

Paper ID:199

Experimental Verification of Design Proposal for Cross-sectional Curved Steel Plates in Shear

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ABSTRACT

The use of curved steel plates has been increased over the last few years, especially when it comes to the cross-sectional level. They increase the bridge's aesthetics and can be beneficial to the overall bridge performance. Examples of curved webs in steel box girders can be found in Belgium, The Netherlands and Vietnam. Unfortunately, no standard or code covers the design criteria for curved plates in shear. The lack of rules or codes results in a rather conservative design or more complicated computational work. Based on numerical analysis, the authors of this research have published a design proposal that works similar as for flat plates in shear. Since this design proposal is surely based on finite element analysis, it is not possible to have a 100% certainty about its reliability. Especially since curved plates are believed to be very imperfection sensitive. For this reason, two girders with a single curved web are designed and tested in a three-point-bending test. Both webs were given a different curvature radius, but have equal dimensions. During the test, both strains and deformations were monitored. In addition, the full web behaviour was captured by a 3D photographic system. The experiment showed that the webs had a higher resistance towards buckling than was expected based on the numerical predictions. Finally, the results are compared with the design proposal and numerical calculations.

Keywords: Up to five keywords, 12-point type.

1 INTRODUCTION

The use of curved steel plates has been increased over the last few years, especially when it comes to the cross-sectional level. They increase the bridge's aesthetics and can be beneficial to the overall bridge performance. Examples of curved webs in steel box girders can be found in Belgium, The Netherlands and Vietnam. Figure 1 and Figure 2 gives respectively a general overview and the cross-section of the Zemst railway overpass in Belgium (Van Staen, G.;2021). The bridge is a box girder with two lateral edge members, with curved webs, in order to increase the torsion resistance. Unfortunately, no standard or code covers the design criteria for curved plates in shear. The lack of rules or codes results in a rather conservative design or more complicated computational work. Based on numerical analysis, the authors of this research have published a design proposal that works similar as for flat plates in shear.