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COUPLED CFD/CSD MODELING OF WEAPON DETONATION/FRAGMENTATION IN A TUNNEL

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Application of a recently-developed coupled Computational Fluid Dynamics (CFD) and Computational Structural Dynamics (CSD) methodology to the simulation of scaled weapon detonation and fragmentation in a tunnel and the airblast and fragment interaction with a blast door are described. The coupled algorithm combines FEFLO98 (CFD) and DYNA3D (CSD) via an embedded approach, where the CSD objects float through the CFD domain. This combination enables an easier and more accurate prediction of the physical processes modeling here, namely: weapon detonation, case cracking and fragmentation, airblast and fragment propagation and impact on a steel blast door, and the door response to the loading.

Several experiments were conducted that examined load dependence on the blast door as a function of weapon ignition point (nose or tail) and orientation (horizontal or vertical). To better understand the resulting environment in the tunnel, we compared the predicted fluxes of several variables across many planar cuts. In addition, as some tests were repeated with the blast door replaced by an instrumented concrete wall. We validated the methodology by comparing load predictions to the experimental data.

The results shown in Fig 1 were obtained for a tail-detonated scaled weapon hanging vertically in the tunnel. Figs 1a and 1b show pressure contours across a planar cut at 4.0 microseconds, and velocity contours across the cut at 24.2 microseconds, when most of the case has already fragmented. Figures 1c and 1d show the pressure contours viewed inside the tunnel just before and after impact on the blast door. Finally, Figs 1e and 1f show the experimental blast door (with the front steel plate removed) after the test, and the predicted blast door geometry at 0.1 seconds. Good agreement is shown in term of damage and blast door deformation.



Fig 1a

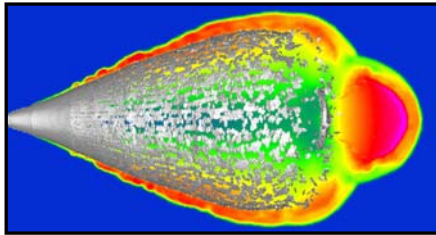


Fig 1b

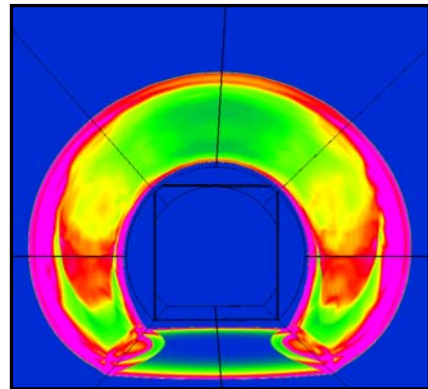


Fig 1c



Fig 1e

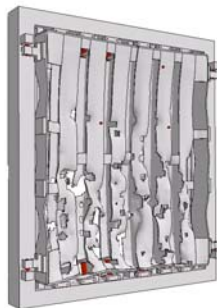


Fig 1f

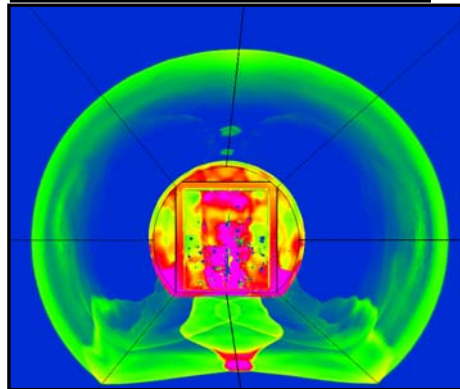


Fig 1d