Blast Resistance of Structural Members

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Summary

This paper gives a bref overvew of the current status of specific resistance design strateges of structural systems against car bomb blast and focuses further on load-carrying behavior and failure modes of load-bearing structural key elements. The axially-loaded column is chosen for structural response and resistance capacity analysis. The ideal outcome should be invention of a strengthening technology, which is effective and "invisible" for terrorists. This study aims at implementing measures on how to prevent local failure of load-bearing structural members by the specific local resistance design approach. The alternate path design approach is not content of this paper. Making steel sections to composite sections is presented as a strengthening measure, which can be appled to new as well as to existing structures. The arising protection concepts are currently elaborated and tested in regard to its effectiveness in comparative analyses. The studes have been performed at the interface of advanced computational simulation software application, material science, experimental testing and continuum mechanics. The analysis is conducted by MSC.DYTRAN and LS DYNA and the appled models backed up by experimental testing.

Keywords: Blast resistant structural member; progressive collapse; non-linear analysis; shear failure; local blast resistance; specific local resistance design approach; failure mode

1. Introduction

Bomb blast pressures on structures count among accidental actions. The Eurocode 1, Part 2.7 [1] determines design strategies on how to deal with accidental actions. While the postulated "reduction of probability and magnitude of action to a reasonable level" does not seem to be accomplishable in case of terrorist-motivated blast detonation, the following design strategies are applicable:

- Protecting the structure against the action.
- Choosing structure design concepts so that local damage will not lead to progressive collapse.
- Designing load-bearing key elements, which are robust enough to either have high blast resistance or to be capable of overtaking redistributed gravity load.

This paper deals with the third design strategy with an emphasis on structural member protection. Its importance is also expressed in [2], where alternate path design approach and specific local resistance design approach are compared. Under certain circumstances, the specific local resistance design approach ameliorates structure protection to a greater extent than the alternate path method [2]. The AISC 7-02 Commentary Section C2.5 [3] defines in "Load Combinations and Extraordinary Events" that "…extraordinary events … should be identified, and measures should be taken to ensure that the performance of key loading-bearing structural systems and components is sufficent to withstand such events". The included studes were conducted to find out the behavior of bridge piers (Fig. 1) and ground floor columns of high-rise buildings under effects

Fig. 1 *Expressway piers in Osaka, Japan*

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