

## Panel Discussion at JSCE 2015 Annual Meeting

### Toward Next Generation of Concrete Engineering Continuing to Contribute to Society after Tokyo 2020 Olympic and Paralympic

Chair:

Mitsuyasu Iwanami (Tokyo Institute of Technology)

Panelists:

Yuji Ikeda (Chugoku Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism)

Fumihiko Sato (Taisei Corporation)

Yuko Ogawa (Hiroshima University)

Keiji Yamazaki (Kajima Corporation)

Yasuhiko Sato (Hokkaido University)



**Photo 1** Panelists



**Photo 2** Brief introduction by Prof. Iwanami

This panel discussion was held by the Concrete Committee as part of the Japan Society of Civil Engineers 2015 Annual Meeting at the Tsushima campus of Okayama University on September 16th, 2015. With proceedings led by Prof. Mitsuyasu Iwanami, five speakers gave presentations focusing on the concrete engineering: Mr. Yuji Ikeda (Recent topics of Road maintenance ~Plan to Prolong the Life of the Infrastructure~), Mr. Fumihiko Sato (Concrete engineering in construction site), Dr. Yuko Ogawa (Concrete engineering from the point of view of woman engineer), Mr. Keiji Yamazaki (Concrete engineering from the point of view of globalization) and Dr. Yasuhiko Sato (Standard specification for concrete and concrete structures in next generations). These presentations were followed by a question and answer panel session.

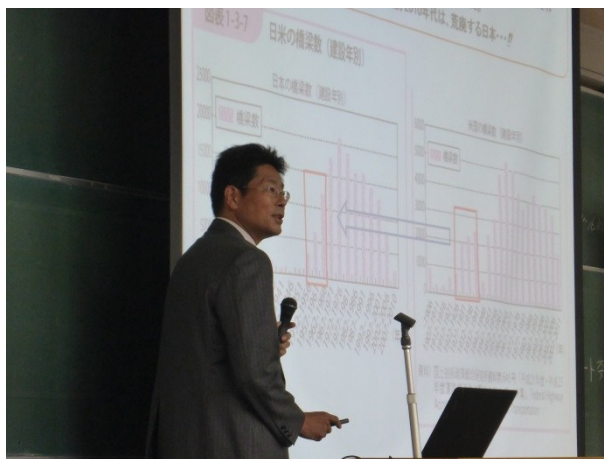
### **Topic1: Recent topics of Road maintenance ~Plan to Prolong the Life of the Infrastructure~ (Mr. Ikeda)**

Most road bridges in Japan have been constructed during the period of rapid economic growth. About 20% of them are over 50 years old and the percentage will become 40% after 10 years, and 70% after 20 years. Ministry of Land, Infrastructure, Transport and Tourism (MLIT) made simultaneous inspection for all road bridges in Japan after 2013. As the results of inspection, it has been observed that the number of damaged bridges gradually increases with time. For the bridges built more than 40 years ago, more than half of the bridges have needed repair or retrofiting. Moreover, about 1400 bridges having more than 15m span length have become traffic regulation or been closed to traffic in 2013. That number become twice for 2008. The road closure has a social impact, especially society in local region.

For the case of United States of America, in 1980's, many infrastructures had been deteriorated and a number of accidents occurred due to damage of the bridges. It was so-called "America in Ruins". The reason is that the budgets for the maintenance of the infrastructures were insufficient. Nowadays, the maintenance costs are reserved and the number of the damaged structures decreased. However, it takes much time to recover the damaged infrastructures. Based on this experience, MLIT has changed the policy of maintenance from the corrective maintenance to the preventive maintenance. In the preventive maintenance, maintenance cycle, inspection, diagnosis, countermeasure and record, is most important. Therefore, the maintenance cycle is introduced in the plan to prolong the life of the infrastructure. Thus, the preventive maintenance is conducted efficiently and effectively.

Current problem is that the civil engineer in local government is insufficient. There is no civil engineer in some region. Therefore, MLIT has started to develop the maintenance technologies and the manager who is not civil engineer will be able to conduct the maintenance cycle more easily by that technologies. MLIT also has started to develop database system for maintenance, in which all information related to the structures and all results of regular inspections are accumulated. Moreover, MLIT provides the field exercise to road managers in local government in order to increase their skills of maintenance techniques. Since financial resources of maintenance are tax, public understanding of maintenance of infrastructures is important. Therefore MLIT also implement public relations for inhabitants.

On the other hands, many structures are under construction in developing countries in Asia and probably they will need maintenance in a few decades. Japanese civil engineers, who engage in the maintenance in Japan currently, will be sure to contribute to this field in the future.



**Photo 3** Presentation by Mr. Ikeda

## **Topic2: Concrete engineering in construction site (Mr. Sato)**

Some issues of concrete engineering at construction site in Niigata were introduced. For the construction of the railway viaduct, there were issues at three processes, that is, concrete mix, concrete placing and concrete curing.

For the concrete mix, mixing of fly ash was one of issues. Since alkali silica reaction had been observed in many structures in Niigata, fly ash was necessary to mix as an admixture. On the other hand, self-consolidating concrete had been adopted and short fibers also had been planned to be mixed. There were no references about self-consolidating fly ash concrete with short fiber at that time, and the characteristics and fundamental properties were unclear. Therefore trial mixes and field tests were conducted and check the applicability. As a result, fly ash did not have effect on workability of self-consolidating concrete and slump loss was only 3cm. Through the test, it was confirmed that self-consolidating fly ash concrete with short fiber can be used to construction railway viaduct.

For the concrete placing, countermeasure of reinforcement congestion was one of issues. Since many rebar were planned to be arranged at the beam and column joint, concrete compacting was considered to be difficult. Therefore, before arranging the rebar, whether concrete vibrator can be inserted or not was checked by using 3D CAD. Moreover, the concrete mix was also changed from normal concrete to self-consolidating concrete. During casting concrete, filling of concrete was checked by using transparent board. As a result, there was no occurrence of the insufficient filling of concrete.

For the concrete curing, the freezing prevention measure in winter was one of issues. Since size of concrete slabs were large, 16m in width and 20m in length, it was difficult to cover slabs by normal way after concrete placing. Therefore, special way was adopted for concrete curing; cover with three layers sheet, spraying warm water and blowing warm air. As a result, there was no freeze trouble.

About the expectation to concrete engineering after Tokyo 2020 Olympic and Paralympic, the keywords are following; quality control, price increase and staff shortage. In the design and the planning, “reducing reinforcement amount” and “simplifying structure” are ones of the solutions. In the construction, “concrete unaffected by weather”, “quality controlled concrete” and “simple placing” are ones of the solutions. In the others, “green concrete” and “color concrete” are ones of the solutions. Summarizing them, “Simple Concrete” is effective for quality, cost and countermeasure of staff shortage.



**Photo 4** Presentation by Mr. Sato

### **Topic3: Concrete engineering from the point of view of woman engineer (Dr. Ogawa)**

Concerning the current situation of concrete research in Japan, many researchers study in all over the areas and the research topics are forefront of concrete engineering. However, in my impression, combinations or connections between each research topics are not so strong. Practical applications of research outcome are also insufficient. Moreover, the discussion in terms of directions for the future is insufficient. It is important for the next generations.

In Hiroshima University, experience science course for high school girl is held every year. When I taught a course on concrete technology, I decided to show a video of chemical reaction of  $C_3A$ . Although it was very professional and a little bit enthusiastic content, favorable comment from some students was received. From this experience, I understand that important thing is to let people know about concrete. And face-to-face talking is effective to spread understanding of concrete. People's impression of concrete is commonly bad, such as cold, dark and inanimate. On the other hand, some people have good impression, for example, strong against the disaster and essential for our life and social. The positive impression, "reliable concrete", should be kept to the future with our efforts.

There is "The Society of Women Civil Engineers" in Japan. This society was established in 1983. In the 30th anniversary, "Doboku Mirai Sengen" (Declaration of Civil engineering for the future) was published. This was the declaration from the point of view of women engineer. During the development of the declaration, the future society in Japan was discussed. At the end, opinion of the participant has been aggregated as follows; Japan should try to be a model country of other aging societies.

In order to keep "reliable concrete" to the future, following efforts will be needed. Firstly, individual forefront research will be combined and introduced to practical engineering. Secondly, education and publicity to people for understanding concrete will be steadily continued. Finally, the values and directions for the future will be shared among researchers.



**Photo 5** Presentation by Dr. Ogawa

### **Topic4: Concrete engineering from the point of view of globalization (Mr. Yamazaki)**

Concrete engineering of Japan is evaluated that technical capability and quality are very high though high cost is necessary. However, developing countries don't require so high quality. Therefore Japanese

companies sometimes lose competition against other countries. For overseas expansion in the developing countries, we need to think what their necessary and sufficient technologies are. On the other hand, we need to express to them what the aims of our technologies are. Since we have experienced many things for constructions, we can give them not only our successful experience but also our failure story.

Recently, design–build contract is increased in Asia. For taking advantage of Japanese technology in abroad, design-build contract is acceptable. General contractor in Japan usually has both design section and construction section. It is different from overseas company, in which design work is contracted out to the design consultant. This unique system in Japan might be advantage for Design–build contract.

Concerning the technical specification in overseas projects, the referenced specification is local specification or western specifications such as ASTM, Euro Code and BS. Standard specification for concrete structures in Japan is not generally referred. Since the technologies is usually reflected in the specification, it is necessary to increase the international profile of Japanese specification. We need to consider how to show presence of concrete technology of Japan.

Western companies have an interest to Japanese technologies. However, since our information dissemination force has been weak, they don't know our technologies well. They think that Japanese technologies are difficult to use although the quality is high and only Japanese worker can treat the technologies. Therefore they sometimes avoid using Japanese technologies. On the other hand, the required performance in Japanese specification, such as seismic performance, is too high to apply in abroad.

As a topic of construction industry in abroad, I would like to introduce the movement of introducing five-day week in construction site. In Hong Kong, as a result of a questionnaire carried out in 2012, it was confirmed that 70 % people agree on Saturday off in construction site, and 40% people recommend to work in the construction industry to their friend if the salary doesn't change when five-day week become a reality. 70 % people think that young people may work in the construction industry if five-day week.

Finally, I would like to introduce some comment from engineers in abroad. From the engineer in North America; the concrete technology in Japan is top-level, e.g. thermal stress analysis of mass concrete and special chemical admixture. Japan should disseminate these technologies to Asian countries. However, Japan should think what to do by globalization at the same time. From the engineer in Southeast Asia; since quality of concrete gradually become higher in developing countries, quality of Japanese technologies will be required in the near future. Maintenance technologies in Japan will be also advantages. From Japanese engineer who works for overseas project; even if the Japanese specification will be referred in abroad, structures are designed by not only Japanese specification but also other specifications. Japanese young engineers also need to know western specifications.



**Photo 6** Presentation by Mr. Yamazaki

### **Topic5: Standard specification for concrete and concrete structures in next generations (Dr. Sato)**

Subcommittee on liaison and coordination for standard specifications for concrete structures was established in concrete committee, JSCE. In the subcommittee, young and middle engineers discussed and shared standard specification for concrete structures in the future. Final report has been published in this year as Concrete Engineering Series 107, which consists two parts. In part I, 3 suggestions were released for the standard specification in next generation. In part II, problems in latest standard specification for concrete structures were summarized. Today, I would like to talk about 3 suggestions of the subcommittee.

Firstly, “the way of standard specification” is suggested. In the latest standard specification for concrete structures, a number of concrete technologies are accumulated. In the future, these technologies will be divided into each category and classified as 4 hierarchies in order to clarify the target and purpose. Four hierarchies consists “General”, “Standard”, “Standard specification” and “Specification”. On the other hand, standard specification plays a role in the growth of engineers, that is, young engineers grow up thorough the discussion of standard specification. The engineers gather to discuss their values and ideas. The way of standard specification is similar to the way of education and gathering.

Secondly, “the way of compile” is suggested. For organizing of standard specification, target is not only concrete structures but also civil structures, that is, standard specification for civil structures will be constructed in the future. On the other hand, establishment of standard specification for concrete structures applying to every type of concrete is necessary. Among the each part of standard specification for concrete structures, “Design”, “Materials and Construction” and “Maintenance”, it is necessary to strengthen the link with each other, not only contents but also editors.

Thirdly, “the way of overseas deployment” is suggested. For overseas deployment of standard specification for concrete structures, not only translation to English but also explanation of background of the each technology such as idea and experimental data is important to be used. Moreover, it is necessary to show a merit of the use.

For the future concrete engineering, developing technologies and cultivating engineer is important. In both cases, considering current generation, next generation and overseas is necessary.





Photo 7 Presentation by Dr. Sato

### **Questions and Discussions**

Q : I think that next generation of concrete technology is not necessarily advanced technology and technological progress. There might be important thing even if low technology. People might want usable technology, especially the people in abroad. Please let us know your opinions about that.

Mr. Ikeda: Concrete precast product is one of a solution. Although the price of each product is low, the scale of the market is significantly large. The quality of Japanese concrete precast product is high compare to the other countries. The quality is ordinariness in Japan. Japanese company normally make products with high quality, I think this point is an advantage over other countries.

Mr. Sato: The specification of concrete structures has changed greatly for these 30 years, however ready-mixed concrete has not changed until now. Therefore, workers make a great effort to overcome the problems such as reinforcement congestion. The ability of skilled worker in Japan is also high. I think the technology which anyone can use will be required.

Dr. Ogawa: I think that the preferable technology in the future is the system which can design of concrete mix by selecting the available materials including the waste in local region.

Mr. Yamazaki: Labor cost in Asian developing countries has increased from 20 years ago. It means that the construction cost will increase and it will be difficult to put many workers to the construction in near future. Therefore, laborsaving and automation in the construction will be important issues. I think the simplified technology is the one of the solutions.

Dr. Sato: I've heard that Shinkansen and vessel are designed considering the complex phenomena and behavior by using computation. That is, they are built by taking advantage of the latest technologies. Simple technology is certainly important. However, advanced technology is required in the certain situation. Concrete technology may lose appeal if advanced technology is no longer in use. I think that both simple technology and advanced technology are important.

Prof. Iwanami: The differentiation and hierarchization of the technology will be necessary in the future. It is better to divide into two technologies, the technology which anyone can do and the technology which only someone can do.

Q : Currently, design and construction are separated in the standard specification for concrete structures. I think it is one of the root causes of the problem. The reinforcement congestion is the typical one. Reducing the amount of reinforcement in design is desirable and it leads to an increasing of the productivity in construction site. On the other hand, cast-in-place concrete is standard in the specification. The situation doesn't change from 30 years ago. If the situation is the same 30 years later, it is a very problem. Although the pre-cast concrete is expensive, construction workability will be improved by the application of pre-cast concrete. How do you think we should deal with these problems?

Mr. Ikeda: Simple structure is favorable because it has an advantage in not only construction but also maintenance. However, it has sometimes a disadvantage in overseas deployment for Japan. Simple means anyone can do and it doesn't have to be Japan. Simple technology only Japan can do is desired.

Dr. Sato: AI (artificial intelligence) will exceed human intelligence by the technical development in the future and automation in construction may accelerate. In this case, automation contributes to labor saving and it leads to simple technology. However it is not technical development in concrete technology. I hope that automation make the impossible possible.

Q : I think concrete structures in Japan is easy to maintain. Therefore, it is better to export both construction technology and maintenance technology. Please let us know your opinions about that.

Mr. Ikeda: The contract including maintenance is good idea because total cost becomes small. On the other hand, I don't think that it goes well in developing country because they don't know the importance of maintenance. They also don't know the difficulty of maintenance. In the countries who understand the value of maintenance, it may go well.

Mr. Yamazaki: There are the countries who are interested in maintenance in Asia. Therefore, I think the idea will be accepted in abroad.

Prof. Iwanami: Japan knows the difficulties of maintenance. Introducing our experience of maintenance to Asian countries is also important.

Q: I think highly durable concrete is the duty of us. We need try to leave concrete structures to the future as a legacy. It is our mission and it attracts the people. Please let us know your opinions about that.

Dr. Ogawa: Now, concrete structures need maintenance and the research interest is how we maintain the deteriorated concrete structures for a long time. However it is better to construct Highly-durable concrete structures. On the other hand, since durability of concrete shows different features between research and practice, I make an effort to solve it.