WEIGHT REDUCTION FACTORS FOR SCALED TESTING

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The present terrorist explosive threats varies from a back pack to a car or truck load of explosives. The impact of these explosions on structures and persons is therefore a high priority research topic. Testing the structural response to the resulting blast load is important, in order to verify the numerical simulations and/or analytical predictions. Full scale testing is in most countries limited to a small number of kg explosive weight. Most tests are therefore redesigned to scaled tests.

Scaling a 3D blast with the scaled distance (Z) can result in an identical peak pressure, but the impulse will be different. The corresponding Weight Reduction Factor will be: $WRF=(R_1/R_2)^3$. In other words: reducing the distance by a factor of 2 ($R_1=2R_2$) gives a reduction of weight by a factor 8.
It can also be decided that the impulse must be kept at the same value, where the peak pressure then will be different. The corresponding Weight Reduction Factor will be different and cannot be given in one equation.

In previous work the author has presented scaling rules for a test setup where both peak pressure and impulse can be kept the same, by applying a tunnel to guide the blast energy to the test structure. Based on these scaling rules a Weight Reduction Factor is derived, which only depends on the original distance (R_1) and the surface area of the tunnel cross section (A): $WRF=2\pi R_1^2/A$. Several tests have shown WRF values varying from 18 to 7200, which enables testing the effects of large explosions on small test ranges.