A CASE STUDY OF THE STRUCTURAL RESPONSES OF A TALL BUILDING IN SINGAPORE SUBMITTED TO CLOSE-IN DETONATIONS

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SUMMARY

The response of tall buildings has been a major concern in metropolitan cities, especially with the recent surge in extreme activities targeted at structures with viable commercial values. This paper discusses a study carried out on the structural behaviour of a 2D frame, modelled to represent a tall building with ABAQUS. The model frame was subjected to a charge of the equivalent weight of 1 ton of TNT but placed at two varying cases of 5 and 10-m standoff distances. Plane-strain elements that incorporate the feature of material nonlinearity were utilized to model the structural components of the building and the simulated blast overpressures were obtained from the CONWEP software. The effects of large deformations of beams and columns corresponding to the short time loading duration depicted by the explosions were analysed from a local perspective. The extent of the damage is based on a local index defined as the ratio of curvatures. These local indices are consequently used to determine the possibility of disproportionate collapse of the frame from a global perspective. Finally, the provision of more ductile structural detailing is recommended to enhance the structural integrity of the building, increasing its resilience against blast attacks. Copyright © 2009 John Wiley & Sons, Ltd.

1. INTRODUCTION

Over the past 20 years, accidental or deliberate explosive incidents have revealed the vulnerability of civilian structures to the extreme dynamic loading caused by detonations from short standoff distances (Corley et al., 1998). These types of incidents are characterized by its great intensity and short duration. The collapse of the World Trade Center in New York City has brought the focus of many structural engineers to develop an understanding of the behaviour and resistance of structures when subjected to blast loadings. This unfortunate event has brought about an urgent need for an increased awareness in the behaviour of public buildings, especially commercial high-rise buildings, when placed within a blast environment. In this study, two case scenarios were created to understand the dynamic behaviour of a 30-storey reinforced concrete structure located in Singapore. The two cases involved a similar frame structure modelled to represent an actual 30-storey building and was subjected to a charge of the equivalent weight of 1 ton of TNT but placed at two case scenarios of 5 and 10-m standoff distances. The study was carried out to determine the damage levels sustained by the structure as well as the post-blast behaviour of the damaged building under gravity loading. A conclusion of the vulnerability of this typical building when subjected to such blast incidents is provided based on the findings from the abovementioned analysis.

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