GHAENAT (IRAN) EARTHQUAKE OF NOVEMBER 14, 1979

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SYNOPSIS:

This paper is a concise report of Ghaenat (Iran) Earthquake of November 14, 1979 in which 280 people died and several villages were destroyed. Observations from earthquake effects on the ground as well as buildings are briefly discussed.

INTRODUCTION:

An earthquake of magnitude 6 Richter hit Ghaenat area in the east of Iran at 5:51 local time on November 14, 1979, killing 280 people and destroying several villages.

The earthquake epicenter was at lat. 33.6°N and long. 59.2°E. Most of the casualties were children because adults had left their houses for harvesting saffron when the earthquake took place. If the earthquake had occurred during the night, many more people would have died.

SEISMICITY OF THE GHAENAT AREA:

Several devastating earthquakes have hit the Ghaenat area during past centuries. This area has also seen major earthquakes during the present century. An earthquake of magnitude 6.75 Richter hit Ghaen and Dowlatabad on September 23, 1947 which took the lives of 400 people. Figure 1 shows a clear section of an ancient fault in the Ghaenat area.

EARTHQUAKE EFFECTS ON THE GROUND:

Fault trace on the ground surface was observed along 15 kilometers (Figure 2). Maximum horizontal and vertical displacements on the ground surface were about 1.0 and 0.5 meters, respectively. Figure 3 shows the place of maximum vertical displacement.

EARTHQUAKE EFFECTS ON BUILDINGS:

Almost all of the buildings in the earthquake affected area are adobe brick buildings. These buildings are made from sun-dried clay bricks. Figures 4 and 5 show the typical damage pattern of adobe buildings with domed roofs. Due to the horizontal earthquake vibrations, walls specially at the top tend to move horizontally and separate from the roof, resulting in the collapse of the walls and the roof. Figure 6 shows the interior of a newly built adobe building.

In general, most newly built single-storey building performed relatively better than old and two-storey buildings. Construction of two-storey adobe buildings to resist earthquake forces is not practical. However, it is possible to strengthen single-storey adobe buildings by using buttresses at each corner of the building, tying the adobe walls together by employing angle iron at each corner and steel straps, and by reinforcing the well built adobe walls at their intersections and using a tie beam at the top of the walls.

Figure 7 shows one of the damaged villages built on a hill. Severity of buildings damage decreases from the top to the foot of the hill. It seems that the amplitude of earthquake waves amplifies at the top of the hill due to the reflection of earthquake waves and superposition of reflected waves with original waves. As a result, buildings located at the top of a hill are shaken by a greater force than buildings located on the flat ground.

Figures 8 and 9 show a school building made of brick walls and Jack arch roof with steel beams. There is no tie beam at the top of the walls and most of the openings are located in one of the longitudinal walls. If a continuous tie beam had been built on the top of the walls and walls were connected to the tie beam and concrete foundation by dowels, the collapse of the part of the buildings as seen in the figures could have been prevented.

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Figure 1. – Ancient Fault Trace

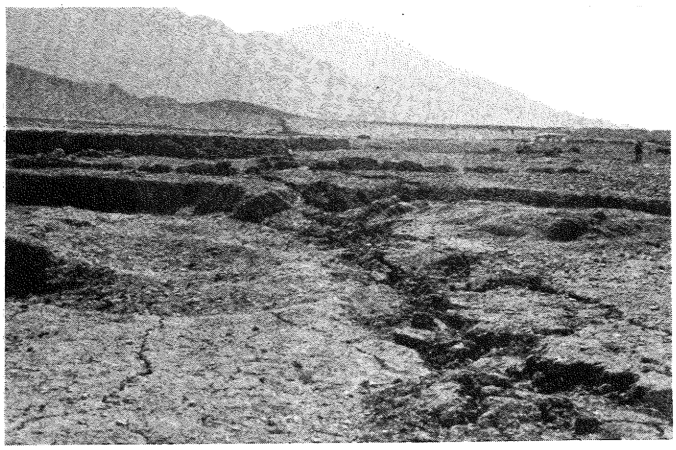

Figure 2. – Fault Trace.

Figure 3. – Maximum Vertical Displacement.

Figure 4. – Damage to domed adobe building.

Figure 5. – Damage to adobe buildings.

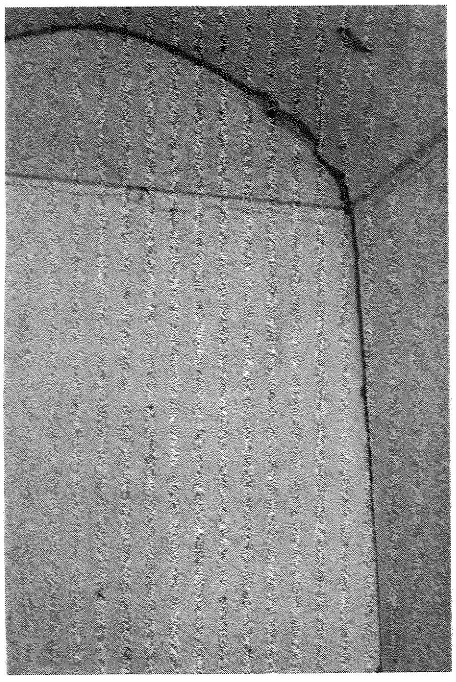

Figure 6. – Damage to newly completed adobe building.

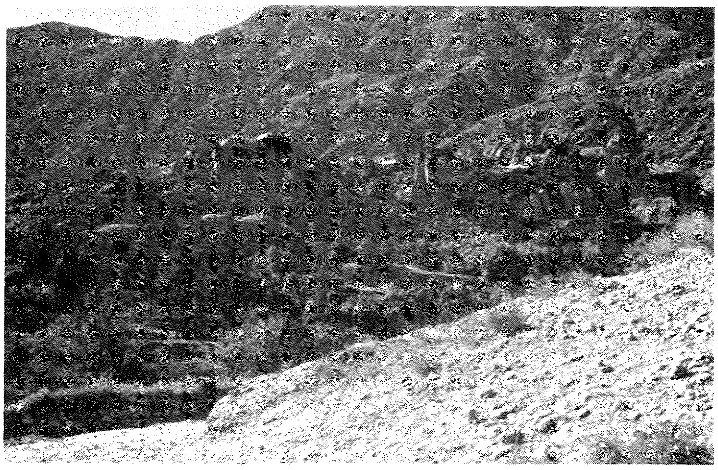

Figure 7. — Damaged village on hill.

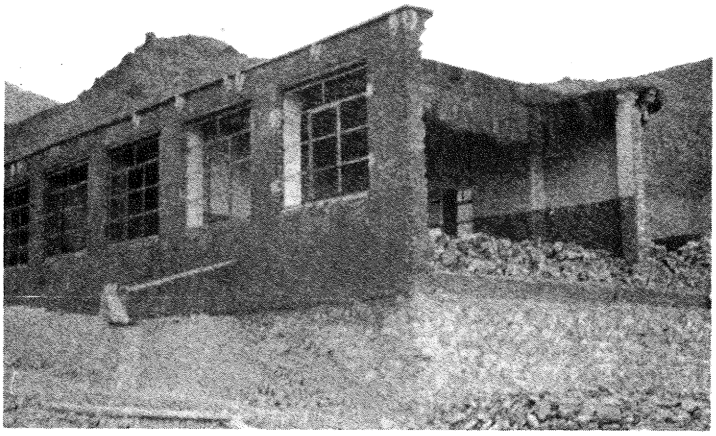

Figure 8. — Damaged brick school.

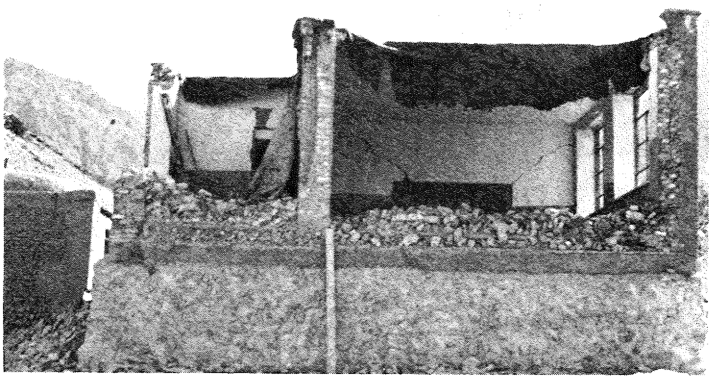

Figure 9. — Damaged brick school.