Proceedings of the Canadian Society for Mechanical Engineering International Congress
32nd Annual Conference of the Computational Fluid Dynamics Society of Canada
Canadian Society of Rheology Symposium
CSME-CFDSC-CSR 2025
May 25–28, 2025, Montréal, Québec, Canada

EXPERIMENTAL STUDY ON PULL-OUT STRENGTH OF SANDWICH COMPOSITE PANELS WITH RECYCLED PET FOAM CORE

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ABSTRACT

Sandwich structures, particularly suitable under flexural loading conditions, are composed of facesheets that carry in-plane loads and a core that supports transverse shear loads. The facesheets are typically made of high-stiffness materials, while the core consists of lightweight materials. Although sandwich structures offer high specific stiffness and strength, they face challenges in joining methods. For polymer matrix composites, the two primary joining techniques are mechanical fastening and adhesive bonding. Adhesive bonding is generally suitable for thin structures with well-defined load paths, whereas mechanical fastening is preferred for thicker structures with complex load paths. Panels examined in the current research were expected to be used in the industrial sectors as a part of the fast-building modular housing and refrigerated truck cabins. In these structures, thick panels are commonly used for their specific thermal insulation properties. Mechanical fastening was considered more suitable for thick panels due to its superior load transfer capabilities, flexibility in assembly, enhanced joint reliability, and ease of inspection and maintenance. One of the crucial aspects of mechanical fasteners is pull-out strength, which ensures the joint ability to resist axial forces, preventing joint failure and maintaining structural integrity under tensile loads. In this study, a pull-out test setup was designed, considering ASTM C900 and ASTM F543 standards, to evaluate the pull-out behavior of screw in sandwich panels. furthermore, a boundary condition was added to the setup to ensure uniform force distribution across the samples and to facilitate numerical modeling for future studies. The examined thermoplastic sandwich composite panels were composed of glass/polypropylene (PP) face sheets bonded to a 100% recycled polyethylene terephthalate (PET) foam core. Sandwich panels with four different PET core densities and three thicknesses were tested to investigate the effects of core density and thickness on pull-out strength. In addition to a variety of composite sandwich panels, the core material (PET) and facesheets (60% glass and 40% PP) were solely assessed under pull-out loading conditions. It has been depicted that besides the effect of core density and thickness on the failure load, the contribution of foam accumulation beneath the facesheet is also significant. Furthermore, different failure modes have been identified in evaluating the peak load values in the force-displacement diagrams. Examination of the cross-sectioned damage areas in the samples also revealed three distinct failure modes in the panel joints: (a) core shear failure, (b) lower face failure, and (c) upper face failure.