UNIVERSITI TEKNOLOGI MARA

FLEXURAL PERFORMANCE OF SELF-COMPACTING FIBRE REINFORCED CONCRETE (SCFRC) RIBBED SLAB

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of the requirements for the degree of
Doctor of Philosophy
(Civil Engineering)

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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

This research aims to assess the full potential of the steel fibres as the only reinforcement combined with self-compacting concrete (SCC) for self-compacting fibre reinforced concrete (SCFRC) ribbed slab application. The main objectives of this research are to analyse the effect steel fibre provision of fully and partially steel fibre reinforcement as well as the effect of topping flange thicknesses to the flexural response of SCFRC ribbed slab panels. A total of thirteen (13) slab samples were cast; i.e. conventionally reinforced solid slab and ribbed slabs as control samples (CRC), fully steel fibre reinforced ribbed slab (SFWS), partially steel fibre reinforced ribbed slab with welded mesh reinforcement (SFT) and finally, partially steel fibre reinforced ribbed slab without welded mesh reinforcement (SFR). Significantly higher first crack loads were also recorded for all SCFRC samples as compared to the control samples, which clearly proved the ability of discreet fibres to arrest cracks in the concrete matrix. The fully steel fibre reinforced samples exhibited the highest and almost equivalent flexural capacity to the conventionally reinforced control samples with a maximum of 20% difference in terms of the ultimate loading achieved satisfactory gradual softening behaviour up to displacement of 32 mm displacement. It also resembled the behaviour of the control samples by experiencing multiple cracking at the slab soffit while the partially reinforced ribbed slab samples experienced single, concentrated major crack. The highest energy absorption capacity was also achieved by the fully steel fibre reinforced samples resembling the effectiveness of the steel fibres to transfer stresses within ribbed slab. Furthermore, the topping flange thickness exhibited significant effect on the fully steel fibre reinforced samples with the highest flexural capacity and energy absorption capacity with 120 mm topping flange thickness. However, the increase resulted in steeper softening curves in all ribbed slab samples. From the FEA findings, slabs with 80 and 100 mm flange thickness showed higher stress-strain values than the experimental results with acceptable maximum percentage difference of 12.9% of the ultimate bending stress and 3% lower for the 120 mm flange thickness sample. The fully steel fibre reinforced sample with the highest topping flange thickness (SFWS120) is proposed as the optimum SCFRC ribbed slab design with high flexural capacity with high corresponding displacement exhibiting sufficient amount of ductility at ultimate limit state. The new knowledge on the promising performance of the SCFRC material obtained from this research offers an essential contribution towards producing a slab structure with equivalent structural performance that could match the existing structure applying conventional construction method. Furthermore, it could also contribute towards sustainability by the introducing the rib profile that utilizes lesser concrete volume, hence minimizing the concrete and cement consumption.

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Hazrina Ahmad

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