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Some Aspects on the Faiyum-Egypt Earthquake of October 12, 1992

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SYNOPSIS: A moderate size earthquake shooked the southern west part of Cairo by 35km at 15:15 P.M. local time on October 12, 1992 causing wide spread devastation leading to loss of many lives and structure damages along the surrounding big cities. The paper describes the behavior of two identical residential buildings constructed on two different site soil conditions. The lesson learnt from the performance differences are highlighted, and some geotechnical and structural aspectes are recorded.

INTRODUCTION

In afternoon on October 12,1992 a moderate earthquake of about Ms5.9 occurred in Faiyum area, Egypt with the epicenter about 35km southwest of cairo as seen in Fig.1, and few kilometers north of Faiyum city in Dahshour town on the western bank of Nile Valley. The focal depth of the hypocenter is estimated to have been about 30 km depth with 56° north of Faiyum city as oriented in Fig.2. In the epiepicentral track the earthquake was accumpanied by rumbling noise and felt for about 10 second duration. The main shock was followed by number of after shocks. The tremer was felt over a wide area and caused a destructive damage for several thousands of buildings, islamic and coptic antiquities. This paper presents a brief account of damages in two identical buildings of reinforced concrete skelton. The reasons from both geotechnical and structural point of view are mentioned and lesson learnt is also discussed.

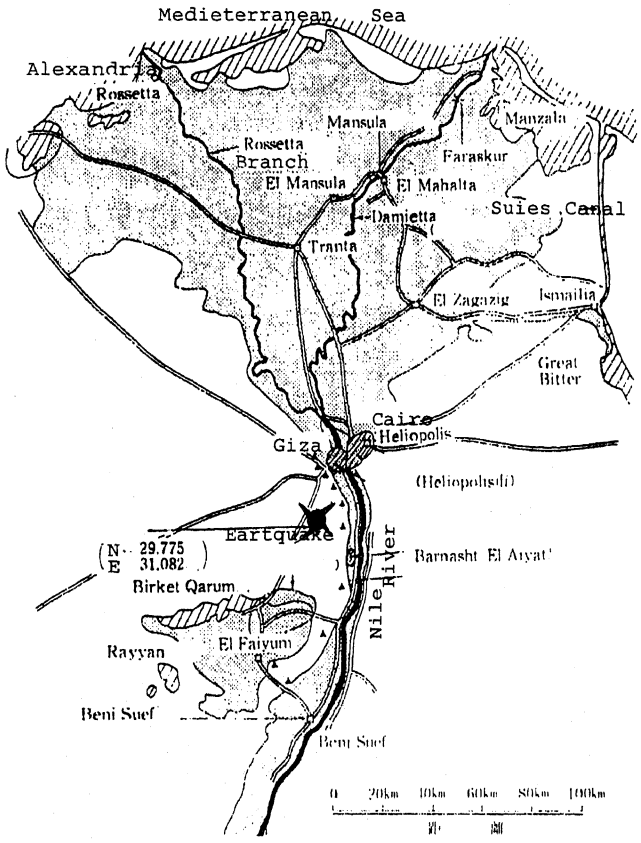


Fig. 1 Map of Egypt and Earthquake Location

BACKGROUND SEISMICITY OF EGYPT

Egypt is located around the sesismic zones of Red-Sea and Medieterranean-Sea belts,and since 2800 B.C. the country from time to

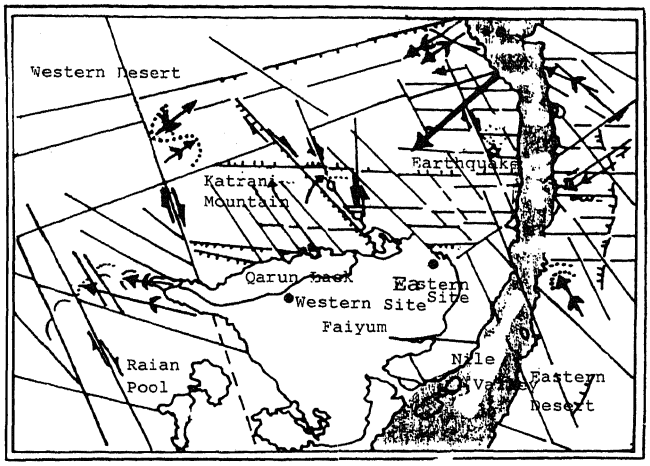


Fig. 2 Faiyum Area and Observed Sites Location

time has been stricken by an earthquake of small to moderate intensity. Table 1 summarizes the historical earthquakes of the region with the estimated magnitude. From Table 1 it can be noted that the intensity ranges are between 5Ms and 6Ms, and the intensive one of 6.3Ms occurred in 1969. The Cairo area and its surroundings have not experinced any destructive earthquake such as the recent one in October 12,1992 since October, 1920 of 4.6Ms and August 12,1847. This means that the Cairo region experienced the same earthquake every 72 year .

Table 1 List of Earthquakes That Occurred in Egypt from 2800 B.C. to 1992

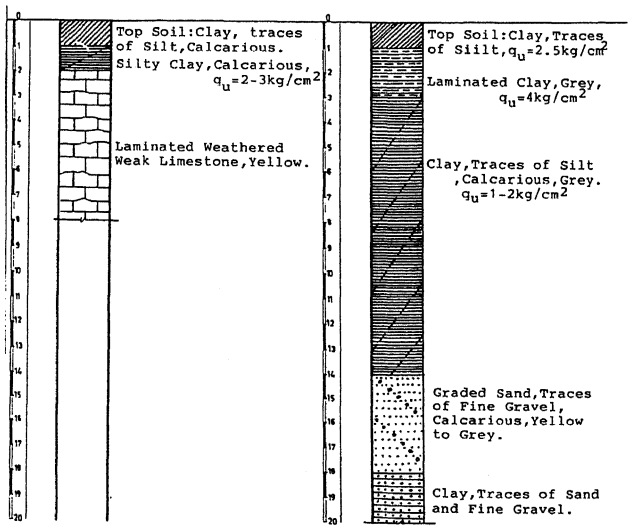
Date	Ms.	Date	Ms
B.C. 2800	---	----------,1375	5.0
B.C. 1210	6.0	January 3,1588	5.0
B.C. 1200	4.9	April 19,1588*	5.2
B.C. 600	5.2	February22,1687	5.5
B.C. 221	5.2	October 2,1698	5.2
B.C. 27	5.5	September,1754	5.5
A.C. 320	5.5	August 17,1847*	5.8
March 16, 796	6.0	July 11,1879	5.0
March --, 875	5.5	October--,1920*	4.6
----- --, 859	5.0	September,1955	6.1
----- --, 912	5.0	November ,1955	5.5
July 26, 950*	5.2	September,1969	6.3
September , 951	5.8	April 29,1974	4.9
January 1, 956	5.5	December9,1978	5.3
January 15,1211*	5.0	November ,1981	5.5
------ --,1262	5.8	-------- ,1983	4.9
------ --,1375	5.0	-------- ,1984	5.1
		October12,1992*	5.9

(*) Cairo area and surroundings

SOIL CONDITIONS AND GEOLOGICAL BACKGROUND

The locations under investigation in the present paper lie inside the Faiyum lands. The first lies in the western of faiyum, and the second lies in the eastern side as marked on Fig.2. The summary of the exploration holes is illustrated with Fig.3. It can seen that the soil in the western site side consists of alluvial deposits of clayey layers followed by sandy layers.The eastern site side is a hilly area and the profile consists of diluvial layers of weak limestones.

From the geological background, the Faiyum depression as shown in Fig.4 formed in both pliocene and pleistocene ages, and it is closed a triangular basin bounded by three faults on both western and eastern sides and along Qarun Lake. The recent alluvial fain covered the depression when the Nile cut through the depression in the pleistocene age. The Basalt formation appear in a broad sector, and it related to the volcanic activity occurred in Egypt between the eocene and oligocene epochs. (Izz, 1971)



(a) Eastern Site (b) Western Site

Fig. 3 Summary of Exploration Holes

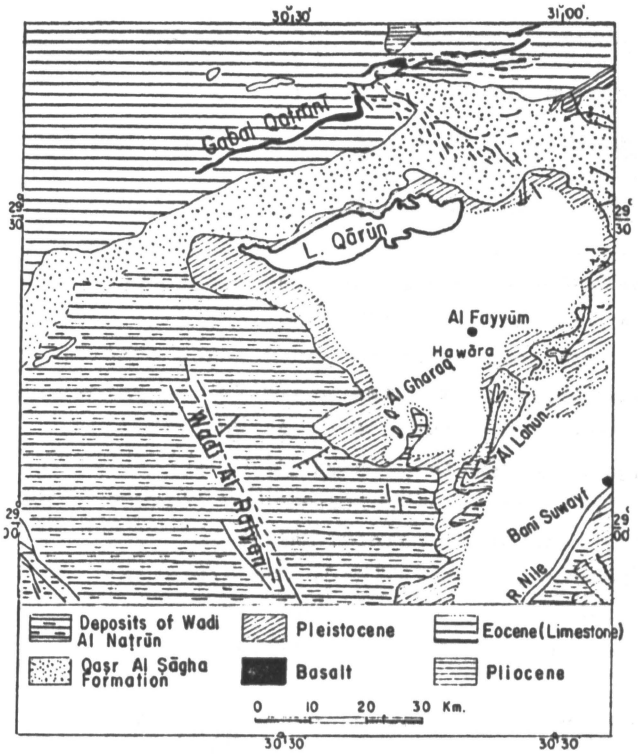


Fig. 4 Geological Map of Faiyum Depression (Unshaded areas consist of Recent alluvial deposits)

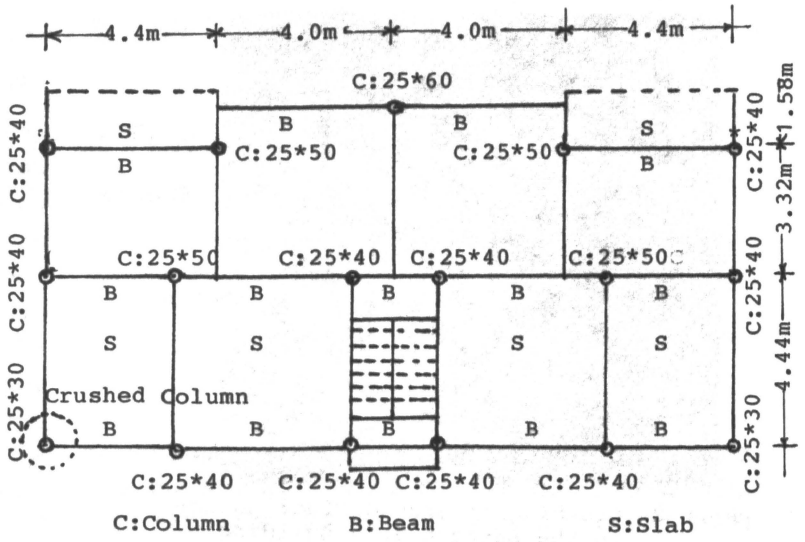


Fig. 5 Sructural System and Columns Configuration.

Photo 1 General View of Building

DAMAGE DESCRIPTION

The investigated two buildings for the present study are of reinforced concrete skelton type, and consist of 5 stories. The structure system is a compination of slabs, beams and columns rested by a system of shallow foundation of solated footings. Photo 1 shows a general view for the building from outside. Fig.5 shows the configuration of columns and dimensions, each building of about 16.8m in length and 9.3m in width. Besides, it is worthy to say that the two structures have same structure system and constructed by same contractor and at the same time of construction.

From the inspection of structure elements, in the two sites it is markedly observed that the structural elements of eastern firm soil site are relatively affected by the eartquake than the western soft soil site on Qarun lake. The observed damages are described in the following,

1. The reinforced concrete columns of firm soil site developed crushing cracks in the ground floor in compare with that of soft soil site. Photo 2 and 3
2. There were horizontal and diagonal cracks are clearly observed on the internal and external walls of firm soil site as shown by photo 4.
3. The common type of failure in the element of soft soil site is light cracking between walls and concrete elements.

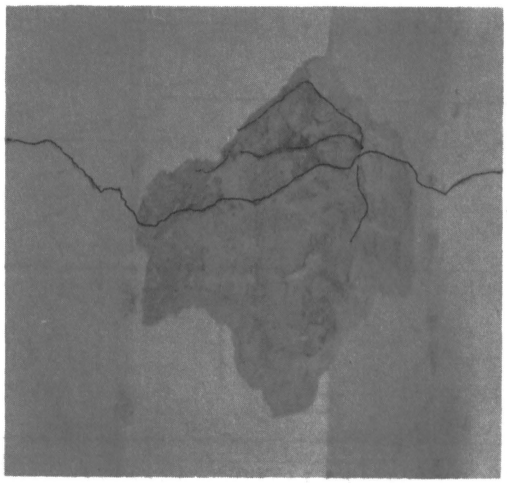


Photo 2 Crushing of Ground Floor Column in the Eastern Site Building

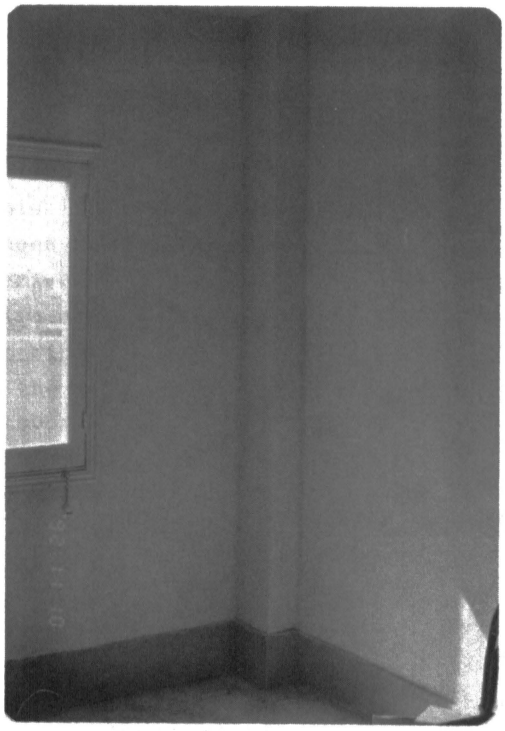


Photo 3 Same Column of Photo 2 in the Western Site Building

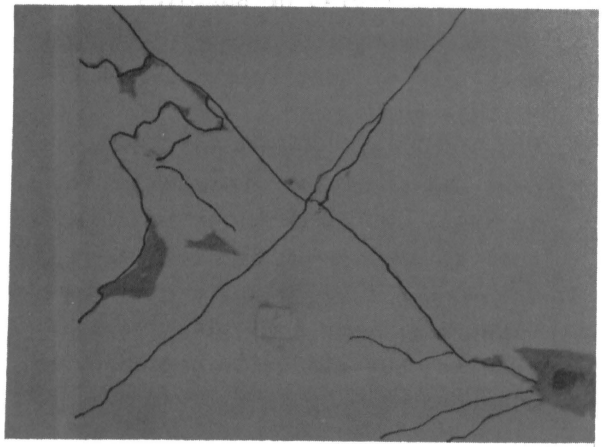


Photo 4 Horizontal and Diagonal Cracks on an External Wall.

INTERPRETAION AND LESSON LEARNT

From the behavior of these two buildings, it can say that the structure at western soft soil site on Qarun lake recieved relatively less severe ground motion because of its greater distance from the shock epicenter as compared to the eastern firm soil site. In addation, the firm deposit of weak limestone enhanced the damages observed for the eastern site comparing with the relative soft deposit of clayey layer at western site.

Although no measures were taken to incorporate the quality of concrete and lack of continuity of steel reinforcement in beams and inadaquate stirups spac, the aforementioned factors are play a significant role as a reasons for structural damages.

The most important lesson learnt from the study of these two cases is that the behavior of structures of same design at different sites in the same earthquake is attributed to differences of shock intensity, local founded soil condition and quality of construction.

Also, connections between elements are need to be developed and incorporated in practice.

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