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EFFECTS OF CORE SPLICES IN STRUCTURES MADE FROM HIGH-PERFORMANCE FIBER-REINFORCED POLYMER SANDWICH SYSTEMS

Abstract

Fiber-reinforced polymer (FRP) sandwich systems as primary load bearing structures have been gaining popularity due to their relatively lower cost and high performance compared to solid laminate systems when designed and built correctly. A common FRP sandwich system consists of solid laminate facesheets on the outer surfaces with an aluminum honeycomb at the core of the sandwich structure. These FRP sandwich structures are currently deployed in a variety of structures ranging from bridge decks, flooring in mass-transit structures to primary load carrying structures in aerospace applications. However, the FRP sandwich structure is prone to damage in all its life phases including transportation, manufacturing, and service. One of the common and potentially catastrophic conditions occurs during manufacturing where splices are needed when using multiple sections of core to form the structure of the FRP sandwich structure. These core splices may result in gaps or discontinuities in the core structure that can result in premature failure in the composite structure.

In this research, the effect of core splice gaps on the performance of FRP sandwich structures consisting of aluminum honeycomb core and carbon-fiber/epoxy facesheets is explored. The experimental and analytical investigation explores the effects of core density, core thickness and facesheet stiffness on the structural response of the FRP sandwich structure. The structure is exposed to bending and low-velocity impact forces to understand how the core splice interacts with the overall structural response. The impacted FRP sandwich panels containing various core splice configurations are examined with thru-transmission ultrasonic inspection to understand the extent of the non-visible damage inside the structure. In addition, 3D Digital Image Correlation is used to investigate the failure modes in the specimens by examining the full-field displacement and strain fields for core-spliced sections of the FRP sandwich structure under loading. Various failure modes are observed ranging from core shear failure, facesheet delamination or fracture depending on the location of the core splice. The result of this research will enable the design and manufacturing of safer and more durable FRP sandwich structures. Best practices for designing and manufacturing of core splices in FRP sandwich structures is proposed with the goal of increasing safety and reliability of FRP sandwich structures.