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Numerical and Experimental Analysis of AISI 316L Butt-Welded Joints Using Local Material Properties

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This research presents a numerical and experimental investigation of AISI 316L stainless steel butt-welded joints, for shipbuilding applications, under quasi-static loading conditions. The focus is on assessing the mechanical response of different weldment zones through localized material characterization. Vickers micro-hardness testing was employed to extract the hardness profile across the welded joint. These hardness values were subsequently converted into mechanical properties, allowing for the derivation of distinct stress-strain curves representative of each zone. A finite element model was developed using these zone-specific properties and was subjected to controlled boundary conditions that replicate the experimental setup. The model's accuracy was evaluated through Digital Image Correlation (DIC), enabling full-field strain measurements for direct comparison with simulation results. The outcomes demonstrate the significance of incorporating local property variations into finite element models for improved prediction of strain localization and global deformation behavior. This methodology supports a more reliable structural assessment of stainless-steel welded joints, particularly in applications where precision and material integrity are critical.

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