Achievement Award

Toyoaki Miyagawa, Distinguished Professor
Center for the Promotion of Interdisciplinary Education and Research, Kyoto University

Reasons for the award

Working in the field of civil engineering materials, Prof. Toyoaki Miyagawa has developed new systems for assessing mechanical performance and durability performance at multiple scales – ranging from the molecular level to civil engineering structures. Among these systems, his research has led to the development of a method for analyzing lifetime scenarios of concrete structures. This enables engineers to freely control the performance of structures at the spatiotemporal scale, thereby making possible structures that are beautiful, yet rugged and sustainable. With respect to his work for JSCE, Prof. Miyagawa has served as chairman of the Concrete Committee and of the Committee to Revise the Standard Specifications for Concrete. Specifically, as chair of the latter committee, he worked for the 2001 edition of the Concrete Standard Specifications [Maintenance], which is the world's first performance-based maintenance standard. Furthermore, in 2014, he was responsible, as chairman, for the great success of the JSCE's 100th anniversary annual conference.

For these reasons, Prof. Miyagawa has been recognized as a worthy recipient of an Achievement Award.

Achievement Award

Keitetsu Rokugou, Distinguished Professor (Honorary Professor)
Gifu University

Reasons for the award

Prof. Keitetsu Rokugou has made considerable achievements in the fracture of concrete and concrete member such as the control of spalling failure phenomena at the fracture, the evaluation of tensile softening behavior at cracking, the evaluation and application of high-ductility fiber-reinforced concrete with tensile hardening behavior. These research achievements have contributed greatly to practical applications in the field of concrete engineering. In addition, he has also made significant contributions to the regional implementation of new technologies, such as robot technology for infrastructure inspection. With respect to work for JSCE, he served as a committee secretary and as a standing member of the Concrete Committee. He also contributed to a revision of the Concrete Standard Specifications and the establishment of various design and construction guidelines. He further served as a chairman of the journal editorial committee, chairman of the paper editing sub-committee, vice-chairman of the structural engineering committee, and member of the Chubu Branch Commercial Council. Through these activities, he has made significant contributions to the development of the JSCE.

For these reasons, he has been recognized as a worthy recipient of an Achievement Award.

Technology Awards

Construction of the main body of the Yamba Dam - high-speed construction of a dam with a volume of 1 million m3 to store 75 million m3 of floods from Typhoon No. 19

Ministry of Land, Infrastructure, Transport and Tourism, Kanto Regional Development Bureau, Yamba Dam Construction Office, Shimizu Corporation, Tekken Corporation, IHI Corporation Dissimilar Construction Joint Venture, Nippon Koei Co., Ltd.

Reasons for the award

The Yamba Dam is a multipurpose dam constructed on the Agatsuma River in the Tone River system. It is a gravity-type concrete dam with a height of 116 m, a length of 290.8 m at the top, a concrete volume of approximately 1 million m^3, and a total water storage capacity of 107,500,000 m^3. The dam is designed to control flooding and reduce flood damage in downstream areas, maintain normal water flows, provide a new municipal water supply to ensure a stable supply in the metropolitan area, and generate electricity with a maximum output of 11,700kw. It is an extremely important project from the perspective of flood control along the Tone River and securing water resources for the metropolitan area, and its early completion was strongly recommended.

To enable construction of the dam, concrete manufacturing, concrete casting, and aggregate manufacturing facilities were enlarged and concrete was cast up to 70,000 m^3 of concrete per month was carried out through proactive adoption of the RCD method, which is rarely used. Use of this method allowed the time frame of construction to be greatly reduced. In addition, the dam itself incorporates many structures, while there are many overhanging areas and slope changes on both upstream and downstream faces. Precast concrete was used to improve the efficiency and safety of construction. Moreover, by devising an installation method for the components of the flood discharge system and ensuring their quality, the construction time frame was made as short as possible even in the winter season.

When the torrential rains of Typhoon No. 19 struck in October last year, causing extensive damage in eastern Japan, the water storage capacity of the dam and its effective operation contributed to a reduction in flood damage downstream. Careful construction and quality management ensured that embankment leakage during this flood test event was extremely low; the dam was shown to be of good quality. The technology used in this project will be useful and informative for future dam construction.

These achievements were highly evaluated and recognized as worthy of the Technology Award.

Technology Awards

Construction of new flood discharge tunnel for the Kanogawa Dam – Large-section tunnel with deep-water portal

Ministry of Land, Infrastructure, Transport and Tourism, Shikoku Regional Development Bureau, Yamatosaka Dam Office, Shimizu-Ando Hazama Joint Venture, Nippon Koei Co., Ltd.

Reasons for the award

This construction of a tunnel flood discharge for the Kanogawa Dam is the first of its kind in Japan, and construction involved a series of works of unprecedented difficulty, including construction of a hydraulic tunnel capacity of releasing up to 1,000m^3 of water per second and connection of the large-section tunnel portal to a steel pipe sheet pile shaft in deep reservoir water.

To achieve the work, the LIBRA-S construction method (a labor-saving underwater breathing method) was adopted for the deep-water construction in the lake. By developing this new technology, the underwater operation required was reduced by 55%, resulting in significant labor saving and process reduction. Further, in connecting the vertical steel sheet pile shaft and the tunnel in the deep-water, the project to open the tunnel into the shaft was managed using a thorough system of countermeasures such as estimation of shaft deformation by 3D FEM and monitoring of various measured parameters. Additional water sealant was injected incrementally in accordance with shaft deformation. Ultimately, a successful connection was achieved without any water leakage. With the implementation of these measures, the project was successfully completed on October 11, 2019.

Flood discharge through the Kanogawa Dam Tunnel has been in operation since a test release of water in March 2019 to ensure the safety and security of the downstream Hijikawa river basin. The project is a major contribution to the dam re-development project, which has been attracting attention in recent years. For this reason, the work is highly rated and was evaluated and recognized as worthy of the Technical Award.

Environmental Award

The development of low-carbon concrete "ECMconcrete" that ensures high durability while reducing CO_2 emissions

Kajima Corporation, Tokyo Institute of Technology, Takenaka Corporation, Nippon Steel Blast Furnace Slag Cement Co., Ltd., DC Co., Ltd., Taiheiyo Cement Corporation, Nippon Steel Cement Co., Ltd., Takemoto Oil & Fat Co., Ltd.

Reasons for the award

While the efforts to reduce carbon dioxide (CO_2) emissions are necessary across the board by developed countries to prevent global warming, cement-related CO_2 emissions by the construction industry account for 4% of Japan's overall CO_2 output. Reducing these emissions is an urgent issue. The use of concrete containing ground granulated blast-furnace slag, which results in emissions about 1/30th those of cement, is expected to significantly reduce CO_2 emissions. However, there are problems with such concrete relating to construction work and quality, such as significant changes in the properties of the fresh concrete over time and low early-age strength development. This new Energy and CO_2 Minimum (ECM) technology overcomes these problems by introducing two innovations: a newly developed dispersant that inhibits property changes and a method of determining an optimum cement composition of gypsum and ground granulated blast-furnace slag with a specific surface area. ECM concrete is able to reduce CO_2 emissions by 65% compared to ordinary concrete. Furthermore, ECM concrete has already been applied to actual structures and can be placed without problems in terms of quality and safety.

ECM concrete was judged to be appropriate for the JSCE Environmental Award because it is a revolutionary technology that has been put to practical use in the effort to drastically reduce CO_2 emissions. The new technology overcomes the shortcomings in quality and construction work when using concrete containing high levels of ground granulated blast furnace slag and the use of this environmentally friendly concrete is expected to spread in the future.

Yoshida Award: Research Accomplishment

Hirotaka Kono, Professor
Kyoto University

Standardization of concrete technology for civil engineering

Reasons for the award

Prof. Hirotaka Kono has been engaged in concrete engineering research in the general civil engineering field for many years and has made significant achievements, especially with regard to technology standardization.

He gained extensive experience with field-based technical guidance while dealing with a wide range of research and engineering problems during his time at the Civil Engineering Research Institute. Taking advantage of his experience, he has contributed to the creation of clear, user-friendly standards and specifications. He has worked on revisions of the JSCE Concrete Standard Specifications for more than 30 years. In particular, taking a user's perspective, he proposed a four-volume structure for the construction section of the 2007 edition as deputy chief editor. In the 2012 edition, he led revision of the specifications as chief editor of the construction section.

Prof. Kono has contributed to the JSCE Concrete Standard Specifications in the sections on performance-based design of concrete dams and pavements. He participated in and led the revision of other practical technical publications, such as road bridge specifications and pavement design/construction guidelines, and also worked on revision of the Japanese Industrial Standards (JIS) for a very large number of testing methods, materials, products, quality, etc. He also served as the chairman of the Civil Engineering Subcommittee of the Japanese Industrial Standards Committee of the Ministry of Economy, Trade and Industry from 2010 to 2014. He was also in charge of drafting technical notices for the former Ministry of Construction and the Ministry of Land, Infrastructure and Transport. This work has contributed greatly to the development and revision of test methods, standards and guidelines related to concrete in academic communities other than JSCE.

As described above, Prof. Hirotaka Kono has been recognized for his outstanding achievements in the advancement, development, and diffusion of concrete engineering technology and is therefore considered worthy of receiving the Yoshida Prize in Research Accomplishment.

Yoshida Award: Research Paper

NUMERICAL SIMULATION OF SEA SALT SPRAY BASED ON PRECISE CONSIDERATION OF WAVE AND WIND ACTION

Journal of JSCE (Division E2), Volume 75 Issue 2 Pages 60-79, 2019 (in Japanese)

Fuminori NAKAMURA, Takumi SHIMOMURA, Ryohei OHARA, Tokuzou HOSOYAMADA

Reasons for the award

This paper describes an accurate technique for predicting the amount of airborne salt, which can contribute to improving the accuracy of predictive analysis of salt-related concrete degradation caused by external environmental effects. It provides quantitative boundary conditions for analysis to predict rebar corrosion in concrete.

A simulation technique is developed for predicting the amount of salt in the air that includes environmental conditions in coastal areas and then a method is proposed for the evaluation of the long-term effects of salinity on real structures. The paper also describes the development of a numerical model that integrates the process of salt transport from generation to deposition, which has not been studied in the past. The acquisition of detailed field observations in the vicinity of structures is explained and a method for evaluating the long-term effects of salt on real structures is proposed. The numerical models are shown to be highly accurate by validating against field measurements of airborne salts, meteorological records, and precise measurements of structural geometry and topography. The numerical results are also used to evaluate the long-term effects of salinity on real structures, while a new method is established that significantly reduces the huge amount of computation time that has been a problem in many studies. The results of this research are expected to find good practical application.

In conclusion, this paper makes a significant contribution to advancements in the prediction of salt degradation of concrete structures and to the development of concrete engineering. It is considered is worthy of receiving the JSCE Yoshida Award in research paper.

Yoshida Award: Research Paper

FROST DAMAGE OF REINFORCED CONCRETE BEAMS AND ANALYTICAL EVALUATION OF ITS STATIC FAILURE BEHAVIOR

Journal of JSCE (Division E2), Volume 75 Issue 4 Pages 293-307, 2019 (in Japanese)

Takeru KANAZAWA, Yasuhiko SATO, Ryosuke TAKAHASHI

Reasons for the award

There have been many efforts to determine the degree of concrete damage caused by freeze-thaw action by evaluating relative dynamic modulus of elasticity. However, there has been little attempt to find a way from that information to obtaining a reasonable understanding of, or even prediction of, damage and performance degradation of concrete structures.

This paper focuses on the anisotropy inherent in RC elements subject to freeze-thaw action and proposes a member analysis method based on simply and clearly explaining the differences between reinforced concrete (RC) and unreinforced concrete. From freeze-thaw tests on RC elements, it was found that the anisotropy of response (mechanical anisotropy) can be explained by the anisotropy of expansion strain (damage anisotropy). Based on this finding, a compressive constitutive law taking into account the mechanical anisotropy due to the presence of the rebar was proposed. Further, an analytical method for coupled damage and mechanical anisotropy was developed and shown to be capability of simulating the change in failure mode due to different degradation distributions as well as the reduction in load-bearing capacity. Not only does this analytical method fit the experimental results, but it also provides insight into degradation phenomena specific to RC. To perform this analysis, the information required is the reinforcement ratio, water-to-cement ratio, and ambient temperature, all of which can be readily obtained in practice. Therefore, this paper provides a workability performance evaluation method for the design and maintenance of RC structures against frost damage and is expected to contribute greatly to the development of performance evaluation.

As described above, this paper is considered worthy of receiving the JSCE Yoshida Award in research paper.

Yoshida Award: Encouragement of Research Award

Motohiro Ohno
The University of Tokyo
Creation of new functions and value of cementitious materials based on metamaterial technologies

Toshinori Kanematsu
Central Research Institute of Electric Power Industry
Development of evaluation method for corrosion rate of rebar in concrete using completely nondestructive inspection method

Wang Tiao
The University of Tokyo
Reliability assessment of cracked reinforced concrete structures by considering the coupled effects of crack development and corrosion initiation and progression mechanisms

Tanaka Award: Achievement

Takao Ioka
Special Adviser of Oriental Shiraishi Corporation (Former President and CEO of the company)

Contribution to the development of construction technology and rationalized construction on concrete bridges

Reasons for the award

Mr. Takao Ioka has been with Oriental Concrete (now Oriental Shiroishi) since 1976. He started as an engineer working mainly in the bridge construction sector. At the time, expansion of high-speed transportation networks such as the Shinkansen (bullet train) and expressways was at its peak and prestressed concrete (PC) bridges were being constructed in large numbers. PC bridge technology was at the time in the early stages of development and he was involved, as site manager, in the construction of many complex projects.

In 1997, he was working on the construction of the superstructure of the Kaimi Bridge on the Yamagata Expressway as a field representative. The work involved construction of both northbound and southbound carriageways, and it was common to place four wagens on each of them. However, he overcame the severe construction period by means of integrating the inbound and outbound lines into a single wagen and rationalizing the interference with each other and the assembly and disassembly of machines and construction.

In 2000, he again acted as field representative on the Kido River Bridge project on the Joban Expressway. In this project, a method of span-by-span construction with precast segments was used and all segments except the terminals were precast and without an under-girder. He successfully implemented this method of which there are no other examples.

In later years, Mr. Ioka became active in work with professional organizations, serving as director and vice-chairman of the Prestressed Concrete Industry Association and as a director of Nikkenren (the Japan Federation of Construction Contractors), contributing greatly to the sound development of the construction industry and of PC bridge work in particular.

Mr. Ioka's achievements over the years have made a significant contribution to the development of bridge technology in Japan and his efforts make him worthy of the Tanaka Award.

Tanaka Award: Artwork Division

Second Komono Elevated Bridge

Central Nippon Expressway Company Limited, Nagoya Branch

Reasons for the award

The second Komono elevated bridge is a viaduct linking the Komono interchange and the Kameyama West junction on the Shin-Meishin Expressway in Komono-cho, Mie Prefecture.

This bridge is a continuous elevated viaduct of 19 spans totaling 1,103 m in length. It is three prestressed reinforced concrete (PRC) continuous extradosed bridge. The center section of 341 m crosses a river and the approach spans on the two sides consist of five PRC continuous box girders. Because the river crossing is skewed, the stranded cable is suspended from one side of the cable and the center section consists of a three-chambered box section PRC structure to accommodate future plan to extend the center span of the bridge with a length of 161 m. It is one of the largest extradosed PRC bridges with these features in Japan.

The basic esthetic design concept of the bridge is harmony with the surrounding environment through use of a steel-concrete composite for the main tower and to use slender structural members throughout. For extended service life, a quadruple anti-corrosion specification with epoxy coated and filled (ECF) strands was adopted to inhibit corrosion. The same countermeasures were applied to the diagonal bracing cables. Fatigue safety was verified by axial tensile fatigue testing. To improve productivity during construction, the semi-prefabricated cables were assembled at the factory to reduce the construction period and ensure the quality of the diagonal bracing cable. In addition, the anchorage part of the diagonal bracing cable was designed for improved efficiency of inspections carried out for maintenance management.

As described above, the Second Komono Elevated Bridge was recognized as deserving of the JSCE Tanaka Award for its contribution to future bridge design by offering solutions to technical issues such as environmental impact, performance verification over the long life of the bridge, productivity improvements, and maintenance.



Tanaka Award: Artwork Division

Kirigataki Bridge widening work

Japan, Ministry of Land, Infrastructure, Transport and Tourism, Hokuriku Regional Development Bureau, Toga dam Engineering Office, Toyama Prefecture

Reasons for the award

The Kirigataki Bridge is a multi-span continuous precast concrete (PC) ramen box girder bridge with a maximum span of 109 m and a maximum pier height of 64 m. The widening work was carried out while two lanes continued in use on this section of the Shin-Tomei Expressway with heavy traffic, where the average daily traffic volume is 45,000 vehicles. In particular, the work on the eastbound carriageway had to be carried out within the restricted width of 1.8 m on the original bridge. For this purpose, a special vehicle was designed and manufactured to remove the bridge railing and lay the new slab. Since the entry points for materials and equipment were limited to one intermediate pier of each bridge, railing removal and slab extension were accomplished by pushing out from the entry points. The standard extension length after expansion is 4.7 m (and the maximum about 6.0m), struts were needed at 3.5m intervals to support the overhanging slab structure. Construction conditions and time constraints dictated that the length of each new slab block was 7.0 m. There were multiple support points for the slab construction vehicle on the struts and the structure was designed to disperse the load. In addition, reaction force was managed throughout the work to prevent harmful cracks in the floor slabs. Techniques used to implement this widening work included measures to control tensile stress in the extension slabs, use of EFC strands for transverse slab tightening, ultra high strength fiber reinforced concrete (UHPFRC) for PC surrounding the cable anchorages, addition of carbon fiber reinforcement for existing main girder webs, and installation of sliding bearings in the widened section.

As described above, the widening work of the Kirigataki Bridge was recognized as worthy of the JSCE Tanaka Award because the successful implementation of the work under the limitations in place will contribute greatly to the development of bridge reconstruction methodologies for the future.



Technology Development Award

Development of a post-construction shear reinforcement method using ceramic anchorage fixtures

Shinichi Yamanobe (Kajima Corporation), Naoki Sokabe (Kajima Corporation), Keigo Tamano (Kajima Corporation), Takuya Iwamoto (Kajima Corporation), Masaaki Ueda (Kajima Renobate Corporation)

Reasons for the award

Existing reinforced concrete (RC) underground structures designed to old standards (prior to 1980) have fewer shear reinforcement bars than required by the latest standards and many of them require seismic reinforcement to prevent shear failure during large earthquakes. In general, seismic reinforcement of underground structures is carried out in the inner space, which avoids large-scale excavation, due to construction period and cost considerations. However, the reinforcement effect is limited and often there is a lot of pipework and equipment in the work area. This has been a major problem when performing this type of reinforcement.

The newly developed work method uses Ceramic Cap bars (CCbs), which are a reinforcement consisting of a threaded rod bar with a ceramic anchor at each end, as additional shear reinforcement installed from inside an underground structure. The use of a non-ferrous material for the anchoring parts ensures anchorage durability and as well as highly effective shear reinforcement. The practical realization for seismic reinforcement method can accommodate to various environmental conditions as the continuous improvements have been done for the tasks on the design and construction revealed in the process of practically adopting this technology.

This technology is worthy of a JSCE Technical Development Award for making possible the seismic reinforcement of underground structures of widely different design and construction. It is expected to contribute greatly to improving the toughness of important social infrastructure such as water and sewage reservoirs and underground structures at power generation facilities.

Technology Development Award

Development of precast slab jointing method using UFC (Slim Fastener®)

Toshio Nomura (Obayashi Corporation), Takayuki Iwaki (Obayashi Corporation), Takayuki Tominaga (Obayashi Corporation), Takashi Kawanishi (Obayashi Corporation), Kazunari Sasaki (Obayashi Corporation)

Reasons for the award

In terms of slab renewal project due to deteriorations or other reasons, precast slabs which enable to high-speed construction were employed across the country. However, the jointing method has to be in site construction. Thus, the rationalization of the jointing method is required for reducing the on-site implementation period.

One important objective of slab replacement is to improve slab durability. The precast slabs manufactured in a factory under controlled maintenance system possess high quality and the fatigue strength as a structure increases due to the prestress applied. Therefore, the precast slab section should also have excellent durability and high strength otherwise the improvement of the durability of whole slabs cannot be achieved.

This developed technology uses ultra-high-strength fiber-reinforced concrete (UFC) with the room-temperature-hardening type as a filling material between the precast slabs. The joint surface has the multiple shear keys consisting of concave and convex shapes so as to ensure the durability and strength that are the same or more than the precast slabs. In addition, because the filling materials can be manufactured on site, the high-speed construction is realized by reducing the critical pass of slab replacement construction. The work saving can be achieved due to the omission of the steel reinforcement processing, rust prevention, and reinforcement arrangement and the use of the embeddable formwork for convertible falsework.

This technology gives the high-speed construction of slab replacement work, the shortening of traffic restrictions, and the high durability of whole slabs. Thus, this technology is worthy of a JSCE Technical Development Award for 2019 for making a significant contribution to society.