FLUID-FILLED SACRIFICIAL CLADDING: IMPULSE SPREADING AND ENERGY EXTRACTION

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Key words: Blast protection, Fluids, Momentum

Abstract:

Controlling the deformation of a target submitted to a blast wave generally involve a few principles: energy redirection (V-hull vehicles), energy dissipation mechanisms (sacrificial architecture, shock propagation in multi-layered and multi-material panels) and floor rigidification. These approaches are particularly efficient in controlling the energy and load applied to the target but cannot easily control the momentum brought by the blast wave. However, when investigating the efficiency of water filled container in blast protection, Bornstein [1] showed that, along several mechanisms, momentum diffusion in the water may help reduce the target deformation.

In this work, we propose to further improve the understanding of this phenomenon, by investigating the wave transmission and general fluid movement inside a fluid-filled panel and the impulse spreading near the rear plate of the panel. A new experimental set-up was designed at ISL where a fluid-filled container was placed underneath a vertical explosive driven shock tube. This container was equipped with pressure sensors located at the bottom of the container to better grasp the distribution of the associated impulse on the target, while the phenomena were recorded with a high-speed camera. Additionally, the experimental setup was enhanced by varying the degree of confinement of the fluid. This study was coupled with numerical simulations made on LS-DYNA in order to consolidate the understanding of the gathered experimental data.

Our results show a direct correlation between the degree of confinement of the fluid and a reduction in the localized impulse measurements, indicating that while spreading does at first occur in the fluid, the boundary conditions and the fluid ability to move freely are the ones conditioning the impulse spreading by the end of the phenomena.

[1] Bornstein H., Ryan S., Mouritz, A. (2016) *Physical Mechanisms for Near-Field Blast Mitigation with Fluid Containers: Effect of Container Geometry*, in International Journal of Impact Engineering 96, pages 61-77.