NUMERICAL MODELLING OF FIRE PERFORMANCE OF CFRP/CONCRETE COMPOSITES INSULATED WITH THE WASTE-BASED INSULATION

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This research presents the numerical investigation of the fire performance of the CFRP (carbon fibre reinforced polymer)/ concrete composite. Also, some insulation methods and results with variable parameters are discussed. Carbon Fibre Reinforced Polymer (CFRP) composites are the best reinforcement system for upgrading concrete and steel structures. But still, the fire resistance of CFRP/Concrete composite is unsolved. So, an appropriate insulation system is needed to protect CFRP/composite from fire. Also, these methods have several drawbacks: expensive, extra load on the structure, technical feasibility, time-consuming, and poor aesthetic appearance. This study is mainly focused on finding waste-based insulation for CFRP/concrete composite by numerical modelling. The bond between CFRP and concrete will be affected heavily when subjected to moderately increased temperatures. Several researchers focused on a finite element model developed to predict the performance of CFRP/concrete composites subjected to high temperatures. A 3-D numerical model of a reinforced concrete beam flexurally strengthened with externally bonded CFRP strips was developed (using ABAQUS software) to perform the simulation. CFRP/concrete interaction was modelled with the single bond-slip law. The numerical results were compared with experimental results. ISO 834 standard fire was applied during the thermal analysis. The model provided a moderately accurate value for the thermo-mechanical fire response of the beam. In the finite element analysis, calcium silicate board, bottom ash-based plaster, rice hush ash-based plaster, bagasse, and rice husk ashes plaster, etc., were thermally modelled as CFRP/concrete composite insulation. As one of the results from the simulations it was observed rice husk fibre insulated beam can withstand 87 mins during ISO 834 standard fire.

Keywords: Epoxy adhesive; Fire; Heat transfer; Insulation; CFRP/concrete composite

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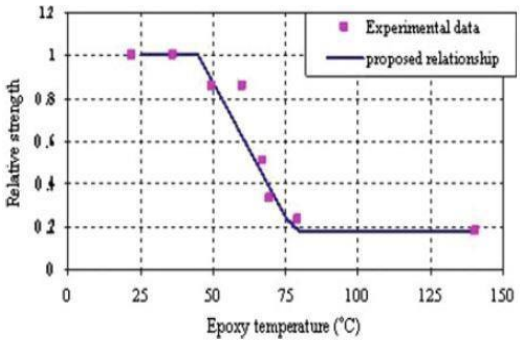
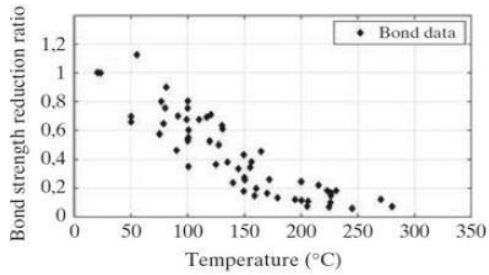
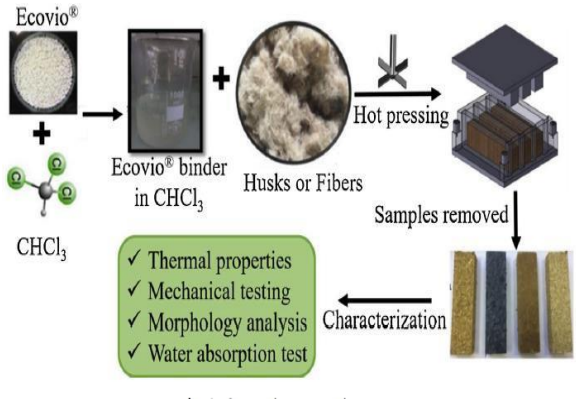


Relative strength of CFRP with epoxy temperature

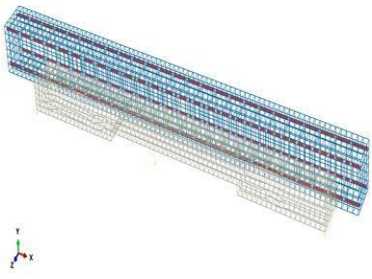


CFRP Bond strength variation with temperature

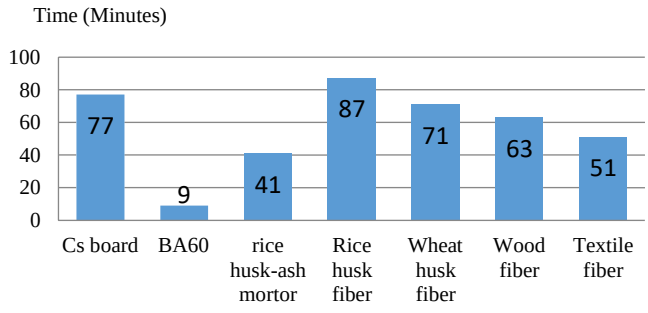


Composite processing steps

Waste based composites



FE mesh of the simulated thermal model



Time to loss of CFRP strengthening for different insulation materials