Predicting Combined Blast - Fragment Effects

Introduction

Blast and fragmentation effects are treated separately in current protective design approaches. Although the synergetic effects of blast and fragmentation loadings are acknowledged, the combined effects are difficult to properly define, model, and implement.

Objectives

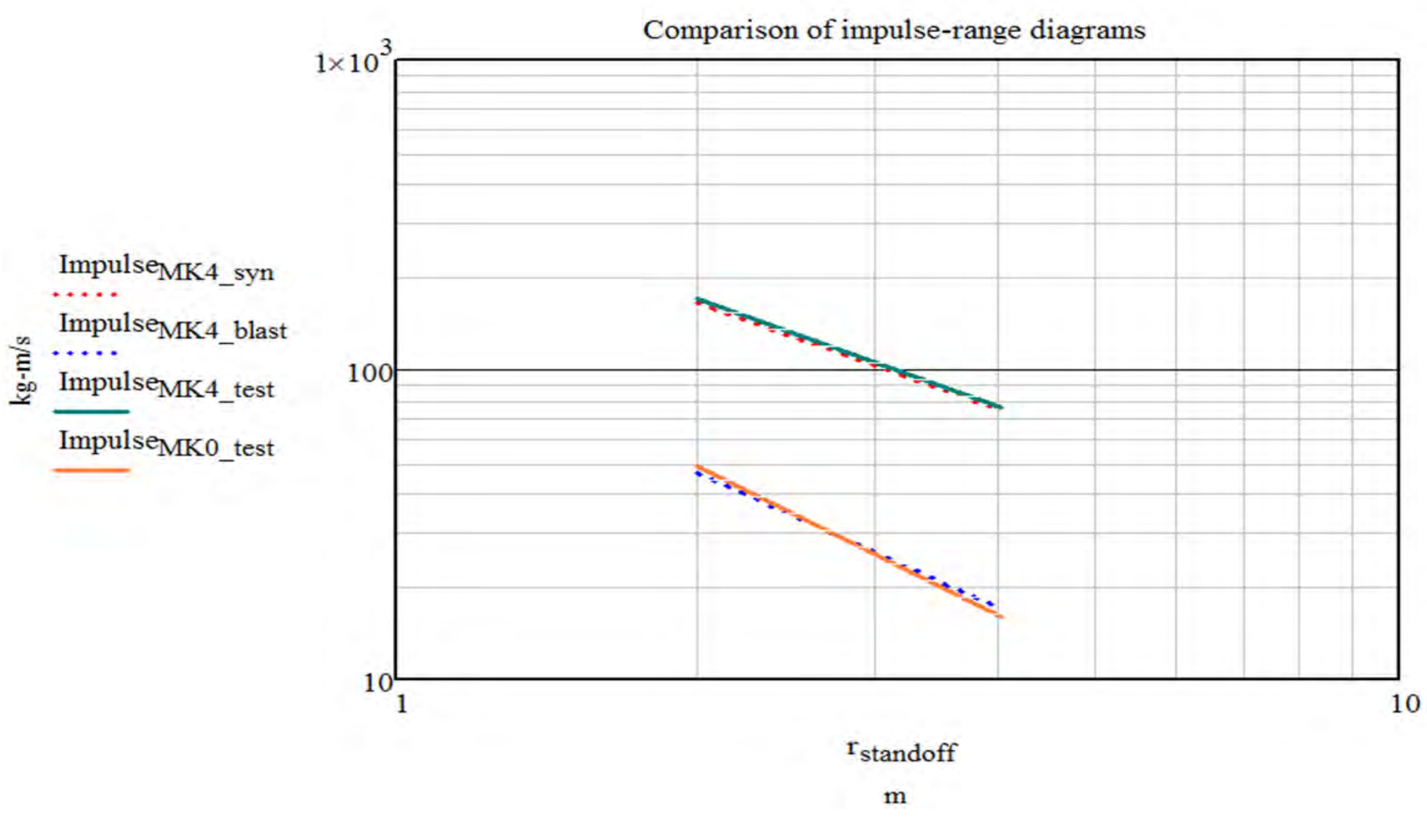
- To investigate, through computer modeling and analysis, the combined effects of blast and fragment loading from previous experimental results.
- To produce a rational combined load function methodology.

Research Approach

- Address several load cases that were investigated by Mehlin and Parr (1983).
- Perform blast simulations with ConWep and Air3D to extract pressure time histories.
- Perform fragmentation calculations with ConWep, and extract a force-time history.
- Combine blast and fragmentation loads-time histories.

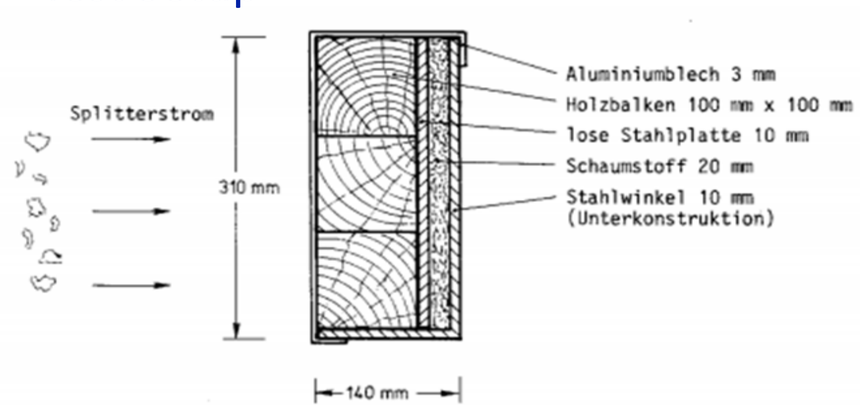
Results

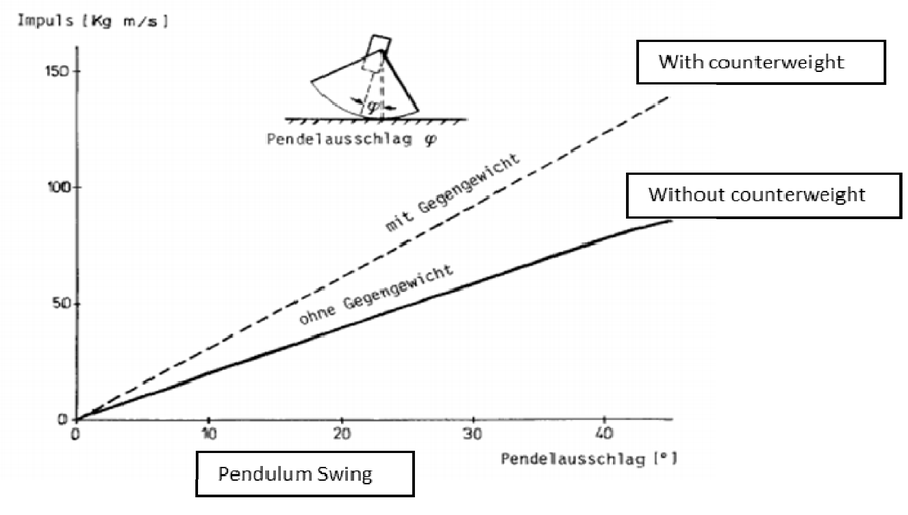
Charge Type	Standoff	Recorded Impulse (m*kg/s)	Proposed Impulse (m*kg/s)	Difference (%)
Mk0	2m	49	46.88	-4.33%
	4m	16	17.1	6.88%
Mk1	2m	90	96.51	7.23%
	4m	Unavailable test data		
Mk2	2m	120	130.76	8.97%
	4m	62	57.1	-7.90%
Mk4	2m	170	164.14	-3.45%
	4m	75	74.14	-1.15%

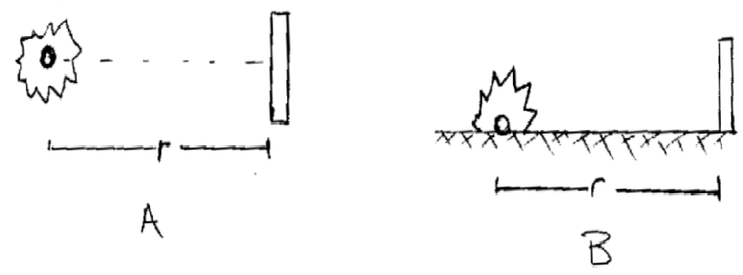


Example for Mk 4 (1kg Comp B and 4 kg cylindrical steel case)

Test Setup







Conclusions

- Load sequencing must be taken into account as it varies with the distance of separation from target and explosive charge. In this study, the fragments reach the target prior to the blast wave.
- The combined effects total impulse was obtained by summing the areas under the load-time history curves.
- The combined effects highlight the significant increase in delivered impulse by fragments to the target.
- Rigorous experimental testing is required to achieve better results.
- Future precision tests are needed to characterize these coupled phenomena more accurately.
- This effort continues, and further refinements of the approach are expected.