Nonlinear Behaviour of Longitudinally Stiffened Girder Webs Subjected to Patch Loading and Bending

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ABSTRACT

This paper is aimed at studying the nonlinear behaviour of longitudinally stiffened girder webs subjected to patch loading and bending. The investigation is carried out by means of nonlinear finite element analysis to study the structural behaviour of the girder components (flanges, web and stiffener) in the postcritical range. Initial geometrical imperfections, plastic material behaviour and large deflection effects were considered in the model. For the validation of the numerical model, the computer results from the simulations are compared with experimental results taken from different sources. A parametric study was carried out in order to investigate the influence of the magnitude of the bending moment and the relative location of the stiffener on the ultimate strength to patch loading. Furthermore, diagrams showing the interaction between the aforementioned parameters are presented.

INTRODUCTION

In general, slender I-girders webs are used in bridge construction. Specially, during erection by incremental launching, bridge girders (box and plate) are subjected to a combination of loads such as: patch loading, bending and shear (Roberts and Shahabian 2001). The bending and shear strengths are increased by means of longitudinal stiffening as observed in several investigations (D’Apice et al. 1966, Evans and Tang 1986). For the patch loading case, Graciano (2002) demonstrated that the resistance to patch loading is also increased considerably with longitudinal stiffening, particularly when the stiffener is placed rather closed to the loaded flange.

Interaction between patch loading and bending moments in longitudinally stiffened girder webs is often treated as for unstiffened webs (Graciano and Johansson 2003). In the last two decades, experimental studies (Galea et al. 1987, Shimizu et al. 1987, Dubas and Tschamper 1990) have shown that longitudinal stiffening increases the ultimate resistance of plate girder