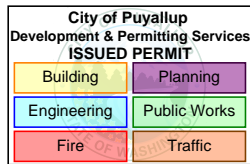
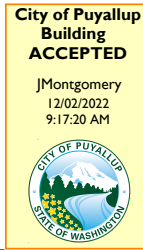


THE APPROVED CONSTRUCTION PLANS, DOCUMENTS AND ALL ENGINEERING MUST BE POSTED ON THE JOB AT ALL INSPECTIONS IN A VISIBLE AND READILY ACCESSIBLE LOCATION.

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



## Supplemental Structural Calculations

PREPARED FOR:

Jason Cornell  
Site Director  
Step By Step / Farm12

PROJECT:

Step By Step Greenhouse Expansion  
2220149.20

PREPARED BY:

Andrew McEachern, P.E., S.E.  
Principal

DATE:

August, 2022

# Supplemental Structural Calculations

## Step By Step Greenhouse Expansion



Project # 2220149.20

Project Principal

Andrew D. McEachern, P.E., S.E.

### Design Criteria

#### Design Codes and Standards

Codes and Standards: Structural design and construction shall be in accordance with the applicable sections of the following codes and standards as adopted and amended by the local building authority: International Building Code, 2018 Edition.

#### Structural Design Criteria:

##### Live Load Criteria:

Roof (Min Blanket Snow):	25 psf
Slab on Grade:	125 psf

##### Wind Load Criteria:

Basic Wind Speed:	97 mph
Risk Category:	II
Wind Exposure:	B
Topographic Factor:	1.0

##### Seismic Criteria:

Risk Category:	II
Seismic Importance Factor:	1.0
$S_s = 1.252$	$S_{ds} = 1.001$
Site Class:	D - default
Seismic Design Category:	D



### Project Description

The structural scope of work for this project involves the structural design of alternate foundations for an expansion to an existing pre-engineered greenhouse structure. It is the intention of the structural design to satisfy the force levels of the IBC 2018. The structural design of the greenhouse framing

The methodology for the design of alternate foundations consists of determining the capacity of the proposed foundations (26" diameter x 60" deep) and designing new foundations that meet or exceed the capacity of the proposed foundation. We also evaluated the capacity of the proposed 3 1/2" square anchor tubes at each of the greenhouse columns and ensured that the proposed and alternate foundations were capable of developing the axial and flexural strength of the anchor tubes.

The proposed pier foundations were sized as cantilevered columns, using a non-constrained footing methodology. The alternate foundations have been sized as cantilevered columns, using a constrained footing methodology that utilizes the interior concrete slab on grade.



EMIS POUR / ISSUED FOR:

INFORMATION

APPROBATION / APPROVAL

PERMIS / PERMIT

CONSTRUCTION

PLANS FINAUX / AS BUILT

**(1) FOUNDATION LUMINOSA (S9) 30' x 144'  
(12' UNDER GUTTER)**

**Step by Step**

13407 80th Street East  
Puyallup,  
WA, USA  
98271

No.Commande/Order No. **212503**

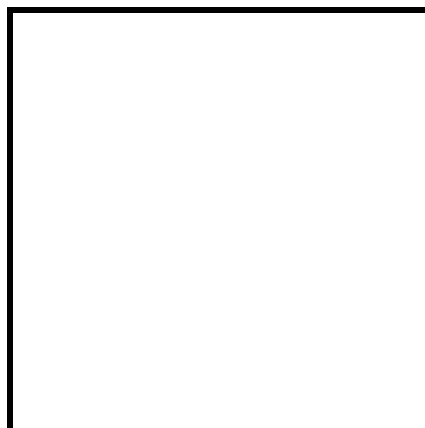
No.Client/Customer No. **U1S018**

**PJ-5251**

AHBL: DESIGN CRITERIA  
INDICATED IS  
STRUCTURALLY  
ACCEPTABLE

Description / Structure	
Largeur / Width	30'
Longueur / Lenght	144'
Espacement / Spacing	12' C/C
Modèle / Model	LUMINOSA S9 30' — HD14 — 12GI
Fondation / Foundation	CONCRETE PIERS
Recouvrement de Structure / Structure Recovery	PCSS
Recouvrement de Pignon / Gables Recovery	PCSS

Charge de Vent / Wind Load	110 mph, ASCE 7-10, cat II Exp B
Charge de Neige / Snow Load	30 psf, HEATED GREENHOUSE
Autre / Other	





AHBL Engineers  
 2215 North 30th Street  
 Suite 300  
 Tacoma, WA 98403  
 253.383.2422

Project Title: Step by Step Greenhouse Expansion  
 Engineer: ADM  
 Project ID: 2220149.20  
 Project Descr: Foundation Design for New Greenhouse Structure

**Pole Footing Embedded in Soil**

Project File: 2220149 calcs.ec6

LIC# : KW-06014847, Build:20.22.7.25

AHBL, INC

(c) ENERCALC INC 1983-2022

**DESCRIPTION:** Proposed Footing Capacity (28" Dia x 5 ft)

**Code References**

Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16  
 Load Combinations Used : ASCE 7-10

**General Information**

Pole Footing Shape	Circular
Pole Footing Diameter	28.0 in
Calculate Min. Depth for Allowable Pressures	
No Lateral Restraint at Ground Surface	
Allow Passive	300.0 pcf
Max Passive	1,500.0 pcf

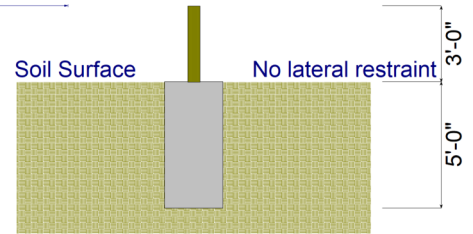
**Controlling Values**

Governing Load Combination	D+0.60W
Lateral Load	1.50 k
Moment	4.50 k-ft
<b>NO Ground Surface Restraint</b>	
Pressures at 1/3 Depth	
Actual	<b>498.603 psf</b>
Allowable	<b>499.292 psf</b>

<b>Minimum Required Depth</b>	<b>5.0 ft</b>
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Footing Base Area	4.276 ft^2
Maximum Soil Pressure	1.473 ksf

Point Load



**Applied Loads**

Lateral Concentrated Load (k)	Lateral Distributed Loads (k)	Vertical Load (k)
D : Dead Load	k/ft	1.80 k
Lr : Roof Live	k/ft	3.60 k
L : Live	k/ft	k
S : Snow	k/ft	4.50 k
W : Wind	k/ft	k
E : Earthquake	k/ft	k
H : Lateral Earth	k/ft	k
Load distance above ground surface	TOP of Load above ground surface	
3.0 ft	ft	
	BOTTOM of Load above ground surface	
	ft	

**Load Combination Results**

Load Combination	Forces @ Ground Surface		Required Depth - (ft)	Pressure at 1/3 Depth		Soil Increase Factor
	Loads - (k)	Moments - (ft-k)		Actual - (psf)	Allow - (psf)	
D Only	0.000	0.000	0.13	0.0	0.0	1.000
+D+Lr	0.000	0.000	0.13	0.0	0.0	1.000
+D+S	0.000	0.000	0.13	0.0	0.0	1.000
+D+0.750Lr	0.000	0.000	0.13	0.0	0.0	1.000
+D+0.750S	0.000	0.000	0.13	0.0	0.0	1.000
+D+0.60W	1.500	4.500	5.00	498.6	499.3	1.000
+D+0.750Lr+0.450W	1.125	3.375	4.50	442.8	442.9	1.000
+D+0.750S+0.450W	1.125	3.375	4.50	442.8	442.9	1.000
+0.60D+0.60W	1.500	4.500	5.00	498.6	499.3	1.000

PRCA20220482



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Tacoma, WA 98403  
253.383.2422

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AHBL, INC

(c) ENERCALC INC 1983-2022

**DESCRIPTION:** Proposed Footing Capacity (28" Dia x 5 ft)

+0.60D	0.000	0.000	0.13	0.0	0.0	1.000
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**Pole Footing Embedded in Soil**

Project File: 2220149 calcs.ec6

LIC# : KW-06014847, Build:20.22.7.25

AHBL, INC

(c) ENERCALC INC 1983-2022

**DESCRIPTION:** Revised Sidewall Footing Capacity (3ft Square x 2.5 ft)

**Code References**

Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16  
 Load Combinations Used : ASCE 7-10

**General Information**

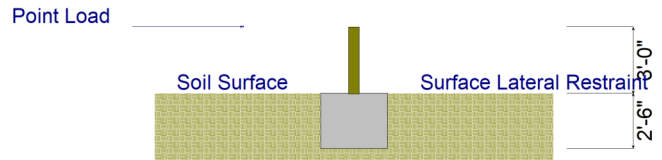
Pole Footing Shape	Rectangular
Pole Footing Width	36.0 in
Calculate Min. Depth for Allowable Pressures	
Lateral Restraint at Ground Surface	
Allow Passive	300.0 pcf
Max Passive	1,500.0 pcf

**Controlling Values**

Governing Load Combination	D+0.60W
Lateral Load	1.50 k
Moment	4.50 k-ft
Restraint @ Ground Surface	
Pressure at Depth	
Actual	723.40 psf
Allowable	750.0 psf
Surface Restraint Force	5,325.0 lbs

<b>Minimum Required Depth</b>	<b>2.50 ft</b>
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Footing Base Area	9.0 ft^2
Maximum Soil Pressure	0.70 ksf



**Applied Loads**

Lateral Concentrated Load (k)	Lateral Distributed Loads (k)	Applied Moment (kft)	Vertical Load (k)
D : Dead Load	k	k-ft	1.80 k
Lr : Roof Live	k	k-ft	3.60 k
L : Live	k	k-ft	k
S : Snow	k	k-ft	4.50 k
W : Wind	2.50 k	k-ft	k
E : Earthquake	k	k-ft	k
H : Lateral Earth	k	k-ft	k
Load distance above ground surface	3.0 ft		
	TOP of Load above ground surface	ft	
	BOTTOM of Load above ground surface	ft	

**Load Combination Results**

Load Combination	Forces @ Ground Surface		Required Depth - (ft)	Pressure at Depth		Soil Increase Factor
	Loads - (k)	Moments - (ft-k)		Actual - (psf)	Allow - (psf)	
D Only	0.000	0.000	0.13	0.0	37.5	1.000
+D+Lr	0.000	0.000	0.13	0.0	37.5	1.000
+D+S	0.000	0.000	0.13	0.0	37.5	1.000
+D+0.750Lr	0.000	0.000	0.13	0.0	37.5	1.000
+D+0.750S	0.000	0.000	0.13	0.0	37.5	1.000
+D+0.60W	1.500	4.500	2.50	723.4	750.0	1.000
+D+0.750Lr+0.450W	1.125	3.375	2.25	669.8	675.0	1.000
+D+0.750S+0.450W	1.125	3.375	2.25	669.8	675.0	1.000
+0.60D+0.60W	1.500	4.500	2.50	723.4	750.0	1.000

PRCA20220482



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**Pole Footing Embedded in Soil**

Project File: 2220149 calcs.ec6

LIC# : KW-06014847, Build:20.22.7.25

AHBL, INC

(c) ENERCALC INC 1983-2022

**DESCRIPTION:** Revised Sidewall Footing Capacity (3ft Square x 2.5 ft)

+0.60D	0.000	0.000	0.13	0.0	37.5	1.000
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**Pole Footing Embedded in Soil**

Project File: 2220149 calcs.ec6

LIC# : KW-06014847, Build:20.22.7.25

AHBL, INC

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**DESCRIPTION:** Revised Interior Footing Capacity (3ft Square x 2.5 ft)

**Code References**

Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16  
 Load Combinations Used : ASCE 7-10

**General Information**

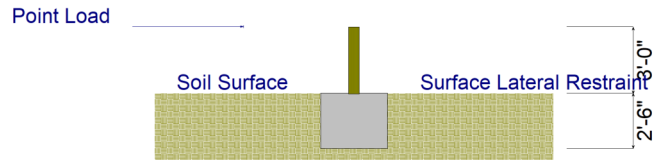
Pole Footing Shape	Rectangular
Pole Footing Width	36.0 in
Calculate Min. Depth for Allowable Pressures	
Lateral Restraint at Ground Surface	
Allow Passive	300.0 pcf
Max Passive	1,500.0 pcf

**Controlling Values**

Governing Load Combination	D+0.60W
Lateral Load	1.50 k
Moment	4.50 k-ft
Restraint @ Ground Surface	
Pressure at Depth	
Actual	723.40 psf
Allowable	750.0 psf
Surface Restraint Force	5,325.0 lbs

<b>Minimum Required Depth</b>	<b>2.50 ft</b>
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Footing Base Area	9.0 ft^2
Maximum Soil Pressure	1.40 ksf



**Applied Loads**

Lateral Concentrated Load (k)	Lateral Distributed Loads (k)	Applied Moment (kft)	Vertical Load (k)
D : Dead Load	k	k-ft	3.60 k
Lr : Roof Live	k	k-ft	7.20 k
L : Live	k	k-ft	k
S : Snow	k	k-ft	9.0 k
W : Wind	2.50 k	k-ft	k
E : Earthquake	k	k-ft	k
H : Lateral Earth	k	k-ft	k
Load distance above ground surface	3.0 ft		
	TOP of Load above ground surface	ft	
	BOTTOM of Load above ground surface	ft	

**Load Combination Results**

Load Combination	Forces @ Ground Surface		Required Depth - (ft)	Pressure at Depth		Soil Increase Factor
	Loads - (k)	Moments - (ft-k)		Actual - (psf)	Allow - (psf)	
D Only	0.000	0.000	0.13	0.0	37.5	1.000
+D+Lr	0.000	0.000	0.13	0.0	37.5	1.000
+D+S	0.000	0.000	0.13	0.0	37.5	1.000
+D+0.750Lr	0.000	0.000	0.13	0.0	37.5	1.000
+D+0.750S	0.000	0.000	0.13	0.0	37.5	1.000
+D+0.60W	1.500	4.500	2.50	723.4	750.0	1.000
+D+0.750Lr+0.450W	1.125	3.375	2.25	669.8	675.0	1.000
+D+0.750S+0.450W	1.125	3.375	2.25	669.8	675.0	1.000
+0.60D+0.60W	1.500	4.500	2.50	723.4	750.0	1.000



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LIC# : KW-06014847, Build:20.22.7.25

AHBL, INC

(c) ENERCALC INC 1983-2022

**DESCRIPTION:** Revised Interior Footing Capacity (3ft Square x 2.5 ft)

+0.60D	0.000	0.000	0.13	0.0	37.5	1.000
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