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Numerical analysis of the mechanical behavior of welded I beam-to-RHS column connections

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Abstract. Considering the increasing use of tubular profiles in civil construction, this paper highlights the study on the behavior of welded connections between square hollow section column and I-beam, with emphasis on the assessment of the joint stiffness. Firstly, a theoretical analysis of the welded joints has been done focusing on prescriptions of the technical literature for the types of geometries mentioned. Then, a numerical analysis of the proposed joints were performed by the finite element method (FEM) with the software ANSYS 16.0. In this study, two models were evaluated for different parameters, such as the thickness of the cross section of the column and the sizes of cross section of the beams. The first model describes a connection in which one beam is connected to the column in a unique bending plane, while the second model describes a connection of two beams to the column in two bending planes. From the numerical results, the bending moment-rotation (M-φ) curve was plotted in order to determine the resistant bending moment and classify each connection according to its rotational capacity. Furthermore, an equation was established with the aim of estimating the rotational stiffness of welded I beam-to-RHS column connections, which can be used during the structure design. The results show that most of the connections are semi-rigid, highlighting the importance of considering the stiffness of the connections in the structure design.

Keywords: steel structures; hollow section column; welded connections; bending moment-rotation

1. Introduction

The increasing use of steel structures is associated with advantageous factors in relation to reinforced concrete structures, highlighting: the upper productivity, the possibility of building structures with longer spans using lighter elements, the high precision of the parts and joints of the structures and the possibility of reusing.

The tubular sections (circular hollow sections CHS and rectangular hollow sections RHS, including square ones) have been highlighted among the steel structures, because these sections provide the most efficient use of a steel cross section in resisting compression, tension, bi-axial bending and torsion (Lu 1997).

The growing demand for the hollow sections in civil construction is related to the several

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