

Evaluation of Building Height Effects on Progressive Collapse of Steel Structures

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ABSTRACT

In the field of passive defence and structural sight of that, one of the most important issues is the progressive collapse of structures that is a catastrophic structural failure mechanism, triggering by an abnormal event such as explosion that makes local damage of a key member in the structure. After that, other failures which are not directly affected by initial abnormal event, occur in the structure; eventually result in the collapse of the whole structure or to an extent disproportionate to the original failure. In this paper, the intermediate steel moment frames structures with different levels of height are studied. For evaluating the potential of progressive collapse, the alternate path method in accordance with both GSA and UFC guidelines is used in two different methods; linear static analysis and nonlinear static analysis. The results of analysis show that, generally, the potential of progressive collapse decreases with increasing the height of the structure and in the low height steel structures, there is not enough redundancy to redistribute loads of the failed elements. It is observed that the effects of the lateral loads in UFC guideline increase with increasing height of the structures and the results of linear and nonlinear analysis in the UFC guideline are closer than in the GSA guideline.

Key Words: progressive collapse, alternate path method, building height, passive defence.

1 INTRODUCTION

Passive defence can be attributed to the measures taken to defend against military, security and terrorist attacks or hostile actions without usage of weapons, so that the probability and the intensity of the damages can be reduced in a specified area, position or structure. One of the most important structural issues that are introduced in passive defence is progressive collapse. There are different definitions and interpretations for progressive collapse in civil engineering literatures and guidelines. Accordance with the American Society of Civil Engineering (ASCE) standard 7-05, "progressive collapse is defined as the spread of an initial local failure from element to element, eventually resulting in the collapse of an entire structure or a disproportionately large part of it"[1]. Progressive collapse can resulted from human-made hazards such as military or security threats and accidental causes. Natural causes such as earthquake can also lead to occurrence of progressive collapse in structures. After the collapse of the Ronan Point apartment towers, in Newham, England in 1968, this phenomenon has been increasingly discussed in the structural engineering community [2]. The Alfred P. Murrah building in Oklahoma City in 1995, is one of the other famous examples of occurrence of progressive collapse, wherein a bomb blast destroyed three perimeter columns and