ABSTRACT

Sohn, Young Moo Ph.D., Purdue University, May 2012. Effects of Realistic Heat Straightening Repair on Damaged Steel Beam Bridges. Major Professor: Amit H. Varma.

Over-height trucks occasionally collide (impact) with steel highway bridges causing structural damage to the steel beams. This permanent deformation can be repaired by heat straightening, which is a structurally efficient and cost-effective repair process.

However, in the real field implementation of heat straightening, the repair process violated the limits and guidelines presented by various state highway agencies and the FHWA. These violations include, but are not limited to: (a) under heating below 1200°F and over restraining, (b) over heating above 1200ºF, and (c) multiple heat straightening of the same beam more than two times. Currently, there is a lack of knowledge of the effects of these imperfections in the heat straightening repair process on the condition and serviceability of the damaged-repaired beams.

The objectives of this research are: (a) determine and evaluate the realistic implementation of heat straightening repair (with imperfections) in Indiana using database analysis and in-situ field measurements, (b) experimentally investigate the effects of realistic heat straightening (with imperfections such as overheating, overstraining, or multiple heat straightening) on the structural properties, fracture toughness, and serviceability performance of steel beam bridges. (c) develop research based guidelines for damaged steel beam bridges subjected to realistic heat straightening with imperfections including multiple heat straightening. (d) recommend realistic tolerances for imperfections in the heat straightening repair process such as overstraining, overheating, and multiple heat straightening.

A 40 ft. long two-span continuous steel bridge with two composite girders that have 6 ft. spacing was constructed to be damaged and repaired following actual field implementation of heat straightening. Variables for the bridge test were derived from Indiana bridge hits database analysis, heat straightening field visit results, and small scale test results. The structural properties, fracture toughness, and serviceability performance of the test bridge were presented and compared. Research based guidelines for damaged steel beam bridges subjected to realistic heat straightening were presented.