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Size effect on splitting strength of hardened cement paste: experimental and numerical study

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Abstract: Cement paste possesses complex microstructural features including defects/pores over a range of length-scales, from nanometres to millimetres in size. As a consequence, it exhibits different behaviour under loading depending on the size. In this work, cubic specimens in a size range of 1: 400 were produced and tested by a one-sided splitting concept using different testing instruments. The smallest specimen with size of 100 µm showed a high nominal splitting strength (18.81MPa), an order of magnitude higher than the measured strength of 40 mm specimen (1.8 MPa). The test results were used to fit existing analytical size effect models. Although a good fit can be found for the existing size effect models, special attention should be given to the physical meaning behind these empirical parameters. In addition, a multi-scale modelling strategy that considers microstructural features at different length scales was adopted to model the trend of decreasing strength with specimen size observed in experiments. A good agreement between experimental observations and modelling results indicates that the featured material structure dominates the observed size effect on measured strength in the size range considered.

Keywords: Micro-mechanical testing; Multiple length scales; Splitting tensile strength; Lattice modelling; Hardened cement paste