ADVANCED MANUFACTURING & POWER SYSTEMS INC.
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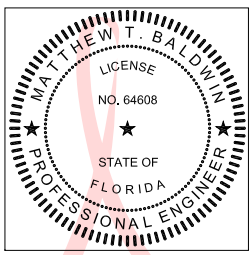
ENGINEERING STRUCTURAL CALCULATIONS
For
Gillette Generators - 246" Frame

February 24, 2020

SP-6500, SP-8000, PR-5400, & PR-6500

Location: Florida
AMPS Project Number: 20190166

Designed in compliance with: **2017 Florida Building Code, 6th Edition**
ASCE 7 - 10 Minimum Design Loads for Buildings and Other Structures
2015 Aluminum Association Design Manual
ANSI/AISC 360-10 - Specification for Structural Steel Buildings



2/24/2020

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Project Information

Project Name/Model #	- Gillette Generators - 246" Frame
Project Number	- 20190166
Project Description	- Sound Attenuated Generator Enclosure
Project Location	- Florida
	-
Mounting Location	- Ground

Enclosure Materials

Roof Bracing	- 11 Ga. Cold Rolled Steel Formed Channel
Roof Panels	- 14 Ga. Cold Rolled Steel Panel
Wall Panels	- 14 Ga. Cold Rolled Steel Panel
Base Frame	- 8 Ga. Cold Rolled Steel Formed Channel

Components

GenSet Manufacturer	- Gillette		
GenSet Size and Model	- SP-6500, SP-8000, PR-5400, & PR-6500	Supported by -	Base Frame
Base	- Steel		

Air Intake

Louvers

Exhaust

Plenum -

Fasteners/Hardware

		Bolt Size	Washer	Nut	Grade/Finish
Roof Panels	-	5/16"-18 SS Bolts	Flat Washers	Hex Nuts	Grade 18-8/SS
Walls Panels	-	5/16"-18 SS Bolts	Flat Washers	Hex Nuts	Grade 18-8/SS
	-				
Enclosure to Base	-	5/16"-18 SS Bolts	Flat Washers	Hex Nuts	Grade 18-8/SS
Base Frame to Pad	-	1/2" Set Bolt Anchors	Flat Washers	Hex Nuts	Grade 5/Galv.
	-				
	-				

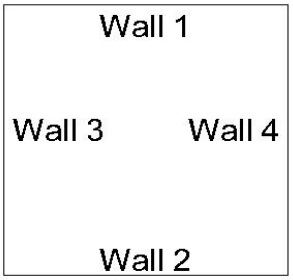
Specification Requirements

Wind Speed	- 180	mph (Greater of Design or Site)	
Exposure Category	- D		
Risk Category	- III		2/24/2020
Ground Snow Load (P_g Fig 7.1)	- 5	psf	
Ice Thickness (t Fig 10-2 to10-6)	- 0.25	in	
and Concurrent Wind Gust (V_c)	- 30	mph	Matthew T. Baldwin, P.E.
Seismic Site Class	B		Florida License #64608

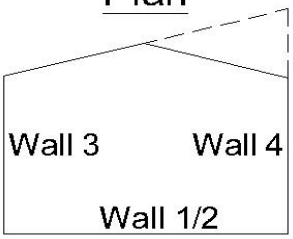
Enclosure Dimensions & Component Weights

Gillette Generators - 246" Frame

Roof Style- Flat



Plan



Elevation

Enclosure Dimensions (ft)

Wall	Length (ft)		Height (ft)
1	7.67	x	8.5625
2	7.67	x	8.5625
3	20.5	x	8.5625
4	20.5	x	8.5625

Base Dimensions

Width (Wall 1/2 Side)	=	92	in
Length (Wall 3/4 Side)	=	246	in
Height	=	8	in

Roof/Eave Information

Roof Pitch Angle - *(θ)*	=	0.0	Degrees
Eave/Roof Height - *h*	=	8.5625	

Structure Areas

Walls 1/2 Area -	*(w1)*	=	65.7	ft^2	=	9,457	in^2
Walls 3/4 Area -	*(w3)*	=	175.5	ft^2	=	25,277	in^2
Roof Area -	*(R)*	=	157.2	ft^2	=	22,642	in^2

Base Side 1/2	*(T1)*	=	736.0 in2
Base Side 3/4	*(T3)*	=	1,968.0 in2

Component Weights

Genset		=	4,540 lbs
Enclosure		=	11,300 lbs
		=	
Base		=	600 lbs

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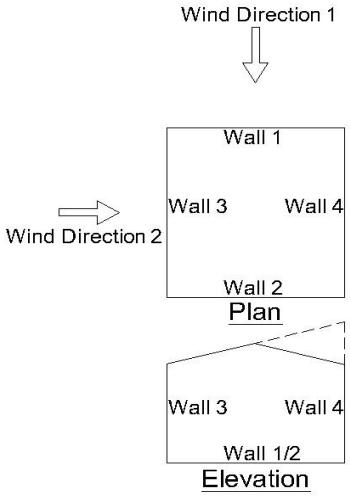
MWFRS Net Pressures

Gillette Generators - 246" Frame

Wind

Analytical Procedure method and Load Combinations from ASCE 7 are utilized in these calculations.

Enclosure Classification	-	Enclosed	
Exposure Category	-	D	
Basic Wind Speed	(V)	180	mph
Importance Factor (Wind)	(I_w)	1.15	
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)	9.23	ft
Velocity Pressure	(q)	83.53	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 4.3	4.3 to 8.6	8.6 to 17.1	> 17.1	
Background Response Factor	(Q)	0.97	0.97	0.95	0.97				
Gust Effect Factors	(G)	0.91	0.91	0.90	0.91				
External Pressure Coefficients	(C_p)	0.80	-0.266	-0.70	-0.90	-0.90	-0.50	-0.3	-0.18
Net Pressures with + (GC_{pi}) - psf	(Net_{p+})	45.7	-35.2	-67.8	-83.3	-83.3	-53.0	-37.8	-28.7
Net Pressures with - (GC_{pi}) - psf	(Net_{p-})	75.7	-5.2	-37.7	-53.3	-53.3	-22.9	-7.7	1.4

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 4.3	> 4.3				
Background Response Factor	(Q)	0.95	0.95	0.97	0.95					
Gust Effect Factors	(G)	0.90	0.90	0.91	0.90					
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+})	45.2	-52.7	-68.2	-93.4	-67.8			-28.6	
Net Pressures with - (GC_{pi}) - psf	(Net_{p-})	75.3	-22.6	-38.1	-63.3	-37.7			1.5	

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

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Snow

Importance Factor (Snow)	(I_s)	1.1	
Exposure Factor	(C_e)	0.8	
Thermal Factor	(C_t)	1.2	
Slope Factor	(C_s)	1.0	
Flat Roof Snow Load	(p_s)	10.5	psf

Seismic

Importance Factor (Seismic)	(I_{sm})	1.25		
Mapped Acceleration Parameter	(S_s)	0.1	Figures 22-1 Thru 22-14	
Mapped Acceleration Parameter	(S_1)	0.06	Figures 22-1 Thru 22-14	
Site Coefficient	(F_a)	1		
Site Coefficient	(F_v)	1		
MCE Spectral Resp. Accel. Short Per.	(S_{MS})	0.100		
MCE Spectral Resp. Accel. 1-s Period	(S_{M1})	0.06		
Design Spectral Accel. Short Period	(S_{DS})	0.067		
Design Spectral Accel. 1-s Period	(S_{D1})	0.04		
Fundamental Period of Structure	(T_a)	0.100	sec	
Long Period Transistion Period	(T_L)	8	sec	Figure 22-15 Thru 22-20
Seismic Design Category	-	A		
Total Effective Seismic Weight	(W_{eff})	19,708	lbs	
Response Modification Coeficient	(R)	2	Table 12.2-1	
System Overstrength Factor	(Ω_o)	2.5	Table 12.2-1	
Deflection Amplification Factor	(C_d)	2	Table 12.2-1	
Seismic Response Coefficient	(C_s)	0.042		

Resultant Seismic Forces

Horizontal Seismic Load Effect -	(E_h)		
Force at Base of Base Fram =	0.2	kips	
Force at Top of Base Fram =	0.2	kips	
Force at Top/Bottom of Enclosure =	0.113	kips	
Force on Silencer =	0	kips	
Vertical Seismic Load Effect (E_v) =	0	(Factor, Used With Deadweight in Load Combinations)	

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Structural Calculations - Roof

Gillette Generators - 246" Frame

Critical Loads & Pressures

Wind Pressures

Downforce	1.477	psf	=	0.01	psi
Uplift	-93.37	psf	=	-0.65	psi

Snow Pressure

11	psf	=	0.073	psi	

Seismic Load

Horizontal	=	113.0	lbs
Vertical Factor	=	0	

Roof Live Load

Downforce 20.0 psf = 0.1389 psi or 300 lbs Concentrated Load

Pressures & loads are the numerical maximums to be analyzed for shear, bending tension, and compression.

Section Properties

11 Ga. Cold Rolled Steel Formed Channel

Cross Sectional Area	(A)	=	1.88	in^2
Moment of Inertia - x	(I_x)	=	2.80	in^4
Moment of Inertia - y	(I_y)	=	N/A	in^4
Section Modulus - x	(S_x)	=	2.13	in^3
Section Modulus - y	(S_y)	=	N/A	in^3
Radius of Gyration - x	(r_x)	=	1.22	in
Radius of Gyration - y	(r_y)	=	N/A	in
Polar Moment of Inertia	(J)	=	4.68	in^4
Weight of Beam	(ω)	=	0.47	lbs/in
Modulus of Elasticity	(E)	=	2.90E+04	ksi
Safety Factor	(Ω)	=	1.67	
Plastic Section Mod. - x	(Z_x)	=	2.25	
Plastic Section Mod. - y	(Z_y)	=	1.85	

Tensile Ultimate Strength	(F_{tu})	=	58	ksi
Tensile Yield Strength	(F_{ty})	=	36	ksi
Compressive Yield Strength	(F_{cy})	=	22	ksi
Shear Ultimate Strength	(F_{su})	=	12	ksi

Roof Frame Calculations

Member Designed for Forces Acting on the Strong Axis

Interior Beam Critical Member Dimensions

Interior Beam Length	(L_i)	=	91.75	in
Load Spanned Width	(W_i)	=	64	in

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Interior Beam Calculated Forces

Distributed Loads

Weight of Beam	(ω)	=	0.468	lbs/in
Wind Load Downforce	(w_d)	=	0.657	lbs/in
Wind Load Uplift Force	(w_u)	=	-41.498	lbs/in
Roof Live Load	(L_r)	=	8.889	lbs/in
Snow Load	(S)	=	4.667	lbs/in

Roof Live Load	(L_r)	=	300.0	lbs

Shear Forces (Maximum at End)

Beam Weight Shear	(V_b)	=	21.45	lbs
Wind DownForce Shear	(V_{wd})	=	30.1	lbs
Wind Uplift Shear	(V_{wu})	=	-1903.7	lbs
Max. Live Load Shear	(V_{Lr})	=	407.8	lbs
Snow Load Shear	(V_S)	=	214.1	lbs
Seismic Load Shear	(V_E)	=	0.0	lbs
Total Shear Downward		=	429.2	lbs
Total Shear Upward		=	1,882.3	lbs
Design Shear	(V_{bi})	=	1882.3	lbs

Stress Forces (Bending)

Beam Weight Moment	(M_b)	=	328	lb·in
Wind Downforce Moment	(M_d)	=	461	lb·in
Wind Uplift Moment	(M_u)	=	-29,111	lb·in
Max. Live Load Moment	(M_{Lr})	=	6,236	lb·in
Snow Load Moment	(M_S)	=	3273.691	lb·in
Seismic Load Moment	(M_E)	=	0.0	lb·in
Total Moments Downward		=	6,564	lb·in
Total Moments Upward		=	-28,783	lb·in
Design Moment	(M_T)	=	28,783	lb·in
Design Stress	(σ_{bi})	=	13,526	psi

Interior Beam Design Calculations

Allowable Shear Strength	(V_n)	=	16,200	lbs
Design Shear Strength		=	9,701	lbs

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Conclusion

(V_{bi}) 1,882 lbs < (V_n) 9,701 lbs **OK**

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Allowable Stress For Flexure

Nominal Flexural Strength

Yielding (M_{ny})	=	81,000	lb·in
Flange Buckling (M_{nf})	=	76,608	lb·in
Web Buckling (M_{nw})	=	80,573	lb·in
Design Flexural Strength	=	45,873	lb·in
Design Flexural Stress (F_b)	=	21,557	psi

Conclusion

(σ_{bi}) 13,526 psi < (F_b) 21,557 psi **OK**

Entire Roof Uplift Calculations

Roof Area

Area of Roof Subjected to Uplift (R) = 22,642 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}) =	-14,681	lbs
Total Roof Design Uplift	(W_{ru}) =	-14,681	lbs

Mounting Hardware - Roof Frame to Wall Panels

Screws Along Length - 1 Side	=	15	5/16"-18 SS Bolts	- Grade 18-8/SS
Screws Along Width - 1 Side	=	6	5/16"-18 SS Bolts	- Grade 18-8/SS
Total Mounting Screws	=	42	5/16"-18 SS Bolts	- Grade 18-8/SS

Entire Roof Uplift Design Calculations

Grade 18-8 Ultimate Strength	=	150,000	psi
5/16" Bolt Nominal Diameter	=	0.313	in
5/16" Bolt Effective Area	=	0.052	in^2
5/16" Bolt Threads per Inch	=	18	
Washer Nominal Diameter	=	0.500	in
Wall Panel Tensile Ult. Strength	=	58	ksi
Wall Panel Tensile Yield Strength	=	36	ksi
Safety Factor	=	3	
Wall Panel Nominal Thickness	=	0.078	in
Maximum Tensile Strength	=	377.5	lbs
Maximum Shear/Bearing Strength	=	416.0	lbs
Max. Tensile Load per Screw	=	377.5	lbs
Max. Total Screws Tensile Strength (P_{ts})	=	15,854	lbs

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Conclusion

(W_{ru}) 14,681 lbs < (P_{ts}) 15,854 lbs **OK**

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Roof Panel Uplift Calculations

Roof Panel Critical Member Dimensions

Critical Panel Length (L_p) = 64 in
Critical Panel Width (W_p) = 92 in

Roof Panel Uplift Calculated Forces

Distributed Loads

Wind Load Uplift Force (w_{pu}) = 3,817.8 lbs

Mounting Hardware - Roof Panel to Roof Frame

Screws Along Length - 1 Side	=	6	5/16"-18 SS Bolts	- Grade 18-8/SS
Screws Along Width - 1 Side	=	2	5/16"-18 SS Bolts	- Grade 18-8/SS

Roof Panel Uplift Design Calculations

Grade 410 Ultimate Strength	=	150,000	psi
5/16" Bolt Nominal Diameter	=	0.313	in
5/16" Bolt Effective Area	=	0.052	in^2
5/16" Bolt Threads per Inch	=	18	
Washer Nominal Diameter	=	0.500	in
Roof Panel Tensile Ult. Strength	=	58	ksi
Roof Panel Tensile Yield Strength	=	36	ksi
Safety Factor	=	3	
Roof Panel Nominal Thickness	=	0.078	in

		Roof Frame	Z-Bar		
Maximum Tensile Strength	=	377.5	337.5	lbs	(Accounts for screw pull-over and pull-out strengths)
Maximum Shear/Bearing Strength	=	416.0	416.0	lbs	
Max. Tensile Load per Screw	=	377.5	337.5	lbs	

Max. Total Screws Tensile Strength (P_{ts}) = 5,560 lbs

Conclusion

(w_{pu}) 3,818 lbs < (P_{ts}) 5,560 lbs **OK**

Roof Force Calculations - Applied to Single Critical Wall/Column Section

Distributed Loads

Live Load Downforce (L_{Lr})	=	8.89	lbs/in
Wind Load Downforce (L_d)	=	0.66	lbs/in
Wind Load Uplift Force (L_u)	=	-41.50	lbs/in
Snow Load Force (L_S)	=	4.67	lbs/in

Point Loads

Critical Interior Beam (w_{bi}) = 21.4 lbs

Max. Roof Live Load (L_r) = 300 lbs
Seismic Load (L_E) = 0.00 lbs

Maximum Load Force From Roof to Single Wall Panel

Maximum Downforce (W_d) = 430.5 lbs
Maximum Upforce (Wu) = 1,888.3 lbs

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(Results are used for the Structural Calculations - Walls/Columns)

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Structural Calculations - Walls/Columns

Gillette Generators - 246" Frame

Critical Wind Load Pressures and Roof Forces

Walls 1 & 2

Maximum Pressures Acting:

Toward	75.7	psf	=	0.5260	psi
Away	-68.2	psf	=	-0.4733	psi

Walls 3 & 4

Maximum Pressures Acting:

Toward	75.3	psf	=	0.5229	psi
Away	-67.8	psf	=	-0.4706	psi

Roof Forces on Critical Panel (From Roof Frame Calculations)

Maximum Downforce	(W_d)	=	431	lbs
Maximum Upforce	(Wu)	=	1,888	lbs

Pressures and weights are the numerical maximums to be analyzed for shear, tension, and compression.

Critical Wall Panel Dimensions

Critical/Maximum Panel Width		=	60	in
Critical/Maximum Panel Height		=	108.5	in

Section Properties

14 Ga. Cold Rolled Steel Panel
1" Back Tabs

Cross Sectional Area	(A)	=	5.08	in^2
Moment of Inertia - x	(I_x)	=	2.34	in^4
Section Modulus - x	(S_x)	=	9.31	in^3
Radius of Gyration - x	(r_x)	=	0.68	in
Modulus of Elasticity	(E)	=	2.90E+04	ksi
Factor of Safety	(Ω)	=	1.67	
Effective Length Factor	(K)	=	1.0	
Tensile Ultimate Strength	(F_{tu})	=	58	ksi
Tensile Yield Strength	(F_{ty})	=	36	ksi
Shear Ultimate Strength	(F_{su})	=	12	ksi
Compressive Yield Strength	(F_{cy})	=	22	ksi

Critical Wall Panel Calculated Forces

Maximum Wind Pressure on Walls

Maximum + Wind Pressure	=	0.5260	psi
Maximum - Wind Pressure	=	-0.4733	psi

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

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Wind Shear Distributed Loads on Critical Panel

Maximum + Wind Shear	=	31.6	lbs/in
Maximum - Wind Shear	=	-28.4	lbs/in

Total Wind Shear on Critical Panel

Total Panel Design Shear (V_{ww})	=	3,424.4	lbs

Critical Panel Roof Load (Roof to Wall)

Axial Roof Load (W_{wr})	=	430.5	lbs

Stress Forces (Flexure)

Maximum + Wind Moment	=	15,481.0	lb·in	
Maximum - Wind Moment	=	-13,930.0	lb·in	
Axial Roof Stress (σ_r)	=	84.7	psi	(Contributes to both + and - wind stresses)
Stress - Compression (σ_{wc})	=	1,747.2	psi	
Stress - Tension (σ_{wt})	=	1,662.5	psi	

Design Stress - Compression (σ_{wc})	=	1,747.2	psi
Design Stress - Tension (σ_{wt})	=	1,662.5	psi

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	=	6	5/16"-18 SS Bolts	- Grade 18-8/SS
Total Mounting Screws	=	12	5/16"-18 SS Bolts	- Grade 18-8/SS

Wall Panel Design Calculations

Mounting Hardware - Shear and Tension

Grade 18-8 Ultimate Strength	=	150,000	psi	
Grade 18-8 Shear Strength	=	30,000	psi	(Includes Reduction Factor)
Grade 18-8 Tensile Strength	=	57,000	psi	(Includes Reduction Factor)
5/16" Bolt Effective Area	=	0.0520	in^2	
Shear Strength per Bolt	=	1,560	lbs	
Tensile Strength per Bolt	=	2,964	lbs	
Total Bolts Shear Strength (R_{vb})	=	18,720	lbs	
Total Bolts Tensile Strength (R_{tb})	=	35,568	lbs	

Allowable Stresses For Flexure with Axial Loading

Available Axial Stress (F_{ca})	=	18,905	psi
Available Flexural Stress (F_{cb})	=	77,266	psi
Verification Ratio (VR_{fa})	=	0.025	

Conclusions

Bolt Shear

(V_{ww}) 3,424 lbs < (R_{vb}) 18,720 lbs **OK**

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Stress (Flexure with Axial Loading)

(VR_{fa}) 0.025 ≤ 1.0 **OK**

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Structural Calculations - Enclosure to Base/Tank or Pad

Gillette Generators - 246" Frame

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

To be conservative, roof downforce is neglected.

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

Walls 1 & 2	-	80.9	psf =	0.5620	psi
Wall 3 or 4	-	67.8	psf =	0.4706	psi
Roof Uplift	-	83.3	psf =	0.5787	psi

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

Walls 1 & 2	-	80.9	psf =	0.5620	psi
Wall 3 or 4	-	37.7	psf =	0.2617	psi
Roof Uplift	-	53.3	psf =	0.3699	psi

Wind Direction 2

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

Walls 3 & 4	-	97.9	psf =	0.6800	psi
Wall 1 or 2	-	68.2	psf =	0.4733	psi
Roof Uplift	-	93.4	psf =	0.6484	psi

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

Walls 3 & 4	-	97.9	psf =	0.6800	psi
Wall 1 or 2	-	38.1	psf =	0.2645	psi
Roof Uplift	-	63.3	psf =	0.4396	psi

Seismic

Horizontal Seismic Force (E_h) = 113 lbs

Enclosure Critical Dimensions & Weights

Total Enclosure Weight		*(W_t)*	=	11,300	lbs	(Includes all components)
Walls 1/2 Area	-	*(w1)*	=	9457.1	in^2	
Walls 3/4 Area	-	*(w3)*	=	25276.5	in^2	
Roof Area	-	*(R)*	=	22641.8	in^2	

Enclosure Calculated Forces

Maximum Wind Load Forces on Walls

Wind Direction 1

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

Walls 1/2	-	=	5,315	lbs
Wall 3 or 4	-	=	11,894	lbs
Roof Uplift	-	=	13,103	lbs

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

Walls 1/2	-	=	5,315	lbs
Wall 3 or 4	-	=	6,616	lbs
Roof Uplift	-	=	8,375	lbs

Wind Direction 2

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

Walls 3/4	-	=	17,188	lbs
Wall 1 or 2	-	=	4,476	lbs
Roof Uplift	-	=	14,681	lbs

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

Walls 3/4	-	=	17,188	lbs
Wall 1 or 2	-	=	2,501	lbs
Roof Uplift	-	=	9,953	lbs

Enclosure Overturn Forces (Includes Seismic)

(Postive forces act upward, negative forces act downward)

Wind Direction 1

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

Overturn on Walls 1/2	=	2,012	lbs
Overturn on Walls 3/4	=	7,541	lbs

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

Overturn on Walls 1/2	=	-353	lbs
Overturn on Walls 3/4	=	2,230	lbs

Wind Direction 2

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

Overturn on Walls 3/4	=	11,284	lbs
Overturn on Walls 1/2	=	2,625	lbs

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

Overturn on Walls 3/4	=	8,920	lbs
Overturn on Walls 1/2	=	-151	lbs

Design Overturn Force (O_E) = 11,284 lbs Acting On Wall 3/4

Mounting Hardware - Enclosure to Base/Tank or Pad

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

No. of Bolt Connections Along Wall 3/4 = 11 5/16"-18 SS Bolts - 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	=	0.052	in^2
Shear Strength per Bolt	=	1,560	lbs

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Total Bolts Shear Strength (R_{vb}) = 17,160 lbs

Conclusion

(O_E) 11,284 lbs < (R_v) 17,160 lbs **OK**

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Structural Calculations - Enclosure With Base/Tank to Pad

Gillette Generators - 246" Frame

Critical Wind Load Pressures

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

Wind Direction 1

To be conservative, roof downforce is neglected.

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

Walls 1 & 2	-	80.9	psf =	0.5620	psi
Wall 3 or 4	-	67.8	psf =	0.4706	psi
Roof Uplift	-	83.3	psf =	0.5787	psi

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

Walls 1 & 2	-	80.9	psf =	0.5620	psi
Wall 3 or 4	-	37.7	psf =	0.2617	psi
Roof Uplift	-	53.3	psf =	0.3699	psi

Wind Direction 2

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

Walls 3 & 4	-	97.9	psf =	0.6800	psi
Wall 1 or 2	-	68.2	psf =	0.4733	psi
Roof Uplift	-	93.4	psf =	0.6484	psi

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

Walls 3 & 4	-	97.9	psf =	0.6800	psi
Wall 1 or 2	-	38.1	psf =	0.2645	psi
Roof Uplift	-	63.3	psf =	0.4396	psi

Seismic

Enclosure Horiz. Seismic Force	(EE_h)	=	113	lbs
Base/Tank Horiz. Seismic Force	(EB_h)	=	197	lbs

Enclosure With Base/Tank Critical Dimensions & Weights

Total Enclosure Weight		*(W_t)* =	16,440	lbs	(Includes all components)
Walls 1/2 Area	-	*(w1)* =	10,193	in^2	(Includes Base/Tank Surface Area)
Walls 3/4 Area	-	*(w3)* =	27,245	in^2	(Includes Base/Tank Surface Area)
Roof Area	-	*(R)* =	22,642	in^2	

Enclosure With Base/Tank Calculated Forces

Maximum Wind Shear Forces on Walls Including Base/Tank

Wind Direction 1

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

Walls 1/2	-	=	5,728	lbs
Wall 3 or 4	-	=	12,820	lbs
Roof Uplift	-	=	13,103	lbs

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

Walls 1/2	-	=	5,728	lbs
Wall 3 or 4	-	=	7,131	lbs
Roof Uplift	-	=	8,375	lbs

Wind Direction 2

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

Walls 3/4	-	=	18,526	lbs
Wall 1 or 2	-	=	4,825	lbs
Roof Uplift	-	=	14,681	lbs

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

Walls 3/4	-	=	18,526	lbs
Wall 1 or 2	-	=	2,696	lbs
Roof Uplift	-	=	9,953	lbs

Enclosure with Base/Tank Maximum Wind Force = 18,526 lbs Acting On Wall 3/4

Coefficient of Friction - Steel to Wet Concrete (μ_s) = 0.45
Frictional Resisting Force (Total Weight x μ_s) = 7,398

Enclosure with Base/Tank Design Shear (V_{EB}) = 11,128

Enclosure With Base/Tank Overturn Forces (Inlcudes Seismic)

Postive forces act upward

Wind Direction 1

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

Overturn on Walls 1/2	=	-322	lbs
Overturn on Walls 3/4	=	6,198	lbs

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

Overturn on Walls 1/2	=	-2,686	lbs
Overturn on Walls 3/4	=	411	lbs

Wind Direction 2

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

Overturn on Walls 3/4	=	10,420	lbs
Overturn on Walls 1/2	=	264	lbs

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

Overturn on Walls 3/4	=	8,056	lbs
Overturn on Walls 1/2	=	-2,579	lbs

Design Overturn Force (O_{EB}) = 10,420 lbs Acting On Wall 3/4

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Mounting Hardware - Enclosure With Base/Tank to Pad

No. of Bolt Connections Along Wall 3/4 = 6 Bolts 1/2" Set Bolt Anchors - Grade 5/Galv.

Enclosure With Base/Tank Design Calculations

Mounting Hardware - Shear and Tension

Carbon Steel	Ultimate Stress	=	100,000	psi
Carbon Steel	Nom. Shear Stress	=	40,000	psi
Carbon Steel	Nom. Tensile Stress	=	75,000	psi
1/2 in. Bolt Nominal Area		=	0.196	in^2
1/2 in. Bolt Net Tensile Area		=	0.142	in^2
Shear Strength per Bolt		=	3,920	lbs
Tensile Strength per Bolt		=	7,350	lbs
Avail. Tensile Strength per Bolt		=	6,077	lbs (Combined Tension and Shear)

Total Bolts Shear Strength	(R_{vb})	=	23,520	lbs
Total Bolts Tensile Strength	(R_{tb})	=	36,465	lbs

Conclusion

Shear

(V_{EB})	11,128	lbs	<	(R_{tb})	23,520	lbs	**OK**

Tension

(O_{EB})	10,420	lbs	<	(R_{tb})	36,465	lbs	**OK**

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