Appendix XVIII

The Period of Vibration and Equivalent Earthquake Loads with the Single Mode Spectral Analysis Method for the Steel Girder Bridge

West Bound Bridge

$$\alpha = \int v_s(x)dx = 12{,}986$$

$$\beta = \int w(x)v_s(x)dx = 7663$$

$$\gamma = \int w(x)v_s(x)^2 dx = 63{,}585$$

$$T = 2\pi\sqrt{\frac{\gamma}{p_0 g\alpha}} = 2\pi\sqrt{\frac{63{,}585}{(100k/in.)(386in./s^2)(12{,}986)}} = 0.0708\,\text{sec}\,ond$$

$$p_e(x) = \frac{\beta S_a}{\gamma} w(x)v_s(x) = \frac{(7663)(0.405)}{63{,}585} w(x)v_s(x) = 0.0488w(x)v_s(x)$$

East Bound Bridge

$$\alpha = \int v_s(x)dx = 6{,}709$$

$$\beta = \int w(x)v_s(x)dx = 4922$$

$$\gamma = \int w(x)v_s(x)^2 dx = 21069$$

$$T = 2\pi\sqrt{\frac{\gamma}{p_0 g\alpha}} = 2\pi\sqrt{\frac{21069}{(100k/in.)(386in./s^2)(6{,}709)}} = 0.0567\,\text{sec}\,ond$$

$$p_e(x) = \frac{\beta S_a}{\gamma} w(x)v_s(x) = \frac{(4922)(0.405)}{21069} w(x)v_s(x) = 0.0946w(x)v_s(x)$$

Table XVIII-1. The calculation to get the period of vibration and equivalent lateral loads for the West Bound of the steel girder bridge using the single mode spectral analysis method.

Deflection	Coefficient		Coefficient		Coefficient		Period	$p_e(x)$
0	1	0.00	1.00	0.00	1.00	0.00		0.00000
-0.386	4	-1.54	1.99	-0.77	1.99	0.30		0.00936
-1.383	2	-2.77	0.99	-1.37	0.99	1.90		0.03353
-2.769	4	-11.08	1.99	-5.50	1.99	15.24		0.06713
-4.349	2	-8.70	0.99	-4.32	0.99	18.79		0.10544
-5.956	4	-23.82	1.99	-11.84	1.99	70.49		0.14440
-7.447	2	-14.89	0.99	-7.40	0.99	55.10		0.18054
-8.708	4	-34.83	1.99	-17.30	1.99	150.69		0.21112
-9.652	2	-19.30	0.99	-9.59	0.99	92.56		0.23400
-10.218	4	-40.87	1.99	-20.31	1.99	207.48		0.24772
-10.371	1	-10.37	1.97	-20.44	1.97	212.03		0.99768
		-168.2		-98.8		824.6		
		6660		3914		32653		
0	1	0.00	1.00	0.00	1.00	0.00		0.00000
-0.366	4	-1.46	1.99	-0.73	1.99	0.27		0.00887
-1.317	2	-2.63	0.99	-1.31	0.99	1.72		0.03193
-2.646	4	-10.58	1.99	-5.26	1.99	13.91		0.06415
-4.174	2	-8.35	0.99	-4.15	0.99	17.31		0.10119
-5.741	4	-22.96	1.99	-11.41	1.99	65.50		0.13918
-7.217	2	-14.43	0.99	-7.17	0.99	51.75		0.17497
-8.49	4	-33.96	1.99	-16.87	1.99	143.24		0.20583
-9.477	2	-18.95	0.99	-9.42	0.99	89.24		0.22976
-10.116	4	-40.46	1.99	-20.10	1.99	203.36		0.24525
-10.371	1	-10.37	2.01	-20.87	2.01	216.43		1.01838
		-164.2		-97.3		802.7		
		6326		3748		30932		
	Alpha=	12986	Beta=	7663	Gamma=	63585		
						Period=	0.0708	

Note – Deflections are in inches, equivalent earthquake loads $p_e(x)$ are in kips, α is in in^2, β is in kips-in, and γ is in $kips\text{-}in^2$.

Table XVIII-2. The calculation to get the period of vibration and equivalent lateral loads for the East Bound of the steel girder bridge using the single mode spectral analysis method.

Deflection	Coefficient		Coefficient		Coefficient		Period	$p_e(x)$
0	1	0.00	1.00	0.00	1.00	0.00		0.0000
-0.198	4	-0.79	2.45	-0.49	2.45	0.10		0.0115
-0.711	2	-1.42	1.23	-0.87	1.23	0.62		0.0412
-1.423	4	-5.69	2.45	-3.49	2.45	4.96		0.0825
-2.236	2	-4.47	1.23	-2.74	1.23	6.13		0.1296
-3.062	4	-12.25	2.45	-7.51	2.45	22.98		0.1775
-3.83	2	-7.66	1.23	-4.69	1.23	17.98		0.2220
-4.48	4	-17.92	2.45	-10.98	2.45	49.20		0.2597
-4.967	2	-9.93	1.23	-6.09	1.23	30.24		0.2879
-5.26	4	-21.04	2.45	-12.89	2.45	67.82		0.3049
-5.34	1	-5.34	2.52	-13.48	2.52	71.98		1.2752
		-86.52		-63.23		272.00		
		3435		2510		10798		
0	1	0.00	1.00	0.00	1.00	0.00		0.0000
-0.189	4	-0.76	2.45	-0.46	2.45	0.09		0.0110
-0.679	2	-1.36	1.23	-0.83	1.23	0.57		0.0394
-1.364	4	-5.46	2.45	-3.34	2.45	4.56		0.0791
-2.151	2	-4.30	1.23	-2.64	1.23	5.67		0.1247
-2.959	4	-11.84	2.45	-7.25	2.45	21.46		0.1715
-3.719	2	-7.44	1.23	-4.56	1.23	16.95		0.2156
-4.375	4	-17.50	2.45	-10.72	2.45	46.92		0.2536
-4.883	2	-9.77	1.23	-5.98	1.23	29.22		0.2831
-5.211	4	-20.84	2.45	-12.77	2.45	66.56		0.3021
-5.34	1	-5.34	2.57	-13.74	2.57	73.39		1.3001
		-84.60		-62.31		265.39		
		3274		2411		10271		
	Alpha=	6709	Beta=	4922	Gamma=	21069		
						Period=	0.0567	

Note – Deflections are in inches, equivalent earthquake loads $p_e(x)$ are in kips, α is in in^2, β is in kips-in, and γ is in $kips\text{-}in^2$.