

Discussion on the revisions of JSCE Standard Specifications for Concrete Structures

Introduction

JSCE Standard Specifications for Concrete Structures have been widely used in practical applications within Japan with a great reputation from users in various fields of design, construction and maintenance of concrete structures while undergoing repeated modifications and revisions, ever since the 1931 publication of the predecessor, *Standard Specifications for Reinforced Concrete Structures*. As codes that define the methodologies of planning, design, construction and maintenance of concrete structure should be, it has been contributing remarkably to the development of concrete technology in Japan. The 2002 revision was particularly significant, marking a transition from standards with prescriptive specification format to those with performance-based format. Today, ten years later, the concrete committee is working on the 2012 revision of the *Standard Specifications for Concrete Structures*, which will incorporate the latest technological developments and applications. The 2007 editions of the specifications consisted of four parts, “Design”, “Materials and Construction”, “Maintenance”, and “Dam concrete”. The new part, named “General principles”(Provisional name), relating to all parts of the specifications will be added to the 2012 edition.

As a special New Year's article in the 2012 newsletter, the leading members of the Specifications Revision Subcommittee have held a discussion concerning the background, purpose, features, and prospects of the 2012 revision of the Specifications, which are the most important technical standards for concrete in Japan and represent some of the highest-level concrete specifications in the world, as well as information on utilization of the Specifications around the world.

Members Attending the Discussion

JSCE Standard Specifications for Concrete Structures Revision Committee:

Kyuichi Maruyama	Chairman (Professor, Nagaoka University of Technology)
Koji Takewaka	Editor in chief of “General Principles” (Professor, Kagoshima University)
Koichi Maekawa	Editor in chief of “Design” (Professor, University of Tokyo)
Hiroataka Kawano	Editor in chief of “Materials and Construction” (Professor, Kyoto University)
Hiroshi Yokota	Editor in chief of “Maintenance” (Professor, Hokkaido University)
Kimitaka Uji	Editor in chief of “Dam Concrete” (Professor, Tokyo Metropolitan University)

Discussion coordinator

Yoshinobu Nobuta	Member, international affairs committee (Kajima Corporation)
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Special feature compiled by:

Shingo Asamoto Member, international affairs committee (Saitama University)

Hiroshi Murata Member, international affairs committee (Taisei Corporation)

Discussion

(Speakers' titles have been omitted.)

Nobuta: In our discussion today, I would like to hear your views about the kinds of revisions that you intend to make in each part of the 2012 revised edition, as well as your thoughts about uses and applications of the *Standard Specifications for Concrete Structures(JSCE Concrete Code)*. First, I would like to invite Chairman Maruyama to explain the significance of the *JSCE Concrete Code* and to give an overview of the scope of applicability, features, usage procedures, and ways in which the *JSCE Concrete Code* are being used.



Mr. Nobuta

Maruyama: Historically, the first *JSCE Concrete code* was compiled with regard to design and construction, but was focused primarily on construction with relatively little content on design. Thereafter, individual parts were expanded as the various types of concrete structures were introduced and new technologies were developed, resulting in the present form of the code. It would not be appropriate for users to refer to just one of these expanded volumes, such as the design part or the materials and construction part; so we need to look at the overall framework of the individual parts and indicate the intended directions of the overall code to users. Therefore, I believe that the purpose of *JSCE Concrete code* should be summarized in the new part of “General Principals” which is to be added in the revision 2012. I think our code should be basically a model code; however, some specification-based standards should be retained for the sake of engineers on site. Although these are standards, the *JSCE Concrete Code* also has the role of compiling and presenting newly developed high-technologies.



Prof. Maruyama

Nobuta: Thank you. Next, I would like to ask about the revision work on each part, turning first to Professor Maekawa, editor of the design part.

Maekawa: In the part of design, we plan to carry on with the approach of the previous revision, which combined the former structural performance verification part and the seismic performance verification part together,

resulting in sections of standard methods and references(case studies) to support performance-based aspects as well as aspects of creation in terms of design. Technically, we plan to expand and develop the existing provisions, incorporating the latest findings obtained since FY 2007 after such findings have been verified. In particular, standards have been set on the safe side by encompassing a variety of cases relating to salt damage and corrosion. We plan to move ahead with the current revision in a way that



Prof. Maekawa

will allow the handling of design according to individual circumstances, including the types of cement, conditions of curing, and construction. New findings have been obtained concerning shrinkage, crack width, and other factors, so we will correct the inadequate parts in the standards. Standards related to structural performance will be revised to include shear capacity calculations, which have not been covered for certain members in the past, while improving consistency with existing formulas. We would also like to make improvements concerning nonlinear analysis in a form that can be used by the average engineer, since nonlinear analysis has become more sophisticated and widespread. In addition, we plan to incorporate post-earthquake restoration design in order to make it possible to begin urgent design and restoration work immediately after an earthquake has occurred.

Nobuta: The American Concrete Institute handles civil engineering and buildings in combination, and the ACI 318 Building Code is clearly aimed at designers while the ACI 301 Building Code is aimed at constructors. What are the target users of the design part of the *JSCE Concrete code*?

Maekawa: The *JSCE Concrete Code* is not separated by target. For example, the issues of alkali-aggregate reactions and shrinkage are related to both materials and construction, and the issue of thermal cracking in massive concrete is related to both design and construction. Therefore, we believe that it is preferable not to separate these by user.

Maruyama: Aiming that constructors and designers should be familiar with aspects of both design and construction, I think that the present style is better for our goal.

Nobuta: Next, I'd like to hear from Professor Kawano, editor of the materials and construction part.

Kawano: In the materials and construction part, the overall switch to a performance-based standards occurred at the time of the next-to-last revision in 2002 and the mixing section was moved to an appendix, leading to complaints from the field that this made it confusing. Therefore, in the last revision in 2007, the general requirements section

was organized to enable performance-based construction, but the content of the former specification-based standards was incorporated into the construction standards section, so that it could be used in the same way as the former arrangement. Inspection standards section was also made independent for ease of use. In the current revision, we would like to publish just the construction standards and inspection standards sections in a compact arrangement on size A5 paper, so that they can be conveniently carried into the field. The next-to-last revision had a separate chapter for each type of special concrete based on performance-based standards, but in the current revision, this information will be also combined in a compact fashion, clearly indicating the features of each type. The ideal would be to prepare a guide that can be easily used in the field by any engineers without hesitation; but I believe that it is necessary to arrive at a compromise between performance-based and specification-based standards.



Prof. Kawano

Takewaka: Many types of guidelines have been published for construction besides the *JSCE Concrete code*, and I think that the code should refer specifically to such sources. However, it's important that those guidelines should be accessible, and I think they ought to be preserved by digitization, including older ones.

Maruyama: That sort of expanded accessibility would be very helpful for engineers to study for their purposes, since it is not possible to take all of the reference guidelines into the *JSCE Concrete Code*.

Kawano: The volume of materials and construction has become too thick, and digitization would be a good way to slim it down.

Nobuta: Next, let's turn to Professor Yokota, editor of the maintenance part.

Yokota: At present, the part of maintenance consists of just two parts: "maintenance" and "maintenance for specific deterioration mechanisms." However, in the new revision, the part of maintenance will consist of four parts: "general requirements," "maintenance standards," "maintenance for specific deterioration mechanisms," and "case studies."



Prof. Yokota

The approach taken with regard to structural performance is an important point in maintenance. It would be fine if performance could be expressed numerically, but this would be very difficult to achieve. I should like this part to help managers be aware of the performance of structures that should be ensured. In addition, we will explain the stages in which

repairs should be performed in the section of maintenance for specific deterioration in order to maintain the performance requirements, using a new indicator called a "management limit" which denotes the level of performance that is allowable in terms of maintenance with a safety factor. I should also like to develop a system to allow budget-based maintenance so that people will be able to take incentive in performing maintenance in practical work. In addition, I should like to add content that will allow maintenance to be handled in a simple manner on the basis of symptoms such as cracking and rust stains, even if the degradation mechanism cannot be clearly identified.

Kawano: Maintenance is quite challenging, and it is necessary to perform effective maintenance while limiting costs. The revision process includes the difficult question of how to incorporate the actual views of people working in the field.

Takewaka: It is also important to improve the expertise of engineers. Universities have a significant role to play in such improvement.

Maekawa: Because experience is so important in maintenance, it is effective to make use of senior engineers' experiences. In fact, some local governments are drawing on the expertise of retired persons.

Maruyama: Follow-up after repair or strengthening is important. We also need to provide information on what we have done for maintenance, including cases where we could not get successfully what had expected.

Nobuta: Next, let's hear from Professor Uji, editor of the dam concrete part.

Uji: There are three major items for study with respect to the dam concrete part for the current revision. The first is to study appropriate test methods for evaluation of aggregate freeze-thaw resistance, considering the decline in aggregate quality. The second relates to the cracking index; this is the question of whether the approach to concrete cracking that is used for general concrete structures is also applicable to dams. Specifically, in the existing dam concrete part, thermal cracking is taken into consideration under the restraint intensity matrix method; but since a thermal cracking index method also exists, we are currently conducting a comparison of these two methods. The third item for study relates to small-scale dams. With an increasing number of small-scale dams being constructed or redeveloped, we would like to summarize the important points for consideration when using ready mixed concrete.



Prof. Uji

The dam concrete part covers the entire gamut of design, construction, and maintenance. People depend on the dam concrete part for the aspects of materials and construction, but there are still some areas

where we cannot go into much depth with respect to design because these are based on an ordinance called the Cabinet Order Concerning Structural Standards for River Management Facilities, etc.

In the 2007 edition, cemented sand and gravel (CSG) dams were added as an appendix. This technology is still being improved and enhanced, so we plan to leave it as an appendix in the current revision, advising users to refer to related publications issued by the Japan Dam Engineering Center.

Nobuta: What are your thoughts concerning overseas application of the dam concrete part?

Uji: Japan is actively engaged in trapezoidal CSG dam technology, and there are high expectations in this area. In general, Japan is seen as having high levels of safety in comparison with overseas standards, and I think it is necessary to consider whether this is valid. In addition, Japan has developed a great deal of experience and an extensive track record concerning design and construction, including thermal analysis; and I hope to be able to introduce Japanese technologies to developing countries.

Nobuta: Last, Professor Takewaka, would you please introduce your objectives as an editor of the newly established part of “General Principals”.

Takewaka: I'd like to begin by explaining the background of why the new part is being established. A common preface for each part was added in the *JSCE Concrete Code* for the first time in the 2007 edition. This preface included an explanation of the basic concept concerning the organization of the *JSCE Concrete code*, the roles and deployment of responsible engineers, and the system for ensuring the reliability of structures, as well as a summary of the role and makeup of each part. Meanwhile, most of the content of the code is very specialized, and some users complained that its separation into individual parts made it difficult to read. In response, the idea arose of clarifying the makeup of the *JSCE Concrete Code* and creating a new part to summarize the content that is shared by all of the parts, and this led to the decision to work on preparing a common part.



Prof. Takewaka

In the general principals part, I would like to first summarize the role and system of the *JSCE Concrete code*, with reference to the preface of the previous code; and to clearly indicate the roles of engineers in the achievement of reliable structures as well as the correlations among design, construction, and maintenance. The existing code does not mention the issue of environmental impact. Although this is a difficult problem to address, it is related to all acts from design to construction and maintenance. Therefore, the general principals part will indicate

an approach for dealing with environmental impact. We are discussing the approach to be taken concerning environmental impact in the code, based on statements such as, for example, "Design is to decide design variables for materials and structural forms, etc. in such a way as to optimize the objective functions for economy, environmental impact, and so on, with the limiting condition for satisfying the required performance in terms of load capacity, durability, and other factors."

Maruyama: I spoke with some people overseas who are using high-strength concrete to achieve greater durability as a means of environmental consideration. Considering the environmental friendliness of creating highly durable structures in order to avoid wasting resources, it could be said that part of what we have already been doing involves consideration for environmental impact.

Maekawa: I have heard that the amount of carbon dioxide emissions depends on the amount of material (cement) that is used. If that is true, then there is some equivalence between economic and environmental considerations.

Kawano: The *JSCE Concrete Code* provide a system for building structures economically while also ensuring that they are appropriately constructed, so I think it is fine to take an approach of trying to minimize carbon dioxide emissions, rather than establishing a specific limit on emissions.

Uji: The priority should be placed on structural safety and usability, and I think we should indicate that environmental considerations do not have an equivalent level of priority.

Nobuta: Next, I would like to hear your views on achieving close cooperation among the parts in the current revision.

Maekawa: The maintenance part and the design part need to be better coordinated with each other. For example, evaluation of the structural performance of a deteriorated concrete structure is related to both design and maintenance. Several joint committee meetings have been held between the design part and the maintenance part, and these discussions have been very fruitful. When cracks or corrosion occur that were not anticipated in the design, this involves technical matters of both design and maintenance, so although more research is needed, I think it is desirable for both the design part and the maintenance part to come up with proposals to strengthen coordination.



Also, concerning thermal stress, I would like to set new standards for thermal stress in tangible forms such as numerical values based on verification data from JCI(Japan Concrete Institute) etc., in coordination with the dam concrete part.

I think that structural planning can be covered in a more understandable way by presenting it in two stages in the general principals part and the design part. The general principals part will cover overall planning including structural format and the like, and the design part will cover detailed planning.

Takewaka: I think it is necessary in the general principals part to include a discussion of the coordination of each part. The general principals part should give a clear picture of the entire story from the planning of a structure to design, construction, and maintenance, even if this is only a brief outline. When engineers use the *JSCE Concrete Code*, I hope that they will read the general principals part first. Having read the general principals part, they should have an understanding of the overall flow.

Nobuta: Last, Professor Maruyama, please tell us about utilization of the *JSCE Concrete code* in other countries and related plans. I would also like to hear your general comments about today's discussion.

Maruyama: It is difficult to devise effective ways for promoting the *JSCE Concrete code* to use in other countries. However, Japan's technological capabilities are trusted abroad. I thought it would be very important. While we must have obtained that such trust, it still needs some time before the *JSCE Concrete code* is used abroad. Although it will take time, we will continue to develop English versions of the *JSCE Concrete Code* as we have done up to now, and I expect that acceptance will build gradually. Concerning future plans on the *JSCE Concrete code*, I hope that we will be able to expand the scope of application as widely as possible. We will continue to revise the code by making further improvements based on feedback including questionnaire surveys, as well as reliably incorporating dependable new technologies. Our goal is to publish the 2012 edition of the *JSCE Concrete Code* by March 2013. We plan to hold some seminars for guidance of new version in Tokyo in late March.

I hope to promote digitization on DVDs and other media in order to make it easy to access the necessary information; this was also mentioned in today's discussion. In particular, I think that it would be beneficial for future revision work if we could include additional revision materials in a digital edition to pass along an understanding of the process by which the revision was performed.

Nobuta: Thank you, all for your discussion today and your efforts for the 2012 revisions. We are looking forward to the new edition soon.