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INVESTIGATION AND COMPARISON OF THE DESTRUCTION OF BRICK AND CONCRETE STRUCTURES USING THE BLAST

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As there are buildings in Iran, and especially in its large cities, that are nearing the end of their useful lifespans; in some cases, the only way to demolish them is through the use of explosives. In the near future, building demolitions by using explosions will be one of the needs of the country. Therefore, in the present study, we investigate the process of demolition of brick and concrete structures using explosives. During an explosion, the shock waves that are propagated can cause severe damage to buildings and harm the living creatures around these structures. The load of the explosion, due to its very short time span, has a shocking and traumatic nature and is very different from other sideway loads such as earthquakes. In each explosion, part of the released energy of matter is consumed to create vibrations in the ground. The shaking of the ground can damage adjacent buildings, shed plasterworks, break glass, etc. In many cases, ground vibrations have more of a detrimental psychological impact on individuals rather than actual destructive effects, especially in residential areas under question.

The amount of ground vibrations and its impact on adjacent buildings is subject to several factors including the geological status of the area. Land quality of the area has a significant impact on the transmission of waves and energy resulting from the explosion. In order to determine how vibration waves are transmitted in the ground, multiple small test explosions using small amounts of explosives must be carried out in the area before the actual costly explosive mission is carried out and the amount of vibration in the ground must be measured. The relation between the vibration speed in the ground with the explosion parameters is as follows:

$$V = \frac{KQ^a}{D^b} \tag{1}$$

In this equation, V is the ground vibration speed measured in millimeters per second, K, a and b are fixed coefficients that are functions of the geological status of the site and are obtained through multiple test explosions. Q is the amount of explosives used in kilograms and D is the distance from the explosion to the geophone is in meters, given the fact that existing structures are typically designed based on gravity loads and conventional vibration loads, the performance of these structures must be assessed under the loads caused by the explosion.

Due to the very complex process of an explosion, it is not easily possible to predict the severity of the effects of the explosion, but plenty of laboratory data and results obtained from the explosion of a kilogram of TNT is available and may be used as the basis for the calculations regarding larger amounts of TNT. Thus, these results can be used to assess the results of an imaginary explosion by normalizing and comparing its explosive strength with the detonation of one kilogram of TNT. The time length of loading is extremely short during an explosion. As can be seen in Figure 1, in the space of a few thousandth of a second, the atmospheric pressure reaches a maximum amount of (p_{so}^{+}) from (p o) and then back to the usual. Then, in the space of a few tenth of a second, the (p_{so}^{-}) is created. The maximum (p_{so}^{+}) resulting from the explosion reduces significantly as we move away from the center of the explosion and on the contrary, the loading phase (the time in which the force resulting from the explosion affects the structure) increases as we move away from the center of the explosion.

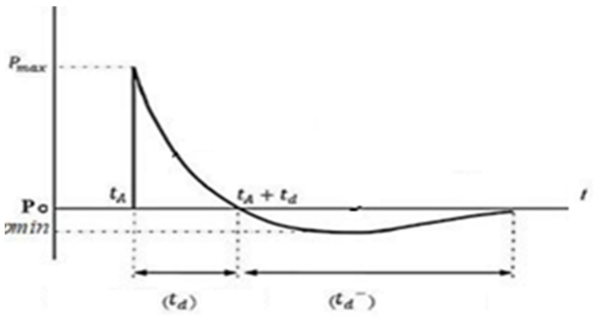

Figure 1. Schematic of the time history of the pressure caused by the explosion.

In this paper, we will conclude that the use of explosives for the demolition of all types of structures such as brick and concrete structures is an economically efficient and safe technique. According to the findings of the article, we can briefly mention some of the advantages of utilizing explosives (the high speed of the operation, safety in locations that have traffic problems, a high potential in controlling the operation, only creating dust for a short period of time) compared to other traditional techniques. Also, the behavior of a concrete structure that is under the force of explosion will be assessed. To do this, and in order to simulate the explosion, the 3D model of the concrete structure is made in the Ansys Workbench software and then, to simulate the explosion we enter the Autodyn software. General results such as temperature counters, damage and displacement are obtained from the model. Overall, we can summarize the results of this simulation thus: at the instant that the explosion wave reaches the structure, the first points in the structure that are damaged are the connecting points of beams to columns and the connecting points of the columns to the ground as a result of their firmness and inflexibility. Also, the columns that were across from the point of explosion had more damage imposed on them than other columns. As the explosion wave moves within the structure, a return force in displacement is created in the structure and this displacement occurs more often in columns that are further away from the location of the explosion. The most destruction in the structure refers to beams especially the ones that were located in the middle of the span.

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