UNIVERSITY TEKNOLOGI MARA

PHYSICAL, MECHANICAL AND MICROSCOPIC ANALYSIS OF HYBRID POLYPROPYLENE-STEEL FIBRE REINFORCED CONCRETE UNDER ELEVATED TEMPERATURE

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MSc

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Concrete, when exposed to high temperature, can cause spalling, cracking, and severe damage, which could lead to sudden collapse of a building. One of the solutions for overcoming this weakness of concrete is by incorporating fibres in the concrete mix. Concrete incorporated with more than one type of fibres is often known as Hybrid Fibre Reinforced Concrete (HFRC). HFRC offers numerous benefits in terms of its physical properties such as compressive and flexural strength, and microstructural properties such as cement-aggregate interfacial bond, micro-crack and pore structure. This study employs two different fibres incorporated with HFRC which are steel fibre (SF) and polypropylene fibre (PPF) to provide better mechanical and durability properties compared to other combination of hybrid fibres. To determine the resistance of high-performance concrete with fibres on its physical and microscopic behaviours when it is exposed to elevated temperatures ranging from 200°C to 800°C, compression test and 3-point bending test are conducted. The HFRC was prepared by incorporating 0.5% SF and 0.5% PPF with high strength concrete grades 50 and 60. In general, it was found that combination of PPF and SF in the HFRC inhibited cracks in concrete and improved both the compressive and flexural strengths even after it was exposed to high temperatures. Scanning Electron Microscope (SEM) was used to study the microstructural properties of HFRC in terms of cement-aggregate interfacial bond, micro-crack and pore structure. As a result, from compressive and flexural tests, it was found that the failure mode of the hybrid concrete delayed significantly compared to the control concrete samples. The test result of the HFRC also indicates as the highest percentage of improvement in terms of the mechanical properties i.e. residual strengths of compressive and flexural with 60% and 39%, respectively. It was shown that the HFRC has effectively improved in physical properties i.e. bonding and lowering the tendency of spalling at high temperature due to bridging effect of SF and the cement-aggregate interfacial improvement bond resulted from the micro-pores filled by melted PPF that was observed from the SEM analysis. Thus, the use of the HFRC can be very effective in improving the physical, mechanical and microscopic properties of HFRC after being exposed to high temperatures.

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