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Numerical models for near explosions. Effects on structures

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The successive terrorist attacks on sensitive buildings using explosives (Ed Murray in Oklahoma City-1995-, Barajas T4 Parking -2006-, Brussels Airport -2016-, among others), cause that important public resources have been used to both national as well as international level to put in place protection systems either in buildings for public use (transport terminals, sports stadiums...) or in military installations or vehicles.

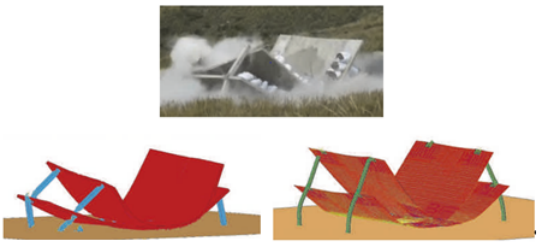
For the development of these protection measures, given that the trials are expensive, the use of adequate numerical models is shown as a necessary tool to lighten costs. However, the validation of these models cannot do it without performing some kind of physical tests to calibrate them.

In this talk we are going to focus on two fundamental aspects: the modeling of the behavior of explosives and their effects on all kind of structures.

For modeling the effects of explosives we can start from the approximation provided by CONWEP [1] based on empirical trials that provide the necessary parameters (explosive wave pressure, impulse of the positive phase of the wave, phase duration, arrival time for the explosive wave, ...). In this way, in the FE models used, pressure curves are applied on the faces of the selected elements that vary with time, this option is directly implemented in several FE codes, particularly in the code namely LS-DYNA [2] used in these studies [3, 4]. The other way is to directly (or explicitly) model the explosive using the appropriate material model (high explosive burn) and the equation of state (JWL), using in the simulation different formulations like: Lagrangian, ALE or particle methods (SPH) [5].

To study the effects on both metallic and reinforced concrete structures, different materials models used and their calibrations are shown in contrast with some basic experimental results [6, 7].

Finally, for the tests of complete structures, both FE models and field results will be shown to show the accuracy level obtained with the simulations [8].



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