UTS UNIVERSITY OF TECHNOLOGY SYDNEY

Assessment of Residual Load Capacity of ASR Affected Reinforced Concrete Structures

by Jinsong Cao

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DOCTOR OF PHILOSOPHY

under the supervision of

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Certificate of Original Authorship

I, *Jinsong Cao*, declare that this thesis, is submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the School of Civil and Environmental Engineering, Faculty of Engineering and Information Technology at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualification at any other academic institution.

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Abstract

Alkali-silica reaction (ASR) in concrete is one of the most harmful long-term durability problems for concrete structures. Concerns about the potential risks of ASR to the affected structures led to considerable research in the past several decades. Conventionally, field load testing on actual structures, or large scale in-situ testing are employed to assess the residual load capacity of the ASR affected structures. Such methods, however, are labour intensive, time consuming and may cause unpredictable further damage to the structure. This study aims to investigate the residual load capacity and bond deterioration of ASR affected reinforced concrete structures through laboratory accelerated tests. Based on previous research on accelerated autoclave test for ASR, a novel multi-cycle accelerated test by adopting 80 °C steam warming, with 60-hour cycles and appropriate alkali loading is investigated. Results revealed that, for concrete with highly reactive dacite aggregate and 2.5% alkali boosting, an expansion of 0.18% was achieved after 3 cycles. The compressive strength showed an initial increase at low expansion levels followed by a reduction at higher expansion levels. Modulus of elasticity, however, systematically decreased with increasing expansion. Furthermore, the multi-cycle accelerated test was applied to study the flexural and shear behaviour of small-scale reinforced concrete beams. Results suggest that chemical prestressing induced by ASR expansion has beneficial effects on strength and stiffness of the affected structure at early stages. Effect of high ASR expansion levels on the long-term structural behaviour, however, needs further investigation.