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Modelling of Braided Fibre Reinforced Concrete

M. Cortis[1], L. Kaczmarczyk[2] and C.J. Pearce[3]

[1] The University of Glasgow, Rankine Building, School of Engineering, Oakfield Avenue, Glasgow, G12 8LT, United Kingdom, m.cortis.1@research.gla.ac.uk
[2] The University of Glasgow, Rankine Building, School of Engineering, Oakfield Avenue, Glasgow, G12 8LT, United Kingdom, Lukasz.Kaczmarczyk@glasgow.ac.uk
[3] The University of Glasgow, Rankine Building, School of Engineering, Oakfield Avenue, Glasgow, G12 8LT, United Kingdom, Chris.Pearce@glasgow.ac.uk

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Braided fibre reinforced concrete represents a novel fire-resistant structural material. Fibres such as carbon and glass resist temperatures above 500^{o}C in inert environments. The lack of polymer matrix, which melts at temperatures below 200^{o}C, will avoid lubrication between fibres and concrete. The mechanical behaviour of braided fibres (ropes) and the bond behaviour between fibres and concrete have been studied experimentally by the authors to understand the stress transfer between the two materials. Preliminary results show a feasible ribbing system for Marlow T12 Technora fibre ropes, achieving a good adhesion bond between the braided ropes and concrete [1].

This paper presents a large strain finite element modelling approach using hierarchical p-refinement [2] to investigate braided fibre reinforced concrete. The performance and convergence properties of the p-refinement strategy is demonstrated.

In the pre-processing stage, a python/Aprepro script was programmed to generate the geometry and mesh for braided ropes on Cubit [3]. The braided ropes are modelled using a transversely isotropic material. The fibre directions were obtained by solving a potential flow problem, whereby the velocity gradient was determined at every integration point. The interface was modelled using a cohesive zone formulation. Performance of the complete model is demonstrated on a number of numerical examples, including comparison with experimental results. In particular, the behaviour of the braided ropes with and without the proposed ribbing system is shown.

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