EWI

TECHNICAL INSIGHTS

Fatigue Design Assessment

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Welded structures can be subject to metal fatigue, when cycles of loading cause the structure to be damaged by the growth of a crack even when the loading from a single cycle would have had no effect on the structure. Design checks are available for common materials, with widely available processes and standard shapes. EWI can develop design methods for dealing with new materials, new configurations and new processes. These assessments can build off the expectations built up of other materials.

For example, EWI has developed methods for assessment of titanium alloys used for structural welds. Titanium alloys have been used widely in aerospace, but their strength and density between steel and aluminum make them acceptable for many other structural applications. The development included demonstrating what range of welds would be acceptable. For instance, in Figure 1, test results for four types of welds are shown allowing the comparison of cruciform (cross-shaped) specimens and specimens with attachments along the direction of loading. The GMAW welds were designed with high weld caps, performing much more poorly on the cruciform specimens than GTAW. However, the long attachment specimens did not differ in performance between the two types of welds.

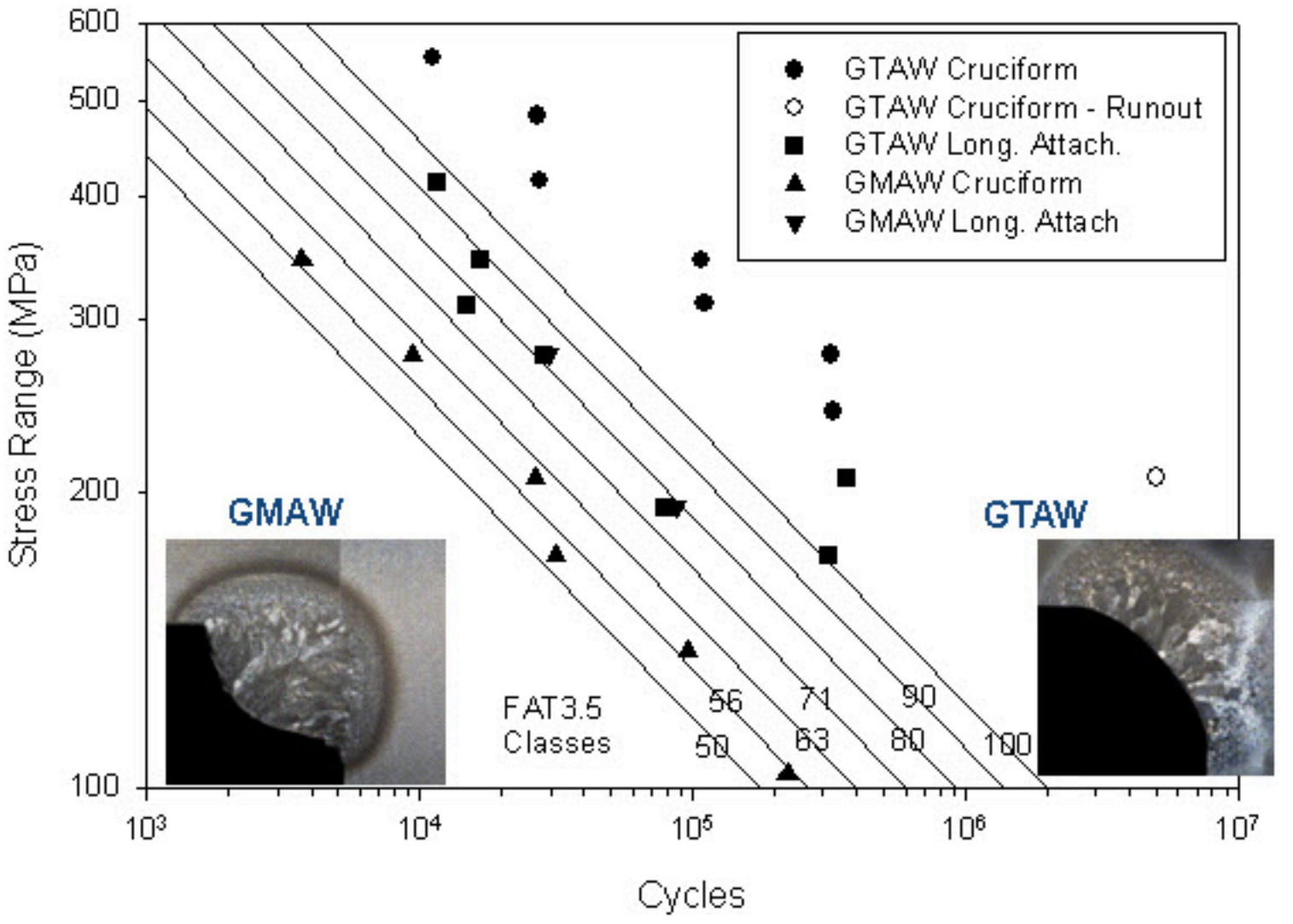

Figure 1. Data on Titanium Welded Specimen Fatigue

Design for fatigue can also account for welding imperfections, like those found during inspection, and properties that are not easily determined by inspection, like the welding residual stress state.

EWI also develops specialized testing systems, such as the full-scale pipe resonance fatigue testing system. One of these systems is shown in Figure 2. A system like this one can test multiple welds at a time under cyclic bending and pressurized conditions. This can simulate the environmental fatigue of tendon or riser pipe used for offshore oil and gas production offshore. Testing has been performed on a wide array of materials including steel, titanium, and aluminum alloys, as well as composite-reinforced metals.

Figure 2. Resonance Fatigue Testing Rig

Learn More

To learn more about fatigue design assessment, contact the author, Dr. William (Bill) Mohr, EWI Principal Engineer, Structural Integrity, at **bmohr@ewi.org** or 614.688.5182.

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