Test and Evaluation Report

Testing and Evaluation of the US63 Bridge in Davis County

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Prepared For

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Introduction

On September 15, 2005, the US 63 bridge in Davis County just north of Bloomfield was tested using the Iowa Department of Transportation snooper truck which was driven from North to South at a crawl speed (2-5 mph). Testing consisted of driving the snooper truck along three different paths summarized below thought to capture the overall behavior of the bridge:

- Path 1 – driver side wheel 2' from face of east curb
- Path 2 – truck centered on bridge
- Path 3 – passenger side wheel 2' from face of west curb

This structure is a four girder bridge composed of steel I-girders with the exterior girders having been strengthened by steel angles bolted to the web in the positive moment regions of each of the three spans. Top and bottom flange strain data were collected at four cross-sections on the four bridge girders (Section 1 – 33" south of the north bearing in the north end span, Section 2 – midspan of the north end span, Section 3 – 33" north of the north pier in the north end span, Section 4 – midspan of center span). In addition, strain data were collected on the steel angles when applicable. The collected strain data are the basis of the results and conclusions made herein. For reference, the four girders are numbered 1 through 4 with Girder 1 (G1) being the westernmost and Girder 4 (G4) being the easternmost.

Test Results

Table 1 shows the peak strain values measured during each of the three test runs at Sections 2 through 4 (Section 1 data were collected to investigate the level of rotational end restraint). As can be seen from these data, the maximum bottom flange strain values for the exterior and interior girders, respectively, are: Section 2 – 98 and 82; Section 3 – 65 and 47; Section 4 – 112 and 90. The maximum recorded strain (112 at Section 4) is equivalent to a stress of approximately 3.3 ksi. Maximum strain values in the negative moment region (Section 3) near the location of cover plate cutoff, a location of interest based on rating calculations, are equivalent to a stress of approximately 1.9 ksi.

Figure 1 illustrates the strain distribution for girders G1 and G4, which were strengthened with steel angles, for load case 2, section 2. This figure is representative of the strain distribution for all exterior girders for all load cases. From Fig. 1 it is evident that there is a relatively linear strain distribution in the exterior girders with the steel angles included. This suggests that load is adequately being transferred to the steel angles and subsequently providing additional bending strength and stiffness.

Table 2 summarizes the fraction of a single truck carried by each girder for the cases of one lane loaded. Thus, for a single lane loaded it appears that a distribution factor of 0.43 for the exterior girders and 0.36 for the exterior girders is appropriate. Testing did not allow a formal two lane load case to be investigated, however, an approximation of the two lane loaded distribution factors may be obtained by combining load cases 1 and 2 for a upper bound limit and combining load cases 1 and 3 as a lower bound limit. Doing so results in distribution factor ranges as follows: 0.48 – 0.64 for exterior girders, 0.54 – 0.69 for interior girders. It appears that there is a

non-negligible amount of rotational restraint occurring at the abutments. Although non-negligible, the rotational restraint is not significant and much closer to a "pinned" condition than a "fixed" condition.

Table 1. Peak strain values – Load Case 1 through 3, Sections 2 through 4

Load Case 1

	W			E
Section 2	G1	G2	G3	G4
TF	1	5	1	18
TFangle	3	NA	NA	25
BFangle	7	NA	NA	63
BF	9	38	82	98

	W			E
Section 3	G1	G2	G3	G4
TF	0	6	21	8
BF	-6	-24	-45	-64

	W			E
Section 4	G1	G2	G3	G4
TF	0	0	-7	10
TFangle	0	NA	NA	24
BFangle	9	NA	NA	90
BF	10	45	90	112

Load Case 2

	W			E
Section 2	G1	G2	G3	G4
TF	7	10	2	6
TFangle	17	NA	NA	16
BFangle	25	NA	NA	29
BF	39	69	75	43

	W			E
Section 3	G1	G2	G3	G4
TF	0	18	21	0
BF	-30	-44	-43	-30

	W			E
Section 4	G1	G2	G3	G4
TF	5	-2	-8	4
TFangle	9	NA	NA	10
BFangle	45	NA	NA	45
BF	50	78	81	53

Load Case 3

	W			E
Section 2	G1	G2	G3	G4
TF	13	-7	-2	1
TFangle	25	NA	NA	2
BFangle	58	NA	NA	8
BF	94	78	41	11

	W			E
Section 3	G1	G2	G3	G4
TF	6	20	8	1
BF	-65	-47	-25	-6

	W			E
Section 4	G1	G2	G3	G4
TF	13	-1	0	0
TFangle	21	NA	NA	1
BFangle	90	NA	NA	10
BF	102	86	47	11

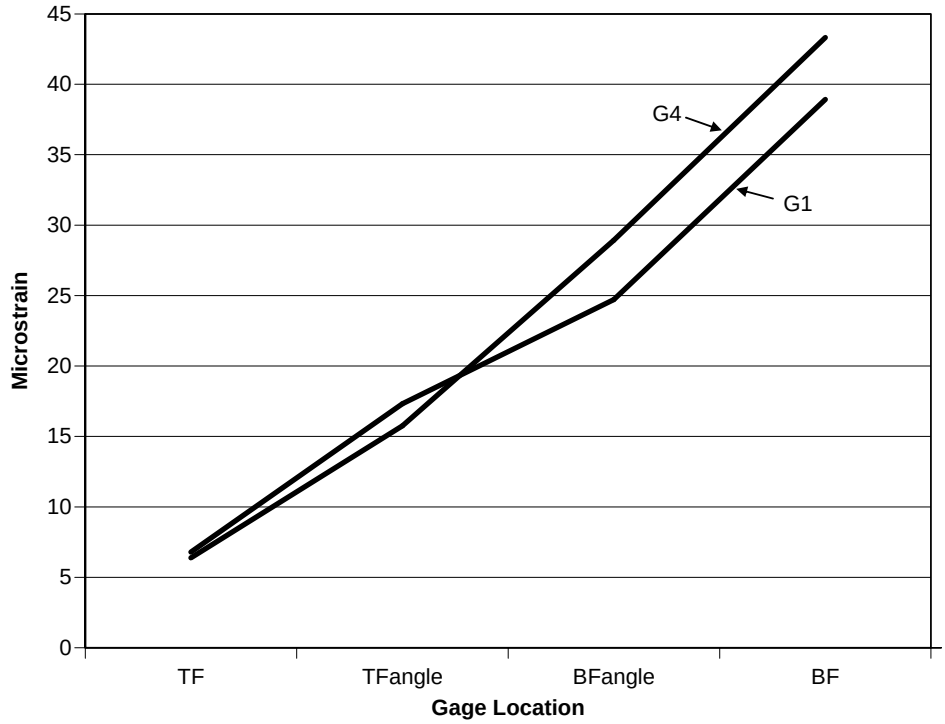

Figure 1. Exterior girder strain distribution, Load Case 2, Section 2.

Table 2. Distribution factors (trucks per girder)

	One Lane
G1	0.42
G2	0.35
G3	0.36
G4	0.43

NOTE: Approximate Two Lane Distribution Factors discussed in text