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Rhombus pattern-polished stainless steel (see pages 9~10)

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Kansai International Airport Access Bridge—Restoration from Tanker Collision in Just Seven Months

by Junichi Samizo, West Nippon Expressway Company Limited

Damage Conditions

On September 4, 2018, a tanker in mooring in the vicinity of the Kansai International Airport collided with the Kansai International Airport Access Bridge, also known as Sky Gate Bridge R, due to violent typhoon winds, which caused serious damage to the bridge girders.

The Kansai International Airport Access Bridge with a total extension of 3.75 km serves as a highway/railway bridge that connects the manmade island on which the Kansai International Airport is built with the opposite shore area. The highway section is managed by West Nippon Expressway Company Limited (NEXCO West). The center section of the bridge is a truss bridge with integrated construction for combined use for highway and railway, and both end sections are composed of steel box girder bridges of the separated structure for use for each of highway and railway.

The tanker collided with the bridge section in the vicinity of P2 of the highway bridge at around 13:40, September 4 (Fig. 1). Meanwhile, the highway had been closed due to strong winds since 13:20.

On the next day after the tanker collision, visual surveys were made of the damage condition. As a result, it was found that two spans from A1 to P1 and P2 to P3 were severely damaged due to the tanker collision (Photo 1).

In the collision section of the bridge, the girder in the A1 to P1 span (90 m) was dislocated in the lateral direction by about 1.5 m at the P1 support section,


Photo 1 Damage of P1-P2 girder

Fig. 1 Location of Kansai International Airport Access Bridge

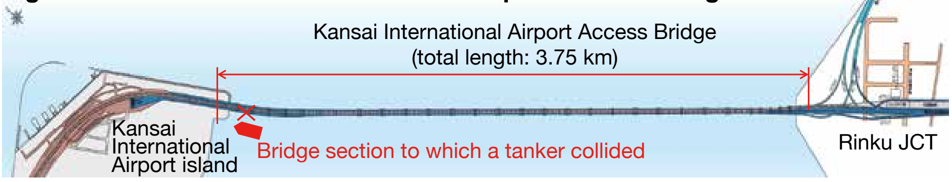


Fig. 2 Bridge Section to which A Tanker Collided

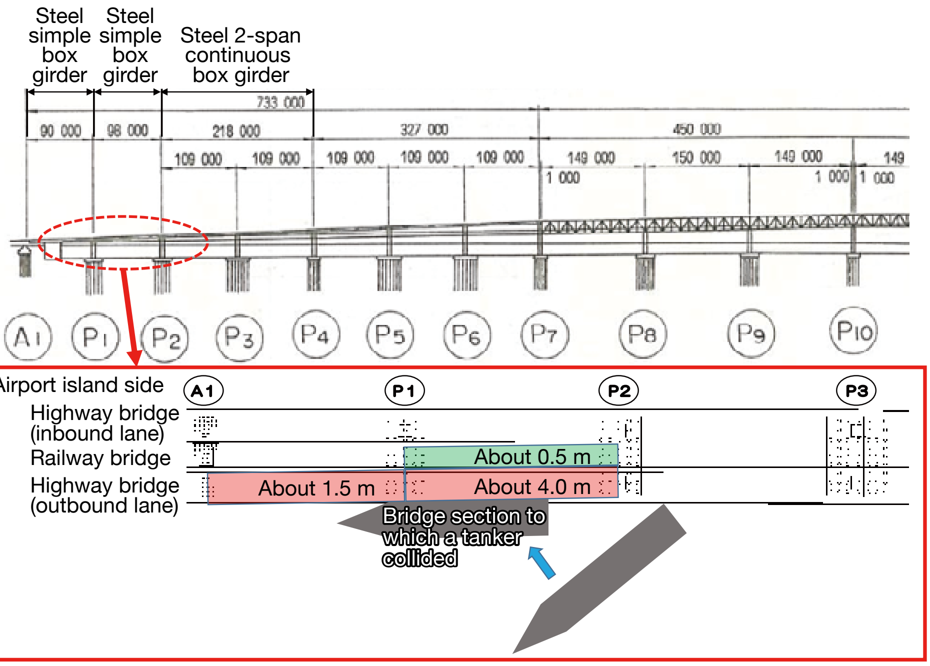
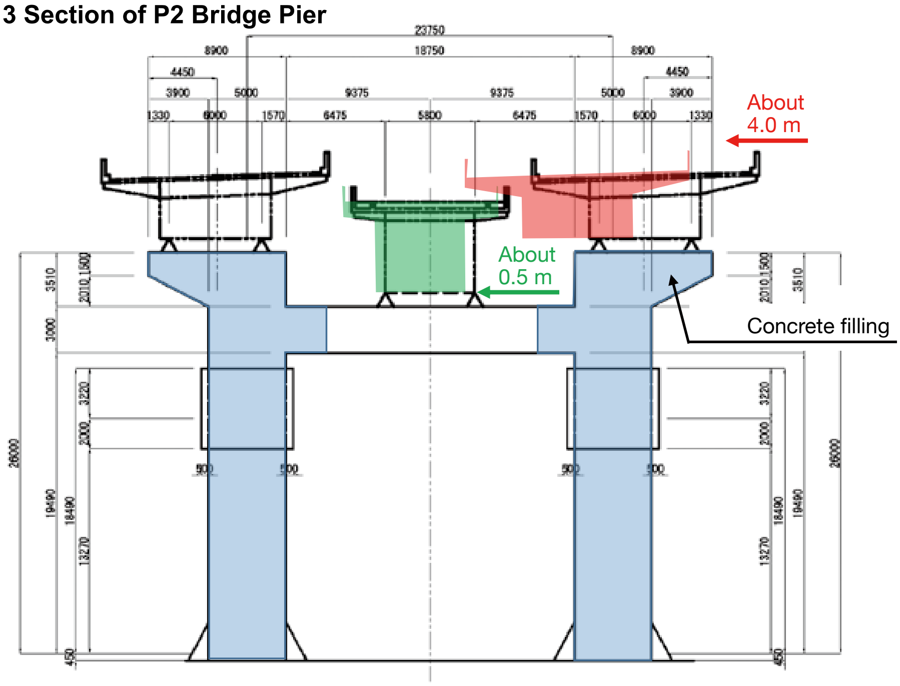


Fig. 3 Section of P2 Bridge Pier



and the girder in the P1 to P2 span (98 m) was also dislocated in the lateral direction by about 4 m at the P2 support section (Figs. 2 and 3). In addition, the highway bridge collided with the railway bridge due to the effect of the lateral movement of P1 to P2 girders to cause the lateral-direction movement of the railway bridge by about 50 cm.

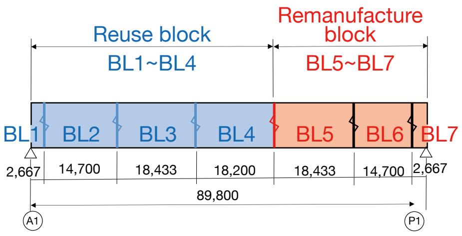
The pivot bearing was adopted for bearing support, and the upper shoe on P1 and P2 were completely separated from the lower shoe due to the girder movement. In the steel bridge pier, concrete was filled up to the crest of the column section, and while peeling-off of painting was found, it was confirmed that the steel plate caused no deformation.

Traffic Operations after Damage

As a result of an inspection of the inbound-lane bridge, it was confirmed that the bridge suffered no damage, and then the one-way alternating traffic of emergency vehicles started at 0:40 on September 5. Then, various improvements were made of the median strip on the truss bridge of the access bridge to install a crossover that connected the inbound and the outbound lanes. At 5:10 on September 7, two-way traffic using only the inbound lane started.

Meanwhile, the railway bridge was restored by the railway operating company after the removal of the damaged highway bridge to resume railway operations on September 18.

Fig. 4 Range of Reuse of A1-P1 Girder



Removal of Damaged Bridge Girders

Because the bridge girders in the two spans from A1 to P1 and from P1 to P2 were severely damaged, it was decided that, first of all, the damaged girders would be removed using a large-capacity floating crane barge and that the restoration method then be worked out.

The floating crane barge *Musashi* (lifting capacity: 3,700 tons), Japan's largest class of its kind, was used in the removal of the damaged girders. The metal fittings for use for large block erection were re-attached to the cut track of the attachment of the fittings that were used in the initial erection of this access bridge.

The damaged girders in the A1 to P1 span were lifted and removed on September 12, and those in the P1 to P2 span on September 14 (Photo 2). During removal, because the operations of the railway and airport were not yet restored, the lifting/removal work could be done in the daytime. The removed girders were loaded on the barge one by one, and the girder in the A1 to P1 span was transported to the Wakayama Plant of TAKADAKIKO Co., Ltd., and that from the P1 to P2 span was transported to the Sakai Plant of IHI Infrastructure Systems Co., Ltd.

Reuse and Remanufacture of Girders

Detailed surveys were made of the removed girders at each plant. It was decided after the surveys that, in cases when fractures and large deformations were found in a girder block divided by splice section, that block would not be reused. As a result, in the total of 7 blocks of the A1-P1 girder, 4 blocks were reused, and 3 blocks were remanufactured (Fig. 4). Regarding the P1-P2 girder, because damage occurred on its entire length, the girder was fully remanufactured.

In order to reduce the girder remanufacturing steps, the box girder configuration, steel floor slab thickness (12 mm) and other basic structural details were settled to those applied at the stage of initial erection. For the shop remanufacture of the girder (950 tons), 4 lines in 2 plants were allocated, shop assembly was eliminated, and wall/handrail members were unitized, all of which led to reduced steps in remanufacturing.

Meanwhile, the bearing support was subjected to a structural change from a pivot bearing to a BP-P bearing, and then the bearing was remanufactured. The steel finger joint that was significantly deformed was also remanufactured.

Girder Erection and Full-scale Restoration

The reused/remanufactured A1-P1 and P2-P3 girders were erected during the nights of February 13 and 14, 2019. Because the railway and airport had already been put into full operation, the erection time was restricted to nighttime. The erection was carried out employing the floating crane barge used in the removal (Photo 3).

After the girder erection, the expansion joint was installed, and the bridge surface was paved. The operation of the outbound lane finally resumed on February 27.

Then, the crossover used for two-way traffic was removed, and the median strip was restored. Finally, at 6:00 am on April 8, 2019, the full-scale restoration of the Kansai International Airport Access Bridge from the tanker collision was completed in the extremely short period of seven months after the collision.

Photo 2 Removal of damaged P1-P2 girder

Photo 3 Lifting of remanufactured P1-P2 girder from barge

Long-period Pulse-type Seismic Motions at Uemachi Fault and Example of Effective Countermeasures

by Yasuhiko Tashiro and Satoshi Yoshida, Nikken Sekkei Ltd.

The Uemachi fault traverses the City of Osaka area from south to north, where an inland-type earthquake is forecast to occur with the Uemachi fault zone as a hypocenter. This long-period pulse-type earthquake and a high-rise building constructed by incorporating effective countermeasures are introduced below:

Uemachi Fault Seismic Waves

In the peak period of the Holocene glacial retreat about 6,000 years ago, the sea level was higher by 5~6 m than the current level. In those days, most of the area of the current City of Osaka was sunken in the sea that spread to the west edge of the Ikoma mountain range as the Kawachi Bay in those days. Also in those days, the Uemachi plateau was a narrow peninsula that struck out from south to north.

The present-day Uemachi plateau is about 25 m above sea level, and its west side abruptly falls. When observing the underground condition of the Uemachi plateau, there is a great difference in terms of the initial-stage marine clay Mal layer emergence level—about 400 m between the Uemachi plateau surface and the Osaka Bay coast. The plateau has undergone upheavals over a long period of hundreds of thousands of years due to the activities of the Uemachi fault zone that traverses Osaka from north to south. How many fault activities and how huge an earthquake has the Uemachi plateau experienced to reach its current form? Looking at the topography on and in the ground, one cannot help but imagine its tremendous history of formation.

Since the occurrence of the Great Hanshin Earthquake in 1995, concerns about guarding against an Uemachi fault-induced earthquake has grown among citizens in Osaka and has steadily become conspicuous. Since 2000, studies have made rapid progress on the prediction of the strong seismic motions that are assumed to occur in a hypocentral fault, and in 2006 the Committee on Comprehensive Countermeasures against Natural Disasters" established by the Osaka Prefectural Government and the City of Osaka prepared a report "Assumptions of Large-scale Disaster" based on the strong seismic motion prediction results obtained by assuming the activities of several inland active faults.

In the report, 35 cases of hypocentral regions were assumed for the Uemachi fault zone-induced earthquakes, and simulated seismic motion waveforms (predicted seismic waves) were obtained for every 500 to 250 m-mesh zone of the City of Osaka area pertaining to each of its 35 hypocentral regions. The number of predicted strong seismic waves in the report totals about 110,000 in the City of Osaka area.

In 2009, the "research group on seismic motions for building design and design methods to resist an inland-type earthquake in Osaka" (research goup[1)]) was inaugurated as an industry-public-academia joint research organ with the Kansai Branch of JSCA (Japan Structural Consultants Association) as its secretariat. The "research group" has aimed at preparing design seismic motions based on the predicted seismic waves prepared by the City of Osaka and Osaka Prefectural Government. It analyzed the response spectrum of 110,000 seismic waves and as a result notified that the waveform can be classified into two types: flat-type seismic motion in an entire cycle and pulse-type seismic motion in a long-period sphere. (Figs. 1 and 2)

Long period-type seismic motion is frequently observed in the end of fault fracture direction, or in the wave advancing direction sphere, which coincides with the "directional pulse" (Fig. 3) occurring due to the advancing-direction composition (Doppler effect) of the waves generated at each zone.

An outline of the design input seismic motions publicly released by the "research group"[1)] in 2012 is introduced below:

- **Area: Division of City of Osaka Area to 6 Zones** (Fig. 4)
- **Level: Settlement of 3 Levels for Level 3 Seismic Motion**
  —Level 3A: Average level
  —Level 3B: Level incl. about 70 percentile of predicted seismic motions
  —Level 3C: Level incl. about 85 percentile
- **By Type of Seismic Motion: Settlement of 2 Types by Zone**
  —Seismic motion ①: Seismic motion with flat-type spectrum characteristics (flat type)
  —Seismic motion ②: Long-period pulse-type seismic motions selected from among predicted waves (pulse type) (Refer to Fig. 5)

Fig. 1 Flat-type Seismic Motion Group

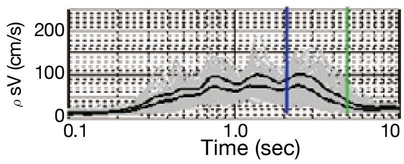


Fig. 2 Long-period Pulse-type Seismic Motion Group

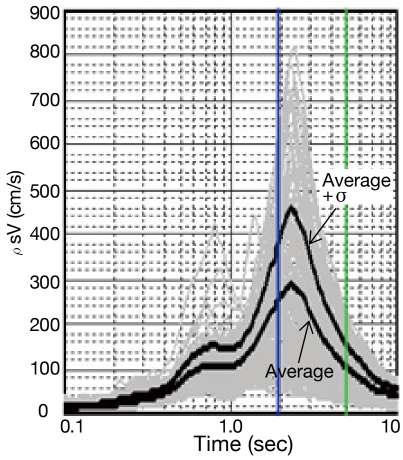


Fig. 3 Conceptual Drawing of Directional Pulse

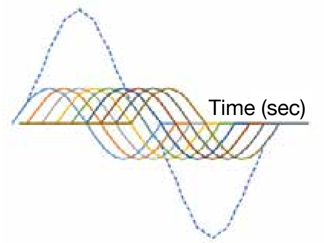


Fig. 4 Zone Division in City of Osaka Area

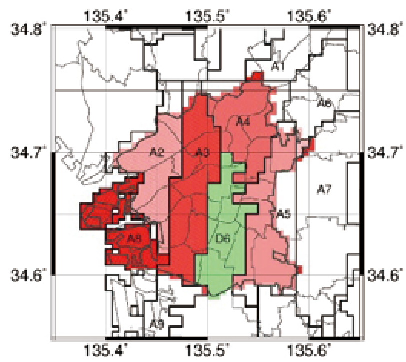
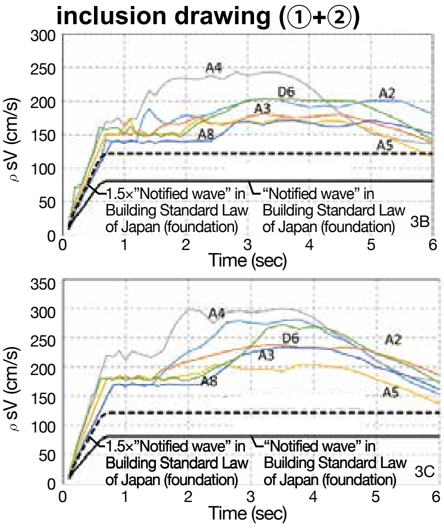


Fig. 5 Uemachi Fault Waves Analyzed by research grioup[1)]Maximum response spectrum inclusion drawing (①+②)



Example of Building Employing Effective Countermeasures

• Outline of Building and Structure

Name: Nakanoshima Festival Tower West (Photo 1)

Project owner: The Asahi Shimbun Company, Takenaka Corporation

Location: Nakanoshima, Kita-ku, Osaka

Applications: Hotel, office, art museum, shop

Total floor area: 151,000 m^2

Height: About 200 m

No. of stories: 41/-4/P2

Structure: Seismic-response structure, S/SRC/R structure

Construction term: July 2014~March 2017

Fig. 6 shows the framing elevation and damper arrangement. The building is composed of a response-control structure and features a low-rise floor-intensive response-control structure in which large-capacity oil dampers with a maximum damping capacity of 6,000 kN are arranged intensively in the low-rise section in addition to the arrangement of oil dampers inside the standard floor center core.

Photo 1 Nakanoshima Festival Tower West

• Seismic Design Criteria

Table 1 shows the seismic design criteria to treat great and maximum earthquakes (excerpt). The Uemachi default seismic wave of the "research group"[1)] introduced above is treated as the seismic wave of Level 3 maximum earthquake in the table.

In order to treat Level 2 seismic motion, the inter-story drift angle of the structural member adopted for this building is settled at 1/150 or lower, which shows high seismic performance of the building.

• Verification of Effect of Intensive Response-control System

Fig. 7 shows the comparison of responses (Level 2 "notified wave") between the installation of intensively damper-arranged low-rise floors and no installation. It is understood from the figure that the response is improved at floors other than low-rise floors.

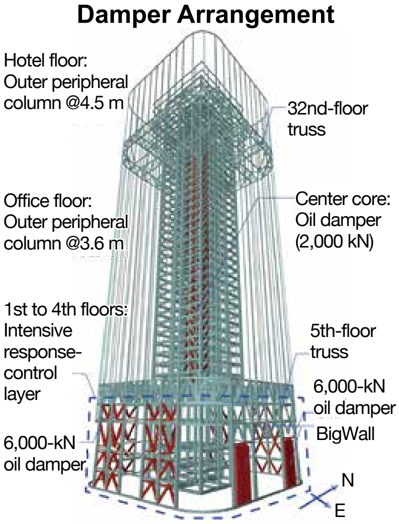
• Result of Response to Uemachi Fault Wave of the "research group"[1)]

Fig. 8 shows the maximum inter-story drift angle to the Uemachi fault wave (3B) of the "research group"[1)]. In this building, the maximum inter-story drift angle reaches 1/75 and the layer plasticization rate reaches 2.0 at its maximum, which thus satisfy the need for design criteria for Level 3 seismic motion.

♦ ♦ ♦

Specific features of long-period pulse-type seismic motion lies in that the number of waves is less and that a building having a period longer than the pulse period suffers from great ground displacement as if the footing is lost. Currently, any established countermeasure against long-period pulse-type earthquakes is unavailable, and thus example of effective countermeasures against long-period pulse-type earthquake adopted in a highly seismic-resistant building was introduced above.

Fig. 6 Framing Elevation and Damper Arrangement



Reference

1) "research group on seismic motions for building design and design methods to resist an inland-type earthquake in Osaka"

Fig. 7 Comparison of Responses between Installation of Intensively Damper Arranged Low-rise Floor and No Installation

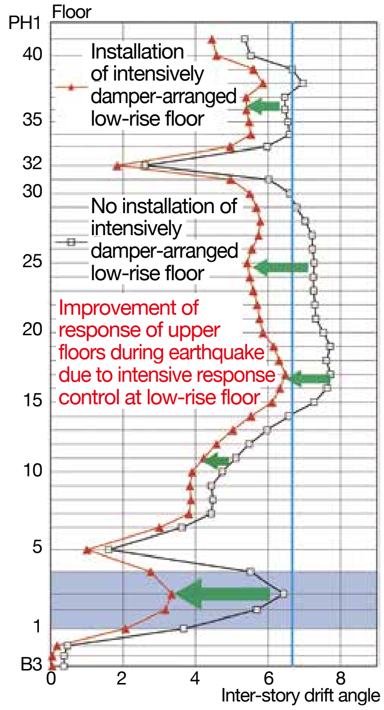


Fig. 8 Response to Uemachi Fault Wave 3B ("research group"[1)])

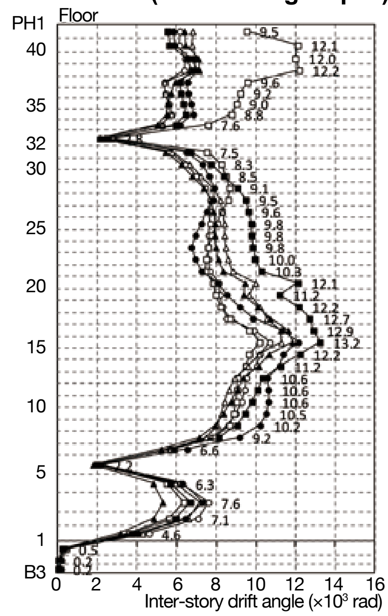


Table 1 Seismic Design Criteria (Excerption)

Earthquake scale	Level 2 seismic motion (great earthquake)	Level 3 seismic motion (maximum earthquake)
Wave adopted	"Notified wave" Observed wave Site wave	Notified wave×1.5 Uemachi fault wave of "research group"[1)]: 3B
Target criteria for upper floors	Elastic limit strength: (1. 1F-Z) or lower Inter-story drift angle: 1/150 or lower	Ultimate strength or lower

Heavy Rain/Heavy Snow/Strong Wind Disasters in Railways and Countermeasures

by Ryota Sato, Railway Technical Research Institute

Railways are composed of many facilities such as rolling stock, track and electric train overhead wire, and accordingly the kinds of railway disasters that suffer from meteorological phenomena are diverse. Focusing on heavy rainfall, heavy snowfall and strong wind, the kind of disasters that railways suffer and an outline of hardware and software countermeasures against these disasters are introduced below:

Heavy Rainfall Disasters in Railways and Countermeasures

In Japan, the annual precipitation is about twice the world average, and the mountainous region accounts for three-fourths of national territory. As a result, not only slope collapse and other sediment disasters but flooding and other river disasters occur during rainfall almost every year. The sediment and river disasters and countermeasures taken in railways are outlined below:

• Sediment Disasters

In examining the countermeasure against sediment disaster, it is necessary to understand the features peculiar to each type of disaster.

Specifically, in the case of embankment collapse, the groundwater level rises due to rainwater penetration to cause a lowering of the strength of the embankment, which is cited as a main cause for embankment collapse. In the collapse of the embankment, the amount of collapsed soil reaches several hundred cubic meters[1]. On the other hand, the debris flow that occurs during heavy rains causes the soil to contain a large amount of water and become fluid, causing damage over a wide area. In debris flows, the amount of collapsed soil can reach 100,000 cubic meters[2].

Among hardware countermeasures against collapse of the embankment are drain pipe installation (Fig. 1)[3] and slope improvement to prevent embankment collapse. Among hardware countermeasures against debris flow are debris barriers and channel improvement. Furthermore, as a software measure, railway operations are regulated according to the amount of rainfall.

• River Disasters

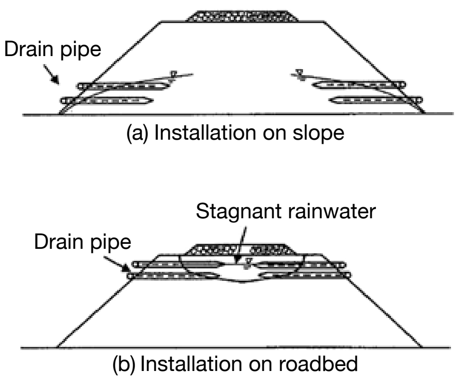
Disasters caused by the rise of river water levels are divided into disasters of bridges and revetments. Major causes for these disasters are the scouring of bridge piers or embankment wall foundations and the lowering of riverbeds. When scouring or lowering progresses, there are cases in which the stability of bridge foundations falls and bridge piers fall down.

Among the hardware countermeasures against these disasters are the method in which heavyweight materials are installed on the river bed in the vicinity of bridge piers, and the method in which the periphery of bridge piers is surrounded with heavyweight materials to prevent fall down even when scouring progresses (Fig. 2)[4]. Furthermore, as a software countermeasure, railway operations are regulated depending on the river water level.

Avalanche and Snow Accretion Disasters in Railways and Countermeasures

About 40% of Japan's total railway lines of about 28,000 km are laid in heavy snowfall areas, and thus snowfall disasters have occurred on many railway lines. Avalanches and snow accretion to vehicle and countermeasures are outlined in the following:

Fig. 1 Outline of Drainage Measure Employing Drain Pipes



• Snow Avalanches

Snow accumulated on slopes is affected by various meteorological effects to cause changes to the accumulation depth and properties of accumulated snow, and thus there are cases in which snow avalanches occur. The occurrence of avalanches along railway lines sometimes brings about serious disasters such as the overturning of running trains and destruction of railway facilities.

Among the hardware countermeasures against avalanche disaster are avalanche prevention forests and fences that prevent avalanches from occurring, as well as retaining walls, snow sheds that protect railway tracks and trains from av-

Fig. 2 Basic Practice of Scouring-prevention Work

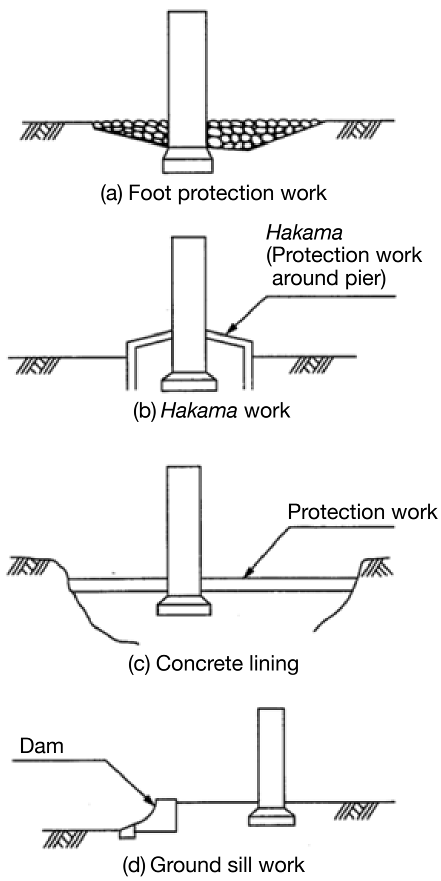
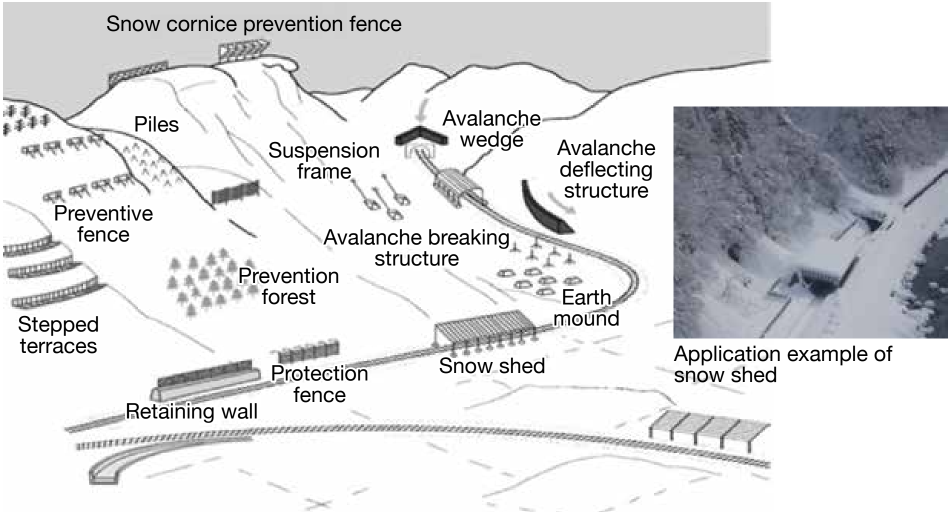


Fig. 3 Major Countermeasures against Avalanche



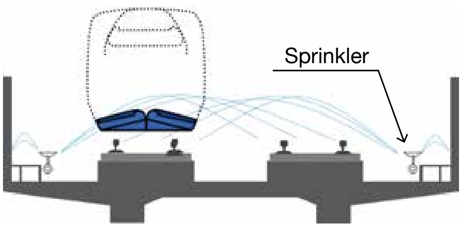
alanches (Fig. 3). Furthermore, as a software countermeasure, railway operations are regulated depending on new snowfall amount, temperature, rainfall and other guidelines.

• Snow Accretion to Vehicle

Snow flying up from the track during train running adheres to the bogie. When the adhered snow drops due to temperature changes and vehicle vibration during train running, there are cases in which the aboveground facility is damaged by the snow falling impact.

Among the hardware countermeasures against snow accretion are measures taken aboveground in which the flying snow is suppressed by sprinkle water on the track and changing to high moisture snow (Fig. 4). On the other hand, the vehicle suppresses snow accretion by flattening the underfloor. Furthermore, as a software measure, railway operations are regulated according to the amount of snow depth on the tracks.

Fig. 4 Countermeasure against Flying Snow by Means of Water Sprinkle on Track



Strong Wind Disasters in Railways

In Japan, not only strong winds blow in large areas such as monsoons and typhoons, but also gusts may blow in small areas such as tornadoes. The derailment and overturn of trains due to these strong winds and countermeasures are outlined in the following:

The derailment and overturning of trains caused by strong winds occur when strong wind force working on the train surpasses the train's resistance to the strong wind. The weight and running speed of trains, the structural type of trains and many other elements affect the occurrence of derailment and overturn.

In order to prevent overturn due to strong winds, wind-prevention fences are arranged in areas where strong winds blow due to topographical conditions (Photo 1). Furthermore, as a software measure, railway operations are regulated according to the amount based on measurement values obtained from anemometers (3 cup-type and propeller-type, see Photos 2 and 3).

Towards Improved and Stabilized Railway Operations

Of the meteorological disasters the railway suffers, heavy rainfall/snowfall- and strong wind-induced disasters and countermeasures are outlined above. Because the types of disasters will be affected by climate changes forecasted to occur in the future, the scale and frequency will be likely to change.

Along with the development of observation technologies employing meteorological radar systems, it has recently become possible to understand wind, rainfall, snowfall and other external meteorological forces in a multi-faceted and highly resolution level by the use of radar systems[5) 6)]. Further, the accuracy of external meteorological force forecasting is being improved due to advanced calculation technologies and enhanced calculation speed.

We consider that the examination of how to effectively apply these advanced countermeasures to be obtained by capitalizing on these advanced observation and forecast technologies will be useful for safer and more stable railway transport.

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Photo 1 Example of wind-preventive fence

Photo 2 Three cup-type anemometer

Photo 3 Windmill-type anemometer

Key to Traffic Restoration: Emergency Steel Bridges—Importance and Technical Developments

by Kazuhisa Fujii, Ministry of Land, Infrastructure, Transport and Tourism

Highways are an essential infrastructure used by everyone. They support our daily life and economic activities and, at the same time, when disasters occur, highways are expected to play a key role in smooth emergency/rescue operations, the transport of emergency supplies and other support activities. To that end, when it is anticipated that highways will suffer from disasters, restoration is required very quickly.

In order to restore the traffic function of damaged highways at an earliest stage, it is necessary to make full preparations even before the occurrence of disaster. In this regard, the emergency bridges with rapid construction design (a type of portable, prefabricated, truss bridge), one of these key preparations, is introduced in the following discussion.

Outline of Emergency Bridge with Rapid Construction Design

When a bridge is damaged or washed out due to river water rise, earthquake, avalanche and other factors and its regular use becomes impossible, an emergency bridge is erected for temporary use in order to secure the traffic function of highways quickly. The bridge structural components prepared in advance are transported to the site where the disaster occurs. The emergency bridge can then be rapidly erected by means of component assembly.

Currently, a total of 30 emergency bridges are prepared at the Ministry of Land, Infrastructure, Transport and Tourism (MLIT). They are stored and maintained by the technical and national highway departments of respective MLIT Regional Development Bureaus located nationwide from Okinawa to Hokkaido.

The type of emergency bridge currently in use is the truss type structure that is easy to handle. Capitalizing on the characteristic performance peculiar to the truss bridge, the bridge can meet the need for diverse lengths and spans in conformity with on-site conditions and can be erected by assembling prefabricated bridge components on site.

Example of Application of Emergency Steel Bridges

In a wide area extending from Kyushu to other adjoining areas, the 2020 Kyushu Floods brought about a serious disaster that resulted in damage to many human lives, houses, lifelines, and local industries. Currently, the national government is promoting authorized disaster restoration projects in the area which extends to approximately 100 km in length covering National Highway Route 219 along the Kuma River between Yatsushiro and Hitoyoshi, and the Kumamoto prefectural road. The restoration includes 10 bridges that were washed out.

Among the washed-out bridges was the Nishise Bridge that spans the Kuma River on the Hitoyorshi-Minamata prefectural road. This bridge serves as a lifeline road and school-access road for Hitoyoshi citizens. However, the bridge was fully closed as of July 4, 2020 due to the washing out of a 43 m-long bridge girder, a center section of the bridge having a total length of 174 m. Therefore, the school-access road was forced to detour to National Highway Route 219 where traffic is heavy. To remedy this adverse situation, an emergency bridge was provided for the emergency restoration of the Nishise Bridge. By September 4, this measure led to successful resumption of the traffic function as not only a lifeline road but also a school-access road.

In this emergency restoration work, an emergency bridge (assembly-type Warren truss bridge) that was prepared by the Kyushu Technical Office of the Kyushu Regional Development Bureau was employed. Because the prepared bridge could meet only a 40-m span of the required 43-m girder span length, the remaining 3-m section was manufactured in the prefabrication shop. In the bridge erection, an en-bloc erection method using a 500-ton crawler crane was adopted due to the flood season conditions, thereby avoiding an erection in which intermediate bents are installed. In this way, some devices were incorporated to allow earlier erection.

On the assumption of the use over several years, the existing bridge pier and the emergency bridge pier (bent) were repaired using bolts to fortify an integrated bridge pier so as to make it difficult for the emergency bridge to be washed out. In addition, a steel H-beam for preventing driftwood collapse was installed on the upper stream side of the bent so as to prevent a direct hit.

In the utilization of emergency bridges, the basic practice currently adopted is to use emergency bridges owned by each Regional Development Bureau in each local region. However, in order to meet the request for diversifying applications and renting to other bureaus, a flexible system has been adopted in which the bridges owned by one bureau can be used by another bureau.

Towards the Smooth Application of Emergency Steel Bridges

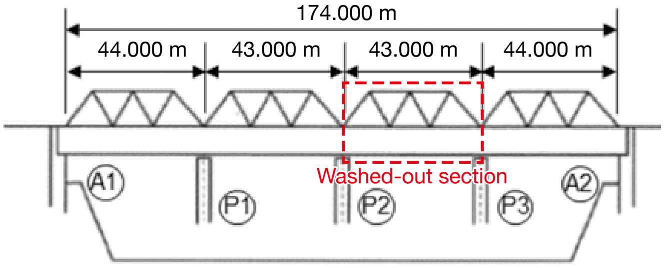
A major requirement for emergency bridges is that the bridge can promptly be erected at the disaster-stricken site in an emergency. In order to allow for prompt erection, it is essential to implement erection training, to hold training courses and to carry out periodic inspections of bridges in storage at all times.

For the erection training and training course, various devices are incorporated by respective local areas, among which is the joint offering of a training course by the staff of the Regional Development Bureau. They collaborate on this training with the staff of local public organizations and with local construction associations based on their disaster response agreements.

Further, through the implementation of erection training and training courses, it is important to nurture and secure not only engineers and local construc-

Earlier Traffic Restoration Employing Emergency Steel Bridge (Nishise Bridge)

Dimensions of Nishise Bridge
- Bridge length: 174.0 m
- Type of bridge: 4-span steel simple truss bridge
- Completion: 1967



Damage condition

Erection of emergency bridge


Opening of emergency bridge

tion companies that can quickly respond in an emergency but also to locate human resources that can offer cooperation during a disaster. It is also important to increase the number of cooperative companies that can collaborate during a disaster.

New Technical Developments for Emergency Steel Bridges

In the situation in which natural disasters frequently occur and the incidence of terrible disasters increases, it will be imperative to reliably secure highway traffic immediately after a disaster. For that purpose, a specific duty imposed on the engineers engaged in highway maintenance is to make necessary preparations in advance so that emergency bridges can be erected as quickly as possible as the need arises.

In order to meet the needs of diverse erection conditions, expectations are high for new technical developments that will lead to the rapid erection of emergency bridges. Among these new technical developments are the further unitization of steel bridge components, minimized number of bolts applied for joining components and reduced weight of steel members used for the emergency bridge. These developments must proceed while maintaining the bridge's designated design load and allowing for reduction of the period required for emergency bridge erection. In addition, the reduced weight of steel components used for emergency bridges offers the possibility to erect emergency bridges in sites where large-capacity construction machinery cannot enter or be installed.

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Currently, socio-economic activities are shifting towards the ostensible "just-in-time system" of manufacturing which is based on the principle of keeping inventory as low as possible and producing only the amount of goods needed at a particular time. At the same time, supply chains are becoming more widespread and complex. Given this situation, the need to minimize the impact of a disaster on highway networks, once it has occurred, is of concern and the related social requirements are expected to become even stronger in the future.

In order to be able to respond to these needs in the future, we would like to acquire help from the Japanese Society of Steel Construction and also to promote collaboration with those who are concerned in local public entities and construction industry-related associations. As we thus intend to appropriately provide for remediation of disasters and to take adequate measures in the event of a disaster, we would like to ask for continued patronage and cooperation of all concerned.

Fukuoka Lawyer's Hall

—Stainless Steel for Interior and Exterior Achieving Traditional Hakata Woven Pattern by Optimized Use of Stainless Steel with Various Polishing—

by Koichi Furumori, Furumori Koichi Architects

Opened Lawyer's Hall

With the relocation of Kyushu University, three legal professional functions (court, public prosecutor's office, lawyer's hall) will gather at the place of Ropponmatsu campus before, along with complex facilities and apartments. Therefore, the lawyer's hall was selected by a publicly-offered proposal. The main point of the proposal statements is that: "I want to emphasize a lawyer's hall open to society in order to comply with the principle of the rule of law for society in general. It is the consistent attitude of this project to express lawyer's aspirations in public."

At the Entrance Hall, Fukuoka symbol's *Hakata-ori* texture was emphasized right the way because it is the first impressive of visitor, not only the local citizens but also foreigners. A step sequence of brainstorm way can be described as below.

First, I got a cloth with a tribute pattern, pinned it on the wall of the office, and occasionally looked at it. Then I found that the angle or direction in which a person looks at an object can decide the differences of the motifs. It is the ""Differences in perspective viewpoint" or the "Variation principle of near and far in visual." When I look at it from a distance, a simple striped pattern appeared. Approaching closer, I recognized that as a rhombus pattern. Certainly, it was one of the charms of the *Hakata-ori* tribute pattern. Placing related elements in close proximity and adding the stainless steel there, a stunning creative material was born. Here, we will introduce the process leading to the realization of the *Hakata-ori* stainless steel texture.
(See Photos 1 and 2)

Photo 1 Full view of Fukuoka Lawyer's Hall

Collaborative Design

In recent years, in our design, we often think about cooperating with many craftsmen. By accumulating many technologies and knowledge, we aim to achieve the unique expression. The process is called "Collaborative design." Until now, collaboration has been carried out in all aspects of construction. The outstanding thing is that the person who is spending most of time in manufacturing takes part in the design deeply.

This time also, we did set up a meeting together from the beginning of design process. We believe this combination will lead the project in the spotlight as well as possible. An expert stainless steel polishing craftsmen performed the detail of *Hakata-ori* pattern in the mass steel excellently. It has been over more than our expectation. A unique material was created in reality.

Stainless Steel

• Target/What I Aim for

Until now, there have been several expressions of the *Hakata-ori* tribute pattern, in term of the traditional woven pattern, with different colors such as tiles and paint. However, this time, I tried to convey the image of *Hakata-ori* tribute pattern through the type of stainless steel polishing only, not by the difference in color.

Photo 2 *Hakata-ori* tribute pattern

• Problem Definition

First of all, I wondered if I can reflect the characteristics of *Hakata-ori* tribute pattern, especially in the texture. Its look is like a stripe line in the distant view, but the rhombus pattern gradually appears when seeing closer. The work of this abstraction seemed to be extremely difficult. The most hard one is polishing the rhombus texture. If the outline is blurred, the attractiveness of the stripe will not

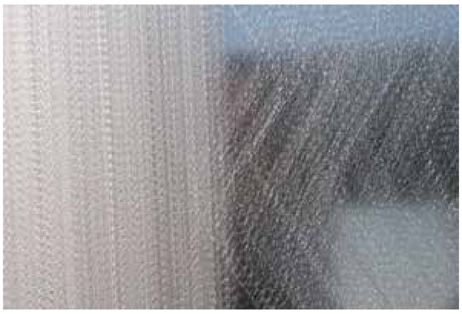


Photo 3 Rhombus pattern mockup

Photo 4 On-site mockup

be transmitted when viewed from a distance, and if the outline is sharpened, the texture will not be understood clearly. (See Photos 3 and 4)

• Technology that Led to Solution

According to Mr. Kadotani, who took charge of stainless steel polishing in this project, he said: “In order to express the vertical stripe texture, which is the core of the design, I adopted inhomogeneous polishing. It is the latest technology to abstractly express *Hakata-ori* tribute pattern.”

• Specific Technology

There are three types of expression of solid vertical stripes:

—”Buffing that gives the luster of stainless steel without glazing”

—”Uneven vertical lines that are following the sharpness of *Hakata-ori*”

—”Diamond polishing that is conscious of unique patterns”

The three types of polishing were combined to 1 m panel widths. Then 10 patterns were created and arranged randomly but do not break the rhythm as well. Finishing material was merged in shining white silver pattern with 2 types (exterior and interior). Exterior one used is highly corrosion-resistant ferritic stainless steel NSSC-220M. Interior one adopted is environmentally friendly white stainless steel NSSC-FW2. (See Photos 5 and 6)

• Surface Finish

As a result of making many prototypes and very delicate examinations in a special manufacturing process of polishing or looking from remote and closed distances, a fine surface finish was successfully obtained. This surface finish is a mere stripe in the distant view, but when approaching, a diamond-shaped expression appears. Finally, our team could reflect an historical silk texture regarding to this city, Hakata city, in term of stainless steel. Generally, stainless steel products are standardized, but it was confirmed that by applying handmade polishing, an abundant expression is created with many potential.

Conclusion

Looking at the building and the material that are standing on site now, it deeply impresses us. It is the result of many studies and experiments that are not easy to have chance to get an opportunity. Fukuoka Lawyers Association and Japan Institute of Architects, who managed the project, carefully planned and created an environment where we can concentrate on design. In addition, I am deeply grateful to Okumura Corporation, Nittetsu Stainless Steel Corporation, Sanwa Tajima Co., Ltd., and Toyo Stainless Steel Polishing Industry Co., Ltd. for deeply understanding their feelings and taking over the challenge. I can’t find any words to express. I am really proud of all.

Finally, when looking at the completed building, we can see that many craftsmen’s ideas have been merged together, and that strength and kindness coexist in the space, thereby creating a variety of potential elements. We hope that Fukuoka Lawyer’s Hall will lead to the understanding of lawyers and citizens and become the place that helps citizens in trouble, and that it will gradually open up the aspirational feelings of lawyers to the citizens.

Photo 5 Exterior stainless steel

Photo 6 Interior stainless steel

Aichi International Exhibition Center (Aichi Sky Expo)

Prize winner: Takenaka Corporation

Features of Aichi International Exhibition Center

This building was constructed by Aichi Prefecture and is the first exhibition hall in Japan directly connected to an international airport. The exhibition area is one of the largest in Japan at 60,000 m^2, and Exhibition Hall A is a pillar-less large space with an exhibition area of 10,000 m^2 and 100 m×100 m, and has a 20 m height under the beam, allowing for music concerts to be held.

The five halls (Exhibition Halls B through F) are large spaces with a height of 14 meters under the beams, and can be used together to a maximum of 50,000 square meters.

With a large-capacity solar power generation system and various energy-saving technologies, it is the first exhibition hall in Japan to achieve CASBEE S rank and ZEB Ready.

Outline of Structural Planning

The west wing, including Exhibition Hall A, which is a column-free space of about 100 m×100 m, adopts a two-way truss structure, and the truss pitch and truss size are set based on the optimization study of the members. The truss columns are V-shaped to secure both interior space and MEP space.

In the east wing of Halls B through F, six columns having knee braces are installed in each of the five 10,000 m^2 exhibition halls with 14 m under beams. These columns realize the rational single-layer roof frame with H-shaped beam.

The 200 m-long large eave structure of the entrance is equipped with 45 vertical greening units, "Vertical Forest," planned to bloom with seasonal flowers throughout the year. For the wind pressure resistance and salt damage resistance specific to the building site, we devised a new greening structure system using SUS316, which contributes to the impressive and symbolic design of the entrance space.

Outline of the Vibration Control Structure

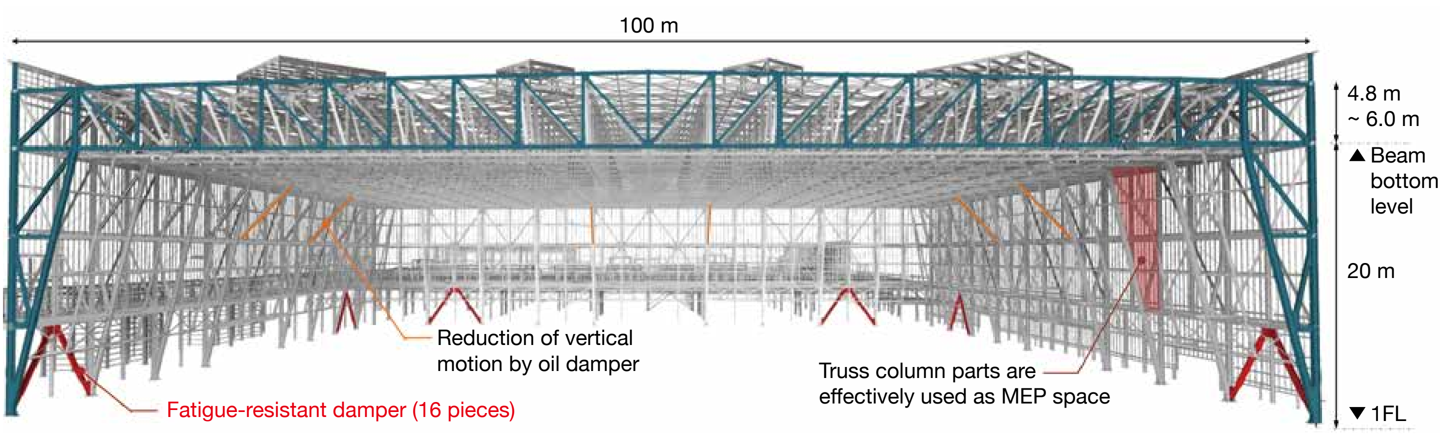
Oil dampers were installed to reduce vertical movement. The vertical response acceleration is reduced about 20-30%, reducing the risk of falling of suspended objects for events in the exhibition hall and improving the safety of the large space structure.

Since the construction site is also close to the epicenter of the Nankai Trough earthquake, it was necessary to secure a margin for large-amplitude cyclic deformations under long duration ground motions. Takenaka Corporation, National Institute for Material Science (NIMS) and Awaji Materia have jointly developed a bracing type damper with 10 times higher fatigue durability than ordinary steel damper, using excellent fatigue-resistant characteristics of Fe-Mn-Si-based alloy, and applied it for the first time.

Entrance canopy of Aichi International Exhibition Center

Installation of fatigue-resistant damper

Outline of Structural Planning



The Okura Tokyo

Prize winner: Taisei Corporation

The Okura Tokyo project is a rebuilding plan for the former Hotel Okura Tokyo. Two major propositions were imposed on the rebuilding plan: the complete reappearance of the former Okura lobby, and the realization of a hotel and office where you can safely and securely pass time.

Structural Plans

For the guest room floors located on the upper section of this high-rise building, a "braced tube structure frame" was adopted in which the mega braces to restrict multi layers were arranged on the wall position, a boundary between the guest room corridor and the void, thereby enhancing the horizontal stiffness of the entire guest room floors. As a result, it was possible to lessen the horizontal load borne by the peripheral columns and to make narrow the column sectional dimensions, which led to an improved layout of guest rooms and securement of a fine view. Because all of the guest room floors were consolidated by the use of braces, the inter-story drift angle became small and damage to high-grade finishing members and fittings of the guest room totaling about 370 was mitigated.

Because of the difference of column allocation between the upper guest room floors and the lower office floors, diagonal columns that can smoothly transfer the column axial force were arranged at the structure switchover floor. A 20-ton cast steel joint was adopted for every diagonal column end joint section where columns and beams gather three-dimensionally and in a complex manner so as to secure a reasonable, continuous transfer of column axial force.

The accurate reappearance of the Okura lobby was a proposition from the initial stage of the rebuilding plan. Further, the column span and outer dimension of 800 mm×800 mm were designated to follow to those of the original design, and the outer dimension of structural columns was restricted to 600 mm×600 mm. In order to realize these demands, ultrahigh-strength concrete-filled steel tube columns employing 780 N/mm² high-strength steel product and Fc150 concrete were adopted for columns subjected directly to the large column axial force of high-rise floors.

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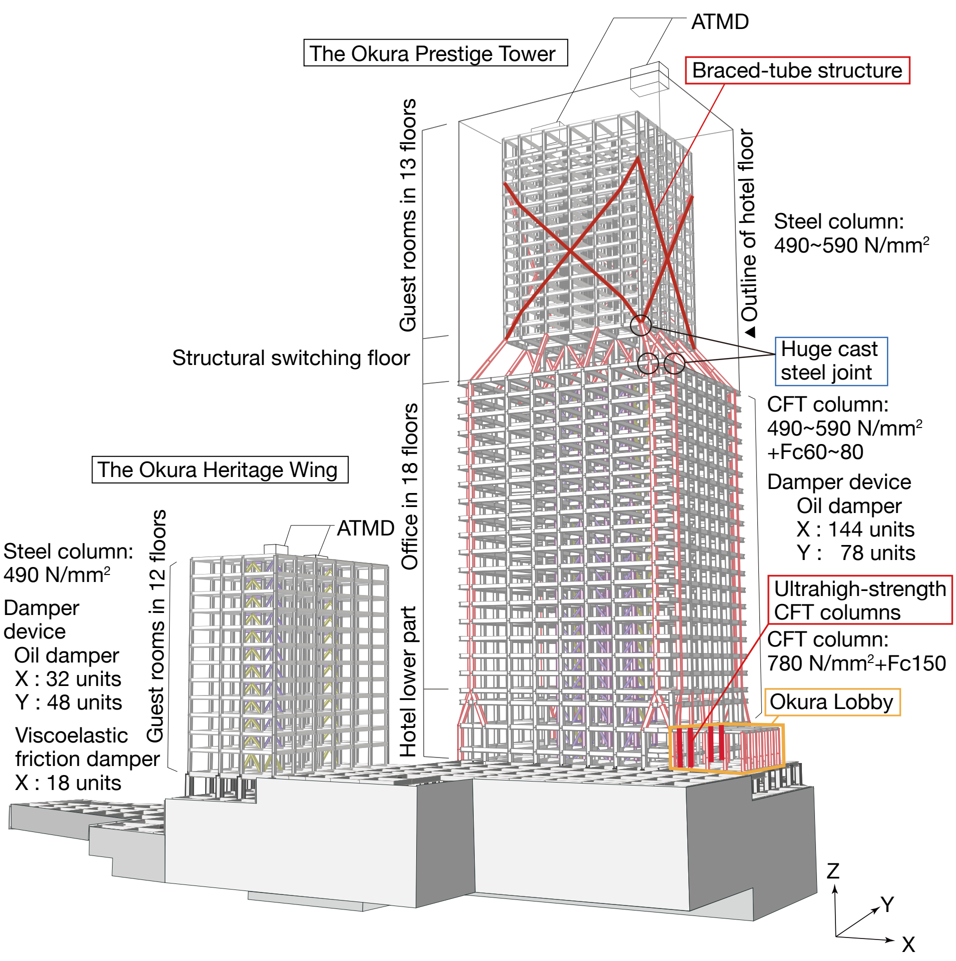
Capitalizing on these advanced structural plans and diverse tests and examinations preceding practical construction, we contributed towards the completion of a high-grade, highly seismic-resistant building and the succession of the long-established tradition of the former Hotel Okura Tokyo through the reappearance of the traditional Okura lobby.

Structural Overview



External image

Ultrahigh-strength concrete-filled steel tube column

Huge cast steel joint

DaiyaGate Ikebukuro

Prize winners: Nikken Sekkei Ltd. and Joint Venture of Obayashi Corporation and Seibu Construction Co., Ltd.

Seismic-isolation System on Intermediate Floor

In the design of the office building "DaiyaGate Ikebukuro," the project owner submitted a request to realize high seismic resistance that would allow for the building to continue business operations even in the event of an inland earthquake in the Tokyo metropolitan area as forecast to occur in the near future. To meet this request, a seismic-isolated intermediate floor structure was adopted that also secures high stiffness for both upper and lower floors.

Specifically, a structural system was adopted in which the seismic-isolated intermediate floor is sandwiched between upper and lower floors with high floor stiffness (upper floors: brace framing; lower floor: mega framing employing diagonal columns that crosses over the railway line). Also, a seismic-isolated intermediate floor system was adopted that could maximize the seismic energy absorption efficiency by means of the intensification of horizontal deformation occurring during an earthquake to the seismic-isolated floor.

Further, because the foundation structure located at both sides under railway lines cannot be linked to each other, redundant deformation capacity was secured for the framing to be able to resist the inland earthquake motion, which also led to the security of the entire building.

Minute Examinations for Exposed Braces

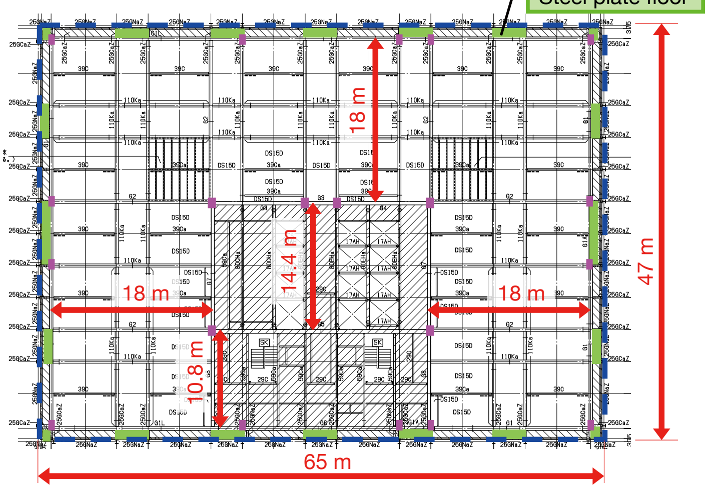
Aiming for a building that would serve as a landmark in Ikebukuro, a downtown area of Tokyo, a structural type was chosen that exposed the seismic-resistant brace outward. Further its appearance was designed so that bolt joints could not be seen due to the transfer of the brace axial force only by a web. In order to realize the maintenance-free application of exposed braces, hot-dip galvanized steel members were adopted. Thus, a building was completed in which the appearance design and structural rationality are well fused.

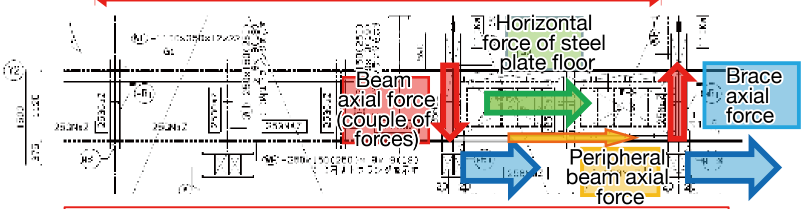
Minute examinations were extended in every process from detailed joint design to the manufacture and quality control of the seismic-resistant braces exposed to the exterior. In particular, advance examinations were extensively made for full-scale brace members: examination of full-scale model→test piece manufacture→hot-dip galvanizing→performance confirmation test. Every piece of knowledge obtained from these examinations was shared among construction companies, fabricators and those engaged in on-site work and applied in full to the construction to complete the DaiyaGate Ikebukuro with not only high seismic resistance but fine structural aesthetics.

Full view of DaiyaGate Ikebukuro

Framing Elevation at Standard Floor

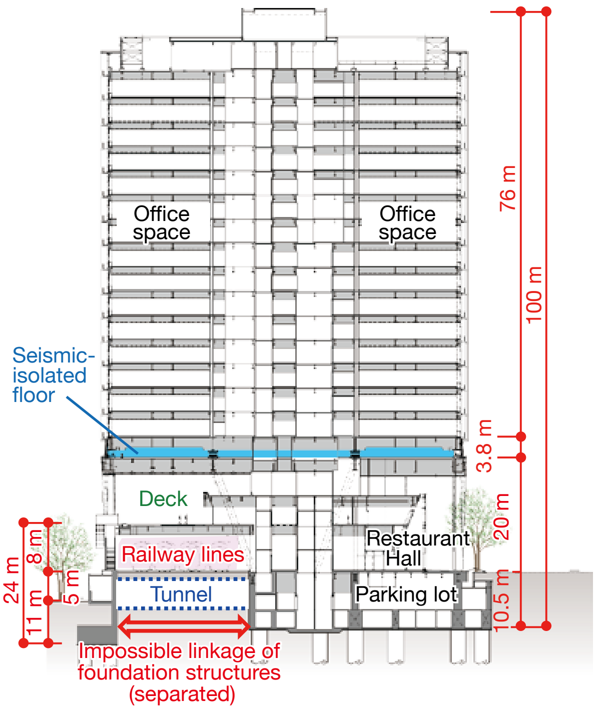
All seismic forces to be borne by outer framing braces; maximization of office space by the use of slender (400×400 square) and long-span inner columns





System to transfer inertia force from office space via steel plate floor

Cross Section Plan



Elasto-Plastic Analytical Program with Generalized Plastic Hinge for Steel Square Tube Column with Local Buckling

Prize winners: Kai Sakuma, Motohide Tada, Yurika Yasui and Seiji Mukaide

Motohide Tada
1982: Graduated from Graduate School of Engineering, Osaka University
1982: Entered NIKKEN SEKKEI LTD.
1989: Assistant Professor, Osaka University
2007: Professor, Osaka University

Targeting square steel tube columns that cause local buckling due to the application of axial force and biaxial bending, we have developed a program to analyze the cyclic elasto-plastic behavior of columns by the use of the generalized plastic hinge method, an outline of which is introduced below:

Reloading Behavior after Deterioration due to Local Buckling

The loading-deformation behavior of columns after local buckling was analyzed by means of shell element-applied finite element analysis. As a result, it was found that the deterioration lower limit for the relationship between the dimensionless bending moment (*m*) and the member end rotation angle (θ) can be specified by the use of the lower limit surface obtained by contracting the outer yield surface centering on the tension-side singular point as shown in Fig. 1. The *n* in the figure shows the dimensionless axial force.

Further, it was found that the cyclic behavior can be specified by contracting the yield surface centering on the tension-side singular point and then by slanting the base line on the *n* axis as shown in Fig. 2.

Updating Rule for Multiple Yield Surfaces

Based on the knowledge thus obtained, it was decided to specify an updating rule for the yield surface of the generalized plastic hinge model as in the following. Fig. 3 (a) shows an example of *m*-θ relationships, and Fig. 3 (b~g) shows the movement of the stress point on the corresponding *m*-*n* plane.

After arrival at the maximum strength at stage ②, the outer yield surface is contracted centering on the tension-side singular point and the base line on the *n* axis is slanted. After the outer yield surface contacts with the deterioration lower-limit surface at stage ④, *m*-θ point reaches stage ⑤ by setting the tangential stiffness at 0 and fixing the yield surface. At stage ⑥, the stress point reaches the yield surface at the *m*-axis negative side to cause re-yielding after the reversal of θ. During the course from stage ⑥ to stage ⑦ after re-yielding, the slanted base line is returned to the original position and the size of the yield surface is contracted. On this occasion, the yield surface is settled to surely pass point B in Fig. 3 (f).

Fig. 1 Lower Limit Surface

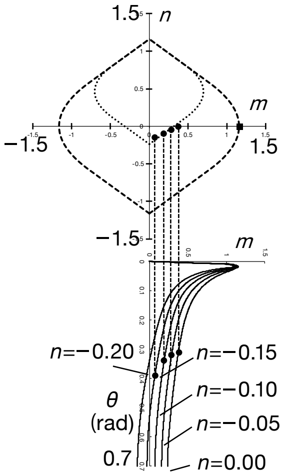
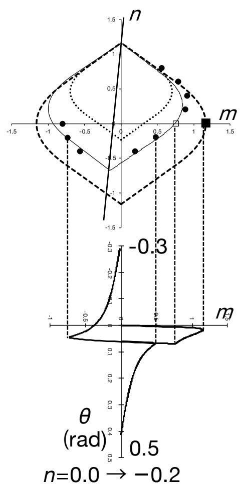
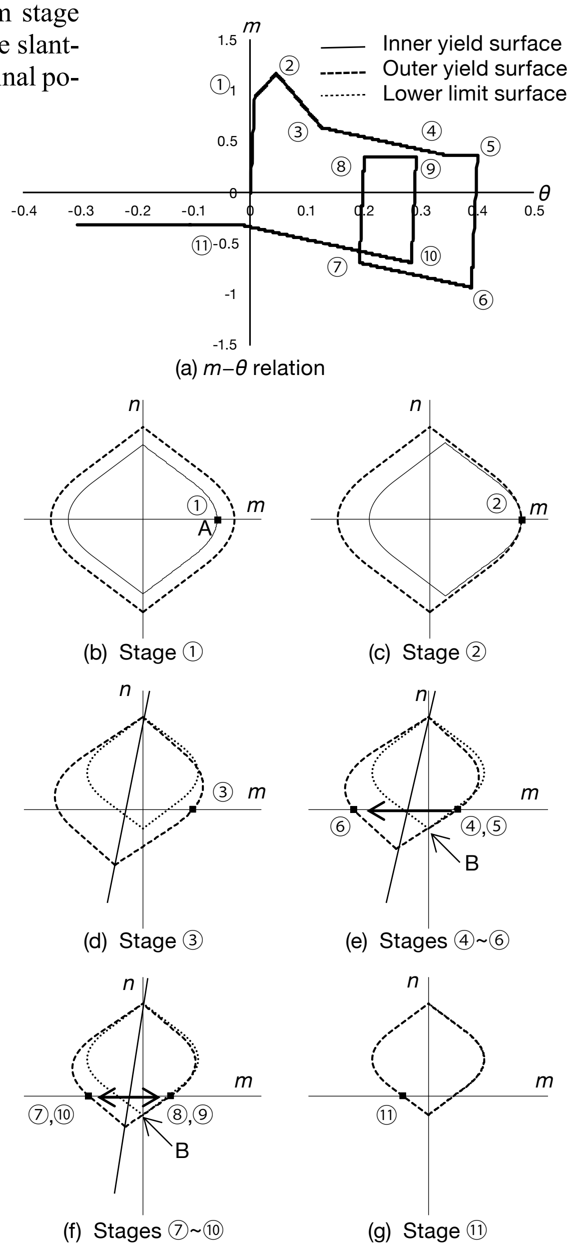


Fig. 2 Update of Yield Surface



In the prize-winning thesis, the behavior in which the space steel structure completely collapses due to an attack by a huge earthquake was analyzed using the generalized plastic hinge model.

Fig. 3 Update of Yield Surface Corresponding to *m*-*θ* Relation



Mechanical Properties of Steels for Bridge High Performance Structures Subjected to Heating and Cooling Processes Simulating Fire

Prize winners: Mikihito Hirohata, Daiki Teraguchi and Yasuo Kitane

Mikihito Hirohata
2008: Graduated from Doctoral Course, Graduate School of Engineering, Osaka University
2008: Specially Appointed Assistant Professor, Joining and Welding Research Institute, Osaka University
2011: Assistant Professor, Graduate School of Engineering, Nagoya University
2015: Associate Professor, Graduate School of Engineering, Nagoya University
2018: Associate Professor, Graduate School of Engineering, Osaka University

Steel Bridges Exposed to Fire

In the survey of damage conditions and degradation of steel bridges subjected to fire, it is important to assume the maximum heating temperature of the bridge members exposed to fire. It is reported that, in the case of the heating of general rolled steel products to 600°C, their mechanical properties after heating and cooling show no change. Accordingly, taking into account the safe-side allowance, the standard maximum heating temperature for which the survey of changes of mechanical properties is judged unnecessary is prescribed at 400°C for general rolled steel products.

High yield-point steel for bridge construction (SBHS: Steel for Bridge High Performance Structures) was standardized in JIS in 2008. Data on the mechanical properties of SBHS after being subjected to heating and cooling has not yet been prepared. Accordingly, in the case when SBHS with which high performance is imparted by means of thermo-mechanical control is subjected to thermal hysteresis due to fire, it is considered important to make it clear how its mechanical properties will undergo change.

Maximum Heating Temperature for SBHS

In this study, heating/cooling experiments (Fig. 1) and various kinds of material tests based on the assumption of fire heating and extinguishing in steel bridges were conducted for two grades of SBHS400 and SBHS500. In the case of air or water cooling after heating to 600°C, the mechanical properties nearly did not change compared to those before air or water cooling, as seen in Fig. 2. Under the condition of air or water cooling after heating to 900°C, the mechanical properties greatly changed, and there were cases in which the mechanical properties did not satisfy the values specified in JIS.

Based on the above results, examinations were made on the standard maximum heating temperature to judge whether or not a survey of changes in mechanical properties is required in cases when steel bridges employing SBHS400 and SBHS500 are subjected to fire, which led to a maximum heating temperature likely to be applicable of 400°C for SBHS400 and SBHS500 as with general rolled steel products.

Fig. 1 Appearance of Heating Experiment

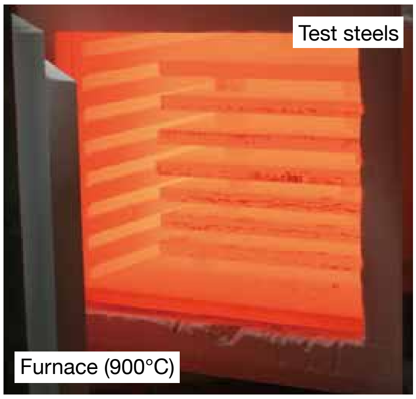


Fig. 2 Strengths of SBHS400 with Heating and Cooling

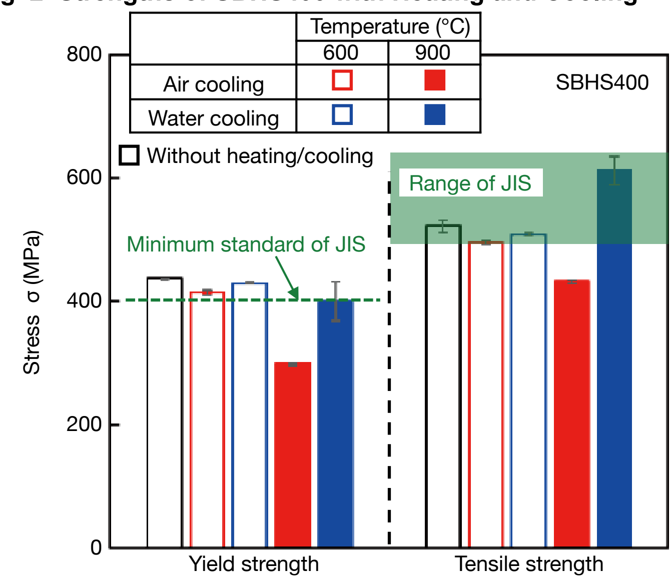
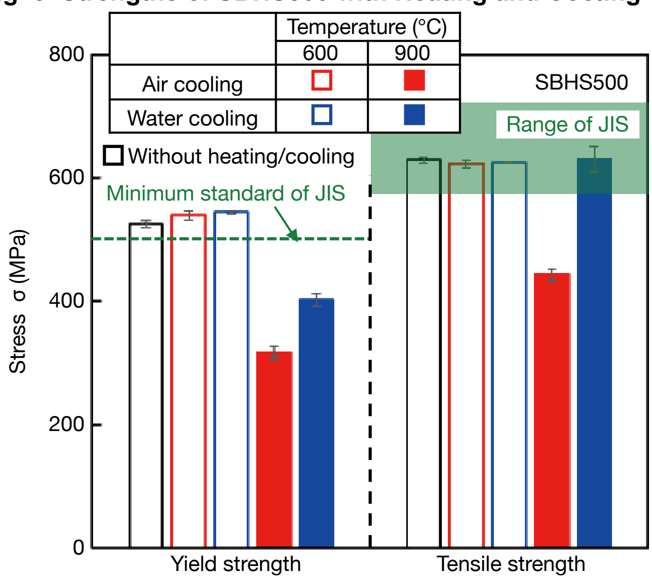


Fig. 3 Strengths of SBHS500 with Heating and Cooling



Plastic Deformation Capacity of Pre-assembled Type Built-up H-shaped Beam by Submerged Arc Welding

Prize winners: Mototsugu Tabuchi, Tatsuya Nakano, Hayato Asada, Kohei Takatsuka, Tsuyoshi Tanaka, Ryuichi Shimura, Takao Fukumoto, Kazuhiro Toyama, Kazuhiko Kamakura, Seiji Fujisawa, Toshiomi Itatani, Yukihiro Shimano, Hideo Otsuka and Yasuo Ichinohe

Mototsugu Tabuchi
1971: Graduated from Graduate School, Kobe University
1995: Professor, Kobe University
2010: Professor Emeritus, Kobe University
Professor, Otemae University
2018: Retired from Otemae University

Preface

In this study, in order to prevent premature brittle fractures occurring in built-up H-shaped (BH) beams produced by means of submerged arc welding (SAW), we investigated the effect of the toughness of SAW metal on the plastic deformation capacity of BH beam connected with RHS column (Fig. 1). The study consisted of the following three parts:

Part 1: Mechanical Properties of the Fillet Weld Metal by One-pass Submerged Arc Welding

The toughness of SAW metal is guaranteed in JIS Z 3183, for which multi-layer multi-pass welding is used as shown in Fig. 2 (a). Meanwhile, SAW used for producing BH beams is one-pass fillet welding (Fig. 2 (b)), and accordingly, as shown in Fig. 3, the toughness of the SAW metal changes depending on the kind of fluxes applied, and further the toughness of one-pass fillet welding ($_vE_0$) is lower than that obtained from JIS testing methods.

Part 2: Full-scale Sub-assemblage Tests

A total of 16 full-scale test specimens, which were prepared by changing the beam section to 3 kinds (t_w/t_f=25/36, 16/25, 9/16) and the toughness of the SAW metals to 3 kinds, were tested under a constant cyclic loading (θ/θ_p=3).

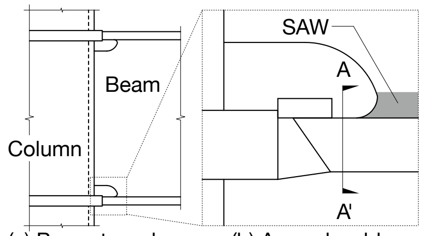
The typical fracture mode of the beam end is as follows: The strain-concentrated point is formed in the SAW metal as shown in Fig. 4, and the ductile crack develops from that point to cause the fracture of the beam flange.

The fracture mode can be classified depending on the toughness of the SAW metals. In the case of low toughness (Fig. 5 (a)), the ductile cracking that occurs in the strain-concentrated point transforms to a brittle fracture within the SAW metal. Meanwhile, in the case of high toughness (Fig. 5 (b)), the ductile cracking develops into the beam flange base metal. Further, the ductile cracking that occurs in the inferior-penetrated weld tip does not constitute a direct cause for fracture.

Part 3: Relationship between Plastic Deformation Capacity and Toughness

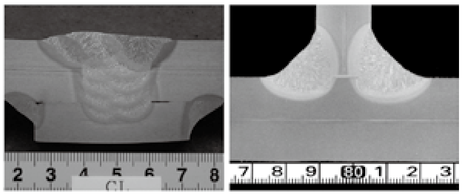
Fig. 6 shows the relationship between the fracture cycle (N_f) and Charpy absorbed energy of the SAW metal ($_vE_{test}$). As $_vE_{test}$ becomes larger, N_f becomes larger, which reveals that in cases when $_vE_{test}$ is about 30 (J) or lower, it is impossible to satisfy the plastic deformation capacity N_f≒5 required for the beam end of a high-rise building to possess.

Fig. 1 Detail of Beam-end Connection



(a) Beam-to-column connection (b) Around weld access hole

Fig. 2 Macro Photo of SAW Metal



(a) Deposited metal in JIS (b) Fillet weld of BH beam

Fig. 3 Toughness of SAW Metal

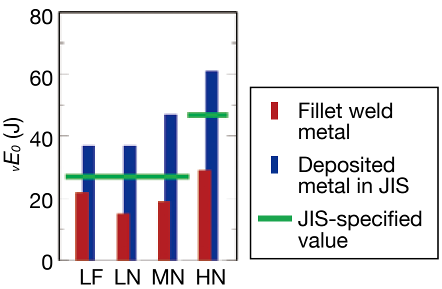
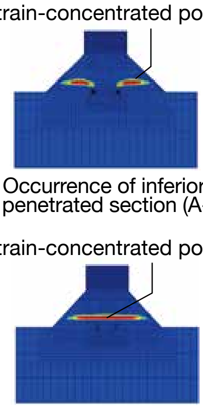


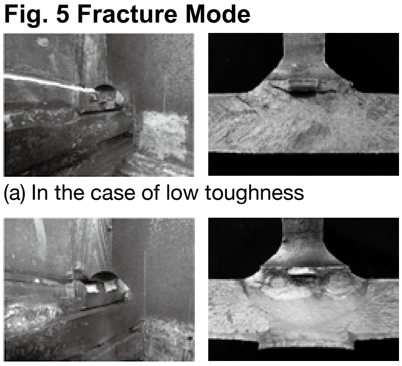
Fig. 4 Strain-concentrated Point



(a) Occurrence of inferior-penetrated section (A-A')

(b) No occurrence of inferior-penetrated section (A-A')

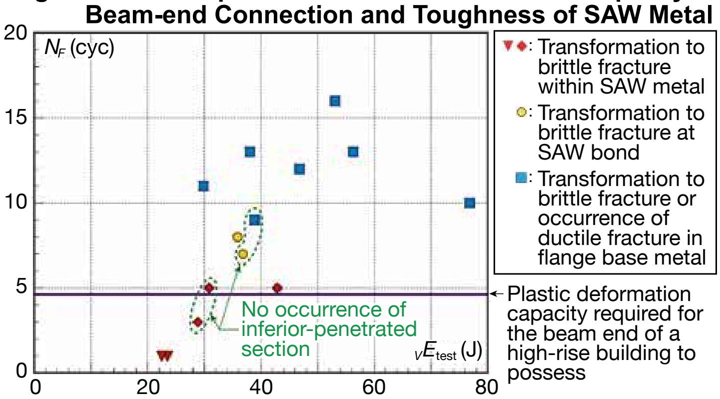
Fig. 5 Fracture Mode



(a) In the case of low toughness

(b) In the case of high toughness

Fig. 6 Relationship between Plastic Deformation Capacity of Beam-end Connection and Toughness of SAW Metal



A Series of Studies on Repairs to Low-rise Braced Structures after Disasters

Prize winners: Shotaro Nakada and Shoichi Kishiki

Shotaro Nakada
2017: Graduated from the Faculty of Engineering, University of the Ryukyus
2019: Enrolled in a doctoral course, School of Environment and Society, Tokyo Institute of Technology
2020: Research Fellowship for Young Scientists (DC2), Japan Society for the Promotion of Science

Study Purposes

Because gymnasiums are used as emergency public shelters in the event of a disaster, the securement of its seismic performance is an important task for disaster prevention. Meanwhile, even when braces avoid its serious damage such as fractures of joints, damage such as residual deflection due to plastic deformation is observed, and thus many examples have been reported in which gymnasiums employing such the damaged structure have not been applied for emergency public shelters.

In this study, for turnbuckle braces, the relationship between the scale of aftershocks and the response deformation/repair effect was investigated by numerical analysis. And then, the repair method by means of turnbuckle retightening was established through structural experiments.

Study Results

At first, setting the peak ground velocity (*PGV*) as the parameter for seismic ground motion, examinations by means of seismic response analysis were made of the following two items: the scale of aftershocks and need or no need for repair; and the effect of the repair including partial repair on deformation reduction. Fig. 1 shows the relationship between the scale of aftershocks and the braces repaired for reducing deformation. The vertical axis in the figure indicates the ratio of the repaired brace to all braces, and the horizontal axis the ratio of the *PGV* of aftershocks to the *PGV* of mainshocks. The solid line in the figure shows the upper-limit value obtained based on all analysis results.

It was found from the analysis results that in cases when most of aftershocks are roughly 20% or lower than the mainshock in terms of scale, the response deformation of aftershock does not increase compared to that of the mainshock and thus urgent repair is not required. Further, it was found that when the scale of aftershocks is more than 20% that of mainshocks, prompt repair is required and that when the scale of aftershocks is about 54% or higher than that of the mainshock, all turnbuckles should be retighten.

Next, a structural experiment was carried out to establish repair method by retightening of turnbuckles (Fig. 2). For the hysteresis curve after retightening (solid line in Fig. 3), slip behavior due to damage was eliminated and the hysteresis curve after retightening almost exceeded that at the stage of damage loading (broken line in Fig. 3). It was confirmed that the repair method by means of turnbuckle retightening is useful.

In addition, the retightening workability was investigated, through which it was experimentally made clear that damage of the screw section due to cyclic plastic deformation was not caused and stabilized retightening workability was thus obtained.

Fig. 1 Relationship between the Scale of Aftershock and the Repair that Can Suppress Deformation

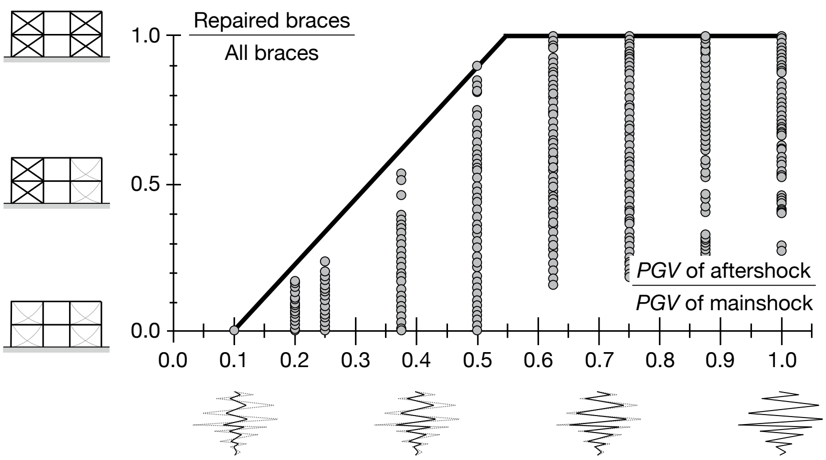


Fig. 2 Setup of Structural Experiment

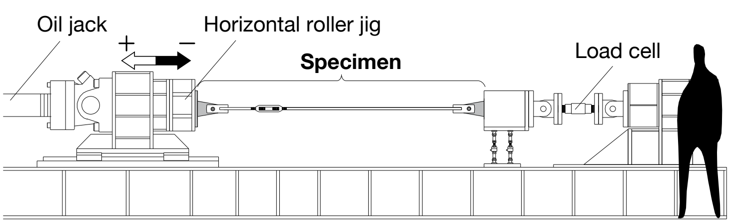
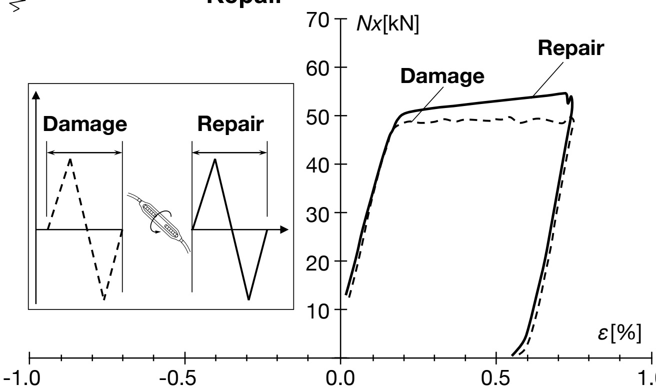


Fig. 3 Effect of Turnbuckle Retightening on Repair



The First IABSE Online Conference 2020

by Shunichi Nakamura, Tokai University, Vice President of IABSE

The whole world has suffered the COVID-19 pandemic, which has affected almost everybody. It has changed the IABSE events planned for the year 2020. To cope with such circumstances, IABSE (International Association for Bridge and Structural Engineering) organized the First IABSE Online Conference 2020. The conference was held on September 2-3 on Zoom. The Japanese Group of IABSE organized this conference with the Chinese and Korean Groups. Prof. Y. Ge (President of IABSE) made a welcome address at the opening session. The Japanese Society of Steel Construction serves as a secretariat of Japanese group of IABSE.

Facing the New Age!

The conference main theme was 'Facing the New Age!—How do structural engineers tackle the COVID-19 era?,' which is the urgent and serious matter the structural engineers must consider. In the keynote sessions four distinguished experts presented their views on this main theme. From Japan, Prof. Koichi Kato (The University of Tokyo, Architectural Historian) presented "Construction in the History of Social Change—Learning from Epidemic in Late Medieval Europe." He reviewed what happened to the construction activities in the Black Death Period and discussed the matter of construction after COVID-19 society from the long-term viewpoint. Other keynote speakers were Mr. Klaus Ostenfeld (Former President of IABSE), Dr. Liming Yuan (Central-South Architectural Design Institute), and Prof. Young Sang Kwon (Seoul National University).

The conference adopted four sub-topics: T1: Recent extreme events on infrastructures, T2: AI-based monitoring and maintenance of infrastructures, T3: Development of long-span cable supported bridges, and T4: Digital inclusion in structural engineering. A total of 16 international experts presented the latest technologies and research at the Topic Sessions.

Four experts from the Japanese Group made presentations. For Topic-1, Prof. S. Fujikura (Utsunomiya University) talked on "Field Investigation and Restoration of Damaged Bridges in 2016 Kumamoto Earthquake" and Prof. K. Nishijima (Kyoto University) presented "Disaster of buildings caused by Typhoons Jebi and Faxai." For Topic-2, Prof. P-J Chun (The University of Tokyo) presented "Application of AI and data platform to infrastructure maintenance and its future prospects." For Topic-3, Dr. H. Kanaji (Hansin Expressway) presented "Conceptual and Schematic Design of a Multi-span Cable-stayed Bridge in Kobe." For Topic-4, Prof. T. Nagayama (The University of Tokyo) presented "Monitoring taking advantage of and materializing digital twins."

Successful Online Conference

The whole conference was operated in the zoom webinar mode. Presentations were all pre-recorded. At the sessions, the chair introduced the recorded presentations and the Q&A sessions were conducted live. The audience sent the questions to the Panel (the session chairs and the presenters) using the Q&A function. The presenters answered aurally and discussions were conducted between the presenters and the audience. Questions came from not only China, Korea and Japan but also from Europe, America, India, Oceania and so on. The Q&A sessions were very active and lively. The whole procedures went smoothly and efficiently.

The recent structures were introduced at lunch time. From Japan, Large rehabilitation project of the Metropolitan Expressway, Mukogawa Bridge, Tokyo National Sports Facilities, Tainan Art Museum were shown.

We adopted a new style of international conference, remote and online system. This was a real challenge. A total of 330 people registered in the conference and, in addition, the Chinese Group of IABSE had 219 local participants. The maximum number of live participants was over 400, which was over our expectation. This online conference is a success and would be a promising style for the future IABSE activities.

Prof. Y. Ge, President of IABSE

Q&A with Prof. K. Kato (Keynote Speaker) with Prof. S. Nakamura (Chair)

Topic Session 1: Prof. S. Fujikura, Prof. K. Nishijima (Invited Speakers) with Prof. H. Katsuchi (Chair)

Topic Session 2, 3, 4: Prof. S. Chun, Dr. H. Kanaji and Prof. T. Nagayama (Invited Speakers)

Program to Foster Steel Construction Engineers

The Japanese Society of Steel Construction has carried out a "Program to Foster Steel Construction Engineers" since 2009. Its main aim is to foster young engineers with a career of several years after joining companies and for the succession of steel construction technologies. In addition to lectures delivered by learned persons and those working in the practical steel construction field, study courses and site tours are also held.

The number of participants to the program has surpassed 26,000 over the past 12 years. This fostering program has gained a high reputation from JSSC member companies as a good opportunity for backbone engineers to obtain knowledge useful in taking a steady leap forward.

In 2020, two study courses for the practice of high-strength bolt joining, two study courses for the practice of welding, and three site tours each to civil engineering project, building construction and steel-frame fabricator.

Among these programs was an on-site tour to the "Seismic Retrofitting of the Kamihirai Flood Gate" that appeared in issue No. 59 (April 2020) of *Steel Construction Today & Tomorrow*. In this regard, JSSC received comments from participants such as—"We were able to understand that, because the gate is equipped with an opening/closing system and other facilities peculiar to the flood gate, it is necessary to acquire not only knowledge about steel-frame fabrication and erection involved in bridge construction but knowledge about electrical systems" and "Because the gate is an infrastructure facility needed in the event of a disaster and in case of emergency as well, the doubled and redoubled failsafe functions are provided with an opening/closing system, and thus we were deeply impressed by a high technical level of the gate."

Site tour to Kamihirai Flood Gate

JSSC International Committee

Message from Chairman

by Hiroshi Katsuchi, Chairman, International Committee (Professor, Yokohama National University)

The Japanese Society of Steel Construction (JSSC) has conducted a wide range of activities in the form of surveys, research and technological development aimed at promoting the spread of steel construction and improving associated technologies, and at the same time it has extended cooperation to related overseas organizations. Aimed at spreading Japan's steel construction technologies and developing overseas markets, the JSSC's International Committee was responsible for issue No. 61.

Issue No. 61 features "Natural Disasters: Restoration and Countermeasures," in which four examples are introduced—the short-term restoration of Kansai International Airport Access Bridge from a tanker collision due to typhoon winds, inland earthquake countermeasures adopted for buildings, countermeasures against natural disasters on railways and emergency bridges for temporary use for flown-out bridges.

In addition, this issue introduces the JSSC commendations for outstanding achievements in 2020 in the field of steel construction and thesis. As a special article on stainless steel, the Fukuoka Lawyer's Hall is introduced that applies finely-polished stainless steel for exterior and interior finishing.

As for JSSC activities, the First IABSE Online Conference 2020 organized jointly by Japanese, Chinese and Korean groups is introduced. Diverse programs to foster steel construction engineers, carried out in 2020, are reported.

We hope for a fast recovery from COVID-19 and the revisiting of the security and development of society. We would also like for everyone to understand the activities of JSSC and at the same time we would like to hear your opinions at any time.

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