Investigation of Strain Concentration around Geometric Features in Welding

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In the realm of structural integrity, the measurement of strain at weld joints with varying geometric configurations presents a significant challenge. Particularly, areas of strain concentration are pivotal to the assessment of structural integrity. This study focuses on the evaluation of stress and strain singularities around structural features. The primary object of this research is the excess weld metal, commonly referred to as the weld reinforcement, found in butt joint configurations. The initial phase of the investigation involves a geometric simulation of this type of welding and the picture of testing sample is shown in the figure 1 .

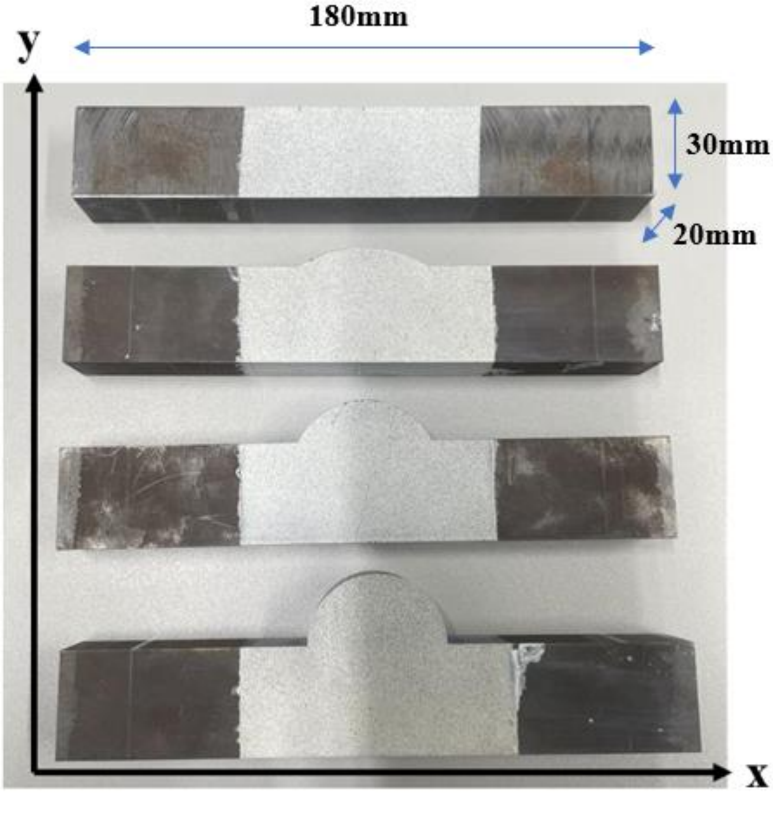

figure 1: Sample for simulating welding geometry

Figure 1 showcases a series of samples created to replicate butt joint welds with varying degrees of acuity. The approach adopted for measuring strain concentration areas utilizes Digital Image Correlation (DIC), a sophisticated technique ensuring high-precision data capture. In assessing the mechanical properties of these materials, the four-point bending test was the method of choice, selected for its significant advantages. This method enables the induction of a uniform strain field on the specimen, particularly notable between the two inner supports. Such a uniform strain distribution is crucial for accurately quantifying the material's response at the geometric features characteristic of welded joints. By implementing this method, we ensure the fidelity of our strain measurements, which is essential when evaluating the strain behaviour at the critical weld geometry junctures.

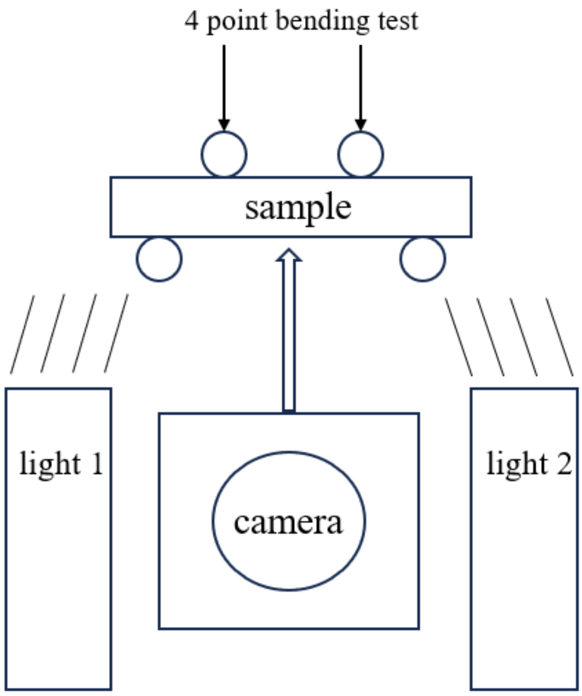

figure 2 the schematic of 4 point bending test with DIC

After the experiments were done, we compared the real experiment data with the data from computer simulations using Finite Element Analysis (FEA) (figure 3). This step is very important because it checks if the FEA models can correctly predict what happens in real life. If there are any differences between what we observed in the experiments and what the FEA predicted, these can help us make the computer models better by adjusting the simulation settings. This makes our computer models more accurate overall.

A combined experimental and numerical approach to the consideration of strains around geometric features which potential cause strain singularities allows us to interrogate the length scale over which current assessment technologies are both valid and accurate and explore ways of improving this.

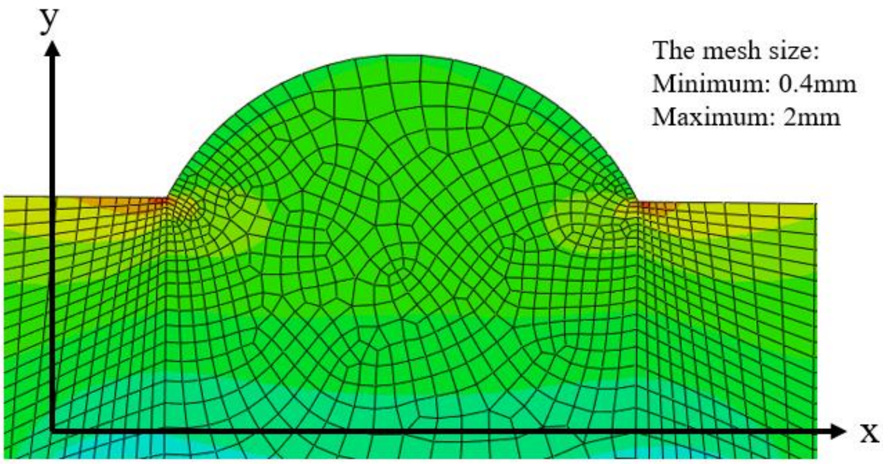

figure 3 the strain concentration area in simulation