Extracts† from

Recconnaissance Report of Geotechnical Observations
for the 4 March 1977 Romanian Earthquake

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GEOTECHNICAL EFFECTS

Bucharest.--Although about 33 multistory buildings collapsed in Bucharest during the earthquake, no foundation failures were involved in any of these collapses. One collapsed building was left in an inclined position after the shock; however investigators from the Building Design Institute found that the failure was entirely within the structure and did not involve the foundation. The Building Design Institute has monitored the settlement history of many buildings in Bucharest on an annual basis by surveying a series of bench marks established on the buildings. A resurvey of these bench marks following the earthquake revealed that no increased settlement had occurred during the earthquake. A boring log showing some details of subsurface conditions at INCERC in Bucharest is given in Figure 3.

Romania outside Bucharest.--No serious foundation or ground failure problems were observed or reported in outlying parts of Romania as a consequence of the earthquake. Several relatively minor effects of liquefaction were observed by myself and other investigators. Some of these effects could

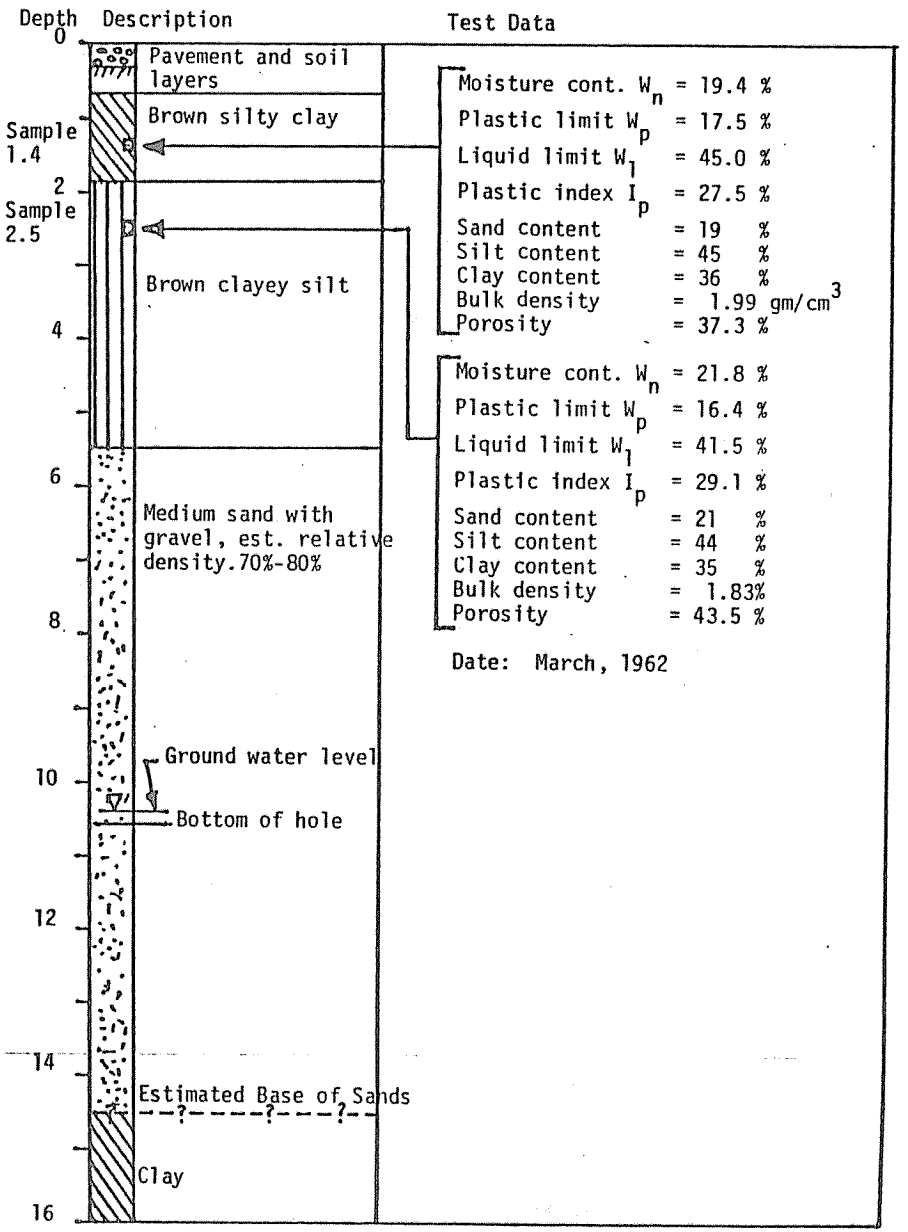


Fig. 3--Boring log from Building Research Institute (INCERC), Bucharest

† These notes on geotechnical effects of the Romania Earthquake have been clipped out of Les Youd's Open-File Report. They compliment the EERI May 1977 NEWSLETTER Report. --DL

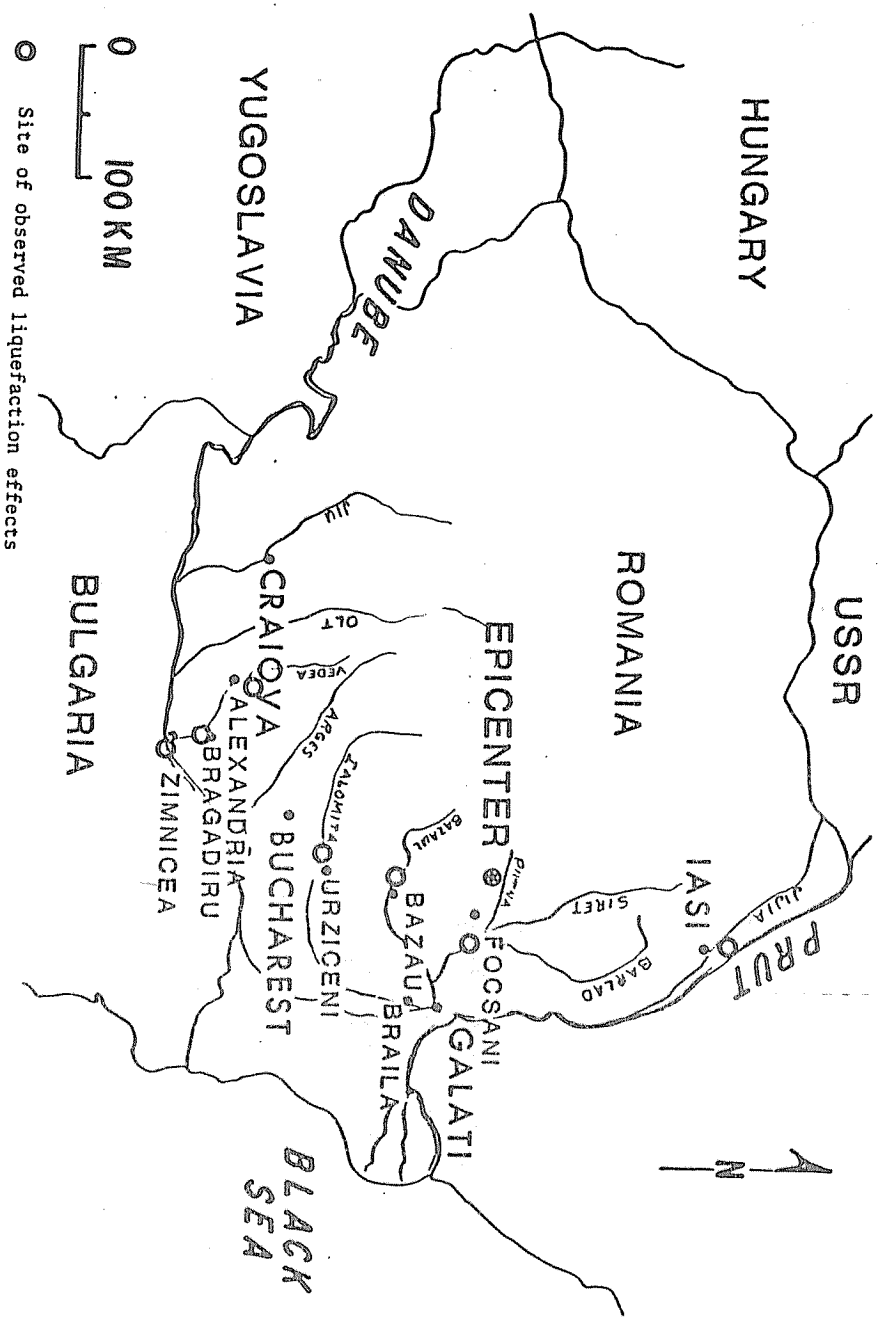
have led to some significant damage, had they occurred in heavily populated areas. The localities at which liquefaction effects were observed are plotted on Fig. 1, and are described in the following paragraphs.

Prof. N. N. Ambraseys (personal comm.) reported that between Zimnicea and the Danube, about 500 m north of a flood dike, water and sand was ejected from a series of long east-west trending ground cracks. At the time of observance, these cracks and sand boils were under several centimeters of water. Reportedly, water was seen gushing out of these cracks shortly after the earthquake and the area was later flooded by ground water. Water level in the Danube, which was in a mild flood stage, was apparently (but not confirmed) at a higher level than the affected ground behind the dike.

Prof. Ambraseys observed a "more substantial case" of liquefaction just south of the village of Bragadiru on the east bank of the River Vedea. Many small sand boils littered the ground over an area of about 10,000 m^2. Slumping of the ground near Bragadiru was also noted.

Lloyd Cluff (personal comm.) and Prof. Bruce Bolt observed the following effects at Bragadiru: Lateral spreading as a consequence of liquefaction produced extensional displacements under some parts of the village causing substantial damage to several houses and some disruptions to highway pavements though not severe enough to impede traffic. Houses in this region, other than those damaged by ground failure movements, suffered very little earthquake damage. A graben 3 m - 5 m wide and about 1 m deep was also observed at the edge of a terrace near the village. Many sand boils were observed near these features indicating that liquefaction was a factor in their generation. Bragadiru is located on a terrace composed of either loess or fine grained fluvial deposits. The terrace is about 3 m - 5 m above the nearby swampy flood plain of the river Vedea.

Fig. 1.--Map of Romania showing cities where major earthquake effects



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effects of liquefaction were found, nor was there evidence of recent shedding of debris by bluffs on

Mr. Cluff also reported that several houses in a village, about 2 km from Bragadiru, suffered settlement of footings accompanied by heaving of intermediate floor slabs. Sand boils were observed at that location as well indicating that liquefaction was a factor in generating these effects.

Prof. Ambraseys (personal comm.) found one set of sand boils in the narrow flood plain of a local rivulet 20.5 km north of Alexandria. These sand boils had been partly obliterated by farmers cultivating the surrounding fields at the time of Prof. Ambraseys visit.

During my field trip from Bucharest to the epicenter and Galati, numerous sand boils and cracks were observed in channel deposits, and locally on the floodplainof the River Ialomita near Urzinceni, and in channel deposits of the River Bazaul near Bazau. Similar effects were also observed in channel deposits of the River Sitet, 28 km southeast of Focsani.

In his field work, Prof. Ambraseys (personal comm.) observed fissures and sand boils in channel and floodplain deposits of a tributary to the River Prut near the U.S.S.R. border at a locality 14 km northeast of Iasi. Local slumping of loess and floodplain ddeposits in company with sand boils were also observed at that location.

It is likely that minor effects of liquefaction would be found in many additional stream deposits and other highly susceptible areas in the zone between Zimnicea and Iasi if a thorough investigation were made.

During my field studies, three additional areas of some significance were searched for liquefaction and ground failure effects with nothing except a few superficial cracks being found.

The first area searched was a 1 km long segment of broad flood plain along the River Putna and adjacent steep bluffs and hillsides. This area was east of Focsani and very near the epicenter. No sand boils or other possib

effects of liquefaction were found, nor was there evidence of recent shedding of debris by bluffs or other steep slopes, nor of any new movements on several recently active landslides in the area. Visible damage to villages in the epicentral area was very minor consisting of a few collapsed chimneys (less than 1% of total) and a few instances of spalled plaster.

The second area searched for liquefaction effects was along the Danube river between Galati and Chiscani, a village about 5 km south of Braila. Three specific sites were investigated; a new section of Galati where the river course runs near a 30-m high loess bluff (that was actively being reshaped for development), a 0.5-km river-front section of Braila and a wide section of the Danube river flood plain at Chiscani. No ground effects of the earthquake were observed or reported at these sites other than one small crack in an asphalt pavement near the river in Braila.

The third area was along the River Ialomita near Slobozia (downstream from Urziceni where abundant effects were observed). A few small cracks in an active sand bar in the channel were seen. Undoubtedly, these cracks were caused by the earthquakes, but there were no sand boils or other effects seen here, nor were there any new debris shed by a 10-m high loess bluff at the edge of the river channel.

In summary, many localities in a rather narrow, 440 km long, northeast trending zone from the Danube, near Zimnicea, to the U.S.S.R. border, near Iasi, experienced earthquake shaking at a threshold level for producing minor liquefaction effects in very susceptible sediments, such as active channel deposits. The shaking level was high enough to produce some ground failures in extremely susceptible sediments at Bragadiru and northeast of Iasi. Less susceptible sediments apparently were not effected.

No significant landslides were generated by this earthquake.