PACIFIC NORTHWEST STRUCTURAL GROUP, LLC

A PROFESSIONAL ENGINEERING COMPANY

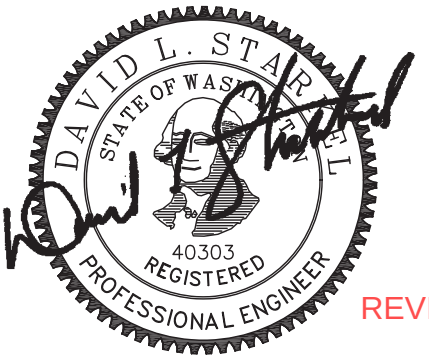
Reviewed for code compliance
with IRC 2015
Kitsap County Building Department
lasmith@co.kitsap.wa.us
11/13/2020

6193 NE MALBON CT.
KINGSTON, WA 98346
360.903.2803

STRUCTURAL CALCULATIONS

19-002A RED BARN LANE - DUPLEX I880/I620A
NW HOGAN LN & NELS NELSON RD NW
BREMERTON, WA 98311

ALL COMPUTATIONS AND ENGINEERING FOR THIS PROJECT HAVE BEEN PERFORMED BY MYSELF OR UNDER MY SUPERVISION.



BASIC PERMIT PACKAGE
REVIEWED FOR CODE COMPLIANCE
WITH IRC 2015
KITSAP COUNTY BUILDING DEPARTMENT

22-JUN-19

DIGITAL SIGNATURE
Digitally signed by David L. Starkel Date: 2019.06.22 08:48:04 -07'00'

Established Basic Permit#
19-03650

Permit Number: 20-04898

Pacific Northwest Structural Group, LLC				
	Project	Red Barn Lane - Duplex 1620/1880	Designer	DLS
	Location	NW Hogan Ln & Nels Nelson Rd NW, Bremerton, WA	Project No.	19-002
	Client	Envision Northwest, LLC	*Revised*	*15-Sep-18*
	Design Live and Dead Loads, Soil Data			

DESIGN LIVE AND DEAD LOADS

ROOF LOAD :		
Asphalt Shingles	1.5	PSF
Re-Roof	1.5	PSF
Roof Shtg	1.5	PSF
Truss @ 24" oc	3.3	PSF
Insulation	1.6	PSF
Gypsum Shtg	2.2	PSF
		PSF
		PSF
SUB-TOTAL	11.6	PSF
SLOPE CORRECTION "X:12" 6.00	1.1	
MISCELLANEOUS	2.0	PSF
ROOF DEAD LOAD	15.0	PSF
ROOF SNOW LOAD	25.0	PSF
REDUCED SNOW LOAD	N/A	PSF
ROOF LIVE LOAD	16.0	PSF

EXTERIOR WALL LOAD		
Siding	4.0	PSF
Wall Shtg	1.5	PSF
2x6 @ 16" oc	1.7	PSF
Bottom & Top Plates	0.8	PSF
Insulation	0.5	PSF
Gypsum Shtg	2.2	PSF
Mech., Elec., & Misc.	0.3	PSF
EXTER. WALL DEAD LOAD	11.0	PSF

INTERIOR WALL LOAD		
Gypsum Shtg	4.4	PSF
2X4 @ 16" oc	1.1	PSF
Insulation	0.5	PSF
Bottom & Top Plates	0.8	PSF
Mech., Elec., & Misc.	1.2	PSF
INTERIOR WALL DEAD LOAD	8.0	PSF

FLOOR LOAD		
Floor Covering	1.0	PSF
Floor Shtg	2.3	PSF
Floor Joist	3.3	PSF
Insulation	1.3	PSF
Gypsum Sheathing	5.6	PSF
Mech., Elec., & Misc.	1.5	PSF
		PSF
FLOOR DEAD LOAD	15.0	PSF
FLOOR LIVE LOAD	40.0	PSF

DECK OR BALCONY DEAD LOAD		
2x Decking	4.5	PSF
Deck Joist	3.3	PSF
Mech., Elec., & Misc.	4.2	PSF
		PSF
DECK DEAD LOAD	12.0	PSF
DECK LIVE LOAD	60.0	PSF

		PSF
		PSF
		PSF
		PSF
		PSF
		PSF
		PSF
FLOOR DEAD LOAD	-	PSF
FLOOR LIVE LOAD		PSF

SOILS DATA

SOILS REPORT	N/A		
GEOTECHNICAL ENGINEER	N/A	DATE OF REPORT	N/A

BASIC BEARING PRESSURE		
PADS & CONT. FND	1,500	PSF
INCREASE FOR WIDTH	N/A	%
INCREASE FOR DEPTH	N/A	%
MAX. SOIL PRESSURE	1,500	PSF
ISOLATED FOUNDATIONS	N/A	PSF

ACTIVE SOIL PRESSURE		
PASSIVE PRESSURE	N/A	PCF
SOIL FRICTION	N/A	
E.F.P. (Cantilever)	N/A	PCF
E.F.P. (Restrained)	N/A	PCF

Established Basic Permit#
19-03650

Permit Number: 20-04898

Pacific Northwest Structural Group, LLC				
	Project	Red Barn Lane - Duplex 1620/1880	Designer	DLS
	Location	NW Hogan Ln & Nels Nelson Rd NW, Brem	Project No.	19-002
	Client	Envision Northwest, LLC	*Revised*	*15-Sep-18*
	2015 IBC Section 1609.6 Wind Loads			

BUILDING DATA:				
Ultimate Design Wind Speed, V_{ult}	110	MPH	Figure 1609	
Exposure	B		1609.4	Exposure: B / C / D
Roof Pitch	6.00	:12		
θ=	26.57			
	Condition 1			
Building Length	34.00	ft		
Building Width	40.00	ft		
1st Level Plate Height	8.08	ft		
2nd Level Plate Height	9.08	ft		
3rd Level Plate Height	8.08	ft		
Gable Height	35.24	ft		
Roof Height	10.00	ft		
Mean Roof Height h =	30.24	ft		
1609.6 Alternate All-Heights Method				
Wind directionality factor, K_d	0.85			
Topographic Factor, K_{zt}	1.00			
Velocity pressure factor, K_z	0.70		ASCE 7-10, 27.3-1	

IBC 2015 Table 1609.6.2, Net Pressure Coefficients, C_{net}

Description	+ Internal pressure	- Internal pressure
Windward Wall	0.43	0.73
Leeward Wall	(0.51)	(0.21)
Sidewall	(0.66)	(0.35)
Wind perpendicular to ridge Leeward roof or flat roof	(0.66)	(0.35)
Wind parallel to ridge and flat roofs	(1.09)	(0.79)
Windward roof slopes	0.06	0.37

Description	Pressure	
Windward Wall	21.45	psf
Leeward Wall	13.31	psf
Sidewall	18.67	psf
Wind perpendicular to ridge Leeward roof or flat roof	18.67	psf
Windward roof slopes	7.95	psf

Allowable Uniform Wind Load				
Level	Transverse		Longitudinal	
1st Level Plate	178.9	plf	96.1	plf
2nd Level Plate	178.9	plf	96.1	plf
3rd Level Plate	132.0	plf	101.3	plf

Established Basic Permit#
19-03650

Permit Number: 20-04898

Pacific Northwest Structural Group, LLC					
	Project	Red Barn Lane - Duplex 1620/1880		Designer	DLS
	Location	NW Hogan Ln & Nels Nelson Rd NW, Breme		Project No.	19-002
	Client	Envision Northwest, LLC		*Revised*	*15-Sep-18*
	2015 IBC Section 1613 Earthquake Loads				

ASCE 7-10 & IBC 2015 Section 1613, EARTHQUAKE LOADS

Soil Site Class	D			ASCE 7-10 11.4.2 (Default=D)
Response Spectral Acc. (0.2 sec) S_s	1.39			ASCE 7-10 Figure(s) 22-1 through 22-18
Response Spectral Acc.(1.0 sec) S_1	0.55			
Site Coefficient F_a	1.00			ASCE 7-10 Table 11.4-1
Site Coefficient F_v	1.50			ASCE 7-10 Table 11.4-2
Max Considered Earthquake Acc. S_{MS}	1.387	$F_a.S_s$		ASCE 7-10 (11.4-1)
Max Considered Earthquake Acc. S_{M1}	0.828	$F_v.S_1$		ASCE 7-10 (11.4-2)
@ 5% Damped Design S_{DS}	0.925	$2/3.S_{MS}$		ASCE 7-10 (11.4-3)
S_{D1}	0.552	$2/3.S_{M1}$		ASCE 7-10 (11.4-4)
Risk Category			II	ASCE 7-10 Table 1-1
Design Category Consideration:				
In each of the two orthogonal directions, the approximate fundamental period of the structure, Ta, determined in accordance with Section 12.8.2.1 is less than 0.8Ts, where Ts is determined in accordance with Section 11.4.5.			Yes	ASCE 7-10 11.6
In each of two orthogonal directions, the fundamental period of the structure used to calculate the story drift is less than Ts.			Yes	
Diaphragms are rigid as defined in Section 12.3.1 or for diaphragms that are flexible, the distance between vertical elements of the seismic force-resisting system does not exceed 40 ft.			Yes	
Seismic Design Category (SDC)	-			ASCE 7-10 11.4.1
Seismic Design Category for 0.1 sec	D			ASCE 7-10 Table 11.6-1
Seismic Design Category for 1.0 sec	D			ASCE 7-10 Table 11.6-2
S1 < .75g	-			ASCE 7-10 11.6
Seismic Design Category (SDC)	D			ASCE 7-10 11.6
Seismic Force-Resisting System	**A. BEARING WALL SYSTEMS**			
	15. Light-frame (wood) walls sheathed with wood structural panels rated for shear resistance or steel sheets			
Footnotes	-	-		
	-	-		
	-	-		
ASCE 7 Section Where Detailing Requirements Are Specified	14.1 and 14.5			
Building ht. h_n	30.24	ft	Limited Building Height (ft) = 65	
C_t	0.020	x	0.75	ASCE 7-10 Table 12.8-2
C_u	1.400	for SD1 of 0.552g		ASCE 7-10 Table 12.8-1
Approximate Fundamental Period, T_a	0.258	sec	$C_t.(h_n)^x$	ASCE 7-10 (12.8-7)
T_s	0.597	sec	S_{D1}/S_{DS}	ASCE 7-10 11.4.5
T_L	6.00	sec		ASCE 7-10 11.4.5
Period for Computing Drift	0.361	sec	$C_u.T_a$	
Fundamental Period, T	0.258	sec		
$0.8T_s$	0.478	sec	$0.8(S_{D1}/S_{DS})$	ASCE 7-10 11.6
Response Modification Coef. R	6.50			ASCE 7-10 Table 12.14-1

Established Basic Permit#
19-03650

Permit Number: 20-04898

Pacific Northwest Structural Group, LLC	Project	Red Barn Lane - Duplex 1620/1880	Designer	DLS
	Location	NW Hogan Ln & Nels Nelson Rd NW, Breme	Project No.	19-002
	Client	Envision Northwest, LLC	*Revised*	*15-Sep-18*
	2015 IBC Section 1613 Earthquake Loads			

Over Strength Factor Ω_o	3.00		ASCE 7-10 Table 12.14-1
Deflection Amplification Factor, C_{db}	4.00		ASCE 7-10 Table 12.14-1
Importance factor I_E	1.00		ASCE 7-10 Table 1.5-2, UFC 3-301-01 Table 2-2
C_s	0.142	$S_{DS}/R/I_E$	ASCE 7-10 (12.8-2)
T<=TL therefore Cs need not to exceed	0.329	$S_{D1}/(T(R/I_E))$	ASCE 7-10 (12.8-3)
T<TL therefore (12.8-4) N/A	N/A	$S_{D1}.T_L/T^2(R/I_E)$	ASCE 7-10 (12.8-4)
C_s	0.041	$0.044S_{DS}.I_E \geq 0.01$	ASCE 7-10 (12.8-5)
S1 < 0.6g (12.8-6) N/A	N/A	$0.5S_1/(R/I_E)$	ASCE 7-10 (12.8-6)
Use C_s	0.142		
Design Base Shear V	0.142 W	Control	ASCE 7-10 (12.8-1)
Design Service Level Base Shear V	0.1 W		

Seismic Load					
Level	W_x (lbs)	h_x (ft)	$W_x.h_x$	C_{vx}	F_x (lbs)
1st Level Plate	32,963	8.1	266,339	0.404	3,177
2nd Level Plate	20,015	9.1	181,734	0.276	2,168
3rd Level Plate	26,097	8.1	210,864	0.320	2,515
	79,075	$\Sigma W_x.h_x$	658,938		

Design Service Level Base Shear V	7,860	lbs		
	Transverse		Longitudinal	
Diaphragm Width	34.00	ft	40.00	ft
1st Level Plate	93.4	plf	79.4	plf
2nd Level Plate	63.8	plf	54.2	plf
3rd Level Plate	74.0	plf	62.9	plf

Established Basic Permit#
19-03650

Permit Number: 20-04898

Pacific Northwest Structural Group, LLC				
	Project	Red Barn Lane - Duplex 1620/1880	Designer	DLS
	Location	NW Hogan Ln & Nels Nelson Rd NW, Breme	Project No.	19-002
	Client	Envision Northwest, LLC	*Revised*	*18-May-18*
	ASCE 7-10 Snow Loads			

ASCE 7-10 7.3 FLAT ROOF SNOW LOAD			
Ground Snow Load, p_g	30.0	PSF	ASCE 7-10 7.2
Exposure Category	B		ASCE 7-10 26.7.3 Exposure Categories
Exposure of Roof	Partially Exposed		ASCE 7-10 Table 7-2 Exposure Factor
Thermal Condition	All structures except as indicated below		
Risk Category	II		ASCE 7-10 Table 1.5-1, UFC 3-301-01 Table 2-2
Snow load importance factor, I_s	1.0		ASCE 7-10 Table 1.5-2, UFC 3-301-01 Table 2-2
Snow exposure factor, C_e	1.00		ASCE 7-10 Table 7-2 Exposure Factor
Thermal factor, C_t	1.00		ASCE 7-10 Table 7-3 Thermal Factor
Flat-roof snow load, p_f	21.0	PSF	ASCE 7-10 (7.3-1) $0.7C_eC_tI_sp_g$
Min. Design Flat Roof Snow Load, p_m	20.0	PSF	ASCE 7-10 7..4 $p_g \le 20$ PSF I_sp_g, $p_g > 20$ PSF $20I_s$
Design Flat Roof Snow Load, p_f	21.0	PSF	

ASCE 7-10 7.4 SLOPE ROOF SNOW LOAD			
Roof Pitch	6	:12	
Roof Slope, Θ	26.57	°	
Roof Surface	All Other Surfaces		
Warm Roof Slope Factor, C_s	1.00		ASCE 7-10 Section 7.4.1, 7.4.2, 7.4.3 Figure(s)
Slope Roof Design Snow Load, p_s	21.0	PSF	ASCE-7-10 (7-.4-1) C_s*p_f

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project:	Red Barn Lane Single Family & Duplex - Duplex	Design By:	DLS
Location:	LF-1 Concrete Shearwall to BM Connection	Checked By:	19-002
Client:	Envision Northwest, LLC	*Last Update:*	
Timber Mechanical Connection - Bolts - Double Shear		*12-Jan-11*	

Bolt Material	ASTM A307
Wood Species (Main)	Douglas Fir-Larch
Wood Species (Side)	A36

G_M	0.50	
G_S	-	
t_m	5 1/4	in
t_s	3/8	in
θ_M	-	degrees
θ_S	-	degrees
D	5/8	in
K_θ	1.00	
$F_{em\ par.}$	5,600	psi
$F_{em\ perp}$	2,824	psi
$F_{em\ \theta}$	5,600	psi
$F_{es\ par.}$	58,000	psi
$F_{es\ perp.}$	58,000	psi
$F_{es\ \theta}$	58,000	psi
F_{em}	5,600	psi
F_{es}	58,000	psi
F_{yb}	45,000	psi
R_e	0.0966	
R_t	14.0	
k_3	6.343	

Bolted Connection - Double ShearYield Modes, (lbs)				
Z	$Z_{I\,M}$	$Z_{I\,S}$	$Z_{III\,S}$	Z_{IV}
2,482	4,594	6,797	2,482	3,022

Calculated Allowable Load Per Bolt (Lbs)	Load Duraction Factor	Wet Service Factor	Temperature Factor	Group Action Factor	Geometery Factor	Factored Allowable Load (Lbs)
Z	C_D	C_M	C_t	C_g	C_D	Z'
2,482	1.60	1.00	1.00	1.00	1.00	7,927

Group Action Factor						
A_m	52.50	in^2		u	1.009	
A_s	3.75	in^2		m	0.874	
E_m	1,400,000	psi		R_{EA}	0.6759	
E_s	#########	psi				
s	6.00	in				
n	2	Bolts				
g	133,409	lbs/in				

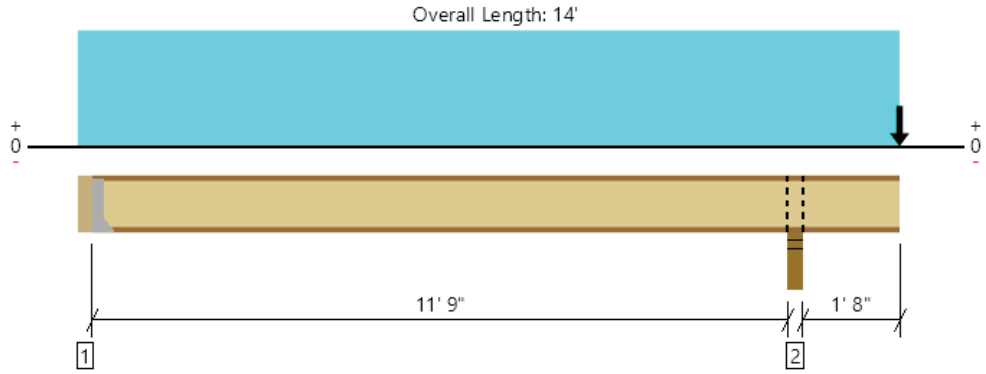
FORTE WEB

MEMBER REPORT

PASSED

Level, JST2-1

1 piece(s) 11 7/8" TJI® 360 @ 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)	1984 @ 12' 2 1/4"	2460 (3.50")	Passed (81%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	1341 @ 12' 4"	1705	Passed (79%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	-2329 @ 12' 2 1/4"	6180	Passed (38%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.058 @ 14'	0.200	Passed (2L/754)	--	1.0 D + 1.0 L (Alt Spans)
Total Load Defl. (in)	0.098 @ 14'	0.200	Passed (2L/444)	--	1.0 D + 1.0 L (Alt Spans)
TJ-Pro™ Rating	64	55	Passed	--	--

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

- Deflection criteria: LL (L/480) and TL (L/240).
- Overhang deflection criteria: LL (2L/0.2") and TL (2L/0.2").
- Top Edge Bracing (Lu): Top compression edge must be braced at 9' 7" o/c unless detailed otherwise.
- Bottom Edge Bracing (Lu): Bottom compression edge must be braced at 6' 2" o/c unless detailed otherwise.
- A structural analysis of the deck has not been performed.
- Deflection analysis is based on composite action with a single layer of 7/8", 1" Panel (32" Span Rating) that is glued and nailed down.
- Additional considerations for the TJ-Pro™ Rating include: 1/2" Gypsum ceiling, bridging or blocking at max. 8' o.c..

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Total	
1 - Hanger on 11 7/8" DF beam	3.50"	Hanger[1]	1.75" / 1.75" [2]	35	333/-91	368/-91	See note [1]
2 - Stud wall - DF	3.50"	3.50"	3.50"	816	1168	1984	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.
- [2] Required Bearing Length / Required Bearing Length with Web Stiffeners

Connector: Simpson Strong-Tie

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

Vertical Loads	Location (Side)	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PSF)	0 to 14'	16"	15.0	40.0	Residential - Living Areas
2 - Point (PLF)	14'	16"	428.0	486.0	

Weyerhaeuser Notes

Weyerhaeuser warrants that the sizing of its products will be in accordance with Weyerhaeuser product design criteria and published design values. Weyerhaeuser expressly disclaims any other warranties related to the software. Use of this software is not intended to circumvent the need for a design professional as determined by the authority having jurisdiction. The designer of record, builder or framer is responsible to assure that this calculation is compatible with the overall project. Accessories (Rim Board, Blocking Panels and Squash Blocks) are not designed by this software. Products manufactured at Weyerhaeuser facilities are third-party certified to sustainable forestry standards. Weyerhaeuser Engineered Lumber Products have been evaluated by ICC-ES under evaluation reports ESR-1153 and ESR-1387 and/or tested in accordance with applicable ASTM standards. For current code evaluation reports, Weyerhaeuser product literature and installation details refer to www.weyerhaeuser.com/woodproducts/document-library.

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

ForteWEB Software Operator	Job Notes
David L Starkel Pacific Northwest Structural Group, Inc. (360) 903-2803 [illegible]	

6/21/2019 10:15:20 PM UTC
ForteWEB v2.1, Engine: V7.3.2.309, Data: V7.2.0.2
File Name: 19-002 Floor Joists_Imported

Established Basic Permit# 19-03650

Permit Number: 20-04898

ForteWEB Software Operator	Job Notes
David L Starkel Pacific Northwest Structural Group, Inc. (360) 903-2803 [illegible]	

Established Basic Permit# 19-03650

Permit Number: 20-04898

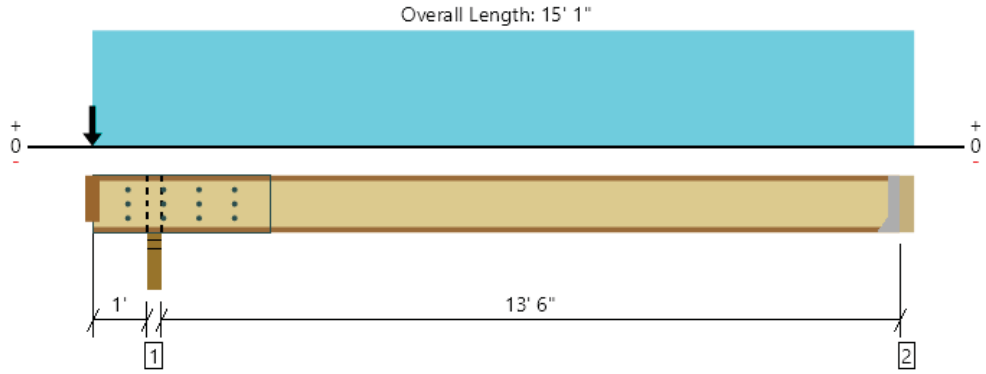
FORTE WEB

MEMBER REPORT

PASSED

Level, JST2-2

1 piece(s) 11 7/8" TJI® 360 @ 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)	4201 @ 1' 1 3/4"	4920 (3.50")	Passed (85%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	3407 @ 1'	3410	Passed (100%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	-3868 @ 1' 1 3/4"	6180	Passed (63%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.106 @ 7' 11 5/8"	0.341	Passed (L/999+)	--	1.0 D + 1.0 L (Alt Spans)
Total Load Defl. (in)	0.114 @ 0	0.200	Passed (2L/242)	--	1.0 D + 1.0 L (Alt Spans)
TJ-Pro™ Rating	57	55	Passed	--	--

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

- Deflection criteria: LL (L/480) and TL (L/240).
- Overhang deflection criteria: LL (2L/480) and TL (2L/0.2").
- Top Edge Bracing (Lu): Top compression edge must be braced at 9' 7" o/c unless detailed otherwise.
- Bottom Edge Bracing (Lu): Bottom compression edge must be braced at 4' 8" o/c unless detailed otherwise.
- A structural analysis of the deck has not been performed.
- Deflection analysis is based on composite action with a single layer of 23/32" Panel (24" Span Rating) that is glued and nailed down.
- Additional considerations for the TJ-Pro™ Rating include: 1/2" Gypsum ceiling, bridging or blocking at max. 8' o.c..

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Total	
1 - Stud wall - DF	3.50"	3.50"	3.50"	1726	2476	4202	Blocking, Cantilever Reinforcement
2 - Hanger on 11 7/8" DF beam	3.50"	Hanger[1]	1.75" / 1.75" [2]	20	379/-146	399/-146	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.
- Left end cantilever reinforcement: Double joist assembly with filler block per SPECIFIER'S GUIDE detail E4.
- 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.
- [2] Required Bearing Length / Required Bearing Length with Web Stiffeners

Connector: Simpson Strong-Tie

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

Vertical Loads	Location (Side)	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PSF)	0 to 15' 1"	16"	15.0	40.0	Residential - Living Areas
2 - Point (PLF)	0	16"	1083.0	1417.0	

- Web stiffeners required at location 0 due to loads.

Weyerhaeuser Notes

Weyerhaeuser warrants that the sizing of its products will be in accordance with Weyerhaeuser product design criteria and published design values. Weyerhaeuser expressly disclaims any other warranties related to the software. Use of this software is not intended to circumvent the need for a design professional as determined by the authority having jurisdiction. The designer of record, builder or framer is responsible to assure that this calculation is compatible with the overall project. Accessories (Rim Board, Blocking Panels and Squash Blocks) are not designed by this software. Products manufactured at Weyerhaeuser facilities are third-party certified to sustainable forestry standards. Weyerhaeuser Engineered Lumber Products have been evaluated by ICC-ES under evaluation reports ESR-1153 and ESR-1387 and/or tested in accordance with applicable ASTM standards. For current code evaluation reports, Weyerhaeuser product literature and installation details refer to www.weyerhaeuser.com/woodproducts/document-library.

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

ForteWEB Software Operator	Job Notes
David L Starkel Pacific Northwest Structural Group, Inc. (360) 903-2803 [illegible]	

6/21/2019 10:19:16 PM UTC
ForteWEB v2.1, Engine: V7.3.2.309, Data: V7.2.0.2
File Name: 19-002 Floor Joists_Imported

Established Basic Permit# 19-03650

Permit Number: 20-04898

ForteWEB Software Operator	Job Notes
David L Starkel Pacific Northwest Structural Group, Inc. (360) 903-2803 [illegible]	

Established Basic Permit# 19-03650

Permit Number: 20-04898

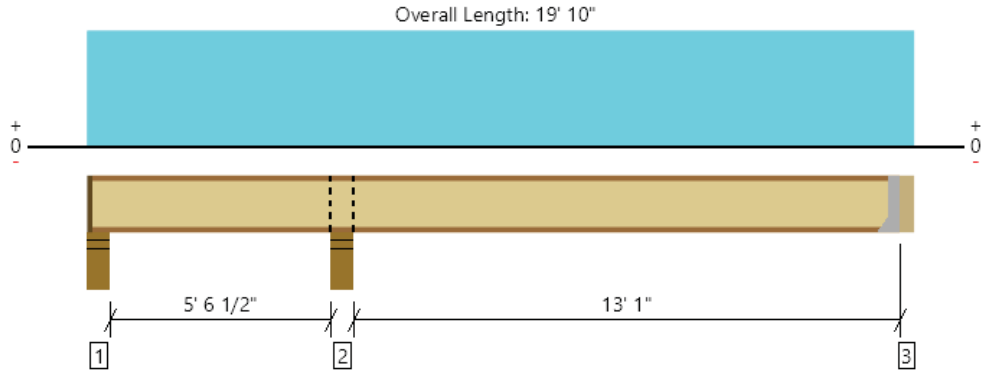
FORTE WEB

MEMBER REPORT

PASSED

Level, JST2-3

1 piece(s) 11 7/8" TJI® 360 @ 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)	401 @ 19' 6 1/2"	1080 (1.75")	Passed (37%)	1.00	1.0 D + 1.0 L (Alt Spans)
Shear (lbs)	539 @ 6' 5 1/2"	1876	Passed (29%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	-1224 @ 6' 2 3/4"	6180	Passed (20%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.066 @ 13' 5 1/2"	0.333	Passed (L/999+)	--	1.0 D + 1.0 L (Alt Spans)
Total Load Defl. (in)	0.089 @ 13' 5 11/16"	0.666	Passed (L/999+)	--	1.0 D + 1.0 L (Alt Spans)
TJ-Pro™ Rating	56	55	Passed	--	--

System : Floor
Member Type : Joist
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 9' 2" o/c unless detailed otherwise.
- Bottom Edge Bracing (Lu): Bottom compression edge must be braced at 8' 8" o/c unless detailed otherwise.
- A structural analysis of the deck has not been performed.
- Deflection analysis is based on composite action with a single layer of 23/32" Panel (24" Span Rating) that is glued and nailed down.
- Additional considerations for the TJ-Pro™ Rating include: bridging or blocking at max. 8' o.c..

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Total	
1 - Stud wall - DF	5.50"	4.25"	1.75"	9	164/-135	173/-135	1 1/4" Rim Board
2 - Stud wall - DF	5.50"	5.50"	3.50"	274	730	1004	Blocking
3 - Hanger on 11 7/8" DF beam	3.50"	Hanger[1]	1.75" / 1.75" [2]	114	309	423	See note [1]

- Rim Board is assumed to carry all loads applied directly above it, bypassing the member being designed.
- 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.
- [2] Required Bearing Length / Required Bearing Length with Web Stiffeners

Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
3 - Face Mount Hanger	Connector not found	N/A	N/A	N/A	N/A	

Vertical Load	Location (Side)	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PSF)	0 to 19' 10"	16"	15.0	40.0	Residential - Living Areas

Weyerhaeuser Notes

Weyerhaeuser warrants that the sizing of its products will be in accordance with Weyerhaeuser product design criteria and published design values. Weyerhaeuser expressly disclaims any other warranties related to the software. Use of this software is not intended to circumvent the need for a design professional as determined by the authority having jurisdiction. The designer of record, builder or framer is responsible to assure that this calculation is compatible with the overall project. Accessories (Rim Board, Blocking Panels and Squash Blocks) are not designed by this software. Products manufactured at Weyerhaeuser facilities are third-party certified to sustainable forestry standards. Weyerhaeuser Engineered Lumber Products have been evaluated by ICC-ES under evaluation reports ESR-1153 and ESR-1387 and/or tested in accordance with applicable ASTM standards. For current code evaluation reports, Weyerhaeuser product literature and installation details refer to www.weyerhaeuser.com/woodproducts/document-library.

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

ForteWEB Software Operator	Job Notes
David L Starkel Pacific Northwest Structural Group, Inc. (360) 903-2803 [illegible]	

6/21/2019 10:19:42 PM UTC
ForteWEB v2.1, Engine: V7.3.2.309, Data: V7.2.0.2
File Name: 19-002 Floor Joists_Imported

Established Basic Permit# 19-03650

Permit Number: 20-04898

ForteWEB Software Operator	Job Notes
David L Starkel Pacific Northwest Structural Group, Inc. (360) 903-2803 [illegible]	

Established Basic Permit# 19-03650

Permit Number: 20-04898

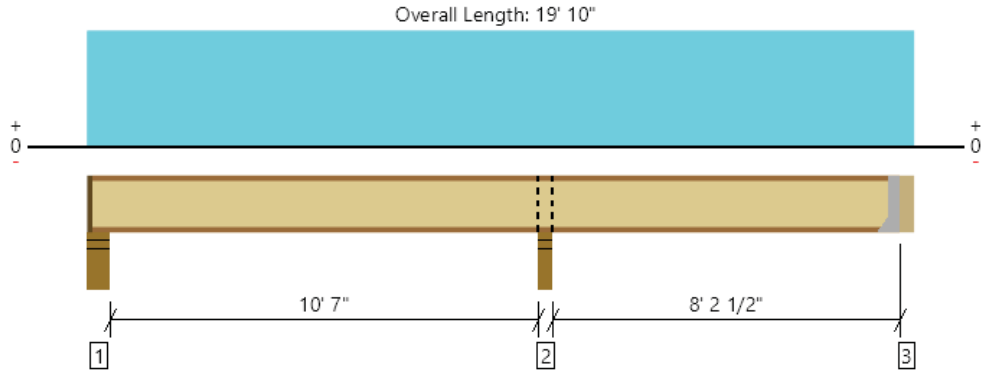
FORTE WEB

MEMBER REPORT

PASSED

Level, JST2-4

1 piece(s) 11 7/8" TJI® 110 @ 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)	890 @ 11' 2 1/4"	1935 (3.50")	Passed (46%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	445 @ 11' 1/2"	1716	Passed (26%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	-883 @ 11' 2 1/4"	3160	Passed (28%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.046 @ 5' 5 3/16"	0.270	Passed (L/999+)	--	1.0 D + 1.0 L (Alt Spans)
Total Load Defl. (in)	0.061 @ 5' 4 7/16"	0.541	Passed (L/999+)	--	1.0 D + 1.0 L (Alt Spans)
TJ-Pro™ Rating	64	55	Passed	--	--

System : Floor
Member Type : Joist
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 6' 7" o/c unless detailed otherwise.
- Bottom Edge Bracing (Lu): Bottom compression edge must be braced at 6' 1" o/c unless detailed otherwise.
- A structural analysis of the deck has not been performed.
- Deflection analysis is based on composite action with a single layer of 23/32" Panel (24" Span Rating) that is glued and nailed down.
- Additional considerations for the TJ-Pro™ Rating include: 1/2" Gypsum ceiling, bridging or blocking at max. 8' o.c..

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Total	
1 - Stud wall - DF	5.50"	4.25"	1.75"	93	268/-13	361/-13	1 1/4" Rim Board
2 - Stud wall - DF	3.50"	3.50"	3.50"	243	647	890	Blocking
3 - Hanger on 11 7/8" DF beam	3.50"	Hanger[1]	1.75" / 1.75" [2]	61	214/-37	275/-37	See note [1]

- Rim Board is assumed to carry all loads applied directly above it, bypassing the member being designed.
- 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.
- [2] Required Bearing Length / Required Bearing Length with Web Stiffeners

Connector: Simpson Strong-Tie

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

Vertical Load	Location (Side)	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PSF)	0 to 19' 10"	16"	15.0	40.0	Residential - Living Areas

Weyerhaeuser Notes

Weyerhaeuser warrants that the sizing of its products will be in accordance with Weyerhaeuser product design criteria and published design values. Weyerhaeuser expressly disclaims any other warranties related to the software. Use of this software is not intended to circumvent the need for a design professional as determined by the authority having jurisdiction. The designer of record, builder or framer is responsible to assure that this calculation is compatible with the overall project. Accessories (Rim Board, Blocking Panels and Squash Blocks) are not designed by this software. Products manufactured at Weyerhaeuser facilities are third-party certified to sustainable forestry standards. Weyerhaeuser Engineered Lumber Products have been evaluated by ICC-ES under evaluation reports ESR-1153 and ESR-1387 and/or tested in accordance with applicable ASTM standards. For current code evaluation reports, Weyerhaeuser product literature and installation details refer to www.weyerhaeuser.com/woodproducts/document-library.

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

ForteWEB Software Operator	Job Notes
David L Starkel Pacific Northwest Structural Group, Inc. (360) 903-2803 [illegible]	

6/21/2019 10:20:15 PM UTC
ForteWEB v2.1, Engine: V7.3.2.309, Data: V7.2.0.2
File Name: 19-002 Floor Joists_Imported

Established Basic Permit# 19-03650

Permit Number: 20-04898

ForteWEB Software Operator	Job Notes
David L Starkel Pacific Northwest Structural Group, Inc. (360) 903-2803 [illegible]	

Established Basic Permit# 19-03650

Permit Number: 20-04898

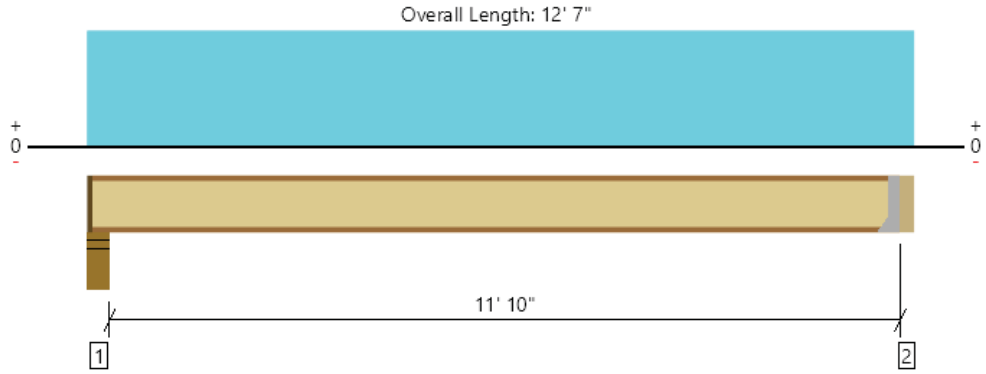
FORTE WEB

MEMBER REPORT

PASSED

Level, JST2-5

1 piece(s) 11 7/8" TJI® 110 @ 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)	413 @ 12' 3 1/2"	910 (1.75")	Passed (45%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	413 @ 12' 3 1/2"	1560	Passed (26%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	1231 @ 6' 4"	3160	Passed (39%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.089 @ 6' 4"	0.298	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.116 @ 6' 4"	0.596	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	58	55	Passed	--	--

System : Floor
Member Type : Joist
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 5' 2" o/c unless detailed otherwise.
- Bottom Edge Bracing (Lu): Bottom compression edge must be braced at 12' 2" o/c unless detailed otherwise.
- A structural analysis of the deck has not been performed.
- Deflection analysis is based on composite action with a single layer of 23/32" Panel (24" Span Rating) that is glued and nailed down.
- Additional considerations for the TJ-Pro™ Rating include: 1/2" Gypsum ceiling, bridging or blocking at max. 8' o.c..

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Total	
1 - Stud wall - DF	5.50"	4.25"	1.75"	101	338	439	1 1/4" Rim Board
2 - Hanger on 11 7/8" DF beam	3.50"	Hanger[1]	1.75" / 1.75" [2]	100	333	433	See note [1]

- Rim Board is assumed to carry all loads applied directly above it, bypassing 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.
- [2] Required Bearing Length / Required Bearing Length with Web Stiffeners

Connector: Simpson Strong-Tie

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

Vertical Load	Location (Side)	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PSF)	0 to 12' 7"	16"	12.0	40.0	Residential - Living Areas

Weyerhaeuser Notes

Weyerhaeuser warrants that the sizing of its products will be in accordance with Weyerhaeuser product design criteria and published design values. Weyerhaeuser expressly disclaims any other warranties related to the software. Use of this software is not intended to circumvent the need for a design professional as determined by the authority having jurisdiction. The designer of record, builder or framer is responsible to assure that this calculation is compatible with the overall project. Accessories (Rim Board, Blocking Panels and Squash Blocks) are not designed by this software. Products manufactured at Weyerhaeuser facilities are third-party certified to sustainable forestry standards. Weyerhaeuser Engineered Lumber Products have been evaluated by ICC-ES under evaluation reports ESR-1153 and ESR-1387 and/or tested in accordance with applicable ASTM standards. For current code evaluation reports, Weyerhaeuser product literature and installation details refer to www.weyerhaeuser.com/woodproducts/document-library.

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
David L Starkel Pacific Northwest Structural Group, Inc. (360) 903-2803 [illegible]	

6/21/2019 10:20:38 PM UTC
ForteWEB v2.1, Engine: V7.3.2.309, Data: V7.2.0.2
File Name: 19-002 Floor Joists_Imported

Established Basic Permit# 19-03650

Permit Number: 20-04898

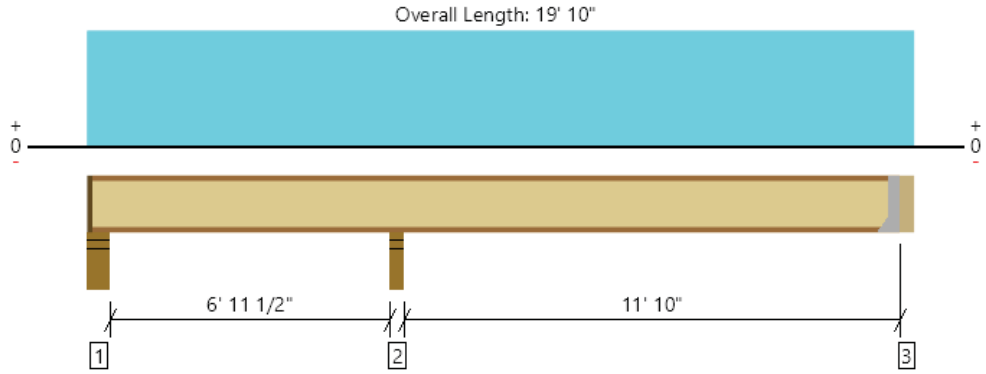
FORTE WEB

MEMBER REPORT

PASSED

Level, JST2-6

1 piece(s) 11 7/8" TJI® 110 @ 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)	925 @ 7' 6 3/4"	1935 (3.50")	Passed (48%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	488 @ 7' 8 1/2"	1716	Passed (28%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	-1000 @ 7' 6 3/4"	3160	Passed (32%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.063 @ 13' 11 13/16"	0.299	Passed (L/999+)	--	1.0 D + 1.0 L (Alt Spans)
Total Load Defl. (in)	0.085 @ 14' 1/4"	0.599	Passed (L/999+)	--	1.0 D + 1.0 L (Alt Spans)
TJ-Pro™ Rating	56	55	Passed	--	--

System : Floor
Member Type : Joist
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 6' o/c unless detailed otherwise.
- Bottom Edge Bracing (Lu): Bottom compression edge must be braced at 5' 9" o/c unless detailed otherwise.
- A structural analysis of the deck has not been performed.
- Deflection analysis is based on composite action with a single layer of 23/32" Panel (24" Span Rating) that is glued and nailed down.
- Additional considerations for the TJ-Pro™ Rating include: bridging or blocking at max. 8' o.c..

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Total	
1 - Stud wall - DF	5.50"	4.25"	1.75"	41	194/-78	235/-78	1 1/4" Rim Board
2 - Stud wall - DF	3.50"	3.50"	3.50"	252	673	925	None
3 - Hanger on 11 7/8" DF beam	3.50"	Hanger[1]	1.75" / 1.75" [2]	103	285	388	See note [1]

- Rim Board is assumed to carry all loads applied directly above it, bypassing 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.
- [2] Required Bearing Length / Required Bearing Length with Web Stiffeners

Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
3 - Face Mount Hanger	Connector not found	N/A	N/A	N/A	N/A	

Vertical Load	Location (Side)	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PSF)	0 to 19' 10"	16"	15.0	40.0	Residential - Living Areas

Weyerhaeuser Notes

Weyerhaeuser warrants that the sizing of its products will be in accordance with Weyerhaeuser product design criteria and published design values. Weyerhaeuser expressly disclaims any other warranties related to the software. Use of this software is not intended to circumvent the need for a design professional as determined by the authority having jurisdiction. The designer of record, builder or framer is responsible to assure that this calculation is compatible with the overall project. Accessories (Rim Board, Blocking Panels and Squash Blocks) are not designed by this software. Products manufactured at Weyerhaeuser facilities are third-party certified to sustainable forestry standards. Weyerhaeuser Engineered Lumber Products have been evaluated by ICC-ES under evaluation reports ESR-1153 and ESR-1387 and/or tested in accordance with applicable ASTM standards. For current code evaluation reports, Weyerhaeuser product literature and installation details refer to www.weyerhaeuser.com/woodproducts/document-library.

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

ForteWEB Software Operator	Job Notes
David L Starkel Pacific Northwest Structural Group, Inc. (360) 903-2803 [illegible]	

6/21/2019 10:20:56 PM UTC
ForteWEB v2.1, Engine: V7.3.2.309, Data: V7.2.0.2
File Name: 19-002 Floor Joists_Imported

Established Basic Permit# 19-03650

Permit Number: 20-04898

ForteWEB Software Operator	Job Notes
David L Starkel Pacific Northwest Structural Group, Inc. (360) 903-2803 [illegible]	

Established Basic Permit# 19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: Wall-Roof-Exterior
Wall
[2015 International Building Code(2015 NDS)]
1.5 IN x 5.5 IN x 7.71 FT @ 16 O.C.
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 87.1%
Controlling Factor: Combined Stress Factor

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:24 PM

DEFLECTIONS

Deflection due to lateral loads only:	Defl = 0.06	IN = L/1659
Live Load Deflection Criteria:		L/180

VERTICAL REACTIONS

Live Load:	Vert-LL-Rxn =	0	lb
Dead Load:	Vert-DL-Rxn =	113	lb
Total Load:	Vert-TL-Rxn =	113	lb

HORIZONTAL REACTIONS

Total Reaction at Top of Column:	TL-Rxn-Top =	90	lb
Total Reaction at Bottom of Column:	TL-Rxn-Bottom =	90	lb

WALL DATA

Total Stud Length:	7.71	ft
Wall Dead Weight:	11	psf
Unbraced Length (X-Axis) Lx:	7.71	ft
Unbraced Length (Y-Axis) Ly:	0	ft
Stud End Condition-K (e):	1	
Axial Load Duration Factor	1.15	
Lateral Load Duration Factor (Wind/Seismic)	1.60	

STUD PROPERTIES

#2 - Douglas-Fir-Larch

	Base Values	Adjusted
Compressive Stress:	Fc = 1350 psi	Fc' = 1339 psi
	Cd=1.60 Cf=1.10 Cp=0.56	
Bending Stress (X-X Axis):	Fbx = 900 psi	Fbx' = 2153 psi
	Cd=1.60 CF=1.30 Cr=1.15 Cl=1.00	
Bending Stress (Y-Y Axis):	Fby = 900 psi	Fby' = 2153 psi
	Cd=1.60 CF=1.30 Cr=1.15	
Modulus of Elasticity:	E = 1600 ksi	E' = 1600 ksi

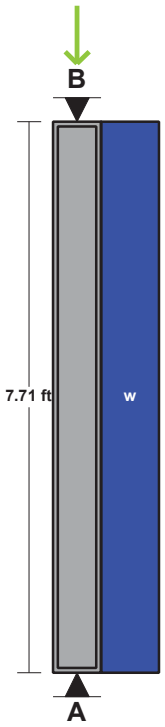
Stud Section (X-X Axis):	dx =	5.5	in
Stud Section (Y-Y Axis):	dy =	1.5	in
Area:	A =	8.25	in2
Section Modulus (X-X Axis):	Sx =	7.56	in3
Section Modulus (Y-Y Axis):	Sy =	2.06	in3
Slenderness Ratio:	Lex/dx =	16.82	
	Ley/dy =	0	

Stud Calculations (Controlling Case Only):

Controlling Load Case: Axial Dead Load and Lateral loads (D + W or E)

Actual Compressive Stress:	Fc =	14	psi
Allowable Compressive Stress:	Fc' =	1339	psi
Eccentricity Moment (X-X Axis):	Mx-ex =	0	ft-lb
Eccentricity Moment (Y-Y Axis):	My-ey =	0	ft-lb
Moment Due to Lateral Loads (X-X Axis):	Mx =	173	ft-lb
Moment Due to Lateral Loads (Y-Y Axis):	My =	0	ft-lb
Bending Stress Lateral Loads Only (X-X Axis):	Fbx =	275	psi
Allowable Bending Stress (X-X Axis):	Fbx' =	2153	psi
Bending Stress Lateral Loads Only (Y-Y Axis):	Fby =	0	psi
Allowable Bending Stress (Y-Y Axis):	Fby' =	2153	psi
Combined Stress Factor:	**CSF =**	**0.13**	

LOADING DIAGRAM



WALL LOAD CALCULATOR

	Live Load		Dead Load		Tributary Width	
Load Tracker:	LL = 0	plf	DL = 0	plf		
Roof:	LL = 25	psf	DL = 15	psf	TA = 0	ft
Upper Floor:	LL = 40	psf	DL = 15	psf	TA = 0	ft
Upper Floor Height:	0	ft				
Middle Floor:	LL = 40	psf	DL = 15	psf	TA = 0	ft
Middle Floor Height:	0	ft				
Calculated Load:	**LL = 0**	**plf**	**DL = 84.8**	**plf**		

AXIAL LOADING

Live Load:	PL = 0	plf *
Dead Load:	PD = 85	plf *
Total Axial Load:	PT = 85	plf

* Load obtained from Load Tracker. See Summary Report for details.

LATERAL LOADING (Dy Face)

Uniform Lateral Load: wL-Lat = 18 psf

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: Wall-Roof-Interior
Wall
[2015 International Building Code(2015 NDS)]
1.5 IN x 3.5 IN x 7.71 FT @ 16 O.C.
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 90.2%
Controlling Factor: Combined Stress Factor

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

page of

StruCalc Version 10.0.1.6 6/21/2019 4:03:24 PM

DEFLECTIONS

Deflection due to lateral loads only:	Defl = 0.06	IN = L/1497
Live Load Deflection Criteria:		L/180

VERTICAL REACTIONS

Live Load:	Vert-LL-Rxn =	0	lb
Dead Load:	Vert-DL-Rxn =	113	lb
Total Load:	Vert-TL-Rxn =	113	lb

HORIZONTAL REACTIONS

Total Reaction at Top of Column:	TL-Rxn-Top =	26	lb
Total Reaction at Bottom of Column:	TL-Rxn-Bottom =	26	lb

WALL DATA

Total Stud Length:	7.71	ft
Wall Dead Weight:	11	psf
Unbraced Length (X-Axis) Lx:	7.71	ft
Unbraced Length (Y-Axis) Ly:	0	ft
Stud End Condition-K (e):	1	
Axial Load Duration Factor	1.15	
Lateral Load Duration Factor (Wind/Seismic)	1.33	

STUD PROPERTIES

#2 - Douglas-Fir-Larch

	Base Values	Adjusted
Compressive Stress:	Fc = 1350 psi	Fc' = 627 psi
	Cd=1.33 Cf=1.15 Cp=0.30	
Bending Stress (X-X Axis):	Fbx = 900 psi	Fbx' = 2065 psi
	Cd=1.33 CF=1.50 Cr=1.15 Cl=1.00	
Bending Stress (Y-Y Axis):	Fby = 900 psi	Fby' = 2065 psi
	Cd=1.33 CF=1.50 Cr=1.15	
Modulus of Elasticity:	E = 1600 ksi	E' = 1600 ksi

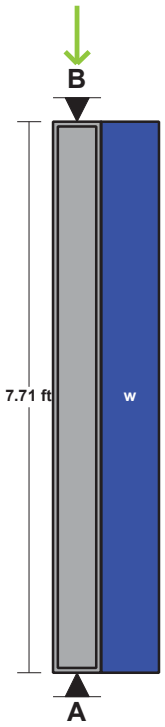
Stud Section (X-X Axis):	dx =	3.5	in
Stud Section (Y-Y Axis):	dy =	1.5	in
Area:	A =	5.25	in2
Section Modulus (X-X Axis):	Sx =	3.06	in3
Section Modulus (Y-Y Axis):	Sy =	1.31	in3
Slenderness Ratio:	Lex/dx =	26.43	
	Ley/dy =	0	

Stud Calculations (Controlling Case Only):

Controlling Load Case: Axial Dead Load and Lateral loads (D + W or E)

Actual Compressive Stress:	Fc =	22	psi
Allowable Compressive Stress:	Fc' =	627	psi
Eccentricity Moment (X-X Axis):	Mx-ex =	0	ft-lb
Eccentricity Moment (Y-Y Axis):	My-ey =	0	ft-lb
Moment Due to Lateral Loads (X-X Axis):	Mx =	50	ft-lb
Moment Due to Lateral Loads (Y-Y Axis):	My =	0	ft-lb
Bending Stress Lateral Loads Only (X-X Axis):	Fbx =	194	psi
Allowable Bending Stress (X-X Axis):	Fbx' =	2065	psi
Bending Stress Lateral Loads Only (Y-Y Axis):	Fby =	0	psi
Allowable Bending Stress (Y-Y Axis):	Fby' =	2065	psi
Combined Stress Factor:	**CSF =**	**0.1**	

LOADING DIAGRAM



WALL LOAD CALCULATOR

	Live Load		Dead Load		Tributary Width	
Load Tracker:	LL = 0	plf	DL = 0	plf		
Roof:	LL = 25	psf	DL = 15	psf	TA = 0	ft
Upper Floor:	LL = 40	psf	DL = 15	psf	TA = 0	ft
Upper Floor Height:	0	ft				
Middle Floor:	LL = 40	psf	DL = 15	psf	TA = 0	ft
Middle Floor Height:	0	ft				
Calculated Load:	**LL = 0**	**plf**	**DL = 84.8**	**plf**		

AXIAL LOADING

Live Load:	PL =	0 plf *
Dead Load:	PD =	85 plf *
Total Axial Load:	PT =	85 plf

* Load obtained from Load Tracker. See Summary Report for details.

LATERAL LOADING (Dy Face)

Uniform Lateral Load: wL-Lat = 5 psf

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: Wall-3rd Flr-Exterior
Wall
[2015 International Building Code(2015 NDS)]
1.5 IN x 5.5 IN x 9.08 FT @ 16 O.C.
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 83.9%
Controlling Factor: Combined Stress Factor

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

page of

StruCalc Version 10.0.1.6 6/21/2019 4:03:25 PM

DEFLECTIONS

Deflection due to lateral loads only:	Defl = 0.09	IN = L/1170
Live Load Deflection Criteria:		L/180

VERTICAL REACTIONS

Live Load:	Vert-LL-Rxn =	533	lb
Dead Load:	Vert-DL-Rxn =	333	lb
Total Load:	Vert-TL-Rxn =	867	lb

HORIZONTAL REACTIONS

Total Reaction at Top of Column:	TL-Rxn-Top =	92	lb
Total Reaction at Bottom of Column:	TL-Rxn-Bottom =	92	lb

WALL DATA

Total Stud Length:	9.08	ft
Wall Dead Weight:	11	psf
Unbraced Length (X-Axis) Lx:	9.08	ft
Unbraced Length (Y-Axis) Ly:	0	ft
Stud End Condition-K (e):	1	
Axial Load Duration Factor	1.15	
Lateral Load Duration Factor (Wind/Seismic)	1.60	

STUD PROPERTIES

#2 - Douglas-Fir-Larch

	Base Values	Adjusted
Compressive Stress:	Fc = 1350 psi	Fc' = 1049 psi
	Cd=1.60 Cf=1.10 Cp=0.44	
Bending Stress (X-X Axis):	Fbx = 900 psi	Fbx' = 2153 psi
	Cd=1.60 CF=1.30 Cr=1.15 Cl=1.00	
Bending Stress (Y-Y Axis):	Fby = 900 psi	Fby' = 2153 psi
	Cd=1.60 CF=1.30 Cr=1.15	
Modulus of Elasticity:	E = 1600 ksi	E' = 1600 ksi

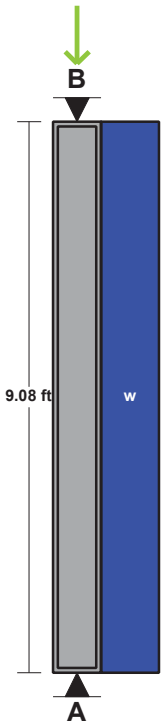
Stud Section (X-X Axis):	dx =	5.5	in
Stud Section (Y-Y Axis):	dy =	1.5	in
Area:	A =	8.25	in2
Section Modulus (X-X Axis):	Sx =	7.56	in3
Section Modulus (Y-Y Axis):	Sy =	2.06	in3
Slenderness Ratio:	Lex/dx =	19.81	
	Ley/dy =	0	

Stud Calculations (Controlling Case Only):

Controlling Load Case: Axial Dead Load and Lateral loads (D + W or E)

Actual Compressive Stress:	Fc =	40	psi
Allowable Compressive Stress:	Fc' =	1049	psi
Eccentricity Moment (X-X Axis):	Mx-ex =	0	ft-lb
Eccentricity Moment (Y-Y Axis):	My-ey =	0	ft-lb
Moment Due to Lateral Loads (X-X Axis):	Mx =	209	ft-lb
Moment Due to Lateral Loads (Y-Y Axis):	My =	0	ft-lb
Bending Stress Lateral Loads Only (X-X Axis):	Fbx =	331	psi
Allowable Bending Stress (X-X Axis):	Fbx' =	2153	psi
Bending Stress Lateral Loads Only (Y-Y Axis):	Fby =	0	psi
Allowable Bending Stress (Y-Y Axis):	Fby' =	2153	psi
Combined Stress Factor:	**CSF =**	**0.16**	

LOADING DIAGRAM



WALL LOAD CALCULATOR

	Live Load		Dead Load		Tributary Width	
Load Tracker:	LL = 0	plf	DL = 0	plf		
Roof:	LL = 25	psf	DL = 15	psf	TA = 0	ft
Upper Floor:	LL = 40	psf	DL = 15	psf	TA = 10	ft
Upper Floor Height:	0	ft				
Middle Floor:	LL = 40	psf	DL = 15	psf	TA = 0	ft
Middle Floor Height:	0	ft				
Calculated Load:	**LL = 400**	**plf**	**DL =249.9**	**plf**		

AXIAL LOADING

Live Load:	PL =	400	plf *
Dead Load:	PD =	250	plf *
Total Axial Load:	PT =	650	plf

* Load obtained from Load Tracker. See Summary Report for details.

LATERAL LOADING (Dy Face)

Uniform Lateral Load:	wL-Lat =	15	psf

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: Wall-2nd Flr-Exterior Wall
[2015 International Building Code(2015 NDS)]
1.5 IN x 5.5 IN x 9.08 FT @ 16 O.C.
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 84.0%
Controlling Factor: Combined Stress Factor

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:25 PM

DEFLECTIONS

Deflection due to lateral loads only:	Defl = 0.09	IN = L/1170
Live Load Deflection Criteria:		L/180

VERTICAL REACTIONS

Live Load:	Vert-LL-Rxn =	533	lb
Dead Load:	Vert-DL-Rxn =	321	lb
Total Load:	Vert-TL-Rxn =	854	lb

HORIZONTAL REACTIONS

Total Reaction at Top of Column:	TL-Rxn-Top =	92	lb
Total Reaction at Bottom of Column:	TL-Rxn-Bottom =	92	lb

WALL DATA

Total Stud Length:	9.08	ft
Wall Dead Weight:	10	psf
Unbraced Length (X-Axis) Lx:	9.08	ft
Unbraced Length (Y-Axis) Ly:	0	ft
Stud End Condition-K (e):	1	
Axial Load Duration Factor	1.15	
Lateral Load Duration Factor (Wind/Seismic)	1.60	

STUD PROPERTIES

#2 - Douglas-Fir-Larch

	Base Values	Adjusted
Compressive Stress:	Fc = 1350 psi	Fc' = 1049 psi
	Cd=1.60 Cf=1.10 Cp=0.44	
Bending Stress (X-X Axis):	Fbx = 900 psi	Fbx' = 2153 psi
	Cd=1.60 CF=1.30 Cr=1.15 Cl=1.00	
Bending Stress (Y-Y Axis):	Fby = 900 psi	Fby' = 2153 psi
	Cd=1.60 CF=1.30 Cr=1.15	
Modulus of Elasticity:	E = 1600 ksi	E' = 1600 ksi

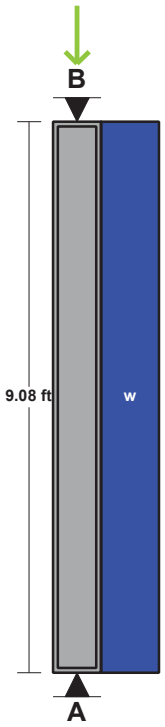
Stud Section (X-X Axis):	dx =	5.5	in
Stud Section (Y-Y Axis):	dy =	1.5	in
Area:	A =	8.25	in2
Section Modulus (X-X Axis):	Sx =	7.56	in3
Section Modulus (Y-Y Axis):	Sy =	2.06	in3
Slenderness Ratio:	Lex/dx =	19.81	
	Ley/dy =	0	

Stud Calculations (Controlling Case Only):

Controlling Load Case: Axial Dead Load and Lateral loads (D + W or E)

Actual Compressive Stress:	Fc =	39	psi
Allowable Compressive Stress:	Fc' =	1049	psi
Eccentricity Moment (X-X Axis):	Mx-ex =	0	ft-lb
Eccentricity Moment (Y-Y Axis):	My-ey =	0	ft-lb
Moment Due to Lateral Loads (X-X Axis):	Mx =	209	ft-lb
Moment Due to Lateral Loads (Y-Y Axis):	My =	0	ft-lb
Bending Stress Lateral Loads Only (X-X Axis):	Fbx =	331	psi
Allowable Bending Stress (X-X Axis):	Fbx' =	2153	psi
Bending Stress Lateral Loads Only (Y-Y Axis):	Fby =	0	psi
Allowable Bending Stress (Y-Y Axis):	Fby' =	2153	psi
Combined Stress Factor:	**CSF =**	**0.16**	

LOADING DIAGRAM



WALL LOAD CALCULATOR

	Live Load		Dead Load		Tributary Width	
Load Tracker:	LL = 0	plf	DL = 0	plf		
Roof:	LL = 25	psf	DL = 15	psf	TA = 0	ft
Upper Floor:	LL = 40	psf	DL = 15	psf	TA = 10	ft
Upper Floor Height:	0	ft				
Middle Floor:	LL = 40	psf	DL = 15	psf	TA = 0	ft
Middle Floor Height:	0	ft				
Calculated Load:	**LL = 400**	**plf**	**DL =240.8**	**plf**		

AXIAL LOADING

Live Load:	PL =	400	plf *
Dead Load:	PD =	241	plf *
Total Axial Load:	PT =	641	plf

* Load obtained from Load Tracker. See Summary Report for details.

LATERAL LOADING (Dy Face)

Uniform Lateral Load: wL-Lat = 15 psf

NOTES

Established Basic Permit# 19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: Wall-1st Flr-Exterior
Wall
[2015 International Building Code(2015 NDS)]
1.5 IN x 5.5 IN x 9.08 FT @ 16 O.C.
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 80.7%
Controlling Factor: Combined Stress Factor

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

page of

StruCalc Version 10.0.1.6 6/21/2019 4:03:25 PM

DEFLECTIONS

Deflection due to lateral loads only:	Defl = 0.09	IN = L/1170
Live Load Deflection Criteria:		L/180

VERTICAL REACTIONS

Live Load:	Vert-LL-Rxn =	533	lb
Dead Load:	Vert-DL-Rxn =	333	lb
Total Load:	Vert-TL-Rxn =	867	lb

HORIZONTAL REACTIONS

Total Reaction at Top of Column:	TL-Rxn-Top =	92	lb
Total Reaction at Bottom of Column:	TL-Rxn-Bottom =	92	lb

WALL DATA

Total Stud Length:	9.08	ft
Wall Dead Weight:	11	psf
Unbraced Length (X-Axis) Lx:	9.08	ft
Unbraced Length (Y-Axis) Ly:	0	ft
Stud End Condition-K (e):	1	
Axial Load Duration Factor	1.15	
Lateral Load Duration Factor (Wind/Seismic)	1.33	

STUD PROPERTIES

#2 - Douglas-Fir-Larch

	Base Values	Adjusted
Compressive Stress:	Fc = 1350 psi	Fc' = 1006 psi
	Cd=1.33 Cf=1.10 Cp=0.51	
Bending Stress (X-X Axis):	Fbx = 900 psi	Fbx' = 1790 psi
	Cd=1.33 CF=1.30 Cr=1.15 Cl=1.00	
Bending Stress (Y-Y Axis):	Fby = 900 psi	Fby' = 1790 psi
	Cd=1.33 CF=1.30 Cr=1.15	
Modulus of Elasticity:	E = 1600 ksi	E' = 1600 ksi

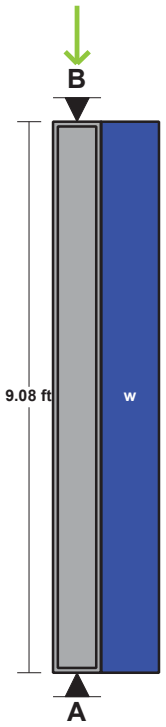
Stud Section (X-X Axis):	dx =	5.5	in
Stud Section (Y-Y Axis):	dy =	1.5	in
Area:	A =	8.25	in2
Section Modulus (X-X Axis):	Sx =	7.56	in3
Section Modulus (Y-Y Axis):	Sy =	2.06	in3
Slenderness Ratio:	Lex/dx =	19.81	
	Ley/dy =	0	

Stud Calculations (Controlling Case Only):

Controlling Load Case: Axial Dead Load and Lateral loads (D + W or E)

Actual Compressive Stress:	Fc =	40	psi
Allowable Compressive Stress:	Fc' =	1006	psi
Eccentricity Moment (X-X Axis):	Mx-ex =	0	ft-lb
Eccentricity Moment (Y-Y Axis):	My-ey =	0	ft-lb
Moment Due to Lateral Loads (X-X Axis):	Mx =	209	ft-lb
Moment Due to Lateral Loads (Y-Y Axis):	My =	0	ft-lb
Bending Stress Lateral Loads Only (X-X Axis):	Fbx =	331	psi
Allowable Bending Stress (X-X Axis):	Fbx' =	1790	psi
Bending Stress Lateral Loads Only (Y-Y Axis):	Fby =	0	psi
Allowable Bending Stress (Y-Y Axis):	Fby' =	1790	psi
Combined Stress Factor:	**CSF =**	**0.19**	

LOADING DIAGRAM



WALL LOAD CALCULATOR

	Live Load		Dead Load		Tributary Width	
Load Tracker:	LL = 0	plf	DL = 0	plf		
Roof:	LL = 25	psf	DL = 15	psf	TA = 0	ft
Upper Floor:	LL = 40	psf	DL = 15	psf	TA = 10	ft
Upper Floor Height:	0	ft				
Middle Floor:	LL = 40	psf	DL = 15	psf	TA = 0	ft
Middle Floor Height:	0	ft				
Calculated Load:	**LL = 400**	**plf**	**DL =249.9**	**plf**		

AXIAL LOADING

Live Load:	PL =	400	plf *
Dead Load:	PD =	250	plf *
Total Axial Load:	PT =	650	plf

* Load obtained from Load Tracker. See Summary Report for details.

LATERAL LOADING (Dy Face)

Uniform Lateral Load:	wL-Lat =	15	psf

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: FJT3-1
Floor Joist
[2015 International Building Code(2015 NDS)]
1.5 IN x 9.25 IN x 8.0 FT (5.8 + 2.2) @ 24 O.C.
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 248.4%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

page of

StruCalc Version 10.0.1.6 6/21/2019 4:03:26 PM

DEFLECTIONS

	Center		Right
Live Load	0.02	IN L/3701	-0.02 IN 2L/2314
Dead Load	0.00	in	0.00 in
Total Load	0.02	IN L/3196	-0.02 IN 2L/2198

Live Load Deflection Criteria: L/480 Total Load Deflection Criteria: L/360

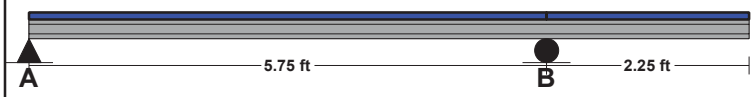
REACTIONS

	A	B
Live Load	345 lb	668 lb
Dead Load	73 lb	167 lb
Total Load	418 lb	835 lb
Uplift (1.5 F.S)	**-4 lb**	0 **lb**
Bearing Length	0.45 in	0.89 in

SUPPORT LOADS

	A	B
Live Load	173 plf	334 plf
Dead Load	37 plf	84 plf
Total Load	209 plf	418 plf

LOADING DIAGRAM



MATERIAL PROPERTIES

#2 - Douglas-Fir-Larch

	Base Values	Adjusted
Bending Stress:	Fb = 900 psi	Fb' = 1139 psi
	Cd=1.00 CF=1.10 Cr=1.15	
Shear Stress:	Fv = 180 psi	Fv' = 180 psi
	Cd=1.00	
Modulus of Elasticity:	E = 1600 ksi	E' = 1600 ksi
Comp. ⊥ to Grain:	Fc - ⊥ = 625 psi	Fc - ⊥' = 625 psi

Controlling Moment: 582 ft-lb
2.76 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
Controlling Shear: -385 lb
At a distance d from right support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2, 3

JOIST DATA

	Center	Right
Span Length	5.75 ft	2.25 ft
Unbraced Length-Top	0 ft	0 ft
Unbraced Length-Bottom	0 ft	0 ft

Floor sheathing applied to top of joists-top of joists fully braced.
Floor Duration Factor 1.00

JOIST LOADING

Uniform Floor Loading		Center	Right
Live Load	LL =	60 psf	60 psf
Dead Load	DL =	15 psf	15 psf
Total Load	TL =	75 psf	75 psf
TL Adj. For Joist Spacing	wT =	150 plf	150 plf

Comparisons with required sections:

	Req'd	Provided
Section Modulus:	6.14 in3	21.39 in3
Area (Shear):	3.21 in2	13.88 in2
Moment of Inertia (deflection):	20.53 in4	98.93 in4
Moment:	582 ft-lb	2029 ft-lb
Shear:	-385 lb	1665 lb

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: MLB3-1
Multi-Loaded Multi-Span Beam
[2015 International Building Code(2015 NDS)]
3.5 IN x 7.25 IN x 6.33 FT
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 40.9%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:26 PM

DEFLECTIONS Center

Live Load	0.07	IN L/1120
Dead Load	0.02	in
Total Load	0.09	IN L/883

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/240

REACTIONS A B

Live Load	1057	lb	1057	lb
Dead Load	283	lb	283	lb
Total Load	1340	lb	1340	lb
Bearing Length	0.61	in	0.61	in

BEAM DATA Center

Span Length	6.33	ft
Unbraced Length-Top	0	ft
Unbraced Length-Bottom	6.33	ft
Live Load Duration Factor	1.00	
Notch Depth	0.00	

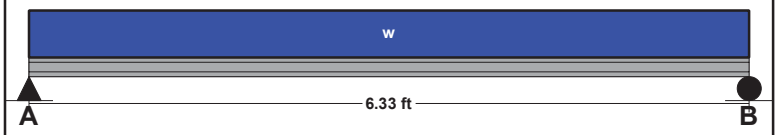
MATERIAL PROPERTIES
#2 - Douglas-Fir-Larch

	Base Values		Adjusted	
Bending Stress:	Fb = 900 psi		Fb' = 1170	psi
	Cd=1.00 CF=1.30			
Shear Stress:	Fv = 180 psi		Fv' = 180	psi
	Cd=1.00			
Modulus of Elasticity:	E = 1600 ksi		E' = 1600	ksi
Comp. ⊥ to Grain:	Fc - ⊥ = 625 psi		Fc - ⊥' = 625	psi

Controlling Moment: 2121 ft-lb
3.16 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
Controlling Shear: 1099 lb
At a distance d from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Comparisons with required sections:	Req'd		Provided	
Section Modulus:	21.76	in3	30.66	in3
Area (Shear):	9.16	in2	25.38	in2
Moment of Inertia (deflection):	35.73	in4	111.15	in4
Moment:	2121	ft-lb	2989	ft-lb
Shear:	1099	lb	3045	lb

LOADING DIAGRAM



UNIFORM LOADS Center*

Uniform Live Load	334	plf
Uniform Dead Load	84	plf
Beam Self Weight	6	plf
Total Uniform Load	424	plf

* Load obtained from Load Tracker. See Summary Report for details.

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: MLBT3-2
Multi-Loaded Multi-Span Beam
[2015 International Building Code(2015 NDS)]
(2) 1.5 IN x 9.25 IN x 8.0 FT (5.8 + 2.2)
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 158.5%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:26 PM

CAUTIONS
* Laminations are to be fully connected to provide uniform transfer of loads to all members

DEFLECTIONS	Center		Right	
Live Load	0.02	IN L/3567	-0.02	IN 2L/2230
Dead Load	0.01	in	-0.01	in
Total Load	0.03	IN L/2707	-0.03	IN 2L/1772

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/240

REACTIONS	A		B	
Live Load	716	lb	877	lb
Dead Load	249	lb	359	lb
Total Load	965	lb	1236	lb
Bearing Length	0.51	in	0.66	in

BEAM DATA	Center		Right	
Span Length	5.75	ft	2.25	ft
Unbraced Length-Top	0	ft	0	ft
Unbraced Length-Bottom	5.75	ft	2.25	ft
Live Load Duration Factor	1.00			
Notch Depth	0.00			

MATERIAL PROPERTIES
#2 - Douglas-Fir-Larch

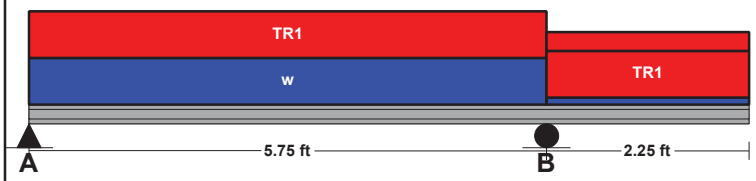
	Base Values		Adjusted	
Bending Stress:	Fb = 900	psi	Fb' = 990	psi
	Cd=1.00 CF=1.10			
Shear Stress:	Fv = 180	psi	Fv' = 180	psi
	Cd=1.00			
Modulus of Elasticity:	E = 1600	ksi	E' = 1600	ksi
Comp. ⊥ to Grain:	Fc - ⊥ = 625	psi	Fc - ⊥' = 625	psi

Controlling Moment: 1365 ft-lb
2.82 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
Controlling Shear: -767 lb
At a distance d from right support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2, 3

Comparisons with required sections:	Req'd	Provided
Section Modulus:	16.55 in3	42.78 in3
Area (Shear):	6.39 in2	27.75 in2
Moment of Inertia (deflection):	31.95 in4	197.86 in4
Moment:	1365 ft-lb	3529 ft-lb
Shear:	-767 lb	3330 lb

NOTES

LOADING DIAGRAM



UNIFORM LOADS	Center*		Right	
Uniform Live Load	189	plf	0	plf
Uniform Dead Load	71	plf	0	plf
Beam Self Weight	6	plf	6	plf
Total Uniform Load	266	plf	6	plf

* Load obtained from Load Tracker. See Summary Report for details.

TRAPEZOIDAL LOADS - CENTER SPAN

Load Number	One
Left Live Load	60 plf
Left Dead Load	15 plf
Right Live Load	60 plf
Right Dead Load	15 plf
Load Start	0 ft
Load End	5.75 ft
Load Length	5.75 ft

RIGHT SPAN

Load Number	One	Two
Left Live Load	60 plf	0 plf
Left Dead Load	15 plf	14 plf
Right Live Load	60 plf	0 plf
Right Dead Load	15 plf	14 plf
Load Start	0 ft	0 ft
Load End	2.25 ft	2.25 ft
Load Length	2.25 ft	2.25 ft

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: FJT3-2
Floor Joist
[2015 International Building Code(2015 NDS)]
1.5 IN x 9.25 IN x 9.42 FT @ 24 O.C.
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 66.3%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:27 PM

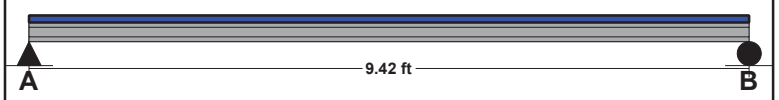
DEFLECTIONS	Center	
Live Load	0.09	IN L/1263
Dead Load	0.03	in
Total Load	0.12	IN L/918

Live Load Deflection Criteria: L/480 Total Load Deflection Criteria: L/360

REACTIONS	A		B	
Live Load	377	lb	377	lb
Dead Load	141	lb	141	lb
Total Load	518	lb	518	lb
Bearing Length	0.55	in	0.55	in

SUPPORT LOADS	A		B	
Live Load	189	plf	189	plf
Dead Load	71	plf	71	plf
Total Load	259	plf	259	plf

LOADING DIAGRAM



MATERIAL PROPERTIES

#2 - Douglas-Fir-Larch

	Base Values		Adjusted	
Bending Stress:	Fb = 900	psi	Fb' = 1139	psi
	Cd=1.00 CF=1.10 Cr=1.15			
Shear Stress:	Fv = 180	psi	Fv' = 180	psi
	Cd=1.00			
Modulus of Elasticity:	E = 1600	ksi	E' = 1600	ksi
Comp. ⊥ to Grain:	Fc - ⊥ = 625	psi	Fc - ⊥' = 625	psi

Controlling Moment: 1220 ft-lb
4.71 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
Controlling Shear: -435 lb
At a distance d from right support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

JOIST DATA	Center	
Span Length	9.42	ft
Unbraced Length-Top	0	ft
Unbraced Length-Bottom	0	ft

Floor sheathing applied to top of joists-top of joists fully braced.
Floor Duration Factor 1.00

JOIST LOADING

Uniform Floor Loading		Center	
Live Load	LL =	40	psf
Dead Load	DL =	15	psf
Total Load	TL =	55	psf
TL Adj. For Joist Spacing	wT =	110	plf

Comparisons with required sections:	Req'd		Provided	
Section Modulus:	12.86	in3	21.39	in3
Area (Shear):	3.63	in2	13.88	in2
Moment of Inertia (deflection):	38.78	in4	98.93	in4
Moment:	1220	ft-lb	2029	ft-lb
Shear:	-435	lb	1665	lb

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: MLBT3-3
Multi-Loaded Multi-Span Beam
[2015 International Building Code(2015 NDS)]
3.5 IN x 13.25 IN x 12.17 FT
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 29.7%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:27 PM

DEFLECTIONS	Center	
Live Load	0.11	IN L/1293
Dead Load	0.03	in
Total Load	0.15	IN L/990

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/240

REACTIONS	A	B
Live Load	1542 lb	1390 lb
Dead Load	509 lb	415 lb
Total Load	2051 lb	1805 lb
Bearing Length	0.94 in	0.83 in

BEAM DATA	Center
Span Length	12.17 ft
Unbraced Length-Top	0 ft
Unbraced Length-Bottom	12.17 ft
Live Load Duration Factor	1.00
Notch Depth	0.00

MATERIAL PROPERTIES

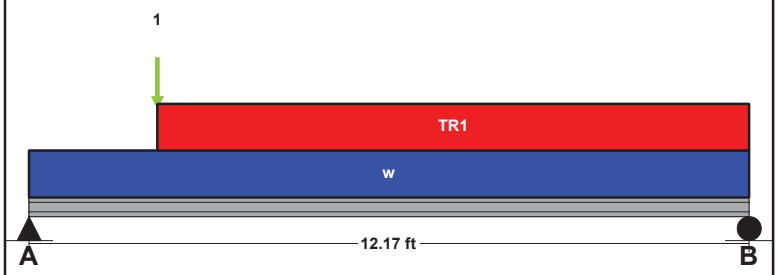
#2 - Douglas-Fir-Larch

	Base Values	Adjusted
Bending Stress:	Fb = 900 psi	Fb' = 900 psi
	Cd=1.00 CF=1.00	
Shear Stress:	Fv = 180 psi	Fv' = 180 psi
	Cd=1.00	
Modulus of Elasticity:	E = 1600 ksi	E' = 1600 ksi
Comp. ⊥ to Grain:	Fc - ⊥ = 625 psi	Fc - ⊥' = 625 psi

Controlling Moment: 5923 ft-lb
5.6 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
Controlling Shear: 1980 lb
At a distance d from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Comparisons with required sections:	Req'd	Provided
Section Modulus:	78.98 in3	102.41 in3
Area (Shear):	16.5 in2	46.38 in2
Moment of Inertia (deflection):	188.85 in4	678.48 in4
Moment:	5923 ft-lb	7681 ft-lb
Shear:	1980 lb	5565 lb

LOADING DIAGRAM



UNIFORM LOADS	Center
Uniform Live Load	40 plf
Uniform Dead Load	15 plf
Beam Self Weight	10 plf
Total Uniform Load	65 plf

POINT LOADS - CENTER SPAN	
Load Number	One *
Live Load	716 lb
Dead Load	249 lb
Location	2.17 ft

* Load obtained from Load Tracker. See Summary Report for details.

TRAPEZOIDAL LOADS - CENTER SPAN	
Load Number	One *
Left Live Load	173 plf
Left Dead Load	37 plf
Right Live Load	173 plf
Right Dead Load	37 plf
Load Start	2.17 ft
Load End	12.17 ft
Load Length	10 ft

* Load obtained from Load Tracker. See Summary Report for details.

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: PST-MLB3-3
Column
[2015 International Building Code(2015 NDS)]
1.5 IN x 3.5 IN x 9.08 FT
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 13.6%

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:27 PM

VERTICAL REACTIONS

Live Load:	Vert-LL-Rxn =	1542	lb
Dead Load:	Vert-DL-Rxn =	519	lb
Total Load:	Vert-TL-Rxn =	2061	lb

COLUMN DATA

Total Column Length:	9.08	ft
Unbraced Length (X-Axis) Lx:	9.08	ft
Unbraced Length (Y-Axis) Ly:	0	ft
Column End Condition-K (e):	1	
Axial Load Duration Factor	1.00	

COLUMN PROPERTIES

#2 - Douglas-Fir-Larch

	Base Values	Adjusted
Compressive Stress:	Fc = 1350 psi	Fc' = 454 psi
	Cd=1.00 Cf=1.15 Cp=0.29	
Bending Stress (X-X Axis):	Fbx = 900 psi	Fbx' = 1350 psi
	Cd=1.00 CF=1.50	
Bending Stress (Y-Y Axis):	Fby = 900 psi	Fby' = 1350 psi
	Cd=1.00 CF=1.50	
Modulus of Elasticity:	E = 1600 ksi	E' = 1600 ksi

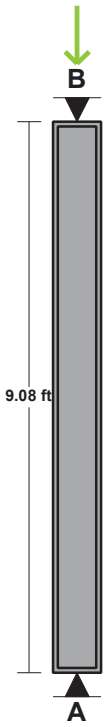
Column Section (X-X Axis):	dx =	3.5	in
Column Section (Y-Y Axis):	dy =	1.5	in
Area:	A =	5.25	in2
Section Modulus (X-X Axis):	Sx =	3.06	in3
Section Modulus (Y-Y Axis):	Sy =	1.31	in3
Slenderness Ratio:	Lex/dx =	31.13	
	Ley/dy =	0	

Column Calculations (Controlling Case Only):

Controlling Load Case: Axial Total Load Only (L + D)

Actual Compressive Stress:	Fc =	393	psi
Allowable Compressive Stress:	Fc' =	454	psi
Eccentricity Moment (X-X Axis):	Mx-ex =	0	ft-lb
Eccentricity Moment (Y-Y Axis):	My-ey =	0	ft-lb
Moment Due to Lateral Loads (X-X Axis):	Mx =	0	ft-lb
Moment Due to Lateral Loads (Y-Y Axis):	My =	0	ft-lb
Bending Stress Lateral Loads Only (X-X Axis):	Fbx =	0	psi
Allowable Bending Stress (X-X Axis):	Fbx' =	1350	psi
Bending Stress Lateral Loads Only (Y-Y Axis):	Fby =	0	psi
Allowable Bending Stress (Y-Y Axis):	Fby' =	1350	psi
Combined Stress Factor:	**CSF =**	**0.86**	

LOADING DIAGRAM



AXIAL LOADING

Live Load:	PL =	1542	lb *
Dead Load:	PD =	509	lb *
Column Self Weight:	CSW =	10	lb
Total Axial Load:	PT =	2061	lb

* Load obtained from Load Tracker. See Summary Report for details.

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: FJT3-3
Floor Joist
[2015 International Building Code(2015 NDS)]
1.5 IN x 11.25 IN x 12.17 FT @ 24 O.C.
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 34.0%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:28 PM

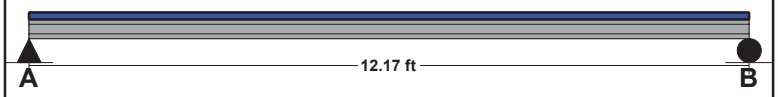
DEFLECTIONS	Center	
Live Load	0.14	IN L/1053
Dead Load	0.05	in
Total Load	0.19	IN L/766

Live Load Deflection Criteria: L/480 Total Load Deflection Criteria: L/360

REACTIONS	A		B	
Live Load	487	lb	487	lb
Dead Load	183	lb	183	lb
Total Load	670	lb	670	lb
Bearing Length	0.71	in	0.71	in

SUPPORT LOADS	A		B	
Live Load	244	plf	244	plf
Dead Load	92	plf	92	plf
Total Load	335	plf	335	plf

LOADING DIAGRAM



MATERIAL PROPERTIES

#2 - Douglas-Fir-Larch

	Base Values		Adjusted	
Bending Stress:	Fb = 900	psi	Fb' = 1035	psi
	Cd=1.00 CF=1.00 Cr=1.15			
Shear Stress:	Fv = 180	psi	Fv' = 180	psi
	Cd=1.00			
Modulus of Elasticity:	E = 1600	ksi	E' = 1600	ksi
Comp. ⊥ to Grain:	Fc - ⊥ = 625	psi	Fc - ⊥' = 625	psi

Controlling Moment: 2036 ft-lb
6.09 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
Controlling Shear: -576 lb
At a distance d from right support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

JOIST DATA	Center	
Span Length	12.17	ft
Unbraced Length-Top	0	ft
Unbraced Length-Bottom	0	ft

Floor sheathing applied to top of joists-top of joists fully braced.
Floor Duration Factor 1.00

JOIST LOADING

Uniform Floor Loading	Center		
Live Load	LL =	40	psf
Dead Load	DL =	15	psf
Total Load	TL =	55	psf
TL Adj. For Joist Spacing	wT =	110	plf

Comparisons with required sections:	Req'd	Provided
Section Modulus:	23.61 in3	31.64 in3
Area (Shear):	4.8 in2	16.88 in2
Moment of Inertia (deflection):	83.63 in4	177.98 in4
Moment:	2036 ft-lb	2729 ft-lb
Shear:	-576 lb	2025 lb

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: WALL2-1-I
Wall
[2015 International Building Code(2015 NDS)]
1.5 IN x 3.5 IN x 9.08 FT @ 16 O.C.
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 86.3%
Controlling Factor: Combined Stress Factor

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:28 PM

DEFLECTIONS

Deflection due to lateral loads only:	Defl = 0.12	IN = L/916
Live Load Deflection Criteria:		L/180

VERTICAL REACTIONS

Live Load:	Vert-LL-Rxn =	0	lb
Dead Load:	Vert-DL-Rxn =	97	lb
Total Load:	Vert-TL-Rxn =	97	lb

HORIZONTAL REACTIONS

Total Reaction at Top of Column:	TL-Rxn-Top =	30	lb
Total Reaction at Bottom of Column:	TL-Rxn-Bottom =	30	lb

WALL DATA

Total Stud Length:	9.08	ft
Wall Dead Weight:	8	psf
Unbraced Length (X-Axis) Lx:	9.08	ft
Unbraced Length (Y-Axis) Ly:	0	ft
Stud End Condition-K (e):	1	
Axial Load Duration Factor	1.00	
Lateral Load Duration Factor (Wind/Seismic)	1.33	

STUD PROPERTIES

#2 - Douglas-Fir-Larch

	Base Values	Adjusted
Compressive Stress:	Fc = 1350 psi	Fc' = 465 psi
	Cd=1.33 Cf=1.15 Cp=0.23	
Bending Stress (X-X Axis):	Fbx = 900 psi	Fbx' = 2065 psi
	Cd=1.33 CF=1.50 Cr=1.15 Cl=1.00	
Bending Stress (Y-Y Axis):	Fby = 900 psi	Fby' = 2065 psi
	Cd=1.33 CF=1.50 Cr=1.15	
Modulus of Elasticity:	E = 1600 ksi	E' = 1600 ksi

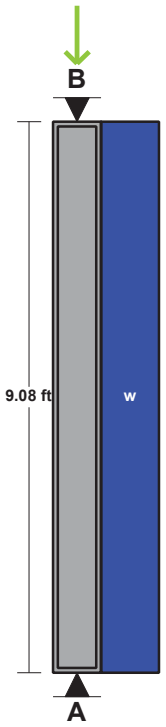
Stud Section (X-X Axis):	dx =	3.5	in
Stud Section (Y-Y Axis):	dy =	1.5	in
Area:	A =	5.25	in2
Section Modulus (X-X Axis):	Sx =	3.06	in3
Section Modulus (Y-Y Axis):	Sy =	1.31	in3
Slenderness Ratio:	Lex/dx =	31.13	
	Ley/dy =	0	

Stud Calculations (Controlling Case Only):

Controlling Load Case: Axial Dead Load and Lateral loads (D + W or E)

Actual Compressive Stress:	Fc =	18	psi
Allowable Compressive Stress:	Fc' =	465	psi
Eccentricity Moment (X-X Axis):	Mx-ex =	0	ft-lb
Eccentricity Moment (Y-Y Axis):	My-ey =	0	ft-lb
Moment Due to Lateral Loads (X-X Axis):	Mx =	69	ft-lb
Moment Due to Lateral Loads (Y-Y Axis):	My =	0	ft-lb
Bending Stress Lateral Loads Only (X-X Axis):	Fbx =	269	psi
Allowable Bending Stress (X-X Axis):	Fbx' =	2065	psi
Bending Stress Lateral Loads Only (Y-Y Axis):	Fby =	0	psi
Allowable Bending Stress (Y-Y Axis):	Fby' =	2065	psi
Combined Stress Factor:	**CSF =**	**0.14**	

LOADING DIAGRAM



WALL LOAD CALCULATOR

	Live Load		Dead Load		Tributary Width	
Load Tracker:	LL = 0	plf	DL = 0	plf		
Roof:	LL = 25	psf	DL = 15	psf	TA = 0	ft
Upper Floor:	LL = 40	psf	DL = 15	psf	TA = 0	ft
Upper Floor Height:	0	ft				
Middle Floor:	LL = 40	psf	DL = 15	psf	TA = 0	ft
Middle Floor Height:	0	ft				
Calculated Load:	**LL = 0**	**plf**	**DL = 72.6**	**plf**		

AXIAL LOADING

Live Load:	PL =	0 plf *
Dead Load:	PD =	73 plf *
Total Axial Load:	PT =	73 plf

* Load obtained from Load Tracker. See Summary Report for details.

LATERAL LOADING (Dy Face)

Uniform Lateral Load: wL-Lat = 5 psf

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: WALL-FJT3-3
Wall
[2015 International Building Code(2015 NDS)]
1.5 IN x 3.5 IN x 9.08 FT @ 16 O.C.
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 86.3%
Controlling Factor: Combined Stress Factor

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

page of

StruCalc Version 10.0.1.6 6/21/2019 4:03:28 PM

DEFLECTIONS

Deflection due to lateral loads only:	Defl = 0.12	IN = L/916
Live Load Deflection Criteria:		L/180

VERTICAL REACTIONS

Live Load:	Vert-LL-Rxn =	0	lb
Dead Load:	Vert-DL-Rxn =	97	lb
Total Load:	Vert-TL-Rxn =	97	lb

HORIZONTAL REACTIONS

Total Reaction at Top of Column:	TL-Rxn-Top =	30	lb
Total Reaction at Bottom of Column:	TL-Rxn-Bottom =	30	lb

WALL DATA

Total Stud Length:	9.08	ft
Wall Dead Weight:	8	psf
Unbraced Length (X-Axis) Lx:	9.08	ft
Unbraced Length (Y-Axis) Ly:	0	ft
Stud End Condition-K (e):	1	
Axial Load Duration Factor	1.00	
Lateral Load Duration Factor (Wind/Seismic)	1.33	

STUD PROPERTIES

#2 - Douglas-Fir-Larch

	Base Values	Adjusted
Compressive Stress:	Fc = 1350 psi	Fc' = 465 psi
	Cd=1.33 Cf=1.15 Cp=0.23	
Bending Stress (X-X Axis):	Fbx = 900 psi	Fbx' = 2065 psi
	Cd=1.33 CF=1.50 Cr=1.15 Cl=1.00	
Bending Stress (Y-Y Axis):	Fby = 900 psi	Fby' = 2065 psi
	Cd=1.33 CF=1.50 Cr=1.15	
Modulus of Elasticity:	E = 1600 ksi	E' = 1600 ksi

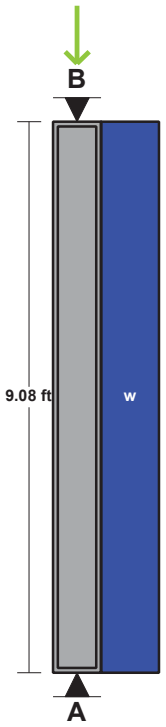
Stud Section (X-X Axis):	dx =	3.5	in
Stud Section (Y-Y Axis):	dy =	1.5	in
Area:	A =	5.25	in2
Section Modulus (X-X Axis):	Sx =	3.06	in3
Section Modulus (Y-Y Axis):	Sy =	1.31	in3
Slenderness Ratio:	Lex/dx =	31.13	
	Ley/dy =	0	

Stud Calculations (Controlling Case Only):

Controlling Load Case: Axial Dead Load and Lateral loads (D + W or E)

Actual Compressive Stress:	Fc =	18	psi
Allowable Compressive Stress:	Fc' =	465	psi
Eccentricity Moment (X-X Axis):	Mx-ex =	0	ft-lb
Eccentricity Moment (Y-Y Axis):	My-ey =	0	ft-lb
Moment Due to Lateral Loads (X-X Axis):	Mx =	69	ft-lb
Moment Due to Lateral Loads (Y-Y Axis):	My =	0	ft-lb
Bending Stress Lateral Loads Only (X-X Axis):	Fbx =	269	psi
Allowable Bending Stress (X-X Axis):	Fbx' =	2065	psi
Bending Stress Lateral Loads Only (Y-Y Axis):	Fby =	0	psi
Allowable Bending Stress (Y-Y Axis):	Fby' =	2065	psi
Combined Stress Factor:	**CSF =**	**0.14**	

LOADING DIAGRAM



WALL LOAD CALCULATOR

	Live Load		Dead Load		Tributary Width	
Load Tracker:	LL = 0	plf	DL = 0	plf		
Roof:	LL = 25	psf	DL = 15	psf	TA = 0	ft
Upper Floor:	LL = 40	psf	DL = 15	psf	TA = 0	ft
Upper Floor Height:	0	ft				
Middle Floor:	LL = 40	psf	DL = 15	psf	TA = 0	ft
Middle Floor Height:	0	ft				
Calculated Load:	**LL = 0**	**plf**	**DL = 72.6**	**plf**		

AXIAL LOADING

Live Load:	PL =	0 plf *
Dead Load:	PD =	73 plf *
Total Axial Load:	PT =	73 plf

* Load obtained from Load Tracker. See Summary Report for details.

LATERAL LOADING (Dy Face)

Uniform Lateral Load: wL-Lat = 5 psf

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: MLBT3-4
Multi-Loaded Multi-Span Beam
[2015 International Building Code(2015 NDS)]
3.5 IN x 11.25 IN x 4.5 FT
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 598.4%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:29 PM

DEFLECTIONS	Center	
Live Load	0.00	IN L/MAX
Dead Load	0.00	in
Total Load	0.00	IN L/MAX

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/240

REACTIONS	A	B
Live Load	549 lb	549 lb
Dead Load	226 lb	226 lb
Total Load	775 lb	775 lb
Bearing Length	0.35 in	0.35 in

BEAM DATA	Center
Span Length	4.5 ft
Unbraced Length-Top	0 ft
Unbraced Length-Bottom	4.5 ft
Live Load Duration Factor	1.00
Notch Depth	0.00

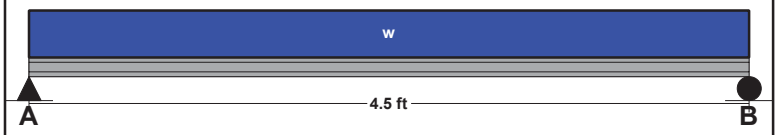
MATERIAL PROPERTIES
#2 - Douglas-Fir-Larch

	Base Values		Adjusted	
Bending Stress:	Fb = 900	psi	Fb' = 990	psi
	Cd=1.00 CF=1.10			
Shear Stress:	Fv = 180	psi	Fv' = 180	psi
	Cd=1.00			
Modulus of Elasticity:	E = 1600	ksi	E' = 1600	ksi
Comp. ⊥ to Grain:	Fc - ⊥ = 625	psi	Fc - ⊥' = 625	psi

Controlling Moment: 872 ft-lb
2.25 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
Controlling Shear: 465 lb
At a distance d from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Comparisons with required sections:	Req'd	Provided
Section Modulus:	10.57 in3	73.83 in3
Area (Shear):	3.88 in2	39.38 in2
Moment of Inertia (deflection):	9.38 in4	415.28 in4
Moment:	872 ft-lb	6091 ft-lb
Shear:	465 lb	4725 lb

LOADING DIAGRAM



UNIFORM LOADS	Center*	
Uniform Live Load	244	plf
Uniform Dead Load	92	plf
Beam Self Weight	9	plf
Total Uniform Load	345	plf

* Load obtained from Load Tracker. See Summary Report for details.

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: PST-MLB3-4
Column
[2015 International Building Code(2015 NDS)]
(2) 1.5 IN x 3.5 IN x 9.08 FT
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 83.3%

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:29 PM

CAUTIONS
* Laminations to be nailed together per National Design Specifications for Wood Construction Section 15.3.3.1

VERTICAL REACTIONS

Live Load:	Vert-LL-Rxn =	549	lb
Dead Load:	Vert-DL-Rxn =	247	lb
Total Load:	Vert-TL-Rxn =	796	lb

COLUMN DATA

Total Column Length:	9.08	ft
Unbraced Length (X-Axis) Lx:	9.08	ft
Unbraced Length (Y-Axis) Ly:	0	ft
Column End Condition-K (e):	1	
Axial Load Duration Factor	1.00	

COLUMN PROPERTIES
#2 - Douglas-Fir-Larch

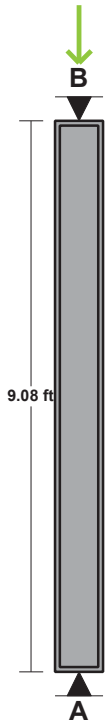
	Base Values	Adjusted
Compressive Stress:	Fc = 1350 psi	Fc' = 454 psi
	Cd=1.00 Cf=1.15 Cp=0.29	
Bending Stress (X-X Axis):	Fbx = 900 psi	Fbx' = 1350 psi
	Cd=1.00 CF=1.50	
Bending Stress (Y-Y Axis):	Fby = 900 psi	Fby' = 1350 psi
	Cd=1.00 CF=1.50	
Modulus of Elasticity:	E = 1600 ksi	E' = 1600 ksi

Column Section (X-X Axis):	dx =	3.5	in
Column Section (Y-Y Axis):	dy =	3	in
Area:	A =	10.5	in2
Section Modulus (X-X Axis):	Sx =	6.13	in3
Section Modulus (Y-Y Axis):	Sy =	2.63	in3
Slenderness Ratio:	Lex/dx =	31.13	
	Ley/dy =	0	

Column Calculations (Controlling Case Only):
Controlling Load Case: Axial Total Load Only (L + D)

Actual Compressive Stress:	Fc =	76	psi
Allowable Compressive Stress:	Fc' =	454	psi
Eccentricity Moment (X-X Axis):	Mx-ex =	0	ft-lb
Eccentricity Moment (Y-Y Axis):	My-ey =	0	ft-lb
Moment Due to Lateral Loads (X-X Axis):	Mx =	0	ft-lb
Moment Due to Lateral Loads (Y-Y Axis):	My =	0	ft-lb
Bending Stress Lateral Loads Only (X-X Axis):	Fbx =	0	psi
Allowable Bending Stress (X-X Axis):	Fbx' =	1350	psi
Bending Stress Lateral Loads Only (Y-Y Axis):	Fby =	0	psi
Allowable Bending Stress (Y-Y Axis):	Fby' =	1350	psi
Combined Stress Factor:	**CSF =**	**0.17**	

LOADING DIAGRAM



AXIAL LOADING

Live Load:	PL =	549	lb *
Dead Load:	PD =	226	lb *
Column Self Weight:	CSW =	21	lb
Total Axial Load:	PT =	796	lb

* Load obtained from Load Tracker. See Summary Report for details.

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: MLBT3-5
Multi-Loaded Multi-Span Beam
[2015 International Building Code(2015 NDS)]
3.5 IN x 15.25 IN x 19.5 FT
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 0.6%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:30 PM

DEFLECTIONS Center

Live Load	0.27	IN L/876
Dead Load	0.13	in
Total Load	0.39	IN L/595

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/240

REACTIONS A B

	A		B	
Live Load	1200	lb	1055	lb
Dead Load	575	lb	516	lb
Total Load	1775	lb	1571	lb
Bearing Length	0.81	in	0.72	in

BEAM DATA Center

Span Length	19.5	ft
Unbraced Length-Top	0	ft
Unbraced Length-Bottom	19.5	ft
Live Load Duration Factor	1.00	
Notch Depth	0.00	

MATERIAL PROPERTIES

#2 - Douglas-Fir-Larch

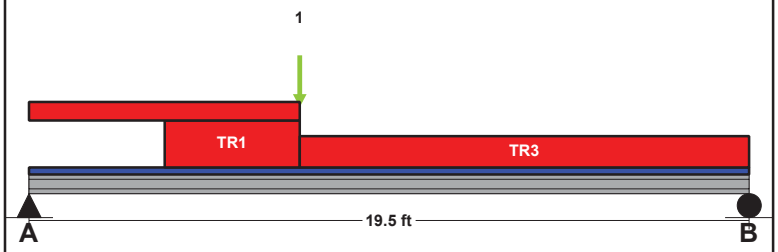
	Base Values		Adjusted	
Bending Stress:	Fb = 900	psi	Fb' = 900	psi
	Cd=1.00 CF=1.00			
Shear Stress:	Fv = 180	psi	Fv' = 180	psi
	Cd=1.00			
Modulus of Elasticity:	E = 1600	ksi	E' = 1600	ksi
Comp. ⊥ to Grain:	Fc - ⊥ = 625	psi	Fc - ⊥' = 625	psi

Controlling Moment: 10110 ft-lb
7.41 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Controlling Shear: 1697 lb
At a distance d from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Comparisons with required sections:	Req'd	Provided
Section Modulus:	134.8 in3	135.66 in3
Area (Shear):	14.14 in2	53.38 in2
Moment of Inertia (deflection):	425.34 in4	1034.42 in4
Moment:	10110 ft-lb	10175 ft-lb
Shear:	1697 lb	6405 lb

LOADING DIAGRAM



UNIFORM LOADS Center

Uniform Live Load	0	plf
Uniform Dead Load	0	plf
Beam Self Weight	12	plf
Total Uniform Load	12	plf

POINT LOADS - CENTER SPAN

Load Number	One *	
Live Load	549	lb
Dead Load	226	lb
Location	7.33	ft

* Load obtained from Load Tracker. See Summary Report for details.

TRAPEZOIDAL LOADS - CENTER SPAN

Load Number	One		Two		Three	
Left Live Load	120	plf	40	plf	80	plf
Left Dead Load	45	plf	15	plf	30	plf
Right Live Load	120	plf	40	plf	80	plf
Right Dead Load	45	plf	15	plf	30	plf
Load Start	3.67	ft	0	ft	7.33	ft
Load End	7.33	ft	7.33	ft	19.5	ft
Load Length	3.66	ft	7.33	ft	12.17	ft

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: PST-MLB3-5
Column
[2015 International Building Code(2015 NDS)]
(2) 1.5 IN x 5.5 IN x 9.08 FT
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 88.1%

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:30 PM

CAUTIONS
* Laminations to be nailed together per National Design Specifications for Wood Construction Section 15.3.3.1

VERTICAL REACTIONS

Live Load:	Vert-LL-Rxn =	1200	lb
Dead Load:	Vert-DL-Rxn =	607	lb
Total Load:	Vert-TL-Rxn =	1807	lb

COLUMN DATA

Total Column Length:	9.08	ft
Unbraced Length (X-Axis) Lx:	9.08	ft
Unbraced Length (Y-Axis) Ly:	0	ft
Column End Condition-K (e):	1	
Axial Load Duration Factor	1.00	

COLUMN PROPERTIES
#2 - Douglas-Fir-Larch

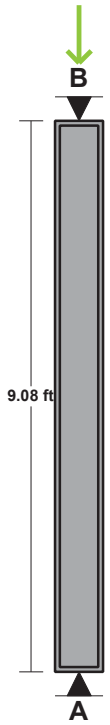
	Base Values	Adjusted
Compressive Stress:	Fc = 1350 psi	Fc' = 918 psi
	Cd=1.00 Cf=1.10 Cp=0.62	
Bending Stress (X-X Axis):	Fbx = 900 psi	Fbx' = 1170 psi
	Cd=1.00 CF=1.30	
Bending Stress (Y-Y Axis):	Fby = 900 psi	Fby' = 1170 psi
	Cd=1.00 CF=1.30	
Modulus of Elasticity:	E = 1600 ksi	E' = 1600 ksi

Column Section (X-X Axis):	dx =	5.5	in
Column Section (Y-Y Axis):	dy =	3	in
Area:	A =	16.5	in2
Section Modulus (X-X Axis):	Sx =	15.13	in3
Section Modulus (Y-Y Axis):	Sy =	4.13	in3
Slenderness Ratio:	Lex/dx =	19.81	
	Ley/dy =	0	

Column Calculations (Controlling Case Only):
Controlling Load Case: Axial Total Load Only (L + D)

Actual Compressive Stress:	Fc =	110	psi
Allowable Compressive Stress:	Fc' =	918	psi
Eccentricity Moment (X-X Axis):	Mx-ex =	0	ft-lb
Eccentricity Moment (Y-Y Axis):	My-ey =	0	ft-lb
Moment Due to Lateral Loads (X-X Axis):	Mx =	0	ft-lb
Moment Due to Lateral Loads (Y-Y Axis):	My =	0	ft-lb
Bending Stress Lateral Loads Only (X-X Axis):	Fbx =	0	psi
Allowable Bending Stress (X-X Axis):	Fbx' =	1170	psi
Bending Stress Lateral Loads Only (Y-Y Axis):	Fby =	0	psi
Allowable Bending Stress (Y-Y Axis):	Fby' =	1170	psi
Combined Stress Factor:	**CSF =**	**0.12**	

LOADING DIAGRAM



AXIAL LOADING

Live Load:	PL =	1200	lb *
Dead Load:	PD =	575	lb *
Column Self Weight:	CSW =	32	lb
Total Axial Load:	PT =	1807	lb

* Load obtained from Load Tracker. See Summary Report for details.

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: FJT3-4
Floor Joist
[2015 International Building Code(2015 NDS)]
3.5 IN x 11.25 IN x 19.5 FT @ 24 O.C.
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 20.7%
Controlling Factor: Deflection

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:30 PM

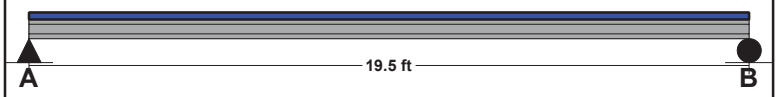
DEFLECTIONS	Center	
Live Load	0.39	IN L/597
Dead Load	0.15	in
Total Load	0.54	IN L/435

Live Load Deflection Criteria: L/480 Total Load Deflection Criteria: L/360

REACTIONS	A	B
Live Load	780 lb	780 lb
Dead Load	293 lb	293 lb
Total Load	1073 lb	1073 lb
Bearing Length	0.49 in	0.49 in

SUPPORT LOADS	A	B
Live Load	390 plf	390 plf
Dead Load	147 plf	147 plf
Total Load	537 plf	537 plf

LOADING DIAGRAM



MATERIAL PROPERTIES

#2 - Douglas-Fir-Larch

	Base Values	Adjusted
Bending Stress:	Fb = 900 psi	Fb' = 1139 psi
	Cd=1.00 CF=1.10 Cr=1.15	
Shear Stress:	Fv = 180 psi	Fv' = 180 psi
	Cd=1.00	
Modulus of Elasticity:	E = 1600 ksi	E' = 1600 ksi
Comp. ⊥ to Grain:	Fc - ⊥ = 625 psi	Fc - ⊥' = 625 psi

JOIST DATA	Center	
Span Length	19.5	ft
Unbraced Length-Top	0	ft
Unbraced Length-Bottom	0	ft

Floor sheathing applied to top of joists-top of joists fully braced.
Floor Duration Factor 1.00

JOIST LOADING

Uniform Floor Loading	Center	
Live Load	LL = 40	psf
Dead Load	DL = 15	psf
Total Load	TL = 55	psf
TL Adj. For Joist Spacing	wT = 110	plf

Controlling Moment: 5228 ft-lb
9.75 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
Controlling Shear: -987 lb
At a distance d from right support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Comparisons with required sections:	Req'd	Provided
Section Modulus:	55.11 in3	73.83 in3
Area (Shear):	8.22 in2	39.38 in2
Moment of Inertia (deflection):	344.04 in4	415.28 in4
Moment:	5228 ft-lb	7004 ft-lb
Shear:	-987 lb	4725 lb

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: MLB3-2
Multi-Loaded Multi-Span Beam
[2015 International Building Code(2015 NDS)]
3.5 IN x 7.25 IN x 2.83 FT
#2 - Alaska Cedar - Dry Use
Section Adequate By: 389.6%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:31 PM

DEFLECTIONS	Center	
Live Load	0.00	IN L/8049
Dead Load	0.00	in
Total Load	0.01	IN L/5790

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/240

REACTIONS	A	B
Live Load	552 lb	552 lb
Dead Load	215 lb	215 lb
Total Load	767 lb	767 lb
Bearing Length	0.42 in	0.42 in

BEAM DATA	Center
Span Length	2.83 ft
Unbraced Length-Top	0 ft
Unbraced Length-Bottom	2.83 ft
Live Load Duration Factor	1.00
Notch Depth	0.00

MATERIAL PROPERTIES

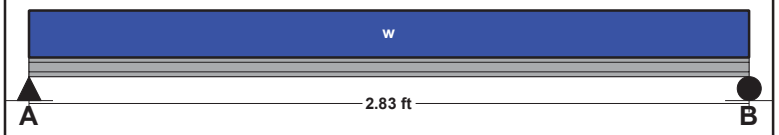
#2 - Alaska Cedar

	Base Values		Adjusted	
Bending Stress:	Fb = 800 psi		Fb' = 1040 psi	
	Cd=1.00 CF=1.30			
Shear Stress:	Fv = 165 psi		Fv' = 165 psi	
	Cd=1.00			
Modulus of Elasticity:	E = 1200 ksi		E' = 1200 ksi	
Comp. ⊥ to Grain:	Fc - ⊥ = 525 psi		Fc - ⊥' = 525 psi	

Controlling Moment: 543 ft-lb
1.41 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
Controlling Shear: -445 lb
At a distance d from right support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Comparisons with required sections:	Req'd	Provided
Section Modulus:	6.26 in3	30.66 in3
Area (Shear):	4.05 in2	25.38 in2
Moment of Inertia (deflection):	4.97 in4	111.15 in4
Moment:	543 ft-lb	2657 ft-lb
Shear:	-445 lb	2791 lb

LOADING DIAGRAM



UNIFORM LOADS	Center*
Uniform Live Load	390 plf
Uniform Dead Load	147 plf
Beam Self Weight	5 plf
Total Uniform Load	542 plf

* Load obtained from Load Tracker. See Summary Report for details.

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: FJT3-5
Floor Joist
[2015 International Building Code(2015 NDS)]
3.5 IN x 13.25 IN x 14.17 FT @ 16 O.C.
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 379.9%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:31 PM

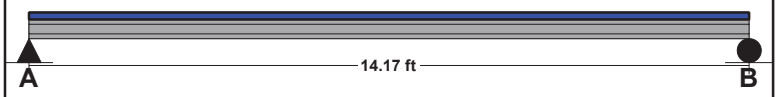
DEFLECTIONS	Center	
Live Load	0.04	IN L/3816
Dead Load	0.02	in
Total Load	0.06	IN L/2775

Live Load Deflection Criteria: L/480 Total Load Deflection Criteria: L/360

REACTIONS	A		B	
Live Load	378	lb	378	lb
Dead Load	142	lb	142	lb
Total Load	520	lb	520	lb
Bearing Length	0.24	in	0.24	in

SUPPORT LOADS	A		B	
Live Load	284	plf	284	plf
Dead Load	107	plf	107	plf
Total Load	390	plf	390	plf

LOADING DIAGRAM



MATERIAL PROPERTIES

#2 - Douglas-Fir-Larch

	Base Values		Adjusted	
Bending Stress:	Fb = 900	psi	Fb' = 1035	psi
	Cd=1.00 CF=1.00 Cr=1.15			
Shear Stress:	Fv = 180	psi	Fv' = 180	psi
	Cd=1.00			
Modulus of Elasticity:	E = 1600	ksi	E' = 1600	ksi
Comp. ⊥ to Grain:	Fc - ⊥ = 625	psi	Fc - ⊥' = 625	psi

Controlling Moment: 1841 ft-lb
7.09 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
Controlling Shear: 447 lb
At a distance d from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Comparisons with required sections:	Req'd	Provided
Section Modulus:	21.34 in3	102.41 in3
Area (Shear):	3.72 in2	46.38 in2
Moment of Inertia (deflection):	88.01 in4	678.48 in4
Moment:	1841 ft-lb	8833 ft-lb
Shear:	447 lb	5565 lb

JOIST DATA	Center	
Span Length	14.17	ft
Unbraced Length-Top	0	ft
Unbraced Length-Bottom	0	ft

Floor sheathing applied to top of joists-top of joists fully braced.
Floor Duration Factor 1.00

JOIST LOADING

Uniform Floor Loading		Center	
Live Load	LL =	40	psf
Dead Load	DL =	15	psf
Total Load	TL =	55	psf
TL Adj. For Joist Spacing	wT =	73.3	plf

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: FJT3-6
Floor Joist
[2015 International Building Code(2015 NDS)]
3.5 IN x 13.25 IN x 15.83 FT @ 16 O.C.
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 284.5%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:31 PM

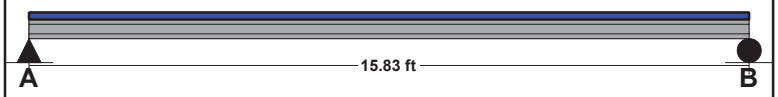
DEFLECTIONS	Center	
Live Load	0.07	IN L/2737
Dead Load	0.03	in
Total Load	0.10	IN L/1991

Live Load Deflection Criteria: L/480 Total Load Deflection Criteria: L/360

REACTIONS	A	B
Live Load	422 lb	422 lb
Dead Load	158 lb	158 lb
Total Load	580 lb	580 lb
Bearing Length	0.27 in	0.27 in

SUPPORT LOADS	A	B
Live Load	317 plf	317 plf
Dead Load	119 plf	119 plf
Total Load	435 plf	435 plf

LOADING DIAGRAM



MATERIAL PROPERTIES

#2 - Douglas-Fir-Larch

	Base Values	Adjusted
Bending Stress:	Fb = 900 psi	Fb' = 1035 psi
	Cd=1.00 CF=1.00 Cr=1.15	
Shear Stress:	Fv = 180 psi	Fv' = 180 psi
	Cd=1.00	
Modulus of Elasticity:	E = 1600 ksi	E' = 1600 ksi
Comp. ⊥ to Grain:	Fc - ⊥ = 625 psi	Fc - ⊥' = 625 psi

Controlling Moment: 2297 ft-lb
7.91 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
Controlling Shear: -511 lb
At a distance d from right support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Comparisons with required sections:	Req'd	Provided
Section Modulus:	26.63 in3	102.41 in3
Area (Shear):	4.26 in2	46.38 in2
Moment of Inertia (deflection):	122.7 in4	678.48 in4
Moment:	2297 ft-lb	8833 ft-lb
Shear:	-511 lb	5565 lb

JOIST DATA	Center
Span Length	15.83 ft
Unbraced Length-Top	0 ft
Unbraced Length-Bottom	0 ft

Floor sheathing applied to top of joists-top of joists fully braced.
Floor Duration Factor 1.00

JOIST LOADING

Uniform Floor Loading	Center
Live Load	LL = 40 psf
Dead Load	DL = 15 psf
Total Load	TL = 55 psf
TL Adj. For Joist Spacing	wT = 73.3 plf

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: MLBT3-6
Multi-Loaded Multi-Span Beam
[2015 International Building Code(2015 NDS)]
3.5 IN x 11.25 IN x 4.42 FT
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 524.3%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:32 PM

DEFLECTIONS Center

Live Load	0.00	IN L/MAX
Dead Load	0.00	in
Total Load	0.01	IN L/MAX

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/240

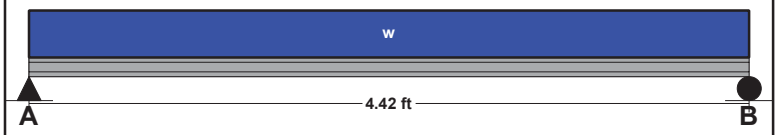
REACTIONS A B

Live Load	628	lb	628	lb
Dead Load	255	lb	255	lb
Total Load	883	lb	883	lb
Bearing Length	0.40	in	0.40	in

BEAM DATA Center

Span Length	4.42	ft
Unbraced Length-Top	0	ft
Unbraced Length-Bottom	4.42	ft
Live Load Duration Factor	1.00	
Notch Depth	0.00	

LOADING DIAGRAM



UNIFORM LOADS Center*

Uniform Live Load	284	plf
Uniform Dead Load	107	plf
Beam Self Weight	9	plf
Total Uniform Load	400	plf

* Load obtained from Load Tracker. See Summary Report for details.

MATERIAL PROPERTIES

#2 - Douglas-Fir-Larch

	Base Values		Adjusted	
Bending Stress:	Fb = 900	psi	Fb' = 990	psi
	Cd=1.00 CF=1.10			
Shear Stress:	Fv = 180	psi	Fv' = 180	psi
	Cd=1.00			
Modulus of Elasticity:	E = 1600	ksi	E' = 1600	ksi
Comp. ⊥ to Grain:	Fc - ⊥ = 625	psi	Fc - ⊥' = 625	psi

Controlling Moment: 976 ft-lb
2.21 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
Controlling Shear: -512 lb
At a distance d from right support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Comparisons with required sections:	Req'd		Provided	
Section Modulus:	11.83	in3	73.83	in3
Area (Shear):	4.27	in2	39.38	in2
Moment of Inertia (deflection):	10.34	in4	415.28	in4
Moment:	976	ft-lb	6091	ft-lb
Shear:	-512	lb	4725	lb

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: MLBT3-7
Multi-Loaded Multi-Span Beam
[2015 International Building Code(2015 NDS)]
3.5 IN x 13.25 IN x 9.17 FT
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 63.8%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:32 PM

DEFLECTIONS	Center	
Live Load	0.05	IN L/2369
Dead Load	0.02	in
Total Load	0.07	IN L/1684

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/240

REACTIONS	A		B	
Live Load	1453	lb	1453	lb
Dead Load	592	lb	592	lb
Total Load	2045	lb	2045	lb
Bearing Length	0.93	in	0.93	in

BEAM DATA	Center	
Span Length	9.17	ft
Unbraced Length-Top	0	ft
Unbraced Length-Bottom	9.17	ft
Live Load Duration Factor	1.00	
Notch Depth	0.00	

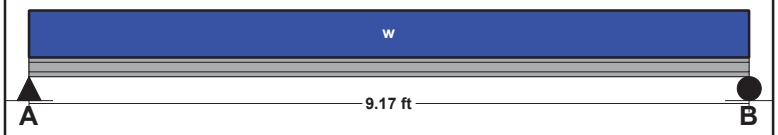
MATERIAL PROPERTIES
#2 - Douglas-Fir-Larch

	Base Values		Adjusted	
Bending Stress:	Fb = 900	psi	Fb' = 900	psi
	Cd=1.00 CF=1.00			
Shear Stress:	Fv = 180	psi	Fv' = 180	psi
	Cd=1.00			
Modulus of Elasticity:	E = 1600	ksi	E' = 1600	ksi
Comp. ⊥ to Grain:	Fc - ⊥ = 625	psi	Fc - ⊥' = 625	psi

Controlling Moment: 4689 ft-lb
4.58 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
Controlling Shear: -1554 lb
At a distance d from right support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Comparisons with required sections:	Req'd		Provided	
Section Modulus:	62.51	in3	102.41	in3
Area (Shear):	12.95	in2	46.38	in2
Moment of Inertia (deflection):	103.11	in4	678.48	in4
Moment:	4689	ft-lb	7681	ft-lb
Shear:	-1554	lb	5565	lb

LOADING DIAGRAM



UNIFORM LOADS	Center*	
Uniform Live Load	317	plf
Uniform Dead Load	119	plf
Beam Self Weight	10	plf
Total Uniform Load	446	plf

* Load obtained from Load Tracker. See Summary Report for details.

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: MLBT3-8
Multi-Loaded Multi-Span Beam
[2015 International Building Code(2015 NDS)]
3.5 IN x 11.25 IN x 15.83 FT
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 121.8%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:32 PM

DEFLECTIONS Center

Live Load	0.12	IN L/1521
Dead Load	0.07	in
Total Load	0.19	IN L/994

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/240

REACTIONS A B

Live Load	379	lb	816	lb
Dead Load	212	lb	391	lb
Total Load	591	lb	1207	lb
Bearing Length	0.27	in	0.55	in

BEAM DATA Center

Span Length	15.83	ft
Unbraced Length-Top	0	ft
Unbraced Length-Bottom	15.83	ft
Live Load Duration Factor	1.00	
Notch Depth	0.00	

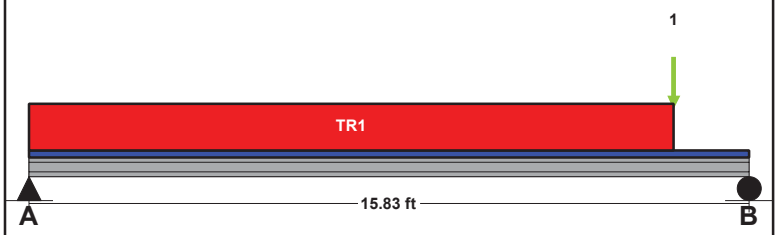
MATERIAL PROPERTIES
#2 - Douglas-Fir-Larch

	Base Values		Adjusted	
Bending Stress:	Fb = 900	psi	Fb' = 990	psi
	Cd=1.00 CF=1.10			
Shear Stress:	Fv = 180	psi	Fv' = 180	psi
	Cd=1.00			
Modulus of Elasticity:	E = 1600	ksi	E' = 1600	ksi
Comp. ⊥ to Grain:	Fc - ⊥ = 625	psi	Fc - ⊥' = 625	psi

Controlling Moment: 2746 ft-lb
9.34 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
Controlling Shear: -1200 lb
At a distance d from right support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Comparisons with required sections:	Req'd	Provided
Section Modulus:	33.28 in3	73.83 in3
Area (Shear):	10 in2	39.38 in2
Moment of Inertia (deflection):	100.32 in4	415.28 in4
Moment:	2746 ft-lb	6091 ft-lb
Shear:	-1200 lb	4725 lb

LOADING DIAGRAM



UNIFORM LOADS Center

Uniform Live Load	0	plf
Uniform Dead Load	0	plf
Beam Self Weight	9	plf
Total Uniform Load	9	plf

POINT LOADS - CENTER SPAN

Load Number	One *	
Live Load	628	lb
Dead Load	255	lb
Location	14.17	ft

* Load obtained from Load Tracker. See Summary Report for details.

TRAPEZOIDAL LOADS - CENTER SPAN

Load Number	One	
Left Live Load	40	plf
Left Dead Load	15	plf
Right Live Load	40	plf
Right Dead Load	15	plf
Load Start	0	ft
Load End	14.17	ft
Load Length	14.17	ft

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: PST-MLBT3-7-MLBT3-8
Column
[2015 International Building Code(2015 NDS)]
3.5 IN x 3.5 IN x 9.08 FT
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 41.1%

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:33 PM

VERTICAL REACTIONS

Live Load:	Vert-LL-Rxn =	2269	lb
Dead Load:	Vert-DL-Rxn =	1007	lb
Total Load:	Vert-TL-Rxn =	3276	lb

COLUMN DATA

Total Column Length:	9.08	ft
Unbraced Length (X-Axis) Lx:	9.08	ft
Unbraced Length (Y-Axis) Ly:	9.08	ft
Column End Condition-K (e):	1	
Axial Load Duration Factor	1.00	

COLUMN PROPERTIES

#2 - Douglas-Fir-Larch

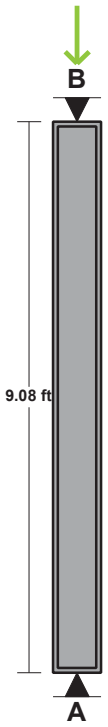
	Base Values	Adjusted
Compressive Stress:	Fc = 1350 psi	Fc' = 454 psi
	Cd=1.00 Cf=1.15 Cp=0.29	
Bending Stress (X-X Axis):	Fbx = 900 psi	Fbx' = 1350 psi
	Cd=1.00 CF=1.50	
Bending Stress (Y-Y Axis):	Fby = 900 psi	Fby' = 1350 psi
	Cd=1.00 CF=1.50	
Modulus of Elasticity:	E = 1600 ksi	E' = 1600 ksi

Column Section (X-X Axis):	dx =	3.5	in
Column Section (Y-Y Axis):	dy =	3.5	in
Area:	A =	12.25	in2
Section Modulus (X-X Axis):	Sx =	7.15	in3
Section Modulus (Y-Y Axis):	Sy =	7.15	in3
Slenderness Ratio:	Lex/dx =	31.13	
	Ley/dy =	31.13	

Column Calculations (Controlling Case Only):
Controlling Load Case: Axial Total Load Only (L + D)

Actual Compressive Stress:	Fc =	267	psi
Allowable Compressive Stress:	Fc' =	454	psi
Eccentricity Moment (X-X Axis):	Mx-ex =	0	ft-lb
Eccentricity Moment (Y-Y Axis):	My-ey =	0	ft-lb
Moment Due to Lateral Loads (X-X Axis):	Mx =	0	ft-lb
Moment Due to Lateral Loads (Y-Y Axis):	My =	0	ft-lb
Bending Stress Lateral Loads Only (X-X Axis):	Fbx =	0	psi
Allowable Bending Stress (X-X Axis):	Fbx' =	1350	psi
Bending Stress Lateral Loads Only (Y-Y Axis):	Fby =	0	psi
Allowable Bending Stress (Y-Y Axis):	Fby' =	1350	psi
Combined Stress Factor:	**CSF =**	**0.59**	

LOADING DIAGRAM



AXIAL LOADING

Live Load:	PL =	2269	lb *
Dead Load:	PD =	983	lb *
Column Self Weight:	CSW =	24	lb
Total Axial Load:	PT =	3276	lb

* Load obtained from Load Tracker. See Summary Report for details.

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: MLBT3-9
Multi-Loaded Multi-Span Beam
[2015 International Building Code(2015 NDS)]
5.5 IN x 15.25 IN x 19.5 FT
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 36.8%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:33 PM

DEFLECTIONS Center

Live Load	0.24	IN L/991
Dead Load	0.12	in
Total Load	0.36	IN L/657

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/240

REACTIONS

	A	B
Live Load	1089 lb	2305 lb
Dead Load	595 lb	1080 lb
Total Load	1684 lb	3385 lb
Bearing Length	0.49 in	0.98 in

BEAM DATA

	Center
Span Length	19.5 ft
Unbraced Length-Top	0 ft
Unbraced Length-Bottom	19.5 ft
Live Load Duration Factor	1.00
Notch Depth	0.00

MATERIAL PROPERTIES

#2 - Douglas-Fir-Larch

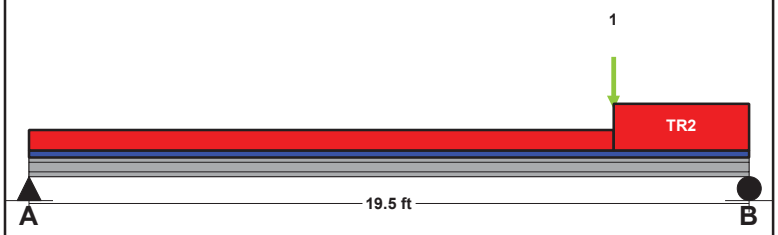
	Base Values	Adjusted
Bending Stress:	Fb = 875 psi	Fb' = 852 psi
	Cd=1.00 CF=0.97	
Shear Stress:	Fv = 170 psi	Fv' = 170 psi
	Cd=1.00	
Modulus of Elasticity:	E = 1300 ksi	E' = 1300 ksi
Comp. ⊥ to Grain:	Fc - ⊥ = 625 psi	Fc - ⊥' = 625 psi

Controlling Moment: 11062 ft-lb
13.06 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Controlling Shear: -3068 lb
At a distance d from right support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Comparisons with required sections:	Req'd	Provided
Section Modulus:	155.8 in3	213.18 in3
Area (Shear):	27.07 in2	83.88 in2
Moment of Inertia (deflection):	593.38 in4	1625.52 in4
Moment:	11062 ft-lb	15136 ft-lb
Shear:	-3068 lb	9506 lb

LOADING DIAGRAM



UNIFORM LOADS Center

Uniform Live Load	0 plf
Uniform Dead Load	0 plf
Beam Self Weight	18 plf
Total Uniform Load	18 plf

POINT LOADS - CENTER SPAN

Load Number	One *
Live Load	1453 lb
Dead Load	592 lb
Location	15.83 ft

* Load obtained from Load Tracker. See Summary Report for details.

TRAPEZOIDAL LOADS - CENTER SPAN

Load Number	One	Two
Left Live Load	80 plf	184 plf
Left Dead Load	30 plf	69 plf
Right Live Load	80 plf	184 plf
Right Dead Load	30 plf	69 plf
Load Start	0 ft	15.83 ft
Load End	15.83 ft	19.5 ft
Load Length	15.83 ft	3.67 ft

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: PST-MLBT3-9B
Column
[2015 International Building Code(2015 NDS)]
(2) 1.5 IN x 5.5 IN x 9.08 FT
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 77.4%

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:34 PM

CAUTIONS
* Laminations to be nailed together per National Design Specifications for Wood Construction Section 15.3.3.1

VERTICAL REACTIONS

Live Load:	Vert-LL-Rxn =	2305	lb
Dead Load:	Vert-DL-Rxn =	1112	lb
Total Load:	Vert-TL-Rxn =	3417	lb

COLUMN DATA

Total Column Length:	9.08	ft
Unbraced Length (X-Axis) Lx:	9.08	ft
Unbraced Length (Y-Axis) Ly:	0	ft
Column End Condition-K (e):	1	
Axial Load Duration Factor	1.00	

COLUMN PROPERTIES
#2 - Douglas-Fir-Larch

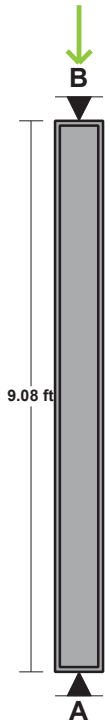
	Base Values	Adjusted
Compressive Stress:	Fc = 1350 psi	Fc' = 918 psi
	Cd=1.00 Cf=1.10 Cp=0.62	
Bending Stress (X-X Axis):	Fbx = 900 psi	Fbx' = 1170 psi
	Cd=1.00 CF=1.30	
Bending Stress (Y-Y Axis):	Fby = 900 psi	Fby' = 1170 psi
	Cd=1.00 CF=1.30	
Modulus of Elasticity:	E = 1600 ksi	E' = 1600 ksi

Column Section (X-X Axis):	dx =	5.5	in
Column Section (Y-Y Axis):	dy =	3	in
Area:	A =	16.5	in2
Section Modulus (X-X Axis):	Sx =	15.13	in3
Section Modulus (Y-Y Axis):	Sy =	4.13	in3
Slenderness Ratio:	Lex/dx =	19.81	
	Ley/dy =	0	

Column Calculations (Controlling Case Only):
Controlling Load Case: Axial Total Load Only (L + D)

Actual Compressive Stress:	Fc =	207	psi
Allowable Compressive Stress:	Fc' =	918	psi
Eccentricity Moment (X-X Axis):	Mx-ex =	0	ft-lb
Eccentricity Moment (Y-Y Axis):	My-ey =	0	ft-lb
Moment Due to Lateral Loads (X-X Axis):	Mx =	0	ft-lb
Moment Due to Lateral Loads (Y-Y Axis):	My =	0	ft-lb
Bending Stress Lateral Loads Only (X-X Axis):	Fbx =	0	psi
Allowable Bending Stress (X-X Axis):	Fbx' =	1170	psi
Bending Stress Lateral Loads Only (Y-Y Axis):	Fby =	0	psi
Allowable Bending Stress (Y-Y Axis):	Fby' =	1170	psi
Combined Stress Factor:	**CSF =**	**0.23**	

LOADING DIAGRAM



AXIAL LOADING

Live Load:	PL =	2305	lb *
Dead Load:	PD =	1080	lb *
Column Self Weight:	CSW =	32	lb
Total Axial Load:	PT =	3417	lb

* Load obtained from Load Tracker. See Summary Report for details.

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: MLB3-3
Multi-Loaded Multi-Span Beam
[2015 International Building Code(2015 NDS)]
3.125 IN x 10.5 IN x 6.33 FT
24F-V4 - Visually Graded Western Species - Dry Use
Section Adequate By: 32.3%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:34 PM

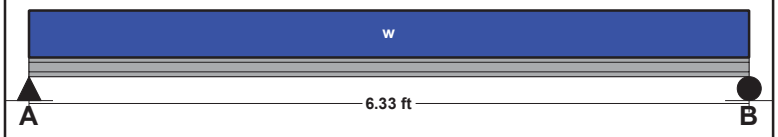
DEFLECTIONS	Center		
Live Load	0.07	IN	L/1075
Dead Load	0.04	in	
Total Load	0.12	IN	L/658

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/240

REACTIONS	A		B	
Live Load	3361	lb	3361	lb
Dead Load	2124	lb	2124	lb
Total Load	5485	lb	5485	lb
Bearing Length	2.70	in	2.70	in

BEAM DATA	Center	
Span Length	6.33	ft
Unbraced Length-Top	0	ft
Unbraced Length-Bottom	6.33	ft
Live Load Duration Factor	1.00	
Camber Adj. Factor	1	
Camber Required	0.04	
Notch Depth	0.00	

LOADING DIAGRAM



UNIFORM LOADS	Center*	
Uniform Live Load	1062	plf
Uniform Dead Load	664	plf
Beam Self Weight	7	plf
Total Uniform Load	1733	plf

* Load obtained from Load Tracker. See Summary Report for details.

MATERIAL PROPERTIES

24F-V4 - Visually Graded Western Species

		Base Values		Adjusted	
Bending Stress:	Fb =	2400	psi	*Controlled by:*	
	Fb_cmpr =	1850	psi	Fb' =	2400 psi
	Cd=1.00				
Shear Stress:	Fv =	265	psi	Fv' =	265 psi
	Cd=1.00				
Modulus of Elasticity:	E =	1800	ksi	E' =	1800 ksi
Comp. ⊥ to Grain:	Fc - ⊥ =	650	psi	Fc - ⊥' =	650 psi

Controlling Moment: 8680 ft-lb
3.16 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
Controlling Shear: -4059 lb
At a distance d from right support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Comparisons with required sections:	Req'd		Provided	
Section Modulus:	43.4	in3	57.42	in3
Area (Shear):	22.98	in2	32.81	in2
Moment of Inertia (deflection):	109.88	in4	301.46	in4
Moment:	8680	ft-lb	11484	ft-lb
Shear:	-4059	lb	5797	lb

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: MLB3-4
Multi-Loaded Multi-Span Beam
[2015 International Building Code(2015 NDS)]
3.5 IN x 7.25 IN x 4.33 FT
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 30.1%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:34 PM

DEFLECTIONS	Center	
Live Load	0.03	IN L/1984
Dead Load	0.02	in
Total Load	0.04	IN L/1192

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/240

REACTIONS	A	B
Live Load	1275 lb	1275 lb
Dead Load	848 lb	848 lb
Total Load	2123 lb	2123 lb
Bearing Length	0.97 in	0.97 in

BEAM DATA	Center
Span Length	4.33 ft
Unbraced Length-Top	0 ft
Unbraced Length-Bottom	4.33 ft
Live Load Duration Factor	1.00
Notch Depth	0.00

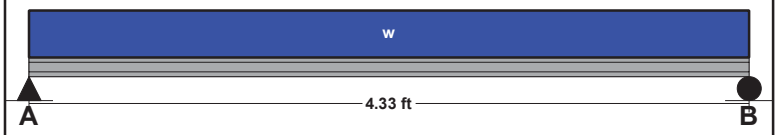
MATERIAL PROPERTIES
#2 - Douglas-Fir-Larch

	Base Values		Adjusted	
Bending Stress:	Fb = 900	psi	Fb' = 1170	psi
	Cd=1.00 CF=1.30			
Shear Stress:	Fv = 180	psi	Fv' = 180	psi
	Cd=1.00			
Modulus of Elasticity:	E = 1600	ksi	E' = 1600	ksi
Comp. ⊥ to Grain:	Fc - ⊥ = 625	psi	Fc - ⊥' = 625	psi

Controlling Moment: 2298 ft-lb
2.16 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
Controlling Shear: -1571 lb
At a distance d from right support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Comparisons with required sections:	Req'd	Provided
Section Modulus:	23.57 in3	30.66 in3
Area (Shear):	13.09 in2	25.38 in2
Moment of Inertia (deflection):	22.38 in4	111.15 in4
Moment:	2298 ft-lb	2989 ft-lb
Shear:	-1571 lb	3045 lb

LOADING DIAGRAM



UNIFORM LOADS	Center*	
Uniform Live Load	589	plf
Uniform Dead Load	386	plf
Beam Self Weight	6	plf
Total Uniform Load	981	plf

* Load obtained from Load Tracker. See Summary Report for details.

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: WALL2-EXT-1
Wall
[2015 International Building Code(2015 NDS)]
1.5 IN x 5.5 IN x 9.08 FT @ 16 O.C.
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 83.2%
Controlling Factor: Combined Stress Factor

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

page of

StruCalc Version 10.0.1.6 6/21/2019 4:03:35 PM

DEFLECTIONS

Deflection due to lateral loads only:	Defl = 0.09	IN = L/1170
Live Load Deflection Criteria:		L/180

VERTICAL REACTIONS

Live Load:	Vert-LL-Rxn =	648	lb
Dead Load:	Vert-DL-Rxn =	571	lb
Total Load:	Vert-TL-Rxn =	1220	lb

HORIZONTAL REACTIONS

Total Reaction at Top of Column:	TL-Rxn-Top =	92	lb
Total Reaction at Bottom of Column:	TL-Rxn-Bottom =	92	lb

WALL DATA

Total Stud Length:	9.08	ft
Wall Dead Weight:	11	psf
Unbraced Length (X-Axis) Lx:	9.08	ft
Unbraced Length (Y-Axis) Ly:	0	ft
Stud End Condition-K (e):	1	
Axial Load Duration Factor	1.00	
Lateral Load Duration Factor (Wind/Seismic)	1.60	

STUD PROPERTIES

#2 - Douglas-Fir-Larch

	Base Values	Adjusted
Compressive Stress:	Fc = 1350 psi	Fc' = 1049 psi
	Cd=1.60 Cf=1.10 Cp=0.44	
Bending Stress (X-X Axis):	Fbx = 900 psi	Fbx' = 2153 psi
	Cd=1.60 CF=1.30 Cr=1.15 Cl=1.00	
Bending Stress (Y-Y Axis):	Fby = 900 psi	Fby' = 2153 psi
	Cd=1.60 CF=1.30 Cr=1.15	
Modulus of Elasticity:	E = 1600 ksi	E' = 1600 ksi

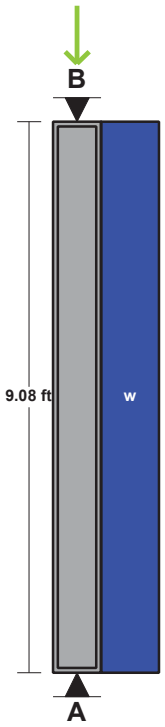
Stud Section (X-X Axis):	dx =	5.5	in
Stud Section (Y-Y Axis):	dy =	1.5	in
Area:	A =	8.25	in2
Section Modulus (X-X Axis):	Sx =	7.56	in3
Section Modulus (Y-Y Axis):	Sy =	2.06	in3
Slenderness Ratio:	Lex/dx =	19.81	
	Ley/dy =	0	

Stud Calculations (Controlling Case Only):

Controlling Load Case: Axial Dead Load and Lateral loads (D + W or E)

Actual Compressive Stress:	Fc =	69	psi
Allowable Compressive Stress:	Fc' =	1049	psi
Eccentricity Moment (X-X Axis):	Mx-ex =	0	ft-lb
Eccentricity Moment (Y-Y Axis):	My-ey =	0	ft-lb
Moment Due to Lateral Loads (X-X Axis):	Mx =	209	ft-lb
Moment Due to Lateral Loads (Y-Y Axis):	My =	0	ft-lb
Bending Stress Lateral Loads Only (X-X Axis):	Fbx =	331	psi
Allowable Bending Stress (X-X Axis):	Fbx' =	2153	psi
Bending Stress Lateral Loads Only (Y-Y Axis):	Fby =	0	psi
Allowable Bending Stress (Y-Y Axis):	Fby' =	2153	psi
Combined Stress Factor:	**CSF =**	**0.17**	

LOADING DIAGRAM



WALL LOAD CALCULATOR

	Live Load	Dead Load	Tributary Width
Load Tracker:	LL = 0 plf	DL = 0 plf	
Roof:	LL = 25 psf	DL = 15 psf	TA = 8.3 ft
Upper Floor:	LL = 40 psf	DL = 15 psf	TA = 7 ft
Upper Floor Height:	9.1 ft		
Middle Floor:	LL = 40 psf	DL = 15 psf	TA = 0 ft
Middle Floor Height:	0 ft		
Calculated Load:	**LL =486.3 plf**	**DL =428.5 plf**	

AXIAL LOADING

Live Load:	PL =	486 plf
Dead Load:	PD =	429 plf
Total Axial Load:	PT =	915 plf

LATERAL LOADING (Dy Face)

Uniform Lateral Load:	wL-Lat =	15 psf

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: WALL2-EXT-2
Wall
[2015 International Building Code(2015 NDS)]
1.5 IN x 5.5 IN x 9.08 FT @ 16 O.C.
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 84.1%
Controlling Factor: Combined Stress Factor

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:35 PM

DEFLECTIONS

Deflection due to lateral loads only:	Defl = 0.09	IN = L/1170
Live Load Deflection Criteria:		L/180

VERTICAL REACTIONS

Live Load:	Vert-LL-Rxn =	0	lb
Dead Load:	Vert-DL-Rxn =	266	lb
Total Load:	Vert-TL-Rxn =	266	lb

HORIZONTAL REACTIONS

Total Reaction at Top of Column:	TL-Rxn-Top =	92	lb
Total Reaction at Bottom of Column:	TL-Rxn-Bottom =	92	lb

WALL DATA

Total Stud Length:	9.08	ft
Wall Dead Weight:	11	psf
Unbraced Length (X-Axis) Lx:	9.08	ft
Unbraced Length (Y-Axis) Ly:	0	ft
Stud End Condition-K (e):	1	
Axial Load Duration Factor	1.00	
Lateral Load Duration Factor (Wind/Seismic)	1.60	

STUD PROPERTIES

#2 - Douglas-Fir-Larch

	Base Values	Adjusted
Compressive Stress:	Fc = 1350 psi	Fc' = 1049 psi
	Cd=1.60 Cf=1.10 Cp=0.44	
Bending Stress (X-X Axis):	Fbx = 900 psi	Fbx' = 2153 psi
	Cd=1.60 CF=1.30 Cr=1.15 Cl=1.00	
Bending Stress (Y-Y Axis):	Fby = 900 psi	Fby' = 2153 psi
	Cd=1.60 CF=1.30 Cr=1.15	
Modulus of Elasticity:	E = 1600 ksi	E' = 1600 ksi

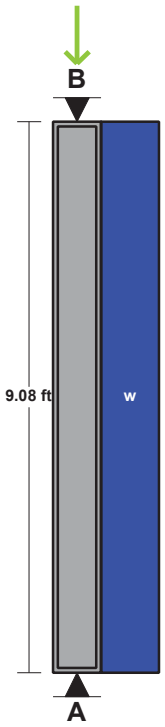
Stud Section (X-X Axis):	dx =	5.5	in
Stud Section (Y-Y Axis):	dy =	1.5	in
Area:	A =	8.25	in2
Section Modulus (X-X Axis):	Sx =	7.56	in3
Section Modulus (Y-Y Axis):	Sy =	2.06	in3
Slenderness Ratio:	Lex/dx =	19.81	
	Ley/dy =	0	

Stud Calculations (Controlling Case Only):

Controlling Load Case: Axial Dead Load and Lateral loads (D + W or E)

Actual Compressive Stress:	Fc =	32	psi
Allowable Compressive Stress:	Fc' =	1049	psi
Eccentricity Moment (X-X Axis):	Mx-ex =	0	ft-lb
Eccentricity Moment (Y-Y Axis):	My-ey =	0	ft-lb
Moment Due to Lateral Loads (X-X Axis):	Mx =	209	ft-lb
Moment Due to Lateral Loads (Y-Y Axis):	My =	0	ft-lb
Bending Stress Lateral Loads Only (X-X Axis):	Fbx =	331	psi
Allowable Bending Stress (X-X Axis):	Fbx' =	2153	psi
Bending Stress Lateral Loads Only (Y-Y Axis):	Fby =	0	psi
Allowable Bending Stress (Y-Y Axis):	Fby' =	2153	psi
Combined Stress Factor:	**CSF =**	**0.16**	

LOADING DIAGRAM



WALL LOAD CALCULATOR

	Live Load		Dead Load		Tributary Width	
Load Tracker:	LL = 0	plf	DL = 0	plf		
Roof:	LL = 25	psf	DL = 15	psf	TA = 0	ft
Upper Floor:	LL = 40	psf	DL = 15	psf	TA = 0	ft
Upper Floor Height:	9.1	ft				
Middle Floor:	LL = 40	psf	DL = 15	psf	TA = 0	ft
Middle Floor Height:	0	ft				
Calculated Load:	**LL = 0**	**plf**	**DL = 199.8**	**plf**		

AXIAL LOADING

Live Load:	PL = 0	plf *
Dead Load:	PD = 200	plf *
Total Axial Load:	PT = 200	plf

* Load obtained from Load Tracker. See Summary Report for details.

LATERAL LOADING (Dy Face)

Uniform Lateral Load: wL-Lat = 15 psf

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: DJST2-1
Floor Joist
[2015 International Building Code(2015 NDS)]
1.5 IN x 9.25 IN x 7.75 FT Pressure Treated @ 16 O.C.
#2 - Hem-Fir - Dry Use
Section Adequate By: 104.2%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

page of

StruCalc Version 10.0.1.6 6/21/2019 4:03:36 PM

DEFLECTIONS Center

Live Load	0.05	IN L/1750
Dead Load	0.01	in
Total Load	0.07	IN L/1400

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/240

REACTIONS

	A		B	
Live Load	310	lb	310	lb
Dead Load	78	lb	78	lb
Total Load	388	lb	388	lb
Bearing Length	0.64	in	0.64	in

SUPPORT LOADS

	A		B	
Live Load	233	plf	233	plf
Dead Load	59	plf	59	plf
Total Load	291	plf	291	plf

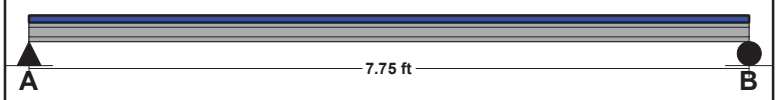
MATERIAL PROPERTIES
#2 - Hem-Fir

	Base Values		Adjusted	
Bending Stress:	Fb = 850	psi	Fb' = 860	psi
	Cd=1.00 CF=1.10 Cr=1.15 Ci=0.80			
Shear Stress:	Fv = 150	psi	Fv' = 120	psi
	Cd=1.00 Ci=0.80			
Modulus of Elasticity:	E = 1300	ksi	E' = 1235	ksi
	Ci=0.95			
Comp. ⊥ to Grain:	Fc - ⊥ = 405	psi	Fc - ⊥' = 405	psi

Controlling Moment: 751 ft-lb
3.88 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
Controlling Shear: 318 lb
At a distance d from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Comparisons with required sections:	Req'd		Provided	
Section Modulus:	10.47	in3	21.39	in3
Area (Shear):	3.97	in2	13.88	in2
Moment of Inertia (deflection):	20.35	in4	98.93	in4
Moment:	751	ft-lb	1533	ft-lb
Shear:	318	lb	1110	lb

LOADING DIAGRAM



JOIST DATA Center

Span Length	7.75	ft
Unbraced Length-Top	0	ft
Unbraced Length-Bottom	0	ft

Floor sheathing applied to top of joists-top of joists fully braced.
Floor Duration Factor 1.00

JOIST LOADING

Uniform Floor Loading		Center	
Live Load	LL =	60	psf
Dead Load	DL =	15	psf
Total Load	TL =	75	psf
TL Adj. For Joist Spacing	wT =	100	plf

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: MLBD-2-1
Multi-Loaded Multi-Span Beam
[2015 International Building Code(2015 NDS)]
3.5 IN x 9.25 IN x 8.83 FT Pressure Treated
#2 - Hem-Fir - Dry Use
Section Adequate By: 16.8%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

page of

StruCalc Version 10.0.1.6 6/21/2019 4:03:36 PM

DEFLECTIONS Center

Live Load	0.11	IN L/948
Dead Load	0.03	in
Total Load	0.14	IN L/741

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/240

REACTIONS A B

	A		B	
Live Load	1029	lb	1029	lb
Dead Load	287	lb	287	lb
Total Load	1316	lb	1316	lb
Bearing Length	0.93	in	0.93	in

BEAM DATA Center

Span Length	8.83	ft
Unbraced Length-Top	0	ft
Unbraced Length-Bottom	8.83	ft
Live Load Duration Factor	1.00	
Notch Depth	0.00	

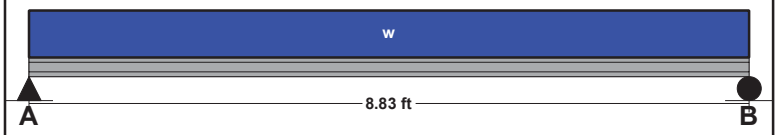
MATERIAL PROPERTIES
#2 - Hem-Fir

	Base Values		Adjusted	
Bending Stress:	Fb = 850	psi	Fb' = 816	psi
	Cd=1.00 CF=1.20 Ci=0.80			
Shear Stress:	Fv = 150	psi	Fv' = 120	psi
	Cd=1.00 Ci=0.80			
Modulus of Elasticity:	E = 1300	ksi	E' = 1235	ksi
	Ci=0.95			
Comp. ⊥ to Grain:	Fc - ⊥ = 405	psi	Fc - ⊥' = 405	psi

Controlling Moment: 2905 ft-lb
4.41 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
Controlling Shear: 1105 lb
At a distance d from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Comparisons with required sections:	Req'd		Provided	
Section Modulus:	42.72	in3	49.91	in3
Area (Shear):	13.82	in2	32.38	in2
Moment of Inertia (deflection):	87.66	in4	230.84	in4
Moment:	2905	ft-lb	3394	ft-lb
Shear:	1105	lb	2590	lb

LOADING DIAGRAM



UNIFORM LOADS Center*

Uniform Live Load	233	plf
Uniform Dead Load	59	plf
Beam Self Weight	6	plf
Total Uniform Load	298	plf

* Load obtained from Load Tracker. See Summary Report for details.

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: FJT3-7
Floor Joist
[2015 International Building Code(2015 NDS)]
5.5 IN x 15.5 IN x 19.5 FT (5 + 14.5) @ 24 O.C.
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 563.4%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:36 PM

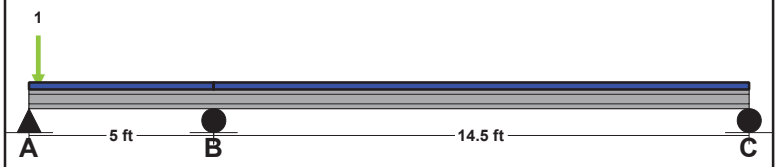
DEFLECTIONS	Left		Center	
Live Load	0.00	IN L/MAX	0.02	IN L/8651
Dead Load	0.00	in	0.01	in
Total Load	0.00	IN L/MAX	0.03	IN L/6422

Live Load Deflection Criteria: L/480 Total Load Deflection Criteria: L/360

REACTIONS	A	B	C
Live Load	1455 lb	1296 lb	472 lb
Dead Load	929 lb	517 lb	173 lb
Total Load	2384 lb	1813 lb	645 lb
Bearing Length	0.69 in	0.53 in	0.19 in

SUPPORT LOADS	A	B	C
Live Load	728 plf	648 plf	236 plf
Dead Load	465 plf	259 plf	87 plf
Total Load	1192 plf	907 plf	323 plf

LOADING DIAGRAM



MATERIAL PROPERTIES

#2 - Douglas-Fir-Larch

	Base Values		Adjusted	
Bending Stress:	Fb = 875 psi		Fb' = 836 psi	
	Cd=1.00 Cl=0.98 CF=0.97			
Shear Stress:	Fv = 170 psi		Fv' = 170 psi	
	Cd=1.00			
Modulus of Elasticity:	E = 1300 ksi		E' = 1300 ksi	
Comp. ⊥ to Grain:	Fc - ⊥ = 625 psi		Fc - ⊥' = 625 psi	

Controlling Moment: -2314 ft-lb
Over left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 1, 2
Controlling Shear: -904 lb
At a distance d from left support of span 1 (Left Span)
Created by combining all dead loads and live loads on span(s) 1, 2

Comparisons with required sections:	Req'd	Provided
Section Modulus:	33.19 in3	220.23 in3
Area (Shear):	7.98 in2	85.25 in2
Moment of Inertia (deflection):	95.68 in4	1706.78 in4
Moment:	-2314 ft-lb	15351 ft-lb
Shear:	-904 lb	9662 lb

JOIST DATA	Left	Center
Span Length	5 ft	14.5 ft
Unbraced Length-Top	0 ft	0 ft
Unbraced Length-Bottom	0 ft	0 ft

Floor sheathing applied to top of joists-top of joists fully braced.
Floor Duration Factor 1.00

JOIST LOADING		Left	Center
Uniform Floor Loading			
Live Load	LL =	40 psf	40 psf
Dead Load	DL =	15 psf	15 psf
Total Load	TL =	55 psf	55 psf
TL Adj. For Joist Spacing	wT =	110 plf	110 plf
Wall Loading			
Wall One			
Live Load (⊥ to Joists):	L1 =	672 plf	0 plf
Dead Load (⊥ to Joists)	D1 =	517 plf	0 plf
Load Location	X1 =	0.25 ft	0 ft

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: MLB2-1
Multi-Loaded Multi-Span Beam
[2015 International Building Code(2015 NDS)]
3.5 IN x 7.25 IN x 2.5 FT
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 459.0%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:37 PM

DEFLECTIONS Center

Live Load	0.00	IN L/MAX
Dead Load	0.00	in
Total Load	0.00	IN L/8869

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/240

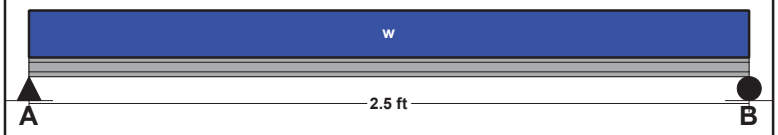
REACTIONS A B

Live Load	618	lb	618	lb
Dead Load	238	lb	238	lb
Total Load	856	lb	856	lb
Bearing Length	0.39	in	0.39	in

BEAM DATA Center

Span Length	2.5	ft
Unbraced Length-Top	0	ft
Unbraced Length-Bottom	2.5	ft
Live Load Duration Factor	1.00	
Notch Depth	0.00	

LOADING DIAGRAM



UNIFORM LOADS Center*

Uniform Live Load	494	plf
Uniform Dead Load	185	plf
Beam Self Weight	6	plf
Total Uniform Load	685	plf

* Load obtained from Load Tracker. See Summary Report for details.

MATERIAL PROPERTIES

#2 - Douglas-Fir-Larch

	Base Values		Adjusted	
Bending Stress:	Fb = 900 psi		Fb' = 1170	psi
	Cd=1.00 CF=1.30			
Shear Stress:	Fv = 180 psi		Fv' = 180	psi
	Cd=1.00			
Modulus of Elasticity:	E = 1600 ksi		E' = 1600	ksi
Comp. ⊥ to Grain:	Fc - ⊥ = 625 psi		Fc - ⊥' = 625	psi

Controlling Moment: 535 ft-lb
1.25 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
Controlling Shear: 445 lb
At a distance d from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Comparisons with required sections:	Req'd	Provided
Section Modulus:	5.48 in3	30.66 in3
Area (Shear):	3.71 in2	25.38 in2
Moment of Inertia (deflection):	3.26 in4	111.15 in4
Moment:	535 ft-lb	2989 ft-lb
Shear:	445 lb	3045 lb

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: MLB2-2
Multi-Loaded Multi-Span Beam
[2015 International Building Code(2015 NDS)]
3.5 IN x 7.25 IN x 2.5 FT
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 445.5%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:37 PM

DEFLECTIONS Center

Live Load	0.00	IN L/MAX
Dead Load	0.00	in
Total Load	0.00	IN L/8654

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/240

REACTIONS

	A		B	
Live Load	633	lb	633	lb
Dead Load	244	lb	244	lb
Total Load	877	lb	877	lb
Bearing Length	0.40	in	0.40	in

BEAM DATA Center

Span Length	2.5	ft
Unbraced Length-Top	0	ft
Unbraced Length-Bottom	2.5	ft
Live Load Duration Factor	1.00	
Notch Depth	0.00	

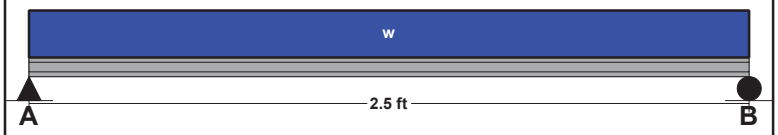
MATERIAL PROPERTIES
#2 - Douglas-Fir-Larch

	Base Values		Adjusted	
Bending Stress:	Fb = 900	psi	Fb' = 1170	psi
	Cd=1.00 CF=1.30			
Shear Stress:	Fv = 180	psi	Fv' = 180	psi
	Cd=1.00			
Modulus of Elasticity:	E = 1600	ksi	E' = 1600	ksi
Comp. ⊥ to Grain:	Fc - ⊥ = 625	psi	Fc - ⊥' = 625	psi

Controlling Moment: 548 ft-lb
1.25 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
Controlling Shear: -456 lb
At a distance d from right support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Comparisons with required sections:	Req'd		Provided	
Section Modulus:	5.62	in3	30.66	in3
Area (Shear):	3.8	in2	25.38	in2
Moment of Inertia (deflection):	3.33	in4	111.15	in4
Moment:	548	ft-lb	2989	ft-lb
Shear:	-456	lb	3045	lb

LOADING DIAGRAM



UNIFORM LOADS Center*

Uniform Live Load	506	plf
Uniform Dead Load	190	plf
Beam Self Weight	6	plf
Total Uniform Load	702	plf

* Load obtained from Load Tracker. See Summary Report for details.

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: MLB2-3
Multi-Loaded Multi-Span Beam
[2015 International Building Code(2015 NDS)]
3.5 IN x 7.25 IN x 2.67 FT
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 131.3%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:38 PM

DEFLECTIONS	Center	
Live Load	0.01	IN L/5782
Dead Load	0.00	in
Total Load	0.01	IN L/3436

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/240

REACTIONS	A	B
Live Load	1151 lb	1151 lb
Dead Load	786 lb	786 lb
Total Load	1937 lb	1937 lb
Bearing Length	0.89 in	0.89 in

BEAM DATA	Center
Span Length	2.67 ft
Unbraced Length-Top	0 ft
Unbraced Length-Bottom	2.67 ft
Live Load Duration Factor	1.00
Notch Depth	0.00

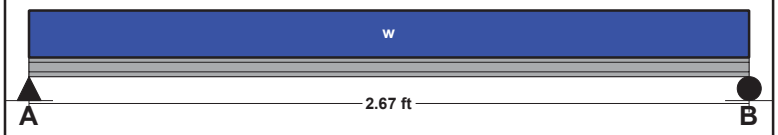
MATERIAL PROPERTIES
#2 - Douglas-Fir-Larch

	Base Values		Adjusted	
Bending Stress:	Fb = 900 psi		Fb' = 1170 psi	
	Cd=1.00 CF=1.30			
Shear Stress:	Fv = 180 psi		Fv' = 180 psi	
	Cd=1.00			
Modulus of Elasticity:	E = 1600 ksi		E' = 1600 ksi	
Comp. ⊥ to Grain:	Fc - ⊥ = 625 psi		Fc - ⊥' = 625 psi	

Controlling Moment: 1293 ft-lb
1.34 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
Controlling Shear: -1084 lb
At a distance d from right support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Comparisons with required sections:	Req'd	Provided
Section Modulus:	13.26 in3	30.66 in3
Area (Shear):	9.04 in2	25.38 in2
Moment of Inertia (deflection):	7.76 in4	111.15 in4
Moment:	1293 ft-lb	2989 ft-lb
Shear:	-1084 lb	3045 lb

LOADING DIAGRAM



UNIFORM LOADS	Center*
Uniform Live Load	862 plf
Uniform Dead Load	583 plf
Beam Self Weight	6 plf
Total Uniform Load	1451 plf

* Load obtained from Load Tracker. See Summary Report for details.

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: MLB2-5
Multi-Loaded Multi-Span Beam
[2015 International Building Code(2015 NDS)]
3.5 IN x 11.25 IN x 13.67 FT (12 + 1.7)
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 381.2%
Controlling Factor: Deflection

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:38 PM

DEFLECTIONS	Center		Right	
Live Load	0.05	IN L/2772	-0.02	IN 2L/1732
Dead Load	-0.02	in	0.01	in
Total Load	0.03	IN L/5228	-0.01	IN 2L/3154

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/240

REACTIONS	A		B	
Live Load	444	lb	576	lb
Dead Load	-215	lb	-284	lb
Total Load	229	lb	292	lb
Uplift (1.5 F.S)	**-223**	**lb**	**-284**	**lb**
Bearing Length	0.10	in	0.13	in

BEAM DATA	Center		Right	
Span Length	12	ft	1.67	ft
Unbraced Length-Top	0	ft	0	ft
Unbraced Length-Bottom	12	ft	1.67	ft
Live Load Duration Factor	1.00			
Notch Depth	0.00			

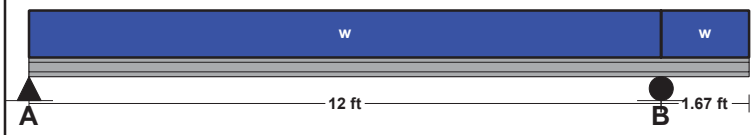
MATERIAL PROPERTIES
#2 - Douglas-Fir-Larch

	Base Values		Adjusted	
Bending Stress:	Fb = 900	psi	Fb' = 872	psi
	Cd=0.90 Cl=0.98 CF=1.10			
Shear Stress:	Fv = 180	psi	Fv' = 162	psi
	Cd=0.90			
Modulus of Elasticity:	E = 1600	ksi	E' = 1600	ksi
Comp. ⊥ to Grain:	Fc - ⊥ = 625	psi	Fc - ⊥' = 625	psi

Controlling Moment: -631 ft-lb
5.88 Ft from left support of span 2 (Center Span)
Created by dead loads only on all span(s).
Controlling Shear: 192 lb
At a distance d from right support of span 2 (Center Span)
Created by dead loads only on all span(s).

Comparisons with required sections:	Req'd		Provided	
Section Modulus:	8.69	in3	73.83	in3
Area (Shear):	1.78	in2	39.38	in2
Moment of Inertia (deflection):	86.31	in4	415.28	in4
Moment:	-631	ft-lb	5362	ft-lb
Shear:	192	lb	4253	lb

LOADING DIAGRAM



UNIFORM LOADS	Center*		Right*	
Uniform Live Load	74	plf	74	plf
Uniform Dead Load	-45	plf	-45	plf
Beam Self Weight	9	plf	9	plf
Total Uniform Load	38	plf	38	plf

* Load obtained from Load Tracker. See Summary Report for details.

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: JST2-11
Floor Joist
[2015 International Building Code(2015 NDS)]
1.5 IN x 11.25 IN x 3.42 FT @ 16 O.C.
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 2445.3%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:39 PM

DEFLECTIONS Center

Live Load	0.00	IN L/MAX
Dead Load	0.00	in
Total Load	0.00	IN L/MAX

Live Load Deflection Criteria: L/480 Total Load Deflection Criteria: L/360

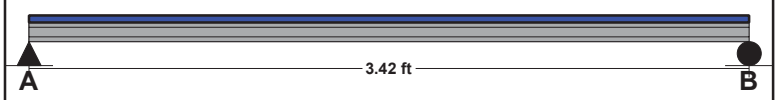
REACTIONS A B

Live Load	91	lb	91	lb
Dead Load	34	lb	34	lb
Total Load	125	lb	125	lb
Bearing Length	0.13	in	0.13	in

SUPPORT LOADS A B

Live Load	68	plf	68	plf
Dead Load	26	plf	26	plf
Total Load	94	plf	94	plf

LOADING DIAGRAM



MATERIAL PROPERTIES
#2 - Douglas-Fir-Larch

	Base Values		Adjusted	
Bending Stress:	Fb = 900	psi	Fb' = 1035	psi
	Cd=1.00 CF=1.00 Cr=1.15			
Shear Stress:	Fv = 180	psi	Fv' = 180	psi
	Cd=1.00			
Modulus of Elasticity:	E = 1600	ksi	E' = 1600	ksi
Comp. ⊥ to Grain:	Fc - ⊥ = 625	psi	Fc - ⊥' = 625	psi

Controlling Moment: 107 ft-lb
1.71 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
Controlling Shear: -58 lb
At a distance d from right support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

JOIST DATA Center

Span Length	3.42	ft
Unbraced Length-Top	0	ft
Unbraced Length-Bottom	0	ft

Floor sheathing applied to top of joists-top of joists fully braced.
Floor Duration Factor 1.00

JOIST LOADING
Uniform Floor Loading Center

Live Load	LL =	40	psf
Dead Load	DL =	15	psf
Total Load	TL =	55	psf
TL Adj. For Joist Spacing	wT =	73.3	plf

Comparisons with required sections:

	Req'd	Provided
Section Modulus:	1.24 in3	31.64 in3
Area (Shear):	0.48 in2	16.88 in2
Moment of Inertia (deflection):	1.24 in4	177.98 in4
Moment:	107 ft-lb	2729 ft-lb
Shear:	-58 lb	2025 lb

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: JST2-10
Floor Joist
[2015 International Building Code(2015 NDS)]
1.5 IN x 11.25 IN x 15.67 FT @ 16 O.C.
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 21.2%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:39 PM

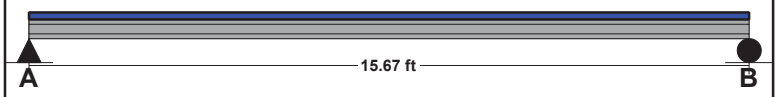
DEFLECTIONS	Center	
Live Load	0.25	IN L/740
Dead Load	0.10	in
Total Load	0.35	IN L/538

Live Load Deflection Criteria: L/480 Total Load Deflection Criteria: L/360

REACTIONS	A		B	
Live Load	418	lb	418	lb
Dead Load	157	lb	157	lb
Total Load	575	lb	575	lb
Bearing Length	0.61	in	0.61	in

SUPPORT LOADS	A		B	
Live Load	314	plf	314	plf
Dead Load	118	plf	118	plf
Total Load	431	plf	431	plf

LOADING DIAGRAM



MATERIAL PROPERTIES

#2 - Douglas-Fir-Larch

	Base Values		Adjusted	
Bending Stress:	Fb = 900	psi	Fb' = 1035	psi
	Cd=1.00 CF=1.00 Cr=1.15			
Shear Stress:	Fv = 180	psi	Fv' = 180	psi
	Cd=1.00			
Modulus of Elasticity:	E = 1600	ksi	E' = 1600	ksi
Comp. ⊥ to Grain:	Fc - ⊥ = 625	psi	Fc - ⊥' = 625	psi

Controlling Moment: 2251 ft-lb
7.84 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
Controlling Shear: -517 lb
At a distance d from right support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Comparisons with required sections:	Req'd	Provided
Section Modulus:	26.1 in3	31.64 in3
Area (Shear):	4.31 in2	16.88 in2
Moment of Inertia (deflection):	119.02 in4	177.98 in4
Moment:	2251 ft-lb	2729 ft-lb
Shear:	-517 lb	2025 lb

JOIST DATA	Center	
Span Length	15.67	ft
Unbraced Length-Top	0	ft
Unbraced Length-Bottom	0	ft

Floor sheathing applied to top of joists-top of joists fully braced.
Floor Duration Factor 1.00

JOIST LOADING

Uniform Floor Loading		Center	
Live Load	LL =	40	psf
Dead Load	DL =	15	psf
Total Load	TL =	55	psf
TL Adj. For Joist Spacing	wT =	73.3	plf

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: PST-MLB2-6B
Column
[2015 International Building Code(2015 NDS)]
3.5 IN x 5.5 IN x 12.0 FT
#1 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 6.5%

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:40 PM

VERTICAL REACTIONS

Live Load:	Vert-LL-Rxn =	3724	lb
Dead Load:	Vert-DL-Rxn =	1477	lb
Total Load:	Vert-TL-Rxn =	5201	lb

COLUMN DATA

Total Column Length:	12	ft
Unbraced Length (X-Axis) Lx:	12	ft
Unbraced Length (Y-Axis) Ly:	12	ft
Column End Condition-K (e):	1	
Axial Load Duration Factor	1.00	

COLUMN PROPERTIES

#1 - Douglas-Fir-Larch

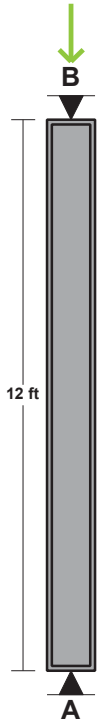
	Base Values	Adjusted
Compressive Stress:	Fc = 1500 psi	Fc' = 289 psi
	Cd=1.00 Cf=1.10 Cp=0.18	
Bending Stress (X-X Axis):	Fbx = 1000 psi	Fbx' = 1300 psi
	Cd=1.00 CF=1.30	
Bending Stress (Y-Y Axis):	Fby = 1000 psi	Fby' = 1300 psi
	Cd=1.00 CF=1.30	
Modulus of Elasticity:	E = 1700 ksi	E' = 1700 ksi

Column Section (X-X Axis):	dx =	5.5	in
Column Section (Y-Y Axis):	dy =	3.5	in
Area:	A =	19.25	in2
Section Modulus (X-X Axis):	Sx =	17.65	in3
Section Modulus (Y-Y Axis):	Sy =	11.23	in3
Slenderness Ratio:	Lex/dx =	26.18	
	Ley/dy =	41.14	

Column Calculations (Controlling Case Only):
Controlling Load Case: Axial Total Load Only (L + D)

Actual Compressive Stress:	Fc =	270	psi
Allowable Compressive Stress:	Fc' =	289	psi
Eccentricity Moment (X-X Axis):	Mx-ex =	0	ft-lb
Eccentricity Moment (Y-Y Axis):	My-ey =	0	ft-lb
Moment Due to Lateral Loads (X-X Axis):	Mx =	0	ft-lb
Moment Due to Lateral Loads (Y-Y Axis):	My =	0	ft-lb
Bending Stress Lateral Loads Only (X-X Axis):	Fbx =	0	psi
Allowable Bending Stress (X-X Axis):	Fbx' =	1300	psi
Bending Stress Lateral Loads Only (Y-Y Axis):	Fby =	0	psi
Allowable Bending Stress (Y-Y Axis):	Fby' =	1300	psi
Combined Stress Factor:	**CSF =**	**0.94**	

LOADING DIAGRAM



AXIAL LOADING

Live Load:	PL =	3724	lb *
Dead Load:	PD =	1427	lb *
Column Self Weight:	CSW =	50	lb
Total Axial Load:	PT =	5201	lb

* Load obtained from Load Tracker. See Summary Report for details.

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: MLB2-7
Multi-Loaded Multi-Span Beam
[2015 International Building Code(2015 NDS)]
3.125 IN x 10.5 IN x 7.33 FT
24F-V4 - Visually Graded Western Species - Dry Use
Section Adequate By: 864.2%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

page of

StruCalc Version 10.0.1.6 6/21/2019 4:03:40 PM

DEFLECTIONS Center

Live Load	0.02	IN L/5072
Dead Load	0.00	in
Total Load	0.02	IN L/4754

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/240

REACTIONS

	A	B
Live Load	382 lb	393 lb
Dead Load	53 lb	52 lb
Total Load	435 lb	445 lb
Bearing Length	0.21 in	0.22 in

BEAM DATA Center

Span Length	7.33 ft
Unbraced Length-Top	0 ft
Unbraced Length-Bottom	7.33 ft
Live Load Duration Factor	1.00
Camber Adj. Factor	1.5
Camber Required	0
Notch Depth	0.00

MATERIAL PROPERTIES

24F-V4 - Visually Graded Western Species

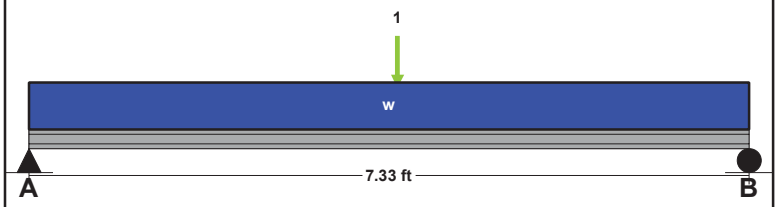
	Base Values		Adjusted	
Bending Stress:	Fb =	2400 psi	*Controlled by:*	
	Fb_cmpr =	1850 psi	Fb' =	2400 psi
	Cd=1.00			
Shear Stress:	Fv =	265 psi	Fv' =	265 psi
	Cd=1.00			
Modulus of Elasticity:	E =	1800 ksi	E' =	1800 ksi
Comp. ⊥ to Grain:	Fc - ⊥ =	650 psi	Fc - ⊥' =	650 psi

Controlling Moment: 1191 ft-lb
3.74 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Controlling Shear: -394 lb
At a distance d from right support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Comparisons with required sections:	Req'd	Provided
Section Modulus:	5.96 in3	57.42 in3
Area (Shear):	2.23 in2	32.81 in2
Moment of Inertia (deflection):	21.4 in4	301.46 in4
Moment:	1191 ft-lb	11484 ft-lb
Shear:	-394 lb	5797 lb

LOADING DIAGRAM



UNIFORM LOADS Center

Uniform Live Load	40	plf
Uniform Dead Load	15	plf
Beam Self Weight	7	plf
Total Uniform Load	62	plf

POINT LOADS - CENTER SPAN

Load Number	One *
Live Load	481 lb
Dead Load	-57 lb
Location	3.75 ft

* Load obtained from Load Tracker. See Summary Report for details.

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: PST-MLB2-6A
Column
[2015 International Building Code(2015 NDS)]
3.5 IN x 5.5 IN x 9.08 FT
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 81.5%

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:41 PM

VERTICAL REACTIONS

Live Load:	Vert-LL-Rxn =	2289	lb
Dead Load:	Vert-DL-Rxn =	971	lb
Total Load:	Vert-TL-Rxn =	3260	lb

COLUMN DATA

Total Column Length:	9.08	ft
Unbraced Length (X-Axis) Lx:	9.08	ft
Unbraced Length (Y-Axis) Ly:	0	ft
Column End Condition-K (e):	1	
Axial Load Duration Factor	1.00	

COLUMN PROPERTIES

#2 - Douglas-Fir-Larch

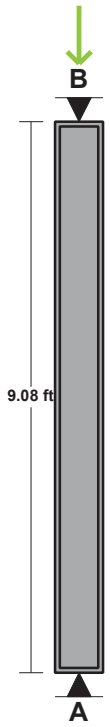
	Base Values	Adjusted
Compressive Stress:	Fc = 1350 psi	Fc' = 918 psi
	Cd=1.00 Cf=1.10 Cp=0.62	
Bending Stress (X-X Axis):	Fbx = 900 psi	Fbx' = 1170 psi
	Cd=1.00 CF=1.30	
Bending Stress (Y-Y Axis):	Fby = 900 psi	Fby' = 1170 psi
	Cd=1.00 CF=1.30	
Modulus of Elasticity:	E = 1600 ksi	E' = 1600 ksi

Column Section (X-X Axis):	dx =	5.5	in
Column Section (Y-Y Axis):	dy =	3.5	in
Area:	A =	19.25	in2
Section Modulus (X-X Axis):	Sx =	17.65	in3
Section Modulus (Y-Y Axis):	Sy =	11.23	in3
Slenderness Ratio:	Lex/dx =	19.81	
	Ley/dy =	0	

Column Calculations (Controlling Case Only):
Controlling Load Case: Axial Total Load Only (L + D)

Actual Compressive Stress:	Fc =	169	psi
Allowable Compressive Stress:	Fc' =	918	psi
Eccentricity Moment (X-X Axis):	Mx-ex =	0	ft-lb
Eccentricity Moment (Y-Y Axis):	My-ey =	0	ft-lb
Moment Due to Lateral Loads (X-X Axis):	Mx =	0	ft-lb
Moment Due to Lateral Loads (Y-Y Axis):	My =	0	ft-lb
Bending Stress Lateral Loads Only (X-X Axis):	Fbx =	0	psi
Allowable Bending Stress (X-X Axis):	Fbx' =	1170	psi
Bending Stress Lateral Loads Only (Y-Y Axis):	Fby =	0	psi
Allowable Bending Stress (Y-Y Axis):	Fby' =	1170	psi
Combined Stress Factor:	**CSF =**	**0.18**	

LOADING DIAGRAM



AXIAL LOADING

Live Load:	PL =	2289	lb *
Dead Load:	PD =	933	lb *
Column Self Weight:	CSW =	38	lb
Total Axial Load:	PT =	3260	lb

* Load obtained from Load Tracker. See Summary Report for details.

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: MLB2-8
Multi-Loaded Multi-Span Beam
[2015 International Building Code(2015 NDS)]
5.5 IN x 12.0 IN x 8.83 FT
24F-V4 - Visually Graded Western Species - Dry Use
Section Adequate By: 55.0%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:41 PM

DEFLECTIONS Center

Live Load	0.12	IN L/914
Dead Load	0.08	in
Total Load	0.19	IN L/550

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/240

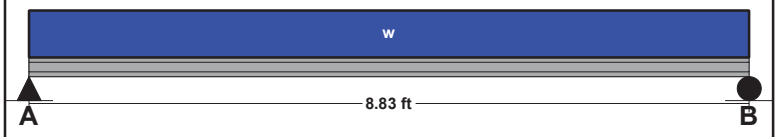
REACTIONS A B

Live Load	5333	lb	5333	lb
Dead Load	3538	lb	3538	lb
Total Load	8871	lb	8871	lb
Bearing Length	2.48	in	2.48	in

BEAM DATA Center

Span Length	8.83	ft
Unbraced Length-Top	0	ft
Unbraced Length-Bottom	8.83	ft
Live Load Duration Factor	1.15	
Camber Adj. Factor	1	
Camber Required	0.08	
Notch Depth	0.00	

LOADING DIAGRAM



UNIFORM LOADS Center*

Uniform Live Load	1208	plf
Uniform Dead Load	787	plf
Beam Self Weight	14	plf
Total Uniform Load	2009	plf

* Load obtained from Load Tracker. See Summary Report for details.

MATERIAL PROPERTIES

24F-V4 - Visually Graded Western Species

	Base Values		Adjusted	
Bending Stress:	Fb = 2400 psi		*Controlled by:*	
	Fb_cmpr = 1850 psi		Fb' = 2760 psi	
	Cd=1.15			
Shear Stress:	Fv = 265 psi		Fv' = 305 psi	
	Cd=1.15			
Modulus of Elasticity:	E = 1800 ksi		E' = 1800 ksi	
Comp. ⊥ to Grain:	Fc - ⊥ = 650 psi		Fc - ⊥' = 650 psi	

Controlling Moment: 19583 ft-lb
4.41 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Controlling Shear: -6919 lb
At a distance d from right support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Comparisons with required sections:	Req'd		Provided	
Section Modulus:	85.14	in3	132	in3
Area (Shear):	34.06	in2	66	in2
Moment of Inertia (deflection):	345.78	in4	792	in4
Moment:	19583	ft-lb	30360	ft-lb
Shear:	-6919	lb	13409	lb

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: PST-MLB2-8A
Column
[2015 International Building Code(2015 NDS)]
5.5 IN x 5.5 IN x 9.08 FT
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 46.9%

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:42 PM

VERTICAL REACTIONS

Live Load:	Vert-LL-Rxn =	5333	lb
Dead Load:	Vert-DL-Rxn =	3598	lb
Total Load:	Vert-TL-Rxn =	8931	lb

COLUMN DATA

Total Column Length:	9.08	ft
Unbraced Length (X-Axis) Lx:	9.08	ft
Unbraced Length (Y-Axis) Ly:	9.08	ft
Column End Condition-K (e):	1	
Axial Load Duration Factor	1.00	

COLUMN PROPERTIES

#2 - Douglas-Fir-Larch

	Base Values		Adjusted	
Compressive Stress:	Fc = 700	psi	Fc' = 556	psi
	Cd=1.00 Cp=0.79			
Bending Stress (X-X Axis):	Fbx = 750	psi	Fbx' = 750	psi
	Cd=1.00 CF=1.00			
Bending Stress (Y-Y Axis):	Fby = 750	psi	Fby' = 750	psi
	Cd=1.00 CF=1.00			
Modulus of Elasticity:	E = 1300	ksi	E' = 1300	ksi

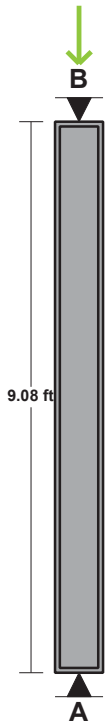
Column Section (X-X Axis):	dx =	5.5	in
Column Section (Y-Y Axis):	dy =	5.5	in
Area:	A =	30.25	in2
Section Modulus (X-X Axis):	Sx =	27.73	in3
Section Modulus (Y-Y Axis):	Sy =	27.73	in3
Slenderness Ratio:	Lex/dx =	19.81	
	Ley/dy =	19.81	

Column Calculations (Controlling Case Only):

Controlling Load Case: Axial Total Load Only (L + D)

Actual Compressive Stress:	Fc =	295	psi
Allowable Compressive Stress:	Fc' =	556	psi
Eccentricity Moment (X-X Axis):	Mx-ex =	0	ft-lb
Eccentricity Moment (Y-Y Axis):	My-ey =	0	ft-lb
Moment Due to Lateral Loads (X-X Axis):	Mx =	0	ft-lb
Moment Due to Lateral Loads (Y-Y Axis):	My =	0	ft-lb
Bending Stress Lateral Loads Only (X-X Axis):	Fbx =	0	psi
Allowable Bending Stress (X-X Axis):	Fbx' =	750	psi
Bending Stress Lateral Loads Only (Y-Y Axis):	Fby =	0	psi
Allowable Bending Stress (Y-Y Axis):	Fby' =	750	psi
Combined Stress Factor:	**CSF =**	**0.53**	

LOADING DIAGRAM



AXIAL LOADING

Live Load:	PL =	5333	lb *
Dead Load:	PD =	3538	lb *
Column Self Weight:	CSW =	60	lb
Total Axial Load:	PT =	8931	lb

* Load obtained from Load Tracker. See Summary Report for details.

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: PST-MLB2-8B
Column
[2015 International Building Code(2015 NDS)]
(2) 1.5 IN x 5.5 IN x 9.08 FT
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 38.8%

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:42 PM

CAUTIONS
* Laminations to be nailed together per National Design Specifications for Wood Construction Section 15.3.3.1

VERTICAL REACTIONS

Live Load:	Vert-LL-Rxn =	5333	lb
Dead Load:	Vert-DL-Rxn =	3570	lb
Total Load:	Vert-TL-Rxn =	8903	lb

COLUMN DATA

Total Column Length:	9.08	ft
Unbraced Length (X-Axis) Lx:	1	ft
Unbraced Length (Y-Axis) Ly:	1	ft
Column End Condition-K (e):	1	
Axial Load Duration Factor	1.00	

COLUMN PROPERTIES
#2 - Douglas-Fir-Larch

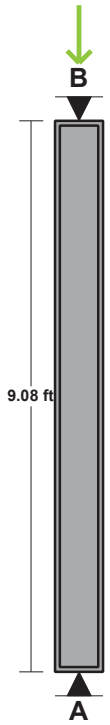
	Base Values	Adjusted
Compressive Stress:	Fc = 1350 psi	Fc' = 882 psi
	Cd=1.00 Cf=1.10 Cp=0.59	
Bending Stress (X-X Axis):	Fbx = 900 psi	Fbx' = 1170 psi
	Cd=1.00 CF=1.30	
Bending Stress (Y-Y Axis):	Fby = 900 psi	Fby' = 1170 psi
	Cd=1.00 CF=1.30	
Modulus of Elasticity:	E = 1600 ksi	E' = 1600 ksi

Column Section (X-X Axis):	dx =	5.5	in
Column Section (Y-Y Axis):	dy =	3	in
Area:	A =	16.5	in2
Section Modulus (X-X Axis):	Sx =	15.13	in3
Section Modulus (Y-Y Axis):	Sy =	4.13	in3
Slenderness Ratio:	Lex/dx =	2.18	
	Ley/dy =	4	

Column Calculations (Controlling Case Only):
Controlling Load Case: Axial Total Load Only (L + D)

Actual Compressive Stress:	Fc =	540	psi
Allowable Compressive Stress:	Fc' =	882	psi
Eccentricity Moment (X-X Axis):	Mx-ex =	0	ft-lb
Eccentricity Moment (Y-Y Axis):	My-ey =	0	ft-lb
Moment Due to Lateral Loads (X-X Axis):	Mx =	0	ft-lb
Moment Due to Lateral Loads (Y-Y Axis):	My =	0	ft-lb
Bending Stress Lateral Loads Only (X-X Axis):	Fbx =	0	psi
Allowable Bending Stress (X-X Axis):	Fbx' =	1170	psi
Bending Stress Lateral Loads Only (Y-Y Axis):	Fby =	0	psi
Allowable Bending Stress (Y-Y Axis):	Fby' =	1170	psi
Combined Stress Factor:	**CSF =**	**0.61**	

LOADING DIAGRAM



AXIAL LOADING

Live Load:	PL =	5333	lb *
Dead Load:	PD =	3538	lb *
Column Self Weight:	CSW =	32	lb
Total Axial Load:	PT =	8903	lb

* Load obtained from Load Tracker. See Summary Report for details.

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: MLB2-6
Multi-Loaded Multi-Span Beam
[2015 International Building Code(2015 NDS)]
3.5 IN x 12.0 IN x 17.17 FT (9.2 + 8)
24F-V4 - Visually Graded Western Species - Dry Use
Section Adequate By: 82.7%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:43 PM

DEFLECTIONS	Center		Right	
Live Load	0.09	IN L/1286	-0.03	IN L/3324
Dead Load	0.03	in	-0.01	in
Total Load	0.12	IN L/917	-0.04	IN L/2511

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/240

REACTIONS	A	B	C
Live Load	2289 lb	3724 lb	481 lb
Dead Load	933 lb	1427 lb	-57 lb
Total Load	3222 lb	5151 lb	424 lb
Uplift (1.5 F.S)	**0 lb**	**0 lb**	**-519 lb**
Bearing Length	1.42 in	2.26 in	0.19 in

BEAM DATA	Center	Right
Span Length	9.17 ft	8 ft
Unbraced Length-Top	0 ft	0 ft
Unbraced Length-Bottom	9.17 ft	8 ft
Live Load Duration Factor	1.00	
Notch Depth	0.00	

MATERIAL PROPERTIES

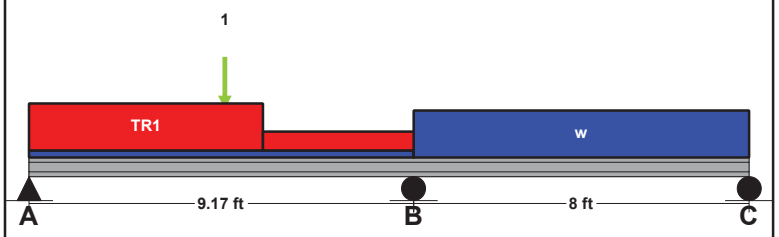
24F-V4 - Visually Graded Western Species

		Base Values		Adjusted	
Bending Stress:	Fb =	2400	psi	*Controlled by:*	
	Fb_cmpr =	1850	psi	Fb' =	2400 psi
	Cd=1.00				
Shear Stress:	Fv =	265	psi	Fv' =	265 psi
	Cd=1.00				
Modulus of Elasticity:	E =	1800	ksi	E' =	1800 ksi
Comp. ⊥ to Grain:	Fc - ⊥ =	650	psi	Fc - ⊥' =	650 psi

Controlling Moment: 9195 ft-lb
4.68 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
Controlling Shear: -3561 lb
At a distance d from right support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2, 3

Comparisons with required sections:	Req'd	Provided
Section Modulus:	45.97 in3	84 in3
Area (Shear):	20.15 in2	42 in2
Moment of Inertia (deflection):	141.1 in4	504 in4
Moment:	9195 ft-lb	16800 ft-lb
Shear:	-3561 lb	7420 lb

LOADING DIAGRAM



UNIFORM LOADS	Center	Right*
Uniform Live Load	0 plf	136 plf
Uniform Dead Load	0 plf	29 plf
Beam Self Weight	9 plf	9 plf
Total Uniform Load	9 plf	174 plf

* Load obtained from Load Tracker. See Summary Report for details.

POINT LOADS - CENTER SPAN	
Load Number	One *
Live Load	2269 lb
Dead Load	1007 lb
Location	4.67 ft

* Load obtained from Load Tracker. See Summary Report for details.

TRAPEZOIDAL LOADS - CENTER SPAN		
Load Number	One *	Two *
Left Live Load	382 plf	136 plf
Left Dead Load	144 plf	29 plf
Right Live Load	382 plf	136 plf
Right Dead Load	144 plf	29 plf
Load Start	0 ft	5.58 ft
Load End	5.58 ft	9.17 ft
Load Length	5.58 ft	3.59 ft

* Load obtained from Load Tracker. See Summary Report for details.

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: Wall-3rd Flr-Interior
Wall
[2015 International Building Code(2015 NDS)]
1.5 IN x 3.5 IN x 9.08 FT @ 16 O.C.
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 67.1%
Controlling Factor: Combined Stress Factor

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:43 PM

DEFLECTIONS

Deflection due to lateral loads only:	Defl = 0.12	IN = L/916
Live Load Deflection Criteria:		L/180

VERTICAL REACTIONS

Live Load:	Vert-LL-Rxn =	533	lb
Dead Load:	Vert-DL-Rxn =	261	lb
Total Load:	Vert-TL-Rxn =	794	lb

HORIZONTAL REACTIONS

Total Reaction at Top of Column:	TL-Rxn-Top =	30	lb
Total Reaction at Bottom of Column:	TL-Rxn-Bottom =	30	lb

WALL DATA

Total Stud Length:	9.08	ft
Wall Dead Weight:	5	psf
Unbraced Length (X-Axis) Lx:	9.08	ft
Unbraced Length (Y-Axis) Ly:	0	ft
Stud End Condition-K (e):	1	
Axial Load Duration Factor	1.15	
Lateral Load Duration Factor (Wind/Seismic)	1.33	

STUD PROPERTIES

#2 - Douglas-Fir-Larch

	Base Values	Adjusted
Compressive Stress:	Fc = 1350 psi	Fc' = 460 psi
	Cd=1.15 Cf=1.15 Cp=0.26	
Bending Stress (X-X Axis):	Fbx = 900 psi	Fbx' = 1785 psi
	Cd=1.15 CF=1.50 Cr=1.15	
Bending Stress (Y-Y Axis):	Fby = 900 psi	Fby' = 1785 psi
	Cd=1.15 CF=1.50 Cr=1.15	
Modulus of Elasticity:	E = 1600 ksi	E' = 1600 ksi

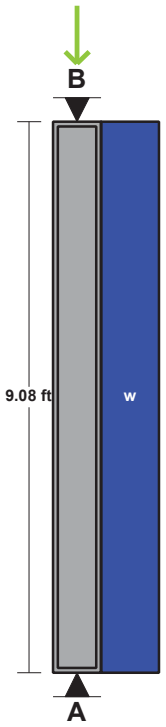
Stud Section (X-X Axis):	dx =	3.5	in
Stud Section (Y-Y Axis):	dy =	1.5	in
Area:	A =	5.25	in2
Section Modulus (X-X Axis):	Sx =	3.06	in3
Section Modulus (Y-Y Axis):	Sy =	1.31	in3
Slenderness Ratio:	Lex/dx =	31.13	
	Ley/dy =	0	

Stud Calculations (Controlling Case Only):

Controlling Load Case: Axial Total Load Only (L + D)

Actual Compressive Stress:	Fc =	151	psi
Allowable Compressive Stress:	Fc' =	460	psi
Eccentricity Moment (X-X Axis):	Mx-ex =	0	ft-lb
Eccentricity Moment (Y-Y Axis):	My-ey =	0	ft-lb
Moment Due to Lateral Loads (X-X Axis):	Mx =	0	ft-lb
Moment Due to Lateral Loads (Y-Y Axis):	My =	0	ft-lb
Bending Stress Lateral Loads Only (X-X Axis):	Fbx =	0	psi
Allowable Bending Stress (X-X Axis):	Fbx' =	1785	psi
Bending Stress Lateral Loads Only (Y-Y Axis):	Fby =	0	psi
Allowable Bending Stress (Y-Y Axis):	Fby' =	1785	psi
Combined Stress Factor:	**CSF =**	**0.33**	

LOADING DIAGRAM



WALL LOAD CALCULATOR

	Live Load		Dead Load		Tributary Width	
Load Tracker:	LL = 0	plf	DL = 0	plf		
Roof:	LL = 25	psf	DL = 15	psf	TA = 0	ft
Upper Floor:	LL = 40	psf	DL = 15	psf	TA = 10	ft
Upper Floor Height:	0	ft				
Middle Floor:	LL = 40	psf	DL = 15	psf	TA = 0	ft
Middle Floor Height:	0	ft				
Calculated Load:	**LL = 400**	**plf**	**DL =195.4**	**plf**		

AXIAL LOADING

Live Load:	PL =	400	plf *
Dead Load:	PD =	195	plf *
Total Axial Load:	PT =	595	plf

* Load obtained from Load Tracker. See Summary Report for details.

LATERAL LOADING (Dy Face)

Uniform Lateral Load:	wL-Lat =	5	psf

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: Wall-1st Flr-Interior
Wall
[2015 International Building Code(2015 NDS)]
1.5 IN x 3.5 IN x 9.08 FT @ 8 O.C.
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 83.6%
Controlling Factor: Combined Stress Factor

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

page of

StruCalc Version 10.0.1.6 6/21/2019 4:03:43 PM

DEFLECTIONS

Deflection due to lateral loads only:	Defl = 0.06	IN = L/1833
Live Load Deflection Criteria:		L/180

VERTICAL REACTIONS

Live Load:	Vert-LL-Rxn =	267	lb
Dead Load:	Vert-DL-Rxn =	130	lb
Total Load:	Vert-TL-Rxn =	397	lb

HORIZONTAL REACTIONS

Total Reaction at Top of Column:	TL-Rxn-Top =	15	lb
Total Reaction at Bottom of Column:	TL-Rxn-Bottom =	15	lb

WALL DATA

Total Stud Length:	9.08	ft
Wall Dead Weight:	5	psf
Unbraced Length (X-Axis) Lx:	9.08	ft
Unbraced Length (Y-Axis) Ly:	0	ft
Stud End Condition-K (e):	1	
Axial Load Duration Factor	1.15	
Lateral Load Duration Factor (Wind/Seismic)	1.33	

STUD PROPERTIES

#2 - Douglas-Fir-Larch

	Base Values	Adjusted
Compressive Stress:	Fc = 1350 psi	Fc' = 460 psi
	Cd=1.15 Cf=1.15 Cp=0.26	
Bending Stress (X-X Axis):	Fbx = 900 psi	Fbx' = 1785 psi
	Cd=1.15 CF=1.50 Cr=1.15	
Bending Stress (Y-Y Axis):	Fby = 900 psi	Fby' = 1785 psi
	Cd=1.15 CF=1.50 Cr=1.15	
Modulus of Elasticity:	E = 1600 ksi	E' = 1600 ksi

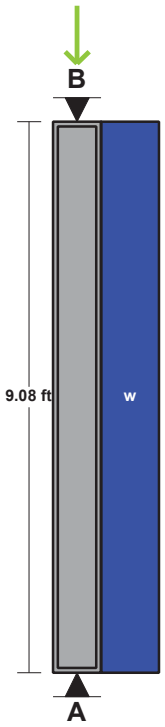
Stud Section (X-X Axis):	dx =	3.5	in
Stud Section (Y-Y Axis):	dy =	1.5	in
Area:	A =	5.25	in2
Section Modulus (X-X Axis):	Sx =	3.06	in3
Section Modulus (Y-Y Axis):	Sy =	1.31	in3
Slenderness Ratio:	Lex/dx =	31.13	
	Ley/dy =	0	

Stud Calculations (Controlling Case Only):

Controlling Load Case: Axial Total Load Only (L + D)

Actual Compressive Stress:	Fc =	76	psi
Allowable Compressive Stress:	Fc' =	460	psi
Eccentricity Moment (X-X Axis):	Mx-ex =	0	ft-lb
Eccentricity Moment (Y-Y Axis):	My-ey =	0	ft-lb
Moment Due to Lateral Loads (X-X Axis):	Mx =	0	ft-lb
Moment Due to Lateral Loads (Y-Y Axis):	My =	0	ft-lb
Bending Stress Lateral Loads Only (X-X Axis):	Fbx =	0	psi
Allowable Bending Stress (X-X Axis):	Fbx' =	1785	psi
Bending Stress Lateral Loads Only (Y-Y Axis):	Fby =	0	psi
Allowable Bending Stress (Y-Y Axis):	Fby' =	1785	psi
Combined Stress Factor:	**CSF =**	**0.16**	

LOADING DIAGRAM



WALL LOAD CALCULATOR

	Live Load	Dead Load	Tributary Width
Load Tracker:	LL = 0 plf	DL = 0 plf	
Roof:	LL = 25 psf	DL = 15 psf	TA = 0 ft
Upper Floor:	LL = 40 psf	DL = 15 psf	TA = 10 ft
Upper Floor Height:	0 ft		
Middle Floor:	LL = 40 psf	DL = 15 psf	TA = 0 ft
Middle Floor Height:	0 ft		
Calculated Load:	**LL = 400 plf**	**DL = 195.4 plf**	

AXIAL LOADING

Live Load:	PL =	400 plf *
Dead Load:	PD =	195 plf *
Total Axial Load:	PT =	595 plf

* Load obtained from Load Tracker. See Summary Report for details.

LATERAL LOADING (Dy Face)

Uniform Lateral Load: wL-Lat = 5 psf

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: Wall-2nd Flr-Interior
Wall
[2015 International Building Code(2015 NDS)]
1.5 IN x 3.5 IN x 9.08 FT @ 16 O.C.
#1 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 69.3%
Controlling Factor: Combined Stress Factor

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:44 PM

DEFLECTIONS

Deflection due to lateral loads only:	Defl = 0.11	IN = L/974
Live Load Deflection Criteria:		L/180

VERTICAL REACTIONS

Live Load:	Vert-LL-Rxn =	533	lb
Dead Load:	Vert-DL-Rxn =	261	lb
Total Load:	Vert-TL-Rxn =	794	lb

HORIZONTAL REACTIONS

Total Reaction at Top of Column:	TL-Rxn-Top =	30	lb
Total Reaction at Bottom of Column:	TL-Rxn-Bottom =	30	lb

WALL DATA

Total Stud Length:	9.08	ft
Wall Dead Weight:	5	psf
Unbraced Length (X-Axis) Lx:	9.08	ft
Unbraced Length (Y-Axis) Ly:	0	ft
Stud End Condition-K (e):	1	
Axial Load Duration Factor	1.15	
Lateral Load Duration Factor (Wind/Seismic)	1.33	

STUD PROPERTIES

#1 - Douglas-Fir-Larch

	Base Values	Adjusted
Compressive Stress:	Fc = 1500 psi	Fc' = 493 psi
	Cd=1.15 Cf=1.15 Cp=0.25	
Bending Stress (X-X Axis):	Fbx = 1000 psi	Fbx' = 1984 psi
	Cd=1.15 CF=1.50 Cr=1.15	
Bending Stress (Y-Y Axis):	Fby = 1000 psi	Fby' = 1984 psi
	Cd=1.15 CF=1.50 Cr=1.15	
Modulus of Elasticity:	E = 1700 ksi	E' = 1700 ksi

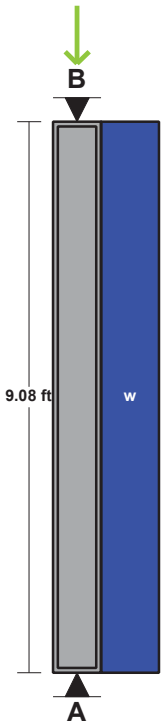
Stud Section (X-X Axis):	dx =	3.5	in
Stud Section (Y-Y Axis):	dy =	1.5	in
Area:	A =	5.25	in2
Section Modulus (X-X Axis):	Sx =	3.06	in3
Section Modulus (Y-Y Axis):	Sy =	1.31	in3
Slenderness Ratio:	Lex/dx =	31.13	
	Ley/dy =	0	

Stud Calculations (Controlling Case Only):

Controlling Load Case: Axial Total Load Only (L + D)

Actual Compressive Stress:	Fc =	151	psi
Allowable Compressive Stress:	Fc' =	493	psi
Eccentricity Moment (X-X Axis):	Mx-ex =	0	ft-lb
Eccentricity Moment (Y-Y Axis):	My-ey =	0	ft-lb
Moment Due to Lateral Loads (X-X Axis):	Mx =	0	ft-lb
Moment Due to Lateral Loads (Y-Y Axis):	My =	0	ft-lb
Bending Stress Lateral Loads Only (X-X Axis):	Fbx =	0	psi
Allowable Bending Stress (X-X Axis):	Fbx' =	1984	psi
Bending Stress Lateral Loads Only (Y-Y Axis):	Fby =	0	psi
Allowable Bending Stress (Y-Y Axis):	Fby' =	1984	psi
Combined Stress Factor:	**CSF =**	**0.31**	

LOADING DIAGRAM



WALL LOAD CALCULATOR

	Live Load	Dead Load	Tributary Width
Load Tracker:	LL = 0 plf	DL = 0 plf	
Roof:	LL = 25 psf	DL = 15 psf	TA = 0 ft
Upper Floor:	LL = 40 psf	DL = 15 psf	TA = 10 ft
Upper Floor Height:	0 ft		
Middle Floor:	LL = 40 psf	DL = 15 psf	TA = 0 ft
Middle Floor Height:	0 ft		
Calculated Load:	**LL = 400 plf**	**DL =195.4 plf**	

AXIAL LOADING

Live Load:	PL =	400 plf *
Dead Load:	PD =	195 plf *
Total Axial Load:	PT =	595 plf

* Load obtained from Load Tracker. See Summary Report for details.

LATERAL LOADING (Dy Face)

Uniform Lateral Load: wL-Lat = 5 psf

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: FTG-PST-MLB2-8A
Footing
[2015 International Building Code(2015 NDS)]
Footing Size: 2.0 FT x 2.0 FT x 10.00 IN
Reinforcement: #4 Bars @ 8.00 IN. O.C. E/W / (3) min.
Section Footing Design Adequate

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:44 PM

FOOTING PROPERTIES

Allowable Soil Bearing Pressure:	Qs =	2500	psf
Concrete Compressive Strength:	F'c =	2500	psi
Reinforcing Steel Yield Strength:	Fy =	60000	psi
Concrete Reinforcement Cover:	c =	3	in

FOOTING SIZE

Width:	W =	2	ft
Length:	L =	2	ft
Depth:	Depth =	10	in
Effective Depth to Top Layer of Steel:	d =	6.25	in

COLUMN AND BASEPLATE SIZE

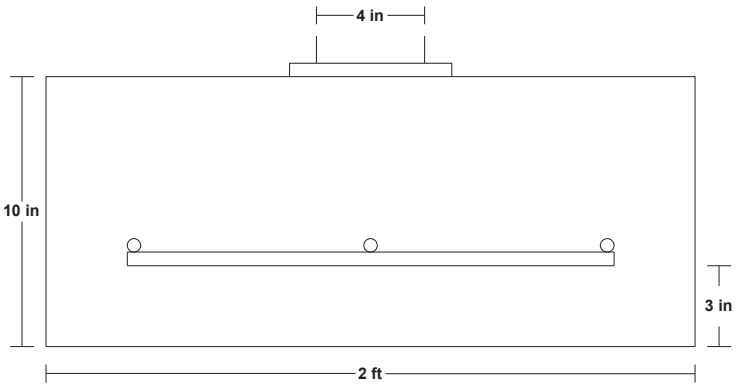
Column Type:	Steel		
Column Width:	m =	4	in
Column Depth:	n =	4	in
Baseplate Width:	bsw =	6	in
Baseplate Length:	bsl =	6	in

FOOTING CALCULATIONS

Bearing Calculations:			
Ultimate Bearing Pressure:	Qu =	2233	psf
Effective Allowable Soil Bearing Pressure:	Qe =	2375	psf
Required Footing Area:	Areq =	3.76	sf
Area Provided:	A =	4.00	sf
Baseplate Bearing:			
Bearing Required:	Bear =	12850	lb
Allowable Bearing:	Bear-A =	99450	lb
Beam Shear Calculations (One Way Shear):			
Beam Shear:	Vu1 =	1740	lb
Allowable Beam Shear:	Vc1 =	11250	lb
Punching Shear Calculations (Two Way Shear):			
Critical Perimeter:	Bo =	45	in
Punching Shear:	Vu2 =	10027	lb
Allowable Punching Shear (ACI 11-35):	vc2-a =	63281	lb
Allowable Punching Shear (ACI 11-36):	vc2-b =	79688	lb
Allowable Punching Shear (ACI 11-37):	vc2-c =	42188	lb
Controlling Allowable Punching Shear:	vc2 =	42188	lb
Bending Calculations:			
Factored Moment:	Mu =	24161	in-lb
Nominal Moment Strength:	Mn =	187693	in-lb
Reinforcement Calculations:			
Concrete Compressive Block Depth:	a =	0.69	in
Steel Required Based on Moment:	As(1) =	0.07	in2
Min. Code Req'd Reinf. Shrink./Temp. (ACI-10.5.4):	As(2) =	0.43	in2
Controlling Reinforcing Steel:	As-reqd =	0.43	in2
Selected Reinforcement:	#4's @ 8.0 in. o.c. e/w (3) Min.		
Reinforcement Area Provided:	As =	0.59	in2
Development Length Calculations:			
Development Length Required:	Ld =	15	in
Development Length Supplied:	Ld-sup =	6.5	in

Note: Plain concrete adequate for bending,
therefore adequate development length not required.

LOADING DIAGRAM



FOOTING LOADING

Live Load:	PL =	5333	lb *
Dead Load:	PD =	3598	lb *
Total Load:	PT =	8931	lb *
Ultimate Factored Load:	Pu =	12850	lb
Footing plus soil above footing weight:	Wt =	322	lb

* Load obtained from Load Tracker. See Summary Report for details.

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: Ftg-Wall-1st-Exterior
Footing
[2015 International Building Code(2015 NDS)]
Footing Size: 16.0 IN Wide x 8.0 IN Deep Continuous Footing With 8.0 IN Thick x 18.0 IN Tall Stemwall
LongitudinalReinforcement: (2) Continuous #4 Bars
TransverseReinforcement: #4 Bars @ 13.00 IN. O.C. (unnecessary)
Section Footing Design Adequate

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:45 PM

FOOTING PROPERTIES

Allowable Soil Bearing Pressure:	Qs =	2500	psf
Concrete Compressive Strength:	F'c =	2500	psi
Reinforcing Steel Yield Strength:	Fy =	60000	psi
Concrete Reinforcement Cover:	c =	3	in

FOOTING SIZE

Width:	W =	16	in
Depth:	Depth =	8	in
Effective Depth to Top Layer of Steel:	d =	4.25	in

STEMWALL SIZE

Stemwall Width:	8	in
Stemwall Height:	18	in
Stemwall Weight:	150	pcf

FOOTING CALCULATIONS

Bearing Calculations:

Ultimate Bearing Pressure:	Qu =	1973	psf
Effective Allowable Soil Bearing Pressure:	Qe =	2400	psf
Width Required:	Wreq =	1.1	ft

Beam Shear Calculations (One Way Shear):

Beam Shear:	Vu1 =	0	lb
Allowable Beam Shear:	Vc1 =	3825	lb

Transverse Direction:

Bending Calculations:

Factored Moment:	Mu =	1872	in-lb
Nominal Moment Strength:	Mn =	0	in-lb

Reinforcement Calculations:

Concrete Compressive Block Depth:	a =	0.41	in
Steel Required Based on Moment:	As(1) =	0.01	in2
Min. Code Req'd Reinf. Shrink./Temp. (ACI-10.5.4)	As(2) =	0.17	in2
Controlling Reinforcing Steel:	As-reqd =	0.17	in2
Selected Reinforcement:	Trans: #4's @ 13.0 in. o.c.		
Reinforcement Area Provided:	As =	0.17	in2

Development Length Calculations:

Development Length Required:	Ld =	15	in
Development Length Supplied:	Ld-sup =	1	in

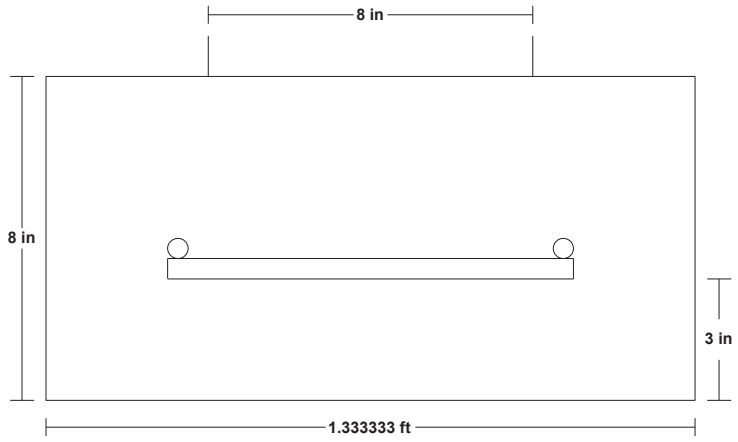
Longitudinal Direction:

Reinforcement Calculations:

Min. Code Req'd Reinf. Shrink./Temp. (ACI-10.5.4):	As(2) =	0.23	in2
Controlling Reinforcing Steel:	As-reqd =	0.23	in2
Selected Reinforcement:	Longitudinal: (2) Cont. #4 Bars		
Reinforcement Area Provided:	As =	0.39	in2

NOTES

LOADING DIAGRAM



FOOTING LOADING

Live Load:	PL =	1472	plf *
Dead Load:	PD =	1008	plf *
Total Load:	PT =	2630	plf *
Ultimate Factored Load:	Pu =	3745	plf

* Load obtained from Load Tracker. See Summary Report for details.

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: Ftg-Wall-1st Flr-Interior
Footing
[2015 International Building Code(2015 NDS)]
Footing Size: 48.0 IN Wide x 10.0 IN Deep Continuous Footing With 11.0 IN Thick x 18.0 IN Tall Stemwall
LongitudinalReinforcement: (5) Continuous #4 Bars
TransverseReinforcement: #4 Bars @ 10.00 IN. O.C.
Section Footing Design Adequate

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:45 PM

FOOTING PROPERTIES

Allowable Soil Bearing Pressure:	Qs =	2500	psf
Concrete Compressive Strength:	F'c =	2500	psi
Reinforcing Steel Yield Strength:	Fy =	60000	psi
Concrete Reinforcement Cover:	c =	3	in

FOOTING SIZE

Width:	W =	48	in
Depth:	Depth =	10	in
Effective Depth to Top Layer of Steel:	d =	6.25	in

STEMWALL SIZE

Stemwall Width:	11	in
Stemwall Height:	18	in
Stemwall Weight:	150	pcf

FOOTING CALCULATIONS

Bearing Calculations:

Ultimate Bearing Pressure:	Qu =	1215	psf
Effective Allowable Soil Bearing Pressure:	Qe =	2375	psf
Width Required:	Wreq =	2.05	ft

Beam Shear Calculations (One Way Shear):

Beam Shear:	Vu1 =	1789	lb
Allowable Beam Shear:	Vc1 =	5625	lb

Transverse Direction:

Bending Calculations:

Factored Moment:	Mu =	24991	in-lb
Nominal Moment Strength:	Mn =	0	in-lb

Reinforcement Calculations:

Concrete Compressive Block Depth:	a =	0.51	in
Steel Required Based on Moment:	As(1) =	0.08	in2
Min. Code Req'd Reinf. Shrink./Temp. (ACI-10.5.4)	As(2) =	0.22	in2
Controlling Reinforcing Steel:	As-reqd =	0.22	in2
Selected Reinforcement:	Trans: #4's @ 10.0 in. o.c.		
Reinforcement Area Provided:	As =	0.22	in2

Development Length Calculations:

Development Length Required:	Ld =	15	in
Development Length Supplied:	Ld-sup =	15.5	in

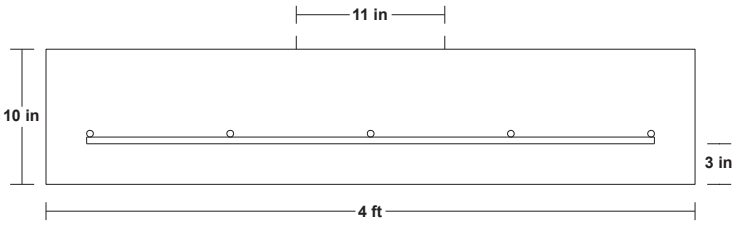
Longitudinal Direction:

Reinforcement Calculations:

Min. Code Req'd Reinf. Shrink./Temp. (ACI-10.5.4):	As(2) =	0.86	in2
Controlling Reinforcing Steel:	As-reqd =	0.86	in2
Selected Reinforcement:	Longitudinal: (5) Cont. #4 Bars		
Reinforcement Area Provided:	As =	0.98	in2

NOTES

LOADING DIAGRAM



FOOTING LOADING

Live Load:	PL =	2944	plf *
Dead Load:	PD =	1710	plf *
Total Load:	PT =	4860	plf *
Ultimate Factored Load:	Pu =	7010	plf

* Load obtained from Load Tracker. See Summary Report for details.

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: FTG-PST-MLB2-6B
Footing
[2015 International Building Code(2015 NDS)]
Footing Size: 2.0 FT x 2.0 FT x 10.00 IN
Reinforcement: #4 Bars @ 8.00 IN. O.C. E/W / (3) min.
Section Footing Design Adequate

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:45 PM

FOOTING PROPERTIES

Allowable Soil Bearing Pressure:	Qs =	2500	psf
Concrete Compressive Strength:	F'c =	2500	psi
Reinforcing Steel Yield Strength:	Fy =	60000	psi
Concrete Reinforcement Cover:	c =	3	in

FOOTING SIZE

Width:	W =	2	ft
Length:	L =	2	ft
Depth:	Depth =	10	in
Effective Depth to Top Layer of Steel:	d =	6.25	in

COLUMN AND BASEPLATE SIZE

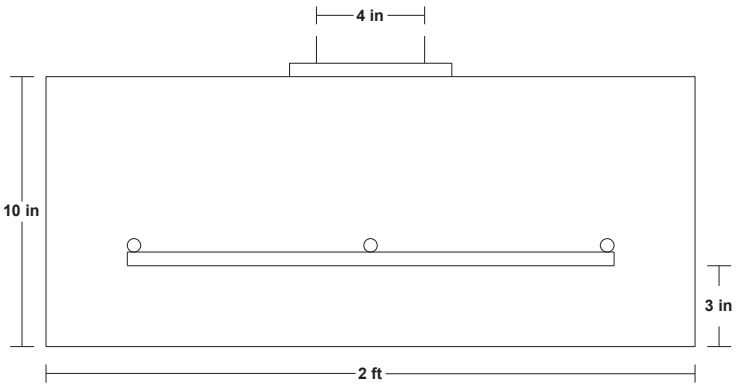
Column Type:	Steel		
Column Width:	m =	4	in
Column Depth:	n =	4	in
Baseplate Width:	bsw =	6	in
Baseplate Length:	bsl =	6	in

FOOTING CALCULATIONS

Bearing Calculations:			
Ultimate Bearing Pressure:	Qu =	1300	psf
Effective Allowable Soil Bearing Pressure:	Qe =	2375	psf
Required Footing Area:	Areq =	2.19	sf
Area Provided:	A =	4.00	sf
Baseplate Bearing:			
Bearing Required:	Bear =	7731	lb
Allowable Bearing:	Bear-A =	99450	lb
Beam Shear Calculations (One Way Shear):			
Beam Shear:	Vu1 =	1047	lb
Allowable Beam Shear:	Vc1 =	11250	lb
Punching Shear Calculations (Two Way Shear):			
Critical Perimeter:	Bo =	45	in
Punching Shear:	Vu2 =	6032	lb
Allowable Punching Shear (ACI 11-35):	vc2-a =	63281	lb
Allowable Punching Shear (ACI 11-36):	vc2-b =	79688	lb
Allowable Punching Shear (ACI 11-37):	vc2-c =	42188	lb
Controlling Allowable Punching Shear:	vc2 =	42188	lb
Bending Calculations:			
Factored Moment:	Mu =	14536	in-lb
Nominal Moment Strength:	Mn =	187693	in-lb
Reinforcement Calculations:			
Concrete Compressive Block Depth:	a =	0.69	in
Steel Required Based on Moment:	As(1) =	0.04	in2
Min. Code Req'd Reinf. Shrink./Temp. (ACI-10.5.4):	As(2) =	0.43	in2
Controlling Reinforcing Steel:	As-reqd =	0.43	in2
Selected Reinforcement:	#4's @ 8.0 in. o.c. e/w (3) Min.		
Reinforcement Area Provided:	As =	0.59	in2
Development Length Calculations:			
Development Length Required:	Ld =	15	in
Development Length Supplied:	Ld-sup =	6.5	in

Note: Plain concrete adequate for bending,
therefore adequate development length not required.

LOADING DIAGRAM



FOOTING LOADING

Live Load:	PL =	3724	lb *
Dead Load:	PD =	1477	lb *
Total Load:	PT =	5201	lb *
Ultimate Factored Load:	Pu =	7731	lb
Footing plus soil above footing weight:	Wt =	322	lb

* Load obtained from Load Tracker. See Summary Report for details.

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: MLB2-4
Multi-Loaded Multi-Span Beam
[2015 International Building Code(2015 NDS)]
3.5 IN x 11.875 IN x 9.33 FT
1.55E Timberstrand LSL - iLevel Trus Joist
Section Adequate By: 148.9%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:46 PM

DEFLECTIONS Center

Live Load	0.05	IN L/2240
Dead Load	0.08	in
Total Load	0.13	IN L/844

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/240

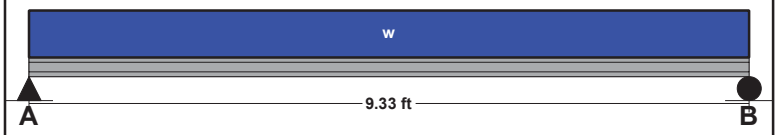
REACTIONS A B

	A		B	
Live Load	1036	lb	1036	lb
Dead Load	1712	lb	1712	lb
Total Load	2748	lb	2748	lb
Bearing Length	0.87	in	0.87	in

BEAM DATA Center

Span Length	9.33	ft
Unbraced Length-Top	0	ft
Unbraced Length-Bottom	9.33	ft
Live Load Duration Factor	1.00	
Notch Depth	0.00	

LOADING DIAGRAM



UNIFORM LOADS Center*

Uniform Live Load	222	plf
Uniform Dead Load	354	plf
Beam Self Weight	13	plf
Total Uniform Load	589	plf

* Load obtained from Load Tracker. See Summary Report for details.

MATERIAL PROPERTIES

1.55E Timberstrand LSL - iLevel Trus Joist

	Base Values		Adjusted	
Bending Stress:	Fb = 2325	psi	Fb' = 2327	psi
	Cd=1.00 CF=1.00			
Shear Stress:	Fv = 310	psi	Fv' = 310	psi
	Cd=1.00			
Modulus of Elasticity:	E = 1550	ksi	E' = 1550	ksi
Comp. ⊥ to Grain:	Fc - ⊥ = 900	psi	Fc - ⊥' = 900	psi

Controlling Moment: 6409 ft-lb
4.66 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
Controlling Shear: -2198 lb
At a distance d from right support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Comparisons with required sections:	Req'd	Provided
Section Modulus:	33.05 in3	82.26 in3
Area (Shear):	10.64 in2	41.56 in2
Moment of Inertia (deflection):	138.86 in4	488.41 in4
Moment:	6409 ft-lb	15953 ft-lb
Shear:	-2198 lb	8590 lb

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: MLB2-9
Multi-Loaded Multi-Span Beam
[2015 International Building Code(2015 NDS)]
3.5 IN x 11.875 IN x 9.0 FT
1.55E Timberstrand LSL - iLevel Trus Joist
Section Adequate By: 20.2%
Controlling Factor: Moment

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:46 PM

DEFLECTIONS Center

Live Load	0.15	IN L/710
Dead Load	0.10	in
Total Load	0.26	IN L/423

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/240

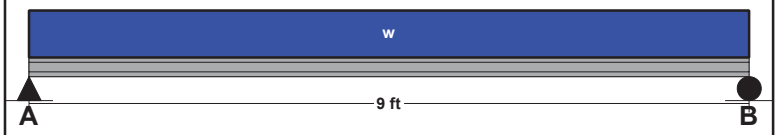
REACTIONS A B

	A		B	
Live Load	3510	lb	3510	lb
Dead Load	2389	lb	2389	lb
Total Load	5899	lb	5899	lb
Bearing Length	1.87	in	1.87	in

BEAM DATA Center

Span Length	9	ft
Unbraced Length-Top	0	ft
Unbraced Length-Bottom	9	ft
Live Load Duration Factor	1.00	
Notch Depth	0.00	

LOADING DIAGRAM



UNIFORM LOADS Center*

Uniform Live Load	780	plf
Uniform Dead Load	518	plf
Beam Self Weight	13	plf
Total Uniform Load	1311	plf

* Load obtained from Load Tracker. See Summary Report for details.

MATERIAL PROPERTIES

1.55E Timberstrand LSL - iLevel Trus Joist

	Base Values		Adjusted	
Bending Stress:	Fb = 2325 psi		Fb' = 2327 psi	
	Cd=1.00 CF=1.00			
Shear Stress:	Fv = 310 psi		Fv' = 310 psi	
	Cd=1.00			
Modulus of Elasticity:	E = 1550 ksi		E' = 1550 ksi	
Comp. ⊥ to Grain:	Fc - ⊥ = 900 psi		Fc - ⊥' = 900 psi	

Controlling Moment: 13274 ft-lb
4.5 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Controlling Shear: 4720 lb
At a distance d from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Comparisons with required sections:	Req'd	Provided
Section Modulus:	68.44 in3	82.26 in3
Area (Shear):	22.84 in2	41.56 in2
Moment of Inertia (deflection):	277.42 in4	488.41 in4
Moment:	13274 ft-lb	15953 ft-lb
Shear:	4720 lb	8590 lb

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project: 19-002 Framing - Duplex

Location: PST-MLB2-7
Column
[2015 International Building Code(2015 NDS)]
(2) 1.5 IN x 3.5 IN x 9.08 FT
#2 - Douglas-Fir-Larch - Dry Use
Section Adequate By: 78.9%

David L. Starkel
Pacific Northwest Structural Group, LLC
6193 NE Malbon Ct.
Kingston, WA 98346

StruCalc Version 10.0.1.6 6/21/2019 4:03:47 PM

CAUTIONS
* Laminations to be nailed together per National Design Specifications for Wood Construction Section 15.3.3.1

VERTICAL REACTIONS

Live Load:	Vert-LL-Rxn =	382	lb
Dead Load:	Vert-DL-Rxn =	74	lb
Total Load:	Vert-TL-Rxn =	456	lb

COLUMN DATA

Total Column Length:	9.08	ft
Unbraced Length (X-Axis) Lx:	9.08	ft
Unbraced Length (Y-Axis) Ly:	9.08	ft
Column End Condition-K (e):	1	
Axial Load Duration Factor	1.00	

COLUMN PROPERTIES
#2 - Douglas-Fir-Larch

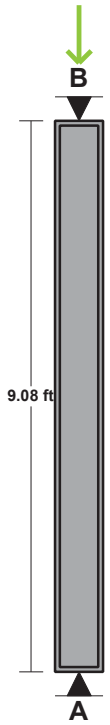
	Base Values	Adjusted
Compressive Stress:	Fc = 1350 psi	Fc' = 205 psi
	Cd=1.00 Cf=1.15 Cp=0.13	
Bending Stress (X-X Axis):	Fbx = 900 psi	Fbx' = 1350 psi
	Cd=1.00 CF=1.50	
Bending Stress (Y-Y Axis):	Fby = 900 psi	Fby' = 1350 psi
	Cd=1.00 CF=1.50	
Modulus of Elasticity:	E = 1600 ksi	E' = 1600 ksi

Column Section (X-X Axis):	dx =	3.5	in
Column Section (Y-Y Axis):	dy =	3	in
Area:	A =	10.5	in2
Section Modulus (X-X Axis):	Sx =	6.13	in3
Section Modulus (Y-Y Axis):	Sy =	2.63	in3
Slenderness Ratio:	Lex/dx =	31.13	
	Ley/dy =	36.32	

Column Calculations (Controlling Case Only):
Controlling Load Case: Axial Total Load Only (L + D)

Actual Compressive Stress:	Fc =	43	psi
Allowable Compressive Stress:	Fc' =	205	psi
Eccentricity Moment (X-X Axis):	Mx-ex =	0	ft-lb
Eccentricity Moment (Y-Y Axis):	My-ey =	0	ft-lb
Moment Due to Lateral Loads (X-X Axis):	Mx =	0	ft-lb
Moment Due to Lateral Loads (Y-Y Axis):	My =	0	ft-lb
Bending Stress Lateral Loads Only (X-X Axis):	Fbx =	0	psi
Allowable Bending Stress (X-X Axis):	Fbx' =	1350	psi
Bending Stress Lateral Loads Only (Y-Y Axis):	Fby =	0	psi
Allowable Bending Stress (Y-Y Axis):	Fby' =	1350	psi
Combined Stress Factor:	**CSF =**	**0.21**	

LOADING DIAGRAM



AXIAL LOADING

Live Load:	PL =	382	lb *
Dead Load:	PD =	53	lb *
Column Self Weight:	CSW =	21	lb
Total Axial Load:	PT =	456	lb

* Load obtained from Load Tracker. See Summary Report for details.

NOTES

Established Basic Permit#
19-03650

Permit Number: 20-04898

Pacific Northwest Structural Group, LLC				
	Project:	Red Barn Lane - Duplex 1880/1620	By:	DLS
	Location:	NW Hogan Ln & Nels Nelson Rd NW, Bremerton, WA 98311	Project No.:	19-002
	Client:	Envision Northwest, LLC	*Last Update:*	22-Feb-19
	AWC SDPWS-2008 - Wood Shear Wall Design Aid ALLOWABLE STRESS DESIGN			

Mark	Sheating Type, Nail Size, Panel Edges Fastener Spacing, & Capacity	Capacity (plf)
A	15/32" Sheathing W/ 8d @ 6" oc	365
B	15/32" Sheathing W/ 8d @ 4" oc	533
C	15/32" Sheathing W/ 8d @ 3" oc	685
	None	#N/A
	None	#N/A
	None	#N/A

Mark	Simpson Strong-Tie Holdowns	Capacity (lb)	Holdown Deflection at Highest Load (in)	
1	HDU2-SDS2.5 W/ 3" Post	3,075	0.088	
2	HDU5-SDS2.5 W/ 3" Post	5,645	0.115	
	None	N/A	N/A	○ SEISMIC
	None	N/A	N/A	◉ WIND
	None	N/A	N/A	
	None	N/A	N/A	
	None	N/A	N/A	
	None	N/A	N/A	
	None	N/A	N/A	
	None	N/A	N/A	
	None	N/A	N/A	
	None	N/A	N/A	

Shear Wall Deflection		
G	90,000	psi
E	1,200,000	psi
A	8.25	in^2

Established Basic Permit#
19-03650

Permit Number: 20-04898

3rd Level

Lateral Trib. Width	ft	10.0
V from above	k	-
Uniform v this level	plf	101.3
Total Wall Length	ft	31.92
V this level	k	1.0
V accum.	k	1.0
Unit Wall Shear	plf	32
Shear Wall Capcity	plf	365
Demand vs. Capcity Ratio		0.09
Apparent Stiffness, Ga	K/in	10.00

Shearwall Type: A

Overturning Moment

		Wall 1	Wall 2	Wall 3	Wall 4	Wall 5	Wall 6
M_{OT} from above	k-ft						
Story Ht	ft	8.08	8.08	8.08	8.08	8.08	-
Length	ft	6.00	8.25	3.92	6.92	6.83	-
Diaphragm Ratio		1.35	0.98	2.06	1.17	1.18	-
Modified Capacity		365	365	365	365	365	NA
M_{OT}	k-ft	1.5	2.1	1.0	1.8	1.8	-
M_{OT} accum	k-ft	1.5	2.1	1.0	1.8	1.8	-

Shear Wall Defection

Δ_B	in	0.027	0.020	0.041	0.023	0.024	-
Δ_V	in	0.246	0.246	0.246	0.246	0.246	-
Δ_{HD}	in	-	-	-	-	-	-
Δ_{SW}	in	0.273	0.265	0.287	0.269	0.270	-

Resisting Moment

M_R from above		k-ft	-	-	-	-	-	-
Distr Wts.	Wall Wt	psf	11.0	11.0	11.0	11.0	11.0	-
	Trib above	ft	11.0	11.0	11.0	11.0	11.0	-
	Wt above	psf	15.0	15.0	15.0	15.0	15.0	-
End Wts.	Hdr. Trib	ft	-	-	-	-	-	-
	tnb to hdr	ft	-	-	-	-	-	-
	Wt to hdr	psf	-	-	-	-	-	-
Perp. Wall Wts.	Dist to wall	ft	6.00	8.25	3.92	6.92	6.83	-
	Wt of wall	lb	350	350	375	350	350	-
	Dist to wall	ft	-	-	-	-	-	-
	Wt of wall	lb	-	-	-	-	-	-
M_R this level		k-ft	6.67	11.53	3.42	8.50	8.31	-
M_R accum		k-ft	6.67	11.53	3.42	8.50	8.31	-

Hold Down Forces

Wt. Reduction		0.60	0.60	0.60	0.60	0.60	0.60
T_R accum	k	1.11	1.40	0.87	1.23	1.22	-
HD Offset	ft	-	-	-	-	-	-
HD Force	k	-	-	-	-	-	-
HD Capacity	k	-	-	-	-	-	-
Hold Down Type		-	-	-	-	-	-

2nd Level

Lateral Trib. Width	ft	10.0
V from above	k	1.0
Uniform v this level	plf	96.1
Total Wall Length	ft	30.42
V this level	k	1.0
V accum.	k	2.0
Unit Wall Shear	plf	65
Shear Wall Capcity	plf	365
Demand vs. Capcity Ratio		0.18
Apparent Stiffness, Ga	K/in	10.00

Shearwall Type: A

Overturning Moment

		Wall 1	Wall 2	Wall 3	Wall 4	Wall 5	Wall 6
M_{OT} from above	k-ft	1.5	2.1	1.0	1.8	1.8	-
Story Ht	ft	9.08	9.08	9.08	9.08	9.08	-
Length	ft	6.00	4.00	4.17	9.42	6.83	-
Diaphragm Ratio		1.51	2.27	2.18	0.96	1.33	-
Modified Capacity		365	365	365	365	365	NA
M_{OT}	k-ft	3.5	2.4	2.5	5.6	4.0	-
M_{OT} accum	k-ft	5.1	4.5	3.5	7.3	5.8	-

Shear Wall Defection

Δ_B	in	0.079	0.118	0.113	0.050	0.069	-
Δ_V	in	0.276	0.276	0.276	0.276	0.276	-
Δ_{HD}	in	-	-	-	-	-	-
Δ_{SW}	in	0.355	0.394	0.389	0.326	0.345	-

Resisting Moment

M_R from above		k-ft	6.7	11.5	3.4	8.5	8.3	-
Distr Wts.	Wall Wt	psf	11.0	11.0	11.0	11.0	11.0	-
	Trib above	ft	10.0	10.0	10.0	10.0	10.0	-
	Wt above	psf	15.0	15.0	15.0	15.0	15.0	-
End Wts.	Hdr. Trib	ft	-	-	-	-	-	-
	tnb to hdr	ft	-	-	-	-	-	-
	Wt to hdr	psf	-	-	-	-	-	-
Perp. Wall Wts.	Dist to wall	ft	6.00	4.00	4.17	9.42	6.83	-
	Wt of wall	lb	500	-	650	500	500	-
	Dist to wall	ft	-	-	-	-	-	-
	Wt of wall	lb	-	-	-	-	-	-
M_R this level		k-ft	7.50	2.00	4.88	15.80	9.24	-
M_R accum		k-ft	14.17	13.53	8.30	24.30	17.56	-

Hold Down Forces

Wt. Reduction		0.60	0.60	0.60	0.60	0.60	0.60
T_R accum	k	2.36	3.38	1.99	2.58	2.57	-
HD Offset	ft	-	-	-	-	-	-
HD Force	k	-	-	-	-	-	-
HD Capacity	k	-	-	-	-	-	-
Hold Down Type		-	-	-	-	-	-

1st Level

Lateral Trib. Width	ft	10.0
V from above	k	2.0
Uniform v this level	plf	96.1
Total Wall Length	ft	36.75
V this level	k	1.0
V accum.	k	2.9
Unit Wall Shear	plf	80
Shear Wall Capcity	plf	365
Demand vs. Capcity Ratio		0.22
Apparent Stiffness, Ga	K/in	10.00

Shearwall Type: A

Overturning Moment

		Wall 1	Wall 2	Wall 3	Wall 4	Wall 5	Wall 6
M_{OT} from above	k-ft	5.1	4.5	3.5	7.3	5.8	-
Story Ht	ft	9.08	-	9.08	9.08	9.08	-
Length	ft	14.33	-	6.17	9.42	6.83	-
Diaphragm Ratio		0.63	-	1.47	0.96	1.33	-
Modified Capacity		365	NA	365	365	365	NA
M_{OT}	k-ft	10.4	-	4.5	6.8	5.0	-
M_{OT} accum	k-ft	15.5	4.5	7.9	14.2	10.7	-

Shear Wall Defection

Δ_B	in	0.040	-	0.094	0.062	0.085	-
Δ_V	in	0.276	-	0.276	0.276	0.276	-
Δ_{HD}	in	-	-	-	-	-	-
Δ_{SW}	in	0.317	-	0.370	0.338	0.361	-

Resisting Moment

M_R from above		k-ft	14.2	13.5	8.3	24.3	17.6	-
Distr Wts.	Wall Wt	psf	11.0	-	11.0	11.0	11.0	-
	Trib above	ft	10.0	-	10.0	10.0	10.0	-
	Wt above	psf	15.0	-	15.0	15.0	15.0	-
End Wts.	Hdr. Trib	ft	-	-	-	-	-	-
	tnb to hdr	ft	-	-	-	-	-	-
	Wt to hdr	psf	-	-	-	-	-	-
Perp. Wall Wts.	Dist to wall	ft	11.50	-	6.17	9.42	6.83	-
	Wt of wall	lb	250	-	250	250	250	-
	Dist to wall	ft	-	-	-	-	-	-
	Wt of wall	lb	-	-	-	-	-	-
M_R this level		k-ft	28.53	-	6.30	13.44	7.54	-
M_R accum		k-ft	42.70	13.53	14.60	37.74	25.09	-

Hold Down Forces

Wt. Reduction		0.60	0.60	0.60	0.60	0.60	0.60
T_R accum	k	2.98	-	2.37	4.01	3.67	-
HD Offset	ft	-	-	-	-	-	-
HD Force	k	-	-	-	-	-	-
HD Capacity	k	-	-	-	-	-	-
Hold Down Type		-	-	-	-	-	-

Project:	Red Barn Lane - Duplex 1880/1620
Location:	LF-1
Client:	Envision Northwest, LLC
By:	DLS
Job No.:	19-002
Last Update:	22-Feb-2019

Wood Shear Wall Design Aid

Comments:

6/21/2019 4:08 PM
C:\Users\dlsta\Dropbox\PNW Project Files\2019 Projects\19-002 Red Barn Lane Single Family & Duplex\ENGR\19-002 Timber Shear Wall 2018 - Duplex.xlsx\LF-1

Established Basic Permit#
19-03650

Permit Number: 20-04898

3rd Level

Lateral Trib. Width	ft	20.0
V from above	k	-
Uniform v this level	plf	101.3
Total Wall Length	ft	24.00
V this level	k	2.0
V accum.	k	2.0
Unit Wall Shear	plf	84
Shear Wall Capcity	plf	365
Demand vs. Capcity Ratio		0.23
Apparent Stiffness, Ga	K/in	10.00

Shearwall Type: A

Overturning Moment

		Wall 1	Wall 2	Wall 3	Wall 4	Wall 5	Wall 6
M_{OT} from above	k-ft						
Story Ht	ft	8.08	8.08	-	-	-	-
Length	ft	12.00	12.00	-	-	-	-
Diaphragm Ratio		0.67	0.67	-	-	-	-
Modified Capacity		365	365	NA	NA	NA	NA
M_{OT}	k-ft	8.2	8.2	-	-	-	-
M_{OT} accum	k-ft	8.2	8.2	-	-	-	-

Shear Wall Defection

Δ_B	in	0.036	0.036	-	-	-	-
Δ_V	in	0.246	0.246	-	-	-	-
Δ_{HD}	in	-	-	-	-	-	-
Δ_{SW}	in	0.282	0.282	-	-	-	-

Resisting Moment

M_R from above		k-ft	-	-	-	-	-	-
Distr Wts.	Wall Wt	psf	11.0	11.0	-	-	-	-
	Trib above	ft	10.0	10.0	-	-	-	-
	Wt above	psf	15.0	15.0	-	-	-	-
End Wts.	Hdr. Trib	ft	-	-	-	-	-	-
	tnb to hdr	ft	-	-	-	-	-	-
	Wt to hdr	psf	-	-	-	-	-	-
Perp. Wall Wts.	Dist to wall	ft	12.00	12.00	-	-	-	-
	Wt of wall	lb	350	350	-	-	-	-
	Dist to wall	ft	-	-	-	-	-	-
	Wt of wall	lb	-	-	-	-	-	-
M_R this level		k-ft	21.40	21.40	-	-	-	-
M_R accum		k-ft	21.40	21.40	-	-	-	-

Hold Down Forces

Wt. Reduction		0.60	0.60	0.60	0.60	0.60	0.60
T_R accum	k	1.78	1.78	-	-	-	-
HD Offset	ft	-	-	-	-	-	-
HD Force	k	-	-	-	-	-	-
HD Capacity	k	-	-	-	-	-	-
Hold Down Type		-	-	-	-	-	-

2nd Level

Lateral Trib. Width	ft	20.0
V from above	k	2.0
Uniform v this level	plf	96.1
Total Wall Length	ft	24.00
V this level	k	1.9
V accum.	k	3.9
Unit Wall Shear	plf	165
Shear Wall Capcity	plf	365
Demand vs. Capcity Ratio		0.45
Apparent Stiffness, Ga	K/in	10.00

Shearwall Type: A

Overturning Moment

		Wall 1	Wall 2	Wall 3	Wall 4	Wall 5	Wall 6
M_{OT} from above	k-ft	8.2	8.2	-	-	-	-
Story Ht	ft	9.08	9.08	9.08	9.08	9.08	-
Length	ft	12.00	12.00	-	-	-	-
Diaphragm Ratio		0.76	0.76	-	-	-	-
Modified Capacity		365	365	NA	NA	NA	NA
M_{OT}	k-ft	17.9	17.9	-	-	-	-
M_{OT} accum	k-ft	26.1	26.1	-	-	-	-

Shear Wall Defection

Δ_B	in	0.100	0.100	-	-	-	-
Δ_V	in	0.276	0.276	-	-	-	-
Δ_{HD}	in	-	-	-	-	-	-
Δ_{SW}	in	0.376	0.376	-	-	-	-

Resisting Moment

M_R from above		k-ft	21.4	21.4	-	-	-	-
Distr Wts.	Wall Wt	psf	11.0	11.0	-	-	-	-
	Trib above	ft	10.0	10.0	-	-	-	-
	Wt above	psf	15.0	15.0	-	-	-	-
End Wts.	Hdr. Trib	ft	-	-	-	-	-	-
	tnb to hdr	ft	-	-	-	-	-	-
	Wt to hdr	psf	-	-	-	-	-	-
Perp. Wall Wts.	Dist to wall	ft	12.00	12.00	-	-	-	-
	Wt of wall	lb	500	500	-	-	-	-
	Dist to wall	ft	-	-	-	-	-	-
	Wt of wall	lb	-	-	-	-	-	-
M_R this level		k-ft	23.99	23.99	-	-	-	-
M_R accum		k-ft	45.39	45.39	-	-	-	-

Hold Down Forces

Wt. Reduction		0.60	0.60	0.60	0.60	0.60	0.60
T_R accum	k	3.78	3.78	-	-	-	-
HD Offset	ft	-	-	-	-	-	-
HD Force	k	-	-	-	-	-	-
HD Capacity	k	-	-	-	-	-	-
Hold Down Type		-	-	-	-	-	-

1st Level

Lateral Trib. Width	ft	20.0
V from above	k	3.9
Uniform v this level	plf	96.1
Total Wall Length	ft	24.00
V this level	k	1.9
V accum.	k	5.9
Unit Wall Shear	plf	245
Shear Wall Capcity	plf	365
Demand vs. Capcity Ratio		0.67
Apparent Stiffness, Ga	K/in	10.00

Shearwall Type: A

Overturning Moment

		Wall 1	Wall 2	Wall 3	Wall 4	Wall 5	Wall 6
M_{OT} from above	k-ft	26.1	26.1	-	-	-	-
Story Ht	ft	9.08	9.08	-	-	-	-
Length	ft	12.00	12.00	-	-	-	-
Diaphragm Ratio		0.76	0.76	-	-	-	-
Modified Capacity		365	365	NA	NA	NA	NA
M_{OT}	k-ft	26.6	26.6	-	-	-	-
M_{OT} accum	k-ft	52.8	52.8	-	-	-	-

Shear Wall Defection

Δ_B	in	0.148	0.148	-	-	-	-
Δ_V	in	0.276	0.276	-	-	-	-
Δ_{HD}	in	0.067	0.067	-	-	-	-
Δ_{SW}	in	0.491	0.491	-	-	-	-

Resisting Moment

M_R from above		k-ft	45.4	45.4	-	-	-	-
Distr Wts.	Wall Wt	psf	11.0	11.0	-	-	-	-
	Trib above	ft	10.0	10.0	-	-	-	-
	Wt above	psf	15.0	15.0	-	-	-	-
End Wts.	Hdr. Trib	ft	-	-	-	-	-	-
	tnb to hdr	ft	-	-	-	-	-	-
	Wt to hdr	psf	-	-	-	-	-	-
Perp. Wall Wts.	Dist to wall	ft	10.00	10.00	-	-	-	-
	Wt of wall	lb	750	750	-	-	-	-
	Dist to wall	ft	-	-	-	-	-	-
	Wt of wall	lb	-	-	-	-	-	-
M_R this level		k-ft	25.49	25.49	-	-	-	-
M_R accum		k-ft	70.88	70.88	-	-	-	-

Hold Down Forces

Wt. Reduction		0.60	0.60	0.60	0.60	0.60	0.60
T_R accum	k	5.91	5.91	-	-	-	-
HD Offset	ft	-	-	-	-	-	-
HD Force	k	0.85	0.85	-	-	-	-
HD Capacity	k	3.08	3.08	-	-	-	-
Hold Down Type		I	I	-	-	-	-

Project:	Red Barn Lane - Duplex 1880/1620
Location:	LF-2
Client:	Envision Northwest, LLC
By:	DLS
Job No.:	19-002
Last Update:	22-Feb-2019

Wood Shear Wall Design Aid

Comments:

6/21/2019 4:08 PM
C:\Users\dlsta\Dropbox\PNW Project Files\2019 Projects\19-002 Red Barn Lane Single Family & Duplex\ENGR\19-002 Timber Shear Wall 2018 - Duplex.xlsx\LF-2

Established Basic Permit#
19-03650

Permit Number: 20-04898

3rd Level

Lateral Trib. Width	ft	10.0
V from above	k	-
Uniform v this level	plf	101.3
Total Wall Length	ft	32.41
V this level	k	1.0
V accum.	k	1.0
Unit Wall Shear	plf	31
Shear Wall Capcity	plf	365
Demand vs. Capcity Ratio		0.09
Apparent Stiffness, Ga	K/in	10.00

Shearwall Type: A

Overturning Moment

		Wall 1	Wall 2	Wall 3	Wall 4	Wall 5	Wall 6
M_{OT} from above	k-ft						
Story Ht	ft	8.08	-	8.08	-	8.08	-
Length	ft	9.00	-	11.83	-	11.58	-
Diaphragm Ratio		0.90	-	0.68	-	0.70	-
Modified Capacity		365	NA	365	NA	365	NA
M_{OT}	k-ft	2.3	-	3.0	-	2.9	-
M_{OT} accum	k-ft	2.3	-	3.0	-	2.9	-

Shear Wall Defection

Δ_B	in	0.018	-	0.014	-	0.014	-
Δ_V	in	0.246	-	0.246	-	0.246	-
Δ_{HD}	in	-	-	-	-	-	-
Δ_{SW}	in	0.264	-	0.259	-	0.260	-

Resisting Moment

M_R from above		k-ft	-	-	-	-	-	-
Distr Wall Wts.	Wall Wt	psf	11.0	-	11.0	-	11.0	-
	Trib above	ft	11.0	-	11.0	-	11.0	-
	Wt above	psf	15.0	-	15.0	-	15.0	-
End Wall Wts.	Hdr. Trib	ft	-	-	-	-	-	-
	tnb to hdr	ft	-	-	-	-	-	-
	Wt to hdr	psf	-	-	-	-	-	-
Perp. Wall Wts.	Dist to wall	ft	9.00	-	11.83	-	-	-
	Wt of wall	lb	-	-	-	-	-	-
	Dist to wall	ft	-	-	-	-	-	-
	Wt of wall	lb	-	-	-	-	-	-
M_R this level		k-ft	10.28	-	17.77	-	17.02	-
M_R accum		k-ft	10.28	-	17.77	-	17.02	-

Hold Down Forces

Wt. Reduction		0.60	0.60	0.60	0.60	0.60	0.60
T_R accum	k	1.14	-	1.50	-	1.47	-
HD Offset	ft	-	-	-	-	-	-
HD Force	k	-	-	-	-	-	-
HD Capacity	k	-	-	-	-	-	-
Hold Down Type		-	-	-	-	-	-

2nd Level

Lateral Trib. Width	ft	10.0
V from above	k	1.0
Uniform v this level	plf	96.1
Total Wall Length	ft	23.24
V this level	k	1.0
V accum.	k	2.0
Unit Wall Shear	plf	85
Shear Wall Capcity	plf	365
Demand vs. Capcity Ratio		0.23
Apparent Stiffness, Ga	K/in	10.00

Shearwall Type: A

Overturning Moment

		Wall 1	Wall 2	Wall 3	Wall 4	Wall 5	Wall 6
M_{OT} from above	k-ft	2.3	-	3.0	-	2.9	-
Story Ht	ft	9.08	-	9.08	9.08	9.08	-
Length	ft	2.75	-	4.33	4.58	11.58	-
Diaphragm Ratio		3.30	-	2.10	1.98	0.78	-
Modified Capacity		365	NA	365	365	365	NA
M_{OT}	k-ft	2.1	-	3.3	3.5	8.9	-
M_{OT} accum	k-ft	4.4	-	6.3	3.5	11.9	-

Shear Wall Defection

Δ_B	in	0.224	-	0.142	0.135	0.053	-
Δ_V	in	0.276	-	0.276	0.276	0.276	-
Δ_{HD}	in	-	-	-	0.174	-	-
Δ_{SW}	in	0.500	-	0.419	0.585	0.329	-

Resisting Moment

M_R from above		k-ft	10.3	-	17.8	-	17.0	-
Distr Wall Wts.	Wall Wt	psf	11.0	-	11.0	11.0	11.0	-
	Trib above	ft	11.0	-	11.0	11.0	11.0	-
	Wt above	psf	15.0	-	15.0	15.0	15.0	-
End Wall Wts.	Hdr. Trib	ft	-	-	-	-	-	-
	tnb to hdr	ft	-	-	-	-	-	-
	Wt to hdr	psf	-	-	-	-	-	-
Perp. Wall Wts.	Dist to wall	ft	2.75	-	4.33	4.58	11.58	-
	Wt of wall	lb	500	-	500	500	500	-
	Dist to wall	ft	-	-	-	-	-	-
	Wt of wall	lb	-	-	-	-	-	-
M_R this level		k-ft	2.38	-	4.65	5.07	23.55	-
M_R accum		k-ft	12.66	-	22.41	5.07	40.57	-

Hold Down Forces

Wt. Reduction		0.60	0.60	0.60	0.60	0.60	0.60
T_R accum	k	4.60	-	5.18	1.11	3.50	-
HD Offset	ft	-	-	-	-	-	-
HD Force	k	-	-	-	0.11	-	-
HD Capacity	k	-	-	-	3.08	-	-
Hold Down Type		-	-	-	I	-	-

1st Level

Lateral Trib. Width	ft	10.0
V from above	k	2.0
Uniform v this level	plf	96.1
Total Wall Length	ft	36.83
V this level	k	1.0
V accum.	k	2.9
Unit Wall Shear	plf	80
Shear Wall Capcity	plf	365
Demand vs. Capcity Ratio		0.22
Apparent Stiffness, Ga	K/in	10.00

Shearwall Type: A

Overturning Moment

		Wall 1	Wall 2	Wall 3	Wall 4	Wall 5	Wall 6
M_{OT} from above	k-ft	4.4	-	6.3	3.5	11.9	-
Story Ht	ft	8.08	-	8.08	-	8.08	-
Length	ft	16.33	-	2.58	-	17.92	-
Diaphragm Ratio		0.49	-	3.13	-	0.45	-
Modified Capacity		365	NA	365	NA	365	NA
M_{OT}	k-ft	10.5	-	1.7	-	11.5	-
M_{OT} accum	k-ft	14.9	-	8.0	3.5	23.4	-

Shear Wall Defection

Δ_B	in	0.025	-	0.158	-	0.023	-
Δ_V	in	0.246	-	0.246	-	0.246	-
Δ_{HD}	in	-	-	-	-	-	-
Δ_{SW}	in	0.271	-	0.404	-	0.269	-

Resisting Moment

M_R from above		k-ft	12.7	-	22.4	5.1	40.6	-
Distr Wall Wts.	Wall Wt	psf	11.0	-	11.0	-	11.0	-
	Trib above	ft	11.0	-	11.0	-	11.0	-
	Wt above	psf	15.0	-	15.0	-	15.0	-
End Wall Wts.	Hdr. Trib	ft	-	-	-	-	-	-
	tnb to hdr	ft	-	-	-	-	-	-
	Wt to hdr	psf	-	-	-	-	-	-
Perp. Wall Wts.	Dist to wall	ft	17.00	-	2.58	-	17.92	-
	Wt of wall	lb	1,000	-	1,000	-	1,000	-
	Dist to wall	ft	-	-	-	-	-	-
	Wt of wall	lb	-	-	-	-	-	-
M_R this level		k-ft	50.85	-	3.42	-	58.68	-
M_R accum		k-ft	63.51	-	25.84	5.07	99.26	-

Hold Down Forces

Wt. Reduction		0.60	0.60	0.60	0.60	0.60	0.60
T_R accum	k	3.89	-	10.01	-	5.54	-
HD Offset	ft	-	-	-	-	-	-
HD Force	k	-	-	-	-	-	-
HD Capacity	k	-	-	-	-	-	-
Hold Down Type		-	-	-	-	-	-

Project:	Red Barn Lane - Duplex 1880/1620
Location:	LF-3
Client:	Envision Northwest, LLC
By:	DLS
Job No.:	19-002
Last Update:	22-Feb-2019

Wood Shear Wall Design Aid

Comments: See Perforated Shear Calculations

6/21/2019 4:08 PM
C:\Users\dlsta\Dropbox\PNW Project Files\2019 Projects\19-002 Red Barn Lane Single Family & Duplex\ENGR\19-002 Timber Shear Wall 2018 - Duplex.xlsx\LF-3

Established Basic Permit#
19-03650

Permit Number: 20-04898

2rd Level

Lateral Trib. Width	ft	20.5
V from above	k	-
Uniform v this level	plf	132.0
Total Wall Length	ft	16.34
V this level	k	2.7
V accum.	k	2.7
Unit Wall Shear	plf	166
Shear Wall Capcity	plf	365
Demand vs. Capcity Ratio		0.45
Apparent Stiffness, Ga	K/in	10.00

Shearwall Type: A

Overturning Moment

		Wall 1	Wall 2	Wall 3	Wall 4	Wall 5	Wall 6
M_{OT} from above	k-ft	-	-	-	-	-	-
Story Ht	ft	8.08	8.08	8.08	8.08	-	-
Length	ft	4.50	4.50	3.67	3.67	-	-
Diaphragm Ratio		1.80	1.80	2.20	2.20	-	-
Modified Capacity		365	365	365	365	NA	NA
M_{OT}	k-ft	6.0	6.0	4.9	4.9	-	-
M_{OT} accum	k-ft	6.0	6.0	4.9	4.9	-	-

Shear Wall Defection

Δ_B	in	0.188	0.188	0.231	0.231	-	-
Δ_V	in	0.246	0.246	0.246	0.246	-	-
Δ_{HD}	in	0.158	0.158	0.194	0.194	-	-
Δ_{SW}	in	0.592	0.592	0.670	0.670	-	-

Resisting Moment

M_R from above		k-ft	-	-	-	-	-	-
Distr. Wts.	Wall Wt	psf	11.0	11.0	11.0	11.0	-	-
	Trib above	ft	6.0	6.0	6.0	6.0	-	-
	Wt above	psf	15.0	15.0	15.0	15.0	-	-
End Wts.	Hdr. Trib	ft	-	-	-	-	-	-
	trib to hdr	ft	-	-	-	-	-	-
	Wt to hdr	psf	-	-	-	-	-	-
Perp. Wall Wts.	Dist to wall	ft	4.50	4.50	3.67	3.67	-	-
	Wt of wall	lb	250	250	250	250	-	-
	Dist to wall	ft	-	-	-	-	-	-
	Wt of wall	lb	-	-	-	-	-	-
M_R this level		k-ft	2.94	2.94	2.12	2.12	-	-
M_R accum		k-ft	2.94	2.94	2.12	2.12	-	-

Hold Down Forces

Wt. Reduction		0.60	0.60	0.60	0.60	0.60	0.60
T_R accum	k	0.65	0.65	0.58	0.58	-	-
HD Offset	ft	-	-	-	-	-	-
HD Force	k	0.95	0.95	0.99	0.99	-	-
HD Capacity	k	3.08	3.08	3.08	3.08	-	-
Hold Down Type		1	1	1	1	-	-

1st Level

Lateral Trib. Width	ft	20.5
V from above	k	2.7
Uniform v this level	plf	178.9
Total Wall Length	ft	10.66
V this level	k	3.7
V accum.	k	6.4
Unit Wall Shear	plf	598
Shear Wall Capcity	plf	685
Demand vs. Capcity Ratio		0.87
Apparent Stiffness, Ga	K/in	15.00

Shearwall Type: C

Overturning Moment

		Wall 1	Wall 2	Wall 3	Wall 4	Wall 5	Wall 6
M_{OT} from above	k-ft	-	-	-	-	-	-
Story Ht	ft	9.09	9.09	9.09	9.09	-	-
Length	ft	3.58	3.58	1.75	1.75	-	-
Diaphragm Ratio		2.54	2.54	5.19	5.19	-	-
Modified Capacity		685	685	685	685	NA	NA
M_{OT}	k-ft	19.5	19.5	9.5	9.5	-	-
M_{OT} accum	k-ft	19.5	19.5	9.5	9.5	-	-

Shear Wall Defection

Δ_B	in	1.216	1.216	2.488	2.488	-	-
Δ_V	in	0.519	0.519	0.519	0.519	-	-
Δ_{HD}	in	0.292	0.292	0.597	0.597	-	-
Δ_{SW}	in	2.027	2.027	3.605	3.605	-	-

Resisting Moment

M_R from above		k-ft	2.9	2.9	2.1	2.1	-	-
Distr. Wts.	Wall Wt	psf	11.0	11.0	11.0	11.0	-	-
	Trib above	ft	6.0	6.0	6.0	6.0	-	-
	Wt above	psf	15.0	15.0	15.0	15.0	-	-
End Wts.	Hdr. Trib	ft	-	-	-	-	-	-
	trib to hdr	ft	-	-	-	-	-	-
	Wt to hdr	psf	-	-	-	-	-	-
Perp. Wall Wts.	Dist to wall	ft	3.58	3.58	1.75	1.83	-	-
	Wt of wall	lb	500	500	500	500	-	-
	Dist to wall	ft	-	-	-	-	-	-
	Wt of wall	lb	-	-	-	-	-	-
M_R this level		k-ft	3.01	3.01	1.17	1.21	-	-
M_R accum		k-ft	5.94	5.94	3.29	3.33	-	-

Hold Down Forces

Wt. Reduction		0.60	0.60	0.60	0.60	0.60	0.60
T_R accum	k	1.66	1.66	1.88	1.90	-	-
HD Offset	ft	-	-	-	-	-	-
HD Force	k	4.44	4.44	4.31	4.29	-	-
HD Capacity	k	5.65	5.65	5.65	5.65	-	-
Hold Down Type		2	2	2	2	-	-

Project:	Red Barn Lane - Duplex 1880/1620	By:	DLS
Location:	(Enter Shear Wall Line)	Job No.:	19-002
Client:	Envision Northwest, LLC	Last Update:	22-Feb-19

Wood Shear Wall Design Aid

Comments: See Perforated Shear Calculations & FTAO for 2nd Floor

6/21/2019 4:08 PM
C:\Users\dlsta\Dropbox\PNW Project Files\2019 Projects\19-002 Red Barn Lane Single Family & Duplex\ENGR\19-002 Timber Shear Wall 2018 - Duplex.xlsx\TF-1

Established Basic Permit#
19-03650

Permit Number: 20-04898

3rd Level

Lateral Trib. Width	ft	20.5
V from above	k	-
Uniform v this level	plf	132.0
Total Wall Length	ft	19.42
V this level	k	2.7
V accum.	k	2.7
Unit Wall Shear	plf	139
Shear Wall Capcity	plf	365
Demand vs. Capcity Ratio		0.38
Apparent Stiffness, Ga	K/in	10.00

Shearwall Type: A

Overturning Moment

		Wall 1	Wall 2	Wall 3	Wall 4	Wall 5	Wall 6
M_{OT} from above	k-ft						
Story Ht	ft	8.08	8.08	8.08	8.08	-	-
Length	ft	4.00	3.92	3.00	8.50	-	-
Diaphragm Ratio		2.02	2.06	2.69	0.95	-	-
Modified Capacity		365	365	365	365	NA	NA
M_{OT}	k-ft	4.5	4.4	3.4	9.6	-	-
M_{OT} accum	k-ft	4.5	4.4	3.4	9.6	-	-

Shear Wall Defection

Δ_B	in	0.178	0.182	0.238	0.084	-	-
Δ_V	in	0.246	0.246	0.246	0.246	-	-
Δ_{HD}	in	0.178	0.181	0.237	0.084	-	-
Δ_{SW}	in	0.602	0.609	0.720	0.413	-	-

Resisting Moment

M_R from above		k-ft	-	-	-	-	-	-
Distr Wall Wts.	Wall Wt	psf	11.0	11.0	11.0	11.0	-	-
	Trib above	ft	6.0	6.0	6.0	6.0	-	-
	Wt above	psf	15.0	15.0	15.0	15.0	-	-
End Wts.	Hdr. Trib	ft	-	-	-	-	-	-
	tnb to hdr	ft	-	-	-	-	-	-
	Wt to hdr	psf	-	-	-	-	-	-
Perp. Wall Wts.	Dist to wall	ft	4.00	3.92	3.00	8.50	-	-
	Wt of wall	lb	250	250	250	250	-	-
	Dist to wall	ft	-	-	-	-	-	-
	Wt of wall	lb	-	-	-	-	-	-
M_R this level		k-ft	2.43	2.35	1.55	8.59	-	-
M_R accum		k-ft	2.43	2.35	1.55	8.59	-	-

Hold Down Forces

Wt. Reduction		0.60	0.60	0.60	0.60	0.60	0.60
T_R accum	k	0.61	0.60	0.52	1.01	-	-
HD Offset	ft	-	-	-	-	-	-
HD Force	k	0.76	0.77	0.81	0.52	-	-
HD Capacity	k	3.08	3.08	3.08	3.08	-	-
Hold Down Type		1	1	1	1	-	-

2nd Level

Lateral Trib. Width	ft	20.5
V from above	k	2.7
Uniform v this level	plf	178.9
Total Wall Length	ft	14.83
V this level	k	3.7
V accum.	k	6.4
Unit Wall Shear	plf	430
Shear Wall Capcity	plf	533
Demand vs. Capcity Ratio		0.81
Apparent Stiffness, Ga	K/in	13.00

Shearwall Type: B

Overturning Moment

		Wall 1	Wall 2	Wall 3	Wall 4	Wall 5	Wall 6
M_{OT} from above	k-ft	4.5	4.4	3.4	9.6	-	-
Story Ht	ft	9.08	9.08	9.08	9.08	9.08	-
Length	ft	2.83	-	7.50	2.50	2.00	-
Diaphragm Ratio		3.21	-	1.21	**3.63**	**4.54**	-
Modified Capacity		533	NA	533	533	533	NA
M_{OT}	k-ft	11.0	-	29.3	9.8	7.8	-
M_{OT} accum	k-ft	15.5	4.4	32.6	19.3	7.8	-

Shear Wall Defection

Δ_B	in	1.102	-	0.416	1.248	1.560	-
Δ_V	in	0.403	-	0.403	0.403	0.403	-
Δ_{HD}	in	0.369	-	0.139	0.418	0.522	-
Δ_{SW}	in	1.874	-	0.958	2.069	2.485	-

Resisting Moment

M_R from above		k-ft	2.4	2.4	1.6	8.6	-	-
Distr Wall Wts.	Wall Wt	psf	11.0	11.0	11.0	11.0	-	-
	Trib above	ft	6.0	6.0	6.0	6.0	-	-
	Wt above	psf	15.0	15.0	15.0	15.0	-	-
End Wts.	Hdr. Trib	ft	-	-	-	-	-	-
	tnb to hdr	ft	-	-	-	-	-	-
	Wt to hdr	psf	-	-	-	-	-	-
Perp. Wall Wts.	Dist to wall	ft	2.83	5.75	7.50	5.83	-	-
	Wt of wall	lb	500	500	500	500	-	-
	Dist to wall	ft	-	-	-	-	-	-
	Wt of wall	lb	-	-	-	-	-	-
M_R this level		k-ft	2.18	2.88	9.09	3.51	-	-
M_R accum		k-ft	4.61	5.23	10.65	12.10	-	-

Hold Down Forces

Wt. Reduction		0.60	0.60	0.60	0.60	0.60	0.60
T_R accum	k	1.63	-	1.42	4.84	-	-
HD Offset	ft	-	-	-	-	-	-
HD Force	k	4.52	-	3.50	4.83	3.90	-
HD Capacity	k	5.65	-	5.65	5.65	5.65	-
Hold Down Type		2	-	2	2	2	-

1st Level

Lateral Trib. Width	ft	20.5
V from above	k	6.4
Uniform v this level	plf	178.9
Total Wall Length	ft	33.91
V this level	k	3.7
V accum.	k	10.0
Unit Wall Shear	plf	296
Shear Wall Capcity	plf	365
Demand vs. Capcity Ratio		0.81
Apparent Stiffness, Ga	K/in	10.00

Shearwall Type: A

Overturning Moment

		Wall 1	Wall 2	Wall 3	Wall 4	Wall 5	Wall 6
M_{OT} from above	k-ft	15.5	4.4	32.6	19.3	7.8	-
Story Ht	ft	-	8.08	8.08	8.08	-	-
Length	ft	-	8.08	20.08	5.75	-	-
Diaphragm Ratio		-	1.00	0.40	1.41	-	-
Modified Capacity		NA	365	365	365	NA	NA
M_{OT}	k-ft	-	19.3	48.0	13.6	-	-
M_{OT} accum	k-ft	15.5	23.7	80.7	33.1	7.8	-

Shear Wall Defection

Δ_B	in	-	0.187	0.075	0.263	-	-
Δ_V	in	-	0.246	0.246	0.246	-	-
Δ_{HD}	in	-	0.088	0.035	0.162	-	-
Δ_{SW}	in	-	0.521	0.357	0.671	-	-

Resisting Moment

M_R from above		k-ft	4.6	5.2	10.6	12.1	-	-
Distr Wall Wts.	Wall Wt	psf	-	-	-	-	-	-
	Trib above	ft	-	11.0	11.0	11.0	-	-
	Wt above	psf	-	6.0	6.0	6.0	-	-
End Wts.	Hdr. Trib	ft	-	15.0	15.0	15.0	-	-
	tnb to hdr	ft	-	-	-	-	-	-
	Wt to hdr	psf	-	-	-	-	-	-
Perp. Wall Wts.	Dist to wall	ft	-	10.58	11.58	8.75	-	-
	Wt of wall	lb	-	750	750	750	-	-
	Dist to wall	ft	-	-	-	-	-	-
	Wt of wall	lb	-	-	-	-	-	-
M_R this level		k-ft	-	10.09	21.99	7.65	-	-
M_R accum		k-ft	4.61	15.32	32.64	19.75	-	-

Hold Down Forces

Wt. Reduction		0.60	0.60	0.60	0.60	0.60	0.60
T_R accum	k	-	1.90	1.63	3.43	-	-
HD Offset	ft	-	-	-	-	-	-
HD Force	k	-	1.80	3.04	3.69	-	-
HD Capacity	k	-	3.08	3.08	5.65	-	-
Hold Down Type		-	1	1	2	-	-

Project: Red Barn Lane - Duplex 1880/1620
Location: TF-2
Client: Envision Northwest, LLC
By: DLS
Job No.: 19-002
Last Update: 22-Feb-2019

Wood Shear Wall Design Aid

Comments: See Perforated Shear Calculations

6/21/2019 4:08 PM
C:\Users\dlsta\Dropbox\PNW Project Files\2019 Projects\19-002 Red Barn Lane Single Family & Duplex\ENGR\19-002 Timber Shear Wall 2018 - Duplex.xlsx\TF-2

Established Basic Permit#
19-03650

Permit Number: 20-04898

	Project:	Red Barn Lane - Duplex 1880/1620	By:	DLS
	Location:	NW Hogan Ln & Nels Nelson Rd NW, Bremerton, WA 98311	Project No.:	19-002
	Client:	Envision Northwest, LLC	Last Update:	22-Feb-19
	PERFORATED SHEAR WALL EFFECTIVE SHEAR CAPACITY RATIO			

Wall Line	Force to Wall [P] (K)	Total Length of Wall [L] (ft)	Length of Full Height Shearwall [A1+A3+A5] (ft)	Unit Shear in Wall (plf)	Percent Full Height Sheathing	Plate Height [H] (ft)	Maximum Unrestrained Opening Height (B2+B3) (ft)	(%)	Effective Shear Capacity Ratio	Required Capacity (plf)	Shearwall Capacity (plf)	Ratio	Revised Shearwall Type	Combined Resisting Force (K)	Required Uplift Capacity (K)	Revised Holdown Type
LF-1-3RD LVL-WALL 1&2	1.49	15.00	9.00	166	60%	8	4	50%	0.835	198	365	0.5433	A	-	1.60	(1)
LF-1-3RD LVL-WALL 3&4	1.21	14.33	7.33	166	51%	8	4	50%	0.809	205	365	0.5606	A	-	1.65	(1)
LF-2=3RD LVL-WALL 1&2	1.10	9.50	7.92	139	83%	8	4	50%	0.926	151	365	0.4124	A	-	1.22	(1)
LF-2=3RD LVL-WALL 3&4	1.32	16.50	9.50	139	58%	8	4	50%	0.828	168	365	0.4611	A	-	1.36	(1)
LF-1-3ND LVL-WALL 3-5	1.33	25.00	20.42	65	82%	9	4	44%	0.946	69	365	0.1878	A	-	0.62	(1)
LF-2-2ND LVE-WALL 3-5	1.74	28.50	20.49	85	72%	9	4	44%	0.916	93	365	0.2539	A	-	0.84	(1)
LF2-1ST LVL-WALL 3&5	1.63	23.00	20.50	80	89%	8	4	50%	0.948	84	365	0.2303	A	-	0.68	(1)
TF-1-2ND LVL-WALL 1&2	4.28	15.00	7.16	598	48%	9	3	33%	1.000	598	685	0.8728	C	1.66	3.77	(2)
TF-2-2ND LVL-WALL 1&2	1.22	10.58	2.83	430	27%	9	4	44%	0.827	520	532.5	0.9765	B	0.40	4.32	(2)
TF-2-2ND LVL-WALL 3&4	4.30	19.92	10.00	430	50%	9	4	44%	0.872	493	532.5	0.9258	B	2.53	1.95	(1)
TF-2-1ST LVL WALL 1-3	10.04	40.00	33.91	296	85%	8	4	50%	0.931	318	365	0.8712	A	2.72	(0.15)	-
	-	-	-			-	-							-	-	-
	-	-	-			-	-							-	-	-
	-	-	-			-	-							-	-	-
	-	-	-			-	-							-	-	-
	-	-	-			-	-							-	-	-
	-	-	-			-	-							-	-	-
	-	-	-			-	-							-	-	-
	-	-	-			-	-							-	-	-
	-	-	-			-	-							-	-	-
	-	-	-			-	-							-	-	-
	-	-	-			-	-							-	-	-
	-	-	-			-	-							-	-	-
	-	-	-			-	-							-	-	-
	-	-	-			-	-							-	-	-
	-	-	-			-	-							-	-	-
	-	-	-			-	-							-	-	-
	-	-	-			-	-							-	-	-
	-	-	-			-	-							-	-	-
	-	-	-			-	-							-	-	-
	-	-	-			-	-							-	-	-
	-	-	-			-	-							-	-	-
	-	-	-			-	-							-	-	-
	-	-	-			-	-							-	-	-
	-	-	-			-	-							-	-	-
	-	-	-			-	-							-	-	-
	-	-	-			-	-							-	-	-
	-	-	-			-	-							-	-	-

Established Basic Permit#
19-03650

Permit Number: 20-04898

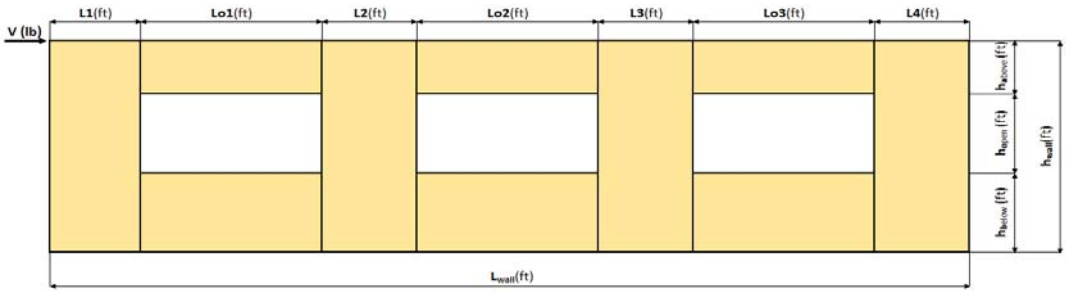
Force Transfer Around Openings Calculator

THREE OPENINGS

The force transfer around openings (FTAO) method of shear wall analysis is an approach that aims to reinforce the wall such that it performs as if there was no opening. This approach lends certain advantages over segmented shear walls: more versatility, because it allows for narrower wall segments while still meeting the height-to-width ratios and, often, fewer required hold-downs.

Project Information

Code:	2015 IBC	**Date:**	
Designer:	DLS		
Client:			
Project:			
Wall Line:	TF-2 2nd Level		



Input Variables

			Opening 1		Opening 2		Opening 3	Wall Pier Aspect Ratio		Adj. Factor
V	6400 lbf									
h_{wall}	9.00 ft	ha1	2.00 ft	ha2	2.00 ft	ha3	2.00 ft	P1=ho1/L1=	1.41	N/A
L1	2.83 ft	ho1	4.00 ft	ho2	4.00 ft	ho3	4.00 ft	P2=ho2/L2=	0.53	N/A
L2	7.50 ft	hb1	3.00 ft	hb2	3.00 ft	hb3	3.00 ft	P3=ho3/L3=	1.60	N/A
L3	2.50 ft	Lo1	2.00 ft	Lo2	6.00 ft	Lo3	2.00 ft	P4=ho3/L4=	2.00	N/A
L4	2.00 ft									
L_{wall}	24.83 ft									

1. Hold-down forces: $H = Vh_{wall}/L_{wall}$ 2320 lbf

2. Unit shear above + below opening

First opening: va1 = vb1 = H/(ha1+hb1) =	464 plf
Second opening: va2 = vb2 = H/(ha2+hb2) =	464 plf
Third opening: va3 = vb3 = H/(ha3+hb3) =	464 plf

3. Total boundary force above + below openings

First opening: O1 = va1 x (Lo1) =	928 lbf
Second opening: O2 = va2 x (Lo2) =	2784 lbf
Third opening: O3 = va3 x (Lo3) =	928 lbf

4. Corner forces

F1 = O1(L1)/(L1+L2) =	254 lbf
F2 = O1(L2)/(L1+L2) =	674 lbf
F3 = O2(L2)/(L2+L3) =	2088 lbf
F4 = O2(L3)/(L2+L3) =	696 lbf
F5 = O3(L3)/(L3+L4) =	516 lbf
F6 = O3(L4)/(L3+L4) =	412 lbf

5. Tributary length of openings

T1 = (L1*Lo1)/(L1+L2) =	0.55 ft
T2 = (L2*Lo1)/(L1+L2) =	1.45 ft
T3 = (L2*Lo2)/(L2+L3) =	4.50 ft
T4 = (L3*Lo2)/(L2+L3) =	1.50 ft
T5 = (L3*Lo3)/(L3+L4) =	1.11 ft
T6 = (L4*Lo3)/(L3+L4) =	0.89 ft

6. Unit shear beside opening

V1 = (V/L)(L1+T1)/L1 =	308 plf
V2 = (V/L)(T2+L2+T3)/L2 =	462 plf
V3 = (V/L)(T4+L3+T5)/L3 =	527 plf
V4 = (V/L)(T6+L4)/L4 =	372 plf
Check V1*L1+V2*L2+V3*L3+V4*L4=V?	6400 lbf **OK**

7. Resistance to corner forces

R1 = V1*L1 =	871 lbf
R2 = V2*L2 =	3467 lbf
R3 = V3*L3 =	1317 lbf
R4 = V4*L4 =	745 lbf

8. Difference corner force + resistance

R1-F1 =	616 lbf
R2-F2-F3 =	706 lbf
R3-F4-F5 =	106 lbf
R4-F6 =	332 lbf

9. Unit shear in corner zones

vc1 = (R1-F1)/L1 =	218 plf
vc2 = (R2-F2-F3)/L2 =	94 plf
vc3 = (R3-F4-F5)/L3 =	42 plf
vc4 = (R4-F6)/L4 =	166 plf

APA Disclaimer

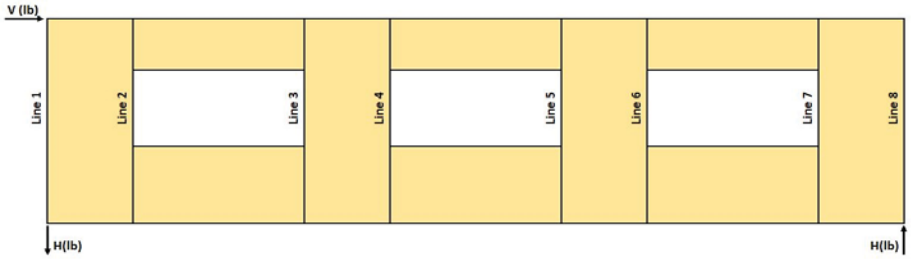
The information contained herein is intended for use as a resource to aid in the shear wall design based on APA – The Engineered Wood Association's testing and knowledge of wood-framed shear wall system design utilizing the force transfer around openings (FTAO) methodology. Neither APA, nor its member manufacturers, make any warranty, expressed or implied, or assume any legal liability or responsibility for the accuracy, use, application of, and/or reference to opinions, findings, conclusions, or recommendations included in this calculator. Consult your local jurisdiction or design professional to assure compliance with code, construction, and performance requirements. Because APA has no control over quality of workmanship or the conditions under which engineered wood products are used, it cannot accept responsibility of product performance or designs as actually constructed.

Established Basic Permit# 19-03650

Permit Number: 20-04898

Project Information

Code:	2015 IBC	**Date:**	
Designer:	DLS		
Client:			
Project:			
Wall Line:	TF-2 2nd Level		



Check Summary of Shear Values for Three Openings

Line 1: vc1(ha1+hb1)+V1(ho1)=H?		1089	1231	2320 lbf
Line 2: va1(ha1+hb1)-vc1(ha1+hb1)-V1(ho1)=0?	2320	1089	1231	0
Line 3: vc2(ha1+hb1)+V2(ho1)-va1(ha1+hb1)=0?	471	1849	2320	0
Line 4: va2(ha2+hb2)-V2(ho2)-vc2(ha2+hb2)=0?	2320	1849	471	0
Line 5: va2(ha2+hb2)-vc3(ha2+hb2)-V3(ho2)=0?	2320	212	2108	0
Line 6: va3(ha3+hb3)-V3(ho3)-vc3(ha3+hb3)=0?	2320	2108	212	0
Line 7: va3(ha3+hb3)-vc4(ha3+hb3)-V4(ho3)=0?	2320	831	1489	0
Line 8: vc4(ha3+hb3)+V4(ho3)=H?		831	1489	2320 lbf

Design Summary

Req. Sheathing Capacity	527 lbf	**4-Term Deflection**	0.552 in.	**3-Term Deflection**	0.562 in.
Req. Strap Force	2088 lbf	**4-Term Story Drift %**	0.020 %	**3-Term Story Drift %**	0.021 %
Req. HD Force	2320 plf		See Page 3		See Page 4

APA Disclaimer

The information contained herein is intended for use as a resource to aid in the shear wall design based on APA – The Engineered Wood Association's testing and knowledge of wood-framed shear wall system design utilizing the force transfer around openings (FTAO) methodology. Neither APA, nor its member manufacturers, make any warranty, expressed or implied, or assume any legal liability or responsibility for the accuracy, use, application of, and/or reference to opinions, findings, conclusions, or recommendations included in this calculator. Consult your local jurisdiction or design professional to assure compliance with code, construction, and performance requirements. Because APA has no control over quality of workmanship or the conditions under which engineered wood products are used, it cannot accept responsibility of product performance or designs as actually constructed.

Established Basic Permit# 19-03650

Permit Number: 20-04898

Project Information

Code:	2015 IBC	**Date:**	
Designer:	DLS		
Client:			
Project:			
Wall Line:	TF-2 2nd Level		

Deflection Calculation Input Variables

Sheathing:		Wood End Post Values:			Nails:	8d common	(penny weight)
Plywood	Sheathing Material	Species:					
15/32	Performance Category	E:	1.60E+06	(psi)		Pier 1	Pier 4
APA Rated Sheathing	Grade	Qty:	2		Nail Spacing:	4	4 (in.)
		Stud Size:	2x6		HD Capacity:	2490	2490 (lbf)
	Gt Override	A:	16.5	($in.^2$)	HD Deflection:	0.08	0.08 (in.)
	Ga Overide	A Override:		($in.^2$)			

Four-Term Equation Deflection Check

$$\Delta = \frac{8vh^3}{EAb} + \frac{vh}{Gt} + 0.75he_a + d_a\frac{h}{b} \qquad \text{(Equation 23-2)}$$

	Pier 1-L	Pier 1-R	Pier 2-L	Pier 2-R	Pier 3-L	Pier 3-R	Pier 4-L	Pier 4-R	
Sheathing:	15/32	15/32	15/32	15/32	15/32	15/32	15/32	15/32	
Nail:	8d common	8d common	8d common	8d common	8d common	8d common	8d common	8d common	
v_{asd}:	308	308	462	462	527	527	372	372	(plf)
$v_{strength}$:	440	440	660	660	753	753	532	532	(plf)
E:	1.60E+06	1.60E+06	1.60E+06	1.60E+06	1.60E+06	1.60E+06	1.60E+06	1.60E+06	(psi)
h:	9.00	6.00	6.00	6.00	6.00	6.00	6.00	9.00	(ft)
A:	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	($in.^2$)
Gt:	27,000	27,000	27,000	27,000	27,000	27,000	27,000	27,000	(lbf/in.)
Nail Spacing:	4	4	3	3	4	4	4	4	(in.)
Vn:	147	147	165	165	251	251	177	177	(plf)
e:	0.0131	0.0131	0.0188	0.0188	0.0665	0.0665	0.0233	0.0233	(in.)
b:	2.83	2.83	7.50	7.50	2.50	2.50	2.00	2.00	(ft)
HD Capacity:	2490	2490	5715	5715	5715	5715	2490	2490	(lbf)
HD Defl:	0.08	0.08	0.064	0.064	0.064	0.064	0.08	0.08	(in.)

Check Total Deflection of Wall System

Pier 1 (left)				Pier 1 (right)			
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-1	Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-2
0.034	0.147	0.088	0.404	0.010	0.098	0.059	0.180
		Sum	0.673			Sum	0.346
Pier 2 (left)				Pier 2 (right)			
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-1	Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-2
0.006	0.147	0.085	0.036	0.006	0.147	0.085	0.036
		Sum	0.273			Sum	0.273
Pier 3 (left)				Pier 3 (right)			
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-1	Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-2
0.020	0.167	0.299	0.121	0.020	0.167	0.299	0.121
		Sum	0.608			Sum	0.608
Pier 4 (left)				Pier 4 (right)			
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-1	Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-2
0.017	0.118	0.105	0.308	0.059	0.177	0.157	0.692
		Sum	0.548			Sum	1.085

Total Defl.	
0.552	(in.)
0.0204	%drift

APA Disclaimer

The information contained herein is intended for use as a resource to aid in the shear wall design based on APA – The Engineered Wood Association's testing and knowledge of wood-framed shear wall system design utilizing the force transfer around openings (FTAO) methodology. Neither APA, nor its member manufacturers, make any warranty, expressed or implied, or assume any legal liability or responsibility for the accuracy, use, application of, and/or reference to opinions, findings, conclusions, or recommendations included in this calculator. Consult your local jurisdiction or design professional to assure compliance with code, construction, and performance requirements. Because APA has no control over quality of workmanship or the conditions under which engineered wood products are used, it cannot accept responsibility of product performance or designs as [illegible] specific project.

Established Basic Permit#
19-03650

Permit Number: 20-04898

Project Information

Code:	2015 IBC	**Date:**	
Designer:	DLS		
Client:			
Project:			
Wall Line:	TF-2 2nd Level		

Three-Term Equation Deflection Check

$$\delta_{sw} = \frac{8vh^3}{EAb} + \frac{vh}{1000G_a} + \frac{h\Delta_a}{b} \qquad (4.3\text{-}1)$$

	Pier 1-L	Pier 1-R	Pier 2-L	Pier 2-R	Pier 3-L	Pier 3-R	Pier 4-L	Pier 4-R	
Sheathing:	15/32	15/32	15/32	15/32	15/32	15/32	15/32	15/32	
Nail:	8d common	8d common	8d common	8d common	8d common	8d common	8d common	8d common	
v_{asd}:	308	308	462	462	527	527	372	372	(plf)
$v_{strength}$:	440	440	660	660	753	753	532	532	(plf)
E:	1.60E+06	1.60E+06	1.60E+06	1.60E+06	1.60E+06	1.60E+06	1.60E+06	1.60E+06	(psi)
h:	9.00	6.00	6.00	6.00	6.00	6.00	6.00	9.00	(ft)
A:	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	(in.^{2})
Ga:	13	13	13	13	13	13	13	13	(kips/in.)
b:	2.83	2.83	7.50	7.50	2.50	2.50	2.00	2.00	(ft)
HD Capacity:	2490	2490	5715	5715	5715	5715	2490	2490	(lbf)
HD Defl:	0.08	0.08	0.064	0.064	0.064	0.064	0.08	0.08	(in.)

Check Total Deflection of Wall System

Pier 1 (left)			Pier 1 (right)		
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 1 Bending	Term 2 Shear	Term 3 Fastener
0.034	0.304	0.404	0.010	0.203	0.180
	Sum	0.743		Sum	0.393
Pier 2 (left)			**Pier 2 (right)**		
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 1 Bending	Term 2 Shear	Term 3 Fastener
0.006	0.305	0.036	0.006	0.305	0.036
	Sum	0.346		Sum	0.346
Pier 3 (left)			**Pier 3 (right)**		
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 1 Bending	Term 2 Shear	Term 3 Fastener
0.020	0.347	0.121	0.020	0.347	0.121
	Sum	0.489		Sum	0.489
Pier 4 (left)			**Pier 4 (right)**		
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 1 Bending	Term 2 Shear	Term 3 Fastener
0.017	0.245	0.308	0.059	0.368	0.692
	Sum	0.570		Sum	1.119

Total Defl.	
0.562	(in.)
0.0208	%drift

Comment: The 3-term equation is calibrated to be approximately equal to 4-term equation at 1.4*ASD capacity.

APA Disclaimer

The information contained herein is intended for use as a resource to aid in the shear wall design based on APA – The Engineered Wood Association's testing and knowledge of wood-framed shear wall system design utilizing the force transfer around openings (FTAO) methodology. Neither APA, nor its member manufacturers, make any warranty, expressed or implied, or assume any legal liability or responsibility for the accuracy, use, application of, and/or reference to opinions, findings, conclusions, or recommendations included in this calculator. Consult your local jurisdiction or design professional to assure compliance with code, construction, and performance requirements. Because APA has no control over quality of workmanship or the conditions under which engineered wood products are used, it cannot accept responsibility of product performance or designs as actually constructed.

Established Basic Permit#
19-03650

Permit Number: 20-04898