Florida Department of Transportation Research

Experimental Investigation of the Effect of Surface Markings on the Mechanical Integrity of Weathering Bridge Steels – Phase III

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Current Situation

The manufacture of steel bridge components often involves the accurate assembly of parts weighing thousands of pounds, which requires marking for welding positions, correct orientation for assembly, and identification. Mark placement is determined with manual measurements and then the mark is made with either a die stamp or spray paint. Marking procedures can be very time consuming, and manufacturers have sought techniques to speed up production. One such alternative involves etching the steel with plasma, an extremely hot and narrow gas jet. For weathering steels that develop a protective coat of oxide, the question has arisen whether plasma marking can create hotspots for corrosion or fatigue and shorten the design life of the bridge component.

Weathering steel has a rusty surface that protects the steel from environmental damage.

Research Objectives

University of Florida researchers examined how parameters that control the plasma marking process correlate with effects on weathering steel and its expected fatigue life.

Project Activities

The plasma marking process is controlled by two parameters: the amount of current used and how fast the writing head moves over the steel surface. Together, these parameters determine the notch depth of the mark. But they also control how much heat the steel is exposed to, creating a heat-affected zone (HAZ) in the steel. The researchers examined the effects of various settings of amperage and writing speed on notch depth and the depth of the HAZ.

Plates of high strength, low alloy steel were acquired from a Florida steel manufacturer. Three plates were used for notch and HAZ depth testing, and ten plates were used for fatigue testing. The manufacturer prepared the steel as they would for any bridge installation. First, they sandblasted the steel to clean it. Then, they marked it using three different amperages and three writing speeds. The steel was weathered and delivered to the researchers.

The researchers cut the plates into smaller sections for analysis of notch and HAZ depths. They were specially treated to reveal the microstructure of the steel, which was analyzed using optical microscopy, grain size measurements, and hardness testing. Results of fatigue testing were analyzed statistically to determine their relationship to notch and HAZ depths.

Guidelines developed in the project suggested that plasma marking should use 10 amps at a writing speed of 75 to 250 inches per minute. The researchers determined that these settings make a useful mark and have a very low probability of lowering the expected fatigue lifetime to below standard requirements.

Project Benefits

Plasma marking can increase manufacturing efficiency, and this project helps set marking parameters that will assure that plasma-marked steel is acceptable for use in Florida bridges.

For more information, please see www.fdot.gov/research/.