Bridge hangers as cruciform sections – Advantages and behaviour under wind loading

Miguel Candeias

ArcelorMittal Global R&D, Esch-sur-Alzette, Luxembourg

Riccardo Zanon

ArcelorMittal Steligence Engineering, Esch-sur-Alzette, Luxembourg

Jacques Berthellemy

CEREMA, Champs-sur-Marne, France

Contact: miguel.candeias@arcelormittal.com

Abstract

Tied-arch bridges consist in aesthetic crafted structures with efficient design, providing opportunities for cost reduction and increased sustainability when compared to other bridge configurations. One particular hanger solution, designed by Jacques Berthellemy and implemented typically in radial tied-arch bridge configurations, involves a cruciform element with a variable cross-section along its axis. In this paper the main advantages of using this type of hangers are presented and an assessment is shown regarding the response of this unique hanger under wind loading, an aspect that is not fully addressed within the scope of the simplified approach prescribed by the European standards. The outcome shows that the hanger geometry combines an optimised structural behaviour with an efficient performance, not susceptible to significant vibration risks arising from vortex shedding phenomena.

Keywords: bridge hangers; wind resistance; shape factor; CFD analysis

1 Introduction

Tied-arch bridges are recognized for harmonizing aesthetics with structural efficiency, providing an optimal choice for bridges spanning mid-range distances [1].

The primary structural mechanism of tied-arch bridges revolves around the interaction between the arch and the hanger elements. In the design, the arch is in equilibrium subjected to compressive forces and the hangers to tensile forces. The hangers are attached to the arch at various intervals along its length and connected at the lower part to the bridge's tie members.

There are multiple layout options available for the hanger arrangement, offering design flexibility and amplifying the potential of tied-arch bridges. Simple suspension arrangements, such as vertical or fan-shaped hangers, are generally preferred for short and medium-span bridges. Radial

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