Assessment on Ultimate Strength of Composite Hybrid Steel Box Girder with Thinner Web Panel by Using FE Analysis

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In case of design of the hybrid girder, there is a certain limitation of the width to thickness ratio of the web specified in some design codes. However, it has been reported experimentally that the composite action of the hybrid girder with much thinner web plate and RC slab can make the ultimate bending strength in positive flexure improve up to fully plastic bending moment. In this study, in order to investigate both the limitation of width to thickness ratio of the web and the ultimate strength of the hybrid girder which consists of different grades of steels for the thinner web and the flange, a parametric FE analysis is carried out for thr hybrid girders subjected to the positive flexure by varying the width to thickness ratio of the web, material strengths of the steels. It is concluded that the ultimate strength of the hybrid girder with thinner web and high yield strength steel, YP500 flange, can be evaluated by the full plastic bending moment and the reduction factor considering the neutral axis position and the width to thickness ratio of the compression area at the web.

Experimental Study on Member-Axial Stress-Strain Relationship of Concrete-Filled Steel Members Subjected to Compression, Bending and Torsion

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Steel Construction Engineering, Vol.13, No.50, pp.83-93(2006) (in Japanese).

It is important to investigate the structural behavior of concrete-filled steel members with transverse constraint up to and in the vicinity of the ultimate state for evaluating the strength and ductility of these members. For this purpose, the structural behavior and the ultimate strength and ductility of both concrete-filled steel box members subjected to compression and bending and concrete-filled steel box and circular members subject to torsion are investigated experimentally. The influence of the lateral constraint on the constitutive behavior of encased concrete and on the strength and ductility of the concrete-filled members with transverse constraint is verified.

Recent Retrofitting Trend of Steel Bridges in Japan

Toshiyuki KITADA and Masahide MATSUMURA

The 26th Republic of China and Japan Engineering and Technology, Taipei (2006) (in Chinese, in Japanese).

This paper presents recent retrofitting trend of steel bridges in Japan. Retrofitting trends are to be distinguished to the topic onto seismic retrofitting and the others. The topic onto seismic retrofitting includes damages due to the Hyogo-ken Nambu Earthquake and the seismic retrofitting techniques, seismic design in Japan, isolation bearings and bridge piers of high seismic performance, seismic retrofitting method for a long span bridge and simulation program for dynamic response analysis of steel bridges. The other topics include aging damages to existing steel bridges and the repair method, environmental surroundings of existing steel bridges, maintenance and development of bridge management system.

Experimental Study on Load Carrying Capacity of Composite Hybrid Steel Box Girder with RC/SW Slab using High Performance Steel

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In general, the hybrid girder consisting of different grades of steels for the web and the flange is superior in the cost to the homogenous girder consisting of same grades of steels. However, for the hybrid girder, the width to thickness ratio of web is required to be smaller than that for the homogeneous girder because of yielding of web before flange yields. In this study, proposed is the composite hybrid girder with newly developed high performance steel, in which the web and the upper flange are made of the normal grade steel, but the lower flange is by the high performance steel. It is demonstrated experimentally that by making the width of rectangular box section narrow and combining the hybrid girder with RC/SW slab, the web can be a non-stiffened thinner plate with the large width to thickness ratio, so that the proposed girder system can contribute the cost reduction.

Strrength and Ductility of Transeversely Profiled Compression Flange of Steel I Section

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Journal of Structural and Earthquake Engineering (Division A),Vol.62, No.3, pp.531-542(2006) (in Japanese)
Studied herein is the strength, ductility and energy absorption capacity of steel plate profiled transversely under uniform compression. In order to assess the effect of the taper ratio of steel plate thickness on the structural performance, the elasto-plastic finite displacement analysis is carried out, varying the taper ratio as well as the plate slenderness parameter. The analysis is also extended to assess the bending performance of I-shaped steel member with tapered flange and web. It is concluded that the transversely profiled steel plate in the shape of convexity can have superiority in strength, ductility as well as energy absorption capacity.

Proposition of Multi-column Pier System with High Seismic Performance using Steel Tubes for Elevated Bridges
Masahide MATSUMURA, Toshiyuki KITADA and Shigeki OKASHIRO (NEWJEC Inc.)
Tubular Structures XI, Taylar & Francis, pp.677-681(2006)
Steel bridge piers of high seismic performance and economical advantage are required in Japan especially after the Hyogo-ken Nambu Earthquake. Presented in this paper are a design concept and a numerical calculation on a newly developing multi-column pier system with high seismic performance for elevated bridges using plural standardized steel tubes for structural purpose. Fundamental behavior and adoptability of the multi pier system and its design concept are verified through FEM analysis.

Study on Seismic Behavior of Steel Arch Bridges with Semi-Rigid Jointed Connections
Shugang SONG, Takashi YAMAGUCHI, Toshiyuki KITADA and Masahide MATSUMURA
The Tenth East Asia-Pacific Conference on Structural Engineering and Construction, pp.273-278, Bangkok, Thailand, (2006)
In this study, an exiting steel arch bridge is adopted as the analytical model for the dynamic response analysis carried out by using EPASS/USSP for investigating the effect of the semi-rigid connection between the posts and the bracing members onto the seismic behavior of the bridge. Based on the numerical results, the influence of the joint rigidity on the seismic performance of the bridge is discussed through comparing the original model of the rigid connection with the model of the semi-rigid connection. It is proved that the maximum response displacement becomes a little bit larger but the plastic region of the members decreases by using the semi-rigid connection.

On Future Development and State of the Art on Buckling and Ultimate Strength in Steel Bridge Field
Toshiyuki KITADA
Structural Engineering Frontier, Nagoya University, pp.69-95(2006) (in Japanese).
This paper describes, (1)assuming that almost all the participants of this Workshop on Structural Frontier are complete beginners at the subjects of steel bridge engineering and the buckling and ultimate strength of steel bridges and bridge members, first of all, fundamental items necessary for the participants to be able to understand my lecture. (2)Then, the brief state-of-the-art on the buckling and ultimate strength is described. (3)After that, described in this paper is what I have done until now in this state-of-the-art on the buckling and ultimate strength. (4)Next, items are shown that I was delighted with so far in my researches on the buckling and ultimate strength. (5)Then, some items are shown that I had difficulties in my researches on the buckling and ultimate strength. (6)And then, described are the issues that I have not still been able to solve among the difficult items. (7)Research subjects necessary for the future sustainability of the field on the buckling and ultimate strength are also shown. (8)Items that researchers and engineers should not do on the buckling and ultimate strength are described. (9)Then, items that recent researchers and engineers can not do are shown. (10)Finally, desirable attitudes are commented for researchers in the field of the buckling and ultimate strength and engineers concerning works on the buckling and ultimate strength.

Deformation Capacity of Steel Plated Panels with Key Member Bolted
Masahide MATSUMURA, Toshiyuki KITADA and Yoshihiko TAKADA (Hanshin Expressway Management Technology Center)
Proceedings of SDSS 2006, International Colloquium on Stability and Ductility of Steel Structures, Lisbon, Institute Superior Tecnico, Vol.2, pp.935-942(2006)
Investigated in this paper is a new retrofitting technique enhancing the deformation capacity of a steel plated panel by attaching an additional stiffening member with high strength bolts on it. Firstly, the fundamental stiffening effect of the technique is analytically investigated. Next, a cyclic loading test using 3 types of beam-column specimens with thin-walled box cross section; a basic beam-column type specimen without stiffening, a stiffened

version by the additional stiffening member welded and also a stiffened version with the one bolted is carried out to verify the technique and to observe the collapse mechanism. Both the analytical and experimental results show that the additional stiffening member bolted to the steel plated panel with insufficient ductility capacity effectively works and can improve the deformation capacity as expected.

Development of an Elasto-Plastic and Finite Displacement Dynamic Analysis System for Spatial Bridge Structures Consisting of Thin-Walled Steel and Composite Members

Masato KANO (JIP Techno Science Corp.), Masahide MATSUMURA and Toshiyuki KITADA

IABSE Reports, Volume 92, pp.102-103(2006)

This paper describes the outline of EPASS/USSP, a multi-purpose static/dynamic FEM solver for spatial bridge structures consisting of thin-walled and composite members, and its several new features. Numerical examples are analyzed and the result of a model of an actual Nielsen-type bridge by the program is compared with the one of experimental tests to verify the accuracy of the program. Application of the elasto-plastic and finite displacement dynamic analyses to design for seismic repair and reinforcement of existing bridge structures is also considered through an analysis of an actual langer girder bridge.

Several Considerations on Bolted Joints Expecting Bearing and Friction Resistance

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Journal of Constructional Steel, JSSC, Vol.14, pp.647-654(2006) (in Japanese).

In this paper, the design method of the bolted joints expecting bearing and friction resistance is studied by using the literature and calculation. We treated the bolted joints with some clearance between a bolt and a hole considering construction. The mechanics of resistance and the limit states are classified considering joint stability and its ultimate behavior. And a design method is proposed considering its energy absorbtion capacity by slip.

Fundamental Study on Evaluation Method for Ultimate Strength of Steel Structural Members Considering Various Kinds of Uncertainties

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Haltec Technical Report, No.3, pp.106-109(2006) (in Japanese).

Steel structural member has some imperfection, which is not usually considered into calculating the ultimate strength of them. However sometime the imperfection influences seriously on the ultimate strength. Then, analytically investigated and suggested in this paper is an evaluation method for the ultimate strength of steel plated panel by focusing on initial deflection of the steel plate and yield strength of steel material.

Experimental Study on Vibration Control of Steel Poles Using Chloroprene Rubber

Tomohiko ISHIBASHI, Toshiyuki KITADA and Takashi YAMAGUCHI

Memoirs of the Faculty of Engineering, Osaka City University, Vol. 47, pp.25-30(2006) (in Japanese).

Recently, it is pointed out that the bridge vibration due to the traffic causes damage to a pole type steel structure like a lighting pole or a marker pole on an elevated bridge. As some damage induces collapse in the severe case and the collapse may cause secondary accident resulting in injury, vibration problem of the pole type steel structure is to be solved as soon as possible. As the number of such steel poles is too large to maintain sufficiently, it is important to avoid resonance and to improve damping effect of the steel pole by some economical technique. Then the authors present in this paper a vibration controlling technique for a steel pole by using chloroprene rubber and the effectiveness of the technique is investigated experimentally. It is found through the vibration test that there is large effect even if the rubber of the special material is not used.