QUANTUM
CONSULTING ENGINEERS

May 10, 2019

STRUCTURAL CALCULATIONS
(Permit Submittal)

LAI DECK ROOF ADDITION
7505 92nd Ave. SE
Mercer Island, WA 98040

Quantum Job Number: 19175.01

Prepared for:
JOSH ARTISAN +
ARCHITECTURE

Prepared by:
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Lai Deck Roof Addition
7505 92nd. Ave SE, Mercer Island, WA

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INDEX

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LAI DECK ROOF ADDITION
7505 92ND AVE. SE,
MERCER ISLAND, WA

Quantum Job Number: 19175.01

DESIGN CRITERIA

QUANTUM | CONSULTING ENGINEERS

STRUCTURAL DESIGN CRITERIA

LAI DECK ROOF ADDITION
7505 92ND AVE SE,
MERCER ISLAND, WA 98040.

QUANTUM JOB NUMBER: 19175.01

CODE CRITERIA:

BUILDING CODE..... 2015 INTERNATIONAL BUILDING CODE
BUILDING DEPARTMENT.....CITY OF MERCER ISLAND
WIND CRITERIA ..... 110 MPH; EXPOSURE "C"
.....RISK CATEGORY = II
.....K_{zt}= 1.00

SNOW LOAD .....25 PSF
GUARDRAILS AND HANDRAILS LIVE LOAD .....200 LBS

SOILS CRITERIA:

ALLOWABLE BEARING PRESSURE (ASSUMED).....2,500 PSF
MINIMUM FOOTING WIDTH ..... CONTINUOUS: 18" MIN., ISOLATED: 24" MIN.
FROST DEPTH .....36" MIN.
PASSIVE SOIL PRESSURE.....300 PCF
COEFFICIENT OF FRICTION.....0.35 PCF

MATERIALS CRITERIA:

CONCRETE (28 DAY STRENGTH):

FOUNDATION/S.O.G.....F'C=2,500 PSI

REINFORCING STEEL:

GRADE 40 (#4 BAR).....FY=40,000 PSI

WOOD FRAMING:

2X, 3X, & 4X FRAMING MBRS.....HF#2 OR DF#2
6X FRAMING MBRS.....DF#1
PARALLAM BEAMS..... 2.2E WS PARALLAM PSL
LSL MEMBERS – BEAMS & HEADERS.....1.55E LSL
WOOD SHTG..... APA RATED

STRUCTURAL DESIGN CRITERIA

LAI DECK ROOF ADDITION
7505 92ND AVE SE,
MERCER ISLAND, WA 98040.

QUANTUM JOB NUMBER: 19175.01

ASSEMBLY WEIGHTS

ROOF LOADS		GRAVITY	SEISMIC	**COMMENTS**
STANDARD SHINGLE & TPO ROOFING		3.0 PSF	3.0 PSF	
15/32"APA PLYWOOD SHEATHING		1.7 PSF	1.7 PSF	
ROOF JOISTS @ 16" O.C.		3.3 PSF	3.3 PSF	
MISCELLANEOUS		1.0 PSF	1.0 PSF	
	ROOF DL	9.0 PSF	9.0 PSF	SL = 25 PSF

CEILING LOADS		GRAVITY	SEISMIC	**COMMENTS**
CEILING JOISTS @ 16" O.C.		2.0 PSF	2.0 PSF	
LIGHTS & ELECTRICAL		0.5 PSF	0.5 PSF	
5/8" GWB		2.8 PSF	2.8 PSF	
MISCELLANEOUS		0.7 PSF	0.7 PSF	
	ROOF DL	6.0 PSF	6.0 PSF	LL = 10 PSF

ATC Hazards by Location

Search Information

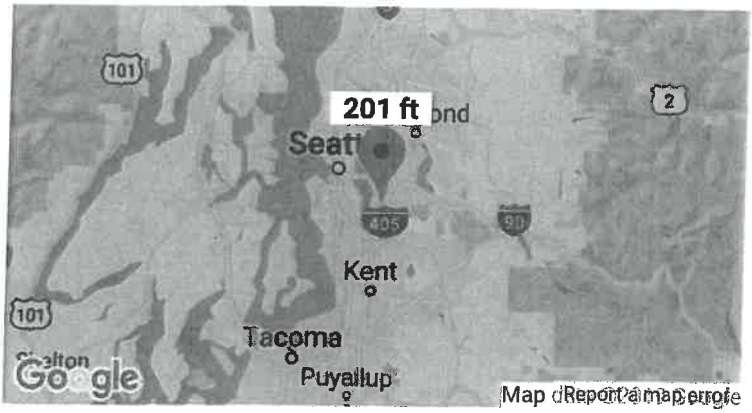
Address: 7505 92nd Ave SE, Mercer Island, WA 98040, USA

Coordinates: 47.5357451, -122.21620289999998

Elevation: 201 ft

Timestamp: 2019-05-10T19:15:37.089Z

Hazard Type: Wind



ASCE 7-16		ASCE 7-10		ASCE 7-05	
MRI 10-Year	68 mph	MRI 10-Year	72 mph	ASCE 7-05 Wind Speed	85 mph
MRI 25-Year	74 mph	MRI 25-Year	79 mph		
MRI 50-Year	79 mph	MRI 50-Year	85 mph		
MRI 100-Year	83 mph	MRI 100-Year	91 mph		
Risk Category I	92 mph	Risk Category I	100 mph		
Risk Category II	98 mph	Risk Category II	110 mph ← used		
Risk Category III	105 mph	Risk Category III-IV	115 mph		
Risk Category IV	109 mph				

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Disclaimer

Hazard loads are interpolated from data provided in ASCE 7 and rounded up to the nearest whole integer. Per ASCE 7, islands and coastal areas outside the last contour should use the last wind speed contour of the coastal area – in some cases, this website will extrapolate past the last wind speed contour and therefore, provide a wind speed that is slightly higher. NOTE: For queries near wind-borne debris region boundaries, the resulting determination is sensitive to rounding which may affect whether or not it is considered to be within a wind-borne debris region.

Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

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Mercer Island Wind Exposure and Wind Speed-Up (Topographic Effect)

by Development Services Group (DSG), City of Mercer Island
April 2009

0 0.5 1 Kilometers 1:12,000
0 0.5 1 Miles
TN

WIND EXPOSURE CATEGORIES & WIND SPEED-UP FACTORS
(ICC Section 1609 & ASCE 7-05 Chapter 6)

It is the responsibility of the Owner (or their Design Professional) to review site conditions and determine the Kzt factor to be utilized for each specific project. The Kzt factors and wind exposure categories indicated on this map are the minimum values accepted by the City of Mercer Island without requiring the design professional to submit additional calculations and supporting topographic documentation (to verify the values utilized in their wind load determination).

Please note -- The Kzt values indicated on this map are approximations based upon periodic calculations of representative samplings around Mercer Island. These values are intended for City of Mercer Island's plan review purposes only.

WIND EXPOSURE CATEGORIES:

Wind Exposure Category	
	Exposure 'C' (1500 feet from Lake)
	Exposure 'B' (all other areas)

WIND SPEED-UP (TOPOGRAPHIC EFFECT) - K_zt Factor :

K_zt Factor	
	$K_zt = 1.0$
	$K_zt = 1.3$
	$K_zt = 1.6$
	$K_zt = 1.9$

GENERAL NOTES FOR WIND EXPOSURE AND WIND SPEED-UP MAP

This map is the Wind Exposure Category and Wind Speed-up (Topographic Effects) Map for the City of Mercer Island. This map shows the minimum wind exposure category and the minimum wind speed-up, "K_zt" factor, which will be accepted without site specific documentation and calculation.

Other wind speed phenomena may occur on Mercer Island that is not specifically indentified on this map. It is the responsibility of the Owner (or their Design Professional) to review site conditions and determine the appropriate design wind speed and exposure category for their specific project and location.

This map is for the sole use of the staff of the City of Mercer Island's Development Services Group (DSG) for the purposes of permit application evaluation. This map provides DSG staff a general assessment of Wind Exposure Category and Wind Speed-up (Topographic Effects). All areas have not been specifically evaluated and there may be locations that are not correctly represented on this map. It is the responsibility of individual property owners and map users to evaluate risk associated with their proposed development. No site-specific assessment of risk is implied or otherwise indicated by the City of Mercer Island with this map.

Information about data used for the map, references, and data limitation are all described the associated "Read Me" document. The digital version of this map is accompanied by a meta data file containing pertinent information about map construction. This data map is available on the City of Mercer Island website.

The City of Mercer Island is using guidance provided within ICC Section 1609 & ASCE 7-05 Chapter 6 regarding definitions used when creating this map.

DEFINITIONS:

K_zt factor:	The topographic effect of wind speed-up at isolated hills, ridges, and escarpments constituting abrupt changes in the general topography, located in any exposure category, that meet all of the conditions noted in ASCE 7-05 Minimum Design Loads for Buildings and Other Structures, Section 6.5.7.
Exposure B:	The wind exposure category that applies where the site in question is located a minimum of 1500 feet from the shoreline and the mean roof height is less than or equal to 30 feet per IBC 2006 section 1609.4.3.
Exposure C:	The wind exposure category that applies where the site in question is located within 1500 feet from the shoreline per IBC 2006 section 1609.4.3.
Wind Speed:	Minimum 85 mph 3-second gust per IRC Figure R301.2(4)

Hazards by Location

Search Information

Address: 7505 92nd Ave SE, Mercer Island, WA 98040, USA

Coordinates: 47.5357451, -122.21620289999998

Elevation: 201 ft

Timestamp: 2019-04-18T23:45:09.698Z

Hazard Type: Snow

Used

ASCE 7-16

Ground Snow Load ..... ▲ 16 lb/sqft

The reported ground snow load applies at the query location of 201 feet up to a maximum elevation of 320 feet with a tolerance of 100 feet.

ASCE 7-10

Ground Snow Load ..... ▲ 15 lb/sqft

The reported ground snow load applies at the query location of 201 feet up to a maximum elevation of 400 feet.

ASCE 7-05

Ground Snow Load ..... ▲ 15 lb/sqft

The reported ground snow load applies at the query location of 201 feet up to a maximum elevation of 400 feet.

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Disclaimer

Hazard loads are interpolated from data provided in ASCE 7 and rounded up to the nearest whole integer.

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MERCER ISLAND, WA

Quantum Job Number: 19175.01

WIND AND SNOW CALCULATIONS

Roof Snow Loading

Per IBC 2015 and ASCE 7-10

Structure:	Lai Deck Roof	
Address:	7505 92nd Ave. SE, Mercer Island, Wa 98040	
Roof Designation:		
p_g (psf):	15	Ground Snow Load per IBC
I_s:	1.00	per ASCE Table 1.5-2

Flat Roof Snow Loading per ASCE Section 7.3

Terrain Category:	C	Open Terrain w/ scattered obstructions per ASCE 26.7.3 (Wind Exposure Definitions) and Table 7-2
Roof Exposure:	Partially Exposed	Roofs not considered Fully Exposed or Sheltered
C_e:	1.00	per ASCE Table 7-2
Thermal Condition:	Unheated Structures	
C_t:	1.20	per ASCE Table 7-3
$p_{minimum}$ (psf):	**15**	**= Is * pg; pg <= 20 psf per ASCE 7.3.4**
p_f (psf):	**13**	**= 0.7*Ce*Ct*Is*pg per ASCE 7.3**

Sloped Roof Snow Loading per ASCE Section 7.4

Roof Slope ($^x/_{12}$):	1.50/12	= 7.13 deg
Warm/Cold Roof:	Cold	Ct > 1.0: per ASCE Section 7.4
Slippery Surface:	No	per ASCE Section 7.4
C_s:	1.00	per ASCE Figure 7-2c
p_s (psf):	**13**	**= C_s*p_f per ASCE Eq. 7.4-1**

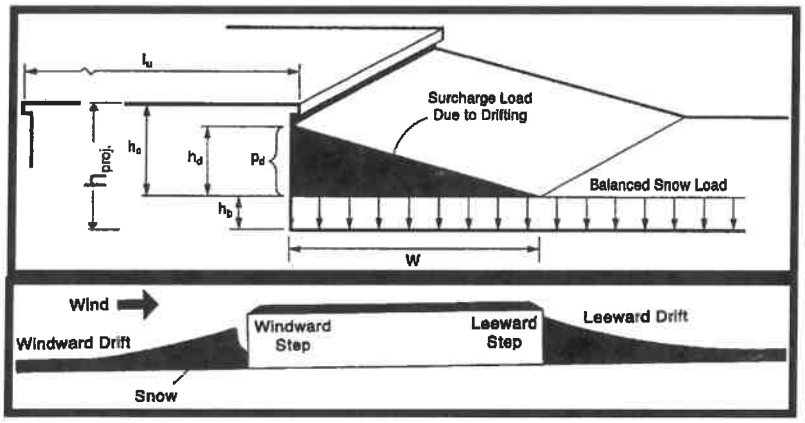
Snow Drifting

Per IBC 2015 and ASCE 7-10

Structure: Lai Deck Roof
Address: 7505 92nd Ave. SE, Mercer Island, Wa 98040
Roof Designation:

p_g (psf):	15	Ground Snow Load
p_s (psf):	13	Roof Snow Load
γ (pcf):	16.0	= Minimum of $0.13p_g + 14$ or 30 pcf: per ASCE Eq. 7.7-1
h_b (ft):	0.79	= $(p_s)/\gamma$: per ASCE Section 7.7.1

Cause of Snow Drift: Lower Roof of a Structure per ASCE 7.7.1
Not Applicable Do not fill in the blank



ASCE Figure 7-8
Configuration of Snow Drifts on Lower Roofs

ASCE Figure 7-7
Drifts Formed at Windward and Leeward Steps

L_l (ft):	18.50	lower roof length	L_u (ft):	59.00	upper roof length (zero if parapet)
h_{proj} (ft):	13.00		h_c (ft):	12.21	
h_c/h_b:	15.46	**=> 0.2; Snow Drift Calc Required per ASCE 7.7.1**			

Windward Snow Drift Loading per ASCE Section 7.7

h_d (ft):	0.98	< hc	$h_{d\ use}$ (ft):	1.0
p_d (psf):	**15.69**			
W (ft):	**3.93**	**< Ll**		

Leeward Snow Drift Loading per ASCE Section 7.7

h_d (ft):	2.24	< hc	$h_{d\ use}$ (ft):	2.2
p_d (psf):	**35.78**			
W (ft):	**8.97**	**< Ll**		

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Project	Lal Deck Roof Addition	Job #	19175.01	Page	#1
Client	Josh Artisan + Architect	By	MDA	Date	05/10/19
Subject	Wind Loads - Deck Roof	Checked		Date	

Wind Per ASCE 7-10, Chapter 30 Part 5 - Wind Loads - Components and Cladding (OPEN)

Step 1: Determine Risk Category

Risk Category	II	

Step 2: Determine Basic Wind Speed, V

Basic Wind Speed, V	110	MPH (ATC Web Site)

Step 3: Determine Wind Load Parameters

Exposure Category	C	Section 26.7
Topgraphic Factor, Kzt	1.00	Section 26.8.2
Roof Height, h	12.50	FT
Pressure Exposure Coeff., Kz	0.85	Table 27.3-1
Wind Directionality Factor, Kd	0.85	Section 26.6

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Project	Lal Deck Roof Addition	Job #	19175.01	Page	#2
Client	Josh Artisan + Architect	By	MDA	Date	05/10/19
Subject	Wind Loads - Deck Roof	Checked		Date	

Wind Per ASCE 7-10, Chapter 30 Part 5 - Wind Loads - Components and Cladding (OPEN)

Step 4: Determine Wind Pressures Section 30.8.2

Velocity Pressure, qh	22.4	PSF	Section 27.3.2
Gust Effect Factor, G	0.85		Section 26.9

Corner Zone Dimension "a"

Lmin	20.00	FT Minimum Building Dimension
h	11.00	FT Mean Roof Height
0.10Lmin	2.00	FT
0.40h	4.40	FT
a	**3.00**	FT

Net Pressure Coeff., C_N	-2.9	Uplift	Figure 30.8-1
	2.7	Downforce	

Design Wind Pressures	-55.2	PSF Uplift	(LRFD)
	51.4	PSF Downforce	(LRFD)

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Quantum Job Number: 19175.01

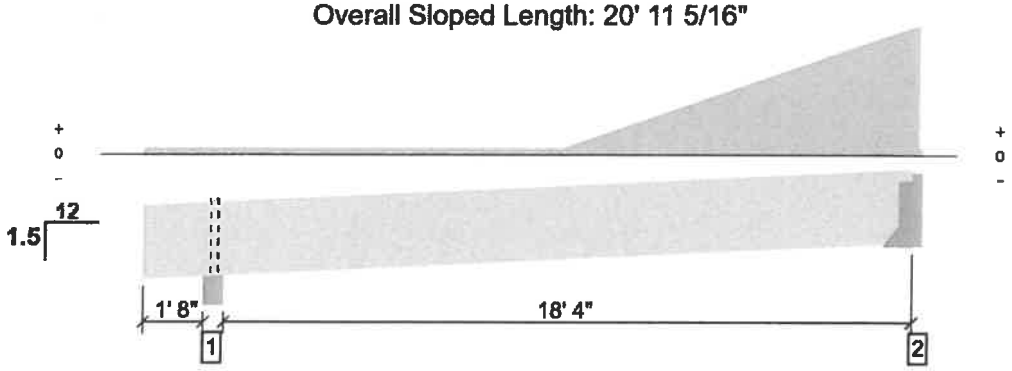
GRAVITY CALCULATIONS

FORTE® MEMBER REPORT *roof, DR-1*

1 piece(s) 2 x 12 Douglas Fir-Larch No. 2 @ 16" OC

PASSED

Overall Sloped Length: 20' 11 5/16"



All locations are measured from the outside face of left support (or left cantilever end).All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	602 @ 20' 5 1/2"	1406 (1.50")	Passed (43%)	--	1.0 D + 1.0 S (Alt Spans)
Shear (lbs)	518 @ 19' 6 5/16"	2329	Passed (22%)	1.15	1.0 D + 1.0 S (Alt Spans)
Moment (Ft-lbs)	2288 @ 12' 1/16"	3138	Passed (73%)	1.15	1.0 D + 1.0 S (Alt Spans)
Live Load Defl. (in)	0.395 @ 11' 4 3/4"	0.624	Passed (L/568)	--	1.0 D + 1.0 S (Alt Spans)
Total Load Defl. (in)	0.508 @ 11' 4 1/4"	0.935	Passed (L/442)	--	1.0 D + 1.0 S (Alt Spans)

System : Roof
Member Type : Joist
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD
Member Pitch: 1.5/12

- Deflection criteria: LL (L/360) and TL (L/240).
- Overhang deflection criteria: LL (2L/360) and TL (2L/240).
- Top Edge Bracing (Lu): Top compression edge must be braced at 5' 9" o/c unless detailed otherwise.
- Bottom Edge Bracing (Lu): Bottom compression edge must be braced at 20' 7" o/c unless detailed otherwise.
- A 15% increase in the moment capacity has been added to account for repetitive member usage.
- -207 lbs uplift at support 1' 10 3/4". Strapping or other restraint may be required.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Snow	Wind	Total	
1 - Beveled Plate - DF	5.50"	5.50"	1.50"	136	413	-481	549/-481	Blocking
2 - Hanger on 11 1/4" DF beam	2.50"	Hanger[1]	1.50"	114	504	-405	618/-405	See note [1]

- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.
- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

Connector: Simpson Strong-Tie Connectors

Support	Model	Seat Length	Top Nails	Face Nails	Member Nails	Accessories
2 - Face Mount Hanger	Connector not found	N/A	N/A	N/A	N/A	

Loads	Location (Side)	Spacing	Dead (0.90)	Snow (1.15)	Wind (1.60)	Comments
1 - Uniform (PSF)	0 to 20' 8"	16"	9.0	25.0	-	roof dead and snow load
2 - Tapered (PLF)	11' 2" to 20' 7"	N/A	-	0.0 to 48.0	-	snow drift load
3 - Uniform (PSF)	0 to 20' 8"	16"	-	-	-32.0	wind uplift load

Member Notes

Deck roof rafter #1

Weyerhaeuser Notes

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The product application, input design loads, dimensions and support information have been provided by Forte Software Operator

SUSTAINABLE FORESTRY INITIATIVE

Forte Software Operator	Job Notes
Mario Alvarado quantum (206) 957-3900 malvarado@quantumce.com	

5/10/2019 11:18:42 AM
Forte v5.4, Design Engine: V7.1.1.3
Lai Deck Roof.4te

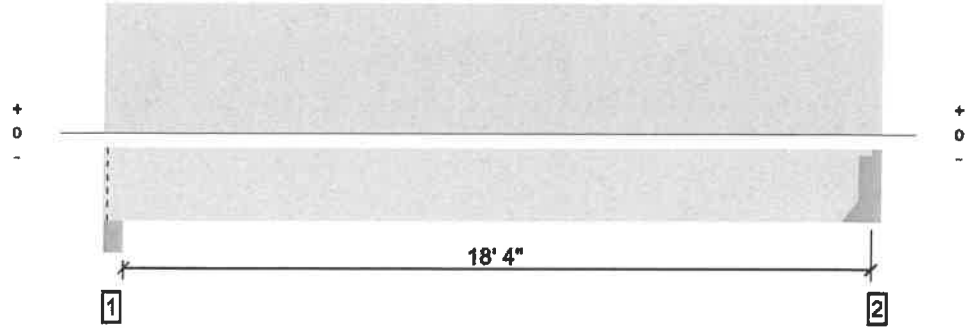
FORTE®

MEMBER REPORT *roof, CJ-1*

1 piece(s) 2 x 8 Douglas Fir-Larch No. 2 @ 16" OC

14 PASSED

Overall Length: 19'



All locations are measured from the outside face of left support (or left cantilever end).All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	196 @ 18' 9 1/2"	1406 (1.50")	Passed (14%)	--	1.0 D + 1.0 Lr (All Spans)
Shear (lbs)	184 @ 18' 2 1/4"	1631	Passed (11%)	1.25	1.0 D + 1.0 Lr (All Spans)
Moment (Ft-lbs)	904 @ 9' 7"	1700	Passed (53%)	1.25	1.0 D + 1.0 Lr (All Spans)
Live Load Defl. (in)	0.453 @ 9' 7"	0.614	Passed (L/488)	--	1.0 D + 1.0 Lr (All Spans)
Total Load Defl. (in)	0.725 @ 9' 7"	0.921	Passed (L/305)	--	1.0 D + 1.0 Lr (All Spans)

System : Roof
Member Type : Joist
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD
Member Pitch: 0/12

- Deflection criteria: LL (L/360) and TL (L/240).
- Top Edge Bracing (Lu): Top compression edge must be braced at 13' 5" o/c unless detailed otherwise.
- Bottom Edge Bracing (Lu): Bottom compression edge must be braced at 18' 10" o/c unless detailed otherwise.
- A 15% increase in the moment capacity has been added to account for repetitive member usage.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Roof Live	Total	
1 - Beam - HF	5.50"	5.50"	1.50"	77	128	205	Blocking
2 - Hanger on 7 1/4" HF beam	2.50"	Hanger[1]	1.50"	75	126	201	See note [1]

- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.
- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

Connector: Simpson Strong-Tie Connectors

Support	Model	Seat Length	Top Nails	Face Nails	Member Nails	Accessories
2 - Face Mount Hanger	LU26	1.50"	N/A	6-10d	4-10dx1.5	None

Loads	Location (Side)	Spacing	Dead (0.90)	Roof Live (non-snow: 1.25)	Comments
1 - Uniform (PSF)	0 to 19'	16"	6.0	10.0	ceiling joist dead and roof live load

Member Notes

Deck roof ceiling joist #1

Weyerhaeuser Notes

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The product application, input design loads, dimensions and support information have been provided by Forte Software Operator

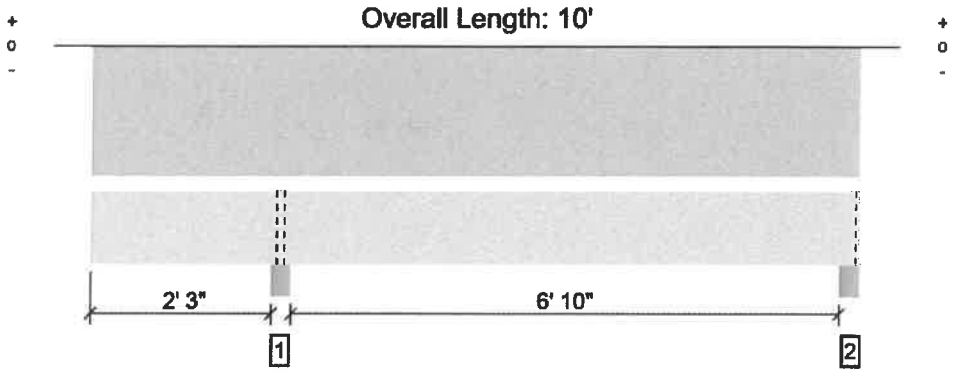
SUSTAINABLE FORESTRY INITIATIVE

Forte Software Operator	Job Notes
Mario Alvarado quantum (206) 957-3900 malverado@quantumce.com	

5/10/2019 11:18:59 AM
Forte v5.4, Design Engine: V7.1.1.3
Lai Deck Roof.4te

MEMBER REPORT *roof, B-1*

1 piece(s) 6 x 8 Douglas Fir-Larch No. 1



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	3120 @ 2' 5 3/4"	18906 (5.50")	Passed (17%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	1520 @ 3' 4"	5376	Passed (28%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	2620 @ 6' 4 3/8"	5930	Passed (44%)	1.15	1.0 D + 1.0 S (Alt Spans)
Live Load Defl. (in)	0.092 @ 0	0.200	Passed (2L/650)	--	1.0 D + 0.6 W (Alt Spans)
Total Load Defl. (in)	0.083 @ 0	0.248	Passed (2L/718)	--	0.6 D + 0.6 W (Alt Spans)

System : Roof
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD
Member Pitch: 0/12

- Deflection criteria: LL (L/360) and TL (L/240).
- Overhang deflection criteria: LL (0.2") and TL (2L/240).
- Top Edge Bracing (Lu): Top compression edge must be braced at 10' o/c unless detailed otherwise.
- Bottom Edge Bracing (Lu): Bottom compression edge must be braced at 10' o/c unless detailed otherwise.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)					Accessories
	Total	Available	Required	Dead	Roof Live	Snow	Wind	Total	
1 - Column - DF	5.50"	5.50"	1.50"	1106	624	2014	-4633	3744/-4633	Blocking
2 - Column - DF	5.50"	5.50"	1.50"	596	356	1150	305/-2799	2407/-2799	Blocking

- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Loads	Location (Side)	Tributary Width	Dead (0.90)	Roof Live (non-snow: 1.25)	Snow (1.15)	Wind (1.60)	Comments
0 - Self Weight (PLF)	0 to 10'	N/A	10.4				
1 - Uniform (PSF)	0 to 10' (Front)	11'	-	-	-	-32.0	wind uplift force
2 - Uniform (PLF)	0 to 10' (Top)	N/A	102.0	-	309.8	-360.8	Linked from: DR-1, Support 1
3 - Uniform (PLF)	0 to 10' (Back)	N/A	57.8	96.0	-	-	Linked from: CJ-1, Support 1

Member Notes

beam #1

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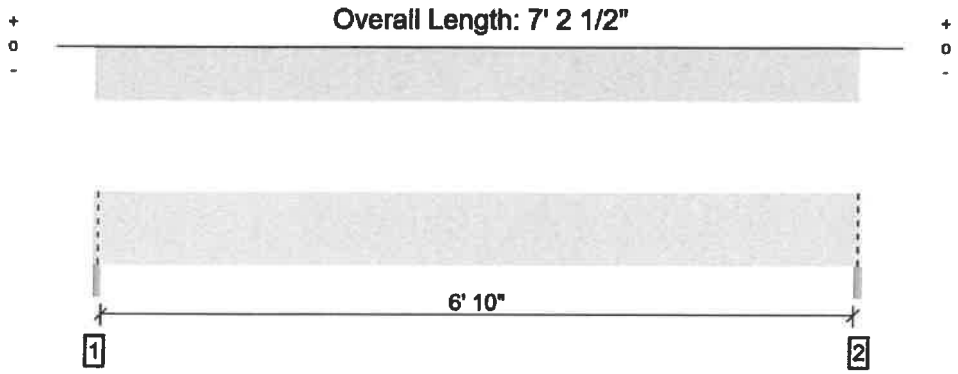
The product application, input design loads, dimensions and support information have been provided by Forte Software Operator

SUSTAINABLE FORESTRY INITIATIVE

Forte Software Operator	Job Notes
Mario Alvarado quantum (206) 957-3900 malvarado@quantumce.com	

5/10/2019 11:21:41 AM
Forte v5.4, Design Engine: V7.1.1.3
Lai Deck Roof.4te



All locations are measured from the outside face of left support (or left cantilever end).All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	1730 @ 3/4"	7734 (2.25")	Passed (22%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	1340 @ 9 3/4"	5376	Passed (25%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	3010 @ 3' 7 1/4"	5930	Passed (51%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.057 @ 3' 7 1/4"	0.236	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.088 @ 3' 7 1/4"	0.354	Passed (L/967)	--	1.0 D + 1.0 S (All Spans)

System : Roof
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD
Member Pitch: 0/12

- Deflection criteria: LL (L/360) and TL (L/240).
- Top Edge Bracing (Lu): Top compression edge must be braced at 7' 3" o/c unless detailed otherwise.
- Bottom Edge Bracing (Lu): Bottom compression edge must be braced at 7' 3" o/c unless detailed otherwise.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)					Accessories
	Total	Available	Required	Dead	Roof Live	Snow	Wind	Total	
1 - Column - DF	2.25"	2.25"	1.50"	613	346	1116	-2569	2075/-2569	Blocking
2 - Column - DF	2.25"	2.25"	1.50"	607	342	1103	-2554	2052/-2554	Blocking

- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Loads	Location (Side)	Tributary Width	Dead (0.90)	Roof Live (non-snow: 1.25)	Snow (1.15)	Wind (1.60)	Comments
0 - Self Weight (PLF)	0 to 7' 2 1/2"	N/A	10.4				
1 - Uniform (PSF)	0 to 7' 2 1/2" (Front)	11'	-	-	-	-32.0	wind uplift force
2 - Uniform (PLF)	0 to 7' 2" (Top)	N/A	102.0	-	309.8	-360.8	Linked from: DR-1, Support 1
3 - Uniform (PLF)	0 to 7' 2" (Back)	N/A	57.8	96.0	-	-	Linked from: CJ-1, Support 1

Member Notes

beam #1

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The product application, input design loads, dimensions and support information have been provided by Forte Software Operator

SUSTAINABLE FORESTRY INITIATIVE

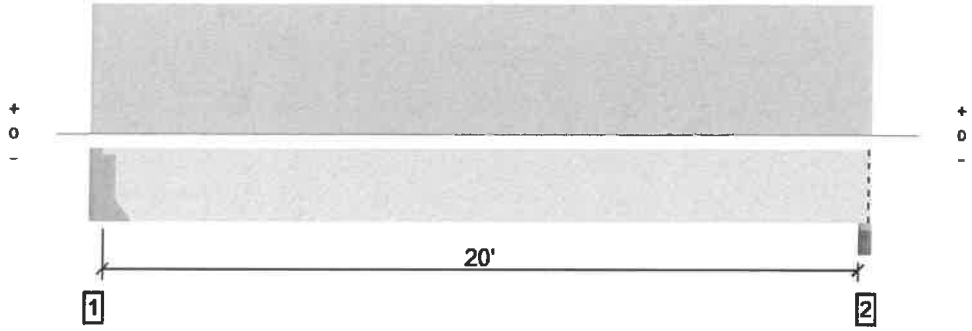
Forte Software Operator	Job Notes
Mario Alvarado quantum (206) 957-3900 malvarado@quantumce.com	

FORTE® **MEMBER REPORT** *roof, stair stringer*

1 piece(s) 6 x 12 Douglas Fir-Larch No. 1

17 **PASSED**

Overall Length: 20' 7"



All locations are measured from the outside face of left support (or left cantilever end).All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	1610 @ 3 1/2"	5156 (1.50")	Passed (31%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	1457 @ 1' 3"	7168	Passed (20%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	8101 @ 10' 4 1/4"	13638	Passed (59%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.441 @ 10' 4 1/4"	0.503	Passed (L/547)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.588 @ 10' 4 1/4"	1.006	Passed (L/410)	--	1.0 D + 1.0 L (All Spans)

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Top Edge Bracing (Lu): Top compression edge must be braced at 20' 4" o/c unless detailed otherwise.
- Bottom Edge Bracing (Lu): Bottom compression edge must be braced at 20' 4" o/c unless detailed otherwise.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Total	
1 - Hanger on 11 1/2" DF beam	3.50"	Hanger[1]	1.50"	410	1243	1653	See note [1]
2 - Plate on concrete - DF	3.50"	3.50"	1.50"	409	1228	1637	Blocking

- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.
- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

Connector: Simpson Strong-Tie Connectors

Support	Model	Seat Length	Top Nails	Face Nails	Member Nails	Accessories
1 - Face Mount Hanger	Connector not found	N/A	N/A	N/A	N/A	

Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	3 1/2" to 20' 7"	N/A	16.0		
1 - Uniform (PSF)	0 to 20' 7" (Front)	2'	12.0	60.0	Residential - Living Areas

Member Notes

deck stair stringer

Weyerhaeuser Notes

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The product application, input design loads, dimensions and support information have been provided by Forte Software Operator

SUSTAINABLE FORESTRY INITIATIVE

Forte Software Operator	Job Notes
Mario Alvarado quantum (206) 957-3900 malvarado@quantumce.com	

5/10/2019 11:22:08 AM
Forte v5.4, Design Engine: V7.1.1.3
Lai Deck Roof.4te

General Footing

Description : F1.5

Code References

Calculations per ACI 318-14, IBC 2015, CBC 2010, ASCE 7-10
Load Combinations Used : ASCE 7-10

General Information

Material Properties

f'c : Concrete 28 day strength	=	2.50 ksi
fy : Rebar Yield	=	40.0 ksi
Ec : Concrete Elastic Modulus	=	2,850.0 ksi
Concrete Density	=	145.0 pcf
φ Values Flexure	=	0.880
Shear	=	0.750

Analysis Settings

Min Steel % Bending Reinf.	=	
Min Allow % Temp Reinf.	=	0.00180
Min. Overturning Safety Factor	=	1.0 : 1
Min. Sliding Safety Factor	=	1.0 : 1
Add Ftg Wt for Soil Pressure	:	Yes
Use ftg wt for stability, moments & shears	:	Yes
Add Pedestal Wt for Soil Pressure	:	Yes
Use Pedestal wt for stability, mom & shear	:	Yes

Soil Design Values

Allowable Soil Bearing	=	2.50 ksf
Increase Bearing By Footing Weight	=	No
Soil Passive Resistance (for Sliding)	=	300.0 pcf
Soil/Concrete Friction Coeff.	=	0.350

Increases based on footing Depth

Footing base depth below soil surface	=	3.0 ft
Allowable pressure increase per foot of depth	=	ksf
when footing base is below	=	ft

Increases based on footing plan dimension

Allowable pressure increase per foot of depth	=	ksf
when maximum length or width is greater	=	ft

Dimensions

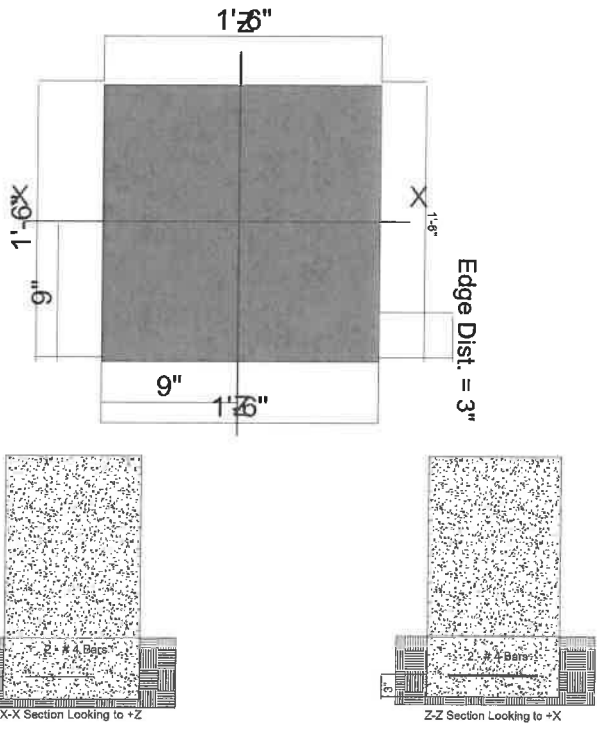
Width parallel to X-X Axis	=	1.50 ft
Length parallel to Z-Z Axis	=	1.50 ft
Footing Thicknes	=	8.0 in

Pedestal dimensions...

px : parallel to X-X Axis	=	18.0 in
pz : parallel to Z-Z Axis	=	18.0 in
Height	=	24.0 in

Rebar Centerline to Edge of Concrete..

at Bottom of footing	=	3.0 in



Reinforcing

Bars parallel to X-X Axis		
Number of Bars	=	2.0
Reinforcing Bar Size	=	# 4
Bars parallel to Z-Z Axis		
Number of Bars	=	2.0
Reinforcing Bar Size	=	# 4

Bandwidth Distribution Check (ACI 15.4.4.2)

Direction Requiring Closer Separation	n/a
# Bars required within zone	n/a
# Bars required on each side of zone	n/a

Applied Loads

		D	Lr	L	S	W	E	H	
P : Column Load	=	1.30	0.80		2.950	0.0			k
OB : Overburden	=								ksf
M-xx	=								k-ft
M-zz	=								k-ft
V-x	=								k
V-z	=								k

General Footing

Description : F1.5

DESIGN SUMMARY

Design OK

	Min. Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.9104	Soil Bearing	2.276 ksf	2.50 ksf	+D+S+H about Z-Z axis
PASS	n/a	Overturning - X-X	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Overturning - Z-Z	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Uplift	0.0 k	0.0 k	No Uplift
PASS	0.0	Z Flexure (+X)	0.0 k-ft	0.0 k-ft	No Moment
PASS	0.0	Z Flexure (-X)	0.0 k-ft	0.0 k-ft	No Moment
PASS	0.0	X Flexure (+Z)	0.0 k-ft	0.0 k-ft	No Moment
PASS	0.0	X Flexure (-Z)	0.0 k-ft	0.0 k-ft	No Moment
PASS	n/a	1-way Shear (+X)	0.0 psi	75.0 psi	n/a
PASS	n/a	1-way Shear (-X)	0.0 psi	75.0 psi	n/a
PASS	n/a	1-way Shear (+Z)	0.0 psi	75.0 psi	n/a
PASS	n/a	1-way Shear (-Z)	0.0 psi	75.0 psi	n/a
PASS	n/a	2-way Punching	0.0 psi	75.0 psi	n/a

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc	Zecc	Actual Soil Bearing Stress +Z	Actual Soil Bearing Stress +Z	Actual Soil Bearing Stress -X	Actual Soil Bearing Stress -X	Actual / Allowable Ratio

Overturning Stability

Rotation Axis & Load Combination...	Overturning Moment	Resisting Moment	Stability Ratio	Status

Footing Has NO Overturning

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Which Side ?	Tension @ Bot or Top ?	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.40D+1.60H	0.0	+Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +1.40D+1.60H	0.0	-Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +1.20D+0.50Lr+1.60L+1.60H	0.0	+Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +1.20D+0.50Lr+1.60L+1.60H	0.0	-Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +1.20D+1.60L+0.50S+1.60H	0.0	+Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +1.20D+1.60L+0.50S+1.60H	0.0	-Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +1.20D+1.60Lr+0.50L+1.60H	0.0	+Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +1.20D+1.60Lr+0.50L+1.60H	0.0	-Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +1.20D+1.60Lr+0.50W+1.60H	0.0	+Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +1.20D+1.60Lr+0.50W+1.60H	0.0	-Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +1.20D+1.60Lr-0.50W+1.60H	0.0	+Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +1.20D+1.60Lr-0.50W+1.60H	0.0	-Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +1.20D+0.50L+1.60S+1.60H	0.0	+Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +1.20D+0.50L+1.60S+1.60H	0.0	-Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +1.20D+1.60S+0.50W+1.60H	0.0	+Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +1.20D+1.60S+0.50W+1.60H	0.0	-Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +1.20D+1.60S-0.50W+1.60H	0.0	+Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +1.20D+1.60S-0.50W+1.60H	0.0	-Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +1.20D+0.50Lr+0.50L+W+1.60H	0.0	+Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +1.20D+0.50Lr+0.50L+W+1.60H	0.0	-Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +1.20D+0.50Lr+0.50L-1.0W+1.60	0.0	+Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +1.20D+0.50Lr+0.50L-1.0W+1.60	0.0	-Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +1.20D+0.50L+0.50S+W+1.60H	0.0	+Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +1.20D+0.50L+0.50S+W+1.60H	0.0	-Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +1.20D+0.50L+0.50S-1.0W+1.60H	0.0	+Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +1.20D+0.50L+0.50S-1.0W+1.60H	0.0	-Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +1.20D+0.50L+0.20S+E+1.60H	0.0	+Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +1.20D+0.50L+0.20S+E+1.60H	0.0	-Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +0.90D+W+0.90H	0.0	+Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +0.90D+W+0.90H	0.0	-Z	Top	0.1728	Min Temp %	0.2667	3.748	OK
X-X, +0.90D-1.0W+0.90H	0.0	+Z	Top	0.1728	Min Temp %	0.2667	3.748	OK

General Footing

Description : F1.5

X-X, +0.90D-1.0W+0.90H	0.0	-Z	Top	0.1728	Min Temp %	0.2667	3.748	OK

General Footing

Description : F1.5

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Which Side ?	Tension @ Bot or Top ?	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
Z-Z, +1.40D+1.60H	0.0	-X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +1.40D+1.60H	0.0	+X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +1.20D+0.50Lr+1.60L+1.60H	0.0	-X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +1.20D+0.50Lr+1.60L+1.60H	0.0	+X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +1.20D+1.60L+0.50S+1.60H	0.0	-X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +1.20D+1.60L+0.50S+1.60H	0.0	+X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +1.20D+1.60Lr+0.50L+1.60H	0.0	-X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +1.20D+1.60Lr+0.50L+1.60H	0.0	+X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +1.20D+1.60Lr+0.50W+1.60H	0.0	-X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +1.20D+1.60Lr+0.50W+1.60H	0.0	+X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +1.20D+1.60Lr-0.50W+1.60H	0.0	-X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +1.20D+1.60Lr-0.50W+1.60H	0.0	+X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +1.20D+0.50L+1.60S+1.60H	0.0	-X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +1.20D+0.50L+1.60S+1.60H	0.0	+X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +1.20D+1.60S+0.50W+1.60H	0.0	-X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +1.20D+1.60S+0.50W+1.60H	0.0	+X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +1.20D+1.60S-0.50W+1.60H	0.0	-X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +1.20D+1.60S-0.50W+1.60H	0.0	+X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +1.20D+0.50Lr+0.50L+W+1.60H	0.0	-X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +1.20D+0.50Lr+0.50L+W+1.60H	0.0	+X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +1.20D+0.50Lr+0.50L-1.0W+1.60	0.0	-X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +1.20D+0.50Lr+0.50L-1.0W+1.60	0.0	+X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +1.20D+0.50L+0.50S+W+1.60H	0.0	-X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +1.20D+0.50L+0.50S+W+1.60H	0.0	+X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +1.20D+0.50L+0.50S-1.0W+1.60H	0.0	-X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +1.20D+0.50L+0.50S-1.0W+1.60H	0.0	+X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +1.20D+0.50L+0.20S+E+1.60H	0.0	-X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +1.20D+0.50L+0.20S+E+1.60H	0.0	+X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +0.90D+W+0.90H	0.0	-X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +0.90D+W+0.90H	0.0	+X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +0.90D-1.0W+0.90H	0.0	-X	Top	0.1728	Min Temp %	0.2667	3.748	OK
Z-Z, +0.90D-1.0W+0.90H	0.0	+X	Top	0.1728	Min Temp %	0.2667	3.748	OK

One Way Shear

Load Combination...	Vu @ -X	Vu @ +X	Vu @ -Z	Vu @ +Z	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D+1.60H	0 psi	0 psi	0 psi	0 psi	0 psi	75 psi	0	OK
+1.20D+0.50Lr+1.60L+1.60H	0 psi	0 psi	0 psi	0 psi	0 psi	75 psi	0	OK
+1.20D+1.60L+0.50S+1.60H	0 psi	0 psi	0 psi	0 psi	0 psi	75 psi	0	OK
+1.20D+1.60Lr+0.50L+1.60H	0 psi	0 psi	0 psi	0 psi	0 psi	75 psi	0	OK
+1.20D+1.60Lr+0.50W+1.60H	0 psi	0 psi	0 psi	0 psi	0 psi	75 psi	0	OK
+1.20D+1.60Lr-0.50W+1.60H	0 psi	0 psi	0 psi	0 psi	0 psi	75 psi	0	OK
+1.20D+0.50L+1.60S+1.60H	0 psi	0 psi	0 psi	0 psi	0 psi	75 psi	0	OK
+1.20D+1.60S+0.50W+1.60H	0 psi	0 psi	0 psi	0 psi	0 psi	75 psi	0	OK
+1.20D+1.60S-0.50W+1.60H	0 psi	0 psi	0 psi	0 psi	0 psi	75 psi	0	OK
+1.20D+0.50Lr+0.50L+W+1.60H	0 psi	0 psi	0 psi	0 psi	0 psi	75 psi	0	OK
+1.20D+0.50Lr+0.50L-1.0W+1.60H	0 psi	0 psi	0 psi	0 psi	0 psi	75 psi	0	OK
+1.20D+0.50L+0.50S+W+1.60H	0 psi	0 psi	0 psi	0 psi	0 psi	75 psi	0	OK
+1.20D+0.50L+0.50S-1.0W+1.60H	0 psi	0 psi	0 psi	0 psi	0 psi	75 psi	0	OK
+1.20D+0.50L+0.20S+E+1.60H	0 psi	0 psi	0 psi	0 psi	0 psi	75 psi	0	OK
+0.90D+W+0.90H	0 psi	0 psi	0 psi	0 psi	0 psi	75 psi	0	OK
+0.90D-1.0W+0.90H	0 psi	0 psi	0 psi	0 psi	0 psi	75 psi	0	OK

Punching Shear

All units k

Load Combination...	Vu	Phi*Vn	Vu / Phi*Vn	Status
+1.40D+1.60H	0 psi	150 psi	0	OK
+1.20D+0.50Lr+1.60L+1.60H	0 psi	150 psi	0	OK
+1.20D+1.60L+0.50S+1.60H	0 psi	150 psi	0	OK
+1.20D+1.60Lr+0.50L+1.60H	0 psi	150 psi	0	OK
+1.20D+1.60Lr+0.50W+1.60H	0 psi	150 psi	0	OK
+1.20D+1.60Lr-0.50W+1.60H	0 psi	150 psi	0	OK
+1.20D+0.50L+1.60S+1.60H	0 psi	150 psi	0	OK
+1.20D+1.60S+0.50W+1.60H	0 psi	150 psi	0	OK
+1.20D+1.60S-0.50W+1.60H	0 psi	150 psi	0	OK

Description : F1.5

Punching Shear

All units k

Load Combination...	Vu	Phi*Vn	Vu / Phi*Vn	Status
+1.20D+0.50Lr+0.50L+W+1.60H	0 psi	150 psi	0	OK
+1.20D+0.50Lr+0.50L-1.0W+1.60H	0 psi	150 psi	0	OK
+1.20D+0.50L+0.50S+W+1.60H	0 psi	150 psi	0	OK
+1.20D+0.50L+0.50S-1.0W+1.60H	0 psi	150 psi	0	OK
+1.20D+0.50L+0.20S+E+1.60H	0 psi	150 psi	0	OK
+0.90D+W+0.90H	0 psi	150 psi	0	OK
+0.90D-1.0W+0.90H	0 psi	150 psi	0	OK

Design Method	Allowable Stress Design (ASD)
Connection Type	Lateral loading
Fastener Type	Nail
Loading Scenario	Single Shear

Main Member Type	Douglas Fir-Larch
Main Member Thickness	1.5 in.
Side Member Type	Douglas Fir-Larch
Side Member Thickness	1.5 in.
Nail Type	Common Wire
Nail Size	10d (D = 0.148 in.; L = 3 in.)
Load Duration Factor	C_D = 1.6
Wet Service Factor	C_M = 1.0
End Grain Factor	C_eg = 1.0
Temperature Factor	C_t = 1.0
Diaphragm Factor	C_di = 1.0

Connection Yield Modes

Im	751 lbs.
Is	751 lbs.
II	311 lbs.
IIIm	273 lbs.
IIIs	273 lbs.
IV	188 lbs.

Adjusted ASD Capacity	**188 lbs.**

- Nail bending yield strength of 90000 psi is assumed.
- The Adjusted ASD Capacity does not apply for toe-nails installed in wood members.
- Length of tapered tip is assumed to be two times the nail diameter for calculating dowel bearing length in the main member.
- The Adjusted ASD Capacity only applies for nails that have been driven flush with the side member surface. It does not apply for nails that have been overdriven into the side member.

While every effort has been made to insure the accuracy of the information presented, and special effort has been made to assure that the information reflects the state-of-the-art, neither the American Wood Council nor its members assume any responsibility for any particular design prepared from this on-line Connection Calculator. Those using this on-line Connection Calculator assume all liability from its use.

The Connection Calculator was designed and created by Cameron Knudson, Michael Dodson and David Pollock at Washington State University. Support for development of the Connection Calculator was provided by American Wood Council.

Design Method	Allowable Stress Design (ASD)
Connection Type	Lateral loading
Fastener Type	Nail
Loading Scenario	Single Shear

Main Member Type	Douglas Fir-Larch
Main Member Thickness	-- Other (in inches) -- 2.0
Side Member Type	Douglas Fir-Larch
Side Member Thickness	1.5 in.
Nail Type	Common Wire
Nail Size	16d (D = 0.162 in.; L = 3.5 in.)
Load Duration Factor	C_D = 1.0
Wet Service Factor	C_M = 1.0
End Grain Factor	C_eg = 1.0
Temperature Factor	C_t = 1.0
Diaphragm Factor	C_di = 1.0

Connection Yield Modes

Im	685 lbs.
Is	514 lbs.
II	253 lbs.
IIIm	243 lbs.
IIIs	190 lbs.
IV	141 lbs.

Adjusted ASD Capacity	**141 lbs.**

- Nail bending yield strength of 90000 psi is assumed.
- The Adjusted ASD Capacity does not apply for toe-nails installed in wood members.
- Length of tapered tip is assumed to be two times the nail diameter for calculating dowel bearing length in the main member.
- The Adjusted ASD Capacity only applies for nails that have been driven flush with the side member surface. It does not apply for nails that have been overdriven into the side member.

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Design Method	Allowable Stress Design (ASD) ▼
Connection Type	Withdrawal loading ▼
Fastener Type	Lag Screw ▼
Loading Scenario	N/A ▼

Main Member Type	Douglas Fir-Larch ▼
Main Member Thickness	9.5 in. ▼
Side Member Type	Douglas Fir-Larch ▼
Side Member Thickness	-- Other (in inches) -- ▼ 7.25
Washer Thickness	1/8 in. ▼
Nominal Diameter	3/8 in. ▼
Length	12 in. ▼
Load Duration Factor	C_D = 1.6 ▼
Wet Service Factor	C_M = 1.0 ▼
End Grain Factor	C_eg = 0.75 ▼
Temperature Factor	C_t = 1.0 ▼

Adjusted ASD Capacity	**1613 lbs.**

- The Adjusted ASD Capacity only applies to withdrawal of the fastener from the main member. It does not address head pull-through capacity of the fastener in the side member.

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LAI DECK ROOF ADDITION
7505 92ND AVE. SE,
MERCER ISLAND, WA

Quantum Job Number: 19175.01

HANDRAIL CONNECTION CALCULATION

Guard Rail Connection Check

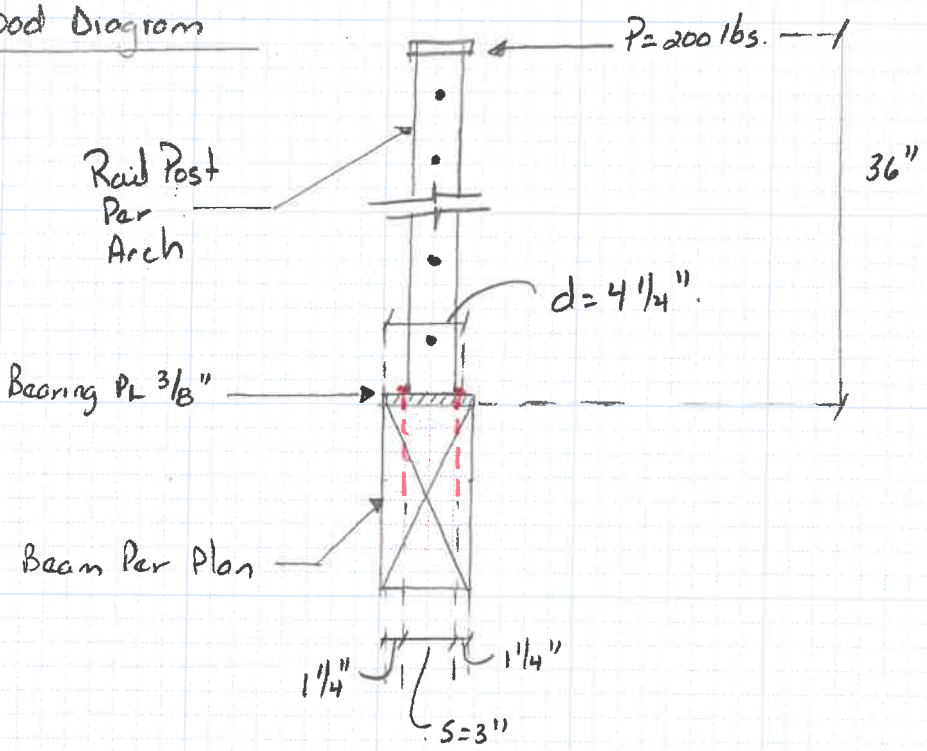
I- Generals

* out of Plane Load = 200 lbs at Guardrail Post ; Rail Post height = 3'0"

Max Guardrail span = 4'6" ; Fastener 3/8" Ø x 6" Lag screw (HDG) - hot dipped Galvanized

PL 3/8" (Fy = 36 ksi)

II- Load Diagram



III- Calcs

* $M_p = P * h = 200 \text{ lbs} * 36" = 7{,}200 \text{ lb·in}$ (7.2 k·in)

$T_p = M_p / d = \frac{7{,}200 \text{ lb·in}}{4.25"} = 1694 \text{ lbs}$

$T_p \approx 1700 \text{ lbs}$ //

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Lai Stair Guard Rail (project)	04/25/2019 (date)	19175.01 (project no.)
	NOA (designer)	#1 (sheet)
Josh Artison + Architect (client)	(checked by)	

IV - Fastener Check

→ shear check :

* $V_p = 200$ lbs

Per AWC Connections spreadsheet we obtain the following Results :

$V_A = 162\ lb/screw \times 4$ screws

$V_A = 648$ lbs.

$V_p = 200$ lbs $<$ $V_A = 648$ lbs ; ok // ∴ shear check

→ Tension Check

* $T_p = 1700$ lbs

Per AWC Connections Spreadsheet we obtain the following Results :

$T_A = 1201$ lbs *

$T_A = 1201\ lbs/screw * 2$ screws $= 2402$ lbs.

* Load includes a C_D impact load factor, but Per NDS 2015 a max. value of C_D 1.6 was used, as permissible for connections

$T_p = 1700$ lbs $<$ $T_A = 2402$ lbs ; ok // ∴ Tension check

→ Moment Check

$M_p = 7200$ lb·in

$M_A = T_A * 5$

$= 1201\ lb/screw * 2$ screws $* 3.0$"

$M_A = 7206$ lbs·in.

$M_p = 7200$ lb·in $<$ $M_A = 7206$ lb·in ; ok // ∴ Moment check

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Lai Stair Guard Rail (project)	04/25/2019 (date)	19175.01 (project no.)
	MDA (designer)	#2 (sheet)
Josh Artison + Architect (client)	(checked by)	

Design Method	Allowable Stress Design (ASD)
Connection Type	Lateral loading
Fastener Type	Lag Screw
Loading Scenario	Single Shear

Main Member Type	Douglas Fir-Larch
Main Member Thickness	11.5 in.
Main Member: Angle of Load to Grain	90
Side Member Type	Steel
Side Member Thickness	1/4 in.
Side Member: Angle of Load to Grain	0
Washer Thickness	1/8 in.
Nominal Diameter	1/4 in.
Length	6 in.
Load Duration Factor	C_D = 1.6
Wet Service Factor	C_M = 1.0
End Grain Factor	C_eg = 0.67
Temperature Factor	C_t = 1.0

Connection Yield Modes

Im	1665 lbs.
Is	1447 lbs.
II	686 lbs.
IIIm	685 lbs.
IIIs	223 lbs.
IV	162 lbs.

Adjusted ASD Capacity	**162 lbs.**

- Lag Screw bending yield strength of 70000 psi is assumed.
- The Adjusted ASD Capacity is only applicable for lag screws with adequate end distance, edge distance and spacing per NDS chapter 11.
- ASTM A36 Steel is assumed for steel side members 1/4 in. thick, and ASTM A653 Grade 33 Steel is assumed for steel side members less than 1/4 in. thick.

The Connection Calculator was designed and created by Cameron Knudson, Michael Dodson and David Pollock at Washington State University. Support for development of the Connection Calculator was provided by American Wood Council.

Design Method	Allowable Stress Design (ASD) ▼
Connection Type	Withdrawal loading ▼
Fastener Type	Lag Screw ▼
Loading Scenario	N/A ▼

Main Member Type	Douglas Fir-Larch ▼
Main Member Thickness	11.5 in. ▼
Side Member Type	Steel ▼
Side Member Thickness	1/4 in. ▼
Washer Thickness	1/8 in. ▼
Nominal Diameter	3/8 in. ▼
Length	6 in. ▼
Load Duration Factor	C_D = 1.6 ▼
Wet Service Factor	C_M = 1.0 ▼
End Grain Factor	C_eg = 0.75 ▼
Temperature Factor	C_t = 1.0 ▼

Adjusted ASD Capacity	**1201 lbs.**

- The Adjusted ASD Capacity only applies to withdrawal of the fastener from the main member. It does not address head pull-through capacity of the fastener in the side member.

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QUANTUM
CONSULTING ENGINEERS

June 17, 2019

STRUCTURAL CALCULATIONS
(Supplemental permit calcs)

LAI DECK ROOF ADDITION
7505 92nd Ave. SE
Mercer Island, WA 98040

Quantum Job Number: 19175.01

Prepared for:
JOSH ARTISAN +
ARCHITECTURE

Prepared by:
QUANTUM CONSULTING ENGINEERS
1511 Third Avenue, Suite 323
Seattle, WA 98101
TEL 206.957.3900
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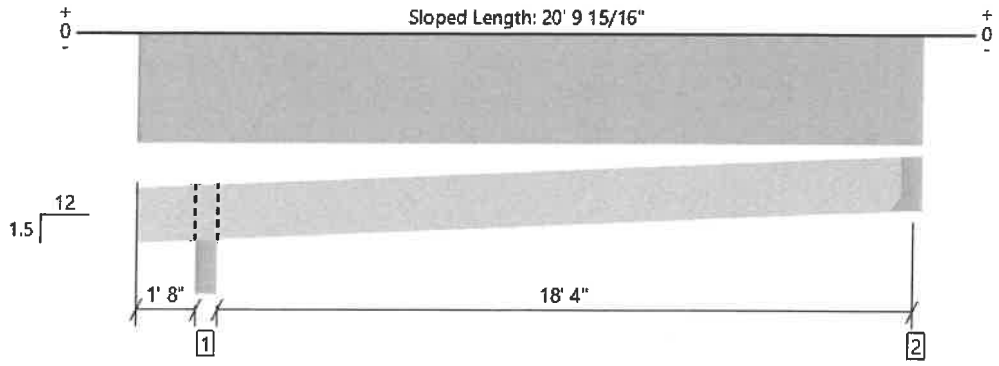
FORTE WEB

MEMBER REPORT

PASSED

roof, REv DR-1

1 piece(s) 2 x 12 Douglas Fir-Larch No. 2 @ 16" OC



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Member Length : 20' 8 13/16"

System : Roof
Member Type : Joist
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD
Member Pitch : 1.5/12

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	357 @ 20' 5 1/2"	1406 (1.50")	Passed (25%)	--	1.0 D + 1.0 Lr (Alt Spans)
Shear (lbs)	321 @ 19' 6 5/16"	2531	Passed (13%)	1.25	1.0 D + 1.0 Lr (Alt Spans)
Moment (Ft-lbs)	1647 @ 11' 2 7/8"	3411	Passed (48%)	1.25	1.0 D + 1.0 Lr (Alt Spans)
Live Load Defl. (in)	0.251 @ 11' 2 5/16"	0.624	Passed (L/895)	--	1.0 D + 1.0 Lr (Alt Spans)
Total Load Defl. (in)	0.363 @ 11' 2 3/8"	0.935	Passed (L/618)	--	1.0 D + 1.0 Lr (Alt Spans)

- Deflection criteria: LL (L/360) and TL (L/240).
- Overhang deflection criteria: LL (2L/360) and TL (2L/240).
- Top Edge Bracing (Lu): Top compression edge must be braced at 9' 2" o/c unless detailed otherwise.
- Bottom Edge Bracing (Lu): Bottom compression edge must be braced at 20' 7" o/c unless detailed otherwise.
- A 15% increase in the moment capacity has been added to account for repetitive member usage.
- -207 lbs uplift at support located at 1' 10 3/4". Strapping or other restraint may be required.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Roof Live	Wind	Total	
1 - Beveled Plate - DF	5.50"	5.50"	1.50"	136	301	-481	437/-481	Blocking
2 - Hanger on 11 1/4" DF beam	2.50"	Hanger[1]	1.50"	114	252	-405	366/-405	See note [1]

- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.
- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
2 - Face Mount Hanger	LRU28Z	1.94"	N/A	6-10dx1.5	5-10d	

Vertical Loads	Location (Side)	Spacing	Dead (0.90)	Roof Live (non-snow: 1.25)	Wind (1.60)	Comments
1 - Uniform (PSF)	0 to 20' 8"	16"	9.0	-	-	roof dead load
2 - Uniform (PSF)	0 to 20' 8"	16"	-	-	-32.0	wind uplift load
3 - Uniform (PSF)	0 to 20' 8"	16"	-	20.0	-	roof live load

Member Notes
Deck roof rafter #1

ForteWEB Software Operator	Job Notes
Mario D. Alvarado Jr. Quantum Consulting Engineers (206) 957-3904 malvarado@quantumce.com	

6/17/2019 8:54:58 PM UTC
ForteWEB v2.1, Engine: V7.3.2.309, Data: V7.2.0.2
File Name: Lai Deck Roof_Imported

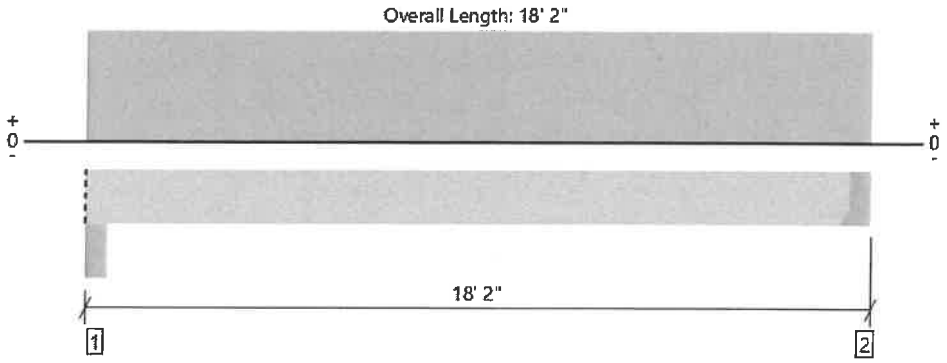
FORTE WEB

MEMBER REPORT

PASSED

roof, REV CJ-1

1 piece(s) 2 x 8 Douglas Fir-Larch No. 2 @ 16" OC



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	305 @ 17' 11 1/2"	1406 (1.50")	Passed (22%)	--	1.0 D + 1.0 Lr (All Spans)
Shear (lbs)	284 @ 17' 4 1/4"	1631	Passed (17%)	1.25	1.0 D + 1.0 Lr (All Spans)
Moment (Ft-lbs)	1340 @ 9' 2"	1700	Passed (79%)	1.25	1.0 D + 1.0 Lr (All Spans)
Live Load Defl. (in)	0.753 @ 9' 2"	0.879	Passed (L/280)	--	1.0 D + 1.0 Lr (All Spans)
Total Load Defl. (in)	0.978 @ 9' 2"	1.172	Passed (L/216)	--	1.0 D + 1.0 Lr (All Spans)

System : Roof
Member Type : Joist
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD
Member Pitch : 0/12

- Deflection criteria: LL (L/240) and TL (L/180).
- Top Edge Bracing (Lu): Top compression edge must be braced at 8' o/c unless detailed otherwise.
- Bottom Edge Bracing (Lu): Bottom compression edge must be braced at 18' o/c unless detailed otherwise.
- A 15% increase in the moment capacity has been added to account for repetitive member usage.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Roof Live	Total	
1 - Beam - HF	5.50"	5.50"	1.50"	73	244	317	Blocking
2 - Hanger on 7 1/4" HF beam	2.50"	Hanger[1]	1.50"	72	240	312	See note [1]

- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.
- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

Connector: Simpson Strong-Tie

Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
2 - Face Mount Hanger	LU26	1.50"	N/A	6-10d	4-10dx1.5	

Vertical Load	Location (Side)	Spacing	Dead (0.90)	Roof Live (non-snow: 1.25)	Comments
1 - Uniform (PSF)	0 to 18' 2"	16"	6.0	20.0	ceiling joist dead and roof live load

Member Notes

Deck roof ceiling joist #1

Weyerhaeuser Notes

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The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Weyerhaeuser SUSTAINABLE FORESTRY INITIATIVE

ForteWEB Software Operator	Job Notes
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6/15/2019 12:21:29 AM UTC
ForteWEB v2.1, Engine: V7.3.2.309, Data: V7.2.0.2
File Name: Lai Deck Roof_Imported

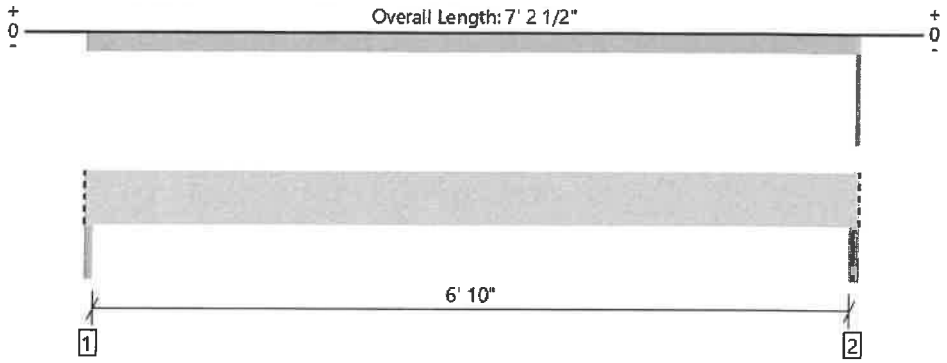
FORTE WEB

MEMBER REPORT

PASSED

roof, Copy of B-2

1 piece(s) 6 x 8 Douglas Fir-Larch No. 1



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	1719 @ 3/4"	7734 (2.25")	Passed (22%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	1331 @ 9 3/4"	5376	Passed (25%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	2991 @ 3' 7 1/4"	5930	Passed (50%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.057 @ 3' 7 1/4"	0.236	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.087 @ 3' 7 1/4"	0.354	Passed (L/973)	--	1.0 D + 1.0 S (All Spans)

System : Roof
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD
Member Pitch : 0/12

- Deflection criteria: LL (L/360) and TL (L/240).
- Top Edge Bracing (Lu): Top compression edge must be braced at 7' 3" o/c unless detailed otherwise.
- Bottom Edge Bracing (Lu): Bottom compression edge must be braced at 7' 3" o/c unless detailed otherwise.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)					Accessories
	Total	Available	Required	Dead	Roof Live	Snow	Wind	Total	
1 - Column - DF	2.25"	2.25"	1.50"	603	660	1116	-2569	2379/-2569	Blocking
2 - Column - DF	2.25"	2.25"	1.50"	596	652	1103	-2554	2351/-2554	Blocking

- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Roof Live (non-snow: 1.25)	Snow (1.15)	Wind (1.60)	Comments
0 - Self Weight (PLF)	0 to 7' 2 1/2"	N/A	10.4	--	--	--	
1 - Uniform (PSF)	0 to 7' 2 1/2" (Front)	11'	-	-	-	-32.0	wind uplift force
2 - Uniform (PLF)	0 to 7' 2" (Top)	N/A	102.0	-	309.8	-360.8	Linked from: DR-1, Support 1
3 - Uniform (PLF)	0 to 7' 2" (Back)	N/A	54.8	183.0	-	-	Linked from: REV CJ-1, Support 1

Member Notes

beam #1

Weyerhaeuser Notes

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The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Weyerhaeuser SUSTAINABLE FORESTRY INITIATIVE

ForteWEB Software Operator	Job Notes
Mario D. Alvarado Jr. Quantum Consulting Engineers (206) 957-3904 malvarado@quantumce.com	

6/17/2019 9:01:59 PM UTC
ForteWEB v2.1, Engine: V7.3.2.309, Data: V7.2.0.2
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Guard Rail Connection Check

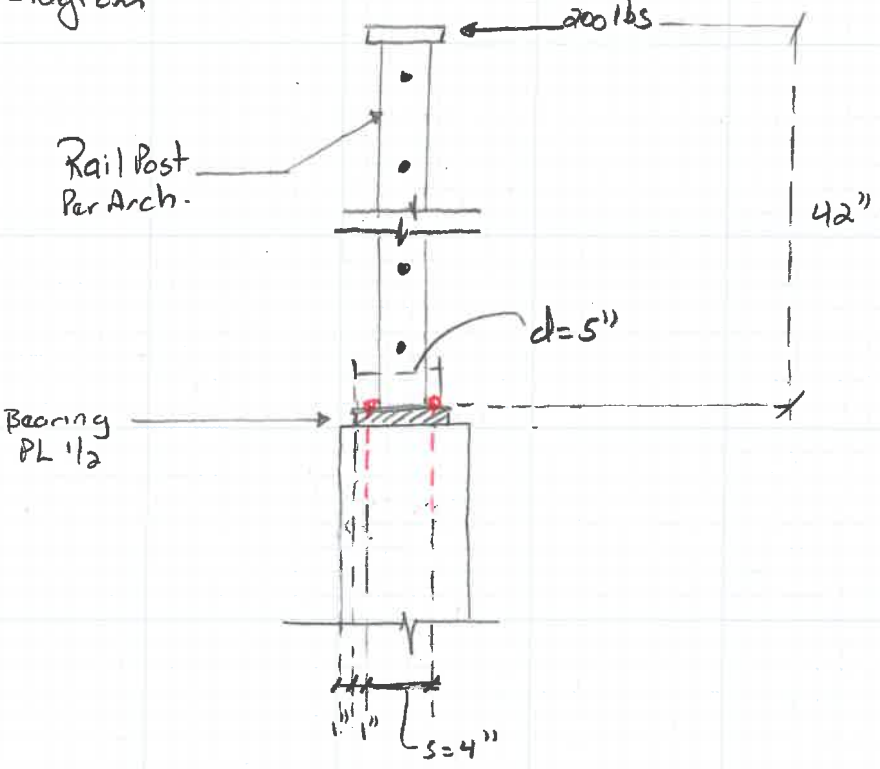
I- Generals

* out of plane at Guardrail Post = 200 lbs ; Rail Post height = 42"

Max Guardrail span = 4'0" ; Fastener = 1/2" ϕ F1554 G36

PL 1/2" (Fy = 36 ksi)

II- Load Diagram



III - Calcs

$M_p = P * h = 200 lbs * 42" = 8400$ lb-in. (8.4 k-in)

$T_p = M_p / d = \frac{8.4 \text{ k-in}}{5"} = 1680$ lbs.

$T_p \approx 1700$ lbs //

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Rei Deck Addition (project)	06/17/2019 (date)	P175.01 (project no.)
	MOA (designer)	#1 (sheet)
Josh Artison + Architect (client)	(checked by)	

IV - Fastener Check

→ shear Check:

* $V_p = 200$ lbs

Per Simpson Strong-Tie Anchor Design Software we obtain the following Results:

* $V_A = 1356$ lbs.

$V_p = 200$ lbs $< V_A = 1356$ lbs ; ok // ∴ shear check

→ Tension Check:

$T_p = 1700$ lbs.

Per Simpson Strong Tie Anchor Design Software we obtain the following Results:

$T_A = 3800$ lbs. (for adhesive)

$T_D = 1700$ lbs $< T_A = 3800$ lbs ; ok // ∴ Tension check

→ Moment Check:

$M_p = 8400$ lb·in

$M_A = T_A * S$

$= 3800$ lbs $* 4'' = 15{,}200$ lb·in.

$M_p = 8400$ lb·in $< M_A = 15{,}200$ lb·in ; ok // ∴ Moment check

∴ Use (4) 1/2"ϕ F1554 G36 Epoxy Anchors w/ set 36 Adhesive @ 5 1/2" min Embed.

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Lear Deck Addition (project)	06/17/2019 (date)	19175.01 (project no.)
	MDA (designer)	#2 (sheet)
Josh Artisan + Architect (client)	(checked by)	

SIMPSON Strong-Tie®

Anchor Designer™ Software
Version 2.7.6990.45

Company:		Date:	6/17/2019
Engineer:		Page:	1/6
Project:			
Address:			
Phone:			
E-mail:			

1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location:
Fastening description:

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: F1554 Grade 36
Diameter (inch): 0.500
Effective Embedment depth, h_{ef} (inch): 5.500
Code report: ICC-ES ESR-4057
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 6.75
c_{ac} (inch): 9.64
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 36.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: A tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: Yes
Ignore concrete breakout in tension: Yes
Ignore concrete breakout in shear: No
Hole condition: Dry concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 6.00 x 7.00 x 0.50

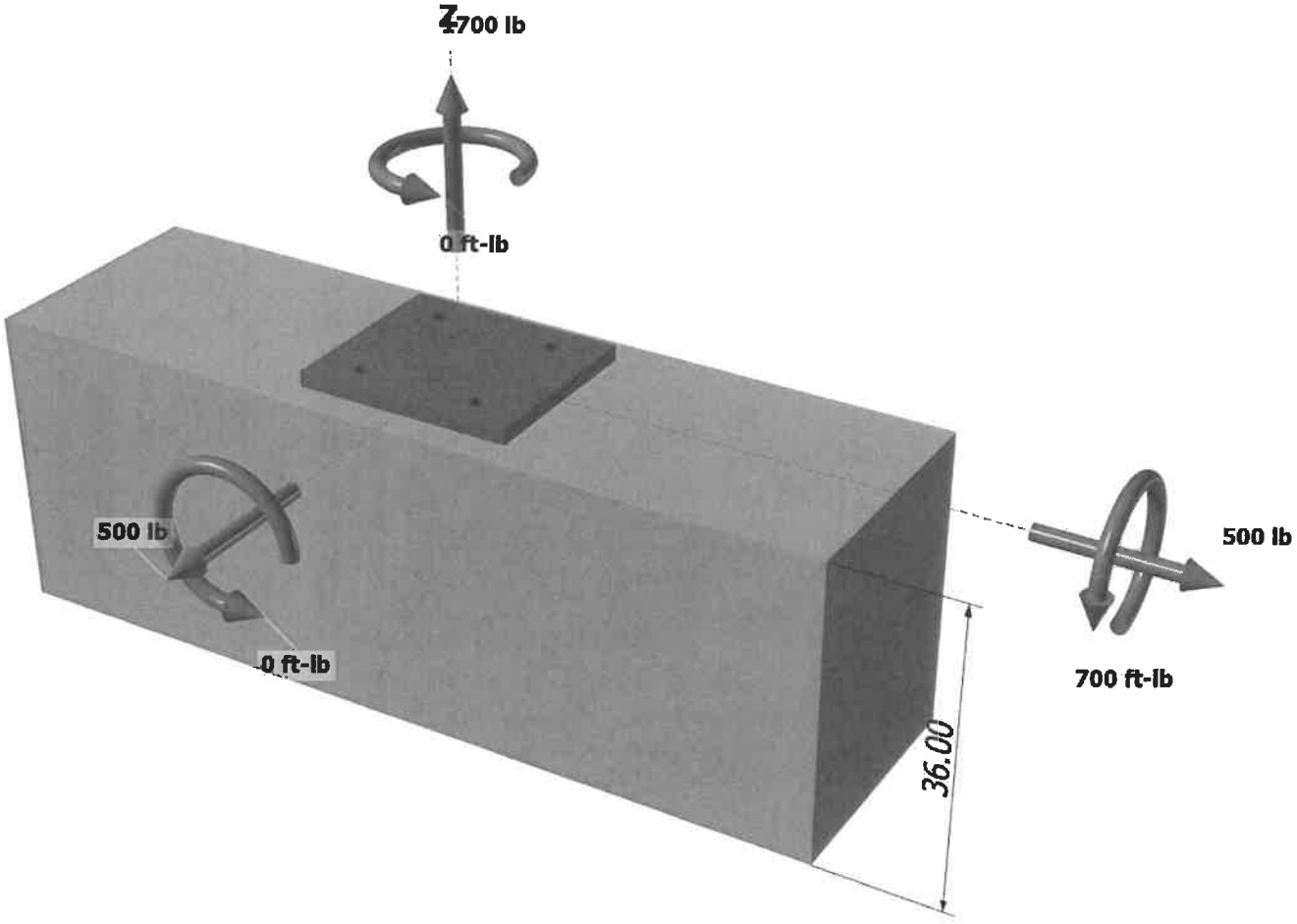
Recommended Anchor
Anchor Name: SET-3G - SET-3G w/ 1/2"Ø F1554 Gr. 36
Code Report: ICC-ES ESR-4057

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: No
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

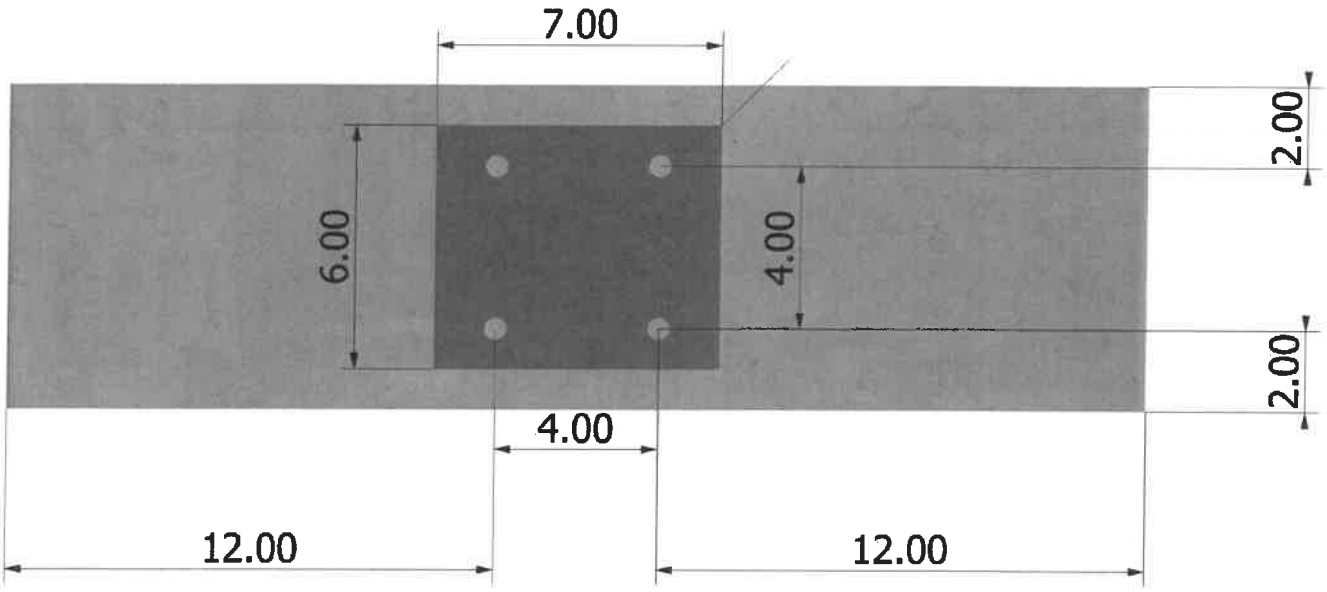
Strength level loads:

N_{ua} [lb]: 1700
V_{uax} [lb]: 500
V_{uay} [lb]: 500
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 700
M_{uz} [ft-lb]: 0

<Figure 1>



<Figure 2>

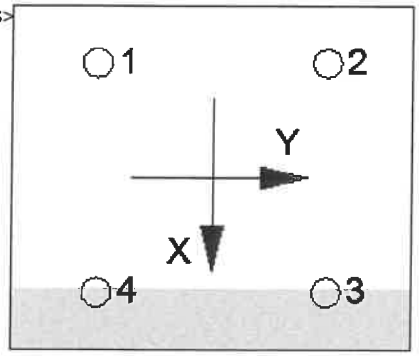


3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	1388.0	125.0	125.0	176.8
2	1388.0	125.0	125.0	176.8
3	0.0	125.0	125.0	176.8
4	0.0	125.0	125.0	176.8
Sum	2776.0	500.0	500.0	707.1

Maximum concrete compression strain (‰): 0.07
Maximum concrete compression stress (psi): 287
Resultant tension force (lb): 0
Resultant compression force (lb): 1075
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
8235	0.75	6176

6. Adhesive Strength of Anchor in Tension (Sec. 17.4.5)

$\tau_{k,cr} = \tau_{k,cr} f_{short\text{-}term} K_{sat} (f'_c / 2{,}500)^n$

$\tau_{k,cr}$ (psi)	$f_{short\text{-}term}$	K_{sat}	f'_c (psi)	n	$\tau_{k,cr}$ (psi)
1304	1.00	1.00	3000	0.24	1362

$N_{ba} = \lambda_a \tau_{cr} \pi d_a h_{ef}$ (Eq. 17.4.5.2)

λ_a	τ_{cr} (psi)	d_a (in)	h_{ef} (in)	N_{ba} (lb)
1.00	1362	0.50	5.500	11770

$\phi N_{ag} = \phi (A_{Na} / A_{Na0}) \Psi_{ec,Na} \Psi_{ed,Na} \Psi_{cp,Na} N_{ba}$ (Sec. 17.3.1 & Eq. 17.4.5.1b)

A_{Na} (in²)	A_{Na0} (in²)	c_{Na} (in)	$c_{a,min}$ (in)	$\Psi_{ec,Na}$	$\Psi_{ed,Na}$	$\Psi_{cp,Na}$	N_{ba}(lb)	ϕ	ϕN_{ag} (lb)
142.59	191.09	6.91	2.00	1.000	0.787	1.000	11770	0.55	3800

8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
4940	1.0	0.65	3211

9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.5.2)

Shear perpendicular to edge in y-direction:

$V_{by} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5};\ 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
4.00	0.500	1.00	3000	16.00	26299

$\phi V_{cbgy} = \phi\ (A_{Vc} / A_{Vco})\Psi_{ec,V}\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{by}$ (Sec. 17.3.1 & Eq. 17.5.2.1b)

A_{Vc} (in²)	A_{Vco} (in²)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cbgy} (lb)
192.00	1152.00	1.000	0.725	1.000	1.000	26299	0.70	2224

Shear perpendicular to edge in x-direction:

$V_{bx} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5};\ 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
4.00	0.500	1.00	3000	2.00	1162

$\phi V_{cbgx} = \phi\ (A_{Vc} / A_{Vco})\Psi_{ec,V}\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{bx}$ (Sec. 17.3.1 & Eq. 17.5.2.1b)

A_{Vc} (in²)	A_{Vco} (in²)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgx} (lb)
30.00	18.00	1.000	1.000	1.000	1.000	1162	0.70	1356

Shear parallel to edge in x-direction:

$V_{by} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5};\ 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
4.00	0.500	1.00	3000	12.00	17082

$\phi V_{cbgx} = \phi\ (2)(A_{Vc} / A_{Vco})\Psi_{ec,V}\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{by}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1b)

A_{Vc} (in²)	A_{Vco} (in²)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cbgx} (lb)
144.00	648.00	1.000	1.000	1.000	1.000	17082	0.70	5314

Shear parallel to edge in y-direction:

$V_{bx} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5};\ 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
4.00	0.500	1.00	3000	2.00	1162

$\phi V_{cbgy} = \phi\ (2)(A_{Vc} / A_{Vco})\Psi_{ec,V}\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{bx}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1b)

A_{Vc} (in²)	A_{Vco} (in²)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgy} (lb)
30.00	18.00	1.000	1.000	1.000	1.000	1162	0.70	2712

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag};\ k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na} / A_{Na0})\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba};\ k_{cp}(A_{Nc} / A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in²)	A_{Na0} (in²)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	142.59	191.09	0.787	1.000	1.000	11770	6910

A_{Nc} (in²)	A_{Nco} (in²)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
164.00	272.25	1.000	0.773	1.000	1.000	12010	5591	0.70

ϕV_{cpg} (lb)
7827

11. Results

Interaction of Tensile and Shear Forces (Sec. 17.6.)

Tension	Factored Load, N_{ua} (lb)	Design Strength, ϕN_n (lb)	Ratio	Status
Steel	1388	6176	0.22	Pass
Adhesive	**2776**	**3800**	**0.73**	**Pass (Governs)**

Shear	Factored Load, V_{ua} (lb)	Design Strength, ϕV_n (lb)	Ratio	Status
Steel	177	3211	0.06	Pass
T Concrete breakout y+	500	2224	0.22	Pass
T Concrete breakout x+	250	1356	0.18	Pass
|| Concrete breakout y-	250	5314	0.05	Pass
|| Concrete breakout x-	250	2712	0.09	Pass
Concrete breakout, combined	**-**	**-**	**0.29**	**Pass (Governs)**
Pryout	707	7827	0.09	Pass

Interaction check	$N_{ua}/\phi N_n$	$V_{ua}/\phi V_n$	Combined Ratio	Permissible	Status
Sec. 17.6..1	0.73	0.00	73.0 %	1.0	Pass

SET-3G w/ 1/2"Ø F1554 Gr. 36 with hef = 5.500 inch meets the selected design criteria.

12. Warnings

- Concrete breakout strength in tension has not been evaluated against applied tension load(s) per designer option. Refer to ACI 318 Section 17.3.2.1 for conditions where calculations of the concrete breakout strength may not be required.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer's product literature for hole cleaning and installation instructions.