Development of Live Load Distribution Factors for CT Girder Bridges

Jon Pinkham, Department of Civil and Environmental Engineering, University of Maine Advisor: Dr. Bill Davids

Goals and Scope

One composite tub (CT) girder bridge is already built in Hampden, ME and another is nearing completion in the same town among others in different states such as Florida and Rhode Island. The proximity of two bridges gives the ability to perform live load test to verify the performance of this bridge technology.. Live load test results for moment and shear within girders will play a great role in quantifying distribution factors (DFs). Shear testing is specifically important for buckling and shear distribution between the two webs of a single girder as seen in fig. 1.

The overarching goal of this research is to develop live load distribution factors commonly referred to as “g” for shear and moment in interior and exterior CT girder bridges. Currently there is no standard values, and the practice is to follow AASHTO guidelines for a concrete type c box girder which Table 1 shows to be a crude assumption through a comparison of DFs for AASHTO and ones inferred from previous live load tests. These results show how important it is to quantify applicable live load DFs for this new girder type.

Table 1: Comparison of AASHTO DFs and Maximum Test Computed GLFs

Source	Girder 1	Girder 2	Girder 3	Girder 4	Girder 5
AASHTO	0.286	0.601	0.601	0.601	0.609
HGMB 12/20	0.504	0.457	0.565	0.460	0.626
HGMB 7/22	0.543	0.384	0.566	0.620	0.621

Research Approach

1. Live load test both Hampden Bridges
2. Create FE models of both Hampden Bridges
3. Calibrate FE models to test results to verify FE analysis
4. Create Suite of FE models for a parametric study
5. Use results to develop equations for live load distribution factors of interior and exterior girders.

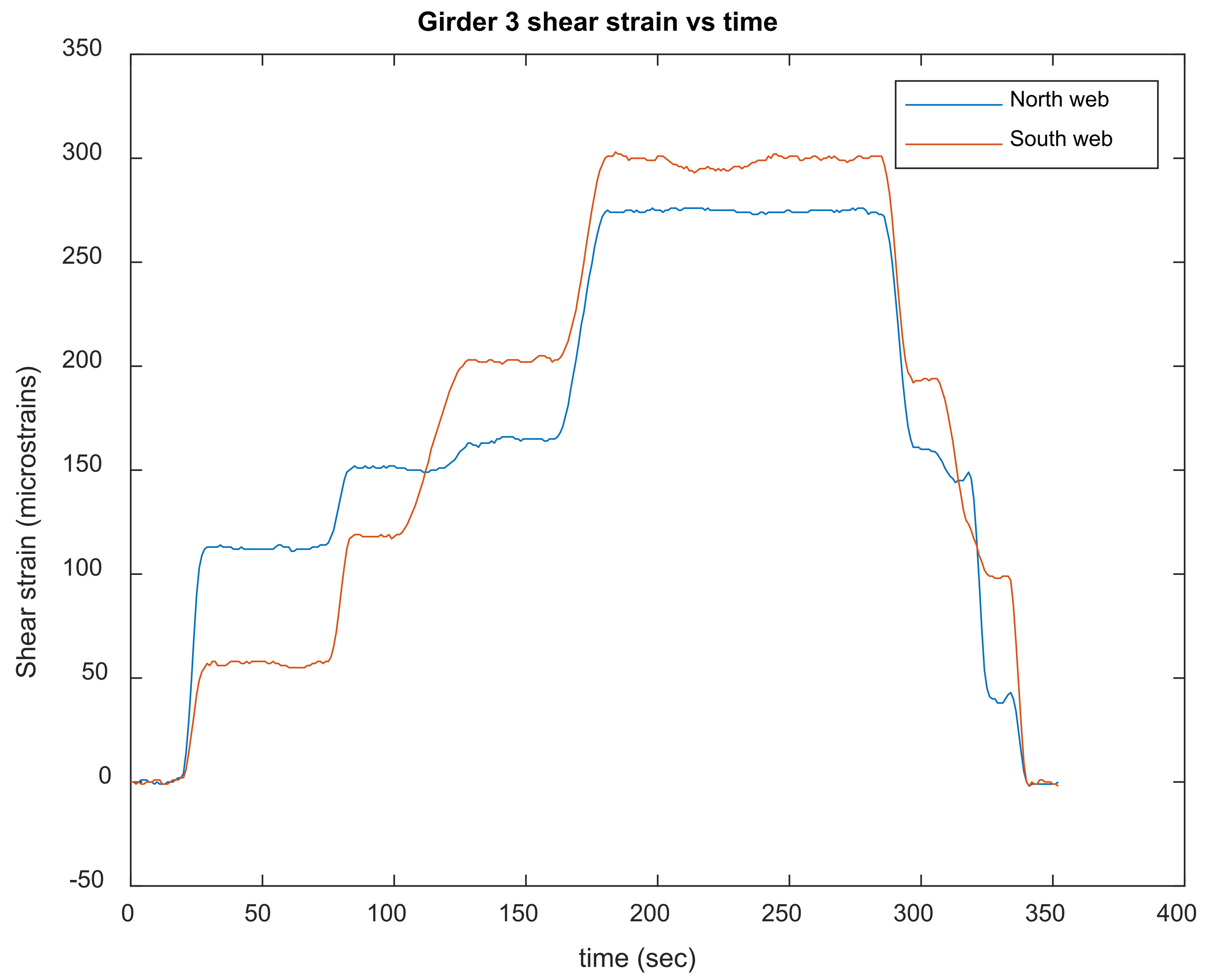
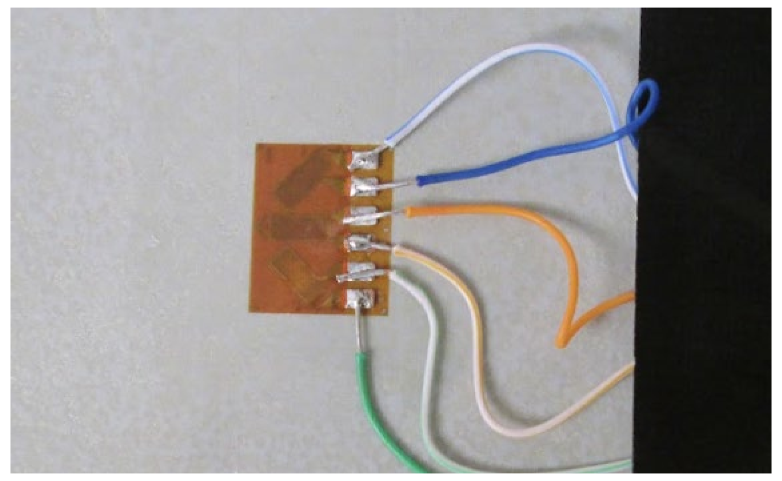


Figure 1: Shear Strains most interior girder Maximized shear load test run

Parameters included in study:

- Span length
- Girder spacing
- Skew angle
- Number of girders
- Overhang
- Deck thickness.
- Estimated 3330 models in suite for parametric study
- Each model will have a girder cross section designed for using the design guidelines in development for CT girder bridges based on previous research.

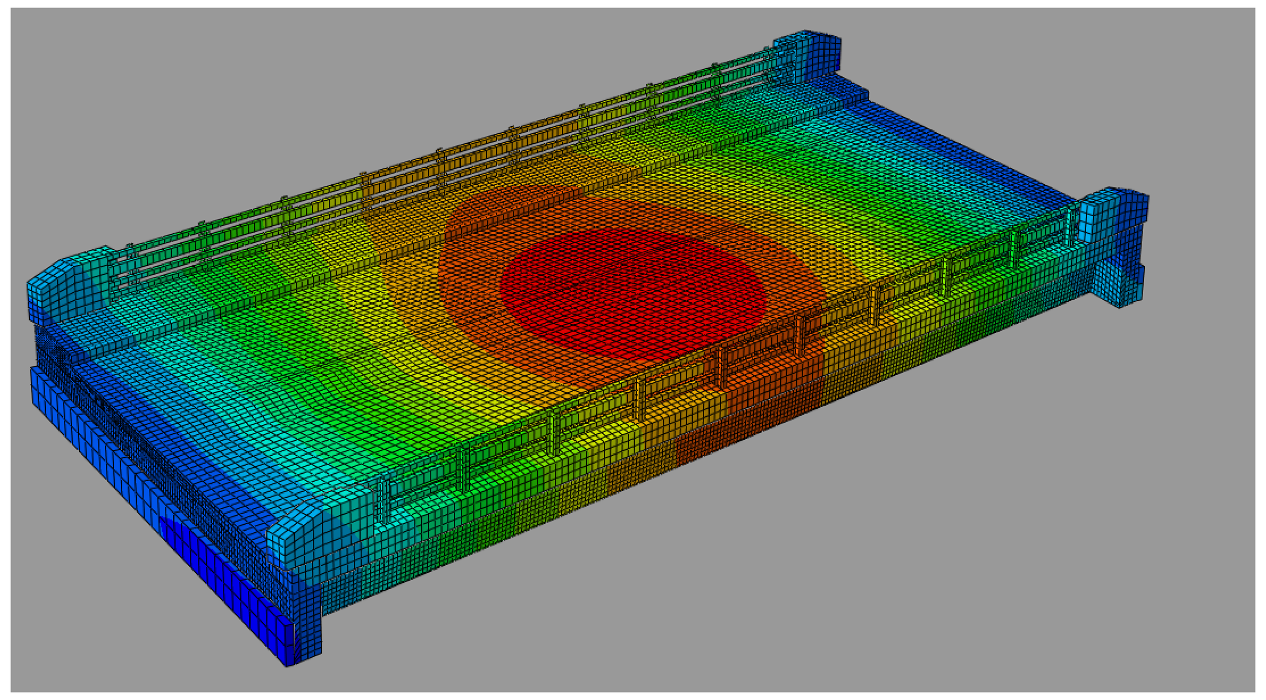


Strain Rosette installed on the outer face sheet of a HGMB girder.

Current Status

In July 2022, a second diagnostic live load test was performed on Hampden Grist Mill Bridge (HGMB) in Hampden, ME. Test highlights include:

- Implementation of longitudinal strain gauges and rosettes (shown in image above)
- Gauges give data on flexural and shear strains (Fig. 1)
- Data used to infer GLF values on each girder
- Data used to calibrate FE models created for the bridge
- Access bridge behavior, for example Fig. 1 shows slight differential shear distribution across two webs of girder.



HGMB FEM analysis results for displacement due to two lanes of truck load at center.

Acknowledgements: Funding for this research is provided by the Transportation Infrastructure Durability Center at the University of Maine under grant 69A3551847101 from the U.S. Department of Transportation’s University Transportation Centers Program. MaineDOT.