Learning from Earthquakes

Preliminary Observations on the May 1, 2003, Bingöl, Turkey, Earthquake

Immediately following the earthquake, EERI members and colleagues from two universities in Turkey (Middle East Technical University [METU] and Kandilli Observatory and Earthquake Research Institute [KOERI] at Boğaziçi University) dispatched teams to the field.

Team members from METU included Polat Gülkan, Sinan Akkar, Ali Koçyigit, and Nuretdin Kaymakçi. Team members from Boğaziçi University included Mustafa Erdik, M. Demircioğlu, K. Beyen, K. Şeşetyan, N. Aydinoğlu, M. Gül, B. Siyahi, G. Önem, C. Tüzün, A. Salkin, and Y. Kaya. A geotechnical team from METU went into the field: B. Sadik Bakir, K. Önder Çetin, and Reşat Ulusay. A. Nuray Karanci and Bahattin Aksit, professors in the Departments of Psychology and Sociology at METU, also conducted field reconnaissance.

EERI supplemented these field activities by sending William Mitchell, a political scientist from Baylor University, and Seref Polat, a structural designer with Rutherford and Chekene on leave from KOERI, to assist in the reconnaissance. This work was partially supported with funding from the National Science Foundation, under grant # CMS-0131895.

All teams have produced independent reports, full versions of which are available from links on EERI's home page ***www.eeri.org****. The opinions and observations expressed in those reports do not necessarily reflect the views of the National Science Foundation or EERI.*

Introduction

The Bingöl, Turkey, earthquake caused damage in Bingöl Province and at least one village in Elazig Province. The magnitude Mw=6.4 earthquake struck at 3:27 a.m. local time on May 1, 2003, with an epicenter located about 15 km N-NW of Bingöl city (Figure 1). This is a sparsely populated region with one major city (Bingöl), 350 small villages and hamlets, and a population of 253,739 (*2000 General Census of Population)*. Most of the 177 fatalities and 530 injuries occurred in Bingöl City (at least 27 were killed in the collapsed Korkmaz apartments in Düzaðaç mahalle), although 84 students perished in the school dormitory in Çeltiksuyu village.

Bingöl Province and its Population

Bingöl (population 68,900) is a provincial center in eastern Turkey, located on a plain in the upper Murat River (Euphrates) watershed on the eastern Anatolian plateau. The city sits on both sides of the Capakcur River, which flows through an entrenched alluvial valley. Damage was concentrated on both sides of the river, particularly in Saray and Inonu suburbs, two of the city's 13 districts.

Bingöl Province has an extremely rough terrain, with mountain elevations in the 2500-3000 m range, plateaus of tectonic origin, and deep valleys. The entire province is situated within the highest hazard zone of the 1996 Hazard Zones Map for Turkey.

Bingöl is one of the least populated and poorest provinces in Turkey. It is well known that eastern Turkey lags behind the western part in socio-economic indicators. A rural development project has been in effect in the region for over a decade, and the Eastern Anatolia Project Plan 2000 is also an effort to improve economic conditions (see the Karanci and Aksit report at **www.eeri.org**).

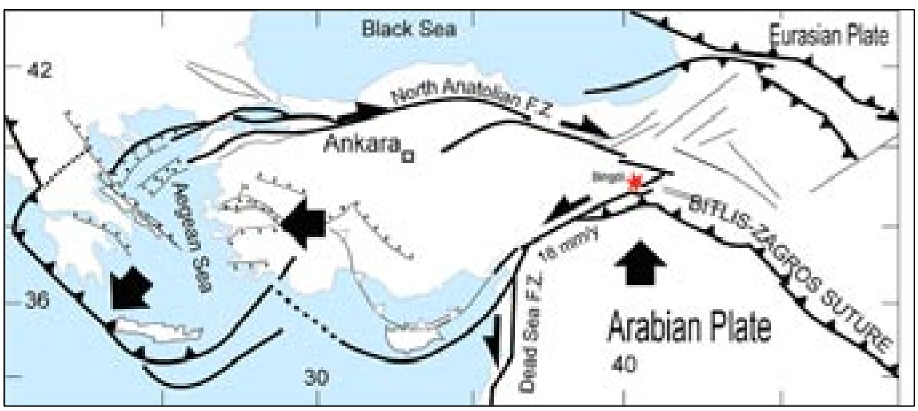

Figure 1. *Location of the May 1, 2003, Bingöl earthquake (source: Dr. N. Kaymakçý).*

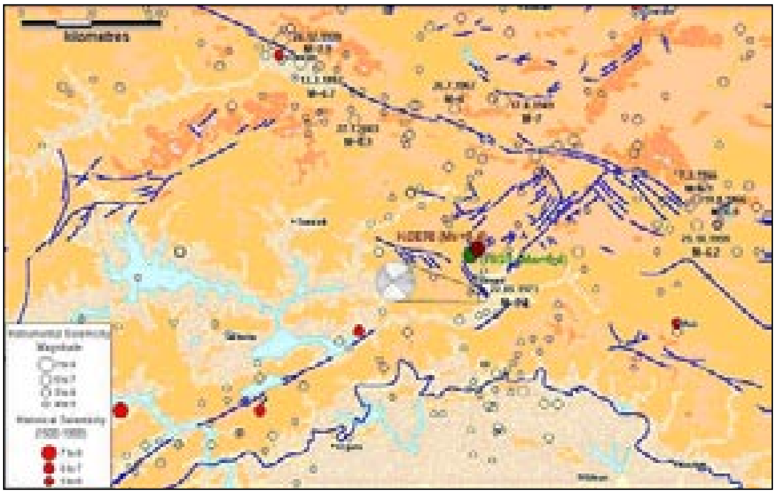

Figure 2. *Seismic activity in the East Anatolian Region.*

Employment is mainly in agriculture, although the province accounts for a very small percentage of Turkey's overall agricultural production. Crops are cereals, legumes, tubers, and industrial crops such as cotton and tobacco. According to recent government statistics, the province has around 72,000 cattle and roughly 500,000 sheep and goats, many of which were killed in the earthquake.

Turkey has experienced accelerated rural-to-urban migration for several decades. This has resulted in drastic increases in the suburbs of large cities. Between 1990 and 2000, the growth rate was -22.06% for villages in Bingöl Province, but 50.43% for the municipality of Bingöl — almost double the national average (*2000 General Census of Population*).

Seismotectonics

The tectonics of the region are controlled by the 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 Anatolian block is bounded to the north and to the southeast by the North Anatolian and the East Anatolian faults, respectively.

The North Anatolian fault (NAF) is the most eminent tectonic feature of the region and one of the best known strike-slip faults in the world.

The East Anatolian Fault Zone is a 550 km-long, approximately northeast-trending, left lateral strike-slip fault zone. The fault zone takes up the relative motion between the Anatolian and the Eurasian plates, and between the Arabian and African plates. The East Anatolian Fault Zone extends from Karlýova triple junction in the northeast to the Maraþ triple junction in the southwest, where it intersects the Dead Sea fault.

The following major earthquakes occurred on the East Anatolian fault during the 20th century: December 4, 1905 (M=6.8) Malatya; September 28, 1908 (M=6.7); May 22, 1971 (M=6.8) Bingöl; and May 5, 1986 (M=6.0) Sürgü. The location of the 1971 Bingöl earthquake is very close to that of the present earthquake. The historical and instrumental seismic activity of the East Anatolian region is illustrated in Figure 2.

The northeastern segment of the East Anatolian fault between the Karlýova triple junction and Bingöl is about 60 km long and is composed of many closely spaced parallel strike-slip fault strands. The 1971 Bingöl earthquake produced a belt of surface breaks, approximately 38 km long, from SE of Bingöl to Çobantasi.

Both field observations on surface breaks and earthquake mechanism solutions (Dewey, 1976; Taymaz et al.1991) reveal a left-lateral strike slip geometry (Taymaz et al. 1991). The relocated epicenter for the 1971 earthquake is at the southwestern end of the surface breaks.

Although the exact locations are not known, two historical earthquakes of similar size, namely the 1789 and the 1875 events, are reported to have occurred in the vicinity of this segment (Barka and Kadinsky-Cade 1988).

The 1971 event, preceded by a few foreshocks, caused considerable damage in Bingöl and its vicinity: 881 dead, 1157 injured, 3965 collapsed housing units, 6950 heavily damaged housing units, and about 1000 moderately damaged housing units.

	KOERI	USGS
Date-Time	2003 05 01 – 00:24:04 UTC	
Location	39.0130N 40.4688E	38.99N 40.46E
Depth	10 km	
Magnitude	6.4 (Ms)	6.4 (Mw)

Table 1. *Parameters of the May 01, 2003, Bingöl earthquake*

Aftershocks of the 2003 Bingol earthquake have been generally located in the the Bingöl-Adaklý-Sancak-Karakoçan region. This aftershock region contains numerous small faults forming a zone. One of the faults (the so-called Sudüðünü fault) in this zone has been identified as the causative fault by Kocyiðit and Kaymakcý (2003). This is a right lateral strike-slip fault of about 20 km long and N60°W strike.

Refer to the Erdik et al. report at **www.eeri.org** for a more complete discussion, color maps, and detailed references.

Seismology

The parameters of the May 1, 2003, Bingöl earthquake, as given by KOERI and USGS, are presented in Table 1.

The fault plane solution provided by USGS and Harvard CMT indicate a dominantly strike-slip earthquake with some normal component (Harvard CMT). The finite fault plane has a strike of N26E (USGS) and N28E (Harvard CMT), with a dip of 88^0 (USGS) and 68^0 (Harvard CMT). This fault plane coincides with the aftershock distribution and is belived to represent the actual fault plane. The seismic moment M_0 is reported to be 4.4×10^{18} Nm (USGS) and

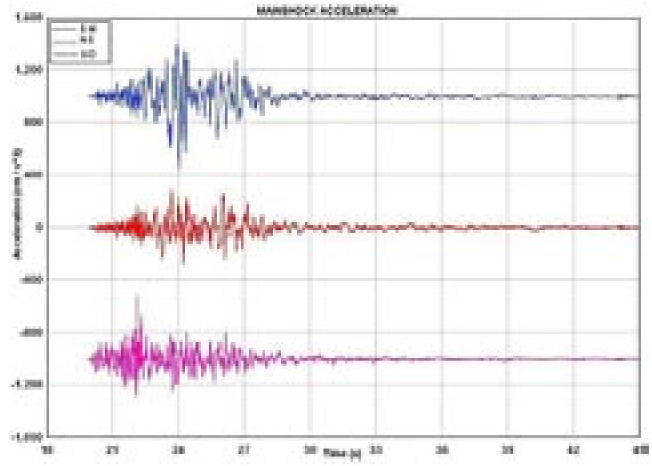

***Figure 4**. Main shock acceleration time history.*

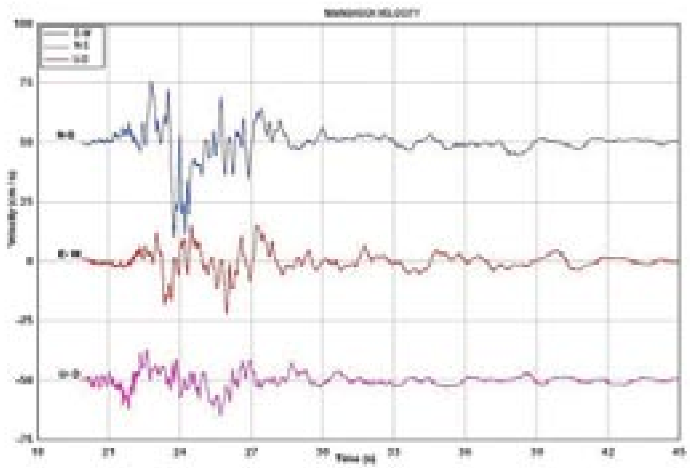

***Figure 5.** Main shock velocity time history.*

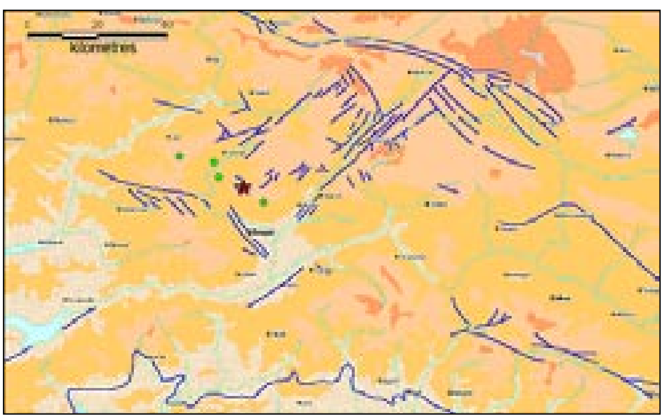

***Figure 3.** Aftershock Activity (>Mw=4.3).*

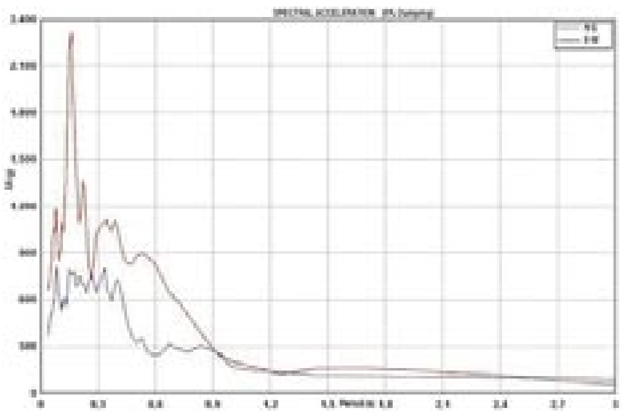

***Figure 6.** 5% damped response spectra.*

Figure 7. *One of the most significant seismically induced landslides along the Sogukcesme section of the country roadway extending from Bingöl to Karliova.*

4.1×10^{18} Nm (Harvard CMT). Half duration of the fault slip is given as 3.6s by Harvard CMT.

Although the aftershock distribution with M>2 exhibits a somewhat diffuse pattern, the alignment of the aftershocks with magnitude > 4.3 (Figure 3) is also in agreement with the suggestion of a NW-SE trending fault break.

Strong Motion Records

A digital instrument situated in a low-rise appurtenant building adjacent to the local office of the Ministry of Public Works and Settlement recorded the main shock. The main service building, built according to a template design, experienced what appeared to be moderate damage. An identical building in Bolu was subjected to the November 12, 1999, earthquake centered near Düzce, and was damaged more severely. (Interestingly, an identical instrument in Bolu had then recorded a peak of about 0.79 g.)

The instrument had been set upon a support in the back of the appurtenant building. The Earthquake Research Division of the General Directorate of Disaster Affairs, an agency with a mission similar to that of FEMA, released the digital record on their website (**www.deprem.gov.tr**) on the day the earthquake occurred. Figure 4 displays the main shock acceleration time history, and Figure 5, the main shock velocity time history.

Soil Conditions

Bingöl City is located on the Capakcur Basin, which is surrounded by the Karaboga and Musguneyi Mountains in the northern and southern regions, respectively. Geologic formation of the surrounding region is mainly composed of basalt, and the basin is composed of alluvial deposits.

The Göynük Stream, which is one of the branches of Murat River, passes along the city center. The pancaked Çeltiksuyu School is built on the flood plain of the Göynük River. The old sections of the city are founded on the Pleistocene alluvial fans of the Bingöl and Bayram Rivers. New parts of the city expand onto the alluvial terraces of these rivers. The terraces consist of gravel and silt and, in western sections, finer sediments.

The earthquake caused rock and debris falls, several landslides (Figure 7), and surface tension cracks. Landslides contributed to building damage in Ýçpýnar and Göltepe ve Çiçekdere villages.

Seismically induced mudflows were observed in several villages, including Kurtulus Village, where mud covered hundreds of meters (Figure 8). Villagers reported that the mudflow started immediately after the earthquake and continued until the next morning.

Although there is the possibility of liquefaction in the flood plains of Bayram and Göynük Rivers, none was observed. See the report on “Geotechnical Aspects of the Bingol Earthquake” at **www.eeri.org** for the locations and discussion of these ground deformations.

Figures 8a and 8b. *Mudflow at Kurtulus Village.*

Figure 9. *Shear failure at column base due to insufficient amount of transverse reinforcement.*

Structural Performance

Following the 1971 earthquake, Bingöl City had developed toward the north. In this section of the city, the buildings are reinforced concrete apartments of five or six stories with hollow clay masonry tile infill walls, almost without exception. Bingöl City is also made up of himis buildings (composed of timber frames and braces with adobe infills) and unreinforced masonry structures. Both himis and masonry buildings are concentrated in the old part of the city, and both types performed poorly.

Of the reinforced concrete buildings that were damaged, a significant portion comprised government buildings (schools, dormitories, and state buildings). Recently built structures (five years old or less) generally performed better than older reinforced concrete. The two main causes were poor detailing at critical points of structural elements and poor quality concrete (Figures 9 and 10). Site effects also contributed to damage, as can be seen in the subsequent discussion.

Figure 10. *Observed shear failure at shear wall due to insufficient transverse reinforcement and poor concrete quality.*

Figure 11. *Çeltiksuyu Regional Primary Education School Building. (Note entrance canopy partially visible on left. The ground story collapsed fully in exactly the same way as that in Figure 13.)*

Figure 12. *Metal storage lockers partially support floor of school.*

The most tragic building collapse occurred at Çeltiksuyu Regional Primary Education School, where both the dormitory building and the adjacent school block were badly damaged (Figures 11 and 12). This building was completed in 1998. An identical school building (Kaleönü) closer to the city and some 7 km away from the collapsed dormitory failed in identical fashion (Figure 13). The story mechanism appeared to have been triggered by flexural action. Column reinforcement was plain bars; transverse confinement in columns was negligible, and was nonexistent within joints.

Regional schools are the response of the Government of Turkey to fulfill its obligation to provide facilities for the mandatory eight years of primary education. Children from the small villages and hamlets in the surrounding area are able to live in them as boarders. Some facilities are for combined boarder/daily commuter students when they are close to cities, and others may serve children attending during the day only with no adjacent dormitories.

The buildings in rural parts of Bingöl performed comparatively well in general during the May 1 earthquake. While total collapses in this category were rare, the common form of damage was partial failure of exterior, inner, and partition walls (Figure 14).

The traditional rural construction is overwhelmingly single-story buildings with hewn stone masonry exterior walls of 25-40 cm width. Concrete mortar is generally used as the bonding agent between the stones. An additional inner wall up to a thickness of 50 cm is constructed to keep out cold during the harsh winters. The inner walls and partition walls are either stone masonry with clay mortar or, rarely, adobe.

Ceilings are constructed of tree trunks extended over the walls and overlaid by a soil layer of variable thickness. At the roofs, the wooden trusses are covered with metal sheets because the snow, which often exceeds 1 m in this area, will slide down relatively easily.

Figure 14. *A traditionally built rural house that was heavily damaged.*

Figure 15. *Map of Bingöl City.*

Site Effects and Structural Damage

The Gayt streambed in the new north part of the city divides the characteristic deep terrace deposits underlying the city by a deep valley extending in the east-west direction. The northern outskirts of the city extend into the valley (Figure 15). Cliffs bound the valley on both sides, with slopes exceeding 45° and reaching 40 m height on the west.

Structural damage in the area was markedly concentrated within about a 50-m-wide strip from the crest of

Figure 13. *Kaleönü Primary Education School Building.*

Figure 16. *A collapsed building in the close vicinity of the southern cliff crest of the Gayt Stream valley.*

Figure 17. *Typical first-story collapse.*

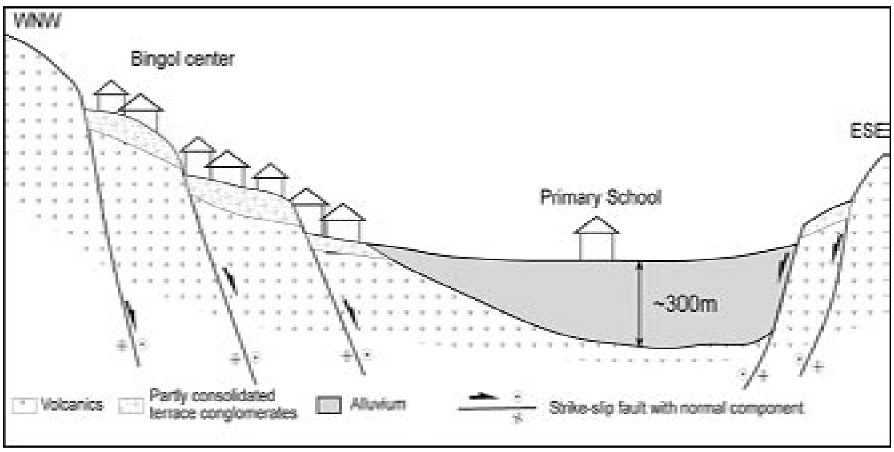

Figure 18 (*not to scale)****.*** *E-W section for Bingől. The school denotes the Çeltiksuyu Regional Primary Education facility that is about 10 km from the town center (source: Dr. N. Kaymakçi).*

the southern cliff, where habitation was relatively dense. While all of the collapses and a great majority of the heavily damaged buildings in the area were enclosed within in this zone, only a few heavily damaged buildings were observed outside. This discrepancy in the distribution of structural damage can be attributed to the topographic amplification effect of the cliff on the free-field ground motion within a short distance of the cliff.

The material observed, reaching depths up to 4-5 m in the trial pits opened near the area's collapsed buildings, is invariably the typical terrace deposit encountered in Bingöl vicinity. The deposit consists of a stiff, dark brown-colored clay matrix containing round and semi-round stone blocks of various sizes.

Water observed at the bottom of some of the pits was possibly due to heavy rains that persisted in the area before and following the earthquake, rather than being an indication of the ground water. No deformations or falls were observed on the vertically cut walls of the trial pits, which is an indication of the material stiffness.

The Çeltiksuyu and Kaleönü Primary School sites are both located at a relatively lower altitude (about 50 m) with respect to the central part of the city and within the valleys formed by the Gayt Stream and Çapakçur River (Figure 18). The similar terrace deposit observed in other parts of the city was also encountered at the trial pits opened at these sites. The depth and relevant engineering properties (such as the shear wave velocity profile) of the deposit that can be related to the amplification characteristics of these sites are not known at present.

However, it is not possible to construct an obvious link between site effects and the collapse cases for the following two reasons: (1) at the Çeltiksuyu facility, a three-story building that housed teachers and a water tower (with a height of about 20 m)

Figure 19. *Substandard detached aggregate material in the debris of the collapsed Çeltiksuyu School building.*

were not damaged at all. Both the building and the water tower were the same reinforced concrete as the collapsed buildings; (2) in all cases of reinforced concrete building collapse, the aggregate observed was stream run, round or semi-round material with a considerable content of oversize blocks (Figure 19). In several instances, these blocks could be pulled out of the damaged reinforced concrete frame elements by hand; a layer of fine soil could be scratched from the surface of the cavity. This made clear the reason for the rather weak bond: the material used as aggregate was not even washed before it was mixed!

After tests of specimens acquired from collapsed and heavily damaged buildings in Bingöl, the Chamber of Civil Engineers of Turkey reported that the concrete quality was rather poor in general, with compressive strength values as low as one-third of those considered in design. The substandard aggregate material must be a major contributing factor in the overall poor quality of concrete, and hence in the collapse of the buildings.

Design is also a potential contributing factor, especially in the case of collapsed similar primary school buildings in Çeltiksuyu and Kaleönü, which were constructed from generic designs.

Detailed information on the distribution of damaged buildings is given in the reports available at the EERI web site.

Emergency Response

Turkey had prepared for an anticipated influx of thousands of Iraqi-Kurdish refugees with the start of the American-led coalition attack to remove Saddam Hussein from Iraqi leadership. The Turkish military and the Red Crescent had worked together in preparation for the expected refugee crises. Fortunately, the massive stockpiles of medical equipment, medicine, surgical kits, trauma equipment, supplies, tents, food, and sanitation equipment were already in place in southeastern Turkey, relatively close to Bingol.

Additionally, the Red Crescent had trained provincial leadership for crisis response. Deputy Governors from the southeast were trained by the Red Crescent in camp organization, management, crisis care, emergency and psychological conditioning, and other areas that were also appropriate for postearthquake emergencies.

Furthermore, since the 1999 northwest Turkey earthquakes, the country's emergency preparedness effort has resulted in over 50 nongovernmental search and rescue organizations now available. At least 45 members from these Turkish NGOs participated, some with imaging and sound detection devices, in the Bingöl search and rescue. Several sources now indicate that there are over 400 members of NGOs working on earthquake preparedness and mitigation projects in Turkey.

Besides the materials and equipment from the Turkish military and the Red Crescent, relief supplies were also sent by the Red Crescent Society of Iran. Supplies valued at $68,123 were flown to Erzurum on May 6 and convoyed to Bingöl. Blankets, rice, vegetable oil, sugar, canned foods, and clothes were included.

The International Red Cross and Red Crescent Societies called for member donations of 2,384,000 Swiss francs (US$1.7 million) to assist the emergency relief operations for Bingöl. The American Red Cross indicated that it would send 14,000 kitchen utensils for the Bingöl victims.

The timely response to the earthquake demonstrated that Turkey has made improvements in its overall ability to respond to disasters. Although there were widely reported and televised skirmishes with police authorities in Bingöl City directed against the governor for alleged slowness and partiality with tent, food, and water distribution, the actual relief figures indicated reasonable response. Prime Minister Tayip Erdogan, who visited Bingöl province soon after the earthquake, attributed the protest and skirmishes to provocateurs. He announced a plan on May 11 to eliminate the discrepancies between western and eastern Turkey by providing tax, social security premiums, and land ownership incentives for poor provinces.

Search and Rescue

In Bingöl, as with most destructive earthquake events, the local residents began immediately searching and attempting to rescue their relatives and neighbors buried under the rubble and debris. The search and rescue teams from the military (Turkish Natural Disaster Rescue Battalion), the Red Crescent (Kizilay), AKUT (an NGO), and others quickly responded for this disaster. Search and rescue teams from Ankara, Van, and Diyarbakir deployed to the site. The Civil Defense Crisis Center at Diyarbakir was used to direct and coordinate initial operations.

These organizations, with few exceptions, were widely and frequently praised for their sensitivity, competency, devotion, and professionalism. The army's search and rescue team was acclaimed for leading the cooperative efforts and delegating responsibilities among the several S&R teams. Psychosocial teams came from Silopi at the Turkish-Iraqi border, from Adana University hospital, and from other locations.

By late afternoon on the first day, 70 students had been rescued at the Celiksuyu Elementary School dormitory building. Most of the survivors were near steel bunk beds or steel lockers, which helped provide space from the crushing concrete floors and walls. Six were rescued during the night of the first day and before dawn on the second day. On the second day, 30 hours after the earthquake, another student was rescued alive. Search and rescue was officially concluded on May 4.

Greece offered S&R assistance, but the Turkish government did not request it due to the limited destruction of the earthquake. Turkey had the trained personnel and resources to competently handle the emergency response for Bingol and did not need foreign S&R team support.

In rural areas, local people using their own resources carried out most of the search and rescue. For example, in Sancak, Çimenli District/Village, six people were trapped under the rubble of a stone building and died. Crisis center staff stated, "that family did not have relatives or close friends in the village, and therefore rescue went to them quite late." This seems to point out that local community networks for search and rescue are very crucial for rural areas to which external aid may not be delivered in time.

Living Conditions following the Earthquake

The municipality of Bingöl announced that 308 housing units collapsed, 2566 were heavily damaged, and 2546 were lightly damaged. By May 20, the Red Crescent (Kizilay) had provided over 13,000 tents (Figures 20 and 21). Fifty people from the organization were in the field. Contributions of over 340,000 hot meals by Kizilay alone, along with 18,000 blankets and various other materials, were made available to the residents (Figure 22).

The Deputy Director of Kizilay, Oktay Ergunay, took a proactive role at the Bingol Crisis Center by making himself available to the crowds and conducting "question and answer" sessions with the survivors. For the first eight days, with the use of a megaphone, this obviously concerned official was there to listen and explain what was being done for the victims.

Housing: In central Bingöl, the Kizilay tents were situated between and adjacent to buildings that were not yet clearly assessed for damage.

Figure 20. *Temporary shelters outside the municipality crisis center.*

Figure 21. *Family size tents for earthquake victims in Bingöl.*

Figure 22. *Hot meals served in Bingol. Note water tanker in background.*

Figure 23. *Military tent city in Bingöl.*

The people referred to these as "fear tents" and used them for sleeping. Women and their children were using their homes for cooking and washing during the day. They said they felt that they could run away if another quake or an aftershock occurred during the day, but if an aftershock or quake occurred during the night, they could not.

This situation does not keep the survivors away from the damaged buildings and poses a threat to their security. It would be very useful to create a consciousness in survivors about the risks of going into buildings that are not yet assessed by the authorities.

The haphazard settlement of tents in areas close to the damaged buildings also poses challenges for the maintenance of healthy environments and could increase the risk of contagious diseases. Furthermore, it creates difficulties for providing material and social support to the survivors, resulting in dissatisfaction. Our interviews with these tent residents indicated that the main reason for their reluctance to leave their neighborhoods was fear of theft and the insecurity of their belongings in their homes.

Therefore, it seems important to implement security measures and to inform the community members of such measures, to persuade them of the safety of their belongings, so they will agree to go to tent cities if necessary (Figure 23).

Schools: Most of the schools in Bingöl were damaged by the earthquake. Over 31,000 students were without available classrooms on May 1. Four schools within the city were totally destroyed, nine others would have to be destroyed, and 11 others sustained light or minimal damage. UNICEF planned to send 100 semi-winterized tents to be used for classrooms. Schools were reopened in temporary accommodations on May 12 (Figure 24). On May 18, classes were observed in these tents in several locations in Bingöl.

Governor Avni Cos announced that all damaged and destroyed schools would be repaired or rebuilt by the start of the new school year in October. The prime minister announced in parliament on May 6 that all public buildings and especially schools would be examined for retrofitting.

Hospitals: Three hospitals in Bingöl were damaged and required evacuation of severely injured patients to hospitals in Elazig, Erzurum, and Diyarbakir. The German Red Cross completed a medical assessment and determined that health needs had been adequately met. There were no outbreaks of disease. Three weeks after the event, only ten of the 520 injured and treated victims remained in critical condition; all others had been released from the hospital.

By May 6, all communication lines and electricity in the region had been restored and were functioning at normal capacity. There was no major damage to the sewer and water systems. Microbiological analysis of the water in the state hospital indicated the water was safe.

Political Currents

The press was quick to assert that this earthquake was similar to most in the past with reference to poor quality construction collapsing and killing people. Many political leaders and academics complained and accused builders, contractors, and the government for disregarding building codes, quality control, and geological considerations. On May 6, President Ahment Sezer, during a television broadcast and in many newspaper reports, urged punishment for those who were

Figure 24. *UNICEF tents for school classes in Bingöl. Classes were in session.*

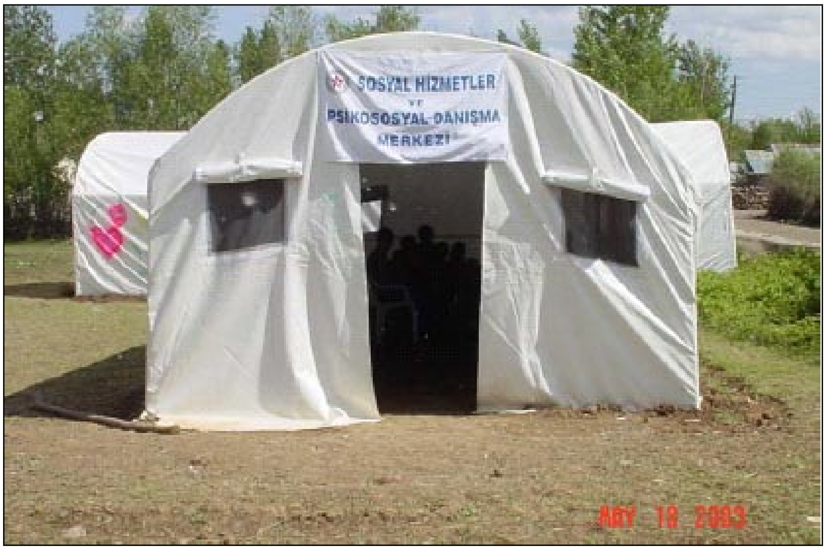

Figure 25. *Social and psychological counseling assistance in temporary facilities for Çeltiksuyu children.*

responsible for constructing the government buildings that collapsed. Prime Minister Tayyip Erdogan was quick to assert that, "…the pain in Bingöl has clearly put on the agenda our infrastructure problem…stealing materials, corruption, illegalities, and injustice [must be corrected]" (*Relief Web*, 4 may 2003, **http://www.reliefweb.int/5/4/03**). Nebil Yengun-er, Turkish Chamber of Engineers and Architects, reportedly stated, "The placement of the buildings is wrong, the construction techniques are wrong, the concrete is extremely weak." (*Washington Post*, May 5, 2003). Several sources indicated that Ali Erbay, public prosecutor for Bingöl Province, has initiated investigations into the collapsed school buildings.

Although earthquake insurance is now required in Turkey, only about 12% of all property owners have actually purchased policies. This subscription rate is much lower in the east and in rural settlements. The government will likely provide free homes for the majority of property owners in Bingöl Province that did not have coverage, in spite of the provision in the insurance scheme that says such people will not be given funds to repair their damaged structures. The future ramifications of this action can only be speculated upon.

The collapse of the boarding schools may also have very serious adverse implications for the future.

Figure 26. *Temporary shelters for the medical staff and patients at the state hospital in Bingöl.*

Parents who have lost faith in the safety of public school buildings may be reluctant to send their children to schools. This may increase the illiteracy rate, which would be, by itself, an additional disaster.

Therefore, a “Campaign to Prevent the Collapse of School Buildings” is crucial to rebuild the trust of parents. The future hopefulness and the happiness of the children of the region depend on campaigns to strengthen existing buildings and build new disaster-resistant buildings and local community networks.

Recommendations

A more detailed picture of the situation will emerge when damage assessment surveys are completed. However, the collapse of the dormitory block at the Çeltiksuyu Boarding School is most disturbing, and steps must be taken immediately to prevent future collapses of such schools.

The routine practice for many of the buildings intended for governmental services (schools, hospitals, health clinics, administrative centers, public libraries, and tax collection offices) is to use template designs that have been developed by the General Directorate of Construction Affairs. The rationale for this is to save on architectural fees and ensure quality control. Hence, there are standard buildings all over the country for ten-classroom schools, or 120-bed hospitals.

If quality of contracting services, workmanship, and material cannot be ensured, as reported in many newspapers, then perhaps a number of targeted minimum design requirements may be imposed by the Construction Directorate so that these buildings will perform better in earthquakes. Surely, it would be worth a minor increase in construction costs to avoid constantly recurring replacement costs and the accompanying social trauma.

Additional recommendations for policy changes and further research are contained in several of the detailed reports available at the EERI web site. See particularly Gülkan et al. and Karanci and Aksit.

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Figure 27. *Mothers’ Day Celebration in Mehmetçik II Tent City.*