COUPLED CFD/CSD/DPM MODELING OF WALL RESPONSE TO BLAST LOADING

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A coupled methodology that incorporates Computational Fluid Dynamics (CFD), Computational Structural Dynamics (CSD) and Discrete Particle Method (DPM) codes is described. The coupled algorithm combines the FEFLO98 fluid dynamics code and the MARS3D CSD/DPM code, via an embedded approach, where the CSD objects float through the CFD domain.

The coupled code has been applied to modeling a wall response to a large bare HE charge. The barrier (Fig 1a) is composed of a lower concrete wall closer to the blast source that was modeled as non-responding, and a taller wall composed of extreme layers of brick (two layers at each end) filled with sand. The bricks were modeled as solids and the sand particles were modeled as DPM particles, allowing for load transmission between the particles. Only the section of the wall most likely to sustain a severe damage was modeled as a responding wall. The rest was modeled as non-responding. The ultimate objective of this study is to evaluate the blast loading on the targeted facility, and ensure that the wall does not contribute to increased target loading by flying bricks/sand impact.

Several simulations were conducted with different charge sizes. Figure 1b shows the results obtained with the smaller charge. The results show the surface CFD velocity contours at t=5.4 ms, and the resultant bricks and particle velocity. As the blast front propagated past the responding wall section, only the top layers of bricks were moving, at a fairly low velocity. Fairly slow sand velocity is observed through about 1/5 the sand layer. Significantly higher brick and sand velocities were observed for the larger charge (Figs 1c and 1d). These results, at 22.5 ms, show that the front brick top layers, as well as the sand top layer, attained high velocity. In addition, just above the floor, the higher stagnation pressure behind the concrete wall resulted in higher outer brick, sand, and inner brick velocities.

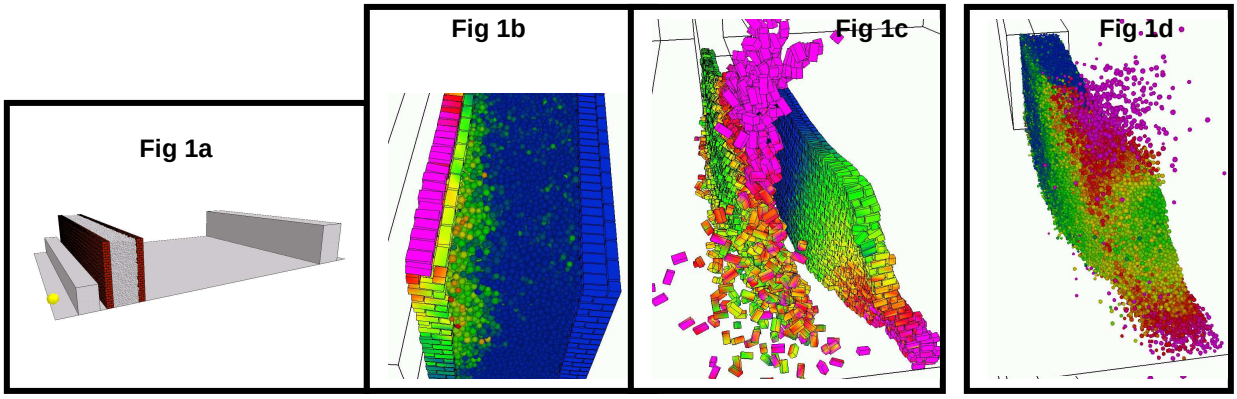

Fig 1. Blast wall geometry and response to smaller charge (Fig 1b) and larger charge (Figs 1c and 1d).