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Investigation of Residual Stresses Distribution in High Strength Steel Beams Using Neutron Diffraction

Residual stresses induced in the fabrication of steel components may lead to distortion and a significant loss of strength in a steel structure. Accordingly, research on the residual stress distribution in steel sections is becoming an important consideration in steel structural analysis. The characteristics of residual stresses in hot-rolled and welded mild steel sections have been extensively reported and integrated in national design standards. However, it is questionable as to whether such patterns are applicable for high strength steel. Currently, very high strength low-alloy steels produced by quenching-tempering and thermo-controlled processes offer yield strengths as high as 1000 MPa with good weldability, and because of this they have been receiving much attention in mega-structure applications such as long-span bridges or high-rise buildings. To promote the use of such materials, knowledge of welding residual stresses is vital.
This study presents the measurement of residual stresses in I-beam sections welded from Australian BISPLATE80 and BISPLATE100 high strength steel using neutron diffraction technique. Tensile coupon testing shows the base plate materials have corresponding yield stresses of 851 MPa and 1003 MPa respectively, with the weld material yield strength as high as 810 MPa. The residual stress measurement was taken on the KOWARI strain scanner at ANSTO. Due to the complexity and the large size of samples the SSCANSS software and a virtual instrument of KOWARI were utilised to position a sample and optimise the measurement procedure. Important features of the residual stress distribution in welded high strength steel I-sections have been obtained across the beam and within the weld. These results are the essential in order to validate a residual stress model able to be used in future high strength steel structural analysis, design and assessment.

Topic

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