STRUCTURAL CALCULATIONS

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DATE: February 20, 2020

PROJECT: 18-220 **T-BRACKET (TBWS)**

BY: JOSHUA ANNETT
CHECKED BY: RICK HERNANDEZ, P.E., S.E. (OR and WA)
RON DERRICK, P.E., (CA)

FOR: **WOODSTONE STRUCTURES, LLC**

PROJECT DESCRIPTION & SCOPE OF SERVICES:
Structural design in accordance with the 2012 International Building Code (IBC) for the above referenced project as follows:

Wood-Bolted Connection Analysis	Steel Assembly Analysis

Should conditions differ from those depicted in this report or accompanying drawings, contact this office for further direction. The analyses contained herein apply only to the steel T-Bracket and typical fastener connection between steel side-plates and a wood main member. Branch Engineering, Inc. has not reviewed any framing for any structure considered to be supported by the above referenced product and/or the connected roof system.

SPECIAL INSPECTION:
None

NOTES:
Analysis based upon measurements taken from drawing of bracket assembly, supplied by Woodstone Structures, LLC, October 2019.
No analysis of supporting structure or supporting framing has been conducted in conjunction with this report. Consult a local Engineer for each individual installation scenario.
See additional notes below "TBWS Allowable Loads" table.

STRUCTURAL
REGISTERED PROFESSIONAL
ENGINEER
#67092PE
DIGITALLY SIGNED
OREGON
DEC. 30, 2011
RICARDO HERNANDEZ
Renews: JUNE 30, 2023

STRUCTURAL ENGINEERING REPORT

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DATE: February 24, 2020
PROJECT: 18-220 PATIO ROOF RISER
CLIENT: WOODSTONE STRUCTURES, LLC
REPORT BY: BRANCH ENGINEERING, INC.

T-BRACKET (TBWS)

DESCRIPTION:

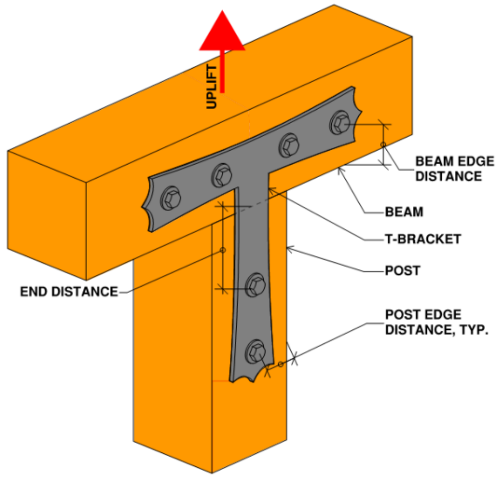
This structural engineering report has been requested by Woodstone Structures, LLC for analysis of a proprietary product called, "T-BRACKET." The objective of this analysis is to report the allowable capacity of the product for use in supporting vertical loading in the uplift direction.

ASSUMED MATERIAL:

STEEL PLATE - 1/4" ASTM A36
(6) 1/2" DIA. ASTM A307 BOLT
OR (6) 1/2" DIA. ASTM A307 LAG SCREWS

OPTIONS:

1. Bracket may be installed in pairs or single-sided with a reduced allowable capacity.
2. Brackets may be installed using ½" diameter lag screws.



TYPICAL TBWS INSTALLATION

TBWS ALLOWABLE LOADS - THRU-BOLT

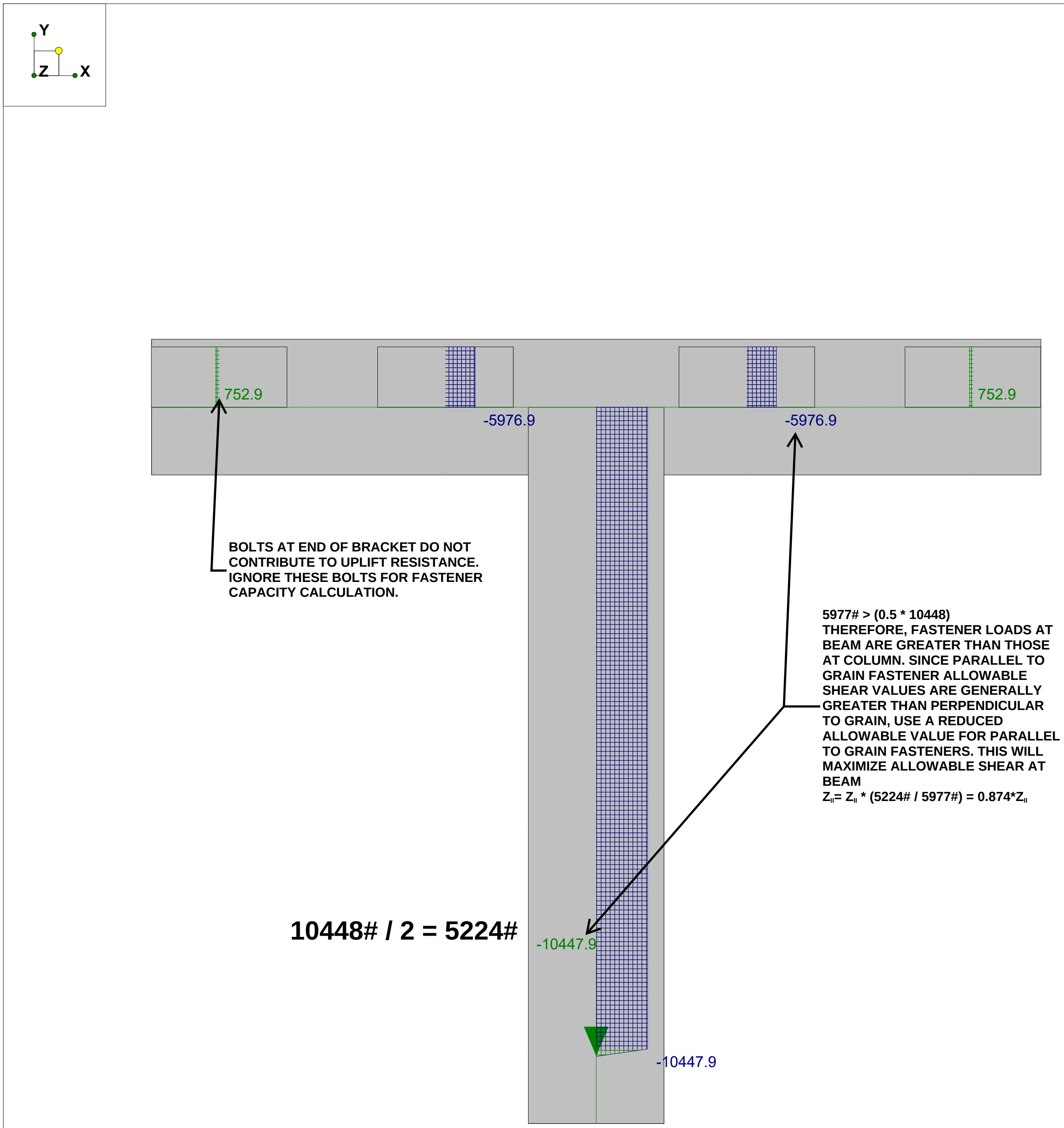
MODEL & ANCHORAGE	COLUMN SIZE (NOM.)	FASTENERS		DF/SP UPLIFT (160)
		QTY.	DIA.	(lb)
TBWS PAIR	4x6 OR 6x6	6	1/2"	3296
TBWS SINGLE-SIDED	4x6 OR 6x6	6	1/2"	1632

TBWS ALLOWABLE LOADS - LAG SCREW

MODEL & ANCHORAGE	MIN. FASTENER PENETRATION	FASTENERS		DF/SP UPLIFT (160)
	(in)	QTY.	DIA.	(lb)
TBWS PAIR	4	12	1/2"	2048
TBWS SINGLE-SIDED	4	6	1/2"	1024

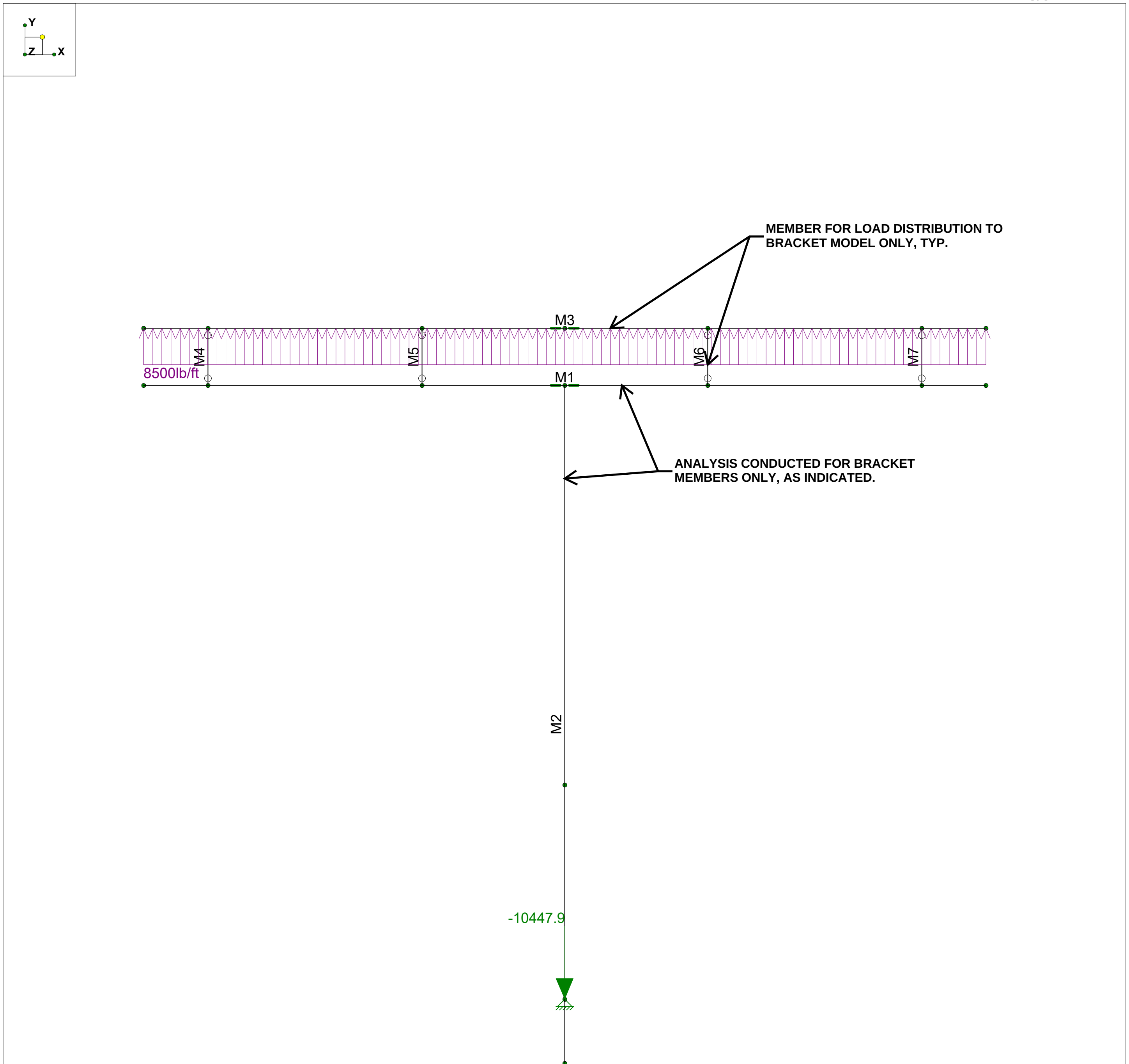
NOTES:

1. NOTES APPLY TO INSTALLATIONS WITH THRU-BOLTS OR LAG SCREWS.
2. FOR TBWS INSTALLED ONLY ON ONE-SIDE, USE SINGLE-SIDED ALLOWABLE LOAD VALUES. UPLIFT LOADS SHALL BE APPLIED ONLY TO THE SIDE OF THE ATTACHED MEMBERS HAVING THE TBWS, IN ORDER TO ACHIEVE THE STATED ALLOWABLE LOAD.
3. ALLOWABLE LOADS SHOWN ARE FOR A SINGLE TBWS OR (2) TBWS BRACKETS INSTALLED UTILIZING A DOUBLE SHEAR CONFIGURATION.
4. ANALYSIS AND ALLOWABLE LOADS ARE FOR THE STEEL BRACKET AND BOLTS INSTALLED THROUGH WOOD MAIN MEMBER WITH STEEL SIDE-PLATES.
5. CONSULT WITH A LOCAL ENGINEER FOR EACH INDIVIDUAL INSTALLATION.
6. NO DESIGN OF SUPPORTING OR SUPPORTED FRAMING HAS BEEN CONDUCTED. CONSULT AN INDEPENDENT ENGINEER FOR DESIGN OF SUCH FRAMING.
7. UPLIFT LOADS HAVE BEEN INCREASED FOR WIND OR SEISMIC LOADING, WITH NO FURTHER INCREASE ALLOWED.
8. ALLOWABLE LOADS ARE FOR VERTICAL LOADS ONLY. LATERAL BRACING MUST BE SUPPLIED BY OTHER LATERAL FORCE RESISTING SYSTEMS DESIGNED BY OTHERS. LATERAL BRACING SYSTEMS MUST BE INDEPENDENT FROM THE TBWS SUPPORT BRACKET & POSTS.
9. FASTENERS SHALL BE INSTALLED AT THE CENTERLINE (OR ABOVE AT BEAM) OF EACH ATTACHED MEMBER.
10. NOT VALID FOR UPLIFT LOADS WHEN THE BEAM FASTENERS ARE INSTALLED CLOSER TO THE BOTTOM FACE OF BEAM THAN THE TOP FACE OF BEAM.
11. ALLOWABLE LOADS ASSUME A CONTINUOUS BEAM.
12. EDGE DISTANCE SHALL BE GREATER THAN OR EQUAL TO 2" (4D) FOR BEAM & 3/4" (1.5D) FOR POST.
13. MULTIPLY ALLOWABLE LOADS BY 0.5 WHERE POST END DISTANCE IS LESS THAN 3 1/2". POST END DISTANCE SHALL NOT BE LESS THAN 1 3/4" MIN.
14. ALLOWABLE LOADS SHOWN ARE FOR DRY-SERVICE CONDITIONS ONLY (MOISTURE CONTENT <19%). FOR WET-SERVICE CONDITIONS, MULTIPLY BY 0.7.
15. BOLT HOLES SHALL BE A MINIMUM OF 1/32" AND A MAXIMUM OF 1/16" LARGER THAN THE BOLT DIAMETER (PER 2012 NDS SEC. 11.1.3.2)
16. COMPONENTS MAY EXPERIENCE YIELDING AT THE ABOVE STATED UPLIFT CAPACITY. SUBSEQUENT REPLACEMENT MAY BE REQUIRED.
17. WHERE INSTALLATION IS COMPLETED USING LAG SCREWS, THE LENGTH OF THE LAG SCREW SHOULD BE SUCH THAT THE MINIMUM PENETRATION OF THE LAG SCREW INTO THE MAIN MEMBER IS GREATER THAN OR EQUAL TO 8X THE SCREW DIAMETER (8D). FOR PENETRATION IN MAIN MEMBER LESS THAN 8D, MULTIPLY THE ALLOWABLE LOADS BY THE RATIO OF ACTUAL PENETRATION TO MINIMUM PENETRATION (p/8D). IN NO CASE SHALL THE PENETRATION BE LESS THAN 4D.
18. WHERE INSTALLATION OF TBWS PAIR UTILIZES LAG SCREW OPTION, MAIN MEMBER AND/OR LAG SCREW LENGTH SHALL BE SUCH THAT LAG SCREWS INSTALLED FROM OPPPOSING DIRECTIONS DO NOT CONTACT EACH OTHER.
19. LOAD ASSUMED TO BE UNIFORMLY DISTRIBUTED OVER THE LENGTH OF ATTACHED BEAM.



Loads: BLC 1, UPLIFT
Results for LC 2, UPLIFT
Member Axial Forces (lb)
Y-direction Reaction Units are lb and lb-ft

BRANCH ENGINEERING,...	
JOSHUA ANNETT	Oct 28, 2019 at 10:53 AM
	T Bracket.r2d



Loads: BLC 1, UPLIFT
Results for LC 2, UPLIFT
Y-direction Reaction Units are lb and lb-ft

BRANCH ENGINEERING,...		
JOSHUA ANNETT		Oct 28, 2019 at 11:07 AM
		T Bracket.r2d

Company	:	BRANCH ENGINEERING, INC.
Designer	:	JOSHUA ANNETT
Job Number	:	
Model Name	:	

Oct 28, 2019
11:04 AM
Checked By: RICK HERNANDEZ, P.E., S.E.

Hot Rolled Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm (\1E5 F)	Density[lb/ft^3]	Yield[ksi]
1	A36 Gr.36	29000	11154	.3	.65	490	36

Hot Rolled Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rules	A [in2]	I (90,270) [in4]	I (0,180) [in4]
1	HR1A	PL1/4x2.25	Beam	None	A36 Gr.36	Typical	.563	.003	.237

Member Primary Data

	Label	I Joint	J Joint	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rules
1	M1	N5	N10		HR1A	Beam	None	A36 Gr.36	Typical
2	M2	N1	N4		HR1A	Beam	None	A36 Gr.36	Typical
3	M3	N11	N12		WOOD1A	Beam	None	#2 DF	Typical
4	M4	N6	N15		HR1A	Beam	None	A36 Gr.36	Typical
5	M5	N7	NO ANALYSIS - LOAD DISTRIBUTION ONLY, TYP.					A36 Gr.36	Typical
6	M6	N8	N17		HR1A	Beam	None	A36 Gr.36	Typical
7	M7	N9	N18		HR1A	Beam	None	A36 Gr.36	Typical

Member Advanced Data

	Label	I Release	J Release	I Offset[in]	J Offset[in]	T/C Only	Physical	Defl Rati...	TOM	Inactive
1	M1						Yes			
2	M2						Yes			
3	M3						Yes			Exclude
4	M4	PIN	PIN				Yes			Exclude
5	M5	PIN	PIN				Yes			Exclude
6	M6	PIN	PIN				Yes			Exclude
7	M7	PIN	PIN				Yes			Exclude

Hot Rolled Steel Design Parameters

	Label	Shape	Length[in]	Lb-out[in]	Lb-in[in]	Lcomp top[in]	Lcomp bot[in]	L-torqu...	K-out	K-in	Cb	Function
1	M1	HR1A	14.75			Lb out						Lateral
2	M2	HR1A	11.875			Lb out						Lateral
3	M4	HR1A	1			Lb out						Lateral
4	M5	HR1A	1			Lb out						Lateral
5	M6	HR1A	1			Lb out						Lateral
6	M7	HR1A	1			Lb out						Lateral

Member Distributed Loads (BLC 1 : UPLIFT)

	Member Label	Direction	Start Magnitude[lb/ft,F,ksf]	End Magnitude[lb/f...	Start Locat...	End Location[in,%]
1	M3	Y	8500	8500	0	0

Load Combinations

	Description	Sol..	PD..	SR..	BLC	Fact..	BLC	Fact..	BLC	Fact..	BLC	Fact..	BLC	Fact..	BLC	Fact..	BLC	Fact..	BLC	Fact..	BLC	Fact..	BLC	Fact...
1	LRFD																							
2	UPLIFT	Yes	Y		1	1																		

Member AISC 14th(360-10): LRFD Steel Code Checks

	LC	Member	Shape	UC Max	Loc[in]	Shear UC	Loc[in]	phi*Pnc[lb]	phi*Pnt[lb]	phi*Mn[lb-ft]	Cb	Eqn
1	2	M1	PL1/4x2.25	1.000	7.375	.716	7.375	3115.136	18241.2	853.2	1.638	H1-1b
2	2	M2	PL1/4x2.25	.573	1.237	.000	0	4806.112	18241.2	781.867	1	H1-1a

<=1.0 OK!

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310 5th Street
Springfield, Oregon 97477
Telephone: (541) 746 0637

DATE: 2/20/2020

PROJECT: 18-220 WOODSTONE STRUCTURES
BY: JOSHUA ANNETT
CHECKED BY: RICK HERNANDEZ, P.E., S.E.
SHEET: PLvert

Bolted Shear Connection Design for Bolts in Standard Holes

Steel thickness:	**0.25 in**	F_y:	36 ksi	
Steel width:	**2.25 in**	F_u:	58 ksi	
Steel specification:	**A36**	ϕF_{nv}:	20.25 ksi	
Bolt diameter, d:	**0.5 in**	A_{gv}:	0.56 in^2	Shear Yielding
Bolt specification:	**A307**	A_g:	0.56 in^2	Tensile Yielding
Thread condition:	**N**	A_{nv}:	0.98 in^2	Shear Rupture
Bolt Hole Preparation Method:	**Punch**	A_e:	0.41 in^2	Tensile Rupture
Threaded Part F_u:	**60 ksi**	A_{nv}:	0.98 in^2	Block Shear
Bolt spacing, s:	**3.75 in**	A_{gv}:	1.22 in^2	Block Shear
Edge distance, L_{ev}:	**1.125 in**	A_{nt}:	0.13 in^2	Block Shear
Side distance, L_{eh}:	**1.125 in**	U_{bs}:	1	Block Shear
Number of bolts in row:	**2**	U:	1	Shear Lag Factor
Number of rows:	**1**			

Shear Yielding: ϕR_n =	12.15 kip
Tensile Yielding: ϕR_n =	18.23 kip
Shear Rupture: ϕR_n =	25.69 kip
Tensile Rupture: ϕR_n =	17.67 kip
Block Shear Rupture: ϕR_n =	25.18 kip
Bolt Shear Strength: ϕR_n =	7.95 kip
Bearing Strength at Bolt Hole: ϕR_n =	21.21 kip

Connection Design Strength: 7.95 kips

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DATE: 2/20/2020

PROJECT: 18-220 WOODSTONE STRUCTURES
BY: JOSHUA ANNETT
CHECKED BY: RICK HERNANDEZ, P.E., S.E.
SHEET: PLhoriz

Bolted Shear Connection Design for Bolts in Standard Holes

Steel thickness:	**0.25 in**	F_y:	36 ksi	
Steel width:	**14.75 in**	F_u:	58 ksi	
Steel specification:	**A36**	ϕF_{nv}:	20.25 ksi	
Bolt diameter, d:	**0.5 in**	A_{gv}:	1.13 in^2	Shear Yielding
Bolt specification:	**A307**	A_g:	3.69 in^2	Tensile Yielding
Thread condition:	**N**	A_{nv}:	0.84 in^2	Shear Rupture
Bolt Hole Preparation Method:	**Drill**	A_e:	3.13 in^2	Tensile Rupture
Threaded Part F_u:	**60 ksi**	A_{nv}:	0.21 in^2	Block Shear
Bolt spacing, s:	**3.75 in**	A_{gv}:	0.28 in^2	Block Shear
Edge distance, L_{ev}:	**1.125 in**	A_{nt}:	2.84 in^2	Block Shear
Side distance, L_{eh}:	**1.125 in**	U_{bs}:	0.5	Block Shear
Number of bolts in row:	**1**	U:	1	Shear Lag Factor
Number of rows:	**4**			
Spacing between rows:	**4.1667 in**			

Shear Yielding: ϕR_n =	24.30 kip
Tensile Yielding: ϕR_n =	119.48 kip
Shear Rupture: ϕR_n =	22.02 kip
Tensile Rupture: ϕR_n =	135.94 kip
Block Shear Rupture: ϕR_n =	66.41 kip
Bolt Shear Strength: ϕR_n =	15.90 kip
Bearing Strength at Bolt Hole: ϕR_n =	44.04 kip

Connection Design Strength: 15.90 kips

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DATE: 2/20/2020

PROJECT: 18-220 WOODSTONE STRUCTURES
BY: JOSHUA ANNETT
CHECKED BY: RICK HERNANDEZ, P.E., S.E.
SHEET: Fasteners (T)

FASTENER LATERAL DESIGN VALUES

QTY	FASTENER DIAMETER	TYPE	SINGLE/ DOUBLE SHEAR	STEEL SIDE MEMBER THICKNESS	MIN MAIN MEMBER FOR FASTENER LATERAL DESIGN VALUE	PARALLEL TO GRAIN LOAD REDUCTION FACTOR	ALLOWABLE LATERAL DESIGN VALUE: PARALLEL TO GRAIN	ALLOWABLE LATERAL DESIGN VALUE: PERP. TO GRAIN	MIN. PENETRATION LENGTH INTO MAIN MEMBER, p	p/8D	GEOMETRY FACTOR, CΔ	LOAD DURATION FACTOR, CD	WET SERVICE FACTOR, CM	TOTAL ADJUSTED ALLOWABLE SHEAR, Z'
2	0.5	BOLT	SINGLE	0.25	3.5	0.874	830	510	THRU	1	1	1.6	1	1632
2	0.5	BOLT	DOUBLE	0.25	3.5	0.874	1650	1030	THRU	1	1	1.6	1	3296
2	0.5	LAG	SINGLE	0.25	3.5	0.874	520	320	4	1	1	1.6	1	1024
2	0.5	LAG	DOUBLE	0.25	3.5	0.874	1040	640	4	1	1	1.6	1	2048

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PROJECT: 18-220 WOODSTONE STRUCTURES
BY: JOSHUA ANNETT
CHECKED BY: RICK HERNANDEZ, P.E., S.E.
SHEET: Capacity Summary (TBWS)

FASTENER LATERAL DESIGN VALUES

	LAG SCREWS		**THRU BOLTS**		
COMPONENT	ALLOWABLE WIND UPLIFT LOAD w/ (1) TBWS	ALLOWABLE WIND UPLIFT LOAD w/ TBWS PAIR	ALLOWABLE WIND UPLIFT LOAD w/ (1) TBWS	ALLOWABLE WIND UPLIFT LOAD w/ TBWS PAIR	
THRU-BOLTS IN WOOD COLUMN	1024	2048	1632	3296	CONTROLS DESIGN
STEEL ASSEMBLY	6269	12538	6269	12538	
BOLT HOLES IN STEEL AT BEAM	9543	19085	9543	19085	
BOLT HOLES IN STEEL AT COLUMN	4771	9543	4771	9543	