BSE

Brienen **S**tructural **E**ngineers, P.S.

Calculations required to be provided by the Permittee on site for all Inspections

PRCTI20241136

City of Puyallup
Development & Permitting Services
ISSUED PERMIT

Building	Planning
Engineering	Public Works
Fire	Traffic

City of Puyallup
Building
REVIEWED FOR COMPLIANCE
SKinnear
11/12/2024
1:25:35 PM

CITY OF PUYALLUP
STATE OF WASHINGTON

Barnes & Noble
South Hill Mall - Unit #800
3500 S Meridian
Puyallup, WA 98373

Structural Calculations
Replacement RTU Roof Check and Anchorage

SARA CARLENE IMBRUGLIO
STATE OF WASHINGTON
47475
REGISTERED
PROFESSIONAL ENGINEER

Project Number 24415
07/01/2024

BSE

B rienen ***S*** tructural ***E*** ngineers, P.S.

Existing Roof Framing Check

Phone: (206) 397-0000 1316 Central Avenue S, Suite 200, Kent, WA 98032 www.bse-ps.com

ROOFTOP UNIT SCHEDULE (RTU #) — OPTION #1

(PROVIDED BY LANDLORD)

UNIT TAG	RTU-1	RTU-2	RTU-3	RTU-4	RTU-5	RTU-6
AREA SERVED	SALES	SALES	SALES	STOCK AREA	RRs/OFFICES	CAFE
MANUFACTURER	LENNOX	LENNOX	LENNOX	LENNOX	LENNOX	LENNOX
MODEL NUMBER	LHT180H4M	LHT180H4M	LHT180H4M	LHT036H4E	LHT048H4E	LHT060H4E
TYPE	HEAT PUMP	HEAT PUMP	HEAT PUMP	HEAT PUMP	HEAT PUMP	HEAT PUMP
NOMINAL CAPACITY (TON)	15	15	15	3	4	5
EER/IEER	11.1 EER	11.1 EER	11.1 EER	12.3 EER	12.8 EER	12.2 EER
MIN OUTSIDE AIR CFM	600	600	600	120	160	200
SUPPLY FAN						
CFM	6000	6000	6000	1200	1600	2000
ESP	0.80"	0.80"	0.80"	0.80"	0.80"	0.80"
HP	5.0	5.0	5.0	0.5 W/ MSAV	1.0 W/ MSAV	1.5
TYPE	BELT MSAV	BELT MSAV	BELT MSAV	ECM	ECM	DIRECT MSAV
FILTERS						
TYPE	THROWAWAY	THROWAWAY	THROWAWAY	THROWAWAY	THROWAWAY	THROWAWAY
DEPTH	2"	2"	2"	2"	2"	2"
MERV	8	8	8	8	8	8
MEAN APD	0.03"	0.03"	0.03"	0.03"	0.04"	0.05"
HEAT PUMP PERFORMANCE						
HEATING CAP. @ DESIGN	111,700 BTUH	111,700 BTUH	111,700 BTUH	22,000 BTUH	29,500 BTUH	37,400 BTUH
C.O.P. HI/LO	3.4/2.1	3.4/2.1	3.4/2.1	3.8/2.3	3.9/2.4	3.7/2.3
AUXILIARY ELECTRIC HEATING COIL						
CFM	6000	6000	6000	1200	1600	2000
KW	30.0	30.0	30.0	7.5	7.5	15.0
DX COOLING COIL						
CFM	6000	6000	6000	1200	1600	2000
EAT DB/WB	76.0/61.4	76.0/61.4	76.0/61.4	76.0/61.4	76.0/61.4	76.0/61.4
LAT DB/WB	51.7/50.7	51.7/50.7	51.7/50.7	52.6/51.2	52.7/51.3	42.2/42.2
COND. EAT	85.0	85.0	85.0	85.0	85.0	85.0
SENSIBLE/TOTAL MBH	161.1/180.0	161.1/180.0	161.1/180.0	31.1/34.9	41.9/46.7	74.0/83.2
REFRIGERANT TYPE	R-410A	R-410A	R-410A	R-410A	R-410A	R-410A
COMPRESSOR						
TYPE	SCROLL	SCROLL	SCROLL	SCROLL	SCROLL	SCROLL
QUANTITY	2	2	2	1	1	1
STAGES	3	3	3	2	2	2
ECONOMIZER	0-100%	0-100%	0-100%	0-100%	0-100%	0-100%
ELECTRICAL						
MCA/MFS	88/90	88/90	88/90	23/25	25/25	36/40
V-PH-CY	480/3/60	480/3/60	480/3/60	480/3/60	480/3/60	480/3/60
DISCONNECT	FACTORY	FACTORY	FACTORY	FACTORY	FACTORY	FACTORY
OPERATING WEIGHT (LBS)	2636	2636	2636	877	873	918
REMARKS	PROVIDE UNIT WITH SINGLE ENTHALPY ECONOMIZER, BAROMETRIC RELIEF, CONDENSER COIL HAIL GUARDS & 14" SEISMIC CURB. 5 YEAR COMPRESSOR WARRANTY, FACTORY POWERED CONVENIENCE RECEPTACLE, WITH POWER EXHAUST, PROVIDE UNIT WITH CARBON DIOXIDE (CO2) SENSOR/CONTROLLER, FACTORY INSTALLED MODEL DH400 SMOKE DETECTOR IN RETURN AIR SYSTEM AND ALL AN RTS451KEY REMOTE KEY OPERATED TEST STATION	PROVIDE UNIT WITH SINGLE ENTHALPY ECONOMIZER, BAROMETRIC RELIEF, CONDENSER COIL HAIL GUARDS & 14" SEISMIC CURB. 5 YEAR COMPRESSOR WARRANTY, FACTORY POWERED CONVENIENCE RECEPTACLE, WITH POWER EXHAUST, PROVIDE UNIT WITH CARBON DIOXIDE (CO2) SENSOR/CONTROLLER, FACTORY INSTALLED MODEL DH400 SMOKE DETECTOR IN RETURN AIR SYSTEM AND ALL AN RTS451KEY REMOTE KEY OPERATED TEST STATION	PROVIDE UNIT WITH SINGLE ENTHALPY ECONOMIZER, BAROMETRIC RELIEF, CONDENSER COIL HAIL GUARDS & 14" SEISMIC CURB. 5 YEAR COMPRESSOR WARRANTY, FACTORY POWERED CONVENIENCE RECEPTACLE, WITH POWER EXHAUST, PROVIDE UNIT WITH CARBON DIOXIDE (CO2) SENSOR/CONTROLLER, FACTORY INSTALLED MODEL DH400 SMOKE DETECTOR IN RETURN AIR SYSTEM AND ALL AN RTS451KEY REMOTE KEY OPERATED TEST STATION	PROVIDE UNIT WITH SINGLE ENTHALPY ECONOMIZER, BAROMETRIC RELIEF, CONDENSER COIL HAIL GUARDS & 14" SEISMIC CURB. 5 YEAR COMPRESSOR WARRANTY, FACTORY POWERED CONVENIENCE RECEPTACLE, PROVIDE UNIT WITH CARBON DIOXIDE (CO2) SENSOR/CONTROLLER, FACTORY INSTALLED MODEL DH400 SMOKE DETECTOR IN RETURN AIR SYSTEM AND ALL AN RTS451KEY REMOTE KEY OPERATED TEST STATION	PROVIDE UNIT WITH SINGLE ENTHALPY ECONOMIZER, BAROMETRIC RELIEF, CONDENSER COIL HAIL GUARDS & 14" SEISMIC CURB. 5 YEAR COMPRESSOR WARRANTY, FACTORY POWERED CONVENIENCE RECEPTACLE, PROVIDE UNIT WITH CARBON DIOXIDE (CO2) SENSOR/CONTROLLER, FACTORY INSTALLED MODEL DH400 SMOKE DETECTOR IN RETURN AIR SYSTEM AND ALL AN RTS451KEY REMOTE KEY OPERATED TEST STATION	PROVIDE UNIT WITH SINGLE ENTHALPY ECONOMIZER, BAROMETRIC RELIEF, CONDENSER COIL HAIL GUARDS & 14" SEISMIC CURB. 5 YEAR COMPRESSOR WARRANTY, FACTORY POWERED CONVENIENCE RECEPTACLE, PROVIDE UNIT WITH CARBON DIOXIDE (CO2) SENSOR/CONTROLLER, FACTORY INSTALLED MODEL DH400 SMOKE DETECTOR IN RETURN AIR SYSTEM AND ALL AN RTS451KEY REMOTE KEY OPERATED TEST STATION
CONTROLS	PROGRAMMABLE CONTROL PANEL W/ HEATING/COOLING ZONE LOCKOUT, ECONOMIZER DEFAULT DETECTION, AND AUXILIARY HEAT USE VISUAL INDICATION	PROGRAMMABLE CONTROL PANEL W/ HEATING/COOLING ZONE LOCKOUT, ECONOMIZER DEFAULT DETECTION, AND AUXILIARY HEAT USE VISUAL INDICATION	PROGRAMMABLE CONTROL PANEL W/ HEATING/COOLING ZONE LOCKOUT, ECONOMIZER DEFAULT DETECTION, AND AUXILIARY HEAT USE VISUAL INDICATION	PROGRAMMABLE CONTROL PANEL W/ HEATING/COOLING ZONE LOCKOUT, ECONOMIZER DEFAULT DETECTION, AND AUXILIARY HEAT USE VISUAL INDICATION	PROGRAMMABLE CONTROL PANEL W/ HEATING/COOLING ZONE LOCKOUT, ECONOMIZER DEFAULT DETECTION, AND AUXILIARY HEAT USE VISUAL INDICATION	PROGRAMMABLE CONTROL PANEL W/ HEATING/COOLING ZONE LOCKOUT, ECONOMIZER DEFAULT DETECTION, AND AUXILIARY HEAT USE VISUAL INDICATION

NOTES:
1. MECHANICAL CONTRACTOR IS TO PROVIDE ALL CONTROLLERS, PANELS, RELAYS, ETC. AS REQUIRED FOR OPERATION OF UNITS PER SECTION 15906 OF MECHANICAL SPECIFICATIONS
2. CONTACT KRAG MERCER WITH LENNOX COMMERCIAL PRODUCT APPLICATIONS @ (972) 497-7738 FOR ADDITIONAL INFORMATION

* - UNITS WILL BE RESELECTED/ UPDATED FOR 480/3/60

RTU 1-3 ARE ALL THE SAME WEIGHT/DIMENSIONS W/ 14" CURB - CURB WEIGHT IS 169LBS

RTU 4-6 ARE APPROXIMATELY ALL THE SAME WEIGHT/DIMENSIONS W/ 14" CURB - CURB WEIGHT IS 108LBS

PACKAGED HEAT PUMP

RTU 1 - 3

Enlight™ Rooftop Units
High Efficiency - 60 Hz

Bulletin No. 210986
January 2024
Supersedes August 2023

COMMERCIAL PRODUCT SPECIFICATIONS

ENLIGHT

CORE CONTROL SYSTEM

SMARTWIRE™ SYSTEM

ASHRAE 90.1 COMPLIANT

ENERGY STAR

13 to 20 Tons
Net Cooling Capacity – 150,000 to 224,000 Btuh
Net Heating Capacity - 144,000 to 224,000 Btuh
Optional Electric Heat - 15 to 90 kW

MODEL NUMBER IDENTIFICATION

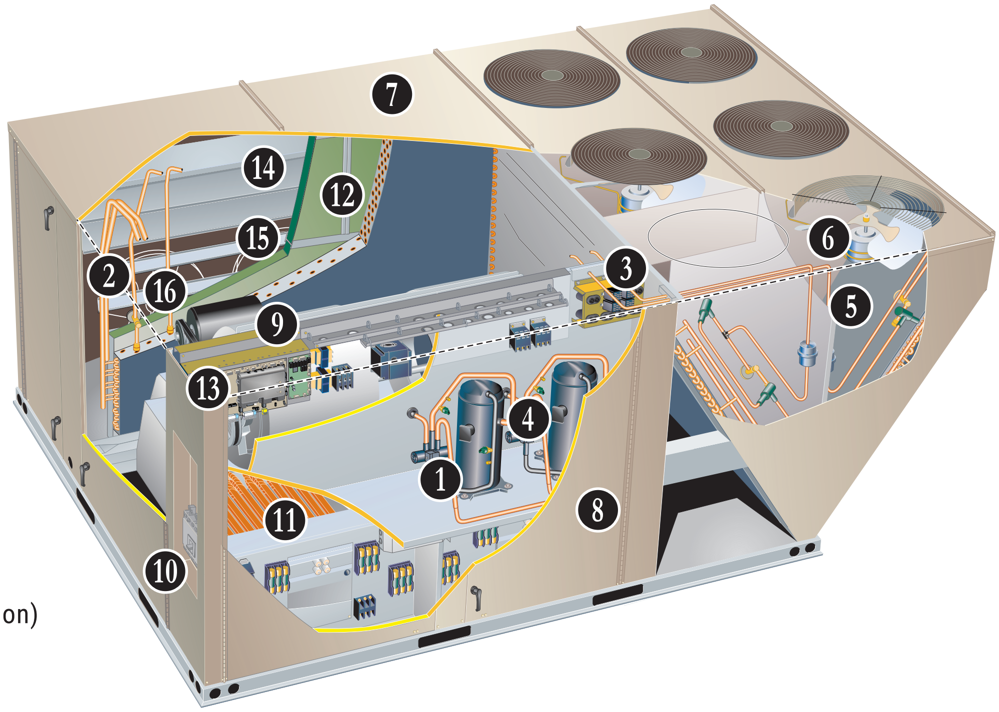
L H T 240 H 4 M N 1 Y

- **Brand/Family** — L = Enlight™
- **Unit Type** — H= Heat Pump Unit
- **Major Design Sequence** — T = 1st Generation
- **Nominal Cooling Capacity - Tons** — 156 = 13 Tons; 180= 15 Tons; 240 = 20 Tons
- **Cooling Efficiency** — H = High Efficiency
- **Refrigerant Type** — 4 = R-410A
- **Blower Type** — M = MSAV® Multi-Stage Air Volume, Belt Drive
- **Factory Installed Electric Heat** — N = No Heat; E = 15 kW Electric Heat; J = 30 kW Electric Heat; K = 45 kW Electric Heat; L = 60 kW Electric Heat; P = 90 kW Electric Heat
- **Minor Design Sequence** — 1 = 1st Revision
- **Voltage** — Y = 208/230V-3 phase-60Hz; G = 460V-3 phase-60Hz; J = 575V-3 phase-60Hz

FEATURE HIGHLIGHTS

Enlight™ rooftop units featuring the Lennox® CORE Control System create a bright future through a highly energy-efficient and environmentally sustainable design. Comprehensive configurations meet a wide range of applications, making it the most flexible product line Lennox has to offer.

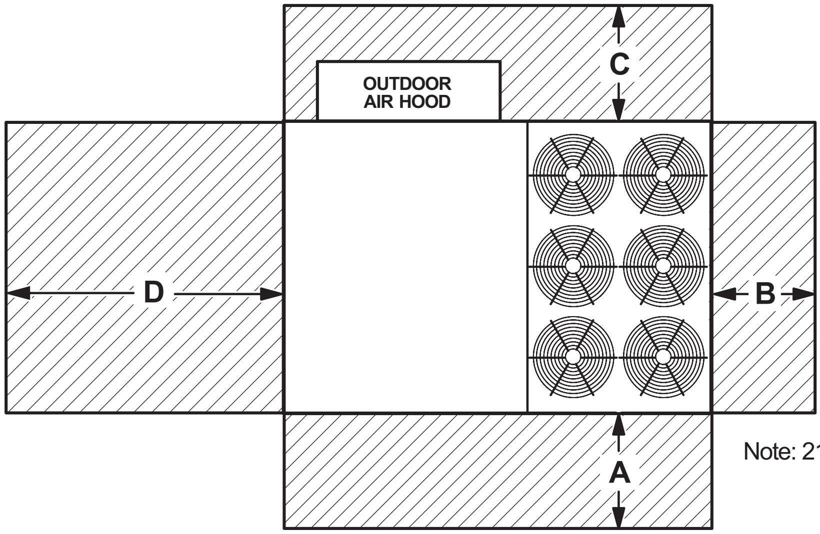
1. Scroll Compressors
2. Check/Thermal Expansion Valves
3. Filter/Driers
4. Reversing Valves
5. Copper Tube Outdoor Coil
6. Outdoor Coil Fan Motors
7. Heavy Gauge Steel Cabinet
8. Hinged Access Panels
9. MSAV® Multi-Stage Air Volume Blower
10. Disconnect Switch (option)
11. Electric Heat (option)
12. Air Filters
13. Lennox CORE® Control System
14. Economizer (option)
15. Barometric Relief Dampers (option)
16. Power Exhaust (option)



CONTENTS

UNIT CLEARANCES

Unit With Economizer



Note: 210-240-300 sizes shown

[1] Unit Clearance	A		B		C		D		Top Clearance
	in.	mm	in.	mm	in.	mm	in.	mm	
Service Clearance	60	1524	36	914	36	934	66	1676	Unobstructed
Minimum Operation Clearance	45	1143	36	914	36	914	41	1041	

NOTE - Entire perimeter of unit base requires support when elevated above the mounting surface.

[1] **Service Clearance** - Required for removal of serviceable parts.
Minimum Operation Clearance - Required clearance for proper unit operation.

OUTDOOR SOUND DATA

Unit Model Number	Octave Band Sound Power Levels dBA, re 10^{-12} Watts - Center Frequency - Hz							[1] Sound Rating Number (dBA)
	125	250	500	1000	2000	4000	8000	
156, 180, 240	79	84	88	89	85	82	73	94

Note - The octave sound power data does not include tonal corrections.

[1] Sound Rating Number according to AHRI Standard 370-2001 (includes pure tone penalty).
Sound Rating Number is the overall A-Weighted Sound Power Level (LWA), dBA (100 Hz to 10,000 Hz).

WEIGHT DATA — UNIT

Model Number	Net lbs.	Net kg	Shipping lbs.	Shipping kg
156 Base Unit	2198	997	2398	1088
156 Max. Unit	2488	1129	2688	1219
180 Base Unit	2226	1010	2426	1100
180 Max. Unit	2516	1141	2716	1232
240 Base Unit	2268	1029	2468	1119
240 Max. Unit	2558	1160	2758	1251

NOTE - Max. Unit is the unit with ALL INTERNAL OPTIONS Installed. (Economizer, Standard Static Power Exhaust Fans, Controls, etc.). Does not include accessories EXTERNAL to unit.

WEIGHT DATA — OPTIONS / ACCESSORIES

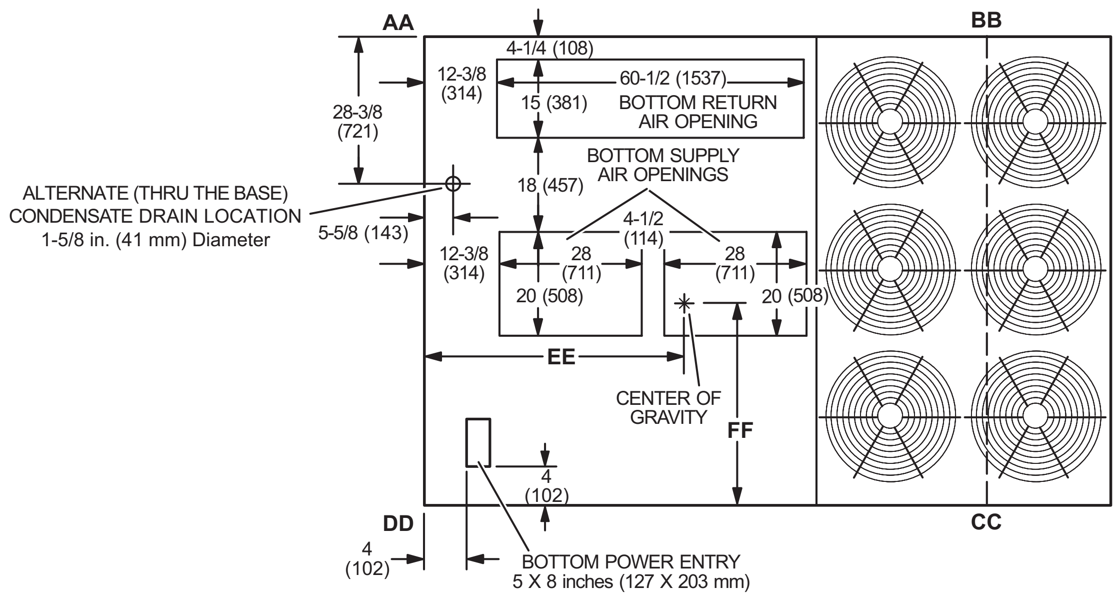
		Shipping Weight lbs.	Shipping Weight kg
ECONOMIZER / OUTDOOR AIR / EXHAUST			
Economizer			
Economizer Dampers (with Outdoor Air Hood)		167	76
Barometric Relief Dampers (downflow)		30	14
Barometric Relief Dampers (horizontal)		20	9
Outdoor Air Dampers with Hood (downflow)			
Motorized		39	18
Manual		22	10
Power Exhaust		62	28
ELECTRIC HEAT			
15 kW		59	27
30 kW		59	27
45 kW		76	34
60 kW		76	34
90 kW		84	38
COMBINATION COIL/HAIL GUARDS			
All models		36	16
ROOF CURBS			
Hybrid Roof Curbs, Downflow			
8 in. height		136	62
14 in. height		169	77
18 in. height		191	87
24 in. height		224	102
Adjustable Pitch Curb, Downflow			
14 in. height		224	102
Horizontal, Standard			
26 in. height			
37 in. height			
CEILING DIFFUSERS			
Step-Down	RTD11-185S	168	76
	RTD11-275S	238	108
Flush	FD11-185S	168	76
	FD11-275S	238	108
Transitions	C1DIFF33C-1	80	36
	C1DIFF34C-1	75	34

DIMENSIONS

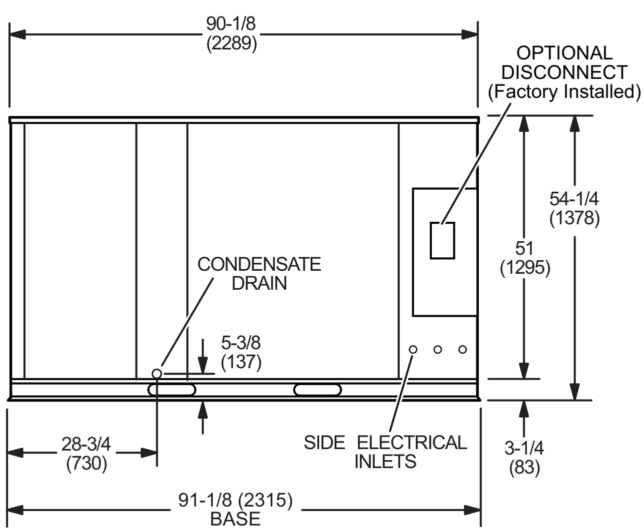
CORNER WEIGHTS									CENTER OF GRAVITY			
Model No.	AA		BB		CC		DD		EE		FF	
	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	in.	mm	in.	mm
LHT156 Base Unit	411	187	485	220	705	321	598	272	58-3/8	1481	37-1/8	943
LHT156 Max. Unit	509	231	575	261	745	338	659	300	57-1/8	1452	39-3/4	1010
LHT180 Base Unit	412	187	486	221	719	327	610	277	58-3/8	1482	36-3/4	934
LHT180 Max. Unit	511	232	577	262	758	345	671	305	57-1/8	1452	39-3/8	1000
LHT240 Base Unit	415	189	488	222	738	336	628	285	58-1/4	1479	36-1/4	921
LHT240 Max. Unit	513	233	578	263	777	353	690	314	57	1450	38-7/8	987

Base Unit - The unit with NO INTERNAL OPTIONS.

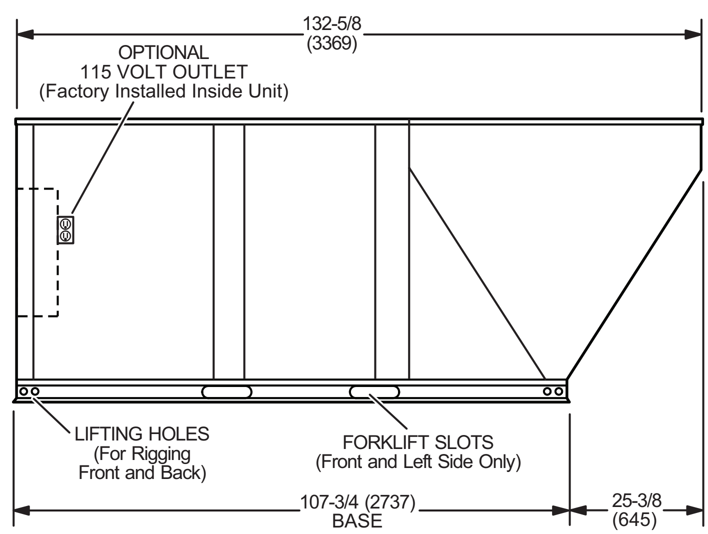
Max. Unit - The unit with ALL INTERNAL OPTIONS Installed. (Economizer, Standard Static Power Exhaust Fans, Controls, etc.). Does not include accessories external to unit.



TOP VIEW

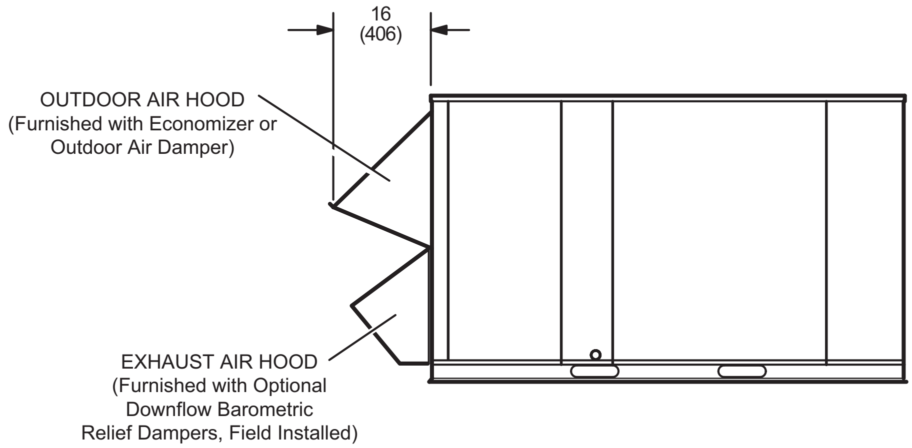


END VIEW



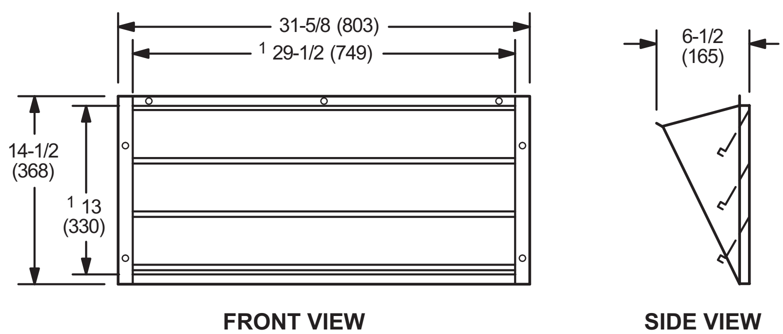
SIDE VIEW

OUTDOOR AIR HOOD DETAIL



OPTIONAL HORIZONTAL BAROMETRIC RELIEF DAMPERS WITH HOOD

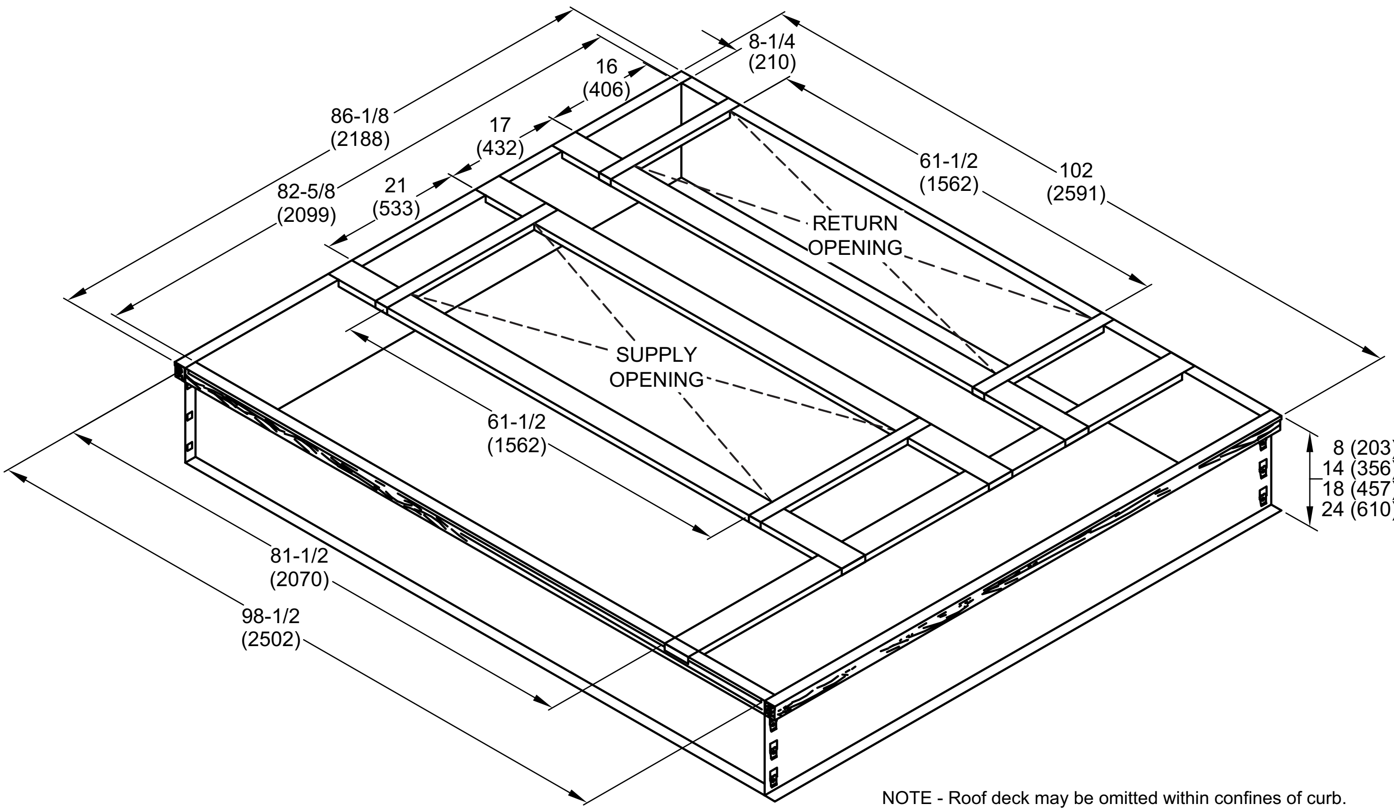
(Field installed in horizontal return air duct adjacent to unit)



NOTE - Two furnished per order no.

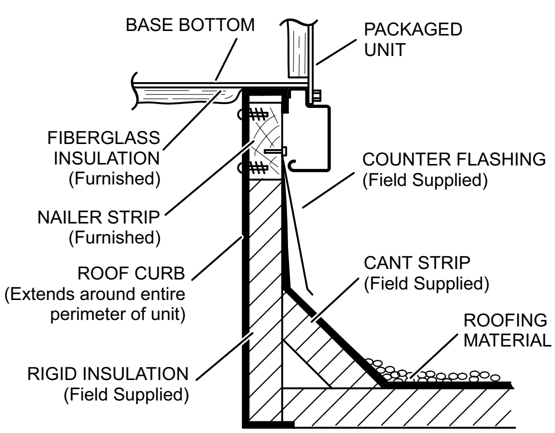
[1] NOTE - Opening size required in return air duct.

HYBRID ROOF CURBS - DOUBLE DUCT OPENING

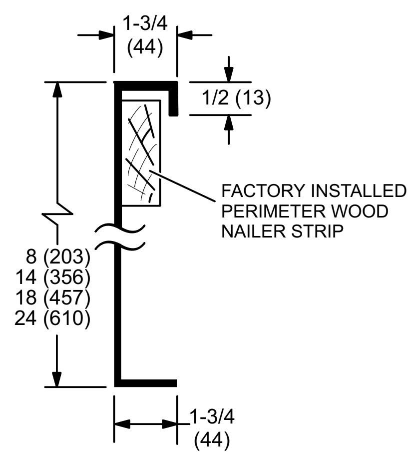


NOTE - Roof deck may be omitted within confines of curb.

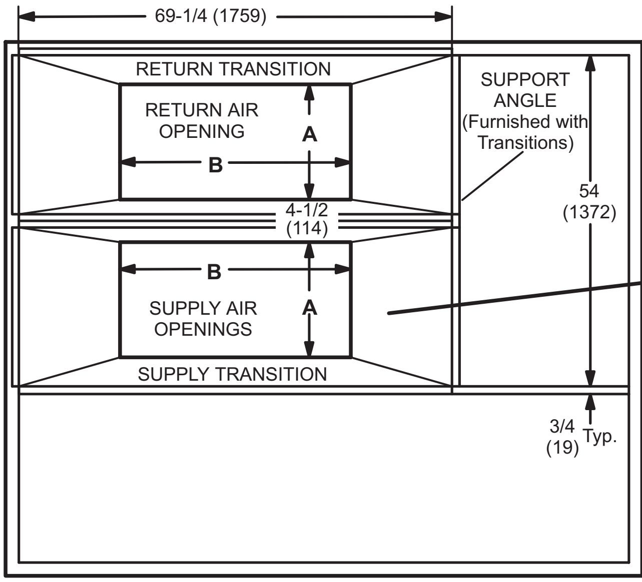
TYPICAL FLASHING DETAIL FOR ROOF CURB



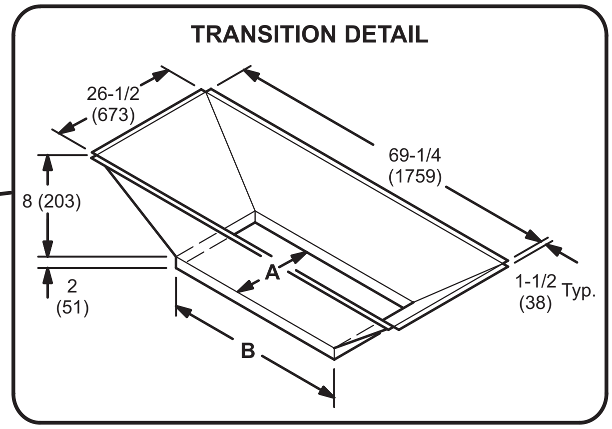
DETAIL ROOF CURB



ROOF CURBS WITH SUPPLY & RETURN AIR TRANSITIONS FOR CEILING DIFFUSERS



TOP VIEW

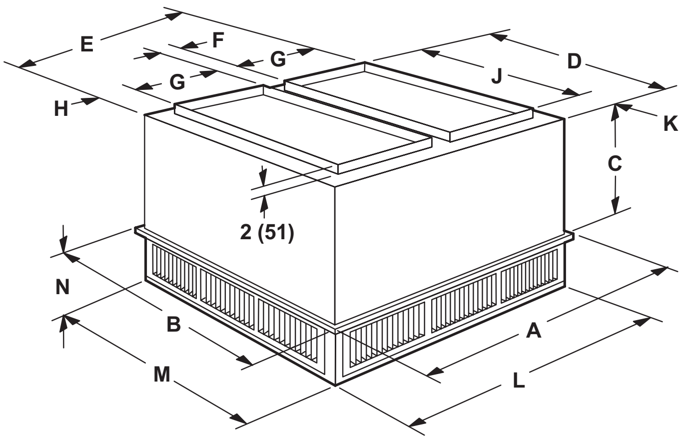


TRANSITION OPENING SIZES

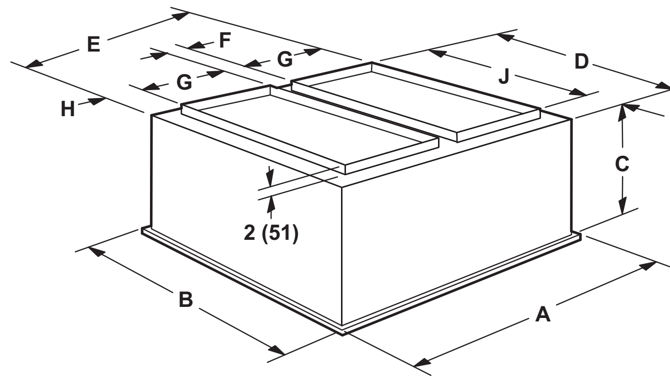
Model Number	A inch	A mm	B inch	B mm
C1DIFF33C-1	18	457	36	914
C1DIFF34C-1	24	610	48	1219

COMBINATION CEILING SUPPLY AND RETURN DIFFUSERS

STEP-DOWN CEILING DIFFUSER



FLUSH CEILING DIFFUSER



Model Number		RTD11-185S	RTD11-275S
A	in.	47-5/8	59-5/8
	mm	1210	1514
B	in.	47-5/8	59-5/8
	mm	1210	1514
C	in.	24-5/8	30-5/8
	mm	625	778
D	in.	45-1/2	57-1/2
	mm	1156	1461
E	in.	45-1/2	57-1/2
	mm	1156	1461
F	in.	4-1/2	4-1/2
	mm	114	114
G	in.	18	24
	mm	457	610
H	in.	2-1/2	2-1/2
	mm	64	64
J	in.	36	48
	mm	914	1219
K	in.	4-3/4	4-3/4
	mm	121	121
L	in.	45-1/2	57-1/2
	mm	1156	1461
M	in.	45-1/2	57-1/2
	mm	1156	1461
N	in.	10-1/8	11-1/8
	mm	257	283
Duct Size	in.	18 x 36	24 x 48
	mm	457 x 914	610 x 1219

Model Number		FD11-185S	FD11-275S
A	in.	47-5/8	59-5/8
	mm	1210	1514
B	in.	47-5/8	59-5/8
	mm	1210	1514
C	in.	29-1/4	35-1/4
	mm	743	895
D	in.	45	57
	mm	1143	1148
E	in.	45	57
	mm	1143	1448
F	in.	4-1/2	4-1/2
	mm	114	114
G	in.	18	24
	mm	457	610
H	in.	2-1/4	2-1/4
	mm	57	57
J	in.	36	48
	mm	914	1219
K	in.	4-1/2	4-1/2
	mm	114	114
Duct Size	in.	18 x 36	24 x 48
	mm	457 x 914	610 x 1219

PACKAGED HEAT PUMP

RTU 4 - 6

Enlight™ Rooftop Units
High-Efficiency - 60 Hz

Bulletin No. 210984
February 2024
Supersedes all previous versions

LENNOX

COMMERCIAL PRODUCT SPECIFICATIONS

ENLIGHT

LENNOX CORE CONTROL SYSTEM

SMARTWIRE™ SYSTEM

ASHRAE 90.1 COMPLIANT

ENERGY STAR

2 to 5 Tons
Net Cooling Capacity - 24,000 to 57,200 Btuh
Net Heating Capacity - 24,000 to 54,500 Btuh
Optional Electric Heat - 5 to 22.5 kW

MODEL NUMBER IDENTIFICATION

L H T 060 H 4 E N 1 Y

Brand/Family
L = Enlight™

Unit Type
H = Packaged Heat Pump

Major Design Sequence
T = 1st Generation

Nominal Cooling Capacity - Tons
024 = 2 Ton
036 = 3 Tons
048 = 4 Tons
060 = 5 Tons

Cooling Efficiency
H = High Efficiency

Refrigerant Type
4 = R-410A

Blower Type
E = ECM Direct Drive Blower Motor

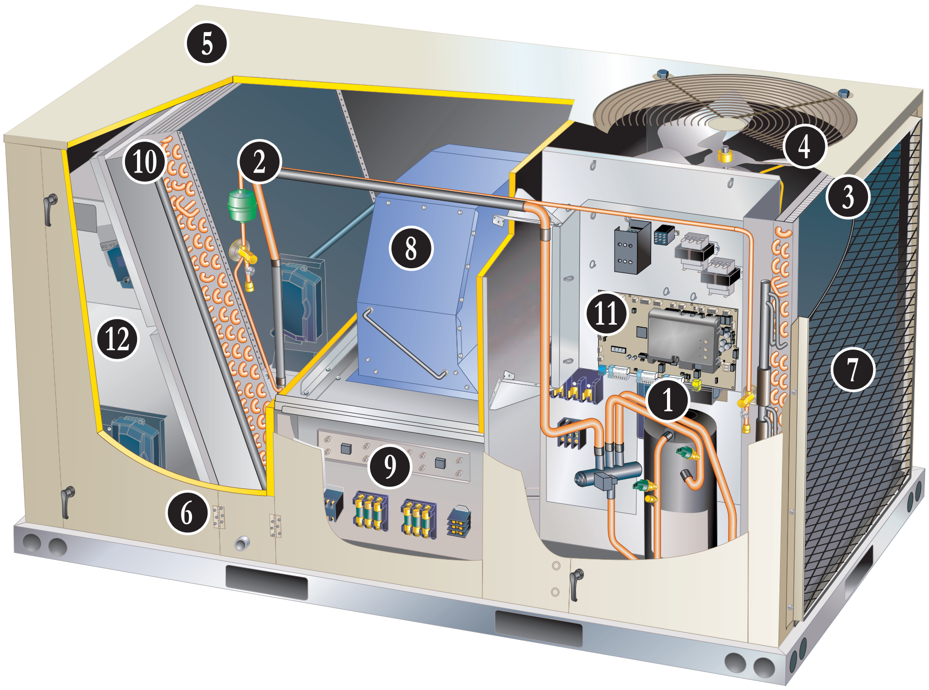
Factory Installed Electric Heat
N = No Heat
Q = 5 kW Electric Heat
C = 7.5 kW Electric Heat
D = 10 kW Electric Heat
E = 15 kW Electric Heat
G = 22.5 kW Electric Heat

Minor Design Sequence
1 = 1st Revision

Voltage
P = 208/230V-1 phase-60Hz
Y = 208/230V-3 phase-60Hz
G = 460V-3 phase-60Hz
J = 575V-3 phase-60Hz

FEATURE HIGHLIGHTS

Enlight™ rooftop units featuring the Lennox® CORE Control System create a bright future through a highly energy-efficient and environmentally sustainable design. Comprehensive configurations meet a wide range of applications, making it the most flexible product line Lennox has to offer.



1. Two Stage Compressor
2. Filter/Drier
3. Outdoor Coil
4. Variable Speed (ECM) Fan Motor
5. Heavy Gauge Steel Cabinet
6. Hinged Access Panels
7. Combination Coil/Hail Guards (option)
8. Supply Air Direct Drive (ECM) Blower
9. Electric Heat (option)
10. Air Filters
11. Lennox® CORE Control System
12. Economizer (option)

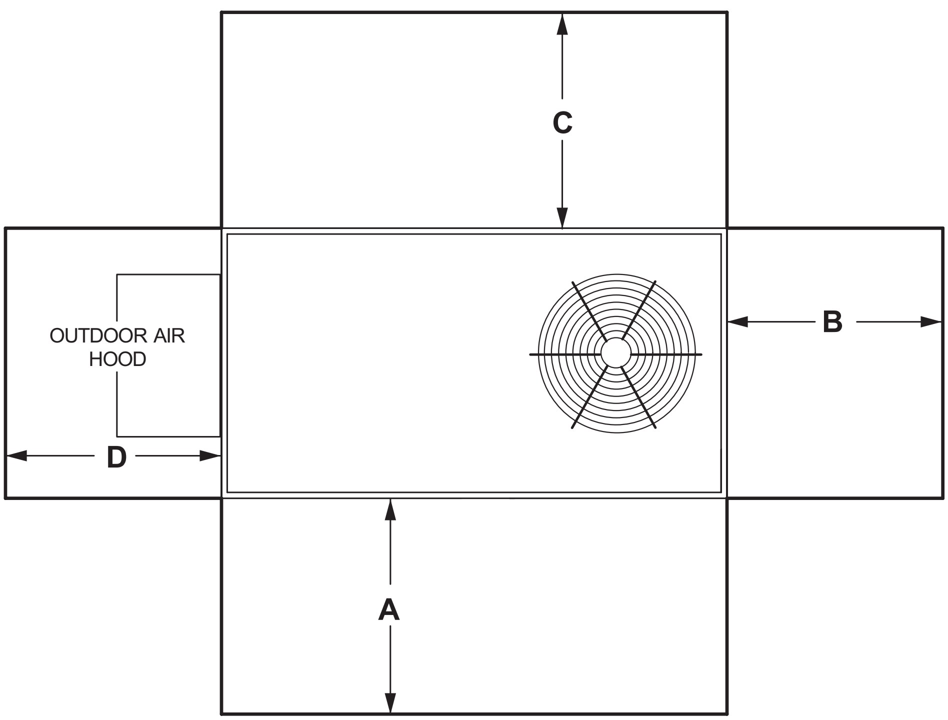
CONTENTS

ELECTRIC HEAT CAPACITIES

Input Voltage	5 kW			7.5 kW			10 kW		
	No of Stages	kW input	Btuh Output	No of Stages	kW input	Btuh Output	No of Stages	kW input	Btuh Output
208	1	3.8	12,800	1	5.6	19,200	1	7.5	25,600
220	1	4.2	14,300	1	6.3	21,500	1	8.4	28,700
230	1	4.6	15,700	1	6.9	23,500	1	9.2	31,400
240	1	5.0	17,100	1	7.5	25,600	1	10.0	34,200
440	- - -	- - -	- - -	1	6.3	21,500	- - -	- - -	- - -
460	- - -	- - -	- - -	1	6.9	23,500	- - -	- - -	- - -
480	- - -	- - -	- - -	1	7.5	25,600	- - -	- - -	- - -
550	- - -	- - -	- - -	1	6.3	21,500	- - -	- - -	- - -
575	- - -	- - -	- - -	1	6.9	23,500	- - -	- - -	- - -
600	- - -	- - -	- - -	1	7.5	25,600	- - -	- - -	- - -

Input Voltage	15 kW			22.5 kW		
	No of Stages	kW input	Btuh Output	No of Stages	kW input	Btuh Output
208	1	11.2	38,400	1	16.9	57,700
220	1	12.6	43,000	1	18.9	64,500
230	1	13.8	47,000	1	20.7	70,700
240	1	15.0	51,200	1	22.5	76,800
440	1	12.6	43,000	1	18.9	64,500
460	1	13.8	47,000	1	20.7	70,700
480	1	15.0	51,200	1	22.5	76,800
550	1	12.6	43,000	1	18.9	64,500
575	1	13.8	47,000	1	20.7	70,700
600	1	15.0	51,200	1	22.5	76,800

UNIT CLEARANCES



[1] Unit Clearance	A		B		C		D		Top Clearance
	in.	mm	in.	mm	in.	mm	in.	mm	
Service Clearance	36	914	36	914	36	934	36	914	Unobstructed
Minimum Operation Clearance	36	914	36	914	36	914	36	914	

NOTE - Entire perimeter of unit base requires support when elevated above the mounting surface.
[1] Service Clearance - Required for removal of serviceable parts.
Minimum Operation Clearance - Required clearance for proper unit operation.

OUTDOOR SOUND DATA

Unit[1] Model No.	Octave Band Sound Power Levels dBA, re 10^{-12} Watts Center Frequency - Hz							Sound Rating Number[1] dBA
	125	250	500	1000	2000	4000	8000	
024, 036, 048	63	66	70	71	68	62	53	75
060	67	72	77	76	73	68	61	82

NOTE - The octave sound power data does not include tonal corrections.

[1] Sound Rating Number according to AHRI Standard 270-95 (includes pure tone penalty). Sound Rating Number is the overall A-Weighted Sound Power Level, (Lwa), dBA (100 Hz to 10,000 Hz).

WEIGHT DATA — UNIT

Model Number	Net		Shipping	
	lbs.	kg	lbs.	kg
024 Base Unit	646	293	686	311
024 Max. Unit	765	[illegible]	805	365
036 Base Unit	645	[illegible]	685	311
036 Max. Unit	764	347	804	365
048 Base Unit	641	291	681	309
048 Max. Unit	760	[illegible]	800	363
060 Base Unit	686	311	727	330
060 Max. Unit	792	359	833	378

RTU 4 (036 Max. Unit)
RTU 5 (048 Max. Unit)
RTU 6 (060 Max. Unit)

WEIGHT DATA — OPTIONS / ACCESSORIES

		Shipping Weight	
		lbs.	kg
ECONOMIZER / OUTDOOR AIR / EXHAUST			
Economizer			
Economizer, Includes Combination Outdoor Air Hood and Barometric Relief Dampers		131	59
Outdoor Air Dampers			
Motorized		40	18
Manual		30	14
Power Exhaust		35	17
ELECTRIC HEAT			
5 kW		31	14
7.5 kW		31	14
15 kW		31	14
22.5 kW		35	16
30 kW		35	16
COMBINATION COIL/HAIL GUARDS			
All models		31	14
ROOF CURBS			
Hybrid Roof Curbs, Downflow			
8 in. height		86	39
14 in. height		108	49
18 in. height		125	57
24 in. height		147	67
Adjustable Pitch Curb, Downflow			
14 in. height		147	67
CEILING DIFFUSERS			
Step-Down	RTD11-95S	118	54
Flush	FD11-95S	118	54
Transitions	T1TRAN20N-1	21	10

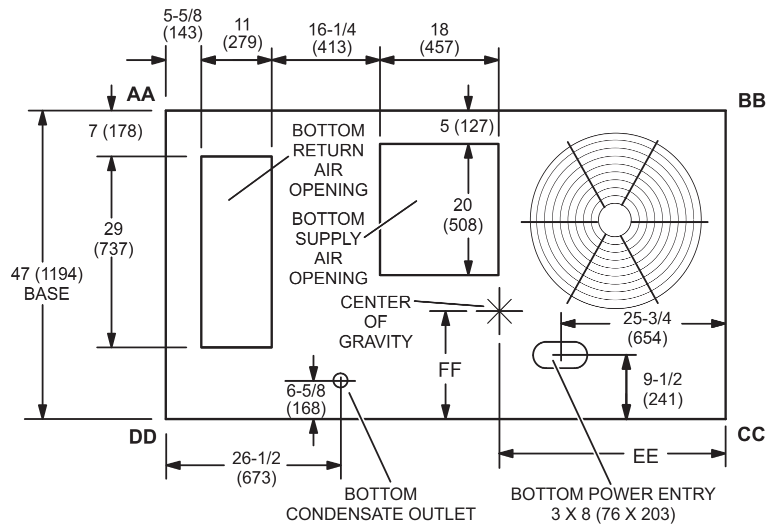
DIMENSIONS — UNIT

CORNER WEIGHTS									CENTER OF GRAVITY			
Model No.	AA		BB		CC		DD		EE		FF	
	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	in.	mm	in.	mm
LHT024 Base Unit	138	63	164	74	187	85	157	71	38	965	22	559
LHT024 Max Unit	181	82	177	80	202	92	205	93	42	[illegible]	22	559
LHT036 Base Unit	138	63	164	74	186	84	157	71	38	[illegible]	22	559
LHT036 Max. Unit	180	82	177	80	201	91	205	93	42	1067	22	559
LHT048 Base Unit	137	62	163	74	185	84	156	71	38	[illegible]	22	559
LHT048 Max. Unit	179	81	176	80	200	91	204	93	42	[illegible]	22	559
LHT060 Base Unit	140	64	167	76	206	93	173	78	38	965	21	533
LHT060 Max. Unit	166	75	171	78	231	105	224	102	41	1041	20	508

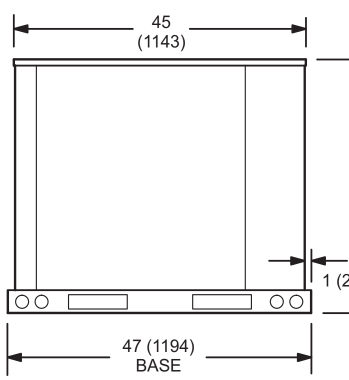
RTU 4 — LHT036 Max. Unit
RTU 5 — LHT048 Max. Unit
RTU 6 — LHT060 Max. Unit

Base Unit - The unit with NO INTERNAL OPTIONS.

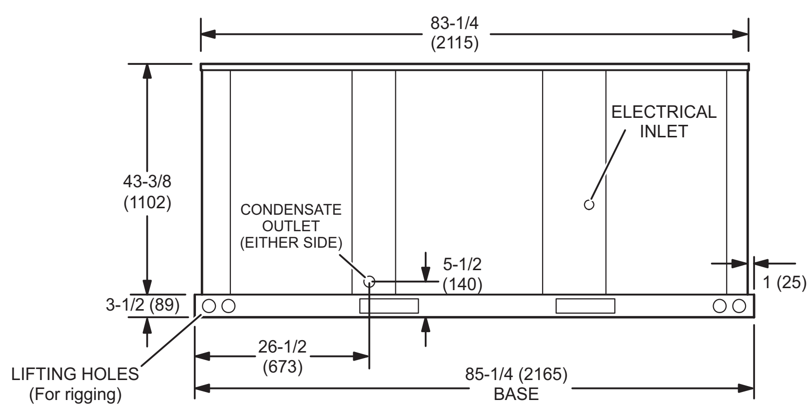
Max. Unit - The unit with ALL INTERNAL OPTIONS Installed. (Economizer, Standard Static Power Exhaust Fans, Controls, etc.). Doe[illegible] accessories external to unit or high static power exhaust.



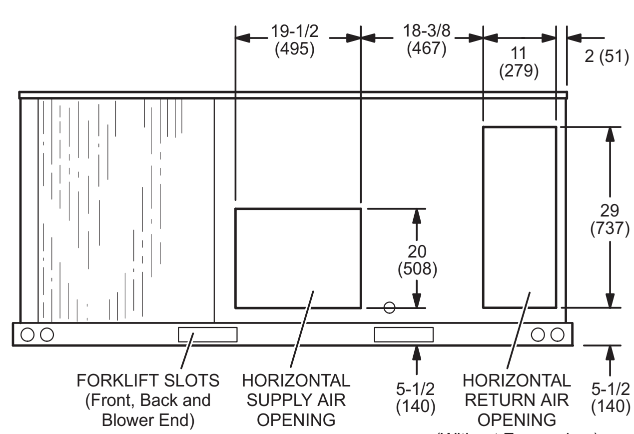
TOP VIEW (Base)



END VIEW

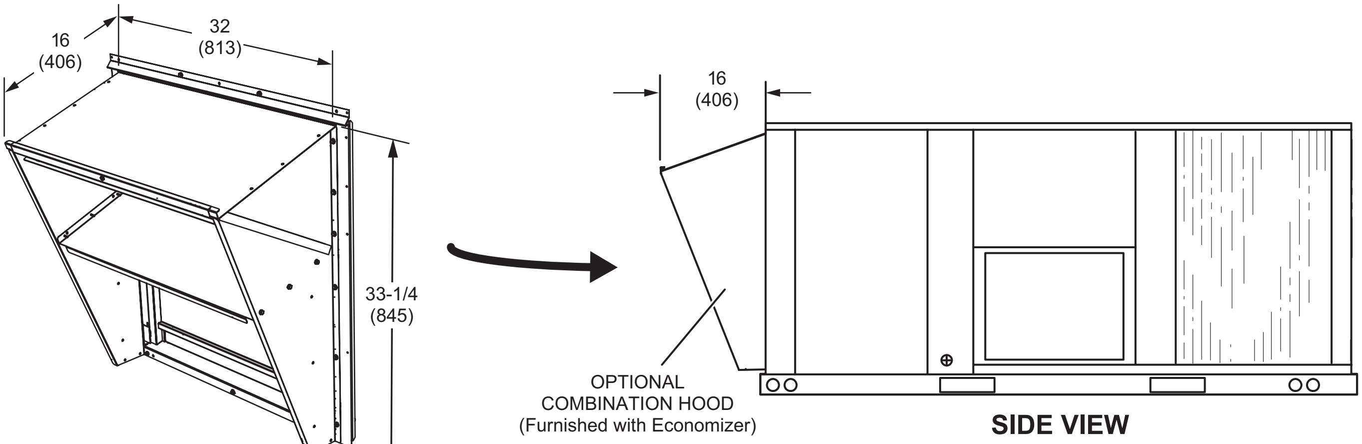


SIDE VIEW



BACK VIEW

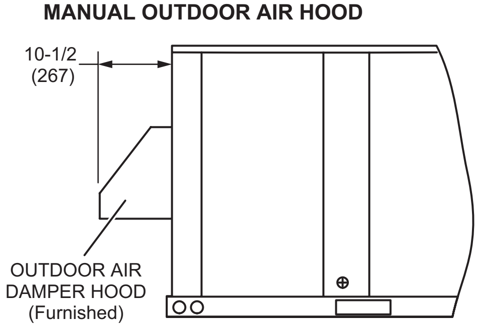
COMBINATION OUTDOOR AIR HOOD DETAIL FOR OPTIONAL ECONOMIZER AND BAROMETRIC RELIEF DAMPERS
(Furnished With Economizer for Downflow Applications)



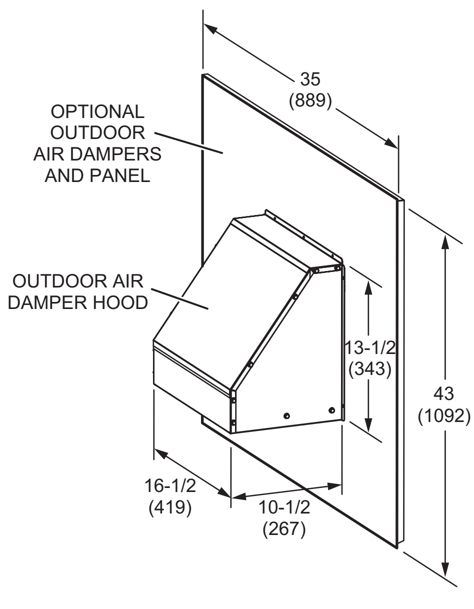
SIDE VIEW

OUTDOOR AIR DAMPER HOOD DETAIL (Downflow or Horizontal Applications)

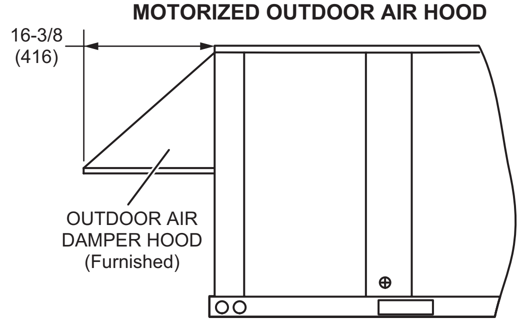
MANUAL OUTDOOR AIR HOOD



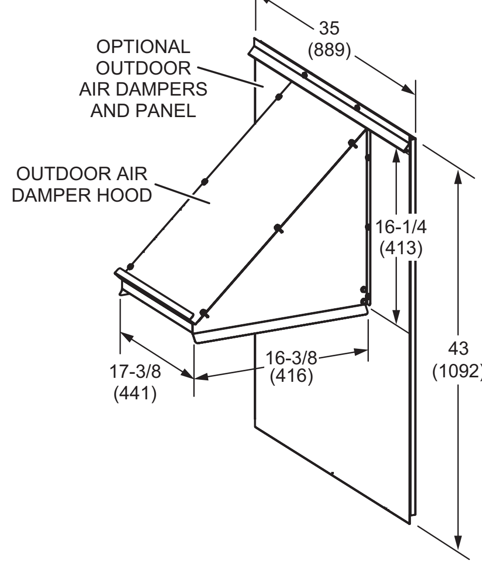
SIDE VIEW



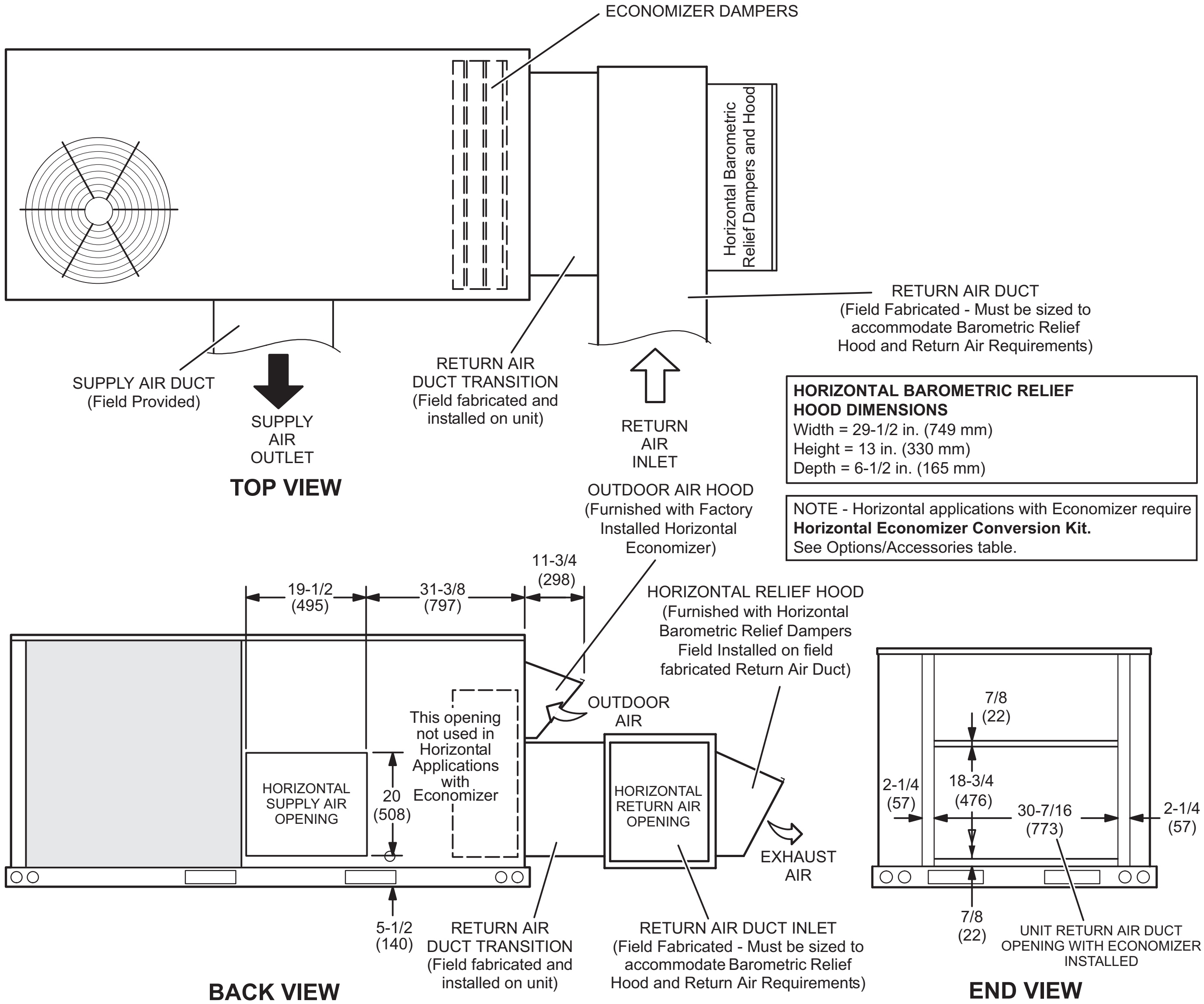
MOTORIZED OUTDOOR AIR HOOD



SIDE VIEW

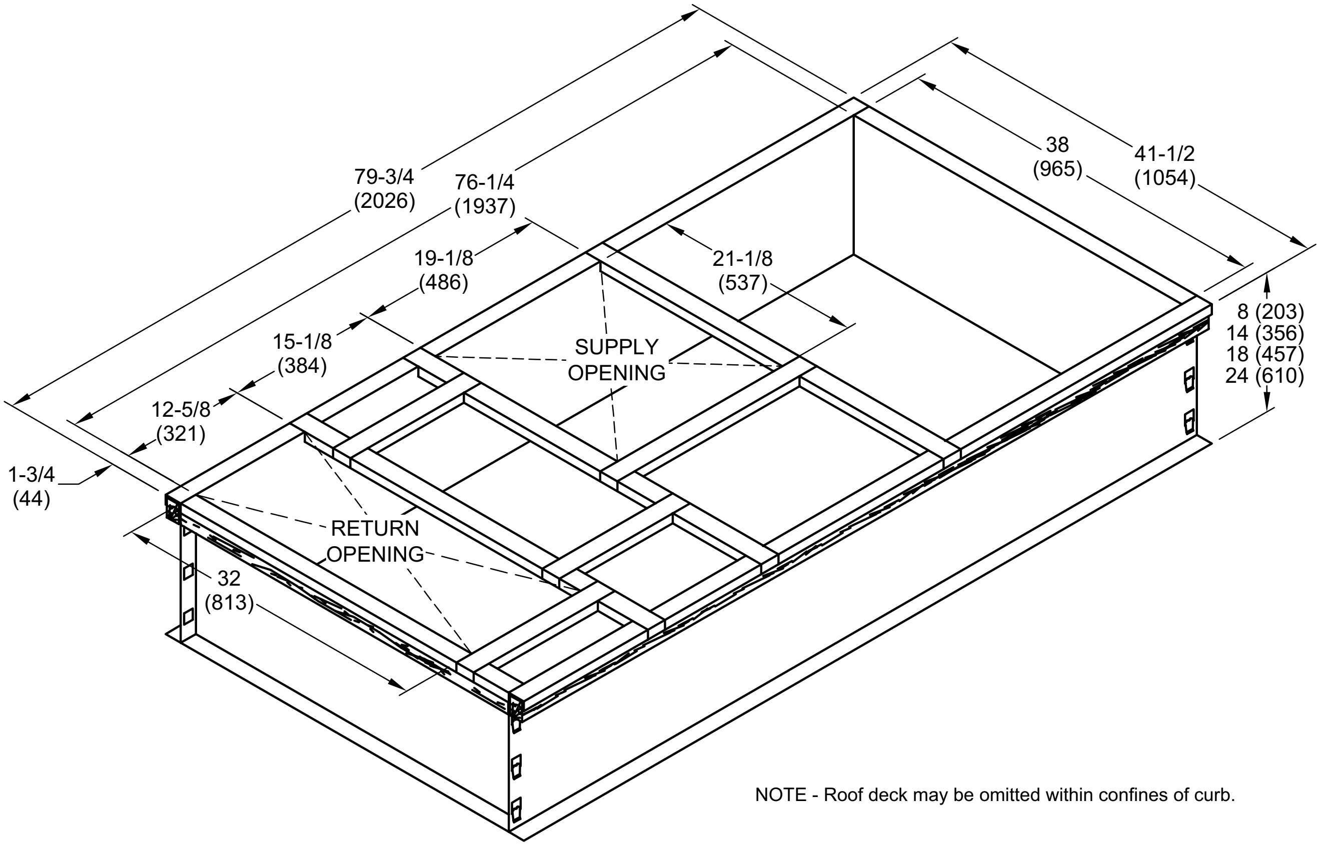


HORIZONTAL ECONOMIZER APPLICATIONS - OUTDOOR AIR HOOD DETAIL WITH OPTIONAL ECONOMIZER DAMPERS AND OPTIONAL HORIZONTAL BAROMETRIC RELIEF DAMPERS AND HOOD



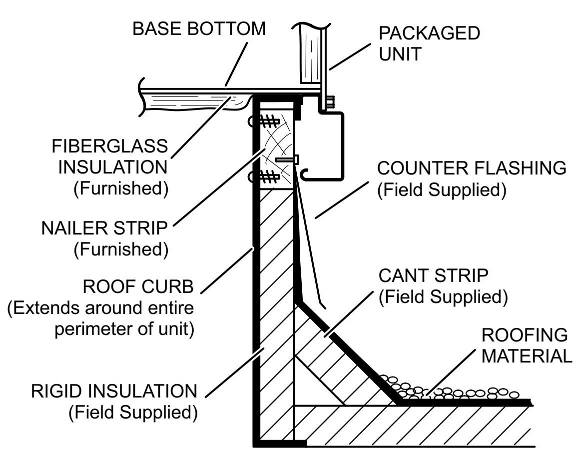
NOTE - Return Air Duct and Transition must be supported.

HYBRID ROOF CURBS - DOUBLE DUCT OPENING

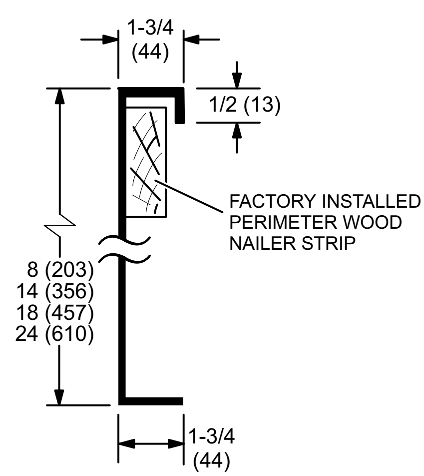


NOTE - Roof deck may be omitted within confines of curb.

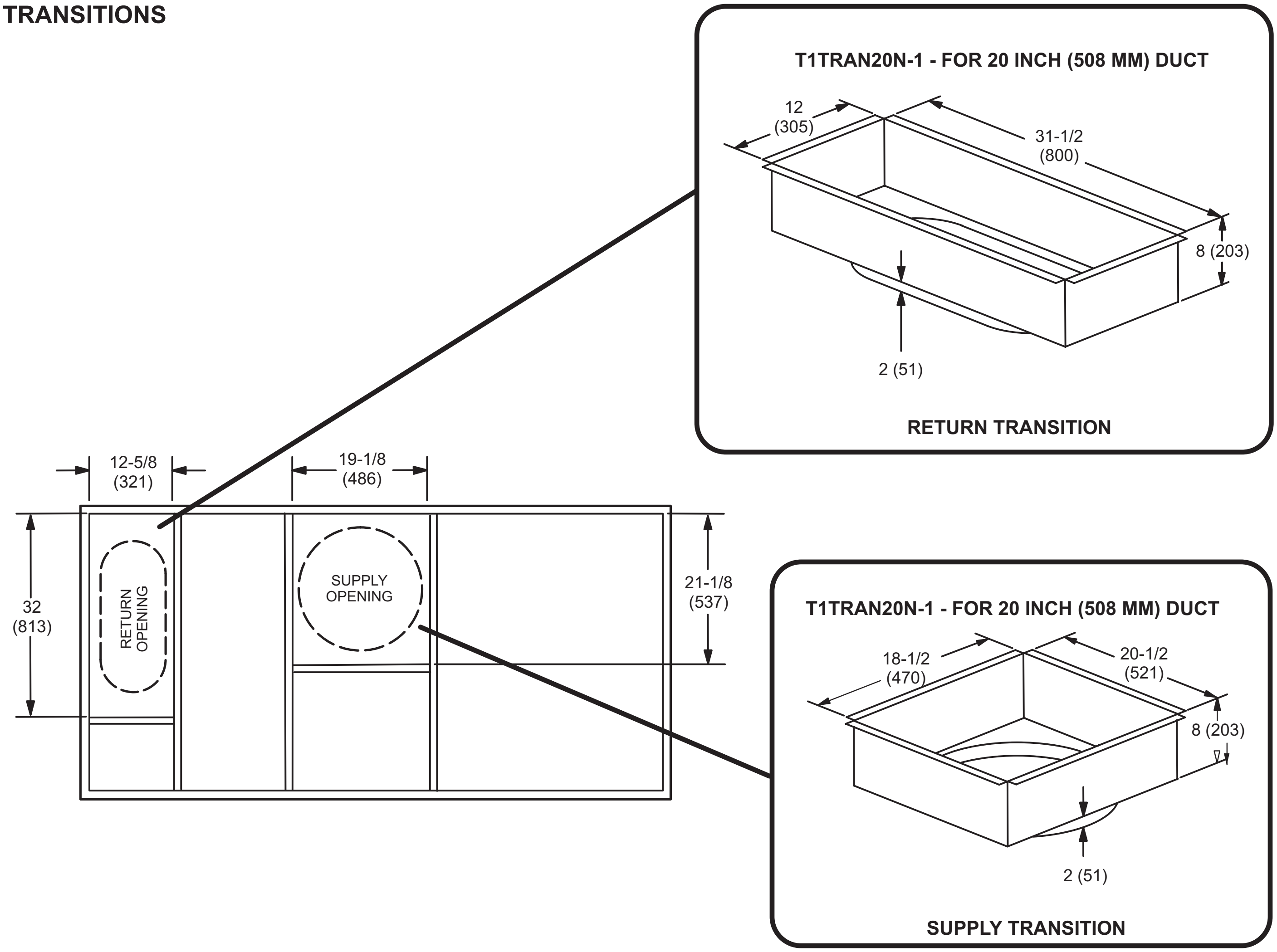
TYPICAL FLASHING DETAIL FOR ROOF CURB



DETAIL ROOF CURB



TRANSITIONS



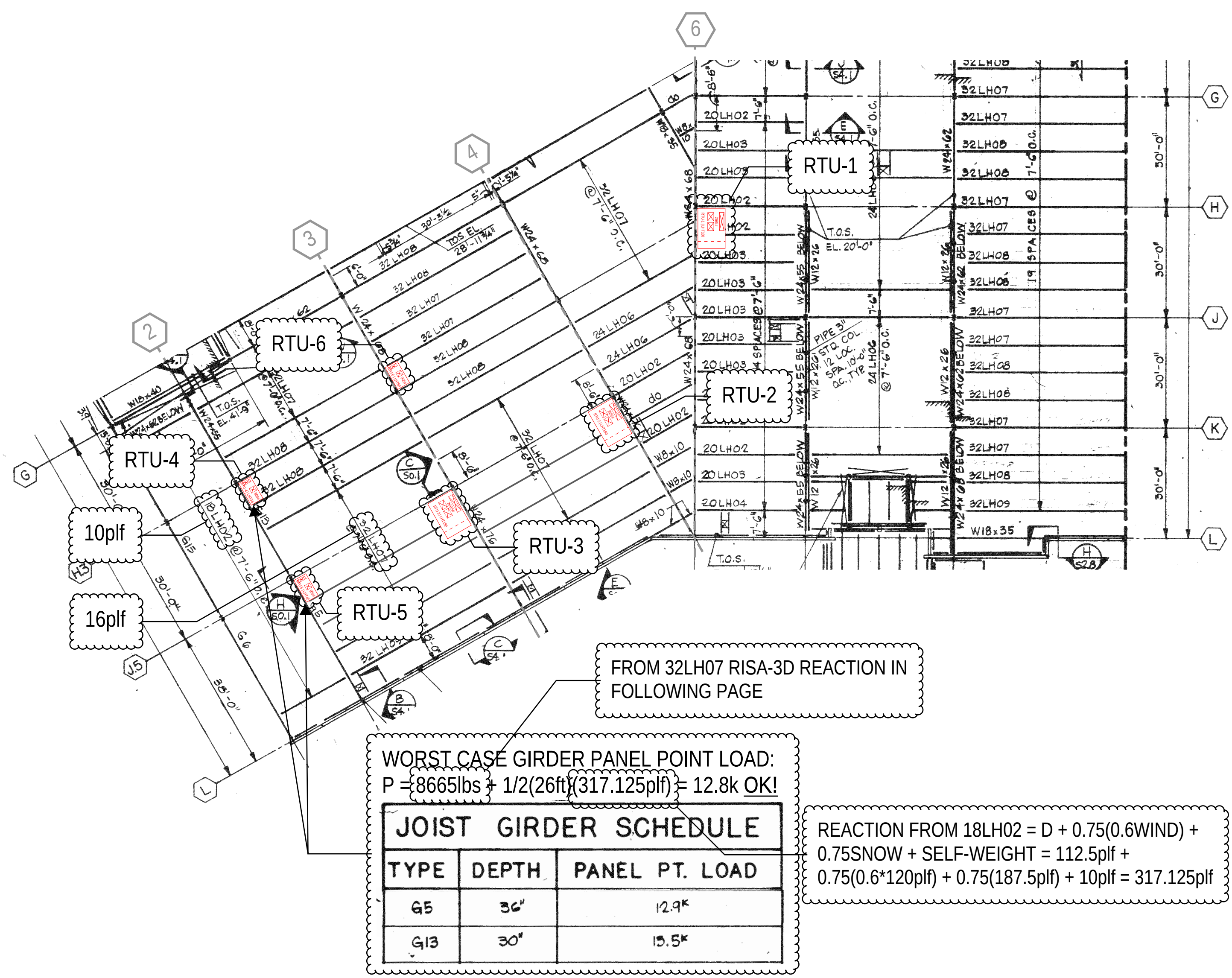
Existing Roof Loading

Existing Roof Loads

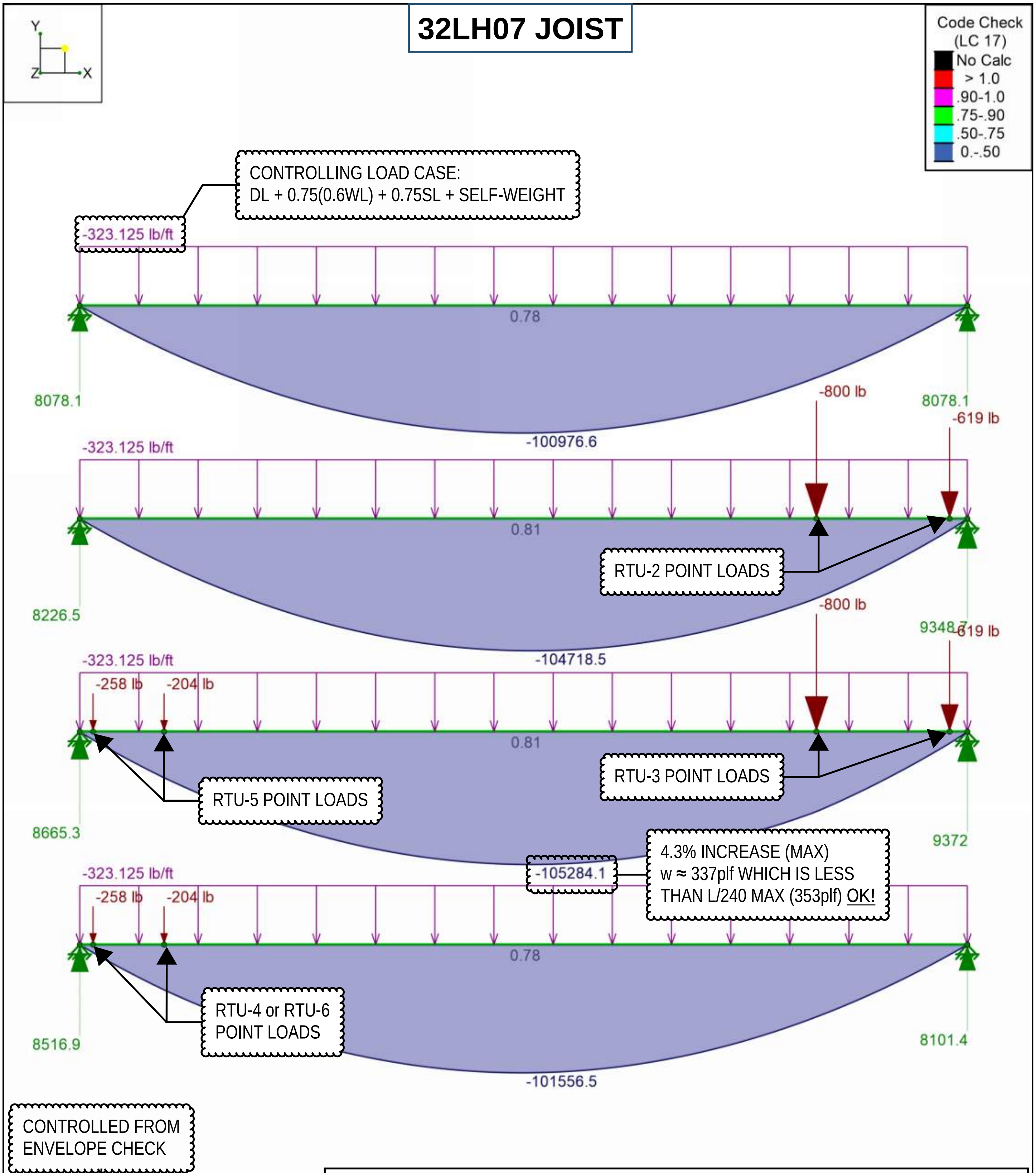
Total DL	= 15psf * 7.5ft = 112.5plf
Roof Live Load	= 20psf * 7.5ft = 150plf
Snow Load	= 25psf * 7.5ft = 187.5plf
Wind Load	= 16psf * 7.5ft = 120plf

Equipment Weight

-Analyze RTU load at each location with point loads per RTU specifications.



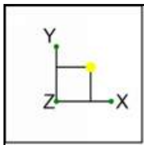
32LH07 JOIST



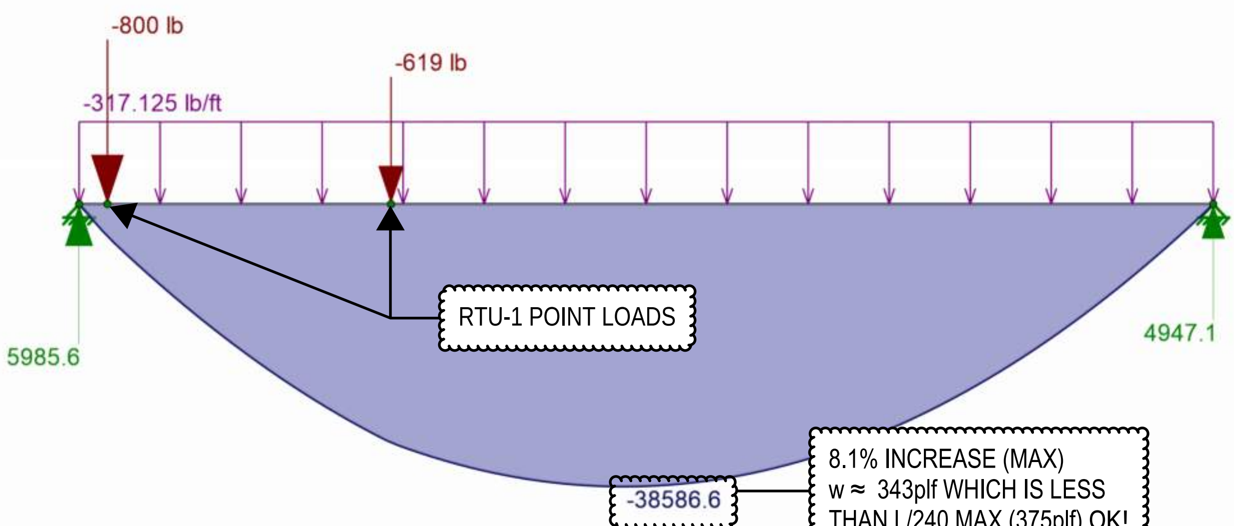
Member Code Checks Displayed
Loads: LC 17, RTU2 ASD 6 (b)
Results for LC 17, RTU2 ASD 6 (b)
Member Z Bending Moments (lb-ft)
Y-direction Reaction Units are lbs and lb-ft

PER THE TABLES ATTACHED FOR LH-SERIES STEEL JOISTS, CONSIDERING TOTAL SAFE UNIFORMALY DISTRIBUTED LOADS, THE MAXIMUM APPLIED DISTRIBUTED LOAD IS 379plf FOR THIS SPAN, RESULTING IN MOMENT CAPACITY OF 118438ft-lb AND MAX REACTION OF 9475lb. UNDER WORST CASE LOADING WITH NEW RTUS, DESIGN MOMENT IS 105284ft-lb AND DESIGN REACTION IS 9372lb. NEW RTUS DO NOT EXCEED EXISTING JOIST CAPACITY. APPROXIMATED DISTRIBUTED LOAD BASED ON THIS DESIGN MOMENT IS 337plf, LESS THAN THE L/240 LIMIT BEING 353plf."

Brienen Structural Engineers		SK-1
BBeaudette		Jun 12, 2024
		32LH07 Joist Calculations.r3d



20LH02 JOIST



CONTROLLED FROM
ENVELOPE CHECK

Loads: LC 17, RTU2 ASD 6 (b)
Results for LC 17, RTU2 ASD 6 (b)
Member z Bending Moments (lb-ft)
Y-direction Reaction Units are lbs and lb-ft

PER THE TABLES ATTACHED FOR LH-SERIES STEEL JOISTS, CONSIDERING TOTAL SAFE UNIFORMALY DISTRIBUTED LOADS, THE MAXIMUM APPLIED DISTRIBUTED LOAD IS 388plf FOR THIS SPAN, RESULTING IN MOMENT CAPACITY OF 43650ft-lb AND MAX REACTION OF 5820lb. UNDER WORST CASE LOADING WITH NEW RTUS, DESIGN MOMENT IS 38587ft-lb AND DESIGN REACTION IS 5986lb. THE NEW RTUS DO EXCEED EXISTING JOIST REACTION CAPACITY BY ~2.9% BUT THE RTU LOAD IS REALISTICALLY SPREAD ACROSS (3) JOISTS WHICH WOULD REDUCE OUR REACTIONS TO A SAFE AMOUNT. APPROXIMATED DISTRIBUTED LOAD BASED ON THIS DESIGN MOMENT IS 343plf, LESS THAN THE L/240 LIMIT BEING 375plf."

Brienen Structural Engineers		SK-2
BBeaudette		Jun 12, 2024
		20LH02 Joist Calculations.r3d

STANDARD ASD LOAD TABLE

LONGSPAN STEEL JOISTS, LH-SERIES

Based on a 50 ksi (345 MPa) Maximum Yield Strength
Adopted by the Steel Joist Institute May 1, 2000
Revised to May 18, 2010 – Effective December 31, 2010

CALCULATE L/240 DEFLECTION LIMITS

The **BLACK** figures in the Load Table give the TOTAL safe uniformly distributed load-carrying capacities, in pounds per linear foot, of **ASD** LH-Series Steel Joists.

The approximate joist weights, in pounds per linear foot (kiloNewtons per meter), given in the Load Table may be added to the other building weights to determine the DEAD load. In all cases the DEAD load, including the joist self-weight, must be deducted from the TOTAL load to determine the LIVE load. The approximate joist weights do not include accessories.

The **RED** figures in the Load Table represent the uniform load, in pounds per linear foot (kiloNewtons per meter), which will produce an approximate joist deflection of 1/360 of the span. This load can be linearly prorated to obtain the uniform load for supplementary deflection criteria (i.e. a uniform load that will produce a joist deflection of 1/240 of the span may be obtained by multiplying the **RED** figures by 360/240). In no case shall the prorated load exceed the TOTAL load-carrying capacity of the joist.

The Load Table applies to joists with either parallel chords or pitched top chords. Joists can have a top chord pitch up to 1/2 inch per foot (42 mm per meter). If the pitch exceeds this limit, the Load Table does not apply. When top chords are pitched, the load-carrying capacities are determined by the nominal depth of the joists at the center of the span. Sloped parallel-chord joists shall use span as defined by the length along the slope.

Where the joist span is in the **RED SHADED** area of the Load Table, the row of bridging nearest the mid span shall be diagonal bridging with bolted connections at chords and intersections. Hoisting cables shall not be released until this row of bolted diagonal bridging is completely installed. The **RED SHADED** area extends up through 60’–0” (18288 mm).

Where the joist span is in the **BLUE SHADED** area of the Load Table, all rows of bridging shall be diagonal bridging with bolted connections at chords and intersections. Hoisting cables shall not be released until the two rows of bridging nearest the third points are completely installed. The **BLUE SHADED** area starts after 60’–0” (18288 mm) and extends up through 100’–0” (30175 mm).

The approximate gross moment of inertia (not adjusted for shear deformation) of a standard joist listed in the Load Table may be determined as follows:

$I_j = 26.767(W)(L^3)(10^{-6})$ in^4 or $2.6953(W)(L^3)(10^{-5})$ mm^4, where W= **RED** figure in the Load Table, and
L = (span – 0.33) in feet or (span – 102) in millimeters

Loads for span increments not explicitly given in the Load Table may be determined using linear interpolation between the load values given in adjacent span columns.

*The safe uniform load for the spans shown in the SAFE LOAD Column is equal to (SAFE LOAD) / (span). The TOTAL safe uniformly distributed load-carrying capacity, for spans less than those shown in the SAFE LOAD Column are given in the MAX LOAD Column.

To solve for a RED figure for spans shown in the SAFE LOAD Column (or lesser spans), multiply the RED figure of the shortest span shown in the Load Table by (the shortest span shown in the Load Table – 0.33 feet [101 mm])^2 and divide by (the actual span – 0.33 feet [101 mm])^2. In no case shall the calculated load exceed the TOTAL load-carrying capacity of the joist.

ASD

STANDARD LOAD TABLE FOR LONGSPAN STEEL JOISTS, LH-SERIES
Based on a 50 ksi Maximum Yield Strength - Loads Shown In Pounds Per Linear Foot (plf)

Joist Designation	Approx. Wt in Lbs. Per Linear Ft. (Joists only)	Depth in inches	Max Load (plf)	SAFE LOAD* in Lbs. Between	SPAN IN FEET														
			< 22	22-25	26	27	28	29	30	31	32	33	34	35	36				
18LH02	10	18	553	12160	468	442	418	391	367	345	324	306	289	273	259				
					313	284	259	234	212	193	175	160	147	135	124				
18LH03	11	18	613	13480	521	493	467	438	409	382	359	337	317	299	283				
					348	317	289	262	236	213	194	177	161	148	136				
18LH04	12	18	714	15700	604	571	535	500	469	440	413	388	365	344	325				
					403	367	329	296	266	242	219	200	182	167	153				
18LH05	15	18	806	17740	684	648	614	581	543	508	476	448	421	397	375				
					454	414	378	345	311	282	256	233	212	195	179				
18LH06	15	18	954	20980	809	749	696	648	605	566	531	499	470	443	418				
					526	469	419	377	340	307	280	254	232	212	195				
18LH07	17	18	990	21780	840	809	780	726	678	635	595	559	526	496	469				
					553	513	476	428	386	349	317	288	264	241	222				
18LH08	19	18	1032	22700	876	843	812	784	758	717	680	641	604	571	540				
					577	534	496	462	427	387	351	320	292	267	246				
18LH09	21	18	1105	24320	936	901	868	838	810	783	759	713	671	633	598				
					616	571	527	491	458	418	380	346	316	289	266				
			< 23	23-25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
20LH02	10	20	498	11460	442	437	431	410	388	365	344	325	307	291	275	262	249	237	225
					306	303	298	274	250	228	208	190	174	160	147	136	126	117	108
20LH03	11	20	529	12160	469	463	458	452	434	414	395	372	352	333	316	299	283	269	255
					337	333	317	302	280	258	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	133	123
20LH04	12	20	648	14900	574	566	558	528	496	467	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	303	289
					428	406	386	352	320	291	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	149	139
20LH05	14	20	697	16020	616	609	602	595	571	544	513	484	458	434	411	390	371	353	336
					459	437	416	395	366	337	308	281	258	238	219	202	187	173	161
20LH06	15	20	930	21380	822	791	763	723	679	635	596	560	527	497	469	444	421	399	379
					606	561	521	477	427	386	351	320	292	267	246	226	209	192	178
20LH07	17	20	991	22800	878	845	814	786	760	711	667	627	590	556	526	497	471	447	425
					647	599	556	518	484	438	398	362	331	303	278	256	236	218	202
20LH08	19	20	1023	23520	908	873	842	813	785	760	722	687	654	621	588	558	530	503	479
					669	619	575	536	500	468	428	395	365	336	309	285	262	242	225
20LH09	21	20	1119	25740	990	953	918	886	856	828	802	778	755	712	673	636	603	572	544
					729	675	626	581	542	507	475	437	399	366	336	309	285	264	244
20LH10	23	20	1207	27760	1068	1028	991	956	924	894	865	839	814	791	748	707	670	636	604
					786	724	673	626	585	545	510	479	448	411	377	346	320	296	274

L/240 = 250plf(360/240) 375plf MAX

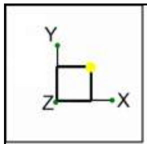
SJI STEEL JOIST INSTITUTE

ASD

STANDARD LOAD TABLE FOR LONGSPAN STEEL JOISTS, LH-SERIES
Based on a 50 ksi Maximum Yield Strength - Loads Shown In Pounds Per Linear Foot (plf)

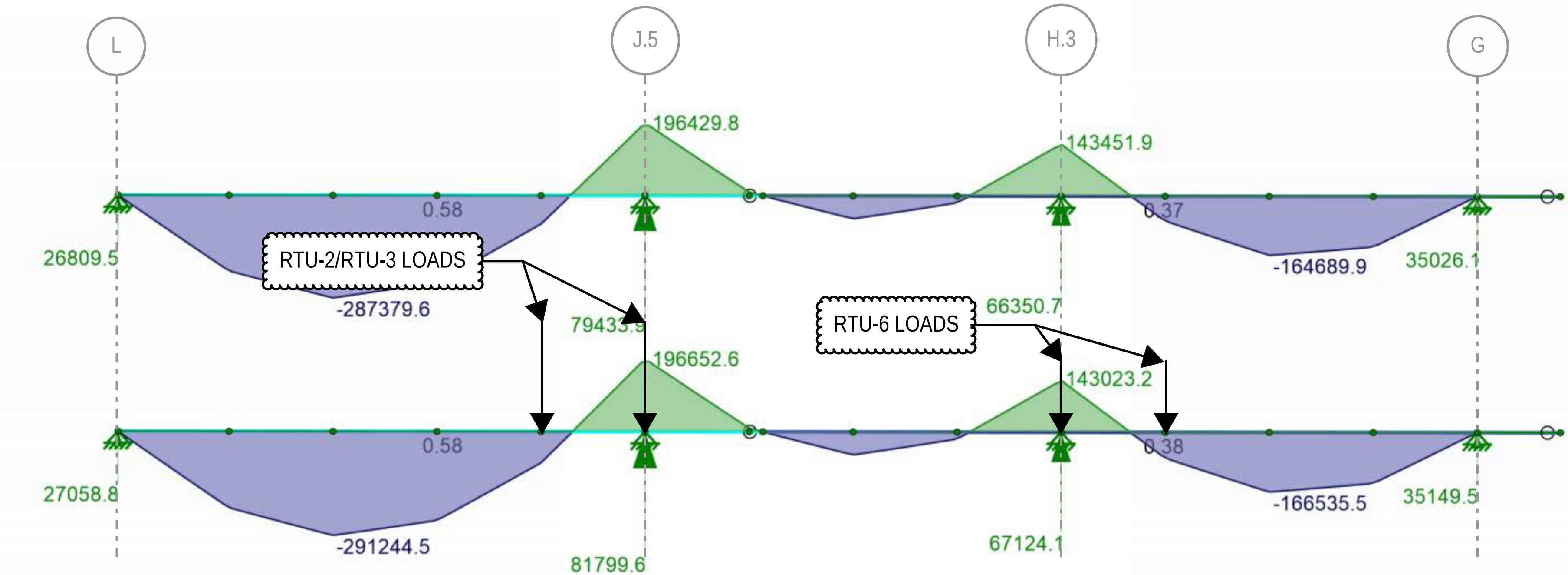
Joist Designation	Approx. Wt in Lbs. Per Linear Ft. (Joists only)	Depth in inches	Max Load (plf)	SAFELOAD* in Lbs. Between			SPAN IN FEET														
			< 29	29-33			34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
24LH03	11	24	401	11620			342	339	336	323	307	293	279	267	255	244	234	224	215	207	199
							235	226	218	204	188	175	162	152	141	132	124	116	109	102	96
24LH04	12	24	491	14240			419	398	379	360	343	327	312	298	285	273	262	251	241	231	222
							288	265	246	227	210	195	182	169	158	148	138	130	122	114	107
24LH05	13	24	526	15260			449	446	440	419	399	380	363	347	331	317	304	291	280	269	258
							308	297	285	264	244	226	210	196	182	171	160	150	141	132	124
24LH06	16	24	708	20520			604	579	555	530	504	480	457	437	417	399	381	364	348	334	320
							411	382	356	331	306	284	263	245	228	211	197	184	172	161	152
24LH07	17	24	777	22540			665	638	613	588	565	541	516	491	468	446	426	407	389	373	357
							452	421	393	367	343	320	297	276	257	239	223	208	195	182	171
24LH08	18	24	829	24040			707	677	649	622	597	572	545	520	497	475	455	435	417	400	384
							480	447	416	388	362	338	314	292	272	254	238	222	208	196	184
24LH09	21	24	976	28300			832	808	785	764	731	696	663	632	602	574	548	524	501	480	460
							562	530	501	460	424	393	363	337	313	292	272	254	238	223	209
24LH10	23	24	1031	29900			882	856	832	809	788	768	737	702	668	637	608	582	556	533	511
							596	559	528	500	474	439	406	378	351	326	304	285	266	249	234
24LH11	25	24	1087	31520			927	900	875	851	829	807	787	768	734	701	671	642	616	590	567
							624	588	555	525	498	472	449	418	388	361	337	315	294	276	259
			< 34	34-41			42	43	44	45	46	47	48	49	50	51	52	53	54	55	56
28LH05	13	28	415	14120			337	323	310	297	286	275	265	255	245	237	228	220	213	206	199
							219	205	192	180	169	159	150	142	133	126	119	113	107	102	97
28LH06	16	28	552	18760			448	429	412	395	379	364	350	337	324	313	301	291	281	271	262
							289	270	253	238	223	209	197	186	175	166	156	148	140	133	126
28LH07	17	28	623	21180			505	484	464	445	427	410	394	379	365	352	339	327	316	305	295
							326	305	285	267	251	236	222	209	197	186	176	166	158	150	142
28LH08	18	28	667	22680			540	517	496	475	456	438	420	403	387	371	357	344	331	319	308
							348	325	305	285	268	252	236	222	209	196	185	175	165	156	148
28LH09	21	28	821	27920			667	639	612	586	563	540	519	499	481	463	446	430	415	401	387
							428	400	375	351	329	309	291	274	258	243	228	216	204	193	183
28LH10	23	28	898	30540			729	704	679	651	625	600	576	554	533	513	495	477	460	444	429
							466	439	414	388	364	342	322	303	285	269	255	241	228	215	204
28LH11	25	28	964	32760			780	762	736	711	682	655	629	605	582	561	540	521	502	485	468
							498	475	448	423	397	373	351	331	312	294	278	263	249	236	223
28LH12	27	28	1058	35980			857	837	818	800	782	766	737	709	682	656	632	609	587	566	546
							545	520	496	476	454	435	408	383	361	340	321	303	285	270	256
28LH13	30	28	1103	37500			895	874	854	835	816	799	782	766	751	722	694	668	643	620	598
							569	543	518	495	472	452	433	415	396	373	352	332	314	297	281
			< 39	39-46	47-49		50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
32LH06	14	32	431	16820	16820		338	326	315	304	294	284	275	266	257	249	242	234	227	220	214
							211	199	189	179	169	161	153	145	138	131	125	119	114	108	104
32LH07	16	32	485	18920	18920		379	366	353	341	329	318	308	298	288	279	271	262	254	247	240
							235	223	211	200	189	179	170	162	154	146	140	133	127	121	116
32LH08	17	32	527	20540	20540		411	397	383	369	357	345	333	322	312	302	293	284	275	267	259
							255	242	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	151	144	137	131	125
32LH09	21	32	661	25780	25780		516	498	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	367	356	345	335	325
							319	302	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	189	180	172	164	157
32LH10	21	32	731	28500	28500		571	550	531	512	495	478	462	445	430	416	402	389	376	364	353
							352	332	315	297	282	267	254	240	228	217	206	196	186	178	169
32LH11	24	32	801	31220	31220		625	602	580	560	541	522	505	488	473	458	443	429	416	403	390
							385	363	343	325	308	292	277	263	251	239	227	216	206	196	187
32LH12	27	32	939	36640	36640		734	712	688	664	641	619	598	578	559	541	524	508	492	477	463
							450	428	406	384	364	345	327	311	295	281	267	255	243	232	221
32LH13	30	32	1048	40880	40880		817	801	785	771	742	715	690	666	643	621	600	581	562	544	527
							500	480	461	444	420	397	376	354	336	319	304	288	275	262	249
32LH14	33	32	1079	42080	42080		843	826	810	795	780	766	738	713	688	665	643	622	602	583	564
							515	495	476	458	440	417	395	374	355	337	321	304	290	276	264
32LH15	35	32	1115	43500	43500		870	853	837	821	805	791	776	763	750	725	701	678	656	635	616
							532	511	492	473	454	438	422	407	393	374	355	338	322	306	292
			< 43	43-46	47-56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
36LH07	16	36	393	16900	16900		292	283	274	266	258	251	244	237	230	224	218	212	207	201	196
							177	168	160	153	146	140	134	128	122	117	112	107	103	99	95
36LH08	18	36	433	18600	18600		321	311	302	293	284	276	268	260	253	246	239	233	227	221	215
							194	185	176	168	160	153	146	140	134	128	123	118	113	109	104
36LH09	21	36	554	23840	23840		411	398	386	374	363	352	342	333	323	314	306	297	289	282	275
							247	235	224	214	204	195	186	179	171	163	157	150	144	138	133
36LH10	21	36	611	26260	26260		454	440	426	413	401	389	378	367	357	347	338	328	320	311	303
							273	260	248	236	225	215	206	197	188	180	173	165	159	152	146
36LH11	23	36	667	28660	28660		495	480	465	451	438	425	412	401	389	378	368	358	348	339	330
							297	283	269	257	246	234	224	214	205	196	188	180	173	166	159
36LH12	25	36	798	34300	34300		593	575	557	540	523	508	493	478	464	450	437	424	412	400	389
							354	338	322	307	292	279	267	255	243	232	222	213	204	195	187
36LH13	30	36	938	40340	40340		697	675	654	634	615	596	579	562	546	531	516	502	488	475	463
							415	395	376	359	342	327	312	298	285	273	262	251	240	231	222
36LH14	36	36	1034	44460	44460		768	755	729	706	683	661	641	621	602	584	567	551	535	520	505
							456	434	412	392	373	356	339	323	309	295	283	270	259	247	237
36LH15	36	36	1090	46880	46880		809	795	781	769	744	721	698	677	656	637	618	600	583	567	551
							480	464	448	434	413	394	375	358	342	327	312	299	286	274	263

L/240 = 235plf(360/240) = 353plf MAX



GL3 & GL4 GIRDER

Code Check
(LC 11)
No Calc
> 1.0
.90-1.0
.75-.90
.50-.75
0.-.50

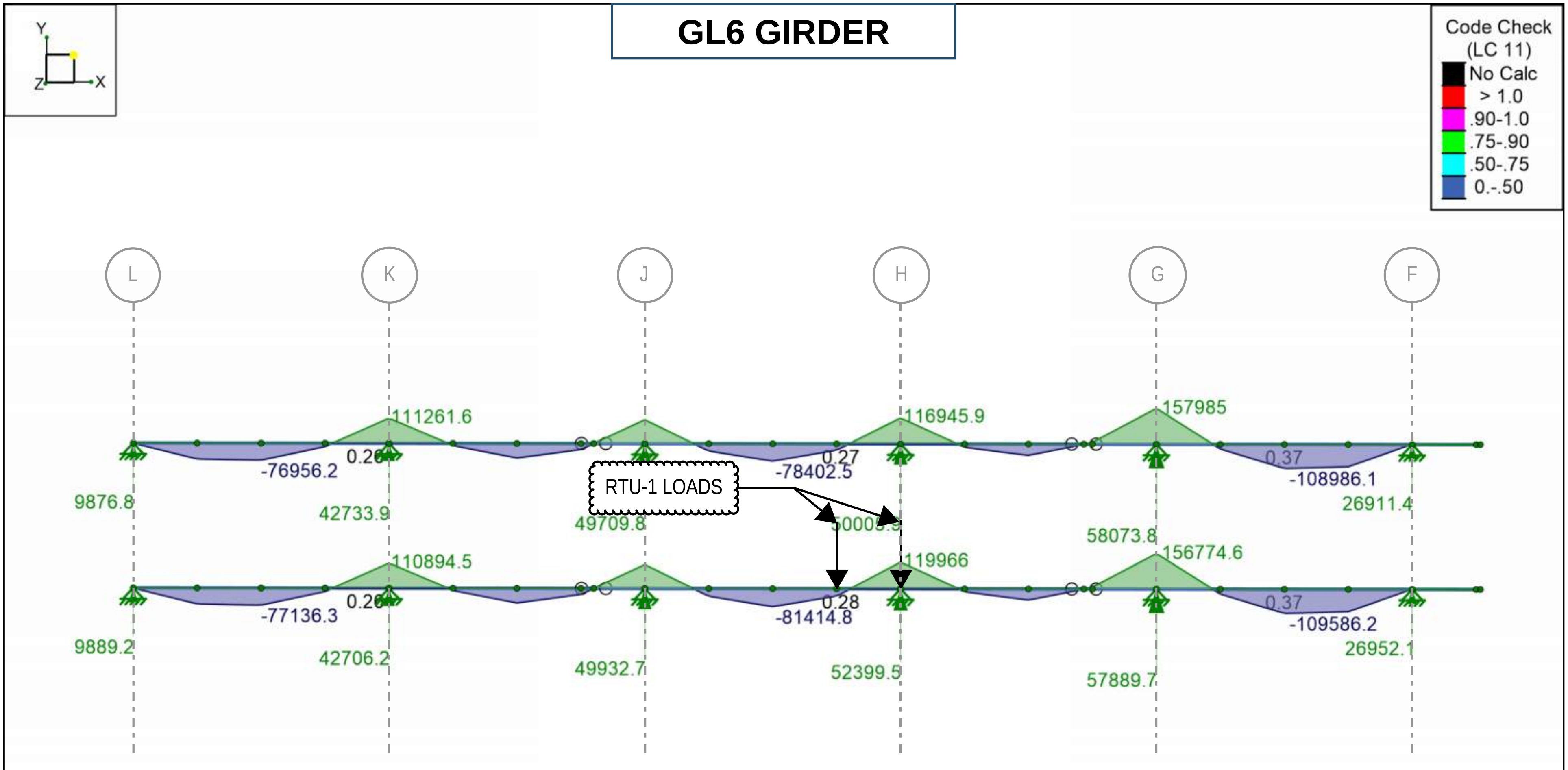


Member Code Checks Displayed
Results for LC 11, RTU1 ASD 6 (b)
Member z Bending Moments (lb-ft)
Y-direction Reaction Units are lbs and lb-ft

LOADS INCREASED ONLY BY ~1.3% AND DEFLECTION BY ~2.2% WHICH IS WELL BELOW THE DEMAND AND DEFLECTION LIMITS OF THE GIRDERS. OK!

Brienen Structural Engineers		SK-3
BBeaudette		Jun 12, 2024
	GL 3 Girder (GL 4 SIM)	Existing Girders.r3d

GL6 GIRDER



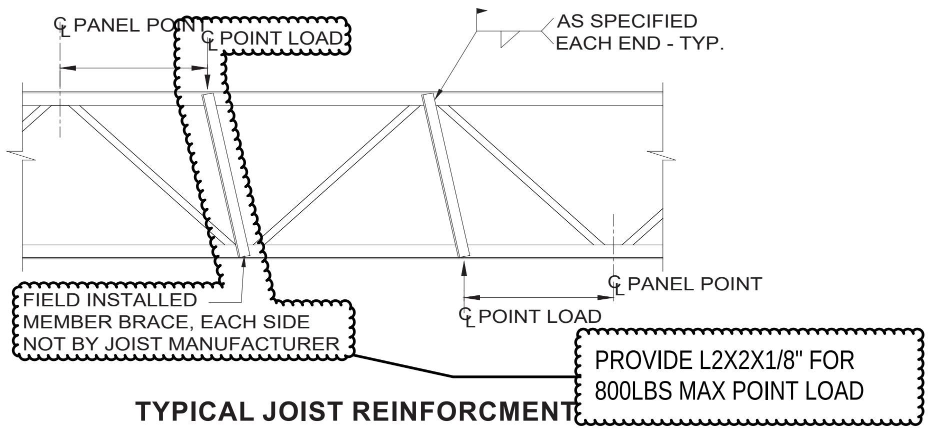
Member Code Checks Displayed
Results for LC 11, RTU1 ASD 6 (b)
Member z Bending Moments (lb-ft)
Y-direction Reaction Units are lbs and lb-ft

LOADS & DEFLECTION INCREASED LESS THAN 5% WHICH IS WELL BELOW THE DEMAND AND DEFLECTION LIMITS OF THE GIRDER. OK!

Brienen Structural Engineers		SK-4
BBeaudette		Jun 12, 2024
	GL 6 Girder	Existing Girders.r3d

Roof Strengthening

CONCENTRATED LOADS AT JOIST CHORDS



TYPICAL JOIST REINFORCMENT AT CONCENTRATED LOADS

For nominal concentrated loads between panel points, which have been accounted for in the specified uniform design loads, a "strut" to transfer the load to a panel point on the opposite chord shall not be required, provided the sum of the concentrated loads within a chord panel does not exceed 100 pounds and the attachments are concentric to the chord.

Although standard K-Series, including KCS joists, and standard LH-Series and DLH-Series joists are designed specifically to support uniformly distributed loads applied to the top chord, research conducted by the Steel Joist Institute, using second-order inelastic analysis, has demonstrated that the localized accumulation of uniform design loads of up to 100 pounds within any top or bottom chord panel has a negligible effect on the overall performance of the joist, provided that the load is applied to both chord angles in a manner which does not induce torsion on the chords.

Concentrated loads in excess of 100 pounds or which do not meet the criteria outlined above, must be applied at joist panel points, or field strut members must be utilized as shown in the detail above.

When exact dimensional locations for concentrated loads are provided by the specifying professional, the joist manufacturer will design the joist for the loads and load locations provided without the need for additional field applied web members at the specified locations.

For a traveling load with no specific location, the manufacturer can consider the worst case for both the shear and bending moment. When a traveling load is specified, the contract drawings should indicate whether the load is to be applied at the top or bottom chord, and at any panel point, or at any point with the local bending effects considered. For additional information see SJI Code of Standard Practice, Section 2.4 – Specifying Design Loads.

4.2.3.2 Compression: $\phi_c = 0.90$ (LRFD), $\Omega_c = 1.67$ (ASD)

Use L2x2x1/8 Angles, calculate for 32in joist since it will be worst case being longer.
Assume 45° webs such that worst case
L = √(32in^2 + 32in^2) = 45.3in
kL/r = 0.65(45.3in)/0.391 = 75.3

Design Stress = $0.9F_{cr}$ (LRFD) (4.2-3)

Allowable Stress = $0.6F_{cr}$ (ASD) (4.2-4)

Where:

For members with $\frac{k\ell}{r} \leq 4.71\sqrt{\frac{E}{QF_y}}$

4.71√29,000ksi/(0.45*36ksi) = 199

$$F_{cr} = Q\left[0.658^{\left(\frac{QF_y}{F_e}\right)}\right]F_y \qquad (4.2\text{-}5)$$

For members with $\frac{k\ell}{r} > 4.71\sqrt{\frac{E}{QF_y}}$

$$F_{cr} = 0.877F_e \qquad (4.2\text{-}6)$$

Fcr = 0.45(0.658^(0.45*36ksi/51.2ksi))*36ksi = 14.2ksi
Allowable Stress = 0.6(14.2ksi) = 8.5ksi
Max Point Load = (8.5ksi)(0.491in^2) = 4174lbs

Where F_e = Elastic buckling stress determined in accordance with Equation 4.2-7

$$F_e = \frac{\pi^2 E}{\left(\frac{k\ell}{r}\right)^2} \qquad (4.2\text{-}7)$$

Fe = π^2*29000ksi/(74.8)^2 = 51.2ksi

In the above equations, ℓ is the length, k is the effective length factor, and r is the corresponding radius of gyration of the member as defined in Section 4.3. E is equal to 29,000 ksi (200,000 MPa).

For hot-rolled sections and cold-formed angles, Q shall be taken as the full reduction factor for slender compression members as determined in accordance with AISC 360-10.

Exception: Where a compression web member is a crimped-end angle member intersecting at the first bottom chord panel point, whether hot-rolled or cold-formed, then Q shall be determined as follows:

$$Q = [5.25/(w/t)] + t \leq 1.0 \qquad (4.2\text{-}8a)$$

Q = 5.25/(2in/0.125in)+0.125in = 0.45

Where: w = angle leg length, inches
t = angle leg thickness, inches

or,

$$Q = [5.25/(w/t)] + (t/25.4) \leq 1.0 \qquad (4.2\text{-}8b)$$

Where: w = angle leg length, millimeters
t = angle leg thickness, millimeters

For all other cold-formed sections the method of calculating the nominal compression strength shall be in accordance with AISI S100.

4.2.3.3 Bending: $\phi_b = 0.90$ (LRFD), $\Omega_b = 1.67$ (ASD)

Bending calculations shall be based on the elastic section modulus.

BSE

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RTU Anchorage Design

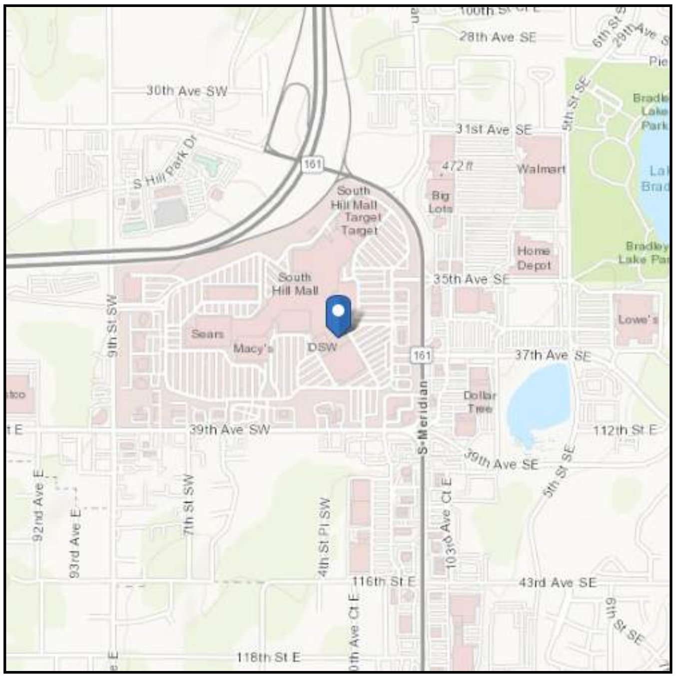
Phone: (206) 397-0000 1316 Central Avenue S, Suite 200, Kent, WA 98032 www.bse-ps.com

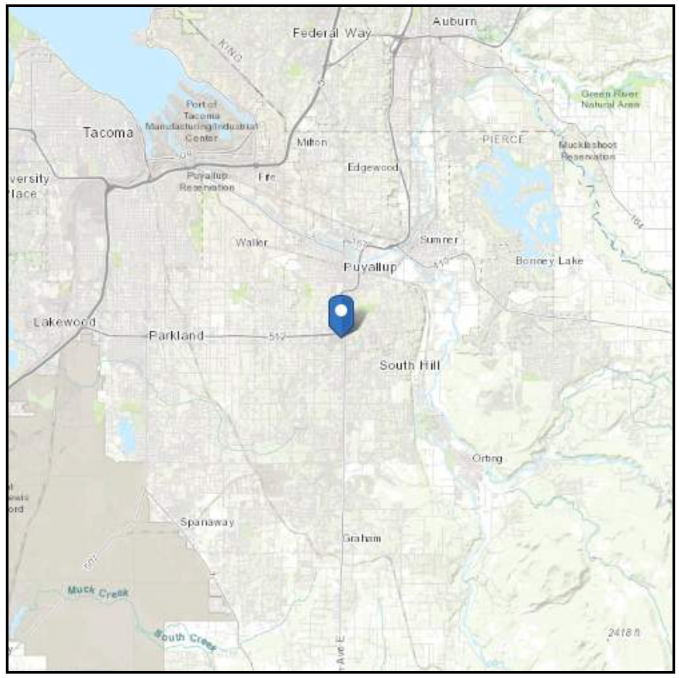
ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

ASCE Hazards Report

Address:
3500 S Meridian
Puyallup, Washington
98373

Standard:	ASCE/SEI 7-16
Risk Category:	III
Soil Class:	D - Default (see Section 11.4.3)
Latitude:	47.157047
Longitude:	-122.295981
Elevation:	437.8945197901832 ft (NAVD 88)





Wind

Results:

Wind Speed	104 Vmph
10-year MRI	67 Vmph
25-year MRI	73 Vmph
50-year MRI	78 Vmph
100-year MRI	83 Vmph

Data Source:	ASCE/SEI 7-16, Fig. 26.5-1C and Figs. CC.2-1–CC.2-4, and Section 26.5.2
Date Accessed:	Wed May 29 2024

Value provided is 3-second gust wind speeds at 33 ft above ground for Exposure C Category, based on linear interpolation between contours. Wind speeds are interpolated in accordance with the 7-16 Standard. Wind speeds correspond to approximately a 3% probability of exceedance in 50 years (annual exceedance probability = 0.000588, MRI = 1,700 years).

Site is not in a hurricane-prone region as defined in ASCE/SEI 7-16 Section 26.2.

ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

Seismic

Site Soil Class: D - Default (see Section 11.4.3)

Results:

S_S :	1.263	S_{D1} :	N/A
S_1 :	0.436	T_L :	6
F_a :	1.2	PGA :	0.5
F_v :	N/A	PGA_M :	0.6
S_{MS} :	1.516	F_{PGA} :	1.2
S_{M1} :	N/A	I_e :	1.25
S_{DS} :	1.01	C_v :	1.353

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

Data Accessed: Wed May 29 2024

Date Source: USGS Seismic Design Maps

The ASCE Hazard Tool is provided for your convenience, for informational purposes only, and is provided "as is" and without warranties of any kind. The location data included herein has been obtained from information developed, produced, and maintained by third party providers; or has been extrapolated from maps incorporated in the ASCE standard. While ASCE has made every effort to use data obtained from reliable sources or methodologies, ASCE does not make any representations or warranties as to the accuracy, completeness, reliability, currency, or quality of any data provided herein. Any third-party links provided by this Tool should not be construed as an endorsement, affiliation, relationship, or sponsorship of such third-party content by or from ASCE.

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Nonstructural Component Seismic Forces
ASCE7-16 Chapter 13

Input Data:

Design Spectral Resp. Acc., S_{DS} =	1.01		
Average Roof Height, h =	20	ft	
Height of Attachment, z =	20	ft	
Importance Factor, I_p =	1.00		
Component Weight, W_p =	2636	lbs	
Component Type =	Mechanical and Electrical Components		*(Table 13.6-1)*
	1a	Air-side HVAC, fans, air handlers, AC units, cabinet heaters, air distribution boxes, and other mech. comp. constructed of sheet metal framing	

Results:

Amplification Factor and Respose Modification Coefficient:

Amplification Factor, a_p =	2.5	*(Table 13.6-1)*
Response Mod. Coef., R_p =	6.0	*(Table 13.6-1)*

Component Seismic Forces (LRFD):

F_{ph} =	1331.2	lbs., $F_{ph} = (0.4*a_p*S_{DS}*W_p)*(1+2*z/h)/(R_p/I_p)$, *(Eqn. 13.3-1)*
$F_{ph(max)}$ =	4259.8	lbs., $F_{ph} = 1.6*S_{DS}*I_p*W_p$, *(Eqn. 13.3-2)*
$F_{ph(min)}$ =	798.7	lbs., $F_{ph} = 0.3*S_{DS}*I_p*W_p$, *(Eqn. 13.3-3)*
Horizontal Design Force, F_{ph} =	**1331.2**	**lbs**
Vertical Design Force, F_{pv} =	**532.5**	**lbs., $F_{pv} = 0.2*S_{DS}*W_p$, *(Eqn. 12.4-4)***

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Rooftop Equipment Wind Forces
ASCE7-16 Chapter 29

Input Data:

Wind Speed, V =	104	mph	Roof Height, h =	20	ft
Exposure Category =	C		Building Width, B =	300	ft
Importance Factor, I_p =	1.00				
Wind Directionality Factor, K_d =	0.85		Unit Width, B_e =	91	in
Topographic Factor, K_{zt} =	1.00		Unit Length, L_e =	133	in
			Unit Height, H_e =	54	in

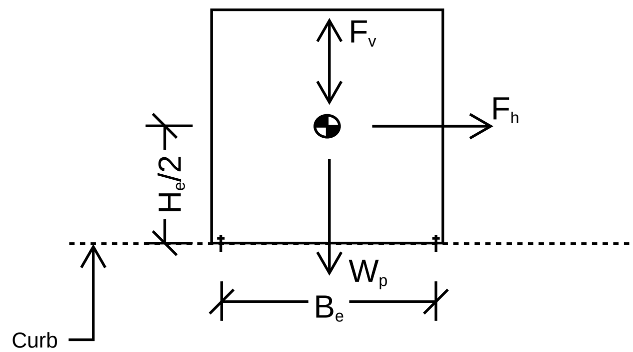
Results:

Calculated Factors:

Vertical Projected Area, A_f =	49.88	ft^2, Af = max(Be, Le)*He
Horizontal Projected Area, A_r =	84.05	ft^2, Ar = Be*Le
Horizontal GC_r =	1.90	*Section 29.4.1*
Vertical GC_r =	1.50	*Section 29.4.1*
Velocity Pressure Exp. Coef., K_z =	0.90	*Table 26.10-1*
Velocity Pressure, q_z =	21.18	psf, qz = 0.00256*Kz*Kzt*Kd*V^2 *(Eqn. 26.10-1)*

Rooftop Equipment Wind Forces:

Horizontal Wind Force, F_h =	**2007.3**	**lbs., Fh = qz*GCr*Af, *(Eqn. 29.4-2)***
Vertical Wind Force, F_v =	**2670.5**	**lbs., Fv = qz*GCr*Ar, *(Eqn. 29.4-3)***



Seismic Overturning Forces

W_p = 2636lbs
$B_e/2$ = 91in / 2 = 45.5in
He/2 = 54in / 2 = 27in
F_h = 1331.2lbs
F_v = 532.5lbs

-Controlling Load Combination: 0.6D + 0.7E

$M_{ot} = (0.7F_h * H_e/2) + (0.7F_v * B_e/2) - (0.6W_p * B_e/2)$
M_{ot} = (0.7 * 1331.2lbs * 27in) + (0.7 * 532.5lbs * 45.5in) - (0.6 * 2636lbs * 45.5in)
M_{ot} = -29.8k-in < 0 $\therefore$ No Overturning Occurs

Wind Overturning Forces

W_p = 2636lbs
$B_e/2$ = 91in / 2 = 45.5in
He/2 = 54in / 2 = 27in
F_h = 2007.3lbs
F_v = 2670.5lbs

-Controlling Load Combination: 0.6D + 0.6W

$M_{ot} = (0.6F_h * H_e/2) + (0.6F_v * B_e/2) - (0.6W_p * B_e/2)$
M_{ot} = (0.6 * 2007.3lbs * 27in) + (0.6 * 2670.5lbs * 45.5in) - (0.6 * 2636lbs * 45.5in)
M_{ot} = 33.5k-in

Anchorage Forces

- Wind Overturning Forces control the anchorage design.

- Anchor Shear
Vblt = Fh / n = 2007.3lbs / 12 screws = 167lbs
Vall = 177lbs > Vblt [OK]

- Anchor Tension
Tblt = (Mot) / b / 6 screws per side= (33.5k-in) / 91in / 6
Tblt = 61lbs
Tall = 84lbs > Tblt [OK]

USE (6) #10 SMS EQUALLY SPACED EA SIDE OF UNIT TO CONNECT TO ADAPTOR CURB

Screw Capacities

Table Notes

1. Capacities based on AISI S100 Section E4.
2. When connecting materials of different steel thicknesses or tensile strengths, use the lowest values. Tabulated values assume two sheets of equal thickness are connected.
3. Capacities are based on Allowable Strength Design (ASD) and include safety factor of 3.0.
4. Where multiple fasteners are used, screws are assumed to have a center-to-center spacing of at least 3 times the nominal diameter (d).
5. Screws are assumed to have a center-of-screw to edge-of-steel dimension of at least 1.5 times the nominal diameter (d) of the screw.
6. Pull-out capacity is based on the lesser of pull-out capacity in sheet closest to screw tip or tension strength of screw.
7. Pull-over capacity is based on the lesser of pull-over capacity for sheet closest to screw header or tension strength of screw.
8. Values are for pure shear or tension loads. See AISI Section E4.5 for combined shear and pull-over.
9. Screw Shear (Pss), tension (Pts), diameter, and head diameter are from CFSEI Tech Note (F701-12).
10. Screw shear strength is the average value, and tension strength is the lowest value listed in CFSEI Tech Note (F701-12).
11. Higher values for screw strength (Pss, Pts), may be obtained by specifying screws from a specific manufacturer.

Allowable Screw Connection Capacity (lbs)

Thickness (Mils)	Design Thickness	Fy Yield (ksi)	Fu Tensile (ksi)	#6 Screw (Pss = 643 lbs, Pts = 419 lbs) 0.138" dia, 0.272" Head			#8 Screw (Pss= 1278 lbs, Pts = 586 lbs) 0.164" dia, 0.272" Head			#10 Screw (Pss= 1644 lbs, Pts = 1158 lbs) 0.190" dia, 0.340" Head			#12 Screw (Pss= 2330 lbs, Pts = 2325 lbs) 0.216" dia, 0.340" Head			¼" Screw (Pss= 3048 lbs, Pts = 3201 lbs) 0.250" dia, 0.409" Head		
				Shear	Pull-Out	Pull-Over	Shear	Pull-Out	Pull-Over	Shear	Pull-Out	Pull-Over	Shear	Pull-Out	Pull-Over	Shear	Pull-Out	Pull-Over
18	0.0188	33	33	44	24	84	48	29	84	52	33	105	55	38	105	60	44	127
27	0.0283	33	33	82	37	127	89	43	127	96	50	159	102	57	159	110	66	191
30	0.0312	33	33	95	40	140	103	48	140	111	55	175	118	63	175	127	73	211
33	0.0346	33	45	151	61	140	164	72	195	177	84	265	188	95	265	203	110	318
43	0.0451	33	45	214	79	140	244	94	195	263	109	345	280	124	345	302	144	415
~~54~~	~~0.0566~~	~~33~~	~~45~~	~~214~~	~~100~~	~~140~~	~~344~~	~~118~~	~~195~~	~~370~~	~~137~~	~~386~~	~~394~~	~~156~~	~~433~~	~~424~~	~~180~~	~~521~~
~~68~~	~~0.0713~~	~~33~~	~~45~~	~~214~~	~~125~~	~~140~~	~~426~~	~~149~~	~~195~~	~~523~~	~~173~~	~~386~~	~~557~~	~~196~~	~~545~~	~~600~~	~~227~~	~~656~~
~~97~~	~~0.1017~~	~~33~~	~~45~~	~~214~~	~~140~~	~~140~~	~~426~~	~~195~~	~~195~~	~~548~~	~~246~~	~~386~~	~~777~~	~~280~~	~~775~~	~~1,016~~	~~324~~	~~936~~
~~118~~	~~0.1242~~	~~33~~	~~45~~	~~214~~	~~140~~	~~140~~	~~426~~	~~195~~	~~195~~	~~548~~	~~301~~	~~386~~	~~777~~	~~342~~	~~775~~	~~1,016~~	~~396~~	~~1,067~~
54	0.0566	50	65	214	140	140	426	171	195	534	198	386	569	225	625	613	261	752
68	0.0713	50	65	214	140	140	426	195	195	548	249	386	777	284	775	866	328	948
97	0.1017	50	65	214	140	140	426	195	195	548	356	386	777	405	775	1,016	468	1,067
118	0.1242	50	65	214	140	140	426	195	195	548	386	386	777	494	775	1,016	572	1,067

Weld Capacities

Table Notes

1. Capacities based on the AISI S100 Specification Sections E2.4 for fillet welds and E2.5 for flare groove welds.
2. When connecting materials of different steel thicknesses or tensile strengths, use the lowest values.
3. Capacities are based on Allowable Strength Design (ASD).
4. Weld capacities are based on E60 electrodes. For material thinner than 68 mil, 0.030" to 0.035" diameter wire electrodes may provide best results.
5. Longitudinal capacity is considered to be loading in the direction of the length of the weld.
6. Transverse capacity is loading in perpendicular direction of the length of the weld.
7. For flare groove welds, the effective throat of weld is conservatively assumed to be less than 2t.
8. For longitudinal fillet welds, a minimum value of EQ E2.4-1, E2.4-2, and E2.4-4 was used.
9. For transverse fillet welds, a minimum value of EQ E2.4-3 and E2.4-4 was used.
10. For longitudinal flare groove welds, a minimum value of EQ E2.5-2 and E2.5-3 was used.

Allowable Weld Capacity (lbs / in)

Thickness (Mils)	Design Thickness	Fy Yield (ksi)	Fu Tensile (ksi)	Fillet Welds		Flare Groove Welds	
				Longitudinal	Transverse	Longitudinal	Transverse
43	0.0451	33	45	499	864	544	663
~~54~~	~~0.0566~~	~~33~~	~~45~~	~~626~~	~~1084~~	~~682~~	~~832~~
~~68~~	~~0.0713~~	~~33~~	~~45~~	~~789~~	~~1365~~	~~859~~	~~1048~~
~~97~~	~~0.1017~~	~~33~~	~~45~~	~~1125~~	~~1269~~	[1]	[1]
54	0.0566	50	65	905	1566	985	1202
68	0.0713	50	65	1140	1972	1241	1514
97	0.1017	50	65	1269	1269	- [1]	- [1]

[1] Weld capacity for material thickness greater than 0.10" requires engineering judgment to determine leg of welds, W1 and W2.

Nonstructural Component Seismic Forces
ASCE7-16 Chapter 13

Input Data:

Design Spectral Resp. Acc., S_{DS} =	1.01		
Average Roof Height, h =	20	ft	
Height of Attachment, z =	20	ft	
Importance Factor, I_p =	1.00		
Component Weight, W_p =	2805	lbs	
Component Type =	Mechanical and Electrical Components		*(Table 13.6-1)*
	1a	Air-side HVAC, fans, air handlers, AC units, cabinet heaters, air distribution boxes, and other mech. comp. constructed of sheet metal framing	

Results:

Amplification Factor and Respose Modification Coefficient:

Amplification Factor, a_p =	2.5	*(Table 13.6-1)*
Response Mod. Coef., R_p =	6.0	*(Table 13.6-1)*

Component Seismic Forces (LRFD):

F_{ph} =	1416.5	lbs., $F_{ph} = (0.4*a_p*S_{DS}*W_p)*(1+2*z/h)/(R_p/I_p)$, *(Eqn. 13.3-1)*
$F_{ph(max)}$ =	4532.9	lbs., $F_{ph} = 1.6*S_{DS}*I_p*W_p$, *(Eqn. 13.3-2)*
$F_{ph(min)}$ =	849.9	lbs., $F_{ph} = 0.3*S_{DS}*I_p*W_p$, *(Eqn. 13.3-3)*
Horizontal Design Force, F_{ph} =	**1416.5**	**lbs**

Vertical Design Force, F_{pv} =	**566.6**	**lbs., $F_{pv} = 0.2*S_{DS}*W_p$, *(Eqn. 12.4-4)***

BSE

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Rooftop Equipment Wind Forces
ASCE7-16 Chapter 29

Input Data:

Wind Speed, V =	104	mph	Roof Height, h =	20	ft
Exposure Category =	C		Building Width, B =	300	ft
Importance Factor, I_p =	1.00				
Wind Directionality Factor, K_d =	0.85		Unit Width, B_e =	91	in
Topographic Factor, K_{zt} =	1.00		Unit Length, L_e =	133	in
			Unit Height, H_e =	68	in

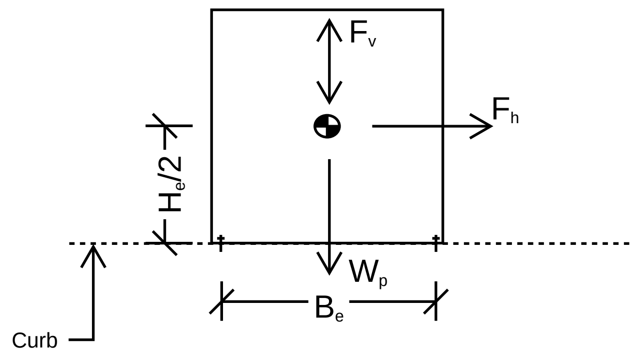
Results:

Calculated Factors:

Vertical Projected Area, A_f =	62.81	ft^2, $A_f = \max(B_e, L_e) * H_e$
Horizontal Projected Area, A_r =	84.05	ft^2, $A_r = B_e * L_e$
Horizontal GC_r =	1.90	*Section 29.4.1*
Vertical GC_r =	1.50	*Section 29.4.1*
Velocity Pressure Exp. Coef., K_z =	0.90	*Table 26.10-1*
Velocity Pressure, q_z =	21.18	psf, $q_z = 0.00256 * K_z * K_{zt} * K_d * V^2$ *(Eqn. 26.10-1)*

Rooftop Equipment Wind Forces:

Horizontal Wind Force, F_h =	**2527.7**	**lbs., $F_h = q_z * GC_r * A_f$, *(Eqn. 29.4-2)***
Vertical Wind Force, F_v =	**2670.5**	**lbs., $F_v = q_z * GC_r * A_r$, *(Eqn. 29.4-3)***



Seismic Overturning Forces

W_p =2805lbs
$B_e/2$ = 91in / 2 = 45.5in
He/2 = 14in + 54in / 2 = 34in
F_h = 1416.5lbs
F_v = 566.6lbs

-Controlling Load Combination: 0.6D + 0.7E

$M_{ot} = (0.7F_h * H_e/2) + (0.7F_v * B_e/2) - (0.6W_p * B_e/2)$
M_{ot} = (0.7 * 1416.5lbs * 34in) + (0.7 * 566.6lbs * 45.5in) - (0.6 * 2805lbs * 45.5in)
M_{ot} = -24.8k-in < 0 ∴ No Overturning Occurs

Wind Overturning Forces

W_p = 2805lbs
$B_e/2$ = 91in / 2 = 45.5in
He/2 = 14+ 54in / 2 = 34in
F_h = 2527.7lbs
F_v = 2670.5lbs

-Controlling Load Combination: 0.6D + 0.6W

$M_{ot} = (0.6F_h * H_e/2) + (0.6F_v * B_e/2) - (0.6W_p * B_e/2)$
M_{ot} = (0.6 * 2527.7lbs * 34in) + (0.6 * 2670.5lbs * 45.5in) - (0.6 * 2805lbs * 45.5in)
M_{ot} = 47.9k-in

Anchorage Forces

- Wind Overturning Forces control the anchorage design.

- Anchor Shear
Vblt = Fh / n = 2527.7lbs / 16 screws = 140lbs
Vall = 177lbs > Vblt [OK]

- Anchor Tension
Tblt = (Mot) / b / 8 screws per side= (47.9k-in) / 91in / 8
Tblt = 65.8lbs
Tall = 84lbs > Tblt [OK]

USE (8) #10 SMS EQUALLY SPACED EA SIDE OF UNIT TO CONNECT CURB TO ROOF DECK

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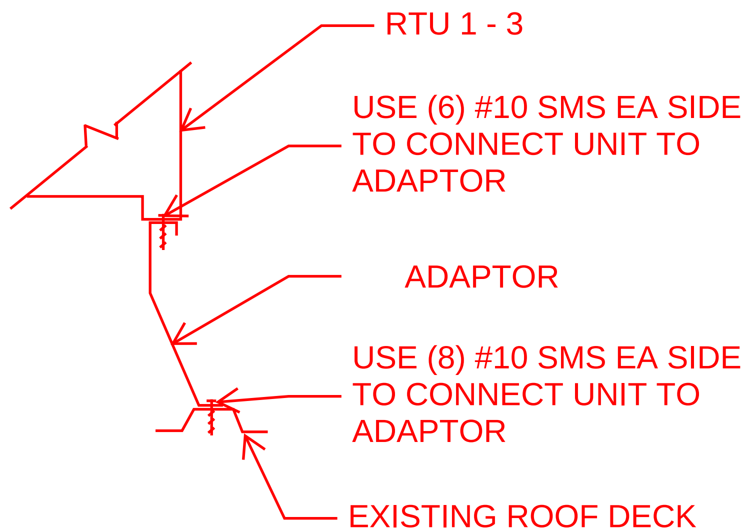


1 RTU 1 - 3 ANCHORAGE DETAIL
N.T.S.

Nonstructural Component Seismic Forces
ASCE7-16 Chapter 13

Input Data:

Design Spectral Resp. Acc., S_{DS} =	1.01	
Average Roof Height, h =	20	ft
Height of Attachment, z =	20	ft
Importance Factor, I_p =	1.00	
Component Weight, W_p =	918	lbs
Component Type =	Mechanical and Electrical Components	*(Table 13.6-1)*
	1a	Air-side HVAC, fans, air handlers, AC units, cabinet heaters, air distribution boxes, and other mech. comp. constructed of sheet metal framing

Results:

Amplification Factor and Respose Modification Coefficient:

Amplification Factor, a_p =	2.5	*(Table 13.6-1)*
Response Mod. Coef., R_p =	6.0	*(Table 13.6-1)*

Component Seismic Forces (LRFD):

F_{ph} =	463.6	lbs., $F_{ph} = (0.4*a_p*S_{DS}*W_p)*(1+2*z/h)/(R_p/I_p)$, *(Eqn. 13.3-1)*
$F_{ph(max)}$ =	1483.5	lbs., $F_{ph} = 1.6*S_{DS}*I_p*W_p$, *(Eqn. 13.3-2)*
$F_{ph(min)}$ =	278.2	lbs., $F_{ph} = 0.3*S_{DS}*I_p*W_p$, *(Eqn. 13.3-3)*
Horizontal Design Force, F_{ph} =	**463.6**	**lbs**
Vertical Design Force, F_{pv} =	**185.4**	**lbs., $F_{pv} = 0.2*S_{DS}*W_p$, *(Eqn. 12.4-4)***

Rooftop Equipment Wind Forces
ASCE7-16 Chapter 29

Input Data:

Wind Speed, V =	104	mph	Roof Height, h =	20	ft
Exposure Category =	C		Building Width, B =	300	ft
Importance Factor, I_p =	1.00				
Wind Directionality Factor, K_d =	0.85		Unit Width, B_e =	47	in
Topographic Factor, K_{zt} =	1.00		Unit Length, L_e =	85	in
			Unit Height, H_e =	47	in

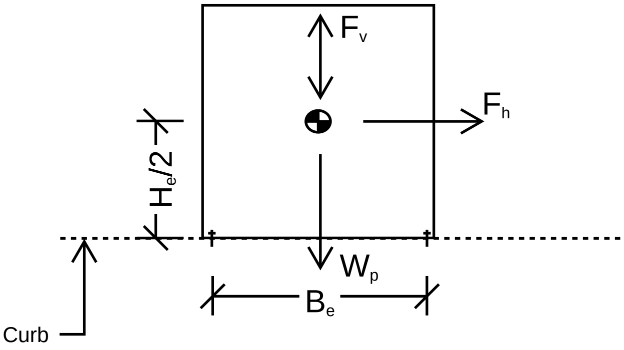
Results:

Calculated Factors:

Vertical Projected Area, A_f =	27.74	ft^2, $A_f = \max(B_e, L_e) \cdot H_e$
Horizontal Projected Area, A_r =	27.74	ft^2, $A_r = B_e \cdot L_e$
Horizontal GC_r =	1.90	*Section 29.4.1*
Vertical GC_r =	1.50	*Section 29.4.1*
Velocity Pressure Exp. Coef., K_z =	0.90	*Table 26.10-1*
Velocity Pressure, q_z =	21.18	psf, $q_z = 0.00256 \cdot K_z \cdot K_{zt} \cdot K_d \cdot V^2$ *(Eqn. 26.10-1)*

Rooftop Equipment Wind Forces:

Horizontal Wind Force, F_h =	**1116.5**	**lbs., $F_h = q_z \cdot GC_r \cdot A_f$, *(Eqn. 29.4-2)***
Vertical Wind Force, F_v =	**881.5**	**lbs., $F_v = q_z \cdot GC_r \cdot A_r$, *(Eqn. 29.4-3)***



Seismic Overturning Forces

W_p = 918lbs
$B_e/2$ = 47in / 2 = 23.5in
He/2 = 47in / 2 = 23.5in
F_h = 463.6lbs
F_v = 185.4lbs

-Controlling Load Combination: 0.6D + 0.7E

$M_{ot} = (0.7F_h * H_e/2) + (0.7F_v * B_e/2) - (0.6W_p * B_e/2)$
M_{ot} = (0.7 * 463.6lbs * 23.5in) + (0.7 * 185.4lbs * 23.5in) - (0.6 * 918lbs * 23.5in)
M_{ot} = -2268lb-in < 0 $\therefore$ No Overturning Occurs

Wind Overturning Forces

W_p = 918lbs
$B_e/2$ = 47in / 2 = 23.5in
He/2 = 47in / 2 = 23.5in
F_h = 1116.5lbs
F_v = 881.5lbs

-Controlling Load Combination: 0.6D + 0.6W

$M_{ot} = (0.6F_h * H_e/2) + (0.6F_v * B_e/2) - (0.6W_p * B_e/2)$
M_{ot} = (0.6 * 1116.5lbs * 23.5in) + (0.6 * 881.5lbs * 23.5in) - (0.6 * 918lbs * 23.5in)
M_{ot} = 15.2k-in

Anchorage Forces

- Wind Overturning Forces control the anchorage design.

- Anchor Shear
Vblt = Fh / n = 1116.5lbs / 8 screws = 139.6lbs
Vall = 177lbs > Vblt [OK]

- Anchor Tension
Tblt = (Mot) / b / 4 screws per side= (15.2k-in) / 47in / 4
Tblt = 80.9lbs
Tall = 84lbs > Tblt [OK]

USE (4) #10 SMS EQUALLY SPACED EA SIDE OF UNIT TO CONNECT TO ADAPTOR CURB

Nonstructural Component Seismic Forces
ASCE7-16 Chapter 13

Input Data:

Design Spectral Resp. Acc., S_{DS} =	1.01	
Average Roof Height, h =	20	ft
Height of Attachment, z =	20	ft
Importance Factor, I_p =	1.00	
Component Weight, W_p =	1026	lbs
Component Type =	Mechanical and Electrical Components	*(Table 13.6-1)*
	1a	Air-side HVAC, fans, air handlers, AC units, cabinet heaters, air distribution boxes, and other mech. comp. constructed of sheet metal framing

Results:

Amplification Factor and Respose Modification Coefficient:

Amplification Factor, a_p =	2.5	*(Table 13.6-1)*
Response Mod. Coef., R_p =	6.0	*(Table 13.6-1)*

Component Seismic Forces (LRFD):

F_{ph} =	518.1	lbs., $F_{ph} = (0.4*a_p*S_{DS}*W_p)*(1+2*z/h)/(R_p/I_p)$, *(Eqn. 13.3-1)*
$F_{ph(max)}$ =	1658.0	lbs., $F_{ph} = 1.6*S_{DS}*I_p*W_p$, *(Eqn. 13.3-2)*
$F_{ph(min)}$ =	310.9	lbs., $F_{ph} = 0.3*S_{DS}*I_p*W_p$, *(Eqn. 13.3-3)*
Horizontal Design Force, F_{ph} =	**518.1**	**lbs**
Vertical Design Force, F_{pv} =	**207.3**	**lbs., $F_{pv} = 0.2*S_{DS}*W_p$, *(Eqn. 12.4-4)***

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Rooftop Equipment Wind Forces
ASCE7-16 Chapter 29

Input Data:

Wind Speed, V =	104	mph	Roof Height, h =	20	ft
Exposure Category =	C		Building Width, B =	300	ft
Importance Factor, I_p =	1.00				
Wind Directionality Factor, K_d =	0.85		Unit Width, B_e =	47	in
Topographic Factor, K_{zt} =	1.00		Unit Length, L_e =	85	in
			Unit Height, H_e =	61	in

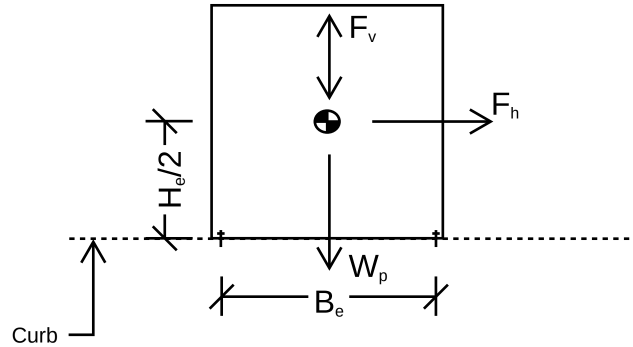
Results:

Calculated Factors:

Vertical Projected Area, A_f =	36.01	ft^2, $A_f = \max(B_e, L_e) \cdot H_e$
Horizontal Projected Area, A_r =	27.74	ft^2, $A_r = B_e \cdot L_e$
Horizontal GC_r =	1.90	*Section 29.4.1*
Vertical GC_r =	1.50	*Section 29.4.1*
Velocity Pressure Exp. Coef., K_z =	0.90	*Table 26.10-1*
Velocity Pressure, q_z =	21.18	psf, $q_z = 0.00256 \cdot K_z \cdot K_{zt} \cdot K_d \cdot V^2$ *(Eqn. 26.10-1)*

Rooftop Equipment Wind Forces:

Horizontal Wind Force, F_h =	**1449.1**	**lbs., $F_h = q_z \cdot GC_r \cdot A_f$, *(Eqn. 29.4-2)***
Vertical Wind Force, F_v =	**881.5**	**lbs., $F_v = q_z \cdot GC_r \cdot A_r$, *(Eqn. 29.4-3)***



Seismic Overturning Forces

W_p =1026lbs
$B_e/2$ = 47in / 2 = 23.5in
He/2 = 14in + 47in / 2 = 30.5in
F_h = 518.1lbs
F_v = 207.3lbs

-Controlling Load Combination: 0.6D + 0.7E

$M_{ot} = (0.7F_h * H_e/2) + (0.7F_v * B_e/2) - (0.6W_p * B_e/2)$
M_{ot} = (0.7 * 518.1lbs * 30.5in) + (0.7 * 207.3lbs * 23.5in) - (0.6 * 1026lbs * 23.5in)
M_{ot} = 5lb-in ≈0

Wind Overturning Forces

W_p = 1026lbs
$B_e/2$ = 47in / 2 = 23.5in
He/2 = 14in + 47in / 2 = 30.5in
F_h = 1449.1lbs
F_v = 881.5lbs

-Controlling Load Combination: 0.6D + 0.6W

$M_{ot} = (0.6F_h * H_e/2) + (0.6F_v * B_e/2) - (0.6W_p * B_e/2)$
M_{ot} = (0.6 * 1449.1lbs * 30.5in) + (0.6 * 881.5lbs * 23.5in) - (0.6 * 1026lbs * 23.5in)
M_{ot} = 24.5k-in

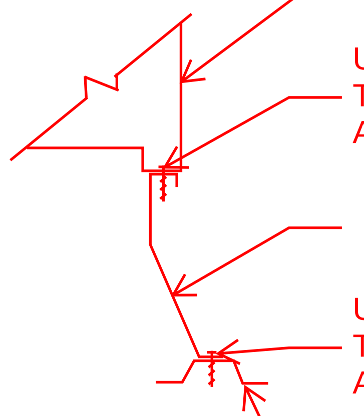
Anchorage Forces

- Wind Overturning Forces control the anchorage design.

- Anchor Shear
Vblt = Fh / n = 1449.1lbs / 14 screws = 103.5lbs
Vall = 177lbs > Vblt [OK]

- Anchor Tension
Tblt = (Mot) / b / 7 screws per side= (24.5k-in) / 47in / 7
Tblt = 74.5lbs
Tall = 84lbs > Tblt [OK]

USE (7) #10 SMS EQUALLY SPACED EA SIDE OF UNIT TO CONNECT CURB TO ROOF DECK



1 RTU 4 - 6 ANCHORAGE DETAIL
N.T.S.

Precast Wall Opening

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Precast Wall Opening

Existing Wall Length Along GL L = 83'-8"
Wall Length with New Opening = 80'-8"

Reduction in stiffness = 3.6% < 5% **OK!**

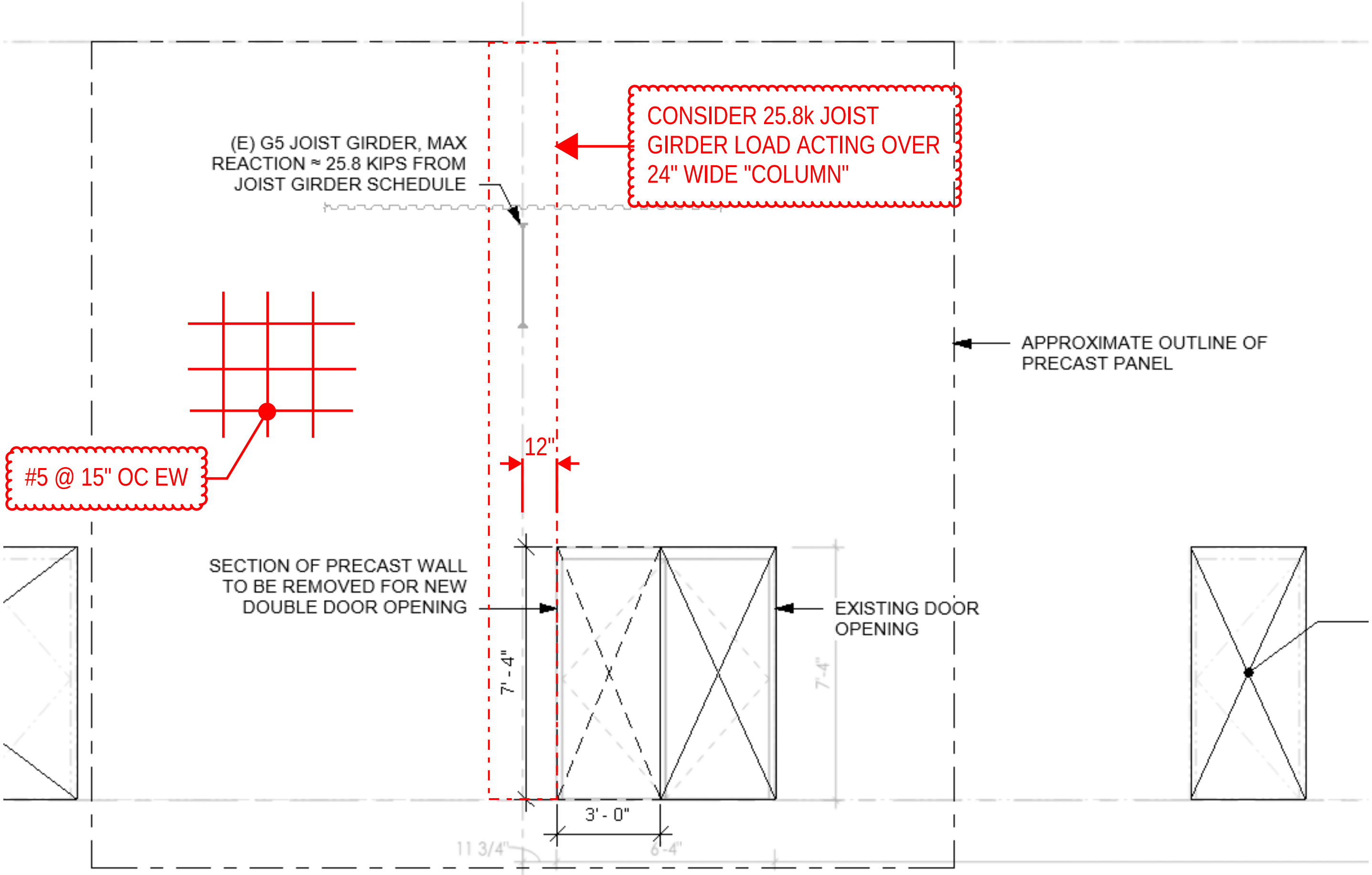
Check Wall Capacity At Joist Girder Point Load:

Total ASD Load = 25.8 kips
Controlling ASD Load Combination = D + 0.75(0.6W) + 0.75S
Back-solving our point loads based on tributaries:

- Dead = 10psf = 7180 lbs
- Snow = 25psf = 17940 lbs
- Wind = 16psf = 11480 lbs

Controlling LRFD Load Combination = 1.2D + 1.6S + 0.5W
Total LRFD Load = 43.1 kips

See attached Concrete Column P-M Interaction Diagram.



Project Title:
Engineer:
Project ID:
Project Descr:

Concrete Column

Project File: Barnes&Noble.ec6

LIC# : KW-06013076, Build:20.22.8.17 | Brienen Structural Engineers | (c) ENERCALC INC 1983-2022

DESCRIPTION: Precast Wall Below GL 2' Joist Girder

Code References

Calculations per ACI 318-14, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : ASCE 7-16

General Information

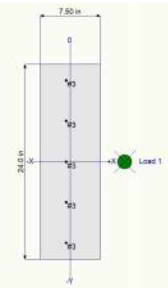
f'c : Concrete 28 day streng	=	3.0 ksi
E =	=	3,122.0 ksi
Density	=	150.0 pcf
β	=	0.850
fy - Main Rebar	=	60.0 ksi
E - Main Rebar	=	29,000.0 ksi
Allow. Reinforcing Limits		*ASTM A615 Bars Used*
Min. Reinf.	=	1.0 %
Max. Reinf.	=	8.0 %

Overall Column Height = 22.0 ft
End Fixity Top & Bottom Pinned
Brace condition for deflection (buckling) along colum
X-X (width) axis :
Unbraced Length for buckling ABOUT Y-Y Axis = 17 ft, K = 1.0
Y-Y (depth) axis :
Unbraced Length for buckling ABOUT X-X Axis = 17 ft, K = 1.0

Column Cross Section

Column Dimensions : 24.0in high x 7.50in Wide, Column Edge to Rebar Edge Cover = 2.0in

Column Reinforcing : general



ENERCALC NEEDS A MINIMUM OF (4) BARS —
USED (5) #3 BARS, AREA = 0.55 IN^2
ACTUAL (2) #5 BARS, AREA = 0.62 IN^2

Rebar Sizes & Locations

Total bars = 5 | X & Y distances measured from lower-left corner.

Bar Size #	X in	Y in	Bar Size #	X in	Y in	Bar Size #	X in	Y in	Bar Size #	X in	Y in
# 3	3.250	2.000	# 3	3.250	7.000	# 3	3.250	12.000	# 3	3.250	17.000
# 3	3.250	22.000									

Applied Loads

Entered loads are factored per load combinations specified by user.

Column self weight included : 4,125.0 lbs * Dead Load Factor
AXIAL LOADS . . .
Total: Axial Load at 17.0 ft above base, Xecc = 6.750in, D = 7.180, S = 17.940, W = 11.480 k
BENDING LOADS . . .
Wind: Lat. Uniform Load creating My-y, W = 0.040 k/ft

DESIGN SUMMARY

Load Combination +1.20D+1.60S+0.50W
Location of max.above base 21.852 ft

Maximum Stress Ratio **0.879 : 1**

Ratio = (Pu^2+Mu^2)^.5 / (PhiPn^2+PhiMn^2)^.5

Pu =	48.010	k	φ * Pn =	54.873	k
Mu-x =	0.0	k-ft	φ * Mn-x =	0.0	k-ft
Mu-y =	-17.842	k-ft	φ * Mn-y =	20.289	k-ft
Mu Angle =	90.0	deg			
Mu at Angle =	17.842	k-ft	φMn at Angle =	20.298	k-ft

Pn & Mn values located at Pu-Mu vector intersection with capacity curve

Column Capacities . .

Pnmax : Nominal Max. Compressive Axial Capacit	490.598	k
Pnmin : Nominal Min. Tension Axial Capacity		k
φ Pn, max : Usable Compressive Axial Capacity	255.111	k
φ Pn, min : Usable Tension Axial Capacity		k

Maximum SERVICE Load Reactions .

Top along Y-Y	0.8577 k	Bottom along Y-Y	0.6423 k
Top along X-X	0.0 k	Bottom along X-X	0.0 k

Maximum SERVICE Load Deflections . .

Along Y-Y 0.0 in at 0.0 ft above base
for load combination :

Along X-X -0.2257 in at 11.812 ft above base
for load combination : +D+S

General Section Informatio φ = 0.650 β = 0.850 θ = 0.80

ρ : % Reinforcing	0.3056 %	Rebar < Min of 1.0 %
Reinforcing Area	0.550 in^2	
Concrete Area	180.0 in^2	

DESCRIPTION: Precast Wall Below GL 2' Joist Girder

Governing Load Combination Results

Governing Factored Load Combination	Moment X-X	Moment Y-Y	Dist. from base ft	Axial Load k Pu	Axial Load k φ * Pn	Bending Analysis k-ft δ x	δ x * Mux	δ y	δy * Muy	Alpha (deg)	δ Mu	φ Mn	Utilization Ratio
+1.20D+1.60S+0.50W		Actual	21.85	48.01	54.87			1.000	-17.84	90.000	17.84	20.30	**0.879**

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction **k** @ Base	X-X Axis Reaction @ Top	Y-Y Axis Reaction @ Base	Y-Y Axis Reaction @ Top	Axial Reaction @ Base	Mx - End Moments **k-ft** @ Base	Mx - End Moments @ Top	My - End Moments @ Base	My - End Moments @ Top
D Only	0.184	0.184			11.305				
+D+S	0.642	0.642			29.245				
+D+0.750S	0.528	0.528			24.760				
+D+0.60W	0.096	0.624			18.193				
+D+0.450W	0.118	0.514			16.471				
+D+0.750S+0.450W	0.462	0.858			29.926				
+0.60D+0.60W	0.022	0.550			13.671				
+0.60D	0.110	0.110			6.783				
S Only	0.459	0.459			17.940				
W Only	0.146	0.734			11.480				

Maximum Moment Reactions

Note: Only non-zero reactions are listed.

Load Combination	Moment About X-X Axis @ Base	Moment About X-X Axis @ Top		Moment About Y-Y Axis @ Base	Moment About Y-Y Axis @ Top	
D Only			k-ft			k-ft
+D+S			k-ft			k-ft
+D+0.750S			k-ft			k-ft
+D+0.60W			k-ft			k-ft
+D+0.450W			k-ft			k-ft
+D+0.750S+0.450W			k-ft			k-ft
+0.60D+0.60W			k-ft			k-ft
+0.60D			k-ft			k-ft
S Only			k-ft			k-ft
W Only			k-ft			k-ft

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection	Distance	Max. Y-Y Deflection	Distance
D Only	-0.0645 in	11.812 ft	0.000 in	0.000 ft
+D+S	-0.2257 in	11.812 ft	0.000 in	0.000 ft
+D+0.750S	-0.1854 in	11.812 ft	0.000 in	0.000 ft
+D+0.60W	-0.0782 in	12.107 ft	0.000 in	0.000 ft
+D+0.450W	-0.0747 in	11.960 ft	0.000 in	0.000 ft
+D+0.750S+0.450W	-0.1956 in	11.812 ft	0.000 in	0.000 ft
+0.60D+0.60W	-0.0524 in	12.255 ft	0.000 in	0.000 ft
+0.60D	-0.0387 in	11.812 ft	0.000 in	0.000 ft
S Only	-0.1612 in	11.812 ft	0.000 in	0.000 ft
W Only	-0.0234 in	13.141 ft	0.000 in	0.000 ft

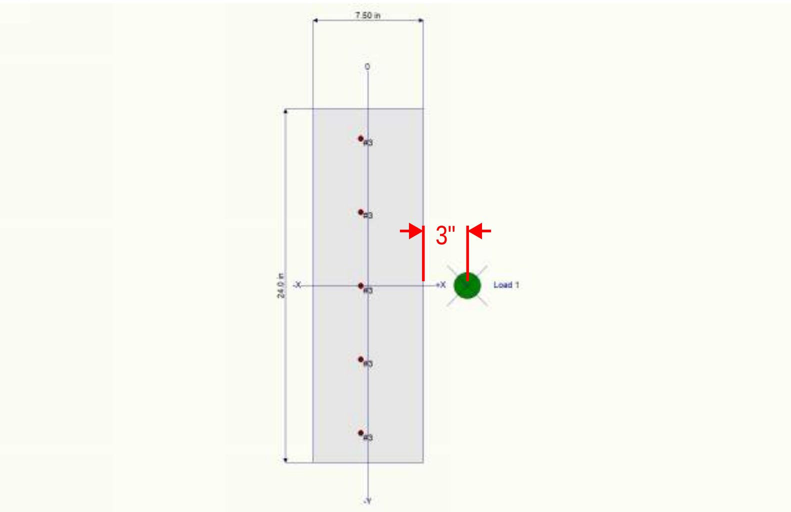
Concrete Column

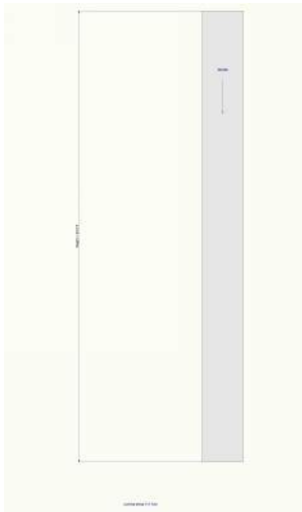
Project File: Barnes&Noble.ec6

LIC# : KW-06013076, Build:20.22.8.17 Brienen Structural Engineers

DESCRIPTION: Precast Wall Below GL 2' Joist Girder

Sketches



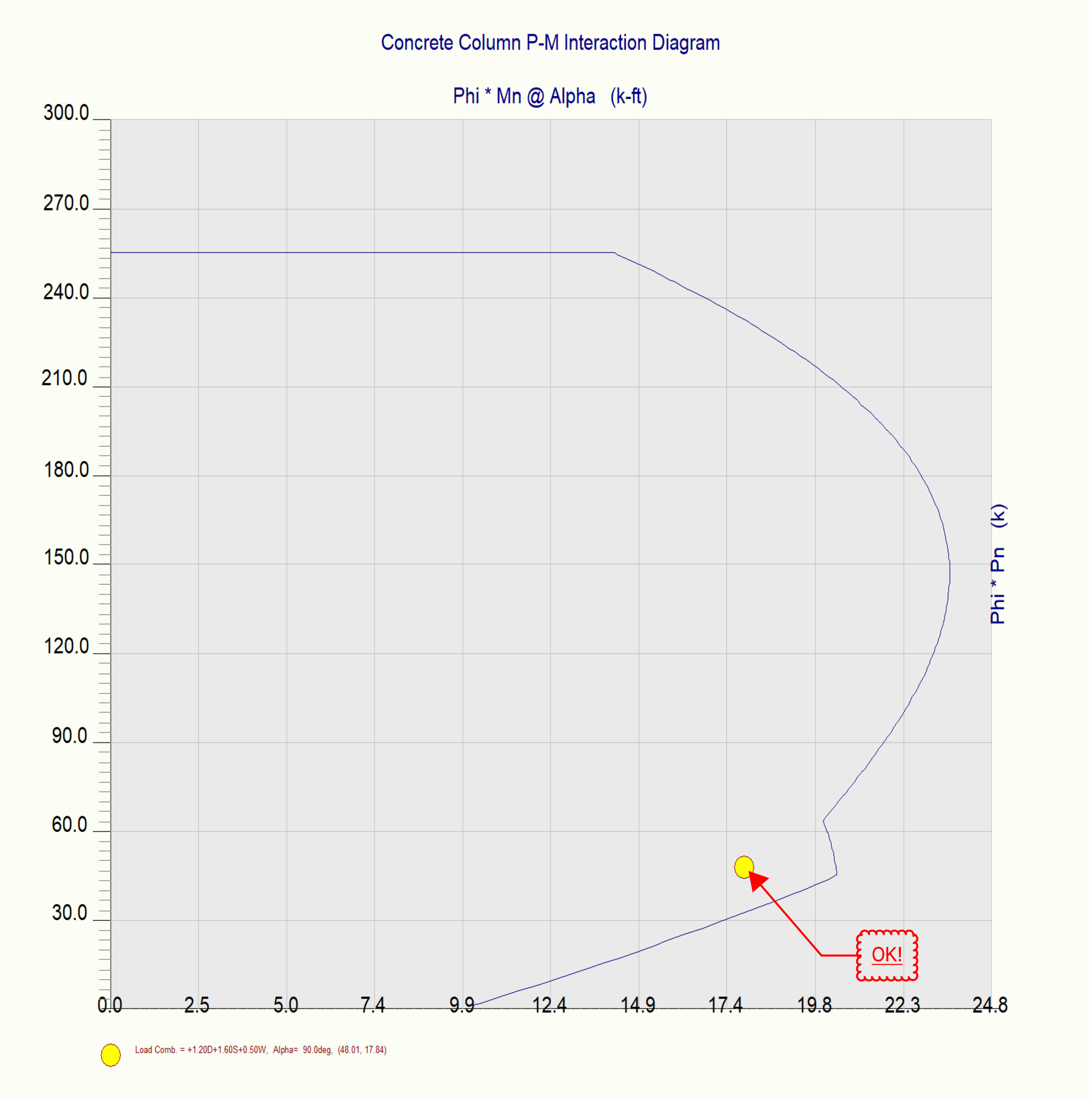


Interaction Diagrams

Concrete Column

Project File: Barnes&Noble.ec6

DESCRIPTION: Precast Wall Below GL 2' Joist Girder



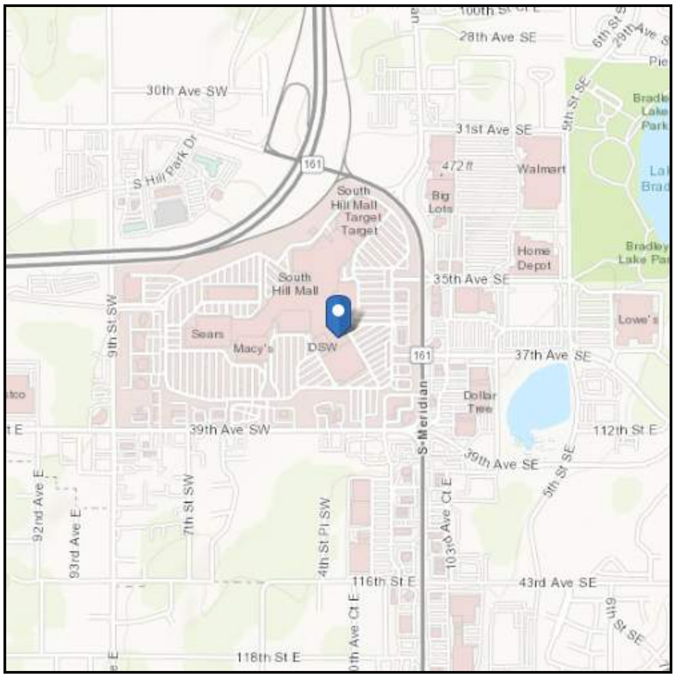
Storefront Framing

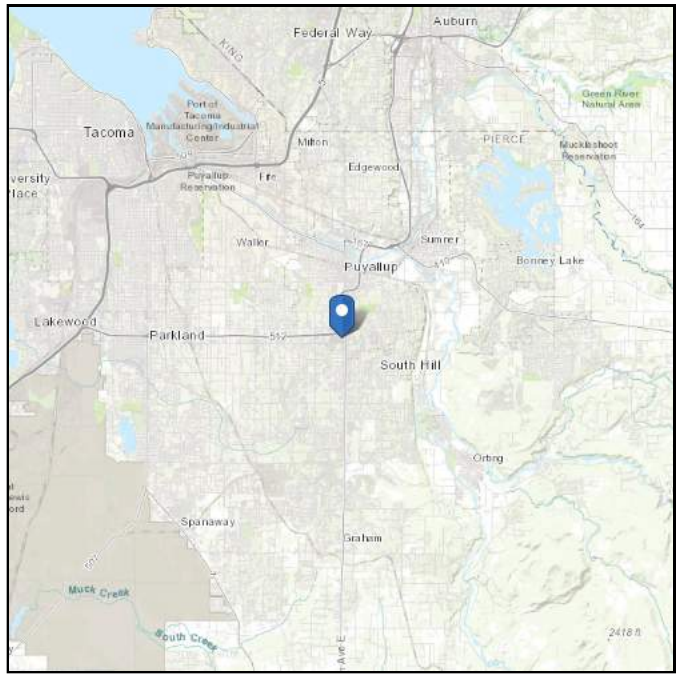
ASCE Hazards Report

Address:
3500 S Meridian
Puyallup, Washington
98373

Standard: ASCE/SEI 7-16
Risk Category: III
Soil Class: D - Default (see Section 11.4.3)

Latitude: 47.157047
Longitude: -122.295981
Elevation: 437.8945197901832 ft (NAVD 88)





Wind

Results:

Wind Speed	104 Vmph
10-year MRI	67 Vmph
25-year MRI	73 Vmph
50-year MRI	78 Vmph
100-year MRI	83 Vmph

Data Source: ASCE/SEI 7-16, Fig. 26.5-1C and Figs. CC.2-1–CC.2-4, and Section 26.5.2
Date Accessed: Wed May 29 2024

Value provided is 3-second gust wind speeds at 33 ft above ground for Exposure C Category, based on linear interpolation between contours. Wind speeds are interpolated in accordance with the 7-16 Standard. Wind speeds correspond to approximately a 3% probability of exceedance in 50 years (annual exceedance probability = 0.000588, MRI = 1,700 years).

Site is not in a hurricane-prone region as defined in ASCE/SEI 7-16 Section 26.2.

Seismic

Site Soil Class: D - Default (see Section 11.4.3)

Results:

S_S :	1.263	S_{D1} :	N/A
S_1 :	0.436	T_L :	6
F_a :	1.2	PGA :	0.5
F_v :	N/A	PGA_M :	0.6
S_{MS} :	1.516	F_{PGA} :	1.2
S_{M1} :	N/A	I_e :	1.25
S_{DS} :	1.01	C_v :	1.353

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

Data Accessed: Wed May 29 2024

Date Source: USGS Seismic Design Maps

The ASCE Hazard Tool is provided for your convenience, for informational purposes only, and is provided “as is” and without warranties of any kind. The location data included herein has been obtained from information developed, produced, and maintained by third party providers; or has been extrapolated from maps incorporated in the ASCE standard. While ASCE has made every effort to use data obtained from reliable sources or methodologies, ASCE does not make any representations or warranties as to the accuracy, completeness, reliability, currency, or quality of any data provided herein. Any third-party links provided by this Tool should not be construed as an endorsement, affiliation, relationship, or sponsorship of such third-party content by or from ASCE.

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Calculations Prepared by:
Brienen Structural Engineers
1316 Central Ave S Ste 200
Kent, WA, 98032

Date: Apr 02, 2024
File Location: G:\2024\24415 South Hill Mall Barnes&Noble\Calcs\Barnes&Noble.wnd

General:

Wind Load Standard	=	ASCE 7-16	Basic Wind Speed	=	104.0 mph
Exposure Classification	=	B	Risk Category	=	III
Structure Type	=	Building	Design Basis for Wind Pressures	=	LRFD
MWFRS Analysis Method	=	Ch 27 Pt 1	C&C Analysis Method	=	Ch 30 Pt 1
Dynamic Type of Structure	=	Rigid	Show Advanced Options	=	False

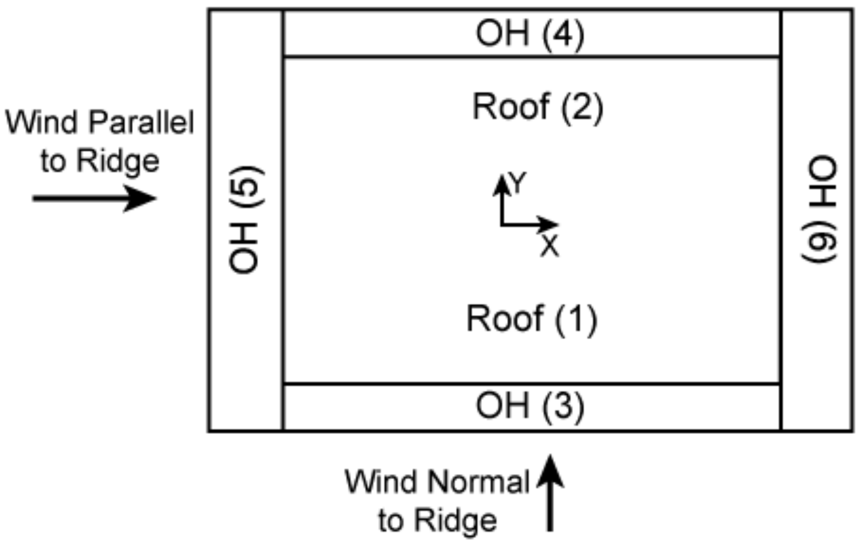
Building:

Roof	=	Roof Type	=	Flat	Encl	=	Enclosure Classification	=	Enclosed
Help	=	Help on Building Roof Type	=	Help	RfHt	=	Roof Height	=	20.000 ft
W	=	Building Width	=	300.000 ft	L	=	Building Length	=	400.000 ft
OH	=	Type of Overhang	=	None	Par	=	Parapet	=	None
HT_{over}	=	Override Mean Roof Height	=	False	Ht_{man}	=	Mean Roof Height	=	20.000 ft
RA_{over}	=	Override Roof Area	=	False	GC_{pi_o}	=	Override GC_{pi}value	=	False

Exposure Constants [Tbl 26.11-1]:

α = 3-s Gust-speed exponent	=	7.000	Z_g= Nominal Ht of Boundary Layer	=	1200.000 ft
$\hat{a}$ = Reciprocol of α	=	0.143	b = 3 sec gust speed factor	=	0.840
α_m= Mean hourly Wind-Speed Exponent	=	0.250	b_m= Mean hourly Windspeed Exponent	=	0.450
c = Turbulence Intensity Factor	=	0.300	ε = Integral Length Scale Exponent	=	0.3333

Main Wind Force Resisting System (MWFRS) Wind Calculations per Ch 27 Pt1



h	=	Mean structure height	=	20.000 ft
h_{grade}	=	Elevation from Grade to Top of Structure	=	20.000 ft
K_h	=	$2.01 \cdot (h_{grade}/Z_g)^{2/\alpha}$[Tbl 26.10-1]	=	0.624
K_{zt}	=	No Topographic feature specified	=	1.000
K_d	=	Wind Directionality Factor per Tbl 26.6-1	=	0.85
$+GC_{pi}$	=	Enclosed Positive Internal Pressure Tbl 26.13-1	=	+0.18
$-GC_{pi}$	=	Enclosed Negative Internal Pressure Tbl 26.13-1	=	-0.18
LF	=	Load Factor based upon STRENGTH Design	=	1.00
K_e	=	Ground Elev Factor [Tbl 26.9-1]	=	1.000
q_h	=	$0.00256 \cdot K_h \cdot K_{zt} \cdot K_d \cdot K_e \cdot V^2 * LF$ [Eq 26.10-1]	=	14.69 psf
RA	=	Roof Area	=	120000.00 ft^2
q_h	=	$0.00256 \cdot K_h \cdot K_{zt} \cdot K_d \cdot K_e \cdot V^2 * LF$ [Eq 26.10-1]	=	14.69 psf
q_{in}	=	Negative Internal Pressure: $q_h \cdot LF$	=	14.69 psf
q_{ip}	=	Positive Internal Pressure: $q_h \cdot LF$	=	14.69 psf

MWFRS Wind Loads [Normal to Ridge]

h	=	Mean Roof Height Of Building	= 20.000 ft
RHt	=	Ridge Height Of Roof	= 20.000 ft
B	=	Horizontal Dimension Of Building Normal To Wind Direction	= 400.000 ft
L	=	Horizontal Dimension Of building Parallel To Wind Direction	= 300.000 ft
L/B	=	Ratio Of L/B used For Cp determination	= 0.750
h/L	=	Ratio Of h/L used For Cp determination	= 0.067
Slope	=	Slope Of Roof	= 0.0 Deg

Gust Factor Calculation for Wind: [Normal to Ridge]

Gust Factor Category I Rigid Structures - Simplified Method

G_1	=	Simplified: For Rigid Structures can use 0.85	= 0.85

Gust Factor Category II Rigid Structures - Complete Analysis

Z_m	=	Equiv Struc Height: Max(0.6•h, Z_{min})	= 30.000 ft
I_{zm}	=	Turbulence Intensity: $c \cdot (33/Z_m)^{1/6}$ [Eq 26.11-1]	= 0.305
L_{zm}	=	Turbulence Integral Length Scale: $\ell \cdot (Z_m/33)^{\varepsilon}$ [Eq 26.11-9]	= 309.993 ft
B	=	Building Width Width Normal to Wind Direction	= 400.000 ft
Q	=	$[1/(1+0.63 \cdot [(B+h)/L_{zm}]^{0.63})]^{0.5}$ [Eq 26.11-8]	= 0.753
G_2	=	Detailed: $0.925 \cdot [(1+1.7 \cdot g_q \cdot I_{zm} \cdot Q)/(1+1.7 \cdot g_v \cdot I_{zm})]$ [Eq 26.11-6]	= 0.779

Gust Factor Used in Analysis

G	=	Gust Factor: Min(G_1, G_2)	= 0.779
Cp_{WW}	=	Windward Wall Coefficient (All L/B Values)	= 0.800
Cp_{LW}	=	Leeward Wall Coefficient using L/B	= -0.500
Cp_{SW}	=	Side Wall Coefficient (All L/B values)	= -0.700

Wind Pressures [Normal to Ridge]
All wind pressures include a Load Factor (LF) of 1.0

Elev ft	GC_{pi}	q_i psf	K_z	K_{zt}	q_z psf	Windward Press psf	Leeward Press psf	Side Press psf	Total Press psf	Minimum Pressure* psf
20.000	+0.18	14.69	0.624	1.000	14.69	6.51	-8.37	-10.65	14.88	16.00
20.000	-0.18	14.69	0.624	1.000	14.69	11.80	-3.08	-5.37	14.88	16.00

K_z = $2.01 \cdot (z_{grade}/Z_g)^{2/\alpha}$ [Tbl 26.10-1]
GC_{pi} = Enclosed Internal Pressure Tbl 26.13-1
q_{ip} = Positive Internal Pressure: $q_h \cdot LF$
Side = $q_h \cdot G \cdot Cp_{SW} - q_{ip} \cdot (+GC_{pi})$ [Eq 27.3-1]
Windward = $q_z \cdot G \cdot Cp_{WW} - q_{ip} \cdot (+GC_{pi})$ [Eq 27.3-1]
K_{zt} = No Topographic feature specified
*q_z = $0.00256 \cdot K_z \cdot K_{zt} \cdot K_d \cdot K_e \cdot V^2$ *LF [Eq 26.10-1]*
q_{in} = Negative Internal Pressure: $q_h \cdot LF$
Leeward = $q_h \cdot G \cdot Cp_{LW} - q_{ip} \cdot (+GC_{pi})$ [Eq 27.3-1]
Total = Windward - Leeward

- *Minimum Pressure: § 27.1.5 no less than 16.00 psf (Incl LF) applied to Walls*
- *Positive Pressures Act TOWARD Surface and Negative Pressures Act AWAY from Surface*

Roof Wind Pressures [Normal to Ridge]
All wind pressures include a Load Factor (LF) of 1.0

Component	Description	Location	Start ft	End ft	GC_{pi}	C_{pMin}	C_{pMax}	P_{CpMin} psf	P_{CpMax} psf	P_{min} psf
Roof	Roof (0 to h)	All	0.000	20.000	+0.18	-0.900	-0.180	-12.94	-4.70	8.00
Roof	Roof (h to 2*h)	All	20.000	40.000	+0.18	-0.500	-0.180	-8.37	-4.70	8.00
Roof	Roof (>= 2*h)	All	40.000	300.000	+0.18	-0.300	-0.180	-6.08	-4.70	8.00
Roof	Roof (0 to h)	All	0.000	20.000	-0.18	-0.900	-0.180	-7.66	0.58	8.00
Roof	Roof (h to 2*h)	All	20.000	40.000	-0.18	-0.500	-0.180	-3.08	0.58	8.00
Roof	Roof (>= 2*h)	All	40.000	300.000	-0.18	-0.300	-0.180	-0.79	0.58	8.00

Roof Pressures based upon Ch 27 Pt1:
Component = The building component for pressures
Start = Start Dist from Windward Edge
C_{pMin} = Smallest Coefficient Magnitude
P_{CpMin} = $q_h \cdot G \cdot C_{pMin} - q_{ip} \cdot GC_{pi}$ [Eq 27.3-1]
Location = Reference Graphic in Output for Values
End = End Dist from Windward Edge
C_{pMax} = Largest Coefficient Magnitude
P_{CpMax} = $q_h \cdot G \cdot C_{pMax} - q_{in} \cdot GC_{pi}$ [Eq 27.3-1]
P_{min} = Min Press projected on vertical plane [§ 27.1.5]

- *No reduction factor was applicable*
- *The smaller uplift pressures due to C_{pMin} can become critical when wind is combined with roof live load or snow load; load combinations are given in ASCE 7*
- *Positive Pressures Act TOWARD Surface and Negative Pressures Act AWAY from Surface*

MWFRS Wind Loads [Parallel to Ridge]

h	=	Mean Roof Height Of Building	= 20.000 ft
RHt	=	Ridge Height Of Roof	= 20.000 ft
B	=	Horizontal Dimension Of Building Normal To Wind Direction	= 300.000 ft
L	=	Horizontal Dimension Of building Parallel To Wind Direction	= 400.000 ft
L/B	=	Ratio Of L/B used For Cp determination	= 1.333
h/L	=	Ratio Of h/L used For Cp determination	= 0.050
Slope	=	Slope Of Roof	= 0.0 Deg

Gust Factor Calculation for Wind: [Parallel to Ridge]

Gust Factor Category I Rigid Structures - Simplified Method

G_1 = Simplified: For Rigid Structures can use 0.85 = 0.85

Gust Factor Category II Rigid Structures - Complete Analysis

Z_m = Equiv Struc Height: Max(0.6•h, Z_{min}) = 30.000 ft
I_{zm} = Turbulence Intensity: $c•(33/Z_m)^{1/6}$ [Eq 26.11-1] = 0.305
L_{zm} = Turbulence Integral Length Scale: $\ell•(Z_m/33)^{\varepsilon}$ [Eq 26.11-9] = 309.993 ft
B = Building Width Width Normal to Wind Direction = 300.000 ft
Q = $[1/(1+0.63•[(B+h)/L_{zm}]^{0.63})]^{0.5}$ [Eq 26.11-8] = 0.780
G_2 = Detailed: $0.925•[(1+1.7•g_q•I_{zm}•Q)/(1+1.7•g_v•I_{zm})]$ [Eq 26.11-6] = 0.795

Gust Factor Used in Analysis

G = Gust Factor: Min(G_1, G_2) = 0.795

Cp_{WW} = Windward Wall Coefficient (All L/B Values) = 0.800
Cp_{LW} = Leeward Wall Coefficient using L/B = -0.433
Cp_{SW} = Side Wall Coefficient (All L/B values) = -0.700

Wind Pressures [Parallel to Ridge]
All wind pressures include a Load Factor (LF) of 1.0

Elev ft	GC_{pi}	q_i psf	K_z	K_{zt}	q_z psf	Windward Press psf	Leeward Press psf	Side Press psf	Total Press psf	Minimum Pressure* psf
20.000	+0.18	14.69	0.624	1.000	14.69	6.70	-7.70	-10.82	14.40	16.00
20.000	-0.18	14.69	0.624	1.000	14.69	11.99	-2.42	-5.53	14.40	16.00

K_z = $2.01•(z_{grade}/Z_g)^{2/\alpha}$ [Tbl 26.10-1]
GC_{pi} = Enclosed Internal Pressure Tbl 26.13-1
q_{ip} = Positive Internal Pressure: q_h•LF
Side = $q_h•G•Cp_{SW}-q_{ip}•(+GC_{pi})$ [Eq 27.3-1]
Windward = $q_z•G•Cp_{WW}-q_{ip}•(+GC_{pi})$ [Eq 27.3-1]
K_{zt} = No Topographic feature specified
*q_z = $0.00256•K_z•K_{zt}•K_d•K_e•V^2$*LF [Eq 26.10-1]*
q_{in} = Negative Internal Pressure: q_h•LF
Leeward = $q_h•G•Cp_{LW}-q_{ip}•(+GC_{pi})$ [Eq 27.3-1]
Total = Windward - Leeward

- *Minimum Pressure: § 27.1.5 no less than 16.00 psf (Incl LF) applied to Walls*
- *Positive Pressures Act TOWARD Surface and Negative Pressures Act AWAY from Surface*

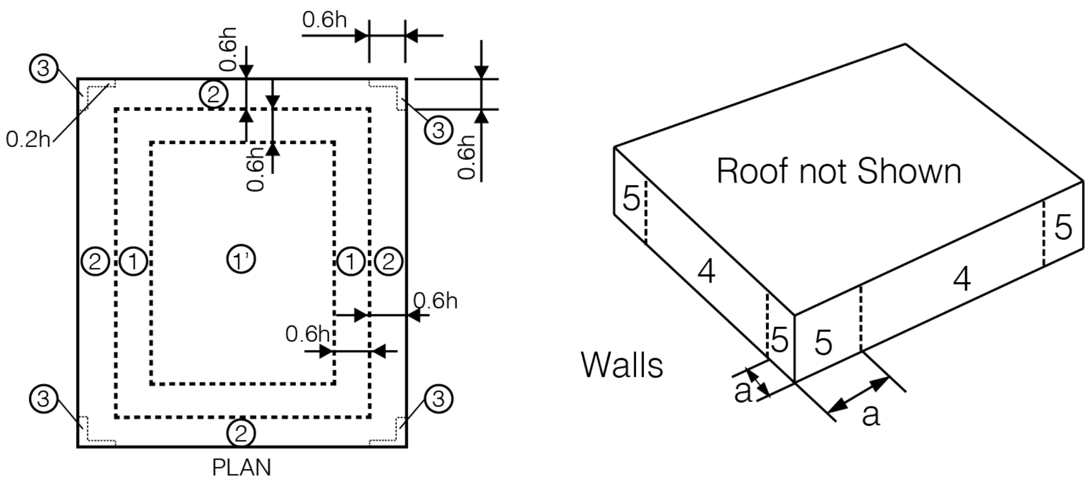
Roof Wind Pressures [Parallel to Ridge]
All wind pressures include a Load Factor (LF) of 1.0

Component	Description	Location	Start ft	End ft	GC_{pi}	C_{pMin}	C_{pMax}	P_{CpMin} psf	P_{CpMax} psf	P_{min} psf
Roof	Roof (0 to h)	All	0.000	20.000	+0.18	-0.900	-0.180	-13.15	-4.75	8.00
Roof	Roof (h to 2*h)	All	20.000	40.000	+0.18	-0.500	-0.180	-8.48	-4.75	8.00
Roof	Roof (>= 2*h)	All	40.000	400.000	+0.18	-0.300	-0.180	-6.15	-4.75	8.00
Roof	Roof (0 to h)	All	0.000	20.000	-0.18	-0.900	-0.180	-7.87	0.54	8.00
Roof	Roof (h to 2*h)	All	20.000	40.000	-0.18	-0.500	-0.180	-3.20	0.54	8.00
Roof	Roof (>= 2*h)	All	40.000	400.000	-0.18	-0.300	-0.180	-0.86	0.54	8.00

Roof Pressures based upon Ch 27 Pt1:
Component = The building component for pressures
Start = Start Dist from Windward Edge
C_{pMin} = Smallest Coefficient Magnitude
P_{CpMin} = $q_h•G•C_{pMin}-q_{ip}•GC_{pi}$ [Eq 27.3-1]
Location = Reference Graphic in Output for Values
End = End Dist from Windward Edge
C_{pMax} = Largest Coefficient Magnitude
P_{CpMax} = $q_h•G•C_{pMax}-q_{in}•GC_{pi}$ [Eq 27.3-1]
P_{min} = Min Press projected on vertical plane [§ 27.1.5]

- *No reduction factor was applicable*
- *The smaller uplift pressures due to C_{pMin} can become critical when wind is combined with roof live load or snow load; load combinations are given in ASCE 7*
- *Positive Pressures Act TOWARD Surface and Negative Pressures Act AWAY from Surface*

Components and Cladding (C&C) Wind Loads per Ch 30 Part 1 Roof & Wall



h/W = Ratio of mean roof height to building width = 0.067

h/L	=	Ratio of mean roof height to building length	=	0.050
h	=	Mean structure height	=	20.000 ft
h_{grade}	=	Elevation from Grade to Top of Structure	=	20.000 ft
K_h	=	$2.01\bullet(h_{grade}/Z_g)^{2/\alpha}$[Tbl 26.10-1]	=	0.624
K_{zt}	=	No Topographic feature specified	=	1.000
K_d	=	Wind Directionality Factor per Tbl 26.6-1	=	0.85
$+GC_{pi}$	=	Enclosed Positive Internal Pressure Tbl 26.13-1	=	+0.18
$-GC_{pi}$	=	Enclosed Negative Internal Pressure Tbl 26.13-1	=	-0.18
LF	=	Load Factor based upon STRENGTH Design	=	1.00
K_e	=	Ground Elev Factor [Tbl 26.9-1]	=	1.000
q_h	=	$0.00256\bullet K_h\bullet K_{zt}\bullet K_d\bullet K_e\bullet V^2*LF$ [Eq 26.10-1]	=	14.69 psf
LHD	=	Least Horizontal Dimension: Min(B, L)	=	300.000 ft
a_1	=	Min(0.1•LHD, 0.4•h)	=	8.000 ft
a	=	Max(a_1, 0.04•LHD, 3 ft [0.9 m])	=	12.000 ft
h/B	=	Ratio of mean roof height to least horizontal dim: h/B	=	0.067
0.2*h	=	Parameter used to define Zone 3	=	4.000 ft
0.6*h	=	Parameter used to define Zones 1 and 2	=	12.000 ft

Wind Pressures for C&C Ch 30 Pt 1 Roof & Wall
All wind pressures include a Load Factor (LF) of 1.0

Description	Zone	Width ft	Span ft	Area ft²	1/3 Rule	Figure	GCp Max	GCp Min	p Max psf	p Min psf
Zone 1	1	1.000	1.000	1.00	No	30.3-2A	0.300	-1.700	16.00	-27.61
Zone 1'	1'	1.000	1.000	1.00	No	30.3-2A	0.300	-0.900	16.00	-16.00
Zone 2	2	1.000	1.000	1.00	No	30.3-2A	0.300	-2.300	16.00	-36.42
Zone 3	3	1.000	1.000	1.00	No	30.3-2A	0.300	-3.200	16.00	-49.64
Zone 4	4	1.000	1.000	1.00	No	30.3-1	0.900	-0.990	16.00	-17.18
Zone 5	5	1.000	1.000	1.00	No	30.3-1	0.900	-1.260	16.00	-21.15
20LH	1	8.000	30.000	300.00	Yes	30.3-2A	0.200	-1.091	16.00	-18.67
20LH	1'	8.000	30.000	300.00	Yes	30.3-2A	0.200	-0.661	16.00	-16.00
20LH	2	8.000	30.000	300.00	Yes	30.3-2A	0.200	-1.518	16.00	-24.93
20LH	3	8.000	30.000	300.00	Yes	30.3-2A	0.200	-1.635	16.00	-26.65
24LH	1	8.000	40.000	533.33	Yes	30.3-2A	0.200	-1.000	16.00	-17.33
24LH	1'	8.000	40.000	533.33	Yes	30.3-2A	0.200	-0.537	16.00	-16.00
24LH	2	8.000	40.000	533.33	Yes	30.3-2A	0.200	-1.400	16.00	-23.20
24LH	3	8.000	40.000	533.33	Yes	30.3-2A	0.200	-1.400	16.00	-23.20
32LH	1	8.000	50.000	833.33	Yes	30.3-2A	0.200	-1.000	16.00	-17.33
32LH	1'	8.000	50.000	833.33	Yes	30.3-2A	0.200	-0.440	16.00	-16.00
32LH	2	8.000	50.000	833.33	Yes	30.3-2A	0.200	-1.400	16.00	-23.20
32LH	3	8.000	50.000	833.33	Yes	30.3-2A	0.200	-1.400	16.00	-23.20

Area = Span Length x Effective Width
1/3 Rule = Effective width need not be less than 1/3 of the span length
GCp = External Pressure Coefficients taken from Figures 30.3-1 through 30.3-7
p = Wind Pressure: $q_h\bullet[GC_p-GC_{pi}]$ [[Eq 30.3-1]]
** Per § 30.2.2 the Minimum Pressure for C&C is 16.00 psf [0.766 kPa] {Includes LF}*
Since Roof Slope= 10°, the Wall GCp values for Zone 4 & 5 are reduced by 10%

WIND LOAD - ASCE 7-16

104 mph, Exposure B, Mean Roof Height = 20.0 ft

K_{zt} at Base = 1

K_d = 0.85 , Roof Slope 0.0 degrees

Enclosed Building, GC_{pi} = 0.18

(Wind Loads Shown are for Alternate Basic Load Combinations Using Allowable Stress Design and are Multiplied by a Factor of 0.6 to convert to ASD)

WALL COMPONENTS AND CLADDING per ASCE7-16 Figure 30.3-1

Tributary Area (ft2)	GCp by Zone Zone 4 (+/-)	Zone 5 (+/-)
10 ft^2	0.90/-0.99	0.90/-1.26
50 ft^2	0.79/-0.88	0.79/-1.04
500 ft^2	0.63/-0.72	0.63/-0.72

VALUES ARE SLIGHTLY HIGHER THAN FROM MECAWIND RESULTS OK!

Height z (ft)	K_z	K_{zt}	K_e	q_z (psf)	Tributary Area (ft2)	Wind Pressures (psf) by Zone () Windward (4,5)	Leeward (4)	Leeward (5)
0 - 20	0.70	1.00	1.00	16.49	10	10.7	-11.6	-14.2
					50	9.6	-10.5	-12.0
					500	9.6	-9.6	-9.6

PARAPETS

GCp by Case and Zone

Tributary Area (ft2)	Case A (Zone 4/-2) Front/-Back	Case A (Zone 4 or 5/-3) Front/-Back	Case B (Zone -4/4 or 5) -Front/Back	Case B (Zone -5/4 or 5) -Front/Back
10 ft^2	0.90/-2.30	0.90/-3.20	-0.99/0.90	-1.26/0.90
50 ft^2	0.79/-1.93	0.79/-2.46	-0.88/0.79	-1.04/0.79
500 ft^2	0.63/-1.40	0.63/-1.40	-0.72/0.63	-0.72/0.63

Wind Pressures (psf) by Case and Zone ()

Top of Parapet (ft)	K_z	K_{zt-p}	K_e	q_{h-p}	Tributary Area (ft2)	Case A (4/-2)	Case A (4 or 5/-3)	Case B (-4/4 or 5)	Case B (-5/4 or 5)
25	0.70	1.00	1.00	16.49	10	31.7	40.6	-18.7	-21.4
					50	26.9	32.2	-16.5	-18.1
					500	20.1	20.1	-13.4	-13.4

The GCp Values

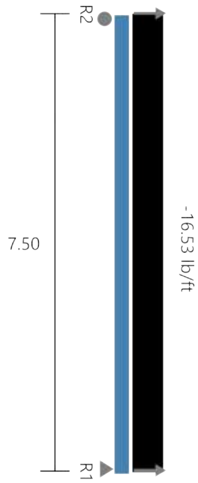
Do Not Always Vary Linearly between these Areas in Figures 30.3-1 through 30.5-1.

Therefore, Interpolation of These Calculated Values is Not Recommended.

ROOF COMPONENTS AND CLADDING - Gable ROOF ASCE7-16 Figure 30.3-2A

K_h = 0.70; K_{zt} at roof = 1.00; K_e = 1.00; q_h = 16.49 psf

	Positive Pressure, p (psf)				Negative Pressure, p (psf)					
	A=10		A=100		A=10		A=100		A=500	
Zone	GC_p	p	GC_p	p	GC_p	p	GC_p	p	GC_p	p
Roof 1	0.30	9.60	0.20	9.60	-1.70	-18.60	-1.29	-14.52	-1.00	-11.67
Roof 2	0.30	9.60	0.20	9.60	-2.30	-24.54	-1.77	-19.29	-1.40	-15.63
Roof 3	0.30	9.60	0.20	9.60	-3.20	-33.44	-2.14	-22.96	-1.40	-15.63
Roof 1'	0.30	9.60	0.20	9.60	-0.90	-10.68	-0.90	-10.68	-0.55	-9.60



Section : 600S137-33 (33 ksi) @ 16" o.c. Single C Stud (punched)
Maxo = 748.6 ft-lb **Va =** 638.1 lb **I =** 1.55 in^4

Loads have not been modified for strength checks
Loads have been multiplied by 0.70 for deflection calculations

Bridging Connectors - Design Method =AISI S100

Span	Axial KyLy, KtLt	Flexual, Distortional	Connector	Stress Ratio
Span	NA	48.0", 90.0"	LSUBH3.25 (Min)	0.23

Web Crippling

Support	Load (lb)	Bearing (in)	Pa (lb)	M (ft-lbs)	Max Int.	Stiffener?
R2	-62.00	--Slip Track Design, Ref Connectors--				NO
R1	-62.00	--Stud/Track Design, Ref Connectors--				NO

Gravity Load

Type	Load (lb)
Uniform	

	Code Check	Required	Allowed	Interaction	Notes
Span	Max. Axial, lbs	0.0(t)	-	0%	KΦ=0.00 lb-in/in Max KL/r = 214
	Max. Shear, lbs	62.0	638.1	10%	Shear (Punched)
	Max. Moment (MaFy, Ma-dist), ft-lbs	116.2	682.1	17%	Ma-dist (control),KΦ=0.00 lb-in/in
	Moment Stability, ft-lbs	116.2	687.8	17%	
	Shear/Moment	0.16	1.00	16%	Shear 0.0, Moment 116.2
	Axial/Moment	0.17	1.00	17%	Axial 0.0(c), Moment 116.2
	Deflection Span, in	0.018	--meets L/4989--		

Support	Rx(lb)	Ry(lb)	Simpson Strong-Tie Connector	Connector Interaction	Anchor Interaction
R2	-62.0	0.0	600SLT250-33 (33) & (1) .157", 3/4" embed SST PDPA/PDPAT to 2500 nw concrete	41.33 %	79.85 %
R1	-62.0	0.0	600T125-33 (33) & (1) .157", 3/4" embed SST PDPA/PDPAT to 2500 nw concrete	25.52 %	51.67 %

* Reference catalog for connector and anchor requirement notes as well as screw placement requirements

3.2.5.2 MATERIAL SPECIFICATIONS

Fastener designation	Fastener material	Fastener plating[1]	Steel washer or clip material[1,2]	Washer or clip plating[1,2]
X-P	Carbon Steel	5 µm Zinc	N/A	N/A
X-U	Carbon Steel	5 µm Zinc	Carbon Steel	5 µm Zinc
DS/EDS	Carbon Steel	5 µm Zinc	N/A	N/A
X-C	Carbon Steel	5 µm Zinc	Carbon Steel	5 µm Zinc
X-R, X-CR[3]	SAE 316	N/A	SAE 316	N/A
X-C/ X-P/ X-PN/ X-S: G2/G3/B3	Carbon Steel	2-10 µm Zinc	N/A	N/A
X-CT Forming Nail	Carbon Steel	5 µm Zinc	N/A	N/A
BC X-C	Carbon Steel	5 µm Zinc	Carbon Steel	5 µm Zinc

1 The 5 µm zinc coating is in accordance with ASTM B 633, SC 1, Type III. Refer to Section 2.3.3.1 for more information.
2 Most fasteners have a plastic washer for guidance when installing. Not all fastener lengths have a pre-mounted steel washer. Refer to Section 3.2.2.4 for more information on available fasteners.
3. The X-CR and X-R fastener material is a proprietary material, which provides a corrosion resistance equivalent to SAE 316 stainless steel. The steel washer material is SAE 316 stainless steel.

* More details about the innovative X-P and X-U fasteners can be found in Section 3.2.6.

3.2.5.3 TECHNICAL DATA

Allowable loads in normal weight concrete [1,2]

Fastener description	Fastener	Shank diameter in. (mm)	Minimum embedment in. (mm)	Concrete compressive strength							
				2000 psi		4000 psi		6000 psi		8000 psi	
				Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)
Premium Concrete Fastener	X-P	**0.157** (4.0)	**3/4** (19)	**100** (0.44)	**155** (0.69)	**100** (0.44)	**175** (0.78)	**105** (0.47)	**205** (0.91)	**135** (0.60)	**205** (0.91)
			1 (25)	**165** (0.73)	**220** (0.98)	**180** (0.80)	**225** (1.00)	**150** (0.67)	**300** (1.33)	**150** (0.67)	**215** (0.96)
			1-1/4 (32)	**240** (1.07)	**310** (1.38)	**280** (1.25)	**310** (1.38)	**180** (0.80)	**425** (1.89)	–	–
			1-1/2 (38)	**310** (1.38)	**420** (1.87)	–	–	–	–	–	–
Universal Knurled Shank Fasteners	X-U	**0.157** (4.0)	**3/4** (19)	**100** (0.44)	**125** (0.57)	**100** (0.44)	**125** (0.57)	**105** (0.47)	**205** (0.91)	–	–
			1 (25)	**165** (0.73)	**190** (0.85)	**170** (0.76)	**225** (1.00)	**110** (0.49)	**280** (1.25)	–	–
			1-1/4 (32)	**240** (1.07)	**310** (1.38)	**280** (1.25)	**310** (1.38)	**180** (0.80)	**425** (1.89)	–	–
			1-1/2 (38)	**275** (1.22)	**420** (1.87)	**325** (1.45)	**420** (1.87)	–	–	–	–
Standard Fastener	X-C (Black collated strip or guidance washer)	**0.138** (3.5)	**3/4** (19)	**45** (0.20)	**75** (0.33)	**65** (0.29)	**105** (0.47)	**95** (0.42)	**195** (0.87)	–	–
			1 (25)	**85** (0.38)	**150** (0.67)	**160** (0.71)	**200** (0.89)	**105** (0.47)	**270** (1.20)	–	–
			1-1/4 (32)	**130** (0.58)	**210** (0.93)	**270** (1.20)	**290** (1.29)	**165** (0.73)	**325** (1.45)	–	–
			1-1/2 (38)	**175** (0.78)	**260** (1.16)	**270** (1.20)	**360** (1.60)	–	–	–	–
Heavy Duty Fastener	DS	**0.177** (4.5)	**3/4** (19)	**50** (0.22)	**120** (0.53)	**125** (0.56)	**135** (0.60)	–	–	–	–
			1 (25)	**130** (0.58)	**195** (0.87)	**155** (0.69)	**240** (1.07)	–	–	–	–
			1-1/4 (32)	**220** (0.98)	**385** (1.71)	**270** (1.20)	**425** (1.89)	–	–	–	–
			1-1/2 (38)	**300** (1.33)	**405** (1.80)	**355** (1.58)	**450** (2.00)	–	–	–	–
Stainless Steel Fastener	X-CR	**0.145** (3.7)	**3/4** (19)	**30** (0.13)	**40** (0.18)	**65** (0.29)	**40** (0.18)	–	–	–	–
			1 (25)	**55** (0.24)	**185** (0.82)	**120** (0.53)	**190** (0.85)	**100** (0.44)	**170** (0.76)	–	–
			1-1/4 (32)	**110** (0.49)	**290** (1.29)	**125** (0.56)	**300** (1.33)	**120** (0.53)	**440** (1.96)	–	–
			1-1/2 (38)	**265** (1.18)	**405** (1.80)	**350** (1.56)	**450** (2.00)	–	–	–	–
		0.157 (4.0)									
Gas Fastener	X-C B3, X-C G3	**0.118** (3.0)	**3/4** (19)	**110** (0.5)	**190** (0.9)	**110** (0.5)	**190** (0.9)	**110** (0.5)	**190** (0.9)	–	–
Premium Gas Fastener	X-P 17 G2, X-P 20 G2, X-P G3, X-P B3	**0.118** (3.0)	**5/8** (16)	–	–	**50** (0.2)	**120** (0.5)	**50** (0.2)	**90** (0.4)	–	–
			3/4 (19)	**80** (0.4)	**120** (0.5)	**50** (0.2)	**120** (0.5)	**50** (0.2)	**90** (0.4)	–	–
Forming Fastener	X-CT 47[3]	**0.145** (3.7)	**1** (25)	**60** (0.27)	**65** (0.29)	–	–	–	–	–	–
	X-CT 62[3]	**0.145** (3.7)	**1** (25)	**75** (0.33)	**75** (0.33)	–	–	–	–	–	–

1 The tabulated allowable load values are for the low-velocity fasteners only, using a safety factor that is greater than or equal to 5.0, calculated in accordance with ICC-ES AC70. Wood or steel members connected to the substrate must be investigated in accordance with accepted design criteria.
2 Multiple fasteners are recommended for any attachment.
3 For temporary fastening of formwork only.

Allowable loads in minimum ASTM A36 ($F_y \geq 36$ ksi, $F_u \geq 58$ ksi) steel[1,2,4,5]

Fastener description	Fastener	Shank diameter in. (mm)	Steel thickness (in.)											
			1/8		3/16		1/4		3/8		1/2		≥3/4	
			Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)
Universal knurled shank*	X-U[6]	**0.157** (4.0)	–	–	**500** (2.22)	**720** (3.20)	**775** (3.45)	**720** (3.20)	**935** (4.16)	**720** (3.20)	**900** (4.00)	**720** (3.20)	**350** (1.56)	**375** (1.67)
Stepped-shank knurling-lengthwise	X-U 15[7]	**0.145** (3.7)	–	–	**155** (0.69)	**395** (1.76)	**230** (1.02)	**395** (1.76)	**420** (1.87)	**450** (2.00)	**365** (1.62)	**500** (2.22)	**365** (1.62)	**400** (1.78)
Standard knurled shank	X-S13	**0.145** (3.7)	**140** (0.62)	**300** (1.33)	**300** (1.33)	**450** (2.00)	**300** (1.33)	**450** (2.00)	**300** (1.33)	**450** (2.00)	–	–	–	–
Drywall smooth shank w/metal top hat washer	X-S16[10]	**0.145** (3.7)	–	–	**315** (1.40)	**480** (2.14)	**315** (1.40)	**480** (2.14)	**315** (1.40)	**530** (2.36)	**315** (1.40)	**480** (2.14)	–	–
Heavy duty knurled shank	EDS[3]	**0.177** (4.5)	–	–	**305** (1.36)	**615** (2.74)	**625** (2.78)	**870** (3.87)	**715** (3.18)	**870** (3.87)	**890** (3.96)	**960** (4.27)	**400** (1.78)	**655** (2.91)
Heavy duty smooth shank	DS	**0.177** (4.5)	–	–	**365** (1.62)	**725** (3.22)	**580** (2.58)	**725** (3.22)	**695** (3.09)	**725** (3.22)	**735** (3.27)	**860** (3.83)	–	–
Stainless steel smooth shank	X-R[9], X-CR	**0.145** (3.7) **0.157** (4.0)	–	–	**460** (2.05)	**460** (2.05)	**615** (2.74)	**500** (2.22)	–	–	–	–	–	–
Stainless steel smooth shank	X-R[8,9]	**0.145** (3.7)	**300** (1.33)	**190** (0.85)	**615** (2.74)	**495** (2.20)	**760** (3.38)	**500** (2.22)	**220** (0.98)	**325** (1.45)	**225** (1.00)	**335** (1.49)	–	–
Standard gas fastener for steel	X-S 14 B3	**0.118** (3.0)	**140** (0.62)	**230** (1.02)	**220** (0.98)	**245** (1.09)	**225** (1.00)	**290** (1.29)	**280** (1.25)	**330** (1.47)	**280** (1.25)	**330** (1.47)	**280** (1.25)	**330** (1.47)
Standard gas fastener for steel	X-S 14 B3[8]	**0.118** (3.0)	–	–	**220** (0.98)	**295** (1.31)	**260** (1.16)	**355** (1.58)	**280** (1.25)	**385** (1.71)	**280** (1.25)	**385** (1.71)	**280** (1.25)	**385** (1.71)
Premium gas fastener	X-P G3, X-P B3	**0.118** (3.0)	**125** (0.56)	**230** (1.02)	**170** (0.76)	**245** (1.09)	**200** (0.89)	**230** (1.02)	**250** (1.11)	**255** (1.13)	–	–	–	–

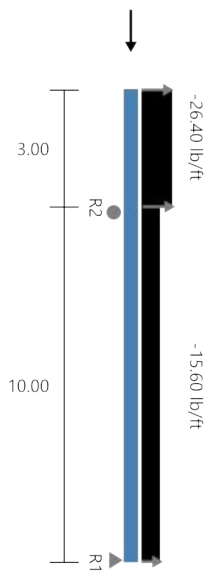
1 The tabulated allowable load values are for the low-velocity fasteners only, using a safety factor that is greater than or equal to 5.0, calculated in accordance with ICC-ES AC70. Wood or steel members connected to the substrate must be investigated in accordance with accepted design criteria.
2 Low-velocity fasteners shall be driven to where the point of the fastener penetrates through the steel base material in accordance with Section 3.2.2.3, except as noted in this table.
3 EDS fasteners installed into greater than 1/2" thick steel require 1/2" minimum penetration.
4 Multiple fasteners are recommended for any attachment.
5 Refer to guidelines for fastening to steel, Section 3.2.2, for application limits.
6 Tabulated allowable load values provided for 3/4" steel are based upon minimum point penetration of 1/2" into the steel. If 1/2" point penetration into the steel is not achieved, but a point penetration of at least 3/8" is obtained, the tabulated tension value should be reduced by 20 percent and the tabulated shear load should be reduced by 8 percent.
7 X-U 15 fasteners installed into greater than 3/8" thick steel require 15/32" minimum penetration into the steel.
8 Based on testing with F_y = 50 ksi base material.
9 Fasteners installed into 3/8" or thicker base require 0.38" minimum penetration depth into the steel.
10 Published values may vary from values in ICC-ESR

Allowable tensile pullover and shear bearing load capacities for steel framing with power driven fasteners[1,2,3,4]

Fastener description	Fastener	Head dia. in. (mm)	Sheet steel thickness													
			14 ga.		16 ga.		18 ga.		20 ga.		22 ga.		24 ga.		25/26 ga.	
			Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)
0.157" shank with or w/o plastic washers or MX collation	X-U, X-P	**0.322** (8.2)	**825** (3.67)	**1,085** (4.83)	**685** (3.05)	**720** (3.20)	**490** (2.18)	**525** (2.34)	**360** (1.60)	**445** (1.98)	**300** (1.33)	**330** (1.47)	**205** (0.91)	**255** (1.13)	**120** (0.53)	**145** (0.64)
0.145" shank with or w/o plastic washers or MX collation	X-C, X-R	**0.322** (8.2)	–	**985** (4.38)	**685** (3.05)	**720** (3.20)	**490** (2.18)	**515** (2.29)	**360** (1.60)	**440** (1.96)	**300** (1.33)	**310** (1.38)	**205** (0.91)	**235** (1.05)	**120** (0.53)	**145** (0.64)
0.177" shank without washer	DS, EDS	**0.322** (8.2)	**965** (4.29)	**1,085** (4.83)	**810** (3.60)	**815** (3.63)	**625** (2.78)	**535** (2.38)	**460** (2.05)	**465** (2.07)	**360** (1.60)	**350** (1.56)	**300** (1.33)	**260** (1.16)	**240** (1.07)	**180** (0.80)
0.145" shank with plastic top hat washers	X-S13 THP X-S16 TH	**0.322** (8.2)	–	**985** (4.38)	**685** (3.05)	**720** (3.20)	**490** (2.18)	**515** (2.29)	**360** (1.60)	**440** (1.96)	**300** (1.33)	**310** (1.38)	**205** (0.91)	**235** (1.05)	**120** (0.53)	**145** (0.64)

1 Allowable load values are based on a safety factor of 3.0.
2 Allowable pullover capacities of sheet steel should be compared to the allowable fastener tensile load capacities in concrete, steel, and masonry to determine controlling resistance load.
3 Allowable shear bearing capacities of sheet steel should be compared to allowable fastener shear capacities in concrete, steel and masonry to determine controlling resistance load.
4 Data is based on the following minimum sheet steel properties, F_y = 33 ksi, F_u = 45 ksi (ASTM A653 material).

* More details about the innovative X-U fastener can be found in Section 3.2.6.



Section : 800S162-43 (33 ksi) @ 16" o.c. Single C Stud (punched)
Maxo = 1678.4 ft-lb **Va =** 1051.2 lb **I =** 4.50 in^4

Loads have not been modified for strength checks
Loads have been multiplied by 0.70 for deflection calculations

Bridging Connectors - Design Method =AISI S100

Span	Axial KyLy, KtLt	Flexual, Distortional	Connector	Stress Ratio
Top Cant.	None, None	None, 36.0"	N/A	-
Span	None, None	None, 120.0"	N/A	-

Web Crippling

Support	Load (lb)	Bearing (in)	Pa (lb)	M (ft-lbs)	Max Int.	Stiffener?
R2	-169.08	--Shear Connection w/ clip--				NO
R1	-66.12	--Shear Connection w/ clip--				NO

Gravity Load

Type	Load (lb)
Uniform	13.33plf (Top Cantilever), 13.33plf (Span)

	Code Check	Required	Allowed	Interaction	Notes
Top Cant.	Max. Axial, lbs	40.0(c)	3956.7(c)	1%	KΦ=0.00 lb-in/in Max KL/r = 66
	Max. Shear, lbs	79.2	1051.2	8%	Shear (Punched)
	Max. Moment (MaFy, Ma-dist), ft-lbs	118.8	1527.4	8%	Ma-dist (control),KΦ=0.00 lb-in/in
	Moment Stability, ft-lbs	75.8	1678.4	5%	
	Shear/Moment	0.10	1.00	10%	Shear 79.2, Moment 118.8
	Axial/Moment	0.09	1.00	9%	Axial 40.0(c), Moment 118.8
	Deflection Cant., in	0.005	--meets L/15972--		2 x Cantilever
Span	Max. Axial, lbs	173.3(c)	1021.5(c)	17%	KΦ=0.00 lb-in/in Max KL/r = 220
	Max. Shear, lbs	89.9	1051.2	9%	Shear (Punched)
	Max. Moment (MaFy, Ma-dist), ft-lbs	140.1	1527.4	9%	Ma-dist (control),KΦ=0.00 lb-in/in
	Moment Stability, ft-lbs	140.1	736.6	19%	
	Shear/Moment	0.11	1.00	11%	Shear 89.9, Moment 118.8
	Axial/Moment	0.31	1.00	31%	Axial 125.1(c), Moment 137.1
	Deflection Span, in	0.012	--meets L/10148--		

Support	Rx(lb)	Ry(lb)	Simpson Strong-Tie Connector	Connector Interaction	Anchor Interaction
R2	-169.1	0.0	SCB47.5(2) & (2) 1/4" x 1-3/4" Titen turbo to 2500 psi concrete	27.72 %	51.24 %
R1	-66.1	173.3	FCB47.5 Min(4#12-14) & (3) 1/4" x 1-3/4" Titen Turbo to 2500 concrete	60.08 %	72.36 %

* Reference catalog for connector and anchor requirement notes as well as screw placement requirements

FCB/MFCB Bypass Framing Fixed-Clip Connector | BYPASS CONNECTOR

This product is preferable to similar connectors because of a) easier installation, b) higher loads, c) lower installed cost, or a combination of these features.

The FCB/MFCB clip is an economical, high-performance fixed-clip connector that can be used for a variety of framing applications. It is rated for tension, compression, shear and in-plane loads and offers the designer the flexibility of specifying different screw and anchorage patterns that conform to desired load levels.

Features:

- Rated for tension, compression, shear and in-plane loads
- Provides design flexibility with varying screw and anchorage patterns that achieve different load levels
- Strategically placed stiffeners, embossments and anchor holes maximize connector performance

Material: FCB — 54 mil (16 ga.); MFCB — 68 mil (14 ga.)

Finish: Galvanized (G90)

Installation:

- Use the specified type and number of anchors.
- Use the specified number of #12 self-drilling screws to CFS framing. Note that #10 self-drilling screws can be used per the load tables given on **strongtie.com**.
- For installations to wood framing, see Simpson Strong-Tie® engineering letter L-CF-FIXCLIPW at **strongtie.com**.

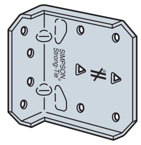
Codes: See p. 13 for Code Reference Key Chart

Ordering Information:

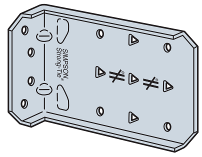
FCB43.5-R25, MFCB43.5-R25, FCB45.5-R25, MFCB45.5-R25, FCB47.5-R25, MFCB47.5-R25, FCB49.5-R25, FCB411.5-R25 contain:

- Box of 25 connectors (screws not included)

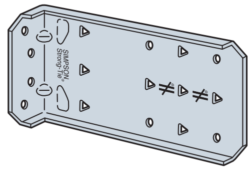
FCB43.5 *(MFCB43.5 similar)* NEW



FCB45.5 *(MFCB45.5 similar)* NEW

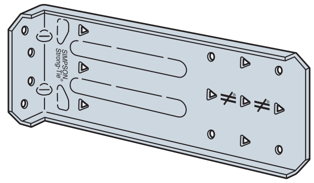


FCB47.5 *(MFCB47.5 similar)* NEW

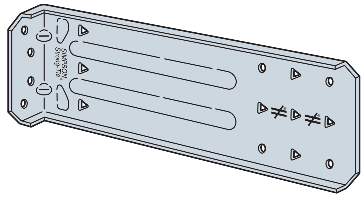


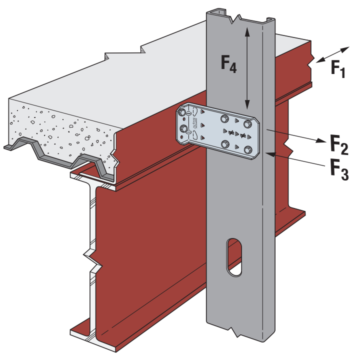
US Patent: 8,555,592

FCB49.5

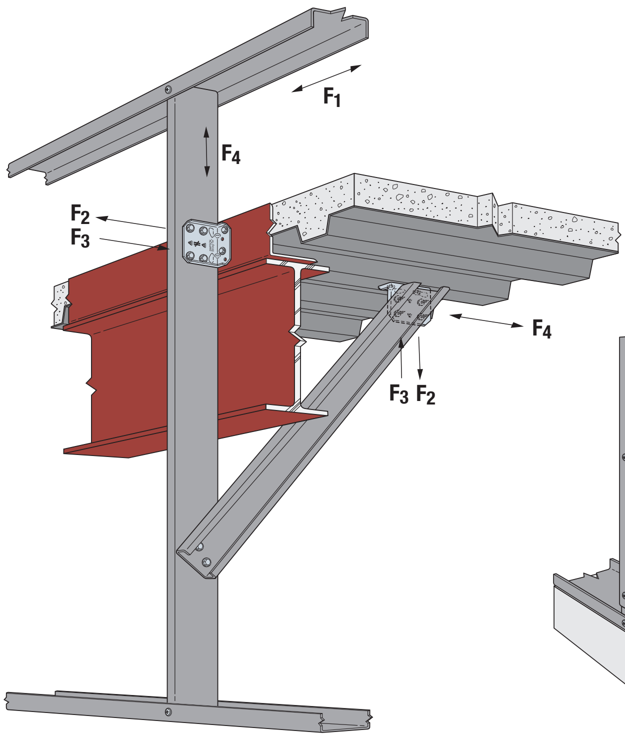


FCB411.5

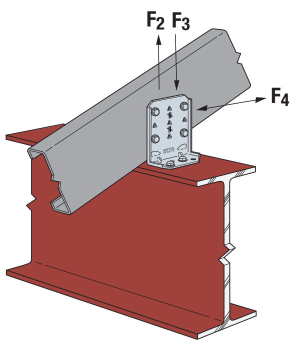




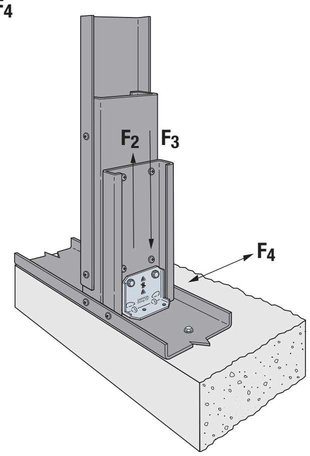
Typical FCB/MFCB Installation at Bypass Framing



Typical FCB/MFCB Installation at Sprandrel Studs and Kickers



Typical FCB/MFCB Installation for Roof Rafters



Typical FCB/MFCB Installation at the Base of a 6" Jamb Stud

Rigid Connectors

FCB/MFCB Bypass Framing Fixed-Clip Connector

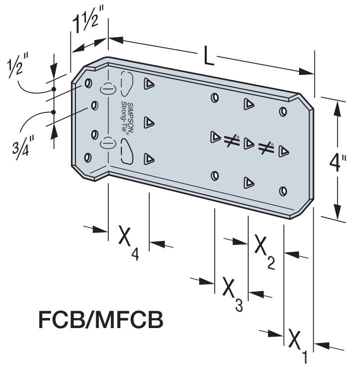
FCB/MFCB Allowable Connector Loads (lb.)

Model No.	Connector Material Thickness mil (ga.)	L (in.)	Min./ Max.	No. of #12–14 Self-Drilling Screws	Stud Thickness												Code Ref.
					33 mil (20 ga.)				43 mil (18 ga.)				54 mil (16 ga.)				
					$F_1^{3,4}$	F_2	F_3	F_4	$F_1^{3,4}$	F_2	F_3	F_4	$F_1^{3,4}$	F_2	F_3	F_4	
FCB43.5	54 (16)	3½	Min.	4	140	755	755	755	175	1,105	905	1,055	330	1,250	905	1,235	IBC, FL, LA
			Max.	6	205	1,100	1,130	1,075	260	1,105	1,105	1,350	330	1,250	2,245	1,770	
MFCB43.5	68 (14)	3½	Min.	4	140	755	755	755	220	1,105	1,105	1,055	410	1,530	2,280	1,595	
			Max.	6	205	1,130	1,130	1,075	260	1,265	1,105	1,545	410	1,530	2,630	1,770	
FCB45.5	54 (16)	5½	Min.	4	120	755	755	700	150	1,105	905	875	285	1,105	905	1,100	
			Max.	9	155	1,100	1,260	1,095	195	1,105	1,105	1,380	330	1,105	2,245	1,785	
MFCB45.5	68 (14)	5½	Min.	4	170	755	755	700	220	1,105	1,105	1,030	410	1,530	2,280	1,595	
			Max.	9	170	1,265	1,260	1,695	220	1,265	1,105	2,315	410	1,605	3,205	2,315	
FCB47.5	54 (16)	7½	Min.	4	90	755	755	220	110	1,105	875	330	215	1,105	875	815	
			Max.	12	110	1,100	1,260	705	135	1,105	1,260	1,050	260	1,105	2,245	1,345	
MFCB47.5	68 (14)	7½	Min.	4	165	755	755	415	215	1,105	1,105	540	410	1,580	2,280	1,025	
			Max.	12	165	1,265	1,260	1,345	215	1,265	1,405	1,530	410	1,605	3,350	2,700	
FCB49.5	54 (16)	9½	Min.	4	—	755	755	170	—	1,105	905	255	—	1,105	905	340	
			Max.	12	—	1,100	1,260	750	—	1,105	1,260	1,115	—	1,105	2,245	1,200	
FCB411.5	54 (16)	11½	Min.	4	—	755	755	140	—	1,105	935	205	—	1,105	935	340	
			Max.	12	—	1,100	1,260	795	—	1,105	1,260	860	—	1,105	2,245	860	

1. Min. fastener quantity and load values — fill all round holes; max. fastener quantity and load values — fill all round and triangular holes.
2. Allowable loads are based on clip capacity only and do not consider anchorage. The capacity of the connection system will be the minimum of the tabulated value and the allowable load from the FCB/MFCB Allowable Anchorage Loads table on p. 75.
3. Anchorage to the supporting structure using welds or a minimum of (2) #12–24 self-drilling screws is required.
4. Tabulated F_1 loads are based on assembly tests with the load through the centerline of stud. Tested failure modes were due to screw pullout; therefore compare F_1 against F_p calculated per ASCE 7-16 Chapter 13 with a_p = 1.25 and R_p = 1.0.
5. Tabulated values for 54 mil (16 ga.) CFS framing may be used for 68 mil (14 ga.) and greater steel thickness.

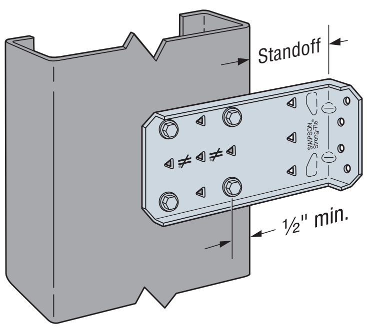
FCB/MFCB Standoff Distances

Model No.	L (in.)	Min./ Max.	No. of #12–14 Self-Drilling Screws	Maximum Standoff (in.)
FCB43.5	3½	Min.	4	1
		Max.	6	1
MFCB43.5	3½	Min.	4	1
		Max.	6	1
FCB45.5	5½	Min.	4	1½
		Max.	9	1
MFCB45.5	5½	Min.	4	1½
		Max.	9	1
FCB47.5	7½	Min.	4	3½
		Max.	12	1
MFCB47.5	7½	Min.	4	3½
		Max.	12	1
FCB49.5	9½	Min.	4	5½
		Max.	12	1
FCB411.5	11½	Min.	4	7½
		Max.	12	1

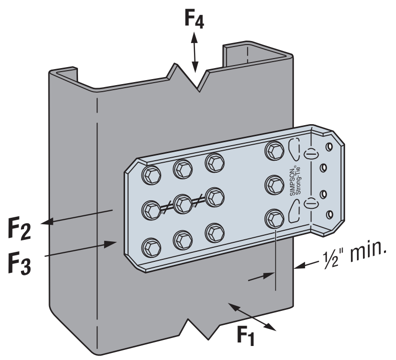


FCB/MFCB

Variable	Dimensions (in.)				
	FCB/MFCB				
	43.5	45.5	47.5	49.5	411.5
X_1	¾	1	1	1	1
X_2	1¼	1¼	1¼	1¼	1¼
X_3	—	1¼	1¼	1¼	1¼
X_4	—	—	1½	1½	1½
L	3½	5½	7½	9½	11½



FCB/MFCB Installation with Min. Fasteners



FCB/MFCB Installation with Max. Fasteners

FCB/MFCB Bypass Framing Fixed-Clip Connector

FCB Allowable Anchorage Loads (lb.)

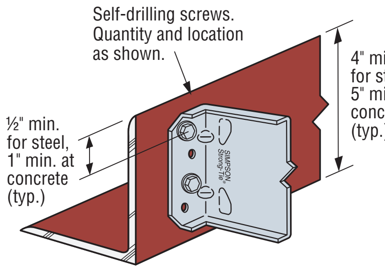
Anchorage Type	Minimum Base Material	No. of Anchors	Allowable Load (lb.)									
			F_1	F_2 and F_3	F_4							
					FCB43.5	FCB45.5	FCB47.5		FCB49.5		FCB411.5	
					Min./Max.	Min./Max.	Min.	Max.	Min.	Max.	Min.	Max.
#12–24 self-drilling screws Simpson Strong-Tie® X and XL Metal screws	A36 steel 3⁄16" thick	2	165	795	645	895	555	1,075	535	535	370	535
		3	250	1,120	970	1,340	830	1,610	545	560	370	560
		4	330	1,590	1,290	1,785	1,105	2,145	545	560	370	560
Simpson Strong-Tie 0.157" x 5⁄8" power-actuated fasteners PDPAT-62KP	A36, A572 or A992 steel 3⁄16" thick	2	—	390	535				535	535	370	535
		3	—	715	560				545	560	370	560
		4	—	970	560				545	560	370	560
Simpson Strong-Tie 1⁄4" x 1¾" Titen Turbo™ TNT25134H	Concrete f'$_c$ = 2,500 psi	2	—	380	415	315	195	315	140	205	140	150
		3	—	525	470	470	290	470	210	305	210	225
		4	—	675	645	630	390	630	280	410	280	300
Weld E70XX electrodes	A36 steel 3⁄16" thick	Hard side: 2" Free side: 1"	1,205	1,740	1,770	1,840	1,105	2,650	450	1,200	450	860

See footnotes below.

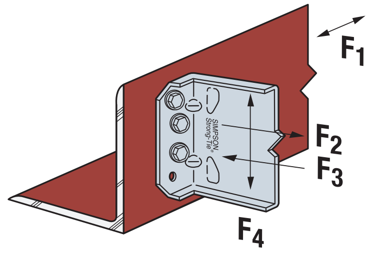
MFCB Allowable Anchorage Loads (lb.)

Anchorage Type	Minimum Base Material	No. of Anchors	Allowable Load (lb.)					
			F_1	F_2 and F_3	F_4			
					MFCB43.5	MFCB45.5	MFCB47.5	
					Min./Max.	Min./Max.	Min.	Max.
#12–24 self-drilling screws Simpson Strong-Tie X and XL Metal screws	A36 steel 3⁄16" thick	2	205	1,045	800	1,160	695	1,350
		3	310	1,725	1,195	1,735	1,045	2,025
		4	410	2,090	1,595	2,315	1,390	2,700
Simpson Strong-Tie 0.157" x 5⁄8" power-actuated fasteners PDPAT-62KP	A36, A572 or A992 steel 3⁄16" thick	2	—	390	535			
		3	—	715	560			
		4	—	970	560			
Simpson Strong-Tie 1⁄4" x 1¾" Titen Turbo TNT25134H	Concrete f'$_c$ = 2,500 psi	2	—	380	415	315	195	315
		3	—	525	470	470	290	470
		4	—	675	645	630	390	630
Weld E70XX electrodes	A36 steel 3⁄16" thick	Hard side: 2" Free side: 1"	1,485	4,570	1,770	2,315	1,390	3,335

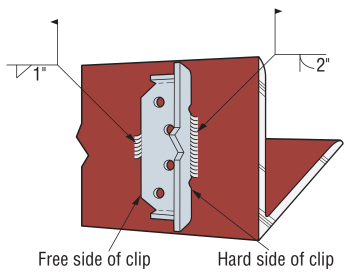
1. For additional important information, see General Information and Notes on p. 26.
2. Min. fastener quantity and load values — fill all round holes; max. fastener quantity and load values — fill all round and triangular holes.
3. Allowable loads are for clip anchorage only. The capacity of the connection system will be the minimum of the tabulated allowable anchorage loads the allowable load from the FCB/MFCB Allowable Connector Load table on p. 74.
4. Allowable loads for #12–24 self-drilling screws and PDPAT powder-actuated fasteners are based on installation in minimum 3⁄16"-thick structural steel with F_y = 36 ksi. PDPAT values are also provided for A572 steel. Values listed above maybe used where other thicknesses of steel are encountered or other manufacturers are used, provided that the fastener has equal or better tested values (see p. 26). It is the responsibility of the designer to select the proper length fasteners based on the steel thickness installation.
5. For attachment with 0.157" x 5⁄8" PDPAT-62KP to 3⁄16" thick, A572 or A992 steel, F_2 and F_3 allowable loads can increase to 585 lb., 800 lb. and 1,170 lb. for two, three and four fasteners, respectively.
6. For screw fastener installation into steel backed by concrete, predrilling of both the steel and the concrete is suggested. For predrilling use a maximum 3⁄16"-diameter drill bit.



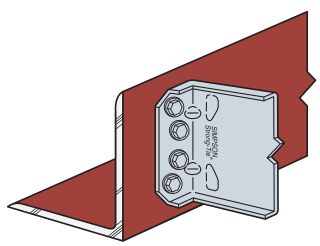
Two Anchors



Three Anchors



Weld



Four Anchors

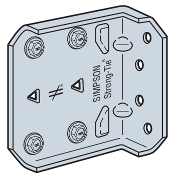
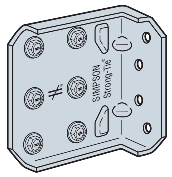
FCB/MFCB Anchor Layout

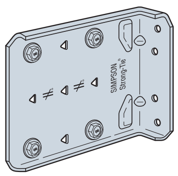
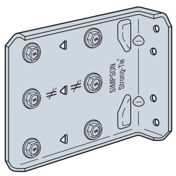
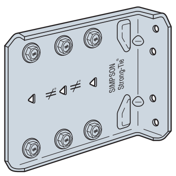
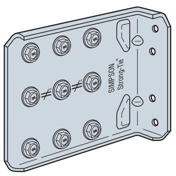
FCB/MFCB Bypass Framing Fixed-Clip Connector

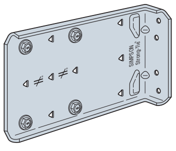
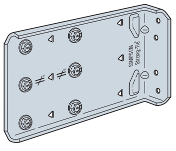
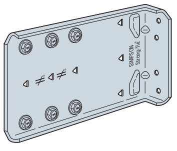
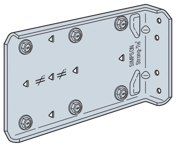
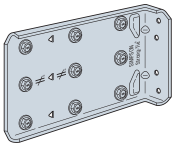
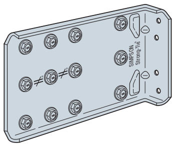
The following FCB/MFCB supplemental information is given to help designers with value-engineered solutions for our FCB/MFCB connectors. Loads are given on our website for fastener patterns other than our standard "min." (fill all round holes) and "max." (fill all round and triangle holes). In addition, the tables on the website give LRFD loads and loads for #10 screws as well as #12 screws. Please visit **strongtie.com/cfs** and reference FCB/MFCB clip.

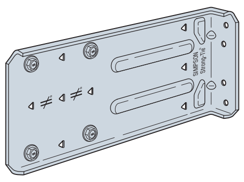
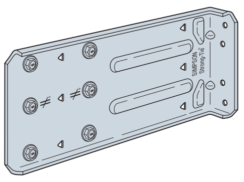
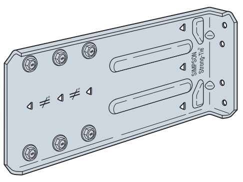
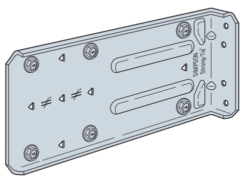
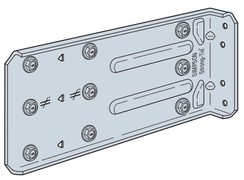
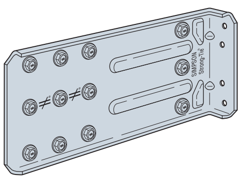
Table 1: FCB/MFCB Screw Patterns

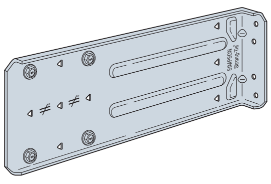
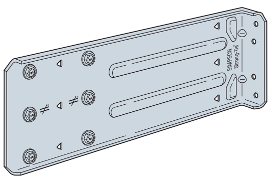
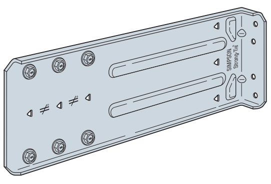
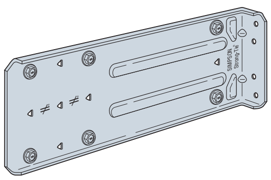
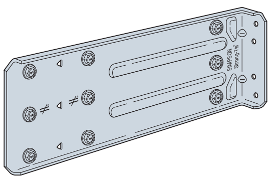
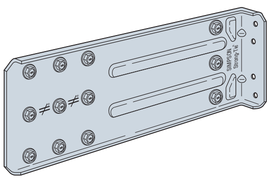
For load capacities for patterns 1 through 10, refer to FCB/MFCB clip on **strongtie.com**.

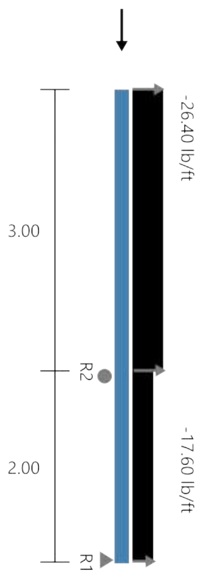
Model	Pattern "Min."	Pattern "Max."
FCB43.5 MFCB43.5		

Model	Pattern "Min."	Pattern 1	Pattern 2	Pattern "Max."
FCB45.5 MFCB45.5				

Model	Pattern "Min."	Pattern 3	Pattern 4	Pattern 5	Pattern 6	Pattern "Max."
FCB47.5 MFCB47.5						

Model	Pattern "Min."	Pattern 7	Pattern 8
FCB49.5			
	Pattern 9	Pattern 10	Pattern "Max."
			

Model	Pattern "Min."	Pattern 11	Pattern 12
FCB411.5			
	Pattern 13	Pattern 14	Pattern "Max."
			



Section : 800S162-43 (33 ksi) @ 16" o.c. Single C Stud (punched)
Maxo = 1678.4 ft-lb **Va =** 1051.2 lb **I =** 4.50 in^4

Loads have not been modified for strength checks
Loads have been multiplied by 0.70 for deflection calculations

Bridging Connectors - Design Method =AISI S100

Span	Axial KyLy, KtLt	Flexual, Distortional	Connector	Stress Ratio
Top Cant.	None, None	None, 36.0"	N/A	-
Span	None, None	None, 24.0"	N/A	-

Web Crippling

Support	Load (lb)	Bearing (in)	Pa (lb)	M (ft-lbs)	Max Int.	Stiffener?
R2	-156.20	--Shear Connection w/ clip--				NO
R1	41.80	--Shear Connection w/ clip--				NO

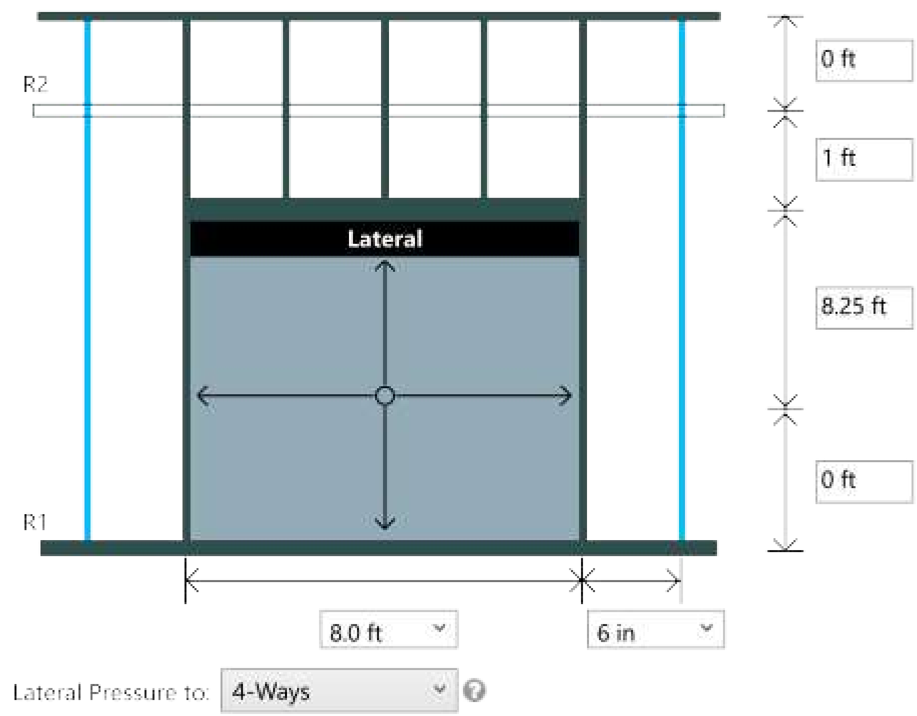
Gravity Load

Type	Load (lb)
Uniform	13.33plf (Top Cantilever), 13.33plf (Span)

	Code Check	Required	Allowed	Interaction	Notes
Top Cant.	Max. Axial, lbs	40.0(c)	3956.7(c)	1%	KΦ=0.00 lb-in/in Max KL/r = 66
	Max. Shear, lbs	79.2	1051.2	8%	Shear (Punched)
	Max. Moment (MaFy, Ma-dist), ft-lbs	118.8	1527.4	8%	Ma-dist (control),KΦ=0.00 lb-in/in
	Moment Stability, ft-lbs	75.8	1678.4	5%	
	Shear/Moment	0.10	1.00	10%	Shear 79.2, Moment 118.8
	Axial/Moment	0.09	1.00	9%	Axial 40.0(c), Moment 118.8
	Deflection Cant., in	0.004	--meets L/16215--		2 x Cantilever
Span	Max. Axial, lbs	66.7(c)	4171.2(c)	2%	KΦ=0.00 lb-in/in Max KL/r = 44
	Max. Shear, lbs	77.0	1051.2	7%	Shear (Punched)
	Max. Moment (MaFy, Ma-dist), ft-lbs	118.8	1527.4	8%	Ma-dist (control),KΦ=0.00 lb-in/in
	Moment Stability, ft-lbs	89.3	1678.4	5%	
	Shear/Moment	0.10	1.00	10%	Shear 77.0, Moment 118.8
	Axial/Moment	0.09	1.00	9%	Axial 40.0(c), Moment 118.8
	Deflection Span, in	0.000	--meets L/97776--		

Support	Rx(lb)	Ry(lb)	Simpson Strong-Tie Connector	Connector Interaction	Anchor Interaction
R2	-156.2	0.0	SCB47.5(2) & (2) 1/4" x 1-3/4" Titen turbo to 2500 psi concrete	25.61 %	47.33 %
R1	41.8	66.7	FCB47.5 Min(4#12-14) & (3) 1/4" x 1-3/4" Titen Turbo to 2500 concrete	24.98 %	30.95 %

* Reference catalog for connector and anchor requirement notes as well as screw placement requirements



Design Loads

Wind Selection :	**ASCE 7-16 Wind, Leeward (4)**
Trib. Area : Span :	**Length^2/3**
Wall Lateral Pressure :	**-10.9 psf**
Parapet Lateral Pressure :	
RO Lateral Pressure :	**4-Ways**
Lateral element force multiplier	
Strength :	**1.0**
Deflection :	**0.7**
Header:	**Box (lateral combined)**
Gravity Load at Header:	**22 psf**

Brace Settings

Component(s)	Members(s)	Flexural Bracing	Axial KyLy	Axial KtLt	Distortional K-Phi(lb-in/in)	Distortional Lm	Interconnection Spacing
Jamb Studs	400S137-43(33), Boxed	None	None	None	0	None	12 in
Vertical Header	600S137-43(33), Boxed	Full	N/A	N/A	0	None	N/A
Lateral Header	400T125-43(33), Boxed	Full	N/A	N/A	0	None	N/A

Analysis Results

Component(s)	Members(s)	Axial Load (lb)	Max KL/r	Max. Moment (ft-lb)	Max. Shear (lb)	Bottom Reaction (lb)	Top or End Reaction (lb)
Jamb Studs	400S137-43(33), Boxed	88.0	103	379.3	192.5	-214.3	-192.5
Vertical Header	600S137-43(33), Boxed	N/A	N/A	176.0	88.0	N/A	88.0
Lateral Header	400T125-43(33), Boxed	N/A	N/A	276.1	109.0	N/A	109.0

Design Results

		Deflection					
Component(s)	Members(s)	Span	Parapet	A + M Interaction	V + M Interaction	Web Stiffners	Design OK
Jamb Studs	400S137-43(33), Boxed	L/1254	L/0	0.338	0.32	No	Yes
Vertical Header	600S137-43(33), Boxed	L/5701	NA	0.08	0.08	No	Yes
Lateral Header	400T125-43(33), Boxed	L/1754	NA	0.30	0.30	No	Yes

Simpson Strong-Tie® Connectors @ Jambs

Support	Rx(lb)	Ry(lb)	Simpson Strong-Tie® Connector	Connector Interaction	Anchor Interaction
R2	-192.45	0.00	By Others & Anchorage Designed by Engineer	NA	NA
R1	-214.25	184.25	FC32-5/97(4#10) & (2) 1/4" x 1-7/8" Titen HD to 3000 concrete (uncracked A or B) (Base Clip)	20.41 %	37.92 %

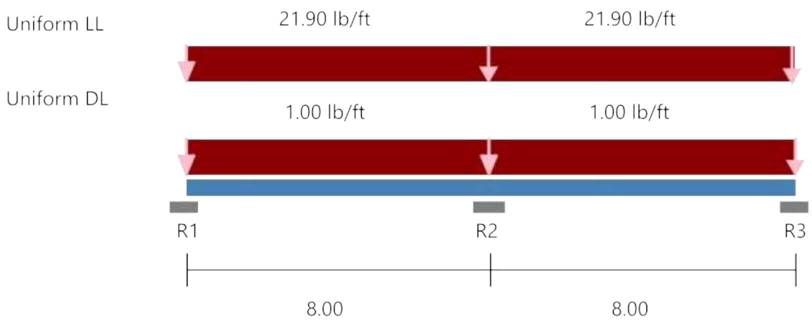
* Reference catalog for connector and anchor requirement notes as well as screw placements requirement

Simpson Strong-Tie® Wall Stud Bridging Connectors @ Jambs

Span/Parapet	Bracing Length(in.)	Design Number of Braces	Pn(lb.)	LSUBH (Min)[1]	LSUBH (Max)[1]	SUBH (Min)[1]	SUBH (Max)[1]	MSUBH (Min)[1]	MSUBH (Max)[1]
Span	Span	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Notes:

1) Values in parentheses are stress ratios.
2) Bridging connectors are not designed for back-back, box, or built-up sections.
3) Reference www.strongtie.com for latest load data, important information, and general notes.
4) CFS Designer will not select bridging connectors unless all flexural and axial bracing settings are the same.
5) If the bracing length is larger than the span length, bridging connectors are not designed.



Section :	(2) 600S137-43 (33 ksi) @ 12 in" o.c. Back-To-Back C Stud (punched)		
Maxo =	2122.8 ft-lb	**Va =** 2831.3 lb	**I =** 4.081 in^4

Deflection Limits: Total Load - 240 Live Load - 360

Load Comb:
1. DL + LL All spans
2. DL + LL Even spans
3. DL + LL Odd spans
4. LL All spans
5. LL Even spans
6. LL Odd spans

Joist Flexural and Deflection

	Mmax (ft-lb)	K-phi (lb-in/in)	Lm (in)	Ma-dist (ft-lb)	Mmax/ Ma min	Load Comb.	TL Defl	Load Comb.	LL Defl	Load Comb.
Left Span	183	0.0	96.0	1970.0	0.093	1	L/7938	3	L/8149	6
Right Span	183	0.0	96.0	1970.0	0.093	1	L/7938	2	L/8149	5

Joist Bending and Web Crippling

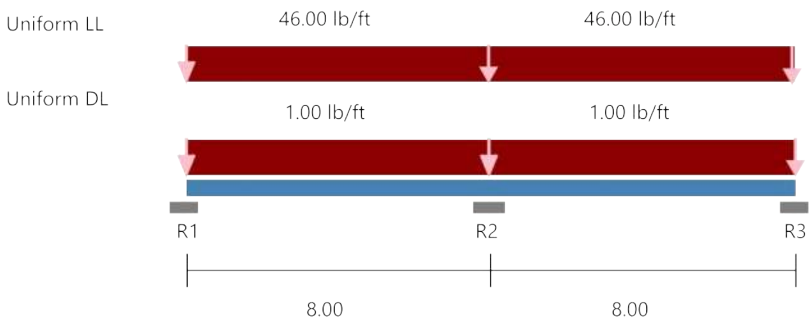
Support	Load (lb)	Load Comb.	Bearing (in)	Pa (lb)	Pn (lb)	Max Intr.	Load Comb.	Stiffeners Required
R1	79.7	3	1.00	1268.0	2535.9	0.03	3	NO
R2	229.0	1	1.00	1856.0	3248.0	0.12	1	NO
R3	79.7	2	1.00	1268.0	2535.9	0.03	2	NO

Joist Bending and Shear

Support	Vmax (lb)	Load Comb.	Va Factor	V/Va	M/Ma	Intr. Unstiffened	Load Comb.	Intr. Stiffened	Load Comb.
R1	79.7	3	1.000	0.03	0.00	0.03	3	N/A	N/A
R2	114.5	1	1.000	0.04	0.09	0.10	1	N/A	N/A
R3	79.6	2	1.000	0.03	0.00	0.03	2	N/A	N/A

Joist Reaction and Connections

Support	Rx(lb)	Ry(lb)	Simpson Strong-Tie Connector	Connector Interaction	Anchor Interaction
R1	0.0	79.7	SSC4.25 (4#10) & (3) #10 to A36 steel (Joist Bearing on Support)	0.91 %	0.85 %
R2	0.0	229.0	SSC4.25 (4#10) & (3) #10 to A36 steel (Joist Bearing on Support)	0.00 %	0.00 %
R3	0.0	79.7	SSC4.25 (4#10) & (3) #10 to A36 steel (Joist Bearing on Support)	0.91 %	0.85 %



Section :	(2) 400T125-43 (33 ksi) @ 12 in" o.c. Back-To-Back Track (unpunched)		
Maxo =	928.0 ft-lb	**Va =** 3478.2 lb	**I =** 1.332 in^4

Deflection Limits: Total Load - 240 Live Load - 360

Load Comb:
1. DL + LL All spans
2. DL + LL Even spans
3. DL + LL Odd spans
4. LL All spans
5. LL Even spans
6. LL Odd spans

Joist Flexural and Deflection

	Mmax (ft - lb)	Mmax/ Maxo	Load Case	Total Ld Defl	Load Case	LL Defl	Load Case
Left Span	376.0	0.405	1	L/1251	3	L/1266	6
Right Span	376.0	0.405	1	L/1251	2	L/1266	5

Joist Bending and Web Crippling

Support	Load (lb)	Load Comb.	Bearing (in)	Pa (lb)	Pn (lb)	Max Intr.	Load Comb.	Stiffeners Required
R1	164.0	3	1.00	1270.5	2541.0	0.06	3	NO
R2	470.0	1	1.00	1859.7	3254.5	0.37	1	NO
R3	164.0	2	1.00	1270.5	2541.0	0.06	2	NO

Joist Bending and Shear

Support	Vmax (lb)	Load Comb.	Va Factor	V/Va	M/Ma	Intr. Unstiffened	Load Comb.	Intr. Stiffened	Load Comb.
R1	164.0	3	1.000	0.05	0.00	0.05	3	N/A	N/A
R2	235.0	1	1.000	0.07	0.41	0.41	1	N/A	N/A
R3	164.0	2	1.000	0.05	0.00	0.05	2	N/A	N/A

Joist Reaction and Connections

Support	Rx(lb)	Ry(lb)	Simpson Strong-Tie Connector	Connector Interaction	Anchor Interaction
R1	0.0	164.0	SSC4.25 (4#10) & (3) #10 to A36 steel (Joist Bearing on Support)	2.30 %	2.14 %
R2	0.0	470.0	SSC4.25 (4#10) & (3) #10 to A36 steel (Joist Bearing on Support)	0.00 %	0.00 %
R3	0.0	164.0	SSC4.25 (4#10) & (3) #10 to A36 steel (Joist Bearing on Support)	2.30 %	2.14 %

RCA Rigid Connector Angles

JAMB & HEADER CONNECTOR TO METAL STUD

The Simpson Strong-Tie® rigid connector angle is a general purpose clip angle designed for a wide range of cold-formed steel construction applications. With prepunched holes for fastener attachment, these L-shaped clips save time and labor on the job.

Features:

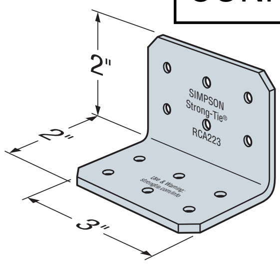
- Use with miscellaneous header/sill connections to jamb studs, jamb stud reinforcement at track, u-channel bridging, stud-blocking, bypass curtain-wall framing, joist connections and other versatile options
- Easy to install, with prepunched holes for quick and accurate fastener attachment

Material: RCAXXX/54 — 54 mil (16 ga.), 50 ksi
RCAXXX/68 — 68 mil (14 ga.), 50 ksi
RCAXXX/97 — 97 mil (12 ga.), 50 ksi
(**Note:** "XXX" is model number shown below.)

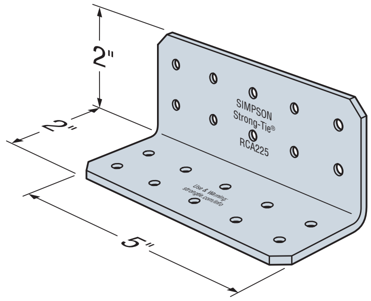
Finish: Galvanized (G90)

Installation:

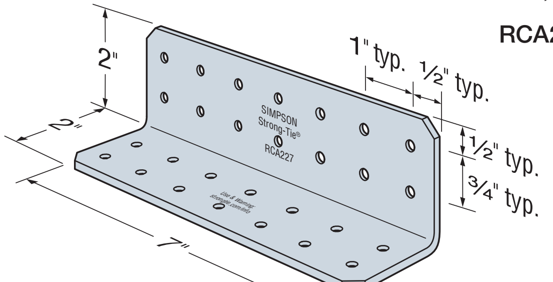
- Use all specified anchors/fasteners



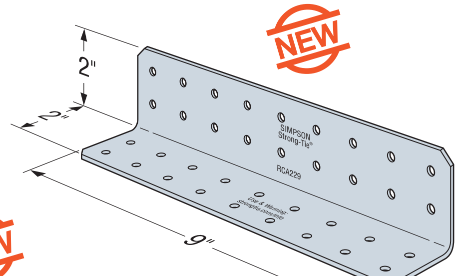
RCA223



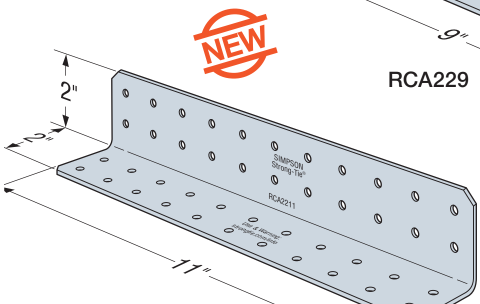
RCA225



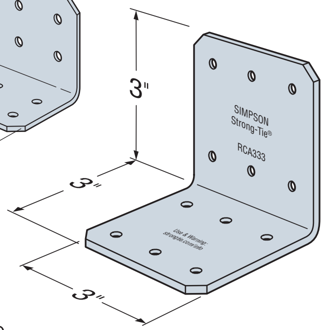
RCA227



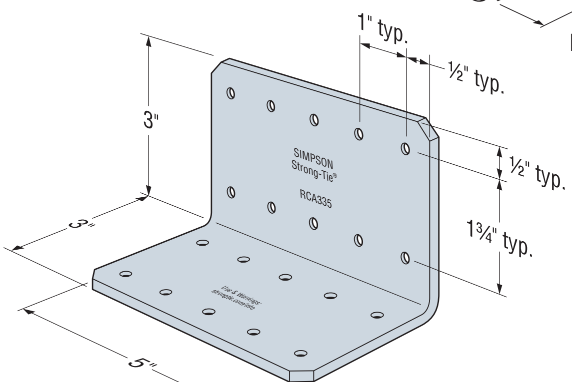
RCA229



RCA2211



RCA333



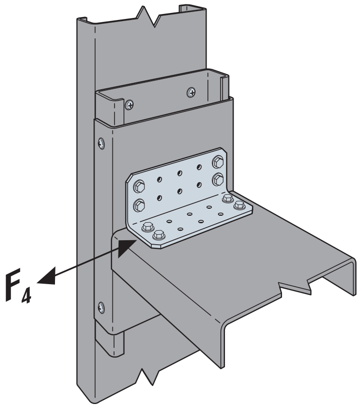
RCA335

Ordering Information

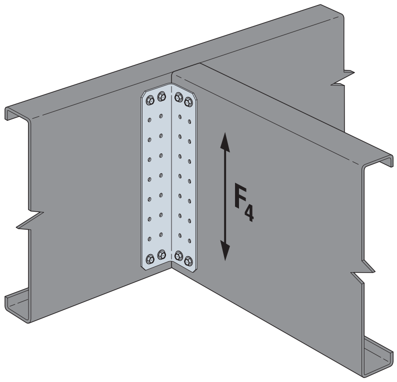
Model No.	Ordering SKU	Bucket Quantity
RCA223/54	RCA223/54-R150	150
RCA223/68	RCA223/68-R125	125
RCA223/97	RCA223/97-R90	90
RCA225/54	RCA225/54-R90	90
RCA225/68	RCA225/68-R75	75
RCA225/97	RCA225/97-R55	55
RCA227/54	RCA227/54-R65	65
RCA227/68	RCA227/68-R55	55
RCA227/97	RCA227/97-R40	40
RCA229/54	RCA229/54-R50	50
RCA229/68	RCA229/68-R50	50
RCA229/97	RCA229/97-R35	35
RCA2211/54	RCA2211/54-R45	45
RCA2211/68	RCA2211/68-R40	40
RCA2211/97	RCA2211/97-R30	30
RCA333/54	RCA333/54-R100	100
RCA333/68	RCA333/68-R85	85
RCA333/97	RCA333/97-R60	60
RCA335/54	RCA335/54-R60	60
RCA335/68	RCA335/68-R50	50
RCA335/97	RCA335/97-R35	35

RCA Rigid Connector Angles

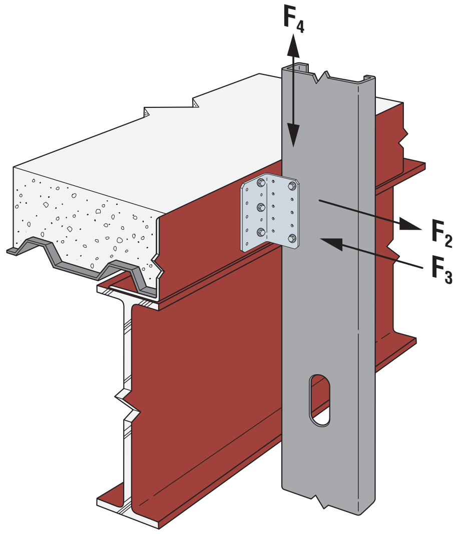
SIMPSON Strong-Tie



Typical RCA225 Installation at Sill/Jamb

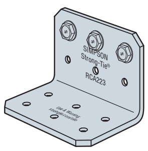
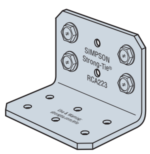
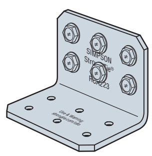
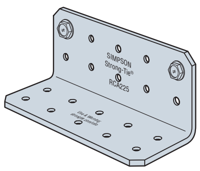
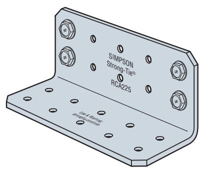
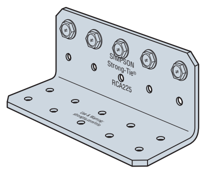
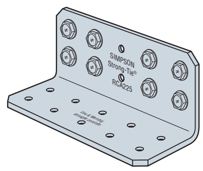
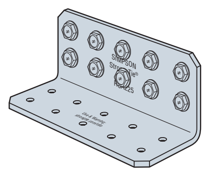


Typical RCA229 Installation at Joist Connection



Typical RCA335 Installation at Bypass Framing

Screw Patterns for Rigid Connector Angles

Models	Pattern 3A	Pattern 3B	Pattern 3C		
RCA223/54 RCA223/68 RCA223/97 RCA333/54 RCA333/68 RCA333/97					
Models	**Pattern 5A**	**Pattern 5B**	**Pattern 5C**	**Pattern 5D**	**Pattern 5E**
RCA225/54 RCA225/68 RCA225/97 RCA335/54 RCA335/68 RCA335/97					
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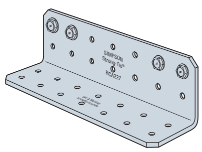
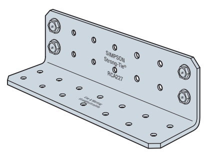
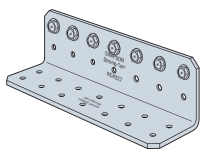
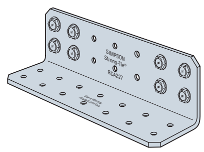
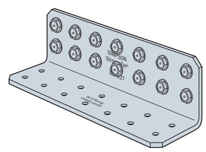
RCA227/54 RCA227/68 RCA227/97					
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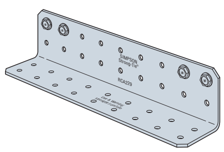
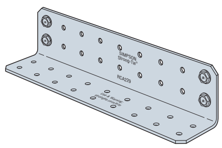
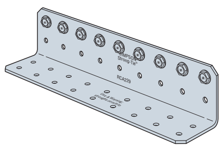
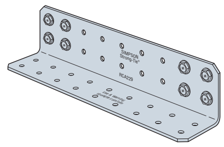
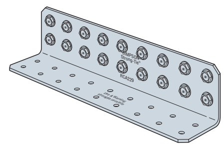
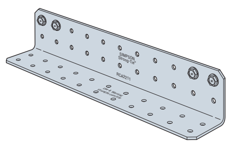
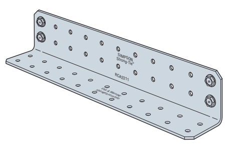
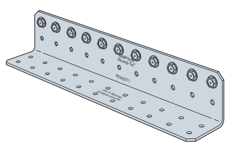
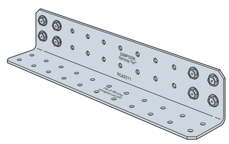
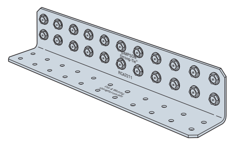
RCA229/54 RCA229/68 RCA229/97					
Models	**Pattern 11A**	**Pattern 11B**	**Pattern 11C**	**Pattern 11D**	**Pattern 11E**
RCA2211/54 RCA2211/68 RCA2211/97					

RCA Rigid Connector Angles

SIMPSON Strong-Tie

RCA Rigid Connector Angles Allowable Loads (lb.)

Model	No. of #10 Screws[5,6]	Screw Pattern	Stud Framing Thickness[11]								
			33 mil (20 ga.)			43 mil (18 ga.)			54 mil (16 ga.)		
			F_2	F_3	F_4	F_2	F_3	F_4	F_2	F_3	F_4
RCA223/54	3	3A	205	495	200	205	590	310	205	590	620
	4	3B	205	580	390	205	580	605	205	580	1,095
	6	3C	205	865	480	205	865	740	205	865	1,095
RCA223/68	3	3A	310	495	200	310	765	310	310	815	620
	4	3B	310	660	390	310	805	605	310	805	1,210
	6	3C	310	990	480	310	1,205	740	310	1,205	1,350
RCA223/97	3	3A	495	495	200	630	765	310	630	1,415	620
	4	3B	630	660	390	630	1,020	605	630	1,265	1,210
	6	3C	630	990	480	630	1,530	740	630	1,895	1,485
RCA225/54	2	5A	330	330	265	340	390	410	340	390	815
	4	5B	340	580	535	340	580	830	340	580	1,660
	5	5C	340	825	460	340	980	705	340	980	1,310
	8	5D	340	1,155	915	340	1,155	1,420	340	1,155	1,825
	10	5E	340	1,445	1,035	340	1,445	1,600	340	1,445	1,825
RCA225/68	2	5A	330	330	265	510	510	410	520	545	815
	4	5B	520	660	535	520	805	830	520	805	1,660
	5	5C	520	825	460	520	1,275	705	520	1,360	1,415
	8	5D	520	1,320	915	520	1,605	1,420	520	1,605	2,255
	10	5E	520	1,650	1,035	520	2,010	1,600	520	2,010	2,255
RCA225/97	2	5A	330	330	265	510	510	410	1,020	945	815
	4	5B	660	660	535	1,020	1,020	830	1,050	1,265	1,660
	5	5C	825	825	460	1,050	1,275	705	1,050	2,360	1,415
	8	5D	1,050	1,320	915	1,050	2,040	1,420	1,050	2,525	2,835
	10	5E	1,050	1,650	1,035	1,050	2,550	1,600	1,050	3,155	3,200
RCA227/54	4	7A	475	660	545	475	785	840	475	785	1,675
	4	7B	475	580	595	475	580	920	475	580	1,840
	7	7C	475	1,155	765	475	1,280	1,185	475	1,280	1,685
	8	7D	475	1,155	1,120	475	1,155	1,730	475	1,155	2,555
	14	7E	475	2,025	1,685	475	2,025	2,555	475	2,025	2,555
RCA227/68	4	7A	660	660	545	725	1,020	840	725	1,090	1,675
	4	7B	660	660	595	725	805	920	725	805	1,840
	7	7C	725	1,155	765	725	1,780	1,185	725	1,780	2,370
	8	7D	725	1,320	1,120	725	1,605	1,730	725	1,605	3,155
	14	7E	725	2,310	1,685	725	2,810	2,605	725	2,810	3,155
RCA227/97	4	7A	660	660	545	1,020	1,020	840	1,470	1,890	1,675
	4	7B	660	660	595	1,020	1,020	920	1,470	1,265	1,840
	7	7C	1,155	1,155	765	1,470	1,785	1,185	1,470	3,080	2,370
	8	7D	1,320	1,320	1,120	1,470	2,040	1,730	1,470	2,525	3,460
	14	7E	1,470	2,310	1,685	1,470	3,570	2,605	1,470	4,420	4,490
RCA229/54	4	9A	615	660	595	615	1,020	920	615	1,100	1,840
	4	9B	615	660	620	615	815	960	615	815	1,920
	9	9C	615	1,485	1,105	615	2,295	1,705	615	2,475	3,410
	8	9D	615	1,320	1,210	615	1,630	1,865	615	1,630	3,735
	18	9E	615	2,970	2,375	615	3,665	3,670	615	3,665	4,715
RCA229/68	4	9A	660	660	595	935	1,020	920	935	1,525	1,840
	4	9B	660	660	620	935	1,020	960	935	1,130	1,920
	9	9C	935	1,485	1,105	935	2,295	1,705	935	3,435	3,410
	8	9D	935	1,320	1,210	935	2,040	1,865	935	2,260	3,735
	18	9E	935	2,970	2,375	935	4,590	3,670	935	5,090	5,750
RCA229/97	4	9A	660	660	595	1,020	1,020	920	1,890	2,040	1,840
	4	9B	660	660	620	1,020	1,020	960	1,890	1,610	1,920
	9	9C	1,485	1,485	1,105	1,890	2,295	1,705	1,890	4,590	3,410
	8	9D	1,320	1,320	1,210	1,890	2,040	1,865	1,890	3,220	3,735
	18	9E	1,890	2,970	2,375	1,890	4,590	3,670	1,890	7,240	7,340

See footnotes on p. 106.

RCA-C Rigid Connector Angle for Concrete

JAMB & HEADER CONNECTOR TO CONCRETE

Our lineup of rigid connector angles (RCA) has a new addition with the RCA-C. The RCA-C is an ideal solution for attaching stud framing to concrete supports. This connector provides the most anchor options for attaching to concrete in comparison to other similar connectors on the market. The connector's design includes holes for a ½"-diameter anchor, or two ¼"-diameter concrete screws, accompanied by a wide array of fastening options — thus saving the installer the time and cost of drilling connector holes at the jobsite. In addition, the RCA connectors have been rigorously tested and load rated, giving you the confidence of quality and performance for your job.

Features:

- 2" x 2" legs provide plenty of room to make attachments to structure and stud framing.
- Multiple screw pattern options to stud framing for different load ratings.
- Can be used as either a heavy-duty shear and tension connector or light-duty moment connection.
- Prepunched holes for screws to stud framing and attachment to concrete. Prepunched holes on anchor leg provide options for (1) ½"-diameter anchor, (2) ¼"-diameter anchors, or (2) ¼"-diameter concrete screws.
- Attachment to concrete or masonry can be achieved with ½"-diameter Titen HD®, ½"-diameter Strong-Bolt® 2, ¼"-diameter Titen HD, or ¼"-diameter Titen Turbo™.

Material: RCA-C — 97 mil (12 ga.), 50 ksi

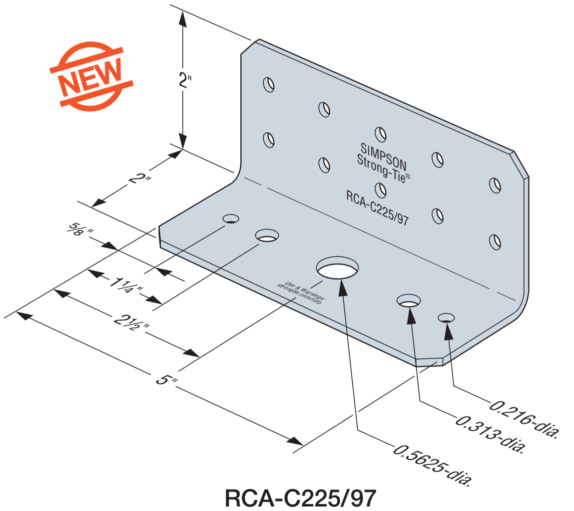
Finish: Galvanized (G90)

Installation:

- Use all specified anchors/fasteners.

Codes: Tested per ICC-ES AC261 and calculations per AISI RP18-4, AISI S100 or generally accepted industry standards. Visit **strongtie.com** for the latest load values and testing information.

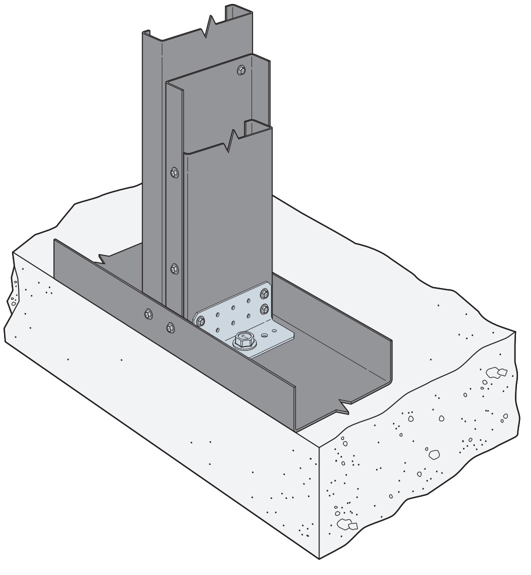
Ordering Information: RCA-C225/97-R55
(55 connectors per bucket)



RCA-C225/97

Simpson Strong-Tie® Anchors for RCA-C Attachment to Concrete or Masonry

Anchor Type	Anchor Diameter
Titen HD Heavy-Duty Screw Anchor	½" or ¼"
Strong-Bolt 2 Wedge Anchor	½"
Titen Turbo Concrete and Masonry Screw Anchor	¼"



RCA-C Installation at Post

RCA-C Rigid Connector Angle for Concrete

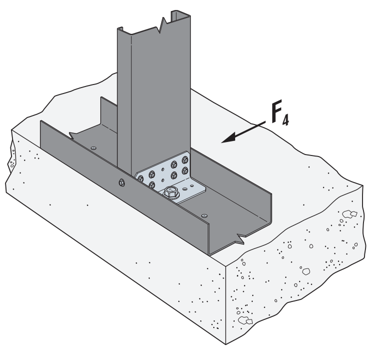


Figure A
F_4 Loading
(one anchor shown)

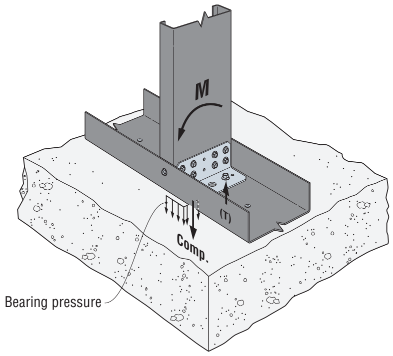


Figure B
Anchor Tension, T, Created from Moment
(two anchors shown)

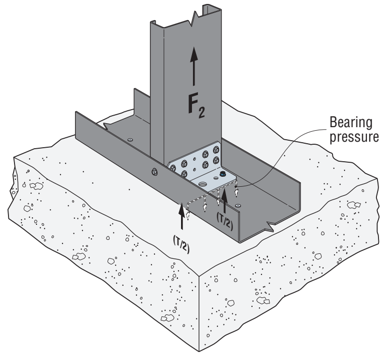


Figure C
Anchor Tension, T, Created from F_2
(two anchors shown)

Table 1: RCA-C Allowable Connector Loads (lb.)

Model No.	Anchor Type	Fastener Pattern	No. of #10 Fasteners to Stud	Framing Member Thickness mil (ga.)	Connector Rotational Stiffness β (in.-kip/rad.)	Allowable Load			Anchor Tension, T	
						Moment M (in.-lb.)	Tension F_2 (lb.)	Shear F_4 (lb.)	At Allowable Moment, M (lb.) f'c = 4,000 psi	At Allowable Tension Load, F_2 (lb.) f'c = 4,000 psi
RCA-C225/97	(1) ½"-diameter Titen HD® or (1) ½"-diameter Strong-Bolt® 2	4A	4	33 (20)	130	845	660	425	345	705
				43 (18)	160	1,500	1,020	550	615	1,105
				54 (16)	165	1,900	1,050	1,050	785	1,140
		8A	8	33 (20)	155	1,830	1,050	845	755	1,140
				43 (18)	160	3,215	1,050	1,105	1,355	1,140
				54 (16)	175	4,075	1,050	2,100	1,745	1,140
		10A	10	33 (20)	155	3,430	1,050	845	1,455	1,140
				43 (18)	160	4,905	1,050	1,105	2,140	1,140
				54 (16)	175	7,640	1,050	2,100	3,540	1,140
	(2) ¼"-diameter Titen HD	4B	4	33 (20)	155	1,100	660	480	295	705
				43 (18)	200	1,770	1,020	625	480	1,105
				54 (16)	220	2,005	1,050	1,185	545	1,140
		8B	8	33 (20)	170	2,375	1,050	960	645	1,140
				43 (18)	220	3,795	1,050	1,250	1,040	1,140
				54 (16)	240	4,300	1,050	2,375	1,180	1,140
		10B	10	33 (20)	170	4,450	1,050	960	1,225	1,140
				43 (18)	220	5,790	1,050	1,250	1,610	1,140
				54 (16)	240	8,060	1,050	2,375	2,285	1,140
	(2) ¼"-diameter Titen Turbo™	4C	4	33 (20)	190	1,100	660	480	250	705
				43 (18)	250	1,770	1,020	625	405	1,105
				54 (16)	310	2,005	1,050	1,185	460	1,140
		8C	8	33 (20)	200	2,375	1,050	960	545	1,140
				43 (18)	260	3,795	1,050	1,250	880	1,140
				54 (16)	320	4,300	1,050	2,375	995	1,140
		10C	10	33 (20)	200	4,450	1,050	960	1,035	1,140
				43 (18)	260	5,790	1,050	1,250	1,355	1,140
				54 (16)	320	8,060	1,050	2,375	1,910	1,140

1. For additional important information, see General Information and Notes on p. 26.
2. The designer is responsible for anchorage design. Reference Table 2 on p. 114 for anchorage solutions.
3. See illustrations for fastener pattern placement.
4. Tabulated values are based on framing members with track and stud of the same thickness and (1) #10 screw into each stud flange unless otherwise noted.
5. Tabulated moment values correspond to maximum connector strength without consideration of serviceability. The designer must check out-of-plane deflections using tabulated rotational stiffness.
6. Tabulated connector rotational stiffness may be used for any wall heights. The designer must consider member deflection due to bending in the stud member.
7. Per IBC 2021, 2018, 2015, 2012 Table 1604.3 footnote f, wind load is permitted to be taken as 0.42 times "component and cladding loads" for deflection checks. For IBC 2009 and earlier, the factor is 0.7 instead of 0.42. Tabulated values have not been adjusted.
8. Allowable loads are based on cold-formed steel members with a minimum F_y of 33 ksi and F_u of 45 ksi for 43 mil (18 ga.) and thinner and a minimum F_y of 50 ksi and F_u of 65 ksi for 54 mil (16 ga.) and thicker.
9. Connectors subjected to tension, shear and moment loads: $F_2/F_{2all} + F_4/F_{4all} + M/M_{all} \leq 1.0$. F_4 interaction with Moment not required to be checked for walls 2'-0" or taller. Where: F_2, F_4 and M are the applied ASD tension, shear and moment, respectively. F_{2all}, F_{4all}, M_{all} are the allowable tension, shear and moment from Table 1, respectively.
10. Anchor tension, T, is the force in the anchor, or both anchors for two-anchor solutions, at maximum allowable, M, or maximum allowable tension, F_2. See Table 2 on p. 114 for pre-engineered anchorage solutions that incorporate anchor T into the solution.
11. Anchor tension is calculated using AISC Steel Design Guide 1. The Anchor Bolt Design illustration (Figure B) shows the anchor tension, T, based on an applied moment, M. An illustration for the anchor tension, T, based on a vertical tension load, F_2, shown in Figure C.
12. Anchor tension, T, may be interpolated. Examples:
    - M_{req} = 3,312 in.-lb. (given), fastener pattern 10C, 54 mil studs. Anchor tension, T, at allowable moment = (3,312/8,060) x 1,910 = 785 lb.
    - T_{req} = 525 lb. (given), fastener pattern 4A, 33 mil studs. Anchor tension, T, at allowable tension load, F_2 = (525/660) x 755 = 601 lb.
13. Tabulated anchor tension, T, is based on f'c = 4,000 psi. For f'c = 3,000 psi, use an increase factor of 1.05.

RCA-C Rigid Connector Angle for Concrete

SIMPSON Strong-Tie

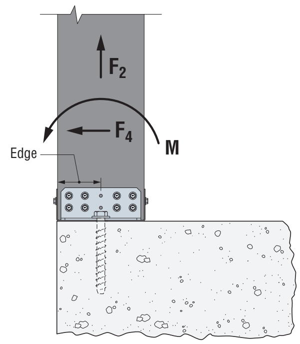


Figure A
One Anchor

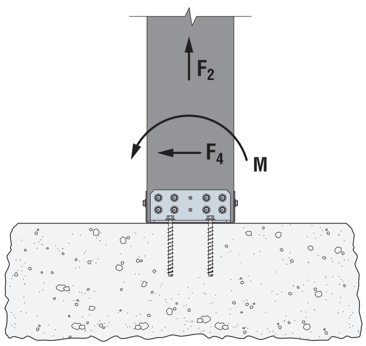


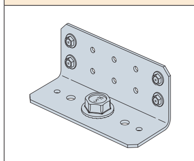
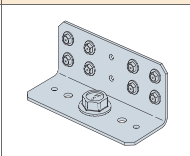
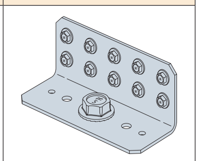
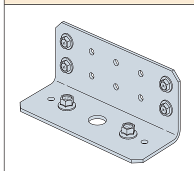
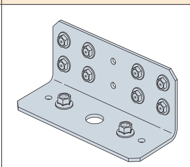
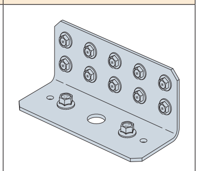
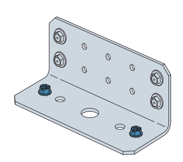
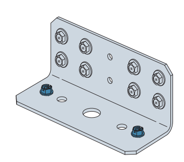
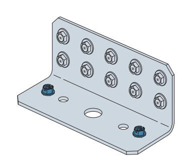
Figure B
Two Anchors

Table 2: RCA-C Allowable Anchorage Loads (lb.)

Model No.	Type of Concrete	Anchor Type	Nominal Embedment Depth, h_{nom} (in.)	Min. Concrete Thickness, $h_{min.}$ (in.)	Min. Anchor Edge Distance (in.)	Uncracked 4,000 psi Concrete			Cracked 4,000 psi Concrete					
						Wind and Seismic in SDC A and B			Wind and Seismic in SDC A and B			Seismic in SDC C and D		
						Allowable			Allowable			Allowable		
						Moment M (in.-lb.)	Tension F_2 (lb.)	Shear F_4 (lb.)	Moment M (in.-lb.)	Tension F_2 (lb.)	Shear F_4 (lb.)	Moment M (in.-lb.)	Tension F_2 (lb.)	Shear F_4 (lb.)
RCA-C225/97	SLWC	(1) ½"-diameter Titen HD®	3¼	5	3	3,015	1,165	885	2,190	845	635	785	305	295
					12	3,425	1,320	1,560	2,465	950	1,105	885	340	515
		(1) ½"-diameter Strong-Bolt® 2	2¾	6	4	2,185	845	975	2,315	895	965	830	320	450
					12	2,890	1,115	1,465	2,315	895	1,035	830	320	485
		(2) ¼"-diameter Titen HD	1⅝	3¼	1½	1,265	565	445	1,205	540	315	425	190	150
					6	2,410	1,025	1,070	1,375	595	680	485	210	315
		(2) ¼"-diameter Titen Turbo™	1¾	3¼	1¾	1,360	590	495	—	—	—	—	—	—
					3	1,955	835	520				—	—	—
	NWC	(1) ½"-diameter Titen HD	3¼	5	3	4,330	1,670	1,305	3,165	1,225	930	1,150	445	435
					12	4,895	1,890	2,295	3,555	1,375	1,625	1,295	500	760
		(1) ½"-diameter Strong-Bolt 2	2¾	6	4	3,160	1,220	1,435	3,345	1,290	1,420	1,215	470	665
					12	4,150	1,605	2,150	3,345	1,290	1,525	1,215	470	710
		(2) ¼"-diameter Titen HD	1⅝	3¼	1½	1,855	825	655	1,765	785	465	625	280	220
					6	3,515	1,475	1,455	2,010	860	995	710	310	465
		(2) ¼"-diameter Titen Turbo	1¾	3¼	1¾	1,990	855	520	—	—	—	—	—	—
					3	2,860	1,205	520	—	—	—	—	—	—

1. Anchor allowable loads have been determined using ACI 314-14 Chapter 17 anchorage calculations with the minimum concrete compressive strength, f'_c, and slab thickness listed. Sand-Lightweight Concrete is abbreviated as SLWC, Normal Weight Concrete is abbreviated as NWC.
2. Load values are for anchor based on ACI 318-14, condition B, load factors from ACI 318 Section 5.3, no supplemental edge reinforcement, $\Psi_{c,V} = 1.0$ for cracked concrete and periodic special inspection. Reference ICC-ES or IAPMO-UES evaluation reports for further information.
3. Allowable Stress Design (ASD) values were determined by multiplying calculated strength design values by a conversion factor, Alpha (α), of 0.7 for seismic loads and 0.6 for wind loads. ASD values for other load combinations may be determined using alternate conversion factors.
4. End distances are assumed as N/A perpendicular to load.
5. Tabulated allowable ASD loads for Wind and Seismic in SDC A and B are based on using wind conversion factors and may be increased by 1.17 for seismic SDC A and B only.
6. Allowable loads have been divided by an Omega (Ω) seismic factor of 2.5 for brittle failure as required by ACI 318-14 Chapter 17.
7. Tabulated capacities are based on maximum allowable anchorage loads only. The capacity of the connection system shall be the minimum of the tabulated value and the RCA-C allowable load value listed on Table 1 on p. 113.
8. Tabulated loads in Table 2 are based on $f'_c = 4{,}000$ psi. For $f'_c = 3{,}000$ psi, use an adjustment factor of 0.86.
9. For anchor subjected to tension, shear and moment loads:
   When $(F_4/F_{4all}) \le 0.2$ — $F_2/F_{2all} + M/M_{all} \le 1.0$
   When $(F_2/F_{2all} + M/M_{all}) \le 0.2$ — $F_4/F_{4all} \le 1.0$
   When $(F_4/F_{4all}) > 0.2$ and $(F_2/F_{2all} + M/M_{all}) > 0.2$ — $(F_2/F_{2all} + M/M_{all}) + (F_4/F_{4all}) \le 1.2$
   Where: F_2, F_4 and M are the applied ASD tension, shear and moment, respectively.
   F_{2all}, F_{4all}, M_{all} are the allowable tension, shear and moment from Table 2, respectively.

RCA-C Fastener Patterns

(1) ½"-Diameter Titen HD/Strong-Bolt 2		
Pattern 4A	Pattern 8A	Pattern 10A
		
(2) ¼"-Diameter Titen HD		
Pattern 4B	Pattern 8B	Pattern 10B
		
(2) ¼"-Diameter Titen Turbo		
Pattern 4C	Pattern 8C	Pattern 10C
		

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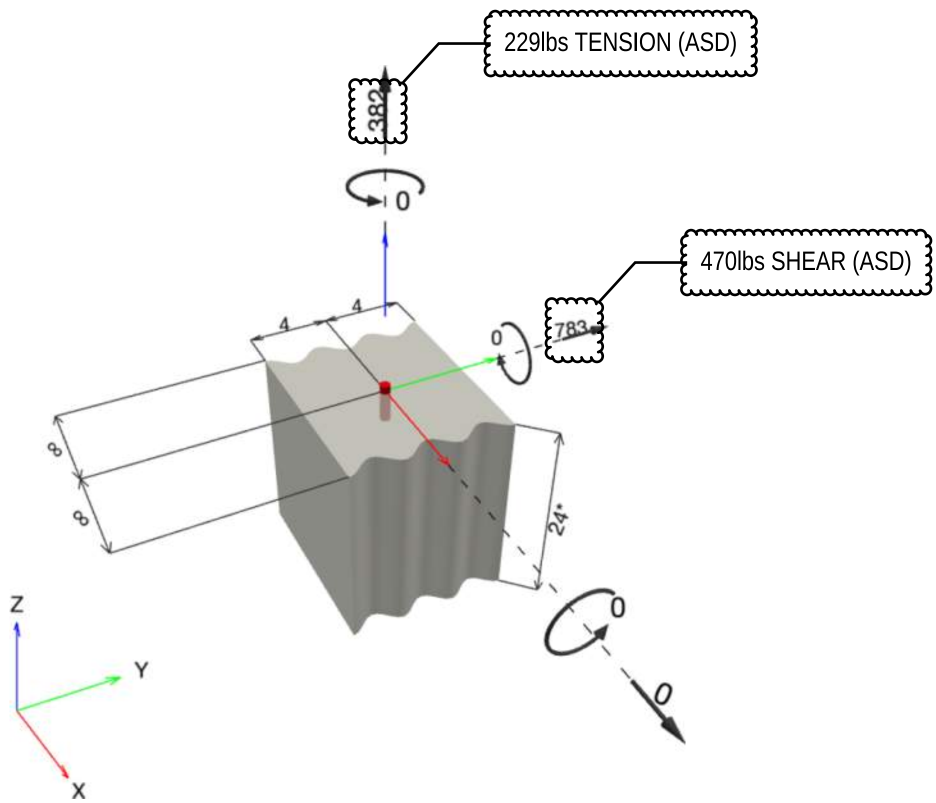
Phone I Fax:	2063970000 |	E-Mail:	
Design:	Concrete - Jun 14, 2024	Date:	6/14/2024
Fastening point:			

Specifier's comments:

1 Input data

Anchor type and diameter:	**KWIK HUS-EZ (KH-EZ) 1/2 (2 1/4)**
Item number:	418070 KH-EZ 1/2"x2 1/2"
Effective embedment depth:	$h_{ef,act}$ = 1.520 in., h_{nom} = 2.250 in.
Material:	Carbon Steel
Evaluation Service Report:	ESR-3027
Issued I Valid:	4/1/2022 | 12/1/2023
Proof:	Design Method ACI 318-19 / Mech
Stand-off installation:	
Profile:	
Base material:	cracked concrete, 4000, f_c' = 4,000 psi; h = 24.000 in.
Installation:	**automatic cleaned drilled hole, Installation condition: Dry**
Reinforcement:	tension: not present, shear: not present; no supplemental splitting reinforcement present
	edge reinforcement: none or < No. 4 bar

Geometry [in.] & Loading [lb, in.lb]



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1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 382; V_x = 0; V_y = 783; M_x = 0; M_y = 0; M_z = 0;	no	56

2 Load case/Resulting anchor forces

Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	382	783	0	783

3 Tension load

	Load N_{ua} [lb]	**Capacity ϕ N_n [lb]**	**Utilization $\beta_N = N_{ua}/\phi\ N_n$**	**Status**
Steel Strength*	382	11,778	4	OK
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	382	1,310	30	OK

* highest loaded anchor **anchor group (anchors in tension)

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3.1 Steel Strength

N_{sa} = ESR value — refer to ICC-ES ESR-3027

$\phi\ N_{sa} \geq N_{ua}$ — ACI 318-19 Table 17.5.2

Variables

$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
0.16	112,540

Calculations

N_{sa} [lb]
18,120

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
18,120	0.650	11,778	382

3.2 Concrete Breakout Failure

$N_{cb} = \left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b$ — ACI 318-19 Eq. (17.6.2.1a)

$\phi\ N_{cb} \geq N_{ua}$ — ACI 318-19 Table 17.5.2

A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ — ACI 318-19 Eq. (17.6.2.1.4)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.4.1b)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.6.1b)

$N_b = k_c\ \lambda_a\ \sqrt{f'_c}\ h_{ef}^{1.5}$ — ACI 318-19 Eq. (17.6.2.2.1)

Variables

h_{ef} [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f'_c [psi]
1.520	4.000	1.000	2.750	17	1.000	4,000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
20.79	20.79	1.000	1.000	2,015

Results

N_{cb} [lb]	$\phi_{concrete}$	$\phi\ N_{cb}$ [lb]	N_{ua} [lb]
2,015	0.650	1,310	382

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4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi$ V_n	Status
Steel Strength*	783	5,547	15	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	783	1,410	56	OK
Concrete edge failure in direction y+**	783	2,190	36	OK

* highest loaded anchor **anchor group (relevant anchors)

4.1 Steel Strength

V_{sa} = ESR value refer to ICC-ES ESR-3027
$\phi\ V_{steel} \geq V_{ua}$ ACI 318-19 Table 17.5.2

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
0.16	112,540

Calculations

V_{sa} [lb]
9,245

Results

V_{sa} [lb]	ϕ_{steel}	ϕ V_{sa} [lb]	V_{ua} [lb]
9,245	0.600	5,547	783

4.2 Pryout Strength

$V_{cp} = k_{cp} \left[\left(\frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ed,N} \; \psi_{c,N} \; \psi_{cp,N} \; N_b \right]$ ACI 318-19 Eq. (17.7.3.1a)

$\phi \; V_{cp} \geq V_{ua}$ ACI 318-19 Table 17.5.2

A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)

$A_{Nc0} = 9 \, h_{ef}^2$ ACI 318-19 Eq. (17.6.2.1.4)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.4.1b)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.6.1b)

$N_b = k_c \; \lambda_a \; \sqrt{f'_c} \; h_{ef}^{1.5}$ ACI 318-19 Eq. (17.6.2.2.1)

Variables

k_{cp}	h_{ef} [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
1	1.520	4.000	1.000

c_{ac} [in.]	k_c	λ_a	f'_c [psi]
2.750	17	1.000	4,000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
20.79	20.79	1.000	1.000	2,015

Results

V_{cp} [lb]	$\phi_{concrete}$	$\phi \; V_{cp}$ [lb]	V_{ua} [lb]
2,015	0.700	1,410	783

4.3 Concrete edge failure in direction y+

$V_{cb} = \left(\frac{A_{Vc}}{A_{Vc0}}\right) \psi_{ed,V}\ \psi_{c,V}\ \psi_{h,V}\ \psi_{parallel,V}\ V_b$ ACI 318-19 Eq. (17.7.2.1a)

$\phi\ V_{cb} \geq V_{ua}$ ACI 318-19 Table 17.5.2

A_{Vc} see ACI 318-19, Section 17.7.2.1, Fig. R 17.7.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-19 Eq. (17.7.2.1.3)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-19 Eq. (17.7.2.4.1b)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-19 Eq. (17.7.2.6.1)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda_a \sqrt{f'_c}\ c_{a1}^{1.5}$ ACI 318-19 Eq. (17.7.2.2.1a)

Variables

c_{a1} [in.]	c_{a2} [in.]	$\psi_{c,V}$	h_a [in.]	l_e [in.]
4.000	-	1.000	24.000	1.520

λ_a	d_a [in.]	f'_c [psi]	$\psi_{parallel,V}$
1.000	0.500	4,000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
72.00	72.00	1.000	1.000	3,128

Results

V_{cb} [lb]	$\phi_{concrete}$	$\phi\ V_{cb}$ [lb]	V_{ua} [lb]
3,128	0.700	2,190	783

5 Combined tension and shear loads, per ACI 318-19 section 17.8

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.292	0.555	5/3	51	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

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6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2021, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Refer to the manufacturer's product literature for cleaning and installation instructions.
- For additional information about ACI 318 strength design provisions, please go to https://submittals.us.hilti.com/PROFISAnchorDesignGuide/
- Hilti post-installed anchors shall be installed in accordance with the Hilti Manufacturer's Printed Installation Instructions (MPII). Reference ACI 318-19, Section 26.7.

Fastening meets the design criteria!

7 Installation data

Anchor type and diameter: KWIK HUS-EZ (KH-EZ) 1/2 (2 1/4)

Profile: -

Item number: 418070 KH-EZ 1/2"x2 1/2"

Hole diameter in the fixture: -

Maximum installation torque: 540 in.lb

Plate thickness (input): -

Hole diameter in the base material: 0.500 in.

Hole depth in the base material: 2.625 in.

Drilling method: SafeSet - automatic cleaning

Minimum thickness of the base material: 4.500 in.

Cleaning: Automatically performed while drilling

Hilti KH-EZ screw anchor with 2.25 in embedment, 1/2 (2 1/4), Carbon steel, installation per ESR-3027

7.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Vacuum cleaner	• No accessory required	• Torque wrench

Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	0.000	0.000	-	-	4.000	4.000

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8 Remarks; Your Cooperation Duties

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