Gusset plate between bridge hanger and arch formed by a H rolled section – Design considerations based on numerical analysis

Riccardo Zanon, Miguel Candeias

ArcelorMittal Global R&D, 66 rue de Luxembourg, L-4009 Esch-sur-Alzette, Luxembourg

Contact: riccardo.zanon@arcelormittal.com

Abstract

The paper investigates the detailing of the gusset plate serving as connection of the hanger to an arch member in form of a H-shaped rolled section in the frame of a tied-arch bridge. The driver of the investigation is the fatigue resistance which is usually critical for this element. Since the rolled sections used for this application belong to the same geometrical family it is possible to define a common geometric basis for this study.

At first a variety of geometric shapes have been considered and analysed by means of FEM numerical simulations. This preliminary analysis has delivered a rating in term of sensitivity to fatigue resistance, with best grades obtained for the shapes with lower the stress peaks. Beside the rating based on structural performance, a second rating has been proposed based on easy of execution. The combined results from these two ratings have permitted to identify the most suitable gusset shape. This shape has been afterwards investigated more in detail in term of hot-spot stress peaks, in particular considering the influence of the different hanger – arch inclination. This study leads to a proposal for the most appropriate geometric detailing for the gusset plate in the case of the arch as H- rolled sections, providing the lowest possible stress peaks and at the same time an easier fabrication process.

Keywords: Tied-Arch bridge, bowstring bridge, hanger connection, gusset plate.

1 Introduction

The tied-Arch bridges are classical typology which is lately experiencing a renaissance thanks to its valuable aesthetics and structural efficiency. The arch develops above the horizonal deck which carries the lane and is suspended to the arch by means of hangers. Various hanger arrangements are possible [3]. The specificity lies in the fact that the arch is connected at its end in the deck itself (which acts like a tie) to form a self-equilibrated structure. This implies that when it is subjected to vertical loads it transmits only vertical reactions at supports, differently from other arched structures.

Figure 1. WD-431 on S5 near Rawicz (2008) [6]