Safety level of longitudinally stiffened plates under biaxial loading considering different launching bearings and eccentricities

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Abstract

In general, today two types of launching bearings are used in the construction of large steel and steel concrete composite bridges: sliding rockers and systems with hydraulic bearings. During incremental launching, the centre of the webs of the superstructure is not perfectly in line with the centre of the launching bearings due to unavoidable tolerances. These eccentricities are not considered in the current design against plate buckling according to DIN EN 1993-1-5 [2]. Furthermore, there is a significant difference between the different types of launching bearings due to the boundary conditions. At the Technical University Munich, large-scale buckling tests were carried out on longitudinally stiffened plates under biaxial stresses with different types of launching bearings and eccentric load introduction. The test results as well as the results from the validated numerical model demonstrate the influence of different types of launching bearings on the buckling behaviour. The results are compared with the buckling verification according to the reduced stress method proposed in DIN EN 1993-1-5 [2].

Keywords: incremental launching; buckling behaviour; eccentric load introduction; large scale buckling tests; multi axial stress states, safety level

1 Introduction

During incremental launching of steel and composite bridges, the superstructure is subjected at different stages of construction to different loads and boundary conditions. During launching, the superstructure acts as a continuous beam supported by different bearings. Just before reaching the next pier, part of the superstructure behaves temporarily as a long cantilever (fig. 1). As a result a big bending moment and reaction forces, which acts as a concentrated patch load at the last support occur. The interaction of the internal forces results in a biaxial stress state in the cross-section, which reaches its maximum above the last pier. This load case is usually ruling for the structural design of the webs. A schematic representation of the resulting internal forces of the superstructure and the biaxial stress state at the last support is presented in Figure 1.

In this case, the buckling verification must be performed considering longitudinal and transverse stresses. While the longitudinal compression results from the hogging bending during the incremental launching, the transverse compression is introduced locally by the launching bearings at the pier head.

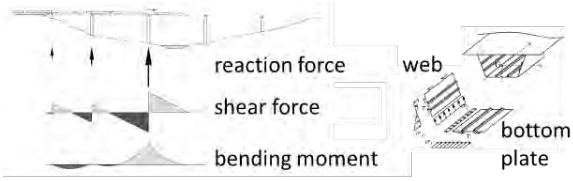

Figure 1. Schematic representation of the loading over the launching bearing [11] and [1].