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FATIGUE ASSESSMENT OF S690QL WELDED JOINTS FROM MINIATURIZED SPECIMENS

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Summary: Wagons are primarily assembled though welding, and while this process is effective in joining materials, it inherently introduces stress concentrations, residual stresses, and microstructural heterogeneities. These factors can significantly affect the integrity of the structures, particularly when subjected to cyclic loading. Therefore, evaluating the mechanical performance and quality of welded joints in railway wagon construction, with an emphasis on fatigue behaviour, is crucial for accurately predicting the lifespan of these structures. This work studies the fatigue behaviour of S690QL welded joints, aimed for railway applications, using a novel testing methodology that employs miniaturized specimens. This approach allows for a detailed analysis of the different weld regions under cyclic loading. The methodology includes hardness testing of each weld region for direct comparison with their fatigue behaviour, finite element analysis (FEA) for the determination of the stress concentration factor at the specimens' notch, and fatigue testing to compare the behaviour of each weld region. In addition, the study compares the results from this testing method with those from other conventional fatigue testing methods, with the objective of evaluating the reliability of the miniaturized specimens for fatigue testing of welded joints.The results align directly with the previous studies performed on this welded joint using conventional rotating bending fatigue tests, revealing differences in fatigue performance across the weld regions, with the weld metal showing the highest fatigue resistance, followed by the base material and the heat-affected zone. Furthermore, the study evidences the reliability of using miniaturized specimens for fatigue testing of welded joints, offering a viable alternative to conventional methods, but highlights some limitations, particularly in the direct numerical comparison of these results with tests that operate under different stress ratios.

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