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

Artikel: Deformability of long-span cable-stayed bridges for railways
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DOI: https://doi.org/10.5169/seals-62153

Deformability of Long-Span Cable-Stayed Bridges for Railways

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Abstract

Cable-stayed bridges have been of great interest in recent years, particularly with respect to the fan-shaped scheme as a valid and alternative solution to suspension bridges for long spans.

Troitsky (1) and Gimsing (2) have reviewed the problems and advantages of cable-stayed bridge solutions and reported on the latest and most interesting projects.

For long-span bridges one of the most important problems is related to the deformability under live loads. In the case of bridges carrying both road and railway traffic, and for spans greater than 1000 m, this aspect can seriously influence the design and the feasibility of the structure.
In this work an analysis of the static and dynamic behaviour of the bridge is developed, modeling the train passage as a dynamical action or an equivalent static load.

Como *et al.* (3) analyzed the static behaviour of long span stayed-cable bridges showing the prevailing truss behaviour of the bridge. Bruno and Grimaldi (4) investigated the nonlinear static behaviour of cable-stayed bridges using both a continuous and a discrete model of the bridge, and showed the strong influence of nonlinearities for long spans. Moreover, the dynamic behaviour of cable-stayed bridges has been investigated by Bruno (5) analyzed the effects of moving loads, and by Bruno, Maceri and Leonardi (6) who analyzed aerodynamic instability problems.

In the above studies fan-shaped cable-stayed bridges were studied using both a continuous and a discrete model of the bridge, and the dominant truss behaviour of the bridge was found. In particular, the influence of the dynamic properties and geometric nonlinearities of towers are included in the analysis.

In this paper the continuous model proposed in the previous works is employed to develop static and dynamic analyses. In addition a discrete model is also applied to give some useful comparisons between analytical and numerical results.

The aim of the paper is to give same results and conclusions related the main geometric and mechanical parameters able to influence or control the bridge deformability.

In particular, the geometric aspect ratio L/H between the main span length and the tower height, the loads ratio p/g between live and dead loads, the relative flexural stiffness between girder and stays, are taken into account.

Obtained results show the strong influence of the rail load on the midspan deflection and on the girder slopes. As well known these last quantities in many cases represent the main parameter which have to be considered in deformability control.