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3D & three phase's micromechanical constitutive model for the Uniaxial compression test of concrete

I.Rasoolan[1] S.A.Sadrnejad[2]

1- Assistant professor of civil Eng ,Eng. Faculty, shahid chamran university of ahvaz
2-Professor of civil Eng ,Civil Eng. Faculty ,K.N.T University
Email:Rasoolan82@gmail.com -sadrnejad@hotmail.com
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ABSTRACT

The mechanical behavior of concrete materials is strongly influenced by its microstructure. The macroscopic properties of concrete materials such as strength and stiffness are dependent on the properties micromechanics. The advance of composite mechanics and advanced computing technologies has made possible the micromechanical analysis of concrete materials.. In the first status of micromechanical modeling with special emphasis on the advantage and disadvantage of each model is presented.
The current paper focuses on the geometrical description and numerical simulation of normal-weight concrete at the mesoscale. In the first part the numerical representation of concrete at the mesoscale is introduced. The internal structure of concrete is considered at the micro level, and is treated as a three phase material comprised of aggregate particle, matrix, and the aggregate-matrix interfaces The generation of the mesoscale geometry, the finite element discretisation and the applied material laws Whit micro plane theory are described.
The main objective of this paper is to investigate the macroscopic behavior and Progressive failure of concrete materials under static loading, as influenced by the properties of its constituents at the meso level.

Keywords: Three phases, Concrete, ITZ, Finite element, Micromechanical

1. INTRODUCTION

Concrete is one of the most popular construction materials, and people have been Using it for long time. Many models, theories and numerical techniques have been developed to represent its mechanical behaviour, including a large variety of constitutive models, damage models and other novel developments such as the micro plane model. However, progressively more elaborated constitutive relations have also required a large number of parameters, sometimes difficult to obtain and with no clear physical meaning.

In the 1980s, the meso mechanical approach, sometimes known as numerical concrete, was proposed by roelfstra et al, and then was followed by others [1]. It consisted of discretizing the first level of material (meso structure) and assigning to each material component its individual geometry and properties. There is no doubt that the complexity of the nonlinear behaviour of concrete may be largely associated to its heterogeneity and components. Therefore,it seems reasonable that onsidering explicitly each material component(geometry and mechanical properties) will allow us to consider simpler constitutive assumption in exchange for an increasing size of the global problem. After the pioneering work of roelfstra, different methodologies for considering the meso structure have been proposed such as lattice models, particle models, continuum meso models, DEM models [2] and FEM models [3].