



**PRELIMINARY RECONNAISSANCE REPORT ON THE 22 NOVEMBER, 1995
GULF OF AQABA EARTHQUAKE
(SAUDI ARABIAN SIDE)**

M.S. Al-Haddad*, M.A. Al-Dail**, A.M. Al-Amri*

* King Saud University, P.O. Box 800, Riyadh, Saudi Arabia 11421

** King Abdulaziz City for Science and Technology,
Riyadh, Saudi Arabia 11442

ABSTRACT

On Nov. 22nd, 1995, a swarm of earthquakes began in the northern portion of the Gulf of Aqaba with a maximum magnitude of $M_D = 5.8$ and focal depth < 10 km causing damage to some buildings and houses. According to official report, the deaths are 2 and the wounded are 29 persons. During the next 40 days of activity, more than 8000 after shocks were recorded. Nearly all of events occurred north of latitude 29° , close to the eastern bank of the Gulf of Aqaba. Information compiled on effects of the earthquake is reported. Observations related to damage and secondary geological effects are exhibited by photos and preliminary assessment of the intensity distribution is made. The intensive damage and total collapse were observed in engineered buildings rather than in non-engineered ones, and that may be attributed to random problems of construction and soil. The most intensive damage occurred in government structures in Ad Durrah customhouse neighboring Jordan. Three wide space reinforced concrete sheds were totally destroyed, a precast slab of wide-span was partially collapsed, and columns of three large warehouses were severely damaged. The important lesson learned from this earthquake is that, effective measures to reduce the seismic vulnerability at the Gulf of Aqaba region must be urgently undertaken.

KEYWORDS

Reconnaissance, Gulf of Aqaba; Modified Mercalli Intensity, Satellite, Precast Concrete, Bearing Walls; Foundation, Soil; Acceleration

INTRODUCTION

The November 22, 1995, Gulf of Aqaba earthquake ($M_D = 5.8$) was the latest in the long historical evidences of several significant earthquakes occurred in the area in the past (i.e. 1068, 1588, 1927). This earthquake was scientifically of particular interest because it was the first known earthquake related to surface ruptures along the Southern Dead Sea transform. In addition, it followed by a long series of after shocks recorded more than 8000 events ($1.5 \leq M_D \leq 5.8$). This moderate-size earthquake was a tragic demonstration of the warning that has been revealed by several studies conducted on the seismic hazard in the region. Probabilistic seismic hazard estimates for Gulf of Aqaba region have been reported by several studies conducted in Saudi Arabia (Al-Haddad et al. 1990, 1992, 1994, Thenhaus et al. 1986).

The region is classified as the most seismic active area in Saudi Arabia. Peak ground acceleration (PGA) predicted for 10% probability of being exceeded in 50 and 100 years are about 0.20 g and 0.30 g, respectively. A live demonstration of the earthquake potential in the region was also revealed by the relatively recent swarms of earthquakes in 1984 ($M_L = 4.8$), and 1993 ($M_D = 5.5$) which have been felt by the residents of the region. However, the 1995 earthquake was an unique experience for them. This earthquake is the only damaging one has ever occurred in the last few centuries in Saudi Arabia.

Field investigation conducted immediately following damaging earthquakes offers an opportunity to recommend measures that can be taken to reduce risk in future earthquakes. On the same day of the earthquake, King Abdulaziz City for Science and Technology (KACST), being the authorized agency on this matter, sent two teams to the epicentral area; one, was for reconnaissance surveying and the other for monitoring aftershocks.

This paper presents only, observations made on secondary geological and geotechnical effects of the earthquake, and observations related to damage.

INTENSITY DISTRIBUTION IN THE INVESTIGATION AREA

The reconnaissance team started the investigation in Tabuk, the main city in the northernwest region of Saudi Arabia (Tabuk province). Tabuk city is located about 240 km. from the epicenter of the earthquake and has a population of 292,000. The earthquake made people in Tabuk woke up and run from their beds, but no damage at all occurred in the city.

The damage caused by the earthquake is localized in the sparsely and lightly populated coastal part of Tabuk province. Specifically, the affected areas (within 90 km from the epicenter) have population of 30,000 to 35,000. According to official report, the deaths are 2 and the wounded are 29 persons.

Figure 1 is a preliminary map of the Modified Mercalli Intensity (MMI) distribution of the earthquake. Areas of inspection are along the eastern coast of the Gulf of Aqaba as far south as Saudi-Jordanian borders, east, along Tabuk-Haql road, as far as Tabuk. The smoothed contours of the isoseismal map represent the highest predominant levels of (MMI) based on building damage and the secondary geological affects.

MMI (VII) effects were widespread in the coastal area of Tabuk province to approximately 90 km from the epicenter. The principal bases of this estimate were the widespread of rockfalls in the area fall of unbraced brick parapets, and severely cracking in infill walls of few reinforced concrete in newer three- and two-story reinforced concrete buildings. The considerable damage in columns of a main bridge, approximately 60 km east of the epicenter, also qualify for a site-specific MMI assessment of VII. Complete collapse of three reinforced concrete-framed sheds in Ad Durrah-customhouse, about 87 km from the epicenter, would qualify for a site-specific MMI of IX. This case was not considered in assessment of the intensity because it was considered an isolated case of collapse of a structure with engineering deficiencies.

Maximum MMI VIII effects were observed at the epicentral area (30 km from the epicenter). The bases of this assessment were, the widespread structural cracks in reinforced concrete-bearing walls of two-story dwellings, heavy rockfalls, and ground fractures, with up to 40 centimeter of opening.

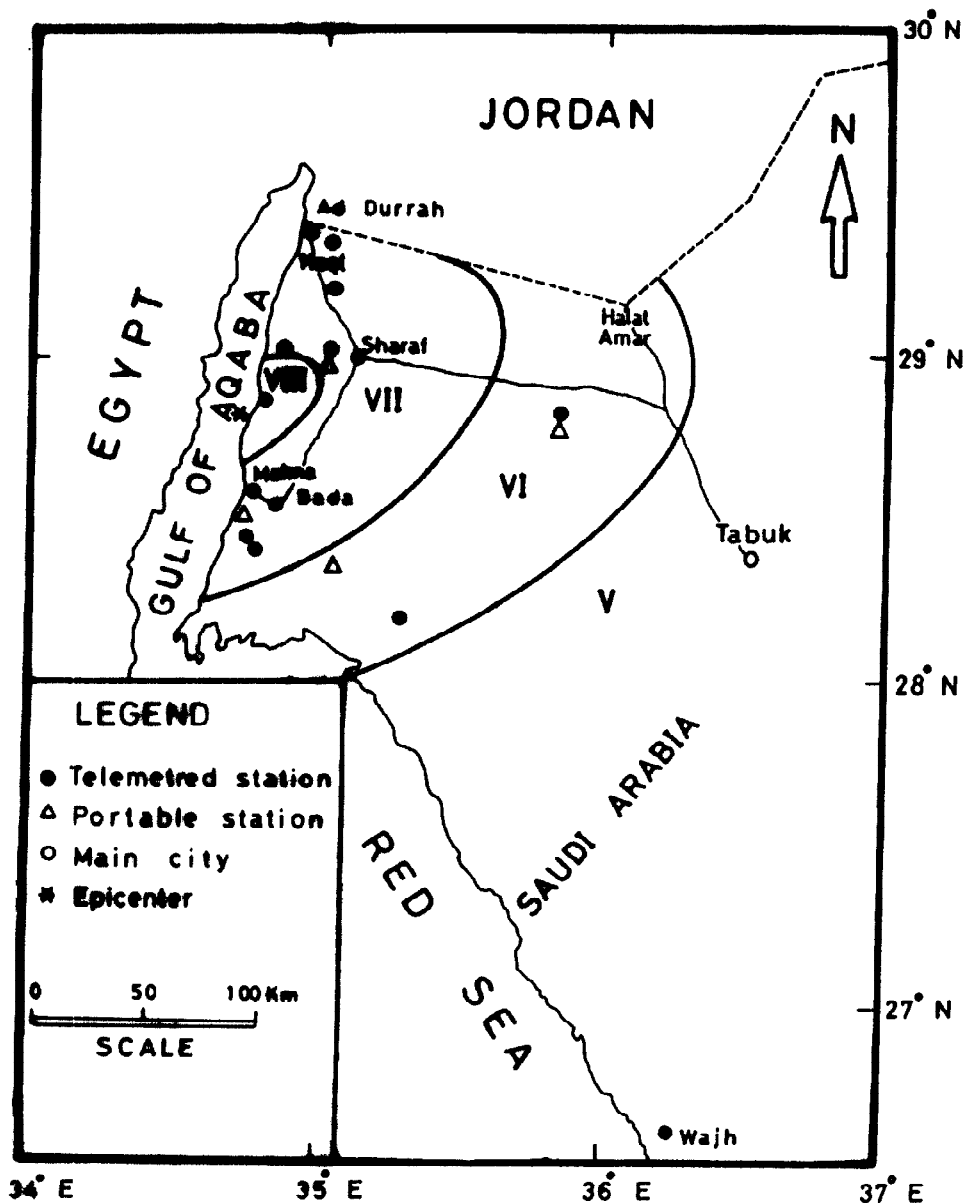


Fig. 1. Preliminary intensity distribution of the Nov. 22, 1995 Gulf of Aqaba Earthquake

GEOLOGICAL EFFECTS OF THE EARTHQUAKE

Geologic effects of the earthquake included widespread of rockfalls and ground fractures. This could be a source of great danger to the traffic on the local roads. Actually, one of the local main roads was blocked for a while by the fallen rocks. Also the concrete fence of a coast guard center was damaged by a big fallen rock in its way into the yard of the center. Fractures in wet ground surface were observed in different sparsely places in areas of inspection. The predominant fractures showed at most only few centimeters of opening. Few wider fractures of up to 40 cm opening were observed 30 km, east and NE from the epicenter. Figures 2 and 3 show examples of observations on geological effects.

