Structural Drawings
For
One North – Instrument RTU

Portland, Oregon
Holst Architecture

July 24, 2019
Job Number – 19-T132

REGISTERED PROFESSIONAL ENGINEER
83585PE
OREGON
MAY 10, 2015
SETH PAUL DAVIS
EXPIRES: 12/31/19

City of Portland
REVIEWED FOR CODE COMPLIANCE
SEP 13 2019
Permit Number

FROELICH
ENGINEERS

*** * * LIMITATIONS * * ***

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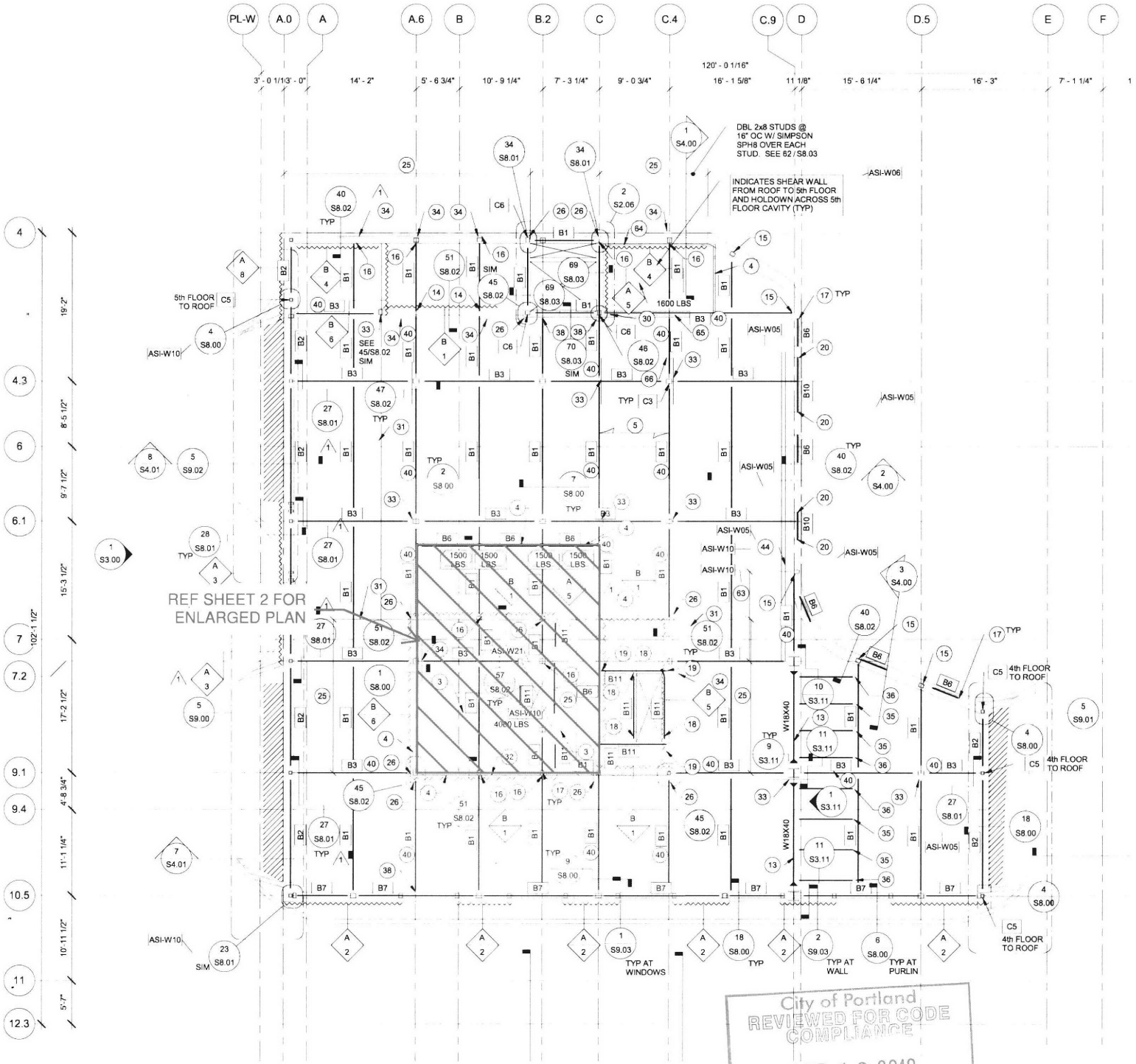
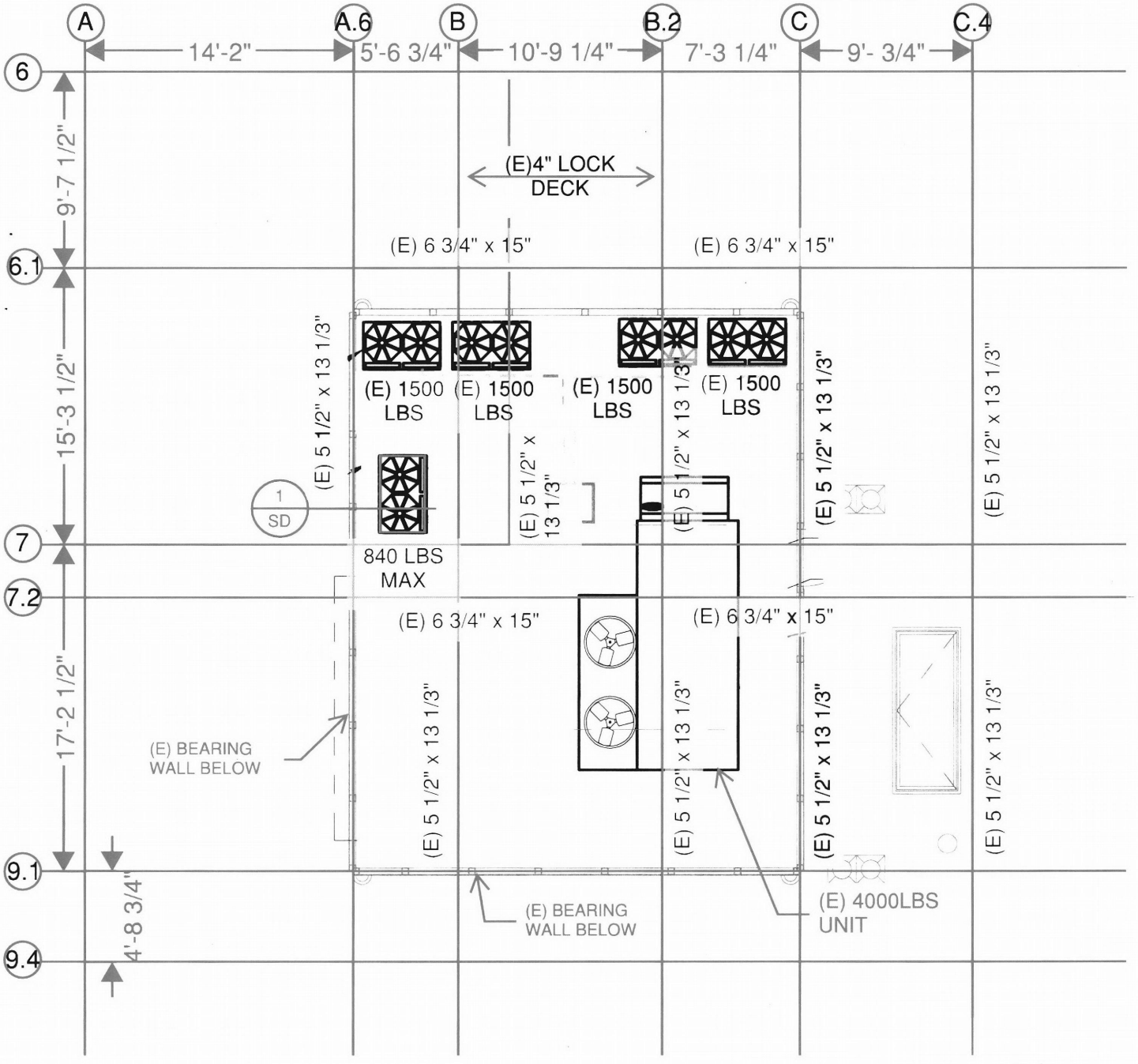
2-19-1065524-RZ00



1 ROOF FRAMING PLAN

NTS



2 ENLARGED ROOF FRAMING PLAN

NTS

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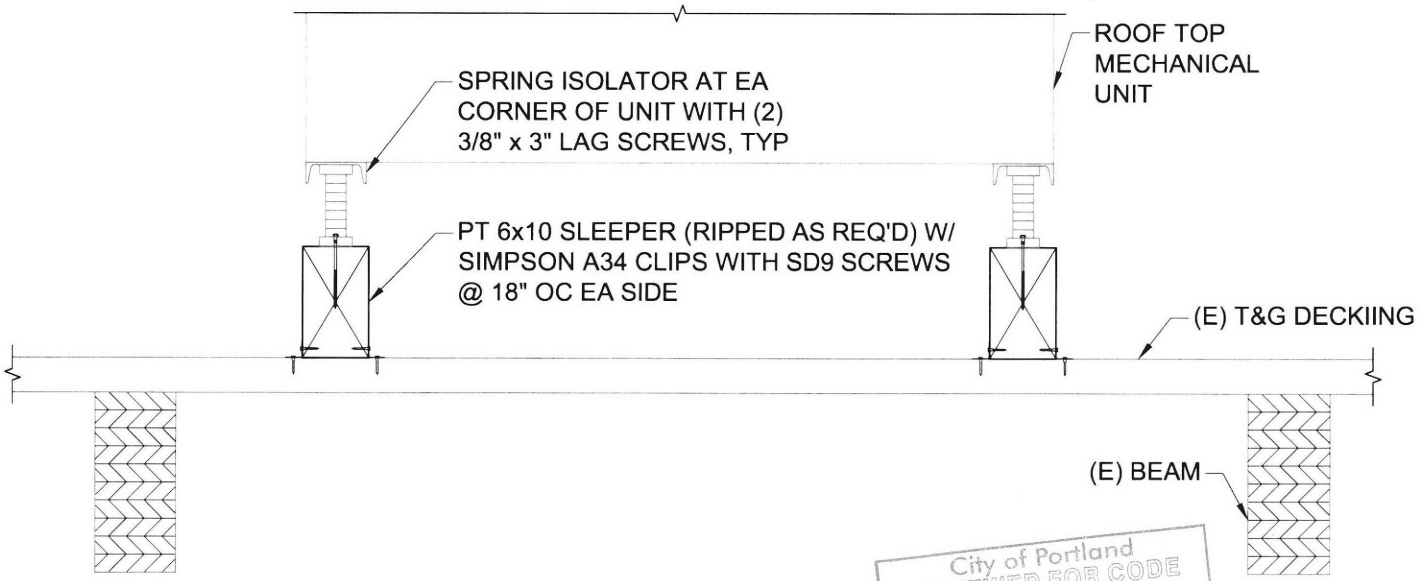

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1 / SD ROOF TOP MECHANICAL UNIT
SCALE: 3/4"=1'-0"

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Bend, OR.
Denver, CO.
froelich-engineers.com

ONE NORTH - INSTRUMENT RTU

3514 N VANCOUVER AVE
PORTLAND, OR 97227

PROJECT NO:	19-T132
DATE:	07/03/19
REVISION:	
SCALE:	AS SHOWN
SHEET REFERENCE:	

SHEET NUMBER:

Structural Calculations
For
One North – Instrument RTU

Portland, Oregon
Holst Architecture

July 3, 2019
Job Number – 19-T132

REGISTERED PROFESSIONAL ENGINEER
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FROELICH
ENGINEERS

Scope of Work

Client: Holst
Project: One North – Instrument RTU
Project Number: 19-T132
Date: July 3, 2019
By: CMS

Scope of Work:

Froelich Consulting Engineers, Inc. (FCE) has provided full structural lateral and gravity design of the project per the 2012 International Building Code (IBC) and 2014 Oregon Structural Specialty Code (OSSC).

Froelich Consulting Engineers, Inc. has provided details only to the areas pertaining to our design. Froelich Consulting Engineers, Inc. did not design or review the details for the entire project.

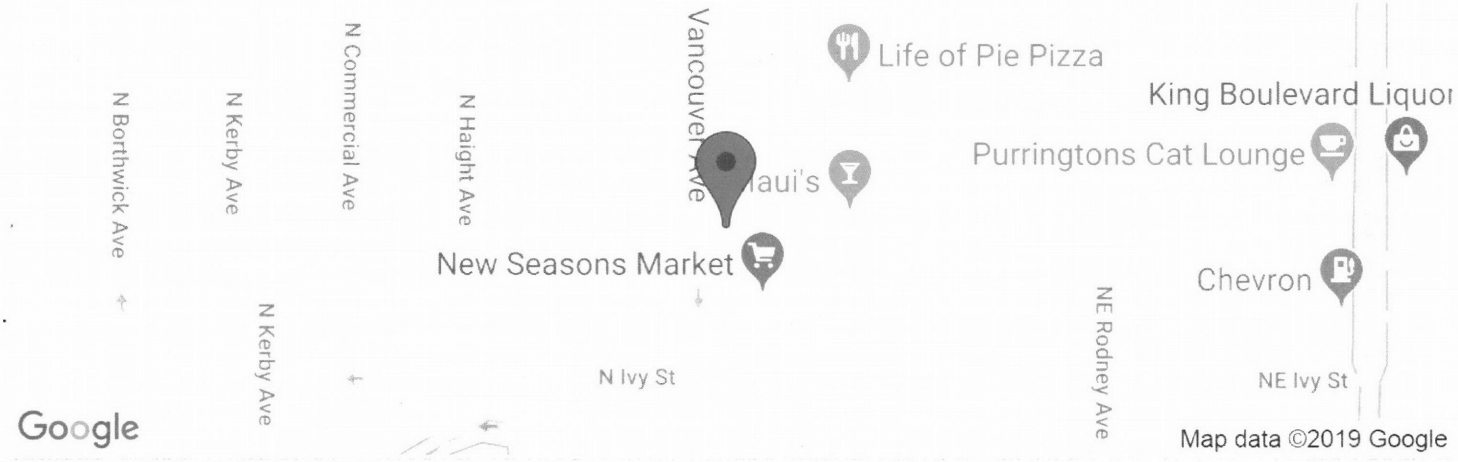
Project Description:

New roof top mechanical unit

OSHPD

3514 N Vancouver Ave, Portland, OR 97227, USA

Latitude, Longitude: 45.54848339999999, -122.66767800000002

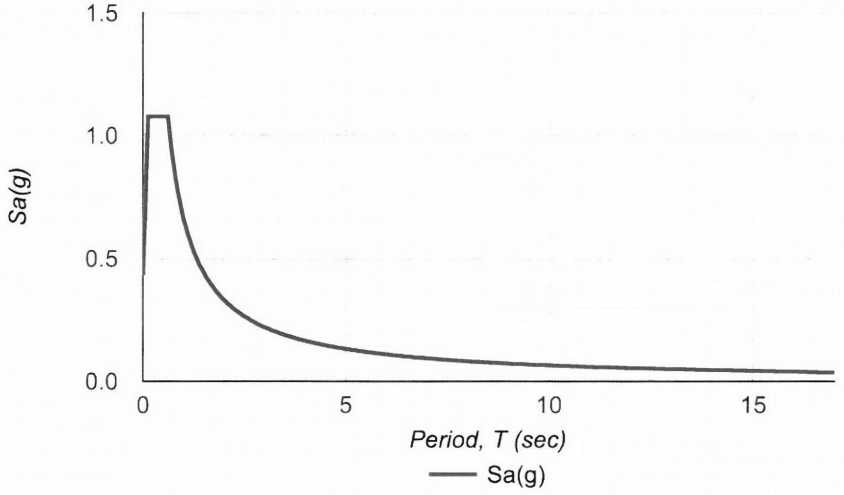


Date	7/3/2019, 7:31:42 AM
Design Code Reference Document	IBC-2012
Risk Category	II
Site Class	D - Stiff Soil

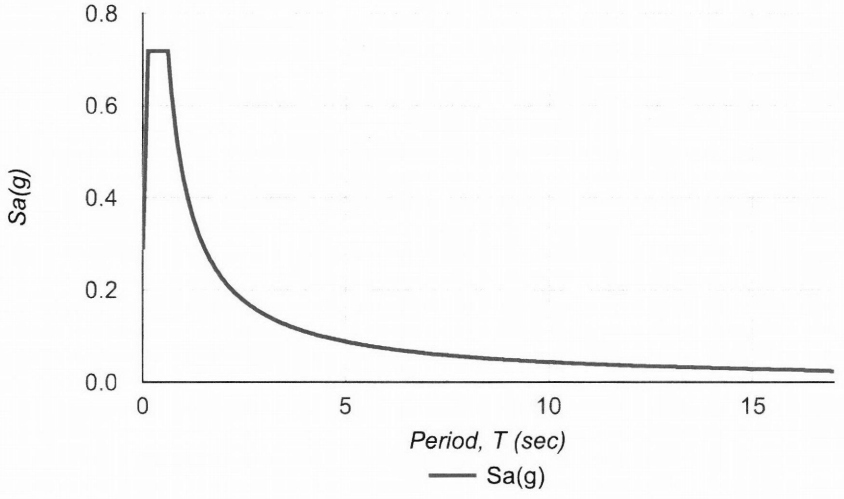
Type	Value	Description
S_S	0.971	MCE_R ground motion. (for 0.2 second period)
S_1	0.416	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.079	Site-modified spectral acceleration value
S_{M1}	0.659	Site-modified spectral acceleration value
S_{DS}	0.719	Numeric seismic design value at 0.2 second SA
S_{D1}	0.44	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1.112	Site amplification factor at 0.2 second
F_v	1.584	Site amplification factor at 1.0 second
PGA	0.42	MCE_G peak ground acceleration
F_{PGA}	1.08	Site amplification factor at PGA
PGA_M	0.453	Site modified peak ground acceleration
T_L	16	Long-period transition period in seconds
SsRT	0.971	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.081	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	2.027	Factored deterministic acceleration value. (0.2 second)
S1RT	0.416	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.475	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.783	Factored deterministic acceleration value. (1.0 second)
PGAd	0.769	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	0.898	Mapped value of the risk coefficient at short periods
C_{R1}	0.876	Mapped value of the risk coefficient at a period of 1 s

MCER Response Spectrum



Design Response Spectrum



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FROELICH ENGINEERS

Client:
Project:
Project #:
Date:
By:

Seismic Design for Nonstructural Components

ASCE 7-10, Chapter 13

Component Description: RTU-1
Component Location: Roof

Physical Properties:

h	64.4 ft.	average roof height of structure with respect to the base	1.001553 z/h
z	64.5 ft.	height in structure of point of attachment with respect to the base	
R_p	6.0	component response modification factor (table 13.5-1 or 13.6-1)	
W_p	840 lb.	component operating weight	
I_p	1.0	component importance factor	
a_p	2.5	component amplification factor (table 13.5-1 or 13.6-1)	
S_{DS}	0.72	spectral acceleration, short period	
H_m	5.5 ft.	height of mechanical unit	
W_m	4.0 ft.	width of mechanical unit	
L_m	2.5 ft.	length of mehanical unit	

Seismic Design Force (F_p)

181 lb.	lower limit per eq. 13.3-3	$F_p = 0.3 S_{DS} I_p W_p$
303 lb.	seismic design force per eq 13.3-1	$F_p = \frac{0.4 a_p S_{DS} W_p}{\left(\frac{R_p}{I_p}\right)}\left(1 + 2\frac{z}{h}\right)$
968 lb.	upper limit per eq. 13.3-2	$F_p = 1.6 S_{DS} I_p W_p$

Seismic Design Force

F_p = 303 lb. % DL = 36.0%

Allowable Stress - Seismic Design Force(F_p * 0.7)

F_p = 212 lb. % DL = 25.2%

Check Overturning:

H_{CG} =	3.67	ft.	Height of mehcanical unit center of gravity (conservatively assume 2/3*H_m)
M_{OT} =	0.7769635	ft-kips	Overturning Moment: (0.7F_p*H_{CG})
M_{RES-W} =	1.008	ft-kips	Resisting Moment respect to W: (0.6*W_p*W_M/2)
M_{RES-L} =	0.63	ft-kips	Resisting Moment respect to L: (0.6*W_p*L_M/2)

Factor of Safety against overturning.

F.S. $_W$	**1.3**	**> 1.0**	No additional anchors required for overturning
F.S. $_L$	**0.8**	**< 1.0**	Anchors required for overturning
	-58	lbs	Uplift

Check Sliding:

F_p = 212 lbs Seismic Shear Force

A34 W/ SD9 SCREWS = 495LB/EA
USE A34 W/ SD9 SCREWS EA SIDE @ 18" OC
(2) 3/8" x 3" LAG SCREWS = 540LB
USE (2) 3/8"x 3" LAG SCREWS AT EA CORNER
THERE FOR OKAY

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CLIENT:

PROJECT:

NUMBER: 19-T132

DATE:

BY:

CHECK LOCK-DECK

(E) LOADS

SL = 25 PSF

DL = 23 PSF

TOTAL LOAD = 48 PSF

REMAINING LOAD IN LOCK DECK: 186.9 - 48 = 138.9 PSF

(N) RTU DL = 84 PSF ∴ OKAY

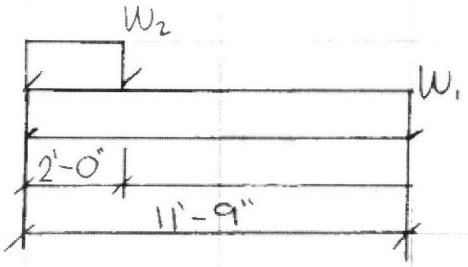
CHECK (E) BEAM

SPAN: 11'-9"

W_1 = SL = 25 PSF (8'-0")

DL = 23 PSF (8'-0")

W_2 = DL = 86 PSF (2'-6")



(E) 5 1/2 x 13 1/2 GL

∴ (E) BEAM OKAY

FROELICH ENGINEERS

Client:
Project:
Proj. #:
Date:
By:

T&G Decking Calculation

Typical Corridor

Drop Down Selection
Automatically Filled

Decking Type Lock-Deck Doug-Fir Larch
Loading Type Dead Load

F_bC_r	2300	psi	from Table 4E of 2012 NDS ASD/LRFD Specification
C_F	1.00		Size Factor (1.10 for 2" decking, 1.04 for 3" decking, 1.0 for 4" decking and Laminated Decking)
C_D	0.90		Load Duration Factor, Table 2.3.2 of 2012 NDS/LRFD
F'_b	2070	psi	
d	2.875	in.	1.5, 2.5 or 3.5" (1.4375", 2.1875", 2.875", 3.65625" for Lock-Deck)
l	96	in.	Span between supports
L/ 360			Total Deflection Criteria
Δ	0.267	in.	
E'	1800000	psi	from Table 4E of 2012 NDS ASD/LRFD Specification

Allowable Loads for Lumber Decking

per 2012 IBC Table 2306.1.4

σ_b Allowable total uniform load limited by bending.

σ_Δ Allowable total uniform load limited by deflection.

Pattern	Allowable Area Load	
	Flexure	Deflection
	σ_b (psf)	σ_Δ (psf)
Simple Span	356.5	123.8
Two-span continuous	356.5	298.1
Combination simple- and two-span continuous	356.5	211.1
Cantilevered pieces intermixed	297.0	169.2
Controlled Random Layup		
Mechanically Laminated Decking	297.0	161.2
2-inch decking	297.0	161.2
3 and 4-inch decking	297.0	186.9

Max dead plus live load = 126 psf

For Fire Design of Decking (if required)

Ref AWC Technical Report No. 10, Example 4.4.1

Required Fire Endurance	1 Hour	
B_{eff}	1.80	NDS Table 16.2.1A
a_{char}	1.80	NDS Table 16.2.1A
Design Stress to Member Strength Factor	2.85	NDS Table 16.2.2

Allowable Fire Loads for Lumber Decking

per 2012 IBC Table 2306.1.4

σ_{bF} Allowable total uniform load limited by bending for Fire.

Pattern	Allowable Area Load	
	Flexure	Deflection
	σ_{bF} (psf)	σ_Δ (psf)
Simple Span	142.0	Not Considered for Fire
Two-span continuous	142.0	
Combination simple- and two-span continuous	142.0	
Cantilevered pieces intermixed	118.4	
Controlled Random Layup		
Mechanically Laminated Decking	118.4	
2-inch decking	118.4	
3 and 4-inch decking	118.4	

WoodWorks® SOFTWARE FOR WOOD DESIGN

COMPANY	PROJECT
July 3, 2019 13:08	Beam1

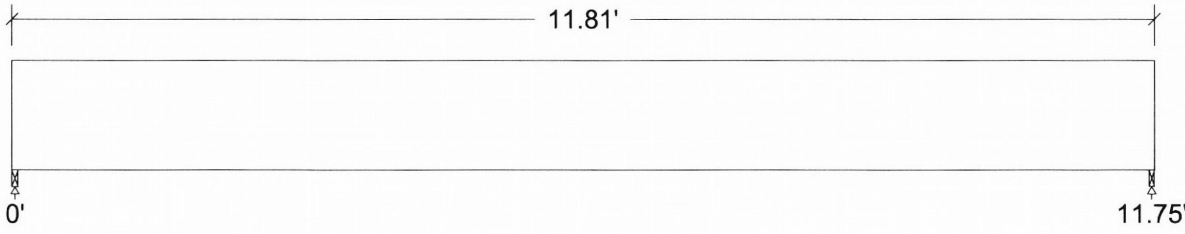
Design Check Calculation Sheet

WoodWorks Sizer 11.1

Loads:

Load	Type	Distribution	Pat-tern	Location [ft] Start	End	Magnitude Start	End	Unit
Load1	Dead	Full Area				25.00	(8.00')	psf
Load2	Snow	Full Area				23.00	(8.00')	psf
Load3	Dead	Partial Area		0.03	2.03	86.00	(2.50')	psf
Self-weight	Dead	Full UDL				17.1		plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :



Unfactored:			
Dead	1675		1318
Snow	1087		1086
Factored:			
Total	2762		2404
Bearing:			
Capacity			
Beam	2762		2404
Support	2837		2469
Des ratio			
Beam	1.00		1.00
Support	0.97		0.97
Load comb	#2		#2
Length	0.77		0.67
Min req'd	0.77		0.67
Cb	1.00		1.00
Cb min	1.00		1.00
Cb support	1.07		1.07
Fcp sup	625		625

Glulam-Unbal., West Species, 24F-1.8E WS, 5-1/2"x13-1/2"

9 laminations, 5-1/2" maximum width,
Supports: All - Timber-soft Beam, D.Fir-L No.2
Total length: 11.81'; Clear span: 11.69'; volume = 6.1 cu.ft.
Lateral support: top= at supports, bottom= at supports;

Analysis vs. Allowable Stress and Deflection using NDS 2015 :

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 41	Fv' = 305	psi	fv/Fv' = 0.14
Bending(+)	fb = 513	Fb' = 2697	psi	fb/Fb' = 0.19
Live Defl'n	0.04 = <L/999	0.39 = L/360	in	0.10
Total Defl'n	0.11 = <L/999	0.59 = L/240	in	0.19

Additional Data:

FACTORS:	F/E(psi)	CD	CM	Ct	CL	CV	Cfu	Cr	Cfrt	Notes	Cn*Cvr	LC#
Fv'	265	1.15	1.00	1.00	-	-	-	-	1.00	1.00	1.00	2
Fb'+	2400	1.15	1.00	1.00	0.977	1.000	1.00	1.00	1.00	1.00	-	2
Fcp'	650	-	1.00	1.00	-	-	-	-	1.00	-	-	-
E'	1.8 million		1.00	1.00	-	-	-	-	1.00	-	-	2
Eminy'	0.85 million		1.00	1.00	-	-	-	-	1.00	-	-	2

CRITICAL LOAD COMBINATIONS:

```
 Shear      : LC #2  = D+S, V max =   2750, V design =   2049 lbs
 Bending(+): LC #2  = D+S, M =   7138 lbs-ft
 Deflection: LC #2  = D+S  (live)
             LC #2  = D+S  (total)
·D=dead L=live S=snow W=wind I=impact Lr=roof live Lc=concentrated E=earthquake
 All LC's are listed in the Analysis output
 Load combinations: ASCE 7-10 / IBC 2015
```

CALCULATIONS:

```
 Deflection:  EI =   2030e06 lb-in2
 "Live" deflection = Deflection from all non-dead loads (live, wind, snow…)
 Total Deflection = 1.50(Dead Load Deflection) + Live Load Deflection.
 Lateral stability(+):  Lu = 11.75'  Le = 22.50'  RB = 11.0
```

Design Notes:

1. WoodWorks analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.
2. Please verify that the default deflection limits are appropriate for your application.
3. Glulam design values are for materials conforming to ANSI 117-2015 and manufactured in accordance with ANSI A190.1-2012
4. GLULAM: bxd = actual breadth x actual depth.
5. Glulam Beams shall be laterally supported according to the provisions of NDS Clause 3.3.3.
6. GLULAM: bearing length based on smaller of Fcp(tension), Fcp(comp'n).