Resistance of steel I-sections under axial force and biaxial bending

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Abstract

The plastic criteria for the verification of steel cross-sections resistance are usually based on some basic hypotheses such as the development of plastic hinges, which depend on the interaction between the internal forces and the cross-section shape; therefore, specific equations are required for each type of cross-section.

This paper presents new alternative interaction criteria for the analysis of steel I-sections subjected to an axial force and biaxial bending moments, at the elastic or the plastic limit states (as long as buckling phenomena are not involved).

The plastic interaction criteria are presented, in a first step, for some particular combinations of the internal forces, such as axial loading with bending about a main axis, and biaxial bending without axial loading. In these cases, they are given by exact equations (within the frame of the hypotheses adopted in this study). All these plastic interaction criteria are compared with the corresponding plastic criteria adopted in the Eurocode 3 (EC3).

Afterwards, a simplified global criterion is proposed for the simultaneous combination of an axial force and bending moments about both the main axes of inertia. This new simplified plastic criterion and the corresponding plastic criterion adopted in the EC3 are compared with the exact solution, obtained by a mixed numerical and analytical integration procedure. This comparison shows that this simplified criterion usually leads to results closer to the exact solutions. Some suggestions are then presented to improve the results given by the EC3.