Appendix: Section properties of standard precast concrete girders

Richard Brice and Richard Pickings

This appendix provides tables listing the section properties for the standard precast concrete girders considered in the study presented in "Saint-Venant Torsion Constant of Modern Precast Concrete Bridge Girders," by Richard Brice and Richard Pickings, which appears on pages 23 through 31 of the May–June 2021 issue of *PCI Journal*.

For each table, the first seven columns list the girder section name, cross-sectional area, location of the centroid from the top and bottom of the girder, major and minor axis moments of inertia, and torsion constant computed with the refined analysis method used in the study. The remaining six columns list the cross-sectional area of the finite difference mesh, the ratio of the mesh area to the girder cross-sectional area, torsion constant computed with the approximate equations given in the American Association of State Highway and Transportation Officials' *AASHTO LRFD Bridge Design Specifications*[1] (if applicable), and the ratio of the approximate-to-refined values of the torsion constant. The tables are structured such that the left group of columns can be easily incorporated into design references and the right group of columns contains information for assessing the accuracy of the analysis and the AASHTO LRFD specifications approximate equations.

Table A.1. Section properties of AASHTO standard girders

Name	A, in.^{2}	Y_t, in.	Y_b, in.	I_x, in.^{4}	I_y, in.^{4}	J, in.^{4}	A_{mesh}, in.^{2}	A_{mesh}/A	J_1, in.^{4}	J_1/J	J_2, in.^{4}	J_2/J
Type I	276.0	15.41	12.59	22,744	3352	4592	275	0.996	3996	0.87	5559	1.21
Type II	369.0	20.17	15.83	50,979	5333	7621	368	0.997	7466	0.98	8231	1.08
Type III	559.5	24.73	20.27	125,390	12,217	16,734	558	0.997	16,190	0.97	17,803	1.06
Type IV	789.0	29.27	24.73	260,741	24,374	32,334	787	0.998	31,006	0.96	33,980	1.05
Type V	1013.0	31.04	31.96	521,163	61,235	37,925	1011	0.998	31,774	0.84	45,202	1.19
Type VI	1085.0	35.62	36.38	733,320	61,619	39,461	1083	0.998	33,310	0.84	43,584	1.10
BT-54	659.0	26.37	27.63	268,051	37,310	10,827	659	1.000	9112	0.84	15,441	1.43
BT-63	713.0	30.88	32.12	392,516	37,472	11,475	713	1.000	9760	0.85	15,026	1.31
BT-72	767.0	35.40	36.60	545,857	37,634	12,123	767	1.000	10,408	0.86	14,828	1.22

Note: A = area of cross section; A_{mesh} = area of cross section of finite difference mesh; AASHTO = American Association of State Highway and Transportation Officials; I_x = major axis moment of inertia; I_y = minor axis moment of inertia; J = torsion constant; J_1 = approximate torsion constant computed with *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-1); J_2 = approximate torsion constant computed with of the *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-2); Y_b = location of the centroid from the bottom of the girder; Y_t = location of the centroid from the top of the girder. 1 in. = 25.4 mm; 1 in.^{2} = 645.2 mm^2; 1 in.^{4} = 416,231 mm^4.

Table A.2. Section properties of California Department of Transportation standard girders

Name	A, in.^{2}	Y_t, in.	Y_b, in.	I_x, in.^{4}	I_y, in.^{4}	J, in.^{4}	A_{mesh}, in.^{2}	A_{mesh}/A	J_1, in.^{4}	J_1/J	J_2, in.^{4}	J_2/J
BT49	876.1	23.66	25.34	275,738	67,877	28,628	878	1.003	17,953	0.63	42,858	1.50
BT55	924.3	26.74	28.38	372,768	68,126	29,656	927	1.003	18,951	0.64	41,388	1.40
BT61	970.6	29.69	31.31	482,117	68,366	30,643	974	1.003	19,907	0.65	40,301	1.32
BT67	1017.0	32.66	34.24	608,811	68,606	31,639	1021	1.004	20,868	0.66	39,486	1.25
BT73	1064.1	35.66	37.22	755,114	68,849	32,637	1068	1.004	21,840	0.67	38,900	1.19
BT79	1110.4	38.61	40.14	917,506	69,088	33,624	1115	1.004	22,796	0.68	38,517	1.15
BT85	1156.6	41.55	43.07	1,099,060	69,327	34,611	1162	1.004	23,753	0.69	38,293	1.11
WF48	885.2	27.09	20.91	273,886	89,512	27,050	885	1.000	17,196	0.64	42,239	1.56
WF54	924.2	30.54	23.46	368,045	89,649	27,599	924	1.000	17,745	0.64	39,849	1.44
WF60	963.2	33.95	26.05	478,505	89,786	28,148	963	1.000	18,295	0.65	37,864	1.35
WF66	1002.2	37.32	28.68	606,007	89,924	28,697	1002	1.000	18,844	0.66	36,239	1.26
WF72	1041.2	40.67	31.33	751,287	90,061	29,246	1041	1.000	19,393	0.66	34,921	1.19
WF78	1080.2	43.99	34.01	915,075	90,198	29,795	1080	1.000	19,942	0.67	33,858	1.14
WF84	1119.2	47.29	36.71	1,098,097	90,336	30,344	1119	1.000	20,492	0.68	33,005	1.09
WF90	1158.2	50.57	39.43	1,301,077	90,473	30,893	1158	1.000	21,041	0.68	32,327	1.05
WF96	1197.2	53.83	42.17	1,524,734	90,610	31,442	1197	1.000	21,590	0.69	31,793	1.01
WF102	1236.2	57.08	44.92	1,769,788	90,748	31,991	1236	1.000	22,139	0.69	31,380	0.98
WF108	1275.2	60.31	47.69	2,036,953	90,885	32,540	1275	1.000	22,689	0.70	31,067	0.95
WF114	1314.2	63.53	50.47	2,326,945	91,022	33,089	1314	1.000	23,238	0.70	30,841	0.93
WF120	1353.2	66.73	53.27	2,640,476	91,160	33,638	1353	1.000	23,787	0.71	30,687	0.91
I36	432.0	18.88	17.13	62,957	8238	10,018	431	0.997	8386	0.84	12,230	1.22
I42	474.0	22.03	19.97	95,424	8410	10,703	473	0.997	9072	0.85	12,154	1.14
I48	516.0	25.15	22.85	136,404	8581	11,389	515	0.997	9758	0.86	12,224	1.07
I54	558.0	28.26	25.74	186,659	8753	12,075	557	0.997	10,444	0.86	12,403	1.03
I60	600.0	31.35	28.65	246,947	8924	12,761	599	0.998	11,130	0.87	12,663	0.99
I66	642.0	34.43	31.57	318,025	9096	13,447	641	0.998	11,816	0.88	12,983	0.97
Tub55	1337.0	30.94	24.19	462,263	1,131,753	28,675	1335	0.999	22,584	0.79	n/a	n/a
Tub61	1432.4	34.03	26.97	605,522	1,296,561	30,760	1433	1.000	24,555	0.80	n/a	n/a
Tub67	1527.8	37.10	29.78	773,444	1,473,328	32,675	1528	1.000	26,527	0.81	n/a	n/a
Tub73	1623.8	40.17	32.62	968,969	1,664,925	34,600	1624	1.000	28,512	0.82	n/a	n/a
Tub79	1720.6	43.26	35.49	1,194,944	1,868,824	36,488	1720	0.999	30,512	0.84	n/a	n/a
Tub85	1815.9	46.29	38.34	1,447,432	2,084,224	38,424	1815	1.000	32,484	0.85	n/a	n/a

Source: Data from California Department of Transportation, Design Aid for Precast Prestressed Girders (2016).

Note: A = area of cross section; A_{mesh} = area of cross section of finite difference mesh; AASHTO = American Association of State Highway and Transportation Officials; I_x = major axis moment of inertia; I_y = minor axis moment of inertia; J = torsion constant; J_1 = approximate torsion constant computed with *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-1); J_2 = approximate torsion constant computed with of the *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-2); n/a = not applicable; Y_b = location of the centroid from the bottom of the girder; Y_t = location of the centroid from the top of the girder. 1 in. = 25.4 mm; 1 in.^{2} = 645.2 mm^2; 1 in.^{4} = 416,231 mm^4.

Table A.3. Section properties of Colorado Department of Transportation standard girders

Name	A, in.^{2}	Y_t, in.	Y_b, in.	I_x, in.^{4}	I_y, in.^{4}	J, in.^{4}	A_{mesh}, in.^{2}	A_{mesh}/A	J_1, in.^{4}	J_1/J	J_2, in.^{4}	J_2/J
CBT 30	739.8	15.06	14.94	84,963	88,783	18,607	739	0.999	11,375	0.61	43,089	2.32
CBT 36	781.8	18.22	17.78	136,525	88,955	19,281	781	0.999	12,061	0.63	41,410	2.15
CBT 45	844.8	22.92	22.08	240,424	89,212	20,309	844	0.999	13,090	0.64	38,620	1.90
CBT 54	907.8	27.60	26.40	378,473	89,469	21,338	907	0.999	14,119	0.66	36,275	1.70
CBT 63	970.8	32.26	30.74	553,233	89,727	22,366	970	0.999	15,148	0.68	34,529	1.54
CBT 72	1033.8	36.90	35.10	767,268	89,984	23,395	1033	0.999	16,177	0.69	33,304	1.42
CBT 81	1096.8	41.52	39.48	1,023,134	90,241	24,424	1096	0.999	17,206	0.70	32,488	1.33
CBT 90	1159.8	46.13	43.87	1,323,390	90,498	25,452	1159	0.999	18,235	0.72	31,988	1.26

Source: Data from Colorado Department of Transportation, Prestressed Concrete CBT (2020), https://www.codot.gov/library/bridge/design-standards/structural-worksheets-pdfs/b-600/b-618-cbt2-1/view.

Note: A = area of cross section; A_{mesh} = area of cross section of finite difference mesh; AASHTO = American Association of State Highway and Transportation Officials; I_x = major axis moment of inertia; I_y = minor axis moment of inertia; J = torsion constant; J_1 = approximate torsion constant computed with *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-1); J_2 = approximate torsion constant computed with of the *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-2); Y_b = location of the centroid from the bottom of the girder; Y_t = location of the centroid from the top of the girder. 1 in. = 25.4 mm; 1 in.^{2} = 645.2 mm^2; 1 in.^{4} = 416,231 mm^4.

Table A.4. Section properties of Florida Department of Transportation standard girders

Name	A, in.^{2}	Y_t, in.	Y_b, in.	I_x, in.^{4}	I_y, in.^{4}	J, in.^{4}	A_{mesh}, in.^{2}	A_{mesh}/A	J_1, in.^{4}	J_1/J	J_2, in.^{4}	J_2/J
FIB-36	806.6	19.51	16.49	127,545	81,070	30,342	806	0.999	19,365	0.64	50,721	1.67
FIB-45	869.6	24.79	20.21	226,581	81,327	31,361	869	0.999	20,394	0.65	46,426	1.48
FIB-54	932.6	29.96	24.04	359,930	81,585	32,389	932	0.999	21,423	0.66	42,830	1.32
FIB-63	995.6	35.04	27.96	530,314	81,842	33,418	995	0.999	22,452	0.67	40,122	1.20
FIB-72	1058.6	40.06	31.94	740,417	82,099	34,447	1058	0.999	23,481	0.68	38,167	1.11
FIB-78	1100.6	43.37	34.63	903,862	82,271	35,132	1100	0.999	24,167	0.69	37,196	1.06
FIB-84	1142.6	46.66	37.34	1,086,921	82,442	35,818	1142	0.999	24,853	0.69	36,437	1.02
FIB-96	1226.6	53.18	42.82	1,514,980	82,785	37,190	1226	0.999	26,225	0.71	35,417	0.95
FIB-102	1370.6	56.01	45.99	1,852,726	90,538	45,248	1370	0.999	32,252	0.71	45,397	1.00
FUB-48	1207.5	28.55	19.45	321,913	907,842	27,476	1208	1.000	14,280	0.52	n/a	n/a
FUB-54	1275.7	32.00	22.00	440,294	1,027,767	28,148	1276	1.000	13,587	0.48	n/a	n/a
FUB-63	1378.1	37.09	25.91	660,469	1,224,143	29,155	1378	1.000	12,549	0.43	n/a	n/a
FUB-72	1480.5	42.09	29.91	935,639	1,441,228	30,162	1481	1.000	11,510	0.38	n/a	n/a

Source: Data from Florida Department of Transportation, Standard Plans for Road and Bridge Construction (2021), https://www.fdot.gov/design/standardplans/SPRBC.shtm.

Note: A = area of cross section; A_{mesh} = area of cross section of finite difference mesh; AASHTO = American Association of State Highway and Transportation Officials; I_x = major axis moment of inertia; I_y = minor axis moment of inertia; J = torsion constant; J_1 = approximate torsion constant computed with *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-1); J_2 = approximate torsion constant computed with of the *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-2); n/a = not applicable; Y_b = location of the centroid from the bottom of the girder; Y_t = location of the centroid from the top of the girder. 1 in. = 25.4 mm; 1 in.^{2} = 645.2 mm^2; 1 in.^{4} = 416,231 mm^4.

Table A.5. Section properties of Illinois Department of Transportation standard girders

Name	A, in.^{2}	Y_t, in.	Y_b, in.	I_x, in.^{4}	I_y, in.^{4}	J, in.^{4}	A_{mesh}, in.^{2}	A_{mesh}/A	J_1, in.^{4}	J_1/J	J_2, in.^{4}	J_2/J
IL27-1830	457.9	15.93	11.07	33,880	20,443	12,293	458	1.000	8658	0.70	20,240	1.65
IL36-2438	728.2	21.30	14.70	100,447	50,897	29,418	728	1.000	21,157	0.72	46,452	1.58
IL36-3838	805.6	19.52	16.48	124,645	69,535	30,393	805	1.000	21,791	0.72	54,220	1.78
IL45-2438	791.2	26.82	18.18	182,649	51,154	30,426	791	1.000	22,186	0.73	41,905	1.38
IL45-3838	868.6	24.68	20.32	223,618	69,792	31,401	868	1.000	22,820	0.73	48,495	1.54
IL54-2438	854.2	32.20	21.80	295,471	51,411	31,454	854	1.000	23,215	0.74	38,373	1.22
IL54-3838	931.6	29.76	24.24	357,105	70,050	32,429	931	1.000	23,849	0.74	44,078	1.36
IL63-2438	917.2	37.45	25.55	441,757	51,669	32,483	917	1.000	24,244	0.75	35,859	1.10
IL63-3838	994.6	34.76	28.24	527,783	70,307	33,458	994	1.000	24,878	0.74	40,900	1.22
IL72-2438	980.2	42.61	29.39	624,278	51,926	33,574	981	1.000	25,273	0.75	34,130	1.02
IL72-3838	1057.6	39.70	32.30	738,301	70,564	34,486	1057	1.000	25,907	0.75	38,664	1.12

Source: Data from Illinois Department of Transportation (2019), http://www.idot.illinois.gov/Assets/uploads/files/Doing-Business/Manuals-Guides-&-Handbooks/Highways/Bridges/CADD/Bridge-Cell-Libraries/prestressed.pdf.

Note: A = area of cross section; A_{mesh} = area of cross section of finite difference mesh; AASHTO = American Association of State Highway and Transportation Officials; I_x = major axis moment of inertia; I_y = minor axis moment of inertia; J = torsion constant; J_1 = approximate torsion constant computed with *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-1); J_2 = approximate torsion constant computed with of the *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-2); Y_b = location of the centroid from the bottom of the girder; Y_t = location of the centroid from the top of the girder. 1 in. = 25.4 mm; 1 in.^{2} = 645.2 mm^2; 1 in.^{4} = 416,231 mm^4.

Table A.6. Section properties of Minnesota Department of Transportation standard girders

Name	A, in.^{2}	Y_t, in.	Y_b, in.	I_x, in.^{4}	I_y, in.^{4}	J, in.^{4}	A_{mesh}, in.^{2}	A_{mesh}/A	J_1, in.^{4}	J_1/J	J_2, in.^{4}	J_2/J
27M	515.44	13.39	13.61	42,975	27,513	12,154	515	0.999	10,727	0.88	25,034	2.06
36M	569.44	18.03	17.97	93,351	27,675	12,793	569	0.999	11,375	0.89	21,719	1.70
30MH	636.23	16.27	13.61	69,557	53,140	15,641	636	1.000	10,503	0.67	33,386	2.13
35MH	668.73	19.08	15.80	104,440	53,254	16,088	668	1.000	10,961	0.68	31,704	1.97
40MH	701.23	21.86	18.02	147,568	53,368	16,545	701	1.000	11,419	0.69	30,083	1.82
MN45	689.86	24.40	20.60	178,573	36,047	19,578	690	1.000	11,905	0.61	26,382	1.35
MN54	748.36	29.35	24.65	284,943	36,253	20,402	748	1.000	12,729	0.62	24,412	1.20
MN63	806.86	34.24	28.76	421,358	36,459	21,225	807	1.000	13,553	0.64	23,144	1.09
MW82	905.79	43.61	38.39	798,229	33,593	20,775	906	1.000	18,525	0.89	20,231	0.97
MW96	996.79	50.89	45.11	1,186,420	33,914	22,056	997	1.000	19,807	0.90	20,224	0.92

Source: Data from Minnesota Department of Transportation, Bridge Details Manual Part II (2020), http://www.dot.state.mn.us/bridge/bridgedetails2.html.

Note: A = area of cross section; A_{mesh} = area of cross section of finite difference mesh; AASHTO = American Association of State Highway and Transportation Officials; I_x = major axis moment of inertia; I_y = minor axis moment of inertia; J = torsion constant; J_1 = approximate torsion constant computed with *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-1); J_2 = approximate torsion constant computed with of the *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-2); Y_b = location of the centroid from the bottom of the girder; Y_t = location of the centroid from the top of the girder. 1 in. = 25.4 mm; 1 in.^{2} = 645.2 mm^2; 1 in.^{4} = 416,231 mm^4.

Table A.7. Section properties of Nebraska Department of Roads standard girders

Name	A, in.^{2}	Y_t, in.	Y_b, in.	I_x, in.^{4}	I_y, in.^{4}	J, in.^{4}	A_{mesh}, in.^{2}	A_{mesh}/A	J_1, in.^{4}	J_1/J	J_2, in.^{4}	J_2/J
NU900	647.6	19.31	16.09	109,971	61,200	14,012	649	1.002	9211	0.66	25,695	1.83
NU1100	694.3	23.76	19.54	182,159	61,335	14,580	696	1.003	9752	0.67	23,852	1.64
NU1350	752.1	29.19	23.91	301,563	61,503	15,288	755	1.005	10,422	0.68	22,029	1.44
NU1600	810.5	34.60	28.40	458,491	61,672	16,038	815	1.006	11,100	0.69	20,738	1.29
NU1800	857.1	38.88	32.02	611,854	61,808	16,604	863	1.007	11,641	0.70	20,027	1.21
NU2000	903.1	43.06	35.64	789,351	61,941	17,165	910	1.007	12,175	0.71	19,536	1.14

Source: Data from K. E. Hanna, G. Morcous, and M. K. Tadros, "Design Aids of NU I-Girder Bridges," SPR-P1(09) P322 (Nebraska Department of Roads, 2010), https://matc.unl.edu/assets/documents/matcfinal/Morcous_NDORdesignaidsofNU-IGriderBridges.pdf.

Note: A = area of cross section; A_{mesh} = area of cross section of finite difference mesh; AASHTO = American Association of State Highway and Transportation Officials; I_x = major axis moment of inertia; I_y = minor axis moment of inertia; J = torsion constant; J_1 = approximate torsion constant computed with *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-1); J_2 = approximate torsion constant computed with of the *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-2); Y_b = location of the centroid from the bottom of the girder; Y_t = location of the centroid from the top of the girder. 1 in. = 25.4 mm; 1 in.^{2} = 645.2 mm^2; 1 in.^{4} = 416,231 mm^4.

Table A.8. Section properties of PCI Northeast bulb-tee girders

Name	A, in.^{2}	Y_t, in.	Y_b, in.	I_x, in.^{4}	I_y, in.^{4}	J, in.^{4}	A_{mesh}, in.^{2}	A_{mesh}/A	J_1, in.^{4}	J_1/J	J_2, in.^{4}	J_2/J
NEBT 39	746.5	20.34	19.03	149,232	61,849	22,648	746	0.999	10,475	0.46	36,770	1.62
NEBT 47	802.2	24.61	22.63	238,228	62,083	23,556	801	0.999	11,410	0.48	34,483	1.46
NEBT 55	858.1	28.84	26.28	352,074	62,317	24,486	857	0.999	12,346	0.50	32,713	1.34
NEBT 63	913.9	33.03	29.96	492,240	62,551	25,387	912	0.998	13,281	0.52	31,437	1.24
NEBT 71	969.8	37.19	33.68	660,835	62,785	26,309	968	0.998	14,217	0.54	30,559	1.16
NEBT 79	1025.6	41.33	37.41	859,180	63,019	27,215	1023	0.997	15,152	0.56	29,992	1.10
NEBT 83	1053.5	43.39	39.29	970,272	63,136	27,673	1051	0.997	15,620	0.56	29,801	1.08
NEBT 87	1081.4	45.45	41.16	1,089,211	63,252	28,120	1078	0.997	16,087	0.57	29,664	1.05

Source: Data from PCI Northeast, Northeast Bulb-Tees (2019), https://www.pci.org/PCI_Docs/PCI_Northeast/Technical_Resources/Bridge/NEBT_US_Customary.pdf.

Note: A = area of cross section; A_{mesh} = area of cross section of finite difference mesh; AASHTO = American Association of State Highway and Transportation Officials; I_x = major axis moment of inertia; I_y = minor axis moment of inertia; J = torsion constant; J_1 = approximate torsion constant computed with *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-1); J_2 = approximate torsion constant computed with of the *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-2); Y_b = location of the centroid from the bottom of the girder; Y_t = location of the centroid from the top of the girder. 1 in. = 25.4 mm; 1 in.^{2} = 645.2 mm^2; 1 in.^{4} = 416,231 mm^4.

Table A.9. Section properties of North Carolina Department of Transportation standard girders

Name	A, in.^{2}	Y_t, in.	Y_b, in.	I_x, in.^{4}	I_y, in.^{4}	J, in.^{4}	A_{mesh}, in.^{2}	A_{mesh}/A	J_1, in.^{4}	J_1/J	J_2, in.^{4}	J_2/J
BT63	770.13	30.71	32.29	408,315	40,308	14,305	770	1.000	12,128	0.85	19,602	1.37
BT72	833.13	35.21	36.79	570,260	40,566	15,333	833	1.000	13,157	0.86	197,18	1.29

Source: Data from North Carolina Department of Transportation (2019), https://connect.ncdot.gov/resources/Structures/Pages/Design-Manual.aspx.

Note: A = area of cross section; A_{mesh} = area of cross section of finite difference mesh; AASHTO = American Association of State Highway and Transportation Officials; I_x = major axis moment of inertia; I_y = minor axis moment of inertia; J = torsion constant; J_1 = approximate torsion constant computed with *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-1); J_2 = approximate torsion constant computed with of the *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-2); Y_b = location of the centroid from the bottom of the girder; Y_t = location of the centroid from the top of the girder. 1 in. = 25.4 mm; 1 in.^{2} = 645.2 mm^2; 1 in.^{4} = 416,231 mm^4.

Table A.10. Section properties of Ohio Department of Transportation standard girders

Name	A, in.^{2}	Y_t, in.	Y_b, in.	I_x, in.^{4}	I_y, in.^{4}	J, in.^{4}	A_{mesh}, in.^{2}	A_{mesh}/A	J_1, in.^{4}	J_1/J	J_2, in.^{4}	J_2/J
WF36-49	877.9	17.82	18.18	145,539	102,564	28,068	877	0.999	17,704	0.63	59,863	2.13
WF42-49	925.9	20.90	21.10	217,378	102,820	29,084	925	0.999	18,728	0.64	57,392	1.97
WF48-49	973.9	23.97	24.03	305,873	103,076	30,108	973	0.999	19,752	0.66	55,004	1.83
WF54-49	1021.9	27.03	26.97	411,891	103,332	31,131	1021	0.999	20,776	0.67	52,923	1.70
WF60-49	1069.9	30.09	29.91	536,297	103,588	32,155	1069	0.999	21,800	0.68	51,200	1.59
WF66-49	1117.9	33.14	32.86	679,955	103,844	33,179	1117	0.999	22,824	0.69	49,820	1.50
WF72-49	1165.9	36.19	35.81	843,730	104,100	34,202	1165	0.999	23,848	0.70	48,743	1.43
Modified Type IV (60 in.)	859.4	31.24	28.76	384,248	36,812	28,713	858	0.998	25,680	0.89	32,393	1.13
Modified Type IV (66 in.)	907.4	34.40	31.60	491,660	37,068	29,737	906	0.998	26,704	0.90	32,061	1.08
Modified Type IV (72 in.)	1015.4	35.48	36.52	684,726	61,986	31,303	1014	0.998	28,228	0.90	35,596	1.14

Source: Data from Ohio Department of Transportation, Standard Bridge Drawings (2021), http://www.dot.state.oh.us/Divisions/Engineering/Structures/standard/Bridges/Pages/StandardBridgeDrawings.aspx.

Note: A = area of cross section; A_{mesh} = area of cross section of finite difference mesh; AASHTO = American Association of State Highway and Transportation Officials; I_x = major axis moment of inertia; I_y = minor axis moment of inertia; J = torsion constant; J_1 = approximate torsion constant computed with *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-1); J_2 = approximate torsion constant computed with of the *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-2); Y_b = location of the centroid from the bottom of the girder; Y_t = location of the centroid from the top of the girder. 1 in. = 25.4 mm; 1 in.^{2} = 645.2 mm^2; 1 in.^{4} = 416,231 mm^4.

Table A.11. Section properties of Oregon Department of Transportation standard girders

Name	A, in.^{2}	Y_t, in.	Y_b, in.	I_x, in.^{4}	I_y, in.^{4}	J, in.^{4}	A_{mesh}, in.^{2}	A_{mesh}/A	J_1, in.^{4}	J_1/J	J_2, in.^{4}	J_2/J
BI51	564.8	25.78	25.22	190,826	16,167	9604	564	0.999	8356	0.87	12,286	1.28
BI63	636.8	31.84	31.16	326,602	16,383	10,467	636	0.999	9220	0.88	11,982	1.14
BI75	708.8	37.88	37.12	508,221	16,599	11,331	708	0.999	10,084	0.89	12,020	1.06
BT48	556.0	23.49	24.51	177,152	32,850	7487	555	0.999	6507	0.87	11,377	1.52
BT60	628.0	29.55	30.45	307,817	33,066	8351	627	0.999	7371	0.88	11,407	1.37
BT72	700.0	35.59	36.41	483,694	33,282	9214	699	0.999	8235	0.89	11,611	1.26
BT84	772.0	41.63	42.37	709,969	33,498	10,078	771	0.999	9099	0.90	11,944	1.19
BT90	935.0	43.98	46.02	1,061,317	73,832	13,463	934	0.999	11,630	0.86	16,832	1.25
BT96	971.0	46.97	49.03	1,242,172	73,940	13,895	970	0.999	12,062	0.87	16,886	1.22

Source: Data from Oregon Department of Transportation (2019), https://www.oregon.gov/ODOT/Engineering/Pages/Details-Bridge.aspx.

Note: A = area of cross section; A_{mesh} = area of cross section of finite difference mesh; AASHTO = American Association of State Highway and Transportation Officials; I_x = major axis moment of inertia; I_y = minor axis moment of inertia; J = torsion constant; J_1 = approximate torsion constant computed with *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-1); J_2 = approximate torsion constant computed with of the *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-2); Y_b = location of the centroid from the bottom of the girder; Y_t = location of the centroid from the top of the girder. 1 in. = 25.4 mm; 1 in.^{2} = 645.2 mm^2; 1 in.^{4} = 416,231 mm^4.

Table A.12. Section properties of Texas Department of Transportation standard girders

Name	A, in.^{2}	Y_t, in.	Y_b, in.	I_x, in.^{4}	I_y, in.^{4}	J, in.^{4}	A_{mesh}, in.^{2}	A_{mesh}/A	J_1, in.^{4}	J_1/J	J_2, in.^{4}	J_2/J
Tx28	585.3	15.02	12.98	52,772	40,559	16,986	585	0.999	10,842	0.64	31,439	1.85
Tx34	627.3	18.49	15.51	88,355	40,731	17,660	627	0.999	11,528	0.65	29,991	1.70
Tx40	669.3	21.90	18.10	134,990	40,902	18,345	669	0.999	12,214	0.67	28,524	1.55
Tx46	761.3	25.90	20.10	198,089	46,478	25,692	761	0.999	19,253	0.75	34,339	1.34
Tx54	817.3	30.49	23.51	299,740	46,707	26,607	817	0.999	20,168	0.76	32,200	1.21
Tx62	910.1	33.72	28.28	463,072	57,351	28,148	909	0.999	21,461	0.76	32,951	1.17
Tx70	966.1	38.09	31.91	628,747	57,579	29,062	965	0.999	22,376	0.77	31,727	1.09
U40	977.0	23.65	16.35	183,050	670,769	16,885	977	1.000	7610	0.45	n/a	n/a
U54	1121.1	31.54	22.46	403,458	910,532	18,044	1121	1.000	6407	0.36	n/a	n/a

Source: Data from Texas Department of Transportation, Texas Bridge Standards (2019), ftp://ftp.dot.state.tx.us/pub/txdot-info/cmd/cserve/standard/bridge/igdstds1-17.pdf.

Note: A = area of cross section; A_{mesh} = area of cross section of finite difference mesh; AASHTO = American Association of State Highway and Transportation Officials; I_x = major axis moment of inertia; I_y = minor axis moment of inertia; J = torsion constant; J_1 = approximate torsion constant computed with *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-1); J_2 = approximate torsion constant computed with of the *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-2); n/a = not applicable; Y_b = location of the centroid from the bottom of the girder; Y_t = location of the centroid from the top of the girder. 1 in. = 25.4 mm; 1 in.^{2} = 645.2 mm^2; 1 in.^{4} = 416,231 mm^4.

Table A.13. Section properties of Virginia Department of Transportation standard girders

Name	A, in.^{2}	Y_t, in.	Y_b, in.	I_x, in.^{4}	I_y, in.^{4}	J, in.^{4}	A_{mesh}, in.^{2}	A_{mesh}/A	J_1, in.^{4}	J_1/J	J_2, in.^{4}	J_2/J
PCBT-29	634.7	14.34	14.66	66,823	62,045	15,218	634	0.998	10,030	0.66	31,480	2.07
PCBT-37	690.7	18.57	18.43	126,033	62,273	16,128	690	0.998	10,945	0.68	30,214	1.87
PCBT-45	746.7	22.77	22.23	207,282	62,502	17,042	746	0.998	11,860	0.70	28,806	1.69
PCBT-53	802.7	26.94	26.06	312,376	62,731	17,957	802	0.999	12,774	0.71	27,668	1.54
PCBT-61	858.7	31.08	29.92	443,115	62,959	18,871	858	0.999	13,689	0.73	26,858	1.42
PCBT-69	914.7	35.21	33.79	601,300	63,188	19,785	914	0.999	14,604	0.74	26,336	1.33
PCBT-77	970.7	39.33	37.67	788,728	63,417	20,700	970	0.999	15,518	0.75	26,046	1.26
PCBT-85	1026.7	43.43	41.57	1,007,196	63,645	21,614	1026	0.999	16,433	0.76	25,940	1.20
PCBT-93	1082.7	47.52	45.48	1,258,498	63,874	22,528	1082	0.999	17,348	0.77	25,978	1.15

Source: Data from Virginia Department of Transportation, Prestressed Concrete Bulb-T's (2005), http://www.virginiadot.org/business/sandb/resources/vol5p2/pc-bulb-t-12.pdf.

Note: A = area of cross section; A_{mesh} = area of cross section of finite difference mesh; AASHTO = American Association of State Highway and Transportation Officials; I_x = major axis moment of inertia; I_y = minor axis moment of inertia; J = torsion constant; J_1 = approximate torsion constant computed with *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-1); J_2 = approximate torsion constant computed with of the *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-2); Y_b = location of the centroid from the bottom of the girder; Y_t = location of the centroid from the top of the girder. 1 in. = 25.4 mm; 1 in.^{2} = 645.2 mm^2; 1 in.^{4} = 416,231 mm^4.

Table A.14. Section properties of Washington State Department of Transportation standard girders

Name	A, in.^{2}	Y_t, in.	Y_b, in.	I_x, in.^{4}	I_y, in.^{4}	J, in.^{4}	A_{mesh}, in.^{2}	A_{mesh}/A	J_1, in.^{4}	J_1/J	J_2, in.^{4}	J_2/J
W42G	373.3	23.06	18.94	76,092	5408	4670	373	0.999	4110	0.88	5954	1.27
W50G	525.5	27.19	22.81	164,958	13,363	8509	525	1.000	7584	0.89	10,691	1.26
W58G	603.5	30.00	28.00	264,609	17,065	9499	603	1.000	8520	0.90	11,773	1.24
W74G	746.7	35.42	38.08	546,110	34,759	10,489	746	0.999	9019	0.86	13,379	1.28
WF36G	690.8	18.46	17.54	124,772	71,291	13,997	688	0.997	8467	0.60	29,034	2.07
WF42G	727.5	21.64	20.36	183,642	71,406	14,428	724	0.996	8927	0.62	27,462	1.90
WF50G	776.5	25.85	24.15	282,559	71,559	15,004	772	0.995	9540	0.64	25,670	1.71
WF58G	825.5	30.03	27.97	406,266	71,712	15,580	820	0.994	10,152	0.65	24,292	1.56
WF66G	874.5	34.20	31.80	556,339	71,865	16,155	868	0.993	10,765	0.67	23,278	1.44
WF74G	923.5	38.34	35.66	734,356	72,018	16,731	916	0.992	11,378	0.68	22,553	1.35
WF83G	976.4	42.80	39.83	959,393	72,184	17,352	968	0.992	12,039	0.69	22,023	1.27
WF95G	1049.1	48.90	45.60	1,328,995	72,411	18,207	1039	0.991	12,948	0.71	21,609	1.19
WF100G	1082.8	51.73	48.27	1,524,912	72,516	18,602	1072	0.990	13,369	0.72	21,512	1.16
U54G4	1038.8	33.03	20.97	292,423	493,926	19,520	1039	1.000	14,543	0.75	n/a	n/a
U54G5	1110.8	34.19	19.81	314,382	788,289	20,390	1111	1.000	15,407	0.76	n/a	n/a
U54G6	1254.8	35.84	18.16	341,728	1,189,384	26,355	1255	1.000	16,271	0.62	n/a	n/a
U66G4	1208.5	39.55	26.45	516,677	637,751	22,285	1209	1.000	17,315	0.78	n/a	n/a
U66G5	1280.5	40.87	25.13	554,262	997,354	23,153	1281	1.000	18,179	0.79	n/a	n/a
U66G6	1424.5	42.85	23.15	605,412	1,475,908	29,085	1425	1.000	19,043	0.65	n/a	n/a
U78G4	1378.2	45.94	32.06	827,453	798,969	24,971	1378	1.000	20,087	0.80	n/a	n/a
U78G5	1450.2	47.38	30.62	885,451	1,227,303	25,808	1450	1.000	20,951	0.81	n/a	n/a
U78G6	1594.2	49.65	28.35	969,347	1,786,807	31,774	1594	1.000	21,815	0.69	n/a	n/a
UF60G4	1207.7	33.97	26.03	483,298	639,795	22,376	1208	1.000	15,929	0.71	n/a	n/a
UF60G5	1279.7	35.26	24.74	519,561	999,184	23,246	1280	1.000	16,793	0.72	n/a	n/a
UF60G6	1423.7	37.21	22.79	568,717	1,477,463	29,210	1424	1.000	17,657	0.60	n/a	n/a
UF72G4	1377.4	40.31	31.69	787,605	800,958	25,127	1378	1.000	18,701	0.74	n/a	n/a
UF72G5	1449.4	41.74	30.26	844,135	1,229,061	26,008	1451	1.001	19,565	0.75	n/a	n/a
UF72G6	1593.4	43.97	28.03	925,720	1,788,272	31,979	1595	1.001	20,429	0.64	n/a	n/a
UF84G4	1547.1	46.58	37.42	1,190,828	980,507	27,829	1548	1.000	21,473	0.77	n/a	n/a
UF84G5	1619.1	48.11	35.89	1,272,553	1,480,814	28,673	1619	1.000	22,337	0.78	n/a	n/a
UF84G6	1682.4	49.56	34.44	1,341,320	1,750,988	29,851	1681	0.999	23,059	0.77	n/a	n/a

Source: Data from Washington State Department of Transportation, Standard Prestressed Concrete Girders (2020), https://wsdot.wa.gov/publications/fulltext/Bridge/Web_BSD/5.6_A4_2.pdf.

Note: A = area of cross section; A_{mesh} = area of cross section of finite difference mesh; AASHTO = American Association of State Highway and Transportation Officials; I_x = major axis moment of inertia; I_y = minor axis moment of inertia; J = torsion constant; J_1 = approximate torsion constant computed with *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-1); J_2 = approximate torsion constant computed with of the *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-2); n/a = not applicable; Y_b = location of the centroid from the bottom of the girder; Y_t = location of the centroid from the top of the girder. 1 in. = 25.4 mm; 1 in.^{2} = 645.2 mm^2; 1 in.^{4} = 416,231 mm^4.

Reference

1. AASHTO (American Association of State Highway and Transportation Officials). 2017. *AASHTO LRFD Bridge Design Specifications*. 8th ed. Washington, DC: AASHTO.

Notation

A = area of cross section

A_{mesh} = area of cross section of finite difference mesh

I_x = major axis moment of inertia

I_y = minor axis moment of inertia

J = torsion constant

J_1 = approximate torsion constant computed with American Association of State Highway and Transportation Officials' *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-1)

J_2 = approximate torsion constant computed with American Association of State Highway and Transportation Officials' *AASHTO LRFD Bridge Design Specifications* Eq. (C4.6.2.2.1-2)

Y_b = location of the centroid from the bottom of the girder

Y_t = location of the centroid from the top of the girder