INVESTIGATION OF INTERNAL AIRBLAST PROPAGATION AT SMALL-SCALE

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ABSTRACT

Airblast environments resulting from explosions within buildings or other confined spaces are exceedingly complex, consisting of a) direct, reflected, and diffracted shocks, and b) the rapid expansion of detonation products throughout the confining aspects of the target geometry. In order to improve numerical and engineering-level models of internal airblast phenomena, experiments are needed to provide empiricism and/or validate predictive methods. At full-scale, such experiments are exceedingly costly, and new measurement capabilities are sometimes difficult to incorporate into the constraints of existing building construction.

The US Air Force Research Laboratory, Munitions Directorate (AFRL/RW) has been exploring the concept of using small-scale building models to investigate internal airblast phenomena more cost effectively. Of particular interest has been the study of detonation product flow and expansion resulting from internal detonations within building-type geometries. AFRL/RW constructed a scale model of a typical building geometry, involving a hallway and several adjoining rooms. The scale model was fabricated mostly from steel, although various ceiling components were also fabricated from transparent materials. For a typical test, the detonation room would employ a steel ceiling to withstand the high airblast pressures. Outside the detonation room, transparent ceilings were employed to enable high speed photography of the detonation product flow throughout the building geometry. In this way, pressure measurements in the scale model could be augmented with imagery of the detonation product flow.

This paper describes these experiments, and explores the utility of the small-scale model test with transparent panels to study internal airblast propagation. Emphasis is placed upon: a) scalability of results from small to full-scale, and b) utility of high-speed imagery to quantify detonation product flow. Comment is given with regard to potential applications of the technique to provide empirical data and insight for predictive model development and validation.