PERFORMANCE INVESTIGATION OF A FIBER REINFORCED COMPOSITE HONEYCOMB DECK FOR BRIDGE APPLICATIONS

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RESEARCH

Introduction

This report focuses mainly on the evaluation of stiffness and ultimate load-carrying capacity of Glass Fiber Reinforced Polymer (GFRP) honeycomb sandwich panels, with a sinusoidal core, used in bridge applications. Evaluation of fatigue performance is also included.

Project Objective

A preliminary proposal for design procedure of wraps is presented. Several 3D Finite Element models were developed and analyzed in order to better understand the behavior of these complex structural systems.

Project Description

Sixteen full scale panels with cross-section depths ranging from 5-in (125 mm) to 31.5-in (800 mm), instrumented with electrical resistance strain gages, displacement transducers, acoustic emission sensors and optical fibers for strain measurement, have been tested. A complete summary of experimental results is provided for each test, typically in the form of graphs of load vs. deflection and load vs. strain for all measured channels and photographs of failure modes. Coupon tests and shear tests on double lap specimens provided information about constituent material properties.

Project Results

The effect of width-to-depth ratio on unit stiffness was shown to be insignificant for panels with a constant depth of 6-in (150 mm) and width-to-depth ratios between one and five. A simple analytical formula for bending and shear stiffness, based on the material properties and geometry of a transformed section, was found to predict deflections within 20% accuracy. Although some factors influencing the ultimate load carrying capacity were clearly identified in this study, a reliable analytical prediction of the ultimate flexural capacity was not attained. This is due to the fact that failures occur in the bond lines between the outer faces and core, and significant geometric variations along these bond lines can exist due to the wet lay up process—even for theoretically identical specimens. Therefore, the use of wraps or internal ties (seven tested specimens had external wraps) is recommended. This serves to strengthen the relatively weak core-face interface and, as the research suggests, it could bring more consistency in determining the ultimate load-carrying capacity by shifting the ultimate failure from the resin bond material to the glass fibers.

Report Information

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