Structural response of spatial arches with imposed curvature

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Summary

Spatial arch bridges have an important out of plane behaviour, or are not even contained in a plane in some cases. The structural behaviour and the geometrical configurations of inferior-deck arch bridges with imposed curvature (those in which the curved plan projections of both, arch and deck, coincide) are being studied in detail by the authors. The present study focuses on the influence of multiple variables on the structural behaviour of this bridge typology with the aim of proposing the most appropriate solutions for controlling the out-of-plane response.

Keywords: spatial arch bridges, imposed curvature, curved balcony beam, rigidity, anti-funicular shapes

1. Introduction

Nowadays, some urban bridges have acquired additional functions. Further than physically communicating two points, they seek to create city landmarks, as symbols of originality and innovation.

A new arch bridge typology- “spatial arch bridges”- has appeared as a response to this new demand. They are defined [1] as bridges in which, vertical deck loads produce internal forces not contained in the arch plane, due to their geometrical and structural configuration. Moreover, the arch itself may not be contained in a plane.

New geometries that have recently arisen (such as inclined arches, asymmetries or stay cables that hint ruled surfaces dividing the space) may be considered provocative from the structural standpoint.

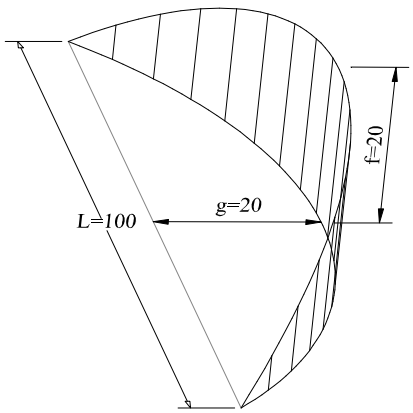

Fig. 1: Nomenclature and reference values for the models that have been studied for inferior deck arch bridges with imposed curvature

With these new forms, appears the need of a deeper study and research of their behaviour in order to establish design criteria and to provide formulae for controlling their structural stability.

This paper mainly deals with the structural behaviour of inferior-deck arch bridges with imposed curvature.

In order to understand the behaviour of these arches, different frame 3D models have been developed and analyzed with commercial software, as part of a set of thorough parametric analyses. The influence of the arch definition, the deck and arch plan curvature measured as rise in plan (*g*), the arch rise (*f*) (*Fig. 1*), the cross-section area of the arch, the cross-sections rigidity of the arch, deck and hangers, as well as the link conditions between structural members, have been studied.

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