the volunteers, distribution of individıual household preparedness packages and recruitment of volunteers to the committees. This meeting consititutes the second basic step for the organization in the neighborhood. Lastly, goals for the next meeting, what needs to be done to achieve

these goals and the date for the second general meeting shoud be set by the end of the meeting.

Following meetings: Future meetings are devoted to presentation of the work done by the committees, recruiting new volunteers and various announcements and trainings to keep up the motivational level of the inhabitants of the neighborhood.

Preparation of Materıals for Publıc Education.

All the activities described above will require the development of written and visual material that shows a commonality of approach as well as content. Preparation of such materials with a view towards multiple usages would increase verim. A number of possible multiple uses are listed below:

1. The applied public education program has to be made into a book/booklet. Such a book can be distributed in schools and other such institutions with appropriate revisions.
2. The content of that book can be distributed in sections to schools, newspapers, magazines, neighborhood officials (muhtar) etc.
3. The modules of the visual media program can be produced in CD format as a whole or in parts, and distributed to the same institutions, or even other cities.
4. Some examples from this program can be used as flyers, advertisements etc. as an aid in arousing interest and awareness.

6.1.4 Requirements for Formulating Education Programs as Projects

The best way to formulate mitigation education as discrete projects is to take the Earthquake Master Plan as a unity and to consider the educational efforts within that unity. This necessity can be understood more clearly by considering the aims of education programs. These aims can be ordered from a micro to macro level as follows:

- Predisaster personal preparation (e.g. learning what to do during and after an earthquake)
- Predisaster family preparation (e.g. preparing a plan for what to do during and after an earthquake as a family)
- Predisaster non-structural mitigation
- Predisaster structural mitigation
- Predisaster preparation and organization in the neighborhood (taking responsibility about the immediate environment)
- Taking responsibility for the city (e.g. cooperating with local administrations to monitor official prevention activities)

The aims listed above, except the personal and non-structural preparations, have intersecting points with some other parts of the Earthquake Master Plan. For instance, structural mitigation overlaps with the reports of the Structure, Settlements, Law and Resource groups, and neighborhood organizations overlap with the reports of the same groups stated above plus the report of the Disaster Management group. To explain the quality of these overlapping parts, we can take the issue of retrofitting as an example. Retrofitting relates to the Structure group and law and Resource group. Besides these groups, retrofitting, urban reformation, new settlements are related to the Soil Conditions Studies and Settlements group.

The relation of education to retrofitting has two important aspects. Face to face, applied public education increases the self-efficacy beliefs of the public, by informing them with concrete applications and by demonstrating the feasibility of preparedness, thereby helping them understand the importance of structural mitigation. Since direct public education can be given only to small size samples, a large-scale awareness and motivation can be created only by a widespread media campaign. As can be seen, the proposed applied public education and widespread media campaign programs include almost all the topics of the Earthquake Master Plan. Disaster Management also intersects with local organizations, which is a part of education.

Based on these thoughts, educational projects must be coordinated at least in terms of time between the separate groups stated above. Furthermore, rather than applying the project to the whole of the Istanbul mega city, an appropriate pilot area (e.g. Zeytinburnu) may be selected and first applications may be tested and extended gradually. Thus, the proposal below depicts how education programs, combined with the work of other groups, can be implemented in a pilot area.

The Integration of Education and Other Work on a Pilot Basis:

If the logic of integration is applied in the Master Plan, the principles stated earlier as musts can increase the probability of success. It is especially important for the work of construction evaluation and retrofitting to be carried out in coordination with education. Education within such an integrative approach can follow a sequence as explained below:

Planning Stage:

1. Selection of the Pilot area: the Municipality and other decision makers can select an area, which requires immediate intervention, as a pilot area. Socio-economic and demographic information related to the pilot area schools, hospitals, fire stations, health centers e.g. must be obtained.
2. Preparation of Action Plans: Starting work on the programs that are going to be carried out.

   ...Stating priorities and preparing a time chart for the programs
   ...Preparing a budget; examining the resources, locating resources that can be enhanced and finding new resources,
   ...Noting the legal problems,
   ...Noting the present administrative situation in terms of rights and responsibilities, starting necessary cooperation.
   ... Selecting a target population for education, preparing a publicity campaign to reach the selected group, locating appropriate venues for education (e.g. schools, tea-houses, public education centers)
   ...Preparing the materials for training of trainers, public education of media representatives,
   ...Preparing a widespread education campaign via visual media.
   ...Identifying probable loci for community organization, locating key personnel, looking for the possibilities of economic support, getting in contact with relevant NGO's and other organizations (e.g. Red Crescent, Istanbul Directory of Civil Defense, Directory of Fireworks, related NGO's)
   ....Preparing an education program for media representatives, etc.

Implementation Stage:

1. Publicity: A publicity campaign by local officials, a widespread visual media campaign to gain notice and create an atmosphere of mobilization.
2. Locating already present educated trainers (e.g. NGO's like AKA, ADV; Kandilli DAM; İTÜ AYM) and other volunteer educators, starting cooperation with them.
3. Educating media representatives.

4. Starting education programs for the target population.
5. Providing the necessary education/consulting for the initiation of community organization.
6. Impact evaluation after the completion of each program.

A probable time-chart for the implementation of programs is shown in Appendix 1.

Proposed Project Packages for Mitigation Against Earthquakes

The topics below are listed as project packages, resulting from the observations and recommendations presented earlier, and parallel to the table shown in Appendix 1. It is crucial to restate that; all the reports of the Master Plan overlap significantly. Therefore, rather than looking at the Master Plan as separate project packages, it must be conceived as an integrated action plan with interrelated subprojects.

Project Packages.

- P1. Publicity for Implementation in the Pilot Area
- P2. Widespread Visual Media Campaign
- P3. Preparation of Education Materials
- P4. Training of Trainers
- P5. Education of the Media Representatives
- P6. Applied Public Education
- P7. CommunityOrganization
- P8. Evaluation of the Programs

P1. PROJECT ON PUBLICITY FOR IMPLEMENTATION IN THE PILOT AREA.

i. **Aim :** If a pilot area is selected for the Earthquake Master Plan, informing the people of that area about the coming program.

ii. **Method:** A short-term (1 to 2 months) publicity campaign carried out by the central and local authorities of the pilot area.

iii. **Content :** The content of the campaign includes the activities stated below:

1. An "area meeting" to explain the activities that are going to be carried out and the reasons for selecting that area. All the inhabitants of that area, the media and interested citizens are invited.
2. Similar meetings in smaller communities in the pilot area (neighborhoods, streets etc.) organized by those responsible for the neighborhoods.
3. Posters and placards in the pilot area, to keep the interest up.

iv. **Implementers:** The Municipality and other local administrators are responsible for the campaign. Project consultants are the relevant experts involved in the Master Plan.

v. **Implementation:** Implementation starts after the completion of all preparation for the pilot work and proceeds in the order as stated in the Master Plan. The initiation of the widespread visual media campaign before the pilot study may be a preparatory factor.

P 2. PROJECT ON WIDESPREAD VISUAL MEDIA CAMPAIGN FOR PUBLIC EDUCATION.

i. **Aim:** Although a campaign is usually seen as an information dissemination method, in the case of the Istanbul Earthquake Master Plan, it is additionally important to awaken the acceptance and willing cooperation of the public in the programs stipulated by the Master Plan. The aim of this program is to elicit informed ownership of earthquake mitigation by the public, to educate the public about mitigation and foster organization at the community level. It is crucial to present the information, warning, reinforcements and recommendations in an easily accessible format and venue in order to develop the attitudes and behaviors needed to take action.

ii. **Method :** A TV documentary/educational series consisting of about a dozen weekly sequential modules, which can also be used separately, is recommended. The formats of the modules are geared to the goals below:

...to provoke curiosity and questions in the audience,
...to present understandable answers to probable questions,
...to use specialists who can reinforce the call for preparedness
...to explain and show in detail all the necessary preparations,
...to present the necessary information, encouragement, and incentive in order to enable the internalization of the recommendations.

Suggestion: Selecting a volunteer family (e.g. from Zeytinburnu), recording the activities in each module step by step with the family and presenting a concrete implementation each week will provide vividness and credibility to the program.

Note: The reason for creating modules that can be used individually, separate from the series is to enable the use of some modules, which are relevant beyond Istanbul in other contexts.

iii. **Content** : There are nine (9) modules in the proposed program, however the final number of modules and weeks can be determined based on how much detail is desired in the final product. The length of each module should not exceed 45 minutes to accommodate the attention span of the audience. The issue of series length is elaborated further where each module is explained in detail. The content of the first module is given as a detailed scenario and the proposed outlines of the other modules are given in the previous section. The modules, following a sequential logic, include information on earthquake risk and what can be done to reduce risk.The basic themes are as follows:

1. The expected earthquake in Istanbul from the perspective of public expectations, attitudes, etc.; examples from behaviors
2. Explanation of the real situation and expert expectations.
3. What can be done: detailed, concrete recommendations.
4. Presentation of incentives and reinforcements.
5. Reinforcement of the concepts of necessity and capability.

iv. **Implementers of the Modules:** Almost all subtopics of the Master Plan are dealt with in the preparation and detailed elaboration of the themes. Therefore, those responsible for each topic utilize information from the relevant groups involved in the Master Plan and from the detailed content of the applied public education program. Consistency of content and approach in each module is a precondition for success. The overall consistency of the program and the effectiveness of its psychological persuasiveness are supervised by the project co consultants.

v. **Implementation**: It is necessary to get in contact with a production group approved by the Municipality to start the project. Project consultants, the Municipality and the production group work together.

P3 PROJECT ON THE PREPARATION OF EDUCATIONAL MATERIALS

i. **Aim:** A series of educational materials consistent in content and presentation will be prepared for use in the education programs. These are going to include the following themes:

1. "The Handbook of Coping with Earthquakes". This handbook will be used in applied public education. The number of copies printed will depend on the number of households in the selected pilot area.
2. "The Trainer's Handbook of Coping with Earthquakes" and the materials case: This handbook will be prepared in a similar format. The necessary demonstration material will be distributed to each trainer.
3. Preparing a scenario for the visual media campaign: This will be prepared in an order similar to the applied public education program.
4. In addition to the "The Handbook of Coping with Earthquakes" a brief reference booklet for media representatives will be prepared.
5. Small brochures will be prepared for use during the community organization process. In addition, a "Disaster Response Manual" can be prepared for the use of neighborhood disaster volunteers.

ii. **Method:** Since consistency of content and approach is essential, a basic information template will be prepared and adapted to each education program in accordance with their unique needs.

iii. **Content :** The program templates presented previously in the proposed outlines section and the already present KOERI booklet will be utilized in preparing the materials.

iv. **Implementers :** The project group will prepare the materials, while the financial responsibilities belong to the Municipality.

v. **Implementation :** The implementation will start with the selection of the pilot area and last for 3 months.

P.4. PROJECT ON THE TRAINING OF TRAINERS.

i **Aim :** The already present trainer teams specialized in the field will train the volunteers, thus enlarging the team of educators who will be certified upon completing the training.

ii **Method :** The education programs, given to groups of 20-25 persons, will be application oriented and will include the essential theoretical information as well as training in instructional techniques.

iii **Duration of education :** Each group program lasts 16 hours. The related templates are given in the outlines section.

iv **Trainers :** Supervisors previously educated by a team of specialists will form the first chain of the trainer staff. The possible groups who can participate in the program as supervisors are listed below:

- The staff educated at the Kandilli Observatory and Earthquake Research Institute
- İTÜ-FEMA staff
- Turkish Psychologists Association (TPD) members
- Red Crescent members
- Relevant staff from TSK (Turkish Armed Forces)
- The staff of relevant branches of the Municipality

- This supervisor team will carry the education to groups of trainers. Volunteer application to groups is a prerequisite for the selection of trainers. Possible sources of volunteers are as follows:
- NGO's and volunteer candidates (mostly teachers)
- Civic Defense staff
- Volunteers from hospital staff
- A team from the project group will monitor the overall consistency of the training.

v **Evaluation :** A meeting will be held between the supervisors and the trainers right after the completion of the first public education trial for evaluation purposes. These meetings will be repeated within regular periods.

P.5. PROJECT ON THE EDUCATION OF MEDIA REPRESENTATIVES

i **Aim :** To utilize the help of the media in increasing public awareness of earthquake risks so as to be ready to cope with the hazards, know what to do during a disaster, by using the ability of the media to disseminate news easily and rapidly. In order for news reporters to give accurate information they need to be educated about coping with an earthquake. Therefore, an effort will be made to train media representatives selected for the purpose. Reporters thus equipped will be able to help the public in mitigation activities as well as preparation.

ii **Method :** It is aimed to give earthquake awareness training to at least two people from each national media group, with a special focus on those that are most favored by the public. This will be done with groups of 20-25 people at a time. The training will consist of theoretical material as well as demonstrations and practice. It is expected that these people will reach the public through written and audio-visual media.

The method of media education will be parallel to applied public education. In addition, the media is expected to help the public not to give in to panic, feel ready once the preparations are in place, and not be so much affected in their daily lives, and to that end, the reporters will need to be guided by experts in using psychological approaches to help them achieve this. An effort will be made to help the media use ways of reaching the people, getting them mobilized, facilitating preparedness, keeping earthquake awareness alive, in short creating a sustainable awareness program that keeps morale high.

iii **Content :** The content of media education will be parallel to applied public education. It is expected that this training will take 6 hours.

- 1st Part: What is an earthquake? What is the risk in Istanbul?
- 2ndPart: Preparations (from micro to macro level) that must be done prior to the earthquake.
- 3rd Part: What to do during an earthquake?
- 4th Part: What to do right after the earthquake?
- 5th Part: General evaluation

iv **Implementers :** The Municipality officials, the Project Group and consultants will organize the trainings. The Project Group will determine the materials. The educators will be selected from the group of trainers already trained for the education projects.

v **Implementation :** Once the training preparations and materials are ready, media education can start, with the contributions of the Municipality. Depending on the needs of the reporters, the training can take one whole day or be given in three units (2 hours per unit) on separate days. If it is going to be given on separate days, the first unit will cover the 1st part and the initial issues of the 2nd part, the second unit will include the rest of the 2nd part and the 3rd part, and the last unit will cover the 4th and the 5th parts.

P6. PROJECT ON APPLIED PUBLIC EDUCATION

i **Aim:** The aim of applied public education is to increase the awareness and knowledge of the public about mitigation and preparedness and to enhance their present attitudes and behaviors in a constructive manner.

ii **Method:** The participatory, group based program will be based on both theoretical knowledge and demonstrations.

iii **Content :** The themes included in the program are listed below. This program lasts 6 hours.

- 1st Part: What is an earthquake? What is the risk in Istanbul?
- 2nd Part: Preparations (from micro to macro level) that must be done prior to the earthquake.
- 3rd Part: What to do during an earthquake?
- 4th Part: What to do right after the earthquake?
- 5th Part: General evaluation

The template of the education program is given in the outlines section.

iv **Implementers:** The project group, that is responsible for the certified trainers, is responsible for this program.

v **Implementation :** Depending on the needs of the target population, the education can be presented on one day or on 3 separate days (3 units of 2 hours). If it is going to be given on separate days, the first unit will cover the 1st part and the initial issues of the 2nd part, the second unit will include the rest of the 2nd part and the 3rd part, and the last unit will cover the 4th and the 5th parts. The program will be carried out in places easily accessible by the participants (e.g. schools, public education centers, etc.).

P 7. PROJECT ON NEIGHBORHOOD/COMMUNİTY ORGANIZATION

i **Aim :** Preparation for local organization on a neighborhood basis and providing the necessary consultative support.

ii **Method :** Neighborhood organization must be built gradually stage by stage. Preparing an organizational plan, role definitions and collaboration with volunteers and local associations must form it. The details of these stages are given in the outlines section.

iii **Content :** The model of neighborhood organization, presented in this project, includes the structure of the Neighborhood Disaster Committee, role definitions of sub-committees, the activities involved and details of collaboration. The essential steps for such an organization are stated below:

I. Selecting a core group,
II. Consulting to the core group provided by the Municipality, involved NGO's and a social scientist, and the project group,
III. Defining the borders of the neighborhood,
IV. Locating the resources available within the neighborhood,
V. Preparing a work plan, role definitions and a time-chart for the program,

VI. Calling for a meeting,
VII. 1st meeting,
VIII. Other meetings

The details of the community organization program are given in the outlines section.

iv **Implementers :** The collaborators are the Municipality, volunteers from the community, involved NGO's and a social scientist. The project group gives additional consultation.

v **Implementation :** A stepwise organization model, which starts right after the selection of a pilot area and presentation of the Master Plan, is planned. The Neighborhood Disaster Committee is supported in following through the steps identified in the outlines section.

P 8. PROJECT ON PROGRAM IMPACT EVALUATION.

i **Aim :** The outcome and productivity of the completed programs will be evaluated, the strong and weak aspects will be defined, and based on the evaluation, and recommendations to improve the programs will be presented. The programs on training of trainers, applied public education, community organization, media campaign, and the training of media representatives will be evaluated separately.

ii **Evaluation method :** A separate evaluation survey for each program will be prepared and administered to selected samples, 3 months after the completion of each program. Surveys will be carried out by individual interviews and the interviewers will be recruited from an independent group. An evaluation report will be written based on the analysis of the completed surveys. Reports will cover the productivity of the programs and recommendations for improving the weak points of the program.

iii **Duration of the study :** The field study for each program evaluation will last 1 month, the data analysis 2 months and the report preparation 2 months.

iv **Sample Size :** Sample size will differ for each program evaluation. It will be approximately 50 subjects for "training of trainers", 200 subjects for "applied public education", 100 for "community organization", 30 for "training of media representatives" and 250 for "the media campaign". The Project Group and an independent research company will do the sample selection

v **Materials :** The Project group including the interests of the Municipality will prepare a separate survey for each program. The sample size of each program will determine the number of surveys printed.

vi **Interviewers :** Interviewers trained by an independent research company will carry out the face-to-face interviews. Depending to the sample size, a minimum of 5 and a maximum of 25 interviewers will work in the program evaluations.

vii **Analysis:** The research company will prepare the data files in SPSS (Statistical Program for the Social Sciences) format and the Project Group will do the necessary analyses. Evaluation reports will be written based on these analyses. Based on the reports, the required improvements and changes in the programs will be decided by the Project group and the Municipality.

6.1.5 Post-Disaster Studies.

The psychosocial conditions after a disaster need to be looked at from two viewpoints: the social/ community reactions and damage to the social fabric of the community, and the individual or familial reactions due to psychological trauma. These two concerns require both joint and separate interventions, thus it is reasonable to address each separately.

Damage to The Social Fabric Of The Community

We think the response to this concern should come not after but prior to the disaster. This need cannot be emphasized enough. And the actualization of this need rests entirely upon the existence of an integrated disaster management organization. This point also cannot be emphasized enough. Thus, the Municipality's Master Plan initiative, and the integrated activities inherent in this plan, are qualified to provide the groundwork for the most potent response to future post disaster decmpensations.

The main cause of social decompensation in disaster areas is the inadequacy of coping with the situation. Administrative inadequacies such as organizational failures, absence of organization, slowness of response, confusion regarding rights and responsibilities, lack of enough help, drive a populace already in shock into further distress, distrust and helplessness. In time this leads to dysfunctional expectations such as "everyman out for himself" or "let the state look after me", and angry reactions intensify when the situation does not improve.

Another very important feature in addition to the Disaster Management proposal is community organization at the local level. This topic has been discussed in the sections on educational activities. Once again it is clear that local organization has to proceed in coordination with disaster management. The point to stress is this: the probability of social/community decompensation is very low in a context that is disaster ready, where it is clear who should do what during and after the disaster, and what to expect from whom. There may be individual problems but intervention for individual problems is the subject matter of the next topic.

In short, since this topic cannot be considered independent of Disaster Management, a separate project package has not been prepared.

Psychological Reactions

There are two types of post disaster reactions, an Acute Stress Syndrome immediately after the disaster, and a Post Traumatic Stress Disorder that develops over time. Concerning the first reaction, the 1999 earthquakes heralded a mobilization on the part of the psychology, psychiatry and counseling and guidance communities of the country, and with the help of trainers from abroad, considerable expertise has been accumulated. This has made it possible to provide a variety of psychological and psychiatric help soon after the earthquakes, especially psychological first aid in centers like İzmit, Yalova, Gölcük, Düzce, Adapazarı. Avcılar in Istanbul. Some of these services were short term, others lasted more than a year. The services were provided in open spaces, containers, tent cities, and buildings if possible. Thus a modus operandi has developed that can accommodate itself to the conditions. Thus, by virtue of this capability, services could be quickly organized and provided after the Afyon and recent Bingol earthquakes.

All these are activities were developed by professional organizations such as The Turkish Psychologists Association, Turkish Psychiatric Association, YÖRET (Foundation for the Advancement of Counseling in Education), also involving cooperation with universities. Further the Ministry of Health personnel have also done similar work. The most extensive knowledge and expertise are currently available in Istanbul and Ankara, with Izmir a close second. Psychotherapy centers, especially those in Istanbul are continuing to work with posttraumatic stress disorder.

In short, there is a certain amount of expertise and readiness in Istanbul and more efforts will be underway to further this expertise. The current issue once again is organization and coordination. The professional groups, which have a history of cooperation form previous earthquakes, need to develop a plan of cooperation-collaboration, and achieve cooperation with the Ministry of Health. The basic job is to once again get attached to a disaster management plan. The official responsible for mobilizing and administering the work groups after the disaster needs to know when to call on whom; those called on need to know where to go how and who to contact there. This requires a reasonable disaster management work plan. If a pilot area is chosen in the implementation of the Master Plan, and the recommendations are put to trial, then the issue of organizing psychological support will need to be considered within an overall disaster management implementation.

Project On Preparatıon For Coordınatıon In Post Dısaster Psychologıcal Response

i **Aim :** Preparing the groundwork for post disaster psychological response and recovery, initiating cooperation with relevant organizations. This project needs to be owned by the Municipality, however a consultative relationship can be formed with the psychologists who have worked on the Master Plan.

ii **Method :** The Municipality is to ask the relevant professional organizations to make suggestions for preparation, and to evaluate the suggestions proposed. Similarly contact will be made with the relevant ministries, especially the Ministry of Health. Effort will be made to harmonize the suggestions with the disaster management plan of the Master Plan.

iii **Content :**

a The Municipality will contact the organizations stated above and ask for the number of personnel available to work with children or adults in the modes stated below, their level of competence, contact information etc (contact with the Ministry of Health is an absolute must):

II. Primary Prevention (Debriefing); group work done immediately after the disaster, aiming at psychological relief and first aid.

III. Secondary Prevention: Psychological and psychiatric intervention with those suffering from acute stress syndrome.

IV. Tertiary Prevention: Psychological and psychiatric intervention with those suffering from post traumatic stress disorder.

b Recovery Work: Laying the groundwork for helping those who suffer functional losses after the disaster (work loss, bodily damage etc.) will require coordination between various institutions. It is important for the Neighborhood organizations to provide data on the population under their jurisdiction and work in light of these data. Cooperation between the Municipality, the Governorship, the Ministry of Education, the Ministry of Health, the Social Service and Child Protection Agency, the Ministry of Work and local NGO's is a requirement.

iv **Implementers :** The individual/office responsible for post disaster order is responsible for contacting the above-mentioned institutions and asking for proposals in line with the disaster management plan.

v **Implementation :** Contact with the relevant organizations should be made as soon as the disaster management plan of the Master Plan is decided upon. Since these suggestions involve the work to be done by the involved Municipality officials, they have not been made into detailed project packages.

6.1.6 Appendices

Appendix 1. Tıme-Table of The Phases of The Project

		Months 1	2	3	4	5	6	7	8	9	10	11	12
1.	**PILOT AREA SELECTION**												
	1a. Preparation of the demographic data Municipality	→											
2.	**PREPARATION OF THE ACTION PLAN**												
	2a. Administrative preparation												
	2a.1. Time table planning Municipality- PG (Project Group)	→											
	2a.2. Budget Planning Municipality	→	→										
	2a.3. Legal preparation Municipality	→											
	2a.4. Evaluation of the Administrative situation Municipality (Mun)	→											
	2b. Preparation of programs												
	2b.1. Sample selection for education Mun.- PG	→											
	2b.2. Preparation of an introductory campaign to reach the sample Mun.- PG		→	→									
	2b.3. Deciding on locations for education Mun-PG		→										
	2b.4. Preparation of the material for Trainer training PG		→	→	→								
	2b.5. Preparation of the material for public education PG		→	→	→								
	2b.6. Preparation of the material for education of media representatives . PG			→	→	→							
	2b.7. Preparation of the visual media campaign PG		→	→	→								
	2b.8. Deciding on the sample for neighborhood organiation Mun- PG			→	→								

	2b.9. searching for possible financial support Mun	→	→	→	→								
	2b.10. Deciding on the institutions to collaborate with and establishing contact Mun	→	→	→	→								
	2b.11. Preparation of the education for media representatives PG		→	→	→								
3.	**PHASES OF PROGRAMS**												
	3a. Introduction Mun			→	→	→							
	3b. Selecting already educated trainers and collaboration Mun- PG				→	→	→						
	3c. Deciding on other volunteer trainers Mun- PG				→	→	→						
	3d. Training of trainers PG							→	→	→			
	3e. Appliied public education PG										→	→	→
	3f. Education of volunteer media representatives PG								→	→			
	3g. Media campaign PG					→	→	→					
	3g. Consulting and education for neighborhood organization PG					→	→	→	→	→	→	→	→
4.	**EVALUATION OF PROGRAMS PG**												
	4a. Sample selection for each completed program												
	4b. Preparation of survey for each program												
	4c. Interviews (3 months after the completion of programs)												
	4d. Data analysis (2 months after the completion of interviews)												
	4e. Preparation of the report of program evaluations (after data analysis)												

Appendix 2. List of Neighborhood Organizations.

Note : The information below is taken from http://www.iahep.org.

1. Altunizade Yurttaş İnisiyatifi
Amaçları : Mahalle çapında organizasyon ve risk değerlendirilmeleri, mahalledeki uzmanların katılımıyla gönüllü danışmanlık, girişimler arası işbirliği ve koordinasyon.
İşbirliği Yaptıkları kurumlar : Sivil Savunma, Muhtarlık, çeşitli semt dernekleri

2. Arnavutköy Semt Girişimi
Amaçları : Arama kurtarma ve ilkyardım çalışmaları

3. Avcılar- Gümüşpala Dayanışma Derneği
Amaçları : Dayanışma ruhunu, afet zararlarını ve yarattığı tahribatı en aza indirmek, olası bir afete hazırlanmak, Afetzedelere hukuksal ve psikolojik destek, halkı afet ve afet ile ilgili konularda bilinçlendirmek
İşbirliği Yaptıkları kurumlar : Depremzede Dernekleri, Dayanışma gönüllüleri, Semt Organizasyonları İletişim Ofisi

4. Ayaspaşa Çevre Yaşatma ve Güzelleştirme Derneği
Amaçları : Afet ile ilgili bina yapısı değerlendirilmesi ve araştırması.
İşbirliği Yaptıkları kurumlar : Beyoğlu Belediyesi, Muhtarlık, Cihangirler Derneği.

5. Bakırköy Çevre Dostları Derneği
Amaçları : Bilinçlendirme, ilkyardım, arama kurtarma, afet komisyonu oluşturmak
İşbirliği Yaptıkları kurumlar : 41 organizasyon ile oluşturulan platform

6. Bağlarbaşı Soyak Evleri Acil Yardım Koord. Grubu

Amaçları : Site sakinleri ve çevrede yaşayanların eğitilmesi, gönüllü organizasyonların genişletilmesi, sivil inisiyatiflerin birikimlerinin paylaşılması

7. Bebekliler Derneği
Amaçları : İlkyardım, arama kurtarma, iletişim
İşbirliği Yaptıkları kurumlar : Belediye, Beşiktaş Kaymakamlığı, Arnavutköy İnisiyatifi, Boğaziçi Üniversitesi

8. Beylikdüzü Beykent Üniv. Acil Yardım Ekipleri
Amaçları : Okulda ve okul çevresinde arama kurtarma çalışması yapmak, ilkyardım eğitimleri, can kurtarma eğitimleri, arama – kurtarma eğitimleri
İşbirliği Yaptıkları kurumlar : DAAK, Bakırköy Doğa Sporları Kulübü, Büyükşehir Belediyesi Sağlık Daire Başkanlığı

9. Cihangir Güzelleştirme Derneği
Amaçları :Eğitim Programları
İşbirliği Yaptıkları kurumlar : İnsan yerleşimleri derneği, Büyükşehir Bel., İTÜ

10. Çağdaş Levent Derneği
Amaçları : Levent beldesinin yürürlükte bulunan kanunlar çerçevesinde konut alanı kimliğine yeniden kavuşturulması, geliştirilip güzelleştirilmesi.

İşbirliği Yaptıkları kurumlar : Muhtarlık, Belediye.

11. Esenkent – Afet Hazırlık ve Kurtarma (Esenak)

Amaçları : Esenkent ve çevresinde meydana gelebilecek bir afete karşı semt sakinlerini bilinçlendirmek, tedbirler almak, arama kurtarma faaliyetlerini organize etmek, Esenkent'te eğitim organize etmek, afet durumu için yerleşim planları yapmak, ilkyardım merkezi kurmak.

12. Esentepe Çevre Koruma ve Kültür Derneği

Amaçları : Esentepe'nin güzelleştirilmesi, çarpık yapılaşmayı önlemek, diğer çevre örgütleri ile organize olarak tüm çevrenin korunması.
İşbirliği Yaptıkları kurumlar : Doğa ile Barış Derneği, Sivil Savunma.

13. Gayrettepe Çevre Kültür ve İşletme Koop.

Amaçları :MAY – Mahalle Afet Yönetimi, MAP – Mahalle Mastır Planı, KET – Kentsel Plan
İşbirliği Yaptıkları kurumlar : Beşiktaş Belediyesi

14. Gazhane Çevre Gönüllüleri Koop.

Amaçları : Depreme mahalle halkını hazırlamak, İlkyardım bilgilendirilmesi, depreme karşı hazırlık, Kadıköy Belediyesinin deprem çalışmalarının tanıtılması
İşbirliği Yaptıkları kurumlar : Kadıköy Belediyesi ve diğer sivil kuruluşlar.

15. Kuzguncuklular Derneği
Amaçları : Çevre dokusunun tahribine yerel anlamda müdahaleci olmak, İlkyardım ve hafif arama kurtarma eğitimi verilmesi. Afete karşı bilinçlendirme için halk eğitimi, gönüllü kayıtları. Afet sonrası çalışmalar için kullanılmak üzere ihtiyaçların belirlenmesi ve temini. Bina yapı ve insan envanterinin çıkarılması. Toplanma alanlarının ve kriz merkezinin belirlenmesi.
İşbirliği Yaptıkları kurumlar : Sivil Koordinasyon Merkezi, Istanbul Semt Sakinleri, Kuzguncuk Sağlık Ocağı.
16. Mahalle Afet Yönetimi Projesi
Amaçları : Muhtar ve mimarın birlikteliğiyle, mahalleliyle bütünleşerek, yerel bir STK çatısı altında mahalleyi depreme hazırlamak. MAY Projesi halen Gayrettepe, Yıldız, İdealtepe, Göktürk, Kemerburgaz, Kemer Country'de uygulanmaktadır.
İşbirliği Yaptıkları kurumlar : Muhtarlıklar, Sivil Kuruluşlar
17. Merter Çevre Koruma ve Güzelleştirme Derneği
Amaçları : Deprem konusunda semt halkının bilinçlenmesini sağlamak amacıyla uzman kişilerin katılımıyla paneller hazırlanması, Arama kurtarma ekibi kurmak. İlkyardım bilincinin geliştirilmesi amacıyla seminerler hazırlamak.
İşbirliği Yaptıkları kurumlar : Muhtarlık, İlçe Belediye ve Kaymakamlığı
18. Moda Gönüllüleri
Amaçları : Moda sakinlerinin olası bir deprem öncesi deprem anı ve deprem sonrası yapması gerekenleri öğretmek, Afet ve bilinçlendirme konusunda STKlarla işbirliğiyle çeşitli paneller ve seminerler düzenlenmesi.
19. Yeşilköy Sivil Girişimi
Amaçları : Olası bir afetin zararlarını en aza indirmek, İlkyardım eğitimi, hafif arama kurtarma eğitimi, ortak iletişim ofisi açılması
İşbirliği Yaptıkları kurumlar : Lokman Hekim Vakfı, İnsan Yerleşimleri Derneği, Hızır Acil Servis

Appendix 3. Non-governmental organizations related to disaster.

A more detailed list of non-governmental organizations related with disasters are given at http://www.iahep.org. The list below is prepared by Açık Radyo (Open Radio).

HEALTH

1	Türk Tabipler Birliği	Dr.H.Serdar İSKİT	5326136931
2	Türk Tabipler Birliği	Dr.Özlem SARIKAYA	5323628107
3	Istanbul Tabip Odası	Tuğrul ERBAYDAR	5325644994
4	Istanbul Tabip Odası	Leyla BAKIRCI	5324814404
5	Kızılay Genel Müdürlüğü	Ömer TAŞLI	5336332096
6	Kızılay Genel Müdürlüğü	Kaan SANER	(312)2454500/ 50 HAT
7	Acil Tıp Derneği	Mesut YARIMBIYIKLI	(212)4650900- 1054- 5352796686
8	Acil Tıp Derneği	Seda USAL	5336482191
9	Anne bebek Sağ.Vakfı	Tülay ADIYILMAZ	(212)2332505
10	Anne bebek Sağ.Vakfı	Güngör SUVEREN	(212)2332505
11	Küçükcekmece Sağ.GrBş	Dr.Murat ŞEKER	(212)5481897
12	Küçükcekmece Sağ.GrBş	Dr.Raşit YILDIRIM	(212)5481897
13	Abidinpaşa sağ.grub.bşk.	Dr.Mustafa Necmi İLHAN	(312)3725054

SEARCH AND RESCUE

1	Çanakkale Ara. Kurt. AcilYard.	Dr.Ufuk HÜŞAN	(286)2171004
2	Çanakkale Ara. Kurt. AcilYa	Dr.Hülya İLHAN	
3	Fransız gön.ara.kurt.ekibi	Giray GÜNGÖR	(212)4493300
4	Gölcük GESOTİM ara.kur	Tuğba ERGENELİ	5356346901
5	Gölcük GESOTİM ara.kur	Necmi KOCAMAN	5323773915
6	Gölcük GESOTİM ara.kur	Ergun ŞAHİN	5356346901
7	Gölcük GESOTİM ara.kur	Selahattin ARABACI	5356346901
8	İdeal Tepe Ara.Kurt.Ekibi	Sevinç MERMER	5336291049
9	İdeal Tepe Ara.Kurt.Ekibi	İmran ULUÇ	5362673353
10	K77 yalova arama KurDer	Hüseyin UYGUN	0226 8149072
11	K77 yalova arama KurDer	Necdet DÜVENCİ	
12	Kocaeli Gönüllü İtfaiyeciler	Umut ÖCAL	(262)3246838
13	SAKU	Yalçın ÜLKER	(216)4895755
14	SAKU	Kemal MAHMUTÇEBİ	(216)4895755
15	Secouriste Sans Frontieres Turque	Ayşe Öktener	(0212)3470974
16	Sınırsız arama kurtarma	Ercan MUALLAOĞLU	(212)4493300
17	Sivil İletişim Ağı Derneği	Çiğdem TÜRKOĞLU	532 271 97 97
18	Su altı Kurtar.Destek.Gru	Yıldız YILMAZ	

19	Sultanbey bld.Sivil Savun.	İsmet AKSU	(216)4199579
20	Sultanbey bld.Sivil Savun.	Ednan KAYA	(216)4199579
21	Türk.Ara.Kurt.Plat.Gönüll	Tuğba KOÇAN	5325730916
22	Türkiye Aram.Kurt.Platfor	Levent TÜZEL	(216)4188745
23	Van Arama ve Kurtarma	Ömer Fikret ŞAHİN	0432 216 63 26
24	Van Arama ve Kurtarma	Turhan ALA	0432 216 10 51

CIVIC COORDINATION

1	Afet Koordinasyon Mer.	Dr.Gülsen ATASEVEN	(212)5250641
2	Afete Karş.Siv.Koo.Der.	Şeyda TALU	(212)2923929
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6.2 Community Education and Social Networking

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6.2.1 The Evaluation of the Current situation in Community Education and Social Networking

Disaster management process has several stages. These stages can be conceptualized as, the disaster mitigation, preparedness, response, recovery and rehabilitation phases. For effective and sustainable disaster management it is essential to empower local communities and increase their capacities to cope with various phases of disasters (Dynes 1993, World Conference on Natural Disaster Reduction, 1995). In the long term, for effective mitigation and preparedness it is necessary to inform the community members about the risks of hazards and to empower them with skills and information. Community participation is essential for sustainable disaster management. Therefore, it is necessary to establish community networks and to institutionalize such networks (Habitat International Coalition 1996; Bates et al., 1991; Karancı, Akşit, Sucuoğlu 1996).

Disaster management is not the responsibility of only the State or Local governments. Unfortunately, the current disaster laws and decrees in Turkey, do not give adequate amounts of responsibility to local municipalities and to non-governmental organizations. (Şener, Tezer, Kadıoğlu, Helvacıoğlu, Trabzon, 2002). For effective management, it is important to get the involvement of all sectors (individual, community, local governments, public and private sector, etc) and to adapt an all-hazards approach. (Sözen, Piroğlu, 1999).

For disaster preparedness, the preparedness of the Governorship, District Governorships and the Majorship alone is not sufficient. Using the following principle; “Istanbul will be ready for disasters, when everyone in Istanbul is ready for them”, community members need to be involved in their own safety action plans and their implementations. For this, community education on disaster risks, preparedness, fire fighting, search and rescue, first- aid, disaster psychology and networking needs to be implemented urgently (Akman, Ural, 2001).

Furthermore, it is necessary to communicate to the local community the work that will be carried out in the framework of the “Istanbul earthquake master plan” (by the media, postal system, exhibitions, meetings, etc) and get their evaluations and suggestions (by using questionnaires, meetings, focus groups), and to get their participation in the decision making process (Kadıoğlu, İskender, 2001). As it will be discussed in the following sections, it is important to identify the characteristics of the target population (where they reside, socio-cultural characteristics, level of education, etc), and to delineate channels and methods suitable for reaching them.

The content of community education and social networking involves the following aspects;

- To give an awareness of disasters to all segments of the community,
- To give appropriate awareness education and skills training covering the mitigation, preparedness, response and recovery phases in order to enhance the capacity of local community members in disaster management,

- To conduct networking activities in order to strengthen the connections between NGO's and to facilitate their ownership and participation in disaster management activities throughout all phases of the cycle.

6.2.2 Current Community Education and Networking Practices in Turkey

In Turkey, awareness education and skills training (first aid, search and rescue, healthy living in temporary accommodation after the quake, psycho-social support for the earthquake survivors) programs for disasters has been rather scarce before the 1999 Marmara and Düzce earthquakes. Before 1999, it was accepted that activities related to preparedness, mitigation and response were the duties of a number of public institutions. However, following the 1999 quake it became apparent that the public sector cannot deal with all these and that local participation and empowerment are necessary. Relatedly, community education and networking activities have increased significantly following the 1999 quake.

The General Directorate of Civil Defense is responsible for providing disaster preparedness, search and rescue education to the members of the community. In line with this, every year selected community members are trained. However, these individuals do not voluntarily apply to be trained, they are rather designated as civil defense helpers and are then trained. This is an important problem in the current practices on education. Not being volunteers these designated helpers seem to lack the motivation to learn the necessary skills. However, recently the General Directorate of Civil Defense (e.g.; AKUT; Turkish Nurses Association, etc), and the local Civil Defense Units have made protocols with voluntary individuals and non-governmental organizations and have provided training to them. This is a very favorable improvement in the desired direction. Apart from the General Directorate of Civil Defense, other disaster related education and training programs are generally those that have started following the 1999 quake as specific projects.

In Turkey, we can see that education and community participation and networking efforts has been underway since the Erzincan and Dinar earthquakes. However, these applications had a rather limited scope (Karancı and Akşit, 1999). Karancı and Akşit (1999) project can be given as an example to such programs. This program was undertaken in Bursa in 1998. "Earthquake Preparedness Pilot Project" aimed to increase mitigation and preparedness in Bursa, which is a province situated in the first-degree seismic zone of Turkey, by increasing community awareness and participation. The program aimed to involve all relevant sectors. The participation of local public and private sectors and NGO's in disaster mitigation, preparedness, response and recovery activities was targeted. In line with this target, a working group was formed from the representatives of local public and private sectors, municipalities and NGO's . Local Agenda 21 staff , under the Bursa Metropolitan Municipality, facilitated the working group. The working group prepared an action plan. In order to launch a community awareness program a handbook for training of trainers and a booklet for community members was prepared (Karancı, Akşit, Anafarta, Oğul and Üner; 1999a ve 1999b). However, there were important setbacks in the project. The main issue was the relationship between the local public sector, designated to be responsible for disaster management by current disaster Laws and the Municipality. Another hindering factor was the lack of motivation to conduct mitigation and preparedness activities in Bursa. Furthermore, during the project implementation local and general elections were held and there were changes in the municipality, which led to the dispersion of the working group. An important conclusion from this study was that when local communities do not have adequate awareness and anxiety about future earthquakes it is not possible to carry out sustainable measures. In this project a handbook for trainers was prepared. The handbook contained the following subjects; **"**What is an earthquake? ", "Before the earthquake: Building safety; Family meeting plan; Important family information; Establishing safety in your home; Securing the furniture and their contents; First aid materials; Food and water for emergency situations; light sources; Personal care and hygiene ;", , "What to do/not do during the quake" and finally "After the earthquake: Search and Rescue; Emotional responses of families and their children; temporary settlement" . Information on education methods and strategies and specific drills were provided in the handbook. A booklet, titled as " Lets get ready for earthquakes" to be distributed to community members during the education is also prepared. The booklet contains brief information about the topics covered for the handbook.

Karancı ve Akşit (2002) also conducted a project in the province Çankırı for community education. The Governorship, Civil Defense and Municipality worked together. Initially after individual and focus group interviews, earthquakes, floods and landslides were chosen as important hazards for Çankırı. Subsequently, the handbook for trainers and the booklet for community members developed in the Bursa project, were revised and extended to include the above specified disaster types. After this 95 potential trainers from public and private sector, municipality and NGO's were trained in Çankiri using the training of trainers handbook. Following their training the 95 trainers gave awareness education to nearly 4000 community members. The effects of this training were monitored, by administering a questionnaire to a randomly selected 400 community members and a control group of 400 adults, not taking part in these awareness programs. The results showed that the awareness education increases risk perception, loss expectation and worry about future disasters. It also increases the belief in mitigation and preparedness. However, it does not increase actual preparedness behaviors. The trainers in this program, during the end of project evaluation meeting stated that it would have been more effective if they had audio-visual education materials, and if the education was extended to a longer period of time. Furthermore, they stated that teachers seem to become more effective community disaster awareness educators.

Following the 1999 Marmara-Düzce Earthquakes, a large number of non-governmental organizations organized activities within disaster related areas. Some of them were involved in community disaster education and training activities. Skills, which are mostly needed during and immediately after the earthquake, such as first-aid and search and rescue, were focused upon in these education and training programs. Thus, there doesn't seem to be a systematic program focusing on all phases of the disaster management cycle. Some other examples for these community education programs were; The Kuşadası Arama Kurtarma Ekibi Derneği (KAKEB) (Kuşadası Search and Rescue Association) formed a youth chamber and has given training and practice to 7 000 students; The Turkish Psychological Association prepared a number of booklets on the psychological responses and coping strategies of different groups of survivors. These booklets were distributed in the earthquake area for increasing the awareness of the survivors. Apart from these attempts, some NGO's were established in the earthquake region in order to address the economical, social, and psychological and other difficulties of the survivors. In Kocaeli a project to involve community members as volunteers has been initiated with the collaboration of the Kocaeli Governors' Office, Swiss Development Bank, Provincial Directorate of Civil Defense, İzmit Municipality, Kocaeli University,etc. The project, titled as " District Disaster Support Project"(Mahalle Afet Destek Projesi (MADP), provided a very good example of local participation and planning for disaster management. Within the scope of this project district teams were formed and networks between district teams were strengthened. The project aims to train about 15 district teams equipped with necessary disaster kits and to form connections between thee district support centers and the local crises organization. The education given within the scope of this project includes disaster awareness, disaster psychology, basic fire extinction, first aid and search and rescue skills. Different local institutions carry out the public education. For example, the basic first-aid training is given by Kocaeli Chamber of Medics, basic fire extinction education by İzmit and Gölcük Fire Fighters. Thus, the training resources in the province were utilized.

As can be seen from the above discussions, before the 1999 Marmara earthquake there weren't systematic public education and training programs on disaster mitigation and preparedness in Turkey. An important aspect of community education and training is the adequate training of the trainers. When we examine the training of trainers programs we see a lack of standardized, culturally appropriate and tested training materials. The educational materials that are developed needs to be based on a consideration of different segments of the community and be tailored to different levels. In order to reach all segments of the community the community education program needs to be institutionalized. The education and training programs given by the Directorates of Civil Defense fail to reach all segments of the population. Furthermore, mainly the stages of response and recovery are covered in these programs, whereas, beliefs and actions on mitigation are not strongly presented. Previous programs on community education had a rather limited scope. However, from these applications important principles of community education can be deduced. We have seen the possible role and impact of NGO's in community education following the 1999 earthquakes. In Turkey the principles and processes of adult education have been defined by the decree of offering adult education courses, dated 02/2001-2521. Thus, the Municipalities, Chambers and the NGO's can open adult education courses on disaster mitigation / preparedness by following the rules of this decree, and run programs under the approval of the Ministry of Education.

6.2.3 The Current Situation in Istanbul

Especially following the 1999 earthquakes the important role of community education and local networks has been seen in Istanbul as well. This can be seen from the preparations and community education programs carried out by the Istanbul Governorship, the Great Metropolitan Municipality and all the other district municipalities, the work of a number of NGO's, a number of Chambers and Universities. In this regard it can be stated that there has been important advances in Istanbul. However, coordination is still lacking and needs to be formed for all the education programs. Furthermore, all phases of the disaster management cycle needs to be focused upon. It is also necessary to review all the disaster management and awareness community programs run by different institutions and to come to a standardization of these programs. In the following sections the earthquake education and social networking activities of the Governorship, Metropolitan Municipality, NGO's, Professional Chambers and the Universities will be summarized and evaluated.

Education Programs run by the Governorship

The Ministry of Education, in the year 2000, prepared and distributed 150 000 copies of a booklet on earthquake preparedness and response in schools. Earthquake risks, preparedness and response topics were included in the content of some courses thought at the elementary education level. At the secondary education level these topics were included into the contents of geography courses. In 2001, nearly 2, 9000 teachers attended a disaster management course provided by the Kandilli Observatory. In all schools, following the 12 November Düzce earthquake, this date was set as an anniversary, and earthquake response drills are applied in schools. (JICA and IMM, 2002).

Other activities included the training of the disaster Management Center staff in search and rescue, disaster management principles and disaster preparedness education. (JICA ve IMM, 2002).

Istanbul Governorship is using an FM radio station and is broadcasting at certain time periods every day to increase community awareness on earthquakes. The audience can participate in these programs by posing questions. The programs target different community groups. It is very positive that students and adults are targeted separately in these programs. The programs also focus on news published in the media. Thus, these programs seem to be very effective for increasing community awareness and to provide a motivational basis for participation in further training.

Community Education and Social networking Implementations of the Istanbul Metropolitan and District Municipalities

In order to increase community awareness, in 2001, booklets have been prepared. The booklets focused on mitigation and preparedness. The initial aim was to distribute these booklets in schools. However, since the Ministry of Education and thus the schools are under the administration of the Governorship, the Municipality could not distribute the booklets in schools systematically. This, seems to be an example of lack of coordination and collaboration between different sectors responsible from disaster mitigation and preparedness activities. Instead, the booklets were distributed to community members upon request (JICA ve IMM, 2002). It will be favorable to develop protocols with the Governorship and to integrate community education efforts.

The education and training of volunteers from the community has been carried out by a number of NGO's, supported by district municipalities. It will be very favorable to institutionalize such implementations within sustainable mechanisms.

The Municipality has close alliances with the media. They have a monthly magazine for the citizens. This, magazine has the potential of becoming an important resource for broadcasting information on earthquakes, mitigation and preparedness.

The Emergency Rescue Services, Civil Defense and the Fire Brigade run joint programs on volunteer training. The Emergency Rescue Division of the Municipality has been giving training to volunteer community members. The Civil Defense Division of the Municipality has been giving search and rescue training to students and community members. Certificates are given to the participants of these programs.

As summarized above, The Municipality has programs on first aid, search and rescue targeting students and adult community members. Furthermore, some district municipalities work in collaboration with NGO's to provide training to volunteers at the district level. All these activities seem very promising. However, these programs need to become more systematic, need to cover all phases of the disaster management cycle and standards need to be developed and applied to the education and training materials, content and processes.

Community Education and Social Projects of the NGO's

In Istanbul, a vast number of NGO's have been working actively or are planning to work on disaster preparedness and response since the 1999 earthquake (Selek ve Petal, 2000). For example, Ak Insurance formed an education and simulation center giving free of charge experience and information to students and adults on earthquake preparedness and response.

The NGO's are themselves getting training from the Civil Defense Units. The interest and resources of NGO's can become an important power for municipalities in carrying out community education and training programs and in creating district social networks. However, the material to be used in the education and training programs and the methods need to be developed and standardized so that the work of NGO's becomes more efficient. It is also important to monitor and evaluate the impact of education/training programs. Without careful standardization the education given to community members may give them a sense of pseudo efficiency, which may be quite dangerous in the long run. Thus, the standardization and evaluation of materials and programs seem to be crucial.

District Social Networks

In Istanbul there are a number of district networks formed by various NGO's following the 1999 earthquakes. The district networks generally work on disaster preparedness and risk assessment, developing local search and rescue teams, first-aid seminars, and the development of communication skills and methods. Examples to these are; Altunizade Yurttaş İnisiyatifi (Altunizade Citizen Initiative); Avcılar-Gümüşpala Dayanışma Derneği (Avcılar-Gümüşpala Support Association), Esenkent-Afet Hazırlık ve Kurtarma (Esenak)(Esenkent-Disaster preparedness and Rescue). The district networks work in collaboration with the Directorate of Civil Defense, Governorship, Metropolitan and District Mayoralties, District Heads (Muhtar) in developing and implementing education and training programs.

Following the 1999 earthquakes, there have been very important advancements in social projects in Istanbul. These projects are on community education and social networking conducted by the Istanbul Governorship, Istanbul Metropolitan Municipality, Istanbul Technical University, Bogazici University and some NGO's.

Search and Rescue Groups

In Istanbul there are various search and rescue groups formed by NGO's and voluntary citizens. They get training and support from the Directorate of Civil Defense. Some examples are, Istanbul Yardım Grubu, (Istanbul Support Group), AKUT and AKA.

District Networks

The Istanbul branches of the Chambers of Geology Engineers, Architects, City Planners, Civil Engineers and , Medics are implementing community education programs. It will be fruitful to integrate the work of the Chambers with the master plan to get favorable results, especially on technical education.

Universities

Some universities have important contributions for community awareness education and disaster training. Istanbul Technical University (ITU), Disaster Management Center made a protocol with FEMA. Within the scope of this protocol staff from ITU received training of trainers education program from FEMA, on disaster management. The trainers from ITU, have translated FEMA resource books and has given training to a large number of administrators from Istanbul and other provinces of Turkey. The experience of ITU Disaster Management center staff is an invaluable resource that can be used within the Istanbul Master Plan .Thus, the training of trainers, monitoring and evaluation of programs can be conducted by the ITU staff. Furthermore, ITU started a masters degree program on disaster management. The staff of the Municipality can be trained by this program.

The Bogazici University, Kandilli Observatory and Earthquake Research Institute have been running a community-networking program. The "Disaster Preparedness Education Program" (IAHEP) is a very crucial step in the direction of community education and networking. The evaluation of this project can provide valuable guidelines for the development of district disaster volunteers, education and networking specific for Istanbul.

The Contributions of the Media to Community Education

It is known that the media can play an important role in community awareness programs. Although, there are articles and programs on seismic risks of Istanbul, mitigation and preparedness issues, we cannot say that these are adequate. It is important to stress that the media needs to scrutinize information for scientific validity, otherwise the news can lead to false knowledge and panic (Akman, İskender, Kadıoğlu, Kapdaşlı, Ural, 2001). For this reason it is important to get the collaboration of the media and to offer them awareness and education on ethical issues related to news broadcasting for disasters.

6.2.4 General Evaluation

As discussed in the preceding sections following the 1999 Marmara and Düzce Earthquakes there have been important advances in community education and training programs in Turkey, and in Istanbul. Particularly, the implementations of the Istanbul Metropolitan Municipality and District Municipalities in collaboration with the NGO's are very favorable. In general, the institutionalization of these first steps will render community education more systematic, extensive, abiding with scientific information and sustainable. It is seen that the response and recovery phases are represented more in the current education programs. It is necessary to include mitigation in these programs. It is important to provide a framework for the coordination of different institutions involved in community education, and to develop standards for community education and training programs. It is also necessary to plan extending the education to all segments of the population in Istanbul. Another important issue is the standards for the training of trainers and the monitoring and evaluation of educational activities. Furthermore, the Istanbul Master Plan needs to be known and accepted by the Istanbul residents. Thus, an effective public campaign for the Master Plan needs to be implemented.

6.2.5 The Principles of Community Education

For developing awareness, knowledge and skills on mitigation, preparedness, response and recovery firstly we need to define target populations and the trainers, the content and the methods of the education/training programs, the locations in which education will be delivered, and lastly, necessary arrangements for institutionalizing the programs needs to be specified. In the following sections the principles for these issues will be discussed.

Target Populations

a. **Community Education: It is important that the education reaches all segments of the population. In this respect different age groups ; Children (Basic education), adolescents and youth (high school; University; Apprentices; Military cadets) and adults (women/men; different occupational groups; Elderly population ; Handicapped, etc) need to be targeted as different groups to be educated. It is important to plan to reach women (house-wives) and adults from various socio-economic levels. In order to reach various segments, it is important to have the demographic information (age; gender; occupation; education; household size) of Istanbul, on a street-district basis in GIS medium. This data can be used to plan the basic awareness education and training programs.**

Taking into consideration the traditional roles of teachers as leaders, it is important to involve them as trainers in community awareness raising and training programs.

The students of basic and higher educational institutions need to be targeted and systematic programs need to be developed to expose them to disaster mitigation and preparedness education/training programs. For every school disaster action plans need to be developed. These plans need to be supported by information on other hazards, or secondary hazards that follow earthquakes, such as fires, chemical spills, etc.

Today, the curriculum and educational materials of basic and secondary level educational institutions are not adequate for raising the awareness of earthquake risks, and creating motivation and a knowledge base for mitigation and preparedness. Similarly, the university programs in engineering and social sciences do not give adequate coverage to disaster related themes.

In addition to these, songs, games, plays, films, painting books, education parks should be created for effectively creating a disaster awareness and knowledge base in children.

a. Training/Educating workers who are responsible for emergency management: It is necessary to increase the knowledge and skills of some administrators (Public sector, Municipalities, NGO's) and some professional groups (Fire Brigade staff, Media Workers, Kızılay staff, etc) on disaster management skills. Further training needs to be given to fire brigadiers and civil defense staff. The training can be facilitated if a college similar to the Civil Defense College, in Ankara can be established in Istanbul. The education of these groups takes place in the Disaster Management section of this report.
b. The education of Media Personnel: It is important to provide education to media who has an important role in mitigation, preparedness and response.

The media can have important effects on community preparedness, factors that can increase vulnerability to disaster effects, and preventive measures. They can influence the community members greatly. Therefore, it will be fruitful to provide education to them on mitigation, preparedness and response.

It is possible to create a disaster resilient community by using the television, Internet, radio, magazines and newspapers, shopping bags, electricity ,gas, water and phone bills and billboards. Istanbul Metropolitan Municipality can use all these channels and make an annual work plan of advertisements for building up public disaster awareness (**Kadıoğlu, İskender, 2001)**.

Training of Trainers

For effective community education, it is necessary to select and train potential trainers. The trainers to be selected need to be knowledgeable in disaster related topics, experienced in giving education/training and able to communicate with the target groups.

Training of trainers handbooks need to be prepared and these handbooks should give detailed information on the contents and methods of education. By using the handbook, the trainers need to be trained , evaluated and certificates can be given to trainers in the end of these programs. Since trainers will be trained for particular target populations (e.g.; children; youth, elderly, etc), the certificates should indicate the target group with which the trainer can work.

The Content of the Education

The education should cover all the phases of disasters (mitigation, preparedness, response, recovery) and needs to have a scientific basis. For this reason topics such as, what are disasters, how can disaster damage be mitigated, preparedness, what to do and not to do during disasters need to be covered. Skills needed for preparedness (e.g.; stabilizing furniture, finding safe places, etc) , post-disaster period (e.g.; first-aid; search and rescue, etc) and healthy living and nutrition in temporary settlement period needs to be covered. Furthermore, disaster legislation (e.g.; insurance-DASK; Building codes; Damage assessments etc)needs to be included in the content of such programs.

Education Materials

Booklets to be distributed to community members, administrators and other professional groups need to be prepared. These booklets should cover the material that will be presented in the educational programs. They should be suitable for the levels of different target groups.

Technical language needs to be avoided as much as possible in these booklets. Audio-visual material to support the educational programs (e.g.; posters, short films, etc) and material to be used in the training courses (e.g.; First aid manikins, fire extinguishers, etc) needs to be prepared.

Method of Education

For adult community members, participatory adult education methods , getting the active participation and involvement of the target population need to be used. They should be encouraged to apply what they learn through homework assignments and other exercises. It is not adequate just to distribute booklets. The booklets need to be used as an adjunct to interactive participatory education sessions.

The education needs to be continuous. It is important to provide refreshment courses to both trainers and the community members. In the education of children it is important to consider the characteristics of the particular age group, to introduce entertainment into the programs to increase motivation, and to encourage learning by active involvement.

Institutionalizing Education

It is important to make sure that education reaches different segments of the population. Therefore, the programs should be delivered in easily accessible places. If such places do not exist then they need to be created. In order to reach the adult population, especially housewives places that are very accessible and close to their homes needs to be selected. Through protocols with the Ministry of Education, school buildings can be used for this purpose. Fire Brigade buildings, cultural convention halls, Muhtar's offices in various districts can also be used.

Taking the educational experience of teachers can be used as trainers in providing education to children, youth and adults in various districts. For using teachers as trainer's protocols between the Ministry of Education and the Municipality needs to be developed. In order to provide motivation to the teachers the Municipality can arrange for a payment of the services.

For giving disaster education and training to basic and secondary level students, the Ministry of Education, educational curriculum needs to be revised to include courses on disaster management. In addition to revising the curriculum, teacher-training programs also needs to be revised to include these topics.

The Municipalities can make protocols with the NGO's to facilitate their involvement in the education of their members and other community members.

It is necessary to create interest in various phases of disaster management before launching community education programs. We know that the residents of Istanbul have such an interest and worry to certain degree. Methods to convert this interest and fear into motivation to attend educational programs voluntarily needs to be discovered. Extensive campaigns on the master plan need to be undertaken. With these campaigns the Istanbul Earthquake Master Plan needs to be introduced to all segments of the population. Posters and billboards can be prepared, seminars, panels and conferences can be organized. Similarly, the master plan can be advocated in sports competitions and in various entertainment programs.

In order to convert the basic community education into sustainable district disaster networks, competitions between districts and best case examples can be developed. Municipalities can play a central role in these activities in collaboration with NGO's.

6.2.6 General Evaluation and Conclusions

In Turkey, the provision of community education is mostly within the scope of the public sector (Civil Defense; Ministry of Education etc)and the municipalities and NGO's have not been given adequate responsibility in this area. However, Municipalities, Professional Chambers, NGO's can open adult education courses within the framework of the regulations set forward by the Ministry of Education. Education on earthquakes is provided to basic and secondary school children within the Turkish educational system. However, this education needs to be revised and improved and use applied teaching methods to be more effective. On the other hand, there are no systematic program frameworks to offer earthquake related education to adult community members. The FM radio broadcasts of the Istanbul Governorship, the magazine for citizens published by the Istanbul Metropolitan Municipality and the booklets on earthquakes are some examples which needs to be increased and systematized.

It is important to develop standards of community education and networking, to explore means of reaching various target communities, to get the active participation of local communities and NGO's and to develop standards and materials for the training of trainers. It is also crucial to develop the means for the monitoring and evaluation of various community education programs.

Currently, there are programs implemented in Istanbul to establish district disaster community networks. However, these groups are very few in comparison to all the districts of Istanbul and their sustainability has not been tested. In education programs there seems to be a biased stress to the periods covering during and after the earthquake with the neglect of the mitigation period. In the educational programs within the scope of the master plan, it is important to stress the mitigation period and activities.

Based on the discussions put forward, the following projects can be implemented to ensure that Istanbul residents are aware of the Master Plan and actively get involved in it. The projects are given and described in the next section.

6.2.7 Projects on Community Education and Social Networks

The following projects on community education and social networks can be implemented by the İBB within the framework of the Master Plan.

P1. Campaign for the Istanbul Master Plan
P1.1. Deciding on the campaign activities and the materials that will be used
P1.2. Implementation of the Campaign
P1.3. Evaluation of the Campaign Results

P2. Community Education : Basic Awareness Building
P2.1. Preparation of the Educational Materials
P2.2. Training of Trainers
P2.3. Implementation of Community Education , Monitoring and Evaluation

P3. Providing Disaster Skills Training to Volunteers
P3.1. Preparation of the Educational Materials
P3.2. Selection of Trainers, Training of Trainers and Certification
P3.3. Implementation of Volunteer Skills Training , Monitoring and Evaluation

P4. Networking and Participation of local Community in Disaster Management
P4.1. Preparation of the Educational Materials
P4.2. The Training of Community Facilitator for Community Participation in Disaster Management
P4.3. The Implementation of Community Participation Action Plans, Monitoring and Evaluation

P5. Community Education: Community Awareness Raising Campaigns
P5.1. Deciding on campaign Activities and the Preparation of Materials to be Used
P5.2. Implementation of the Campaign

P1. Campaign for the Istanbul Master Plan

General Aim: To introduce the Istanbul Earthquake Master Plan with all its components to Istanbul residents, aiming for the acceptance of the plan, to increase motivation and participation in its implementations.

Content: Within this project conferences, seminars, workshops, sports competitions, festivals, exhibitions, composition-writing contests in schools and slogan competitions for adults will be carried out to introduce the master plan. Also, posters, short TV spots, shopping bags, electricity, gas , water, and phone bills will be prepared containing information about the master plan. With all these materials and activities the Master Plan will be presented to all segments of the community, NGO's, Media; Professional Chambers, Public and Private sectors so that motivation for mitigation and preparedness is created.

Total Duration*:* 10 months

Target Groups: With the campaign different professional groups (e.g.; teachers, engineers, doctors, planners, soldiers, Media Staff, tradesmen, public workers, universities), members of NGO's and professional chambers, basic and secondary school students, university students, housewives, and retired should be informed about all aspects of the master plan.. It is especially important to present the plan to media workers and to form collaboration with them in planned interventions.

P1.1. Determining the Campaign Activities and Preparing Campaign Materials

Aim: To determine which possible activities will be suitable for the campaign. It is important to select a varied list of activities appealing to natural interests of different target groups. Thus, activities that will be interesting to children, adults, housewives, retired needs to be explored and selected. The material that will be used in the campaign, such as short TV spots and films, posters, and advertisements need to be prepared.

Content: The campaign should include all the components of the master plan and should be presented at different levels for various target groups.

The campaign should cover the following topics:

- What is the situation of Istanbul in terms of earthquake risk and possible consequent
- damage ?
- Why is IBB getting the the "Istanbul Earthquake Master Plan" prepared?
- The importance of community participation in the implementation of the plan.
- The activities that needs to be conducted within the plan in order to render Istanbul a safer city:

- Technical suggested projects (Building assessment, strengthening and infrastructure)
- Administrative implementations
- City planning , development implementations
- Projects in the area of legal framework
- Projects related to the creation of financial resources
- Awareness and skills education and community participation projects.
- Risk and disaster management projects.

Method: Before preparing the campaign materials research on the attitudes and expectations of different target groups will be conducted. The campaign materials will be based upon the results of this survey. Effective messages for different target groups will be built upon these results.

Qualifications: All the material that will be used in the campaign needs to be developed by a team composed of experts of education methods, communication, individual and group psychology in earthquake preparedness, geology and civil engineering and City Planning.

Quantity: The material should cover all aspects of the plan, have three different types of presentations for each component. TV spots, written and visual posters, magazine and newspaper advertisements, and short introductory booklets. From the short booklets 1 000 000 copies are needed to be distributed to various target groups. 500 posters are needed. Seminars, conferences, competitions should be planned for a period of two months and as two activities in each of the 32 boroughs.

Duration: Four Months

Supervision and Approval: The comprehensibility, suitability and adequacy of the material prepared will be reviewed and approved by IBB consultants.

P1.2. The Implementation of the Campaign

Aim: To determine suitable mediums for the campaign, such as TV channels that will be used for the campaign, and other audio-visual media (newspapers, magazines, radio stations) and other mediums (shopping bags, various bills, boards etc). To determine the activities that will be used in various boroughs, to plan and to announce them. To start all the activities simultaneously in the 32 Boroughs of Istanbul.

The Method of the Campaign: The campaign can be carried out by various seminars, conferences, festivals, sports competitions, presentations in the audio-visual media. It is important to create interest and to make repetitions. However, to prevent boredom and to increase the impact, the repetitions should be the presentation of the same topics by different methods. Celebrities for different target groups can also be used in the campaign.

Duration of the Campaign: Four months

The Campaign Materials: The material developed in the P1.a project part will be used.

Implementers of the Campaign: Experts from communication, education, psychology, civil and geological engineering and city planning should form a team for implementing the campaign.

***Approval*:** The implementation of the campaign will be reviewed and approved by IBB consultants.

P1.3. The Evaluation of Campaign Results

Aim: The main aim of the evaluation is to see to what extent the Istanbul Master Plan is presented to different target groups, and the information and attitudes towards it.

Method: Evaluation will be conducted by focus group interviews and questionnaires in different Boroughs of Istanbul. Prior to the evaluation campaign effectiveness indicators will

be specified. The indicators need to be related to information about the campaign, and motivation about mitigation, preparedness and participation.
Duration: *Two months*
Evaluation Tool: Questions on the effect of the campaign and attitudes about the master plan. A questionnaire and focus group questions on these topics will be presented.
Implementers of the Evaluation: Experts on measurement and evaluation, psychology, sociology, and earthquakes will conduct the evaluation.
Supervision**:** The questionnaire and the focus group questions will be approved by the IBB consultants.

GENERAL TECHNICAL SPECIFICATIONS (P1)
Title of the Project: Presenting all aspects of the Istanbul earthquake master plan to Istanbul residents and creating motivation for participation.
Project Budget : (?)

Article 1: PARTIES

The owner of the project is the Client, and the carrier is the Contractor.

Article 2: THE SUBJECT OF THE PROJECT

To present the Istanbul Master Plan to Istanbul residents, media, NGO's and professional groups in order to increase their motivation for disaster management and facilitate their participation. For this, short films and spots in the audio-visual media , various seminars, conferences , festivals, short brochures and posters will be prepared and distributed to all target populations. This will create an awareness and motivation for the implementation of the master plan.

Article 3: TECHNICAL STAFF

In this project a minimum of six experts from the disciplines of communication, psychology, sociology, civil engineering, geology engineering, city planning and measurement and evaluation have to work as a team to develop the material and the programs for the campaign and to evaluate the effects of the campaign. In order to ensure that the campaign is run effectively staff will be employed for all the duration (i.e.: 10 months) of the project.

Article 4: MATERIALS

All the Campaign materials will be developed and prepared by the contractor. Audio-visual media mediums, billboards, conference rooms will be provided by the client.

Article 5: WORK METHAOD AND PROGRAM

The campaign will be launched after the preparation of all campaign materials. The campaign materials need to be attractive to draw attention, has to cover all aspects of the master plan and be suitable for different target groups. The campaign needs to be started in different Boroughs simultaneously; local TV must be used for initial presentation, followed by conferences, seminars, workshops, festivals, sports competitions in various places. At the end of the campaign period, questionnaires will be administered and focus group interviews will be conducted to assess the impact.

Article 7: DURATION OF THE PROJECT

Total duration of the project is 10 months.

Article 8: PAYMENTS

Will be arranged by the Client

P2. Community Education: Awareness Raising

General Aim: To give a basic awareness to Istanbul residents about earthquake risks, mitigation, preparedness and effective response to earthquakes and to enable them to acquire basic information.

Content: Within the scope of this project trainers will be identified, educational material for the trainers and the community members will be prepared, training of trainers program will be implemented, and lastly the trainers will deliver the basic awareness educational program , on mitigation, preparedness , response and recovery to community members from various target groups.

P2.1. Preparation of the Educational Materials

Aim: To prepare the handbook of training of trainers, and a booklet to be distributed to the community members during the educational program and the posters announcing the program will be prepared. Other necessary visual material will also be prepared (e.g.; maps, methods of stabilizing the furniture, etc).

Content: Mitigation and preparedness behaviors prior to earthquakes, how to behave during and after earthquakes. The content that is described below will be included in the training of trainer's handbook and the brochures that will be given to trainees.

- What is an earthquake ?
- What is the earthquake risk for Istanbul and what are the probable losses/damage ?
- Is it possible to mitigate/prepare for earthquake damage/losses ? What can be done?
- Things to do before an earthquake:
    - Establishing the safety of the Buildings (mitigation/ Suitability according to building codes /strengthening/ city plans /Permits/ Natural Disaster Insurance (DASK)
    - Preparing a family re-union plan
    - Securing the safety of the home: Non-structural arrangements, "Earthquake Safety Plan"; Storing necessary materials
    - Things to do during an earthquake (Behavioral and psychological) At home, at work, at school, at open places , at closed public places.
- Things to do after an earthquake
    - How should we behave after an earthquake (Secondary hazards: Gas leakage, fire, etc and protection against them; Keeping away from damaged buildings; Showing respect to others; collaboration with authorities and NGO's)
    - Basic search and rescue principles
    - How to behave if trapped under the rubble ?
    - How to behave during after shocks ?
    - The psychological reactions of families, children and adults.
    - How can we help others physically and psychologically ?
    - How can healthy living conditions be established during temporary settlement ?
- What skill do we need during and after the quakes ? (first-aid; basic search and rescue; fire extinction), the education for these skills will not be given, however the motivation to attend further courses on these skills will be reinforced and courses in which such skills can be learned will be announced.

- General Evaluation:
    - What kinds of setbacks are anticipated in the mitigation and preparedness topics covered during the education ?
    - What kinds of resources are needed to convert what has been discussed during the education into action ?
    - Which institutions give basic skills training, their places, requirements and schedules will be given.

In addition to all the topics listed above, adult education principles and the importance of community education will be given in the trainer's handbook.
In order to announce the education program to the community, to create interest and awareness posters will be prepared. To support the educational program visual material on some of the content, like stabilizing the furniture will also be prepared.
Qualification: The educational material needs to be prepared by a team of experts on adult education, disaster management, psychology, earthquake engineering and geology.
Quantity: 4000 copies of the training of trainers handbook; 2 000 000 copies of booklets to be distributed to community members ; 1500 copies of posters.
Supervision and Approval: The comprehensibility, clarity and the suitability of the educational material will be examined and approved by IBB consultants.
P2.2. Training of Trainers
Aim: To identify suitable trainers to conduct the community education program, to give training to this group by a group of central trainers, to evaluate the trainers and to issue certificates to those who are found to be successful.
The Method of Education: Education will use participatory adult education principles, and will be have a theoretical and applied phase. The education will be given by the central trainers using the "Training of Trainers Handbook" as described in P2.1.
The Duration of the Training: *Two days* (16 hours)
***Number of Trainers to be Trained*:** 2 000 (Each trainer will educate approximately 1 000 individuals).

Educational Material: The "Training of Trainers Handbook" and the "Lets be Ready For Earthquakes" booklets described in P2.1 will be used. Visual material needed for training will also be used.
Trainers: The trainers will be selected from among Civil Defense area teachers in basic level and secondary schools, Civil Defense staff, members of NGO's working in the area of disasters and members of professional chambers. These individuals can participate in the training of trainers program.
***The Qualification of Central Trainers*:** The central trainers need to be graduate of disaster management, civil/geological engineering, education, and city planning, sociology or psychology departments of well-established programs.
***Number of Central Trainers*:** Minimum of 10 central trainers is needed.

Evaluation: The potential trainers who participate in the training of trainers programs will be given theoretical and applied assessment. They will be asked to deliver the education to a group of community members, their application will be observed by the central trainers. Furthermore, they will also be given theoretical examination. Those who are successful will be given a certificate.
***Approval*:** The examinations, the evaluation of the performances of the trainers will be evaluated and approved by the IBB consultants who were involved in the evaluation of the training of trainers educational materials.

P2.3. Community Education Process

Aim: To create a basic awareness in community members on earthquake risks, mitigation of damage , preparedness, response and recovery issues.

Method of Education: The education will be given by using participatory adult education principles, and by the trainers using the Training of Trainers Handbook. At the end of the education the community members will be given the booklets as described in section P2.1.

Duration of the Education: *3 hours*

Number of people who will be educated**:** 2 000 000

Educational Material: The "Training of Trainers Handbook" and "Lets be Ready for Earthquakes" booklets as described in P2.1 will be used. The posters prepared for announcing the education program and the visual material as described previously will also be used.

Trainers: The trainers selected and trained in P2.2 will deliver the community education.

Target Community Groups: Awareness education should be given to individuals from different professions (e.g.; Teachers, Doctors, Engineers, Social Scientists, Tradesman, Religious Workers, etc), to NGO members, housewives, secondary school and university students, retired and elderly population, handicapped (Visual, auditory, orthopedic), to residents of various districts in each borough.

The Qualifications of trainers: The trainers who will deliver education needs to have attended the training program and certificates as described in section P.2.2.

Evaluation: A random sample of community members who received the awareness education will be selected to get their evaluation of the program, and to assess their information on mitigation, preparedness, response and recovery issues.

Approval: The evaluation methods and materials to be used with the community members, the program implementation by the trainers will be approved by IBB consultants.

GENERAL TECHNICAL SPECIFICATIONS (P2)

Title of the Project: "To create an awareness of earthquake risks, mitigation, preparedness and response in Istanbul residents by participatory adult education methods"

Locality of the Project: Istanbul Province and Boroughs

Project Budget : (?)

Article 1: PARTIES

The owner of the project is the Client, and the carrier is the Contractor.

Article 2: THE SUBJECT OF THE PROJECT

To establish awareness in Istanbul population on earthquake risks, mitigation, preparedness and response through a basic awareness raising educational program. To develop educational material to be used in the program, to train trainers, to evaluate and issue certificates to them. Lastly to implement an extensive community education program and to evaluate the impact of the program.

Article 3: TECHNICAL STAFF

In this project a minimum of 15 staff will work to prepare the educational material and to deliver training for the trainers. For delivering community education 2 000 trainers are needed.

Article 4: MATERIALS

Training of trainers handbooks to be used in trainer education, the booklets to be distributed to community member at the end of the education program, posters to announce the education, and visual aids for education. All these will have been developed previously and will be delivered by the client. The client will also provide suitable places for education.

Article 5: WORK METHOD AND PROGRAM

2 000 trainers who will deliver community education will receive a 16 hours training from ten central trainers. Subsequently they will be evaluated and certificates will be issued to successful trainers. Community awareness raising education will be delivered in groups and will take 3 hours. In this education "What is an earthquake ?; "Cab earthquake damage be mitigated ?" , " What can we do to get prepared for future earthquakes ?"; "What to do and not to do during earthquakes" ; "Search and rescue after earthquakes" and "Our physical and psychological health following earthquakes" will be covered. The booklet "Lets be ready for earthquakes" will be distributed to community members who participate in the educational program. After this, a randomly selected group of community members who received the education will be evaluated.

Article 6: THE SUBMISSION OF THE WORK COMPLETED

At the end of the program demographic information on the participants of the education programs and the impact of the education program will be delivered to client as a report.

Article 7: DURATION OF THE PROJECT

Total duration is 12 months.

Article 8: PAYMENTS

Will be arranged by the client.

P3. Basic Skills Training and Implementation for Local Communities: Search and Rescue for Beginners; Non-Structural Preparedness Measures at Home; Physical and Psychological First Aid; Health Principles after Earthquake; Fire Extinguishing

Overall Objective: Volunteers from among adult residents of Istanbul will be trained to acquire and implement skills necessary for earthquake preparedness and intervention.

Contents: Volunteers will be given theoretical and practical training in such skills as First Aid, Fixing and Securing of Household Items, Search and Rescue by members of Civil Defense and Fire Department, concerned NGOs (such as AKUT, Red Crescent and Association of Psychologists), related professional chambers (such as Chambers of Physicians and Civil Engineers).

P3.1. Preparation of Training Materials

Objective: Training of volunteers will be carried out by local trainers who need "Training Manual for Trainers" for their own training as well as for training volunteers. For implementation at household and neighborhood levels, volunteers need brochures for each of the skills they will learn. The title of the brochures for each skill be will be as follows: "Skills for Preparedness and Effective Intervention in Earthquakes: Physical and Psychological First Aid"; "Skills for Preparedness and Effective Intervention in Earthquakes: Fire Extinguishing". Brochures with similar titles will also be prepared for the following skills: Search and Rescue for Beginners, Non-Structural Preparedness Measures at Home; Health Principles after Earthquake. Posters will also be prepared for announcement of skill training workshops.

Contents: Search and Rescue for Beginners; Non-Structural Preparedness Measures at Home; Physical and Psychological First Aid; Health Principles after Earthquake; Fire Extinguishing

Qualifications/Sufficiency*:* Knowledge and experience should be searched for the members of the team to prepare training materials in the following fields: adult education; non-structural preparedness measures for earthquake security; search and rescue, physical and psychological first aid; health principles after earthquake; fire extinguishing.

Quantities: 250 Training Manual for Trainers; 250 from each of the materials necessary for implementation; 25 000 brochures to be distributed to the trainee volunteers; 500 posters.

Explanations: Quality of printing, color of pictures and cover design will be specified in technical specifications.
Assessment and Approval: Appropriateness, understandability and sufficiency of the prepared material will be inspected, evaluated and approved by the expert consultants of the Master Plan implementation.
P3.2. Identification of Trainers
Objective: Identification of Trainers and their Certification
Number of Trainers**:** 250 (Each trainer will train 100 volunteers)
Trainers: Trainers will be selected on the basis their knowledge on the following topics: non-structural preparedness measures for earthquake security; physical and psychological first aid; search and rescue; health principles after earthquake; fire extinguishing. Trainers can be selected from the following institutions and organizations: Civil Defense Provincial Directorate; Members and volunteers from Greater Istanbul Municipality and District Municipalities Fire Departments; Members and volunteers from Red Crescent; Members and volunteers from relevant Civil Society Organizations.
Assessment and Certification**:** Selected trainers will be evaluated on the basis of theoretical knowledge and practical skills. They will be asked to train one group of volunteers by using trainer's manual and evaluation will be carried out on the basis of observations of their performance. There will also be a written exam. Those who succeed in these evaluations will be given trainer certificates in the topics that they are qualified.
Monitoring and Approval: Exam questions, evaluation of exam and implementation performances will be evaluated and approved by the Greater Municipality consultants who prepared training materials.
P3.3. Training of Community Volunteers
Objective: Volunteers from communities in the neighborhoods will be trained to learn skills and know-how in one or more of the following disaster preparedness topics: non-structural preparedness measures for earthquake security; physical and psychological first aid; search and rescue; health principles after earthquake; fire extinguishing.
Training Method: Training of community volunteers will be carried out on the basis of participatory adult education principles, emphasizing both theoretical and practical aspects of the topic and using "Training Manual for Trainers".

Duration of Training: Different time periods for each topic.

Number of people to be trained: 25 000.
Training Material: Training Manual for Trainers as specified and developed in section *P3.1* and brochures; other materials necessary during training sessions.
Trainers: Certified trainers as specified in P3.2 will carry out training.
Qualification of Trainers: Trainers should have trainer certificates as specified in P3.2.
Number of Trainers to train volunteers**:** There will be at least 7 central trainers in each of the six topics specified above totaling 42 central trainers.
Assessment: A random sample of volunteer trainees will be asked to evaluate the training they went through. A short test and practical application will also be given to the sample.
Monitoring and Approval**:** Exam questions, conduct of training of community volunteers and to what extent community benefited from these programs will be evaluated and approved by the Greater Municipality consultants.
GENERAL TECHNICAL SPECIFICATION (P3)
Name of the Project: "Training of Community Volunteers for Earthquake Preparedness and Intervention Skills in Istanbul"
Project Area: District Municipalities of Greater Municipality of Istanbul.
Estimated Project Budget: (?)

Article 1: PARTIES

Owner of the project is CLIENT, the carrier is CONTRACTOR.

Article 2: PROJECT TOPIC

Training of local community volunteers from various neighborhoods of Istanbul to acquire knowledge and skills necessary for earthquake preparedness and intervention in the following topics: Search and Rescue for Beginners; Non-Structural Preparedness Measures at Home; Physical and Psychological First Aid; Health Principles after Earthquake; Fire Extinguishing. The other activities to be carried out are the following: preparation of appropriate training materials, selection and certification of central trainers and training of community volunteers.

Article 3: TECHNICAL PERSONNEL

In order to train all community volunteers from all neighborhoods of district municipalities of Greater Istanbul Municipality 300 persons will be employed for various durations. These people will be employed for the preparation of training materials and training of the community volunteers.

Article 4: MATERIALS

The manual, the brochures and posters have to be developed by the contractor if not already developed by another contractor and provided by the client. The rooms and other accessible spaces will be provided by the client.

Article 5: WORK PROGRAM AND METHOD

After completing the identification and certification of trainers, training of community volunteers will start. The duration of training sessions of each of topic/skill will be determined on a specific basis. The training will be conducted as specified in the Training Manual for Trainers and at the end of the training the following brochures will be distributed: "Skills for Preparedness and Effective Intervention in Earthquakes: Physical and Psychological First Aid"; "Fire Extinguishing"; "Search and Rescue for Beginners"; "Non-Structural Preparedness Measures at Home"; "Health Principles after Earthquake".

Article 6: OUTPUTS OF THE PROJECT

The number of trainers and their socio-demographic characteristics and the number of community volunteers trained and their socio-demographic characteristics will be provided to the Client by the contractor at the end of the project.

Article 7: DURATION OF THE WORK

12 months.

Article 8: PAYMENTS

Payments will be arranged by the client.

P4. Local Community Networking and Community Participation for Disaster Management

Overall Objective: The objective of this project is community networking, development of civil society organizations, instigation of community participation and participatory preparation of action plans and their implementation for the effective intervention of local communities in disaster preparedness and mitigation.

Contents: Preparation of Community Participation Facilitator Manual is initial step for the training and activity of Community Participation Facilitators (CPF). CPFs will be selected form among the trainers successful in community volunteer training, from successful muhtars and members of elderly council and from already existing civil society organizations. They will be trained by using Community Participation Facilitator Manual. They will use Community Facilitator Manual for the preparation of participatory action plans and implementing them by securing community participation at household, apartment, neighborhood, sub district and district levels.

P4.1. Preparation of Training/Education Materials

Objective: Community Participation Facilitator Manual will encapsulate material and methods for training of community participation facilitators, preparation of participatory action plans and implementation in the form of networks of organized communities.

Contents:

Gathering of data and knowledge about local community structures, traditions, values and already existing social relationships are necessary for the successful organization of community participation. For this purpose, the manual will present how to use rapid assessment procedures to collect required data and knowledge.

Secondly, it is necessary to identify local partners, resource persons, key informants for successful organization and networking. The manual will show how to do this.

Thirdly, methods of preparation of participatory action plan will be specified in the manual.

Fourthly, methods of networking and community participation at household, apartment, neighborhood, sub district and district level will be specified.

Community Participation Facilitator should be a practical researcher in order to gather data and knowledge about the community s/he is going to organize. For this purpose a chapter should be included in the manual. Some of the topics in this chapter will be the following:

Knowledge about the local community: Community participation necessitates a delicate networking activity. This requires fieldwork. To carry out fieldwork using rapid assessment procedures, community participation facilitator should be prepared for an objective, non-prejudiced and open positioning in the community.

Priority topics in rapid assessment: Since community participation is for disaster preparedness and mitigation, local knowledge and practices about disasters and especially earthquakes should be assessed. Not only engineering and legal knowledge, but also values, emotions, fears and anxieties should be learned in detail. Additionally already existing networks, civil society organizations should be contacted and harnessed for local community participation. The manual should outline and specify how these will be done.

Methods of Data Gathering and Tapping Local Knowledge: These can be grouped into quantitative and qualitative methods.

Quantitative methods use questionnaires with precoded questions and administer these questionnaires to large samples in order to statistically analyze these data to reach generalizable knowledge. Qualitative methods show how to acquire already existing local knowledge rather than gathering data for analysis. Already existing local knowledge is learned by depth interviews with local key informants and resource persons. Focus-group interviews are used to find out how relatively homogenous groups assess local knowledge and practices about specified topic. The use of both quantitative and qualitative methods in a local community for community participation purposes is called **Rapid Assessment Procedures**. The manual should include simple ways of using rapid assessment procedures.

- The manual should also include methods of identification of partners, stakeholders and resource persons in the local community. These methods could also be used in identifying volunteers and community leaders. It might be also the case that stake holders and partners might be potentially there but their activation might require work by community participation facilitators. This can be titled as **identification of volunteers, and formation of stakeholder and partner groups and personalities.**
- Thirdly, the manual should include ways of **Developing Action Plans**. Action plans are developed in a participatory way through meetings of partners, stakeholders, other community leaders and volunteers. Community participation facilitators should facilitate the emergence of Community Mind minding disaster resistance of community.
- The fourth component that the manual should include is **Institutionalization of Community Participation** at household, neighborhood, sub district and district levels of the Greater Metropolitan City of Istanbul.

Qualifications/Sufficiency: The manual should be prepared by sociologists and psychologists experienced in community participation and disaster management. The same or similar team should train community participation facilitators and volunteers in usage of the manual. This training should be not only at the theoretical level, but also through practical applications in the selected communities.

Quantity: The number of Community Participation Facilitator Manuals to be printed should be equal or more than the number of Community Participation Facilitators. The neighborhood sizes in the districts in Istanbul varies between 5000 and 15000. In some neighborhoods 2 or more CPFs might be required. In short, the number of manuals should be between 600 and 2000 depending on comprehensiveness and intensiveness of the community participation mobilization.

Explanations: *Q*uality of printing, color of pictures and cover design will be specified in technical specifications.

Monitoring and Approval: Appropriateness, understandability and sufficiency of the prepared material will be inspected, evaluated and approved by the expert consultants of the Master Plan implementation.

P4.2. Training of Community Participation Facilitators (CPFs) in Disaster Management

Objective: Identification of Community Participation Facilitators and their training, evaluation and certification.

Training Method: Theoretical education and practical skills training within the framework of participatory adult education will be the focus of attention. Training will be carried out by using Community Facilitator Training Manual.

***Duration of Training*:** Facilitators will be trained in groups of 25-30 for a period of 3-5 days, depending on prior experience of each group. Training will be given to 20-66 groups depending on the size of facilitators to be trained.

Training Material: Community Participation Facilitator Manual developed in P4.1 will be used.

Facilitators: They will be selected from among the civil defense teachers in primary schools, members of relevant civil society organizations, members of relevant professional chambers, social workers and graduates of other social science disciplines and muhtars and members of neighborhood elderly council who are qualified for such work.

***Qualifications of Trainers*:** Members of departments experienced in disaster management, earthquake/disaster research and other relevant social science research, research on civil society organizations and adult education.

***Number of Trainers*:** Two trainers are needed for conducting the education and training of 25-30 facilitator groups.

Assessment: Facilitators will be evaluated theoretically and in terms of application of practical skills. Successful ones will be certified and recruited as community participation facilitators.

***Monitoring and Approval*:** Exam questions, conduct of training of community volunteers and to what extent community benefited from these programs will be evaluated and approved by the Greater Municipality consultants.

GENERAL TECHNICAL SPECIFICATIONS (P4)

Name of the Project: "Local Community Networking and Community Participation for Residents of Istanbul in Disaster Management"
Project Area: District Municipalities of Greater Municipality of Istanbul.
Estimated project Cost: ( )

Article 1: PARTIES

Owner of the project is CLIENT, the carrier is CONTRACTOR.

Article 2: PROJECT TOPIC

This scope of the present project includes community networking, organizing and participatory preparation of action plans and their implementation for the effective intervention of local communities in disaster preparedness and mitigation. Community participation facilitators will be initiating agents of such networking. For the training of community participation facilitators (CPFs) preparation of Community Participation Facilitator Manual is necessary. CPFs will be selected form among the trainers successful in community volunteer training, from successful muhtars and members of elderly council and from already existing civil society organizations. They will be trained by using Community Participation Facilitator Manual which encapsulates material and methods gathering data and knowledge about local communities and training of community participation facilitators, preparation of participatory action plans and implementation in the form of networks of organized communities. Facilitators will be assessed, certified and recruited for community participation in household, neighborhood, sub district and district levels of Istanbul.

Article 3: TECHNICAL PERSONNEL

A team of at least five members should be recruited for the preparation of the manual and selection and training of facilitators. Additionally, auxiliary personnel could also be recruited into the team.

Article 4: MATERIALS

The community participation facilitator manual has to be developed by the contractor if not already developed by another contractor and provided by the client. The rooms and other accessible spaces will be provided by the client.

Article 5: WORK PROGRAM AND METHOD

First step is writing Community Participation Facilitator Manual with a content outlined above. Second step is it's printing as many as the expected number of facilitator.

Third step is selection of candidates for facilitators from among the groups specified above.

Fourth step is education of facilitators in theory and methodology of community participation and networking and training them in practical skills of depth interviewing, focus-group interviewing, arranging and facilitating meetings, facilitation of brain storming, facilitation of development of action plans and so on.

Fifth step is assessment and certification of successful facilitators and their recruitment.

Sixth step is actual work of community participation, networking and organizing for disaster preparedness and mitigation.

Seventh step is monitoring, evaluation and approval activities almost at every step by the consultants of the client.

Article 6: OUTPUTS OF THE PROJECT

The information about the facilitators, the number of meetings and other networking and organizing activities will be provided to the client by the contractor at the end of the project.

Article7: DURATION OF THE WORK

12 months.

Article 8: PAYMENTS

Payments will be arranged by the client.

P5. Adult Education: Social Awareness Campaigns

General Objective: Making the residents of Istanbul aware of the dangers, risks and threat to their buildings, streets, sub districts and districts due to Earthquakes and earthquake triggered disasters such as fire, floods and poisonous matters. The main emphasis will be on making Istanbul residents aware of the fact that they can do something about these threats by being prepared and by engaging into mitigation activities.

Contents: Within the scope of this project, threats and risks of earthquakes and earthquake related disasters and being prepared against them and possibility of reducing losses from them by taking proper measures will be illustrated through the following activities and ways of communication: conferences, seminars, workshops, sports activities, festivals, posters, short TV spots, and advertisements in newspapers. One of the main messages will be the existence of Earthquake Master Plan. Awareness campaigns should be conducted in such a way that already existing civil society organizations such as professional chambers, media institutions and emerging networks and organizations and stakeholders should become partners in Earthquake Master Plan activities.

Duration: 6 months

P5.1. Specification/Identification of Campaign Activities and Preparation of Campaign Materials

Objective: Identification of most effective campaign activities such as conferences, seminars, workshops, sports activities, festivals, posters, brochures, short TV spots, and advertisements in newspapers; identification of their frequency, messages to be written to gas and electricity bills, shopping bags and advertisements and their combinations in time sequences. Campaign

activities and messages should be specified such that all sectors of population should be contacted and reached.
Contents: Earthquake hazard for Istanbul will be the main focus, but earthquake triggered disasters such as fires, floods and poisonous matters should also be included. The target groups should also have a very wide spectrum of adults, children, professional and occupational groups, center and periphery of Istanbul, tourists and so on.
Qualification: The campaign materials, the methods of communication and education to be used during the campaign should be prepared, approved and implemented by a team of experts from fields of psychology, sociology, earthquake engineering, geology, meteorology, urban planning and disaster management.

Duration: Three months.
Quantity: All dimensions of disasters should be exposed at least three times in TV spots, advertisements and posters. 1000000 brochures to be distributed to the people; 500 posters. Seminars, workshops, conferences and competitions should be performed at least four times in 32 districts of Greater Municipality during these two months.
Explanations: **Quality of printing, color of pictures and cover design will be specified in technical specifications.**
Monitoring and Approval: Appropriateness, understandability and sufficiency of the prepared material will be inspected, evaluated and approved by the expert consultants of the Master Plan implementation.

P5.2. Management of the Campaign

Objective: Identification of TV Channels and other media and activities to communicate and distribute messages. Planning and announcement of activities in each district and simultaneous onset of various types of campaign activities.
Method of the Campaign: The campaign should include activities that will appeal to all sectors of society. Campaign should diversify into the following activities: conferences, seminars, workshops, sports activities, festivals, posters, brochures, short TV spots, and advertisements in newspapers, messages to be written to gas and electricity bills, shopping bags and so on. Football matches and concerts by popular singers could be best places for exposure of appropriate messages. Famous personages can also be used for distribution of messages and information. Campaign messages should be conveyed in multimedia context.

Duration of the Campaign: Three months.
Materials of the campaign: Campaign activities, brochures, messages, TV spots and other material described and developed in P5.1 component of the project.
Qualification: The campaign should be carried out by a team of experts from fields of psychology, sociology, communication, education, earthquake engineering, geology, meteorology, and urban planning and disaster management.
Monitoring and Approval: Campaign materials to be prepared and activities to be conducted will be inspected, evaluated and approved by the expert consultants of the Master Plan implementation.

GENERAL TECHNICAL SPECIFICATIONS (P5)
Name of the Project: Awareness Campaigns for Istanbul Residents about Earthquake and other related risks and threats and Possibility of Mitigation and Preparedness
Project Area: District Municipalities of Greater Municipality of Istanbul.
Project Budget: (?)

Article 1: PARTIES
Owner of the project is CLIENT, the carrier is CONTRACTOR.

Article 2: PROJECT TOPIC

Identification of most effective campaign activities such as conferences, seminars, workshops, sports activities, festivals, posters, brochures, short TV spots, and advertisements in newspapers for Earthquake hazard in Istanbul and earthquake triggered disasters such as fires, floods and poisonous matters. The campaign will raise awareness of such groups as adults, children, professional and occupational groups, tourists, members of various media and civil society organizations.

Article 3: TECHNICAL PERSONNEL

The campaign should be carried out by a team of at least five experts from fields of psychology, sociology, communication, education, earthquake engineering, geology, meteorology, and urban planning and disaster management.

Article 4: MATERIALS

Campaign materials will be developed by the contractor. The local media, spot panels and space for conferences, workshops, seminars and space for other campaign activities will be provided by the client.

Article 5: WORK METHODS AND PROGRAM

The first step is identification of campaign activities and preparation of campaign materials. The second step is implementation of campaign program.

Article 7: DURATION OF CAMPAIGN

Six months.

Article 8: PAYMENTS

It will be arranged by the client.

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7 RISK AND DISASTER MANAGEMENT

7.1 Development Of A Framework For Risk And Disaster Management

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7.1.1 Introduction

The "Risk and Disaster Management" study group aims to develop an emergency plan and provide recommendations for reengineering management processes within the scope of the "Istanbul Earthquake Master Plan" project. The emergency plan does not only consider the post-earthquake response actions to mitigate the negative effects of the disaster, but it also considers the planning phase to manage the activities effectively.

Since the main concepts of risk and disaster management are presented in Chapter 6, here we will present the work done on process analysis, response plan and decision support systems.

Istanbul Disaster Management Master Plan considers all possible disasters that threaten Istanbul (such as natural disasters, technologic disasters, political, social and terrorist chaos) and it is the integration of methods and fundamentals that manage and coordinate activities for

- Risk Mitigation
- Preparation and Planning
- Response
- Recovery

In this context, it is the integrated and simultaneous planning and supervision of all activities of public, private institutions, and non-govermental organizations from a common perspective within a sustainable development model.

Moreover, Istanbul Earthquake Master Plan is an extensive plan that focuses on earthquake risk mitigation, first response, and strengthening of building stock in the same context given above.

The Istanbul Emergency Action Plan is on the other hand, is a process that tries to define, plan, execute and supervise the activities, in the response phase;

- Operations/Functions
  - L. Definition of goals/services
  - M. Determination of definitions
- Management policies and strategies
- Administrational structure and organization
  - A. Primary responsible organizations and agencies
  - B. Supporting organizations and agencies
- Authority and responsibility hierarchy
- Procedures and necessary resources

according to regulations and laws in a systematic and extensive way.

Firstly the main principles and processes to be followed throughout the study are determined:

1. Development and reconstruction of national risk and disaster policies is inevitable to reduce loss of life and property.

2. The problems encountered in disaster management fall into authority and responsibility of different decision-makers in various public-private and civil society organizations. In the current administrative organization, not only within the local administrations (Governorship, metropolitan municipality, district municipalities) also within the central government (General Directorate of Disaster Affairs, General Directorate of Civil Defense, General Directorate of Turkey Emergency Management), social solidarity associations (voluntary search and rescue associations, social assistance aid fund), Turkish Armed Forces, representatives of private sectors (TÜSİAD, İSO, İTO, TOBB), neighborhood level voluntary activities, universities and research institutions (TÜBİTAK, MTA), there is an authority and responsibility redundancy and multiplicity.
3. Because of the reasons given below, reengineering the current disaster management is needed :

- Central Decision-Making
- Weakness of coordination
- Unclear definition of duty, responsibility and authority
- Excess of bureaucracy
- Irrational use of resources
- Incapability in transfer of activities in an active and effective manner.

4. First steps for rapid and correct decision-making in preparedness and first response can be summarized as:

- Removal of unnecessary activities with no function
- To simplify the work flow procedures by examining the process flows in institutions
- Development of an authority system that provides "lean" coordination between institutions
- To transfer central authority to local administrations.
- Transferring authority to neighborhood, voluntary, civil society associations to improve service quality and capability.

5. Qualified and expert people should be employed, and salaries, staff system and performance measurement system should be examined periodically.
6. The existing, dispersed law should be unified and updated, the authority redundancy should be eliminated and new regulations that comply with the changing environment should be set.
7. The voluntarism concept should become widespread to improve "Civil Society Consciousness" and "Individual Participation". The voluntary organizations have great responsibility in "being prepared", "public education" and "practices". These duties and responsibilities should be clearly defined, written regulations on increasing importance and power of voluntarism should be investigated.
8. "Living With Disaster" culture and volunteer participation should be improved, education and public practices should be executed with societies having different cultural backgrounds regularly. This may be accomplished by promoting wide and confident public participation.

The main stages of "Process Analysis" that will be followed in development of emergency response plan are summarized as:

STAGE 1: Carrying out the process analysis in a unified structure and system approach, and defining the work flows.

STAGE 2 (Administrative Structure - Personnel Structure): Determination of responsible people and their responsibilities in related institutions, distribution of duties-responsibilities, determination of service flow are presented in Chapter 3.

STAGE 3 (Legal Structure): Examination of existing law and regulations, determination of gaps and requirements, development of suggestions as presented in Chapter 7.

STAGE 4 (Technical Structure): Communication network, communication system, database management, design of automation as discussed in Chapter 2.

STAGE 5 (Technical Structure): Design of decision support systems related with every module:

- Logistic decision support planning
- Psycho-social education and planning

STAGE 6: Self-evaluation of emergency response and preparedness.

STAGE 7: Explanation of earthquake master plan to administrators, related institutions, Press / Application / Practices / Public Education (given in Chapter 9)

STAGE 8: Development of related documentation and release plan.

7.1.2 Disaster Management

Disaster management process is a continuous process that covers the time from one disaster to the next one. This process consists of 4 phases, namely;

- **Risk Mitigation Phase:** When the formation of settlements in Turkey is considered, it is seen that earthquake factor is not seriously and effectively taken into consideration by the residents and decision makers for a long period of time. Preparing the physical environment for the upcoming earthquake, retrofitting the buildings, making resistible against earthquake has not been very successful because of legal, social and economic dilemmas. There are two ways to achieve these: Firstly, it is needed to improve the safety of already existing environment, and secondly the location and construction of new settlements should be done in a manner such that the effect of earthquake will be minimized. This is a long-lasting process, and its success depends on creating common behavior and dedication appropriate to this goal. In this phase, it is required to develop mitigation plans and projects, reinforce the infrastructure, make legal arrangements, set construction inspection standards and create disaster consciousness in public and construction sector.
- **Preparation and Planning Phase:** This phase is an accelerated phase, in which the post-earthquake response and service works are planned, updated and practiced according to earthquake scenarios. The success of these studies depend on the extent of risk mitigation work that has been done. This phase includes the activiites concerning the organization and allocation of all types of resources. The first study is the development of emergency preparation and response plans, planning the key human resources in government, public organizations and emergency management centers that will be involved in these activities. Preparation for earthquake requires having the inventory of personnel and equipment to be utilized. Determination of this inventory depends on the size of the expected risk, and inventory of actions to be realized, that is the the disaster scenarios. The other point to be considered is the determination of institutions or logistical units that will supply the personnel and equipment. It is clear that, just after the earthquake, affected people constitute also an important human resource for search and rescue and first aid operations. For this reason, planning, training and supplying equipment within accessible reach of public are necessary for effective first response. In this phase, works on plannning secure places for discharging

and emergency services, practicing emergency operations, designing warning systems and emergency communication systems, preparing education programs, educating the public, making publications, and updating should be intensified.

- **Emergency Response:** The main objective of emergency response is to move the search and rescue teams to the affected area as soon as possible and rescue as many people as possible. Things to be done simultaneously are to evacuate the injured people, supply food and shelter and medical material immediately, establish temporary medical centers, bury dead people, take measures against secondary disasters, prevent spread of fires, floods if exist, repair communication infrastructure, fix the electricity and water infrastructure to operate, etc. If the disaster management system is readily implemented before the earthquake, it will be easier to cope with the chaos. Time gained and rational usage of human resources prevents further loss of life to some extend. At the disaster moment, **Emergency Response Plans** will be put into practice and **Disaster Management Information Systems** will start to work. Successful organization of response activities depend on the planning and execution of these systems in pre-disaster phases.
- **Reconstruction and Reforming:** After completion of the first aid works, the reconstruction phase starts. In this phase, standard of living should be improved; totally and severely damaged buildings should be demolished, removed and reconstructed in safe places. New areas for settlements, new dwellings should be opened and employment in the affected area should be promoted. Additionally, the changing profile of places should be reevaluated. Renewal of basic services, repairing and reinforcing the buildings, supplying temporary housing, physical and psychological rehabilitation of affected people are the basic subjects that define the rahabilitation reconstruction phase. Reinforcing the construction systems, developing strategies, supporting the scientific studies about disaster experience and information buildup, making plans about reducing the effects of next disaster are the actions to be taken in this phase.

7.1.3 Process Analysis

In the first stage of this study, the functions within the context of emergency response planning are examined from the point of planning, execution, supervision and coordination views.

Some of the activities are carried out by more than one institution, and for some of the activities there are not any responsible institution according to current regulations. To eliminate this indefiniteness and simplify the complex structure, disaster management process has been taken as a single model and main functions and sub-functions related to these main functions have been determined. In this manner, the function – institution mappings given in Table 7.1.1 and 7.1.2 were obtained. After carrying out interviews with authorities, these function - institution mappings were updated. The two-stage Delphi method was applied to test the applicability of the proposed plan. Information need is determined by carrying out questionnaires and interviews with the selected authorities from related institutions. In the light of the information gained in this study, the research team developed models and suggestions empirically.

7.1.4 Work Flow Analysis

In this part, to execute the activities given in the process analysis, work definitions have been made. In this respect, for each function defined in section 7.1.2 "**Work and Workflow Diagrams**" were prepared. With this presentation not only the work-responsibility matching, also all sub-functions forming these main processes, data relationships were defined, so it is possible to study all stages of a work in "Process Analysis" representation.

Table 7.1.1Main processes and sub-functions of mitigation and preparedness – institution relationship

PROCESS	INSTITUTION
1 Determination of Hazards	
1.1 Earthquake observation	
Observation of strong seismic activities, foundation and development of earthquake record networks	B.U. Kandilli Observatory & Earthquake Res. Ins. and Ministry of Pub. Works & Settl.- Lab. Dept.
Observation of microseismic activities and earthquake prediction	B.U. Kandilli Observatory & Earthquake Res. Ins., Ministry of Pub. Works & Settl. and M.M. Soil & Eq. Investigation Dir.
Monitoring the release of hydraulic, radon and geochemical materials	TUBİTAK and M.M. Dir. of Soil and Eq. Investigation
Foundation and development of warning systems	Ministry of Pub. Works & Settl., TÜBİTAK and Universities
1.2 Disaster scenarios	
Preparation of realistic disaster scenarios	M.M. Dir. of Soil and Eq. Investigation and Ministry of Pub. Works & Settl.
1.3 Risk analysis	
Determination of risk that the population, building stock, industrial facilities and natural environment facing to, according to disaster scenarios	M.M. Dir. of Soil and Eq. Investigation and Ministry of Public Works & Settl.
1.4 Settlement plans that form basis for development planning	
Execution of microzonation work	M.M. Dir. of Soil and Eq. Investigation
Preparation of 1/5000 size geology maps	M.M. Dir. of Soil and Eq. Investigation
Preparation of 1/1000 size geology maps	District Munic.
Comparing 1/5000 and 1/ 1000 maps	M.M. Dir. of Soil and Eq. Investigation
Approval	Gen Dir. of Disaster Affairs
1.5 Settlements	
Determination of regions open to disasters, informing public about the counter measures	Ministry of Public Works & Settl. and Gen Dir. of Disaster Affairs - Eq. Investigation Inst.
2. Education and Public Relationships	
2.1 Public Education	
Educating engineers, architects, workmen, apprentices and other technical staff about the disasters	TMMO
Preparation of public education programs to improve the disaster consciousness	Governorship of Istanbul, M.M. AKOM
Preparation and distribution of books and brochures about the earthquake and what should be done before and after the earthquake	Ministries, Governorship, M.M. , MTA and Turkish Psychologists Ass.
Information sharing by Internet, preparation of websites to inform public	Governorship of Ist. AYM, M.M. AKOM
Preparation of seminars and fairs	Governorship of Ist., M.M. AKOM
2.2 Media	
Preparing and broadcasting radio programs to make public conscious	Governorship of Ist. AYM, M.M. AKOM, TRT
Preparing and broadcasting TV programs to make public conscious	Governorship of Ist. AYM, M.M. AKOM, TRT
3 Settlement Planning	
3.1 Determination of risky areas in current settlement areas from the soil and earthquake point of view	
Planning	
Execution of ground- soil research	M.M. Dir. of Soil and Eq. Investigation
Preparation of 1/5000 size geology maps	M.M. Dir. of Soil and Eq. Investigation
Preparation of 1/1000 size geology maps	District Munic.
Informing	
Informing construction planners about the ground conditions	M.M. Dir. of Soil and Eq. Investigation
Informing public about the ground they are living	M.M. Dir. of Soil and Eq. Investigation

Table 7.1.1 Main processes and sub-functions of mitigation and preparedness – institution relationship (cont)

PROCESS	INSTITUTION
Taking measures	
Determination of construction and project principles in disaster areas	Ministry of Public Works and Settl. Technical Investigation & Appl. Dir.
Determination of risky areas and prevention of construction	Ministry of Public Works & Settl.
Making the decision on transferring the settlements in risky areas to safe regions	Council of Ministers
Applying the construction prohibition	M.M., District Munic.
Demolishing buildings that do not obey the construction prohibition rules	M.M., Governorship and District Head
3.2 Revision of development plan	
Planning	
Revision of land use plans	M.M. Direc. of Planning and Reconstruction and Dir. of City Planning
Preparation of regional development plans	M.M. Direc. of Planning and Reconstruction
Informing	
Informing public and official institutions	M.M. Direc. of Planning and Reconstruction
Execution	M.M. Direc. of Planning and Reconstruction
3.3 Post-earthquake permanent housing	
Planning	İller Bank, M.M. .Dir. of City Planning, TOKİ
Resource planning	
Financial and infrastructure planning	İller Bank, M.M. Dir. of City Planning
Material / equipment / location planning	Ministry of Public Works & Settl.
3.4 Temporary housing (Tent cities and prefabricated houses)	
Planning/Preparation	Gen. Dir. of Disaster Affairs and Red Crescent
Resource planning	
Producing plans and projects	Gen. Dir. of Disaster Affairs and Red Crescent
Planning the human resources	Gen. Dir. of Disaster Affairs and Red Crescent
Financial resource planning	Gen. Dir. of Disaster Affairs and Red Crescent
Requirements planning	
Material / equipment / location planning	Ministry of Pub. Works & Settl. and Governorship Provincial Crisis Man. Center and Red Crescent
4 Services Related with the Structures	
4.1 Removal of debris	
Planning	
Planning of debris pouring points	Rural Affairs
Determination of heavy vehicle gathering points and depots	Rural Affairs
Listing the inventory of heavy vehicles and materials belonging to public and private sector and doing necessary planning	Governorship of Istanbul AYM
4.2 Reinforcement of privately owned and public structures – infrastructures	
Determination of repair and reinforcement principles	Gen. Dir. of Disaster Affairs and Prov. Dir. of Public Works
Planning of personnel, vehicle and material for technical building investigation	District Munic. and M.M. Dir. of Reconstruction
Execution of technical investigation studies before earthquake	District Munic. and M.M. Dir. of Reconstruction
Reinforcement of weak structures, according to results of investigation studies	
Informing	
Informing public and official institutions	Universities
4.3 Reinforcement of historical works	
Determination of repair and reinforcement principles	Ministry of Culture, Committee of Monuments, Gen. Dir. of Foundations
Execution of technical investigation studies	
Reinforcement of weak structures	

Table 7.1.1. Main processes and sub-functions of mitigation and preparedness – institution relationship(cont)

PROCESS	INSTITUTION
4.4 Reinforcement of technical infrastructure	
Planning / Execution / Supervision	
Highway Transportation Infrastructure	Regional Dir. of Highways, M.M. Dir. of Road Main. & Repair and District Munic.
Maritime Line Transportation Infrastructure	TDİ
Airway Transportation Infrastructure	DHMİ
Water and Sewage Infrastructure	İSKİ
Natural Gas Infrastructure	İGDAŞ
Communication Infrastructure	Turk Telekom and Private GSM Firms
Electricity Infrastructure	TEAŞ, TEDAŞ and BEDAŞ
4.5 Reinforcement of critical facilities	
Planning / Execution / Coordination / Supervision	
Dams	Ministry of Pub. Works & Settl. (DSİ) and İSKİ
Industrial Facilities	Ministry of Industry and Commerce and Ministry of Energy and Nat. Res.
Energy production, transmission and distribution system	Ministry of Energy & Nat. Res.
4.6 Preliminary damage assessment	
Planning	
Planning of preliminary damage assessment personnel	Ministry of Pub. Works & Settl. and Governorship Provincial Crisis Man. Center
Education of preliminary damage assessment staff	Ministry of Pub. Works & Settl. and Governorship Provincial Crisis Man. Center
4.7 Final damage assessment	
Planning	
Planning of staff to be charged with fixed damage assessment	Ministry of Pub. Works & Settl. - Dir. of Dam. Ass.
Education of staff	Ministry of Pub. Works & Settl. - Dir. of Dam. Ass.
4.8 Insurance and reinsurance	
Determination of strategical policies	DASK
Determination of working principles	DASK
Determination of insurance firms that will sell earthquake insurance	DASK
Determination of indemnity payment principles	DASK
Informing	
Informing public about insurance and reinsurance and taking promoting actions	DASK
Execution of insurance policy sales	Insurance Firms
4.9 Construction supervision	
Investigation of plans and projects of new settlements	M.M. Dir. of Reconstruction , District Munic. and Private Const. Supervision Firms
Supervision of development plans	M.M. Dir. of Reconstruction
Inspection of construction materials and conformity of constructions to projects	
5 Infrastructure	
5.1 Technical Infrastructure	
5.1.1 Water and sewage	
Emergency Response Planning	İSKİ
Planning of human resources	İSKİ
Planning of materials and equipment	İSKİ
Planning of emergency drinking water depots and capacities for emergency	İSKİ
Determination of critical facilities, that need continuous service	İSKİ
Reinforcement	
Inspection of infrastructure before the earthquake	İSKİ

Table 7.1.1. Main processes and sub-functions of mitigation and preparedness – institution relationship (cont)

PROCESS	INSTITUTION
Preparation of reinforcement projects	ISKI
Execution of reinforcement works	İSKİ
Foundation of an information system that can transmit the problems and damage to AKOM	İSKİ
5.1.2 Electricity	
Emergency Response Planning	TEDAŞ and BEDAŞ
Planning of human resources	TEDAŞ and BEDAŞ
Planning of materials and equipment	TEDAŞ and BEDAŞ
Determination of critical facilities, that need continuous electricity service	TEDAŞ and BEDAŞ
Reinforcement	
Inspection of infrastructure before the earthquake	TEDAŞ and BEDAŞ
Preparation of reinforcement projects	TEDAŞ and BEDAŞ
Execution of reinforcement works	TEDAŞ and BEDAŞ
Foundation of an information system that can transmit the damage in electricity network to the main center	TEDAŞ and BEDAŞ
5.1.3 Natural Gas	
Emergency Response Planning	İGDAŞ
Planning of human resources	İGDAŞ
Planning of materials and equipment	İGDAŞ
Determination of critical facilities, that need continuous natural gas service	İGDAŞ
Foundation and development of automatic systems that will stop distribution of natural gas before the earthquake	Universities and İGDAŞ
Reinforcement	İGDAŞ
Inspection of infrastructure before the earthquake	İGDAŞ
Preparation of reinforcement projects	İGDAŞ
Execution of reinforcement works	İGDAŞ
Foundation of an information system that can transmit the damage in natural gas network to main center	İGDAŞ
5.1.4 Communication	
Emergency Response Planning	Regional Dir. of Turk Telekom
Planning of human resources	Regional Dir. of Turk Telekom
Planning of materials and equipment	Regional Dir. of Turk Telekom
Planning of alternative communication means	Regional Dir. of Turk Telekom
Planning of continuous power resources and alternative ways	Regional Dir. of Turk Telekom
Determination of critical facilities that need continuous communication	Regional Dir. of Turk Telekom
Determination of locations where mobile satellite communication systems to be founded and facilities that will take this service after earthquake	Regional Dir. of Turk Telekom
Planning of location and capacity of telephone centers to be founded	Regional Dir. of Turk Telekom
Reinforcement	
Inspection of infrastructure before the earthquake	Regional Dir. of Turk Telekom
Preparation of reinforcement projects	Regional Dir. of Turk Telekom
Execution of reinforcement works	Regional Dir. of Turk Telekom
Foundation of an information system that can transmit the damage in communication network to the main center	Regional Dir. of Turk Telekom
5.1.4.1.1 Mobile communication	
Emergency Response Planning	Private GSM Firms
Planning of human resources	Private GSM Firms
Planning of materials and equipment	Private GSM Firms
Planning of continuous power resources and alternative ways	Private GSM Firms

Table 7.1.1. Main processes and sub-functions of mitigation and preparedness – institution relationship (cont)

PROCESS	INSTITUTION
Planning of alternative communication channels	Private GSM Firms
Determination of locations where mobile satellite communication systems to be founded and critical facilities that will take service after earthquake	Private GSM Firms
Planning of location and capacity of telephone centers to be founded in streets	Turk Telekom and Private GSM Firms
Planning of human and equipment resources for emergency radio communication	Gen. Dir. of Radio
Listing of material and equipment that public institutions and radio amateurs have, for emergency use	Gen. Dir. of Radio
Planning of walkie talkie and radiophone need for health, first aid-search and rescue teams	Ministry of Health, Gen. Dir. of Civil Defense
Foundation of an information system that can transmit the damage in communication network to the main center	Private GSM Firms
5.1.5 Warning systems (Earthquake recording system)	
Observation of strong seismic activities	Ministry of Public Works & Settl. - Lab. Division, B.Ü. Kandilli Obs. And Eq. Research Ins.
Care and repair	Ministry of Public Works & Settl.
Observation of microseismic activities and earthquake prediction	Ministry of Public Works & Settl., M.M. Soil & EQ Research Dir. and Universities
Development of warning systems	Ministry of Public Works & Settl.
Monitoring the release of hydraulic, radon and geochemical materials	TÜBİTAK, M.M. Soil & EQ Research Dir.
Foundation and development of warning systems	Ministry of Public Works & Settl. and Universities
5.1.6 Geographical Information Systems	
Planning of data transmission and updating work on GIS system	Governorship AYM
Education of personnel	Governorship AYM
Data collection	Governorship AYM
Communication	Governorship AYM
Dissemination of data to official institutions and public	Governorship AYM
Promotion of public institutions to base their information system on GIS	Governorship AYM
Supervision of internet based data transmission and updating	Governorship AYM
5.2 Transportation Infrastructure	
5.2.1 Highways	
5.2.1.1 State highways	
Emergency response planning	Regional Dir. of Highways
Planning of human resources	Regional Dir. of Highways
Planning of materials and equipment	Regional Dir. of Highways
Planning of alternative transportation ways	Regional Dir. of Highways
Reinforcement	
Inspection of bridges' and viaducts' resistance against seismic risk	Regional Dir. of Highways
Reinforcement of highways and infrastructure	Regional Dir. of Highways
Establishing a real time continuous monitoring system to follow the traffic flow and damage situation after the earthquake	Regional Dir. of Highways
5.2.1.2 City ways	
Emergency response planning	M.M. Dir. of Transportation Plan.
Planning of human resources	M.M. Dir. of Transportation Plan.
Planning of materials and equipment	M.M. Dir. of Transportation Plan.
Determination of roads and alternatives of critical facilities like fire brigade and hospital,, whose traffic flow should be maintained	M.M. Dir. of Transportation Plan.
Determination first, secondary and tertiary precedence emergency roads, which will be used by emergency teams and vehicles	M.M. Dir. of Transportation Plan.
Reinforcement	
Inspection of bridges, flyovers, tunnels against seismic risk	M.M. Dir. Infrastructure Coord.

Table 7.1.1. Main processes and sub-functions of mitigation and preparedness – institution relationship (cont)

PROCESS	INSTITUTION
Establishing a real time continuous monitoring system to follow the traffic flow and damage situation after the earthquake in arterials and city	M.M. Dir. of Traffic
5.2.1.3 Mass transportation	
Emergency response planning	İETT
Planning of human resources	İETT
Planning of materials and equipment	İETT
Making the necessary agreements with private busses, minibus for emergency collaboration	
Planning of resources for effective usage in emergency	M.M. Dir. of Transportation Plan.
Determination of first precedence routes, vehicles and personnel for emergency	İETT
Establishment of information systems	
5.2.2 Maritime line	
5.2.2.1 Harbors and related services	
Emergency response planning	T.D.İ. Harbor Enterprises
Planning of human resources	T.D.İ. Harbor Enterprises
Planning of materials and equipment	T.D.İ. Harbor Enterprises
Planning of emergency mass transportation services	T.D.İ. Harbor Enterprises
Reinforcement	
Inspection of harbors against seismic risk	T.D.İ. Harbor Enterprises
Reinforcement of harbors	T.D.İ. Harbor Enterprises
Planning of warehousing of foreign and native aids that will arrive by seaway	T.D.İ. Harbor Enterprises
Establishment of information systems	
5.2.2.2 Wharfs and maritime mass transportation	
Emergency response planning	T.D.İ. City Lines and M.M. İDO
Planning of human resources	T.D.İ. City Lines and M.M. İDO
Planning of materials and equipment	T.D.İ. City Lines and M.M. İDO
Planning of emergency mass transportation services	
Determination of routes, vehicles and personnel to be charged in emergency	T.D.İ. City Lines and M.M. İDO
Making necessary agreements with private sea transport firms for cooperation in emergency	T.D.İ.
Determination of locations of floating wharfs	T.D.İ. City Lines and M.M. İDO
Planning of vehicles and personnel that will transport humane aid, search and rescue personnel and equipment	T.D.İ. City Lines and M.M. İDO
Reinforcement	
Inspection of wharfs against seismic risk	T.D.İ. City Lines and M.M. İDO
Reinforcement of wharfs	T.D.İ. City Lines and M.M. İDO
Establishment of information systems	T.D.İ. City Lines and M.M. İDO
5.2.3 Railways	
5.2.3.1 Stations and mass transportation	
Emergency response planning	TCDD
Planning of human resources	TCDD
Planning of materials and equipment	TCDD
Planning of warehousing of foreign and native aids that will arrive by railway	TCDD
Planning of vehicles and personnel that will transport humane aid, search and rescue personnel and equipment	TCDD
Reinforcement	TCDD

Table 7.1.1. Main processes and sub-functions of mitigation and preparedness – institution relationship (cont)

PROCESS	INSTITUTION
Inspection / reinforcement of rail stations against seismic risk	TCDD
Establishment of information systems	TCDD
5.2.3.3 Light railway and Subway	
Emergency response planning	M.M. Dir. of Transportation Plan. and Transp. A.Ş.
Planning of human resources	M.M. Dir. of Transportation Plan. and Transp. A.Ş.
Planning of materials and equipment	M.M. Dir. of Transportation Plan. and Transp. A.Ş.
Planning of emergency mass transportation	M.M. Dir. of Transportation Plan. and Transp. A.Ş.
Reinforcement	M.M. Dir. of Transportation Plan. and Transp. A.Ş.
Inspection / reinforcement of underground system against seismic risk	M.M. Dir. of Transportation Plan. and Transp. A.Ş.
Establishment of information systems	M.M. Dir. of Transportation Plan. and Transp. A.Ş.
5.2.4 Airways	
5.2.4.1 Airports and air transportation	
Emergency response planning	Gov. Airports Enterprise
Planning of human resources	Gov. Airports Enterprise
Planning of materials and equipment	Gov. Airports Enterprise
Planning of warehousing of foreign and native aids that will arrive by airway	Gov. Airports Enterprise
Planning of alternative airports in case of damage in Atatürk and Sabiha Gökçen Airports	Gov. Airports Enterprise
Planning of emergency air freight transportation	Gov. Airports Enterprise
Reinforcement	
Inspection / reinforcement of airports against seismic risk	Gov. Airports Enterprise
Establishment of information systems	Gov. Airports Enterprise
5.2.4.2 Helicopter landing areas and air transportation	
Emergency response planning	
Planning of helicopter landing areas	M.M. Dep. of Transportation Planning
Determination vehicles and personnel to be charged in emergency	TSK
Construction of helipads	M.M. Dir. of Infrastructure Coord.
6. Search and rescue services	
Emergency response planning	
Planning of human resources	Gen. Dir. of Civil Defense
Planning of materials and equipment	Gen. Dir. of Civil Defense
Listing the inventory of equipment, vehicle and trained search and rescue personnel in public, voluntary and private institutions	Gen. Dir. of Civil Defense
Preparation of emergency action plans for effective mobilization in emergency	Gen. Dir. of Civil Defense
Training of search and rescue unions	Gen. Dir. of Civil Defense - Civil Defense College
Training of civil defense personnel in institutions	Gen. Dir. of Civil Defense - Civil Defense College, M.M. Civil Defense
Training of volunteers	Gen. Dir. of Civil Defense - Civil Defense College
Informing, training public about basic search and rescue	Gen. Dir. of Civil Defense
7. Humane Services-Mass Care	
7.1 Sheltering	
Planning	
For temporary sheltering;	
Determination of temporary shelter unit need according to various disaster scenarios	Governorship
Determination of social facilities and capacities that may be used as temporary shelter after disaster	Governorship

Table 7.1.1. Main processes and sub-functions of mitigation and preparedness – institution relationship (cont)

PROCESS	INSTITUTION
For tent cities:	
Determination of tent unit need according to various disaster scenarios	Red Crescent and Governorship
Determination of appropriate locations and capacities for tent cities	Red Crescent and Governorship
Planning of infrastructure for tent cities	Related Institutions
For prefabricated houses;	
Determination of prefabricated house uni need according to various disaster scenarios	Ministry of Public Works & Settl.
Determination of appropriate locations and capacities for prefabricated houses	Ministry of Public Works & Settl.
Planning of infrastructure for prefabricated houses	İller Bank
Establishment of information and recording systems	
7.2 Food, Water and Cloth	
Planning	
Listing of factories and warehouses that produce or store food and making necessary agreements for cooperation in emergency	Prov. Dir. of Agriculture
Listing of firms that store, distribute drinking water and making agreements for cooperation in emergency	İSKİ, DSİ
Planning of location and capacity of inner-city water storage tanks	İSKİ
Listing of firms producing cleaning and hygiene agents and making agreements for cooperation in emergency	Ministry of Health
Determination of warehouse locations, capacities and requirements for storing food, water, cleaning material and clothing	Governorship AYM
Planning of distribution points, where food, water, clothing will be delivered	Governorship AYM
Planning of personnel and vehicle to be charged in the receive, dispatching, inventory and distribution of aid material	Governorship AYM
7.3 Social Services	
7.3.1 Caring old/child/disabled people	
Planning	
Estimating the number of old/child/disabled people that may need care after a disaster	Ministry of Health & Social Ass., Social Services and Child Protection Association
Planning of possible locations and centers to be founded to accommodate old/child/disabled people that need care	Ministry of Health & Social Ass., Social Services and Child Protection Association
Reinforcement	
Investigation of child and old people residences against seismic risk	Ministry of Health & Social Ass., Social Services and Child Protection Association
Reinforcement of child and old people residences	Ministry of Health & Social Ass., Social Services and Child Protection Association
7.3.2 Psychological support	
Planning	
Planning of psychological support center locations	Prov. Dir. of Health, Ministry of Health and Assoc. of Turkish Psychologists
Planning of personnel to be charged in psychological support centers	Prov. Dir. of Health, Ministry of Health and Assoc. of Turkish Psychologists
7.6 Burial works	
Planning	
Determination of empty capacity in current graveyards	M.M. Dir. of Cemeteries
Determination of additional graveyard capacity to be needed according to earthquake scenarios	M.M. Dir. of Cemeteries
Determination of additional graveyard locations	M.M. Dir. of Cemeteries
Planning of personnel and vehicle to be used in burial works	M.M. Dir. of Cemeteries
Planning of sterilization agents and personnel to be used in burial works	M.M. Dir. of Cemeteries
Development of information and recording systems	M.M. Dir. of Cemeteries
7.7 Fuel and gas supply - heating	
Planning	
Planning of fuel oil and heating agents for people that will accommodate in planned tent cities and prefabricated houses	Ministry of Energy and Nat. Res. and Ministry of Agriculture, Forestry and Rural Affairs

Table 7.1.1. Main processes and sub-functions of mitigation and preparedness – institution relationship (cont)

PROCESS	INSTITUTION
7.8 Lightening	
Planning	
Planning of lightening need for people that will accommodate in planned tent cities and prefabricated houses	Ministry of Energy and Nat. Res.
8 Medical Services	
8.1 First aid and ambulance services	
Emergency response planning	
Planning of doctors, nurses and medical personnel	Provincial Direc. of Health
Planning of materials and equipment	Provincial Direc. of Health
Planning of ambulances of state, private, SSK, university hospitals and private ambulance firms and making necessary collaboration agreements	Prov. Dir. of Health and M.M. Dir. of Emergency and Rescue
Planning of neighboring provinces' ambulances	Provincial Direc. of Health
Determination of triage locations	Provincial Direc. of Health
Training civil defense personnel on first aid	Provincial Direc. of Health and Gen. Dir. of Civil Defense.
Educating public officials on first aid	Gen. Dir. of Civil Defense
Educating public on first aid	Gen. Dir. of Civil Defense and M.M. Dir. of Emergency and Rescue
8.2 Immunity works and prevention of epidemic diseases	
Emergency response planning	
Planning of personnel that will work on vaccination and prevention of epidemic diseases	Prov. Dir. of Health and M.M. .Dir. of Health Protection.
Planning of material, equipment, medicine and disinfectant agents	Prov. Dir. of Health and M.M. Dir. of Health Protection.
Planning of dead animal collection works and burial	Prov. Dir. of Agriculture
Planning of drinking water and food control works	Gen. Dir. of Basic Health Services
Educating public about hygiene and protecting themselves against epidemic diseases	Prov. Dir. of Health and M.M. Dir. of Health Protection.
Setting regulations about environment and public health	Ministry of Health and Social Ass.
8.3 Diagnosis and treatment	
Emergency response planning	
Determining the necessary doctor, nurse and medical staff number with bed capacity according to various disaster scenarios	
Planning of personnel	Ministry of Health and Social Ass., Ministry of Work and Social Security and Provincial Direc. of Health
Planning of material and equipment	Ministry of Health and Social Ass. and Ministry of Work and Social Security
Planning of bed capacity in neighboring cities	Ministry of Health and Social Ass. and Ministry of Work and Social Security
Planning of location and capacities of mobile surgery hospitals	Provincial Direc. of Health
Reinforcement	
Investigation of hospitals against seismic risk	The owner of the hospital / related ministry
Reinforcement of hospitals if required	The owner of the hospital / related ministry
Information systems	Provincial Direc. of Health
8.4 Distribution of medicine and medical material	
Emergency response planning	
Determination of medicine requirements according to various disaster scenarios	Provincial Direc. of Health
Medicine and medical equipment requirements planning for hospitals within the city	Provincial Direc. of Health
Listing the inventory of medicine and medical equipment producing, storing firms and making necessary agreements for cooperation in emergency	Provincial Direc. of Health
Determining the locations of warehouses to store medicines coming from neighboring cities in appropriate conditions	Provincial Direc. of Health

Table 7.1.1. Main processes and sub-functions of mitigation and preparedness – institution relationship (cont)

PROCESS	INSTITUTION
Planning of personnel and vehicle to be charged in medical material storage, dispatching and distribution	Provincial Direc. of Health
8.5 Blood Services	
Emergency response planning	
Personnel and vehicle planning	Red Crescent
Planning of blood and blood products requirements according to various disaster scenarios	Red Crescent
Planning of emergency stock for blood centers within the city boundary	Red Crescent
8.6 Morgue services	
Emergency response planning	
Determination of necessary morgue capacity according to various disaster scenarios	Provincial Direc. of Health
Planning of morgue capacities of state, private, university and SSK hospitals within the city boundary	Provincial Direc. of Health
Planning of alternative places that may be used as morgue	Provincial Direc. of Health
Planning of bags for dead body and sterilization agents	Provincial Direc. of Health
Development of record and DNA testing banks to determine the identity of dead people	Ministry of Health
9 Prevention of Secondary Disasters	
9.1 Fire extinguishment	
Planning	
Planning of personnel to be charged in fire extinguishment	Fire Brigade
Planning of material and equipment	Fire Brigade
Training of fire brigade personnel	Gen. Dir. of Civil Defense and Fire Brigade Education Center
Training of public officials about fire extinguishment	Gen. Dir. of Civil Defense
Educating public about fire extinguishment activities	Gen. Dir. of Civil Defense
Measures to be taken for settlements	
Determining the risky regions that are open to fires	Municipality Assembly
Fixing these regions as disaster prone region	Governor or Head of the District
Declaring these regions as prohibited disaster regions	Municipality Assembly
Mitigating risk	
Determination of facilities that produce or store explosive / flammable materials	Fire Brigade, Prov. Dir. of Environment and M.M. Flammable & Chem. Materials Warehouse
Fixing the necessary fire extinguishment and environmental protection equipments that industrial facilities and chemical material producing / storing firms should have present	Fire Brigade, Prov. Dir. of Environment and M.M. Flammable & Chem. Materials Warehouse
Inspection of obedience of firms to these measures	Prov. Dir. of Environment and M.M. Flammable & Chem. Materials Warehouse
9.2 Floods	
Planning	
Planning of personnel	Fire Brigade
Planning of material and equipment	Fire Brigade
Training the staff	Gen. Dir. of Civil Defense and Fire Brigade Education Center
Measures to be taken for settlements	
Determining the risky regions that are open to floods	Ministry of Public Works & Settl.
Fixing these regions as disaster prone region	Council of Ministers
Declaring these regions as prohibited disaster regions	Municipality Assembly
9.3 Landslides	
Planning	Fire Brigade
Planning of personnel	Fire Brigade
Planning of material and equipment	Fire Brigade

Table 7.1.1. Main processes and sub-functions of mitigation and preparedness – institution relationship (cont)

PROCESS	INSTITUTION
Training the staff	Gen. Dir. of Civil Defense and Fire Brigade Education Center
Measures to be taken for settlements	
Determining the risky regions that are open to floods	Ministry of Public Works & Settl.
Fixing these regions as disaster prone region	Council of Ministers
Declaring these regions as prohibited disaster regions	Municipality Assembly
9.4 Environmental Protection	
Planning	
Planning of personnel	Prov. Dir. of Environment
Planning of material and equipment	Prov. Dir. of Environment
Educating public	Prov. Dir. of Environment
Planning of personnel that will measure the nuclear / biological / chemical materials leakage	Civil Defense SAR Teams
Taking measures	
Listing the inventory of firms that the chemical / flammable material stored may cause an explosion or leakage after disaster	Prov. Dir. of Environment and M.M. Flammable & Chemical Materials Warehouse
Fixing the necessary equipment and measures that these type of facilities should have present	Prov. Dir. of Environment and M.M. Flammable & Chemical Materials Warehouse
Inspection of obedience of firms to these measures	Prov. Dir. of Environment and M.M. Flammable & Chemical Materials Warehouse
10 Security Services	
10.1 Traffic control	
Planning	
Planning of personnel	Prov. Dir. of Police and M.M. Dep. of Transp. Planning and Regional Dir. of Highways
Planning of material and equipment	Prov. Dir. of Police - Traffic Service
Training of personnel	Prov. Dir. of Police - Traffic Service
Educating public	Prov. Dir. of Police - Traffic Service
Determination of first precedence emergency roads, emergency roads for hospitals, fire brigades and their alternatives	M.M. Dep. of Transportation Planning
Setting parking bans and traffic signalization and other regulatory measures for emergency roads	M.M. Dir. of Traffic
Planning of traffic control points	M.M. Dir. of Traffic
Establishing real-time highway and main arterial traffic control systems	M.M. Dir. of Traffic and Regional Dir. of Highways
10.2 Preserving security and public order	
Planning	Provincial Directorate of Police
Planning of personnel	Provincial Directorate of Police
Planning of material and equipment	Provincial Directorate of Police
Training of personnel	Provincial Directorate of Police
Educating public	Provincial Directorate of Police
Determining the public buildings, museums, historical works that should be secured against pillage or theft	Provincial Directorate of Police
Determining the shopping malls, banks, supermarkets that should be secured against pillage or theft	Provincial Directorate of Police
Listing schools, dormitories, old people residence that may need urgent response after earthquake	Provincial Directorate of Police
Listing tanks, factories, warehouses that contain chemical material and may cause an explosion or leakage that may threat life and property	Provincial Directorate of Police

Table 7.1.2. Main processes and sub-functions of emergency response– institution relationship

PROCESS	INSTITUTION
1. Education and Public Relationships	
1.1 Media	
Broadcasting educational programs, news by TV, radio, newspaper	Governorship of Istanbul AYM, TRT , Newspapers
Announcing the needs of disaster region by media	Governorship of Istanbul AYM, TRT , Newspapers
Informing disaster victims about aid distribution conditions and requirements to receive aid	Governorship of Istanbul AYM, TRT , Newspapers
2 Settlement Planning	
2.1 Revision of development plan	
Revising the land usage plans	M.M. Dir. of City Planning
Preparing / revising regional development plans	M.M. Dir. of City Planning and Reconstruction
Informing	
Informing public / officials	M.M. Direc. of Planning and Reconstruction
Execution	M.M. Direc. of Planning and Reconstruction
2.2 Post-earthquake permanent housing	
About public residences and disaster related permanent housing;	
Make / get to make researches, projects	Ministry of Pub. Works & Settl.
Make / get to make the main repair	Ministry of Pub. Works & Settl.
Determining project standards	Ministry of Pub. Works & Settl.
Inspect / get to inspect applications providing technical help if necessary	Ministry of Pub. Works & Settl.
Make / get to make plans of infrastructure and public works	Ministry of Pub. Works & Settl.
Make / get to make research, maps, projects and investigations	Ministry of Pub. Works & Settl.
Make / get to make constructions	Ministry of Pub. Works & Settl.
Settling people to permanent residences	Governorship
2.3 Temporary housing (Tent cities and prefabricated houses	
Deciding on the type of temporary housing (tent / prefabricated house / public facilities)	Ministry of Public Works & Settl. Dam. Assessment
Construction of infrastructure	İller Bank and M.M. Dir. of Planning and Public Works
Execution	M M. Direc. of Planning and Reconstruction and Ministry of Public Works & Settl.
Supervision	Ministry of Public Works & Settl.
3 Services Related with the Structures	
3.1 Preliminary damage assessment	
Execution of preliminary damage assessment	Governorship, Police and Prov. Dir. of Pub. Works Dir. of Preliminary Damage Assessment
Determining the building damage situation in neighborhood level	Governorship and Ministry of Pub. Works & Settl. - Dir. of Preliminary Damage Assessment
Supervision / Coordination	Governorship and Ministry of Pub. Works & Settl. - Dir. of Preliminary Damage Assessment
3.2 Final damage assessment	Ministry of Pub. Works & Settl. Dam. Ass. Dir.
Execution of final damage assessment	
Determining the people who will receive fund and according to damage and ownership status	Ministry of Pub. Works & Settl. Dam. Ass. Dir.
Determining the buildings that require repair and reinforcement	Ministry of Pub. Works & Settl. Dam. Ass. Dir.
Determining the buildings to be demolished	Ministry of Pub. Works & Settl. Dam. Ass. Dir.
Supervision	Ministry of Pub. Works & Settl.
3.3 Removal of debris	
Charging the vehicles in gathering points in a coordinative way	Prov. Dir. of Rural Affair and Governorship AYM

Table 7.1.2. Main processes and sub-functions of emergency response – institution relationship(cont)

PROCESS	INSTITUTION
Execution	General Directorate of Highways, Prov. Dir. of Rural Affairs
Debris removal for opening roads	M.M. Dir. of Road Maint. and Repair., Regional Dir. of Highways
Debris removal for search and rescue	Civil Defense and Rural Affairs
Removing the debris generated by totally collapsed and heavily damaged buildings	Rural Affairs and Private Firms
3.4 Insurance and reinsurance	
Payments of compensations to people who paid their insurance premiums	DASK
Supervision	Ministry of Finance
4 Infrastructure	
4.1 Technical Infrastructure	
4.1.1 Water and sewage	
Inspection / repair of damage in water-sewage infrastructure	İSKİ
Supplying water to critical facilities and taking the dirty water	İSKİ
Activating the inner-city water depots and water distribution companies to satisfy the water demand	İSKİ and DSİ
Supplying water to temporary houses and tent cities and taking away dirty water	İSKİ and DSİ
Coordination of activities	İSKİ, AKOM and Governorship
Coordination of aid coming from neighboring cities	ISKI and Governorship
Supervision	Governorship
4.1.2 Electricity	
Inspection / repair of damage in electricity infrastructure	TEAŞ, TEDAŞ and BEDAŞ
Supplying electricity to temporary houses / prefabricated houses and tent cities	TEAŞ, TEDAŞ and BEDAŞ
Supplying electricity to critical facilities	TEAŞ, TEDAŞ and BEDAŞ
Coordination of activities	TEAŞ, TEDAŞ, BEDAŞ and Governorship
Supervision	Governorship
4.1.3 Natural gas - Heating	
Shutoff the natural gas before the earthquake as quick as possible	IGDAŞ
Inspection / repair of damage in natural gas infrastructure	İGDAŞ
Extinguishment of fires caused by failures/ cracks in natural gas network	Fire Brigade
Supplying natural gas and heating agent to temporary houses, tent cities and prefabricated houses	İGDAŞ and Ministry of Agriculture, Forestry & Rural Affairs
Supplying natural gas and heating agent to critical facilities	İGDAŞ and Ministry of Agriculture, Forestry & Rural Affairs
Coordination of activities	İGDAŞ, AKOM and Governorship
Supervision	Governorship
4.1.4 Communication infrastructure	
Inspection / repair of damage in communication network	Reg. Dir. of Turk Telekom
Setting up mobile satellite communication systems, mobile telephone exchange and supplying communication service to critical facilities	Reg. Dir. of Turk Telekom
Founding telephone centers in streets for public use	Reg. Dir. of Turk Telekom
Founding telephone centers in tent cities, temporary houses and prefabricated houses	Reg. Dir. of Turk Telekom
Coordination of activities	Reg. Dir. of Turk Telekom and Governorship
Supervision	Governorship
4.1.4.1 Mobile communication	
Inspection / repair of damage in mobile communication network	Private GSM Firms
Setting up mobile satellite communication systems, mobile telephone exchange and supplying communication service to critical facilities	Private GSM Firms

Table 7.1.2. Main processes and sub-functions of emergency response – institution relationship(cont)

PROCESS	INSTITUTION
Founding telephone centers in streets for public use	Private GSM Firms
Activating emergency radio communication	Gen. Dir. of Radio
Supplying walkie-talkies and other radio communication means to health institutions, first aid- search and rescue teams and ambulances	Gen. Dir. of Radio and Governorship AYM
Supervision	Governorship
4.2 Transportation Infrastructure	
4.2.1 Highways	
4.2.1.1 State highways	
Inspection / repair of damage in highway transportation network	Regional Dir. of Highways
Removing the debris on highway transportation network	Regional Dir. of Highways
Coordination of works	Regional Dir. of Highways and Governorship
Supervision	Governorship
4.2.1.2 City roads	
Inspection / repair of damage in inner-city transportation network	M.M. Dir. of Road Maint. and Repair. and Dir. of Infrastructure Coord.
Monitoring the traffic flow and controlling inner-city roads	M.M. Dir. of Traffic
Preserving the traffic flow and removing the debris on emergency roads	M.M. Dir. of Traffic, M.M. Dir. of Road Maint. and Repair and Dir. of Infrastructure Coord.
Removing the debris on general transportation network	M.M. Dir. of Road Maint. And Repair, Dir. of Infrastructure Coord. and District Munic.
Construction of inner-city roads for tent-cities and prefabricated houses	M.M. Dir. of Road Maint. and Repair and Dir. of Infrastructure Coord.
Coordination of teams	AKOM and Governorship
Supervision	Governorship
4.2.1.3 Mass transportation	
Providing inner-city mass transportation service	İETT
Providing mass transportation to prefabricated houses and tent cities	M.M. Dir. of Transportation Plan., İETT, Private Public Busses, Minibus
Coordination of activities	AKOM
Supervision	Governorship
4.2.2 Maritime Line	
4.2.2.1 Harbors and related services	
Inspection / repair of damage in harbors	T.D.İ. Harbor Enterprises
Receiving, recording and storing humane aid	T.D.İ. Harbor Enterprises
Transportation and dispatching the humane aid	T.D.İ. Harbor Enterprises
Coordination and supervision	Governorship
4.2.2.2 Wharfs and maritime mass transportation	
Inspection of damage in wharfs and sea vehicles	T.D.İ. City Lines and M.M. İDO
Providing sea mass transportation	T.D.İ. City Lines and M.M. İDO, Private Sea Transp. Firms
Opening alternative wharfs and routes to service	T.D.İ. City Lines and M.M. İDO
Transferring humane aid, personnel and patient	T.D.İ. City Lines and M.M. İDO, Private Sea Transp. Firms
Coordination	Governorship and AKOM
Supervision	Governorship
4.2.3 Railways	
4.2.3.1 Stations and mass transportation	
Providing mass transportation	TCDD
Receiving, recording and storing humane aid coming by railway and dispatching	TCDD
Inspection / repair of damage in stations and railways	TCDD

Table 7.1.2. Main processes and sub-functions of emergency response – institution relationship(cont)

PROCESS	INSTITUTION
Coordination and supervision	Governorship
4.2.3.2 Light railway (Tram) and Subway	
Inspection / repair of damage in light railway-tram	Transp. A.Ş.
Providing mass transportation	Transp. A.Ş.
Coordination of services	AKOM and Governorship
Supervision	Governorship
4.2.4 Airways	
4.2.4.1 Airports and air transportation	
Inspection / repair of damage in airports	Gov. Airports Enterprise (DHMİ)
Providing landing service for airplanes carrying aid personnel and humane aid	DHMİ
Receiving, recording and storing humane aid coming by airway	DHMİ
Dispatching patient-wounded people and humane aid	THY and Privately owned Air Transportation Firms
Coordination of services	DHMİ and THY
Supervision	Governorship and Ministry of Transportation
4.2.4.2 Helicopter landing areas and air transportation	
Giving permission for helicopter use	Governorship
Transferring and dispatching patient, aid material and personnel	TSK, Public and Private Institutions
Coordination of services	Governorship
Supervision	Governorship
5. Search and Rescue	
Execution of search and rescue activities	Provincial Search and Aid Committee, Civil Defense Search and Rescue Teams, M.M. Civil Defense
Supplying additional vehicle- material necessities by purchasing, renting or seizing	Governorship
Coordination of native and foreign aid teams	Governorship, Head of the District, Gen. Dir. of Civil Defense, Civil Defense - SAR Teams, Military Forces
Supervision	Governorship
6. Humane Services-Mass Care	
6.1 Sheltering	
Temporary Housing	
To move disaster victims temporarily into planned, undamaged social facilities, schools and dormitories	Governorship
Tent cities	
Founding tent cities	Red Crescent
Providing infrastructure to tent cities	Related Inst. (İSKİ, TEDAŞ, BEDAŞ, Gen. Dir. of Highways)
To settle disaster victims to tent cities	Red Crescent and Governorship
Prefabricated houses	
Founding prefabricated houses	Ministry of Public Works & Settl.
Providing infrastructure	İller Bank
To settle disaster victims	Governorship
Coordination of native and foreign aids	Governorship, Iller Bank and Red Crescent
Supervision	Governorship
6.2 Food, Water and Clothing	
Storing and recording the aid material coming by purchasing, seizing and donation	Governorship, TSK and Red Crescent
Dispatching of aid materials	Red Crescent, TSK
Purchasing, renting, and seizing to meet victims needs	Governorship
Informing people about aid distribution points and ways to receive food, water or clothing aids	Governorship

Table 7.1.2. Main processes and sub-functions of emergency response – institution relationship(cont)

PROCESS	INSTITUTION
Providing meal to tent cities and prefabricated houses	Red Crescent
Providing drinking water to tent cities and prefabricated houses	İSKİ and DSİ
Providing meal to disaster victims	Red Crescent
Providing water to disaster victims	İSKİ and DSİ
Coordination of meal, water and clothing distribution	Governorship and Red Crescent
Supervision	Provincial Search and Aid Committee
6.3 Social Services	
6.3.1 Caring old/child/disabled people	
Determining children / old / disabled people that need care	Governorship
To settle these people in undamaged dormitories, social facilities	Ministry of Health & Social Ass., Social Services and Child Protection Association
Supervision	Governorship
6.3.2 Psychological support	
Founding psychological support centers	Provincial Direc. of Health , Turkish Psychologists Ass., Ministry of Health - Mental Health Dept.
Supervision of services	Governorship and Ministry of Health
6.4 Burial works	
Opening planned new graveyards according to need	M.M. Dir. of Cemeteries
Recording people, that lost their lives	M.M. Dir. of Cemeteries
Burial of dead people and sterilization of graveyards	M.M. Dir. of Cemeteries
Supervision of services	AKOM and Governorship
6.5 Fuel and gas supply - heating	
Determining the heating need of tent cities and prefabricated houses and providing heating agent accordingly	Ministry of Energy and Nat. Res. and Ministry of Agriculture, Forestry and Rural Affairs
Coordination / Supervision	Governorship
6.6 Lightening	
Lightening city, tent cities, prefabricated houses	TEDAŞ, TEAŞ
Supervision of services	Governorship
7 Medical Services	
7.1 First aid and ambulance services	
Execution of first aid services	Provincial Direc. of Health, Gen. Dir. of Civil Defense and M.M. Dir. of Emergency and Relief
Founding triage points and execution of services	Provincial Direc. of Health
Transferring patients with ambulances to hospitals and mobile hospitals	Provincial Direc. of Health and Gen. Dir. of Civil Defense, M.M. Dir. of Emergency and Relief, TSK and Private Ambulance Firms
Coordination of first aid and ambulance services	Provincial Search and Aid Committee - First Aid and Health Services Group
Coordination of additional personnel, equipment and ambulance assistance coming from neighboring cities	Provincial Search and Aid Committee - First Aid and Health Services Group
Supervision of services	Provincial Search and Aid Committee - First Aid and Health Services Group
7.2 Immunity works and prevention of epidemic diseases	
Taking actions to prevent epidemic diseases and vaccination work	Provincial Dir. of Health and M.M. Dir. of Health Protection.
Controlling foods and drinking water	Gen. Dir. of Basic Health Services
Collecting dead animals and disinfection	Gen. Dir. of Basic Health Services and Prov. Dir. of Agriculture, Forestry and Rural Affairs
Coordination of services	Provincial Search and Aid Committee First Aid and Health Services Group
Supervision	Provincial Search and Aid Committee First Aid and Health Services Group

Table 7.1.2. Main processes and sub-functions of emergency response – institution relationship(cont)

PROCESS	INSTITUTION
7.3 Diagnosis and treatment	
Execution of diagnosis and treatment works	Hospitals related to Prov. Dir. of Health, Red Crescent and Military Hospitals
Supervision of treatment services	Hospitals related to Prov. Dir. of Health, Red Crescent and Military Hospitals
Storing and coordinating assistant personnel, vehicle and equipment coming from neighboring provinces	Hospitals related to Prov. Dir. of Health, Red Crescent and Military Hospitals
Execution of patient transfer to neighboring provinces	Hospitals related to Prov. Dir. of Health, Red Crescent and Military Hospitals
Coordination of patient transfer	Provincial Direc. of Health , TSK and Provincial Search and Aid Committee First Aid and Health Services Group
Supervision of patient transfer	Provincial Search and Aid First Aid and Health Services Group
7.4 Distribution of medicine and medical material	
Medical equipment and medicine purchase / seize to satisfy medical material need	Governorship
Storing, recording the medical material obtained by purchasing, seizing or donation	Provincial Dir. of Health , Governorship and Red Crescent
Distribution of medical material according to demands set by hospitals, mobile hospitals and other medical institutions	Prov. Dir. of Health and Governorship
Coordination of services	Provincial Search and Aid Committee First Aid and Health Services Group
Supervision	Provincial Search and Aid Committee First Aid and Health Services Group
7.5 Blood Services	
Getting touch with International Red Crescent and Red Cross Association to satisfy the blood and related needs	Gen Dir. of Red Crescent
Dispatch / distribution of blood, blood products and medical material	Red Crescent
Starting blood donation campaign	Gen Dir. of Red Crescent
Coordination and supervision of services	Gen Dir. of Red Crescent, Governorship
7.6 Morgue Services	
Keeping people who lost their lives in morgues for a specified time and determining their identity	Provincial Direc. of Health
Taking blood/tissue samples from people whose identity could not be determined	Provincial Direc. of Health
Saving / keeping the records	Provincial Direc. of Health
Supervision of services	Provincial Search and Aid Committee First Aid and Health Services Group
8 Prevention of Secondary Disasters	
8.1 Fire extinguishment	
Execution of fire extinguishment and search and rescue activities in residences and industrial facilities	Fire Brigade
Execution of fire extinguishment activities in forests	Gen. Dir. of Civil Defense and Fire Brigade
Execution of fire extinguishment in roads and highways	Regional Dir. of Highways and Fire Brigade
Supplying additional equipment and vehicle if necessary	Governorship
Coordination of local and assistant forces coming from neighboring provinces	M.M. AKOM and Governorship
Supervision	Governorship
8.2 Floods	
Execution of search and rescue operations in residences and facilities	Fire Brigade
Supplying additional equipment and vehicle if necessary	Governorship
Coordination of local and assistant forces coming from neighboring provinces	M.M. AKOM and Governorship
Supervision	Governorship

Table 7.1.2 Main processes and sub-functions of emergency response – institution relationship(cont)

PROCESS	INSTITUTION
8.3 Landslides	
Execution of search and rescue operations in regions where landslide occurred	Fire Brigade
Supplying additional equipment and vehicle if necessary	Governorship
Coordination of local and assistant forces coming from neighboring provinces	M.M. AKOM and Governorship
Supervision	Governorship
8.4 Environmental Protection	
Determination of facilities that cause environmental pollution because of the damage occurred in facility	Prov. Dir. of Environment
Execution of nuclear / biologic / chemical materials' analysis	Civil Defense SAR Teams
Cleaning / taking the chemical material leaking to water reservoirs or sea under control	TDİ Dir. of Shore Security and Prov. Dir. of Environment
Getting the material leakage mixing with air and soil under control	Prov. Dir. of Environment
Coordination of services	Prov. Dir. of Environment and Governorship
Supervision	Governorship
9 Security Services	
9.1 Traffic control	
Activating traffic control points and taking the traffic flow in primary emergency roads under control	Prov. Dir. of Police - Traffic Teams and M.M. Dir. of Traffic
Opening roads of critical facilities like hospitals and fire brigade and emergency roads, blocked by debris, to access.	Regional Dir. of Highways and M.M. Dir. of Road Maintenance And Repair
Providing additional vehicle, equipment by purchasing, seizing or renting to remove debris on roads	Governorship
Coordination of services	M.M. AKOM and Governorship
Supervision	Governorship
9.2 Preserving security and public order	
Preserving the public security, preventing theft and confusion	Provincial Directorate of Police, Gendarmerie
Securing the damaged/undamaged public buildings, historical works, shopping malls, shops against pillage and robbery	Provincial Directorate of Police, Gendarmerie
Determining facilities that threat people's lives and property with leakage, fire or explosion they cause, informing related institutions	Provincial Directorate of Police, Gendarmerie
Securing the aid material and the route they follow	Provincial Directorate of Police, Gendarmerie
Preserving the security in prisons	Gendarmerie, Provincial Directorate of Police
Transferring convicts to safe places if severe damage has occurred in prisons	Ministry of Justice, Provincial Directorate of Police

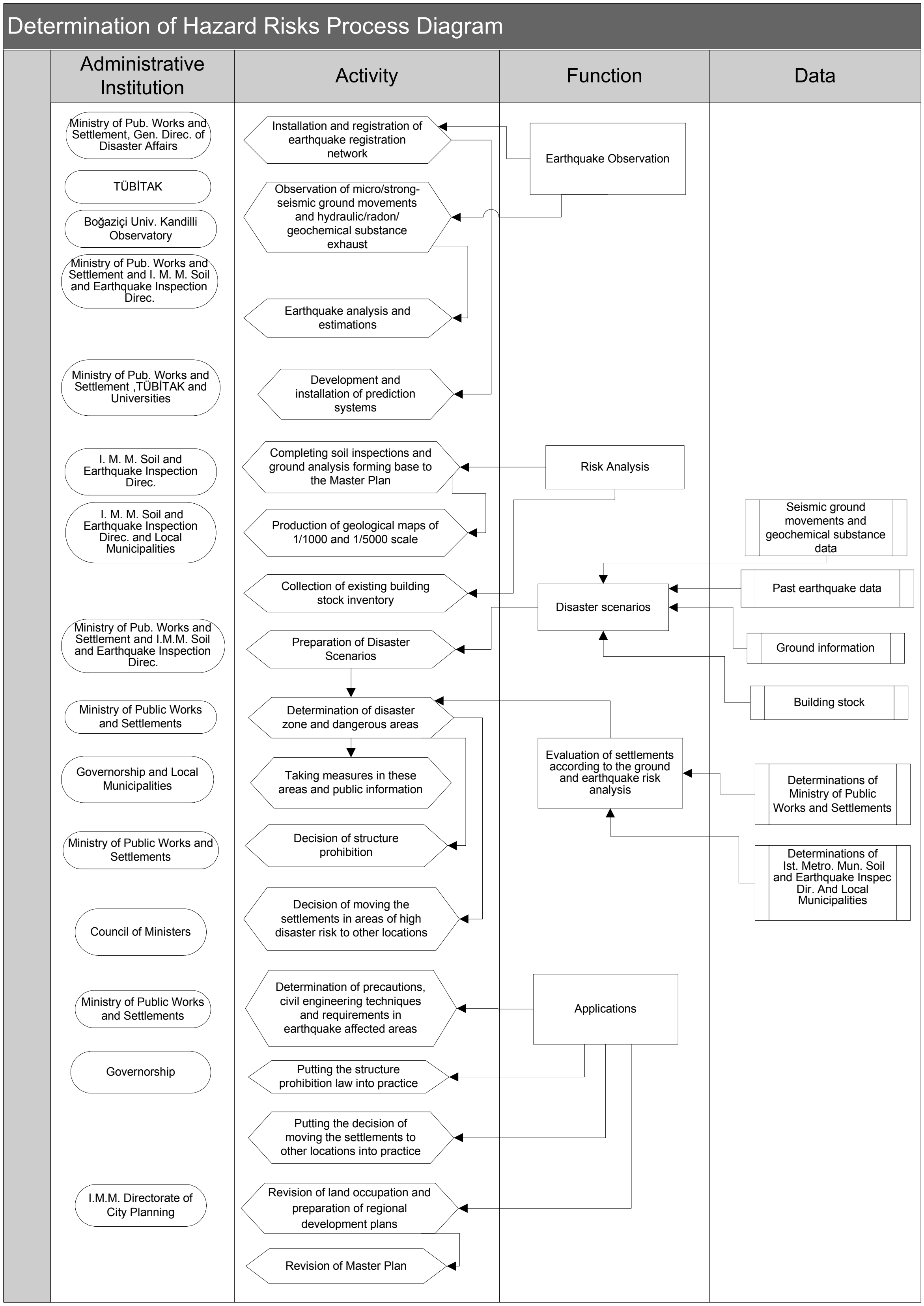

Figure 7.1.1. Process diagram of hazard risks

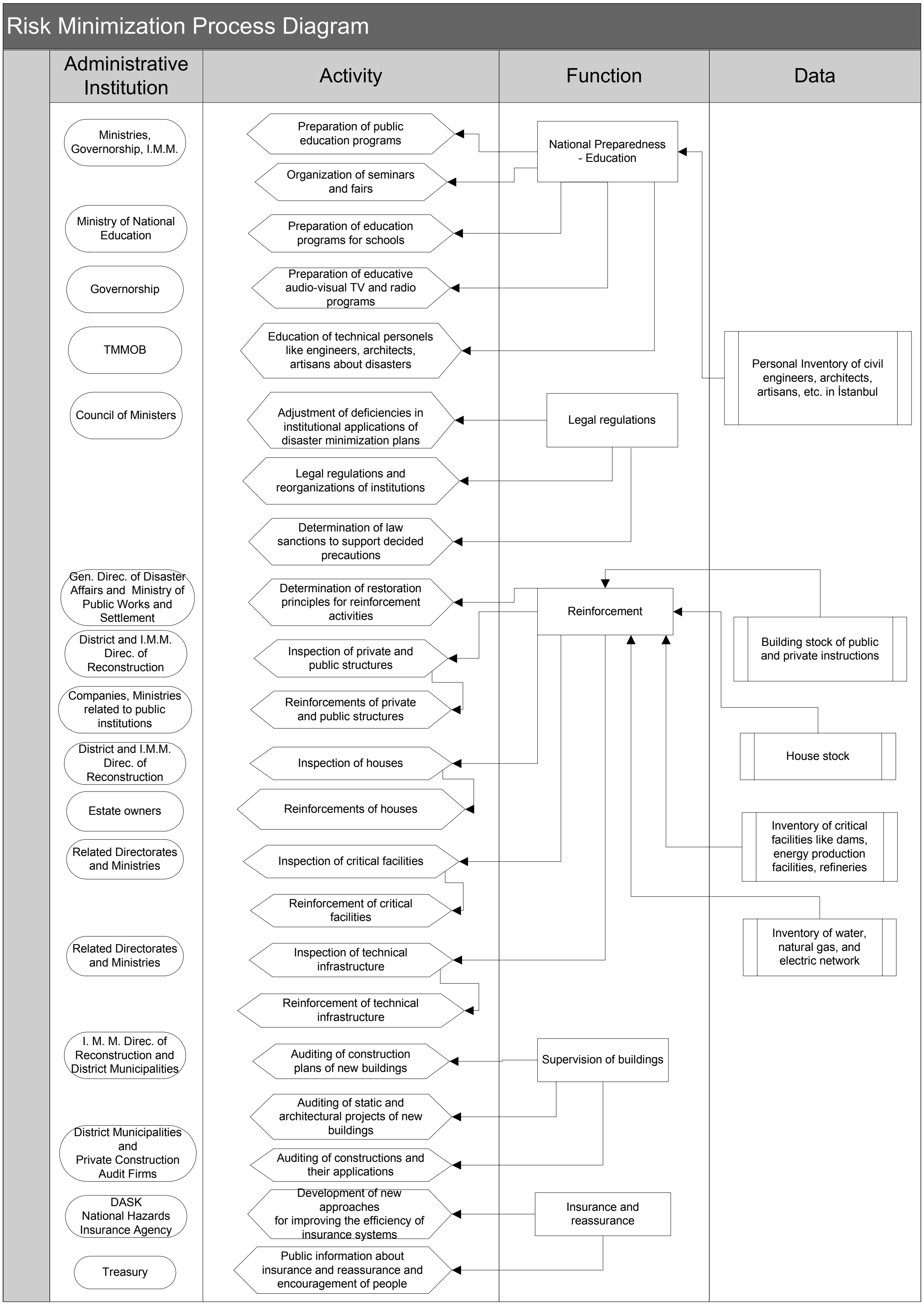

Figure 7.1.2. Process diagram of risk minimization

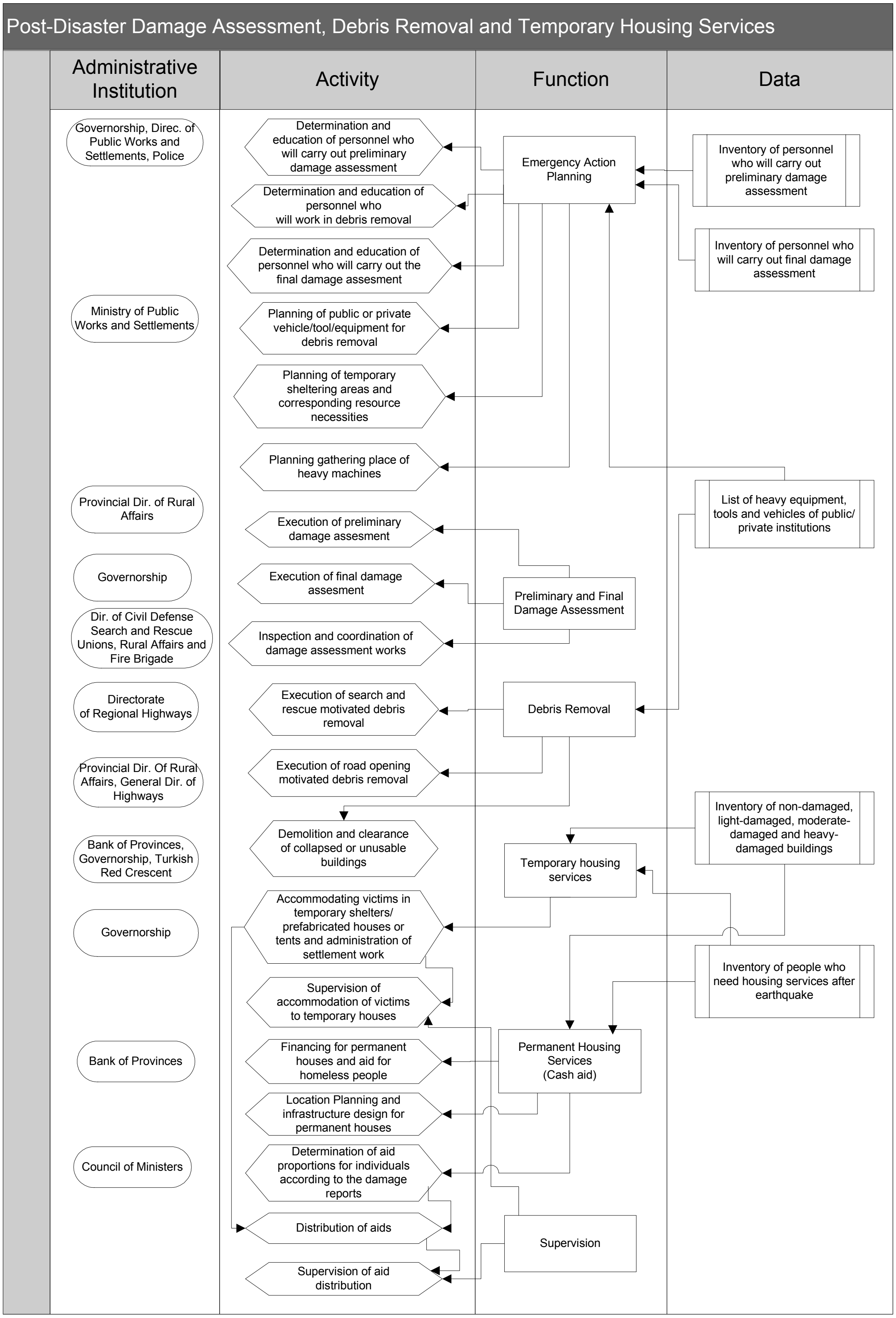

Figure 7.1.3. Process diagram of damage assessment debris removal and temporary housing services

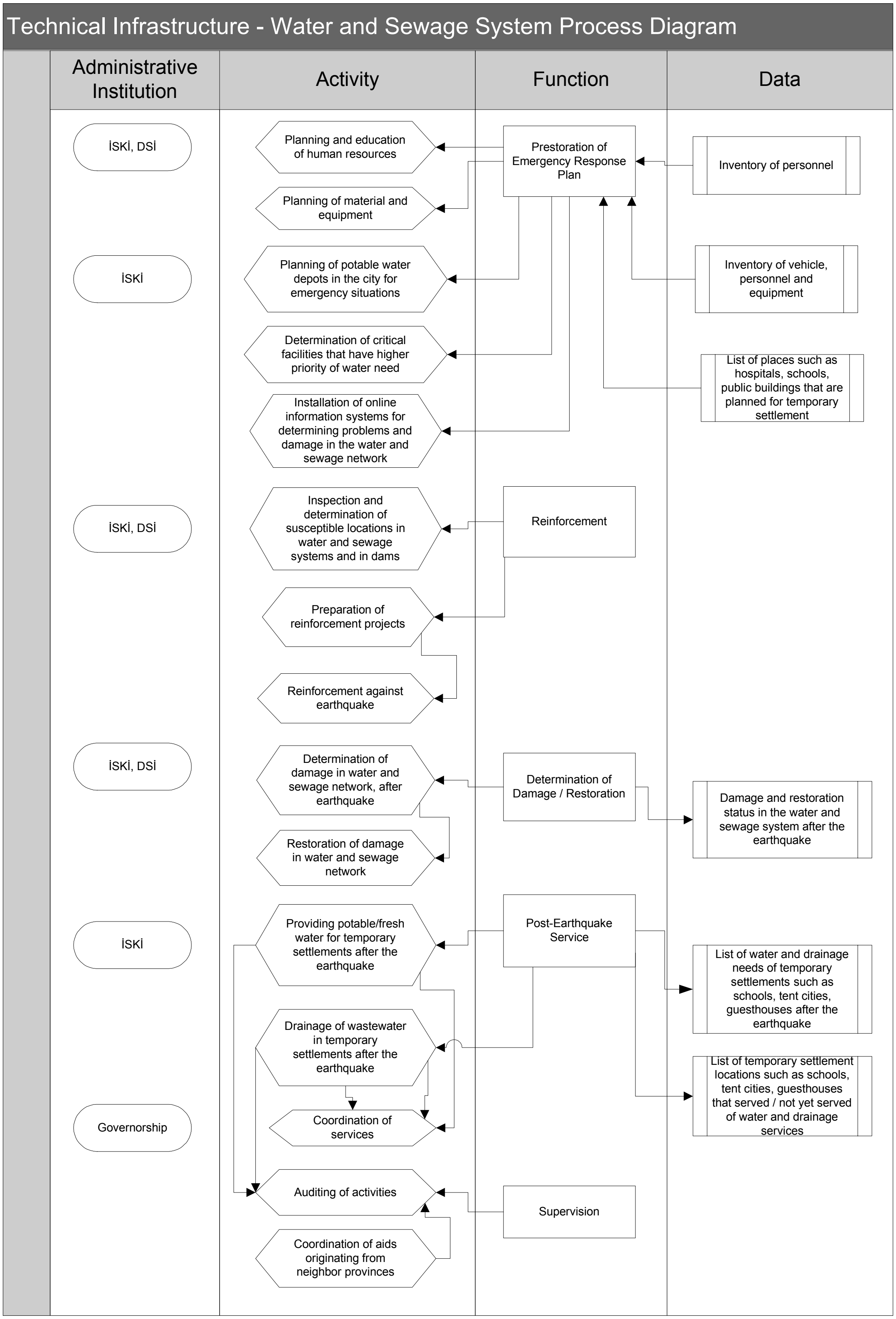

Figure 7.1.4. Process diagram of technical Infrastructure – Water and sewage services

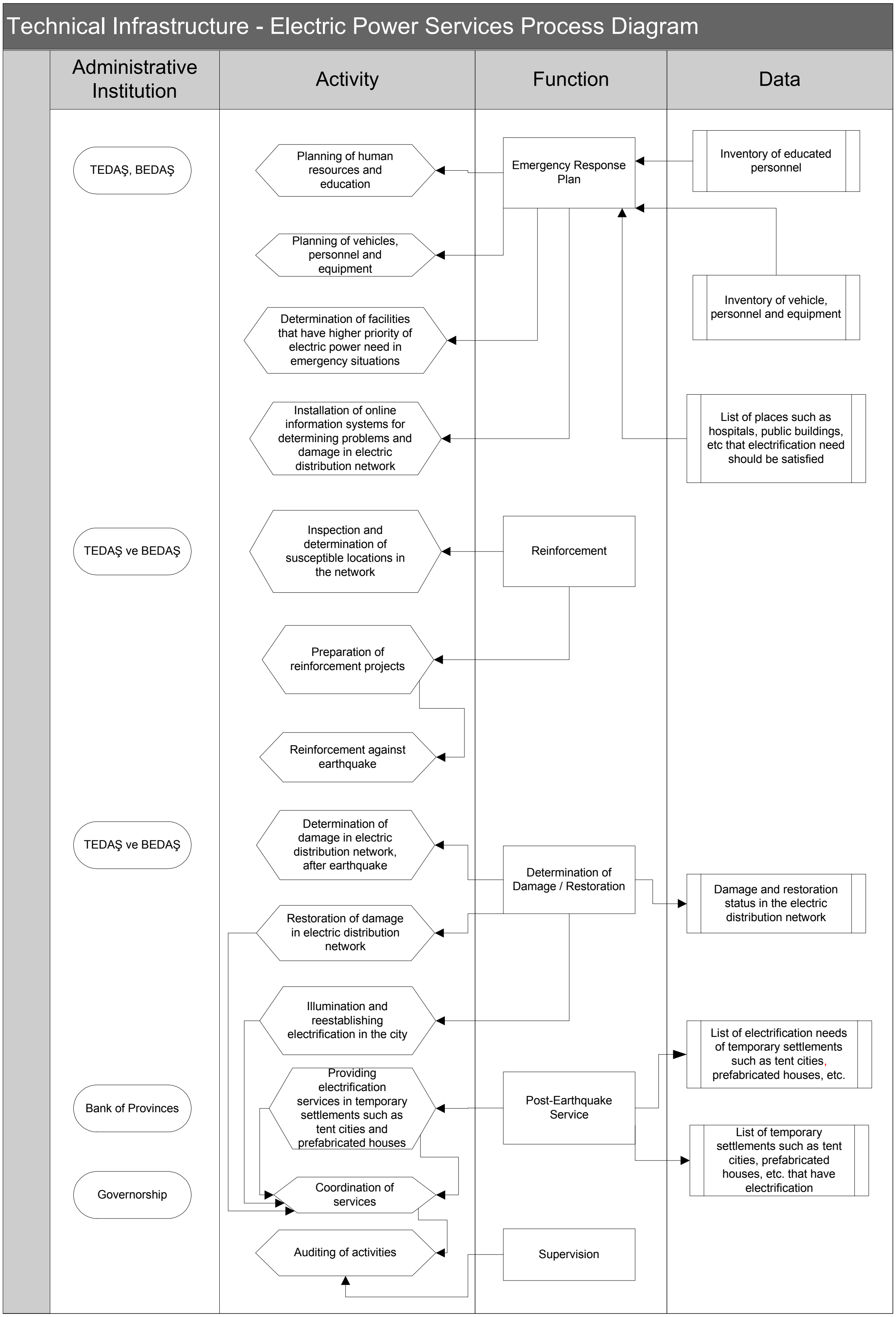

Figure 7.1.5. Process diagram of technical infrastructure – Electric and power services

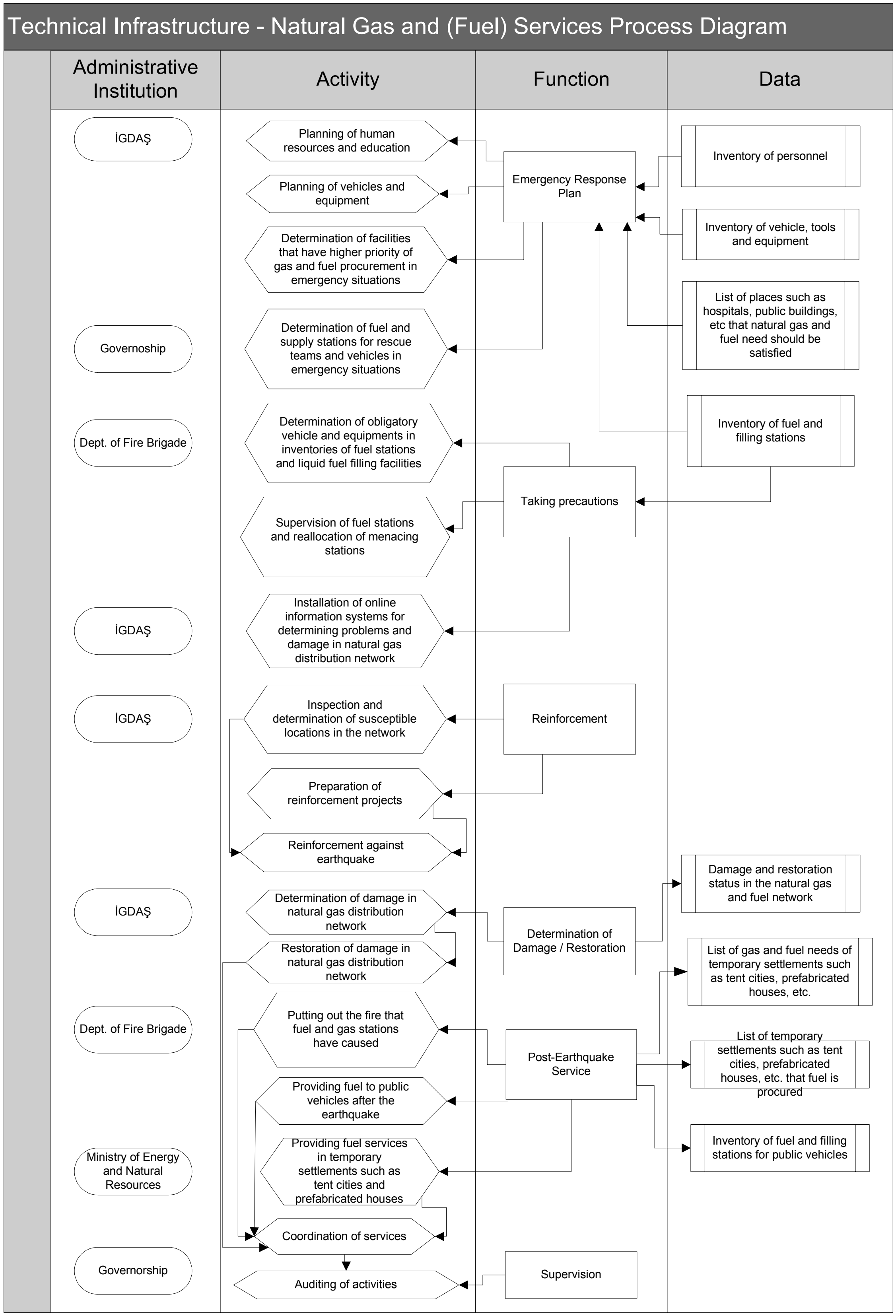

Figure 7.1.6. Process diagram of technical infrastructure – Natural gas and fuel services

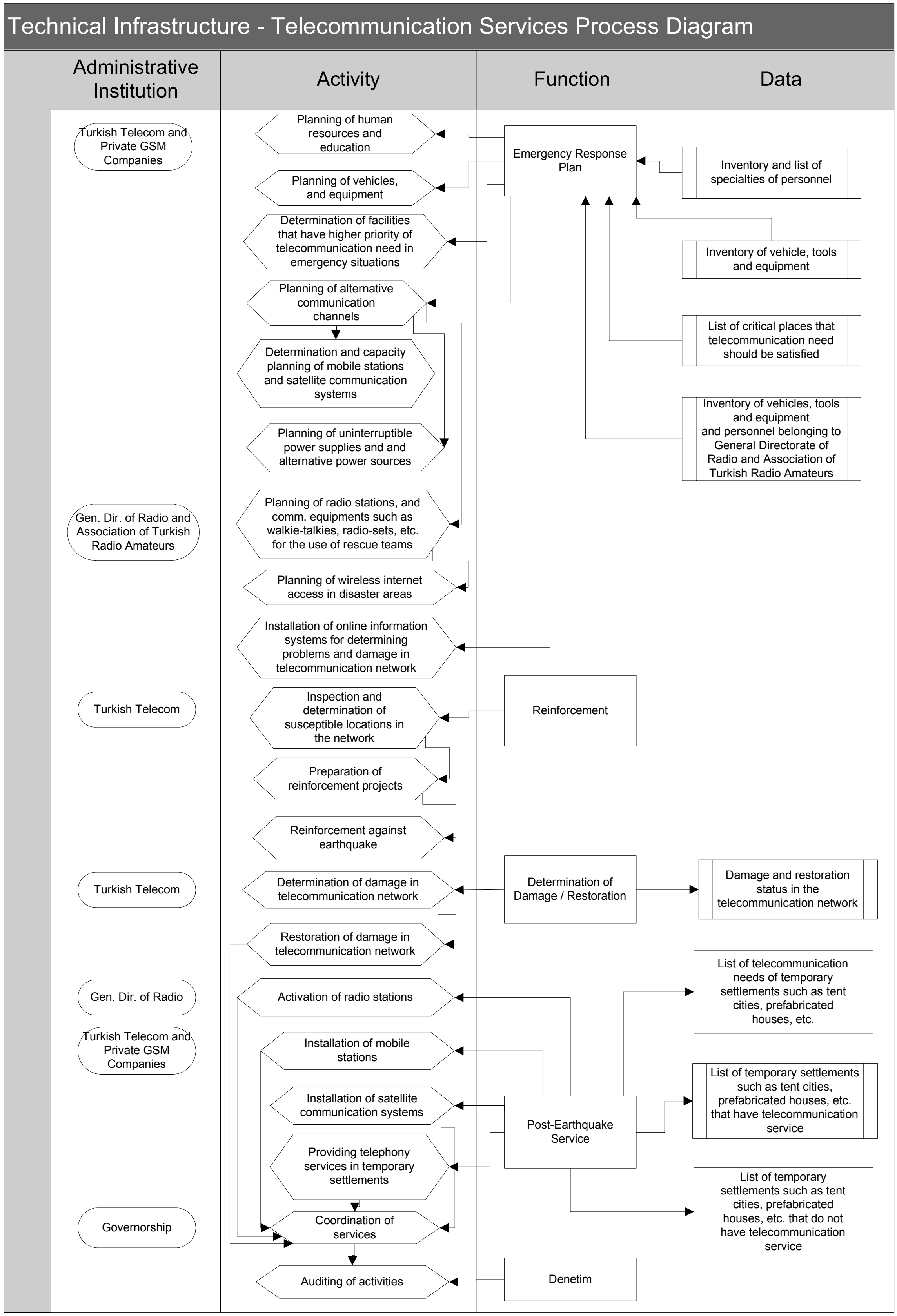

Figure 7.1.7. Process diagram of technical infrastructure – Telecommunication services

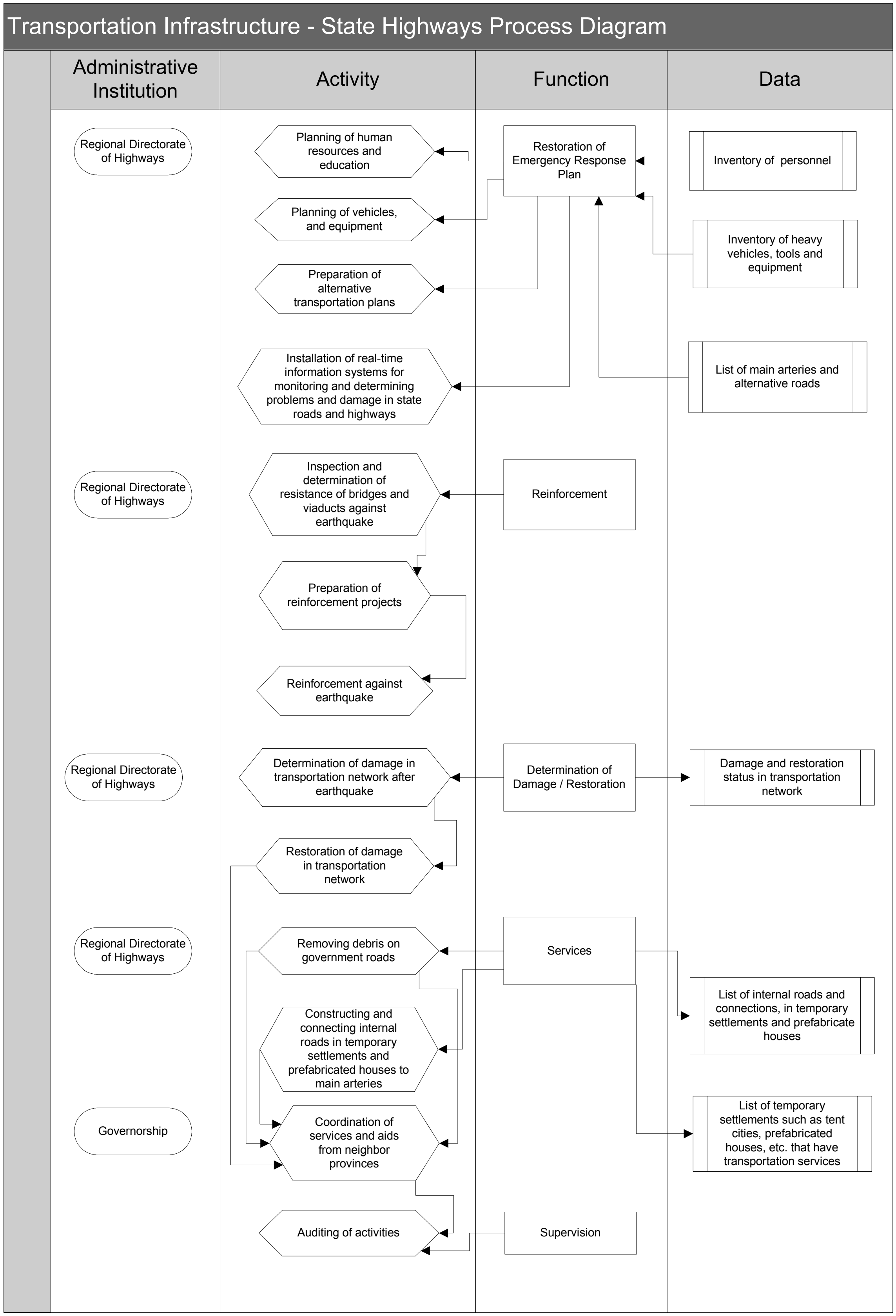

Figure 7.1.8. Process diagram of transportation infrastructure – State highways services

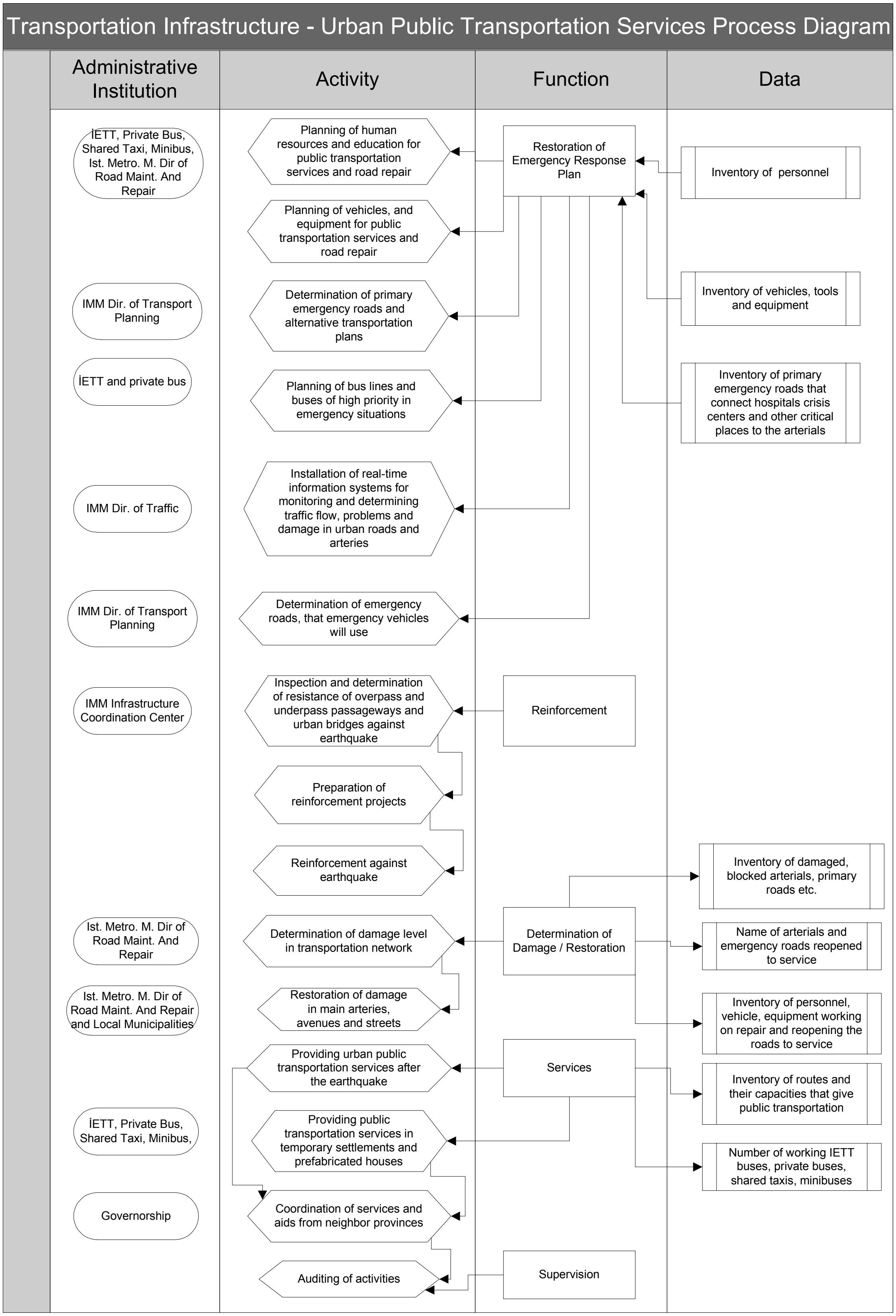

Figure 7.1.9. Process diagram of transportation infrastructure – Urban public transportation services

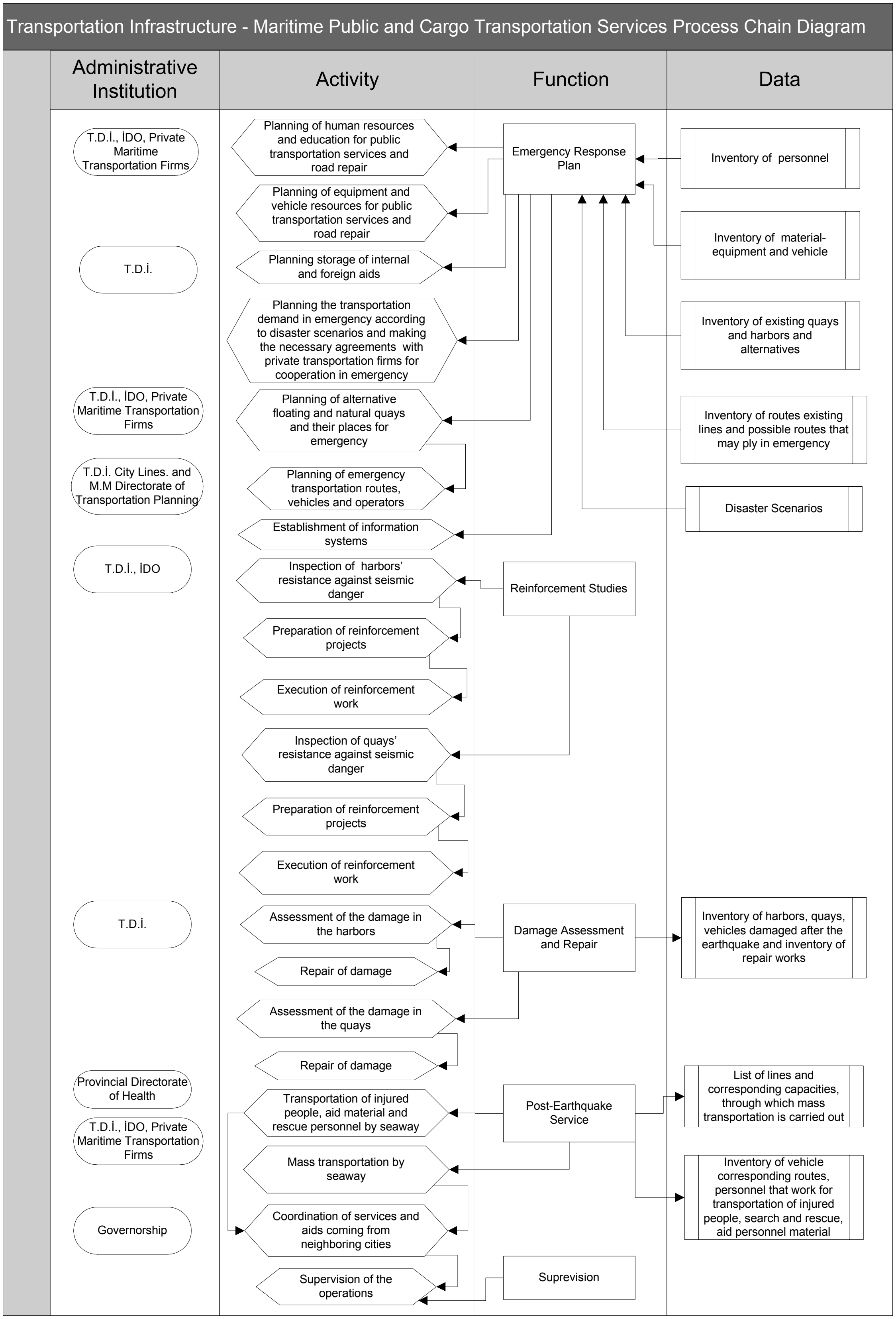

Figure 7.1.10. Process diagram of transportation infrastructure –Seaway public cargo transportation

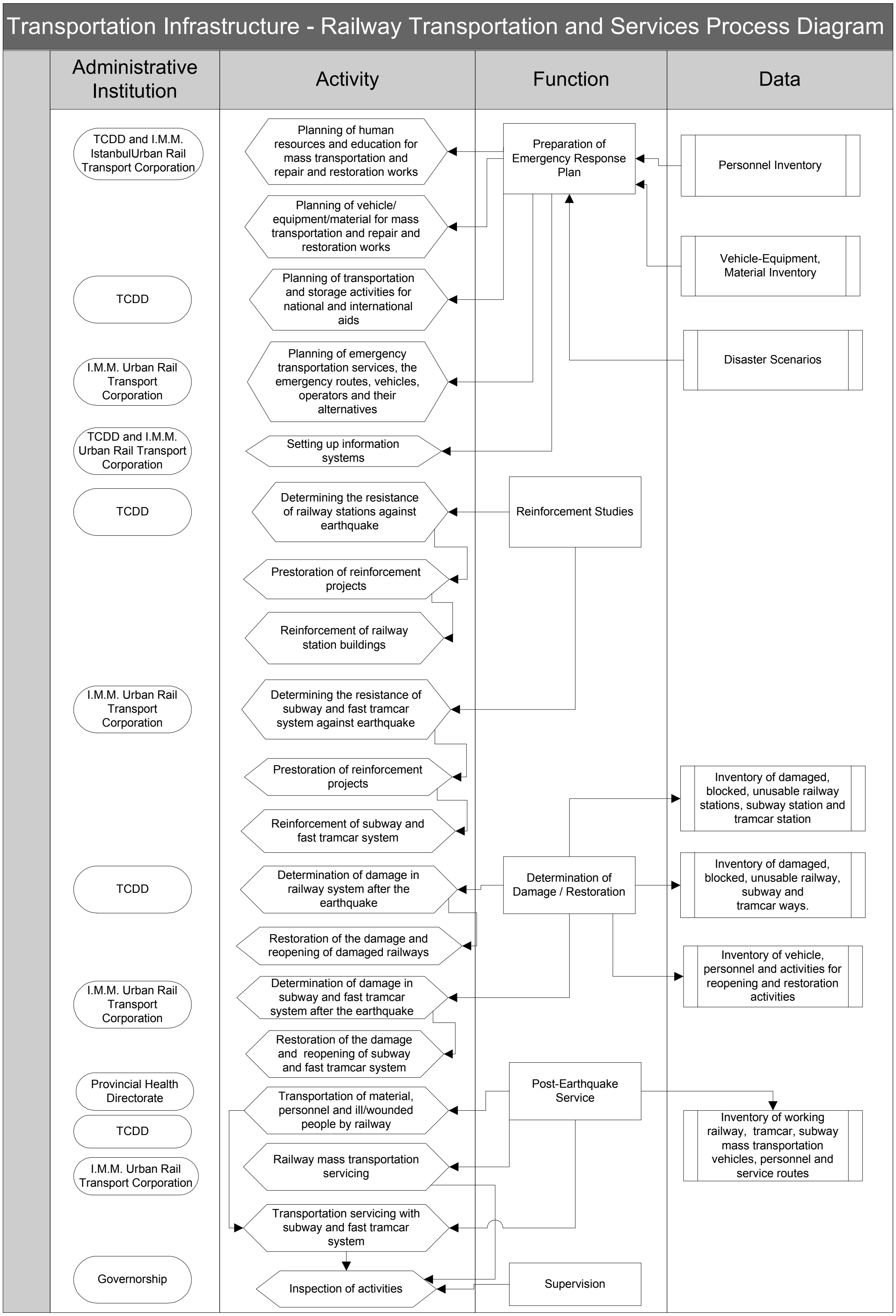

Figure 7.1.11. Process diagram of transportation infrastructure – Railway transportation services

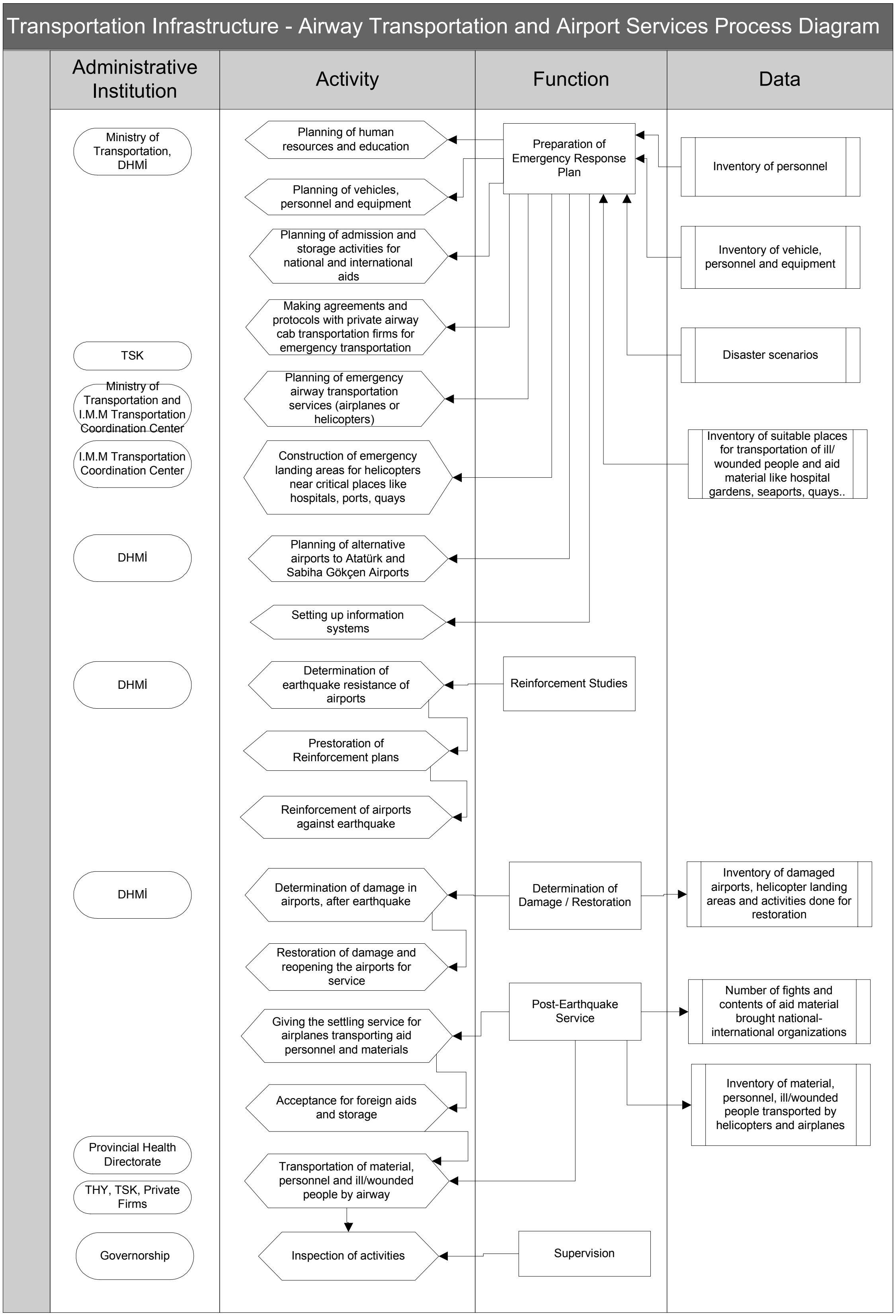

Figure 7.1.12. Process diagram of Transportation Infrastructure – Airway transportation & airport services

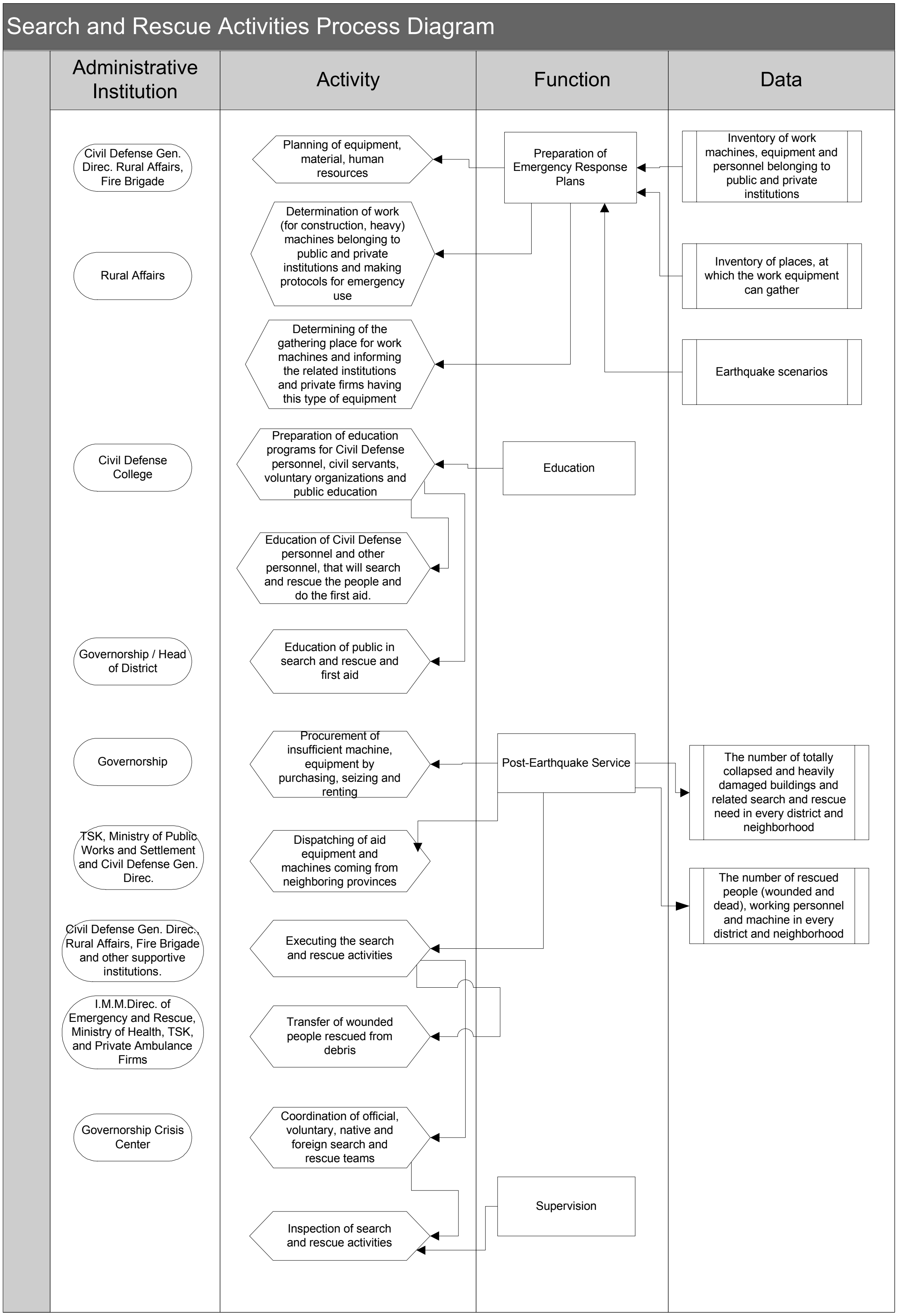

Figure 7.1.13. Process diagram of search and rescue activities

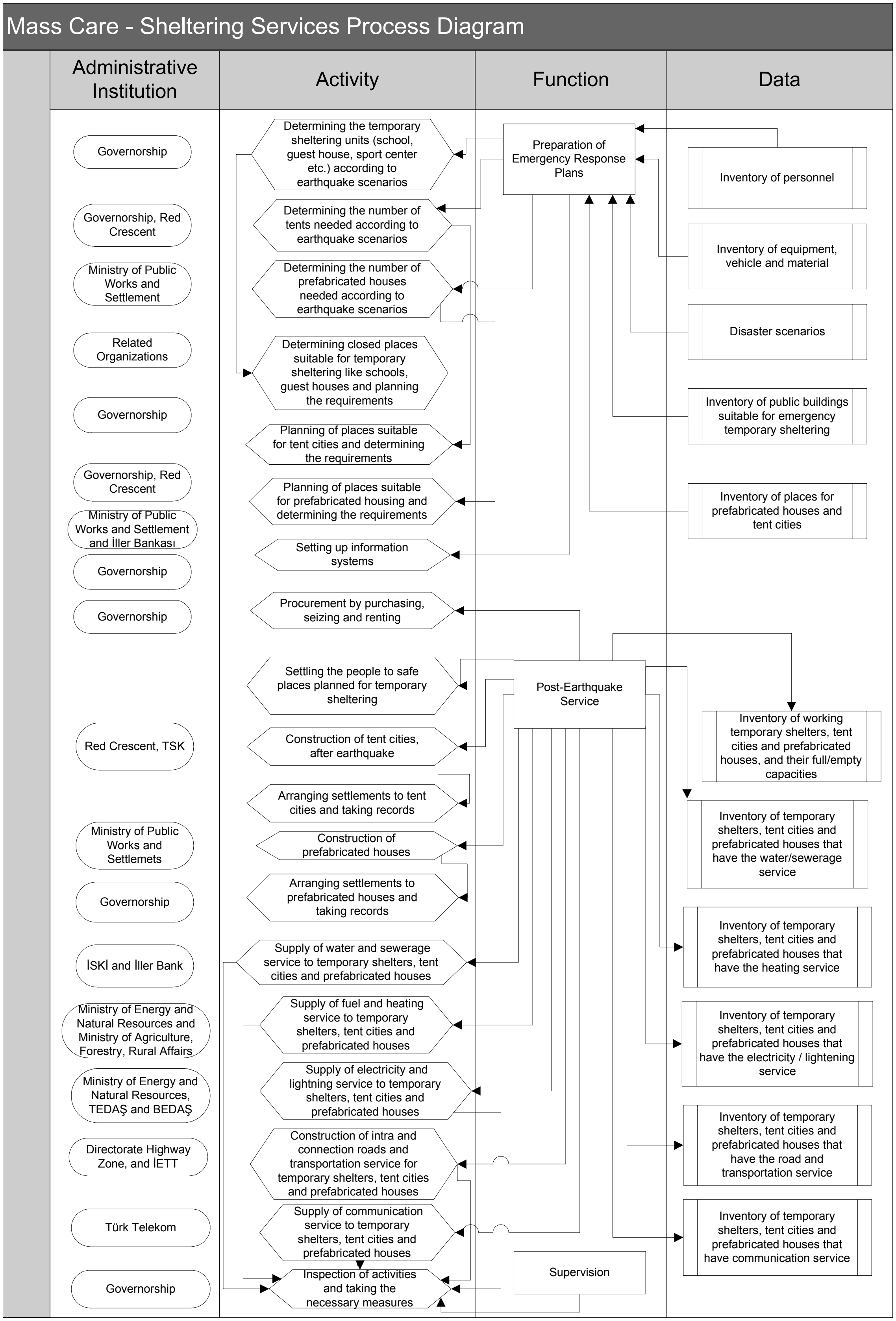

Figure 7.1.14. Process diagram of mass care – Sheltering services

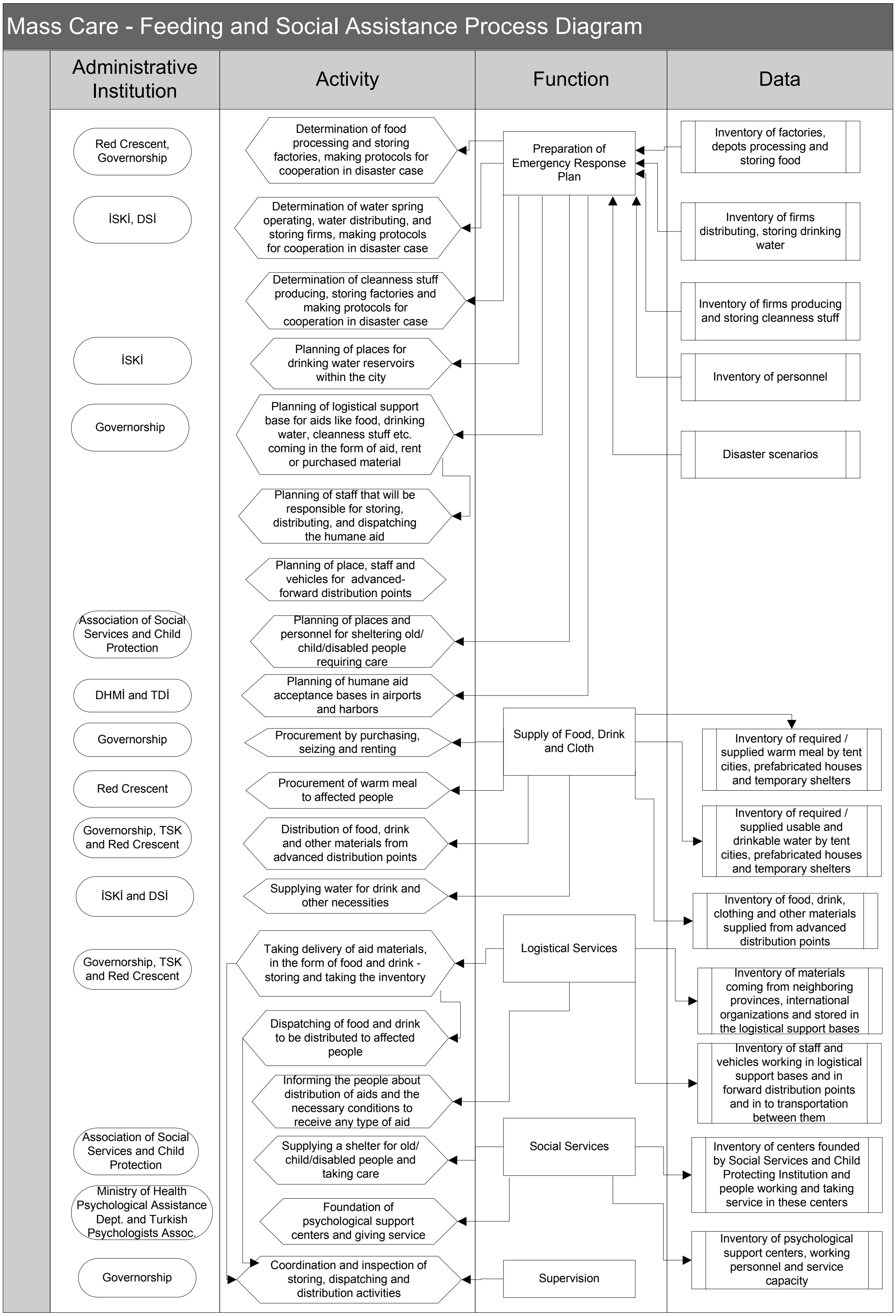

Figure 7.1.15. Process diagram of mass care – Feeding and social assistance

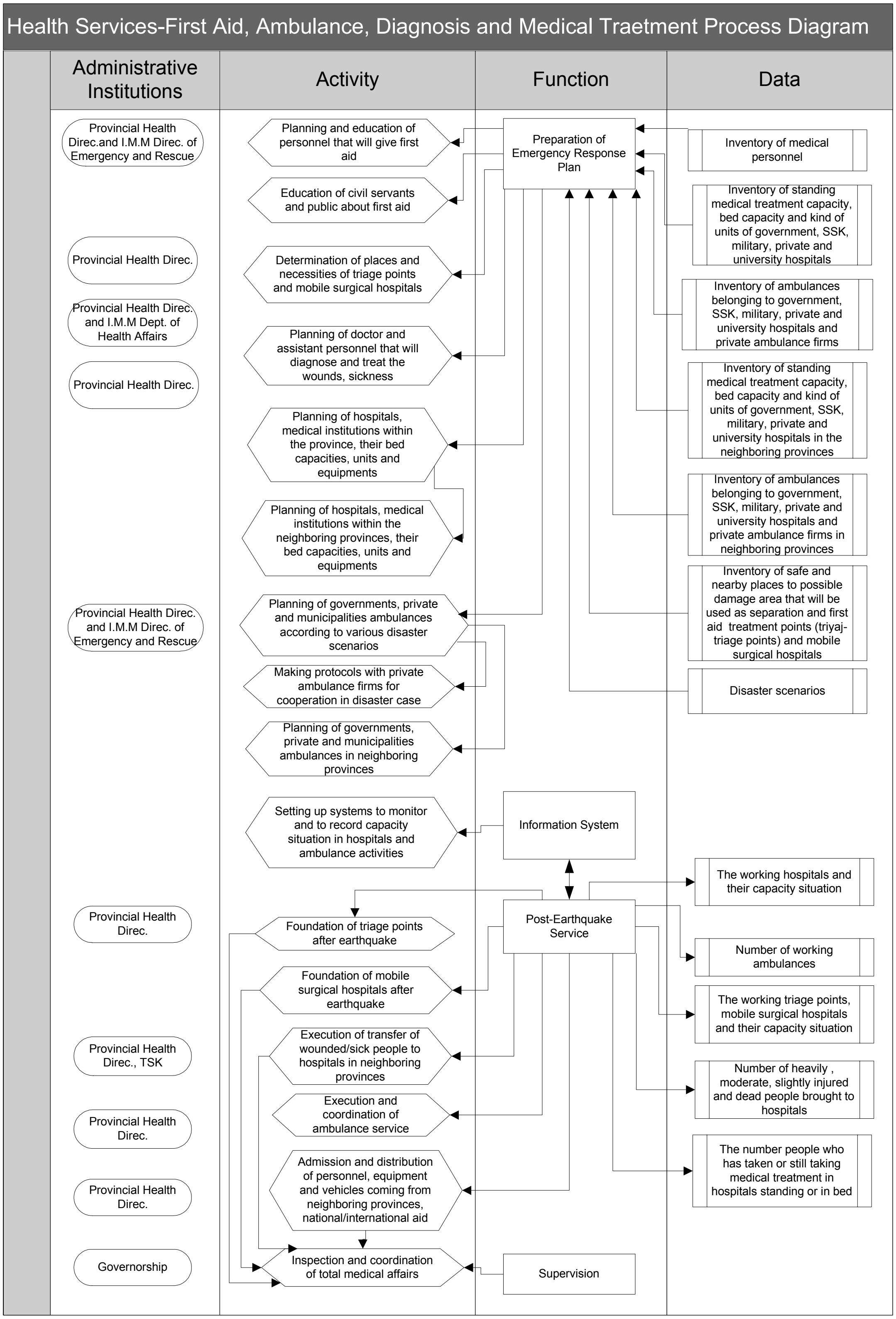

Figure 7.1.16. Process diagram of health services – First aid, ambulance, diagnosis & medical treatment

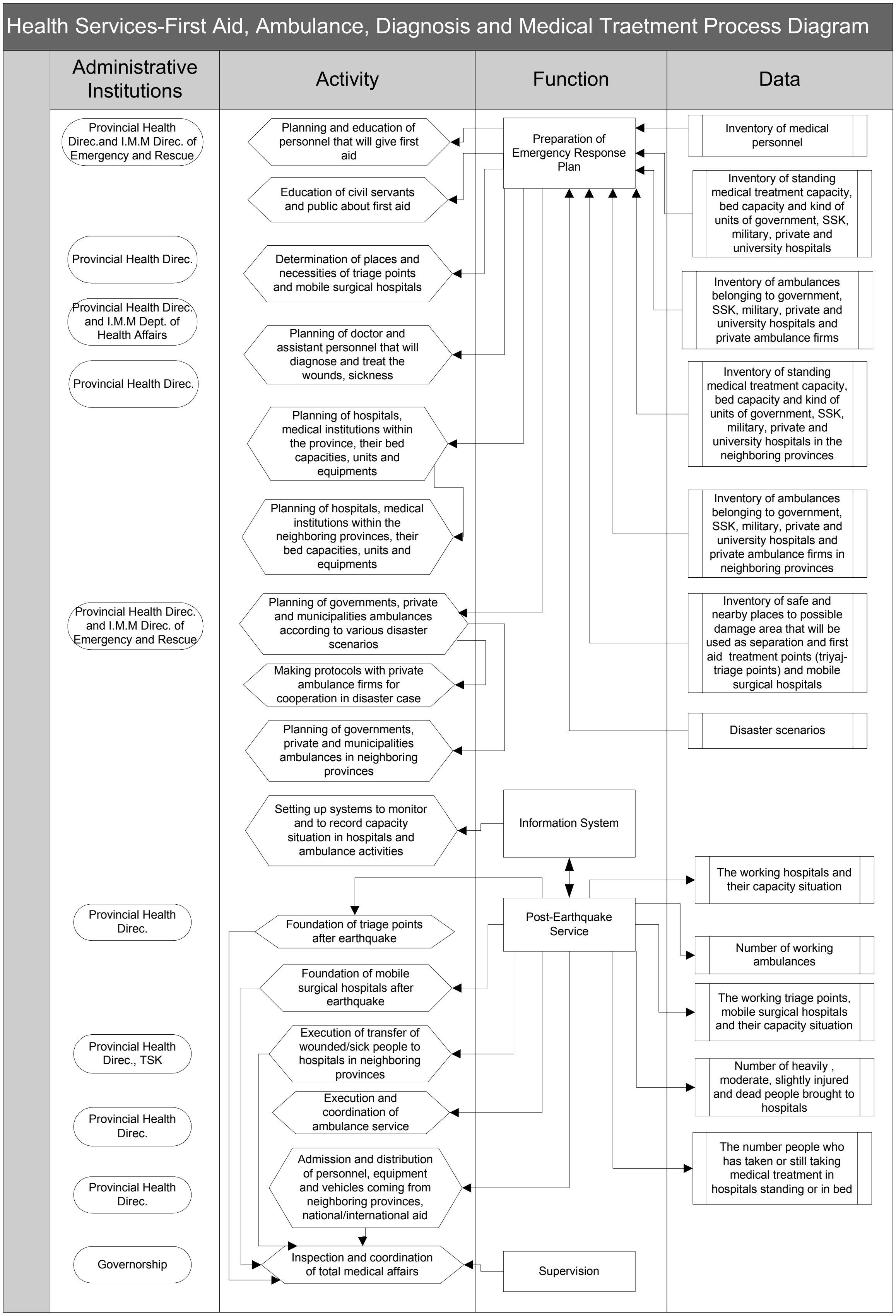

Figure 7.1.17. Process diagram of Health Services –Immunity, blood

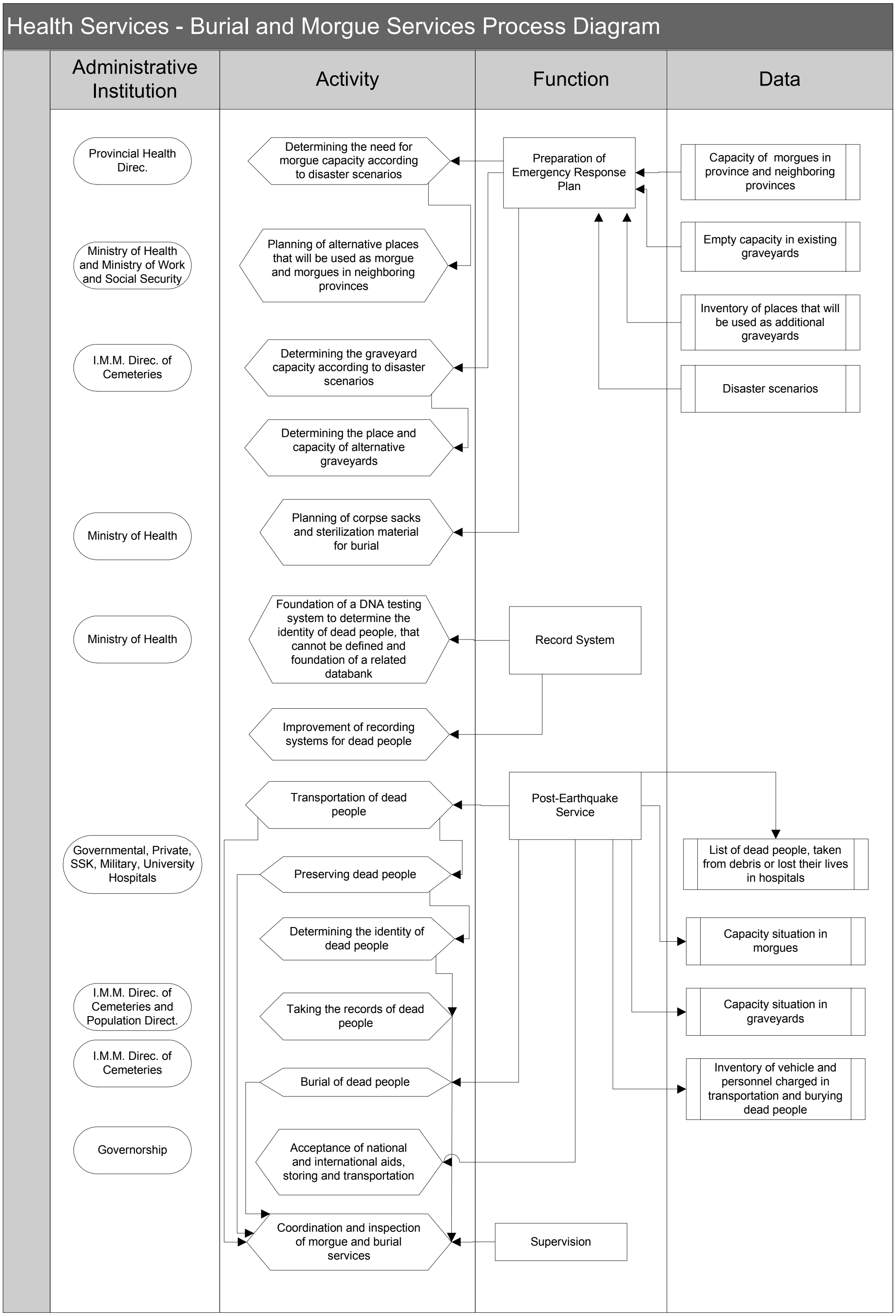

Figure 7.1.18. Process diagram of health services – Burial and morgue services

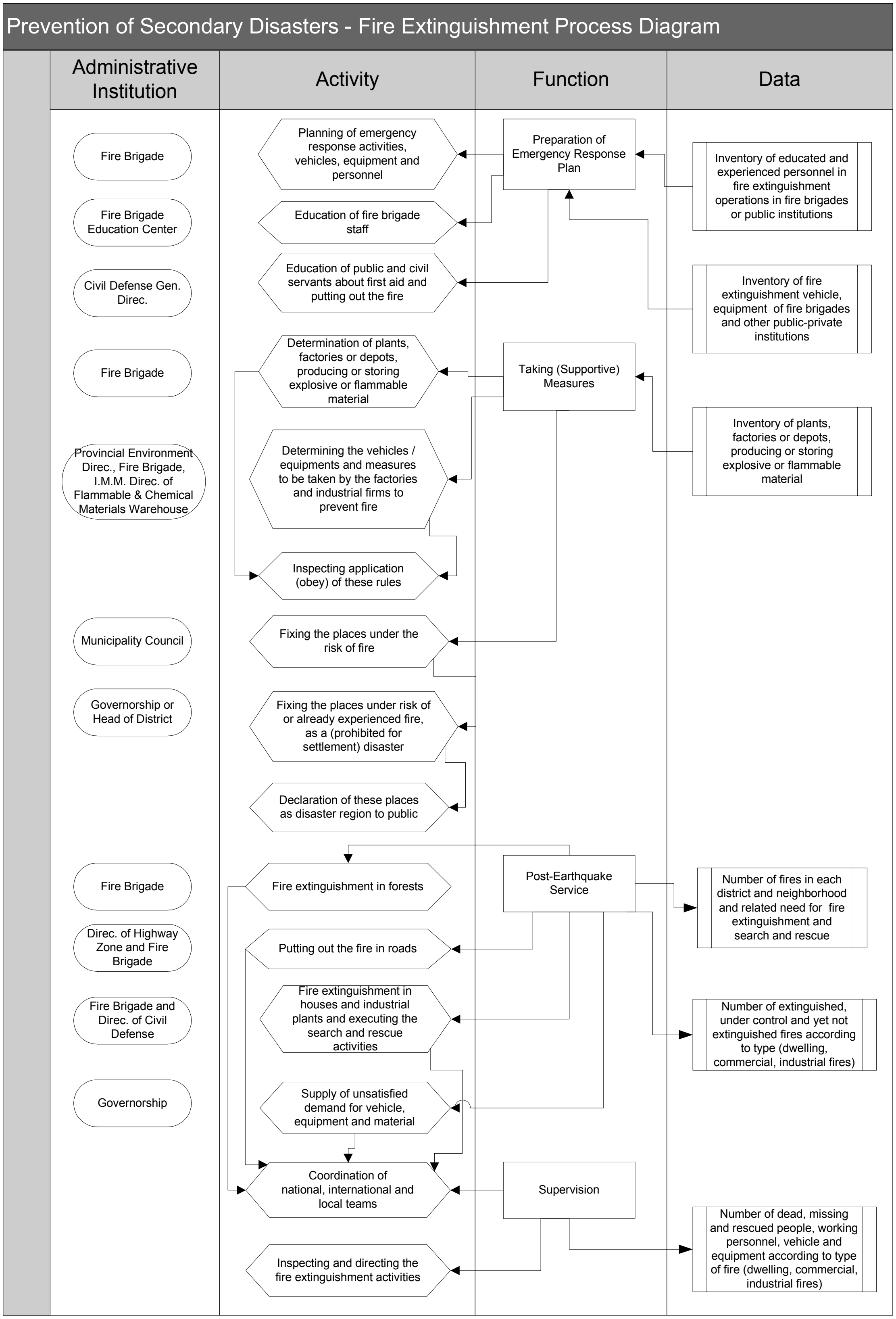

Figure 7.1.19. Process diagram of prevention of secondary disasters – Fire extinguishment

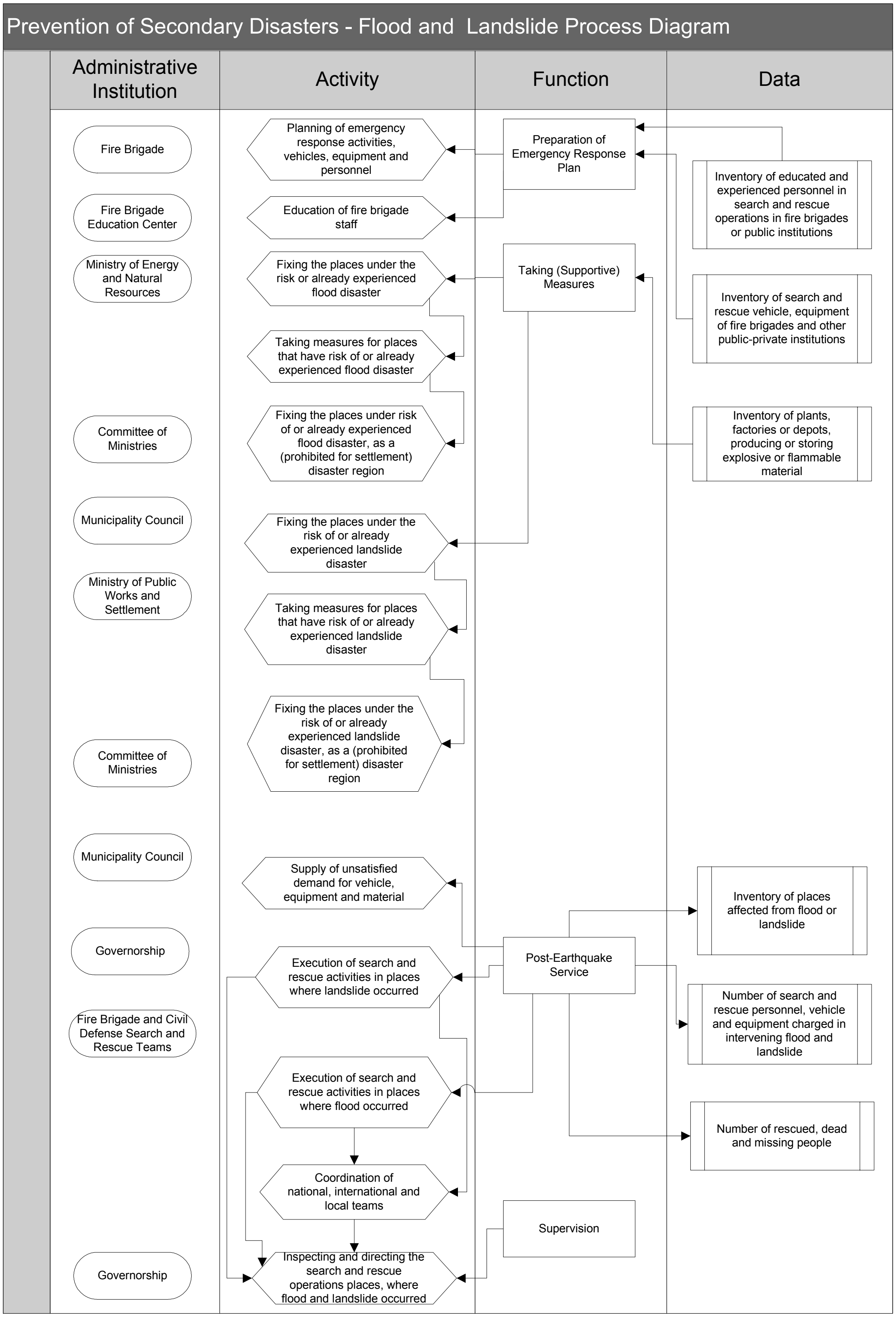

Figure 7.1.20. Process diagram of prevention of secondary disasters – Flood & Landslide

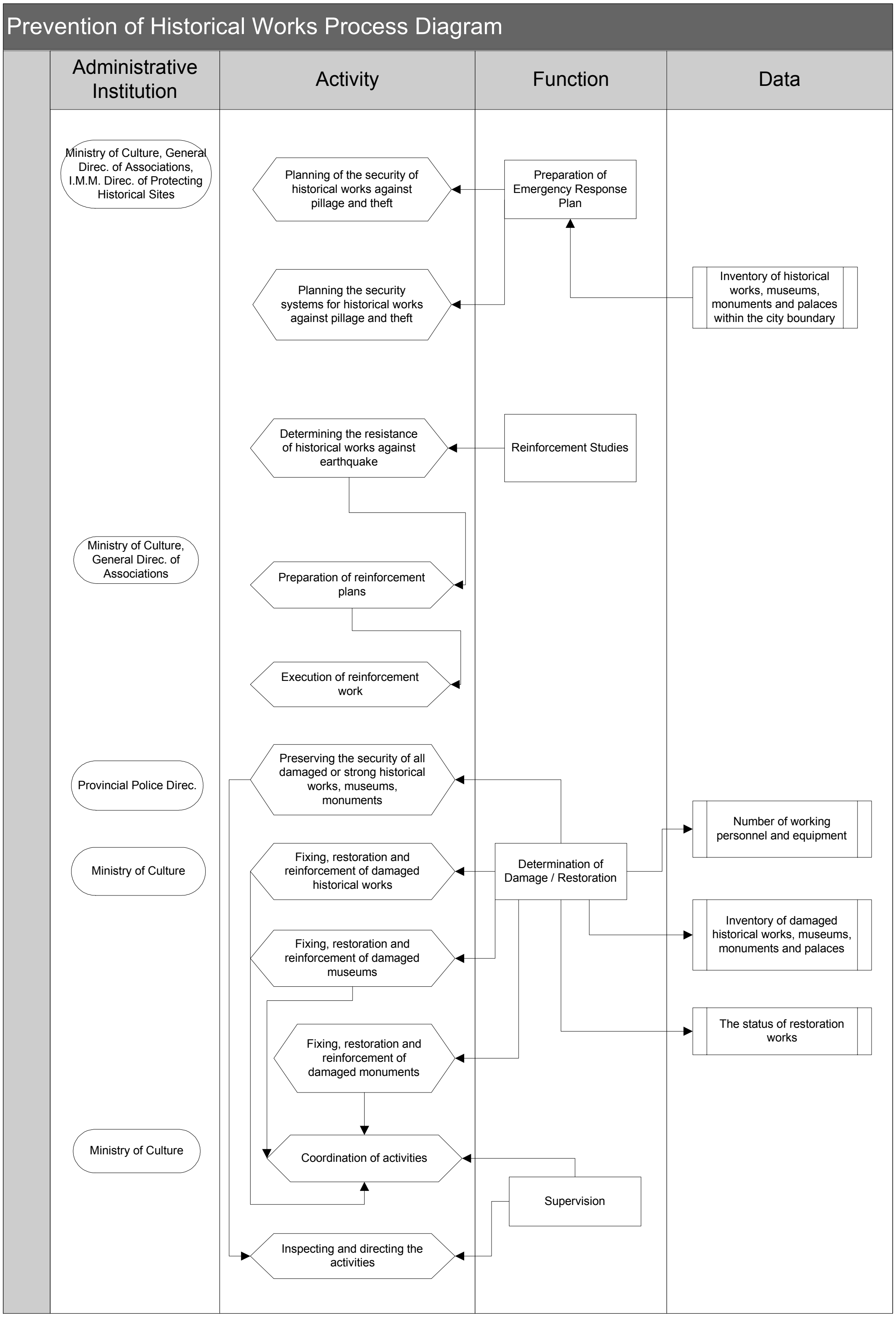

Figure 7.1.21. Process diagram of prevention of historical works

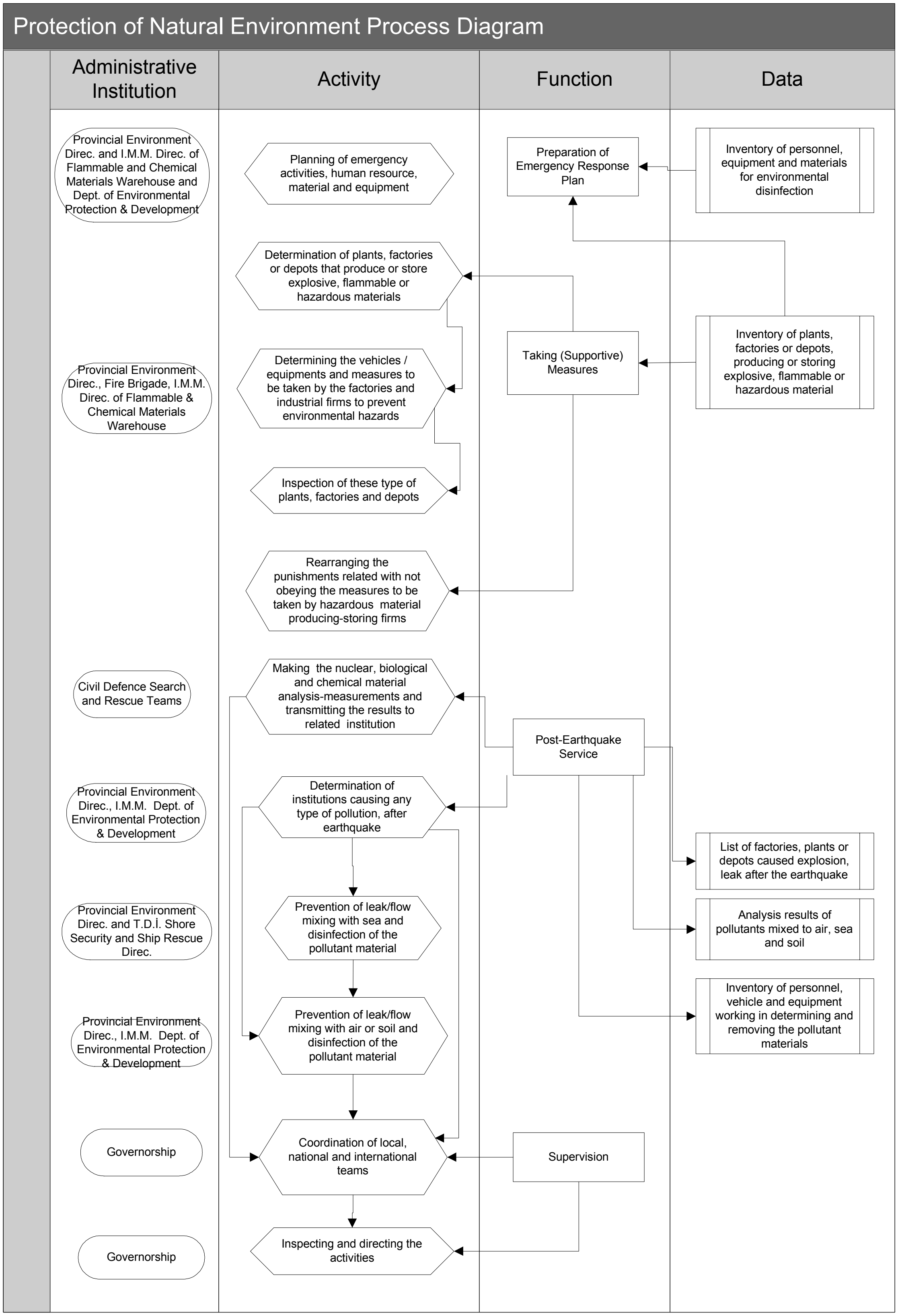

Figure 7.1.22. Process diagram of protection of natural environment

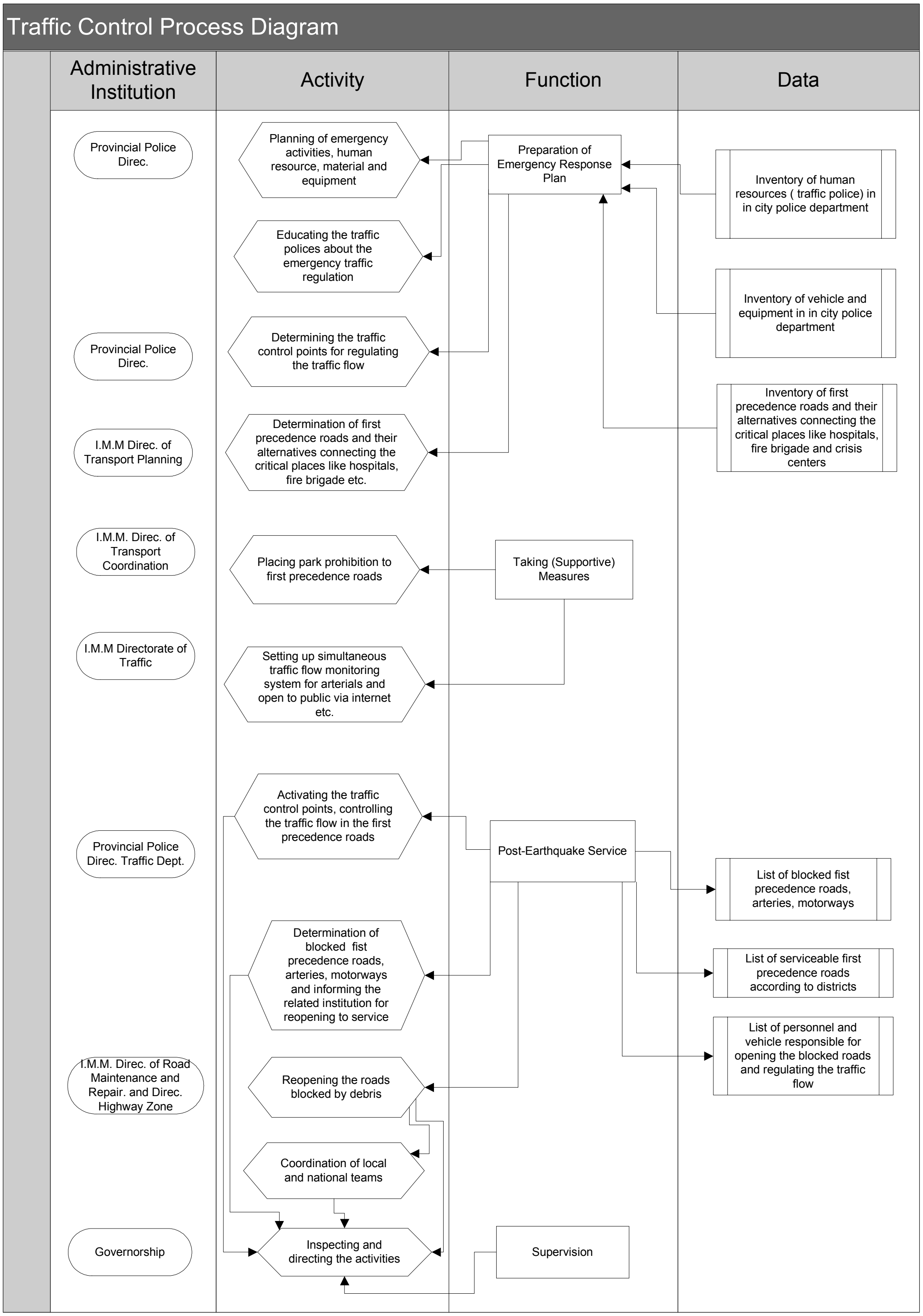

Figure 7.1.23. Process diagram of traffic control

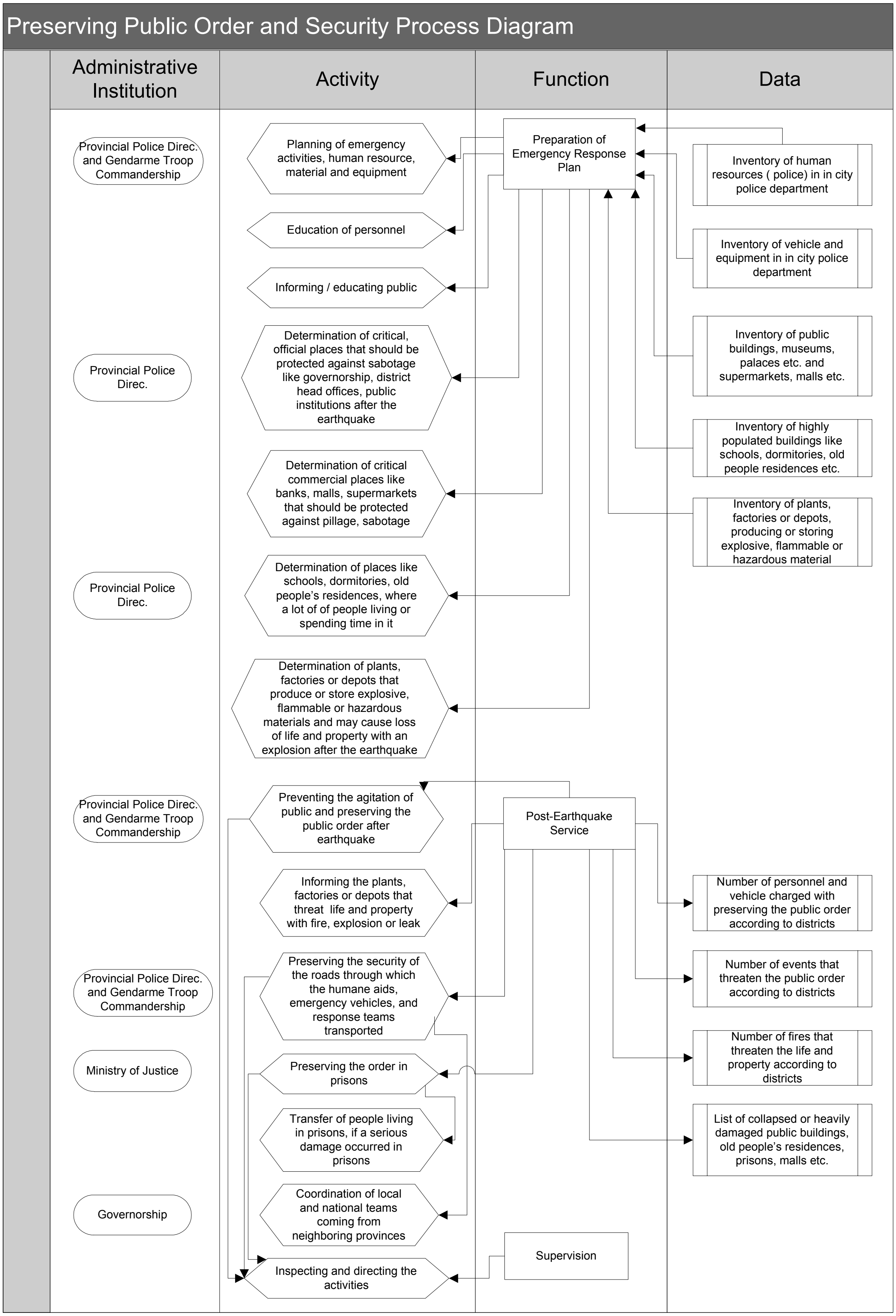

Figure 7.1.24. Process diagram of preserving public order and security

7.1.5 Definitions – Emergency Response Functions

Reconstruction of processes was made according to the assumption that civilian administration related to disaster management will keep its current formation. If there will be an arrangement including ministries, governorship and municipalities, the method given below has the flexibility to be applied in the same manner.

The emergency response functions defined with this approach are as follows:

11. **Search and Rescue:** Search and rescue of people under debris of collapsed and heavily damaged buildings is the first precedence activity.
12. **Logistics of Patient/ Injured People-Hospitalization-Immunity Works-Burial:** People rescued alive from debris, should be transferred immediately to medical institutions. According to the degree of wound and the capacity - sufficiency of the neighboring hospitals, the patient may be transferred to surrounding hospitals. The importance of fast and organized transportation of patients produces a need for a special transportation system like helicopter or ambulance transportation. Other considerable points in health services after the earthquake are the serviceability of hospitals and traffic flow in emergency roads. If there is a considerable damage in a hospital, a portable hospital should be founded and mobile hospitals should be transmitted to disaster area. Additionally, the inspection of drinking and usage water, controlling the environment against origins of pollution that threatens human health, should be carried out simultaneously. It is required to found health centers for treatment of small injuries and treatments for strengthening the immunity system like vaccination. The damage in water and sewage system may end up with mixing of clean and dirty water and may cause health problems. Burial of dead people, taking records are another field of activity in health area.

- **Mass Care:** A two phase discharging procedure, which is discharging people from damaged areas to secure places and transferring willing ones to safe regions, should be applied. Additionally, a sheltering problem may arise for people that lost their homes or people, who are afraid of entering their dwellings. The size of the problem may increase according to the season or weather conditions. For these reasons, tents and required equipments should be transmitted to the disaster region as soon as possible. In the second phase, an environment, that meets the minimum basic needs of homeless people, such as drinking water, food and clothing should be supplied.
- **Public Works and Engineering:** This function include the preliminary and fixed damage assessment works, restoring the inferior and outer (infra) structures, that need urgent repair, and than taking technical measures for mitigation and prevention.
- **Communication:** Communication is the most important activity that should be fulfilled. The communication may be down because of the damage in power stations or in cable lines or excessive loading for call. Informing the provincial disaster management center and other key organizations about the emergency and providing effective management depend highly on communication between the key organizations. So it is needed to found a special communication line for emergency use. After disaster, repairing damages in communication system and reopening to service if system is down, are the principal works of communication function.
- **Intercity and Inner-city Transportation-Traffic Control:** Transfer of injured people, transferring the rescue teams and aid materials to the disaster region are vital subjects. Many people want to reach the disaster area at the same time to help their relatives, which causes traffic congestions within and in the entrance of the city. This disorder brings about delays in transferring aid materials and teams. In addition to the traffic

congestions, collapsed buildings, damaged bridges or viaducts may also cause interruptions in transportation network.

- **Technical Infrastructure (Water-Natural Gas-Electricity):** The water-sewage system may be down because of bursts-breaks of pipes and for this reason, aridity and need for usable water may arise. The second important point with infrastructure is, preventing secondary disasters by closing the electricity and natural gas system just before the earthquake with the aid of warning systems. If there is damage in electricity system, the city and the critical facilities like hospitals, emergency management centers could not take service. For this reason the problems of the technical infrastructure should be solved urgently. Additionally, an activity area for producing alternatives for these critical services (at least for the critical facilities, which take great role in response) should be formed.
- **Security:** The pillage of the damaged businesses, and emptied dwellings by people coming from neighboring cities or pillage of shops, supermarkets with panic is a common event, so preserving the security and public order is another area for activity.
- **Secondary Disasters:** The effect of secondary disasters like floods, fires, technological disasters may exceed the damage of the own disaster. Preventing the existence of such secondary events, and taking measures for preventing its spread is an important topic in active response.

Provincial Search and Rescue Committee: The center, from which all of these activities will be coordinated, is Provincial Rescue and Aid Committee. The committee is gathered with the presidency of Governor, or Assistant Governor charged by Governor, without invitation in a great disaster. The committee takes vehicle, equipment and personnel inventory from public and private institutions for charging them in Emergency Aid Service Groups, and commission them according to the needs of service groups. The service groups prepare their own action plans by applying the directions and principal decisions given by the committee and by coordinating and cooperating with other service groups. The Disaster Bureau fulfills the secretariat of the committee. With the presidency of Governor of Assistant Governor, Provincial Rescue and Aid Committee consist of:

- Municipality Mayor
- Provincial Gendarmerie Troop Commandership,
- Provincial Director of Police,
- Provincial Director of Civil Defense,
- Provincial Director of National Education, Youth and Sport,
- Provincial Director of Public Works and Settlements,
- Provincial Director of Health and Social Aid,
- Provincial Director of Agriculture, Forestry and Rural Affairs
- Provincial Representative of Red Crescent,
- Garrison Commander / Greatest Military Unit Representative

The services coordinated by the committee are executed by the service groups given below:

- Communication Services Group,
- Transportation Services Group,
- Rescue and Removing the Debris Services Group,
- First Aid and Health Services Group,

- Preliminary Damage Assessment and Temporary Sheltering Services Group,
- Security Services Group,
- Purchasing, Renting, Seizing and Distribution Services Group,
- Agricultural Services Group,
- Electricity, Water-Sewage Services Group,
- The head of these service groups are determined by the Governor.

The structure of activities carried out in local and provincial level should be arranged according to the Emergency Management Model given below. This model is valid for any emergency response process (function), and forms a basis for effective response.

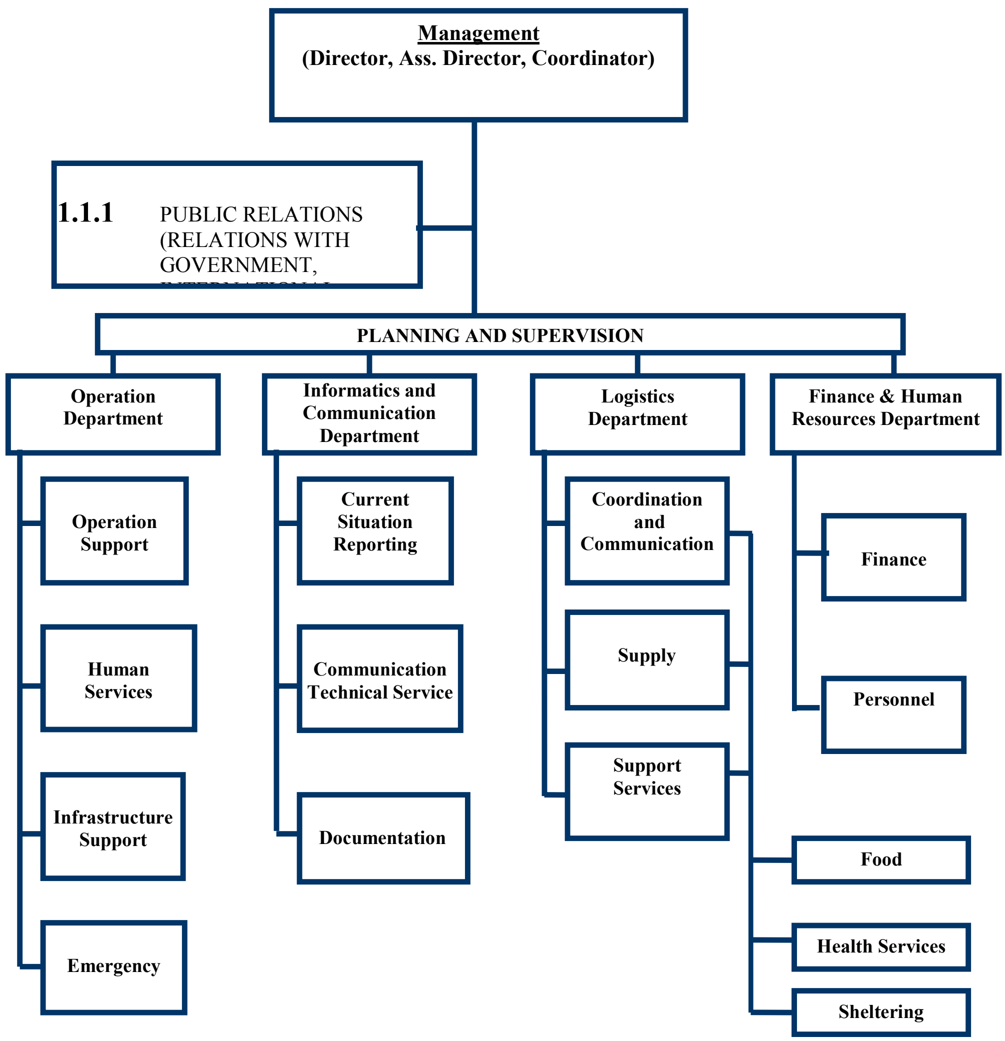

Figure 7.1.25 Emergency management model

Search And Rescue

Institutions Responsible for Coordination: General Directorate of Turkish Emergency Management (TAY), Disasters Central Coordination Committee, Governorship's Provincial Rescue and Aid Committee

Executive Institution: General Directorate of Civil Defense-Civil Defense Search and Rescue Unions

Supporting Institutions: Turkish Armed Forces, General Directorate of Highways, Fire Brigade, Provincial Directorate of Rural Affairs, Metropolitan Municipality Search and Rescue Teams, Governmental Water Affairs (DSİ), Police Department (provincial and local)

Aim: Search and Rescue emergency function may be defined as:

- Determination of search and rescue and first aid standards,
- Educating the personnel of Civil Defense, and a group of personnel in public institutions, private institutions and voluntary organizations on search and rescue and first aid,
- Preparation of emergency plans, making practices,
- Revision of these plans and practices continuously by evaluation of current applications, before the disaster.
- Just after the disaster, mobilization of aid personnel and equipment as quickly as possible,
- Rescuing people under debris,
- Performing the first aid operations to injured people.

Scope: Search and Rescue function covers the given titles:

- The Search and Rescue teams consist of firstly Civil Defense and Fire Brigade personnel, which are highly educated and experienced. According to size of the disaster educated forces of TSK, public institutions and voluntary organizations may participate the action under the coordination of Disasters Central Coordination Committee and Provincial Rescue and Aid Committee.
- At local level, the coordination of activities is executed by Provincial or District Rescue and Aid Committees, and at the central level the coordination is carried out by the Disasters Central Coordination Committee. The equipment and personnel needs arising from search and rescue activities are supplied by District or Provincial Rescue and Aid Committees, in case of incapability of resources of these committees. Disasters Central Coordination Committee allocate these needs by means of national resources/aids and international aids. The activities performed are reported in the same hierarchical order up to the president, and redirected according to the feedbacks coming from upper committee.

Policies:

- National Search and Rescue Policy is developed by Directorate of Civil Defense,
- Directorate of Civil Defense also prepares the working procedures of official, voluntary teams, given education, inspect their ability and preparedness by examinations and practices, directorate also covers the expenses for special equipments, and education.
- Beyond these activities General Directorate of Civil Defense prepares time-phased mobilization plans among institutions for activating the resources effectively just after the earthquake, based on disaster scenarios.
- Continuous communication is a must for quick and effective response in search and rescue activities. Foundation of an emergency communication system that will be used by response teams and coordination centers and putting it into practice before the disaster is one of the first precedence policies.

Assumptions about the Post-Earthquake Situation: Even the most optimistic earthquake scenarios estimate the number of heavily damaged buildings in ten thousands. This expectation indicates that the demand for search and rescue will highly exceed the resources of official, private and voluntary organizations. For this reason, a mobilization plan that is activated with the first signals of earthquake should be prepared. Since the works done by local teams can suffice to some extent, the voluntary works should be managed effectively until the professional teams reach to disaster area. The alternative transportation plans of search and rescue teams-equipment by sea, highway, railway or airway should be predetermined, by considering every kind of untoward event. Against the possibility of Atatürk Airport, Haydarpaşa Railway Station, Harbor, or the highways connecting the city to neighboring cities being down, the alternative way of each transportation mean, the vehicles, operators and their alternatives should be planned. Additionally the personnel being planned may be affected from the first shock, and may not be available in response time and even they exist. It should also be noted that they are open to secondary shocks and disasters like epidemic diseases, fires etc.

Organizations, Responsibilities and Operation Process Flow:

- **National Level:**

General Directorate of Turkish Emergency Management (TAY): TAY promotes foundation of emergency management centers in every public foundation, determine their working principles, supervise and set the coordination between them for effective management in emergency situation. It coordinates making use of transportation means (air, sea, rail, highways) and search and rescue vehicles belonging to public and private sector in emergency response operations. Additionally the directorate makes promoting regulations for voluntary organizations, and coordinate the receiving, storage and transportation of aid material.

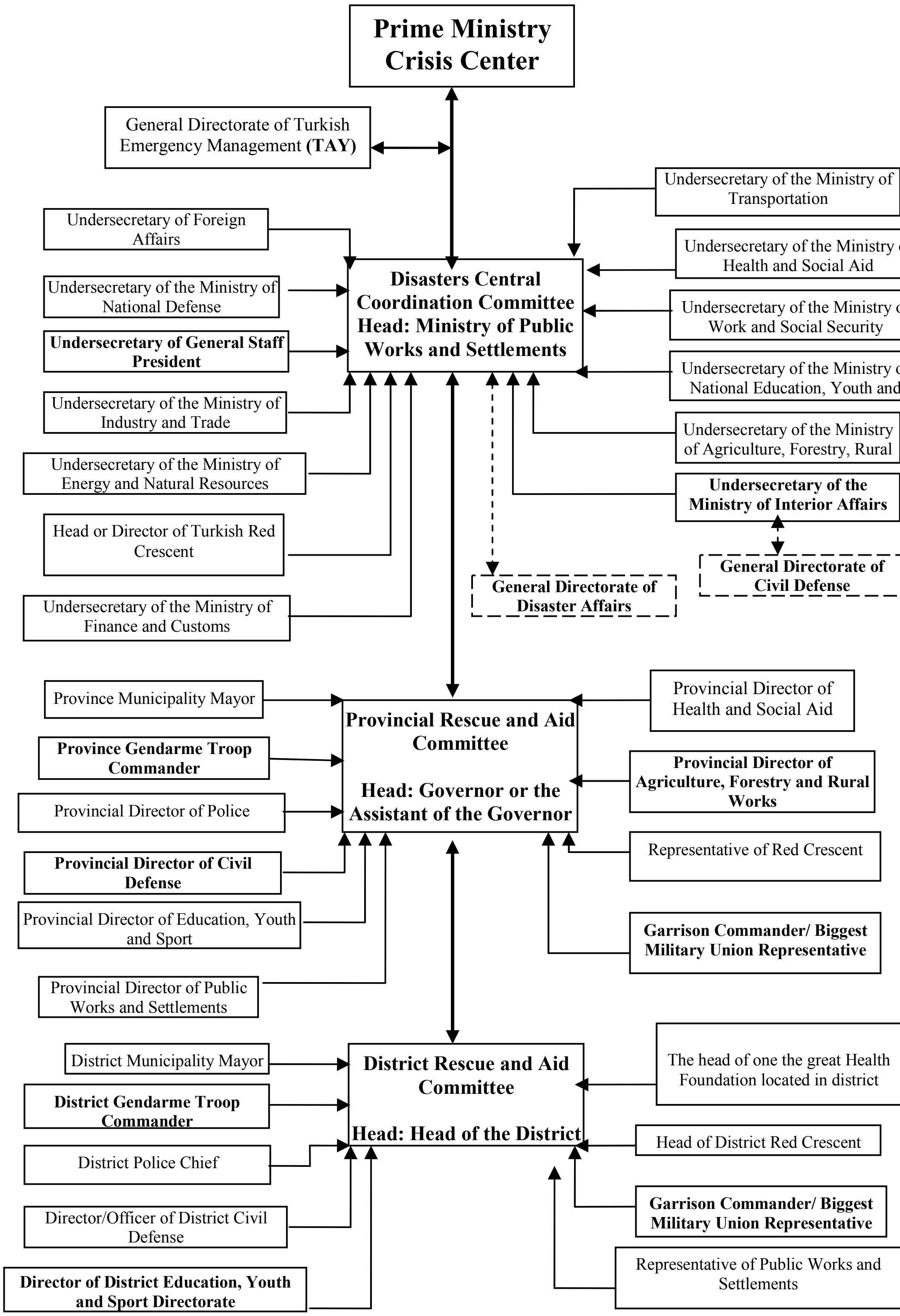

Figure 7.1.26. Operation process plan for search and rescue activities

Disasters Central Coordination Committee: The committee gathers on invitation of Undersecretary of Ministry of Public Works and Settlements. It takes decisions and actions according to information coming from disaster area Provincial Rescue and Aid Committee to meet the demands and needs for any type of resource. The committee coordinates the foreign and national aids. Besides these functions, it gets the president's directions to apply and present reports, which summarizes the activities and needs in disaster area.

General Directorate of Civil Defense - Search and Rescue Unions: The major tasks of the directorate is to set the standards for search-rescue and first aid activities, to educate the teams of Civil Defense Search and Rescue Unions, Fire Brigade, assist public institutions in preparation of emergency action plans, to evaluate the activities and practices and revise the plans accordingly. Civil Defense promotes the voluntary works by educating and adding them into the practices. It also prepares the mobilization plans, alternative ways to respond the need in shortest time, and accordingly performs communication, gathering, loading and transition practices. In emergency, it activates, dispatches, coordinates the Civil Defense Search and Rescue Unions, and the educated civil defense personnel according to need.

Ministry of Transportation: The undersecretary of Ministry of Transportation is charged in Disasters Central Coordination Committee, so it takes actions according to directions coming from this committee. It dispatches the foreign and national aids and resources to disaster area by air, rail, sea or highway. It takes measures to facilitate any kind of transportation to disaster area, reinforces the means for transportation and reopening the ways blocked off by damage.

- **Local Level :**

Governorship – Provincial Rescue and Aid Committee: The Search and Debris Removal Service Group, founded after the disaster, acts upon the information coming from the subunits and the principal decisions and directions of the committee. The head of the service group is Provincial Directorate of Civil Defense and charged with the vehicle and equipment resources informed by the committee. The service coordinates the emergency search and rescue and debris removal personnel and vehicle, try to supply the need for any type of search and rescue resource by purchasing, renting, seizing or applying to Disasters Central Coordination Committee.

AKOM: AKOM establishes equipped search and rescue teams educated by Civil Defense before the disaster. It mobilizes its search and rescue teams and firemen according to directions coming from Provincial Rescue and Aid Committee. The Fire Brigade charges its personnel to support search and rescue activities, after fulfilling its primary responsibilities.

Directorate of Provincial Civil Defense: The provincial Directorate of Civil Defense is the head organization of the search and rescue and debris removal service group. Under normal conditions, the fire department handles rescue work dealing with car accidents or collapsed buildings. When state of emergency is declared by the central government, the rescue responsibility is shifted primarily to civil defense.

Directorate of Provincial Rural Affairs: The directorate organizes its vehicle, equipments and personnel for debris removal and search and rescue activities. The preparation activities include planning, preparing the inventory of heavy machines belonging to public and private institutions, determining the places for gathering these heavy machines and their operators for emergency use. After the disaster, it mobilizes the personnel and equipment according to directions and coordination of Provincial Rescue and Aid Committee. It executes the debris removal work after ten days that means it is not possible to find any alive people under the debris.

Provincial/District Gendarmerie Troops: The educated gendarmerie forces execute search and rescue operations firstly in rural areas according to directions coming from Provincial Rescue and Aid Committee and they also support the Civil Defense and Rural Affair teams in urban area.

Garrison Commander/ Biggest Military Institution in the Region: The educated military forces execute search and rescue operations according to directions coming from Provincial Rescue and Aid Committee.

Regional Directorate of Highways: The regional directorate supports the search and rescue activities under the direction of Provincial Rescue and Aid Committee, besides/ after completing its primary duties such as assessment and repair of damage in highways, bridges and viaducts.

Directorate of Provincial/District Police Department: Police traffic groups take the primary emergency arterials, roads and their alternatives, determined by Greater Municipality Transportation Planning Department, under its control for emergency vehicle use. They also control the traffic flow in other roads and prevent blockage. Police teams secure transportation of all emergency response equipment, vehicles in roads. Additionally it supports the search and rescue operations with its personnel.

Logistics of Patients/ Injured People-hospitalization-Immunity Works-Burial

Institutions Responsible for Coordination: General Directorate of Turkish Emergency Management (TAY), Disasters Central Coordination Committee, Governorship Provincial Rescue and Aid Committee

Executive Institution: Ministry of Health and Social Aid, Ministry of Work and Social Security, Provincial Health Directorate, Metropolitan Municipality Directorate of Emergency and Rescue, Metropolitan Municipality Directorate of Health Protection, Metropolitan Municipality Directorate of Cemeteries, Private Ambulance Firms

Supporting Institutions: TSK, General Directorate of Highways, Provincial Police Directorate,

Aim: Health services, which are one of the most important functions of emergency response, are defined as: Serving with governmental, private, university, SSK hospitals within and in the neighboring cities and supplying all kind of resources related with them, like personnel, equipment, and patient transportation mean, after disaster. Taking precautious measures against epidemic diseases and burial of dead people are major health activities after the disaster.

Scope: The health services function covers the below items:

- The institution, personnel, vehicle and equipment that will be used in health services should be met primary from city's resources. According to size of disaster, resources in neighboring cities may be used. The national and foreign aids are charged according to directions given by Disasters Central Coordination Committee and Provincial Rescue and Aid Committee.
- The activities in disaster area are coordinated by command centers within the Provincial/District Rescue and Aid Committee. On the other hand, activities are coordinated and directed by Disasters Central Coordination Committee at the national level. The activities are reported in the same order to president and redirected by feedbacks.

- The damage in hospitals and health centers should be assessed and slight damages should be repaired, as soon as possible. The units in service should be monitored; the full and empty bed capacities, needs and unmeet demands should be followed-up.
- The arterials and emergency roads, through which the ambulances pass, should be under control and the traffic flow should be in order.
- The places and capacities of additional graveyards, with the vehicles, personnel and equipment should be planned according to earthquake scenarios, and post-disaster activities should be executed according to these plans.
- Coordination of the health personnel coming from other cities/countries and receiving, storage, keeping the inventory records, and distribution of medical materials should be executed according to pre-disaster plans.
- Dispatching of injured people with helicopters, ambulances and sea transportation means should be pre-planned and executed according to this emergency action plans.
- Maintaining the security of roads through which medical material, personnel are transferred.
- Military support may be requested, if medical treatment capacity of province does not suffice.

Policies:

- Reinforcement of hospitals' buildings and then other medical institutions' buildings in terms of construction and medical equipment, material and bed capacity.
- Preparation of emergency plans, determining which personnel in which hospital will be charged, the alternative of the personnel within the city and from the neighboring city, the emergency bed capacities, and ambulatory treatment capacities of hospitals.
- Determination of safe places for triage points, mobile surgery hospitals, nearby the probable damage area and planning their capacities / needs according to earthquake scenarios.
- Establishment of a control center for public and private institution's ambulances and getting all of these ambulances from the city and from neighboring cities under the control of this command center.
- Establishing a communication, radio infrastructure for executing the patient logistics effectively, equipping the control center and all ambulances, search and rescue teams with this communication mean, and realizing this project before the earthquake.
- The importance of helicopter in patient transfer is known, but the high demand besides the available helicopter number and the opportunity of marine transportation will direct the planner to consider mass transportation means such as marine and railway. So planning of marine transportation should be promoted.
- Establishment of an online system that can transmit hospitals' full, empty bed capacity situation, number of ill/injured people taking service, Number of personnel working according to specialization, medical needs to Provincial Health Directorate and Provincial Rescue and Aid Committee.
- Making the agreements with drug firms, medical material/ equipment producing, storing firms for joint and effective response.
- Planning of disinfection and vaccination operations to prevent epidemic diseases, planning of vaccination centers, personnel to be charged, and getting all of these plans to be ready in emergency use.

- Establishment of a blood and tissue bank that will store the samples taken from the unidentified dead people, and establishment of a record system for burial operations.
- Determination of blood and blood related materials need according to earthquake scenarios, setting up an infrastructure for storing the blood and blood products, determination of personnel to be charged in emergency.
- Inspection of the planned / working system with practices, determination of weak points and revising the plans.
- Managing the operations according to Provincial Rescue and Aid Committee's directions, transmitting the works done and the necessities emerged during these operations to the upper committee. Supplying these needs with resources within the city, otherwise informing the Disasters Central Coordination Committee about the needs and providing the necessities by national resources or international aids.

Assumptions about the Post-Earthquake Situation and Points to Be Considered in Planning:

The earthquake scenarios point out the demand for medical treatment in hundreds of thousands. Even the most optimistic scenarios show that the hospitals within the city will be loaded with maximum capacity in the first 6 hours. This situation requires mobilization of the neighboring city's as well the entire country's hospitals, mobile surgery hospitals and medical centers. With the aid of exterior resources, a need for a special transportation mean will emerge, but as the number of available helicopter/ ambulances and the need for them is compared, it is seen that there is a great difference. In this respect, marine-railway mass transportation of patients may be a solution. Also vehicles that may turn into mobile hospitals should be planned and prepared.

The capacity and sufficiency of a hospital against a mobile surgery hospital, is another important point. The service of a mobile surgery hospital won't be as capacitated like a fully equipped hospital. Secondly, the time passed in constructing a mobile hospital (first 48 hours), the first shock will be over, and the system adapts itself to this emergency situation. In this respect, the mobile surgery hospitals may service to patients having small injuries or regular patients and lessen the load over the hospitals and prevent crush. The most important point in health services is the serviceability of the government, university, SSK hospitals after the earthquake. The geotechnical investigations show that most of the hospitals are located in high risk regions and share the same risk with the building stock. For this reason the feasibility studies on whether reinforcing or reconstructing the risky hospitals in some other place should be completed and accordingly the necessary actions should be taken.

The number of ambulances within the city and neighboring cities will somehow meet the need, but in 1999 earthquake, mismatching of demand and supply, which means the absence of coordination, was a common event. To prevent repeating this situation, it is necessary to found a command center with vehicle following system, to set up a communication infrastructure between the control center, ambulances and hospitals and to facilitate the system with optimization tools. Certainly the ambulances, whether private or public, working in the damage area should be under the command of this center. Also all ambulances should be equipped with a common communication mean (radio) before the earthquake. With this method, the excess or insufficiency of ambulances is prevented, and with using shortest and fastest path, ambulances will gain time. The helicopters that should be charged should also be planned.

To supply the medicine and medical equipment, the agreements with the medicine and sub products producing firms should be completed. Planning of the central depots, besides the personnel and vehicles to be charged in storage and distribution should be completed before the earthquake. In the same manner, the need for blood, blood products, and vaccine and disinfection materials should also be planned, and the stock that will meet the first day demand should be held.

The psychological effect of disaster on people and the counter action is an important activity. Planning psychological rehabilitation places, the personnel to be charged in these centers should be a joint work of Provincial Health Directorate and Turkish Psychologists Association.

The last action in the health function group is burial of death. The earthquake scenarios indicate the number of dead people over fifty thousand. Even this number highly exceeds the current graveyard stock. For this reason, the alternative graveyards should be pre-planned. The only proposition to burial work is foundation of a blood-tissue bank, to designate the identity of unknown people. This data bank with records of burial places of people will be a service for people looking for their lost relatives in the earthquake region.

Organizations, Responsibilities and Operation Process Flow:

- **National Level:**

General Directorate of Turkish Emergency Management (TAY): TAY was established under the Prime Ministry and fulfils the actions including the health services given below:

- -to establish emergency management centers within the local governments, determine their principles and carry out inter-institutional coordination.
- -to carry out preliminary actions, make short and long-term plans, monitor and evaluate databases in order to prevent and mitigate disasters
- -to coordinate the utilization of public and civilian vehicles and facilities in case of emergency
- -to promote volunteer efforts by organizations and individuals in emergencies.
- -to coordinate the procurement, warehousing and distribution of relief materials.

Disasters Central Coordination Committee: The committee takes decisions and actions according to information coming from Provincial Rescue and Aid Committee of disaster area, to meet the demand and necessities for any type of resource. The committee coordinates the foreign and national aids. Besides these functions, it gets the president's directions to apply and present reports, which summarizes the activities and needs in disaster area.

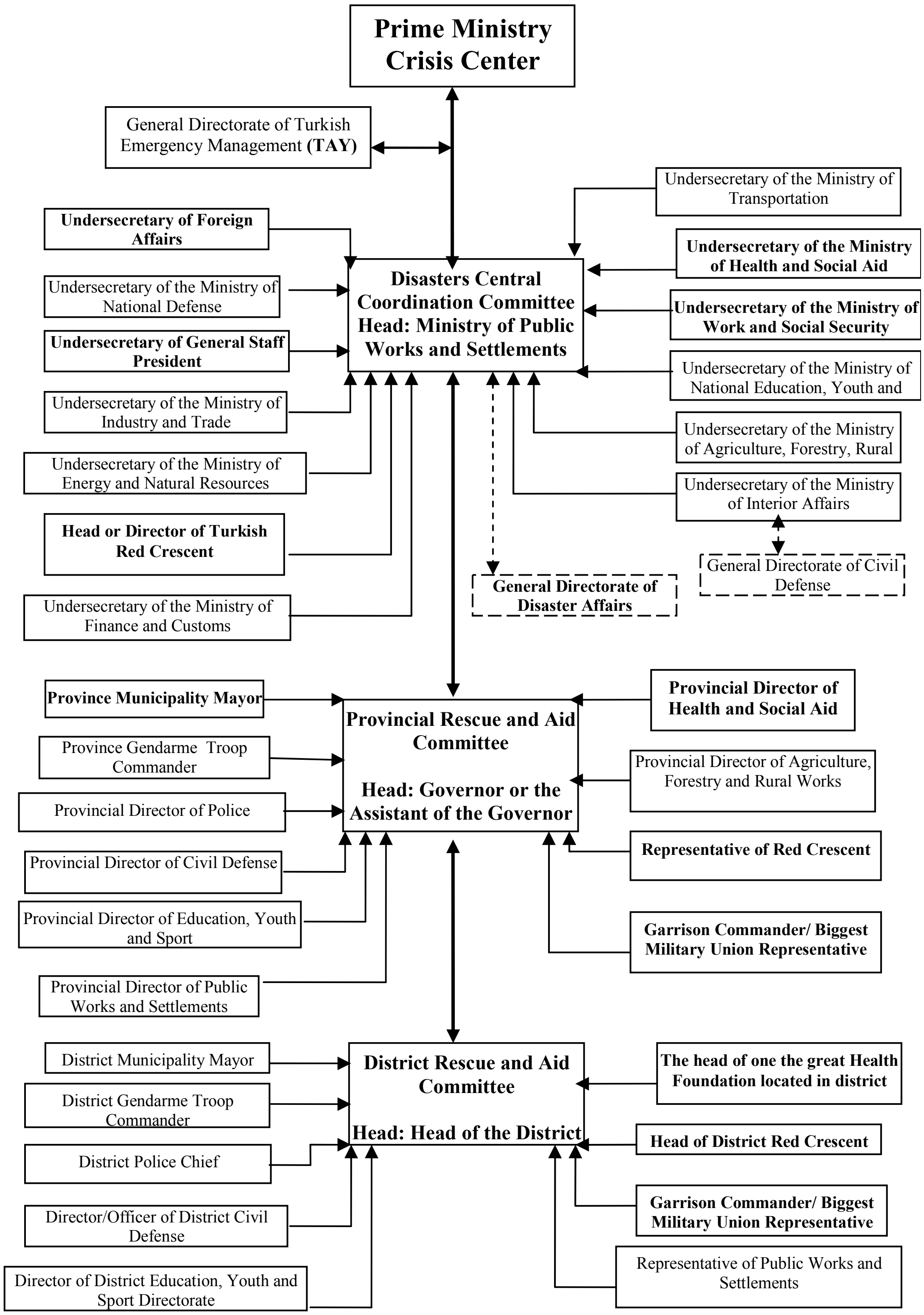

Figure 7.1.27. Operation process plan for health services

Ministry of Health and Social Aid: In case of emergency, the Ministry of Health will work under the Disasters Central Coordination Committee. Information will be provided by the Prime Ministry or Provincial Directorate of Health. In Ankara, four departments are standing by on alert for a possible disaster 24 hours a day. These departments are Information Flow Gathering and Coordination, Administration and Finance, the Secretary for Communication and Documentation and the Computing Departments. Additionally, ministry prepares a resource inventory that includes staff, medicines, trucks and ambulances for each province and the number of beds including beds available in hotels and lodgings. These inventories are sent to neighbor provinces for mutual help. The ministry also plans access routes to dispatch aid to damaged areas. Provincial hospitals are planned and additionally tent hospitals will also be used in emergency medical operations. The Ministry of Health has a mutual help system set up among neighbor provinces, where each regional crisis center is programmed to help a neighbor province

Ministry of Work and Social Security: In emergency, the Ministry of Work and Social Security will work under the Disasters Central Coordination Committee. It plans the medical activities pre-disaster and it gives the hospitalization service after the earthquake in coordination with Ministry of Health and Red-Crescent.

- **Local Level :**

Governorship – Provincial Rescue and Aid Committee: The First Aid and Health Services Group, founded after the disaster, acts upon the information coming from the subunits and the principal decisions and directions of the committee. It gives directions to health institutions, coordinate the supply and dispatching of medical aid, personnel, vehicle and equipment. The committee provides the necessities unmeet by purchasing, renting, seizing or tries to find the resource by applying the upper committees.

AKOM (Metropolitan Municipality (M.M.) Directorate of Emergency and Rescue, M.M. Directorate of Health Protection and M.M. Directorate of Cemeteries): AKOM mobilizes the related departments and firms within its constitution according to action plans. It reports the activities and needs to Provincial Rescue and Aid Committee and applies the directions coming from the committee.

Provincial Health and Social Services Directorate: The Provincial Directorate of Health is the chief organization of First Aid and Health Service Group. There are twelve organizations in five sub-groups. These subgroups are First Aid and Emergency Relief, Hospitalization, Supply and Logistic Support, Rehabilitation and Primary Care and Dead Body Burial. These groups work in triage, transportation of victims to hospitals, select, treat and hospitalize, collect medicine from abroad, distribute and deliver them into hospitals, work for environmental health and epidemic diseases and assists with burial of dead people. According to size and effect of earthquake the directorate founds tent and mobile hospitals. It reports the activities and needs to Provincial Rescue and Aid Committee.

10.5.3 MASS CARE SERVICES

Institutions Responsible for Coordination: General Directorate of Turkish Emergency Management (TAY), Disasters Central Coordination Committee, Governorship Provincial Rescue and Aid Committee
Executive Institution: Red Crescent, Ministry of Public Works and Settlement, Ministry of Health and Social Services Governorship Provincial Rescue and Aid Committee
Supporting Institutions: TSK

Aim: The mass care function is defined as discharging people from risky areas, providing permanent shelter, whose dwelling is damaged or providing temporary shelter for people who are afraid of entering their homes, provide feeding, information gathering to give the right aid to right people. The related activities are planning and preparing the necessary infrastructure before the disaster, and executing all these activities after disaster.

Scope: The Mass Care function covers the following topics:

- This function primary sets the responsibilities of organizations related with feeding, sheltering and determines aid distribution principles.
- The coordination link between the involved organizations in this function, foremost with the Red Crescent, should be satisfied.
- The first actions after the earthquake are, discharging the people to predetermined safe areas, opening the planned safe public buildings like schools, sport halls etc. for temporary sheltering, establishing the tent cities, constructing prefabricated houses etc.
- The disaster left some old, disabled and children without relatives. So planning places, in which these people may reside and personnel to be charged, is an important point.
- The feeding of disaster victims may be satisfied by fixed refectories, mobile refectories, and by distribution. The control of appropriateness and sufficiency of the distributed foods is also a duty to be fulfilled.
- Setting an Information- Communication System (BIS) is a requirement for dispatching relatives each other, for gathering relatives that lost each other or for finding an injured relative which is taken away by ambulances. With this system it will be possible for a relative outside from the disaster area to find his/her relative and transporting the victim to his/her relative if he/she desires.
- The Information System will also be used in forward distribution points to distribute the sufficient aid material in sufficient amount to victims deserving the aid.
- Managing the operations according to Provincial Rescue and Aid Committee's directions, transmitting the works done and the necessities emerged during these operations by reports to committee as feedbacks.
- The number of people that will need mass care should be determined based on earthquake scenarios. Accordingly the discharging areas, temporary shelters, places for tent cities and prefabricated houses and need for feeding should be determined and resources have to be planned before the earthquake.

Policies:

- Determining the places for discharging according to the needs proposed by earthquake scenarios. For places, where housing is intensive and empty places are rare, opening this type of safe areas, and informing the public about the location of discharging areas.
- Fixing the buildings that are appropriate for temporary sheltering and to subject other buildings to same treatment of risky dwellings. Besides, planning the personnel, vehicle, equipment before the disaster,
- Planning the appropriate places for tent cities, the personnel, vehicle going to work in construction and servicing,
- Determining the places for prefabricated houses, planning of equipment, vehicle, personnel and other necessities for providing service on time,
- Planning the places for fixed refectories, determining the need and related capacity. Setting the principles of service and establishing communication infrastructure for

coordinating the activities between responsible organizations and voluntary organizations for effective service,

- Determining the main depots in which humane aid will be stored and the distribution points from which this aids will be distributed to earthquake victims, planning the personnel and vehicle being charged,
- Designing the Information Communication System and integrating some critical facilities like hospitals, Provincial/ District Emergency Management Centers to the system.,
- Informing the public about what to do after the earthquake and how they can receive the humane aid,
- Managing the operations according to Provincial Rescue and Aid Committee's directions, transmitting the works done and the necessities emerged during these operations to committee as feedbacks. Supplying these needs with city's resources if possible, otherwise informing the Disasters Central Coordination Committee about the needs and providing the necessities by national resources or international aids.

Assumptions about the Post-Earthquake Situation:

After the earthquake, the building stock and infrastructure may be heavily damaged, highways, airports and communication systems may be down, and accordingly the preliminary damage and needs may not be determined exactly. The personnel planned for mass care activities may not be on charge because he/she may lost his/her life, may be injured or concern with rescue of his/her relatives. He/she may also not be in duty place because of the traffic congestion etc.

Hundred thousands of people may leave their homes, to find a safer place, a group of vulnerable people like children, old/disabled without relatives may appear. The individuals may experience the earthquake in different places, and may search for each other. If the earthquake strikes in near future, people in some districts could not find a safe place for discharging, and found themselves temporary shelters between the highly damaged risky buildings.

Organizations, Responsibilities and Operation Process Flow:

- **National Level:**

General Directorate of Turkish Emergency Management: TAY was established under the Prime Ministry and fulfils all actions including the mass care services given below:

- -to establish emergency management centers within the local governments, determine their principles and carry out inter-institutional coordination.
- -to carry out preliminary actions, make short and long-term plans, monitor and evaluate databases in order to prevent and mitigate disasters
- -to coordinate the utilization of public and civilian vehicles and facilities in case of emergency
- -to promote volunteer efforts by organizations and individuals in emergencies
- -to coordinate the procurement, warehousing and distribution of relief materials.

TAY makes arrangements for associations and voluntary organizations supplying aid, it coordinates the receival, storage and transportation aid materials to disaster area.

Disasters Central Coordination Committee: The committee takes decisions and actions according to information coming from disaster area Provincial Rescue and Aid Committee to meet the demand and necessities for any type of resource. The committee coordinates the foreign and national aids. Besides these functions, it gets the president's directions to apply and present reports, which summarizes the activities and needs in disaster area.

Ministry of Health and Social Aid: The ministry supply shelter and care the vulnerable people, having no relatives, besides giving health services. The ministry accommodates these people in social residences within the city or in the neighboring cities. In this respect, the ministry plans the capacity of the residences, personnel, and takes the measures.

General Directorate of Red Crescent Association: The Red Crescent carries out relief operations to assist victims of disasters, and combines this with development work to strengthen the capacities of its member societies. The federation's work focuses on four core areas: promoting humanitarian values, disaster response, disaster preparedness, and health and community care. Planning of the Turkish Red Crescent is centralized under the Ankara Planning Directorate, which plans the distribution of food and tents. After disaster, it supplies temporary sheltering, and feeding services, receive the aid materials coming from international Red Crescent / Red Cross Organizations, and dispatch them to places determined by Disasters Central Coordination Committee.

Ministry of Public Works and Settlement: The number of necessary temporary-permanent settlement unit is estimated using earthquake scenario analysis, and accordingly the appropriate places are determined. After the earthquake, type of the temporary housing, tent or prefabricated house is decided according to climate by the ministry. It constructs or gets construct the prefabricated houses and deliver to governorship to distribute them to holder of this right.

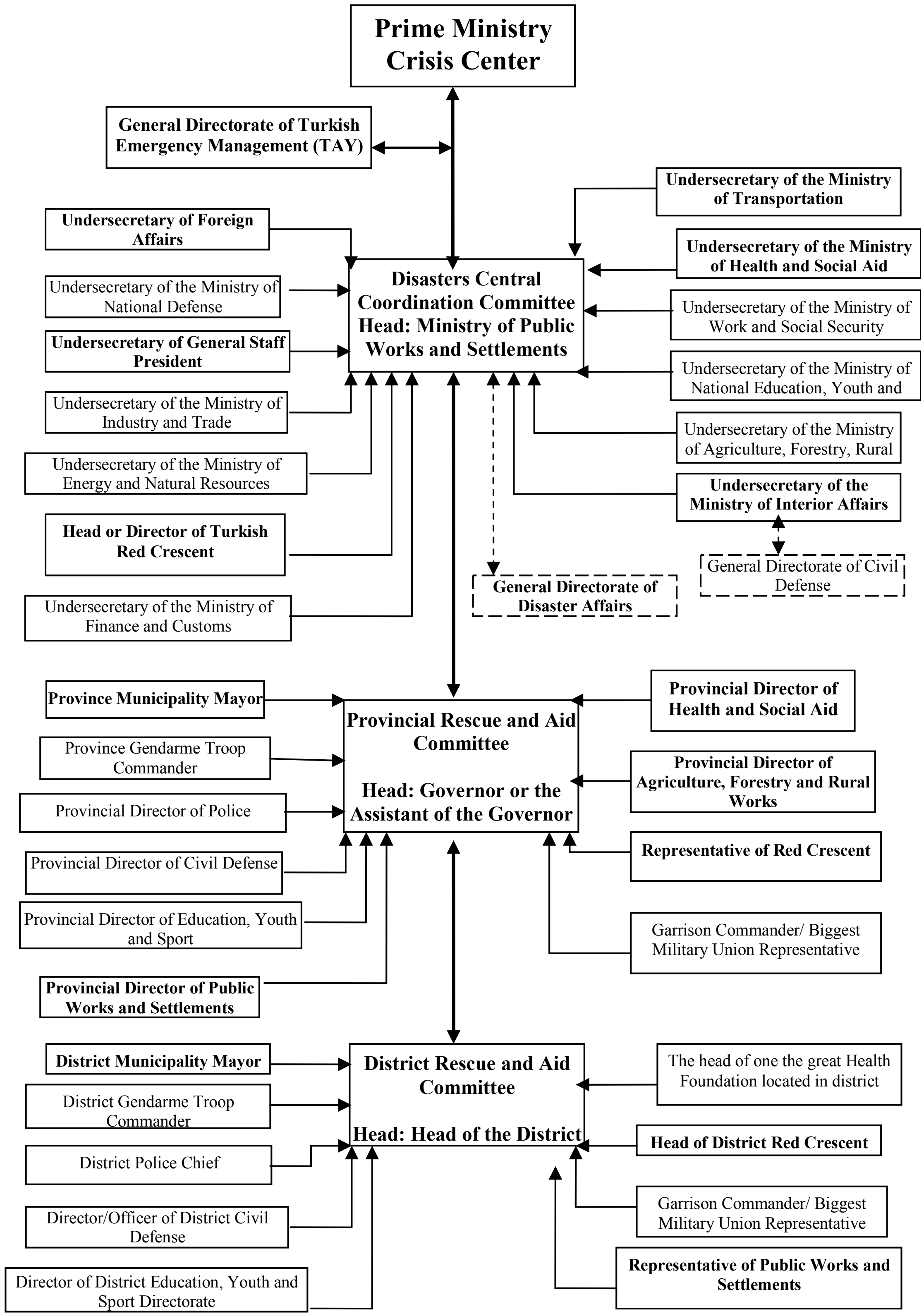

Figure 7.1.28. Operation process plan for mass care services

- **Local Level:**

Governorship – Provincial Rescue and Aid Committee: The Preliminary Damage Assessment and Temporary Housing Service Group with Purchasing, Renting, Seizing and Distribution Service Group founded after the disaster, acts upon the information coming from the subunits and the principal decisions and directions of the committee. It coordinates the operations for temporary accommodation of the people to pre-planned public buildings, like schools, sport halls, guest houses, get the tent cities to found. The committee satisfies the needs by purchasing, renting, seizing or by requesting help from upper committee. It also receives stores and distributes the aid materials.

Provincial Directorate of Health and Social Aid: The directorate prepares the action plan, and plans its resources before the disaster for effective and on time response. The directorate works in Provincial Rescue and Aid Committee, and does determination of the vulnerable people without relatives, and accommodates them in social residences of the institution. Also the people living in damaged residences of the directorate are also transferred to safe places in neighboring cities. The directorate evaluates the activities and informs the Committee about the necessities.

Provincial Directorate of Public Works and Settlements: The directorate works with governorship before the earthquake, to determine the appropriate places for prefabricated houses and related needs. After the earthquake, the directorate is the chief organization of Preliminary Damage Assessment and Temporary Housing Service group in Provincial Rescue and Aid Committee. It executes the construction works of prefabricated houses, renting or allotment of buildings from public institutions. The activities and necessities are reported to Provincial Rescue and Aid Committee.

Red Crescent Representative: Red Crescent works within the Health, Purchase and Preliminary Assessment service group. The Red Crescent works within a triangle cooperation of the Prime Ministry, General Directorate of Red Crescent in Ankara, and Provincial Governorship. The Red Crescent supplies feeding, tent and blanket in disaster area, besides health services. It distributes hot meal to victims with mobile refectories.

TSK: In case of insufficiency of tent and temporary shelters, the TSK forces found tent cities, and meet all kind of need arising. It also supports the Provincial Rescue and Aid Committee in storage and distribution of aid materials.

PUBLIC WORKS AND ENGINEERING SERVICES

Institutions Responsible for Coordination: General Directorate of Turkish Emergency Management (TAY), Disasters Central Coordination Committee, Ministry of Public Works and Settlement

Executive Institution: Governorship - Provincial Rescue and Aid Committee, Provincial Directorate of Public Works and Settlements, Provincial Directorate of Rural Affairs, Regional Directorate of Highways, Insurance Firms

Supporting Institutions: Province/District Gendarmerie Troops, Provincial/District Police Forces, Regional Directorate of Government Water Affairs (DSI), TSK

Aim: The objective of Public Works and Engineering Services are; assessing the damage in public buildings, residences, and determining the aid that the right holders will take, assessing the damage in lifelines and technical infrastructure, repairing or get repaired the critical ones like sewage-drinking water system, electricity, highways, bridges etc., taking mitigative actions to prevent damage, setting the technical requirements for construction and supervising construction auditing.

Scope: Public Works and Engineering Services cover the following titles:

- Promoting the pre-disaster reinforcement works, determining the buildings' resistances against earthquake.
- Determining the technical requirements of construction
- Supervising the construction auditing works
- Supplying technical support for reinforcement of dams, electricity, water-sewage, natural gas, highways etc.
- Assessing the damage in public buildings, infrastructure and residential buildings, determining the associated necessities.
- Determining the type of aid for right holders in residential buildings, repairing the critical infrastructure as quickly as possible.
- Supporting the works for removing debris and repairing damage in highways for transportation of aid material, response personnel and vehicles to disaster area on time.
- Managing the removal of debris.
- Determining the emergency routes, and opening these routes, bridges blocked off by debris.
- Repairing the damaged public service buildings, or supplying a temporary place to continue service after the earthquake.
- Demolishing or getting demolished the buildings, which are impossible to repair and removing the debris, reinforcing the convenient public service buildings, like moderately damaged or slightly damaged ones.
- Constructing or getting constructed of prefabricated houses for disaster victims.

Policies:

- Firstly, the critical facilities like energy power stations', dams', then public service buildings', industrial-commercial buildings' then the residential buildings' resistances against earthquake should be inspected. Accordingly decision for reconstruction or reinforcement should be given and promotions for reinforcement of private properties should be offered. To realize this work some part of Disasters' Fund should be separated for investigating the building stock and offering low interest funds for reconstruction/ reinforcement works.
- A new construction auditing system, including the construction inspection institutions and insurance firms, should be founded. With this system the responsibility of bed work will be divided between the contractor, project engineer, the construction supervisor and the master civil engineers committee of insurer firm. If damage occurs above the acceptable limits, the supervisor that audits the construction and the insurance firm that accept the building as within the standards, will be as responsible as the contractor and project engineer. This system auto controls itself without involving bureaucrative work, and decreases the government's involvement in follow up the work. And to achieve this aim, illegal construction should be prevented. The dissuasive punishments should be put into practice.
- The vehicles, personnel and equipment from public institutions or private firms that will work in debris removal and gathering places should be pre-determined. Also practices on communication and gathering after disaster should be performed and preparedness situation for response has to be assessed.

- The places where the debris will be discharged and the vehicles and personnel being charged in his action have to be planned, the necessary environmental protection measures should be taken.
- Personnel that will assess the damage and work on repairing and reopening the critical facilities should be planned and practices for action has to be repeated regularly.

Assumptions about the Post-Earthquake Situation: An earthquake in or near Istanbul may coerce the local and government resources' capacity. Besides the damage in buildings, the damage in infrastructure like damage in highways or airports may get the response action more difficult. The planned personnel for damage assessment, debris removal may be affected from earthquake or could not reach the duty place. In this respect, the debris or damage in highways, inner city roads hindering the transportation should be primarily removed / repaired.

The preliminary damage assessments are generally roughly made, so may not reflect the real situation, for this reason the final damage assessment should be done and informed by expert people as soon as possible, and accordingly the critical response process and potential work loads should be determined. Also the damage in buildings should be reassessed after aftershocks, excess some magnitude.

Organizations, Responsibilities and Operation Process Flow:

- **National Level:**

General Directorate of Turkish Emergency Management (TAY): TAY supports the inspection, reinforcement and reconstruction works for preparation. It also coordinates the preparation works like planning, practices and applications in various public and private institutions. After the earthquake the directorate gives any kind of support for mobilizing the national resources.

General Directorate of Disaster Affairs: The works of Disaster Affairs is to fix the places under the risk of natural disasters, taking counter measures, to prepare or get prepared the public against disaster. The directorate coordinates every kind of work for reducing loss of life and property in disaster regions. After the earthquake, it coordinates emergency aid applications for temporary settling, provides temporary-permanent shelters, and transmits the aids, necessities for public works.

Disasters Central Coordination Committee: The Ministry of Public Works and Settlement is the chief organization of Disasters Central Coordination Committee. The committee takes decisions and actions according to information coming from disaster area Provincial Rescue and Aid Committee to meet the demand and necessities for any type of resource. The committee coordinates the foreign and national aids for public works. Besides these functions, it gets the president's directions to apply and present reports, which summarizes the activities and needs in disaster area.

Ministry of Public Works and Settlement: The main objective of the ministry is to reduce the risk of death and injury of the population and reduce the scale of the economic risk arising from natural disasters. In this respect the ministry is organized in three main service units: General Directorate of Construction Affairs, General Directorate of Disaster Affairs and General Directorate of Technical Investigations and Applications. The work done by Disaster Affairs is defined above, Construction Affairs deals with providing necessary measures for constructing earthquake-resistant structures and developing basic principles for the rehabilitation of structures damaged by earthquakes. The Directorate of Technical Investigations and Applications mainly works for establishing, operating and developing the National Seismological Observation Network and for monitoring micro seismic activity to aid in earthquake prediction and to study aftershock activities. The ministry assesses the damage in all building stock after the disaster, execute / coordinate the debris removal work and provide temporary shelter for disaster victims.

- **Local Level:**

Governorship – Provincial Rescue and Aid Committee: The Preliminary Damage Assessment and Temporary Housing, Rescue and Debris Removal and Transportation Services Groups founded after the disaster, act upon the information coming from the subunits and the principal decisions and directions of the committee. The committee coordinates the operations for reopening the emergency roads, making preliminary damage asses

sment and removing the debris on roads. It also coordinates the distribution of prefabricated houses, satisfies the needs by purchasing, renting, seizing or by requesting assistance from upper committee.

Provincial Directorate of Public Works and Settlements: The directorate executes the final damage assessment of commercial, public and residential buildings, decide on the type of aid the share holders will receive. It supports the repair of damage in technical infrastructure, like highways, water-sewage system etc.

Regional Directorate of Highways: The directorate inspects the resistance of tunnels, viaducts, bridges on highway, make the necessary enforcement. After the disaster it repairs the damage in highways and opens to service. The resources that fulfill their primary responsibilities support the search and rescue motivated debris removal work according to directions of Provincial Rescue and Debris Removal.

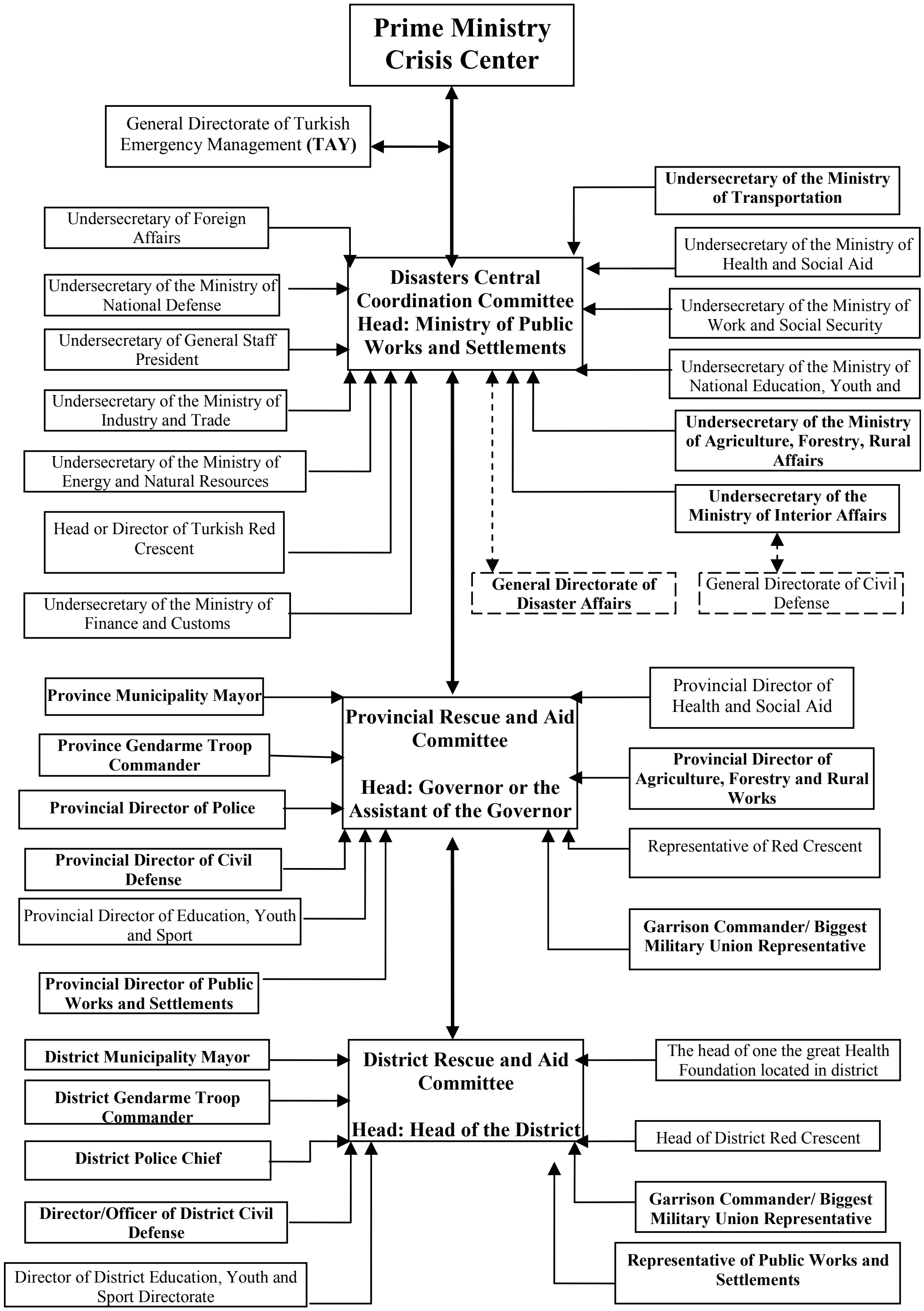

Figure 7.1.29. Operation process plan for public works and engineering

Provincial Directorate of Rural Affairs: The directorate is the head organization of Rescue and Debris Removal Service Group. Before earthquake it registers the existing heavy machines belonging to public and private institutions, making protocols with them, determines the gathering places for these heavy machines, and after the earthquake it executes the debris removal work. It reports the activities and necessities to Provincial Rescue and Aid Committee regularly.

Regional Directorate of Government Water Affairs (DSİ): The directorate inspects the resistance of dams and purification facilities, makes the necessary enforcement. After the disaster it repairs the damage in dams and opens to service. The resources that fulfill their primary responsibilities support the search and rescue motivated debris removal work and repair of water-sewage infrastructure in the city, according to directions of Provincial Rescue and Debris Removal.

TSK: It supports the debris removal work when Provincial Rescue and Aid Committee requests.

Provincial/District Gendarmerie Troops: It supports the debris removal work when Provincial Rescue and Aid Committee requests, it also regulates the traffic flow and preserve the security.

Provincial Directorate of Police: It supports the debris removal work, it also regulates the traffic flow and preserves the security.

COMMUNICATION

Institutions Responsible for Coordination: General Directorate of Turkish Emergency Management (TAY), Disasters Central Coordination Committee, Ministry of Transportation
Executive Institution: Governorship - Provincial Rescue and Aid Committee, Turk Telekom, Private GSM Firms and General Directorate of Radio
Supporting Institutions: Turkish Radio Amateurs, Provincial Directorate of Police, TSK
Aim: Communication Service is mobilizing all national resources to meet the communication need between central, local and executive units, after declaration of emergency.
Scope: This function deals with the design and implementation of emergency communication channels, enforcement of existing infrastructure, repair of damage and reopening communication systems to service. This function is based on planning and making use of the national resources and covers all institutions and organizations take part in emergency response operations.

Policies:

- For local and central authorities to give the right decisions and to get them applied depends on accessing right information on time. For this respect, the institutions responsible in coordinating and managing the operations should be equipped with satellite, radio communication means besides fixed communication infrastructure for continuous communication. This system should be realized before the disaster to ensure the effective usage.
- The response teams, like ambulances, search and rescue teams, debris removal teams, traffic control teams, and security teams should have a mobile communication or radio communication mean.
- The places and capacities of mobile telephone switchboards, mobile satellite communication systems, and power supplies for continuous communication should be planned
- The places and capacities of telephone centers that will meet the public’s communication demand should be planned.

- A radio channel that aims to inform public about mitigative activities before the earthquake, and about the current situation unbiased manner and ways of taking the humane aid after the earthquake, should be founded. Forming a public relation unit that give right and sufficient information for TV and radios, and making an agreement on broadcasting positive actions and the needs of victims instead of giving continuously dramatic views of people.
- There should be a communication infrastructure between the coordination center and local teams, since the reports summarizing the activities and necessities will be sent using this infrastructure. For this reporting system, Internet will decrease the loss of time in communication, brings the only necessary and sufficient information forth and prevent heaping of reports and tens of people working to extract the necessary information. The important point is to found a robust and stable system that will not be affected from the break off of telephone lines, or being down of telephone switchboard.

Assumptions about the Post-Earthquake Situation: The fixed telephone system may be heavily damaged; the communication of disaster region with other regions may be totally down. The transportation of temporary communication means like telephone switchboards, mobile satellite communication systems is impossible, because of the damage in highways, harbors and airports. In this respect transportation plans for conveying this type of material by all means should be prepared and some auxiliary resources should be stored in safe places in risky regions for emergency. Additionally the fixed assets that can support the risky area should be determined and get ready for emergency use.

The importance of first hours in emergency operations is known. The arrival of central aid may delay, because of the negative conditions. So the problem should be solved with the provincial resources. The Amateur Radio association members can supply communication between key institutions despite of any negativeness. The important topic is establishment of a communication system between institutions like Governor's Crisis Center, AKOM, district disaster management centers, fire brigade units, Directorate of Rural Affairs, big governmental hospitals etc., supporting this system with satellite communication and mobile communication, and getting ready for any time use.

Organizations, Responsibilities and Operation Process Flow:

- **National Level:**

General Directorate of Turkish Emergency Management (TAY): TAY promotes the preparation and mitigation activities in public institutions. Additionally the directorate makes promoting regulations for voluntary organizations. After the earthquake the directorate gives any kind of support for mobilizing the national communication resources.

Disasters Central Coordination Committee: The committee takes decisions and actions according to information coming from disaster area Provincial Rescue and Aid Committee to meet the demand and necessities for any type of resource. The committee coordinates the foreign and national aids for communication. Besides these functions, it gets the president's directions to apply and present reports, which summarizes the activities and needs in disaster area.

Ministry of Transportation: Before the earthquake it does the reinforcement in infrastructures, which are belonging to related institutions like Turk Telekom, Directorate of Turkish Radio Communication. It promotes foundation of emergency communication systems, plans the emergency action plans. After the earthquake the ministry coordinates the work of government and private communication channels in a supplementary way. It facilitates the transportation of communication materials. It includes the radio amateurs into the emergency plans and practices, and after the disaster the Ministry locates them to places where communication need arises.

- **Local Level :**

Governorship – Provincial Rescue and Aid Committee: The Governorship works for establishment of a stable communication mean between the Provincial Disaster Management Center and district disaster management centers. It search for alternative channels, plans and practices the emergency communication mean for better performance. The Communication Service Group founded after the disaster, act upon the information coming from the subunits and according to the principal decisions and directions of the committee. The committee coordinates the operations for repairing and reopening the damaged communication structure to service, to find quick solutions for communication need, distributes the resources in hand fairly and effectively. The committee put the information communication system to practice, to serve the victims in searching for their relatives in hospitals, tent cities etc.

Turk Telekom: Turk Telekom is a nationwide government-owned company. The pre-disaster preparation works includes, preparation of emergency plans, providing an emergency communication system for governmental organizations, planning of emergency public telephones at tent cities. In case of emergency, the engineers and vehicles work under Governorship Disaster Management Center. Assessing and repairing the telephone lines will be carried out also by Turk Telekom.

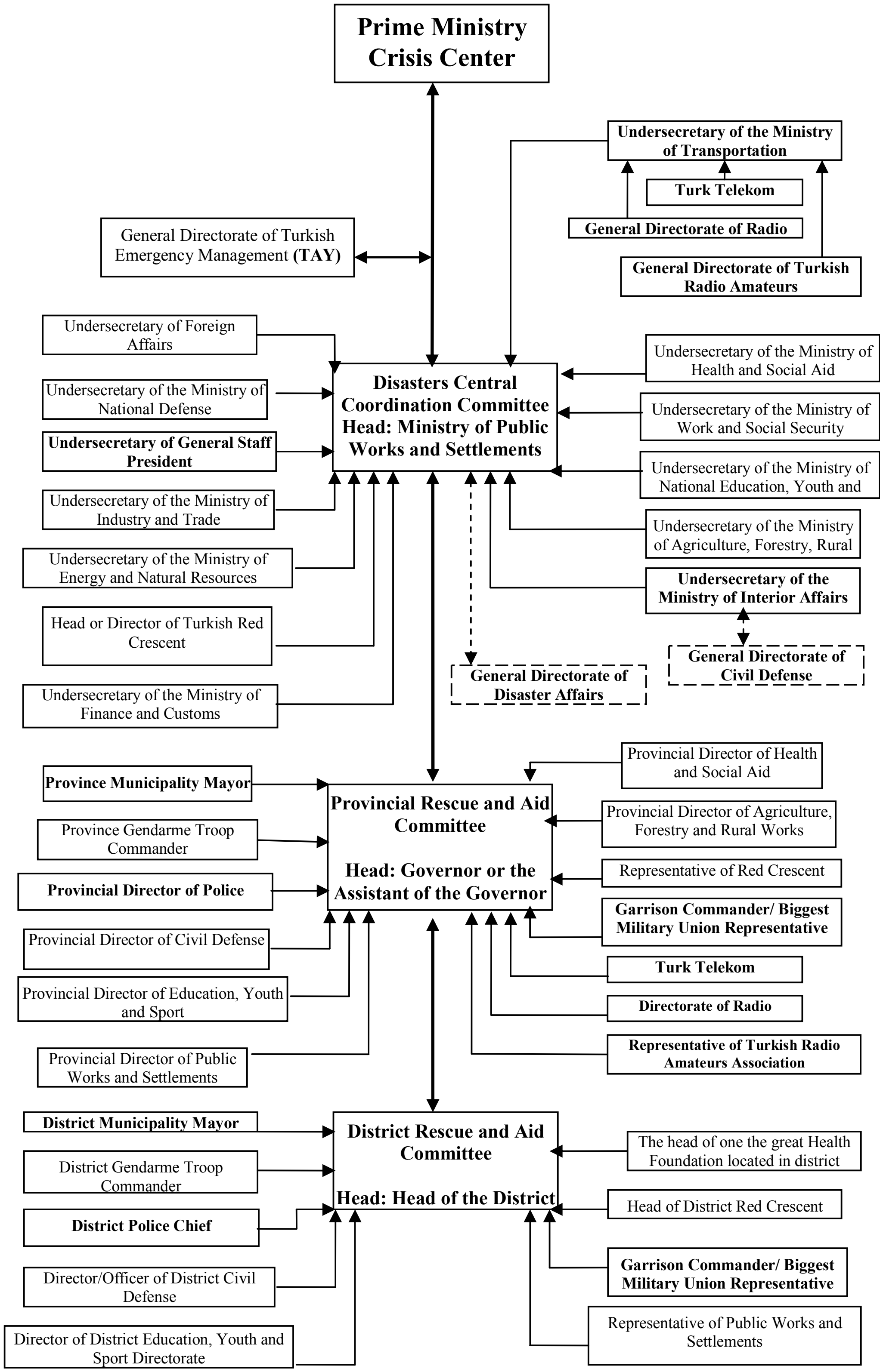

Figure 7.1.30. Operation process plan for communication services

Private GSM Firms: The duties of private GSM firms are to maintain servicing and providing emergency communication for authorities and response teams after the earthquake. For this aim, the firms reinforce their infrastructure, educate and practice their personnel and plan places for public telephones.

General Directorate of Radio and Turkish Radio Amateurs: The most probable communication mean in emergency, between the command points and response teams is the radio communication, if the telephone and mobile telephone lines cannot service. For this respect, the General Directorate of Radio and Turkish Radio Amateurs should prepare their personnel and equipment according to worst case scenario, and practice their resources such that within an hour the communication between all local disaster management centers is all right.

Provincial Directorate of Police: The directorate supports the emergency communication with its communication infrastructure, if needed.

Garrison Commandership / Greatest Military Unit Representative: The commandership supports the emergency communication between official institutions with its communication infrastructure, if needed.

TRANSPORTATION

Institutions Responsible for Coordination: General Directorate of Turkish Emergency Management (TAY), Disasters Central Coordination Committee, Governorship Provincial Rescue and Aid Committee

Executive Institutions: Ministry of Transportation, General Directorate of Highways, Governmental Airports Enterprise (DHMİ), Turkish Governmental Railways (TCDD), Turkish Maritime Enterprises (TDI), Metropolitan Municipality Disaster Coordination Center (AKOM), Provincial Police Directorate

Supporting Institutions: TSK

Aim: The aim of the Transportation function is to supply inter city and inner city transportation of injured people, aid material, response teams and equipment, to repair damage in transportation network, offering mass transportation to public and stabilizing the flow and public order in traffic.

Scope: The Transportation function covers the following topics:

- Inspection and analysis of resistance of transportation network, quickly completing the reconstruction/reinforcement work.
- Inspection of the damage in transportation network, analyzing the effect of earthquake in national and regional transportation systems, monitoring the capacity usage and interruptions.
- Coordination and execution of reopening to service motivated debris removal and repair works.
- To maintain the traffic flow and security in city roads, through which emergency service vehicles travel.
- Providing regional and intercity mass transportation, utilizing the national resources to meet the transportation demand.
- Coordination of rescue related transportation activities

- Supporting design and application of alternative transportation means, requesting military support for transportation of aid material, personnel
- Maintaining the security in roads, through which the aid material is transported.
- Fulfilling the transportation of aid materials to forward distribution points, and supplying vehicle, personnel assistance.

Policies:

- In transportation planning, firstly the resources of provincial public institution are taken for emergency use. If it is not possible to meet all of the demand, assistance from, neighboring provinces, military forces and central government is requested.
- The plans prepared in district and provincial level for transporting humane aid and controlling traffic flow and the precedence relations are taken as basis.
- The standards set in regional transportation plan determine the cooperation between the subgroups of Ministry of Transportation.
- In order to mobilize the local and national forces a time-phased mobilization plan including every transportation mean and public-private transportation establishment, should be prepared.
- Agreements or cooperation plans should be signed between the official responsible authority and institutions, firms that transport passenger or cargo.
- An emergency management center and emergency communication system should be established in every official-private institution before the earthquake.

Assumptions about the Post-Earthquake Situation: An earthquake in Istanbul will damage the maritime, railway, highway transportation systems. The service will be interrupted because of the damage in roads, quays and vehicles, the collapsed buildings, flyovers, bridges etc. At the same time, there will be an extraordinary demand for transportation, for conveying the response-aid material to affected region. The assistance of central authority and national resources will be requested for transporting the aid materials to disaster area, removing the debris over the transportation network, repairing the damaged facilities, and reopening the services to public.

For planning study the following assumptions may be taken into account:

- The transportation infrastructure may be damaged such that it is impossible to reach the region with highways, railways or maritime transportation.
- The need for inner-city transportation may exceed the capacity
- The interruptions in communication system may prohibit effective coordination
- The unorganized transportation of aid materials and crowd of people coming from neighboring provinces to aid their relatives may block the entrance highways and roads inside the city.

Organizations, Responsibilities and Operation Process Flow:

- **National Level:**

General Directorate of Turkish Emergency Management (TAY): The General Directorate coordinates making use of transportation means (air, sea, rail, highways) and search and rescue vehicles belonging to public and private sector in emergency response operations.

Additionally the directorate makes promoting regulations for voluntary organizations, and coordinates the receival, storage and transportation of aid material.

Disasters Central Coordination Committee: The committee takes decisions and actions according to information coming from disaster area Provincial Rescue and Aid Committee to meet the demand and necessities for resources. The committee coordinates the foreign aids and national resources for transportation. Besides these functions, it gets the president's directions to apply and present reports, which summarizes the activities and needs in disaster area.

Ministry of Transportation: The undersecretary of Ministry of Transportation works in Disasters Central Coordination Committee after the disaster. The ministry executes and coordinates the transportation of aid material coming from foreign countries and nationwide, by airways, railways, highways or maritime. It takes the necessary measures to facilitate the transfer of aid material and traffic flow in transportation network. It repairs or gets repaired the damage in airports, quays, highways, railways and try to open them to service as soon as possible. The ministry reconstructs the damaged parts, if it is not possible to restore. Additionally, it takes the measures and does the agreements with private, voluntary transportation firms for cooperating after disaster or for public's free benefit from transportation means.

- **Local Level:**

Governorship – Provincial Rescue and Aid Committee: The Transportation Service Group founded after the disaster, acts upon the information coming from the subunits and the principal decisions and directions of the committee. The transportation service has seven subgroups:

- -Highway and Express Way Group, headed by Highway 17th Directorate
- -State and Provincial Road Group, headed by Highway 1st Directorate
- -Inner City Road Group, headed by IMM
- -Village Road Group, headed by Rural Affairs
- -Seaway Group, headed by the Maritime
- -Railroad Group, headed by the Turkish Railroad
- -Airway Group, headed by Turkish Airways
- Like the other service groups the head of the service group is appointed by the Governor. The group directs the dispatching of aid materials and response teams, execution of public transportation services, repair and debris removal works in transportation network. The Committee tries to satisfy the vehicle, personnel, equipment needs by purchasing, renting or requesting from upper committees.

Regional Directorate of Highways: The Highway 17th Regional Directorate is the head organization in the transportation service group of the Provincial Rescue and Aid Committee. The directorate determines the risky points in the highway network, and does the necessary reinforcements. After the earthquake, emergency damage assessment shall be performed by highway patrol members, and repaired by highways resources. The repair works and related needs are reported to Provincial Aid and Rescue Committee, and the forces completing their primary duties support the debris removal studies guided by Governorship.

TDI: TDI is the head of Seaway Group of Transportation Service Group of Provincial Rescue and Aid Committee. The enterprise receives, stores and records the foreign and national aid coming by seaway. It charges the personnel, vehicles and equipments for transportation of emergency response personnel, aid material according to directions coming from the Provincial Rescue and Aid Committee. Additionally it provides public transportation with ferries, and put alternative floating wharfs into service. The Ship Rescue and Shore Security Department response the fires and chemical leaks in the sea. The transportation and repair works and related needs are reported to Provincial Aid and Rescue Committee regularly.

DHMI and Turkish Airlines: DHMI assess and repairs the damage in airports. It gives service by alternative airports planned before the earthquake and gives landing service for foreign and national flights, transporting aid. It also receives and stores the aid material appropriately, takes record of items and prepares the consignment of aid according to directions of Provincial Rescue and Aid Committee. Turkish Airlines transport the aid cargos, collected from all over the country.

AKOM: AKOM prepared an emergency transportation response plan covering the general directorates and enterprises; IETT, IDO, Transportation A.Ş., Traffic, Road Maintenance and Repair, Infrastructure Coordination and Transport Planning. These directorates and enterprises repair the damage and open the inner city roads, arterials, primary emergency roads, flyovers to service and give transportation service with IETT busses, IDO sea busses. The transportation and repair works and related needs are reported to Provincial Aid and Rescue Committee regularly.

Provincial Directorate of Police: The directorate works on maintaining the security and traffic flow in primary, secondary and tertiary emergency roads determined by IMM Transportation Planning Directorate. The Police forces also escort and secure the aid material.

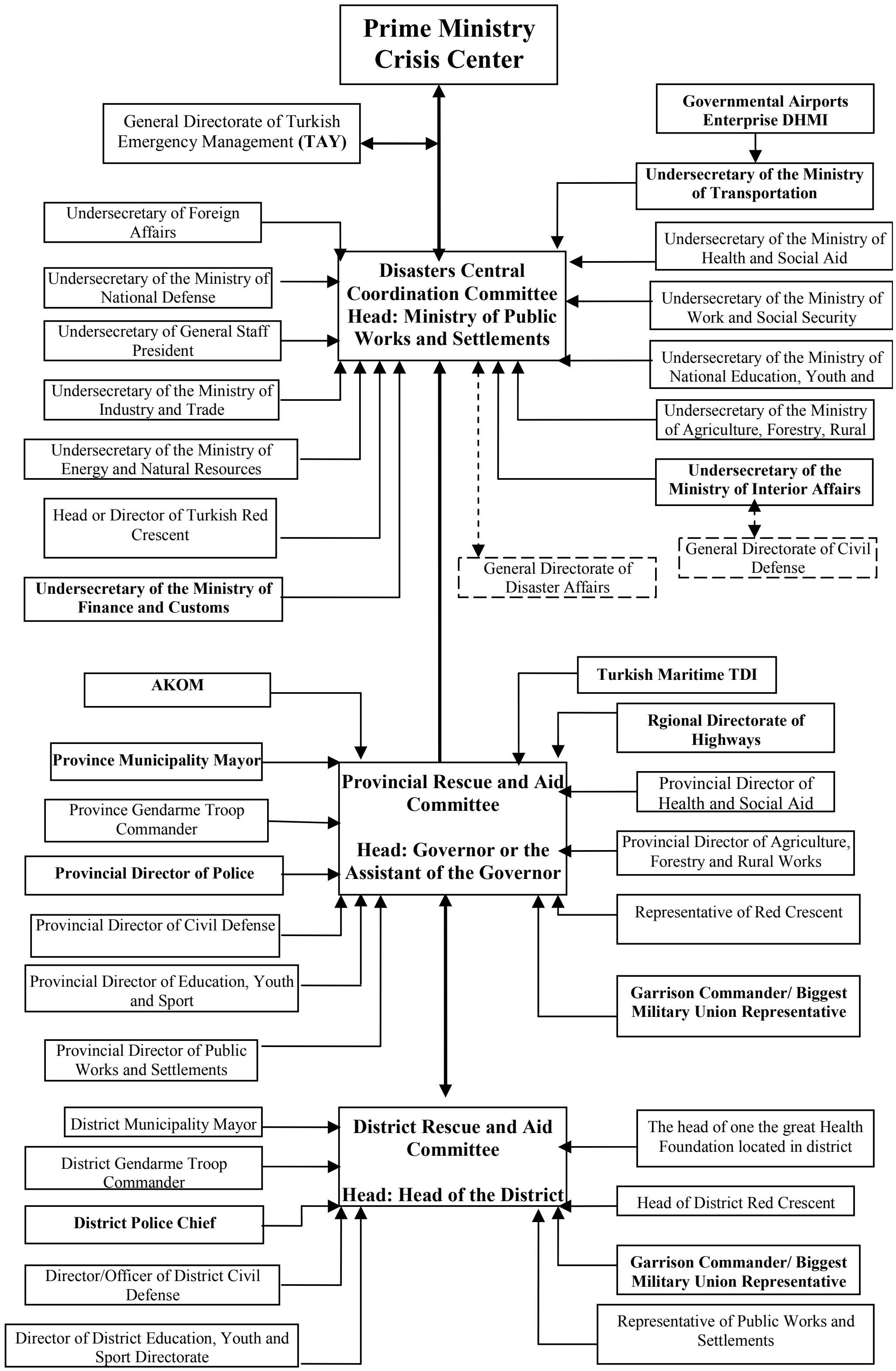

Figure 7.1.31. Operation process plan for transportation services

Technical Infrastructure- Water-Natural Gas And Electricity

Institutions Responsible for Coordination: Institutions Responsible for Coordination: General Directorate of Turkish Emergency Management (TAY), Disasters Central Coordination Committee, Governorship Provincial Rescue and Aid Committee

Executive Institutions: Metropolitan Municipality Disaster Coordination Center (AKOM), ISKI, İGDAŞ, BEDAŞ, TEDAŞ

Supporting Institutions: DSI, Ministry of Energy and Natural Resources, Ministry of Public Works and Settlement

Aim: Technical Infrastructure function aims to fix the deficiencies and vulnerability of critical infrastructure and to carry out the required enforcements, besides educating personnel and planning the resources, emergency alternative-auxiliary water-energy sources for probable collapse of infrastructure after the earthquake. Fulfilling the repair and reopening the facilities to service are also primary objectives of the function.

Scope: Technical Infrastructure function covers the following topics:

- Assessing the probable effect of earthquake on water-sewage, natural gas and electricity infrastructures and reinforcing the weak points.
- Determining emergency response activities, educating and preparing the personnel on emergency actions and constructing auxiliary resources within the city like water reservoirs, power generators for critical facilities like hospitals, disaster management centers etc.
- Assessing the damage in infrastructures and do the necessary repairs after the earthquake, serving with auxiliary resources temporarily in the mean time.
- Coordinating with other organizations to prevent secondary disasters like fires resulted from natural gas pipeline cracks or floods arising from overflow of water reservoirs etc.

Policies:

- A warning system that senses the earthquake before it occurs and simultaneously shuts down the service and a monitoring system displaying simultaneously the breaks-defects in the network, should be established.
- Educated teams for technical care and repair should be founded, and emergency action plans should be prepared.
- The auxiliary water depot places that satisfy the drinking-usage water need of hospitals, victims, response personnel should be determined and put into practice. Cooperation plans and agreements should be signed with private water distribution firms
- The electricity needs of critical facilities like hospitals, disaster management centers, public service buildings should be planned and these building should be supported with auxiliary energy generators, and the necessary power inputs.
- The fuel and heating need for fuel according to seasons should be determined and fuel for the first 2-3 days should be present in safe, within reach of the city.
- The filling stations that may meet the gasoline demand of heavy machines, ambulances, official vehicles and voluntary aid vehicles should be determined, and necessary agreements should be made.

Assumptions about the Post-Earthquake Situation: After the expected Istanbul earthquake the water-sewage, electricity, natural gas services may not function properly in some places or may be totally down. The educated response personnel to repair the defects may become the victims of the earthquake or could not reach their workplaces. The cracks or breaks in the network may end up with fires, water floods that can give much greater damage than the disaster itself. The planned auxiliary resources may also be damaged and unusable. For this respect the personnel, resources and their alternatives should be carefully examined and for some positions alternative of the alternative should be planned.

Organizations, Responsibilities and Operation Process Flow:

- **National Level:**

General Directorate of Turkish Emergency Management (TAY): The General Directorate supports and coordinates the disaster preparation works carried out in public institutions. Additionally the directorate makes coordinates the receival, storage and transportation of aid material.

Disasters Central Coordination Committee: The committee takes decisions and actions according to information coming from disaster area Provincial Rescue and Aid Committee to meet the demand and necessities for any type of resource. The committee coordinates national aid-resources for repair of the infrastructure and for meet the instantaneous need for these functions. Besides, it gets the president's directions to apply and present reports, which summarizes the activities and needs in disaster area.

Ministry of Public Works and Settlement: The Ministry supports the reinforcements in technical infrastructure and after the earthquake it assists the assessment and repair work in water-sewage, electricity network.

Ministry of Energy and Natural Resources: The ministry executes the reinforcement of electricity network, forms and trains the emergency response teams before the earthquake. After the earthquake, it repairs or gets repaired the damaged electricity network, and tries to give electricity to critical facilities determined by Ministry of Industry and Trade. Besides, it takes the measures for meeting the heating demand of disaster victims and provides lightening of tent cities and prefabricated houses.

Ministry of Agriculture, Forestry and Rural Affairs: The ministry plans and after the earthquake provides firewood for heating and meets the lightening need of temporary shelters

- **Local Level:**

Governorship – Provincial Rescue and Aid Committee: The Electricity-Water-Sewage Service Group, founded after the earthquake acts upon the information coming from the subunits and the principal decisions and directions of the committee. The committee coordinates repair activities of damaged infrastructure, mobilization of auxiliary resources, and follows demand-supply status for each service. The committee satisfies the needs by purchasing, renting, seizing or by requesting assistance from upper committee.

AKOM: AKOM prepared an emergency response plan covering the general directorates and enterprises; ISKI, IGDAS. These directorates and enterprises repair the damage; open the water-sewage and natural gas infrastructures to service and supply water to temporary settlements like tent cities and prefabricated houses. The service and repair works and related needs are reported to Provincial Aid and Rescue Committee regularly.

TEDAŞ-BEDAŞ: These firms execute the reinforcement of electricity distribution network, establish and train the emergency response teams. They also determine the alternative electricity service routes for critical facilities like hospitals, official buildings and undamaged industrial facilities. After the earthquake, they repair damaged electricity network, and try to give electricity to critical facilities and industrial facilities determined by Ministry of Industry and Trade. Besides, they take measures to meet the heating demand of disaster victims and provide lightening of tent cities and prefabricated houses.

Regional Directorate of Government Water Affairs: The directorate reinforces the dams and purification systems for seismic resistance. The directorate assesses and repairs the damage in dams and assists the repair and water distribution works of ISKI. The two institutions distribute drinking and usage water to disaster victims and temporary shelters like tent cities and prefabricated settlements.

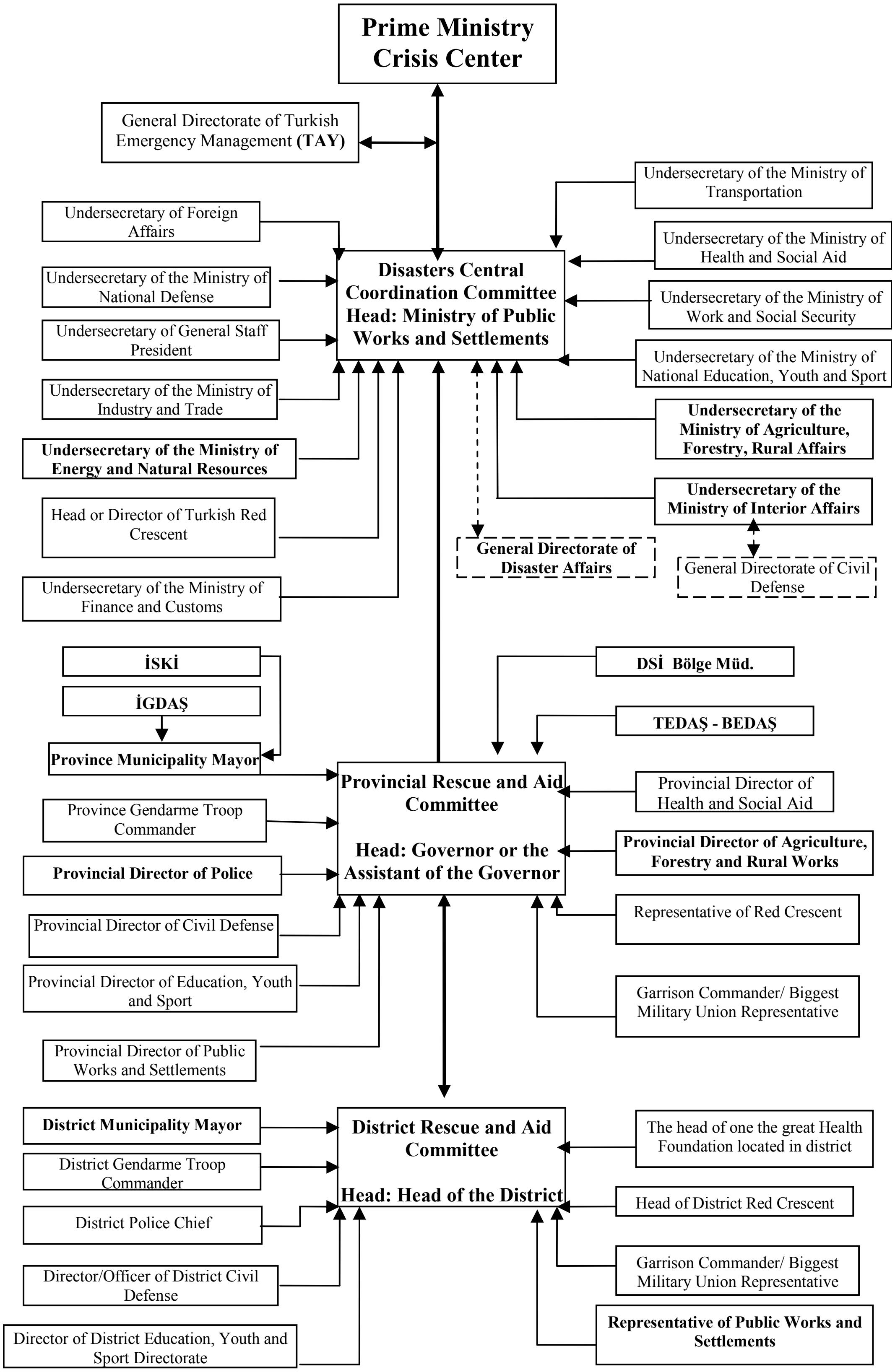

Figure 7.1.32. Operation process plan for technical infrastructure

Security And Public Order

Institutions Responsible for Coordination: General Directorate of Turkish Emergency Management (TAY), Disasters Central Coordination Committee, Governorship Provincial Rescue and Aid Committee

Executive Institutions: Ministry of Internal Affairs, Provincial Police Directorate

Supporting Institutions: Provincial/District Gendarmerie Troops, TSK

Aim: The public order and security function deals with preserving the public order, securing the life and property against looting and sabotage, preventing the blocking of traffic ways and escorting the deliveries of aid.

Scope: Security and Public Order function covers the following topics:

- Prevention of theft, looting in collapsed, damaged and discharged houses, setting and applying dissuasive punishments to people,
- Securing the commercial places like shops, supermarkets and malls against theft, looting and sabotage,
- Securing the national, historical work of art like museums, palaces, and monuments against theft, pillage and sabotage,
- Securing the damaged, discharged official buildings against sabotage ,
- Maintaining the public order,
- Preventing the blocking of traffic ways, especially controlling the primary emergency roads and allowing passage of only the emergency vehicles, controlling the traffic flow,
- Escorting the deliveries of goods, and rescue teams.

Policies:

- The resistance of buildings belonging to Provincial Directorate of Police should be checked and necessary enforcements should be made.
- Benefiting from victims situation in unjustifiable way (theft, sabotage, unfair pricing etc.) should be punished heavily, for this respect the laws and applications should be revised.
- List of schools, dormitories, teahouses, mosques, flammable materials storage sites should be determined as priority locations for search and rescue.
- List of historical buildings, museums, official buildings, shopping malls, information bureau etc. that should be secured against theft and sabotage should be determined.
- The list of police forces, vehicles and their duty places should be planned.
- The police forces that will work mobile and among the public should be educated on victims' psychology for appropriate treatment.
- The first precedence emergency roads should be controlled both before and after the earthquake. Parking without permission and blockage should be prevented any time. The first and second precedence emergency roads should be controlled and traffic flow should be allowed for only the emergency vehicles and official vehicles in emergency.

Assumptions about the Post-Earthquake Situation: The success of the operations depends on servicing capability of Police Department after the earthquake. The prerequisite for each public institution to continuing servicing is, recovering from the earthquake without great damage. The buildings of Police Department shares the same risk with residential building stock, supposing damage in any district's police station ends up with loss of personnel that will preserve the security, and a chain of disorder. Besides, the personnel may become the victims of disaster at their homes or on duty. The first precedence emergency roads their alternatives may be blocked by momentary crowd, collapsed buildings etc. To surpass the confusion in the city, existing resources may not suffice. In this respect the planning of security forces should be carried out collectively with Provincial Police Department, TSK and Provincial Gendarmerie Troops.

Organizations, Responsibilities and Operation Process Flow:

- **National Level:**

General Directorate of Turkish Emergency Management (TAY): The General Directorate supports and coordinates the disaster preparation works carried out in public institutions.

Disasters Central Coordination Committee: The committee takes decisions and actions according to information coming from disaster area Provincial Rescue and Aid Committee to meet the demand and necessities for any type of resource. The committee coordinates national resources to maintain the security and public order in the disaster region and tries to meet the instantaneous need for this function. Besides, it gets the president's directions to apply and present reports, which summarizes the activities and needs in disaster area.

Ministry of Internal Affairs: The ministry prepares action plans for public order and security, applies or gets applied nation wide practices, prepares regional support plans, and reinforces the buildings of Police Department. After the earthquake it supervises the activities, tries to meet the personnel, vehicle demand with national resources.

- **Local Level :**

Governorship – Provincial Rescue and Aid Committee: The Provincial Directorate of Police is the head organization of the Security Service Group founded after the earthquake. The committee supervises the activities and coordinates the forces within the province. The unmeet demand is satisfied by requesting assistance from neighboring provinces, upper committees, TSK and Gendarmerie Forces.

AKOM: The Directorates Traffic and Transportation Planning determine the emergency roads for response teams and classified them according to their importance as firstly, secondary, and tertiary emergency roads and the precautions for these roads are determined and put into practice before the earthquake. Additionally the arterials and some primary emergency roads are equipped with cameras for simultaneously determining the damage and the traffic flow.

Maintaining the traffic flow and control work will be carried out by traffic forces of police department. In case of blockage of the emergency roads after the earthquake, the Provincial Rescue and Aid Committee, so the ambulances and other response vehicles will be informed about the alternative ways.

Provincial Police Directorate: The Directorate determines the places

- to be secured,
- -that accommodate mass of people and may require urgent search and rescue,
- that may contain flammable, explosive materials and may threat life and property security. Additionally, the directorate prepares action and mobilization plans for organized response. After the earthquake the directorate heads the Security Service Group in Provincial Rescue and Aid Committee. The police forces observe and inform

the governorship about the damage, just after the earthquake. They control the traffic flow, and maintain the public order. All activities and necessities are reported regularly to Provincial Rescue and Aid Committee.

Provincial Gendarmerie Troop Commandership: The Commandership participate the planning activities before the earthquake and after the event, they support the Police Department with gendarmerie forces.

Commandership of 1st Army: The Commandership participate the planning activities before the earthquake and after the event they support the Police Department with army forces.

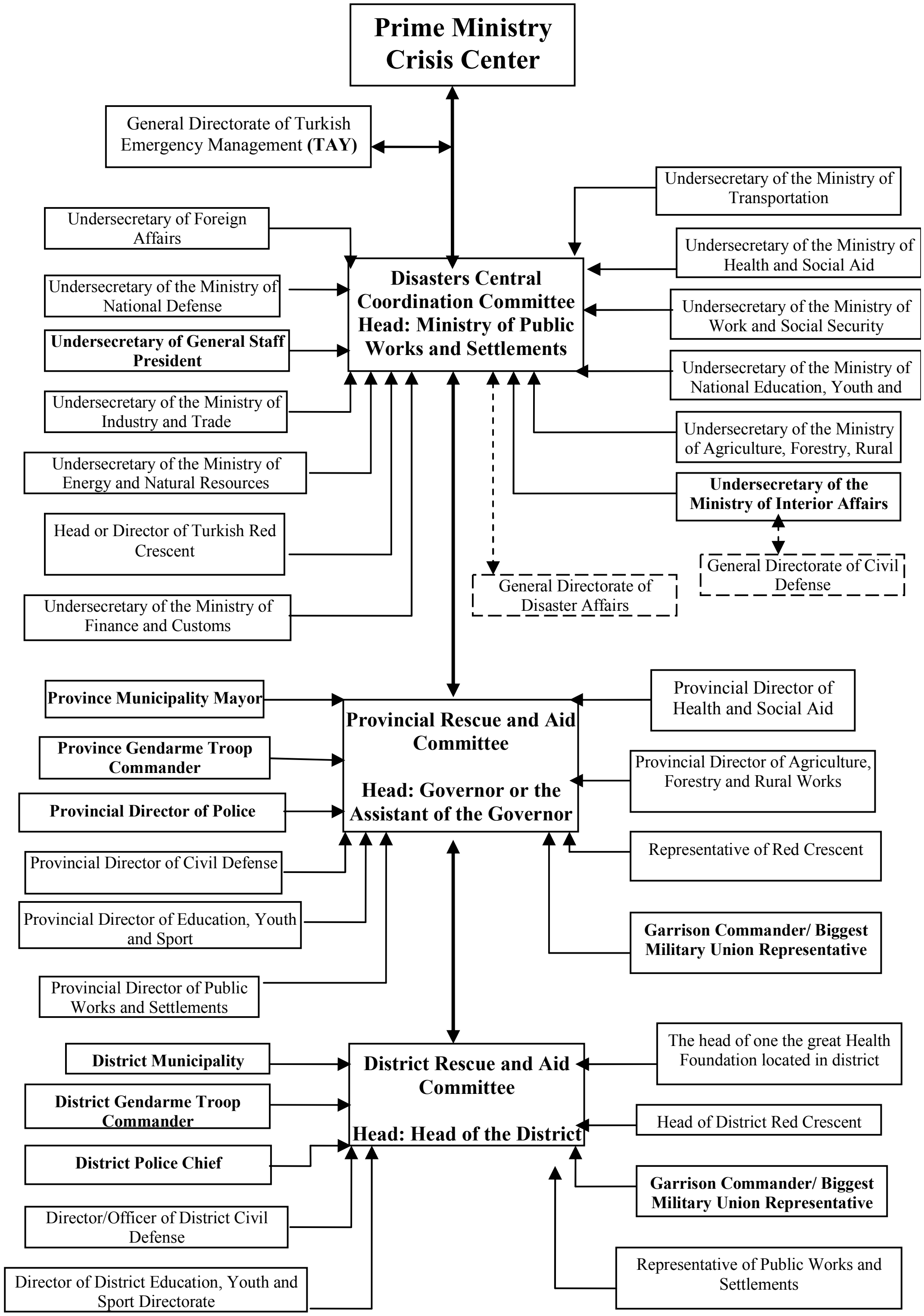

Figure 7.1.33. Operation process plan for security and public order

Prevention Of Secondary Disasters

Institutions Responsible for Coordination: General Directorate of Turkish Emergency Management (TAY), Disasters Central Coordination Committee, Governorship Provincial Rescue and Aid Committee, AKOM

Executive Institutions: Fire Brigade, Metropolitan Municipality Flammable and Chemical Materials Warehouse, Ministry of Environment, Ministry of Energy and Natural Resources, Ministry of Industry and Trade

Supporting Institutions: TSK, General Directorate of Civil Defense, General Directorate of Highways

Aim: The objective of this function is to prevent the great fires, explosions, leaks, floods, landslides that threat human life and property, and after the earthquake taking the fires, leaks under control to prevent further damage.

Scope: Prevention of Secondary Disasters covers the following topics:

- Determination of risky places which are open to fire, landslides, and flood, and taking measures accordingly.
- Listing of firms, factories that produce / store flammable or explosive materials.
- Determination of equipment and vehicles that flammable, explosive material producing / storing firms should have and checking their compliance to these standards.
- Execution and coordination of fire extinguishing activities, and supplying personnel and equipment after disaster.
- Execution and coordination of search and rescue activities in areas that flood and landslide occurred.
- Taking under control and cleaning of poisonous leaks mixed with water, air or soil.

Policies:

- The equipment and vehicles that flammable, explosive material producing / storing firms have present should be determined and their compliance to these standards should be checked. The firms not obeying the rules should be seriously punished.
- The dams, reservoirs and water-sewage system that may cause floods because of the earthquake damage should be reinforced.
- Precautious actions should be taken in places where land sliding or flood previously occurred, or risky places like settlements founded in sharp slopes. If necessary, these regions should be announced as "disaster regions" and settlements in these places should be transferred to safe regions.
- In public buildings, private firms and factories, equipped teams for fire extinguishing, or first response should be established. These teams should also take part in provincial disaster practices.
- The medium and small sized factories-workshops within the city should be gradually transferred to organized industrial regions, and for each one or a group of industrial organized regions should have a fire brigade and a response team that may control the fire and chemical leak without going out of control.
- The special response teams to deal with the fires, explosions resulted from cracks or breaks of natural gas system should be formed. Additionally the early warning and immediate gas cut off systems should be improved.

Assumptions about the Post-Earthquake Situation: The industrialization tendency in Istanbul is moving to eastern and western borders, but the small and medium sized workshops continue to work within city. One can find workshops, depots and filling stations Even in basement of apartment buildings. Besides some energy powerhouses and industrial factories, those threaten the human life and property, continue producing and storing chemicals within the city. These big-medium-small sized industrial enterprises may cause loss of life and property after an earthquake, in the mean time the loss in the enterprise itself creates loss in economy and employment. Instead of planning these dangerous material producing / using workshops for emergency, they should be settled in isolated, safe industrial regions, with necessary response possibilities. Same methodology should be applied to gasoline filling stations. If the preventive measures will not be taken, the explosions, fires caused by natural gas pipeline cracks, gas filling stations, workshops, and chemical material depots will harm the city more than the earthquake's damage itself. Additionally, the leak to air, water, and soil will not cause a momentary pollution, on the contrary they show the long term effects by increase in illnesses in next years.

Organizations, Responsibilities and Operation Process Flow:

- **National Level:**

General Directorate of Turkish Emergency Management (TAY): The General Directorate supports and coordinates the disaster preparation works carried out in public institutions.

Disasters Central Coordination Committee: The committee takes decisions and actions according to information coming from disaster area Provincial Rescue and Aid Committee to meet the demand and necessities for any type of response activity. The committee coordinates national resources for fire extinguishment in industrial plants, natural gas system, and dwellings, for search and rescue activities in landslide / flood areas and tries to meet the needs to response uncontrollable fires, landslides or flood. Besides, it gets the president's directions to apply and present reports, which summarizes the activities and needs in disaster area.

Ministry of Environment: The Ministry determines the standards for flammable, explosive or chemical material production and storage. It controls the compliance of firms to these standards. The Ministry also trains equipped teams for treating chemical leakage, and charge them after the disaster. It executes the environmental pollution clearing activities.

Ministry of Energy and Natural Resources: The Ministry reinforces the energy plants, electricity transmission lines, transformers and dams for earthquake resistance, after the earthquake it assesses and repairs the damage as soon as possible.

Ministry of Industry and Trade: The ministry determines the critical industrial plants before the earthquake, it promotes the movement of factories to secure organized industrial regions. It promotes formation of organized areas for small and medium sized workshops. After the earthquake the ministry provides any kind of easiness for industrial enterprises to prevent economic loss.

- **Local Level:**

Governorship – Provincial Rescue and Aid Committee: The committee acts upon the information coming from the Fire Brigade and the principal decisions and directions of the committee. The committee coordinates the fire extinguishing activities, search and rescue operations in landslides and floods, repair activities of damaged infrastructure, mobilization of auxiliary resources. The committee satisfies the needs by purchasing, renting, seizing or by applying upper committee.

AKOM: AKOM**-** Fire Brigade prepares emergency response plan to response effectively the fires, floods and landslides. The directorate determines the industrial plants, workshops, gas filing stations they may cause fires and explosions after the disaster, and prepares action plans and do training practices with IGDAŞ to respond fires caused by damage in the natural gas pipeline. The fire brigade buildings are reinforced in the preparation phase. After the earthquake, the directorate fulfills all fire extinguishing and search and rescue operations in landslides and floods. The service and repair works and related needs are reported to Provincial Aid and Rescue Committee regularly.

The Directorate of Flammable, Chemical Materials Warehouse provides loading, unloading and storing of hazardous and dangerous materials. The Directorate also determines the standards of storing or using these flammable, explosive or hazardous raw materials in production, supervises the compliance of firms to these standards. AKOM coordinates the precautious activities within the municipality and directs the forces according to directions coming from Provincial Rescue and Aid Committee.

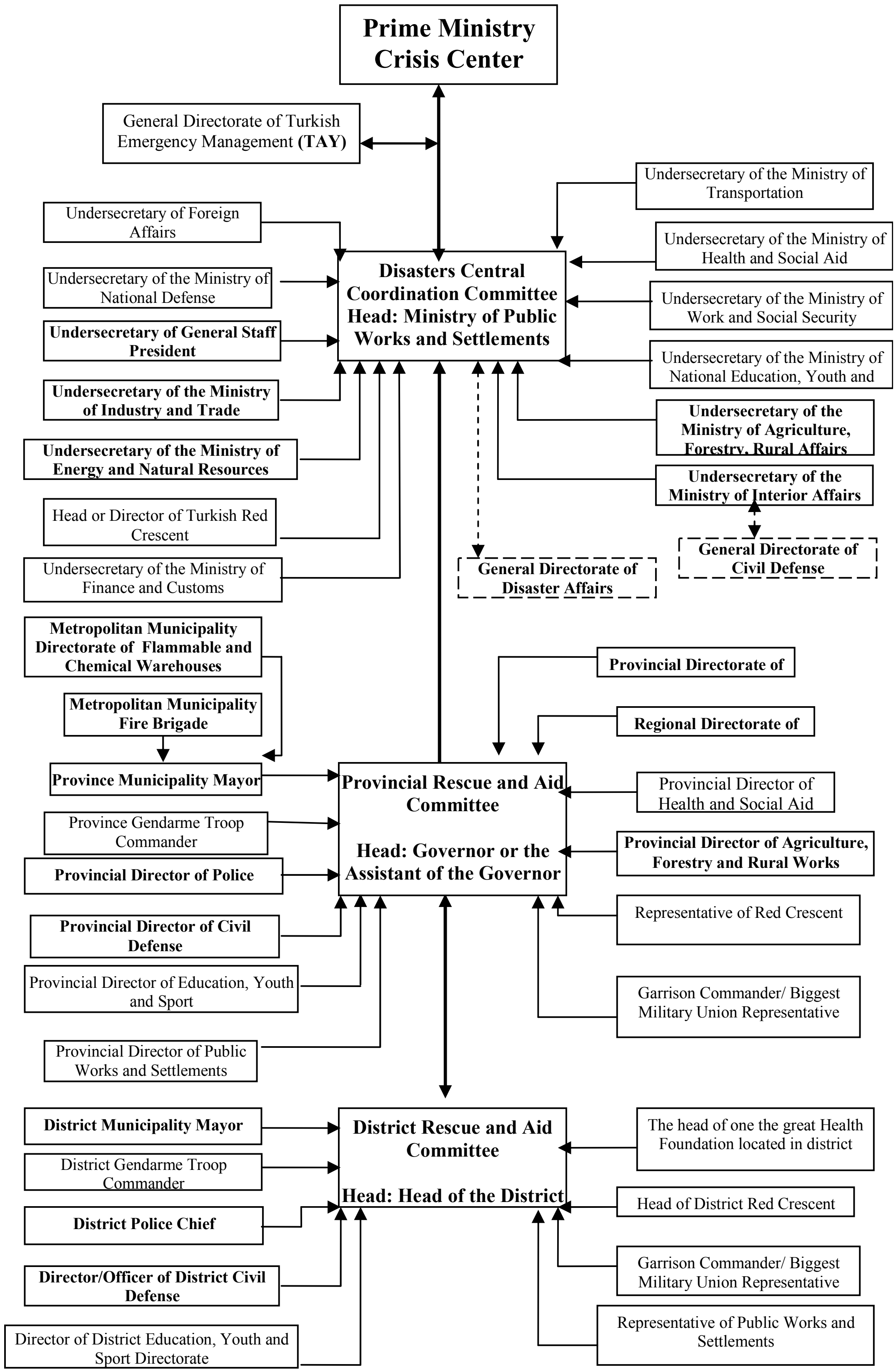

Figure 7.1.34. Operation process plan for prevention of secondary disasters

TSK: TSK forces joins the action plans for search and rescue of victims in landslide and flood areas as supporting unit.

Civil Defense Search and Rescue Teams: The Civil Defense Search and Rescue teams join the training practices in search and rescue operations in landslides and floods. After the earthquake teams act with Fire Brigade search and rescue teams coordinally.

General Directorate of Highways: After completing its primary duties, the directorate assists Fire Brigade forces.

7.1.6 Decision Support Systems

The effects of natural disasters can be lessened by taking correct and timely measures and activities. For this respect, good and reliable information is the most important component of disaster management in each phase. New and developing information technologies, observation techniques and communication means can be integrated with management systems. By this way it is possible to have immediate information about the emergency situation, evaluate the risk and manage it. In addition of these, a communication and information environment that may be used by different users in different levels be achieved.

Information technologies constitute the most important tool for disaster management in last decades in developed countries. In developing countries, use of information technologies have already taken a running start and planning of hazard mitigation and prevention activities were put into practice. In this connection most of the Asian countries have started to establish disaster information and decision support systems peculiar to disasters that the country is faced on.

Establishing an extensive national information network and a decision support system which is fed by the correct and current information, should be Turkey's one of the first precedence objectives. Establishing a provincial information-decision support system in the short term should be followed by a national disaster prevention and mitigation information-decision support system in the long run.

In this study, the current work done by developing Asian countries and scientific studies carried out in U.S.'s universities are considered, and it is aimed to determine the necessities of an information-decision support system appropriate to our country and aim of the project. In this section some decision support software related with disaster management will be tried to summarized. Design and technologic features of the desired information system are given in information system module, so in this section the focus will be on decision support systems.

Decision support system is a group of models that produce fast reliable and intelligent solutions in complex situations and report the probable results of these solutions. The goal of decision support systems is to ease the complex disaster management processes and coordinate.

As an application example of decision support system we may give an intelligent system that transfers the real data from disaster region to system and being able to form new plans. A more clear example; to prevent an epidemic disease spread by air, it is possible to estimate the number of possible affected people by atmospheric conditions, wind blow strength and direction, population information about the disaster area with appropriate probability models. By this way it is possible to plan the medical equipment and vaccination necessary in the region and take counter measures.

From this point of view the necessary information needed by disaster managers are classified in two main titles. The first one the base information about the region and the risks that the region face to and secondly the real-time information about the effect of disaster and current resources in that and neighboring region.

The tools needed may be summarized also as follows:

- Existence of an assessment tool that may give the vulnerability of public and property against any disaster risk.
- Assessment of probable hazard and daily / total cost incurred.
- Determination of damage a geographical region, population and infrastructure bears.
- Possibility to reach disaster plans and current resources
- Recording the realized operations and situation reporting
- Following the resources which are appointed or free to use
- Allocating the resources in most effective way
- Selecting the optimum places of emergency facilities in planning stage
- Determining the optimum routes for emergency vehicles and ambulances in emergency response phase

To give the right decisions, analyzing the risk and taking counter measures, information produced in various sectors should be integrated and opened to access of disaster managers in each level. Establishing such a system requires integration and normalization of distributed data, which are produced / stored in various institutions from bottom to top. This system should include at least the given databases:

- Hazard assessment maps
- Vulnerability
- Demographic distribution
- Infrastructure, critical services and building stock
- Logistics and transportation infrastructure
- Human and material resources that may be used in disaster
- Communication resources

There are some prerequisite works to transform the mass of information into a level that disaster managers can benefit from, such as:

- Assessing probable risks, the effects of risk on different sections of public, data on population, infrastructure and vulnerability
- Preparation of algorithms and models for determining the time, cost, resources and results of alternative response strategies.
- Providing real-time communication between departments and institutions.
- Defining emergency type, scope and potential effect in distributed databases by real time access.
- Real time processing critical events and response activities to Geographical Information System.

These prerequisites show that the decision support system should be based on some specific information technologies. First step in this connection is establishing inter-institutional interactive communication network. When foreign applications are studied, it is seen that a sound and stable internet connection satisfies this need. In addition to this, existence of a geographical information system that may depict graphically the changes in the region is inevitable. Mathematical models, simulation models, scientific and statistical calculation methods should be also be integrated to calculate the probabilities and losses of hazards. Intelligent reasoning tools have to be designed additionally.

Technological advances like portable computer technologies, wireless communication, geographical information systems (GIS), global positioning systems (GPS), remote sensing (RS) and high resolution visualization provide new tools that may be used in disaster preparation, response and recovery phases.

A personnel doing a field study can reach maps about disaster, information obtained by remote sensing, GIS information and textual data by using his / her portable computer. By means of these tools, he/she will have enough information about the current situation and will take right actions accordingly. Moreover, he may report personnel, material needs immediately and inform the management center about the situation.

In the figures given below, you will see how a personnel who carries out preliminary damage assessment enters the collapsed, damaged or blocking (transportation) buildings data to the system by means of hand computer and GIS software. The data in dbf format processed by hand computer can be transferred to the center with a cellular phone having bluetooth feature. The information sent by field personnel can be brought together in the center and a detailed and rapid information about the damage situation is obtained. By an internet server these information may be transmitted to district disaster management centers, fire brigade, police, hospitals and higher level coordinators.

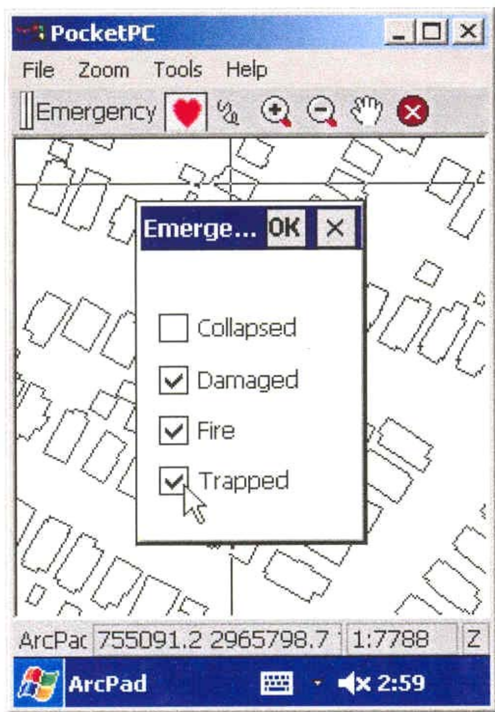

Figure 7.1.35. Example of GIS based building damage data entered by a hand computer

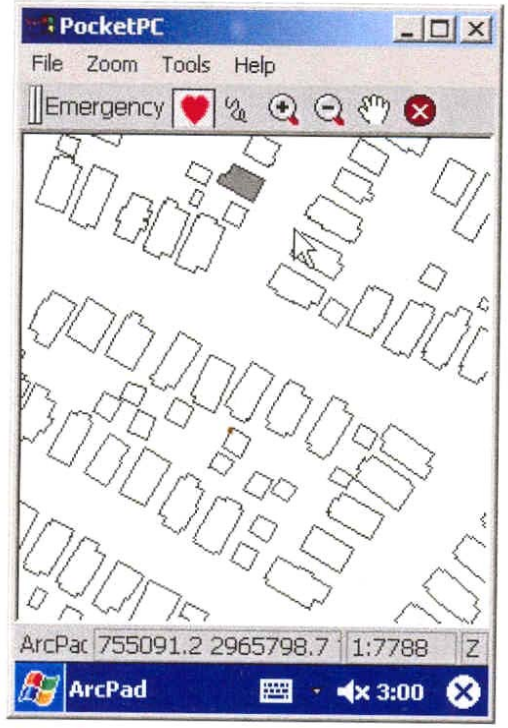

Figure 7.1.36. City map that shows the processed data (damaged building) with gray color

Figure 7.1.37. Hardware required to gather digital damage building data, a hand computer and cellular phone having bluetooth interface

Effective disaster management requires getting data from different sources, integrating and disseminating it to other institutions. GIS in this connection can store the daily data produced in these sources in a very effective format that can be transmitted to disaster managers and field personnel working on response operations. In response phase, GIS can produce maps in different sizes, formats and scales, brings data together and allows visualization. In this respect a well designed GIS system will reduce the time of decision making in complex disaster situation.

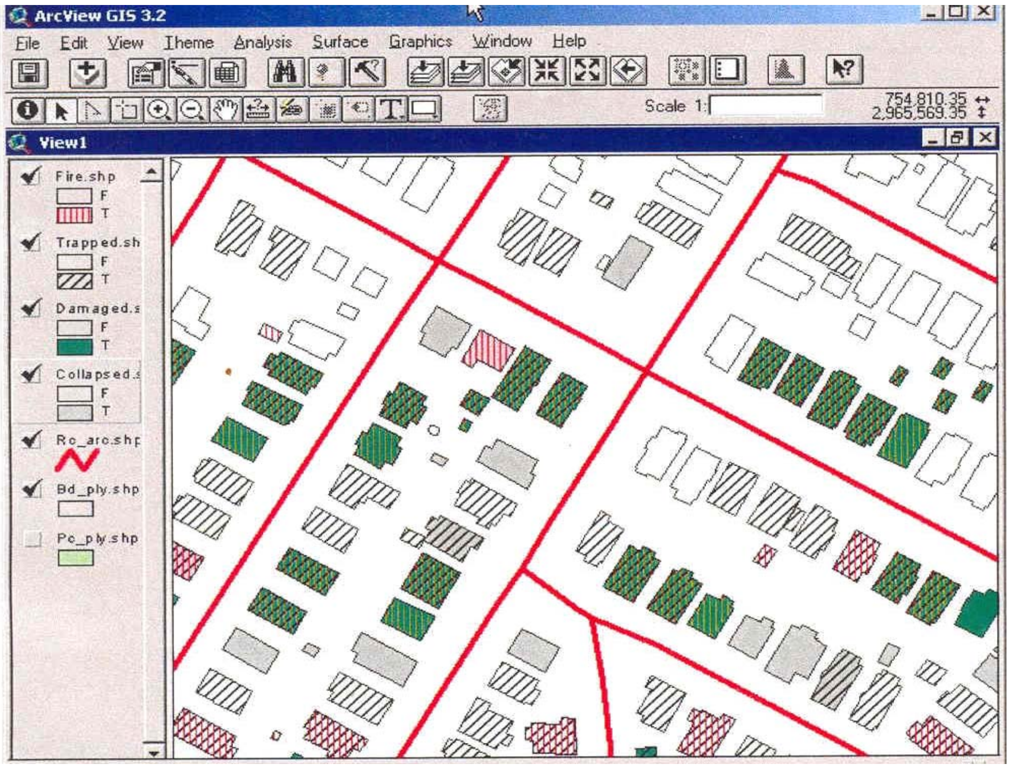

Figure 7.1.38. An Arcview screen-shot that integrates the data coming from end units and representing the collapsed buildings by gray, damaged buildings by green, burning buildings by red lines and buildings blocking the road by black lines

The transportation network may be damaged severely after the earthquake. Processing of damage in highways, bridges, tunnels and passages in GIS system allows planning of repair works and determination of emergency transportation routes for response teams and vehicles. GIS maps can provide spatial data for services that require geographical coordinates, like patient transfer with helicopters. A technology that combines GIS and global positioning systems (GPS) can be used in vehicle dispatching and direction. GPS data is exact and correct but without a map it is very hard to interpret and use. The projection of emergency vehicles' GPS coordinates on a map allows one to follow the vehicles, redirect them when they loose their ways and to appoint new assignments according to their locations. If the blocked roads are also processed in GIS maps, the irrelevant distance to be proceeded will be prevented and as a result the efficiency of the service will be improved. Given the direction and occupancy status of ambulances, incorrect appointments can be prevented.

GIS has the ability to georeferance the data obtained by remote sensing. Information obtained with remote sensing could be combined with other source data and maps and transformed in a format that can be used by disaster managers and field personnel.

If the response system using technologies such as visualization by remote sensing, GIS and GPS were exist in response activities carried out in 1999 earthquakes, all rescue and service activities would produce better results. With such a system;

- Aid requests coming from different provinces and districts could be entered directly to the record system, so could be managed in a more coordinative way.
- Native and foreign search and rescue teams could be directed to high demand areas.

- Buildings, in which search and rescue (SAR) activities were finished or points that received some specific service may be recorded and misappointments of resources such as charging a SAR team to a place where SAR activities have been already completed, would be prevented.
- Difficulties in finding or determining addresses, because of collapsed buildings, damaged road marks would be solved by GPS.
- Highly damaged areas, blocked roads and areas where SAR activities are carried out would be followed by management - coordination center.
- SAR teams and vehicles could be informed on open-closed routes, areas on which SAR activities finished / yet not finished etc.

The first step in establishing GIS based information system, supported with latest technology, should find the answers of the questions below:

- Which information, in which format and to what detail and currency do high-level strategic decision makers (such as Prime Ministry Crisis Center, Provincial Crisis Management Center) need?
- Which information, in which format and to what detail and currency do medium-level tactical decision makers (such as response teams coordinator, district disaster management centers etc.) need?
- To what level the response teams should use GIS / GPS / RS systems ? How will their connection with coordination centers be satisfied? (hand computer or laptop, battery or generator etc.) Which information will be provided by coordination center and which information in what detail will be sent to center? To what degree visualization is required?
- Which methods will be used to gather data about pre- and post-disaster situation ?
- How should be the structure and characteristics of the database that will be used in emergency management? What should be the standard data sharing format on which the institutions agree?

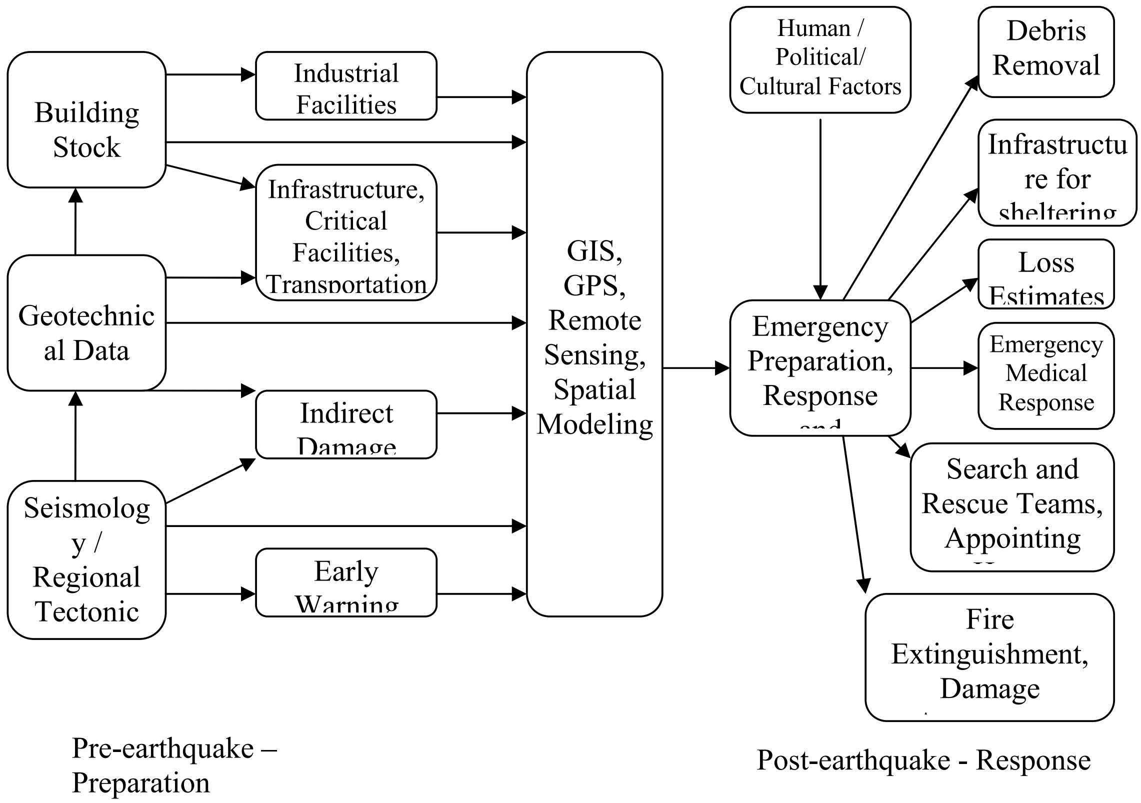

Figure 7.1.39. The general structure of spatially based decision support system

Existing Disaster Management – Decision Support Systems

As the information and decision support systems in use or in development phase are investigated it is seen that, most of the countries develop systems peculiar to their geographical, administrative structure and disasters that the country is exposed to.

Hazards of United States (HAZUS), is such GIS based software, which uses earthquake loss estimation methodology. HAZUS, aims to be a base and a source for disaster preparedness, response planning, risk mitigation planning and related decision making processes. HAZUS, takes hazards such as ground shaking, liquefaction, land sliding and produces estimates of damage on infrastructure, building stock and loss of life, number of injured people, need for sheltering, economic loss etc.

There are six main modules constitute HAZUS:

- Potential geological hazards: Estimates risks of ground motions, liquefaction and land sliding.
- Inventory: Keeps the necessary information about the region such as physical infrastructure, demographic information, general building stock, critical facilities, transportation ways and infrastructure.
- Direct damage: Produces estimates of damage to the infrastructure and building stock, and serviceability of some critical facilities.
- Indirect damage: Calculates indirect damage caused by secondary disasters such as fires, floods, chemical material leakage and indirect hazards of main disaster.

- Direct loss: Calculates economic and social losses caused by direct and indirect damages.
- Indirect loss: Gives the short and long term results of economic and social losses caused by disaster.

The first step for establishing such extensive earthquake loss estimation software and a system that will provide current and correct post-disaster information for decision makers, is to set a pilot project on GIS based information system and a living database. Design of a decision support system peculiar to Turkey's characteristics should be carried out parallel with this work and should include all relevant functions in ready software packages. In table 10.3. examples of existing emergency management software are summarized. The evaluation is made according to existence of a disaster management planning, management, evaluation of results, scope, existence of real time support and visual support component. Some military institutions, civil society organizations, emergency coordination support centers in U.S. and other countries use these software. A part of these packages are used for emergency situations like earthquakes, fires, floods, environmental disasters, road accidents or terrorist attacks and some of them are designed for special objectives. It is seen that, a few of these packages contain an information system, information gathering for emergency, preparation, education, exercises, simulation models, planning and special functions for emergency management. The common characteristics of these software are their integrability with GIS software and their ability to transfer to - receive from data from GIS software.

ALESTA given in Table 10.3 is a product of Turkish – American partnership firm ETC-IS and it is an institutional disaster management software including disaster management planning, management and result evaluation functions.

Table 7.1.3. Existing Disaster Management Software

Product	Producer	Disaster Management Planning	Disaster Management	Evaluation of Disaster Results	Real Time Support	Scope	Visual Support Component
ROGSI/ DMS V4	ROG Disaster Management Solutions	Exists	-	Exists	-	General	-
E-Team	E-Team	-	Exists	Exists	Exists	General	GIS
Response Information Management System	California Office of Emergency Services	-	Exists	Exists	Exists	In State Level	GIS
EMIS Technologies	EM/2000™ Emergency Management Software System	Exists	Exists	Exists	Exists	General	Limited with GIS
Incident command software for public safety	FieldSoft Inc	Exists	Exists	Exists	Exists	Limited With Fire	-
Emergency Call	Critical - Critical Event Notification Toolset	-	Exists	-	Exists	General	-
REDI for Campus, Community, Hospital, School Incident Management	BowMac Software Inc.	Exists	Exists	Exists	-	Special	-
Emergency Information Systems	Emergency Software Products, Inc.	Exists	Exists	Exists	-	General	-

Table 7.1.3. Existing Disaster Management Software - Continued

Product	Producer	Disaster Management Planning	Disaster Management	Evaluation of Disaster Results	Real Time Support	Scope	Visual Support Component
Emergency Voice Systems	VASTNetworks, LLC	-	Exists	-	Exists	General	-
SAFER SOFTWARE SYSTEMS	ERMC	-	Exists	Exists	Exists	Chemical Pollution	-
SoftRisk v5.1	SoftRisk Technologies	Exists	Exists	Exists	-	General	-
ADMS Advanced Disaster Management System	ETC	Exists	-	-	-	Educational Purpose	Exists
ALESTA	ETC-IS	Exists	Exists	Exists	Exists	General	Exists

Status Reports

The next step is preparation of situation reports to be used after an earthquake. These reports will be used to summarize the response work done and the damage status of specified service and building stock. These forms should be integrated with the GIS based information system (given in Chapter 2) and decision support system given in section 10.6.

Table 7.1.4. Preliminary damage assessment report

Report No						
Name of the institution						
Name of the reporter						
Reporting date (day, hour, minute)						
Shift that report belongs to (from day, hour- to day, hour)						
Number of personnel working						
District						Total
Neighborhood						
Number of collapsed dwellings						
Number of heavily damaged dwellings						
Number of medium damaged dwellings						
Number of slightly damaged dwellings						
Number of collapsed business buildings						
Number of heavily damaged business buildings						
Number of medium damaged business buildings						
Number of slightly damaged business buildings						
Number of collapsed administrative buildings						
Number of heavily damaged administrative buildings						
Number of medium damaged administrative buildings						
Number of slightly damaged administrative buildings						
Number of collapsed hospitals						
Number of heavily damaged hospitals						
Number of medium damaged hospitals						
Number of slightly damaged hospitals						
Number of collapsed schools/dormitories						
Number of heavily damaged schools/dormitories						
Number of medium damaged schools/dormitories						
Number of slightly damaged schools/dormitories						
Number of collapsed police stations						
Number of heavily damaged police stations						
Number of medium damaged police stations						
Number of slightly damaged police stations						

Table 7.1.5. Search and rescue and debris removal activities report

Report No						
Name of the institution						
Name of the reporter						
District						
Reporting date (day, hour, minute)						
Shift that report belongs to (from day, hour- to day, hour)						
Number of additional personnel need (with attribute)						
Additional vehicle/equipment need with respective quantity						
Team no						Total
Address						
Start time						
Finish time						
Number of personnel working						
Number of vehicles working						
Number of dead people taken from debris						
Number of wounded people rescued						

Table 7.1.6. Debris removal activities report

Report No						
Name of the institution						
Name of the reporter						
District						
Reporting date (day, hour, minute)						
Shift that report belongs to (from day, hour- to day, hour)						
Number of removed debris (collapsed building)						
Number of additional personnel need (with attribute)						
Additional vehicle/equipment need with respective quantity						
Number of debris on which activities are still going on						
Number of collapsed buildings on which debris removal work yet not started						
Team no						Total
Address						
Start time						
Finish time						
Number of personnel working						
Number of vehicles working						
Number of dead people taken from debris						
Number of wounded people rescued						

Table 7.1.7. Water and sewage services progress report

Report No					
Name of the institution					
Name of the reporter					
District					
Reporting date (day, hour, minute)					
Shift that report belongs to (from day, hour- to day, hour)					
Neighborhoods / regions that can not receive service because of the damage in infrastructure					
Number of additional personnel need (with attribute)					
Additional vehicle/equipment need with respective quantity					
Start date of repair works					
(Probable) Finish date-hour					
Neighborhoods					Total
Amount of distributed drinking water					
Hospitals					Total
Amount of distributed drinking water					
Amount of distributed usage water					
Hospitals whose sewage-waste water is taken					
Tent Cities					Total
Amount of distributed drinking water					
Amount of distributed usage water					
Tent cities whose sewage-waste water is taken					
Prefabricated houses					Total
Amount of distributed drinking water					
Amount of distributed usage water					
Prefabricated houses whose sewage-waste water is taken					

Table 7.1.8. Electricity and lightening services progress report

Report No						
Name of the institution						
Name of the reporter						
District						
Reporting date (day, hour, minute)						
Shift that report belongs to (from day, hour- to day, hour)						
Neighborhoods / regions that can not receive service because of the damage in electricity infrastructure						
Start date of repair works						
(Probable) Finish date-hour						
Number of additional personnel need (with attribute)						
Additional vehicle / equipment need with respective quantity						
Neighborhoods / regions that electrification service is provided						
Hospitals						
Hospitals that have electricity service						
Hospitals that do not have electricity						
Hospitals for which repair work is in progress						
Tent Cities						
Tent cities that have electricity service						
Tent cities that do not have electricity						
Tent cities for which repair work is in progress						
Prefabricated houses						
Prefabricated houses that have electricity service						
Prefabricated houses that do not have electricity						
Prefabricated houses for which repair work is in progress						

Table 7.1.9. Natural gas and heating agent providing services progress report

Report No					
Name of the institution					
Name of the reporter					
District					
Reporting date (day, hour, minute)					
Shift that report belongs to (from day, hour- to day, hour)					
Neighborhoods / regions that can not receive service because of the damage in natural gas infrastructure					
Start date of repair works					
(Probable) Finish date-hour					
Number of additional personnel need (with attribute)					
Additional vehicle/equipment need with respective quantity					
Neighborhoods/regions that can receive natural gas					
Hospitals that can receive natural gas / heating agent					
Hospitals for which repair work are in progress					
Hospitals that cannot receive natural gas / heating agent					
Tent cities having natural gas / heating agent					
Tent cities for which repair work for providing service are in progress					
Tent cities that cannot receive heating agent					
Prefabricated houses having natural gas / heating agent					
Prefabricated houses for which repair work for providing service are in progress					
Prefabricated houses that cannot receive heating agent					

Table 7.1.10. Communication services status report

Report No					
Name of the institution					
Name of the reporter					
Region					
Reporting date (day, hour, minute)					
Shift that report belongs to (from day, hour- to day, hour)					
Neighborhoods / regions that can not receive service because of the damage in communication infrastructure					
Start date of repair works					
(Probable) Finish date-hour					
Number of additional personnel need (with attribute)					
Additional vehicle/equipment need with respective quantity					
Districts / regions in which communication service is working					
Administrative buildings having communication mean					
Type of communication provided (radio – mobile switchboard system – satellite communication system – GSM etc.)					
Hospitals having communication mean					
Type of communication provided (radio – mobile switchboard system – satellite communication system – GSM etc.)					
Tent cities having communication mean					
Type of communication provided (radio – mobile switchboard system – satellite communication system – GSM etc.)					
Prefabricated houses having communication mean					
Type of communication provided (radio – mobile switchboard system – satellite communication system – GSM etc.)					
Streets that have telephone centers					
Capacity of the center					

Table 7.1.11. State highways damage, repair and service progress report

Report No					
Name of the institution					
Name of the reporter					
Region					
Reporting date (day, hour, minute)					
Shift that report belongs to (from day, hour- to day, hour)					
Number of additional personnel need (with attribute)					
Additional vehicle/equipment need with respective quantity					
Blocked / closed ways because of damage					
Start date of repair works					
(Probable) Finish date-hour					
Number of personnel working					
Number of vehicles working					
Tent cities whose connection and interior roads are completed					
Tent cities for which roads making work is in progress					
Tent cities that don’t have connection and interior roads					
Prefabricated houses whose connection and interior roads are completed					
Prefabricated houses for which roads making work is in progress					
Prefabricated houses that don’t have connection and interior roads					

Table 7.1.12. Inner-city roads damage, repair and service progress report

Report No					
Name of the institution					
Name of the reporter					
District					
Reporting date (day, hour, minute)					
Shift that report belongs to (from day, hour- to day, hour)					
Number of additional personnel need (with attribute)					
Additional vehicle/equipment need with respective quantity					
Main arterials / arterials / avenues blocked by damage or debris					
Closed-blocked emergency roads to access critical facilities like hospitals, fire brigade, crisis centers					
Number of personnel working					
Number of vehicles working					
Start date of repair works					
(Probable) Finish date-hour					

Table 7.1.13. Inner-city mass transportation status report

Report No					
Name of the institution					
Name of the reporter					
Reporting date (day, hour, minute)					
Shift that report belongs to (from day, hour- to day, hour)					
Number of additional personnel need (with attribute)					
Additional vehicle/equipment need with respective quantity					
Tent-cities that have mass transportation					Total
Tent-cities that don’t have mass transportation					
Prefabricated houses that have mass transportation					
Prefabricated houses that don’t have mass transportation					
Number of vehicle working under the institution					
Number of personnel working under the institution					

Table 7.1.14. Damage and service status report in harbors

Report No					
Name of the institution					
Name of the reporter					
Reporting date (day, hour, minute)					
Shift that report belongs to (from day, hour- to day, hour)					
Damage in vehicles and equipments in harbors and related institutions					
Number of ships / boats that brought human aid					
Number of additional personnel need (with attribute)					
Additional vehicle/equipment need with respective quantity					
Amount of aid materials brought according to their type such as food / clothing / beverages / cleaning agent / medicine / medical equipment / tent etc.					
Amount of aid material stored in harbors warehouses according to their type					
Amount of material transported according to their types					
Number and type of vehicles charged with transportation of patients and human aid					
Number of personnel charged with transportation of patients and human aid					

Table 7.1.15. Wharfs and maritime mass transportation services, damage status report

Report No					
Name of the institution					
Name of the reporter					
Reporting date (day, hour, minute)					
Shift that report belongs to (from day, hour- to day, hour)					
Damage in vehicles and equipment which belong to Maritime City Lines					
Number of additional personnel needed (with attribute)					
Additional vehicle/equipment needed with respective quantity					
Wharfs that can give service					
Floating / alternative wharfs opened to service					
Number of passenger ferries working for public					
Number of car ferries working for public					
Number of privately owned boats and other sea transportation vehicles working for public					
Number of passenger / car ferries working for human aid / personnel / patient transfer					
Number of personnel working					

Table 7.1.16. Stations and railway mass transportation services, damage status report

Report No					
Name of the institution					
Name of the reporter					
Reporting date (day, hour, minute)					
Shift that report belongs to (from day, hour- to day, hour)					
Damage status in stations and vehicles					
Damage status in railway network					
Start date of repair works (day, hour)					
(Probable) Finish date of repair works (day, hour)					
Number of trains (units) that brought human aid					
Number of additional personnel need (with attribute)					
Additional vehicle/equipment need with respective quantity					
Amount of aid materials brought according to their type such as food / clothing / beverages / cleaning agent / medicine / medical equipment / tent etc.					
Amount of aid material stored in T.C.D.D. warehouses according to their type					
Amount of material transported according to their types					
Number and type of vehicles charged with transportation of patients and human aid					
Number of personnel charged with transportation of patients and human aid					

Table 7.1.17. Subway and light railway mass transportation services, damage status report

Report No					
Name of the institution					
Name of the reporter					
Reporting date (day, hour, minute)					
Shift that report belongs to (from day, hour- to day, hour)					
Damage status in subway and vehicles					
Damage status on light railway system					
Start date of repair works (day, hour)					
(Probable) Finish date of repair works (day, hour)					
Number of additional personnel need (with attribute)					
Additional vehicle/equipment need with respective quantity					
Number of vehicle working					
Number of personnel working					

Table 7.1.18. Airway transportation activity report

Report No					
Name of the institution					
Name of the reporter					
Reporting date (day, hour, minute)					
Shift that report belongs to (from day, hour- to day, hour)					
Damage status in airports and vehicles					
Start date of repair works (day, hour)					
(Probable) Finish date of repair works (day, hour)					
Number of airplanes that brought human aid					
Number of additional personnel need (with attribute)					
Additional vehicle/equipment need with respective quantity					
Amount of aid materials brought according to their type such as food / clothing / beverages / cleaning agent / medicine / medical equipment / tent etc.					
Amount of aid material stored in DHMI 's warehouses according to their types					
Amount of material transported according to their types					
Number and type of vehicles charged with transportation of patients and human aid					
Number of personnel charged with transportation of patients and human aid					

Table 7.1.19. Helicopter transportation status report

Report No				
Name of the institution				
Name of the reporter				
Reporting date (day, hour, minute)				
Shift that report belongs to (from day, hour- to day, hour)				
Number of additional personnel need (with attribute)				
Number of personnel working				
Number of helicopters that transfer humane aid, aid personnel and patient				
Additional vehicle/equipment need with respective quantity				
Additional helicopter landing areas (coordinates) needed				
Amount of aid materials transported with helicopters according to their type such as food / clothing / beverages / cleaning agent / medicine / medical equipment / tent etc.				
Patient-wounded people transferred with helicopters				
SAR, first aid, medical personnel transferred with helicopters				

Table 7.1.20. Temporary sheltering requirements report

Report No					
District					
Name of the institution					
Name of the reporter					
Reporting date (day, hour, minute)					
Shift that report belongs to (from day, hour- to day, hour)					
Name of the temporary shelter					Total
Type of the temporary shelter (school-dormitory etc)					
Does water/sewage system working? (yes/no)					
Does electricity system working? (yes/no)					
Does it have a heating agent? (yes/no) If no state possible heating system					
Does mass transportation exist? (yes/no)					
Does any telecommunication mean exist? (yes/no)					
Number of people accommodating					
How many people can be further accommodate					
Number of families accommodating					
How many families can be further accommodate					
Existing blanket					
Needed blanket					
Existing WC					
Needed WC					
Existing shower capacity					
Needed shower capacity					
Existing refectory capacity					
Needed refectory capacity					
Existing personnel					
Needed personnel					

Table 7.1.21. Logistical support unit activity report

Report No	
Name of the institution	
Name of the reporter	
District	
Reporting date (day, hour, minute)	
Shift that report belongs to (from day, hour- to day, hour)	
Number of personnel working	
Number of vehicle working	
Number of additional personnel need (with attribute)	
Additional vehicle/equipment need with respective quantity	

Aid materials and respective quantities stored in logistical support unit (food / clothing / beverages / cleaning agent / medicine / medical equipment / tent/blanket etc)					
Name of the distribution points feed by the logistical support unit					
Amount and type of aid material sent to distribution points					
Amount and type of aid material sent to tent cities					
Amount and type of aid material sent to prefabricated houses					

Table 7.1.22. Social services activity report

Report No					
Name of the institution					
Name of the reporter					
District					
Reporting date (day, hour, minute)					
Shift that report belongs to (from day, hour- to day, hour)					
Number of personnel working					
Number of vehicle working					
Number of additional personnel need (with attribute)					
Additional vehicle/equipment need with respective quantity					
Number of children / disabled/ old people that need protection					
Number of children / disabled/ old people accommodating in temporary social centers					
Number of children / disabled/ old people accommodating in dormitories social care facilities					
Number of children / disabled/ old people accommodating temporary social centers in neighboring provinces					

Table 7.1.23. First aid, diagnosis and treatment activity report

Report No				
Name of the institution				
Name of the reporter				
Reporting date (day, hour, minute)				
Shift that report belongs to (from day, hour- to day, hour)				
District				
Number of ambulances working				
Number of additional ambulances needed				
Name of the hospital-mobile hospital-triage point				
Number of personnel working (with attribute)				
Number of additional personnel need (with attribute)				
Bed / ambulatory patient capacity				
Number of treated patient in that shift				
Number of free capacity at the end of shift				
Morgue capacity				
Free morgue capacity at the end of shift				
Additional medical material/equipment need at the end of shift				
Additional medicine need (with type)				
Additional blood and blood products (with type)				

Table 7.1.24. Immunity works activity report

Report No				
Name of the institution				
Name of the reporter				
Reporting date (day, hour, minute)				
Shift that report belongs to (from day, hour- to day, hour)				
District				
Disinfected regions to prevent epidemic diseases				
Name of the hospital – village clinic – mobile hospital				
Number of personnel working (with attribute)				
Number of additional personnel need (with attribute)				
Number of people vaccinated (with type of vaccine)				
Amount of vaccine needed (with type)				
Amount of additional medical equipment (with type)				

Table 7.1.25. Blood and blood products services activity report

Report No				
Name of the institution				
Name of the reporter				
Reporting date (day, hour, minute)				
Shift that report belongs to (from day, hour- to day, hour)				
Name of the Red Crescent unit				
Number of personnel working (with attribute)				
Number of additional personnel need (with attribute)				
Blood and blood products inventory according to their types				
Amount of additional medical equipment (with type)				

Table 7.1.26. Cemeteries activity report

Report No				
Name of the institution				
Name of the reporter				
Reporting date (day, hour, minute)				
Shift that report belongs to (from day, hour- to day, hour)				
Number of cemetery vehicles working				
Number of additional cemetery vehicles needed				
Name of the current and additional cemeteries in service				
Number of personnel working (with attribute)				
Number of additional personnel need (with attribute)				
Total capacity of cemetery				
Free capacity at the end of shift				
Additional vehicle/equipment need with respective quantities				

Table 7.1.27. Fire extinguishment activity report

Report No						
Name of the institution						
Name of the reporter						
Reporting date (day, hour, minute)						
Shift that report belongs to (from day, hour- to day, hour)						
District						
Number of fire brigade vehicles working						
Number of additional fire brigade vehicles needed						
Additional vehicle/equipment need with respective quantity						
Number of personnel working (with attribute)						
Number of additional personnel need (with attribute)						
Neighborhoods						Total
Number of fires						
Number of fires under control						
Number of extinguished fires						
Number of fires that are not under control						
Number of dead people						
Number of wounded people rescued						
Number of casualties						

Table 7.1.28. Report of activities to control floods

Report No						
Name of the institution						
Name of the reporter						
Reporting date (day, hour, minute)						
Shift that report belongs to (from day, hour- to day, hour)						
District						
Number of fire brigade vehicles working						
Number of additional fire brigade vehicles needed						
Additional vehicle/equipment need with respective quantity						
Number of personnel working (with attribute)						
Number of additional personnel need (with attribute)						
Regions that are exposed to flood						Total
Number of rescued people						
Number of casualties						

Table 7.1.29. Report of activities to control landslides

Report No						
Name of the institution						
Name of the reporter						
Reporting date (day, hour, minute)						
Shift that report belongs to (from day, hour- to day, hour)						
District						
Number of fire brigade vehicles working						
Number of additional fire brigade vehicles needed						
Additional vehicle/equipment need with respective quantity						
Number of personnel working (with attribute)						
Number of additional personnel need (with attribute)						
Regions where landslide occurred						Total
Number of rescued people						
Number of casualties						

Table 7.1.30. Environmental protection activities report

Report No						
Name of the institution						
Name of the reporter						
Reporting date (day, hour, minute)						
Shift that report belongs to (from day, hour- to day, hour)						
District						
Name of the facility that threat environment and public health with leakage or explosion						Total
Type and amount of vehicles that work for cleaning environment						
Additional vehicle/equipment need with respective quantity						
Number of personnel working (with attribute)						
Number of additional personnel need (with attribute)						
Water-air analysis reports around the facility						

Table 7.1.31. Traffic services activity report

Report No				
Name of the institution				
Name of the reporter				
District				
Reporting date (day, hour, minute)				
Shift that report belongs to (from day, hour- to day, hour)				
Number of personnel working				
Number of additional personnel need (with attribute)				
Number of vehicle working				
Additional vehicle/equipment need with respective quantity				
Arterials and primary emergency roads damaged or blocked by debris				
Reason of damage				
Is transportation possible? (yes/no/controlled way)				
Alternative if exist				

Table 7.1.32. Preserving public security and order services report

Report No				
Name of the institution				
Name of the reporter				
Reporting date (day, hour, minute)				
Shift that report belongs to (from day, hour- to day, hour)				
District				
Number of personnel working on securing the aid materials and personnel transported and the routes they follow				
Number of vehicles working on securing the aid materials and personnel transported and the routes they follow				
Name of the neighborhoods				
Number of personnel working				
Number of additional personnel need (with attribute)				
Number of vehicle working				
Number of additional vehicle needed (with attribute)				
Number of theft events				
Number of pillage event				
Name and addresses of facilities that threaten lives and property with explosion, fire or leakage				

7.1.7 Result

The activities defining the four phases of extensive disaster management are not independent and unrelated; on the contrary they define a structure, constituted from subtitles supporting each other and directed to the same goal, which is mitigation of disaster risk. This structure necessitates establishing organizations directed to this object, arranging the relations and disaster organization between these institutions, and process planning in this respect. It is not possible to think this structure independent from Turkey's economic, social and administrative systems, on the contrary the peculiar conditions of the country should be taken into consideration. As a matter of fact, disaster management is executed by different institutional formations in different countries all over the world.

There are two cornerstones in disaster management. These are ***Disaster Scenarios*** and ***Emergency Response Plans***. The loss of life and property after an earthquake is not just a function of the effect of earthquake, at the same time it is a function of the weak points of inferior and outer structure. In this respect, reasons for damage, that means the weak points in economic, social, law, ethical systems should be determined and strengthened. For example, after an earthquake, if damage in buildings excesses the estimations, this situation will result in looking over the construction phases, creating new systems like **construction inspection** and **insurance system** and creating organs for execution and rearranging the legal system.

From another point of view, the basis of the damage is the disorders in economic system. Unbalanced income distribution, abundance of bureaucracy and inflexibility and populist politicians direct people to illegal housing. The disorder in ethic and value systems in public, disorders in education system form the other causes of the damage. It is not possible to change the earthquake risk, but it is possible to reduce its effects. The way for mitigation passes through reorganization of all subsystems that causes disaster. The common aim should be, establishing a system dealing with the public's social and economic structure and reducing continuously the risk by national consciousness.

7.1.8 References

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7.2 Disaster Management

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The aim of providing a modern emergency management model for Istanbul is to minimize the loss of life, to prevent injuries and to protect property and the environment in case of a possible earthquake and other disasters. This model should be structured to organize the local government divisions and responsible individuals in defining their emergency responsibility assignments and establishing the way of communication in emergency situations. Together with the training of responsible personnel in local government, the public awareness and training will help to improve the success of emergency preparedness in case of major disasters.

At the initial stage of this work, after examining the existing emergency management models of the several countries in the world, it has been emphasized that not only the response and recovery phases of the emergency management but also preparedness and mitigation phases should be taken into consideration at every level in order to achieve a successful emergency management. During the initial talks with the municipality personnel (of İMM) we understood that their expectations for this project was focused only on the response (operational preparation) level. Although this level of management may be important in the current roles and responsibilities of the local government, we have included the other topics related to three phases of the emergency management (namely, mitigation, preparedness and recovery) to shape the model within the content of this work in order to improve the success of conducting emergency operations.

Another important topic of Emergency Management Model of Istanbul Earthquake Master Plan (IEMP) is training. Within this framework, several questions should be answered such as who is going to be trained by whom, what is the scope of the training programme and what are the methods of the training.

It is important to define how to shape the training concept, considering the four phases of the disaster management, to train not only the emergency response personnel but also the other civilians. Although emergency management and the training of the emergency managers are covered in the related sections of the IEMP, the public training section is handled separately as indicated in the Master Plan Protocol.

As indicated in the second interim report of IEMP, response dominated emergency management model is focused on four main actions and is also presented in the final report. According to the project protocol, this model is focused on response phase of emergency management categories and consists of the following sub-sections:

- Coordination
- Incident Command System
- Resource Management
- Training

In relation to these sub-sections, the training requirements of each section will be explained in detail in this report.

Table 7.2.1. Summary of the Emergency Management Model

<table>
<tr><th colspan="2" rowspan="2"></th><th colspan="4">THE FOUR PHASES OF EMERGENCY MANAGEMENT</th></tr>
<tr><th>1. Preparedness</th><th>2. Mitigation</th><th>3. Response</th><th>4. Recovery</th></tr>
<tr><td colspan="2">COORDINA-TION</td><td colspan="4">⇤ EVALUATING THE CURRENT LAWS AND REGULATIONS RELATED TO THE FOUR PHASES OF E. M. (Section 7.2.2) ⇥</td></tr>
<tr><td colspan="2">ICS</td><td></td><td></td><td>DEFINITION OF INCIDENT COMMAND SYSTEM ESPECIALLY AT RESPONSE LEVEL (Section 7.2.3)</td><td></td></tr>
<tr><td colspan="2">RESOURCE MANAGE-MENT</td><td colspan="4">⇤ RESOURCE ASSESSMENT WITH RESPECT TO EACH PHASE(All kinds of resources; personnel, equipment, financial resources etc.) (Section 7.2.4) ⇥</td></tr>
<tr><td rowspan="3">TRAINING</td><td>EOC Personnel</td><td>Equipment, standard operation procedures (SOP) and emergency management training for the units in coordination with the EOC (Section 7.2.5.).</td><td>Long term planning, training for reducing risks at structural level, training about emergency planning and management for local government's the infrastructure divisions (Section 7.2.5.).</td><td>Specialized training for the operational personnel, training for the coordination of local government, central government and the NGOs, developing SOPs (Section 7.2.5.).</td><td>Specialized training for the operational personnel, training for the coordination of local government, central government and the NGOs, developing SOPs (Section 7.2.5.).</td></tr>
<tr><td>Public Training</td><td>Starting the phrase of "Emergency Preparedness Starts At Home" to describe the things can be done by every individual at home (Section 6.2.).</td><td>Training programs targeted to reduce both structural and non-structural risks in living places (Section 6.2.).</td><td>To train people what to do immediately after the disaster may reduce the disaster related risk and damage. It is important to train people to help the responders in an organized manner and this will improve the requirement of man power in any disaster situation (Section 6.2.).</td><td>The public should be aware of getting any help to return to normal after the disaster. This may include available resources, getting help from the government and training in the physiological first aid (Section 6.2.).</td></tr>
<tr><td>VOLUNTEER ORGANIZA-TIONS</td><td colspan="2">Volunteer Organizations' training on emergency management and on special topics, coordinating their public training programs such as first aider training etc. (Section 7.2.5.).</td><td>Training of Volunteer Organizations on the response and operations to help public including their coordination and cooperation with the local government (Section 7.2.5.).</td><td>Programs developed to improve the NGO's and Volunteer Organizations' involvement at the recovery stage (both at infrastructure and humanitarian level) (Section 7.2.5.).</td></tr>
</table>

7.2.1 The sociological basis for disaster management

Any kind of damage, material or moral, caused by a probable earthquake in Istanbul will be remedied with a contemporary disaster management model. This model will be composed of well-organized local bodies, the definition of the roles of employees for existing and emergency conditions and developed communication facilities among individuals. By this way, firstly, local governments, then individuals will become aware of the risks of disasters through public education programs.

The Sociological Dimension of Disaster Management

The increasing public awareness and developed public communication channels are important key factors due to the strengthening of the durability of dynamic social structure against disasters.

Certain subjects should be mentioned in order to increase the awareness of society against disasters:

- The development of the society's communications channel
- Increasing the organization level of society
- Increasing the level of knowledge about disasters
- Increasing the quality of human capital

Administrative Restructuring

In order to establish a well-organized, dynamic administrative structure, there should be cooperation and coordination in every level of governance from top to bottom. This is important for both the implementation of macro and micro policies and to take action faster after a probable earthquake, in other words in an emergency situation. This structure should include:

- **National Scale**: It is not possible for a local government to overcome the problems that will emerge after such an earthquake by using only its material and moral sources. In this respect, there is a great need for developed organizational structures that are competent of implementing first aid, providing logistic and other essential organizational facilities. If there are existing groups facilitating these areas in society, it will be very beneficial and constructive for horizontal organization and reaching the local sources for coordination and reaching to the local knowledge that has high priority for implementation of disaster management policies.
- **Regional Scale**: The spatial reorganizations and socio-economic problems that come out after the earthquake will have effects not only for a specific area but also for the entire region. In this respect, it is important to ensure access to the communication channels and provide coordination among settlements in a region.
- **Metropolitan Scale**: In this scale, qualified human capital is the most important requirement. In an emergency situation and after that there will be a great need for people who can manage/lead the socio-economic interactions among the regions, which will be in a difficulty. Following a probable earthquake, management of aid and assistance, and realizing an organizational structure that can provide logistic and psychological support is essential.
- **Town Scale**: After an earthquake, the municipalities will be under pressure due to the socio-economic transformation in the local scale. Therefore, municipalities have great importance of collecting local data that helps in planning and prevention of the probable social and economic risks.
- **District Scale**: In this scale, to build up a developed interaction between police, disaster management centre, fire department etc and to increase their capability of responding to

the population, who needs help, living in the respective district after an earthquake will be the most essential preparations.

- **Neighborhood Scale**: It is very important to identify the usage and function of buildings in the local scale related to the risks they carry.

Housing Areas and the Social Structure

The characteristics of the housing areas and the structure of the society living in that area are determinant. While categorizing these areas, the growth of population, spatial development trends, and habits of society must be taken into consideration. The social groups who are in economically disadvantaged situations and have settled in the unplanned areas will be the major concern of authorities.

There can be different problems in different housing areas regarding response and recovery efforts after an earthquake. According to the family structure in some areas, there can be high proportion of children and aged population who can face with serious problems in an emergency.

In conclusion, because of the reasons mentioned previously the *socio-economic models* that will be realized in the master plan of Istanbul have to contain the proportion of aging population, the sex ratio, and the education levels of the society. In addition, the culture produced in the city, the way how people socially interact and affect the spatial development of the city and future expectations have to be explained in the plan.

The main structure of the plan should be categorized into long, medium, short term perspectives and should be revised systematically. Besides all, the most important contribution of the municipalities is collecting the latest socio-economic data by a standard questionnaire which will be distributed to all local governors in Istanbul.

7.2.2 Coordination in Disaster Management

Regulations and ordinances for disaster management have a comprehensive structure in Turkey but as authorization is distributed to many institutions, authority and responsibility uncertainties are created among all of them (see Table 7.2.2). The disaster management system in Turkey demonstrates as a structure of "risk management" instead of "crisis management" unfortunately. This structure prevents the creation of a more comprehensive and contemporary disaster and emergency management system in the country. After each disaster, although the importance of local governments, volunteer organizations, non-governmental organizations have been recognized with their valuable support and contributions, the relevant regulations covering all of their involvements have not been included in new regulation arrangements.

In the context of the Law Numbered: 7269, Governorships have the authority to direct disaster aid, debris management, fire prevention, food supply and major tasks during a crisis. Therefore, almost all of the authority has been directed to Governorships at the local level. Meanwhile, elected officials, local municipalities have also been taking some roles in practice.

Table 7.2.2 Major Laws/Regulations related to disasters and responsible ministries in Turkey

Name of the Law	Law Number	Related Ministry/Institution
Civil Defense Law	7126	Min. of Interior
Law Related to Precautions and Aids for Disasters Effect Life in General	7269	Min. of Public Works
Regulation for Emergency Response Organizations and Planning Principles for Disasters	88/12777	Chamber of Ministers, Min. of Interior, Min. of Public Works, Genel Kurmay Başkanlığı, Related Ministries, Redcressent
Regulation for Management of Prime Ministry Crisis Center	96/8716	Chamber of Ministers
General Directorate of Turkish Emergency Management	2000/600	Chamber of Ministers
Law of Turkish Atomic Energy	2690	Prime Ministery / Institution of Turkish Atomic Energy
Extraordinary Situation Law	2935	Chamber of Ministers
Construction/Development Law	3194	Min. of Public Works

The absence of a top institution coordinating the mitigation efforts of different institutions creates serious conflicts after disasters. This occurs due to the lack of role sharing and coordination ability among them. Therefore, there is a need for a coordinating institution for long term strategic planning, preparedness, training and logistic planning for disasters. The General Directorate of Turkish Emergency Management law numbered 2000/600 was in effect for this reason but indeed it is not functioning as it was initially proposed.

General Evaluation on Disaster Management Models at the National Level

An effective disaster and emergency management model is possible only with a clear and uncomplicated structure. Institutions supplying society's security for emergencies and disasters have to have roles in disaster management procedures, too. In this context local governments have to have authority, and this structure has to facilitate the contribution and delegation of central government authorities more according to the scale of disasters and emergencies.

Disaster/emergency management has to have a structure on the above of Ministries as being a coordinating institution and it has to have its own financial, training, organization and personnel ordinances.

Role of Municipalities on Province Emergency Management

In the 88/12777 numbered law describes some responsibilities for local municipalities with "Province and Districts Emergency Response Teams and Their Responsibilities" sub-title;

- Hospital, ambulance service,
- Determination of graveyards,
- Damage assessment and temporary housing services,
- Pre-damage assessment,
- Planning of temporary housing areas,
- article-24 rescue and debris removal services,
- article-26-establishing fire brigades ,
- article-27 first aid and health services establishment and planning,
- article -29 service of hospitals group,
- article -31 body identification and burial service,

- article -32 pre-damage assessment and temporary housing services
- article -36 planning and establishment of procurement, hiring, confiscate and distribution services,
- article -37 procurement, hiring, confiscate services,
- article -39 planning, establishment and task definition of agricultural services,
- article -40 agricultural service and planning group,
- article -41 electricity, water and sewage service group,
- article -42 establishment and repair group of electrical facilities,
- article -43 rural drinking water establishment and repair group,
- article -44 municipalities drinking water establishment and repair group,
- article -45 sewage facilities establishment and repair group,

In practice, the roles of municipalities in disaster tasks are generally for support functions and service groups but not operational duties. Another important problem at the local level is the coordination difficulties and inefficiencies among the institutions of Governorship and Municipality. Municipalities have to have organizational roles in disasters and emergencies for the response phase as having fire brigades in their organizational structures.

Governorship and Municipality Coordination at the Province Level

Response to a disaster or emergency at province level is under the authority of central government representative-Governor and Kaymakam at district level. Governors and Kaymakams are regulated by the Ministry of Interior. On the other side municipalities have some responsibilities for the preparedness. Fire brigades as dealing daily emergencies are under the authority of municipalities.

After the devastating disaster in 1999, Province Emergency Management Center was established in the Governorship and Emergency Coordination Center (AKOM) in the Metropolitan Municipality of Istanbul as part of restructuring process for disasters and emergencies.

Fire Department connectedly working with AKOM has to have responsibilities for “response” primarily and “preparedness” and “mitigation” but not only serving as a support function to emergencies. Because, Fire Department of Istanbul serves in 32 districts of Istanbul with its 40 facilities and has the possibility to be capable in the coordination of AKOM with Governorship’s Civil Defense Province Directory. The relationship between AKOM and the Province Crisis Center of Istanbul has the importance for coordination in this sense.

On the other side, some of the sub-directories under the framework of AKOM for emergency situations are listed below;

- Head of Fire Department,
- Secretary of Defense,
- Head of Transportation Department,
- Department of Construction,
- Head of Partnership Directory,
- Head of Health Directory,
- Head of Social and Administrative Works,
- Directory of Road Maintenance,
- Directory of Ground and Earthquake Works,
- Directory of External Affairs,

- İSKİ (Directory of Water and Sewage of Istanbul),
- İGDAŞ (Gas and Natural Gas Associated Corporation of Istanbul),

Coordination between Municipality and District Governorship

Districts Emergency Response Teams and their responsibilities are defined in the second section of the 82/12777 numbered Regulation for Emergency Response Organizations and Planning Principles for Disasters. District Rescue Team and Aid Committee meets under the head of Province Governor and with the participation of mayor. Mayor has the responsibility of the coordination of sub-response service groups in districts under the supervision of Province Governor.

On the other side fire departments are very well known, strategically accessible, convenient and familiar places for public perception. These centers can be used for;

- To communicate with public,
- To practice for exercises for preparedness phase,
- For any kind of training purposes for disasters,
- To communicate with local volunteer organizations,
- To facilitate for Muhtars-Head of Sub-districts to get involved for disaster tasks,
- To communicate with non-governmental organizations,
- To achieve training from non-governmental organizations.

District Fire Department Centers can be used for "preparedness and mitigation centers of community" with the participation of Muhtars to facilitate the coordination among related parties of the community. Henceforth, the district's fire department centers can be used as an attraction and coordination location points for training centers by consisting of 10-12 sub-districts. When these centers have coordination with the District's Civil Defense Centers, they will serve as emergency management centers at district level and they will undertake important responsibilities for disaster/emergency management tasks.

Fire Department Centers in districts can have responsibilities for training, restructuring response teams of sub-districts, to establish common action plan of 10-12 sub-districts with the leadership of their heads-Muhtars.

Establishing the relationship between Muhtars and the aid-containers of the first 72 hours of disaster/emergency situations, structuring the rescue teams of sub-districts with volunteer contributions under the supervision of Muhtars, leading volunteer teams to have "D" level training with the coordination of fire departments and civil defense service and reformation of disaster response coordination from metropolitan level to sub-district level are the significant features of restructuring efforts to be changed for disaster management coordination.

Therefore, district fire department centers can be used for "Community Emergency Center" with the contribution of;

- Muhtars-Head of districts,
- Volunteer groups of districts,
- Non-governmental organizations and
- District Civil Defense Teams,

On the other side, these restructuring efforts may necessitate for renewal and improvement of the facilities and networks of fire department centers in districts.

Some of the improvement issues are listed below;

- Meeting and training rooms of fire departments,

- Improvement of accommodation facilities for the related personnel of fire departments during disasters/emergencies
- Facilities and spaces for short-term rest, food supply for personnel and volunteer groups during disasters/emergencies,
- Providing security, in-door warehousing spaces for search and rescue and response services at district level,
- Providing semi-outdoor temporary housing spaces,
- Providing distribution locations (semi-outdoor spaces),
- Providing Medical on-site Hospitals (Semi-covered spaces),
- Long-distance facilities and rooms
- Heliport space when needed

to provide the need for the restructuring regulations for fire departments.

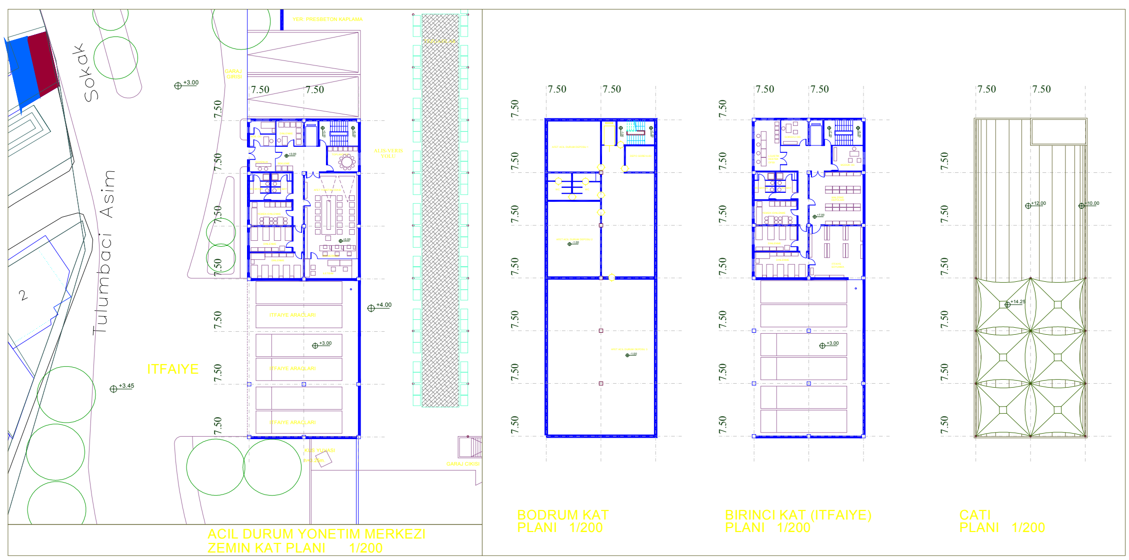


Table 7.2.3. Sample Diagram for Typical Fire Department Center at District Level (Kadıköy-Kuşdili Çayırı Location)

7.2.3 Incident Command System in Disaster Management

This section discusses the tasks, responsibilities and the qualifications of role players in the incident command system that are the essential components of contemporary disaster management. The subjects in this section also evaluate the linkage of incident command system with other disaster management organizations.

The aim of this organization called "incident command system" mainly shapes the core of the model of the disaster management. So, it aims to enhance the performance of responsive power of professional or volunteer groups, and to create coordination with other disaster management systems.

The contemporary disaster management always motivates us to create an efficient incident command system (ICS) in the neighborhood scale. Therefore the established system will provide the linkage and cooperation with small organizations in the limits of the neighborhood. The headquarter building of local ICS serving coordination, training and planning activities might be local fire brigade building and its facilities. This proposal may not create any problem in existing facilities of all over districts of Istanbul, except small renovation and alterations in existing buildings. The facilities can be considered as local headquarters of ICS, and they will functionalize for educational and public purposes. This type of building can be considered as the closest public facility for citizens in the neighborhood. These facilities do not provide only the training program for fire protection, but they will also serve specific training programs for mitigation and preparedness phases. The aim of this model will provide another perception in the public. The local training programs that will be held in facilities will enhance the importance and generosity of the fire brigades like during the westernization process of Turkish society in the past. These strategies also motivate to expand the concept of local disaster organizations in the neighborhood scale.

This model will enhance the strength of the resilient communities in the neighborhood scale, and the local professional response teams such as fire brigades. So, the local fire brigades will gain importance and credibility in the society.

Cooperation with Disaster Management Centers in the Province and the District Scale

The cooperation centers of local incident command system can be assumed as district fire brigade and its facilities. This center also cooperates with the District Management Center called as AKOM (Disaster Management Center of The Great Municipality of Istanbul). The incident commander of the district is the district governor, and he / she is the director of the disaster management center of the district. This center always coordinates with the disaster management center of the province as well as other districts, and it also implements disaster and emergency action plans, and it provides the coordination with local ICS units.

The District Management Center always interacts with the district fire brigade especially in emergency cases. The chief of the fire brigade is not only the assistant of the local governor about the disaster management of the district, but he/she is the chief commander of operations.

The existing administrative structure for disaster management interacts in similar logic starting from the neighborhood units to the disaster management centers of the province (Fig.7.2.4).

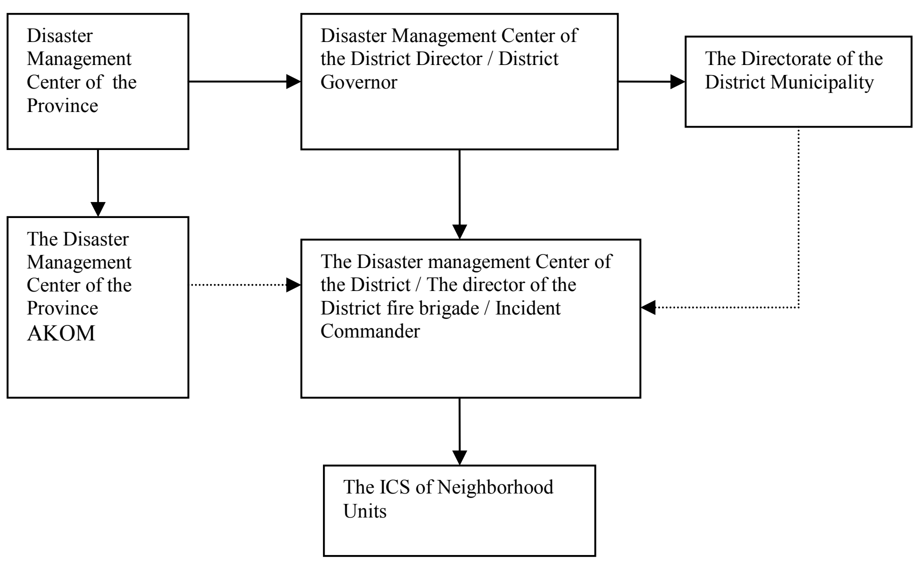


Table 7.2.4. The ICS and its Coordination in Disaster Management Model of the District

The Roles in Incident Command System

The coordinated units with disaster management center interact in the framework of incident command system. The typical incident command system has four units. These units may be considered as Operations / Response Teams, Planning, Logistics and Finance.

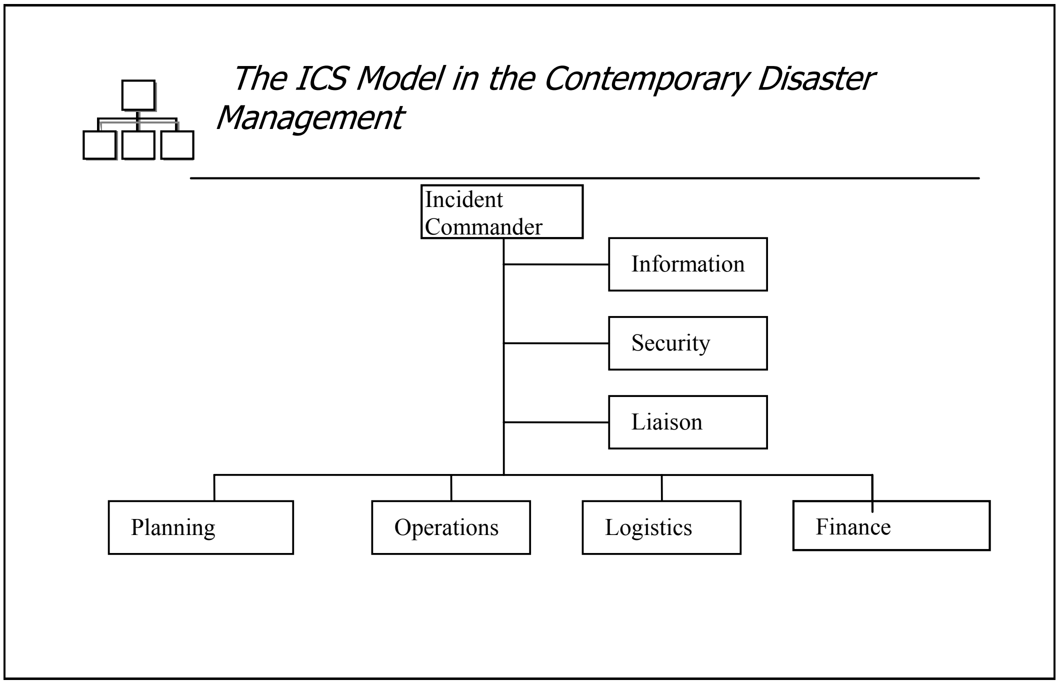


Table 7.2.5. The Structure of Incident Command System (adapted from Ünlü and Dikbaş,2001)

There are six roles in incident command system that is indicated in Fig.7.2.5. The roles can be ranked as incident commander, planning chief, operation chief, finance chief, logistics chief and assistants to the incident commander. There is variety in qualifications regarding the training and experience especially in members of the system. So the tasks in ICS can be determined in accordance with the training and experience of the person. In sum, there is a strong relationship of disaster management training and incident command system.

The Task and Qualifications of Incident Commander

The commander of all operations in the district level should be controlled by the manager of the district fire brigade. According to Turkish law the incident commander in the district level covering all tasks such as planning, operation, logistics and finance is the district governor (Fig. 7.2.5). This also means that more ICS units can be established in the district due to the administrative zones corresponding to quarters (mahalleler).

The incident commander is the responsible person regarding to all aspects of ICS like operation, logistics, planning and resource inventory. This person can be the chief of the fire brigade or the chief of fire squads in accordance with emergency cases and operations.

The incident commander who has taken A level disaster management training level is the top qualified person due to the experience and training for civil protection, disaster management and fire prevention (Yentürk et. al., 2002). This model also proposes more ICS units according to the number of neighborhoods in a district. The important issue is there is a tremendous need for qualified professionals at the top of the ICS structures.

The ICS is basically participated by volunteers and NGOs in the neighborhood, so it can be controlled and coordinated by the disaster management center of the district. The chief incident commander at the neighborhood level can be determined due to the experience in volunteer forces. If there is volunteer participation for ICS in the neighborhood level, the incident commander can be determined as a person who completed A level disaster management training.

Planning Chief and the Task and Qualifications of Planners

The emergency action plans will be updated and actualized by the disaster management center of the district. These plans also consist of other plans like emergency operation plans and emergency logistic plans. The planning group do not control emergency action plans, but they also develop specific emergency action plans in the micro zoning level.

The top level of this group is a professional or volunteers who have been trained in A level. The selected volunteers who completed B level of disaster management training can also work in this unit.

The Chief of Operation Department and Qualification of Participants

The operation department consists of at least three units in emergency cases. The search and rescue, emergency medical service and security teams are some should work cooperation in an ICS unit. The operation chief of these three teams should be a professional who completed A level disaster management training. The chief may be a responsible person of a fire squad. It is better to assign professionals to this task unless an urgent need occurs for volunteers. The temporarily task should be accorded with the level and scope of the disaster and it should be managed by a person who comes to the place of the incident. The other step is to transfer of the commanding post to the eligible person who comes later.

Qualification of Search and Rescue Teams

The commanding post should have qualified A level professionals. It is better to add up commanding post B level certified volunteers as supportive forces.

Qualification of Emergency Medical Service

This task is mainly operated by volunteers who have medical experience and certified in at least C level disaster management training.

Qualification of Security Unit

This unit is mainly shaped by volunteers who their occupation is security. The volunteers should complete at least C level certificate, so their main task is to protect the disaster areas against looting or other violations. Their activities continue until the law enforcement units reaching to the incident area.

Qualification of Logistics Chief and Participants

The chief of logistics is the person who rules the resource management of ICS and applies the emergency logistics plan. For this post, it is better to assign a professional in the fire brigade who has an experience on mechanical works such as tools and equipments maintenance and repairing. The assignment of volunteers who completed at least C level disaster management training will enhance the participation to ICS.

Qualification of Finance Chief and Participants

It is better to have a finance chief who completed at least B level training. The chief should organize the data inventory of incident command system in relation to the fire brigade and the close neighborhoods. The chief should also keep the data inventory for all resources, so he/she should proceed the cost analysis of the incidents, and should regulate the cost analysis, procurement and man hour estimations during the emergency cases. The volunteers should also support this post. The volunteers should be selected and qualified participants who have eligibility for cost estimation. The volunteers should have at least C level disaster management training.

Other Participants

It is better to mention three participants who work under the incident commander especially in larger scale disasters. These posts are determined as liaison, information and security officers who directly linked to the incident commander. The liaison officer constructs a linkage between the squads in the incident area and the disaster management center of the district. The information officer has experience with public information strategies. The role of media in the incident area and dissemination of media information are some important tasks of this person. The last post is the security person who has responsibility about the limits of the incident area as well as safety regulations about role players like professionals and volunteers. The participants for security and safety units should have at least B level training in disaster management.

7.2.4 Resource Management in Disasters

In order for the greater Istanbul municipality to be prepared and to respond to disasters effectively, all resources must be determined beforehand. The principles of resource management include planning, organization, management and control. The resources to be managed include manpower (in charge and volunteers), machinery, equipment, and technical information.

Resource Planning

The authorities taking part in the emergency operations center at the greater Istanbul municipality need to determine the current resources, their status, and what their goal will be during a response to a disaster.

According to the goals, strategic planning is required and the resources required have to be determined. During the response effort, a continuous status check has to be performed. During the status control, many questions have to be answered. What are the threats, if the situation is under control or not, how widespread (in terms of population and area, and transportation routes) the damage is, are a few that come to mind.

The greater Istanbul municipality should have the primary goal of protecting those that will take active part in the recovery phase, and then protect the citizens of the city. In order to be able to make this happen, strategic goals have to be placed in terms of personnel, equipment, machinery and technical know-how. The source of where resources will be allocated from during the response stage of a disaster has to be known, and these resources must be in working order. Resources needed from private sector, NGO and other government agencies have to be requested and agreements should be made in advance.

Resource Organization

Organization of resources entails lining up and placing all resources to be used during a response to a disaster. Those Greater Istanbul Municipality employees to be situated at the site during the response phase have to know exactly what their jobs will be, and they must be trained to perform their tasks correctly. They also must know the chain of command in the jobs, and also know how to communicate and what means they will communicate with.

The technical works directorate of the greater Istanbul municipality holds important resources to support the greater city and the smaller counties. This support is important for debris removal and management, evacuation routes and preparing existing roads for evacuations.

Another important resource for the greater Istanbul municipality is the local construction companies and contractors. Preparing agreements prior to disasters, during the planning phase is important.

Resource Management

In order for the emergency operations center to be successful, those that will be actively involved must have control and decision making roles and abilities. Resources can be managed easiest by motivation and leadership. All resources to be managed must be listed (including those of the private sector and NGO's) prior to a disaster, and all required permissions must be granted to the municipality beforehand.

Security measures for all resources must be planned, as well as a defined and ready to spend budget. The management will be carried out by an incident commander, logistics director and equipment director to be selected by the municipality.

Controlling Resources

Standards must be placed, and responsible parties must be chosen to control resources. During a response to a disaster, responsible parties must include at least 2 people instead of 1, in order to provide effective service. The directors and controllers must evaluate conditions at close intervals of time to ensure that the correct resources go to the neediest locations. If the evaluation shows that resources are not being provided adequately, the incident commander will request an alternative method for service.

Kaynak Yönetiminde İtfaiyenin yeri

The Istanbul fire brigade became a part of the greater Istanbul municipality in 1923. The Istanbul fire brigade is the most important resource for disaster response (not only fires) and saving lives. Its importance was observed in the year 2000 when the "Disaster Response Center" was established.

Figure 7.2.6. shows the events responded to in the year 2001 and Figure 7.2.7 depict the role of the Istanbul fire brigade in the municipality's AKOM Disaster coordination center.

The Fire Events in 2001

Fire Event \ Directorship	ISTANBUL	BOSPHORUS	ANATOLIAN	TOTAL	%
Number of Fire Cases	6428	4075	4509	15012	75
Number of Lifesavings	891	423	1539	2853	14
Fire Denunciation	952	220	1258	2430	9,5
Water Discharge	137	92	123	352	1,5
Number of Total Cases	8408	4810	7429	20647	100

Table 7.2.6. Events in 2001 (Yalın, 2003)

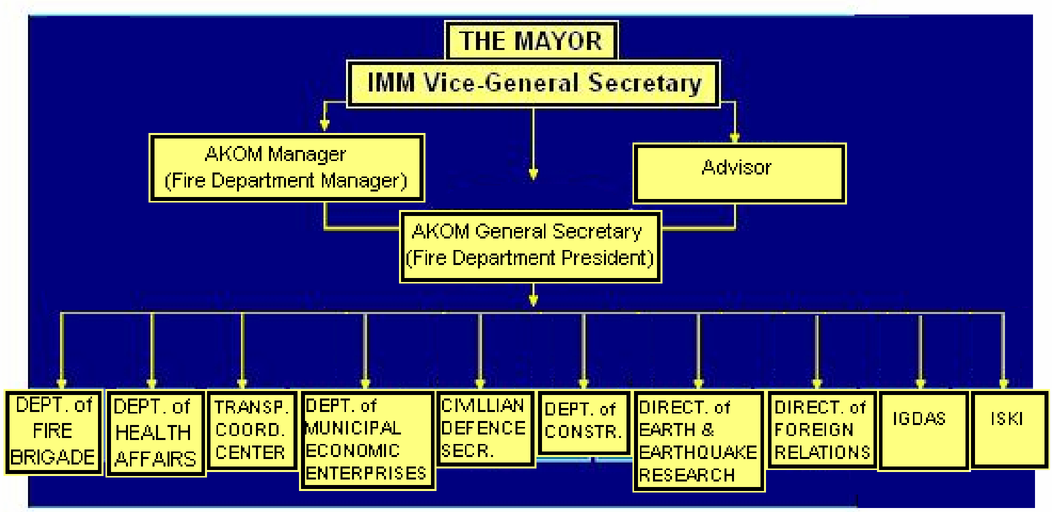


Table 7.2.7. AKOM – Disaster Coordination Center (Yalın, 2003)

The Istanbul fire brigade should take active part, not only in disaster response, but also human resources and planning, organization, management and control stages of disaster management.

Status of Fire Brigades Equipment

The current status of the Istanbul fire brigades machinery and equipment is shown in Figures 7.2.8 and 7.2.9. Most of the equipment has been attained following the 2 large earthquakes that took place in 1999.

S/N	VEHICLE TYPE	QUANTITY
1	Chimney Vehicle	35
2	General Purpose Vehicle	30
3	Help Vehicle	15
4	Small Crash Truck	2
5	Big Crash Truck	4
6	Hook-and-Ladder Truck 18m.	8
7	Hook-and-Ladder Truck 30m.(with elevator)	21
8	Hook-and-Ladder Truck 44m.	1
9	Hook-and-Ladder Truck 52m.(with elevator)	3
10	Ladder Snorkel 30m.	2
11	Hovercraft	2
12	Foam-Water Tower	2
13	Forest Vehicle	14
14	Mobile Tube Vehicle	1
15	Water Tank 7 ton	46
16	Water Tank 10 ton	18
17	Water Tank 20 ton	4
18	Crane Truck 40 ton	2
	TOTAL INTERVENTION VEHICLES	**210**
19	Refueling Vehicle	1
20	Mobile Greasing Vehicle	1
21	Pickup Truck	53
22	Minibus	20
23	Passenger-Service Car	23
	TOTAL SUPPORT VEHICLES	**98**
	GENERAL TOTAL	**308**

Table 7.2.8. General Vehicles of the Municipality (Yalın, 2003)

TOOLS and EQUIPMENTS	COST
20 Rescue Vehicles	6.500.000 DM
14 Hook-and-Ladder Trucks	13.000.000 DM
2 Hovercrafts	400.000 DM
2 Foam-Water Towers	2.149.000 DM
13 Water Supply Vehicle	2.000.000 DM
75 Various Rescue Equipments	6.000.000 DM
TOTAL	30.049.000 DM

Table 7.2.9. Equipment attained following the 1999 earthquakes (Yalın, 2003)

In addition to the Istanbul fire brigade resources, the technical works division resources and other divisions of the greater Istanbul municipality has to be up to date and included in the earthquake master plan resource management list. This inventory list should be maintained by AKOM and updated at regular intervals, and all equipment and machinery should be listed according to their locations and technical experts who can use them.

Human resources

The persons that will take part in the response of an earthquake should be categorized in two groups: employees and volunteers. The employees of the Istanbul municipality that will take part will include the AKOM members who represent the civil defense, transportation, technical works, health, social and management, road works, geotechnical and earthquake research, public relations directorates and ISKI and IGDAS employees. The emergency operations center, headed by the Istanbul fire brigade will also have members of non-governmental organizations taking part in its efforts on a logistical or operational basis. The fire brigades human resources are given in Figure 7.2.10.

S/N	Directorship	Civil Servant	Worker	Total
1	Directorate of Central Fire Brigade	117	67	184
2	Directorate of Fire Brigade for Istanbul Region	208	395	610
3	Directorate of Fire Brigade for Bosphorus Region	153	288	441
4	Directorate of Fire Brigade for Anatolian Region	292	409	701
TOTAL		770	1159	1929

Table 7.2.10**.** Istanbul Fire brigade employees (Yalın, 2003)

The city of Istanbul is in need of professional fire fighters at a rate of 1 per 1000 population. The current 1929 employees are not enough for the city, and the number urgently has to be increased to 9000. The number of volunteer firefighters is expected to be 3000.

Neighborhood/Central Government/Private sector agreements

In order for the greater Istanbul municipality to reach the citizens of Istanbul effectively and efficiently during a response to an earthquake, it must have cooperative agreements with neighborhoods (muhtarlık) for resource sharing and management. The municipality must similarly be ready to cooperate with public and private organizations.

One example that can be addressed is the orange disaster stations that the governor has placed in each neighborhood of Istanbul. There needs to be a standard operations procedure that both the fire brigade and neighborhood muhtars can work together.

Other important human resources that can take active part in response to earthquakes in Istanbul include imams, barbers, and taxi drivers. These groups must be included during the resource planning stage.

7.2.5 Disaster Management, Education and Exercise Programs

The governors of province and sub-provinces, mayors of greater city and sub-provinces are the first response mechanisms to disasters in Istanbul and they have some other direct responsibilities for disaster management. Some of these responsibilities are preparation and implementation of disaster response plans and implementation of training and exercising activities.

Municipalities and governorates are also responsible for mitigation activities. Some of them are as follows. Implementation of earthquake resistant design code and other standards and regulations related to construction law. Land-use planning, Building control. The organizational structure for disaster management at provincial level. Each governorate establishes a "Provincial Rescue and Aid Committee". There are also nine service groups during disasters to implement effective response and recovery efforts. Sub-provinces also establish the same structure for their disaster management activities.

More branch offices of the governorates and municipalities are therefore getting involved in local response planning because of the expectation by the local government to become part of their response system. The staff in these branches will need basic training in the field of Disaster Management to ensure their participation and contribution to the communities they serve is effective and valuable.

Recently experts are warning us about the impending large earthquake in Istanbul, and yet the citizens are clearly unprepared. Population growth, movement and urbanization, the degradation of the environment, the massive demand for housing leading to rapid and uncontrolled construction means that Turkey has the potential for a disaster on an unprecedented scale.

The aim of the Disaster Management Training or Education is, therefore, to train local and organizational officials for disaster management, who are employed as public or private officials required to work at disaster sites, officials working in local authorities, and emergency operations centers and architects, engineers, teachers and students. All new techniques and knowledge regarding Disaster Management has been conveying by seminars and courses to the target groups listed above. The long and short-term goals of these trainings are to train officials for disaster prevention and mitigation. Priority is given to emergency managers of relevant institutions and local authorities and secondly, public training programs are considered. The most important outcome of the project is the training of local disaster management officials in order to prepare the cities in Istanbul and its people for a possible future disaster, minimize any possible losses, and accelerate the recovery stage following a disaster.

Experience to date has shown a lack of adequate communication, coordination, and integration between central authorities and provincial administrations before, during, and after a natural disaster in terms of mitigation, preparedness, response, and recovery.

The media in general has done its job in reaching average man in the street thus making him more aware of his rights and the failure of government to provide a safe environment for him to live with his family. The messages from the media are not always accurate and this sector needs to be factored in the development of the key messages to benefit the public during an emergency.

Istanbul, unfortunately, has not formed the necessary mechanism for public participation and integration in the disaster response system so far. However, it is a fact that without active participation and support from the public, it is almost impossible to take necessary action for mitigation and preparedness.

Many NGOs and community self-help groups are coordinating their own public education activities and community based initiatives. Many are already training the trainers in Light Search and Rescue, Non-structural Mitigation and First Aid. Added to these private efforts are the efforts from some municipalities who are also in the process of preparing response plans to be able to cope with possible disasters. These initiatives will of course have to be synchronized in each community with all response agencies and the government agencies at their local and national level to avoid confusion and produce the desired impact.

Local governments have tended to overlook this component when making land-use decisions within their jurisdictions. Engineers and planners have long complained that urban vulnerability and environmental degradation have reached alarming proportions because land-use policies have not been put into effect by municipalities.

Continuous pressure is being exerted on the representatives of the government and the local authorities, through their various crisis councils, to design and conduct public awareness training and preparedness campaigns. Training and education should not be one-time events, but rather a continuous process of refresher courses and introduction of new information. An exercise program should supplement all disaster training. It will involve senior government management as well as the whole citizenry, and ideally, it will have to be started in the primary schools curriculum.

Recent experience has indicated that dispatching local public employees to disaster sites in neighboring provinces is a sensible and practical alternative. In-house and on-site training programs for the local disaster managers should be provided regularly to keep them at the highest level of professionalism in the field of disaster management

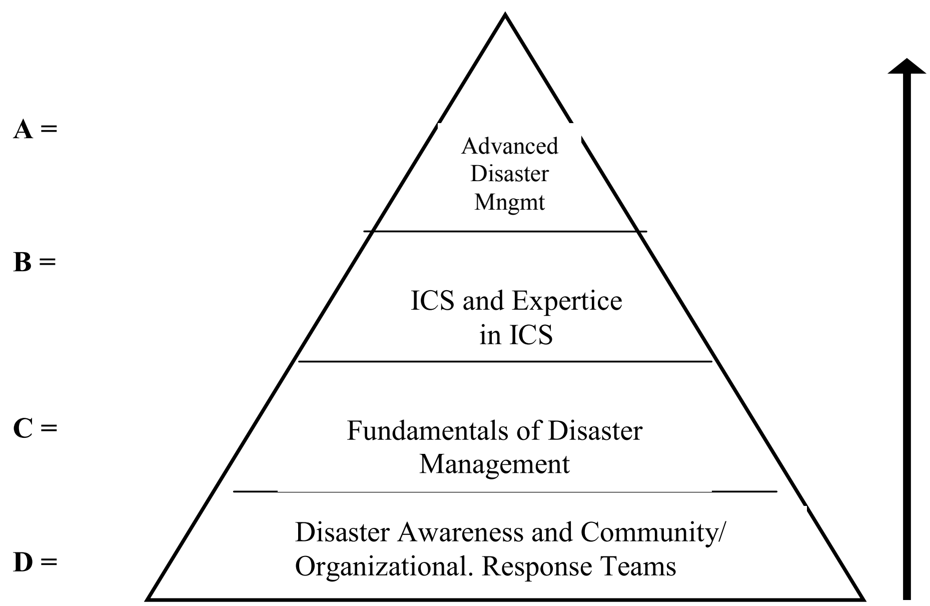
Framework

The faculty members who are certified by FEMA will take part in the education for the Istanbul covering topics of Disaster Management.

There are 7 main education topics (see the Appendix for the complete lists of the available courses and their contents):

- Emergency Management and Emergency Planning
- Basic Operations
- Mitigation
- Orientation to Community Disaster Exercises
- Preparedness for Disasters
- Building Consensus in Disaster Resistant Communities
- Earthquake Integrated Emergency Management

In order to keep consistency and mean full training the level and steps should be followed as depicted in the following training-education pyramid.



These training levels can be summarized as follows:

D-Level: Community/Organizational Response Team (CERT)

C-Level: Fundamentals of Disaster Management

B-Level: ICS/Expertise in Incident Command Systems Subjects

A-Level: Advanced Training or Education in Disaster Management (Disaster Management, Education and Exercise Implementation Program or M.Sc. in Disaster Management).

Method and Scope

Method: Along with classroom discussions and lectures, there will be educational group activities and participant-lecturer discussions and applications exercises.

Scope : An education plan for each sub-city and greater city area will be prepared taking into consideration the regional priorities and properties. The topics included inn the education program will be from those topics covered in the disaster management education project.

The prioritized lists of local regions to take part in the education project, along with the calendar and implementation details/s will be determined by the Istanbul Municipality.

The Target Group

· Local Authorities

· Governors, Deputy Governors

· Mayors

· Managers in charge of local Emergency Management

· NGO's Directors

· Schools' Managers and Teachers

· Media Staffs

Related Officials : Police Officials, Fire Officials, Health Officials, Construction and Public Works Officials, Social Service Officials, Transportation Officials Structural Safety Officers, Local Electricity Officials, Natural Gas Officials, Water Officials, Water Officials and Communications Officials.

Expected Outcome

The most important outcome of the project will be the training of local disaster management officials in order to prepare the city and its people for a possible future disaster, minimize any possible losses, and accelerate the recovery stage following a disaster. Along with this citywide project, work towards preparing a citywide disaster preparedness plan will be initiated.

7.2.6 Conclusion

Public awareness programs play an important role to introduce and to raise interest of the Istanbul Earthquake Master Plan (IEMP). The level of acceptance and adaptation in a rationale way will also improve by these programs. Planning, handling the disaster situation, disaster response organizations, public organizations and training programs covering the large population are the topics included in IEMP form the metropolitan level to a single home. Building a disaster resilient community is not an easy task considering the multi-dimensionality of the problem and difficulty in changing the individuals' every day habits. To use every possible mass communication methods in training will speed up the process to prepare the community to face and overcome the disaster situations.

In this work, we presented an emergency management model for a well prepared and disaster resilient community. This model also includes the incident command system and its centers which will operate in case of a possible earthquake, to select the personnel working in these centers, the methods to choose and manage the available resources before, during and after the operations, the way of coordination between the local and central government.

In order to have a successful emergency management model for Istanbul, emergency management training is very important covering both local and central government representatives, as well as NGO's, utilizing the private sector resources. This model should also include the four phases of the disaster management, considering all kinds of hazards. Periodical training sessions will result in using standard methods and terminology adopted by professional and volunteer emergency managers. Therefore current laws, regulations and procedures should be revised and changed accordingly. A model emergency management training program is presented in this report.

The adaptation of the emergency management model presented to the IEMP will help prepare citizens of Istanbul against the results of a possible earthquake and minimize the loss of life and property.

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7.2.8 APPENDIX - Fundamentals of Disaster Management Courses

The objective of this program will be the preparing of local governors and disaster management officials in order to prepare Istanbul and its people for a possible future disaster, minimize any possible losses, and accelerate the recovery stage following a disaster. The followings are the main courses of this education.

1.Emergency Management Principles

Overview of an Integrated Emergency Management System (IEMS), The Four Phases of Emergency Management: Mitigation, Preparedness, Response, and Recovery. Coordination: The role of local, and State governments; private sector and the role of a citizen. All hazards emergency management approach. Integrating the eight core functions of emergency management: Direction and Control; Communications; Warning; Emergency Public Information; Evacuation; Mass Care; Health and Medical; and Resource Management.

2. Emergency Planning

Jurisdictional Division of Sectors, Evaluation of Previous Cases, Hazards Analysis, Evaluation of Vulnerability Grade, Developing Main Plan, Plan Suffixes, Law Enforcement for Implementations, Operational Planning, Emergency Operations Planning Period and Long-term Planning.

3. Mitigation/Loss Prevention

Mitigation Strategies, Risk Reducing Methods for Emergency Managers, Hazards Identification, Selection and Implementation of Mitigation Resolutions, Identification and Usage of Mitigation Resources, Mitigation Resources of Turkey, Role of Mitigation Planning Group, Creating and Implementation a Mitigation Plan, Determination of Post-disaster Strategies, and Principals of Mitigation Simulation.

4. Preparation and Early Warning

Purpose, Situation and Assumptions, Spotters, Fire and Hazmat, Weather Watch and Warnings, Weather Radio, Outdoor Warning Sirens, Telephone Notification System, Cable television Systems, Emergency Alert System (EAS), Public address system announcements using emergency vehicles, Door to door notification.

5. Emergency Operation Center and Incident Command Systems

Designing, properly locating, operationally establishment of an EOC and seeking for financial support, management of EOC, disaster management in a high-stress disaster environment and functionality of EOC, applying EOC Operations Standard Operation Procedures in EOC, briefing management in EOC, preparation and evaluation of EOC simulations, decision making techniques and problem solving. Establishment of Incident Command Systems (ICS), locations, functions and operations of ICS. ICS / EMC relations, roles and responsibilities of ICS and EMC. Basic principles, sub-processes and actions upon Incident Management period.

6. Disaster Response Planning

Survey of possible hazards and incidents that may occur in a disaster, and survey of parameters generating the incidents. Development of “emergency plans” in accordance with regions, planning process based on assumptions of incidents which may occur during disaster preparedness as well as during disasters. Management of resources including staff, equipment and materials. Basic principles, sub-processes and actions upon Incident Management period. Jurisdictional Division of Sectors, Evaluation of Previous Cases, Hazards Analysis, Evaluation of Vulnerability Grade, Developing Main Plan, Plan Suffixes, Law Enforcement for Implementations, Operational Planning, Emergency Operations Planning Period and Long-term Planning.

7. Information Technologies in Disaster Management

Geographical Information System (GIS) - based information and management system which will operate using the Remote Sensing System (RSS), the Global Positioning System(GPS) and other data collection techniques. GIS will be used for emergency planning and administration, disaster management and damage estimation and a decision support system for central and local authorities (ministries and local administrative units) at other times. It will serve as a nationwide model for all of the above. The goal of this lecture is to introduce this technology to participants.

8. Community Response Teams

Creating a community that is able to specify possible hazards within their home and their local area for disaster preparedness, Function and responsibilities of community emergency response teams, Preparedness steps, precautions against fire and fire suppression, self-help first aid for public and medical duties, planning and assessment for search and rescue situations, practical tactics, team safety, disaster psychology and CERT organization and recording systems.

9. Emergency Management Public Information

The Emergency Management Public Information Officer, What Are the Media?, Writing Skills for PIOs, Speaking to Groups, News Interviews and Conferences, Awareness Campaigns, Emergency Public Information Planning, PIO Response Case Study, Emergency Public Information.

10. Development of Voluntary Resources

Purpose and Objectives, Introduction, Why Volunteers? Resources, Program Planning, Recruitment and Placement, Supervision and Evaluation, Special Considerations

11. Donation Management

Introduction to the Donations Management Process, Preparedness Activities, Response Activities, Recovery Activities, Mitigation Activities, Identifying Organizations, Interagency Collaboration, Guidelines for Donors, Reaching the Public, Problems with Unsolicited Donations, Donations Data Management, Setting Up and Managing a Phone Bank, Managing Cash, Managing Goods, Facilities, and Transportation, Managing Volunteers/Services.

12. Resource Management

Purpose and Objectives, Relationships Among EM, RM, and Resource Needs Assessment and Analysis, Determine Resources Needed to Manage a Disaster, Determine Existing Resources and Capabilities, Identify Sources for Procurement, Validate Resource Distribution Centers, Develop SOPs, Using Job Aids, Activate the RM System, Document Return of Resources, Exercise, Review, Evaluate and Revise RM Systems.

13. Exercise Development

Possible emergency cases, magnitudes of those and frequency of occurrences, identification of needs, defining staff and facilities, developing strategies under the conditions of non-stress environment such as tabletop studies, composing and preparing prime facts and details what supports main theme in scenario, list of response operations planned to be implemented in future, defining roles of disaster workers representing various organizations, noting messages, practicing visual and full-scaled simulations by high-stress conditions, control, co-ordination, and evaluation of simulation, recommendations for adjustments and developing a archive of obstacles, etc. Simulation control during exercise, ensuring and testing accordance in order to evaluate system and as a result; requirements, deficiencies of EOCs and present plan, serviceable resources and responsibilities.

14. Building a Disaster Resistant Community

Basic principles for encouraging high attendance of class, content and vision of the project for "Creating a Disaster Resistant Community Mobilization", planning of public service announcements stating objectives, roles and responsibilities of responders, project implementation, use of necessary tools and techniques, local damage assessment, aid collection management, creating local emergency teams, donations management, liaison for NGOs.

15. Earthquake Integrated Disaster Management

This course covers discussion for the vitality of earthquake integrated disaster management relations in accordance with mitigation, preparedness and response; roles of the state, the police department and the army, hospitals, the health organization and municipalities responsible for response operations, rehabilitation works and planning; role, organization and internal co-ordination of EOCs, developing relations with Media / Press, initiating mutual relief agreements, internal and external operations of EOCs during disaster cases, damage assessment, rehabilitation works and enhancement of reporting techniques; composing earthquake case scenarios and practicing exercises performed on those scenarios.