Effectiveness of Incomplete Welds in Nodes of Bridge Truss Girder Nodes with Hollow Core Profile Members

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Abstract

Steel truss structures are a powerful and reliable type of bridge girders. The complex part of trusses are the nodes, especially if more than 4 members are converging. Such nodes include internal welds; inaccessible after completion. This study assesses whether all of the internal welds are indispensable, or alternatively, what are the consequences if they are omitted. The latter is tested for a particular bridge, consisting of hollow core profiles. After determining the member forces, including bending moments, an alternative load path is indicated, generated if the internal welds are missing. Formulas are given to determine the weld stresses. In ULS some of the welds require a small amount of strengthening if the internal welds are omitted. In addition fatigue resistance was determined. Certainly for this example internal node welds may be left out, although this does not necessarily apply to more complex node cases. This indicates omitting of some internal welds may well be acceptable

Keywords: welded truss nodes; eliminating internal welds; alternative load path; equal stress distribution in welds.

1 Introduction

Truss girders are again used both for smaller bridges and in larger roofs of buildings. This is related to the fact that designers have rediscovered the many advantages of truss girders and also due to the strong and evident character of this type of load-carrying structure. In particular, the use of hollow core profiles for the members is considered as an important asset, because of the easy connection. In addition, the latter have a neat view, in contrast to the rather complex members, produced in the 19th and early 20th century. Obviously, the simplicity of connecting the truss nodes is in favour of hollow core profiles, whether they be cold formed or assembled from plates.

If the truss bars can be simple, the character of truss becomes more complex for the nodes. The Warren-truss has the simplest nodes, since the number of members connecting at a node is maximum 4. This type of truss may also be used in arch bridges, especially of the tubular type [1]. In some trusses the number of bars, intersecting at the same node may reach 5. This occurs if Warren trusses are supplemented with vertical bars, to increase the number of nodes. In addition, hollow core profiles may collapse due to the lateral pressure or tension perpendicular to their thin walls. This additional type of stress may require complex internal stiffening of the profiles at the nodes. The latter may require optimization of this type of stiffening [2]. As a result, truss nodes often need to be welded in a particular sequence and some of the welds cannot be reached, nor inspected after completion of the steel structure. The latter certainly complicates the work, and may

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