Microstructure Based Life-Cycle Assessment and Durability Design of Concrete Bridges

ABSTRACT:
Moisture and cracks are the main sources of structural concrete nonlinearity, and understanding the interactions between the two is the key to determine long-term durability performances. The seminar firstly deals with moisture migration and its volume change with creep in four in-service PC bridge viaducts that are experiencing excessive deflections by using a 3D integrated micro-material-structural modeling. It is found that moisture-migration related deflections driven by the capillary surface tension and disjoining pressures in micro pores account for 25 to 45% of the macroscopic deflections.

The technical talk then deals with water-crack interaction in RC bridge decks under moving loads. It is found that the water presence on the upper deck parts, when subjected to high-speed traffics, can shorten the deck fatigue life by one-and-a-half order of life-span. This reduction in life is due to high water pressure developing over a large numbers of wheel passages as well as the reduced shear transfer along crack planes. The crack-to-water interaction is formulated in use of Biot's theorem on which the possibility of simulating the solidification in between cracks will be discussed.

BIO:
Dr. Eng. Koichi Maekawa is a Professor of Department of Civil Engineering at the University of Tokyo, Japan. He is also the Director of Center for International Affairs of School of Engineering and Advisory Board member to the Dean. His research fields are nonlinear mechanics of reinforced concrete, seismic design, multi-scale modeling of cementitious composites, self-compacting high performance concrete (the first patent holder of SCC) and soil-structure interaction. He serves as Chairman of Structural Design Code Committee of Japan Society of Civil Engineers (JSCE), Chairman of Japan Concrete Institute (JCI) Scientific Committee, Editor-in-chief of Journal of Advanced Concrete Technology and Chairman of Screening Committee on Engineering Grant-in-Aid of Ministry of Land and Transport of The Japanese Government. Professor Maekawa has received many awards. In 2011 alone, he received the Japan Concrete Institute Award (research), the Distinguished Service Award from Japan Society of Civil Engineers, the Book of the Year Award from Japan Society of Civil Engineers, the Small and Medium Enterprises New Technology Award, and three outstanding papers of the year 2011 in the J. Advanced Concrete Technology.