Curved shell-supported footbridges

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Abstract

After Maillart's curved bridges, the improved building technologies in structural concrete and steel work led designers to realize different typologies of curved bridges. Jörg Schlaich's contribution in the design of curved bridges has been fundamental, through developing different typologies of suspended and cable-stayed curved bridges. In the '60s of the past century, Sergio Musmeci gave another innovative contribution to bridge design, by shaping shell supported bridges with minimal shell surface, and finally realizing the Basento Bridge in Potenza, Italy, a concrete shell bridge considered as his masterpiece. Accounting for Schlaich's and Musmeci's work on, respectively, curved and shell bridges, a curved footbridge supported by an anticlastic concrete shell with minimal surface is herein studied. The influence of the boundary conditions on bridge shape, and the advantages of prestressing the ring girder supporting the cantilevered deck are studied.

Keywords: shell footbridge, curved bridge, cantilevered deck, ring box girder; externally prestressed, anticlastic shell, concrete, unwished bending effects

1 Introduction

When designing bridges with the deck supported by a concrete shell (with tensile strength much lower than compressive strength), it should be better to shape the shell in order to be compressed in any direction [1-2].

Shells with anticlastic surface are suitable for this aim, since compressions in the shell induced by the deck loads in the vertical direction induce compressive stresses also in the other directions [3]. Shaping an anticlastic shell is therefore necessary. For this aim, it is convenient to shape an auxiliary tension structure with same shape and same boundary conditions of the shell, as well as same internal and external forces, but with the opposite sign [4]. By suitably choosing the boundary points of the shell at the abutments and along the deck, an anticlastic shell supporting the deck of a curved bridge can be obtained. The reciprocal position of the boundary points at the abutments with respect to those along the curved

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