Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 213 (2018) 426–436

Procedia Engineering

www.elsevier.com/locate/procedia

7th Fatigue Design Conference, Fatigue Design 2017

Evaluation regarding fatigue for various type of hangers used for tied arch bridges.

Jacques BERTHELLEMY[1]

Cerema - Innovation and Large Bridges Division
Dtitm (ex Sétra), Sourdun France

Abstract

The roads represent an important heritage owned by the French Ministry of Transports. Even more than corrosion, the fatigue is the principal aging process that affects the durability of steel bridges. Several examples illustrate in the article the importance of affecting a right consideration to the fatigue design of bridges.

Details that may appear as accessory to most of the usual bridge designers may be in fact of a crucial importance. It is in particular the case of the welded joints. The fillet joints are much more sensible to the fatigue stresses and should be avoided when there is a doubt, because their evaluation is very complicated. If the designer of a bridge uses such attachment, he has to verify the relevance regarding fatigue **before calling for tender** because the time for such studies is generally not available during the execution studies.

Calculation FEM techniques are used to evaluate the **stress concentration factor** that has to be taken into account for the fatigue design. For bridges, many fatigue details are classified in the Eurocode 3 (part 9) from tests. But some details that cannot be found in the Eurocode, and can however be studied and evaluated by computation. Several examples of tied arch bridges are presented. The article presents also an example where the fatigue class of the detail regarding longitudinal stresses is evaluated thanks to a FE-modelization according to the 2008 IIW Fatigue Recommendations at the location of the attachment of a hanger.

Crack in a similar fillet weld of the attachment of the stiffener of a box girder bridge is presented to illustrate that fatigue may really cause severe trouble.

Peer-review under responsibility of the scientific committee of the 7th International Conference on Fatigue Design.

Keywords : Road bridges; Fatigue design, hangers, Fillet welds, **stress concentration factor;**

1 * Corresponding author. Tel.: +33 1 60 52 32 69;
E-mail address: **jacques.berthellemy@cerema.fr**

1877-7058
Peer-review under responsibility of the scientific committee of the 7th International Conference on Fatigue Design.
10.1016/j.proeng.2018.02.042

1. Experience regarding the design of tied arch bridges

The author has a long experience in the design of tied arch bridges. At Sétra he designed the Saint-Gilles Bridge over River Rhone [1] with cable-stays for a span of 120m (figure **1**) and the much smaller Roboul bridge of figure **2** for the East-Pyrenean local Authority in France [2].

Sétra was involved with the Roboul bridge in the conception of a pilot-project for a Mediterranean bridge allowing to cross a river in one span without intermediate piers to reduce the hydraulic impact, the risk of the soil to be washed away near the intermediate pier, and to preserve upstream area from catastrophic flooding [3]. For this purpose the Roboul bridge presents welded suspending rods which are elegant, rustic and economic. The economic pertinence of steel concrete tied arch bridges was proven at this occasion even for a small 40 meters span.

Sétra also participated to the conception of the bridge of Bédarieux for the French Hérault Local Authority in 2009. This bridge (figure **3**) shows that a span of 90 m with the same type of welded suspending rods as in for the Roboul-river crossing. If need be, it is of course also possible to embed this type of bridge on the abutment to remove the road joints and to constitute an integral bridge.

The Ko-We-Kara bridge for the New-Caledonian Southern Province is an other example of realization of this solution designed by Sétra for the structural as well as for the esthetical design [4].

All these bridges present a radial disposition of the hangers which simplifies and standardizes their connections. All upper connections to the arches are the same.

Figure 1 : Saint-Gilles bridge crossing the Rhône