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Curved deck arch bridges supported by an inclined arch

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Abstract

Curved arch bridges with curved deck supported by an inclined arch either through web members or without are studied. Reference to shell-supported bridges is first made. It must be taken into account that even if the deck is supported by a shell, its bottom free edge (usually stiffened) is described by a thrust line, so that the shell connects the curved deck (that is a horizontal arch) with an inclined 3D funicular arch. A limit case is that the ring girder of the curved deck and the funicular arch merge dividing the shell into two parts, so that, if shell thickness tends to zero, no shell connects them. This is the case of curved bridges supported only at mid-span by an inclined arch. The efficiency of different arches is compared. Moreover, the deck can be supported not only at mid-span but also by web members connecting deck girder and inclined arch. In this latter case, the most appropriate form of the inclined arch is obtained.

Keywords: Bridges, Conceptual Design and Realization, Concrete shell, Steel, Inclined arch, Bracing type, Pretensioning system.

1 Introduction

In the last years curved bridges are of particular interest, not only for being sometimes really necessary and for their architectural value, but also because they are often something like a symbol, as desired by the commissioning body and as often enjoyed by the citizens.

The first curved arch bridge with single span was Mallart's Schwandbach Bridge built in 1933 near Hinterfultigen [1-2]. Mallart designed some other curved arch bridges, but after Mallart not many single-span curved bridges were designed in the successive decades until, in the 80's of the last century, Jörg Schlaich gave a great impetus to the design and construction of curved bridges. His work in this field is a milestone in the history of bridges, especially curved suspended and cable-stayed bridges, but also curved arch bridges [3].

Schlaich built his first curved suspended bridge in Kelheim [3] over the canal between Rheine and Danube, where the deck was a prestressed ring girder made of reinforced concrete. In his successive suspended and cable-stayed curved footbridges, stresses, instead of flowing in the "black box" of the concrete deck [4], were channelled through structural elements specifically designed to bear them. Besides suspended and cable-stayed curved bridges, Schlaich designed also curved arch bridges. The

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