Zeitschrift: IABSE reports = Rapports AIPC = IVBH Berichte

Band: 82 (1999)

Artikel: Identification of minimum width-to-span ratio of long-span cable-stayed

bridges based on lateral torsional buckling and flutter analyses

Autor: Nagai, Masatsugu / Xie, Xu / Yamaguchi, Hiroki

DOI: https://doi.org/10.5169/seals-62113

Nutzungsbedingungen

Die ETH-Bibliothek ist die Anbieterin der digitalisierten Zeitschriften auf E-Periodica. Sie besitzt keine Urheberrechte an den Zeitschriften und ist nicht verantwortlich für deren Inhalte. Die Rechte liegen in der Regel bei den Herausgebern beziehungsweise den externen Rechteinhabern. Das Veröffentlichen von Bildern in Print- und Online-Publikationen sowie auf Social Media-Kanälen oder Webseiten ist nur mit vorheriger Genehmigung der Rechteinhaber erlaubt. Mehr erfahren

Conditions d'utilisation

L'ETH Library est le fournisseur des revues numérisées. Elle ne détient aucun droit d'auteur sur les revues et n'est pas responsable de leur contenu. En règle générale, les droits sont détenus par les éditeurs ou les détenteurs de droits externes. La reproduction d'images dans des publications imprimées ou en ligne ainsi que sur des canaux de médias sociaux ou des sites web n'est autorisée qu'avec l'accord préalable des détenteurs des droits. En savoir plus

Terms of use

The ETH Library is the provider of the digitised journals. It does not own any copyrights to the journals and is not responsible for their content. The rights usually lie with the publishers or the external rights holders. Publishing images in print and online publications, as well as on social media channels or websites, is only permitted with the prior consent of the rights holders. Find out more

Download PDF: 21.11.2025

ETH-Bibliothek Zürich, E-Periodica, https://www.e-periodica.ch



Identification of Minimum Width-to-Span Ratio of Long-Span Cable-Stayed Bridges Based on Lateral Torsional Buckling and Flutter Analyses

Masatsugu NAGAI

Professor Nagaoka University of Technology Nagaoka, Japan Xu XIE

Kaihatsu Consultant Co., Ltd. Tokyo, Japan

Hiroki YAMAGUCHI

Professor Saitama University Urawa, Japan Yozo FUJINO

Professor University of Tokyo Tokyo, Japan

Abstract

Using a 1400-meter cable-stayed bridge model, in which four cross sections of the girder having different widths with a fixed depth of 3.5 meters are selected, static and dynamic instability analyses are carried out. Their behavior under wind load is made clear and the design material for identifying a minimum width-to-span ratio of the girder is presented, which ensures safety against the instabilities.

1. Introduction

In the design of long-span cable-stayed bridges, ensuring safety against static and dynamic instabilities under wind load is an important issue, because the shape and dimension of the girder are controlled mainly by above instabilities. In this paper, using a 1400-meter cable-stayed bridge model, a nonlinear static analysis under displacement-dependent wind load and a flutter analysis based on multi-mode coordinate are carried out. Four types of cross section of the box girder having different widths of 25, 28, 32 and 35 meters with a fixed depth of 3.5 meters are chosen. The employed box girders are preliminary designed, in which the yield point of steel is only selected to be an instability criterion. By carrying out above instability analyses, the critical wind velocities of lateral torsional buckling and flutter are investigated. Finally, the design material for obtaining minimum cross-sectional shape and dimension of the girder is presented.

2. Bridge Model

The bridge model for the analyses is shown in Fig.1. A height of the tower from the deck level is one fifth of the center span length. Since the total normal stress induced by the dead and wind loads becomes large, the girder near the tower has to be reinforced (see fig.1(c)).

3. Results and Discussions

Considering appropriately the aerodynamic forces, the finite displacement analysis is carried out to check the static instability. Flutter analysis based on modal coordinate is also carried out for the dynamic instability. Fig.2 shows lateral displacements, vertical (upward) displacements and rotational angles at the middle of the center span of the bridges. They diverge in the range of the



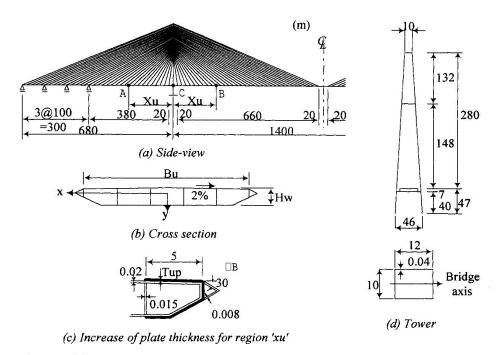


Fig.1: Bridge model

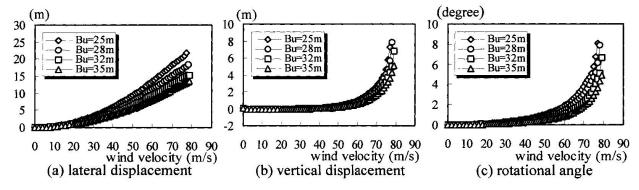


Fig. 2: Displacements at the middle of the center span

wind velocity from 75 to 80m/s which is high enough compared with the design wind velocity of 60m/s. The static instability of the bridge under construction was also analyzed and assured to be safe enough. From the result of flutter analysis, it is interesting to know that the flutter wind velocity is higher than the above critical wind velocity under static wind load.

4. Concluding Remarks

The followings are main results obtained from this study. 1) Flutter onset wind velocity is higher than critical wind velocity under static wind load. 2) It is found that static instability under displacement-dependent wind load controls the dimension of long-span cable-stayed girders.

3).On condition that the bridge is designed based on the procedure proposed, the girder with a width-to-span ratio of around 1/55 (corresponding to the case of Bu=25m) can be used.