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Effect of bolt preloading on rotational stiffness of stainless steel end-plate connections

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ABSTRACT

This study investigates the effect of bolt preloading on the rotational stiffness of stainless steel end-plate connections. An experimental programme incorporating 11 full scale joint specimens are carried out comparing the behaviours of fully pre tensioned (PT) and snug tightened (ST) flush/extended end plate connections, made of austenitic or lean duplex stainless steels. It is observed from the tests that the presence of bolt preloading leads to a significant increase in the rotational stiffness. A parallel finite element analysis (FEA) validated against the test results demonstrates that the geometric imperfection of end plate has a strong influence on the moment rotation response of preloaded end plate connections, which is crucial to explain the observed two stage behaviour of these connections. Based on the data obtained from the tests and FE parametric study, the performance of the Eurocode 3 predictive model is evaluated, which exhibits a significant deviation in predicting the rotational stiffness of stainless steel end plate connections. A modified bi-linear model, which incorporates three key properties, is therefore proposed to enable a better prediction. Finally, the effect of bolt preloading is demonstrated at the system (structure) level considering the serviceability of semi continuous stainless steel beams with end plate connections.

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