



A p p e n d i x I





Single Span (Class U)

A_c (in ⁴) =	94
I (in ³) =	343
Z_t (in ³) =	98
Z_b (in ³) =	98
K_t (in) =	-1.17
K_b (in) =	1.17
y_t (in) =	3.5
y_b (in) =	3.5
M_{min} (k-in) =	64.8
M_{max} (k-in) =	151.2

• t_s (psi) =	-530
• c_i (psi) =	2100
• s_{us} (psi) =	2250
• c_s (psi) =	3000
• t_i (psi) =	177.5
• =	0.8
w_{LL} (plf) =	100
w_{sup} (plf) =	10
w_{wt} (plf) =	75
w_{Tot} (plf) =	185

Feasible Domain Inequalities

I	$e_o <$	1.17	+	(1/F _i) *	8.22E+04
II	$e_o <$	-1.17	+	(1/F _i) *	2.71E+05
III	$e_o >$	1.17	+	(1/F _i) *	1.79E+05
IV	$e_o >$	-1.17	+	(1/F _i) *	1.24E+05
V	$e_o <$	1			

1/F	I	II	III	IV	V
0	1.17	-1.17	1.17	-1.17	1.00
5.00E-07	1.21	-1.03	1.08	-1.11	1.00
1.00E-06	1.25	-0.90	0.99	-1.05	1.00
1.50E-06	1.29	-0.76	0.90	-0.98	1.00



2.00E-06	1.33	-0.63	0.81	-0.92	1.00
2.50E-06	1.38	-0.49	0.72	-0.86	1.00
3.00E-06	1.42	-0.36	0.63	-0.80	1.00
3.50E-06	1.46	-0.22	0.55	-0.74	1.00
4.00E-06	1.50	-0.09	0.46	-0.67	1.00
4.50E-06	1.54	0.05	0.37	-0.61	1.00
5.00E-06	1.58	0.18	0.28	-0.55	1.00
5.50E-06	1.62	0.32	0.19	-0.49	1.00
6.00E-06	1.66	0.45	0.10	-0.43	1.00
6.50E-06	1.70	0.59	0.01	-0.36	1.00
7.00E-06	1.75	0.72	-0.08	-0.30	1.00
7.50E-06	1.79	0.86	-0.17	-0.24	1.00
8.00E-06	1.83	0.99	-0.26	-0.18	1.00
8.50E-06	1.87	1.13	-0.35	-0.12	1.00
9.00E-06	1.91	1.27	-0.44	-0.05	1.00
9.50E-06	1.95	1.40	-0.53	0.01	1.00
1.00E-05	1.99	1.54	-0.62	0.07	1.00
1.05E-05	2.03	1.67	-0.70	0.13	1.00
1.10E-05	2.07	1.81	-0.79	0.19	1.00
1.15E-05	2.12	1.94	-0.88	0.26	1.00
1.20E-05	2.16	2.08	-0.97	0.32	1.00
1.25E-05	2.20	2.21	-1.06	0.38	1.00
1.30E-05	2.24	2.35	-1.15	0.44	1.00
1.35E-05	2.28	2.48	-1.24	0.51	1.00
1.40E-05	2.32	2.62	-1.33	0.57	1.00
1.45E-05	2.36	2.75	-1.42	0.63	1.00
1.50E-05	2.40	2.89	-1.51	0.69	1.00
1.55E-05	2.44	3.02	-1.60	0.75	1.00
1.60E-05	2.49	3.16	-1.69	0.82	1.00
1.65E-05	2.53	3.29	-1.78	0.88	1.00
1.70E-05	2.57	3.43	-1.86	0.94	1.00
1.75E-05	2.61	3.57	-1.95	1.00	1.00

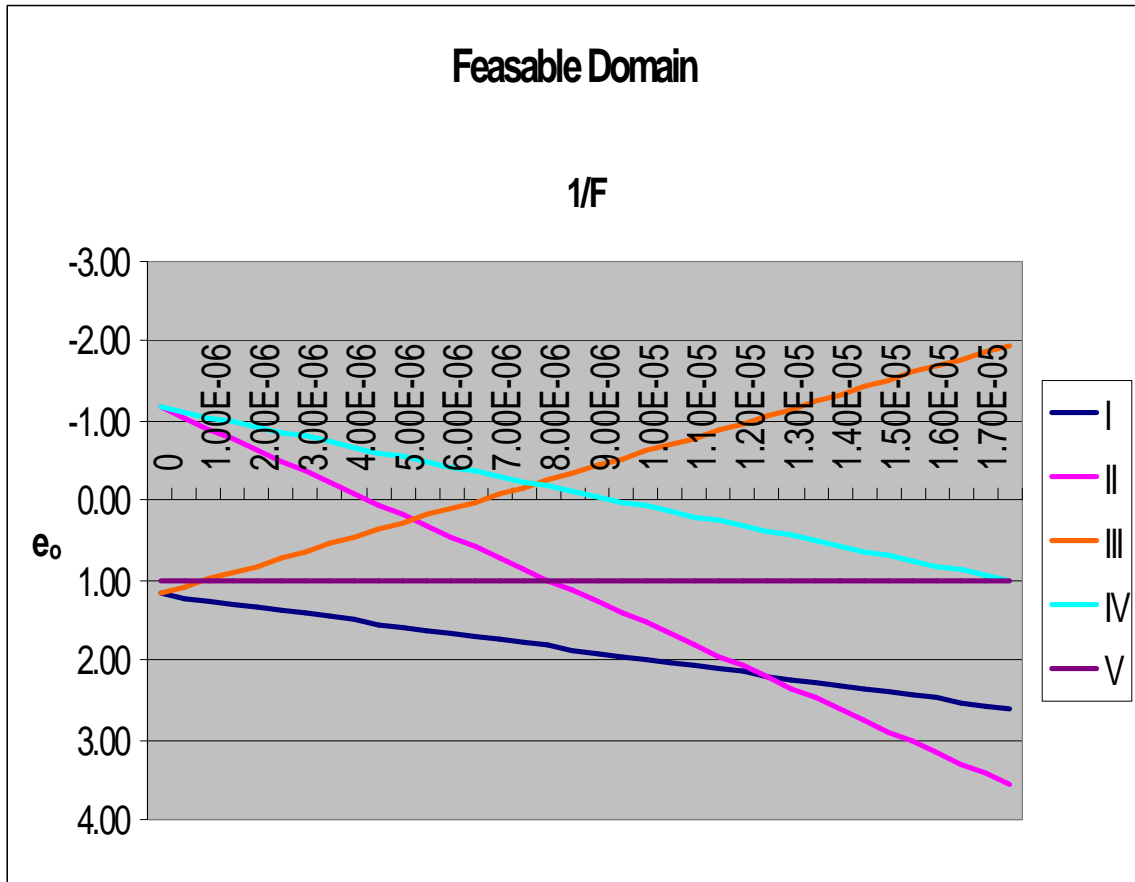
Distance	M_{min}	M_{max}	I	II	III	IV	V
(ft)	(k-in)	(k-in)	$e_o <$	$e_o <$	$e_o >$	$e_o >$	$e_o <$
0	0	0	1.54	3.26	-6.73	-2.57	1.00
2	19.8	47.4	1.97	4.28	-5.46	-1.29	1.00
4	36	85.92	2.32	5.10	-4.42	-0.26	1.00
6	48.6	115.56	2.59	5.74	-3.63	0.54	1.00
8	57.6	136.32	2.78	6.19	-3.07	1.10	1.00
10	63	148.2	2.90	6.44	-2.75	1.42	1.00
12	64.8	151.2	2.94	6.51	-2.67	1.50	1.00
14	63	145.32	2.90	6.38	-2.83	1.34	1.00
16	57.6	130.56	2.78	6.06	-3.22	0.94	1.00
18	48.6	106.92	2.59	5.56	-3.86	0.31	1.00

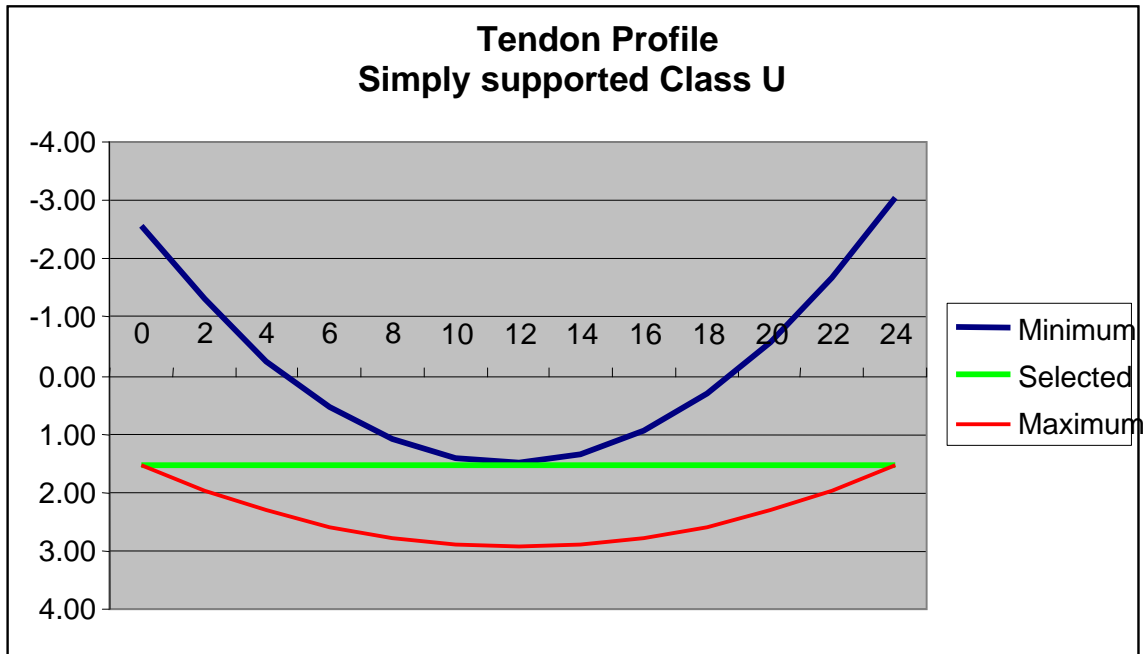


20	36	74.4	2.32	4.86	-4.73	-0.57	1.00
22	19.8	33	1.97	3.97	-5.85	-1.68	1.00
24	0	-17.28	1.54	2.88	-7.20	-3.03	1.00

Tendon Profile Parameters

Distance (ft)	Eccentricities(in)		Tendon Profile
	Min	Max	
0	-2.57	1.54	1.52
2	-1.29	1.97	1.52
4	-0.26	2.32	1.52
6	0.54	2.59	1.52
8	1.10	2.78	1.52
10	1.42	2.90	1.52
12	1.50	2.94	1.52
14	1.34	2.90	1.52
16	0.94	2.78	1.52
18	0.31	2.59	1.52
20	-0.57	2.32	1.52
22	-1.68	1.97	1.52
24	-3.03	1.54	1.52







Simple Span (Class T)

A_c (in ⁴) =	72
I (in ³) =	216
Z_t (in ³) =	72
Z_b (in ³) =	72
K_t (in) =	-1
K_b (in) =	1
y_t (in) =	3
y_b (in) =	3
M_{min} (k-in) =	64.8
M_{max} (k-in) =	151.2

• t_s (psi) =	- 848.5
• c_i (psi) =	2100
• s_{us} (psi) =	2250
• c_s (psi) =	3000
• t_i (psi) =	- 177.5
• =	0.8
w_{LL} (plf) =	100
w_{sup} (plf) =	10
w_{wt} (plf) =	75
w_{Tot} (plf) =	185

Feasible Domain Inequalities

I	$e_o <$	1	+	(1/F _i) *	7.76E+04
II	$e_o <$	-1	+	(1/F _i) *	2.16E+05
III	$e_o >$	1	+	(1/F _i) *	- 8.10E+04
IV	$e_o >$	-1	+	(1/F _i) *	1.13E+05
V	$e_o <$	1			

1/F	I	II	III	IV	V
0	1.00	-1.00	1.00	-1.00	1.00
5.00E-07	1.04	-0.89	0.96	-0.94	1.00
1.00E-06	1.08	-0.78	0.92	-0.89	1.00
1.50E-06	1.12	-0.68	0.88	-0.83	1.00
2.00E-06	1.16	-0.57	0.84	-0.77	1.00
2.50E-06	1.19	-0.46	0.80	-0.72	1.00



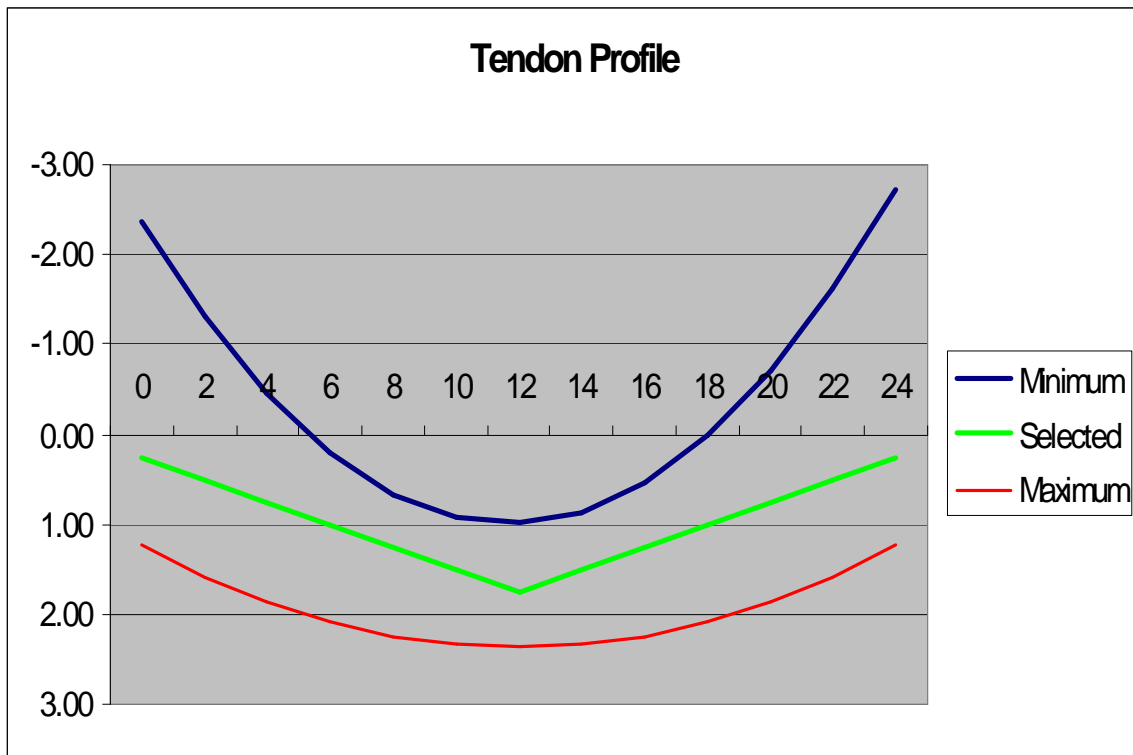
3.00E-06	1.23	-0.35	0.76	-0.66	1.00
3.50E-06	1.27	-0.24	0.72	-0.61	1.00
4.00E-06	1.31	-0.14	0.68	-0.55	1.00
4.50E-06	1.35	-0.03	0.64	-0.49	1.00
5.00E-06	1.39	0.08	0.60	-0.44	1.00
5.50E-06	1.43	0.19	0.55	-0.38	1.00
6.00E-06	1.47	0.30	0.51	-0.32	1.00
6.50E-06	1.50	0.40	0.47	-0.27	1.00
7.00E-06	1.54	0.51	0.43	-0.21	1.00
7.50E-06	1.58	0.62	0.39	-0.16	1.00
8.00E-06	1.62	0.73	0.35	-0.10	1.00
8.50E-06	1.66	0.84	0.31	-0.04	1.00
9.00E-06	1.70	0.94	0.27	0.01	1.00
9.50E-06	1.74	1.05	0.23	0.07	1.00
1.00E-05	1.78	1.16	0.19	0.13	1.00
1.05E-05	1.81	1.27	0.15	0.18	1.00
1.10E-05	1.85	1.38	0.11	0.24	1.00
1.15E-05	1.89	1.48	0.07	0.30	1.00
1.20E-05	1.93	1.59	0.03	0.35	1.00
1.25E-05	1.97	1.70	-0.01	0.41	1.00
1.30E-05	2.01	1.81	-0.05	0.46	1.00
1.35E-05	2.05	1.92	-0.09	0.52	1.00
1.40E-05	2.09	2.02	-0.13	0.58	1.00
1.45E-05	2.12	2.13	-0.17	0.63	1.00
1.50E-05	2.16	2.24	-0.22	0.69	1.00
1.55E-05	2.20	2.35	-0.26	0.75	1.00
1.60E-05	2.24	2.46	-0.30	0.80	1.00
1.65E-05	2.28	2.56	-0.34	0.86	1.00
1.70E-05	2.32	2.67	-0.38	0.91	1.00
1.75E-05	2.36	2.78	-0.42	0.97	1.00

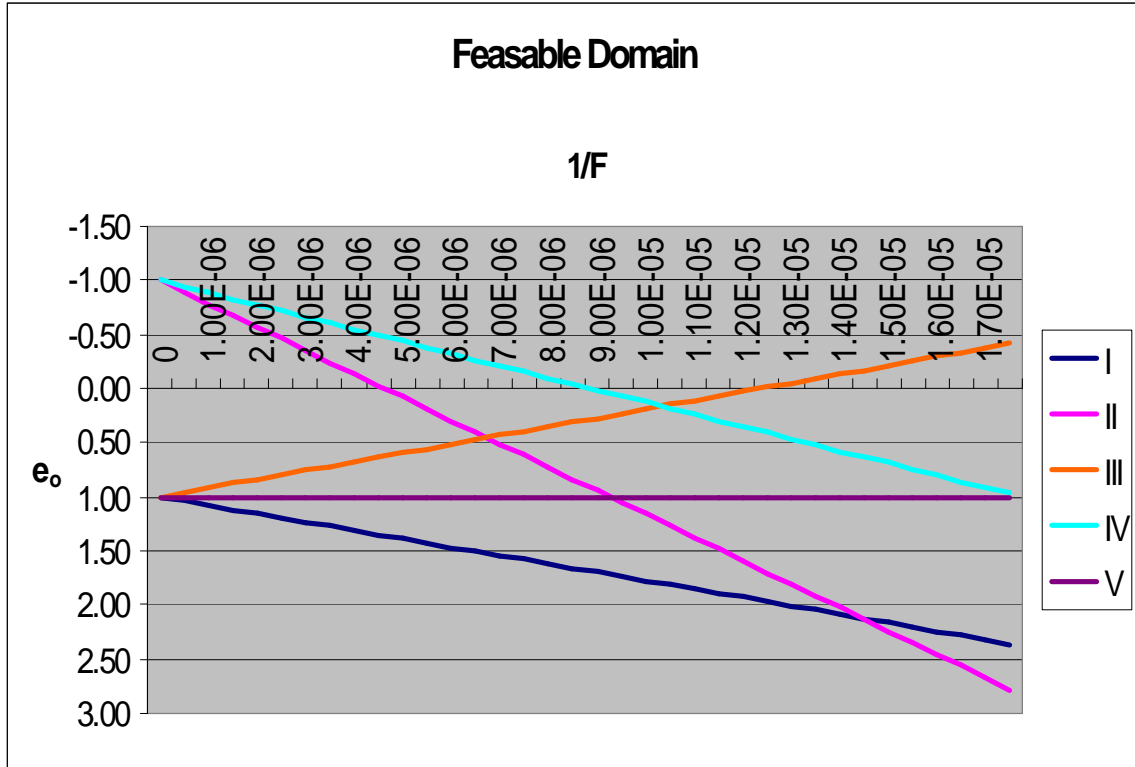
Distance (ft)	M _{min} (k-in)	M _{max} (k-in)	I e _o <	II e _o <	III e _o >	IV e _o >	V e _o <
0	0	0	1.23	1.68	-3.78	-2.35	1.00
2	19.8	47.4	1.58	2.52	-2.73	-1.30	1.00
4	36	85.92	1.86	3.20	-1.88	-0.45	1.00
6	48.6	115.56	2.09	3.72	-1.22	0.21	1.00
8	57.6	136.32	2.25	4.09	-0.76	0.66	1.00
10	63	148.2	2.34	4.30	-0.50	0.93	1.00
12	64.8	151.2	2.37	4.35	-0.43	0.99	1.00
14	63	145.32	2.34	4.25	-0.56	0.86	1.00
16	57.6	130.56	2.25	3.99	-0.89	0.54	1.00
18	48.6	106.92	2.09	3.57	-1.41	0.01	1.00
20	36	74.4	1.86	2.99	-2.13	-0.71	1.00
22	19.8	33	1.58	2.26	-3.05	-1.62	1.00



24	0	-17.28	1.23	1.37	-4.16	-2.73	1.00
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Distance (ft)	Eccentricities(in)		Tendon Profile
	Min	Max	
0	-2.35	1.23	0.25
2	-1.30	1.58	0.50
4	-0.45	1.86	0.75
6	0.21	2.09	1.00
8	0.66	2.25	1.25
10	0.93	2.34	1.50
12	0.99	2.37	1.75
14	0.86	2.34	1.50
16	0.54	2.25	1.25
18	0.01	2.09	1.00
20	-0.71	1.86	0.75
22	-1.62	1.58	0.50
24	-2.73	1.23	0.25







Continuous Span (class U)

A_c (in ⁴) =	66
I (in ³) =	166.4
Z_t (in ³) =	60.5
Z_b (in ³) =	60.5
K_t (in) =	-0.92
K_b (in) =	0.92
y_t (in) =	2.75
y_b (in) =	2.75
M_{min} (k-in) =	47.5
M_{max} (k-in) =	123.6

\bullet_{ts} (psi) =	-530
\bullet_{ci} (psi) =	2100
\bullet_{sus} (psi) =	2250
\bullet_{cs} (psi) =	3000
\bullet_{ti} (psi) =	-177.5
$\bullet =$	0.8
w_{LL} (plf) =	100
w_{sup} (plf) =	10
w_{wt} (plf) =	68.75
w_{Tot} (plf) =	178.75

Feasible Domain Inequalities

I	$e_o <$	0.92	+	$(1/F_i)^*$	5.82E+04
II	$e_o <$	-0.92	+	$(1/F_i)^*$	1.75E+05
III	$e_o >$	0.92	+	$(1/F_i)^*$	7.24E+04
IV	$e_o >$	-0.92	+	$(1/F_i)^*$	1.14E+05
V	$e_o <$	0.75			

1/F	I	II	III	IV	V
0	0.92	-0.92	0.92	-0.92	0.75
5.00E-07	0.95	-0.83	0.88	-0.86	0.75
1.00E-06	0.98	-0.75	0.85	-0.81	0.75
1.50E-06	1.01	-0.66	0.81	-0.75	0.75
2.00E-06	1.04	-0.57	0.78	-0.69	0.75
2.50E-06	1.07	-0.48	0.74	-0.63	0.75
3.00E-06	1.09	-0.40	0.70	-0.58	0.75



3.50E-06	1.12	-0.31	0.67	-0.52	0.75
4.00E-06	1.15	-0.22	0.63	-0.46	0.75
4.50E-06	1.18	-0.13	0.59	-0.41	0.75
5.00E-06	1.21	-0.05	0.56	-0.35	0.75
5.50E-06	1.24	0.04	0.52	-0.29	0.75
6.00E-06	1.27	0.13	0.49	-0.23	0.75
6.50E-06	1.30	0.21	0.45	-0.18	0.75
7.00E-06	1.33	0.30	0.41	-0.12	0.75
7.50E-06	1.36	0.39	0.38	-0.06	0.75
8.00E-06	1.39	0.48	0.34	0.00	0.75
8.50E-06	1.42	0.56	0.30	0.05	0.75
9.00E-06	1.44	0.65	0.27	0.11	0.75
9.50E-06	1.47	0.74	0.23	0.17	0.75
1.00E-05	1.50	0.83	0.20	0.22	0.75
1.05E-05	1.53	0.91	0.16	0.28	0.75
1.10E-05	1.56	1.00	0.12	0.34	0.75
1.15E-05	1.59	1.09	0.09	0.40	0.75
1.20E-05	1.62	1.17	0.05	0.45	0.75
1.25E-05	1.65	1.26	0.02	0.51	0.75
1.30E-05	1.68	1.35	-0.02	0.57	0.75
1.35E-05	1.71	1.44	-0.06	0.62	0.75
1.40E-05	1.74	1.52	-0.09	0.68	0.75
1.45E-05	1.76	1.61	-0.13	0.74	0.75
1.50E-05	1.79	1.70	-0.17	0.80	0.75
1.55E-05	1.82	1.79	-0.20	0.85	0.75
1.60E-05	1.85	1.87	-0.24	0.91	0.75
1.65E-05	1.88	1.96	-0.27	0.97	0.75
1.70E-05	1.91	2.05	-0.31	1.03	0.75
1.75E-05	1.94	2.13	-0.35	1.08	0.75

Distance (ft)	M _{min} (k-in)	M _{max} (k-in)	I e _o <	II e _o <	III e _o >	IV e _o >	V e _o <
0	0	0	1.08	0.94	-2.40	-1.51	0.75
4	36	85.92	1.60	2.20	-0.83	0.07	0.75
8	57.6	136.32	1.92	2.94	0.09	0.99	0.75
12	64.8	151.2	2.03	3.15	0.37	1.26	0.75
16	57.6	130.56	1.92	2.85	-0.01	0.88	0.75
20	36	74.4	1.60	2.03	-1.04	-0.15	0.75
24	0	0	1.08	0.94	-2.40	-1.51	0.75
28	36	85.92	1.60	2.20	-0.83	0.07	0.75
32	57.6	136.32	1.92	2.94	0.09	0.99	0.75
36	64.8	151.2	2.03	3.15	0.37	1.26	0.75
40	57.6	130.6	1.92	2.85	-0.01	0.88	0.75
44	36	74.4	1.60	2.03	-1.04	-0.15	0.75
48	0	0	1.08	0.94	-2.40	-1.51	0.75



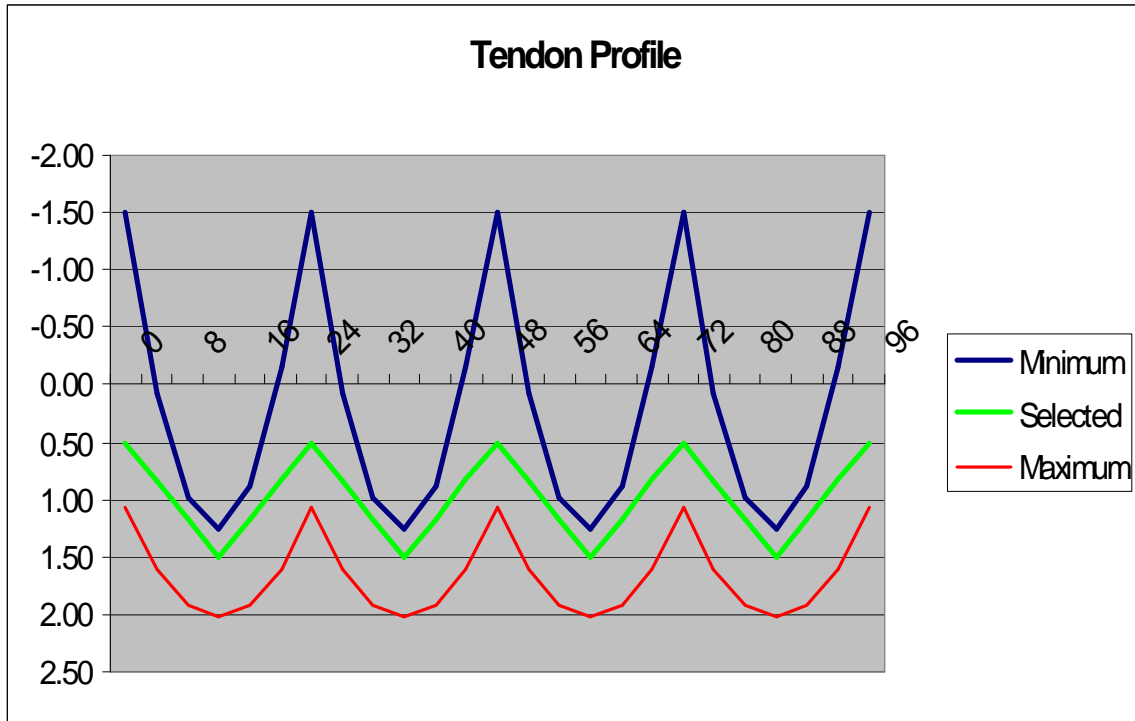
52	36	85.92	1.60	2.20	-0.83	0.07	0.75
56	57.6	136.32	1.92	2.94	0.09	0.99	0.75
60	64.8	151.2	2.03	3.15	0.37	1.26	0.75
64	57.6	130.6	1.92	2.85	-0.01	0.88	0.75
68	36	74.4	1.60	2.03	-1.04	-0.15	0.75
72	0	0	1.08	0.94	-2.40	-1.51	0.75
76	36	85.92	1.60	2.20	-0.83	0.07	0.75
80	57.6	136.32	1.92	2.94	0.09	0.99	0.75
84	64.8	151.2	2.03	3.15	0.37	1.26	0.75
88	57.6	130.6	1.92	2.85	-0.01	0.88	0.75
92	36	74.4	1.60	2.03	-1.04	-0.15	0.75
96	0	0	1.08	0.94	-2.40	-1.51	0.75

Tendon Profile Parameters

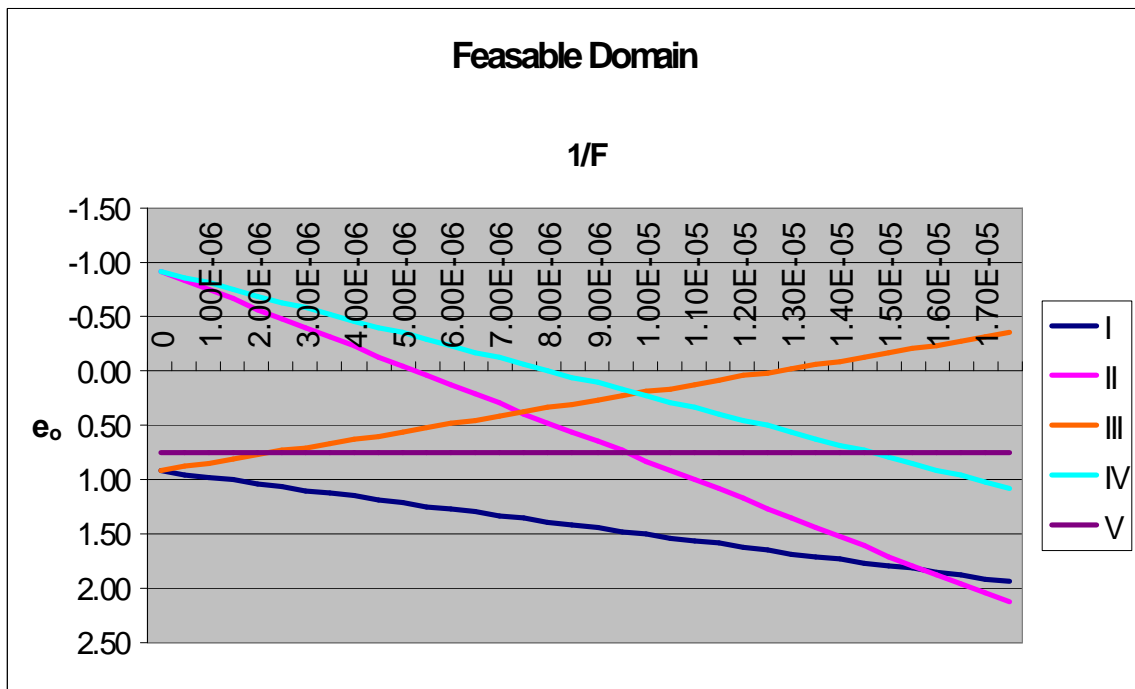
Distance (ft)	Eccentricities (in)		Tendon Profile
	Min	Max	
0	-1.51	1.08	0.50
4	0.07	1.60	0.83
8	0.99	1.92	1.17
12	1.26	2.03	1.50
16	0.88	1.92	1.17
20	-0.15	1.60	0.83
24	-1.51	1.08	0.50
28	0.07	1.60	0.83
32	0.99	1.92	1.17
36	1.26	2.03	1.50
40	0.88	1.92	1.17
44	-0.15	1.60	0.83
48	-1.51	1.08	0.50
52	0.07	1.60	0.83
56	0.99	1.92	1.17
60	1.26	2.03	1.50
64	0.88	1.92	1.17
68	-0.15	1.60	0.83
72	-1.51	1.08	0.50
76	0.07	1.60	0.83
80	0.99	1.92	1.17
84	1.26	2.03	1.50
88	0.88	1.92	1.17
92	-0.15	1.60	0.83
96	-1.51	1.08	0.50



Tendon Profile



Feasible Domain





Continuous Span (Class T)

A_c (in ⁴) =	60
I (in ³) =	125
Z_t (in ³) =	50
Z_b (in ³) =	50
K_t (in) =	-0.83
K_b (in) =	0.83
y_t (in) =	2.5
y_b (in) =	2.5
M_{min} (k-in) =	43.2
M_{max} (k-in) =	119.2

• t_s (psi) =	- 848.5
• c_i (psi) =	2100
• s_{us} (psi) =	2250
• c_s (psi) =	3000
• t_i (psi) =	- 177.5
• =	0.8
w_{LL} (plf) =	100
w_{sup} (plf) =	10
w_{wt} (plf) =	62.5
w_{Tot} (plf) =	172.5

Feasible Domain Inequalities

I	$e_o <$	0.83	+	$(1/F_i)^*$	5.21E+04
II	$e_o <$	-0.83	+	$(1/F_i)^*$	1.48E+05
III	$e_o >$	0.83	+	$(1/F_i)^*$	- 3.85E+04
IV	$e_o >$	-0.83	+	$(1/F_i)^*$	9.60E+04
V	$e_o <$	0.5			

1/F	I	II	III	IV	V
0	0.83	-0.83	0.83	-0.83	0.50
5.00E-07	0.86	-0.76	0.81	-0.78	0.50
1.00E-06	0.88	-0.68	0.79	-0.73	0.50
1.50E-06	0.91	-0.61	0.77	-0.69	0.50
2.00E-06	0.93	-0.53	0.75	-0.64	0.50
2.50E-06	0.96	-0.46	0.73	-0.59	0.50



3.00E-06	0.99	-0.39	0.71	-0.54	0.50
3.50E-06	1.01	-0.31	0.70	-0.49	0.50
4.00E-06	1.04	-0.24	0.68	-0.45	0.50
4.50E-06	1.06	-0.16	0.66	-0.40	0.50
5.00E-06	1.09	-0.09	0.64	-0.35	0.50
5.50E-06	1.12	-0.01	0.62	-0.30	0.50
6.00E-06	1.14	0.06	0.60	-0.25	0.50
6.50E-06	1.17	0.13	0.58	-0.21	0.50
7.00E-06	1.19	0.21	0.56	-0.16	0.50
7.50E-06	1.22	0.28	0.54	-0.11	0.50
8.00E-06	1.25	0.36	0.52	-0.06	0.50
8.50E-06	1.27	0.43	0.50	-0.01	0.50
9.00E-06	1.30	0.50	0.48	0.03	0.50
9.50E-06	1.32	0.58	0.46	0.08	0.50
1.00E-05	1.35	0.65	0.45	0.13	0.50
1.05E-05	1.38	0.73	0.43	0.18	0.50
1.10E-05	1.40	0.80	0.41	0.23	0.50
1.15E-05	1.43	0.87	0.39	0.27	0.50
1.20E-05	1.45	0.95	0.37	0.32	0.50
1.25E-05	1.48	1.02	0.35	0.37	0.50
1.30E-05	1.51	1.10	0.33	0.42	0.50
1.35E-05	1.53	1.17	0.31	0.47	0.50
1.40E-05	1.56	1.24	0.29	0.51	0.50
1.45E-05	1.59	1.32	0.27	0.56	0.50
1.50E-05	1.61	1.39	0.25	0.61	0.50
1.55E-05	1.64	1.47	0.23	0.66	0.50
1.60E-05	1.66	1.54	0.21	0.71	0.50
1.65E-05	1.69	1.62	0.19	0.75	0.50
1.70E-05	1.72	1.69	0.18	0.80	0.50
1.75E-05	1.74	1.76	0.16	0.85	0.50

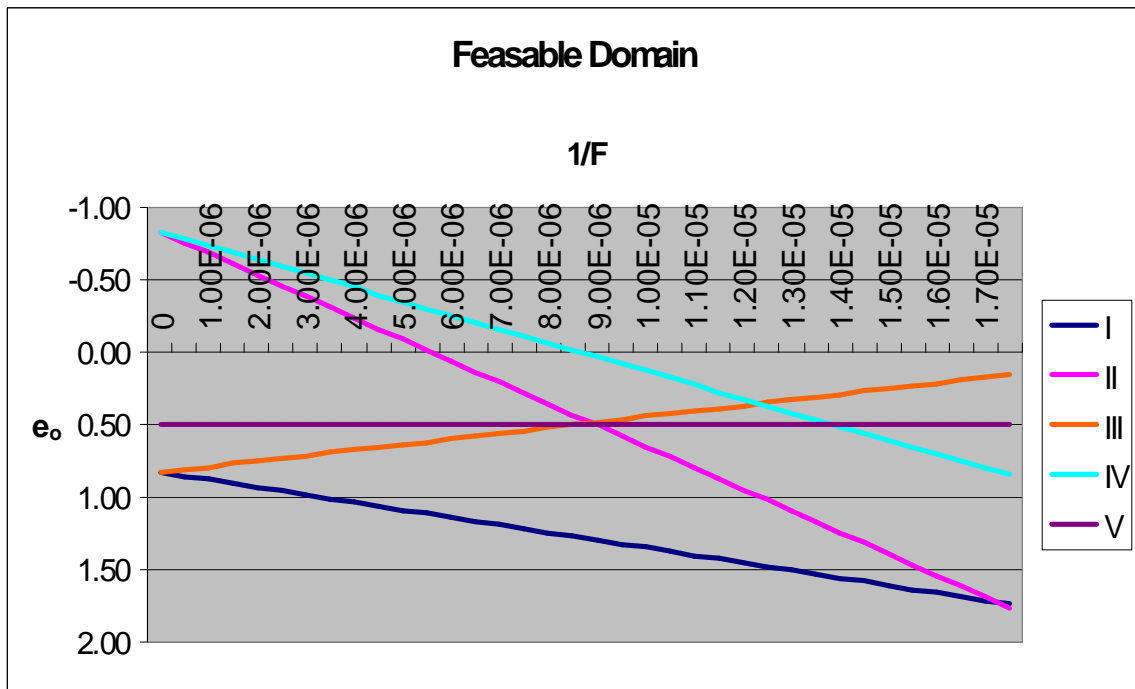
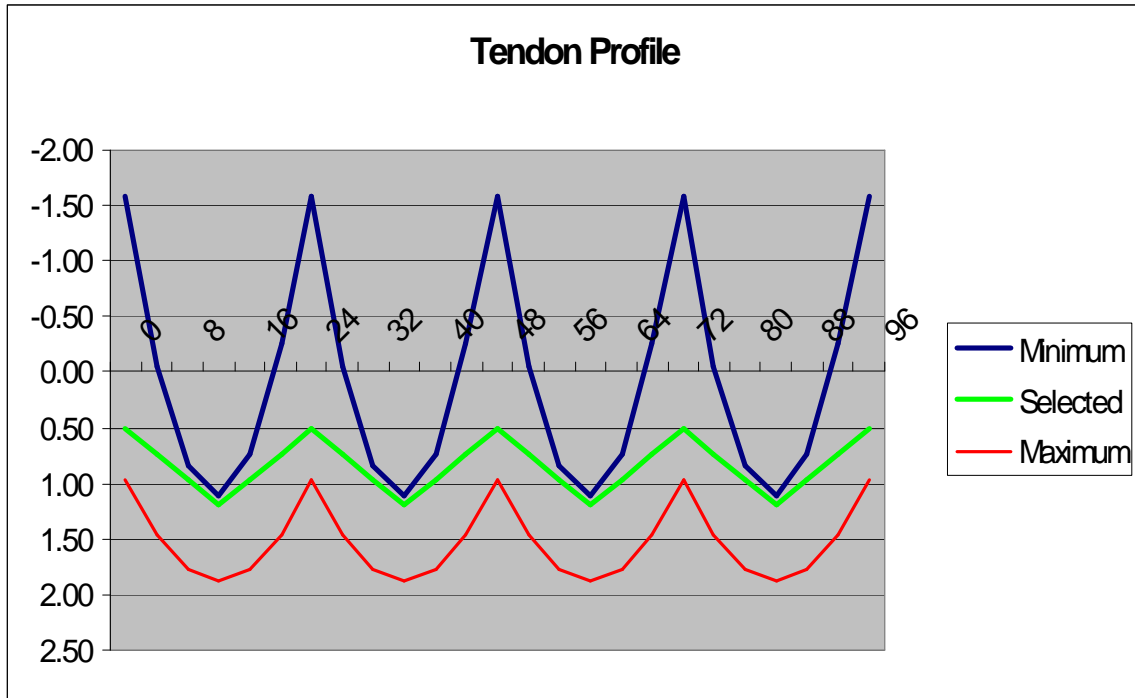
Distance	M _{min}	M _{max}	I	II	III	IV	V
(ft)	(k-in)	(k-in)	e _o <	e _o <	e _o >	e _o >	e _o <
0	0	0	0.96	0.67	-1.85	-1.59	0.50
4	36	85.92	1.47	1.90	-0.31	-0.05	0.50
8	57.6	136.32	1.78	2.62	0.59	0.85	0.50
12	64.8	151.2	1.88	2.83	0.85	1.11	0.50
16	57.6	130.56	1.78	2.54	0.48	0.74	0.50
20	36	74.4	1.47	1.73	-0.52	-0.26	0.50
24	0	0	0.96	0.67	-1.85	-1.59	0.50
28	36	85.92	1.47	1.90	-0.31	-0.05	0.50
32	57.6	136.32	1.78	2.62	0.59	0.85	0.50
36	64.8	151.2	1.88	2.83	0.85	1.11	0.50
40	57.6	130.6	1.78	2.54	0.48	0.74	0.50



44	36	74.4	1.47	1.73	-0.52	-0.26	0.50
48	0	0	0.96	0.67	-1.85	-1.59	0.50
52	36	85.92	1.47	1.90	-0.31	-0.05	0.50
56	57.6	136.32	1.78	2.62	0.59	0.85	0.50
60	64.8	151.2	1.88	2.83	0.85	1.11	0.50
64	57.6	130.6	1.78	2.54	0.48	0.74	0.50
68	36	74.4	1.47	1.73	-0.52	-0.26	0.50
72	0	0	0.96	0.67	-1.85	-1.59	0.50
76	36	85.92	1.47	1.90	-0.31	-0.05	0.50
80	57.6	136.32	1.78	2.62	0.59	0.85	0.50
84	64.8	151.2	1.88	2.83	0.85	1.11	0.50
88	57.6	130.6	1.78	2.54	0.48	0.74	0.50
92	36	74.4	1.47	1.73	-0.52	-0.26	0.50
96	0	0	0.96	0.67	-1.85	-1.59	0.50

Tendon Profile Parameters

Distance (ft)	Eccentricities (in)		Tendon Profile
	Min	Max	
0	-1.59	0.96	0.50
4	-0.05	1.47	0.73
8	0.85	1.78	0.97
12	1.11	1.88	1.20
16	0.74	1.78	0.97
20	-0.26	1.47	0.73
24	-1.59	0.96	0.50
28	-0.05	1.47	0.73
32	0.85	1.78	0.97
36	1.11	1.88	1.20
40	0.74	1.78	0.97
44	-0.26	1.47	0.73
48	-1.59	0.96	0.50
52	-0.05	1.47	0.73
56	0.85	1.78	0.97
60	1.11	1.88	1.20
64	0.74	1.78	0.97
68	-0.26	1.47	0.73
72	-1.59	0.96	0.50
76	-0.05	1.47	0.73
80	0.85	1.78	0.97
84	1.11	1.88	1.20
88	0.74	1.78	0.97
92	-0.26	1.47	0.73
96	-1.59	0.96	0.50



Design Calculations

Project	Prepared by	Date
Subject/Title	Reviewed by	Date
Simple Span (Class U)	Calculation Number	Sheet 1 of

$$L = 24'$$

$$B = 1'$$

$$LL = 100 \text{ psf (residential)}$$

$$DL_{sup} = 10 \text{ psf (superimposed)}$$

$$\begin{aligned} \text{Weight} &= 150 \text{ pcf (7"/12)} \quad (\text{weight assumption}) \\ &= 75 \text{ psf} \end{aligned}$$

$$f'_c = 5000 \text{ psi}$$

$$f'_ci = 3500 \text{ psi}$$

$$f_{pu} = 270 \text{ ksi}$$

$$W_{LL} = 100 \text{ psf} \times 1' = 100 \text{ plf}$$

$$W_{sup} = 10 \text{ psf} \times 1' = 10 \text{ plf}$$

$$W_{WT} = 75 \text{ psf} \times 1' = 75 \text{ plf}$$

$$\begin{aligned} M_{min} &= \frac{w_x(l-x)}{2} = \frac{75x(24-x)}{2} = 900x - 37.5x^2 \\ &= 5400 \text{ lb-ft} = 64.8 \text{ k-in} \quad (@ \text{ midspan}) \end{aligned}$$

$$\begin{aligned} M_{max} &= \frac{w_x(l-x)}{2} = \frac{185x(24-x)}{2} = 2160x - 92.5x^2 \\ &= 12600 \text{ lb-ft} = 151.2 \text{ k-in} \quad (@ \text{ midspan}) \end{aligned}$$

$$b = 12''$$

$$I = \frac{bh^3}{12} = \frac{12(7)^3}{12} = 343 \text{ in}^4$$

$$Z_x = Z_b = \frac{I}{y_x} = \frac{343}{3.5} = 98 \text{ in}^3$$

$$y_x = y_b = 3.5''$$

$$A_c = 12'' \times 7'' = 84''^2$$

$$k_x = -Z_b/A_c = -98/84 = -1.17'' \quad k_b = 1.17''$$

Design Calculations

Project	Prepared by	Date
Subject/Title	Reviewed by	Date
	Calculation Number	Sheet 2 of

Allowable Stresses (ACI)

$$\bar{\sigma}_{xs} = 7.5\sqrt{f'_c} = 7.5\sqrt{5000} = 530 \text{ psi (18.3.3) (class U)}$$

$$\bar{\sigma}_{ci} = 0.6f'_ci = 0.6(3500) = 2100 \text{ psi (18.4.1)}$$

$$\bar{\sigma}_{sus} = 0.45f'_c = 0.45(5000) = 2250 \text{ psi (18.4.2)}$$

$$\bar{\sigma}_{cs} = 0.6f'_c = 0.6(5000) = 3000 \text{ psi (18.4.2)}$$

$$\bar{\sigma}_{xi} = 3\sqrt{f'_ci} = 3\sqrt{3500} = 177.5 \text{ psi (18.4.1)}$$

Feasible Domain

$$\begin{aligned} \text{I } e_o &\leq k_b + (1/F)(M_{\min} - \bar{\sigma}_{xi} Z_t) \\ &\leq 1.17 + (1/F)(64.8 - (-.18)(98)) \\ &\leq 1.17 + (1/F)(82.44) \end{aligned}$$

$$\begin{aligned} \text{II } e_o &\leq k_t + (1/F)(M_{\min} + \bar{\sigma}_{ci} Z_b) \\ &\leq -1.17 + (1/F)(64.8 + (2.1)(98)) \\ &\leq -1.17 + (1/F)(270.6) \end{aligned}$$

$$\begin{aligned} \text{III } e_o &\geq k_b + (1/F)(M_{\max} - \bar{\sigma}_{cs} Z_t)(1/\eta) \\ &\geq 1.17 + (1/F)(151.2 - (3)(98)(1/8)) \\ &\geq 1.17 + (1/F)(-178.5) \end{aligned}$$

$$\begin{aligned} \text{IV } e_o &\geq k_t + (1/F)(M_{\max} + \bar{\sigma}_{xs} Z_b)(1/\eta) \\ &\geq -1.17 + (1/F)(151.2 + (-.53)(98)(1/8)) \\ &\geq -1.17 + (1/F)(124.1) \end{aligned}$$

$$\text{V } e_o \leq y_b - (d_c) = 3.5 - 2 = 1.5''$$

Design Calculations

Project	Prepared by	Date
Subject/Title	Reviewed by	Date
	Calculation Number	Sheet 3 of

$$IV = V$$

$$\Rightarrow 1.5 = -1.17 + (1/F)(124.1)$$

$$\Rightarrow F = 46.5 \text{ K}$$

$$\text{ACI limit for } f_{pi} = 0.74 f_{pu} = .74(270) = 199.8 \text{ ksi}$$

$$f_{pi} = \frac{F_i}{A_s} \Rightarrow A_s = \frac{F_i}{f_{pi}} = \frac{46.5}{199.8} = 0.23 \text{ in}^2$$

using $\frac{1}{2}$ " ϕ strands ($A = 0.19 \text{ in}^2$)

\Rightarrow use 2 strands ($A = .38 \text{ in}^2$)

$$F_i = 199.8 \times .38 = 75.9 \text{ K}$$

Check ultimate capacity

$$\begin{aligned} m_u &= 1.2 \text{ DL} + 1.6 \text{ LL} \\ &= 1.2 \left(\frac{85 \times 24^2}{8} \right) + 1.6 \left(\frac{100 \times 24^2}{8} \right) \\ &= 18,864 \text{ lb-ft} = 226.4 \text{ K-in @ midspan} \end{aligned}$$

$$\begin{aligned} m_{cr} &= F(e_o - k_e) - f_r Z_b \\ &= 75.9(1.52 + 1.17) - (-17.5 \sqrt{5000}) \times (98) / 1000 \\ &= 256.14 \text{ K-in @ midspan} \end{aligned}$$

$$f_{ps} = f_{pu} \left\{ 1 - \frac{\gamma_p}{\beta_1} \left[\frac{\rho}{\rho_p} \frac{f_{pu}}{f'_c} \right] \right\}$$

Design Calculations

Project	Prepared by	Date
Subject/Title	Reviewed by	Date
	Calculation Number	Sheet 4 of

low-relaxation strands
 $\Rightarrow \delta_p = 0.28, \beta_1 = .75$

$$\rho_p = \frac{0.38}{(6'' \times 12'')} = 0.00528$$

$$f_{ps} = 270 \left\{ 1 - \frac{.28}{.75} \left[0.00528 \times \frac{270}{5} \right] \right\} = 241.3 \text{ ksi}$$

$$a = \frac{A_{ps} f_{ps}}{.85 f'_c b} = \frac{(.38)(241.3)}{.85(5)(12)} = 1.79''$$

$$\begin{aligned} M_n &= A_{ps} f_{ps} (d_p - a/2) \\ &= (.38)(241.3)(5' - 1.79/2) \\ &= 376.4 \end{aligned}$$

$$\begin{aligned} \phi M_n &= 338.7 > M_u = 226.4 \text{ k-in} && \text{OK} \\ &> 1.2 M_{cr} = 307.4 \text{ k-in} && \text{OK} \end{aligned} \quad \left. \vphantom{\begin{aligned} \phi M_n \\ > M_u \\ > 1.2 M_{cr} \end{aligned}} \right\} \text{No compressive steel needed}$$

Design Calculations

Project	Prepared by	Date
Subject/Title	Reviewed by	Date
Simple Span (class T)	Calculation Number	Sheet of

$$L=24'$$

$$B=1'$$

$$WT = 150(6/12) \\ = 75 \text{ psf}$$

$$M_{min} = \frac{wx(l-x)}{2} = \frac{75x(24-x)}{2} = 900x - 37.5x^2 = 64.8 \text{ k-in}$$

$$M_{max} = 2160x - 92.5x^2 = 151.2 \text{ k-in}$$

$$b=12''$$

$$I = \frac{bh^3}{12} = \frac{12(6)^3}{12} = 216 \text{ in}^4$$

$$Z_x = Z_b = I/y_x = 216/3 = 72 \text{ in}^3$$

$$A_c = 12 \times 6 = 72 \text{ in}^2$$

$$k_a = -1, k_b = 1$$

Allowable stresses

$$\bar{\sigma}_{cs} = -12\sqrt{5000} = -848.5 \text{ psi}$$

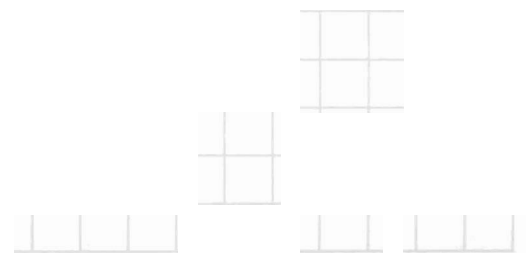
$$\bar{\sigma}_{ci} = 2100 \text{ psi}$$

$$\bar{\sigma}_{sus} = 2250 \text{ psi}$$

$$\bar{\sigma}_{cs} = 3000 \text{ psi}$$

$$\bar{\sigma}_{ti} = -177.5 \text{ psi}$$

see excel for feasible domain



Design Calculations

Project	Prepared by	Date
Subject/Title	Reviewed by	Date
	Calculation Number	Sheet 6 of

$$IV = V$$

$$e_0 = -1 + \frac{1}{F} (1.13 \times 10^5)$$

$$\Rightarrow F = 56.5 \text{ K}$$

$$f_{pi} = \frac{F_i}{A_s} \Rightarrow A_s = \frac{F_i}{f_{pi}} = \frac{56.5}{199.8} = 0.28 \text{ in}^2$$

\Rightarrow Use 2 $\frac{1}{2}$ " ϕ Strands

$$F_i = 199.8 \times 0.38 = 75.9 \text{ K}$$

$$M_u = 226.4 \text{ K-in}$$

$$M_{cr} = 56.5(1+1) + 12 \sqrt{5000} \times 172 / 1000$$

$$= 174.1 \text{ K-in}$$

$$f_{ps} = 241.3 \text{ ksi}$$

$$a = 1.79''$$

$$M_N = (38)(241.3)(4 - \frac{1.79}{2}) = 284.7 \text{ K-in}$$

$$\left. \begin{array}{l} \phi M_N = 256 > M_u = 226.4 \\ > 1.2 M_{cr} = 208.9 \end{array} \right\} \text{ No compression steel needed}$$

Design Calculations

Project	Prepared by	Date
Subject/Title	Reviewed by	Date
Continuous Span (class U)	Calculation Number	Sheet of

$$L = 96'$$

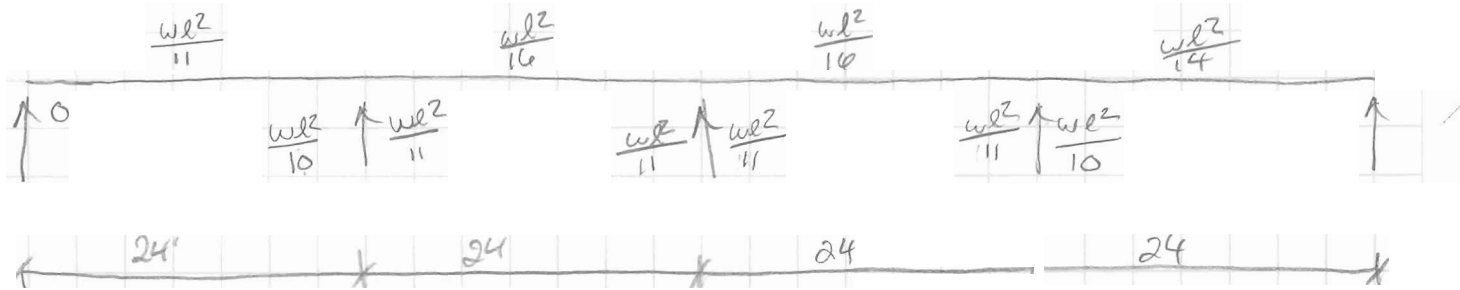
$$B = 1'$$

$$LL = 100 \text{ psf}$$

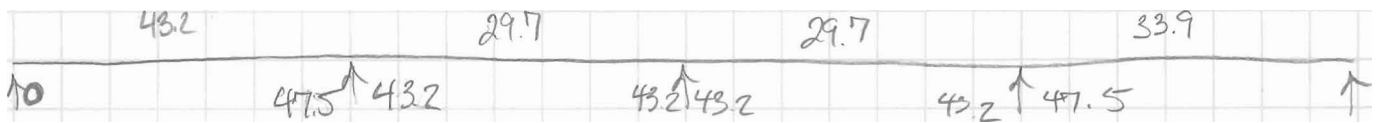
$$DL = 10 \text{ psf}$$

$$WT = 150 \times \frac{59}{12} = 68.75 \text{ psf}$$

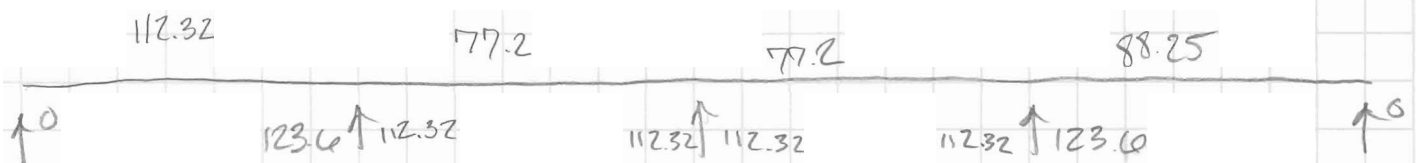
From ACI Chapter 8



Min (k-in)



Max (k-in)



Design Calculations

Project	Prepared by	Date
Subject/Title	Reviewed by	Date
	Calculation Number	Sheet of

$$h = 5.5''$$

$$b = 12''$$

$$y_x = y_b = 2.75''$$

$$I = \frac{bh^3}{12} = 166.4 \text{ in}^4$$

$$A_c = 66 \text{ in}^2$$

$$k_x = -.92$$

$$k_b = .92$$

$$Z_x = Z_b = 60.5 \text{ in}^3$$

$$I_{\text{eff}} =$$

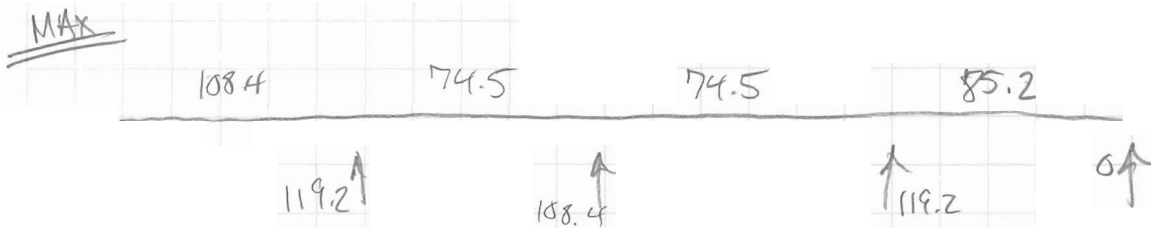
$$-.92 + \sqrt[3]{F(1.14 \times 10^5)} = .75 \Rightarrow F = 68.3 \text{ k}$$

$$f_{pi} = \frac{F_i}{A_s} = A_s = \frac{68.3}{199.8} = 0.34 \text{ in}^2 \Rightarrow \text{use 2 } \frac{1}{2}'' \phi \text{ strands}$$

Design Calculations

Project	Prepared by	Date
Subject/Title	Reviewed by	Date
Continuous Class (T)	Calculation Number	Sheet of

$L = 96'$ $WT = 62.5 \text{ psf}$
 $B = 1'$



$$b = 12''$$

$$y_x = y_b = 2.5''$$

$$I = \frac{bh^3}{12} = 125 \text{ in}^4$$

$$Z_x = Z_b = 50 \text{ in}^3$$

$$A_c = 60 \text{ in}^2$$

$$k_x = -.83$$

$$k_b = .83$$

$$V = IV$$

$$-.83 + 1/F (9.6 \times 10^4) = .5 \Rightarrow F = 170.17 \text{ K}$$

$$A_s = \frac{70.7}{199.8} = 0.35 \Rightarrow (2) \ 1/2'' \ \phi \ \text{strands}$$

