Subcommittee on Design System for Reinforced Concrete
(Subcommittee 340)

The JCSE research subcommittee on Design System of Reinforced Concrete (Subcommittee 340) was established in 2008 and is chaired by Dr. Tadatomo Watanabe of Hokubu Consultant Corporation. The subcommittee held discussions about a future design system for reinforced concrete from 2008 to 2011 (its first term of activity). An interim report was published in May 2011. The committee held further discussions from 2011 to 2014 (its second term of activity) and published a final report in July 2014.

The first term

The subcommittee's mission during its first term was to investigate the process of design used for good (well-designed) existing reinforced concrete structures and also the historical evolution of Japanese design codes, focusing specifically on structural details. Two working groups were set up to move forward with this mission.

The Design System Working Group was mandated to consider an ideal system to design and construct reinforced concrete structures. The 2007 edition of Standard Specifications for Concrete Structures published by JSCE includes a "structural planning" section in which the type of structure and other structural requirements shall be determined, taking into consideration such factors as structural characteristics, materials, construction method, maintenance method and economy, such that the performance requirements can be met. Against this background, the working group discussed the definition of "good design" for reinforced concrete structures and practical methods of implementing it, taking in a wide range of interests including design versus verification, contracts, standards, and the education of designers.

The Structural Details Working Group was mandated to investigate the history and significance of structural details. Structural shapes, dimensions, reinforcement layouts and other structural details may restrict the freedom of a designer in developing a design. It is not easy to eliminate such structural details from the design process, since simplified methods of verifying performance requirements are based on them. This working group was tasked with investigating ways of eliminating the restrictions they impose using the latest understanding and techniques, such as numerical analysis using the finite element method.

The second term

The goal of the subcommittee in the second term was set to propose the first draft of an advanced design system, as outlined in Figure 1. A brief summary of the final report is given below.

Performance Requirements:

In the design of structures, it is necessary to specify the performance required to meet the purpose of the structure during the design service life. Although certain aspects of performance, such as safety, serviceability and restorability, may be specified in the JSCE's standard specifications for design, there is no clear direction as regards other performance requirements, such as environmental compatibility and economic considerations. The subcommittee attempted to redefine performance requirements while giving sustainability the highest order of

attention.

Design Methods:

The work of designing a reinforced concrete structure is to decide the shapes, dimensions, and reinforcement layouts of its components. The most important task for designers in carrying out this work is the final decision-making process. The subcommittee discussed primary factors, such as regional and cultural compatibility, that lead to an optimal design result.

Combination of Structural and Material Design:

In general, structures are designed using construction materials with specifications determined by their suppliers. Materials could, however, be sourced local to a construction site and be optimized for a particular structure. The subcommittee attempted to effectively combine such material design with structural design in the design process.

Advanced Verification Methods:

Methods of performance verification have become more advanced with the development of computer technology. It is now possible to understand the total behavior of a structure over its service life by taking a nonlinear numerical approach. It is possible that numerical approaches are the most suitable methods to comprehensively understand and accurately predict the performance of structures. The subcommittee classified the various evaluation methods according to their characteristics and considered ways of performance verification using advanced prediction methods such as the nonlinear finite element method.

Consideration of Construction in the Design Process:

The design-build system is one of the promising methods of realizing optimized structures. Currently, the design of public works projects in Japan is generally carried out either by the owner or a design consultant, while construction is done by a separate construction contractor. The subcommittee investigated how the design and construction processes might be integrated so as to realize high-quality structures in an efficient manner.

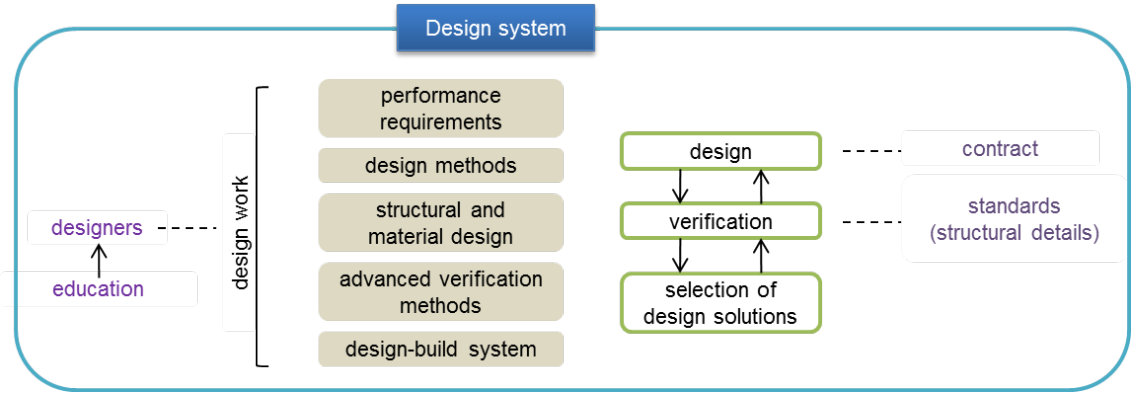

Figure 1 Advanced design system