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A simplified five-point inverse analysis method to determine the tensile properties of uhpfrc from unnotched four-point bending tests

Juan Ángel López, PhD Student, Pedro Serna, University Professor, Juan Navarro-Gregori, Assistant Professor, Hugo Coll

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ABSTRACT

Characterisation of the tensile behaviour of UHPFRC remains a challenge for researchers, and an agreement on the standard test set-up and advisability of notch is yet to be reached. Bending tests are easier to conduct if compared to direct tensile tests, but require a sophisticated post-process to obtain the uniaxial tensile behaviour of specimens. Unlike notched tests, unnotched tests allow the determination of strain-hardening behaviour, which characterises UHPFRC tensile behaviour. However, post-cracking behaviour is more difficult to analyse.

This work focuses on the development of a new simplified inverse analysis method applied to unnotched four-point bending tests which improves current simplified methods, but maintains the accuracy of more complex ones. For this purpose, an analytical model based on a quadrilinear assumption of tensile behaviour in tension was assumed. A statistical analysis of theoretical flexural strength *vs.* displacement on mid-span analytical curves was conducted to link the assumed tensile behaviour to the analytical flexural behaviour that derived from it. After this process, a simplified method to obtain not only the stress-strain behaviour prior to crack localisation, but also the stress-crack opening relationship after that point is proposed. The new method is based on the determination of only five key points in experimental bending strength *vs.* displacement at mid-span curves and in the application of a back-of-the-envelope calculation.

The analytical basis on which the method is based, justification of key point selection, and the process followed to achieve the simplified formulation, which allows dispensing with the use of a computer, are presented. An application example on a UHPFRC unnotched four-point bending test specimen, and its comparison with a point-by-point inverse analysis, are included.