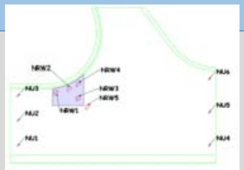
Gusset-less Truss Connection Physical and Structural Model to Aid Bridge Inspection and Condition Assessment

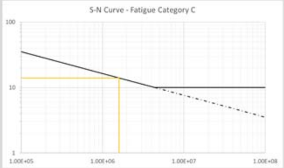
Project Number: NHDOT 26962M

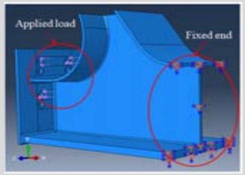
In 2013, the Memorial Bridge, located between Portsmouth, NH, and Kittery, ME, was opened to traffic. The structural system of the bridge is composed of truss elements with a unique "Gusset-less" connection which utilizes curved steel to transition from the chords to the diagonals where splice plates join the members. With such a unique connection, it is important to verify the design assumptions and assess its performance. In this study, the fatigue performance of the Gusset-less connection is primarily investigated through an experimental fatigue test of a scale model of the connection.

Design of Gusset-less Connection Specimen

Focusing on the main goal of this study and considering test limitations, this experimental program was designed with the primary objective of comparing the magnitude and distribution of stresses under the curved flange to those obtained from a finite element analysis of the connection. The minimum target stress level used for specimen design was 10 ksi: the stress range corresponding to the endurance limit of a Category C weld.







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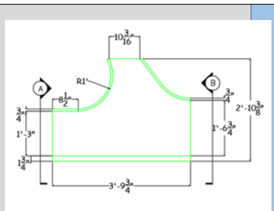
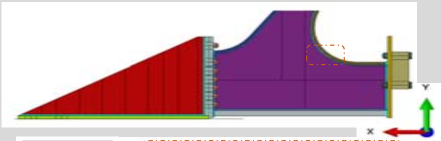
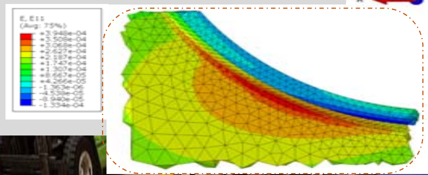
Experimental Set up and Fatigue Test Results

The main goal was to design an experimental setup system capable of supporting the specimen on one side and the actuator on the other.



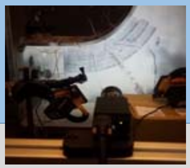


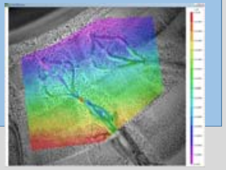


Comparisons were also made between the Finite element model (FEM), the strain rosettes and strain collected via digital image correlation (DIC). This comparison showed an overall difference was 6.4% on average between the FEM and the strain rosettes and 3.7% between the FEM and DIC.

Location	Data Source	Max Principal Strain (με)	Difference
NRW2	DIC	249	
	NRW2	268	7.6%
	FEM	296	10.7%
NRW4	DIC	296	
	NRW2	301	1.6%
	FEM	298	0.8%

In terms of fatigue testing results, the measured strain in the specimen indicates that the corresponding stresses are below the theoretical endurance limit for the assumed design fatigue category (i.e. C) as expected. A conclusion from this work is that the design assumption of a category C fatigue detail was conservative, and the endurance limit of the actual fatigue specimen may be higher than expected.





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