Buckling of Curved Webs in Steel Box Girders

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Abstract

Today, bridge girders with curved flanges and webs are becoming more common in order to increase the aesthetic value and to improve the quality of the structure. Despite the use of these new shapes, not much research has been done in this field. The aim of the present research is to find the influence of the web curvature on the buckling resistance. Therefore, numerical models are created, which have curvature radii of 1500, 5, 3, 5/3, 1, 0.7 and 0.55 times the web height. GMNIA is performed with these models, the first mode shape being used as geometric imperfection. Amplitudes of 0.1 times to 3 times the web thickness are used. The results are analyzed on multiple levels. The imperfection sensitivity towards curved webs is visible by the deformation pattern, the buckling load, and the load-deformation curve of a web. These last curves also give an indication of the behaviour in the post buckling region.

Keywords: Curved webs, FEA modelling, imperfection sensitivity, panel buckling

1 Introduction

Designers have become keen on using curved shapes in bridge designs. Curves are used in the longitudinal direction and webs and flanges of girders are given curved shapes. A rail bridge in Zemst [1] and a cyclist bridge in Bruges (Figure 1) [2] are recent examples in Belgium, where curved webs are used.

These shapes are used in order to increase the aesthetic value and to improve the overall quality of the structure. However, when using these curves, there are no standards or codes available to design the panels. In addition, not much research is available in this field, especially not regarding the use in bridge design.

A main concern is the way these curved panels transform the shear forces between the flanges, and whether the elastic buckling capacity of the curved webs remains sufficient.

Figure 1. Cyclist bridge in Bruges

Previous research [3] stated that the failure load of a beam with two curved webs, increases for an increasing radius of the curvature. The failure load values were chosen as the maximum load the beam can support. Although it is not clear

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