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Performance and Damage Detection of Composite Structural Insulated Panels Subjected to Shock Wave Loading

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Abstract : In the current study, a new type of Composite Structural Insulated Panels (CSIPs) is developed and investigated its performance against shock loading which can replace the conventional wooden structural materials. The CSIPs is made of Fibre Cement Board (FCB)/aluminum as the facesheet and the expanded polystyrene foam as the core material. As tornadoes are very often in the western countries, it is suggestable to monitor the health of the CSIPs during its lifetime. So, the composite structure is installed with three smart sensors located randomly at definite locations. Each smart sensor is fabricated with an embedded half stainless phononic crystal sensor attached to both ends of the nylon shaft that can resist the shock and impact on facesheet as well as polystyrene foam core and safeguards the system. In addition to the granular crystal sensors, the accelerometers are used in the horizontal spanning and vertical spanning with a definite offset distance. To estimate the health and damage of the CSIP panel using granular crystal sensor, shock wave loading experiments are conducted. During the experiments, the time of flight response from the granular sensors is measured. The main objective of conducting shock wave loading experiments on the CSIP panels is to study the effect and the sustaining capacity of the CSIP panels in the extreme hazardous situations like tornados and hurricanes which are very common in western countries. The effects have been replicated using a shock tube, an instrument that can be used to create the same wind and pressure intensity of tornado for the experimental study. Numerous experiments have been conducted to investigate the flexural strength of the CSIP. Furthermore, the study includes the damage detection using three smart sensors embedded in the CSIPs during the shock wave loading.

Keywords : composite structural insulated panels, damage detection, flexural strength, sandwich structures, shock wave loading
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