

Analytical prediction of the plastic shear resistance of the panel zone in welded steel beam-to-column joints

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ABSTRACT

In classical strong axis steel and steel-concrete composite beam-to-column joints, the panel zone (PZ) may be defined, at the intersection between beam and column axes, as the sum of the column web panel (CWP) and the surrounding elements (SE), i.e. the column flanges and possible transverse column web stiffeners, aligned with the beam flanges. This zone is known to play a key role in the design of steel and steel-concrete composite joints as it may govern the joint resistance in a significant number of situations under both static and seismic loading conditions. Therefore, its behaviour has been studied for years and these research efforts have ended up with the current simple analytical model proposed in the Part 1-8 of Eurocode 3, which allows predicting the behaviour of this component in terms of initial stiffness and plastic shear resistance.

However, a recent research project, conducted by the same authors and already published, has demonstrated through comparisons between existing experimental results and Eurocode 3 predictions that, in many cases, this simple analytical model significantly overestimates the actual resistance of the PZ. As another outcome of this project, it was shown by means of an extensive parametric study carried out with the Abaqus© software on stiffened and unstiffened single- and double-sided welded joints that the plastic shear resistance of the PZ ($V_{PZ,RK}$) may always be divided into the contribution of the CWP ($V_{Y,RK}$) and that of the SE ($\Delta V_{Y,RK}$), whatever the type of joint configuration. These two contributions need however to be re-evaluated.

Present paper precisely aims at addressing this gap. Results of the numerical simulations on beam-to-column welded joints have been investigated in order to master the physics of the phenomena governing the plastic shear resistance of the PZ. The influence of an axial load in the column has also been appraised by means of additional numerical simulations. Based on these observations, a complex analytical model has been derived for each contribution in the case of stiffened and unstiffened single- and double-sided configurations. These models have then been simplified in view of their possible integration in design codes. Comparisons with numerical and experimental results clearly show that the proposed analytical approach provides a better and more

coherent estimation of the plastic shear resistance of the PZ than the current Eurocode 3 model.

Keywords: *joints, component method, panel zone, column web panel in shear, FEM*