Collection of International Seminar on Sharing Experience on Disaster Risk Reduction in Asian Countries

National Disaster Reduction Center of China
Asian Disaster Preparedness Center
October 13th–15th 2010
Beijing, China

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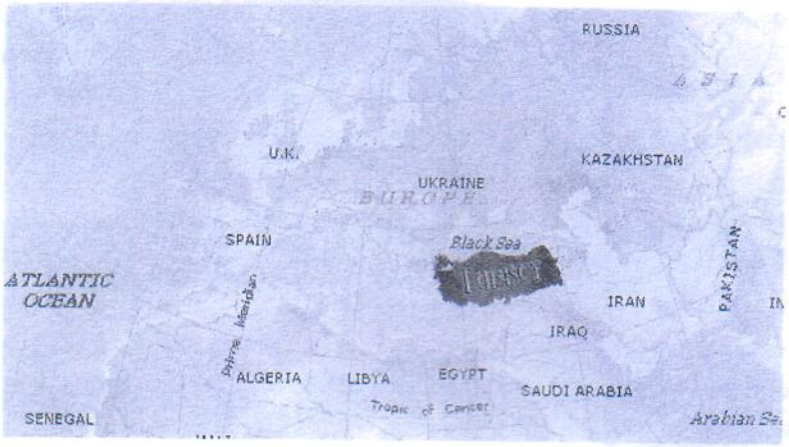


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Disaster Risk Reduction in Turkey

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A. BASIC INFORMATION OF TURKEY



Formal Name: Republic of Turkey
GDP - per capita (PPP): $11,200 (2009 est.)
Turkey is a country located in the Southwestern Eurasia and Southeastern Europe with a total land area of 814.578 square km including lakes and islands. Its capital is Ankara. Turkey borders the Black Sea, the Mediterranean, the Aegean and the Marmara Sea and has a total coastline of 8333 km. The Anatolian part of Turkey accounts for 97% of the country's area. Anatolian Central Plateau is semiarid and rimmed by hills and mountains which in many places limit access to the fertile, densely settled coastal regions. The European portion of Turkey encompasses 3% of the total area but is home to more than 10% of the total population. Istanbul, the largest city of Europe and Turkey, has a population of about 13 million, while the total population of the country is about 73 million.

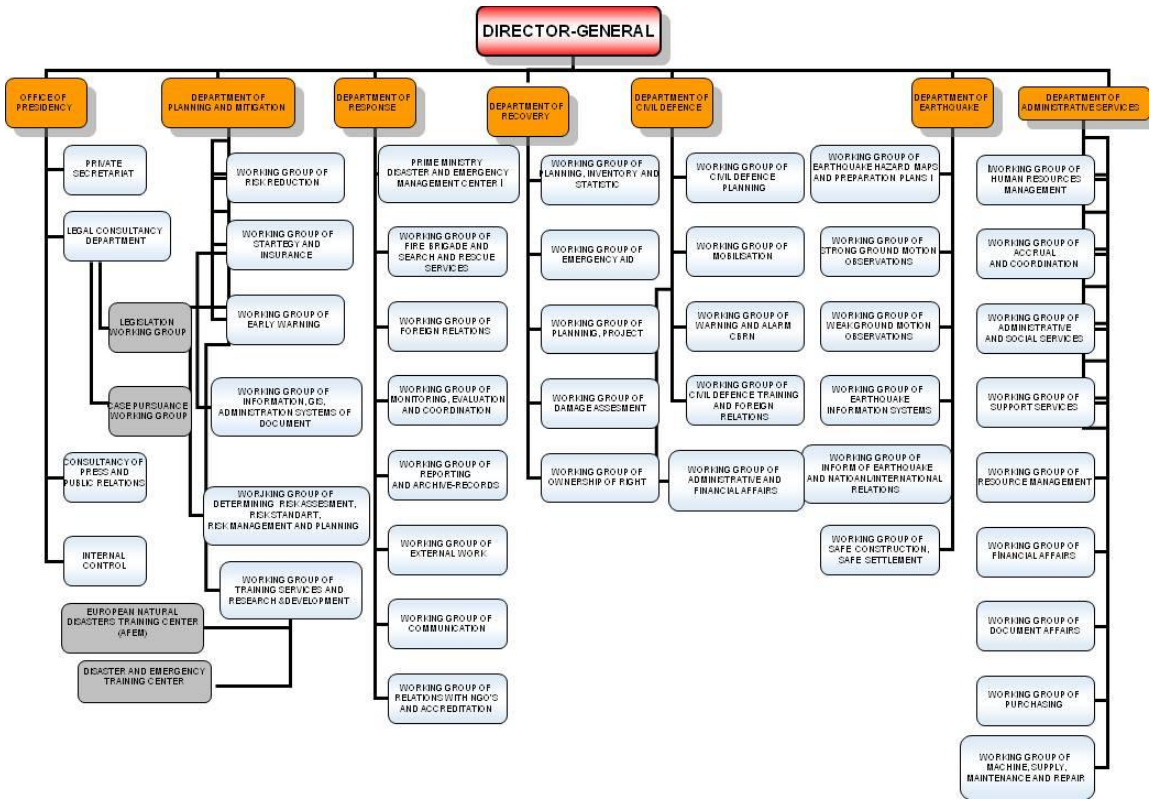
Turkey is an extremely seismically active country, as Anatolian micro-block is located at the collision zone of the Arabian and Eurasian Plates. Being located in this collision zone, Anatolian block escapes toward west with a speed of 2cm/yr. As a result, Turkey has three significant faulting zones, North Anatolian Fault Zone (Right lateral strike slip faulting mechanism) with about 1500 km length, East Anatolian Fault Zone (Left Lateral strike slip faulting mechanism) with about 550 km length and South-west Anatolian Fault Zones (Aegean Graben System) which consists of several grabens and horsts bounded by oblique E-W trending normal faults. Turkey, as a country with a history of devastating earthquakes, has been also effected by Tsunamis in its past. Besides inclosing the Marmara Sea, Turkey is a peninsula surrounded by Black, Aegean and Mediterranean Sea, which are all historically proven to be locations of tsunamigenic sources. Historical re-

cords reveal that, during the observation period over 3000 years, the coastal and surrounding areas of Turkey have been affected by more than ninety tsunamis.

Turkey ranks high among countries that have suffered centuries of loss of life and property due to earthquakes. In the twentieth century, earthquakes in Turkey caused over 110,000 deaths, 250,000 hospitalized injuries and the destruction of 600,000 housing units. Following the losses suffered during two major earthquakes in 1999 (Izmit and Duzce Earthquakes), there is broad recognition among government, non-government and academic organizations that extensive response planning is needed in Turkey based upon detailed risk analyses of likely seismic hazards in Turkey. In recent decades, earthquake disaster risk for Turkey's urban centers has increased, mainly due to high rates of urbanization, faulty land-use planning and construction, inadequate infrastructure and services, and environmental degradation (Erdik M., Aydinoglu N., Earthquake Risk to Buildings in Istanbul and a Proposal towards Its Mitigation).

In Turkey, especially in urban areas, people live in concrete structures, while, in particular in eastern part of the country, people generally live in masonry and mud-brick houses. Besides, very low amount of the community live in precuts. However, the mid-rise reinforced concrete structures constructed before 1980 were even found to constitute the most vulnerable building class. Hence, in order to reduce the structural vulnerability, siting and land-use regulations, design and construction regulations, relocation of communities, and public awareness programs are viable for the mitigation of earthquake risk. Due to high rates of urbanization, many residential retrofitting projects are enacted in Marmara Region of the country (Erdik M., Aydinoglu N., Earthquake Risk to Buildings in Istanbul and a Proposal towards Its Mitigation).

Organization



(Ministry Disaster and Emergency Management Presidency of Turkey)

Two consecutive major earthquakes in 1999 became the turning point in disaster management in Turkey. Pre-disaster measures came into the agenda of the government and country, together with these earthquakes. Turkey's Disaster Management System was mainly focused on the post-disaster period and there were no incentives or legislations to encourage risk analysis or risk reduction approaches before these earthquakes. Both the academic and the technical authorities agreed that the country's strong need was, to develop pre-disaster precautions covering a revised legislation and administrative restructuring.

Three core institutions (General Directorate of Turkey Emergency Management under Prime Ministry, General Directorate of Civil Defence under Ministry of Interior, General Directorate of Disaster Affairs under Ministry of Public Works) have unified under single independent authority with the act adopted by the parliament and entered into force in June, 2009. The name of the new institution is "Prime Ministry Disaster and Emergency Management Presidency" (DEMP).

In order to take necessary measures for an effective emergency management and civil protection issues nationwide, the presidency conducts; pre-incident works such as preparedness, mitigation and risk management, during incident works such as response, post incident works such as recovery and reconstruction.

Amongst the Governmental, NGO and private institutions, presidency provides coordination, formulates policies and implements policies.

By the new system in Central Government the only responsible organization is DEMP and affiliated to the Prime Ministry.

A. INFORMATION ON EARTHQUAKE

a. Standard for Classification of Earthquake Disasters in Terms of Disaster Scale;

Earthquake intensity is the index of the damage severity in earthquake disaster area. The damage definition levels of 1998 European Macroseismic Scale (EMS) are used for classification of earthquake disasters. For the vulnerability class where the general reinforced concrete multi-story building stock is located, EMS-1998 provides the following damage definitions (Erdik M., Aydinoglu N., Earthquake Risk to Buildings in Istanbul and a Proposal towards Its Mitigation).

Intensity V : A few buildings sustain very light damage
Intensity VI : Many buildings suffer very light damage; a few receive light damage
Intensity VII : A few buildings sustain moderate damage
Intensity VIII : Many buildings suffer moderate damage; a few receive substantial to heavy damage
Intensity IX : Many buildings suffer substantial to heavy damage; a few very heavy damage
Intensity X : Many building sustain very heavy damage
Intensity XI : Most buildings suffer very heavy damage

Where "Few" describes less than 20% and "Many" describes between 20% and 60%. (Development Of Seismic Vulnerability Assessment Methodologies Over The Past 30 Years; Iset Journal Of Earthquake Technology, Paper No. 472, Vol. 43, No. 3, September 2006, Pp. 75-104)

b. Major Earthquake Disasters Occurred Since 1950 (M ≥ 5);

No	Date	Origin Time (Local Time)	Location	Intensity	Mag Ms	Deaths	Damaged Buildings
1	08.04.1951	23:38	Iskenderun(ANTAKYA)	VIII	5.8	6	13
2	13.08.1951	20:33	Kursunlu (CANKIRI)	IX	6.9	50	3354
3	03.01.1952	08:03	Hasankale (ERZURUM)	VIII	5.8	41	701
4	22.10.1952	19:00	Ceyhan –Misis(ADANA)	VIII	5.6	10	617
5	18.03.1953	21:06	Yenice (CANAKKALE)	IX	7.2	265	6750
6	07.09.1953	05:58	Kursunlu (CANKIRI)	VIII	6.0	2	230
7	16.07.1955	09:07	Soke-Balat (AYDIN)	IX	6.8	23	470
8	20.02.1956	22:31	ESKISEHIR	VIII	6.4	1	2819
9	25.04.1957	04:25	FethiyeRodos(MUGLA)	IX	7.1	67	3200
10	26.05.1957	08:33	Abant (BOLU)	IX	7.1	52	5200
11	25.04.1959	02:26	Koycegiz (MUGLA)	VIII	5.9	-	775
12	23.05.1961	04:45	FethiyeRodos(MUGLA)	VIII	6.3	-	61
13	18.09.1963	18:58	Cınarcık (ISTANBUL)	VIII	6.3	1	230
14	30.01.1964	19:45	Tefenni (BURDUR)	VIII	5.7	-	39
15	14.06.1964	15:15	MALATYA	VIII	6.0	8	847
16	06.10.1964	16:31	Manyas (BALIKESIR)	IX	7.0	23	5398
17	13.06.1965	22:01	DENIZLI	VIII	5.7	14	488
18	07.03.1966	03:16	Varto-Hinis (MUS)	VIII	5.6	14	1100
19	19.08.1966	14:22	Varto (MUS)	IX	6.9	2396	20007
20	22.07.1967	18:56	Mudurnu(ADAPAZARI)	IX	6.8	89	7116
21	26.07.1967	20:53	Pulumur (TUNCELI)	VIII	5.9	97	1282
22	03.09.1968	10:19	Bartin (ZONGULDAK)	VIII	6.5	29	2478
23	23.03.1969	23:08	Demirci (MANISA)	VIII	5.9	-	945
24	28.03.1970	03:48	Alasehir (MANISA)	VIII	6.5	53	3072
25	06.04.1969	05:49	Karaburun (IZMIR)	VIII	5.9	-	1360
26	28.03.1970	23:02	Gediz (KUTAHYA)	IX	7.2	1086	19291
27	19.04.1970	15:29	Gediz (KUTAHYA)	VIII	5.8	-	1360
28	23.04.1970	11:01	Demirci (MANISA)	VIII	5.6	-	411
29	12.05.1971	08:25	BURDUR	VIII	5.9	57	3227
30	22.05.1971	18:43	BINGOL	VIII	6.8	878	9111
31	06.09.1975	12:20	Lice (DIYARBAKIR)	VIII	6.6	2385	8149

32	24.11.1976	14:22	Muradiye (VAN)	IX	7.5	3840	9232
33	05.07.1983	15:01	Biga (CANAKKALE)	VIII	6.1	3	85
34	30.10.1983	07:12	ERZURUM – KARS	VIII	6.9	1155	3241
35	18.09.1984	15:26	Balkaya (ERZURUM)	VIII	6.4	3	570
36	05.05.1986	06:35	Dogansehir(MALATYA)	VIII	5.9	7	824
37	06.06.1986	13:39	Dogansehir(MALATYA)	VIII	5.6	1	1174
38	07.12.1988	09:41	Kars – ERMENISTAN	X	6.9	4	546
39	13.03.1992	19:08	ERZINCAN	VIII	6.8	653	8057
40	15.03.1992	18:16	Pulumur (TUNCELI)	VII	5.8	-	439
41	06.11.1992	21:08	Doganbey (IZMIR)	VII	6.0	-	55
42	28.01.1994	17:45	MANISA	VI	5.1	-	44
43	01.10.1995	17:57	Dinar (AFYON)	VIII	6.1	90	14156
44	05.12.1995	18:49	Kigi (TUNCELI)	VI+	5.7	1	-
45	14.08.1996	01:55	Mecitozu (AMASYA)	VI+	5.6	1	2606
46	22.01.1997	17:57	ANTAKYA	VI+	5.4	1	1841
47	13.04.1998	18:14	Karliova (BINGOL)	VI	5.0	-	148
48	27.06.1998	16:55	Ceyhan (ADANA)	VIII	6.2	146	31463

No	Date	Origin Time (Local Time)	Location	Intensity	Mag M_W	Deaths	Damaged Buildings	Depth (km)	Economic Loss USD bn
49	17.08.1999	03:01	IZMIT	X	7.4	17480	73342	17	18
50	12.11.1999	18:57	DUZCE	IX	7.2	763	35519	14	1
51	06.06.2000	05:41	Orta (CANKIRI)	VII	6.0	1	1766	10.5	-
52	15.12.2000	18:44	Sultandagı (AFYON)	VII	6.0	6	547	10	-
53	25.06.2001	16:28	OSMANIYE	VII	5.5	-	66	5	-
54	03.02.2002	09:11	Cay - Sultandagıı (AFYON)	VII	6.5	45	622	9	-
55	27.01.2003	07:26	Pulumur (TUNCELI)	VII	6.0	1	50	10	-
56	01.05.2003	03:27	BINGOL	VIII	6.4	176	6000	10	-
57	25.03.2004	21:30	Kandilli-Askale (ERZURUM)	VII	5.5	9	1280	10	-
58	02.07.2004	01:30	Dogubayazit (AGRI)	VII	5.0	17	1000	10	-
59	25.01.2005	17:24	Hakkari	VII	5.5	2		30	-
60	24.03.2005	09:36	Karliova (Bingol)	VII	5.9	-	100	5	-
61	20.12.2007	11:48	Bala (Ankara)	VII	5.5	-	834	5	-

62	08.03.2010	04:32	Basyurt-Karakocan (ELAZIG)	VII	6.1	42	987	5	-

(Bogazici University, Kandilli Observatory & Earthquake Research Institute, USGS)

c. Recent Major Disasters (Mw ≥ 6.0);

Izmit Earthquake (August 1999)



The August 17 (magnitude 7.4) and November 12 (magnitude 7.2) earthquakes struck the western industrialized corridor of Turkey, southeast of Istanbul.

(Event Report Kocaeli, Turkey Earthquake RMS Reconnaissance Team, Kekovali K., Seismic Observation in Turkey).

On August 17 1999 at the time of 03:01, a magnitude Mw 7.4 earthquake struck the Izmit, Kocaeli and Sakarya provinces in northwestern Turkey on the western part of the North Anatolian Fault Zone, a densely populated region in the industrial heartland of Turkey. 17,480 people killed, nearly 50,000 injured, thousands missing, about 500,000 people homeless and estimated 3 to US$6.5 billion damage in Istanbul, Kocaeli and Sakarya Provinces. This event is the turning point of Turkish legislative system (Erdik M, Report on 1999 Kocaeli and Duzce (Turkey) Earthquakes).

The magnitude 7.4 earthquake ruptured more than a 110-kilometer (70-mile) section of the northernmost strand of the North Anatolian Fault (NAF) system which is one of the world's longest tectonic systems. It serves as the boundary between the Eurasian Plate and the Anatolian and Arabian plates, and is similar in characteristics to the San Andreas Fault in California, with predominantly right lateral strike slip movement. The fault experiences about 20 to 30 millimeters of slip annually, more than the San Andreas, which has about 17 to 24 millimeters of slip each year (Event Report Kocaeli, Turkey Earthquake RMS Reconnaissance Team, Kekovali K., Seismic Observation in Turkey).

Seismic imaging of the Kocaeli earthquake rupture indicated almost pure lateral strike-slip rupture that runs west at a velocity of about 3km/s and towards east at a very high velocity of 4.7km/s for a distance of about 40km before dropping to about 3.1km/s at the easternmost segment. The largest slip 7m occured between 25km to 45km east of the epicenter. West of the epicenter the slip is large between distances of 10 to 30km. The pure strike-slip rupture in

Kocaeli earthquake is dominated by the bilateral braking of a central asperity located between Karamursel (29.7E) and Arifiye (30.3E). Slip lasts 45 to 50 s but most of the energy is released in 15s. Rupture velocity to the west is 3km/s (Erdik M, Report on 1999 Kocaeli and Duzce (Turkey) Earthquakes).
Some twenty strong motion instruments were triggered in the earthquake. Damage was concentrated in the area within 40 kilometers (25 miles) of the earthquake's epicenter, where free-field peak horizontal ground accelerations (PGAs) were 0.32 g to 0.41 g. By comparison, PGAs in the Istanbul area (80 kilometers, or 50 miles, from the epicenter) ranged from 0.04 g to 0.25 g. Pockets of intense shaking and damage were dispersed across the region, including the west side of Istanbul, Yalova at the tip of the Izmit peninsula, and Bolu in the east (Event Report Kocaeli, Turkey Earthquake RMS Reconnaissance Team, Kekovali K., Seismic Observation in Turkey).

Soil effects played an important role in localized damage concentrations. For example, nearly every building along a 2-kilometer (1.2-mile) stretch of the main street in Adapazari's city center was completely destroyed. Buildings punched through the highly saturated soil layer that liquefied in the earthquake, sinking by more than 1 meter (3.3 feet), and often collapsing as a result. Some structures with adequately reinforced mat foundations stayed intact, saving the occupants and some building contents, but earthquake-induced differential settlement caused them to slowly sink or lean onto their sides. Besides, although not as dramatic as in Adapazari, settlement was the main cause of dock and port-related damages to the industrial facilities that ring Izmit Bay. Damages included concrete piers, loading equipment and piping fractures, pavement buckling, and foundation failures. Nearly half of the jetties in the region were destroyed. The Istanbul neighborhood of Avcilar is more than 90 kilometers (56 miles) from the earthquake fault, but severe shaking destroyed more than 60 buildings and rendered another 1,000 uninhabitable. PGAs of 0.25 g were recorded here, and the area's soft alluvium was vulnerable to long-period motions (Event Report Kocaeli, Turkey Earthquake RMS Reconnaissance Team, Kekovali K., Seismic Observation in Turkey).

Duzce Earthquake (November 1999)

On 12 November 1999, a destructive Earthquake occured in Duzce in South-Western Turkey with a 7.2 on Richter scale. It was triggered by August 17, 1999 earthquake. 763 people killed, more than 3,000 injured, and several hundred missing. The November 12, 1999 Earthquake leaded to collapses of buildings, and mosques and tore apart highways. Estimate damage is around US$10 billion (BU-KOERI, USGS).

The November 12, 1999 Duzce earthquake is the second largest earthquake which ruptured 45 km of surface. Horizontal and vertical displacements, with 3.0 m and 5.0 m respectively, have occurred along the rupture. The west end of the rupture line located close to the point of the east end of the rupture line of the August 17 earthquake. Duration of ground motion from the November earthquake was a great deal shorter than those of the August quake and lasted somewhere between 15 to 20 seconds. Ground displacements covered an area of about 80 km in length along the fault (Sahin M. and Tari E.,The August 17 Kocaeli and the November 12 Duzce earthquakes in Turkey)

Taking in the account 17 August Izmit and 12 November Duzce earthquakes, the four districts most severely affected (Kocaeli, Sakarya, Bolu and Yalova) contribute over 7 per cent of the country's GDP and 14 per cent of industrial value added. Per capita income is almost double the national average. Though containing only 4 per cent of the nation's population, the region

contributes over 16 per cent of budget revenues. The immediately surrounding districts (of Bursa, Eskisehir, and Istanbul) have been mainly affected indirectly by their close economic linkages with the former area, e.g., industries and small businesses supplying services or material inputs to each other's production processes. They were subjected to a shared seismic risk and so face magnified uncertainty for the future as a fall-out of the recent events. Taking all seven cities together, the wider earthquake region accounts 35 per cent of national GDP and almost half of the nation's industrial output. Building losses are reported to amount to about US$5 billion. Damage to lifelines is estimated to be in the order of US$1 billion. The total loss is about 18 Billion US$. As a result, after the 1999 Izmit and Duzce earthquakes, several significant legal and institutional reforms were enacted in the Turkish disaster management system. In order to improve coordination among disaster organizations before and after disasters, The General Directorate of Turkey Emergency Management and the National Earthquake Council were added to the system. The general Directorate of Civil Defense established 11 professional rescue groups in different parts of the country to increase the response capacity of the system. Some important legal changes were also made after the earthquakes. The most important legal initiatives for reducing the hazardous effects of earthquakes are a mandatory earthquake insurance system and cabinet decisions for a new Building Construction Control System (Erdik M, Report on 1999 Kocaeli and Duzce (Turkey) Earthquakes).

Afyon Earthquake (February 2002)



The red star shows the epicenter of the earthquake. (http://argithani.orgfree.com)

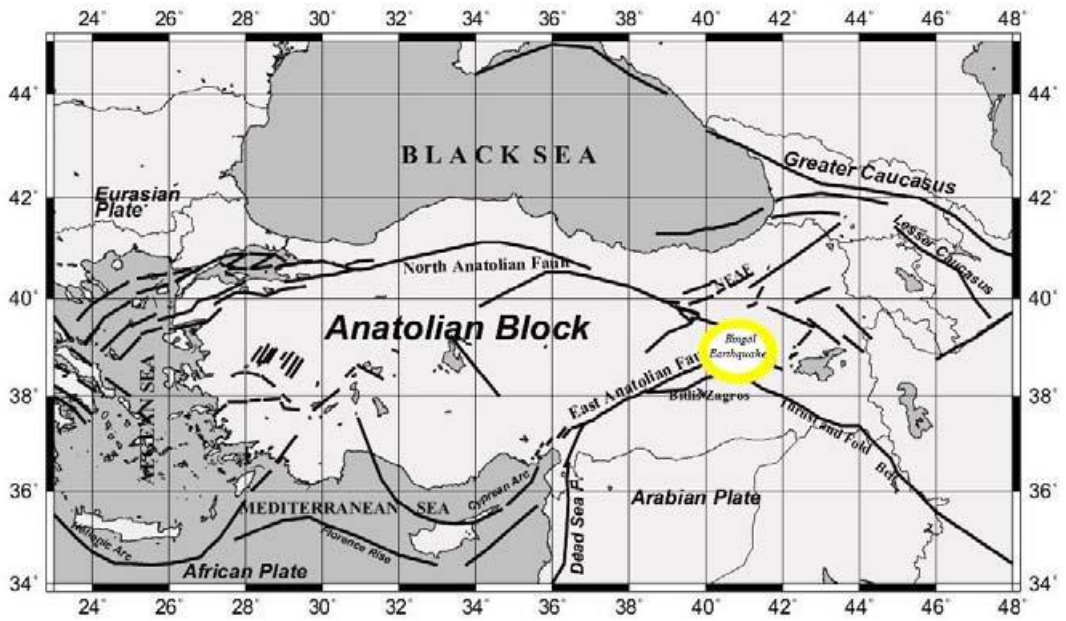
On 3 February 2002, an Earthquake occurred in Sultandagi, Afyon in Turkey. It killed 45 people, 318 persons were wounded and 622 buildings were moderate to heavily damaged. Local time of the event was 09:11 with Moment Magnitude of 6.5 and it triggered another earthquake

at 11:26 with Moment Magnitude 6.0. Peak ground acceleration of the main shock at the nearest station is 0.113g.

Sultandagi earthquake occurred on the northern end of the Isparta bend which holds a significant place in the neotectonic structure of Turkey hampering the westerly escape of Anatolian block. Isparta bend is bounded by the Sultandagi fault in its north-northeastern front. In the Active Fault Map of Turkey prepared and published by MTA in 1992 the Sultandagi fault was described as a reverse active fault. The Afyon-Aksehir basin that was shaped relevant to the movement of the Sultandagi fault is the easternmost section of the graben structures that developed related to the Aegean extensional tectonic regime. The Sultandagi fault traced between the Sultandagi rise and the graben basins to the east and north of it has an approximate length of 100 km on the Active Fault Map of Turkey. When the Afyon graben related to the fault is included, the length of the fault reaches up to 150 km. The Sultandagi fault is a low-angle normal fault. The main fault lies in a zone of tens of meters to a few kilometers. Morphotectonic data suggests that the vertical displacement exceeds 1000 m in its northern end around Cay. The 3 February 2002 earthquake occurred on the northwestern end of the fault. During the surface rupture mapping indications on the Holocene activity of the fault in some locations were observed. Fault scarps and deformations in Holocene sediments related to the previous earthquakes are obvious in the area (Preliminary Report on the 3 February 2002 Sultandagi Earthquake, MTA)

Furthermore, despite the presence of large plains on the hanging wall of the fault, only in some limited areas liquefaction process was observed after the Sultandagi earthquake. The most significant liquefaction examples were found next to Sanayi Sitesi (Industrial Site) which stands on the recent river bed of the Cay creek (Preliminary Report on the 3 February 2002 Sultandagi Earthquake, MTA).

Bingol Earthquake (May 2003)



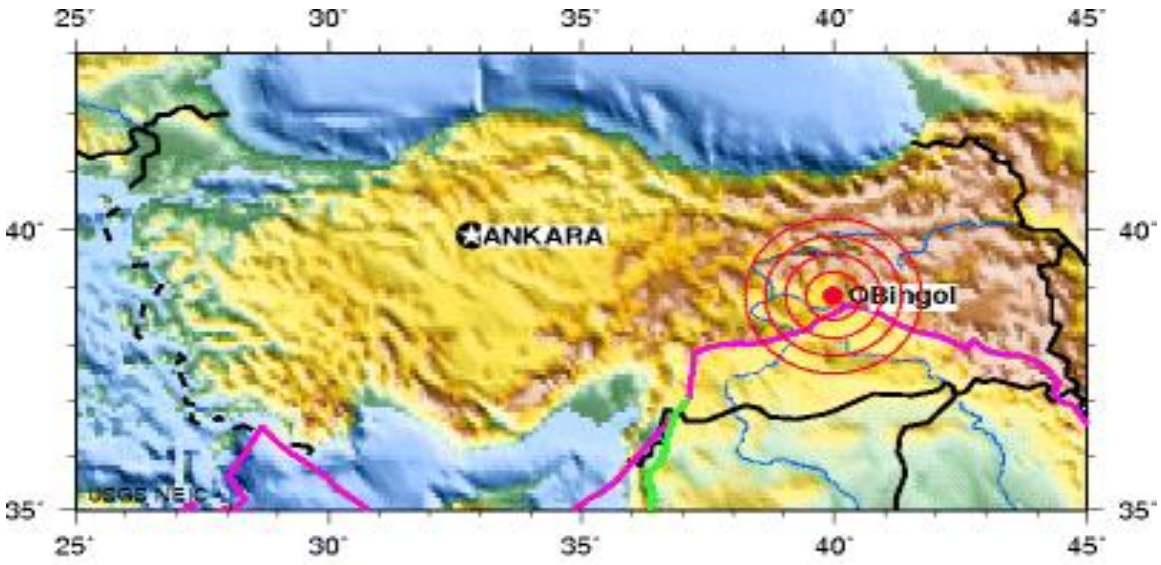
The yellow ellipse shows the earthquake region.
(May 1, 2003 Bingol (Turkey) Earthquake, BU-KOERI, seismology division).

On 1 May 2003, an Earthquake with a 6.4 on Richter scale occured in Bingol on the East Anatolian Fault Zone. At least 176 people killed, 521 wounded, and 245,000 affected. 570 buildings were collapsed and about 6000 others were damaged. Following the occurrence of the mainshock, a total of more 6700 aftershocks were recorded between 1-8 May. The number of aftershocks decreased with time (KOERI, USGS).

The tectonics of the region are controlled by collision of the Arabian and Eurasian plates. The northward motion of the Arabian plate relative to Eurasia causes lateral escape of the Anatolian block to the west and the Northeast Anatolian block to the east. The well-known active fault zones, namely the North Anatolian Fault (NAF), East Anatolian Fault (EAF) and associated conjugate faults surround the earthquake stricken area. Due to the presence of several active faults, the Bingol – Karliova - Erzincan triangle is the most important region where destructive earthquakes occur quite often (May 1, 2003 Bingol (Turkey) Earthquake, BU-KOERI, seismology division).

Moreover, the fault plane solution indicated that the causative fault was a right-lateral strike slip fault (strike 153°, dip 88°). This fault plane coincides with the aftershock distribution and is believed to represent the actual fault plane (May 1, 2003 Bingol (Turkey) Earthquake, BU-KOERI, seismology division).

Elazig Earthquake (March 2010)

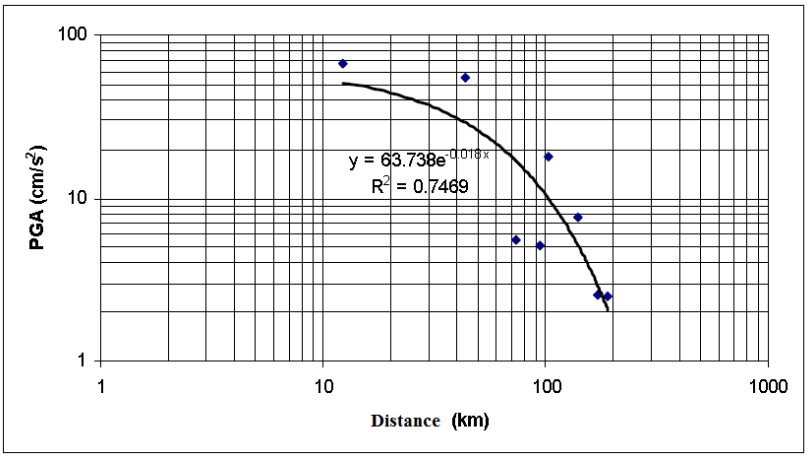


(The red dot shows the epicenter of the event.)

On 8 March 2010, an Earthquake occurred in Elazig in Eastern Turkey with Moment Magnitude 6.1. Intensity is VII. Being a seismic gap on a branch of East Anatolian Fault Zone, Elazig earthquake wasn't a surprise for geophysicists. Due to the event, 47 people killed, 137 injured, lots of mud-brick houses collapsed, and 987 buildings damaged in Elazig and Bingol regions. It was noted that around 95% of the building population in the region are non-engineered structures, and about 10,000 people were affected by the earthquake. It was felt by Iraq and Syria as well. The event is located in the rural area of East Anatolian Fault Zone (EAFZ) which has a speed of 1cm/yr. Fault plane solution of Elazig earthquake indicates a left lateral strike slip faulting mechanism that is compatible with EAFZ. The following figure shows the seismic acceleration peak distribution versus distance. PGA value from the nearest station is 66.5

cm/s^2, and it is getting decrease with the increasing epicentral distance, while there is no linear relationship (KOERI Report of Elazig Earthquake, MTA Report of Elazig Earthquake).

PGA distribution versus distance;



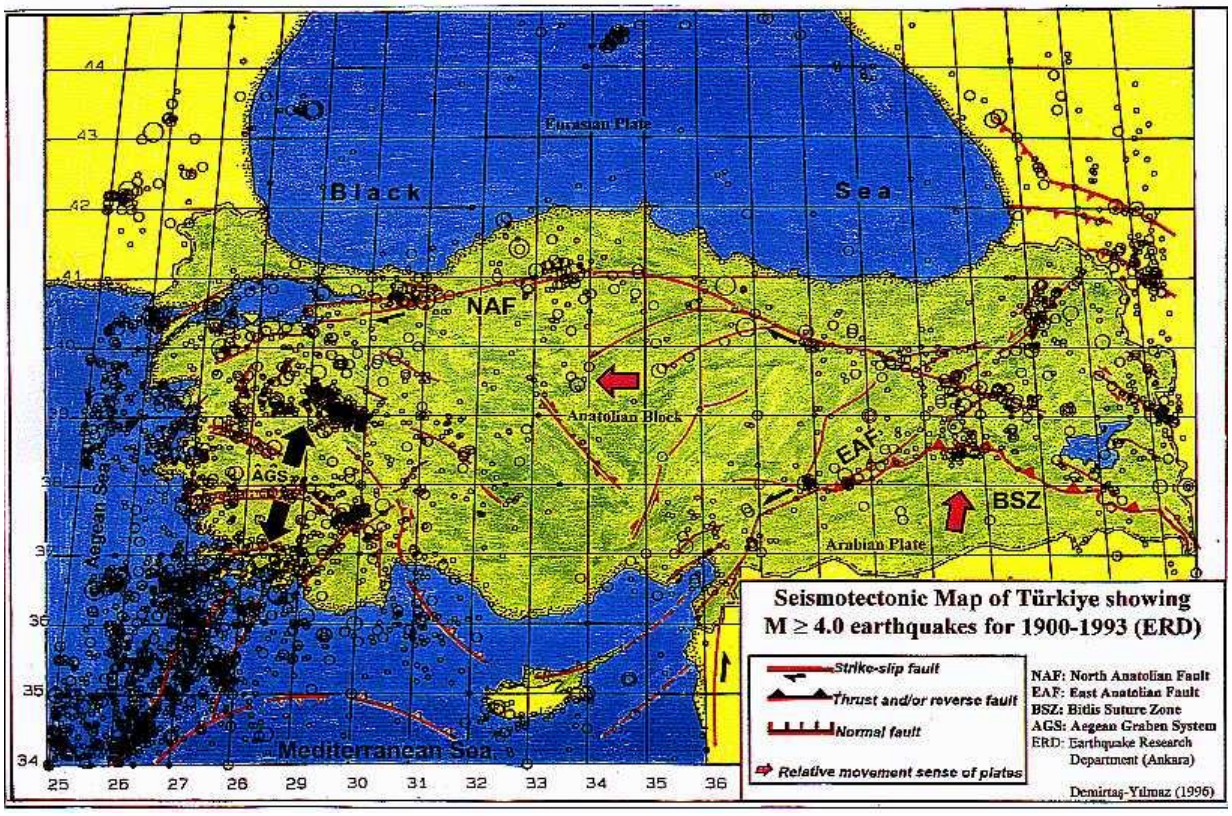
A mud-brick house;



An Iron Concrete House;

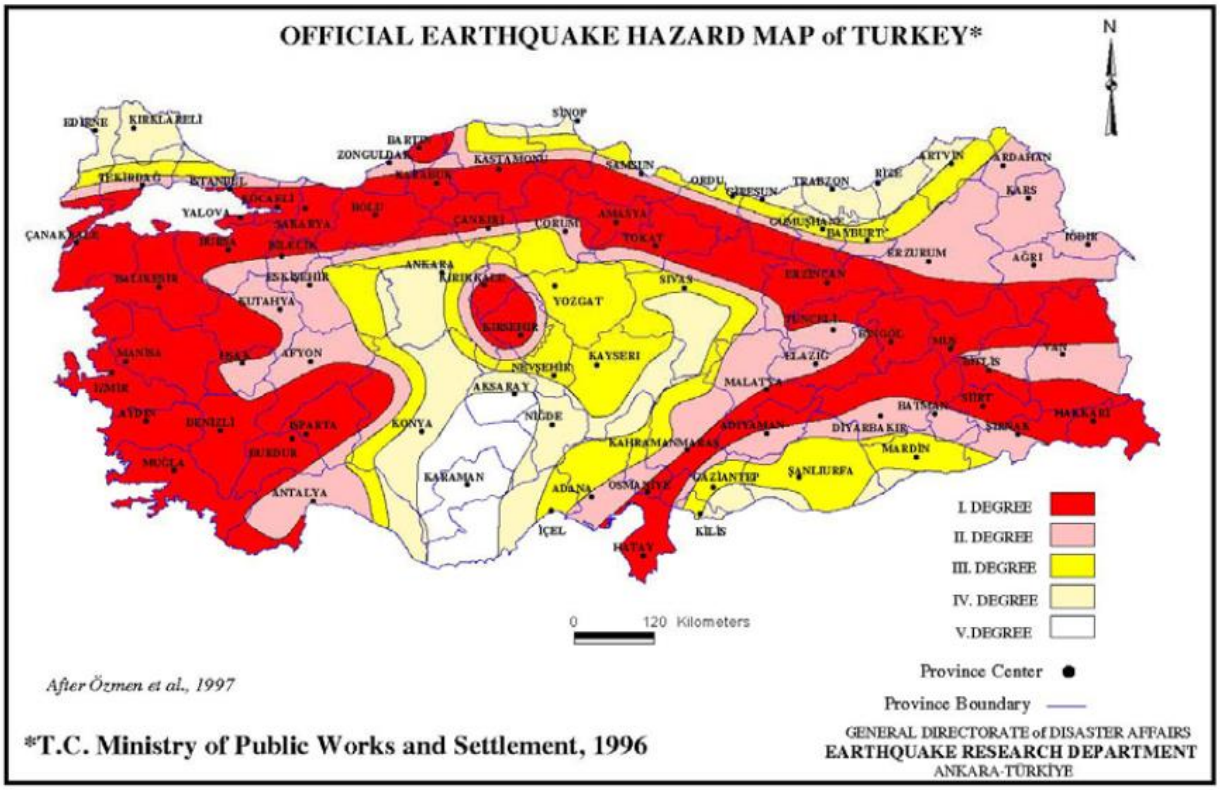


d. Seismotectonic Map of Turkey;



(Demirtas R.-Yilmaz R., Seismotectonics of Turkey)

The Official Earthquake Hazard Map of Turkey;



(Ozmen B., Earthquake Risk Reduction Studies at General Directorate of Disaster Affairs**)**
The Ministry of Public Works and Settlement published an official Earthquake Hazard Zoning Map of Turkey was developed by General Directorate of Disaster Affairs (GDDA) in 1996. It based on expected a maximum acceleration value that has calculated with probabilistic method. It assumes that a normal construction, which has 50 years of economical life, may not be exposed larger than these expected maximum acceleration values with 90 percent probability. The whole country is divided into the 5 different hazard zones as it can be shown from the Official Earthquake Hazard Map of Turkey above (Ozmen B. (2003), Earthquake Risk Reduction Studies at General Directorate of Disaster Affairs).

Distributions of Elements at Risk in Turkey;

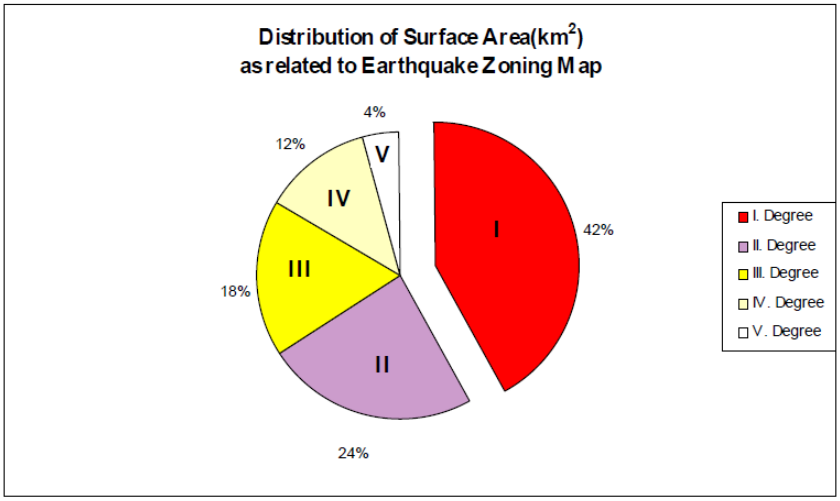
Earthquake Zone	Surface Area (%)	Population (%)	Industry (%)	Dams (%)
Zone 1 (pga >= 0.40 g)	42	45	51	46
Zone 2 (pga = 0.30 - 0.39 g)	24	26	25	23
Zone 3 (pga = 0.20 - 0.29 g)	18	14	11	14
Zone 4 (pga = 0.10 - 0.19 g)	12	13	11	11
Zone 5 (pga < 0.10 g)	4	2	2	6
TOTAL	**100**	**100**	**100**	**100**

(Ozmen B., Earthquake Risk Reduction Studies at General Directorate of Disaster Affairs)

The *pga* is the expected peak ground acceleration with 90 percent probability of nonexceedance during 50 years. g: gravity (981 cm/s).

Sixty six percent of the surface area of Turkey lies in Zone 1 and Zone 2 degrees of seismic risk, and the percentage of the population living in these risk areas is %71. In addition, most of the industrial sites and dams are also located in these seismically active areas.

Distribution of surface area as related to earthquake zoning map;



(Ozmen B., Earthquake Risk Reduction Studies at General Directorate of Disaster Affairs)

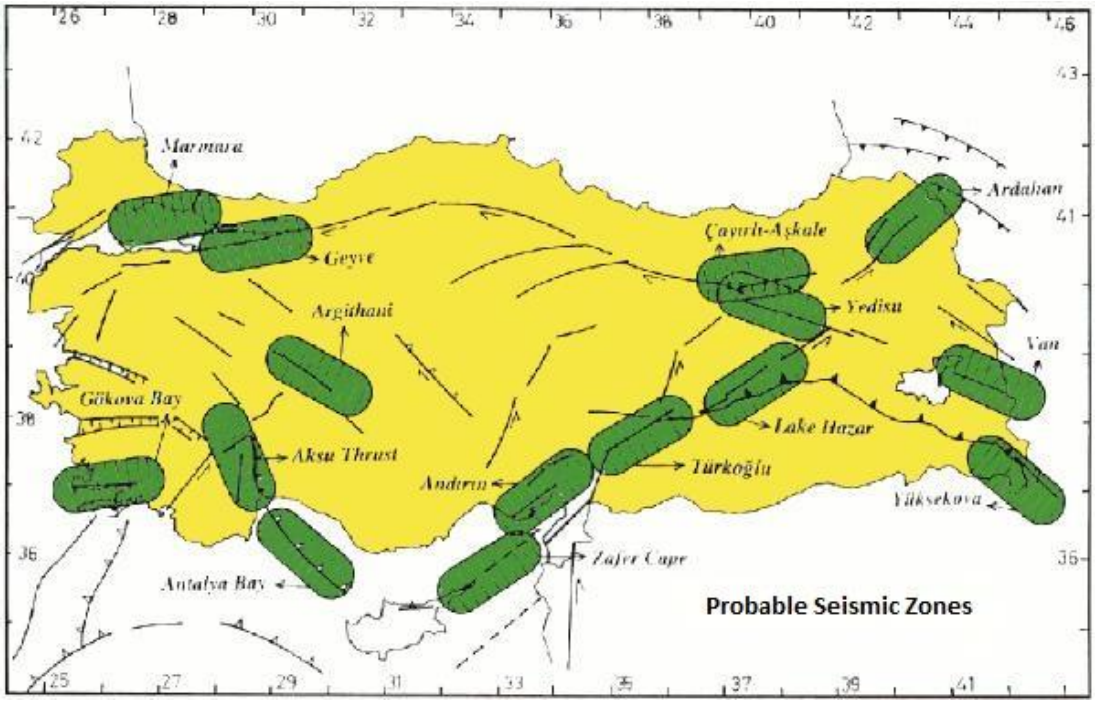
It is situated at I degree hazard zone % 43 of provinces center in the Turkey, at II degree hazard zone % 28 of provinces, at III degree hazard zone % 16 of provinces, at IV degree hazard zone % 11 of provinces and at V degree hazard zone % 3 of provinces.

Province, District and Sub-District city center number as related to earthquakes zoning map;

Earthquake zone	Province number	Percent (%)	District number	Percent (%)	SubDistrict Number	Percent (%)
I	34	43	406	48	335	49
II	22	28	176	21	152	22
III	13	16	130	15	98	14
IV	9	11	116	14	78	12
V	2	3	19	2	15	2
Total	**80**		**847**		**678**	

(Ozmen B., Earthquake Risk Reduction Studies at General Directorate of Disaster Affairs)

Probabilistic Seismic Zoning Map of Turkey;



(TURKNET)

e. Current and Historical Fortification Code;

<u>The Roots of Turkish Disaster Laws</u>

The first written document regarding Turkish disaster was about the earthquake that occurred in 1509. Following that disaster which killed 13 thousand people in Istanbul, II Beyazit, the Sultan of the Ottoman State gave 20 orders to assist the earthquake victims. The Ottoman administration gave 20 gold pieces to each family, and assigned construction experts to rebuild their homes. Similar post-disaster efforts were during the Ottoman Era (Celik S. (2007), Towards Local and Protective Turkish Disaster Management System).

In 1848, the Ottoman administration established Ebniyye Nizannamesi, a regulation, to control construction facilities in Istanbul. In 1877, this regulation was expanded to encompass all municipalities within the Ottoman State. The law of Ebniyye was extended in 1882 to regulate infrastructure and roads. Although these regulations were established to manage urbanization, they can be considered the first attempt to reduce the vulnerabilities of Turkish communities to disaster (Celik S. (2007), Towards Local and Protective Turkish Disaster Management System).

After the foundation of modern Republic of Turkey, the approach to disaster management did not differ considerably from the Ottoman State. In 1933, the Act of 1990, The Municipality Building and Roads Law, significantly altered the Ebniyye Nizannamesi. This law decided all regulations regarding land development, infrastructure, roads, buildings and construction activities. Subsequent to the Erzincan earthquake on December 26, 1939, the deadliest earthquake in Turkish history, Turkish public administration established some temporary regulations and policies to assist the victims of the earthquakes. However, some following earthquakes showed that it is not possible to diminish the negative consequences of a disaster by simply rebuilding homes after an earthquake. In 1944, the Turkish disaster administration took the first steps toward mitigation (Celik S. (2007), Towards Local and Protective Turkish Disaster Management System).

In 1944, Turkey passed The Law for Measures to be Taken Before and After Earthquakes. This Law (No.4623) was the first regulation that Turkish public administration established for mitigation purposes. It required Turkish administration to identify seismic risk prone areas, create special rules for construction facilities in these areas, develop aid and rescue plans before earthquakes, and prevent settlement before geological examination of the land. As a result, in 1945, the Public Works Ministry created the first seismic risk map of Turkey and established the first regulation of mandatory construction codes for disaster prone areas (Celik S. (2007), Towards Local and Protective Turkish Disaster Management System).

The primary laws, regulations and institutional establishments were established during 1958-1999, including disaster Law 7269, the new Development Law 3194, and Civil Defense Law 7126. During this period, the key institutions, Public Works and Settlement Ministry, General Directorate of Civil Defence were founded. The primary legal and organizational progress in the Turkish Disaster Management System from 1958 to 1999 shaped the fundamental patterns of the Turkish disaster system (Celik S. (2007), Towards Local and Protective Turkish Disaster Management System).

The Disaster Law of 7269

The main law that regulates the Turkish Disaster Management is Disaster Law (No. 7269), which was passed by Turkish Grand National Assembly in 1959 (Afet Isleri Genel Mudurlugu, 1998). This law covers all regulations regarding disaster affairs and mainly identifies the task of disaster organizations before and after disasters. It remains the primary law governing disaster affairs. Under the light of new circumstances, the Law has been partly changed and various amendments (1968/1051, 1981/2479, 1985/3177, 1995/4133) were enacted into the law (TBMM 1997; Akdag 2002). By the Act 29/5/2009 dated and No.5902 Establishment of Disaster and Emergency Management Presidency; General Directorate of Turkey Emergency Management under Prime Ministry, General Directorate of Civil Defence under Ministry of Interior, General Directorate of Disaster Affairs under Ministry of Public Works and Settlement were closed (Istanbul Turkey Disaster Risk Management Profile 2005; Celik S. (2007), Towards Local and Protective Turkish Disaster Management System).

The Disaster law 7269 did not specify detailed emergency planning and organizational schema until 1988. In that year, Disaster Regulation of 1277 was created to clarify emergency planning issues. The regulation provided an outline for the national emergency plan and required institutions, ministries, province, and district governments to create their own specific emergency plans. Disaster law 7269 awards extraordinary authorities to provincial and district governments to undertake necessary actions and to public, private and even military properties for response operations (Celik S. (2007), Towards Local and Protective Turkish Disaster Management System).

The Civil Defence Law (7126)

The Civil Defence law defines the duties of the Civil Defense Organization, which are minimizing loss of life and property during natural disasters and fires, protection and rescue, protection, repair and renovation of crucial public and private organizations, and getting support from the civil public for defense (Turkey Disaster Risk Management Profile 2005).

Building Supervision Law (4708)

The law enacted in 2001. After the huge losses of the 1999 earthquakes, a number of important regulations have been enacted, mostly in the form of decrees, two of the most important are cited here:

- Compulsory Earthquake Insurance, decree No. 587, Dec. 1999
- Building Construction Supervision, decree No. 595, April, 2000

National land use management system and relevant legislation;

In terms of central administrative structure, Turkey is divided into provinces on the basis of geographical situation, economic conditions, and public service requirements; provinces are further divided into lower levels of administrative districts. The administration of the provinces is based on the principle of devolution of wider powers. As can be easily understood from aforesaid regulations, Local administrations are inseparable part of the executive, together with the central government. Local authorities, by decision of their decision-making body, may issue by-laws in order to ensure the application of laws and regulations relating to their particular fields of separation, provided that they are not contrary to these laws and regulations. Also, they can form unions, among them, with the permission of the Cabinet, in order to meet their common necessities collaboratively and efficiently. The following bodies are responsible for the legislation and regulations concerning human settlements in Istanbul:

- State Planning Organization is responsible for the preparation of Five Year Development Plans or preparation of Regional Plans or having them prepared.

- The Ministry of Public Works and Settlement is responsible, among other aspects, for the preparation and approval of territorial plans through

Planning Law No: 3194/1985; the preparation of land use plans for areas subject to disaster and their approval through Disaster Law No: 7269/1051; the preparations and approval of land-use plans of Squatter Prevention Areas or Rehabilitation Zones through the Squatter Law No: 775/3384 (Turkey Disaster Risk Management Profile 2005).

f. Capacity of Preventing and Mitigating Earthquake Disasters;

Turkey has developed its disaster and crisis management system since 1930, which mostly depended on experiences. The current disaster and crisis management system is governed by a centralized structure which is the responsibility of different ministries. Nonetheless, the system is very weak at local level. Furthermore, participation of non-profit organizations is very limited at both national and local levels. Thus, coordination and management of first-response operations during crises are problematic and ineffective (Disaster and crisis management in Turkey: a need for a unified crisis management system, Vol. 19 No. 2, 2010, pp. 155-174, Emerald Group Publishing Limited).

Most of the crises have revealed the truth that the Turkish government's response is more reactionary than pre-planned. The government plans for handling crises were usually enacted immediately after crises. For instance, the government's first crisis policy was shaped in the 1930s after the Erzincan earthquake. This policy has been revised many times, but only after

natural disasters in order to meet people's changing expectations. Similarly, the latest regulations are based on the 1999 Marmara Earthquake experience (Disaster and crisis management in Turkey: a need for a unified crisis management system, Vol. 19 No. 2, 2010, pp. 155-174, Emerald Group Publishing Limited).

The Marmara (Izmit, 1999) earthquake is the most destructive earthquake in Turkey since 1939 Erzincan earthquake. The Marmara earthquake was a regional earthquake heavily affecting Avcilar, (Istanbul), Kocaeli, Sakarya, Yalova and Bolu provinces. As a central government unit, the General Directorate of the Civil Defence officials arrived at the area at 05:30 a.m., approximately two hours after the earthquake. However, without sufficient communication infrastructure and radio dispatches on trucks, there was great uncertainty about organization of the rescue operations. The lack of correct information prevented the government authorities from sending the right type of aid to the correct locations. When new rescue teams arrived, they had no idea where to go, how to start, how to communicate with other rescue teams and government officials. Therefore, the first day of the earthquake was the least effective day with regard to the whole rescue operations conducted specifically for this earthquake (Disaster and crisis management in Turkey: a need for a unified crisis management system, Vol. 19 No. 2, 2010, pp. 155-174, Emerald Group Publishing Limited).

Therefore, The Marmara Earthquake in 1999 was the turning point for Turkish crisis management; it showed the weaknesses and inefficiencies of the previous disaster policies. The Government took the following steps to enhance the crisis management ability. With the Cabinet decisions Nos. 583/1999 and 600/2000, the Turkish Emergency Management General Directorate (TEMGD) was founded to coordinate public organizations in emergencies. Another stage in progress was to increase the number of professional rescue personnel and the emergency centers at the General Directorate of Civil Defence (GDCD) by the Cabinet decision No. 586/1999. Based on the regulation, the number of search and rescue centers increased from three to 11, modern equipment and vehicles were provided, and 120 more rescue personnel were hired (Disaster and crisis management in Turkey: a need for a unified crisis management system, Vol. 19 No. 2, 2010, pp. 155-174, Emerald Group Publishing Limited).

The Turkish Armed Forces transformed one of its battalions to a search and rescue to strengthen its effectiveness in disasters. The foundation of the Natural Disasters Search and Rescue Troop by Turkish Ground Forces was another stage in progress in army preparedness for the crisis. Turkish Ground Forces provided the new organization with modern equipment, helicopters and central coordination centers that control five separate teams (Disaster and crisis management in Turkey: a need for a unified crisis management system, Vol. 19 No. 2, 2010, pp. 155-174, Emerald Group Publishing Limited).

Currently, the main government organizations responsible for disaster management are the Turkish Emergency Management Directorate (TEMGD) of the Prime Ministry, the General Directorate of Disaster Affairs (GDDA) of the Ministry of Public Works and Settlement, the General Directorates of Civil Defence (GDCD) of the Ministry of the Interior, and finally the General Directorate State Hydraulic Works (SHW) under Energy Ministry. Decree No. 600 regulates the process by giving more authority and responsibility to TEMGD to coordinate post-disaster activities and mitigation efforts (Disaster and crisis management in Turkey: a need for a unified crisis management system, Vol. 19 No. 2, 2010, pp. 155-174, Emerald Group Publishing Limited). Moreover, many other ministries, state agencies and institutions are also responsible as a part of the crisis management system. It was designed in "regulation concerning the fundamentals of emergency aid organizations and planning associated with disasters"

(Disaster and crisis management in Turkey: a need for a unified crisis management system, Vol. 19 No. 2, 2010, pp. 155-174, Emerald Group Publishing Limited).

ADMINISTRATIVE BODY-CENTRAL

- Ministry of Public Works and Settlement (GD of Disaster Affairs and other GD)
- Ministry of Interior (GD of Civil Protection)
- Turkish Red - Crescent
- Other Ministries
- DASK (Natural Disaster Insurance Council)
- TUBITAK (Turkish Scientific and Technical Institute), Universities (BU-KOERI, ODTU-DMC), MTA (GD of Mineral Research and Technical Exploration)
- GD of Turkey Emergency Management
- TSK (Turkish Military Force)

NON-PROFIT ORGANIZATIONS AND CIVIL SOCIETY IN CRISIS MANAGEMENT;

The Turkish Red Crescent Society (TRCS) is one of the main and non-governmental organizations of disaster management structures of Turkey established in 1868. It has national, provincial, district level committees, and it actively operates in the disaster areas. TRCS also provides blood transfusion services, AIDS and first aid trainings, and disaster preparedness training as preparedness efforts. A well-equipped Disaster Operation Centre (AFOM) was also established in Ankara (Kizilay, 2008), (Disaster and crisis management in Turkey: a need for a unified crisis management system, Vol. 19 No. 2, 2010, pp. 155-174, Emerald Group Publishing Limited).

The development of non-profit organizations in disaster response was another milestone for Turkish Disaster Crisis Management. Before the 1999 earthquake, the role of private firms and non-profit organizations was underestimated. The Turkish government has moved away from a traditional "paternalistic" approach and has reallocated responsibilities. Local governments had held construction inspection but after the 1999 earthquake central government believed that they had failed to inspect constructions (Ganapati, 2008). This responsibility was given to private Building Inspection Firms (BIFs) (Law on Building Inspection, No. 4708 2000: Decree on Procedures and Principles for Construction Inspection, No. 24491 2001). Another initiative after the 1999 earthquake was the establishment of an independent organization called the National Earthquake Council. It consists of scientists from different fields such as earth scientists, structural and earthquake engineers, environmental engineers, architects, urban planners and psychologists. The goal of the council is to identify priority research areas for disaster mitigation in the country. Although the Council has no enforcement power, it proposed strategies for better mitigation. The first report published was "National Earthquake Mitigation Strategy" in 2002. Nevertheless, the Council is not as effective as expected. The establishment of National Disasters Insurance Administration (under the Treasury) was another important improvement in the disaster and crisis management system after the 1999 earthquake. The administration is headed by seven Executive Board members from the public and private sectors such as insurance and finance organizations. The organization collects the mandatory earthquake insurance from homeowners for the Turkish Catastrophe Insurance Pool. The organization provides services by outsourcing activities; for instance policy distribution and marketing is held by 24 insurance companies and their agencies. One of the weaknesses of the

insurance pool is that it is limited to earthquakes. It does not cover other disasters such as floods, landslides or avalanches.

The non-profit organizations' role in disaster preparedness and life-saving efforts during the emergency response and rescue period led government to regulate their existence in the disaster and crisis management system. The Ministry of Interior regulated how non-government organizations are involved in the system after 2000 (Ministry of Interior's Directive on Conditions of participation of Volunteers in Civil Defense Service 2000). The Turkish Radio Amateur Club (TRAC) was founded in 1962 to provide post-disaster communication services. TRAC facilitates communication during the crisis and makes agreements with national organizations that are responsible for crisis management: some cities, Mayors and fire departments, and health departments as well. TRAC has an office in each province in Turkey and coordinates local relationships. AKUT was also the first volunteer search and rescue organization after 1995. It became the leading model for many volunteer search and rescue organizations. AKUT has nine regional offices and increasingly gets public support through volunteer participation and fund- raising activities.

Furthermore, The Prime Ministry's Office established a scientific, independent National Earthquake Council in March 2000. The National Earthquake Council was created to evaluate and unite discussions among experts about future earthquakes. According to the decision 2000/9, the Council consists of 20 experts selected from universities, public disaster organizations, and professional institutions. The scientific and Technical Research Council of Turkey (TUBITAK) became the responsible organization for the foundation of the Council. TUBITAK also performs as the secretary of the Council. The major missions of this Council are (Balamir, 2001b);

- To evaluate the assertions and predictions for the future seismic risk, and to share the findings with the authorities and public,
- To identify priorities for research activities for reducing seismic risk,
- To provide consultation for public disaster agencies,
- To prepare strategic disaster policies,

However, unfortunately because of changes in the administration of TUBITAK, after its first report (2002), the Council has not been very effective in gathering the responsible organizations in order to discuss and implement the policies that the strategic record recommended. Hence, the Council was abolished in 2007 (Celik S. (2007), Towards Local and Protective Turkish Disaster Management System).

Furthermore, the Disaster Law is considered highly advanced and comprehensive for the ear in which it was created, however, it has not adopted over time to changing conditions (National Earthquake Council, 2002). Although the Disaster Law clarifies the tasks to be carried out before and after disasters, it focuses fundamentally on the response and recovery stages of disasters. The major goal of Disaster Law 7269 is to recover and rehabilitate after a disaster happens, rather than to reduce seismic risk and create a disaster resilient community.

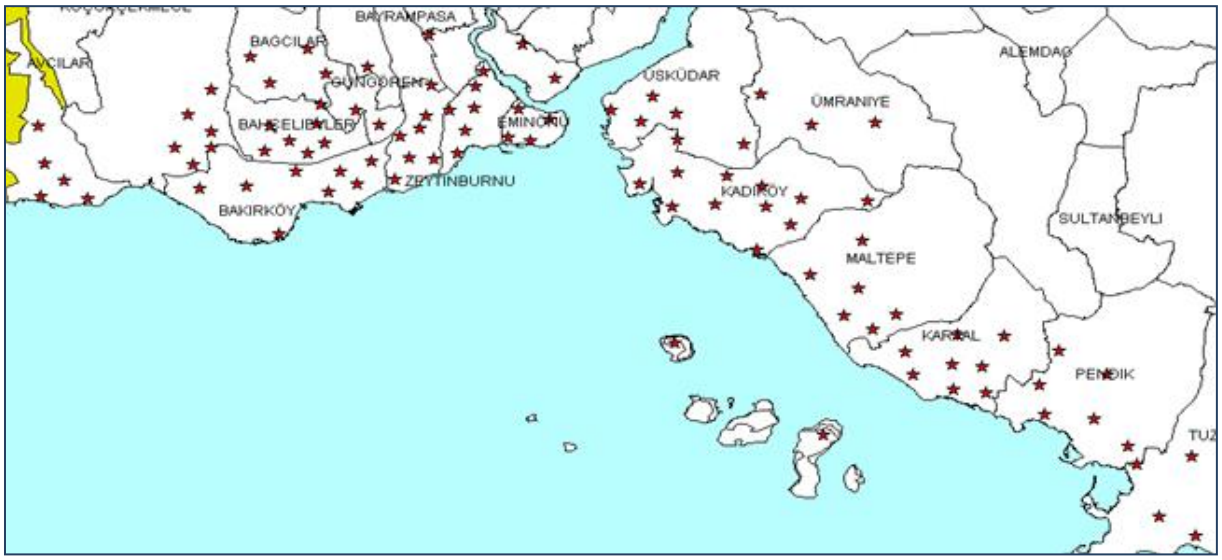
g. Assessment Methods of Earthquake Disaster Risk and Earthquake Risk Assessment Maps;

Regional Tsunami Warning System

After the Sumatra earthquake in 2004, the global community felt the need of establishing regional tsunami warning systems, and within this framework, KOERI is setting up a Tsunami Warning Center which is expected to act also as a regional center under the UNESCO Intergovernmental Oceanographic Commission – Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS) initiative.

Early Warning and (Emergency) Rapid Response

Especially after Izmit (1999) earthquake, by taking into consideration the vital importance of Early Warning and (Emergency) Rapid Response, Istanbul Earthquake Rapid Response and Early Warning Project is coordinated by Bogazici University Kandilli Observatory and Earthquake Research Institute (BU-KOERI).

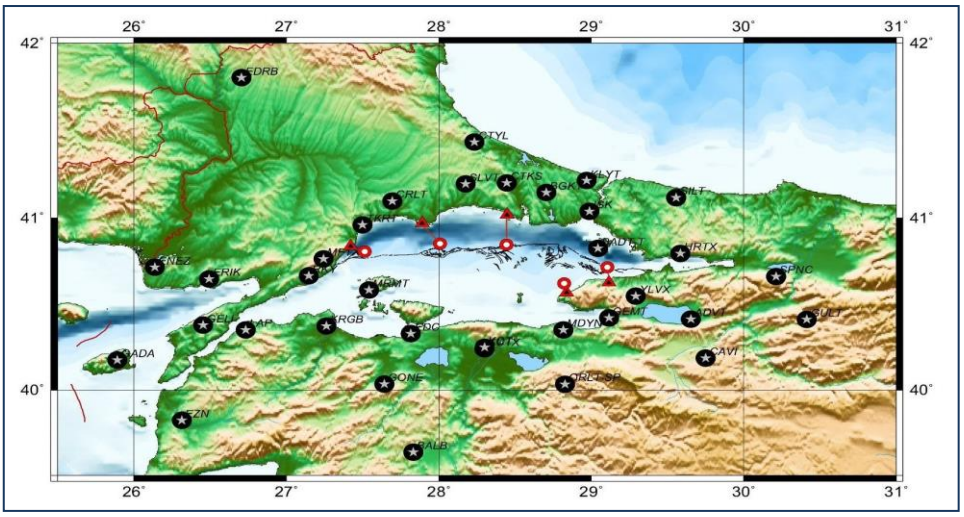


(Bogazici University,Kandilli Observatory & Earthquake Institution)

Red stars show the stations which are used for Early Warning System in Istanbul.

Sea Floor Observation System

Bogazici University, Kandilli Observatory & Earthquake Research Institute has established a 5-station network in the Marmara Sea. Currently one station (OBO5 Armutlu Esenköy) is operational and remaining 4 planned to be deployed in 2 campaigns (in October and November). Expected completion time is the end of this year.



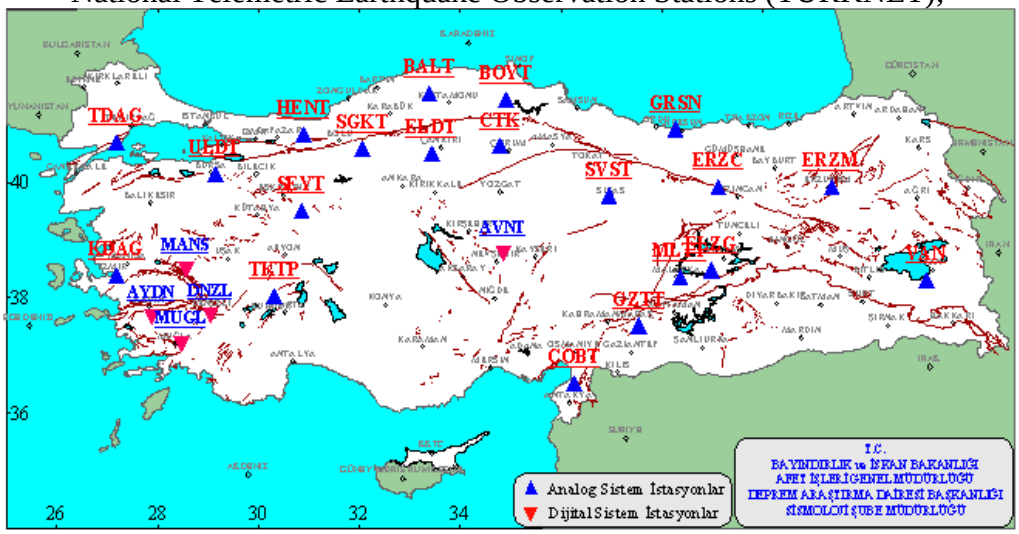
Marmara Sea Bottom Observatory Network

Red dots including white small dots indicate the sea floor observation stations.

National Telemetric Earthquake Observation Stations (TURKNET)

TURKNET has been established by Seismology Division of the Earthquake Research Department, the General Directorate of Disaster Affairs. For the first step, seismic telemetred systems of 13 stations are being installed on the North Anatolian Fault Zone, from Izmit to Sivas provinces. Now the number of stations has become twenty-four around the country. After a strong earthquake people of the seismology division work twenty-four hours continuously. All information obtained in the center is open for all the universities and related institutions (Ozmen B. (2003), Earthquake Risk Reduction Studies at General Directorate of Disaster Affairs).

National Telemetric Earthquake Observation Stations (TURKNET);



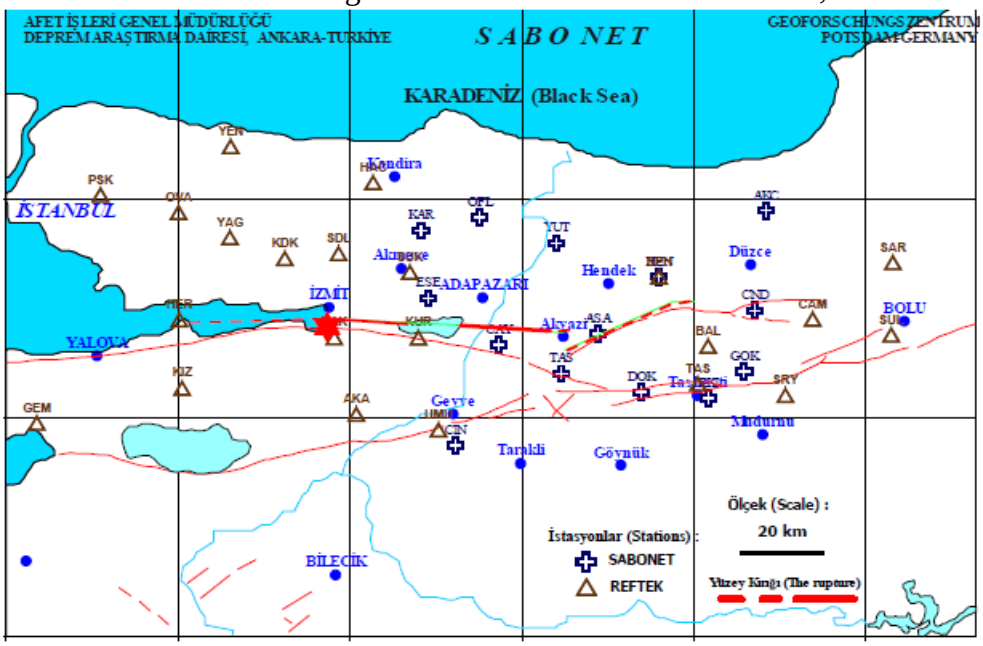
(Ozmen B., Earthquake Risk Reduction Studies at General Directorate of Disaster Affairs)

Microearthquake Studies around Sakarya-Bolu Region

In the frame of Turkish and German joint project on earthquake prediction, in the western part of the North Anatolian fault zone, around Izmit-Bolu area, a multidisciplinary earthquake

research studies have been carried on since 1984. In the frame of this project between 1985 1996, seismological studies carried out by using magnetic tape recording systems (MLR) and data processing systems. In November 1996, more developed fifteen digital telemetric micro earthquake stations have been installed instead of MLR recording systems and a data processing centre (SABONET) has been established in Sakarya at the Directorate of Public Works and Settlement. The telemetric earthquake stations, related equipments and software used for data processing centre prepared by the Nanometrics Company in Canada. The earthquake data from the stations are transmitted to the data processing centre directly or via transmitters (Ozmen B. (2003), Earthquake Risk Reduction Studies at General Directorate of Disaster Affairs).

SABONET Regional Seismic Observation Network;

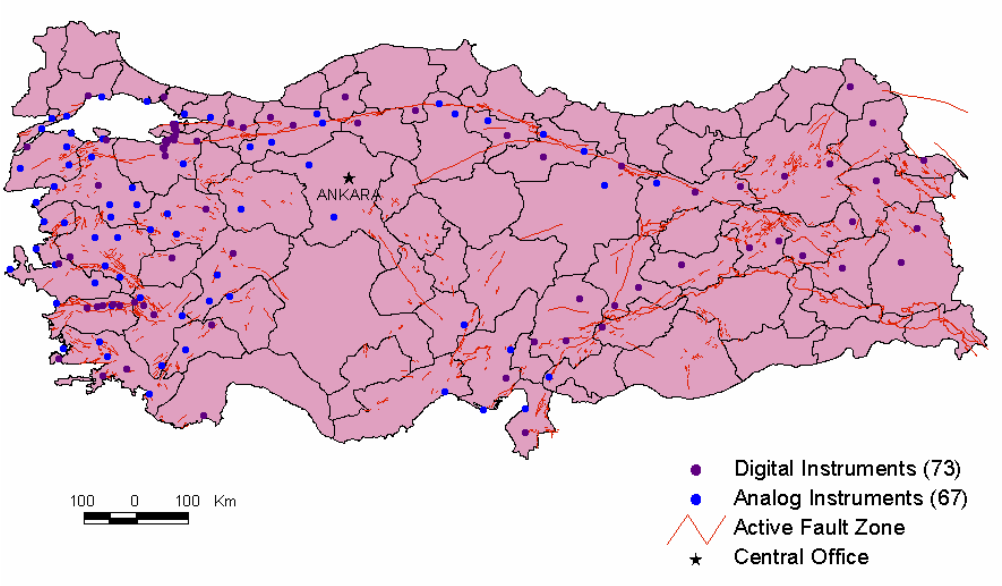


(Ozmen B., Earthquake Risk Reduction Studies at General Directorate of Disaster Affairs)

Turkey Strong Ground Motion Network Project

The Project of Establishing a Strong Ground Motion Network of Turkey has been started in 1973. The aim is to measure the ground accelerations that occur during earthquakes. These acceleration data give important engineering information for designing earthquake resistant structures. The acceleration data can also be used to develop attenuation relations for ground acceleration with distance and the strong ground motion recorded at a station can be used to estimate the damages it may cause in any inhabited places at various distances. During the realization of the Project, 120 acceleration recorders have been bought in total of which 67 are analog and 53 are digital instruments. Of these 120 instruments, 110 are deployed in the field, the rest are in the laboratory for repair, maintenance and to be deployed in the epicentral area for recording the ground strong motion of aftershocks in case a large earthquake. The principle used in the selection of the sites where the instruments are installed is that the network should be able to record the earthquakes which might occur on the active fault zones of Turkey. In the Eastern and Southeastern parts of Turkey digital instruments from which data can be retrieved by telephone lines are preferred since access to these sites for data retrieval and return by technicians take considerably time. Acceleration recordings are stored in a database and being updated right after any value is recorded (Ozmen B. (2003), Earthquake Risk Reduction Studies at General Directorate of Disaster Affairs).

Strong Motion Acceleration Network of Turkey;



(Ozmen B., Earthquake Risk Reduction Studies at General Directorate of Disaster Affairs)

Besides, in order to develop national strong ground motion network 20 digital acceleration recorders are obtained. 14 of them are distributed between Bursa-Yalova and remaining 6 of them will be established between Aydın-Denizli. The first strong ground motion record of a relatively large earthquake was taken on 19th July 1976 from Denizli. All the earthquakes of Turkey having large magnitudes which had occurred since August 1976 have been recorded by this network.

Using the peak acceleration record value, the magnitude of the earthquake and the epicentral distance to the recording point, attenuation relations of acceleration with the distance and magnitude has been calculated for Turkey. Previously, attenuation relations developed with records taken at different places of the world had been used in Turkey. The use of an attenuation relation developed from the records of Turkish earthquakes is an important progress. The attenuation relation developed from Turkish records is as given below. The PGA, The Peak Ground Acceleration, depends on Magnitude (M) and Distance (R), (in kilometers).

$$\text{LogPGA} = 0.65M - 0.9\text{LogR} - 0.44$$

Earthquake Disaster Prevention Research Center (Turkish – Japanese Joint Project)

A Joint project was started in April 1993 as a five-year program between the Governments of the Republic of Turkey and Japan. Support has been made by the Japan International Cooperation Agency (JICA), an extra-departmental organization of the Ministry of Foreign Affairs, Japan. The objectives of the project are to study systematically, develop and improve

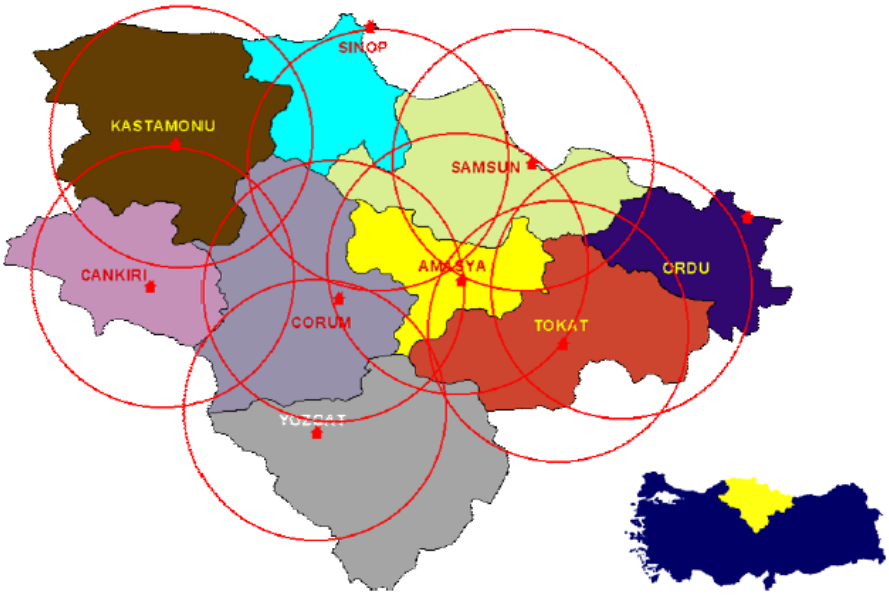
technologies and techniques for earthquake disaster prevention and mitigation through joint research activities in the Earthquake Disaster Prevention Research Center.

The targets of the project

a) To determine the earthquakes parameters and making a pre-estimation about the human loss and damage just after the earthquake,
b) To provide a reliable data transmission between local stations, the regional and main centers by using a computer network,
c) To evaluate the results and transmit them to administrative organizations in approximately within 20 minutes.

The project service area is located in the central part of the North Anatolian Fault Zone and covers Samsun, Sinop, Kastamonu, Cankırı, Corum, Yozgat, Amasya, Tokat and Ordu provinces. The earthquake observation system consists of a main center in Ankara, a regional center in Samsun and local stations in Amasya, Cankırı, Corum, Kastamonu, Samsun, Vezirkopru, Tokat, Niksar and Yozgat (Ozmen B. (2003), Earthquake Risk Reduction Studies at General Directorate of Disaster Affairs).

The project servis area of Turkish – Japanese Joint Project;



(Ozmen B., Earthquake Risk Reduction Studies at General Directorate of Disaster Affairs)

An Example of Determination of Natural Hazard and Risk;

The main aim of the General Directorate of Disaster Affairs (GDDA) is to reveal natural hazard and risk of some provinces in Turkey by using recent technologies like Geographic Information System (GIS) and Remote Sensing (RS). The outputs of this study are multi-hazard map (earthquake, landslide, snow avalanche, rockfall). Those maps are prepared for decision makers and governorate in order to assist them during upgrading of Emergency Aid Plans of the city and its countries. Geographic Information System (GIS) and Remote Sensing (RS) techniques are used during this project aiming to create a disaster information network.
These works are being carried out:

- To determine hazard and risk level of provinces

- To prepare regulations and data which are based on disaster emergency plans
- To guide city planners to prepare regional land use plans
- And to provide necessary information to decision makers

By all these studies, natural hazard maps are prepared. In addition, disaster scenarios are carried out to be able to assess probable damages beforehand. One of such studies has already been completed and published for Kastamonu province. GDDA plans to enhance that kind of projects for all around the country. Determination of natural hazard and risk of provinces are underway for Bartın, Karabük and Zonguldak provinces (Ozmen B. (2003), Earthquake Risk Reduction Studies at General Directorate of Disaster Affairs).

Microzonation Studies for Mitigation of Disaster Risk

The main goal of the project supported by the Government of Switzerland is to develop land use management for reducing earthquake risk in Turkey. The Project is intended to demonstrate the use of seismological, geological and geotechnical data in terms of state of the art microzonation. In this framework, microzonation maps will be prepared for pilot areas in Sakarya and Kocaeli provinces. The outcomes of these studies are planned to use land use management in Turkey and to prepare a guide for seismic microzonation. The project will be implemented by World Institute for Disaster Risk Management, USA, General Directory of Disaster Affairs, a number of national universities, the municipalities concerned and participants in project activities (Ozmen B. (2003), Earthquake Risk Reduction Studies at General Directorate of Disaster Affairs).

Investigate area of DRM project;



(Ozmen B., Earthquake Risk Reduction Studies at General Directorate of Disaster Affairs)

Microzonation and Earthquake Scenarios for Istanbul

The project was performed for Istanbul by Bogazici University-KOERI, Earthquake Engineering Department. The purpose for seismic microzonation is to identify areas having different earthquake hazard potentials. The seismic microzonation maps would indicate the distribution of site response with respect to:

- Ground shaking
- Liquefaction
- Landslide susceptibility

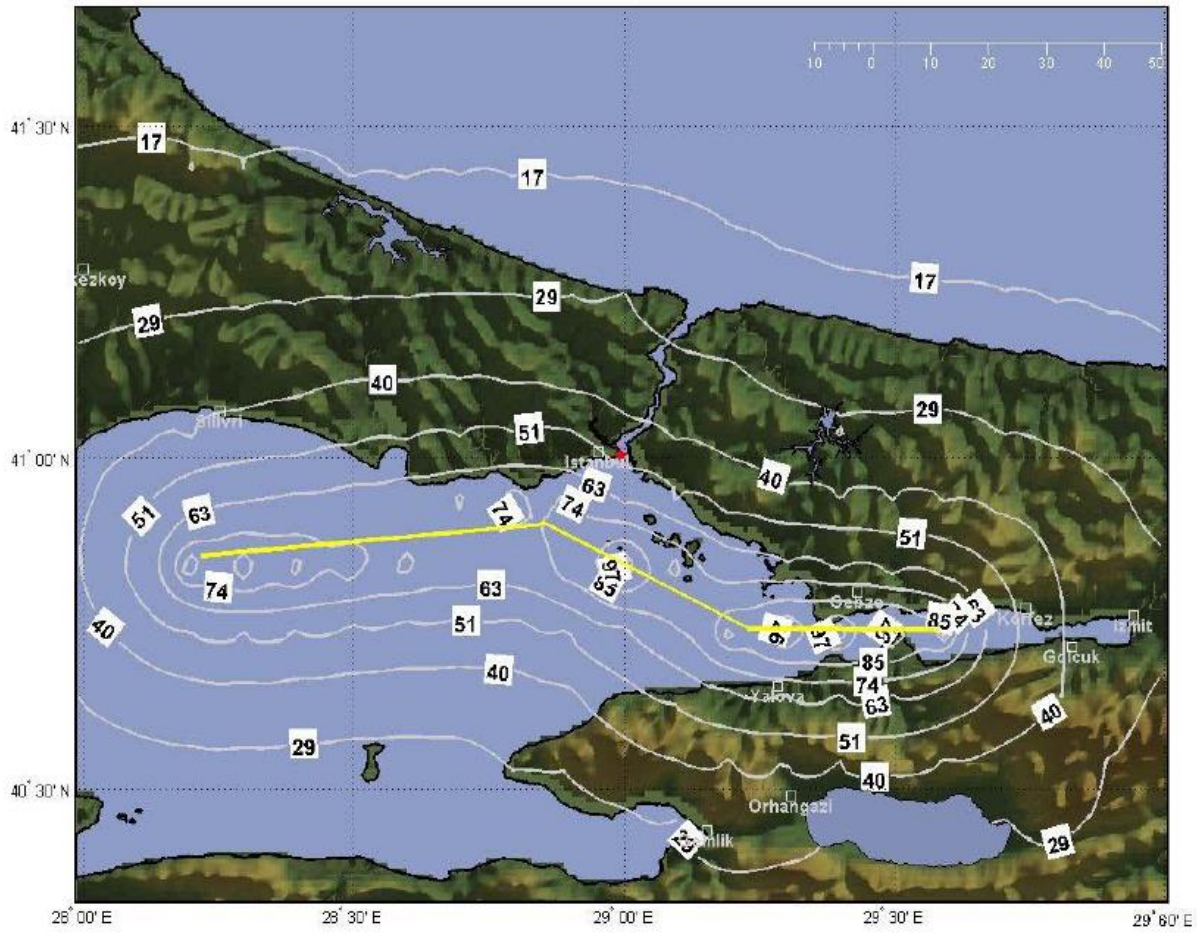
Thus they provide an input for urban planning and earthquake mitigation priorities at urban scale. The purpose for earthquake damage scenarios are mainly for assigning the priorities in the implementation of the risk reduction, disaster preparedness, and urban planning.

The process of loss estimation due to earthquakes involves:

- Analysis of seismic hazard on the engineering bedrock
- Site dependent earthquake ground motion characteristics
- Complication of building inventories
- Estimation of vulnerability of the building inventories.

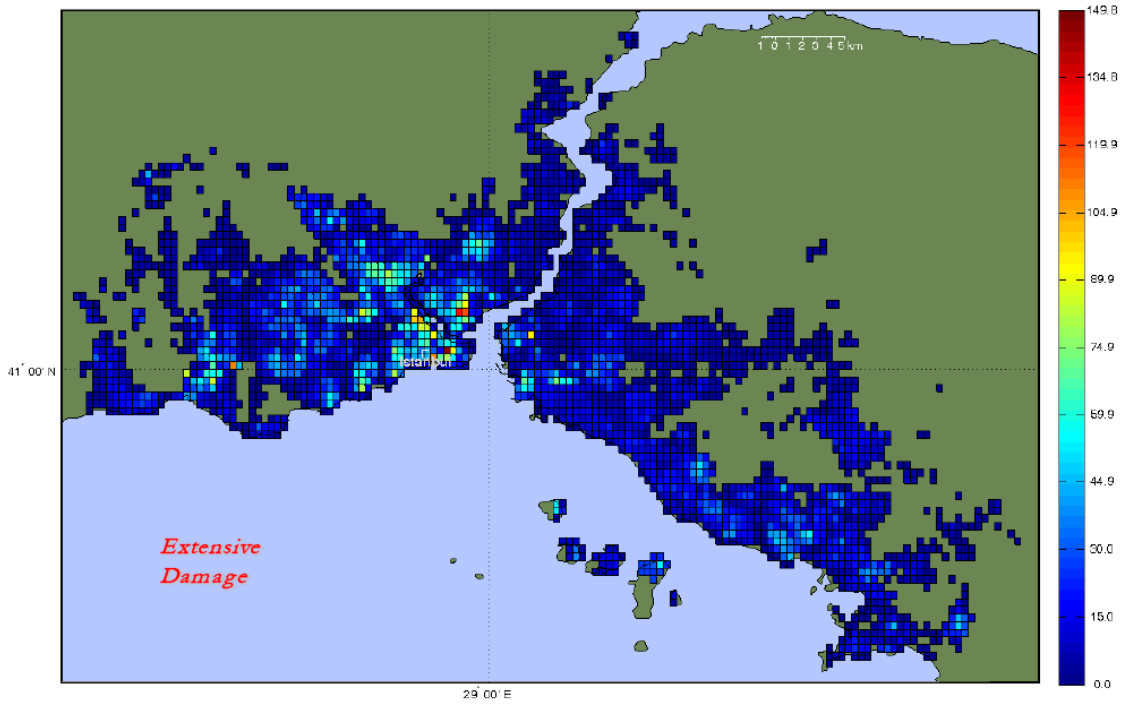
(Microzonations and Earthquake Scenarios for Istanbul, Atilla Ansal, Gökce Tonuk, Asli Kurtulus, BU-KOERI, earthquake engineering)

Earthquake Loss Assessment for Istanbul Mw=7.5 Scenario Earthquake, based on Boore-Atkinson 2007 Attenuation Relation;



(Microzonations and Earthquake Scenarios for Istanbul, Ansal A., Tonuk G., Kurtulus A, BU-KOERI, earthquake engineering)

Earthquake Loss Assessment for Istanbul Mw=7.5 Scenario Earthquake, based on Boore-Atkinson 2008 GMRE;



(Microzonations and Earthquake Scenarios for Istanbul, Ansal A., Tonuk G., Kurtulus A, BU-KOERI, earthquake engineering)

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