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JSSC President Prizes 2011

Hoki Museum

Prize winners: Nikken Sekkei Ltd. and Obayashi Corporation

A notable structural feature of the Hoki Museum is the 100 m-long box-shaped steel plate structure that constitutes one section of the museum. Supported at two points so that it floats above the lower structure, the box-shaped section is cantilevered for 30 m at one end (Photo 1). This structural system expresses the architectural concept of "floating in the forest."

Jutting outward in one direction, the box-shaped girder has a cross-sectional configuration consisting of two walls, and two floors (a floor and a roof). The outer wall of the box beam has a gentle arc shape (Photos 2 and 3), the undulation of which is overlapped by the inner wall that serves as an exhibition wall. Since the overlapped section houses the stairs, adequate overlap was provided in the front and rear of the stairs. Therefore, resistance is provided by the inner and outer walls.

The two horizontal surfaces (floor and roof) and the two walls of the box-shaped girder comprise a double-walled steel plate structure containing steel shapes (H250) and light-gauge steel channels (C250). Coated steel plates were used as-is to provide a finished surface for the exterior walls, exhibition walls and ceilings. Many small holes are added in the ceiling plate and used for LED lighting and air-conditioning vents. Wiring and ducts run through the double-walled steel plate structures. Paintings are hung on the steel-plate exhibition wall using magnets. (Photos 4 and 5) The steel plate itself defines the structure, the design and the function—as well as the architecture.

The structural properties of the double-walled steel plate structure were confirmed by means of plug welding, stiffening effect and cyclic shear tests. In addition, the actual performance characteristics of the completed cantilevered structure were verified by means of loading tests. Because this museum is an architecturally unusual structure, three-dimensional building information was shared among the related parties during member manufacture and installation. Advanced technologies were extensively utilized to secure the highest accuracy in on-site welding, straightening and installation. On top of this, we strongly feel that this project enabled the related parties to share interests and capabilities inherent in *monodzukuri*, or building construction. The Hoki Museum is a steel-structured building with a scale, weight limitations and functions that only steel products can provide.

Photo 1 Full view of box-shaped steel-plate structure

Photo 2 Cantilever structure

Photo 3 On-site construction

Photo 4 Inner view of box-shaped steel-plate structure

Photo 5 Construction of box-shaped steel-plate structure

Nagoya City Science Museum

Prize winner: Nikken Sekkei Ltd. and Takenaka Corporation

A notable feature of the Nagoya City Science Museum is the spherical structure with an outside diameter of about 40 m that houses a world-class planetarium. The spherical structure is sandwiched between the east- and west-side buildings having a nearly regular rectangular plane configuration. Since the spherical structure is not supported by pillars, it looks as if it floats (Photo 1).

The spherical structure is composed of upper and lower hemispheres, taking into account their respective construction processes. The upper hemisphere constitutes the dome of the planetarium, and in order for the whole sphere to float, the lower hemisphere is designed to support the spherical structure's great weight of about 40,000 kN. (Refer to Fig. 1 and Photo 2)

In constructing the lower hemisphere, an arch frame to carry the vertical load was installed in the X-shaped plane position that connects support columns in the east- and west-side buildings and the core of the sphere (Fig. 2). The structure's rigidity is obtained by installing a truss frame in the outer shell and on the floor of the spherical structure.

In the construction of the upper hemisphere, a composite truss structure composed of system trusses and steel tubes was adopted to mitigate the burden placed on the lower hemisphere, thereby reducing the weight of the entire spherical structure.

A single-span rigid-frame system, approximately 20 m in length in the lateral direction, was adopted to effectively utilize building space. Because the horizontal rigidity of a single-span rigid frame is low, the necessary rigidity and strength were secured by filling the steel tube columns with concrete and applying steel-frame braces and viscous dampers.

The construction plans called for the buildings on the east and west sides to be built first, followed by the spherical structure. In the construction of the spherical structure, the lower hemisphere was temporarily supported by 31 bent columns, and after completion of the steel-frame work for the lower hemisphere, it was lowered into the prescribed position using jacks. The spherical structure employs closed framing, and thus high dimensional accuracy is required for both the manufacture and installation of the frame. To attain this, various approaches were applied to secure structural precision—an elaborate temporary assembly process, precision control of the installation, and stress measurements.

Fig. 1 Section of Nagoya City Science Museum

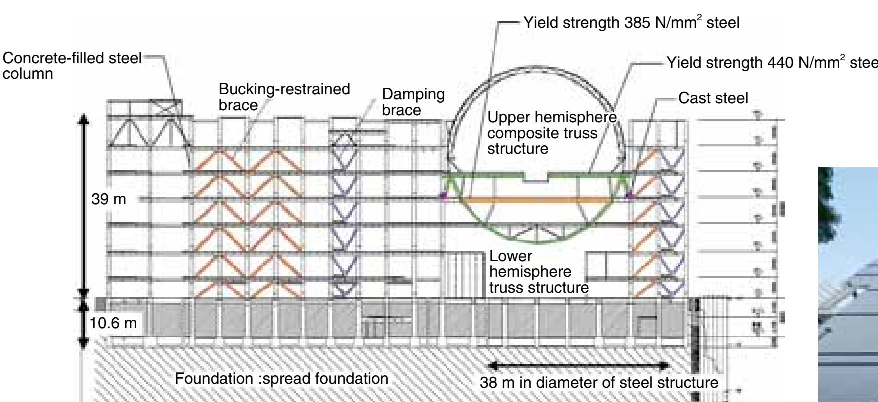


Fig. 2 Structure of Lower Hemisphere

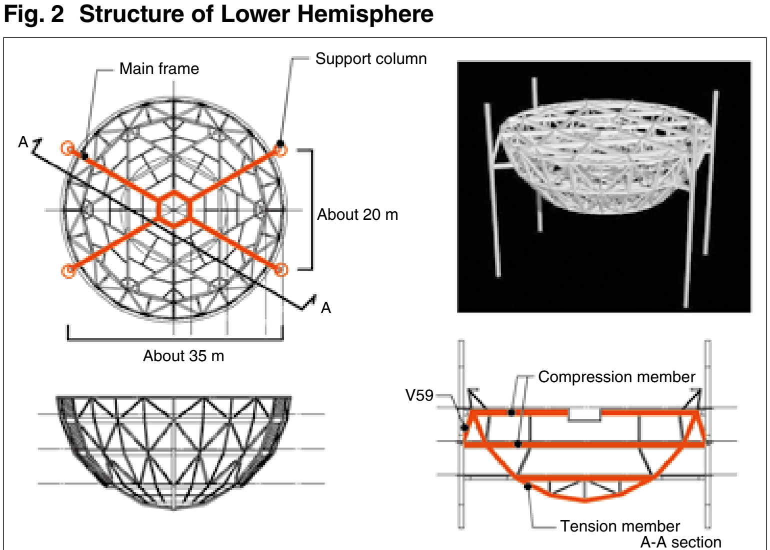


Photo 1 Spherical structure to house a planetarium

Photo 2 Full view of Nagoya City Science Museum

Large-roof Sliding Method for Airport Building

Prize winner: Kajima Corporation

A large roof was installed over the check-in lobby of the international passenger terminal that opened in October, 2010, at Tokyo International (Haneda) Airport. The roof has a bow-shaped cross section that recalls the lower slope of Mt. Fuji.

The large roof is a long-span steel-frame space truss structure (69 × 162 m) composed of ten connected space truss frames sitting on columns spaced 69 m apart. A sliding method was used for construction of 16,000 m^2 out of 18,000 m^2 of total roof expanse. Excluded were one span on the northern tip and a part of railway access section.

In the sliding method, each integrated space truss frame (9 × 92 m) was slid 18 m on temporary rail beams placed on column heads via a sliding jack provided on the heads of the truss-support columns; the frame was then connected with another space truss frame. Because the final slide involved 9 rows of connected space truss frames weighing about 5,000 tons, the roof was slid using two PC wire strands (28.6 dia.) set on each column head and two 50-ton center hole jacks. The jacks moved the heavy roof by use of the stroke of the jacks with the reaction set ahead of 2 spans (L=36 m). The stroke position and loading condition of each jack were automatically controlled employing a built-in CPU control box.

The huge roof was fortunately completed on schedule thanks to successful large-scale sliding work that had never before been used in building construction. This achievement shows new potential in the construction of large-span steel structures. It is expected that the new know-how obtained in the current project will be put to practical use in a diverse array of construction sites.

Photo: © Ishiguro Photographic Institute

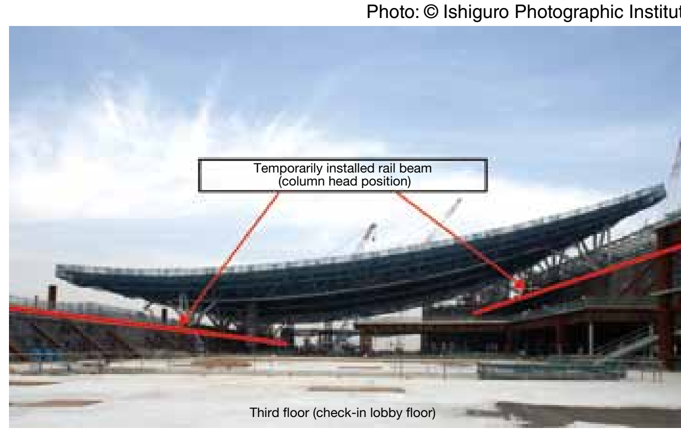


Photo 2 Fifth sliding
Sliding from the rear (north side) to the front (south side) in 6~8 hours

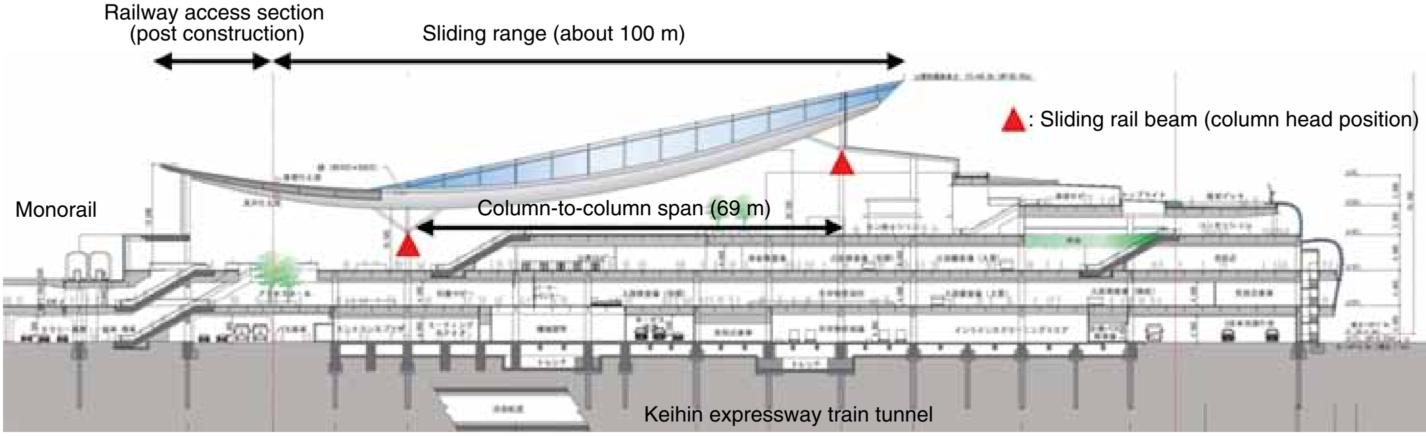
Photo: SS Tokyo: Hisaaki Suehiro

Photo 1 Full view of large roof of international passenger terminal building

Photo: © Ishiguro Photographic Institute

Photo 3 Seventh sliding
Under construction of metallic roof in 5 spans; installation of 5-row skylights

Fig. 1 Section of International Passenger Terminal Building



Using Steel to Restore the Attractiveness of RC Structures

Prize winner: Takenaka Corporation

The building construction market is surrounded by many emerging issues—the reduction of new building markets due to a declining population and a maturing society and the need to respond to a low-carbon society, enhanced disaster prevention requirements and seismic reinforcement efforts. Given this situation, it is necessary to ensure that existing buildings are transferred to the next generation as sound-quality social stock. In promoting the seismic retrofitting of existing buildings, it is now required that not only seismic resistance be improved but that added values such as restored attractiveness be improved as well.

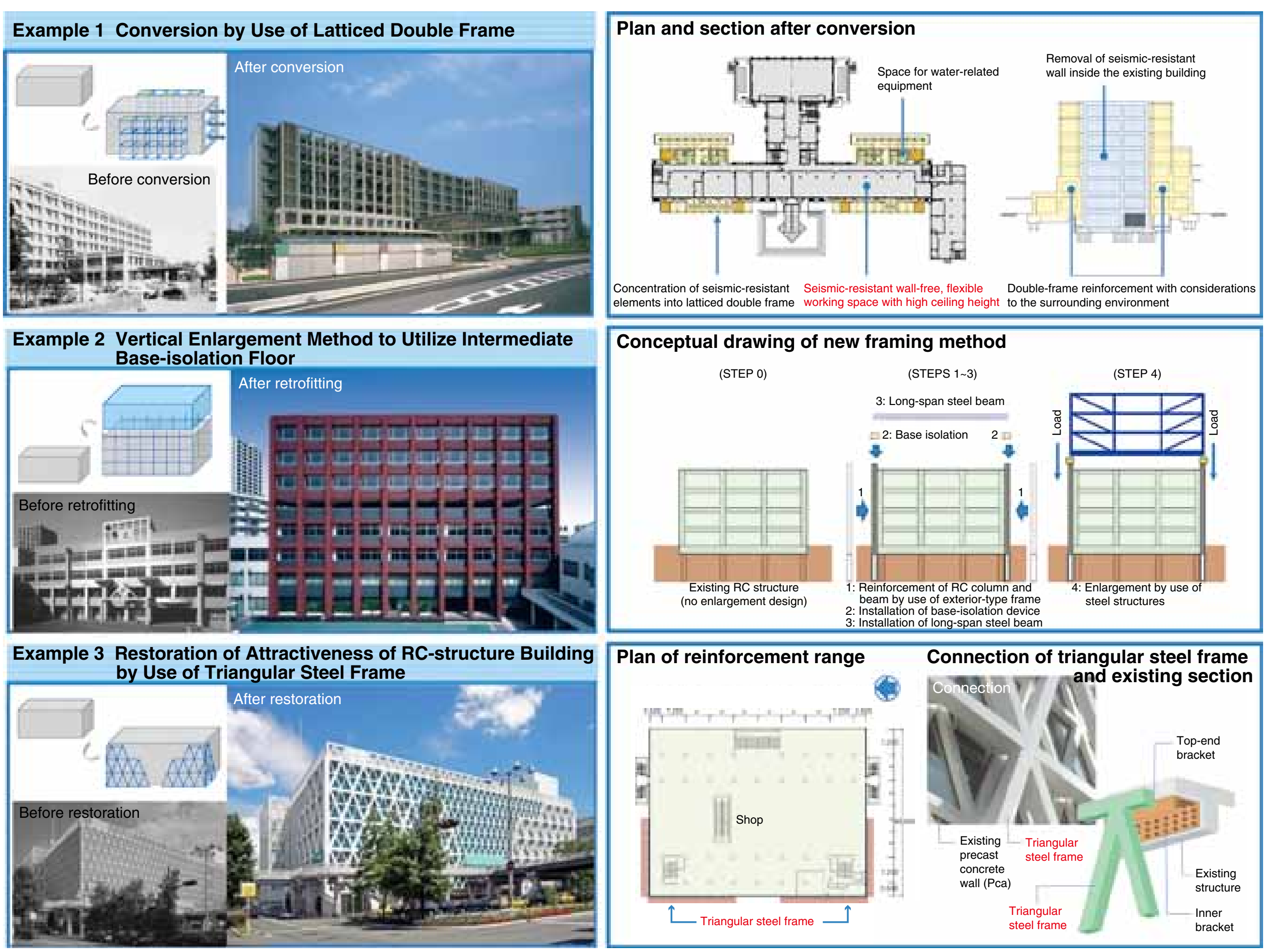
In conventional seismic reinforcement, because the RC walls or steel-frame braces are installed on a building's exterior or interior, seismic reinforcement often imposes restrictions on building use during reinforcement work or after the reinforcement work is complete. Reinforcement from a building's exterior (outer shell reinforcement) is the most suitable method for securing the building's interior functions, making possible continuous use and the ability to respond to future needs.

To these ends, diverse retrofitting ideas have been put into practical use that meet the need for improved appearance of design, environmental sensitivity, or a shorter construction term. These efforts have been made possible by capitalizing on the positive attributes of lightness of weight, rigidity and strength peculiar to steel materials and, further, by exploiting the slenderness, lightness, and prefabrication potential of structural members made of steel materials. Three recent examples are introduced below.

● **Example 1:** A hospital building was converted to a welfare promotion center. The RC wall inside the building was removed, and a double-frame structure was designed and installed on the building façade as a latticed steel frame so as to produce compound values: harmony with the surroundings, equipment concentration, higher ceilings, enhanced greening, and the effect of eaves.

● **Example 2:** An existing 4-story RC school building was retrofitted to an attractive 8-story building. A new framing method was applied that added 3 floors above the rooftop and provided a base-isolation system in the intermediate floor so as to retrofit the old school building as a symbol of both school and local community.

● **Example 3:** An existing RC department store building was seismically reinforced. By using triangular precast walls familiar to local citizens to produce the desired appearance, the building was vigorously retrofitted capitalizing on the use of a triangular steel frame. This is an excellent example in which higher strength is achieved and an aesthetically refined building is restored by the effective use of steel's strength.



Thesis Prizes 2011

Experimental Research on the Mechanical Behaviors of Multi-row High-strength Bolted Friction Joints with Thick Plates

Prize winner: Takashi Yamaguchi, Professor of Osaka City University and three other members

Takashi Yamaguchi

1996: Finished doctoral course, Graduate School of Engineering, Kyoto University
1996: Assistant to Professor, Graduate School of Engineering, Kyoto University
2009: Professor, Graduate School of Engineering, Osaka City University

In steel bridge construction, there are increasing applications of heavy steel plate with thicknesses surpassing 75 mm as a way to create rational structures, although this idea has never been put into practice. In the research on the use of high-strength bolted friction joints in these heavy plates, tests to determine slip factor were conducted setting the number of bolt rows and the slip-to-yield strength ratio β as parameters. Supposing a joint with 75 mm-thick plate using M24 high-strength bolts, a reduction model of 50 mm-thick plate using M16 high-strength bolts was prepared as a test specimen (Photo 1).

The following were confirmed in the tests: In joints with four rows of bolts, simultaneous slip through the entire joint occurred. Contrary to this, in joints with 12 rows of bolts, this kind of slip did not occur; rather, it first began outside the joint and then inside. Accordingly, as shown in Fig. 1(a), as the number of rows increases, the slip factor decreases. In joints with a larger β where joint yielding occurs first, the reduction of axial force in the outside bolts is large, and the reduction of the slip factor due to the increase in rows becomes large. Further, as shown in Figs. 1(b) and (c), in noting the reduction of bolt axial force at the moment slip occurs, it was learned that major slip occurs when the axial force reduction rate of the center bolt, whose axial force is the last to decrease, surpasses about 8%.

Photo 1 Overview of the specimen

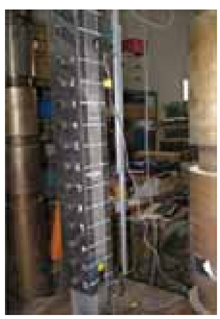
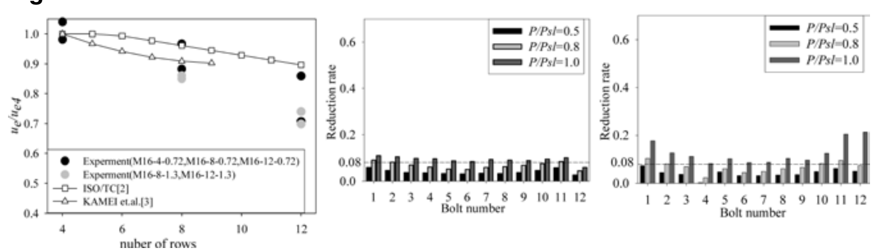


Fig. 1 Test Results



(a) Relation between number of bolt rows and reduction of slip factor

(b) Change in axial force of M16-12-0.72

(c) Change in axial force of M16-12-1.3

Effects of Welding Conditions on the Charpy Absorbed Energy of Low-toughness Steel HAZ

Prize winner: Yoshihiro Sakino, Assistant Professor, Osaka University

Yoshihiro Sakino

Assistant Professor, Joining and Welding Research Institute, Osaka University

You-Chul KIM
Professor, Joining and Welding Research Institute, Osaka University

In the research targeting steel with extremely low toughness, the heat affected zone (HAZ) was simulated by means of a synthetic heat-affected zone test as a uniform microstructure with unchanged material properties, which was subjected to the Charpy impact test. The heat cycle during multi-layer welding in the test was found using three-dimensional unsteady-heat-conduction analysis. Based on this, an examination was made of the welding conditions under which the Charpy absorbed energy of low-toughness steel increases.

As a result of this examination, in the case of single-run welding of low-toughness steel as applied in the research, the Charpy absorbed energy increased in FGHAZ and ICHAZ, but remained low in CGHAZ. However, when low-toughness steel is subjected to a heat cycle in which the temperature reaches 880°C after the maximum temperature in the bond line reaches1,350°C in multi-layer welding, the Charpy absorbed energy of the low-toughness steel increased greatly to 70J or more (at 0°C).

As seen above, the research made clear that not only are there cases in which welding lowers the Charpy absorbed energy of steel products but that there is also the possibility that the Charpy absorbed energy of low-toughness steel can be increased by means of weld heat input control and postheating treatment.

Fig. 1 Charpy Transition Curve of Low-toughness Steel Applied

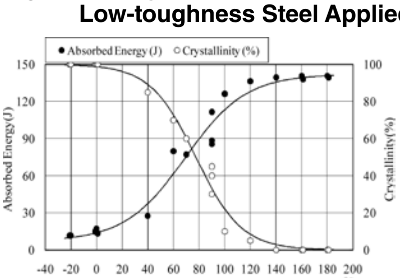
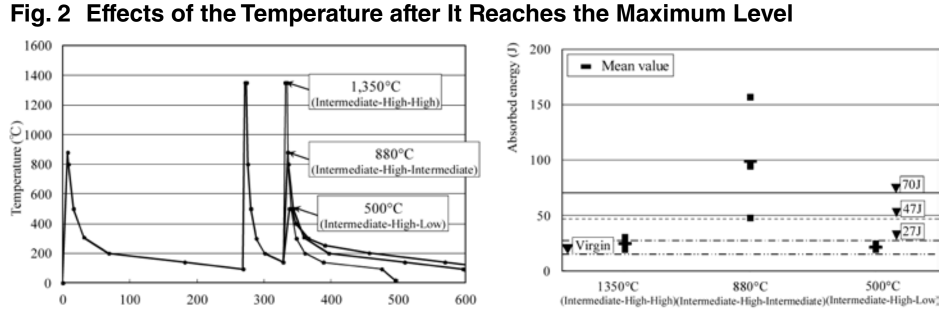


Fig. 2 Effects of the Temperature after It Reaches the Maximum Level



(a) Simulated welding heat cycle

(b) Relation between maximum temperature in final run and Charpy absorbed energy

Study on the Static Characteristics of Web Connected Part of WBFW-type Beam-end Connection

Prize winner: Yugo Sato, Nippon Steel & Sumikin Metal Products Co., Ltd.

Yugo Sato

2005: Graduated from Faculty of Architecture, Utsunomiya University
2007: Graduated from Graduate School of Engineering, Utsunomiya University
2007: Entered Nippon Steel & Sumikin Metal Products Co., Ltd.

When using beam-end connection in steel building construction, the WBFW (web-bolted, flange-welded)-type beam-end connection method is adopted, i.e. beam webs are joined using high-strength bolts and beam flanges are joined using on-site welding. Up to now, the dynamic properties of beam-web high-strength bolt friction joints had not yet been clarified. The study has targeted: to understand the dynamic properties of beam-web high-strength bolt joints in WBFW-type beam-end connection and to accumulate the basic data required for assessing the dynamic properties of WBFW-type beam-end connection. For this purpose, elasto-plastic finite element analysis was used with the column width-to-thickness ratio and the arrangement of the high-strength bolts as parameters.

It was obtained from the analytical results that, when the column width-to-thickness ratio is low and as the number of bolts used increases, the bending moment to be borne by the beam-web joint tends to rise. Further, it is known that the column width-to-thickness ratio and the arrangement of the bolts affect the dynamic properties of beam-web high-strength bolt joints. Noting the time when sliding occurs and maximum yield strength is reached, the stress distribution of the various high-strength bolts was compared to examine the differences in stress distribution due to the column width-to-thickness ratio and the bolt arrangement.

Fig. 1 B62-Dt22: Stress Distribution of Beam-web High-strength Bolt Joint at the Time of Sliding Occurrence

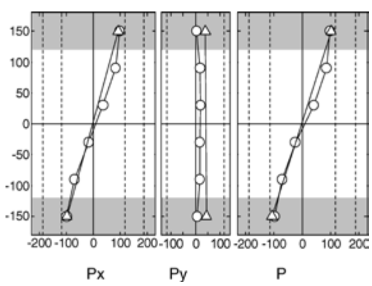


Fig. 2 B62-Dt22: Stress Distribution of Beam-web High-strength Bolt Joint at the Time of Maximum Yield Strength

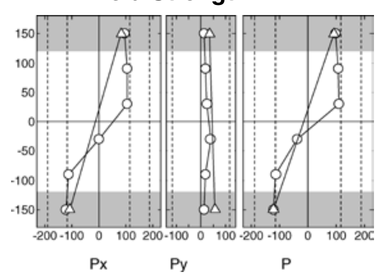
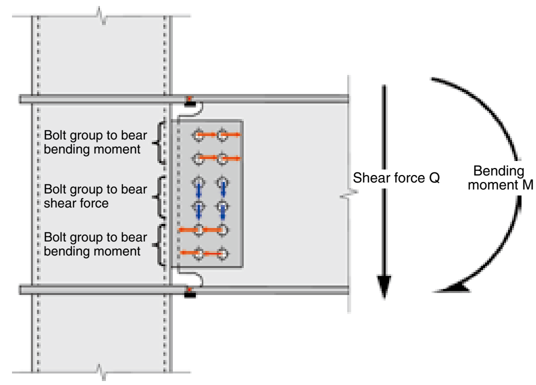


Fig. 3 Stress Condition of Beam-web High-strength Bolt Joint Assumed in the Current Design Method



Effects of Various Parameters on the Collapse Mechanism of Panels with Offset Beam-to-Column Connections of Steel Structures

Prize winner: Susumu Kuwahara, Associate Professor, Osaka University

Susumu Kuwahara

1990: Graduated from Course of Architectural Engineering, Osaka University
1992: Assistant Professor, Course of Architectural Engineering, Osaka University
2005: Associate Professor, Architecture and Design, Kyoto Institute of Technology
2008: Associate Professor, Division of Global Architecture, Osaka University

In general, standard beam-to-column connection panels are commonly adopted in which both the right and left beams connected to a column share identical beam depth and flange position. However, due to functional requirements and with the aim of reducing the weight of the steel frame, connections were adopted in which the beams on either side of the columns have a different beam depth and flange position (Fig. 1). Such panels are called uneven (offset) panels. As shown in Fig. 2, these panels exhibit several collapse mechanisms.

In this paper, an equation is proposed that calculates yield strength during the formation of various collapse mechanisms based on the elastic analytical method, and at the same time an examination using parametric calculations is made of the effect of various parameters on panel yield strength. The research results thus obtained have clarified the collapse mechanisms to be examined at the design stage depending on the sectional configuration of the columns and panels.

Fig. 1 Offset Panel

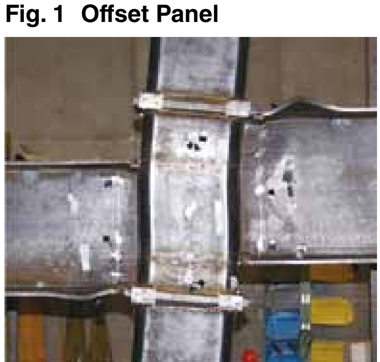
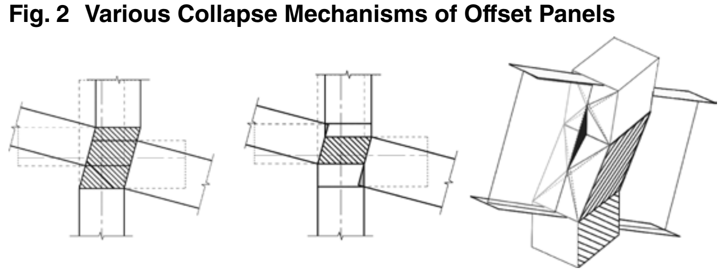


Fig. 2 Various Collapse Mechanisms of Offset Panels



Great East Japan Earthquake

— Damages to Bridges, Port Facilities and Buildings, and Their Restoration and Reconstruction —

By Masatsugu Nagai
Chairman, International Committee, Japanese Society of Steel Construction

At 14:46 on March 11, 2011, the Great East Japan Earthquake (magnitude: 9.0) occurred, unleashing seismic movement and tsunamis that caused immense damage. The Japanese Government has named this quake the East-Japan Great Earthquake Disaster (Great East Japan Earthquake), or the 2011 Off the Pacific Coast of Tohoku Earthquake (Japan Meteorological Agency). According to data collected as of March 11, 2012, a total of 15,854 lives were lost, with 3,155 persons still missing. In the current earthquake, the damage caused by the tsunamis was more serious than damage resulting from seismic motions.

The earthquake was of the ocean plate type with a seismic intensity of 7 (the maximum value on the seismic intensity scale of the Japan Meteorological Agency) and a recorded magnitude of 9, the largest ever observed in Japan. The hypocenter was located 130 km off the coast of Tohoku at a depth of 24 km. The fault zones covered a wide area (extending 500 km from north to south and 200 km from east to west off the Pacific coast from the Sanriku area to Ibaragi Prefecture) and caused three disastrous events in succession (Fig. 1).

The maximum acceleration observed was 2,933 gal (at Kurihara, Miyagi Prefecture), and large accelerations of 2,000 gal or more were observed at 19 other observation sites.

Fig. 1 Drawing of Epicenters (Map)

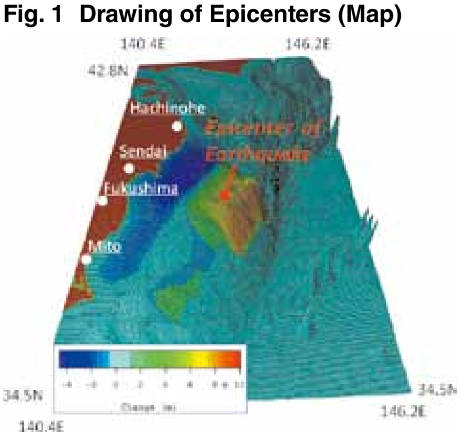


Fig. 2 Comparison of Spectral Acceleration Responses
(Source: Hirose, East Nippon Expressway Company Limited)

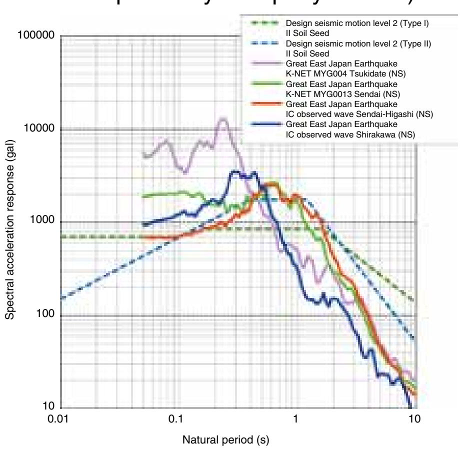


Fig. 2 shows the spectral acceleration response of the current earthquake. While the seismic motion was comparatively large, structures suffered relatively little seismic damage. A major reason for this was the current earthquake was dominated by spectral acceleration with a short natural period of 0.3~0.5 seconds, compared to the natural period that commonly dominates buildings and public facilities. Another reason for less structural damage was the implementation of seismic reinforcements against great earthquakes that was carried out following the Great Hanshin Earthquake (1995). Among other features of the current quake were an extended vibration time and long-period seismic motion components exceeding 20 seconds.

The most notable feature of the Great East Japan Earthquake was the serious damage caused by tsunamis. Waves with a maximum height of 16 m not only brought about destructive damage to structures. It is reported that death by drowning accounted for 95% of all fatalities. Further it is reported that the maximum run-up height of the tsunami waves was about 39 m. Photo 1 shows examples of tsunami damage, and Photo 2 offers an example of ground liquefaction that occurred along wide areas of reclaimed coastal land facing Tokyo Bay.

The following special feature on the Great East Japan Earthquake introduces disastrous seismic damage and restoration/reconstruction efforts in the field of construction:

- Highway bridges
- Elevated expressway bridges
- Railway bridges
- Port and harbor facilities
- Steel-structure buildings

In closing, restoration and reconstruction measures employing the "new structural system building" are proposed:

- New structural system buildings employing innovative structural materials

Photo 1 Tsunami damages

Photo 2 Ground liquefaction

Highway Bridges

By Takashi Tamakoshi
National Institute for Land and Infrastructure Management
Ministry of Land, Infrastructure, Transport and Tourism

The Great East Japan Earthquake caused many incidences of great damage in which highway bridges installed in coastal areas or across rivers were washed away by the associated tsunami (Photo 1). But, then again, in areas where the tsunami height was confirmed to have exceeded that of a bridge's superstructure, many of these bridges were not washed away. In addition, there were cases in which the earthworks adjoined next to a bridge section were washed away by the tsunami, while the bridge structure itself remained in place (Photo 2). Currently, surveys and other research on the mechanism of tsunami-generated bridge damage are being promoted in many fields.

In cases where damage was caused by seismic motion, there is no confirmation of fatal damage leading to bridge collapse in bridges built in accordance with the design standards contained in *Specifications for Highway Bridges* (issued after 1996 in response to the Great Hanshin Earthquake of 1995) or reinforced based on those standards. On the other hand, in unreinforced bridges, damage such as the buckling and fracture of superstructures members was confirmed, as was damage to bridge piers and bearings (Photo 3), as observed in previous large-scale earthquakes. In addition, even when damage to a bridge structure was slight, there were many examples of level differences of the road surface produced by the sinking of back-filled soil of a bridge abutment inhibiting the quick recovery of traffic functions.

In this earthquake, it was confirmed that ground liquefaction occurred in a wide area of the coastal zone and caused damage to housing. However, among highway bridges, no remarkable damage due to liquefaction was confirmed in bridges conforming to design standards issued after the implementation of new seismic design codes in 1971 that contain design specs for the prevention of liquefaction. Meanwhile, damage did occur in some bridges installed in conformance with technical standards issued before 1971.

Soon after the earthquake, efforts were made to secure emergency transport routes by repairing level differences of the road surface and restoring collapsed embankment, removing debris, and using emergency assembly bridges (Photo 4). Temporary bridges were installed in washed-out bridge sections and emergency restoration work was undertaken on damaged bridges. Currently, the main highway networks have nearly returned to normal operations, excluding those in tsunami- and radiation-ravaged areas. Studies and other work aimed at permanent recovery will be continuously pursued and accelerated.


Photo 1 Washing away of superstructure


Photo 2 Washing away of earthwork in the front and rear of bridge


Photo 3 Damage of top lateral bracing of through Langer arch bridge


Photo 4 Emergency assembly bridge

Elevated Expressway Bridges

By Kazuo Kaneda
East Nippon Expressway Company Limited

Around 14:46 on March 11th, 2011, the M9 Great East Japan Earthquake, the largest ever observed in Japan, struck off the Sanriku coast. Strong tremors from the quake were felt over a wide range extending from Tohoku to Kanto. In Kurihara, Miyagi Prefecture, a reading of 7 (the maximum value on the seismic intensity scale of the Japan Meteorological Agency) was recorded. Intense seismic activity was measured on various expressways: the highest was 6.3 at the Mito-Minami interchange of the Kita-Kanto Expressway, while 6.2 intensity was recorded at the Taiwa and Izumi interchanges of the Tohoku Expressway and the Sendai-Higashi interchange of the Sendai-Tobu Expressway.

Fig. 1 shows the spectral acceleration responses associated with the Great East Japan Earthquake and recorded in the vicinity of the Sendai-Tobu elevated bridge of Sendai-Tobu Expressway. At the Sendai-Higashi interchange and K-NET Sendai where 6.2 was measured on the seismic intensity scale, the spectral acceleration response reached nearly the same level as the standard spectral acceleration response of design seismic motion level 2 (Type II) in the vicinity of a natural period of 1 second. Meanwhile, regarding the seismic motion observed on expressways, the peak spectral acceleration response was on the short natural period side (in the vicinity from 0.2 to 0.5 seconds) at many sites. The following introduces the damage and emergency restoration conditions of the Sendai-Tobu elevated bridge that suffered damage characteristic to steel bridges.

The Sendai-Tobu elevated bridge, located between the Sendai-Higashi and Sendai-Kokita interchanges, is a continuous elevated bridge with a total length of 4,390 m that opened to traffic in 2001. The area of the bridge that suffered the greatest damage consisted of 2 sections—a continuous 4-span steel girder bridge (P52~P56) and a continuous 2-span steel I-girder bridge (P56~P58). As regards the support conditions for these bridge sections, in the case of level 2 seismic motion, elastic support is adopted along both the bridge's longitudinal axis and the perpendicular axis for all bridge piers, and joint protectors (level 1) are installed for the perpendicular axis.

Photos 1~2 show the damage to the Sendai-Tobu elevated bridge. The earthquake caused fracturing of the rubber bearings of the P52 and P56 piers at the girder-to-girder crossed sections, and, further, fracturing and deformation of the joint protectors of nearly all the bridge piers. Residual displacement was observed in the bridge superstructure—the amount of deviation being about 15 cm in the direction perpendicular to the bridge axis in the P52 pier, and about 50 cm in the direction perpendicular to the bridge axis and about 40 cm vertically in the P56 pier. From this, it is believed that deformation surpassing the fracture strain of the rubber bearings occurred in the superstructure. In addition, there were observed traces of contact of the expansion devise in the direction perpendicular to the bridge axis. Because the bearing height of the box-girder rubber bearings is greater than that of the I-girder rubber bearings and because the deformable level of the box-girder rubber bearings in the direction perpendicular to the bridge axis is high, the deformation of the I girder was caused by that of the box girder, and as a result, the rubber bearings were likely to cause the fractures. Meanwhile, because the bridge collapse-prevention device was installed in the direction of the longitudinal axis at the girder-to-girder crossed section, bridge collapse did not occur.

Just after the earthquake, a bent was installed (Photo 3) and vertical stiffeners were weld-joined to reinforce the girder, and, further, emergency temporary support work using saddles was implemented. Then the girder was straightened and returned to its original position using a jack for temporary support (Photo 4), and, further, a rubber bearing conforming to the original design was manufactured and re-installed. In this way, the emergency restoration work for the Sendai-Tobu elevated bridge was completed. The design made by reflecting the cause of rubber beating fracture is planned to adopt in the full-scale restoration of the bridge.

In the Sendai-Tobu elevated bridge, damage occurred to the seismic horizontal force distribution-type rubber bearings. This damage was not found anywhere else in Japan. To this end, an examination committee was established to clarify the cause of the fracturing. The committee will do a simulation analysis using three-dimensional nonlinear dynamic analysis employing site waves and will confirm the elongation capacity of the rubber bearings and the material quality of the rubber used. When the study is completed, the cause of the fracturing and other examination results will be made public.

Fig. 1 Spectral Acceleration Responses

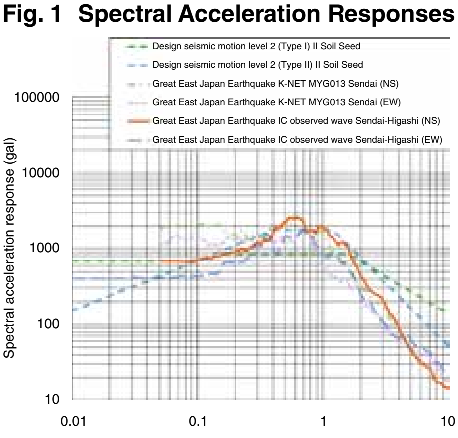


Photo 1 Damage of rubber bearing (P56)

Photo 2 Residual displacement after earthquake (P56)

Photo 3 Installation of temporary bent

Photo 4 Temporary support

Railway Bridges

By Shinichiro Nozawa
East Japan Railway Company

The Great East Japan Earthquake of March 2011 caused the damage of railway facilities throughout a wide area.

On the Tohoku Shinkansen super-express line, the collapse of electrification posts and elevated RC railway bridges and other types of damage occurred along a 500-km stretch from Omiya Station to Iwate-Numakunai Station. Photo 1 shows the damage inflicted on a pin bearing of the Kakyoin Bridge, a 73 m-long composite girder bridge located at the Sendai Station terminal. The pin fractured from the center. During the restoration work, the pin was used as it was, and the girder and the bearing were returned to their original position and a device was attached to restrict movement solely to the direction of the bridge's transverse axis. While a large aftershock occurred on April 7, the entire Tohoku Shinkansen line resumed operations on April 29, 49 days after the Great East Japan Earthquake occurred.

Existing railway lines also suffered damages in a wide area extending from the Tohoku region to the Kanto region. Photo 2 shows the slippage of a girder on the Daiichi-Kyuchu overbridge located at Kashima Jingu Station of the Kashima Line. The bridge is installed with a skew angle of about 60° at the composite girder of the box-girder section. While it was found that rotational behavior occurred due to the horizontal seismic motion of the skewed girder, the previous completion of girder seat expansion work prevented the bridge from collapsing. Most existing railway lines, excluding those in tsunami-damaged areas, resumed operations by the end of April 2011.

The tsunamis caused serious damage to railway facilities. Among the damaged facilities, the Ohamagawa Bridge on the Hachinohe Line suffered only comparatively slight damage, while four 10-m spans of the deck steel plate girders were washed away by tsunamis (Photo 3), and thus it was decided that the bridge would continue in use, with some restoration work. While some of the structural members were replaced, most of the deformities in the girders were corrected by means of heating, and the girders were re-installed in their original position in December 2011 (Photo 4).

The entire Hachinohe Line is slated to resume operations in the spring of 2012. Plans call for the restoration of other tsunami-damaged railway sections under an integrated restoration scheme involving town buildings to be promoted by national and local governments.

Photo 1 Damage of pin bearing and slippage of composite girder (Sendai Station terminal, Tohoku Shinkansen)

Photo 2 Slippage of skewed girders (Kashima Jingu Station, Kashima Line)

Photo 3 Outflow of bridge girders due to tsunamis (Ohamagawa Bridge on Hachinohe Line)

Photo 4 Installation of repaired girders (Ohamagawa Bridge on Hachinohe Line)

Port and Harbor Facilities

By Mitsuyasu Iwanami
Port and Airport Research Institute

On March 11, 2011, an M9 ocean trench-type earthquake, the Great East Japan Earthquake, occurred with an epicenter in the Pacific Ocean off the coast of the Tohoku area. Triggered by the earthquake, huge tsunami waves of unprecedented scale attacked the coastal areas of East Japan, causing massive destruction. In port and harbor facilities, damage, collapse, displacement and other disastrous events occurred in breakwaters, piers, quays and other port facilities in a wide area extending from Aomori Prefecture to Chiba Prefecture.

Two major features punctuate the current earthquake: very strong seismic motion, as seen in the highest maximum acceleration ever recorded in the strong-motion earthquake observation in port and harbor areas, and seismic motions of long duration. In addition, because the tsunami waves that attacked the coast were larger in scale than forecasted in the design of disaster-prevention facilities, civil engineering and building structures, including port and harbor facilities, suffered serious damage. (Refer to Fig. 1 and Photo 1)

A characteristic type of damage found in steel port and harbor structures after the current earthquake is the disruption of interlocking joints of steel sheet piles of sheet-pile-type quaywalls, causing the collapse of the quaywalls (Photo 2). The cause of the collapse is thought to be the uplifting forces and hydraulic forces that acted on portions damaged by seismic forces occurring in the steel sheet piles and apron pavement. This damage can be defined as typical of disasters caused by complex earthquake-tsunami events.

Further, in the current earthquake, not only the existing breakwaters at Hachinohe, Kuji, Miyako and Soma Ports suffered tsunami damage, but the breakwaters installed at the mouths of Kamaishi and Ofunato Ports to prevent tsunami damage also suffered greatly (Photo 3).

In order to securely protect human life and assets from huge tsunamis, an important task for the future will be to improve breakwaters, seawalls and other disaster-prevention facilities. Table 1 shows an example of performance matrix against design tsunamis for disaster-prevention facilities[1]. According to the table, for Level 1 tsunamis, disaster-prevention facilities are required to securely protect human life and assets and to withstand all structural damage. For Level 2 tsunamis, such as the one that accompanied the current earthquake, these facilities must protect human life as a matter of course and prevent fatal damage to structures and, further, possess sufficient "toughness" to prevent serious secondary damage to structures. On top of this, for Level 2 tsunamis, disaster-prevention measures should include not only facility improvements but also supplementary measures such as the preparation of refuge facilities, escape routes and strengthened warning systems.

Reference

1) S. Takahashi et al: Urgent Survey for 2011 Great East Japan Earthquake and Tsunami Disaster in Port and Coast, Technical Note of Port and Airport Research Institute, No.1231, 2011.4

Fig. 1 Results of Surveys of Tsunami Height

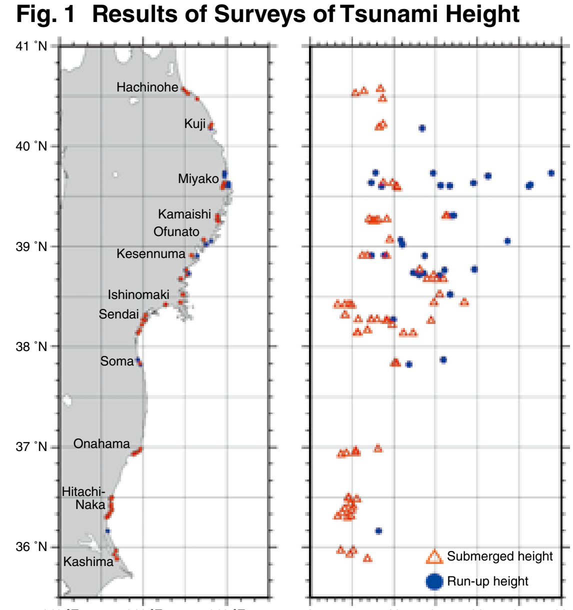


Table 1 Example of Required Performances against Design Tsunamis

Tsunami	Scale (occurrence probability)	Performance requirements
Level 1	Largest in recent years (about once in 100 years)	• Protecting human life • Protecting assets • Maintaining economic activities
Level 2	Expected maximum (about once in 1,000 years)	• Protecting human life • Mitigating economic loss • Preventing large secondary damage • Allowing quick restoration

Photo 1 A vessel that ran onto the quaywall

Photo 2 Collapse of sheet-pile-type quaywall

Photo 3 Collapse of breakwater installed for tsunami disaster prevention

Steel-structure Buildings

By Isao Nishiyama
National Institute for Land and Infrastructure Management
Ministry of Land, Infrastructure, Transport and Tourism

Disastrous Earthquake of Unprecedented Scale

The Great East Japan Earthquake (moment magnitude: 9.0) that occurred on March 11, 2011, was the largest thrust quake ever observed in Japan. The hypocenter of the quake lay in the Pacific Ocean off the Sanriku coastline. The quake, also called the 2011 Earthquake off the Pacific Coast of Tohoku, occurred at the boundary between the North American Plate on which the Tohoku area of Japan lies and the Pacific Plate that subducts the North American Plate. As of November 14, 2011, the number of deaths stood at more than 15,000 and the number of fully destroyed houses and other buildings at about 120,000.

According to the hypocenter model[1] (Fig. 1) released by the Meteorological Research Institute of the Japan Meteorological Agency, the area of the hypocenter of the Great East Japan Earthquake extends lengthwise about 450 km in a south-north direction and laterally about 150 km in an east-west direction, off the coasts of Iwate, Miyagi, Fukushima and Ibaragi Prefectures. Seismic intensity of about 6 (out of a maximum of 7 on the seismic intensity scale of the Japan Meteorological Agency) was recorded throughout wide areas of these prefectures.

With particular reference to steel-structure buildings, this article introduces an outline of the seismic motion and tsunami damages[2),3)] associated with the current earthquake and describes the extensive efforts being promoted towards restoration and reconstruction.

Outline of Damage to Steel-structure Buildings

● Damage due to Seismic Motion

Visual surveys conducted on steel-structure buildings in Sendai City, Miyagi Prefecture—located relatively near the epicenter—found almost no serious damage such as building collapses, only instances of slight damage such as fallen non-structural members (Photo 1). Damage to building structures was of the standard type, such as the breakage of exposed column bases and the buckling and fracture of braces. While brittle fractures are known to have occurred in the vicinity of beam-end web scallops in steel-structure buildings during the Great Hanshin Earthquake of 1995 (Photo 2),

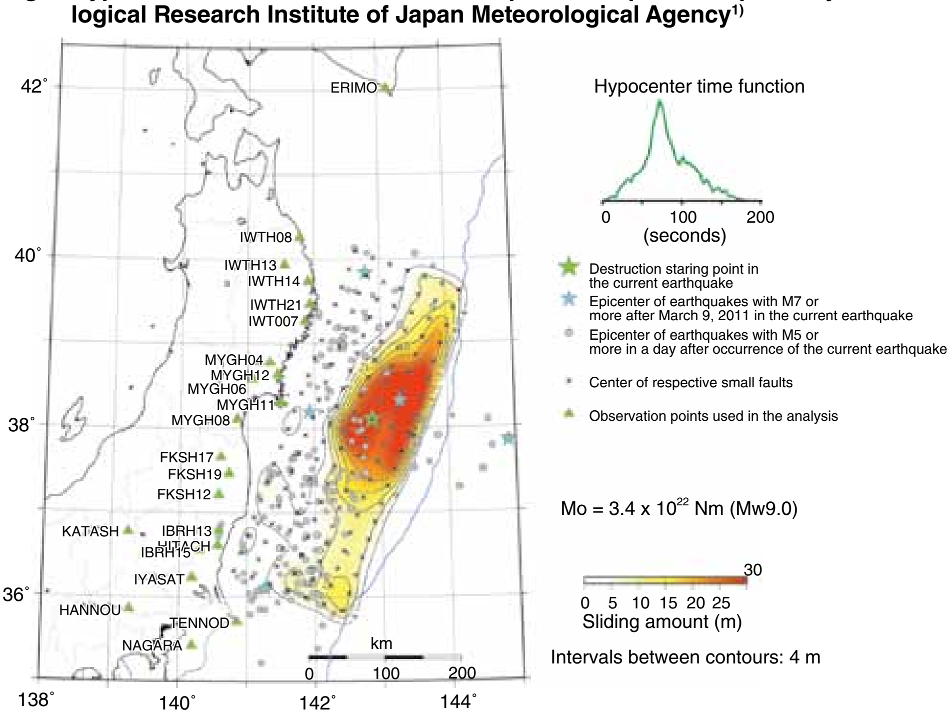
Photo 1 Falling of non-structural members

Photo 2 Example of beam-end flange fracture that occurred in a great number in the Great Hanshin Earthquake

Photo 3 Damage of bearing

Photo 4 Falling of ceiling

Fig. 1 Hypocenter Model in the Great East Japan Earthquake, Prepared by Meteorological Research Institute of Japan Meteorological Agency[1)]



there has been almost no confirmation of such damage in the Great East Japan Earthquake. This may be because, according to the survey results, these brittle fractures are regarded as being nearly non-existent.

Visual surveys seeking steel-structure damage were conducted on a total of 65 school gymnasiums in Ibaragi Prefecture, because 1) gymnasiums are public buildings subject to interior surveys, 2) gymnasiums are similar in structure to plant and warehouse buildings and 3) the seismic intensity registered in Ibaragi Prefecture was nearly identical to that in Miyagi Prefecture. The damage suffered by joints connecting RC columns to steel-frame roofs (bearing section) is cited as typical (Photo 3). As regards the fallen non-structural members observed in Sendai, ceiling damage was particularly notable in the gymnasiums (Photo 4). In addition, the standard types of damage were observed: buckled vertical braces and fractured joints; deflection, buckling and fracture of horizontal braces installed on the roof plane; and cracking of concrete cover at column bases.

Many factors may be involved in the damage, but the main causes seem to be the following two: localized forces produced by seismic motion with a dominant short-period element[3] worked on the joints between different kinds of structural members, and the huge scale of the current earthquake that resulted in repetitious seismic motions of long duration.

In the Great East Japan Earthquake, a high-rise building in Osaka, 700 km away from the hypocenter, continued vibrating for 10 minutes or more due to resonance (Fig. 2). Similar problems associated with long-period seismic motion were observed at various sites as well[3].

The National Institute for Land and Infrastructure Management in collaboration with the Ministry of Land, Infrastructure, Transport and Tourism has already made public tentative seismic countermeasures against long-period seismic motions[4]. Triggered by the current earthquake, the Institute is promoting the verification of these countermeasures and is working to make them the effective standard as quickly as possible.

Assuming the occurrence of a great earthquake in the Nankai Trough, it is said that long-period seismic motion elements would be amplified by the trough's accretionary wedge. Accordingly, there is a pressing need to prepare the above-mentioned effective standard. The design natural period of the above-mentioned high-rise building was 5.3 seconds, but the building experienced resonance due to seismic motion with a predominant period of 7.0 seconds, thereby exposing a problem pertaining to the seismic modeling of buildings.

● Damage due to Tsunamis

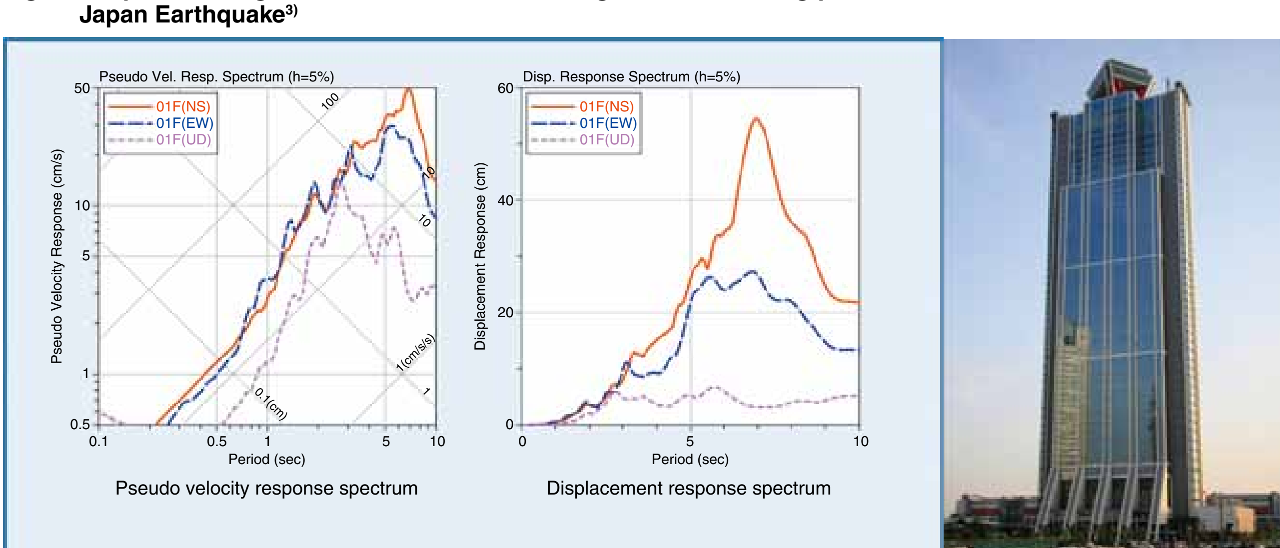
Among the loading effects that tsunamis can exert on buildings are tsunami wave pressure, scouring, buoyancy and collision by drifts. In the Great East Japan Earthquake, tsunami wave pressure worked as a force to form yielding mechanisms on RC wall structures just as illustrated (Photo 5), and, further, it caused fractures in the column base welds of steel-structure buildings (Photo 6). Scouring due to tsunami flow deeply excavated soil around foundations, causing building inclination (Photo 7). In contrast to RC-structure buildings, steel-structure buildings whose exterior members fractured at an early stage were difficult to form air accumulation inside the

Photo 5 Yielding mechanism formed on RC wall

Photo 6 Fracture of column base weld

Photo 7 Inclination of RC-structure building due to scouring

Fig. 2 Response of High-rise Steel-structure Building in Osaka in Long-period Seismic Motion in Great East Japan Earthquake[3]



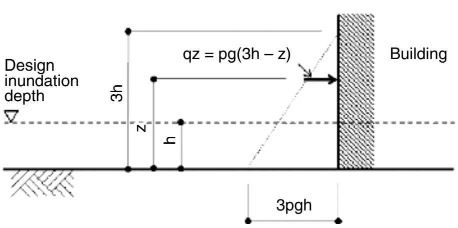
Pseudo velocity response spectrum

Displacement response spectrum

Photo 8 Overturning of steel-structure building due to floating

Photo 9 Damage due to collision by drift

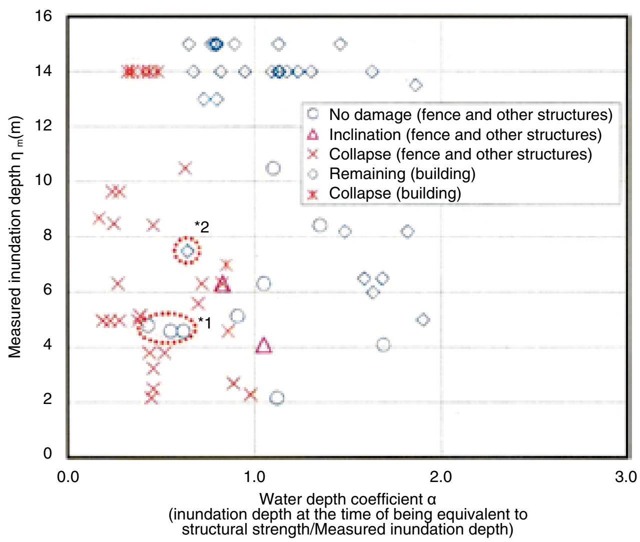
Fig. 3 Calculation Method for Tsunami Wave Pressure in the Guidelines of Cabinet Office[5]



building, and thus rarely suffered overturning caused by interaction with buoyancy (Photo 8). The collision of drifts with buildings could be observed from the residual deformation seen in steel columns (Photo 9).

The *Guidelines for Tsunami Refuge Buildings* prepared by the Cabinet Office[5] prescribes tsunami wave pressure (Fig. 3). In the *Guidelines*, an expedient is proposed in which virtual static water pressure is three times the height of the design inundation depth and is assumed to work only on one side of a building. By verifying buildings damaged by the tsunami that was generated by the recent earthquake, the value of 3 shown in the expedient was found to actually be around 0.6 to 1 times[6] (Fig. 4). This seems to be attributable to the construction of breakwaters; and, even in cases when a breakwater was partially broken, it effectively worked to reduce the tsunami wave flow velocity.

Fig. 4 Numerical Values Indicating Tsunami Loading Effect Obtained by Back Calculation from On-site Survey Data[6]



In the newly proposed provisional *Guidelines*[6], even in cases when the effect of the breakwaters mentioned above might be expected, a value two times the inundation depth was finally shown. Although a value of two times inundation depth has sufficient allowance, this value was proposed by taking into account the indeterminacy of the tsunami run-up simulation that determines the hazard map (map of assumed inundation depths). Because of this, improvements in analytical technology are strongly called for.

Toward Restoration and Reconstruction

Most of the areas subjected to the tsunami disaster associated with the Great East Japan Earthquake had previously experienced the Meiji-Sanriku Great Tsunami and Showa-Sanriku Earthquake Tsunami. It is natural that the lessons learned from these past tsunami disasters should be fully utilized in the restoration and reconstruction projects currently being promoted, and thus the means to relocate towns and villages to higher ground are abundant. However, it is quite natural that engineering should play a more significant role when it comes to effectively utilizing spacious land that is likely susceptible to inundation. Specifically, a means is conceivable to employ pilotis for the lower stories of buildings in order to avoid tsunami wave pressure as much as possible. Another means is to securely support buildings with piles to prevent overturning due to scouring. These and other engineering approaches will make it possible to build structures that can sufficiently resist tsunamis in vulnerable areas.

The proposal of laws to build tsunami disaster-prevention areas was decided at a Cabinet meeting held at the end of October 2011. In addition, diverse movements toward restoration and reconstruction are progressing rapidly. It is strongly hoped that positive responses to these movements are steadily being promoted by not only the building construction field but other fields as well.

Lastly, I would like to express our condolences to those who have suffered in the Great East Japan Earthquake.

References

1) Meteorological Research Institute of the Japan Meteorological Agency: Estimated Distribution of Fault Sliding in the 2011 Earthquake off the Pacific Coast of Tohoku—Analysis Using Near-source Strong Seismic Waveforms, Apr. 26, 2011 (revised)
2) National Institute for Land and Infrastructure Management: Summary of the Field Survey and Research on "The 2011 off the Pacific coast of Tohoku Earthquake" (the Great East Japan Earthquake), Technical Note of NILIM No. 647, Sept. 2011
3) Isao Nishiyama et. al.: Building Damage by the 2011 off the Pacific Coast of Tohoku Earthquake and Coping Activities by NILIM and BRI Collaborated with the Administration, Pre-proceedings of 43rd Joint Meeting of US-Japan Panel on Wind and Seismic Effects, UJNR, Aug. 29-30 2011
4) Building Guidance Division, Housing Bureau, Ministry of Land, Infrastructure, Transport and Tourism: Tentative Seismic Countermeasures against Long-period Seismic Motions, Dec. 21, 2010
5) Examination Committee on Guidelines for Tsunami Refuge Buildings, Director General for Policy Planning (Disaster Prevention), Cabinet Office: Guidelines for Tsunami Refuge Buildings, June 2005
6) Building Guidance Division, Housing Bureau, Ministry of Land, Infrastructure, Transport and Tourism: Supplementary Knowledge concerning Design Method for Safe Building with Structural Strength for Tsunamis, Nov. 17, 2011

New Structural System Buildings Employing Innovative Structural Materials — Proposal to Use These Buildings for Restoration and Reconstruction —

Association of New Urban Housing Technology
The Japan Iron and Steel Federation
Japanese Society of Steel Construction

New Structural System Buildings Employing Innovative Structural Materials is a government-private sector tie-up R&D project that was promoted from 2004 to 2008. Specifically, the project was promoted jointly by the major Japanese steelmakers and general contractors in conjunction with the Cabinet Office; the Ministry of Economy, Trade and Industry; and the Ministry of Land, Infrastructure, Transport and Tourism. The first major target of the project was to develop “new steel products having twice the strength of conventional products.” This was followed by the acquisition of a firm base for the practical use of long lasting structures made of the new structural system buildings employing innovative structural materials and offering three characteristic features: the rational incorporation of different functions within a building, the possibility of greater flexibility in the alteration of inner structures after completion, and the reuse of structural members. (Refer to Fig. 1)

Improved Seismic Resistance

The highest priority performance required of buildings with a long service life is high seismic resistance. Three major related premises were incorporated in the development of the New Structural System Buildings Employing Innovative Structural Materials:

- The maximum scale of earthquakes occurring during a building’s service life shall be set at 7 (the highest point on the seismic intensity scale of the Japan Meteorological Agency).
- Buildings shall remain within their elastic range during maxim seismic motion.
- Buildings shall be capable of continued use after suffering a great earthquake.

Fig. 1 Town Developed with New Structural System Buildings

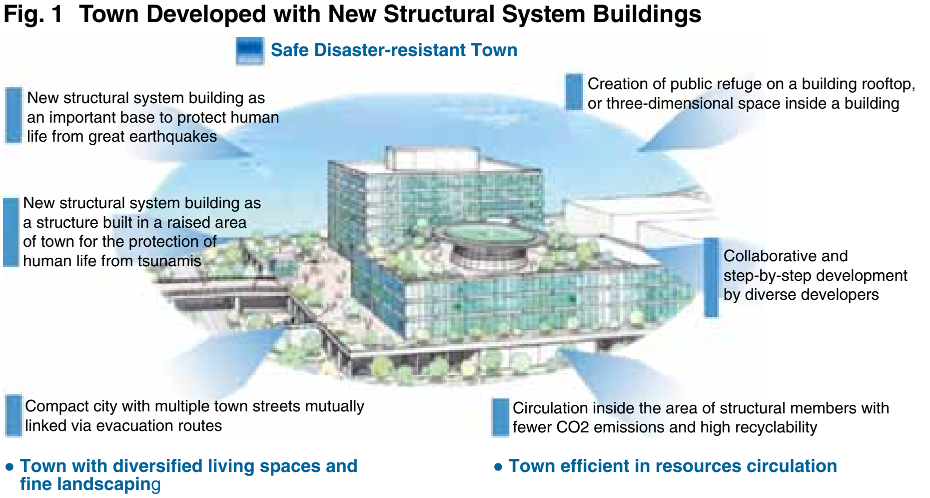
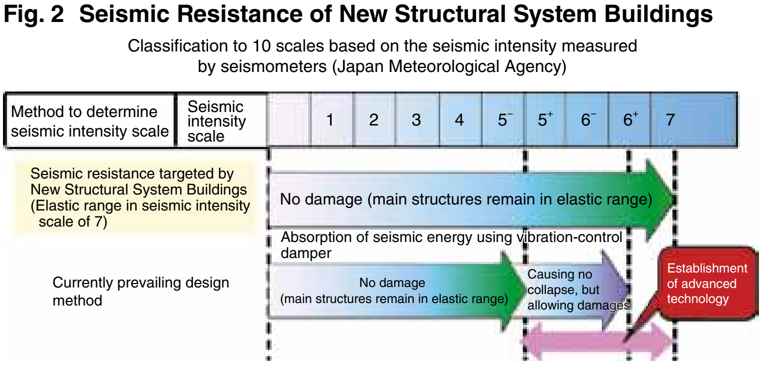


Fig. 2 Seismic Resistance of New Structural System Buildings



The currently prevailing building regulations pertaining to the seismic resistance required of common buildings specify that plastic deformation of structural members is allowed during seismic motion with a seismic intensity level of 5$^+$, but that the building should not collapse. When compared to this level of seismic resistance, it is easy to understand just how much higher is the seismic resistance targeted for the New Structural System Buildings. (Refer to Fig. 2)

New High-strength Steel

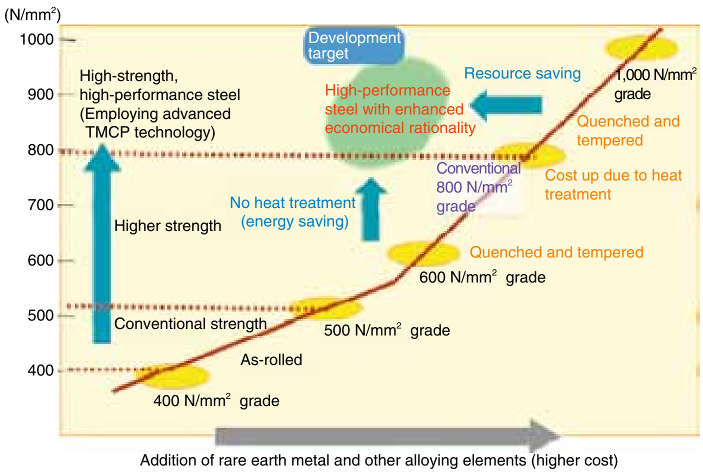
When funding is high, it is not difficult to produce “steel having twice the strength of conventional steel.” However, in the current project, the target was to realize twice the strength while maintaining market competitiveness. For that reason, it was decided not to increase the addition of rare earth metals and other alloying elements and to eliminate or simplify the QT (quenched and tempered) heat-treatment process. To this end, a new high-strength steel meeting the originally targeted specifications was successfully developed in the project by making optimum use of TMCP (thermo-mechanical control process), currently the most advanced plate-rolling technology (Fig. 3). TMCP itself is an efficient energy-saving process and thus this high-strength steel eliminates building weight and is conducive to constructing building structures with fewer CO2 emissions.

New Structural System Buildings Employing Innovative Structural Materials

The new structural system buildings are damage-resistant, have a long service life, support variable inner applications, and, further, allow the free addition or removal of structural members. These buildings go beyond conventional building concepts in creating distinct urban buildings that incorporate some urban infrastructure. (Fig. 4)

The huge tsunami generated by the seismic motion of the Great East Japan Earth-

Fig. 3 Economical Rationality in Development of New High-strength Steel



quake caused destructive damage to a great number of fishing ports as well as agricultural and urban areas extending up and down Japan's eastern coastline from Tohoku to Kanto. Fatal damage befell not only buildings but also all urban infrastructures that had been installed to support building structures: such as ground, road, water and sewage, gas and electrical power supply systems, in addition to communication networks.

In tackling the recent massive disaster, a true national crisis, expectations are high for restoration and reconstruction work that will employ the extensive achievements obtained through the concerted efforts of both governmental and private sectors in developing the new structural system buildings. These buildings offer the following advantages for reconstruction:

- Being composed of strong slender columns produced using steel with twice the strength of conventional steel, the framing structure can fend off the massively destructive force of tsunamis in the lower floors and provide structurally safe space in the upper floors.
- In contrast to building construction that starts after the completion of urban infrastructure provided by civil engineering, the new structural system buildings allow the rapid commencement and completion of building construction concurrently with the construction of urban infrastructure.
- The new structural system buildings allow detailed step-by-step improvements that meet local needs by first satisfying emergency building demands and then varying the inner applications to conform to the progress of reconstruction.

(Refer to Figs. 5~7)

In addition to withstanding level-7 seismic intensity within the elastic range, the New Structural System Buildings Employing Innovative Structural Materials are superior to other buildings in terms of tsunami resistance. They also possess a framing structure that plays a significant role in and is suitable for reconstruction projects carried out in response to damage caused by the Great East Japan Earthquake. We intend to appeal the advantages derived from New Structural System Buildings Employing Innovative Structural Materials.

Fig. 4 Role of New Structural System Buildings in the Reconstruction of New Town

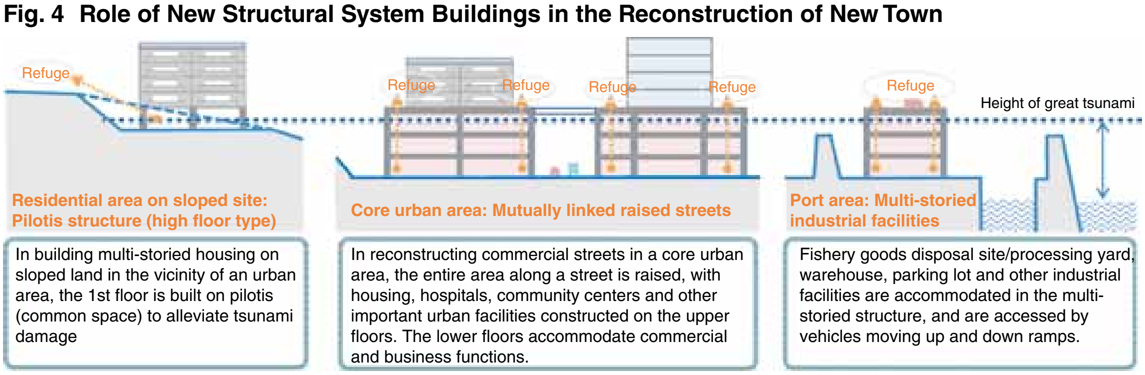


Fig. 5 Proto-type Model of Distribution Center

Distribution center with floors that are easily accessible by cars using two ramps: Mixed three-dimensional arrangement of plants and offices capitalizing on high ceilings and large spans—great advantages provided by New Structural System Buildings

Fig. 6 Proto-type Model of Regional Base

In order to protect the building from great earthquakes and huge tsunamis, the entire street level structure is raised, the upper floors accommodate high-performance administrative and regional disaster-prevention functions, and the lower floors house a parking lot and rental space.

Fig. 7 Proto-type Model of Dense Urban Area

Redevelopment model for a dense urban area with dangerously inadequate disaster prevention features. Raised street area is developed using New Structural System Buildings in which the lower floors house existing commercial and business facilities and the upper floors accommodate multi-storied housing around a refuge square.

Symposium and International Events

JSSC Symposium 2011 on Structural Steel Construction

The Japanese Society of Steel Construction (JSSC) has annually held the "JSSC Symposium on Structural Steel Construction" since 2004. The aim of the symposium is to provide a venue for the comprehensive integration of all operational results attained by JSSC's various committees and research groups and to provide a site for mutual exchanges between members and others engaged in steel construction. In order to hold a symposium organized to produce substantial results, elaborate plans and studies are made jointly by the Public Relations Committee and the Committee for the Implementation of Symposia.

JSSC Symposium 2011 on Structural Steel Construction was held in November 2011 in Tokyo. The symposium offered wide-ranging events through the joint cooperation of the JSSC membership and committees and other related organizations. The events included a special lecture, a stainless steel session, a report on the latest movements of ISO/TC167, an engineering session, the presentation of JSSC prizes and the prizewinners' lecture, and an academy session.

The prize-winning structural works and papers were introduced at the panel exhibition. They were also exhibited at the social gathering venue using a mobile device so that they could be seen by many participants.

In order to make the symposium more appealing and to increase the number of symposium participants, notice of the event was distributed not only by the respective committees but also via e-mail. As a result, advance applicants numbered about 350 and the two-day total was about 1,000. The symposium served as a useful site for exchanges between researchers and engineers working in the steel construction field, and also for collecting the latest information on steel construction.

JSSC Symposium on Structural Steel Construction for 2012 is slated for the 15th and 16th of November, 2012.

Greeting by JSSC President Koichi Takanashi

Outline of Symposium Programs

November 17, 2011

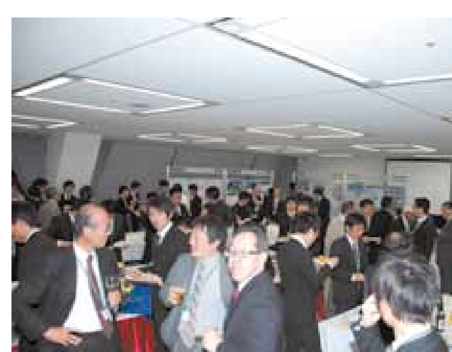
	Engineering Session, Awarding of JSSC President Prizes, Social Gathering		Academy Session		
AM	International Committee	Stainless steel session		Joint I (building construction)	
PM	Technology/Standardization Committee	Awarding of JSSC President Prizes/Lecture by prize-winners	Bridge (civil engineering)	Joint II (building construction)	Loading capacity (civil engineering)
PM		Special lecture	Structural analysis (building construction/civil engineering)	Structural member I (beam) (building construction)	Fatigue/Fracture (civil engineering)
PM	Social gathering				

November 18, 2011

AM			Vibration/Vibration control/Seismic resistance (civil engineering)	Repair/Reinforcement (civil engineering)	Structural member II (column, brace, etc) (building construction)
PM			Vibration control (building construction)	Maintenance I (civil engineering)	Framing I (building construction)
PM			Hybrid and composite structure (building construction)	Maintenance II (civil engineering)	Framing II (building construction)

Awarding of JSSC President Prizes

Special lecture meeting



Social gathering

The Grand Prize of AIJ 2011 to Emeritus Prof. Koichi Takanashi

Emeritus Prof. Koichi Takanashi of The University of Tokyo (President of the Japanese Society of Steel Construction) was awarded the Grand Prize of AIJ (Architectural Institute of Japan) 2011.

This prize is the most prestigious given by the Architectural Institute of Japan and is presented to individual members whose achievements contribute to the advancement of architecture and structural engineering. His distinguished achievements are diverse: initiatives over many years of research in the fields of plastic design, seismic design and limit-state design in steel construction in Japan, and internationally acclaimed contributions to the promotion and practical use of standards and specifications. These achievements led to his selection for the Grand Prize of AIJ 2011.

Dr. Takanashi (right) receives the Grand Prize of AIJ 2011

Fazlur Khan Medal of CTBUH to Emeritus Prof. Akira Wada

Emeritus Prof. Akira Wada of the Tokyo Institute of Technology was awarded the Fazlur R. Khan Lifetime Achievement Medal of the Council on Tall Buildings and Urban Habitat (CTBUH) for 2011.

This prize was established in 2004 in commemoration of the achievements of Dr. Fazlur Khan who designed a succession of high-rise building structures incorporating new concepts, as represented by the John Hancock Center in Chicago. Dr. Wada has long promoted extensive research in architectural technology and seismic engineering as well as the practical application of the results of that research. These efforts have contributed to the development of seismic design for high-rise buildings not only in Japan but abroad. High international praise for these achievements led to his being chosen to receive this award.

Dr. Wada (left) receives the Fazlur Khan Medal of CTBUH

Lecture by Dr. Wada to commemorate his award

The Robert H. Scanlan Medal to Prof. Yozo Fujino

Prof. Yozo Fujino of The University of Tokyo was awarded the Robert H. Scalan Medal of the American Society of Civil Engineers (ASCE).

The Scanlan Medal was inaugurated in 2002 by the Engineering Mechanics Institute of ASCE to commemorate Prof. Robert H. Scanlan's lifetime contribution in the field of engineering mechanics. It is a prestigious prize presented to individuals who attain remarkable and extensive achievements in the field of engineering mechanics based on scholarly contributions to both theory and practice, and the area of achievement will generally be structural mechanics, wind engineering or aerodynamics. Further, it is an open prize given without regard for ASCE membership or nationality. Past Japanese recipients were Emeritus Prof. Masaru Matsumoto of Kyoto University and Prof. Masanobu Shinozuka of the University of California, Irvine.

Dr. Fujino (center) receives the medal

The medal was given in high recognition of the great contributions made by Prof. Fujino in the areas of dynamics, wind effects, soundness evaluation and active/passive control technology pertaining to bridges.

Mr. and Mrs. Scanlan and Dr. Fujino

The Robert H. Scanlan Medal

To Our Readers

By Masatsugu Nagai
Chairman of International Committee, JSSC
(Professor, Nagaoka University of Technology)

As a representative of the Japanese Society of Steel Construction (JSSC), I would like to begin by expressing my sincerest sympathy to the victims of the Great East Japan Earthquake. On this occasion, we are committed to extending our maximum efforts for reconstruction and support in close cooperation with those working in steel construction in Japan. Further, we would like to express our deepest appreciation for the warm-hearted support received from many foreign countries.

Starting with issue No. 26 of *Steel Construction Today & Tomorrow*, JSSC's International Committee assumed responsibility for the editorial planning of one of the journal's thrice-annual issues. Since its inauguration, JSSC has promoted surveys, research and technological development to promote the use of steel construction and to improve steel construction technologies. At the same time, JSSC regularly extends cooperation to related organizations overseas.

Following the merger of JSSC with the Stainless Steel Building Association of Japan in 2010, JSSC's field of operation expanded to include not only carbon steel but also highly corrosion-resistant stainless steel. Consequently, we intend to actively transmit information throughout the world related to a wider range of steel construction areas.

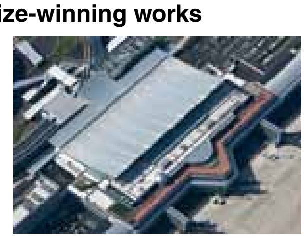
As was true in issue No. 32, the current issue, No. 35, leads with an announcement of the 2011 JSSC President Prize and Thesis Prize winners. A special feature treats the Great East Japan Earthquake: specifically, damage to steel structures due to the quake, aftershocks and the tsunami, and subsequent restoration and reconstruction work. Other major topics included the presentation of awards—the Grand Prize of AIJ 2011 to JSSC President Koichi Takanashi, the Fazlur Khan Medal of CTBUH to Prof. Akira Wada and the Robert H. Scanlan Medal to Prof. Yozo Fujino—and a description of JSSC Symposium 2011 on Structural Steel Construction, which is held annually with support from the JSSC membership, its related committees, and related organizations.

The International Committee, while working on multi-faceted responses to the internationalization of steel construction codes, promotes exchanges of technical information and personnel with overseas organizations. As one aspect of these operations, we inform our readers of JSSC operations, trends in steel construction, and the technologies and technological development involved in the planning, design, and building of steel structures in Japan through this "Special Issue on the Japanese Society of Steel Construction," which is published as one of the three annual issues of *Steel Construction Today & Tomorrow*.

If you wish to obtain more detailed information about the various articles contained in this issue or to receive related technical information, please do not hesitate to contact JSSC staff member Hiroshi Sugitani (h.sugitani@jssc.or.jp).

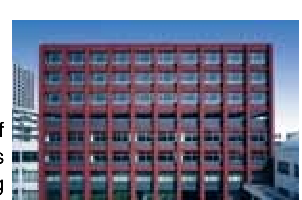
JSSC President Prize-winning works

Cantilevered box-shaped steel structure of Hoki Museum



Large-roof sliding method used for airport building

Spherical structure at Nagoya City Science Museum



Restoration of the attractiveness of RC building using steel frame

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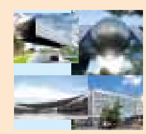

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Four selections of JSSC President Prizes for 2011: (*upper left*) Hoki Museum (for details, see page 1); (*upper right*) Nagoya City Science Museum (page 2); (*lower left*) Large-roof sliding method for airport building (page 3); (*lower right*) Using steel to restore the attractiveness of RC structures (page 4)

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