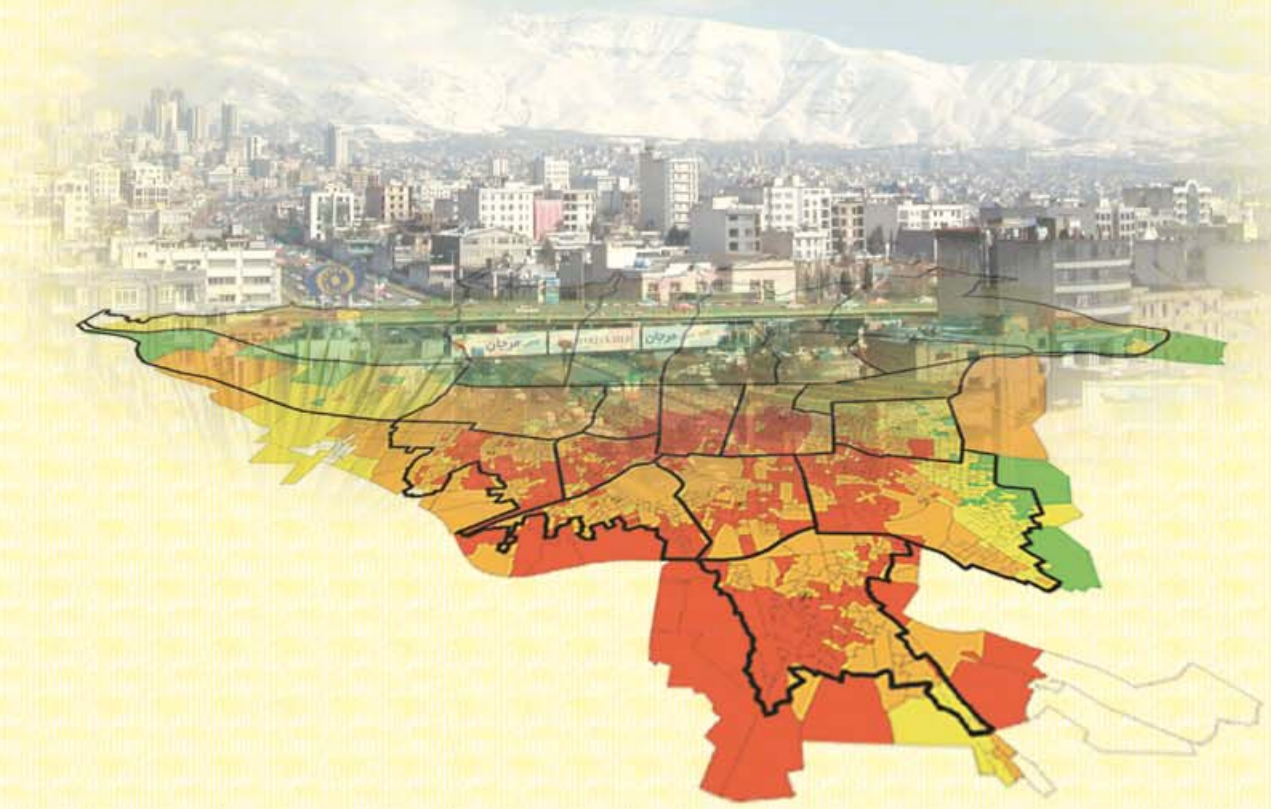
Japan International Cooperation Agency (JICA)
Tehran Disaster Mitigation and Management Center (TDMMC)

No.

THE COMPREHENSIVE MASTER PLAN STUDY ON URBAN SEISMIC DISASTER PREVENTION AND MANAGEMENT FOR THE GREATER TEHRAN AREA IN THE ISLAMIC REPUBLIC OF IRAN

FINAL REPORT
- SUMMARY -



December 2004

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The exchange rate applied in the Study is:

US $ 1.00 = Rls.8,500

(April, 2004)

PREFACE

In response to the request from the Government of the Islamic Republic of Iran, the Government of Japan decided to conduct a Comprehensive Master Plan Study on Urban Seismic Disaster Prevention and Management for the Greater Tehran Area in the Islamic Republic of Iran and entrusted the Study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched the Study Team headed by Mr. Itaru Mae of Pacific Consultants International, consisted of Pacific Consultants International and OYO International Corporation, to the Islamic Republic of Iran from August 2002 to August 2004. JICA set up an Advisory Committee chaired by Dr. Kimiro Meguro from the University of Tokyo, which examined the study from the specialist and technical points of view.

The Study Team held discussions with the officials concerned of the Government of the Islamic Republic of Iran and conducted the Study in collaboration with the Iranian counterparts. Upon the last return to Japan, the Study Team finalized the study results for delivery of this Final Report.

I hope that this report will contribute to the promotion of relevant projects for urban seismic disaster prevention and management and to the enhancement of friendly relationship between the two countries.

Finally, I wish to express my sincere appreciation to all the officials concerned of the Government of the Islamic Republic of Iran for their close cooperation extended to the Study.

December 2004

Estuo KITAHARA
Vice President
Japan International Cooperation Agency

Mr. Estuo KITAHARA
Vice President
Japan International Cooperation Agency
Tokyo, Japan

December 2004

Letter of Transmittal

Dear Mr. KITAHARA,

We are pleased to formally submit herewith the final report entitled "The Comprehensive Master Plan Study on Urban Seismic Disaster Prevention and Management for the Greater Tehran Area in the Islamic Republic of Iran".

This report compiles the results of the study which was undertaken in the Islamic Republic of Iran from August 2002 to August 2004 by the Study Team organized jointly by Pacific Consultants International and OYO International Corporation under the contract with the JICA

The Final Report is composed of the "Executive Summary", "Main Report", and "Sector Report". In the Main Report, mitigation countermeasures for pre-earthquake, emergency response just after earthquake, and post-earthquake rehabilitation and reconstruction are prepared in the form of comprehensive master plan on urban seismic disaster prevention and mitigation, including the project profiles for urgent action projects. In addition, the Sector Report compiles overall procedures of the master plan formulation in each sector. It is truly hoped that the outcomes of the Final Report will contribute to reducing the risks of earthquake occurrence in the Islamic Republic of Iran.

Finally, we would like to express our sincere gratitude and appreciation to all the officials of your agency, the JICA advisory Committee, the Embassy of Japan in the Islamic Republic of Iran, and Ministry of Foreign Affairs. We also would like to send our great appreciation to all those who have extended their kind assistance and cooperation to the Study Team, in particular, relevant officials of Tehran Disaster Mitigation and Management Center (TDMMC), the Iranian counterpart agency.

Very truly yours,

Itaru Mae
Team Leader, JICA Study Team
The Comprehensive Master Plan Study on
Urban Seismic Disaster Prevention and Management for the
Greater Tehran Area in the Islamic Republic of Iran

Executive Summary

THE COMPREHENSIVE MASTER PLAN STUDY ON URBAN SEISMIC DISASTER PREVENTION AND MANAGEMENT FOR THE GREATER TEHRAN AREA

EXECUTIVE SUMMARY

General

Subsequent to the previous study on the Seismic Microzoning of the Greater Tehran Area conducted by Japan International Cooperation Agency (hereinafter referred to as "JICA") in 1999-2000, this study for the Comprehensive Master Plan Study on Urban Seismic Disaster Prevention and Management for the Greater Tehran Area (hereinafter referred to as "the Study") was initiated again by JICA as agreed upon between the Centre for Earthquake and Environment Studies of Tehran (hereinafter referred to as "CEST") and JICA on 16 April 2002. In February 2003, the Mayor's Decree of Tehran was issued, declaring the establishment of "Tehran Disaster Mitigation and Management Center (hereinafter referred to as "TDMMC"), in which two disaster-related organizations of Tehran, CEST and Tehran Comprehensive Emergency Management Plan Secretariat (hereinafter referred to as "CEMS") were merged. According to the establishment of TDMMC, the authorities as a counterpart agency to the JICA Study Team were transferred from CEST to TDMMC.

The Study commenced in August 2002 and will complete in July 2004, taking the study period of 2 years. The conduct of the Study proceeds in 3 phases to achieve the following sequential study objectives.

Phase 1 (August 2002-March 2003)
Comprehensive Diagnosis of Disaster Prevention and Management Situation in Tehran

Phase 2 (April 2003-October 2003)
Preparation of the Master Plan for Urban Seismic Disaster Prevention and Management in Tehran

Phase 3 (November 2003-July 2004)
Preparation of an Action Plan for the Implementation of Urgent Priority Projects and Programs

1. Introduction

Laws and Regulations
In response to requirements of the Iranian Constitution, which stipulates the Government's responsibility for providing assistance to Iran's population in coping with disaster related effects, the Government of Iran has adopted over the past decade or so policies and implemented measures that are intended to establish an adequate and suitable country-wide disaster management system. The system is to address the whole range of natural and man-made disasters with special emphasize on earthquake induced catastrophes, and it is to comprise disaster mitigation, preparedness, emergency response and reconstruction and rehabilitation plans.

At Tehran Municipality level, the "Tehran Disaster Mitigation and Management Center – TDMMC", which was formed in 2003 as a merger of two earlier disaster management related entities, forms the core institution for overall disaster management within Tehran. At present, TDMMC falls under the direct control and guidance of Tehran's Mayor. The mandate of the Center, though still under further review and discussion, covers all relevant natural disasters and the disaster management areas of mitigation, preparedness, emergency response and reconstruction and rehabilitation.

Implementation of the Tehran-specific disaster management system is tailored around the "Tehran Comprehensive Emergency Management Plan". The plan is an emergency response plan that organizes 24 central, local government and NGO organizations under the umbrella of 22 committees with three core functions. The core functions are: relief and rescue management, settlement management, and logistics management.

The early establishment of an independently fully functional "Emergency Communication System" and an "Emergency Operations Center" at TDMMC is needed. Particular emphasize has to be placed at the hardware and software integration of both components, if possible, in combination with a fully functional "Disaster Management Information System" that incorporates all relevant national and Tehran level disaster response and management entities

Full integration of community based disaster response capabilities into the existing emergency response system is also one of the core issues that Tehran has to cope with.

Basic Policy of the Study

Goal

The lives and properties of the citizens of Tehran are being made safer from a potentially devastating earthquake by formulation and implementation of a comprehensive disaster management plan. The goal of the master plan is to establish a safe and secure urban environment against a potential earthquake.

Planning Period

The implementation plan should be divided into three phases:

Short term	2004-2006
Medium term	2007-2010
Long term	2011-2015

The master plan will cover the years 2004 to 2015, or a total of 12 years.

Objectives

In order to achieve the goal, the Master Plan sets three objectives to accomplish by the year 2015. The objectives are:

- to secure lives and properties of the citizens of Tehran;
- to protect citizen's life after the event; and
- to prepare rehabilitation and reconstruction.

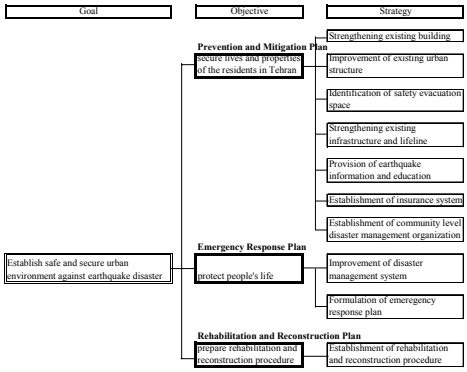
Strategies

To achieve the objectives, ten strategies are selected as follows:

- Strengthening existing buildings
- 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 and reconstruction procedure

Framework of the Master Plan

The framework of the master plan study can be organized as shown below.



The three objectives are in correspondence with three plans: prevention and mitigation plan, emergency response plan and rehabilitation and reconstruction plan. The ten strategies are classified dependent on earthquake countermeasures.

2. Conditions for the Master Plan

Objective Earthquake

Three types of scenario earthquakes, namely Ray Fault Model, North Tehran Fault (NTF) Model, and Mosha Fault Model were adopted for seismic microzoning analyses. Among the three scenario earthquakes, Ray Fault Model is estimated to cause the most serious damage in Tehran Municipality. Therefore, Ray Fault Model is the objective earthquake in the master plan study.

	Ray Fault	NTF	Mosha
Length (km)	26	58	68
Magnitude (Mw)	6.7	7.2	7.2
Peak Ground Acceleration (gal)	North<200 South>400	North>400 South<200	<200
Intensity (MMI)	North: 8 South: 9	North: 9 South: 7-8	7

As a result of the damage estimation, damages to residential buildings and human casualties are summarized below.

	Ray	NTF	Mosha
Bldg Damage	483,000	313,000	113,000
Damage Ratio	55%	36%	13%
No. of Deaths	383,000	126,000	20,000
Death Ratio	6%	2%	0.3%

Note: The number of existing buildings and population were assumed at 876,000 and 6,360,000, respectively.

Economic Damage Analysis

The effects of an earthquake event can be broken down into three: the economic cost, the human cost including loss of life and personal injuries and the ecological cost

among other damage to ecosystem. The economic loss caused by the earthquake can be categorized into three items: direct loss, indirect loss and secondary effects of the earthquake.

Direct Loss

In order to estimate direct loss, previous study results are used. As for the building damage, the replacement costs of each building type are estimated based on the existing building construction practice. The total direct damage by the heavily collapsed buildings is Rial 191,977 billion, or US$ 22.6 billion. The total direct damage by the bridges and lifelines is Rial 238 billion, or US$ 28.0 million, and Rial 70.7 billion, or US$ 8.3 million, respectively.

Indirect Costs and Secondary Effects of Earthquake Damage

Those costs are estimated using available statistical data and the experience of other countries. The indirect damage is estimated at US$ 9.2 billion. Secondary effects of the earthquake damage are estimated at 1.0 percent to 1.2 percent of total GNP, or approximately US$ 1.2 billion.

Total Damage

Total economic impact of earthquake of Ray fault model is summarized as follows:

Direct loss	US$ 22.6 billion
Indirect loss	US$ 9.2 billion
Secondary loss	US$ 1.2 billion
Total Loss	US$ 33.0 billion

Total damage of the earthquake is 56 percent of the GNP.

Emergency Response Costs

Emergency response costs include emergency response costs to Tehran residents, removal of debris and temporary shelter provisions. The total costs are estimated at US$ 2.9 billion.

Rehabilitation and Reconstruction Costs

The rehabilitation and reconstruction costs are estimated to cover 31,000 ha, or 44 percent of the Tehran Municipality. In financial terms, it is about US$ 195 billion, or 3.4 times of the GNP.

Economic Analysis of Earthquake Damage Estimation

Target of damage reduction level is one-tenth of Ray Fault Model's estimated building damage, as indicated in Chapter 1 of this report. In order to achieve this goal, the government and private sector should spend money on earthquake damage mitigation measures. When the damage amount is reduced, emergency response and rehabilitation and reconstruction costs are reduced as well. The following table shows the preliminary analysis results.

		Case 1 (Do Nothing case)	Case 2 (30 percent decrease of damage)	Case 3 (90 percent decrease of damage)
Earthquake Damage	Building Damage	483,000	330,792	51,058
	Human Casualty	383,000	265,572	57,071
	Homeless Victims	3,126,000	2,167,563	465,809
	Debris (1,000 ton)	124,000	85,981	18,477
Costs (US$)	Building Damage	23.5 billion	16.5 billion	3.5 billion
	Building Strengthening	-	14.5 billion	63.0 billion
	Emergency Response	2.9 billion	2.1 billion	0.4 billion
	Rehabilitation and Reconstruction	195.3 billion	130.9 billion	19.5 billion
	Total	221.7 billion	164.0 billion	86.4 billion
Remarks		The damage of earthquake is derived from estimation results in Ray Fault Model.	This case is decrease of damage about 30 percent. This alternative is target reduction level within the period of master plan.	The ultimate case for the damage reduction. It will be 90 percent of damage reduction level. In this case, the damage level can be handled in emergency response.

Note:

In case 1 earthquake damage is derived from "The Study on Seismic Microzoning of the Greater Tehran Area in the Islamic Republic of Iran, November 2000."

Building Damage Cost is calculated based on the replacement costs of the building.

Building Strengthening Cost is calculated by the building analysis results, using GIs value to determine reconstruction and retrofitting. The unit cost of strengthening building is determined based on the actual conditions and applied to the number of the objective buildings.

Emergency response cost is calculated at US$ 57 per victim per month and it will continue for six months.

Rehabilitation and reconstruction costs are estimated at US$ 6.3 million per hectare based on area development calculation in Appendix 4-3.

SECURE LIVES AND PROPERTIES OF THE CITIZENS OF TEHRAN (DISASTER PREVENTION AND MITIGATION PLAN)

3. Strengthening Existing Buildings

Building Investigation

In order to gauge the seismic resistance of buildings in Tehran, building investigation was conducted on a sub-contracted basis. The sample buildings for investigation were selected as follows, and pertinent design drawings were collected upon obtaining permission for investigation.

Building Type		Sample Nos.
Public Facility	Major public facilities	70
	Hospitals	80
	Schools	100
	Other public facilities	10
Residential buildings	South	10
	Central	40
	North	40
Total		350

Notes: Major public facilities include municipality, fire brigades and police offices. Other public facilities include libraries, museums and theaters.

Method of Analysis

The diagnostic method adopted for analyzing seismic resistance was the "Code of Comprehensive Diagnosis and Renovation of Government Buildings" enacted in Japan in 1996, which is expressed by the Seismic Index of Structure "*Is*" obtained from the following equation.

$$Is = Qu / (\alpha \cdot Qun)$$

Where, *Is* : Seismic Index of Structure
Qu : Seismic force level for ultimate capacity check
Qun : Required seismic force level for ultimate capacity check
α : Correction coefficient

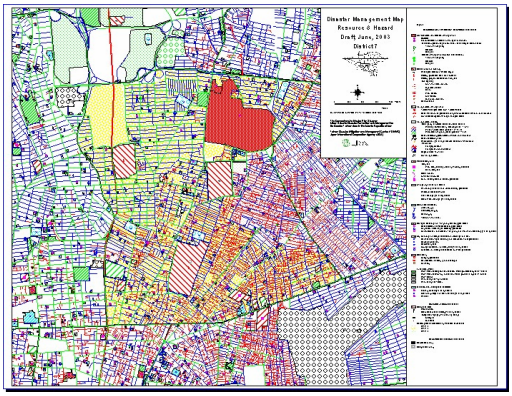
Results

By using *Is*, it was estimated that 50% of existing buildings in Tehran would take heavily damage by the target earthquake. It was also revealed that Masonry structure, which is a dominant structure type in Tehran, is particularly weak.

4. Improvement of Existing Urban Structure

Disaster Management Map and District Diagnosis Sheet

In order to assess the availability situation of existing disaster preventive resources, a Disaster Management Map was prepared by district based on the collected data from district level. District disaster diagnosis sheet is prepared to show the resources and vulnerability level of each district.



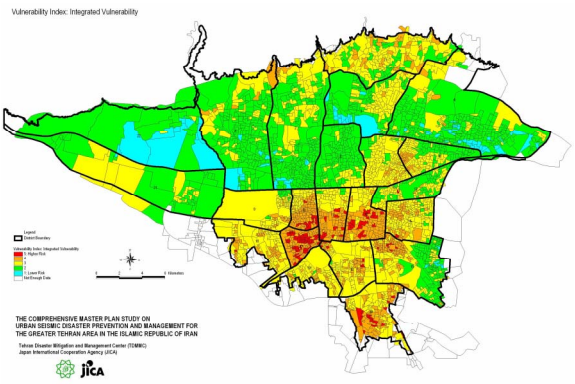
District-wise Diagnosis for Earthquake Vulnerability

In order to evaluate the vulnerability for earthquakes district-wise, three indices, which are Building Damage Index, Evacuation Index, and Secondary Damage Index, are used for the evaluation.

- Building Damage Index:
  Possible highest rates of collapsed buildings to the total buildings resulted from the previous study under the three scenario earthquakes.
- Evacuation Index:
  The evacuation includes open space area, narrow road ratio, number of evacuees and number of disaster weak.
- Secondary Damage Index:
  The variables include hazardous facility, gas pipeline damage and electric power cable damage.

Results of Diagnosis

Integrated vulnerability is assessed on the sum of the estimated three vulnerability indices of building collapse, people's evacuation and secondary disaster. The results of the analysis are shown in the next figure.



Regional Characteristics of Urban Vulnerability

It would be appropriate to evaluate the relative vulnerability of Tehran Municipality in an integrated manner as a whole, yet it is insufficient to indicate the specific problems. To understand specific vulnerability,

the Study Team reorganized each vulnerability index into eight categories as shown below.

Evaluation Index	Characteristics of Disaster Management
AAA	Relatively less vulnerable urban structure
AAB	High risk on secondary disaster
ABA	High risk on evacuation possibility
BAA	High risk on building collapse
ABB	High risk on evacuation possibility and secondary disaster
BAB	High risk on building collapse and secondary disaster
BBA	High risk on building and evacuation possibility
BBB	High risk on all variables

The results of analysis show that districts 10 and 17 are the most vulnerable districts.

In order to mitigate existing urban structure in Tehran, the following mitigation measures could be applied based on the analysis above.

1. Urban redevelopment
2. Road and urban infrastructure improvement
3. Area-based building reconstruction and retrofitting
4. Individual building retrofitting and reconstruction

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-resistant design codes and inspection system to secure design-compliant building acts

5. Identification of Safety Evacuation Space

The evacuation system mentioned in the Study is proposed as follows:

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 lives of evacuating persons from dangers such as spreading of fire or others that arise at the time of a large-scale earthquake.

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. The place shall be such as urban parks, sports field, school, religious facility, etc. in which the safety of assembled persons can be secured.

Evacuation Route

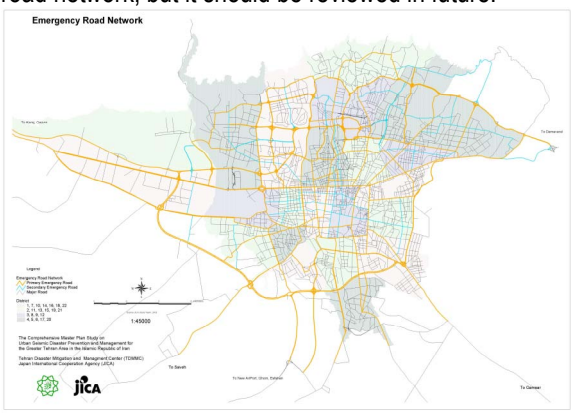
In this Study, regional evacuation place is identified from public space such as parks and open space. The Study Team identified 136 candidates. Primary evacuation place will be identified by each district.

Emergency road network has been identified in this Study. Emergency road system is proposed as follows:

Primary Emergency Road, linking with Disaster Management Centers of national, provincial, municipality, district, and sub-district municipalities and major airport and seaport as for transportation nodes. In order to set-up the network, all of centers have to be clearly identified and categorized on the base map.

Secondary Emergency Road, linking with all the identified emergency response centers of rescue/fire fighting/security, emergency road, and medical care. Also, all emergency response centers have to be clearly identified and categorized on the base map.

The following figure shows the proposed emergency road network, but it should be reviewed in future.



6. Strengthening Existing Infrastructure and Lifeline

Bridges

The previous Microzoning study estimated six bridges as "Collapsed" and five bridges as "Unstable." Compared with building damage in Tehran, bridge damage is relatively low. Most of those bridges are not reinforced or rebuilt so far. In order to reinforce the existing bridges, a detailed investigation of those bridges is required before any work is carried out. There are several methodologies for reinforcement work.

Water

The previous microzoning study showed the pipeline damage points. The damage analysis on other water supply facility has not been done. It is required to assess the vulnerability of the water supply facility and improve it according to the analysis results.

Gas

The previous microzoning study showed the damage analysis on gas pipeline but not on other related facilities. Based on the previous study results, Gas company has carried out further vulnerability study on gas facility.

Electricity

Damage analysis on electrical power cable damage was done by the previous microzoning study. The other facilities should have been evaluated based on the assessment results.

7. Provision of Earthquake Information and Education

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

Education for government staff

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

Disaster -related Organization

- 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
- The past disasters and issues for emergency responses, etc.

Education for School Students

Tehran Municipality and district offices will provide education with the following in mind:

- 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 educational materials such as supplementary readers and audio-visual aids in accordance with students' development levels
- To instruct "importance of life," "family ties," "mutual cooperation", etc. through implementation of learning by experience of nature life, welfare and voluntary activities, etc.

Education for the General Public

As knowledge of daily preparation for earthquake and what to do in case of earthquake, the following items will be enlightened:

- 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

Social Education

Knowledge of earthquake will be disseminated and enlightened through various seminars and trainings with some target groups (NGOs and CBOs) such as women's groups, environmental groups, youth association and PTA, etc., so that local residents can have consciousness as members of society and increase awareness of their contribution to local disaster preparedness.

8. Establishment of Disaster Mitigation Policy

Insurance

It is the primary responsibility of the Government to promote and motivate insurance coverage for natural

disasters, including earthquakes. The fact that the Government doesn't even insure its own assets, including cultural assets of the country, sends the wrong signal to society.

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

There are many examples of countries, such as Japan, the United States, New Zealand, France, Spain, Caribbean and Latin American countries that have in place one or the other form of disaster insurance scheme.

Governmental Assistance Policies

Three political measures to assist in promoting private building strengthening are possibly considered; low-rate loan, subsidy and insurance. Each of those policy or options by mixture can be applied case by case.

- Low-Rate Loan
  Low-rate loan scheme with an annual interest rate of 8% and 10 years of payback period is applied to the cost for building strengthening, considering an annual open market rate of 15% in Tehran.
- Subsidy
  Subsidy will be applied to the cost of building diagnosis and a part of building strengthening cost.
- 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.

Considering building characteristics of steel or RC frame and masonry, it is recommended to apply different policy settings to steel or RC frame building owners and masonry building owners, for both strengthening and reconstruction cases. The total amount of yearly required cost is estimated as approximately US$ 122.8 million, including the cost for seismic diagnosis covered by subsidy.

Management of Revenue

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.

9. Establishment of Community Level Disaster Management Organization

Community-Based Activities for Disaster Preparedness

In order to protect life and property of the local people from earthquake damages, it is important for all disaster-related organizations at national to community levels to take measures as best as they could. At the same time, individual local resident has to get a concept of self-protection, have enough knowledge of earthquake, accumulate training, learn countermeasures of disaster by experience and implement these activities at home, in the community and workplaces, etc. Furthermore, these measures for disaster preparedness can be effective if the local community cooperate, collaborate with existing community organizations such as youth association and women's groups and establish 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.

Roles of Workplace

The role and contents to be implemented by industries and workplaces for local disaster management activities are described here. The persons who manage or operate the workplaces and facilities will protect and keep safe the employers and users and implement appropriate activities for disaster preparedness in order to prevent the area from expanding the disaster. Additionally, the workplaces will make efforts to 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 make groups of self-disaster-preparedness, contact with other groups of self-disaster-management in the related area and try to secure the safety of the workplaces and the related area actively.

Support and Guidance from Tehran Municipality

Tehran Municipality and district offices will promote involvement of the existing CBOs and NGOs and establishment of groups for self-disaster-management in Tehran and support for the vitalization of their activities. Areas to be considered with attention are areas (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.

Community Level Organization
As to administrative level, there exists sub-district under district. Since mahale is not an administrative division, there is no formal links 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.

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

These places can be a center for disseminating information and collecting people for training and seminars provided by district offices. And the people in these places will be able to respond to emergency as 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 to cover all area of Tehran.

PROTECT CITIZEN'S LIFE AFTER THE EVENT (EMERGENCY RESPONSE PLAN)

10. Improvement of Emergency Response System

Emergency Response Scenario
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 are assumed.

Legal Background of Emergency Response
According to 29th Act of the Constitution, the Iranian governments regulate themselves to provide social security services for health and treatment services and medical care, etc. The governments should prepare emergency response plan and procedure to cope with the situations. At the national level, the Red Crescent Society of Iran has a responsibility for rescue and relief activities.
Upon the request from the Mayor of Tehran, the National Committee for Natural Disaster Reduction asked the relevant organizations to formulate a disaster management plan at Tehran Municipality level. Tehran Comprehensive Disaster Management Plan was formulated by the Tehran Municipality. Therefore, the Study covers whole disaster management fields and this section deals with emergency response based on the existing disaster management efforts.

Organization and Management System
Organization
The Tehran Comprehensive Disaster Management Plan proposed the establishment of an emergency response organization based on Incident Command System (ICS), which is a model for command, planning and coordination after emergency.

Commanding system
The comprehensive disaster management plan proposed to have an ICS together with Standard Emergency Management System (SEMS). Standard Operation Plan is established in Tehran Municipality.

Organization for Initial Action
According to the existing laws and regulations, the organization for the emergency response is shown as follows:

11. Formulation of Emergency Response Plan

Information and Communication System
If the disaster and rescue network will be newly installed, all desirable functions will be equipped in this occasion.

Necessary Information in Disaster and Rescue Network
The necessary information is divided into two categories, one is for victims and public and the other is for rescue and relief operations.
The information is summarized in three.
- Information of next earthquake and fire as after shock
- Safety information of family, friends and relatives
- Detail earthquake information such as hypocenter and seismic intensity

While, the following information should be required for rescue and relief operations.
- Information of number of victims to be nursed in each area

- Road blockade information
- Notification of designated evacuation route and place
- Information of commodity supply such as water and food

Configuration of Disaster and Rescue Network

The backbone of the network is newly established with microwave system connected between TDMMC and 22 district buildings. TDMMC is a hub station, and all the necessary information are collected and analyzed, and sub-disaster management center is also provided for security reason.

The core network is very stable and has large capacities, so it is recommended to use the core network in routine works during office hours.

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

Radio LAN network and private PHS mobile system is also to be studied (it is the access network in Japan).

The most important role in the management center is to prepare the optimum formation for rescue and relief operations to meet the damage size judging from obtained daily observation data.

Search and Rescue

Resources for search and rescue operation in Tehran is expected totally short to meet exploding needs after the earthquake. Given the circumstances, some important strategies to fulfill the overall objective will be to:

Move promptly based on the simplified command and coordination mechanism

Search and Rescue operation is commonly understood to be critically effective until 72 hours after the building destruction by the earthquake. Only simplified system to make decisions, which might be realized by uniting local Task Force Organizations with national organizations, can make it possible to mobilize the resources over the country and concentrate them on Tehran in the shortest time.

Utilize the community resources for disaster response to the fullest extent

It will be impossible to put Search & Rescue teams into countless collapsed buildings. Rescue operations will not reach the people in any other way but by counting on community people's help for the trapped in ruins of residential buildings with three or less stories.

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 disaster management.

Search and rescue teams

Search and rescue teams at three levels defined in table below will be deployed over the affected area. In principle, one District Rescue Team and ten Community Rescue Teams may be thrown 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

Field Care

Casualties will be managed through the standardized in
It consists of four vital emergency elements: community-based response activity, AMPs at sites, Hospital care and Logistics. Among them one of key components is AMP, which will play a role of checking point before sending the injured to hospitals to control their flow.

Role of team at AMP

Time, Place & Job principles
A. During emergency period – for first 5 to 7 days after the impact
Target: community people who are injured by impact or fire Place: At the entrance of health center, hospital and in evacuation places 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 for 24 hours 4) Have drugs, consumables and equipment for trauma cases mainly
B. Post emergency period – from 6 to 8 day onward
Target: evacuated people at shelters and camps, and patients who need care at sites Place: not always AMP but at fixed- shelters/camps and affected area on visiting base 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

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). Community people will be organized and mobilized on voluntary basis to assist Community Authority and Local Health Personnel.

Player	Role in the Urgent period
Community*	Set up of **Emergency Committee** Dissemination of information Search and Rescue operations Fire Extinguish operations Transfer of casualty Assistance of Reception at Health Centers or Hospitals
Local Health Personnel	Organizing Health Centers or Hospitals Triage 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

Evacuation

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

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

TDMMC and District Municipality

When a danger is imminent in an area of jurisdiction, the District Municipality shall, upon communicating with TDMMC, recommend or instruct evacuation after 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 or bodies, District Municipality shall establish a warning area and restrict or prohibit the entry into such area and order to move-out from such area.

Even in an 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 of self-governing situation at the time of evacuation.

Regional Firefighting Department

Firefighting Department 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.

Evacuation Guidance

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

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 Fighting

At the Community Evacuation Place, staff of the District Municipality shall formulate groups of respective areas, communities or companies by obtaining assistance of a Police Department and a Firefighting Department. 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. On such occasion, it shall cause persons who are vulnerable to disaster such as sick persons, senior citizens or disabled persons to evacuate on top priority

It shall allocate necessary number of guides at the Regional Evacuation Places. They engage in collection of information relating to damage and public relations activity and getting hold of missing people. They also shall take measures of re-evacuation when it judges dangerous and shall make efforts to keep the order at the evacuation place.

Firefighting Department

Firefighting Department 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, diffusion route of fire and operation of fire fighting.

When evacuation begins, Firefighting Department shall engage in evacuation guidance by activities of firemen.

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

Traffic

Control from Space Aspect

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 road or emergency transportation routes falls under this category.

Area Control

The area control is to regulate the traffic, in a uniform manner, not only for disaster-affected areas but also 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 roads houses, buildings, power poles or fences and so on and road traffic function is paralyzed in the surrounding blocks of areas.

Control from Time Aspect

Detailed regulation by a unit of time is unrealistic in a state in which traffic is confused at the time of disaster, and rough regulation, which takes into account the actual situation of traffic in daytime or night time 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 reason being 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.

Traffic Enforcement and Provision of Information

Whether or not the traffic regulation can achieve its objectives largely depends on the implementation system of the traffic enforcement. If, although emergency transportation routes are proposed, number of entry point on crossing roads and areas along roads are enormous, it is quite difficult to restrict the inflow of ordinary vehicles only by means of barrier, cone or allocation of police officers. 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.

Health and Medical Service Operation

Medical resources available in Tehran is expected totally short to cope with enormously surging needs after the earthquake. Given the circumstances, some important strategies to fulfill the overall objective will be:

To place first priority on life-saving care throughout the medical care operations

Treatments must be selectively provided to the injured who will be judged savable through triage at every treatment point.

To mobilize and utilize available resources fully regardless of locations, ownership and source

Government commitment is crucially important to mobilize private sector totally by endorsing monetary compensation for their expenses to treat the injured unconditionally.

To make systematic response by establishing treatment level tiered-system over the country

Establishment of system to provide care, from community first, then to transfer to hospitals in local network, and to hospitals in metropolitan and national network, is crucially important.

To provide health care to fit people's needs which change over time

Health resources must shift from treatment for surgical cases during first several days to care for acute internal cases followed by patients with chronic diseases.

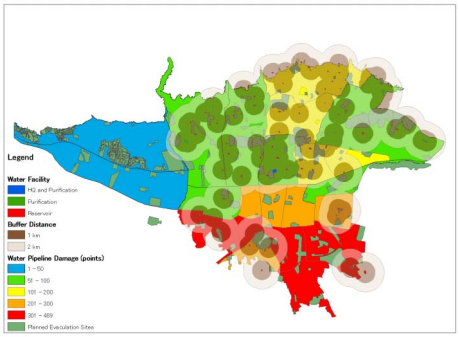
Lifeline

In Tehran Municipality, by initiation of TDMMC, each Sub-committee, including Water Committee, Natural Gas Committee, Power Committee, prepared a Standard Operation Plan for emergency response. Furthermore, based on the Standard Operation Plan, Greater Tehran Gas Company, and Tehran Regional Electric Company prepared a more detailed Emergency Response Plan. Especially, GTGC is revising their plan by reviewing the Emergency Response Plan of Osaka Gas, which covers all the necessary part of emergency response. It is necessary to prepare such a plan and each staff must be aware and well understand the purpose and importance of such a plan. According to the meeting with Tehran Water and Sewage Company, they have not prepared a detailed emergency response plan yet; 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 the information, it is necessary to prepare a detailed emergency response plan in the near future. In the later section, tentative emergency response plan is prepared for the reference.

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 be occurred and, therefore, establishment of emergency water supply plan in advance will be extremely important to avoid a disorderly situation.

Distribution and the capacity of Water Reservoirs



Emergency Water Capacity by District

District	Population	Area (ha)	Total amount of water in Reservoirs (m3)	Amount of water available (liter/person)	No of Days to be no supply 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

It shows that after 11 days, people with access 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 hard to estimate all the transmission pipes will be damaged. Therefore, this is the worst case and it can be said that total volume stock of water by water reservoirs is comparatively large even if compared with other countries.

Foods Provision

The following measures are the necessary requirements for Tehran Municipality.

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

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

To make an agreement on foods provision with retailers and wholesalers

The emergency foods should be put 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.

To establish a cooperative setup and define the sphere of responsibility and roles with Red Crescent

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

PREPARE REHABILITATION AND RECONSTRUCTION (REHABITITATION AND RECONSTRUCTION PLAN)

12 Establishment of Rehabilitation and Reconstruction Procedure

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

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 a post-disaster reconstruction headquarters.

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.

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 a basic plan for rebuilding the town and with this clarify the both the fundamental plan for the regeneration of the whole of the Tehran City and/or each area that has suffered damage and also the methods for achieving this.

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.

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 carry this out rapidly, endeavors to secure financial resources will be indispensable.

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

14 Implementation Plan

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.

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

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

The cost for private building strengthening promotion project is omitted.

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 1,931.1

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.

The individual projects in the long list are measured by the assumed evaluation indicators as follows:

(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

Based on this criteria, the Study Team selected priority project as shown below:

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

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Abbreviations and Acronyms

3C-S	Command-Control-Communication Structure
ADPCM	Adaptive Differential Pulse Code Modulation
AEO	Atomic Energy Organization; Office of the President
AMP	Advance Medical Post
BHRC	Building and Housing Research Center
BOR	Bed Occupancy Ratio
BSCSRA	Bureau for Studies and Coordination of Safety and Recovery Affairs
BTS	Base Transmitting Station
CAR	Contractors All Risk
CBO	Community Based Organization
CDE	Council for Determination of Exigencies (see also SEC)
CDMA	Code Division Multiple Access
CEAAAO	Civil Employment And Administrative Affairs Organization; Office of the President
CEMS	Tehran Comprehensive Emergency Management Plan Secretariat
CEST	Center for Earthquake and Environmental Studies of Tehran
CGC	Council of Guardians of the Constitution
CIC	Commander-in-Chief
CP	Collecting Point or Command Post
CPMR-SCCR	Council of Policy Making for Reconstruction – The Supreme Council of Cultural Revolution
CRO	Civil Retirement Organization; Office of the President
DAMA	Demand Assignment Multiple Access
DEG	Diesel Engine Generator
DEMP-NL	Disaster Emergency Master Plan at National Level
DHC	District Health Center
DM	Disaster Management
DMG	Disaster Management Group
DMH	Disaster Medical Hospital
EAR	Erect All Risks
ECS	Emergency Communications System
EMS	Emergency Medical Service
EMTFM-DL	Emergency Management Task Force – District Level
EMTFM-ML	Emergency Management Task Force – Municipality Level
EMTFM-SDL	Emergency Management Task Force – Sub-district Level
EOC	Emergency Operations Center
EPO	Environmental Protection Organization; Office of the President
ER	Emergency Response
ER	Emergency Room
ERP	Emergency Response Plan
FEMA	Federal Emergency Management Agency
FWA	Fixed Wireless Access
GIS	Geographic Information System
GOI	Government of Iran
GOJ	Government of Japan
GSM	Global System for Mobile communications
GTA	Greater Tehran Area
GTGC	Greater Tehran Gas Company
GTMA	Greater Tehran Municipality Area
HLR	Home Location Register
I.R.I.	Islamic Republic of Iran
ICA	Islamic Consultative Assembly (also “Majlis”)
ICS	Incident Command System

ICU	Intensive Care Unit
IIEES	International Institute of Earthquake Engineering and Seismology
INDMP	Integrated Disaster Management Plan
ITU	International Telecommunication Union
IUMS	Iran University of Medical Science
JICA	Japan International Cooperation Agency
LHP	Local Health Personnel
LOS	Length of Stay
LS	Local Switch
MCM	Mass Casualty Management
MDF	Main Distributing Frame
MMI	Modified Mercali Intensity
MOAJ	Ministry of Agriculture Jihad
MOC	Ministry of Commerce
MOCHE	Ministry of Culture & Higher education
MOCO	Ministry of Cooperatives
MODAFL	Ministry of Defense & Armed Forces Logistics
MOE	Ministry of Energy
MOEAF	Ministry of Economic Affairs & Finance
MOET	Ministry of Education & Training
MOFA	Ministry of Foreign Affairs
MOH	Ministry of Health (and Medical Education)
MOHUD	Ministry of Housing & Urban Development
MOI	Ministry of Interior
MOIC	Ministry of Information & Communication
MOICG	Ministry of Islamic Culture & Guidance
MOIM	Ministry of Industry & Mines
MOIS	Ministry of Intelligence & Security
MOJ	Ministry of Justice
MOLSA	Ministry of Labor & Social Affairs
MOP	Ministry of Petroleum
MORT	Ministry of Roads & Transport
MPO	Management & Planning Organization, Office of the President
MU	Medical University
NCNDR	Law of Foundation of National Committee for Mitigation of Natural Disaster Effects
NDOI	National Documents Organization of Iran; Office of the President
NDTF	National Disaster Task Force
NDTFOrg	National Disaster Task Force Organization
NGO	Non-Governmental Organization
NIGC	National Iranian Gas Company
NPWG	National Preparatory Working Group
NTF	North Tehran Fault
ODA	Official Development Assistance
PAHO	Pan American Health Organization
PDC	Personal Digital Cellular telecommunication system
PDTF	Provincial Disaster Task Force
PDTFOrg	Provincial Disaster Task Force Organization
PEO	Physical Education Organization; Office of the President
PGA	Peak Ground Acceleration
PHS	Personal Handyphone System
PO	The President's Office
PP	Participation Papers
PPWG	Provincial Preparatory Working Group
PR	Public Relations
QPSK	Quadrature Phase Shift Keying
R&R	Reconstruction & Rehabilitation

RCS	Red Crescent Society of Islamic Republic of Iran
RRCP	Rescue & Relief Comprehensive Plan
SEC	State Exigency Council (also referred to as CDE)
SMTCI	State Management Training Centre of Iran; Office of the President
SNG	Satellite News Gathering
SOP	Standard Operation Plan
SPV	Special Project Vehicle
SUMS	Shahid Beheshti University of Medical Science
TCEMP	Tehran Comprehensive Emergency Management Plan
TCI	Telecommunication Company of Iran
TCIP	Turkish Catastrophe Insurance Pool
TCT	Telecommunication Company of Tehran
TCTTS	Tehran Comprehensive Traffic and Transportation Study
TDD	Time Division Duplex
TDMA	Time Division Multiple Access
TDMMC	Tehran Disaster Mitigation and Management Center (Merged CEST and CEMS)
TDMO	Tehran Disaster Management Organization
TETCO	Tehran Engineering Technical Consulting Organization
TF	Task Force
TGIS	Tehran GIS Center
TM	Tehran Municipality
TMCSO	Tehran Municipality Computer Service Organization
TMN	Total Management Network
TPWG	Township Preparatory Working Group
TREC	Tehran Regional Electric Company
TTTO	Tehran Traffic and Transportation Organization
TUMS	Tehran University of Medical Science
TWSC	Tehran Water and Sewage Company
UBC	Uniformed Design Code
UNDP	United Nations Development Program
VSAT	Very Small Aperture Terminal
WB	World Bank
WHO	World Health Organization
WLL	Wireless Local Loop
WTO	World Trade Organization

General

GENERAL

1. Introduction

In response to the official request of the Government of Islamic Republic of Iran (hereinafter referred to as "GOI"), the Government of Japan (hereinafter referred to as "GOJ") has decided to conduct "The Comprehensive Master Plan Study on Urban Seismic Disaster Prevention and Management for the Greater Tehran Area in the Islamic Republic of Iran" (hereinafter referred to as "the Study").

The Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of technical cooperation programs of GOJ, undertook the Study in accordance with the relevant laws and regulations in force in Japan.

On the part of GOI, the Center for Earthquake and Environmental Studies (hereinafter referred to as "CEST") acted as the counterpart agency to the Japanese Study Team (hereinafter referred to as "the Study Team") and also as the coordinating body in relation with other governmental and non-governmental organizations concerned with the smooth implementation of the Study.

In February 2003 the Decree of the Mayor of Tehran was issued, declaring the establishment of "Tehran Disaster Mitigation and Management Center (hereinafter referred to as "TDMMC"), in which existed two disaster-related organizations of Tehran, CEST and Tehran Comprehensive Emergency Management Plan Secretariat (hereinafter referred to as "CEMS") were merged. The establishment of TDMMC was confirmed through the official letter from TDMMC to JICA with reference to No 190/2452 dated 8 September 2003. According to the establishment of TDMMC, the authorities as a counterpart agency to JICA Study Team were transferred from CEST to TDMMC.

This Final Report is compiled to summarize all the Study contents.

2. Background of the Study

Tehran City is located at the foot slope of the Alborz Mountain Ranges that form part of the Alpide-Himalayan Orogenic Zone, which is a high potential earthquake zone having many peculiar active faults. "The Study on Seismic Microzoning of the Greater Tehran Area in the Islamic Republic of Iran" was conducted with the cooperation of JICA and Tehran Municipality between 1999 and 2000. As a result of this study, it is pointed out that a strong earthquake caused by the fault activity of the Ray Fault will largely affect Tehran City. Huge seismic damages to both buildings and people are estimated, especially in the Southern part of

Tehran City where dense populations and traditional non-seismic-resistant buildings are dominant.

Tehran Municipality does not yet have a comprehensive and firmly approved disaster management master plan, though there are various important activities and documents toward that end. The Red Crescent Society of Islamic Republic of Iran (RCS), for example, is preparing a rescue and relief plan that will cover the immediate "ex-post event" emergency response measures. Master plans for prevention, preparation and rehabilitation still need to be completed.

Taking those circumstances into consideration, GOI requested GOJ to conduct the Study as a technical cooperation program. The Study commenced in August 2002.

3. Scope of the Study

3.1. Study Objectives

The objectives of the Study are:

1) To formulate a master Plan and its implementation plan for urban Seismic Disaster Prevention and management for Tehran City; and

2) To transfer skills and technical knowledge on urban seismic disaster prevention and management to counterpart personnel of CEST (subsequently TDMMC) in the course of the Study.

3.2. Study Area

The study area covered the entire area of Tehran City, which is composed of 22 districts and boundary zones as shown in Figure G. 1

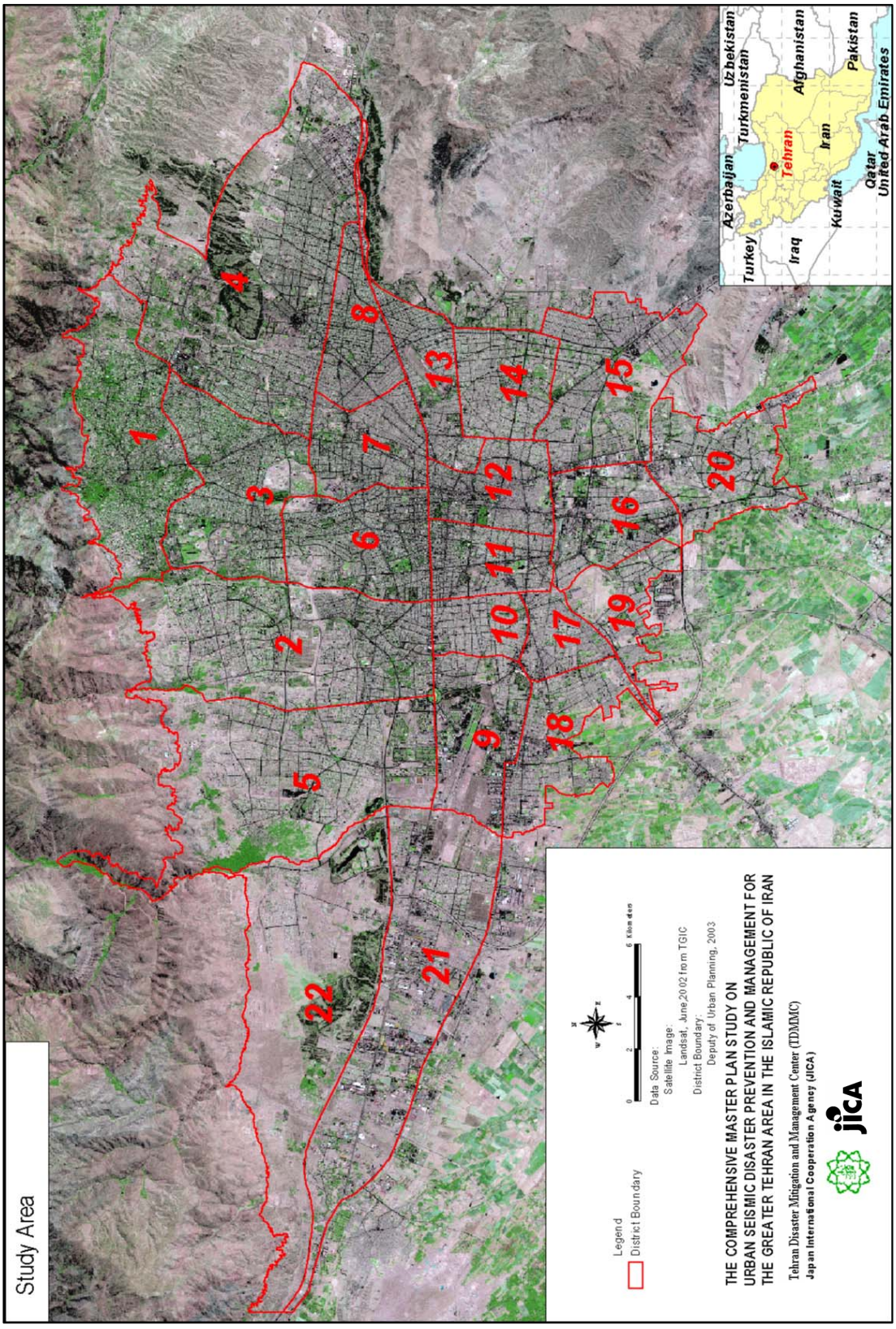


Figure G. 1 Study Area

3.3. Schedule of the Study

The Study consisted of a variety of tasks. Figure G. 2 shows the work schedule, interrelations among the tasks and the logical flow of the Study.

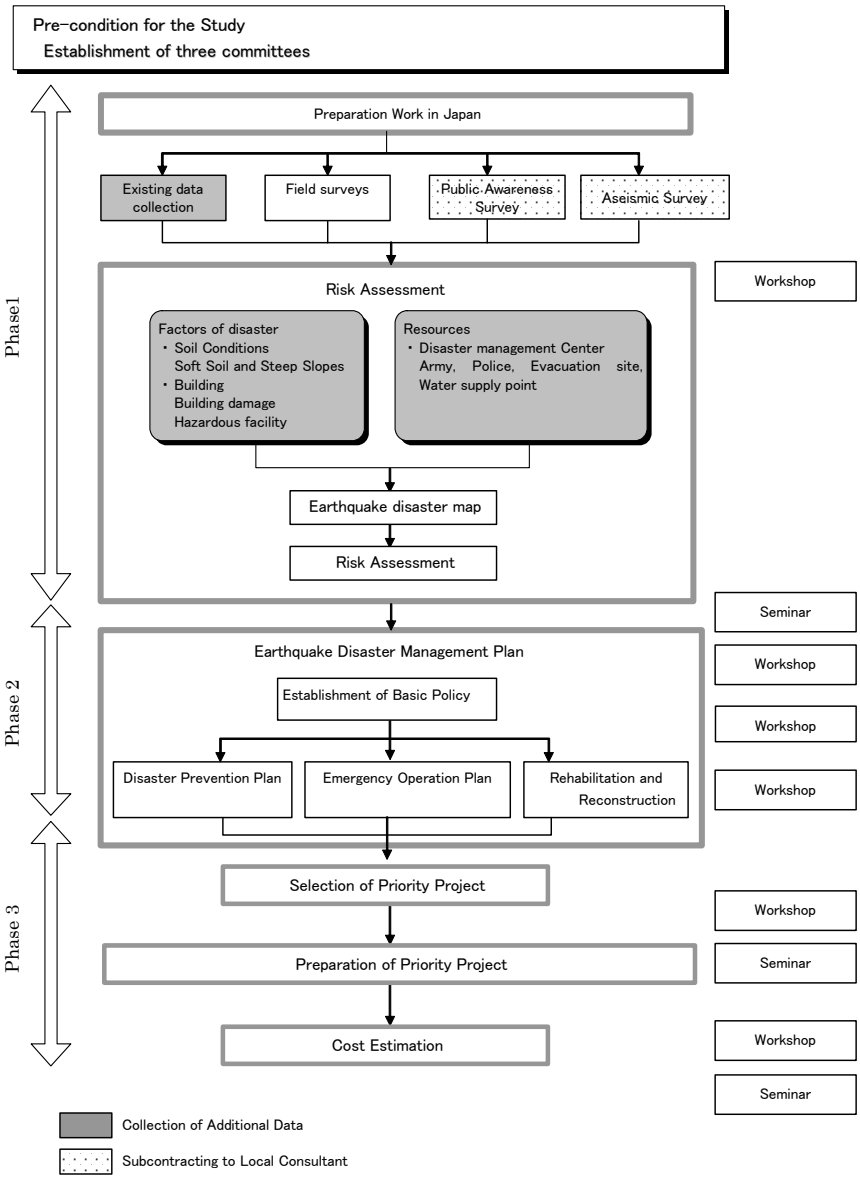


Figure G. 2 Flow Chart of the Study

3.4. Implementing Organizations

The Study was carried out through the joint efforts of the JICA Study Team and Iranian counterpart personnel, who formed the study implementing body. The JICA Study Team was comprised of members from Pacific Consultants International (PCI) and OYO International (OYO). The Iranian counterparts were delegated from CEST and subsequently TDMMC.

Figure G. 3 shows the relationship of study organizations, followed by the member lists of Japanese side study organizations shown in Table G. 1. Members of the Steering Committee, Technical Committee and Implementation Committee are shown in Table G. 2 and Table G. 3. Member of Counterparts are shown in Table G. 4.

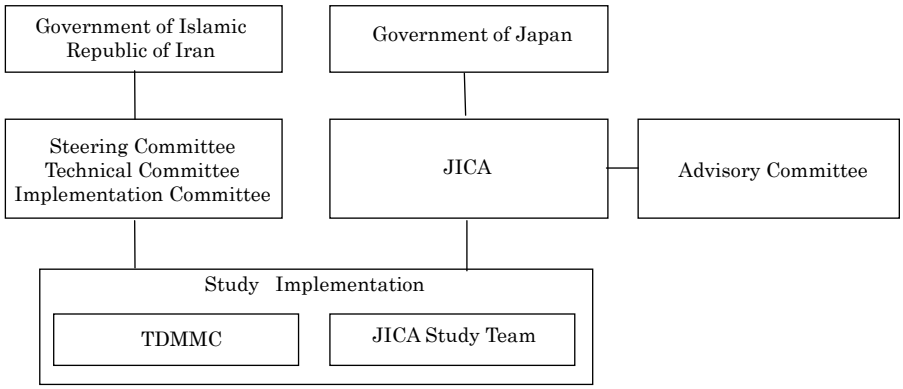


Figure G. 3 Study Organization

Table G. 1 Member Lists of the Japanese Side Study Organizations

JICA Advisory Committee

Dr. Kimiro Meguro	Leader	The University of Tokyo
Dr. Shuichi Takeya	Member	Ministry of Land, Infrastructure and Transport
Dr. Shingo Nagamatsu	Member	Disaster Reduction and Human Renovation Institution
Mr. Katsunori Ishida	Observer	Hyogo Prefectural Government

Study Team

Mr. Itaru Mae	Team Leader
Mr. Ichiro Kobayashi	Deputy Team Leader / Urban Disaster Management
Mr. Osamu Nishii	Deputy Team Leader / Disaster Prevention and Management
Mr. Kanao Ito	Urban Planning (1)
Ms. Mihoko Ogasawara	Urban Planning (2)
Dr. Akio Hayashi	Building Structure
Mr. Ryoji Takahashi	Infrastructure and Lifeline
Dr. Nahoko Nakazawa	Community Disaster Prevention and Management (1)
Ms. Junko Okamoto	Community Disaster Prevention and Management (2)
Ms. Tomoko Show	Social Analysis
Mr. Masatoshi Kaneko	Economic Analysis
Mr. Schneider Klaus-Dieter	Organization and Institution for Disaster Management (1) / Project Implementation
Mr. Makoto Nakamura	Organization and Institution for Disaster Management (2)
Mr. Kazumi Akita	Disaster Rescue and Medical Response
Mr. Hiroyuki Maeda	GIS Specialist
Mr. Masahiro Satake	Disaster Information and Communication Management
Mr. Shukyo Segawa	Seismology
Mr. Toshitsugu Shimodaira	Coordinator
Mr. Kazushige Mizui	Coordinator

JICA Tokyo Headquarters

Mr. Itsu Adachi (April 2003-) Mr. Senichi Kimura (August 2002 – March 2003)	Group Director	Group III (Water Resources and Disaster Management), Global Environment Department
Mr. Masafumi Nagaishi (December 2003 -) Ms. Katsura Miyazaki (August 2002 – November 2003)	Team Director	Water Resources and Disaster Management Team II, Group III (Water Resources and Disaster Management), Global Environment Department
Ms. Ai Yamazaki (September 2003 -) Mr. Kotaro Taniguchi (August 2002 –August 2003)	Staff	Water Resources and Disaster Management Team II, Group III (Water Resources and Disaster Management), Global Environment Department

JICA Expert

Mr.Junji Wakui (June 2004 -) Mr. Izumi Tanaka (August 2002 –May 2004)	JICA Expert	ODA Advisor in Iran

Table G. 2 Member Lists of the Three Committees from August 2002 to May 2004

Steering Committee Members

Mr. Rasool Zargar	Advisor to Tehran Mayor/Tehran Municipality
Mr. Javad Haghani	Deputy for City Services/Tehran Municipality
Mr. Javad Sharbaf	Deputy for Technical and Development Affairs/Tehran Municipality
Mr. Gholam Hossein Pordeli	Deputy for Urban Planning & Architecture/Tehran Municipality
Dr. Ali Akbar Moinfar	Senior Advisor/Center for Earthquake Studies of Tehran
Mr. Abbas Jazayeri	Director/National Disaster Task Force/Ministry of Interior
Mr. Amir Farjami	General Manager, Rural and Urban Development/MPO
Dr. Mohsen Ebrahimi	Director/Tehran Disaster Management Center
Mr. Farid Mehdian	Director/Center for Earthquake Studies of Tehran
Mr. Ahmad Naderzadeh	Head /Center for Earthquake Studies of Tehran
Dr. Ghasem Heidarinezhad	Director/Building and Housing Research Center
Dr. Mehdi Ghalibafian	Professor/School of Engineering, Tehran University

Technical Committee Members

Dr. Ali Akbar Moinfar	Structural and Earthquake Engineering
Prof. Mehdi Ghalibafian	Structural Engineering
Prof. Hossein Bahraini	Urban Planning and Environment
Prof. Behrooz Gatmiri	Geotechnical Engineering
Prof. Mohsen Ashtiani	Earthquake Engineering
Mr. Ahmad Naderzadeh	Structural and Earthquake Engineering
Dr. Nemat Hasami	Lifeline Engineering
Dr. Firooz Tofigh	Management and Planning
Mr. Farid Mehdian	Architecture and Urban Planning

Implementation Committee Members

Mr. Javad Sharbaf	Deputy for Technical and Development Affairs/Tehran Municipality
Mr. Gholam Hossein Pordeli	Deputy for Urban Planning & Architecture/Tehran Municipality
Mr. Javad Haghani	Deputy for City Service/Tehran Municipality
Mr. Mohammad-Mehdi Khorsandnia	Deputy for Transportation and Traffic/Tehran Municipality
Mr. Mehdi Moeini	Tehran GIS Center
Mr. Yoosef Khosroshahi	Computer Service Organization/Tehran Municipality
Mr. Mohsen Ebrahimi	Director/Tehran Disaster Management Center
Mr. Farid Mehdian	Director/Center for Earthquake Studies of Tehran
Mr. Ahmad Naderzadeh	Head, Earthquake Studies and Research/CEST
Mr. Abbas Jazayeri	Director/National Disaster Task Force/Ministry of Interior
Mr. Ali Ahmadi	Deputy for Security/Ministry of Interior
Mr. Amir Farjami	Urban and Rural Housing/Management and planning Organization
Mr. Ali Jahanbakhshi	Disaster Task Force/Tehran Province
Dr. Mahmood Fatemi Aghda	Center for Natural Disasters Research and Studies
Mr. Khosravi	Housing and Urban Organization of Tehran Province
Mr. Fereydoon Esfandiari	Fire Fighting Organization/Tehran Municipality
Mr. Bizhan Daftari	Red Crescent Society of Tehran Province
Mr. Ghamami	Deputy for Urban Planning/ Ministry of Housing and Urban development
Mr. Mohammad-Taghi Araghi	Iran National Gas Company
Mr. Reza Jamal	Tehran Electric Company
Mr. Asad Balakhesal	Tehran Water and Sewage Company
Mr. Kamran Khosravi	Iran Telecommunication Company
Mr. Hamid Damavandi	Technical Department/Tehran and Suburbs Railway Company
Mr. Ghavam Shafati	Fire Fighting and Safety Depertment/Petroleum Products Distribution Company
Dr. Fayyazi	Emergency Response Management/Ministry of Health

Table G. 3 Member Lists of the Three Committees from May 2004

Steering Committee Members

Dr. H. Shakib	Member of City Council and Advisor to the Mayor
Mr. M. Aliabadi	Deputy for Technical & Civil Affairs/Tehran Municipality
Mr. M.J. Mohammadi Zadeh	Deputy for Urban Services/Tehran Municipality
Mr. GH. Pordeli	Deputy for Urban Planning & Architecture/Tehran Municipality
Mr. M. Hashemi	Deputy for Districts Affairs/Tehran Municipality
Dr. M. Hosseini	President/TDMMC
Dr. M. Ebrahimi	Deputy for Disaster Management/TDMMC
Dr. K. Amini	Advisor to the President of TDMMC
Mr. S.A. Jazayeri	Ministry of Interior (National Committee)
Dr. Rohani Manesh	Tehran & Suburb Urban Railway Co.
Dr. Nogol	Professor, Geological Survey of Iran
Mr. Habibollahian	Head of Tehran Planning Organization and Advisor of the Mayor

Technical Committee Members

Dr. Maziar Hosseini	Structure and Earthquake Engineering/President of TDMMC
Dr. M.T. Kazemi	Structure and Earthquake Engineering/Professor of Sharif University
Dr. K. Amini	Engineering Geology/Advisor to the President of TDMMC
Dr. H. Shakib	Earthquake Engineering/Member of City Council
Dr. Motamedi	Psychology/Welfare Org., General Manager of Bureau Social Damages
Dr. A. Shariat	Lifelines/Professor of Science & Tech. University
Ms. F. Saleh	Urban Planning/TDMMC
Dr. M. Ebrahimi	Disaster Management/TDMMC
Dr. H. Pedram	Infrastructures
Mr. S. Montazer Ghaem	Geotechnique and Structure/TDMMC
Dr. V. Hosseini Jenab	Rescue & Relief/TDMMC
Dr. B. Abdi	Rescue & Relief/TDMMC
Dr. A. Tarighi Rasekhi	Rescue & Relief/TDMMC
Mr. R. Radnia	Media and Public Relations/TDMMC
Mr. A.R. Sabeti	Environment/TDMMC
Mr. M. Novin	Information and Communication/Head of Telecommunication Center, Tehran Municipality

Implementation Committee Members

Mr. M. Aliabadi	Deputy for Technical & Civil Affairs/Tehran Municipality
Mr. M.J. Mohammadi Zadeh	Deputy for Urban Services/Tehran Municipality
Mr. GH. Pordeli	Deputy for Urban Planning & Architecture/Tehran Municipality
Dr. H. Behbahani	Deputy for Transportation and Traffic/Tehran Municipality
Dr. M. Hosseini	President/TDMMC
Dr. M. Ebrahimi	Deputy for Disaster Management/TDMMC
Dr. H. Shakib	Member of City Council
Dr. K. Amini	Advisor to President/TDMMC
Mr. S.A. Jazayeri	Ministry of Interior (National Committee)
Mr. A. Azarifar	Deputy for Security-Disciplinary/Tehran Governorship
Dr. Farshbaf Maherian	Head of Management and Planning Organization of Tehran Province
Mr. A. Jahan-bakhshi	Taskforce HQ of Tehran Province
Dr. Fatemi Aghda	President of Iran Natural Disaster Research Center
Mr. Hagh-shenas	Deputy for Islamic Revolution Housing Foundation
Mr. A. Ziaie	President of Fire Fighting and Safety Services Organization
Mr. B. Daftari	Deputy for Rescue and Relief/Red Crescent Society
Dr. H.R. Dehghan	Managing Director/Tehran Red Crescent Society
Mr. Habibollahian	Head of Tehran Planning Organization
Mr. M.T. Araghi	Managing Director/Gas Co. of Tehran Metropolitan
Mr. M. Jannatian	Managing Director/Tehran Regional Electric Co.
Mr. S. Mahmoodi	Managing Director of Tehran Water and Sewage Co.
Mr. M. Khosravi	Iran Telecommunication Co.
Dr. Rohani Manesh	Tehran & Suburb Urban Railway Co.
Mr. GH. Shafati	Oil Products Distribution Co.
Dr. V. Kianpour Atabaki	Disaster HQ of Ministry of Health
Dr. H. Abbasi	IIEES
Dr. M. Ghafoori Ashtiani	President/IIEES

Table G. 4 Member Lists of Counterparts

Dr. Maziar Hosseini	Project Manager
Dr. Kambod Amini Hosseini	TDMMC President's Advisor
Dr. Mohsen Ebrahimi Mojarad	Emergency Traffic System
Ms. Fatemeh Saleh	Urban Planning and Community-based Disaster Management, Training
Ms. Forough Basirat	GIS
Ms. Mitrana Mokhtari Tirani	Coordination Affairs and Training
Ms. Leila Talebi	GIS
Mr. Koosha Sina	GIS
Mr. Alireza Sabeti	Lifelines
Dr. Bahram Abdi Farkoosh	Disaster Management, Organization and Institutionalization
Ms. Zahra Sadat Hosseini	Social Studies
Mr. Saeed Montazer Ghaem	Structure
Dr. Ali Tarighi Rasekhi	Disaster Management, Rescue and Relief
Mr. Shahin Mohammadi Yeganeh	Community-based Disaster Management, Emergency Network
Mr. Bijan Yabar	Urban Planning and Community-based Disaster Management
Mr. Moezedin Babakhani Teymori	Infrastructure and Lifeline
Mr. Ramin Radnia	Mass Disaster and Training

4. Major Activities of the Study

The major activities of the Study are summarized in Table G. 5.

Table G. 5 Major Activities of the Study

Study Stage	Date	Topics and Contents
Phase I	August, 2002	Commencement of the Study in Iran
	September 3, 2002	1st Joint Steering Committee Meeting, agreeing upon the Inception Report between CEST and the JICA Study Team
	September 4, 2002	Signing on Minutes of Meeting on Inception Report
	September 16, 2002	Technical Committee and Implementation Committee Meetings, presenting and discussing the master planning study for seismic disaster prevention and management
	October 2, 2002	Technical Transfer Workshop (1), presenting major results of the previous Microzoning Study
	February 4, 2003	2nd Joint Steering Committee Meeting, presenting the study progress in Phase I
	February 9, 2002	1st Seminar at Esteghlal Hotel, presenting study result in Phase I
	February 10, 2002	Signing on Minutes of Meeting on the Progress Report (1)
Phase II	May 3~13, 2003	Technology Transfer Training Course, exercising microzoning technique for further comprehension and utilization targeting on counterpart personnel in CEST
	June 24, 2003	Meeting with Mayor of Tehran City, presenting the Study and discussing the cooperative backup of Tehran Municipality for the Study
	July 2, 2003	Community Workshop (1), holding a meeting on community-based disaster preparedness activities
	August 5, 2003	Community Workshop (2), orienting community-based disaster map creation in selected area (District 17)
	August 6, 2003	Community Workshop (2), orienting community-based disaster map creation in selected area (District 2, cooperative housing area)

	August 7, 2003	Community Workshop (2), orienting community-based disaster map creation in selected area (District 2, housing complex)
	August 13, 2003	Community Workshop (2), orienting community-based disaster map creation in selected area (District 10)
	August 18, 2003	District Meeting on Selected Pilot Study in District 10, explaining the pilot study and establishing close relationship between District 10 and the JICA Study Team
	August 18, 2003	Community Workshop (3), preparing community-based disaster map for disaster preparedness planning
	August 19, 2003	District Meeting on District Level Disaster Prevention and Mitigation Plan, explaining the idea to all Mayors from 22 Districts in Tehran Municipality
	August 20, 2003	3rd Steering Committee Meeting, presenting progress of Phase II Study and agreeing upon its contents between TDMMC and the JICA Study Team
	August 21, 2003	Signing on Minutes of Meeting on 3rd Steering Committee Meeting
	August 26, 2003	Structure Workshop at TDMMC building, presenting and discussing building diagnosis and strengthening
	September 14, 2003	Community Workshop (4), examining existing community organizations
	September 15, 2003	Community Workshop (4), enlightening and enhancing awareness of seismic disaster for school children
	September 16, 2003	Technology Transfer Workshop at TDMMC Building, guiding a preparation of master plan for seismic disaster targeting on counterpart personnel in TDMMC
	September 21, 2003	4th Steering Committee Meeting, explaining the study progress and basic principles of the Master Plan and agreeing upon its contents between TDMMC and the JICA Study Team
	September 22, 2003	Signing on Minutes of Meeting on 4th Steering Committee Meeting
	September 22, 2003	Community Workshop (4), examining on-going community activities
	December 23, 2003	2nd Seminar at Laleh Hotel, presenting study result in Phase II
	December 24, 2003	Signing on Minutes of Meeting on the Submission of the Interim Report
Phase III	June 6, 2004	5th Steering Committee Meeting, presenting and agreeing upon the contents of Interim Report
	June 6, 2004	Signing on Minutes of Meeting on 5th Steering Committee Meeting
	June 9, 2004	Community Workshop (5), enhancing awareness of seismic disaster for school children by creating disaster map
	June 16, 2004	Community Workshop (5), promoting community-based disaster activity for Basij
	August 8, 2004	6th Steering Committee Meeting
	August 10, 2004	3rd Seminar

5. Other Publications of the Study

The publications other than Reports prepared in the course of the Study are as follows.

1) Newsletter

For the purpose of developing the network, heightening of consciousness of disaster mitigation and management activities and sharing the information among all the governmental organizations, research institutes, NGOs and communities relating to disaster management activities, newsletters presenting any topics relating to the Study were published in the course

of the Study. Total six(6) series with 300 sets each of newsletters detailed below were distributed aforementioned entities through TDMMC.

Newsletter No.1, Inaugural Issue, published in October, 2002

Newsletter No.2, Featuring Citizen Participation, published in February, 2003

Newsletter No.3, Featuring Building Vulnerability, published in June, 2003

Newsletter No.4, Featuring GIS, published in September, 2003

Newsletter No.5, Featuring Bam Earthquake, published in March, 2004

Newsletter No.6, Contribute Articles to the JICA Study, published in August, 2004

2) Video Program for the Promotion of Community-based Disaster Management Activities

In order to promote community-based activities in Tehran by the own effort of citizens, the Study Team prepared a video program, in which concept, managing techniques and contents of a series of workshops held in the course of the Study are presented. This video program was distributed to organizations relating to community-based disaster management activity in Tehran including TDMMC.

3) Maps for District-based Assessment of Vulnerability to Earthquake Disaster

Study team carried out intensive data collection during Phase 1 and Phase two of the study. The collected data were input into the GIS database, which developed by this study, to formulate district level disaster management map. The map includes the disaster management resources and earthquake hazards for each district. Together with disaster management map, Study Team prepared the disaster management sheet for each district, which contains the disaster management resources and earthquake risk in number. In order to formulate disaster management plan for each district, Study team proposed countermeasures for each district.

In order to understand the Tehran municipality's earthquake disaster risk, Study Team prepared the vulnerability analysis in Tehran municipality. Study Team distributed vulnerability map in Tehran municipality for the district to prepare the disaster management plan for the city.

4) Pilot Study for District 17 to support district-based disaster management plan formation

In order to promote a formulation of the plan at district level, a pilot study was carried out for District 17, which has a high potential of earthquake damage and a high social awareness on earthquake disaster. In the course of the Study, Study Team selected two district, district 17 and 10, for pilot study, yet district 10 could not be produced the output of the study.

5) Poster competition

In order to increase awareness of disaster preparedness and mitigation not only among the children but also among school staff, families of the children and the general public as a whole, TDMMC and Study Team organized a poster competition in cooperation with the Institute for

the Intellectual Development of Children and young Adults (Kanoon). The target children for the competition are third and fifth grades of elementary school and first grade of secondary school students in Tehran. There were 125 entries screened and 13 children are awarded.

6) Attitude survey for building strengthening

Study team carried out survey for preference of the residents for strengthening the their buildings. The number of sample is 200 from municipality, special emphasis on masonry building. The results show the there is clear difference in willingness to pay for structure strengthening by type of the building. Based on the results, Study team proposed policy options for private house strengthening.

Chapter 1
Introduction

CHAPTER 1 INTRODUCTION

1.1 Existing Disaster Management System

1.1.1 Existing Laws and Regulations

1) National Level

The legal and administrative foundations, including the prevailing policy directions, for the regulatory frameworks governing at national and Tehran Municipality levels of the disaster management system as a whole, including the system's major features, components, functions and procedures, are codified in few legal, policy and/or administrative documents as listed in Table 1.1.

Table 1.1 Regulatory Framework - Policy Directions & Executive Orders

Regulatory Framework	Primary Function & Level of Relevance	Fundamental Character
The 1979/1989 Constitution	Governs the basic principles and establishes the responsibilities of the Government	Fundamental Legal Basis
"Law of Foundation of National Committee for Mitigation of Natural Disaster Effects"(NCNDR)	The documentation available contains the text of the law as well as a cover letter signed by the then President. The law establishes the Committee and relevant sub-committees.	Law & Executive Regulation
Council of Minister's Decree (s)	Of concern here mainly: The decision of April 06th, 2003 approving the "Rescue & Relief Comprehensice Plan". The plan stipulates the basic disaster management system structure and major functions of the systems.	Policy Direction & Executive Order
Decisions of the "State Exigency Council - SEC"	This entity has provided guidelines in its early 2004 decision "Basic Policies for Disaster Mitigation and Prevention"	Policy Direction & Executive Order
Decree of the Major of Tehran	Of concern here mainly: The decree of early 2003 that regulates the establishment and functions of TDMMC	Executive Order
Resolution by Disaster Related Committee(s)	Of concern here mainly are the resolutions of those of the "National Disaster Task Force - NDTF"	Planning Guideline

Note: Reference to the relevant texts is made in the main text of the Sector Report.

Source: JICA Study Team

The Islamic Consultative Assembly or Majlis approved on 31 July 1991 a law titled "The Law of Foundation of National Committee for Mitigation of Natural Disaster Effects."[1] This proposed law in turn was signed into binding law by the President of I.R.I. on 13 August 2002.

This law, which was complemented in 2003 by a Decree of the Council of Ministers, establishes the fundamentals of Iran's disaster management system in the following manner:

- The law establishes the Ministry of the Interior (MOI) as the supervisory body for disaster management related entities and activities;

[1]) The JICA Study Team translated the formal title of this law into English. It is not an official translation.

- It explicitly identifies the following disasters that need to be addressed, namely: storm, flood, drought, cold stroke, botanic pests, air pollution, earthquake and landslides, and reflux of seas, lakes and rivers;
- It identifies 14 individual line ministries, government entities and NGOs as the principal entities in disaster management and it delegates the authority to include and/or call on the assistance of any other entity to the Head of the National Committee (the Minister of the Interior);
- It passes the authority to establish the required sub-committees to the National Committee and it empowers this Committee to announce any emergency situation;
- It delegates the authority to the National Committee to approve the budget (credit) needed by the above entities for the realization of their responsibilities;
- It charges the Ministry of the Interior to issue the necessary instructions for the establishment of provincial level committees to be under the supervision of the governor of each province; and
- It charges the Ministry of the Interior to inform all Islamic Consultative Assembly Commissions about the results of the activities of all involved entities at a six months cycle.

Execution of the above law is further detailed by Council of Ministers' decision on 12 April 2003, which comprises 14 individual articles and one attachment that deals with the individual duties of the Sub-committee for risk assessment. Article 1 of this Council of Ministers' Decree identifies the core-function(s) for nine specialized Sub-committees established by the Decree

The Government of Iran (GOI) in a further step approved and put into force by the Council of Ministers' Decree dated 12 April 2003 the national level "Rescue & Relief Comprehensive Plan" (RRCP),[2] which is a legally and fully binding executive order. Article 4 of the RRCP establishes the six fundamental functions of the plan as identified in Table 1.2.

[2]) The discussion on the RRCP is based on the text of an unofficial English translation prepared by a Tehran law firm.

Table 1.2 Core Functions of the RRCP

Core Function	Descriptions
1	To realize scientific study and research that transfers modern and advanced disaster management methods from inside and outside of the Islamic Republic of Iran (I.R.I.) to the administrative system
2	To implement national and district level plans and investment with priority attached to prevention and mitigation
3	To provide a unified management and to outline the duties and responsibilities of all executive branch organizations
4	To attract people's participation and to organize and train volunteer forces of a disaster management network
5	To ensure efficient utilization of government and non-government resources
6	To ensure the required support of line ministries, other organizations and the Armed Forces, in particualr the "Resistance Mobilization Force"

Note: Based on Article 4 of the April 06th, 2003 RRCP.

Source: JICA Study Team compilation based on an unofficial translation of the oroginal Farsi document.

2) Tehran Municipality

The Tehran Comprehensive Emergency Management Plan (TCEMP) is in the strict sense a planning and not a regulatory reference document. The TCEMP is an emergency response plan or ERP that organizes 24 organizations under the umbrella of 22 committees to address an emergency situation that may arise within the Tehran Municipality covering all types of disasters as defined by the TCEMP itself and other related national level disaster management policy and planning documents. This ERP is tailored around three major functions and its implementation is on-going. TDMMC is currently the responsible entity for the ERP, fully in charge of supervising and coordinating the realization of the TCEMP.

1.1.2 Disaster Management Organization

The Tehran Municipality is so far the only local Government entity in I.R.I. that is, though embedded in the national system, somewhat outside the main stream of the disaster management system, with the Mayor as Commander-in-Chief of the Tehran-system and the City Council as a regulatory body that may call for adjustments in the Tehran level system, as long as they do not bypass and/or contradict national level stipulations.

CEMS, one of the two predecessor-organizations to TDMMC, has sourced standard operating plans from similar organizations in other countries, the selection criteria being “best-practice.” All 22 Standard Operating Plans (SOPs) have been finalized and distributed to the participating organizations for application.

The rationale for using an Incident Command System (ICS) is to introduce among the various participating entities a common language that uses standardized terms, and also to realize within the participating organizations a uniform command structure in terms of functional assignments and responsibilities that should facilitate inter-agency communications.

- The consolidation and strengthening of the "institutional anchor" TDMMC through the provision of a firm mandate and core functions as well as the provision of adequate financial, human and training resources
- The early establishment of an independently fully functional "Emergency Communication System" and an "Emergency Operations Center" at TDMMC. Particular emphasize has to be placed at the hardware and software integration of both components, if possible, in combination with a fully functional "Disaster Management Information System" that incorporates all relevant national and Tehran level disaster response and management entities
- Strengthening of the Municipality's Fire Brigade's capacity and capability in general emergency response operations and, in particular, in the handling of hazardous materials during natural and man-made disaster times
- The early formation and binding implementation at operational level (ops-plan) of a first "72-hours emergency response plan". Particular attention should be paid in this context on a viable "chain-of-command" and the selection of the most suitable entity for tactical command at area level
- The provision of training in general disaster management, emergency response, risk management, salvage operations, first aid, stress management and so on for all directly responsible and participating people of the Municipality and District Offices,
- Full integration of community based disaster response capabilities into the existing emergency response system.

The above list of priority issues is by no means comprehensive. It just lists the most pressing core issues that would need to be addressed over the short term.

1.2 Basic Policy of the Study

1.2.1 Background

1) Objective Earthquake

The previous study[3] done by JICA developed three types of scenario earthquakes, namely Ray Fault Model, North Tehran Fault (NTF) Model, and Mosha Fault Model, and these were adopted for seismic microzoning analyses. Scale, peak ground acceleration, and seismic intensity of each scenario earthquake are summarized in Table 1.3.

[3]The Study on Seismic Mcrozoning of the Greater Tehran Area in the Islamic Republic of Iran, November 2000, Japan International Cooperation Agency.

Table 1.3 General Features of Scenario Earthquake Models

	Ray Fault	NTF	Mosha
Length (km)	26	58	68
Magnitude (Mw)	6.7	7.2	7.2
Peak Ground Acceleration (gal)	North<200 South>400	North>400 South<200	<200
Intensity (MMI)	North: 8 South: 9	North: 9 South: 7-8	7

Source: Seismic Microzoining of the Greater Tehran Area, 2000 JICA

The damage estimation produced the following damages to residential buildings and human casualties:

Table 1.4 Damages of Scenario Earthquake Models

	Ray	NTF	Mosha
Bldg Damages	483,000	313,000	113,000
Damage Ratio	55%	36%	13%
No. of Deaths	383,000	126,000	20,000
Death Ratio	6%	2%	0.3%

Note: The number of existing buildings and population were assumed at 876,000 and 6,360,000, respectively.

Source: Seismic Microzoining of the Greater Tehran Area, 2000 JICA

The above results show that Ray Fault Model seems the most disastrous scenario that would generate worst damages to Tehran.

1.2.2 Goal

The lives and properties of the citizens of Tehran are being made safer from potentially devastating earthquake by formulation and implementation of a comprehensive disaster management master plan.

The goal of the master plan is:

To establish a safe and secure urban environment against a potential earthquake.

In order to have a more concrete mitigation target, the Study Team proposes to reduce the number of damaged buildings to one-tenth of the estimated damage in Ray Fault case. Ultimate target damage caused by the Ray Fault Model is 48,000 buildings, which should be strengthened or rebuilt.

1.2.3 Planning Period

The implementation plan should be divided into three phases:

- Short term (2004-2006)
- Medium term (2007-2010)

- Long term (2011-2015)

1.2.4 Objectives

In order to achieve the goal, the Master Plan sets three objectives to accomplish by the year 2015. The objectives of the master plan are:

- to secure lives and properties of the citizens of Tehran;
- to protect citizen's life after the event; and
- to prepare for rehabilitation and reconstruction.

1.2.5 Strategies

Increased emergency response capacity within the governmental organization is also important to control earthquake damage. The government sector should take care of after earthquake situations.

The Study Team examines measures, structural and non-structural, to achieve the goal and objectives. The Team selected those measures and determined 10 strategies in order to achieve the goals by considering experiences of Japan. Those strategies include structural and non-structural measures.

The 10 strategies are as follows:

- Strengthening existing buildings
- 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 and reconstruction procedure

Those ten strategies are re-organized into disaster prevention and management plan formulation, emergency response plan and rehabilitation and reconstruction.

1.3 Framework of the Master Plan

1) Framework for the Master Plan

The framework of the master plan study can be organized as shown in Figure 1.1. The three objectives are in correspondence with three plans: prevention and mitigation plan, emergency response plan and rehabilitation and reconstruction plan. Ten strategies are classified depending on earthquake countermeasures.

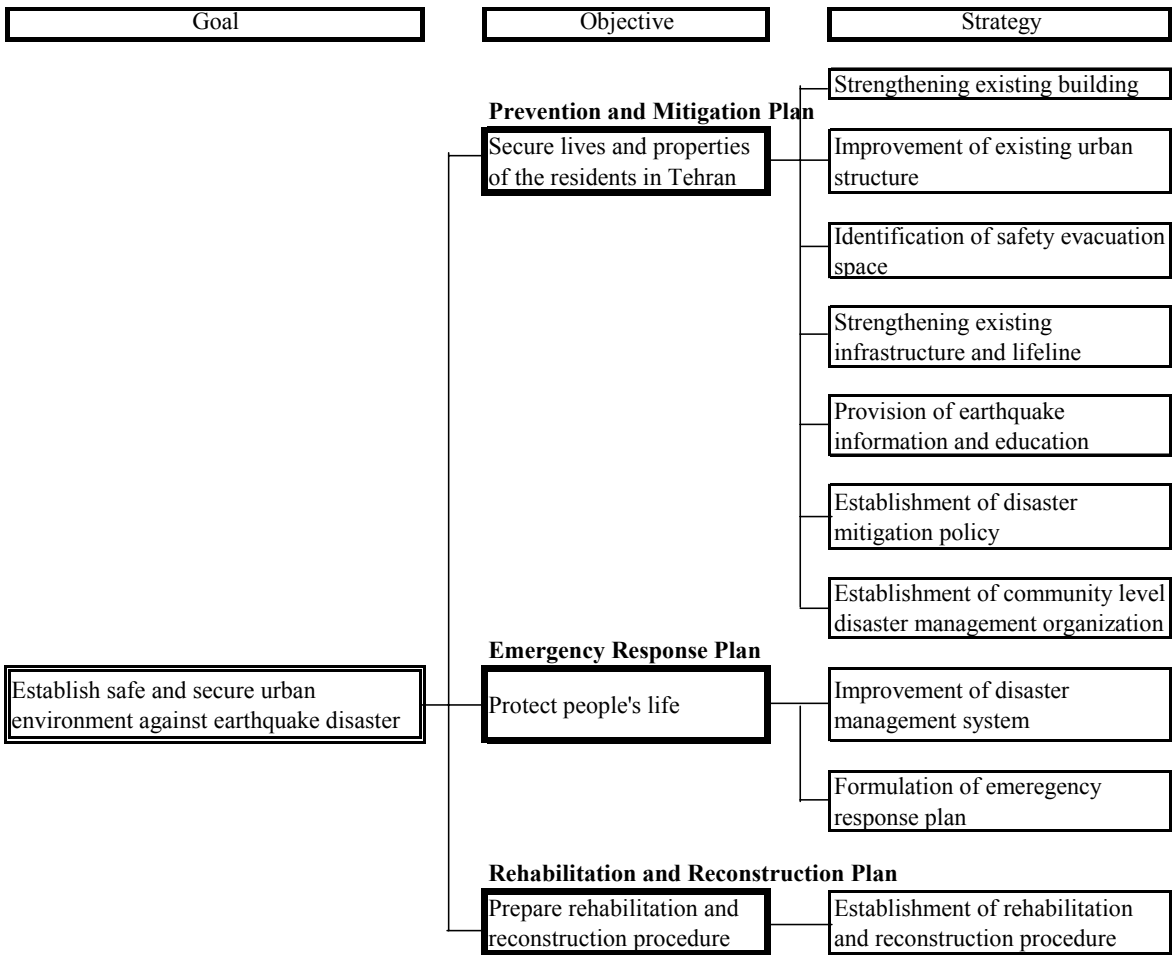


Figure 1.1 Framework of the Master Plan

2) Implementation Plan

The Study Team compiled long lists, which included all projects in order to implement the master plan. Based on the list, the Study Team selected priority projects and programs. The priority project and programs have been formulated by inter-sectoral approach to achieve the stated goals, and corresponding project profiles drawn up. The responsibility of each project is shown for easy implementation of the project.

The Study Team has prepared the total investment costs for each responsible organization and compared its budgets for the realization of the project. There is a problem of the resource mobilization to the disaster management field, because of low recognition by the governments. Each organization should start preparing their disaster management plans in accordance with the recommendation of the master plan.

Chapter 2
Conditions for the Master Plan

CHAPTER 2 CONDITIONS FOR THE MASTER PLAN

2.1 Damage Estimation

2.1.1 Objective Earthquake

Three types of scenario earthquakes, namely Ray Fault model, North Tehran Fault (NTF) model and Mosha Fault model were established in the previous study. Fault models for each earthquake were constructed for numerical calculation. Scale, peak ground acceleration and seismic intensity for each scenario earthquake are summarized as shown in Table 2.1.

Table 2.1 Summary of Three Scenario Earthquakes

	Objective Earthquake		
	Ray Fault model	NTF (North Tehran Fault) model	Mosha Fault model
Length (km)	26	58	68
Moment Magnitude (Mw)	6.7	7.2	7.2
Peak Ground Acceleration (gal)	Northern Area: 200 and less Southern Area: 400 and over	Northern Area: 400 and over Southern Area: 200 and less	200 and less
Seismic Intensity MMI	Northern Area: 8 Southern Area: 9	Northern Area: 9 Southern Area: 7 to 8	7

Source: The Study on Seismic Microzoning of the Greater Tehran Area in the Islamic Republic of Iran, November 2000

2.1.2 Damage

In order to estimate seismic damage, in the previous study,[4] a total of 34,805 census blocks are identified and these blocks are aggregated into 3,173 census zones. Statistical data on population and buildings are accumulated based on these census units. The census boundary is used as the base unit for the special data analysis.

Seismic intensity of each census zone was calculated based on the three scenario earthquakes. Then, seismic damage was estimated together with database, population, building and infrastructure and lifeline. The damage estimation was done in each zone.

Table 2.2 shows the results of the estimation.

[4]The Study on Seismic Microzoning of the Greater Tehran Area in the Islamic Republic of Iran, November 2000, Japan International Cooperation Agency.

Table 2.2 Damage Estimation Results

Item	Unit	Amount
Heavily Damaged and Collapsed Residential Building		
Ray	nos	483,000
North Tehran	nos	313,000
Mosha	nos	113,000
Human Death		
Ray	nos	383,000
North Tehran	nos	127,000
Mosha	nos	20,000
Water Pipeline		
Ray	point	3,900
North Tehran	point	800
Mosha	point	10
Gas Pipeline		
Ray	point	540
North Tehran	point	140
Mosha	point	2
Electricity Cable		
Ray	m	18,500
North Tehran	m	2,700
Mosha	m	0
Telephone Line		
Ray	m	12,800
North Tehran	m	2,200
Mosha	m	0

Note: ☐ Objective Earthquake
Source: The Study on Seismic Microzoning of the Greater Tehran Area in the Islamic Republic of Iran, November 2000

Based on the previous study results, the Study Team estimates heavily damaged and collapsed floor area, debris removal and homeless victims.

Table 2.1 summarizes the damage estimation based on the results of the previous Microzoning Study.

Table 2.3 Damage Estimation Based on Microzoning Study

Item	Unit	Amount
Heavily damaged and collapsed floor area		
Ray	Ha	17,000
North Tehran	Ha	15,000
Mosha	Ha	6,000
Debris of heavily damaged and collapsed building		
Ray	1000 ton	124,000
North Tehran	1000 ton	109,000
Mosha	1000 ton	46,000
Debris of heavily damaged and collapsed building on emergency road		
Ray	1000 ton	3,700
North Tehran	1000 ton	3,300
Mosha	1000 ton	1,400
Homeless victims		
Ray	Nos	3,126,000
North Tehran	Nos	1,999,000
Mosha	Nos	763,000

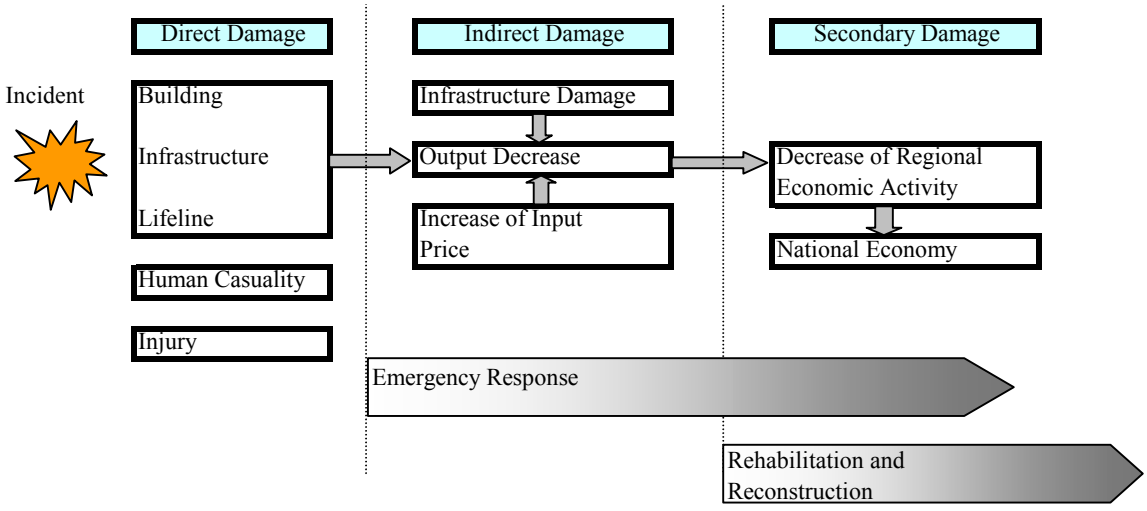
Note: Objective Earthquake

Source: The Study on Seismic Microzoning of the Greater Tehran Area in the Islamic Republic of Iran, November 2000

2.2 Economic Analysis

2.2.1 Economic Damage Analysis

The economic loss caused by the earthquake can be categorized into three items: direct loss, indirect loss and secondary effect of the earthquake. Figure 2.1 shows the links of those damage items.



Source: JICA Study Team

Figure 2.1 Damage Link

The previous study shows the possible physical damages of an earthquake in Tehran. Damage is not clear, however, in monetary terms. Monetary value of the damage would direct overall disaster management alternatives in the coming master plan.

2.2.2 Direct Loss

In this Study, the only available economic costs are a part of direct loss. The other economic costs, such as indirect costs and secondary effects of the earthquake damage, are estimated based on assumptions and other studies because of limitation of data. The Study Team utilizes the previous study results of damage estimation to estimate direct loss of the earthquake damage.

1) Building Damage

Data used for the analysis derived from the cadastral database, which is managed by computer service organization. Damaged floor area is calculated for each building structure using same damage ratio, which is derived from previous study. Damaged loss is calculated by using unit replacement costs by each structure type.

The direct damage loss of the building is RIAL 191,977 billion or USD 22.6 billion

2) Bridge Damage

In the previous study, 164 bridges located within the Study Area were evaluated. The evaluation is classified into three types: 1) collapsed, 2) unstable, and 3) stable. For the calculation of Direct Loss from bridge damages, approximate cost is applied temporarily. This unit cost for bridge construction will be updated when most updated unit cost information is received from TETCO.

3) Lifeline Damage

Lifeline consists of 1) Water, 2) Gas, 3) Electricity, and 4) Telecommunications. For each lifeline, since damage is estimated in the previous study, the Study Team attempted to estimate damage loss from lifeline network damage.

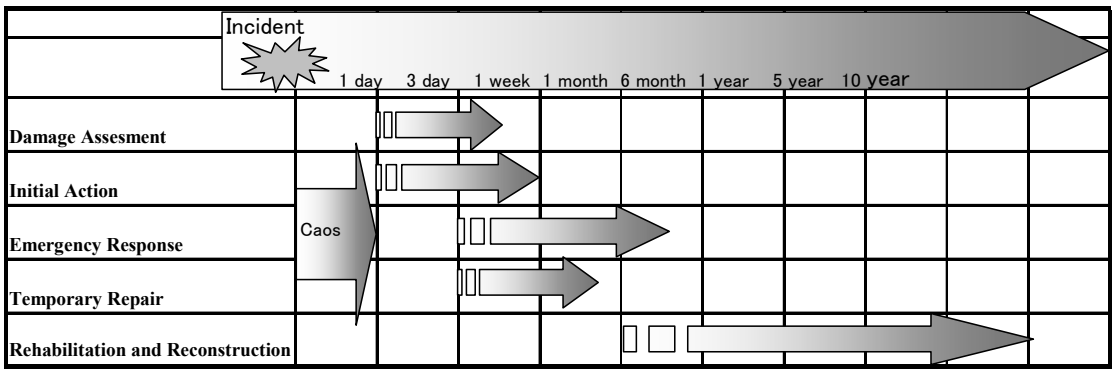
The amount of damage is RIAL 70.7 billion or USD 8.3 million in total lifeline damage.

4) Total Direct Loss

The analysis of the earthquake economic loss shows the amount of direct loss is 191,977 billion or USD 22.6 billion. It is equivalent to 37% of national GDP, RIAL 520,000 billion, or 106% of the annual municipality revenue. The preliminary analysis included only part of direct loss.

2.2.3 Indirect Costs and Secondary Effects of Earthquake Damage

Indirect damage costs and secondary effects of the earthquake are difficult to estimate in Tehran with the limited statistical data and without proper assumptions after earthquake (see Figure 2.2)



Source: JICA Study Team

Figure 2.2 Disaster Management Activities

Total economic impact of earthquake damage of Ray fault model is summarized as follows:

Direct Loss	USD 22.6 billion
Indirect Loss	USD 9.2 billion
Secondary Effect	USD 1.2 billion
Total	USD 33.0 billion

Total damage of the earthquake is 56% of the GNP of the nation.

2.2.4 Emergency Response Costs

After the earthquake, the governmental and other organizations will implement emergency response activities. The past experience in Iran is not available to estimate emergency response costs. The World Bank has carried out damage estimation and emergency response cost estimation in Marmara Earthquake in Turkey.[5] Based on the experience of the past earthquake in Turkey, emergency response cost is ranged between USD 150-200 per victim, which includes personal compensation for death and injury.

Emergency response cost is estimated at USD 2.9 billion.

2.2.5 Rehabilitation and Reconstruction Costs

After the earthquake damage, it is estimated more than 400,000 buildings will be collapsed. The inclusion of other damaged buildings would increase the number of buildings needing repair. The distribution of damaged building can be found in the southern part of Tehran. The

[5]Turkey Marmara Earthquake Assessment, The World Bank, September 14, 1999.

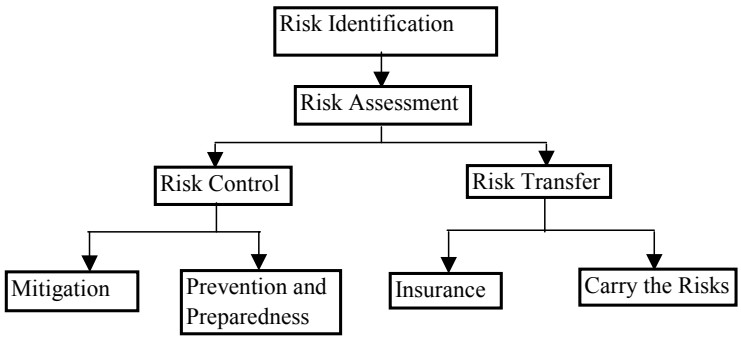
previous microzoning study shows the building damage distribution as a percentage of each zone. It is assumed that more than 50% of building collapse area would require area-development after the earthquake. Total area for area-development is about 31,000 ha, which is 44% of Tehran municipality.

The cost of area-development is estimated at USD 6.3 million per hectare, including housing development and infrastructure development. Total development costs will be USD 195 billion in total, which is 3.4 times of the country's GNP.

2.2.6 Economic Analysis of Earthquake Damage Estimation

1) Risk Management of Natural Disaster

Risk management of the natural disaster can be broken down as shown in Figure 2.3.



Source: Kiyoshi, Kobayashi, Japan Society of Civil Engineering, Vol. 85, July 2000

Figure 2.3 Risk Management of Natural Disaster

The first step is to identify risks. This work was done by the previous study, Seismic Microzoning of the Greater Tehran, in November 2000. Based on the identified earthquake risks, an assessment of their potential impacts and magnitudes has been clarified in this Study. Those are shown in number or volume and monetary terms of damages in this section. The building damage is large and earthquake impact is serious in the Tehran area. Therefore, risk control measures on building are considered in the next section.

The third step is to determine risk control methods and clearly identify measures to disaster management.

2) Economic Analysis on Mitigation

Target of damage reduction level is one-tenth of the Ray Fault Model, as indicated in Chapter 1. In order to achieve this goal, the Government and private sector should spend money on earthquake damage mitigation of the buildings, infrastructure and lifeline structure. The outcomes of the mitigation works can reduce the following estimated costs.

In this section, the Study Team attempts to compare the earthquake damage and required investment in three cases: Do Nothing, Reduced Damage at 30% and Reduced Damage at the Ultimate Level (90%). The three cases are compared as shown in Table 2.4

Table 2.4 Comparison of Damages and Costs for Three Cases: Do Nothing, 30% Damage Reduction, 90% Damage Reduction

		Case 1 (Do nothing case)	Case 2 (30% decrease of damage)	Case 3 (90% decrease of damage)
Earthquake Damage	Building Damage	483,000	330,792	51,058
	Human Casualty	383,000	265,572	57,071
	Homeless Victims	3,126,000	2,167,563	465,809
	Debris (1,000 ton)	124,000	85,981	18,477
Costs	Building Damage Costs	US$ 22.6 billion	US$ 15.9 billion	US$ 3.4 billion
	Building Strengthening	-	US$ 14.5 billion	US$ 63.0 billion
	Emergency Response	US$ 2.9 billion	US$ 2.1 billion	US$ 0.4 billion
	Rehabilitation and Reconstruction	US$ 195.3 billion	US$ 130.9 billion	US$ 19.5 billion
	Total	US$ 220.8 billion	US$ 163.4 billion	US$ 86.3 billion
Remarks		The damage of earthquake is derived from estimation results in Ray fault model.	This case is decrease of damage about 30%. This alternative is target reduction level within the period of master plan.	The ultimate case of 90% damage reduction. In this case, the damage level can be handled in emergency response.

Note:

1. In case 1 earthquake damage is derived from "The Study on Seismic Microzoning of the Greater Tehran Area in the Islamic Republic of Iran, November 2000."
2. Building Damage Cost is calculated based on the replacement costs of the building.
3. Building Strengthening Cost is calculated by the building analysis results, using GIs value to determine reconstruction and retrofitting. The unit cost of strengthening building is determined based on the actual conditions and applied to the number of the objective buildings.
4. Emergency response cost is calculated at US$ 57 per victim/ month and it will continue for six months.
5. Rehabilitation and reconstruction costs are estimated at US$ 6.3 million per hectare based on area development calculation.
6. The calculation of other case could be derived from assumption made from building sector report.

Source: JICA Study Team

The preliminary analysis on building risk management assumes the same scenario earthquake. The analysis on the damage reduction shows the building damage cost, building strengthening cost, emergency response cost and rehabilitation and reconstruction cost in monetary terms, yet the cost of human life is excluded from the analysis. The analysis also has not taken into account the time factor of the earthquake, because it is very difficult to predict when the earthquake will hit Tehran Municipality.

The analysis shows that the money spent before earthquake would result in minimizing total damage cost, if all costs were included. Reducing earthquake damage as much as possible will lead to the most efficient way for the earthquake disaster management. The emphasis should be given to the strengthening of the existing weak buildings before the event. This will continue efforts towards achievement of the ultimate goal.

Chapter 3
Strengthening Existing Buildings

CHAPTER 3 STRENGTHENING EXISTING BUILDINGS

3.1 Analysis of Existing Buildings in Tehran

The number of existing buildings in Tehran is summarized in Table 3.1, according to the taxation data obtained from Tehran Municipality Computer Service Organization (TMCSO) in 2002.

Table 3.1 Number of Existing Buildings in Tehran by Structural Type and Usage

Abbrev. of Structure	Description	Usage	Building Numbers
RC	Reinforced Concrete Structure	Educational	443
		Health	33
		Residential	35,863
		Governmental	272
		Other	1,360
Sub Total			**37,971**
WM	Weak Masonry (Brick or cement block or stone skeleton with middle steel columns/Brick skeleton with middle steel or concrete columns with 3 stories and up)	Educational	567
		Health	59
		Residential	166,433
		Governmental	242
		Other	5,508
Sub Total			**172,809**
URM	Unreinforced Masonry	Educational	3,810
		Health	374
		Residential	413,748
		Governmental	936
		Other	33,963
Sub Total			**452,831**
SEM	Semi-Enginerred Masonry	Educational	423
		Health	0
		Residential	0
		Governmental	0
		Other	0
Sub Total			**423**
ST	Steel	Educational	1,286
		Health	115
		Residential	235,239
		Governmental	888
		Other	16,535
Sub Total			**254,063**
AD	Adobe	All	6,770
HAN	Hangars and Canopies	All	11,054
MIX	Mix of 1~6	All	6,769
OT	Others	All	894
Total			**943,584**

Source: TMCSO, 2002

Total number of buildings in Tehran is 943,584, in which an approximate percentage of each structural type in the total is as follows; 4% for RC, 18% for Weak Masonry, 48% for Unreinforced Masonry, 1% for Semi-Engineered Masonry, and 27% for Steel. Approximately 90% of all buildings in Tehran are used for Residential purpose.

The building type Masonry was divided into three categories "Weak Masonry", "Unreinforced Masonry" and "Semi-Engineered Masonry". In each category obvious earthquake resistance is identified.

In order, to gauge the seismic resistance of buildings in Tehran, building investigation was conducted on a sub-contractual basis. The prearranged target numbers of buildings for investigation are shown in Table 3.2.

Table 3.2 Target of Building Investigation

Building Type		Sample Nos.
Public Facility	Major public facilities	70
	Hospitals	80
	Schools	100
	Other public facilities	10
Residential buildings	South	10
	Central	40
	North	40
Total		350

Source: JICA Study Team

The investigated buildings amounted to 287, in which 118 buildings were counted as Steel structure, 62 were RC and 107 were Masonry.

The following data and items were collected for each building:

- General configuration of the building (location, usage, structure types, construction year, outlook, number of stories, etc)
- Pertinent structural drawings

Throughout the site inspection, the following items were checked:

- Aging deterioration (crack, rust)
- Quality of construction materials (composition, brick, grout)
- Workmanship (welding)

Buildings of strategic importance in the event of disaster such as schools, hospitals and public and lifeline facilities were selected for building investigation and diagnosis, as those facilities should be utilized as a hub of evacuation and disaster mitigation. However, due to the veto for site inspection from authorities or property owners, or the fact that property owners seldom kept the original drawings, the number of investigated buildings were different from the prearranged target numbers at the beginning of the Study.

3.2 Evaluations of Earthquake Resistance

3.2.1 Objectives

Objectives of building diagnosis are as follows:

1) To comprehend earthquake resistance capacity of buildings in Tehran theoretically;
2) To estimate earthquake damage quantitatively on the basis of building investigation and diagnosis;
3) To comprehend structural weakness, which in turn provides useful information and offers suggestions for specific method of strengthening;
4) To estimate the improved effect of strengthening quantitatively, and
5) To make suggestions for building diagnosis method and its application to Iranian system.

3.2.2 Diagnosis Methodology

There is not specific building diagnosis method that has the force of law in Tehran currently. For some cases, US specification "FEMA356" has been referred.

For the Study, a main concept of Japanese building diagnosis system called "Specification on Earthquake Resistance Diagnosis and Strengthening for Governmental Buildings (Building Maintenance and Management Center of Japan)" is adopted, and the design earthquake is given based on "Iranian Code of Practice for Seismic Resistance Design of Buildings Standard #2800" (hereinafter referred to as Standard #2800).

There exist some specifications for building diagnosis in Japan, but only GI_S system has capability to evaluate earthquake resistance capacity of both steel frame structure and RC structure from a unified point of view. Since Steel Frame and RC structure types are of particular importance in predicting a construction trend in Tehran, the main concept of GI_S system was adopted for the Study.

The Japanese Specification provides the seismic index of structure, GI_S, in order to evaluate the seismic resistance capacity of building structure. GI_S is given as follows:

$$GI_S = \frac{Q_u}{\alpha \cdot Q_{un}}$$

Where, GI_S : Seismic Index of Structure

Q_u : Seismic force level for ultimate capacity check

Q_{un} : Required seismic force level for ultimate capacity check

α : Correction coefficient

The detail of diagnosis methodology is presented in Sector Report

Average GI_S value for each building type obtained by building diagnosis is summarized in Table 3.3. Detail observation with peeling off exterior cladding was not done exactly in this project, because strengthening does not necessarily follow building investigation. So this report does not offer the diagnosis result for each individual building.

Table 3.3 Average GI_s Value for Each Building Type

Structure	Usage	Number of Story	GI_S
Reinforced Concrete Structure	All	1～3	0.50
		4～7	0.40
		More than 7	0.50
Weak Masonry (Brick or cement block or stone skeleton with middle steel columns / Brick skeleton with middle steel or concrete columns with 3 stories and up)	All	All	0.16
Unreinforced Masonry	All	1～2	0.14
		More than 2	0.19
Semi-Engineered Masonry	Educational	All	0.20
Steel	Educational	All	0.25
	Health		0.25
	Residential		0.21
	Governmental		0.25
	Other		0.25
Adobe	All	All	0.02
Hangars and Canopies	All	All	0.15
Mix	All	All	0.15
Others	All	All	0.15

Source: JICA Study Team

3.3 Application of Building Diagnosis

It is inherent in definition that GI_S value refers to the physical quantity that is obtained by dividing structure capacity by required capacity. Therefore GI_S value can be converted to "damage ratio of buildings P" because the damage ratio is defined as probability of damage. Main concepts of this conversion are based on "Probability theory" and "Reliability design method". The theory and algorithm to reach the damage ratio, P, is presented in Sector Report.

The amount of anticipated building damage for Tehran is estimated by using damage ratio and database (TMCSO), as shown in Table 3.4.

Table 3.4 Damage Summary of Existing Buildings

(Unit: Million Rial)

Number of Existing Building	Number of Damaged Building	Damaged Property by Cost
943,584	473,399	188,101,557

Source: JICA Study Team

Using the same concept of damage estimation for existing buildings in Tehran explained in the above sections, the effect of strengthening and reconstruction on a reduction of vulnerability of buildings in Tehran can be estimated. Table 3.5 shows the estimation result for the case that damage is reduced to the level of realistically coping with an earthquake disaster event.

Table 3.5 Number of Damaged Buildings After Strengthening and Reconstruction

	Number of Building	Number of Damaged Building
Number of Not Strengthened nor Reconstructed Building	21,583	6,440
Number of Strengthened Building	89,512	25,679
Number of Reconstructed Building	832,489	18,939
Total	943,584	51,058

Source: JICA Study Team

Table 3.6 shows the estimated cost for strengthening and reconstruction.

Table 3.6 Estimated Cost for Strengthening and Reconstruction

(Unit: Million Rial)

Cost for Strengthening	Cost for Reconstruction	Total
33,412,050	470,609,722	504,021,773

Source: JICA Study Team

3.4 Strengthening Countermeasures

The fundamental measures for strengthening the buildings are "Demolition and Reconstruction", "Strengthening existing building", and "Area Redevelopment". "Demolition and Reconstruction" is the most effective. However, even the newly built buildings do not have enough earthquake resistance because a building construction appraisal system does not control the quality sufficiently in the current state either. Effective system of building construction appraisal is needed for Tehran.

3.5 Building Construction Application and Procedure

For the building construction in Tehran, Tehran Municipality issues construction permit and certificate of construction completion. According to "Performance Statistics of Secretariat of Commission, Article 5," a total of 2,847 certificates of building construction completion in Tehran were issued in Year 2000.

The Department of Urban Planning and Architecture of Tehran Municipality published the guideline for building construction, "Basis for Action", in September 2002, in which all the regulations, procedures and standards related to building construction are described, namely, "Issuing Construction Permit", "Division of Lands and Properties, Business", "Issuing

Non-Offense and Construction Completion Certificates, Duties" and "Supervising Engineers Affairs". According to the guideline, the procedure of building construction can be divided into four phases: appraisal phase, designing phase, construction phase and completion phase. The schematic flow of building construction practice is shown in Figure 3.1.

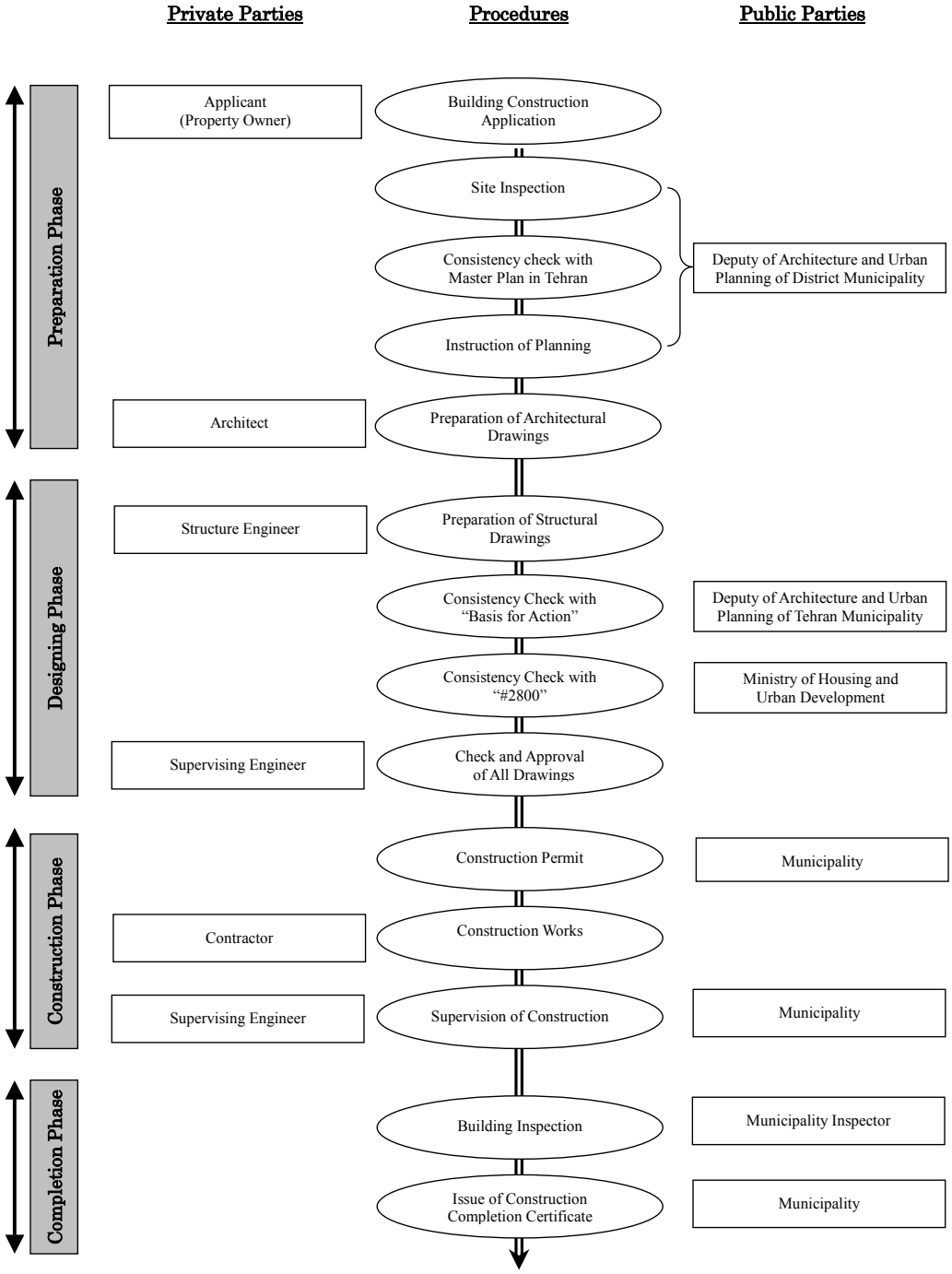


Figure 3.1 Schematic Flow of Building Construction Practice

The fundamental issues for the existence of low seismic resistance of buildings in Tehran are inappropriate appraisal system and lack of strict regulation and observation ability in Tehran

Municipality. The loose regulation for the employment of engineers hired by property owner allows the construction of buildings with poor seismic resistance due to financial constraint. In addition, Tehran Municipality does not have a capability of appraising the seismic resistance of building, which in turn resulted in relying on the judgment of appropriateness in issuing permit mainly on compliance with architectural plans, city planning regulations and the documents prepared by property owner's employees.

In recent years Tehran Municipality established the Office of Building Design Control, whose duty is to double-check the design accuracy of important buildings. However, this office lacks the proper legal power and entity and therefore does not have the authorized enforcing power to control the building construction. Table 3.7 summarizes the problems in building construction procedure.

Table 3.7 Problems and Consequent Effects in Building Construction Procedure

Procedures	Problems		Consequential Effects
	Private Parties	Public Bodies	
Building Construction Application	The Property Owner hires Architect, Structural Engineer, Supervising Engineer and Construction Contractor by him/herself.		The duties of those engineers tend to be dependent on Property Owner's preference, not on regulations and theories.
Issue of Construction Permit		Municipality does not have a capability to check structural aspect of building designing. Construction permit is usually given based on architectural drawings.	The emphasis of building construction has been made on architectural and city planning regulations and aspects, resulting in the existence of many low seismic resistant buildings.
Supervision of Construction		Municipality relies its supervising duties of building construction on the reports of Supervising Engineer, who is hired by Property Owner.	As-built construction has been made as a result of persuring freedom and low cost of construction. Not a small numbers of private masonry buildings has been constructed with over two stories, being opposite to regulation in Standard #2800.
Construction Works	Property Owners have usually hired non-engineering construction workers.		The use of poor quality materials and poor execution of welding would be induced.
Building Inspection		Building inspection is made by Municipality Inspector, who usually check only external apperence of building.	Property Owner spends less for structural materials and construction qualities in order to obtain cost effectiveness.

Source: JICA Study Team

For the establishment of a functional building construction appraisal system, Tehran Municipality should conduct the following reforms in the appraisal system.

<u>Legal empowerment capacity development of the newly established Office of Building Design Control</u>

The fragmented appraisal responsibility causes the loose check and control practice. The Office of Building Design Control should have capability of handling the entire appraisal and a legal power to control building construction. The Office should have the function and

human resources to check particularly the structural appropriateness to be consistent with Standard #2800.

Ensure that only licensed individuals are involved in building construction

Every engineer involved in building construction should be a registered engineer of Tehran Municipality. In addition, a supervising engineer should be assigned by Tehran Municipality.

3.6 Action Plan

3.6.1 Implementation of Building Diagnosis

A fundamental issue for building strengthening and securing a city's safety is to identify the buildings of poor earthquake resistance and to examine the effect and validity of building strengthening. In order to do so, building diagnosis is indispensable.

1) Discussion about a specification on building diagnosis

No specific building diagnosis method that has the force of law in Tehran currently exists. However, a unified indication that has the force of law is needed in order to implement effective action for earthquake-proofing.

A committee should be formed to discuss about a specification on building diagnosis in Tehran. Purposes of this committee are providing a certain procedure for the particular situation of Tehran and providing the full force of law behind this specification.

The main body of this committee should be Tehran Municipality, and members should be selected from public research organization (BHRC, IIEES, Tehran University, etc.) and some engineers who belong to construction or consulting firms.

2) Experimental research on existing buildings

There is a need to recognize characteristics of existing building structures by experimental study in order to certify reliability of diagnosis method.

Some researches have already been carried out by public research organization in Tehran, but the samples of the experiments do not target on the low quality buildings. It is very important to evaluate the earthquake resistance capacity of the low quality buildings, because diagnosis system must point out the insufficient capacity by quantitative accuracy. There are a lot of misunderstandings about earthquake resistance of the buildings because of few quantitative evidence obtained from inspection.

Without modeling experiments and analyses that reflect the real situation of existing buildings in Tehran, no calibration of mathematical analysis is obtained. Practical specification should be provided for all the engineers in Iran.

3) Implementation

Firstly, building diagnosis should be carried out targeting public facility by utilizing the specification prepared by above-mentioned committee. This implementation should be conducted as a case study of diagnosis, considering that many property owners do not understand the significance of building diagnosis.

The standard to judge a building as "sufficient", "strengthening is needed" or "demolish and reconstruct" should be based on the result of this implementation.

In this Study, "seismic index of structure GI_S" is recommended. The relationship between damage ratio and GI_S value is explained to give the information about Judgmental standard in the sector report. If this quantitative indicator is utilized, a practical way of judgment can be given for each particular building.

Remaining tasks are to calibrate this system and to give the evidence of accuracy to the system. Sufficient discussion should be done in the committee to obtain a consensus about the system.

3.6.2 Implementation of Strengthening

First of all, it is necessary to implement a public building strengthening project as an example, but majority of earthquake damage may be that of private building (i.e. residential buildings or small shops). However, the project cannot be executed directly by turning to public budget. Some kind of project is needed to offer incentive to each individual landowner as follows.

- The low-interest loans
- The capital promotion by public organization
- The redevelopment project to area where buildings of low earthquake resistance concentrate

The matters which the Teheran City should immediately focus on are as follows.

- Establishing a system by relevant authority
- Providing public information of system
- Setting up an information desk for citizens
- Establishing an authority in charge of implementing detailed diagnosis
- Developing a computer software to help diagnosis
- Devising a screening method before conducting a detailed diagnosis

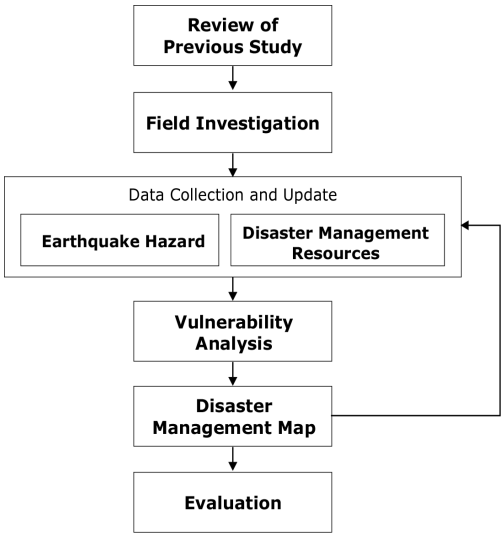
Chapter 4
Improvement of Existing Urban Structure

CHAPTER 4 IMPROVEMENT OF EXISTING URBAN STRUCTURE

4.1 District Diagnosis Analysis

4.1.1 Diagnosis Procedure

In order to evaluate district earthquake hazard and response, the study team has carried out a district earthquake disaster diagnosis analysis. The purpose of the analysis is to keep each district informed about disaster hazard and disaster prevention resources, so that district municipalities and related parties understand the existing situations. Basic idea of this study makes use of previous study results and integrated data and information as a GIS database. The Study Team takes the steps in Figure 4.1 to conduct the analysis:



Source: JICA Study Team

Figure 4.1 Procedure of District Diagnosis Analysis

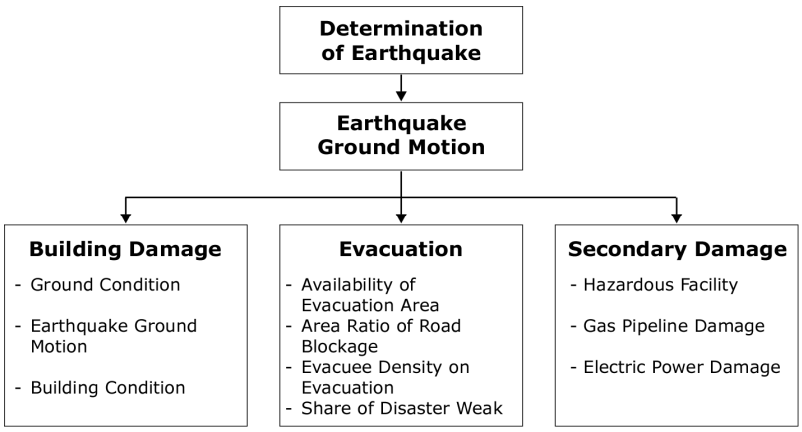
4.1.2 Disaster Management Resource

Disaster management resource analysis for each district is carried out based on two sources of information. One is land use data from Tehran GIS Center (hereinafter referred to as "TGIS") which is mainly for disaster management resources, collected by the previous study. The others are "Parks and Open Space", "Public Education Facilities" and "Disaster Management Facility" collected data by the Study Team's efforts during the project. The results of the analysis are compiled into "District Disaster Diagnosis Sheet" in the Sector Report.

4.2 Vulnerability Analysis in Tehran Municipality

4.2.1 Methodology

The previous study quantified the damage caused by earthquake in terms of building, human casualty, bridge and lifeline by each microzone. In order to evaluate the area's vulnerability to earthquake, the Study Team carried out area vulnerability analysis based on those data and information. To analyze an area's vulnerability, the Study Team selects three variables; "building damage", "evacuation" and "secondary damage", and the index are used to represent each variable. The analysis takes the following steps:



Source: JICA Study Team

Figure 4.2 Procedure of Vulnerability Analysis

4.2.2 Analysis

1) Building Collapse

Vulnerability to building collapse in each microzone is assessed on the estimated maximum building damage ratio of the three earthquake scenarios of Ray Fault, North Tehran Fault and Mosha Fault from the previous JICA Microzoning Study.

2) Evacuation

Vulnerability to people's evacuation is assessed on the four sub-fields as follows.

- Availability of Evacuation Place by District
- Population Share of Disaster Weak by District
- Road Blockage Ratio by Microzone
- Evacuee Density on Evacuation Route by Microzone

3) Secondary Damage - Secondary Disaster

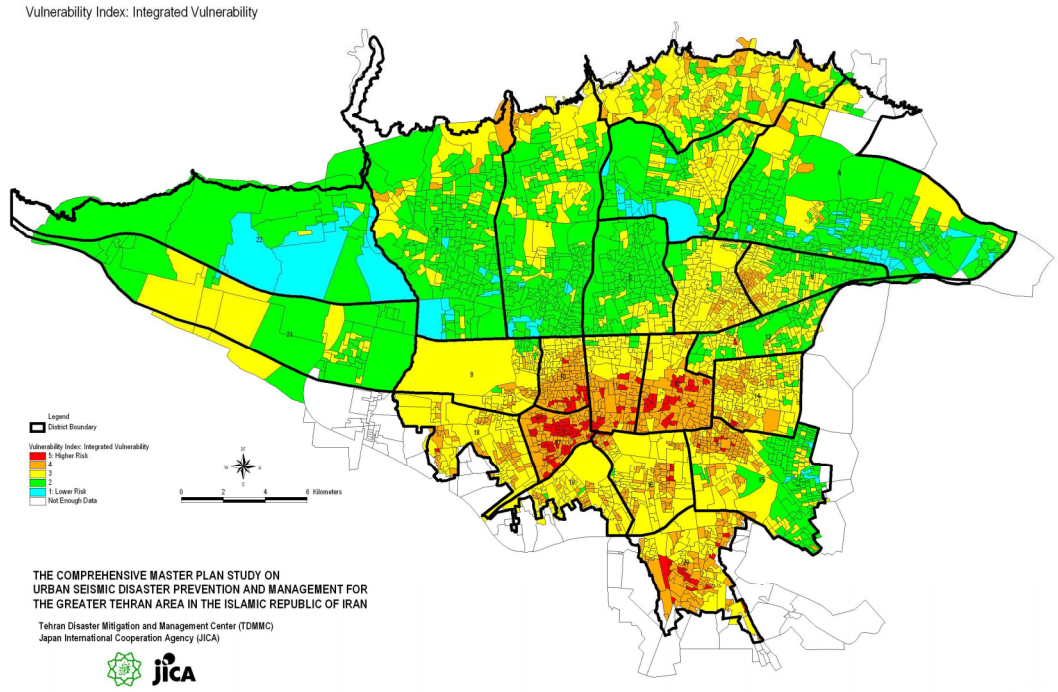
After an earthquake event, more serious human casualties will be caused by secondary disasters, which will be generated by hazardous facilities and damaged hazardous infrastructures such as collapsed/heavily damaged buildings with natural gas supply pipes, damaged electric power supply cable and so on.

4.2.3 Integrated Vulnerability

Integrated vulnerability is assessed on the sum of the estimated three vulnerability indices of building collapse, people's evacuation and secondary disaster. Three variables are weighted as shown below.

- Vulnerability to Building Collapse: 2
- Vulnerability to People's Evacuation: 2
- Vulnerability to Secondary Disaster: 1

The weighted sum of the estimated vulnerability indices in each microzone is classified into five ranks of 1 to 5. A result of Integrated vulnerability analysis is shown in Figure 4.3.



Source: JICA Study Team, 2004

Figure 4.3 Integrated Vulnerability Index

4.2.4 Regional Characteristics of Urban Vulnerability

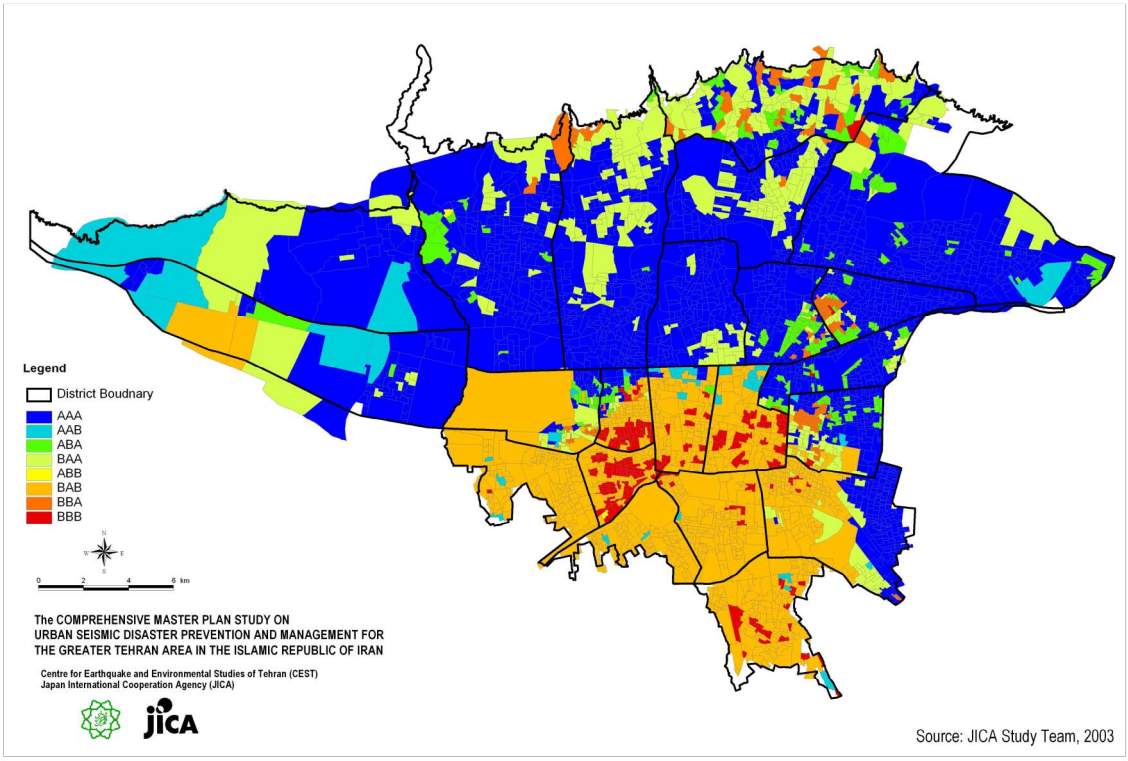
In order to understand specific vulnerability, the Study Team reorganized each vulnerability index into eight categories. AAA stands for not serious vulnerable area, on the contrary BBB stands for most vulnerable area. The first letter applies to building damage, the second is evacuation, and the third is secondary disaster.

Table 4.1 Evaluation Criteria and Urban Characteristics

Evaluation Index	Characteristics of Disaster Management
AAA	Relatively less vulnerable urban structure
AAB	High risk on secondary disaster
ABA	High risk on evacuation possibility
BAA	High risk on building collapse
ABB	High risk on evacuation possibility and secondary disaster
BAB	High risk on building collapse and secondary disaster
BBA	High risk on building and evacuation possibility
BBB	High risk on all variables

Source: JICA Study Team

The result of the vulnerability analysis, which is given according to the eight categories of risk, is shown in Figure 4.4.



Note: The map is produced based on the evaluation criteria in Table 4.2.3.

Source: JICA Study Team

Figure 4.4 Characteristics of Vulnerability

4.3 Urban Development for Disaster Prevention

4.3.1 Issues from Aspect of Disaster Prevention

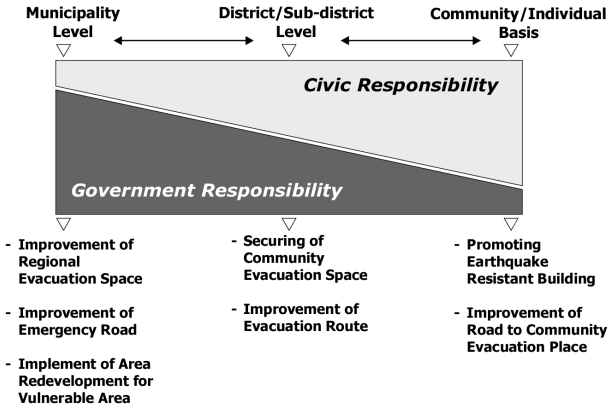
Based on the vulnerability analysis, it is found that Tehran is not strong enough against earthquakes affecting major problems which are 1) high density, 2) inadequate evacuation facilities, and 3) structurally weak and old buildings.

The most vulnerable area is typical of congested with weak and old buildings and lack of open spaces which are distributed mainly in the central of Tehran.

4.3.2 Basic Approach for Disaster Resistant City

To be an earthquake resistant city, Tehran City has to make a breakthrough in the current conditions, or to attain following things as objectives which are 1) to decrease density of vulnerable area, 2) to secure sufficient spaces for evacuation, and 3) to increase earthquake resistant buildings.

To achieve the objectives above can bring about to lessen the disaster damage and to keep urban function when an earthquake happens as well as to make smooth evacuation and relief activities after the occurrence. Practical major strategies and the responsibilities are shown in Figure 4.5.



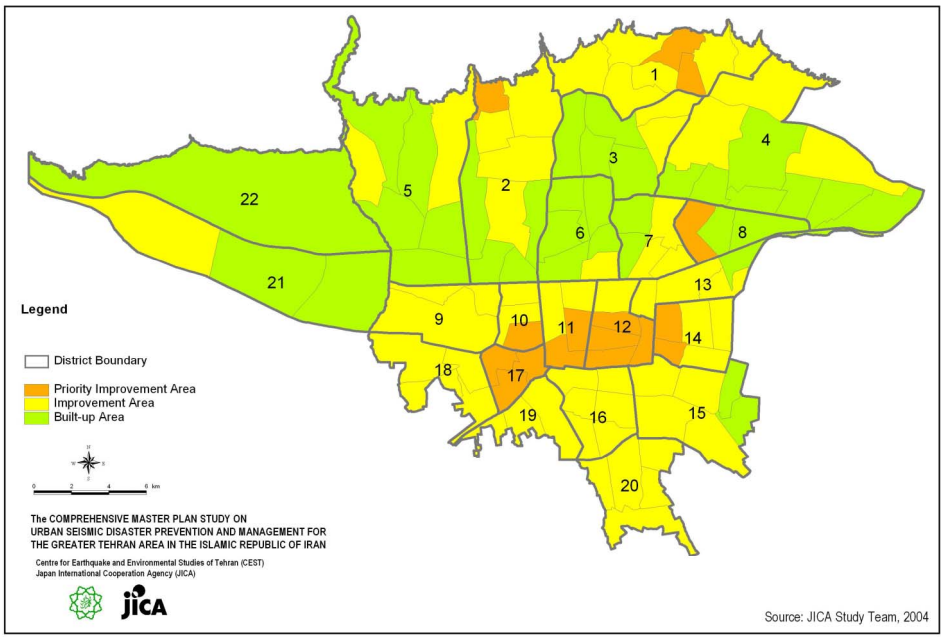
Source: Based on Urban Disaster Prevention Handbook, 1997, Gyosei, modified JICA Study Team

Figure 4.5 Strategy and Responsibility for Disaster Prevention

4.3.3 Basic Policy of Urban Development

Based on the vulnerability analysis, the study team carried out analysis to classify Nahiye districts in the study area into three categories, namely "Priority Improvement Area," "Improvement Area" and "Built-up Area" in terms of undertaking urban improvements by priority (see Figure 4.6). The comparison of each area's characteristics is shown in

Table 4.2.



Source: JICA Study Team

Figure 4.6 Zoning of Improvement Area

Table 4.2 Major Features of Three Categorized Areas

Vulnerability/ Characteristics	Basic Approach	Supporting System	Institution Concerned
1. Priority Improvement Area			
Vulnerability • Building Collapse Index-B Evacuation Index-B Characteristics • Out of the coverage of regional evacuation place • High density • Old building	Regional Level • Large-scale area redevelopment • Designation and legislation of "Disaster-proof Living Zoning"	• Area redevelopment in right conversion system • PPP scheme • Dedicated fund for urban redevelopment system • Financial cross-subsidization system • Legal process for formulating consensus among residents • Cadastral-based land registration and appropriate property assessment system • Taxation systems to capture accrued benefits from beneficiaries	• TDMMC • Tehran Municipality • Ministry of Housing and Urban Development • Ministry of Interior
2. Improvement Area			
Vulnerability • Building Collapse Index-B Evacuation Index-A • Building Collapse Index-A and Evacuation Index-B Characteristics • Not all area inside the coverage of regional evacuation place • Middle to high density	District Level • Development for disaster prevention plan at community level • Securing of Community Evacuation Space • Improvement of Evacuation Route • Small-scale land redevelopment	• Dedicated fund for urban redevelopment • Practical land readjustment system • Legal process for formulating consensus among residents • Enforcement of earthquake-resistant design codes and inspection system to secure design-compliant building act	• TDMMC • District Municipality • Local Community
3. Built-up Area			
Vulnerability • Building Collapse Index-A Evacuation Index-A Characteristics • Inside of coverage of regional evacuation place • Low to middle density	Individual Level • Individual implementation for disaster prevention • Strengthening of individual buildings	• Enforcement of earthquake resistant design codes and inspection system to secure design-compliant building act • Introducing incentive system to promote strengthening buildings • Dedicated fund for urban redevelopment system	• District Municipality • Local Community • Ministry of Housing and Urban Development

Source: JICA Study Team

Chapter 5
Identification of Safety Evacuation Space

CHAPTER 5 IDENTIFICATION OF SAFETY EVACUATION SPACE

5.1 Evacuation System

5.1.1 Regional Evacuation Place

1) Evacuation System

It is vital that residents can evacuate to safe place through certain route when an earthquake happens. Accordingly, evacuation system, a wide area evacuation place and evacuation roads, should be provided, that is, it is necessary to specify and secure open space which is large enough to accommodate residents and roads which is wide enough and linked with evacuation place. In addition to, the system should be well-known by residents.

(1) Regional Evacuation Place

It is an open space such as a large-scale park or green space without any slope and surface, which is for protection evacuees from any dangers such as falling of buildings and others when a large-scale earthquake hit.

(2) Community Evacuation Place

It is a place for evacuating persons to form a group temporarily to evacuate to the regional evacuation place. The place shall be such as urban parks, sports field, school, religious facility, etc. in which the safety of assembled persons can be secured.

(3) Evacuation Route

It is a road that leads form 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. Appropriate width of road as evacuation route is more than 15 meters.

2) Selection of Regional Evacuation Place and Evacuation Route

Approximately 1,030 locations are listed by municipality in which candidate regional evacuation places are selected by using certain software called “Tehran Temporary Housing Software”. Candidates for the place are 136 locations which are selected from the list and combined area of those facilities by the appropriate criteria.

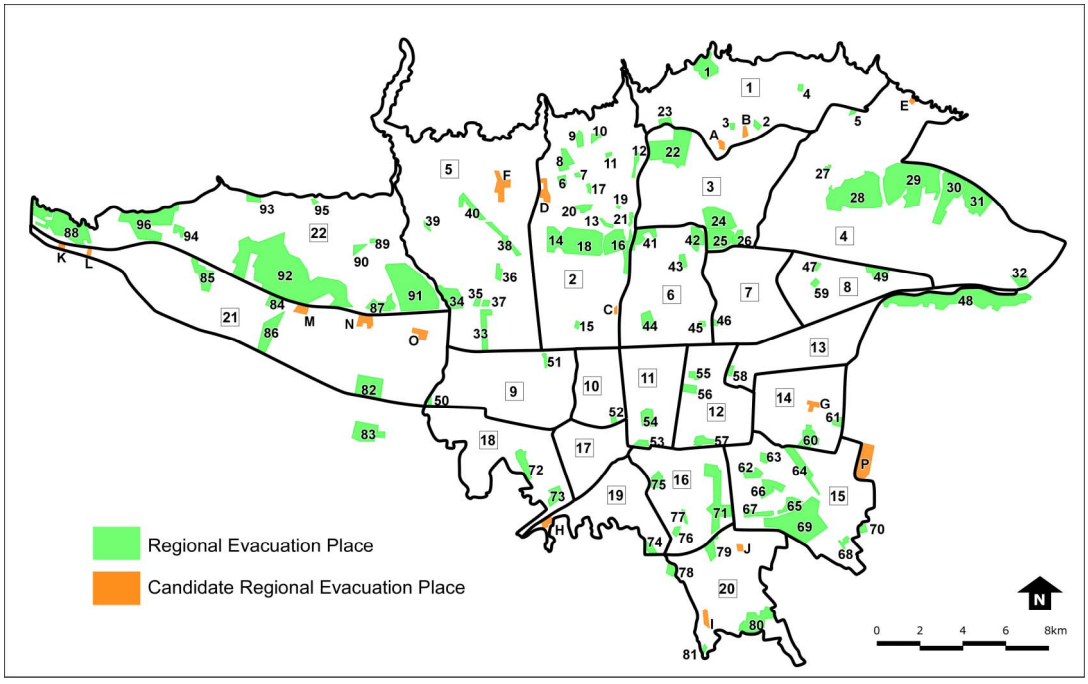
3) Screening of Regional Evacuation Place

Candidates for the place are selected from the list and combined area of those facilities by the criteria as follows:

- Public owned land and facilities for stability,
- Major park, open space and sport ground for flexible utilization,
- Public facilities with enough seismic resistant building structure,
- Without any natural hazardous area,
- Without any hazardous chemical facilities in and around the area, and
- Emergency potable water supply, toilet (tank), and emergency goods storage are proposed.

4) Regional Evacuation Space

Based on the criteria as above, the study team identified 96 areas out of 136 identified locations for regional evacuation place which is in total 6,655 ha. Additionally, 15 locations, are not belonging to public utilization, are identified as candidate regional evacuation places. Identified regional evacuation places and candidate places are shown in Figure 5.1.



Source: JICA Study Team 2004

Figure 5.1 Location of Regional Evacuation Place and the Candidate Place

Based on the analysis conducted by the study team, regional evacuation spaces are not enough for District 7, 9, 10, 12, 14, 17, 19 in term of the capacity. But in light of distance from those evacuation places, most of the districts hold certain areas outside of coverage of the evacuation place. The study team proposed some private lands should be identified as candidate regional evacuation areas.

5) Basic Approach for Improvement of Regional Evacuation Place

The study team proposed to establish a "Committee for Regional Evacuation Place" in TDMMC or Tehran Municipality Office. Major roles of the committee can be considered as follows;

- To review the regional evacuation place regularly in cooperate with Park and Open Space Organization,
- To coordinate with the private owners of candidate regional evacuation place to designate those areas as regional evacuation place, and
- To approach to land use planning and redevelopment projects for securing open space as regional evacuation place.

6) Installation of Facilities in the Regional Evacuation Place

Based on size of each regional evacuation place, it should keep appropriate facilities and/or equipments for occurrence of an earthquake, that is, helicopter port, toilets, telecommunication system, water tank, food storage, and so on. Accordingly, relevant signboards should be set up at the regional evacuation place in order to easy evacuation. Major role of the committee is to designate community evacuation places and evacuation route base upon opinions from community's representatives.

5.1.2 Community Evacuation Place and Evacuation Route

The study team recommends that a "Committee of Evacuation Place and Route" is established at District Municipality which can be consists of district officers and as well as volunteers from communities or local residence.

1) Selection of Community Evacuation Place

Each district shall identify its community evacuation places, and the evacuation place should cover the whole Tehran Municipality completely. The study team prepared a guideline regarding community level evacuation place identification and distributed it to each district through TDMMC.

2) Evacuation Route

Designation of evacuation route is proposed to link and connect from community gathering/evacuation places to regional evacuation area safely. In the selection of evacuation route, the following should be considered for safety reasons:

- Select roads wider than 15 m,
- Do not select route adjacent to the identified hazardous facilities as much as possible,
- Do not select route passing through vulnerable building area as much as possible, and

- Do not select the designated emergency road network as much as possible.

Maintenance and improvement of identified evacuation route should be done by district municipality and communities.

5.2 Emergency Road Network

5.2.1 Review of Emergency Road Network Plan by TDMMC

Primary emergency road network has made by TDMMC on September 2003. Based on the network, policy and approach of TDMMC are fairly different from that of study team. Taking the differences into consideration, the basic policy and recommendations for traffic control are presented in the next section.

5.2.2 Proposed Emergency Road Network System

The proposed Emergency Road Network System consists of two levels of road networks, which correspond to the required timing of emergency response activities as follows.

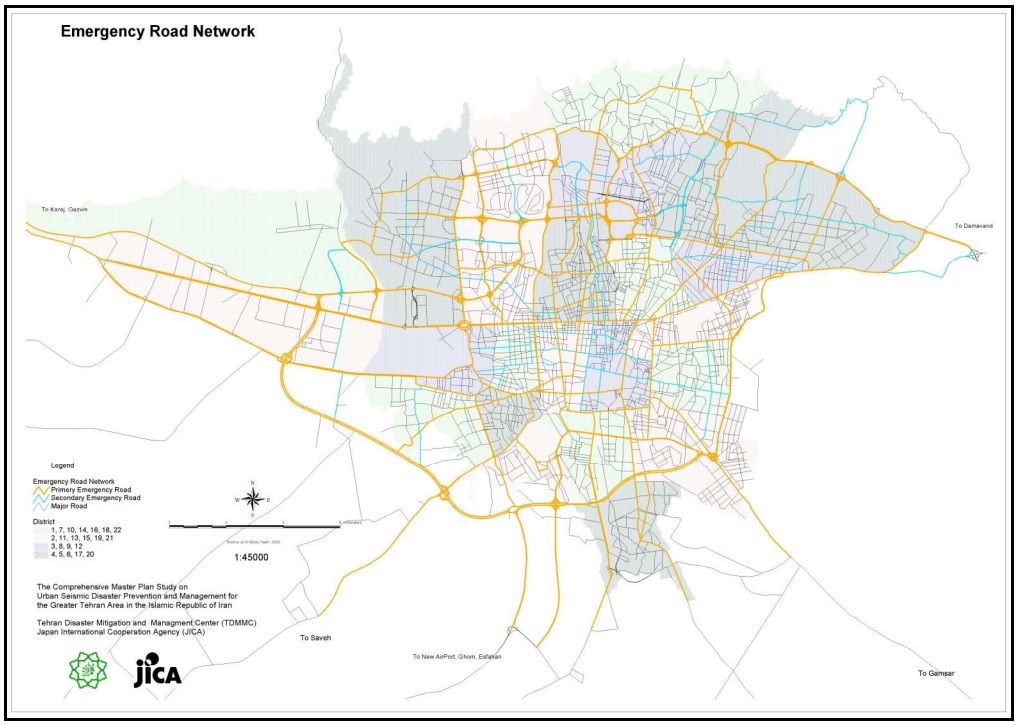
- **Primary Emergency Road:** linking with Disaster Management Centers of national, provincial, municipality, district, and sub-district municipalities and major airport and seaport as for transportation nodes.
- **Secondary Emergency Road:** linking with all the identified emergency response centers of rescue/fire fighting/security, emergency road, and medical care.

5.2.3 Approach and Method for Emergency Road Network

GIS-based Shortest Path Analysis Method is proposed and applied to identify the minimum time distance route to link with the identified centers for each level of emergency road. The shortest path is analyzed on the road inventory database of TCTTS.

5.2.4 Emergency Road Network

The Study Team identified the emergency road network by using shortest path analysis. The following figure shows emergency road network in the Study Area.



Source: JICA Study Team

Figure 5.2 Proposed Emergency Road Network

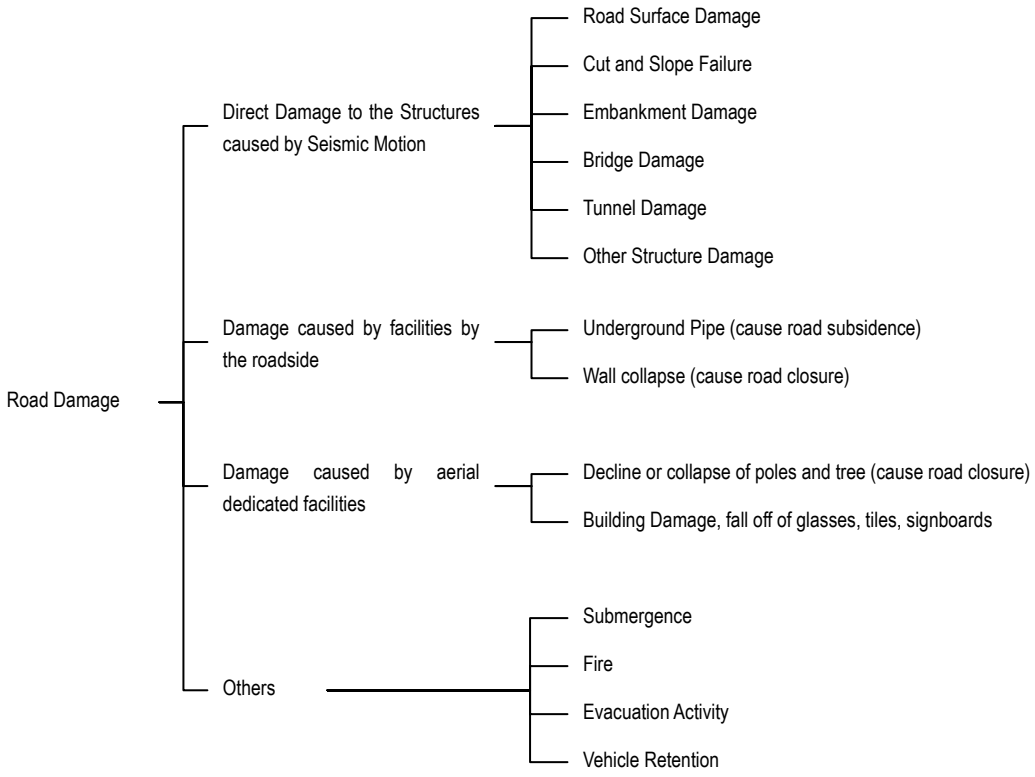
Improvement of identified emergency roads, both in primary and secondary should be carried out fully for preparation to occurrence of disaster. The improvement and maintenance can be done by TDMMC cooperate with other organizations such as the police department and traffic police.

Chapter 6
Strengthening Existing Infrastructure and Lifeline

CHAPTER 6 STRENGTHENING EXISTING INFRASTRUCTURE AND LIFELINE

6.1 Strengthening of Road Structure

Road Damage against Earthquake can be categorized as shown in Figure 6.1, 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.



Source: Japan Road Association, 1998

Figure 6.1 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 facility, bridge collapse will create the most serious malfunction of road network. Therefore, strengthening method is explained in the following section.

6.2 Strengthening of Bridge Structure

6.2.1 Concept

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.

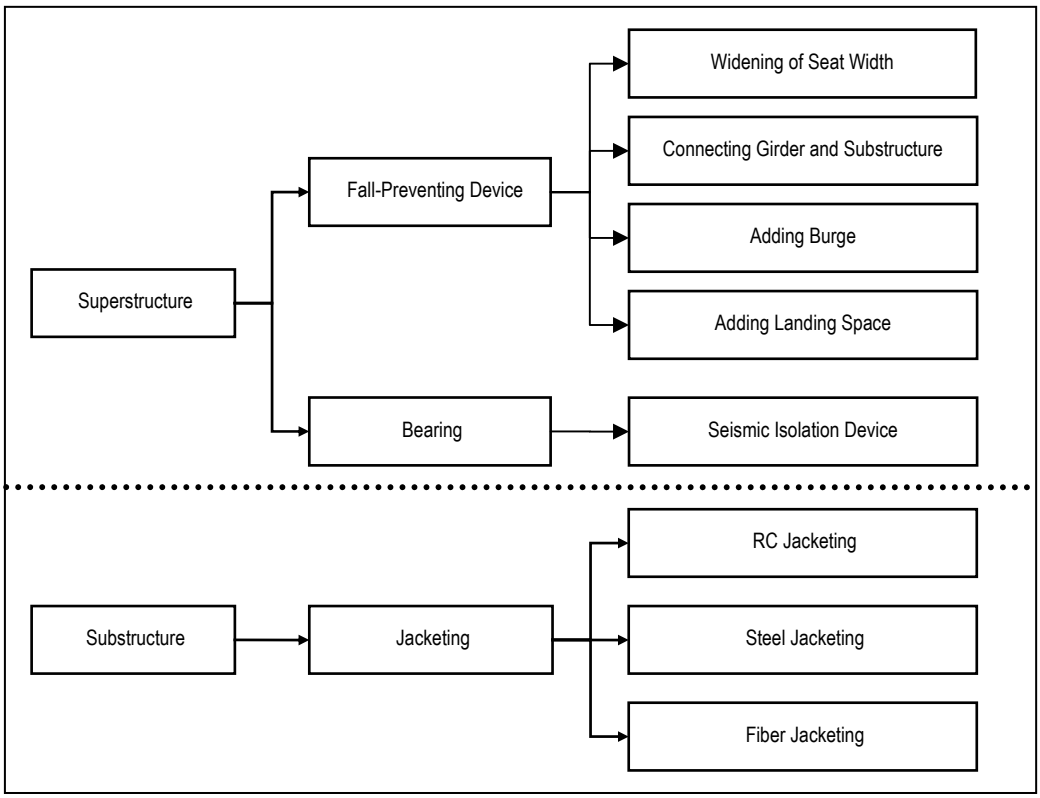
In this damage estimation, bridge inventory data prepared by Tehran Engineering and Technical Consulting Organization and JICA Study Team were used. This inventory list of bridges includes 239 bridges and 168 bridges out of 239 bridges identified with location.

In this study, those bridges were observed, and finally, in case of Ray Fault mode, five bridges are estimated as “Collapsed” and 4 bridges are estimated as “Unstable.”

6.2.2 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 6.2 shows typical types of strengthening method widely used in Japan.



Source: JICA Study Team, 2004

Figure 6.2 Types of Strengthening Method for Bridge Structure

Typical types of strengthening method for superstructures and substructures are shown in the main text of main report.

6.3 Strengthening of Lifeline Structure

6.3.1 General

Critical infrastructure systems called "lifeline" such as water, gas, electricity, and telecommunications are becoming increasingly interdependent 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 telecommunications 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.

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.

6.3.2 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 considering seismic resistance. Measures for seismic resistance will be indicated for the points estimated to incur damage.

6.3.3 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, review seismic resistance of facilities and carefully consider the appropriate maintenance and management.

To install new pipelines, 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" with the cooperation of 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 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 about damage from earthquake and is doing its best as far as possible to establish a central safety control system in the near future.

6.3.4 Electricity Facility

Knowing past trend of damage to electric power facility will help to strength existing facility. In this section of the main repot, damage characteristics caused by earthquake are 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.

Chapter 7
Provision of Earthquake information and Education

CHAPTER 7 PROVISION OF EARTHQAUKE INFORMATION AND EDUCATION

7.1 Present Condition

Based on the social survey and interviews carried out in Tehran, major characteristics of districts in Tehran are identified as follows. Those in the southern neighborhoods generally have vulnerable structures, are poor, with high density, low levels of literacy and young populations. The central districts share some of the southern characteristics in a lesser degree but also have some of the city's cultural buildings and have a much higher population in the daytime as compared to the nighttime. The northern districts are characterized by stronger and often newer structures, higher incomes, and higher rates of literacy. The new peripheral districts are for the most part better designated and have a lot more open spaces but they lack much of the social cohesion seen in the older neighborhoods. While all active local persons should be considered, their levels of cooperation with the local organizations were minimal.

The households had few extra resources that could prove useful in case of an earthquake. 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 was not very prevalent because of the inappropriate lending system. Therefore, a large payment for housing lays a burden on household.

The most important source of general information for the respondents was television followed by newspaper and radio. People who had received earthquake-related training or information are not many and very few knew of the year of the National Disaster Mitigation Week in Iran. Many people, however, have some general information about what to do in case of an earthquake. Overall the higher the socio-economic level of the respondents the more likely it was 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, many respondents thought that when the earthquake occurs, there would be widespread devastation. Respondents in the north had more reasonable attitude toward risk while more of those in the south thought that the gods would decide their destiny. Similarly, there was more or less a relationship between socio-economic level and risk attitudes. The number of respondents who state that they had talked about earthquake preparedness and mitigation at home or in the office was generally low.

Most of the local groups were either religious or sport-related and they 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 socio-economic strata.

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, 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.

7.2 Education for Disaster Preparedness

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

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. Staff of district offices will be also trained on their individual roles and activities. 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 local staff visit disaster-related facilities and hazardous areas so that they can observe and carry out field survey to develop appropriate judgment activities.

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 and Fire Brigade Department and TDMMC.

It is important that students understand the dangers to occur 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. The Ministry of Education, Deputy of Education in Tehran Municipality and the International Institute of Earthquake Engineering and Seismology (IIEES) will manage and control some of these items in order to promote disaster education in schools and other educational facilities.

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. 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 and 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. Knowledge of earthquake will be disseminated and further enhanced through various seminars and trainings with target of some groups (NGOs and CBOs) such as women's groups, environmental groups, youth associations and PTA, 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. Considering the characteristics and usual activities of each group, suitable items will be added.

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, newsletter, 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 rescue and relief in collaboration with the local residents and the related organizations.

Chapter 8
Establishment of Disaster Mitigation Policy

CHAPTER 8 ESTABLISHMENT OF DISASTER MITIGATION POLICY

8.1 Insurance

8.1.1 Insurance System Profile

Iran has presently a still government dominated and controlled insurance sector, which is modeled around European insurance systems. The Government's privatization efforts have resulted in the formation of around seven private insurance companies that are, however, still a minor market force. The present system covers standard type of "life" and "non-life" related insurances, the premium for which are determined along standard rates applicable in Europe with the regulatory framework requiring that companies' risk exposure is re-insured on either the domestic or international re-insurance markets.

However, the current system does not offer explicit stand-alone disaster related insurance, in particular for public and private non-movable (building) and movable (museum exhibits) assets, which must be considered a system-anomaly in a disaster prone country. The Government is now pursuing a policy that seeks to remedy this situation.

8.1.2 Selected Policy Issues

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. Many details still need to be established, such as legal framework requirements, implement ability, enforcement, risk transfer and risk financing mechanisms.

8.2 Promotion of Private Building Strengthening

8.2.1 Governmental Assistance with 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.

8.2.2 Proposed Governmental Assistance Policies

1) Policy Options

Three political measures to assist in promoting private building strengthening are possibly considered; low-rate loan, subsidy and insurance. Each of those policy or options by mixture can be applied case by case.

- Low-Rate Loan

  Low-rate loan scheme with an annual interest rate of 8% and 10 years of payback period is applied to the cost for building strengthening, considering an annual open market rate of 15% in Tehran.

- Subsidy

  Subsidy will be applied to the cost of building diagnosis and a part of building strengthening cost.

- 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.

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 strengthened and the same amount shall be strengthened.

3) Strengthening Cost

Table 8.1 shows the cost of building diagnosis, strengthening and reconstruction by structure type.

Table 8.1 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

Attitude survey was conducted to grasp the acceptance level of 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.

According to the attitude survey, 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.

Table 8.2 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 that of masonry building. The total willingness to pay value of Tehran citizen is calculated as US$ 1,868.7 million.

Table 8.2 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

5) Options for Assistance Policy Application

(1) Assistance Policy for Strengthening

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.

On the other hand, a loan-favored option shall be applied for owners of steel or RC frame building, considering the higher value of willingness to pay.

(2) Assistance Policy for Reconstruction

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 owners of 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 with the conditions of 8 % of an interest rate and 10 years of payback period will be available.

On the other hand, 10% of total reconstruction cost exclusively used for the structural improvement to be seismic resistant shall be provided by subsidy, considering a natural and spontaneous reconstruction demand of those buildings in Tehran.

6) Cost Estimation

The total amount of yearly required cost counts for approximately US$ 122.8 million, including the cost for seismic diagnosis covered by subsidy. 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.

7) Management of Revenue

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.

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 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.

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

In order to protect life and property of the local people in case of an earthquake, it is important for all disaster-related organizations from national to community levels to take measures at full efforts. At the same time, individual 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 and workplaces, etc. Furthermore, these measures for disaster preparedness can be effective if the local community cooperate, collaborate with existing community organizations such as youth associations and women's groups and establish 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.

The role of local residents is very important for disaster preparedness and management. Local residents have to have the intention of securing their safety by themselves and to implement the available measures of disaster preparedness steadily both in the normal condition and in the outbreak of earthquake. 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 a definite purpose to work for disaster management, they can then cooperate with district offices and start to prepare disaster management plan and implement the activities based on the discussion with district offices. Major activities of the groups are accumulating knowledge for disaster preparedness, creation of the community-based disaster map, preparation of the plan for the temporary life at shelter, implementation of drills for disaster preparedness, etc.

The persons who manage or operate the workplaces and facilities are to ensure the safety of the employees and users and 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.

Tehran Municipality and district offices will promote involvement of the existing CBOs and NGOs and establishment of self-management groups in Tehran and support for the vitalization of their activities. Areas to be considered for attention are areas (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. Supporting activities are committee for promotion of NGOs, CBOs and groups of self-disaster management, development plan for self-disaster management groups, community file for safety and relief, involvement of disaster preparedness activities in the group activities, utilization of community centers, and subsidy for groups for self-disaster management.

9.2 Community Level Organization

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.

Some existing organizations or groups can be considered for functioning for that purpose. Also, there are various types of aggregation of the local people and the places to absorb a lot of community members can be found. 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 to cover all area of Tehran. However, in order to make all these bridges work well, they have to be provided education and training in advance and be ready and committed to act in emergency case.

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. 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.

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 directly access the local residents, if they have wireless, Internet and other communication tools. NGOs and 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 and schools are places where people gather still and with their loud speakers, play a role of providing information to the people for emergency. 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 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 dissemination to all residents, checking safety of all residents, management of evacuation site and temporary shelters, providing food and water, etc. On the other hand, condition of the local area will be reported to district through the organizations and facilities.

Chapter 10
Improvement of Disaster Management System

CHAPTER 10 IMPROVEMENT OF DISASTER MANAGEMENT SYSTEM

10.1 Emergency Response Scenario

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. Ray Fault model is taken as the scenario earthquake to contribute to the study for appropriate emergency plan by Tehran Municipality. Emergency response scenario of 1) Municipality Emergency Response Headquarters, 2) Rescue, Relief and Medical Treatment, 3) Evacuation, 4) Traffic and 5) Lifelines are assumed.

10.2 Organization and Management of Emergency Response for Tehran

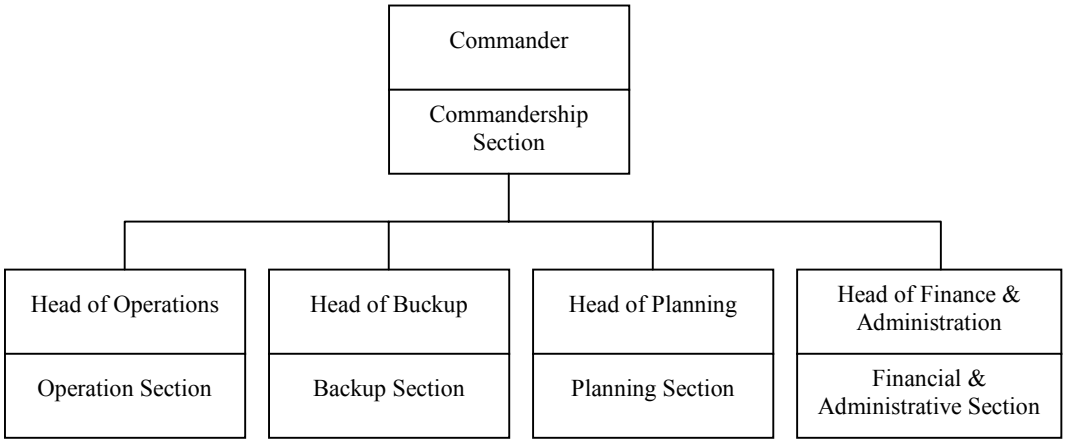
10.2.1 Legal Background of Emergency Response

At the national level, the RCS has a responsibility for rescue and relief activities. The RRCP is 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 starts 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.

10.2.2 Organizations

The Tehran Comprehensive Disaster Management Plan proposed the establishment of an emergency response organization based on Incident Command System (hereinafter referred to as "ICS"). 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 10.1 Disaster Command System in Tehran

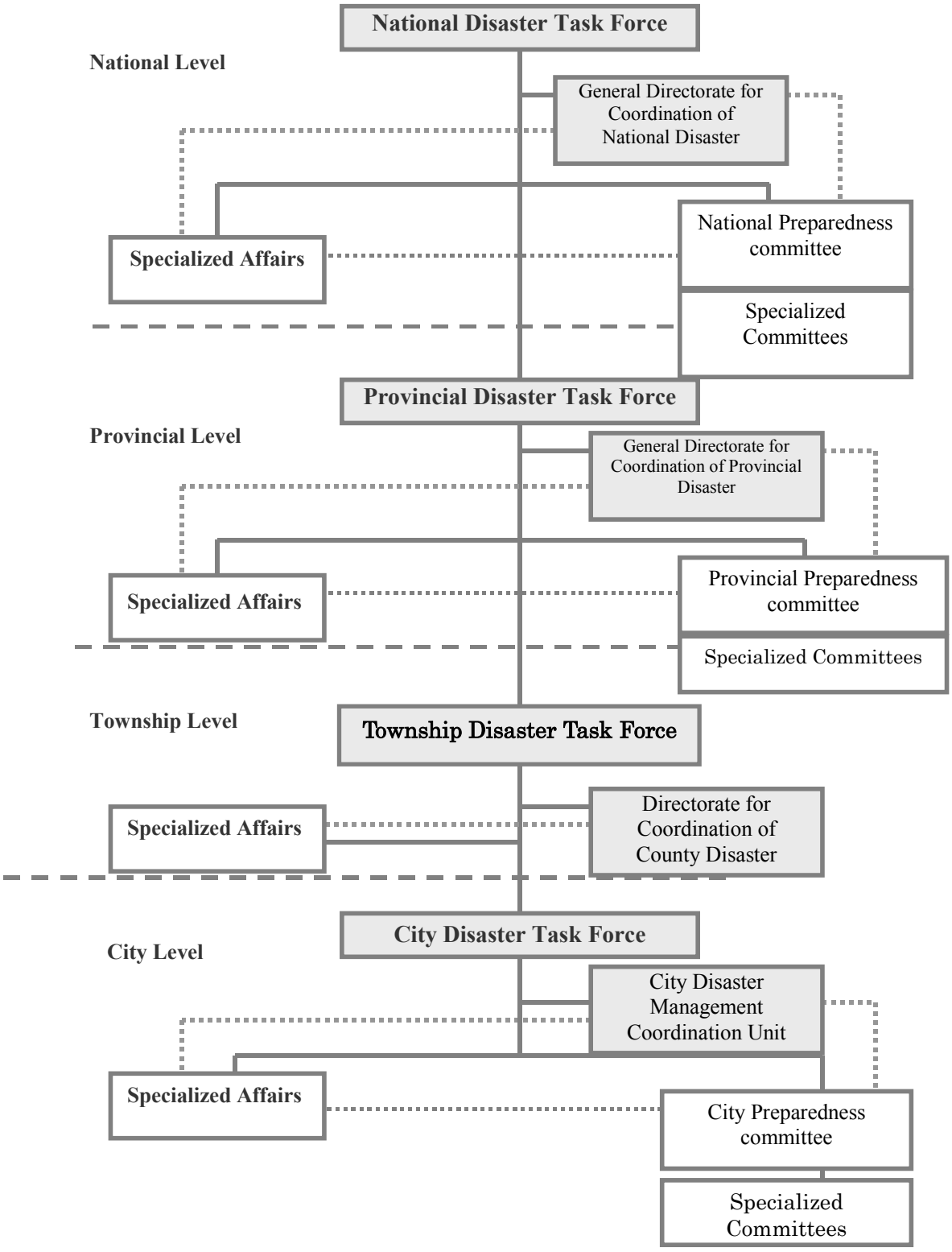
The Incident Command will have three command staff members: an information officer, a safety officer and a liaison officer. The emergency response organization should have those functions. However, the responsibility and role of each disaster management organization has not been determined by the plan.

The comprehensive disaster management plan is proposed to have a Standard Emergency Management System together with ICS commanding system. Standard Operation Plan is established in Tehran Municipality. 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 explanation nor type of disaster determined.

10.2.3 Initial Actions

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

Figure 10.2 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.



Source: TDMMC

Figure 10.2 Disaster Management Organization Chart in I.R.I.

10.3 Other 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 organizations. The cooperation from the other provinces is also important to include in the plan. However, Tehran Municipality has not made arrangements on mutual cooperation with other organizations after a disaster. The mutual cooperation with other organizations should be established before the event.

Chapter 11
Formulation of Emergency Response Plan

CHAPTER 11 FORMULATION OF EMERGENCY RESPONSE PLAN

11.1 Information and Communication System

11.1.1 Concept

Serious damage is given by earthquake disaster instantly, in addition to the direct damage, indirect damage as a secondary is gradually developed to be serious situation. The main reason is lack of necessary information, because the telecommunication network was disrupted by the disaster. The lack of information does not make research and rescue operations effectively, and rumor and incorrect information are buzzed round public and become panic. Then the damage is to be more developed. According to questionnaire survey in Japan, the victims and people living the disaster area are seriously required the following information:

- Information of next earthquake and fires as after shock
- Safety information of family, relatives and friends
- The detail earthquake information such as hypocenter and seismic intensity

In order to prevent panic and minimized the secondary damage, the above information and evacuation instruction are frequently released to the public frequently through the high performance disaster network. At present, Teheran city has not yet an effective disaster network.

As far as the disaster network, the following functions should be at least furnished:

- Strong earthquake-resistant
- Immediacy operation
- Stable communication with moving terminals
- Flexible network

11.1.2 Disaster Information and Telecommunication Network

According the past disaster study, it is obvious that radio system is clearly superior to the cable system in terms of earthquake-resistant, so that it is indispensable to introduce the radio system as a transmission method for the disaster network. There are two measures to create the strong disaster information and telecommunication network, one is reinforcement of the existing public telecommunication network and another is newly installed exclusive disaster network. The former plan has an advantage in cost-wise, but it is feared that the reinforced

network is not fully strong against the greater earthquake. In addition, call connection becomes very difficult by congestion of inquiry calls after the disaster.

Considering all conditions, this master plan recommended the new installation plan of the exclusive disaster communication network.

11.1.3 Configuration of the Disaster Network

The new disaster network is basically consisted of backbone network and access system. The both networks are introduced by radio system. The backbone network is connected with TDMMC main center and 21 district centers in uninterrupted loop configuration by microwave radio system and the access network is covered to make the communication services within the district area by PHS mobile system. Access network is mainly connected with search and rescue vehicles near the disaster site and the backbone network, and all required information is gathering into the TDMMC main center.

TDMMC main center is the most significant hub station to manage and control the search and rescue operations in the whole Teheran area, the center is to collect and distribute the necessary information, early estimation of the damage, decision making and coordination work with the associated organizations. The district centers and Sub-district stations are near to the disaster site, so they can collect the latest and collect information about the disaster damage and send it to the main center.

The most important point is that the disaster network has never collapsed easily by earthquake disaster, but has kept the communication services. And, since the network is not so frequently used in normal condition, PHS access system is recommended as the most cost-effective system in the disaster network at the present moment.

11.2 Search and Rescue

Resources for search and rescue in Tehran are estimated totally short to meet exploding needs after the earthquake. Given the circumstances, overall objective of Rescue operations will be "to save as many lives as possible – those trapped and in danger – in E3 to E4 level situations. Some important strategies to fulfill this 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

   Search and Rescue operation is commonly understood to be critically effective until 72 hours after the building destruction by the earthquake. Only simplified system to make decisions can make it possible to mobilize and concentrate the resources in the shortest time.

2) Utilize the community resources to support rescue activities to the fullest extent

It will be impossible to put Search & Rescue teams into countless collapsed buildings. Rescue operations will not reach the people in any other way but by counting on community people's help for the trapped in ruins of residential buildings with three or less stories.

3) Search and rescue teams

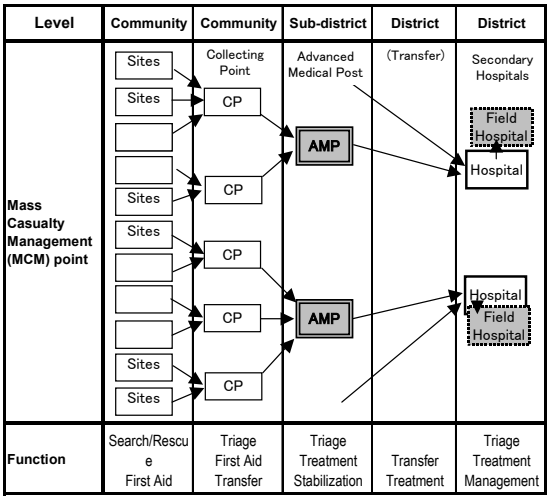
Search and rescue teams at three levels defined in table below will be deployed over the affected area (see Table 11.1). In principle, one District Rescue Team and ten Community Rescue Teams may be thrown in a district impartially, while two to three Hyper Rescue Teams, which are equipped with advanced search devices, will be dispatched to the highest priority facilities

Table 11.1 Search and Rescue Teams Formation

Level	Team category	Target/Area
III	Hyper-rescue team: 100–200 staff	Priority facility in all the city area
II	District rescue team: 20 – 100 staff	Mid- and high-rise buildings in District
I	Community rescue team: 10 – 20 staff	Conventional residential building in Community

4) Establish Mass Casualty Management (MCM) system as a part of systematic response

Casualties will be managed through the standardized MCM system that is composed of four vital emergency elements: community- based response activity, Advance Medical Posts (AMPs) at sites, Hospital care and Transportation. Among them one of key components is AMP, which will play a role of checking point before sending the injured to hospitals to control their flow (see Figure 11.1). Tertiary level hospitals need to be protected from being overwhelmed by massive light cases. Establishment of control system of victims' flow from the scenes to hospitals through AMP is crucially important for effective emergency disaster treatment. AMP will be set up one at least in a sub-district and its role will change with time from triage and treatment for the injured to care for internal cases.



Source: JICA Study Team

Figure 11.1 Mass Casualty Management (MCM) system

5) Community-based Rescue and Treatment Activities

Community people will be organized and mobilized on voluntary basis to assist Community Authority and Local Health Personnel (see Table 11.2).

Table 11.2 Role of Community and Local Health Personnel in Rescue and Relief Activities

Player	Role in the Urgent period
Community authorities	Set up of **Emergency Committee,** Dissemination of information, Search and Rescue operations, Fire Extinguish operations, Transfer of casualty, Assistance of Reception at Health Centers or Hospitals
L H P	Organizing Health Centers or Hospitals, Triage, On site treatment

Note: * local authorities and persons or groups are who concern themselves with rescue, communications, transport, shelter etc.

Source: JICA Study Team

11.3 Health and Medical Service Operation

Medical resources available in Tehran is also expected short to cope with enormously surging needs after the earthquake. Given the circumstances, the objective of "Health and Medical Services" operations will be to reduce as much mortality and morbidity as possible in E3 to E4 level situations. Some important strategies to fulfill the objective will be:

1) To place first priority on life-saving care throughout the medical care operations

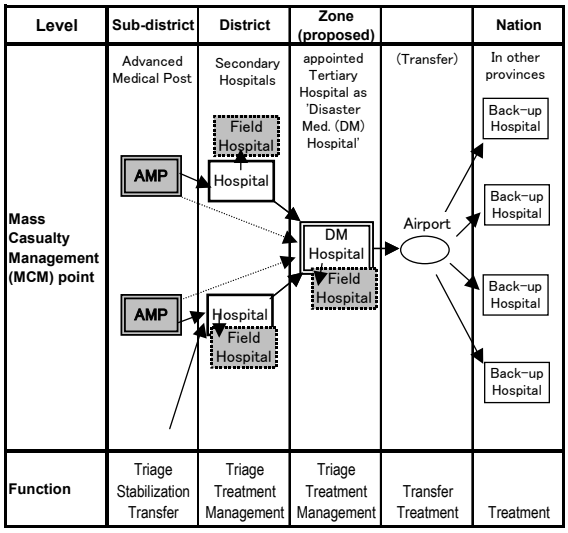
Treatments must be selectively provided to the injured who will be judged savable through triage at every treatment point.

2) To mobilize and utilize available resources fully regardless of locations, ownership and source

Not only government commitment but pre-arrangements about the way to utilize them is crucially important by endorsing monetary compensation for their expenses to treat the injured unconditionally.

3) To make organized response by establishing treatment level tiered-system over the country

Establishment of system to provide care, from community first, then to transfer to hospitals through AMPs in local network, and to hospitals in metropolitan and national network, is crucially important. Hospitals will be assigned roles according to its EMS level from I (primary) to III (tertiary) in order to utilize scarce resources, based on the zoning system with a couple of III level hospitals on the top (see Figure 11.2, Table 11.3).



Source: JICA Study Team

Figure 11.2 Management Flow of The injured After AMP

Table 11.3 Role of Hospitals During the Disaster Period by Emergency Levels

ER Level	Current Level	Expected role during the disaster
I	Primary and a part of Secondary	No inpatient service Almost as the same function as those of AMP
II	Secondary and a part of Tertiary	Outpatient treatment: Triage and providing simple treatment Inpatient service: To intermediate cases only
III	Tertiary	Inpatient treatment: severely injured but savable only

Source: JICA Study Team

4) To provide health care to meet victims' needs which change over time

Health resources must shift from treatment for trauma cases during first several days to care for acute internal cases followed by patients with chronic diseases. And Environmental Health and Disease prevention activities including expanded daily services should be developed over the area soon after the critical period (see Table 11.4).

Table 11.4 Activities in Health Area

Area	Response Activities
Environment Health	Supervision of evacuation camp and shelter conditions, 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
Disease Prevention	Surveillance, Diagnosis, treatment and Laboratory test, Isolation of patients if necessary Control of disease sources Supporting vulnerable groups Vaccination, Nutrition and Comoprophilacsy
Expanded daily services	Mother and child health Oral health and Dental clinic Counseling and Mental health Logistics

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

11.4 Evacuation

11.4.1 Definition of Evacuation System

The effective evacuation method at the time of earthquake disaster is a group evacuation method. The JICA Study Team proposes two steps of emergency evacuation system.

Step 1 : Primary Evacuation to Community Evacuation Place

Step 2 : Secondary Evacuation to Regional Evacuation Place through Evacuation Route

In Chapter 5, the JICA Study Team preliminarily proposed the regional evacuation places for each district.

11.4.2 Method of Evacuation

Recommendation and instruction of evacuation shall be made by TDMMC, District Municipality and Fire Fighting Department 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 fire breaks out at the same time caused by an earthquake and fires spread and expand.
- When it is deemed necessary to protect residents from disaster.

After placing the recommendation or instruction of the evacuation, TDMMC and District Municipality 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

The Fire Brigade shall notify TDMMC and the District Municipality about most safe route and directions of evacuation. When evacuation begins, the fire-fighters shall engage in evacuation guidance.

11.4.3 Operation and Maintenance of Evacuation Place

The operation of evacuation places shall be conducted, in principle, by RCS. However, the District Municipality shall take appropriate measures including 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.

TDMMC and District Municipality shall maintain the wireless system that is used for evacuation guidance and aid activity. The wireless system shall also be used for the direction,

order and information distribution between the RCS, the Fire Brigade and the Police Department.

11.5 Traffic

11.5.1 General

The implementing policy of traffic control is proposed. It can be classified into control from space aspect and time aspect. Traffic control from space aspect includes route control and area control.

11.5.2 Route Control

The route control covers road sector and route. Designation of emergency road 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 and shall obtain a slip and a certificate. Emergency roads network and emergency transportation route shall be designated in advance. The JICA Study Team preliminarily proposed the emergency road network shown in Chapter 5. 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.

11.5.3 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. 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 of 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. The Study Team recommends that a decision on the unit of blocks for the area regulation be made beforehand. If a unit block for the subject of regulation is decided, in advance, to be the minimum unit of certain areas that is 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.

11.5.4 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. Fairly rough regulation which takes into account 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 reason is that, if

the regulation is changed frequently, it becomes difficult to make information concerning regulation fully understood.

11.5.5 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.

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 of main report, 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 network 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.

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 and well understand the purpose and importance of such a plan. According to Tehran Water and Sewage Company (TWSC), the Study Team learned that the company has not yet prepared a detailed emergency response plan. Therefore, utilizing these recommendations from the study, it is necessary to prepare a detailed emergency response plan in the near future.

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

Main objective of emergency response for water facility is to pursue the following:

1. to maintain water supply at emergency phase,
2. to make a quick response to recover damaged facilities, and
3. 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

11.6.4 Gas Facility

As mentioned in Chapter 6, GTGC is implementing "Research Project for Strengthening and Control of Tehran Gas Network against Earthquake."

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 and understand the contents of GTGC's security measures.

11.6.5 Electricity Facility

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: Disaster Levels E1, E2, E3, E4
4. Relevant Tasks: 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 about 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. 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.

11.7 Water Supply

11.7.1 General

Potable water is indispensable resource for human life. After the event of earthquake, it is easy to imagine that lack of water will be occurred 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.

11.7.2 Existing Condition of Water Reservoirs

At present, there are over 80 water reservoirs in Tehran, and their total capacity is approximately 2.4 million m^3. 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.

11.7.3 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.

In case of Japanese Standard, water consumption volume is 3 liters per person up to 4 days, and increase 3 to 20 liters (up to 10 days), 20 to 100 liters (up to 20 days), and 100 to 250 liters (up to 1 month).

There is more capacity of water in Northern part of Tehran, which also shows less damage to buildings. If no water supplies form dams, 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.

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, 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 other countries.

11.7.4 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

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.

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. At the emergency case, this facility will be open to public and used as emergency water supply.

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. 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, only 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.

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 following measures are the necessary requirements for Tehran Municipality:

- 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 office, traffic police, 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.

- To make an agreement on foods provision with retailers and wholesalers

  The relevant institutions should have a contract with retailers and wholesalers for additional provision by order in the case of lack of foods.

- 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. Tehran Municipality should adopt the subsequent steps for each timeframe of disaster as follows:

  Normal time

  Tehran Municipality should prepare human resources and machinery implements for foods provision as follows:

  - 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

  Initial response time to disaster

  The following are required countermeasures in this term:

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

Recovering time after 3 days of earthquake occurrence

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

Chapter 12
Establishment of Rehabilitation and Reconstruction Procedure

CHAPTER 12 ESTABLISHMENT OF REHABILITATION AND RECONSTRUCTION PROCEDURE

12.1 Introduction

The rehabilitation and reconstruction phase can be divided into the recovery phase and the rehabilitation and reconstruction phase. In recovery phase, the purpose is to return to before the 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.

12.2 Laws and Regulations

1) Regulatory Framework

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.[6] Such framework should establish and/or refer to at least (i) technical standards for reconstruction 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

In Tehran Municipality level, it is important to establish regulations or decrees for rehabilitation and reconstruction, because the problems of Tehran area, 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

[6]) "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.

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.

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 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.

12.4 Proposed Basic Process for Urban Rehabilitation and Reconstruction

The process for urban rehabilitation and reconstruction is proposed. It is divided chronologically into five stages from the moment of the disaster.

Stage 1: Establishing the Preliminary Framework for Urban Reconstruction

(Within one week from the time of the earthquake)

Stage 2: Formulation of Basic Policies for Urban Reconstruction

(From one week to one month after the earthquake)

Stage 3: Formulation of Basic Plan for Urban Reconstruction

(From one month to six months on)

Stage 4: Confirmation of the Work Program for Urban Reconstruction

(From six months to a year on)

Stage 5: Implementation of Urban Reconstruction Projects

(One year and onwards)

Work procedures of these planning and implementation programs in each stage are interrelated and can not be in line in an orderly way. Figure 12.1 shows the conceptual flow of these activities.

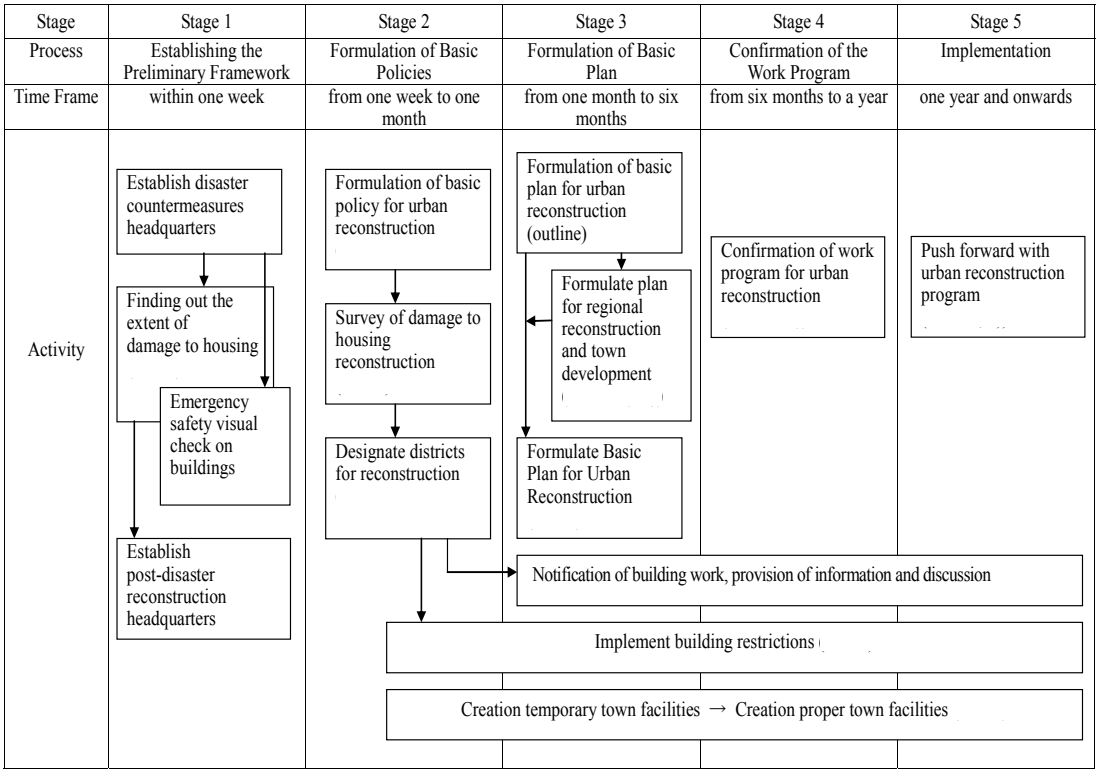


Figure 12.1 Basic Process of Urban Rehabilitation and Reconstruction

12.5 Basic Consideration for Rehabilitation of Citizen's Living

It is one of the most important issues to rehabilitate citizen's living after the earthquake disaster. The Governmental Organizations shall be demanded utmost to support and cooperate for the citizen's life to recover the original and stable conditions. Table 12.1 summarizes the basic execution items for rehabilitation of citizen's living.

Table 12.1 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

Chapter 13
Development of GIS database

CHAPTER 13 DEVELOPMENT OF GIS DATABASE

13.1 GIS Database Master Plan

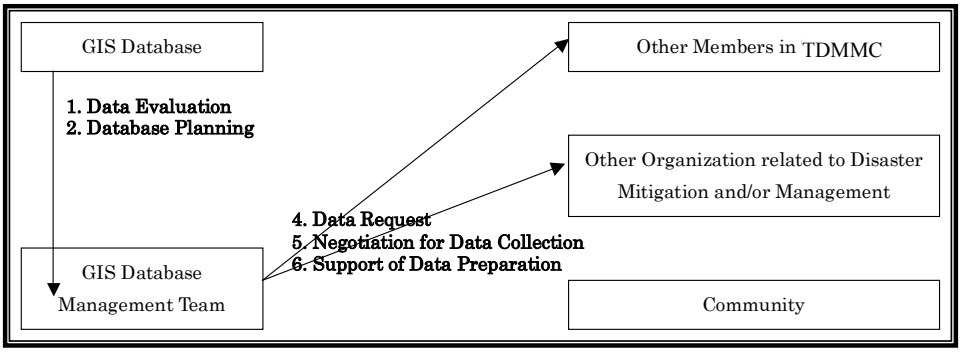
The primary purpose of GIS database is "Planning of disaster mitigation, management, rescue and rehabilitation by quantitative and geographical analysis, by cooperation work with related organizations." The secondary purpose is publishing of any approved analysis and/or plans to disaster responses, by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

13.2 Work Flow before Disaster

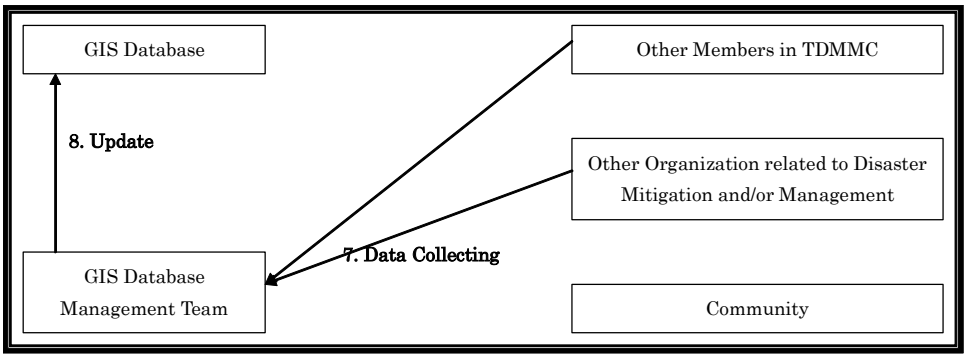
13.2.1 Database Maintenance

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



Source: JICA Study Team

Figure 13.1 Work Flow Before Disaster: Database Maintenance (1)

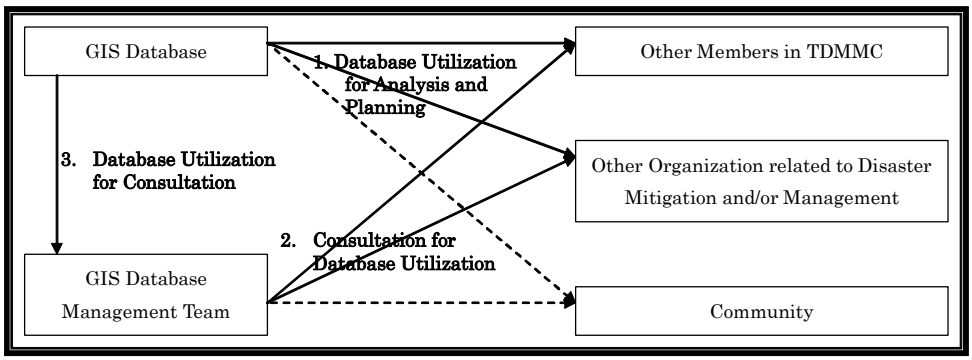


Source: JICA Study Team

Figure 13.2 Work Flow Before Disaster: Database Maintenance (2)

13.2.2 Analysis and Planning

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

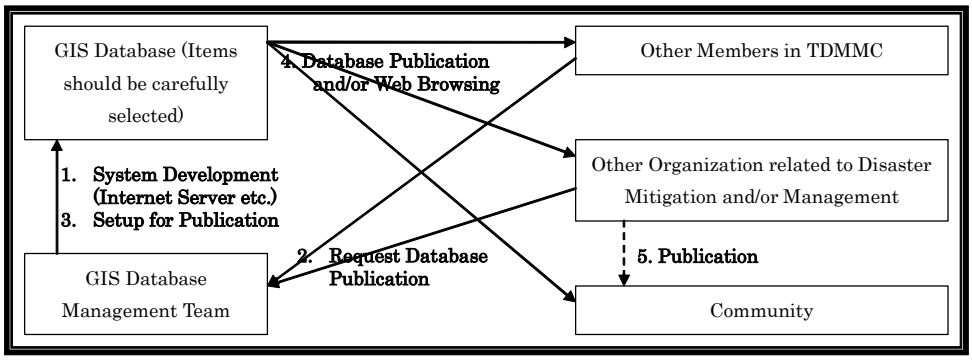


Source: JICA Study Team

Figure 13.3 Work Flow Before Disaster: Analysis and Planning

13.2.3 Public Relations

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

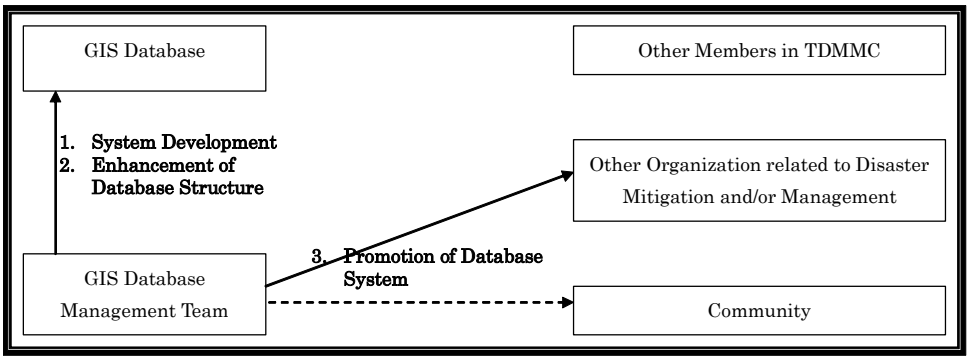


Source: JICA Study Team

Figure 13.4 Work Flow Before Disaster: Public Relations

13.2.4 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 13.5 Work Flow Before Disaster: Preparation for Disaster Response Stage

TDMMC has responsibility to update database and it is necessary to strengthen capability in cooperation with other disaster management related agencies.

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. In addition, the involvement of private sector in project implementation mechanism is also essential. The government shall establish supporting system to strengthen the designated evacuation facilities, even if the target facility is owned by private sector.

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.

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

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. The governmental program for the private building strengthening or area-development scheme shall start in this term.

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 continuously be 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 item that could not formulate the priority program will be mentioned in the recommendation.

14.2.2 Project Long List

The project long list is shown as follows:

Table 14.1 Long List

1. Strengthening of the Existing Building

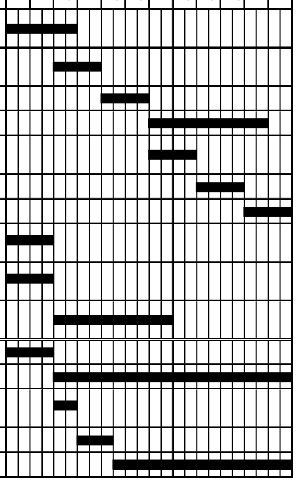
Sector	No. in Priority Projects	Program		Project Name	Implementation Body	Estimated Cost (Mil. US$)	Implementation Schedule (Short Term Y1–Y3 / Medium Term Y4–Y7 / Long Term Y8–Y12)
Standardization	EBS-01	New-Creation of Standard	1-1	New-creation of "Specification of Building Diagnosis on Seismic Resistance 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)



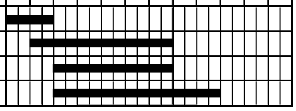
* Implementation Body of the project, "2-4 Improvement of Urban Redevelopment" is not necessarily District Affairs Deputy Office of Tehran Municipality.

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)

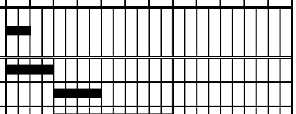


Sub Total Cost (Million US$) : 73.50

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$)	Implementation Schedule (Short Term Y1–Y7 / Medium Term Y4–Y7 / Long Term Y8–Y12)
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	

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$)	Implementation Schedule (Short Term Y1–Y7 / Medium Term Y4–Y7 / Long Term Y8–Y12)
Rehabilitation	-	Area Rehabilitation	10.1	Area Rehabilitation Scheme	Tehran Municipality (TDMMC)	3.00	
	-		10.2	F/S Area Rehabilitation Scheme		2.50	

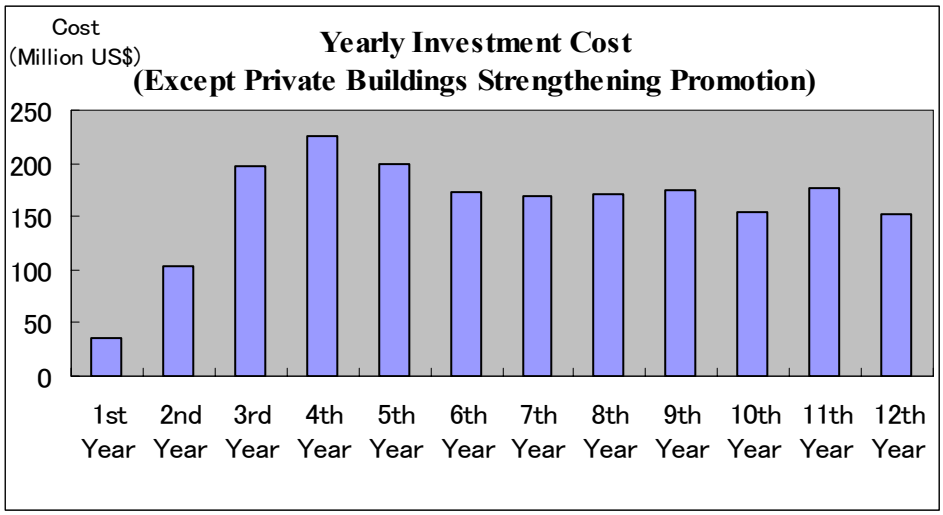
Sub Total Cost (Million US$) : 5.50

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 14.1 shows a yearly distribution of total investment cost excluding the cost for the private building strengthening promotion project.



Source: JICA Study Team

Figure 14.1 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.

2) Organization

Table 14.2 shows the allotment of investment cost in each organization level: governmental, municipality, district, semi-governmental and non-governmental. The cost for private building strengthening promotion project is omitted.

Table 14.2 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

14.3 Selection of Priority Projects and Programs

The individual projects in the long list are measured by the assumed evaluation indicators as follows:

Table 14.3 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

Through the selection process by scoring, the following 15 combined projects were selected as a priority project as summarized in Table 14.4.

Table 14.4 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

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 14.5.

Table 14.5 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 14.6. The implementation of all priority projects will promote the activities of disaster management in Tehran at every disaster stages; mitigation, preparedness, emergency response and rehabilitation and reconstruction.

Table 14.6 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 of each priority projects are described in a form of project profile summary sheets as follows.

Recommendation

RECOMMENDATION

1. Overview

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

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.

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 Summary Sheet No 1
STRENGTHENING AND REPLACEMENT OF EXISTING PUBLIC BUILDING

Objectives	To secure the capacity of city regarding "rescue and relief," "mission control" and "extending cooperation to other regions," survivability of major public buildings must be checked and reinforced.
Implementation Agency	Building & Housing Research Center, Ministry of Housing and Urban Development, Ministry of Interior, Tehran Municipality, Tehran Police Department, Red Crescent Society, Ministry of Defense, Ministry of Health, Ministry of Health, Tehran Fire Brigade and Safety Service, Ministry of Road and Transportation
Estimated Cost	US$ 549.45 million
Project Status	Each competent authority is making individual effort to implement preparation for earthquake resistance right now. However, specific building investigation based on unformulated and coordinated method is not yet started. Each strengthening is carried out using procedure limited in each individual project, because there is no mandated code or guideline about earthquake resistant diagnosis and strengthening for buildings. It is necessary to start actual action for constitution of code or guideline.
Project Duration and Timing	The duration for the creation of new specification on earthquake resistance diagnosis and strengthening is 3 years, commencing in the first year of the master plan period. The implementation of seismic diagnosis and strengthening should be conducted without loss of time, depending on the characteristics and feasibility decided by above mentioned implementation bodies.
Rationale /Justification	Public facilities are indispensable candidate for the center of resistance, i.e. "rescue and relief," "mission control" and "extending cooperation to other regions." A fair and equitable principle must be adopted for implementation, because public facilities are provided by public charge.
Project Input	Planning Phase: Engineers, Budget Implementation Phase: Engineers, Workers, Equipment and Materials for Construction, Budget
Project Outcome	Center of resistance, i.e. "rescue and relief," "mission control" and "extending cooperation to other regions"
Project Components	EBS-01: New-creation of "SPECIFICATION ON EARTHQUAKE RESISTANCE DIAGNOSIS AND STRENGTHENING" EBS-02~41: Implementation of building diagnosis and strengthening for each public building.
Project Monitoring and Evaluation	Project monitoring and evaluation start from beginning of a plan preparation, up to the time of construction.
Project Sustainability	Implementation in a unified way with fair and equitable principle and establishment of close contact between each relevant organization are indispensable, because coordination in this activity is of primary importance.

Project Profile Summary Sheet No 2
PROMOTION OF STRENGTHENING OF EXISTING PRIVATE BUILDINGS

Objectives	The objective is to mitigate the estimated damage of 483,000 residential buildings and other private buildings in Ray Fault Model by means of promoting strengthening of those buildings utilizing financial assistance system for building diagnosis and strengthening.
Implementation Agency	Ministry of Interior, Tehran Municipality, BHRC
Estimated Cost	US$ 1,354.8 million
Project Status	The past cases of strengthening of private buildings carried out in Tehran are several hotels and office buildings, and few residential buildings. Disaster Insurance system exists in Iran for compensating owners of damaged buildings after the event. Nonetheless, insurance itself does not have an incentive to promote strengthening of private buildings in terms of mitigating the earthquake damage.
Project Duration and Timing	Duration for examination, appraisal and enactment of financial assistance system for building diagnosis and strengthening shall be 1 year. It should be noted that "SPECIFICATION ON EARTHQUAKE RESISTANCE DIAGNOSIS AND STRENGTHENING," which is proposed as one of Priority Projects entitled "Strengthening and Replacement of Public Buildings," should also be applied to private buildings. Therefore, a setup of financial assistance system and new-creation of specification shall be progressed simultaneously. Targeted buildings are to be diagnosed and strengthened after the enactment of financial assistance system. The system shall be applied for 2 years after the enactment as Phase 1, and sequential application term as Phase 2 for 4 years and Phase 3 for 5 years shall be continued after modification based on the ex-post total evaluation of Phase 1.
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.
Project Input	Setup of financial assistance system: Policy making specialists, Budget Implementation Phase: Engineers, Construction Workers, Heavy Vehicles, Equipment and Materials for Construction, Budget
Project Outcome	Reduction of the amount of estimated building collapse.
Project Components	EBS-01: New-creation of "SPECIFICATION ON EARTHQUAKE RESISTANCE DIAGNOSIS AND STRENGTHENING" GSS-01: Setup of financial assistance system GSS-02,04,06: Enactment of governmental financial assistance scheme GSS-03,05,07: Evaluation of the scheme
Project Monitoring and Evaluation	Project monitoring and mid-term evaluation shall be conducted on yearly basis after the enactment of financial assistance system, and ex-post total evaluation shall be conducted at the end of Phase 1.
Project Sustainability	The success of the project depends on the sustainability due to the enormous numbers of target private buildings to be strengthened, numbering 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.

Project Profile Summary Sheet No 3
IMPROVEMENT OF BUILDING QUALITY

Objectives	This project aims to secure a practical effect of building construction appraisal system by providing concrete action plans with time frame made in coordination with relevant authorities and organizations. It is essential to build up and execute a practical construction appraisal system in order to improve the structural safety of buildings in Tehran.
Implementation Agency	Building & Housing Research Center, Research Institute, Tehran Municipality, Ministry of Education, Each property Owner, Ministry of Housing and Urban Development
Estimated Cost	US$ 1.58 million
Project Status	Regarding "Building Construction Appraisal System," appraisal of individual buildings is carried out by each of the 22 district offices. Double checking of the appraisal is carried out by the office in Tehran Municipality in-charge of this task. However, both of these appraisals cannot afford to check each of the structures from a theoretical aspect. Regarding "masonry structures," some Iranian researchers (i.e. BHRC, IIEES) and engineers have little comprehension about retrofitting mechanism, but definite draft of procedure cannot be found.
Project Duration and Timing	2 years for establishment of committee for building quality improvement and revision of construction appraisal system. And capacity development of double Checking Office of Tehran Municipality is to be conducted in 7 years.
Rationale /Justification	The current seismic code in Iran, "Iranian Code of Practice for Seismic Resistant Design of Buildings" originated in 1964 and its revision in 1985 is acknowledged to reach at international standard level. Despite the presence of this code, a large number of buildings that do not satisfy the requirement of the code have been constructed. This circumstance is induced by the following: 1. lack of ability of relevant authorities and organizations in checking the conformity of building with code, and 2. absence of compelling force of rebuilding in construction appraisal system. The circumstances of illegal building construction would not be improved unless these two essential issues were overcome.
Project Input	Planning Phase: People of experience or academic standing, Engineers, Budget Implementation Phase: Engineers, Workers, Equipment and Materials for Construction, Budget
Project Outcome	To secure a steady implementation of building construction appraisal system To secure enforcement of construction regulation
Project Components	ESB-42~45: Research on Strengthening Scheme for Masonry Structure, Selection and Implementation of pilot project site ESB-46~52: Revision and Improvement of Building Construction Appraisal System, Establishment of Engineering Skill
Project Monitoring and Evaluation	A committee is formed to deliberate the methodology and evaluate the validity at each implementation stage of "Research on Strengthening Scheme for Masonry Structure, Selection and Implementation of Pilot Project Site" and "Revision and Improvement of Building Construction Appraisal System, Establishment of Engineering Skill."
Project Sustainability	The key aspect is raising the popularization of the system by raising public awareness. This should be lead by the committee.

Project Profile Summary Sheet No 4
PROMOTION OF URBAN REDEVELOPMENT FOR DISASTER PREVENTION

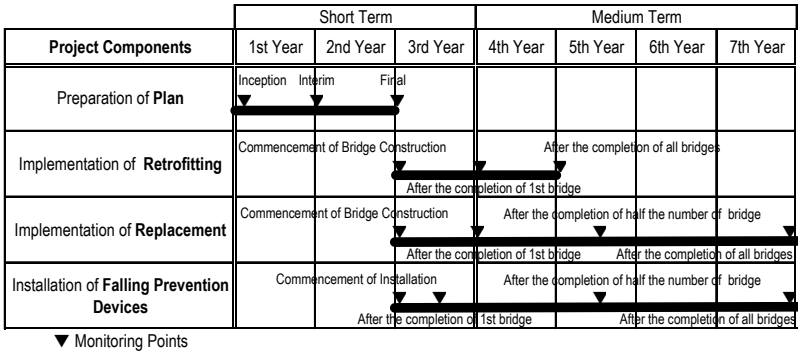
Objectives	Based on the vulnerability analysis, it is found that the most vulnerable area, with an accumulation of weak building structures against earthquake and inappropriate space for evacuation, is in the central part of urban area. The project intends to implement urban redevelopment for those areas to eliminate those risks.
Implementation Agency	Department of Urban Planning, Urban Renewal Organization, District Municipality
Estimated Cost	US$ 308 million
Project Status	District municipality government has selected urban redevelopment area of approximately 50 hectares. A local consultant has finished the basic study.
Project Duration and Timing	Introducing disaster-proof zoning system should start after the master plan study. Identification of project area and preparation of the plan should start after development of the zoning system. Actual construction of the housing complex will start approximately 4.5 years after the master plan study.
Rationale/ Justification	The area redevelopment scheme is most effective and practical method to improve living environment in the central area. Provision of the evacuation place and safe building for the residents of the central district is a must. The potential area will be 44.5 km2 with a population of 933,000. Cost-benefit analysis on the area development scheme is attached in sector report. The feasibility of the project will depend on the land acquisition and selling price of the property. In order to implement the project, the government should provide assistance to the project monetarily as well as technically.
Project Input	1. Introducing disaster-proof zoning system - Urban Disaster Management Specialist - Urban Planner 2. Identification of the development area - Urban Planner - Redevelopment Specialist - Social Analysis Specialist - Economist 3. Formulation of detailed design and scheme - Physical Planner - Urban Planner - Redevelopment Specialist - Social Analysis Specialist - Architect - Landscape Architect 4. Construction of the area
Project Outcome	Tehran City will gain safe and secure urban environment against earthquake. The city's urban environment will be improved.
Project Components	Development zoning system Feasibility study for urban development Formulation of detailed design and scheme Implementation of the project
Project 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: progress of study and construction
Project 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.

Project Profile Summary Sheet No 5
PROVISION OF REGIONAL EVACUATION SITE AND ITS FACILITY

Objectives	- To develop the regional evacuation sites - To develop safe evacuation routes - To provide the emergency goods storage for the regional evacuation place
Implementing Agency	TDMMC District Municipality
Estimated Cost	US$ 46 million (Cost for land acquisition is not included)
Project Status	TDMMC has started to collect information on the regional evacuation candidate from the District Municipalities. At District 17, a pilot study on the selection of community and regional evacuation place and route is ongoing. After the Bam Earthquake, many discussion and studies have been conducted on appropriate evacuation system.
Project Duration and Timing	- 2 years to formulate development plan for the evacuation sites and route. - 10 years to develop 80 regional evacuation sites
Rationale/Justification	Seismic damage estimation indicates that more than 3 million people would lose their houses in the worst case. Especially in the central area of Tehran, for example, at District 11, area of the open space/park is 7 ha in spite of the necessary space of 48 ha in the worst case. Thus, setting of the emergency evacuation place, development of the evacuation route, installation of the emergency equipment and maintenance of these facilities are matters of urgent necessity.
Project Input	- Person in charge for establishment from TDMMC, all District Municipality, Urban Planning Deputy, Red Crescent Society, and Park Organization - Person in charge for maintenance from Park Organization - Budget to acquire or rent land - Budget to maintain evacuation place
Project Outcome	- 80 regional evacuation places; 1200 ha in total area - Safe and wide evacuation route with guide facility such as map and signboard - Warehouse equipped with rescue equipment, first aid, potable water and emergency foods
Project Components	- Formation of emergency evacuation plan and manual - Identification and designation of regional evacuation sites - Identification of safe evacuation routes - To provide the emergency facilities for the regional evacuation place
Project Monitoring and Evaluation	Project Monitoring and evaluation will be done by the Special Committee for Evacuation and TDMMC. Items to be monitored are: - Number and area of developed evacuation places. - Number of victims which can be accepted. - Number of victims which can evacuate using developed evacuation route and evacuation guide systems
Project Sustainability	Selected regional evacuation place should be utilized not only for the evacuation places. They should be developed as park, school ground, and sports complex, which can be fully used for the citizens. 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., transfer of knowledge and training of evacuation for citizens through drills. Project on “Capacity Building of Community for Organized Disaster Management” should be strongly incorporated into this project.

Project Profile Summary Sheet No 6
STRENGTHENING AND REPLACEMENT OF BRIDGES ALONG MAJOR ROAD NETWORK

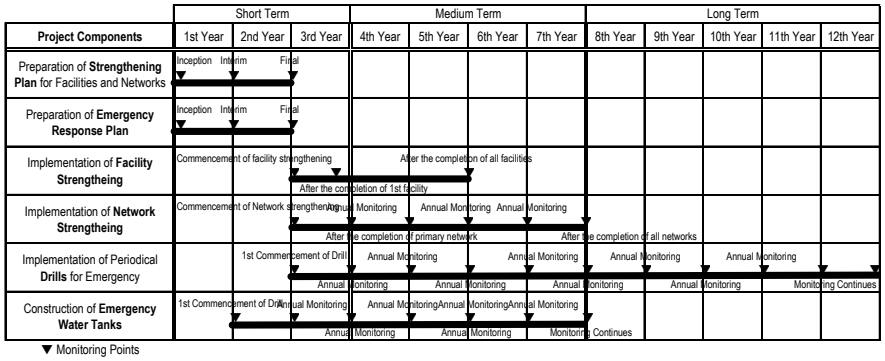
Objectives	Major Road Networks play an important role after the event – to support smooth traffic flow for vehicles used in emergency operations. To secure the road network, vulnerable bridges must be strengthened urgently. In this project, bridges that were estimated as "collapsed" or "unstable" must be replaced or strengthened. Out of 9 vulnerable bridges, 4 are estimated as "unstable" and 5 are estimated as "collapsed." All 5 bridges estimated as "collapsed" have to be replaced. Among those estimated as "unstable," 2 bridges have to be retrofitted and the other 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.
Implementation Agency	Tehran Municipality, Deputy for Technical and Civil Affairs, Tehran Engineering Technical Consulting Organization (TETCO)
Estimated Cost	US$ 37 million
Project Status	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 time.
Project Duration and Timing	Detail Diagnosis of the 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.
Rationale /Justification	Bridges along major road network must be prevented from collapsing in order to maintain road network after earthquake disaster. These bridges are first priority to implement retrofitting or replacement.
Project Input	**Planning Phase**: Engineers, Budget **Implementation Phase**: Engineers, Workers, Heavy Vehicles, Equipment and Materials for Construction, Budget
Project Outcome	Secure Safe Road Network after earthquake event.
Project Components	**INF-01**: Preparation of Plan (Diagnosis of 9 bridges, strengthening and replacement plan, diagnosis of other bridges and installation plan of falling prevention devices) **INF-02**: Implementation of Retrofitting **INF-03**: Implementation of Replacement **INF-04**: Installation of Falling Prevention Devices
Project Monitoring and Evaluation	Project monitoring and evaluation start from beginning of a plan preparation, up to the time of construction.



Project Sustainability	Tehran Municipality must maintain all the bridges periodically to secure the bridge safety. Necessary database must be kept and updated periodically to keep sustainability of the project.

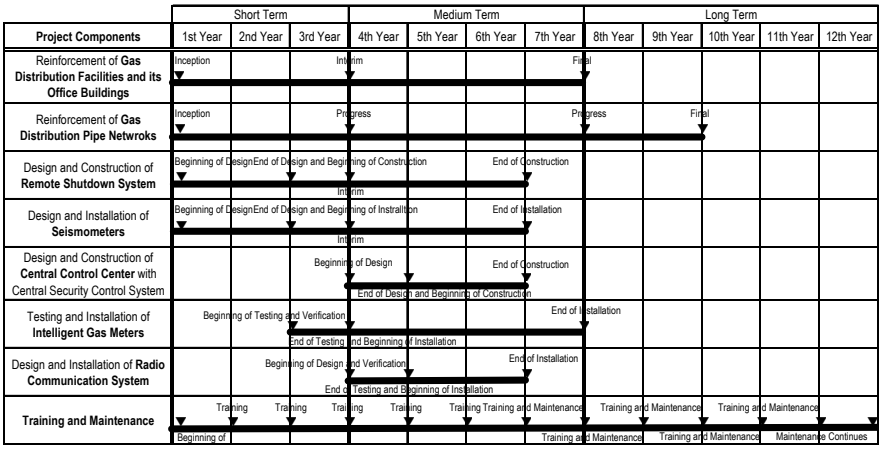
Project Profile Summary Sheet No 7
STRENGTHENING OF WATER SUPPLY FACILITY AND NETWORK

Objectives	The recent earthquake in Bam brought to light the vulnerability of water supply network against strong earthquakes. Among lifelines, water resource is the most important in terms of necessity to keep human life. Therefore, to secure water supply after earthquake event, necessary strengthening and improvement of facilities and networks must be implemented. Together with strengthening, emergency operation plan also must be prepared and periodical training to utilize the plan smoothly must be implemented.
Implementation Agency	Tehran Water and Sewage Company (TWSC)
Estimated Cost	US$ 42 million
Project Status	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 should be included.
Project Duration and Timing	Preparation of plans will take approximately 2 years. Project implementation needs 3 years for facility and 5 years for network, and 6 years for emergency water tank in total after commencement.
Rationale /Justification	There will be no income from the project; however, for security reason, this project is indispensable.
Project Input	Planning Phase: Engineers, Budget Implementation Phase: Engineers, Workers, Heavy Vehicles, Equipment and Materials for Construction, Budget
Project Outcome	Secure Continuous Supply of Water after earthquake event
Project Components	**LIF-01**: Preparation of Strengthening Plan for Facilities and Networks **LIF-02**: Preparation of Emergency Response Plan **LIF-03**: Implementation of Facility Strengthening **LIF-04**: Implementation of Network Strengthening **LIF-05**: Implementation of Periodical Drills for Emergency **LIF-06**: Construction of Emergency Water Tanks
Project Monitoring and Evaluation	Project monitoring and evaluation start from beginning of a plan preparation, and continues for periodical drills.



Project Sustainability	Project Sustainability is very much depending on Tehran Water and Sewage Company. However, once the project is completed, continuation of efforts to secure water distribution will be sustainable.

Project Profile Summary Sheet No 8
INSTALLATION OF CENTRAL CONTROL SYSTEM FOR NATURAL GAS DISTRIBUTION SYSTEM

Objectives	Iran is one of the 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 is doing every control manually. To secure safety of Gas distribution, installation of Central Control System is indispensable.
Implementation Agency	Greater Tehran Gas Company (GTGC)
Estimated Cost	US$ 265 million
Project Status	At present, a study team from Osaka Gas is implementing "Research Project for Strengthening and Control of Tehran Gas Network Against Earthquake" including design of central control system. GTGC has serious intentions of installing this system; therefore, financial support must be sought from international donors.
Project Duration and Timing	Plan will be completed in a few months. Project implementation will take 9 years in total after commencement.
Rationale /Justification	There will be no income from the project; however, for security reason, this project is indispensable.
Project Input	**Implementation Phase:** Engineers, Workers, Equipment, Materials, and Budget
Project Outcome	Secure Safety of Natural Gas Distribution after earthquake event
Project Components	**LIF-07**: Reinforcement of Gas Distribution Facilities and its Office Buildings **LIF-08**: Reinforcement of Gas Distribution Pipe Network **LIF-09**: Design and Construction of Remote Shutdown System **LIF-10**: Design and Installation of Seismometers **LIF-11**: Design and Construction of Central Control Center with Central Security Control System **LIF-12**: Testing and Installation of Intelligent Gas Meters **LIF-13**: Design and Installation of Radio Communication System **LIF-14**: Training and Maintenance
Project Monitoring and Evaluation	Project monitoring and evaluation start from beginning of installation, and continues for maintenance. 
Project Sustainability	Project Sustainability is very much depending on Greater Tehran Gas Company. However, the company very serious in its intentions; therefore, once the project installation is

	completed, continuation of efforts to secure safe natural gas distribution will be sustainable.

Project Profile Summary Sheet No 9
ESTABLISHMENT OF MODEL SCHOOLS FOR DISASTER EDUCATION WITH DIFFERENT CHARACTERISTICS AT TEHRAN MUNICIPALITY LEVEL

Objectives	In order to increase awareness and capacities of students and school staff for disaster management, school is one of the most effective places. Model schools are used for experimenting and evaluating disaster education in school, preparing disaster education policy and manual and promoting school disaster-related activities based on the results of this project, which will be applied to all educational facilities in Tehran.
Implementation Agency	Ministry of Education (Supporting Agencies are IIEES, Tehran Municipality)
Estimated Cost	US$ 2.06 million
Project Status	IIEES has published some educational materials for disaster and distributed them to some schools. Also, disaster drills have been carried out in some schools as model school. However, these activities are likely to be done haphazardly and systematic approaches have not been established yet.
Project Duration and Timing	7 years for the implementation of the project with 100 model schools. In the 3rd year of the project, additional 1,000 schools will be covered based on the previous implementation results and considering the characteristics of each school.
Rationale/Justification	There are 1,089 primary schools, 689 intermediate schools and 649 high schools in Tehran Municipality (156 higher educational facilities). Students and school staff in model schools will be targeted directly and their families, friends and neighbors can be also involved in the activities. Once the manual and leading cases are made, the project can be easily spread to others. Results of the project cannot be calculated and seen in clear shape in a short period but the triple effect is considered to be large in quality and quantity.
Project Input	Expert on disaster education, Trainers of disaster management, Materials and Budget
Project Outcome	- Trained teachers for disaster management and disaster education - School disaster education plan, disaster management plan and evacuation plan - Implementation of disaster education and drills in and out of schools - Establishment of network among the model schools to exchange information
Project Components	- Training of teachers for disaster management - Preparation of school disaster education plan, disaster management plan and evacuation plan and its utilization - Preparation of disaster educational materials and equipment and their utilization
Project Monitoring and Evaluation	Monitoring and evaluation will be done by the committee consisting of the implementation agency and the relevant agencies. Monitoring will be carried out all the time, 1st evaluation will be done 6 months after the project starts, the end of the 1st year as the 2nd evaluation and followed by the end of each year. Items of monitoring and evaluation are: - No. of model schools, students and school staff - No. of materials and plans produced - No. of disaster drills implemented Regular meetings will be held to present the progress and issues among the model schools and the relevant agencies.
Project Sustainability	The target group and the objectives are so clear that continuous and systematic project implementation has a high possibility. If more than 50% of the existing schools will be involved in the project, influence on the community will be outstanding. However, for the establishment of systematic disaster education, authorization and leadership of Ministry of Education is indispensable.

Project Profile Summary Sheet No 10
DESIGNATION OF MODEL COMMUNITIES FOR ORGANIZATION OF COMMUNITY LEVEL DISASTER MANAGEMENT GROUP AND SYSTEM

Objectives	In order to increase public awareness of disaster and capacities of community members for disaster management, some communities are targeted to experiment and evaluate disaster education/training in community, to prepare disaster education/training policy and manual and to promote community-based activities, which will be applied to other communities in Tehran.
Implementation Agency	Tehran Municipality and District (Deputy of Social and Cultural Affairs)
Estimated Cost	US$ 0.78 million
Project Status	Some districts have already started their own activities involving the local communities considering the socio-economic conditions. They are local governments taking the initiative into disaster activities and local people themselves taking actions for disaster preparedness. However, in terms of Tehran disaster management as a whole, public awareness level of disaster is still low and systematic and planned community involvement has not been established.
Project Duration and Timing	5 years for one cycle of project implementation with the selected 2 communities each in 22 districts to be leading communities, and in the 4th year involvement of more and more communities will start based on the 1st implementation.
Rationale/Justification	Public awareness for disaster is still low even among the governmental staff. It is clear that rescue/relief teams cannot reach the damaged people soon after the disaster and local residents cannot help to take measures by themselves, which was the case in the Bam earthquake disaster. Therefore, it is required to increase awareness and capacity of the local people.
Project Input	Experts on community disaster organization, Trainers of community disaster leaders, Materials and Budget
Project Outcome	- Community disaster plan and disaster map - Education/training programs and materials for community disaster management - Trained community leaders and community groups for disaster management - Network of community disaster groups
Project Components	- Review the existing community groups and key persons as community leaders and select model communities - Training of community leaders and government staff in charge - Produce educational/training materials - Implement disaster drill, first aid and rescue/relief training
Project Monitoring and Evaluation	Tehran Municipality and district offices will monitor and evaluate the project. Items of monitoring/evaluation: - No. of community disaster groups and members in the model communities - No. of materials, equipment and plans prepared - No. of disaster drill and training courses implemented 6months after the project stars as the first evaluation, the end of the first year as the 2nd evaluation and followed by the end of each year. Regular meetings will be held to present the progress and issues among the model communities and the relevant agencies.
Project Sustainability	Sustainability is heavily dependent on the willingness and capacity of staff in government and community leaders. If the appropriate communities are selected and the different types of activities of model communities are available, the model activities can be utilized widely in Tehran.

Project Profile Summary Sheet No 11
TEHRAN DISASTER MITIGATION AND MANAGEMENT CENTER – INSTITUTIONAL CAPACITY BUILDING -

Objectives	Direct Objective 1: To increase TDMMC's institutional capability and capacity in the areas of disaster "mitigation," "preparedness," "emergency response" and "rehabilitation & reconstruction" Direct Objective 2: To enhance TDMMC's emergency response function through the establishment of a fully functional "Emergency Operations Center" and related communications and disaster information hardware and software systems Direct Objective 3: To strengthen TDMMC's function as the GIS database "focal point" for disaster management within Tehran Municipality
Implementation Agency	Tehran Disaster Mitigation & Management Center (TDMMC)
Estimated Cost	Institution Building Component, including GIS database: US$ 5-10 million Design & Construction of EOC: US$ 40-50 million Emergency Communication System: US$ 30-40 million Note: Due to the different ODA character of the components involving financial assistance, details depend on the individual packaging.
Project Status	Detailed Project Outline at "opportunity study level" is available. Project request could be formulated on short notice.
Project Duration and Timing	Depending on the packaging of project components (for example including or excluding construction and so on), a minimum of 36 calendar months, i.e. 3 years duration, is envisaged. Project should commence in the beginning of 2005.
Rationale / Justification	TDMMC is the only formalized institutional entity mandated for disaster management (all four areas) in Tehran. There is no informal or formal institutional alternative to TDMMC. However, due to an institutional history beyond TDMMC's control, the institute is still in its "infant phase" and it will need development support over the short to medium term, in order to develop into a fully functional and professional disaster management entity. Proper TDMMC institutional capability and capacity is an absolute prerequisite for the successful realization of an effective and efficient disaster management system in GTA.
Project Input	Project inputs, depending on eventual packaging, will range from provision of expertise (consulting services) in a variety of areas, to the provision of facilities, major and minor equipment, including a sizeable training and fellowship component (for details see Project Outline)
Project Outcome	The project will result in a minimum of 23 direct project outputs geared at the establishment of a fully effective and efficient institutionalized TDMMC.
Project Components	As per item cost estimate above.
Project Monitoring and Evaluation	Progress of project implementation is to be monitored through regular bi-annual progress reports. The project is to be subjected to formal annual tri-partite project evaluations and an "ex-post" total evaluation.
Project Sustainability	The key factors for maintaining project sustainability will be: An adequate legal basis & institutional mandate, Provision of adequate financial resources to TDMMC, and Recruitment of more professional staff.

Project Profile Summary Sheet No 12
ESTABLISHMENT OF EMERGENCY TRAFFIC SYSTEM IN TEHRAN

Objectives	- To designation of emergency road network - To establish the emergency traffic control system - To enforce the existing Traffic Control Center
Implementing Agency	Traffic and Transportation Deputy of Tehran Municipality TDMMC
Estimated Cost	US$ 1.8 million for study, US$ 7.7 million for traffic control center and US$ 18 million for traffic light system
Project Status	TDMMC has to set up the preliminary emergency transportation network in 2002. But this study is suspended and no further schedule is determined yet. Traffic and Transportation Deputy is planning to enforce the Traffic Control Center by installing new traffic lighting system and traffic cameras. In this opportunity, further study on the emergency road network and its control system should be done inclusively with above enforcement plan.
Project Duration and Timing	- 2 years for the study on the emergency traffic network and its control system - 6 years for installing new traffic lighting system and additional traffic camera - 1 year for monitoring and evaluating the effect of the control system
Rationale/Justification	Considering the heavy traffic jam in Tehran, apparently, in case of disaster occurrence, 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 is indispensable.
Project Input	- Person in charge of emergency transportation network study for TDMMC, TCTTS, Traffic and Transportation Deputy and Traffic Police - Person in charge of emergency traffic control system and enforcement of Traffic Control Center from TDMMC, TCTTS, Traffic and Transportation Deputy, Traffic Police and Recycling Organization - New traffic lights and its control system - Traffic monitoring camera and its operation facilities
Project Outcome	- Emergency traffic control plan - Debris removal plan from emergency road - Enforced traffic monitoring system - New traffic light control system
Project Components	- 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 monitoring facilities
Project Monitoring and Evaluation	Monitoring and evaluation will be done by the Special Committee of Transportation and Traffic and TDMMC. Items to be monitored are: - Analysis result of traffic flow in emergency case - Manual for emergency traffic control - Number of installed monitoring camera and traffic lights - Traffic flow status before and after installation
Project Sustainability	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 utilize the Traffic Control Center. However, there is no coordination and cooperation system among these organizations. Such system must be formulated.

Project Profile Summary Sheet No 13
INSTALLATION OF NEW DISASTER INFORMATION AND TELECOMMUNICATION NETWORK

Objectives	Earthquake disaster killed many people and destroyed huge amount of properties. And telecommunication network was frequently interrupted and calls were not easily connected by flood calls just after the disaster. In these circumstances, the necessary rescue information was not gathered, and it seriously affected the search and rescue activities. The lack of information made people panic and it expanded the damage. In order to save more lives and properties, necessary information should be shared and give support to make operation effective through the solid disaster network. In this project, new independent disaster information and telecommunication network is proposed. The outline of the network is consisted of backbone and access mobile system. The backbone system is connected with 22 districts by microwave and access mobile network is covering all the district area.
Implementation Agency	Tehran Disaster Mitigation and Management Center, Telecommunication Company of Iran, Telecommunication Company of Tehran, Mobile System Company
Estimated Cost	US$ 20 million
Project Status	Primarily, it is desirable to utilize the existing reinforced telecommunication network as disaster network. This plan can be regarded as a solution from the economic point of view, but it has some concerns about strength against big earthquake and flood calls problem after disaster outbreak. In this study, the first priority is given to the security, so new establishment of the independent network is employed as priority project.
Project Duration and Timing	This project is planned to introduce radio system, and radio system can be completed within a shorter time than cable system in installation period because road excavation is not necessary. The project can be finished within 1.5 years, after completion of site purchase and site development.
Rationale /Justification	The damage by disaster is expanded gradually after outbreak, since the necessary rescue information cannot be gathered to search and rescue center, and groundless rumors abound. In order to make operation effective, the latest and correct information is essential through network. Therefore, the solidity of disaster network is indispensable for search and rescue operations.
Project Input	**Planning Phase**: Engineers, Budget **Implementation Phase**: Engineers, Workers, Equipment and Materials for Construction, Budget
Project Outcome	New Disaster Information and Telecommunication Network
Project Components	- Backbone Microwave System - Access Mobile System - Overall Network Operation and Maintenance System - Seismic Intensity Monitoring System
Project Monitoring and Evaluation	Project monitoring and evaluation start from beginning of a plan preparation, up to the time of construction.

Components	1st Year	2nd Year	3rd Year	4th Year	5th Year
Preparation Plan	↓ ↓	↓ —			
Feasibility Study		↓ —			
Tendering and Contract		▲			
Installation of Network		↓ ↓ —	↓ ↓ —		
Factory Training		▲			
Operation and Maintenance			↓ →		

↓ Monitor Points

Project Sustainability	This network is perfect as telecommunication system as a whole despite its smaller scale. So, the operation and maintenance (OM) works should be required to be the same level executed in public telecommunication network. But it still presents a challenge to TDMMC personnel. In order to establish smooth operation, this project proposes to formulate the standard OM manual in cooperation with TCI, TCT, MSC and Equipment supplier before project commencement. By having the manual, even with the scant experience of TDMMC personnel, they can perfectly carry out OM works and maintain the disaster network.

Project Profile Summary Sheet No 14
STRENGTHENING OF EMERGENCY RESPONSE CAPABILITY AND CAPACITY OF THE TEHRAN FIRE FIGHTING AND SAFETY SERVICES ORGANIZATION

Objectives	Direct Objective 1: To increase TFFSSO's institutional capability and capacity in the area of disaster emergency response, in particular "rescue & relief operations" Direct Objective 2: To enhance TFFSSO's emergency response function in the field of "handling of hazardous materials"
Implementation Agency	Tehran Fire Fighting and Safety Services Organization (TFFSSO)
Estimated Cost	Institution Building Component: US$ 6.75 million Design & Establishment of Emergency Response Network, including Handling of Hazardous Materials: US$ 55 million Note: Due to the different ODA character of the components involving financial assistance, details depend on the individual packaging.
Project Status	Detailed Project Outline at "opportunity study level" is available. Project request could be formulated on short notice.
Project Duration and Timing	Depending on the packaging of project components (for example including or excluding construction and so on), a minimum of 84 calendar months, i.e. 7 years duration is envisaged. Project should commence in 2005.
Rationale / Justification	TFFSSO is primarily responsible for fire control and safety issues related to fire and other safety threats. TFFSSO is partner agency to the Red Crescent Society in search & rescue operations in post-disaster emergency response. However, due to the absence of a suitable and adequate legal basis and regulatory framework that would codify, regulate and support its authority, the TFFSSO lags behind its actual function in terms of mandate, authority, human and equipment resources. The TFFSSO will need focused support over the short to medium term, in order to develop into a fully functional emergency response entity in the fields of search, rescue, relief and hazardous material's related activities. Proper TFFSSO institutional capability and capacity building is an absolute prerequisite for the successful realization of an effective and efficient emergency response system in Tehran.
Project Input	Project inputs, depending on eventual packaging, will range from provision of expertise (consulting services) in a variety of areas, to the provision of facilities, major and minor equipment, including a sizeable training and fellowship component (for details see Project Outline).
Project Outcome	The project will result in a minimum of 20 direct project outputs geared at the establishment of a fully effective and efficient emergency response system at TFFSSO.
Project Components	As per item "cost estimate" above.
Project Monitoring and Evaluation	Progress of project implementation is to be monitored through regular bi-annual progress reports. The project is to be subjected to formal annual tri-partite project evaluations and an "ex-post" total evaluation.
Project Sustainability	The key factors for maintaining project sustainability will be: Establishment and passing of a suitable & adequate "Fire & Safety Service Law, including related rules & regulations, Provision of adequate financial resources to TFFSSO, Recruitment of more professional staff and purchase of relevant equipment, and Provision of extensive in- and out-house training.

Project Profile Summary Sheet No 15
STRENGTHENING OF EMERGENCY RESPONSE CAPACITY FOR THE GOVERNMENTAL HEALTH ORGANIZATION

Objectives	1) To formulate and start an inter-organizational earthquake disaster management system in Tehran to operate swift and effective health/medical response activities from national to community level 2) Empower the capacities of health facilities and personnel for life-saving and disease prevention at major hospitals and community health centers
Implementation Agency	Ministry of Health and Medical Education (MOH&ME)
Estimated Cost	US$ 17.31 million
Project Status	MOH&ME and three medical universities in Tehran recognize the importance of establishing disaster management system far in advance, especially against the potential earthquake, and have already started the preparedness activities. In this sense, the project has been already commenced.
Project Duration and Timing	Project period: 7 years in total Project timing: First two years is allocated for planning including facilities development. Implementation of the project will start from the 2nd year and urgent action plans will be realized in the earlier stage.
Rationale /Justification	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.
Project Input	At planning phase: Formulation of a task force team in the ministry, various experts, budget for planning. At implementation phase: Formulation of a project coordination team in the ministry, budget for implementation.
Project Outcome	Possible increase of the savable lives and reduction of the avoidable disables
Project Components	**SHC -01**: Formulation of Health Disaster Management Plan in Tehran **SHC -02**: Strengthening overall Capacity of MOH&ME for Disaster Response **SHC -03**: Improvement of Hospital Capacity for Disaster Medical Services **SHC -04**: Strengthening of Logistic Capacity **SHC -05**: Expansion of Education and Training Program for Health Personnel
Project Monitoring and Evaluation	Monitoring: at the end of every year Evaluation: at the middle and the end of the period of every component project
Project 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 excessive plan: 1) Expanding the large emergency wards or purchasing vehicles or equipment that may not be utilized in normal time 2) Stockpiling too much drugs and medical consumables

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		▬	▬	▬	▬	▬	