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Guidelines for Seismic Design of Highway Bridges

公路桥梁抗震设计细则

Issued on August 29, 2008 **Implemented on October 1, 2008**

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Chief Development Organization: Chongqing Communications Research and Design Institute
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Announcement on Publishing "Guidelines for Seismic Design of Highway Bridges" (JTG/T B02-01-2008)

"Guidelines for Seismic Design of Highway Bridges" (JTG/T B02-01-2008) is hereby published as a professional recommendatory standard of highway engineering. It will be implemented on October 1, 2008. Corresponding proportions in the original standard "Specifications of Earthquake Resistant Design for Highway Engineering" (JTJ 004-89) shall be abolished simultaneously.

The Ministry of Transport is responsible for the management and explanation of this guideline. Chongqing Communications Research and Design Institute are in charge of the routine explanation and management. All relevant organizations are kindly requested to sum up experiences in actual practices during the process of implementing this guideline. The relevant opinions, whenever necessary, can be posted or passes on to Chongqing Communications Research and Design Institute for revision reference.

It is hereby announced.

Ministry of Transport of the People's Republic of China
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Foreword

According to the requirements of Document Highway Fa [1999] No.82 issued by the Ministry of Transport - "Notice on Issuing the Development and Revision Plan of National Construction Standards, Codes and Quota in 1999", Chongqing Communications Research and Design Institute organized to revise the seismic design parts for bridges specified in "Specifications of Earthquake Resistant Design for Highway Engineering" (JTJ 004-89) and prepared "Guidelines for Seismic Design of Highway Bridges".

During the preparation process, the preparation team have carried out related special studies, learned the research findings and actual engineering experiences of the relevant domestic scientific research, academy and design institutes, consulted and drawn lessons from domestic and international advanced seismic standards and codes. After the draft standard for comment was completed in October, 2005, they had solicited broad opinions from the relevant departments and individuals on communications, railways, construction and earthquake throughout the country. According to the feedback opinions and advice, the preparation was finally completed in July, 2008 through repeated discussions and revisions.

The post-revised "Guidelines for Seismic Design of Highway Bridges" includes 11 chapters and 4 annexes, with the main revised contents as follows:

(1) The application scope has been expanded and contents about seismic design for irregular bridges have also been increases. As for cable stayed bridges, suspension bridges, oversize span beam bridge and arch bridges whose single span exceeds 150m, the seismic design criteria and relevant regulations have been described. Design principles and relevant regulations for isolated bridges also have been increased.

(2) The corresponding fortification standards and fortification targets have been revised by adopting two-level fortification, two-stage design seismic design ideology. And single-strength seismic design has been revised to seismic design controlled by strength and deformation these two indicators.

(3) The relevant regulations of site and foundation have been supplemented and detailed.

(4) The earthquake action and horizontal design acceleration response spectrum have been revised with the response spectrum period being increased from 5s to 10s. In addition, contents about the site coefficient, damping adjustment coefficient and vertical design acceleration response spectrum, as well as the relevant regulations of the earthquake action component combinations and design seismic ground motion time history also have been increased; while the combined effect coefficient has been cancelled. Calculation formulae for seismic earth pressure have been supplemented and revised.

(5) Relevant regulations on ductility seismic design of the bridges and criteria for capacity protection of the bridges as well as the ductility structural details design have been increased.

(6) Relevant regulations on seismic analysis and modeling criteria and seismic analysis methods have been increased.

(7) Relevant regulations on seismic measures have been revised.

All relevant organizations are kindly requested to contact with the chief development organization timely in terms of any problem or advice and opinions (address: No.33, Xuefa Avenue, Nan'an District, Chongqing, 400067 China; Telephone: +86-023-62653430) in order for revision reference.

Chief Development Organization: Chongqing Communications Research and Design Institute

Participating development organizations: Tongji University

Institute of Engineering Mechanics, China Earthquake Administration

Tsinghua University

Chang'an University

Dalian University of Technology

Yunnan Research Institute of Highway

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Contents

1 General Provisions

1.0.1 This guideline was established with a view to implementing "Law of the People's Republic of China on Protecting Against and Mitigating Earthquake Disasters", adopting the policy of prevention first, alleviating the earthquake damages on highway bridges, protecting people's life and property safety, decreasing economic losses and better exerting the functions of the highway traffic network and its actions in the seismic relief.

1.0.2 This guideline is mainly applicable to concrete beam bridges, masonry or concrete arch bridges whose single span is no more than 150m. As for the cable stayed bridges, suspension bridges and oversize span beam bridges and arch bridges whose single span exceeds 150m, they may be designed referring to the seismic design criteria given in this guideline.

1.0.3 According to the significance of highway bridges and difficulty of restoration (emergency repair) in this guideline, the seismic fortifications for bridges are classified into four classes, namely, class A, class B, class C and class D, respectively corresponding to different seismic fortification criterions and fortification targets.

1.0.4 As for highway bridges in areas where the seismic fortification intensity is magnitude 6 and above, seismic design must be carried out for them.

1.0.5 This guideline is applicable to the seismic design of highway bridges in areas where the seismic fortification intensity is magnitude 6, 7, 8 and 9. As for bridges in areas where the seismic fortification intensity is larger than magnitude 9 and large-span or special bridges with special requirements, their seismic design shall be studied specially and conducted according to the relevant specific requirements.

1.0.6 The seismic fortification intensity must be determined according to those documents (drawings) approved and issued by the national due authorities. As a rule, the seismic fortification intensity may be adopted in accordance with the basic seismic intensity specified in the current "Seismic Ground Motion Parameter Zonation Map of China". As for those bridges whose sites have already been conducted with special seismic safety evaluation, their seismic fortification shall be carried out according to the approved seismic fortification intensity or design seismic ground motion parameters.

1.0.7 As for the seismic design of highway bridges, except for the requirements in this guideline, those in the relevant national and professional standards and codes also shall be complied with.

2 Terms and Symbols

2.1 Terms

2.1.1 Seismic fortification intensity

The seismic intensity approved by the national due authorities is taken as the seismic fortification basis of one area.

2.1.2 Seismic fortification criterion

The criterion is used to measure the requirements of seismic fortification, it is determined by the significance of the seismic fortification intensity and functions of the highway bridges.

2.1.3 Earthquake action

Ground motion is acted on the structures, including horizontal earthquake action and vertical earthquake action.

2.1.4 Earthquake action El

It refers to the earthquake action with a shorter recurrence interval of the construction site, it is corresponding to class A fortification level.

2.1.5 Earthquake action E2

It refers to the earthquake action with a longer recurrence interval of the construction site, it is corresponding to class B fortification level.

2.1.6 Seismic effect

It refers to the generic term of bridge structure's internal force and deformation effects caused by earthquake actions.

2.1.7 Design basic acceleration of ground motion

It is the design acceleration value of ground motion whose recurrence interval is 475 years.

2.1.8 Characteristic period

The periodic quantity is corresponding to the starting point of the sloping portion in the acceleration response spectrum curving used for seismic design, it depends upon the seismic environment and site classification.

2.1.9 Scenario earthquake

The earthquake is determined according to the site seismic risk probability estimate and regional seisimc ground motion attenuation relationship and is consonant to the fortification ground motion. It is expressed in magnitude and distance.

2.1.10 Multi-support-excitation

The ground motion excitation of various bridge piers are different in the seismic analysis, especially the time history analysis for oversize span bridges, it reflects the spatial variability and spatial correlation of the ground motion field.

2.1.11 Liquefaction

It refers to such a phenomenon that the pore-water pressure in the covering soil layer rises up sharply during an earthquake and is difficult to dissipate temporarily, so that the shear strength of the earth is greatly reduced. Most occur in the saturated silty fine sands accompanied with water spraying, sand boiling and structure settlement/dumping phenomena.

2.1.12 Lateral spreading

The phenomenon is accompanied with liquefaction and it feature horizontal spreading of subsoil in a large scope.

2.1.13 Seismic concept design

The basic design criteria and design concept is inducted according to the earthquake disaster and engineering experiences for general arrangement of the bridge structures and determining the detailed structures.

2.1.14 Elastic seismic design

The bridge structures are not allowed to have any plastic deformation. The member strength shall be taken as the indicator to measure the structural performances, so nothing remains but to checking whether the member strength meets the requirements.

2.1.15 Ductility seismic design

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