

You are cordially invited to the seminar organised
by Protective Technology Research Centre (PTRC).

Seminar on

Evaluation of Residual Performance of Corroded RC Structures by Meso-Scale 3D Discrete Analysis Model

Abstract:

Corrosion is one of the most serious problems affecting old infrastructure. Evaluation of the residual performance of corroded structures is important for the maintenance of existing infrastructure, but where corrosion is present the non-uniformity of the damage presents a more difficult situation. The local nature of such damage means that structural capacity can vary with location. Moreover, cracking damage resulting from local corrosion is unsuitable for analysis by the smeared crack concept.

The aim of this study is to develop a numerical model based on discrete analysis, which is more suitable for this three-dimensional (3D) corrosion problem. A numerical system for predicting post-corrosion structural behaviour and residual capacity at the meso scale is developed using the discrete analysis method known as the Rigid Body Spring Model (RBSM). Model development is based on experimental data on surface crack width and corrosion percentage obtained from actual corroded reinforced concrete members. The simulation scheme is divided into two components: a corrosion damage simulation and a mechanical loading simulation. This corrosion model consists of algorithms for expansion damage, reduction in rebar effective cross-sectional area, and bond deterioration. A model for the interface between corroded rebars and concrete is developed based on rebar pull-out experiments.

Using the new model, beams with different corrosion patterns are simulated and analysed. The simulation results are then compared with previous experimental results in order to verify the applicability of developed model. Good agreement is obtained, and the model is able to simulate the residual capacity and stiffness reduction of corroded beams appropriately. Cracking patterns similar to those seen in the experimental results are obtained.

In the real structures, however, corrosion level in the concrete is difficult to estimate that causes the difficulty of evaluation of the structural performance. Therefore, it becomes important to capture the surface damage condition efficiently and estimate the inside. Here, new technology to detect the surface damages, delamination and rebar exposure, from images by Fully Convolutional Network (FCN), one of Deep Learning technics, is introduced. Also, an attempt to estimate the inside corrosion level from the surface cracking condition by 3D RBSM and the future perspective are presented in the seminar.

Speaker:

Dr Kohei NAGAI is an Associate Professor at the International Center for Urban Safety Engineering (ICUS), Institute of Industrial Science, The University of Tokyo. After he received his PhD from Hokkaido University, Japan in 2005, he spent two years as a JSPS Post-Doctoral Research Fellow at the Swiss Federal Institute of Technology Zurich (ETH). He was appointed as an Assistant Professor in 2007 at The University of Tokyo, and has been in the current position since 2011. His research interests are in the field of structural engineering and its management. He is doing research on meso-scope simulations of concrete materials and reinforced concrete structures, mechanics of fiber reinforced cementitious composites, analysis and utilisation of road and bridge inspection database, and infrastructure management for developed society.

Date: 2 April 2019 (Tuesday)

Time: 11.00am to Noon

Venue: CEE Seminar Room A, Block N1, Level B1, N1-B1b-06

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