A NUMERICAL STUDY AND EXTRACTED ANALYTICAL MODEL FOR BLAST JETTING IN CORRIDORS

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For many platforms like buildings and ships, internal explosions are still a major threat. In order to perform a lot of simulations for the blast resistant design of such platforms, there is a need for methods faster than CFD.

TNO has developed three sophisticated and validated fast models for the main aspects of the internal blast loading. The first one is an analytical so called 'mirror' model for the spatial distributed blast waves in the explosion room. The second is an analytical-empirical one for the built-up of the QSP and the third one deals with the more or less stationary isentropic venting from the explosion room and the pressure built-up in the adjacent rooms. All are based on quite simple differential equations and solved with a quick time step approach. They are linked to equations of motion for the structural response and failure of the surrounding walls. The remaining fourth main blast aspect was missing. This is the rise of compression waves in corridors and adjacent compartments in case the adjacent corridor has a much smaller width than the explosion room or when the wall of the explosion room is destroyed very quickly. This gas dynamic phenomenon is called blast jetting here.

We decided to construct the jetting model with the aid of a numerical study based on various non dimensional parameters. These parameters include the size of the HE charge, dimensions of the various rooms, the amount of venting to the ambient and the mass of the panel or door that separates the explosion room from the adjacent corridors or rooms. Hence, 432 well defined and CPU demanding simulations were carried out with the in-house developed Eulerian CFD code BLAST3D and the same number with a code based on the more stationary isentropic venting. Compression and extraction of the enormous amount of data was conducted. Physical relations of the main blast aspects were clarified and a comparison to the more stationary venting was performed in order to exclude the jetting component. A generalized profile of the jetting phenomenon was made.

The last step was to determine mathematical relations within a 5 dimensional space to couple all varying parameters. Finally a model was constructed and an algorithm established. This was implemented into our RESIST software and compared with new CFD simulations, outside the previously defined scope.