SIMULATING EXPLOSIVE DETONATIONS WITHIN BUILDINGS WITH FRAGIBLE WALLS

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The detonation of an explosive charge within a building produces propagating blast pressures that are strongly influenced by the building's room layout and construction of interior walls. This paper looks at the effects of internal blast on non-structural walls such as gypsum clad steel or wood stud walls and unreinforced CMU walls. Their blast response is investigated through experimental and numerical models with the goal of understanding the blast pressure propagation into rooms adjacent to the blast. A better understanding of the failure mechanisms and pressure transmission characteristics of typical frangible office and light industrial building walls will lead to improved vulnerability assessments.

Structural finite-element programs do reasonably well at predicting damage to structures due to blast if an incident pressure pulse is well defined. However, to accurately predict the dynamic response of light walls to an internal explosion and the resulting pressure conditions in adjacent rooms requires a coupled 'fluid dynamics – structural finite element' program to capture the strongly coupled interaction of the fluid pressures and failing walls. For this investigation, the explicit, non-linear finite element program NLFLEX was coupled to the GEMINI computational fluid dynamics code to simulate coupled response. Full-scale single and multi-room experiments were conducted in a shock tube to provide controlled simulations of pressure loading of internal walls. Pressure gages were positioned in key locations on the driver side and in adjacent rooms to quantify the pressures and impulse transmitted throughout the structure. These tests were used to validate the high-fidelity coupled numerical model and to validate a new fast running model of 'blast through failing wall' response developed based on calculations and test results. Close agreement was obtained between the experimental and numerical results for both wall response and transmitted pressure.