



AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
STRUCTURAL ENGINEERING DEPARTMENT

A Proposed Design for Mobile Explosive Chamber for Small Charges

Thesis

Submitted in Partial Fulfillment of the
Requirements for the Degree of

MASTER OF SCIENCE
in
CIVIL ENGINEERING (STRUCTURES)

by

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STATEMENT

This thesis is submitted to Ain Shams University in partial fulfilment of the requirements for the degree of Master of Science in Civil Engineering (Structural).

The work included was carried out by the author.

No part of this thesis has been submitted for a degree or a qualification at any other university or institution.

Date: / /2017

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This Thesis is dedicated to the soul of my dear father

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ABSTRACT

A Proposed Design for Mobile Explosive Chamber for Small Charges

Recently, blast loads have received more attention as major of terrorist attacks use explosive devices to attack people and buildings around the world. The Police officers at the Bomb Squad department are mainly responsible for ensuring public safety. The hard work circumstances results in large number of injuries and fatalities. The increase in the number of injuries and fatalities drives the need of Mobile Explosive Chamber (MEC). The main purpose of MECs is to provide a total containment against explosion effects after specialists investigate any suspected item. The MEC protects the person who is responsible for bomb disposal, as well as it ensures safe detonation of the surrounding area. Accordingly, a study of the behavior and response of MEC is needed.

This thesis presents numerical analysis and design of a half-spherical MEC subjected to internal blast loads, using ANSYS AUTODYN commercial software. Different parameters such as chamber thickness and mass of explosive charge were studied in order to determine blast confinement capability against blast pressure result from the detonation.

A previous work using a steel cylindrical blast chamber was carried out by **(Snyman, Mostert et al. 2016)**. **(Snyman, Mostert et al. 2016)** models were conducted to present the verification of the numerical analysis results obtained from AUTODYN. The obtained results were compared to the theoretical as well as the experimental results with reasonable accuracy. Also, the predicted values for the quasi-static pressures from AUTODYN agree with empirical and experimental relationships as given in the literature.

The 1st stage of this research focuses on studying the effect of the chamber wall thickness on the dynamic response of the MEC. Different chamber wall thicknesses (10mm, 20mm, 30mm) were tested using two various explosive charges mass of (2kg TNT, 5kg TNT). Fully restrained boundary condition was applied to the MEC to study the effect of the chamber wall thickness regardless of any other parameter. The results of this stage show that the MEC thickness has an influence effect on maximum displacement and maximum strain of MEC. Increasing the MEC thickness decreases the maximum displacement by a percentage that raises between 13% to 72%. In some cases increasing the thickness prevents the MEC from failure. Also, the MEC has a significant contribution in decreasing the incident pressure values in case of the chamber failure. The attenuation of the pressure is represented after the chamber failure in this study. It was found that the MEC existence delays the arrival time of the shock wave by 64% to 73% and decays the peak incident pressure by 39% to 56%.

The 2nd and 3rd stages of this research study the effect of attaching a ring to the MEC and restrain the points at bolts locations. Various parameters such as ring thickness, number of restrained points and the mass of explosive charge were studied to obtain the influence of changing the boundary conditions on the MEC response. In the 2nd stage, the number of restrained points was 12 points while in the 3rd stage it was 24 points. For both stages various ring thicknesses and explosive charge masses were applied. The results presented in those stages show that, ring thickness and number of restrained points have a significant influence on the maximum displacement of the chamber as well as the ring.

Keywords: Internal blast Loading, Charge weight, AUTODYN, Deformation, Explosive chamber, Detonation chamber.

