Standard Specifications for Concrete Structures and Technical Development

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Since the Standard Specifications for Concrete Structures were issued in 1931, they summarize the state of concrete technology and indicate the directions for continuing technical development. In Europe and the USA they are referred to as a Code (FIB Code, ACI Code). But comparing these codes, their social and cultural backgrounds are reflected in them, so they are not necessarily the same. Science and each individual technology have no national boundaries, but standard specifications and codes differ subtly as systems, and this serves as the basis of new technical development.

From the initial publication, the Standard Specifications for Concrete Structures emphasized materials and construction. They greatly contributed to the development of the national land and ensuring energy as the basis for the development of concrete materials and development of construction technology for application to the construction of ports, road pavements, dams, etc. In design, the allowable stress design method was adopted, which had been used until the limit state design method was adopted in 1986.

From the 1970s, research into the mechanical properties of concrete structures was vigorously undertaken by the JSCE Concrete Committee. The scientific methods of Europe were positively taken up, while referring to the American practical research methods, and research and development of concrete structures progressed greatly in Japan. The results of more than 15 years work were reflected in the 1986 edition of the Standard Specifications for Concrete Structures "Design", which was published as a separate volume. There was a major change from the allowable stress design method, which was used for more than 55 years, to the limit state design method, and the number of pages also increased by more than a factor of 3 from about 60 pages to more than 180 pages.

At that time new content was also added to the Construction Part. Items were added for numerical calculation methods for mass concrete temperature and cracking control. The occurrence of cracking is predicted by specifically calculating the deformation based on the amount of heat generation of concrete, and the stresses induced by the deformation is compared with the concrete strength. This was the beginning of a connection between concrete materials, construction technology, and structural design. Thereafter research in this field expanded greatly, and at present our technology regarding temperature stresses and control of temperature cracking has attracted worldwide interest.

Comparing the current Standard Specifications for Concrete Structures with the FIB Model Code and the ACI Code, the major differences are that design and construction are dealt with at the same time and equally, even though they are separate volumes. The composition of the Sub-committee on Revision of Standard Specifications for Concrete Structures includes specialists in structures, materials, and construction, who carry out comprehensive discussions. As a result structural design is carried out reflecting the status of materials and construction, and materials development and construction technology development is carried out keeping in mind the properties of structures. Typical examples of these include the development of high fluidity concrete and self-compacting concrete, the establishment of concrete mix design systems based on construction performance, and the development of techniques for predicting concrete shrinkage and creep.

On the other hand, looking at the contents of the codes, in the case of FIB and ACI they mainly deal with design. This is not to say that materials and construction are not dealt with, but their volumes are very small. ACI has separately published many documents regarding construction. However, these have been produced by completely different committees of specialists.

A feature of the Standard Specifications for Concrete Structures is that numerical analysis technology is positively incorporated. In addition to the deformation analysis in temperature stress and creep analysis, non-linear time history response analysis is a basic approach in seismic design. The collapse of concrete structures in the Great Hanshin Earthquake that occurred in 1995 shocked engineers and researchers in this field. In the "Seismic Design" volume of the Standard Specifications for Concrete Structures, the static analysis used up to that time was limited and seismic performance verification methods were introduced based on dynamic response analysis. Thereafter with the development of technology it became possible to carry out time history response analysis of structures based on the material non-linearity and hysteretic properties of steel and concrete, so in this field we lead the world.

Information regarding individual technologies are summarized in "Japan's Concrete Technology", which was published to commemorate the centenary of the Japan Society of Civil Engineers. I encourage you to read this.