10.3.3. Recommended Future Urban Development Directions for the Land Use Master Plan

The coastal areas along the Marmara Sea, within the IMM, are assessed as high-risk areas for earthquake disaster damages based on the estimated earthquake motion of the 4 earthquake scenarios in the JICA Study. Based on this finding, it is recommended that the future urban expansion direction of the IMM shift from the areas along Marmara Coast to the inland areas. This is especially true for the European side.

The designated urban expansion and densification areas along the Marmara Coast on the master plan and district land use zoning plans should be carefully reviewed and shifted away from the identified risks of earthquake disaster damages, especially like those found on the European side, and into safer inland areas. However, shifted urban expansion direction towards the inland areas should be well-coordinated with the present conservation areas for water resources and natural environmental resources on the inland areas. This is identified as one of key policy of the IMM in the master plan.

10.3.4. Recommended Comprehensive Urban Growth Management System for Metropolitan Istanbul

The administrative area of Istanbul Metropolitan Municipality is legislated clearly in Law No. 3030. On the other hand, the power to execute urban planning and urban growth management by the Istanbul Metropolitan Municipality is currently limited to only covering the presently developed and urbanized areas within the area defined in Law No. 3030. Under this condition, almost all of the present urbanized areas in the IMM were developed without urban development regulations, the standards of the IMM, or consistent with the urban development master plan of the IMM. The end results under these contradictions are that the administrative and urban planning areas are seriously generating an accumulation of uncontrollable chaotic urbanized areas in the IMM.

(1) Recommended Administrative and Urban Planning Area for the Metropolitan Area

In order for proper urban management to aid in strengthening buildings and urban structures for earthquake disaster prevention and nature conservation in the IMM, the IMM must have a consistent system of administrative and execution power for urban planning/urban growth management. Currently, urban expansion trends of Istanbul Metropolitan exceed beyond the area defined in Law No. 3030. The proposed consistent administrative and urban growth management/planning area is wider than the area defined in Law 3030.

(2) Planning and Execution Powers for Urban Reconstruction Plan Before/After Disaster

Under Law No. 3030, all urban planning powers are clearly granted to the metropolitan municipalities. The master plan for the metropolitan area was formulated and enacted by the IMM. Zoning plans are formulated and enacted by district municipalities under the guidance of the IMM. However, the execution and planning powers of urban reconstruction after a disaster are not legally localized to the metropolitan municipalities by the Ministry of Public Works and Housing.

For the future, a preliminary urban reconstruction plan should be formulated in coordination with the metropolitan master plan before the occurrence of an urban disaster. After an urban disaster, the formulated preliminary urban reconstruction plan should be revised and finalized with actual disaster damage information and with the implementation programme of urban reconstruction works.

To establish the recommended future urban reconstruction system, planning and execution powers of urban reconstruction should be localized to the Metropolitan Municipality of Istanbul under the coordination of the Ministry of Public Works and Housing.

(3) Improvement and Capacity Buildings of Planning and Execution Functions for Urban Growth Management

Currently, the steps needed to move from the comprehensive master plan to the district implementation plans (zoning plans) are taking time and manpower resources in order to enforce the zoning plans.

- Comprehensive Master Plan of Metropolitan Istanbul: 1/50,000 formulated by the IMM and approved by municipal assembly
- District Plans (narrowed down version of the above master plan): 1/25,000 formulated by the IMM
- District Application Plans: 1/5,000 formulated by the IMM
- District Implementation Plans: 1/1,000 formulated by district municipalities under guidance of the IMM and approved by district assembly

The present planning steps are recommended to simplify the district planning and the district application planning steps in a manner that will minimize the needs of the planning staffs and experts.

Human resources for formulation and execution of the above plans are distributed on a limited basis in the metropolitan municipality, especially in the district municipalities. For example:

- In the City Planning Directorate of the IMM, a technical staff of 150 urban planners and architects with temporary technical assistants are working to formulate a master plan, other district plans, district application plans, and also to provide support to district municipalities formulating implementation plans.
- In the Construction Directorate of the IMM, a technical staff of 37 architects and structural engineers, and additional 37 staff members, are working to provide supervision and guidance to district municipalities regarding building applications.
- In district municipalities, 15 technical staff members are working to check applications, issue building permits and site inspections on completion of the process.

For the IMM, the roles of planning and executing plans and regulations are clearly demarcated as those of City Planning and Construction Directorates. Top-down policy direction from the City Planning Directorate and bottom-up information and issues from the Construction Directorate should be well-coordinated with each other to establish a better unified planning and execution system in IMM.

Capacity building with respect to urban planning and implementation for the 28 district municipalities is a crucial issue to establish the proper planning and execution system to cover all of the development and building applications within the metropolitan area.

10.4. Recommended Measures to Promote and Support Seismic Resistant Buildings

10.4.1. Recommended Strategic Measures to Improve Structurally Weak Building by the Private Sector

Most of the weak building structures in the metropolitan municipality are illegally and irregularly developed and constructed without any development and building permits. This occurs because of persistent optimistic views about earthquake disaster and lack of public awareness of the public on the high probability of an urban earthquake disaster. All of the experiences and wisdom regarding the power of earthquake damages handed down from generation to generation among the Istanbul population had not been transmitted to the present citizens. It is likely to have been forgotten in the past period of more than a century, in which residents lived without any earthquakes, and with the subsequent explosion of urban expansion in the past 3 decades.

However, these accumulated structurally weak buildings in the metropolitan area will be seriously and catastrophically damaged by the next estimated earthquake disaster. In order to mitigate and minimize building damages and related human casualties, the strengthening of the assessed structurally weak buildings shall be identified as an indispensable measure and the only solution that would allow citizens to survive. The increase of public awareness of earthquake disaster damage mechanisms and understandings of structurally weak buildings will also be important to achieve, as well as to implement the appropriate strengthening measures. The subsequent public support will also be indispensable in enhancing and promoting heavy investment by the private sector to strengthen structurally weak buildings.

- **Preparation Measure 1:** Preliminary assessment of seismic resistant building structure for all private buildings by the local government with assistance from NGO experts. The results of this assessment should be to identify the required levels of reconstruction or reinforcement. The estimated building damages found in the JICA Study may be utilized to prioritize the assessment work deemed necessary.
- **Preparation Measure 2:** Preparation of funding resources and the establishment of a Seismic Resistant Building Fund that will create a rolling fund system for the following soft loan scenarios;
  - Estimated damaged building floor areas;

    Heavily: 36 million

    Moderately: 46 million

Total: 82 million m^2

- Estimated improvement costs (in the case of unit cost: \$100/ m^2);

  Heavily: 3.6 billion

  Moderately: 4.6 billion

  Total: \$8.2 billion

- Required original fund sources (3 rolling shifts)

  Heavily: 1.2 billion

  Moderately: 1.5 billion

  Total: \$2.7 billion -

- This estimated \$2.7 billion figure will be the minimum fund amount necessary to cover buidings assessed through Preparation Measure 1.
- **Preparation Measure 3:** Modification of real estate through a common ownership law to promote smooth reinforcement and reconstruction (change from common consent to majority of consent).
  - **Incentive 1**: To introduce a new reductive rate of earthquake disaster insurance for improved seismic resistant buildings.
  - **Incentive 2:** To exempt real estate tax for improved seismic resistant buildings (especially building tax).
  - **Incentive 3:** To apply a soft loan system for the assessed buildings to be reconstructed or reinforced by the Preparation Measure 1.

The resources of the established Seismic Resistant Building Fund are not only proposed to be utilized for the assessed structurally weak buildings, but also for the required urban reconstruction projects for areas with serious building and urban structure vulnerabilities.

10.4.2. Recommended Supporting Measures to Establish Effective Improvement Methods and Construction Industries

- Establishing an effective execution system requires supporting measures dealing with reinforcement and reconstruction technology, qualified and enhanced construction industries, and qualified technicians and workers. For example:
- **Measure for Technology:** To develop, establish, and apply effective reinforcement and reconstruction design, materials, and methods to reduce human casualties through cost efficient technology investments.

- **Measure for Construction Industry:** To upgrade quality standards in construction industries through the use of a proper construction registration system. This will enhance the capability of construction industries through taxation and financial measures. It will promote quality in the related industries of construction materials, machinery, etc., through regulations and supporting measures in the metropolitan area.
- **Measure for Qualified Manpower:** To upgrade technician and worker skill and quality by establishing an occupational training and registration system

10.5. Frameworks for Emergency Response and Rehabilitation Works

The Emergency Response System should be planned and organized primarily with the scientific estimated disaster damages for the worst case earthquake scenarios in an earthquake-prone region or nation. However, in metropolitan Istanbul, the present emergency response system could not be organized on scientifically estimated disaster damages because that information was not available until JICA carried the Study.

The demand or framework for each emergency response operation is based on the estimated damages of the worst earthquake scenario Model C. The following frameworks for emergency response and rehabilitation efforts are based on those estimated damages.

- **Framework for Community Evacuation Place:** Population of the damaged area
- **Framework for Emergency Debris Removal from the Proposed Emergency Road Network:** Estimated debris of heavily and moderately damaged building along emergency roads
- **Framework for Emergency Rescue Operation:** Estimated number of residents in estimated heavily and moderately damaged buildings
- **Framework for Emergency First Aid:** Estimated heavily and slightly injured population
- **Framework for Emergency Medical Care:** Estimated heavily injured population
- **Framework for Emergency Fire Fighting Operation:** Estimated fire outbreaks from identified and registered hazardous facilities
- **Framework for Emergency Portable Water and Foods Supply:** Estimated refugees and victims
- **Framework for Tent Village:** Estimated residents in heavily, moderately, and partially damaged building
- **Framework for Temporary Housing:** Estimated residents in heavily damaged buildings
- **Framework for Preparation of Cemetery, Funeral, and Burial Services:** Estimated number of dead
- **Framework for Emergency Lifeline Rehabilitation Works:** Damaged points and length of lifeline

- **Framework for Debris Removal:** Estimated total amount of debris from building damages

10.5.1. Framework for Community Evacuation Place

(1) Present Situation

Presently, the emergency evacuation system has not been introduced and established in metropolitan Istanbul and Turkey. Second or third aftershocks and secondary disasters will greatly increase the amount of human casualties after the initial earthquake. In order to mitigate and minimize human casualties, a community evacuation system is proposed to be introduce to metropolitan Istanbul. Also, proposed community evacuation and gathering places could be used to collect primary damage information from local residents to be used for organizing effective emergency operation taskforces.

(2) Recommended Community Evacuation Area

A community evacuation and gathering area should be identified and designated for each neighborhood where building and other damages are estimated in the Microzonation Study. The estimated building damage is calculated for all 625 mahalles with settlements, where building damages range from the minimum 4% partially damaged building ratio to the maximum 80% heavily, moderately and partially damaged building ratio. Mahalles with no building damage were not identified in Earthquake Scenario C. Based on the above results, community evacuation and gathering areas are recommended for all neighborhood communities in the 625 mahalles.

- Recommended distribution standard: Neighborhood community as primary school zone (300 to 500 dwelling units with 1,500 to 2,000 pop.)
- Recommended area standard: Identified and designated area should provide a minimum net area of 0.5 m^2/person (1.5 m^2/person minimum gross area) for all residents and citizens within the neighborhood community.

Candidates for the community evacuation area should be selected under the following conditions:,

- Stabilized land title, preferably publicly-owned land.
- Stabilized suitable land-use conditions such as public facilities and open space.
- Areas commonly distributed to neighborhood communities such as schools, religious facilities, and parks/open spaces.

- Seismically resistant buildings in the area. However, the existing public facilities could not be categorized as being sufficiently seismic resistant because of the limitation of data. This matter should be decided using the results of the seismic resistance diagnosis for all public facilities.
- Safety from surrounding building damage would make small and narrow parks and open spaces fall into an inappropriate category.
- Other safety conditions include not having any hazardous facilities in or around the areas.
- The evacuation location should be easily recognized and understood by the residents and citizens within the community.

In the metropolitan area, parks and open spaces should be selected as appropriate candidates for evacuation areacs based on the above conditions.

(3) Availability of Parks and Open Space for Community Evacuation Areas

A database of neighborhood communities in the metropolitan area is currently not available. Availability of parks and open spaces for community evacuation and gathering area are analyzed and assessed on the available demographic and geographic data by mahalle under the following conditions:

The area demand of community evacuation areas is estimated to be around 1,320 ha for 8.8 million citizens in the metropolitan area. The existing parks and open spaces in the metropolitan area are counted at 1,425 and over an area of 1,782 ha. This is 1.35 times the estimated area demand of community evacuation areas. On the other hand, mahalle-based area availability of parks and open spaces for community evacuation area are as follows:

- 138 mahalles (22%): Existing area (park/open space) over the estimated demand.
- 68 mahalles (11%): Existing areas are 50% to 99% of the estimated demand.
- 419 mahalles (67%): Existing areas are less than 50% of the estimated demand.

Based on this assessment of availability, the total area of existing parks and open space in the metropolitan area is enough for the estimated total area demand for community evacuation areas. However, almost all mahalles are assessed as not having enough parks and open spaces for a community evacuation area. Based on both results, it is concluded that the existing parks and open spaces are not evenly developed and standardized because of past illegal and irregular urban development.

Table 10.5.1 Demand and Availability of Parks/Open Space for Community Evacuation Areas

Area	District		Demand: evacuation		Existing Park/Open Space in District			Mahalle by Level of Availability		
	Code	Name	1.Pop 2000	2.Evacuation area demand (ha)	3.No. of park/open space	4.Area (ha)	5.Area Supply/ Demand Ratio (4/2)	6.over 100% of demand	7.50% to 99% of demand	8.less than 50% of demand
Historic District	12	EMİNÖNÜ	54,518	8	49	69	838	16	2	15
	14	FATİH	394,042	59	82	116	196	16	5	48
	7	BEYOĞLU	234,964	35	36	40	115	10	4	31
	Subtotal		683,524	103	167	225	219	42	11	94
Europe: Marmara Coast	32	ZEYTİNBURNU	239,927	36	29	30	83	1	3	9
	4	BAKIRKÖY	206,459	31	92	224	725	9	3	3
	15	CÜNGÖREN	271,874	41	30	8	20	0	1	10
	3	BAHÇELİEVLER	469,844	70	43	20	28	0	3	8
	2	AVCILAR	231,799	35	32	35	101	3	0	6
	Subtotal		1,419,903	213	226	317	149	13	10	36
Europe: Bosphorus	8	BESİKTAŞ	182,658	27	80	89	325	13	3	7
	19	KAĞITANE	342,477	51	44	231	449	2	1	16
	26	ŞİŞLİ	271,003	41	38	57	140	3	2	23
	23	SARIYER	212,996	32	53	70	218	5	5	13
	Subtotal		1,009,134	151	215	446	295	23	11	59
Europe: Inland	13	EYÜP	232,104	35	92	61	177	7	4	9
	16	GAZİOSMANPAŞA	667,809	100	91	22	22	1	0	27
	10	BAYRAMPAŞA	237,874	36	44	66	185	2	3	6
	902	ESENLER	388,003	58	15	5	8	1	1	15
	5	BAĞCILAR	557,588	84	44	12	15	0	1	21
	20	KÜÇÜKÇEKMECE	589,139	88	39	17	19	1	1	21
	Subtotal		2,672,517	401	325	184	46	12	10	99
Total/Average of European Side			5,785,078	868	933	1,172	135	90	42	288
Asian: Marmara	1	ADALAR	17,738	3	19	4	142	3	1	1
	17	KADIKÖY	660,619	99	66	89	90	6	1	21
	21	MALTEPE	345,662	52	38	57	110	3	0	16
	18	KARTAL	332,090	50	58	19	38	1	4	15
	22	PENDİK	372,553	56	43	130	232	5	3	21
	28	TUZLA	100,609	15	27	10	68	4	3	3
	Subtotal		1,829,271	274	251	309	113	22	12	77
Asian: Bosphorus	30	ÜSKÜDAR	496,402	74	168	100	135	17	9	28
	6	BEYKOZ	182,864	27	36	171	624	8	4	7
	29	ÜMRANİYE	443,358	67	37	30	45	1	1	12
	Subtotal		1,122,624	168	241	302	179	26	14	47
Total/Average of Asian Side			2,951,895	443	492	611	138	48	26	124
Outside IMM	9	BÜYÜKÇEKMECE	NA	NA	NA	NA	NA	0	0	0
	903	ÇATALCA	15,624	2	0	0	0	0	0	2
	904	SİLİVRİ	44,432	7	0	0	0	0	0	5
	Subtotal		60,056	9	0	0	0	0	0	7
Total			8,797,029	1,320	1,425	1,782	135	138	68	419

Source: JICA study team

(4) Recommended Measures to Establish Community Evacuation System

The following considerations and measures are recommended to be incorporated into proposed detailed disaster prevention plans by each district municipality.

- Set-up and designate each neighborhood community as a Community Evacuation Zone.
- Identify facilities, parks, and open space candidates to be designated as community evacuation areas within the designated Community Evacuation Zone.
- Create a community hazard map (including natural hazards, vulnerable buildings, narrow roads inappropriate for safety evacuation or hazardous facilities, and disaster weak (handicapped, elderly, children, etc.).
- Select and designate a community evacuation area from the identified candidates using the created community hazard map.
- Select safety evacuation routes to the community evacuation location from each residential block.
- Provide guides and signs along the selected routes and in the selected evacuation locations.

10.5.2. Framework for Emergency Debris Removal from the Proposed Emergency Road Network

The proposed emergency road network is around 782 km, which is 6% of the 14,700 km total road length in the metropolitan area. It is indispensable to keep the proposed emergency road network functioning for effective emergency operations and response after a disaster occurs. On the other hand, some designated emergency roads will likely be closed or cut off by collapsed road facilities and buildings in the following ways:

- Collapsed road facilities such as lighting poles, traffic signs/signals, fallen street tree, and bridges.
- Debris from collapsed and damaged buildings, fences and billboards along the road.
- Damaged poles and cables from electricity and telecommunication networks.

The biggest factor closing and cutting off emergency roads will be the debris of collapsed and damaged buildings in the metropolitan area. The total volume of debris by building damages is estimated at around 140 million tons in the metropolitan area. 2.6 million tons (1.8% of the estimated total) of debris may close down and cut off the emergency road network. This estimated debris on the emergency road network should be temporarily removed to surrounding areas in order to re-open roads for emergency vehicle operation within 3 days. The order of debris removal should be based on the emergency roads' priority (primary, secondary and tertiary).

Table 10.5.2 Framework for Debris Removal from Emergency Road

Area	District		Total Debris of Damaged Building (ton)	Road Length			Debris on Emergency Road		Required Machinery to Remove within 3 days	
	Code	Name		all road (km)	emergency road (km)	emergency road ratio	volume (ton)	share (%)	H.G.Vehicle (8ton/10/d)	Machinery (500ton/d)
Historic District	12	EMINÖNÜ	3.310.000	118	14	12	100.000	4	400	70
	14	FATİH	7,592,000	268	17	7	109,000	4	500	70
	7	BEYOĞLU	4,359,000	240	22	9	101,000	4	400	70
	Subtotal		15.261.000	626	53	8	310.000	12	1.300	210
Europe: Marmara Coast	32	ZEYTİNBURNU	7.229.000	235	25	11	150.000	6	600	100
	4	BAKIRKÖY	7,519,000	349	49	14	275,000	10	1,100	180
	15	CÜNGÖREN	5,946,000	186	16	9	144,000	6	600	100
	3	BAHÇELİEVLER	10,262,000	373	30	8	192,000	8	800	130
	2	AVCILAR	5,369,000	432	23	5	83,000	3	300	60
	Subtotal		36.325.000	1.575	142	9	844.000	33	3.400	570
Europe: Bosphoras	8	BESİKTAS	2.814.000	326	30	9	70.000	3	300	50
	19	KAĞITANE	2,999,000	344	20	6	38,000	2	200	30
	26	ŞİŞLİ	4,550,000	475	25	5	95,000	3	400	60
	23	SARIYER	1,123,000	496	25	5	16,000	1	100	10
	Subtotal		11.486.000	1.641	100	6	219.000	9	1.000	150
Europe: Inland	13	EYÜP	2.669.000	488	30	6	59.000	2	200	40
	16	GAZİOSMANPAŞA	5,103,000	861	22	3	38,000	2	200	30
	10	BAYRAMPAŞA	4,945,000	235	14	6	88,000	3	400	60
	902	ESENLER	4,363,000	517	20	4	60,000	2	300	40
	5	BAĞCILAR	7,974,000	562	30	5	106,000	4	400	70
	20	KÜÇÜKÇEKMECE	11,182,000	1,256	63	5	168,000	6	700	110
	Subtotal		36.236.000	3.919	180	5	519.000	20	2.200	350
Total/Average of European Side			99.308.000	7.761	474	6	1.892.000	74	7.900	1.280
Asian: Marmara	1	ADALAR	839.000	123	0	0	0	0	0	0
	17	KADIKÖY	10,688,000	733	60	8	225,000	9	900	150
	21	MALTEPE	5,190,000	740	30	4	91,000	3	400	60
	18	KARTAL	4,591,000	612	30	5	66,000	2	300	40
	22	PENDİK	5,175,000	741	40	5	90,000	3	400	60
	28	TUZLA	2,217,000	558	37	7	42,000	2	200	30
	Subtotal		28.700.000	3.508	197	6	514.000	20	2.200	340
Asian: Bosphoras	30	ÜSKÜDAR	5,078,000	757	52	7	108,000	4	400	70
	6	BEYKOZ	793,000	555	29	5	12,000	1	0	10
	29	ÜMRANİYE	3,548,000	982	29	3	27,000	1	100	20
	Subtotal		9,419,000	2,294	110	5	147,000	6	500	100
Total/Average of Asian Side			38.119.000	5.801	307	5	661.000	26	2.700	440
Outside IMM	9	BÜYÜKCEKMECE	1.401.000	133	10	7	27.000	1	100	20
	903	ÇATALCA	181,000	NA	7	NA	NA	NA	NA	NA
	904	SİLİVRİ	927,000	NA	19	NA	NA	NA	NA	NA
	Subtotal		2.509.000	133	36	NA	27.000	1	100	20
Total			139.936.000	13.695	818	6	2.580.000	100	10.700	1.740

Source: JICA Study Team

10,700 heavy goods vehicles and 1,740 civil engineering machinery vehicles will be required to remove the estimated 2.6 million tons of debris from emergency roads to surrounding areas within 3 days. The present emergency response plan regarding emergency road should be reviewed and re-organized using the above detailed demand and frameworks.

10.5.3. Framework for Emergency Rescue Operation

(1) Estimated Candidates for Rescue Operation

Emergency rescue operations are not only required for the estimated 223,000 missing and seriously injured citizens, but also for the other residents in the estimated damaged buildings. Rescue operation demands are for residents or persons in heavily damaged buildings as well as for residents and persons in moderately and partially damaged buildings. The required formation of rescue taskforce teams depend on the conditions of trapped missing persons such as those crushed under a collapsed building, under overturned furniture, in a fixed door, or window, etc., and the following conditions:

a. Heavily damaged buildings: Approximately 712,000 residents

The majority of residents or persons in heavily damaged buildings will perish, be seriously injured, slightly injured, or remain trapped under the collapsed building.

Most of these residents and persons will only be rescued from collapsed or heavily damaged buildings through the use of specialized taskforces with civil engineering machinery. Specialized taskforce teams will be effectively supported by local information and knowledge.

b. Moderately damaged buildings: Approximately 912,000 residents

A portion of residents and persons in moderately damaged buildings will be will perish, be seriously or slightly injured or trapped under collapsed walls, furniture, or fixed doors/windows, etc.

All those residents and persons especially vulnerable to disaster can be rescued by either a community taskforce or a specialized taskforce.

c. Partially damaged buildings: Approximately 1,939,000 residents

A limited amount of residents and persons especially vulnerable to disaster will be slightly injured or trapped under overturned furniture or fixed doors and windows.

All of these residents and persons can be rescued by community taskforces without civil engineering machinery.

(2) Frameworks and Recommended Measures for Rescue Operations

The estimated 222,700 of missing, dead, and heavily injured citizens will not be able to evacuate from a collapsed or heavily damaged building by themselves. Part of the estimated 405,300 slightly injureds will also need help to be able to evacuate from damaged buildings People especially vulnerable to disaster such as the handicapped, bedridden, aged, or

infants will not be able to evacuate by themselves. Approximately 1 million citizens in the metropolitan area will require rescue operations.

Rescue operations for the majority of people missing or trapped will be heavily dependent on pinpoint information and the self initiated rescue operation work of surviving family members and residents in same community. It is proposed that Self-Community Disaster Taskforces be established and organized in each neighborhood community before an earthquake disaster occurs.

Additionally, a majority of missing and trapped people in heavily damaged buildings will not be rescued through self-community rescue without expert knowledge and machinery. Those difficult rescue operations will depend heavily on the specialized rescue taskforce teams of the Civil Defence, military forces, fire brigades, and other national and international teams.

As part of the emergency rescue operation planning efforts, a capability analysis should be carried out for each framework to further assess emergency response plans, organization and operational programmes.

Table 10.5.3 Framework of Candidate Population for Rescue Operation

Area	District		Residents in Heavily Damaged Buildings	Residents in Moderately Damaged Buildings	Residents in Partially Damaged Buildings	Total Residents	Total Death And Serious Injuries	Slight Injuries
	Code	Name						
Historic District	12	EMİNÖNÜ	6,700	6,900	12,700	26,300	7,700	14,500
	14	FATİH	61,800	64,000	105,100	230,900	15,100	24,700
	7	BEYOĞLU	17,100	21,400	49,000	87,500	8,900	16,400
	Subtotal		85,600	92,300	166,800	344,700	31,700	55,600
Europe: Marmara Coast	32	ZEYTİNBURNU	47,700	49,300	67,500	164,500	12,900	22,400
	4	BAKIRKÖY	47,300	44,100	55,800	147,200	10,500	18,900
	15	CÜNGÖREN	39,500	48,100	79,500	167,100	9,500	17,300
	3	BAHÇELİEVLER	81,400	91,600	136,600	309,600	14,900	24,500
	2	AVCILAR	43,900	45,100	62,500	151,500	11,500	20,500
	Subtotal		259,800	278,200	401,900	939,900	59,300	103,600
Europe: Bosphoras	8	BESİKTAŞ	6,100	10,400	31,900	48,400	3,800	7,600
	19	KAĞITANE	10,700	18,700	58,800	88,200	4,900	9,800
	26	ŞİŞLİ	8,000	14,600	47,600	70,200	4,600	9,100
	23	SARIYER	2,200	4,600	22,300	29,100	1,200	2,400
	Subtotal		27,000	48,300	160,600	235,900	14,500	28,900
Europe: Inland	13	EYÜP	13,600	18,500	45,600	77,700	5,700	11,200
	16	GAZİOSMANPAŞA	18,900	35,700	118,300	172,900	7,000	13,300
	10	BAYRAMPAŞA	24,600	29,200	59,100	112,900	10,500	18,800
	902	ESENLER	30,400	43,500	96,300	170,200	8,700	16,100
	5	BAĞCILAR	48,500	69,000	144,200	261,700	12,500	21,900
	20	KÜÇÜKÇEKMECE	66,000	80,300	148,300	294,600	14,600	24,100
	Subtotal		202,000	276,200	611,800	1,090,000	59,000	105,400
Total/Average of European Side			574,400	695,000	1,341,100	2,610,500	164,500	293,500
Asian: Marmara	1	ADALAR	4,000	2,900	4,100	11,000	4,900	9,800
	17	KADIKÖY	32,600	54,000	144,900	231,500	10,200	18,400
	21	MALTEPE	21,000	31,900	79,400	132,300	7,000	13,300
	18	KARTAL	23,100	32,600	76,900	132,600	7,800	14,600
	22	PENDİK	22,400	32,800	81,500	136,700	8,200	15,300
	28	TUZLA	7,200	9,900	22,500	39,600	4,800	9,500
	Subtotal		110,300	164,100	409,300	683,700	42,900	80,900
Asian: Bosphoras	30	ÜSKÜDAR	12,900	25,100	85,700	123,700	5,300	10,500
	6	BEYKOZ	2,600	4,900	20,300	27,800	1,200	2,400
	29	ÜMRANİYE	9,400	19,200	68,300	96,900	3,900	7,800
	Subtotal		24,900	49,200	174,300	248,400	10,400	20,700
Total/Average of Asian Side			135,200	213,300	583,600	932,100	53,300	101,600
Outside IMM	9	BÜYÜKÇEKMECE	0	0	0	0	2,900	6,000
	903	ÇATALCA	400	700	2,400	3,500	100	200
	904	SİLİVRİ	2,100	3,400	9,100	14,600	1,900	4,000
	Subtotal		2,500	4,100	11,500	18,100	4,900	10,200
Total			712,100	912,400	1,936,200	3,560,700	222,700	405,300

Source: The JICA Study Team

10.5.4. Framework for Emergency First Aid

The estimated seriously injured in this Study are counted as approximately 135,000 people in the metropolitan area. Generally, slightly injured persons may be estimated at approximately 3 times the number of seriously injured people. In the total, approximately 540,000 people with injuries will require emergency first aid services with medicine and equipment on-site.

The required volume and variety of medicine and equipment for first aid services on site should be properly planned and stocked for the needs of the metropolitan, district, and local areas in the formulation of the emergency response plans. Each district municipality should programme and organize the dispatch of a commensurate amount of first aid service teams to meet the needs of the huge number of injuries. Furthermore, the metropolitan crisis management centre should prepare supporting programmes to establish an emergency storage system of medicine and equipment and organize supporting medical and first aid service teams for heavily and catastrophically damaged districts under the following framework:

Table 10.5.4 Framework and Estimated Injuries for Emergency First Aid Services

Area	District		Pop 2000	Seriously Injured	Slightly Injured	Total Injuries (person)	Share (%)
	Code	Name					
Historic District	12	EMINÖNÜ	54,518	4,800	14,400	19,200	35
	14	FATİH	394,042	8,200	24,600	32,800	8
	7	BEYOĞLU	234,964	5,500	16,500	22,000	9
	Subtotal		683,524	18,500	55,500	74,000	11
Europe: Marmara Coast	32	ZEYTİNBURNU	239,927	7,500	22,500	30,000	13
	4	BAKIRKÖY	206,459	6,300	18,900	25,200	12
	15	CÜNGÖREN	271,874	5,800	17,400	23,200	9
	3	BAHÇELİEVLER	469,844	8,200	24,600	32,800	7
	2	AVCILAR	231,799	6,800	20,400	27,200	12
	Subtotal		1,419,903	34,600	103,800	138,400	10
Europe: Bosphoras	8	BESİKTAS	182,658	2,500	7,500	10,000	5
	19	KAĞITANE	342,477	3,300	9,900	13,200	4
	26	ŞİŞLİ	271,003	3,000	9,000	12,000	4
	23	SARIYER	212,996	800	2,400	3,200	2
	Subtotal		1,009,134	9,600	28,800	38,400	4
Europe: Inland	13	EYÜP	232,104	3,700	11,100	14,800	6
	16	GAZİOSMANPAŞA	667,809	4,400	13,200	17,600	3
	10	BAYRAMPAŞA	237,874	6,300	18,900	25,200	11
	902	ESENLER	388,003	5,400	16,200	21,600	6
	5	BAĞCILAR	557,588	7,300	21,900	29,200	5
	20	KÜÇÜKÇEKMECE	589,139	8,000	24,000	32,000	5
	Subtotal		2,672,517	35,100	105,300	140,400	5
Total/Average of European Side			5,785,078	97,800	293,400	391,200	7
Asian: Marmara	1	ADALAR	17,738	3,300	9,900	13,200	74
	17	KADIKÖY	660,619	6,100	18,300	24,400	4
	21	MALTEPE	345,662	4,400	13,200	17,600	5
	18	KARTAL	332,090	4,900	14,700	19,600	6
	22	PENDİK	372,553	5,100	15,300	20,400	5
	28	TUZLA	100,609	3,200	9,600	12,800	13
	Subtotal		1,829,271	27,000	81,000	108,000	6
Asian: Bosphoras	30	ÜSKÜDAR	496,402	3,500	10,500	14,000	3
	6	BEYKOZ	182,864	800	2,400	3,200	2
	29	ÜMRANİYE	443,358	2,600	7,800	10,400	2
	Subtotal		1,122,624	6,900	20,700	27,600	2
Total/Average of Asian Side			2,951,895	33,900	101,700	135,600	5
Outside IMM	9	BÜYÜKCEKMECE	NA	2,000	6,000	8,000	NA
	903	ÇATALCA	15,624	100	300	400	3
	904	SİLİVRİ	44,432	1,300	3,900	5,200	12
	Subtotal		60,056	3,400	10,200	13,600	NA
Total			8,797,029	135,100	405,300	540,400	6

Source: JICA Study Team

10.5.5. Framework for Emergency Medical Care

The estimated 135,000 seriously injured will require proper emergency medical services to order to survive. However, the existing medical care facilities in the metropolitan area consist of 201 hospitals with 19,433 beds (approx. 100 beds/hospital) and 267 clinics. The capability of the present medical care facilities in a disaster will be limited in the following ways:

- More than half of the existing beds (12,000) will be occupied by patients already admitted before the disaster. s.
- Less than half of the existing beds (7,000) will be supplied for the estimated seriously injured.
- Extra beds (7,000) will be distributed to designated public and tented spaces in and around hospital buildings.

Based on the above two factors, only approx. 10% of the seriously injured will be cared for by the existing medical care facilities and their extra beds. Temporary field hospitals set up by the government and NGOs may be able to care for a portion of the remaining 90% of seriously injured. However, the major part of the remaining 90% of injuries should be transferred to the surrounding major metropolitan areas by ship and cared for in the better conditions with intact lifelines (water, gas, electricity, etc.).

The estimated building damage ratios of the existing medical care facilities are as follows: 1) 8% heavily damaged, 2) 10% moderately damaged, and 3) 21% partially damaged. This is about the same building damage ratio average in the rest of the metropolitan area. Medical care facilities must be sufficiently seismic resistant and have proper emergency back-up systems of water and electricity supply and telecommunication networks. This is one of the top priority conditions in the disaster prevention plan. Measures to strengthen the existing structurally weak buildings are recommended as follows:

- 16.5% of masonry buildings are recommended to be reconstructed.
- The remaining 83.5% of buildings require proper seismic resistance diagnosis.
- Based on the results of diagnosis, reinforcement and reconstruction works with emergency back-up systems are required through an implementation programme.

For disaster medical care on the framework, the following emergency storage and supply systems are also recommended:

- Improvement and establishment of a rolling storage system for the required volume and variety of medicines, blood, and blood products to meet the demands of the estimated seriously injured.
- Improvement and establishment of a storage system for other medical care materials and equipment to meet the demands of the estimated seriously injured.
- Establishment of a shared storage system of temporary beds and tents between the metropolitan municipalities.

Table 10.5.5 Framework for Disaster Medical Care

Area	District		Seriously Injured	Population share(%)	Existing Medical Care Facilities			Ratio of Beds/Injured
	Code	Name			Hospitals	Clinics	Beds	
Historic District	12	EMİNÖNÜ	4,800	9	3	7	420	0.088
	14	FATİH	8,200	2	16	16	1,081	0.132
	7	BEYOĞLU	5,500	2	8	15	861	0.157
	Subtotal		18,500	3	27	38	2,362	0.128
Europe: Marmara Coast	32	ZEYTİNBURNU	7,500	3	6	10	1,325	0.177
	4	BAKIRKÖY	6,300	3	10	10	4,229	0.671
	15	GÜNGÖREN	5,800	2	6	1	207	0.036
	3	BAHÇELİEVLER	8,200	2	12	0	1,126	0.137
	2	AVCILAR	6,800	3	5	6	323	0.048
	Subtotal		34,600	2	39	27	7,210	0.208
Europe: Bosphoras	8	BESİKTAŞ	2,500	1	4	0	173	0.069
	19	KAĞITANE	3,300	1	3	0	285	0.086
	26	ŞİŞLİ	3,000	1	21	0	1,597	0.532
	23	SARIYER	800	0	3	15	510	0.638
	Subtotal		9,600	1	31	15	2,565	0.267
Europe: Inland	13	EYÜP	3,700	2	4	10	75	0.020
	16	GAZİOSMANPAŞA	4,400	1	11	0	491	0.112
	10	BAYRAMPAŞA	6,300	3	6	12	259	0.041
	902	ESENLER	5,400	1	3	11	147	0.027
	5	BAĞCILAR	7,300	1	4	23	177	0.024
	20	KÜÇÜKÇEKMECE	8,000	1	6	21	334	0.042
	Subtotal		35,100	1	34	77	1,483	0.042
Total/Average of European Side			97,800	2	131	157	13,620	0.139
Asian: Marmara	1	ADALAR	3,300	19	2	0	685	0.208
	17	KADIKÖY	6,100	1	20	42	1,127	0.185
	21	MALTEPE	4,400	1	5	2	85	0.019
	18	KARTAL	4,900	1	6	9	918	0.187
	22	PENDİK	5,100	1	5	11	244	0.048
	28	TUZLA	3,200	3	0	0	0	0.000
	Subtotal		27,000	1	38	64	3,059	0.113
Asian: Bosphoras	30	ÜSKÜDAR	3,500	1	17	16	2,036	0.582
	6	BEYKOZ	800	0	3	6	300	0.375
	29	ÜMRANİYE	2,600	1	4	24	87	0.033
	Subtotal		6,900	1	24	46	2,423	0.351
Total/Average of Asian Side			33,900	1	62	110	5,482	0.162
Outside IMM	9	BÜYÜKÇEKMECE	2,000	NA	4	0	134	0.067
	903	ÇATALCA	100	1	1	0	50	0.500
	904	SİLİVRİ	1,300	3	3	0	147	0.113
	Subtotal		3,400	6	8	0	331	0.097
Total			135,100	2	201	267	19,433	0.144

Source: Database of emergency response plan of the Crisis Management Centre and JIA Study Team

10.5.6. Framework for Emergency Fire Fighting Operation

There are 882 hazardous facilities registered in the metropolitan area by the Licensing Directorate of the IMM for the years 2000 and 2001. The estimated fire outbreak points from the registered and identified 814 hazardous facilities on GIS are counted as 14 and 16 points for Earthquake Scenario A and C, respectively. Fire out-breaks and explosions from the damaged 13 points of natural gas pipelines and 28,700 service boxes in 185,000 subscribers could not be estimated in the JICA Microzonation Study because of a lack of data for past disasters. Additionally, fire out-breaks from electric power short circuits for the large number of estimated heavily/moderately damaged buildings could not be estimated for the same reasons. Many fire out-breaks were reported during the last earthquake disaster in Avcilar, but statistical data was not available.

Based on the available information, the estimated fire out-break points are a small number, reflective of the limited data availability. However, fire fighting taskforces should not be optimistic about the fire out-break and explosion factors of short-circuits or about the damages caused by natural gas service boxes.

Due to the difficulties mentioned above, the fire-spread potential was assessed by the analysis of wooden building coverage ratio in each mahalle. Because of this, fire-spread potential was not identified in the 642 mahalles in the metropolitan area.

Table 10.5.6 Estimated Fire Out-break Points from Registered Hazardous Facilities

Area	District		Registered Hazardous Facilities	Estimated Fire Out-break Points from Hazardous Facility		Fire Fighting Station
	Code	Name		Scenario-A	Scenario-C	
Historic District	12	EMINÖNÜ	7	0.3	0.3	0
	14	FATİH	29	1.8	2.0	1
	7	BEYOĞLU	22	0.3	0.3	2
	Subtotal		58	2.4	2.6	3
Europe: Marmara Coast	32	ZEYTİNBURNU	35	1.2	1.4	1
	4	BAKIRKÖY	19	0.4	0.4	1
	15	CÜNGÖREN	18	0.6	0.7	1
	3	BAHÇELİEVLER	36	1.6	1.9	1
	2	AVCILAR	17	0.6	0.7	1
	Subtotal		125	4.3	5.1	5
Europe: Bosphoras	8	BESİKTAŞ	18	0.1	0.2	1
	19	KAĞITANE	44	0.6	0.7	2
	26	ŞİŞLİ	33	0.2	0.2	2
	23	SARIYER	20	0.1	0.1	2
	Subtotal		115	1.0	1.1	7
Europe: Inland	13	EYÜP	29	0.6	0.6	2
	16	GAZİOSMANPAŞA	59	0.3	0.4	1
	10	BAYRAMPAŞA	21	0.5	0.6	2
	902	ESENLER	12	0.1	0.1	0
	5	BAĞCILAR	61	1.4	1.8	1
	20	KÜÇÜKÇEKMECE	43	0.6	0.7	2
	Subtotal		225	3.6	4.2	8
Total/Average of European Side			523	11.2	13.1	23
Asian: Marmara	1	ADALAR	NA	NA	NA	4
	17	KADIKÖY	46	0.4	0.5	2
	21	MALTEPE	26	0.4	0.5	1
	18	KARTAL	46	0.7	0.8	1
	22	PENDİK	67	0.5	0.5	1
	28	TUZLA	6	0.1	0.1	2
	Subtotal		191	2.1	2.3	11
Asian: Bosphoras	30	ÜSKÜDAR	33	0.1	0.2	2
	6	BEYKOZ	13	0.0	0.0	0
	29	ÜMRANİYE	54	0.2	0.3	1
	Subtotal		100	0.4	0.5	3
Total/Average of Asian Side			291	2.4	2.8	14
G. Total			814	13.7	15.9	37

Source: Fire Brigade Department of IMM, Licensing Directorate of IMM, and the JICA Study Team

Table 10.5.7 Estimated Damages to Natural Gas Supply System

Area	District		Estimated Damage		
	Code	Name	Point of Pipeline	Service Box	Damaged Box Ratio
Historic District	12	EMINÖNÜ	0	100	20
	14	FATİH	1	4,033	26
	7	BEYOĞLU	0	510	14
	Subtotal		1	4,643	24
Europe: Marmara Coast	32	ZEYTİNBURNU	1	700	33
	4	BAKIRKÖY	1	2,490	31
	15	CÜNGÖREN	0	1,653	23
	3	BAHÇELİEVLER	1	2,866	25
	2	AVCILAR	1	1,426	33
	Subtotal		4	9,134	28
Europe: Bosphoras	8	BEŞİKTAŞ	0	656	7
	19	KAĞITANE	1	133	7
	26	ŞİŞLİ	0	574	7
	23	SARIYER	0	151	2
	Subtotal		1	1,514	6
Europe: Inland	13	EYÜP	1	498	16
	16	GAZİOSMANPAŞA	0	631	8
	10	BAYRAMPAŞA	0	2,246	19
	902	ESENLER	0	589	16
	5	BAĞCILAR	1	807	17
	20	KÜÇÜKÇEKMECE	1	2,023	24
	Subtotal		3	6,794	17
Total/Average of European Side			9	22,084	19
Asian: Marmara	1	ADALAR	NA	NA	NA
	17	KADIKÖY	1	1,868	10
	21	MALTEPE	1	1,096	14
	18	KARTAL	1	1,272	16
	22	PENDİK	1	725	18
	28	TUZLA	0	28	19
		Subtotal	4	4,990	13
Asian: Bosphora	30	ÜSKÜDAR	0	1,325	6
	6	BEYKOZ	NA	NA	NA
	29	ÜMRANİYE	0	330	5
	Subtotal		0	1,655	6
Total/Average of Asian Side			4	6,645	10
Total			13	28,729	16

Source: IGDAS, the JICA Study Team (damages)

10.5.7. Framework for Emergency Potable Water and Foods Supply

Ensuring the avaialability of emergency potable water and foods supply for emergency response activities is an indispensable measure to support survivors of an earthquake disaster. After an earthquake disaster, ordinary food and water supply systems will not function as normal.

- **Foods supply system**: A majority of restaurants, shopping centres, and stores will be damaged and will remain closed due to lifeline damages.
- **Foods material and water supply system**: Transportation of food and water supplies will be severely hampered by damage and debris on road networks.

Under these conditions, emergency foods and potable water supply systems should be prepared and established for the two following stages:

- **First 3 Days - Initial Emergency Operation Period**: Almost all of the ordinary supply systems for food and water will be damaged and will not be functioning. Any remaining emergency foods and potable water should be supplied to citizens from emergency storage systems, which should be established and function at individual homes, self-community disaster taskforces, district municipality and metropolitan municipality levels.
- **First 1 to 3 Weeks - Emergency Operation Period**: Planned emergency foods supply systems should all be functioning and be based on the rehabilitation of emergency road networks for all victims and refugees in tent villages and all families in areas where lifeline services have failed.

The demands of the two periods of emergency foods/water supply are estimated as follows:

Table 10.5.8 Framework for Emergency Foods and Potable Water Supply

Area	District		First 3 Days: Demand Pop 2000	1-3 Weeks: Demand of SurvivingRefugees in Tent Villages			
	Code	Name		Heavily Damaged Buildings (100%)	Moderately Damaged Buildings (50%)	Partially Damaged Buildings (10%)	Total Refugees
Historic District	12	EMINÖNÜ	54.518	4.100	3.300	1.200	8.600
	14	FATİH	394,042	63,900	32,600	9,900	106,400
	7	BEYOĞLU	234,964	17,400	11,800	4,800	34,000
	Subtotal		683.524	85.400	47.700	15.900	149.000
Europe: Marmara Coast	32	ZEYTİNBURNU	239.927	42.900	23.500	6.500	72.900
	4	BAKIRKÖY	206,459	41,400	20,900	5,500	67,800
	15	CÜNGÖREN	271,874	36,000	23,400	7,700	67,100
	3	BAHÇELİEVLER	469,844	70,600	43,300	13,300	127,200
	2	AVCILAR	231,799	38,400	21,700	6,100	66,200
	Subtotal		1.419.903	229.300	132.800	39.100	401.200
Europe: Bosphoras	8	BESİKTAS	182.658	6.200	5.600	3.200	15.000
	19	KAĞITANE	342,477	13,600	11,100	5,900	30,600
	26	ŞİŞLİ	271,003	8,400	7,800	4,600	20,800
	23	SARIYER	212,996	2,600	2,600	2,200	7,400
	Subtotal		1.009.134	30.800	27.100	15.900	73.800
Europe: Inland	13	EYÜP	232.104	14.600	9.900	4.400	28.900
	16	GAZİOSMANPAŞA	667,809	21,800	19,800	11,700	53,300
	10	BAYRAMPAŞA	237,874	27,300	15,300	5,600	48,200
	902	ESENLER	388,003	26,200	20,300	9,100	55,600
	5	BAĞCILAR	557,588	40,500	31,800	13,800	86,100
	20	KÜÇÜKÇEKMECE	589,139	62,300	37,400	13,800	113,500
	Subtotal		2.672.517	192.700	134.500	58.400	385.600
Total/Average of European Side			5.785.078	538.200	342.100	129.300	1.009.600
Asian: Marmara	1	ADALAR	17.738	3.000	1.500	400	4.900
	17	KADIKÖY	660,619	31,600	26,800	13,900	72,300
	21	MALTEPE	345,662	23,100	16,500	7,500	47,100
	18	KARTAL	332,090	27,600	17,900	7,400	52,900
	22	PENDİK	372,553	27,000	18,400	7,900	53,300
	28	TUZLA	100,609	8,200	5,500	2,200	15,900
	Subtotal		1.829.271	120.500	86.600	39.300	246.400
Asian: Bosphoras	30	ÜSKÜDAR	496,402	13,700	13,000	8,200	34,900
	6	BEYKOZ	182,864	2,900	2,700	2,000	7,600
	29	ÜMRANİYE	443,358	10,600	10,100	6,600	27,300
	Subtotal		1,122,624	27,200	25,800	16,800	69,800
Total/Average of Asian Side			2.951.895	147.700	112.400	56.100	316.200
Outside IMM	9	BÜYÜKÇEKMECE	0	NA	NA	NA	NA
	903	ÇATALCA	15,624	400	400	200	1,000
	904	SİLİVRİ	44,432	1,600	1,500	800	3,900
	Subtotal		60.056	2.000	1.900	1.000	4.900
Total			8.797.029	687.900	456.400	186.400	1.330.700

Source: The JICA Study Team

For the emergency foods and water supply, a centralized single centre system will work effectively in guiding, coordinating, and establishing an emergency foods/water stock system and procurement at each emergency stage. However, actual emergency foods and water distribution cannot be managed for the estimated huge scales of demands solely by a centralized single system. Therefore, it is recommended that an actual emergency foods and water supply system be established with the demand information supplied by each district municipality and self-community disaster taskforces.

10.5.8. Framework for Tent Village

In Turkey, a tent village system is established to supply emergency temporary shelter for refugees and victims of urban disasters, which is a regional evacuation area located in Japan. The demand for tent villages is estimated by the number of surviving people out of 100% of the residents in heavily damaged buildings, 50% of residents in moderately damaged buildings, and 10% of residents in partially damaged buildings. The total demand for tent villages is estimated at around 83 to 117 km^2 with 333,000 tents (families) for 1.3 million refugees. On the other hand, designated existing tent villages have an area of 100 km^2, which lie in the middle of Case 1 and Case 2 of the estimated area demands for tent villages. The designated tent villages are unevenly distributed in the 30 districts. It is recommended that existing tent village plans within the emergency response plan be revised according to the estimated demands in each district.

Table 10.5.9 Framework for Tent Village

Area	District		Demand of Tent Village				Designated Tent Village (ha)	Area Supply Ratio (designated/demand)	
	Code	Name	Total Refugee	Tent (family)	Case-1: 35m²/tent(ha)	Case-2: 25m²/tent(ha)		Demand Case 1	Demand Case 2
Historic District	12	EMINÖNÜ	8,600	2,200	7.7	5.5	0.0	0.0	0.0
	14	FATİH	106,400	26,600	93.1	66.5	10.4	11.2	15.6
	7	BEYOĞLU	34,000	8,500	29.8	21.3	14.9	50.1	70.1
	Subtotal		149,000	37,300	130.6	93.3	25.3	19.4	27.1
Europe: Marmara Coast	32	ZEYTİNBURNU	72,900	18,200	63.7	45.5	12.9	20.3	28.4
	4	BAKIRKÖY	67,800	17,000	59.5	42.5	5.8	9.7	13.6
	15	CÜNGÖREN	67,100	16,800	58.8	42.0	15.3	26.1	36.5
	3	BAHÇELİEVLER	127,200	31,800	111.3	79.5	0.0	0.0	0.0
	2	AVCILAR	66,200	16,600	58.1	41.5	6.8	11.7	16.3
	Subtotal		401,200	100,400	351.4	251.0	40.8	11.6	16.3
Europe: Bosphoras	8	BESİKTAS	15,000	3,800	13.3	9.5	4.5	33.5	46.9
	19	KAĞITANE	30,600	7,700	27.0	19.3	15.3	56.7	79.3
	26	ŞİŞLİ	20,800	5,200	18.2	13.0	26.3	144.6	202.5
	23	SARIYER	7,400	1,900	6.7	4.8	7.5	113.2	158.4
	Subtotal		73,800	18,600	65.1	46.5	53.6	82.3	115.2
Europe: Inland	13	EYÜP	28,900	7,200	25.2	18.0	5.7	22.4	31.4
	16	GAZİOSMANPAŞA	53,300	13,300	46.6	33.3	11.9	25.5	35.7
	10	BAYRAMPAŞA	48,200	12,100	42.4	30.3	19.8	46.7	65.4
	902	ESENLER	55,600	13,900	48.7	34.8	3.3	6.8	9.5
	5	BAĞCILAR	86,100	21,500	75.3	53.8	52.7	70.0	98.0
	20	KÜÇÜKÇEKMECE	113,500	28,400	99.4	71.0	34.9	35.1	49.2
	Subtotal		385,600	96,400	337.4	241.0	128.2	38.0	53.2
Total/Average of European Side			1,009,600	252,700	884.5	631.8	247.9	28.0	39.2
Asian: Marmara	1	ADALAR	4,900	1,200	4.2	3.0	6.2	147.1	206.0
	17	KADIKÖY	72,300	18,100	63.4	45.3	195.0	307.7	430.8
	21	MALTEPE	47,100	11,800	41.3	29.5	18.4	44.5	62.3
	18	KARTAL	52,900	13,200	46.2	33.0	26.4	57.2	80.1
	22	PENDİK	53,300	13,300	46.6	33.3	166.3	357.3	500.3
	28	TUZLA	15,900	4,000	14.0	10.0	7.4	52.9	74.1
	Subtotal		246,400	61,600	215.6	154.0	419.7	194.7	272.5
Asian: Bosphoras	30	ÜSKÜDAR	34,900	8,700	30.5	21.8	12.0	39.4	55.2
	6	BEYKOZ	7,600	1,900	6.7	4.8	14.5	217.3	304.3
	29	ÜMRANİYE	27,300	6,800	23.8	17.0	37.7	158.6	222.0
	Subtotal		69,800	17,400	60.9	43.5	64.2	105.4	147.6
Total/Average of Asian Side			316,200	79,000	276.5	197.5	483.9	175.0	245.0
Outside IMM	9	BÜYÜKCEKMECE	NA	NA	NA	NA	173.8	NA	NA
	903	CATALCA	1,000	300	1.1	0.8	90.0	8,566.9	11,993.7
	904	SİLİVRİ	3,900	1,000	3.5	2.5	0.0	0.0	0.0
	Subtotal		4,900	1,300	4.6	3.3	263.7	5,796.2	8,114.7
Total			1,330,700	333,000	1,165.5	832.5	995.5	85.4	119.6

Source: Provincial Crisis Management Center, JICA Study Team

10.5.9. Framework for Temporary Housing

After an earthquake disaster, the assigned emergency taskforces for temporary housing should take the following measures for the residents in the heavily, moderately and partially damaged housing:

- Prepare, set-up, open, and operate tent villages.

- Provide an assessment of building damage conditions for all building (collapsed/heavily damaged/demolish, repair/usable, partially damaged, and not damaged).
- Support measures of finance and material supply to repair the assessed repairable housing.
- Register and select applicants for temporary housings.
- Modify temporary housing plan and preparation works of lands and materials.
- Construct lifelines and temporary housing.
- Open and operate temporary housing.

In Japan, the target temporary housing number is set to 30% of heavily damaged housing and excludes victims moving out from the municipality and staying in relative's homes. The estimated demands of temporary housing are 516 ha with around 52,000 housing units for 207,000 victims, 30% of the estimated 688,000 residents in heavily damaged buildings. The following recommendations will help to minimize the demand for temporary housing:

- Proposed supporting measures to repair housing assessed as repairable.
- Supporting measures to help victims move out of the municipality.
- Supporting measures to help victims stay with relatives.

Table 10.5.10 Framework for Temporary Housing

Area	District		Pop 2000	Surviving Residents in Heavily Damaged Building	Pop. Demand of Temporary Housing	Demand of Temporary Housing Units	Demand Temporary Housing Area (ha)
	Code	Name			30% of Heavy Damage	4 persons/ family	100 housing units/ha
Historic District	12	EMINÖNÜ	54,518	4,100	1,200	300	3
	14	FATİH	394,042	63,900	19,200	4,800	48
	7	BEYOĞLU	234,964	17,400	5,200	1,300	13
	Subtotal		683,524	85,400	25,600	6,400	64
Europe: Marmara Coast	32	ZEYTİNBURNU	239,927	42,900	12,900	3,200	32
	4	BAKIRKÖY	206,459	41,400	12,400	3,100	31
	15	CÜNGÖREN	271,874	36,000	10,800	2,700	27
	3	BAHÇELİEVLER	469,844	70,600	21,200	5,300	53
	2	AVCILAR	231,799	38,400	11,500	2,900	29
	Subtotal		1,419,903	229,300	68,800	17,200	172
Europe: Bosphoras	8	BESİKTAS	182,658	6,200	1,900	500	5
	19	KAĞITANE	342,477	13,600	4,100	1,000	10
	26	ŞİŞLİ	271,003	8,400	2,500	600	6
	23	SARIYER	212,996	2,600	800	200	2
	Subtotal		1,009,134	30,800	9,300	2,300	23
Europe: Inland	13	EYÜP	232,104	14,600	4,400	1,100	11
	16	GAZİOSMANPAŞA	667,809	21,800	6,500	1,600	16
	10	BAYRAMPAŞA	237,874	27,300	8,200	2,100	21
	902	ESENLER	388,003	26,200	7,900	2,000	20
	5	BAĞCILAR	557,588	40,500	12,200	3,100	31
	20	KÜÇÜKÇEKMECE	589,139	62,300	18,700	4,700	47
	Subtotal		2,672,517	192,700	57,900	14,600	146
Total/Average of European Side			5,785,078	538,200	161,600	40,500	405
Asian: Marmara	1	ADALAR	17,738	3,000	900	200	2
	17	KADIKÖY	660,619	31,600	9,500	2,400	24
	21	MALTEPE	345,662	23,100	6,900	1,700	17
	18	KARTAL	332,090	27,600	8,300	2,100	21
	22	PENDİK	372,553	27,000	8,100	2,000	20
	28	TUZLA	100,609	8,200	2,500	600	6
	Subtotal		1,829,271	120,500	36,200	9,000	90
Asian: Bosphoras	30	ÜSKÜDAR	496,402	13,700	4,100	1,000	10
	6	BEYKOZ	182,864	2,900	900	200	2
	29	ÜMRANİYE	443,358	10,600	3,200	800	8
	Subtotal		1,122,624	27,200	8,200	2,000	20
Total/Average of Asian Side			2,951,895	147,700	44,400	11,000	110
Outside IMM	9	BÜYÜKÇEKMECE	0	NA	NA	NA	0
	903	ÇATALCA	15,624	400	100	0	0
	904	SİLİVRİ	44,432	1,600	500	100	1
	Subtotal		60,056	2,000	600	100	1
Total			8,797,029	687,900	206,600	51,600	516

Source: JICA Study Team

10.5.10. Framework for Preparation of Cemetery, Funnel, and Burial Services

Registered cemetery areas in the metropolitan areas have 442 ha in gross area and 221 ha in net area with a 1.15 million capacity, as estimated by the Directorate of Cemeteries of the IMM. The existing net area unit per grave is estimated at approximately 1.9 m^2.

In the worst-case earthquake Model C, it is estimated that around 87,000 deaths will occur, requiring 9.5 to 22.3 ha of new net cemetery area within the metropolitan area.

Before the next disastrous event occurs, the following measures should be formulated and implemented into the emergency response plan to help the city cope with the number of fatalities.

- The required cemetery areas should be identified, purchased, and registered by the Directorate of Cemeteries of the IMM.
- Procurement and supply systems of coffins, gravestones, and other related items should be formulated to deal with the massive demands.
- Mass funerals and burial systems should be formulated.

Table 10.5.11 Framework for Funeral and Cemetery

Area	District		Estimated Deaths	Cemetery Area Demand 1: 1.5 m^2/p	Cemetery Area Demand 2: 3.5 m^2/p
	Code	Name			
Historic District	12	EMINÖNÜ	2,871	0.4	1.0
	14	FATİH	6,866	1.0	2.4
	7	BEYOĞLU	3,464	0.5	1.2
	Subtotal		13,200	2.0	4.6
Europe: Marmara Coast	32	ZEYTİNBURNU	5,455	0.8	1.9
	4	BAKIRKÖY	4,204	0.6	1.5
	15	CÜNGÖREN	3,703	0.6	1.3
	3	BAHÇELİEVLER	6,724	1.0	2.4
	2	AVCILAR	4,678	0.7	1.6
	Subtotal		24,764	3.7	8.7
Europe: Bosphoras	8	BESİKTAS	1,226	0.2	0.4
	19	KAĞITANE	1,662	0.2	0.6
	26	ŞİŞLİ	1,520	0.2	0.5
	23	SARIYER	372	0.1	0.1
	Subtotal		4,779	0.7	1.7
Europe: Inland	13	EYÜP	1,938	0.3	0.7
	16	GAZİOSMANPAŞA	2,526	0.4	0.9
	10	BAYRAMPAŞA	4,180	0.6	1.5
	902	ESENLER	3,358	0.5	1.2
	5	BAĞCILAR	5,167	0.8	1.8
	20	KÜÇÜKÇEKMECE	6,515	1.0	2.3
	Subtotal		23,685		
Total/Average of European Side			66,428	6.4	15.0
Asian: Marmara	1	ADALAR	1,648	0.2	0.6
	17	KADIKÖY	4,040	0.6	1.4
	21	MALTEPE	2,532	0.4	0.9
	18	KARTAL	2,905	0.4	1.0
	22	PENDİK	3,114	0.5	1.1
	28	TUZLA	1,597	0.2	0.6
	Subtotal		15,836	2.4	5.5
Asian: Bosphoras	30	ÜSKÜDAR	1,803	0.3	0.6
	6	BEYKOZ	374	0.1	0.1
	29	ÜMRANİYE	1,262	0.2	0.4
	Subtotal		3,439	0.5	1.2
Total/Average of Asian Side			19,275	2.9	6.7
Outside IMM	9	BÜYÜKCEKMECE	926	0.1	0.3
	903	ÇATALCA	41	0.0	0.0
	904	SİLİVRİ	604	0.1	0.2
	Subtotal		1,571	0.2	0.5
Total			87,273	9.5	22.3

Source: JICA Study Team

10.5.11. Framework for Emergency Rehabilitation Works of Lifeline Services (Gas, Water, Electricity, etc).

The emergency response plans for each lifeline service have been formulated and submitted to the Provincial Crisis Management Centre by each lifeline company. However, the submitted emergency response plans were not quantitatively formulated because of the lack of magnitude of damage estimates, except the water and sewage company of the IMM, which is called ISKI.

The submitted emergency response plans of the other lifeline companies should be reviewed based on the estimated lifeline damages of this Study and from the following point of views regarding preparedness, emergency response, and rehabilitation measures:

(1) Preparedness Measures

- Introduce and establish monitoring and control systems for electric power supply switches and natural gas supply valves. This will help to mitigate secondary disaster occurrences from damaged points on cables and pipelines, short-circuits, and damaged service boxes.
- Establish procurement/storage systems for emergency response and rehabilitation measures.
- Establish prioritized emergency lifeline network systems for crisis management centres, emergency response centres, etc.

(2) Emergency Response Measures

- Temporary emergency potable water supply system in each proposed community evacuation area, tent village, and temporary housing area.
- Temporary emergency toilet systems at each of the proposed community evacuation areas, tent village, and temporary housing areas.
- Temporary telecommunication system to provide a public telephone centre also in the proposed community evacuation, tent village, and temporary housing areas.
- Implementation of emergency rehabilitation systems for the established emergency lifeline network systems for crisis management centres and emergency response centres, etc.

(3) Rehabilitation Measures

- Estimation of required rehabilitation taskforce teams needed to cover the estimated damages within the target period.

- Review of the present organization structure and task distributions for the identified taskforce teams.
- Estimation of required spare parts and materials needed to cover the estimated damages.
- Review of the present storage supplies, procurement, and goods circulation systems for the required spare parts, materialss and machinery needed for rehabilitation works within the target period.

Table 10.5.12 Framework for Lifeline Rehabilitation Works

Area	District		Damage length of electricity cable			Damages of natural gas supply system		Damage point of water pipeline	Damage point of sewage pipeline
	Code	Name	overhead	underground	total (km)	point of pipeline	service box		
Old Town	12	EMINÖNÜ	1	18	19	0	100	41	NA
	14	FATİH	2	56	59	1	4,033	122	NA
	7	BEYOĞLU	9	23	32	0	510	54	57
	Sub-Total		12	97	109	1	4,643	217	57
Europe: Marmara Coast	32	ZEYTİNBURNU	15	51	65	1	700	70	NA
	4	BAKIRKÖY	9	36	45	1	2,490	97	91
	15	CÜNGÖREN	8	51	59	0	1,653	70	NA
	3	BAHÇELİEVLER	11	58	68	1	2,866	115	162
	2	AVCILAR	44	31	75	1	1,426	66	85
	Sub-Total		87	226	313	4	9,134	417	339
Europe: Bosphoras	8	BESİKTAS	2	4	6	0	656	31	36
	19	KAĞITANE	7	9	16	1	133	27	70
	26	ŞİŞLİ	6	8	14	0	574	21	23
	23	SARIYER	9	7	17	0	151	19	18
	Sub-Total		25	29	54	1	1,514	98	147
Europe: Inland	13	EYÜP	16	17	33	1	498	69	NA
	16	GAZİOSMANPAŞA	18	12	30	0	631	30	NA
	10	BAYRAMPAŞA	18	22	40	0	2,246	55	NA
	902	ESENLER	20	25	45	0	589	36	NA
	5	BAĞCILAR	22	47	69	1	807	98	136
	20	KÜCÜKCEKMECE	23	65	88	1	2,023	142	165
	Sub-Total		118	188	306	3	6,794	429	301
Total/Average of European Side			242	540	782	9	22,084	1,161	843
Asian: Marmara	1	ADALAR	NA	NA	NA	NA	NA	21	NA
	17	KADIKÖY	38	52	89	1	1,868	85	103
	21	MALTEPE	18	27	45	1	1,096	56	73
	18	KARTAL	14	23	37	1	1,272	71	81
	22	PENDİK	16	23	40	1	725	69	51
	28	TUZLA	8	14	21	0	28	32	47
	Sub-Total		94	138	232	4	4,990	334	354
Asian: Bosphoras	30	ÜSKÜDAR	17	19	36	0	1,325	42	46
	6	BEYKOZ	3	4	7	NA	NA	21	28
	29	ÜMRANİYE	8	9	17	0	330	19	28
	Sub-Total		28	32	60	0	1,655	82	102
Total/Average of Asian Side			122	171	292	4	6,645	416	456
Total			364	711	1,075	13	28,729	1,577	1,299

Source: The JICA Study Team

10.5.12. Framework for Debris Removal

After an earthquake disaster, urban reconstruction and the search for dead bodies require the removal of all collapsed/damaged building debris and other supper-/infrastructure debris in the metropolitan area. The majority of debris from the estimated building damages is estimated at approximately 140 million tons. The required machinery to remove the debris is estimated at around 44,000 to 73,000 heavy goods vehicles and 2,800 to 4,700 civil engineering machinery vehicles to keep the targeted periods of 60 or 100 days before the commencement of urban reconstruction activities.

Debris disposal sites are proposed in order to utilize vacant and unused lands of mining and quarry sites in the northern part of the IMM. The required disposal sites have an estimated area of 56 km^2, based on the 2.5 m average depth of those vacant sites. The traffic demand of the heavy goods vehicles needed to transfer the debris is estimated at around 175,000 to 292,000 daily trips, which requires 12 to 20 lane roads, to the northern disposal sites from damaged districts. The existing road network to the north cannot cater to the estimated traffic demand within the targeted periods of 60 to 100 days.

Additionally, the estimated traffic demand to remove debris will is well over the capacity of emergency road networks in the same catastrophic damaged districts. This in turn will disturb other emergency vehicle operations on the emergency road network.

Before another earthquake disaster occurs, the present emergency response plan for debris removals should be reconsidered and revised with the following preparedness measures in mind:

(1) Proposed Preparedness Measures

- Implementation of road widening projects for narrow designated emergency roads.
- Formulation of debris removal road networks to the northern disposal sites, which can later be effectively utilized for weekend recreational activities of citizens.

(2) Proposed Emergency Response Measures

- Programmes to acquire a huge number of heavy-goods dump trucks and power shovels from the private sector and with drivers and operators from outside the metropolitan area.
- Programmes to establish fuel and maintenance centres for heavy-goods vehicles and machinery.
- Programmes to utilize vacant mining and quarry sites as debris disposal sites.

Table 10.5.13 Framework for Debris Removal and Disposal

Area	District		Total Estimated Debris from Damaged Building (ton)	Required Machinery to Remove Debris within 60days		Required Machinery to Remove Debris within 100days	
	Code	Name		Heavy Good Vehicle (8t/4t/d)	Heavy Machinery (500t/d)	Heavy Good Vehicle (8t/4t/d)	Heavy Machinery (500t/d)
Old Town	12	EMINÖNÜ	3.310.000	1.724	110	1.034	66
	14	FATİH	7,592,000	3,954	253	2,373	152
	7	BEYOĞLU	4,359,000	2,270	145	1,362	87
	Sub-Total		15.261.000	7.948	509	4.769	305
Europe: Marmara Coast	32	ZEYTİNBURNU	7.229.000	3.765	241	2.259	145
	4	BAKIRKÖY	7,519,000	3,916	251	2,350	150
	15	CÜNGÖREN	5,946,000	3,097	198	1,858	119
	3	BAHÇELİEVLER	10,262,000	5,345	342	3,207	205
	2	AVCILAR	5,369,000	2,796	179	1,678	107
	Sub-Total		36.325.000	18.919	1.211	11.352	726
Europe: Bosphoras	8	BESİKTAS	2.814.000	1.466	94	879	56
	19	KAĞITANE	2,999,000	1,562	100	937	60
	26	ŞİŞLİ	4,550,000	2,370	152	1,422	91
	23	SARIYER	1,123,000	585	37	351	22
	Sub-Total		11.486.000	5.982	383	3.589	230
Europe: Inland	13	EYÜP	2.669.000	1.390	89	834	53
	16	GAZİOSMANPAŞA	5,103,000	2,658	170	1,595	102
	10	BAYRAMPAŞA	4,945,000	2,575	165	1,545	99
	902	ESENLER	4,363,000	2,272	145	1,363	87
	5	BAĞCILAR	7,974,000	4,153	266	2,492	159
	20	KÜÇÜKÇEKMECE	11,182,000	5,824	373	3,495	224
	Sub-Total		36.236.000	18.873	1.208	11.324	725
Total/Average of European Side			99.308.000	51.723	3.310	31.034	1.986
Asian: Marmara	1	ADALAR	839.000	437	28	262	17
	17	KADIKÖY	10,688,000	5,567	356	3,340	214
	21	MALTEPE	5,190,000	2,703	173	1,622	104
	18	KARTAL	4,591,000	2,391	153	1,435	92
	22	PENDİK	5,175,000	2,695	173	1,617	104
	28	TUZLA	2,217,000	1,155	74	693	44
	Sub-Total		28.700.000	14.948	957	8.969	574
Asian: Bosphoras	30	ÜSKÜDAR	5,078,000	2,645	169	1,587	102
	6	BEYKOZ	793,000	413	26	248	16
	29	ÜMRANİYE	3,548,000	1,848	118	1,109	71
	Sub-Total		9,419,000	4,906	314	2,943	188
Total/Average of Asian Side			38.119.000	19.854	1.271	11.912	762
Outside IMM	9	BÜYÜKÇEKMECE	1.401.000	730	47	438	28
	903	ÇATALCA	181,000	95	6	57	4
	904	SİLİVRİ	927,000	483	31	290	19
	Sub-Total		2.509.000	1.307	84	784	50
Total			139.936.000	72.884	4.665	43.730	2.799

Source: The JICA Study Team

10.6. Recommended Measures to Establish Emergency Road Network System

An emergency road network system has been introduced and planned in the metropolitan area by the crisis management centres at the metropolitan and district municipality levels. The first emergency road network was designated to follow the identified road hierarchy of level 1 to 3 as indicated in the Road Network Master Plan of metropolitan Istanbul. Presently, the first plan is reviewed from the proposed designation system of emergency roads as follows:

(1) Recommended Emergency Road Network System by the JICA Study Team

The emergency road network should be prioritized by emergency factors composed from the following responses: 1) disaster damage information collection/exchange; 2) proper emergency response operations; and 3) emergency goods circulation after the earthquake. The prioritized emergency road networks should link the crisis management centres, emergency response centres, and emergency goods circulation centres through proper road networks. For example:

- **Primary Emergency Road Network** should link all the identified crisis management centres at the province, municipality and district levels, and it should also link these to all of the major transportation nodes, such as airports and seaports.
- **Secondary Emergency Road Network** should add to the selected primary road network and also link all the identified emergency response centres.
- **Tertiary Emergency Road Network** should add to the selected primary and secondary road networks and link emergency goods storage sites, and gathering and circulation centres.

(2) Proposed Emergency Road Network

Based on the proposed system, the length of emergency road networks is composed of 455 km of primary emergency roads, 360 km of secondary emergency roads, and 3 km of tertiary emergency roads. These emergency road networks are linked with the identified crisis management centres, emergency response centres and emergency goods centres by the provincial crisis management centres as the following demonstrates:

Table 10.6.1 Identified Centers Linked by Emergency Road Network

	Identified Centres by Provincial Crisis Management Centre	No. Centre
Centres for Primary Emergency Road	Crisis Management Centres of Province/Department	4
	IMM Disaster Management Centre	1
	District Crisis Management Centre	30
	Related Government Offices	60
	Airport	4
	Ports	5
	Total facilities	104
Centres for Secondary Emergency Road	IMM Relief and Response units	18
	Gathering Area for District Search-Rescue Teams	23
	Fire Brigade	44
	Military	46
	Health Facilities	95
	Main Gathering Centres for Machinery	2
	Gathering Area for District Machinery	13
	Piers	44
	Heliport (helipad)	200
	Tent Village	486
	Total facilities	971
Centres for Tertiary Emergency Road	Loading Civil Engineering Machinery	5
	Centres for Unloading and Loading Vehicle Equipment	3
	Centre for Unloading and Loading Supply Materials	4
	Centres for Vehicle Unloading and Loading: Truck Terminal	9
	Centres for Unloading and Loading : Sea and Land Transport	6
	Logistic Support and Coordination Centres	2
	Total facilities	29
G. Total		1104

Source: Database was provided by the provincial crisis management centre. The identified centres were selected and categorized by JICA Study Team

Some identified centres for secondary and tertiary emergency roads are linked by proposed primary emergency roads or secondary emergency roads.

Table 10.6.2 Length and Width of Proposed Emergency Road

Area	District		Length of Proposed Emergency Road(km)				Length by Road Width (km)			
	Code	Name	Primary	Secondary	Tertiary	Total	2-6m	7-11m	12-15m	over 15m
Old Town	12	EMINÖNÜ	12	2	0	14	0	3	0	10
	14	FATİH	11	6	0	17	1	3	1	13
	7	BEYOĞLU	14	8	0	22	1	5	2	13
	Sub-Total		37	15	0	53	1	11	4	37
Europe: Marmara Coast	32	ZEYTİNBURNU	14	11	0	25	1	7	4	13
	4	BAKIRKÖY	30	19	0	49	3	18	2	26
	15	CÜNGÖREN	7	9	0	16	1	9	1	4
	3	BAHÇELİEVLER	15	14	0	30	0	9	9	11
	2	AVCILAR	16	6	1	23	0	8	4	11
	Sub-Total		82	59	1	142	5	51	19	66
Europe: Bosphoras	8	BESİKTAS	10	20	0	30	0	15	2	13
	19	KAĞITANE	13	7	0	20	0	3	7	10
	26	ŞİŞLİ	15	10	0	25	0	2	6	17
	23	SARIYER	8	17	0	25	1	10	8	6
	Sub-Total		46	54	0	100	1	30	22	46
Europe: Inland	13	EYÜP	14	16	0	30	0	8	5	17
	16	GAZİOSMANPAŞA	7	15	0	22	1	6	4	10
	10	BAYRAMPAŞA	13	1	0	14	1	5	1	8
	902	ESENLER	14	6	0	20	0	9	1	10
	5	BAĞCILAR	21	10	0	30	1	11	10	9
	20	KÜÇÜKÇEKMECE	13	50	0	63	3	39	5	16
	Sub-Total		82	98	0	180	7	78	25	70
Total/Average of European Side			248	226	1	474	15	171	71	218
		Share (%)	52	48	0	100	3	36	15	46
Asian: Marmara	1	ADALAR	0	0	0	0	0	0	0	0
	17	KADIKÖY	34	26	0	60	2	15	21	23
	21	MALTEPE	16	14	0	30	1	8	7	14
	18	KARTAL	19	10	0	30	1	8	7	14
	22	PENDİK	25	16	0	40	6	20	5	9
	28	TUZLA	14	21	2	37	3	19	6	8
	Sub-Total		108	87	2	197	13	70	46	68
Asian: Bosphoras	30	ÜSKÜDAR	25	27	0	52	1	16	10	25
	6	BEYKOZ	22	7	0	29	2	15	0	12
	29	ÜMRANİYE	16	13	0	29	0	1	9	19
	Sub-Total		63	47	0	110	3	32	20	56
Total/Average of Asian Side			171	134	2	307	16	102	65	124
		Share (%)	56	43	1	100	5	33	21	40
Outside IMM	9	BÜYÜKCEKMECE	10	0	0	10	0	4	0	6
	903	ÇATALCA	7	0	0	7	1	2	1	4
	904	SİLİVRİ	19	0	0	19	0	0	0	19
	Sub-Total		36	0	0	36	1	6	1	28
Total			455	360	3	818	31	278	137	371
		Share (%)	56	44	0	100	4	34	17	45

Source: The JICA Study Team

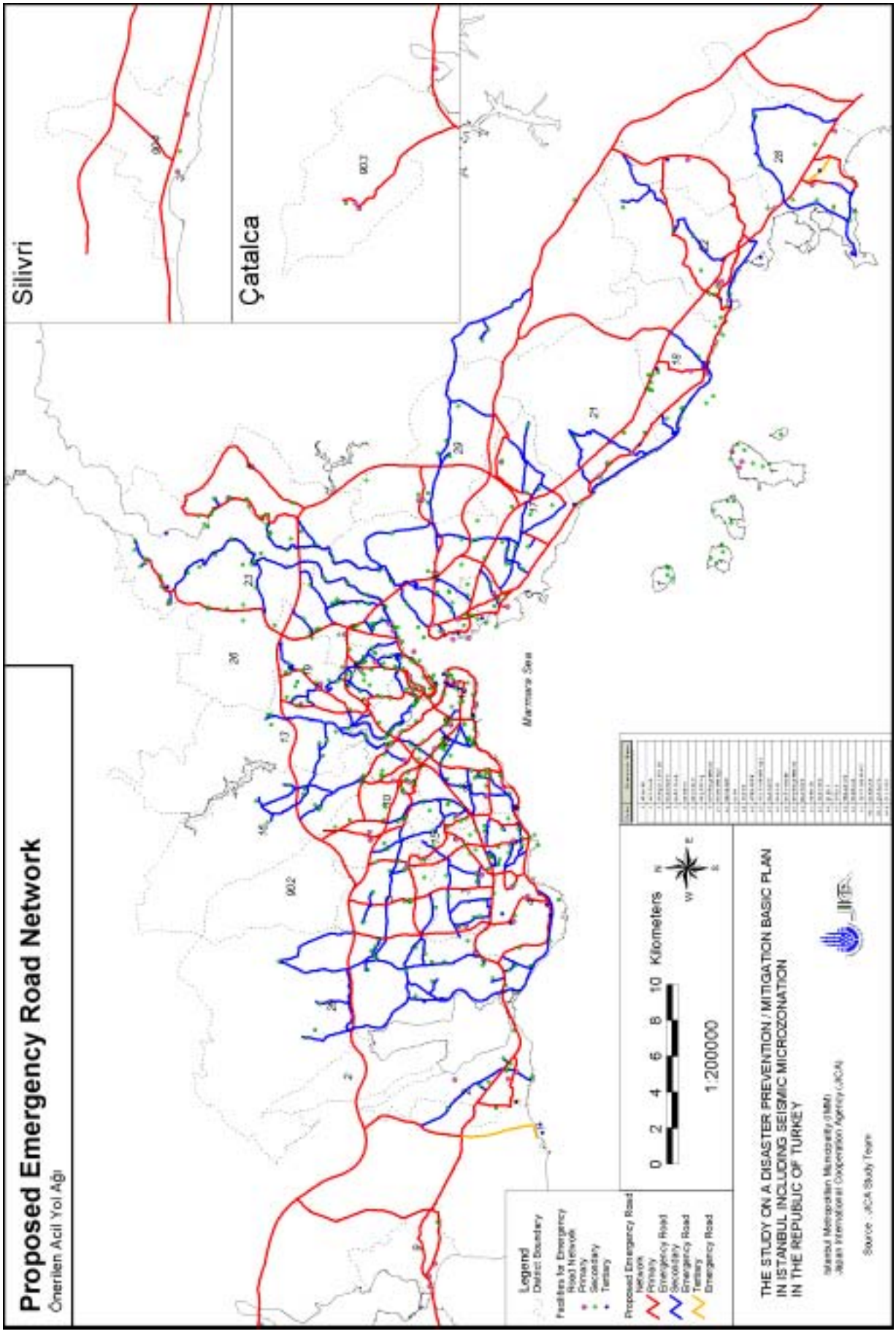

Figure 10.6.1 Proposed Emergency Road Networks

(3) Proposed Preparedness Measures to Establish Emergency Road Network

Preparedness measures are proposed to strengthen and establish proper emergency road networks. They should be effectively utilized by all emergency response activities during the disaster period. They include the following:

- The emergency road network plan should be periodically reviewed and updated to link the modified centres.
- Increased public awareness of emergency road network system, objectives, network, and regulations (strict control of street car parking, and private vehicle access during disaster periods).
- During ordinary times, provide signs to clearly demarcate emergency roads and control of on-street car parking.
- Reinforcement projects for crisis management centres, response centres, etc., that are assessed as structurally weak buildings.Widening projects for inappropriately narrow roads. The proper width of an emergency road is recommended to be over 15 m to minimize impacts from roadside debris. Prioritization of road widening projects is recommended as follows:
  - **Top priority**: 31 km of roads 2 to 6 m wide
  - **Second priority**: 278 km of roads 7 to 11 m wide
  - **Third priority**: 137 km of roads 12 to 15 m wide
- Recommended bridge reinforcement projects for bridges assessed as weak through seismic resistance diagnosis.

(4) Proposed Emergency Response Plan for Emergency Road Network

In order to maintain the emergency road network, the following emergency response tasks are recommended:

- **Tasks to maintain road function:** Collection and inspection of damages of the road. Setting up and communication of alternate routes to centres. Supply required taskforce teams with proper machinery/good vehicles. Dispatch debris removal/rehabilitation taskforce teams.
- **Tasks to control access to roads and private traffic on roads:** Provision of license to emergency vehicles. Checking the license and control of private vehicle access to the road prohibiting and removing private vehicle traffic from the roads.

- **Tasks to manage traffic on the road:** Monitor and collect traffic condition information on the roads. Identify the shortest time distance routes and inform emergency vehicles of shortest paths.

10.7. Proposed Measures to Strengthen Crisis Management Centres

10.7.1. Existing Condition of Crisis Management Centre

Emergency response operations are legally controlled by the national government system, such as ministries and their regional departments, provincial governorships, and district governorships. Presently, the local government system of the metropolitan municipality and district municipalities only take on portions of tasks necessary in emergency response operations. Task distribution for emergency response operations is centralized to the ministries and provincial governorships rather than district governorships. This centralized decision-making and ordering system has some disadvantages with regards to the quick and careful actions required. This is especially truewhere local demands are of a huge scale due to an urban earthquake disaster, such as in a megalopolis like Istanbul.

The existing crisis management centres in the metropolitan area are not properly organized nor are they properly located.

- Provincial Crisis Management Centre has a 24 hours operation system in a temporary prefabricated building in the provincial government compund. A new provincial crisis management centre is planned to be constructedwith the Centre of Civil Defence near the international airport.
- IMM constructed a new disaster management centre, sufficiently seismic resistant to withstand a foreseeable earthquake disaster.
- District crisis management centres had been organized and developed in each district by the district governorship or district municipalities. Almost all of the centres, which were organized and developed by district municipality, were subsequently transferred to the district governorship. The existing conditions of these centres are not yet standardized with respect to organization, staff/experts, and building structure.

10.7.2. Recommended Measures to Establish Proper Crisis Management Centres

The decentralization of emergency response tasks and the organization of a joint operation system of central and local governments will help to establish a proper and effective emergency response effort. The following are some recommendations:

(1) Recommended Institutional Measures

- Clear and differentiated task responsibilities of crisis management centres at the national, provincial and district levels

- The organization and establishment of a joint operation system between the provincial crisis management centre of the governorship and that of the metropolitan municipality
- The organization and establishment of a joint operation system between the district crisis management centres of the governorship and that of the district municipalities.

(2) Recommended Physical Measures

- Development of a new proper Provincial Crisis Management Centre to serve as an earthquake disaster information/research centre, awareness centre of citizens, and training centre of community leaders.
- Existing district crisis management centers, district governorship offices, or district municipality offices are proposed to improve or reconstruct their buildings to ensure they are seismic resistant and can perform the required crisis management center functions and emergency foods/water storage functions in the event of an earthquake.
- Development and establishment of a specialized emergency communication system between all crisis management centres, emergency response centres and emergency goods centres.

10.7.3. Proposed Facilities for Establishing New Provincial Crisis Management Centres

The following recommendations for functions and facilities are for developing new provincial crisis management centres:

(1) Functions of Crisis Management Centre:

Crisis management centre should be able to keep functioning even if lifeline services are cut off by earthquake damage. The following facilities and functions are recommended:

- Main meeting and command room with audio-visual system supported by an information network
- Press and press-release rooms
- Meeting rooms for the emergency taskforce group with audio-visual system supported by an information network
- Rooms for all taskforce agencies with computers supported by an information network
- Multi-modal communication room with wireless, satellite, and other common communication networks
- Dining and kitchen facilities

- Rooms designated as rest areas
- Emergency foods and potable water storage
- Emergency back-up systems for lifelines (power generators, batteries, seismic resistant water reservoirs, seismic resistant fuel tanks, etc.).

(2) Functions of Earthquake Disaster Information Centre

- Database library of earthquake disaster information
- Research centre for earthquake disasters
- Earthquake disaster damage simulation model supported by seismograph system with telemeter network

(3) Functions of Awareness Centre of Earthquake Disaster for Citizens

(4) Functions of Training Centre for Community Leaders

10.7.4. Recommended Facilities for District Crisis Management Centre

(1) Functions of Crisis Management Centre

- Main meeting and command room with audio-visual system supported by an information network
- Rooms for all taskforce members with computers supported by an information network
- Multi-modal communication room with wireless, satellite and other common communication networks
- Dining and kitchen facilities
- Rooms designated as rest areas

(2) Functions of Emergency Back-up System for Lifelines

- Emergency foods and potable water storage
- Emergency back-up systems of lifeline services (power generators, batteries, seismic resistant water reservoirs, seismic resistant fuel tanks, etc.).

(3) Functions of Emergency Foods/Potable Water Storage/Circulation Centre for Refugees in Each District

Chapter 11.
Recommended Measures for Earthquake Disaster Mitigation

Chapter 11. Recommended Measures for Earthquake Disaster Mitigation

11.1. Introduction

Turkish experts, especially earthquake researchers, have recognised that the danger of another earthquake striking the Istanbul area is likely to occur 15 years after the Izmit Earthquake. Already three (3) years have passed without any mitigation measures being done. The earthquake damage analysis of the Study calculated large-scale building damage and human casualties as well as infrastructure damage. By way of concluding the Study, measures to mitigate earthquake disaster are recommended herein based on the results of the study.

The necessary earthquake disaster mitigation measures are basically project-oriented and are laid out in short and medium to long-term perspectives. The short-term measures are to be implemented as soon as possible. The mid- to long-term measures are to be done within the next 5 to 10 years, or more. Short-term measures include retrofitting important facilities and infrastructure in order to secure their operational function in the event of an earthquake disaster. Middle to long-term measures involves non-structural recommendations. Basic concepts of methodology for urban structure improvements are the redevelopment of areas of high population density, the widening of narrow road networks, or the review of existing land use in order to have more open space areas with special consideration of the earthquake disaster preventive land use of Istanbul. The organisation of institutional systems for disaster management is also an important measure for the smooth and quick response to a large-scale earthquake disaster.

11.2. Short-Term Measures

(1) Retrofitting of Hospitals

According to the collected data, the total number of hospitals in the Study Area is 635. Those are established and managed by different entities such as national agencies, SSK, universities, the private sector, and the military. After the Erzincan Earthquake, the World Bank had a survey conducted on building resistivity against a high intensity earthquake for 59 hospitals in Izmir and Istanbul in 1994. The survey report concluded that the structural resistivity of the surveyed hospitals was quite vulnerable to a high intensity earthquake and retrofitting was recommended; however, this has not yet been undertaken.

It is a very important measure to secure the medical services function of hospitals in times of an earthquake disaster. Therefore, to begin, a diagnosis for building resistivity against earthquakes should be conducted, and this diagnosis should include a comprehensive evaluation. Based on that evaluation, the necessary retrofitting or reconstruction plan should be prepared by the relevant agencies as soon as possible, and the necessary actions (including practical implementation) should be undertaken.

(2) Retrofitting of School Buildings

Retrofitting project for school buildings in Istanbul has been started already; however, the implementation ratio is not very high. According to this study, the total number of schools is 2,252, of which some 300 buildings were constructed using the new school building design standard established in 1997. The Study Team conducted a preliminary diagnosis of the earthquake resistance of two school buildings based on design drawings provided by the relevant agency and an on site survey. In this diagnosis, mainly the building structure and material are checked in detail. Finally, all data prepared by the survey is input into a specific formula and calculated to get the IS value, which is an indicator of the building's resistance to earthquakes. The result shows that even a new building design standard is not enough to prevent a pancake-like collapse of school buildings. This collapse must be prevented from happening because of the many pupils in the classrooms during weekdays. Retrofitting school buildings should be accelerated to cover all buildings in Istanbul and the design standard should be also reviewed.

(3) Retrofitting of Public Facilities, City Hall, and Governmental Buildings

Istanbul City Hall has now been closed for more than a year in order to complete retrofitting. This is a good example of retrofitting for a typical public facility. In case of a large-scale earthquake disaster, the functions of public facilities such as City Hall, district offices, fire stations, and governmental buildings must be maintained, and the facilities must be utilised as centres for emergency rescue operations, or as disaster management centres. Therefore, these facilities must be safe against a strong earthquake. The earthquake resistance of existing public facilities should be checked, and necessary retrofitting or reconstruction plans should be implemented by relevant agencies.

(4) Retrofitting of Bridges

In this study, data on a total of 480 bridges was collected and site surveys were also conducted by the Study Team. Finally, collected data was filed into bridge inventories, except the first and the second Bosphorus Bridge and the Fathi Sultan bridges. Vulnerability of bridges was analyzed statistically based on Katayama's methodology. As a result of the analysis, 24 bridges were calculated as having a higher possibility of collapse

and 2 bridges constructed as viaduct structures were calculated as having a higher vulnerability to a Model C earthquake. The retrofitting of bridges is necessary to secure transportation routes not only for emergency rescue operations but also to support restoration and reconstruction activities. Thus, bridge retrofittings should be evaluated based on their priority for necessity of transportation network in a large-scale earthquake disaster. Some bridges are slated for retrofitting this year; however, the rest of the highly vulnerable bridges should be retrofitted by relevant agencies as soon as possible.

(5) Retrofitting of Port Facilities

Retrofitting port facilities is also very important to secure maritime transportation routes in the event of an earthquake. After the Izmit Earthquake, the port facility of Izmit and its surrounding area were damaged seriously due to liquefaction. Piers were damaged and some cranes collapsed. Damage to the port facility and port area should be prevented in an earthquake occurrence because the port area is considered to be utilised as disaster prevention base. Large amount of rescue materials supplied by both domestic and foreign aid will be received through the port. These materials will be redistributed to damaged areas by smaller ships or land transportation systems. In Istanbul, the Haidar Pasya Port, which functions as a deep seaport, should continue to be maintained and operated even after a strong earthquake. The earthquake resistance of the port facility and existing ground conditions should be checked, and necessary improvements should be undertaken by the responsible agency.

(6) Retrofitting of Lifelines

In Istanbul City, urban utilities such as gas, water, electricity, sewage, and telecommunication systems are operated by private or city-owned companies. Supply of water, gas, and electricity is essential to maintain the daily life of communities; however, in case of a strong earthquake, these pipeline networks or cables will be damaged in many places. The gas supply system, especially, should be automatically shut down to prevent a secondary disaster such as fire or explosion. Technical matters regarding integrated gas supply and pipeline management systems related to earthquakes should be discussed, starting with the feasibility of their implementation. Based on the feasibility study, an introduction of automatic shut down systems should be discussed.

Water pipelines in the Istanbul area have been constructed and renewed in the last ten years; however, many damage points were calculated based on ground conditions and pipeline material. Basic materials necessary for restoration of service in earthquake-damaged areas should be stocked at the appropriate stations to facilitate the recovery of the areas in a short period of time.

Underground electricity cables will be damaged in many points. Based on the result of damage analysis, recovery plans should be prepared by relevant agencies.

For the sewage system, the earthquake resistance of sewage treatment plants should be checked, and necessary improvements should be made.

(7) Construction of Disaster Management Centre

The Disaster Coordination Centre of Istanbul (AKOM) was constructed in 2001 but installation of the necessary equipment related to disaster information collection and dissemination systems has not yet been completed. Construction of another disaster management centre (AYM) is planned by the Governorship of Istanbul Prefecture, and its construction has just started. These are the main disaster management centres covering the Istanbul urban area and prefecture. In order to manage a large-scale earthquake disaster, these centres should be networked effectively with district offices or other disaster-related offices by telecommunication systems. These telecommunication systems must be maintained and operated at the time of an earthquake disaster occurrence to collect damage information, dispatch necessary orders for rescue operations, and communicate with each related agency. Therefore, construction plans of disaster management centres, including the main centre, back-up centre, and district centre, should be discussed. Basic functions and facilities for each disaster management centre should also be discussed. According to the Study, construction priority should be granted to higher damage estimated districts.

(8) Campaign for Raising Awareness on Disaster Prevention

An earthquake disaster prevention awareness campaign for citizens of Istanbul City should be held continuously through community-based information dissemination, rescue operation drills, and through the recognition of mutual help in cooperation with community organisations, NGOs, the municipal administration, and academic researchers. For disaster prevention, especially in the administration of first aid, community participation is indispensable. People's awareness on disaster prevention should be raised even more by combining various activities and campaigns.

11.3. Medium- to Long-Term Measures

(1) Master Plan for Earthquake Disaster Prevention

Damage estimation and analysis of urban problem areas were conducted by this JICA Study. Structural problems of buildings were also analyzed. However, the study accuracy is still in the macro level, showing fairly detailed aspects of earthquake damage distribution covering the whole Study Area and recommendations for improvement of existing conditions for earthquake disaster management, including urban planning and institutional

aspects. Based on these study results, a detailed earthquake disaster prevention plan such as district-wise plan for Istanbul City should be formulated. In this case, building statistics should be improved to assist in classifying more detailed categories for structures. Population data should also be improved as to clarify daytime and nighttime variations. This master plan should be deeply related to future land-use zoning to secure enough open spaces, road networks, environmental protection areas and locations of public facilities. Detailed plans should be examined and formulated for the following: the location of evacuation sites and routes, review of road network priority for emergency operations, necessary emergency storage supplies, community participation for rescue operations, medical equipment emergency systems, and emergency communication systems.

(2) Formulation of Urban Redevelopment Plan Aimed at Earthquake-Resistant City

In addition to developing a detailed earthquake disaster prevention master plan, a redevelopment plan for higher damage estimated areas should be formulated based on a detailed area redevelopment plan as a model case. The methodology and concepts for this detailed area redevelopment plan should be prepared by joint collaborations between municipality and community organisations, with the approach of providing for the improvement of existing urban conditions to create an earthquake-resistant urban area. This detailed urban redevelopment plan should be applied to an area of extremely high population density on the European side first. However, it seems to take a rather long time to reach a basic agreement and consensus by stakeholders and people concerned for the practical implementation of redevelopment to occur. The municipality should provide the specific guidelines for these redevelopment plans.

(3) Promotion of Research on Earthquake-Resistant Buildings

Basic research on earthquake-resistant buildings including structure, material, and design standards should be promoted by the academic sector. If regulations for stronger building structures against earthquakes could be standardised in earthquake-prone areas, damage will be largely reduced. From this point of view, more research and recommendations concerning building structures and materials should be promoted by research institutes. Based on these activities, building code and design standards must be improved. The private sector engaged in housing should also be involved in these activities.

(4) Establishment of Credit System for Earthquake-Resistant Housing

It seems to be a very important policy to establish a financial assistance scheme for citizens who want to build an earthquake-resistant building. A long-term credit system by the government should be discussed to enhance and provide incentives to the people living in earthquake-prone areas. Special low interest rates for this credit scheme should be prepared

for this purpose. Also, property taxation should be reviewed and improved to help those engaged in housing and construction. As a result of long-term accumulation of these activities, stronger houses and buildings could be continually constructed to realise an earthquake-resistant urban structure. Therefore, it is necessary to conduct a study and discussion on fund sources to realise this scheme.

(5) Institutional System Improvement for Disaster Management

The concept of disaster prevention should be introduced into the land-use system of the Reconstruction Act. The building code should mention other aspects, such as materials, and should cover comprehensive aspects regarding disaster prevention. A "Disaster Law" should introduce basic concepts of mitigation efforts that can be undertaken before a disaster occurs to reduce damage. Emergency aid regulation should include civic organisations and public relations on disaster information. Centralism has been strengthened under the 1982 Constitution, and so disaster management organisations have come into existence. However, since the population in one district in IMM is nearly equal to that of a neighboring province, and communication and transportation will likely be disrupted initially in case of a disaster, a centralised provincial governorship emergency office would not be likely respond quickly in case of a disaster. Therefore, a realistic plan should be made to empower a district or a community to respond independently to the event for the first several days. To realise this, the Provincial Governor's Disaster Management Centre should reorganise its members and tasks, especially its interdependent tasks, and then it should be restructured. At the district level, some key efforts include the strengthening of the linkage between the district chief and the mayor of the district municipality, the establishment of an organisation including residents and volunteers in mahalles, the disclosure of damage estimation study results to the public, and the provision of disaster prevention resource information collected in AYM and AKOM. A strong linkage between public service companies in IMM and each district would be necessary. The highest priority should be put on the seismic strengthening of public facilities so that they can function as emergency response centres. Privatisation of inspection of newly constructed buildings would be effective utilising engineers in public service companies of IMM. As for rescue and first aid training, providing training, increasing the number of trainers, and reducing the training hours in order to more efficiently train the public would be very effective. In order to ensure emergency preparation, the utilisation of professional engineers for damage inspections, the inclusion of mass media as part of disaster prevention organisations, utilising a strong public relations basis for providing disaster information, and the readiness to accept international aid is also necessary.