Lateral torsional buckling of plate girder composite bridges – general method

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Abstract

According to Eurocode 4-2, lateral torsional buckling check should be performed for any steel flange in compression that is not laterally restrained. In common steel-concrete composite bridges, with slab on top of the main girders and no additional horizontal bracing, this applies for the bottom flanges over internal supports of a continuous beams. The check is also relevant for the bottom flanges at the abutments of integral composite bridges.

Eurocode 4-2 gives recommendations for the use of three verification methods for LT buckling: Inverted U-frame method, General method, and Simplified method. In this paper the three methods are discussed. Their restrictions for practical application are commented. Application of the General and Simplified methods over a single span integral composite bridge is illustrated. Comparison of the results between the General method and the Simplified method is presented.

Keywords: steel-concrete composite bridges; LT buckling; General method; Simplified method.

1 Introduction

Steel-concrete composite plate girder bridges with open cross section are economically feasible solution for small and medium spans (30m – 80m) road and railway bridges. The common solution for the superstructure combines reinforced concrete slab over steel girders. The statical schemes are simply supported or continuous beams on several spans. In the case of integral bridges, the single or multi-span frames are utilized.

During construction the steel structure is usually supporting the concrete, prior to realization of the composite action. In this respect the lateral-torsional stability of the steel structure is, in most cases, the governing design check during execution phase. In this phase investigation of the overall stability of the pairs of girders, connected by discrete vertical bracings only, is usually one complex task, that will not be discussed in this article.

During service, the top flanges of the main girders are already laterally restrained by the concrete slab. In this respect, lateral buckling check should be performed only for the bottom flanges, where they are in compression. Usually these are the intermediate support regions of continuous beams/frames and the end supports of integral bridges. Because of the lateral and elastic torsional restraint of the main girders at the level of the shear connection with the concrete slab, the lateral buckling of the bottom flange is more distortional (change of the form of the bridge cross section) than pure lateral torsional buckling.

In service, the lateral buckling check of the steel section, may be performed on the basis of the

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