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A statistical description of explosion produced debris dispersion

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Abstract

The handling of explosives and ammunition introduces a safety risk for personnel and third parties. Accidents related to storage, transport and transshipment may result in severe injury and material damage. Dispersion of structural debris is one of the main hazards resulting from detonations inside structures. Reliable prediction models for debris dispersion are essential for risk assessment methods.

In this article we give a statistical description of the dispersion of explosion produced debris. The basis is a general expression for the projectile areal number density in the horizontal and vertical plane. Combined with engineering models for the launch conditions, predictions can be made. An analytical solution to the equations of motion may be used to allow for fast calculations. A parameter study shows consistent results. The model has been validated with internal detonation tests of bare charges in reinforced concrete structures. The validation clearly shows the prediction capabilities of the model for three loading regimes described in the literature.

We give a thorough description of the validity and limitations of the model, and an outlook of current and future research. Examples are the failing debris mass distribution prediction for reinforced concrete in the shock overloading regime, and ricochet and roll and break-up at impact phenomena.

Keywords
explosion; detonation; risk; debris; dispersion; throw