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A review of the chloride transport properties of cracked concrete: experiments and simulations

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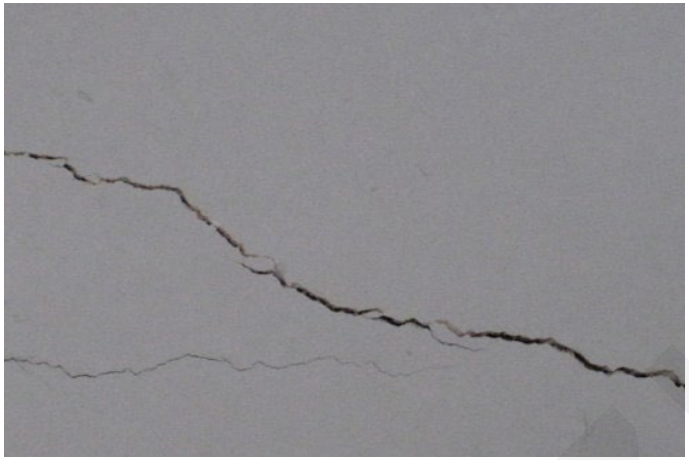
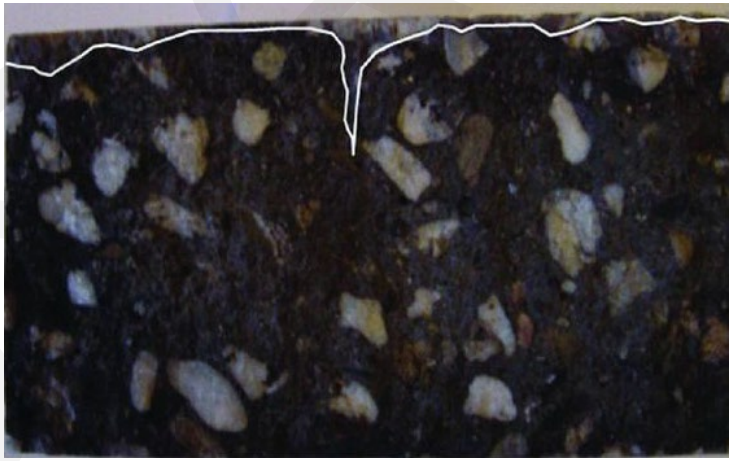
Introduction

- Cracks in Concrete:



- Chlorides transport in cracked concrete:



- Cracks can alter the chloride transport behavior in concrete and influence the service life of concrete structure;

- Aim of the paper:

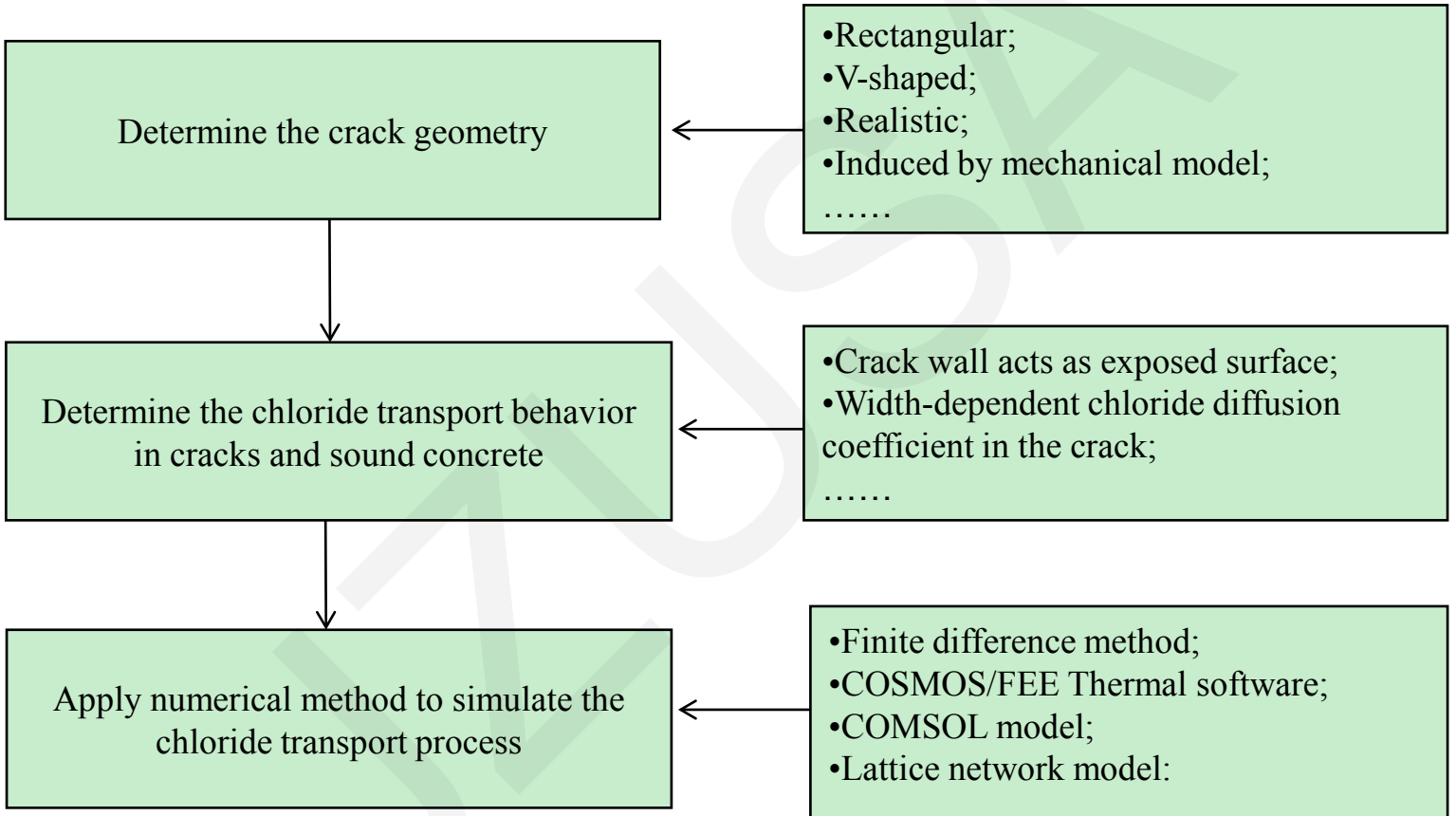
The aim of this paper is to review the research efforts on the experimental studies and simulations on the influence of cracks on the chloride transport properties of concrete

Experimental studies

The influence of crack width on the chloride transport properties of cracked concrete

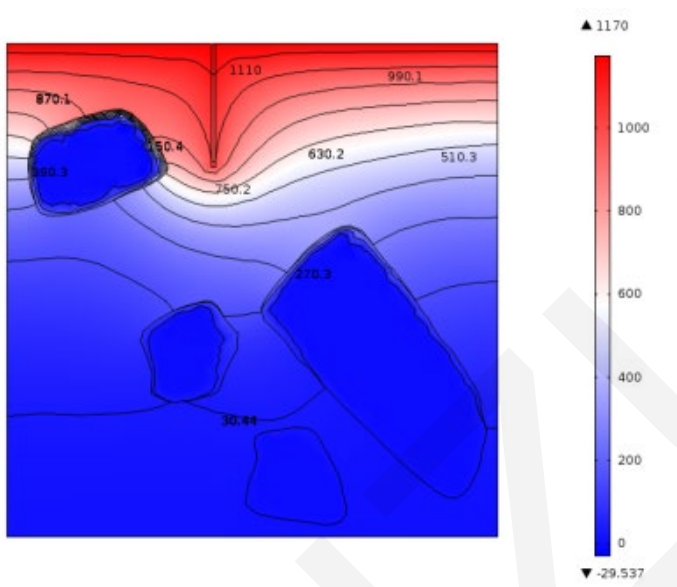
	Method to produce cracks	No obvious influence (no diffusion occurs along the crack path)	Influenced by the crack width	Crack walls considered as surfaces exposed to chloride
Ismail et al., 2008	Expansive core method	< 0.03 mm	0.08-0.1 mm	> 0.2 mm
Rodriguez and Hooton, 2003	Artificial cracks	--	--	0.08 - 0.68 mm
Marsavina et al., 2009	Artificial cracks	--	--	0.2 - 0.5 mm
Audenaert et al., 2009a	Three-point bending test and Brazilian splitting test	--	0-0.1 mm	0.1 - 0.2 mm
Yoon and Schlangen, 2010; 2014	Artificial cracks	< 0.013 mm for short term test; < 0.04 mm for long term test;	--	--

Simulations

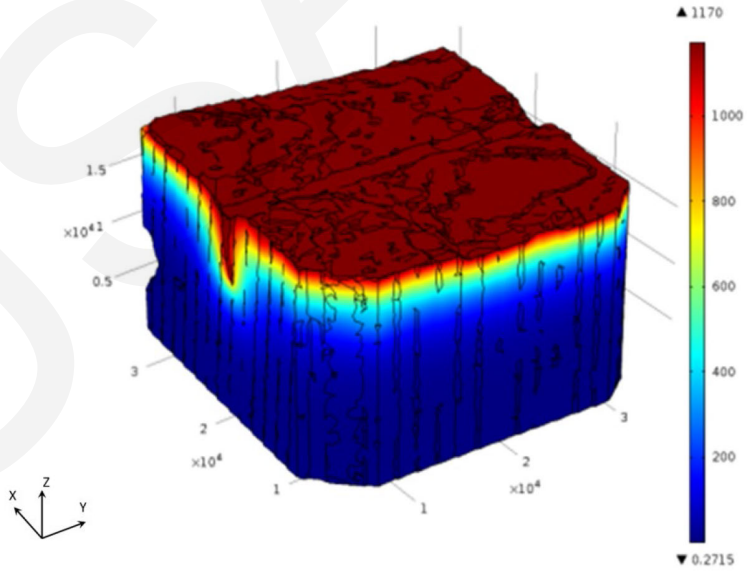


Procedures to simulate the chloride transport process in cracked concrete

Simulations



The chloride concentration contour at a cutting plane of a virtual concrete structure at 30 days



The simulated chloride concentration contour in cracked concrete at 30 days

Conclusions

- For concrete structures exposed to chloride environments, the corrosion of reinforced steel is the major deterioration mechanism. In most cases, cracks exist in concrete structures and play an important role in their durability, and may especially affect the chloride transport properties of the concrete.

- Both experimental and simulation studies have been performed on the influence of cracks on the chloride transport process in cracked concrete. Many achievements have been made, providing significant insights on this phenomenon.

- Although some progress have been made on this subject, further studies are still necessary. Further studies on chloride transport properties and deterioration mechanisms of cracked concrete could lead us closer to making reliable models for predicting the service life of real cracked concrete structures.