

### **Fundamental Study on Dynamic Behavior of Steel Bridge Pier Based on Shaking Table Test using Small-size Specimen**

Yasuyuki NAKANISHI, Masahide MATSUMURA and Toshiyuki KITADA

*Proceedings of the 11th Symposium on Ductility Design Method for Bridges, Earthquake Engineering Committee, JSCE, pp. 305 -310 (2008) (in Japanese)*

In the dynamic responses analysis, a simplified and idealized model is employed and the dynamic behavior of the structure is evaluated based on the analytical results. However it is important to check the differences between the dynamic behaviors of an actual structure and the analytical result. Then, shaking table test can be one of effective methods to investigate the dynamic behavior of the structure.

Investigated in this paper is dynamic response of steel bridge pier, a cantilever type single column with a squash load, through shaking table test using small-size specimens with 50x50 mm of rectangular cross section. Dynamic response analysis of the specimen is also carried out and the differences between the analysis and the shaking table test is checked and the adaptability of the shaking table test using the small-size specimen for evaluating the dynamic behaviors of an actual large-size structure is discussed.

### **Analytical Study on Analytical Modeling Method for Evaluating In-plane Seismic Response of Rigid Framed Steel Bridge Pier**

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*Proceedings of the 11th Symposium on Ductility Design Method for Bridges, Earthquake Engineering Committee, JSCE, pp. 311-316 (2008) (in Japanese)*

Steel bridge piers had some damages by the attack of the Hyogo-ken Nambu Earthquake occurred in 1995. After that, the ductility design method, which evaluates the load carrying capacity and the ductile capacity beyond the elastic range of the structural system, is developed. Also the numerical calculation method is developed and enables to realize an actual dynamic behavior of the structure when detailed analytical model is employed. In this study, a rigid framed steel bridge pier, which has typical dimensions and is designed according to the current design method, is modeled by the shell elements to account for the influences of plate buckling. Then static and dynamic analysis are carried out and the validity of the modeling methods using both the shell elements and the beam-column elements is discussed compared with the analytical model by the shell elements.

### **Analytical Study on Repair Method for Existing Riveted Joints Replaced Some Rivets by High Strength Bolts as Frictional Connection**

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*Journal of Structural Engineering, Vol.54A, JSCE, pp. 555-562 (2008) (in Japanese)*

In case of the repair of a superannuated riveted joint, three methods are considered: 1. replacement of the superannuated rivets, 2. installing the bearing type of the bolts, and 3. installing the high strength bolts as the frictional joint. Using high strength frictional bolted connection is preferable method from the viewpoint of repair cost and easiness of repair works. However, the mechanical behavior of the riveted joint in which some rivets are replaced by the frictional bolted joint is not clear. The objective of this study is to investigate analytically the strength of the riveted connection replaced some rivets by the high strength bolts, and to discuss the applicability of such repaired riveted joint considering the number and the position of the replaced rivets. It is concluded from the analytical results that the strength of the repaired riveted connection by using high strength bolts is sufficient for a repairing method of superannuated riveted joints.

### **Experimental Study on Emergency Repair for Bridge Members using Frictional Connections by Vises**

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*Journal of Structural Engineering, Vol.54A, JSCE, pp. 575-581 (2008) (in Japanese)*

In this study, it is proposed to use frictional connections by vises for the repair of bridge members, such as temporary joints in which corroded rivets or high strength bolts are replaced to new ones and for emergency repairs of members where fatigue cracks are detected. The tensile loading tests and the cyclic tensile loading tests are carried out to confirm the slip behavior of the frictional connections by vises. In the experiment, three types of specimens are prepared, a single frictional surface of vised joints, two frictional surfaces of vised joints and high strength bolted frictional connections. It is found that the vised frictional specimens have the same slip coefficient as that of the high strength bolted frictional specimens. However, it is necessary to investigate the appropriate value of installation torque for the vised frictional joints in case of the emergency repairs of bridge members.

### **Study on Strengthening Effectiveness of I Shaped Steel Girder with High Modulus CFRP Strips**

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*Journal of Structural Engineering, Vol.54A, JSCE, pp. 834-841 (2008) (in Japanese)*

The use of CFRP sheets and plates instead of steel plates can be effective for strengthening a superannuated existing steel I girder with regard to improving its load carrying capacity. Experimentally investigated in this study is the strengthening effect of I shaped steel girder with high modulus CFRP strips through a bending test by using four girder specimens. The strengthening effect derived from the differences in the elastic modulus of CFRP plates are verified through the comparisons between the strengthening effects by the CFRP plates of the high tensile strength and the high elastic modulus. As result, it is concluded that CFRP plates of high elastic modulus shows better improvements in the load carrying capacity of superannuated steel girders than CFRP plates of high tensile strength.

### **Evaluation of Ultimate Strength of Longitudinally and Transversely Profiled Steel Plate**

Takuji KUMANO (Kawatetsu Bridge and Steel Structure), Takashi YAMAGUCHI, Kunitomo SUGIURA (Kyoto University), Yasuo SUZUKI (Utsunomiya University) and Kunitaro HASHIMOTO (Kyoto University)

*Steel Construction Engineering, Vol.15, No.57, JSSC, pp.87-102 (2008) (in Japanese)*

Tapered steel plates are classified into 2 categories by the difference of directions of applied force and thickness change; Longitudinally profiled steel plates and transversely profiled steel plates. It is confirmed that the former can be applied to steel bridges and make it possible to reduce the construction cost and improve structural rationality. The latter is also studied and it is shown that it is also effective for improving strength and ductility in case of the square plate by parametric numerical analysis. Proposed herein is the evaluation of ultimate strength of both tapered steel plates considering various boundary conditions, longitudinally and transversely profiled steel plate and its validity has been discussed.

### **Slip Coefficient and Contact Surface Condition of Friction Type of High Strength Bolted Connections**

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*JSCE Journal A, Vol.64, No.1, JSCE, pp.48-59 (2008) (in Japanese)*

Slip coefficient of friction type of high strength bolted connections is well known to depend on the condition of contact surfaces. However, the coefficient is determined as 0.4 in the Japanese specifications for steel highway bridges, in which contact surfaces are to be rough without mill scale or have inorganic zinc rich paint. If the coefficient higher than 0.4 can be applied, the number of bolts and size of splice plates can be reduced. In this study, slip resistance tests on the joints with various contact surface conditions have been done. A lot of existing data have been collected and assembled. On the basis of above examinations, slip coefficient is proposed in consideration of contact surface conditions.

### **Experimental Study on Base Anchors with High Fatigue Resistance for Additional Column Structures on Elevated Bridges**

Tomohiko ISHIBASHI (Nasu Denki-Tekko Co., Ltd.), Takashi YAMAGUCHI, Toshiyuki KITADA, Kanji NAKAMOTO (Nasu Denki-Tekko Co., Ltd.) and Masahide MATSUMURA

*Steel Construction Engineering, Vol.15, No.58, JSSC, pp. 69-77 (2008) (in Japanese)*

This paper deals with the base anchor structures with high fatigue resistance for additional column members such as poles for lighting and information on elevated highway bridges. The lower part of the steel column and the bottom flange plate are generally strengthened with triangular rib plates in order to set tightly the additional column member on the highway bridge. However, unfavorable stress concentration is often observed around the welded zone at the tops of the triangular rib plates. These welded zones are also one of the locations where welding defect tend to occur because of the difficulty of welding. For these reasons, two new types of base anchor structures without triangular rib plates are proposed. These are the flare type and the increased thickness type of base anchor structures. It is concluded through the fatigue test that these new type base anchor structures could have high fatigue resistance compared with the ordinary base anchor structure using triangular rib plates. It is also observed from the fatigue test that the fatigue strength of the base anchor structure using triangular rib plates can be improved substantially by finishing smoothly the welding beads at the tops of the triangular rib plates.

### **Effectiveness of Rupture Controllable Steel Side Blocks for Elevated Girder Bridges with Isolation Bearings**

Naohiro ASADA, Masahide MATSUMURA, Toshiyuki KITADA, Minoru SAKAIDA (Teikoku Engineering

Consultants Inc.) and Masahiko YOSHIDA (Kawaguchi Metal Industries Co., Ltd.)

*Bridge Maintenance, Safety, Management, Health Monitoring and Informatics*, Taylor & Francis Group, London, UK, (8pages, CD-ROM) (2008)

Steel side blocks, which are generally designated a joint protector to restrain the transverse displacement of an isolated bridge, are set near both sides of isolating bearings. In considering more effective and rational use of the side blocks, the side blocks can be designed to have the following two functions; the joint protector against the Level 1 Earthquake as well as a knock-off member to provide isolating effect against the Level 2 Earthquake. Then, a steel side block with the knock-off function has been developed by the authors and design formula of the side block is proposed by referring to static and dynamic loading test results. Also presented in this paper is the dynamic behavior of a viaduct with isolation bearings and the side block with the knock-off function.

#### **Investigation on the Severe Corroded Steel Girder Bridge, Hakkeibashi-Bridge**

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*Bridge Maintenance, Safety, Management, Health Monitoring and Informatics*, Taylor & Francis Group, London, UK, (8pages, CD-ROM) (2008)

Hakkeibashi-Bridge consists of 4 simple supported girder bridges. Three of them are steel bridges which has 7 steel I girders and RC slab, and the rest one is RC slab bridge. This bridge has been erected at Aomori prefecture about 50 years ago and removed due to severe corroded damages and deterioration of the slab in 2007. The objectives of this study are to investigate the corrosion of the steel girders in detail and to make the residual load carrying capacity of the girder clear by using some parts of girders which were taken from Hakkeibashi-Bridge.

#### **Eigenfrequency Estimation for Bridges using the Response of A Passing Vehicle with Excitation System**

Yoshinobu OSHIMA (Kyoto University), Takashi YAMAGUCHI, Yoshikazu KOBAYASHI (Nicizou Tech, Co. Ltd.) and Kunitomo SUGIURA (Kyoto University)

*Bridge Maintenance, Safety, Management, Health Monitoring and Informatics*, Taylor & Francis Group, London, UK, (8pages, CD-ROM) (2008)

In this study, we proposed and experimentally evaluated the method to extract the low-order eigenfrequencies of a bridge from the responses of a passing vehicle. In the experiment, associated with the monitoring vehicle, the exciting heavy vehicle with the excitation machine to yield a constant vibration also passed the bridge. As a result, the bridge vibrated with some dominant frequencies but close to the exciting frequency. And the estimated frequency based on the unsprung mass responses agreed well with the dominant frequency directly monitored on the bridge; however one trial can extract one frequency. Thus to extract low-order eigenfrequencies, the monitoring vehicle and the exciting vehicle with several frequencies need to pass the bridge several times and the resonance frequencies must be extracted in the Bode diagram drawn by the estimated frequencies and its intensity.

#### **Blind Source Deconvolution of Bridge Vibration Components using Independent Component Analysis**

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*Journal of Applied Mechanics*, Vol.11, JSCE, pp. 971-978 (2008) (in Japanese)

This paper reports on the blind source deconvolution of bridge vibration from the vehicle response using independent analysis. The vibration response of the vehicle passing a bridge may include bridge vibration. Thus herein, the eigenfrequency of a bridge is estimated by the vehicle response using independent component analysis (ICA), based on the system model of a vehicle. A state space model and ARMA model is combined into system model for ICA algorithm. In the experiment, a vehicle with measurement system passes a simple beam bridge, together with a heavy vehicle. The responses of sprung and unsprung mass are analyzed by ICA to extract the bridge vibration component. As a result, it is found that adequate degree for ARMA model must be determined to obtain bridge eigenfrequency.

#### **Pilot Experiments of High Strength Bolted Friction Joints using Ultra High Strength Bolt**

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*Steel Construction Engineering*, Vol.15, No.58, JSSC, pp.99-107 (2008) (in Japanese)

Ultra high strength bolt, which strength is more than about 1600MPa has been developed by NIMS. For steel connections of civil/building structures, such bolts will make it possible to reduce the fabrication/construction cost and to change such joints simple and rational. In this study, pilot experiments using Ultra high strength bolts has been carried out to discuss feasibility of application of such bolts and to find further research problems for general

use. 3 experiments have been executed; tensile tests for bolts considering actual use, nut rotation angle tests and tensile tests for frictional joints.

### **Characteristics of Cylinder-Type Dampers and Application Example to An Existing Arch Bridge**

Masahiko YOSHIDA (Kawaguchi Metal Industries Co., Ltd.), Takehiko HIMENO (Kawaguchi Metal Industries Co., Ltd.), Masahide MATSUMURA and Toshiyuki KITADA

*Steel Construction Engineering, Vol.15, No.59, JSSC, pp. 33-44 (2008) (in Japanese)*

Damping devices, which are properly designed and installed, are effective in reducing the working stress, force, and displacement etc. of bridge structures during an earthquake. In application of damping devices, it is necessary to realize the basic characteristics of each device in terms of velocity dependence before selecting a device, adequate modeling for dynamic response analysis and so on. Then presented in this paper are the characteristics of the cylinder-type damper, which is one of damping devices for bridge structures, and an application example to an existing arch bridge.

### **Proposition of Rapture Controllable Steel Side Blocks for Viaduct with Isolation Bearings**

Masahide MATSUMURA, Minoru SAKAIDA (Sakaida Bridge Engineering & Consulting), Masahiko YOSHIDA (Kawaguchi Metal Industries Co., Ltd.), Toshiyuki KITADA, Masaki MORITA (Kawaguchi Metal Industries Co., Ltd.) and Naohiro ASADA

*Steel Construction Engineering, Vol.15, No.59, JSSC, pp. 45-56 (2008) (in Japanese)*

Steel side blocks are set near the both sides of the rubber isolating bearings of a viaduct and are designed as a joint protector to restrain the transverse displacement of the bridge against the Level 1 earthquake. The steel side block knocked off as a fuse member by the seismic load larger than the specified one can provide isolation effect not only in the direction of the bridge axis but also in the transverse direction against the Level 2 earthquake. Then this type of steel side block has been proposed by the authors on the basis of static loading tests. Proposed in this paper is a revised design method of this type of steel side block considering a contact speed between the side block and the bridge superstructure through dynamic loading test.

### **Analytical Study on Validity of Seismic Retrofitting Method by Filling Hollow Steel Members with Concrete in Deck Type Arch Bridge**

Satoshi UCHIDA (NEWJEC Inc.), Masahide MATSUMURA and Toshiyuki KITADA

*Steel Construction Engineering, Vol.15, No.59, JSSC, pp. 23-32 (2008) (in Japanese)*

Steel column members with Embedded Plastic Segment (EPS) has been developed and proposed as a new seismic retrofitting technique for existing steel bridge piers to enhance the ductility with less increment in the ultimate strength of the column members. In this paper, an application of the EPS method together with the ordinary concrete-filled method to an existing deck type arch bridge is investigated through static and dynamic analysis of the arch bridge. It is concluded from this analytical investigation that the validity of the application of the seismic retrofitting method using the EPS method together with the ordinary concrete-filled method into the side ones of the deck supporting rigid framed column members and the arch ribs of the deck type arch bridge can be effective.

### **Fundamental Study on Ultimate Strength of Plate Girder Ends with Cracks Around Sole Plates Subjected to Predominant Shear Force**

Im-Ho KIM, Takashi YAMAGUCHI, Toshiyuki KITADA and Tomoaki NAKAMURA (Yokogawa Construction, Co Ltd.)

*JSCE Journal A, Vol.64, No.4, JSCE, pp. 841-856 (2008) (in Japanese)*

The residual load carrying capacity of a plate girder end panel with a fatigue crack around the sole plate subjected to predominant shear force is investigated experimentally and analytically in this study. First of all, the experiment is carried out using 3 types of the test specimens with cracks of different length. Then, elasto-plastic and finite displacement with analysis is conducted varying the crack length for investigating the influence of the crack length on the residual load carrying capacity. It can be found through the experiment and analysis that the load carrying capacity of the plate girder end panel with a crack passing throughout the cross section of the lower flange plate and penetrating the lower web part shorter than 1/6 times the web height does not decrease significantly compared with that of the intact plate girder end panel. Finally it is suggested that the residual shear buckling capacity of the plate girder end panel with the crack can be approximately evaluated by using the plate slenderness parameter  $R_{tw}$  using the reduced aspect ratio considering the location of the crack.

### **Experimental Study on Bending Behavior of High Strength Bolted Tensile Joints with Sealant**

Yasuo SUZUKI (Utsunomiya University), Megumi NOZAWA (Utsunomiya University), Akinori NAKAJIMA

(Utsunomiya University) and Takashi YAMAGUCHI

*The 11th East Asia-Pacific Conference on Structural Engineering & Construction*, Taipei, Taiwan, (CD-ROM), (2008)

The short type bolted tensile connection such as end-plate connection is one of the rational methods for connecting steel structural members because of their good characteristics, such as high rigidity, high fatigue durability, easiness of erection without using special facilities and so on. However, in the case of end-plate connections, the prying force occurs due to the deformation of the end plates, and the prying force reduces the strength of the joint. In order to make it possible to reduce the prying force easily, the sealant named as deflective filler plate for the bolted tensile connection has been proposed. In this study, in order to examine the applicability of the sealant, which consists of soft rubber and steel rings, to the steel bridge structures, experimental tests for I-shaped beam specimens connected by the end-plate connection with the proposed sealant are carried out. Based on the experimental results, the influence of the sealant on the bending behavior of the joints is discussed.

### **Strength and Ductility of Steel Plate Girders with Tapered Web Plate**

Kosuke OTSUKA (Kyoto University) , Takashi YAMAGUCHI, Kunitomo SUGIURA (Kyoto University) , Kunitaro HASHIMOTO (Kyoto University) , Yasuo SUZUKI (Utsunomiya University) and Takuji KUMANO (JFE Engineering Corp.)

*The 11th East Asia-Pacific Conference on Structural Engineering & Construction*, Taipei, Taiwan, (8pages, CD-ROM) (2008)

The Steel plates with varied thickness have a potential for rationalization of steel bridge design. For example, longitudinally profiled steel plates have been already applied to flanges of an I-shaped girder or a box girder to reduce the weight of the steel bridge and the process of bridge construction successfully. Recently, the analytical investigation on girders with transversely profiled web plate has been carried out, and it was concluded that there exists the effective cross sectional shape of steel plate from the viewpoint of the load carrying capacity and ductility. In this paper, the static loading tests of I-shaped girders with a web plate profiled in depth are carried out. It is found that the girder which has a web plate with larger thickness in the middle height has superiority in shear buckling strength; on the other hand, that the girder which has a web plate with larger thickness as close to flange plates has superiority in bending strength.

### **Experimental Study on Bending Behavior of Box Section Column with Transversely Profiled Steel Plates**

Masaya SHIROTANI (Kyoto University) , Takashi YAMAGUCHI, Kunitomo SUGIURA (Kyoto University) , Kunitaro HASHIMOTO (Kyoto University) , Yasuo SUZUKI (Utsunomiya University) and Takuji KUMANO (JFE Engineering Corp.)

*The 11th East Asia-Pacific Conference on Structural Engineering & Construction*, Taipei, Taiwan, (7pages, CD-ROM), (2008)

Recently, as one of the rational design of steel structures, applicability and efficiency of using tapered steel plates to the structures have been investigated in Japan. In this study, the cyclic loading test for the box column with the tapered cross section have been carried out to investigate the efficiency on the load carrying capacity and the deformability of it experimentally. In the experiment, two kinds of test specimens have been prepared. One is the column with the uniform thickness cross section, and the other is the column with the tapered cross section, which taper ratio is 0.038. The width-thickness ratio for these two specimens is 0.53 defined by the average thickness of the cross section. It is found that the load carrying capacity and the local buckling behavior of the column with the tapered cross section is almost same as those of the column with the uniform thickness cross section. However, it is confirmed that the energy absorption capacity and the deformability of the column with the tapered cross section are significantly improved compared with those of the column with the uniform thickness cross section.

### **Fundamental Study on Health Monitoring of Bridge by using Vehicle-Bridge Interaction**

Kei KITAGAKI, Takashi YAMAGUCHI, Toshiyuki KITADA, Kunitomo SUGIURA (Kyoto University) , Yoshinobu OSHIMA (Kyoto University) and Kunitaro HASHIMOTO (Kyoto University)

*The 11th East Asia-Pacific Conference on Structural Engineering & Construction*, Taipei, Taiwan, (8pages, CD-ROM), (2008)

In this study, in order to identify the natural frequencies of bridges by the vehicle response information, a vehicle running test for a typical steel girder bridge constructed about 35 years ago has been carried out several times when the structural characteristics of the bridge was changed by the repair works. The bearings are changed to rubber bearings and some strengthening girders are installed in the repair works. The change of the natural frequency due to the structural change by each repair work is discussed based on the measurement results. It is

concluded that the bridge vibration characteristics and its mode by Fourier spectrums of a microtremor measurement and the vehicle running tests have been changed.

#### **Investigation on Development of Multi-Column Bridge Pier System and its Application to Viaducts**

Masahide MATSUMURA, Nobuhito OCHI (Akashi National College of Technology), Toshiyuki KITADA and Shigeki OKASHIRO (Japan Bridge Engineering Center)

*Journal of Constructional Steel, Vol.16, JSSC, pp. 139-146 (2008) (in Japanese)*

Steel bridge piers having structural redundancy against strong seismic action and having economical advantage are required after the Hyogo-ken Nambu Earthquake. Presented in this paper are a design concept and the results of numerical calculation for investigating the effect of a multi-column pier system of high seismic performance newly developed for the purpose of using it as a steel bridge pier for a viaduct. Fundamental behavior and adaptability of the design concept of the proposed bridge pier are investigated through shaking table test and dynamic response analysis. It is concluded that the design concept of the proposed bridge pier is verified and the proposed bridge pier is adaptable for bridge pier of a viaduct. Further investigations are necessary for the appropriate design of the practical structure using the proposed bridge pier.

#### **Analytical Study on Seismic Retrofitting Effect using Low Yield Steel Plates**

Masahide MATSUMURA, Tomohiko ISHIBASHI (Nasu Denki-Tekko Co., Ltd.), Hideo ISHA (Techno art cruise), Jun OKADA (Hitachi Zosen Corp.) and Toshiyuki KITADA

*Journal of Constructional Steel, Vol.16, JSSC, pp. 567-570 (2008) (in Japanese)*

Low-yield steel plates are used to absorb seismic energy through the plastic deformation of the steel plate under the cyclic loading. Investigated in this study are strengthening effects on steel bridge piers with rectangular cross section by adding the steel plate of low-yield stress through FEM analysis. It is the aim of the strengthening that the low-yield steel plates deform plastically prior to the steel bridge pier so as to reduce the damage of the steel bridge pier. It can be concluded that additional structural damping is obtained by installing the low-yield steel plate while the bridge pier is in elastic condition.

#### **Analytical Study on Seismic Performance Evaluation by Focusing on Modeling of Cylindrical Steel Bridge Piers**

Yasuyuki NAKANISHI, Masahide MATSUMURA and Toshiyuki KITADA

*Journal of Constructional Steel, Vol.16, JSSC, pp. 191-196 (2008) (in Japanese)*

Dynamic response analysis has been adapted to reveal the dynamic behavior and to check the safety of the structures into seismic design. The development of analytical tools enables to calculate the structured behaviors including a local buckling of component plates precisely. While a beam-column element of generally used in the seismic design in the design due to easiness in the modeling and a cost effectiveness. Then, analytically investigated in this paper is a dynamic response of a cantilever type single column member with circular cross section and with a squash load by focusing on effects of modeling method of the column member on shear deformation and local buckling.

#### **Stability Analysis of Transmission Tower on Deep Foundations Considering 3D Soil-Foundation-Structure Interaction**

Yuki YAMAKAWA (Tohoku University), Shoya NAKAICHI (Tohoku University), Kiyohiro IKEDA (Tohoku University), Toshiyuki OZAKI (Kyusyu Electric Engineering Consults Inc.), Masahide MATSUMURA and Toshiyuki KITADA

*JSCE Journal C, Vol. 64, No. 4, JSCE, pp. 782-801 (2008) (in Japanese)*

A series of three-dimensional soil-foundation-structure coupled analyses of transmission tower is performed to investigate the strength of the entire system. Nonlinear finite element analysis is conducted to capture the progressive failure of the foundations and the buckling behavior of the tower. In the series of analyses, various landforms, load directions and neighboring of the piles are considered to evaluate the performance of the foundation under actual condition. The coupled analysis of the entire system reveals that the displacement of the foundation is influential on the collapse of the tower. Moreover, it is pointed out that the critical component in the collapse of the entire system drastically changes depending on the mode of external loads.

#### **Sensitivity Law and Probabilistic Variation of Elasto-Plastic Ultimate Strength of Imperfect Plates**

Kiyohiro IKEDA (Tohoku University), Toshiyuki KITADA, Yuki YAMAKAWA (Tohoku University), Masahide MATSUMURA, Akira SHIBASAKI (Tohoku University) and Yuuichi KARINO (Tohoku University)

*JSCE Journal A, Vol. 64, No. 4, JSCE, pp.926-934 (2008) (in Japanese)*

The mechanism of imperfection sensitivity of elastic–plastic plates under compression is complex as they undergo elastic and/or plastic buckling, dependent on their width–thickness ratio. The Koiter power law is extended by implementing the quadratic law so as to describe the elastic and plastic buckling of the plates with probabilistically varying initial deflection and yield stress. The finite-displacement, elastic–plastic analysis was conducted on simply-supported square plates under compression by varying the plate thickness, yield stress, and the initial deflection of a sinusoidal form. In accordance with the change of the mechanism of buckling, the power law is changed pertinently to describe the complex imperfection sensitivity of the compression plates in a synthetic manner. A theoretical framework to describe the probabilistic variation of the ultimate strength of the plates has been proposed, and has been put to use in the evaluation of the influence of width–thickness ratio.

### **Fundamental Study on Seismic Response of Steel Bridge Piers through Dynamic Analysis and Shaking Table Test using Small-size Specimens**

Masahide MATSUMURA, Yasuyuki NAKANISHI and Toshiyuki KITADA

*International Journal of Steel Structures, Special Issue on “Dynamics of Steel Bridges”, Vol.8, pp.261-266 (2008)*

Understanding of a dynamic responses of structure subjected to an earthquake motion is a key in evaluating a structural safety against the earthquake. In the analysis, some assumptions onto material properties such as stress-strain relationship of material, damping properties and so on are employed. While in the shaking table test these assumptions are included into the test results except for some items due to a specimen size.

Then investigated in this paper is dynamic response of a cantilever type single steel column with a squash loading on the top of the column through the shaking table test using 2 types of smaller size specimens. Experimental results are compared with analytical results of the dynamic response analyses. It is concluded that both the analytical and test results indicate good agreements when an accurate analytical model, which details the cross-sectional profile of the specimen and the material properties, is employed.

### **Investigation of Estimating Overall Buckling of Steel Columns by Geometrically and Materially Nonlinear Analysis**

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*Journal of Constructional Steel, Vol.16, JSSC, pp.203-208 (2008) (in Japanese)*

A guideline proposed some seismic design methods on the basis of the idea that overall buckling of steel column is considered in geometrically and materially nonlinear frame analysis automatically. However, the setting way of initial imperfections such as residual stress in the frame analysis was not specified, whereas many previous studies clarified that overall buckling strength of steel columns is affected by initial imperfections. In this study, fiber model analyses with considering the effects of initial imperfections were undertaken for previous experimental results of steel column so as to reveal that overall buckling is estimated in geometrically and materially nonlinear frame analysis automatically.