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Methodologies for Crack Initiation in Welded Joints Applied to Inspection Planning

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Abstract : Crack initiation and propagation threatens structural integrity of welded joints and normally inspections are assigned based on crack propagation models. However, the approach based on crack propagation models may not be applicable for some high-quality welded joints, because the initial flaws in them may be so small that it may take long time for the flaws to develop into a detectable size. This raises a concern regarding the inspection planning of high-quality welded joins, as there is no generally acceptable approach for modeling the whole fatigue process that includes the crack initiation period. In order to address the issue, this paper reviews treatment methods for crack initiation period and initial crack size in crack propagation models applied to inspection planning. Generally, there are four approaches, by: 1) Neglecting the crack initiation period and fitting a probabilistic distribution for initial crack size based on statistical data; 2) Extrapolating the crack propagation stage to a very small fictitious initial crack size, so that the whole fatigue process can be modeled by crack propagation models; 3) Assuming a fixed detectable initial crack size and fitting a probabilistic distribution for crack initiation time based on specimen tests; and, 4) Modeling the crack initiation and propagation stage separately using small crack growth theories and Paris law or similar models. The conclusion is that in view of trade-off between accuracy and computation efforts, calibration of a small fictitious initial crack size to S-N curves is the most efficient approach.

Keywords : crack initiation, fatigue reliability, inspection planning, welded joints
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