

## Influence of imperfections on the buckling behaviour of longitudinal stiffened panels with eccentric load application

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### ABSTRACT

During *incremental launching* (a known manufacturing method in bridge construction) of steel and composite bridges, biaxial stresses occur in webs and bottom plates of box girders, which mostly dominates their design. An eccentric loading from the launching bearings into the webs is practically unavoidable due to mounting tolerances, variations in plate thicknesses and tolerance requirements of the lateral restraint. The buckling verification of longitudinally stiffened plates under biaxial compression is defined in EN 1993-1-5:2019 section 10 [1] through the *reduced stress method*. While the geometric and structural imperfections are considered using the coefficient  $\alpha$  or an equivalent geometric imperfection (term from Eurocode, including geometric and structural imperfections) according to Annex C of this code, the influence of eccentricity has not been considered by this code. In order to investigate the impact of the load eccentricity on the buckling behaviour of longitudinally stiffened plates, large-scale buckling tests were carried out under biaxial compression at the Technical University of Munich. Based on the test results, a numerical model was validated and an extensive parametric study was carried out. It was observed that the direction of the equivalent geometric imperfection of the longitudinally stiffened plates is significant for the load capacity of the plates. With a centric load application, the minimum load capacity is always found when the equivalent geometric imperfection is located on the opposite side of the stiffeners. In the case of eccentric loading, the load capacity is further influenced by the combination of the directions from the eccentric load application and the equivalent geometric imperfection. As a result, an eccentric loading leads to an increased buckling resistance compared to a centric loading when the equivalent geometric imperfection is on the same side of eccentric loading.

**Keywords:** Incremental launching; Buckling behaviour; Eccentric loading; Biaxial stresses; Steel plates

### 1 INTRODUCTION

Eccentric transverse loading on longitudinally stiffened plates under biaxial loading typically occurs in the web of hollow box sections during incremental launching. The buckling behavior of