NUMERICAL AND EXPERIMENTAL STUDY OF BLAST WAVE SHAPE IN TUNNELS

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When an explosion occurs in a tunnel, the study of the blast wave quickly becomes complicated, due to the blast wave (Incident wave, regular and Mach reflections) and to the geometrical conditions. Considering this problem, two patterns can be revealed. Near the explosive, one can see the well known free-field overpressure (spherical propagation, Fig. 1). This overpressure, during its propagation, after multiple reflections on the tunnel's walls, can behave like a one-dimensional wave. (Fig. 2)

The aim of this paper is to determine the position of this transition zone along the tunnel. Both numerical and experimental methods are presented. Previous experimental works have been done on this topic, but based on a real scale. In this work, the experiments are realized in the laboratory using a $1/30^{th}$ scaled model, simulating TNT detonations ranging from 0.1 kg to 12 kg in a tunnel of 25 square meters cross section and 30 meters length. The experiment on scaled models allows us to realize many costless experiments; an accurate profile of the overpressure can be determined along the tunnel. The transition zone between the free-field and the one-dimensional decay law is presented using non-dimensional parameters.
The numerical simulation is based in a unstructured finite-volume cell-centered approach using the upwind scheme and a two stage explicit time integration technique. The spatial discretization is performed using an automatic Cartesian grid generator.

Computed arrival times of the blast wave, overpressure values, position of the 3D / 1D blast wave transition are compared to the experiments. This work improves the knowledge about the vulnerability of underground structures facing explosion hazards.

Fig. 1 – Spherical propagation

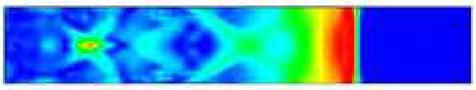

Fig. 2 – One-dimensional propagation