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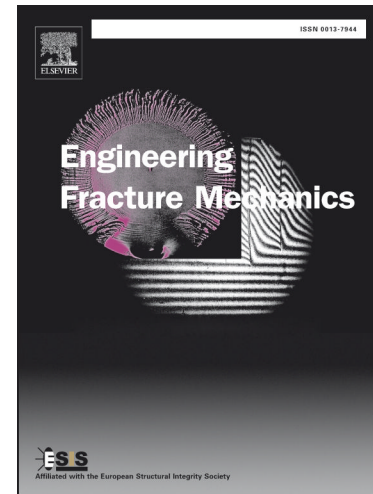
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A NOVEL APPROACH TO ESTIMATE THE EVOLUTION OF FRACTURE ENERGY AND TENSILE SOFTENING CURVE OF CONCRETE FROM VERY EARLY AGE

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Abstract:

Concrete fracture properties and their evolution over time are critical inputs for numerous engineering aspects. Despite substantial efforts invested, there exists a crucial need to establish a comprehensive model for reliable estimation of such evolution. In this paper, combining reliable experimental data and in-depth analyses, a novel approach for estimating of the evolution of fracture energy and tensile softening curve of concrete from early age is proposed. Fundamentally, the approach relies on three criteria, namely (i) Tensile strength, (ii) Tensile strength-fracture energy correlation and especially, (iii) Centroid coordinates of the area under actual stress-crack opening curve. Through detailed assessment of all mentioned criteria and with provided examples of direct applications, the capability and reliability of the approach are clearly demonstrated.

Keywords: Fracture energy; tensile softening curve; centroid coordinate; bi-linear approximation; power approximation.

1. Introduction

Since its first introduction by Hillerborg [1], the cohesive model has become widespread with *fracture energy and tensile softening behaviour* being two of the most important factors, when it comes to the study of concrete fracture properties. Along with extensive effort invested so far for mature concrete [2-10], there exists a crucial necessity to establish an appropriate model, to estimate the evolution of both indicated factors at different age, spanning from concrete's infancy to its maturity. The obtained knowledge is *not only* critical for numerous direct applications such as pre-casting, pre-stressing and practical design against premature cracking, *but also* important for further research by simulation/modelling.

Despite its significance, very limited available studies can be found, and most of which unfortunately suffers at least one of the following drawbacks:

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