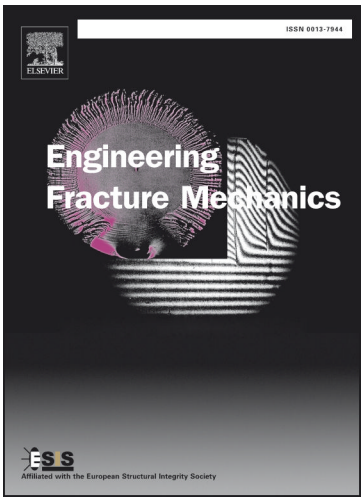

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Effect of Meso-structure on Strength and Size Effect in Concrete under Compression

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Abstract

The effect of heterogeneity in meso level geometric and material properties on compressive strength and size effect in concrete cylinders is investigated. Crucial meso geometric parameters are identified by studying specimens belonging to three distinct gradations and spanning a range of sizes. A statistical analysis is used to account for dependencies between the parameters. Compressive strength and size effect are seen to depend on the degree of heterogeneity of critical meso parameters. For moderately sized specimens, major trends in the size effect are seen to be almost entirely explained by heterogeneity in the meso geometry; heterogeneity in meso level material properties is seen to be of comparatively less importance.

Keywords: Size effect; Meso-structure; Discrete element method; Concrete.

1. Introduction

Since the experiments of Gonnerman (Gonnerman, 1925) it has been widely accepted that compressive strength in concrete is specimen size dependent. For a long time, it was believed that the size effect was purely statistical in nature. However research by Bazant and others has led to an appreciation of the role of deterministic factors, often collectively referred to as the energetic size effect. Bazant & Xiang (1997) used a continuum formulation and the concept of a propagating "splitting band" to explain the size effect in compression. The authors suggested that global failure was driven by buckling of micro-slabs of material within an inclined splitting band. The size effect was found to vary as $D^{-2/5}$, D being the characteristic size of the specimen. Kim *et al*. (2002) took as their starting point the Bazant size effect law of 1984 (Bazant, 1984), which describes the energetic size effect in specimens with a pre-existing crack, and proposed modifications to allow its use in specimens without initial cracks. They also suggested the use of an effective specimen dimension to enable extension of the size effect law to non-self similar specimens. Subsequently, Viso *et al*.