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Survivability of underground structures subjected to a near-surface nuclear explosion: building of database by numerical simulations

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Abstract

The objective of this paper is to describe a methodology to build a computerized database addressing the survivability of underground generic structures subjected to a near surface nuclear explosion. The goal is to propose a fast response numerical tool from which a common user after choosing a specific configuration of a structure (type of soil, depth, thickness and geometry), could obtain, for a selected weapon yield, the horizontal distance of survivability of the structure. This methodology involves the following requirements:

- Determine a statistically-based procedure to identify the minimum set of finite-difference costly computations: Considering that we cannot run all the calculations corresponding to the complete combination of the different parameters, we have to select a limited number of calculations in order to build an empirical mathematical model giving the survivability of all the possible combinations of underground structures configurations with a pre-determined accuracy,
- Identify the empirical mathematical model by running the limited number of physical calculations with a specific set of finite-difference hydrocodes used to reproduce the mechanical phenomena observed from the point of explosion to the structure, and to determine the mechanical response of the structure,
- Check the confidence of the empirical model through the comparison of empirical calculations and physical calculations performed on various selected configurations.

These three steps are succinctly described in this paper. Details about the finite-difference hydrocodes linked together to simulate the propagation of the shock waves in air and soil and the mechanical behavior of the generic underground structure, have been presented in the previous MABS [1]. Results obtained by physical and empirical calculations are discussed.