SIMPLIFIED BLAST LOADING FOR INTERNAL EXPLOSIONS USING SPHERICAL, CYLINDRICAL AND PLANAR BLAST

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ABSTRACT

One key aspect of a naval vessel subjected to an incoming missile is the assessment of the damage caused by a detonating warhead inside a compartment. This event applies a blast loading on the bulkheads and decks followed by a Quasi-Static Pressure (QSP) loading and likely venting through openings and/or failing panels. For the assessment of several cases (different ship designs, different scenarios, etc.) it is impractical to perform detailed CFD simulations to provide the blast and QSP loading on the structure. One common method to apply a simplified blast loading which accounts for shock reflections is to make use of so-called mirror charges. However, one of the limitations of this method is the absence of shock coalescence. In other words, shock waves don't interact with each other using the mirror approach. In this study, the effect of this limitation is quantitatively assessed for different compartment shapes and charge positions in terms of bulkhead displacement. It is shown that the error made by using this approach can be as much as ±50% in terms of bulkhead displacement, especially for long and narrow compartments. In order to reduce such inaccuracies, a new approach based on the use of either Spherical, Cylindrical or Planar (SCP) blast is presented. The essence of this approach is to use a planar blast for long and narrow compartments, a cylindrical blast for wide and long compartments (relative to the compartment height) or a spherical blast for a cubical compartment. The motivation behind using the three blast configurations is to account for the shock coalescence at the shock front propagating across the compartment. It is shown that the SCP approach reduces the inaccuracies by two to threefold depending on the compartment geometries. Although the SCP approach is applied in this study to ship compartments, it can also be used for a wider range of applications involving internal explosions.