

STEEL CONSTRUCTION

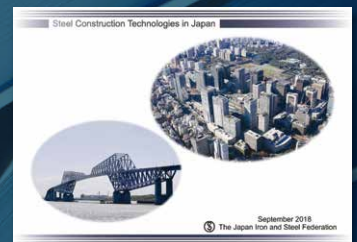
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Feature Article

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Steel Construction Technologies in Japan



Published Jointly by



The Japan Iron and Steel Federation



Japanese Society of Steel Construction

Performance-based Infrastructure Asset Management and Design Specifications for Road Structures

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Performance-based Infrastructure Asset Management

On the road, when any defect occurs in road structures such as tunnels and bridges, a serious hindrance is likely to occur in the function of road networks. That is, the physical performance of road structures needs to be managed to ensure traffic and other road functions. In light of this, the primary aim required for road infrastructure asset management is to optimize the condition of each road structure in order to ensure road function to the required level. (Refer to Figs. 1 and 2)

"Infrastructure management by means of the optimization of the physical performance of structures incorporated in the infrastructure system from the perspective of the infrastructure system's functionality and contribution to society"—the author calls this "performance-based infrastructure asset management (for road structures)" (referred to as PBIAM). This article discusses the concept of PBIAM and tasks for its practical application.

Relationship of Performance between Roads and Road Structures

For the practical application of PBIAM, two tasks are required—firstly, it is required for PBIAM to be able to estimate the physical performance of the road structures, each of which has significantly different characteristics but all of which support an identical road function, at any given time using the same evaluation indicators that can be relatively compared regardless of their age, thereby enabling PBIAM to prioritize and optimize the content of measures such as repair and reinforcement; and secondly, it should be ensured for PBIAM that performance assignment during construc-

Fig. 1 Structures to Support Road Functions

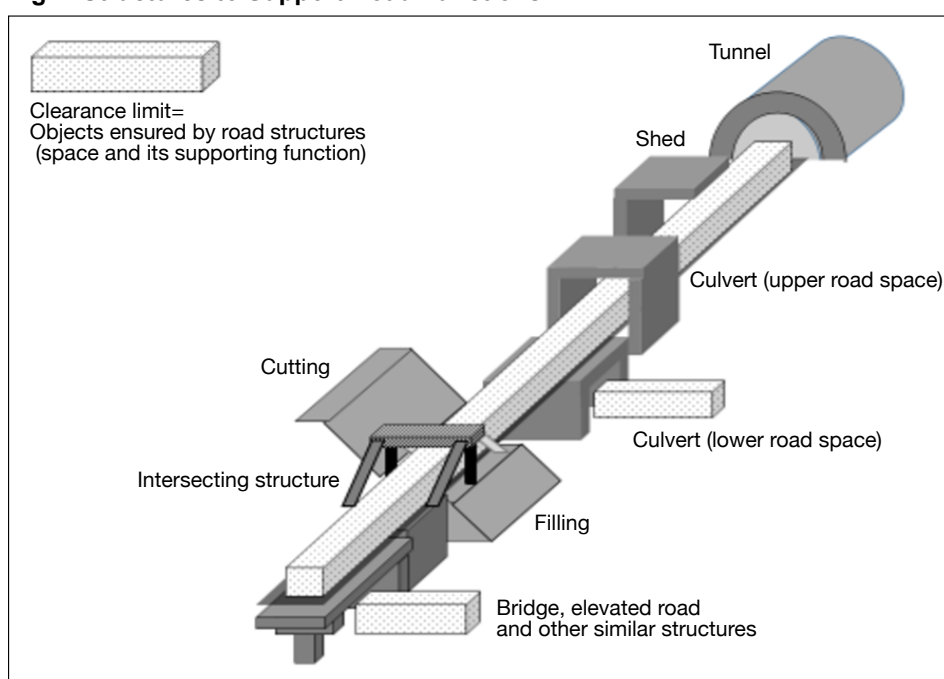


Fig. 2 Performance of Roads and Performance of Structures

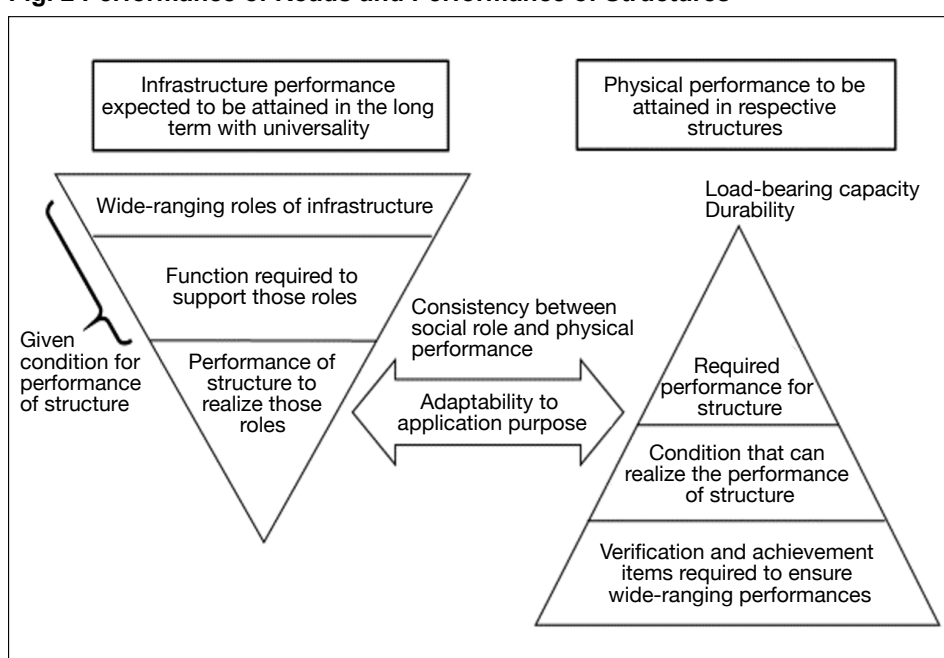
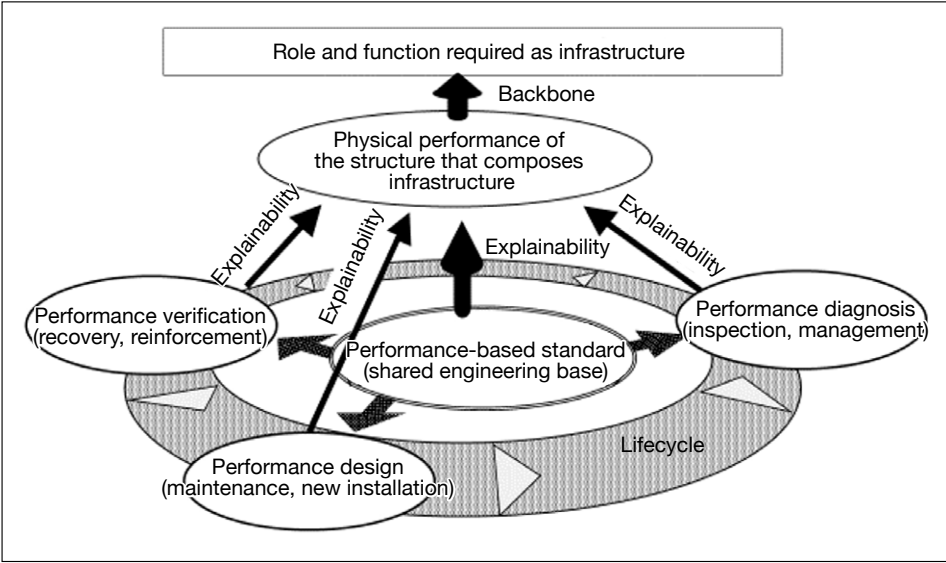


Fig. 3 Adjustment of the Performance of Structures to Support Infrastructure



tion, performance diagnosis at the maintenance phase, and the estimation of performance recovery effects during repair and reinforcement are all carried out on an identical engineering basis so that the performance of all road structures can be compared as accurately as possible. (Refer to Fig. 3)

In structures such as road bridges, the target load-bearing capacity is put into effect by suppressing the stress, displacement and other responses caused by anticipated actions such as seismic motion and automobile running while in-service to an allowable range from the aspect of their effect on the road performance.

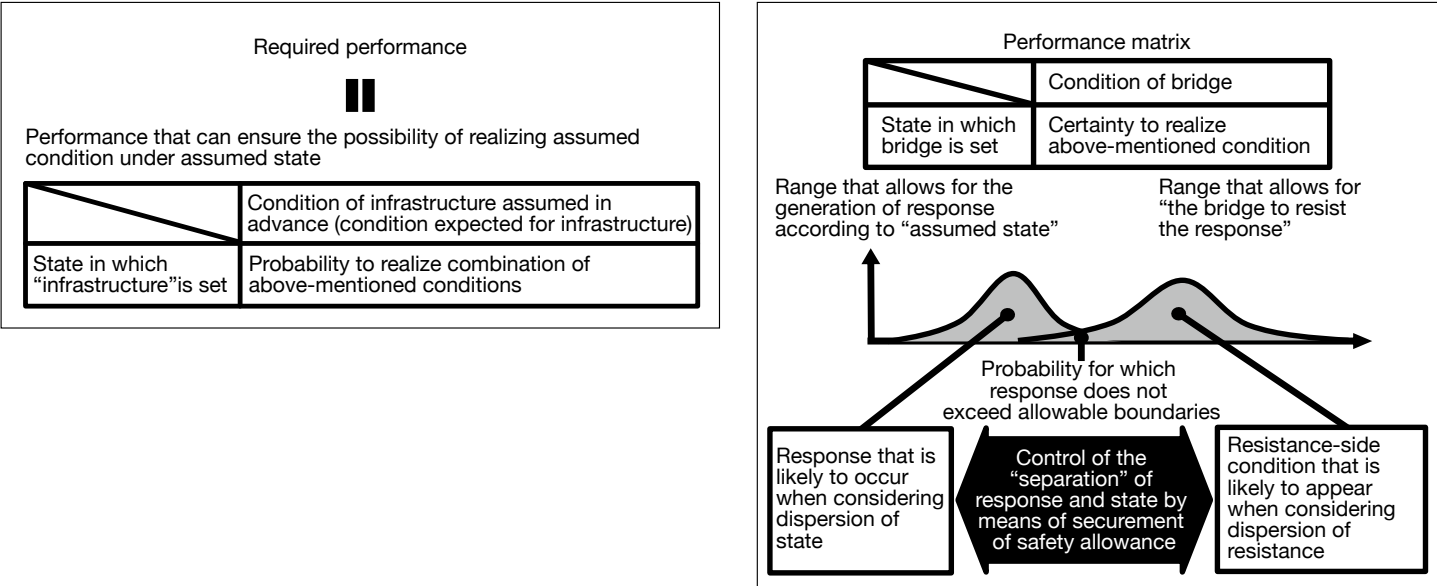
Meanwhile, the design standard of road structures in Japan has been prepared with design concepts and specification methods that are different for each kind of road structure, and thus the methods to specify load-bearing capacity and to verify expected performance differ according to the kind of road structure. As a result, it is difficult to compare the load-bearing capacity of different kinds of road structures, whether existing or newly constructed.

Performance-based Design Standards for Road Bridges

As the method for estimating the load-

bearing capacity of structures such as road bridges, it is considered universal, highly explainable and efficient to assess the possible condition of the structure in its assumed state of application as its performance. Particularly in Japan, roads repeatedly suffer natural disasters such as earthquakes and typhoons. In light of this, it is important from the viewpoint of explainability to the general public to assess the performance level required in the design standards for roads using an easily understandable representation method in terms of the relationship between the practical states and practical conditions of road bridges. (Refer to Fig. 4)

Fig. 4 Required Performance in Performance-based Standards



Given this, aiming at practical application of PBIAM, the road bridge design standard (Japanese Design Specifications for Highway Bridges published by the Japan Road Association, referred to as JDSHB) has been converted to a performance-based design standard ahead of that of other road structures, for which continued improvements are underway. Another aim in this conversion is to clarify the relationship with the performance levels ensured for road function in the JDSHB.

There are innumerable combinations of load types and their magnitudes that may act on a highway bridge during its long design service life. Therefore, in the design of road bridges, the states to be considered are classified into three main domains according to their peculiar characteristics, and then the design load is specified that is selected so as to cover as much as possible the design states that will have a dominant effect on the structure in each category. The JDSHB specifies that design states are assessed by classifying them into domains ① to ③ as shown in Fig. 5.

In assessing the load-bearing capacity of a bridge, the performance characteristics peculiar to each component, which are guaranteed to allow a one-by-one response to the magnitude of the action with a required level of reliability, are applied to verify whether the condition of the component remains within an acceptable range under the anticipated actions. If it is possible to guarantee that, while the state of a component continuously changes as the load increases, it always returns to the predicted state, and if it is possible to confirm that the response to a certain load does not exceed the allowable limit, then it is possible to guarantee that the response will not exceed the allowable limit even when smaller loads act. (Refer to Figs. 6 and 7)

In the design of road bridges, there are many choices in terms of the type of structure and other conditions. Thus, in order to make it possible to devise a method according to a great variety of bridge-erection conditions and scales, while ensuring that a minimum-level of satisfactory load-bearing capacity is achieved in the design standard, it is also necessary not to unnecessarily restrict freedom in the selection of structural types and materials.

With an intention of a higher level of achievement for these two conflicting requirements in the design standard, the

Fig. 5 Concept of Classifying Design States

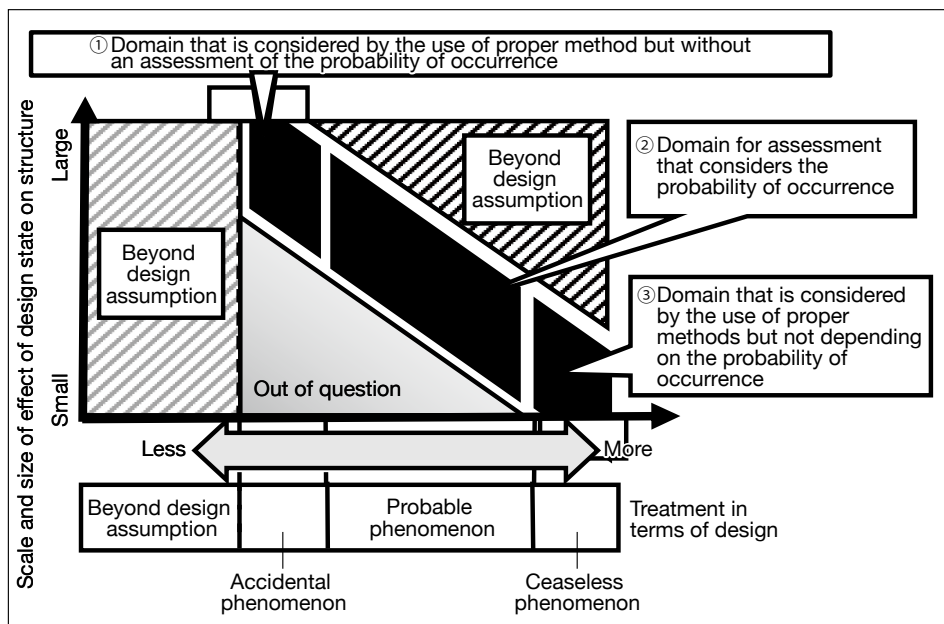


Fig. 6 Performance Curve Image

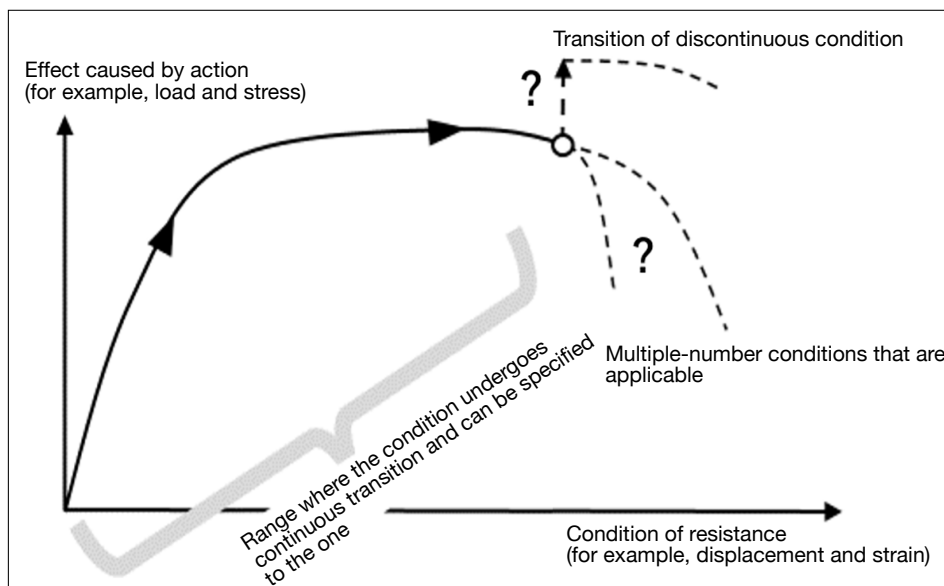
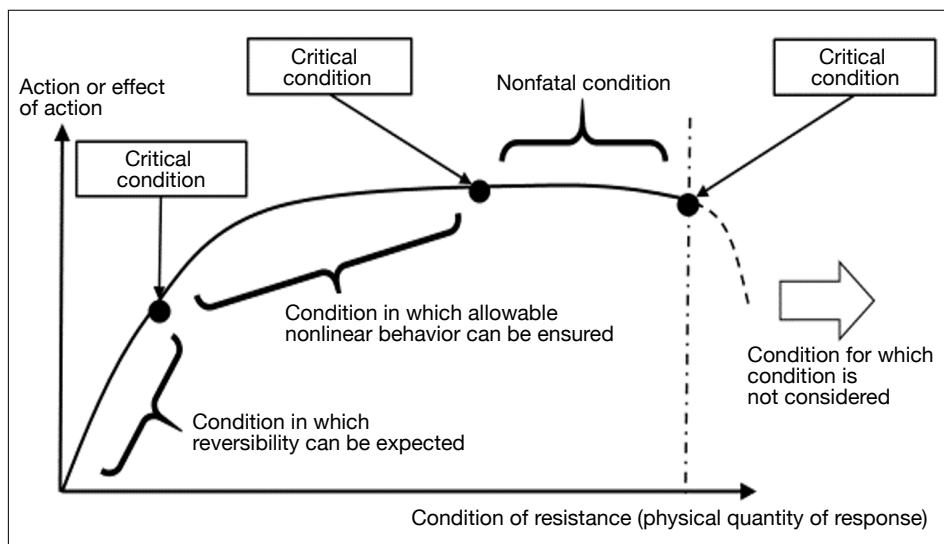


Fig. 7 Relationship between Condition and Critical Condition



JDSHB recommends the following concept. Specifically, based on the structural configuration characteristics common to bridges, the bridge is conceived as a structure composed of three structural elements with different roles—superstructure, substructure and superstructure-substructure connecting structure, and in the assumed design state, it is required for the bridge to remain in a condition of whether the role and function to be borne by these respective structural elements are satisfied or not. Accordingly, if it is ensured that the condition to be provided for the entire bridge is satisfied, it is allowed for ingenuity to be provided with regard to the kinds of structural type and members to be selected in order to realize these three structural elements. (Refer to Figs. 8 and 9)

As time elapses, the condition of infrastructure changes due to deterioration and other factors. Given this, in order to ensure that the load-bearing capacity of the bridge will be maintained to the expected condition in the event of large loads that are difficult to predict during the design service life, it is also necessary to guarantee that the component dimensions, which were considered as a prerequisite in the evaluation of the load-bearing capacity, will be maintained over the target period.

The JDSHB considers this concept as durability and requires its verification as a premise for load-bearing capacity (Fig. 9). Incidentally, because it is considered acceptable to forecast the replacement of members during the member service period, the target period for durability may be set separately for each member from the design service period of bridge.

Digital Management of Infrastructure Assets

Decision-making in public property management requires a high level of transparency and explainability. However, because there are so many factors that affect the deterioration of structures that make up the infrastructure, it is inevitable that the estimate of their deterioration rate and future load-bearing capacity will vary widely. In managing infrastructure assets that face such problems, it is expected that the use of digital technology may improve the quality and the explainability of decision-making.

Evolving digital technology is rapidly removing the restrictions on the

Fig. 8 Example of Breakdown of Structural Elements to Carry Load-bearing Capacity in Bridge

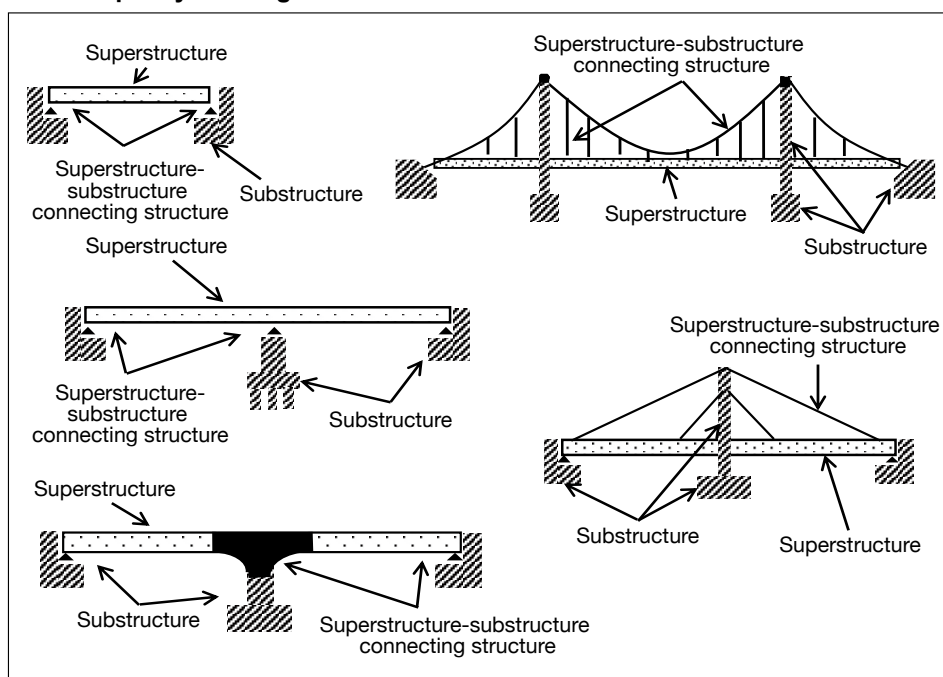
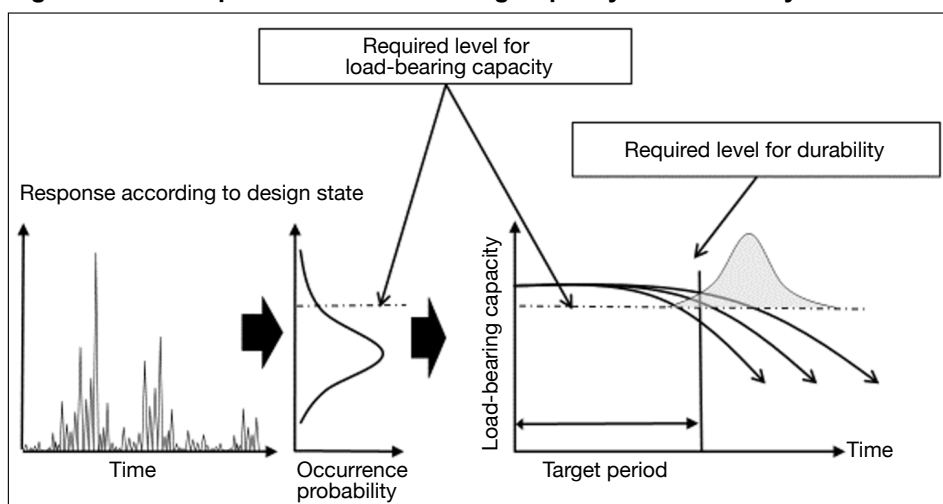


Fig. 9 Relationship between Load-bearing Capacity and Durability



amount of information that can be handled, thereby making comprehensive monitoring and constant status monitoring easier. In addition, it is certain that increasingly-sophisticating AI and data processing technologies will gradually make it possible to reveal differences in the characteristics of infrastructure and the trends/patterns of changes in infrastructure status that are currently impossible to detect or recognize.

When considering that the primary objectives of infrastructure asset management, namely “risk reduction” and “avoiding fatal personal injury,” are ultimately based on probability theory, effective application of the probability information backed by a vast amount of data has the potential to substantially improve the quality of decision-making and greatly improve infrastructure asset management.

In large-scale infrastructure facilities such as bridges, the following three tasks apply to structural optimization: limitations of full-scale reproduction, limitations of reproducing design conditions, and limitations of reproducing

the actual state of structures. For example, even by the use of world-class loading test equipment, there are many cases in which experiments on infrastructure facilities such as road bridges can only be performed on partial facilities or on scaled-down models. In addition, for civil engineering structures in which the effect of gravity is dominant, while centrifugal loading test is conducted to satisfy the similarity rule, but when the only test specimens that can be used are extremely small and scaled-down models, there remains a limitation to the reproduction of performance. (Refer to Photo 1)

As for the deterioration phenomenon of infrastructure, while the chemical action-induced degradation of material performance and chain of physical collapses like fatigue cracking are known, micro phenomena are dominant in both cases and their degradation mechanisms have not yet been fully clarified. As a result, countermeasures against deterioration have been entrusted to empirical approaches.

On the other hand, the progress of

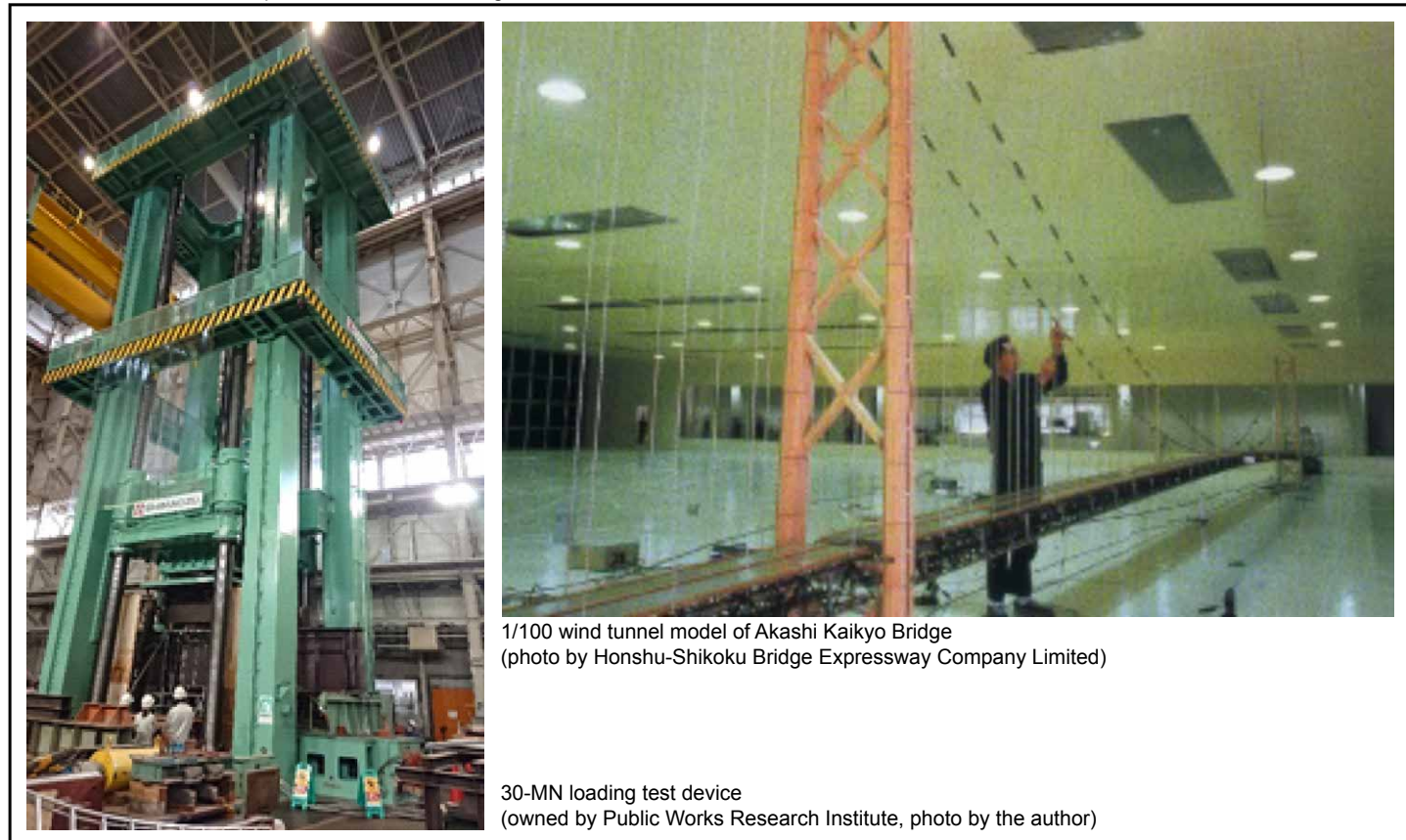
digital and other advanced technologies is making it possible to structure detailed analytical models for the minute reflection of characteristic features of materials and grounds, to minutely observe the microstructure of civil engineering structural materials, to observe the fine particle- and molecule-level material change and responses, and to generate high-resolution numerical analysis models using image data thus obtained (Photo 2).

Capitalizing on the high-resolution and faithful expression of the behaviors and numerical modeling of physicochemical properties employing advanced digital technologies, it should become possible to perform highly-reliable full-scale simulations that faithfully reflect degradation mechanisms in a cyber space. To that end, expectations are high for infrastructure asset management based on highly-reliable forecasts of the future to attain rapid progress.

Towards the Practical Application of PBIAM

In infrastructure asset management, many trials have been made aimed at estab-

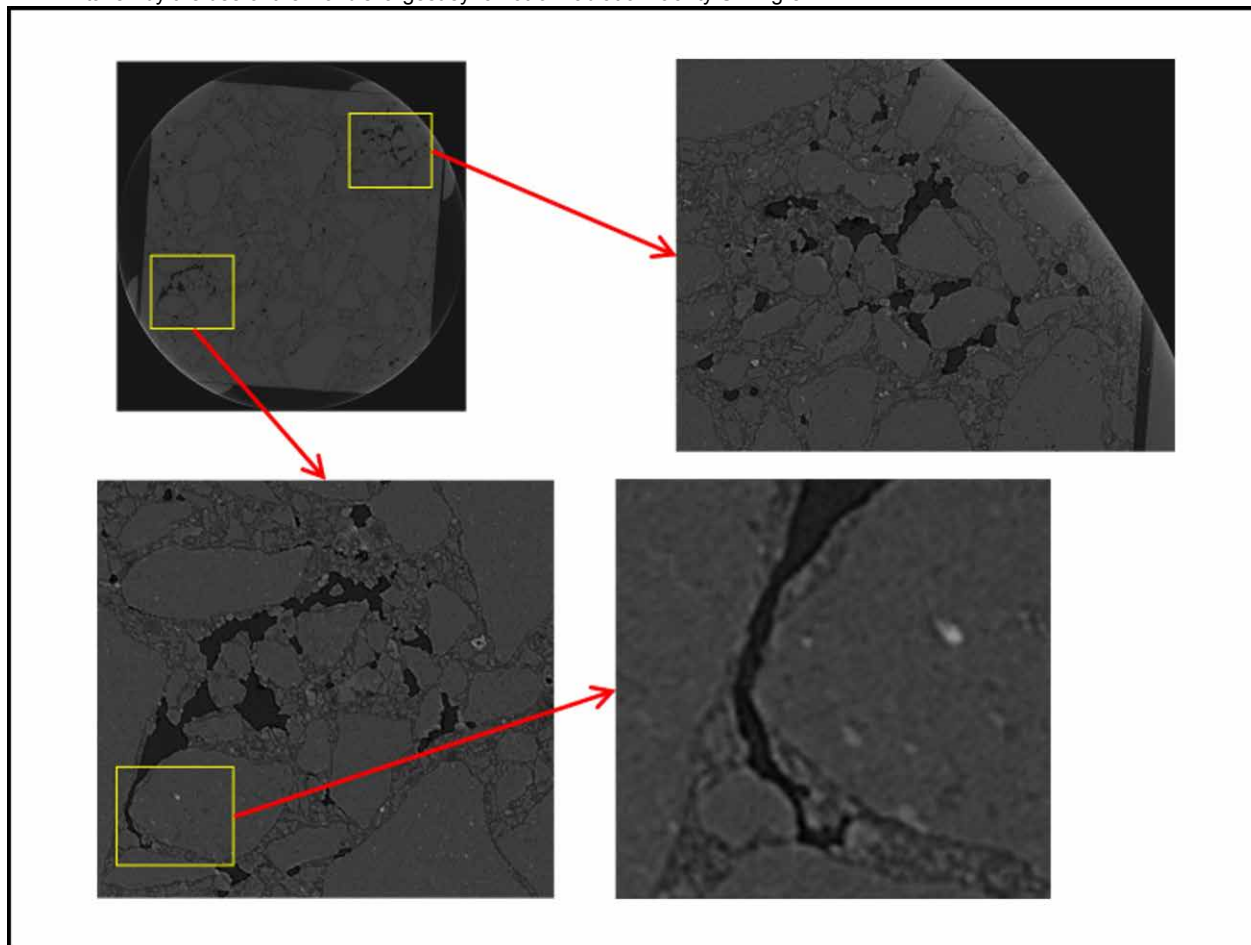
Photo 1 Large-capacity loading test device and large-scale wind tunnel/wind tunnel model used to assess the performance of road bridges



1/100 wind tunnel model of Akashi Kaikyo Bridge
(photo by Honshu-Shikoku Bridge Expressway Company Limited)

30-MN loading test device
(owned by Public Works Research Institute, photo by the author)

Photo 2 X-ray CT image showing the crack development characteristic of asphalt pavement, taken by the use of the world's largest synchrotron radiation facility SPring-8



lishing a deterioration forecast approach using the statistical analysis of past inspection data. However, in the case of road bridges, for which the location environment and structural characteristic greatly differ one by one, it is difficult to secure the amount of relevant population data, and thus a highly-reliable deterioration prediction technology has not yet been established. To that end, the accumulation of data by making full use of digital technologies offers the potential to improve this situation. However, digitalization has another aspect of permanently throwing away a vast amount of information so far accumulated in exchange for the objectification and fixa-

tion of information, and accordingly its advantages and disadvantages should be carefully judged.

While the performance-based specification of design standards realizes the optimization of respective structures, it becomes difficult to secure relevant population data. As a result, reliable deterioration prediction by the use of a probabilistic statistical approach may become increasingly difficult.

For the practical application of PBI-AM—performance-based infrastructure asset management, it is necessary to ensure that all structures that support infrastructure functions maintain harmonized conditions by means of not only perfor-

mance control employing design standards but also maintenance level control employing management technology, while at the same time taking into account the technological development involved in infrastructure asset management.

Major Activities of the Research Committee on Structural Performance and Durability of Steel Bridges

Kazuo Tateishi

Chairman of Research Committee on Structural Performance and Durability of Steel Bridges (Professor, Graduate School of Engineering, Nagoya University)



Kazuo Tateishi: After finishing the master course at the Tokyo Institute of Technology, he entered East Japan Railway Company in 1988. Then, he served as associate professor at the Tokyo Institute of Technology and The University of Tokyo in 1997. He assumed his current position as professor of the Graduate School of Engineering, Nagoya University in 2003.

Long-term Research on Steel Bridges

The Japanese Society of Steel Construction has conducted surveys of and research pertaining to steel bridges as a commissioned project from The Japan Iron and Steel Federation. In light of this, it has established a series of research committees on steel bridges over the period from 1997 to 2025 (Table 1).

Beginning with the establishment of the first committee, the Research Committee on Next-generation Civil Engineering Steel Structures, the committee was repeatedly reorganized in response to changes in the technological environment such as the introduction of performance-based design, the diffusion of rationalized structures for bridges and demand for the higher resilience of steel structures. In this regard, the current Research Committee on Structural Performance and Durability of Steel Bridges is the eighth such committee.

After taking into account the needs arising in each respective period, these committees have issued tasks involved in steel bridges, tackled solving them, and accumulated research results to reflect these solutions in the design standards and other documents.

Research Committee on Structural Performance and Durability of Steel Bridges

In recent years, a social need is arising in the field of civil engineering—contributing towards maintaining the vitality of the national economy through levelling-up of preparations for increasingly stricter natural disasters and the implementation of steady recovery of functions of superannuated structures. In light of this, it is required to establish the technologies conducive to maintaining the function of

structure such as damage control provided for unexpected situations and the realization of resilient structures, to keeping structural functions over a long period and

to recovering structural functions which have deteriorated due to superannuation.

In the field of steel bridges, diverse tasks are emerging—preparations for a mega-

Table 1 Chronology of Research Committees on Steel Bridges

| FY | Research Committee | Working Group |
|-----------|---|---|
| 1997-1999 | Research Committee on Next-generation Civil Engineering Steel Structures | <ul style="list-style-type: none"> Working Group on Design of Rationalized Steel Bridge Girders Working Group on Seismic Design Method for Steel Bridges Working Group on Application of High-performance Steel Products for Steel Bridges |
| 2000-2002 | Research Committee on the Performance-based Design of Steel Bridges | <ul style="list-style-type: none"> Working Group on Safety and Applicability of Steel Bridges Working Group on Corrosion Protection and LCC for Steel Bridges Working Group on Seismic Resistance of Steel Bridges Working Group on Higher Performance of Steel Bridges |
| 2003-2005 | Research Committee to Improve Steel Bridge Performance | <ul style="list-style-type: none"> Working Group on Rationalized Design Methods Working Group on Improvement of Steel Bridge Durability Working Group on Seismic Design Guidelines for Steel Bridges Working Group on Weathering Steel Bridges |
| 2006-2008 | Research Committee to Improve Performance and Reliability of Steel Bridges | <ul style="list-style-type: none"> Working Group on Rationalized Structure and Design for Steel Bridges Working Group on Fatigue Strength of Steel Bridges Working Group on Seismic Design Guidelines for Steel Bridges Working Group on Weathering Steel Bridges |
| 2009-2012 | Research Committee on Improvement of Structures and Design Method for Steel Bridges | <ul style="list-style-type: none"> Working Group on Rationalized Structure and Design for Steel Bridges Working Group on Fatigue Strength of Steel Bridges Working Group on Seismic Design Method for Steel Bridges Working Group on Weathering Steel Bridges |
| 2013-2014 | Research Committee on Improvement of Structures and Durability of Steel Bridges | <ul style="list-style-type: none"> Working Group on Rationalized Structure and Design for Steel Bridges Working Group on Fatigue Strength of Steel Bridges Working Group on Maintenance for Weathering Steel Bridges |
| 2015-2017 | Research Committee on Steel Bridges with Higher Resilience and Longer Service Life (1st Term) | <ul style="list-style-type: none"> Working Group on Rationalized Design Working Group on Fatigue Strength Working Group on Corrosion and Durability |
| 2018-2019 | Research Committee on Steel Bridges with Higher Resilience and Longer Service Life (2nd Term) | <ul style="list-style-type: none"> Working Group on Rationalized Design Working Group on Fatigue Strength Working Group on Corrosion and Durability |
| 2020-2022 | Research Committee on Structural Performance and Durability of Steel Bridges | <ul style="list-style-type: none"> Working Group on Structural Performance Working Group on Fatigue Performance Working Group on Corrosion and Durability |
| 2023-2024 | Research Committee on Structural Performance and Durability of Steel Bridges (2nd Term) | <ul style="list-style-type: none"> Working Group on Structural Performance Working Group on Fatigue Performance Working Group on Corrosion and Durability |

earthquake that is forecast to occur in the near future, countermeasures against natural disasters, which are becoming more intense, and the superannuation of many structures that constitute lifelines, and as a result, the performance requirements for structures is becoming diversified and more sophisticated. In such a situation, aiming at promoting research to meet these requirements, the Research Committee on Structural Performance and Durability of Steel Bridges was established within the Japanese Society of Steel Construction in 2020.

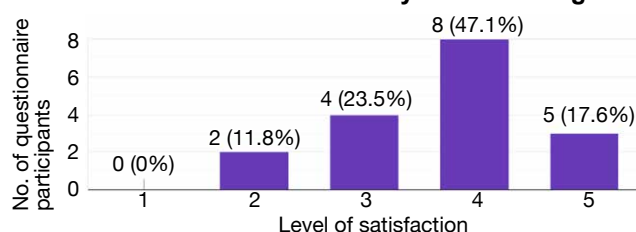
In order to take over the research results of the series of research committees thus far established and to further develop research activities, and by noticing the structural performance (load-bearing capacity, deformation performance) and durability (fatigue strength and corrosion resistance) of steel bridges, the Research Committee established three working groups—Working Group on Structural Performance, Working Group on Fatigue Performance and Working Group on Corrosion and Durability in 2020. Specific research activities were carried out by these working groups from 2020 to 2024. In the following pages, an outline of research results of the Working Group on Structural Performance and the Working Group on Fatigue Performance is introduced. The research results of the Working Group on Corrosion and Durability are introduced in the previous issue, No. 73, of *Steel Construction Today & Tomorrow*.

In the Research Committee on Structural Performance and Durability of Steel Bridges, its research period was set at five years, which was further divided into a former (1st; three-year) and a latter (2nd; two-year) terms. The 1st-term research accomplishments were reported in a whole version of three issues of *JSSC Technical Report*⁽¹⁻³⁾ published in 2023. In the 2nd-term research, various activities aimed at contributing towards the further improvement of technical standards through the accumulation of technological accomplishments during the 1st-term research and accurate response to emerging needs. The 2nd-term research accomplishments will also be reported in *JSSC Technical Report*.

High Assessment of Activities of Research Committees

As is common in conventional research committees, the Research Committee on Structural Performance and Durability of Steel Bridges has received many members from not only research institutes but also such entities as road and railway operating companies, the Japan Iron and

Fig. 1 Level of Overall Satisfaction with the Activities of the Research Committee on Structural Performance and Durability of Steel Bridges



Steel Federation, the Japan Bridge Association and the Japan Civil Engineering Consultants Association and has conducted research activities with a strong awareness of reflecting daily business practices.

The Research Committee is also open to the participation of many young engineers and researchers, and by holding repeated discussions about diverse steel-structure technologies between young engineers and mid-career engineers, the Research Committee has strived to contribute to improving the overall capability of engineers working in the field of steel bridges.

In order to confirm how far these intentions have been put into effect, the author conducted a questionnaire survey on the activities of the above-mentioned three Working Groups on the occasion of the end of activities of the current Research Committee on Structural Performance and Durability of Steel Bridges. Specifically, questionnaires were sent to those studying in the universities participating in the Working Group, and 17 replies were received.

In this questionnaire survey, the following three questionnaires were asked:

- Did the Working Group's activities contribute to the development of your research?
- Did you obtain useful knowledge and information from the Working Group's activities?
- Was the scope of your personal connection expanded through the Working Group's activities?

The author received affirmative replies from nearly all questionnaire participants, and therefore it is considered that a certain amount of research achievements have been made through the Working Group's activities in terms of activating exchange between engineers and improving the overall capability of engineers. On the other hand, to the question of "whether or not the Working Group's activities have contributed toward the increasing application of steel bridges," four negative responses were received.

Fig. 1 shows the questionnaire survey results regarding the level of overall satisfaction with the Working Group's activ-

ities. Only two questionnaire participants rated this level a "2" out of 5 (where "1" is unsatisfactory and "5" is satisfactory).

In the free comment page, some opinions were provided, including "it was difficult to select a research theme" and "collaboration between members of industry, government and academia was not always sufficient." In light of this, the author keenly realizes two important tasks—the concentration of available knowledge of industry, government and academia from the stage of setting practical research themes and the firm establishment of practical and high-impact research themes that will lead to the wider application of steel bridges.

In addition, there were opinions that, as the research period becomes longer, the research members tend to become fixed and that it is important to foster younger engineers. Further, it was pointed out that it was important to regularly reexamine the structure of research committees and their working groups.

Although some problematic opinions were suggested as shown above, a lot of high appreciation has been shown for the wide-ranging activities of a series of research committees including the current Research Committee on Structural Performance and Durability of Steel Bridges (see Table 1). Expectations are high for the successor research committee to attain further accomplishments in the future.

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Development of Next-step Technology for Bridge Performance Evaluation

Yoshiaki Okui

Chief of Working Group on Structural Performance, Research Committee on Structural Performance and Durability of Steel Bridges (Professor, Saitama University)



Yoshiaki Okui: After graduating from the Graduate School of Science and Engineering, Saitama University, he joined Kawasaki Heavy Industries, Ltd. in 1985. Then he served as associate professor at Saitama University in 1993 and visiting researcher at Delft University of Technology in Netherlands in 1996. He assumed his current position as professor at Saitama University in 2009. His areas of expertise cover structural engineering and bridge engineering.

In the 2nd-term research of the Research Committee on Structural Performance and Durability of Steel Bridges (refer to Table 1 on page 7), its Working Group on Structural Performance investigated the following research items:

- Flexural capacity of composite girders with partial shear connection
- Coupled buckling strength of H-shaped section members
- Application of high-performance steel to seismic design
- Study of expanding the application of composite girders
- Repair and reinforcement design and construction methods for steel members using CFRP
- Technology to integrate monitoring data and models

Due to limited space, only the first and second items from the above research are described in the following:

Flexural Capacity of Composite Girders with Partial Shear Connections

In the renewal project for steel bridges with RC slabs, the replacement of slabs is being carried out in Japan. As shown in Fig. 1, durable prestressed concrete (PC) slabs have been used in recent slab replacement work, and precast (Pca) concrete slabs are also often adopted for quick erection and improved concrete quality. In steel girders with Pca-PC slabs, the size and number of breakout holes for shear connectors in Pca-PC slabs are limited due to the transverse-prestressed steel bars, and accordingly, the number of shear connectors in use is small compared to standard RC composite girders. Hence, most renovated composite bridges adopt partial shear connections.

In Eurocode, a method for calculat-

ing the flexural capacity of composite girders with partial shear connection is standardized. However, since this method is intended for buildings, the target is placed on the compact steel section. For steel bridges, a way of following the minimum web thickness regulations of the Japanese Specifications for Highway Bridges²⁾ (JSHB) often results in non-compact steel sections. Therefore, in many cases Eurocode provisions cannot be applied to bridges.

This research aims to develop a method for calculating the flexural capacity of partially composite girders for steel I-girder bridges. FEM analysis was performed considering both the material and geometric nonlinearity of steel, concrete and shear connectors. Parametric study was then conducted for 100 cases by varying the degree of shear connection η determined from the strength ra-

Fig. 1 Schematic Diagram of Precast Deck Slab Replacement Work¹⁾

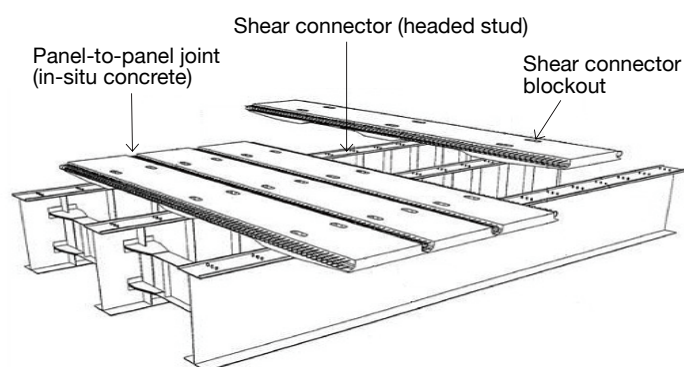
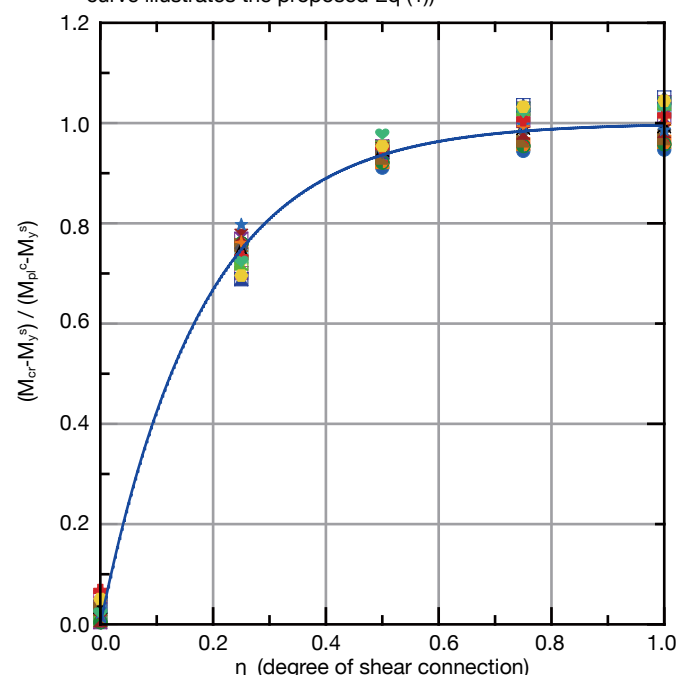


Fig. 2 Relationship between Bending Moment Capacity M_{cr} and Shear Connection η

(The symbols stand for nonlinear FEA results, and the blue curve illustrates the proposed Eq (1))



tio of shear connectors and the slab, web thickness, flange section, and slab width.

From this, Eq (1) for evaluating the flexural capacity M_{cr} from the degree of shear connection was proposed.

$$\frac{M_{cr} - M_y^s}{M_{pl}^s - M_y^s} = (1 - \exp[-5.52\eta]) \quad (1)$$

where M_{pl}^s is the full plastic bending moment of the composite section with full shear connection, and M_y^s is the yield moment of the steel section.

Fig. 2 shows the comparison between FEM analysis results plotted with symbols and the proposed Eq (1) plotted with a curve. The analysis results and the proposed Eq (1) show good agreement, indicating that flexural capacity can be estimated using Eq (1).

Coupled Buckling Strength of H-shaped Section Members

The coupled buckling strength of H-section columns, which considers both member buckling and local buckling, was investigated in this research project. In fiscal 2021, we conducted compression loading tests on compression specimens made of SBHS500 and SM400 steel and having a width-to-thickness ratio parameter $R=0.9$ of the constituent plates of the H-section. In 2022, we carried out compression loading tests on specimens with $R=0.8$.

Fig. 3 shows a comparison between the load-displacement curves obtained from the experiment of the SBHS500

steel specimen and the FE analysis results. It was confirmed that FE analysis can estimate the maximum bearing capacity within a 5% error rate. Furthermore, it was confirmed that JSHB considerably underestimates the coupled buckling strength.

Since the accuracy of numerical results was verified, a parametric study using FE analyses was conducted on models with varying column dimensions to propose an accurate coupled buckling strength evaluation method. In these analyses, initial deflection was introduced based on the allowable values for manufacturing errors in JSJB.

First, we defined the buckling modes of local buckling, overall buckling and coupled buckling with respect to the deformed shape of columns in their ultimate state. Next, we identified the buckling modes from the deformed shape of the column at its ultimate state obtained through analysis. It was shown that for SBHS500 and SM400 columns, coupled buckling occurred depending on the combination of slenderness ratios when R exceeds 0.4.

Furthermore, based on the results of the load-carrying capacity distribution obtained from the parametric analysis, we proposed a coupled buckling strength estimation Eq. (2) by multiplying the JSJB²⁾ column buckling strength formula with a correction factor that represents the influence of local buckling.

$$\sigma_{cr}/\sigma_y = \chi_{H2} \rho_{erg} \quad (2)$$

where σ_{cr} stands for the coupled buckling strength, σ_y is the yield strength, ρ_{erg} represents the strength reduction factor due to column buckling specified in JSJB, and χ denotes a proposed correction factor representing the influence of local buckling, expressed as a function of the width-to-thickness ratio parameter R as shown in Eq. (3).

$$\chi_{H2} = 0.8502R^3 - 2.5532R^2 + 2.0132R + 0.4682 \quad (3)$$

Fig. 4 shows the comparison between the proposed Eq. (2) and the FEM analysis results. The proposed equation shows good agreement with the analysis results over a wide range of width-to-thickness ratio parameters.

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Fig. 3 Comparison between Experiment and FE Analysis of H-section Column Buckling Test for BHS (SBHS500, $R=0.9$)

(The black and red curves stand for FEA and experimental results, respectively. The red dash line is full plastic load; the green and blue dash lines denote estimated axial load capacities based on load and railway bridge specifications, respectively.)

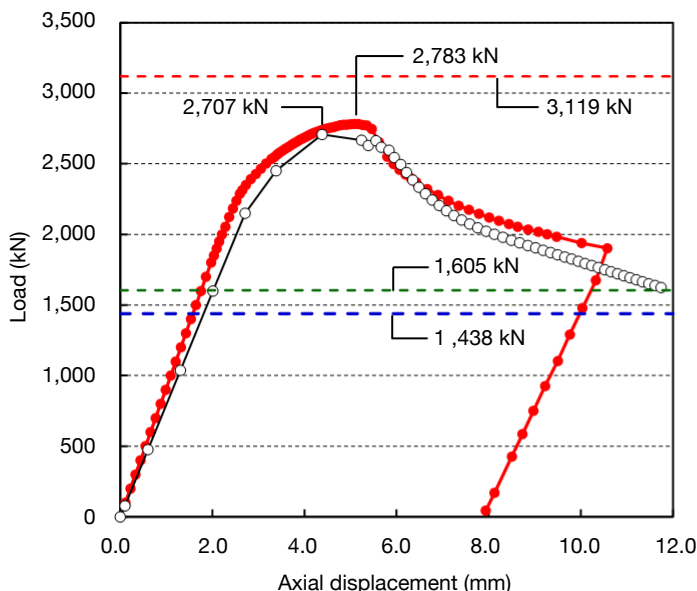
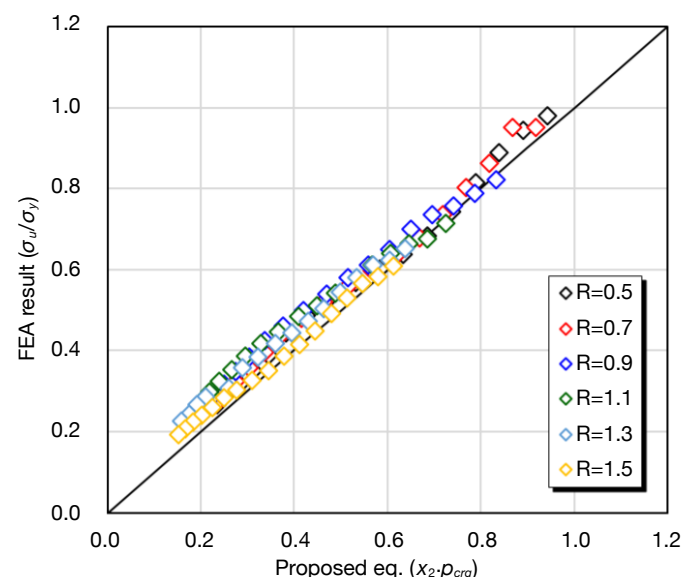


Fig. 4 Comparison of Coupled Buckling Strength between FE Analysis Results and Proposed Eq. (2)



Improvement of Fatigue Strength and Rational Maintenance Technology for Steel Bridges

Kengo Anami

Chief of Working Group on Fatigue Performance, Research Committee on Structural Performance and Durability of Steel Bridges (Professor, Shibaura Institute of Technology)



Kengo Anami: After graduating from the School of Engineering, Tokyo Institute of Technology in 1993, he served as research associate at Lehigh University in the US in 2001 and as associate professor at Shibaura Institute of Technology in 2008. He assumed his current position as professor at the Civil Engineering Program, College of Engineering, Shibaura Institute of Technology in 2014. His areas of expertise cover steel structures and their maintenance.

Working Group on Fatigue Performance

In response to the proposition of improving the structural performance and durability of steel bridges, the Research Committee on Structural Performance and Durability of Steel Bridges, established within the Japanese Society of Steel Construction (JSSC), has conducted various surveys and research. The Working Group on Fatigue Performance was established as a research execution organization of the Research Committee and has tackled specific issues from the aspect of the fatigue of welded joints, such as:

- Quantitative assessment of the influence of peening treatment on the improvement of fatigue strength
- Effective inspection of fatigue-induced cracking and rational design of repair and reinforcement methods
- Assessment method for fatigue strength

Some of the research results obtained thus far are introduced below:

Quantitative Assessment of Influence of Peening Treatment on the Improvement of Fatigue Strength

With respect to peening treatment applied for improving fatigue strength by means of the introduction of compressive residual stress into the weld toe, there is a certain track record of its application in the practical bridge in Japan. However, the fatigue strength after peening treatment has not been prescribed in the Fatigue Design Guidelines of the Japanese Society of Steel Construction, and thus it was difficult to conduct rational fatigue design and repair/reinforcement design by means of peening treatment.

In the former report of issue No. 65 of this magazine, based on the analysis

of fatigue tests for peened specimens and existing fatigue test results, the class of fatigue strength improvement attained by peening treatment was proposed in terms of the relationship between the yield strength of steel products and stress ratio applied, as shown in Fig. 1.

In this regard, aiming at the practical application of peening treatment in the erection of new bridges, the Working Group on Fatigue Performance examined the influence of compressive pre-loading after peening (Fig. 2) and made a new proposal pertaining to the improvement of fatigue strength through fatigue testing and the observation of compressive residual stress in the peened section. Specifically, in this new proposal, when compressive pre-loading greater than half the yield strength of steel products was applied after peening, the fatigue strength improvement was reduced by one class from that shown in Fig. 1 (refer to Fig. 2).

Fig. 1 Proposed Fatigue Design Curve of Peened Welded Joints (Out-of-plane Gusset Welded Joints)

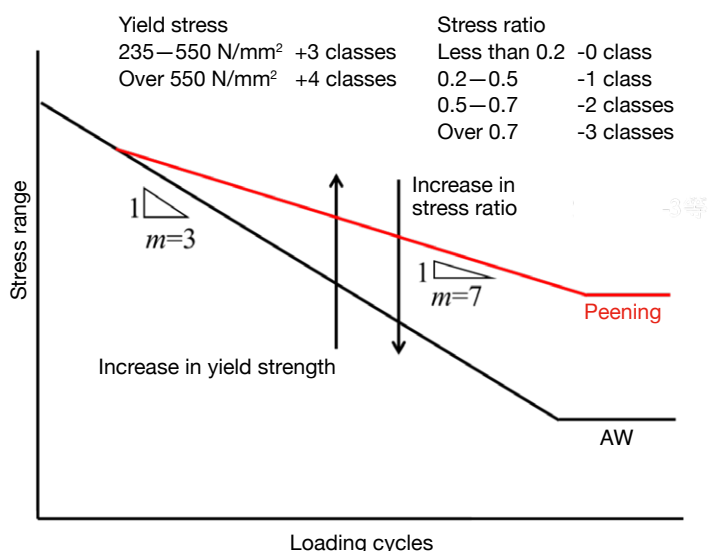


Fig. 2 Influence of Compressive Pre-loading on Residual Stress and Improvement of Fatigue Strength

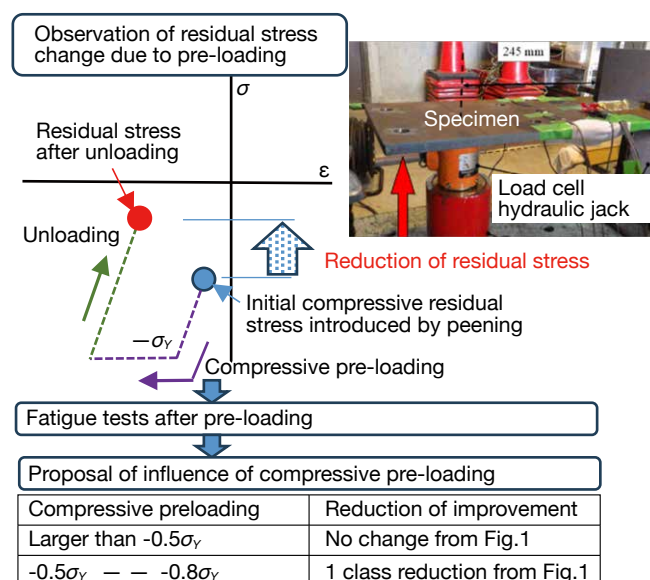
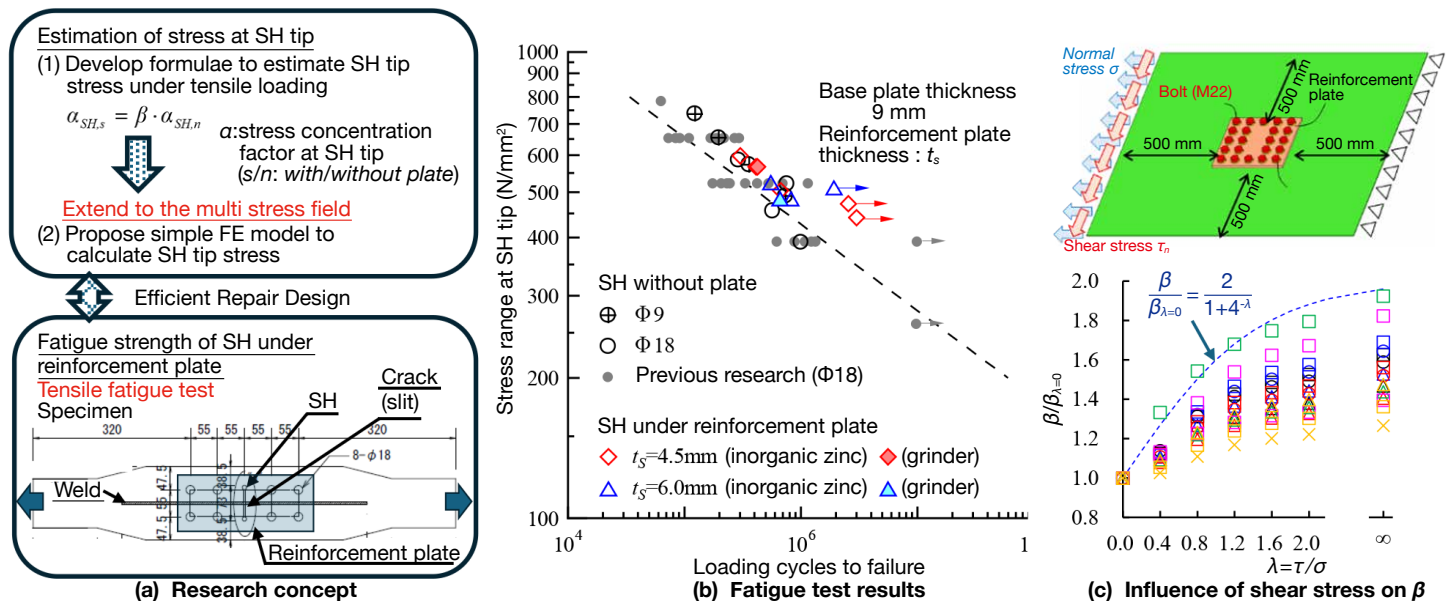


Fig. 3 Research on Efficient Design Method for Stop Holes + Reinforcement Plates



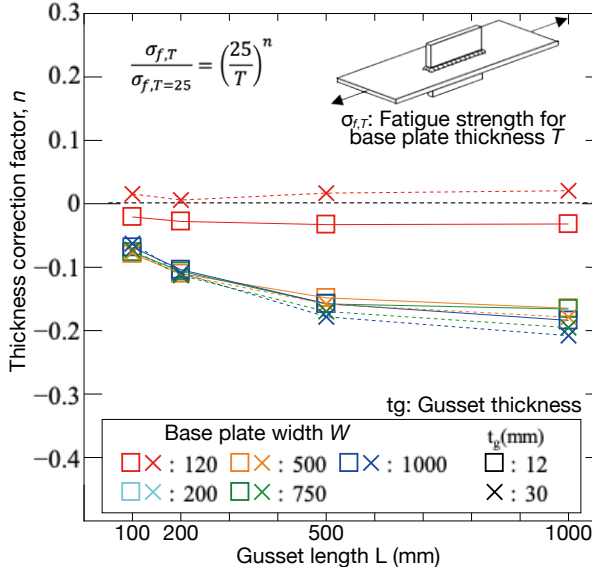
Examination of Inspection and Repair Technologies towards Efficient Maintenance

In order to improve maintenance efficiency, the Working Group extended its examination of the method to screen cracking from the upper surface of coating by means of ultrasonic testing and Eddy current testing and of the earlier detection of cracking occurring below protective rust of weathering steel. It also examined the rational design method for the splice plate reinforcement of cracking, which is introduced in the following:

The Working Group considered that it is possible to design rational splice plate reinforcement if the stress at the stop-hole (SH) tip under the splice plate could be predicted and the fatigue strength could also be verified employing the stress range at the stop-hole tip. As a result of fatigue testing of the specimen in which weld residual stress was introduced and the slit and SH+splice plate are provided as shown in Fig. 3 (a), it was known that, if the stress range at the SH tip was applied as shown in Fig. 3 (b), the fatigue strength could be assessed regardless of whether or not a splice plate was provided.

In another former report in issue No. 54 of this magazine, the Working Group examined an equation to estimate the SH tip stress reduction rate β derived by the use of a splice plate under axial tension stress. However, in the current research, this estimation equation was developed to apply to cases in which the axial tension and shear stress work in the stress field closer to the practical bridge, as shown in Fig. 3 (c).

Fig. 4 Thickness Correction Factor n of Out-of-plane Gusset Welded Joints



Examination of Fatigue Strength Assessment Method

As to the fatigue strength assessment method, the Working Group examined the influence of plate thickness on the fatigue strength of out-of-plane gusset welded joints and the hot-spot stress (type-B: cracking occurring from plate edge surface). Of these two approaches, the influence of plate thickness on the fatigue strength of out-of-plane gusset welded joints is introduced in the following:

Examinations were extended of the wide-ranging parameters covering from the specimen size to the detailed size of practical bridges by means of crack propagation analysis. Fig. 4 shows the plate thickness correction factor n in the case of setting the gusset length L and base plate width W as a parameter. In

this examination, the base plate thickness ranged from 12 mm to 75 mm. As the L and W got closer to those of practical bridges, the plate correction factor n showed a negative value, and as a result, a trend was obtained that is opposite to the commonly-accepted plate thickness effect—the fatigue strength lowered as the plate thickness increased.

This was considered attributable to the fact that, while the stress concentration increased along with the increase in base plate thickness, the plate thickness effect was largely affected by crack propagation life. In the end, it was known that the provision of not considering the influence of plate thickness on the fatigue strength of out-of-plane gusset welded joint in fatigue design, described in the currently-prevailing JSSC Fatigue Design Guidelines, is valid.

New Developments in Structural Engineering in the Age of Generative AI

Pang-jo Chun

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Pang-jo Chun: He received his PhD from Wayne State University in 2010 and subsequently worked at Yonsei University in Korea as a Project Research Associate until he moved to Ehime University in December of the same year. Since May 2025, he has been a Project Professor at the Graduate School of Engineering, The University of Tokyo.

AI Capable of Generating Sophisticated Sentences

In the field of structural engineering and bridge engineering, AI (artificial intelligence) technology is showing increasing applications. Recently, research on damage detection such as the method of detecting the corrosion of steel products and cracking of concrete is rapidly being promoted both in Japan and abroad (Fig. 1)¹⁾. Although generative AI has rapidly undergone technological progress, its application in research on damage detection has not yet progressed sufficiently.

Generative AI is an artificial intelligence technology that learns from a great amount of data and automatically generates new data and content employing the data that it has learned. It can generate text, images, audio, video, three-dimensional models and other diverse forms of content. In particular, AI with a capability of generating sophisticated sentences has recently been put into practical application due to the development of LLMs (large language models).

In light of such a situation, we conducted a Q&A with ChatGPT pertaining to the cause of corrosion occurring in bridge bearings, the result of which is introduced below:

We asked ChatGPT the following question:

- “We’ve found corrosion on the bridge bearings. What’s the probable cause? Is it: 1: Leaking expansion joints, 2: A broken drainpipe mid-span, or 3: A salt plant

in the next country?”

In response to this question, the LLM responded as shown below:

- “The most likely cause is option 1: Leaking expansion joints, particularly since these joints are located near the ends of the bridge.”

Further, as to the reason for the above, the LLM presented the following specialized knowledge:

- “Leaking expansion joints (at the bridge ends): These joints accommodate thermal expansion and contraction. When they begin to leak, water—often carrying deicing salts and other corrosive substances—can infiltrate the bearings. Their location near the bridge ends directly exposes the bearings to this corrosive environment.”
- “Broken drainpipe mid-span: Although a broken drainpipe could lead to water accumulation, its position in the center of the bridge means it is far from the

bridge ends where the bearings are located, making its impact on the bearings less direct.” (For details, see Fig. 2)

These responses look seemingly easy, but in fact, they really show phenomenal evolution.

Research on natural language processing has been tackled since before “deep learning,” and various attempts have been made to make engineer-like decisions by learning from the sentence written by engineers, which however has not led to success. A major reason attributable to this lack of success lies in that, while specialized terms and concepts are covered in the specialized literature prepared by engineers, general common-sense descriptions are not usually described explicitly, such as “water flows from top to bottom,” and “the edge section is separated from the center section.”

Engineer decisions need to be made

Fig. 1 Examples of Corrosion-induced Damage Detection by Means of Deep Learning



Fig. 2 Examples of Questions and Answers with ChatGPT

Question

We've found corrosion on the bridge bearings. What's the probable cause? Is it: 1: Leaking expansion joints, 2: A broken drainpipe mid-span, or 3: A salt plant in the next country?

Answer by ChatGPT o3-mini-high

The most likely cause is option 1: Leaking expansion joints, particularly since these joints are located near the ends of the bridge.

Explanation:

- **Leaking expansion joints (at the bridge ends):** These joints accommodate thermal expansion and contraction. When they begin to leak, water—often carrying deicing salts and other corrosive substances—can infiltrate the bearings. Their location near the bridge ends directly exposes the bearings to this corrosive environment.
- **Broken drainpipe mid-span:** Although a broken drainpipe could lead to water accumulation, its position in the center of the bridge means it is far from the bridge ends where the bearings are located, making its impact on the bearings less direct.
- **Salt plant in the neighboring country:** While airborne salt from a distant source might contribute to corrosion, its effect would be significantly less impactful compared to the direct ingress of water and salt from the leaking expansion joints.

Thus, given the placement of the expansion joints near the bridge ends and the positioning of the drainpipe mid-span away from these critical areas, the corrosion on the bridge bearings is most likely due to leaking expansion joints.

the concept in which the “language” and “words” serve as the spectrum/main component of briefly specifying the situation. In the field of bridge engineering, qualitative evaluation is more prevalent than quantitative evaluation due to the characteristic feature peculiar to bridges. This is attributable to the fact that the bridge is mostly a single-article product and therefore its individuality is high. Consequently, if sensing is applied, it is difficult in the field of bridge engineering to settle a general threshold level such as that settled in the field of medical treatment—“be careful in cases when the blood pressure exceeds a certain level.”

Given such situations, in current bridge engineering, qualitative inspections have been adopted, and knowledge has been accumulated by the use of language expressions such as “inferior drainage may cause corrosion, for which due care is required” and “for welds, fatigue cracking is apt to occur due to the concentration of stress.” This language expression method brings about a significant advantage in the case of combining

by means of a combination of this specialized knowledge and general common sense. With conventional AI that learned by depending only on specialized literature, because it lacked this general common-sense portion, there was a limit in properly making engineer decisions. However, because LLMs learn from not only specialized knowledge but also bulk common texts, it has been possible to make inferences that combine both specialized decisions and general common sense.

The availability of such specialized inferences suggests the ability of generative AI and its applicability in the field of structural engineering. This article discusses an outline of generative AI technology and its applicability in the field of structural engineering, particularly in the field of bridge engineering.

Generative AI

• Before the Advent of LLMs

When looking back upon the history of generative AI, research had been conducted even prior to the advent of large language models (LLMs) on sentence generative AI such as image captioning in which captions are generated from the image. The author et al has also conducted research on the generation of explanations of damage from the photos of damaged bridges (Fig. 3^{2),3)}).

The chance to start this research was

Fig. 3 Examples of Generation of Damage Situation Explanations



1. Degradation of anticorrosive coating detected on the lower lateral bracing.
2. Corrosion detected on the lower lateral bracing.
3. Degradation of anticorrosive coating detected on the cross beam.



1. Corrosion detected on the main girder.
2. Corrosion detected on the cross beam.



1. Corrosion detected on the bearing.
2. Corrosion detected on the anchor bolt.
3. Missing anchor bolt detected.

language-based AI technology.

In addition, such knowledge expression using languages is related with the concept “thinking and recognition are specified with words” in linguistics. While in conventional AI technology, there has been a restriction in the practical application of such a concept, the potential of knowledge expression and treatment by the use of language is vast due to the recent development of generative AI technology.

• Modern Generative AI Technology

The current regenerative AI technology is roughly classified into the following two models—text regenerative technology represented by large language models (LLMs) and image regenerative technology based on diffusion models.

The diffusion model has a mechanism in which the image is gradually generated from noise by learning the process of

gradually adding noise to a clear image and its reverse process (Fig. 4). Capitalizing on this image generation technology, Stable Diffusion, DALL-E and other similar diffusion models generate high-quality images by means of text instruction.

Meanwhile, ChatGPT and Gemini are representative LLMs. They demonstrate the ability to understand context and generate natural sentences by means of advanced learning employing a vast amount of sentence data. Particularly in recent years, steady developments have been achieved in the technology that incorporates outside knowledge, called RAG (Retrieval Augmented Generation, Fig. 5), and the technology that adapts to specified domains, called Fine-tuning, which have thus promoted the application of LLMs in the specialized fields.

More recently, the extension of LLMs to large multimodal models (LMMs), which can handle not only text but also

images, audio and other diverse modalities, is also progressing. This multimodal technology has innovative application potential in the field of structural engineering. For example, capitalizing on LMMs, a new system is becoming feasible that not only analyzes the photo of a corrosion-damaged bridge, 3D-scanned data and past inspection record documents in an integrated manner and assesses the present damage condition, but also simultaneously conducts a prediction of deterioration development and a quantitative assessment of remaining durability. Such a system is an innovative approach that integrates appearance assessment, structural analysis and performance prediction by the use of a single AI system, which are currently carried out separately.

In the case of applying such AI technology, steel structures offer peculiar predominance. Deterioration phenomena (corrosion, cracking) in steel structures often appear on the surface and can di-

Fig. 4 Diagram of Learning and Image Generation in Diffusion Models

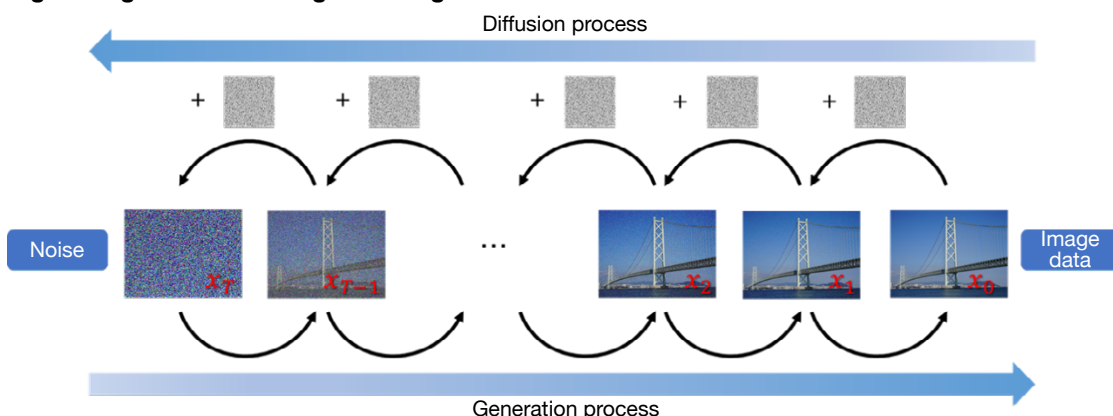
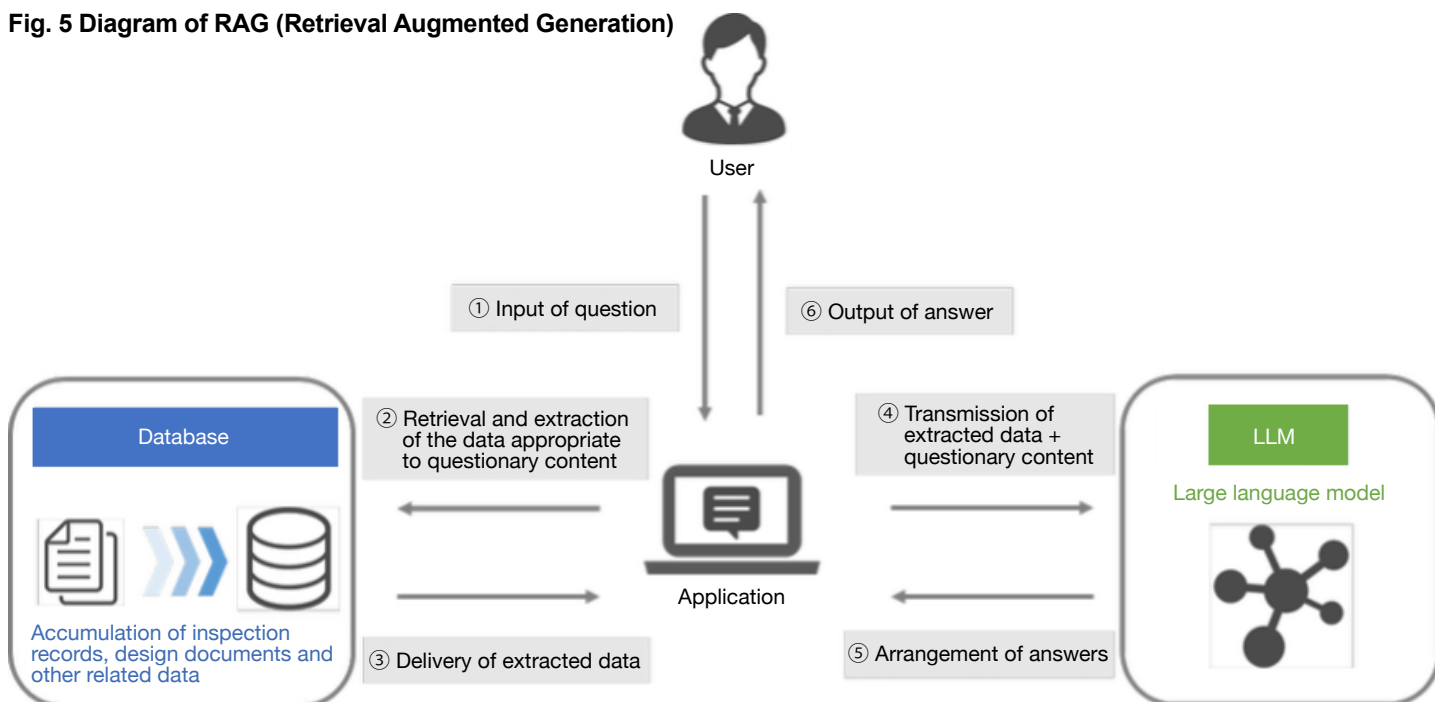


Fig. 5 Diagram of RAG (Retrieval Augmented Generation)



rectly and visually be confirmed. Therefore, when comparing to structures in which invisible deterioration develops in the inside, the deterioration condition of steel structures can be assessed more effectively by means of the acquisition and analysis of visual data thus obtained. In light of such a peculiar characteristic, it is considered that steel structures can be positioned as “structures that are highly AI-compatible.” As AI technology develops, the steel-structure maintenance approach is expected to attain more sophisticated development.

The ease-of-detection of appearance assessment peculiar to steel structures is a major advantage in the age of AI. The reason is because the collection and accumulation of vast high-quality data serves as the base for AI learning and leads to improved prediction accuracy and highly effective abnormality detection. This is an important strategic predominance in the case of putting AI technology into practical use in the maintenance of steel structures.

Generation of Three-dimensional Models

In recent years, various developments have been seen in the field of AI technology. In particular, image generation technology using diffusion models and text generation technology employing LLMs show remarkable progress. Capitalizing on these technologies, it has become possible to generate fine two-dimensional images and videos, however, there remains a task in the field of structural engineering—the difficulty of constructing dynamically- and structurally-valid three-dimensional models required for that field.

In the case of examining the application of LLM-applied text generation technology in bridge engineering, particularly in the inspection and diagnosis of bridges, it is inevitable to construct three-dimensional models. This is because, even if damage is detected from an image as seen in Fig. 1, the seriousness of that damage is largely affected by the three-dimensional damage position relationship and further three-dimensional understanding of damage positions is required to assess the stress transmitting route inside the bridge structure.

Given this, we are developing a new approach employing LLM technology. In this new approach, the unknown parameter is estimated and generated using an LLM, while applying the known structural parameters as is. Specifically

in this new approach, part of the structural and material parameters are given as inputs, based on which LLM generates the remaining unknown parameters in the JSON (JavaScript Object Notation) format, then a three-dimensional model is constructed via an interpreter that interprets all the parameters thus generated (Fig. 6). It has been made possible using this approach to construct bridge models that are structurally valid.

Capitalizing on this newly-developed approach, it has become possible to construct the BIM (building information

modeling) models, walkthrough models and FEM (finite element method) models pertaining to bridges. For example, by constructing a BIM model of an existing bridge and reflecting the inspection result in this BIM model, it becomes possible to visualize the damage condition of the bridge (Fig. 7). In addition, by preparing a walkthrough model, it becomes easier to intuitively understand the bridge, which leads to improved efficiency in maintenance (Fig. 8). On top of this, it is possible to perform practical stress analysis, deformation analysis and

Fig. 6 Approach Proposed to Generate Three-dimensional FEM Model of Bridges

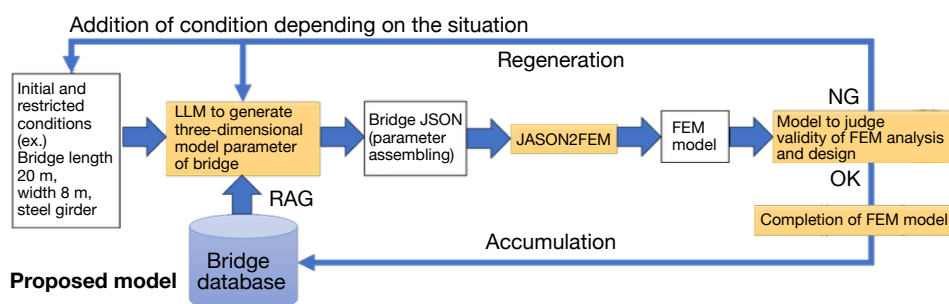


Fig. 7 BIM Model and Viewer for the Use of Steel Bridge Inspection

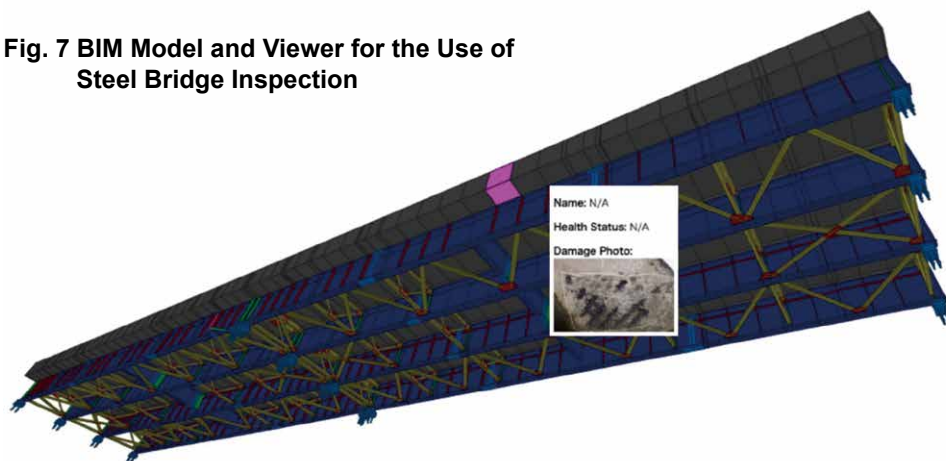
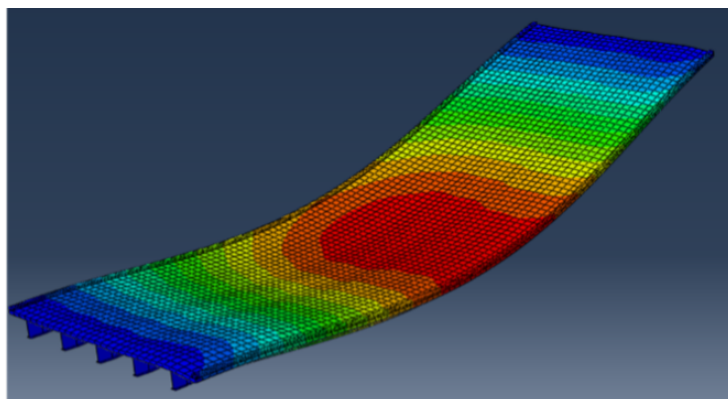
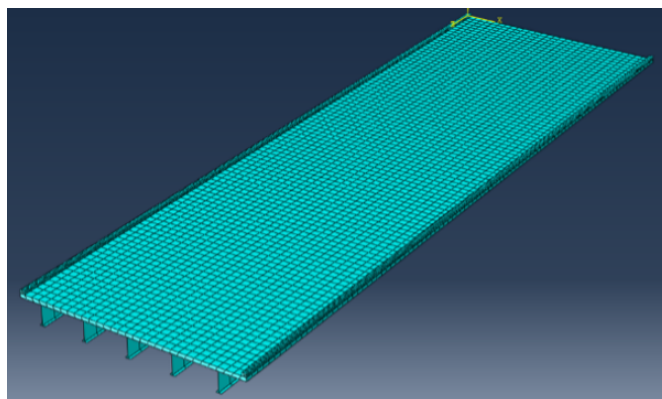


Fig. 8 Walkthrough Model and System



Fig. 9 Result of FEM Model Generation



Result of FEM model generation in conformity with the mechanism shown in Fig. 6 and with the prompt: “Generate the FEM model of the bridge with a length of 10 m. Other values can be randomly generated, but are required to apply the real value based on the knowledge of bridge engineering. And assume the case in which the L load of A live load works.”

other FEM analysis using the constructed FEM models (Fig. 9).

However, the accuracy of unknown parameter generation employing LLMs greatly depends on the quantity and quality of data given. When there is little availability of known parameters, the generation accuracy lowers, and on the contrary, when a certain number of known parameters can be prepared, the prediction and generation accuracy improves. In order to treat this task, the recent progress of measurement technology is bringing about new solutions.

For example, spherical data taken by drones and other devices during inspection and point-group data obtained by laser scanners are initially intended for use only for damage detection and degradation detection, but if the structural parameter can be extracted from this data, it is possible to improve the accuracy to generate unknown parameters employing an LLM. Furthermore, it is possible to construct structurally- and dynamically-valid three-dimensional models by making use of information generated by an LLM

based on more known parameters.

Such an integration of AI and measurement technology offers the possibility for bringing about a new paradigm to the field of maintenance of bridges. The range of measurement has planarly and spatially expanded due to the development of measurement technology, which has thus made it possible to obtain more information not available thus far. However, with the conventional approach, it was difficult to extract “unexpectedly” effective information from the vast data thus obtained.

AI technology, particularly LLMs, has the capability of extracting meaningful information from diverse types of data and generating new knowledge by integrating such information. Based on this, we are promoting the development of an image analysis AI as shown in Fig. 1 and a point-group analysis AI that can highly-precisely obtain the dimension from the point group (refer to Fig. 10). By making full use of these technologies, it is expected that more values can be derived from not only inspection data but

also various kinds of structure data and environmental data.

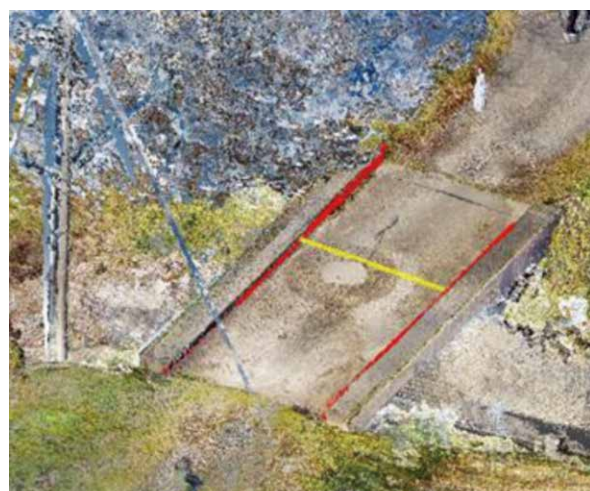
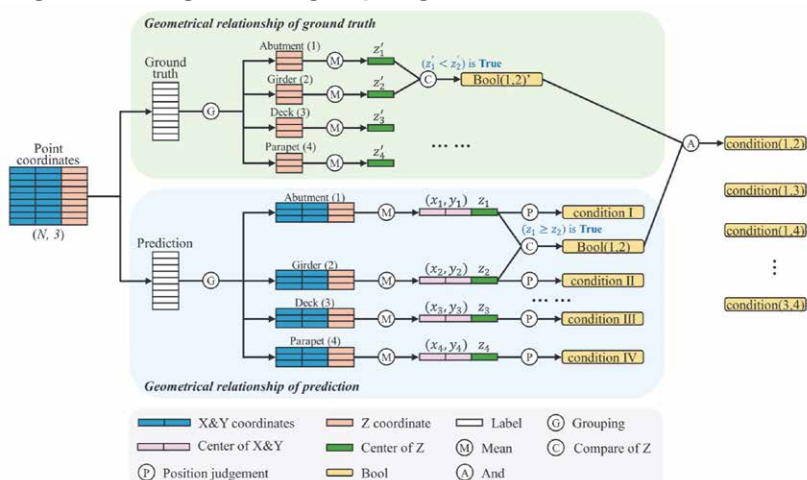
Further, in the future, it is assumed that it will be feasible to construct a system that automatically reflects AI-detected damage information in an FEM model and instantly assesses the currently remaining performance. For example, by detecting plate thickness reduction due to corrosion and automatically reflecting the detected results into the FEM model, it will be possible to assess the current load-bearing capacity of a bridge. Due to the development of these technologies, it is considered that the more effective, highly accurate maintenance of structures will be put into practical application.

Towards the Practical Application of Generative AI in Steel Construction

In this article, new developments attained in structural engineering in the age of generative AI were discussed. Among the specific developments discussed are:

First, generative AI technology, which

Fig. 10 Drawing of Point-group Segmentation Model and Result of Detection of Dimension Measurement Positions⁴⁾



has recently attained rapid development, was introduced, while AI applications in conventional structural engineering has targeted mainly damage detection such as the detection of corrosion of steel products and the detection of cracking in concrete. In particular, the inference ability, in which the specialized knowledge demonstrated by an LLM and general common sense are fused, is making it possible to conduct complex judgement such as that performed by structural engineering specialists.

Next, the transition of generative AI technology and its application in structural engineering were discussed. The development from sentence generative AI before the appearance of LLMs to diffusion models, LLMs and other similar modern generative AI technologies has the potential of radically changing the way of information processing in structural engineering. In the quantitative assessment of single-article products such as bridges, the author considers it important to assess by means of knowledge expression and processing employing language. Further, the LMM technology that integrates text, image, three-dimensional data and other diverse modalities will enable the comprehensive assessment and prediction of structures.

In addition, from the aspect of three-dimensional model generation technology, technological developments were introduced that are being promoted by the author pertaining to the method of constructing dynamically- and structurally-valid bridge models. The approach to estimate and generate unknown parameters making use of LLMs enables the construction of BIM models, walkthrough models and FEM models, and their link with measurement technologies leads to the generation of highly precise models. Image analysis AI and point-group analysis AI are undergoing steady development, and a new paradigm is being developed to extract worthy information from diverse kinds of data and make use of extracted information.

When taking into account these technical developments, the relationship between dynamic models and data analysis is about to change significantly in the field of structural engineering. The trend of the filtering of data analysis into the field of dynamic and physical models will be further accelerated in the future as “new developments in structural engineering.” While it is forecast that generative AI will be firmly established as a future basic technology, the performance

of AI largely depends on the quality and quantity of learned data, and therefore how efficiently high-quality data can be collected and supplied in the field of structural engineering becomes important.

Given such situations, because of the particularly high affinity of steel structures with AI technology due to the high visibility of deterioration phenomena observed in steel structures, the future development of AI technology will be a major advantage for steel structures. Then, as the next step to promote the fusion of AI technology and structural engineering, it will be important to construct three-dimensional models including specialized knowledge and the basic civil engineering models such as the basic corrosion model. For example, the combined use of physical models pertaining to corrosion development and the prediction of corrosion development employing AI is expected to improve the accuracy of predicting aging deterioration.

Along with the rapid development of AI technology, it is required to reconsider the relationship between AI and humans in the field of structural engineering. In the future, it will become important that AI is not positioned as a tool for use for the automation of work but as a cocreation partner that combines specialized knowledge in the field of structural engineering. In order to meet such a requirement, it is necessary for structural engineering experts to understand the properties peculiar to AI and to define the role sharing with regard to which kinds of work should be entrusted to AI and which should be borne by humans. In this regard, a particularly notable fact is that engineers with advanced, specialized knowledge are more likely to extract useful knowledge from AI, which suggests that improved AI literacy will become more important for structural engineers in the future.

This article discussed three new developments in the field of structural engineering in the age of generative AI—the inference capability in which LLM-derived specialized knowledge and general common sense are combined, the potential of LMM technology that integrates diverse modalities, and the approach to construct three-dimensional bridge models employing LLMs. These technologies have the potential to bring about innovative changes to various aspects of structural engineering from damage detection in bridge inspections to the performance assessment of bridge structures.

In particular, steel structures have a high affinity with AI due to the characteristics peculiar to steel structures, and therefore it is expected that their maintenance will be greatly improved. Further, the relationship between structural engineers and AI will cause change, and the role played by specialists with high literacy become more important.

Structural engineering in the age of generative AI is evolving into a new sphere in which the understanding of physical models and data-driven approaches are fused, and these innovative changes have only just started in the field of structural engineering including bridge engineering. Expectations are high for the challenge towards the new technological development of generative AI and its practical application in steel structures to be further accelerated.

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2024 AJSI Seminar Held during SEAISI Forum in Bangkok

The Japan Iron and Steel Federation (JISF) concluded a memorandum with the ASEAN Iron and Steel Council (AISC) in fostering interaction concerning the environment, standardization and trade in May 2014.

In the field of environment, JISF has launched a public-private collaborative scheme called the ASEAN-Japan Steel Initiative (AJSI) with the co-operation of the Ministry of Economy, Trade and Industry. The purpose of this initiative is to provide a platform to exchange knowledge and experiences, thereby contributing to energy saving and environmental protection in ASEAN countries.

In addition, AJSI aims to encourage technology transfer from Japan to the ASEAN steel industry. To achieve this goal, JISF has established three main activities: Steel Plant Diagnosis, Technologies customized List and Public and Private Collaborative Workshop.

On November 20, 2024, JISF held its first on-site AJSI Seminar since

2020, as part of the “2024 ASEAN Iron and Steel Forum: Sustainable Steel and Green Construction” in Bangkok. The seminar featured three sessions.

- Session 1 focused on policies and strategies toward carbon neutrality, including Japan’s decarbonization initiatives, ASEAN’s energy outlook and emission roadmap, and decarbonization analysis for hard-to-abate sectors.
- Session 2 covered steelmakers’ challenges and responses, such as Global Steel Initiatives, the EU’s Carbon Border Adjustment Mechanism emission measuring, and case studies from the GX League and Thai steel industry.
- Session 3 highlighted technological advancements, including the GREINS hydrogen utilization project, Best Available Technologies (BAT) for CO₂ reduction, bio-coke research in electric arc furnaces, and the development of CCU (Carbon Capture and Utilization) technologies.

South East Asia Iron and Steel Institute (SEAISI) expressed gratitude for

Japan’s continued support of the ASEAN steel industry through AJSI, highlighting the seminar as a symbol of co-operation among JISF, SEAISI, and AISC, and expressed hope for its continued support.

JISF, together with the Japanese government, will continue to support energy efficiency and environmental protection in the ASEAN steel industry and cherish the long-term relationship between Japan and ASEAN countries fostered through AJSI.



Steel Construction Technologies in Japan

The Japan Iron and Steel Federation (JISF) has published on its website an English-version document “Steel Construction Technologies in Japan” that introduces 27 types of steel construction technologies and steel products widely used in the fields of building construction and civil engineering. These technologies and products demonstrate high seismic resistance, disaster-prevention performance and other advanced properties. To that end, their final goal is to contribute towards the steady preparation of natural di-

saster-resistant infrastructure worldwide.

Part of the document has been furnished to “constructsteel,” a steel construction market development program of the World Steel Association, in which some of these steel construction technologies and steel products are introduced as “disaster prevention and restoration using steel solutions.”

For a list of technologies and products published on the JISF website, please click on the link below:

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STEEL CONSTRUCTION TODAY & TOMORROW

Published jointly by

The Japan Iron and Steel Federation

3-2-10, Nihonbashi Kayabacho, Chuo-ku, Tokyo 103-0025, Japan

Phone: 81-3-3669-4815 Fax: 81-3-3667-0245

URL <https://www.jisf.or.jp/en/index.html>

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URL <http://www.jssc.or.jp/english/index.html>

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Edited by

Committee on Overseas Market Promotion, The Japan Iron and Steel Federation

Chairman (Editor): Tomoya Tominaga

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