DEVELOPMENT OF AN INSULATION PLASTER FOR FIBER REINFORCED POLYMER (FRP) CONCRETE COMPOSITES USING CEMENTITIOUS MATERIAL

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Degree of Master of Science

Department of Civil Engineering

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DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement 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 acknowledgement is made in the text.

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The above candidate has carried out the research for Masters under my supervision

Name of the supervisor: Dr. (Mrs.) J.C.P.H. Gamage

Signature of the supervisor: Date:

Name of the supervisor: Dr. G.I.P. De Silva

Signature of the supervisor: Date:

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ABSTRACT

The energy used to maintain the thermal comfort of building greatly contributes the greenhouse gas (GHG) emissions and global warming. This study developed a sustainable cost-effective rice husk ash (RHA) based mortar for the wall plaster to improve the thermal insulation, reduce the operational energy and enable the thermal comfort. RHA was partially replaced the sand in the conventional mortar to produce the RHA based plaster. Compressive strength and thermal conductivity tests were conducted, and the results highlight that the RHA can be replaced up to 30% of sand in the conventional mortar to produce a wall plaster with improved thermal insulation with adequate compressive strength. Further, this study investigates the thermal performance of the RHA-based plaster through measured the heat transfer rate under full open weather conditions. Two identical prototype model houses were constructed with RHA-based plaster and conventional plaster, and internal and external wall surface temperatures were measured for 3-days cycles. The results highlighted that on average peak heat flux reduction formed by the RHA-based plaster mortar was 10%. The average daily heat transfer reduction across the wall with RHA-based plaster was 26%. Further, results show that RHA-based plaster can reduce the energy that required to enable the thermal comfort by about 9% than the conventional mortar. The environmental impact analysis was also conducted to assess the sustainable performance of RHA-based mortar. The assessment highlights that RHA-based mortar has less environmental impact than the conventional mortar. Further, the CO_2 emission produced by the production of RHA-based mortar is about 14% less than that of from conventional mortar. At last stage the developed plaster was applied with CFRP specimens and checked for the thermal test and bond test using single shear test. 70% to 73% fire resistance can be achieved respect to the commercially available material (Vermiculite-cement).

Keywords: Plaster; Rice Husk Ash; Thermal properties; Life cycle Assessment; Compressive strength; Heat transfer analysis; Heat flux

LIST OF PUBLICATIONS

International Journals

1. Development of innovative Rice Husk Ash based insulated mortar to enhance thermal performance in buildings– construction and building materials– Under review
2. Utilization of crushed tile coarse aggregate (CTCA) and rice husk ash (RHA) as partial replacements of natural coarse aggregate and binding material in concrete– Advances in Civil Engineering – Under review
3. Behaviour of CFRP strengthened concrete curved beam subject to out of plane bending -Engineering Structures– Under review

International Conferences

1. Thermal Performance of Rice Husk Ash mixed mortar in Concrete and Masonry Buildings - 10th International Conference on Advanced Models and New Concepts in Concrete and Masonry Structures, Poland, Lublin -Indexed conference- journal "Budownictwo i Architektura" (Civil Engineering and Architecture) https://doi.org/10.35784/bud-arch.2121
2. An investigation into the flexural behaviour of horizontally curved beams strengthened with NSM CFRP LAMINATES- International Conference on Civil Engineering and Application, Moratuwa, Sri Lanka - Published

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