PARAMETRIC ANALYSIS OF COMPOSITE PANELS UNDER BLAST LOADING

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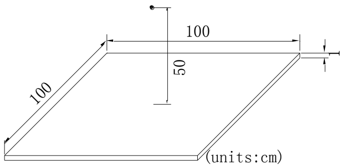
INTRODUCTION

- The scope of this project is to develop composite panels that are optimized for blast resistance.
- The main goal of present work is to investigate the influence of different material parameters on the response of composite panels under blast loading.

PROBLEM GEOMETRY

- Panel size: 1mx1m; Panel thickness: 1cm;
- Subjected to a 500-gram-TNT,which is 50cm above.
- The boundaries are fixed.



PROBLEM MODEL IN LSDYNA

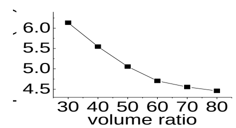
- Discretized with 6561 nodes and 6400 shell elements;
- Type 6 (S/R Hughes-Liu) used to avoid hourglass energy;
- MAT_022 (*MAT_COMPOSITE_DAMAGE) adopted;
  - The associated material parameters with this type are: Density; Young's modulus; Poisson ratio; Shear modulus; Strength;
  - Three failure criteria: tensile fiber mode; tensile matrix mode; compressive matrix mode;

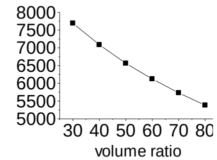
PARAMETRIC ANALYSIS

- **Section I**: Aimed at S-Glass/Epoxy composite and to identify the influence of different material parameters;
- **Section II**: To compare the response of different composite panels under blast loading.

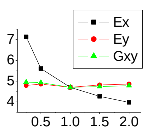
PARAMETRIC ANALYSIS (SECTION I)

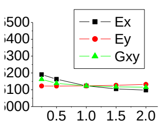
sglass/epoxy	volume ratio					
	30%	40%	50%	60%	70%	80%
density(g/cm^3)	1.587	1.716	1.845	1.974	2.103	2.232
Ex(x10^{7}Pa)	2.93	3.76	4.58	5.41	6.23	7.05
Ey(x10^{7}Pa)	0.837	1.01	1.23	1.55	2.01	2.78
Gxy(x10^{6}Pa)	2.83	3.47	4.33	5.54	7.36	10.5
vxy	0.3267	0.3037	0.2815	0.26	0.2391	0.2188
tensile strength along fiber(x10^{6}Pa)	0.827	1.07	1.32	1.57	1.81	2.06
tensile strength normal to fiber(x10^{4}Pa)	4.90	4.90	4.90	4.00	4.00	4.00
in plane shear strength(x10^{4}Pa)	6.90	6.90	6.90	8.00	8.00	8.00
compressive strength along fiber(x10^{5}Pa)	6.90	6.90	6.90	6.90	6.90	6.90





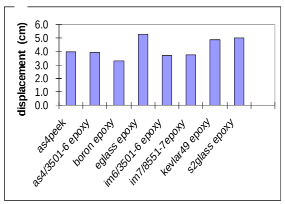
PARAMETRIC ANALYSIS (SECTION I)

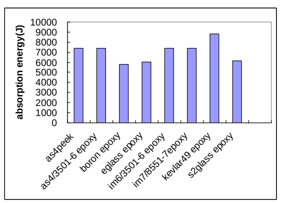




- E_x dominates the deformation response, but little influence on the energy absorption;
- As E_x increases, the displacement will decrease;
- E_y and G_{xy} have little influence on the results of displacement and energy;

PARAMETRIC ANALYSIS (SECTION II)





CONCLUSION

- As the volume ratio increases, the deformation response and absorbed energy both decrease;
- E_x dominates the deformation response, but does not affect absorbed energy apparently;
- E_y and G_{xy} both have little influence on the displacement and absorbed energy;
- Among the selected composites, Kevlar49 epoxy has better performance on the response of both displacement and energy absorption.

FUTURE WORK

- Based on present work, to extend unidirectional composite panels to other types of composite panels and select the appropriate composites with better deformation and energy absorption capacity as the face and bottom sheet of the sandwich structure;
- To build a middle part of the sandwich structure, with which to consume the energy absorbed by the face sheet from blast loading.

ACKNOWLEDGEMENTS

This work has been supported by the Department of Defense through the EPSCoR program. Thanks also goes to Dr. Righman McConnell.