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Ballistic Performance of Cracked Aluminium Plates

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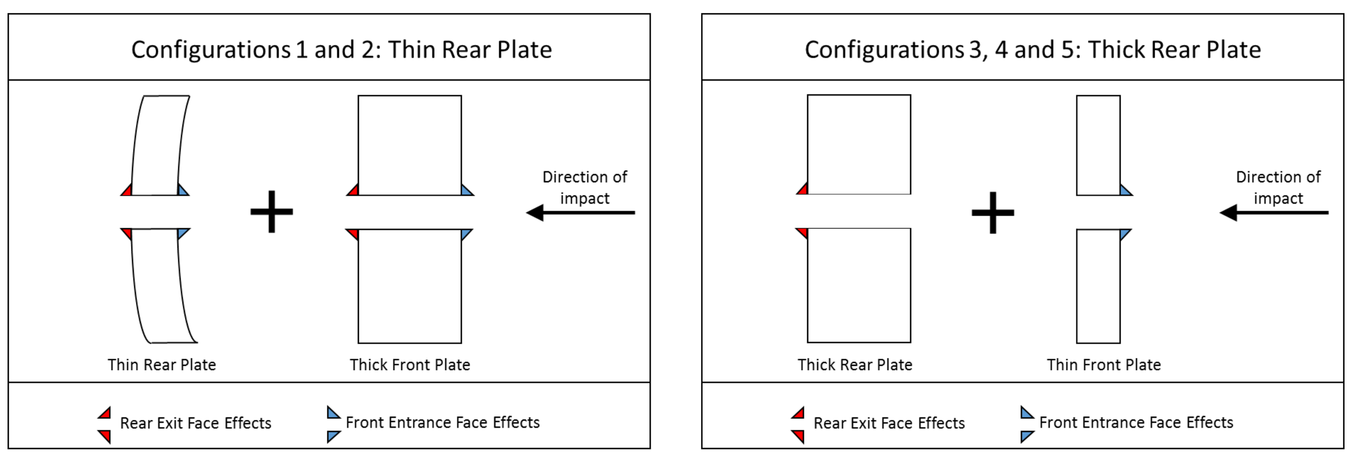
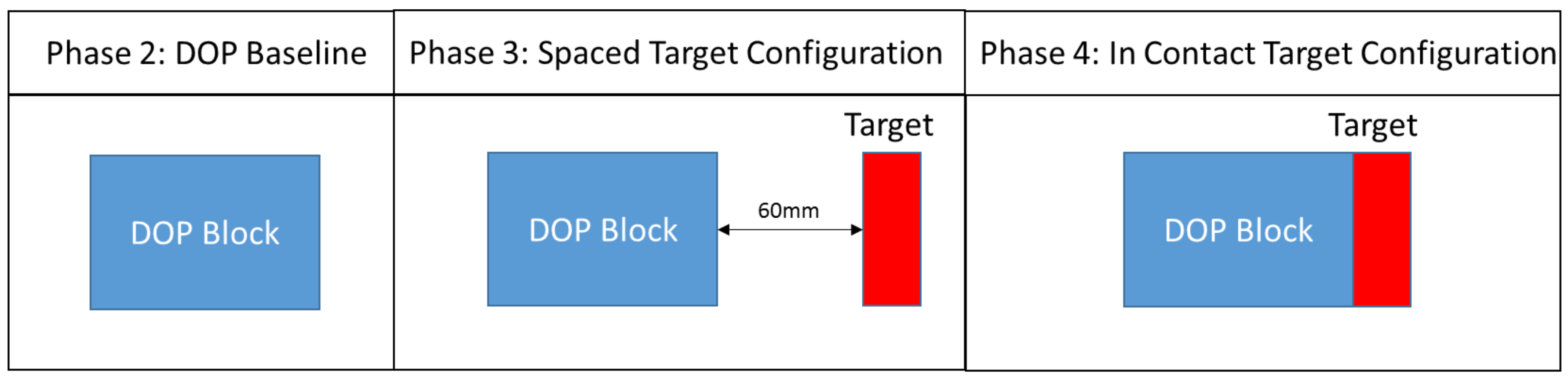
Introduction

- Common use of multi-layered armour designs and expensive repair regimes for in-plane delaminated aluminium armour.
- Previous works demonstrated a 6% decrease in ballistic resistance performance for double-layered aluminium armour as opposed to a monolithic target.
- The decrease in performance was especially prominent in double-layered targets with thin rear plates. Therefore, it was hypothesised that this decrease in performance was due to the rear exit face effects.

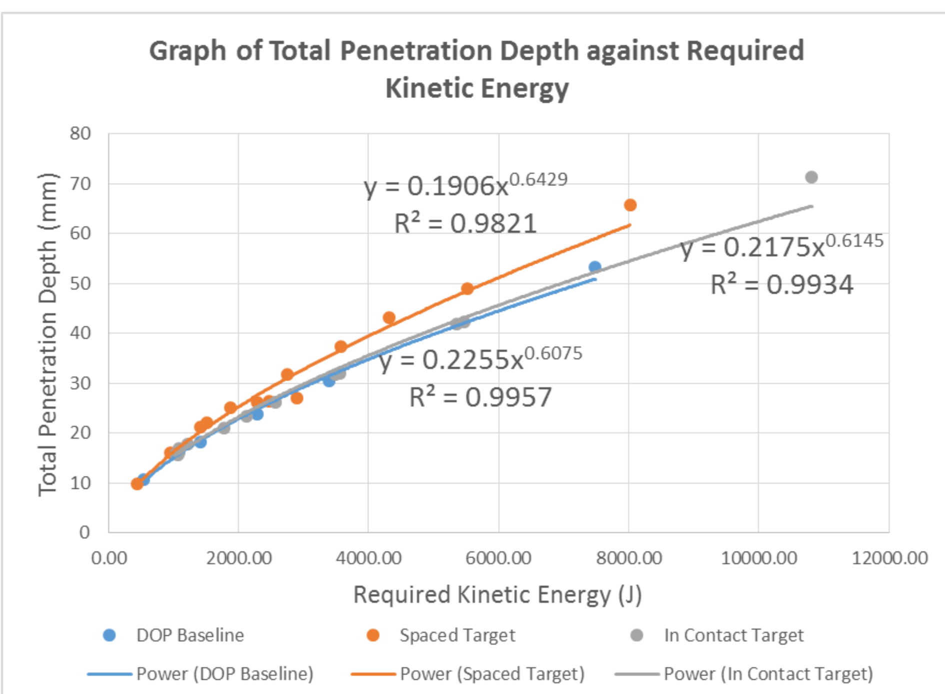


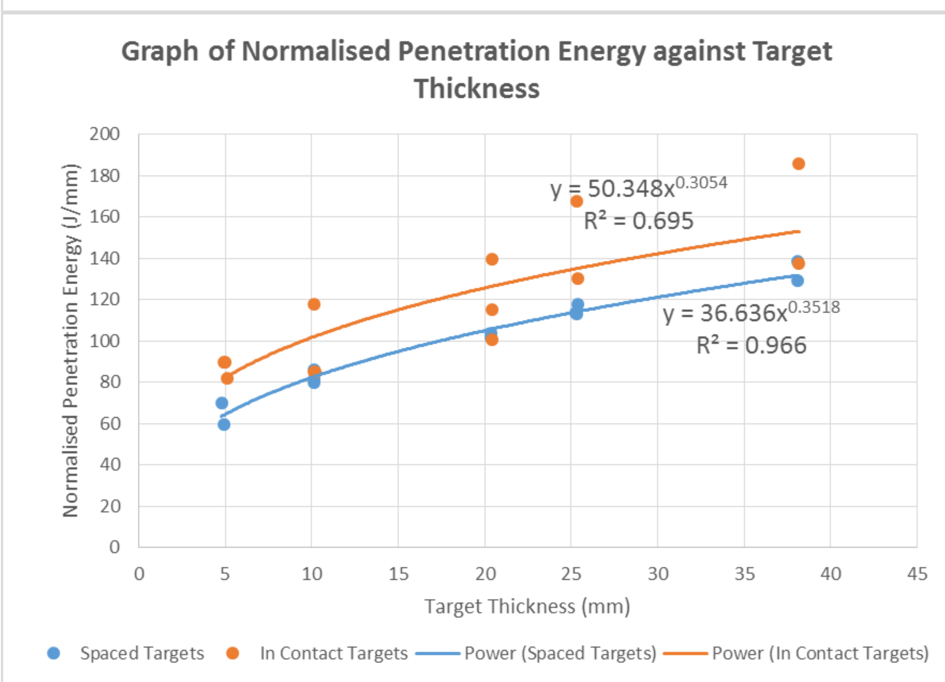
Experimental Methodology



- Experiments conducted to simulate the penetration of only the second armour layer to gain better understanding of the rear exit face effects. It was assumed that the first layer of target was responsible for fully stripping the metal jacket of the round.
- Depth of Penetration (DOP) method used to determine residual penetration into a DOP backing block.
- Ballistic Model Representation: $\frac{1}{2}M_pV^2 = W_{DOP} + W_t$

Results





- In-contact targets required approximately 20% higher kinetic energy for penetration, and appeared to have displayed similar ballistic performance characteristics to a monolithic block.
- The presence of rear face effects decreases ballistic performance largely due to spalling.
- The energy difference is approximately 30J/mm. This effect is present across the entire thickness of the targets, rather than a fixed energy reduction.

Conclusions

- Ballistic resistance performance of in-contact targets were 20% better than that of spaced and unbacked targets with rear exit face.
- The ballistic model constructed in this experiment was used to validate results obtained during previous works. While the model was within 10% accuracy for thin rear plates, the model under predicted the penetration energy required for thick rear plates.
- It is suspected that the entrance phase during penetration had an significant effect on the required energy for penetration. However, this was not examined in this project.
- It is suggested that further work could be undertaken to validate the experimental results from this project with a numerical model, and to attempt to isolate the effects of entrance and exit face.

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