AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING

OPTIMUM CONTROL OF DEMOLITION IN STRUCTURES

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STATEMENT

This dissertation is submitted to the department of Structural Engineering, Faculty of Engineering, Ain Shams University , For **the degree of Doctor of Philosophy in Structural Engineering.**

The work included in this thesis, was carried out by the author in the department of Structural Engineering, Faculty of Engineering, Ain Shams University , from 2005 to 2013.

No part of this thesis has been submitted to any other university or institute for the award of a degree of qualification.

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ABSTRACT

The present thesis deals with the control of structural demolition by implosion. The work done includes an extensive survey for realistic and efficient simulation of structure demolition by means of controlled explosives, damage to surface structures due to blast vibration, standards related to maximum vibration levels for preventing damage of structures and some important building demolition cases by blast around the world. The concept of blasting strategies in the field of demolition of buildings by blast is described in details through illustrative figures. This includes pre-blast considerations, detonators and dynamite, blasting hole for demolition, and safety procedures. Other main types of building demolition such as progressive demolition; deliberate collapse mechanisms and deconstruction are also described. Aspects of progressive collapse and demolition of structure by implosion are described.

The basic important algorithms for finite element modeling in LS-DYNA program which can be used for structural demolition by implosion are described. This includes constitutive material models for concrete, reinforcing steel as well as high energy explosive and its equations of state. Special aspects for modeling i.e. erosion, hourglass and contact segments are illustrated in brief.

The validity of using commercial program SAP2000 for building local collapse analysis "progressive collapse" has been investigated and the results were compared with the corresponding results from LS-DYNA program.

With respect to demolition through use of explosives "implosion", a fully three-dimensional numerical model is proposed for RC columns to idealize arbitrarily set multiple blast holes with different geometrical and loading conditions**.** Validation of the proposed model has been illustrated by comparing its numerical results with the available experiment work performed in the field**.** Further, numerical study for damage patterns of RC columns under demolition blasting has been carried out and compared with the experimental work in literature. The influence of different parameters on the blasting damage pattern of RC columns has been investigated (i. e. steel rebar arrangement, existing loading condition, explosive factors, and concrete strength). In addition, the estimated quantities of charges as well as arrangement and spacing between holes that required to blast reinforced concrete columns have been investigated. The results are summarized and discussed through plotted figures for wave and fracture propagations as well as damage patterns.

A new proposed model considering both blasting stage as well as demolition stage together have been used for applications to different structures. This model together with the three-dimensional numerical model for R.C. columns represent an important scientific addition in the field of Optimum control of demolition in structural buildings. The applications were carried out on different buildings such as: a five story reinforced concrete building, tall chimney and an elevated tank. The results these applications have been discussed.

Summary, conclusions and important recommendations for future extension of the research work done within the thesis are presented.

Keywords: Control; Demolition; Blast; LS-DYNA

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