ULTRASONIC ATTENUATION OF BRIDGE STEELS AND NARROW-GAP IMPROVED ELECTROSLAG WELDS

ABSTRACT

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Ultrasonic testing is presently required as a portion of a two-part inspection process with radiography on all complete joint penetration bridge welds. Ultrasonic testing utilizes sound wave reflections to find and characterize internal features and defects. Inspection with ultrasound is readily used in both fabrication shops and in the field to detect and locate critical defects detrimental to the safety and performance of bridges. Current inspection guidelines and acceptance criteria for bridge welds are found in the 2015 American Welding Society (AWS) D1.5 Bridge Welding Code.

Variables such as frequency, wave propagation, velocity, grain structure, and equipment calibration all separately impact ultrasonic inspection. When ignored or improperly accounted for, these variables lead to inconsistent detection and classification of defects. Experimental data collected on six bridge components revealed an unanticipated difference in material attenuation between various grades of steel. As a result, the objective of the study was to characterize the difference in ultrasonic attenuation in a variety of hot-rolled steels, including heat-treated and controlled-rolled plates. The impacts of frequency, wave propagation, and equipment calibration on the magnitude of ultrasonic attenuation were all evaluated. Additionally, the difference in attenuation between base metal, the heat-affected zone (HAZ), and weld metal of narrow-gap improved electroslag welds was examined.

The experimental data collected confirmed a difference in ultrasonic attenuation between different grades of steel and throughout electroslag welds. The variation in attenuation was sometimes very significant. The frequency of the probe used during inspection had a direct impact on the magnitude of the attenuation found. The findings were used to evaluate possible implications of the current AWS D1.5 guidelines and acceptance criteria for both conventional and phased array ultrasonic testing.