Concrete Committee Research Discussion Session, JSCE 2014 Annual Meeting

Concrete: Changing and constant, developing and enduring

Discussion chair: Prof. Masahiro Ouchi (Kochi University of Technology)

In the format of this session, we will hear from each of the topic presenters and then hold a discussion concerning each of the topics.

Topic presentation: Prof. Kyuichi Maruyama (Nagaoka University of Technology)

On the subject of responding to societal demands, my topic presentation will deal with the Standard Specifications for Concrete Structures and the handling of accidents and disasters.

JSCE was established in 1914, and a council on concrete engineering was organized. It took some time to develop the specifications, and the Standard Specifications for Concrete Structures were first issued 83 years ago, in 1931. This document has been revised every five years since that initial edition. In addition to changes that took place in materials development and construction methods, there were large-scale changes in design methodology in 1986. Because the allowable stress design method had been used for more than 50 years, the old specifications had relatively little to say about design, while the sections on construction, materials, and special concrete (dam concrete and pavement) were thicker. Performance-based regulations were proposed for design as well, and the limit state design method came into use, resulting in a large increase in the volume of the design section.

The Hyogoken-Nanbu Earthquake of 1995 and the Great East Japan Earthquake of 2011 made it clear that our understanding had been inadequate. Following the Hyogoken-Nanbu Earthquake, nearly a year was devoted to directly incorporating the values of the limit state design method and including earthquake resistant design in the design section. More specifics were added concerning durability in construction, and field technologies with regard to maintenance were combined in the maintenance section. With technological advances, verification has become necessary; and design methods for performance verification were added for the first time. Progress has been made in

tsunami research since the Great East Japan Earthquake, and this may be added at the time of the next revision.

The Specifications must not stand in the way of future technological developments; but along with incorporating new knowledge, it is important to wait for technologies to become mature. With the disaster, issues that had never been anticipated now have actually occurred. The ensuing changes in values could also lead to technological advances.

For example, in the investigation into cracks in the Tarui Viaduct, the Concrete Committee gave its full efforts to addressing the problem. The issue of shrinkage of concrete aggregate became apparent for the first time, and this was incorporated into the specifications and standards.

Let's consider how we should deal with changes in society. We must be sure to make any necessary adjustments in our stance toward society; however, we must always continue with technological development and research. Not only in the field of concrete, but in many areas, sudden and dramatic changes sometimes occur as a result of continuing advances in technology. There is no such thing as a perfect technology, so we have no choice but to continue working on development. We must learn from failures and the problems that arise. I would like to encourage young people to maintain a willingness to address new challenges.

Discussion chair

Thank you. I would like to open the floor to questions and comments concerning Prof. Maruyama's speech.

Question 1

I think the issue of responding to societal demands is a matter of compliance. One of the areas of societal demands is the issue of the specifications. Although the new specifications have come out, the content is focused on issues of deterioration and maintenance. We are going at it from the wrong angle if we do not debate issues of maintenance and management in terms of the entire flow, including repair & reinforcement and earthquake resistance, instead of considering maintenance in isolation. I believe that changes should be made in the flow of the specifications.

Prof. Maruyama

We cannot study just maintenance, or just deterioration. Considering these in terms of design, in order to get to the heart of the matter, it is necessary to make decisions first of all on load bearing performance, and second on preventing third party damage. If repairs are made each time there is salt damage, the cost may be four or five times as high as in the case of new construction. This must be stopped. It was not possible to include issues related to time in the current edition of the Standard Specifications. The quality of design and construction is revealed after some time has passed; but in the case of deterioration, because the actual results do not match the results of accelerated testing, we will not know until more time has elapsed.

Question 2

For a long time after publication of the Standard Specifications for Concrete Structures was begun, its purpose was to indicate design standards. Now that it deals with all sorts of concrete structures, there are some outcomes that cannot be fully covered. This raises the question of how the Standard Specifications for structures should be written.

At present, there is an emphasis on presenting the latest scientific theories; but if that is the purpose, it would not need to take the form of specifications. We might as well write a textbook. Since its role has always been to indicate standards for design and construction, there needs to be a consistent approach of presenting how the standards for design and construction should look when informed by the latest scientific theories.

Prof. Maruyama

Before revision of the specifications was begun, we spent about two years discussing how the Standard Specifications should be written, and a variety of opinions and desires were expressed. In the latest revision, we have made some changes in the section on basic principles, indicating standards and aligning the surface aspects. In future, the next generation will have to make the decisions as to how the specifications ought to be written.

Facing the depletion of natural resources: Prof. Makoto Hisada (Tohoku University)

The Great East Japan Earthquake led to the emergence of issues such as disposal of rubble. After the Great Kanto Earthquake and the Hyogoken-Nanbu Earthquake, the basic approach was to dispose of the rubble in landfills; but after the recent Great East Japan Earthquake, a new course has been set toward the processing and reutilization of rubble under the guidance of the Ministry of the Environment and other ministries dealing with reconstruction to promote recycling and resource conservation.

The cost has been on the order of about 1 trillion yen. Processing in Iwate Prefecture and Miyagi Prefecture was completed in March 2014, but because of radioactive contamination, rubble processing is still ongoing in Fukushima Prefecture. The processed rubble has entered the storage stage and is awaiting reuse.

A graph of the progress of rubble processing shows that the first six months were devoted to rescue activities and rubble collection, and rubble processing operations were ordered half a year later, in September. After some trial and error, the pace of processing picked up as confidence built for this policy, and this was completed two years later, in March 2014. It has taken three years' time and 1 trillion yen to process 20 million tons of rubble from the 2011 disaster, but a Nankai Trough earthquake as predicted by the Central Disaster Prevention Council would generate 200 million tons of rubble, ten times the volume produced by the Great East Japan Earthquake. Working at the same pace and cost, it would take 30 years and cost 10 trillion yen to process the rubble from such an earthquake.

Several lessons have been learned from this experience of rubble processing and reuse. It takes time to convert rubble into usable materials and to use those materials, and it must be stored in the meantime, giving rise to the problem of chronological misalignment; there is competition with natural resources for transport expenses, giving rise to the problem of geographic misalignment; and it is difficult to align available resources with needs, giving rise to the problem of organizational misalignment. In addition, the approach to the quality of rubble as a usable material is a particularly significant problem. One of the reasons why processing has taken so much time has been the failure to settle some basic questions: Just how thoroughly does rubble need to be processed in order to make it acceptable as a material? There seems to be no end to the work of washing and sorting, but can some exceptions be made at times of emergencies? Can rubble resources ever measure up to natural resources?

In June 2014, the Ishinomaki processing site was the largest rubble processing site, covering 6 million hectares; but today no trace remains.

In the Tohoku region, which faces shortages of materials, there has been some illegal sand collection and illegal logging. Merely cleaning up the rubble does not solve all the problems. We need to settle the debate concerning the approach to quality control during emergencies by focusing on issues of quality, price, and actual usage experience.

An overly cautious approach is counterproductive. We need to consider the situation from a somewhat broader perspective. This is a cross-section of ancient Roman concrete from approximately 1,500 to 2,500 years ago. I just have to wonder: Was all the aggregate quite uniform in type and place of production? Would its density and water absorption rate have conformed to the requirements of JIS? Would it be acceptable in terms of particle size and shape? Was the percentage of surface moisture managed correctly? You might say that the performance requirements were different back then and leave it at that, but it would be a shame to ignore that ancient expertise on the processing and reuse of rubble. This could also be a good opportunity to promote Japanese technologies internationally. If our goal is to move to performance-based standards in the true sense, there should not be a problem with accepting a little more diversity in terms of materials and methods.

My response to the changing picture of concrete today is to raise the question of whether we can promote the use of recycled rubble, in the sense of broadening the scope of materials, without any changes in quality. We can draw on the lessons learned from our experiences with rubble processing and utilization to become the innovators of new technologies, promoting the use of Japanese technologies internationally instead of importing ideas from other countries.

Question 1

I have often heard that when materials are of a different quality than in the past, the materials can be used in construction of buildings as long as there is ministerial approval, but in civil engineering, the materials cannot be used in a prefecture or municipality until the Regional Development Bureau has issued guidelines. I wonder what can be done to make it easier for small and medium-sized local government organizations to use locally available materials.

Prof. Hisada

In practice, an important role is played by the attitudes and decisions of the ordering party; but prior to that, there needs to be more widespread knowledge concerning materials of a different quality than in the past and related technologies. This may change in the future as the information starts to be communicated better.

Question 2

Japan has the highest quality concrete in the world. The quality would decline if the standards were not so exacting, but the existence of the standards also means that there are restrictions on the choice of materials. The Standard Specifications are standards for construction, and when they are interpreted as some kind of absolute requirement or a legal mandate, that raises questions regarding the approach.

Prof. Hisada

I think of the specifications as having two different levels in their aims. The first level is to provide standards that anyone can use, similar to JIS. The second level is for a gray area, below that first scope, but between it and a scope of projects that should not even be attempted because the challenges would be technically insurmountable. Within that

gray area, it is technically possible to overcome the challenges. I believe it is important to promote the use of a wider scope of resources by establishing minimum values of quality assurance for use in that gray area.

Question 3

Speaking of standards, there have been more calls for revisions to JIS since the disaster in the Tohoku region. I do not believe that JIS should be changed, because its standards are applicable to all of Japan.

Kagawa Prefecture has established an ordinance on the use of waste slag as concrete aggregate that does not conform to JIS. Materials that do not conform to JIS may be used if regulations permit it, but other local governments may not pass similar ordinances. Kagawa Prefecture needed special regulations because it would have risked financial collapse if it had to strictly follow the requirements of JIS. Meanwhile in the Tohoku region, the national government is providing financial assistance for rubble disposal, so there is no risk of financial collapse among local government organizations. Government officials are reluctant to establish new regulations because it would be their fault if anything happened as a result of violating the requirements of JIS. There are calls to make changes in JIS, but this is the standard, and JIS should not be changed with respect to a limited scope of applicability. I think the approach should be that the ordering party takes responsibility when permitting the use of materials.

Prof. Hisada

I'd like to give an example. The Tohoku Regional Development Bureau of the Ministry of Land, Infrastructure, Transport and Tourism used rubble as inner fill material in coastal levees. The bureau made the decision to use rubble based on thorough considerations of quality, even though this material does not satisfy JIS. Confident in its own position as manager, the bureau relied on its own determination concerning the acceptability of rubble, because management of the coastal levees will be handled by the bureau itself into the indefinite future.

In buildings, JIS can be disregarded as long as there is ministerial approval. In civil engineering, JIS can be disregarded if the parties in charge have determined that the quality will not be a problem.

Discussion chair

We have developed a good atmosphere for discussion. Let's continue the session at this same pace.

Long-life structures and materials development: Prof. Etsuro Sakai (Tokyo Institute of Technology)

I would like to discuss various expansion agents that have been developed as a means of controlling cracking in order to ensure long-term durability, along with their workability and dense microstructures. I will also discuss factors that are unique to Japan, as large amounts of waste materials are utilized in the Japanese cement industry, and steps to reduce carbon dioxide emissions will be required in the future.

An expansion additive first came on the market in 1965 and was improved over the next 30 years, to the point that the same performance can be attained with only about 60% of the original amount. By analyzing the reaction mechanism, it was learned that about 30% of the expansion agent was reacting and being lost before the concrete has developed reactive force. The reaction of the expansion agent was controlled and the composition of clinker was adjusted, making it possible to reduce the amount of additive. For expansion agents to come into wide use on the market, further research was needed in order to reduce the price. At present, the expansive force is about 120% of the original level, but research is underway on reducing the expansion force in order to lower the price.

The water reduction rate and amount of additive are also relevant in admixtures which include AE water reducing agents and high-performance AE water reducing agents.

Lignosulfonates and gluconates were studied as the first generation, and melamine and naphthalene derivatives were studied as the second generation. Various other materials were studied in the interim, and then polycarboxylates emerged as the third generation. Naturally, future research can be expected to produce a fourth generation; but at present, only high-performance AE water reducing agents can provide the performance required by the rules of JSCE's Standard Specifications for Concrete Structures concerning unit water content, minimum slump at time of placement, aggregate conditions, and so on. However, high-performance AE water reducing agents are expensive, so the struggle is for a water reduction rate of 15%, a vague level that is somewhere around generation 2.5.

We are conducting research to develop the fourth generation. The mechanism of action of dispersants can be expected to change significantly with respect to ultra-high-strength concrete using ultra-fine "densified small particles" or DSP. Until now, the mechanism of action of dispersants has been understood as improving flowability through adsorption for molecular dispersion and steric constraint, and it was thought that increasing the amount of adsorption would improve apparent flowability. However, in the region of ultra-high strength, a phenomenon is observed where the amount of adsorption remains practically unchanged while flowability suddenly worsens. It seems that in the region of ultra-high strength, the mechanism of dispersion is different than previously observed regions, and the amount of adsorption is completely unrelated to flowability.

If this mechanism can be understood, it could lead to the discovery of the next generation.

I am conducting research to improve the flowability of cement, and I believe that by adjusting the filling properties and shape of the particles, it should be basically possible to control flowability. There are many materials for which it is not possible to change particle shape, although it is still possible to adjust their filling properties. We can create high flowability by changing the filling properties.

At present in the Japanese cement industry, although the volume of cement production has fallen to about half, the price has hardly risen. The main reason is that to produce 1 ton of cement, the industry now makes effective use of about 481 kg of waste, accounting for about half the weight. It has become a new industry as a result.

Another issue is the carbon tax. Although general contractors are doing their utmost to reduce carbon dioxide emissions, cement manufacturers still feel that they have no need to reduce emissions because the regulations do not apply to them. Meanwhile, South Korea has already introduced a carbon tax, and the proportion of admixtures has risen from 5% to 10% as a result. Debate is needed concerning how the industry should respond when a carbon tax is introduced in Japan. Steps will be needed to increase the use of waste materials and use admixtures to reduce carbon dioxide emissions, while maintaining performance.

The best way to improve flowability is to add small amounts of limestone. However, Japan has no standards for Portland cement with added limestone when the limestone content is higher than 5%, so this cannot be used. Either the EN-ISO standards for cement should be followed, or standards should be promptly developed for the use of limestone as an admixture.

It is very important to debate the subject of general purpose cement materials. It will be practically impossible to hold this debate without taking distribution and economic factors into consideration. The institutional systems in this area are excessively complex when it comes to introducing new types of concrete. The process is much slower when compared to electronic materials and the like. Development takes a long time and there are issues with patents. The only way to change concrete at present is to use admixtures, but the view at ready-mixed concrete plants is that it is bad to mix admixtures into cement, because then the product is not cement. Because the building construction market accounts for such a large proportion of demand for cement, it would be difficult to develop materials that would only be for civil engineering, and not for buildings; therefore, changes are needed in the standards relating to cement for buildings. I hope that young people will join in the debate and help to construct positive institutional systems. In South Korea, some ready-mixed concrete companies have their own research institutes, and the two largest firms are quite active in this area. Personally, I believe that it would be easier to develop new materials with that kind of climate.

Question 1

You made a comment about mixing in admixtures at ready-mixed concrete plants. There is anticipation concerning the possibility of innovation by means such as quality control using advanced IT in areas like manufacturing, or manufacturing other than materials, or mechanical equipment. Do you think some level of quality could be ensured by those means?

Prof. Sakai

Under the current circumstances, I do not think that would be possible. I think it is correct to use a powder mixture as cement. It might not be possible to get the proper mixing time, and it would not be practical to do that for all concrete. I think that the correct approach is distribution in the form of cement.

Question 2

Just as earthquake resistant design has changed in response to major earthquake disasters in the past, it would seem that by making the change to performance-based standards at the level of materials as well, it would become possible to pursue materials development with greater freedom while complying with the standards, and this would be incorporated into conventional design and construction.

Prof. Sakai

I believe that the regulations on materials should be eliminated, and it should be enough to ensure a certain level of performance for concrete. Otherwise, the development of materials cannot move ahead. The basic concept of ISO is that the standards do not cover cement, but only strength. This is the approach that must be taken if the results are to be applicable in many different countries.

Question 3

The Ministry of Land, Infrastructure, Transport and Tourism is currently experimenting with a switch to performance-based ordering. In performance-based ordering, the materials and construction methods are not specified, so there is generally a high degree of freedom. Specifically, performance-based ordering means that the ordering party specifies the required performance, but there is no way to prove whether the required performance is satisfied unless suitable verification methods exist. If the ordering party specifies the verification methods as well, it ends up being the content stated in the Standard Specifications for Concrete Structures. In other words, civil engineering can be implemented in any way, as long as it is consistent with the Standard Specifications for Concrete Structures.

Therefore, it is important for the Standard Specifications for Concrete Structures to work with performance verification methods. Otherwise, the specifications will not serve a useful purpose in such cases. The Standard Specifications for Concrete Structures need to include content on the use of verification methods.

Transition from new construction to maintenance: Dr. Yasuhito Sakai (Japan Expressway International Company Limited)

While the stock of infrastructure continues to steadily increase, structural deterioration is also advancing.

The Hanshin Expressway does not have any routes under construction, and the organization itself is focused on maintenance. The overall cost of maintenance has been rising.

Currently, about 18% of the country's road bridges are at least 50 years old, and this proportion will increase to 67% in 20 more years. Twenty years from now, the costs of maintaining and replacing road bridges will account for 80% of the total.

At the time of construction, these bridges were designed without consideration for their future management. With alkali-aggregate reaction and deterioration, some loss of prestress is occurring in sections over the sea, such as the Bayshore route. Salt damage is present on the northern Kobe route (which runs behind Mt. Rokko). Maintenance must be incorporated into design, with an eye to maintaining efficiency in future maintenance operations.

Therefore, the entire organization needs to work together to get a handle on maintenance. The organization has a pyramidal structure with top management, the head office, field personnel, and so on. At other firms such as the Hanshin Expressway and NEXCO, maintenance is outsourced to subsidiaries. If information is not conveyed from the field to top management, or if they receive mistaken information, this is bad for the organization, and the internal governance of the company will break down. The people of the organization need to take care with regard to governance in running its operations. It is especially important to keep records in databases and ensure that information is shared as far as top management.

Even identical concrete structures will deteriorate differently if placed under different conditions. Deterioration curves are often shown as averages, but the extent of deterioration varies according to the situation and place where a concrete structure is located. Variability in deterioration is evaluated organizationally, based on information from the field. For example, in a structure that shows changes at an early stage, there may have been excessive tension in precast concrete during construction, or the structure may have been built in an era when there was a high level of alkali-aggregate reaction. It may be possible to identify factors based on the era, and structures must be managed based on an awareness of those factors.

The Plan-Do-Check-Act (PDCA) cycle is often cited. For example, improvements can be made after using interviews to determine how a design was developed back at the design stage. As another example, a large volume of concrete rubble was generated when the Hanshin Expressway collapsed in the Hyogoken-Nanbu Earthquake of 1995. There was discussion as to whether it could be reused as aggregate, but in the end, this did not become a reality and the rubble was used as fill and as roadbed material for a construction road. For technological improvement, it is necessary to develop various technologies for the use of recycled aggregate. Follow-up is important.

Engineers must think through the entire process of design, construction, and maintenance. For example, considering the potential of concrete floor slabs to cause third party damage, engineers could decide that it is necessary to place fiber sheets at the stage of new construction to mitigate the risk that concrete spalling could cause a major accident, even though there is some cost involved. We do that ourselves, and it is also necessary for young engineers to address this with a new perspective.

Discussion chair

Let's move on to questions. I'm sure many of you would like to delve into some of these issues more deeply.

Question 1

Although the transition from new construction to maintenance is very important, there is a perception that repair and reinforcement is not a profitable market. I understand the thinking, but to focus on repairing each small section would not be a worthy use of the necessary skills. That gap would have to be bridged somehow in order to develop the market. How should this be addressed?

Dr. Sakai

It is a difficult problem. Because it is not economically feasible to fix each area of damage individually as it arises, repairs need to be combined to some extent. On the Hanshin Expressway, we close off a section of road to perform fundamental repairs, and this results in a large enough scale of a construction project to provide an acceptable level of efficiency.

Question 2

You mentioned the importance of sharing information from lower to upper levels of an organization. I believe that human relations and communication are of the greatest importance. Are any steps being taken to promote this at your company, or is there anything you have observed in general in this regard?

Dr. Sakai

When there are changes in personnel, there is a tendency that not all of the relevant information gets passed along. To correct that situation, we are building a database to

record information on failures and problems that have arisen in design or in construction. The experiences of past mistakes are often not conveyed to new personnel, so we are taking steps to ensure that records are kept on the kinds of failures that have occurred. This way, the information can be passed along when there are changes in personnel.

Question 3

Isn't there a tendency to want to cover up mistakes?

Dr. Sakai

Of course, the intention is not to place blame or impose penalties on anyone. It isn't that sort of climate. The intent is only to keep records. For example, Nikkei BP publishes records concerning failures in design and construction. It is important to familiarize others with the kinds of problems that have occurred so that they can develop the next steps to take in maintenance, on the basis of that knowledge.

Question 4

Was it easy to create that sort of climate?

Dr. Sakai

Many different opinions emerge when something new is attempted, although there was not really a force of resistance. The top leadership was fully aware of people's attitudes, and the new approach took hold beginning at top levels, although it was not all done by top management. It will have been 10 years since privatization next year, and this process actually took about 5 to 7 years.

Question 5

As you mentioned, the Hanshin Expressway Public Corporation was privatized a decade ago. Has it changed in the transition from public to private? Could you talk about how the change was handled from public to private management of regional roads?

Dr. Sakai

Although it is technically a joint-stock corporation, all of the shares are owned by the national government. The government is heavily involved. One major change when it became a joint-stock corporation was that highway users came to be thought of as customers. There was a significant shift in attitude, as the company now takes the customers' point of view, listens carefully to their opinions, finds out what it is they want, and makes changes to reflect that. The company has more young employees, and another major change is that communication has become more open than it had been as a public corporation.

Developing an international reach, from the standpoint of academic societies and research institutes: Prof. Tamon Ueda (Hokkaido University)

Because I work at a university, I think of international outreach from the perspective of research. Universities are actively involved in developing an international reach based on programs and subsidies offered by agencies such as the Ministry of Education, Culture, Sports, Science and Technology. This includes endeavors such as providing education in English, sending Japanese students to study abroad, and hiring more international instructors and staff members.

Concerning the international outreach of JSCE and the Concrete Committee, the International Activities Center was established in 2012, with major changes in budget and staffing. In the past, many things could not be done because the necessary funds and personnel were not available, but now the organization has taken a step in the right direction. The long-term strategy goal is for the International Activities Center to serve as the core of JSCE's international activities, with the aim of building the international activities of JSCE to the same scale as its activities within Japan, and growing it into an organization whose executive capabilities are recognized both within Japan and internationally.

Previously, JSCE did not have any official documents about its international strategy, but this documentation has been written by the international committee this year. The strategy includes communicating information in English, holding meetings that are not in Japanese, and placing an emphasis on increasing the organization's international reach in Asia.

The point of view of a committee on international academic societies is one of the necessary perspectives for developing an international reach. It includes activities of JSE and JCI, but there is no need for this to be limited to Japan. The Concrete Committee devotes enormous amounts of energy to the Standard Specifications for Concrete Structures, and there is a great deal of joint research among industry, government, and academia within Japan, but there is no need for that to be limited to Japan; and complementary research techniques could be shared through these joint efforts. It is necessary to convey information in English and develop an English version of the standards, because no one will be aware of what we are doing unless we communicate the information. Also, some technological deployment is possible even when dealing with other advanced countries, although in the past, technology transfer has often been performed based on an approach similar to ODN with regard to superior Japanese technologies.

Because the purpose of engineering research is to meet the needs of society, this is an area of research that is quite suitable for international outreach; and the greater the needs, the more important the research. Clearly, it is important to promote research for developing countries, especially those in Asia. There is a large number of countries with large populations, and it follows that the needs are also significant. There are massive ongoing infrastructure needs. In advanced countries, the focus is on updating the existing

infrastructure; but in most of Asia, a great deal of new construction is occurring. China alone accounts for nearly 60% of cement consumption. Many infrastructure needs are apparent as soon as we look beyond national borders.

Most of the research in civil engineering is based on experience. Just as a wealth of knowledge has emerged from Europe and North America, which have long histories of infrastructure development, the issues currently being debated in Japan will surely become matters of great importance for the rest of Asia in the near future.

Next, I'd like to consider areas of research where Japan is a leader. Since Japan experiences so many natural disasters, its research in the areas of disaster prevention and mitigation technologies is quite advanced, but it has not yet reached the stage of deploying these technologies internationally. Some of the technologies pioneered by Japan include self-compacting concrete and continuous fiber reinforced materials. Self-compacting concrete was first invented in Japan, but at present, more work to improve this technology is being performed in countries other than Japan and France. Not much research on shear fatigue is being performed elsewhere, so this may be a research subject that is unique to Japan.

There are also some technologies where Japan is an international leader. In the international standardization activities of ISO, Japan has the chairmanship of the ISO/TC71 expert committee.

With successful international outreach, for example, Japanese scientists will play a leading role as members or chairpersons in technical committees of organizations such as RILEM and Fib, and will be listed as lead authors on the reports of such committees' findings. The International Federation for Structural Concrete (Fib) is truly an international organization, conducting the sorts of activities performed by JSCE in Japan in multiple countries, centered in Europe. Japan really ought to be participating in Fib. Also, at present, the Concrete Committee basically only debates domestic topics, and hardly ever deals with topics that relate to other countries; but it should be possible for the domestic research committee itself to cooperate with research committees and the like in other countries.

Other involvement would include performing international joint research studies, developing international standards as a way to contribute to society, providing support for Japanese standards abroad, and promoting internationalization in engineer quality assurance programs. Universities, in particular, should engage in more international joint research studies, and this is already a common practice at European and American universities. A variety of people from industry, government, and academia should participate in activities such as the development of ISO standards, just as they also participate in development of the Standard Specifications for Concrete Structures. Also, since the scope of the qualification for concrete diagnosticians is somewhat different than ACI's engineer qualification, these are not in competition with each other; and this could be another potential area for international outreach.

In closing, my hope is that internationalization will be advanced in a wide range of areas. I would like to see greater globalization in terms of human resources, research topics, and organizations. For example, when international university consortia and the like are conducted without limits in terms of borders or nationalities, it may be the case that more

than half of the names on reunion lists will indicate addresses in countries other than Japan. I believe that Japanese academic societies should become more internationalized as well.

Question 1

At my company, we are told to obtain international support. We try to explain our products to customers in other countries, but the biggest problem is that international standards such as ISO do not match up with Japanese standards such as JIS in terms of compression testing. I don't know how these should be translated. Perhaps I haven't been looking in the right place, but I have not been able to find any study that summarizes the differences between the standards. Without that, there is no technical basis for such activities. Our company is not capable of launching such a research project on our own, and I hope that JSCE will perform research concerning the standards.

Prof. Ueda

It would not be enough to simply obtain English translations of the specifications that have been written in Japanese. It is necessary to actually train human resources in the field using those technologies. The effort required would be on another order of magnitude, starting with developing an expert network, and then developing English versions of Japan's outstanding technologies and comparing them with other known technologies around the world. For example, at a famous Swiss company called “Sika”, they do not have Swiss people explaining the technologies, but only local people. This kind of practice is not generally seen among Japanese companies. It has to begin with training local human resources.

Question 2

In terms of real issues, in the world of steel products, we can give explanations using the other side's terminology under ISO or ASC, but this does not exist in the world of concrete.

Prof. Ueda

There is a great deal of correspondence between JIS and ISO, and generally there are no nonconformities with regard to materials. However, ISO standards do not generally exist for subjects beyond the scope of materials, such as construction and design situations. It would be fine for ISO specifications to be developed for those areas. In that case, it would be necessary to have an English version of the Standard Specifications for Concrete Structures.

Question 3

In order to have Japanese standards used in other countries, it is necessary to familiarize engineers with the technologies, but it is not clear what efforts should be undertaken in order to have the technologies incorporated into specifications. It seems that even if we inform engineers in other countries about certain technologies that exist in Japan, there will not be much hope about the outcome unless we also promote Japanese technologies

to consultants and other experts who are active outside Japan and convince them to adopt these technologies. What is your view on this?

Prof. Ueda:

During the three years I spent at the Asian Institute of Technology, I had the impression that the U.S. gets the other side to adopt its systems, rather than handing over money. This is done by the government, and I am not sure exactly how they do it, but they have done things like introducing American systems into Thailand. Japan will need to work on this as a whole. The U.S. has an advantage because of the English language, but I had the strong impression that they were using this kind of approach. I believe Japan will need to use this sort of tactic as well.