

Accepted Manuscript

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PII: S0263-8223(17)33139-2

DOI: <https://doi.org/10.1016/j.compstruct.2017.12.074>

Reference: COST 9231

To appear in: *Composite Structures*

Received Date: 24 September 2017

Revised Date: 5 December 2017

Accepted Date: 28 December 2017



Please cite this article as: Ding, Y., Li, D., Zhang, Y., Quantitative analysis of macro steel fiber influence on crack geometry and water permeability of concrete, *Composite Structures* (2017), doi: <https://doi.org/10.1016/j.compstruct.2017.12.074>

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Quantitative analysis of macro steel fiber influence on crack geometry and water permeability of concrete

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Abstract: In this work, the water permeability of the cracked concrete has been investigated. Three types of cylindrical specimens with different fiber content were pre-cracked by the feedback controlled splitting test, and the specimens without any fiber reinforcement were also studied as reference. The water permeability of the specimens with different crack width was measured by hydraulic permeability test. The coordinate data of the crack surface was collected by the self designed data acquisition system, the total crack length and surface area of the samples were analyzed, the crack geometry (tortuosity and roughness) was evaluated quantitatively. A modified factor ζ was introduced to the Poiseuille law to verify the permeability of the cracked specimen. The results showed that with the addition of macro steel fibers, the deformability of the specimens was improved significantly and the crack width could be controlled. The coefficient of the water permeability of the specimens was declined by fiber addition, the modified Poiseuille law could be used to evaluate the water permeability of the cracked concrete, the modified factor ζ decreased with the increasing of fiber dosage. The crack tortuosity and surface roughness increased obviously with the addition of steel fiber.

Keywords: cracked concrete; steel fiber; water permeability; crack tortuosity; surface roughness

1. Introduction

The water permeability plays a significant role in the serviceability and durability of concrete.

Currently, the water permeability of the concrete is measured by the penetration test of un-cracked

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