Zeitschrift: IABSE reports = Rapports AIPC = IVBH Berichte
Band: 82 (1999)

Artikel: Seismic response of partially earth-anchored cable-stayed bridge
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DOI: https://doi.org/10.5169/seals-62125

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Seismic Response of Partially Earth-anchored Cable-stayed Bridge

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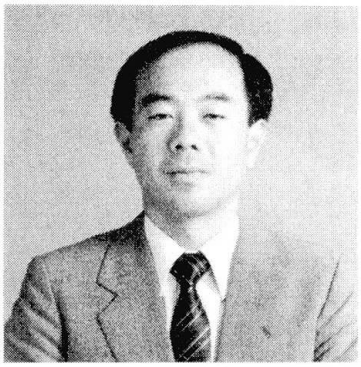

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Abstract

When cable-stayed bridge is applied to long span bridge with main span length of about 1000 meters, large axial force acting on the main girder probably becomes a serious problem because it may cause the buckling of main girder. To reduce this axial force, partially earth-anchored cable-stayed bridge has been proposed by Gimsing as shown in Fig. 1. And a few studies have been carried out to discuss the static characteristics of this type of bridge. However, the seismic characteristics of partially earth-anchored cable-stayed bridges have not been estimated in detail. The purpose of this paper is to investigate the dynamic characteristics of partially earth-anchored cable-stayed bridge subjected to strong earthquake motion based on the results of time-history response analysis. The bridge type is three spans continuous girder type with multiple cables and its main span length is 1000 meters as shown in Fig. 2. Finite Element Method is applied to the dynamic analysis. Hyogo-ken Nanbu Earthquake (Kobe Earthquake) record including both horizontal and vertical components is adopted as input earthquake motion. Only the direction of motion parallel to the bridge axis is considered. Soil-structure interaction and phase-lag of input earthquake motion that arises among two piers and two anchored points of side-span cables are neglected here.

It has been revealed from Fig. 3 that the maximum vertical displacement at the center of main span of partially earth-anchored cable-stayed bridge caused by strong earthquake is enough smaller than the deformation limit although the maximum deformation of partially earth-anchored cable-stayed type is larger than that of self-anchored one.

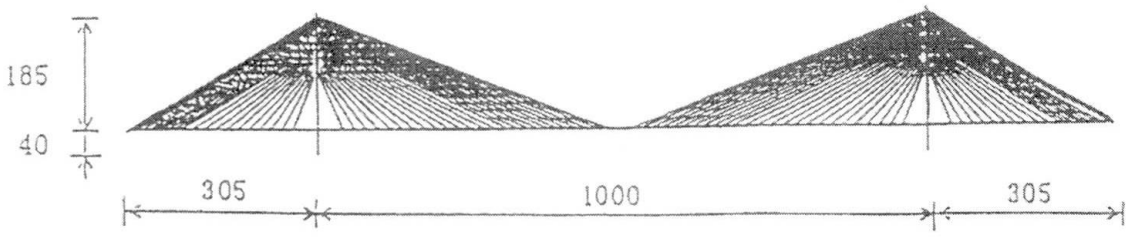

Fig. 1 Schematic diagram of Partially earth-anchored cable-stayed bridge

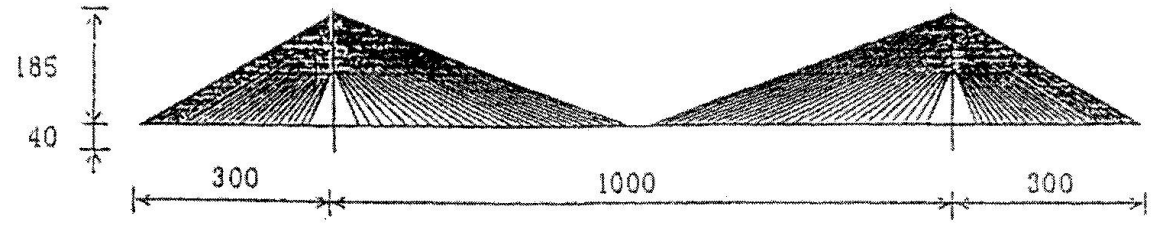

Fig. 2 Partially earth-anchored cable-stayed bridge analyzed in this study

The results also show that the stress resultants of partially earth-anchored cable-stayed bridge are considerably smaller than those of self-anchored one as indicated in Fig. 4. These results indicate that no problem may occur from seismic viewpoint in case of the application of partially earth-anchored cable-stayed bridge to long span bridge with main span length of about 1000 meters. And it is also cleared that the consideration of only horizontal earthquake motion is sufficient in case of the execution of dynamic response analysis of cable-stayed bridge with 1000m main span length.

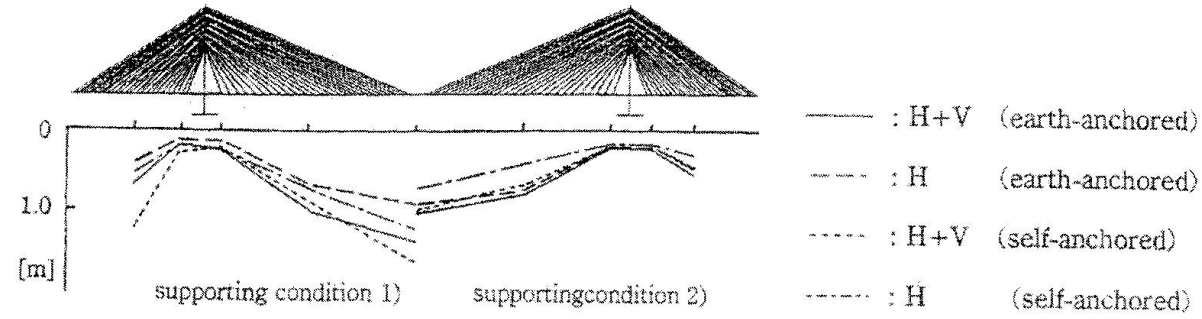

Fig. 3 Maximum vertical displacement of main girder

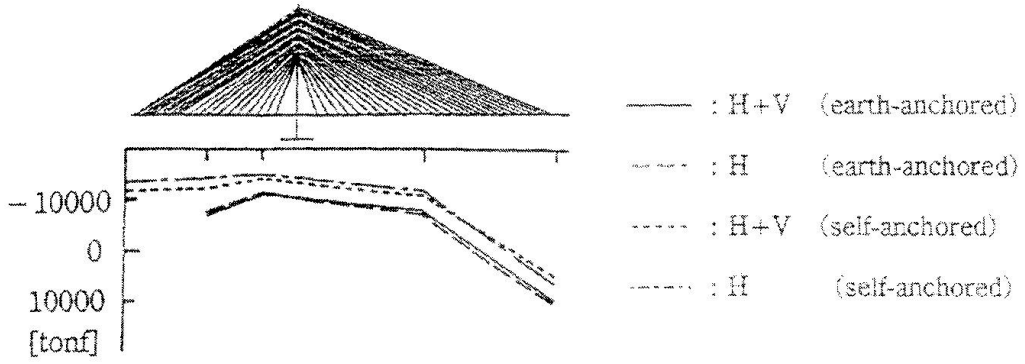

Fig. 4 Axial force of main girder