EXTENDED NEAR-FIELD REGIME IN URBAN CONFINEMENT

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Blast effects in close proximity and semi-confinement of urban environments may be locally enhanced due to both geometric and afterburning effects. The near-field regime, which normally defines a range where scaling rules do not apply, may be extended to include the urban influence that also makes simple blast scaling laws inapplicable. For straight urban streets, an extended near-field regime is defined by the scaled distance at which the street blast load deviates from the blast reflection load on a single wall. This distance occurs at the point where reflections from the far side of the street catch up to and merge with the incident blast wave resulting in an enhanced blast load. Various previous numerical studies employing different representations of the explosive source have shown the wave coalescence along the street, and its dependence on scaled street width. For small charges or large street widths, the two-wall street load approaches that of the single building load. Besides the geometric environment effect, afterburning of fuel-rich detonation products further enhances the blast load within the extended near-field regime. Focusing on cylindrical explosives in straight urban streets with limited wall sizes (1/8 and 1/4 real-world scale), experiments have demonstrated enhanced blast loads with respect to a C4 reference explosive within the extended near-field regime defined above. Numerically we have defined a reference explosive to be TNT without afterburning (i.e., the detonation products are inert and the energy output is from detonation alone). For two-wall streets and single-wall buildings, the loads from afterburning TNT and metallized TNT charges were compared to that of the TNT (detonation alone) baseline. The results show that increasing the fuel richness increases the fireball size and temperature and consequently the wave coalescence occurs at closer ranges further extending the near-field regime. Load ratios for TNT in a straight street were substantially higher than for the single wall reflection. Whereas in open air the near-field limit is taken as the maximum fireball diameter (at about 1 $m/kg^{1/3}$ in scaled distance), the extended urban effect is shown to be significant to a much greater scaled distance. Through numerical simulations, the extended near-field regime has been further investigated for various urban environments where a concept of degree of confinement is introduced. An effort is given to relate the blast enhancement to degree of confinement within the extended near-field regime of urban environments.