THE VENTING CHARACTERISTICS OF SUPPRESSIVE SHIELDS

PW Friend[1], TA Rose[2] and PD Smith[3]

[1]MoD/Defence Estates, Kingston Rd, Sutton Coldfield, West Midlands, B75 7TL, UK
[2]AWE, Aldermaston, Reading, Berkshire, RG7 4PR, UK
[3]Department of Engineering Systems and Management, Cranfield University, Defence Academy, Shrivenham, Swindon, SN6 8LA, UK.

ABSTRACT

A suppressive shield is an integral component of certain explosives storage buildings where there is the possibility of an internal detonation. Should such an event occur, all fragments and debris produced should be contained inside the building which nonetheless allows a degree of venting. A shield typically comprises an assemblage of interlaced structural steel members arranged so that there is no direct 'line of sight' escape path for the fragments to follow; gaps between the members allow venting. The main design guide is a US Army Corps of Engineers (USACE) handbook which makes use of some geometrical relationships between parameters that define the shield although these relationships are acknowledged to have no practical or theoretical validation. Other documents are available, but do not provide sufficient information to verify the USACE handbook methods. This paper is concerned with investigating the appropriateness of the methods for calculating loads on suppressive shields given in the handbook, the effects of covering the shield to assist in weather-proofing and the appropriateness of the simpler calculation methods presented in other documents. A scale model representative of a real building was studied both experimentally using small charges and numerically using the computational fluid dynamics program Air3D. Three suppressive shield types and two vent coverings together with a fully open and nearly fully enclosed model building were investigated. The study concluded that suppressive shields do contain blast loading inside a structure and permit controlled release of the detonation products. There is a penalty associated with confining the blast: increased shield congestion and vent cover mass result in higher internal loading. The USACE handbook methods over-predict the experimentally determined loadings by approximately 60%, though it is conceded that the experimental arrangement used here might produce slightly lower results compared with real structures for which the USACE handbook formulae were originally developed.