



30 ft Gable End Tent with 127/116/110 Tube

Project ID: D1930\Customer: Rainier Industries

Structural evaluation of the Full Strength Tent Frame
in accordance with IBC 2021, CBC 2022 and the ASCE 7-16

Evaluated for use in the following conditions:

20ft, 15 ft, 10 ft bay spacing

8 ft, 10ft Leg

Design wind speed and ground snow loads as indicated in charts

Exposure C terrain

Risk Category = II

Temporay Enclosed Structure

Structural Only



Exp: 09/30/2026

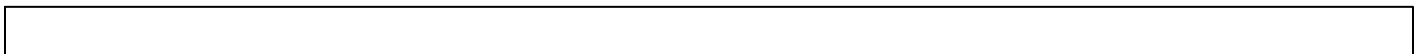
The professional engineer seal on this cover page refers to the calculation sheets contained within this document and to any Appendix or Table sheets that support this document. Any other drawings and documents may require a separate seal for coverage not provided here. Certification of this document only shows that the Professional Engineer of that particular state is in agreement with the report's contents. It does not, however, imply that the structure is generally suitable for use within that state, or that every installation is covered by this report.

The information and illustrations contained within this document remain the sole property of Rainier Industries Ltd, and are to be treated as confidential.

The professional engineers seal, affixed on this document, signifies a responsibility for the structural adequacy of the design of the structure in the completed project. The content contained within this document does not encompass means, methods and safety of erection.

All data, designs, technical representations, engineering calculations and illustrations whether written or implied may not be reproduced in whole or in part nor distributed, used in manufacturing, design or display without the express written consent of Rainier Industries Ltd.

Retention of this document shall constitute acceptance of these terms and conditions.





Rainier Industries Ltd.
18375 Olympic Avenue South
Tukwilla, WA 98188
425-251-1900 (www.rainier.com)

This page intentionally left blank



Rainier Industries Ltd.
18375 Olympic Avenue South
Tukwilla, WA 98188
425-251-1900 (www.rainier.com)

Table of Contents

1. Summary and Recommendations
 2. Determination of Loads
 - Dead Load
 - Live Load
 - Roof Live Load
 - Snow Load
 - Wind Load
 3. Load Combinations
 4. Profile Designs
 5. Bracing Member Design
- Appendix A - Computer Model INPUT
Appendix B - Computer Model OUTPUT

Revision Log

<u>Rev</u>	<u>Rev. Date</u>	<u>Description</u>
0	27 May 2025	- Original Issue



Rainier Industries Ltd.
18375 Olympic Avenue South
Tukwilla, WA 98188
425-251-1900 (www.rainier.com)

This page intentionally left blank



1. Summary and Recommendations

This document, based on technical background information as provided by Rainier Industries Ltd, covers the structural evaluation of the aluminum frame style structure in accordance with U.S. Building Code requirements. The specifications outlined in the Structural Engineering Institute / American Society of Civil Engineers (SEI/ASCE7) "Minimum Design Loads for Buildings and Other Structures" were followed in determining the integrity of the structure. This document is intended to serve as a basis for the acceptability of this temporary, stand-alone, enclosed structure under standard design wind loads at varying levels of exposure (terrain and wind velocities).

Lightweight Design compiled this document based on the existing frame tent system with reference to the applicable building codes in the U.S. This report includes the load cases and combinations used in the analysis and gives an indication as to the wind exposure for which the structure is suitable. Certification of this document only shows that the Professional Engineer of that particular state is in agreement with the report's contents. It does not, however, imply that the structure is generally suitable for use within that state, or that every installation is covered by this report.

As this document was compiled based on design information as provided by Rainier Industries Ltd, the summary and recommendations for this structure and contained within this document can only be valid if the structure is erected with original parts and components provided by Rainier Industries Ltd.

Computer-aided structural frame analysis were involved in the course of the investigation. Different load combinations were considered to identify the critical aspects of the design. Member and detail checks were established to derive the conclusions for the entire report.

Fabric is assumed to be tensioned and directly attached to each arch, and over the whole length of the arch.

As such, we have arrived at the following conclusions and recommendations;

1.1 Wind Speed Rating

Risk category: Cat = "II" Wind exposure: Exposure = "C" Internal pressure coefficient: $GC_{pi} = 0.18$

With Guy Straps

Basic Design Wind Speed		
Bay Spacing	8 ft Legs	10 ft Legs
10 ft	131 mph	115 mph
15 ft	108 mph	95 mph
20 ft	97 mph	85 mph

Reduced Design Wind Speed for Temporary Structure		
Bay Spacing	8 ft Legs	10 ft Legs
10 ft	98 mph	86 mph
15 ft	81 mph	71 mph
20 ft	73 mph	64 mph

Without Guy Straps

Basic Design Wind Speed		
Bay Spacing	8 ft Legs	10 ft Legs
10 ft	108 mph	91 mph
15 ft	91 mph	76 mph
20 ft	84 mph	67 mph

Reduced Design Wind Speed for Temporary Structure		
Bay Spacing	8 ft Legs	10 ft Legs
10 ft	81 mph	68 mph
15 ft	68 mph	57 mph
20 ft	63 mph	50 mph

*Structures wind capacities are designed using reduced design wind speed for temporary structures. Wind speed reduction factors are based on ASCE 37, with a construction period that is less than 6 weeks.

*Guy straps have 6ft offset from the posts and no more than 5 bays are open without bracing.



Exposure Categories (IBC)

1609.4.3 Exposure categories. An exposure category shall be determined in accordance with the following:

Exposure B. Exposure B shall apply where the ground surface roughness condition, as defined by Surface Roughness B, prevails in the upwind direction for a distance of at least 2,600 feet (792 m) or 20 times the height of the building, whichever is greater.

Exception: For buildings whose mean roof height is less than or equal to 30 feet (9144 mm), the upwind distance is permitted to be reduced to 1,500 feet (457 m).

Exposure C. Exposure C shall apply for all cases where Exposures B or D do not apply.

Exposure D. Exposure D shall apply where the ground surface roughness, as defined by Surface Roughness D, prevails in the upwind direction for a distance of at least 5,000 feet (1524 m) or 20 times the building, whichever is greater. Exposure D shall extend inland from the shoreline for a distance of 600 feet (183 m) or 20 times the height of the building, whichever is greater.

Surface Roughness Categories (IBC)

1609.4.2 Surface roughness categories. A ground surface roughness within each 45-degree (0.79 rad) sector shall be determined for a distance upwind of the site as defined in Section 1609.4.3 from the categories defined below, for the purpose of assigning an exposure category as defined in Section 1609.4.3.

Surface Roughness B. Urban and suburban areas, wooded areas or other terrain with numerous closely spaced obstructions having the size of single-family dwellings or larger.

Surface Roughness C. Open terrain with scattered obstructions having heights generally less than 30 feet (9144 mm). This category includes flat open country, grasslands, and all water surfaces in hurricane-prone regions.

Surface Roughness D. Flat, unobstructed areas and water surfaces outside hurricane-prone regions. This category includes smooth mud flats, salt flats and unbroken ice.

1.2 Dead Loads

Dead loads are defined as the weights of the materials of construction and fixed service equipment. For this analysis the weight of the frame and fabric have been accounted for.

1.3 Hanging Dead Loads

Hanging dead loads are ancillary loads that typically are hanging from the structure, but not necessarily part of the standard structure. These can be due to electrical and mechanical fixtures (lighting, HVAC, suspended items, etc.). A total load per frame of 400 lbf is accounted for in this analysis.

1.4 Live Loads

Live loads are loads produced by the use and occupancy of the building are found on Table 1607.1 (IBC). In the case of this structure, there are no additional live loads.

1.5 Seismic Loads

Due to the low mass of the structure, seismic base shear does not control over wind loading shear and thus has not been included in this analysis.



1.6 Snow Load :

The ground snow load is typically determined using extreme value statistical analysis of weather records of snow on the ground. Typically, the log normal distribution is selected to estimate ground snow loads, which have a 2 percent annual probability of being exceeded (50 year mean recurrence interval).

Bay Spacing	30 ft Wide
	Snow Load
10 ft	12 psf
15 ft	8 psf
20 ft	4 psf

*Structures snow capacities are the same regardless of guy straps
 *No more than 5 bays are open without bracing.

For the above mentioned snow load and bay spacing, the structure satisfies the requirements of the "American Society of Civil Engineers Minimum Design Loads for Buildings and Other Structures (ASCE 7), as well as the International Building Code (IBC).

1.7 Base Reactions

The maximum worst case reactions at the foundations/supports due to the rated load and exposure category are given in the table below. Therefore, it should be noted that the value for vertical load may, or may not, occur simultaneously with the value for horizontal load.

With Guy Straps:

30' Wide - 8' leg					
Bay Spacing	Posts			Guy Straps	
	Uplift	Downward	Horiz.	Uplift	Horiz.
10 ft	2171 lb	484 lb	924 lb	884 lb	690 lb
15 ft	2277 lb	389 lb	968 lb	922 lb	719 lb
20 ft	2129 lb	361 lb	830 lb	775 lb	605 lb

30' Wide - 10' leg					
Bay Spacing	Posts			Guy Straps	
	Uplift	Downward	Horiz.	Uplift	Horiz.
10 ft	1624 lb	554 lb	721 lb	1048 lb	650 lb
15 ft	1686 lb	454 lb	751 lb	1032 lb	640 lb
20 ft	1595 lb	441 lb	651 lb	859 lb	533 lb

Without Guy Straps:

30' Wide - 8' leg			
Bay Spacing	Posts		
	Uplift	Downward	Horiz.
10 ft	1302 lb	220 lb	781 lb
15 ft	1419 lb	241 lb	856 lb
20 ft	1543 lb	260 lb	923 lb

30' Wide - 10' leg			
Bay Spacing	Posts		
	Uplift	Downward	Horiz.
10 ft	943 lb	236 lb	620 lb
15 ft	950 lb	258 lb	661 lb
20 ft	936 lb	276 lb	623 lb



Rainier Industries Ltd.
18375 Olympic Avenue South
Tukwilla, WA 98188
425-251-1900 (www.rainier.com)

1.8 Installation Requirements

It is understood that the responsibility of proper installation according to the plans rests upon the installation contractor. This includes, but is not limited to, ensuring the following:

- that the cables are always held taut,
- that the fabric is stretched tight enough to prevent the development of pockets and to maintain the prescribed roof gradient,
- that purlins are installed securely against rafters to resist calculated loads,
- that base plates are secured to their foundations using anchors. The manufacturer provides a base plate and anchoring plan for the structure as a base starting point for average soil conditions. It is the installer's responsibility to ensure that the anchorage provided will resist the reaction loads as indicated in the tables found in this document.



Rainier Industries Ltd.
18375 Olympic Avenue South
Tukwilla, WA 98188
425-251-1900 (www.rainier.com)

2a. Determination of Loads

Dead Load :

Dead loads are defined as the weights of the materials of construction and fixed service equipment. For this analysis the weight of the frame and fabric have been accounted for.

Fabric Roof and/or Side : $\text{AreaWt}_{\text{fabric}} = 24.00\text{-oz per sq yard}$

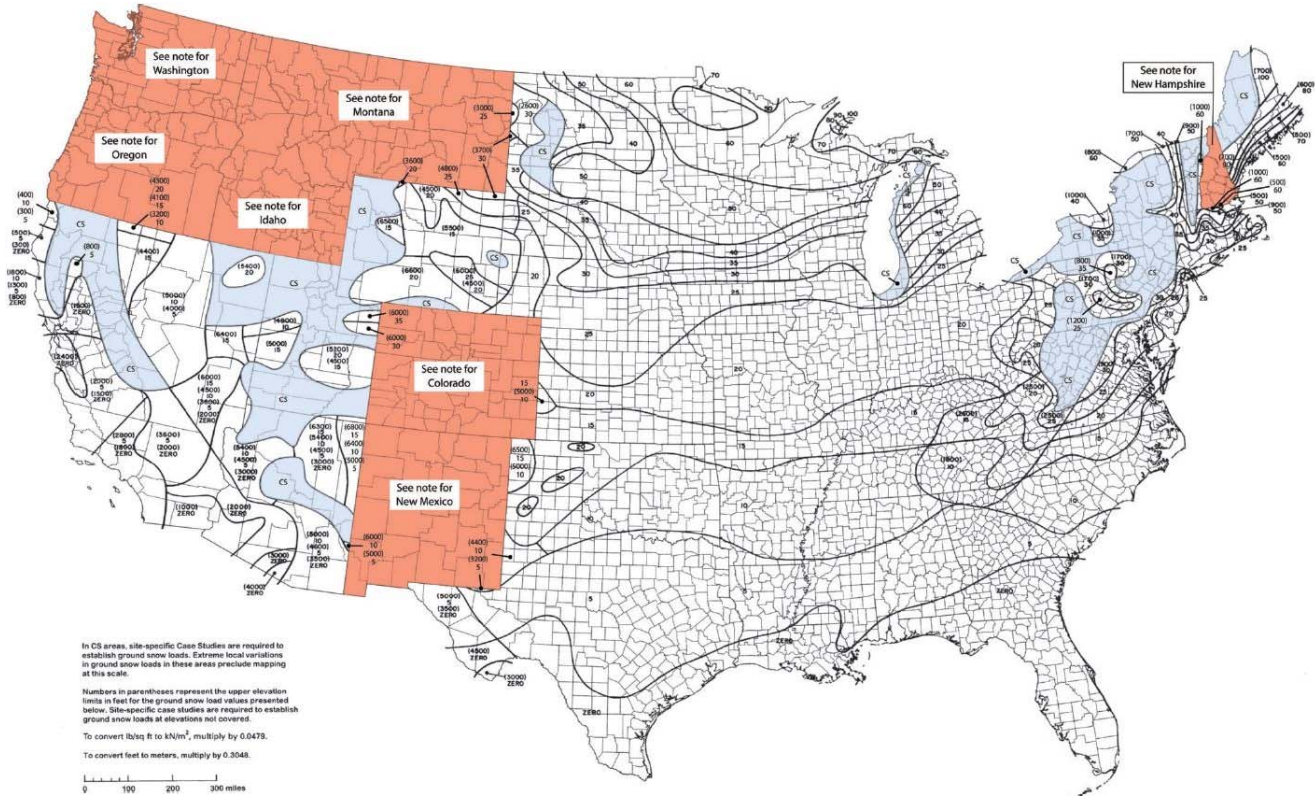
Hanging dead loads are ancillary loads that typically are hanging from the structure, but not necessarily part of the standard structure. These can be due to electrical and mechanical fixtures (lighting, HVAC, suspended items, etc.). A total load per frame of 400 lbf is accounted for in this analysis.

Live Load :

Live loads are loads produced by the use and occupancy of the building are found on Table 1607.1 (IBC). In the case of this structure, there are no additional live loads.



02b. Snow Load - ASCE 7-16 Chapter 7
 Design Parameters



See Table 7.2-2 for Colorado, 7.2-3 for Idaho, 7.2-4 for Montana, 7.2-5 for Washington, 7.2-6 for New Mexico, 7.2-7 for Oregon, or 7.2-8 for New Hampshire

- Ground Snow Load : $p_g = 4 \cdot \text{psf}$ [Fig. 7-1, Table 7-1]
- Terrain Category: Exposure = "C" [Section 26.7]
- Exposure Factor : $C_e = 0.9$ [Table 7-2]
- Description of exposure type = "Roof exposure condition = Fully Exposed"
- Thermal Factor : $C_t = 1$ [Table 7-3]
- Description of thermal condition = "Thermal Condition = All structures except those as indicated in Table 7.3-2"
- Building Risk Category: Cat = "II" [Table 1.5-1]
- Occupancy of Building = "All building and other structure except those listed in Risk Categories I, III, and IV"
- Importance Factor : $I_s = 1.0$ [Table 1.5-2]
- Flat Roof Snow Load : $p_f = 0.7 \cdot C_e \cdot C_t \cdot I_s \cdot p_g$ $p_f = 2.52 \cdot \text{psf}$ [Eq. 7.3-1]



Minimum Snow Load for Low-Slope Roofs :

Per ASCE 7-16 Section 7.3.4, minimum roof snow load, p_m , shall only apply to monoslope, hip and gable roofs with slopes less than 15° , and to curved roofs where the vertical angle from the eaves to the crown is less than 10° . This minimum roof snow load is a separate uniform load case. It need not be used in determining or in combination with drift, sliding, unbalanced, or partial loads.

Check for Minimum Snow Load = "minimum values for low-slope roof need not to be considered "

Sloped Roof Snow Load

Roof Slope Factor : $C_s = 0.67$ *[Figure 7-2a]*

Sloped Roof Load : $p_s = C_s \cdot p_f$ *[Eq. 7.4-1]*

$$p_s = 1.68 \cdot \text{psf}$$

Rain-on-Snow Surcharge Load:

Per ASCE 7-16 Section 7.10, for locations where p_g is 20 psf or less, but not zero, all roofs with slopes (in degrees) less than $W/50$ with W in feet shall include a 5 psf rain-on-snow surcharge load. This additional load applies only to the sloped roof (balanced) load case and need not be used in combination with drift, sliding, unbalanced, minimum, or partial loads.

Rain-on-Snow Surcharge Load = "surcharge load need not be applied" *[Section 7.10]*

Design Balanced Snow Load :

$$S_0 = p_s \cdot L_{\text{bay}}$$

$$S_0 = 1.68 \cdot \text{psf}$$

Design Unbalanced Snow Load Design Check:

Per ASCE 7-16 Section 7.6.1, for hip and gable roofs with a slope exceeding 7 on 12 (30.2°) or with a slope less than 2.38° ($1/2$ on 12) unbalanced snow loads are not required to be applied.

$$\theta_{\text{roof}} = 26.72 \cdot \text{deg} \quad \text{[Section 7.6.1]}$$

Check unbalanced load requirement = "all criteria met; must consider unbalanced loads"



Design Unbalanced Snow Load :

$S = 1.99$ [Section 7.1]

$\gamma_{\text{snow}} = 14.52 \cdot \text{pcf}$ [Eq. 7.7-1]

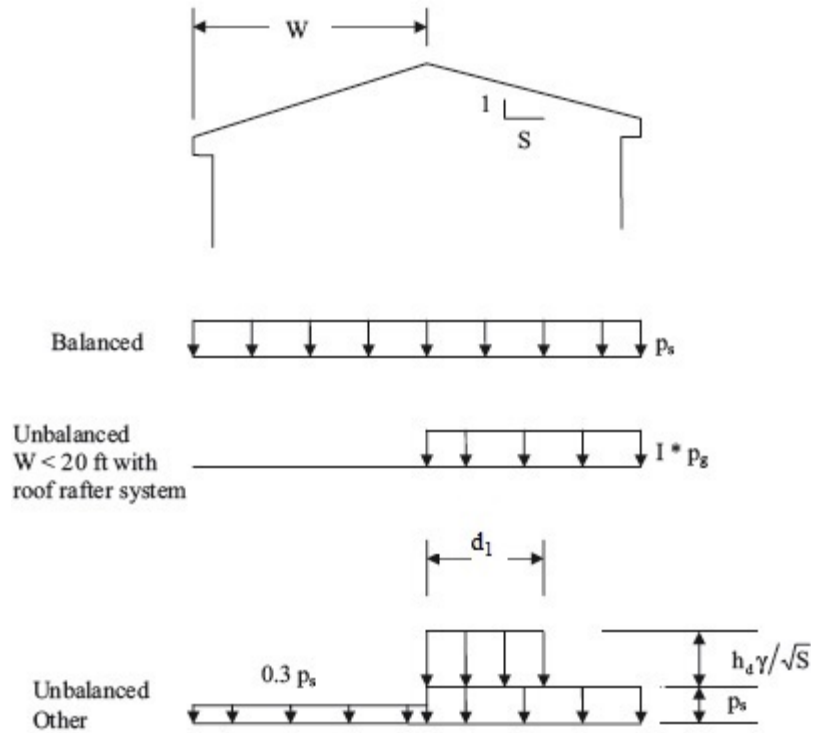
$h_d = 0.76 \cdot \text{ft}$ [Figure 7-9]

$W = 15 \cdot \text{ft}$ [Figure 7-5]

$S_{1,\text{windward}} = 0.00 \cdot \text{psf}$

$d_1 = 2.85 \cdot \text{ft}$

$S_{1,\text{leeward}} = 4 \cdot \text{psf}$

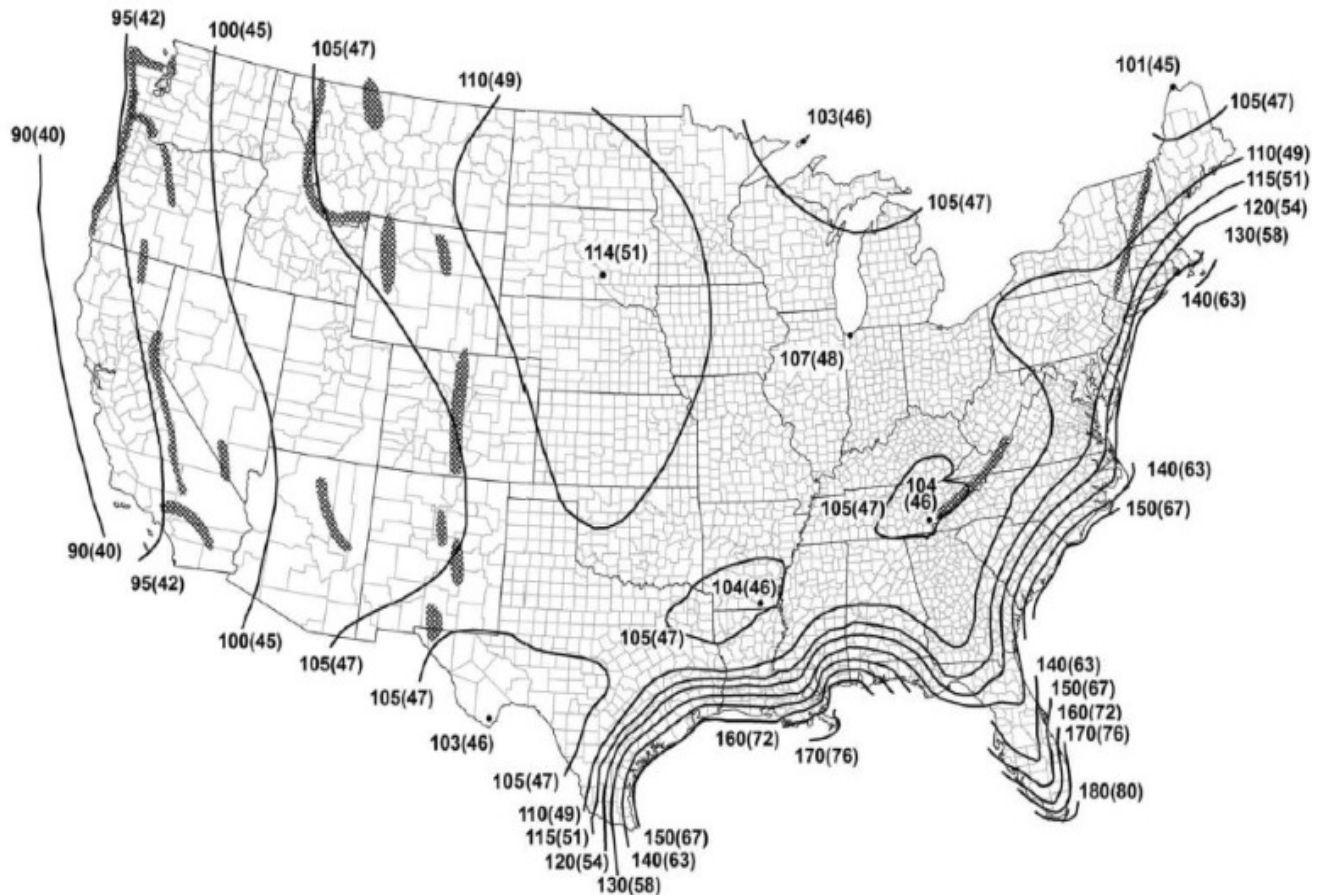


ASCE 7-10 FIGURE 7-10 Balanced and Unbalanced Snow Loads for Hip and Gable Roofs.



02c. Wind Loads - Low Rise Buildings

Design Parameters



Risk Category:	Cat = "II"	[Table 1-1]
Basic Wind Speed:	$V = 93 \cdot \text{mph}$	[Section 26.5.1]
Exposure Category:	Exposure = "C"	[Section 26.7.3]
Expected Length of Installation:	Period = "More than 5 years"	
Reduction Factor:	$R_n = 1$	[ASCE37]
Effective Wind Speed:	$V_r = 93 \cdot \text{mph}$	
Wind Directionality Factor:	$K_d = 0.85$	[Table 26.6-1]
Topographic Factor:	$K_{zt} = 1$	[Section 26.8.2]
Ground Elevation Factor:	$K_e = 1$ Grade = 0·ft	[Section 26.9]
Gust Effect Factor:	$G = 0.85$	[Section 26.9.1]

Per ASCE 7-16 Section 26.11.1, the gust-effect factor for Low-Rise Buildings as defined in Section 26.2, are permitted to be taken as 0.85.



Envelope Procedure for Low Rise Buildings - ASCE 7-16 Chapter 28

Per ASCE 7-16 Section 26.2, buildings with mean roof height h less than or equal to 60 ft, and with mean roof height h does not exceed least horizontal dimension are considered as low-rise building.

Check Low Rise Criteria = "both low-rise conditions are satisfied"

Per ASCE 7-16 Section 28.1.4, no reduction to the velocity pressure is taken due to apparent shielding.

Velocity Pressure :

$$q_z = 0.00256 \cdot K_z \cdot K_{zt} \cdot K_d \cdot K_e \cdot V_r^2 \quad \text{velocity pressure evaluated at peak height} \quad [Eq\ 26.10-1]$$

$$q_h = 0.00256 \cdot K_h \cdot K_{zt} \cdot K_d \cdot K_e \cdot V_r^2 \quad \text{velocity pressure evaluated at mean roof height}$$

where : for $15\text{ft} \leq z \leq z_g$ for $z \leq 15\text{ft}$

$$K_z = 2.01 \cdot \left(\frac{z}{z_g} \right)^\alpha \quad K_z = 2.01 \cdot \left(\frac{15\text{ft}}{z_g} \right)^\alpha \quad [Table\ 26.10-1]$$

*Note: z shall not be taken less than 30 feet in exposure B.

$$z_g = 900 \cdot \text{ft} \quad [Table\ 26.11-1]$$

$$K_z = 0.87 \quad \text{velocity pressure exposure coefficient evaluated at peak height (} z = 17.3\text{ft)}$$

$$K_h = 0.85 \quad \text{velocity pressure exposure coefficient evaluated at mean roof height (} h = 13.52\text{ft)}$$

$$q_z = 16.46 \cdot \text{psf} \quad \text{velocity pressure evaluated at building height, } z$$

$$q_h = 15.98 \cdot \text{psf} \quad \text{velocity pressure evaluated at mean roof height, } h$$

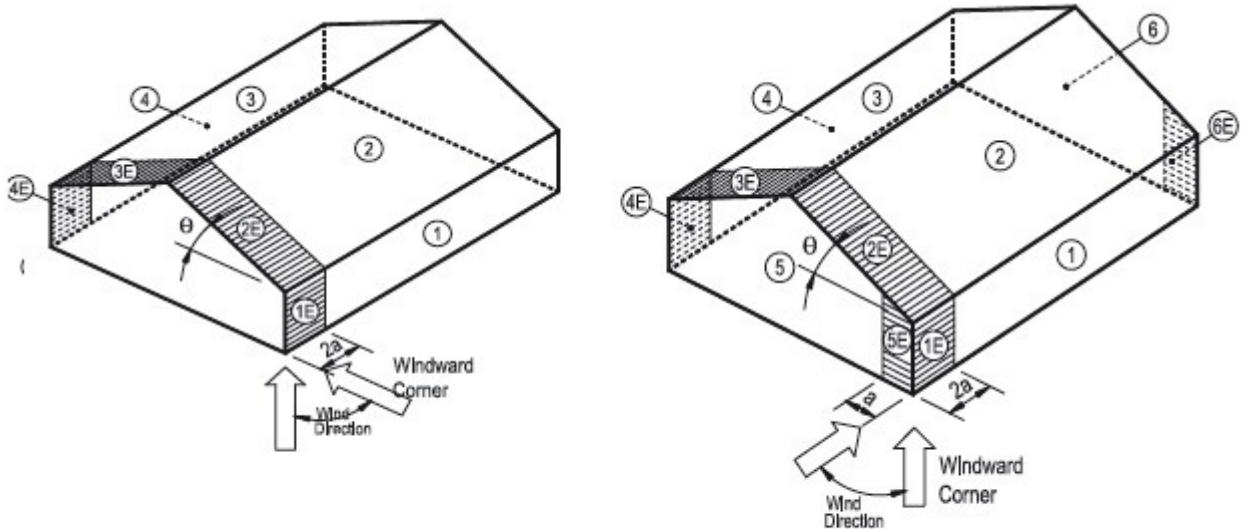


Design Wind Pressure

$$p = q_h \cdot [(GC_{pf}) - (GC_{pi})]$$

[Equation 28.3-1]

External Pressure Coefficients (GC_{pf})



Load Case A

Load Case B

ASCE7-16 Figure 28.3-1 External Pressure Coefficients (GC_{pf})

Transverse Direction (Load Case A)

$GC_{pf,A}$	"1"	"2"	"3"	"4"	"1E"	"2E"	"3E"	"4E"
	0.55	-0.09	-0.45	-0.39	0.73	-0.17	-0.58	-0.53

$a = 3 \cdot ft$
 $2 \cdot a = 6.00 \cdot ft$

(interpolated to the roof slope at: $\theta_{roof} = 26.72 \cdot deg$)

Longitudinal Direction (Load Case B)

$GC_{pf,B}$	"1"	"2"	"3"	"4"	"5"	"6"	"1E"	"2E"	"3E"	"4E"	"5E"	"6E"
	-0.45	-0.69	-0.37	-0.45	0.4	-0.29	-0.48	-1.07	-0.53	-0.48	0.61	-0.43

Application of Pressures on Building Surfaces 2 and 3

Per note 8 in ASCE 7-16 Fig. 28.3-1, the roof pressure coefficient (GC_{pf}), when negative in Zone 2 and 2E, shall be applied in Zone 2/2E for a distance from the edge of the roof equal to $0.5 \cdot$ horizontal dimension of the building parallel to the direction of the MVFRS being designed or $2.5 \cdot$ the eave height at the windward wall, whichever is less; the remainder of Zone 2/2E extending to the ridge line shall use the pressure coefficient (GC_{pf}) for Zone 3/3E.

Zone 2/2E Distance_{CaseA} = 15 · ft

Zone 2/2E Distance_{CaseB} = 24.38 · ft

Internal Pressure Coefficients (GC_{pi})

$GC_{pi} = 0.18$

[Table 26.13-1]



Wind at Transverse Direction (Load Case A)

$P_A =$	"1"	"2"	"3"	"4"	"1E"	"2E"	"3E"	"4E"	·psf
	5.91	-4.24	-10.01	-9.10	8.72	-5.59	-12.18	-11.38	
	11.67	1.51	-4.26	-3.35	14.48	0.16	-6.43	-5.63	

top line = overpressure, bottom line = underpressure

Wind at Longitudinal Direction (Load Case B)

$P_B =$	"1"	"2"	"3"	"4"	"5"	"6"	"1E"	"2E"	"3E"	"4E"	"5E"	"6E"	·psf
	-10.06	-13.9	-8.79	-10.06	3.51	-7.51	-10.54	-19.97	-11.34	-10.54	6.87	-9.75	
	-4.31	-8.15	-3.04	-4.31	9.27	-1.76	-4.79	-14.22	-5.59	-4.79	12.62	-3.99	

Design Wind Pressure on Gable

$P_{\text{gable}} =$	"5"	"6"	"5E"	"6E"	·psf
	3.51	-7.51	6.87	-9.75	
	9.27	-1.76	12.62	-3.99	



3. LRFD Load Combinations :

ASCE 7-16 Section 2.2 : SYMBOLS AND NOTATION

D = dead load

D_i = weight of ice

E = earthquake load

F = load due to fluids with well-defined pressures and maximum heights

F_a = flood load

H = load due to lateral earth pressure, ground water pressure, or pressure of bulk materials

L = live load

L_r = roof live load

R = rain load

S = snow load

T = self-straining force

W = wind load

W_i = wind-on-ice determined in accordance with Chapter 10

ASCE Section 2.3 : COMBINING FACTORED LOADS USING STRENGTH DESIGN

Section 2.3.2 : Basic Combinations. Structures, components, and foundations shall be designed so that their design strength equals or exceeds the effects of the factored loads in the following combinations:

1. $1.4D$
2. $1.2D + 1.6L + 0.5(L_r \text{ or } S \text{ or } R)$
3. $1.2D + 1.6(L_r \text{ or } S \text{ or } R) + (L \text{ or } 0.5W)$
4. $1.2D + 1.0W + L + 0.5(L_r \text{ or } S \text{ or } R)$
5. $0.9D + 1.0W$



Symbols as used in calculations

- | | |
|--------------------------------|---|
| D_1 = dead load; | W_1 = lateral wind (perpendicular to ridge line with overpressure) |
| D_2 = dead load - ancillary; | W_2 = lateral wind (perpendicular to ridge line with underpressure) |
| L_r = roof live load; | W_3 = longitudinal wind (parallel to ridge line with overpressure) |
| L_r = roof live load; | W_4 = longitudinal wind (parallel to ridge line with underpressure) |
| S_1 = balanced snow | W' = minimum wind per section 28.4.4. |
| S_2 = unbalanced snow | |

Combinations as applied in calculations :

- | | | |
|--|---|-----------------------------------|
| 1.01 $1.4D_1$ | 4.01 $1.2D_1 + 1.0L_f + 0.5L_r + 1.0W_{1a}$ | 5.01 $0.9D_1 + 1.0W_{1a}$ |
| 1.02 $1.4D_1 + 1.4D_2$ | .03 $1.2D_1 + 1.0L_f + 0.5L_r + 1.0W_{2a}$ | .03 $0.9D_1 + 1.0W_{2a}$ |
| 2.01 $1.2D_1 + 1.6L_f + 0.5L_r$ | .05 $1.2D_1 + 1.0L_f + 0.5L_r + 1.0W_{3a}$ | .05 $0.9D_1 + 1.0W_{3a}$ |
| .04 $1.2D_1 + 1.2D_2 + 1.6L_f + 0.5L_r$ | .07 $1.2D_1 + 1.0L_f + 0.5L_r + 1.0W_{4a}$ | .07 $0.9D_1 + 1.0W_{4a}$ |
| 3.01 $1.2D_1 + 1.6L_r + 1.0L_f$ | .09 $1.2D_1 + 1.0L_f + 0.5L_r + 1.0W'$ | .09 $0.9D_1 + 1.0W'$ |
| .02 $1.2D_1 + 1.6L_r + 0.5W_{1a}$ | .37 $1.2D_1 + 1.2D_2 + 1.0L_f + 0.5L_r + 1.0W_{1a}$ | .13 $0.9D_1 + 1.2D_2 + 1.0W_{1a}$ |
| .04 $1.2D_1 + 1.6L_r + 0.5W_{2a}$ | .39 $1.2D_1 + 1.2D_2 + 1.0L_f + 0.5L_r + 1.0W_{2a}$ | .15 $0.9D_1 + 1.2D_2 + 1.0W_{2a}$ |
| .06 $1.2D_1 + 1.6L_r + 0.5W_{3a}$ | .41 $1.2D_1 + 1.2D_2 + 1.0L_f + 0.5L_r + 1.0W_{3a}$ | .17 $0.9D_1 + 1.2D_2 + 1.0W_{3a}$ |
| .08 $1.2D_1 + 1.6L_r + 0.5W_{4a}$ | .43 $1.2D_1 + 1.2D_2 + 1.0L_f + 0.5L_r + 1.0W_{4a}$ | .19 $0.9D_1 + 1.2D_2 + 1.0W_{4a}$ |
| .10 $1.2D_1 + 1.6L_r + 0.5W'$ | .45 $1.2D_1 + 1.2D_2 + 1.0L_f + 0.5L_r + 1.0W'$ | .21 $0.9D_1 + 1.2D_2 + 1.0W'$ |
| .40 $1.2D_1 + 1.2D_2 + 1.6L_r + 1.0L_f$ | | |
| .41 $1.2D_1 + 1.2D_2 + 1.6L_r + 0.5W_{1a}$ | | |
| .43 $1.2D_1 + 1.2D_2 + 1.6L_r + 0.5W_{2a}$ | | |
| .45 $1.2D_1 + 1.2D_2 + 1.6L_r + 0.5W_{3a}$ | | |
| .47 $1.2D_1 + 1.2D_2 + 1.6L_r + 0.5W_{4a}$ | | |
| .49 $1.2D_1 + 1.2D_2 + 1.6L_r + 0.5W'$ | | |



4a. Profile Design - 127mm Tube

Section Properties :

$d = 5.000 \cdot \text{in}$	$b = 1.969 \cdot \text{in}$	Shape dimensions
$b_w = 2.075 \cdot \text{in}$	$t_w = 0.118 \cdot \text{in}$	
$b_f = 1.060 \cdot \text{in}$	$t_f = 0.12 \cdot \text{in}$	
$A_g = 2.178 \cdot \text{in}^2$		Cross-sectional area of Shape
$I_x = 5.87 \cdot \text{in}^4$	$I_y = 1.08 \cdot \text{in}^4$	Moment of inertia
$S_x = 2.2 \cdot \text{in}^3$	$S_y = 1.1 \cdot \text{in}^3$	Section Modulus
$r_x = 1.64 \cdot \text{in}$	$r_y = 0.71 \cdot \text{in}$	Radius of Gyration
$J = 0.69 \cdot \text{in}^4$		Torsional constant
$K_x = 1$	$K_y = 1$	Factor for buckling
$L_x = 61 \cdot \text{in}$	$L_y = 93 \cdot \text{in}$	Length for buckling
$L_b := L_y$		Length between Bracing Points



Selected Ratios :

$$\frac{b_w}{t_w} = 17.6 \quad \frac{b_f}{t_f} = 9 \quad \frac{K_x \cdot L_x}{r_x} = 37.1 \quad \frac{K_y \cdot L_y}{r_y} = 131.9$$

The following allowable stresses are based on values from the "2015 Aluminum Design Manual" :

Modulus of Elasticity : $E = 10100 \cdot \text{ksi}$

Design Axial Strengths:

Design Tensile Strength : $\phi P_{n,D} = 56.25 \cdot \text{kip}$ [Section D]

Design Compressive Strength : $\phi P_{n,E} = 9.55 \cdot \text{kip}$ [Section E]

Design Flexural Strengths:

Design Flexural Strength - Closed Section : $\phi M_{nx} = 69 \cdot \text{kip} \cdot \text{in}$ [Section F]

$\phi M_{ny} = 39 \cdot \text{kip} \cdot \text{in}$

Design Shear Strengths:

Design Shear Strength : $\phi V_{nx} = 8.37 \cdot \text{kip}$ [Section G]

$\phi V_{ny} = 4.28 \cdot \text{kip}$



Rainier Industries Ltd.
18375 Olympic Avenue South
Tukwilla, WA 98188
425-251-1900 (www.rainier.com)

Actual Stress:

Member ID = "lms7"

Load Case = "6.03-0.9D1+1.0W3"

$$M_{rx} = 24 \cdot \text{kip} \cdot \text{in} \quad M_{ry} = -13.24 \cdot \text{kip} \cdot \text{in} \quad P_r = -0.06 \cdot \text{kip}$$

$$M_{cx} = 69.43 \cdot \text{kip} \cdot \text{in} \quad M_{cy} = 39.02 \cdot \text{kip} \cdot \text{in} \quad P_c = 9.55 \cdot \text{kip}$$

Eq. H.1-1:
$$\text{Eq1} := \left| \frac{P_r}{P_c} \right| + \left| \frac{M_{rx}}{M_{cx}} \right| + \left| \frac{M_{ry}}{M_{cy}} \right| = 0.69$$
 Eq1 is less than or equal to 1.0 = "OK"

Member ID = "lms5"

Load Case = "6.03-0.9D1+1.0W3"

$$M_{rx} = 26.4 \cdot \text{kip} \cdot \text{in} \quad M_{ry} = -13.64 \cdot \text{kip} \cdot \text{in} \quad P_r = 2.18 \cdot \text{kip}$$

$$M_{cx} = 69.43 \cdot \text{kip} \cdot \text{in} \quad M_{cy} = 39.02 \cdot \text{kip} \cdot \text{in} \quad P_c = 56.25 \cdot \text{kip}$$

Eq. H.1-1:
$$\text{Eq2} := \left| \frac{P_r}{P_c} \right| + \left| \frac{M_{rx}}{M_{cx}} \right| + \left| \frac{M_{ry}}{M_{cy}} \right| = 0.77$$
 Eq2 is less than or equal to 1.0 = "OK"



4b. Profile Design - 116mm Tube

Section Properties :

$d = 4.567 \cdot \text{in}$	$b = 1.969 \cdot \text{in}$	Shape dimensions
$b_w = 1.598 \cdot \text{in}$	$t_w = 0.118 \cdot \text{in}$	
$b_f = 0.446 \cdot \text{in}$	$t_f = 0.12 \cdot \text{in}$	
$A_g = 1.939 \cdot \text{in}^2$		Cross-sectional area of Shape
$I_x = 3.85 \cdot \text{in}^4$	$I_y = 1.02 \cdot \text{in}^4$	Moment of inertia
$S_x = 1.48 \cdot \text{in}^3$	$S_y = 1.04 \cdot \text{in}^3$	Section Modulus
$r_x = 1.41 \cdot \text{in}$	$r_y = 0.73 \cdot \text{in}$	Radius of Gyration
$J = 1.88 \cdot \text{in}^4$		Torsional constant
$K_x = 1$	$K_y = 1$	Factor for buckling
$L_x = 192 \cdot \text{in}$	$L_y = 192 \cdot \text{in}$	Length for buckling
$L_b := L_y$		Length between Bracing Points



Selected Ratios :

$$\frac{b_w}{t_w} = 13.5 \quad \frac{b_f}{t_f} = 3.8 \quad \frac{K_x \cdot L_x}{r_x} = 136.3 \quad \frac{K_y \cdot L_y}{r_y} = 264.3$$

The following allowable stresses are based on values from the "2015 Aluminum Design Manual" :

Modulus of Elasticity : $E = 10100 \cdot \text{ksi}$

Design Axial Strengths:

Design Tensile Strength : $\phi P_{n,D} = 49.44 \cdot \text{kip}$ [Section D]

Design Compressive Strength : $\phi P_{n,E} = 2.12 \cdot \text{kip}$ [Section E]

Design Flexural Strengths:

Design Flexural Strength - Closed Section : $\phi M_{nx} = 50 \cdot \text{kip} \cdot \text{in}$ [Section F]

$$\phi M_{ny} = 35 \cdot \text{kip} \cdot \text{in}$$

Design Shear Strengths:

Design Shear Strength : $\phi V_{nx} = 6.45 \cdot \text{kip}$ [Section G]

$$\phi V_{ny} = 1.8 \cdot \text{kip}$$



Actual Stress:

Member ID = "pe2"

Load Case = "6.04-0.9D1+1.0W4"

$$M_{rx} = 10.35 \cdot \text{kip} \cdot \text{in} \quad M_{ry} = 6.58 \cdot \text{kip} \cdot \text{in} \quad P_r = -1.08 \cdot \text{kip}$$

$$M_{cx} = 50.33 \cdot \text{kip} \cdot \text{in} \quad M_{cy} = 35.09 \cdot \text{kip} \cdot \text{in} \quad P_c = 2.12 \cdot \text{kip}$$

Eq. H.1-1:
$$\text{Eq1} := \left| \frac{P_r}{P_c} \right| + \left| \frac{M_{rx}}{M_{cx}} \right| + \left| \frac{M_{ry}}{M_{cy}} \right| = 0.9$$
 Eq1 is less than or equal to 1.0 = "OK"

Member ID = "pe6"

Load Case = "6.03-0.9D1+1.0W3"

$$M_{rx} = -11.86 \cdot \text{kip} \cdot \text{in} \quad M_{ry} = -5.16 \cdot \text{kip} \cdot \text{in} \quad P_r = 0.61 \cdot \text{kip}$$

$$M_{cx} = 50.33 \cdot \text{kip} \cdot \text{in} \quad M_{cy} = 35.09 \cdot \text{kip} \cdot \text{in} \quad P_c = 49.44 \cdot \text{kip}$$

Eq. H.1-1:
$$\text{Eq2} := \left| \frac{P_r}{P_c} \right| + \left| \frac{M_{rx}}{M_{cx}} \right| + \left| \frac{M_{ry}}{M_{cy}} \right| = 0.4$$
 Eq2 is less than or equal to 1.0 = "OK"



4c. Profile Design - 110mm Tube

Section Properties :

$d = 4.331 \cdot \text{in}$	$b = 1.969 \cdot \text{in}$	Shape dimensions
$b_w = 2.075 \cdot \text{in}$	$t_w = 0.118 \cdot \text{in}$	
$b_f = 0.356 \cdot \text{in}$	$t_f = 0.12 \cdot \text{in}$	
$A_g = 1.582 \cdot \text{in}^2$		Cross-sectional area of Shape
$I_x = 3.02 \cdot \text{in}^4$	$I_y = 0.87 \cdot \text{in}^4$	Moment of inertia
$S_x = 1.29 \cdot \text{in}^3$	$S_y = 0.89 \cdot \text{in}^3$	Section Modulus
$r_x = 1.38 \cdot \text{in}$	$r_y = 0.74 \cdot \text{in}$	Radius of Gyration
$J = 0.58 \cdot \text{in}^4$		Torsional constant
$K_x = 1$	$K_y = 1$	Factor for buckling
$L_x = 240 \cdot \text{in}$	$L_y = 240 \cdot \text{in}$	Length for buckling
$L_b := L_y$		Length between Bracing Points



Selected Ratios :

$$\frac{b_w}{t_w} = 17.6 \quad \frac{b_f}{t_f} = 3 \quad \frac{K_x \cdot L_x}{r_x} = 173.8 \quad \frac{K_y \cdot L_y}{r_y} = 322.8$$

The following allowable stresses are based on values from the "2015 Aluminum Design Manual" :

Modulus of Elasticity : $E = 10100 \cdot \text{ksi}$

Design Axial Strengths:

Design Tensile Strength : $\phi P_{n,D} = 39.26 \cdot \text{kip}$ [Section D]

Design Compressive Strength : $\phi P_{n,E} = 1.16 \cdot \text{kip}$ [Section E]

Design Flexural Strengths:

Design Flexural Strength - Closed Section : $\phi M_{nx} = 36 \cdot \text{kip} \cdot \text{in}$ [Section F]

$\phi M_{ny} = 27 \cdot \text{kip} \cdot \text{in}$

Design Shear Strengths:

Design Shear Strength : $\phi V_{nx} = 8.37 \cdot \text{kip}$ [Section G]

$\phi V_{ny} = 1.44 \cdot \text{kip}$



Rainier Industries Ltd.
18375 Olympic Avenue South
Tukwilla, WA 98188
425-251-1900 (www.rainier.com)

Actual Stress:

Member ID = "pp400" Load Case = "6.04-0.9D1+1.0W4"

$$\begin{aligned} M_{rx} &= -7.99 \cdot \text{kip} \cdot \text{in} & M_{ry} &= -0.06 \cdot \text{kip} \cdot \text{in} & P_r &= -0.39 \cdot \text{kip} \\ M_{cx} &= 35.71 \cdot \text{kip} \cdot \text{in} & M_{cy} &= 27.37 \cdot \text{kip} \cdot \text{in} & P_c &= 1.16 \cdot \text{kip} \end{aligned}$$

Eq. H.1-1:
$$\text{Eq1} := \left| \frac{P_r}{P_c} \right| + \left| \frac{M_{rx}}{M_{cx}} \right| + \left| \frac{M_{ry}}{M_{cy}} \right| = 0.57$$
 Eq1 is less than or equal to 1.0 = "OK"

Member ID = "pp100" Load Case = "6.03-0.9D1+1.0W3"

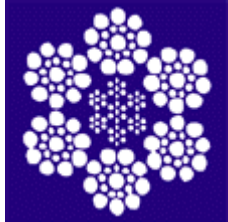
$$\begin{aligned} M_{rx} &= 6.6 \cdot \text{kip} \cdot \text{in} & M_{ry} &= 0 \cdot \text{kip} \cdot \text{in} & P_r &= 0.27 \cdot \text{kip} \\ M_{cx} &= 35.71 \cdot \text{kip} \cdot \text{in} & M_{cy} &= 27.37 \cdot \text{kip} \cdot \text{in} & P_c &= 39.26 \cdot \text{kip} \end{aligned}$$

Eq. H.1-1:
$$\text{Eq2} := \left| \frac{P_r}{P_c} \right| + \left| \frac{M_{rx}}{M_{cx}} \right| + \left| \frac{M_{ry}}{M_{cy}} \right| = 0.19$$
 Eq2 is less than or equal to 1.0 = "OK"



05a. Bracing Cable Assemblies

The roof bracing cables are constructed of 6x19 Galvanized EIPS Wire Rope.



The max factored load in a roof wind brace is $T_{max} = 738 \cdot \text{lbf}$.

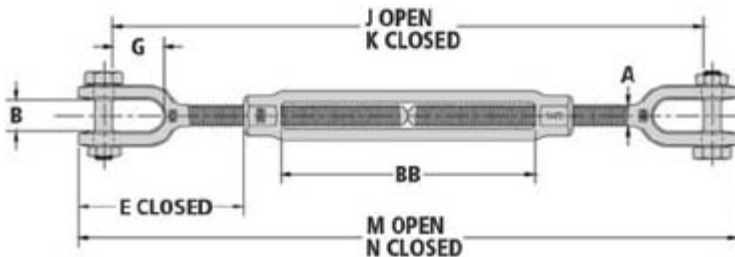
The nominal strength of $\phi = 0.250$ in wire rope is $T_{allow} = 6800 \cdot \text{lbf}$.

$$\text{Safety Factor} := \frac{T_{allow} \cdot 90\%}{T_{max}} = 8.29$$

Rope Diameter (In.)	Nominal Strength*, Tons (Bright & Drawn Galvanized) EIPS		Approximate Wt./Ft. (Lbs.)	
	IWRC	Fiber Core	IWRC	Fiber Core
1/4	3.40	3.02	0.116	0.105
5/16	5.27	4.69	0.18	0.164
3/8	7.55	6.71	0.26	0.236
7/16	10.2	9.09	0.35	0.32
1/2	13.3	11.8	0.46	0.42
9/16	16.8	14.9	0.59	0.53
5/8	20.6	18.3	0.72	0.66
3/4	29.4	26.2	1.04	0.95
7/8	39.8	35.4	1.42	1.29
1	51.7	46.0	1.85	1.68
1 1/8	65.0	57.9	2.34	2.13
1 1/4	79.9	71.0	2.89	2.63
1 3/8	96.0	85.4	3.50	3.18
1 1/2	114.0	101.0	4.16	3.78

USE a 6x19 Galvanized EIPS wire rope with a minimum diameter of $\phi = 0.2500$ in .

Adjustment of the roof bracing cables is through turnbuckles.



The max factored load in a roof wind brace is $T_{max} = 738 \cdot \text{lbf}$.

The working strength of $\phi = 0.375$ in turnbuckle is $T_{work} = 1200 \cdot \text{lbf}$.

The nominal strength of $\phi = 0.375$ in turnbuckle is $T_{allow} = 6000 \cdot \text{lbf}$.

$$\text{Safety Factor} := \frac{T_{allow}}{T_{max}} = 8.13$$

USE a turnbuckle with a minimum thread diameter of $\phi = 0.3750$ in .

Thread Diameter & Take Up (Inches)	Work Load Limit (Lbs.)*	Unit Weight (Lbs.)
† 1/4 x 4	500	.37
† 5/16 x 4-1/2	800	.56
† 3/8 x 6	1200	.85
1/2 x 6	2200	1.82
1/2 x 9	2200	2.29
1/2 x 12	2200	2.71
5/8 x 6	3500	3.21
5/8 x 9	3500	3.95
5/8 x 12	3500	4.58
3/4 x 6	5200	4.80
3/4 x 9	5200	5.85
3/4 x 12	5200	6.72
3/4 x 18	5200	8.45
7/8 x 12	7200	9.37
7/8 x 18	7200	11.80
1 x 6	10000	10.40

* Proof Load is 2.5 Times Work Load Limit.



Rainier Industries Ltd.
18375 Olympic Avenue South
Tukwilla, WA 98188
425-251-1900 (www.rainier.com)

This page intentionally left blank



5b. Bracing Member Design

Section Properties :

$$d = 4.331 \cdot \text{in} \quad b = 1.969 \cdot \text{in} \quad \text{Shape dimensions}$$

$$b_w = 2.000 \cdot \text{in} \quad t_w = 0.125 \cdot \text{in}$$

$$b_f = 2.000 \cdot \text{in} \quad t_f = 0.13 \cdot \text{in}$$

$$A_g = 0.736 \cdot \text{in}^2 \quad \text{Cross-sectional area of Shape}$$

$$I_x = 0.32 \cdot \text{in}^4 \quad I_y = 0.32 \cdot \text{in}^4 \quad \text{Moment of inertia}$$

$$S_x = 0.32 \cdot \text{in}^3 \quad S_y = 0.32 \cdot \text{in}^3 \quad \text{Section Modulus}$$

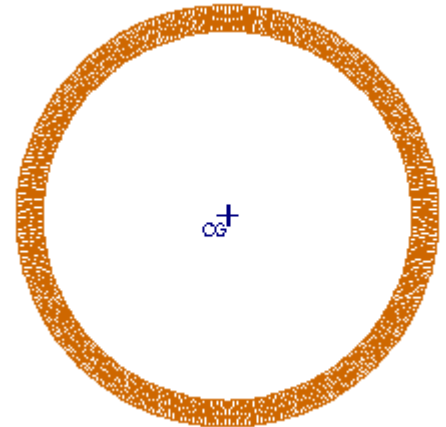
$$r_x = 0.66 \cdot \text{in} \quad r_y = 0.66 \cdot \text{in} \quad \text{Radius of Gyration}$$

$$J = 0.65 \cdot \text{in}^4 \quad \text{Torsional constant}$$

$$K_x = 1 \quad K_y = 1 \quad \text{Factor for buckling}$$

$$L_x = 65 \cdot \text{in} \quad L_y = 65 \cdot \text{in} \quad \text{Length for buckling}$$

$$L_b := L_y \quad \text{Length between Bracing Points}$$



Selected Ratios :

$$\frac{b_w}{t_w} = 16 \quad \frac{b_f}{t_f} = 16 \quad \frac{K_x \cdot L_x}{r_x} = 97.9 \quad \frac{K_y \cdot L_y}{r_y} = 97.9$$

The following allowable stresses are based on values from the "2015 Aluminum Design Manual" :

$$\text{Modulus of Elasticity :} \quad E = 10100 \cdot \text{ksi}$$

Design Axial Strengths:

$$\text{Design Tensile Strength :} \quad \phi P_{n,D} = 14.81 \cdot \text{kip} \quad [\text{Section D}]$$

$$\text{Design Compressive Strength :} \quad \phi P_{n,E} = 5.86 \cdot \text{kip} \quad [\text{Section E}]$$

Design Flexural Strengths:

$$\text{Design Flexural Strength - Closed Section :} \quad \phi M_{nx} = 12 \cdot \text{kip} \cdot \text{in} \quad [\text{Section F}]$$

$$\phi M_{ny} = 11 \cdot \text{kip} \cdot \text{in}$$

Design Shear Strengths:

$$\text{Design Shear Strength :} \quad \phi V_{nx} = 8.55 \cdot \text{kip} \quad [\text{Section G}]$$

$$\phi V_{ny} = 8.55 \cdot \text{kip}$$



Actual Stress - Eave Brace:

Member ID = "Eb106" Load Case = "1.01-1.4D1"

$$\begin{aligned}M_{rx} &= 0.03 \cdot \text{kip} \cdot \text{in} & M_{ry} &= 0 \cdot \text{kip} \cdot \text{in} & P_r &= -0.31 \cdot \text{kip} \\M_{cx} &= 12.17 \cdot \text{kip} \cdot \text{in} & M_{cy} &= 11.19 \cdot \text{kip} \cdot \text{in} & P_c &= 5.86 \cdot \text{kip}\end{aligned}$$

Eq. H.1-1:
$$\text{Eq1} := \left| \frac{P_r}{P_c} \right| + \left| \frac{M_{rx}}{M_{cx}} \right| + \left| \frac{M_{ry}}{M_{cy}} \right| = 0.06$$
 Eq1 is less than or equal to 1.0 = "OK"

Member ID = "Eb101" Load Case = "6.01-0.9D1+1.0W1"

$$\begin{aligned}M_{rx} &= 0.02 \cdot \text{kip} \cdot \text{in} & M_{ry} &= 0 \cdot \text{kip} \cdot \text{in} & P_r &= 2.95 \cdot \text{kip} \\M_{cx} &= 12.17 \cdot \text{kip} \cdot \text{in} & M_{cy} &= 11.19 \cdot \text{kip} \cdot \text{in} & P_c &= 14.81 \cdot \text{kip}\end{aligned}$$

Eq. H.1-1:
$$\text{Eq2} := \left| \frac{P_r}{P_c} \right| + \left| \frac{M_{rx}}{M_{cx}} \right| + \left| \frac{M_{ry}}{M_{cy}} \right| = 0.2$$
 Eq2 is less than or equal to 1.0 = "OK"

Actual Stress - Ridge Brace:

Member ID = "Eb106" Load Case = "1.01-1.4D1"

$$\begin{aligned}M_{rx} &= 0.03 \cdot \text{kip} \cdot \text{in} & M_{ry} &= 0 \cdot \text{kip} \cdot \text{in} & P_r &= -0.31 \cdot \text{kip} \\M_{cx} &= 12.17 \cdot \text{kip} \cdot \text{in} & M_{cy} &= 11.19 \cdot \text{kip} \cdot \text{in} & P_c &= 5.86 \cdot \text{kip}\end{aligned}$$

Eq. H.1-1:
$$\text{Eq1} := \left| \frac{P_r}{P_c} \right| + \left| \frac{M_{rx}}{M_{cx}} \right| + \left| \frac{M_{ry}}{M_{cy}} \right| = 0.06$$
 Eq1 is less than or equal to 1.0 = "OK"

Member ID = "Eb101" Load Case = "6.01-0.9D1+1.0W1"

$$\begin{aligned}M_{rx} &= 0.02 \cdot \text{kip} \cdot \text{in} & M_{ry} &= 0 \cdot \text{kip} \cdot \text{in} & P_r &= 2.95 \cdot \text{kip} \\M_{cx} &= 12.17 \cdot \text{kip} \cdot \text{in} & M_{cy} &= 11.19 \cdot \text{kip} \cdot \text{in} & P_c &= 14.81 \cdot \text{kip}\end{aligned}$$

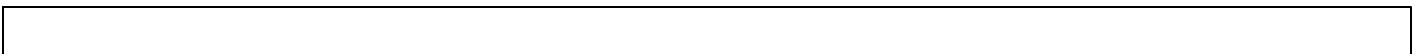
Eq. H.1-1:
$$\text{Eq2} := \left| \frac{P_r}{P_c} \right| + \left| \frac{M_{rx}}{M_{cx}} \right| + \left| \frac{M_{ry}}{M_{cy}} \right| = 0.2$$
 Eq2 is less than or equal to 1.0 = "OK"



Rainier Industries Ltd.
18375 Olympic Avenue South
Tukwilla, WA 98188
425-251-1900 (www.rainier.com)

APPENDIX A

COMPUTER MODEL INPUT





Rainier Industries Ltd.
18375 Olympic Avenue South
Tukwilla, WA 98188
425-251-1900 (www.rainier.com)

This page intentionally left blank

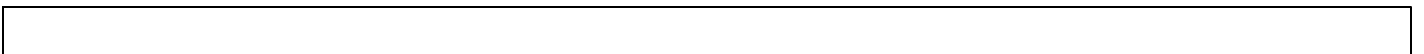


Table of Contents

- Nodes
- Nodal Supports
- Materials
- Service Load Cases
- Result Cases

Name	X in	Y in	Z in	Fix DX	Fix DY	Fix DZ	Fix RX	Fix RY	Fix RZ
N001	0.00	207.60	0.00	No	No	No	No	No	No
N002	131.76	117.02	0.00	No	No	No	No	No	No
N003	-131.76	117.02	0.00	No	No	No	No	No	No
N004	131.76	117.02	720.00	No	No	No	No	No	No
N005	0.00	207.60	240.00	No	No	No	No	No	No
N006	-131.76	117.02	720.00	No	No	No	No	No	No
N007	175.76	99.00	0.00	No	No	No	No	No	No
N008	175.76	99.00	720.00	No	No	No	No	No	No
N009	-175.20	99.00	0.00	No	No	No	No	No	No
N010	-175.20	99.00	720.00	No	No	No	No	No	No
N011	0.00	207.60	720.00	No	No	No	No	No	No
N012	0.00	207.60	480.00	No	No	No	No	No	No
N014	27.04	193.62	0.00	No	No	No	No	No	No
N015	27.04	193.62	240.00	No	No	No	No	No	No
N016	27.04	193.62	720.00	No	No	No	No	No	No
N017	27.04	193.62	480.00	No	No	No	No	No	No
N019	-27.04	193.62	0.00	No	No	No	No	No	No
N020	-27.04	193.62	240.00	No	No	No	No	No	No
N021	-27.04	193.62	720.00	No	No	No	No	No	No
N022	-27.04	193.62	480.00	No	No	No	No	No	No
N101	-174.13	84.61	240.00	No	No	No	No	No	No
N102	-135.60	137.49	240.00	No	No	No	No	No	No
N105	135.60	137.49	240.00	No	No	No	No	No	No
N106	175.76	84.61	240.00	No	No	No	No	No	No
N201	-175.20	84.61	480.00	No	No	No	No	No	No
N202	-135.60	137.49	480.00	No	No	No	No	No	No
N205	135.60	137.49	480.00	No	No	No	No	No	No
N206	175.76	84.61	480.00	No	No	No	No	No	No
n003	-175.20	117.02	0.00	No	No	No	No	No	No
n004	-135.60	137.49	0.00	No	No	No	No	No	No
n008	135.60	137.49	0.00	No	No	No	No	No	No
n009	175.20	117.02	0.00	No	No	No	No	No	No
n102	-175.20	84.61	240.00	No	No	No	No	No	No
n103	175.20	117.02	240.00	No	No	No	No	No	No
n109	175.20	117.02	240.00	No	No	No	No	No	No
n203	-135.60	137.49	720.00	No	No	No	No	No	No
n204	-135.60	137.49	720.00	No	No	No	No	No	No
n208	135.60	137.49	720.00	No	No	No	No	No	No
n209	175.20	117.02	720.00	No	No	No	No	No	No
n212	-175.20	117.02	480.00	No	No	No	No	No	No
n218	175.20	117.02	480.00	No	No	No	No	No	No
ng1	-247.76	0.00	0.00	Yes	Yes	Yes	Yes	Yes	Yes
ng2	247.76	0.00	0.00	Yes	Yes	Yes	Yes	Yes	Yes
ng3	-247.76	0.00	240.00	Yes	Yes	Yes	Yes	Yes	Yes
ng4	247.76	0.00	240.00	Yes	Yes	Yes	Yes	Yes	Yes
ng7	-247.76	0.00	480.00	Yes	Yes	Yes	Yes	Yes	Yes
ng8	247.76	0.00	480.00	Yes	Yes	Yes	Yes	Yes	Yes
ng9	-247.76	0.00	720.00	Yes	Yes	Yes	Yes	Yes	Yes
ng10	247.76	0.00	720.00	Yes	Yes	Yes	Yes	Yes	Yes
np1	-175.20	0.00	0.00	Yes	No	No	No	No	No
np3	175.76	0.00	0.00	Yes	No	No	No	No	No
np4	-175.20	0.00	240.00	Yes	No	No	No	No	No
np5	175.76	0.00	240.00	Yes	No	No	No	No	No
np8	-175.20	0.00	480.00	Yes	No	No	No	No	No
np9	175.76	0.00	480.00	Yes	No	No	No	No	No
np10	-175.20	0.00	720.00	Yes	No	No	No	No	No
np12	175.76	0.00	720.00	Yes	No	No	No	No	No

Nodal Supports

Name	Fix DX	Fix DY	Fix DZ	Fix RX	Fix RY	Fix RZ
ng1	Yes	Yes	Yes	Yes	Yes	Yes

Nodal Supports

Name	Fix DX	Fix DY	Fix DZ	Fix RX	Fix RY	Fix RZ
ng2	Yes	Yes	Yes	Yes	Yes	Yes
ng3	Yes	Yes	Yes	Yes	Yes	Yes
ng4	Yes	Yes	Yes	Yes	Yes	Yes
ng7	Yes	Yes	Yes	Yes	Yes	Yes
ng8	Yes	Yes	Yes	Yes	Yes	Yes
ng9	Yes	Yes	Yes	Yes	Yes	Yes
ng10	Yes	Yes	Yes	Yes	Yes	Yes
np1	Yes	Yes	Yes	No	No	No
np3	Yes	Yes	Yes	No	No	No
np4	Yes	Yes	Yes	No	No	No
np5	Yes	Yes	Yes	No	No	No
np8	Yes	Yes	Yes	No	No	No
np9	Yes	Yes	Yes	No	No	No
np10	Yes	Yes	Yes	No	No	No
np12	Yes	Yes	Yes	No	No	No

Materials

Name	Elasticity, E psi	Poisson, ν	Density, γ lb/m ³	Thermal, α in/in/deg-F	Shear Modulus, G psi
6061-T6-E-All	101,000,000.00	0.33	0.10	1.30E-005	3796992.48
ASTM A36	290,000,000.00	0.29	0.28	6.39E-006	11240310.08
Weightless Steel (FY = 50ksi)	290,000,000.00	0.29	0.00	6.39E-006	11240310.08

Service Load Cases

Name	Source	Vertical Direction
D1	Dead Loads	Exclude
W1	Other Loads	Exclude
W2	Other Loads	Exclude
W3	Other Loads	Exclude
W4	Other Loads	Exclude

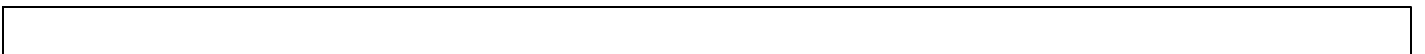
Result Cases

Name	SelfWeight	ID
1.01-1.4D1		6
3.12-1.2D1+1.650+0.5W1		7
3.13-1.2D1+1.650+0.5W2		8
3.14-1.2D1+1.650+0.5W3		9
3.15-1.2D1+1.650+0.5W4		10
3.21-1.2D1+1.651+0.5W1		11
3.22-1.2D1+1.652+0.5W2		12
3.23-1.2D1+1.653+0.5W3		13
3.24-1.2D1+1.654+0.5W4		14
6.01-0.9D1+1.0W1		15
6.02-0.9D1+1.0W2		16
6.03-0.9D1+1.0W3		17
6.04-0.9D1+1.0W4		18



Rainier Industries Ltd.
18375 Olympic Avenue South
Tukwilla, WA 98188
425-251-1900 (www.rainier.com)

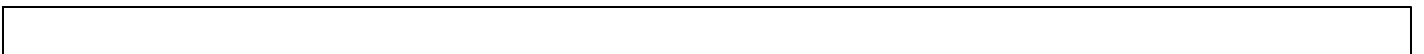
This page intentionally left blank





Rainier Industries Ltd.
18375 Olympic Avenue South
Tukwilla, WA 98188
425-251-1900 (www.rainier.com)

APPENDIX B
COMPUTER MODEL OUTPUT





Rainier Industries Ltd.
18375 Olympic Avenue South
Tukwilla, WA 98188
425-251-1900 (www.rainier.com)

This page intentionally left blank

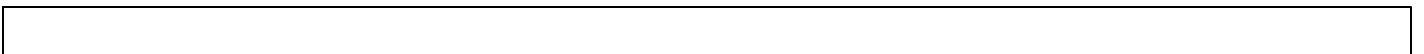


Table of Contents

Result Cases	Member Forces	Node Reactions	Node Results
--------------	---------------	----------------	--------------

Result Cases

Member	Name	ID
1.01-1.4D1		6
3.12-1.2D1+1.650+0.5W1		7
3.13-1.2D1+1.650+0.5W2		8
3.14-1.2D1+1.650+0.5W3		9
3.15-1.2D1+1.650+0.5W4		10
3.21-1.2D1+1.651+0.5W1		11
3.22-1.2D1+1.652+0.5W2		12
3.23-1.2D1+1.653+0.5W3		13
3.24-1.2D1+1.654+0.5W4		14
6.01-0.9D1+1.0W1		15
6.02-0.9D1+1.0W2		16
6.03-0.9D1+1.0W3		17
6.04-0.9D1+1.0W4		18

Member Forces

Member	Fx Min lb	Fx Max lb	Vy lb	Mz Min lb-in	Mz Max lb-in
C101	-1775.74 (15)	913.22 (17)	2439.52 (15)	-2610.18 (15)	1338.68 (17)
Eb101	-3017.20 (15)	1552.53 (17)	1.99 (6)	0.00 (15)	32.49 (6)
Eb102	-2313.44 (18)	1567.87 (17)	-2.07 (6)	0.00 (18)	34.37 (6)
Eb201	-3040.12 (15)	932.63 (17)	2.04 (6)	0.00 (17)	33.72 (6)
Eb202	-1322.59 (15)	1488.51 (16)	-2.07 (6)	0.00 (18)	34.37 (6)
Eb1000	-197.56 (6)	101.09 (15)	2.24 (6)	0.00 (17)	26.32 (6)
Eb1001	-334.59 (15)	-107.81 (18)	-2.27 (6)	0.00 (14)	26.96 (6)
Eb1002	-183.37 (6)	538.75 (15)	-2.24 (6)	0.00 (15)	26.32 (6)
Eb1003	-699.99 (15)	-89.75 (18)	-2.27 (6)	0.00 (14)	26.96 (6)
Ns1	-3046.20 (15)	913.46 (17)	-71.83 (18)	-7111.33 (18)	4107.29 (17)
Ns001	-815.65 (15)	175.99 (18)	-541.82 (15)	-14969.79 (15)	9285.59 (17)
Ns2	-1072.78 (18)	915.19 (17)	732.08 (18)	-7255.01 (18)	4360.47 (17)
Ns002	-2098.66 (15)	935.19 (17)	433.04 (18)	-14969.79 (15)	9285.59 (17)
Ns003	-1643.99 (18)	935.65 (17)	-493.35 (15)	-11033.97 (18)	18315.93 (15)
Ns4	-3064.72 (15)	971.80 (17)	170.29 (17)	-9411.77 (15)	7175.92 (17)
Ns004	-788.18 (18)	-164.36 (16)	364.25 (17)	-11135.04 (15)	8476.15 (17)
Ns5	-1010.36 (18)	980.40 (17)	-2.88.78 (15)	-7255.01 (18)	8476.40 (16)
Ns005	-1035.84 (15)	1035.68 (17)	-609.95 (18)	-20983.07 (16)	10670.93 (18)
Ns6	-1650.41 (18)	918.04 (17)	598.07 (15)	-9011.85 (15)	11150.40 (15)
Ns006	-818.31 (15)	-42.57 (6)	-526.86 (15)	-14542.73 (15)	2880.64 (17)
Ns7	-2105.08 (15)	917.58 (17)	439.09 (16)	-6739.13 (16)	8209.03 (16)
Ns007	-1273.67 (18)	1037.40 (17)	930.22 (15)	-9385.94 (17)	31490.38 (15)
Ns008	-2091.06 (15)	345.36 (16)	-329.43 (16)	-14942.73 (15)	35494.17 (18)
Ns009	-787.01 (15)	55.15 (18)	-295.31 (15)	-11195.10 (15)	53240.00 (17)
Ns010	-1337.15 (15)	759.88 (16)	-609.41 (16)	-20964.82 (16)	6295.14 (18)
Ns011	-1113.02 (15)	606.85 (16)	-480.08 (15)	-4602.37 (18)	17074.66 (15)
Ns14	-2944.12 (15)	595.07 (17)	-478.25 (15)	-40465.07 (15)	20641.68 (17)
Ns014	-586.59 (17)	177.10 (18)	496.65 (18)	-11033.97 (18)	10223.12 (16)
Ns15	-1285.97 (18)	1165.14 (16)	343.75 (18)	-29084.48 (18)	20999.43 (16)
Ns015	-1036.38 (18)	910.86 (16)	926.79 (15)	-5954.21 (17)	31687.63 (15)
Ns16	-1032.87 (16)	581.71 (18)	1297.48 (15)	-37854.90 (15)	19303.00 (17)
Ns016	-663.25 (17)	-164.78 (6)	-775.53 (15)	-2424.61 (15)	17314.95 (16)
Ns17	-668.68 (17)	847.71 (15)	-1044.30 (18)	-29084.48 (18)	20999.43 (16)
Ns017	-302.67 (18)	164.11 (15)	-348.78 (16)	-4602.37 (18)	9967.38 (16)
Ns18	-384.23 (17)	1909.10 (15)	-478.62 (18)	-8666.97 (18)	4818.86 (18)
Ns018	-505.26 (17)	54.19 (18)	-776.65 (15)	-4594.35 (18)	17283.28 (16)
Ns19	-613.62 (16)	815.43 (18)	506.35 (15)	-16185.66 (15)	6135.71 (15)
Ns26	-2925.10 (15)	411.74 (17)	-472.19 (15)	-39951.67 (15)	12271.02 (17)
Ns27	-680.66 (18)	1165.90 (16)	-248.41 (16)	-14010.68 (15)	21018.27 (16)
Ns28	-1031.06 (16)	207.35 (18)	1349.04 (15)	-39951.67 (15)	12271.02 (17)
Ns29	-337.50 (17)	851.60 (15)	650.51 (16)	-14010.68 (15)	21018.27 (16)
Ns30	-265.33 (17)	1945.13 (15)	-395.23 (15)	-1863.37 (18)	4530.31 (15)
Ns31	-617.45 (16)	62.27 (6)	508.75 (15)	-16237.13 (15)	6191.19 (15)
Ns38	-2905.51 (15)	194.60 (17)	-35.01 (18)	-3466.13 (18)	2145.89 (16)
Ns39	-1021.59 (15)	451.11 (16)	80.05 (15)	-7925.02 (15)	1064.96 (16)
Ns41	-3091.72 (15)	251.52 (17)	-522.86 (15)	-11974.28 (15)	2995.98 (17)

Member Forces

Member	Fx Min lb	Fx Max lb	Vy lb	Mz Min lb-in	Mz Max lb-in
Ns42	-741.66 (18)	680.41 (16)	-589.77 (15)	-7925.02 (15)	10063.43 (16)
Ns43	-1119.44 (15)	589.24 (16)	611.34 (15)	-11482.60 (15)	9271.30 (15)
Ns44	-2097.48 (15)	327.75 (16)	447.17 (16)	-5563.02 (16)	9745.47 (16)
Ns45	12.34 (13)	2291.23 (15)	-0.21 (13)	0.00 (13)	7.36 (13)
gg4	10.61 (13)	31.76 (17)	0.00 (13)	0.00 (13)	7.36 (13)
gg5	203.33 (13)	1609.08 (15)	-0.21 (13)	0.00 (13)	7.36 (13)
gg6	205.43 (13)	528.73 (17)	-0.21 (13)	0.00 (13)	7.36 (13)
gg9	90.61 (13)	1590.03 (16)	-0.21 (13)	0.00 (13)	7.36 (13)
gg10	90.94 (13)	300.18 (17)	-0.21 (13)	0.00 (13)	7.36 (13)
gg11	0.20 (13)	2156.51 (15)	0.00 (13)	0.00 (13)	7.36 (13)
gg12	8.57 (17)	9.08 (17)	0.16 (17)	0.00 (17)	5.52 (17)
gh1	-822.44 (17)	1769.17 (15)	0.02 (17)	-0.80 (17)	0.45 (15)
gh001	-395.22 (17)	1826.27 (15)	81.57 (15)	-7736.39 (15)	7658.78 (15)
gh002	-817.52 (17)	1862.00 (15)	0.02 (17)	-173.89 (17)	9.80 (15)
gh4	-301.17 (16)	1329.18 (15)	0.02 (17)	-4.45 (15)	0.80 (17)
gh5	-180.12 (15)	2473.48 (15)	-180.12 (15)	-1099.99 (6)	7658.78 (15)
gh8	-266.01 (17)	1714.58 (17)	-181.91 (15)	-7736.59 (15)	0.00 (18)
gh1	-2024.39 (18)	2.79 (6)	2.79 (6)	0.00 (15)	37.68 (6)
pb2	-1041.27 (18)	1915.42 (17)	-2.79 (6)	0.00 (15)	37.68 (6)
pb4	-1191.96 (18)	1590.88 (16)	-2.79 (6)	0.00 (6)	37.68 (6)
pb5	-1412.04 (15)	913.32 (16)	2.79 (6)	0.00 (15)	37.68 (6)
pe1	-569.78 (17)	1.37 (15)	-116.29 (17)	-10249.15 (17)	12598.95 (17)
pe001	-441.14 (17)	1369.56 (15)	-69.02 (18)	-6703.14 (18)	4800.13 (18)
pe2	-569.87 (17)	4.28 (15)	-116.25 (17)	-10255.32 (17)	12598.95 (17)
pe5	-310.14 (17)	2.12 (15)	-108.07 (18)	-12741.13 (18)	8135.69 (18)
pe005	-441.42 (17)	580.24 (18)	-68.95 (18)	-6697.77 (18)	4789.05 (18)
pe6	-309.62 (17)	3.60 (15)	-107.80 (18)	-12698.95 (18)	8113.59 (18)
pp001	-1899.68 (15)	714.71 (17)	39.30 (18)	-2072.88 (18)	2524.36 (18)
pp100	-1894.44 (15)	122.50 (17)	-33.77 (18)	-2772.88 (18)	2232.75 (17)
pp400	-119.37 (13)	-67.16 (16)	-47.81 (18)	-5116.20 (18)	2224.48 (18)
rb100	119.37 (13)	37.57 (17)	0.00 (13)	0.00 (13)	0.01 (13)
rb101	86.96 (16)	1763.54 (15)	0.00 (6)	0.00 (6)	0.01 (6)
rb102	113.08 (12)	378.42 (17)	0.00 (13)	0.00 (13)	0.01 (12)
rb103	175.75 (6)	931.26 (18)	0.00 (6)	0.00 (6)	0.01 (6)
rb200	85.46 (16)	1761.04 (15)	0.00 (6)	0.00 (11)	0.01 (6)
rb201	238.25 (13)	616.33 (17)	0.00 (13)	0.00 (13)	0.01 (13)
rb202	175.61 (6)	700.20 (18)	0.00 (6)	0.00 (6)	0.01 (6)
rb203	112.31 (12)	616.09 (17)	0.00 (12)	0.00 (12)	0.01 (12)

Node Reactions

Node	Result Case	FX lb	FY lb	FZ lb	MX lb-in	MY lb-in	MZ lb-in
ng1	6.01-0.9D1+1.0W1	-1207.30	-1946.74	0.00	0.00	0.00	0.00
np1	6.01-0.9D1+1.0W1	66.13	3046.20	2.52	0.00	0.00	0.00
np3	1.01-1.4D1	-23.88	2771.16	3.47	0.00	0.00	0.00
np4	6.01-0.9D1+1.0W1	478.23	2944.12	0.12	0.00	0.00	0.00
np5	6.03-0.9D1+1.0W3	241.64	-572.69	-128.89	0.00	0.00	0.00

Node Results

Node	Result Case	DX in	DY in	DZ in
N011	6.01-0.9D1+1.0W1	1.18	-0.07	-0.05
N022	6.01-0.9D1+1.0W1	1.77	-1.77	0.00
N101	6.04-0.9D1+1.0W4	-0.86	-0.01	6.26
N105	6.02-0.9D1+1.0W2	1.09	0.70	0.02
N205	6.01-0.9D1+1.0W1	2.22	0.41	0.00
n004	6.04-0.9D1+1.0W4	0.09	-0.23	8.06



Rainier Industries Ltd.
18375 Olympic Avenue South
Tukwilla, WA 98188
425-251-1900 (www.rainier.com)

This page intentionally left blank

