Chapter 6
Strengthening Existing Infrastructure and Lifeline

CHAPTER 6 STRENGTHENING EXISTING INFRASTRUCTURE AND LIFELINE

6.1 Introduction

Concerning infrastructures, especially road network, it is vital to keep it well functioning to enable a quick and effective operation of activities such as search and rescue, recovery work, and emergency goods transport. If the road network becomes incapacitated, it will increase the scale of disaster.

On the other hand, the development of lifeline is increasing rapidly at present and every citizen relies on this useful facility. Compared to other lifelines, potable water is indispensable for survival, and citizens cannot live long without it. However, lifelines including water, gas, electricity, and telecommunications are interrelated and shortage of electricity will lead other lifelines to malfunction since self-generation of electricity is limited.

Both infrastructure and lifeline are basic necessities to prevent expansion of scale of disaster. Therefore, strengthening of existing facilities is a very effective measure. However, it is to be noted that only strengthening of infrastructure will not be effective, since there is no perfect measure to avoid damage from a huge earthquake. But with people's awareness and periodic training or drills by each related company and organization, damage can be greatly minimized and normal life will be quickly restored.

This chapter discusses measures to strengthen roads and bridges and lifeline consisting of water, gas, and electricity. Telecommunication, which is one of the important facilities to keep good connection to operate all activities, is taken up separately in a different section.

6.2 Strengthening of Road Structure

Concerning the emergency phase triggered by earthquake disasters, maintaining an emergency road network is indispensable. If any part of the network gets blocked, this network will not function and in addition, any rescue, repair, and transport activities cannot be carried out. Therefore, the road network must be secure.

6.2.1 Target Earthquake Resistance of Road

There are three major types of road malfunction that can be considered once road is damaged by earthquake.

1) Intercity Arterial Road (connecting with other cities), which will significantly affect the economic activity in a large area connecting other cities.

2) Emergency Transport Road, major road networks connecting relevant organizations related to disaster management, which will greatly affect the activities at emergency phase in the area.

3) Arterial roads, secondary road networks for relevant emergency activities.

Target earthquake resistance of these road types can be considered as follows:

1) Intercity Arterial Road and Emergency Transport Road

- Probability of suffering from large earthquake during the service duration of structure is low, but if this is not the case and the roads experience a large earthquake, there would be limited damage, and still possible to transport emergency vehicles by minor repair, and secure multi-channel and functionality of road network.
- Against earthquakes which will occur one to two times during service duration of structure

2) Arterial Road

- Probability of suffering from large earthquake during the service duration of structure is low, but if it does go through a large earthquake, damage would not be severe
- Against earthquakes which will occur one to two times during service duration of structure

Structures along the road network shall be newly constructed or strengthened considering the target shown above. However, it is difficult to completely safeguard all structures; therefore, in order to prevent malfunction of the total network in case of some interruption of road network, it is necessary to increase multi-channeling and to prepare alternatives of road network.

6.2.2 Characteristics of Road Damage

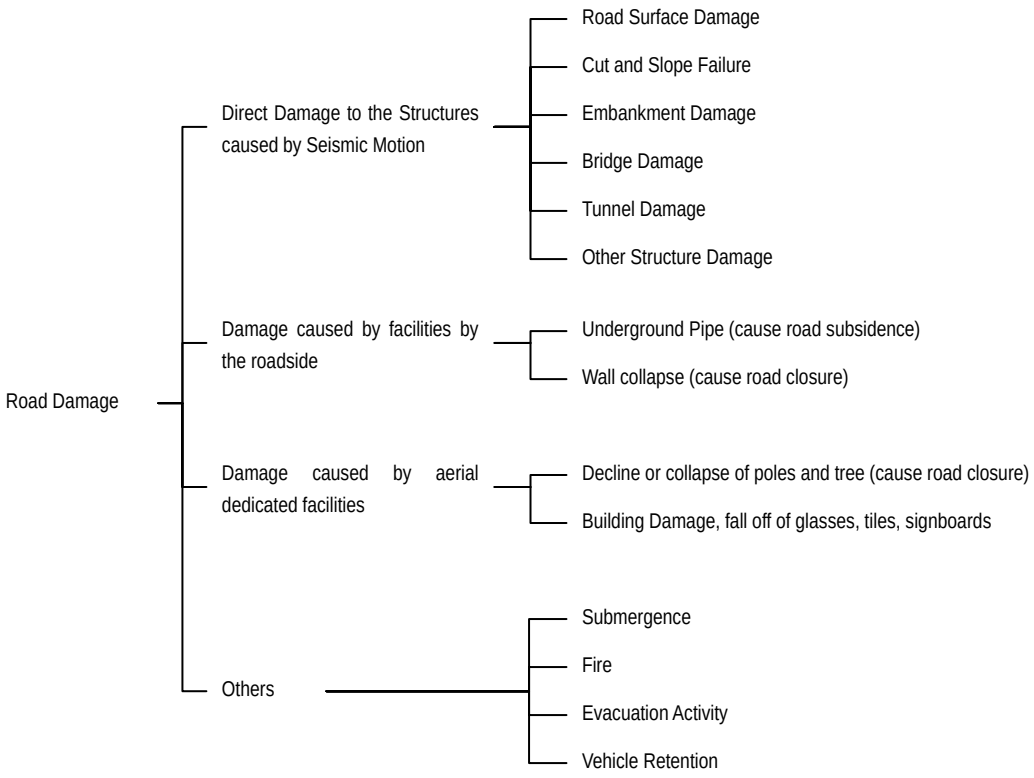
Road Damage against Earthquake can be categorized as shown in Figure 6.2.1, and categorized into four major types of damage. They are: 1) Direct Damage to the Structure caused by Seismic Motion, 2) Damage caused by facilities by the roadside, 3) Damage caused by aerial-dedicated facilities, and 4) Others.

Direct Damages are represented by road surface damage, bridge damage, etc., which will cause physical malfunction to the road network and will take time to recover. This should be prevented in the first priority.

Damages caused by facilities by the roadside are represented by underground pipes and collapse of roadside structures. Underground pipe damage such as water pipe will bring about subsidence of road and collapse of roadside structures will result in road closure.

Damages caused by aerial-dedicated facilities are represented by damage to utility poles and building damages. Fallen debris from the buildings will result in closure of road.

Other damages are represented by Submergence, Fire, etc. They will interrupt the flow of vehicles for all emergency activities.



Source: Japan Road Association, 1998

Figure 6.2.1 Characteristics of Road Damage Against Earthquake

Road network is an important infrastructure, which maintains citizen's life and economic activities. Therefore, once the road function is damaged, it will greatly affect emergency and recovery activities in the disaster-stricken area. Moreover, effect of road damage will not be limited to disaster-stricken area and may spread to other areas. Strengthening of road network is indispensable and it is necessary to put the appropriate effort on it.

Among the road facilities, bridge collapse will create the most serious malfunction of road network. Therefore, strengthening method is explained in detail in the following section.

6.3 Strengthening of Bridge Structure

Bridge structure has to be considered together with road network, since bridge is one of the facilities of road network and bridge collapse will greatly affect the road network.

In the previous study on damage estimation, first screening method called Katayama Method (Disaster Prevention Council of the Tokyo Metropolitan Area, 1978) was used to estimate

possible damage to bridge structures in Tehran. This method is widely used in Japan and it estimated the possible fall of superstructures against strong earthquakes.

In this damage estimation, bridge inventory data prepared by Tehran Engineering and Technical Consulting Organization (TETCO) and JICA Study Team were used. This inventory list of bridges includes 239 bridges and 168 bridges out of 239 bridges identified with location. As a result, in case of Ray Fault model, six bridges are estimated as "Collapsed" and five bridges are estimated as "Unstable." Therefore, in this study, those bridges were observed and result was modified. Consequently, in case of Ray Fault mode, five bridges are estimated as "Collapsed" and 4 bridges are estimated as "Unstable." Details are explained in the Sector Report.

6.3.1 Basic Point

There is some particular difference between the bridge design and building design even though basic principle of design is the same. The main reason is that all of the bridges are public facilities and constructed carefully with appropriate engineering design. Therefore, even though estimated damage of building is high, ratio of bridge collapse is relatively low.

Role of bridge is to maintain road network; therefore, importance of maintaining bridges is extremely high. Bridges must be designed and constructed to survive from the following target earthquakes:

- The intensity of Manjil Earthquake in 1990.
- The intensity of earthquake that is proved in the earthquake resistant design code. Probability of exceeding that earthquake within a period of 50 years may be about 10%.
- The intensity of earthquake caused by scenario earthquake; this is the largest earthquake that can be expected for Greater Tehran Area.

Against the intensities of earthquake mentioned above, there are several ways to control the extent of damage.

- Secure the structure as fully operational.
- Secure the structure as operational with minor repair.

  If some incidental damage occurs, it has to be repaired quickly within a few days. Elastic design method may be applied.

- Prevent excessive reduction of load carrying capacity of the bridge.

  Sufficient ductility must be retained even though some yielding is allowed at some part of the structure. This type of design method is called "Capacity Design." In the

method, some plastic hinge is set in the structure model, and stability of whole structure and displacement is discussed.

To summarize the points, some reasonable correspondence between intensity of earthquake and countermeasure is generated in Table 6.3.1.

Table 6.3.1 Performance Levels of Bridges to Various Design Earthquakes

	Earthquake Performance Level		
	1) Fully Operational	2) Operational but some repair is necessary	3) Prevent complete collapse
1) Frequent Earthquake	✓		
2) Occasional Earthquake		Linear Design	
3) Very Rare Earthquake			Capacity Design

Source: SEAOC, 1995, modified by JICA Study Team

If bridge is designed carefully taking into account the earthquake intensity, which is shown in Table 6.3.1 as "Very Rare Earthquake," it is not very effective to undertake strengthening solely. There can be some cases in which seismic isolation or dynamic structure control gives effective solution. However, there can be some discussions regarding the cost effectiveness because of the price of device, which is rather expensive. Sample of strengthening method will be explained in the later section.

6.3.2 Countermeasures on Designing

Basically, the concerned authorities should have its keeping drawings and specifications of every bridge that must follow the present earthquake resistant design code of bridges. For this purpose, appropriate design code for bridges must be discussed and established.

At the moment, Code of Practice for Seismic Resistant Designs and Computation of Bridges, Deputy for Technical and Civil Affairs, Tehran Municipality, August 1995, is the recent code applied in Tehran. Basically, the code is formulated with a mixture of code from the U.S.A., France, and Italy. If the construction of bridges is carefully following this code, there will be no problem. However, some critical points can be observed in the bridges in Tehran as follows:

- Condition of bearing that controls the behavior of the superstructure is vague.

Most of the material used for bearing in Tehran is made of neoprene. And the condition of movable/fixed bearings is not distinguished in structural details. It can be emphasized that there are many examples of bridges that have collapsed because of bearing malfunction, including in the Great Hanshin Awaji Earthquake.

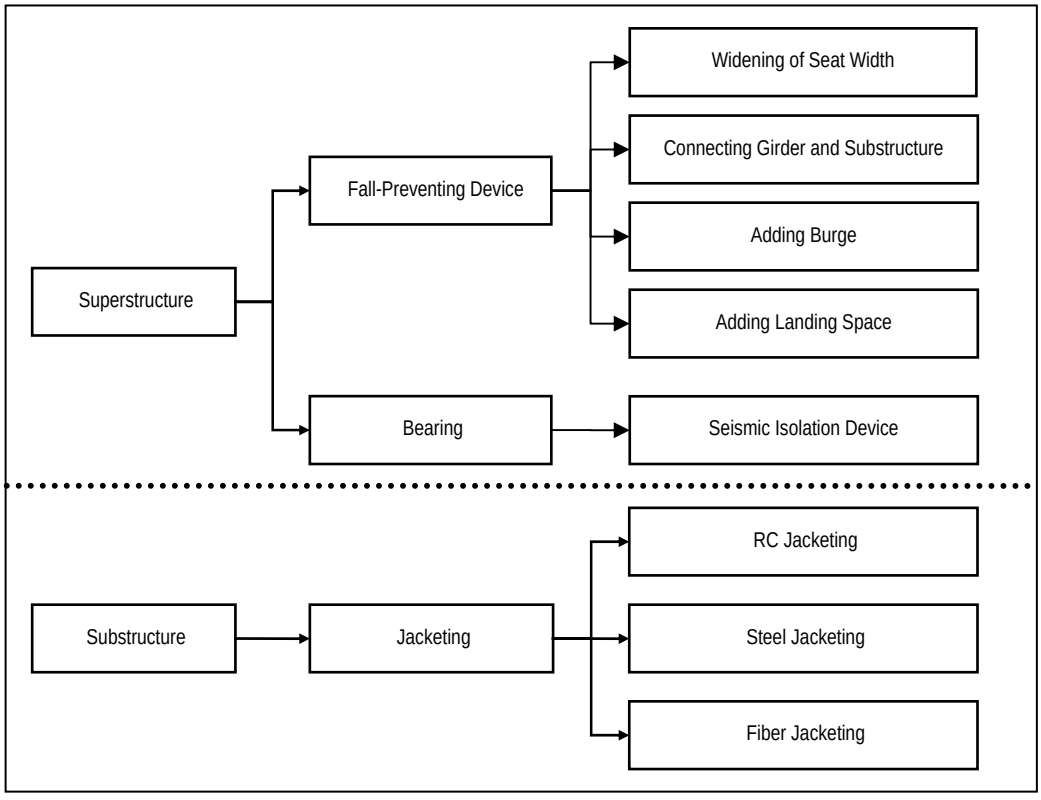
- The unseating prevention system is not considered.
- The shear-reinforcing bar of the pier is not sufficient.

The above-mentioned criteria should be included in the construction of bridges with seismic resistance.

6.3.3 Strengthening Method of Bridge Structure

There are two major parts in bridge structure; one is superstructure such as girders and the other is substructure such as columns. Recently, effective method against earthquake is introduced and certain effect is evaluated. In this section, this strengthening method is explained for the sample for the future strengthening of bridge structure.

Figure 6.3.1 shows typical types of strengthening method widely used in Japan.



Source: JICA Study Team, 2004

Figure 6.3.1 Types of Strengthening Method for Bridge Structure

1) Strengthening Method of Superstructure

(1) Falling-off Device System

Basically, the principle of strengthening is to prevent fall-off of superstructure, and there are three types of strengthening as follows:

1) Extension of seat width on pier cap

2) Control of relative displacement between girder and pier/abutment

3) Control of relative displacement between girder and adjoining girder

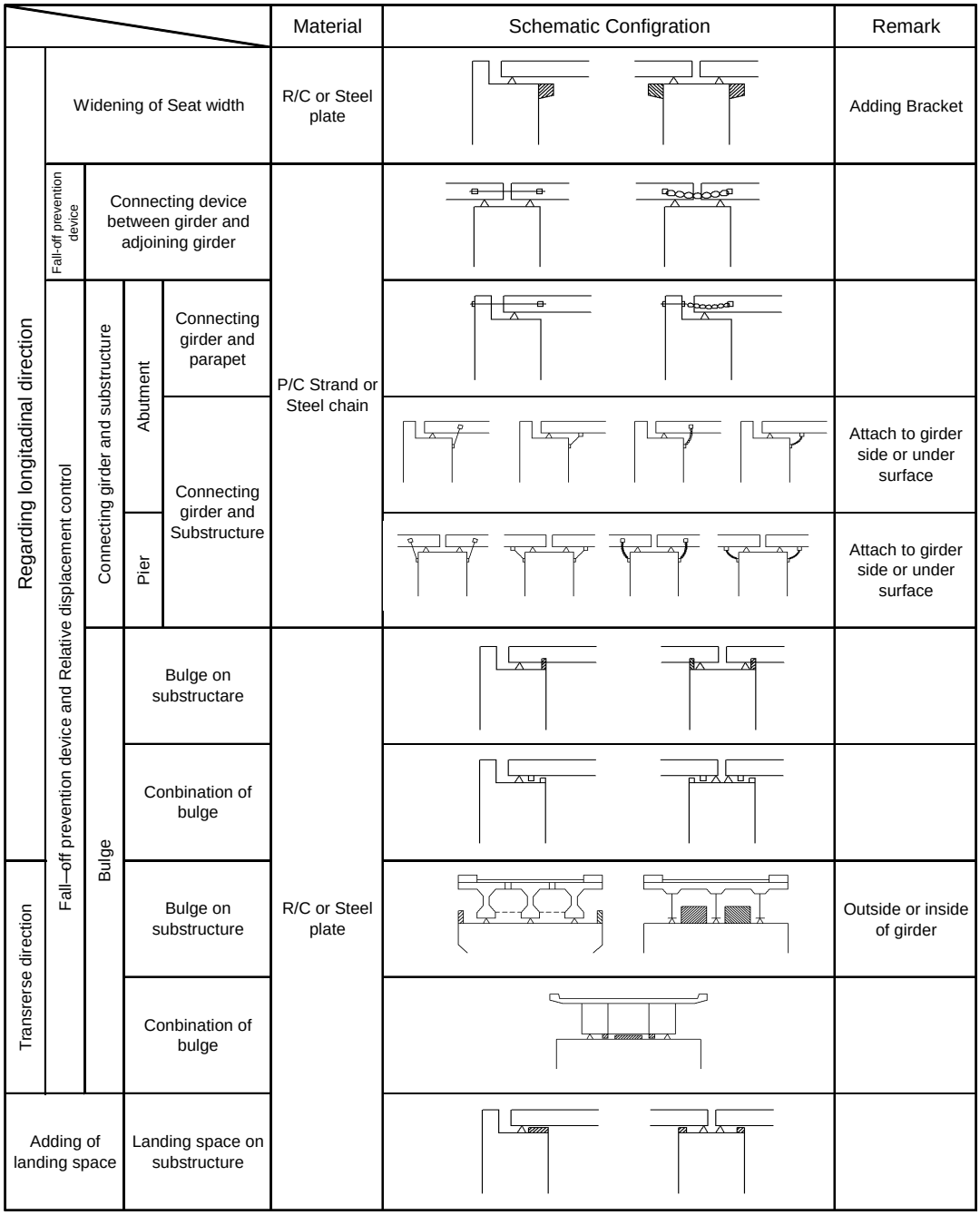
As mentioned before, the worst case of bridge damage is the falling-off of the girder. A bridge can resume emergency activities if the falling-off of the girder is prevented.

Emergency activities can be maintained by covering the void between the girder and adjoining girder with steel plate and asphalt, even if the edge of the girder was destroyed by excessive displacement under earthquake motion.

Even if serious cracks appear on the pier and the load carrying capacity is reduced, supporting the girder with saddle can give the next best solution for urgent use.

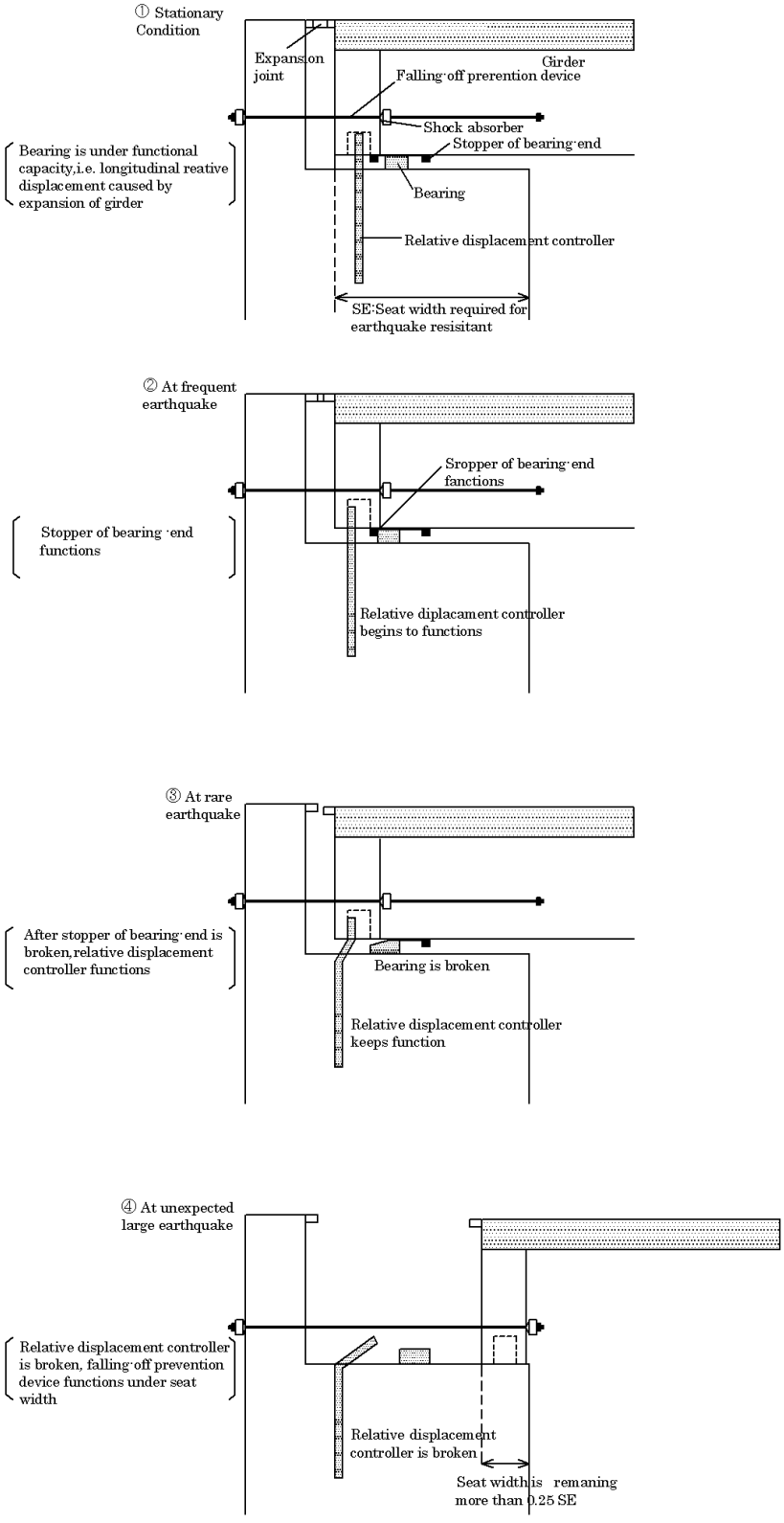
Figure 6.3.2 shows a schematic drawing of “Falling-off Prevention System” widely used in Japan.

Figure 6.3.3 explains the effect at each stage of the earthquake intensity. Figure 6.3.4 shows an example in which relative displacement between the girder and adjoining girder is controlled by damper with specially equipped viscous material.



Source: Japan Road Association, 1998

Figure 6.3.2 Typical Samples of "Falling-off Prevention System"



Source: Japan Road Association, 1998

Figure 6.3.3 Explanation of the Effect at Each Stage of the Earthquake Intensity

Figure 6.3.4 An Example of Displacement Controlling by Damper

(2) Bearing

Replacement of bearing to seismic isolation device is very much effective to control horizontal movement of girders. In Tehran, most of bearings are made of neoprene and they are effective in certain times; however, neoprene hardens in several years and it will not be effective against earthquake motion.

Figure 6.3.5 shows an example of seismic isolation device and Figure 6.3.6 shows behavior of seismic isolation device compared to the ordinary type of bearing.

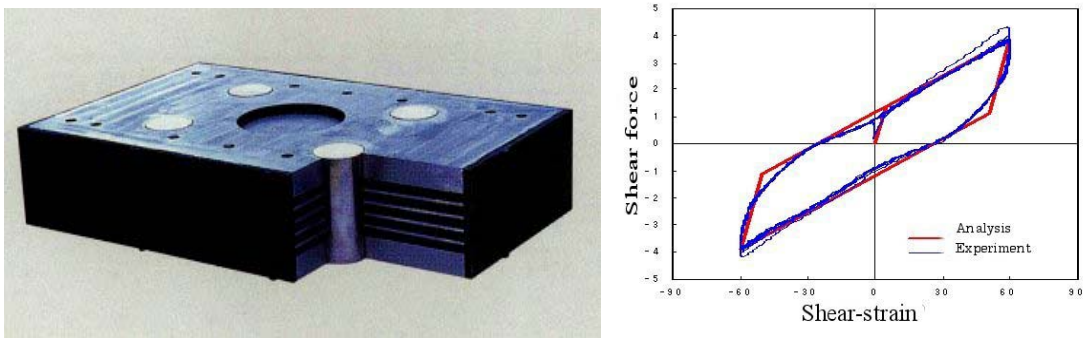


Figure 6.3.5 An Example of Seismic Isolation Device (Lead Rubber Bearing)

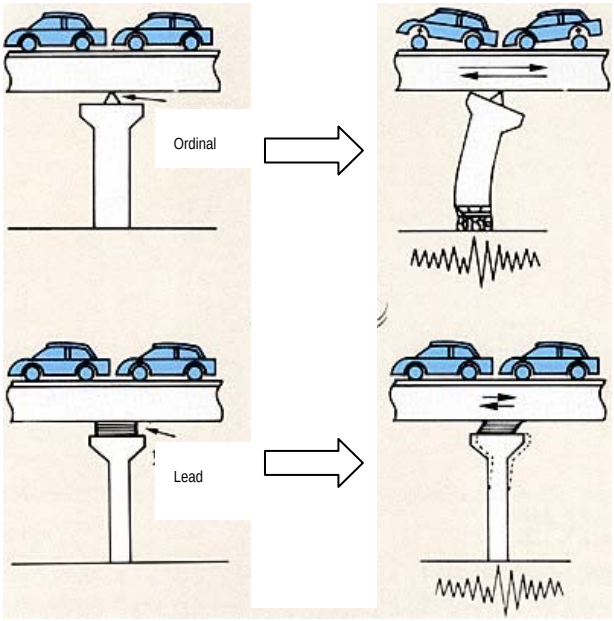


Figure 6.3.6 Behavior of Seismic Isolation Device

2) Strengthening Method of Substructure

Typical strengthening method of substructure is mostly represented by a method called "Jacketing." The system is quite simple and it is basically wrapping up the column by various materials. There are typically three types of jacketing system used in Japan as indicated in Figure 6.3.1.

Firstly, "RC Jacketing" newly allocates bars and creates an additional wall around the existing column. Secondly, "Steel Jacketing" is rendered between the existing column, placing mortar and covering with steel plate. Lastly, "Fiber Jacketing" is wrapping up with fiber string or sheet over existing column and applying a finisher on top of it. This method is very much effective to avoid buckling of columns.

Figure 6.3.7 to Figure 6.3.9 show an example of each jacketing method with sample pictures.

However, compared with the building structures, the bridge structures observed in Tehran are relatively strong except the bridges evaluated as "collapsed" or "unstable" in the previous study. Most of the bridges evaluated as "collapsed" or "unstable" are supposed to be temporary bridges, but they have been standing for a long time now without the appropriate bridge structures constructed to replace them. Those bridges must be replaced with new bridges with seismic resistant design.

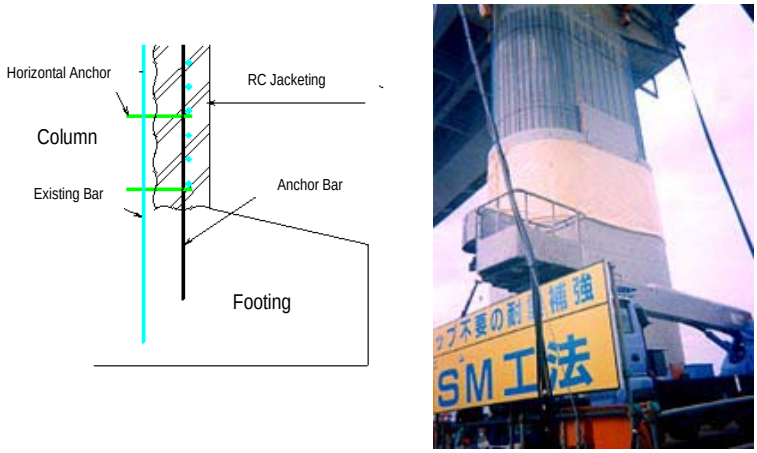


Figure 6.3.7 Example of RC Jacketing Method

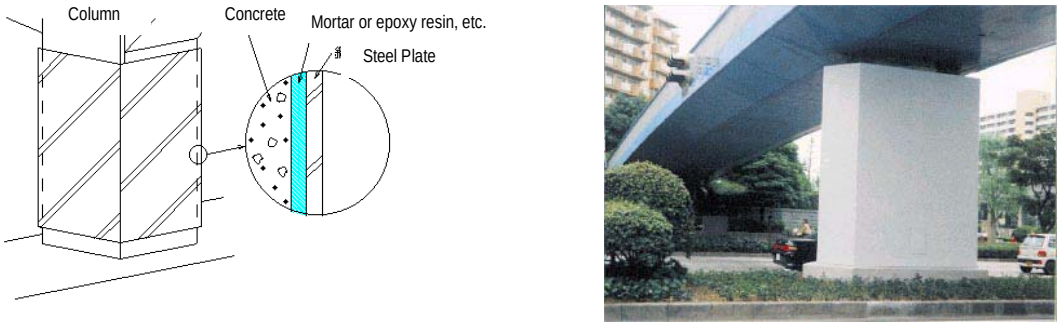


Figure 6.3.8 Example of Steel Jacketing Method

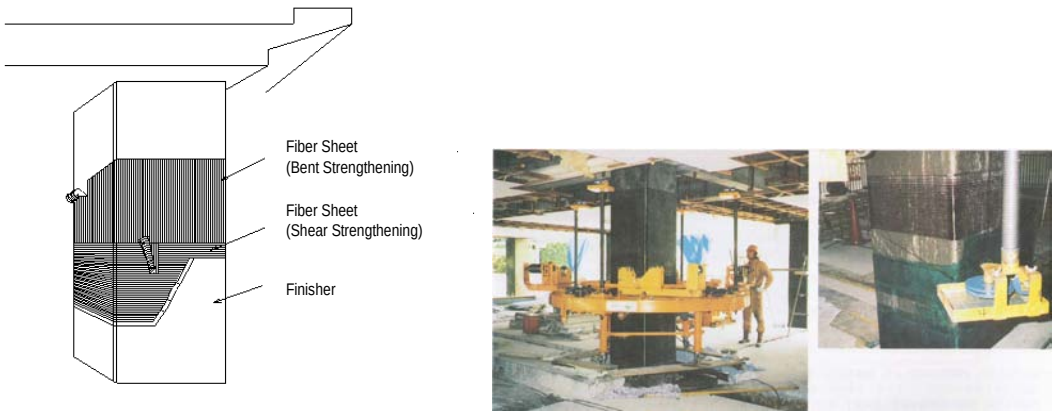


Figure 6.3.9 Example of Fiber Jacketing Method

6.4 Strengthening of Lifeline Structure

Critical infrastructure systems called “lifeline”, such as water, gas, electricity, and telecommunication, are becoming increasingly interdependent according as the digital society matures on a global scale. Consequently, the vulnerability of these stratified networks is raising major concerns worldwide. For instance, the normal operation of water and telecommunication is maintained only if there is a steady supply of electricity. On the other hand, the generation and delivery of electric power cannot be ensured without the provision of fuel, gas, and various telecommunications and computer services for data transfer and control purposes to the power plants and networks.

Lifeline is developed recently, and nowadays the system itself and supplying volume of lifeline is increasing rapidly. Actually, in the past, people did not much rely on lifeline. However, to enjoy a more convenient life, lifelines are developed. And a more complicated lifeline system creates more serious confusion. Therefore, a more centralized control system such as installation of a central control system that will manage security control at the time of disaster will help very much to prevent malfunction of lifeline supply.

6.4.1 Water Facility

Based on the result of diagnosis of facilities, if the facilities are assessed as needing any measures, it is urgently necessary to take appropriate action. And if new facilities will be constructed, it is strongly necessary to plan and construct them considering seismic resistance. Measures for seismic resistance will be indicated for the points estimated to incur damage.

1) Water Intake, Transmission Facility

Since stoppage of delivery of raw water will greatly affect purification and supply of water, seismic resistance of water intake and transmission facility must be strengthened. It is important to stabilize raw water supply. For measures for seismic resistance, alternative channels to transmission system need to be prepared, and old and malfunctioned facilities need to be upgraded or strengthened.

2) Purification Facility

The old purification plant, Purification Plant No.1, located in the central part of Tehran was constructed in 1955. This old and important facility and others like them in Tehran had been planned and constructed under supervision of foreign countries and have rather high seismic resistance. Therefore, risk of building collapse is less. However, there is risk of loss of human lives unless the chlorine facility in Purification Plants is strengthened. At present, strengthening such facilities is being considered in the future. Moreover, among the supplemental facilities such as chemical intake, which have less seismic resistance, they have to be maintained or improved at the same time of renewal of facility.

3) Distribution Facility

Regarding pipes at reservoirs and pumping stations, breakage can be a deterrent; therefore, it is necessary to maintain or improve facilities that are low in seismic resistance.

4) Pipeline to each subscriber

From the past experiences, since many damages to service pipes are expected, at the same time of distribution pipe laying, mainly along the streets, it is better to consider changing to stainless pipes which have high seismic resistance in both material and joint.

6.4.2 Gas Facility

For the countermeasures for natural gas supply system, it is fundamental to arm each facility with enough seismic resistance, and to consider the characteristics of each facility. To build a new city gate station or stations, it must be designed based on earthquake-resistant design guideline, which is essential to be finalized by relevant organization such as Ministry of Oil, and for existing facility, it is necessary to review seismic resistance of facilities and carefully consider the appropriate maintenance and management.

To install new pipelines, it is necessary to follow the guideline for earthquake-resistant design and use materials and joint type with high earthquake resistance. For existing pipes, give a priority to high and mid pressure pipes for upgrading to earthquake-resistant material, and at the same time, set up a disaster prevention system, such as preparation of emergency block shut down system, which will prevent secondary disaster.

At present, Greater Tehran Gas Company (GTGC) is undertaking a research project named “Research Project for Strengthening and Control of Tehran Gas Network against Earthquake” in cooperation with Osaka Gas Engineering Company and Power and Water Institute of Technology. This project consists of three phases: 1) Immediately executable earthquake preparedness, 2) Damage Evaluation of Tehran Gas Facilities, and 3) Planning for strengthening, control, mitigation and restoration and rehabilitation of Tehran Gas System. Continuation of this project and extension by next and new phases can be aimed at by evaluating in detail the risks of gas supplying system and strengthening and upgrading the system including installation of a Central Safety Control System, which will be extremely important to prevent unnecessary disaster caused by gas supplying system. GTGC is seriously considering damage from earthquake and is doing its best as far as possible to establish a central safety control system in the near future.

1) City Gate Stations

To construct city gate stations, it is necessary to follow relevant regulations and consider earthquake resistance measures by necessary analysis. Also, confirm if the facility has enough resistance against input earthquake motion based on relevant regulations.

Moreover, to sustain earthquake resistance capability, it is recommended to prepare a checklist, and undertake inspection and maintenance by following this checklist. And for measures against unexpected disaster, the city gate stations should be equipped with an emergency shut down valve, a fire-extinguishing facility, and/or an emergency power facility.

2) Gas Pipes

Among the network existing in Tehran, there are many old types of pipes that are less resistant to earthquake. However, in reality, it is impossible to replace all of them with high earthquake-resistant pipes. Therefore, for existing facilities, most effective measures have to be implemented as indicated afterwards, and measures such as formulation of block of pipes (Emergency Block Shut Down System) considering other facilities are to be dealt with accordingly.

(1) Newly installed pipes

For newly installed gas pipes, welding connection steel pipe, polyethylene (PE) pipe shall be used, and screw connection pipes should not be used. Anyway, the majority of PE pipe application is very effective. And for the important pipes, it is necessary to consider measures for fault crossing, landslides and liquefaction with automatic shut down system.

(2) Existing pipes

For important and more than mid-pressure pipes, the earthquake resistance shall be evaluated, and if any of them cannot fulfill the requirements, it is appropriate to replace or rehabilitate the pipes. Moreover, among the important pipes, high-pressure pipes are especially of much importance; therefore, if any pipes are buried in the area which is ready for water propagation, fault movement, landslide and high liquefaction, the necessary measures must be undertaken.

3) Riser

A riser is the extension of pipe from the ground into a consumer's building. This is the most critical points in natural gas supplying system in Tehran. Those pipes are very much effective when the building is collapsed. Therefore, vulnerability of riser is formed by buildings and damage ratio of the risers will be almost equal to those of building damage. When risers break after an earthquake, gas shut-off system is very effective. In addition, joint types used in risers are screw joints; therefore, it is at least necessary to use arc-welded joints.

Once these risers break due to building collapse, there are no sufficient measures to prevent leakage of natural gas, which will create secondary disaster. It is necessary to consider reinforcement of buildings and sufficient measures against possible breakage of risers.

6.4.3 Electricity Facility

Knowing past trend of damage to electric power facility will help to strengthen existing facility. In this section, damage characteristics caused by earthquake will be explained in each component of electric power facility.

In fact, most of damage to electricity facilities as a whole, is mainly occurred in the area with high liquefaction potential, therefore, since potential of liquefaction is quite limited to the area, damage will be limited as well. However, considering the magnitude of earthquake, strengthening of existing facilities is extremely important.

1) Power Generation

In the past earthquakes, since it is the most important facility, electrical structures strictly follow the building code. Therefore, no damage is reported except minor damages.

2) Sub Station

Damage at substation is concentrated on porcelain tube type instruments (circuit-breaker, lightening arrester, etc.). Major reason of damage is by sympathetic vibration, ground subsidence, and tension from lines.

3) Transmission line

(1) Overhead Transmission Line

Among overhead transmission lines, damage of steel towers and steel poles are not caused by seismic motion affected foundation or material, but by ground displacement such as liquefaction, which causes steel towers and poles to lean.

The leaning of towers or poles will cause electrical lines to shake and possibly cut off lines.

(2) Underground Transmission Line

Underground transmission line is safer compared to overhead transmission lines. In the past earthquakes, however, it is observed that damage is caused by ground subsidence such as liquefaction. But damage is limited to pipes and the cable itself has very limited damage reported in the recent earthquakes.

4) Distribution Facility

There are four types of damages observed in the past earthquakes: 1) destruction, breakage, or declination of poles, 2) broken or crossed lines, 3) declination of transformers on the poles,

and 4) broken lines to individual users. These damages mostly occur in the area with high liquefaction potential.

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Chapter 7
Provision of Earthquake information and Education

CHAPTER 7 PROVISION OF EARTHQUAKE INFORMATION AND EDUCATION

7.1 Present Condition

7.1.1 District Characteristics

Based on the social survey with 500 samples in Tehran, the respondents were asked to identify the major characteristics of their districts as follows. Those in the southern neighborhoods generally identified vulnerable structures, poverty, high density, low levels of literacy, young populations, and in some cases high rates of immigration and prevalence of industrial or commercial units. The central districts share some of the southern characteristics to a lesser degree but also have some of the city's cultural buildings and have a much larger population in the daytime as compared to the nighttime. The northern districts were characterized by stronger and often newer structures, higher incomes, and higher rate of literacy. The new peripheral districts are for the most part better designed and have much more open spaces. However, they lack much of the social cohesion seen in the older neighborhoods.

The major difficulties that districts faced were reported as low or mixed levels of social and cultural capital, scarcity of social, cultural and sports facilities, low income in several cases, vulnerability of structures, high population density, vulnerability against earthquake, all kinds of pollution, high levels of traffic, and existence of industrial units within residential areas.

About half of the respondents reported the existence of large open space to gather people in case of disaster. Similarly, about half of the respondents stated that such a place has been designated or at least identified. An equal number stated that this was being planned while there were also a few negative answers.

Most respondents stated that the level of social participation in general was satisfactory in their districts. Respondents have tried to include non-governmental organizations in their activities;

- By attracting them to neighborhood associations with the coordination of deputy of social affairs
- By evaluating their role and capacity
- Through defining joint projects
- Through the structure of disaster management
- Through Mahale Council (Shorayari)
- On a case by case basis
- Through exhibitions

- Through mosques and Basij
- Through cultural/community centers

Most respondents indicated the mosques officials, mahale councils, local leaders, teachers, and Basij could be instrumental in pre-crisis guidance and post-crisis operations. Some respondents stated that all active local persons should be considered. Several respondents, however, identified that their levels of cooperation with the local organizations were minimal.

Furthermore, the results of the survey find the following points.

7.1.2 Disaster Resources

The households had few extra resources that could prove useful in case of an earthquake. Very few had water resources other than those of the municipality and a great number reported no available facilities for evacuation in case of an earthquake. Parks and places of worship were considered the main evacuation possibilities followed by schools and cultural centers.

Housing loans were not very prevalent among the respondents. Even, the percentage of planning to use such loans in the future is very low. A great number of respondents thought that the lending system required improvement. In particular, they believed that housing loans should cover all or a greater percentage of the total cost of the unit. Further, a large number of surveyed households thought that interest rates should be lower while repayment periods should be longer. While no overwhelming difference in loan usage was discovered to exist between various socio-economic strata, in general low income families were more likely to have used such a facility. Indeed as housing loan amounts are rather small compared to the price of a housing unit, they are more desirable for less expensive dwellings.

7.1.3 Experience with Earthquake

A significant number of the respondents had experienced big earthquakes and the majority of them had heard stories about previous earthquakes. As an indicator of potential spirit of cooperation in disaster situations, most respondents reported some form of neighborhood cooperation during the war in the 1980s. Indeed many respondents had participated in the formation of neighborhood organizations during this period. Other activities ranged from exchange of information to provision of assistance to others in need.

7.1.4 Earthquake-Related Knowledge

While the most important source of general information for the respondents was public television followed by newspaper and radio, about half of the respondents had received no earthquake-related training or information. Very few people had heard of the JICA project related to earthquake preparedness or the information it provided. Similarly, very few respondents knew of the year of the last big earthquake in Tehran or about the National Disaster Mitigation Week in Iran. The respondents did, however, have some general

information about what to do in case of an earthquake. Overall, the higher the socioeconomic level of the respondents the more likely it was for him/her to have more knowledge about the risks.

Most respondents thought that the earthquake would occur within their lifetime; many thought that it was imminent. Also, a large percentage of the respondents thought that when the earthquake occurs, there would be widespread devastation. Around two-thirds of the respondents thought that their neighborhoods were very dangerous or relatively dangerous. Very few people thought that they would be fine after the earthquake whereas close to 4% of the respondents thought that they would either die or be injured. There was a difference between the south and the north of the city in terms of attitude toward risk. Respondents in the north had a more reasonable attitude toward risk while more of those in the south thought that God would decide their destiny. Similarly, there was more or less a relationship between socio-economic level and risk attitudes.

The majority of respondents stated that they were either completely or to some extent ready for the earthquake. However, the number of respondents who state that they had talked about earthquake preparedness and mitigation at home or in the office was generally low. Similarly, preparation for earthquake at home or in the office was limited according to the respondents' statements, and a small percentage had insurance against earthquake. While level of food storage was reasonable, water storage was minimal among the respondents. It seems that the medium and high socioeconomic categories generally have high storage levels. However, there was little difference across socioeconomic categories in terms of overall preparedness.

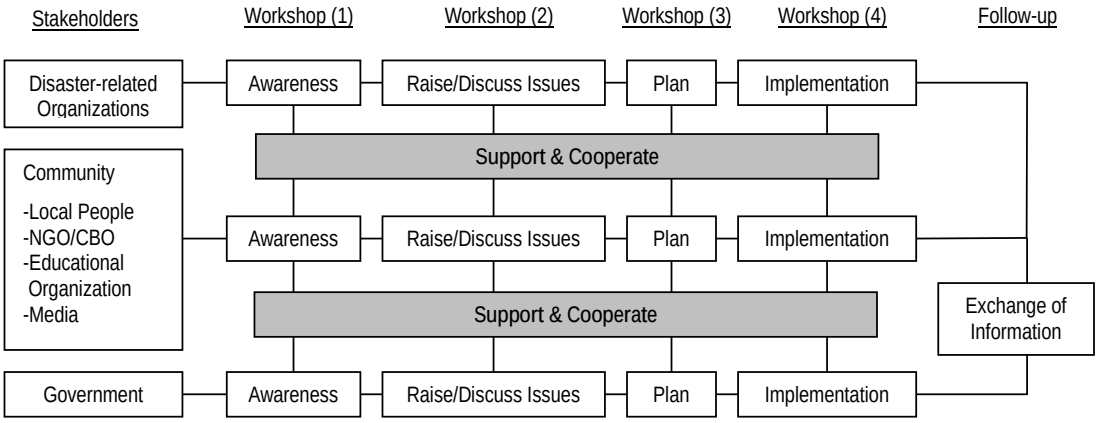
7.1.5 Social Organizations

A general scarcity of local groups was found by the survey. Of the few local groups that the respondents reported, most were either religious or sports-related. This said, most organizations were reported to meet more or less regularly and also hold festivals. Overall, southern districts were more likely to have locally organized groups as well as festivals than northern districts. In line with these findings, social bonds were found to be stronger in the southern districts of Tehran and in the lower socioeconomic strata.

7.1.6 Follow-up of the Workshop

Various workshops organized can show that there are different approaches to the different communities for disaster preparedness and a flow to strengthen the capacity of local disaster preparedness. The flow is staged from creation of awareness of disaster preparedness among the different community members, raising and consideration of the issues and solutions for disaster preparedness, preparation of their own plans for disaster preparedness, implementation of them to exchange of information and performances for further development of their activities and capacities. Because of the complicated structure in Tehran society and

limitation of time and budget of JICA Study Team, target communities during the study were very selective based on the previous survey. In spite of the fact that the workshop approaches were just provided as examples, the impacts are likely to be large on the local community. Communities in collaboration with local governments and disaster-related organizations should make efforts to continue this activity. The flow can produce a multiple effect on the different communities and spread all over the whole Tehran little by little.



Source: JICA Study Team

Figure 7.1.1 Workshop Flow with Involved Stakeholders

7.2 Education for Disaster Preparedness

7.2.1 Objectives of the Plan

In order to prepare for an earthquake and mitigate the damages from an earthquake, this plan is established to increase the knowledge of disaster management, to implement drills to the local government staff and related organizations, to disseminate the knowledge of disaster preparedness to local residents in various occasions and to try to increase their awareness and self-preparedness continuously.

7.2.2 Education for Government Staff at Tehran Municipality and District Levels

For developing the appropriate judgment to be used in case of an earthquake and taking emergency activities smoothly, the staff of local government and disaster-related organizations will be given disaster education thoroughly. Also, necessary knowledge and preparation as local government staff will be given so that they can actively promote measures to reduce risks from disasters during the performance of their administrative work and be able to initiate the implementation of the disaster preparedness activities in the covered area.

1) Disaster Education for Staff in Tehran Municipality and District Offices

The personnel working at Tehran Municipality, district and sub-district levels are required to develop their knowledge and appropriate judgment related to disaster preparedness.

Tehran Municipality will inform the staff of each deputy office about contents of National Emergency Response Plan, roles and activities for disaster preparedness and emergency responses of individual staff in their duties. Also, disaster-related staff will participate in the trainings and seminars provided by national government and the RCS, TDMMC, and sometimes in collaboration with disaster-related organizations and should become proficient in the field.

District offices will inform the personnel of each deputy office about Tehran Comprehensive Emergency Management Plan, roles and activities for individual staff in their duties. The disaster-related staff will participate in the training courses and seminars provided by municipal government and will also try to organize the training courses and seminars in collaboration with RCS and TDMMC.

The following items will be included as necessary information.

- Basic knowledge of earthquake;
- Prediction of earthquake breakout in Tehran;
- Results of the estimated damages and vulnerability of earthquake in Tehran;
- Plan, laws and regulations related to earthquake in Tehran;
- Responsibilities of local government staff in case of earthquake (system of mobilization and tasks of staff), and
- Countermeasure of earthquake at home and measures for developing and strengthening community-based groups for disaster preparedness.

Furthermore, to improve the skills of disaster preparedness and emergency responses for the staff of municipal and district offices, they will be encouraged to participate in drills. It is also necessary that the government staff in charge of disaster management will visit to observe the disaster-related facilities and groups to be cooperated with in emergency case and their activities such as Red Crescent Society, fire brigades and community groups as well as vulnerable/hazardous areas/facilities. It is preferable to carry out field survey on disaster resources and dangers to develop appropriate judgment activities in case of emergency.

2) Disaster Education for Disaster-related Organizations

The disaster-related organizations and companies including fields of transportation, telecommunication, electricity, gas, water supply, etc. will be provided with disaster education based on the plan regarding disaster preparedness drawn up by each organization. Also, the

staff will participate in the drills and training courses provided by Municipality and district offices with support of the RCS, Fire Brigade Department and TDMMC.

The staff of the disaster-related organizations will try to master the following matters through their duties and lecturers, seminars, field visits and surveys, distributed publications, etc.

- Causes of disaster outbreak;
- System and structure of disaster preparedness and duties and functions to be managed by each organization;
- Plan of staff responsibilities in case of emergency;
- System of coordination and communication with and roles of related organizations; and
- The past disasters and issues for emergency responses, etc.

7.2.3 Education for School Students

It is important that students understand the dangers that could arise in case of earthquake and take safe actions according to the development level of students. For this purpose, Deputy of Education and Training and Deputy of Health from national to district levels will guide students to understand well emergency responses through total schooling such as school curriculum, school events and extracurricular activities.

Tehran Municipality and district offices will provide education out of regard for the following:

- To consider the contents of guidance and approaches based on the development levels of students, types of schools and location of schools, etc.;
- To utilize the educational materials such as supplementary readers and audio-visual aids in accordance with students' development levels; and
- To instruct "importance of life," "ties of family," "mutual cooperation," etc. through implementation of learning by experiences of natural life, welfare and voluntary activities, etc.

The Ministry of Education, Deputy of Education in Tehran Municipality and the International Institute of Earthquake Engineering and Seismology (IIEES) will manage and control the following items in order to promote disaster education in schools and other educational facilities:

1. The following issues will be discussed for the solutions by organizing a committee of promotion and coordination of disaster education.

- Coordination and solution of issues regarding preparation of plan of school disaster management
- Methods for effective implementation of drills for disaster preparedness in collaboration with neighboring area
- Coordination and solution of issues in implementation of new disaster education

2. In order to increase the ability of teaching and guiding of educational staff, appropriate training courses, seminars and drills will be developed.

- Organizing of training courses and seminars for general educational staff regarding the basic knowledge of disaster and evacuation activities
- School principals will provide inter-school training and seminars regarding task of each school staff, regular check of disaster related facilities and emergency responses, etc.
- Training courses for developing instructors to promote disaster education

3. Each school will try to develop the system of school disaster management based on the "plan of school disaster management" including the following items.

- Development of disaster management system in schools
  - Basic knowledge of earthquake and measures to be taken in case of earthquake will be instructed through curriculum, in-class activities, extracurricular activities, school events and other educational activities
  - Establishment of quick response system in case of emergency
  - Formation of "Manual for Emergency Responses" for each school
- Fulfillment of disaster education
  - Systematic and scheduled guidance based on the annual teaching plan
  - Development of disaster know-how by devising drills for disaster preparedness (evacuation)
  - Development of the concept of self-help, mutual cooperation, and public assistance
  - Utilization of supplementary books for disaster education
- Promotion of voluntary education
  - Provision of opportunities for learning ideas and concept of volunteering
  - Promotion of participation in the local voluntary activities
- Model schools for disaster preparedness will be selected to experiment various countermeasures in schools
- Training of first aid will be provided to the students to acquire the practical techniques in case of emergency

7.2.4 Education for the General Public

If a large-scale earthquake were to occur, government would become inundated with many calls for help and it would be difficult for the government to deal with all the emergencies. People's living patterns differ and nobody knows where they will be when an earthquake hits. They might be working, studying, involved in social activities, or be at home. Therefore, the local residents should protect themselves and act on their own judgment. Tehran Municipality and district offices, with Deputy of Education and Deputy of Social Affairs as leaders in collaboration with IIEES and TDMMC, will enlighten the local residents on the correct knowledge of earthquake and measures for disaster through drills, trainings and other

enlightening activities. Especially, during the week of disaster mitigation in October, there will be intensive enlightenment sessions on responses in case of a sudden strong earthquake and countermeasures to take at individual homes.

1) General Enlightenment

(1) Contents of the Enlightenment

As knowledge of daily preparation for earthquake and what to do in case of an earthquake, enlightenment will focus on the following items:

- Measures of disaster preparedness regulated by Tehran Municipality and district offices
- Basic knowledge of earthquake and the past earthquake in Iran
- Preparation before occurrence of earthquake and necessary items after occurrence of earthquake

Table 7.2.1 Components of the Enlightenment

Before Earthquake	After Earthquake
- Diagnosis of earthquake resistance of houses, measures to prevent furniture from toppling over (fixing furniture), retrofitting and earthquake-proof renovation, prevention of brick walls falling down, protection against glasses flying, breaking into pieces, etc. - Awareness of vulnerable area in Tehran - Securing of the communication system among the family members - Ways of acquiring information on the disaster - Prevention of fire - Getting first aid - How to evacuate - Preparation of hand-carried items for emergency such as food, water, personal belongings, etc. - Storage of food and drinking water for 3 days - Participation in the voluntary activities including community-based groups for self disaster preparedness - Importance of self disaster prevention activities in community and workplaces, and cooperative efforts among them	- Road transportation regulation and driving behavior - Activities with understanding of the possible hazardous area in case of earthquake - Temporary shelters and evacuation routes - Rescue/relief and first aid - Protection against fire and fire extinguishing - Understanding of the damages around the house and community - Collecting information by Internet, TV and radio - Activities in temporary shelters and evacuation site

Source: JICA Study Team

(2) Measures and Approaches for Enlightenment

Tehran Municipality and district offices will disseminate knowledge of disaster preparedness through the following media:

- Internet, radio, TV, etc.
- Newspaper, pamphlets, leaflets, and other printed matter
- Competitions for slogans, pictures and compositions, etc.
- Town PR magazines, handbills, newsletters, etc.
- Movies, videos and slides

- Utilization of the occasions of commemoration and religious and cultural events and activities including day of disaster mitigation and week of disaster mitigation
- The places where many local people get together such as cultural centers, sports centers, health centers, mosques, etc. should be considered for their utilization as much as possible.

2) Social Education

Knowledge of earthquake will be disseminated and further enlightened through various seminars and trainings targeting some groups (NGOs and CBOs) such as women's groups, environmental groups, youth association and PTA (Parents and Teachers Association), so that local residents can become conscious of their part as responsible members of society and increase awareness of their contribution to local disaster preparedness.

(1) Contents of the Enlightenment

The contents will follow the local residents' enlightenment described above. And considering the characteristics and usual activities of each group, suitable items will be added.

(2) Measures and Approaches for Enlightenment

- On the occasions of various courses, classes, meetings, conferences, workshops, and seminars to be organized by groups, the enlightenment activities will be done.
- By organizing training courses, seminars, providing information and renting movie films, etc., various groups will be educated on concept of disaster preparedness. Through this activity, the disaster knowledge in the organization as members of each group will be promoted.

(3) Education for Drivers

Considering the increasing number of cars and the present driving behavior in Tehran, the traffic conditions in case of emergency is expected to be chaotic. What the drivers have to do in case of a disaster will be instructed thoroughly on occasions of driving license renewal, attendance in driving school classes and at police offices and via mass media.

(4) Education for Managerial Staff of Facilities in Need of Disaster Management

Managers of facilities dealing with hazardous materials and with many and unspecified persons going in and out, such as hospitals and welfare facilities, large-scale dealers, recreational facilities and bazaars, will be educated for knowledge of actions to be taken in case of emergency through guidance of formulation of emergency response plan. Also, the disaster-related organizations such as companies of electricity, gas, telecommunication, and transportation will carry out PR activities to encourage local residents to do their part in case of an emergency.

(5) Consulting Office

Tehran Municipality and district offices will give advice actively to the local residents on the concerned issues categorizing general issues, and matters related to constructions and structures.

7.2.5 Education for the Disaster Weak

In order to secure the safety of the disaster weak such as the elderly and bedridden, the handicapped, retarded, the injured and sick persons, foreigners, infants and children, the dissemination of knowledge of disaster preparedness by distributing pamphlets and leaflets, PR magazines, newsletters, etc., will be done. Tehran Municipality and district offices, especially, Deputies of Education, Social Affairs, Health, etc, will establish the policy for social welfare facilities and develop the system of rescues and relief in collaboration with the local residents and the related organizations. The contents are:

- Dissemination and enlightenment of disaster knowledge
- Development of emergency reporting system
- Cooperation with social welfare facilities and local community
- Drills for disaster management

Chapter 8
Establishment of Disaster Mitigation Policy

CHAPTER 8 ESTABLISHMENT OF DISASTER MITIGATION POLICY

8.1 Insurance

8.1.1 Insurance System Profile

The main legal and regulatory frameworks for the insurance system prevailing in I.R.I. are reflected in Code No. 25/3 regulating insurance coverage tariffs[1] and Articles 55 to 57 of the April 2003 Council of Ministers' decision adopting the "Rescue & Relief Comprehensive Plan"[2]. Code No.25/3 as it refers to earthquake risk insurance in the context of fire insurance policies is based on a risk assessment zoning of Iran using a scale from 1 to 5 ("1" meaning relatively lowest and "5" meaning relatively highest) and five categories of the type of building structure and building materials as summarized in Table 8.1.1. The risk assessment in use by the Iranian insurance sector, which is accepted by international re-insurers, covers province by province and township by township. All townships in Tehran Province, including Tehran proper, fall in the highest risk "Zone 5".

Table 8.1.1 Earthquake Risk Assessment Zoning in I.R.I.

(Unit: Per mill)

Item	Type of Structure / Material	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
1	Clay (old / traditional)	1.0	1.1	1.2	1.5	1.8
2	Brick	0.8	0.9	1.0	1.4	1.6
3	Steel structure	0.6	0.7	0.8	1.1	1.4
4	Concrete	0.4	0.5	0.6	0.8	1.0
5	With design, calculated and construction based on Code 2800 (related to earthquake)	0.2	0.3	0.4	0.6	0.8

Source: Central insurance in Iran

The key element of the Council of Ministers' decision is the requirement for the municipalities' organization to establish an accident insurance fund that would enhance the municipalities' financial ability to address damages caused, *inter alia*, by earthquakes. The internal debate and process of establishing a comprehensive disaster-related insurance system is still on-going. Therefore, it must suffice in this context to introduce the main characteristics of the prevailing insurance system, to highlight policy issues and to introduce some principal options for a comprehensive system derived from a cross-country perspective.

[1] Decision 1373/3/24 of 1994 of the High Council of Insurance regulates the minimum insurance coverage rate by class of vulnerability and type of building.
[2] The details have been introduced and discussed in previous reports and do not need to be repeated here.

The Iranian insurance market is controlled by Iran Central Insurance Co., which is affiliated to the Ministry of Economic Affairs and Finance and is some sort of supervisory body that controls the insurance market and functions as a domestic re-insurer. Since the middle of 2002, some seven private insurance companies have emerged as a result of the privatization policy of the central government.

The insurance sector operates at present along the following main characteristics:

- The system comprises over 10 different types of insurance coverage that are divided into two major categories, namely "life" directly related to human life insurance types[3] and, "non-life" related to insurance[4] types.
- There are, at present, various insurance types that allow indirectly insurance against life and property damage caused by a natural disaster and/or earthquake. The standard life insurance policy covers death caused by most reasons, including natural accidents, such as earthquakes.
- A standard personal accident insurance covers natural calamities, such as floods, storms, lightning, but not personal accidents caused by earthquakes.
- Engineering insurance policies, such as Erection all Risks (EAR), Contractors all Risks (CAR) and other risk policies, include damage caused by earthquakes.
- The normal fire insurance will address fires, explosion and lightning damage, but it normally does not cover fire caused by a natural disaster/ earthquake. However, it is possible to add to the personal accident and fire insurance policies on a voluntary basis damage coverage caused by earthquake. The additional premium to be paid in personal accident insurance is 0.9 per mill and for fire caused by earthquake as categorized and indicated in Table 8.1.1 above
- The current regulatory framework does not permit Iranians to directly conclude life and non-life related insurance policies including earthquake policies outside of I.R.I.
- In fact, the law requires insurance companies to compulsory re-insure with the Iran Central Insurance Co. for 25% of their non-life and 50% of their life insurance portfolios. Hence, in principle insurance companies shoulder the risk for 75% of their non-life and 50% of their life insurance portfolios.
- Existing regulation permits on a voluntary basis that insurance companies hedge their risk by either re-insuring the stated balances of 75% and 25% of their portfolios on the international re-insurance market and/or up to 30% with the Iran Central Insurance Co.

[3] Personal accident, life and health insurance.
[4] Covers, *inter alia*, fire, engineering, marine (cargo and hull), automobile and automobile third party and liability insurance.

- The minimum capital base requirement for an insurance company is currently Rials 140 billion, roughly equivalent to US$ 16.47 million at an exchange rate of Rials 8,500 to one US dollar.
- Existing law permits issuing insurance coverage without re-insurance of up to 20% of the company's capital base in case of the minimum capital requirement example above that would amount to US$ 3.3 million. The value of the insurance portfolio exceeding the 20% must be re-insured, either domestically and/or internationally.

Insurance sector have not been made available time-series data. Therefore, it is difficult to provide a clear picture of the actual structure and performance of the Iranian insurance market, including future performance potentials and constraints. Selective data received during personal interviews with insurers allow to highlight the following somewhat sketchy features:

- It appears that even the Government is lax in insuring its own assets. For example, insuring the oil and petroleum facilities started only five years ago, and only now all old and new petrochemical plants are covered by "all risk" insurance. However, power plants and airports are still not insured against damage caused by natural hazards.
- In general, there persists a strong "awareness gap" about the need for having insurance coverage in spite of the fact that Iran is a disaster-prone country.
- Receipt of insurance fees from all types of insurance increased over the two-year period 1999 to 2000 from about Rials 3,003 billion, roughly equivalent to US$ 353 million, to Rials 4,063 billion, about US$ 478, in Table 8.1.2, reflecting a very robust growth of 35% over a one-year period.
- Revenues in the year 2000 were carried to over 85% by non-life related insurance fees, which in turn were carried in that order of ranking by insurance for medical treatment, 14% of all non-life insurance revenues and 12% of all insurance revenues, fire insurance, 13% of all non-life and 11% of all insurance revenues, and automotive insurance, 13% of all non-life and about 11% of all insurance revenues.
- As a result of the awareness problem in combination with the Government's laxity in putting into place and enforcing a comprehensive disaster (earthquake) insurance policy, the public and private asset base is likely to be heavily under covered with the easy to imagine catastrophic economic and social results should a major event/earthquake occur.

Table 8.1.2 Revenues and Losses of Iranian Insurance Sector, 1999 and 2000

Field	Insurance Fee							Loss							Loss Ratio		
	Issued				Reserve of End of the Year	Reserve of beginning of the Year	Acquired	Paid			Market Share	Delayed of End of the Year	Delayed of Beginning of the Year	Materialized	1999 (%)	2000 (%)	Change (unit)
	1999	2000	Rate of Growth (%)	Market Share				1999	2000	Rate of Growth (%)							
Fire *	396.7	449.6	13.33	11.06	179.8	158.7	428.4	73.7	75.9	2.96	3.09	38.5	37	77.4	19.96	18.08	-1.88
Transportation *	277.1	363.8	31.32	8.95	145.5	110.8	329.1	25.1	40.3	60.16	1.4	96.5	78.9	57.8	11.41	17.57	6.17
Accidents *	106.7	151.8	42.24	3.74	60.7	42.7	133.8	56.7	73.6	29.79	3	18.8	17	75.4	50.7	56.37	5.67
Passengers' Accident	153.1	210.5	37.48	5.18	84.2	61.2	187.5	59.6	87.8	47.27	3.58	24.4	31.9	80.3	47.86	42.83	-5.03
Automobile Insurance *	279.9	434.9	55.36	10.7	195.7	126	365/1	137.6	190.8	38.63	7.78	31.7	20.8	201.7	55.26	55.24	-0.02
Third party	894.6	1091	21.95	26.85	490.9	402.6	1002.6	868.1	1155.6	33.12	47.09	232	195.5	1192.1	120.25	118.9	-1.35
Medical Treatment	413.4	497.2	20.29	12.24	198.9	165.3	463.7	310	450.6	45.36	18.36	29	47.9	431.6	102.65	93.09	-9.56
Ship Insurance	12.9	16.8	29.87	0.41	6.7	5.2	15.2	9.6	9.2	-3.74	0.37	11.8	13.3	7.6	48.46	50.05	1.59
Aircraft	25	38.2	52.6	0.94	15.3	10	32.9	9.1	35.1	285.29	1.43	23	50	8.2	149.45	24.92	-124.52
Engineering *	48.5	64.9	33.93	1.6	26	19.4	58.3	6.7	6.1	-9.46	0.25	35.9	20.5	21.5	30.96	36.85	5.89
Monetary *	2.8	3.9	41.26	0.1	1.6	1.1	3.5	1.8	0.6	-65.66	0.03	2.1	0.7	2.1	51.94	59.2	7.26
Responsibility	68.4	117.1	71.19	2.88	46.8	27.4	97.6	20.8	34	63.02	1.38	32.5	23	43.5	45.11	44.59	-0.51
Other Types	16.1	22.6	40.35	0.55	9	6.4	20	-0.9	10.2	1224.72	0.42	12.8	12.1	10.9	3.9	54.58	50.69
Sub-Total Non-life	2695.1	3462.2	28.46	85.21	1461.2	1136.7	3137.8	1578.1	2169.9	37.5	88.43	589	548.6	2210.3	72.61	70.44	-2.17
Life	307.4	601.2	95.56	14.79	371.7	168.3	397.8	169.5	283.9	67.52	11.57	48.6	55.9	276.6	81.12	69.52	-11.6
Total	3002.5	4063.4	35.33	100	1832.8	1305	3535.6	1747.6	2453.8	40.41	100	637.5	604.5	2486.8	73.39	70.34	-3.06

* Due to revenue of nationalized insurance companies, the figures of delayed loss of beginning of end of the year in these fields are more than revenue of existing insurance companies.

Source: Iran Central Insurance Co.

8.1.2 Selected Policy Issues

1) Policy Weaknesses

Privatization of the insurance sector, which has resulted in an increase in the number of Iranian insurance companies operating in the market, is a first step in the right direction. However, further policy review and reform toward deregulation is needed, if the vast potential of the Iranian insurance market is to be harvested. Key consideration in this context should be as follows:

- It is the primary responsibility of the Government to promote and motivate insurance coverage for natural disasters, including earthquakes. The Government does not even insure its own assets, including cultural assets of the country. This sends the wrong signal to society. Hence, the Government should propose a bill to the Majlis that makes it compulsory to insure all movable and non-movable assets against natural disaster.
- The current policy should be reviewed and amended toward liberalization and deregulation, i.e. the central function of the Iran Central Insurance Co. should be reviewed with a view to turn this entity into a regulatory body concerned only with the financial supervision and control of the actors in the insurance sector. The present policy of "regulating" insurance premiums, though the calculation mechanism may be based on accepted international standards, limits the competitive forces within the insurance sector thereby restricting growth performance and absolute market size of the insurance

sector itself. At present, since premium rates are determined "across-the-board" by the Iran Central Insurance Co., other actors in the insurance sector can not use rebates, discounts and any other price mechanism to improve their competitive position within the market, thereby limiting their capacity to broaden their client base.

- And more importantly, a very close look needs to be taken as to whether making insurance against damage arising from natural disasters/earthquakes compulsory or voluntary and whether to introduce a "ceiling system" as is the case in Japan, where property assets can be insured toward a certain maximum ceiling only, regardless of the actual market value of the property, or an "open system" that would allow to insure up to market value minus depreciation or replacement cost and so on.
- The suggested policy review for the introduction of a natural disaster related insurance system should be systematic and comprehensive. The review should be based on a thorough assessment of the existing and potential insurance market covering natural disasters.

2) Selected Policy Principals to be Incorporated into Policy Review

It would not be prudent to make detailed recommendations in the absence of the thorough assessment and evaluation of the sector as indicated above. However, notwithstanding this fact, some general principles that are derived from experience in other disaster-prone countries may suffice to make the point. These principals are introduced and discussed below.

(1) Minimum capital requirements

The absolute size and time frame for phasing in should be reviewed with a view to ensure that sufficient capital for operations and claim settlement is maintained, in particular in case of a major natural disaster/earthquake event.

(2) Solvency margin regulations

This should be reviewed under the same terms as indicated above.

Exchange controls, if any. This should be reviewed and determined in line with World Trade Organization (WTO) standards.

(3) Reserve requirements

The adequacy of the existing ratios should be considered critically (though, again, existing ratios may follow, in particular, European standards accepted by foreign re-insurers). This issue is to be considered in close connection with tax and tax deductibility issues, since operating margins determine an entity's capacity to set up specific reserve provisions for catastrophe perils before a catastrophic event.

(4) General Regulatory Improvements and Mitigation of Financial Risks

The core concern is that the hazard to be mitigated may turn, in case of an event, into a liquidity crunch with a likely run on the insurance system. In general, the establishment of a strong and effective insurance regulation should therefore include: minimum capitalization requirements for carriers and also brokers; solvency & liquidity levels and adequacy rules for technical reserves; adequate asset/liability management (including maturity and currency matching where applicable), as well as reinsurance credit risk; incentives and requirements, including tax concessions, to build up catastrophe reserve funds up to a minimum required level; minimum standards for non-ceded retention of local coverage; accurate verification and valuation of companies' balance sheets to ensure adequate financial capacity to cover claims; allowances for overseas investments of insurance assets; industry entry requirements including admission of suitable foreign competitors; linkage of insurance regulation to building code compliance prior to providing insurance coverage, or to discounts based on vulnerability reduction measures; proper monitoring and inspection techniques; conditions for revoking licenses and shutting down operations; and consolidated regional and institutional harmonization of regulators and supervisors.

3) Transferring Catastrophic Risks

There are many examples of countries, such as Japan, the United States, New Zealand, France, Spain, the Caribbean and Latin American countries, that have in place a disaster insurance scheme in one form or another. Although there is no need to discuss the different systems in detail, it may be helpful for further consideration by the authorities to introduce the principles for transferring catastrophic risk to capital markets and catastrophe insurance pools.

(1) Catastrophe Bonds

Catastrophe bonds are high yield bonds that will default on all or part of principal and interest, if a catastrophic event occurs during the life span of the bond. The yield in the case of I.R.I. may have to be above the "participation papers" (PP) currently issued by Iran's Central Bank to absorb liquidity from the economy. Such funds are normally invested in risk free instruments. The approach in the capital market has been to create a reinsurance contract between the ceding insurer and a special purpose vehicle (SPV), which then guarantees the contract on the market. Catastrophe bonds are issued to investors, and as a separate transaction, reinsurance is sold to interested insurers, who can then take advantage of the more favorable regulatory accounting treatment. The insured party is not subject to any reinsurer "credit risk," as the insurance coverage is fully collateralized.

(2) Contingent Surplus Notes

In principal, these financial notes are "put" rights that allow the insured party to issue debt to pre-specified buyers in case of a catastrophic event. These notes are in character a risk financing (versus a risk transfer) tool. The issuance of notes can be done in exchange for cash or liquid assets, which are received from the investor. The liquid securities are kept in a trust fund, which, in the event of a disaster, is exchanged for the surplus debt notes issued by the insurer to finance catastrophe loss claims.

(3) Catastrophe Equity Puts

Equity puts are a form of option which, for a pre-paid fee, permit the insurer to sell equity shares on demand to investors as a means of funding claims resulting from a disaster. This instrument, as in the case of contingent surplus notes, is a risk financing instrument that does not actually perform the function of risk transfer, though they provide immediate liquidity.

(4) Catastrophe Swaps

In a catastrophe swap arrangement, an insurance portfolio with potential payment liabilities is swapped for a security and its associated cash flows. An insurer will accept the obligation to pay an investor periodic payments on a specified security or portfolio of securities which the investor was liable for, while conversely the investor would take on the potential liabilities under an insured portfolio. In other words, the investor will make payments for catastrophe losses based on agreed measures of magnitude or severity (catastrophe loss index). For the insurer, payments made on the investors' securities are the equivalent to a reinsurance premium.

4) The Turkish Catastrophe Insurance Pool (TCIP)

The devastating Marmara earthquake in Turkey claimed over 18,000 lives and resulted in multi-billion US$damages for the Turkish economy. In response to this experience, the Turkish government launched in collaboration with a major international financing institution the Turkish Catastrophe Insurance Pool (TCIP) in September 2000. The TCIP is modeled after the California Earthquake Authority and New Zealand Earthquake Commission programs, which provide similar earthquake coverage for homeowners and which rely mainly on international reinsurance and capital markets for their risk capital capacity.

The TCIP was set up in fulfillment of a government decree as a separate state-owned legal entity with its own Board and management to provide compulsory earthquake insurance to all registered residential dwellings in Turkey. So far, over 1.8 million earthquake insurance policies have been issued. The pool provides coverage of up to US$ 25,000 for each dwelling for a premium that varies across the country depending on seismicity, local soil conditions, and

the type and quality of construction. The TCIP's Board comprises representatives from the Government, the private sector and academia.

All employees of the TCIP come from the private insurance sector under sub-contract. Local insurance companies act as distributors of TCIP policies. Coverage in access of the TCIP coverage can be obtained on a voluntary basis from private insurance providers.

8.2 Promotion of Private Building Strengthening

8.2.1 Governmental Assistance for Building Strengthening

The most critical issue in mitigating earthquake damage is to promote the building strengthening of private buildings in Tehran. To increase the seismic resistance of each private building contributes directly to decrease human loss and save efforts and cost of emergency response in the event. Strengthening of private buildings is rather difficult than that of public buildings, since it depends on a willingness of each building owner. Governmental assistance to promote building strengthening by giving an incentive for building owners is essential.

It takes a vast amount of capital investment cost for the promotion of private building strengthening. This amount shall be covered by earthquake disaster related fund, which can be created by use of revenue of Tehran Municipality, interest from return back by loan program and taxing on privatized insurance companies. Sustainability and public consensus are the key factors for the selection of policy for the assistance in promoting private building strengthening. Nonetheless, government should take a drastic action for providing an incentive for the public, considering the huge amount of saving cost for rehabilitation and reconstruction after the event.

The government and Municipality shall allot a certain part of revenue every year for creating and managing the earthquake disaster related fund. In addition, it is recommended that the government insure all the public buildings that would be strengthened. As to the private buildings, utilization of insurance should be promoted among the public. Insurance itself does not have a direct incentive mechanism to promote private building owners to strengthen their building before the occurrence of an earthquake. However, it is possible that lightening the premium burden for seismic resistant building would be effective to motivate building owners to spontaneously strengthen their buildings. It is also rational that government shall levy a tax on insured amount of insurance companies. The revenue from this taxation shall be utilized for earthquake disaster related fund.

8.2.2 Governmental Assistance Policy Options

1) Policy Options

It is reasonable that a various means of managing earthquake disaster related fund shall be provided to private building owners, considering the availability of and willingness for governmental policies. Three political measures to assist in promoting private building strengthening can be considered; low-rate loan, subsidy and insurance. Each of those policy or options by mixture can be applied case by case. The advantages of each policy are described below.

(1) Low-Rate Loan

This policy option is targeting citizens in middle to high class of society that have a consciousness of strengthening their own building. The government is able to manage the policy implementation and operation of this policy with low risk.

(2) Subsidy

This option is a favorable option for relatively poorer citizens, who can not afford to spend for the structural improvement of their own building. As explained later in this section, the difficulty in promoting the strengthening of the private building is due to the monetary constraint for the majority of citizens, in particular, for the citizens residing in the south part of Tehran. This option has an incentive to conduct a building diagnosis, hence raising the awareness of the importance of seismic resistant building. Such a direct financial support of the government has a great impact on inducing the action towards strengthening the private buildings.

(3) Insurance

Government can utilize the insurance system in obtaining investment cost of area development or fund for low-rate loan scheme described above, by taxing on private insurance companies. The insurance policy shall indirectly contribute to the promotion of private building strengthening, although it does not have an incentive for building owners to spend their own expense to strengthen the building.

2) Target Numbers of Building to be Strengthened or Reconstructed

The target numbers of private building to be strengthened or reconstructed is 8,000 on a yearly basis, considering the feasibility in conducting strengthening works, which have rarely been attempted in Tehran in the past. Among those target buildings, reconstructed masonry building accounts for 50% or 4,000 and 10% or 800 shall be strengthened. As to both steel and RC frame buildings, 20% or 1,600 shall be reconstructed and the same amount shall be strengthened.

3) Strengthening Cost

Table 8.2.1 shows the cost of building diagnosis, strengthening and reconstruction by structure type. Based on those figures, an appropriateness and feasibility of proposed governmental assistance policy is evaluated.

Table 8.2.1 Unit Cost of Building Strengthening by Structure Type

(Unit: Rial/m^2)

	Steel	RC	Masonry
Building Diagnosis Cost	64,500	64,500	64,500
Strengthening Cost	433,600	491,465	491,465
Reconstruction Cost	2,400,000	2,400,000	2,160,000

Source: JICA Study Team

4) Public Attitude

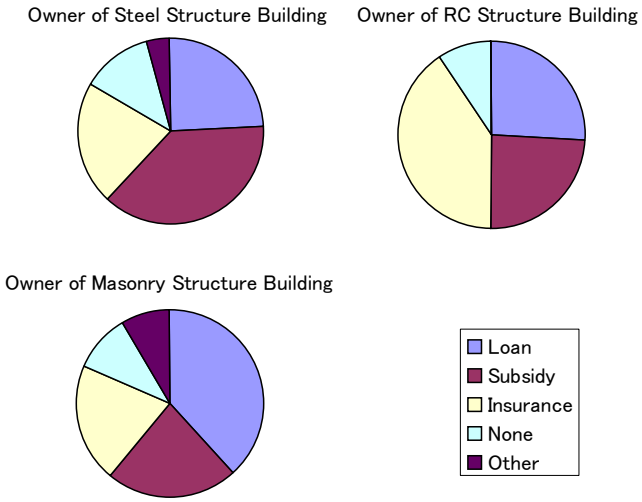
(1) Attitude Survey

Attitude survey was conducted to grasp the acceptance level of the public towards governmental policies for building strengthening. A preference of governmental assistance policy and willingness to pay for building strengthening were revealed by this survey.

(2) Preference in Building Strengthening Promotion Policy

Figure 8.2.1 shows the result of questionnaire for a preference of building owners in each owning building structure type for governmental policy measure to promote strengthening.

The preference in policy differs clearly by building structure type of owners. Steel frame building owners prefer loan assistance in strengthening their buildings, and RC frame building prefer insurance policy. Masonry building owners prefer subsidizing policy much higher than owners of other structure types.



Source: JICA Study Team

Figure 8.2.1 Preference of Political Measure for Promotion of Building Strengthening

(3) Willingness To Pay

Table 8.2.2 shows the willingness to pay of each building owners. Willingness to pay of masonry building owners is quite low value compared to the other owner types, reflecting the difference of income level between the owners of steel and RC frame buildings and those of masonry building.

Table 8.2.2 Willingness To Pay by Owners of Different Building Structure Types

(Unit: Rial)

	Willingness To Pay
Steel Frame Building Owner	23,025,401
RC Frame Building Owner	22,324,446
Masonry Building Owner	14,971,692

Source: JICA Study Team

Using the numbers of buildings shown in Table 3.1.1, the total willingness to pay value of Tehran citizen is calculated as US$ 1,868.7 million.

5) Options for Assistance Policy Application

(1) Selection of Strengthening Method

There exist two ways for increasing in seismic resistance level of private buildings in general; strengthening and reconstruction. The decision on what method would be applied is given by the result of seismic diagnosis. All the target building should be diagnosed before being strengthened or reconstructed.

Building diagnosis analysis, presented in Chapter 3, revealed the relative seismic resistance level of structure by each structure types, which concluded that masonry building is quite vulnerable compared to steel and RC frame structure buildings. Considering this fact, assistance policies for owners of masonry buildings shall be different from those for owners of steel and RC frame buildings.

(2) Policy Presumptions

Above mentioned 3 types of governmental assistance policies, low-rate loan, subsidy and insurance shall be designed with consideration for those characteristics influencing on the preference of private building owners. Low-rate loan scheme with an annual interest rate of 8% and payback period of 10 years is applied to the cost for building strengthening, considering an annual open market rate of 15% in Tehran. On the other hand, subsidy will be applied to the cost of building diagnosis and a part of building strengthening cost, reflecting the vast numbers of buildings to be strengthened. This option shall target to building owners who have less capability to invest in strengthening.

(3) Assistance Policy for Strengthening

A. Policy for Masonry Building Owners

It might be the case that strengthening option is less suitable than reconstruction for the most of masonry building, since the seismic resistance level of masonry buildings is, in general, considerably low. However, there exist some masonry buildings that have relatively higher seismic resistance, if not enough. In this case, a subsidy policy applying to the 20% of strengthening cost and low-rate loan policy for the rest of expenses shall be provided, considering a relatively low value of willingness to pay of owners of masonry building. Contents of this assistance policy are as follows:

a. Subsidy

Condition: Available for 20% of strengthening cost

b. Low-rate loan

Condition: Available for 80% of strengthening cost
8 % of an interest rate
10 years of payback period

B. Policy for Steel and RC Frame Buildings

Considering the higher value of willingness to pay, following subsidy and low-rate loan policies shall be applied to this case.

a. Subsidy

Condition: Available for 10% of strengthening cost

b. Low-rate loan

Condition: Available for 90% of strengthening cost
8 % of an interest rate
10 years of payback period

(4) Assistance Policy for Reconstruction

A. Policy for Masonry Building Owners

Considering that a majority of existing masonry buildings has very low seismic resistance, area development scheme, described in Chapter 4, would be effective to reduce the numbers of vulnerable masonry building in Tehran.

For the masonry buildings that would be out of area development scope, a uniform amount of subsidy, equivalent to US$ 2,000, will be provided to building owners. In addition, for the rest of expenses of reconstruction, a low-rate loan will be available with the below conditions:

Condition: 8 % of an interest rate
10 years of payback period

B. Policy for Steel and RC Frame Building Owners

As described in Chapter 3, yearly demand of reconstruction for steel and RC frame buildings is higher, counting for approximately 20,000 per year. This is a natural and spontaneous demand of reconstruction in Tehran. For the purpose of constructing more seismic resistant buildings, 10% of total reconstruction cost shall be provided by subsidy, exclusively used for the structural improvement to be seismic resistant.

6) Cost Estimation

Required cost for both strengthening and reconstruction is estimated based on the targeted numbers of strengthening or reconstructing building, 8,000 per year, the rate settings and conditions of two policies, subsidy and low-rate loan, for both strengthening and reconstruction options..

For both strengthening and reconstruction, the total amount of yearly required cost by subsidy counts for approximately US$ 122.8 million, including the cost for seismic diagnosis. The total amount of required fund for loan program in ten years counts for approximately US$ 1,573.2 million, and the total interest receipts in ten years count for approximately US$ 755.1 million.

Chapter 9
Establishment of Community Level Disaster Management Organization

CHAPTER 9 ESTABLISHMENT OF COMMUNITY LEVEL DISASTER MANAGEMENT ORGANIZATION

9.1 Community-Based Activities for Disaster Preparedness

9.1.1 Objectives of the Plan

In order to protect life and property of the local people from earthquake damages, it is important for all disaster-related organizations from national to community levels to take measures at full efforts. At the same time, each local resident has to get a concept of self-protection, obtain enough knowledge of earthquake, accumulate training, learn countermeasures of disaster by experience and implement these activities at home, in the community, workplaces, etc. Furthermore, these measures for disaster preparedness can be effective if the local community cooperates, collaborates with existing community organizations such as youth associations and women's groups and establishes community-based groups of disaster preparedness. For this purpose, local government will indicate the standard and regulations for appropriate and effective activities for disaster preparedness.

9.1.2 Roles of Local Residents

The role of local residents is very important for disaster management. Local residents have to have the intention of securing their safety by themselves and to implement the available measures of disaster preparedness steadily including the following items both in the normal condition and in the outbreak of earthquake.

Table 9.1.1 Roles of Local Residents

In Normal Condition	In Case of Emergency
1. Absorption of knowledge of disaster preparedness 2. Understanding of the vulnerability of the area 3. Discussion of disaster preparedness at home 4. Confirmation of temporary shelter, evacuation routes and nearby medical and relief facilities in emergency case 5. Retrofitting of housing 6. Protection of furniture and materials from toppling over 7. Storage of necessities for emergency such as drinking water, food and medical kits.	1. Prevention of fire and extinguishing fire 2. Rescue activities of the injured in collaboration with local community 3. First aid of the injured and relief of the slightly injured 4. Secure one's own life

Source: JICA Study Team

9.1.3 Roles of Local Community-Based Groups

It is more effective that the disaster preparedness measures in the community are implemented in collaboration with community-based groups such as CBOs, NGOs, and residents' association in housing complex. If the groups have definite purpose to work for disaster management, they will cooperate with district offices and start to do the following activities.

1) Preparation of Disaster Management Plan

Participants of the groups will develop their own rules and disaster management plan (action plan) and implement the activities based on the discussion with district offices. The contents of the plan are:

- Structure of groups and tasks (clarification of the roles)
- Dissemination of disaster-related knowledge (items to be disseminated and their methods)
- Collecting and transmitting the information (measures of information collection and transmission)
- Prevention of fire and extinguishing fire (measures of extinguishing and prevention system)
- Rescue and relief (contents of activities and communication with medical facilities)
- Instruction of evacuation and life in temporary shelters (measures how to evacuate, responses for the disaster weak, evacuation routes and places, operation and cooperation for temporary shelters, etc.)
- Supplying food and water (securing food and water, cooking)
- Storage and management of equipment and tools for disaster management (procurement plan, storing places, management ways, etc.)

2) Structure of Groups

Each group, for example, has sections of information and training, fire extinguishing, rescue and relief, evacuation, supplying of food and water, etc. Significant aspects in organizing groups are:

- Involvement of women and different groups in daytime and nighttime,
- Consideration of the local conditions,
- Involvement of disaster management groups in workplaces, and
- Utilization of experts and experienced persons.

3) Activities of the Groups

(1) Accumulating Knowledge for Disaster Preparedness

Obtaining knowledge on disaster preparedness will be promoted using opportunities such as movies, lectures, study meetings, training and workshop, so that each local resident has correct

information and knowledge on disaster preparedness. Major items for dissemination are shown in Table 9.1.2

Table 9.1.2 Major Items for Dissemination

In Normal Condition	In Case of Emergency
1. Increase of knowledge of earthquake in Tehran 2. Increase of knowledge of disaster mitigation 3. Coordination and communication with disaster-related organizations and neighboring self-help groups 4. Understanding of vulnerability in the area 5. Confirmation of water resources for fire extinguishing in the area 6. Disaster preparedness and prevention of fire at home 7. Confirmation of information transmission system in the area 8. Confirmation of evacuation routes and medical facilities 9. Development and management of equipment and tools for disaster management	1. Fire prevention and extinguishing 2. Rescues of the injured 3. Confirmation of safety of local residents 4. Collection and dissemination of information regarding the damages and government announcement 5. Guiding of evacuation and temporary life in shelters 6. Supplying food and water 7. Support for the neighboring areas

Source: JICA Study Team

(2) Creation of the Community-Based Disaster Map

The groups produce and display disaster maps showing dangers, resources for disaster, resource persons and vulnerable persons. Or the maps are distributed to each household to form adequate disaster preparedness plan easier and promote quick and appropriate actions for disaster preparedness and emergency response at home. They can also be used as educational materials in schools and other educational facilities.

(3) Preparation of the Plan for the Temporary life at Shelter

In order to smoothen the temporary settlement of the local residents at the evacuation designated area in emergency, “the plan for living at the temporary settlement” will be prepared.

(4) Drills for Disaster Preparedness

The drills for disaster preparedness in comprehensive, local and other occasions including the following items to react in case of an earthquake will be carried out. In this case, the coordination with community-based groups in other areas, workplaces and district offices will be necessary.

- Collection and transformation of information
- Prevention of fire and extinguishing of fire
- Evacuation
- Rescue and relief
- Food supply
- Coordination with other groups in the area

9.1.4 Roles of Workplaces

The role of industries and workplaces for local disaster management activities is described here. The persons who manage or operate the workplaces and facilities are to ensure the safety of the employees and users and to implement appropriate activities for disaster preparedness in order to prevent expanding the disaster-affected area. The workplaces will also participate in the activities for disaster preparedness such as rescue of the affected people as a member of the community. For this purpose, the workplaces will form self-preparedness groups, make contact with other self-management groups in the related area and try to secure the safety of the workplaces and the related area actively.

The activities of disaster preparedness in the workplaces will be implemented with support from Tehran Municipality and district, especially, TDMMC, Deputies of Labor and Social Affairs, etc., based on the actual conditions of the workplaces covering the following items:

1) Roles in Normal and Emergency Cases

Table below shows roles of workplace in both normal and emergency cases.

Table 9.1.3 Roles of Workplace in Normal and Emergency Cases

In Normal Conditions	In Case of Emergency
1. Education for disaster preparedness to employers 2. Establishment of system for collecting and transmitting of information 3. Countermeasures for fire and other disasters 4. Establishment of evacuation measures 5. Rescue and relief 6. Securing the necessary goods in case of earthquake such as drinking water, food, daily necessary goods, etc. 7. Confirmation of earthquake resistance of building and facilities 8. Development of self-preparedness groups 9. Implementation of disaster drills 10. Participation in the local drills 11. Formation of manual on disaster preparedness (manual for activities in case of emergency)	1. Securing the safety of employees and customers 2. Maintenance of economic activities 3. Contribution to the local community including support for voluntary activities

2) Disaster self-management groups in the industry and workplaces

(1) Target Facilities

- Facilities used by many people (middle- and high-rise buildings, underground parking lots, theaters, large shops, hotels, theaters, hospitals, bazaars, etc.)
- Facilities dealing with dangerous matters (storage and dealers of petroleum, high pressure gas, gunpowder, poisons, radioactive substance, etc.)
- Workplaces with many employees and to be considered effective for establishing self-disaster management groups

- Facilities necessary for establishing organizations for disaster management in collaboration with several workplaces (multi-purpose buildings)

(2) Formulation of the Plan for Self-Disaster Management

Table below shows formulation of self-disaster management plan.

Table 9.1.4 Formulation of Self-Disaster Management plan

Prevention Plan	Drills Plan	Emergency Response Plan
- Organization of prevention and management - Checking of facilities using fire, hazardous matters, flammables, etc. - Checking of facilities for fire extinguishing	- Learning of disaster preparedness - Drills for disaster management	- Organization of emergency activities - Collecting and transmitting of information - Prevention of fire and extinguishing of fire - Guiding of evacuation - Rescue and relief

(3) Activities for Self-Disaster Management

Table below shows activities for self-disaster management.

Table 9.1.5 Activities for Self-Disaster Management

In Normal Condition	In Case of Emergency
1. Drill for disaster preparedness 2. Maintenance drill of facilities 3. Disaster education to employees	1. Collection and transmission of information 2. Prevention of fire and fire extinguishing 3. Guiding evacuation

9.1.5 Support and Guidance from Tehran Municipality and District Offices

Tehran Municipality and district offices will promote involvement of the existing CBOs and NGOs, establishment of self-management groups in Tehran and support for the vitalization of their activities. Areas to be considered for attention are those (a) with high population density, (b) with many disaster weak, (c) with high vulnerability of housing and facilities, (d) with less collaboration among the residents, and (e) with shortage of water for fire extinguishing.

1) Committee for Promotion of NGOs, CBOs and Groups of Self-Disaster Management

Tehran Municipality will form a committee for promotion of NGOs, CBOs and groups of self-disaster management with members including leaders of groups. The committee will discuss the related matters, and provide advice, guidance, information and recommendation to activate the groups.

2) Development Plan for Self-Disaster Management Groups

Tehran Municipality and district offices will prepare a plan for developing the self-management groups, increasing awareness of groups and promoting their development by the following efforts.

- Preparation of materials for enlightenment
- Organization of various lectures and conferences
- Provision of information
- Individual guidance and advice to the community
- Drills and training courses to individual community and for development of group leaders
- Utilization of award system (award to excellent groups and/or communities for disaster management)

3) Community File for Safety and Relief

Tehran Municipality and district offices will expend every effort to promote making a community file for safety and relief, sharing the information of various groups including the self-management groups and giving support for strengthening of cooperation and activation of their activities.

4) Involvement of Disaster Preparedness Activities in the Group Activities

The district offices will instruct the staff in the area appropriately by coordinating with NGOs and CBOs and involve the disaster activities in the group's regular activities. The district offices will organize seminars, training courses and drills, etc. to deepen the recognition of self-disaster preparedness and information exchange among the various groups.

5) Utilization of Community Centers

The district offices will utilize community centers (cultural centers, sports centers, health centers, etc.) as community venues for disaster preparedness and implement the following activities as base of self-preparedness activities.

- In normal conditions, the center will be a place for drills and dissemination of knowledge and information on disaster management.
- In case of earthquake, the center (if the structure is not damaged) will be used for urgent evacuation place and an activity base for emergency responses.

6) Subsidy for Groups for Self-Disaster Management

In order to promote the groups' activities, they must have the necessary equipment and tools and storage. Tehran Municipality and district offices will subsidize the groups when the groups cannot afford to finance themselves.

9.2 Community Level Organization

9.2.1 Network of Community Level Organizations

As to administrative level, there exists sub-district under district. Since mahale is not an administrative division, there is no formal link between district office and local residents. In considering the disaster preparedness and emergency responses, the bridge between district offices and individual local resident is indispensable. As already mentioned in Chapter 7, the reasons for the necessity of some organizations/groups of local community are as follows:

1. When necessary information and trainings will be provided, it is much more effective to provide a group of people than to provide individuals.
2. Emergency responses will be implemented effectively in the community and other people gathering places such as workplace, school, recreational facilities, etc.

Some existing organizations or groups can be considered for functioning for that purpose. Also, there are various types of aggregation of the local people. Additionally, the places to absorb a lot of community members can be found. The prerequisite conditions for the linkage between district office and local community are:

- A place where many people gather, mostly the local people in the area
- People existing in that place and area are confirmed
- Dissemination of information is rather easy
- Some relationship with district office already exists
- Some communication network and equipment exist to be used in emergency case such as loud speakers, wireless and other measures

The candidate places are:

- housing complex
- mahale council
- school
- office, factory and bazaar
- mosque
- cultural center
- health center
- sports center
- NGOs and CBOs
- Basij
- Red Crescent Society
- Public participation center, etc.

These places can be a center for disseminating information and gathering people for training and seminars provided by district offices. Also, the people in these places will be able to respond to emergency in a group if they are provided with information and training. Since the social structure in Tehran is very complex and diversified, these networks should be combined accordingly for the purpose of covering all area of Tehran. However, in order to make all these bridges work well, they have to be provided with education and training in advance and be ready and committed to act in emergency case.

9.2.2 Group of Disaster Management in Housing Complex

If the complex has a group whose members are individually able to cope with disaster, it will be made full use of in emergency case to fulfill its essential purpose. In the housing complexes without such groups, board of directors and resident associations can be applied as a bridge between district office and the large number of local residents. From the local office, the announcement of evacuation, damage conditions and other necessary activities to be done by local people will be provided using a communication network through the board and the association and their substructure, in order to make the local people act effectively and systematically for emergency response. The responsibilities of these groups are:

- Guiding the residents for evacuation
- Fire prevention and firefighting
- First aid, rescue and relief
- Communication with district government to get information of damages other necessities, and disseminate to all residents
- Checking safety of all residents
- Management of evacuation site and temporary shelters
- Providing food and water

On the other hand, from the housing complex to the district office, requests, issues to be solved and conditions in the local area will be reported.

9.2.3 Utilization of Other Existing Organizations and Facilities

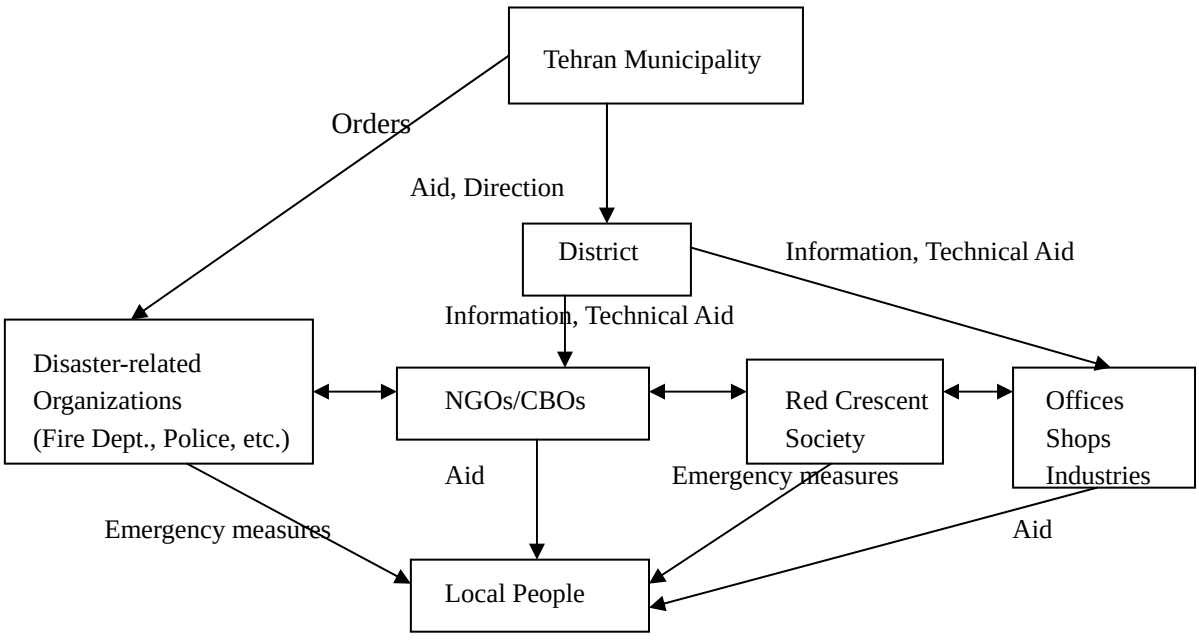
There are many patterns to utilize the existing groups in emergency case. If mahale councils work well, they can be used. Public participation centers and NGO centers will be directly accessed by the local residents, if they have wireless, Internet and other communication tools. NGOs, CBOs and Basij as well can work using their usual channels with local residents if their own activities include some activities related to disaster management. Mosques are places where people gather still and with their loud speakers, play a role of providing information to the people for emergency. Schools have also many students in daytime, and loud speakers can spread information. Also, health centers and communicators can be used as information

transmitters to the local resident. Of course, Red Crescent Society is a major player in emergency response involving its own volunteers. The responsibilities of these organizations and facilities will depend on their characteristics and level of owned equipment and relationship with local residents. The responsibilities could be any of the following but the first item has to be done with priority by all organizations.

- Communication with district government to get information of damages and other necessities and disseminate these to all residents
- Guiding the residents for evacuation
- Fire prevention and firefighting
- First aid, rescue and relief
- Checking safety of all residents
- Management of evacuation site and temporary shelters
- Providing food and water

On the other hand, condition of the local area will be reported to district through the organizations and facilities.

Figure 9.2.1 shows one idea of the cooperation among the related organizations and groups in Teheran to work in case of emergency.



Source: JICA Study Team

Figure 9.2.1 Cooperation among the Related Organizations and Groups in Emergency Case

In order to work all the community organizations and groups effectively for disaster management, training and education are necessary as already described in Chapter 7. Appropriate contents of training (basic knowledge of earthquake, countermeasures, disaster drill, first aid, est.) should be organized considering the characteristics of the following groups and areas accordingly.

- School students
- School staff
- Residents in housing complex
- Residents living in highly vulnerable area
- Members of NGOs and CBOs
- Workers in offices, industries, shops, etc.

Chapter 10
Improvement of Disaster Management System

CHAPTER 10 IMPROVEMENT OF DISASTER MANAGEMENT SYSTEM

10.1 Emergency Response Scenario

10.1.1 Outline

One of the primary objectives of emergency response planning is to protect the life and property of citizens in Tehran. In order to protect life and property through effective planning, it is first necessary to understand the emergency situation caused by the scenario earthquake and its potential damage. Only after understanding the problems in the existing institutional and organizational factors of the emergency response systems, planning for improvement can be effective.

This section deals with the onsite activities after the occurrence of the scenario earthquake. Each subsection covers the detailed scenario from the earthquake in the respective topic, based on the problems identified in the present status.

The logistics required to support the onsite activities after the occurrence of the disaster are also considered. The transportation system must continue to function during and after the occurrence of the earthquake disaster, so that the onsite activities of search and rescue and other socio-economic activities can continue to function. Similarly, the lifelines are other factors playing an important role during the initial stage of a disaster. The existing conditions of these factors are discussed, identifying the underlying problems. Proposals are then made in Chapter 10, such that these facilities for logistics during onsite activities can provide better support.

10.1.2 Condition of Scenario

The purpose of the emergency response scenario formulation is to contribute to the study for appropriate emergency plan by Tehran Municipality. Therefore, the scenario covers a wide area of damages and responses. Each scenario describes damages, risks and thinkable response qualitatively.

Ray Fault model is taken as the scenario earthquake. However, the damage considered to be caused by the Ray Fault model is extraordinarily huge and sometimes beyond imagination. Therefore, some description might not demonstrate the real situation.

Emergency response scenario of 1) Municipality Emergency Response Headquarters, 2) Rescue, Relief and Medical Treatment, 3) Evacuation, 4) Traffic and 5) Lifelines is assumed.

10.1.3 Emergency Response Scenario

Anticipated damage and disaster scenario and its correspondent activities are summarized in Table 10.1.1 and Table 10.1.2, respectively.

Table 10.1.1 Result of Damage Estimation

Item	Unit	Amount
Heavily Damaged and Collapsed Residential Building	no	483,000
Heavily damaged and collapsed floor area	ha	17,000
Debris of heavily damaged and collapsed building	1000ton	124,000
Debris of heavily damaged and collapsed building on emergency road	1000ton	3,7000
Human Death	no	383,000
Homeless victim	no	3,126,000
Water Pipeline	point	3,900
Gas Pipeline	point	540
Electricity Cable	m	18,500
Telephone Line	m	12,800

Source: JICA Study Team

Table 10.1.2 Scenarios of Disaster Event and Response

	Municipality Emergency Response Headquarters		Rescue & Relief and Medical Treatment		Evacuation		Traffic		Lifeline	
	Disaster Situation	Activity	Disaster Situation	Activity	Disaster Situation	Activity	Disaster Situation	Activity	Disaster Situation	Activity
Outbreak	- An earthquake of magnitude 6.7 occurs at the south fringe of Tehran City. - It is visually observed that a huge number of buildings collapsed. - It is estimated that a lot of people died or are injured. - Damages of lifelines take place in the whole Tehran area. - Water pipe is broken at 3,900 points. - A blackout occurs in more than 1/2 of Tehran City. - Gas pipeline is broken at 540 points. - Only satellite wireless communication system is working.	- Half of the Municipal building collapses. - Only about 30% of staff can work at or gather to the Municipal Office.	- 55% of residential buildings collapse. - More than 380,000 people instantly die. - More than 950,000 people are trapped in the collapsed buildings or heavily injured. - A lot of traffic accidents occur on highway and ordinary road. - Almost half of hospitals and medical centers are heavily damaged.	- People try to recover those buried under furniture or collapsed walls in confusion and panic. - On the road, people notice that they can do nothing about car crashes because emergency calls for ambulances do not function. - In health facilities, partial or total destruction of buildings in blackout causes panic coupled with many staff and inpatients injured or killed. - In the rescue organizations, chain of calls is activated according to the response arrangement.	- 55% of residential buildings collapse. - More than 3,500,000 people lose their homes.	- Rescue works by neighbors start. - Some people try to evacuate to open space nearby their house.	- At least 5 flyover bridges collapse. - In the southern area, most of narrow roads with width of less than 6 m are completely blocked by debris. - Large number of pedestrian bridges fall down and block major roads and highways. - No serious damage occur on road itself.	- Half of the Municipal and traffic-relevant office buildings collapse. - Only about 30% of staffs can work at or can gather to their office.	- Damages of lifelines take place in the whole Tehran area. - Water pipe is broken at 3,900 points. - Electricity cables of 18,500 m length are damaged by collapse of electric poles. - Gas pipeline is broken at 540 points. At least 480,000 risers are broken. - Telephone lines of 12,800 m length are damaged. Lots of mobile antennae collapsed.	- Half of lifeline company buildings collapse. - Only about 30% of staffs can work at or can gather to the lifeline companies.
2 to 3 hours later	- Several thousands of people are estimated to die. - Tens of thousands of people are estimated to be injured. - Huge number of injured persons are rushed to hospitals and medical centers. - Water supply is cut off in almost whole area. - Each lifeline company starts to investigate the damage, but finds it difficult to organize their staffs.	- Mayor of Tehran orders to establish emergency operation center. - Emergency operations start by available facilities and staff. - Order of evacuation is announced. But few residents can take note of the order. - Collecting damage data is quite difficult because communication lines are cut off.	- Communication and collection of information by rescue organization and/or medical organization are quite difficult. - Emergency calls by citizens occupy telecommunication lines.	- Damage assesment teams are disseminated to plan the search and rescue operations by responsible organizations such as TDMMC, Fire Fighting, Red Crescent and Military. - Head office of MOH & ME activates the pre-arranged emergency response system, but faces difficulty in collecting information about damages of health facilities and personnel. - Even in the hospitals still standing, night shift staff faces great difficulty to secure and evacuate the inpatients due to shortage of manpower and black out. - People in neighborhood rush to bring the injured to hospitals only to find that the hospitals are unable to function. - First aid and emergency medical treatment start by available facilities and staffs.	- Huge number of injured persons rush to hospitals and medical centers. - People who lost their houses but are not injured do not know how to behave.	- Evacuation activity by residents start. - Rescue works by Fire Fighting, Red Crescent, Police and Military start. - Municipality and District Municipality start to establish regional evacuation places. - Order or guidance of evacuation is announced. But it is difficult to transmit the information to residents.	- Traffic is almost completely blocked in building damaged area. - Rescue team often cannot reach the damaged site. - Huge number of abandoned cars block roads. - People who evacuate/escape by car accelerate the confusion.	- Traffic Police and Police start traffic control so that only emergency vehicles are allowed to enter the damaged area. - But due to shortage of staffs and exiting citizens in panic, it is difficult to control the traffic. - Municipality and Police ask Military to control the traffic.	- Water supply is cut off in almost whole Tehran area. - Black out occurs in more than 1/2 of Tehran area. - Huge number of gas leakage occurs and small explosions take place at whole Tehran area. - Only satellite wireless communication system is available.	- Lifeline companies try to collect information of damage. But due to the lack of communication tools, it is difficult to get precise information. - Lifeline companies try to secure manpower for temporary repair. But sufficient staff cannot be assembled. - Water company tries to supply water to the first aid center. - Electric company tries to supply electricity to the first aid center by power generator. - Gas is shut down at City Gate Station. - Telecommunication company tries to repair damage lines for emergency operation organization.
1 day later	- It is considered that tens of thousands of people died. - Huge confusion takes place at hospitals and medical centers. - People gather to evacuation places, but the situation is in disarray because the places are not ready. - Telecommunication systems are not ready for the public. People rush to available communication points.	- Minister of Interior declares a state of emergency and disaster level. - Wireless system and telecommunication become partially available. - Data of damage gradually come in. - Emergency transportation route is determined. - Staff shortage for shift occurs.	- Great confusion takes place at hospitals and medical centers. - A lot of heavily injured victims are left untreated.	- Less than one-fifth of staff can be contacted and only a few can reach their offices. - Most of offices, health centers, hospitals, fire-stations and other rescue facilities are damaged, unable to function. - Government employees in charge of rescue and relief have orders to be on stand-by and some in neighboring provinces start to move. - While many unorganized rescue works start all over the place, it becomes clear that damages totally overwhelm the rescue resources. - Field care teams start to partially deploy at some evacuation places and hospital sites. - A few hospitals that are still functioning and even health centers are engulfed by the rush of injured people coming in or being brought and attending to them.	- People start to gather to evacuation places, but disorder situations happen because the places are not ready.	- People who cannot get water and food start to evacuate. - Request of food and water supply for evacuation location to Red Crescent and Military is announced. - Municipal staffs are sent to evacuation place for management.	- Traffic situation becomes worse. - People scramble to go into / out from damaged area. - Most of Tehran area except emergency roads is completely blocked by debris and cars.	- Priority of emergency transportation road and method of traffic control are decided. - Municipality starts to remove debris from emergency transportation road. - Military, Traffic Police and Police start cooperative traffic control. - Traffic Control Center begins to announce traffic information through media.	-	- Temporary repair work of lifelines start.

	Municipality Emergency Response Headquarters		Rescue & Relief and Medical Treatment		Evacuation		Traffic		Lifeline	
	Disaster Situation	Activity	Disaster Situation	Activity	Disaster Situation	Activity	Disaster Situation	Activity	Disaster Situation	Activity
2 to 3 days later	- Number of deaths and injuries increase day by day. - Shortage of space, doctor and staffs for first-aid station occurs. - Many people die in first-aid station. - Shortage of medicines ensues. - Huge traffic congestions take place all over the city. - Evacuation places start to operate. But traffic congestion prevents relief goods from reaching these places. - Debris removal from emergency road. - Enough number of mortuaries cannot be secured. Confusion occurs. - Electricity and telecommunication is partially recovered.	- Half the number of staff becomes ready for work. - Acceptance of relief goods and material starts. - Temporary operation facilities are selected.	- Number of deaths and injuries increases day by day. - Great confusion takes place at hospitals and medical centers. - Shortage of space, doctor and staff for first-aid station occurs. - Many people die in first-aid station. - Shortage of medicines ensues.	- It becomes clear that less than half of staff and office facilities survived and remain available. This causes tremendous delay to manage the situation. - Rescue teams of Red Crescent, Fire Brigade, Sepah and international agencies are forced to deploy on appointed places and priority buildings because of limited rescue resources for overwhelming demands against available resources. - Search and Rescue in most residential area is left to the community people's efforts. - Acceptance of relief goods and material coming from other provinces as well as foreign countries starts. - Air transfer of the injured to other provinces goes into full operation but cannot respond to the massive demands. - Even for the fortunate ones rescued, seriously injured victims will be left untreated due to very limited available resources.	- Number of people in evacuation place increase day by day. - People who cannot enter the place stay outside of the place. - Shortage of water, food and relief goods occur due to transportation problems. - Lack of water closets causes huge unsanitary condition - Sickness and disease increase in victims.	- Evacuation places start to operate. - Municipality looks for additional evacuation place. - Identification of evacuated people by municipal staffs begins. - Rescue team from other provinces and overseas reach to the damaged area. - Acceptance of relief goods and material starts.	- Traffic condition of emergency road is gradually improved. - Emergency vehicle and emergency transportation lorry can go in/through emergency transportation road comparatively easily. - Other ordinary roads are completely blocked.	- Debris removal from emergency road continues. - Area traffic control gradually becomes effective.	- Water supply is still cut off in almost whole Tehran area. Emergency water supply starts by Red Crescent and Municipality. - Electricity of major hospitals and public facilities are recovered by temporary repair. But still more than 1/3 of Tehran is without power. - Gas is not available in whole Tehran area. - Telecommunication systems are partially recovered and secured for emergency communication, but still not ready to serve the public. People rush to available communication points.	- Data of damage gradually come in. - Lifeline companies start to make repair plan. But shortage of manpower causes difficulties. - Water company starts emergency water supply for evacuated citizens. - Electric company starts temporary repair work. - Gas company announces safety measure for gas leakage. - Telecommunication company starts temporary repair work for citizens..
1 week later	- Outlines of damage are almost figured out. - Search works for missing still continue. - Most of injured people can get some medical treatment but due to shortage of facilities, operations cannot be performed on many of the victims. - Traffic condition is gradually improved. - Confusions in evacuation places gradually settle down due to arrival of relief goods.	- Re-organization of Municipality starts based on available manpower and facilities taking rehabilitation and reconstruction into consideration.	- Outlines of damage are almost figured out. - Most of injured people can get some medical treatment but due to shortage of facilities, operations cannot be performed on many of the victims.	- Emergency medical operations become organized gradually. - Rescue operations almost ceases, leaving many places unsearched because time runs out. - Many international relief teams deploy on many places to provide treatment. - Many field hospitals are set up in and out of the city area and most treatments are provided here and not by the damaged hospitals. - Disease prevention and environmental health activities increase progressively based on the temporary and survived health centers. - Donated medicines and materials arrive at the airport to be piled up there in huge amount.	- Confusions in evacuation places gradually settle down due to arrival of relief goods. - Still a lot of people are staying without tent or shelter.	- Identification of evacuated people is almost finished. - Construction works of temporary housing start. - Construction of temporary housing start	- Traffic condition is gradually improved.	- Debris removal works from emergency road finish. - Debris removal from major road starts. - Whole city area is still under full traffic control.	- Water supply is gradually recovered. But still most of the area is cut off. - Electric supply is gradually recovered. But by fast and sloppy repair work, leakage and interruption often occur. - Gas is still not available. - Telecommunication system is fairly repaired. But it is still sometimes congested.	- Outlines of damage are almost figured out. - Half the number of staffs become ready for work. - Lifeline companies start to make full repair works.
1 month later	- Number of dead, missing and injured are confirmed. - Still huge numbers of people live in evacuation places. - Traffic situation returns to normal. - Telecommunication system and electricity system is almost completely recovered. - Water and gas supply systems are still in partial recover situation.	- Emergency operation center dissolves. - Municipal staff partially returns to normal work - Reconstruction work of damaged public facilities start.	- Reconstruction of damaged or collaped fire-fighting, health facitlies has not been commenced yet.	- Many mobilized staff from other provinces still keep working at government offices to compensate for missing original staff. - Victims transferred to hospitals in other provinces return in a stream. - Temporary field hospitals work fully to provide care to increasing chronically diseased patients. - Health conditions of evacuated people deteriorate generally and they show signs of becoming unstable mentally. - Mental health teams deploy at major evacuation places and field hospitals but run totally short of needs. - Environment health and disease prevention teams deploy over the city based on the temporarily built health centers.	- Still huge numbers of people live in evacuation places.	- Selection of people moving to temporary housing starts.	-	-	- Outlines of damage are almost figured out. - Half the number of staffs become ready for work. - Lifeline companies start to full repair works.	- Water and gas companies still continue repair work. - Electric and telecommunication company starts reconstruction planning.

Source: JICA Study Team

10.2 Organization and Management of Emergency Response for Tehran

10.2.1 Legal Background of Emergency Response

According to 29th Act of the Constitution, the different levels of government in Iran regulate themselves to provide social security services for health and treatment services, medical care, etc. They should prepare an emergency response plan and its procedure to cope with the situations. At the national level, the RCS has a responsibility for rescue and relief activities. The RRCP is established in response to an RCS initiative, No. 17-202 dated 10 March 1998, and also to the requirements stipulated in Article 44 of the Third Economic, Social and Cultural Development Plan. The RRCP delegates the "strategic command authority," the Task Force Organizations, including its Secretariat, and the Provincial Task Force Organizations (including their Secretariats), with the Governors and the Minister of Interior being the supreme commanders of all response assets in case of an event.

A request from the Mayor of Tehran started the National Committee for Natural Disaster Reduction to seek the relevant organization to formulate a disaster management plan at Tehran Municipality level. The Tehran Municipality formulated Tehran Comprehensive Disaster Management Plan as a first step towards formulation of a disaster management plan. It covered disaster prevention and emergency response. Therefore, the Study will cover whole disaster management fields. This section deals with emergency response based on the existing disaster management efforts.

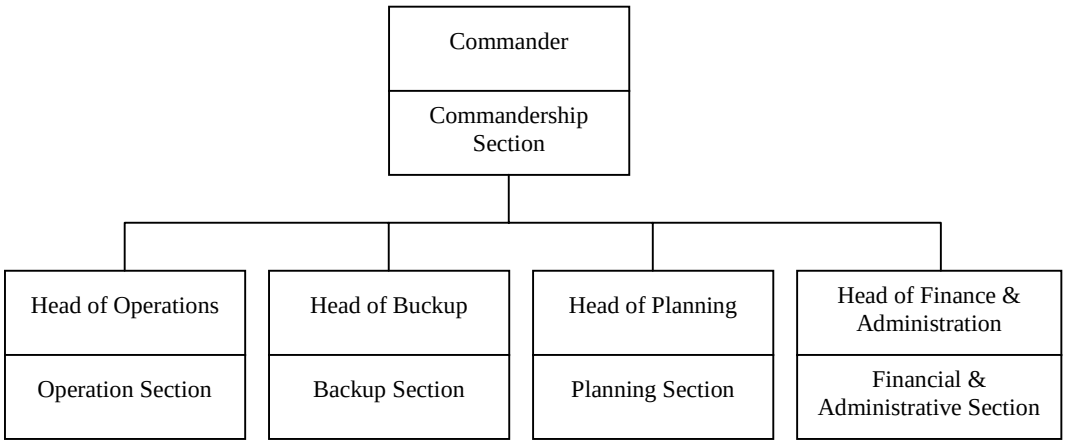
10.2.2 Organizations

1) Organization and Responsibility

(1) Organizational Structure

The Tehran Comprehensive Disaster Management Plan proposed the establishment of an emergency response organization based on Incident Command System (ICS), which was developed in the U.S. The ICS is the model for command, planning and coordination after the emergency. ICS organization is built on five major components: command, planning, operation, logistics and finance and administration.

The ICS organization chart is shown as follows:



Source: TDMMC

Figure 10.2.1 Disaster Command System in Tehran

A description of each section based on the disaster management plan is provided below.

Table 10.2.1 Description of Disaster Command System

Organization	Descriptions
Commandership section	This Section is responsible for directing, ordering and controlling the resources that is done by the Head of responsible organization or his successor. Any information released to the mass media must be done in coordination with this person. Also, the safety of all the staff in disaster situation is his responsibility.
Operation section	Operation Section works in area of activities and has a role in disaster control directly or indirectly. The head of this section is responsible for receiving and implementing operational program of disaster control and acting on decisions about how to use resources and organizing structure of operation section. This person reports to Incident commander and determines the requirements in coordination with him and implements the operation ending order.
Logistic section	This section is responsible for providing facilities, services, human forces, equipment, transportation, communications and controlling resources and other items, which are necessary in disaster situation. It's very important that the supporting section always be prepared so that if disaster occurs, the fastest time supports the activities of operational groups. In this section there are groups that provide services for the personnel involved in disaster. Among them are the medical or recreational groups (providing food and water and shelter for operational groups), which have the duty of providing health and primary requirements of personnel only. (Similar services for people is provided by other organizations)
Planning section	This Section is responsible for collecting information, incident assessment, documentation and using information about disaster situation for planning of response activities procedure and determines the usage of resources in distinct period during disaster.
Finance and Administration section	This section is responsible for financial and administrative affairs and is responsible for assessment of expenses caused by disaster. Any activity not covered by the above for sections would be in the activity zone of this section.

Source: Comprehensive Disaster Master Plan, Comprehensive Emergency Management Secretary

(2) Responsibility for the Commanding Components

ICS consists of five sections: management section, planning, data collection and data processing section, operation section, backup and logistics section and finance and administration section. The responsibility of each section is not clear yet.

The Incident Command will have three command staff members: an information officer, a safety officer and a liaison officer. The responsibility of those officers is as follows:

- The information officer handles all media inquiries and coordinates the release of information to the media.
- The safety officer monitors safety conditions and develops measures for ensuring the safety of all assigned personnel.
- The liaison officer is the on-screen contact for other agencies assigned to the incident.

The emergency response organization should have those functions. Those basic ideas could be applied in the emergency response organization in the Study Area.

The responsibility and role of each disaster management organization has not been determined by the plan.

2) Location and Buildings

The command center should have seismic resistance structure and should be equipped with the emergency facilities to operate emergency response activities. The location of centers is not yet determined, but the TDPMC building is a temporary place for such purposes. At district level, the location is not determined officially, but temporary location exists in district offices.

3) Commanding System

The comprehensive disaster management plan proposed to have an Incident Commanding System (ICS) together with Standard Emergency Management System. Standard Operation Plan is established in Tehran Municipality to determine the commanding system in each responsible organization. The plan provides a mechanism for improving legal and administrative connections, organizational policies and strategic plans for primary and supporting organizations, while there is neither corresponding technical measures nor type of disaster determined.

4) Explanation of emergency level

The Municipality has determined the emergency level based on the situation. Based on the emergency level, the disaster management response has been determined.

10.2.3 Organization for Initial Actions

1) Organization

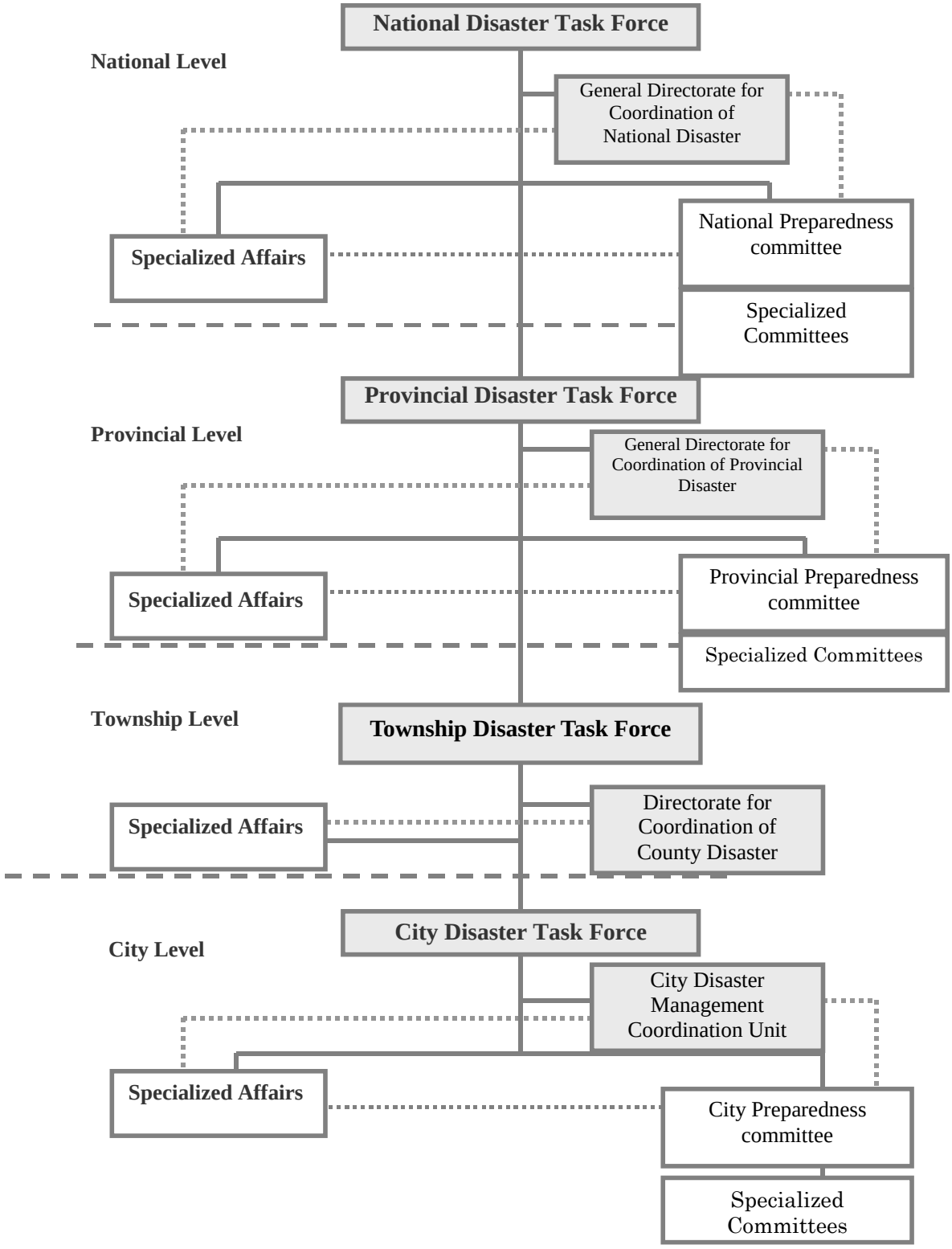
Laws and plans can determine the national disaster management organization. According to the Ministry of Interior, the disaster management related organizations are defined in the national disaster management laws. As mentioned in Chapter 1, the disaster management organization can be categorized into five groups: ministerial level, non-ministerial level, municipality level, academic level and other organizations level. The ministerial level organization includes 16 national level ministries, while non-ministerial level organizations are 12 entities.

TDMMC

Figure 10.2.2 shows the disaster management organization and its relationships with national as well as provincial government. Each level of the government has similar organization and functions from top to bottom.

2) Resource Mobilization

Tehran Municipality determines the emergency level based on the disaster situations. The resource mobilization plan has not been shown in this plan. The mobilization plan of government employees has not been established.



Source: TDMMC

Figure 10.2.2 Disaster Management Organization Chart in I.R.I.

10.3 Other Governmental Organizations

10.3.1 Roles in Emergency Response of Other Governmental Organizations

After the earthquake events, the governmental organization will act according to the previously established rules. However, it is impossible to cope with the emergency situations without cooperation from private organization. The cooperation from the other provinces is also important to be included in the plan. Therefore, it is very important to establish public and private sectors networks before the events.

10.3.2 Cooperation from Other Provinces

Tehran Municipality has not made arrangements on mutual cooperation with other organizations after a disaster. With its limited capacity, the municipality will find it impossible to handle the emergency situations that are sure to arise.

The mutual cooperation with other organizations should be established before the event. The following table shows an example of the mutual agreements:

Table 10.3.1 Areas of Possible Mutual Cooperation Agreements with Other Organizations

Organization	Descriptions
Medical care and support	Doctors and nurses are mobilized to work as a team to treat the injured, the number of which would be too large for the public sector to handle alone.
Emergency broadcasting	The information after the disaster is very important. The government should have agreement with the TV broadcast company as well as radio station.
Truck association	There will be a demand for transportation of emergency goods and supply should be distributed to the damaged area. Since the government sector has not enough trucks and transportation means, the private sector could provide them.
Bus supply	Transportation demand after the event, such as transporting the victims to the hospital, mobilizing help to damaged area, could not be handled by the government sector. To fill the gap, private sector should be included in the plan.

Source: JICA Study Team

References to Chapter 10

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Chapter 11
Formulation of Emergency Response Plan

CHAPTER 11 FORMULATION OF EMERGENCY RESPONSE PLAN

11.1 Information and Communication System

11.1.1 Objectives

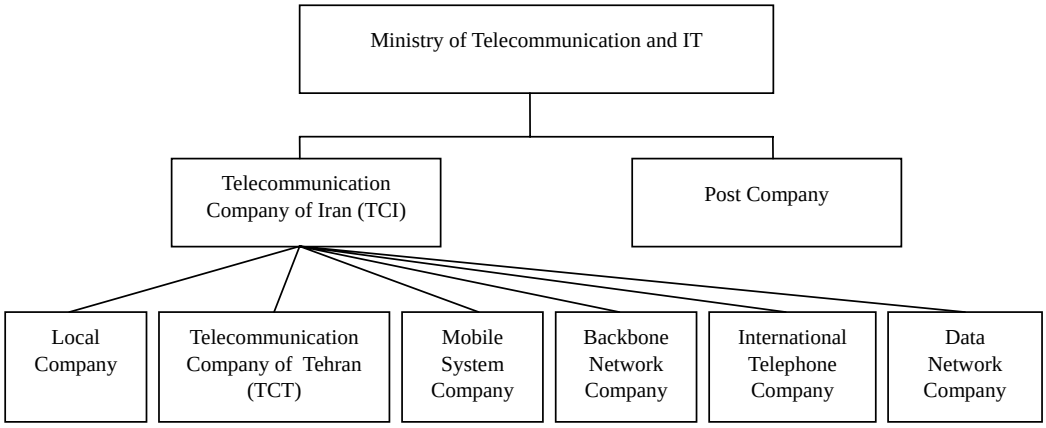
Information and communication system plays a vital role in emergency response. Based on the collected information, every command of emergency response operation is made through a communication system. Following are principal objectives for the establishment of a reliable information and communication system in the event of disaster.

- To secure physical resistance to external force of disaster for reliable information and communication network;
- To shift functions of information and communication system promptly to emergency response;
- To secure flexibility in network configuration; and
- To cover a broad sphere of influence.

11.1.2 Current Situation

1) Telecommunication Network in Iran

Telecommunication and post services in Iran are operated under the Ministry of Telecommunication and IT, and telecommunication sector is divided into several companies, which are under the direction of Telecommunication Company of Iran (TCI), as shown in Figure 11.1.1.



Source: Ministry of Telecommunication and IT

Figure 11.1.1 Organization Tree of Telecommunication in Iran

Public telephone network in Iran is composed of a telephone set, a switching equipment to be connected with subscribers and cable and radio transmission links. The key role of the public telecommunication service is to provide high quality voice and data telecommunication services to the general public throughout the country.

A three hierarchical network forms the STD network, long distance calls, to/from Tehran, as shown in Figure 11.1.2.

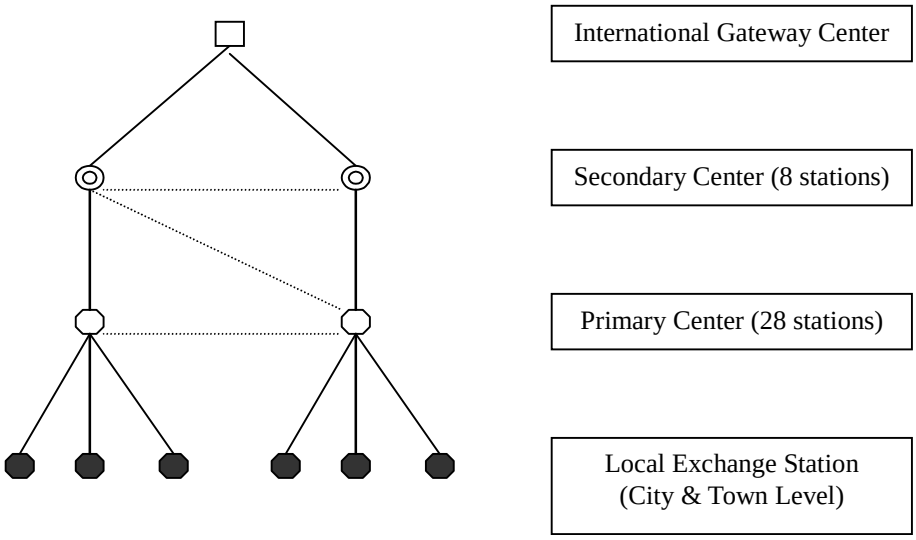


Figure 11.1.2 STD Network in Tehran

There are two gateway stations for STD network in Tehran City. One is LCT station located in the northwest of Tehran and another is Imams SQ No.3 station in the south central of Tehran. All of the major cities in the country are connected to/from both stations using optic fiber and microwave system. The transmission links are made up with loop and multi-path configurations that have a very high reliability. In addition, the distance between the two gateway stations is long enough to prevent simultaneous collapse of both stations.

2) Telecommunication Network in Tehran

Telecommunication Company of Tehran (TCT) is operating the fixed telephone and data services, and GSM telephone is operated by a Mobile Company in Tehran.

(1) Switching Facilities

Local telephone switching system in Tehran is Multi-LS type formation, which is a typical configuration in a large city. There are 77 local switching stations dispersed in the whole city, and those LS stations are integrated into eight tandem-switching areas. The total number of fixed telephone subscribers is about 2,900,000. The digital switching is already the dominant system, but analogue switching is still working in a limited area of Tehran.

Telephone switching stations are concentrated in the central and southern parts of the city, because of their high population density and commercial center. The switching stations have a capacity in average of around 80,000-90,000 lines for the central and southern areas and 40,000-50,000 lines in surrounding areas. Table 11.1.1 shows the number of local switching stations in each tandem area.

Table 11.1.1 Number of Telephone Exchange Stations in Each District

No.	Exchange Code	Exchange Name	No of LS
1.	Code 2	Shahid Bahonar	13
2.	Code 3	Kooshk	11
3.	Code 4	Payam Noor	10
4.	Code 5	Shahid Ghandi	12
5.	Code 6	Danesh Gah	10
6.	Code 7	Valia asr	10
7.	Code 8	Ghods	12
	Suburban area		330
	Karaj		68

Source: Telecommunication Company of Tehran (TCT)

(2) Junction Network in Tehran City

Optic fiber system is installed in most of junction links, and cable PCM and analogue transmission systems are still working in Tehran. Basically, the configuration of junction network is formed with loop and multi-path in Tehran City. As for cable installation, underground duct system, which is superior to the overhead system against earthquake, is the standard practice of TCI and TCT.

(3) Access Network

Access network is a link between MDF in telephone office and subscriber telephone set, which is illustrated in Figure 11.1.3.

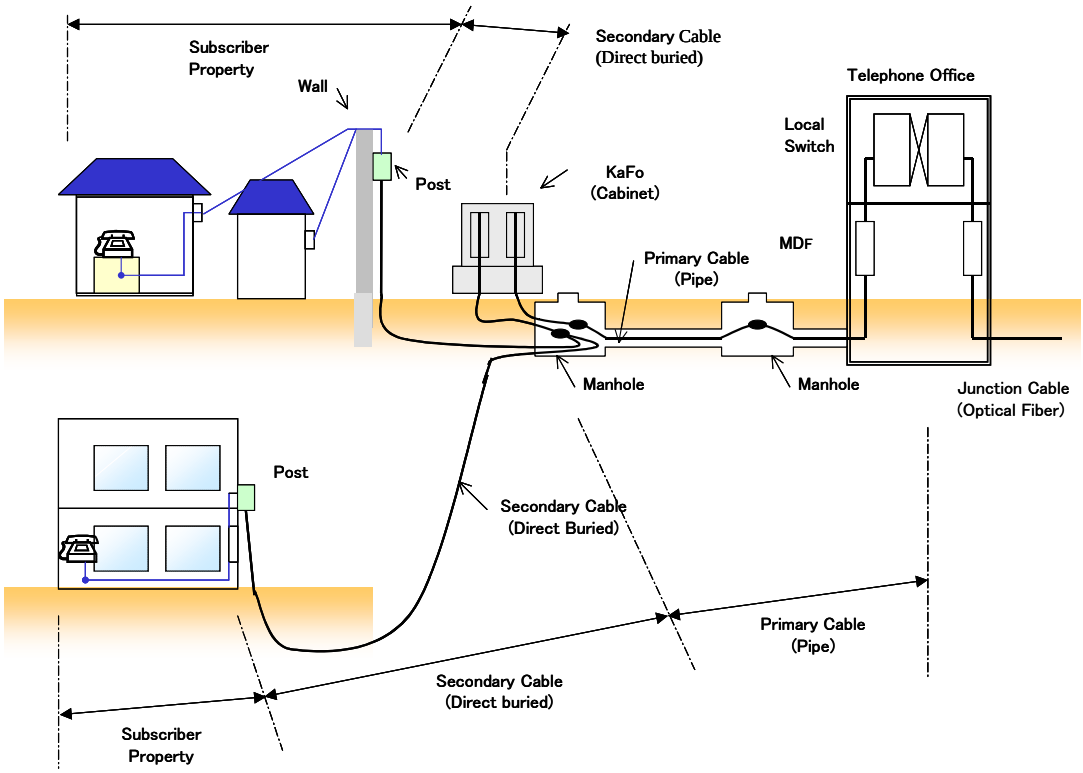


Figure 11.1.3 Illustration of Subscriber Cable Network

The following generally describes the access network in Tehran.

1. Only a 0.4 mm diameter cable is used in access network (uni-gauge system).
2. The underground duct is used for both primary and secondary cables, and overhead cable is wired only in subscriber premises.
3. Two types of distribution cabinets are adopted in the access network; one is cabinet type called “Kafo” installed at junction point of primary and secondary cables. Another is a small box type called “Post,” which is installed nearby subscriber’s premises.
4. Capacity of subscriber cable is insufficient in Tehran City, so a subscriber multiplex system is used. This means that there are several subscriber lines in one pair of cable to/from MDF.

(4) Mobile Telephone Network

The great advantage of a mobile telephone system is easier installation, compared with cable access system, which requires excavation. Therefore, excavation on a heavily trafficked road like Tehran City is required firstly in cable installation. Mobile phone system can easily expand its capacity and coverage area, and accommodates more subscribers rapidly. Total number of subscribers is around 2,000,000 at the end of year 2002 and potential demand is still a huge number.

The GSM mobile system in Tehran is divided into four management and control areas (HLR: Home Location Register Area), and BTS stations are installed within every 300-500 m radius in the city, and they are monitored and controlled by the above master stations.

It was observed in site inspection that the antenna of mobile phone is fixed in various installation practices, which can be categorized into four types from the viewpoint of earthquake resistance. Each type is described as follows:

1. Around 20 m guyed tower on the roof in the existing telephone building.
2. Tower fixed to sidewall of roof in the existing telephone building (4-5 m above rooftop).
3. 20 –30 m self-supporting tower and steel pole above the ground.
4. About 10 m tower on the roof of private and other organizations' buildings.

The typical antenna mounting practices are shown in Figure 11.1.4 and Figure 11.1.5.

Figure 11.1.4 GSM Antenna Fixture in Roof Wall

Figure 11.1.5 GSM Antenna Fixture in Guyed Tower

(5) Other System

Satellite communication system is currently operated by TCI, and three satellite stations are placed in the surrounding of Tehran City. The big dishes are faced to stationary satellites in the Indian and Atlantic Oceans.

The domestic satellite service is also operating. The hub station of the domestic service is placed in the LCT gateway station, and VSAT terminal stations are scattered all over the country.

11.1.3 Estimated Damage by Scenario Earthquake on Telecommunication System

As to telecommunication system, in this study, damage estimation is on a district basis, since an analysis of physical damage in detail is not the principal purpose of the Study.

Since the telecommunication building is so designed to support the heavy equipment such as switching equipment and diesel engine generator, the building itself seems to be stronger than other buildings. However, the telephone calls will be eventually interrupted by the collapse of many subscriber houses.

11.1.4 Countermeasures

1) Basic Concept

It became obvious after the Great Hanshin Earthquake Disaster in 1995 that the telecommunication interruption by earthquake is caused not by main telecommunication equipment but by supplementary equipment such as batteries and overhead cables. It should be noted that such damage would be caused by the collapse of a small part of the ceiling, even if the building were safe.

In case of communication breakdown, prevailing incorrect information might trigger panic and secondary disaster. The rescue and relief activities at the initial stage are the most important in order to accelerate an effective operation and stop further damages. In such activities, the telecommunication network to exchange valuable information is indispensable.

The first reinforcement plan is to strengthen the present telecommunication network. In case of a big earthquake, the reinforced network may collapse, and therefore a new disaster and rescue network, as a second plan, will be required fully considering the importance of being earthquake-resistant. However, it should be noticed that, in both networks, the flood of calls problem happen wherever the disaster occurs. Such calls congestion can be solved by call-traffic control from the existing switching system.

2) High Reliability Network Configuration

The most significant activity of TDMMC (Tehran Disaster Management and Mitigation Center) is to save the life and property of a citizen, and therefore communication disruption should not be allowed to happen.

Telephone cable in TDMMC office is connected with only one telephone exchange nearby at present, in the same as other offices and residences. So, if cable trouble were to occur, there would be no measures to recover and the communication service would be interrupted. To avoid this, subscribers should be connected with more than two exchanges. In this way, when a circuit accidentally breaks down, the remaining spare system can keep communication service without any interruption. When cable routes of the both system are closer to each other, it increases the possibility for simultaneous collapse by disaster, therefore, the both routes have to be far apart from each other. The following are concrete measures to improve the network configuration and its reliability.

(1) Multi-connections of subscriber circuit

According to the statistical data in telecommunication carrier, most of the failures in telecommunication system occur in subscriber cable section. Therefore, it is very useful that subscriber cable is to be connected to more than two exchange stations in order to secure the reliability.

(2) Multi-routes of junction circuit

In case of the junction network, similar measures having plural routes configuration should be employed in order to protect against interruption especially in optical fiber network with a large capacity.

3) Physical Reinforcement Measures

The study of disaster damage shows that main causes of communication services disruption are as follows:

1. Commercial power interruption, failures of DEG, battery and rectifier, i.e. no power feeding to all equipment
2. Mistake in installation practice such as unfit bolt size and less fixture points (it was found that some bolts are broken in DEG fixture)
3. Failure of subscriber overhead cable

The reinforcement measures should be satisfied to improve all the defects mentioned above.

To utilize the existing network as disaster information and communication system, the Study Team carried out the field inspection to confirm its possibility mainly in the following points:

- Earthquake-resistant and fireproof measures
  - Telecommunication building and facilities
  - Fireproof measures
- Redundancy network configuration

As the result of inspection, some insufficiencies are found in installation practice. They are summarized as follows:

- Various installation practices are introduced into equipment fixture, since various suppliers installed equipment in their own way.
- Some equipment is only placed on raised floor without support. It should be firmly fixed from concrete floor below to prevent the equipment from turning over.
- Tall equipment is only fixed at the bottom part. The equipment should be fixed at top part as well to prevent the equipment from its turning over.
- Precious measuring equipment and spare panels are only placed on movable rack. When earthquake hits, the rack shakes and the precious equipment will fall down, so the rack and equipment should be fixed somewhere.
- The cable hole for cabling vertically on the floor is left open without cover. The hole should be covered in order not to spread fire as a chimney effect.
- DEG and Battery fixture in some stations is insufficient. A tighter fixture is required in the heavy equipment as well as the main telecommunication equipment.
- There are roughly four types of fixture practice for mobile antenna. Considering that Iran is an earthquake-prone country, the fixture method seems to be insufficient in several stations.

Having various installation practices probably caused the above problems. Defects and insufficiency can be found usually by comparing finishing of the equipment installation, but because there are different suppliers, it is difficult to do this.

In general, major telephone companies such as TCI and TCT should have their own standard manual of installation, testing and operation, and it is recommended that TCI and TCT formulate a standard manual of installation, if they do not have one yet, ; in case they have one, it should be revised. After completion of the manual, each supplier has to follow this manual to install equipment; consequently installation finishing may be very similar, easy to compare and lead to upgrade the quality of service in TCI and TCT network. The TCI & TCT standardization program should be formulated as a part of long-term program. The Study Team proposes the following for the standardization:

- TCI and TCT should formulate their own standard manual of installation practice fully considering earthquake resistance. The installation finishing by several suppliers can be acceptable for TCI and TCT if done according to the manual thus contributing to upgrade quality of service.
- Supporting facilities such as DEG, battery and Rectifier as well as main telecommunication equipment should be firmly fastened for earthquake resistance.
- Transmission network should be formed in loop and/or multi-path configuration to provide more than one spare system.
- Seismic diagnosis program of the existing buildings is considered in this master plan, and it is recommended to diagnose the telephone building itself.

4) Utilization of the Existing Mobile and Satellite System

It is understood that radio transmission system such as mobile and satellite is considerably stronger than cable system against disaster. In fact, no serious damage was done to the mobile and satellite networks even near the disaster site in previous earthquakes. Therefore, it is indispensable to introduce the radio system in disaster information and communication network. Further study of the advantages of mobile and satellite systems is made as follows.

(1) Mobile System

Mobile telephone service gets through in Iran quickly, and introduction of mobile system has the following advantages as disaster network:

- When nearby base stations fail, the mobile phone can continue to communicate to relay via any other base stations, if the line of sight is obtained.
- Mobile phone has easy mobility in a wide area because it is small and light.
- Conveyable temporary base station can be easily installed nearby disaster site in order to cover whole disaster area, because size of base station equipment is also compact owing to technology development.

It is quite important how to decide the area size to be covered by a mobile base station for mobile network design. Generally speaking, in a metropolitan area having high density and many skyscrapers, mobile system can cover a radius of around 500-800 m, and the base stations are placed in the same interval. On the other hand, a rural area, which has less population and not many tall buildings as obstruction, can reach a larger area depending on its surrounding situation.

There is no doubt that mobile system has a big advantage, but GSM system in Iran is operating as a part of public network, and there are so many mobile base stations placed in the whole Tehran City. Since radio frequency spectrum resource is limited, it seems to be quite difficult

to secure the spectrum exclusively to the disaster network, which is basically operating only in emergency.

(2) Satellite System

Satellite system does not usually suffer from serious damages. Since the big dishes more than 10 m diameter are fixed on the tower facing toward the satellite above the equator, the antenna fixture is generally solid, and no serious damage is received by earthquake disaster. The satellite system has the following advantages over the disaster:

- Antenna fixture is so designed to withstand strong winds during typhoon; consequently there is a very low possibility to collapse tower and antenna by earthquake.
- The satellite is placed 3,600 km above the equator. There is no chance to receive any damage by earthquake.
- One satellite can cover the whole country.
- Simultaneous multi-points command can be easily performed; it is very effective to instruct the public by voice announcement for relief and evacuation operations.

Microwave system is normally repeated at each 40-50 km interval, while satellite system can cover the whole country by one repeating. Therefore, where distance between radio stations is longer, satellite system shows more advantages. This Master Plan is focused only within Tehran area, so cost merit by satellite system cannot be fully exemplified.

The satellite system is clearly preferable for disaster network as it is earthquake-resistant; however, lease cost of satellite transponder is still too expensive. In addition, the disaster network cannot be expected to collect a fee from the public, so it becomes not feasible for disaster communication network. On the other hand, technology development is aggressively advanced in the field of satellite system to dissolve the high cost problem. For example, satellite terminal cost becomes drastically low, and compact and movable in size, and the technology development how to reduce the transponder's high cost is advanced. A way to reduce cost is to use the expensive transponder only when transmitting, which is called DAMA system (Demand Assignment Multiple Access). And VSAT system is used to contribute to lowering the cost. VSAT system consists of many stations with small size antenna, and VSAT service is currently operated by TCI.

Although satellite system is expensive, it is attractive because the system can cover all stations located across the country by one repeating. Convenient cost is to be realized by the technology development, and then, the satellite system will be introduced more frequently in disaster network.

5) New Disaster Information and Telecommunication Network

The reinforcement plan of the existing network has big advantages in terms of cost and work volume, but it is feared that the disaster network may be collapsed by strong earthquake beyond expectation. In order to overcome this, the independent disaster information and communication network should be newly constructed considering full condition against earthquake. The following explain construction of the new disaster network.

(1) Necessary Information in Disaster and Rescue Network

To know what kind of information is exchanged during rescue operation is required to decide the network configuration. The information is divided into two types; one is for general public including victims and another is for search and rescue operations.

The former information is summarized as follows: The information was collected by questionnaire survey after Kobe disaster.

- Information on after shock and fire outbreak
- Safety information regarding family, friends and relatives
- Details of earthquake such as hypocenter and seismic intensity

And the formation required for search and rescue operations is summarized below.

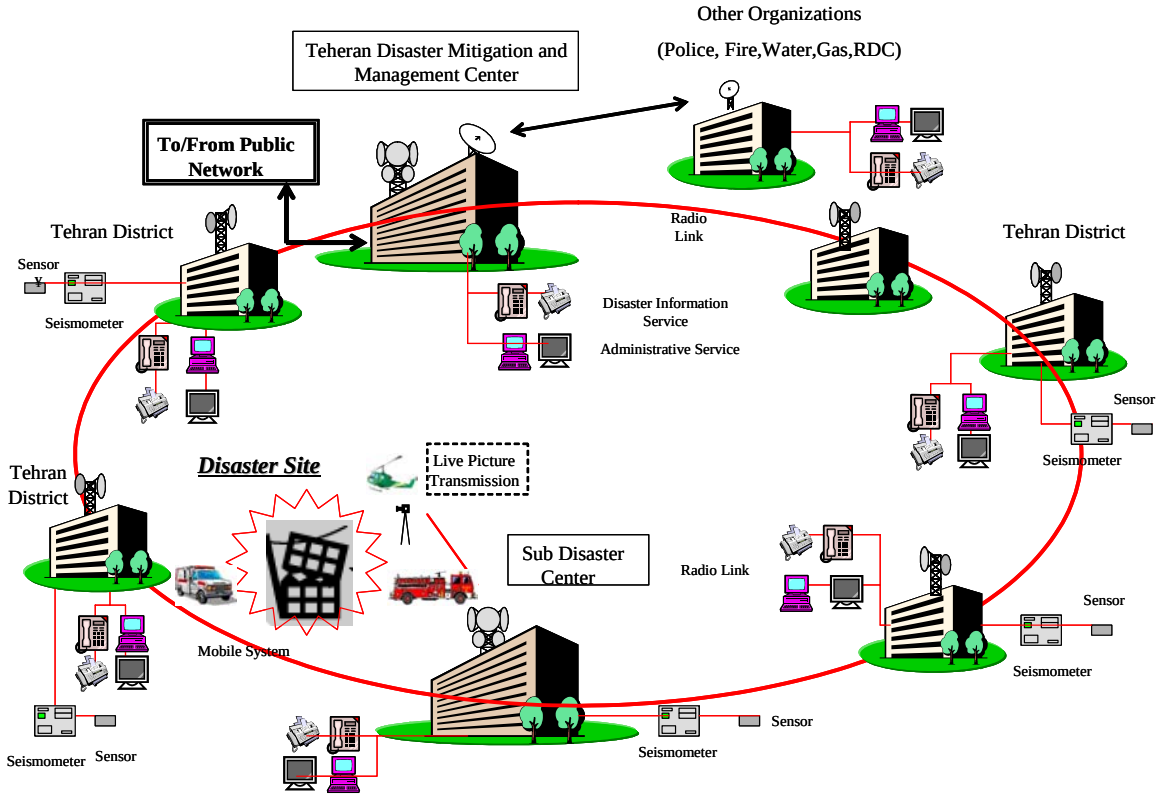
- Number of victims to be nursed in each area
- Road blockade information
- Notification of designated evacuation route and place
- Commodity supply such as water and food

(2) General Configuration of Disaster and Rescue Network

The new disaster network basically consists of backbone network and access system. The backbone network is connected with TDMMC centers and 22 district centers by microwave radio system. Figure 11.1.6 shows typical configuration of disaster network. The main TDMMC center is the most significant hub station to cover the whole Tehran area; its major functions are to collect and analyze the seismometer data, and to exchange the latest disaster and damage information to support the decision-making. If main TDMMC station is to be collapsed, all search and rescue operation will be completely halted. So, it should be required that TDMMC sub-centers undertake all functions as main center in order to continue the significant activities.

The selection standard of the TDMMC sub-center should be considered to avoid simultaneous collapse, so there are at least two conditions: enough separation distance between centers, and no large seismic intensity in the area. According to the total vulnerability diagnosis map in the

previous Seismic Microzoning study, serious damage is expected in the southern part of Tehran City, which has 10 to 20 districts.



Source: JICA Study Team

Figure 11.1.6 Typical Configuration of Disaster Network

A. Backbone Network

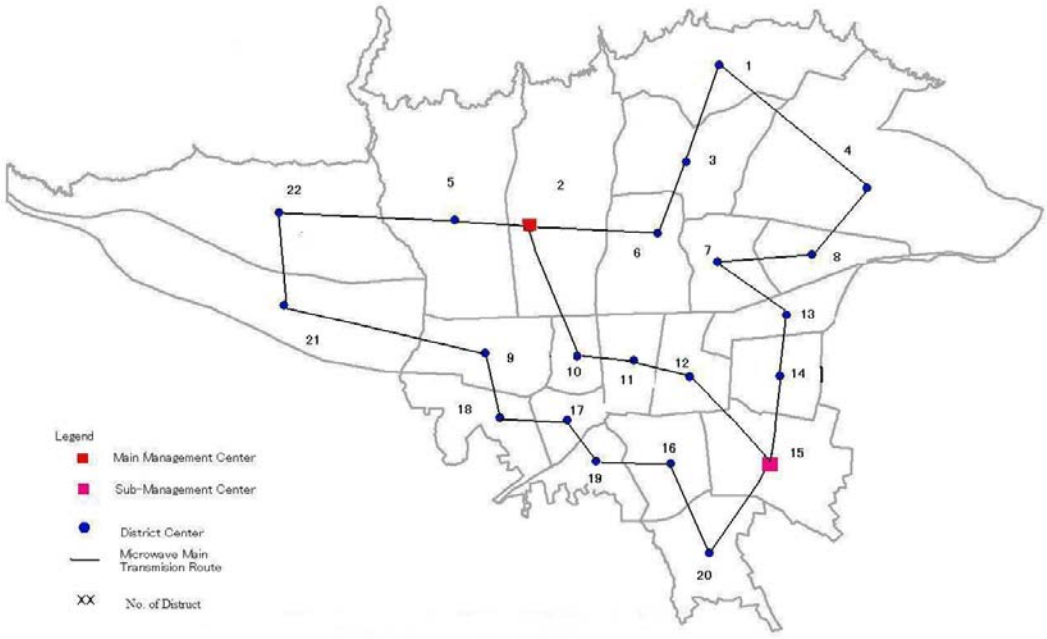
Backbone microwave network is connected with TCMMC centers and each of the 22 district stations, and the transmission route is configured with loop and multi-path formations in order to secure high reliability. Figure 11.1.7 shows microwave backbone transmission route plan.

At present, most of proposed sites are not yet decided in their locations except TDMMC main center. For estimations of system outline and total project cost, the following assumption is made:

- Each district station is located around the geographic center of district
- Antenna height in all backbone stations is 50 m above ground

Antenna height in the backbone microwave system is normally calculated to keep 100% of the fresnel clearance, so circuit quality of the system can be secured to the same high level as the public network. Since this network is planned only for emergency use, it should be desirable to make effective use of the network even during ordinary situation. The following are suggestions on how to use the high quality network:

- To use in daily correspondences such as telephone and FAX within TDMMC organization instead of pay public phone.
- To use TCP/IP protocol in order to enable Internet services access.
- To use in community level enlightenment in order to advance consciousness of the disaster prevention attitude of general public and TDMMC personnel.



Source: JICA Study Team

Figure 11.1.7 Microwave Backbone Transmission Route Plan

B. Accesses Network

Access network is to connect between operation taskforce in the disaster area and the backbone microwave system. The operation teams are normally working with rescue vehicles, so it is indispensable for these teams to establish smooth communication with those vehicles wherever they are. As far as rescue vehicles are concerned, they should be equipped with easy communication equipment, in addition to being earthquake-resistant.

As a result, the following three radio systems are desirable for access network of the disaster system:

- New independent mobile system operated
- Satellite network with small terminal station
- GSM network as a part of public network

The above three are acceptable in terms of mobility and earthquake resistance. The satellite system is already explained not to be feasible for the disaster network because of high cost. GSM mobile system has serious obstruction, namely frequency assignment and flood calls outbreak. Therefore, if the frequency band can be assigned by the Ministry of Post, Telegraph and Telephone, it is fully worthwhile to study further the possibility of its introduction into the disaster network.

Considering all the circumstances, the new independent mobile system is recommended. Figure 11.1.8 shows typical configuration of disaster access network, and the access network is the nearest to the disaster site. In order that TDMMC will operate smoothly, the mobile access network should have the following functions.

1. Seismic Intensity Data Collection

   Seismic intensity data from 22 seismic stations installed in each district is transmitted to TDMMC main center; 24 hours observation is required for an unexpected disaster outbreak. The seismic data is used for estimation of damage scale just after the outbreak to set up suitable organization for search and rescue operation immediately.

2. Disaster and Rescue Information

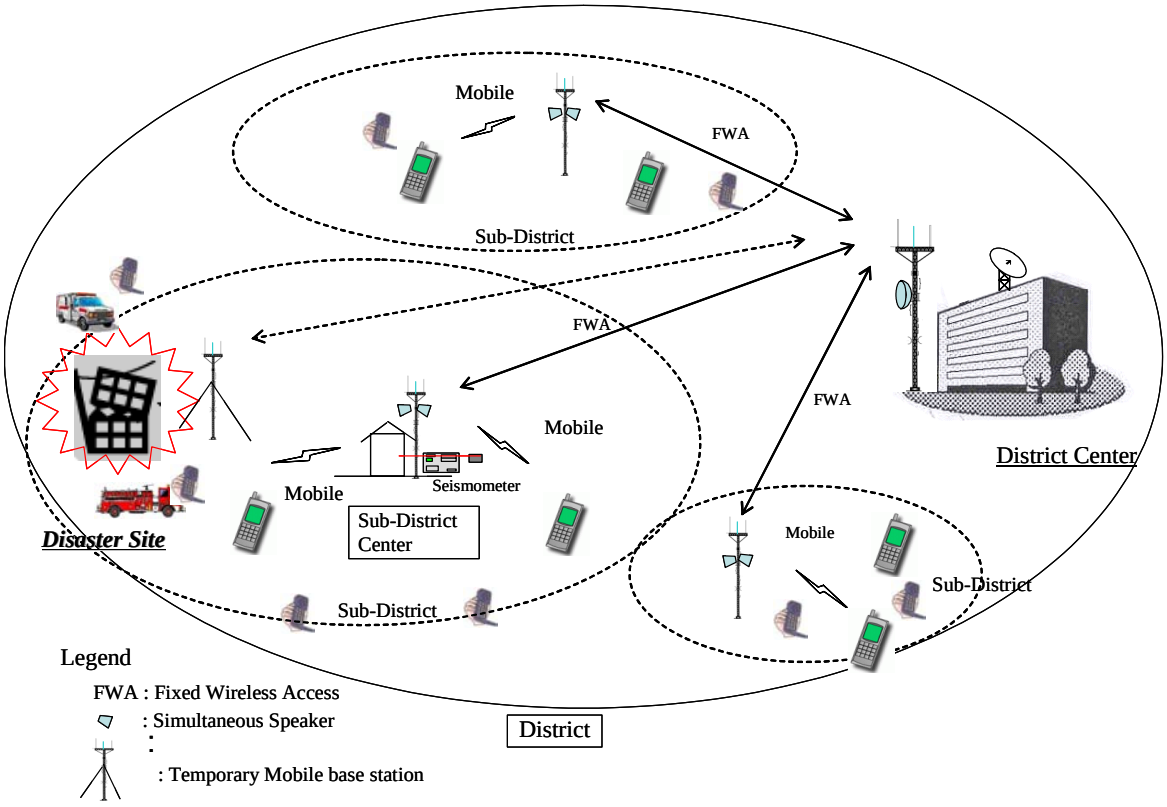
   In order to support search and rescue operation effectively, the latest disaster and damage information is circulated among not only TDMMC centers and other offices, but also all other associated organizations such as Government, Police, Fire department, Gas and Water companies and Red Crescent Society.

3. Voice Simultaneous Announcement

   The voice announcement will be transmitted for emergency instruction, such as disaster and damage and evacuation information, by speakers mounted on the tower or pole in each sub-district site.

4. Disaster Information for Communities Concerned

   This network gathers necessary information for community such as medical, lifeline (gas, water), and road condition in order to share the required information about what is happening around them.



Source: JICA Study Team

Figure 11.1.8 Typical Configuration of Disaster Access Network

(3) Selection of Proper Access Network

Mobile system is already known to be preferable in access network, but there are many types of mobile systems operated all over the world. For example, GSM system of European standard is the largest in the world in number of subscribers, PDC and PHS are mainly used only in Japan and CDMA system, which is the latest mobile protocol, is rapidly gaining popularity worldwide.

In this Master Plan, the first priority should be given to adoption of PHS (Personal Handy-phone System) mobile as access system of the disaster network. Japanese standard PHS, which is developed from cordless phone, has more than 40 million subscribers, and it becomes the third largest protocol in the world.

Utilization of the existing GSM system is still very attractive as the disaster network. However, GSM has the following comparatively serious disadvantages:

- Considering its rapidly increasing potential demand, to assign basic mobile infrastructure resources should be given preference over the waiting subscribers for public use. Therefore, it should be practically difficult for the independent disaster network to secure the exclusive frequency and transmission channels.

- As far as GSM system being a part of public network, it is impossible to escape from flood calls of troubles, and so calls for emergency rescue operation are not completely available.

On the other hand, adoption of PHS system in disaster access network can expect the following advantages:

- Higher voice quality
- Less unnecessary electromagnetic wave
- Low cost
- Higher effective frequency spectrum usage by multi-access
- High quality data transmission (29.2 kbp/ch)
- Third-party communication
- Hand-free communication (both hands can be available while talking)

PHS system is developed not only for public network but also for private network, which is closed network within private purposes such as disaster communication network. And exclusive frequency can be assigned to the private network. This is the most desirable advantage of PHS system – no flood calls and frequency interference with public network.

Although PHS has many advantages, it has serious disadvantage for disaster access networking. Since the access network should be covering the whole district area including disaster site, mobile phone, especially PHS system, can only cover a limited area of about 500 m to1 km radius because of its low output transmitting power.

Using a PHS-FWA system is expected to solve the distance problem. FWA (Fixed Wireless Access), also called WLL system, is to connect between fixed radio stations, so that both stations can mount big and heavy antennas which are expected to boost transmission, thereby extending the distance.

FWA can be connected about 5-10 km in radio path distance depending on system parameter, and if introduced between district center and sub-district site, its distance is also about 5-10 km in average.

FWA system is outlined as follow.

- Each sub-district site is located around the geographic center of sub-district.
- Antenna height in FWA system is 30 m above ground.

The service feasible area by public mobile network is open to more than 90% of inhabitant area, i.e. not land area but population ratio. Considering the above service area specification,

the required number of base stations is decided and those stations are installed at proper intervals. In case of the disaster communication network, the coverage area has to be considerably smaller because of financial reason, that is, the disaster network cannot be expected to collect communication charge from subscribers. There is a larger weak signal area found in the disaster network, but it can be easy to recover communication sifting the position nearby to secure line of sight to any base station.

(4) System Configuration of New Disaster Information and Telecommunication Network

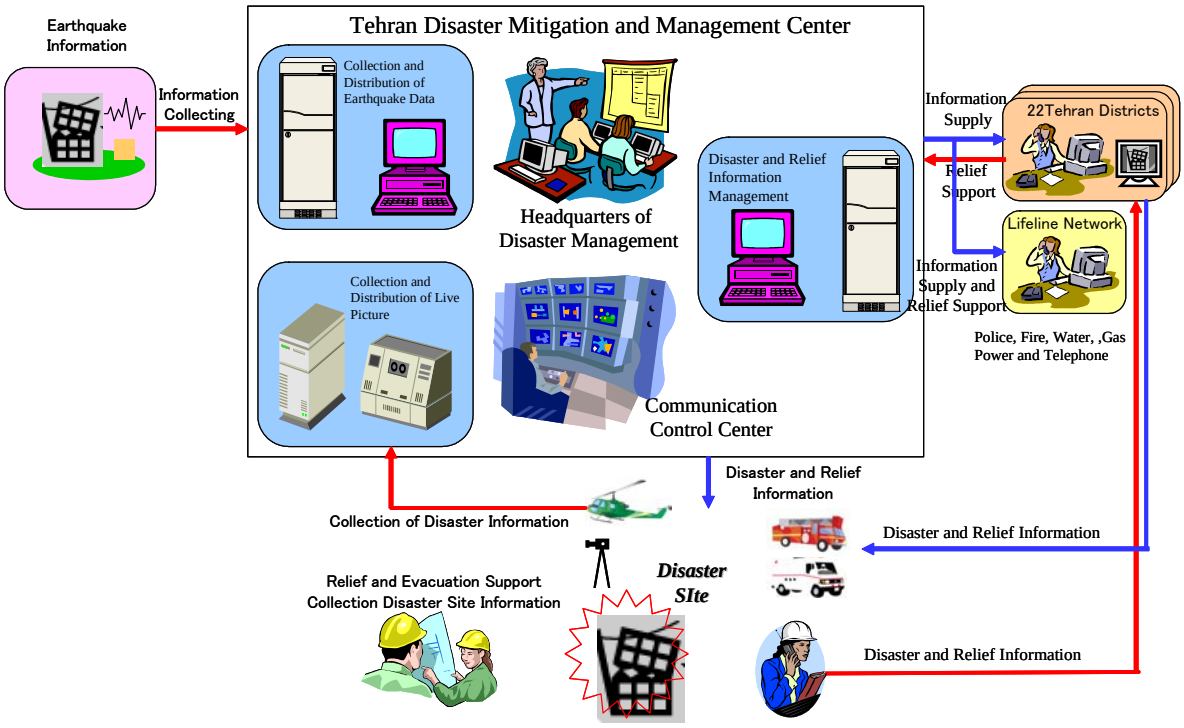
The disaster network consists of backbone system and access system, and the both connect with various node stations. The following is outline of typical node stations.

A. TDMMC Main & Sub-Center

The main TDMMC center is the most significant station to manage disaster search and rescue operations in the whole Tehran area. Its primary function is collection of disaster and damage information to/from Police, fire department, lifeline and other associated organizations. Based on collected information, support to make final decision for over all operation is also one of its important functions. Figure 11.1.9 shows outline of TDMMC disaster management center, and the concrete functions are;

- Set up the disaster and rescue head office
- Collection and analysis of seismic intensity data
- Calculation of damage size based on collected information
- Distribution of necessary disaster information to rescue team, press, and associated organizations
- Support and management of rescue operation more effectively
- Notification of disaster information and instruction of evacuation to the people living in the disaster area.
- Operation and maintenance of disaster information and communication network
- Gateway function with public telephone network and other organizations concerned

It is obvious that effective rescue operation can be achieved depending on how soon search and rescue structure in the initial stage can be well organized. In order to make quick decision, TDMMC main center is furnished with some support facilities of decision-making such as two 100-inch large-display and two 50-inch 4-screen multi-display.



Source: JICA Study Team

Figure 11.1.9 Outline of TDMMC

In the first stage, only seismic intensity data is scheduled to be managed, but all weather information will be introduced in future to transform TDMMC into a total weather observation center, in order to make a more accurate forecast.

B. District Center

District center sets up acting as search and rescue operations office near the disaster area, and the main function is supporting the TDMMC main center in the following manner:

- Gathering all required information from disaster site and forwarding to TDMMC main center, and vice versa
- Giving instruction to lifeline organizations such as Gas, Water, Electricity in order to prevent enlargement of damage
- Acting as interface between access network and backbone system

C. Sub-district Station

This station is the nearest to the disaster site and coverage is the smallest. So, voice announcement becomes effective to neighboring areas. This is un-attendant station with small shelter type, tower/pole and loudspeaker. The functions are:

- Collection of the latest information from disaster site and forwarding to TDMMC main center

- Based on information and suggestion from TDMMC main center, this station makes evacuation instruction such as route and place to the neighboring area by loudspeaker.
- Installation of seismometer in one sub-district station within a district, and sending its data to TDMMC main center
- Provision and storage of emergency communication equipment and mobile radio terminals

D. Power System

A commercial power company supplies electricity to telecommunication facilities and equipment. When disaster strikes, power supply may be often interrupted, and power failure puts a stop to all telecommunication equipment.

In addition, this network is operating for search and rescue operations, so power failure should not be allowed to happen. The following measures are required in order to keep operating even when power fails or is constantly interrupted:

- All district centers should have DEG (Diesel Engine Generator), battery and rectifier as primary power sources instead of commercial power; the capacity of DEG can cover not only telecommunication equipment but also additional facilities to maintain the minimum function of the role of disaster center.
- All sub-district stations have rectifier and battery; the battery should last for 8 hours.
- TDMMC main and sub-centers should be provided with emergency mobile type DEG. It will be used in sub-district station when battery capacity is discharged. The DEG, rectifier and battery are already installed for emergency in TDMMC buildings.

E. Operation and Maintenance for Disaster Communication Network

The proposed disaster network is comparatively small than the general public network in network size, but it consists of a complete set of all telecommunication segments such as switching, transmission and subscriber terminal. When the network will be completed, TDMMC personnel have to start execution of operation and maintenance (OM) work of the full-scale disaster communication network. When this happens, it will be the first time for TDMMC to manage this kind of OM work, so personnel training is a matter of great urgency. However the fund and time are not perfectly settled as yet. In order to solve the problem, proposal for effective training is given in the following:

<u>Supplier's OJT program</u>

In general, TDMMC should enter into a one-year contract with the equipment supplier for operation and maintenance support. Since the supplier should be very familiar with the new system, TDMMC personnel can master know-how through the OJT with supplier's experts.

Work with TCI and TCT engineers

TCI and TCT have similar supervision and control system for the whole telecommunication network in Iran, so TDMMC may invite TCI and TCT engineers to work together and to learn from them through daily OJT operation.

The actual operation and maintenance work in TDMMC main center should be 24 hours basis against disaster, and major OM functions are summarized as follows: monitoring seismic intensity data, operating of the disaster information and communication network, monitoring alarm indication, analyzing and repair operation.

In order to make the works smooth, introduction of PCs and OM standard manuals is indispensable. Legacy technique for OM work is mainly depending on manpower, but the recent network is to be so complicated, so the legacy way becomes ineffective now.

ITU (International Telecommunication Union) recognized that the recent telecommunication network becomes extremely significant for daily life and complicated at the same time, and proposes various recommendations to formulate standardization for OM activities as TMN (Total Management Network) program.

In order to carry out smooth operation, TDMMC should formulate the standard OM manual before commencement by assistance of TCI, TCT and equipment supplier referring to ITU TMN recommendations. When the manual will be completed, TDMMC personnel can easily execute the OM work referring the instruction in own manual.

6) Countermeasure for Flood of Calls Problem

A flood of calls is similar to traffic jam happened in road. It makes the communication for emergency command or information collection difficult. There should be a switching system to control the traffic.

Traffic control is to restrict the amount of calls. However, in order to reduce the amount of calls for information inquiry, the use of message box to provide necessary information to the public is one method to be considered. In addition, it is worth recommending that safety information be frequently broadcasted to the public on TV and radio and by telephone. This type of information dissemination elicited great appreciation from the public in Japan.

(1) Traffic Control Function

The inquiry calls tend to increase when disaster news is broadcasted on TV and radio, and the calls will not stop until callers obtain satisfactory answers. The switching system near a disaster area may be overloaded due to an excessive number of inquiry calls; consequently, urgent calls by police, fire department and other authorized organizations have no chance to get through and finally the switching system becomes clogged.

Most switching systems are equipped with various traffic control functions, which depend on the switching equipment itself and/or signaling system. The main traffic restrictions are:

- Restriction of original calls (local switch)
- Restriction of incoming calls (toll switch)
- Restriction of outgoing calls to specific destinations (local switch and toll switch)
- Restriction of outgoing calls to specific routes (toll switch)
- Call blocking (local switch and toll switch)

(2) Disaster Message Service

This service is intended to exchange necessary information about safety of family or friends from other areas, even if traffic control is executed. The outline of this service is firstly to set up the mailbox like a message board, and the safety information by victims is kept in the box. People who want to know about family and friends can access and get the information from the mailbox. The telephone calls are very congested around the disaster area, but there are fully vacant circuits in other areas. This service can be managed by a Telephone Company like TCI and TCT in order to utilize the resources effectively.

The points of this service are to give up direct conversation and ask for only safety information of family and friends, but it is enough information for those people. In addition, the traffic volume of this service is so small that many people can utilize this massage system.

11.2 Search and Rescue

The plan for search and rescue contains conceptual ideas for further development by Iranian authorities, since none of organizations in charge has yet established any response or operation plan that shows the way to deploy its forces in destructive disasters.

11.2.1 Current Situation

1) Critical Shortage of Resources

(1) Search and Rescue

Search and rescue for the trapped in hundreds of thousands of collapsed buildings requires massive mobilization and deployment of professional teams with special equipment and machinery within a couple of days of the impact. Number of buildings that may be damaged severely is estimated to amount to 483,000 in Ray Fault model, 313,000 in North Tehran Fault model and 113,000 even in Mosha Fault model.

It is clear that available workforce currently will be far below this enormous requirement even for only 1,000 incidents. And this critical shortage of rescue forces indicates that no organized operations by professional teams may reach to the communities deeply however severely damaged they will be, leaving them with self-relief activities. Accordingly, to prioritize the facilities and places to go to work on before the disaster is crucially important. Hospitals will be one of the highest priority facilities among them.

(2) Field Medical Treatment on the scene

A. Facility

For mass casualty management, Advanced Medical Posts (AMP), which are temporary facilities to provide triage, first aids and transportation, must be set up on the disaster scenes. Almost 3,000 AMPs, which are supposed to deploy at the scenes, evacuation places and hospital sites, need to be set up for triage and first aid provisions for more than a million casualties within 24 hours after the earthquake impact. There is clearly not enough resource prepared at all to meet this enormous requirement.

B. Health staff

No fewer than 6,000 teams involving 18,000 medical doctors will be required to deploy at 3,000 AMPs, assuming that a team consists of 3 doctors on two shifts around the clock. This number of doctors is more than twice the 7,500 doctors in Tehran province under MOH. And even if all private practitioners in Tehran could be mobilized, the available number of doctors would still not be enough.

(3) Difficulties in coordination with other agencies in charge

Article 44 of the Relief and Rescue Comprehensive Plan defines the leading role of the Red Crescent Society. But there is still no coordinating and adjusting mechanism about the search and rescue operations among several organizations to cooperate with Red Crescent Society.

2) Other issues on coordination:

- Less coordination on providing Emergency Medical Services with MOH&ME.
- Slow progress in acquisition of lands by Tehran municipality for Red Crescent's rescue bases.
- Slow progress on improvement of Fire Brigade's plan to strengthen its manpower, fire stations and vehicles.
- Less coordination on supply management of international assistance goods, and little training of SUMA system and its distribution

  SUMA is an abbreviation of the term "Humanitarian Supply Management and Logistics in the Health Sector". It is an established system to handle emergency supply developed and promoted by World Health Organization (WHO).
- No pre-arrangement of the places for Advanced Medical Posts for mass casualty treatment, etc.

11.2.2 Frameworks

1) Objective

The overall objective of "Search and Rescue" operations will be "to save as many lives as possible – those trapped and in danger – in E3 to E4 level situations created by earthquakes".

2) Institutional Prerequisite for Implementation

Search and Rescue operations will be implemented in accordance with the following provisions:

- Relief and Rescue Comprehensive Plan of April 2003
- Tehran Comprehensive Emergency Management Plan (TCEMP) of May 2001

Article 43 in the Relief and Rescue Comprehensive Plan endorses the leading position of RCS in search and rescue activity. TCEMP defines responsible agencies as the RCS together with some cooperating or backup agencies listed in Table 11.2.1.

Table 11.2.1 Responsible Organizations for Rescue and Relief Activities

Activity	Agency in charge	Cooperating (Partner) Agencies
Search and Rescue Operation	RCS Tehran Provincial Branch at E2 and E3 Levels National Society at E4 level	*Tehran Fire Brigade & Safety Services *Basij
First Aid	RCS Tehran Provincial Branch at E2 and E3 Levels National Society at E4 level	*Tehran Fire Brigade & Safety Services *Tehran Emergency Medical Service Center *Ministry of Health - Deputy of Health *Tehran Medical University – Deputy of Treatment & Drugs
Transfer & Evacuation of the injured	RCS Tehran Provincial Branch at E2 and E3 Levels National Society at E4 level	*Tehran Emergency Medical Service Center *Ministry of Health - Deputy of Health *Tehran Medical University – Deputy of Treatment & Drugs *I.R.I. Armed Forces *Sepah

Source: JICA Study Team

Response plans, protocols, to implement the operations must be in place at every responsible agency. Among them, the rescue and relief committee in TDMMC has been developing the Standard Operation Procedures. In addition, establishing Incident Command System (ICS) or any other standardized organizational structure in emergency mode will be added to the list of prerequisites. Suggestions in the sub-chapter “Search & Rescue” are developed on the basis of these existing plans.

3) Strategies

Tehran does not have the resources to conduct massive search and rescue operations after the earthquake. Given the circumstances, some important strategies to fulfill the overall objective will be to:

1. Establish an effective coordinating system directed by a strong leadership in order to deploy resources from various organizations on the priority areas in an integrated manner

   Search and Rescue operation is commonly understood to be critically effective until 72 hours after the destruction by the earthquake. Only a simplified system to make decisions, command and coordination can make it possible to mobilize the resources across the country and to deploy them on the scenes effectively.

2. Achieve an effect by planned operation based on the database and information system

   Search & Rescue should be effectively carried out in the shortest time by utilizing information system such as the GIS to avoid overlapping and overleaping searches and to know potential scale of the trapped.

3. Utilize the community resources for disaster response to the fullest extent

   Considering the estimated damages, it will be impossible to deploy Search & Rescue teams into countless collapsed buildings. Rescue operations reaching the people in time will count on community people's participation for the trapped in ruins of residential buildings.

4. Establish Mass Casualty Management as a part of systematic response

   Tertiary level hospitals need to be protected from being overwhelmed by massive light cases. Establishment of control system of victims' flow from community to hospitals is crucially important for effective treatment.

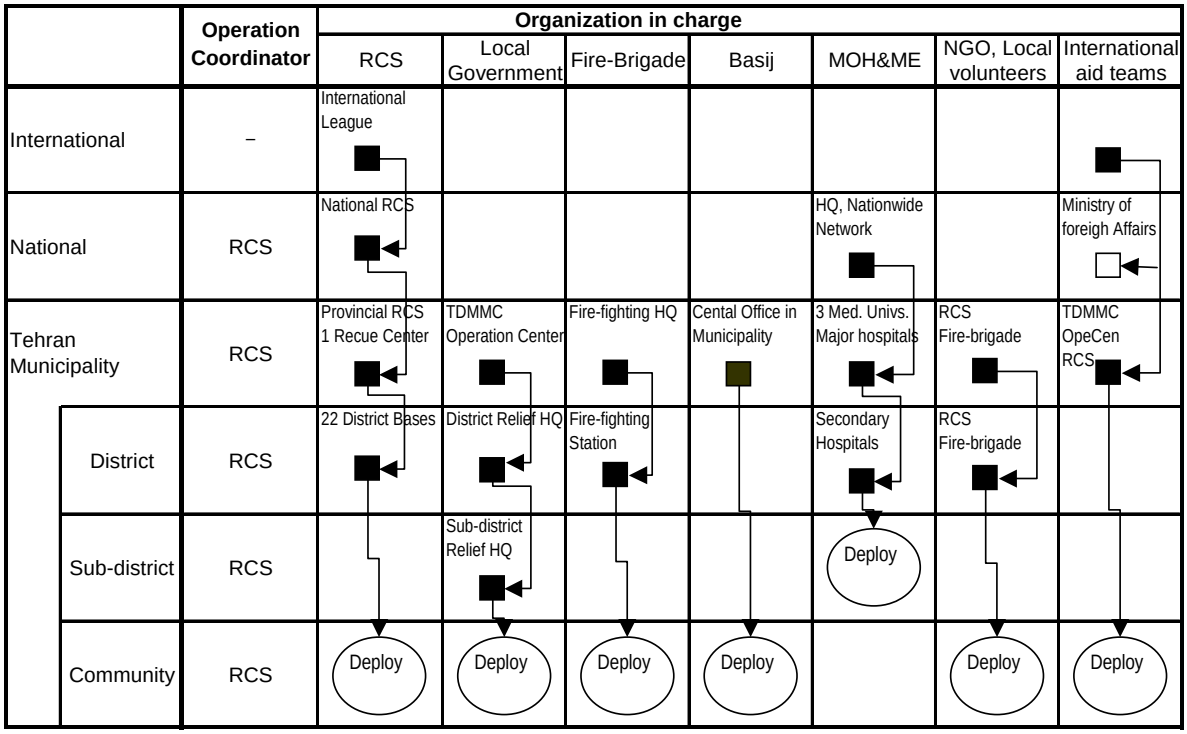
11.2.3 Operation Policy

1) Basic Arrangements

RCS bears primary responsibility to implement, coordinate and evaluate "Search & Rescue" operations. Every agency carries out its activities according to its own response plan, which needs to be prepared and coordinated beforehand based on the general SOP formulated by TDMMC, otherwise they will receive instruction from the RCS.

Figure 11.2.1 illustrates the vertical structure of various Search & Rescue organizations and the overview of their horizontal relations. Many international relief teams will be inevitably involved in the operations as well. In the figure, symbol "■"shows the operation bases of organizations in charge, e.g. RCS has operation bases at four levels: its international league over the world, national network in Iran, provincial network at Tehran and its 22 district bases just under development from which RCS search and rescue teams will deploy over the damaged areas. Symbol "□" shows that Ministry of Foreign Affairs will play a role of window to receive International aid teams, not an actual base for their operation. And symbol "→" shows the direction of search and/or rescue forces from higher or wider level to community levels.

The figure indicates the crucial importance of coordination among organizations since at least six and more teams from different organizations are supposed to operate on the scenes (as for Basij no information is available so far). RCS is appointed as a coordinator for search and rescue operation at all levels, and interrelation among organizations is defined in TCEMP. Also, MOH&ME and three medical universities in Tehran bear the responsibility to manage the services to care for the rescued victims.



Source: JICA Study Team

Figure 11.2.1 Vertical Structure of Search & Rescue Organizations

Priority places/facilities for rescue operation will be selected in the coordinating meeting right after the damage assessment. The selection will be based on prearranged criteria on importance and effectiveness of places/facilities, in which abundant human and physical resources will be intensively placed.

Mobilization of heavy machinery, vehicles and ambulance services in private sector will be carried into effect, based on the pre-arrangement between the RCS and private companies.

District is an administrative and spatial unit for operation in principle, and 21 Rescue Bases of the RCS in Tehran will provide footholds for search and rescue activities.

2) Rescue

Responsible organizations will deploy their teams based on their rescue and relief bases.

(1) RCS

It has developed rescue and relief bases from national, provincial down to district level and has a plan to expand its bases in and out of Tehran Municipality (see Table 11.2.2). Two of 22 district bases have been only realized so far.

Table 11.2.2 Planned Rescue & Relief Bases of RCS

Place	Type	Purpose	Q'ty
Tehran municipality	Rescue Management Center Rescue & Relief Station Cargo Station near Airport	1. Central nerve 2. District bases 3. International aids	1 22 1
Tehran province	1. Rescue Stations in 10 cities 2. Road Rescue Stations 3. Inner City Rescue Stations	1. Each city bases 2. For road accident 3. Back up, Warehouse	10 6 5
Surrounding provinces	Rescue Station	Province's domain	4

Source: Preparation programs for natural disasters and accidents, I.R.I. RCS, 2000

(2) Local Governments

22 District governments will operate their rescue and relief activities based on their District Headquarters and sub-district offices in coordination with RCS. Only District municipalities have bases to operate closely to the communities.

(3) Tehran Fire Brigade

It has four jurisdictions in the Municipality and develops the network of 40 major stations and 20 sub-stations with almost 1,500 active trained staff and vehicles over the area. In this sense, it has the most organized network to carry out the search and rescue operation reaching easily to the community level for the moment, although its human and physical capacities are still far below the standard level in the advanced countries.

Following are some ideas to carry out the effective operations in this area.

1. To utilize the GIS for search and rescue operations: This will become a common tool to share information among organizations and teams to know the priority places to search by database of population, number of residences, building structures, etc, and especially to avoid searching redundantly or slipping over.

2. To study how many teams with proper equipment can be mobilized: Table 11.2.3 shows one example of search and rescue teams at three levels. In principle, one District Rescue Team and ten Community Rescue Teams may be mobilized in a district impartially, while two to three Hyper-Rescue Teams, which are equipped with advanced search devices, will be dispatched to the highest priority facilities. It is essential that potential capacity of every organization to formulate such teams is sanctioned and coordinated beforehand.

Table 11.2.3 Search and Rescue Teams Formation

Level	Team category	Target/Area	Personnel/Equipment
III	Hyper-rescue team : 100 – 200 staff	Target: Priority facility Area: Metropolitan area	Personnel: Experts team from Fire Brigade *Imaging (fiberscope) search equipment *Thermograph detector *Night-viewer *Ground sonar receiver
II	District rescue team : 20 – 100 staff	Target: Mid- and high- rise buildings Area: District	Personnel: Trained team but supported with Experts from Fire Brigade and RCS *Imaging (fiberscope) search equipment *Hydraulic rescue machine *Air compressor rescue machine *Steel cutter *Mobile winch
I	Sub-district rescue team : 10 – 20 staff	Target: Conventional residential building Area: Sub-district	Personnel: Trained team from RCS with people's cooperation *Universal hammer *Chain saw *Steel cutter *Rock drill (lightweight) *Pinch bar (large) *Saw, rope, shovel, etc.

Source: JICA Study Team

3. To organize and train the volunteers and community people to support the professional rescue works: RCS has a plan to develop training programs for rescue and relief activities, but this will not be enough to meet the expected needs. Municipality government and Fire Brigade should bear the responsibility to foster volunteers for this purpose.

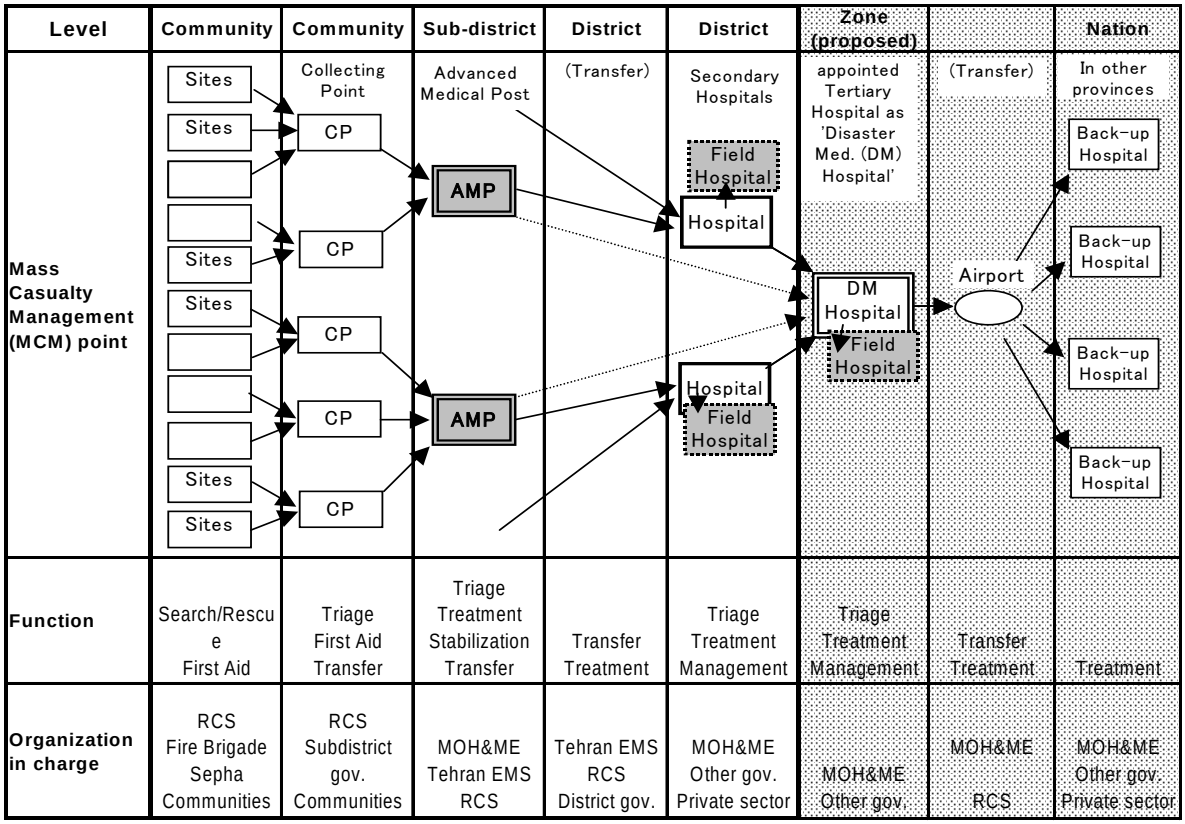
4. To utilize the foreign rescue and relief teams that rush to come to the country to compensate for the critical shortage of local forces during a destructive earthquake: Careful simulation of the rescue operations based on the damage estimation by the Study Team will give an indication of areas to be covered by foreign teams.

3) Field Care

Casualties will be managed through the standardized Mass Casualty Management (MCM) System, from rescue scenes to hospitals through Advanced Medical Posts (AMP), which are supposed to be set up at affected area as shown in Figure 11.2.2. The figure illustrates a model of MCM system in Tehran in the earthquake disaster. This principal structure has been developed based on the guidelines by Pan American Health Organization (PAHO) and World Health Organization (WHO).

Among three operational areas of District, Zone and Nation proposed in the structure, District is the area for rescue chain which will come into effect with four vital components: Collecting Points at communities, AMPs at sub-district and minimally one Hospital at district in addition to Transfer Services between them.

1. Collecting Point: At affected sites in the communities, numerous collecting points will be set up close to collapsed houses/buildings to secure live victims rescued by people and teams. CP is the temporary facility to provide on-site triage and first aid before transferring victims to AMP. This will be organized by RCS, sub-district offices and community people and will be maintained for a couple of days after the impact. Any type of vehicles available will transfer victims locally.



Source: JICA Study Team

Figure 11.2.2 Principal Structure of Medical Relief in the Zone

2. AMP: AMPs are the key facilities in proper operation of the mass casualty management system. Considering the estimated situations in the aftermath, one sub-district may need one to three AMPs, depending on the magnitude of damages, to manage the casualties effectively. AMPs will be set up on the secured places like the appointed evacuation space to keep in place for two weeks to one month. AMP will play a role of checkpoint before sending the injured to hospitals to control their flow. Its role will shift with time as shown in Table 11.2.4, since treatment for surgical cases will be dominant during the first several days but needs for care will certainly shift to those with acute internal injuries followed by patients with chronic diseases after the emergency period.

Table 11.2.4 Role of Team at AMP

Time, Place & Job principles
A. During emergency period – for first 5 to 7 days after the impact
1. Target: citizens who are injured by impact or fire 2. Place: At the entrance of health center, hospital and in evacuation places 3. Major roles are to: 1) Provide first aid at collecting points 2) Carry out triage, minimal treatment and transfer severe cases to hospitals after stabilization 3) Open 24 hours 4) Have drugs, consumables and equipment for trauma cases mainly
B. Post emergency period – from 6th to 8th day onward
1. Target: evacuated people at shelters and camps, and patients who need care at sites 2. Place: not always AMP but at fixed shelters/camps and affected area on visiting base 3. Major roles are to: 1) Transfer severe cases to hospitals 2) Provide 12 hours service for injured cases as well as acute internal and chronic cases 3) Have medical necessities for internal, chronic and mental cases mainly

Source: JICA Study Team

3. Hospital: One hospital with ER, at the least, and an operation center are indispensable to operate MCM system. And every district must have one to several secondary or tertiary level hospitals within its boundary. In case of breakdown of the appointed hospital, back-up hospital should be assigned in advance. Field hospitals have the function to enlarge the capacity of existing hospitals temporarily: 1) to receive victims from the outside, 2) to evacuate the existing inpatients from the damaged facilities and 3) to compensate for shattered functions in the existing hospitals. Hospital capacity is expected to enlarge double for inpatients and five times for outpatients.

4) Community-based Rescue and Treatment Activities

Rescue and Relief related players in community are categorized into two; one is Local authority, personnel and groups, and the other is Local Health Personnel (LHP). Role of each group is summarized by disaster period in Table 11.2.5. Community people will be organized and mobilized on a voluntary basis to assist Community Authority and Local Health Personnel.

Table 11.2.5 Role of Community and Local Health Personnel in Rescue and Relief Activities

Player	Role in the Urgent period
Local Authority*	1. Set up of **Emergency Committee** 2. Dissemination of information 3. Search and Rescue operations 4. Fire Extinguishing operations 5. Transfer of casualty 6. Assistance of Reception at Health Centers or Hospitals
Local Health Personnel	1. Assistance of Organizing Health Centers or Hospitals 2. Triage 3. On-site treatment

Note: * local authorities and persons or groups who concern themselves in the localities with rescue work, communications, transport, shelter and food supply
Source: JICA Study Team

11.2.4 Further Development

RCS is appointed as the primary agency in this sector, although Tehran Municipality, 22 district offices, and Fire Brigade have currently decided to develop the capacity to operate Rescue & Relief activities by themselves to establish networks of bases with equipment. Therefore, coordination and adjustment among related organizations in the preparedness for the disasters becomes increasingly important, especially to avoid duplicated investments for facilities and to make human resources development effective.

1. Arrangement on coordination and command mechanism among many related organizations should be made in advance.

2. Since the damages by three models of earthquake have been estimated by the microzoning method in detail, goals to be achieved in the physical and human development will be feasible now. To prepare the inventory of available resources both in public and private sectors is the first step in the coming development plan.

3. Every leading or cooperating organization must prepare a response and operation plan in a standardized manner that shows the system to deploy planned resources over the city area. This will be the second step. Standardized Response Plan must include the following components:

   - Standard Operation Procedures, which should be in accordance with TCEMP's committee plan.
   - The way to share and coordinate the works among agencies, especially between the RCS and Fire Brigade, Basij and I.R.I. Armed Forces in rescue operations, and between the RCS and MOH&ME in mass casualty management.
   - System to mobilize community people and put them to work on the scene.
   - Criteria to judge important places or facilities for priority rescue operation in occurrence of massive needs over the city at the same time.
   - Study on the feasibility of formulating and organizing community people for self-activity of disaster management.

4. Formulation and implementation of training program; individual response plan should include the program to empower the capacity and capability of both staff in the organizations and the citizens. Table 11.2.6, which is the training program of RCS in "Preparedness plan for natural disasters and accidents in Tehran, 2000," is shown as a model for any organization with ideas to develop the human resource capacity in this field.

Table 11.2.6 Summary of the Training Program of RCS

Category	Program	Target	Content	Hour
Specialized Training Course		-	-	-
1	1. Training Trainers	Trainers	Basic first aid & relief aid knowledge & skill	100 hours
2	2. Training Relief Aids	Persons who have already attended general courses	Relief operations by using tool & equipment	120 hours
3	3. Operational Managers	Rescue & Relief operation manager	Specific skills and abilities of management	Not specified
4	4. Technical & Specialized Courses	Target rescue & relief group	Ability to use all tools & equipment	100 hours
5	5. Courses for Rehearsal & Practice	Organizations	Revision and refresher of previous courses	Not specified
General Training (Self-Aid)		All type of citizens	Primary measures to mitigate effects	50 hours

Source: Preparation programs for natural disasters and accidents, I.R.I. RCS, 2000

11.3 Health and Medical Service Operations

The plan for health and medical service operation contains conceptual ideas for further development by Iranian authorities.

11.3.1 Current Situation

1) Critical Shortage of Hospital Capacity

(1) Structural vulnerability of hospital buildings

Ray Fault Model predicts that 50% of total hospitals may get severely damaged structurally. Hospitals cannot function with damages to non-structural elements and building installations as well. Therefore, no hospitals will keep functioning actually after the earthquake impacts of Ray Fault Model. Any health response plan will not work if almost all of hospitals in Tehran would be unable to function.

(2) Hospitals in aftermath

In Tehran province, there exist 137 public and private hospitals with 27,000 beds in total. Damage estimation indicates that almost 50% of whole hospital buildings in Tehran may be severely damaged, and this also suggests that another 20 to 30% will not be able to keep functioning due to damages to non-structural elements of facilities. On the assumption that 20% of hospitals may keep operational right after the earthquake impact, there remain only 27 hospitals with 5,400 beds at most for 410,000 severely injured victims. Therefore, no hospital beds will be actually left for survivors.

(3) Effect of lifeline disruption

Extensive disruption of lifelines such as electricity, water and gas are predicted for a long period in the city. Accordingly even hospitals, which may be lucky enough to survive the initial earthquake impact, are expected to function partially or very poorly unless they are supplied with water and fuel from the outside.

2) Health and Sanitary Activities

Disease prevention and Environmental health teams need to be deployed to Health Centers over the city in order to prevent the occurrences of potential infectious diseases. The teams are supposed to provide health instructions and consultation to the affected people, and to disinfect the houses and evacuation places. A total of 920 public health doctors and 1,840 nurses are required when 2 teams are assigned to 230 survived Health Centers, and the estimated requirement will by far surpass the current human resources of Health Centers in the province.

3) Fragmented Health Organization

In terms of disaster management, health sector at Tehran provincial level is fragmented at many areas: in jurisdictional areas of medical universities, in treatment, primary health care and pre-hospital care, in public and private providers, in hospitals and health centers, etc. Following are some observations to back up this view.

1. Disaster preparedness planning and policies is the responsibility of Center of Environmental and Occupational Health, not by a unit established exclusively for this task in the central MOH office. In addition, this important task has been bounced between two units of Environmental Health and Medical Emergency. This separation of Health from Treatment is observed at any MOH offices. Therefore, it is no wonder that less priority was put on treatment part in 1999's extensive guidebooks produced by 16 research projects.
2. No database system of health resources is established. Any consistent list of hospitals in Tehran was not available after all during several months study. In consequence, lack of reliable database leads to non-practical researches and plans that looks like textbooks.
3. Tehran EMS is operated by MOH&ME at national level directly, not by medical universities at provincial level. Fragmented medical service delivery system in Tehran may make it impossible to provide EMS by medical universities. And the service zoning system of EMS does not match with medical university's jurisdictions at all.

4) Little preparedness and actually no response plan in health sector

Other than TCEMP's specialized committee plan, no health disaster plan is prepared. It is very difficult to assess the health sector's capacity and capability against potential earthquake without plans and resources lists.

11.3.2 Framework

1) Objective

The overall objective of "Health and Medical Services" operations will be to reduce mortality and morbidity in E3 to E4 level situations in the aftermath of earthquake

2) Institutional Prerequisite for Implementation

Health and Medical Services will be implemented in accordance with the provisions in the following plans:

1. Relief and Rescue Comprehensive Plan of April 2003
2. Tehran Comprehensive Emergency Management Plan of May 2001

TCEMP defines responsible agencies as various units in the MOH&ME together with some cooperating or back-up agencies listed below.

- RCS
- I.R.I. Armed Forces
- Police Force
- Main Office of Culture and Islamic Guidance
- Family Health Organization
- Other back-up organizations

Response plans, protocols to implement the operations, must be in place at every responsible agency. In addition, establishing Incident Command System or any other standardized organizational structure in emergency mode at major agencies will be added to the list of prerequisites.

3) Strategies

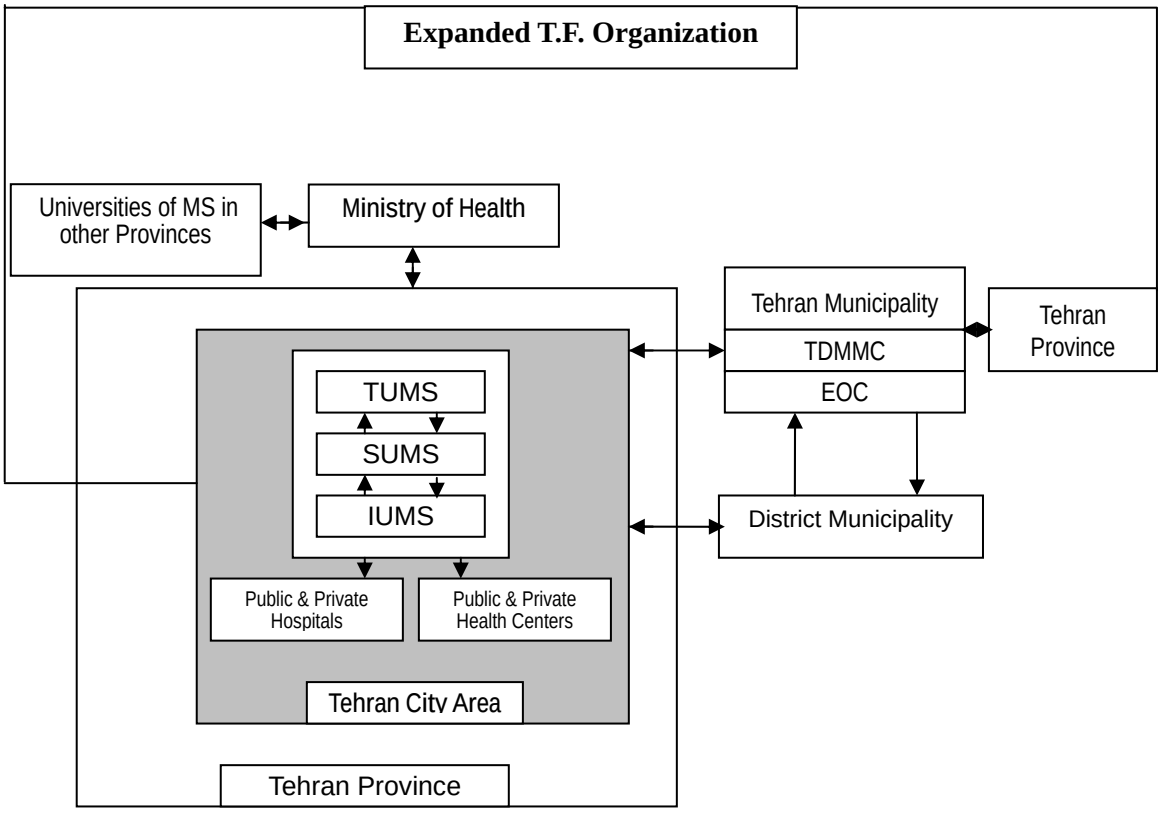
Tehran does not have the available medical resources to cope with enormously surging needs after the earthquake. Given the circumstances, some important strategies to fulfill the overall objective will be to:

1. Place first priority on life-saving care throughout the medical care operations
2. Selectively provide treatments to the injured who will be judged savable through triage at every treatment point
3. Mobilize and utilize available resources fully regardless of location, ownership and source
4. Get government commitment, which is crucially important, to mobilize private sector totally by endorsing monetary compensation for their expenses to treat the injured unconditionally
5. Make a systematic response by establishing a tiered system of treatment across the country
6. Establish a system to provide care, from community first, then to transfer to hospitals in local network, and to hospitals in metropolitan and national network
7. Provide health care to fit people’s needs which change over time
8. Shift health resources from surgical cases during the first several days to acute internal injuries cases followed by chronic diseases cases

11.3.3 Command and Coordination

1) Command Mechanism

Command mechanism in the health sector is one of the critically important issues in case of the city-wise disaster like earthquakes, since coordinating system is decisively needed to call up, deploy, move, transfer and drive the resources extensively and rapidly. And heath personnel are the ones who are especially unfamiliar with this commanding system. Figure 11.3.1 shows this command system in MOH&ME structure and the coordinating relationship between Tehran/District municipalities.



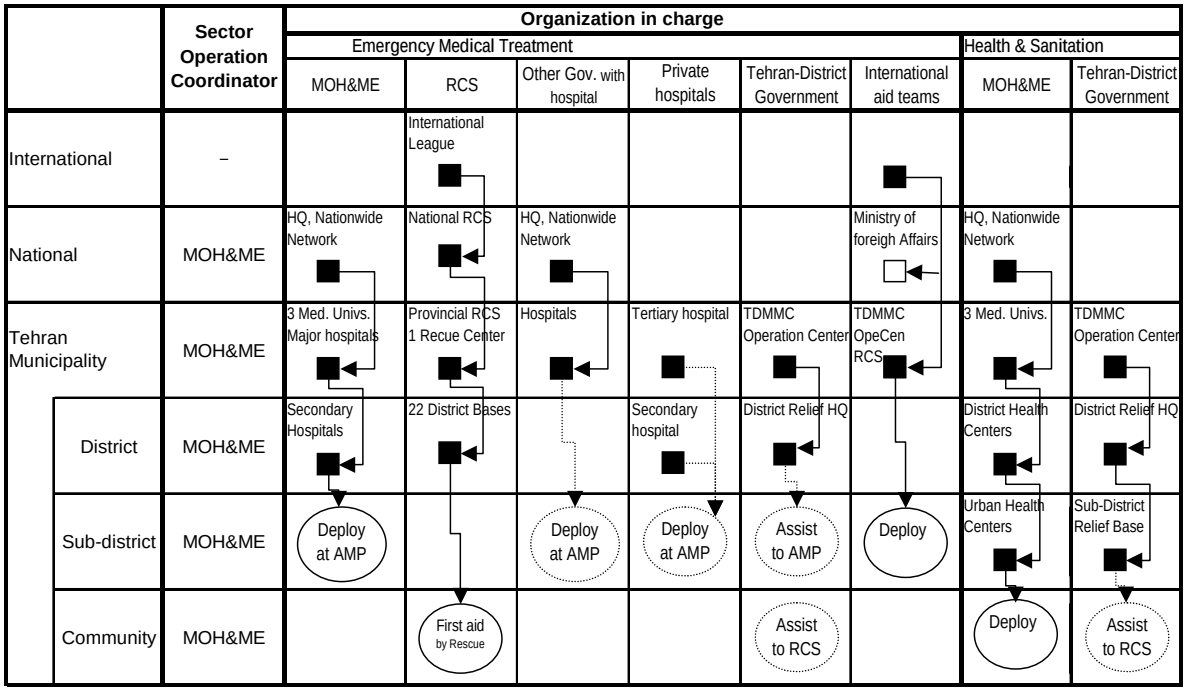
Source: JICA Study Team

Figure 11.3.1 Health Command & Coordination Mechanism in Tehran

Dean of Tehran University of Medical Science (TUMS) is assigned as the incident commander in Tehran, and Shahid Beheshti (SUMS) and Iran (IUMS) are supposed to be linked in this order to cover the three jurisdictions in total.

2) Health Related Organizations and their Coordinating Mechanism

Organizations in charge and their vertical structure to deliver services from national to community level in Medical Treatment & Health Services are illustrated in Figure 11.3.2 In the figure, symbol "■"shows the operation bases of organizations in charge, e.g. MOH&ME has operation bases at three levels: national network in Iran, provincial network at Tehran, hospital network at 22 Districts. And symbol "□" shows that Ministry of Foreign Affairs will play a role of window to receive International aid teams, not an actual base for their operation. And symbol "→" shows the flows of human and physical resources to support the lower levels in each organizational structure. MOH&ME, which is the dominant organization in charge both of Emergency Medical Treatment (EMT) and Health & Sanitation (H&S), will coordinate the operations at all levels from national to community.



Source: JICA Study Team

Figure 11.3.2 Vertical Structure of Major Medical & Health Organizations

In the coordination mechanism, only MOH&ME and International aid teams will operate at sub-district level through the activity at Advanced Medical Posts. However, coordination mechanism should be clearly defined in the following points:

1. Support by Tehran and District Municipalities to three Medical Universities
2. Other government hospitals and health centers
3. Private hospitals and clinics
4. Voluntary medical people

11.3.4 Operations

1) Prospective changes of response operations over time

Operations for medical and health services should be planned in consideration of changes of the victims' needs over time. Figure 11.3.3 shows a prospective phasing for treatment and sanitary, environmental and logistics activities from the occurrence of the incident to the 2nd month.

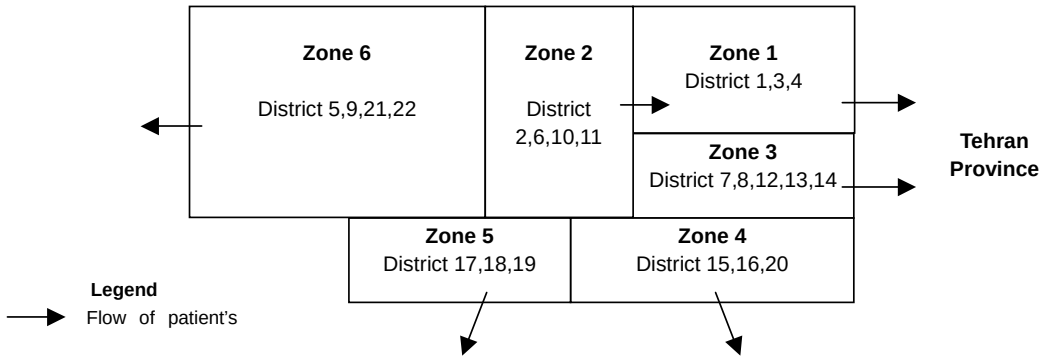
Time	1st. day	2nd.-3rd. day	1st week	2nd. week	1st. month	2nd. month
[Treatment]	Activation	MSC Evacuation	Injured treatment Evacuation	Injured treatments decrease, while Internal cases increase	Chronical cases increase worsening	Living victims health conditions worsen
Operation Phase						
[Health]	Activation	Preparation for deployment	Sanitation, Environmental Health	Sanitation, Environmental Health, Epidemic prevention	Monitoring Overall health condition Needs for mental care increase	Environmental Health, Monitoring, Epidemic prevention
1st. Day	* Activation of Emergency Response System * Employees Call to Duty in Tehran * Initial Damage Assessment of facilities, staff and patients * Patients Evacuation from damaged hospitals					
2nd.-3rd. Day		* Detailed Damage Assessment continue * Nation-wide Call to Duty * Request for International Relief Aids * Many foreign teams arrive and deploy * Further Patients Evacuation from damaged hospitals * Development of mass casualty management system * Development of voluntary-base field care * Exploded increase of the injured to AMPs and functiong facilities * Preparation of sanitation/environment health activities				
1st. Week			* Nationwide transfer of patients from the airport * Set up of many field hospitals over the city * Development of many field hospitals * Peak of the injured visits to AMPs and Increse of internal cases * Development of sanitation/environment health activities * Increasing threats to existing chronic diseases patients like renal failures			
2nd. Week				* Rapid decrese of the injured cases to AMPs * Remarkable increse of internal and chronical cases * Overall worsing of environmental health condition * Expansion of sanitation/environment health activities * Enourmous pile-up of donated drugs and materials		
1st. Month					* Peak of returns of the cured victims from othe area * Rapid and serious increase of worsening chronicic cases * Full development of Sanitation and disease prevention ` Return of foreign assistance teams * Serious effect of destruction of hospitals * Start of mental health care	

Source: JICA Study Team

Figure 11.3.3 Prospective Transition of Medical/Health Response

2) Emergency Medical Response based on District Zoning System

Blockage of main roads and unstable bridges will make difficult EMS operations and transportation of victims across the metropolitan area. This expectation, together with the fact that hospital capacity in each district differs very much, leads to an idea of dividing the metropolitan area into several administrative zones each with approximately one million population, in which some hospitals with established Emergency Units will be appointed as 'Disaster Medical Hospitals.' Figure 11.3.4 illustrates a primary idea of grouping districts to formulate 6 zones. In each zone, hospitals are categorized into three levels according to ability and capacity as proposed in Table 11.3.1.



Source: JICA Study Team

Figure 11.3.4 Tentative Hospital Care Zone in Tehran

3) Victims Flow Management after AMP stage

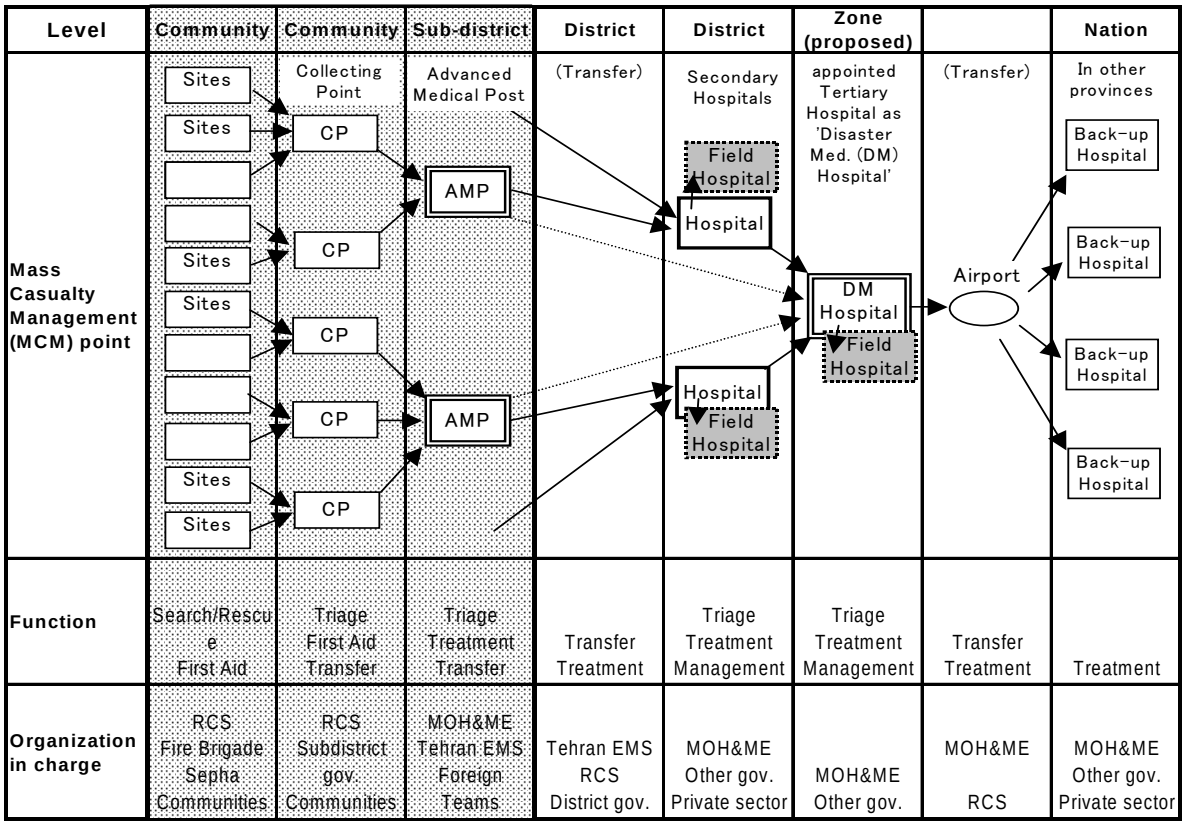
Based on the proposed zoning system, victims' flow for care will be principally managed in the manner shown in Figure 11.3.5.

1. Casualties tagged yellow at AMP are to be transferred to some secondary hospitals equipped with established ER and operating theatre in the district. Transportation measures will be prepared by RCS and District municipality because equipped ambulances of Tehran EMS may be totally busy especially during the first few days. At least two hospitals, mainly MOH's, need to be assigned for this purpose.

2. Serious victims should be referred further to the tertiary hospital, which will be defined as the Disaster Medical (DM) Hospital with the most advanced functions in disaster medical treatment within a proposed zone. Requirement for DM hospital is specified in A total of 13 hospitals is proposed as designated DM hospitals, that is, at least one together with its back-up hospital in every district, and another one must be appointed as the national flagship DM Hospital. Helicopter port (Helipad) is one of indispensable requirements for this type of hospital.

3. Secondary hospitals at district and DM hospital at zone should prepare to enlarge their capacity by stocking up on equipment such as tents, waterproof sheets, beds, ER equipment, and electric generators. Field hospital is defined as part of the mother hospital expansion and should not be set up independently from the existing or mother hospitals but avail itself of their services.

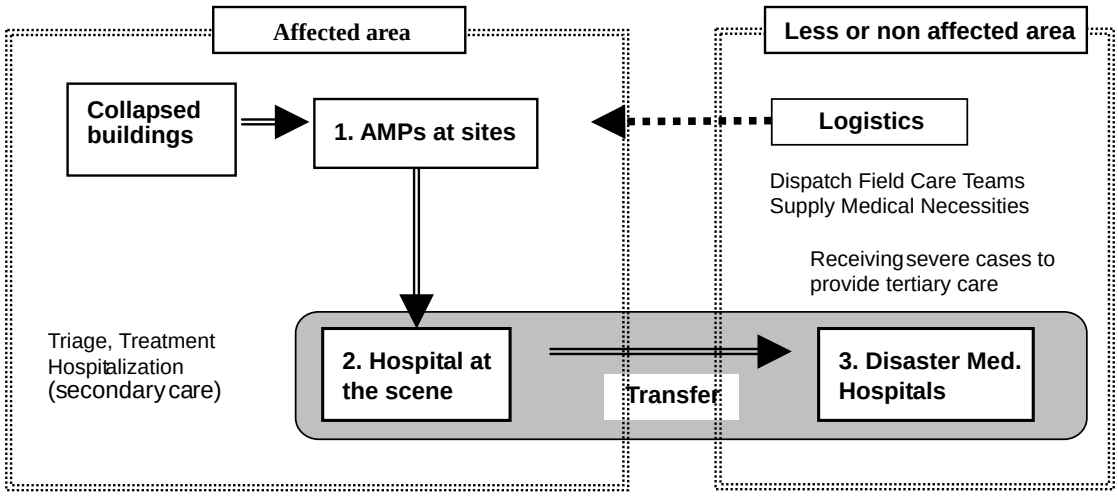
4. At core hospitals, non-critical but serious patients among existing and disaster victims will be moved to the back-up hospitals in other provinces by plane. Transportation of patients from the core hospital to the airport will be carried out by Tehran EMS, hospital cars or helicopters.



Source: JICA Study Team

Figure 11.3.5 Management Flow of The injured After AMP

Overall concept of this system is illustrated in Figure 11.3.6. Principally, the severely injured but the expected savable will not be treated long in the 'core hospitals' within the earthquake-stricken area, but will be transferred to those in less or non-affected area as soon as patient's condition becomes stable. Securing transportation such as ambulances and helicopters will be the responsibility of Tehran EMS.



Source: JICA Study Team

Figure 11.3.6 Principal Structure of Medical Relief in the Zone

4) Hospital Classification for Emergency Response

Since not all hospitals can provide surgical operations and intensive cares, earthquake victims must be transferred to the qualified hospitals properly based on their capability. Categorization of hospitals is shown in Table 11.3.1. Categorization also intends to keep hospitals at level III from being overwhelmed by an enormous influx of patients. Notice that proposed category of Emergency Level does not always coincide with current level on patient referral system.

Table 11.3.1 Role of Hospitals During the Disaster Period by Emergency Levels

ER Level	Current Level	Expected role during the disaster
I	Primary and Part of Secondary	1. 1. Outpatient treatment: Triage and providing simple treatment 2. No inpatient service: Transfer severe cases to hospitals at Level II or III 3. Almost as the same function as those of AMP
II	Secondary and Part of Tertiary	1. Outpatient treatment: Triage and providing simple treatment 2. Inpatient service: To intermediate cases only, severe cases need to be transferred to Level III hospitals 3. Only hospitals with surgical disciplines can provide inpatient services. 4. Need to discharge pre-existing patients to increase capacity
III	Tertiary	1. Outpatient treatment: Not providing principally, but for the transferred patients from AMPs and hospitals at Level II and I. 2. Inpatient service: Provide care to the severely injured but restrict care to those who are expected savable only 3. Need to discharge or transfer pre-existing patients to increase capacity

Source: JICA Study Team

Several Emergency Level III hospitals, regardless of whether they are public or private, will be appointed as Disaster Medical Hospitals (DMHs), which play a key role in life-saving treatment for hospitalized cases. Some key roles are defined as to:

- Provide life-saving care to the severely injured with cases such as multiple-injuries, internal organ damage, crush syndrome and third-degree burns.
- Manage the transfer of the severely injured to hospitals at less or non-affected area.
- Lend medical equipment out to other hospitals in the same zone.

DMHs have met the following requirements given in the below.

1. To have seismic-resistant structures;
2. To be equipped with self-sustainable lifelines: water, electricity, fuel and sewage, for three days at a minimum;
3. To provide tertiary emergency services with 1) Wards for inpatients, 2) ICU, 3) Consultation room, 4) Laboratory, 5) X-ray room, 6) Operating theatres and 7) Dialysis unit;
4. To have enough space to receive twice the number of inpatients and five times the number of outpatients than those in ordinary time in case of a massive disaster;
5. To be equipped with a terminal of wide-area disaster & emergency information system and be able to play a central role;
6. To function as a key channel to admit and/or transfer patients for treatment with the following facilities on a nation-wide basis:
   - At least one emergency ambulance to transport patients, and
   - A helipad for use by helicopters to transport patients accompanied by a medical doctor; and
7. To function to dispatch self-sustained medical aid teams with portable equipment for treatment, drugs, triage tags, tent, power generator, water, food and daily necessities.

In addition, at least one hospital in a zone will have the following functions to contribute to activities of other hospitals:

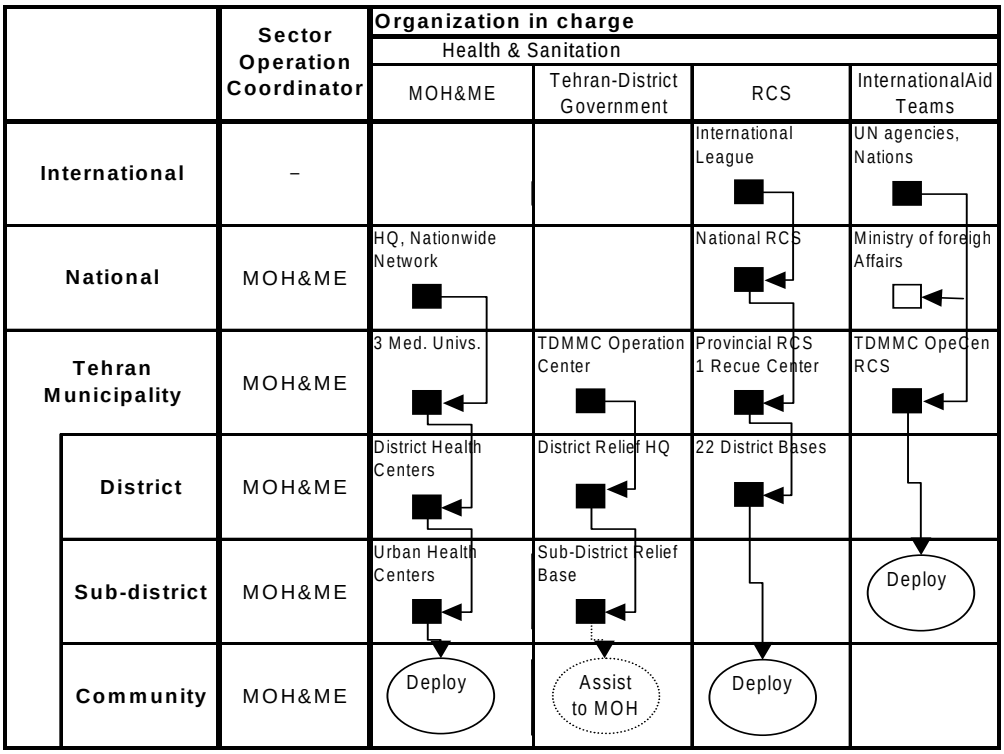
- To lend equipment out to health institutions in the zone with facilities such as portable type beds, treatment kits and storages of equipment and supplies
- To educate and train personnel working in health institutions in the zone

5) Environmental Health and Disease Prevention

Organizations in charge: Natural disasters do not always yield an outbreak of communicable diseases. However, Environmental Health intervention needs to be started as soon as possible after the impact in parallel with medical relief activity. Organizations in charge – dominant MOH&ME and other supporting organizations such as Municipality of Tehran and 22

Districts, RCS and many international aid teams rushing to the country – will activate each response mechanism right after the occurrence. Figure 11.3.7 shows the major organizations and their structural mechanism to deploy their teams over the affected area.

In the figure, symbol "■"shows the operation bases of organizations in charge, e.g. MOH&ME has operation bases at four levels: national network in Iran, provincial network at Tehran, its district health offices at 22 Districts and extensive urban health centers network at sub district level. Symbol "□" shows that Ministry of Foreign Affairs will play a role of window to receive International aid teams, not an actual base for their operation.



Source: JICA Study Team

Figure 11.3.7 Vertical Operation Structure of Major Health Service Organizations

1. **MOH&ME**: In the structure of MOH&ME, that is designated as a coordinator of operations at all levels, Health Affairs of three medical universities in Tehran will conduct the environmental health and epidemic prevention activities by activating all the District Health Centers (DHCs) in Tehran based on a pre-arranged operation plan involving all the Health Centers and Local Health Personnel. TDMMC will also coordinate these activities on the scene between DHCs and 22 district municipalities. At district and sub-district level, physical and human support to MOH's teams from the municipalities will need coordination on the scenes in order to deliver the services to affected people effectively.

2. **Operations**: Apart from the medical treatment for the injured, health area covers the following various and broader sub-areas in addition to Health Center's routine services. These are shown in Table 11.3.2. Health Centers will provide the indispensable bases for the health & relief teams to be deployed in the communities.

Table 11.3.2 Activities in Health Area

Area	Response Activities	Base for operation
Environmental Health	1. Supervision of evacuation camp and shelter conditions 2. Supervision of Drinking Water safety 3. Supervision of Food safety 4. Rodents & Vector Control 5. Disinfections of dwellings, toilets, garbage spots, water ditches, burial sites, etc. 6. Education and Instruction to the public	Health & Relief Team based on the Health Center
Disease Prevention	1. Surveillance 2. Diagnosis, treatment and Laboratory test 3. Isolation of patients if necessary 4. Control of disease sources 5. Supporting vulnerable groups Vaccination, Nutrition and Comoprophylaxis	Surveillance system: Health & Relief Team based on the Health Center
Expanded daily services	1. Maternal and child health 2. Oral health and Dental clinic 3. Counseling and Mental health 4. Logistics	Expanded teams for specific services based on the Health Centers

Source: Structural Health and Medical Management during Disaster in Large Cities, especially Tehran: compiled by Dr. Sadeghipoor and others

3. **Health and Relief Team**: MOH&ME will formulate many Health & Relief Teams and Water Safety Monitoring Teams to support DHCs and Health Centers in order to patrol all the affected area and evacuation places. These Teams will aim to prevent the potential outbreak of epidemics, to detect it earlier and to disinfect the dwellings in case of a potential risk. This will be done for a period of one month after the occurrence. Every Health Center will form at least one team from its own staff together with external volunteers. Composition and function of each type of team, which will include many volunteers, are proposed in Table 11.3.3.

Table 11.3.3 Health & Relief Team and Water Safety Monitoring Team

Type of team	Member	Function
Health & Relief	・Physician ・Environmental Health Specialist ・Nurse ・Management ・Supporting staff ・Driver	・Health check and consultation ・Primary treatment ・Isolation and dis-infection of patients ・Instruction to evacuees on disease prevention and health maintenance ・Community awareness
Water Safety Monitoring	・Sanitary Engineer ・Management ・Supporting staff ・Driver	・Biological examination ・Control of usage of well water

Source: Structural Health and Medical Management during Disaster in Large Cities, especially Tehran: compiled by Dr. Sadeghipoor and others

4. Health-related players in community are categorized into two; one is Local authority, personnel and groups, and the other is Local Health Personnel (LHP) who mainly belongs to Health Centers. Role of each group is summarized by disaster period in Table 11.3.4. Community people will be organized and mobilized on a voluntary basis to assist Community Authority and Local Health Personnel.

Table 11.3.4 Role of Community and Local Health Personnel in Relief Activities

Player	Aftermath period	Preparedness period
Local Authority*	・Assessment of people's needs ・Coordination of external assistance groups ・Family grouping ・Sanitation at shelters ・Monitoring food supply and distribution ・Caring for orphan children ・Dealing with the dead ・Post-disaster development	・Analyzing the past experiences ・Adding to knowledge of the local risks and resources ・Practicing the exercises and activities to promote community preparedness ・Practicing basic education
Local Health Personnel	・Monitoring community's health conditions ・Nutrition ・Instruction/education on health and sanitation ・Mental health care ・Periodic reports	・Improving certain professional knowledge and skills ・Preparedness at Health centers and hospitals ・Training of voluntary health workers ・Preparedness activities for the population

Note: * local authorities and persons or groups who concern themselves in the localities with rescue work, communications, transport, shelter and food supply

6) Logistics

1. **Mobilization of health personnel**: An enormous number of health people is supposed to be mobilized over the country to compensate for the critical shortage of human resources in case of a potential earthquake disaster in Tehran. All the teams from other provinces should bring commodities and facilities to sustain them for 1 to 2 weeks at least. However, places for them to set up operation bases are not discussed yet. Finding open spaces in the city area after the disaster will be totally impossible without prearrangement of the places.

2. **Consumables**: Stock of medical consumables for at least 3 days is internationally recognized as the desirable preparedness for sustained operation. While government hospitals in Tehran possess generally medical consumables for a week and more in average, District Health Centers (DHCs) and Urban Health Centers do not stock sufficient consumables for surgical treatment. MOH&ME is to bear an overall responsibility for logistics, be it public or private hospital. Following measures will be taken to supplement the shortage of medicines and supplies:

- Procurement of stocks in local distribution pipelines.
- Utilization of relief goods supplied through International Humanitarian Assistance.

Relief goods will be distributed to local facilities in need based on the following principle:

- Government Channels:

  MOH&ME will bear responsibility for inventory management but entrust RCS with delivering them to mainly public hospitals.

- Private Channels

  RCS will handle the distribution to mainly private hospitals

11.3.5 Recommendation for Further Development

Provision of earthquake disaster medical services is just one mass of anxiety in Tehran. There is no doubt that a key player is MOH&ME; however, its preparedness activities remain quite primitive. Therefore, recommendations listed below intend to facilitate its preparedness activities and to fully utilize public and private resources.

1. MOH&ME central office and three medical universities in Tehran must make a preparedness and response plan in EMS and Environmental Health at E4 level earthquake disaster, and also prepare a full resource inventory. TDMMC is in charge of preparing the format to standardize response plans and to review them.
2. Standardized Response Plan must include the following components:

- Operating procedures, which should be in accordance with TCEMP's committee plan
- Method to announce or transmit information of damages on health centers and hospitals in case telephone lines are dead
- Method to contact off-duty staff
- The way to share and coordinate the field works between MOH&ME and the RCS in mass casualty management
- System to mobilize community people and put them to work on the scene

- The way to cooperate functionally between hospitals and health centers
- Communication system and logistics

3. Hospitals also should prepare the response plan and practice the disaster drill.
4. Study the feasibility of formulating Disaster Hospital Zone and Disaster Medical Hospitals.
5. Execution of seismic resistance diagnosis of hospital buildings and installations, and of prioritization of hospitals to implement the retrofitting and reinforcement works.
6. Study the feasibility of formulating and organizing community people for self-activity of disaster management.
7. Logistics is one of the areas of most concern in disaster management. The way to manage the humanitarian aids through two channels of government and RCS, and the way to distribute them to many and various demanders, need to be clarified and standardized beforehand.
8. In the response plan, special attention should be paid to the measures to protect people who need continuous medication such as those suffering from kidney failure, cardiac diseases, diabetes and asthma.
9. Hospitals, especially tertiary level hospitals, often use and keep hazardous materials such as chemicals for laboratory examinations, narcotics for pain control and radioisotopes for nuclear medicine. Needless to say these materials must be secured to keep them from leaking out of the controlled area or the hospital boundary according to the regulations. If there is no existing regulation, it is urgently necessary to formulate a guideline instructing the specific measures about the way to handle them.

11.4 Evacuation

11.4.1 Current Situation

Phase I plan on Emergency Evacuation and Temporary Housing Plan for Tehran citizens have been formulated by Tehran Disaster Mitigation and Management Center (TDMMC) on the basis of the Disaster Management Master Plan approved in June 2001.

1) General Description of Emergency Evacuation and Temporary Housing Plan for Districts of Tehran

The main objective of the whole plan is to predict and design the possible methods for evacuation, transfer, and settlement of the citizens in safe places during the disaster. Planning items are defined as follows:

1. Identification and evaluation of existing facilities and capabilities to materialize the main objective of evacuation plan: transfer and settlement of citizens during disaster.
2. Formulation of criterion for designating temporary location among urban and suburban areas.
3. Designation of safe and immune places for probable temporary housing of Tehran citizens.
4. Study on the method of equipping the location designated for temporary settlement of the victims.
5. Designation of locations for depot of facilities and equipment for relief operations during disaster.
6. Study and introduction of strategies for evacuation of endangered citizens to safe and pre-designated places.
7. Designation of main entrance and exit roads from damaged areas to safe places.
8. Study on the role of In-Charge, Back-up, and Partner organizations through formulation of managerial structure for evacuation and temporary housing during disaster.

The Phase I Plan includes up to the item 2) in the above planning items.

Also, in order to formulate and integrate the major policies of the plan and its executive approaches, a specialized group was selected from TDMMC and Training and Research Institute of RCS. The group prepared the primary scope of work for emergency evacuation and temporary housing master plan based on presumptions as follows:

- Formulation of theoretic principles and framework of required activities for executing the plan;

- Determination of the limitations and prerequisites (resources, managerial, structural);
- Designation of locations for temporary housing;
- Designation of locations for settlement of required facilities, equipment and tools for temporary housing points;
- Managerial structure of evacuation and temporary housing during disaster and of In-Charge, Back-up and Partner organizations; and
- Determination of executive approaches for evacuation and temporary housing master plan.

2) Result of Phase I Plan

In order to coordinate and collect necessary information, it was requested from Deputies for Technical & Civil Affairs of District Municipalities to send their latest information about urban spaces such as vacant, cultural, sport, services, commercial, green spaces (forest park, parks and recreational centers), fairs, terminals and other open spaces with more than 2,000 m^2 existing in their districts as primary data to TMPMC.

A group of students of Training & Research Institute of RCS was selected as study teams for site visiting to the above locations, filling the forms and technical evaluations from May 2002.

Until September 2002, out of 1,030 dispatched forms, 846 selected locations were visited and evaluated by Training & Research Institute and the results were sent to TDMMC.

In January 2003, the completion of the Phase I of the Plan was announced based on the following acquired outcomes:

- About 1,030 locations introduced by municipality were evaluated, and selected points were identified and their data registered.
- Particular software was designed and developed for establishing a database of collected data.
- All temporary housing locations were marked on map of different districts.
- Main access roads to these locations were preliminarily marked on districts maps.
- Software called “Tehran Temporary Housing Software” is developed to contain all the above information and other requirements of not only each district but also the whole of Tehran, with enough flexibility to suit users.

3) Review of the Phase I Plan

The JICA Study Team briefly reviewed the plan and following points can be singled out for consideration:

- The plan is quite preliminary and no basic policy of evacuation system is presented.
- The selection of evacuation place was performed only from among those spaces with an area of more than 2,000m^2.
- No other criteria such as required area for unit population and allowable maximum distance of evacuation route are taken into account.
- Evacuation zoning that shows who should evacuate to which place is not identified.

Taking the above points into consideration, the JICA Study Team presents the basic policy and guidelines for formulation of evacuation plan.

11.4.2 Evacuation System

1) Definition of Evacuation System

At the time of an earthquake, it is anticipated that a lot of situation will arise requiring the evacuation of residents. For such purpose, it is necessary to designate, even in ordinary time, an evacuation system, a wide area evacuation place and evacuation roads. In addition, it is essential to specify necessary items concerning the establishment and operation of evacuation places and to ensure that such items are fully understood by residents.

Area of evacuation place is defined as follows:

(1) Regional Evacuation Place

It is an open space such as a large-scale park or green place having a space that is necessary to protect the lives of evacuating persons from danger such as spreading of fire at the time of a large-scale earthquake.

(2) Community Evacuation Place

It is a place for neighboring evacuating persons to temporarily assemble and to watch the situation before evacuating to the Regional Evacuation Place. It is a place for evacuating persons to form a group temporarily to evacuate to the Regional Evacuation Place. It shall be such a place as an urban park, a sports field, a school, or a religious facility, among other places, in which the safety of assembled persons can be secured.

(3) Evacuation Route

It is a road that leads from the Community Evacuation Place to the Regional Evacuation Place. It is designated in advance to enable residents living in an evacuating zone to evacuate quickly and safely to the Regional Evacuation Place.

The effective evacuation method at the time of earthquake disaster is a group evacuation method. Groups are formed for each unit of predetermined areas or companies. However, it is feared at the time of evacuation that independent-minded residents or the evacuation places

located outside the ordinary living area may cause confusion. People form a group in the Community Evacuation Place to prepare for an orderly evacuation and to prevent such confusion. This system has the following merits:

1. It ensures efficient information distribution or other communication;
2. It enables mutual assistance by neighboring residents and confirmation of missing persons; and
3. It ensures orderly behavior since evacuation is carried out by the instruction of the District Municipality, policemen, fire-fighters or the RCS workers.

2) Selection of Evacuation Place and Route

On the plan formulation process, TDMMC should coordinate with each District Municipality to establish the district evacuation plan, especially for regional evacuation zoning and place. In Chapter 5, the JICA Study Team preliminarily proposed the regional evacuation places for each district.

11.4.3 Method of Evacuation

1) Recommendation and Instruction of Evacuation

It is necessary to let residents in the disaster area evacuate quickly to a safe place in the following cases:

- When it is estimated that danger to human lives has seriously increased;
- When it is estimated that human lives in a wide area will face the danger caused by flowing-out and diffusion of gas, etc.;
- When a lot of fires break out at the same time caused by an earthquake and fires spread and expand; and
- When it is deemed necessary to protect residents from disaster.

Recommendation and instruction of evacuation by respective agencies are as follows:

(1) TDMMC and District Municipality

When danger is imminent in its area of jurisdiction, the District Municipality shall, upon communicating with TMPMC, recommend or instruct evacuation after the evacuation needed area and evacuation place are specified.

When disaster has arisen or is about to arise and it is deemed necessary to protect human lives, District Municipality shall establish a warning area and restrict or prohibit the entry into such area and shall give the order when to move out from such area.

Even in ordinary time, it is necessary for each area or community (residents association) to grasp the actual condition of the area in respect of forming a group or self-governing situation at the time of evacuation.

(2) Regional Fire Brigade

The Fire Brigade shall recommend or instruct residents to evacuate when it judges that spreading of fire or diffusion of gas is rapid and that the danger to human lives is seriously imminent. On such occasion, it shall immediately notify the District Municipality.

2) Evacuation Guidance

The role and measures for the evacuation guidance in each organization shall be defined by respective agencies.

(1) TDMMC and District Municipality

When recommendation or instruction is issued, TDMMC shall quickly distribute the contents of recommendation or instruction by following measures:

- Announcement using speaker at mosques or schools
- Oral communication to residents or community leaders directly
- By utilizing mass media
- By utilizing publicity activity by Police Department or Fire Brigade

At the community evacuation place, staff members of the District Municipality shall form groups of respective areas, communities or companies with the assistance of Police Department and Fire Brigade. After that, they shall organize a group leader of communities or persons in managerial position of companies and shall guide them to the regional evacuation place. In such an event, evacuation of persons who are vulnerable to disaster such as sick persons, senior citizens or disabled persons is a top priority.

They shall make efforts to carry out evacuation and guidance for the safety of pupils and students, according to the situation of earthquake disaster, centering on each classroom teacher headed by a school principal.

In addition, TDMMC and District Municipality shall consider in advance the method in cases of evacuation when there is no time to issue recommendation or instruction of evacuation that corresponds to the actual situation of the area or the situation in which disaster takes place.

At the time of evacuation guidance, they shall allocate guides at important points of evacuation roads and carry out ad hoc public announcement on the site

They shall allocate necessary number of guides at the regional evacuation places. They shall collect information relating to damage and public relations activity and help locate missing

persons. They shall also take measures of re-evacuation if necessary and shall make efforts to keep the order at the evacuation place.

(2) Fire Brigade Department

The Fire Brigade shall notify TDMMC and the District Municipality about most safe route and directions of evacuation taking into account the size of disaster, situation of roads and bridges, path of fire and operation of fire fighting.

When evacuation begins, the fire-fighters shall engage in evacuation guidance.

Fire fighting activity after the point when recommendation or instruction is issued shall endeavor to secure the safety of evacuation places and evacuation roads.

11.4.4 Operation and Maintenance of Evacuation Place

1) Operation of Evacuation Place

The operation of evacuation places shall be conducted, in principle, by RCS. However, the District Municipality shall cooperate with the RCS.

In order to maintain the safety of evacuating residents, the District Municipality shall take appropriate measures and quickly respond to the progress of situation and shall specify the operation in advance in respect of details and method.

The measures shall involve the following:

- To allocate staff necessary for the operation, taking into account the size of evacuation places and surrounding situation;
- To secure means of information distribution, to provide accurate information in a timely manner and to issue appropriate instruction;
- To secure first-aid station and first-aid trained staff for the purpose of providing emergency medical care for injured or sick persons;
- To make efforts to maintain sanitary condition of evacuation places;
- To arrange water, food and emergency goods with the cooperation of RCS to specify the distribution method and to execute fair and effective allocation; and
- To guide evacuating persons going back to their homes safely and smoothly when evacuation is lifted.

2) Maintenance of Communication Material and Equipment for Evacuation Guidance

TDMMC and District Municipality shall make efforts to maintain the wireless system that is used when they conduct evacuation guidance of disaster victims and rescue and aid activity. The wireless system shall also be used for the purpose of ensuring the direction, order and

information distribution between the RCS, the Fire Brigade and the Police Department engaged in the on-site activity.

In addition, since it is necessary to obtain a lot of traffic information, they shall make efforts to maintain the wireless system so that proper and timely decision can be made in the regional and community evacuation places.

11.5 Traffic

11.5.1 Current Situation of Emergency Road Network

1) Tehran Primary Emergency Road Network Plan Prepared by TDMMC

Tehran Disaster Mitigation and Management Center formulated "Primary Road Network during Disaster (Roads Required by Fire Brigade)" in cooperation with Tehran Comprehensive Traffic and Transportation Study (TCTTS) in 2002.

(1) Scope of the Study

The objective of this study is preliminary designation of emergency roads from existing road network that are required during disaster.

In this study, network of roads is defined as emergency network for relief operations that can provide access to "Relief Center" to "Vulnerable Units" in Tehran City.

A. Relief Center

In this study, Tehran Fire Brigade which have 55 fire-fighting stations, are recognized as relief center. These organizations with 128 vehicles are in charge of relief & rescue and fire-fighting operations. Road network has been analyzed for access of fire stations to vulnerable areas. Fifty-five (55) fire stations and fire-fighting command headquarters have been identified and a GIS file for these stations and centers were prepared.

B. Vulnerable Units

In this analysis, two groups of vulnerable units that require fire-fighting services are taken into consideration. These units are census units and hazardous facilities.

a. Census Units

Census units numbering 3,169 with populations by the Statistics Center of Iran (SCI) recorded in 1996 were used as destinations of network analysis, as residential hazard points.

b. Hazardous Facilities

The 814 places identified by JICA Study Team in 2000 were used as destinations of network analysis, as hazardous facilities.

This network is to be designated in such a way that it provides the shortest passing route from relief centers to census units and hazardous facilities.

(2) Process of Analysis

The process of analysis is shown in Figure 11.5.1. In the first step, the road network was edited and modified. Then data files of fire-fighting, population and hazardous centers were established based on ArcView and Network Analysis. In the second step, the shortest routes between fire stations and all census units were calculated by using the shortest pass analysis program. Then the calculated shortest routes between fire-fighting stations and census units were prioritized. Prioritization was done in a way that a value was allocated to each designated route from one fire station to one census unit according to its population. Then by aggregating the routes, the values of connections forming these routes were determined on road network. This process was applied for routes between fire stations and hazardous facilities, but in this case the index for evaluation was the risk factor for each hazardous center. At the end of the second step, the primary emergency routes were designated. These primary routes form a network consisting of 44,258 roads, or 30% of road network. To select the most important road of this network, prioritization was done on the basis of value of each connection in the prepared network. For first priority of the road network between fire stations and populations, the connections were selected in such a way that the sum of their total value was 70% of aggregated value of all connections. In the same way the first priority of road network between fire stations and hazardous facilities was determined, a series of roads were selected that consist of 63% of aggregated value of all roads in the network. After this stage, by merging the selected roads for two situations, the primary routes were selected. Finally, some of the routes were modified based on set criterion and by engineering judgment.

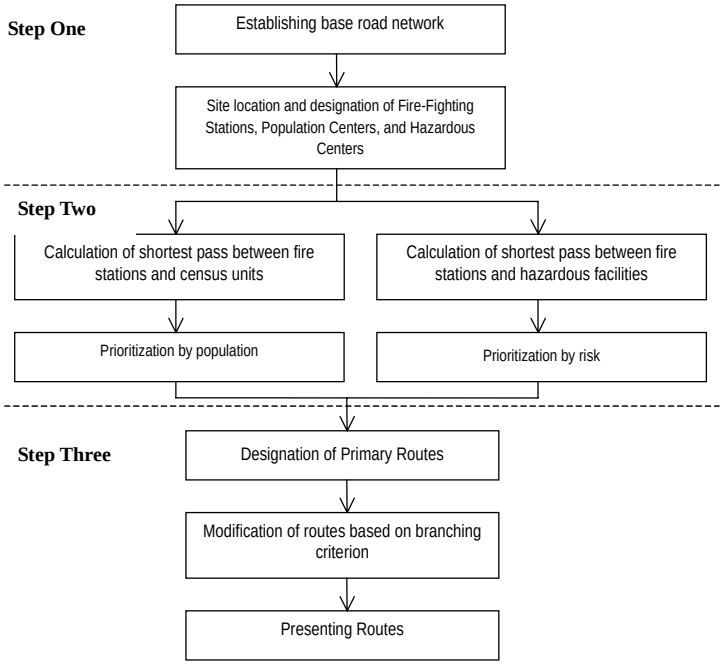
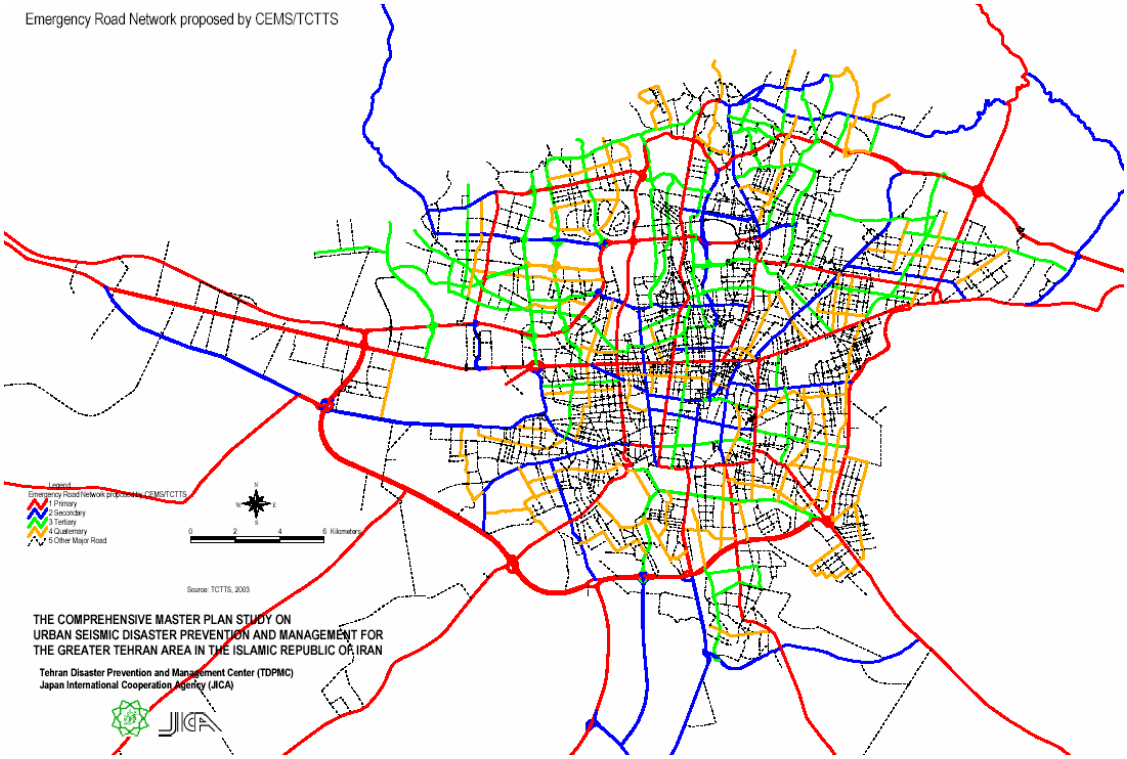


Figure 11.5.1 Study Flow of Emergency Road Network by TDMMC

(3) Result of Analysis

Figure 11.5.2 shows the final result of the analysis.



Source: JICA Study Team

Figure 11.5.2 Primary Emergency Road Network by TDMMC

2) Review of the Plan

The JICA Study Team preliminarily proposed the emergency road network, which is shown in Chapter 5. In this proposed network, governmental offices are selected as origins and destinations of shortest pass analysis for primary emergency road network. Rescue and relief centers such as fire-fighting stations, hospitals and medical centers are used for secondary emergency road network. Thus, policy and approach of the JICA Study Team and TDMMC are fairly different.

The JICA Study Team briefly reviewed the report on Primary Road Network during disaster (Roads Required by Fire Brigade) by TDMMC and following points can be singled out for consideration:

1. Approach to obtain the emergency road network by the JICA Study Team and TDMMC is different. In the JICA Study, government office is considered to be emergency response headquarters and traffic flows between these offices were given the first

priority. This is the general procedure for emergency management control. On the other hand, TDMMC focused the road network specialized for rescue operation.

2. It is completely not clear at present which network is superior or important. Comparison of these networks is not meaningful in this very preliminary stage.

3. Both networks use the same road network data and similar calculation methods. However, data itself are incomplete and no better than "trial."

4. There is common recognition that emergency transportation network shall be analyzed by the shortest pass analysis using GIS database and programs.

5. It is indispensable to investigate and study what kind of origins and destinations of traffic flows have higher priority. Conditions of velocities and quantities of traffic flow shall be determined in order to obtain appropriate networks.

6. Members of the JICA Study Team have transferred the technology of the shortest pass analysis to TDMMC. Therefore, TDMMC shall go into further step with the cooperation of the Traffic and Transportation Deputy and TCTTS. For this purpose, increment of the accuracy of the GIS data should be achieved. At present, aggregated data for each governmental and relevant organization are only classified by their name. The role, function and capability are not very clear. These must be identified and clarified so that the priority of each organization in case of emergency can be distinguished.

Taking the above circumstances into consideration, the JICA Study Team presents the basic policy and recommendations for traffic control in the next section.

11.5.2 Implementing Policy of Traffic Control

The implementing policy of traffic control can be classified into control in space aspect and time aspect.

1) Control from Space Aspect

Traffic control from space aspect includes route control and area control.

(1) Route Control

The route control covers road sector and route. Total prohibition or partial prohibition on traffic, in which passage of vehicles other than designated ones are prohibited, is implemented. Designation of emergency roads or emergency transportation routes falls under this category. If a user of a vehicle intends to go through a road for which traffic regulation is implemented, the user shall apply to the Traffic and Transportation Deputy of the Tehran Municipality and shall obtain a slip and a certificate after the prescribed confirmation procedures are taken. A slip for emergency transportation vehicle is issued to vehicles that engage in emergency

operations. A problem of a slip for passage permission is that hand-written slips or forged slips prepared by copying are used. Because it takes time to establish a system for issuing the slip when a disaster occurs, even formal emergency operation vehicles may try to have counterfeit documents. It becomes necessary to issue a lot of slips immediately after the occurrence of disaster; therefore it is necessary to prepare the system in advance.

Emergency road network and emergency transportation route shall be designated in advance. The JICA Study Team preliminarily proposed the emergency road network shown in Chapter 5. TDMMC also proposed the emergency road for rescue operation. It is not only for enabling persons in charge of traffic control to take subsequent measures promptly, but also for preventing confusion by letting general vehicle users know the emergency transportation routes in advance. In this sense, nothing is more important than letting the general public fully understand emergency transportation roads and rules for the control. In addition, it is necessary to provide information concerning emergency transportation routes and the situation of control on such routes immediately after the occurrence of a disaster by using any and all media.

(2) Area Control

The area control is to regulate the traffic in a uniform manner, not only for disaster-affected areas but also for surrounding areas. One can imagine possible cases in which it becomes impossible to go through roads because of collapse of structures along roads such as roadside houses, buildings, power poles or fences, and road traffic function is paralyzed in the surrounding blocks of areas. In addition, it becomes necessary for some areas in which traffic of ordinary vehicles must be prohibited on roads other than emergency transportation routes for purposes of works of removing debris and recovering lifelines. It is necessary to carry out traffic control for such areas on passage of vehicles other than emergency vehicles and to determine in advance the scope of establishment of, and the implementation policy for, the regulation.

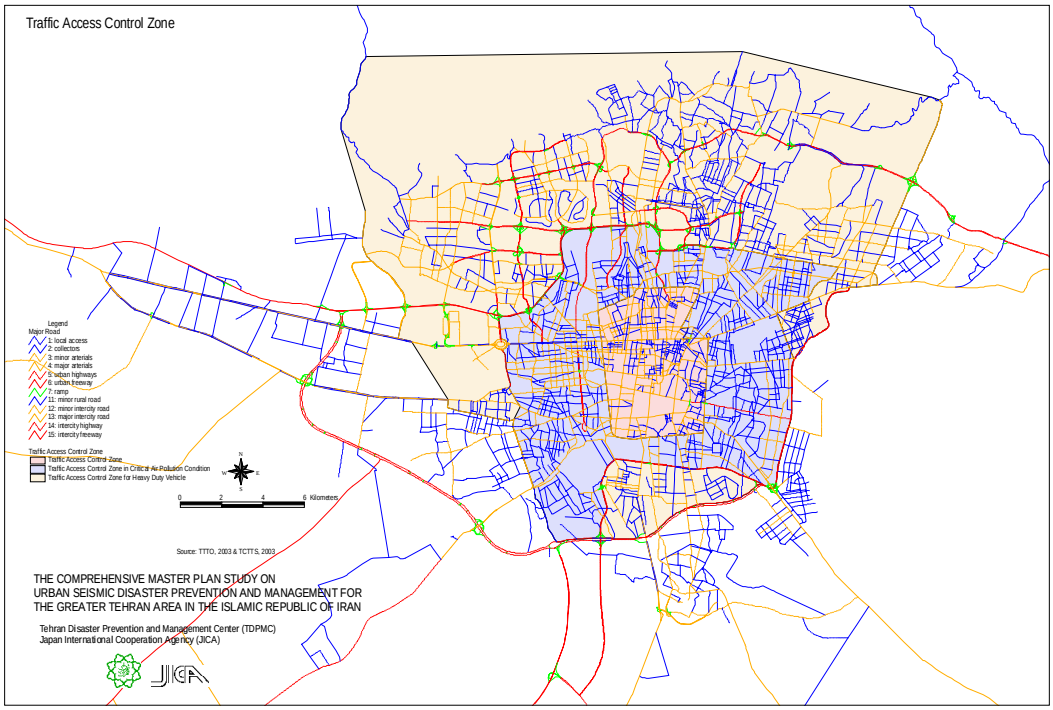
It is desirable for the implementing policy of area regulation to decide, in advance, the unit of blocks for the area regulation. The reason is that it is rather difficult, and it takes time and requires workloads, to establish the subject areas of the area regulation in the confused state of affairs after a disaster occurs. If a unit block for the subject of regulation is decided, in advance, to be the minimum unit of certain areas surrounded by a major trunk road, a trunk road or supplementary trunk road, it is easy to compose a middle unit block or large unit block by combining neighboring unit blocks depending on the situation. In such a case, it would be convenient for the actual regulation, although it depends on the situation of road network, if the minimum unit of a block is made to correspond to the degree by each district.

When a block or a zone for the area regulation is established, the number of inflow roads is limited, and only the permitted vehicles are authorized to enter the subject area. What is important on such occasion is to make ordinary vehicle users be fully aware of information relating to the subject block for which the regulation is implemented, and frequent public relations activity by mass media is necessary.

Enforcement of the area regulation is deemed to be easier than enforcement of route regulation since points of inflow are limited.

Figure 11.5.3 shows the traffic access control zones decided by Tehran Municipality. Red colored zone is central business district and yellow colored zone is heavy-duty vehicle restricted zone. These two zonings are ordinarily applied in the usual time. Blue colored zone is traffic access control zone in case that the condition of air pollution exceeds a certain value.

These zonings are not for emergency. However, these zones are well known and identified by citizens in general who drive vehicles. Therefore, this zoning system can be considered as a first step of the formulation of emergency road control zoning.



Source: JICA Study Team

Figure 11.5.3 Traffic Access Control Zone

2) Control from Time Aspect

Detailed regulation by a unit of time is unrealistic in a state in which traffic is chaotic at the time of disaster, and rough regulation, which takes into account the actual situation of traffic in daytime or nighttime or on weekdays or weekend, is appropriate. However, it would be better to avoid, as much as possible, changing the regulation time depending on the traffic situation. The reasons are that, if the regulation is changed frequently, it becomes difficult to make information concerning regulation fully understood, mistrust to the regulation arises and it is feared that the traffic situation becomes even unstable by contrast.

Since emergency aid is quite important in a confused state immediately after the occurrence of a disaster, it is a basic policy to let emergency vehicles go through on emergency transportation routes firstly and to prohibit any and all passages by ordinary vehicles even on designated roads. As traffic for assistance and recovery gradually increases in two or three days following the occurrence of the disaster and the state of traffic becomes normal, the traffic regulation that makes much of the security of emergency transportation roads is introduced.

In several weeks or approximately a month, it is considered that the volume of traffic becomes different in daytime and nighttime, and it may be thought that the designation of emergency transportation roads is lifted. However, based on the experience at the Great Hanshin Earthquake Disaster, it is considered to be difficult to lift the designation of emergency transportation roads on weekends.

3) Traffic Enforcement and Provision of Information

Whether the traffic regulation can achieve its objectives largely depends on the implementation system of the traffic enforcement. Although emergency transportation routes are proposed, it is quite difficult to restrict the inflow of ordinary vehicles only by means of barrier, cone or allocation of police officers if the number of entry points on crossing roads and areas along roads are enormous. And it can be well imagined that illegal parking or abandoned vehicles on emergency transportation roads cause traffic jam. Therefore, in order to enhance the effect of traffic regulation, it is necessary to provide information quickly by using any and all means.

Disaster information given to vehicle users includes the following:

- Place of occurrence of the disaster;
- Level and scope of the disaster;
- Details of road control;
- Estimated time to recovery, and so on.

The research at the time of the Great Hanshin Earthquake Disaster has revealed that, if the scale of a disaster is large, the percentage of persons who refrain from making a trip by car increases. And, if the situation of traffic regulation is known, users abstain from driving to regulated routes or areas. One can expect an effect of preventing traffic jam from expanding even by providing such simple information.

What is more effective is to offer guided instruction for a roundabout course in addition to the provision of traffic information. In particular, it is desirable to strongly induce traffic through disaster-affected area to take the roundabout course. Information of the situation in which severe regulation is being implemented should be given to vehicles entering the disaster-affected area from points far away from the disaster-affected area.

11.6 Lifeline

11.6.1 General

For emergency response of lifeline, responsibilities of municipality are different, since there are individual companies concerned. Therefore, each company has to prepare its own emergency response plan.

It is the principle that each lifeline company has responsibilities to keep a continuous supply to the customers even in an emergency case. Stoppage of supply of these services will cause serious secondary disasters.

In fact, after the previous microzoning study completed in the late 2000, each company exerted great efforts to prevent damage from earthquake seriously.

In this section, the 'what' and 'how' of things after an earthquake will be discussed and municipality has to be aware of its plan and coordinate responses at the emergency phase.

As mentioned in Chapter 6, preparedness before the earthquake event is extremely important; however, it is very difficult to render all networks seismic-resistant. Therefore, preparing an emergency response plan together with periodic drills to implement quick recovery will be highly important and all staffs of each lifeline company have to fully realize actual recovery operations.

11.6.2 Present Status of Preparedness

To understand the present status of preparedness against possible earthquake, the Study Team vigorously undertook an investigation of each company's effort and resources on disaster preparedness. Table 11.6.1 shows the present status of preparedness of the companies against earthquake.

In Tehran Municipality, lead by TDMMC, each Sub-committee including Water, Natural Gas, and Power Committees prepared a Standard Operation Plan for emergency response. Furthermore, based on the Standard Operation Plan, Greater Tehran Gas Company (GTGC), and Tehran Regional Electric Company (TREC) prepared a more detailed Emergency Response Plan themselves. Especially, GTGC is revising its plan by reviewing the Emergency Response Plan prepared by Osaka Gas Engineering Company, which covers all the necessary parts of emergency response. It is necessary to prepare such a plan and each staff must be aware of and well understand the purpose and importance of such a plan. In a meeting with Tehran Water and Sewage Company (TWSC), the Study Team learned that the company has not yet prepared a detailed emergency response plan; however, in March 2000, "A Study on Seismic Risk, Impact by Service Interruption and Earthquakes Preparedness in Tehran Water Supply System" was completed, and important recommendations are given in the study.

Therefore, utilizing these recommendations from the study, it is necessary to prepare a detailed emergency response plan in the near future. In the later section, a tentative emergency response plan is prepared for reference.

Table 11.6.1 Present Status of Preparedness for Lifelines

No.	Questions	Answers			
Questions for all lifeline companies					
		Water	Gas	Electricity	Telecommunications
1	Is there any emergency operation (repair) team?	There are 6 service districts in Tehran and each has several emergency operation teams.	2 rescue teams in each region and in total, there are 20.	Yes, Metanir Operational Group, Operational groups of Electricity distribution companies	Each of the 7 regions of Tehran has experience and ready team on hand
2	How many persons are involved in this team?	totally 705 persons are in charge of emergency operation team.	20 groups in 10 centers of Gas Company (each center covers 2 districts). Each Repair Group consists of about 25 personnel.	Several groups (No exact number specified)	It is appropriate to the network's facilities' capacity.
3	How many vehicles are prepared for this team?	totally 64 vehicles available for emergency operation.	Normally each group is equipped with 13 automobiles, 2 welding machines, 1 air compressor and 1 generator.	to the number of operational groups (No exact no. specified)	It depends on the number of people and at minimum one vehicle.
4	Is it operational for 24 hours, 7 days a week? If no, what are the operational hours?	It is operational for 24 hours in each service districts	Each group also has a 24-hour department in which 20 individuals are engaged with giving services in 3 shifts.	It is operational for 24 hours.	On call.
5	What is your stock volume for repair work? (Stock of cables or pipes for repair work)	Volume is not certain. They are equipped with pipes and connection joints.	approx. 20 km polyethylene pipes repairs and 10 km steel pipes repairs.	to the extent of restoring the districts	At the main warehouse and small warehouses according to needs.
6	Please indicate location of stock yard and indicate size and volume of them.	Every service district has several stock yards except one district.	Ray next to Tehran Refinery and for maintenance purpose, there are many stock yard inside Tehran	only in the suburban area of Tehran	In different regions of Tehran
7	Is there any stock yard outside Tehran?	No	No	Yes	In different regions of Tehran
8	Do you have any co-operation among other company or branch outside Tehran in case of emergency?	Isfahan Water & Sewage Organization has been selected as auxiliary city and some negotiations have been done in this regard.	Yes, with Isfahan Gas Company	Yes, with Regional Electric Companies of Isfahan, Semnan, Guilan, Azarbaijan	Yes
9	Do you have any communication tools except telephone line? If so, please indicate type of communication tools and how many of them are available.	The only communication way is wireless system.	Walkie-Talkie and mobiles	Yes, landlines, wireless, and PLC	Walkie-Talkie and mobiles
10	In case of emergency, how do you collect information on network damage or facility damage?	Damage in the route is known through drop of pressure.	Walkie-Talkie belonging to colleagues or ordinary citizens. In near future general information from earthquake monitoring institute will be provided to Tehran Gas Co.	through regional dispatching, electric high voltage distribution and distribution, transfer and high voltage distribution transformers, incidents office, citizens reports	From the specific region's responsible person.

No	Questions	Answers			
Questions for all lifeline companies					
		Water	Gas	Electricity	Telecommunications
11	Do you have any other countermeasures against disaster management?	The plan for seismic reinforcement and immunization of Tehran piping water is under study.	Research project "securing and controlling Tehran gas lines against earthquake" and collaborating with Municipal Council in management disaster plans and in taking part in organized maneuvers.	countermeasures and preventive measures in relation to new instructions	Establishing Disaster Management System
12	What is the average daily consumption of water in Tehran?	Approx. 2,400,000 m^3	-	-	-
13	How may cubic square meters of water is reserved in average?	Total capacity of reservoirs is 1,800,000 m3 that an average of about 1,000, 000 m^3 is always available	-	-	-
14	Do you have back up system of electric supply? If so, how many hours will it last?	The only backup system is the reservoirs and their storage is sufficient for 14 hours.	-	-	-
For Gas					
15	What is the average daily consumption of natural gas in Tehran?	-	Approx. Min. daily use is 8 million m3 and max. daily use is 47 million m^3.	-	-
16	What kind of shut down system do you have for regulation valves?	-	Manual shutdown.	-	-
17	Do you have back up system of electric supply? If so, how many hours will it last?	-	Yes, by self generation.	-	-
For Electricity					
18	What is the average daily consumption of electricity in Tehran?	-	-	Approx. 58,465 MWH	-
For Telecommunications					
19	Do you have enough capacity to manage heavy incoming traffic of telephone calls in unpredicted disaster such as earthquake?	-	-	-	The new system has a relatively high capability, but it cannot definitely be said that it can handle such situation.
20	Do you have back up system of electric supply? If so, how many hours will it last?	-	-	-	Emergency Diesel and Battery in each of exchange centers and several Emergency diesels in organizational and official buildings.

Source: JICA Study Team

11.6.3 Water Facility

1) Present Condition

Since TWSC does not have a detailed emergency response plan, the Study Team prepared a brief plan for Tehran Municipality, and the information contained there must be covered by TWSC and each item must be strategically operational in their detailed emergency response plan.

2) Emergency Response Plan for Tehran Municipality

- The main objective of emergency response for water facility is to pursue the following:
- to maintain water supply at emergency phase,
- to make a quick response to recover damaged facilities, and
- to minimize spreading of damage by quick recovery.

To pursue the objectives mentioned above, necessary personnel, vehicles, and materials must be prepared and establishment of a committee to collect data and communicate among agencies is extremely important.

There are several important points to address for emergency response and recovery work.

They are:

- Quick recovery of water supply area
- Minimizing water failure area by controlling distribution of water
- Prioritizing recovery work

In the emergency response plan for water, there are three phases as indicated below.

(1) Preparation for Emergency Response Activities

A. Establishment and Operation of Water Supply Countermeasures Headquarters

In case of occurrence of earthquake disasters, to implement necessary measures quickly and effectively, within the TWSC, “Water Supply Countermeasures Headquarters” shall be established and emergency operations shall be implemented in close communication with “Tehran Municipality Countermeasures Headquarters.”

Furthermore, in case of occurrence of earthquake disasters during weekends and at nighttime, staff members staying at the staff residence, not existing at present, and assigned management staff shall be gathered together and put an effort on collecting information, preparing for the initial action and implementing emergency operation.

B. Establishment of Mobilization System

a. Mobilization

At the time of earthquake disaster, to reserve staff to implement recovery and information sharing activities, it is necessary to secure mobilization system of staff in each branch office and to assign duties for the staff in advance.

In case of occurrence of earthquake disasters during out-of-office hours, depending on the damage condition, it is necessary to gather at the nearest branch office arranged beforehand, and to operate emergency response.

Furthermore, if within the company number of staff is insufficient, it is necessary to ask for assistance via municipality headquarters to municipality, military and local public or private sectors.

b. Requests for Assistance to relevant organizations and constructors

Regarding necessary staff and equipment for recovery work and emergency water supply, ask for assistance in case of emergency from constructors to cope with the catastrophic disaster.

C. Information and Communication Activity

To implement recovery measures efficiently, it is necessary to collect and transmit accurate information promptly, and therefore, means, time, duration and contents of information communication shall be organized in advance.

a. Means of information gathering on damage condition

Information gathering of damage condition shall be conducted using landlines or leased lines.

b. Other means of information gathering

If landlines are out of order, depending on damage scale, alternative way shall be used to communicate as indicated below.

- Disaster communication radio (Governmental)
- Mobile radio
- Satellite Telephone

c. Communication timing and contents

Communications at Water Supply Countermeasures Headquarters shall be limited to certain timing and contents to minimize confusion and overflow of information. These topics shall be prepared in advance.

(2) Temporary Measures

In case of disaster, quick recovery of damaged areas will minimize spreading of unsupplied areas. Therefore, before full recovery work, temporary recovery work will be sufficient to increase the capacity of recovery work with minimum resources.

However, if the scale of damage is limited, this step can be omitted.

A. Preparation of materials and equipment for emergency operation

In principle, necessary materials of pipes and valves for recovery work shall be kept in the stockyards. If the materials are insufficient, supply from contracted companies shall be expected. In order to pursue a quick and effective recovery work, agreements between relevant organizations and companies for assistance shall be concluded.

B. Facility inspection

After the occurrence of earthquake, water facilities shall be inspected promptly, and damage condition shall be noted.

- Dams, water intake facilities, raw water transmission facilities, purification plants, and water reservoirs shall be promptly inspected individually.
- For pipeline networks, important check points (pre-assigned) shall be inspected at the site, and checked for pressure drops, water leakages, road subsidence, etc. to determine the degree of damage. For facilities other than pipeline, degree of damage shall be inspected. Before the inspection, operational condition of purification plants, and pumping stations at reservoirs, shall be gathered.

Important checkpoints are shown as follows:

- Primary and secondary pipeline network
- Pipeline to temporary water supply facilities and evacuation sites
- Important facilities (hospitals, power plants, etc.)
- Pipelines crossing major emergency evacuation roads

C. Temporary Repair

If occurrence of secondary disaster or damage expansion can be anticipated until the time of recovery of damaged points, temporary recovery work shall be performed promptly in the following order:

a. Facilities for water intake, raw water transmission, purification, and reservoirs

If cracks to the water intake and raw water transmission facilities are found, operation of the facility is stopped or capacity is reduced, if necessary.

b. Water supply and distribution pipes

Road subsidence caused by water leakage poses danger to road transportation; as much as possible, try to use fences to avoid traffic accidents.

To minimize the area where water supply is cut off caused by damage to the pipelines, water distribution control shall be done promptly. And rearrangement shall be done based on the progress of operational condition and recovery work of purification plants and reservoirs.

c. Water Supply Facilities

Water facilities at collapsed buildings shall be shut off.

(3) Recovery Measures

A. Recovery work on the facilities for water intake and raw water transmission

Damage to the water intake and raw water transmission facilities may greatly affect its purification function; therefore, the highest priority shall be given upon recovery.

B. Recovery work on purification plants

Among damages to purification plants, the damages that cause serious effect to the facility shall be given priority and recovery work shall be carried out promptly.

C. Recovery plan of pipelines

a. Recovery Plan

For recovery work of pipelines, based on the planned priority (recovery plan shall be prepared in advance) and considering level of damage, difficulty level of recovery, importance of damaged point, operational condition of purification plants and reservoirs, the most effective pipeline to supply water to a wider area shall be selected.

Furthermore, procurement of equipment, recovery arrangement, and emergency level of recovery shall be considered, and if necessary, temporary piping shall be operated.

b. Recovery work on water supply and distribution pipes

It is necessary to confine the area where the water supply is cut off, and to try to supply water constantly as much as possible. Based on the planned prioritized facilities mentioned below, recovery work shall be started.

- Primary pipe network (water line and major distribution pipes with wide coverage area)
- Secondary pipe network (major distribution pipes)
- Important network other than networks mentioned above (pipes connected to important facilities, such as hospitals, emergency water supply points)

c. Recovery work on water supply facilities

Recovery of water supply facilities along public road shall be undertaken together with recovery of pipes and resumption of water supply.

Recovery of water supply facilities in building site shall be undertaken starting with important facilities such as medical facilities and evacuation sites.

11.6.4 Gas Facility

1) Present Condition

Natural Gas is very useful and indispensable for the citizens of Tehran. On the contrary, once an earthquake occurs and gas leaks, this useful resource will change to a dangerous element, which will cause secondary disaster such as explosions and fires.

As mentioned in Chapter 6, GTGC is implementing "Research Project for Strengthening and Control of Tehran Gas Network against Earthquake." This project consists of three phases as follows:

(1) Phase 1: Immediately Executable Earthquake Preparedness

Purpose of Phase 1 is to aid in the planning of countermeasures feasible to start immediately for Iran National Gas Company (INGC) and GTGC. Output of Phase 1 is documents showing information necessary for planning earthquake countermeasures immediately executable by INGC and GTGC.

(2) Phase 2: Damage Evaluation of Tehran Gas Facility

Purpose of Phase 2 is to estimate the earthquake resistance of gas supply systems of Tehran area. Contents and priority of countermeasures are decided by specifying the most vulnerable/critical facilities. It also means that the result of this phase will validate the decision of INGC/GTGC for investment to upgrade the earthquake resistance of gas supply systems from a technical standpoint. The result of this phase also gives valuable information for disaster prevention planning to support activities after occurrence of earthquake.

(3) Phase 3: Planning for Strengthening, Control, Mitigation and Restoration and Rehabilitation of Gas System

In Phase 3, based on the results of Phase 1 and Phase 2, final disaster prevention measures for earthquakes will be proposed.

As mentioned above, in continuation of this project and further phases, all the necessary items to secure GTGC supplying system are covered including installation of the most state-of-the-art security system. Furthermore, preparation of an emergency response plan is also supported in this study, and GTGC is revising its plan. This is the first and most advance study among lifeline companies in Tehran. Therefore, Tehran Municipality has to be aware of and understand the contents of GTGC's security measures.

The Study Team has the un-revised version of GTGC's Emergency Response Plan, which used as reference the Emergency Response Plan prepared by Osaka Gas Company. This GTGC plan is reviewed and summarized by the Study Team as shown in Table 11.6.2.

Table 11.6.2 Summary of Existing Emergency Response Plan in Relation to Gas Facility

No.	Category	Item	Gas	
			Availability	Comment
1	Preparation for Emergency Response Activity	Establishment of Countermeasures Headquarters	Yes	In document Gas- 01, a very brief explanation about necessity and objectives of establishment of disaster committees, and their classification is provided. In document Gas-02, in some forms, according to danger levels some information about the function and active personnel of Informing and Warning Committee is provided.
2		Communication Method (How to gather)	Yes	As mentioned in documents Gas-04 and 05, the key persons and people in-charge have a personal data sheet, containing their phone, mobile and wireless numbers.
3		Assigned Personnel for emergency response	Yes	In documents Gas-03, 04, 05 and 06, key persons in Org. and also managers of departments are introduced with personal data and tasks.
4		Requests for assistance to relevant organizations and constructors	Yes	In document Gas-03, there is a table introducing the responsible/cooperative/Supporter and successor organizations on disaster. But detailed information is needed to be prepared. (No organization is mentioned as cooperator.)
5		Means of information gathering on damage condition	Yes	In document Gas-02, not clear enough; some information can be obtained through "Work-Time-Place" Complexes diagrams. In document Gas-06, in forms related to Tasks of different positions in Event Command, some information can be obtained about this matter, but it's not clearly classified.
6		Other means of information gathering	No	The information gathering means are not mentioned. In the personal data sheet of Responsible persons, telephone, fax and sometimes mobile and wireless are the ways to contact them.
7	Temporary Measures	Preparation of materials and equipment for emergency operation	Yes	In document Gas-04, all materials, equipment and vehicles of Tehran Gas Co. are listed
8		Facility Inspection	Yes	In document Gas-06, through tables of Tasks of positions in Incident Command, there are some unclear items on this subject. And there is no clear part mentioning this matter.
9		Temporary Repair	Yes	In document Gas-02, there are very brief items about temporary recovery while explaining "Work-Time-Place" Complexes tasks. Not explained clearly and not enough as a plan.
10	Recovery Measures	Recovery Measures	No	In documents Gas-02 and 06, there are some items notifying recoveries, but they are not clearly indicated.

Note : Gas-01 : Working Program of Specialized Committees of Comprehensive Master Plan of Tehran Disaster Management : Step-0
Gas-02 : Working Program of Specialized Committees of Comprehensive Master Plan of Tehran Disaster Management : Step-1
Gas-03 : Working Program of Specialized Committees of Comprehensive Master Plan of Tehran Disaster Management : Step-2
Gas-04 : Working Program of Specialized Committees of Comprehensive Master Plan of Tehran Disaster Management : Step-3
Gas-05 : Working Program of Specialized Committees of Comprehensive Master Plan of Tehran Disaster Management : Step-4
Gas-06 : Working Program of Specialized Committees of Comprehensive Master Plan of Tehran Disaster Management : Step-5

Source: JICA Study Team based on documents mentioned above.

2) Emergency Response Plan

In case of emergency, the following three important aspects have to be considered and closely communicated between Countermeasures Headquarters in GTGC and INGC and municipal section and other relevant organizations. Even though the type of facility is different, however, in each lifeline company, items to be covered are similar and detail can be referred to the one for TWSC.

(1) Preparation for Emergency Response Activities

1. Establishment and Operation of Gas Supply Countermeasures Headquarters
2. Establishment of Mobilization System
   - Mobilization of staff to offices
   - Requests for Assistance to relevant organizations and constructors
3. Information and Communication Activity
   - Means of information gathering on damage condition
   - Other means of information gathering (Alternative communication system)
   - Communication timing and contents

(2) Temporary Measures

1. Preparation of materials and equipment for emergency operation
2. Facility inspection
3. Temporary Repair
   - Repair of important facilities (City Gate Stations, Regional Gate Stations)
   - Repair of pipeline network

(3) Recovery Measures

1. Recovery work on important facilities (City Gate Stations, Regional Gate Stations)
2. Recovery work on pipeline network

The above items should be included in emergency response plan and well informed and understood by each staff. Especially, in case of earthquake occurred in weekend or at nighttime, the most critical point is how to communicate with staff and how to gather the responsible offices. Safety communication system and many other alternative means of communication shall be highly recommended and must be secured and prepared to correspond in any case.

11.6.5 Electricity Facility

1) Present Condition

At present, other than Standard Operation Plan prepared for TDMMC, TREC prepared seven volumes of documents related to emergency response plan including:

1. Inspecting and Knowing Disaster Dangers and Disaster Prevention Methods with Required Information on Disaster

2. Characteristics Inventory of Facility: Crucial Points (Tehran Electricity Stations)
3. General Disaster of Company: Disaster Levels E1, E2, E3, E4
4. Disaster Levels E1, E2, E3, E4
5. Disaster Situation and Confronting Them (Draft)
6. Structure, Tasks, Characteristics and Regulations of Members in Fivefold Sectors of Incident Command System
7. Working Program of Specialized Committees, Steps 4 and 5

It can be said on these documents that contents well cover the necessary items for emergency response. In the emergency response plan, it clearly mentions responsibilities and duties of command personnel together with telephone numbers. Communication method is also planned. Based on this plan, TREC held several drills periodically. This effort should be continued in the future. These documents are reviewed and summarized as shown in Table 11.6.3. However, operational flow of emergency response is not clear in the present form of their plan and it is recommended to reform their plan.

For safety measures, TREC is constructing a new building with central safety control system (French system is installed), which can monitor real time condition of electric supply. This will help very much to manage emergency response smoothly and to find out damage points in the central office, which will help to dispatch rescue teams appropriately and effectively.

At present, TREC is preparing contract with Kansai Electric Company from Japan, to implement similar study as GTGC. It is highly recommended to implement the study and strengthen their present plan in the near future.

Table 11.6.3 Summary of Existing Emergency Response Plan for Electricity Facility

No.	Category	Item	Electricity	
			Availability	Comment
1	Preparation for Emergency Response Activity	Establishment of Countermeasures Headquarters	YES	In Document:Electric-01, Electric 05: Establishment In Document: Electric-03, Electric-04: Description of Different Disaster Levels, the Responsible and Supporting Organizations and Personnel In Document: Electric-01: Description of Disaster and the necessary countermeasures In Document Electric-06: Establishment of Event Command Committee, the people in-charge and their characteristics
2		Communication Method (How to gather)	YES	In Document: Electric-01: The process of gathering persons in-charge In Document: Electric-06: The name and other information and access ways of persons in-charge
3		Assigned Personnel for emergency response	YES	In Document: Electric-06, Electric-07: Designation of persons for key posts of Disaster Headquarters and their personal data sheet.
4		Requests for assistance to relevant organizations and constructors	YES	In Document: Electric-06: List of other organizations for cooperation, supporting and succeeding Tehran Regional Electricity Co. in disaster and information of other organizations' facilities for disaster.
5		Means of information gathering on damage condition	YES	According to the Document Electric-01, the responsible organizations and deputies are in charge of informing about disaster.
6		Other means of information gathering	YES	There is no information about special communication system, only Telephone, Mobile phone and Wireless numbers of responsible persons are provided.
7	Temporary Measures	Preparation of materials and equipment for emergency operation	YES	List of required equipment, materials, vehicles of all responsible and relevant organizations and their existing condition are mentioned in some tables.
8		Facility Inspection	YES	In Document Electric-01: in two items some explanations about damage estimation for temporary recovery are given, but there is no detailed information about how the inspection is done.
9		Temporary Repair	YES	In Document Electric-01: some explanations about damage estimation and inspection for temporary recovery are given, but no detailed information is provided.
10	Recovery Measures	Recovery Measures	YES	No detailed information for this matter is provided, just the subject is indicated in Document Electric-01

Note : Electric-01 : Inspecting and Knowing Disaster Dangers and Disaster Prevention Methods with Required Information in Disaster
Electric-02 : Characteristics Inventory of Facility : Crucial Points (Tehran Electricity Stations)
Electric-03 : General Disaster of Company : Disaster Levels E1, E2, E3, E4
Electric-04 : Disaster Levels E1, E2, E3, E4
Electric-05 : Disaster Situation And Confronting them (Draft)
Electric-06 : Structure, Tasks, Characteristics and Orders of members in Fivefold Sectors of Incident Command System
Electric-07 : Working Program of Specialized Committees : Steps 4 and 5

Source: JICA Study Team based on documents mentioned above

2) Emergency Response Plan

In case of emergency, the following three important aspects have to be considered and closely communicated with Countermeasures Headquarters in TREC. Even though the type of facility is different, however, in each lifeline company, items to be covered are similar and detail can be referred to the one for TWSC.

(1) Preparation for Emergency Response Activities

1. Establishment and Operation of Electric Power Supply Countermeasures Headquarters
2. Establishment of Mobilization System
   - Mobilization of staff to offices
   - Requests for Assistance to relevant organizations and constructors
3. Information and Communication Activity
   - Means of information gathering on damage condition
   - Other means of information gathering (Alternative communication system)
   - Communication timing and contents

(2) Temporary Measures

1. Preparation of materials and equipment for emergency operation
2. Facility inspection
3. Temporary Repair
   - Repair of important facilities (Power Plants, Substations)
   - Repair of cable network

(3) Recovery Measures

1. Recovery work on important facilities (Power Plants, Substations)
2. Recovery work on cable network

11.7 Water Supply

Potable water is indispensable resource for human life. After the event of earthquake, it is easy to imagine that lack of water will occur and, therefore, establishment of emergency water supply plan in advance will be extremely important to avoid chaos. In this section, existing condition of Tehran water supply ability at emergency phase after an earthquake is explained and some countermeasures are recommended.

11.7.1 Existing Condition of Water Reservoirs

At present, there are over 80 water reservoirs in Tehran, and their total capacity is approximately 2.4 million m3. Table 11.7.1 shows the total capacity of the water reservoirs in each district. There are several districts that do not have any water reservoirs, especially in the old town of Tehran, such as districts 10, 11, 12, 13, and 20. Water is distributed by pipeline or wells to these districts. However, these areas are estimated as high-risk area of many building and lifeline damages. Therefore, the amount of emergency water will be larger than in other areas.

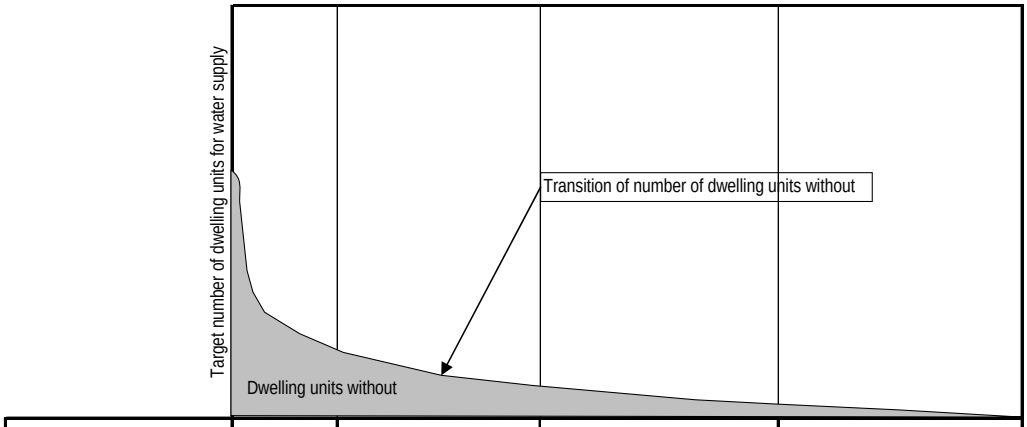
Table 11.7.1 Existing Condition of Water Reservoirs in Tehran

District	Population	Area (ha)	Total amount of water in Water Reservoirs (m3)
1	229,143	3,454	332,200
2	464,773	4,956	278,800
3	237,301	2,938	137,300
4	647,207	7,243	357,900
5	424,960	5,901	317,200
6	242,049	2,144	240,100
7	300,212	1,537	314,500
8	332,005	1,324	37,000
9	173,482	1,955	63,500
10	282,308	806	0
11	234,251	1,206	0
12	189,625	1,358	0
13	238,735	1,389	0
14	367,472	1,456	153,500
15	595,856	2,846	53,700
16	289,999	1,655	0
17	287,367	796	20,000
18	272,534	1,785	52,500
19	202,994	1,149	56,000
20	293,100	2,028	0
21	131,202	5,196	0
22	57,230	6,140	0
Total	6,493,805	59,262	2,414,200

Source: TWSC, 2003

11.7.2 Necessary Water Volume

In general, after the event of earthquake, people cannot access to water, and emergency water supply will be necessary. At the beginning, necessary volume of water will be limited; however, consumption of water will increase. Figure 11.7.1 shows an image of emergency water supply: water supply volume is seen to be increasing three days after the earthquake.



	Right after the incident	Initial Restration	Interim Restration	Final Restration
Target Days Passed after Earthquake	～ 4 days	～ 10 days	～ 20 days	～ 1 month
Target Water Volume	3	3 ～ 20	20 ～ 100	100 ～ 250
Estimated Usage	Drinkin Water	Washinig faces, Washing clothes, toilets	Bath, Shower	Normal Water Supply
Trasport Distance (within)	2 km	2 km ～ 250m	250 m ～ 100m	100 m ～ usual supplying point
Restration Plan of pipelines	Water Supply Control Activity	Restore in priority by order of Primary, Secondary pipelines, important distribution pipelines.		Restore mainly distribution and service pipes
Emergency Water Supply Method: Water Supply Point				
Emergency Water Supply Method: Transport by Tank Lorry				
Emergency Water Supply Method: Temporary Water Supply Point				

Source: Bureau of Waterworks, Tokyo Metropolitan Government, 1999

Figure 11.7.1 Image of Emergency Water Supply by Restoration Period

Based on this image, assuming that all the transmission pipes from dams are stopped, and no damage to reservoirs is found, the number of days the water can last is calculated in each district as shown in Table 11.7.2. There is more capacity of water in Northern part of Tehran, which also shows less damage to buildings. People living in district 1 will have 21 days of water supply after the earthquake and 19 days in district 7, and the average is 12 days.

Table 11.7.2 Emergency Water Capacity by District

District	Population	Area (ha)	Total amount of water in Water Reservoirs (m3)	Amount of water available (liter/person)	No of Days which will finish capacity of water (days)
1	229,143	3,454	332,200	1,450	21
2	464,773	4,956	278,800	600	14
3	237,301	2,938	137,300	579	14
4	647,207	7,243	357,900	553	14
5	424,960	5,901	317,200	746	16
6	242,049	2,144	240,100	992	18
7	300,212	1,537	314,500	1,048	19
8	332,005	1,324	37,000	111	8
9	173,482	1,955	63,500	366	12
10	282,308	806	0	0	0
11	234,251	1,206	0	0	0
12	189,625	1,358	0	0	0
13	238,735	1,389	0	0	0
14	367,472	1,456	153,500	418	12
15	595,856	2,846	53,700	90	7
16	289,999	1,655	0	0	0
17	287,367	796	20,000	70	6
18	272,534	1,785	52,500	193	10
19	202,994	1,149	56,000	276	11
20	293,100	2,028	0	0	0
21	131,202	5,196	0	0	0
22	57,230	6,140	0	0	0
Total	6,493,805	59,262	2,414,200	372	12

Source: TWSC, 2003

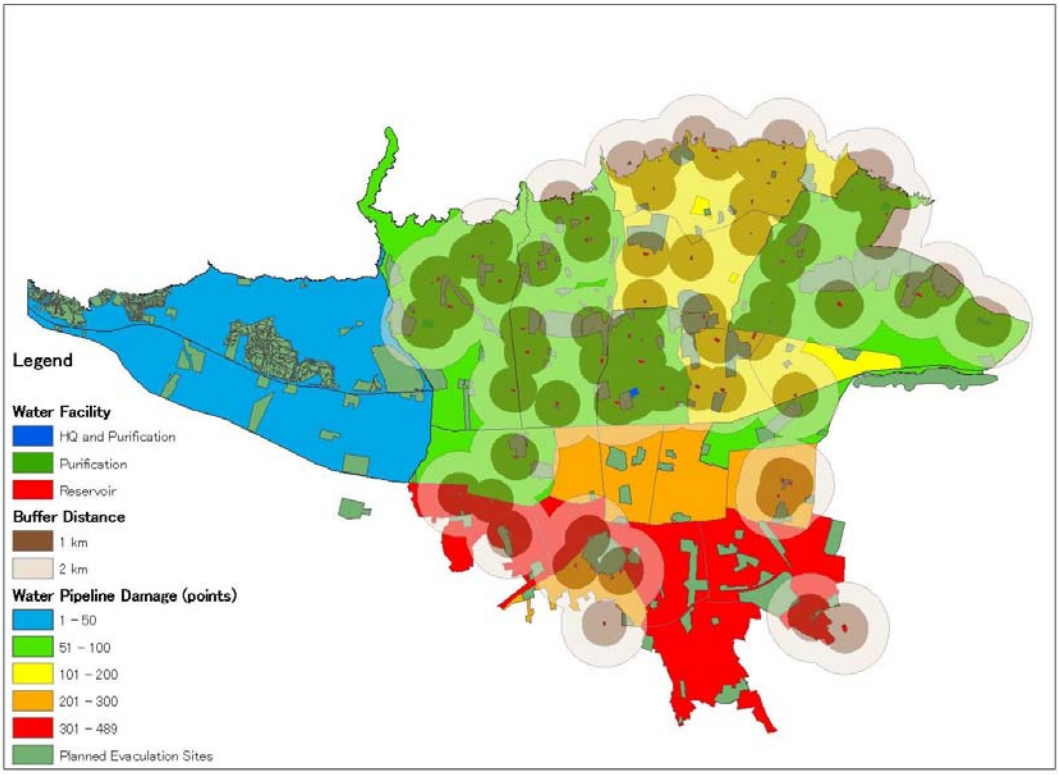
In another way, daily emergency water capacity is also calculated as shown in Table 11.7.3. It shows that after 11 days, people accessible to water will be half of the population in Tehran, and after 21 days, no one will have access to water. However, as mentioned before, this figure assumes that no water transmission is supplied from dam and purification plants. It is hardly estimated that all the transmission pipes will be damaged. Therefore, this is the worst case and it can be said that total stock of water held by water reservoirs is comparatively large compared with that of other countries.

Table 11.7.3 Daily Emergency Water Capacity by Days

Period	Necessary Water (liter/day)	Days	Total Amount Necessary (liter/person)	No of person with water (persons)	Persons with water (%)	No of person without water (persons)	Persons without water (%)
Right after the earthquake	3	1	3	4,777,355	73.6	1,716,450	26.4
		2	6	4,777,355	73.6	1,716,450	26.4
		3	9	4,777,355	73.6	1,716,450	26.4
		4	12	4,777,355	73.6	1,716,450	26.4
Initial Restoration	～ 20	5	32	4,777,355	73.6	1,716,450	26.4
		6	52	4,777,355	73.6	1,716,450	26.4
		7	72	4,489,988	69.1	2,003,817	30.9
		8	92	3,894,132	60.0	2,599,673	40.0
		9	112	3,562,127	54.9	2,931,678	45.1
		10	132	3,562,127	54.9	2,931,678	45.1
Interim Restoration	～ 100	11	232	3,289,593	50.7	3,204,212	49.3
		12	332	3,086,599	47.5	3,407,206	52.5
		13	432	2,545,645	39.2	3,948,160	60.8
		14	532	2,545,645	39.2	3,948,160	60.8
		15	632	1,196,364	18.4	5,297,441	81.6
		16	732	1,196,364	18.4	5,297,441	81.6
		17	832	771,404	11.9	5,722,401	88.1
		18	932	771,404	11.9	5,722,401	88.1
		19	1,032	529,355	8.2	5,964,450	91.8
		20	1,132	229,143	3.5	6,264,662	96.5
Final Restoration	～ 250	21	1,382	229,143	3.5	6,264,662	96.5
		22	1,632	0	0.0	6,493,805	100.0
		23	1,882	0	0.0	6,493,805	100.0
		24	2,132	0	0.0	6,493,805	100.0
		25	2,382	0	0.0	6,493,805	100.0
		26	2,632	0	0.0	6,493,805	100.0
		27	2,882	0	0.0	6,493,805	100.0
		28	3,132	0	0.0	6,493,805	100.0
		29	3,382	0	0.0	6,493,805	100.0
		30	3,632	0	0.0	6,493,805	100.0

Figure 11.7.2 shows distribution of water reservoirs together with result of damage estimation of water pipeline. As clearly shown in the figure, there are less water reservoirs in the area with high risk. In general, transporting water from water reservoir will have difficulty and, therefore, buffers are generated. In the figure, the encircled portion in gray color is 1 km radius, and the one in white color is 2 km radius from reservoir. Northern part of Tehran is well covered by this delineation; while the Southern part of Tehran has no access to water.

It is also true that the southern part can be supplied with water by wells, however, recently water is polluted from chemicals from varied garbage, and water table is declining. It would not be sensible to rely on wells. However, this water can be used as other than drinking purpose.



Source: JICA Study Team

Figure 11.7.2 Distribution of Water Reservoirs

11.7.3 Necessary Measures for the Future

1) Establishment of Water Tank Lorry Dispatching Plan

It is clear that water supply after earthquake will be critical; therefore, consideration of means of water supply in advance should be necessary. One of the methods is dispatching of water tank lorry. It is useful for the area where lack of water occurs and no water reservoir is nearby the area. According to the interview to TWSC, the company owns several 25 m3 tank lorries and dispatching of these lorries has to be secured. However, the number of lorries is not certain, therefore, within TWSC, inventory and location of these lorries shall be cleared.

Moreover, cooperation with the RCS will also be necessary, since this type of transport vehicle will be in short supply. From TWSC, information on lack of water supply shall be given to the RCS and communication system shall be planned.

In addition, there are many water tank lorries that are owned by private companies, since these are used for irrigation, among other purposes. These resources will be very much helpful in case of emergency. Agreement between owners of these vehicles and TWSC will also be helpful.

2) Construction of New Water Reservoirs

As shown in Figure 11.7.2, locations of water reservoirs are concentrated in the northern part of Tehran. It is systemically functional in this form. However, if an earthquake hits the city, it will be critical. For emergency purpose, one of the countermeasures is to construct new water reservoirs in areas where there is a lack of these facilities.

However, system-wise, there is difficulty in construction of such facilities.

Basically, since most of water reservoirs are constructed underground or partially underground, they are rather strong against earthquake. However, necessary inventory on each reservoir must be implemented to secure the security, since they are final and important facilities that can directly supply water to the citizens in evacuation places.

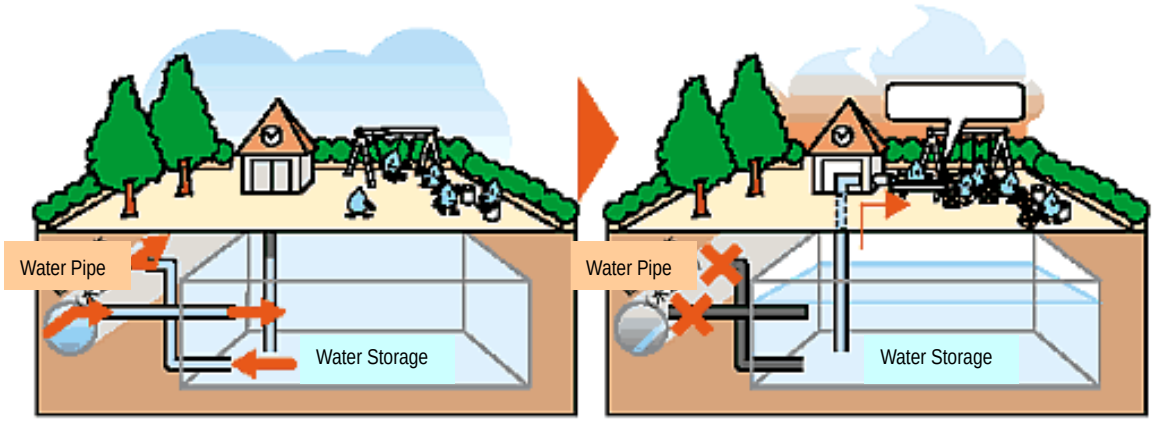
3) Construction of Emergency Water Storage

This idea is especially designed for emergency water usage. Those are mostly located in the public parks. A water tank is constructed underground connected to water pipes and water is distributed through this facility. Small building with pumping facility is installed in it. In the emergency case, this facility will be open to the public and used as emergency water supply. The image of this facility is shown in Figure 11.7.3.

In average, size of this facility is approximately 1,500 m^3 and constructed in RC structure in Japan. It can supply water for approximately 165,000 people for three days.

Also, there are emergency water storages that do not have large water tank underground, but there are small tanks on the ground as shown in Figure 11.7.4. This system does not take time to construct; however, volume of water supply will be limited. But it will be very effective in some locations that will not need a large volume of water.

However, constructing these facilities will not work in case of emergency, and therefore, periodical maintenance of facilities and drills will be important to avoid unnecessary confusion.



Source: Bureau of Waterworks, Tokyo Metropolitan Government, 1999

Figure 11.7.3 Image of Emergency Water Storage

Figure 11.7.4 Example of Emergency Water Facility

11.8 Foods Provision

As well as the emergency water supply, foods provision is counted as a primal humanitarian need in the event of disaster. The preparedness for the food provision is, therefore, an indispensable duty of administrative organizations. However, it is quite difficult for authorities that do not have experience of disaster in the past to arrange proper preparedness and countermeasures. The guidelines and necessary measures of Tehran Municipality for foods provision are presented in this section.

11.8.1 Current Situation

At the present, there exist no explicit regulations for the provision of foods in the case of earthquake disaster in Tehran. The only source for the provision of foods and primary living requirements to be expected is Islamic Republic of Iran Red Crescent Society (RCS).

The advantage to request for food supply to the RCS is its wide-ranging distribution of service centers within and outside of Tehran City. The RCS drew up a "Master Plan" in 2000, in which the establishment of 22 rescue stations for each of the 22 districts in Tehran, and of total 6 emergency rescue and aid centers in cities and towns outside of Tehran, are proposed. Regarding the emergency foods provision, those stations and centers have a function of storing and providing dry foods and primary living requirements for the target of 5,000 and 50,000 families, respectively. However, regrettably, the implementation of the stations and centers by the RCS is yet in the stage of land acquisition.

RCS Master Plan refers to the amount of food demand for each station and center, which is estimated to be 75 t. According to the JICA Study, the estimated demand can be calculated under the following conditions:

Table 11.8.1 Estimated Demand for Emergency Dry Foods

Estimated number of homeless victims	3,500,000
Amount of foods demand including rice and dry foods	0.5kg/person/day
Duration for securing road passage for conveyance of provisions	3 Days
Total Demand	5,300 t

Source: JICA Study Team

Even though the RCS stations and centers were to be implemented, given the limitation of the total amount of store provision, the food stock for Tehran by RCS would be far less than the demand. It is an urgent requirement for Tehran Municipality to prepare the additional foods provision resources.

11.8.2 Measures of Tehran Municipality

The following measures are the necessary requirements for Tehran Municipality:

1) To provide storage facility for foods and primary living requirements in relevant institutions in each of the 22 Districts

Emergency response-related institutions in each of the 22 districts such as district offices, traffic polices, Basij, and military installations are preferable to provide storage facility, taking into account the capability of provisions, which depends on the accessibility to emergency road network.

2) To make an agreement on foods provision with retailers and wholesalers

The emergency foods should be fulfilled in storage facilities at any time. However, given the limitation of storage capacity, emergency foods will be run out in the long disaster recovery term. The relevant institutions should have a contract with retailers and wholesalers for additional provision by order in the case of lack of foods.

3) To establish a cooperative setup and define the sphere of responsibility and roles with the RCS

For the effective foods provision in the event of disaster, the responsible areas to the RCS and Tehran Municipality should be clarified.

In light of the above-mentioned measures to be taken, Tehran Municipality should adopt the subsequent steps for each timeframe of disaster as follows:

(1) Normal time

According to the estimated damage, Tehran Municipality should prepare human resources and machinery implements for foods provision.

Following preparations are required.

- Supplement emergency foods in storage facilities and their maintenance
- Set up a chain of command within administrative structure and with relevant organizations by regulations of emergency foods provision
- Secure human and machinery resources for provisions required for the worst disaster scenario

(2) Initial response time to disaster

Within several days after an earthquake, it is anticipated that the operation of foods delivery will be difficult due to the blockage of debris on the roads. Tehran Municipality should collect damage information and make a distribution plan of dry foods in storage facilities, although a priority of foods provision is given to human resources for emergency operations.

The following are required countermeasures in this term:

- Information collection for damage and preparation of plan for provisions distribution
- Count of remaining foods provision in storage facilities
- Request the additional foods provision to heavily damaged area from the other storages holding redundant provisions

(3) Recovering time after 3 days of earthquake occurrence

It is presumed that emergency road network will be available for foods provision after three days of debris removal. It will also be possible to distribute trucks for hot food making in evacuation places. For the worst case of foods supplement, Tehran Municipality should make the necessary arrangement of additional foods provisions with retailers and wholesalers. The priority for ordering the provision is given to the retailers, considering their efficacy due to their wide-ranging distribution network.

The following are required countermeasures in this term:

- Information collection for required provisions in each district
- Providing information of foods availability to injured
- Order of provisions supplement to retailers and wholesalers
- Request for food-aid to other cities in I.R.I., NGOs and international organizations

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Chapter 12
Establishment of Rehabilitation and Reconstruction Procedure

CHAPTER 12 ESTABLISHMENT OF REHABILITATION AND RECONSTRUCTION PROCEDURE

12.1 Introduction

The rehabilitation and reconstruction of the damaged area can be divided into two categories: restoration of normal life and restoration of urban area. After the event, the normal life of the citizen could be disturbed by damage of earthquake. The damaged urban area should be rebuilt to provide better urban environment. The government sector should play an important role for this area as well.

The rehabilitation and reconstruction phase can be divided into the recovery phase and the rehabilitation and reconstruction phase. In the recovery phase, the purpose is to return to before earthquake situations. Restoration of normal life could be main focus on recovery phase. In reconstruction and rehabilitation phase, the urban reconstruction is the main focus.

Tehran has not prepared for rehabilitation and reconstruction phase in whole aspects. Laws and regulations should be drafted and enacted at the national level and the role and function of Tehran Municipality should be identified. According to law, the establishment of the rehabilitation organization will be the first priority. After the establishment of the organization, procedure on rehabilitation should be established.

12.2 Laws and Regulations

1) Regulatory Framework

Laws and regulations regarding after earthquake has not been well established in Iran. Red Crescent Society has been assigned as primary agency for emergency response just after the event, while nothing is contained in laws on rehabilitation and reconstruction phase. It seems that the national level disaster management committee would determine rehabilitation and reconstruction organizations at ministerial level. For example, rehabilitation of urban area is responsibility for by the Ministry of Housing and Urban Planning and Housing Foundations, and each lifeline organization has responsibility for maintaining their facility in good condition.

The Government needs to put into place and force a proper regulatory framework, preferably through a rehabilitation and reconstruction law, that regulates this issue for urban areas.[1] Such framework should establish and/or refer to at least (i) technical standards for reconstruction

[1]) "Housing Foundation of the Islamic Revolution" is for rural housing reconstruction and rehabilitation those which is a mandates to undertake that task (refer to Chapter 3.6 in Progress Report (1)). No similar law appears to exist for urban areas.

and rehabilitation, (ii) technical and economic threshold values for demolishing property, (iii) eligibility criteria for rehabilitation and/or reconstruction loans, (iv) evidence that is needed in support of requests for reconstruction and/or rehabilitation loans, (v) procedural issues, and (vi) insurance-related issues. The law should also explicitly identify the mandates and principal functions of the institutions/entities involved in rehabilitation and reconstruction activities.

2) Tehran Municipality Level

At Tehran Municipality level, it is important to establish regulations or decrees for rehabilitation and reconstruction, because the problems of Tehran area, the capital city of Iran, will be different from those of other cities. Capital function of the nation should be maintained.

Firstly, establishment of emergency response act is the most urgent regulation. Red Crescent Society is the primary organization for emergency relief and rescue. However, Tehran municipality should establish the regulations or rules for traffic management after the event, the handing over of dead bodies and evacuations. Tehran Municipality is responsible for these sensitive matters.

Secondly, there is a need to clarify evaluation of the building damage level and restriction of building usage. After the event, many buildings are damaged and need evaluation of building damage: inspected, limited usage and safety status. The evaluation is very important to prevent secondary human loss caused by after shock.

Next subject is urban development. The most damaged area should be designated as the construction restriction zone. Within the zone, construction of permanent building is prohibited until completion of the urban redevelopment plan. Formulation of such plan should be designated by the law. Rehabilitation plan should follow normal step of urban development, but in a limited period of time.

The recent urban development policy in Japan emphasizes the inclusion of disaster management urban development in the normal-time urban planning and urban development program. Before the event, the urban development program should focus on the most vulnerable area, i.e., poor urban environmental area, against earthquake.

The restoration of normal life for the citizens of Tehran should address the people who cannot restore their own life by themselves. The public support mechanism is necessary to maintain normal life.

12.3 Institutional Framework

The role and responsibility of Tehran municipality should be clarified in the rehabilitation and reconstruction phase. The responsible organization should be identified and assigned before the event. After the event, the rehabilitation committee should be established in the Tehran municipality. The committee should be formulated into inter-municipality divisions and sections. The intensive coordination work would be necessary with other disaster management organizations at national level, such as Red Crescent Society and NGOs, even international organizations.

The main function in this phase would be formulation of the city rehabilitation plan that should be worked out with the Ministry of Housing and Urban Planning. The provision of temporary housing and permanent housing would be the first priority, while the provision of employment opportunity could be important to restore the economic activities.

12.4 Urban Rehabilitation and Reconstruction

The process for urban rehabilitation and reconstruction can be divided chronologically into five stages from the moment of the earthquake disaster.

1) Stage 1: Establishing the Preliminary Framework for Urban Reconstruction

(Within one week from the time of the earthquake)

This is the period for confirming the initial framework for the reconstruction of the city, and during this time the basic mechanism will be established by the Municipality for tackling urban reconstruction swiftly, including setting up post-disaster reconstruction headquarters.

In addition, a general assessment of the state of damage to residential properties in the whole municipality will be conducted.

2) Stage 2: Formulation of Basic Policies for Urban Reconstruction

(From one week to one month after the earthquake)

During this period, the basic policy regarding the reconstruction of the city will be drawn up at the post-disaster reconstruction headquarters in order to make clear the fundamental approach to be taken towards the rebuilding work, and when this has been determined, the residents will then be notified of it.

In addition, the damage situation will be assessed through on-site surveys and several categories of reconstruction areas will be set up for urban areas depending on the extent of destruction, and the residents will be informed of which areas are targeted for reconstruction.

3) Stage 3: Formulation of Basic Plan for Urban Reconstruction

(From one month to six months on)

During this period, a basic plan will be drawn up for rebuilding the town and with this clarify the both fundamental plan for the regeneration of the whole of Tehran City and/or each area that has suffered from damage and also the methods for achieving this.

The planning process will proceed with the participation of residents.

4) Stage 4: Confirmation of the Work Program for Urban Reconstruction

(From six months to a year on)

In this stage the work will be conducted towards getting the agreement of the local residents and create a program of work for the reconstruction based on the basic plan that was formulated.

5) Stage 5: Implementation of Urban Reconstruction Projects

(One year and onwards)

In this stage, rebuilding the town will be forwarded based upon the work program for urban reconstruction drawn up in Stage 4. In order to rapidly carry out this, endeavors to secure financial resources will be indispensable.

Work procedures of these planning and implementation programs in each stage are interrelated and cannot be lined up in an orderly way. Figure 12.4.1 shows the connectional flow of these activities. Detailed procedure of each work items in Figure 12.4.1 are presented in Sector Report 9.7, “Guideline for Urban Reconstruction Planning”.

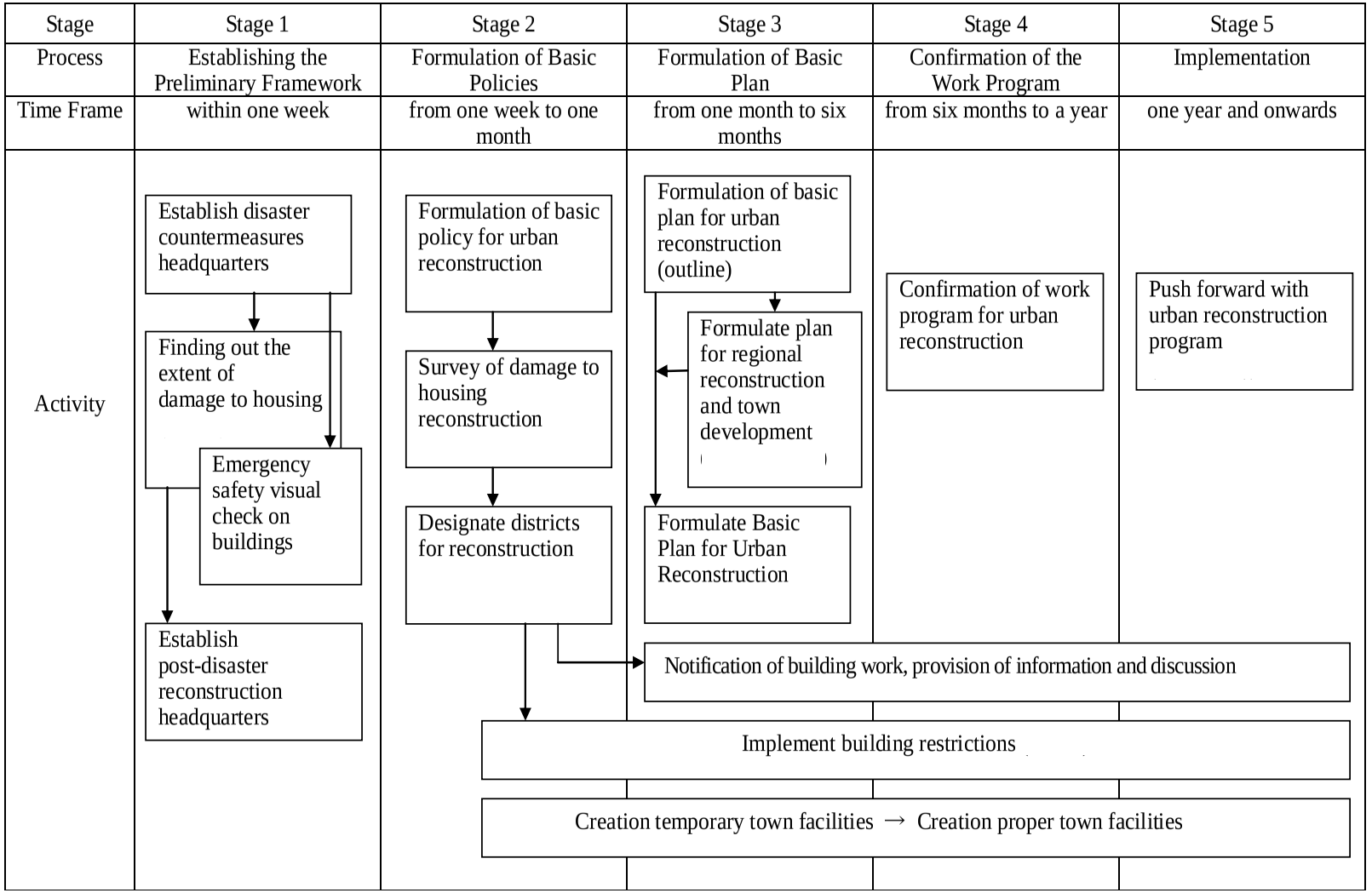

Figure 12.4.1 Basic Process of Urban Rehabilitation and Reconstruction

12.5 Basic Consideration for Rehabilitation of Citizen's Living

One of the most important issues is to rehabilitate citizen's living after the earthquake disaster. The full support and cooperation of the Governmental Organizations shall be demanded in order to recover the original and stable conditions for living life.

12.5.1 Basic Aim and Approach of Rehabilitation of Citizen's Living

While it is a fundamental aim to recover the citizen's life to the original conditions, it is also the principal objective to reconstruct a new lifestyle for the victims who suffered from huge damages onto their minds, bodies and properties. The new style shall conform to new reality of the situation of the disaster and living.

The Municipality shall proceed with the rehabilitation work considering the following approaches in each subject.

1) Medical Treatment, Welfare and Health

These work items are placed as the emergency response items and the response plans are described in Chapter 11. At the same time, these items shall be started first in the rehabilitation work. From the viewpoint of people's life rehabilitation, medical treatment, welfare, health and education-related field is the first priority to start. These work items are directly related to the victim's life and health through the beginning of the disaster to the reconstruction stages. In this regard, it is essential to construct temporary hospitals and clinics as well as to reconstruct the damaged government hospitals and health clinics.

In the field of welfare, various demands of welfare activities will arise. One of the reasons is the increasing number of the objective people of the welfare services. At the same time, it is anticipated that the administration will stop functioning properly because of damage to the welfare organizations. In this regard, it is noteworthy that huge earthquake disaster actualizes various social problems at once which are not newly generated (problems) but potentially exist in large cities.

The countermeasures in the health field include various items. One, it is important to attend to the mental health of victims. The victims suffer from serious mental stress due to the sudden appearance of unexpected realities. All victims will wish to return to the previous conditions before the disaster. Heavy mental and material loads and efforts will be compelled to recover for the citizens. The aim of the mental health care is to support the citizens for overcoming the trauma, for starting the reconstruction of their lives, or for facing the challenge of a new lifestyle in order to conform to new realities. It is also to be noted that those mental health cares will be necessary for the supporting people such as police, fire fighters, lifeline company employees and volunteers.

2) Education and Culture

It is unavoidable to leave out the matters of school education and culture and social education soon after the disaster because these items do not directly concern living, unlike food and clothing. However, these activities are the source of relief for severe atmosphere, for relaxation and energy against the reconstruction work. Therefore, it is necessary to consider the counter plan for these subjects.

In the area of the school education, the confirmation of the safety of school children and pupils is the most urgent matter. And so, municipality should take action for these students not to miss school. For the students who are forced to change schools due to unavoidable circumstances such as collapse of the school building or evacuation to other regions, the Municipality should prepare the environment so as to proceed smoothly with the necessary action to apply.

In the case of earthquake disaster, there will be certain damages on cultural properties. Leaving these properties damaged would lead to further deterioration. The cultural properties are the assets of the Iranian nation and potential tourist attractions. Therefore, swift inspection, restoration and reinforcement shall be conducted. It is also to prevent treasures from being scattered, lost and stolen.

12.5.2 Basic Implementation Items for Rehabilitation of Citizen's Living

Table 12.5.1 summarizes the basic execution items for rehabilitation of citizen's living. Upon proceeding with the project, the following points should be considered:

- Items and fields of the activities shall range widely. The scale of the resources and funds shall be enormous.
- The time frame for the project will be quite long.
- According to the people's restoration and rehabilitation process, there will be considerable differences in the recognition of the necessity of the project among the citizen's. This will be due to the difference of the situation of each citizen's degree of recovery.

Therefore, the Municipality should provide necessary information about the contents, scope, degree of participation by the Municipality and degree of participation by the citizens. Social acceptance on the project should be essential.

Table 12.5.1 Implementation Items for Rehabilitation of Citizen's Living

Sector	Sub Sector	Work Item
Medical Treatment	Regional medical care system	・ Provision of information of restoration condition of regional medical treatment system ・ Establishment and installation of temporary regional hospital / clinic/ health center
	Restoration of hospital's function	・ Restoration of hospital function of governmental hospital/ clinic / health center ・ Support recovery of private hospital / clinic
Welfare	Investigation on demand of welfare activity	・ Collection of information about victim demanding welfare service ・ Damage and restoration condition about welfare facility
	Reconstruction of welfare facility	・ Rehabilitation and reconstruction of governmental welfare facility ・ Support recovery of private and voluntary welfare function
	Preparation and maintenance of welfare service system	・ Secure necessary manpower and resource ・ Preparation of home nursing system
	Support livelihood	・ Loan of money to live ・ Provision of disaster allowance / benefit ・ Collection and distribution of donation ・ Income support
Health	Health	・ Mental health care ・ Health care of victims
	Public health	・ Secure safety of water and food ・ Secure public lavatory and shower
School Education	Reconstruction of school facility	・ Reconstruction of public school ・ Support of reconstruction of private school
	Resumption of class	・ Resumption of class in public school ・ Support of resumption of class in private school`
	Support to student / pupil disaster victim	・ Support to student / pupil disaster victim by placement in another school
Cultural and Social Education	Restoration of cultural and social education facility	・ Reconstruction and restoration of museum, theater and historical monument ・ Management and maintenance of stored object
Citizen's Voluntary Activities	Cooperation with volunteer and community activity	・ Establishment of mutual agreement of cooperation
Consumer's Daily Life	Protection of consumer's daily life	・ Watch dishonest business ・ Protect copycat price increase

Source: JICA Study Team

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Chapter 13
Development of GIS database

CHAPTER 13 DEVELOPMENT OF GIS DATABASE

13.1 Purpose of GIS Database

GIS database for disaster management consists of damage estimation result, disaster management resource and damage response plan. Utilizing GIS database is indispensable to figure out the simulation result of disaster, to develop mitigation and management plans, and to evaluate and improve plans, in both quantitatively and geographically.

GIS database will be effective in disaster response stage, by inputting and sharing the damage information and availability of resources.

Key issues in GIS database for these purposes are as follows:

- Process of collecting data, removing error, updating data and upgrading database structure;
- Process of analysis and planning;
- Process of data sharing and data utilizing consultation to any disaster management entity;
- Process of data input, update and share in disaster response stage; and
- Human resources and network with equipment in order to carry out these tasks.

13.2 Current Situation

13.2.1 Data and System of Tehran Municipality

TDMMC has carried out a number of tasks involving data collection, analysis and planning. However, most of them are still somehow qualitative. Most are not easy to be overlaid to any other information for analysis or planning. These are caused by the following situations:

- Data and planning have a tendency not to be quantitative
- Data collection is not easy because the related entities are divided vertically into divisions
- Many are not GIS data (=geographical and digital data), so not ready for overlay analysis
- Data is generally controlled by the response specialist, and is not shared to other specialists in TDMMC.

These could be improved effectively by the following methods:

- More negotiators and/or managers in higher position for database collection, planning and management.
- Data sharing system and manager for it.
- Database development engineer and database operation engineer for supporting any analyst and planner.

13.2.2 Data and System developed by this JICA Study

JICA Study Team has developed a quantitative GIS database, by the combined efforts of Japanese and Iranian specialists. However, some problems have been encountered.

Collected attribute data are sometimes not full and/or different from the request, and sometimes contain errors. More effective and supportive data requesting negotiation need to be developed.

Database update process is not yet experienced. Cyclical database updating scheme, including upgrading of the database structure, is starting.

The data was strongly forbidden to disclose generally, even to any professionals in TDMMC. Information sharing system should be established to any entity related to disaster management.

13.3 GIS Database Master Plan

The primary purpose of GIS database is "Planning of disaster mitigation, management, rescue and rehabilitation by quantitative and geographical analysis, by cooperation work with related organizations." The secondary purpose is publishing of any approved analysis and/or plans to disaster responses, by database and GIS technology.

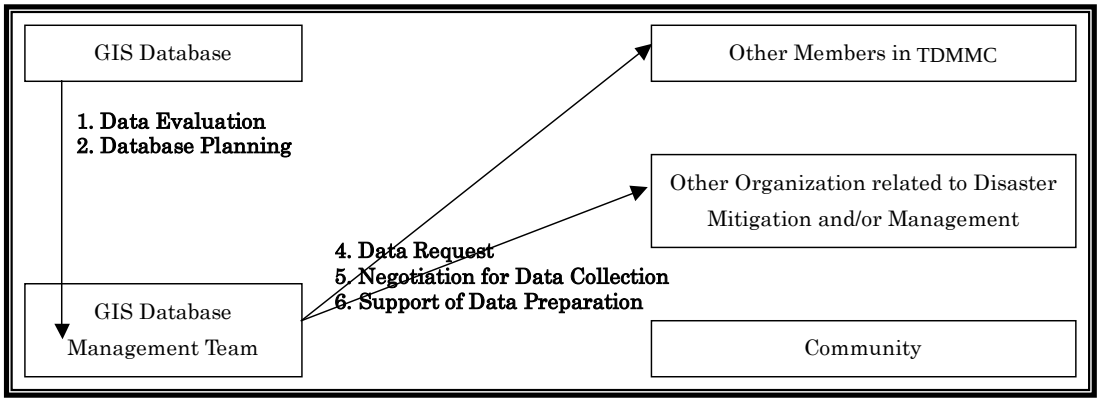
In addition, the GIS database can become the data center in disaster response stage, if the database contains fields for damage and availability information, if there will be enough staff for data updating, and if online information distribution system is developed.

It is necessary to establish GIS Data Center and Consultation Service Center for Disaster Management, which includes the following functions.

13.3.1 Work Flow before Disaster

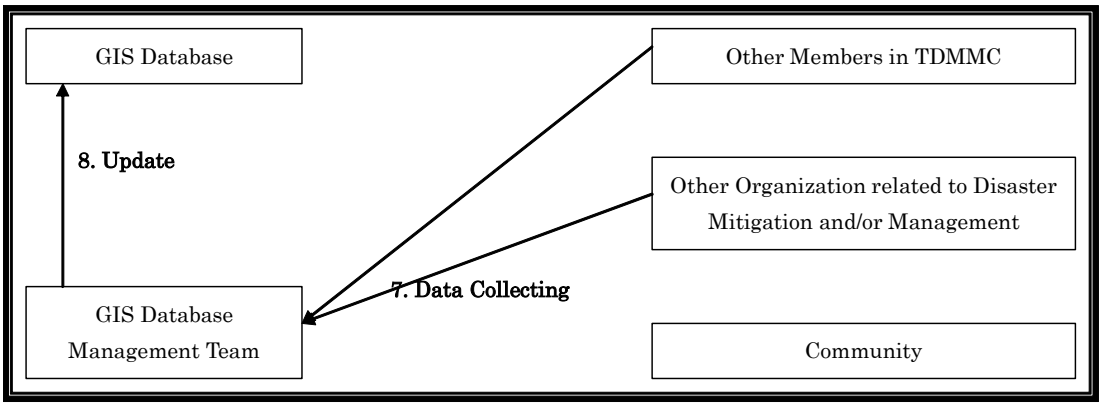
1) Database Maintenance

Database must be up-to-date and error-free. The current GIS team could work more effectively by enforcement of data evaluation, database planning, negotiation for data collection and support of data preparation.



Source: JICA Study Team

Figure 13.3.1 Work Flow Before Disaster: Database Maintenance (1)



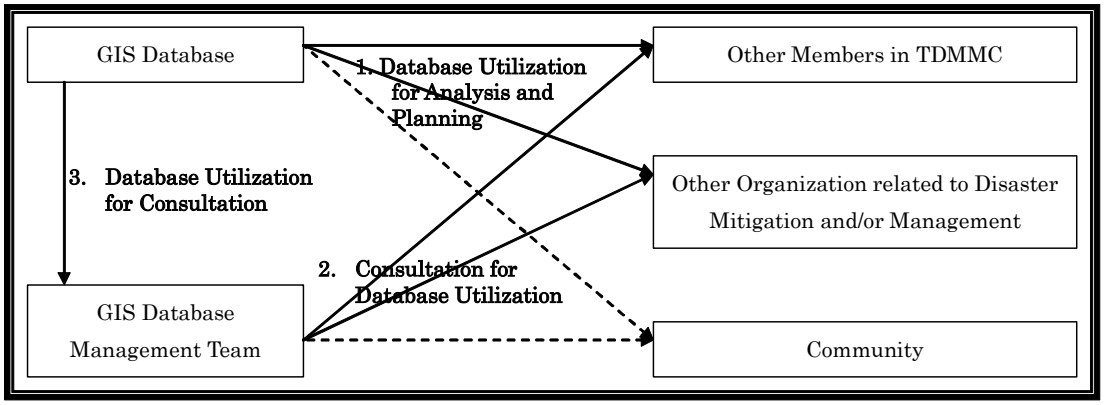
Source: JICA Study Team

Figure 13.3.2 Work Flow Before Disaster: Database Maintenance (2)

2) Analysis and Planning

The current GIS team could work more effectively by enforcement of consultation capability for analyst and planner.

Supporting of communities is also important. For example, mapping engineer should support community mapping for disaster mitigation.

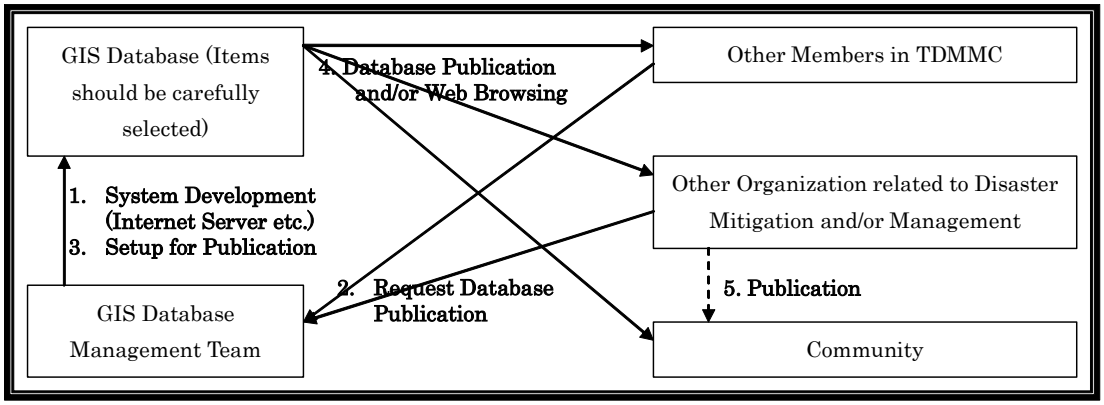


Source: JICA Study Team

Figure 13.3.3 Work Flow Before Disaster: Analysis and Planning

3) Public Relations

Community should be well informed about map output on damage estimation, resources for disaster, and plans, before disaster.

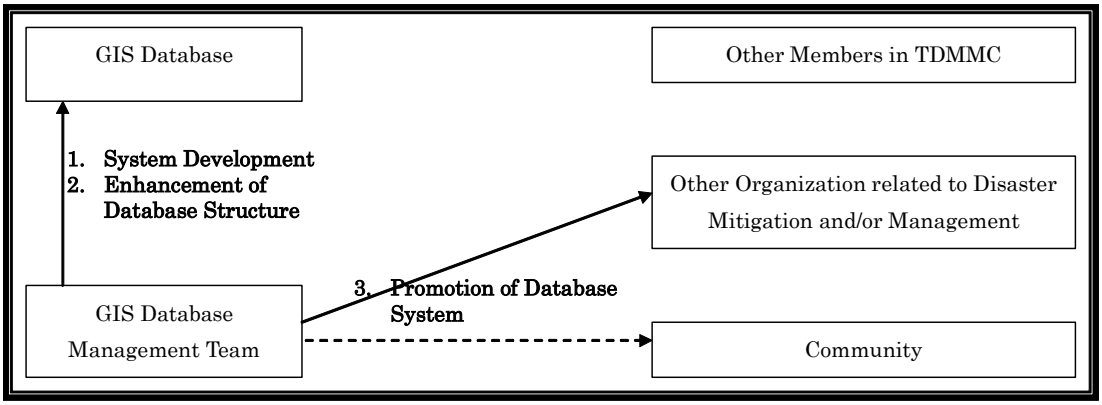


Source: JICA Study Team

Figure 13.3.4 Work Flow Before Disaster: Public Relations

4) Preparation as the Data Center for Disaster Response Stage

System development and enhancement of database structure is indispensable. Promotion of the system is also important.

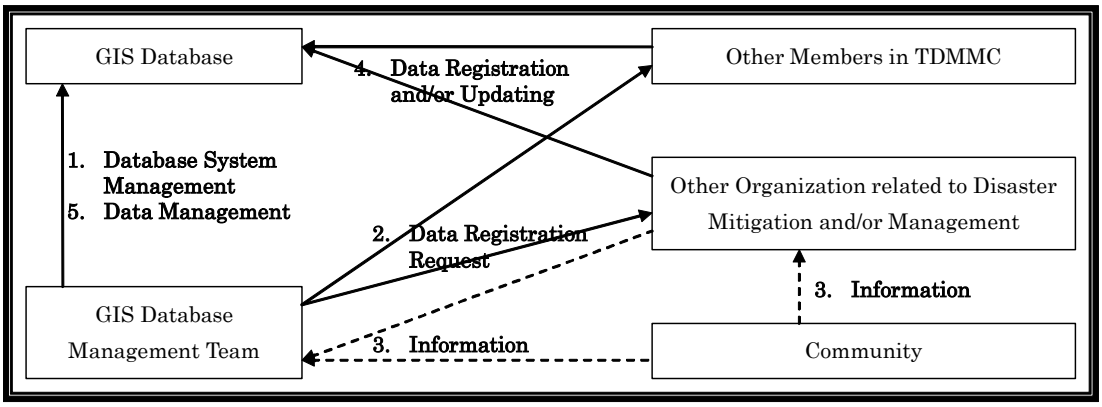


Source: JICA Study Team

Figure 13.3.5 Work Flow Before Disaster: Preparation for Disaster Response Stage

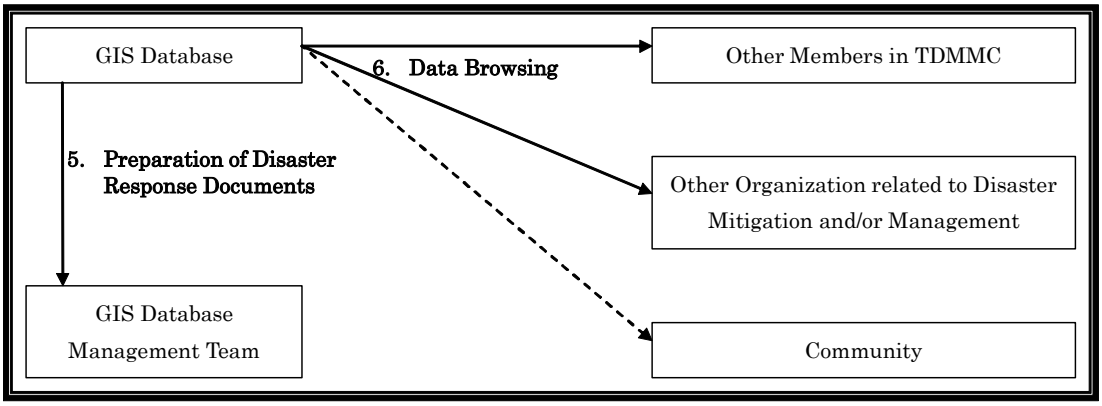
13.3.2 Work Flow in Disaster Response Stage

Database of damages and availability of resources must be updated frequently.



Source: JICA Study Team

Figure 13.3.6 Work Flow in Disaster Response Stage (1)



Source: JICA Study Team

Figure 13.3.7 Work Flow in Disaster Response Stage (2)

13.3.3 Key Issues

The Iranian members of current GIS database management team are not enough, especially regarding the following aspects:

- Management of data collection, including the capability of negotiation and data preparation support to other members in TDMMC and other organizations related to disaster mitigation and/or management
- Management of database structure upgrading
- Management of data input and error checking
- Capability for supporting and negotiating to all analysts and planners related to disaster management
- Specialist for online data publishing service, including internet GIS technology
- Second, data collecting and publishing system must be prepared and developed, that is,
- Internet GIS server, including a mirror server located outside of Tehran
- Internet connection

These can be effectively achieved by development of capability of TDMMC's GIS database team with support from the other GIS-related organizations and consultants.

Chapter 14
Project Implementation

CHAPTER 14 PROJECT IMPLEMENTATION

14.1 Implementation Schedule

14.1.1 Implementation Agency

The implementation agency for the projects will be the governmental sector as shown in the long list. It can be divided into four hierarchal organizational systems: national government, Tehran Municipality, district government and community level as well as semi-governmental agency. The lifeline company, falling into semi-governmental organization, should take responsibility for implementation of their facility.

In order to implement those projects and programs, the coordination mechanism should be established by TDMMC by using the specialized committee that was already established. TDMMC should act as a leading organization for sharing information and idea as well as technical support. The coordination could not be limited by the governmental sector and it should include non-governmental sector such as professional organization, commercial organization, community organization and NGOs.

In addition, the involvement of private sector in project implementation mechanism is also essential. For example, as mentioned in Chapter 4, the designation of regional and community evacuation places shall be decided in collaboration with authorities and communities. In this process, the government shall establish supporting system to strengthen the designated evacuation facilities, even if the target facility is owned by private sector. The government should establish the coordination mechanism between public and private sectors.

14.1.2 Implementation period

1) Short Term

The short-term is to prepare the further coming project by making plan and design. The governmental organizations for disaster management should start their activities based on the proposed projects. Most of the projects are not capital intensive but coordination and planning for implementation. The formulation of training materials and manuals is the most important outcome in this term. Different implementation agencies take responsibility, depending on the project characteristics.

In this term, the vulnerability to earthquake disaster of Tehran would not improve, because the physical improvement will be conducted in the following Medium Term. The consensus and coordination among the governmental sectors would be required in this term.

2) Medium Term

In the end of the Medium Term, the governmental sector shall prepare for earthquake event. The disaster management related governmental buildings will be strengthened and preparedness for the government sector will be finalized. The governmental sector could respond to the earthquake event in an organized manner. TDMMC shall act as a focal organization in the Teheran Municipality to coordinate rescue and relief activities in cooperation with Red Crescent Society. The other organization shall also act for emergency response just after the event.

Apart from the governmental sector, private sector would still carry the risk against earthquake disaster. Most of the earthquake damage risk would not be resolved, since many weak buildings will remain as they currently are. The governmental program for the private building strengthening or area-development scheme shall start in this term. Nevertheless, Tehran still carries the earthquake damage risk.

TDMMC should review damage assessment and risk analysis based on the latest data and information. The implementation of the master plan should be reviewed and necessary adjustment should be done within this term. Based on the mid-term review, the implementation schedule shall be changed.

3) Long Term

By the end of covering term of the master plan study, a full-scale of mitigation measures shall be started in Tehran, targeting especially on weak private buildings. In order to accelerate the building strengthening, the governmental sector would formulate policy for building issues, while the strengthening of the second important governmental building would be progressed in this term. In addition, the implementation framework for mitigation countermeasures and area-development project would be established.

The level of earthquake disaster risk of Tehran would gradually be reduced, but it is not at an appropriate level. The Tehran citizen should be made aware of the governmental commitments towards the earthquake disaster, and these activities should be continuously carried out after the end of the master plan period.

14.2 Long List

14.2.1 Selection of Project

The long list prepared in this study includes the entire projects aiming to achieve goal and objectives for the master plan. The long list is compiled by the strategies of the master plan and re-grouped into the priority program. Some of the items that could not formulate the priority program will be mentioned in the recommendation.

The Study Team carried out the analysis of the existing situations to achieve the goal and objectives, which are described in Chapter 2. The Study Team identified projects and programs to fill the gap between the goals of the master plan and existing situation. The responsible organization might set the target for their plan for the disaster management. In this case, the Study Team would modify the projects.

14.2.2 Project Long List

The project long list is shown as follows:

Table 14.2.1 Long List

1. Strengthening of the Existing Building

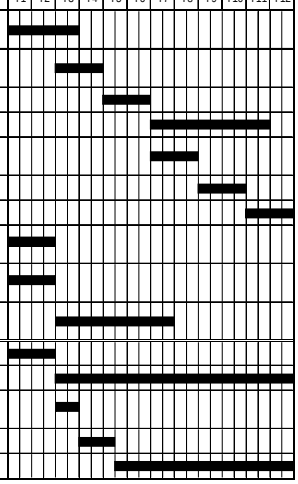
Sector	No. in Priority Projects	Program		Project Name	Implementation Body	Estimated Cost (Mil. US$)	Implementation Schedule (Short Term: Y1–Y3; Medium Term: Y4–Y7; Long Term: Y8–Y12)
Standardization	EBS-01	New-Creation of Standard	1-1	New-creation of "Specification of Building Diagnosis on Seismic Resistance and Strengthening"	Ministry of Housing and Urban Development (BHRC)	0.45	
Public Buildings	EBS-02	Strengthening the emergency commanding centers	1-2	Seismic Diagnosis Study of the MOI Building	Ministry of Interior	0.01	
	EBS-03		1-3	Strengthening of the MOI Building		0.75	
	EBS-04		1-4	Seismic Diagnosis Study of the TDMMC Building	Tehran Municipality (TDMMC)	0.01	
	EBS-05		1-5	Strengthening of the TDMMC Building		0.75	
	EBS-06		1-6	Seismic Diagnosis Study of 22 District Municipality Office Building	Tehran Municipality (District Affairs Deputy Office)	0.30	
	EBS-07		1-7	Strengthening of 22 District Municipality Office Building		16.50	
	EBS-08	Strengthening the buildings for emergency response headquarter buildings	1-8	Seismic Diagnosis Study of the Police Headquarter Building	Ministry of Interior	0.01	
	EBS-09		1-9	Strengthening of the Police Headquarter Building		0.75	
	EBS-10		1-10	Seismic Diagnosis Study of the 11 Red Crescent Society's Headquarter	Red Crescent Society	0.15	
	EBS-11		1-11	Strengthening of the 11 Red Crescent Society's Headquarter		8.25	
	EBS-12		1-12	Seismic Diagnosis Study of the Central Command of Army	Ministry of Defense	0.01	
	EBS-13		1-13	Strengthening of the Central Command of Army		0.75	
	EBS-14	Strengthening Medical and Health Facilities in Tehran Province	1-14	Seismic Diagnosis Study of the Governments' Secondary and Tertiary 44 Hospital Buildings	Ministry of Health & Medical Education	1.72	
	EBS-15		1-15	Strengthening of Governments' Secondary and Tertiary 44 Hospital Buildings		96.30	
	EBS-16		1-16	Seismic Diagnosis Study of Governments' 127 Urban Health Centers		0.84	
	EBS-17		1-17	Strengthening of Government's 127 Urban Health Centers		9.54	
	EBS-18		1-18	Financial Assistance System Arrangement for Seismic Diagnosis Study of 46 Major Private Hospitals		0.63	
	EBS-19		1-19	Financial Assistance System Arrangement for Strengthening of 46 Major Private Hospitals		0.87	
	EBS-20	Strengthening MOH&ME's Office Buildings in Tehran Province	1-20	Seismic Diagnosis Study of the MOH&ME Central Office Buildings	Ministry of Health & Medical Education	0.01	
	EBS-21		1-21	Strengthening of the MOH&ME Central Office Buildings		0.75	
	EBS-22		1-22	Seismic Diagnosis Study of 3 Medical Universities Office Buildings		0.04	
	EBS-23		1-23	Strengthening of 3 Medical Universities Office Buildings		2.25	
	EBS-24		1-24	Seismic Diagnosis Study of Office Buildings for 22 Districts' Health Centers		0.30	
	EBS-25		1-25	Strengthening of Office Buildings for 22 Districts' Health		16.50	
	EBS-26	Strengthening Emergency Response Operation Buildings	1-26	Seismic Diagnosis Study of the 73 Fire Fighting Stations	Tehran Municipality (City Services Deputy Office)	0.99	
	EBS-27		1-27	Strengthening of the 73 Fire Fighting Stations		5.49	
	EBS-28		1-28	Seismic Diagnosis Study of the 16 Traffic Police Stations	Ministry of Interior	0.22	
	EBS-29		1-29	Strengthening of the 16 Traffic Police Stations		1.20	
	EBS-30		1-30	Seismic Diagnosis Study of the 106 Traffic Police Stations	Tehran Municipality (Main Executive Office of Traffic Police)	1.44	
	EBS-31		1-31	Strengthening of the 106 Traffic Police Stations		7.95	
	EBS-32	Strengthening other important governmental	1-32	Seismic Diagnosis Study of the Rest of 17 Ministry Buildings	Each Ministry	0.23	
	EBS-33		1-33	Strengthening of the Rest of 17 Ministry Buildings		12.75	
	EBS-34	Strengthening transportation facilities	1-34	Seismic Diagnosis Study of the Airport	Ministry of Road and Transportation	0.27	
	EBS-35		1-35	Strengthening of the Airport		15.00	
	EBS-36		1-36	Seismic Diagnosis Study of the Train and Bus Terminal	Tehran Municipality (Transportation & Traffic Deputy Office)	1.35	
	EBS-37		1-37	Strengthening of the Train and Bus Terminal		8.00	
	EBS-38	Strengthening school buildings	1-38	Seismic Diagnosis Study of the School Buildings	Ministry of Education	6.00	
	EBS-39		1-39	Strengthening of the School Buildings		330.00	
Private Buildings	EBS-40	Strengthening Promotion of Residential Bldg.	1-40	Research of Strengthening Scheme for Masonry Structure	Ministry of Housing and Urban Development (BHRC) / Research Institutions	0.30	
	EBS-41		1-41	Research of Strengthening Mechanism for Steel/RC Structure Buildings		0.40	
Building Quality	EBS-42	Improvement of Building Quality	1-42	Establishment of Committee for Building Quality Improvement	Ministry of Housing and Urban Development (BHRC) / Tehran Municipality (Urban Development & Architecture Deputy Office) / Research Institutions	0.10	
	EBS-43		1-43	Revision of "Specification of Building Diagnosis on Seismic Resistance and Strengthening"	Ministry of Housing and Urban Development (BHRC) / Tehran Municipality (Urban Development & Architecture Deputy Office) / Research Institutions	0.10	
	EBS-44		1-44	Revision of Building Construction Appraisal System	Tehran Municipality (Urban Development & Architecture Deputy Office)	0.10	
	EBS-45		1-45	Establishment of Engineer Registration System	Ministry of Housing and Urban Development / Tehran Municipality (Urban Development & Architecture Deputy Office)	0.02	
	EBS-46		1-46	Establishment of Engineering Skill Learning School	Tehran Municipality (Urban Development & Architecture Deputy Office)	0.10	
	EBS-47		1-47	Development of Computer-Aid Software for Structural Seismic Resistance Analysis	Ministry of Housing and Urban Development (BHRC) / Research Institutions	0.10	
	EBS-48		1-48	Capacity Development of Double-Checking Offices of Tehran Municipality	Tehran Municipality (Urban Development & Architecture Deputy Office)	1.12	
	EBS-49		1-49	Promotion Campaign of Building Construction Appraisal Procedure		0.06	

Sub Total Cost (Million US$) : 551.74

2. Improvement of Existing Urban Structure

Sector	No. in Priority Projects	Program		Project Name	Implementation Body	Estimated Cost (Mil. US$)
Urban Redevelopment	USI-01	Promotion of Urban Redevelopment for Disaster Prevention (1st Phase)	2-1	Installation of Disaster-Proof Living Zone System	Tehran Municipality (Urban Development & Architecture Deputy Office)	2.10
	USI-02		2-2	Identification of Development Area - "Key Area"		3.60
	USI-03		2-3	Formulation of Detailed Design and Scheme	Tehran Municipality (District Affairs Deputy Office)	4.30
	USI-04		2-4	Implementation of Urban Redevelopment		(329.80)
	-	Promotion of Urban Redevelopment for Disaster Prevention (2nd Phase)	2-5	Identification of Development Area - "Key Area"	Tehran Municipality (Urban Development & Architecture Deputy Office)	3.60
	-		2-6	Formulation of Detailed Design and Scheme	Tehran Municipality (District Affairs Deputy Office)	4.30
	-		2-7	Implementation of Urban Redevelopment		--
	-	Improvement of Earthquake Safety in Vulnerable Area	2-8	Preparation of Improvement Plan for Public Facilities	Tehran Municipality (District Affairs Deputy Office)	1.00
	-		2-9	Introduction of Incentive System for Earthquake-Resistant Buildings in Proposed improvement Area		1.00
	-		2-10	Promotion of Earthquake-Resistant Buildings in Proposed Improved Area	Tehran Municipality (District Affairs Deputy Office)	0.75
Road Development	-	Emergency Road Improvement	2-11	Preparation of Emergency Road Network Plan	Tehran Municipality (Urban Development & Architecture Deputy Office)	1.00
	-		2-12	Land Readjustment along the Primary Emergency Road		40.00
	-		2-13	Development of Road Network for Community Evacuation Route	District Municipality	0.50
	-		2-14	Preparation of Evacuation Route Improvement Plan		1.00
	-		2-15	Land Readjustment along Evacuation Route		20.00

Implementation Schedule: Short Term (Y1 Y2 Y3) | Medium Term (Y4 Y5 Y6 Y7) | Long Term (Y8 Y9 Y10 Y11 Y12)



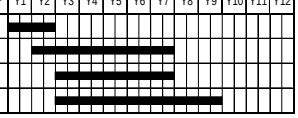
* Implementation Body of the project, "2-4 Improvement of Urban Redevelopment" is not necessarily District Affairs Deputy Office of Tehran Municipality.

Sub Total Cost (Million US$) : 246.65

3. Identification of Safety Evaluation Place

Sector	No. in Priority Projects	Program		Project Name	Implementation Body	Estimated Cost (Mil. US$)
Open Space	EPI-01	Evacuation Place Improvement	3-1	Formulation of Emergency Evacuation Plan and Manual	Tehran Municipality (City Services Deputy Office)	1.00
	EPI-02		3-2	Identification and Designation of Regional Evacuation Place		1.50
	EPI-03		3-3	Identification of Safe Evacuation Route		1.50
	EPI-04		3-4	Provision of Emergency Facilities and Goods		48.00

Implementation Schedule: Short Term (Y1 Y2 Y3) | Medium Term (Y4 Y5 Y6 Y7) | Long Term (Y8 Y9 Y10 Y11 Y12)

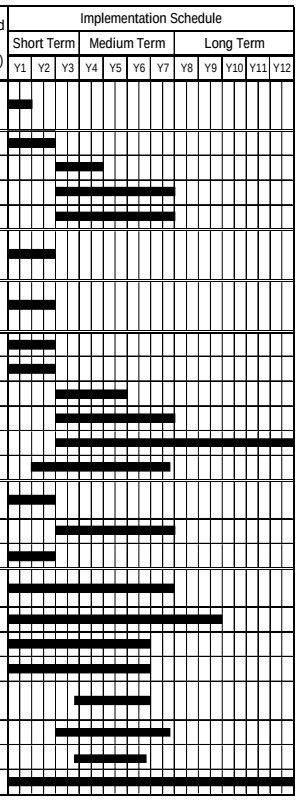


Sub Total Cost (Million US$) : 73.50

4. Strengthening of Existing Infrastructure and Lifeline

Sector	No. in Priority Projects	Program		Project Name	Implementation Body	Estimated Cost (Mil. US$)
Risk Assesment	-	Risk Assesment on Landslide and Liquefaction	4-1	Full-scale Assessment on Landslide and Liquefaction by Microzoning Technique	Tehran Municipality (TDMMC)	0.50
Bridge	INF-01	Strengthening and Replacement of Bridges along Major Road Network	4-2	Preparation of Plan	Tehran Municipality (Tehran Engineering Technical Consulting Organization)	
	INF-02		4-3	Implementation of Strengthening		10.00
	INF-03		4-4	Implementation of Replacement		20.00
	INF-04		4-5	Installation of Falling Prevention Devices		5.00
Metro	-	Vulnerability Assessment of Metro Facilities	4-6	Vulnerability Assessment of Metro Facilities	Tehran Urban & Suburban Railway Company	2.00
Qanat	-	Vulnerability Assessment of Qanat Network	4-7	Investigation of Qanat Network and their Vulnerability Assessment	Ministry of Jihad-e-Agriculture	1.00
Water	LIF-01	Strengthening of Water Supply Facility and Network	4-8	Preparation of Strengthening Plan for Facilities and Network	Tehran Water and Sewage Company	3.00
	LIF-02		4-9	Preparation of Emergency Response Plan		0.50
	LIF-03		4-10	Implementation of Facility Strengthening		10.00
	LIF-04		4-11	Implementation of Network Strengthening		10.00
	LIF-05		4-12	Implementation of Periodical Drills for Emergency		0.50
	LIF-06		4-13	Construction of Emergency Water Tanks	Tehran Water and Sewage Company	18.00
Electricity	-	Secure Safety of Electricity Supply Service	4-14	Strengthening Plan for Diagnosis of Electricity Supply Facilities	Tehran Regional Electric Company	3.00
	-		4-15	strengthening of Electricity Supply Facilities		20.00
	-		4-16	Preparation of Emergency Operation Plan with Manuals		1.00
Gas	LIF-07	Installation of Central Control System for Natural Gas Distribution System	4-17	Reinforcement of Gas Distribution Facilities and its Office Buildings	Greater Tehran Gas Company	37.10
	LIF-08		4-18	Reinforcement of Gas Distribution Pipe Network	Greater Tehran Gas Company	121.90
	LIF-09		4-19	Design and Construction of Remote Shutdown System	Greater Tehran Gas Company	39.75
	LIF-10		4-20	Design and Installation of Seismometers	Greater Tehran Gas Company	42.40
	LIF-11		4-21	Design and Construction of Central Control Center with Central Security Control System	Greater Tehran Gas Company	10.60
	LIF-12		4-22	Testing and Installation of Intelligent Gas Meters	Greater Tehran Gas Company	5.30
	LIF-13		4-23	Design and Installation of Radio Communication System	Greater Tehran Gas Company	2.65
	LIF-14		4-24	Training and Maintenance	Greater Tehran Gas Company	5.30

Implementation Schedule: Short Term (Y1 Y2 Y3) | Medium Term (Y4 Y5 Y6 Y7) | Long Term (Y8 Y9 Y10 Y11 Y12)

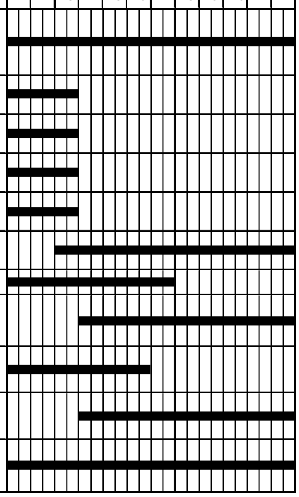


Sub Total Cost (Million US$) : 369.00

5. Provision of Earthquake Information and Education

Sector	No. in Priority Projects	Program		Project Name	Implementation Body	Estimated Cost (Mil. US$)
Earthquake Information and Education	-	Development of Disaster Education Facilities in Disaster Center	5-1	Preparation of Disaster Education Facilities and Materials for the Disaster Education Center in TDMMC	Tehran Municipality (TDMMC)	0.10
	-	Training of Trainers of Governmental Staff for Disaster Management	5-2	National Level Training of Governmental Staff in Charge of Disaster Management	Ministry of Interior / Tehran Municipality (Social and Cultural Affairs Deputy Office)	0.05
	-		5-3	Training of Governmental Staff in Charge of Disaster Management at Municipality Level		0.05
	-	Creation of Leaders for Disaster Management in the Society	5-4	Development of Training Programs of Government Staff of Tehran Municipality	Tehran Municipality (Social and Cultural Affairs Deputy Office)	0.05
	-		5-5	Development of Training Programs for Industry and Community Leaders		0.05
	-		5-6	Training Governmental Staff and Community Members Through the Programs		0.09
	EIE-01	Enhancement of Awareness through Model Schools	5-7	Establishment of Model Schools for Disaster Education	Ministry of Education	1.16
	EIE-02		5-8	Promotion and Systematization of School Educational Activities Related to Disaster Management at National and Municipal Levels		0.90
	-	Enhancement of Community Resistance to Disaster through Social Education	5-9	Development of Community Level Education and Training Programs	Tehran Municipality (Social and Cultural Affairs Deputy Office)	0.08
	-		5-10	Utilization of the Existing Facilities and Organizations		0.10
	-	Information Diffusion through Mass Media	5-11	Effective Use of Mass Media for Disaster Related Information	Individual Organization (TV, Radio, Newspaper, Magazine)	0.24

Implementation Schedule: Short Term (Y1 Y2 Y3) | Medium Term (Y4 Y5 Y6 Y7) | Long Term (Y8 Y9 Y10 Y11 Y12)



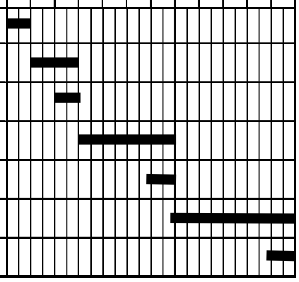
Sub Total Cost (Million US$) : 2.87

6. Establishment of Governmental Support System

Sector	No. in Priority Projects	Program		Project Name	Implementation Body	Estimated Cost (Mil. US$)
Governmental Financial Assistance	-	Strengthening Promotion of Residential Building	6-1	Establishment of Governmental Financial Assistance Scheme for Strengthening of Residential Building	Ministry of Housing and Urban Development	1.00
	-		6-2	Enactment of Governmental Financial Assistance Scheme Phase 1		234.20
	-		6-3	Evaluation and Rearrangement of Governmental Financial Assistance Scheme Phase 1		1.00
	-		6-4	Enactment of Governmental Financial Assistance Scheme Phase 2		312.30
	-		6-5	Evaluation and Rearrangement of Governmental Financial Assistance Scheme Phase 2		1.00
	-		6-6	Enactment of Governmental Financial Assistance Scheme Phase 3		390.40
	-		6-7	Evaluation and Rearrangement of Governmental Financial Assistance Scheme Phase 3		1.00

940.90

Implementation Schedule: Short Term (Y1 Y2 Y3) | Medium Term (Y4 Y5 Y6 Y7) | Long Term (Y8 Y9 Y10 Y11 Y12)

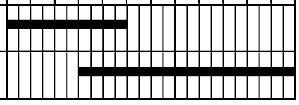


Sub Total Cost (Million US$) : 940.90

7. Establishment of Community Level Disaster Management Organization

Sector	No. in Priority Projects	Program		Project Name	Implementation Body	Estimated Cost (Mil. US$)
Community Level Disaster Management Organization	COE-01	Enhancement of the Community Capacity for Disaster Management	7-1	Designation of Model Communities for Organization of Community Level Disaster Groups and System	Tehran Municipality (Social and Cultural Affairs Deputy Office) / District Municipality	0.38
	COE-02		7-2	Promotion of Community Level Disaster Management Activities		0.40

Implementation Schedule: Short Term (Y1 Y2 Y3) | Medium Term (Y4 Y5 Y6 Y7) | Long Term (Y8 Y9 Y10 Y11 Y12)

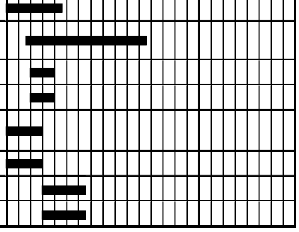


Sub Total Cost (Million US$) : 0.78

8. Improvement of Disaster management System

Sector	No. in Priority Projects	Program		Project Name	Implementation Body	Estimated Cost (Mil. US$)
Disaster Management System	DMS-01	Institutional Capacity and Capability Building	8-1	Operationalization of Emergency Response Plan	Tehran Municipality (TDMMC)	3.00
	DMS-02		8-2	Institutional Capacity Building TDMMC (including training component)		5.00
	DMS-03		8-3	Updating of Data-Base		1.50
	DMS-04		8-4	Preparation of Manual for Disaster Management Activities		1.50
	DMS-05		8-5	Feasibility Study on Emergency Operations Center (including CD, BD,DD)		1.00
	DMS-06		8-6	Feasibility Study on Emergency Communication System		1.75
	DMS-07		8-7	Implementation of Emergency Operation Center		50.00
	DMS-08		8-8	Mid-term Evaluation and Master Planning Updating		3.00

Implementation Schedule: Short Term (Y1 Y2 Y3) | Medium Term (Y4 Y5 Y6 Y7) | Long Term (Y8 Y9 Y10 Y11 Y12)



Sub Total Cost (Million US$) : 66.75

9. Formulation of the Emergency Response Plan

Sector	No. in Priority Projects	Program		Project Name	Implementation Body	Estimated Cost (Mil. US$)
Evacuation	-	Establishment and Preparation of Community Evacuation Places	9-1	Preparation of Plan	Tehran Municipality (District Affairs Deputy Office) / District Municipality	1.00
	-		9-2	Installation of Warehouse		10.00
	-		9-3	Equip Relief Goods and Tools		25.00
Traffic	ETS-01	Establishment of Emergency Traffic System in Tehran	9-4	Analysis of Current Traffic Flow and Estimation of Traffic Flow in Emergency	Tehran Municipality (Transportation & Traffic Deputy Office)	2.00
	ETS-02		9-5	Study on Emergency Road Network		2.00
	ETS-03		9-6	Study on Emergency Traffic Control System		2.00
	ETS-04		9-7	Design and Installation of New Traffic Lighting System		18.00
	ETS-05		9-8	Design and Installation of Traffic Camera and Its Monitoring Facilities		7.00
	-		9-9	Facilitation of Traffic Police Stations along Emergency Road Network		25.00
	-		9-10	Increase in Traffic Control Staffs and Vehicles		5.00
	-		9-11	Securing 5 Fully Equipped Rescue & Relief Helicopters for Emergency Operation		25.00
	-		9-12	Operation and Maintenance of 5 Fully Equipped Rescue & Relief Helicopters for Emergency Operation		27.00
	-		9-13	Formulation of Debris Removal Plan on Emergency Road	Tehran Municipality (City Services Deputy Office)	1.00
Debris	-	Set Up of Debris Removal Management System	9-14	Formulation of Debris Removal Plan and Its Management System	Tehran Municipality (City Services Deputy Office)	2.00
Burial	-	Formulation of Burial Plan	9-15	Feasibility Study on Selection of New Cemetery Park and Burial System	Tehran Municipality (City Services Deputy Office)	1.00
Food and Living Necessities	-	Preparation of Emergency Food and Primary Living	9-16	Formulation of Emergency Food Supply Plan	Tehran Municipality (District Affairs Deputy Office) / District Municipality	1.00
	-		9-17	Construction / Installation of Emergency Food Warehouse		23.00
Telecom	-	Seismic Diagnosis and Strengthening of the Existing Telecommunication Network	9-18	F/S on Strengthening of Telecommunication Network in Teheran	Telecommunication Company of Tehran / MSC	1.50
	-		9-19	Strengthening of Telecommunication Network in Teheran	Telecommunication Company of Tehran / MSC	20.00
	ITN-01	Installation of New Disaster Information and Telecommunication Network	9-20	F/S on Installation of New Disaster Network in Teheran City	Tehran Municipality (TDMMC) / Telecommunication Company of Tehran	1.00
	ITN-02		9-21	Installation of New Disaster Network in Teheran City	Tehran Municipality (TDMMC) / Telecommunication Company of Tehran	18.92
	-		9-22	OJT Training of Operation and Maintenance		2.00
Search & Rescue	SFB-01	Strengthening Search & Rescue Capacity of Tehran Fire Brigade and Safety Services	9-23	Planning: Formulation of Search & Rescue operation plan (including training component and ICS establishment)	Tehran Municipality (City Services Deputy Office)	1.75
	SFB-02		9-24	Implementation (1): strengthening of the Fire Fighting Stations with Vehicles and Equipment for Emergency Operations		24.00
	SFB-03		9-25	Implementation (2): Installation of Underground Water Reservoir Tanks in Sub-Districts		4.00
	SFB-04		9-26	Implementation (3): Expand Education and Training		0.70
Health & Medical Relief	SHC-01	Strengthening Health & Medical Response Capacity	9-27	Planning: Formulation of Plan of MOH & ME for Disaster Medical Services	MOH&ME / Tehran Municipality (TDMMC)	1.50
	SHC-02		9-28	Implementation (1): Strengthening of MOH&ME's overall Capacity for Disaster Response		0.42
	SHC-03		9-29	Implementation (2): Improvement of Hospital Capacities for Disaster Medical Services		22.50
	SHC-04		9-30	Implementation (3): Strengthening of Logistic Capability		0.75
	SHC-05		9-31	Implementation (4): Expand Education and Training		0.70
	-	Mental Care Program	9-32	Development of Training Course of Mental Care		0.70
Post-Event Security	-	Post-Event Security Planning	9-33	Preparation of Post-Event Security Guidelines	Tehran Municipality (TDMMC)	1.00
Emergency Response Capacity Building	ERC-01	Emergency Response Capacity Building	9-34	Hazardous Materials' Operations Plan (including training & drill component)	Tehran Municipality (City Services Deputy Office)	1.50
	ERC-02		9-35	Feasibility Study Hazardous Materials' Emergency Response System		1.75
	ERC-03		9-36	Realization of Hazardous Emergency Response System & Network (including training)		55.00
	ERC-04		9-37	Feasibility Study Industrial Disaster Management Tehran	Tehran Municipality (TDMMC) / Ministry of Industry / Ministry of Energy	1.75
	ERC-05		9-38	Emergency Management Plan for Radioactive Medical Materials	Ministry of Energy / Tehran Municipality (TDMMC)	1.75
	ERC-06		9-39	Implementation Network Radioactive Medical Materials	Ministry of Energy / Tehran Municipality (TDMMC) / Ministry of Health & Medical Education	30.00

Implementation Schedule: Short Term (Y1 Y2 Y3) | Medium Term (Y4 Y5 Y6 Y7) | Long Term (Y8 Y9 Y10 Y11 Y12)

Sub Total Cost (Million US$) : 370.19

10. Establishment of Rehabilitation and Reconstruction Procedure

Sector	No. in Priority Projects	Program		Project Name	Implementation Body	Estimated Cost (Mil. US$)
Rehabilitation	-	Area Rehabilitation	10.1	Area Rehabilitation Scheme	Tehran Municipality (TDMMC)	3.00
	-		10.2	F/S Area Rehabilitation Scheme		2.50

Implementation Schedule: Short Term (Y1 Y2 Y3) | Medium Term (Y4 Y5 Y6 Y7) | Long Term (Y8 Y9 Y10 Y11 Y12)

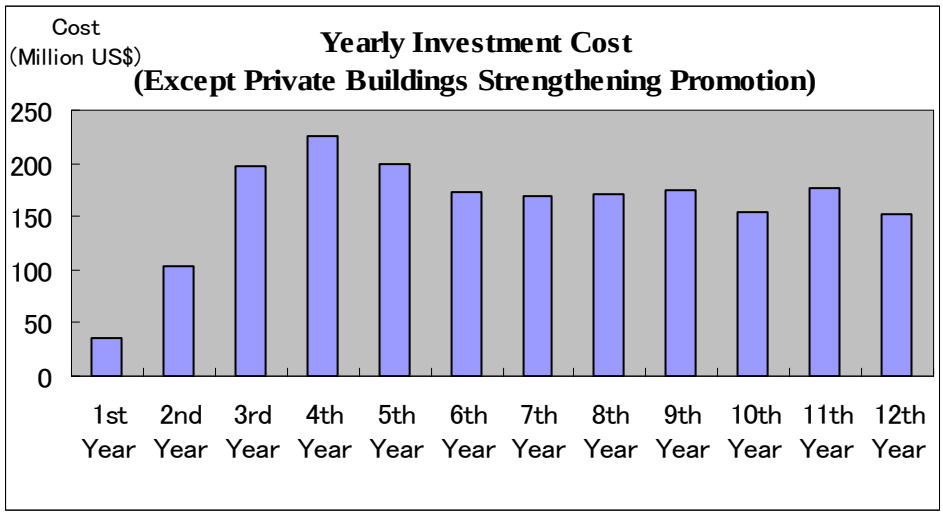
Sub Total Cost (Million US$) : 5.50

14.2.3 Investment Cost for Project Implementation

1) Investment Cost by Year

The total cost for all projects proposed in the long list is estimated at US$ 1,931 million, excluding the project cost for promotion of private building strengthening, amounting to US$ 940.9 million.

Figure 14.2.1 shows a yearly distribution of total investment cost excluding the cost for the private building strengthening promotion project.



Source: JICA Study Team

Figure 14.2.1 Yearly Investment Cost (Excl. Private Building Strengthening Promotion)

Total investment costs by terms are as follows: US$ 334.9 million in Short Term, US$ 765.5 million in Medium Term and US$ 830.6 million in Long Term. The distribution shape in the above figure represents the rational and feasible arrangement of investment cost for earthquake disaster mitigation and preparedness projects, indicating that project undertaking is most active in Medium Term.

2) Organization

Table 14.2.2 shows the allotment of investment cost at each organization level: governmental, municipality, district, semi-governmental and non-governmental. The cost for private building strengthening promotion project is omitted.

Table 14.2.2 Allotment of Investment Cost by Organization Level

Organization Level	Investment Cost (Million US$)
National	Sub Total 541.7
Ministry of Housing and Urban Development	1.4
Ministry of Interior	3.0
Ministry of Defense	0.8
Ministry of Health and Medical Education	156.7
Ministry of Transportation and Traffic	15.3
Ministry of Education	338.1
Other Ministries	26.6
Tehran Municipality	Sub Total 978.3
TDMMC	178.9
District Affairs Deputy Office	58.2
City Service Deputy Office	190.2
Transportation and Traffic Deputy Office	159.4
Urban Development and Architecture Deputy Office	51.8
Social and Cultural Affairs Deputy Office	0.8
Others	339.2
District Municipality	51.9
Government-Owned Lifeline Companies	350.6
Red Crescent Society	8.4
NGOs, Private Sectors	0.2
	Total 1931.1

Source: JICA Study Team

Total investment cost of Tehran Municipality is almost double of national level investment cost. In particular, TDMMC will take a vital role in implementing the earthquake disaster management projects.

It is clear that a vast amount of investment cost is required at each organizational level. Governmental entities shall allot a certain amount of budget on a yearly basis to disaster management projects so as to create the social mainstream to promote disaster management activities. The means for creating the budget, which shall be allocated to disaster management projects, are as follows.

- Compulsory allocation of governmental budget
- Credit taking from foreign aid
- Collection of tax from private entities
- Utilization of disaster management related fund

For the entities at national level, a compulsory allocation of governmental budget and a credit taking from foreign aid are favorable options, considering its mandatory power. Taxation on insurance companies is also favorable, as described in Chapter 8.

On the other hand, for Tehran Municipality, collection of tax is a reasonable mean for creating the budget. In addition, an increase of national subsidy for disaster management in the municipality is indispensable. It is also recommended to utilize the disaster management related fund to promote the strengthening of private buildings as described in Chapter 8.

14.3 Selection of Priority Projects and Programs

14.3.1 Assumptions on Evaluation Indicators

The individual projects in the long list are measured by the assumed evaluation indicators as follows:

Table 14.3.1 Assumed Evaluation Indicators

(1)	**Master Plan Objective Aspect**
(1-1)	Contribution to Securing Lives and Properties (Contribution to Mitigation: Physical Measures)
(1-2)	Contribution to Securing Lives and Properties (Contribution to Preparedness: Software Measures)
(1-3)	Contribution to Protection of Citizen's Life after the Event
(1-4)	Contribution to Preparation of Rehabilitation and Reconstruction
(2)	**Performance Aspect**
(2-1)	Governance Improvement
(2-2)	Neighborhood Consciousness Enhancement
(2-3)	Beneficiaries
(2-4)	Basic Human Need
(3)	**Implementation Aspect**
(3-1)	Urgency
(3-2)	Estimated Project Cost
(3-3)	Financing Potential
(3-4)	Implementing Maturity

Source: JICA Study Team

As a category itself, the indicators in the "master plan objective aspect" relate to those representing also project performance. While the indicators in the Master plan objective aspect are focusing on the degree of contribution to the objective of master plan, the indicators in Performance aspect represent other components of performance than the master plan objective.

1) Master Plan Objective Aspect

This indicator stands for the degree of contribution to master plan objective.

Among the three objectives previously mentioned, the first objective of "to secure lives and properties of the citizens" is subdivided into two sub-objectives, that is, 1) contribution to mitigating disaster damages, and 2) contribution to preparedness. "Mitigation" is rather related to physical measures, while "preparedness" is rather related to software measures. In the rating process, "neutral" is given for the indicators that are of no concern to each master plan objective.

2) Performance Aspect

Indicators in performance aspect are qualitative assessment of the effects of the projects.

(1) Government Preparedness and Response Capacity against Earthquake Disaster

Government preparedness and response capacity against earthquake disaster relates to the contribution of the project in terms of increasing preparedness, managerial, response capacity of administrative organizations and entities, institutions, public companies etc.

(2) Enhancement of Public Awareness

Enhancement of public awareness stands for the contribution of the project regarding the citizen's consciousness against earthquake. The enhancement of public awareness will support the facilitation of mutual aid among neighbors against the earthquake in Tehran.

(3) Beneficiaries

Beneficiaries stand for the magnitude of beneficiaries produced or affected through the implementation of the projects. The magnitude of beneficiaries is measured by rough estimation.

(4) Basic Human Need

Basic human need relates to the project's contribution to the realization / sustainment of basic human need (such basic requirements for human life as water, nutrition, medical care and sanitation.). For example, water supply is indispensable for human life.

3) Implementation Aspect

(1) Urgency

Urgency stands for the degree of the requirement of project's urgent implementation. Depending on the characteristics of the project, the timing of the execution will require an urgent launch. Generally speaking, the urgent execution of the project is a key factor for preventing a further aggravation of issues and facilitating to resolve problems.

(2) Estimated Project Cost

Estimated project cost is one of the indicators to measure the implementation possibility. In general, it can be said that the project with relatively lower cost will have a possibility of easier or sooner implementation than the project with relatively higher cost.

However, the following are to be pointed out:

Although, in general, the development cost of "software related project" is relatively lower than that of "hardware / infrastructure related project," it does not actually warrant the implementation possibility of "software related project." Also, for the implementation of the project, the volume of investment cost is not necessarily an

ultimate deciding factor. For example, even the project with higher cost can be launched, if there will be a higher level decision making.

(3) Financing Potential

Financing potential is one of the key factors to identify an implementing possibility. The availability of financing is an important condition for a successful project. If budgets have been allocated, the project has a higher implementation potential.

(4) Implementation Maturity

Implementation maturity relates to maturity of projects including motivation of implementing entities, negotiation with participated stakeholders, approval by the upper level plans or programs, public relations, etc. It goes without saying that this indicator is much related to the above "financing potential." Here, the indicator of "implementation maturity" is assumed to stand for the components other than financing potential.

14.3.2 Scoring Methods and Results

Each index will be evaluated by indicators A to E, while master plan objective indices include "Neutral," no contribution to the objective. As a score, values of 5,4,3,2,1 and 0 are given for the above "A," "B," "C," "D," "E" and "N," respectively.

Then, the long list projects were sorted by the above obtained total score.

14.3.3 Selected Priority Programs and Projects

Based on the above scoring results, the priority projects are selected. The selection process is as follows:

- Basically, the projects with higher score have precedence for being selected as priority projects.
- Taking the characteristics of each project into account, the projects which can be judged to be appropriate for setting up as a combined project (a combination of plural projects) are integrated.
- In the above process, the balance of numbers of selected priority projects by strategy from the viewpoint of purposes and strategies of master plan was also taken into consideration.

As a result, the following 15 combined projects were selected as a priority project as summarized in Table 14.3.2.

Table 14.3.2 Summary of Selected Priority Projects

No.	Title of Priority Project
1	Strengthening and Replacement of Existing Public Buildings
2	Promotion of Strengthening of Existing Private Buildings
3	Improvement of Building Quality
4	Promotion of Urban Redevelopment for Disaster Prevention
5	Provision of Regional Evacuation Sites and its Facility
6	Strengthening and Replacement of Bridges along Major Road Network
7	Strengthening of Water Supply Facility and Network
8	Installation of Central Control System for Natural Gas Distribution System
9	Establishment of Model Schools for Disaster Education with Different Characteristics at Tehran Municipality Level
10	Designation of Model Communities for Organization of Community Level Disaster Management Group and System
11	Tehran Disaster Mitigation and Management Center - Institutional Capacity Building
12	Establishment of Emergency Traffic System in Tehran
13	Installation of New Disaster Information and Telecommunication Network
14	Strengthening of the Emergency Response Capability and Capacity of the Tehran Fire Fighting and Safety Services Organization
15	Strengthening of Emergency Response Capacity for the Governmental Health Organization

Note: The order of the above priority projects follows the order in the project long list.

Source: JICA Study Team and TDMMC

14.4 Urgent Action Project

Among priority projects, the projects that start from the 1st year of the planning period are selected as urgent action projects, shown in Table 14.4.1.

Table 14.4.1 Urgent Action Project List

Priority Project Name	Urgent Project Name	Cost (Mil. US$)
Strengthening and Replacement of Existing Public Buildings	1.New-creation of "Specification of Building Diagnosis on Seismic Resistance and Strengthening"	0.45
	2.Seismic Diagnosis of Important Public Buildings	Total:12.70
Promotion of Strengthening of Existing Private Buildings	1.Establishment of Governmental Financial Assistance Scheme for Strengthening of Residential Buildings	1.00
Improvement of Building Quality	1.Research of Strengthening Scheme for Masonry Structure	0.30
	2.Establishment of Committee for Building Quality Improvement	0.10
	3.Revision of Building Construction Appraisal System	0.10
	4.Capacity Development of Double Checking Office of Tehran Municipality	1.12
Promotion of Urban Redevelopment for Disaster Prevention	1.Installation of Disaster-Proof Living Zone System	2.10
Provision of Regional Evacuation Sites and its Facility	1.Formulation of Emergency Evacuation Plan and Manual	1.00
Strengthening and Replacement of Bridges along Major Road Network	1.Preparation of Plan	2.00
Strengthening of Water Supply Facility and Network	1.Preparation of Strengthening Plan for Facilities and Networks	3.00
	2.Preparation of Emergency Response Plan	0.50
Installation of Central Control System for Natural Gas Distribution System	1.Reinforcement of Gas Distribution Facilities and its Office Buildings	37.10
	2.Reinforcement of Gas Distribution Pipe Networks	121.90
	3.Design and Construction of Remote Shutdown System	39.75
	4.Design and Installation of Seismometers	42.40
	5.Training and Maintenance	5.30
Establishment of Model Schools for Disaster Education with Different Characteristics at Tehran Municipality Level	1.Establishment of Model Schools for Disaster Education	1.16
Designation of Model Communities for Organization of Community Level Disaster Management Group and System	1.Designation of Model Communities for Organization of Community Level Disaster Groups and System	0.38
Tehran Disaster Mitigation and Management Center - Institutional Capacity Building	1.Institutional Capacity Building	5.00
Establishment of Emergency Traffic System in Tehran	1.Analysis of Current Traffic Flow and Estimation of Traffic Flow in Emergency	2.00
	2.Study on Emergency Road Network	2.00
	3.Study on Emergency Traffic Control System	2.00
Installation of New Disaster Information and Telecommunication Network	1. F /S on Strengthening of Telecommunication Network in Teheran	2.00
	2.F/S on Installation of New Disaster Network in Teheran City	1.00
Strengthening of the Emergency Response Capability and Capacity of the Tehran Fire Fighting and Safety Services Organization	1.Formulation of Emergency Response Operation Plan	1.75
Strengthening of Emergency Response Capacity for the Governmental Health Organization	1.Formulation of Health Disaster Management Plan in Tehran	1.50
		Total : 289.61

Source: JICA Study Team

14.5 Project Profile

Each of selected priority projects has its own objectives that cover the goals and strategies set for this Master Plan as shown in Table 14.5.1. The implementation of all priority projects will promote the activities of disaster management in Tehran at every disaster stage: mitigation, preparedness, emergency response and rehabilitation and reconstruction.

Table 14.5.1 Relationship between Priority Projects and Goals and Strategies of Master Plan

Goals and Strategies of Master Plan / Priority / Projects	Secure Lives and Properties of the Residents in Tehran							Protect People's Life		Prepare Rehabilitation& Reconstruction Procedure
	Strengthening Existing Building	Improvement of Existing Urban Structure	Identification of Safety Evacuation Space	Strengthening Existing Infrastructure and Lifeline	Provision of Earthquake Information and Education	Establishment of Disaster Mitigation Policy	Establishment of Community Level Disaster Management Organization	Improvement of Disaster Management System	Formulation of Emergency Response Plan	Establishment of & Rehabilitation Reconstruction Procedure
Strengthening and Replacement of Existing Public Buildings	◎					○		○		
Promotion of Strengthening of Existing Private Buildings	◎	○			○	◎				
Improvement of Building Quality	◎	○								
Promotion of Urban Redevelopment for Disaster Prevention	○	◎	○			○				○
Provision of Regional Evacuation Sites and its Facility		○	◎						○	
Strengthening and Replacement of Bridges along Major Road Network			○	◎						
Strengthening of Water Supply Facility and Network				◎					○	
Installation of Central Control System for Natural Gas Distribution System				◎					○	
Establishment of Model Schools for Disaster Education with Different Characteristics at Tehran Municipality Level					◎		○	○		
Designation of Model Communities for Organization of Community Level Disaster Management Group and System					○		◎			
Tehran Disaster Mitigation and Management Center - Institutional Capacity Building							○	◎	○	○
Establishment of Emergency Traffic System in Tehran			◎						○	
Installation of New Disaster Information and Telecommunication Network				◎	○				○	
Strengthening of the Emergency Response Capability and Capacity of the Tehran Fire Fighting and Safety Services Organization							○	◎	○	
Strengthening of Emergency Response Capacity for the Governmental Health Organization								○	◎	

Note: ◎ shows great impact on the strategy. ○ shows the medium impact on the strategy

Source: JICA Study Team

Details for the following items of each priority project are described in a form of project profile.

- Introduction
- Background
- Objectives
- Implementation Agency
- Input
- Output
- Rationale & Justification
- Tentative Implementation Schedule
- Monitoring and Evaluation
- Sustainability
- Estimated Project Cost

Recommendation

RECOMMENDATION

1. Overview

It is, in general, inherently difficult to convince policy makers and the public to implement an earthquake disaster management plan because it is hard to predict exactly when and where earthquake will hit. This master plan has been carried out based on the results of the previous microzoning study, which was a breakthrough in the movement of earthquake disaster management activities in Iran. It was the first time for the country to evaluate earthquake risk by using unified data and applying statistical approach, even though many questions and criticisms were raised from Iranian. Earthquake damages are quantified in terms of human casualty, building damage, bridge stability and other physical infrastructure damage, among other things. Up to the present, there exists no study beyond the JICA Study to evaluate earthquake risk quantitatively in Tehran.

The microzoning study pointed out high earthquake risk in Tehran due to the weak building structure. The development history of Tehran shows the rapid urbanization in the 1950s and 60s, and the construction of many low seismic resistant buildings. The accumulation of masonry building and weak steel and RC buildings is the main cause of the high risk against earthquake. The city has a negative legacy of the past development history.

The primary problem for making the master plan is the huge estimated damage, especially building damage. It was estimated that more than 55% of the buildings in Tehran would be damaged in case of Ray Fault model. If the worst earthquake scenario would happen in the city, physical damage and associated loss is astronomical, and consequential economic loss is huge. It would be almost impossible to respond with initial actions by the government in an organized manner. In fact, economic analysis shows that the direct building damage itself amount would be 37% of national GDP.

The message of this master plan study is clear; earthquake damage should reduce within the master plan period and beyond time horizon, otherwise it cannot be handled. Mitigation efforts of physical strengthening are the most effective and efficient countermeasures for the city. It goes without saying that the physical countermeasures are costly and could not be achieved in a short time. Nonetheless, this is not the case to consider leisurely countermeasures. The action by the government is the matter of urgency. As a comprehensive guidance towards disaster management in Tehran, implementation planning presented in this master plan, based on the project long list, gives the most effective way to achieve the goal.

In conclusion, the following five key factors should be considered for immediate action by both national and local governments.

1. Government recognition of the earthquake disaster management

2. Damage reduction efforts

3. Education and information provision to the citizens

4. Tehran Municipality's action

5. Accumulation of research and development works

In Chapter 14, Study Team and TDMMC has selected 15 priority projects to achieve the goal and objectives. JICA Study Team prepared the detailed action plan for priority project. In this section, detailed action plans are attached for smooth implementation of the projects.

2. Government Recognition of the Earthquake Disaster Management

The government recognition of the earthquake disaster management could change the whole disaster management activity in the nation. Despite high earthquake risk in Iran, earthquake disaster management level is inappropriate. In fact, Iran has many earthquake damage records in the last 40 years. Last year's earthquake in Bam was a memorable incident, yet almost 10 years interval; Iran recorded huge earthquake damage and casualty.

The disaster management should be implemented comprehensively and continuously covering policy, planning, organization, operation and management. The disaster management cycle needs to include balance of prevention, mitigation, preparedness, response, and recovery. It seems that the government of Iran concentrated on rescue and relief after the event. Consequently, reduction of risk level of the nation or Tehran municipality has not been addressed appropriately. Therefore, the government recognitions and actions towards earthquake disaster management would be significant impact on whole disaster related development.

The capital function of the national government should be maintained after the event and could not be secured within the existing system. The national government should prepare a plan for maintaining capital functions. The first step will be facilitation of redundancy for the important information and function and physical measures to have enough seismic resistance capacity for important governmental buildings and facilities. Special team should be formed to protect governmental buildings and facilities after the event.

3. Damage Reduction Efforts

In order to reduce earthquake damage, mitigation measures are most effective. There are two policy directions for building structure improvement. One is construction of new building in

accordance with an appropriate building code and the other is strengthening or reconstruction of the existing buildings. As for new building construction, loose regulation and superficial appraisal system in providing building construction permit is another cause of the existence of low seismic capacity buildings in Tehran. Tehran Municipality should restructure the whole appraisal system and overcome the lack of capability in checking structural analysis.

Strengthening of the existing buildings will have impact on reduction of risk level of the city. Although public buildings can be strengthened by government budget allocation, strengthening of private buildings is responsibility for building owners. Without government intervention in this issue, private building strengthening could not be moved forward. The government should provide incentive to promote building strengthening among private owners in light of securing public safety and health. To do this, the government should establish risk transfer mechanism, such as introduction of insurance system, formulation of disaster management funds and low interest of loan. The detailed policy recommendations are available in the master plan.

In order to formulate building strengthening system, sustainability of the system should be considered and put into the system. Physical measures are limited by the financial constraints, because structural measures are costly. The sustainability of mitigation measures should be formulated by collecting money from the beneficiary of the project. For example, to enhance private building quality improvement, some policies mix should be considered; government loan, subsidy, insurance and taxation etc. Incentive should be given to improvement of building quality. At the same time, cost recovery by the government mechanism should be built in the whole system.

The Study, through its vulnerability analysis, found out that the vulnerable urban area is at the center of Tehran City, where weak buildings are concentrated and there is no space for evacuation. The most vulnerable urban area is concentrated at the central area of districts 10, 11, 12, 13, 14 and 17. The Study Team recommends an urban redevelopment scheme, which should fit the conditions in Tehran, because individual building strengthening could not reduce vulnerability level of the area.

From the aspect of creating a more earthquake resistant urban structure, area-wide urban redevelopment projects are preferred in the context that they would accrue diverse benefits such as the improvement of urban environment and the value-added land use to enhance financial viability of the projects. However, the implementation of urban redevelopment projects should be supported by necessary institutional and legislative arrangements to enable the following systems.

- Public-Private-Partnership (PPP) system
- Dedicated fund for urban redevelopment

- Designation and legislation of "Special Urban Redevelopment Zones"
- Practical land readjustment and right conversion systems
- Financial cross-subsidization system
- Legal process for formulating consensus among residents
- Cadastre-based land registration and appropriate property assessment systems
- Taxation systems to capture accrued benefits from beneficiaries
- Enforcement of earthquake resistance design codes and inspection system to secure design-compliant building acts

Moreover, social aspects of the area development scheme would be problem for the implementation of the plan. During planning stage, more realistic scheme should be formulated based on past development experience.

4. Education and Training Provision to the Citizens

The government should formulate disaster management policy at national level to community level. Recent disaster management emphasizes on the importance of the "self-help," "mutual-help" and "government help." It means that the society should participate in disaster management activity with their roles and responsibilities determined by the government in order to develop disaster conscious society. Community activity would be full part of support of and in co-operation with government in whole aspects of disaster management. It is recognized that self-help and mutual-help are the most efficient to save life after the event and the government should provide support to those activities. Moreover, there is strong connection between public awareness and other aspects of the disaster management.

According to the social survey results, the residents of Tehran would have limited earthquake disaster information and most of them are not ready for the crisis situations. It is important for the government to disseminate information to the residents. At the same time, people's participation for community activity should be organized by the government. The Study Team has carried out a series of workshop as a pilot study. At the first time residents in Tehran did not understand the importance of such workshop, yet they understood at the end. Now, there are many requests from the residents for more of such workshop at the community level. Towards the future, TDMMC shall be the leading institution to promote community-based disaster management activities.

In the earthquake disaster management field, formulation of disaster conscious society is required to cope with crisis situations. To promote a self-reliant community and cooperation with the government activity regarding disaster management, disaster management programs at community level are required. The government should inform the community of what

government has planned to do after the event and the community should have a preparedness plan. The community should act as the smallest unit of the earthquake disaster management and prepare own disaster management plan.

The dissemination of earthquake knowledge through the education program will enhance mitigation of private building damage. The community activity for disaster management has been promoted. The education and training are the most effective measures for disaster management. Priority should be given to the public involvement in the earthquake disaster management.

5. Tehran Municipality's Action

The establishment of TDMMC and, as its successor, TDMO with upgraded functions, is the right direction towards the more effective and efficient implementation of disaster management policies and project. TDMMC should act as a leading organization in Tehran Municipality to monitoring the implementation of the disaster management plan. TDMMC has established 22 emergency response committees for the preparation of emergency response plan, which has not been finalized yet, although. As a management tool for emergency response, a disaster information management system is required to be developed for Tehran Municipality in conducting effective and efficient emergency response activities during an earthquake disaster.

The Government has been preparing the disaster management related laws and regulations that saw the realization of the disaster management framework. However, the laws and regulations have many ambiguities in the details of their actual implementation of emergency response at Tehran Municipality and national levels. Moreover, the existing laws and regulations focus particularly on the disaster response side of the disaster management, yet it is important to include disaster management before an earthquake event and rehabilitation of the earthquake damage: mitigation and preparedness of earthquake damage. The existing laws and regulation should be reviewed under three disaster management phases: mitigation and preparedness, emergency response and rehabilitation and reconstruction.

In Tehran Municipality, Urban Planning related laws and regulations should develop to include normal time development process as well as rehabilitation and reconstruction of the city. Before the earthquake, Tehran Municipality should prepare the regulations regarding building quality control and area development. After the event, private right should be restricted by the limitation of usage of dangerous building and the construction of permanent housing.

Tehran Municipality is in the process of preparing an emergency response plan and has identified the responsible organizations; however, each organization has not prepared the action plan after an earthquake event. The preparation of emergency response plan for each

responsible organization has been a matter of urgency. The Study Team prepared guidelines for the development of the emergency response plan for the areas of emergency operation, collection and distribution of information, evacuation, traffic control and district level disaster management plan. According to the guidelines, each responsible organization should prepare the emergency response plan.

Tehran Municipality is the most advanced institutional entity in area of earthquake disaster management in Iran because of JICA's cooperation in this area. By using risk assessment, results of the master plan should be formulated for Tehran. The information and experience of the earthquake disaster management should be shared to other cities in Iran. The role of Tehran Municipality is important in this area because other cities in Iran do not have such information.

6. Accumulation of Research and Development Works

The earthquake disaster management contains many subjects; hazards and risk analysis, organizational aspects, planning and implementation, mitigation measures and human behavior. The research works are effective in the sense that they help to eliminate the repetition of previous mistakes and contribute to improvements in on-going disaster management capacity. Research and development has been carried out by limited institutions in Iran including exchange of information and ideas with other countries and academic institutions. Major factors of research are summarized as follows:

Disaster experience

After the earthquake, a wide range of emergency response activities is required and its improvement is necessary.

Disaster mitigation

Seismic diagnosis and research for practical strengthening method should be encouraged so as to provide effective countermeasures, since building strengthening requires a huge amount of investment for the buildings.

Disaster prevention

In order to reduce the damage, the information of faults and earthquake mechanism should be studied because the effective disaster information system would guide the policy makers to appropriate decision.

Monitoring and available information

The Study Team has established earthquake disaster related GIS for Tehran Municipality. That information should be maintained and monitored by the TDMMC.

Project Profile No 1
STRENGTHENING AND REPLACEMENT OF EXISTING PUBLIC BUILDING

1. Introduction

The best experience for assuming the earthquake damage in Tehran is the Bam Earthquake that happened on 27th of December, 2003. This tragedy caused over 20,000 of human loss, mostly due to the crash death or suffocation by collapsed buildings. It is true that the most of the buildings in Bam was Adobe structure. However, there existed steel or RC frame structure buildings in Bam, which were similar to those in Tehran. Those buildings in Bam were also collapsed by that earthquake.

It goes without saying that a primal concern for disaster management is to reduce a possibility of building collapse in order to mitigate the earthquake damages. This project proposes the following two essential components to strengthen existing public buildings in Tehran

- To develop the standard for building diagnosis and strengthening
- To increase the seismic resistance capacity of existing public buildings in Tehran

2. Background

Without any fixed principle for strengthening of public buildings, a lack of uniformity and unfairness would emerge and those would have a critically negative effect on the promotion of disaster mitigation and preparedness activities in the whole Tehran City. Therefore, the establishment of rule for building strengthening such as the development of standard for building diagnosis and strengthening should be essential.

The rational and effective process for mitigating the building damage is the following:

- Development of standard for building diagnosis and strengthening
- Carrying out of building diagnosis
- Selection of target buildings to strengthened or reconstruction
- Execution of building strengthening and reconstruction

Explanations for those four steps are as follows:

Development of Standard for Building Diagnosis and Strengthening

There exists “Iranian Code of Practice For Seismic Resistant Design of Buildings” in Iran. This code is only for the newly constructed buildings and not for building diagnosis or strengthening. In conducting building diagnosis, different considerations are required compared to the brand-new building in terms of structural strength. On the other hand, the effect of strengthening would not be unified without the standard of strengthening.

Carrying out of Building Diagnosis

Before conducting strengthening, the seismic resistant level and structural weakness of the building should be analyzed for an effective building strengthening.

Selection of Target Buildings to e Strengthened or Reconstruction

In selecting the target buildings to be strengthened or reconstructed, both seismic resistant level and importance of building for disaster management and response activities should be fully considered.

The judgment of such an importance level of public building should be analyzed and set by each responsible disaster related organization.

Execution of Building Strengthening and Reconstruction

Through above process, strengthening or reconstruction should be conducted, according to the level of necessity of strengthening.

3. Objectives

The project goal and objectives are as follows.

GOAL:

To increase the seismic resistant level of existing public buildings in Tehran

OBJECTIVES:

- Establishment of standards and rules for strengthening and reconstruction of existing public buildings
- Generalization of building strengthening and reconstruction process in Tehran

4. Implementation Agency

"Iranian Code of Practice For Seismic Resistant Design of Buildings" was developed by both organizations, Building and Housing Research Center and Ministry of Housing and Urban Development. Considering the consistency of the standard establishment, those organizations should play a leading role in the preparation of standard for building diagnosis and strengthening. In addition, new creation of committee for the purpose of deliberation and appraisal of the standard should be required. This committee should be composed of different organizations relating to building construction field, such as IIEES, research institutions, universities and construction and engineering associations.

As to the implementation body of actual strengthening and reconstruction, the following organization should take an initiative role.

- Ministry of Interior
- Tehran Municipality
- Police Office
- Red Crescent Society
- Ministry of Defense
- Ministry of Health and Medical Education
- Ministry of Education

5. Input

At Planning Stage

For the establishment of standard for building diagnosis and strengthening, assembly of committee is the most important.

As to the creation of rules and strategies of building selection to be strengthened or reconstructed, above mentioned implementation bodies should coordinate.

At implementation Stage

Budget for execution of strengthening or reconstruction works is required

6. Expected Output(s)

As to establishment of standard for building diagnosis and strengthening

- Publication of standard for building diagnosis and strengthening
- Establishment of rules and policies for the selection of public buildings to be seismic resistant by each disaster related organization

As to execution of strengthening and reconstruction

- Comprehensive result of building diagnosis for every important public building
- Increase in seismic resistant level of existing public buildings

7. Rationale & Justification

This project contributes to the effective activation of important public buildings for emergency response in case of earthquake disaster, which, in turn, reduce and mitigate the secondary damage, efforts on emergency activities and related costs directly. This is obviously a responsibility of government.

8. Tentative Implementation Schedule

Following projects are the component of this priority project.

1-1 New-creation of "SPECIFICATION ON EARTHQUAKE RESISTANT DIAGNOSIS AND STRENGTHENING"
1-2 Seismic diagnosis study of the MOI building
1-3 Reinforcement of the MOI building
1-4 Seismic diagnosis study of the TDMMC building
1-5 Reinforcement of the TDMMC building
1-6 Seismic diagnosis study of 22 District Municipality office building
1-7 Reinforcement of 22 District Municipality office building
1-8 Seismic diagnosis study of the police headquarter building
1-9 Seismic diagnosis study of the police headquarter building
1-10 Seismic diagnosis study of the police headquarter building
1-11 Seismic diagnosis study of the police headquarter building
1-12 Reinforcement of the police headquarter building
1-13 Seismic diagnosis study of the 11 Red Crescent Society's Headquarter
1-14 Reinforcement of the 11 Red Crescent Society's Headquarter
1-15 Seismic diagnosis study of the Central Command of Army
1-16 Reinforcement of the Central Command of Army
1-17 Seismic diagnosis study of the governments' secondary and tertiary 22 hospital buildings
1-18 Reinforcement of governments' secondary and tertiary 22 hospital buildings
1-19 Seismic diagnosis study of governments' 127 urban health centers
1-20 Reinforcement of government's 127 urban health centers
1-21 Financial Arrangement for seismic diagnosis study of 46 major private hospitals
1-22 Financial Arrangement for reinforcement of 46 major private hospitals
1-23 Seismic diagnosis study of the MOH&ME central office buildings
1-24 Reinforcement of the MOH&ME central office buildings
1-25 Seismic diagnosis study of 3 medical universities office buildings
1-26 Reinforcement of 3 medical universities office buildings
1-27 Seismic diagnosis study of office buildings for 22 districts' health centers
1-28 Reinforcement of office buildings for 22 districts' health centers
1-29 Seismic diagnosis study of the 73 fire fighting stations
1-30 Reinforcement of the 73 fire fighting stations
1-31 Seismic diagnosis study of the 16 traffic police stations

1-32 Reinforcement of the 16 traffic police stations
1-33 Seismic diagnosis study of the 106 Police Stations
1-34 Seismic diagnosis study of the 106 Police Stations
1-35 Seismic diagnosis study of the buildings in regional evacuation places
1-36 Reinforcement of the buildings in regional evacuation places
1-37 Reinforcement of the rest of 17 ministry buildings
1-38 Reinforcement of the rest of 17 ministry buildings
1-39 Seismic diagnosis study of the Airport
1-40 Reinforcement of the Airport
1-41 Seismic diagnosis study of the train and bus terminal
1-42 Reinforcement of the train and bus terminal
1-43 Seismic diagnosis study of the school buildings
1-44 Reinforcement of the school buildings

Tentative implementation schedule is shown in the long list presented earlier. The diagnosis should be conducted at the earlier stage of the master planning period.

9. Monitoring and Evaluation

The progress of this project shall be monitored at the following timing:

- In the last year of short term and medium term periods in the master plan time frame
- On a yearly basis, each responsible organization shall evaluate the effect of strengthening and reconstruction

10. Sustainability

It is highly dependent on the availability of budget of strengthening and reconstruction costs. The government should be ready for the fund availability before the actual implementation works of strengthening and reconstruction start.

11. Estimated Project Cost (Tentative)

Cost for the project named [New-creation of "Specification of Building Diagnosis on Seismic Resistance and Strengthening"] is approximately US$ 0.45 million.

Cost for the rest projects of building diagnosis and strengthening counts for approximately US$ 549 million.

Project Profile No 2
PROMOTION OF STRENGTHENING OF EXISTING PRIVATE BUILDINGS

1. Introduction

This project aims to promote the strengthening of private buildings by an introduction of governmental assistance policy available for the public. The fact that a vast number of low seismic resistant buildings exist in Tehran implies the difficulty in promoting strengthening of private buildings. Having said that, this project should have a primal importance from an earthquake damage mitigation point of view, since the damage of those buildings directly related to the total damage estimation for Tehran, revealed in the previous microzoning study.

Three menus are presented in this project as a governmental assistance policy in promoting strengthening of private buildings; low-rate loan, subsidy and insurance. The most effective and feasible option by a mixture of those available policy options is proposed in this project, based on the result of public attitude survey for private building owners on building strengthening.

2. Background

The main cause of the huge amount of estimated damage by the Ray Fault Model in the previous microzoning study lies in the majority of low seismic resistant buildings, particularly masonry buildings dominating, in particular, in the southern part of Tehran.

Differently from the strengthening of public buildings, which are owned by governmental bodies, it depends exclusively on the decision of private building owner if his/her building be strengthened. Therefore, it is highly required that some governmental supports to motivate the public to take action should be provided.

According to the result of attitude survey for building owners on the willingness to pay for strengthening of their buildings and a preference of governmental assistance policies in financially supporting strengthening, a need for strengthening seems to be high. However, they are reluctant to invest in the strengthening at the expense of relatively low income, in particular, as for the owners of masonry structure building. On the other hand, the owners of steel or RC frame structure buildings have higher willingness to take action for strengthening their properties. Therefore, case-by-case policy options shall be presented to the public with an incentive for the investment.

In order to run a policy scheme, government shall prepare a fund for the expenses of subsidy and loan. This can be managed by use of internalization of revenue, interest return and taxing on the insured amount from insurance companies in Tehran.

3. Objectives

The project goal and objective are as follows.

GOAL:
To promote the strengthening of private buildings

OBJECTIVE:
Establishment of government assistance policy

4. Implementation Agency

Ministry of Interior, Tehran Municipality

5. Input

Before the commencement of the government assistance policy scheme, the standard for building diagnosis and strengthening, which are proposed in the priority project No 1, should be prepared.

Simultaneously with the preparation of standard, the policy should be examined and well-prepared.

As a financial input for this project, interest return, revenue from taxing on insured amount from insurance company and internalization of the other revenue shall be considered.

6. Expected Output(s)

The following are the expected outputs from this project

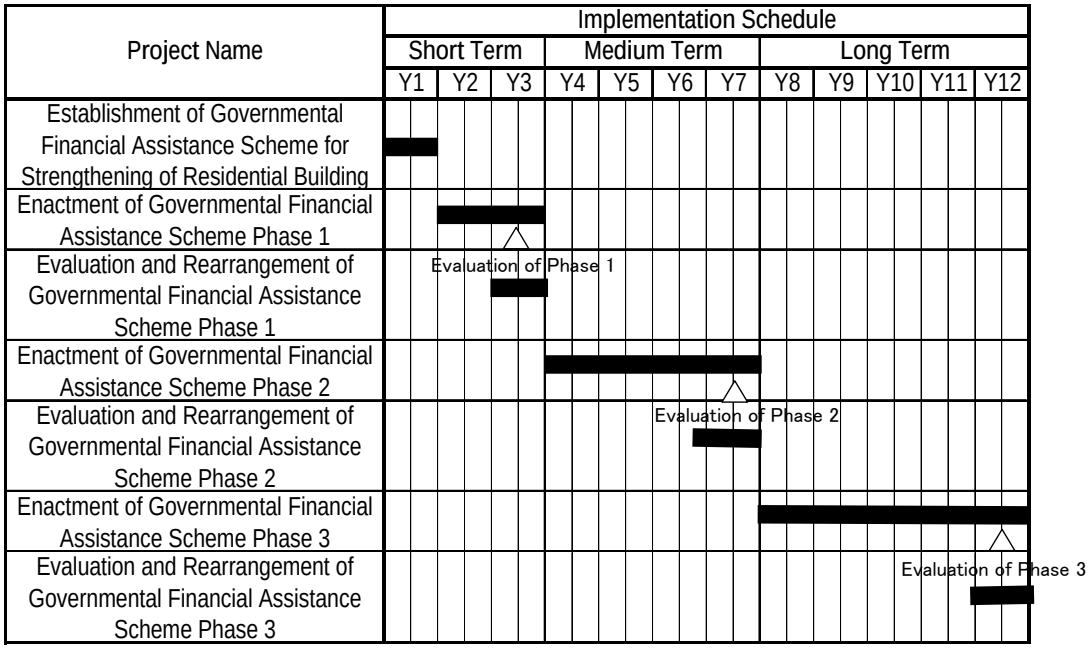
- Establishment of governmental assistance policy in promoting private building strengthening （Subsidy, Low-rate loan and Insurance)
- Managing and running of disaster related fund
- Reduction of low seismic resistant buildings in Tehran

7. Rationale & Justification

Rationality of the project is secured by direct mitigation effect on earthquake damage and resultant effect on saving cost and efforts for emergency response, rehabilitation and reconstruction after the event.

8. Tentative Implementation Schedule

Tentative implementation schedule is shown in the following table. The application term of the policy shall be divided into three phases.



9. Monitoring and Evaluation

The progress of this project shall be monitored at the following timing:

- In the last year of short term, medium and long term periods in the master plan time frame, mid-term evaluation shall be conducted.
- On a yearly basis, monitoring shall be conducted.

10. Sustainability

The success of the project depends on the sustainability due to the enormous numbers of target private buildings to be strengthening, counting to 483,000 for residential and other private buildings.

The most effective result of incentive for the promotion of private building strengthening by the financial assistance system should be secured by evaluation and monitoring at each end of Phases.

11. Estimated Project Cost (Tentative)

The total amount of yearly required cost by subsidy counts for approximately US$ 122.8 million, including the cost for seismic diagnosis. The total amount of required fund for loan program in ten years counts for approximately US$ 1,573.2 million, and the total interest receipts in ten years count for approximately US$ 755.1 million.

Project Profile No 3
IMPROVEMENT OF BUILDING QUALITY

1. Introduction

It is estimated that many existing buildings in Tehran has low seismic resistance, which would be collapsed in the event of earthquake. The newly constructed building should have enough seismic resistance capacity. In addition, the existing low seismic resistant building also should be strengthened or reconstructed with a required seismic resistant level.

This project aims to revise on-going system of building construction appraisal to be reliable and effective.

2. Background

All the buildings in the urbanized area should be built with a sufficient strength in a unified manner. For this purpose, building construction appraisal procedure should be systemized. However, in reality for the case of Tehran, that appraisal system does not work properly, due to the lack of human resources, engineering judgment level and inappropriateness of the system itself.

That system should be revitalized with a legal enforcement and substantial workability.

3. Objectives

The project goal and objectives are as follows.

GOAL:
To improve the structural quality of buildings in Tehran

OBJECTIVES:

- Revision of building construction appraisal system
- Popularization of building appraisal system among public
- Binding of a legal enforcement of the appraisal procedure

4. Implementation Agency

Ministry of Housing and Urban Development
Tehran Municipality
BHRC/Research Institutions
Ministry of Housing and Urban Development

5. Input

Legal enforcement of the system is a key factor for this project to be effectively run. In order to gain a public consensus about the building construction appraisal system, cooperation of engineering association, construction business association and engineering specialists is indispensable.

On the other hand, it is a lack of human resources in Tehran Municipality that the existing system has many loose regulations and practical empowerment. Adequate human resources for inspectors, engineers and officers should be provided.

6. Expected Output(s)

The following are the expected outputs from this project

- Legal enforcement of building construction appraisal system
- Appropriate seismic resistant level of the new constructed and strengthened buildings

7. Rationale & Justification

Considering the current situation of the existence of many low seismic resistant buildings and the current system that have no legal enforcement or any penalty clause, it can be said that this is one of the route causes of vulnerability of Tehran. Future construction of low seismic resistant buildings should be stopped.

8. Tentative Implementation Schedule

Tentative implementation schedule is shown in the following table.

Project Name	Implementation Body	Implementation Schedule											
		Short Term			Medium Term				Long Term				
		Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12
Establishment of Committee for Building Quality Improvement	Ministry of Housing and Urban Development (BHRC) / Tehran Municipality (Urban Development & Architecture Deputy Office) / Research Institutions												
Revision of Building Construction Appraisal System	Tehran Municipality (Urban Development & Architecture Deputy												
Establishment of Engineer Registration System	Ministry of Housing and Urban Development / Tehran Municipality (Urban Development & Architecture												
Establishment of Engineering Skill Learning School	Tehran Municipality (Urban Development & Architecture Deputy												
Development of Computer-Aid Software for Structural Seismic Resistance Analysis	Ministry of Housing and Urban Development (BHRC) / Research Institutions												
Capacity Development of Double-Checking Offices of Tehran Municipality	Tehran Municipality (Urban Development & Architecture Deputy Office)												
Promotion Campaign of Building Construction Appraisal Procedure													

9. Monitoring and Evaluation

The progress of this project shall be monitored at the following timing:

- On a yearly basis, monitoring shall be conducted.

10. Sustainability

Legal binding of the system is the key factor for the sustainability of the project. Considering the balance between supply and demand of building construction market, responsible organization should invest in the capacity building of appraisal system related officers.

11. Estimated Project Cost (Tentative)

The total amount of this project counts for US$ 1.58 million, though this would be flexibly increased, depending on the public consensus with this system and construction demand.

Project Profile No 4
PROMOTION OF URBAN REDEVELOPMENT FOR DISASTER PREVENTION

1. Introduction

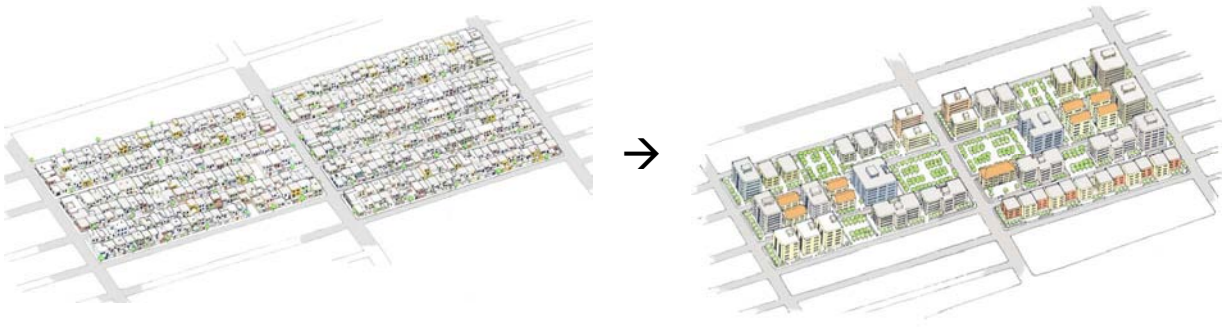
The Islamic Republic of Iran is a disaster-prone country that is regularly affected by earthquakes, floods droughts and other disastrous calamities. Over the last decade alone, there were three major earthquakes (Manjil, Quazvin and Bam) that struck Iran killing hundreds of people and destroying a considerable amount of private and public assets.

Tehran Municipality, the capital of Islamic Republic of Iran, which accounts for roughly 30% of the country's GDP and about 11% of the total population, is situated on top of three active fault lines, namely the Ray Fault, the North Tehran Fault and the Mosha Fault. Seismologists expect, based on the analyses of historical seismic data,[1] that a major earthquake could occur in the Greater Tehran Area (GTA) in the foreseeable future.

2. Background

In Teheran City there are several areas with high disaster vulnerability, in particular, the central part of Tehran City, where there is a concentration of buildings. Those areas are characterized by high-density old buildings, limited open spaces and parks, narrow alleys, and crowded streets with parked cars. For such vulnerable areas, several countermeasures for disaster prevention are proposed.

Urban redevelopment is considered as one of the effective countermeasures from the disaster prevention point of view. Urban redevelopment is designated, in general, for demolishing the existing congested urbanized area, and reconstructing new buildings with appropriate spaces as roads and parks. Redevelopment image is shown in the following figure.



Existing Condition **Redeveloped**

Source: JICA Study Team

Urban redevelopment mainly aims at the following:

- Advancement of urban infrastructure,
- Betterment of environment,
- Upgrade of regional amenity,

[1]) The last major earthquake occurred in 1850 in the area now occupied by Tehran.

- Improvement of regional traffic condition, and
- Strengthening of preventive condition against disaster.

3. Objectives

The project goal and objectives are as follows.

GOAL:

"To provide safer living environment and to promote disaster-resistant city by the urban redevelopment project"

OBJECTIVES:

It is difficult to conduct redevelopment for required lands all at once due to financial and social issues. Thus, projects should be divided into several phases. One phase is expected to complete in a decade, and appropriate size of redevelopment is approximately from 20 to 50 ha at once. The following objectives should be achieved:

- Development of Disaster-proof Zoning System in Priority Improvement Area,
- Identification of priority zones as key areas for redevelopment,
- Prioritizing and making of implementing plan for key areas, and
- Implementing the plan.

4. Implementation Agency

The implementation agency is suggested to be Department of Urban Planning, Tehran Municipality, in coordination and communication with Urban Renewal Organization and District Municipality where target area locates.

5. Input

Introducing Disaster-proof Living Zoning System

The following work items are required for this project:

- To review the sub-districts designated as Priority Improvement Area in the master plan;
- To study aspects of vulnerability, geographical condition and social backgrounds of priority improvement area; and
- To develop appropriate zoning as Disaster-proof Living Zoning in each priority improvement area. It is supposed that Nahiye boundary could be used for the zoning.

It is anticipated that the above activity will, in principle, need following expertise inputs: Urban Disaster Management Specialist, and Urban Planner.

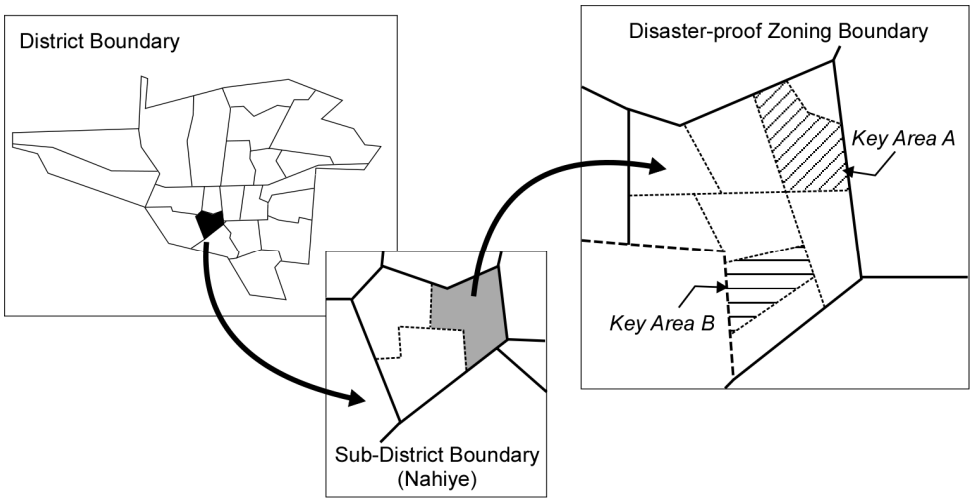
Identification of Development Area - "Key Area"

To redevelop in the order of descending priorities based on vulnerability and urgency requires the following work items. First, redevelopment area is selected by the items.

- To review the sub-districts proposed as Priority Improvement Area in the master plan
- To make a priority of sub-districts
- To identify priority redevelopment zones – "Key Areas" among the highest priority sub-districts from vulnerability and urgency viewpoints

- To study for feasibility of the key area(s)
- To prepare the improvement plan for the key area(s)

It is anticipated that the above activity will, in principle, need the following expertise inputs: Urban Planner, Redevelopment Specialist, Social Analysis Specialist, and Economists. Image of the zoning is shown in the following figure.



Formulation of Detailed Design and Scheme

To make detailed design and scheme for Key Area(s) requires the following work items:

- To review the improvement plan made in previous project
- To make a draft design plan for redevelopment
- To set up a community organization for target area
- To achieve recognition as part of town plan project
- To complete required formal procedures and permissions
- To calculate land allocation in keeping with “Right Conversion System”
- To prepare the detailed design
- To finance using with “Reserved Floor Area”

It is anticipated that the above activity will, in principle, need the following expertise inputs: Physical Planner, Urban Planner, Redevelopment Specialist, Social Analysis Specialist, Architect and Landscape Architect.

Construction

Work items of Implementation are as follows:

- To prepare the substitute housing
- To demolish the existing buildings
- To construct infrastructure, new buildings and open space

It is anticipated that the above activity will, in principle, need a constructor and a project supervisor.

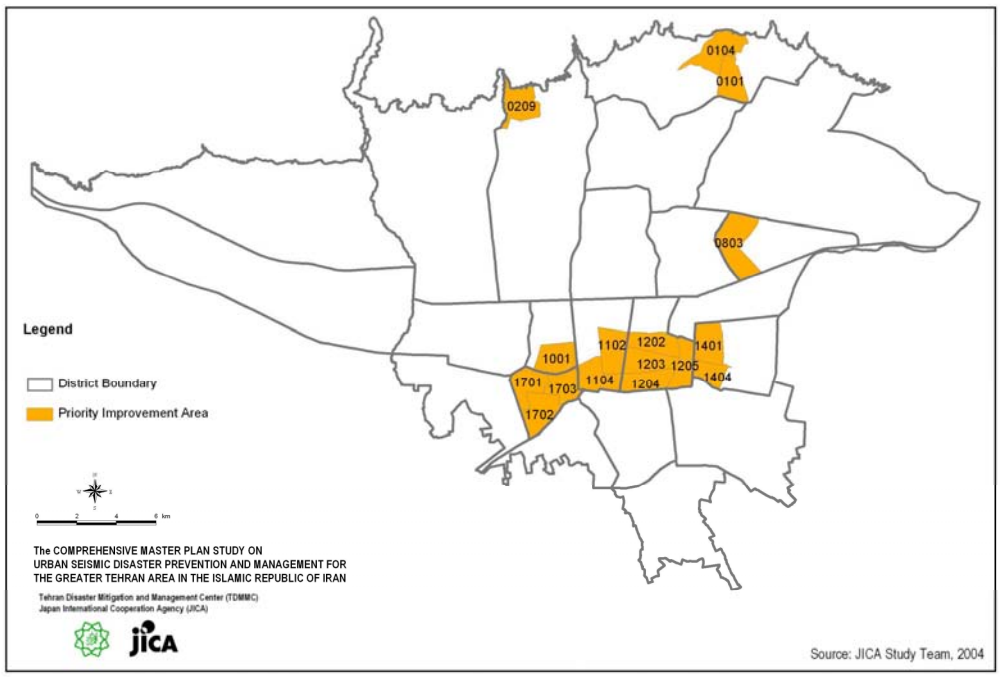
6. Expected Output(s)

The component's outcomes are as follows:

- As disaster-resistant city, Tehran City will gain safe and secure urban environment against an earthquake.
- City's urban environment will be improved a lot.

7. Rationale & Justification

The area redevelopment scheme is most effective and practical method of improving living environment for Tehran citizens. This scheme can provide community evacuation place and safe residence. The potential area, i.e. "priority improvement area" defined in the master plan, is 44.5 km2 in total with a population of 933,000. The following figure shows distribution of priority improvement areas;



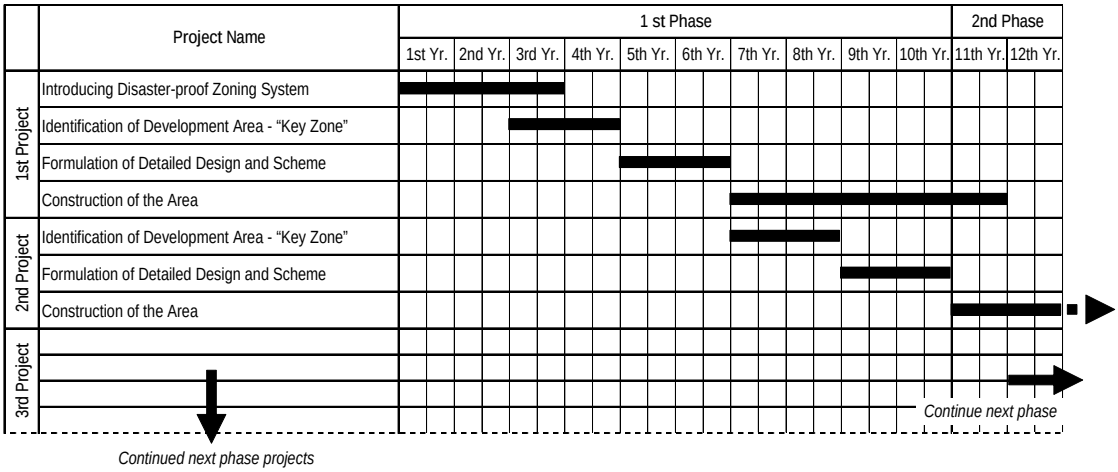
Priority Improvement Area

The feasibility of the project will depend on selling price of the reserved floor area. In order to implement project, the government should provide assistance to the project by monetary as well as technical terms.

8. Tentative Implementation Schedule

Tentative implementation schedule is shown in the following table. Redevelopment project should be conducted in several phases for the following reasons; one is financial issues, because this kind of project needs huge amount of money for construction even if "right conversion system" is applied. It is totally dependent on the selling price of the reserved floor areas for outside people or companies. The other reason is that there should be ample time to explain to residents and communities in order for them to understand, and thus pave the way for a smooth implementation. Thus, phasing method of redeveloping areas little by little can be the most practical way. Introducing Disaster-proof Zoning should be done only at initial stage which targets at whole area of priority improvement area. One phase is expected to complete in a decade.

This period is perhaps the largest unknown in terms of planning a construction schedule. It is achievable if the Government and implementation agency adopt a progressive and persistent approach toward project implementation.



9. Monitoring and Evaluation

Project monitoring will be done in the following timing:

- After two years from commencement of the project
- Completion of the feasibility study
- Every three years during progress of study and construction

10. Sustainability

The project viability depends heavily on the selling price of the reserved floors outside. The government available funds for redevelopment should be ready when actual implementation will be started. For the formulation of plan, there is a need to fit the situation in Tehran.

11. Estimated Project Cost (Tentative)

As in above, area redevelopment is divided into several stages, namely planning stage, feasibility stage and implementing stage. Estimated cost for each component is shown in the following table:

(Unit: US dollars)

Components	Estimated Cost	Memo
Component 1: Installation of Disaster-Proof Zone System	Between 1.5 mil. and 2.5 mil.	Consulting Components
Component 2: Identification of Development Area - "Key Area"	Between 3.0 mil. and 4.0 mil.	Consulting Components
Component 3: Formulation of Detailed Design and Scheme	Between 4.0 mil. and 5.0 mil.	Consulting Components
Component 4: Construction	Between 300.0 million and 400.0 mil.	Land acquisition sets off "right conversion system." Construction cost totally depends on the size.

Total project cost (excluding the Government Counterpart Contribution) for the consulting components and construction is tentatively estimated to be in the range of:

US dollar 350 million.

Project Profile No 5
PROVISION OF REGIONAL EVACUATION SITE AND ITS FACILITY

1. Introduction

After earthquake disaster event, smooth emergency evacuation should be ordered and executed to provide a safety environment for residents and citizens from hazardous and disordered condition and aftershock of earthquake.

Two steps of emergency evacuation system of community and regional levels are proposed by the JICA Study Team in the Master Plan as follows:

Primary Evacuation:

to evacuate all citizens from vulnerable housings /or other buildings to designated Community Evacuation Places by each residential community, private and public establishment bases under the formulated evacuation plan. The evacuation place should be identified and designated in each neighborhood community as community evacuation zone, which should be set within walkable distance. The Community Evacuation Place is proposed to coordinate with community-based disaster prevention system comprising information, evacuation, rescue/first aid, and emergency foods/water supply teams.

Evacuate to Regional Evacuation Place:

to break away and evacuate from the Community Evacuation Place to more safe Regional Evacuation Place through designated safety Evacuation Route by leaders of community and establishment taskforce with security taskforce (police and/or staff of city service in sub-district or district), and

Secondary Evacuation Place:

to prepare and open the designated Regional Evacuation Place for all citizens, who live in the assessed vulnerable area. The Regional Evacuation Place is proposed to select and designate bigger parks/open spaces with safety environment for each sub-district as evacuation zone, having a population of around 100,000.

Based on the proposed system, identification, provision, equipment and maintenance of the Regional Evacuation places are proposed.

2. Background

In the JICA Study, vulnerability analysis of each District was conducted. In the analysis, the vulnerability of people's evacuation potential was assessed on four sub-fields as follows

Availability of Evacuation Place by District:

Available existing parks and open space are assessed and classified into five categories by criterion of 2 m^2/person, which are required semi-gross evacuation area per capita.

Population Share of Disaster Weak by District:

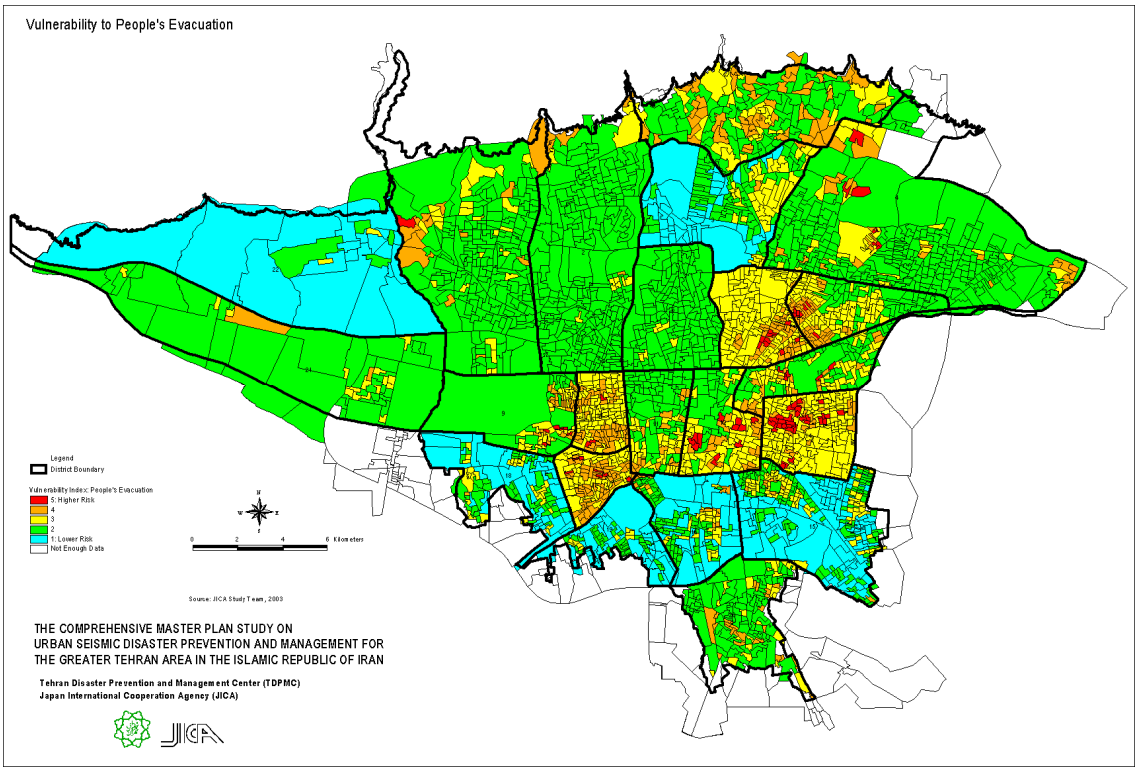
Handicapped person, more than 65 years old person, and children under 5 years old, are categorized as disaster weak. Population share of those persons are assessed and classified into five categories.

Road Blockage Ratio:

Debris of collapsed and heavily damaged buildings on roads will disturb people's evacuation and emergency vehicle operation. The estimated road area covered by debris is assessed and classified into five categories.

Evacuee Density on Evacuation Route:

Population density on the road wider than 15 m, which is categorized as safe evacuation route without influence of roadside hazard, is directly related to evacuation speed.



Vulnerability Index to People's Evacuation

The results show that the people's evacuation condition is quite serious in districts 7, 8, 10, 12, 14 and 17. In districts 1, 5, 4, 9, 11 20 and 21, also some parts of the district are facing difficult condition for evacuation.

Considering the above circumstances, the JICA Study Team identified locations and areas of the proposed Regional Evacuation Places, as shown in Figure 5.1.3 and summarized in Table 5.1.1 in Chapter 5. It shows that there are still necessities of the further detailed study on selection of the Regional Evacuation Places. Further studies on the total evacuation system are also required.

Currently, Phase I Plan on Emergency Evacuation and Temporary Housing Plan for Tehran citizens have been formulated by TDMMC on the basis of the Disaster Management Master Plan approved in June 2001. The main objective of the whole plan is prediction and design of the possible methods for evacuation, transfer, and settlement of the citizens in safe places during disaster.

Also, in order to formulate and integrate the major policies of the plan and its executive approaches, a specialized group was selected from TDMMC and Training and Research Center of Red Crescent Society. The group prepared the primary scope of work for emergency evacuation and temporary housing master plan based on presumptions as follows:

- Formulation of theoretic principles and framework of required activities for executing the plan
- Determining the limitations and prerequisites (resources, managerial, structural)
- Designating locations for temporary housing
- Designating locations for settlement of required facilities, equipment and tools for temporary housing points
- Managerial structure of evacuation and temporary housing during disaster and In Charge, Backup and Partner organizations

- Determining executive approaches for evacuation and temporary housing master plan

The Deputies for Technical & Civil Affairs of District Municipalities sent their latest information about urban spaces such as vacant, cultural, sport, services, commercial, green spaces, fairs, terminals and other open spaces with more than 2,000 m^2 existing in their districts as primary data to TDMMC. Until September 2002, out of 1,030 candidates, 846 selected locations were visited and evaluated by Training & Research Center and the results were sent to TDMMC. In January 2003, the completion of the Phase I of the Plan was announced based on the following acquired outcomes:

- About 1,030 locations introduced by municipality were evaluated and selected points were identified and their data registered.
- A particular software was designed and developed for establishing a database of collected data.
- All temporary housing locations were marked on map of different districts.
- Main access roads to these locations were preliminarily marked on districts maps.

This proposed project shall succeed, upgrade and integrate the above preliminary project activities.

3. Objectives

The main objectives of the project are summarized as follows:

- To develop the Regional Evacuation Places based on the district vulnerability maps and the disaster prevention maps that will guide citizens in the event of a large earthquake
- To develop the safe Evacuation Routes that are linked with the Regional Evacuation Places and facilities to guide emergency response organizations
- To provide the emergency goods storage for the Regional Evacuation Place (rescue equipment, first aid, potable water and emergency foods, etc).

In order to achieve these objectives, the project is composed of the following components.

Formulation of Emergency Evacuation Plan and Manual

This plan and manual shall be formulated prior to the actual designation and equipping the Regional Evacuation Places. The plan shall include the following items:

- Definition of the evacuation system
- Definition of the criteria of evacuation
- Activity of recommendation and/or instruction of evacuation by each organization
- Role and measure for the evacuation guidance in each organization
- Scheme of operation and maintenance of the Regional Evacuation Place
- Method of transportation of victims and mutual cooperation system of relevant organization

Identification and Designation of Regional Evacuation Places

This work consists of the following components:

- Review of the proposed Regional Evacuation Places proposed by the JICA Study
- Review of the selection criteria of the Regional Evacuation Place
- Selection of the candidate of the Regional Evacuation Place
- Designation of the Regional Evacuation Place
- Establishment of the scheme of requisition / lease of private land and premises

- Requisition / contract of the necessary land and premises

Identification of Safe Evacuation Route

Evacuation Route is a road that leads from the Community Evacuation Place to the Regional Evacuation Place. It is designated in advance to enable residents living in an evacuating zone to evacuate quickly and safely to the Regional Evacuation Place. Therefore, in order to identify the Evacuation Route, identification of the Community Evacuation Places is essential. This work component is divided into the following work items:

- Identification of the Community Evacuation Place
- Selection of the Evacuation Route
- Site investigation of the selected Evacuation Route
- Formulation of the plan for the designation and improvement of the Safe Evacuation Route

Provision of the Emergency Facilities for the Regional Evacuation Place

This work includes the following component:

- Selection of necessary emergency facilities / equipment / goods for the identified Regional Evacuation Places
- Installation of warehouse
- Procurement and installation of emergency facilities / equipment / goods
- Installation of signboard to the Regional Evacuation Place and the Safe Evacuation Route
- Implementation to maintain the Regional Evacuation Place

4. Implementation Agency

The main implementation agency is TDMMC. Deputy of District Affairs, Deputy of Urban Planning, and Park Organization of Tehran Municipality are the co-agencies; Red Crescent Society and Fire Fighting and Safety Department provide support.

5. Input

The following are the necessary inputs to the project.

- Person in charge for establishment from TDMMC, all District Municipality, Urban Planning Deputy, Park Organization, Fire Fighting Department and Red Crescent Society
- Person in charge for maintenance from Park Organization
- Budget to acquire or lease land
- Budget to maintain evacuation place

6. Expected Output(s)

The following are expected outputs of the project.

- Appropriate numbers of Regional Evacuation Places more than 1,300 ha in total area
- Safe and wide evacuation route with guide facility such as map and signboard
- Warehouse in the Regional Evacuation Places equipped with rescue equipment, first aid, potable water and emergency foods

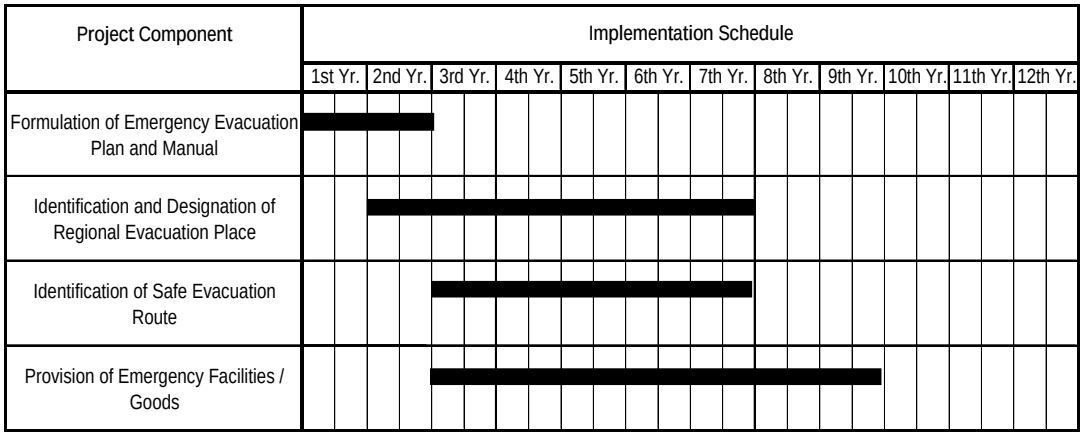
- Establishment of the regional evacuation system for Tehran citizens

7. Rationale / Justification

Seismic Damage estimation conducted in 2000 by JICA indicates that more than 3,500,000 people will lose their houses in case that the Ray Fault is activated. At the time of such destructive earthquake, it is clearly anticipated that a lot of situation will arise, in which the evacuation of those homeless residents will be required. For such purpose, it is necessary to designate, even in an ordinary time, evacuation system, wide area of evacuation place or evacuation roads. Even though the governmental organization designates the place and route, it will not function if people do not know about it. The total 'Evacuation System' should be maintained. In addition, it is necessary to specify necessary matters and procedures concerning the establishment and operation of evacuation places and to ensure that such items are fully understood by residents.

8. Tentative Implementation Schedule

This project shall be implemented and completed in the medium term project timeline. Because once the emergency evacuation plan is formulated and officially approved, there is no element of the project that would take long duration physically. The project schedule shall be highly dependent on the formulation of the official scheme of the requisition / lease of land and premises.



Tentative Schedule

9. Monitoring and Evaluation

Monitoring and evaluation will be done by the Special Committee for Evacuation and TDMMC.

Items to be monitored are:

- Number and area of developed Regional Evacuation Places
- Number of victims that can be accepted by the Regional Evacuation Places
- Number of victims that can evacuate using developed Evacuation Route and evacuation guide systems

Schedule of monitoring/evaluation shall be **once in every year**

10. Sustainability

Selected Regional Evacuation Place should be utilized not only for the evacuation places. They should be developed as park, school ground, sports complex and so on which can be fully used for the citizens in ordinary time. Sustainability also heavily depends on the yearly budget to maintain

the Evacuation Place. Then, TDMMC should coordinate relevant organizations to maintain their daily disaster prevention activities related to evacuation, i.e., dissemination of knowledge and training of evacuation for citizens through drills. Project on "**Designation of Model Communities for Organization of Community Level Disaster Groups and System**" should be strongly incorporated to this project.

11. Estimated Project Cost (Tentative)

Estimated cost of each project component is summarized in Table 1.
It is to be noted that the costs for acquisition and / or lease of land and premises are not included.

Tentative Project Cost

Project Component	Description of Main Cost Component	Estimated Cost (US$)
Formulation of Emergency Evacuation Plan and Manual	Consulting Cost	1.0 million
Identification and Designation of Regional Evacuation Place	Consulting, Site Investigation and Administration	1.5 million
Identification of Safe Evacuation Route	Consulting and Site Investigation and Administration	1.5million
Provision of Emergency Facilities / Goods	Procurement, Installation and Maintenance	48million

Project Profile No 6
STRENGTHENING AND REPLACEMENT OF BRIDGES ALONG MAJOR ROAD NETWORK

1. Introduction

The Islamic Republic of Iran is a disaster-prone country that is regularly affected by earthquakes, floods droughts and other disastrous calamities. Over the last decade alone, three major earthquakes (Manjil, Quazvin and Bam) killed many people and it destroyed a considerable amount of private and public assets. Tehran City located in the northern central part of The Islamic Republic of Iran was a small city populated only 800,000 in approximately 50 years ago. However, within half a century, Tehran city expanded more than 10 times of its population without considering appropriate measures against possible earthquake.

According to historical seismic data, Tehran has suffered from several strong earthquakes with approximate return period of 150 years. However, Tehran City has not suffered form major earthquake since 1830, and seismologists believe that a strong earthquake will strike Tehran in the near future. Herewith, Japan International Cooperation Agency (JICA) dispatched a study team to implement "The Study on Seismic Microzoning in the Greater Tehran Area", and comprehensive vulnerability against several scenario earthquakes was estimated. In the study, vulnerability was identified; however, Tehran Municipality does not have comprehensive disaster management plan, and as a result, this study "The Comprehensive Master Plan Study on Urban Seismic Disaster Prevention and Management for the Greater Tehran Area" has been carried out. As a result of the study, several important priority projects were selected as a package of components in several sectors and this project profile is one of the priority projects to be implemented for future.

2.Background

Major Road Network has an important role after earthquake event, to support smooth traffic flow for vehicles which is dealt with emergency operations. If any of bridges along major road network collapsed, it will greatly disturb various emergency activities. Even though related organizations dealing with disaster management prepare plan to reduce damages, emergency response will not be effectively implemented. Therefore, to secure the road network, vulnerable bridges must be strengthened at the earliest possible.

In the previous study "The Study on Seismic Microzoning of the Greater Tehran Area in the Islamic Republic of Iran", first screening method to pick up vulnerable bridges among bridges exists in Tehran. Damage scale is categorized into 3 levels as follows, 1) Stable, 2) Unstable, and 3) Collapse. Among all the bridges evaluated (168 brides), 9 bridges are selected as vulnerable as listed in the following table for the Ray Fault Model, which cause the biggest possible earthquake can be occurred in Tehran. In this project, bridges which were estimated as "collapse" or "unstable" must be replaced or strengthened. Out of 9 vulnerable bridges, 4 of them are estimated as "unstable" and 5 of them are estimated as "collapse". Among those estimated as "Collapse", all 5 bridges have to be replaced. Among those estimated as "Unstable", 2 bridges have to be retrofitted and 2 bridges have to be replaced with new ones. In addition, all the bridges along major road network should install falling prevention devices to avoid malfunction of road network. Location map of vulnerable bridges is illustrated in the following figure.

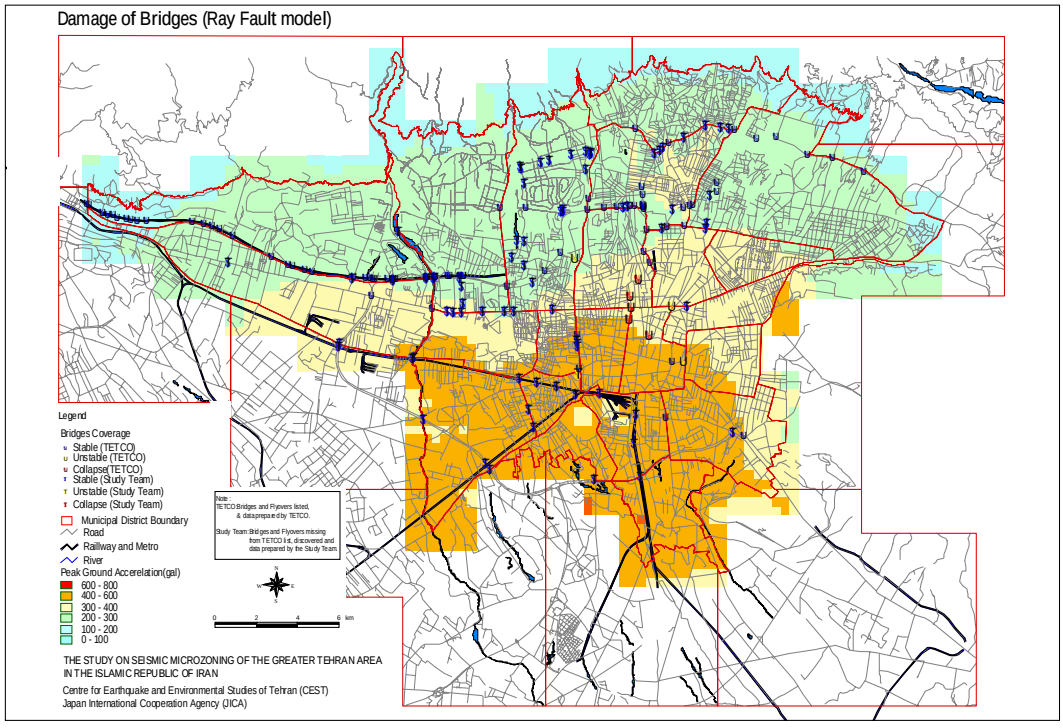
Tehran Municipality is responsible for management of all bridges in Tehran, and TETCO, engineering supervising section of Tehran Municipality, is preparing retrofitting program supported by Management and Planning Organization (MPO). However, necessary retrofitting of bridges is not yet started. It is necessary to start actual implementation at earliest possible. Bridges constructed in recent years are installed with anti falling-off devices and project maturity is quite high to implement the project.

List of Vulnerable Bridges

CODE	TETCO Crossing No	Bridge Name	Structure	Score	Judgment	Type of Measures
				Ray	Ray	
101891	189	Nasr	Steel (Temporary)	23.8	Unstable	Replace
102551	12/255	17 Shahrivar	Steel Girder	21.2	Unstable	Retrofit
104731	473	Hafez	Steel (Temporary)	33.7	Collapse	Replace
104741	474	Jomhury	Steel (Temporary)	33.7	Collapse	Replace
104751	475	Karim-Khan	Steel (Temporary)	33.7	Collapse	Replace
104761	476	Enghelab	Steel (Temporary)	33.7	Collapse	Replace
104771	477	Saadi	Steel (Temporary)	33.7	Collapse	Replace
104781	478	Sepah	Steel (Temporary)	23.8	Unstable	Replace
210081	-	Navab – Helal Ahmar	RC Girder	24.9	Unstable	Retrofit

Source: Microzoning Study-JICA, 2000

Project Location



Source: Microzoning Study-JICA, 2000

3. Objectives

Project Goal and Objectives are mentioned as follows;

GOAL:

Secure Contiguous Connection of Major Road Network after Earthquake Disaster

OBJECTIVES:

- Strengthening capacity of Bridges along major road network to avoid collapse from possible earthquakes
- Maintain continuous flow of vehicles dealt with various emergency activities after event

4. Implementation Agency

Implementation agency is suggested to be Tehran Engineering Technical Consulting Organization (TETCO), Deputy for Technical and Civil Affairs, Tehran Municipality.

5. Input

This project consists of 4 components and each component is described as follows;

Preparation of Plan (Diagnosis of 9 bridges, strengthening and replacement plan, diagnosis of other bridges and installation plan of falling prevention devices)

This component is planning phase to support effective implementation of future physical strengthening of bridge structures. Following items should be considered and executed in this phase.

- Detail Diagnosis of bridges estimated as "Collapse" or "Unstable" in "The Study on Seismic Microzoning of Greater Tehran Area" completed in late 2000.
- Seismic Diagnosis of brides along major road networks
- Selection of Retrofitting Method
- Design for bridges which will be replaced (Temporary Steel Bridges)
- Selection of type of anti falling-off devices

Implementation of Retrofitting

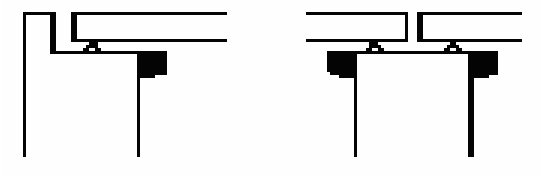
This component is an actual hardware component to strengthen existing bridges along major road network. Some of bridges must be reconstructed, however, most of bridges can be retrofitted to survive from strong earthquakes. Based on results of plan executed in component 1, bridges must be retrofitted.

Implementation of Replacement

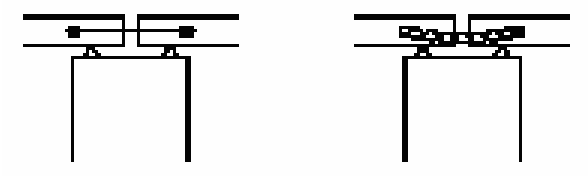
This component is also actual hardware component to rebuilt new bridges after demolishing existing ones along major road network. Reconstruction of bridges will be only in limited bridges, especially those which constructed for temporary purposes, however, this bridges are still in use after a few 10 years of construction. Based on results of plan executed in component 1, bridges must be reconstructed.

Installation of Falling Prevention Devices

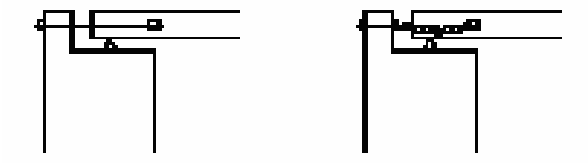
Other than bridges, which is supposed to retrofitted and replaced, falling prevention devices must be installed to secure safer major road networks. Even though, in case of unexpected scale of earthquakes, major road network must be secured, for this reason, falling off of superstructures will create serious disorder, and this phenomenon must be avoided.
Most of bridges can apply several methods, 1) Widening of Seat Width, and 2) Installing Connecting devices between girders, 3) Installing Connecting devices between girder and substructure. Illustrations for each method mentioned above are shown as follows.



Widening of Seat Width



Connection between girders



Connection between girder and substructure

6. Expected Output(s)

Expected outcomes from the project are as follows;

- Safe Road Network
- Safe Bridge Structure

7. Rational / Justification

Securing Major Road Network prevent form possible earthquakes are indispensable to support relevant rescue and relief works right after earthquake event. Mostly malfunction of road network occurs from bridge collapse and debris and other obstacles. Therefore, to maintain strong bridges against earthquakes is strongly necessary measures and high priority among all relevant measures. This bridge retrofitting and replacing project must be implemented at earliest possible.

8. Tentative Implementation Schedule

Detail Diagnosis of these 9 bridges and plan for installation of falling prevention devices should be completed within 2 years.
2 bridges must be retrofitted within 2 years and 7 bridges must be replaced within 5 years.
Each schedule is illustrated in the following.

Project Schedule

	Short Term			Medium Term				Long Term				
Project Components	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year	9th Year	10th Year	11th Year	12th Year
Preparation of Plan												
Implementation of Retrofitting												
Implementation of Replacement												
Installation of Falling Prevention Devices												

9. Monitoring and Evaluation

	Short Term			Medium Term			
Project Components	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year
Preparation of Plan	Inception	Interim	Final				
Implementation of Retrofitting	Commencement of Bridge		After the completion of 1st	After the completion of all			
Implementation of Replacement	Commencement of Bridge		After the completion of 1st	After the completion of half the number of		After the completion of all	
Installation of Falling Prevention Devices	Commencement of		After the completion of 1st	After the completion of half the number of		After the completion of all	

10. Sustainability

Tehran Municipality must maintain all the bridges periodically to secure the bridge safety. In addition, development of bridge inventory database to centrally unify the same format of data base must be implemented and update will be necessary to maintain sustainability of the project.

11. Estimated Project Cost (Tentative)

Tentative estimated project cost is summarized in following table.

Components	Estimated Cost (million US$)
Preparation of Plan	2.00
Implementation of Retrofitting	10.00
Implementation of Replacement	20.00
Installation of Falling-off Devices	5.00
Total	27.00

Project Profile No 7
STRENGTHENING OF WATER SUPPLY FACILITY AND NETWORK

1. Introduction

The Islamic Republic of Iran is a disaster-prone country that is regularly affected by earthquakes, floods droughts and other disastrous calamities. Over the last decade alone, three major earthquakes (Manjil, Quazvin and Bam) killed many people and it destroyed a considerable amount of private and public assets. Tehran City located in the northern central part of The Islamic Republic of Iran was a small city populated only 800,000 in approximately 50 years ago. However, within half a century, Tehran city expanded more than 10 times of its population without considering appropriate measures against possible earthquake.

According to historical seismic data, Tehran has suffered from several strong earthquakes with approximate return period of 150 years. However, Tehran City has not suffered from major earthquake since 1830, and seismologists believe a strong earthquake will strike Tehran in the near future. Herewith, Japan International Cooperation Agency (JICA) dispatched a study team to implement "The Study on Seismic Microzoning in the Greater Tehran Area", and comprehensive vulnerability against several scenario earthquakes was estimated. In the study, vulnerability was identified, however, Tehran Municipality does not have comprehensive disaster management plan, and as a result, this study "The Comprehensive Master Plan Study on Urban Seismic Disaster Prevention and Management for the Greater Tehran Area" has been carried out. As a result of the study, several important priority projects were selected as a package of components in several sectors and this project profile is one of the priority projects to be implemented for future.

2. Background

Earthquake in Bam realized vulnerability of water supply network against strong earthquakes. In Bam, more than half of distribution pipes are made of asbestos, therefore, scale of damage was enormous. In case of Tehran, scale of damage will not be the same with Bam Earthquake, since approximately 95% of pipes are made of Ductile Iron, which is relatively resistant against earthquake. In the previous study "The Study on Seismic Microzoning of the Greater Tehran Area", numbers of damaged point are estimated based on several scenario earthquakes. And in the worst case, which is Ray Fault Model, located in the northern part of Tehran, number of damage was estimated at 3,864 points. Especially in the southern part of Tehran, damage scale will be large, which will suffer from lack of water supply, at the same time, number of water reservoirs are limited and serious lack of water can be expected.

Among lifelines, water resource is the most important in terms of necessity to keep human life, and people can not live without this important resource for long time. In this reason, securing water supply is one of the most important tasks among all relevant activities after earthquake. To avoid large scale of damage, following 3 points must be considered, 1) Increase resistance of water distribution facilities and network against earthquake, 2) Increase Capability of Emergency Response, and 3) Increase Capacity of Emergency Water before earthquake.

At present, JICA is preparing a project for strengthening of water distribution network in Tehran, however, agreement is not signed yet. In this study, evaluation of facilities and its strengthening method, together with emergency operation plan and emergency water tank distribution plan with coordination of evacuation site selection should be included. After the commencement of this study, vulnerable points can be verified and implementation of strengthening project can be effectively carried out. TWSC's awareness is very high and willing to implement this project in the near future.

3. Objectives

Project Goal and Objectives are mentioned as follows;

GOAL:

Secure Continuation of Water Distribution after Earthquake Disaster

OBJECTIVES:

- Physical Strengthening of Existing Facilities
  - Strengthening of Existing Pipeline Networks
  - Strengthening of Existing Water Distribution Facilities (Purification Plants, Water Reservoirs, and etc.)
- Increase Capability of Emergency Response
- Increase Capacity of Emergency Water Supply

4. Implementation Agency

The direct project beneficiary and implementing body should be Tehran Water and Sewage Company (TWSC) with close coordination with Ministry of Energy.

5. Input

This project consists of 6 components and each component is described as follows;

Preparation of Strengthening Plan for Facilities and Networks

This component of the project is preparation of plan which is strengthening of "hardware component". Items to be included in the plan are as follows;

- To evaluate vulnerability of facilities and networks
- To prepare priority among vulnerable parts
- To consider strengthening method for vulnerable parts

Preparation of Emergency Response Plan

This component of the project is preparation of emergency response plan which increases capability of "software component". Items to be included in the plan are as follows;

- Concretize responsibility of each department
- Capacity building of emergency response capability
- Preparation of emergency response manuals

Preparation of emergency response manual must be carried out together with staffs from TWSC to understand the contents effectively. This component is closely related to component 5).

Implementation of Facility Strengthening

In this component of the project, based on the result of Strengthening Plan, facility strengthening will be implemented. Following items can be expected.

- Strengthening of Purification Plants
- Strengthening of Water Reservoirs

- Strengthening of Pumping Stations
- Preparation of Emergency Electric Supply System

Implementation of Network Strengthening

In this component of the project, based on the result of Strengthening Plan, network strengthening will be implemented. Following items can be expected.

- Strengthening of Main Pipes (Transmission Pipes)
- Replacement of Asbestos Pipes (Limited to small area)
- Replacement of Joints

Implementation of Periodical Drills for Emergency

In this component of the project, to support smooth implementation of emergency response activities, drills must be hold periodically. Each staff must be fully aware of their own task mentioned in the manual prepared in component 2) after earthquake event.

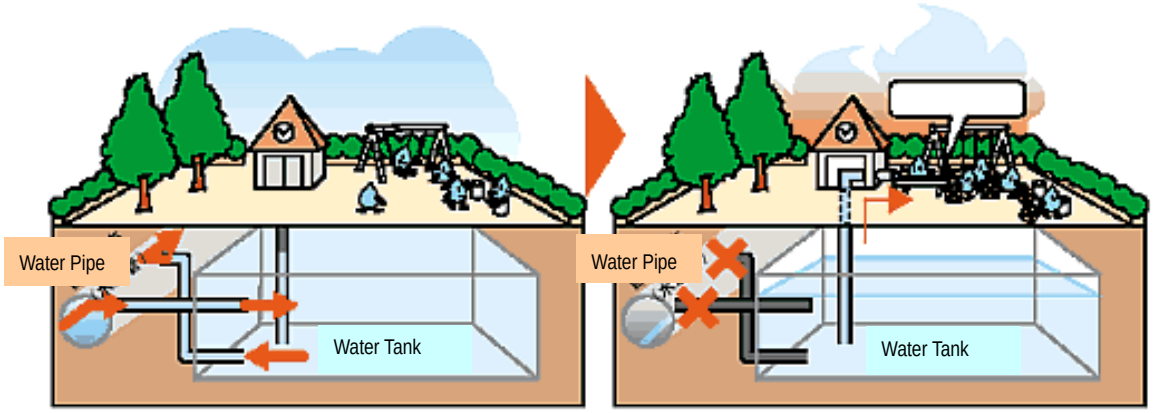
Construction of Emergency Water Tanks

After earthquake event, Damage to water distribution system is expected, and TWSC needs to prepare countermeasures for emergency water supply. Initially, water reservoirs can be used for emergency water supply, however, some of district especially in the southern part of Tehran does not have any water reservoirs. Therefore, emergency water tank will be the best solution to keep water resource in the emergency period after disaster. Emergency water tank must be placed to be able to cover whole Tehran Area. TWSC recently prepared plan for emergency water storage at evacuation site and this needs to have coordination with evacuation site selection by Tehran Municipality.

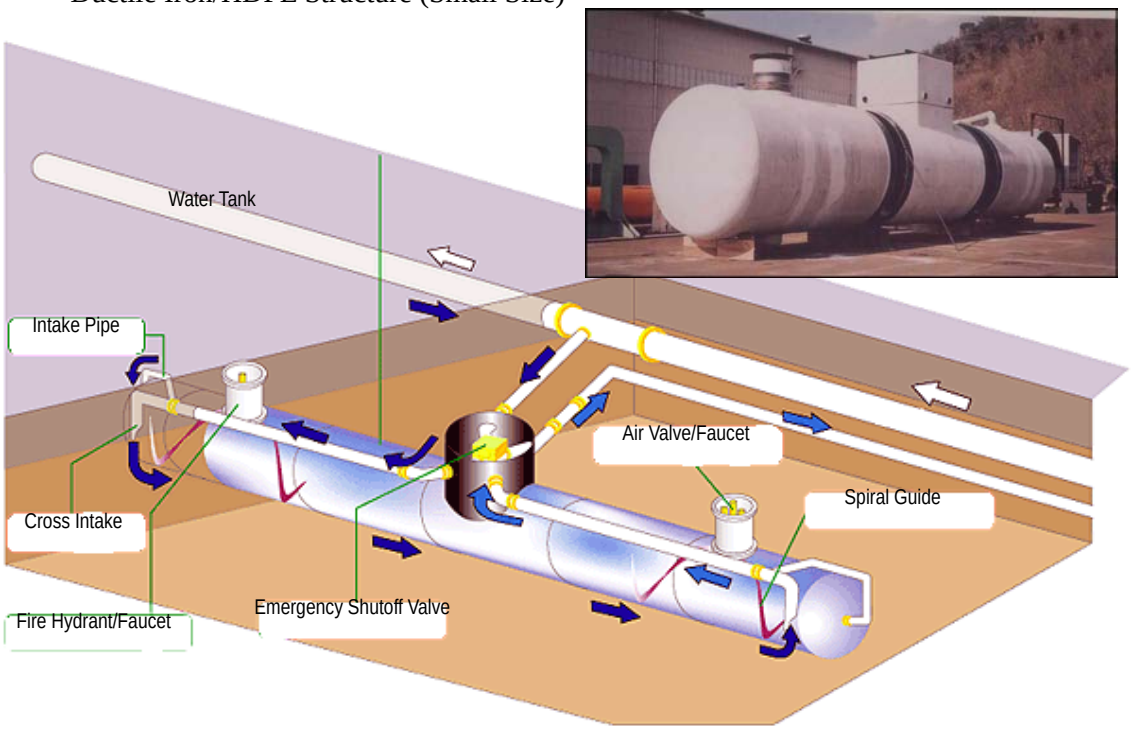
There are several types of emergency water tanks and they are mostly installed underground, which structure is 1) RC for large size (more than 1,000m^3), 2) Ductile Iron and HDPE (High Density Polyethylene) for small size (average size is 100m^3). There is also emergency water tank on the ground. Pictures and illustration of these tanks are mentioned as follows;

Underground Emergency Water Tank

- RC Structure (Large Size)



- Ductile Iron/HDPE Structure (Small Size)



Surface Emergency Water Tank

6. Expected Output(s)

Expected outcomes from the project are as follows;

- Safe Facilities and Networks of Water Distribution
- Safe and Certain Water Supply
- Certain Water Supply in Evacuation Sites

7. Rational / Justification

There will be no income from the project, however, by security reason and responsibility to supply water to citizens in Tehran, this project is indispensable.

8. Tentative Implementation Schedule

Preparation of plans will take approximately 2 years.
Project implementation needs 3 years for facility, 5 years for network, and 6 years for emergency water tank in total after commencement.

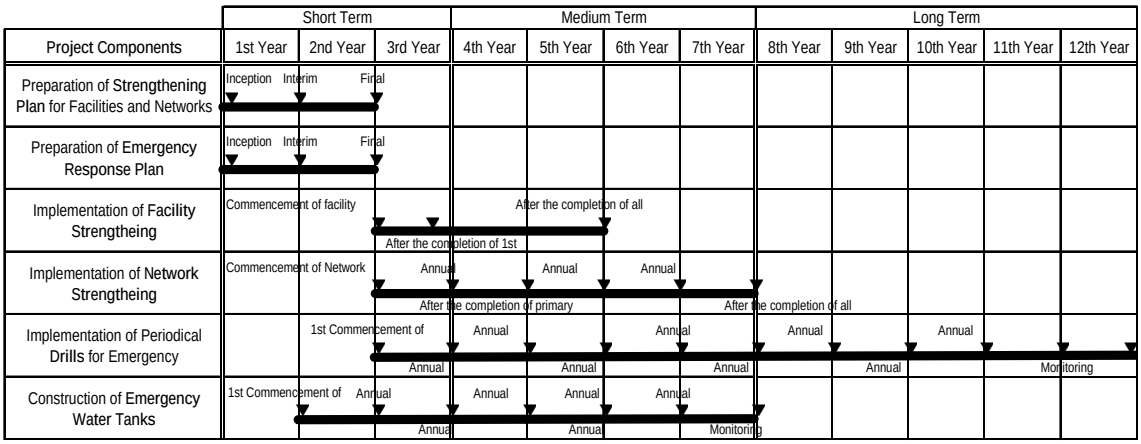
Each schedule is illustrated in the following.

Project Schedule

	Short Term			Medium Term				Long Term				
Project Components	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year	9th Year	10th Year	11th Year	12th Year
Preparation of Strengthening Plan for Facilities and Networks												
Preparation of Emergency Response Plan												
Implementation of Facility Strengtheing												
Implementation of Network Strengtheing												
Implementation of Periodical Drills for Emergency												
Construction of Emergency Water Tanks												

9. Monitoring and Evaluation

Project monitoring and evaluation start from the beginning of installation, and continues for maintenance.



10. Sustainability

Project Sustainability is very much depending on Tehran Water and Sewage Company. However, once the project has completed, continuation of efforts to secure water distribution will be sustainable.

11. Estimated Project Cost (Tentative)

Tentative estimated project cost is summarized in following table.

Components	**Estimated Cost (million US$)**
Preparation of Strengthening Plan for Facilities and Networks	3.00
Preparation of Emergency Response Plan	0.50
Implementation of Facility Strengthening	10.00
Implementation of Network Strengthening	10.00
Implementation of Periodical Drills for Emergency	0.50
Construction of Emergency Water Tanks	10.00
Total	**34.00**

Project Profile No 8
INSTALLATION OF CENTRAL CONTROL SYSTEM FOR NATURAL GAS DISTRIBUTION SYSTEM

1. Introduction

The Islamic Republic of Iran is a disaster-prone country that is regularly affected by earthquakes, floods droughts and other disastrous calamities. Over the last decade alone, three major earthquakes (Manjil, Quazvin and Bam) killed many people and it destroyed a considerable amount of private and public assets. Tehran City located in the northern central part of The Islamic Republic of Iran was a small city populated only 800,000 in approximately 50 years ago. However, within half a century, Tehran city expanded more than 10 times of its population without considering appropriate measures against possible earthquake.

According to historical seismic data, Tehran has suffered from several strong earthquakes with approximate return period of 150 years. However, Tehran City has not suffered from major earthquake since 1830, and seismologists believe a strong earthquake will strike Tehran in the near future. Herewith, Japan International Cooperation Agency (JICA) dispatched a study team to implement "The Study on Seismic Microzoning in the Greater Tehran Area", and comprehensive vulnerability against several scenario earthquakes was estimated. In the study, vulnerability was identified, however, Tehran Municipality does not have comprehensive disaster management plan, and as a result, this study "The Comprehensive Master Plan Study on Urban Seismic Disaster Prevention and Management for the Greater Tehran Area" has been carried out. As a result of study, several important priority projects were selected as a package of components in several sectors and this project profile is one of the priority projects to be implemented for future.

2. Background

Iran is one of major oil and natural gas rich countries in the world, and natural gas is the major energy resource all over the country, therefore, share of distribution of natural gas is very large in Tehran. Natural gas in nature is very convenient energy, however, once a disaster such as earthquake occurs, this resource will trigger serious problems such as fires and explosions. However, at present, GTGC does not have any security system and operating every control manually.

In late 2000, "The Study on Microzoning in the Greater Tehran Area" implemented by JICA was completed and as a result, damage of pipelines were estimated. Basically, gas distribution pipelines for GTGC are mostly steel pipes with welded joints, which is relatively resistant against earthquake. After completion of previous study, awareness of earthquake danger was greatly increased, and GTGC started own risk study "Research Project for Strengthening and Control of Tehran Gas Network against Earthquake" in cooperation with Osaka Gas Engineering Company (Japan), which consists of 3 phases, 1) Immediately Executable Earthquake Preparedness, 2) Damage Evaluation of Tehran Gas Facility, 3) Planning for Strengthening, Control, Mitigation and Restoration and Rehabilitation of Gas System. In this Study, 2 phases were completed and as a result, several points are focused to increase safety of gas distribution system, which are 1) most of pipelines and joints are relatively resistant against earthquakes, 2) weakness of network is concentrated on curve valves near before intake to each building, 3) no automatic shutdown system, and 4) vulnerability of all of office buildings for GTGC. Therefore, 1) vulnerable curve valves must be replaced, 2) automatic control shut down system must be installed, and 3) vulnerable office buildings must be retrofitted or reconstructed.

As a result, to secure safety of Gas distribution for Tehran, this project is indispensable expected to be implemented in the near future. At present, the study team from Osaka Gas Engineering Co. is implementing "Research Project for Strengthening and Control of Tehran Gas Network against Earthquake" including design of central control system. 2nd phase of the study has just completed, and GTGC is under preparation of contract with Osaka Gas Engineering Co. for 3rd phase of the

study. GTGC have high intension to install this system, therefore, financial support must be sought from both internal and international resources to implement this important project.

3. Objectives

Project Goal and Objectives are mentioned as follows;

Goal: *Secure Safety and Continuation of Gas Distribution after Earthquake Disaster*

Objectives:
Project Objectives can be defined as follows;

- Physical Strengthening of Existing Facilities
  - Strengthening of Existing Pipeline Networks
  - Strengthening of Existing Gas Distribution Facilities
  - Strengthening of Office Buildings
- Establishment of Safety System

4. Implementation Agency

The direct project beneficiary and implementing body should be Greater Tehran Gas Company (GTGC) with close coordination with National Iran Gas Company (NIGC) and Ministry of Oil.

5. Input

This project consists of 8 components and each component is described as follows;

Reinforcement of Gas Distribution Facilities and its Office Buildings

This component of the project is physical strengthening of distribution facilities. Type of facilities should be considered as follows;

- District Reduction Station (Approximately 300 buildings)
- GTGC Offices (14 buildings including 1 main office)

In this phase, vulnerability analysis of each building must be carried out to consider the method of measures.

Reinforcement of Gas Distribution Pipe Networks

In the vulnerability analysis implemented by GTGC with cooperation of Osaka Gas Engineering Company, within the GTGC distribution pipeline networks, vulnerable part is focused on curve valves, which is installed near intake to each building. Therefore, in this phase of the project, these vulnerable curve valves must be replaced. In Tehran, there are approximately 600,000 service lines, and among those, approximately 200,000 curve valves must be replaced. Actual replacement has started in several districts and gradually increasing number of replacement.

In addition, for 250psi and 60psi network, which network length is approximately 1,000km and 7,500km respectively, blocking network is very much effective to reduce area without service after earthquake events. This blocking will be effective with combination of automatic shutdown system.

Design and Construction of Remote Shutdown System

At present, all of valves installed are manual valves, however, to respond quickly and effectively, installation of remote shutdown system will increase speed of response drastically. These valves usually installed in medium (250psi) and low (60psi) pressure pipes at entrance of blocks.

In this component of the project, location of remote shutdown valves must be considered carefully to satisfy effective response system.

Design and Installation of Seismometers

At this component of the project, in relation to component 3), seismometers will be installed to activate remote shutdown system automatically. Mainly these seismometers will be installed in each District Reduction Station.

Design and Construction of Central Control Center with Central Security Control System

To activate central security control system, central control center must be designed and constructed with seismic resistant design. It is ideally necessary to apply seismic isolation floor system to avoid unexpected accident against central control system. Data Acquisition system will be based on SCADA.

Testing and Installation of Intelligent Gas Meters

Intelligent Gas Meters are effective to stop leakage of gas inside house, and this meter has small acceleration sensor inside. In Japan, most of meters are replaced with this type in recent years. In this component of the study, testing and installation of intelligent gas meters will be carried out to test possibility of applying this system in Tehran.

Design and Installation of Radio Communication System

After occurrence of disaster such as earthquakes, communication with other branch offices and emergency staffs will be necessary to implement quick response to reduce scale of damages. Therefore, individual radio communication system will be necessary. In this component of the project, design and validity of radio communication system must be carried out before implementation of installation. In addition, to increase the capacity of coordination with coordination organizations, communication system also be connected with TDMMC.

Training and Maintenance

To increase capability and sustainability of central security control system, periodical training and maintenance is indispensable. For training, necessary staffs to operate security control system must be assigned for 24 hours with several shifts and periodical training and drills must be carried out with experts from consultants. For maintenance, operation of seismometers, remote shutoff valves, and its control system must be maintained periodically.

6. Expected Output(s)

Expected outcomes from the project are as follows;

- Safe Facilities and Networks of Gas Distribution
- Safe Gas Distribution
- Continuous Supply of Gas Service
- Reliable Communication System

7. Rational / Justification

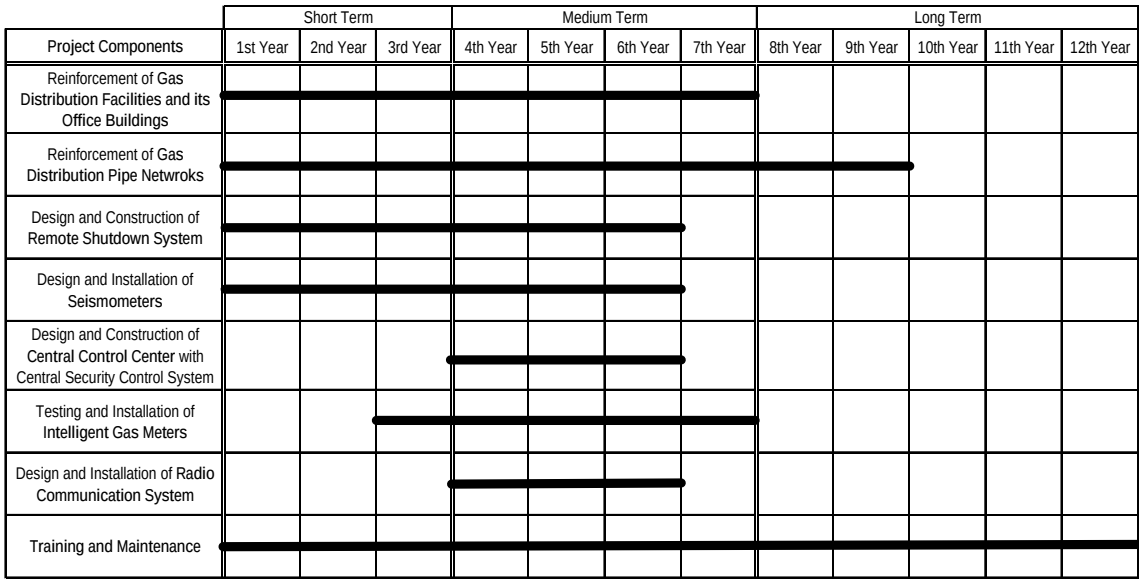
There will be no income from the project, however, by security reason, this project is indispensable. In addition, this effort will increase reliability of GTGC for variety of customers.

8. Tentative Implementation Schedule

Plan will be completed in a few months; however, detail plan for each phase will take several months to complete. Project implementation will take 9 years in total after commencement.

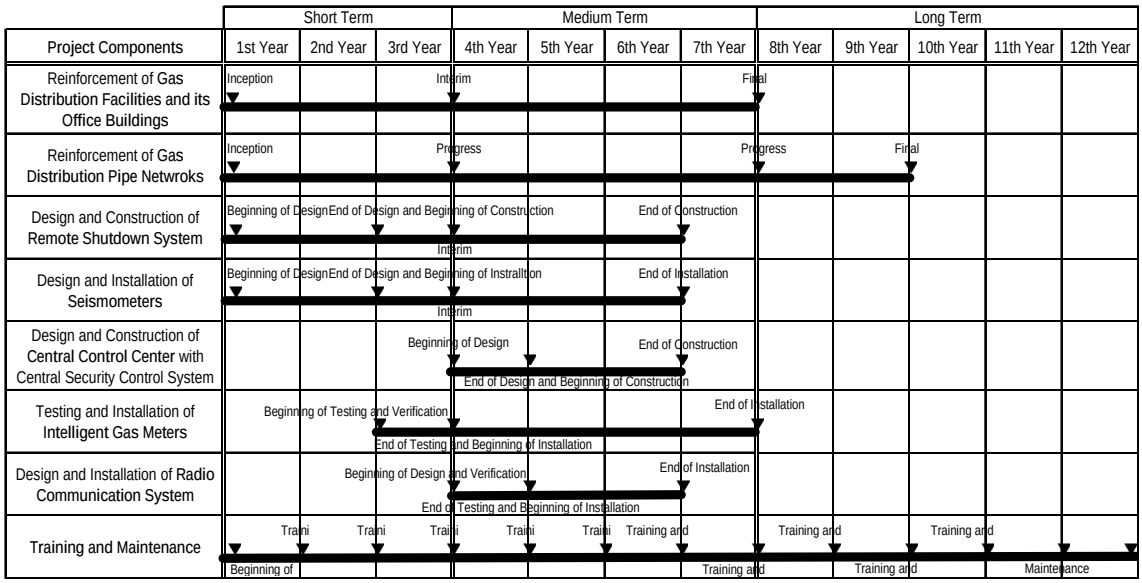
Each schedule is illustrated in the following.

Project Schedule



9. Monitoring and Evaluation

Project monitoring and evaluation start from the beginning of installation, and continues for training and maintenance.



10. Sustainability

Project Sustainability is very much depending on Greater Tehran Gas Company. However, once the project installation is completed, continuation of efforts to secure safety natural gas distribution will be sustainable, since their intension is very high.

11. Estimated Project Cost (Tentative)

Tentative estimated project cost is summarized in following table.

Components	Estimated Cost (million US$)
Reinforcement of Gas Distribution Facilities and its Office Buildings	37.10
Reinforcement of Gas Distribution Pipe Networks	121.90
Design and Construction of Remote Shutdown System	39.75
Design and Installation of Seismometers	42.40
Design and Construction of Central Control Center with Central Security Control System	10.60
Testing and Installation of Intelligent Gas Meters	5.30
Design and Installation of Radio Communication System	2.65
Training and Maintenance	5.30
Total	265.00

Project Profile No 9
ESTABLISHMENT OF MODEL SCHOOLS FOR DISASTER EDUCATION WITH DIFFERENT CHARACTERISTICS AT TEHRAN MUNICIPALITY LEVEL

1. Introduction

The main purpose of disaster education in school is to increase awareness of disaster and cultivate the students' basic ability of disaster preparedness and disaster management. Awareness of disaster and capacity of disaster management will be improved daily for practical purpose through education and the related activities. In order to create many and various human resources to contribute to disaster preparedness and management not only in school but also in the community, a whole education system should be utilized effectively by preparing disaster education plan and by introducing educational staff in charge of disaster-related matters.

School disaster management can be achieved by "disaster education," "disaster management of school facilities," and "organizational activities," and all of them together should be promoted appropriately.

Disaster education

In order to cultivate lifelong ability of disaster management, educational activities including subjects in school curriculum and special activities in and out of school should be utilized totally. The items to be developed are:

- Judgment and activeness to secure oneself from disaster
- Volunteer mindset to work for the local area and community
- Acquisition of basic knowledge of mechanism of natural disaster, local natural environment, previous disasters and technique of disaster preparedness and management, etc.

Disaster management of school facilities

Dangerous environment of school to be causes of accidents in case of disaster should be removed. Also, system for appropriate first aid and safety measures in case of disaster and after disaster should be established. Detailed activities for this purpose are:

- Control and safety check of facilities and equipment
- Measures to make students safe
- Development of information and communication system inside and outside the school
- Evaluation and improvement of school safety
- Storage and management of emergency goods and equipment
- Measures to be taken for school reopening, temporary classes and mental care after disaster

Organizational activities for disaster management

Role of educational staff for disaster education and disaster management in school should be clarified and disaster management system in normal and emergency cases should be established to develop promotion system of disaster education and disaster management in school. Additionally, a special in-school organization dealing with disaster related matter, such as disaster management committee, will be established to make plans of disaster education, disaster management and disaster drill, to review the plans, to prepare the materials and to cooperate closely with students' families, local community and disaster-related organizations. Also, in order to promote the above (1), (2) and (3), training of educational staff for disaster education and management is necessary.

2. Background

There are few people in Tehran with experience of a large earthquake. And there is no continuous disaster-related information supply to the public. The opportunities of training and seminars to learn disaster and develop ability of disaster management are limited. Therefore, the level of public awareness of disaster is low and preparation for earthquake among the people is almost nil. Once an earthquake hits Tehran, a large damage is apprehended. In order to prepare for disaster and manage disaster effectively in future, utilization of younger generation with flexible capacity is the point. Young people are expected to be educated and to be good human resources for that purpose. Since there are many students in Tehran, once they are educated, they can have leading activities not only in schools but also in homes and their communities. In order to create this trickle-down effect, the existing school education should be arranged to involve disaster education. There is, however, no school to try disaster education systematically and no system and materials to be utilized in all schools in Tehran as well as in Iran as a whole. The teachers' workshop on disaster management (held on February 2004 by the JICA Study Team) found that many teachers of geography and civil defense recognize the importance of disaster education and they want to do some actions. But they do not know how to work it out. They desire that the government (e.g. Ministry of Education) will take the initiative in this field.

Additionally, in terms of building structure, many buildings in Tehran are not resistant to earthquake and to say nothing of schools. Considering that schools accommodate a large number of students and staff in the daytime, schools should be retrofitted as soon as possible.

Under these conditions, occasional disaster education and drills are not enough and systematic disaster education, management and the related activities based on the concrete policy and plan become increasingly necessary.

Education and training related to disaster have been somewhat carried out mostly by two organizations such as IIEES and Red Crescent Society. IIEES has published educational materials for disaster preparedness and management and distributed them to some schools. Also, disaster drills have been carried out in some schools as model school. Red Crescent Society has been providing training of first aid, rescue and relief but focused on emergency activities and not on preparedness. However, these activities are likely done haphazardly, and systematic and planned approaches have not been established yet. Also, the series of workshops and interviews conducted by the JICA Study Team revealed the importance of providing training and education to students and school staff, and some opportunities of participation are expected.

3. Objectives

The main objectives of this project are to increase awareness and the capacity of students and school staff for disaster management by experimenting and evaluating disaster education in model schools. Model schools selected from more than 2,500 schools will be used to establish model disaster education policy, plan and organization for schools. During and after the implementation of the project:

- Students will be able to act to keep themselves safe in case of disaster based on their judgment and depending on their capacity development stage in case of disaster.
- Students will be able to contribute to secure the other people, groups and the neighboring community willingly in case of disaster.
- Students will be able to understand mechanism of earthquake and history of disaster in Iran, regional natural environment and disaster prevention system with utilization of educational materials and participation of disaster drills cooperating with local community.
- Systematic and planned disaster management will be carried out both in soft and hard measures through whole educational activities and school structure strengthening.

- Close cooperation among schools, families, local communities and the government will be established.

Various activities will be experimented depending on the characteristics of each model school and the results will be applied to other schools in future.

In order to achieve the objectives, the following steps are necessary:

- To organize a committee of model school project for disaster education consisting of the related organizations (Ministry of Education, IIEES, TDMMC, Deputy of Education and Deputy Social Affairs of Tehran Municipality) as a leading group
- To select model schools (primary, secondary and high schools) by the above committee
- To make a basic policy and plan for disaster education and disaster management, for training of educational staff and training programs to be applied to the model schools by the above committee (1)
- To organize a committee of disaster-related staff in each model school (consisting of principal, vice principal, and staff responsible for disaster education and management) to consider applying the policy and plan prepared by (3) above according to conditions of each school
- To implement the above plans in each model school
- To monitor and evaluate all activities by the above committees (1) and (4)

The concrete activities to be carried out by model schools are:

- Working towards the goal of the project, teaching guidelines and detailed contents of disaster education including disaster drills, first aid and voluntary activities in the community depending on the students' capacity, and location/facilities of each school will be decided and implementation plan will be prepared.
- Disaster management in and out of school will be discussed and the manual will be prepared.
- Training of educational staff to be disaster management trainers and to be responsible for disaster management and training for all staff in school will be planned and arranged with the disaster-related organizations.
  - Training courses, workshops, seminars to be organized by government, fire brigade, Red Crescent Society, universities and other organizations will be utilized for participation of educational staff.
  - Disaster committee in school will initiate to hold training courses including the following items: educational methods for disaster management, ways of collection, confirmation and transmission of the disaster-related information, usage of disaster-related equipment, practical lifesaving technique, mental care, etc.
- All educational materials and teaching method used will be reviewed from the viewpoint of disaster and disaster management and consider the appropriate disaster-related subjects and approaches.
- Disaster drills (for fire and earthquake) will be implemented with support from the related organizations.
- Information network of disaster education will be set up, the approaches to manage mental care of the students will be prepared and the collaboration among home, local community and government, etc. will be organized.
  - Collaboration meeting with community groups and local government will be coordinated to find out and utilize local human resources and educational materials for disaster education.

- Family and neighboring community members will be provided with opportunities to observe and participate in the school disaster management activities.

4. Implementing Agency

Ministry of Education is an implementation agency. IIEES, Deputy of Education and Deputy of Cultural and Social Affairs at Municipality and TDMMC are supporting agencies. A committee for this project will be established with these organizations. Other education-related organizations and groups and district would also be involved as much as possible to exchange information and ideas.

5. Input

Project inputs include experts on disaster education, trainers of disaster management, materials and budget.

6. Expected Output(s)

The following outputs can be expected during and after the project:

- Training programs of key teachers and all educational staff for disaster education and management
- A good number of teachers trained for disaster education and disaster management
- School disaster education policy and plan, disaster management plan and evacuation plan
- Disaster educational materials and equipment
- Network among the model schools to exchange information and develop further activities

7. Rationale/Justification

There are 1,089 primary schools, 689 intermediate schools and 649 high schools in Tehran Municipality (additionally, 156 higher educational facilities). Students and school staff in model schools will be targeted and their families and neighbors can also be involved in the activities. Once standard education policy, plan, manual and leading cases are made, the project can be easily spreading to others. Results of the project cannot be easily calculated and clearly take shape in a short period but the ripple effect is considered to be large in quality and quantity.

8. Tentative Implementation Schedule

The project will be carried out in seven years for 100 model schools. The first and second year of the project will be used to set up the basis of the education (e.g. preparing education policy, plan, manual, materials and implementing them). Concrete activities will be implemented with modification and improvement in the third year based on the results of the activities in the previous year. The following years will have continuous activities with feedback to finalize the policy, plan, manual and so forth. In the third year of the project, additional 1,000 schools will be covered using the previous results.

9. Monitoring and Evaluation

Monitoring and evaluation will be done by a committee consisting of Ministry of Education, Deputy of Education, Deputy of Social Affairs of Tehran Municipality, IIEES and TDMMC based on the report submitted by each model school.

Significance of monitoring and evaluation

Disaster education should be directly related to life and security of students and should be practical. The results of the monitoring and evaluation should be reflected to the policy and the next plan to become more appropriate to the present conditions.

Method of evaluation

In order to evaluate disaster education multi-dimensionally, not only higher-level disaster management committee but also in-school committee in each school will promote monitoring and evaluation. The higher-level committee will visit the model schools to monitor their activities and scrutinize the monitoring report and evaluation report to be submitted by each school.

Items of monitoring and evaluation are as follows.

- Contents of the training programs
- Number of training courses, seminars, workshops to be participated by educational staff
- Number of model schools, students and school staff to be trained
- Number and contents of educational materials and school disaster management plans produced
- Number and contents of disaster drills implemented

Additionally, all educational staff and students will evaluate themselves such as "whether they can get enough ability of disaster management." On the other hand, evaluation by the people and groups outside can be considered such as families, local people and community groups.

The first monitoring and evaluation is scheduled six months after the project starts, with the end of the first year as the second evaluation and followed by the end of each year. Regular meetings will be held to discuss the progress and issues among the model schools and the relevant agencies.

10. Sustainability

The target group and the objectives of this project are so clear that continuous and systematic project implementation has a high possibility. If the target of 100 schools in seven years by this project and additional 1,000 schools will follow to use the same method, almost 50% of the existing schools in Tehran will have benefited by the project. The students are very flexible to absorb new knowledge and as they grow older they get to understand more and become skillful. Also, the influence on the community cannot be overlooked. However, for the establishment of systematic disaster education, authorization and strong leadership and willingness of Ministry of Education are indispensable.

11. Estimated Project Cost (Tentative)

Total estimated cost is US$ 2,060,000. The major components of the activities are:

- Establishment of model schools for disaster management (US$ 1,160,000), and
- Promotion of systematization of school educational activities related to disaster management at national and municipal levels (US$ 900,000).

Project Profile No 10
DESIGNATION OF MODEL COMMUNITIES FOR ORGANIZATION OF COMMUNITY LEVEL DISASTER MANAGEMENT GROUP AND SYSTEM

1. Introduction

Disaster will cause heavy damage across a wide area regardless of age, sex, occupation, and living conditions of the people. In order to protect oneself and families from disasters, daily preparedness and mitigation efforts against various damages are necessary. Once earthquake occurs, however, an individual's or a family's capacity is very limited to prevent the further damages and difficulties that will follow. In this case, it is helpful that the neighboring people should get together and cooperate actively and systematically for disaster. The community members should prepare for disaster daily, and of course, in emergency case. There are many cases that neighbors cooperated and saved many lives and mitigated the damages after the occurrence of earthquake. It is required that the people take necessary actions by themselves because rescue and relief is a fight against time and the people cannot just wait for the support from government and organizations outside the area. Additionally, collaboration of the people and the related organizations can promote the basic activities effectively for disaster management and emergency management.

Activation of community-based groups and establishment of disaster management groups are just some of the measures to strengthen the community disaster capacity. For this purpose, the people and the groups with special knowledge and experience related to disaster should be utilized and community disaster activities without enough capacity should be supplemented financially and technically. Once community disaster groups are organized, they can work not only for preparing for earthquake but also for establishing safe and comfortable community. They will check the safety of the area daily, diffuse and enlighten the disaster knowledge to the local people, implement disaster drill in order to make the local people act appropriately and mitigate the damages in case of disaster. Additionally, in emergency, the groups will be able to perform important roles such as fire fighting, rescue and relief of the suffered, information collection and operation of evacuation sites.

2. Background

Public awareness of disaster preparedness among the Teheran inhabitants is low. This is because the community has not experienced a large earthquake, not anticipated earthquake seriously and been provided little information of earthquake and its potential disastrous aftermath. There are many community-based organizations (CBOs) and NGOs dealing with various fields such as health, education, women, environment and religion. Many of their activities are seasonal and performed independently from other groups. They have worked for rescue and relief for a short time in emergency case but have not followed up. Systematic works have not been implemented yet and disaster-oriented groups are not found. Even if some people want to take actions for disaster management, nobody can instruct them how to do it and what to do. In this circumstance, it is worthy to note that there is a disaster management organization in housing complexes in Tehran. Activities are still in the beginning stage but it works very effectively with strong leadership and objectives in collaboration with all residents, the related organizations and district governments.

Since there are many NGOs, CBOs and small groups working for the community for a long time, these existing groups should be utilized as much as possible for disaster management. Many of them have close relationships with the local people, while the size of members, budget, objectives and coverage are various. Since characteristics of each community and group are different, the government just started to study socio-economic conditions for involvement of the local people into the urban planning and improvement of the living standard.
Some district offices such as those in districts 17 and 4 have already started their own activities involving the local communities in order to improve living conditions and life style. NGO centers

are established in most districts and utilization of activities of NGOs and CBOs are considered for community development. Also, some communities (e.g. housing complex) are trying to promote disaster preparedness and management by themselves in collaboration with local governments, recognizing the importance of the community disaster preparedness and management. However, in terms of Tehran disaster management as a whole, the public awareness level of disaster is still low and systematic and planned community involvement has not been established.

3. Objectives

In order to increase awareness of the local people for disaster and develop their capacity for disaster management, it is necessary to understand their present socio-economic conditions, capacity and possibility of receiving education and training. There are many types of communities and groups in Tehran to be considered as disaster management groups. Since different target groups have different socio-economic background, structure, members, etc., the contents and approaches of disaster education and training will naturally vary from one place to another. The major target groups found so far are:

- Residents in high-rise housing complex
- Basij members
- Members of mahale council
- School students
- Adults and elders coming to mosque and cultural center
- Inhabitants living in old and traditional areas with high vulnerability
- Residents in newly developed area
- NGOs and CBOs working for community

Each group may have some similar lifestyle, idea and principle, etc. Therefore, representative community should be selected as a model community in each district, and some patterns will be formulated for further application to analogous communities. Disaster education and training will be experimented and evaluated in each community. Also, disaster education and training policy and manual will be prepared and community-based activities will be promoted using these materials.

In order to achieve the objectives, the following steps are necessary:

- To organize a committee of the project consisting of the related organizations (Deputy of Social and Cultural Affairs of Tehran Municipality and Districts, TDMMC, Red Crescent Society and Fire Brigade)
- To select model communities by the above committee based on the conditions of the existing communities and community leaders
- To make a policy and plan for community disaster management, education/training of community leaders to be used in each model community by the above committee (1)
- To organize a committee for disaster-related members in each community (consisting of key persons, elders, community group leaders, etc.) to consider applying the policy and plan prepared by the above (3) to each community condition
- To implement the above plans in each model community
- To monitor and evaluate all activities by the above committees (1) and (4)

The concrete activities to be carried out by model communities are as follows:

- Objectives, detailed contents of disaster management and organization of the community disaster group including education and training, disaster drills depending on

the capacity and socio-economic conditions of the residents in each community will be decided and implementation plan will be prepared.

- The functions, roles and specialties of human resources, industries and organizations to be cooperative with community for disaster management will be recognized in advance.
- Training and education programs and materials to be used for community disaster leaders will be prepared.
- Education and training of community leaders in charge of disaster management will be planned and implemented with the disaster-related organizations.
- Disaster drills (for fire and earthquake) will be implemented with support from the related organizations.
- Training and educational materials for the community members will be prepared.
- Information network of disaster management will be set up, dangers existing in the area will be confirmed regularly and a common understanding of situations will be established.
- Community disaster map will be prepared.

4. Implementation Agency

Implementing agencies are Deputy of Social and Cultural Affairs of Tehran Municipality and District. TDMMC, IIEES, Red Crescent Society and Fire Brigade are supporting agencies.

5. Input

Project inputs include experts on community disaster organization, trainers of community disaster leaders, materials and budget.

6. Expected Output(s)

The following outcomes can be expected during and after the project:

- Policy and plan of community disaster preparedness and management
- Education and training programs of creating key community disaster management leaders and community members and their materials
- Some key community leaders of disaster management to facilitate disaster-related activities in community
- A good number of community members trained for disaster preparedness and management
- Community disaster map
- Network of community disaster groups to exchange information and develop cooperation and further activities

7. Rationale/Justification

It is clear that rescue/relief teams cannot reach the damaged people soon after the disaster and local residents cannot do anything to help themselves, which is exemplified by the Bam earthquake case. Therefore, it is required to increase awareness and capacity of the local people. The public awareness for disaster is, however, still low even among the governmental staff. The project had better start with districts having strong willingness and leadership of governmental staff, leaders and key persons in the community and also good cooperation between the government and local people. The existing community-based groups and NGOs with close relationship with and influence on the local community should be utilized and activated for disaster-related activities, if possible. If there is no such a group, establishment of a new community disaster group may be considered.

8. Tentative Implementation Schedule

Two communities per district will be selected as model communities and be covered by the project in five years. In the fourth year of the project, more communities will be involved using the results of the previous model communities.

9. Monitoring and Evaluation

Monitoring and evaluation will be done by a committee consisting of Deputy of Social and Cultural Affairs of Tehran, Municipality and District and TDMMC based on the report to be submitted by each model community.

Significance of evaluation

Different communities may have different activities, directions and achievement goal of the project because of their different characteristics and capacity. Monitoring and evaluation will develop the appropriate ways of the project implementation based on the standard policy and plan of community disaster management prepared by the committee.

Method of evaluation

In order to evaluate community capacity of disaster management multi-dimensionally, not only higher-level disaster management committee but also individual model community such as disaster management committee will promote monitoring and evaluation. The higher-level committee will visit the model communities to monitor their activities, scrutinize report and evaluate reports to be submitted by each model community. Model communities can visit each other and other interested communities (not model communities) can observe the activities for their reference.

Items of monitoring and evaluation are:

- Number of trained leaders of community disaster management
- Number of trained community members
- Number of community disaster groups to be set up and of NGOs and CBOs to be utilized for disaster management
- Number and contents of materials and plans prepared
- Number and contents of disaster drill, seminars, workshops and training courses to be participated by community members

Additionally, community members will do self-assessment such as “whether they can guide other community members for enough disaster preparedness and management” and “whether they are confident of preparing and managing disaster.”

Schedule of evaluation is six months after the project starts as the first evaluation, the end of the 1st year as the 2nd evaluation and followed by the end of each year. Meetings will be held accordingly to present the progress and issues among the model communities and the relevant agencies.

10. Sustainability

Sustainability is heavily dependent on the willingness and capacity of staff in district offices and community leaders. Community leaders and government staff in charge should not be changed frequently in order to keep a steady policy. Also, the governmental staff and community groups should have continuous close cooperation and serious attitudes toward disaster. If the appropriate communities are selected and support from government and the related organizations is strong, the different types of activities of model communities are available and the model activities can be transferred widely in Tehran.

11.Estimated Project Cost (Tentative)

Total cost is estimated at US$ 780,000. The components are:

- Designation of model communities for organization of community level disaster groups and system (US$ 380,000), and
- Promotion of community level disaster management activities (US$ 400,000).

Project Profile No 11
TEHRAN DISASTER MITIGATION AND MANAGEMENT CENTER – INSTITUTIONAL CAPACITY BUILDING -

1. Introduction

The Islamic Republic of Iran (I.R.I.) is a disaster-prone country that is regularly affected by earthquakes, floods, droughts and other disastrous calamities. Over the last decade alone, three major earthquakes (Manjil, Quazvin and Bam) killed many people and it destroyed a considerable amount of private and public assets.

Tehran Municipality, the capital of I.R.I., which accounts for roughly 30% of the country's GDP and about 11% of the total population, is situated on top of three active fault lines, namely the Ray Fault, the North Tehran Fault and the Mosha Fault. Seismologists expect, based on the analyses of historical seismic data,[2] that a major earthquake could occur in the Greater Tehran Area (GTA) in the foreseeable future.

2. Background

The Government of Iran (GOI) has been since the early 90s increasingly aware of the need to establish a suitable and adequate disaster management system in I.R.I and the GOI has over the past decade realized important planning projects and overall regulatory measures toward achieving that end.

Important planning milestones in this process were the preparation and adoption of the "Integrated National Disaster Management Plan – INDPM"; the preparation of a full-fledged microzoning study for Tehran proper and the preparation of a "Comprehensive Master Plan Study On Urban Seismic Disaster Prevention and Management…" for the GTA. Parallel to these efforts, the GOI has put into force a regulatory framework, the most recent pillars of which are the 2003 "Rescue & Relief Comprehensive Plan (RRCP)"[3] and the 2003 policy directive[4]from the State Expediency Council (SEC), that specifies implementation guidelines for the areas of disaster mitigation, preparedness and reconstruction and rehabilitation. The GOI is fully aware that efficient and effective disaster management must encompass suitable measures in all four fields of disaster management, i.e. mitigation, preparedness, emergency response and reconstruction and rehabilitation.

The GOI is also fully aware that the overall regulatory framework needs to be supported and backed up by a proper institutionalized setup, the mandate of which is the timely and efficient realization of the goals, objectives and targets as stipulated in the relevant planning and policy documents.

The Ministry of the Interior assumes at national level overall responsibility for disaster management. The Ministry's role is supported by an inter-agency policy and coordination body, expert advisory groups, as well as an administrative disaster management structure that is mirrored down to province and township levels.

However, there is also a strong perception among government circles that the Tehran Municipality constitutes a "special case," not only because of its relative weight in the country's economy and population base, but also because Tehran is the political, administrative, cultural and commercial center for the whole country. The authorities in Tehran have, in response to this perception created in the last decade two institutes, CEST (Center for Earthquake and Environmental Studies of Tehran) and CEMS (Tehran Comprehensive Emergency Management Plan Secretariat),[5] to address

[2]) The last major earthquake occurred in 1850 in the area now occupied by Tehran.
[3]) A detailed discussion of the RRCP is contained in the JICA Study "Sector Report: Disaster Organization and Management System."
[4]) The full text of this directive in an unofficial English translation can be found in the Sector Report.
[5]) A more in depth discussion of the history, organization, mandate and activities of both organizations is found in Progress Report (1) of the on-going JICA project.

issues pertaining to disaster management in the Tehran Municipality. However, both centers, falling in the past under the supervision and responsibility of a Deputy Mayor, suffered from a number of vital constraints:

- They were "non-formal" institutions, i.e. while actually involved in disaster management related activities, they did not exist as formalized entities with the Municipality's organization;
- They lacked the financial and personnel resources to fully execute their mandates; and
- They lacked a needed level of authority over other government and non-government entities, due to a regulatory framework that wasn't fully in place yet and also, due to their fundamentally "non-formal" status.

This situation has fundamentally changed with the formal establishment by a May 2003 decree of the Mayor of Tehran establishing the Tehran Disaster Mitigation and Management Center (TDMMC) by merging selected facilities and personnel of the former CEST and CEMS entities.

TDMMC is, at this point in time, the only legal and formal entity at Tehran Municipality level, the mandate of which is disaster management at GTA level. Notwithstanding this positive development, there remain many issues that need to be clarified and mapped out.

The more fundamental issues are:

- TDMMC as a formal institutional entity is still, for historical reasons referred to above, in its institutional "infant stage";
- The regulatory frameworks at national and Tehran Municipality levels need to be harmonized and fine-tuned;
- Mandate, core functions and individual functions of TDMMC need to be re-aligned and firmly codified, among other things in order to ensure that they are in full support of codified national level objectives and targets;
- Integration of Tehran-related disaster management activities need to be firmly integrated into the country's overall economic and social development plan and direction; and
- TDMMC needs to be firmly established as the "Emergency Operation Center" that may be needed at both Tehran Municipality and national levels.

The proposed "Institutional Capacity Building Project for the Tehran Disaster Mitigation and Management Center TDMMC" forms the essential institutional core that will be needed for supporting the JICA proposed disaster management master plan's development goal of establishing a safe and secure urban environment against earthquake[6] disaster in the Tehran Municipality. This is the more so evident, since there is no formalized institutional alternative to the existing TDMMC.

3. Objectives

In line with the requirements of the PCM[7] approach, project objectives for the suggested TDMMC institutional capacity building project are divided into two categories, namely the project's "development goal" and its immediate "Project Objectives." They are defined for the purpose of this brief project outline as:[8]

GOAL:

[6]) But not only against earthquake disasters, though that appears to be the biggest threat to Tehran.
[7]) PCM stands for "Project Cycle Management", a standard project management tool and technique applied in ODA projects.
[8]) It may be necessary to adjust and fine-tune goal(s) and direct objectives in the process of discussing the project with the authorities.

"The project's development goal is reduced economic and social cost measured in terms of saved lives, reduced damage to private and public assets, and reduced secondary and tertiary economic and social negative impacts caused by natural and man-made disasters."

OBJECTIVES:

"It is expected that institutional capability & capacity building at TDMMC will contribute to achieving the development goal by:

- Increasing TDMMC's institutional capability and capacity in the areas of disaster "mitigation," "preparedness," "emergency response" and "rehabilitation & reconstruction," and developing the institute over the medium to long term into a fully viable and professional disaster management and coordination entity for Tehran Municipality
- Establishing TDMMC, within the framework of the Emergency Response Plan, into a hardware- and software-wise fully functional "Emergency Operations Center" (EOC) that operates in an emergency response situation as the command & control center for emergency operations, and
- Establishing, upgrading and operating at TDMMC a GIS database and disaster management information and decision support data base that forms the nucleus of the Tehran-wide disaster management information system.

It has to be highlighted that while the proposed project's development goal will hardly cause any serious discussion, the direct project objectives are tentatively formulated making some assumptions about TDMMC's institutional mandate, core functions and future resource endowment in terms of physical facilities, expertise, number of personnel and stable funding sources.

4. Implementation Agency

The direct project beneficiary should be Tehran Municipality (i.e. Tehran's population) through the "Office of the Mayor, Tehran Municipality Organization." The implementation agency is suggested to be logically the Tehran Disaster Mitigation and Management Center (TDMMC), which will provide the needed counterpart facilities and act as the "focal point" for coordination and communication with other municipalities and central Government entities.

5. Input

The project's major input components are, in principle:

- The provision of long- and short-term consulting services for TDMMC capacity building in the areas of disaster "mitigation," "preparedness," "emergency response" and "rehabilitation & reconstruction," including a minor equipment component;
- The provision of consulting services and expertise for regular and continuous updating of the GIS data base and other related data-bases;
- The provision of on-the-job training and scholarships for overseas training and skill upgrading courses in all relevant disaster management fields, including the GIS and other data bases and disaster management information system related software;
- Provision of a concept design, basic design and detailed design of the EOC facility (depending on the overall approach, this form part of the direct institution-building component or part of a separate financial assistance project);
- Provision of equipment and software for the emergency situation communication equipment, including installation, test trial, and handing over and training for the

personnel (depending on further discussions and clarification either with or without a disaster information system, or phased); and

- Provision of civil works and construction supervision services (this component is likely to be a separate financial assistance project).

Major activity blocks and core activities within these blocks can be, at this point in time, identified, as comprising, but not necessarily be limited to:

Activity Block related to Direct Institutional Capacity Building

- Assistance in overall institutional management of TDMMC
- Assistance in the preparation of an operational and fully integrated Emergency Response Management Plan for Tehran Municipality
- Assistance in the preparation of emergency management response plans for Tehran district level (22 Districts)
- Assistance in reviewing and re-drafting, if necessary, of the mandated "mitigation," "preparedness" and "rehabilitation and reconstruction" plans
- Assistance in updating and upgrading of the GIS database, in particular assisting TDMMC in the preparation of data requirements as input into the forthcoming population and building censuses
- Assistance in the establishment of a fully functional disaster management information and decision support system, including integration into the EOC and ECS configurations
- Preparation of training programs and modules for all officials, who will assume functions within the RRCP and TCEMP requirements, including the conduct of training seminars and workshops toward that end
- Assistance in the selection of suitable overseas skill-upgrading and development training programs for all levels of potential trainees in and outside of TDMMC
- Assistance in the preparation of inputs into a new urban development plan for Tehran proper, taking into account seismic resistance criteria, retrofitting requirements and area development schemes
- Assistance in the preparation of techno-economic feasibility studies for use within the Tehran Municipality, as well as other national level entities, such as the Management and Planning Organization
- Assistance in the preparation of a proper regulatory framework for storing, handling and processing of potentially hazardous materials with particular emphasis on an emergency response situation
- Assistance in the preparation of TDMMC's budget and financing plan
- Assistance in project identification and formulation for organizations and entities participating in the emergency response system
- Assistance in the establishment of an appropriate "monitoring & evaluation system" for the performance of the organizations/entities participating in the disaster management system, and
- Assistance in the design, conduct and evaluation of realistic drill exercises
- Assistance in any other matter, such as reporting, that may be required by the City Council and/or other authorities

It is anticipated that the above activity block will, in principle, require the following expertise inputs: disaster management; emergency response management; urban planning and management; management of hazardous materials; emergency medical systems; epidemiology; general planning; economic, financial analysis and budgeting; architecture; public administration; institution

building; environmental protection; flood disaster management; public relations; training & education; and GIS and database management.

Activity Block related to the Emergency Operations Center - EOC

- Assistance in the preparation of an alternative site investigation for the EOC facility, including land acquisition plan, environmental impact assessment and alternative cost estimations
- Preparation of a concept design, basic design and detailed design for the EOC facilities
- Assistance for full integration of the ECS and EOC systems, in particular software integration that will be needed to establish a fully functional and integrated disaster management information and decision support system
- Assistance in the tender preparation and tender process
- Assistance in the tender evaluation(s); and
- Construction supervision.

Activity Block related to the Emergency Communication (and perhaps) Disaster Information System

- Preparation of a concept outlay design, basic outlay design and detailed outlay design for the emergency and possibly disaster information system facilities
- Assistance for full integration of the ECS and EOC systems, in particular software integration that will be needed to establish a fully functional and integrated disaster management information and decision support system
- Assistance in the tender preparation and tender process
- Assistance in the tender evaluation(s); and
- Installation supervision.

6. Expected Output(s)

In principal, the project's outcome may be divided into two major types of outcome, namely expertise-intensive software output and facility-related hardware output. Successful project realization will result in the following tentative outputs:

Expertise-intensive Software Output

Output 1: Fully integrated "Emergency Response Management Operations Plan" for Tehran Municipality," including surrounding areas

Output 2: 22 fully integrated "Emergency Response Management Operations Plan" for Tehran Districts"

Output 3: Fully integrated disaster management information and decision support system

Output 4: Continuously updated and upgraded GIS database and disaster management information and decision support system

Output 5: Principles and guidelines (disaster-related issues only) for a new Tehran Urban Development Plan, including land use, provision of social services and selected area development schemes

Output 6: Techno-economic pre-feasibility and feasibility studies on selected topics and in support of decisions by the Municipality and the City Council

Output 7: Training modules for skill upgrading and higher education in disaster management and related disciplines for TDMMC in-house personnel

Output 8: Training modules for basic training, skill upgrading and higher education in disaster management and related disciplines for government and non-government personnel. Trained personnel in accordance with training schedule to be prepared and at all identified levels

Output 9: Regulatory system (including rules, procedures and so on) for the storage, handling and use of hazardous materials with particular emphasis on emergency situation response

Output 10: A fully formulated and operational "monitoring and evaluation system" for performance measurement of all participating organizations

Output 11: Completed design and Manual for realistic emergency drill exercises, including performance and appraisal standards

Output 12: As a result of all primarily software-oriented inputs & activities, a fully staffed and operational TDMMC that has the institutional standing, merit and level of excellence required for a first-class disaster management institution. Sustainability of TDMMC will be guaranteed by the provision of adequate financial and human resources and the professional services offered to the Municipality and other government and non-government entities.

Depending on how the project components are packaged, the following output may fall under this or the hardware-oriented output elements:

Output 13: Selected site for the EOC, including land acquisition plan, environmental assessment, tender and construction schedules

Output 14: Finalized and approved Detailed Design for the EOC

Output 15: Detailed and approved outlay design for the emergency communication and disaster information systems, including implementation schedule

Facility-related hardware Output

Output 16: Finalized and approved tender documents for the EOC

Output 17: Approved tender evaluation criteria and selected proponent

Output 18: Handed-over civil works

Output 19: As a result of outputs 14 to 16 above, completed EOC civil works, including related facilities

Output 20: Finalized and approved tender documents for the emergency communication and disaster information systems

Output 21: Approved tender evaluation criteria and selected proponent

Output 22: Handed-over emergency communication and disaster information systems

Output 23: As a result of outputs 19 to 20 above, completely installed and fully functional emergency communication and disaster information system, including related facilities

7. Rationale & Justification

The GOI attaches the highest priority to the establishment of a viable national and Tehran Municipality level disaster management system, comprising all four core areas of mitigation, preparedness, emergency response and reconstruction and rehabilitation measures, including a suitable regulatory framework. The formalized foundation of TDMMC in May 2003 (through a Decree by the Mayor of Tehran) and various other directives originating from the highest political authorities have re-emphasized the urgency that is attached to these efforts by the GOI.

As experience in many other countries suggests, proper disaster management cannot function without a fully formalized institutional base. At Tehran Municipality level, TDMMC is the only existing organization that has a fundamental accumulated stock in disaster management expertise with a related mandate. There is presently no alternative formalized or non-formalized institution that could assume a similar or same function for the GTA.

Proper TDMMC institutional capability and capacity building is, therefore, an absolute prerequisite for the realization of an efficient and effective disaster management system at Tehran Municipality level. The proposed project is to assist the GOI in these vital endeavors.

8. Tentative Implementation Schedule

It is suggested, depending on the final definition and agreement on required project inputs and activities, to divide project implementation into either two or three suitable phases. The tentative implementation schedule is presented in the following table.

Tentative Implementation Schedule for TDMMC Capacity Building Project

Fiscal Year	2004/2005	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010
Iranian Year	1383	1384	1385	1386	1387	1388
	Request					
		Phase 1	Phase 2		Phase 3	

Note: The Iranian Fiscal Year covers the period from 21 March to 20 March of the following year.

9. Monitoring and Evaluation

It is proposed to ensure timely a proper project progress through two monitoring missions per year, regular bi-annual progress reports and an annual joint evaluation exercise that involves the GOI/Municipality of Tehran and the respective donor agency.

10. Sustainability

The Municipality of Tehran has recently approved a considerable expenditure ceiling for TDMMC. Sufficient and stable financial resources are a prerequisite for medium- to long-term project sustainability. In addition, continued strong political support will constitute an essential sustainability requirement.

11. Estimated Project Cost (Tentative)

The concept for the short-, medium- and long-term development of TDMMC as the core institution for realization of the Tehran disaster management master plan, requires not only the strengthening of existing and not-yet existing functions, but it also necessitates that TDMMC becomes a fully

fledged Emergency Operations Center (EOC) during a real crisis. Such EOC core function can only materialize if two pre-conditions are met:

- The proper physical facilities for a seismic-resistant EOC building are established in a suitable location that takes into account the results of the projected damage assessment, and
- An independent emergency communication system is established at the EOC.

These two hardware facilities are an integral and essential part for a fully functional TDMMC. However, in the workings of the general ODA mechanism, these two elements, including their direct respective software/consulting components, take the form of "financial assistance," while the more institutional support components, including training and related minor equipment, are typically provided in the form of grant-aid assistance.

It will have to be discussed and clarified in further/future in-depth discussions with the Municipality and the authorities how to address in the most suitable manner related issues. For the purpose of this project outline, the institutional and the hardware components are presented here as "one package".

Total project cost (but excluding the Government Counterpart Contribution) for the hardware and consulting components are tentatively estimated to be in the range of:

US dollar 100 million.

If all major project components are treated as "one package" as indicated above, the cost for major individual project components is presently estimated as summarized in the following table.

Tentative Project Cost Estimate By Major Project Component

(Unit: US dollars)

Major Project Component	Tentative Project Cost (Without GCC)	Comment & Observation
Project Component I Institution Building	Between 5 to 10 million	Comprises mainly consulting services, a training component & minor equipment
Project Component II Construction of the EOC	About 40 to 50 million	Excludes land acquisition cost
Project Component III Emergency Communicatio System	About 30 to 40 million	Per Priority Project 6
Estimated Total	**From 75 to 100 million**	**This is a very preliminary estmation**

Note: 1. GCC = Government Counterpart Contribution

2. The price-base is 2004.

Key issues that need to be discussed in more depth with the authorities are:

- A proper location for the TDMMC/EOC that takes fully into account the results of the disaster scenario projected for Tehran;
- How "synergies" with existing communication and monitoring facilities can be realized;
- Whether the communication system should, from the beginning, include also a disaster information system; and
- A suitable phasing for the establishment of both, the EOC and the disaster communication and information systems.

Project Profile No 12
ESTABLISHMENT OF EMERGENCY TRAFFIC SYSTEM IN TEHRAN

1. Introduction

After earthquake event, most of the existing road network will be disturbed and closed by damaged road/bridge, debris from collapsed buildings in the roadside, parked / abandoned vehicles and massive vehicle traffics in Tehran. Properly maintained and managed road functions shall be indispensable factor for proper and efficient emergency rescue and relief operations, collection of damage information, fire fighting operation, public peace maintenance, first aid/medical care, emergency goods distribution by disaster management and response taskforce. However, emergency traffic control system has not been established in Tehran. Based on the current conditions, establishment of emergency traffic control system is proposed for to maintain road functions and to provide proper network system for efficient and smooth emergency vehicle operation under earthquake disaster.

2. Background

Greater Tehran Metropolitan area covers a huge area and also has an average population density of about 110 persons per hectare. In some urban areas population density reaches 350 per hectare. Based on census of 1996, the population of the city was over 6,700,000 and is said increasing to the double at present. About 46% of the buildings are old and the remaining buildings do not employ any proper structure. In some districts ratio of old buildings reaches 75%.

Based on the previous studies by JICA Study Team, Ray fault will cause most damages of about 380,000 persons or 6% of the population will die. These losses are not limited to human casualties, but social and economic aspects of it are also extensive.

During the earthquake disaster, search, rescue, relief, control and reconstruction should be taken simultaneously. There are several centers in charge of these measures such as hospitals, Red Crescent, fire brigade, police and military forces, and lifeline companies (water, electricity, gas and telecommunication) should have smooth and quick access to road network to reach the damaged areas through it.

In above circumstances, JICA Study Team proposes emergency road network system as shown in Chapter 5.2. The Team proposes two classes of emergency network namely primary emergency network and secondary emergency road. The primary roads are linking with Disaster Management Centers of national, provincial, municipality, district, and sub-district municipalities and major airport and seaport as for transportation nodes. The secondary roads are linking with all the identified emergency response centers of rescue/fire fighting/security, emergency road, and medical care. A total of 95 roads are assigned as the primary emergency road and 61 roads for the secondary emergency road. Also the Team presents the basic policy of traffic control at the emergency case in Chapter 11.4. The polity of route control and area control as the control system from space aspect as well as the system from time aspect. The basic policy of traffic enforcement and information provision is also discussed.

TDMMC formulated “Primary Road Network during Disaster (Roads Required by Fire Brigade)” in cooperation with Tehran Comprehensive Traffic and Transportation Study (TCTTS) in 2002. In this study, a network of roads is defined as emergency network for relief operations that can provide access to only fire fighting stations by using the shortest passing route. But the actual traffic control system for applying this emergency road network was not discussed. This study is suspended and no further schedule is determined yet. On the other hand, Traffic and Transportation Deputy of Tehran Municipality is planning to enforce the Traffic Control Center by installing new traffic lighting system and additional traffic cameras. This is 5-year development plan of adding intelligent traffic lights to 209 new junctions and expanding visual observatory cameras to a total of 220. In this opportunity, further study on the emergency road network and its control system should be done inclusively with above enforcement plan.

3. Objectives

The main objectives of the project are summarized as follows:

- To designation of emergency road network
- To establish the emergency traffic control system
- To enforce the existing Traffic Control Center

The following are proposed project components.

- Analysis of current traffic flow and estimation of traffic flow in emergency
- Study on emergency road network
- Study on emergency traffic control system
- Formulation of debris removal plan in emergency road
- Design and installation of new traffic lighting system

Design and installation of traffic camera and its monitoring facilities

4. Implementation Agency

The main implementation agency is Deputy of Traffic and Transportation, Tehran Municipality with support by TDMMC and Recycling Organizations, Deputy of City Services.

5. Input

The following are the necessary inputs to the project.

- Person in charge of emergency transportation network study for Traffic and Transportation Deputy, TDMMC and TCTTS
- Person in charge of emergency traffic control system and enforcement of Traffic Control Center from Traffic and Transportation Deputy, TDMMC, TCTTS, Traffic Police and Recycling Organization
- Appropriate consultants for traffic flow analysis
- New traffic lights and its control system
- Traffic monitor camera and its operation facilities

6. Expected Output(s)

The following are expected outputs of the project.

- Emergency road network
- Emergency road restricted zoning
- Emergency traffic control plan
- Debris removal plan from emergency road
- Enforced traffic monitoring system
- New traffic light control system

7. Rational / Justification

Tehran has a transportation network consisting of 2,356 km. Intercity highways and freeways consist of 9% of this network. About 12,000,000 passengers use this network daily and 2,000,000 passengers pass through the entrance and the exit roads of Tehran circumference. At present this network only covers 1,200,000 passengers during morning peak hours that has practically caused a heavy traffic jam in most of main roads and some major parts of highways. Apparently, in case of disaster occurrence during peak hours, it is easy to imagine the catastrophic situation of the traffic

flow. Rescue and relief operation, fire fighting and other emergency operations will encounter serious problems. In order to prevent this situation, appropriate traffic control system in case of disaster is indispensable.

8. Tentative Implementation Schedule

This project shall be implemented and completed in the medium term project timeline. Continuous upgrading and addition of traffic lighting system and traffic cameras shall also be recommended in the long term. However, considering the urgency of the implementation of the traffic control system, the project should be completed at least in the medium term.

Tentative Schedule

Project Component	Implementation Schedule										
	1st Yr.	2nd Yr.	3rd Yr.	4th Yr.	5th Yr.	6th Yr.	7th Yr.	8th Yr.	9th Yr.	10th Yr.	11th Yr.	12th Yr.
Analysis of Current Traffic Flow and Estimation of Traffic Flow in Emergency	■	■										
Study on Emergency Road Network	■	■										
Study on Emergency Traffic Control System	■	■	■									
Design and Installation of New Traffic Lighting System		■	■	■	■	■	■					
Design and Installation of Traffic Camera and Its Monitoring Facilities		■	■	■	■	■	■					

9. Monitoring and Evaluation

Monitoring and evaluation will be done by the Special Committee of Transportations and Traffic and TDMMC.

Items to be monitored:

- Emergency road network map
- Emergency road control zoning map
- Analysis result of traffic flow in emergency case
- Manual for emergency traffic control
- Number of installed monitor camera
- Number of installed traffic light
- Traffic flow status before and after installation

Schedule of monitoring/evaluation shall be **twice in every year.**

10. Sustainability

Even though the emergency traffic control system is ready, it is quite difficult to restrict the inflow of ordinary vehicles only by means of barrier, cone or allocation of police officers. It can be well imagined that illegal parking or abandoned vehicles on emergency road network causes traffic jam. Therefore, in order to enhance the effect of traffic control, it is necessary to provide all necessary information quickly by using any and all means. At the same time, considering present Tehran citizen's traffic manner, it is highly necessary to educate people about traffic rules and regulations.

At present, 15 organizations such as traffic police, RCS, taxi association and so on utilize the Traffic Control Center. However, these organizations use the system independently. There is no coordination and cooperation system among these organizations. Such system must be formulated. In order to ensure the practicality of the system, a large scale maneuver shall be conducted by certain intervals.

11. Estimated Project Cost (Tentative)

Estimated cost of each project component is summarized in the following table

Tentative Project Cost

Project Component	Description of Main Cost Component	Estimated Cost (US$)
Analysis of Current Traffic Flow and Estimation of Traffic Flow in Emergency	Consulting and Site Investigation	2.0 million
Study on Emergency Road Network	Consulting Work	2.0 million
Study on Emergency Traffic Control System	Consulting Work	2.0 million
Design and Installation of New Traffic Lighting System	Design, Procurement, Installation and Maintenance	18 million
Design and Installation of Traffic Camera and Its Monitoring Facilities	Design, Procurement, Installation and Maintenance	7 million

Project Profile No 13
INSTALLATION OF NEW DISASTER INFORMATION AND TELECOMMUNICATION NETWORK

1. Introduction

According to the past seismic data, the Islamic Republic of Iran has been frequently affected by strong earthquakes and is always facing the fear of earthquake outbreak. The Government of Japan decided to conduct "The Study on Seismic Microzoning of the Greater Tehran Area in the Islamic Republic of Iran" by Japan International Cooperation Agency (JICA). The Study commenced in April 1999 and aimed to estimate the damage size by earthquake in Tehran City by application of Geographical Information System (GIS) database. According to the Microzoning Study, earthquake by the Ray Fault model located at south part of Tehran is expected to be the biggest seismic intensity and Tehran City will be devastated. At present, Tehran Municipality has yet to prepare effective measures and master plan for prevention of the disaster. In response to the request by the Iran Government, the Government of Japan conducted Master Plan Study from August 2002, namely "The Comprehensive Master Plan Study on Urban Seismic Disaster Prevention and Management for the Greater Tehran Area in the Islamic Republic of Iran" in order to mitigate the damage.

2. Background

In the disaster site, task force such as Police and Fire Department conducts search and rescue operations intensively to save more life and property. In order to make the operation more effective, the activities should be commanded by TDMMC's centralized main center based on the latest information about disaster magnitude and damage extent. It is indispensable to utilize the high performance telecommunication network to minimize the secondary damage by sharing the necessary information. In other words, the effective search and rescue operations can not be realized without steady disaster communication network. Unfortunately, Tehran City has no comprehensive disaster communication network up to now. Therefore, the necessity of the steady disaster network has arisen. As far as disaster network is concerned, excellent earthquake resistance is marginally required; in addition, the stable communication function with moving terminal should be furnished. The required functions for the disaster network are summarized below.

Earthquake-Resistant:

To secure physical resistance from external force by disaster to keep normal operation.

Immediacy:

To operate immediately in emergency as an information and communication network.

Stable communication with moving terminal:

To secure high quality communication to/from moving vehicles.

Flexible-Network:

To restructure the damaged network easily.

When the disaster network is required, it is desirable to make the maximum use of the existing telecommunication network with modification. This plan might be the better solution from the economic point of view, but it has some major concerns about structural strength against big earthquake, and flood calls problem. The flood calls is caused by many inquiry calls about family, friends and relatives concentrated into specific telephone switching offices nearby the disaster area, and calls including emergency call can be scarcely connected. The most significant role for disaster network is keeping the normal operation constantly after earthquake disaster. As a result, the new disaster information and telecommunication network should be selected as a priority project.

3. Objectives

There are two measures to create disaster information and communication network; one is reinforcement of the existing telecommunication network, and the other is new installation of independent disaster network. The former is to improve the existing telecommunication network in physical strength. And since the basic framework of network already exists and the reinforcement work is partially made in vulnerable parts of the network, it has great advantages in terms of cost and installation period.

However, the target network is the existing system, which is currently offering communication services to subscribers. So, it is not permitted to interrupt the services by mistakes during the reinforcement works. As a result, the scale of reinforcement works will tend to shrink to minimize the risk, and some of reinforced network may have insufficient strength to resist an earthquake.

The reinforcement plan covers less work volume than the new network, but the both plans have considerable work volumes. In order to calculate the whole project scale, the Study Team carried out field survey in the existing stations and proposed sites. The following are main inspection items:

- Telephone office and subsidiary facilities
- Equipment installation practice
- Tower and antenna
- Propagation and obstruction condition
- Proposed new radio station site

4. Implementation Agency

This disaster information and telecommunication network is independent from public network, so it is just right that the implementation agency be TDMMC. Since this network is smaller than public communication system in network size, this network is furnished with all telecommunication systems such as switching, transmission and subscriber terminal. It is expected to be quite difficult to manage the fully furnished telecommunication network only by TDMMC from the beginning stage. So, it is a matter of great urgency to train TDMMC personnel. The following suggestions are seemingly helpful for the training to be more effective:

OJT training with equipment supplier

Equipment supplier undoubtedly well understands the installed facilities, so that TDMMC personnel should be transferred the know-how from the supplier's experts under the OJT contract of operation and maintenance support.

Technology transfer from TCI, TCT and MSC

TCI, TCT and MSC have similar operation and maintenance facilities for their telecommunication network. So, TDMMC should request cooperation with those engineers to work together and learn how to operate and maintain the actual network.

5. Input

The project's major input components are, in principle:

- The provision of feasibility study as urgent project
- The provision of basic and detail design to study the final disaster network configuration
- Provision of finance and its source
- Provision of communication equipment, supporting facilities and software for the network
- Provision of installation, testing and operation and maintenance works
- Provision of equipment suppliers and contractors
- Provision of standard manual for installation practice and operation and maintenance

6. Expected Output(s)

The disaster network can not expect to collect charge from subscribers not like the public network, so there is not monetary output. But, project outcome more than monetary may be divided into two types, which are in normal condition and in emergency situation.

Normal Condition

Output 1: High performance disaster information and telecommunication network covering the whole Tehran area.

Output 2: This network is closed private network, so the daily correspondence such as telephone and FAX can be used free within the network.

Output 3: Enlightening training to community level can be performed anytime to advance consciousness for disaster prevention through the private network.

Output 4: Even in emergency, call can be easily connected without any disadvantages happened in public network such as busy and redial for call.

Emergency Situation

Output 1: 24-hour observation of seismic intensity data from 22 stations can be established. The damage size can be estimated from obtained data immediately.

Output 2: The latest and accurate information about disaster and damage can be handled from disaster site in real time.

Output 3: The best operation system can be established based on the real time information obtained at the initial stages, thereby saving more lives and properties.

Output 4: The guidance system for safety evacuation is prepared. The evacuation route and place can be announced directly to people by speakers mounted in the sub-district station nearby disaster area.

7. Rationale & Justification

Damage by the disaster may be divided into two; one is direct damage by the disaster outbreak and the other is so-called secondary damage after the disaster. The secondary damage is gradually expanding because of the lack of necessary information such as safety evacuation instruction, proper medical information, road blockage, and so on. And if the information can be collected, it is only individual basis but not integrated. Therefore, search and rescue teams could not take the most effective operation, and the damage could not be prevented.

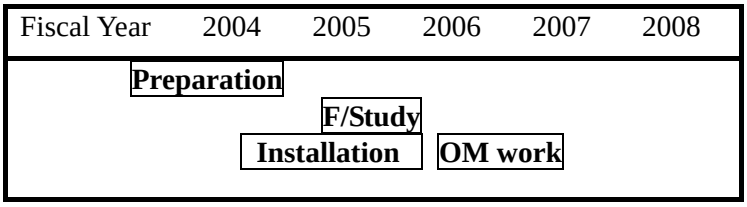
Since most secondary damage is caused by shortage of information, establishing a solid disaster communication network could prevent this from happening. Based on the latest information through the network, search and rescue teams can take the best measures to minimize the damage in cooperation with all associated organizations. When there is lack of necessary information, it will not be possible for TDMMC main center to command any instructions to save more lives and properties. So, the disaster information and telecommunication network is fully worth to be established.

8. Tentative Implementation Schedule

One of the major advantages of mobile system is its shorter installation period compared with cable network system, since road excavation process is not required. The road excavation is very hard and takes a long period not only in work volume, but also in getting permission. Mobile network without road excavation can be established in considerably short implementation period. The tentative implementation schedule shown in the following table is prepared on condition that all site

locations except TDMMC main center are finalized and site development is ready to start installation work:

Tentative Implementation Schedule for Disaster Communication Network



9. Monitoring and Evaluation

It is proposed to conduct a regular review by TDMMC and TCI, TCT and MSC to ensure that the project progresses smoothly. The monitoring period in the installation stage should be executed on a weekly basis; compensation can be recovered if there is delay.

10. Sustainability

Despite its small network scale, this disaster communication network includes all telecommunication systems such as switching, transmission and subscriber terminal. The operation and maintenance works are very complicated; it is almost the same as that of the public network in difficulty and requires high capability of TDMMC engineers to perform the task. In addition, the disaster network can not be expected to collect the telephone charge from subscribers unlike the public network; that is, the basic purpose of disaster network should not pursue the benefit. But undoubtedly, it can contribute to minimizing the disaster damage, and the disaster network is able to give the necessary information to the search and rescue teams to decide effective measures. The disaster network cannot be expected to have any monetary output; however, it is well worth to save more lives and properties. In order to sustain the disaster network, it is recommended that TDMMC use this high performance network in daily works freely and exclusively. And operation and maintenance of this network should be executed by well trained TDMMC personnel in order to minimize the unnecessary expenses.

11. Estimated Project Cost (Tentative)

One telecommunication network should cover the whole country and it is usually the most massive network among various networks, i.e., the establishment of the network requires a huge amount of fund and work volumes. Therefore, the telecommunication project is normally divided into several phases. But, in this project, the target area is limited only in Tehran City, and the network scale is not so large. So, the whole scope of works can be established within one project considering financial and work volume.

The new disaster network consists of backbone network and access system. The backbone network is connected with TDMMC centers, 22 district centers and other associated organizations by microwave radio system, and access network will be covered within each district area by mobile access system. The main TDMMC center is the most significant hub station to cover the whole Tehran area; its major functions include collection and analysis of the seismometer data, exchange of latest and accurate information about disaster and damage, and support for decision making. If main TDMMC station is to be collapsed, all activities will be absolutely stopped. So, TDMMC sub-center which can undertake all functions of TDMMC main center is required to secure normal operation.

Backbone Network

Backbone microwave network is connected with TDMMC centers and each of the 22 district stations, and other organizations concerned. The backbone network is not permitted interruption because of its important role; and so, it is configured in loop and multi-path formations in order to secure normal operation.

Antenna height is normally calculated to secure 100% of the fresnel clearance in the backbone microwave system; that is, the network can offer very high quality service equal with that of public telecommunication network. It is not reasonable to utilize the high quality network only during emergency period, so it is recommended that TDMMC should use this network for the daily business correspondence within the organization to make effective use of the network.

Accesses Network

Access network is to connect between task force in the field and the backbone microwave system. The search and rescue operation teams are working with emergency vehicles, so the disaster network has to be provided the function to make stable communication with those vehicles wherever they are. As far as disaster network goes, the both functions of excellent earthquake-resistant and stable communication with moving terminal are indispensable.

There are three mobile systems which can be acceptable for disaster network, namely satellite communication, the existing GSM mobile, and new installed mobile systems. The satellite system can cover all the stations in the whole project area with one repeater, but it is still too expensive for the disaster network. GSM mobile system is preferable, but it has disadvantages as well; that is, frequency assignment and flood calls outbreak.

It can be easily understood that to secure some frequency band for the disaster network exclusively is quite difficult, since frequency is limited resource anywhere in the world, so that the priority has to be given to public network. In addition, there is shortage of transmission circuits of mobile system infrastructure especially in Tehran City, and this is also a disadvantage.

The existing GSM system is still attractive in financial aspect, and if the frequency band will be officially assigned by the MPTT, there is no doubt in that its use as the disaster network will be reconsidered.

Considering all these aspects, this master plan gives first priority to the new independent mobile system. The access network is the nearest to the disaster site. The disaster access network is expected to support the following functions:

Seismic Intensity Data Collection
Seismic intensity data from 22 seismic stations in each district is transmitted to TDMMC main center, it is necessary to be 24 hours observation system for disaster outbreak that is not expected when it occurs. The seismic data is used for estimation of damage scale of the earthquake in order to decide search and rescue organization at the initial stage.

Disaster and Rescue Information
In order to support search and rescue operation effectively, the latest disaster and damage information is circulated among TDMMC, rescue teams and all other associate organizations including Government, Police, Fire department, Gas, Water, Red Crescent Society.

Voice Simultaneous Announcement
The voice instruction for emergency such as disaster damage and evacuation information is to be announced by speakers mounted on the tower or pole of each sub-district site.

Disaster and Safety Information Community Concerned
This network carries all necessary information required for community people such as medical, hospital, lifeline of gas, water, electricity and road condition in order to support rescue operation effectively.

The overall disaster information and telecommunication network is generally divided into three sub-systems.

- Backbone Microwave Network

- Mobile Access Network
- Operation and Maintenance including decision making support system

Total project cost including the above three sub-systems is estimated to be in the range of*

US dollar 20 million,

Project Profile No 14
STRENGTHENING OF EMERGENCY RESPONSE CAPABILITY AND CAPACITY OF THE TEHRAN FIRE FIGHTING AND SAFETY SERVICES ORGANIZATION

1. Introduction

Tehran Municipality had an absolute population size of 6.742 million people, equivalent to 11.3% of Iran's total population,[9] according to the 1996 population census results. It is estimated that Tehran's absolute population size is 7.5 million people in 2004.[10] Tehran comprises 22 districts on a total land area of about 61,404 ha.[11]

Tehran is situated on top of three active fault lines, namely the Ray Fault, the North Tehran Fault and the Mosha Fault. Seismologists expect, based on the analyses of historical seismic data,[12] that a major earthquake causing devastating damage could occur in the Greater Tehran Area (GTA) in the foreseeable future.

The Government of Iran (GOI) and the Tehran Municipality have adopted various measures to prepare for such event, one key element of which is the Tehran Emergency Response Management and Operations Plan (TERMOP). The project outlined hereunder is designed to strengthen the capability and capacity of the Tehran Municipality to respond to a major earthquake in the fields of search, rescue and relief.

The present project outline is prepared at the "opportunity study" level.

2. Background & Project Rationale

General Resources & Facilities

The Tehran Fire Fighting and Safety Services Organization (TFFSSO) was established in 1921 as a dependent organization of the Tehran Municipality. Since 1991, the TFFSSO has been an independent entity with "organization" status that falls under the jurisdiction and mandate of the Municipality's Deputy Mayor for City Services, Fire Fighting and Safety Department.[13]

The principal current activities of the TFFSSO are:

- To rescue human life in case of fire and protect the national riches;
- To provide training in fire fighting and safety services inside and outside of the TFFSSO; and
- To prepare countermeasures for and to mitigate disaster effects.

The TFFSSO had in the year 2002 a total staff of 1,745 people that is roughly one TFFSSO staff per 4,300 Tehran citizens, if all TFFSSO staff is counted. If only the technical staff is counted (not all of the technical staff are, however, firefighters), the ratio is roughly one TFFSSO technical staff to 6,460 Tehran citizens. The TFFSSO comprises almost 67% technical staff at High School graduate level (see the following table).

[9]) Iran's absolute population size was 60.056 million people according to the 1996 census.
[10]) Excluding statistically not accounted for in-migration.
[11]) Basic socio-economic data are summarized in Appendix I.
[12]) The last major earthquake occurred in 1850 in the area now occupied by Tehran.
[13]) See organiogram of Tehran Municipality in Appendix V.

Tehran Fire Fighting & Safety Organization Staffing & Educational Background, 2002

(Unit: Number of people)

Organizational Rank	Number of Employees	EDUCATIONAL BACKGROUND				
		Ph.D.	M.S.	B.S.	Diploma	Other
Management Position	250	42	5	24	175	4
Senior Technical Staff	76	26	0	12	36	2
Technical Staff	1,161	22	0	26	951	162
Administrative Staff	258	2	2	22	75	157
TOTAL	1,745	92	7	84	1,237	325

Source: Based on information provided by TFFSSO in 2003 (questionnaire)

The financial resources of the TFFSSO comprises regular budget resources from the Tehran Municipality, revenues generated from a safety tax levied by the Tehran Municipality and other minor revenues as summarized in the following table for the years 2000, 2001 and 2002.

TFFSSO Financial Resources, 2000 to 2002

(Unit: Million Rials)

Type of Revenue	2002	2001	2000
Tehran Municipality Budget	131,632	90,706	130,673
Revenues from Safety Taxes	100,000	110,852	25,941
Other Revenues	2,154	5,153	3,823
Total	233,786	206,711	160,437

Source: Based on information provided by TFFSSO in 2003 (questionnaire)

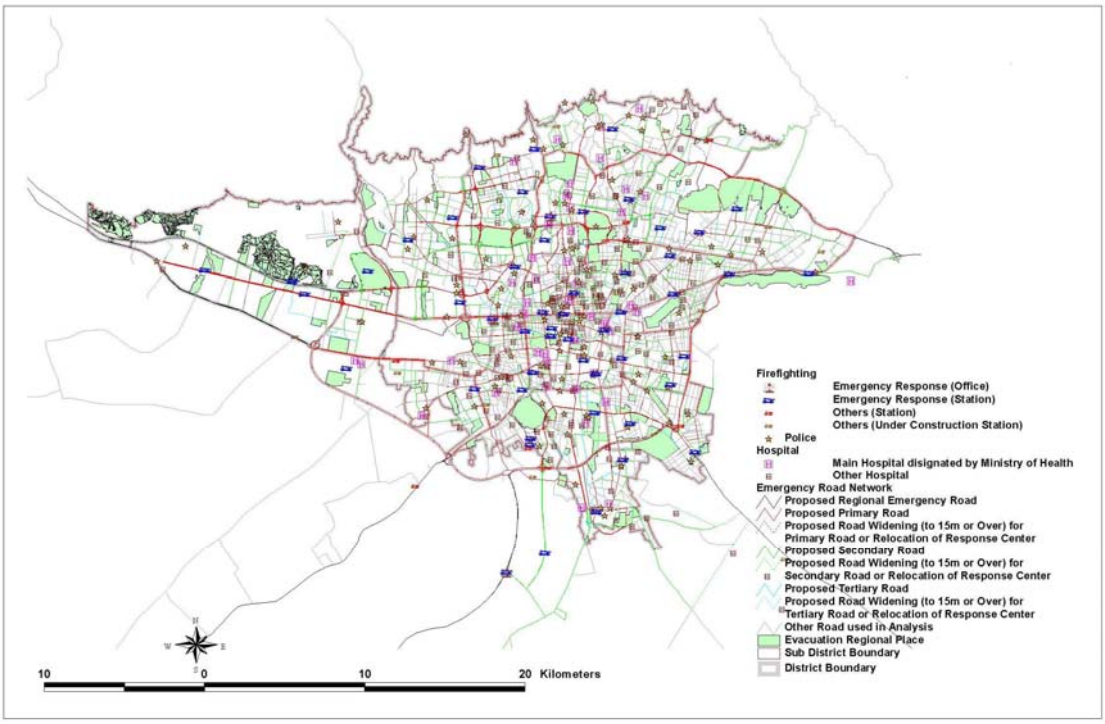
The total financial resources in 2002 accounted for 233,786 million Rials, roughly equivalent to US dollar 27.5 million[14] or 3.7 US dollar per Tehran citizen for fire and safety-related activities of the TFFSSO.

The TFFSSO currently has a network of some 55 fire extinguishing stations, 9 help and rescue stations, 1 training center, 1 headquarters and 1 central office within Tehran proper as illustrated in the following figure. Tehran City is for operational purposes sub-divided into five zones as indicated in the following figure.

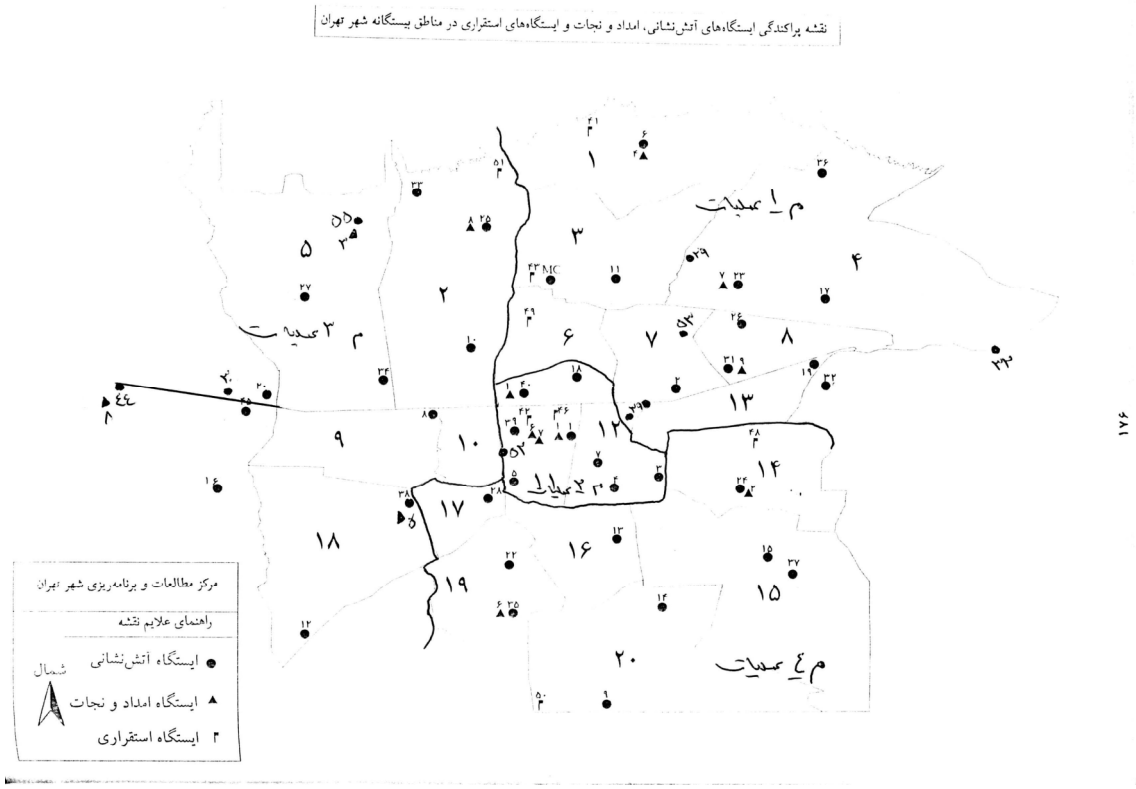
The TFFSSO currently has a limited number of heavy equipment, namely two cranes with a capacity of 25 tons each, two 10-tone cranes, one 6-ton crane, six loaders (four new and two old ones), three excavators and one flooding light.

The communication system of TFFSSO operates on three radio channels. However, coverage of the Tehran Municipality territory is insufficient, though there is one transmitter station near Karaj, which covers roughly 80% of Tehran and another transmitter is located in the northern part of Tehran. It is not clear as to whether these transmitter stations are seismic resistant and, if so, which level of earthquake they could resist before becoming non-operational.

[14]) At an exchange rate of 8,500 Rials to 1 US dollar.



Distribution of Fire Fighting Stations By District In 2004



Division of Tehran Municipality By The Fire Department

Training for the general public in fire prevention, safety and countermeasures are undertaken via public instruction units, which are under the supervision of the Deputy for Education and Research.

So far, some 200 courses were realized, 20 workshops and exhibitions and four seminars covering an audience of over one million people. The objectives of the public training are to familiarize the trainees with causes of fire, and to create awareness about the public measures that are adopted in the case of fire and/or disaster. Professional expert instructions are offered for training fire fighters and rescuers, which will participate in operations. Fire fighting exhibition are offered, in order to familiarize visitors with the equipment used to extinguish fire in its early stages.

Constraints to Emergency Response Operations

However, the TFFSSO is presently and severely constrained in responding efficiently and effectively in a disaster situation of medium or large extent, though there is not insignificant experience in search, rescue and relief from the Iraq – Iran war, when Tehran came under repeated and heavy missile attack from the Iraqi forces. The major areas of concern that need to be addressed in particular in the context of the immediate 72 hours emergency response plan now under preparation by the designated "Tehran Disaster Management Organization" are identified as discussed below.

- **Absence of legal basis and comprehensive operational frameworks**. The TFFSSO operates currently without any fire service law that would govern its activities and that would, importantly so, delegate authority to the TFFSSO to realize its overall mandate. The lack of a proper fire service fighting law is a fundamental omission actually disabling the organization's response capacity not only in normal times, but particularly in emergency situations generated by a natural and/or man-made disaster. The situation is particularly regrettable in the field involving hazardous materials. The Tehran Municipality does not have an organization at present that is specialized and mandated to cope with problems caused by such materials in an emergency situation.
- **Insufficient stations infrastructure water supply & general equipment**. The prevailing fire fighters ratio (to total population size) is too low for a city such as Tehran, and the distributional pattern among Districts as well as equipment and logistics status of the stations is insufficient to meet emergency response needs. The TFFSSO estimates that about one hundred additional stations would be needed to obtain a standard coverage ratio. Another serious difficulty already for normal fire fighting operations is the insufficient water supply infrastructure. If the existing water supply and hydrant system would be damaged in, for example, a strong earthquake, as anticipated, the TFFSSO would virtually run out of water in the shortest of times. Serious deficiencies also exist in the fields of logistics bases, small portable equipment for search and rescue operations, integration of the communications system into the emergency C^3 communication structure and air rescue.
- **Insufficient training facilities and emergency response training.** The training conducted by TFFSSO for normal fire fighting operations is, in general, at a high standard. However, the TFFSSO has only recently acquired a plot in the South of Tehran that it intends to develop into a fully fledged training facility for standard and advanced fire fighter and emergency response training. The general training and skill upgrading element, in particular, in the areas of emergency response, search, rescue, relief and response to emergencies involving hazardous materials needs immediate attention. It will be necessary in this context to quickly develop the needed hardware and software for the above-mentioned facility, including suitable curricula and training programs.
- **Communication system.** As mentioned above, the existing "$C^{3"}$ system for normal operations does not cover all of the Tehran Municipality area and it is not integrated with the emergency response communication system. There is a strong need to review the capacity of the existing system and to integrate it fully into the emergency response communication system under consideration.

3. Objectives

In line with the requirements of the PCM[15] approach, project objectives for the suggested TFFSSO institutional emergency response capacity building project are divided into two categories, namely the project's "development goal" and its immediate "Project Objectives." They are defined for the purpose of this project outline as:[16]

GOAL:

The project's development goal is a reduced casualty rate measured in terms of saved lives, thereby reducing long-term secondary and tertiary economic and social negative impacts caused by natural and man-made disasters.

OBJECTIVE:

It is expected that institutional capability & capacity building at TFFSSO will contribute to achieving the development goal by increasing TFFSSO's institutional capability and capacity in the areas of search, rescue, relief and emergency response involving hazardous materials.

4. Implementation Agency

The implementation agency should be the Tehran Fire Fighting and Safety Services Organization (TFFSSO). The TFFSSO in close cooperation with the Municipality's Department for City Services, Fire Fighting and Safety will provide the needed counterpart facilities and act as the focal point for coordination and communication with other Municipality and central Government entities.

5. Input

The project's major input components are, in principle:

- The provision of long- and short-term consulting services for TFFSSO capacity building in the areas of search, rescue, relief, emergency operations' planning; logistics, training for fire fighters and volunteers, including a minor equipment component;
- The provision of on-the-job training and scholarships for overseas training and skill upgrading courses;
- Identification of equipment needs for the emergency response system, hazardous materials' handling system and communication system, including any software for the emergency situation communication equipment, including installation, test trial, and handing over and training for the personnel (depending on further discussions and clarification either with or without a disaster information system, or phased); and
- Provision of civil works and construction supervision services (this component is likely to be a separate financial assistance project).

Major activity blocks and core activities within these blocks can be, at this point in time, identified, as comprising, but not necessarily be limited to:

Activity Block related to Direct Institutional ER Capacity Building

- Assistance in the preparation of an operational and fully integrated Search, Rescue and Relief Management & Logistics Plan for TFFSSO
- Assistance in the preparation of disaggregated search, rescue and relief management & logistics plans for Tehran district level (22 Districts)

[15]) PCM stands for "Project Cycle Management", a standard project management tool and technique applied in ODA projects.
[16]) It may be necessary to adjust and fine-tune goal(s) and direct objectives in the process of discussing the project with the authorities.

- Assistance in the preparation of an operational and fully integrated Hazardous Materials & Logistics Plan for TFFSSO
- Assistance in drafting a fire safety law and regulations
- Assistance in drafting hazardous materials' handling procedures, rules and regulations
- Preparation of training programs and modules for TFFSSO staff and volunteers, including the conduct of training seminars and workshops toward that end
- Assistance in the selection of suitable overseas skill-upgrading and development training programs for all levels of potential trainees in and outside of TFFSSO
- Preparation of techno-economic feasibility studies at bankable level, namely for the search, rescue and relief network and for the hazardous emergency response system
- Assistance in project identification and formulation for organizations and entities participating in the emergency response system
- Assistance in the establishment of an appropriate monitoring & evaluation system for the performance of the organizations/entities participating in the disaster management system
- Assistance in the design, conduct and evaluation of realistic drill exercises
- Assistance in any other matter, such as reporting, that may be required by TFFSSO and/or the Municipality and/or the City Council and/or other authorities

It is anticipated that the above activity block will, in principle, require the following expertise inputs: disaster management; emergency response management; management of hazardous materials; emergency medical systems; epidemiology; general planning; economic, financial analysis and budgeting; architecture; public administration; institution building; environmental protection; communications system; public relations; training & education; and general data base and GIS and database management.

Activity Block related to the "Search, Rescue & Relief" Stations & Logistics Bases

- Assistance in the preparation of an alternative site investigation for the station/bases facilities, including land acquisition plan, environmental impact assessment and alternative cost estimations
- Identification of equipment (minor and major) needs
- Preparation of a concept design, basic design and detailed design for the bases/stations facilities'
- Assistance in the tender preparation and tender process (if financed and constructed through international competitive bidding (ICB)
- Assistance in the tender evaluation(s)
- Construction supervision

Activity Block related to the Emergency Communication (and perhaps) Disaster Information System

- Preparation of a concept outlay design, basic outlay design and detailed outlay design for the emergency and possibly disaster information system facilities, including its complete integration into Tehran's/TDMO's emergency C^3 system
- Assistance in the tender preparation and tender process
- Assistance in the tender evaluation(s)
- Installation supervision

6. Expected Output(s)

In principal, the project's outcome may be divided into two major types of outputs, namely expertise-intensive software output and facility-related hardware output. Successful project realization will result in the following tentative outputs:

Expertise-intensive Software Output

Output 1: Fully integrated Search, Rescue & Relief Operations Plan for Tehran Municipality"

Output 2: 22 fully integrated Search, Rescue & Relief Management Operations Plan for Tehran Districts

Output 3: Bankable feasibility study for the Search, Rescue & Relief Stations and Bases Network

Output 4: Bankable feasibility study for the Hazardous Materials' Handling System and Network

Output 5: Training modules for skill upgrading and higher education in disaster management, search, rescue & relief; hazardous materials' handling and storage and related disciplines for TFFSSO in-house personnel and volunteers

Output 6: Regulatory system (including rules, procedures and so on) for the storage, handling and use of hazardous materials with particular emphasis on emergency situation response

Output 7: A fully formulated and operational monitoring and evaluation system for performance measurement of TFFSSO personnel and volunteers

Output 8: Completed design and Manual for realistic emergency drill exercises, including performance and appraisal standards

Depending on how the project components are packaged, the following output may fall under this or the hardware-oriented output elements:

Output 9: Selected sites for the search, rescue & relief stations/bases network, including land acquisition plan, environmental assessment, tender and construction schedules

Output 10: Finalized and approved Detailed Design for such stations/bases

Output 11: Detailed and approved outlay design for the fully integrated emergency communication and disaster information systems, including implementation schedule

Facility-related hardware Output

Output 12: Finalized and approved tender documents for the stations/bases (if implemented through ICB)

Output 13: Approved tender evaluation criteria and selected proponents

Output 14: Handed-over civil works

Output 15: As a result of outputs 10 to 11 above, completed EOC civil works, including related facilities

Output 16: Finalized and approved tender documents for the emergency communication and disaster information systems (if implemented through ICB)

Output 17: Approved tender evaluation criteria and selected proponents

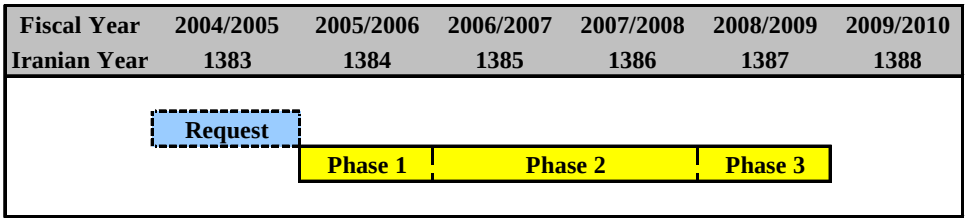
Output 18: Handed-over emergency communication and disaster information systems

Output 19: Completely installed and fully functional emergency communication and disaster information system, including related facilities

8. Tentative Implementation Schedule

It is suggested, depending on the final definition and agreement on required packaging, project inputs, activities and outputs, to divide project implementation into two suitable phases. The tentative implementation schedule is presented in the following table. The software-oriented component should be implemented over 24 calendar months and the investment-oriented component, over 84 calendar months.

Tentative Implementation Schedule for TFFSSO Capacity Building Project



Note: The Iranian Fiscal Year covers the period from 21 March to 20 March of the following year.

9. Monitoring and Evaluation

It is proposed to ensure timely and proper project progress through two monitoring missions per year, regular bi-annual progress reports and an annual joint evaluation exercise that involves TFFSSO, the Municipality of Tehran, the respective donor agency and other stakeholders.

10. Sustainability

It is essential that a proper legal base in the form of a fire safety law should be enacted. Sufficient and stable financial resources in particular for operations and maintenance expenditures are essential for medium- to long-term project sustainability. In addition, continued strong political support will constitute an essential sustainability requirement.

11. Estimated Project Cost (Tentative)

The proposed project package comprises two major elements, namely one technical assistance projects (provision of consulting services, training and minor equipment) and one financial assistance or investment project. However, both elements constitute an integral part of the whole package. It will have to be discussed and clarified in further in-depth discussions with the Municipality and TFFSSO how to package and phase the different package elements.

For the purpose of the project outline, the institutional and the hardware components are presented here as “one package.”

Total project cost (but excluding the Government Counterpart Contribution) for the hardware and consulting components are tentatively estimated to be in the range of:

US dollar 61.75 million,

excluding the air-rescue component.

If all major project components are treated as "one package," as indicated above, the cost for major individual project components is presently estimated as summarized in the following table.

Tentative Project Cost Estimate By Major Project Component

(Unit: US dollars)

Major Project Component	Tentative Project Cost (Without GCC)	Comment & Observation
Project Component I Institution ER Building	About 6.75 million	Comprisies mainly consulting services & training for plan and F/S preparation
Project Component II Stations & Equipment	About 55 million	Covers major ER network hardware facilities and equipment. Excludes land aquisition cost. Excludes air-rescue component.
Estimated Total	**About 61.75 million**	

Note: 1. GCC = Government Counterpart Contribution

2. The price-base is second quarter of 2004.

Project Profile No 15
STRENGTHENING OF EMERGENCY RESPONSE CAPACITY FOR THE GOVERNMENTAL HEALTH ORGANIZATION

1. Introduction

It is true that mass casualty from an extensive earthquake can never be managed so effectively as assumed in the routine emergency system now in place. The previous study in November 2000, which is officially known as "The study on Seismic Microzoning of the Greater Tehran Area in the Islamic Republic of Iran," reveals the potential consequences in both physical and human damages to indicate the rescue and relief operations might be put into action in unusual situations as follows:

- Massive needs for rescue and relief break out in a short time.
- Resources are totally overwhelmed and situations require time-critical assistance.
- Command and coordination arrangements may not work due to serious blow to the nervous system of governments.
- Health personnel is also seriously affected that they become less possible to mobilize.
- Logistics does not work due to damaged transportation and communication system

2. Background

Ministry of Health and Medical Education (MOH&ME) is designated as the major agency in charge of saving lives under threat in these presumed circumstances. Even as it recognizes its own weaknesses, the ministry has to meet the national demands to establish the system to people's demands welling up from citizens in Tehran, to strengthen its resources to respond in terms of physical and human capacities. Some important strategies to fulfill the overall objective will be to:

- Mobilize and utilize any available resources regardless of locations, ownership and source; and
- Make an organized response by establishing a treatment tiered system across the country.

Progress of Preparedness Plan

MOH&ME and three medical universities in Tehran have recognized the importance of establishing a disaster management system, especially against the potential earthquake, and have already started the preparedness activities. In this sense, the project has been already commenced. However, the study brings out the fact that most agencies in charge have either not yet prepared or are just starting to prepare a system, with the exception of Red Crescent Society.

Progress in MOH&ME

MOH carried out the extensive research project on disaster management in 'Committee of Health, Treatment & Natural Disasters Effect Mitigation' in 1999, resulting in producing 16 projects. MOH had compiled 29 guidelines based on those 16 projects and published and disseminated 1,000 copies of them all over the country.

Disaster preparedness activities in MOH&ME are observed to be limited in specific department, since some strongly motivated leaders only have been leading the activities, trying to organize the response system within their organization and territory. Another reason is that planning itself does not base on any concrete quantitative estimation of specific disasters, and then any plans remain very general.

3. Objectives

General

To strengthen the capacity and capability of MOH&ME in order to reduce mortality and morbidity in E3 to E4 level situations in the aftermath of earthquake

Specific

- To formulate and operate an inter-organizational earthquake disaster management system in Tehran in order to enable MOH&ME to take swift and effective response actions at any level
- To empower the capacities of health facilities and health personnel for life-saving and disease prevention at major hospitals and community health centers

4. Implementation Agencies

Ministry of Health and Medical Education (MOH&ME)

5. Input

At planning phase

- Formulation of a task force team in the ministry to supervise the progress of planning, to review and approve the draft plans and manuals
- Organization of the secretariat for the task force team
- Employment of two consultants specialized in disaster medical and health services for first two years
- Invitation of experts from various field related to the sector including NGOs and representatives from Tehran and District municipality
- Establishment of Health Emergency Management Unit with full-time staff in the ministry
- Budget allocation for daily expenses of the task force team activities

At implementation phase

- Continuation of the task force team in the ministry to supervise and monitor the progress of project implementation, to approve the intermediate outcomes of the project
- Budget allocation for daily expenses of the task force team activities

6. Expected Outcome(s)

Possible increase of the savable lives and reduction of the avoidable disables is expected through realizing following outcomes from the implementation of the project components.

- Outcome from Component-01: Earthquake disaster response/operation plan at central, medical university, hospital and health center of MOH's various levels
- Outcome from Component-02: Establishment of HEMU with an Emergency Operation Center
- Outcome from Component-03: Improved hospital facilities for ICU, ER, housing capacity, stockpile of utilities and medical necessities for three days operation
- Outcome from Component-04: Stockpile of equipment for field hospitals, blood and derivatives
- Outcome from Component-05: Trained staff to execute MCM system and organized communities to cooperate in Environmental Health activities.

7. Rationale/Justification

General

Health sector is required, during the disaster period, to make a long time and broad-range response, from triage on the scene, evacuation, hospital treatment, nationwide transfer, sanitary activities, and disease prevention up to mental health care. In Tehran, medical resources are relatively rich while formulation of health/medical response system and capacity building fall far behind. Hence, in terms of effective life saving and epidemic prevention, it is highly reasonable to strengthen the emergency response capacity in Tehran health sector in priority.

Critical Impact of Hospital Malfunctioning

Hospitals in aftermath: In Tehran province, there exist 137 public and private hospitals with 27,000 beds in total. Damage estimation indicates almost 50% of whole hospital buildings may be damaged severely, and this also suggests that another 20% to 30% will not keep functioning due to damages to non-structural elements of facilities. On the assumption that 20% of hospitals may keep operational right after the earthquake impact, there remain only 27 hospitals with a maximum of 5,400 beds for 410,000 severely injured victims. Therefore, it is concluded that only a little of hospitals' capacity will be actually left for survivors.

Weakness in Health Organization

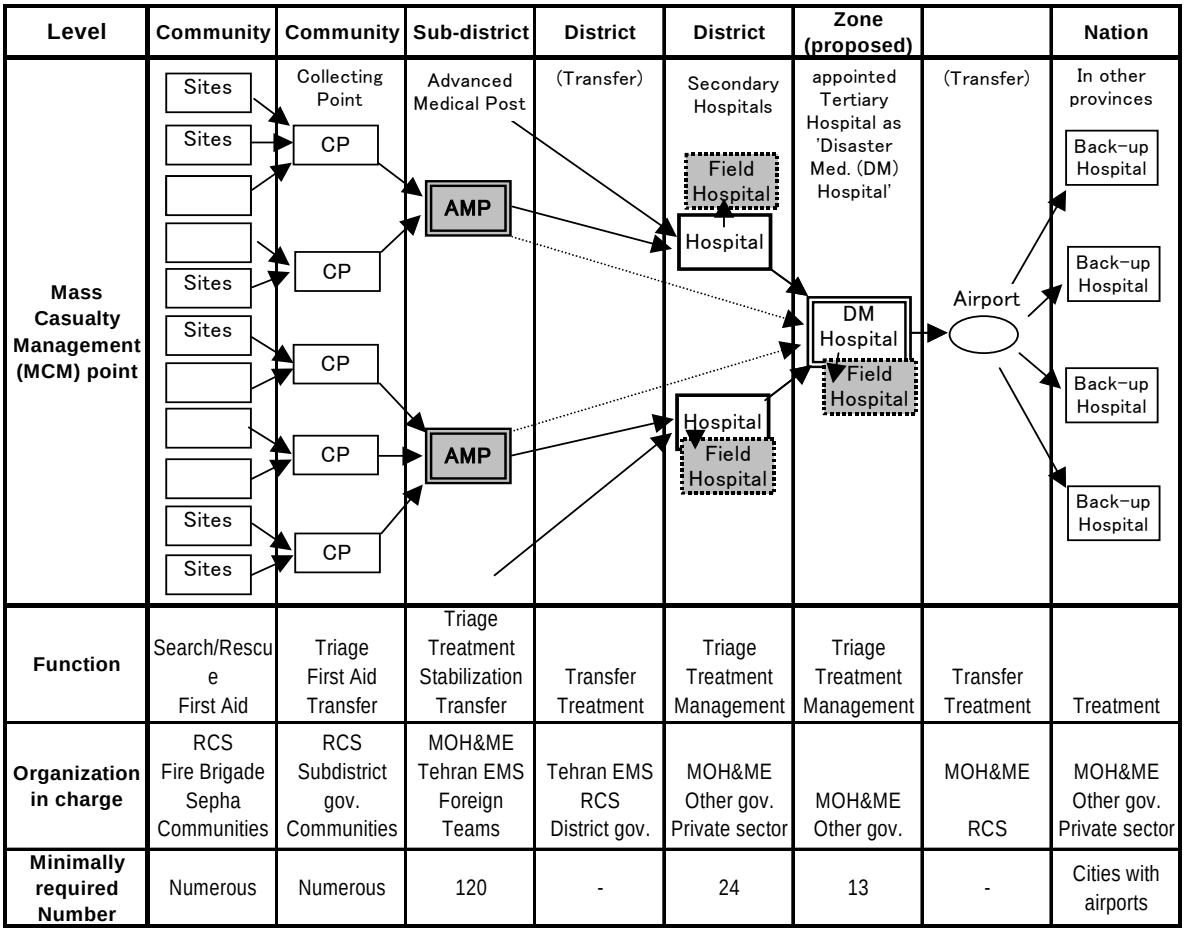
In terms of disaster management, MOH&ME is structured in a very fragmented manner and system. Following are some observations to back up this view.

- Disaster preparedness planning and policies is a responsibility of Center of Environmental and Occupational Health, not of an exclusive unit established for this task in the central MOH office.
- Even in central MOH office, budget allocation for this task has been crucially minimal as well as staff allocation.
- No database of health resources is established.
- Other than TCEMP's specialized committee plan, no health disaster plan is prepared. It is very difficult to assess the health sector's capacity and capability against potential earthquake without plans and resources lists.

Proposed Concept of Health Response Plan

Casualties will be managed through the standardized Mass Casualty Management (MCM) System, from rescue scenes to hospitals through Advanced Medical Posts (AMP). The following figure illustrates a model of MCM system in Tehran in the earthquake disaster. MCM system comes into effect with several essential components: Collecting Points (CP), AMPs, minimally one Hospital within a District's boundary and transportation measures between AMPs and Hospitals. Major components are proposed in the plan as follows:

Fundamental Flow of the Injured in Proposed Mass Casualty Management system



AMP: AMPs are the key facilities in proper operation of MCM system. Considering the estimated magnitude of damages, one sub-district may need one to three AMPs at minimum to deal with the casualties effectively. AMPs will be set up on the secured places like the appointed evacuation space to be kept in place for two weeks to one month. AMP will play a role of checkpoint before sending the injured to hospitals thus controlling the flow.

Hospital: One hospital with ER and operation center, at the least, is indispensable to operate MCM system within a district, and one proposed zone for earthquake emergency services should facilitate a minimum of two Disaster Medical (DM) hospitals. These important hospitals should prepare to enlarge its capacity with the pre-arranged stockpile of equipment such as tents, waterproof sheets, beds, ER equipment and electric generators. Field hospital is defined as the part of the mother hospital expansion, which is not set up independently but rather utilizes the common services functions of the existing or mother hospital.

Environmental Health and Epidemic Prevention: Apart from the medical treatment for the injured, health area covers the following various and broader sub-areas in addition to Health Center's routine services. These are shown in the following table. Health Centers will provide the indispensable bases for the health & relief teams to deploy in the communities.

Activities in Health Area

Area	Response Activities	Base for operation
Environmental Health	Supervision of evacuation camp and shelter conditions Supervision of Drinking Water safety, Food safety Rodents & Vector Control Disinfections of dwellings, toilets, garbage spots, water ditches, burial sites, etc. Education and Instruction to the public	Health & Relief Team based on the Health Center
Disease Prevention	Surveillance, Diagnosis, treatment and Laboratory test Isolation of patients if necessary Control of disease sources Supporting vulnerable groups, Vaccination, Nutrition	Surveillance system, Health & Relief Team based on the Health Center
Expanded daily services	Maternal and child health Oral health and Dental clinic Counseling and Mental health Logistics	Expanded teams for specific services based on the Health Centers

Source: Structural Health and Medical Management during Disaster in Large Cities, especially Tehran: compiled by Dr. Sadeghipoor and others

8. Tentative Schedule

- Project period: Seven years in total
- Project timing: First two years is allocated for planning including facilities development.

Schedule of the Component Projects

Project Components	1st. Year	2nd. Year	3rd. Year	4th. Year	5th. Year	6th. Year	7th. Year
Formulation of Health disaster management plan in Tehran							
Strengthening of Overall Response Capacity							
Improvement of Hospital Emergency Response Capacity							
Strengthening of Logistics							
Education and Training Program							

Implementation of the project will start from the second year and urgent action plans will be realized in the earlier stage.

9. Monitoring and Evaluation

Monitoring

The appointed task force team will carry out the regular monitoring at the end of every year. TDMMC and Red Crescent Society will join the monitoring meeting in order to make their opinions reflect on the project.

Evaluation

The task force team, together with representatives from National Government, Tehran Municipality, Tehran Province and other related organizations, will have the joint evaluation meetings at the start, middle and the end of the period of every component project.

However, as for the component 3 (Health-03) and 5 (Health-05), evaluation will be carried out every two years since it is scheduled for six and five years to complete, respectively.

10. Sustainability

MOH&ME strongly commits to endorse the full execution of the project, and careful design of the project to avoid the excessive investment is a must to sustain the effect of the project. Following are some instances of design considered as excessive investments:

- Expanding the large emergency wards in the District or Disaster Medical (DM) hospitals or purchasing vehicles or equipment that may not be utilized in normal time. To maintain the facilities with low utilization will become heavy financial burden to the ministry and will undermine the sustainability of the project.
- Designing the field hospitals to expand the inpatient capacity and stockpiling equipment for it. To set up temporary field hospitals that function independently from the existing ones is clearly denied by international health organizations such as PAHO.
- Stockpiling too much drugs and medical consumables. International assistance will bring a great amount of goods and materials that recipient country can hardly manage.

12.Estimated Project Cost (Tentative)

No.	Component Title	Cost (in thousand US$)
1	Formulation of Health Disaster Management Plan in Tehran	1,500
2	Strengthening overall Capacity of MOH&ME for Disaster Response	420
3	Improvement of Hospital Capacity for Disaster Medical Services	14,040
4	Strengthening of Logistics Capacity	650
5	Expansion of Education and Training Program for Health Personnel	700
Total		17,3100