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Hassan Baji, Chun-Qing Li

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An Analytical Solution for Hydraulic Conductivity of Concrete Considering Properties of the Interfacial Transition Zone (ITZ)

Hassan Baji[1] and Chun-Qing Li[2*]

[1] Research Fellow, School of Engineering, RMIT University, Melbourne, 3000, Australia.

[2*] Professor, School of Engineering, RMIT University, Melbourne, 3000, Australia,

ABSTRACT

As a composite material, hydraulic conductivity of concrete depends on conductivity of its components that are the mortar, aggregates and the Interfacial Transition Zone (ITZ). Since hydraulic conduction is analogous to heat and electrical conduction, analytical models from these analogous areas relating effective conductivity of composite to conductivity of its components can be used to find the effective hydraulic conductivity of concrete as a function of properties of its components, i.e., aggregate, mortar and the ITZ. However, effect of the conduction in the ITZ has not been considered in these models. This paper presents an analytical solution for the hydraulic conductivity of concrete as a three-phase composite material. The solution is an extension to the model originally proposed for conduction of composite media with randomly suspended spheres. Results of the proposed model compare well against the experimental results and those obtained from rigorous numerical analysis using the Finite Element (FE) method. The principal significance of this study lies in the development of a versatile analytical model that can be employed as a quick tool for assessment of hydraulic conductivity of concrete without the need for sophisticated FE models at the meso-scale level. It offers more insight into effect of different components of concrete on its overall conductivity.

KEYWORDS

Hydraulic Conductivity; Analytical; Concrete; Interfacial Transition Zone (ITZ)

Corresponding Author, Email: chunqing.li@rmit.edu.au

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