CONSIGN, LLC

CONSULTING ENGINEERS

CERTIFICATION OF AUTH. # 31618

14021 SW 143RD COURT - BAY 1, MIAMI, FL 33186 - PHONE - FAX # (305) 253-9442

Cover Sheet
Structural Calculations

PROJECT:

GARY MATZNER PARK CONSTRUCTION

6610 SW 88TH ST
PINECREST, 33156

CUSTOMER: **CONENGINEERS BUILDERS, LLC**

DESIGNER: **Adolfo Espino P.E.**

STATE OF FLORIDA REG. # 98949

CODES AND SPECIFICATIONS:

ALUMINUM DESIGN MANUAL 2020
FLORIDA BUILDING CODE 2023
A.S.C.E 7-22

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by Adolfo M
Espino-Rodriguez
Date: 2026.07.22
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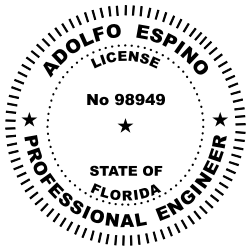

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DESIGN CRITERIA & APPLICABLE CODES

CODES:

- F.B.C 2023 ***- A.S.C.E 7-22***

- ADM 2020

SOLID FREESTANDING WALL WIND LOAD CALCULATIONS

WIND CODE=	ASCE 7-22								
WINDSPEED=	115	MPH		- FBC 2023 - 1616.2.1					
MEAN HEIGHT:		Z=	6.00	ft					
EXPOSURE CATEGORY=		C	- FBC 2023						
Aef=Efective area=	5.00	ft	X	6.00	ft	=	30	ft2	
Kzt=	1	- Section 26.8-2 ASCE 7-22							
Ke=	1	- Table 26.9-1 ASCE 7-22							
Kd=	0.85	- Section 26.6-1 ASCE 7-22							
Kz=	0.85	- Table 26.10-1 ASCE 7-22							
qh=	0.00256 * Kz * Kzt Ke * V2				- Section 30.3-1				
	28.78	psf							
And:									
B=	5.00	ft	- Width of Panel						
s=	6.00	ft	- Height of Panel						
h=	6.00	ft	- Vertical distance from top of panel to ground surface						
B/s=	0.83	- Aspect ratio							
s/h=	1.00	- Clearance ratio							
G=	0.85	- Gust-effect factor from section 26.11							
C_f=	1.45	- Fig. 29.3-1							
W design =	qh x G x C_f x Kd	- Wind design Pressure Section 29.3.1							
	30.15	Psf							
Opening	50%								
	15.07	Psf	- CRITICAL						

P_{ASD} = 0.6 x W design = 9.04 Psf - CRITICAL ASD PRESSURE

CHECKING LOADS COMBINATIONS. - ASCE 7-22

1.- D+L 2.- 0.6D+0.6W

CHECKING CRITICAL ALUMINUM FENCE

CHECKING CRITICAL POST ELEMENT

Try Aluminum SQ. TUBE 2.00" x 1/4"

Sxx= 0.91 in3

Critical Span = 6.00 ft

Fb = 13.6 ksi Welded

w= P_{ASD} * 6.00 = 54.27 lb/ft

M= 54.27 x 36.00 = 976.80 lb-ft

2

M= 977 lb-ft = 11722 lb-in

S rq'd = 11722 / 13600 = 0.86 in3

Sxx= 0.91 in3 > 0.86 in3

USE: Aluminum SQ. TUBE 2.00" x 1/4"

CHECKING CRITICAL TOP AND BOTTOM RAIL

Try Aluminum RT TUBE 2.00"x1.00"x1/8" (h)

Sxx= 0.33 in3

Critical Span = 6.00 ft

Fb = 13.6 ksi Welded

w= P_{ASD} * 3.00 = 27.13 lb/ft

M= 27.13 x 36.00 = 488.40 lb-ft

2

M= 488 lb-ft = 5861 lb-in

S rq'd = 5861 / 13600 = 0.43 in3

Sxx= 0.33 in3 > 0.43 in3

USE: Aluminum RT TUBE 2.00"x1.00"x1/8" (h)

CHECKING CRITICAL PICKET

Try Aluminum SQ. TUBE 1.00" x 1/8"

Sxx= 0.11 in3

Critical Span = 3.50 ft

Fb = 31.8 ksi UnWelded

w= P_{ASD} * 0.33 = 3.01 lb/ft

M= 3.01 x 12.25 = 4.62 lb-ft

8

M= 5 lb-ft = 55 lb-in

S rq'd = 55 / 31800 = 0.00 in3

Sxx= 0.11 in3 > 0.0017 in3

USE: Aluminum SQ. TUBE 1.00" x 1/8"

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CHECKING CRITICAL FOOTING EMBEDMENT AS PER F.B.C 2023 - SECTION 1807.3

For Constrained:	d=	SQRT(4.25 *((P*h)/(S3 * b)))			
For Unconstrained:	d=	0.5A(1+(1+(4.36h/A))^(1/2))		A = 2.34 P / (S1b)	
	b=	diameter of round post or diagonal dimension of square post or footing, ft			
	d=	depth of embedment in earth in feet but not exceed 12 feet for purpose of this calculation			
	P=	applied load, in lbs, at a distance h from the ground			
	h=	distance in feet from ground to point of application of P.			
	S1=	allowable lateral soil bearing pressure in pfs as per table 1806.2 based on a depth of 1/3d.			
	S3=	allowable soil bearing pressure in pfs as per table 1806.2 based on a depth equal to d.			
	d=	2.2	ft		
	Enter b =	1.00	ft (12" ϕ)		
	Enter P =	163	lb		
	Enter h=	6.00	ft		
	Lateral Bearing=	400	psf/ft - As 1806.2		- Worst Case
	S1=	293	psf		
	S3=	880	psf		
	A=	1.299	ft2		
	Then :	**d =**	**2.2**	ft	

CHECKING CRITICAL ALUMINUM SLIDING GATE

CHECKING CRITICAL POST ELEMENT

	Try	Aluminum	SQ. TUBE 3.00" x 1/4"				
	Sxx=	2.33	in3				
Critical Span =	6.00	ft					
Fb	=	31.8	ksi		UnWelded		
w=	P_{ASD}	*	13.50	=	122.10	lb/ft	
M=	122.10	x	36.00	=	2197.80	lb-ft	
		2					
M=	2198	lb-ft	=	26374	lb-in		
S rq'd =	26374	=	0.83	in3			
	31800						
Sxx=	2.33	in3	>	0.83	in3		

USE: Aluminum SQ. TUBE 3.00" x 1/4"

CHECKING CRITICAL FRAME

	Try	Aluminum	SQ. TUBE 2.00" x 1/4"				
	Sxx=	0.91	in3				
Critical Span =	6.00	ft					
Fb	=	13.6	ksi		Welded		
w=	P_{ASD}	*	6.25	=	56.53	lb/ft	
M=	56.53	x	36.00	=	1017.50	lb-ft	
		2					
M=	1017	lb-ft	=	12210	lb-in		
S rq'd =	12210	=	0.90	in3			
	13600						
Sxx=	0.91	in3	>	0.90	in3		

USE: Aluminum SQ. TUBE 2.00" x 1/4"

CHECKING CRITICAL PICKET

	Try	Aluminum	SQ. TUBE 1.00" x 1/8"				
	Sxx=	0.11	in3				
Critical Span =	5.50	ft					
Fb	=	31.8	ksi		UnWelded		
w=	P_{ASD}	*	0.33	=	3.01	lb/ft	
M=	3.01	x	30.25	=	11.40	lb-ft	
		8					
M=	11	lb-ft	=	137	lb-in		
S rq'd =	137	=	0.00	in3			
	31800						
Sxx=	0.11	in3	>	0.0043	in3		

USE: Aluminum SQ. TUBE 1.00" x 1/8"

CHECKING CRITICAL FOOTING EMBEDMENT AS PER F.B.C 2023 - SECTION 1807.3

For Constrained:	d=	SQRT(4.25 *((P*h)/(S3 * b)))			
For Unconstrained:	d=	0.5A(1+(1+(4.36h/A))^(1/2))		A = 2.34 P / (S1b)	
	b=	diameter of round post or diagonal dimension of square post or footing, ft			
	d=	depth of embedment in earth in feet but not exceed 12 feet for purpose of this calculation			
	P=	applied load, in lbs, at a distance h from the ground			
	h=	distance in feet from ground to point of application of P.			
	S1=	allowable lateral soil bearing pressure in pfs as per table 1806.2 based on a depth of 1/3d.			
	S3=	allowable soil bearing pressure in pfs as per table 1806.2 based on a depth equal to d.			
	d=	2.9	ft		
	Enter b =	1.00	ft (12" ϕ)		
	Enter P =	366	lb		
	Enter h=	6.00	ft		
	Lateral Bearing=	400	psf/ft - As 1806.2		- Worst Case
	S1=	380	psf		
	S3=	1140	psf		
	A=	2.256	ft2		
	Then :	**d =**	**2.9**	ft	

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CHECKING CRITICAL ALUMINUM PEDESTRIAN GATE

CHECKING CRITICAL POST ELEMENT

		Try	Aluminum	SQ. TUBE 2.00" x 1/4"				
		Sxx=	0.91	in3				
Critical Span =		4.00	ft					
	Fb	=	31.8	ksi		UnWelded		
	w=	P_{ASD}	*	4.00	=	36.18	lb/ft	
M=		36.18	x	16.00	=	289.42	lb-ft	
			2					
M=		289	lb-ft	=	3473	lb-in		
	S rq'd =	3473	=	0.11	in3			
		31800						
Sxx=		0.91	in3	>	0.11	in3		

USE: Aluminum SQ. TUBE 2.00" x 1/4"

CHECKING CRITICAL FRAME

		Try	Aluminum	SQ. TUBE 2.00" x 1/8"				
		Sxx=	0.53	in3				
Critical Span =		8.00	ft					
	Fb	=	13.6	ksi		Welded		
	w=	P_{ASD}	*	2.00	=	18.09	lb/ft	
M=		18.09	x	64.00	=	578.84	lb-ft	
			2					
M=		579	lb-ft	=	6946	lb-in		
	S rq'd =	6946	=	0.51	in3			
		13600						
Sxx=		0.53	in3	>	0.51	in3		

USE: Aluminum SQ. TUBE 2.00" x 1/8"

CHECKING CRITICAL PICKET

		Try	Aluminum	SQ. TUBE 1.00" x 1/8"				
		Sxx=	0.11	in3				
Critical Span =		3.50	ft					
	Fb	=	31.8	ksi		UnWelded		
	w=	P_{ASD}	*	0.33	=	3.01	lb/ft	
M=		3.01	x	12.25	=	4.62	lb-ft	
			8					
M=		5	lb-ft	=	55	lb-in		
	S rq'd =	55	=	0.00	in3			
		31800						
Sxx=		0.11	in3	>	0.0017	in3		

USE: Aluminum SQ. TUBE 1.00" x 1/8"

CHECKING CRITICAL FOOTING EMBEDMENT AS PER F.B.C 2023 - SECTION 1807.3

For Constrained:	d=	SQRT(4.25 *((P*h)/(S3 * b)))		
For Unconstrained:	d=	0.5A(1+(1+(4.36h/A))^(1/2))	A = 2.34 P / (S1b)	
	b=	diameter of round post or diagonal dimension of square post or footing, ft		
	d=	depth of embedment in earth in feet but not exceed 12 feet for purpose of this calculation		
	P=	applied load, in lbs, at a distance h from the ground		
	h=	distance in feet from ground to point of application of P.		
	S1=	allowable lateral soil bearing pressure in pfs as per table 1806.2 based on a depth of 1/3d.		
	S3=	allowable soil bearing pressure in pfs as per table 1806.2 based on a depth equal to d.		
	d=	1.5	ft	
	Enter b =	1.00	ft (12" ϕ)	
	Enter P =	72	lb	
	Enter h=	4.00	ft	
	Lateral Bearing=	400	psf/ft - As 1806.2	- Worst Case
	S1=	193	psf	
	S3=	580	psf	
	A=	0.876	ft2	
	Then : d =	1.5	ft	

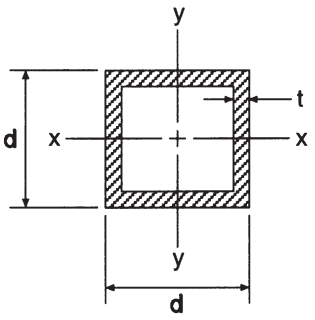


Table 23
SQUARE TUBES

Designation	Depth width d in.	Thickness t in.	Weight lb/ft	Area A in^2	Axis x-x, y-y			J in^4
					I_x, I_y in^4	S_x, S_y in^3	r_x, r_y in.	
RT 1 × 1 × .065	1.000	0.065	0.286	0.243	0.0356	0.0712	0.383	0.0531
RT 1 × 1 × .095	1.000	0.095	0.404	0.344	0.0475	0.0949	0.371	0.0704
RT 1 × 1 × .125	1.000	0.125	0.515	0.438	0.0570	0.114	0.361	0.0837
RT 1.25 × 1.25 × .065	1.250	0.065	0.362	0.308	0.0723	0.116	0.485	0.108
RT 1.25 × 1.25 × .095	1.250	0.095	0.516	0.439	0.0982	0.157	0.473	0.146
RT 1.25 × 1.25 × .125	1.250	0.125	0.662	0.563	0.120	0.192	0.462	0.178
RT 1.375 × 1.375 × .125	1.375	0.125	0.735	0.625	0.164	0.239	0.513	0.244
RT 1.5 × 1.5 × .065	1.500	0.065	0.439	0.373	0.128	0.171	0.586	0.192
RT 1.5 × 1.5 × .078	1.500	0.078	0.522	0.444	0.150	0.200	0.581	0.224
RT 1.5 × 1.5 × .095	1.500	0.095	0.628	0.534	0.176	0.235	0.575	0.263
RT 1.5 × 1.5 × .125	1.500	0.125	0.809	0.688	0.218	0.291	0.564	0.325
RT 1.5 × 1.5 × .250	1.500	0.250	1.47	1.25	0.339	0.451	0.520	0.488
RT 1.75 × 1.75 × .125	1.750	0.125	0.956	0.813	0.360	0.411	0.665	0.536
RT 2 × 2 × .095	2.000	0.095	0.851	0.724	0.439	0.439	0.779	0.657
RT 2 × 2 × .125	2.000	0.125	1.10	0.938	0.552	0.552	0.767	0.824
RT 2 × 2 × .156	2.000	0.156	1.35	1.15	0.657	0.657	0.755	0.978
RT 2 × 2 × .188	2.000	0.188	1.60	1.36	0.754	0.754	0.744	1.12
RT 2 × 2 × .250	2.000	0.250	2.06	1.75	0.911	0.911	0.722	1.34
RT 2.25 × 2.25 × .125	2.250	0.125	1.25	1.06	0.802	0.713	0.869	1.20
RT 2.5 × 2.5 × .125	2.500	0.125	1.40	1.19	1.12	0.896	0.971	1.67
RT 2.5 × 2.5 × .188	2.500	0.188	2.04	1.74	1.56	1.25	0.947	2.32
RT 2.5 × 2.5 × .250	2.500	0.250	2.65	2.25	1.92	1.54	0.924	2.85
RT 2.75 × 2.75 × .125	2.750	0.125	1.54	1.31	1.51	1.10	1.07	2.26
RT 2.75 × 2.75 × .188	2.750	0.188	2.27	1.93	2.12	1.54	1.05	3.16
RT 3 × 3 × .095	3.000	0.095	1.30	1.10	1.55	1.04	1.19	2.33
RT 3 × 3 × .125	3.000	0.125	1.69	1.44	1.98	1.32	1.17	2.97
RT 3 × 3 × .188	3.000	0.188	2.49	2.11	2.80	1.87	1.15	4.18
RT 3 × 3 × .250	3.000	0.250	3.23	2.75	3.49	2.33	1.13	5.20
RT 3 × 3 × .375	3.000	0.375	4.63	3.94	4.61	3.08	1.08	6.78
RT 3.5 × 3.5 × .125	3.500	0.125	1.98	1.69	3.21	1.83	1.38	4.81
RT 3.5 × 3.5 × .250	3.500	0.250	3.82	3.25	5.76	3.29	1.33	8.58
RT 3.5 × 3.5 × .375	3.500	0.375	5.51	4.69	7.74	4.42	1.28	11.4
RT 4 × 4 × .125	4.000	0.125	2.28	1.94	4.85	2.43	1.58	7.27
RT 4 × 4 × .188	4.000	0.188	3.37	2.87	6.96	3.48	1.56	10.4
RT 4 × 4 × .250	4.000	0.250	4.41	3.75	8.83	4.41	1.53	13.2
RT 4 × 4 × .375	4.000	0.375	6.39	5.44	12.0	6.02	1.49	17.9
RT 4 × 4 × .500	4.000	0.500	8.23	7.00	14.6	7.29	1.44	21.4

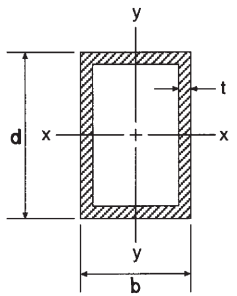
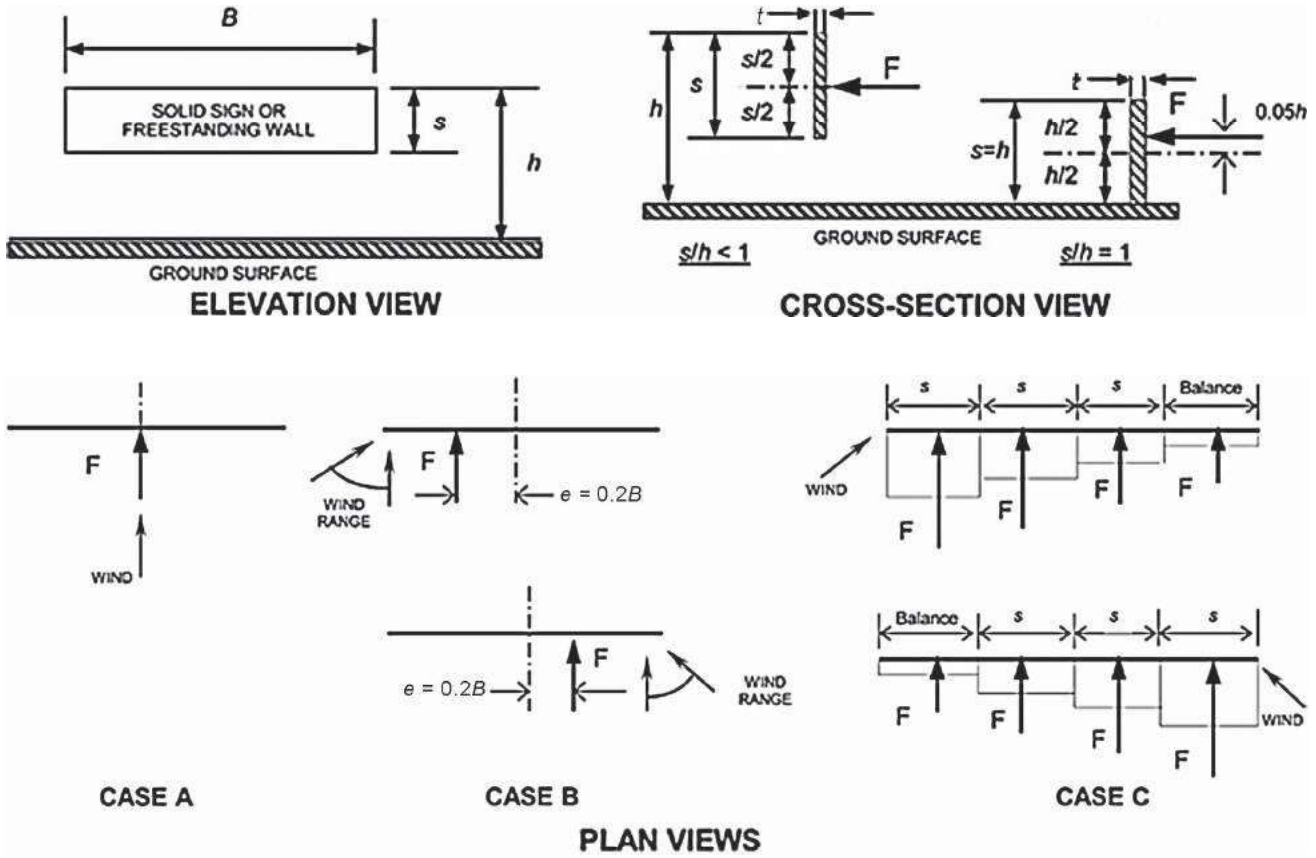


Table 24
RECTANGULAR TUBES

Designation	Width b in.	Depth d in.	Thickness t in.	Weight lb/ft	Area A in^2	Axis x-x I_x in^4	Axis x-x S_x in^3	Axis x-x r_x in.	Axis y-y I_y in^4	Axis y-y S_y in^3	Axis y-y r_y in.	J in^4
RT 1 × 1 1/2 × 1/8	1.000	1.500	0.125	0.662	0.563	0.159	0.212	0.532	0.0811	0.162	0.380	0.161
RT 1 × 2 × 1/8	1.000	2.000	0.125	0.809	0.688	0.332	0.332	0.695	0.105	0.210	0.391	0.245
RT 1 × 2 1/2 × 1/8	1.000	2.500	0.125	0.956	0.813	0.590	0.472	0.852	0.129	0.258	0.399	0.332
RT 1 × 3 × 1/8	1.000	3.000	0.125	1.10	0.938	0.950	0.633	1.01	0.153	0.307	0.404	0.422
RT 1 × 4 × 1/8	1.000	4.000	0.125	1.40	1.19	2.04	1.02	1.31	0.201	0.403	0.412	0.605
RT 1 1/4 × 2 × 1/8	1.250	2.000	0.125	0.882	0.750	0.387	0.387	0.718	0.180	0.288	0.489	0.371
RT 1 1/4 × 2 1/2 × 1/8	1.250	2.500	0.125	1.03	0.875	0.678	0.543	0.881	0.219	0.351	0.501	0.510
RT 1 1/4 × 3 × 1/8	1.250	3.000	0.125	1.18	1.00	1.08	0.720	1.04	0.259	0.415	0.509	0.654
RT 1 1/2 × 1 3/4 × 1/8	1.500	1.750	0.125	0.882	0.750	0.318	0.364	0.652	0.248	0.331	0.575	0.416
RT 1 1/2 × 2 × 1/8	1.500	2.000	0.125	0.956	0.813	0.442	0.442	0.737	0.278	0.370	0.585	0.511
RT 1 1/2 × 2 × 1/4	1.500	2.000	0.250	1.76	1.50	0.719	0.719	0.692	0.438	0.583	0.540	0.798
RT 1 1/2 × 2 1/2 × 1/8	1.500	2.500	0.125	1.10	0.938	0.767	0.613	0.904	0.337	0.449	0.599	0.711
RT 1 1/2 × 3 × 1/8	1.500	3.000	0.125	1.25	1.06	1.21	0.806	1.07	0.396	0.528	0.611	0.919
RT 1 1/2 × 3 × 3/16	1.500	3.000	0.188	1.82	1.55	1.68	1.12	1.04	0.533	0.711	0.586	1.24
RT 1 1/2 × 4 × 1/8	1.500	4.000	0.125	1.54	1.31	2.51	1.25	1.38	0.515	0.686	0.626	1.35
RT 1 1/2 × 6 × 1/8	1.500	6.000	0.125	2.13	1.81	7.20	2.40	1.99	0.752	1.00	0.644	2.25
RT 1 3/4 × 2 × 1/8	1.750	2.000	0.125	1.03	0.875	0.497	0.497	0.753	0.401	0.458	0.677	0.663
RT 1 3/4 × 2 1/4 × 1/8	1.750	2.250	0.125	1.10	0.938	0.661	0.588	0.840	0.442	0.506	0.687	0.795
RT 1 3/4 × 2 1/2 × 1/8	1.750	2.500	0.125	1.18	1.00	0.855	0.684	0.925	0.484	0.553	0.696	0.931
RT 1 3/4 × 2 3/4 × 1/8	1.750	2.750	0.125	1.25	1.06	1.08	0.785	1.01	0.525	0.600	0.703	1.07
RT 1 3/4 × 3 × 1/8	1.750	3.000	0.125	1.32	1.13	1.34	0.892	1.09	0.566	0.647	0.710	1.21
RT 1 3/4 × 3 1/2 × 1/8	1.750	3.500	0.125	1.47	1.25	1.96	1.12	1.25	0.649	0.742	0.721	1.50
RT 1 3/4 × 4 × 1/8	1.750	4.000	0.125	1.62	1.38	2.74	1.37	1.41	0.732	0.836	0.730	1.80
RT 1 3/4 × 4 1/2 × 1/8	1.750	4.500	0.125	1.76	1.50	3.69	1.64	1.57	0.814	0.931	0.737	2.11
RT 1 3/4 × 5 × 1/8	1.750	5.000	0.125	1.91	1.63	4.83	1.93	1.72	0.897	1.03	0.743	2.41
RT 1 3/4 × 5 × 3/16	1.750	5.000	0.188	2.82	2.40	6.91	2.76	1.70	1.23	1.41	0.717	3.33
RT 1 3/4 × 6 × 1/8	1.750	6.000	0.125	2.21	1.88	7.74	2.58	2.03	1.06	1.21	0.753	3.04

Diagrams



Notation

B = Horizontal dimension of wall or sign, ft (m)
e = Eccentricity of force, ft (m)
F = Design wind force for other structures, lb (N)
h = Height of the wall or sign, ft (m)
L_r = Horizontal dimension of return corner, ft (m)
R_{min} = t/min (B and s)
R_{max} = t/max (B and s)
s = Vertical dimension of the wall or sign, ft (m)
t = Thickness of the wall or sign, ft (m)
ε = Ratio of solid area to gross area

Force Coefficients, C_f, for Case A and Case B

Clearance Ratio, s/h	Aspect Ratio, B/s											
	≤0.05	0.1	0.2	0.5	1	2	4	5	10	20	30	≥45
1	1.80	1.70	1.65	1.55	1.45	1.40	1.35	1.35	1.30	1.30	1.30	1.30
0.9	1.85	1.75	1.70	1.60	1.55	1.50	1.45	1.45	1.40	1.40	1.40	1.40
0.7	1.90	1.85	1.75	1.70	1.65	1.60	1.60	1.55	1.55	1.55	1.55	1.55
0.5	1.95	1.85	1.80	1.75	1.75	1.70	1.70	1.70	1.70	1.70	1.70	1.75
0.3	1.95	1.90	1.85	1.80	1.80	1.80	1.80	1.80	1.80	1.85	1.85	1.85
0.2	1.95	1.90	1.85	1.80	1.80	1.80	1.80	1.80	1.85	1.90	1.90	1.95
≤0.16	1.95	1.90	1.85	1.85	1.80	1.80	1.85	1.85	1.85	1.90	1.90	1.95

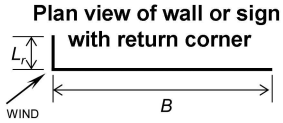
Figure 29.3-1. Design wind loads (all heights): force coefficients, C_f, for other structures—solid freestanding walls and solid freestanding signs.

Force Coefficients, C_f, for Case C

Region (horizontal distance from windward edge)	Aspect Ratio, B/s										
	2	3	4	5	6	7	8	9	10	13	≥45
0 to s	2.25	2.60	2.90	3.10*	3.30*	3.40*	3.55*	3.65*	3.75*	4.00*	4.30*
s to $2s$	1.50	1.70	1.90	2.00	2.15	2.25	2.30	2.35	2.45	2.60	2.55
$2s$ to $3s$		1.15	1.30	1.45	1.55	1.65	1.70	1.75	1.85	2.00	1.95
$3s$ to $10s$			1.10	1.05	1.05	1.05	1.05	1.00	0.95		
$3s$ to $4s$										1.50	1.85
$4s$ to $5s$										1.35	1.85
$5s$ to $10s$										0.90	1.10
$>10s$										0.55	0.55

*Values shall be multiplied by the following reduction factor when a return corner is present:

L_r/S	*Reduction Factor*
0.3	0.90
1.0	0.75
≥2	0.60



Notes

1. Force coefficients for solid walls or signs with openings less than 30% of gross area shall be permitted to be multiplied by the reduction factor $(1 - (1 - \varepsilon)^{1.5})$.
2. To allow for both normal and oblique wind directions, the following cases shall be considered:
   For $s/h < 1$:
   Case A: Resultant force acts normal to the face of the wall or sign through the geometric center.
   Case B: Resultant force acts normal to the face of the wall or sign at a distance from the geometric center toward the windward edge equal to 0.2 times the average width of the wall or sign.
   For double-faced signs with all sides enclosed and $R_{max} \leq 0.4$, it is permitted to use force eccentricity, $e = (0.2 - 0.25R_{max})B$. For double-faced signs with all sides enclosed and $R_{min} \leq 0.75$, it is permitted to multiply tabulated C_f values in Cases A and B by the reduction factor, $(1 - 0.133R_{min})$.
   For $B/s \geq 2$, Case B need not be considered, while Case C must be considered;
   Case C: Resultant forces act normal to the face of the wall or sign through the geometric centers of each region.
   For $s/h = 1$:
   The same cases as above except that the vertical locations of the resultant forces occur at a distance above the geometric center equal to 0.05 times the average height of the wall or sign.
3. For Case C where $s/h > 0.8$, for efficients shall be multiplied by the reduction factor $(1.8 - s/h)$. It is permitted to apply this reduction with those specified in Note 2.
4. Linear interpolation is permitted for values of s/h, B/s, and L_r/s other than shown.

Figure 29.3-1 (*Continued*). Design wind loads (all heights): force coefficients, C_f, for other structures—solid freestanding walls and solid freestanding signs.

$$q_z = 0.00256 K_z K_{zt} K_e V^2 (\text{lb/ft}^2);\ V, \text{mi/h} \qquad (26.10\text{-}1)$$

$$q_z = 0.613 K_z K_{zt} K_e V^2 (\text{N/m}^2);\ V, \text{m/s} \qquad (26.10\text{-}1.\text{SI})$$

where

K_z = Velocity pressure exposure coefficient, see Section 26.10.1;
K_{zt} = Topographic factor, see Section 26.8.2;
K_e = Ground elevation factor, see Section 26.9;
V = Basic wind speed, see Section 26.5; and
q_z = Velocity pressure at height z.

The velocity pressure at mean roof height is computed as $q_h = q_z$ evaluated from Equation (26.10-1) using K_z at mean roof height h.

The basic wind speed, V, used in determination of design wind loads on rooftop structures, rooftop equipment, and other building appurtenances shall consider the Risk Category equal to the greater of the following:

1. Risk category for the building on which the equipment or appurtenance is located, or
2. Risk category for any building or other structure to which the equipment or appurtenance provides a necessary service.

26.11 GUST EFFECTS

26.11.1 Gust-Effect Factor The gust-effect factor for a rigid building or other structure is permitted to be taken as 0.85.

26.11.2 Frequency Determination To determine whether a building or other structure is rigid or flexible as defined in Section 26.2, the fundamental natural frequency, n_1, shall be established using the structural properties and deformational characteristics of the resisting elements in a properly substantiated analysis. Low-rise buildings, as defined in Section 26.2, are permitted to be considered rigid.

26.11.2.1 Limitations for Approximate Natural Frequency As an alternative to performing an analysis to determine n_1, the approximate building natural frequency, n_a, shall be permitted to be calculated in accordance with Section 26.11.3 for structural steel, concrete, or masonry buildings meeting the following requirements:

1. The building height is less than or equal to 300 ft (91 m).
2. The building height is less than four times its effective length, L_{eff}.

The effective length, L_{eff}, in the direction under consideration shall be determined from the following equation:

$$L_{\text{eff}} = \frac{\sum_{i=1}^{n} h_i L_i}{\sum_{i=1}^{n} h_i} \qquad (26.11\text{-}1)$$

The summations are over the height of the building, where h_i is the height above grade of level i, and L_i is the building length at level i parallel to the wind direction.

26.11.3 Approximate Natural Frequency The approximate lower bound natural frequency (n_a), in Hz, of concrete or structural steel buildings meeting the conditions of Section 26.11.2.1 is permitted to be determined from one of the following equations.

For structural steel moment-resisting frame buildings,

$$n_a = 22.2/h^{0.8} \qquad (26.11\text{-}2)$$

$$n_a = 8.58/h^{0.8} \qquad (26.11\text{-}2.\text{SI})$$

For concrete moment-resisting frame buildings,

$$n_a = 43.5/h^{0.9} \qquad (26.11\text{-}3)$$

$$n_a = 14.93/h^{0.9} \qquad (26.11\text{-}3.\text{SI})$$

Table 26.10-1. Velocity Pressure Exposure Coefficients, K_h and K_z.

Height above Ground Level, z or h		Exposure		
ft	m	B	C	D
0–15	0–4.6	0.57 (0.70)*	0.85	1.03
20	6.1	0.62 (0.70)*	0.90	1.08
25	7.6	0.66 (0.70)*	0.94	1.12
30	9.1	0.70	0.98	1.16
40	12.2	0.74	1.04	1.22
50	15.2	0.79	1.09	1.27
60	18.3	0.83	1.13	1.31
70	21.3	0.86	1.17	1.34
80	24.4	0.90	1.21	1.38
90	27.4	0.92	1.24	1.40
100	30.5	0.95	1.26	1.43
120	36.6	1.00	1.31	1.48
140	42.7	1.04	1.34	1.52
160	48.8	1.08	1.39	1.55
180	54.9	1.11	1.41	1.58
200	61.0	1.14	1.44	1.61
250	76.2	1.21	1.51	1.68
300	91.4	1.27	1.57	1.73
350	106.7	1.33	1.62	1.78
400	121.9	1.38	1.66	1.82
450	137.2	1.42	1.70	1.86
500	152.4	1.46	1.74	1.89

* Use 0.70 in Chapter 28, Exposure B, when $z < 30$ ft (9.1 m).

Notes:

1. Velocity pressure exposure coefficient K_z may be determined from the following formula:

For $z < 15$ ft	$K_z = 2.41\,(15/z_g)^{2/\alpha}$
For $z < 4.6$ m	$K_z = 2.41\,(4.6/z_g)^{2/\alpha}$
For 15 ft (4.6 m) $\le z \le z_g$	$K_z = 2.41\,(z/z_g)^{2/\alpha}$
For $z_g < z \le$ 3,280 ft (1,000 m)	$K_z = 2.41$

2. α and z_g are tabulated in Table 26.11-1.
3. Linear interpolation for intermediate values of height z is acceptable.
4. Exposure categories are defined in Section 26.7.

Table 2-19
ALLOWABLE STRESSES F/Ω FOR BUILDING-TYPE STRUCTURES (UNWELDED)

Allowable Stresses F/Ω (k/in^2)	Section	F/Ω
Axial Tension		
axial tension stress on net effective area	D.2b	19.5
axial tension stress on gross area	D.2a	21.2
Shear or torsion		
Shear or torsion rupture	G, H.2	11.7
Bearing		
bolts or rivets on holes	J.3.6a, J.4.6	39.0
bolts on slots, pins on holes, flat surfaces	J.3.6b, J.6.5, J.8	25.9
screws in holes	J.5.5.1	25.3

6061 - T6 ASTM B221, B241, B429
6061 - T6510 ASTM B221
6061 - T6511 ASTM B221
6061 - T6 ASTM B247 0.000 to 4.000 in. thick
6061 - T6 ASTM B308 0.062 in. thick and greater
6351 - T5 ASTM B221 0.000 to 1.000 in. thick

F_{ty} = 35 k/in^2 E = 10,100 k/in^2
F_{cy} = 35 k/in^2 k_t = 1
F_{tu} = 38 k/in^2

		Slenderness λ	F/Ω for $\lambda \le \lambda_1$	λ_1	F/Ω for $\lambda_1 < \lambda < \lambda_2$	λ_2	F/Ω for $\lambda \ge \lambda_2$
Axial Compression							
member buckling	E.2	kL/r	21.2	17.8	0.00047 λ^2 - 0.232 λ + 25.2	66	51,352 /λ^2
Flexure							
lateral-torsional buckling	F.4	see F.4.2		-	see F.4	66	60,414 /λ^2
Elements - Uniform Compression							
flat elements supported on one edge in columns whose buckling axis is not an axis of symmetry	B.5.4.1	b/t	21.2	6.7	27.3 - 0.910 λ	12	2,417 /λ^2
flat elements supported on one edge in all other columns and all beams	B.5.4.1	b/t	21.2	6.7	27.3 - 0.910 λ	10.5	186 /λ
flat elements supported on both edges	B.5.4.2	b/t	21.2	20.8	27.3 - 0.291 λ	33	580 /λ
flat elements supported on both edges and with an intermediate stiffener	B.5.4.4	λ_s	21.2	17.8	23.9 - 0.149 λ	66	60,414 /λ^2
round hollow elements	B.5.4.5	$(R_b/t)^{1/2}$	21.2	5.3	26.2 - 0.944 λ	11.9	3,776 /[$\lambda^2(1+\lambda/35)^2$]
flat elements - direct strength method	B.5.4.6	λ_{eg}	21.2	33.3	27.3 - 0.182 λ	52	928 /λ
Elements - Flexural Compression							
flat elements supported on both edges	B.5.5.1	b/t	31.8	33.1	40.5 - 0.262 λ	77	1,563 /λ
flat elements supported on tension edge, compression edge free	B.5.5.2	b/t	31.8	6.1	40.5 - 1.412 λ	19	4,932 /λ^2
flat elements supported on both edges and with a longitudinal stiffener	B.5.5.3	b/t	31.8	74.2	40.5 - 0.117 λ	173	3,502 /λ
round hollow elements	B.5.5.4	$(R_b/t)^{1/2}$	39.3 - 2.70 λ	7.4	26.2 - 0.944 λ	11.9	3,776 /[$\lambda^2(1+\lambda/35)^2$]
flat elements - direct strength method	B.5.5.5	λ_{eg}	31.8	21.5	40.5 - 0.403 λ	50	1,016 /λ
Elements - Shear							
flat elements supported on both edges	G.2	b/t	12.7	35.3	16.5 - 0.107 λ	63	38,665 /λ^2
flat elements supported on one edge	G.3	b/t	12.7	14.7	16.5 - 0.257 λ	26	6,713 /λ^2
pipes and round or oval tubes	G.4	$2.9(R_b/t)^{5/8}(L_v/R_b)^{1/4}$	12.7	62.5	21.5 - 0.140 λ	63	50,264 /λ^2
Torsion							
pipes and round or oval tubes	H.2.1	$2.9(R_b/t)^{5/8}(L_s/R_b)^{1/4}$	12.7	35.3	16.5 - 0.107 λ	63	38,665 /λ^2

Table 2-19W
ALLOWABLE STRESSES F/Ω FOR BUILDING-TYPE STRUCTURES (WELDED)

6061 - T6	**ASTM B221, B241, B429**	
6061 - T6510	**ASTM B221**	
6061 - T6511	**ASTM B221**	
6061 - T6	**ASTM B247 0.000 to 4.000 thick**	
6061 - T6	**ASTM B308 0.062 thick and greater**	
6351 - T5	**ASTM B221 0.000 to 1.000 in. thick**	
F_{tyw} =	15 k/in^2	E = 10,100 k/in^2
F_{cyw} =	15 k/in^2	k_t = 1
F_{tuw} =	24 k/in^2	

Allowable Stresses F/Ω (k/in^2)	Section	F/Ω
Axial Tension		
axial tension stress on net effective area	D.2b	12.3
axial tension stress on gross area	D.2a	9.1
Shear or torsion		
Shear or torsion rupture	G, H.2	7.4
Bearing		
bolts or rivets on holes	J.3.6a, J.4.6	24.6
bolts on slots, pins on holes, flat surfaces	J.3.6b, J.6.5, J.8	16.4
screws in holes	J.5.5.1	16.0

		Slenderness λ	F/Ω for $\lambda \le \lambda_1$	λ_1	F/Ω for $\lambda_1 < \lambda < \lambda_2$	λ_2	F/Ω for $\lambda \ge \lambda_2$
Axial Compression							
member buckling	E.2	kL/r	9.1	21.8	$0.00007\,\lambda^2 - 0.066\,\lambda + 10.5$	133	$51{,}352/\lambda^2$
Flexure							
lateral-torsional buckling	F.4	see F.4.2		-	see F.4	133	$60{,}414/\lambda^2$
Elements - Uniform Compression							
flat elements supported on one edge in columns whose buckling axis is not an axis of symmetry	B.5.4.1	b/t	9.1	9.0	$12.0 - 0.327\,\lambda$	25	$2{,}417/\lambda^2$
flat elements supported on one edge in all other columns and all beams	B.5.4.1	b/t	9.1	9.0	$12.0 - 0.327\,\lambda$	18.4	$111/\lambda$
flat elements supported on both edges	B.5.4.2	b/t	9.1	28.2	$12.0 - 0.105\,\lambda$	58	$346/\lambda$
flat elements supported on both edges and with an intermediate stiffener	B.5.4.4	λ_s	9.1	21.8	$10.2 - 0.051\,\lambda$	133	$60{,}414/\lambda^2$
round hollow elements	B.5.4.5	$(R_b/t)^{1/2}$	9.1	6.8	$11.8 - 0.396\,\lambda$	20	$3{,}776/[\lambda^2(1+\lambda/35)^2]$
flat elements - direct strength method	B.5.4.6	λ_{eq}	9.1	45.1	$12.0 - 0.065\,\lambda$	92	$554/\lambda$
Elements - Flexural Compression							
flat elements supported on both edges	B.5.5.1	b/t	13.6	36.2	$16.0 - 0.065\,\lambda$	123	$982/\lambda$
flat elements supported on tension edge, compression edge free	B.5.5.2	b/t	13.6	6.7	$16.0 - 0.350\,\lambda$	30	$4{,}932/\lambda^2$
flat elements supported on both edges and with a longitudinal stiffener	B.5.5.3	b/t	13.6	81.2	$16.0 - 0.029\,\lambda$	275	$2{,}201/\lambda$
round hollow elements	B.5.5.4	$(R_b/t)^{1/2}$	$17.7 - 0.933\,\lambda$	11.0	$11.8 - 0.396\,\lambda$	20	$3{,}776/[\lambda^2(1+\lambda/35)^2]$
flat elements - direct strength method	B.5.5.5	λ_{eq}	13.6	23.5	$16.0 - 0.100\,\lambda$	80	$638/\lambda$
Elements - Shear							
flat elements supported on both edges	G.2	b/t	5.5	47.5	$7.3 - 0.038\,\lambda$	126	$38{,}665/\lambda^2$
flat elements supported on one edge	G.3	b/t	5.5	19.8	$7.3 - 0.092\,\lambda$	53	$6{,}713/\lambda^2$
pipes and round or oval tubes	G.4	$2.9(R_b/t)^{5/8}(L_v/R_b)^{1/4}$	5.5	80.0	$9.5 - 0.050\,\lambda$	126	$50{,}264/\lambda^2$
Torsion							
pipes and round or oval tubes	H.2.1	$2.9(R_b/t)^{5/8}(L_s/R_b)^{1/4}$	5.5	47.5	$7.3 - 0.038\,\lambda$	126	$38{,}665/\lambda^2$