Outline of Specifications for Design and Construction of Cable-Stayed Bridge and Extradosed Bridge, 2012

2012年制定　斜張橋・エクストラドーズド橋設計・施工規準の概要

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1. Introduction

This is the English edition of the Specifications for Design and Construction of Cable-stayed Bridge and Extradosed Bridge, published by the Japan Prestressed Concrete Institute under the committee chairmanship of Prof. Shoji Ikeda (**Fig.1**). The guidelines contain the design and construction specifications for both bridge structures, given that the extradosed bridge (EB) structure was first developed in Japan and prestressed concrete (PC) cable-stayed bridges (CSBs) are very popular in Japan. It is our belief that the wealth of knowledge and experience assembled here, which was accumulated through constructing these bridges in Japan, will prove useful for bridge engineers all over the world.

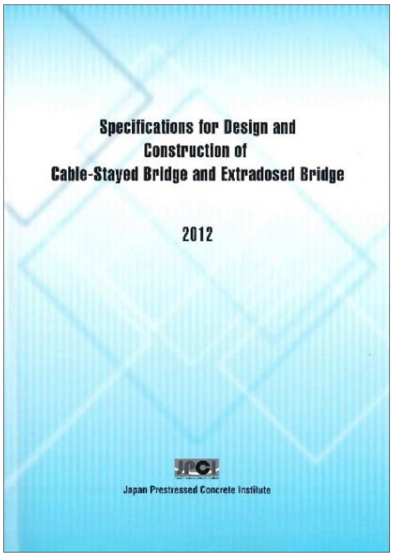

Fig.1 Cover of the Specification

Only a print version is available (price: JPY 3,600). The contact details is follows.
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2. Specifications

(1) Outline

In the 1970s, various countries began constructing PC CSBs, especially Japan. Meanwhile, the world's first EB, Odawara Blueway Bridge, was built in Japan in 1994 (**Fig.2**). Since then, the EB has acquired a track record around the world. These guidelines present the latest findings related to both structures based on construction experience in Japan. They also feature an integrated design approach that applies to both bridge types.

Fig.2 Odawara Blue-way Bridge

(2) Table of Contents

Chapter 1	General
Chapter 2	Basis of Design
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Chapter 8	Loads
Chapter 9	Design
Chapter 10	Construction
Chapter 11	Ensuring of Durability
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3. Special Features of the Specifications

(1) Planning

CSBs and EBs both comprise girders, pylons, cables, and piers and offer very high design flexibility regarding combinations of these components, cable layouts, and more. Although there are no distinct boundaries between CSBs and EBs, the characteristics of both are shown based on bridge construction records to date. The girders and pylons typically used in both structures are indicated, as are the relationships between span length and (i) girder height and (ii) pylon height based on many actual construction projects.

(2) Fatigue Design of Stay Cable

Previously, because they suffer less fatigue, the stay cables in EBs were subject to a limit of 0.6 fpu, which is identical to that for external prestressing cables. By contrast, the allowable value for the stay cables in CSBs was specified as 0.4 fpu. Assuming no boundaries between CSBs and EBs, a study was conducted focusing on the proportion of live load carried by the cables. The findings showed that this proportion and the magnitude of stress fluctuations within the cable are related almost linearly. These findings allow the cable limit value to be specified from the cable stress fluctuations, and the guidelines give stay-cable limit values in a continuous range between 0.4 fpu for CSBs and 0.6 fpu for girder bridges (**Fig.3**). Therefore, a limit can be set for each stay cable depending on the cable's stress fluctuations, thereby giving a more-efficient design.

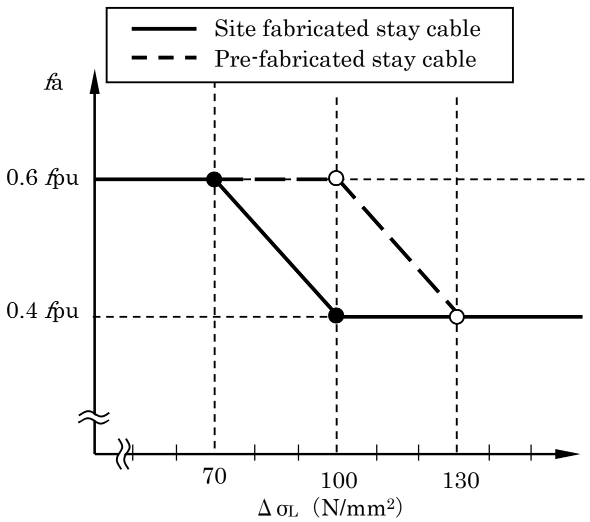


Fig.3 Relationship between stress fluctuations and the cable's stress fluctuations

(3) Design of Pylon

The form and cross-sectional shape of the pylons have a large impact on bridge aesthetics. The design of the pylon cross-sectional shape has to consider such factors as girder width, anchoring space for cables, workability, and economy. More than any other factor, the design of the cable anchorage zone has to consider the stay-cable anchorage, installation, tensioning, and maintenance, as well as safety and durability. Examples and characteristics of typical pylon cross-sectional shapes at the cable anchorage zone are presented in **Fig.4** based on past bridge records.

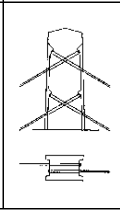
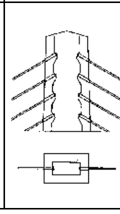
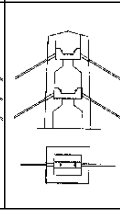
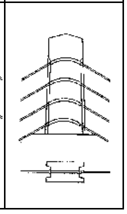
Anchorage method	Separate fixing type			Through fixing type
Name	*Cross anchorage*	*Separate anchorage*	*Coupled anchorage*	*Saddle anchorage*
Side and cross-sectional view				

Fig.4 Cross Section shape of pylon for cable anchorages

(4) Design of Saddle Structure

The Odawara Blueway Bridge, the world's first EB, uses a saddle structure to anchor its cables to the pylons. The main benefit of a saddle structure is that the spacing between cables can be reduced, making it possible to concentrate cables at the top of the pylon and increase eccentricity from the girder. However, fretting fatigue is inevitable because of prestressing tendons coming into contact with each other under fluctuating stress. Therefore, the limit for stress fluctuations due to variable load is specified based on the results of bending-fatigue tests of cables. In addition, an example is shown in **Fig.5** of a saddle structure that is capable of transferring tension to alleviate any difference in tensioning between cables on either side of the saddle.

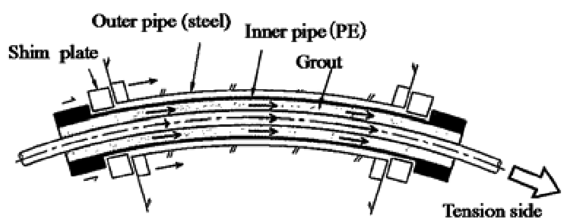


Fig.5 Example of Double-Pipe Structure