26th International Symposium on Military Aspects of Blast and Shock

MABS26, Australia, 2020

CHARACTERIZATION OF EXTERNAL VENTING FROM SMALL-SCALE INTERNAL DETONATION EXPERIMENTS

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Key words: Airblast, Internal Detonation, Quasi-Static Gas Pressure, Venting, Small-Scale

Airblast pressure environments from internal detonations within buildings are characterized by direct and reflected shocks superposed upon the quasi-static gas pressures associated from the detonation products expanding throughout the building's confined spaces. Engineering-level computer models strive to predict the quasi-static gas pressure (QSP) environment with simplified room-to-room mass flow models, assuming the flow between rooms to be satisfactorily approximated by relationships of compressible flow through nozzles (i.e., the doors, windows, etc., are all nozzles). Measured mass flow conditions from experiments are needed to evaluate the assumptions and efficacy of computer models used to predict internal airblast environments from military operations, terrorist/criminal events, or accidental industrial explosions.

The Air Force Research Laboratory, Munitions Directorate (AFRL/RW) employed small-scale experimentation to characterize the flow of detonation products from an internal detonation within a single room to the surrounding atmosphere via a typical door opening. A portion of AFRL/RW's 1/12th-scale complex building geometry model [Ref. 1], with an improvised platform representing an exterior ground surface, was utilized for the study. Each experiment employed airblast pressure measurements within the detonation room, at positions fore and aft of the door opening to the exterior, and a polar array on the simulated ground surface outside of the door opening. High speed imagery was obtained of the detonation products exhausting from the detonation room. Three different explosive charge masses, and four different charge locations within the room, were included in the experiment matrix.

Of particular interest with these experiments was to apply "pressure ratio analysis" [Ref. 2] using the pressure measurements fore and aft of the door opening, along with velocity data obtained via mensuration of the high speed imagery, to characterize the flow of detonation products through the opening. This information could then be compared to outputs of QSP computer models to identify methodology weaknesses and foster improvements. This paper describes the experiments, and presents an application of the pressure ratio analysis to experimental results. Comment is made on the utility of the analysis, as well as further analysis/experimentation that could potentially strengthen the technique.

Distribution A: Approved for Public Release: distribution unlimited. (96TW-2020-0024)

[1] Ohrt, A., Rogers, J., and Oliver, C., (2016) "Investigation of Internal Airblast Propagation at Small-Scale", 24th International Symposium on the Military Aspects of Blast and Shock, Halifax, Nova Scotia.

[2] Ohrt, A. (2018) "Utility of Pressure Ratio Analysis for Internal Detonation Airblast Studies", 25th International Symposium on the Military Aspects of Blast and Shock, The Hague, Netherlands.