



Client: ODOT/District 6
Project: FRA-70 Project 4B
Subject: Bridge No. FRA-23-1075C (4th Street Bridge)
Pier Footing Bearing Pressure Calculations

Job No.: 2015370
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Designed: RHC Date: 5/8/2019
Checked: MOJ Date: 7/11/2022

Pier Footing Bearing Pressure Calculations

Based on AASHTO LRFD Bridge Design Specifications (9th edition) and the 2020 ODOT BDM.

Note: It appears that RC Pier does not correctly calculate the bearing pressure under an eccentrically loaded spread footing.
In accordance with LRFD 10.6.1.3, the load shall be resisted by a reduced effective area equal to:

$$\sigma_v = B' \times L' = (B - 2e_B) (L - 2e_L)$$

Footing resting on = Soil
B = 17.00 ft
L = 85.00 ft

Service I Calculations:

$\Sigma V = 1,132$ kips From RC Pier.
 $\Sigma M_2 = 25,190$ k-ft From RC Pier.
 $\Sigma M_x = 573$ k-ft From RC Pier.
 $e_B = 0.51$ ft
 $e_L = 22.25$ ft
 $B' = 15.99$ ft LRFD 10.6.1.3.
 $L' = 40.49$ ft LRFD 10.6.1.3.
 $\sigma_v = 1.75$ ksf Service I load combination.

Strength I Calculations:

$\Sigma V = 1,418$ kips From RC Pier.
 $\Sigma M_2 = 35,443$ k-ft From RC Pier.
 $\Sigma M_x = 1,001$ k-ft From RC Pier.
 $e_B = 0.71$ ft
 $e_L = 25.00$ ft
 $B' = 15.59$ ft LRFD 10.6.1.3.
 $L' = 35.01$ ft LRFD 10.6.1.3.
 $\sigma_v = 2.60$ ksf Strength I load combination.

Pier Footing Factored Bearing Resistance Calculations

Table From FRA-23-1075 Foundation Exploration Report, Dated July 2022:

Effective Footing Width (ft)	Service Limit Bearing Pressure (ksf) for Specified Settlement (in)			Bearing Resistance at Strength Limit (ksf)	
	0.5"	1.0"	1.5"	Nominal	Factored
5	2.51	4.90	9.11	32.17	16.09
7	2.26	4.07	7.24	32.32	16.16
9	2.12	3.63	6.24	32.46	16.23
11	2.04	3.35	5.62	32.61	16.30
13	1.98	3.17	5.20	32.76	16.38
15	1.94	3.04	4.91	32.90	16.45
17	1.91	2.94	4.69	33.05	16.52
19	1.89	2.87	4.53	33.19	16.60
21	1.88	2.81	4.40	33.34	16.67
23	1.86	2.77	4.30	33.48	16.74
25	1.85	2.73	4.21	33.63	16.82

Use Boring Number: B-008-4-59
 $B' = 15.59$ ft For STRENGTH I maximum bearing pressure value.
Nominal Bearing Resistance = 32.94 ksf
Factored Bearing Resistance = 16.47 ksf
Max. Bearing Pressure = 1.75 ksf For SERVICE.
 $B' = 15.99$ ft For SERVICE maximum bearing pressure value.
Service Bearing Pressure = 1.93 ksf For 0.5" of Settlement.
Service Bearing Pressure = 2.99 ksf For 1.0" of Settlement.
Service Bearing Pressure = 4.80 ksf For 1.5" of Settlement.
Actual Settlement = #N/A 0.42 in Calculation assumes up to 1" of settlement.
Actual Settlement = #N/A in Calculation assumes greater than 1" of settlement.

Effective Footing Width (ft)	Service Limit Bearing Pressure (ksf) for Specified Settlement (in)			Bearing Resistance at Strength Limit (ksf)		Boring Number
	0.5"	1.0"	1.5"	Nominal	Factored	
5	2.51	4.90	9.11	32.17	16.09	B-008-4-59
7	2.26	4.07	7.24	32.32	16.16	
9	2.12	3.63	6.24	32.46	16.23	
11	2.04	3.35	5.62	32.61	16.30	
13	1.98	3.17	5.20	32.76	16.38	
15	1.94	3.04	4.91	32.90	16.45	
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19	1.89	2.87	4.53	33.19	16.60	
21	1.88	2.81	4.40	33.34	16.67	
23	1.86	2.77	4.30	33.48	16.74	
25	1.85	2.73	4.21	33.63	16.82	

Effective Footing Width (ft)	Service Limit Bearing Pressure (ksf) for Specified Settlement (in)			Bearing Resistance at Strength Limit (ksf)		Boring Number
	0.5"	1.0"	1.5"	Nominal	Factored	
5	4.56	15.89	46.73	27.81	12.51	B-012-4-59
7	3.88	12.51	35.37	31.58	14.21	
9	3.51	10.66	28.44	35.43	15.94	
11	3.27	9.49	24.03	39.31	17.69	
13	3.10	8.69	21.00	43.18	19.43	
15	2.99	8.12	18.78	47.01	21.15	
17	2.90	7.69	17.10	50.78	22.85	
19	2.83	7.36	15.78	54.50	24.53	
21	2.77	7.09	14.71	58.16	26.17	
23	2.73	6.88	13.84	61.75	27.79	
25	2.69	6.71	13.11	65.26	29.37	