COCONUT FIBER REINFORCED POLYMER COMPOSITE FOR NON-LOAD BEARING PANEL WALLS

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Degree of Doctor of Philosophy in Civil Engineering

Department of Civil Engineering

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Declaration of candidate and supervisor

I declare that this is my work and this thesis/dissertation does not incorporate without acknowledgment any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgment is made in the text.

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The above candidate has carried out research for the Ph.D. Dissertation under my supervision.

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Abstract

The study's main aim was to develop a lightweight walling panel for apartment buildings by employing coconut [coir] fiber with waste polyethylene. In this study, the flexural performance of coconut fiber reinforced polymer [CFRP] sandwich panels with different core configurations has studied experimentally and numerically. The numerical investigation was carried out using finite element analysis software "ANSYS 17.2". The coconut fiber reinforced polymer sandwich panel was developed with thin CFRP sheets for the outer faces and cell arrangement for the internal core structure which was made by the same CFRP sheets. The sequences of cells with different core structures were considered to determine the optimum solution for flexural behavior. The first part of this study was the investigation of coconut fiber's physical, mechanical, and chemical properties by using an experimental investigation and a literature review. The next step was to develop the CFRP composites. In this study, the coir fiber was used as reinforced material, and the waste polyethylene was utilized as a matrix material. Composite was developed using hand-layup techniques by varying the coir length and coir weight fractions. This composite material was analyzed using ASTM standards for tensile and bending performance. The sample which optimum results obtained relevant to the coir length and weight fraction were used to develop a composite sandwich panel of 400mm x 400mm in size. The most suitable manufacturing conditions were also studied. The flexural properties of this panel were inspected using experimental and numerical methods. The three-point bending test was carried out to investigate the maximum failure stresses for the panel sample. The next part of this study is to develop the numerical models for the three-point bend test using finite element software. Then, the experimental results obtained from the three-point bend test and numerical outcomes are compared and validated. In the end, the numerical analysis is expanded to examine the sample panel's flexural performance of different cell arrangements. Finally, the failure stresses and the volume at minimum failure stress were identified for each cell configuration. This result concluded that the best cell configuration with minimum weight for wall panels was the result. The proposed wall panel should be durable and low-cost. Therefore, service characteristics and production costs were analyzed. Further, to extend this research, the proposed wall system's life cycle cost and embodied energy were analyzed to identify the long-term benefits of the proposed walling system.

Keywords: Coir fiber, Polymer material, Sandwich wall panel, Mechanical properties, Physical properties.

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