SIMULATIONS OF BLAST EFFECTS FROM A 155 MM ARTILLERY SHELL IN NEAR MISS SCENARIOS

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ABSTRACT

In field tests, 155 mm artillery shells were detonated at short distances from concrete mega block walls, representing near-miss scenarios. For the analysis of these tests, it is useful to get more insight in the blast load on the walls. Due to the harsh close-in environment, the blast load cannot be measured and the validity of simplified blast load models are questionable. Therefore, Computational Fluid Dynamics (CFD) simulations of the blast wave expansion were needed. Such simulations are particularly helpful when combined with experimental validation. The field tests included blast measurements, and provided a good source of data for validation and making a valuable estimate for the TNT-equivalence of the 155 mm artillery shell. Since the reproducibility of generated loads from artillery shells is limited, this TNT-equivalence can be used to define surrogate threats, i.e. substitute threats that generate similar effects as the real threat (e.g. the same blast effect). An initial estimate for the equivalent TNT value was made with Fisher's formula. Subsequently, the initial estimate was calibrated by comparing the found impulse values from the simulation with the values found in the field tests. It was found that there is a range of possible values for the equivalent TNT value, and an average of this range has been chosen to be the best representative value. The maximum relative difference in calculated maximum impulse with respect to the measurements was found to be 7%. The calibrated equivalent TNT value derived from the numerical simulations allowed calculating the blast load on the wall face for use in the wall response interpretation. It can also be used for other blast load calculations (e.g. behind the wall). In addition, the calibrated equivalent TNT value opens possibilities to avoid testing with actual 155 mm artillery shells, and use bare charges as a substitute in blast resistant tests for better reproducibility.