EXPLOSION WITHIN A SPHERICAL CONTAINER: COMPARISON WITH TAYLOR'S POINT SOURCE SOLUTION

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This paper is concerned with the spherical blast wave structure produced by an internal detonation of a high explosive charge in a closed vessel. The aim of the work is to provide a quick algorithm for estimating the load required for the design of containment vessels. We present a series of hydro-code calculations using 2nd order accurate numerical schemes. In this series the total energy of the charge is kept constant while the energy density is increased by about two orders of magnitude with respect to normal physical levels. The results show that the pressure time history at the vessel wall is insensitive to the energy density of the charge, and seem to indicate that the series converges to a limiting solution for a point source having finite energy and mass. This solution is contrasted with the well known Taylor self similar solution for a point source explosion having a finite energy but no mass.

We further explore the effect of the finite mass on the point source solution by a second series of calculation where the charge mass was increased gradually from zero to the true value (with constant charge energy). When the charge mass was small compared to the mass of the surrounding air, the Taylor solution was found to reasonably approximate the impulse on the vessel wall. The impulse increases with charge mass, in agreement with formulae developed by Baker [1] and Falcovitz & Fuhs [2].

The numerical results are presented for the case of a TNT charge having a mass of 2 kg detonated within a vessel with a 1 meter radius. The results are compared with predictions from other codes [3].

[1] Baker, W E: "Prediction and Scaling of Reflected Impulse from Strong Blast Waves", Int. J. of Mech. Sci., 9, p. 45-51, 1967.

[2] Falcovitz, J and Fuhs, A E: "Impulsive Loading from a Bare Charge in Space", AIAA J. of Spacecraft and Rockets, 25, p.400-404, 1988.

[3] Y. Kivity et al.: "Effect of Wall Curvature on the Reflected Impulse Produced by an Explosion in Air", proceedings of the 17th MABS conference, Las-Vegas, NV, 10-14 June 2002.