ADVANCED MANUFACTURING & POWER SYSTEMS INC.
1965 BENNETT DRIVE, DELAND, FL 32724
PHONE: 386.822.5565 FAX: 386.822.9669

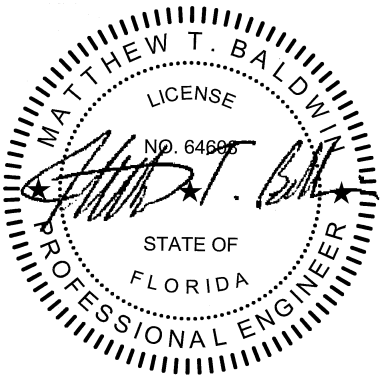
ENGINEERING STRUCTURAL WIND CALCULATIONS
For
Gillette 100-400KW 132" Frame Genset

July 14, 2016

132" LG Frame Genset Models:

PR-1000	**SP-2000**	**SPMD-2500**	**SPVD-2500**	**T4D-1000**
PR-1300		**SPMD-2800**	**SPVD-3000**	**T4D-1500**
PR-1800		**SPMD-3000**	**SPVD-3500**	**T4D-2000**
			SPVD-4000	

Designed with reference from: **2014 Florida Building Code**
ASCE 7 - Minimum Design Loads for Buildings and Other Structures
2005 Aluminum Association Design Manual
ANSI/AISC 360-05 Specifications for Structural Steel Buildings



Matthew T. Baldwin, P.E.
Florida License #64608

Project Information

Project Name/Model #	-	Gillette 100-400KW 132" Frame Genset
Project Number	-	
Project Description	-	180mph Windload Calculations
Project Location	-	
Customer	-	
Mounting Location	-	Ground

Enclosure Materials

Roof Beam	-	0.062 Aluminum Truss - 5052-H34
Roof Panels	-	0.080 Aluminum Panel - 5052-H34
Wall Panels	-	0.080 Aluminum Panel - 5052-H34

Components

GenSet Manufacturer	-	Gillette Generators, Inc.		
GenSet Size and Model	-	100-400 KW - 132" Frame	Supported by -	Base
Base	-	Bent Steel Frame		

Fasteners/Hardware

		Bolt Size			Grade/Finish
Panels	-	5/16" - 18			Grade 18-8/SS
Enclosure to Base	-	5/16" - 18			Grade 18-8/SS

Specification Requirements

Wind Speed	-	180	mph (Greater of Design or Site)
Exposure Category	-	D	

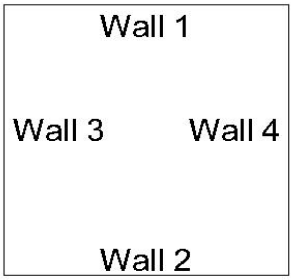
MATTHEW T. BALDWIN
LICENSE
NO. 64608
STATE OF
FLORIDA
PROFESSIONAL ENGINEER

Matthew T. Baldwin, P.E.
Florida License #64608

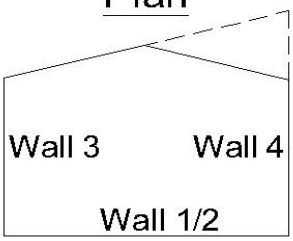
Enclosure Dimensions & Component Weights

Gillette 100-400KW 132" Frame Genset

Roof Style- Flat



Plan



Elevation

Enclosure Dimensions (ft)

Wall	Length (ft)		Height (ft)
1	4.33	x	6.021
2	4.33	x	6.021
3	14.5	x	6.021
4	14.5	x	6.021

Base Dimensions

Width (Wall 1/2 Side)	=	52	in
Length (Wall 3/4 Side)	=	132	in
Height	=	8	in

Roof/Eave Information

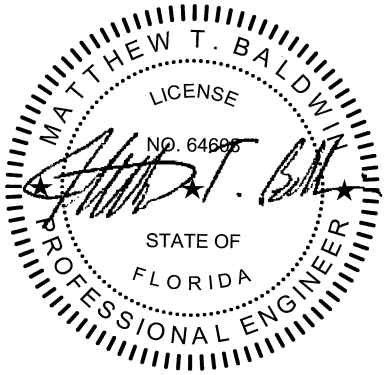
Roof Pitch Angle -	*(θ)*	=	0.0	Degrees
Eave/Roof Height -	*h*	=	6.021	

Structure Areas

Walls 1/2 Area -	*(w1)*	=	26.1	ft^2 =	3,754	in^2
Walls 3/4 Area -	*(w3)*	=	87.3	ft^2 =	12,572	in^2
Roof Area -	*(R)*	=	62.8	ft^2 =	9,041	in^2
Base Side 1/2	*(T1)*	=	416.0	in2		
Base Side 3/4	*(T3)*	=	1,056.0	in2		

Component Weights

Genset	=	4,765	lbs
Enclosure	=	1,270	lbs
Base Frame	=	400	lbs



Matthew T. Baldwin, P.E.
Florida License #64608

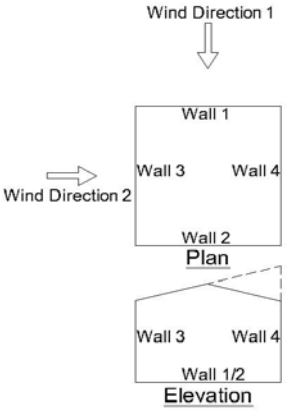
MWFRS Net Pressures

Gillette 100-400KW 132" Frame Genset

Wind

Directional Procedure method from
ASCE 7 are utilized in these calculations.

Enclosure Classification	-	Enclosed	
Exposure Category	-	D	
Basic Wind Speed	(V)	180	mph
Wind Directionality Factors	(K_d)	0.85	
Internal Pressure Coefficients	(GC_{pi})	± 0.18	
Velocity Pressure Exposure Coefficient	(K_z)	1.03	
Roof Mean Height Above Ground Level	(z)	6.69	ft
Velocity Pressure	(q)	72.63	psf



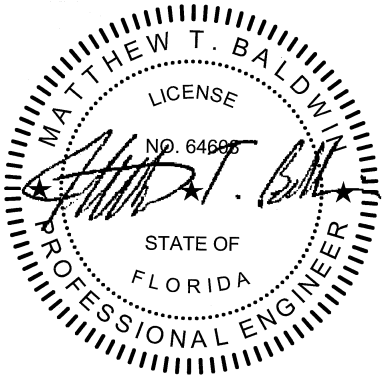
Wind Direction 1

		Enclosure							
		Wall #			Roof				
		1	2	3&4	Parallel to Ridge				
					$(C_p)1$ (Distance From Windward Edge)				$(C_p)2$
		Windward	Leeward	Side	0 to 3.0	3.0 to 6.0	6.0 to 12.0	> 12.0	
Background Response Factor	(Q)	0.97	0.97	0.96	0.97				
Gust Effect Factors	(G)	0.91	0.91	0.91	0.91				
External Pressure Coefficients	(C_p)	0.80	-0.233	-0.70	-0.90	-0.90	-0.50	-0.3	-0.18
Net Pressures with + (GC_{pi}) - psf	(Net_{p+})	39.9	-28.5	-59.1	-72.7	-72.7	-46.2	-33.0	-25.0
Net Pressures with - (GC_{pi}) - psf	(Net_{p-})	66.1	-2.3	-33.0	-46.6	-46.6	-20.1	-6.8	1.1

Wind Direction 2

		Enclosure								
		Wall #			Roof - Normal To Ridge					
		3	4	1&2						
					$(C_p)1$ (Distance From Windward Edge)				$(C_p)2$	
		Windward	Leeward	Side	0 to 3.0	> 3.0				
Background Response Factor	(Q)	0.96	0.96	0.97	0.96					
Gust Effect Factors	(G)	0.91	0.91	0.91	0.91					
External Pressure Coefficients	(C_p)	0.80	-0.5	-0.70	-1.04	-0.70			-0.18	
Net Pressures with + (GC_{pi}) - psf	(Net_{p+})	39.6	-46.0	-59.5	-81.5	-59.1			-24.9	
Net Pressures with - (GC_{pi}) - psf	(Net_{p-})	65.7	-19.8	-33.3	-55.4	-33.0			1.2	

Plus and minus signs signify pressures acting toward or away from the surfaces, respectively.



Matthew T. Baldwin, P.E.
Florida License #64608

Structural Calculations - Roof

Gillette 100-400KW 132" Frame Genset

Critical Loads & Pressures

Wind Pressures

Downforce	1.228	psf	=	0.01 psi
Uplift	-81.52	psf	=	-0.57 psi

Section Properties

0.062 Aluminum Truss - 5052-H34

Cross Sectional Area	(A)	=	0.30 in^2
Moment of Inertia - x	(I_x)	=	0.27 in^4
Moment of Inertia - y	(I_y)	=	N/A in^4
Section Modulus - x	(S_x)	=	0.31 in^3
Section Modulus - y	(S_y)	=	N/A in^3
Radius of Gyration - x	(r_x)	=	0.94 in
Radius of Gyration - y	(r_y)	=	N/A in
Polar Moment of Inertia	(J)	=	N/A in^4
Weight of Beam	(ω)	=	0.03 lbs/in
Modulus of Elasticity	(E)	=	1.02E+04 ksi
Safety Factor	(n_u)	=	1.95
Safety Factor	(n_y)	=	1.65
Coefficient	(k_t)	=	1.00

Tensile Ultimate Strength	(F_{tu})	=	34 ksi
Tensile Yield Strength	(F_{ty})	=	26 ksi
Compressive Yield Strength	(F_{cy})	=	24 ksi
Shear Ultimate Strength	(F_{su})	=	20 ksi

Roof Frame Calculations

Member Designed for Forces Acting on the Strong Axis

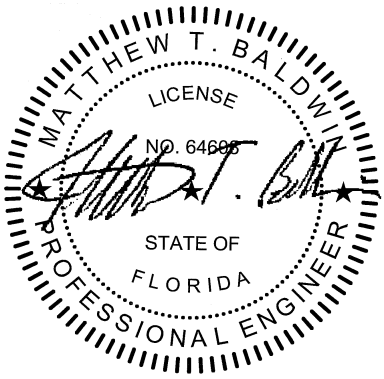
Interior Beam Critical Member Dimensions

Interior Beam Length	(L_i)	=	42.81 in
Load Spanned Width	(W_i)	=	36.19 in

Interior Beam Calculated Forces

Distributed Loads

Weight of Beam	(ω)	=	0.029 lbs/in
Wind Load Downforce	(w_d)	=	0.309 lbs/in
Wind Load Uplift Force	(w_u)	=	-20.486 lbs/in



Matthew T. Baldwin, P.E.
Florida License #64608

Shear Forces (Maximum at End)

Beam Weight Shear	(V_b)	=	0.63	lbs
Wind DownForce Shear	(V_{wd})	=	6.6	lbs
Wind Uplift Shear	(V_{wu})	=	-438.5	lbs
Total Shear Downward		=	7.2	lbs
Total Shear Upward		=	437.9	lbs
Design Shear	(V_{bi})	=	437.9	lbs

Stress Forces (Bending)

Beam Weight Moment	(M_b)	=	4	lb·in
Wind Downforce Moment	(M_d)	=	35	lb·in
Wind Uplift Moment	(M_u)	=	-2,347	lb·in
Total Moments Downward		=	40	lb·in
Total Moments Upward		=	2,342	lb·in
Design Moment	(M_T)	=	2,342	lb·in
Design Stress	(σ_{bi})	=	7,590	psi

Interior Beam Design Calculations

Allowable Shear Strength

Slenderness Limit 1	(S_1)	=	28.54	
Slenderness Limit 2	(S_2)	=	102.40	
Slenderness Ratio	(S)	=	18.0	
Allowable Shear Stress		=	9,098	psi
Allowable Shear Strength	(V_n)	=	2,758	lbs

Conclusion

(V_{bi}) 438 lbs < (V_n) 2,758 lbs **OK**

Allowable Stresses For Tension And Compression (Bending)

Tension

Allowable Tensile Stress (F_t) = 16,000 psi

Compression

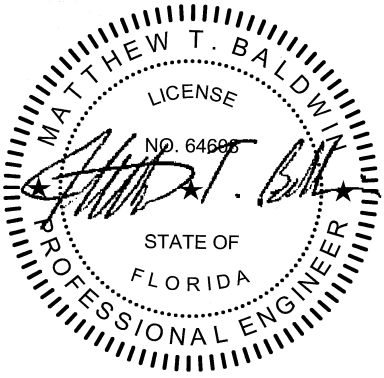
Slenderness Limit 1	(S_1)	=	25.0	
Slenderness Limit 2	(S_2)	=	125.0	
Slenderness Ratio	(S)	=	45.5	

Allowable Compressive Stress (F_c) = 12,755 psi

The Allowable Compressive Stress is the controlling failure design
Therefore, (F_b) = 12,755 psi strength.

Conclusion

(σ_{bi}) 7,590 psi < (F_b) 12,755 psi **OK**



Matthew T. Baldwin, P.E.
Florida License #64608

Entire Roof Uplift Calculations

Roof Area

Area of Roof Subjected to Uplift (R) = 9,041 in^2

Roof Uplift Calculated Forces

To be conservative, the weight of the roof frame and panels is neglected.

Weight of Accessories	(ω_a) =	0	lbs
Wind Load Uplift Force	(w_{ru}) =	-5,118	lbs
Total Roof Design Uplift	(W_{ru}) =	-3,071	lbs

Mounting Hardware - Roof Frame to Wall Panels

Screws Along Length - 1 Side	=	10	5/16" - 18	- Grade 18-8/SS
Screws Along Width - 1 Side	=	3	5/16" - 18	- Grade 18-8/SS
Total Mounting Screws	=	26	5/16" - 18	- Grade 18-8/SS

Entire Roof Uplift Design Calculations

Grade 18-8 Ultimate Strength	=	150,000	psi
5/16 Bolt Nominal Diameter	=	0.255	in
5/16 Bolt Effective Area	=	0.051	in^2
5/16 SBolt Threads per Inch	=	18	
Washer Nominal Diameter	=	0.875	in
Wall Panel Tensile Ult. Strength	=	34	ksi
Wall Panel Tensile Yield Strength	=	26	ksi
Safety Factor	=	3	
Wall Panel Nominal Thickness	=	0.080	in
Maximum Tensile Strength	=	566.7	lbs
Maximum Shear/Bearing Strength	=	408.6	lbs
Max. Tensile Load per Screw	=	408.6	lbs
Max. Total Screws Tensile Strength	(P_{ts}) =	10,623	lbs

Conclusion

(W_{ru}) 3,071 lbs < (P_{ts}) 10,623 lbs **OK**

Roof Panel Uplift Calculations

Roof Panel Critical Member Dimensions

Critical Panel Length	(L_p) =	73.38	in
Critical Panel Width	(W_p) =	52	in

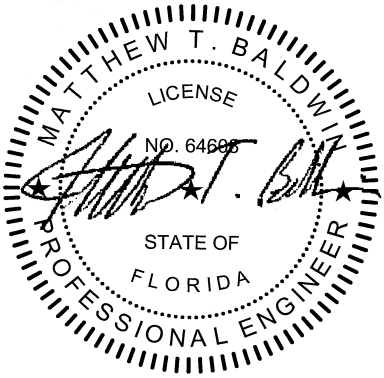
Roof Panel Uplift Calculated Forces

Distributed Loads

Wind Load Uplift Force (w_{pu}) = 1,296.0 lbs

Mounting Hardware - Roof Panel to Roof Frame

Screws Along Length - 1 Side	=	3	5/16" - 18	- Grade 18-8/SS
Screws Along Width - 1 Side	=	3	5/16" - 18	- Grade 18-8/SS



Matthew T. Baldwin, P.E.
Florida License #64608

Roof Panel Uplift Design Calculations

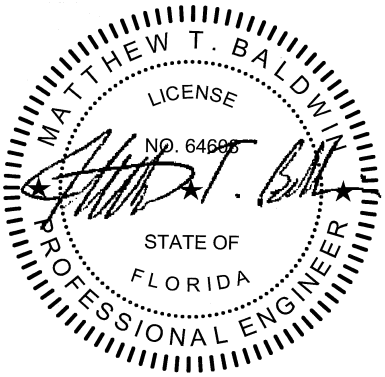
Grade 410 Ultimate Strength	=	150,000	psi
5/16 Bolt Nominal Diameter	=	0.255	in
5/16 Bolt Effective Area	=	0.051	in^2
5/16 Bolt Threads per Inch	=	18	
Washer Nominal Diameter	=	0.875	in
Roof Panel Tensile Ult. Strength	=	34	ksi
Roof Panel Tensile Yield Strength	=	26	ksi
Safety Factor	=	3	
Roof Panel Nominal Thickness	=	0.080	in

		Roof Frame		
Maximum Tensile Strength	=	566.7	lbs	(Accounts for screw pull-over strength)
Maximum Shear/Bearing Strength	=	408.6	lbs	
Max. Tensile Load per Screw	=	408.6	lbs	

Max. Total Screws Tensile Strength (P_{ts}) = 4,903 lbs

Conclusion

(w_{pu}) 1,296 lbs < (P_{ts}) 4,903 lbs **OK**



Matthew T. Baldwin, P.E.
Florida License #64608

Structural Calculations - Walls/Columns

Gillette 100-400KW 132" Frame Genset

Critical Wind Load Pressures and Roof Forces

Walls 1 & 2

Maximum Pressures Acting:

Toward	66.1	psf	=	0.4590	psi
Away	-59.5	psf	=	-0.4130	psi

Walls 3 & 4

Maximum Pressures Acting:

Toward	65.7	psf	=	0.4564	psi
Away	-59.1	psf	=	-0.4107	psi

Critical Wall Panel Dimensions

Critical/Maximum Panel Width	=	52	in
Critical/Maximum Panel Height	=	72.0	in

Section Properties

0.080 Aluminum Panel - 5052-H34

Cross Sectional Area	(A)	=	4.11	in^2
Moment of Inertia - x	(I_x)	=	0.05	in^4
Section Modulus - x	(S_x)	=	0.83	in^3
Radius of Gyration - x	(r_x)	=	0.11	in
Modulus of Elasticity	(E)	=	1.02E+04	ksi
Safety Factor	(n_u)	=	1.95	
Factor of Safety	(n_y)	=	1.65	
Coefficient - Tension Member	(k_t)	=	1.0	
Tensile Ultimate Strength	(F_{tu})	=	34	ksi
Tensile Yield Strength	(F_{ty})	=	26	ksi
Shear Ultimate Strength	(F_{su})	=	20	ksi
Compressive Yield Strength	(F_{cy})	=	24	ksi

Critical Wall Panel Calculated Forces

Maximum Wind Pressure on Walls

Maximum + Wind Pressure	=	0.4590	psi
Maximum - Wind Pressure	=	-0.4130	psi

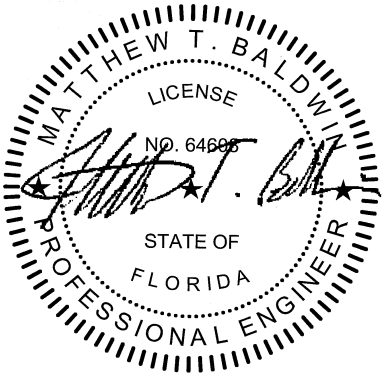
Plus and minus signs signify pressures acting toward or away from the surfaces, respectively.

Wind Shear Distributed Loads on Critical Panel

Maximum + Wind Shear	=	23.9	lbs/in
Maximum - Wind Shear	=	-21.5	lbs/in

Total Wind Shear on Critical Panel

Total Panel Design Shear	(V_{ww})	=	1,718.4	lbs



Matthew T. Baldwin, P.E.
Florida License #64608

Critical Panel Roof Load (Roof to Wall)

Axial Roof Load (W_{wr}) = 0.0 lbs

Mounting Hardware - Wall Panel to Wall Panel

To be conservative, the 'wall to roof' and 'wall to floor' connections are negleted.

Bolts Along Length - 1 Side = 4 5/16" - 18 - Grade 18-8/SS

Total Mounting Screws = 8 5/16" - 18 - Grade 18-8/SS

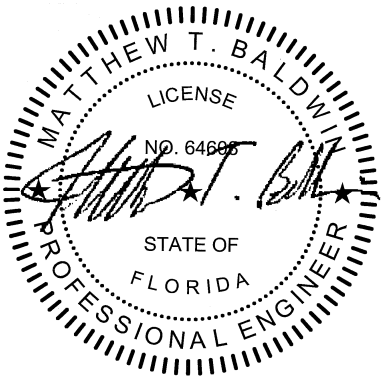
Wall Panel Design Calculations

Mounting Hardware - Shear and Tension

Grade 18-8/SS	=	150,000	psi	
Grade 18-8/SS Shear Strength	=	30,000	psi	(Includes Reduction Factor)
Grade 18-8/SS Tensile Strength	=	57,000	psi	(Includes Reduction Factor)
5/16" Bolt Effective Area	=	0.0510	in^2	
Shear Strength per Bolt	=	1,530	lbs	
Tensile Strength per Bolt	=	2,907	lbs	
Total Bolts Shear Strength (R_{vb})	=	12,240	lbs	
Total Bolts Tensile Strength (R_{tb})	=	23,256	lbs	

Conclusion

(V_{ww}) 1,718 lbs < (R_{vb}) 12,240 lbs **OK**



Matthew T. Baldwin, P.E.
Florida License #64608

Structural Calculations - Enclosure to Base/Tank or Pad

Gillette 100-400KW 132" Frame Genset

Critical Pressures & Loads

To determine maximum moment forces, pressures are algebraically combined relative to toward or away forces (+ & -) and each wind direction.

Wind Direction 1

Net Pressures with + Internal Pressure *(+Gcpi)*

Walls 1 & 2	-	68.4	psf =	0.4752	psi
Wall 3 or 4	-	59.1	psf =	0.4107	psi
Roof Uplift	-	72.7	psf =	0.5050	psi

Net Pressures with - Internal Pressure *(-Gcpi)*

Walls 1 & 2	-	68.4	psf =	0.4752	psi
Wall 3 or 4	-	33.0	psf =	0.2291	psi
Roof Uplift	-	46.6	psf =	0.3234	psi

Wind Direction 2

Net Pressures with + Internal Pressure *(+Gcpi)*

Walls 3 & 4	-	85.6	psf =	0.5941	psi
Wall 1 or 2	-	59.5	psf =	0.4130	psi
Roof Uplift	-	81.5	psf =	0.5661	psi

Net Pressures with - Internal Pressure *(-Gcpi)*

Walls 3 & 4	-	85.6	psf =	0.5941	psi
Wall 1 or 2	-	33.3	psf =	0.2314	psi
Roof Uplift	-	55.4	psf =	0.3845	psi

Enclosure Critical Dimensions & Weights

Total Enclosure Weight		(W_t)	=	1,270	lbs	(Includes all components)
Walls 1/2 Area	-	*(w1)*	=	3754.2	in^2	
Walls 3/4 Area	-	*(w3)*	=	12571.8	in^2	
Roof Area	-	*(R)*	=	9041.0	in^2	

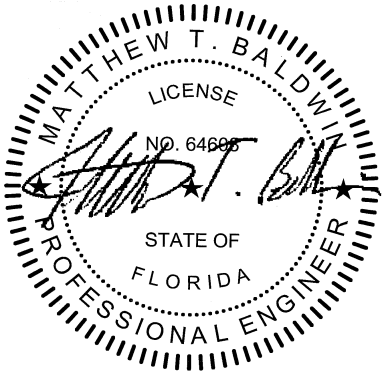
Enclosure Calculated Forces

Maximum Wind Load Forces on Walls

Wind Direction 1

Net Forces with + Internal Pressure *(+Gcpi)*

Walls 1/2	-	=	1,784	lbs
Wall 3 or 4	-	=	5,163	lbs
Roof Uplift	-	=	4,566	lbs



Matthew T. Baldwin, P.E.
Florida License #64608

Net Forces with - Internal Pressure*(-Gcpi)*

Walls 1/2	-	=	1,784	lbs
Wall 3 or 4	-	=	2,880	lbs
Roof Uplift	-	=	2,924	lbs

Wind Direction 2

Net Forces with + Internal Pressure*(+Gcpi)*

Walls 3/4	-	=	7,469	lbs
Wall 1 or 2	-	=	1,550	lbs
Roof Uplift	-	=	5,118	lbs

Net Forces with - Internal Pressure*(-Gcpi)*

Walls 3/4	-	=	7,469	lbs
Wall 1 or 2	-	=	869	lbs
Roof Uplift	-	=	3,476	lbs

Enclosure Overturn Forces

(Postive forces act upward, negative forces act downward)

Wind Direction 1

Net Forces with + Internal Pressure*(+Gcpi)*

Overturn on Walls 1/2	=	322	lbs
Overturn on Walls 3/4	=	2,254	lbs

Net Forces with - Internal Pressure*(-Gcpi)*

Overturn on Walls 1/2	=	-171	lbs
Overturn on Walls 3/4	=	809	lbs

Wind Direction 2

Net Forces with + Internal Pressure*(+Gcpi)*

Overturn on Walls 3/4	=	3,381	lbs
Overturn on Walls 1/2	=	1,094	lbs

Net Forces with - Internal Pressure*(-Gcpi)*

Overturn on Walls 3/4	=	2,889	lbs
Overturn on Walls 1/2	=	-119	lbs

Design Overturn Force (O_E) = 3,381 lbs Acting On Wall 3/4

Mounting Hardware - Enclosure to Base/Tank or Pad

To be conservative, half the bolt connections along the adjacent walls are neglected.

No. of Bolt Connections Along Wall 3/4 = 8 5/16" - 18 - Grade 18-8/SS

Enclosure Overturn Design Calculations

Grade 18-8 Ultimate Strength	=	150,000	psi
Grade 18-8 Shear Strength	=	30,000	psi (Includes Reduction Factor)
5/16" Bolt Effective Area	=	0.051	in^2
Shear Strength per Bolt	=	1,530	lbs

Total Bolts Shear Strength (R_{vb}) = 12,240 lbs

Conclusion

(O_E) 3,381 lbs < (R_v) 12,240 lbs **OK**

MATTHEW T. BALDWIN LICENSE NO. 64608 STATE OF FLORIDA PROFESSIONAL ENGINEER

Matthew T. Baldwin, P.E.
Florida License #64608