Horizontal bracing in steel I-girder bridges with composite concrete decks

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Abstract

This paper treats the use of horizontal trusses between the bottom flanges of new I-girder bridges, to create a box-like behaviour. In contrast to the general vertical cross frames of an I-girder bridge, the horizontal trusses bring along substantial torsional stiffness of the cross section of a bridge. The concept gives large advantages when it comes to fatigue caused by eccentric loading, since the I-girders will share the load more equally. The concept is exemplified by bridges in Finland, Guatemala and France, and some design aspects as well as practical aspects are discussed.

Keywords: I-girders bridges; trusses; bracings; bridge fatigue; box action.

1 Introduction

After the introduction of the Eurocodes throughout Europe, many countries have harder rules for fatigue. As an example, a Swedish composite bridge, with steel I-girders, got almost twice as large bottom flanges in mid-span compared to the design according to the old Swedish bridge code, due to the fatigue design rules. There are many ways to achieve better fatigue performance for steel/composite bridges, like hammer-peening of the welds to increase the detail category for fatigue, or simply adding steel to lower the stress levels.

For symmetric I-girder composite bridges with two I-girders, the dead load can normally be assumed evenly distributed between the girders. However, an eccentric load on the bridge will be unevenly distributed, implying that the girder closest to the load will carry more of the load than the other girder. This is generally the case for the traffic-load. For a box girder section an eccentrically positioned load will be more evenly distributed between the girders (box halves) than for an I-girder bridge, due to the higher torsional stiffness of the box girder, section, provided that the box has diaphragms preventing distortion of the cross-section. See also Figure 1.