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MODELLING UHPFRC TENSION BEHAVIOR UNDER HIGH STRAIN RATES

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Abstract. The advantages of Ultra High Performance Fiber Reinforcd Concrete (UHPFRC) under static loads suggest it is a promissory material to withstand dynamic and especially extreme loads. However, the available results concerning dynamic behaviour of UHPFRC under high strain rates are still rather limited and there are some aspects that require further analysis and the development of numerical tools. A numerical model for UHPFRC is presented and applied to the simulation of high strain tension tests in this paper. The tension tests were performed in a Modified Hopkinson Bar with different strain rates and they include UHPFRC using different contents and orientations of smooth straight steel fibers. The numerical model is based on the modified mixture theory and takes into account the behaviour of the matrix and the fibers and the fiber/matrix sliding using a meso-mechanic pull-out model. The model was implemented in a non-linear dynamic finite element explicit code that constitutes a useful numerical tool for the design and analysis of structures made of this material. High strain rate tension tests were numerically simulated. The comparison of numerical and experimental results allows calibrating the material properties, validating the model and analysing the strain rate dependence of the composite and the contribution of each of the component materials and the pull-out mechanism. Tension dynamic amplification of UHPFRC is mainly due to the Ultra High Performance Concrete (UHPC) matrix and the pull-out mechanism. The dynamic amplification of the fibers pull-out mechanism is lower than that of the matrix and increases with fiber inclination.

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