VALIDATION OF THE CORRELATION BETWEEN URBAN BLAST CONFINEMENT AND STRUCTURAL LOAD

L. Donahue[1], R.C. Ripley[1], F. Zhang[2]

[1]Lloyd's Register Applied Technology Group, 1888 Brunswick St. – Suite 400, Halifax, NS, B3B 3J8, Canada;
[2]Defence R&D Canada – Suffield Research Centre, PO Box 4000, Station Main, Medicine Hat, AB, T1A 8K6, Canada

ABSTRACT

Explosive loading in urban environments is characterized by complex shock loads resulting from confinement of the blast by surrounding structures. This confinement can increase the blast impulse on structures due to reverberating shocks, blast channeling, and wave focusing, and through enhanced mixing and late-time reaction of fuels in the detonation products and metalized particles (i.e., afterburning). In previous work, an extended near-field regime was defined within which the structures impact the blast confinement. A simple hand-calculation method was found to express the degree of confinement of a specific urban blast event as a single value in the range of $0.0 \leq CD \leq 1.0$, with 0.0 representing a free-field blast and 1.0 representing a fully-confined explosion. A correlation between this confinement degree and the expected loading from a non-afterburning explosive detonation was found (the "Urban Blast Load" value). The current work describes an automated method which has been incorporated into the Rapid City Planner tool for explosive threat assessment. An updated correlation based on the automated method is also shown, factoring in the extent of the environment affected by the confined blast.

The degree of confinement concept has been incorporated into a pre-analysis approach to establish worse-case threat placements, by quickly determining the regions within an urban neighbourhood which experience the highest degree of confinement levels for a specific threat. The present work confirms that these locations correspond to the highest overall levels of impulsive structural loading. Detailed simulations will be performed at several of these locations to compare the spatial distribution of loads in the environment to the single Urban Blast Load value. Statistical methods are used to gain greater understanding of the implications of the spatial distribution of the load, and to assess the effectiveness of the Urban Blast Load parameter and correlation to degree of confinement for quick threat pre-assessment.