Robustness for Large Steel-Concrete Composite Structures

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Summary

The paper reports briefly on investigations for large steel-concrete composite structures such as multi-story buildings where the danger of a progressive collapse is prevented by alternate load path methods. Structural redundancy is considered depending on the floor system and on frame action. Focus is given to the influence of joints and the importance of their ductile behaviour for the structural robustness. Report is given also on a new European project developing an advanced design concept for steel-concrete composite structures under defined impact scenarios.

Keywords: robustness, alternate load paths, redundancy, joint ductility, over-strength effects

1. Introduction

In view of recent disasters and their immense economical and human consequences more and more focus is given not only on the safety of structures - to reduce the risk for the life of people by collapse even under exceptional loading – but on minimizing the disastrous results and to enable a quick rebuilding and reuse. One crucial mean to achieve this aim is the design of robust structures. For large steel-concrete composite structures such as multi-story buildings the danger of an unforeseen event like a small fire next to a column, an explosion or impact or any incident causing local damage may initiate either a successive failure of the complete structure or be confined to that localized area of origin. The way a structure reacts to such situations may be characterized by its degree of robustness. In this context the robustness of a structure is defined as the capability of a structure to mitigate disproportional progressive collapse e.g. due to a column loss.

2. Design strategies

2.1 General

The approach to robustness adopted by EN 1991-1-7 [1] is based on the design criteria provided by EN 1990 [2] which states that “a structure shall be designed and executed in such a way that it will not be damaged by events such as explosion, impact and consequences of human errors to an extent disproportionate to the original causes”. To design the structure following this criterion means to limit the failure to an acceptable extent by means of structural measures which still should be economically justifiable.
The choice of the strategy of prevention is among others influenced by the characteristics of the accidental actions. By considering the unforeseen occurrence of the events and the practical impossibility to define “a priori” all the possible scenarios, EN 1991-1-7 distinguishes the accidental actions in identified and unidentified actions, see *Fig. 1* [3] [1]. The probability of

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