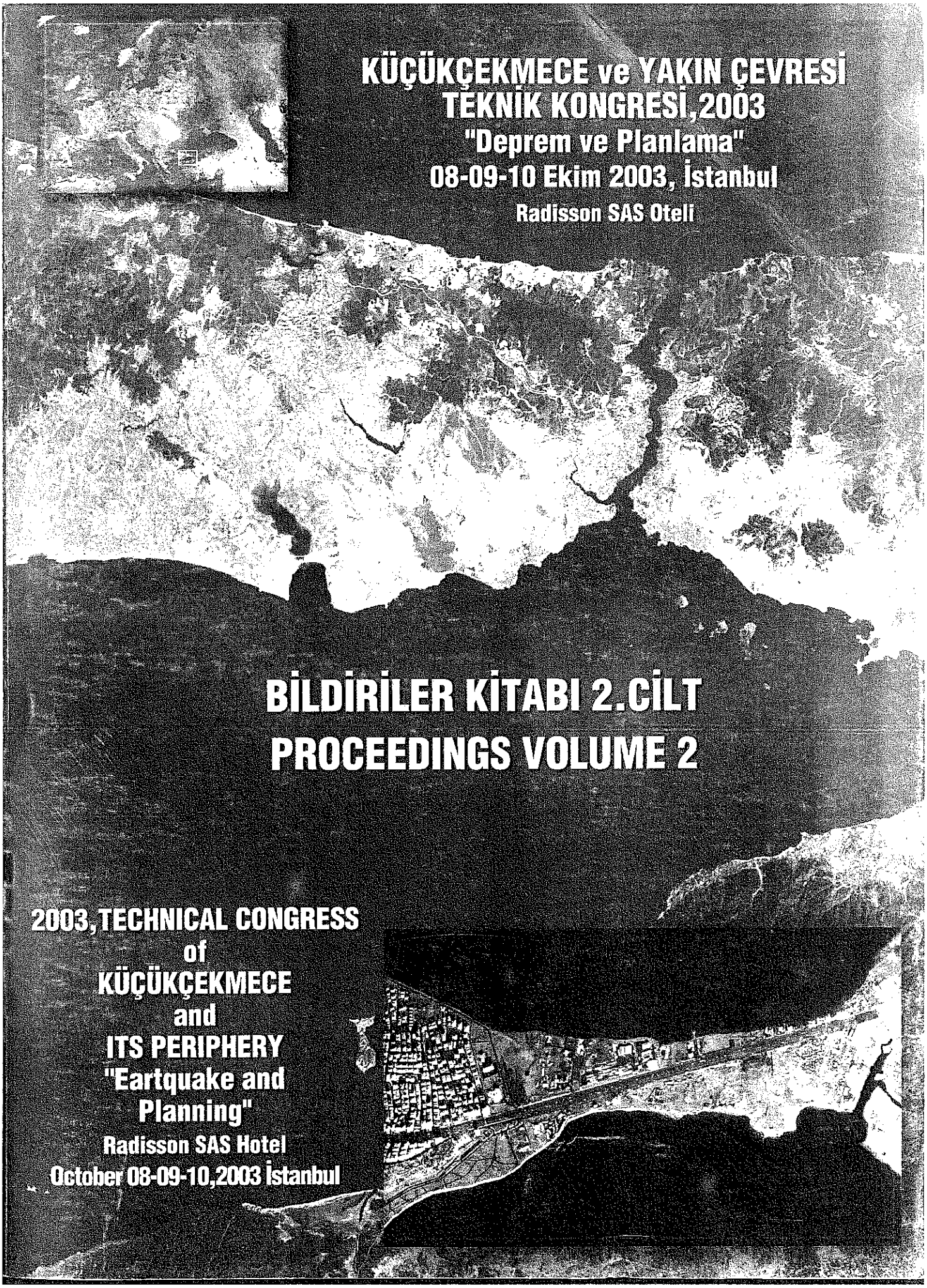

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"Deprem ve Planlama"

08-09-10 Ekim 2003, İstanbul

Radisson SAS Oteli

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"EARTHQUAKE AND PLANNING"

EDITOR
ALİ KOÇAK

08-09-10 EKİM\OCTOBER\ 2003
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ÖNSÖZ

Marmara Bölgesinde yoğun yaşanan Deprem riskinin gündemde tutulması, tartışılması yapılagelen faaliyetlerin tümünde gözlemlenmektedir. Konuya yerel yönetimler açısından toplu bakışın öne çıkarıldığı, somut öneri ve çözümlerin üretilebileceği bir kongrenin düzenlenmesinde katkıda bulunabilmenin gurur ve onurunu taşıyorum.

Kongreye sunulan bildirilerin ve araştırmaların, ülkemiz bilim yuvalarınca önemsenmesi ve Merkezi Yönetimce uygulamaya konulması, sorunun çözümünde önemli katkılar sağlayacağı kanaat ve dileğimdir.

Kongrenin oluşumunda özverili katkılarda bulunarak emeğini esirgemeyen tüm kurullara ve bildiri sunan değerli bilim adamalarına teşekkür eder, kongrenin çalışmalarında da başarılar dilerim.

F. Halidun ÖZBATUR
Küçükçekmece Belediye Başkanı

PREFACE

We observe that the main subject of the eartquake risk of Marmara District is taking a part in an actual events and talking about in the scientific discussions. I'm feeling a big honour to take a part of a Congress that puts the eartquake proplems forward to the Local Authorities as firstly matter, and giving concrete suggestions to solve this problem.

I believe that our Government and Central Administration will lend a hand to manage the problems after those scientific investigations and articles.

I would like to thanks to all scientists who presents their investigations for the Congress and their intensive labour on this subject and, I wish they will be succesfull in the Congress.

F. Halidun ÖZBATUR
Mayor of Küçükçekmece Municipality

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Aslı AKAY

EARTHQUAKE EFFECTS IN ENVIRONMENTAL SYSTEMS

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ÖZET

Depremler, 17 ağustos 1999 yılındaki son yılların en şiddetli zararını veren depremde de görüldüğü gibi altyapı tesislerinde de büyük hasarlar meydana getirmektedir. Bu depremde İzmit, Adapazarı, Gölcük and Yalova şehirlerinde büyük hasarlar meydana gelmiştir. Bu çalışmada, deprem etkisiyle bu şehirlerin altyapılarında meydana gelen hasarlar sıralanmış ve bu tecrübeden elde edilecek verilerle gelecek deprem afetlerinde, Türkiye şartlarında şehir altyapıları için ne gibi tedbirler alınması gerektiği tartışılmıştır.

ABSTRACT

On augustos 17, 1999 at 3:02 a.m., an earthquake along the North Anatolian Fault hit the eastern part of Marmara Region in Turkey. This region is the most densely populated and industrialized area of the country. During the earthquake, buildings, roads and other infrastructures in Izmit, Adapazari, Golcuk and Yalova Cities were heavily destroyed. In this study, damage of environmental systems in the cities are listed and results are discussed in order to have better precautions for the possible future earthquakes by focusing in Turkey's local conditions.

Key Words : Eartquake, water network, pipe types, wastewater.

1.INTRODUCTION

On Augustos 17, 1999 at 3:02 a.m., an earthquake along the North Anatolian Fault hit the eastern part of Marmara Region in Turkey. This region is the most densely populated and industrialized area of the country. The epicenter of the earthquake (Ms=7.4) was determined to be Golcuk city, which is 85 km away from Istanbul City [1]. The earthquake was one of the most powerful in Turkey in the last 20 years. After earthquake, 120.000 families lost their home. Financial cost has been guessed as US$ 20 billion. The event and its aftershocks have had devastating effects on the provinces of İzmit, Yalova, Sakarya (Adapazari) and Istanbul. During the earthquake, buildings, roads and

other infrastructures in Izmit, Adapazari, Golcuk and Yalova cities were heavily destroyed. Electrical supply was disrupted and all communications, including GSM, went down by the earthquake. About 20.000 buildings were collapsed during the earthquake. Also an integrated refinery located near Izmit city which supplies more than 30 % of Turkey's demand was damaged and a subsequent fire began.

Earthquake also damaged infrastructure of the cities and resulted some environmental problems. In this study, damage of environmental systems in the cities are listed and problems are discussed in order to have better precautions for the possible future earthquakes by focusing in Turkey's local conditions.

2. DAMAGE IN CITIES

After the earthquake, significant structure collapse and damage were observed in Adapazari and Golcuk Cities. The reason of huge damage in the cities is not only closeness to the fault but also the rapid misplanned constructed buildings, especially by low and middle income people immigrated to the cities from the rural areas of the country. When initial information on this disaster arrived, according to report of CMO's (Chamber of Environmental Engineers) first examination, 70 % of the 450 km water supply network and transmission lines were damaged in Adapazari City. Sewer pipes were also damaged in many points [2]. In Degirmendere (a small town near to Yalova) and its surroundings, parts of the shore collapsed into the sea. An area of several kilometres in length by 150 m width of the foreshore involving parkland, large hotel, wharf area, cafeterias, shops, toilets and numerous cars, have now been consumed by the sea water. This may lead to seawater being polluted by various substances released from the above-mentioned sources. Chemical pollution could also be expected.

After rescuing works of the first days, one of the most pressing problems was disposal of rubble. A matter of strong concern is the fact that in many locations an active dumping of rubble from the destroyed human settlements into the sea has been underway, which would lead to pollution and long-term consequences for marine ecosystems. A petrol station on the shore in Degirmendere had been affected by the earthquake. As a result, two large underground containers (allegedly almost empty) are exposed to the seawater. Condition and number of other underground containers are unknown. Dumping of rubble into the sea is aggravating the problem of oil pollution, as waste is covering sunken oil, which would remain trapped for a long time. After a few days, local authorities announced that dumping of rubble into the sea had been prohibited.

In the first days of disaster, what matters above all was rescuing every last survivor of the earthquake, and following days food, water and hygiene were important. Environmental and pollution problems in industrial areas and cities were not searched extensively, and still not yet. Problems and repairment works of environmental systems in the cities, mainly stated by local and governmental authorities are listed below.

2.1. Problems of water and wastewater systems in Izmit City

- Some cracks in tanks and pipes of wastewater treatment plant,
- Three cracks in ∅1200 mm. outfall pipeline,
- Water network problems in ∅800 and ∅900 steelpipes, ∅600 and ∅450 ACP (Asbestos Cement Pipe)

Completed construction and repairment works of water and wastewater systems in Izmit City until year of 2000 :

- 16 km new water lines,
- Repairment of 42 points in transmission lines (broken or leakage),
- 587 valves were repaired or changed,
- Repairment of wastewater pipes (lengths and diameters); 650m ∅400, 910 m ∅300, 850 m ∅200, 300 m ∅150, 550 m ∅125 and 600 m ∅100 pipes.

Furthermore, infrastructure of temporary settlements near the cities has been done by municipalities and government agencies.

2.2. Repairment works in Golcuk City until 14 May 2001

- 36 km water network repairment is needed but only 4 % of it has been done,
- 107 km wastewater network repairment is needed but only 55 % the network and 33% of the manholes have been done.

It is said by municipal authorities that financial and technical support by governmental organisations were very unsufficient in Golcuk city although it has the biggest death and damage rate. Many of infrastructure repairment were done by municipality. Furthermore, on March 23 2001, unfortunalety a flood disaster damaged again water and wastewater systems. The problems were as fellow:

- 540m ∅800, 1490m ∅600, 2135m ∅400,2450m ∅300 and 5445m ∅200 wastewater network pipe were damaged,
- 600 m ∅200, 1360 m ∅150 ACP pipes and 6000 m ∅100, 4000 m ∅80 PVC pipes and some of the valves were damaged in water network

2.3. Problems in Adapazari City

The main problem in Adapazari City was cracks of non-elastic asbestos cement transmission lines. Water and wastewater network were also damaged heavily.

- Combined wastewater system was damaged at 70 % rate,
- 80 % of 450 km water network was damaged,
- Two water basins of the city (5050 and 1500 m^3) were cracked,
- In water treatment plant; 5 pumps, electricity lines, basins and chloranization system were damaged,

- 8 km ∅700 and 8 km ∅1200 water transmission lines were damaged at 70 % rate.

Due to misplanned urbanization in the city, buildings were constructed over some pipelines. For that reason, there were no repairment choice and they were changed by new lines. Repairments of the damages in city water network were firstly done by beginning in emergency hospital lines. Damaged asbestos cement water transmission lines (∅700 and ∅1200) were used by inserting polyetilen pipes inside them.

2.4. Problems in Ciftlikkoy (a summer resorts area near to Yalova City)

- 2.6 km of ∅600 wastewater collector pipe was damaged,
- 1.12 km of ∅80 PVC water line and 0.8 km of ∅100 PVC line were damaged,
- Heavy vehicles used for demolition transport had broken the water and wastewater lines and caused to extra problems,
- Deep sea discharge lines of untreated wastewater were completely broken.

2.5. Problems in Yalova City

No information could be obtained from Yalova Municipality, because no responsible authority could be reached.

2.6. Problems in Istanbul City

In Istanbul City, there was no big infrastructure problems except some building collapse and cracks. The main problem of ISKI (Water and Sewage Administration of Greater Istanbul City) was unsufficient chlorine stoks because of refinery fire. It was supplied from far rafineries. Another big problem was saline sea water leak into main sewer collector of a big wastewater treatment plant. Salinity in the collector was 1.8 % affer earthquake, where as it was 0.3 – 0.4 % before quake. It is still a problem of the wastewater treatment plant.

2.7. Activities made by Ilbank

Ilbank (a governmental organization providing financial and technical support for provincies) provided many financial and technical supports for small and big cities. Work and supply list are given below :

- 464 km water supply network is constructed,
- 5.2 million m^3 excavation,
- 5 million m^3 backfill,
- 217 km sewer pipe,
- 19 chlorination equipment, 4 pumps and 100 kw jenerator.

Pipes supplied by Ilbank are listed in Tablo 1.

Tablo 1. Pipes supplied for small and big cities by Ilbank*.

Province	Bolu	Duzce	Adapazari	Izmit	Yalova	Bursa	Total
Pipe length, m (for water network)	28 312	59 564	62 644	60 021	9 436	3 402	223 379
Pipe length, m (for prefabricated settlements)	59 141	128 059	83 058	299 070	86 244		655 572
PVC pipe	79 804	-	41 010	49 956	5 316	402	176 488
ACP	6 342	-	14 720	8 757	2 460	3 000	35 279
Steel pipe	1 730	-	6 914	1 308	1 660	-	11 612
PE	-	-	399 340	-	-	-	339 340
PVC (Temporary settlements)	35.214	56.034	184.704	306.396	73.224		
New building areas							
PVC	1 500	-	852	-	-	-	
Steel	-	-	1 200	9 144	-	-	
PE	-	-	44 688	23 244	-	-	

* Many low cost activities are excluded. Total expenditure was 70,6 trillion Turkish Liras (exchange rate of year 2000 : US$ 1=620 000 TL)

2.8. Activities worked by ISKI in earthquake area

There were not important damage in Istanbul. Therefore, ISKI helped municipalities of earthquake area. Generators, vehicles, disinfection equipment and materials, water tanks and number of 2000 plastic barrels (30 L) for water transport to people were some of aid.

In the cities, especially in Adapazari City, ISKI constructed temporary public toilets over undamaged sewer lines. Toilets were important because almost all of the people were afraid to get into the houses for several days, even there was no damage of building. Another support was lime supply for non-collected solid waste thrown away in the cities. For example, in Izmit city, 50 tons lime was used. Ministry of Environment also distributed 363 tons lime to municipalities.

3. DAMAGE IN INDUSTRIAL TREATMENT PLANTS

Official Report on 17 Semptember 1999 by Izmit City Department of Environment stated that many of treatment plants of the factories were not damaged. Only a few damages were reported. However, many of the factories reported some problems within the facilities. There was no detailed investigation of damage. There has been no monitoring programme for problems of industrial treatment plants. Some of the important factories and their problems in treatment plants are listed in Table 2.

Table 2. Some of the important factories and problems in the treatment plants.

Production	Treatment Plant Type	Damage Situation
Furniture	Biological	Repaired
Water products Processing	Biological	ND*
Agro industry	Biological	ND
Pump manufacturing	Chemical + Biological	Repaired
Dairy-1	Biological	ND
Pulp& Paper	Biological	ND
Pipe & Fittings	Chemical	Heavily damaged, repaired
Nylon production	Chemical + Biological	ND
Edible oil production	Chemical + Biological	ND
Ship repairment	Biological	ND
Chemical + Oil Industry	Chemical + Biological	Repaired
Auto oil production	Chemical + Biological	ND
Electrical cable production	Biological	ND
Fertilizer production-1	Biological	ND
Petroleum products	Chemical	Repaired
Dairy-2	Biological	ND
Machinery production	Biological	ND
Textile (wool)	Chemical	Repaired
Yeast production	Biological	1 month intermittence
Steel wire production	Chemical + Biological	Not worked for long time.
Auto tyre production	Biological	Oil leak
LPG	Chemical + Biological	Repaired
Petrochemical-1	Chemical + Biological	Not worked for sometimes.
Fertilizer-2	Biological	ND
Petrochemical-2	Chemical + Biological	Not worked for sometimes.

* ND : No damage.

4. RESULTS AND DISCUSSION

It is clear that earthquakes cause to important and immidiate damage of infrastructures. There are many problems after earthquakes. For that reason, management and application plans prepared before the earthquake will be very important. It should cover many topics for environmental systems, from water supply to disposal of demolition. It is observed in the earthquake area that Departments of Municipalities still use damage sensitive and unhealty ACP pipes. The reason for that was their stocks of this type pipes. They do not have extra money to change them and not aware to use other types.

Another important environmental problem was dumping of demolition into the sea coast during the first days. Later, it was forbidden and municipalities used their open dumping sites but both of the removal methods could be improved with some planned engineering activities. These low or high dumping quantity, no data could be obtained to calculate the quantity, resulted a high load of pollution into water sources, including hazardous substances. In Turkish cities, shops are generally in basement floors of the buildings. Hazardous materials, such as dye, chemicals, adhesives, tars drugs, etc. in the shops had been removed with demolition materials into the sea or open dumping sites. However, these landfill sites do not have any engineering and research work, and even there was no leachate holding layer, such as silt layer.

More than 2 million people in the region were affected from the damage of the earthquake, not including any big city of Turkey, except some parts of Izmit Greater City. Istanbul, Izmit and Bursa, some of the big cities of Turkey, are in the influence area of that fault and earthquake risk is still discussed in that region. For that reason, mechanisms for the mitigation and/or transfer of such losses in future earthquake should be created. 45 seconds earthquake resulted in about US$ 20 billion total economic loss. It is 10 % of Turkey's GNP. Turkey is a developing country and has only limited financial sources. Furthermore, population increase of cities in that region are higher compared to other region of the country. Limited investment and continuing immigration are resulted in misplanned cities and some infrastructural problems. Earthquake effects should be concerned in environmental systems such as water and wastewater network, treatment plants, etc. Otherwise, repairment cost will be much more and even there will be lack of new investment because of limited finance. This will affect health and comfort of people. It had been seen after the earthquake that clean water supply and toilet systems were the most important needs. Furthermore, damaged electricity lines were a big problem for many activities. It is also observed that many of the administration buildings were damaged during the earthquake and officiers were afraid to get into buildings due to aftershocks and this resulted in mismanagement of coordination. Creation of emergency management agencies and developing risk-based municipal master plans are needed in the cities.

5. CONCLUSION

Earthquakes cause to important and immidiate damage of infrastructures. There are many problems after earthquakes. For that reason, management and application plans prepared before the earthquake will be very important. Creation of emergency management agencies and developing risk-based municipal master plans are needed to lower the damage in the cities.

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