Department of Civil Engineering and Engineering Mechanics
Columbia University

Dynamic Response of Corrugated Sandwich Steel Plates: Finite Element Modeling and Validation

Prof. Jeong-Ho Kim

Associate Professor
Department of Civil and Environmental Engineering, University of Connecticut

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Blasts and explosions can lead to extreme damage to structures. The blast wave, shrapnel, and heat and fire generated during blasts and explosions are the main causes of damage. To mitigate the damage, technology recommendations are the continuity of structures, reserved strength in excess of live loads, redundancy in load bearing paths and increased energy absorption. These concepts can be realized by metal-foams, sandwich structures, and polymers. This presentation focuses on the dynamic response of proof-of-concept corrugated sandwich plates to mitigate the effects of blast wave propagation. This presentation addresses three-dimensional dynamic finite element analysis for strain-rate dependent elastic-plastic sandwich steel plate with various corrugated core arrangements subjected to shock-tube-induced dynamic air pressure loads. The sandwich steel plate consists of top and bottom flat substrates of Steel 1018 and corrugated core layers of Steel 1008, both of which are assumed to follow bilinear strain hardening. The developed model is validated with a set of shock tube experiments, making it feasible for a parametric design study. Various corrugated core arrangements are taken into consideration for optimizing core design parameters in order to maximize mitigation of blast load effects onto the structure.