Report of JSCE-331; Technical Committee on Structural Performance of Deteriorated Concrete Structures

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About JSCE-331

JSCE-331 was organized in May 2004, with about fifty young researchers and engineers in Japan from both academic and industrial fields. The mission of JSCE-331 is to widely study structural performance of deteriorated concrete structures, namely due to reinforcement corrosion, by experimental and numerical approach. The committee published a midterm report in September 2006 and a final report in May 2009 in Japanese.

Research background

In 1990s, a concept "performance-based design" was introduced in the field of structural engineering in Japan. Based on this design concept, every performance of structure, such as structural safety, serviceability and durability, should be verified by rational way. One of the key technologies to realize "performance-based design" is to predict structural performance of concrete structures, namely deflection, load-carrying capacity and ductility, taking into account material deterioration, such as reinforcement corrosion, frost damage and alkali-silica reaction.

On the other hand, maintenance of existing concrete structures, including inspection, repair and strengthening, has become of great importance recent years. In the field of maintenance, it is one of the important and practical problems to predict structural safety of concrete structures with material deteriorations such as reinforcement corrosion.

Fig.1 Reinforcement corrosion

Fig.2 Loading test of real bridge girder

Working groups

Figure 3 schematically shows scope and constitution of JSCE-331. Five working groups were made.

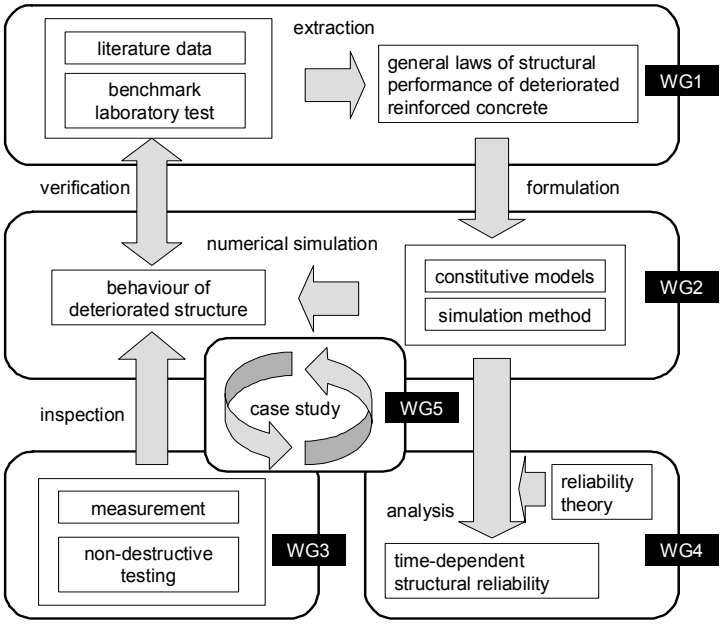

Fig. 3 Working groups in JSCE-331

WG1: Experimental approach

WG1 deals with experimental aspect of structural performance of deteriorated reinforced concrete. Data are collected from literature and original benchmark laboratory tests conducted by the committee members. General relationship between material deterioration and structural performance are investigated and discussed based on the collected data.

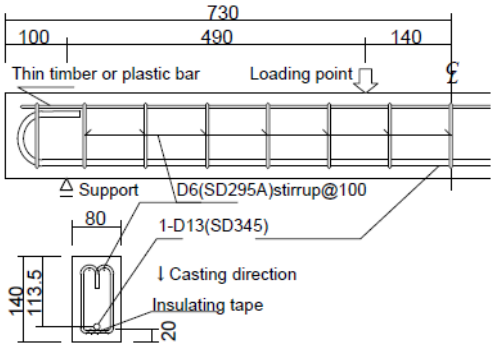

Fig.4 RC beam specimen for benchmark test

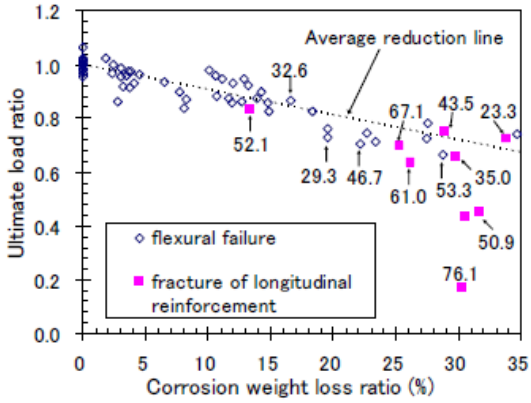

Fig.5 Ultimate load ratio as a function of reinforcement corrosion

WG2: Analytical approach

WG2 covers analytical aspect. They try to develop constitutive models for deteriorated concrete structures, which are employed in numerical analysis. Various analytical methods, namely FEM and RBSN, are tried.

WG3: Inspection methods

WG3 systematizes measurement methods and non-destructive testing method for concrete structures from the viewpoint of obtaining input data for structural analysis of existing structures.

WG4: Reliability approach

WG4 introduces reliability theory to durability problem. Time-dependent structural reliability is analyzed taking into account degradation due to environmental attack. This approach is expected to provide progress in rational durability design and LCC analysis of concrete structures in near future.

WG5: Integrated simulation

WG5 is a common working group which carries out case study of assessment of structural performance of actual deteriorated structures. Load-carrying behavior of reinforced concrete bridge with reinforcement corrosion is calculated by FE analysis, in which input data are determined on the basis of inspection of the structure. It was demonstrated that analytical results depend on accuracy of inspection and modeling of deteriorated portion.

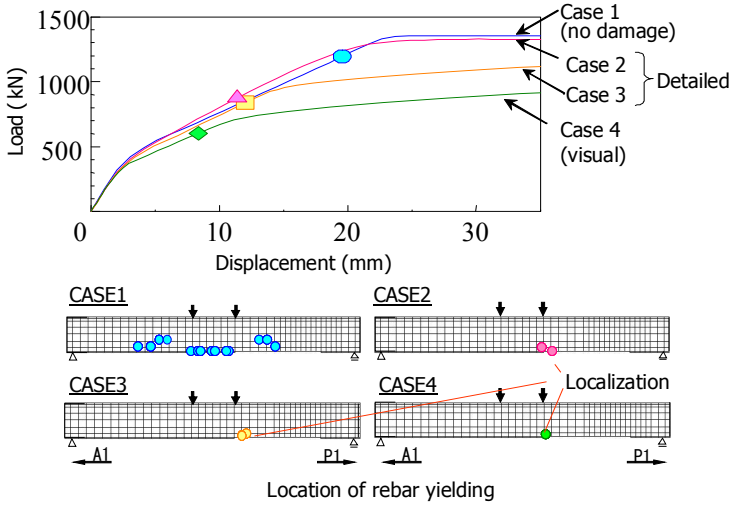

Fig. 6 Analytical results of load-carrying behaviors of the deteriorated bridge

Concluding remarks

Though technical committee JSCE-331 has expired in May 2009, the research project is succeeded by core members for another three years. The results will be presented in both domestic and international symposium and conferences. For further information about JSCE-331, please contact T. Shimomura at Nagaoka University of Technology (e-mail: takumi@nagaokaut.ac.jp).