Insights From Near-Field Blast Tests Examining Cuboid Charge Geometries

P McDonald[1], J Denny[2], Sherlyn Gabriel[3], Tumelo Selialia[3], Steeve Chung Kim Yuen[3]
[1] Viper Applied Science, [2] University of Southampton, [3] University of Cape Town

The characterisation of spherical and hemispherical charges is well established, although significantly less is understood for different charge shapes. Accurate prediction of blast parameters is necessary to ensure structural protection and safety, however, real-world explosions rarely conform to (hemi-)spherical approximations, and the resulting loading may differ substantially from the predicted values. There is currently no recognised tool with the ability to accurately predict loading parameters from non-spherical charge shapes. Furthermore, recent studies have highlighted some disparities with numerical models for small cuboidal charge masses in the near field, highlighting the need for a thorough experimental investigation into the effects of charge shape.

This study presents the results of an investigation of the effects of cuboidal charge geometries with different aspect ratios on primary shock wave properties through a novel experimental framework. While prior studies into charge shape have been conducted at larger scales, these experiments focussed on free-field air bursts using smaller charges (10 g, 50 g) in the near-field regime (scaled distances, Z = 1.5 and 1.8). This configuration therefore explores the role of detonator effects at low charge masses and evaluates the accuracy of computational fluid dynamics (CFD) models in replicating such phenomena.

The results reveal significant deviations in the primary shock characteristics, influenced by the unique test parameters, including the near-field focus, smaller explosive scales and detonator effects. Subsequent numerical analysis using Viper::Blast will aim to replicate these experiments and identify the key contributors to these phenomena, including detonator size, charge shape, and scaled distance effects.

These findings are of increasing importance with the growing emphasis on reduced-scale experimental work to explore obstacle interaction phenomena at relatively small geometric scales. Insights gained from this work are expected to inform the development of more robust predictive tools, with applications ranging from urban resilience to military and security scenarios.