

Appendix B: Additional Results of the Live-Load Finite Element Models

Predicted vs. Measured Curvature Profiles

Figure B-1 through Figure B-4 and Table B-1 show additional curvature predictions from the calibrated live-load model discussed in Chapter 4. These results complement the results shown in Section 4.6 of the main report.

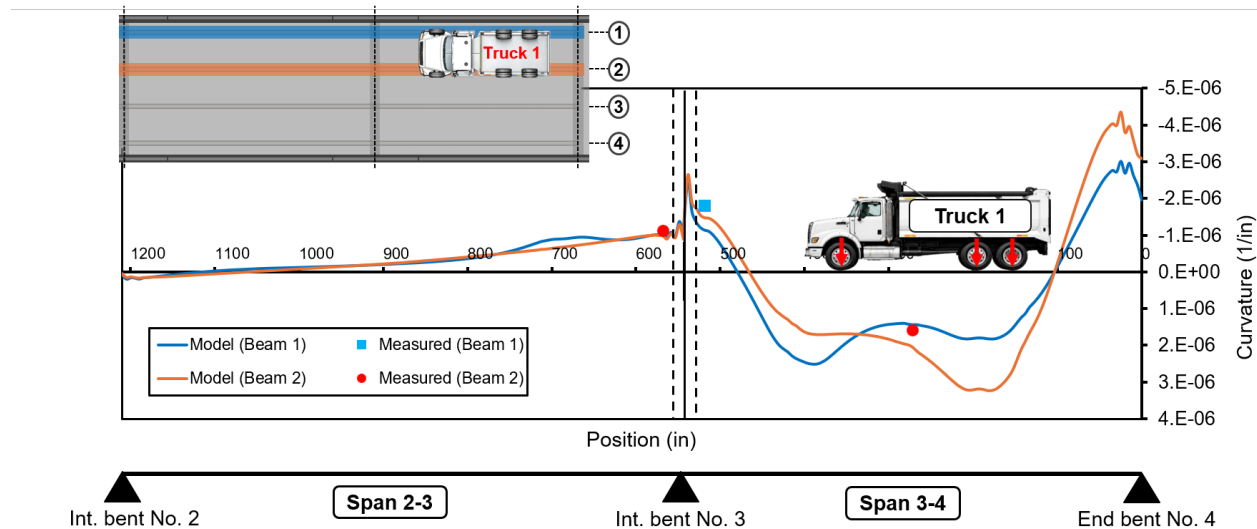


Figure B-1. Predicted and measured curvature profiles for Truck Position 1.

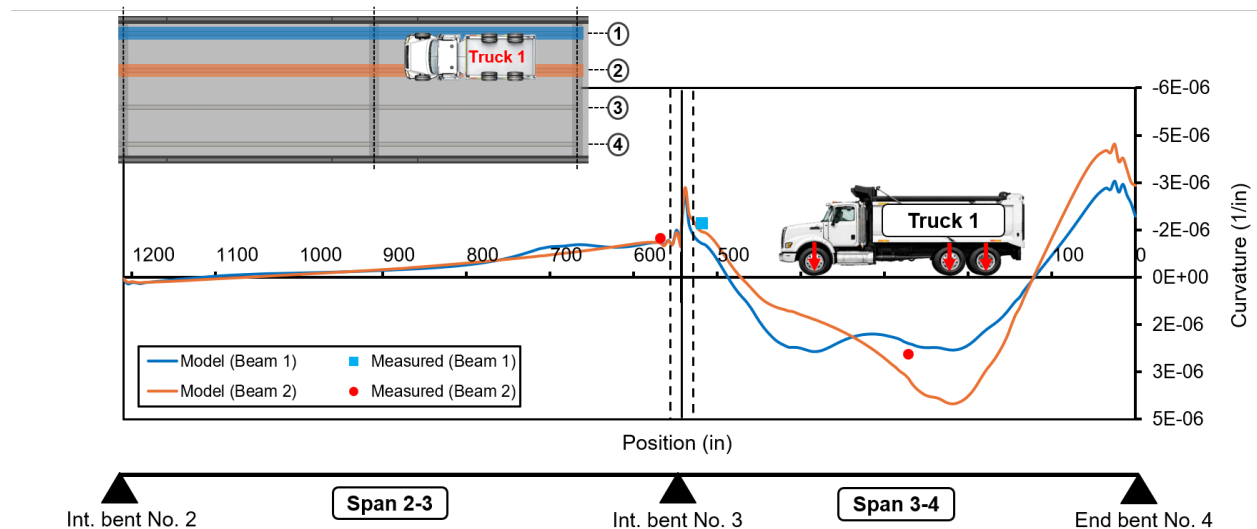


Figure B-2. Predicted and measured curvature profiles for Truck Position 1a.

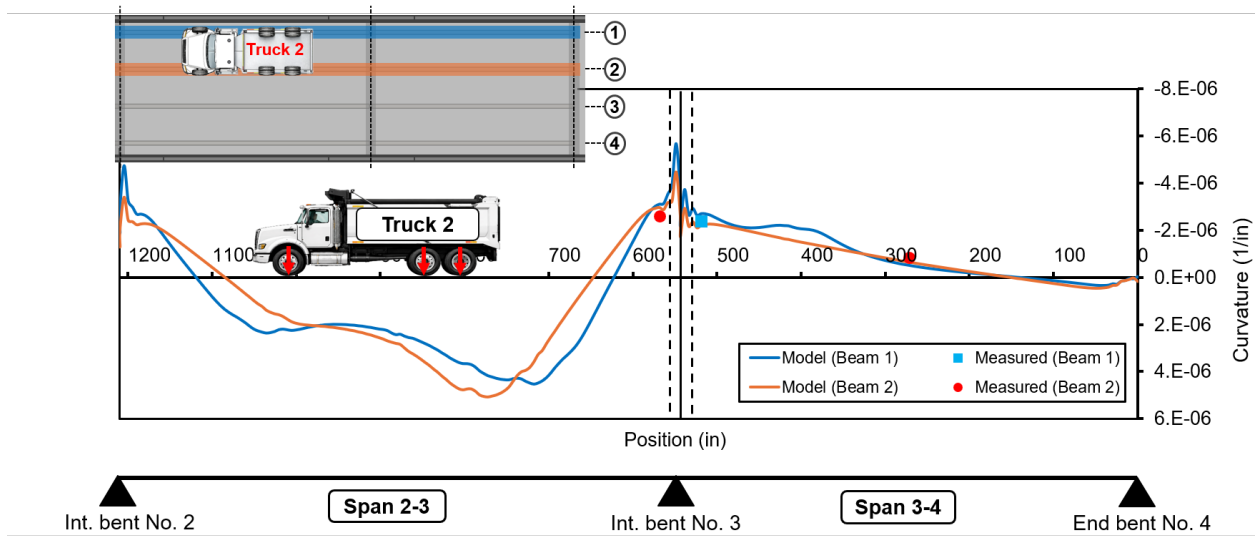


Figure B-3. Predicted and measured curvature profiles for Truck Position 5.

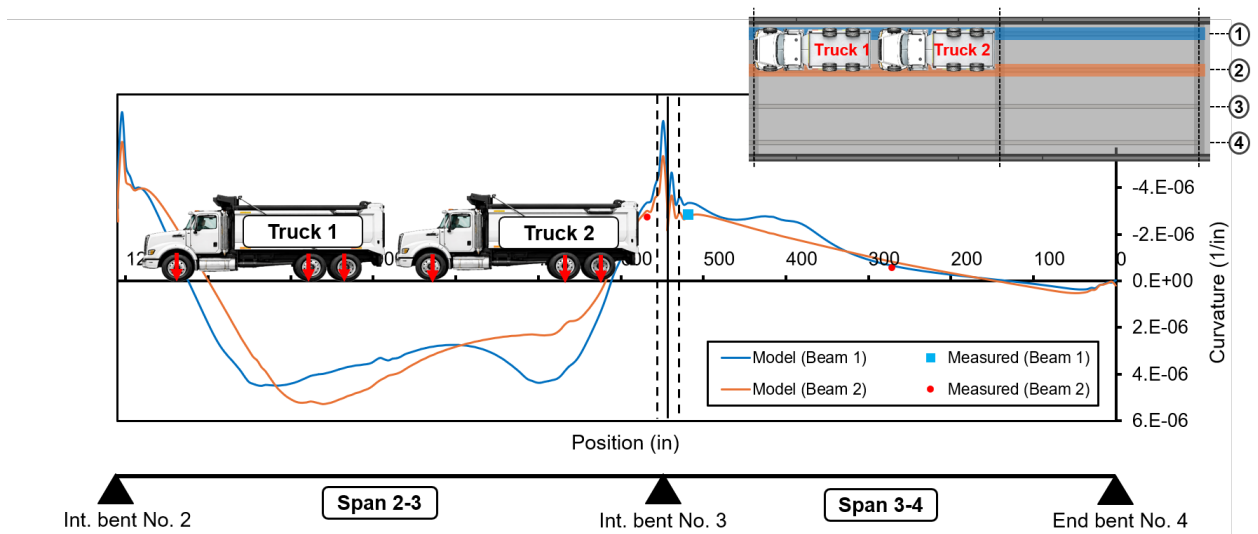


Figure B-4. Predicted and measured curvature profiles for Truck Position 6.

Table B-1. Summary of predicted and measured curvatures during live-load testing

Truck position	Location	Predicted κ ($\times 10^{-6} \text{ in}^{-1}$)	Measured κ ($\times 10^{-6} \text{ in}^{-1}$)	Difference ($\times 10^{-6} \text{ in}^{-1}$)
1	Beam 1 (near support) ^a	-1.12	-1.81	0.69
	Beam 2 (midspan) ^b	2.06	1.57	0.49
	Beam 2 (near support) ^c	-0.97	-1.13	0.16
1a	Beam 1 (near support) ^a	-1.07	-1.71	0.64
	Beam 2 (midspan) ^b	3.2	2.4	0.8
	Beam 2 (near support) ^c	-1.08	-1.25	0.17
2	Beam 1 (near support) ^a	-0.9	-1.4	0.5
	Beam 2 (midspan) ^b	5.18	3.78	1.4
	Beam 2 (near support) ^c	-1.86	-2.17	0.31
3	Beam 1 (near support)	-3.6	-4.13	0.5
	Beam 2 (midspan)	2.58	2.11	0.47
	Beam 2 (near support)	-3.97	-3.85	-0.12
4	Beam 1 (near support)	-3.56	-3.67	0.11
	Beam 2 (midspan)	-1.16	-0.85	-0.31
	Beam 2 (near support)	-4.28	-3.75	-0.53
5	Beam 1 (near support) ^a	-2.71	-2.39	-0.32
	Beam 2 (midspan) ^b	-0.65	-0.85	0.2
	Beam 2 (near support) ^c	-2.97	-2.61	-0.36
6	Beam 1 (near support) ^a	-3.34	-2.87	-0.47
	Beam 2 (midspan) ^b	-0.83	-0.58	-0.25
	Beam 2 (near support) ^c	-3	-2.75	-0.25

^a Curvatures at this location were computed based on readings from ST7 and ST8

^b Curvatures at this location were computed based on readings from ST5 and ST6

^c Curvatures at this location were computed based on readings from ST1 and ST2

Predicted vs. Measured Deflection Profiles

Figure B-5 through Figure B-8 and Table B-2 show additional deflection predictions from the calibrated live-load model discussed in Chapter 4. These results complement the results shown in Section 4.6 of the main report.

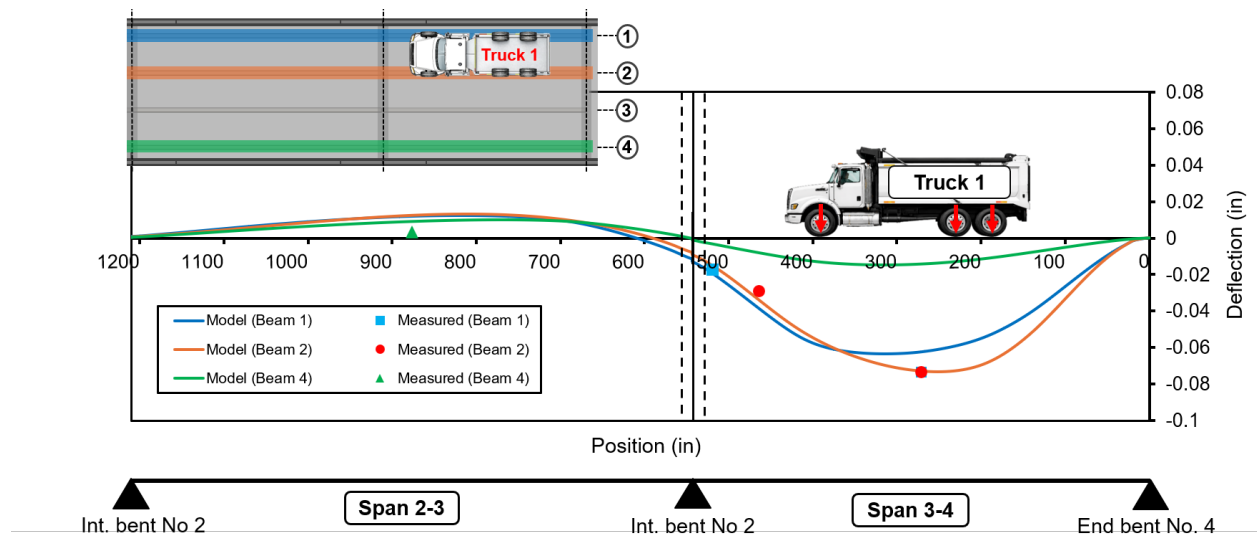


Figure B-5. Predicted and measured deflection profiles for Truck Position 1.

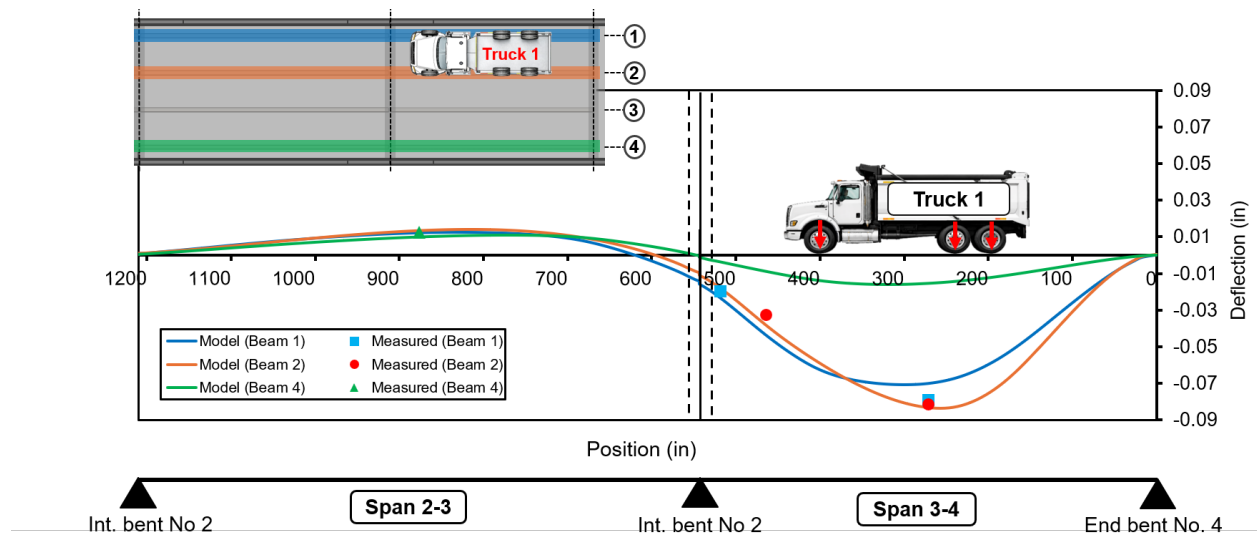


Figure B-6. Predicted and measured deflection profiles for Truck Position 1a.

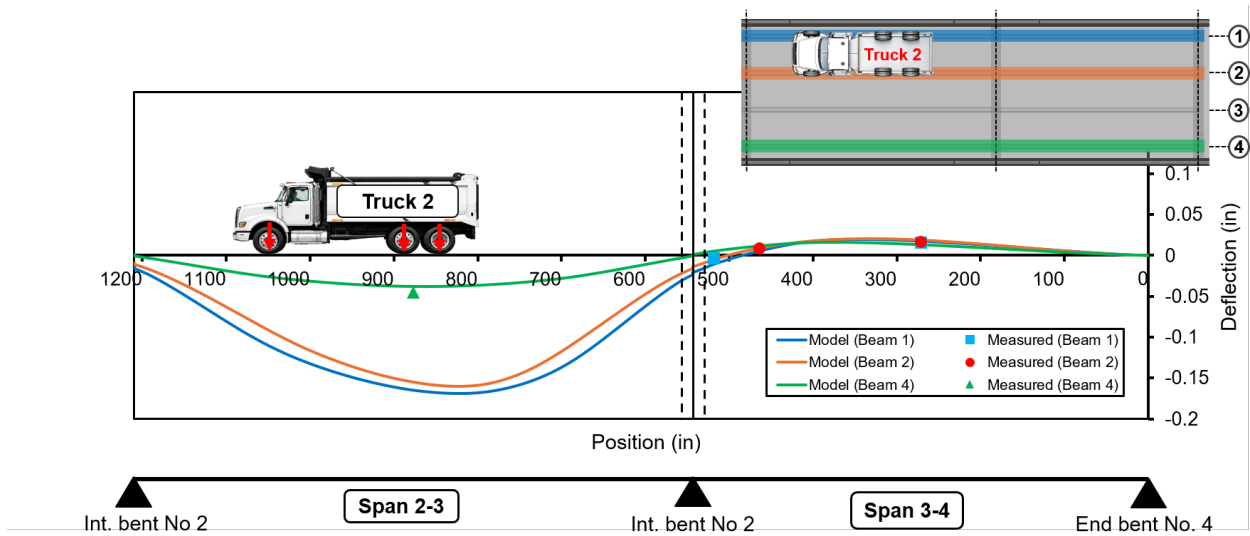


Figure B-7. Predicted and measured deflection profiles for Truck Position 5.

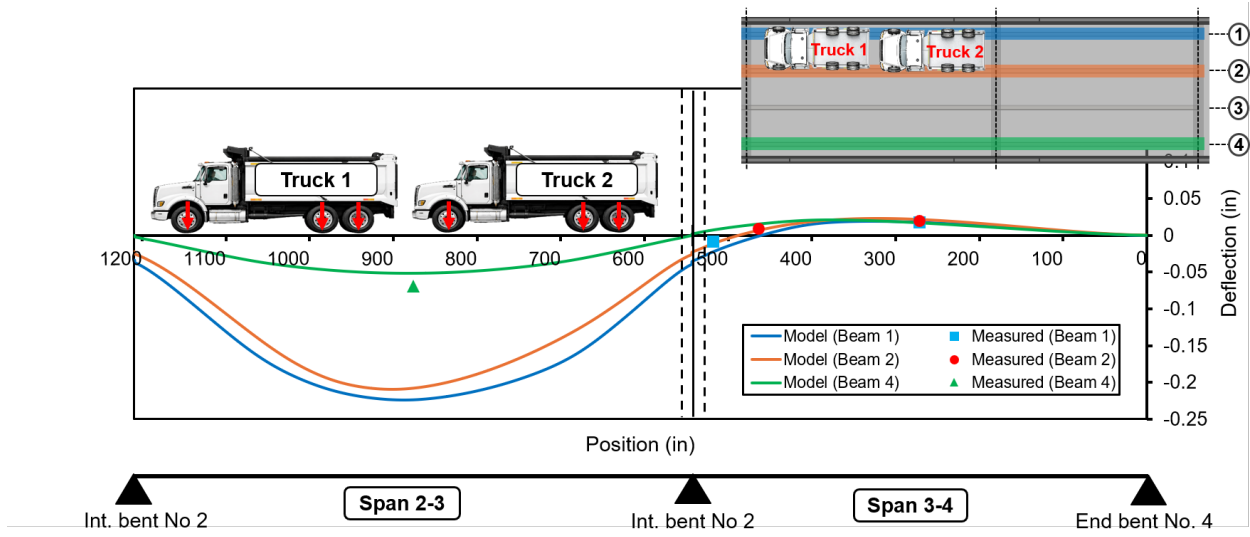


Figure B-8. Predicted and measured deflection profiles for Truck Position 6.

Table B-2. Summary of predicted and measured deflections during live-load testing

Truck position	LVDT	Location ^a	Predicted (in)	Measured (in)	Difference (in)
1	LVDT1	Span 3-4, BL2 near IB3	-0.031	-0.029	0.002
	LVDT2	Span 3-4, BL2 midspan	-0.073	-0.073	-0.001
	LVDT3	Span 3-4, BL1 near IB3	-0.02	-0.017	0.003
	LVDT4	Span 3-4, BL 1 midspan	-0.063	-0.073	-0.01
	SPOT	Span 2-3, BL4 midspan	0.009	0.003	-0.006
1a	LVDT1	Span 3-4, BL2 near IB3	-0.038	-0.032	-0.006
	LVDT2	Span 3-4, BL2 midspan	-0.083	-0.081	-0.002
	LVDT3	Span 3-4, BL1 near IB3	-0.023	-0.020	-0.003
	LVDT4	Span 3-4, BL 1 midspan	-0.070	-0.079	0.009
	SPOT	Span 2-3, BL4 midspan	0.010	0.012	-0.002
2	LVDT1	Span 3-4, BL2 near IB3	-0.059	-0.056	-0.003
	LVDT2	Span 3-4, BL2 midspan	-0.131	-0.137	0.006
	LVDT3	Span 3-4, BL1 near IB3	-0.026	-0.026	0.000
	LVDT4	Span 3-4, BL 1 midspan	-0.084	-0.107	0.023
	SPOT	Span 2-3, BL4 midspan	0.022	0.012	0.010
3	LVDT1	Span 3-4, BL2 near IB3	-0.031	-0.026	-0.005
	LVDT2	Span 3-4, BL2 midspan	-0.066	-0.071	0.005
	LVDT3	Span 3-4, BL1 near IB3	-0.036	-0.024	-0.012
	LVDT4	Span 3-4, BL 1 midspan	-0.054	-0.070	0.016
	SPOT	Span 2-3, BL4 midspan	-0.029	-0.029	0.000
4	LVDT1	Span 3-4, BL2 near IB3	0.018	0.020	-0.002
	LVDT2	Span 3-4, BL2 midspan	0.036	0.034	0.002
	LVDT3	Span 3-4, BL1 near IB3	-0.007	0.001	-0.008
	LVDT4	Span 3-4, BL 1 midspan	0.030	0.031	-0.001
	SPOT	Span 2-3, BL4 midspan	-0.195	-0.174	-0.021
5	LVDT1	Span 3-4, BL2 near IB3	0.008	0.009	-0.001
	LVDT2	Span 3-4, BL2 midspan	0.019	0.017	0.002
	LVDT3	Span 3-4, BL1 near IB3	-0.011	-0.003	-0.008
	LVDT4	Span 3-4, BL 1 midspan	0.018	0.016	0.002
	SPOT	Span 2-3, BL4 midspan	-0.038	-0.045	0.007
6	LVDT1	Span 3-4, BL2 near IB3	0.006	0.009	-0.003
	LVDT2	Span 3-4, BL2 midspan	0.021	0.020	0.001
	LVDT3	Span 3-4, BL1 near IB3	-0.022	-0.008	-0.014
	LVDT4	Span 3-4, BL 1 midspan	0.018	0.018	0.000
	SPOT	Span 2-3, BL4 midspan	-0.052	-0.069	0.017

^a BL refers to beam line and IB refers to intermediate bent

Additional Degree of Continuity Results

Figure B-9 and Figure B-10 report additional degree of continuity estimates beyond those discussed in Chapter 4 (Section 4.8) of the main results.

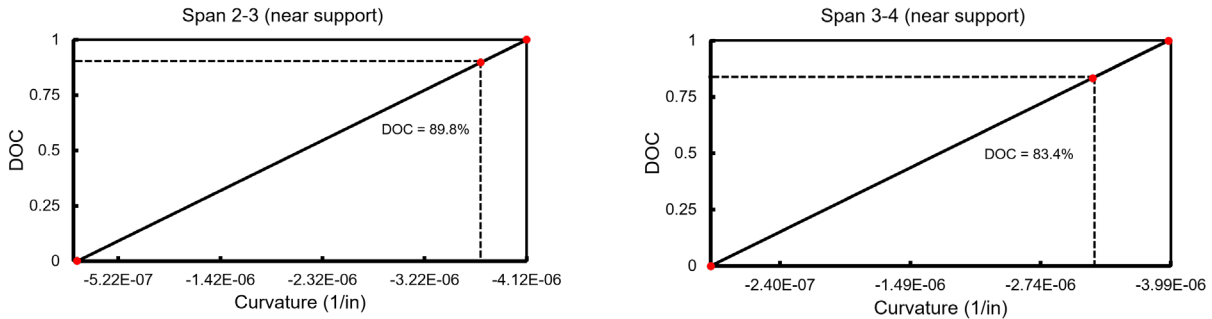


Figure B-9. Curvature-based degree of continuity for Truck Position 3.

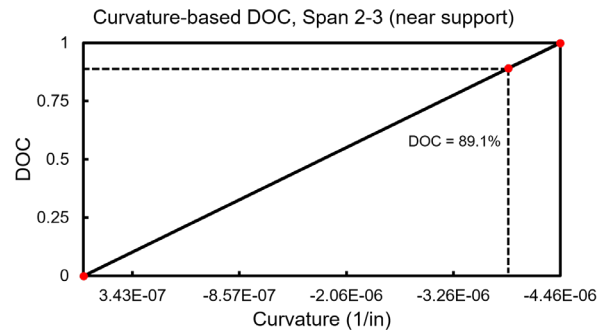


Figure B-10. Curvature-based degree of continuity for Truck Position 4.

Additional Stress Results from the Parametric Models

Table B-3 through Table B-10 show the breakdown of the average deck reinforcement stresses and compression block stresses coming from the factored live loads and superimposed dead loads for the different parametric models considered in Chapter 5 of the main report.

Table B-3. Factored HL-93 and lane load stresses – Base Bridge.

			Deck IB 2		Deck IB 3		Compression block	
			Avg. rein. stress (ksi)	$f_{s,avg}/f_{y,s}$ (%)	Avg. rein. stress (ksi)	$f_{s,avg}/f_{y,s}$ (%)	Avg. stress (ksi)	$f_{c,avg}/f_{y,pl}$ (%)
Fixed diaphragm	No Plate	LC1	7.00	11.67	1.43	2.39	2.44	4.89
		LC2	13.19	21.99	15.59	25.98	4.02	8.04
		LC3	14.50	24.16	12.53	20.88	3.92	7.84
		LC4	3.21	5.36	0.53	0.88	1.29	2.58
		LC5	9.07	15.12	2.72	4.53	2.72	5.44
	Plate	LC1	7.05	11.75	1.43	2.39	2.50	4.99
		LC2	13.23	22.06	15.65	26.08	4.05	8.11
		LC3	14.54	24.23	12.56	20.94	3.95	7.91
		LC4	3.24	5.40	0.53	0.88	1.32	2.63
		LC5	9.08	15.14	2.72	4.54	2.73	5.47
Pinned diaphragm	No Plate	LC1	7.32	12.20	1.68	2.79	1.92	3.84
		LC2	14.63	24.38	17.04	28.39	3.45	6.89
		LC3	15.01	25.02	13.27	22.11	4.26	8.52
		LC4	3.36	5.61	0.63	1.05	1.00	2.00
		LC5	9.62	16.03	2.99	4.98	2.21	4.42
	Plate	LC1	7.35	12.25	1.66	2.77	1.91	3.83
		LC2	14.75	24.58	17.13	28.56	3.46	6.92
		LC3	15.59	25.99	13.80	22.99	3.36	6.71
		LC4	3.27	5.45	0.66	1.11	1.32	2.64
		LC5	9.62	16.03	3.00	4.99	2.22	4.45

Table B-4. Factored superimposed dead load stresses – Base Bridge.

			Deck IB 2		Deck IB 3		Compression block	
			Avg. rein. stress (ksi)	$f_{s,avg}/f_{y,s}$ (%)	Avg. rein. stress (ksi)	$f_{s,avg}/f_{y,s}$ (%)	Avg. stress (ksi)	$f_{c,avg}/f_{y,pl}$ (%)
Fixed diaphragm	No Plate		2.47	4.12	2.46	4.11	0.60	1.20
	Plate		2.47	4.12	2.46	4.11	0.60	1.21
Pinned diaphragm	No Plate		2.63	4.38	2.61	4.35	0.50	1.00
	Plate		2.63	4.39	2.61	4.36	0.50	1.01

Table B-5. Factored HL-93 and lane load stresses – Skew Angle Bridge.

			Deck IB 2		Deck IB 3		Compression block	
			Avg. rein. stress (ksi)	$f_{s,avg}/f_{y,s}$ (%)	Avg. rein. stress (ksi)	$f_{s,avg}/f_{y,s}$ (%)	Avg. stress (ksi)	$f_{c,avg}/f_{y,pl}$ (%)
Fixed diaphragm	No Plate	LC1	4.86	8.10	1.36	2.26	1.14	2.27
		LC2	12.10	20.17	13.41	22.35	1.57	3.14
		LC3	12.69	21.15	11.05	18.41	1.63	3.27
		LC4	3.15	5.25	0.83	1.39	0.61	1.22
		LC5	8.60	14.34	3.31	5.51	0.96	1.93
	Plate	LC1	4.92	8.20	1.35	2.25	1.13	2.26
		LC2	12.33	20.56	13.50	22.50	1.54	3.09
		LC3	12.94	21.57	11.12	18.54	1.61	3.22
		LC4	3.20	5.34	0.81	1.36	0.61	1.22
		LC5	8.73	14.55	3.34	5.57	1.00	2.00
Pinned diaphragm	No Plate	LC1	4.78	7.97	1.39	2.32	0.99	1.98
		LC2	12.04	20.06	13.18	21.96	2.06	4.13
		LC3	12.64	21.07	10.84	18.06	2.33	4.66
		LC4	2.97	4.95	0.93	1.55	0.67	1.35
		LC5	8.46	14.10	3.16	5.27	1.44	2.88
	Plate	LC1	4.86	8.10	1.42	2.37	1.04	2.08
		LC2	12.30	20.50	13.49	22.49	2.14	4.27
		LC3	12.87	21.45	11.08	18.47	2.28	4.56
		LC4	3.01	5.02	0.96	1.60	0.71	1.42
		LC5	8.53	14.22	3.23	5.39	1.49	2.98

Table B-6. Factored superimposed dead load stresses – Skew Angle Bridge.

			Deck IB 2		Deck IB 3		Compression block	
			Avg. rein. stress (ksi)	$f_{s,avg}/f_{y,s}$ (%)	Avg. rein. stress (ksi)	$f_{s,avg}/f_{y,s}$ (%)	Avg. stress (ksi)	$f_{c,avg}/f_{y,pl}$ (%)
Fixed diaphragm	No Plate		1.85	3.08	1.85	3.08	0.45	0.91
	Plate		1.90	3.16	1.90	3.16	0.45	0.90
Pinned diaphragm	No Plate		1.58	2.64	1.75	2.92	0.44	0.89
	Plate		1.57	2.61	1.75	2.91	0.46	0.92

Table B-7. Factored HL-93 and lane load stresses – Plate Girder Bridge.

			Deck IB 2		Deck IB 3		Compression block	
			Avg. rein. stress (ksi)	$f_{s,avg}/f_{y,s}$ (%)	Avg. rein. stress (ksi)	$f_{s,avg}/f_{y,s}$ (%)	Avg. stress (ksi)	$f_{c,avg}/f_{y,pl}$ (%)
Fixed diaphragm	No Plate	LC1	4.86	8.10	0.26	0.43	2.22	4.43
		LC2	10.74	17.89	11.67	19.44	3.25	6.51
		LC3	17.83	29.72	6.63	11.05	4.08	8.16
		LC4	1.67	2.78	0.86	1.43	0.95	1.90
		LC5	20.20	33.67	7.18	11.96	4.57	9.14
	Plate	LC1	4.90	8.17	0.27	0.45	2.15	4.31
		LC2	10.95	18.25	11.89	19.81	3.20	6.41
		LC3	18.06	30.10	6.75	11.24	4.09	8.18
		LC4	1.69	2.81	0.86	1.43	0.92	1.84
		LC5	20.42	34.04	7.30	12.17	4.59	9.17
Pinned diaphragm	No Plate	LC1	4.73	7.88	0.50	0.83	1.87	3.74
		LC2	11.18	18.63	12.04	20.07	3.03	6.06
		LC3	18.22	30.37	6.68	11.13	4.07	8.14
		LC4	1.56	2.60	0.72	1.20	0.79	1.58
		LC5	20.69	34.48	7.23	12.05	4.62	9.25
	Plate	LC1	4.61	7.68	0.60	1.00	1.69	3.38
		LC2	11.17	18.62	12.05	20.08	2.81	5.63
		LC3	18.43	30.71	6.65	11.08	4.06	8.11
		LC4	1.49	2.49	0.65	1.08	0.70	1.40
		LC5	20.87	34.78	7.19	11.98	4.56	9.13

Table B-8. Factored superimposed dead load stresses – Plate Girder Bridge.

			Deck IB 2		Deck IB 3		Compression block	
			Avg. rein. stress (ksi)	$f_{s,avg}/f_{y,s}$ (%)	Avg. rein. stress (ksi)	$f_{s,avg}/f_{y,s}$ (%)	Avg. stress (ksi)	$f_{c,avg}/f_{y,pl}$ (%)
Fixed diaphragm	No Plate		3.19	5.32	3.22	5.37	0.62	1.25
	Plate		3.23	5.38	3.26	5.43	0.62	1.25
Pinned diaphragm	No Plate		3.23	5.38	3.26	5.43	0.62	1.25
	Plate		3.25	5.41	3.28	5.46	0.61	1.23

Table B-9. Factored HL-93 and lane load stresses – Unbalanced Span Bridge.

			Deck IB 2		Deck IB 3		Compression block	
			Avg. rein. stress (ksi)	$f_{s,avg}/f_{y,s}$ (%)	Avg. rein. stress (ksi)	$f_{s,avg}/f_{y,s}$ (%)	Avg. stress (ksi)	$f_{c,avg}/f_{y,pl}$ (%)
Fixed diaphragm	No Plate	LC1	4.27	7.12	0.69	1.14	1.74	3.49
		LC2	13.11	21.84	14.51	24.18	3.56	7.11
		LC3	16.05	26.75	11.84	19.73	4.78	9.55
		LC4	2.01	3.35	0.18	0.30	0.93	1.86
		LC5	10.98	18.30	5.48	9.13	2.86	5.73
	Plate	LC1	4.25	7.08	0.97	1.61	1.77	3.54
		LC2	13.34	22.23	14.77	24.61	4.67	9.34
		LC3	16.40	27.33	12.02	20.03	4.70	9.40
		LC4	2.06	3.43	0.18	0.30	0.94	1.88
		LC5	11.09	18.49	5.59	9.32	2.82	5.63
Pinned diaphragm	No Plate	LC1	4.24	7.07	0.82	1.37	1.58	3.16
		LC2	13.78	22.97	15.10	25.17	4.48	8.97
		LC3	16.38	27.29	12.14	20.23	4.69	9.39
		LC4	2.01	3.36	0.26	0.43	0.84	1.68
		LC5	11.10	18.50	5.65	9.41	2.77	5.54
	Plate	LC1	4.16	6.93	0.86	1.44	1.60	3.20
		LC2	13.73	22.88	14.98	24.96	4.16	8.32
		LC3	16.40	27.33	12.03	20.06	4.59	9.17
		LC4	1.96	3.27	0.28	0.47	0.84	1.68
		LC5	11.08	18.47	5.61	9.35	2.69	5.38

Table B-10. Factored superimposed dead load stresses – Unbalanced Span Bridge.

			Deck IB 2		Deck IB 3		Compression block	
			Avg. rein. stress (ksi)	$f_{s,avg}/f_{y,s}$ (%)	Avg. rein. stress (ksi)	$f_{s,avg}/f_{y,s}$ (%)	Avg. stress (ksi)	$f_{c,avg}/f_{y,pl}$ (%)
Fixed diaphragm	No Plate		3.19	5.32	3.22	5.37	0.62	1.25
	Plate		3.23	5.38	3.26	5.43	0.62	1.25
Pinned diaphragm	No Plate		3.23	5.38	3.26	5.43	0.62	1.25
	Plate		3.25	5.41	3.28	5.46	0.61	1.23