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Four-point-bending device for bending moment controlled cyclic reverse loading on plate materials and its application on AZ31B magnesium sheets

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Abstract

Fatigue testing of materials under various loading conditions is an important basis for designing high performance structures. One common load state is bending that can be often found for thin walled components like sheet metal structures. For this purpose, a four-point-bending device for standard uniaxial test rigs is presented within this work. This device allows fatigue testing of plate materials like sheet metals and offers fatigue testing under pure bending about the sheet metal normal axis and reverse loading from the low- to the high-cycle fatigue regime. An analytic analysis offers the necessary kinematic and kinetic relations for bending moment control. A finite element analysis was performed to validate the performance of the device, showing high accuracy of the analytically predicted specimen's bending moment and stress distribution. Furthermore, strain gauge measurements, optical strain field measurements, and fully reversed bending moment controlled fatigue tests on magnesium sheet metals (AZ31B) were performed to evaluate the four-point-bending device. The fatigue tests show low scattering in results.

Keywords: fatigue test methods, magnesium alloys, fatigue strength, flexural loading, four-point-bending

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