DEGREE OF CONSERVATISM IN PREDICTION OF EXTERNAL BLAST LOADS FROM INTERNAL DETONATIONS

David Yermian, David Powell, David Bogosian

Baker Engineering and Risk Consultants
360 North Pacific Coast Hwy, Ste 1090, El Segundo, CA, USA

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ABSTRACT

Within the realm of protective design and explosives safety, a methodology outlined in UFC 3-340-02 is available for engineers to predict external blast environments from internal detonations, the so-called wrap-around blast load. The methodology predicts shock pressure and impulse through use of empirical charts constructed from experimental test data for three-wall (fully vented) and four-wall (partially vented) cubicles. The charts are provided as a function of standoff, blast direction, structural geometry (cubicle volume and vent area), and standoff from the cubicle. These curves are eminently useful and widely used in the application of UFC 3-340-02 to designs where adjacent portions of a building are subjected to blast escaping from vented cubicles. However, the degree of conservatism inherent in these curves is not known.

In this paper, results for shock pressure and impulse for a wrap-around blast load are compared between the UFC 3-340-02 methodology and high-fidelity computational fluid dynamics (CFD) models built with LS-DYNA. A realistic geometry of hardened (non-responding) structure was represented within the CFD model, while the blast wave was allowed to exit the structure and wrap around onto the many exterior surfaces. For computational economy, a hybrid 2.5-dimensional approach was first used in the CFD model, which is conservative; subsequently, a fully 3D approach was also modeled. The calculated pressure and impulse values are then compared to the values obtained using UFC 3-340-02 methodology. Instructive observations are made regarding the overall level of conservatism of both the methodology outlined in UFC 3-340-02 as well as the 2.5D hybrid approach, which should be useful in future design studies as guidance for determining when a more computationally intensive method is justified over the standard handbook methods.