Protection of structures from shock waves through the use of dissipative systems based on ductile connectors

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Previous researches allowed to reach the conclusion that in a conventional explosion outside a building, the action is firstly local (e.g. column) which can translate into an overall impact (progressive collapse). This finding constitutes the motivation for the development of protective systems to safeguard the structural elements directly exposed to the explosion avoiding catastrophic consequences.

OBJETIVES

The research that is to be carried out is based on the use of a encapsulating system connected to the structure by ductile connectors which allow to dissipate part of the energy of the explosion (impulsive) and to transfer the residual part to the level of the floors, avoiding the energy absorption by structural elements not designed to withstand such amount of stresses.

RESEARCH QUESTIONS

- Research question #1 – Dissipative solutions to mitigate impact effects in the automobile and aeronautics industry could be adapted to buildings?
- Research question #2 – Which materials or special structure configurations are more effective as dissipation elements
- Research question #3 – how the dissipative element should be designed in order to have a wide application in structures?

The increasing use of Improvised Explosive Devices (IEDs) as a weapon of choice by terrorist groups give particular emphasis to the protection of people and infrastructure and thereby to engineering measures that can mitigate these effects. The ability to protect the critical infrastructure and key resources of the allied countries, in land or in operations is vital to our security, public health and safety, economic vitality, and way of life.

METODOLOGY

Step 1 - Study of blast phenomena - The first step is intended to understand the phenomena involved in an explosion, namely the energy released in the processes and the associated physical phenomena (blast and pressures waves). In addition, it was sought to understand the interaction of the shock wave with the crossed obstacles which includes the structure response

Step 2 - Study of the dissipative connectors - In step 2 will be studied the response of the connectors under very short response times. In addition several calculation methods will be studied and compared with numerical methods (non-linear methods).

Step 3 – experimental campaign - To allow the calibration of the numerical models and the extrapolation to different situations, a experimental campaign at real scale will be developed.

RESULTS/RESEARCH IMPACT

Preliminary results indicates that the solution is feasible and highly effective. A normal structure protected with this methodology could withstand explosions with a magnitude which normally just special designed structures could withstand.

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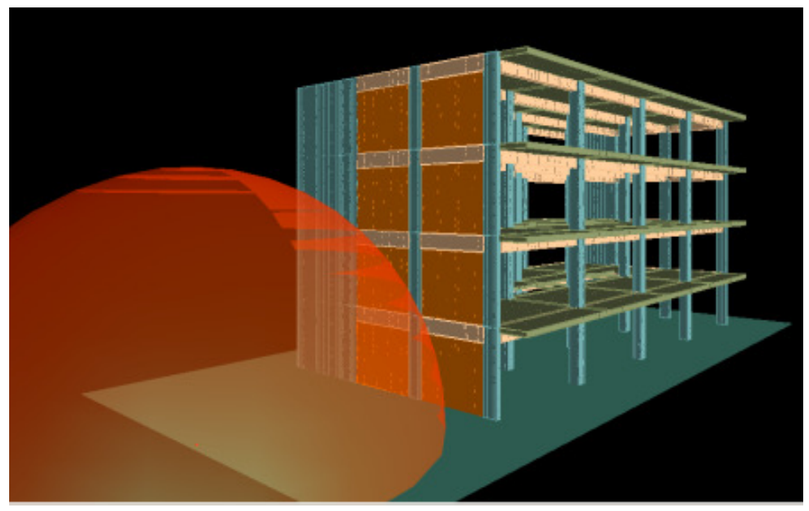
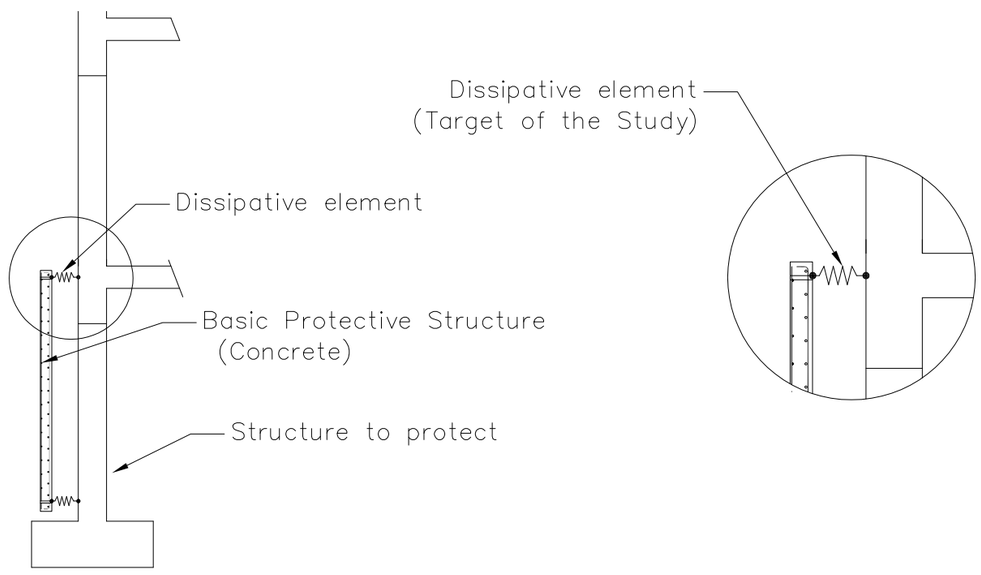


▶ **Fig. 1:** Blast wave in na unprotected structure

▶ **Fig. 2**: Concrete column afected by na explosion



▶ **Fig. 3:** Encapsulating system proposed