THE APPROVED CONSTRUCTION PLANS, DOCUMENTS AND ALL ENGINEERING MUST BE POSTED ON THE JOB AT ALL INSPECTIONS IN A VISIBLE AND READILY ACCESSIBLE LOCATION.

FULL SIZED LEDGIBLE COLOR PLANS ARE REQUIRED TO BE PROVIDED BY THE PERMITEE ON SITE FOR INSPECTION

City of Puyallup Building ACCEPTED
JMontgomery 03/16/2023 3:07:02 PM

PRCA20220482

AHBL

PROJECT MEMO

City of Puyallup
Development & Permitting Services
ISSUED PERMIT

Building	Planning
Engineering	Public Works
Fire	Traffic

TO:	Jason Cornell Step By Step 3303 8th Ave SE, Puyallup, WA	**DATE:**	January 6, 2023
FROM:	Andrew McEachern, P.E., S.E. Tacoma - (253) 383-2422	**PROJECT NO.:**	2220149.20
		PROJECT NAME:	Step By Step Greenhouse Expansion
SUBJECT:	Structural Evaluation of Proposed Greenhouse Structure		

AHBL was recently asked by Step By Step to evaluate the structural design of a proposed Greenhouse Expansion to be located at their facility in Puyallup, WA. The purpose of our review was to determine the adequacy of the original greenhouse design, which was originally designed to comply with the IBC 2015 and ASCE 7-10 building codes.

AHBL was provided a copy of the original design calculations from Harnois Greenhouses (dated June 8th, 2017) as well as a supplemental letter from Harnois Greenhouses (dated December 12th, 2022) which updated the project design criteria to conform with the IBC 2018 and ASCE 7-16 building codes. Additionally, AHBL had previously designed the greenhouse foundations to comply with the IBC 2018 and ASCE 7-16 building codes. It is our understanding that the foundation design has already been reviewed and approved by the City of Puyallup.

Based upon our review of the original design criteria and comparison with the current design criteria required by the IBC 2018, it appears that the proposed greenhouse structures have been designed to meet or exceed the code required vertical and lateral loads. No modifications to the original greenhouse design appear to be necessary to comply with the structural requirements of the current building code (IBC 2018 and ASCE 7-16).

A summary of the original design criteria used by Harnois Greenhouses for the greenhouse structure is:

Snow Load Criteria:

- IBC 2015: 30 psf ground snow load, risk category II, heated greenhouse (Ct = 0.85)
- IBC 2018: 30 psf ground snow load, risk category II, heated greenhouse (Ct = 0.85)

Wind Criteria:

- IBC 2015: 110 mph (ultimate), 3-sec. gust, risk category II, exposure B, K_{zt} = 1, Partially Enclosed
- IBC 2018: 97 mph (basic wind speed), 3-sec. gust, risk category II, exp C, K_{zt} = 1, Partially Enclosed

Seismic Criteria:

- IBC 2015: S_s = 1.252, S_{ds} = 0.834, I_e = 1.0, risk category II, site class D, design category D
- IBC 2018: Additional information not provided by Harnois Greenhouses

In comparison, the minimum structural design criteria per the IBC 2018 determined by AHBL is:

- **Snow Load Criteria:** 18 psf or 25 psf ground snow load, risk category II, heated greenhouse
- **Wind Criteria:** 98 mph, 3-sec. gust, risk category II, exposure C, K_{zt} = 1, Partially Enclosed
- **Seismic Criteria:** S_s = 1.252, S_{ds} = 1.002, I_e = 1.0, risk category II, site class D-default, design category D

According to table 7.2-5 from ASCE 7-16, the design ground snow load in Puyallup is 18 psf. However, a typical ground snow load of 25 psf is used throughout low lying areas of the Puget Sound. Both values are less than the 30 psf ground snow load used in the original design. Thus, the original design is still valid and complies with the current IBC 2018 and ASCE 7-16.

According to figure 26.5-1B from ASCE 7-16 the current design wind speed is 98 mph, versus 110 mph used in the original design based on ASCE 7-10. However, the difference in design wind speed is primarily the result of changes to the wind design analysis methodology between the IBC 2015 and 2018 building codes. The calculated design wind pressures will be roughly equivalent between these (2) wind design methodologies / building codes. Therefore, the original wind analysis based on the older edition of ASCE 7 should still be considered valid. Please see attached ASCE 7-10 and ASCE 7-16 hazard reports.

For the seismic design criteria there is a slight difference between the original ASCE 7-10 seismic design values and the current ASCE 7-16 requirements. Harnois Greenhouses used an S_{ds} value of 0.834 whereas the current ASCE 7-16 code requires an S_{ds} value of 1.002. This variation is a result of changes to the minimum soil values that can be assumed without a geotechnical report, rather than an increase in the code minimum seismic accelerations. However, due to the light weight of the greenhouse structure, the lateral force resisting system for the greenhouse will be governed by wind design, rather than seismic loads. Therefore, the original structural design for the greenhouse is structurally acceptable even with the variation in the seismic design criteria.

If you have any questions, please call us at (253) 383-2422.

ADM/

Q:\2022\2220149\20_STR\NON_CAD\CALCs\Letter\2220149 memo01 - Greenhouse Code Review.docx

01/06/2023

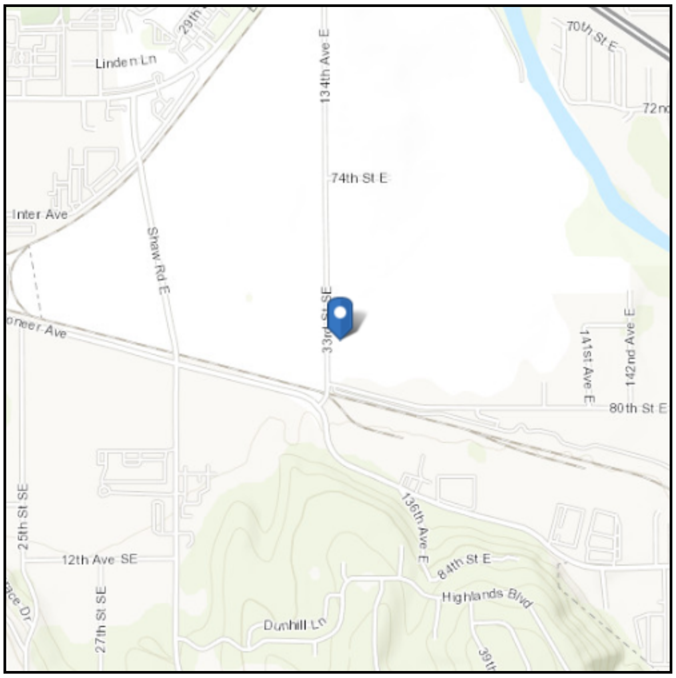
PRCA20220482

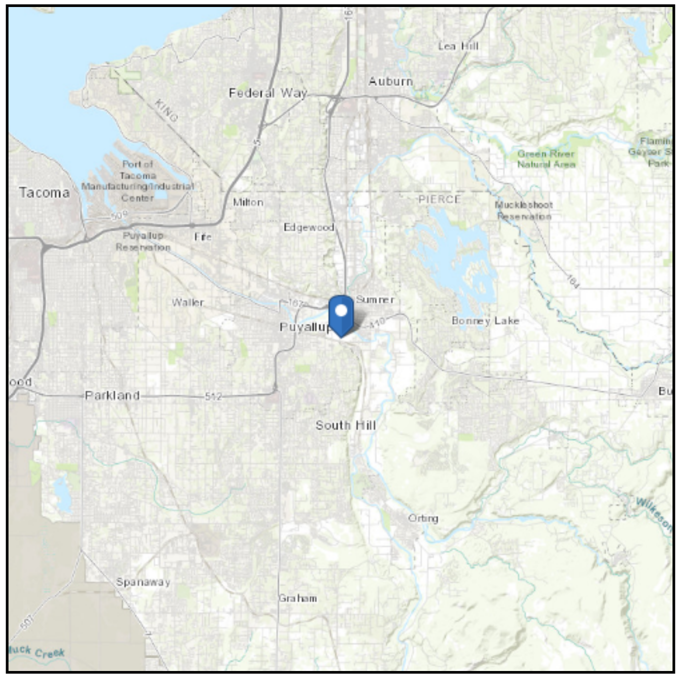
ASCE 7 Hazards Report

Address:
3303 8th Ave SE
Puyallup, Washington
98372

Standard: ASCE/SEI 7-10
Risk Category: II
Soil Class: D - Stiff Soil

Latitude: 47.186031
Longitude: -122.250349
Elevation: 73.75 ft (NAVD 88)





Wind

Results:

Wind Speed	110 Vmph
10-year MRI	72 Vmph
25-year MRI	79 Vmph
50-year MRI	85 Vmph
100-year MRI	91 Vmph

Data Source:	ASCE/SEI 7-10, Fig. 26.5-1A and Figs. CC-1–CC-4, and Section 26.5.2, incorporating errata of March 12, 2014
Date Accessed:	Fri Jan 06 2023

Value provided is 3-second gust wind speeds at 33 ft above ground for Exposure C Category, based on linear interpolation between contours. Wind speeds are interpolated in accordance with the 7-10 Standard. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (annual exceedance probability = 0.00143, MRI = 700 years).

Site is not in a hurricane-prone region as defined in ASCE/SEI 7-10 Section 26.2.

Seismic

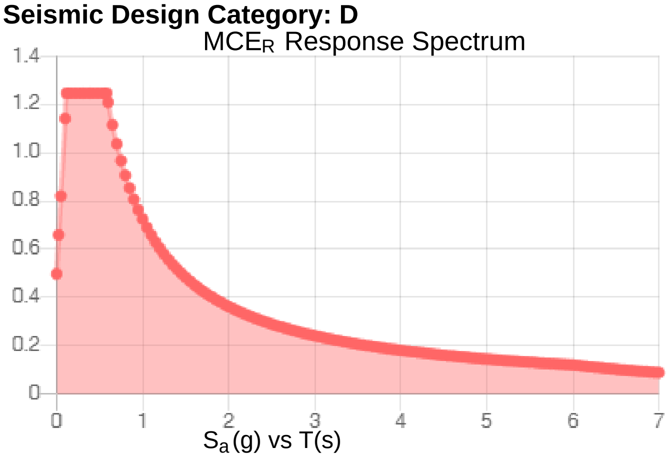
D - Stiff Soil

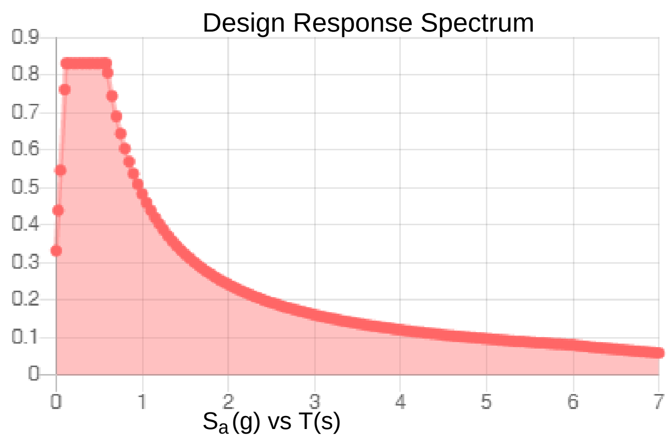
Site Soil Class:

Results:

S_S :	1.242	S_{D1} :	0.483
S_1 :	0.476	T_L :	6
F_a :	1.003	PGA :	0.5
F_v :	1.524	PGA_M :	0.5
S_{MS} :	1.246	F_{PGA} :	1
S_{M1} :	0.725	I_e :	1
S_{DS} :	0.831		

Seismic Design Category: D





Data Accessed: **Fri Jan 06 2023**

Date Source:

USGS Seismic Design Maps based on ASCE/SEI 7-10, incorporating Supplement 1 and errata of March 31, 2013, and ASCE/SEI 7-10 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-10 Ch. 21 are available from USGS.

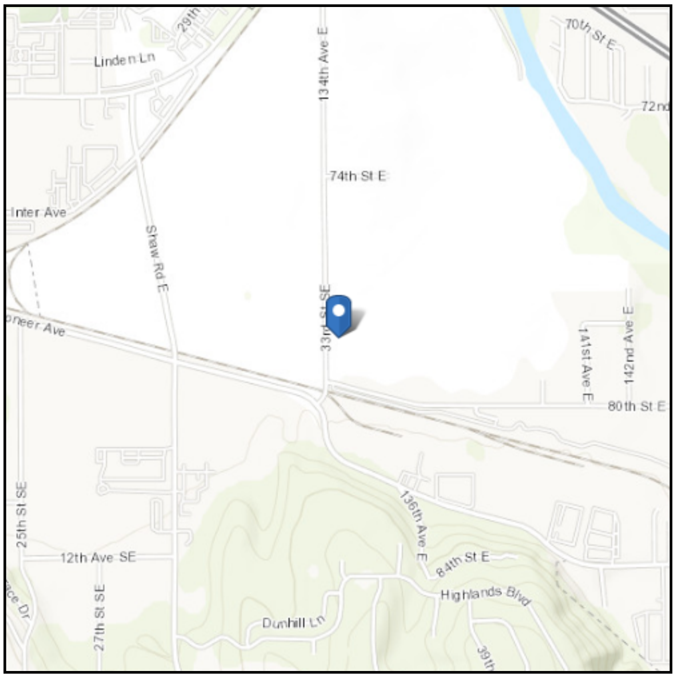
PRCA20220482

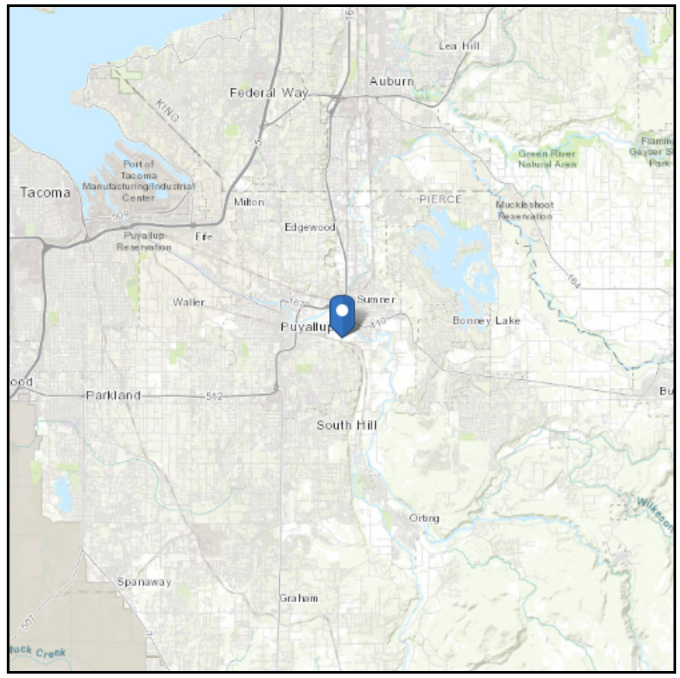
ASCE 7 Hazards Report

Address:
3303 8th Ave SE
Puyallup, Washington
98372

Standard: ASCE/SEI 7-16
Risk Category: II
Soil Class: D - Default (see Section 11.4.3)

Latitude: 47.186031
Longitude: -122.250349
Elevation: 73.75 ft (NAVD 88)





Wind

Results:

Wind Speed	98 Vmph
10-year MRI	67 Vmph
25-year MRI	74 Vmph
50-year MRI	78 Vmph
100-year MRI	83 Vmph

Data Source:	ASCE/SEI 7-16, Fig. 26.5-1B and Figs. CC.2-1–CC.2-4, and Section 26.5.2
Date Accessed:	Fri Jan 06 2023

Value provided is 3-second gust wind speeds at 33 ft above ground for Exposure C Category, based on linear interpolation between contours. Wind speeds are interpolated in accordance with the 7-16 Standard. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (annual exceedance probability = 0.00143, MRI = 700 years).

Site is not in a hurricane-prone region as defined in ASCE/SEI 7-16 Section 26.2.

ASCE AMERICAN SOCIETY OF CIVIL ENGINEERS

Seismic

Site Soil Class: D - Default (see Section 11.4.3)

Results:

S_S :	1.252	S_{D1} :	N/A
S_1 :	0.431	T_L :	6
F_a :	1.2	PGA :	0.5
F_v :	N/A	PGA_M :	0.6
S_{MS} :	1.502	F_{PGA} :	1.2
S_{M1} :	N/A	I_e :	1
S_{DS} :	1.002	C_v :	1.35

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

Data Accessed: Fri Jan 06 2023

Date Source: USGS Seismic Design Maps

GREENHOUSES HARNOIS

December 12th, 2022

STEP BY STEP
PUYALLUP, WA
USA, 98372

Ref: (1) Luminosa (S9) 30' x 144', 12' under gutter
PJ-5251

To whom it may concern,

Hereby, we confirm that the Luminosa greenhouse system manufactured by Les Industries Harnois Inc. per the project in reference conforms to the following standards regarding structural capacity.

Wind Speed: 97 mph, 3-sec. gust, risk category II, exposition C
Snow Load: 30 psf ground snow load, risk category II, heated greenhouse
Reference: IBC 2018 / ASCE 7-16

Please note that all design calculations and structural requirements are based on relating sections of the IBC 2018. Our 3D structural software does compute all members according to the Limit States design standard AISC 360-16 (LRFD).

This notice clarifies and complements all documents and reports already provided for this project.

Best regards,

LES INDUSTRIES HARNOIS INC.

Genadiy Ebert, P. Eng.

1044, Principale
Saint-Thomas
Québec
Canada, J0K 3L0

T. Canada / United States
1 888 427.6647
International
1 450 756.1041

F. 450 756.8389
E. info@harnois.com

harnois.com

PRCA20220482

1044 Principale, St-Thomas de Joliette, QC. J0K 3L0
Phone: 1-888-HARNOIS **Fax**: (450) 756-8389

June 8th, 2017

STEP BY STEP
PUYALLUP, WA
USA, 98271

Ref: (1) Luminosa (S9) 30' x 144' @ 12' under gutter
PJ-1644rev3, Order 184732
Step by Step greenhouses
Puyallup, WA, 98271

To whom it may concern:

We are pleased to submit to you engineering details and foundations design parameters about the greenhouse of referenced project. Please note that our 3D structural software does compute all members according to AISC 360-10 (LRFD). The modeling was done using de design criteria of International Building Code 2015 for the town of Puyallup, WA. The Luminosa S8 is a light steel structure, moment resisting frame in lateral axis, and braced resisting frame in longitudinal axis.

Please feel free to contact me for any questions.

Regards,

LES INDUSTRIES HARNOIS INC.

Carl Savard, P. Eng.

PRCA20220482

GREENHOUSES HARNOIS

1044 rue Principale, St-Thomas de Joliette, Qué. J0K 3L0
Tél: 1-888-HARNOIS **Fax**: (450) 756-8389

GREENHOUSE DESIGN

LUMINOSA S9 30’ @ 12’ GUTTER
(1) bay x 144’ (4 320 ft2)

STRUCTURAL SPECIFICATIONS & FOUNDATION DESIGN PARAMETERS

STEP BY STEP, 2017

1- Structural description of the greenhouse.

Structural composition:

All steel members have a minimum yield of 50 000 psi.
All steel members tubes, arches, interior posts, are galvanized treated galvalum AZ150.
All steel sheets, gutters, are galvanized treated Z600.
All steel welded connector & bracket, exterior posts, are hot dipped galvanized.
All aluminium mouldings are made with 6063-T5 or 6063-T54.
All bolts are made with Zinc-Nickel plated steel grade 5.

Please note that our 3D structural software does compute all members according to the Limit States design standard AISC 360-10 (LRFD).

Greenhouse structures:

- Greenhouse geometry is Luminosa (S9) 30'.
- Column height under gutter is 12'.
- Exterior anchors elements are made with 3-1/2'' x 3-1/2'' x 0.120'' spaced at 12' c/c.
- Exterior columns elements are made with 3-1/2'' x 3-1/2'' x 0.120'' spaced at 12' c/c.
- Structural gutter is made from steel sheet of 0.138'' (10GA).
- Arch elements are made with Harnois Strong Oval tubes 2'' x 3-9/16'' x 0.083'' spaced at 6'.
- Arch unions are made with Harnois Strong Oval tubes 2'' x 3-9/16'' x 0.083'' spaced at 6'.
- X-Bracings are made with square section of 2-1/2'' with wall thickness of 0.083''.
- Trusses 20'' spaced at 12' c/c are made with following elements:
  - Top Chord and Bottom 1-1/2'' x 2-1/2'' x 0.065''
  - Web 1-1/4''SQ x 0.049''
- Trusses are longitudinally stabilised with link.
- Gable end framing are made with following elements:
  - Upright Harnois oval 1-5/8'' x 2-3/4'' x 0.065''.
  - Links square tube of 1-1/4''SQ x 0.049''.
- Gable end reinforcement is made with following elements:
  - Horizontal members made with Harnois oval 2-1/2'' x 3-1/2'' x 0.083''.
  - Diagonal supports made with square tube of 2-1/2''SQ x 0.083''.

2- Design loads basis

Loads, load combinations and safety margin were modeled based on International Building Code (IBC) 2015 and design loads criteria given by ASCE 7-10 for the city of Puyallup, WA. The risk category of the building based on customer usage was establish *RISK CATEGORY II*. For the greenhouse in reference, the following loads were applied:

Dead Load (D):

- Structure weight (all steel members, roof, gutter and systems weight).
- Cladding weight.

Snow Load (S):

- 30 psf ground snow load in accordance with ASCE 7-10. Exposure Factor of (Ce) of 1.0 and thermal factor (Ct) of 0.85 was applied for a continuously heated greenhouse (ASCE 7-10 table 7-2 & 7-3). Uniform snow load and unbalanced snow load were analysed (ASCE 7-10 figure 7-5).

Wind Load (W):

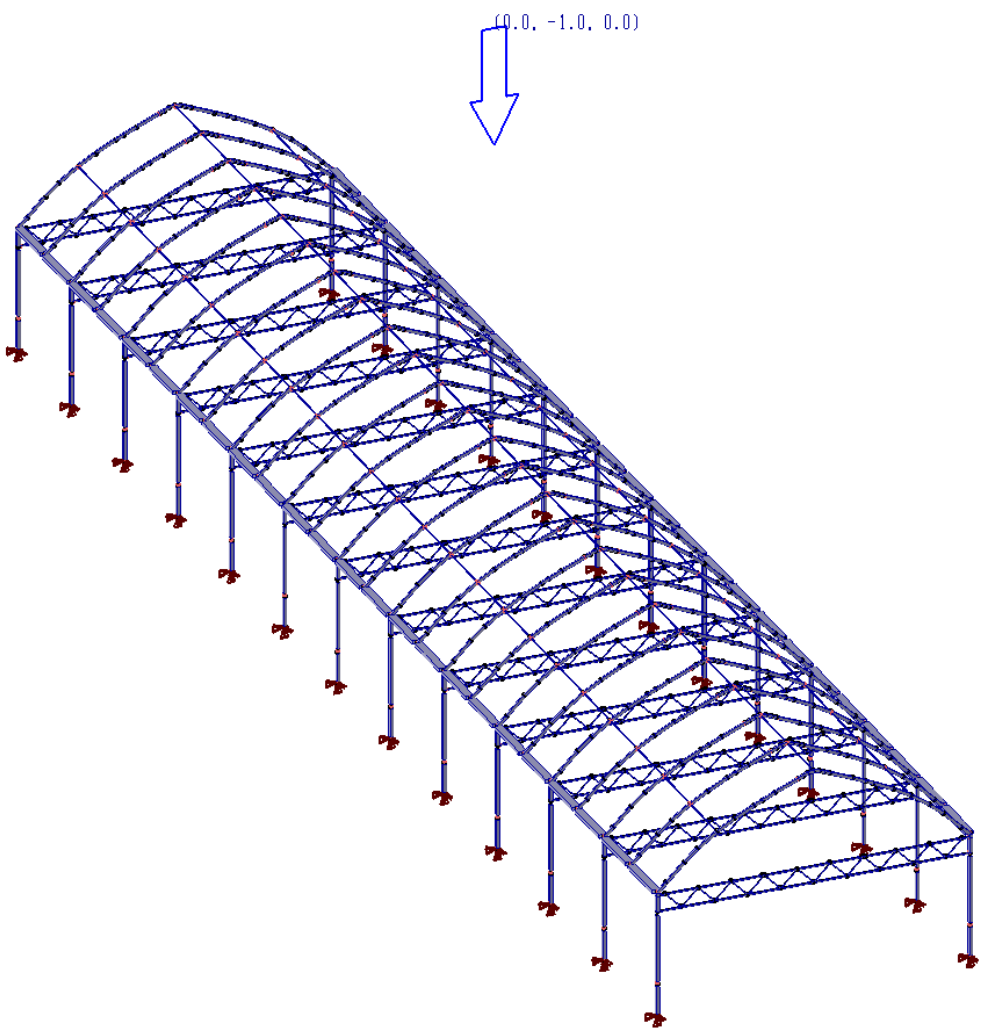
- A wind speed of 110 MPH, 3 seconds gust (ASCE 7-10, Cat II, Exposure B, Partially Enclosed building) is used to established the wind pressure (P1 & P2) applied on the structure. P1/P2 mean internal pressure is negative or positive.

Seismic Load (E):

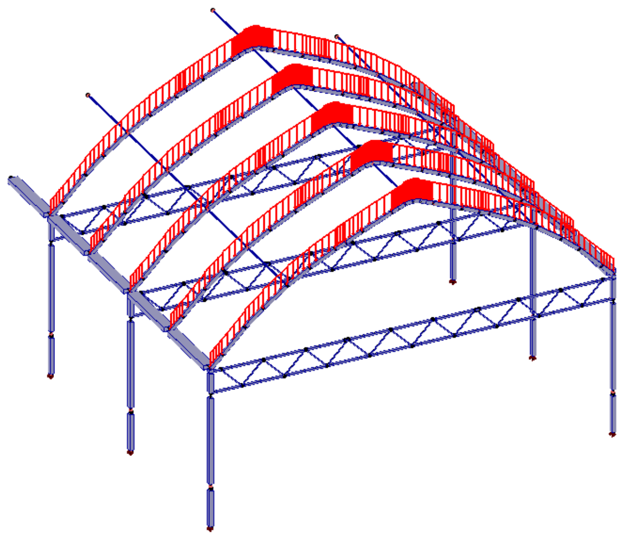
- The seismic design category (SDC) was calculated based on the design spectral response accelaration S_{ds} = 0.834 at site Class = D, Risk Cat II. Luminosa greenhouse is a light steel structure, moment resiting frame in lateral axis, and braced resisting frame in longitudinal axis. This greenhouse model is used accross seismic regions.

Typical Loads :

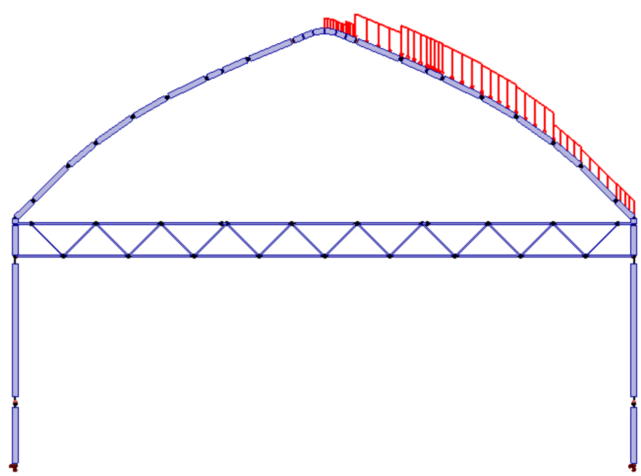
The following pictures show examples of load distribution used to determine the greenhouses design:

Typical examples of loads distribution applied on Luminosa S9 30P model
Dead Load: 

Uniform Snow load:



Unbalanced Snow Load:



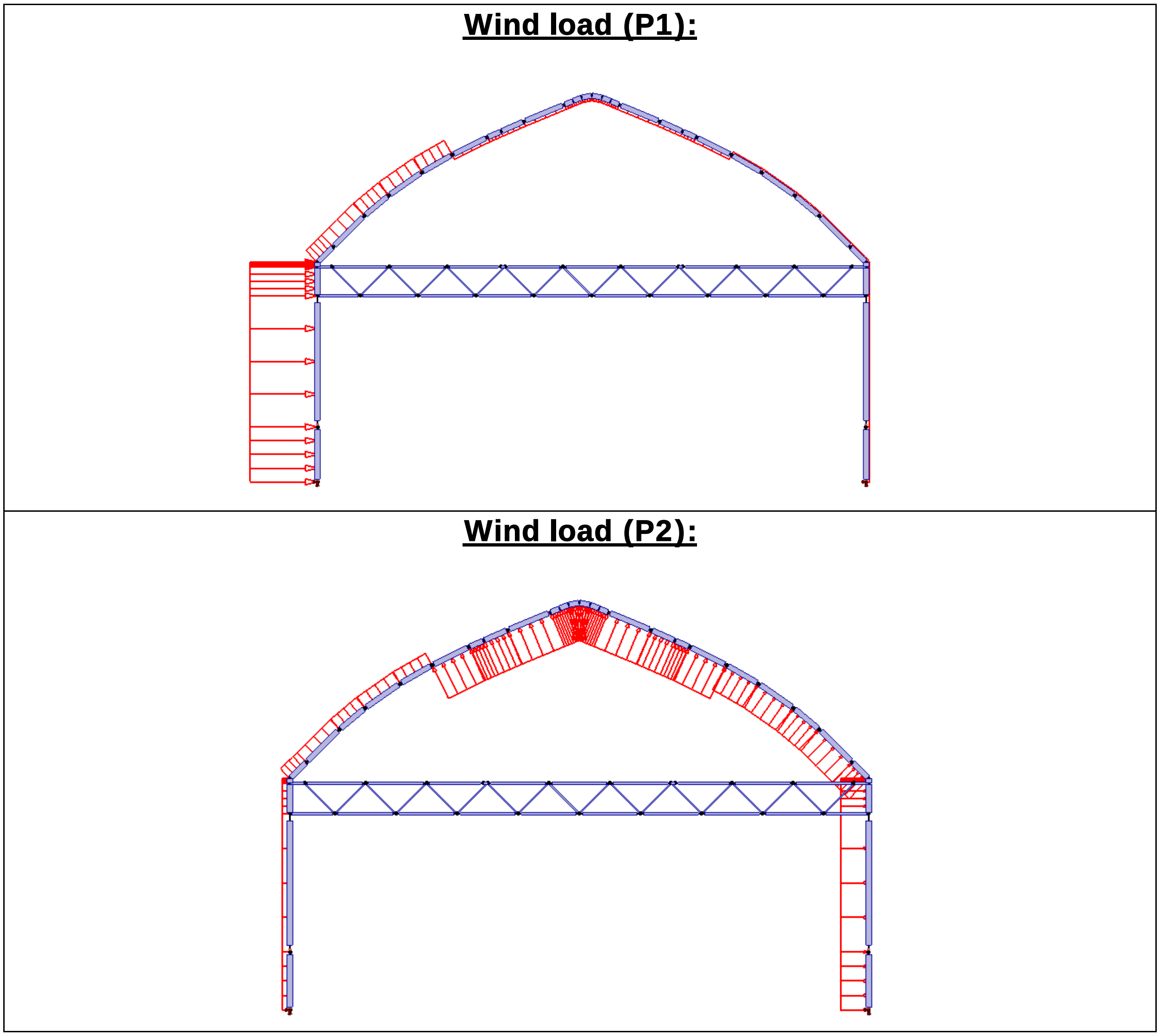


Figure 1 : Typical loads applied on greenhouse

3- Load combinations

The load combinations being used and specified by ASCE 7-10 section 2.3.2 using strength design. The following combinations were analysed:

LC 1: 1.4 (D)

LC 2: 1.2 (D) + 1.6 (S[(1)])

LC 3: 1.2 (D) + 1.6 (S) + 0.5 (W[(2)])

LC 4: 1.2 (D) + 1.0 (W) + 0.5 (S)

LC 5: 1.2 (D) + 1.0 E + 0.2 (S)

LC 6: 0.9 (D) + 1.0 (W)

LC 7: 0.9 (D) + 1.0 (E)

(1) Uniform Snow Load and Unbalanced Snow Load are analyzed in all combination.
(2) W(P1) and W(P2) are analyzed in all combination.

4- Foundations design parameters

The foundations parameters is given for the load which govern the greenhouse design: the uniform snow load and wind load. The table 1 below shows OVERALL **non-factored** reactions forces:

Table 1: Overall reactions forces non-factored

Load combination	Rx (lb)	Ry (lb)*	RMz (lb*ft)
1.0*Dead	0	7 345	0
1.0*Dead + 1.0*Snow	0	79 660	0
1.0*Dead + 1.0*Wind P1	47 674	- 4 832	123 732
1.0*Dead + 1.0*Wind P2	21 373	-129 100	51 574

* Ry negative is an uplift force.

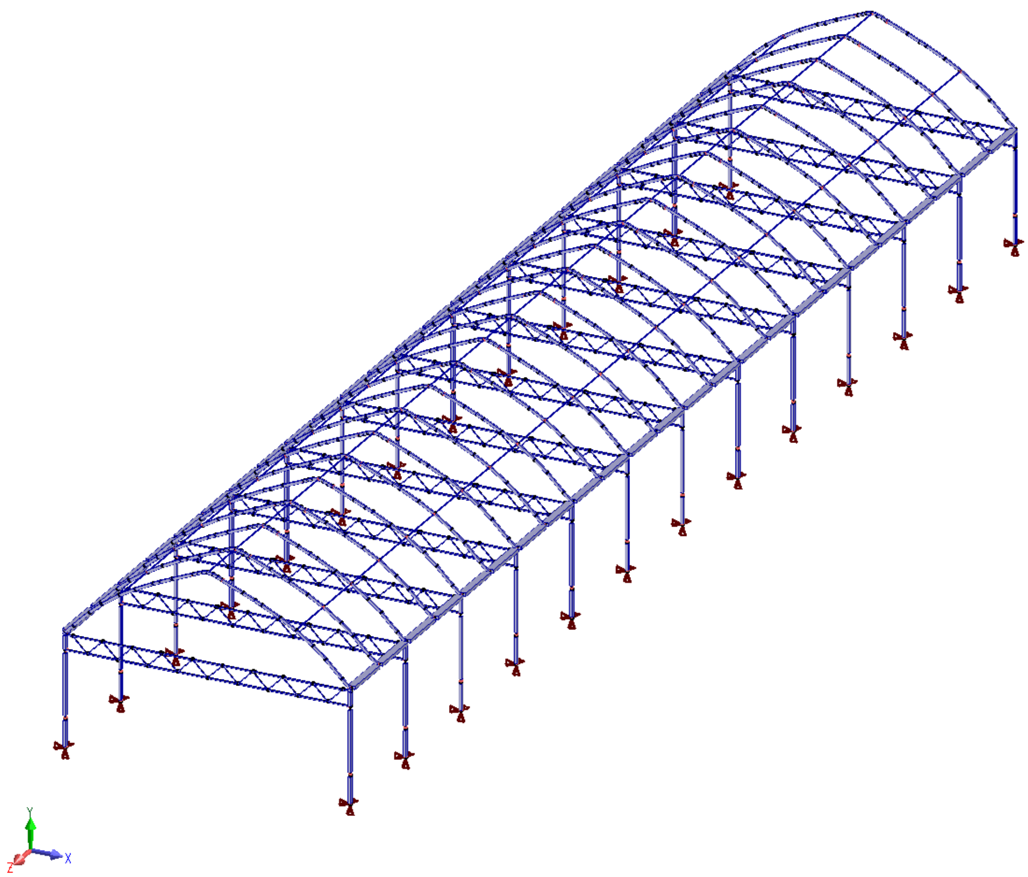


Figure 2 : Greenhouse Overview

The table 2 belows shows maximum individual **non-factored** reactions forces take on center typical axis:

Table 2: Individual maximum reaction forces non-factored

No joint	Combination	Rx (lb)	Ry (lb)	RmZ (lb*ft)
1	1.0D	0	295	0
1	1.0D + 1.0S	0	3 187	0
1	1.0D + 1.0WP1	-2 725	-739	5 913
1	1.0D + 1.0WP2	-523	-5 461	1 512
2	1.0D	0	295	0
2	1.0D + 1.0S	0	3 187	0
2	1.0D + 1.0WP1	-852	283	3 278
2	1.0D + 1.0WP2	-1 094	-4 864	2 359

- Rx can be positive or negative depending the wind direction.
- Ry negative is an uplift force.
- D- Dead Load
- S- Snow Load
- WP1- Wind P1 is when the internal pressure is negative.
- WP2- Wind P2 is when the internal pressure is positive (parachute wind).

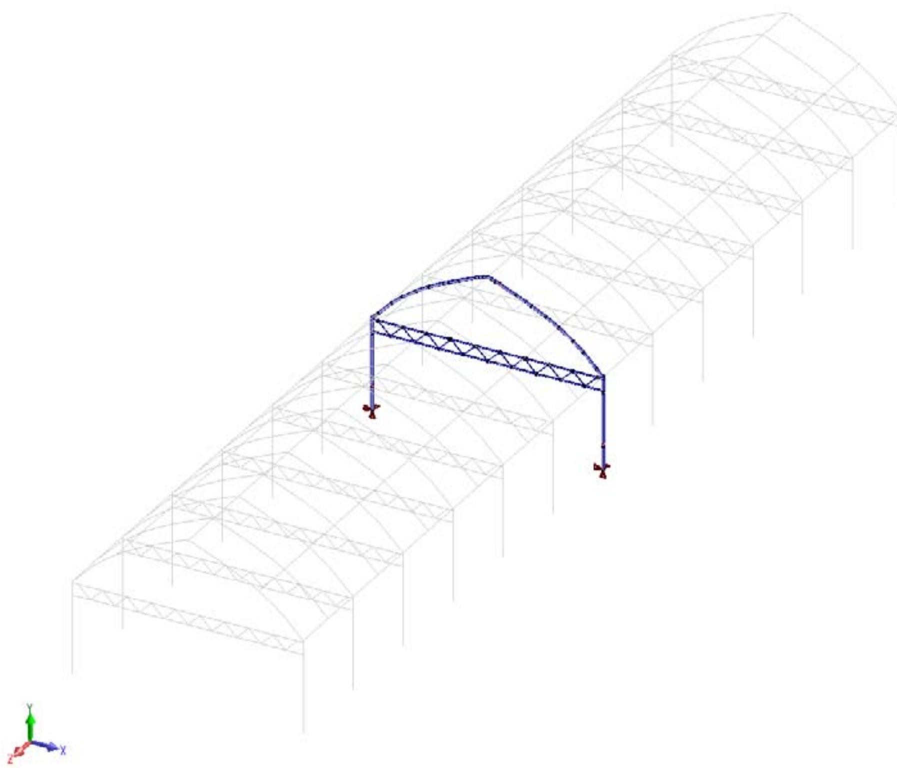


Figure 3 : Typical Center Axis ID

The table 3 belows shows maximum individual **factored** reactions forces take on center typical axis:

Table 3: Individual maximum reaction forces factored

No joint	Combination	Rx (lb)	Ry (lb)	RmZ (lb*ft)
1	1.4D	0	413	0
1	1.2D + 1.6S	0	4 982	0
1	1.2D + 1.0WP1	-2 724	-680	5 911
1	1.2D + 1.0WP2	-522	-5 402	1 511
2	1.4D	0	413	0
2	1.2D + 1.6S	0	4 982	0
2	1.2D + 1.0WP1	-852	342	3 280
2	1.2D + 1.0WP2	-1 095	-4 805	2 360

- Rx can be positive or negative depending the wind direction.
- Ry negative is an uplift force.
- D- Dead Load
- S- Snow Load
- WP1- Wind P1 is when the internal pressure is negative.
- WP2- Wind P2 is when the internal pressure is positive (parachute wind).

*** Please note that with the method of calculation for **wind load** in accordance with ASCE 7-10, the difference between the non-factored and factored reactions forces are low. The ASCE 7-10 method already factored the Wind Speed in accordance with the building risk category. The soil bearing capacity must be factored accordingly.*

GREENHOUSES HARNOIS

4- Conclusion

Harnois Greenhouses is a division of Industries Harnois Inc, a Canadian manufacturer of steel structures to develop and manufacture greenhouse that contribute to the goals achievement of our customers. Every greenhouse family is modeled with 3D structural software and mechanically tested for modeling validation.

The Luminosa S9 (1) x 30’ x 144’ @ 12’ under gutter was designed to support climatic conditions required by the IBC 2015 for the town of Puyallup, WA:

> **Snow load = 30 psf, ground snow load, heated greenhouse**
> **Wind speed = 110 MPH, 3 sec gust, ASCE 7-10, Cat 1, Exp. B, Partially Encl.**

Here is the summary of the maximum column reaction:

Non-factored	Factored
2 725 pounds in lateral force (Rx)	2 724 pounds in lateral force (Rx)
3 187 pounds in compression (Ry+)	4 982 pounds in compression (Ry+)
-5 461 pounds in uplift (Ry-)	-5 402 pounds in uplift (Ry-)
5 913 pounds*foot in moment (RmZ)	5 911 pounds*foot in moment (RmZ)

Please contact me, should you have any questions or if you need additional information.

Best regards.

LES INDUSTRIES HARNOIS INC.

Carl Savard, P.Eng.

Carl Savard, P. Eng.
Engineering Manager
LES INDUSTRIES HARNOIS INC.

5- References

Table 7-2 Exposure Factor, C_e

Terrain Category	Exposure of Roof[a] Fully Exposed	Partially Exposed	Sheltered
B (see Section 26.7)	0.9	1.0	1.2
C (see Section 26.7)	0.9	1.0	1.1
D (see Section 26.7)	0.8	0.9	1.0
Above the treeline in windswept mountainous areas.	0.7	0.8	N/A
In Alaska, in areas where trees do not exist within a 2-mile (3-km) radius of the site.	0.7	0.8	N/A

The terrain category and roof exposure condition chosen shall be representative of the anticipated conditions during the life of the structure. An exposure factor shall be determined for each roof of a structure.

[a]Definitions: Partially Exposed: All roofs except as indicated in the following text. Fully Exposed: Roofs exposed on all sides with no shelter[b] afforded by terrain, higher structures, or trees. Roofs that contain several large pieces of mechanical equipment, parapets that extend above the height of the balanced snow load (h_b), or other obstructions are not in this category. Sheltered: Roofs located tight in among conifers that qualify as obstructions.

[b]Obstructions within a distance of $10h_o$ provide "shelter," where h_o is the height of the obstruction above the roof level. If the only obstructions are a few deciduous trees that are leafless in winter, the "fully exposed" category shall be used. Note that these are heights above the roof. Heights used to establish the Exposure Category in Section 26.7 are heights above the ground.

Table 7-3 Thermal Factor, C_t

Thermal Condition[a]	C_t
All structures except as indicated below Partially heated (effet de serre)	1.0
Structures kept just above freezing and others with cold, ventilated roofs in which the thermal resistance (R-value) between the ventilated space and the heated space exceeds 25 °F × h × ft²/Btu (4.4 K × m²/W).	1.1
Unheated and open air structures	1.2
Structures intentionally kept below freezing	1.3
Continuously heated greenhouses[b] with a roof having a thermal resistance (R-value) less than 2.0 °F × h × ft²/Btu (0.4 K × m²/W)	0.85

[a]These conditions shall be representative of the anticipated conditions during winters for the life of the structure.

[b]Greenhouses with a constantly maintained interior temperature of 50 °F (10 °C) or more at any point 3 ft above the floor level during winters and having either a maintenance attendant on duty at all times or a temperature alarm system to provide warning in the event of a heating failure.

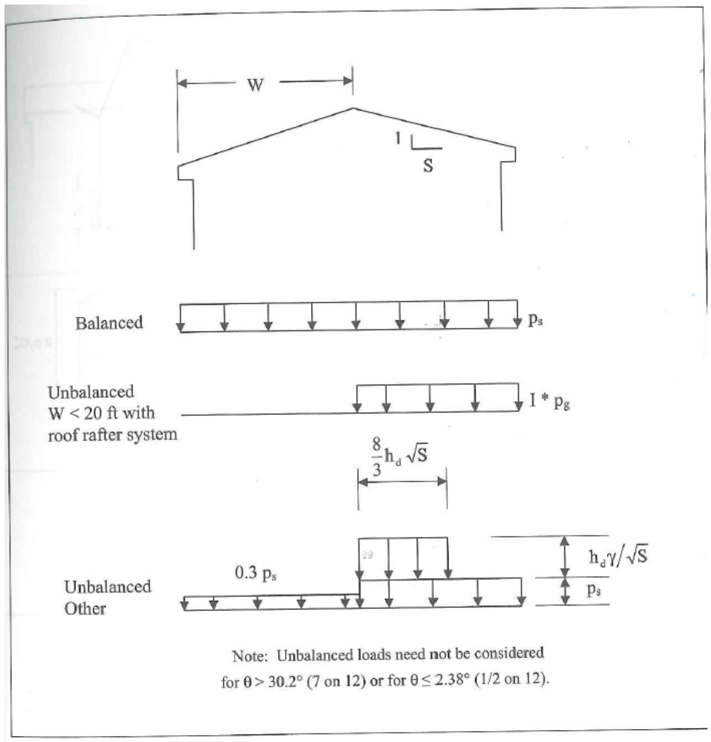
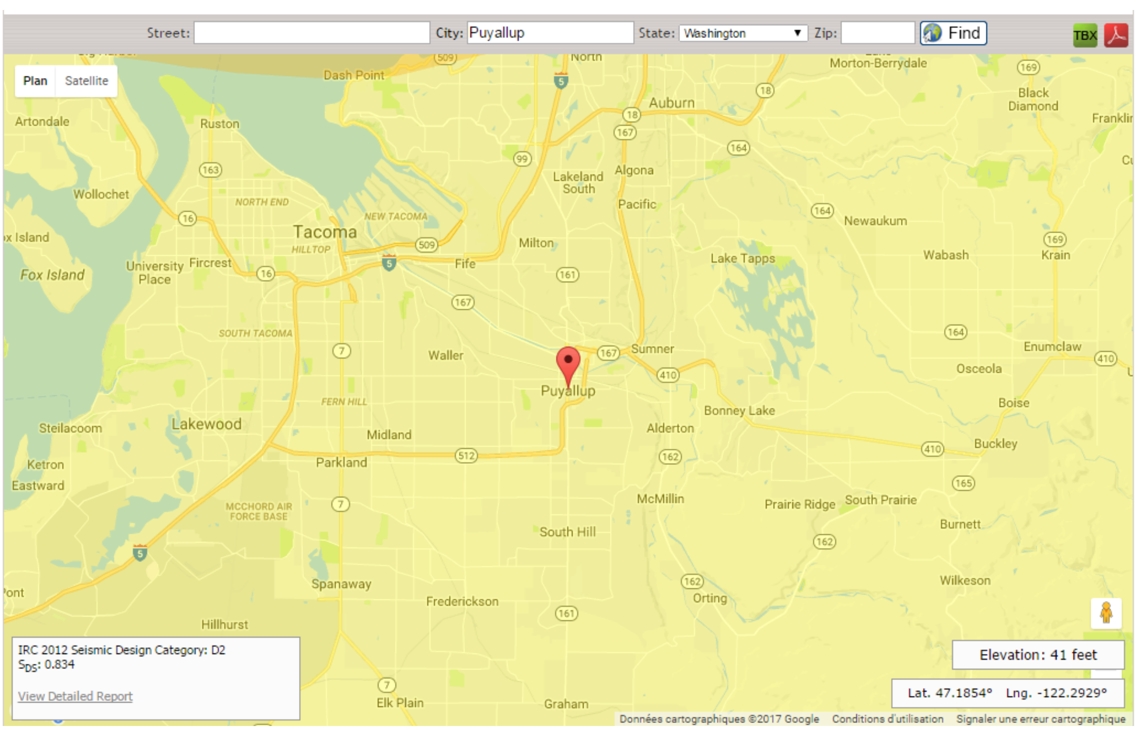


FIGURE 7-5 Balanced and Unbalanced Snow Loads for Hip and Gable Roofs.



Chapter 2
COMBINATIONS OF LOADS

2.1 GENERAL

Buildings and other structures shall be designed using the provisions of either Section 2.3 or 2.4. Where elements of a structure are designed by a particular material standard or specification, they shall be designed exclusively by either Section 2.3 or 2.4.

2.2 SYMBOLS

A_k = load or load effect arising from extra ordinary event A
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 load
W = wind load
W_i = wind-on-ice determined in accordance with Chapter 10

2.3 COMBINING FACTORED LOADS USING STRENGTH DESIGN

2.3.1 Applicability

The load combinations and load factors given in Section 2.3.2 shall be used only in those cases in which they are specifically authorized by the applicable material design standard.

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. $1.2D + 1.0E + L + 0.2S$
6. $0.9D + 1.0W$
7. $0.9D + 1.0E$

EXCEPTIONS:

1. The load factor on L in combinations 3, 4, and 5 is permitted to equal 0.5 for all occupancies in which L_o in Table 4-1 is less than or equal to 100 psf, with the exception of garages or areas occupied as places of public assembly.
2. In combinations 2, 4, and 5, the companion load S shall be taken as either the flat roof snow load (p_f) or the sloped roof snow load (p_s).

Where fluid loads F are present, they shall be included with the same load factor as dead load D in combinations 1 through 5 and 7.

Where loads H are present, they shall be included as follows:

1. where the effect of H adds to the primary variable load effect, include H with a load factor of 1.6;
2. where the effect of H resists the primary variable load effect, include H with a load factor of 0.9 where the load is permanent or a load factor of 0 for all other conditions.

Effects of one or more loads not acting shall be investigated. The most unfavorable effects from both wind and earthquake loads shall be investigated, where appropriate, but they need not be considered to act simultaneously. Refer to Section 12.4 for specific definition of the earthquake load effect E.[1]

Each relevant strength limit state shall be investigated.

2.3.3 Load Combinations Including Flood Load

When a structure is located in a flood zone (Section 5.3.1), the following load combinations shall be considered in addition to the basic combinations in Section 2.3.2:

1. In V-Zones or Coastal A-Zones, $1.0W$ in combinations 4 and 6 shall be replaced by $1.0W + 2.0F_a$.
2. In noncoastal A-Zones, $1.0W$ in combinations 4 and 6 shall be replaced by $0.5W + 1.0F_a$.

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[1]The same E from Section 12.4 is used for both Sections 2.3.2 and 2.4.1. Refer to the Chapter 11 Commentary for the Seismic Provisions.