Shelving Calculations

for

Advanced Auto Parts #8663

3426 Preston Hwy

Louisville, KY 40213



NOTE:
THESE CALCS ARE TO SUPPLEMENT THE SHELVING INSTALLATION MANUALS THAT ARE ISSUED FOR EACH PROJECT. ALL SHELVING COMPONENTS SHALL BE INSTALLED ACCORDING TO THE MANUFACTURER'S RECOMMENDATIONS. NOTIFY ENGINEER WITH ANY DISCREPANCIES.

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

Table of Contents

Design Information.....3 – 5

Frame A.....6 – 23

Frame A1.....24 – 40

Frame B.....41 – 59

Frame C.....60 – 78

Frame E.....79 – 104

Frame E1.....105 – 130

Frame E4.....131 – 148

Anchor Plate Design.....149 – 152

Slab Punch Shear.....153 – 155

Appendix A.....A1 – A58

Appendix B.....B1 – B14

Appendix C (Anchor Bolt Design & ICC ESR Report).....C1 – C106

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

Building Code: 2018 Kentucky Building Code

based on 2015 IBC

ASCE 7-10 & RMI (as it applies)

Location: Louisville, KY

Allowable Shelving Loads

Frame A: **17"B x 48" L x 96"H Wall Shelving (4 Shelves)**

Shelving Loads	DL =	3	spf/ shelf
	PL =	20	spf/ shelf

Frame A1: **13"B x 24" L x 132"H End Wall Shelving (6 Shelves)**

Shelving Loads	DL =	3	spf/ shelf
	PL =	20	spf/ shelf

Frame B: **30" W x 50" L x 96" H Battery Rack (5 Shelves)**

Shelving Loads	DL =	5	spf/ shelf
	PL =	500	lb/ shelf

Frame C: **30" W x 50" L x 96" H Oil Rack (5 Shelves)**

Shelving Loads	DL =	5	spf/ shelf
	PL =	680	lb/ shelf

Frame E: **12/12" W x 48" L x 144" H S-series Shelving (14 Shelves)**

Shelving Loads	DL =	3	spf/ shelf
	PL =	10	spf/ shelf

Frame E1: **18/18" W x 48" L x 144" H S-series Shelving (17 Shelves)**

Shelving Loads	DL =	3	spf/ shelf
	PL =	12.5	spf/ shelf

Frame E4: **20" W x 96" L x 120" H Wide Span Rack (2 Shelves)**

Shelving Loads	DL =	3	spf/ shelf
	PL =	500	lb/ shelf

Shelving Framing Types

Frames A,A1:

Frame is Cantilevered Column System in Transverse Direction
and Moment Frame System in Longitudinal Direction.

Frame B,C,E,E1,E4:

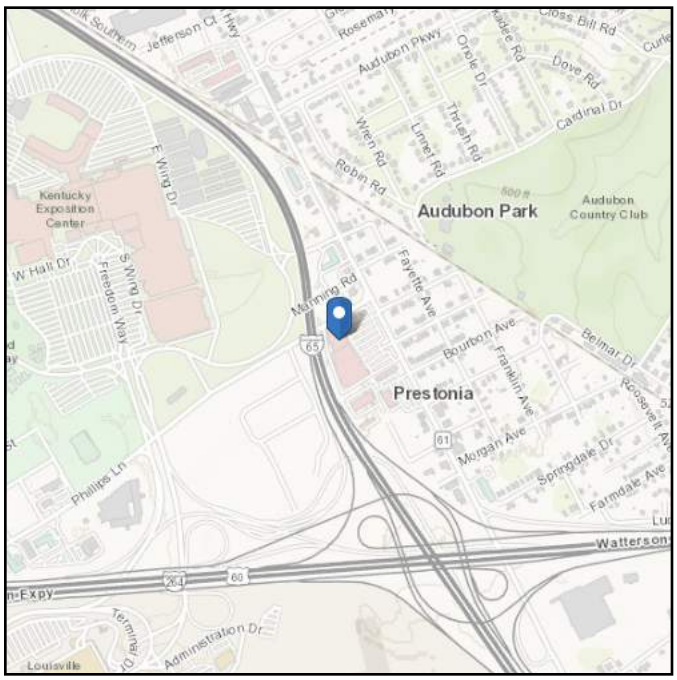
Frame is Moment Frame System in Transverse Direction
and Braced System in Longitudinal Direction.

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

ASCE Hazards Report

Address:
3426 Preston Hwy
Louisville, Kentucky
40213

Standard:	ASCE/SEI 7-10	**Latitude:**	38.196464
Risk Category:	II	**Longitude:**	-85.73272
Soil Class:	D - Stiff Soil	**Elevation:**	498.98504617421384 ft (NAVD 88)





Seismic

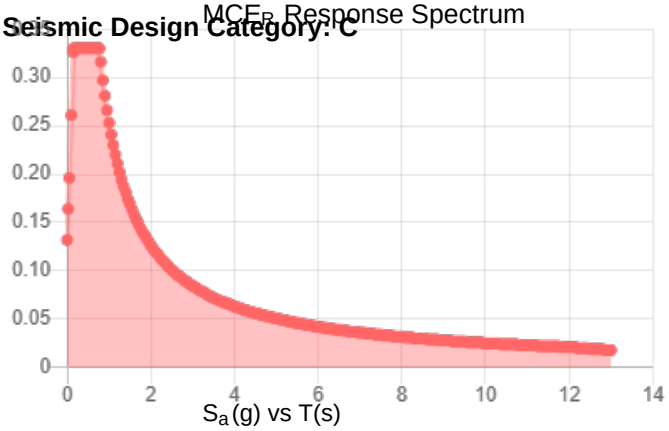
Site Soil Class: D - Stiff Soil

Results:

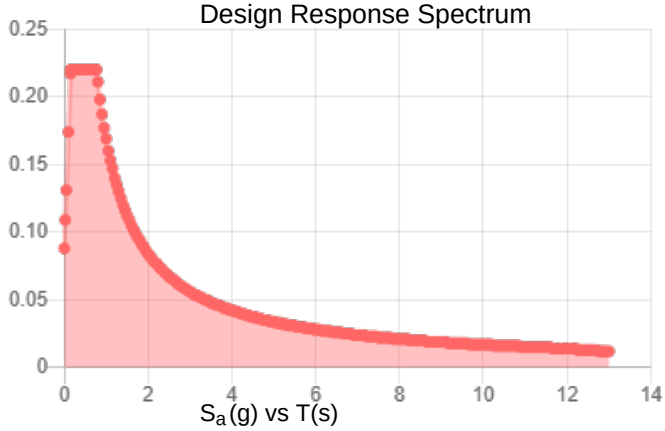
S_S :	0.206	S_{D1} :	0.169
S_1 :	0.106	T_L :	12
F_a :	1.6	PGA :	0.096
F_v :	2.374	PGA_M :	0.153
S_{MS} :	0.33	F_{PGA} :	1.6
S_{M1} :	0.253	I_e :	1
S_{DS} :	0.22		

Seismic Design Category: C

MCE_R Response Spectrum



Design Response Spectrum



Data Accessed: **Wed Aug 26 2026**

Date Source:

USGS Seismic Design Maps based on ASCE/SEI 7-10, incorporating Supplement 1 and errata of March 31, 2013, and ASCE/SEI 7-10 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-10 Ch. 21 are available from USGS.

Frame A

Lozier Wall Mount Shelving

17"B x 48"L x 96"H Wall Mount

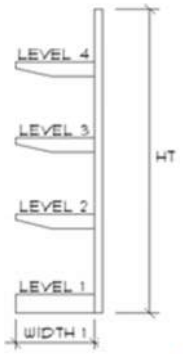
(4 Shelves)

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

SEISMIC DESIGN FRAME A (17"/0". B x 48"L x 96"H WALL)

ASCE 7 & RMI (AS IT APPLIES)

EQUIVALENT LATERAL FORCE PROCEDURE FOR SHELVING



Manuf. =	Lozier		Type =	WALL
Width 1 =	17	IN	Levels =	4
Width 2 =	0	IN	Code =	ASCE 7-10
Length =	48	IN		
Max. Shelving Height =	96	IN		

S_s = 0.206 S_1 = 0.106 Site Class = D

Fa = 1.600 Fv = 2.374

S_{DS} = 0.220 S_{D1} = 0.168

Risk Category = II **SEISMIC DESIGN CATEGORY = C**

R = 4.00 (RMI Sec. 2.6.3) Cd = 3.5

I = 1.50 (ASCE 7 15.5.3,RMI Sec. 2.6.2)

TL = 12 (ASCE 7 Figs. 22-14 thru 22-17)

Redundancy factor (ρ) = 1.0 RMI Sec. 2.6.2.1; ASCE7 Sec.12.4.2.1

$T = 0.02 * h^{(3/4)}$ = 0.10

Anchor Design Factor Ωo = 2.0 (Overstrenght; ACI318 Sec.17; ASCE7 Table 15.4-1)

Seismic Response Coefficient (ASCE 7 Sec.12.8)

C_s = 0.08 << CONTROLS

$C_{s, MAX}$ = 0.66

$C_{s, MIN}$ = 0.01

SEISMIC BASE SHEAR, $V_{BASE} = C_s W_s$

LOADS

	DL =	3	PSF
	PL =	20	PSF
(BASE DECK)	PL =	20	PSF

OPERATING WEIGHT

Ws = DL+67%PL+0.25LL (Per Storage Rack Section)
67%PL (every shelf loaded 67% of its rated load) (PL app)
100%PL (top shelf only loaded 100% of its rated load)

DL = 3 PSF x 1.42 FT x 4 FT x 4 SHELVES = 68.00 LBS

PL app = 20 PSF x 1.42 FT x 4 FT x 3 SHELVES x 0.67 = 227.80 LBS

PL app= 20 PSF x 1.42 FT x 4 FT x 1 SHELVES x 0.67 = 75.93 LBS (BASE DECK)

LOAD COMBINATION ASD (RMI 2.1)	W_{LC}	Ws	E (factor)	V_{BASE}	
DL+0.67PL+0.75(0.7ρE)	371.73	371.73	0.525	16	
$(1+0.105S_{DS})DL+0.75[(1.4+0.14S_{DS})0.7PL+0.7\rho E]$	410.10	371.73	0.525	16	
$(1+0.14S_{DS})DL+(0.85+0.14S_{DS})0.7PL+0.7\rho E$	349.60	371.73	0.700	21	**CONTROLS**
$(0.6 - 0.14S_{DS})DL+(0.6 - 0.14S_{DS})0.67PL+0.7\rho E$	211.59	371.73	0.700	21	
			$V_{BASE\ MAX.}$	21	

W_s = 349.60 LBS V_{BASE} = **21** **LBS**

IF TOP SHELF 100% LOADED ONLY, 0.7ρ x V_{TOP} = **10** **LBS**

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

SEISMIC DESIGN - FRAME A (CONTINUED)

LEVEL	W (lbs.)	h (ft)	$W_x h_x^k$ (lbs-ft)	$\Sigma W_i h_i^k$ (lbs-ft)	$C_v x$	F_x (lbs)
4	87.40	6.50	568.10	1223.61	0.46	9.97
3	87.40	4.50	393.30	1223.61	0.32	6.90
2	87.40	2.50	218.50	1223.61	0.18	3.83
1	87.40	0.50	43.70	1223.61	0.04	0.77

TOTAL = 349.60 lbs per rack P_{STATIC} = 262.20 lbs per post

$COMP._{MAX}$ = 521.33 lbs per post

DISTRIBUTED LATERAL FORCES

$$C_v x = \frac{W x h x^k}{\Sigma W_i h_i^k} \qquad F_x = (C_v x)\, V \qquad k = 1.0 \text{ since } T_a \leq 0.50$$

V_{BASE} = 21 LBS $\Sigma (F_X * h)$ = 105.80 LBS-FT

UPLIFT FORCES FOR ANCHORS

L_W = 17 IN

L_L = 48 IN

CONNECTION DISTANCE H = 68 IN

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

OVERTURNING MOMENTS TOP SHELF LOADED - FRAME A (CONTINUED)

LEVEL	W (lbs.)	h (ft)	$W_x h_x^k$ (lbs-ft)	$\Sigma W_i h_i^k$ (lbs-ft)	$C_v x$	F_x (lbs)
4	130.33	6.50	847.17	974.67	0.87	9.10
3	17.00	4.50	76.50	974.67	0.08	0.82
2	17.00	2.50	42.50	974.67	0.04	0.46
1	17.00	0.50	8.50	974.67	0.01	0.09

TOTAL = 181.33 lbs per frame

DISTRIBUTED LATERAL FORCES

$$C_v x = \frac{W x h x^k}{\Sigma W_i h_i^k}$$

$F_x = (C_v x)\ V$

k = 1.0 since $T_a \leq 0.50$

V_{TOP} = 10 LBS

UPLIFT FORCES FOR ANCHORS

L_W = 17 IN

L_L = 48 IN

CONNECTION DISTANCE H = 68 IN

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

COMPONENT DESIGN FOR FRAME A

NOTE:SECTION PROPERTIES LISTED ON COMPONENT DESIGN SHEETS, REFER TO APPENDIX B IN REPORT, INDICATING SHAPE, SIZE & RISA SECTION PROPERTIES FOR EACH COMPONENT.

17 IN . SHELF: Fy = 20 KSI MIN.

LENGTH OF SHELF (L_L) = 4.00 FT W_{DL+LL} = 32.58 PLF

MAX. $M_{SHELF} = W_{DL+LL} \times L_L^2 / 8 \times 12$ = 782.00 LBS-IN

MAX. $V_{SHELF} = (W_{DL+LL} \times L_L / 2)$ = 65.17 LBS

FROM RISA SECTION:

REQD $S_X = M_{SHELF} / 0.6\ Fy$ = 0.065 IN^3 I_X = 0.173 IN^4

S_X = 0.156 IN^3 **OK**

REQD AREA = $V_{SHELF} / 0.4\ Fy$ = 0.008 IN^2

AREA = 0.853 IN^2 **OK**

THEREFORE SHELF IS OK

SHELF BRACKET: TL STYLE Fy = 50 KSI MIN.

MAX SPAN (L_S) = 17 IN LENGTH OF SHELF (L_L)= 4.00 FT

$w_{DL+LL+0.88PL} = (DL+LL+0.88PL) \times L_L / 2$ = 41.2 PLF

$P_{VERT\ IMPACT} = w_{DL+LL+0.88PL} \times 25\%$ = 10.3 LBS

$M(MAX) = [(w_{DL+LL+0.88PL} \times L_S^2 / 24) + (P_{VERT\ IMPACT} \times L_S)]$ = 671.22 LBS-IN

$V(MAX) = [(w_{DL+LL+0.88PL} \times Ls) + P_{VERT\ IMPACT}]$ = 68.67 LBS

ASSUME ONLY TOP CLIP IN TENSION AREA = 0.951" x 0.12" = 0.11 IN^2

TENSION CAPACITY = AREA x 0.6Fy = 3424 LBS

MOMENT CAPACITY = TENSION CAP. x 1.82 IN = 6231 LBS-IN

MOMENT CAPACITY > M(MAX) **OK**

CHECK SHEAR OF BRACKET

V_{ALLOW} = AREA x 0.4Fy = 3195.36 LBS **OK**

THEREFORE SHELF BRACKET IS OK

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

COMPONENT DESIGN - TRANSVERSE DIRECTION (FRAME A) CONT.

BASE CHANNEL: Fy = 45 KSI MIN.

Ω = 1.67

FROM FRAME --> $\Sigma (F_x \times h) = M_{SEISMIC}$

$M_{SEISMIC}$ = 1269.66 LBS-IN

FROM RISA SECTION PROPS S_X = 0.670 IN^3

$fb/Fb = (M_{SEISMIC} /2) / (S_x \times Fy/\Omega)$ = 0.07 < 1.0

THEREFORE BASE CHANNEL IS OK

BASE BRACKET: Fy = 50 KSI MIN.

$M_{SEISMIC}$ = 1269.66 LBS-IN

ASSUME BOTTOM CLIP IN TENSION AREA = 0.60" x 0.12" x 2 = 0.14 IN^2

$T_{CAPACITY}$ = AREA x Fy/Ω = 4311 LBS

$M_{CAPACITY}$ = TENSION CAP. x 5.69 in = 24531.7 LBS-IN

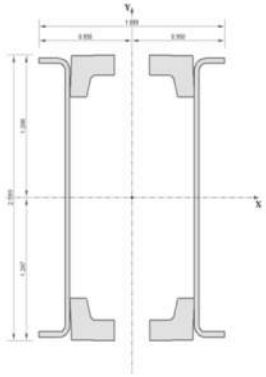
$fb/Fb = (M_{SEISMIC} / (M_{CAPACITY})$ = 0.05 < 1.0

THEREFORE BASE BRACKET IS OK

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

COMPONENT DESIGN - TRANSVERSE DIRECTION (FRAME A)

UPRITE .



SECTION PROPERTIES

SIZE =	UP-STD-Lozier		MAX HT =	96	IN
AREA =	0.757	IN^2	Fy =	55,000	PSI
Ix =	0.817	IN^4	Iy =	0.237	IN^4
Sx =	0.630	IN^3	Sy =	0.250	IN^3
rx =	1.039	IN	ry =	0.560	IN
C_{mx}=	0.6		Ωc=	1.80	
Unbrace Lx-x =	96	IN	Ωb=	1.67	
Unbrace Ly-y =	24	IN	Kx =	1.7	(RMI Sec. 6.3.1.1)
SPAN (L_S) =	17	IN	Ky =	1.0	(RMI Sec. 6.3.1.2)
δ_{SE} =	0.46	IN			
δ_X =	1.07	IN < 5% Structural Height OK			

P_{STATIC} = 349.60 LBS MAX

$M_{STATIC} = P_{STATIC} \times L_S / 24$ = 247.63 LBS-FT

$\frac{kLx}{rx} = \frac{(1.7)(96)}{1.039IN}$ = 157.07 <-- CONTROLS **COLUMN SECTION**

$\frac{kLy}{ry} = \frac{(1)(24)}{0.56IN}$ = 42.86

$Fa = \frac{\pi^2 * E}{(Kl/r)^2}$ = 11601 PSI

$\lambda c = (Fy / Fa)^{1/2}$ = 2.18 >1.5

$F_n = \begin{cases} \lambda_c < 1.5 & (0.658^{\lambda c2}) F_y \\ \lambda_c > 1.5 & (0.877/\lambda c2) F_y \end{cases}$ = 10174 PSI

$Pn = AREA * F_n$ = 7701.65 LBS

$P_{EX} = (\pi^2 E I_X) / (K_X L_X)^2$ = 8779.70 LBS

$\alpha_x = 1 - (\Omega_c P / Pex)$ = 0.93

MAX MOMENT IN COLUMN

$Mx = M_{STATIC}$ = 247.63 LBS-FT <--- CONTROLS

$Mx = M_{SEISMIC} = \Sigma(F_x \times h)$ = 105.80 LBS-FT

$M_n = Sx * Fy$ = 2887.50 LBS-FT

COMBINED STRESS = fa/Fa + fb/Fb =

$(\Omega c P / P_n) + (\Omega_p C_{mx} M_x / M_n \alpha_x)$ = 0.17 < 1.0

THEREFORE UPRITE IS OK

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

COMPONENT DESIGN - LONGITUDINAL DIRECTION (FRAME A)

RELATIVE SHELF STIFFNESS (17". SHELF): E = 29000 KSI

I_{SHELF} = 0.173 IN^4 L_L = 48 IN

$K_{SHELF} = 384EI / L_L^3$ = 17.420

RELATIVE UPRITE STIFFNESS:

I_{UPRITE} = 0.237 IN^4 UNBRACED H = 24 IN

$K_{UPRITE} = 24EI / H^3$ = 11.932

FROM RISA MODEL (SEE NEXT 4 PAGES):

SHELF DESIGN: MAX. M = 0.085 K-FT (MEMBER M14 CONTROLS)

MAX. $M_{IMPACT} = P_{VERT\ IMPACT} * L_S$ = 0.015 K-FT

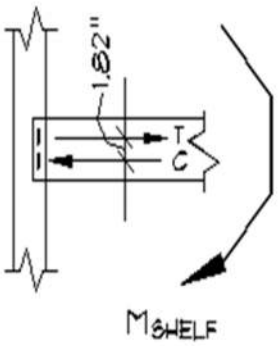
MAX. M = 0.100 K-FT

Sx = 0.156 IN^3

Mallow = $Sx*Fy/\Omega$ = 0.156 K-FT

Mallow > MAX. M **OK**

T = C = M * 12 / 1.82 = 0.66 KIP



ALLOWABLE SHEAR TO RESIST MOMENT:

TAB DISTANCE = 1.82 IN

TAB = 0.95 IN

t = 11 GA

AREA OF TAB = 0.11 IN^2 (SEE COMP.CALCS)

FY = 50 KSI

V_{ALLOW} = 0.4 AREA FY = 2.27 KIP

T = C < V_{ALLOW} **OK**

UPRITE . DESIGN: MAX UNBRACED HT (L_U) = 24 IN Fy = 55000 PSI

L_S = 17 IN

SECTION PROPERTIES FROM RISA SECTION:

AREA = 0.757 IN^2 Sy = 0.250 IN^3

Iy = 0.237 IN^4

$M_{STATIC} = P_{STATIC} /2 * L_S /2$ = 1114.36 IN-LBS ry = 0.560 IN

$\frac{kLy}{ry} = \frac{(0.8)(MAX\ HT)}{0.56}$ = 34.29 Fa = $\frac{12 * \pi^2 * E}{23(Kl/r)^2}$ = 127035 PSI

fa/Fa = $(P_{STATIC})/(AREA*Fa)$ = 0.003 fb/Fb = (M_{STATIC}) / $(Sy*Fy/\Omega)$ = 0.135

fa/Fa + fb/Fb = 0.138 < 1.00

FROM RISA MODEL OF FRAME A ===> $M_{STATIC} + M_{SEISMIC\ (y-y)}$ = 2 LBS-FT

fb/Fb = $(M_{STATIC}+ M_{SEISMIC})$ / $(Sy*Fy/\Omega)$ = 0.003 fa/Fa + fb/Fb = 0.006 < 1.00

THEREFORE UPRITE IS OK

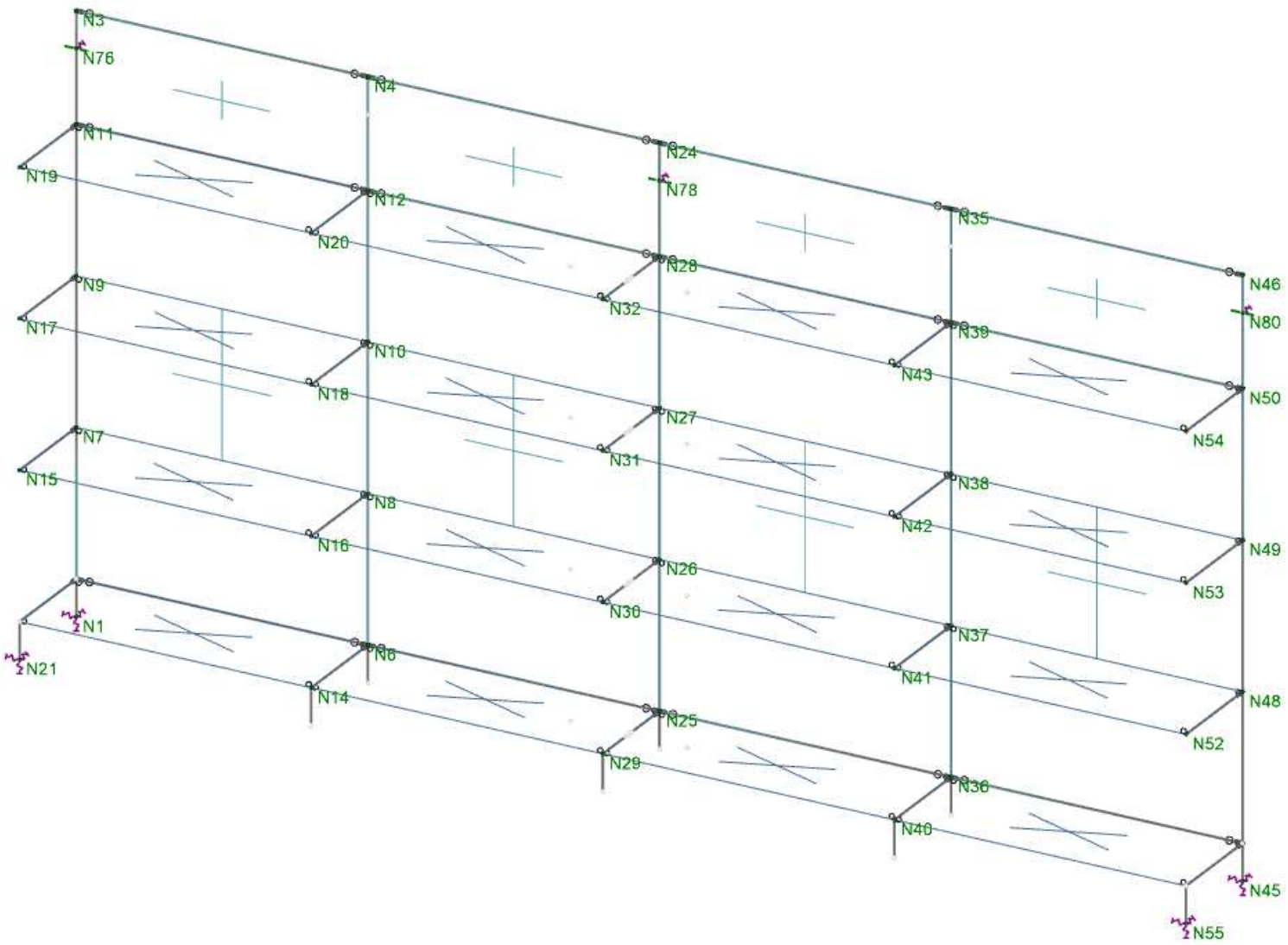
JPH & CLARK, INC.

CONSULTING STRUCTURAL ENGINEERING

1801 N. HAMPTON RD., SUITE 440

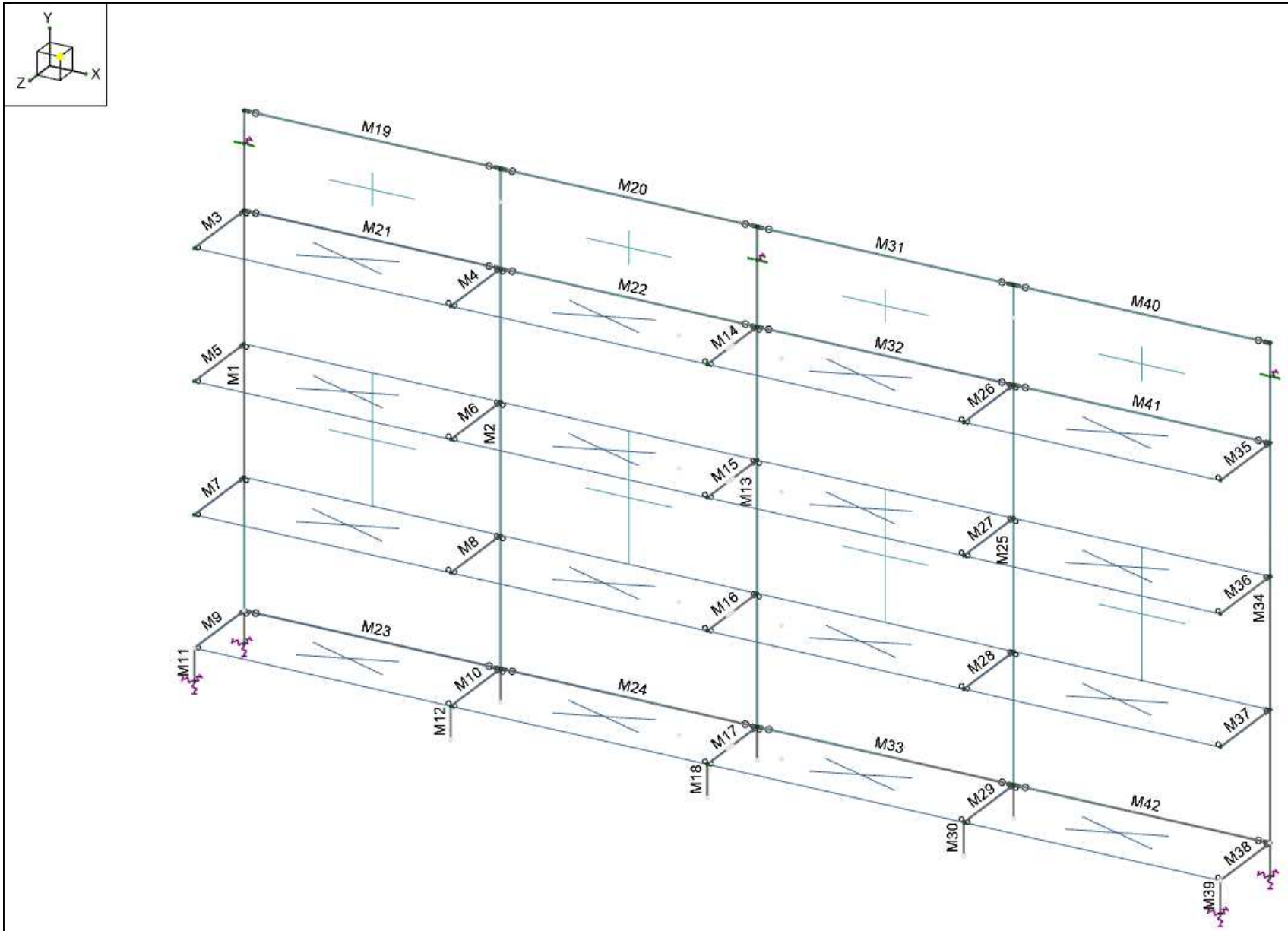
DESOTO, TX 75115-2399

(972) 283-5111



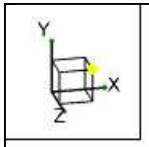
Envelope Only Solution

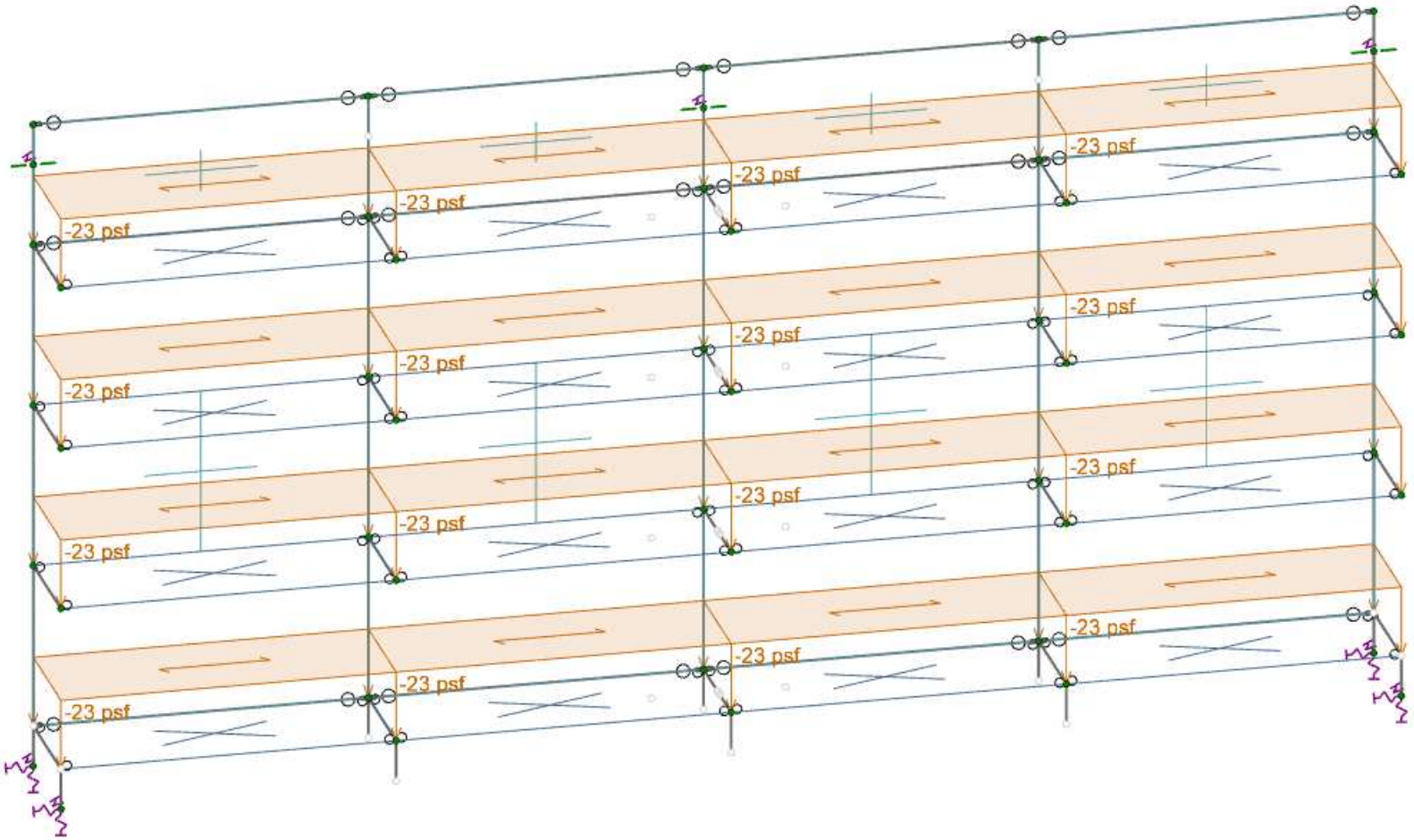
JPH & CLARK, Inc	Frame A - 17x48x96 Wall Mounted	SK-2
AA		Aug 27, 2026 at 03:53 PM
26-460 Advanced Auto Part	Nodes Layout	AAP_A0-17x48x96 - 4LVL - 4Bays.r3d



Envelope Only Solution

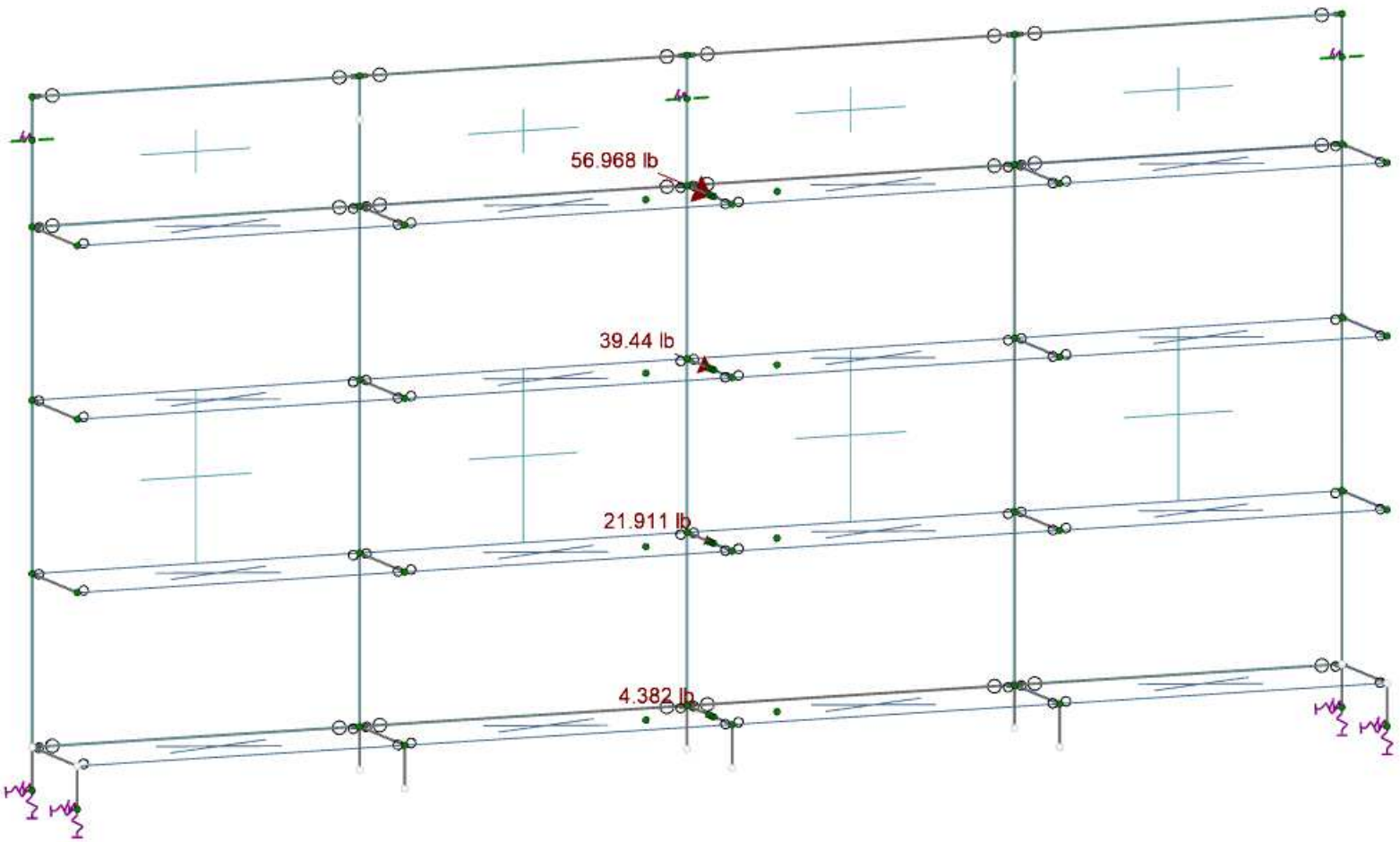
JPH & CLARK, Inc		Frame A - 17x48x96 Wall Mounted	SK-3
AA			Aug 27, 2026 at 03:54 PM
26-460 Advanced Auto Part		Members Label	AAP_A0-17x48x96 - 4LVL - 4Bays r3d





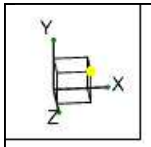
Loads: LC 3, LC-3
Envelope Only Solution

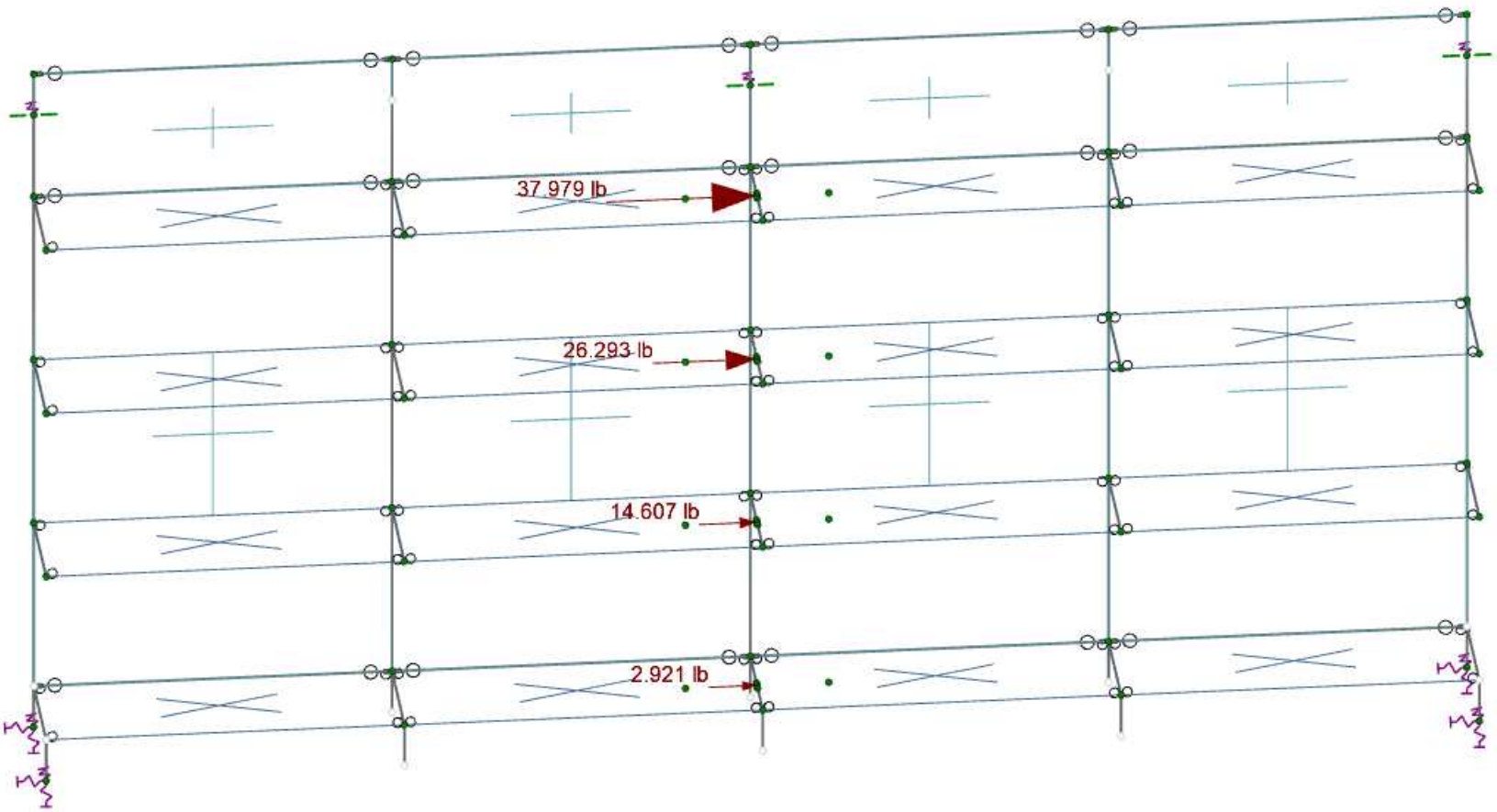
JPH & CLARK, Inc	Frame A - 17x48x96 Wall Mounted		SK-4
AA			Aug 27, 2026 at 03:54 PM
26-460 Advanced Auto Part	DL + LL		AAP_A0-17x48x96 - 4LVL - 4Bays.r3d



Loads: BLC 3, ELZ
Envelope Only Solution

JPH & CLARK, Inc	Frame A - 17x48x96 Wall Mounted		SK-5
AA			Aug 27, 2026 at 03:56 PM
26-460 Advanced Auto Part		ELZ	AAP_A0-17x48x96 - 4LVL - 4Bays r3d





Loads: BLC 4, ELX
Envelope Only Solution

JPH & CLARK, Inc		Frame A - 17x48x96 Wall Mounted	SK-6
AA			Aug 27, 2026 at 03:56 PM
26-460 Advanced Auto Part		ELZ	AAP_A0-17x48x96 - 4LVL - 4Bays r3d

Node Boundary Conditions

	Node Label	X [k/in]	Y [k/in]	Z [k/in]
1	N1	S100	S100	S100
2	N2		CS5000	
3	N21	S100	S100	S100
4	N22		CS5000	
5	N23		CS5000	
6	N33		CS5000	
7	N34		CS5000	
8	N44		CS5000	
9	N45	S100	S100	S100
10	N55	S100	S100	S100
11	N76	Reaction		S20
12	N80	Reaction		S20
13	N78	Reaction		S20

Hot Rolled Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm. Coeff. [1e⁵°F⁻¹]	Density [k/ft³]	Yield [ksi]	Ry	Fu [ksi]	Rt
1	A1008_50	29000	11154	0.3	0.65	0.49	50	1.2	60	1.1
2	A1011_50	29000	11154	0.3	0.65	0.49	50	1.2	60	1.1

Hot Rolled Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rule	Area [in²]	Iyy [in⁴]	Izz [in⁴]	J [in⁴]
1	SHELF-STD-BRK	LOZIER-SHLF-STD-BRK	Beam	RECT	A1011_50	Typical	0.223	0.000268	0.064	0.001
2	BASE-BRK	HD BASE SECTION-N_HRA	Beam	Wide Flange	A1011_50	Typical	0.662	0.047	2.411	0.000485
3	SS-SPANNER	TMB-RAIL-L	HBrace	Wide Flange	A1008_50	Typical	0.279	0.02	0.281	0.000295

Cold Formed Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm. Coeff. [1e⁵°F⁻¹]	Density [k/ft³]	Yield [ksi]	Fu [ksi]
1	A1011 Gr60	29000	11346	0.3	0.65	0.49	60	75
2	A607 C1 Gr.55	29500	11346	0.3	0.65	0.49	55	70

Cold Formed Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rule	Area [in²]	Iyy [in⁴]	Izz [in⁴]	J [in⁴]
1	C-STD-UPRIGHT	UP-STD-LOZ	Column	None	A607 C1 Gr.55	Typical	0.757	0.237	0.817	1.039

Basic Load Cases

	BLC Description	Category	Nodal	Distributed	Area(Member)
1	DL	DL			16
2	PLL	LL			16
3	ELZ	ELZ	4		
4	ELX	ELX	4		
5	BLC 1 Transient Area Loads	None		20	
6	BLC 2 Transient Area Loads	None		20	

Load Combinations

	Description	Solve	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
1	LC-1	Yes	DL	1								
2	LC-2	Yes	LL	1								
3	LC-3	Yes	DL	1	LL	1						
4	LC-4-AEL	Yes	DL	1	LL	0.67						
5	LC-5	Yes	DL	1	LL	0.67	ELX	0.525				
6	LC-6	Yes	DL	1	LL	0.67	ELZ	0.525				
7	LC-7	Yes	DL	1	Sds*DL	0.105	LL	0.735	LL	0.016	Rho*ELX	0.525

Load Combinations (Continued)

	Description	Solve	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
8	LC-8	Yes	DL	1	Sds*DL	0.14	LL	0.595	LL	0.022	Rho*ELX	0.7
9	LC-9	Yes	DL	0.6	Sds*DL	-0.14	LL	0.402	LL	-0.021	Rho*ELX	0.7
10	LC-10	Yes	DL	1	Sds*DL	0.105	LL	0.735	LL	0.016	Rho*ELZ	0.525
11	LC-11	Yes	DL	1	Sds*DL	0.14	LL	0.595	LL	0.022	Rho*ELZ	0.7
12	LC-12	Yes	DL	0.6	Sds*DL	-0.14	LL	0.402	LL	-0.021	Rho*ELZ	0.7
13												
14	AB-FLC5-1	Yes	DL	1.2	Sds*DL	0.2	LL	0.84	LL	0.031	Om*ELX	1
15	AB-FLC5-2	Yes	DL	1.2	Sds*DL	0.2	LL	0.84	LL	0.031	Om*ELZ	1
16	AB-FLC5-3	Yes	DL	1.2	Sds*DL	0.2	LL	0.84	LL	0.031	Om*ELX	-1
17	AB-FLC5-4	Yes	DL	1.2	Sds*DL	0.2	LL	0.84	LL	0.031	Om*ELZ	-1
18	AB-FLC7-5	Yes	DL	0.9	Sds*DL	-0.2	LL	0.603	LL	-0.029	Om*ELX	1
19	AB-FLC7-6	Yes	DL	0.9	Sds*DL	-0.2	LL	0.603	LL	-0.029	Om*ELZ	1
20	AB-FLC7-7	Yes	DL	0.9	Sds*DL	-0.2	LL	0.603	LL	-0.029	Om*ELX	-1
21	AB-FLC7-8	Yes	DL	0.9	Sds*DL	-0.2	LL	0.603	LL	-0.029	Om*ELZ	-1

Node Loads and Enforced Displacements (BLC 3 : ELZ)

	Node Label	L, D, M	Direction	Magnitude [(lb, lb-ft), (in, rad), (lb*s²/in, lb*s²*in)]
1	N61	L	Z	56.968
2	N62	L	Z	39.44
3	N63	L	Z	21.911
4	N64	L	Z	4.382

Node Loads and Enforced Displacements (BLC 4 : ELX)

	Node Label	L, D, M	Direction	Magnitude [(lb, lb-ft), (in, rad), (lb*s²/in, lb*s²*in)]
1	N61	L	X	37.979
2	N62	L	X	26.293
3	N63	L	X	14.607
4	N64	L	X	2.921

Member Area Loads (BLC 1 : DL)

	Node A	Node B	Node C	Node D	Direction	Load Direction	A Magnitude [psf]	B Magnitude [psf]	C Magnitude [psf]	D Magnitude [psf]	Exclude Braces
1	N19	N20	N12	N11	Y	A-B	-3	-3	-3	-3	Yes
2	N17	N18	N10	N9	Y	A-B	-3	-3	-3	-3	Yes
3	N15	N16	N8	N7	Y	A-B	-3	-3	-3	-3	Yes
4	N13	N14	N6	N5	Y	A-B	-3	-3	-3	-3	Yes
5	N20	N32	N28	N12	Y	A-B	-3	-3	-3	-3	Yes
6	N18	N31	N27	N10	Y	A-B	-3	-3	-3	-3	Yes
7	N16	N30	N26	N8	Y	A-B	-3	-3	-3	-3	Yes
8	N14	N29	N25	N6	Y	A-B	-3	-3	-3	-3	Yes
9	N32	N43	N39	N28	Y	A-B	-3	-3	-3	-3	Yes
10	N31	N42	N38	N27	Y	A-B	-3	-3	-3	-3	Yes
11	N30	N41	N37	N26	Y	A-B	-3	-3	-3	-3	Yes
12	N29	N40	N36	N25	Y	A-B	-3	-3	-3	-3	Yes
13	N43	N54	N50	N39	Y	A-B	-3	-3	-3	-3	Yes
14	N42	N53	N49	N38	Y	A-B	-3	-3	-3	-3	Yes
15	N41	N52	N48	N37	Y	A-B	-3	-3	-3	-3	Yes
16	N40	N51	N47	N36	Y	A-B	-3	-3	-3	-3	Yes

Member Area Loads (BLC 2 : PLL)

	Node A	Node B	Node C	Node D	Direction	Load Direction	A Magnitude [psf]	B Magnitude [psf]	C Magnitude [psf]	D Magnitude [psf]	Exclude Braces
1	N19	N20	N12	N11	Y	A-B	-20	-20	-20	-20	Yes
2	N17	N18	N10	N9	Y	A-B	-20	-20	-20	-20	Yes
3	N15	N16	N8	N7	Y	A-B	-20	-20	-20	-20	Yes
4	N13	N14	N6	N5	Y	A-B	-20	-20	-20	-20	Yes
5	N20	N32	N28	N12	Y	A-B	-20	-20	-20	-20	Yes
6	N18	N31	N27	N10	Y	A-B	-20	-20	-20	-20	Yes

Member Area Loads (BLC 2 : PLL) (Continued)

	Node A	Node B	Node C	Node D	Direction	Load Direction	A Magnitude [psf]	B Magnitude [psf]	C Magnitude [psf]	D Magnitude [psf]	Exclude Braces
7	N16	N30	N26	N8	Y	A-B	-20	-20	-20	-20	Yes
8	N14	N29	N25	N6	Y	A-B	-20	-20	-20	-20	Yes
9	N32	N43	N39	N28	Y	A-B	-20	-20	-20	-20	Yes
10	N31	N42	N38	N27	Y	A-B	-20	-20	-20	-20	Yes
11	N30	N41	N37	N26	Y	A-B	-20	-20	-20	-20	Yes
12	N29	N40	N36	N25	Y	A-B	-20	-20	-20	-20	Yes
13	N43	N54	N50	N39	Y	A-B	-20	-20	-20	-20	Yes
14	N42	N53	N49	N38	Y	A-B	-20	-20	-20	-20	Yes
15	N41	N52	N48	N37	Y	A-B	-20	-20	-20	-20	Yes
16	N40	N51	N47	N36	Y	A-B	-20	-20	-20	-20	Yes

Diaphragms

	Node Label	Plane	Inactive	No Wind/Drift
1	N51	ZX		
2	N8	ZX		
3	N10	ZX		
4	N12	ZX		

Envelope Node Reactions

	Node Label		X [lb]	LC	Y [lb]	LC	Z [lb]	LC	MX [lb-ft]	LC	MY [lb-ft]	LC	MZ [lb-ft]	LC
1	N1	max	0.024	10	178.908	3	43.375	3	0	12	0	12	0	12
2		min	-4.366	9	23.336	1	5.658	1	0	1	0	1	0	1
3	N2	max	0	12	553.641	3	0	12	0	12	0	12	0	12
4		min	0	1	72.214	1	0	1	0	1	0	1	0	1
5	N21	max	0	3	15.327	12	50.325	3	0	12	0	12	0	12
6		min	-0.039	9	-1.482	3	5.368	12	0	1	0	1	0	1
7	N22	max	0	12	44.34	3	0	12	0	12	0	12	0	12
8		min	0	1	5.783	1	0	1	0	1	0	1	0	1
9	N23	max	0	12	489.961	3	0	12	0	12	0	12	0	12
10		min	0	1	63.908	1	0	1	0	1	0	1	0	1
11	N33	max	0	12	45.013	3	0	12	0	12	0	12	0	12
12		min	0	1	5.871	1	0	1	0	1	0	1	0	1
13	N34	max	0	12	553.658	3	0	12	0	12	0	12	0	12
14		min	0	1	72.216	1	0	1	0	1	0	1	0	1
15	N44	max	0	12	44.335	3	0	12	0	12	0	12	0	12
16		min	0	1	5.783	1	0	1	0	1	0	1	0	1
17	N45	max	-0.002	1	178.926	3	43.375	3	0	12	0	12	0	12
18		min	-4.371	8	23.338	1	5.658	1	0	1	0	1	0	1
19	N55	max	0	1	15.324	12	50.324	3	0	12	0	12	0	12
20		min	-0.039	8	-2.728	8	5.371	12	0	1	0	1	0	1
21	N76	max	15.593	3	0	12	-7.476	1	0	12	0	12	0	12
22		min	-7.012	9	0	1	-57.316	3	0	1	0	1	0	1
23	N80	max	-2.035	1	0	12	-7.476	1	0	12	0	12	0	12
24		min	-23.807	8	0	1	-57.316	3	0	1	0	1	0	1
25	N78	max	0	12	0	12	-9.491	1	0	12	0	12	0	12
26		min	-21.775	8	0	1	-72.765	3	0	1	0	1	0	1
27	N69	max	NC		NC		NC		LOCKED		NC		LOCKED	
28		min	NC		NC		NC		LOCKED		NC		LOCKED	
29	N65	max	NC		NC		NC		LOCKED		NC		LOCKED	
30		min	NC		NC		NC		LOCKED		NC		LOCKED	
31	N70	max	NC		NC		NC		LOCKED		NC		LOCKED	
32		min	NC		NC		NC		LOCKED		NC		LOCKED	
33	N66	max	NC		NC		NC		LOCKED		NC		LOCKED	
34		min	NC		NC		NC		LOCKED		NC		LOCKED	
35	N71	max	NC		NC		NC		LOCKED		NC		LOCKED	
36		min	NC		NC		NC		LOCKED		NC		LOCKED	
37	N67	max	NC		NC		NC		LOCKED		NC		LOCKED	
38		min	NC		NC		NC		LOCKED		NC		LOCKED	
39	N68	max	NC		NC		NC		LOCKED		NC		LOCKED	

Envelope Node Reactions (Continued)

	Node Label		X [lb]	LC	Y [lb]	LC	Z [lb]	LC	MX [lb-ft]	LC	MY [lb-ft]	LC	MZ [lb-ft]	LC
40		min	NC		NC		NC		LOCKED		NC		LOCKED	
41	N72	max	NC		NC		NC		LOCKED		NC		LOCKED	
42		min	NC		NC		NC		LOCKED		NC		LOCKED	
43	Totals:	max	0.001	11	2085.824	3	0.002	3						
44		min	-57.263	9	272.064	1	-85.87	12						

Envelope Maximum Member Section Forces

	Member		Axial[lb]	Loc[in]	LC	y Shear[lb]	Loc[in]	LC	z Shear[lb]	Loc[in]	LC	Torque[lb-ft]	Loc[in]	LC	y-y Moment[lb-ft]	Loc[in]	LC	z-z Moment[lb-ft]	Loc[in]	LC
1	M1	max	178.908	6	3	56.328	90	3	5.985	93	3	0.138	81	3	1.087	90	9	57.048	78	3
2		min	-11.773	79	3	-2.082	75	12	-5.782	87	3	-0.098	26	8	-2.459	90	3	-39.544	54	3
3	M2	max	553.641	6	3	72.89	78	3	1.033	81	3	0.063	68	8	0.038	42	3	51.712	54	3
4		min	-2.618	79	3	-0.012	94	10	-1.156	75	3	-0.095	26	8	-0.529	78	3	-98.593	78	3
5	M3	max	0	15.704	12	65.179	0	3	0	15.704	12	0	15.704	12	0	15.704	12	42.65	0	3
6		min	0	0	1	0	15.704	1	0	0	1	0	0	1	0	0	1	0	15.704	1
7	M4	max	0	15.704	12	130.362	0	3	0	15.704	12	0	15.704	12	0	15.704	12	85.299	0	3
8		min	0	0	1	-0.002	15.704	3	0	0	1	0	0	1	0	0	1	0	15.704	1
9	M5	max	0	15.704	12	65.179	0	3	0	15.704	12	0	15.704	12	0	15.704	12	42.649	0	3
10		min	0	0	1	0	15.704	1	0	0	1	0	0	1	0	0	1	0	15.704	1
11	M6	max	0	15.704	12	130.363	0	3	0	15.704	12	0	15.704	12	0	15.704	12	85.3	0	3
12		min	0	0	1	-0.001	15.704	3	0	0	1	0	0	1	0	0	1	0	15.704	1
13	M7	max	0	15.704	12	65.179	0	3	0	15.704	12	0	15.704	12	0	15.704	12	42.649	0	3
14		min	0	0	1	0	15.704	1	0	0	1	0	0	1	0	0	1	0	15.704	1
15	M8	max	0	15.704	12	130.363	0	3	0	15.704	12	0	15.704	12	0	15.704	12	85.3	0	3
16		min	0	0	1	-0.001	15.704	3	0	0	1	0	0	1	0	0	1	0	15.704	1
17	M9	max	0	15.704	12	66.659	0	3	0	15.704	12	0.019	15.704	9	0	15.704	12	19.425	0	3
18		min	0	0	1	-15.327	15.704	12	0	0	1	0	0	3	0	0	1	-25.162	15.704	3
19	M10	max	0	15.704	12	86.024	0	3	0	15.704	12	0	15.704	12	0	15.704	12	27.275	0	3
20		min	0	0	1	-44.34	15.704	3	0	0	1	0	0	1	0	0	1	-12.039	8.506	11
21	M11	max	15.327	6	12	0.039	6	9	50.325	6	3	0	6	12	25.162	6	3	0	6	3
22		min	-1.482	0	3	0	0	3	5.368	0	12	0	0	1	0	0	1	-0.019	6	9
23	M12	max	44.34	6	3	0	6	12	0	6	12	0	6	12	0	6	3	0	6	12
24		min	5.783	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1
25	M13	max	489.961	6	3	70.353	90	3	7.532	90	9	0.062	78	8	2.581	90	9	72.185	78	3
26		min	-10.577	79	3	-0.157	91	3	-7.06	91	8	-0.095	6	8	-0.718	78	9	-61.495	54	3
27	M14	max	0.004	7.034	9	130.365	0	3	0	15.704	12	0	15.704	12	0	15.704	12	85.302	0	3
28		min	-0.004	8.834	9	0	15.704	1	0	0	1	0	0	1	0	0	1	0	15.704	1
29	M15	max	0.007	7.034	8	130.364	0	3	0	15.704	12	0	15.704	12	0	15.704	12	85.301	0	3
30		min	-0.007	8.834	8	0	15.704	3	0	0	1	0	0	1	0	0	1	0	15.704	1
31	M16	max	0.003	7.034	8	130.364	0	3	0	15.704	12	0	15.704	12	0	15.704	12	85.302	0	3
32		min	-0.004	8.834	8	0	15.704	1	0	0	1	0	0	1	0	0	1	0	15.704	1
33	M17	max	0	7.034	9	85.351	0	3	0	15.704	12	0	15.704	12	0	15.704	12	26.394	0	3
34		min	0	8.834	9	-45.013	15.704	3	0	0	1	0	0	1	0	0	1	-12.437	8.343	11
35	M18	max	45.013	6	3	0	6	12	0	6	12	0	6	12	0	6	12	0	6	12
36		min	5.871	0	1	0	0	1	0	0	1	0	0	1	0	6	5	0	0	1
37	M19	max	3.078	2.396	3	1.651	46	3	0.278	2.396	3	0	43.125	1	0.059	2.875	3	0.33	43.604	3
38		min	-12.106	43.604	3	-0.066	38.813	3	-0.119	2.875	3	-0.007	0	3	-0.011	43.604	3	-0.326	2.396	3
39	M20	max	-1.689	46	1	0.06	7.188	3	0.128	2.396	3	0.007	46	3	0.034	43.125	8	0.295	2.396	3
40		min	-15.936	14.375	3	-1.478	0	3	-0.159	43.604	8	0	2.875	1	0	0	1	-0.295	43.604	3
41	M21	max	0	46	12	0	46	11	0.551	2.396	3	0.002	2.396	3	0.116	2.875	3	0	2.396	11
42		min	0	0	1	0	0	11	-0.31	2.875	3	-0.008	43.604	3	-0.005	7.667	3	0	32.104	11
43	M22	max	0	46	12	0	46	11	0.56	2.396	3	0.007	2.396	3	0.119	2.875	3	0	2.396	11
44		min	0	0	1	0	0	11	-0.476	43.604	3	-0.005	43.604	3	0	38.333	9	0	32.104	11
45	M23	max	0	46	12	0	46	12	0.271	46	3	0	9.104	3	0.031	23	3	0	46	12
46		min	0	0	1	0	0	1	-0.205	23	3	-0.002	36.896	3	-0.205	36.896	3	0	0	1
47	M24	max	0	46	12	0	46	12	0.246	46	3	0.002	9.104	3	0.046	23	3	0	46	12
48		min	0	0	1	0	0	1	-0.267	0	3	-0.002	36.896	3	-0.202	9.104	3	0	0	1
49	M25	max	553.658	6	3	72.89	78	3	1.146	78	3	0.062	68	8	0.528	78	3	51.71	54	3
50		min	-2.623	79	3	-0.012	94	10	-1.027	79	3	-0.095	26	8	-0.156	54	9	-98.593	78	3
51	M26	max	0	15.704	12	130.362	0	3	0	15.704	12	0	15.704	12	0	15.704	12	85.299	0	3
52		min	0	0	1	-0.002	15.704	3	0	0	1	0	0	1	0	0	1	0	15.704	1
53	M27	max	0	15.704	12	130.363	0	3	0	15.704	12	0	15.704	12	0	15.704	12	85.3	0	3

Envelope Maximum Member Section Forces (Continued)

	Member		Axial[lb]	Loc[in]	LC	y Shear[lb]	Loc[in]	LC	z Shear[lb]	Loc[in]	LC	Torque[lb-ft]	Loc[in]	LC	y-y Moment[lb-ft]	Loc[in]	LC	z-z Moment[lb-ft]	Loc[in]	LC
54		min	0	0	1	-0.001	15.704	3	0	0	1	0	0	1	0	0	1	0	15.704	1
55	M28	max	0	15.704	12	130.363	0	3	0	15.704	12	0	15.704	12	0	15.704	12	85.3	0	3
56		min	0	0	1	-0.001	15.704	3	0	0	1	0	0	1	0	0	1	0	15.704	1
57	M29	max	0	15.704	12	86.028	0	3	0	15.704	12	0	15.704	12	0	15.704	12	27.281	0	3
58		min	0	0	1	-44.336	15.704	3	0	0	1	0	0	1	0	0	1	-12.037	8.506	11
59	M30	max	44.335	6	3	0	6	12	0	6	12	0	6	12	0	6	12	0	6	12
60		min	5.783	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1
61	M31	max	-1.689	2.396	1	1.479	46	3	0.107	2.396	3	0	43.125	1	0.029	43.125	7	0.295	43.604	3
62		min	-15.941	23	3	-0.06	38.813	3	-0.138	43.604	7	-0.007	0	3	-0.009	2.875	9	-0.295	2.396	3
63	M32	max	0	46	12	0	46	12	0.484	2.396	3	0.005	2.396	3	0.117	43.125	3	0	2.396	11
64		min	0	0	1	0	0	11	-0.553	43.604	3	-0.008	43.604	3	0	0	1	0	0	1
65	M33	max	0	46	12	0	46	12	0.269	46	3	0.002	9.104	3	0.046	23	3	0	46	12
66		min	0	0	1	0	0	1	-0.243	0	3	-0.002	36.896	3	-0.204	36.896	3	0	0	1
67	M34	max	178.926	6	3	56.328	90	3	8.98	90	8	0.064	61	8	3.736	90	8	57.048	78	3
68		min	-11.782	79	3	-2.079	75	12	-9.097	91	8	-0.138	78	3	-2.2	6	8	-39.554	54	3
69	M35	max	0	15.704	12	65.188	0	3	0	15.704	12	0	15.704	12	0	15.704	12	42.655	0	3
70		min	0	0	1	0	15.704	1	0	0	1	0	0	1	0	0	1	0	15.704	1
71	M36	max	0	15.704	12	65.188	0	3	0	15.704	12	0	15.704	12	0	15.704	12	42.655	0	3
72		min	0	0	1	0	15.704	1	0	0	1	0	0	1	0	0	1	0	15.704	1
73	M37	max	0	15.704	12	65.188	0	3	0	15.704	12	0	15.704	12	0	15.704	12	42.655	0	3
74		min	0	0	1	0	15.704	1	0	0	1	0	0	1	0	0	1	0	15.704	1
75	M38	max	0	15.704	12	66.663	0	3	0	15.704	12	0.019	15.704	8	0	15.704	12	19.424	0	3
76		min	0	0	1	-15.323	15.704	12	0	0	1	0	0	1	0	0	1	-25.162	15.704	3
77	M39	max	15.324	6	12	0.039	6	8	50.324	6	3	0	6	12	25.162	6	3	0	1.563	1
78		min	-2.728	0	8	0	0	1	5.371	0	12	0	0	1	0	0	1	-0.019	6	8
79	M40	max	5.552	43.125	8	0.066	7.188	3	0.12	43.125	7	0.007	46	3	0.059	43.125	7	0.329	2.396	3
80		min	-12.106	0	3	-1.65	0	3	-0.279	43.604	7	0	2.875	1	-0.016	2.875	8	-0.326	43.604	3
81	M41	max	0	46	12	0	46	12	0.32	43.125	3	0.007	2.396	3	0.117	43.125	3	0	43.604	11
82		min	0	0	1	0	0	1	-0.559	43.604	3	-0.001	43.604	3	-0.011	38.333	8	0	0	1
83	M42	max	0	46	12	0	46	12	0.206	23	3	0.002	9.104	3	0.032	23	3	0	46	12
84		min	0	0	1	0	0	1	-0.27	0	3	0	36.896	3	-0.205	9.104	3	0	0	1

Material Take-Off

	Material	Size	Pieces	Length[in]	Weight[K]
1	General Members				
2	RIGID		5	30	0
3	General Walls			Volume (yds^3)	
4	gen-cf		8	0.1	0.056
5	Total General		13	30.1	0.056
6					
7	Hot Rolled Steel				
8	A1008_50	TMB-RAIL-L	12	552	0.044
9	A1011_50	HD BASE SECTION-N_HRA	5	78.5	0.015
10	A1011_50	LOZIER-SHLF-STD-BRK	15	235.6	0.015
11	Total HR Steel		32	866.1	0.073
12					
13	Cold Formed Steel				
14	A607 C1 Gr.55	UP-STD-LOZ	5	480	0.103
15	Total CF Steel		5	480	0.103
16					
17	Plate Elements	Thickness (in)		Volume (yds^3)	
18	STL	0	16	0	0.081
19	Total Plates		16	0	0.081

Frame A1

Lozier Wall Shelving

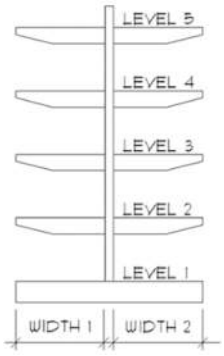
13"B x 48"L x 144"H End Wall

(6 Shelves)

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

SEISMIC DESIGN FRAME A (13"/0". B x 24"L x 132"H ENDCAP)

ASCE 7 & RMI (AS IT APPLIES)



EQUIVALENT LATERAL FORCE PROCEDURE FOR SHELVING

Manuf. =	Lozier		Type =	ENDCAP
Width 1 =	13	IN	Levels =	6
Width 2 =	0	IN	Code =	ASCE 7-10
Length =	24	IN		
Max. Shelving Height =	132	IN		

S_s = 0.206 S_1 = 0.106 Site Class = D

Fa = 1.600 Fv = 2.374

S_{DS} = 0.220 S_{D1} = 0.168

Risk Category = II **SEISMIC DESIGN CATEGORY = C**

R = 4.00 (RMI Sec. 2.6.3) Cd = 3.5

I = 1.50 (ASCE 7 15.5.3,RMI Sec. 2.6.2)

TL = 12 (ASCE 7 Figs. 22-14 thru 22-17)

Redundancy factor (ρ) = 1.0 RMI Sec. 2.6.2.1; ASCE7 Sec.12.4.2.1

$T = 0.02 * h^{(3/4)}$ = 0.12

Anchor Design Factor Ωo = 2.0 (Overstrength; ACI318 Sec.17; ASCE7 Table 15.4-1)

Seismic Response Coefficient (ASCE 7 Sec.12.8)

C_s = 0.08 << CONTROLS

$C_{s, MAX}$ = 0.52

$C_{s, MIN}$ = 0.01

SEISMIC BASE SHEAR, $V_{BASE} = C_s W_s$

LOADS

	DL =	3	PSF
	PL =	20	PSF
(BASE DECK)	PL =	20	PSF

OPERATING WEIGHT Ws = DL+67%PL+0.25LL (Per Storage Rack Section)
67%PL (every shelf loaded 67% of its rated load) (PL app)
100%PL (top shelf only loaded 100% of its rated load)

DL = 3 PSF x 1.08 FT x 2 FT x 6 SHELVES = 39.00 LBS

PL app = 20 PSF x 1.08 FT x 2 FT x 5 SHELVES x 0.67 = 145.17 LBS

PL app= 20 PSF x 1.08 FT x 2 FT x 1 SHELVES x 0.67 = 29.03 LBS (BASE DECK)

LOAD COMBINATION ASD (RMI 2.1)	W_{LC}	Ws	E (factor)	V_{BASE}	
DL+0.67PL+0.75(0.7ρE)	213.20	213.20	0.525	9	
$(1+0.105S_{DS})$DL+0.75[$(1.4+0.14S_{DS})$0.7PL+0.7ρE]	235.21	213.20	0.525	9	
$(1+0.14S_{DS})$DL+$(0.85+0.14S_{DS})$0.7PL+0.7ρE	200.51	213.20	0.700	12	
$(0.6 - 0.14S_{DS})$DL+$(0.6 - 0.14S_{DS})$0.67PL+0.7ρE	121.35	213.20	0.700	12	**CONTROLS**
			$V_{BASE\ MAX.}$	12	

W_s = 121.35 LBS V_{BASE} = **12** **LBS**

IF TOP SHELF 100% LOADED ONLY, 0.7ρ x V_{TOP} = **5** **LBS**

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

SEISMIC DESIGN - FRAME A (CONTINUED)

LEVEL	W (lbs.)	h (ft)	$W_x h_x^k$ (lbs-ft)	$\Sigma W_i h_i^k$ (lbs-ft)	$C_v x$	F_x (lbs)
6	20.23	8.83	178.66	566.32	0.32	3.88
5	20.23	7.17	144.95	566.32	0.26	3.15
4	20.23	5.50	111.24	566.32	0.20	2.42
3	20.23	3.83	77.53	566.32	0.14	1.69
2	20.23	2.17	43.82	566.32	0.08	0.95
1	20.23	0.50	10.11	566.32	0.02	0.22

TOTAL = 121.35 lbs per rack P_{STATIC} = 101.13 lbs per post

$COMP._{MAX}$ = 299.00 lbs per post

DISTRIBUTED LATERAL FORCES

$$C_v x = \frac{W x h x^k}{\Sigma W_i h_i^k}$$

$F_x = (C_v x)\ V$

k = 1.0 since $T_a \leq 0.50$

V_{BASE} = 12 LBS $\Sigma (F_X * h)$ = 78.83 LBS-FT

UPLIFT FORCES FOR ANCHORS

L_W = 13 IN

L_L = 24 IN

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

OVERTURNING MOMENTS TOP SHELF LOADED - FRAME A (CONTINUED)

LEVEL	W (lbs.)	h (ft)	$W_x h_x^k$ (lbs-ft)	$\Sigma W_i h_i^k$ (lbs-ft)	$C_v x$	F_x (lbs)
6	49.83	8.83	440.19	564.78	0.78	3.71
5	6.50	7.17	46.58	564.78	0.08	0.39
4	6.50	5.50	35.75	564.78	0.06	0.30
3	6.50	3.83	24.92	564.78	0.04	0.21
2	6.50	2.17	14.08	564.78	0.02	0.12
1	6.50	0.50	3.25	564.78	0.01	0.03

TOTAL = 82.33 lbs per frame

DISTRIBUTED LATERAL FORCES

$$C_v x = \frac{W x h x^k}{\Sigma W_i h_i^k}$$

$F_x = (C_v x)\ V$

k = 1.0 since $T_a \leq 0.50$

V_{TOP} = 5 LBS

UPLIFT FORCES FOR ANCHORS

L_W = 13 IN

L_L = 24 IN

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

COMPONENT DESIGN FOR FRAME A

NOTE:SECTION PROPERTIES LISTED ON COMPONENT DESIGN SHEETS, REFER TO APPENDIX B IN REPORT, INDICATING SHAPE, SIZE & RISA SECTION PROPERTIES FOR EACH COMPONENT.

13 IN . SHELF: Fy = 20 KSI MIN.

LENGTH OF SHELF (L_L) = 2.00 FT W_{DL+LL} = 24.92 PLF

MAX. $M_{SHELF} = W_{DL+LL} \times L_L^2 / 8 \times 12$ = 149.50 LBS-IN

MAX. $V_{SHELF} = (W_{DL+LL} \times L_L / 2)$ = 24.92 LBS

FROM RISA SECTION:

REQD $S_X = M_{SHELF} / 0.6\ Fy$ = 0.012 IN^3 I_X = 0.096 IN^4

S_X = 0.082 IN^3 **OK**

REQD AREA = $V_{SHELF} / 0.4\ Fy$ = 0.003 IN^2

AREA = 0.600 IN^2 **OK**

THEREFORE SHELF IS OK

SHELF BRACKET: TL STYLE Fy = 50 KSI MIN.

MAX SPAN (L_S) = 13 IN LENGTH OF SHELF (L_L)= 2.00 FT

$w_{DL+LL+0.88PL} = (DL+LL+0.88PL) \times L_L / 2$ = 20.6 PLF

$P_{VERT\ IMPACT} = w_{DL+LL+0.88PL} \times 25\%$ = 5.15 LBS

$M(MAX) = [(w_{DL+LL+0.88PL} \times L_S^2 / 24) + (P_{VERT\ IMPACT} \times L_S)]$ = 212.01 LBS-IN

$V(MAX) = [(w_{DL+LL+0.88PL} \times Ls) + P_{VERT\ IMPACT}]$ = 27.47 LBS

ASSUME ONLY TOP CLIP IN TENSION AREA = 0.951" x 0.12" = 0.11 IN^2

TENSION CAPACITY = AREA x 0.6Fy = 3424 LBS

MOMENT CAPACITY = TENSION CAP. x 1.82 IN = 6231 LBS-IN

MOMENT CAPACITY > M(MAX) **OK**

CHECK SHEAR OF BRACKET

V_{ALLOW} = AREA x 0.4Fy = 3195.36 LBS **OK**

THEREFORE SHELF BRACKET IS OK

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

COMPONENT DESIGN - TRANSVERSE DIRECTION (FRAME A) CONT.

BASE CHANNEL: Fy = 45 KSI MIN.

Ω = 1.67

FROM FRAME --> $\Sigma (F_x \times h) = M_{SEISMIC}$

$M_{SEISMIC}$ = 946.00 LBS-IN

FROM RISA SECTION PROPS S_X = 0.670 IN^3

$fb/Fb = (M_{SEISMIC} /2) / (S_x \times Fy/\Omega)$ = 0.05 < 1.0

THEREFORE BASE CHANNEL IS OK

BASE BRACKET: Fy = 50 KSI MIN.

$M_{SEISMIC}$ = 946.00 LBS-IN

ASSUME BOTTOM CLIP IN TENSION AREA = 0.60" x 0.12" x 2 = 0.14 IN^2

$T_{CAPACITY}$ = AREA x Fy/Ω = 4311 LBS

$M_{CAPACITY}$ = TENSION CAP. x 5.69 in = 24531.7 LBS-IN

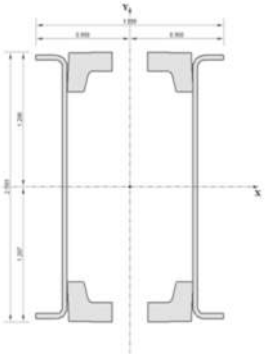
$fb/Fb = (M_{SEISMIC} / (M_{CAPACITY})$ = 0.04 < 1.0

THEREFORE BASE BRACKET IS OK

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

COMPONENT DESIGN - TRANSVERSE DIRECTION (FRAME A)

UPRITE .



SECTION PROPERTIES

SIZE =	UP-STD-Lozier		MAX HT =	132	IN
AREA =	0.757	IN^2	Fy =	55,000	PSI
Ix =	0.817	IN^4	Iy =	0.237	IN^4
Sx =	0.630	IN^3	Sy =	0.250	IN^3
rx =	1.039	IN	ry =	0.560	IN
C_{mx}=	0.6		Ωc=	1.80	
Unbrace Lx-x =	132	IN	Ωb=	1.67	
Unbrace Ly-y =	20	IN	Kx =	1.7	(RMI Sec. 6.3.1.1)
SPAN (L_S) =	13	IN	Ky =	1.0	(RMI Sec. 6.3.1.2)
δ_{SE} =	0.54	IN			
δ_X =	1.26	IN < 5% Structural Height OK			

P_{STATIC} = 200.51 LBS MAX

$M_{STATIC} = P_{STATIC} \times L_S / 24$ = 108.61 LBS-FT

$\frac{kLx}{rx} = \frac{(1.7)(132)}{1.039IN}$ = 215.98 <-- CONTROLS

COLUMN SECTION

$\frac{kLy}{ry} = \frac{(1)(20)}{0.56IN}$ = 35.71

$Fa = \frac{\pi^2 * E}{(Kl/r)^2}$ = 6136 PSI

$\lambda c = (Fy / Fa)^{1/2}$ = 2.99 >1.5

$Fn = \begin{cases} \lambda c < 1.5 & (0.658^{\lambda c2})Fy \\ \lambda c > 1.5 & (0.877/\lambda c^2)Fy \end{cases}$ = 5381 PSI

$Pn = AREA * F_n$ = 4073.60 LBS

$P_{EX} = (\pi^2 E I_X) / (K_X L_X)^2$ = 4643.81 LBS

$\alpha_x = 1 - (\Omega_c P/Pex)$ = 0.92

MAX MOMENT IN COLUMN

$Mx = M_{STATIC}$ = 108.61 LBS-FT <--- CONTROLS

$Mx = M_{SEISMIC} = \Sigma(F_x \times h)$ = 78.83 LBS-FT

$M_n = Sx * Fy$ = 2887.50 LBS-FT

COMBINED STRESS = fa/Fa + fb/Fb =

$(\Omega c P/P_n) + (\Omega_p C_{mx} M_x / M_n \alpha_x)$ = 0.13 < 1.0

THEREFORE UPRITE IS OK

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

COMPONENT DESIGN - LONGITUDINAL DIRECTION (FRAME A)

RELATIVE SHELF STIFFNESS (13". SHELF): E = 29000 KSI

I_{SHELF} = 0.096 IN^4 L_L = 24 IN

$K_{SHELF} = 384EI / L_L^3$ = 77.333

RELATIVE UPRITE STIFFNESS:

I_{UPRITE} = 0.237 IN^4 UNBRACED H = 20 IN

$K_{UPRITE} = 24EI / H^3$ = 20.619

FROM RISA MODEL (SEE NEXT 4 PAGES):

SHELF DESIGN: MAX. M = 0.021 K-FT

MAX. $M_{IMPACT} = P_{VERT\ IMPACT} * L_S$ = 0.006 K-FT

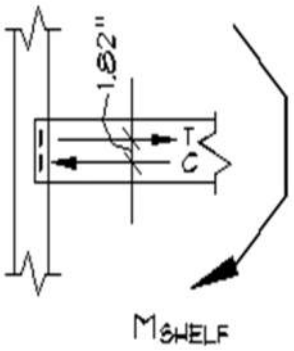
MAX. M = 0.027 K-FT

Sx = 0.082 IN^3

Mallow = $Sx*Fy/\Omega$ = 0.082 K-FT

Mallow > MAX. M **OK**

T = C = M * 12 / 1.82 = 0.18 KIP



ALLOWABLE SHEAR TO RESIST MOMENT:

TAB DISTANCE = 1.82 IN

TAB = 0.95 IN

t = 11 GA

AREA OF TAB = 0.11 IN^2 (SEE COMP.CALCS)

FY = 50 KSI

V_{ALLOW} = 0.4 AREA FY = 2.27 KIP

T = C < V_{ALLOW} **OK**

UPRITE . DESIGN: MAX UNBRACED HT (L_U) = 20 IN Fy = 55000 PSI

L_S = 13 IN

SECTION PROPERTIES FROM RISA SECTION:

AREA = 0.757 IN^2 Sy = 0.250 IN^3

Iy = 0.237 IN^4

$M_{STATIC} = P_{STATIC} /2 * L_S /2$ = 328.67 IN-LBS ry = 0.560 IN

$\frac{kLy}{ry} = \frac{(0.8)(MAX\ HT)}{0.56}$ = 28.57 Fa = $\frac{12 * \pi^2 * E}{23(Kl/r)^2}$ = 182931 PSI

$fa/Fa = (P_{STATIC})/(AREA*Fa)$ = 0.001 $fb/Fb = (M_{STATIC}) / (Sy*Fy/\Omega)$ = 0.040

fa/Fa + fb/Fb = 0.041 < 1.00

FROM RISA MODEL OF FRAME A ===> $M_{STATIC} + M_{SEISMIC\ (y-y)}$ = 2 LBS-FT

$fb/Fb = (M_{STATIC} + M_{SEISMIC}) / (Sy*Fy/\Omega)$ = 0.003 fa/Fa + fb/Fb = 0.004 < 1.00

THEREFORE UPRITE IS OK

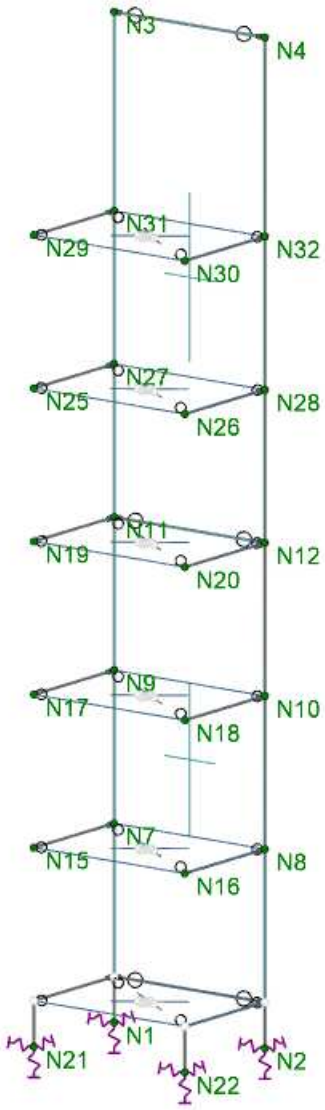
JPH & CLARK, INC.

CONSULTING STRUCTURAL ENGINEERING

1801 N. HAMPTON RD., SUITE 440

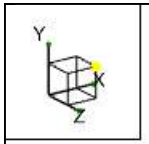
DESOTO, TX 75115-2399

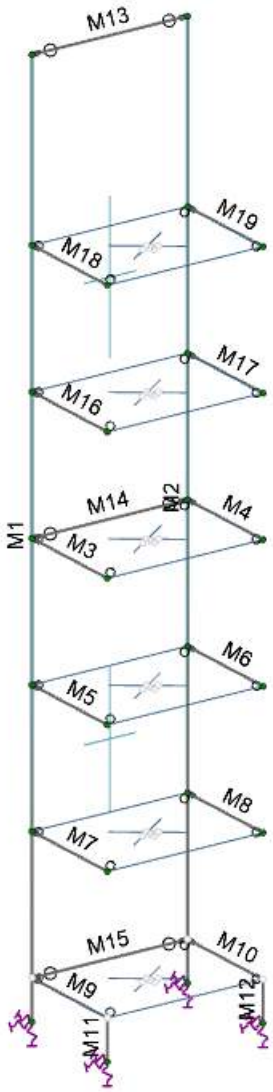
(972) 283-5111



Envelope Only Solution

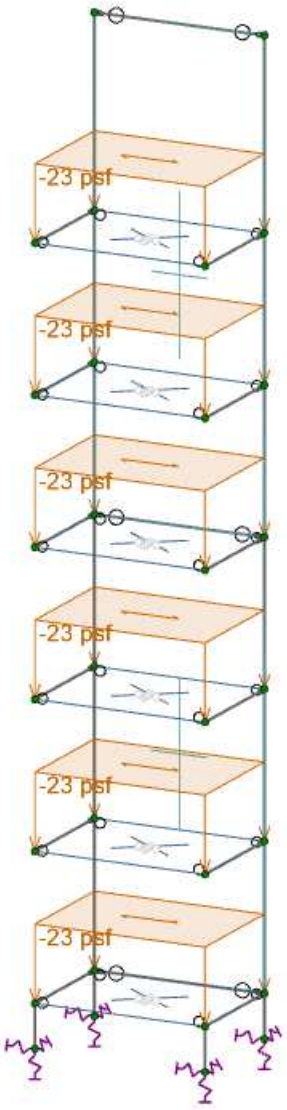
JPH & CLARK, Inc	Frame A1 - 13x24x132 - Endcap		SK-1
AA			Aug 27, 2026 at 05:31 PM
26-460 Advanced Auto Parts	Nodes Layout		AAP_A1 - 13x24x132 - 6Lvl - 1 Bay.r3d





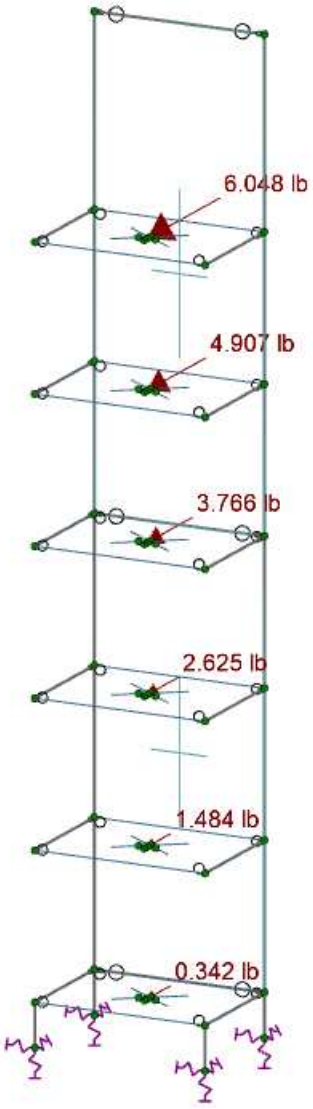
Envelope Only Solution

JPH & CLARK, Inc		Frame A1 - 13x24x132 - Endcap	SK-3
AA			Aug 27, 2026 at 05:33 PM
26-460 Advanced Auto Parts		Members Label	AAP_A1 - 13x24x132 - 6Lvl - 1 Bay.r3d



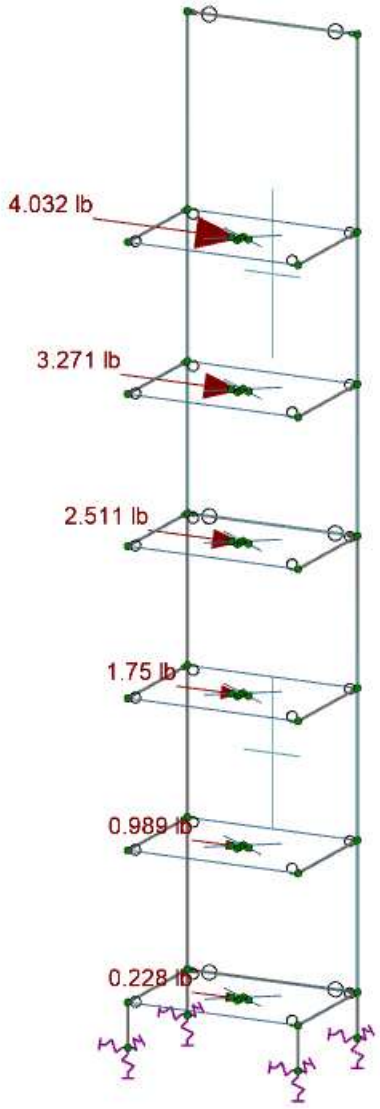
Loads: LC 3, LC-3
Envelope Only Solution

JPH & CLARK, Inc	Frame A1 - 13x24x132 - Endcap	SK-1
AA		Aug 27, 2026 at 05:35 PM
26-460 Advanced Auto Parts	DL + LL	AAP_A1 - 13x24x132 - 6Lvl - 1 Bay.r3d



Loads: BLC 3, ELZ
Envelope Only Solution

JPH & CLARK, Inc		Frame A1 - 13x24x132 - Endcap	SK-2
AA			Aug 27, 2026 at 05:35 PM
26-460 Advanced Auto Parts		ELZ	AAP_A1 - 13x24x132 - 6Lvl - 1 Bay.r3d



Loads: BLC 4, ELX
Envelope Only Solution

JPH & CLARK, Inc	Frame A1 - 13x24x132 - Endcap	SK-3
AA		Aug 27, 2026 at 05:36 PM
26-460 Advanced Auto Parts	ELX	AAP_A1 - 13x24x132 - 6Lvl - 1 Bay.r3d

Node Boundary Conditions

	Node Label	X [k/in]	Y [k/in]	Z [k/in]
1	N21	S20	S20	S20
2	N1	S20	S20	S20
3	N2	S20	S20	S20
4	N22	S20	S20	S20

Hot Rolled Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm. Coeff. [1e⁵°F⁻¹]	Density [k/ft³]	Yield [ksi]	Ry	Fu [ksi]	Rt
1	A1008_50	29000	11154	0.3	0.65	0.49	50	1.2	60	1.1
2	A1011_50	29000	11154	0.3	0.65	0.49	50	1.2	60	1.1

Hot Rolled Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rule	Area [in²]	Iyy [in⁴]	Izz [in⁴]	J [in⁴]
1	SHELF-STD-BRK	LOZIER-SHLF-STD-BRK	Beam	RECT	A1011_50	Typical	0.223	0.000268	0.064	0.001
2	BASE-BRK	HD BASE SECTION-N_HRA	Beam	Wide Flange	A1011_50	Typical	0.662	0.047	2.411	0.000485
3	SS-SPANNER	TMB-RAIL-L	HBrace	Wide Flange	A1008_50	Typical	0.279	0.02	0.281	0.000295

Cold Formed Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm. Coeff. [1e⁵°F⁻¹]	Density [k/ft³]	Yield [ksi]	Fu [ksi]
1	A1011 Gr60	29000	11346	0.3	0.65	0.49	60	75
2	A607 C1 Gr.55	29500	11346	0.3	0.65	0.49	55	70

Cold Formed Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rule	Area [in²]	Iyy [in⁴]	Izz [in⁴]	J [in⁴]
1	C-STD-UPRIGHT	UP-STD-LOZ	Column	None	A607 C1 Gr.55	Typical	0.757	0.237	0.817	1.039

Basic Load Cases

	BLC Description	Category	Nodal	Distributed	Area(Member)
1	DL	DL			6
2	PLL	LL			6
3	ELZ	ELZ	6		
4	ELX	ELX	6		
5	BLC 1 Transient Area Loads	None		12	
6	BLC 2 Transient Area Loads	None		12	

Load Combinations

	Description	Solve	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
1	LC-1	Yes	DL	1								
2	LC-2	Yes	LL	1								
3	LC-3	Yes	DL	1	LL	1						
4	LC-4-AEL	Yes	DL	1	LL	0.67						
5	LC-5	Yes	DL	1	LL	0.67	ELX	0.525				
6	LC-6	Yes	DL	1	LL	0.67	ELZ	0.525				
7	LC-7	Yes	DL	1	Sds*DL	0.105	LL	0.735	LL	0.016	Rho*ELX	0.525
8	LC-8	Yes	DL	1	Sds*DL	0.14	LL	0.595	LL	0.022	Rho*ELX	0.7
9	LC-9	Yes	DL	0.6	Sds*DL	-0.14	LL	0.402	LL	-0.021	Rho*ELX	0.7
10	LC-10	Yes	DL	1	Sds*DL	0.105	LL	0.735	LL	0.016	Rho*ELZ	0.525
11	LC-11	Yes	DL	1	Sds*DL	0.14	LL	0.595	LL	0.022	Rho*ELZ	0.7
12	LC-12	Yes	DL	0.6	Sds*DL	-0.14	LL	0.402	LL	-0.021	Rho*ELZ	0.7
13												
14	AB-FLC5-1	Yes	DL	1.2	Sds*DL	0.2	LL	0.84	LL	0.031	Om*ELX	1
15	AB-FLC5-2	Yes	DL	1.2	Sds*DL	0.2	LL	0.84	LL	0.031	Om*ELZ	1
16	AB-FLC5-3	Yes	DL	1.2	Sds*DL	0.2	LL	0.84	LL	0.031	Om*ELX	-1

Load Combinations (Continued)

	Description	Solve	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
17	AB-FLC5-4	Yes	DL	1.2	Sds*DL	0.2	LL	0.84	LL	0.031	Om*ELZ	-1
18	AB-FLC7-5	Yes	DL	0.9	Sds*DL	-0.2	LL	0.603	LL	-0.029	Om*ELX	1
19	AB-FLC7-6	Yes	DL	0.9	Sds*DL	-0.2	LL	0.603	LL	-0.029	Om*ELZ	1
20	AB-FLC7-7	Yes	DL	0.9	Sds*DL	-0.2	LL	0.603	LL	-0.029	Om*ELX	-1
21	AB-FLC7-8	Yes	DL	0.9	Sds*DL	-0.2	LL	0.603	LL	-0.029	Om*ELZ	-1

Node Loads and Enforced Displacements (BLC 3 : ELZ)

	Node Label	L, D, M	Direction	Magnitude [(lb, lb-ft), (in, rad), (lb*s²/in, lb*s²*in)]
1	N31A	L	Z	6.048
2	N32A	L	Z	4.907
3	N33	L	Z	3.766
4	N34	L	Z	2.625
5	N35	L	Z	1.484
6	N36	L	Z	0.342

Node Loads and Enforced Displacements (BLC 4 : ELX)

	Node Label	L, D, M	Direction	Magnitude [(lb, lb-ft), (in, rad), (lb*s²/in, lb*s²*in)]
1	N31A	L	X	4.032
2	N32A	L	X	3.271
3	N33	L	X	2.511
4	N34	L	X	1.75
5	N35	L	X	0.989
6	N36	L	X	0.228

Member Area Loads (BLC 1 : DL)

	Node A	Node B	Node C	Node D	Direction	Load Direction	A Magnitude [psf]	B Magnitude [psf]	C Magnitude [psf]	D Magnitude [psf]	Exclude Braces
1	N19	N20	N12	N11	Y	A-B	-3	-3	-3	-3	Yes
2	N17	N18	N10	N9	Y	A-B	-3	-3	-3	-3	Yes
3	N15	N16	N8	N7	Y	A-B	-3	-3	-3	-3	Yes
4	N13	N14	N6	N5	Y	A-B	-3	-3	-3	-3	Yes
5	N25	N26	N28	N27	Y	A-B	-3	-3	-3	-3	Yes
6	N29	N30	N32	N31	Y	A-B	-3	-3	-3	-3	Yes

Member Area Loads (BLC 2 : PLL)

	Node A	Node B	Node C	Node D	Direction	Load Direction	A Magnitude [psf]	B Magnitude [psf]	C Magnitude [psf]	D Magnitude [psf]	Exclude Braces
1	N19	N20	N12	N11	Y	A-B	-20	-20	-20	-20	Yes
2	N17	N18	N10	N9	Y	A-B	-20	-20	-20	-20	Yes
3	N15	N16	N8	N7	Y	A-B	-20	-20	-20	-20	Yes
4	N13	N14	N6	N5	Y	A-B	-20	-20	-20	-20	Yes
5	N25	N26	N28	N27	Y	A-B	-20	-20	-20	-20	Yes
6	N29	N30	N32	N31	Y	A-B	-20	-20	-20	-20	Yes

Diaphragms

	Node Label	Plane	Inactive	No Wind/Drift
1	N14	ZX		
2	N8	ZX		
3	N10	ZX		
4	N12	ZX		
5	N28	ZX		
6	N32	ZX		

Envelope Node Reactions

	Node Label		X [lb]	LC	Y [lb]	LC	Z [lb]	LC	MX [lb-ft]	LC	MY [lb-ft]	LC	MZ [lb-ft]	LC
1	N21	max	0.023	10	109.267	10	-1.479	1	0	12	0	12	0	12
2		min	-0.36	9	14.21	1	-14.469	11	0	1	0	1	0	1
3	N1	max	0.204	10	88.738	3	10.95	3	0	12	0	12	0	12
4		min	-4.058	9	5.216	12	1.428	1	0	1	0	1	0	1
5	N2	max	0.266	3	87.229	7	10.772	3	0	12	0	12	0	12
6		min	-4.028	9	2.372	12	1.405	1	0	1	0	1	0	1
7	N22	max	0.025	10	108.925	10	-1.49	1	0	12	0	12	0	12
8		min	-0.359	9	14.165	1	-14.571	11	0	1	0	1	0	1
9	N43	max	NC		NC		NC		LOCKED		NC		LOCKED	
10		min	NC		NC		NC		LOCKED		NC		LOCKED	
11	N37	max	NC		NC		NC		LOCKED		NC		LOCKED	
12		min	NC		NC		NC		LOCKED		NC		LOCKED	
13	N49	max	NC		NC		NC		LOCKED		NC		LOCKED	
14		min	NC		NC		NC		LOCKED		NC		LOCKED	
15	N55	max	NC		NC		NC		LOCKED		NC		LOCKED	
16		min	NC		NC		NC		LOCKED		NC		LOCKED	
17	N44	max	NC		NC		NC		LOCKED		NC		LOCKED	
18		min	NC		NC		NC		LOCKED		NC		LOCKED	
19	N50	max	NC		NC		NC		LOCKED		NC		LOCKED	
20		min	NC		NC		NC		LOCKED		NC		LOCKED	
21	N38	max	NC		NC		NC		LOCKED		NC		LOCKED	
22		min	NC		NC		NC		LOCKED		NC		LOCKED	
23	N56	max	NC		NC		NC		LOCKED		NC		LOCKED	
24		min	NC		NC		NC		LOCKED		NC		LOCKED	
25	N39	max	NC		NC		NC		LOCKED		NC		LOCKED	
26		min	NC		NC		NC		LOCKED		NC		LOCKED	
27	N45	max	NC		NC		NC		LOCKED		NC		LOCKED	
28		min	NC		NC		NC		LOCKED		NC		LOCKED	
29	N51	max	NC		NC		NC		LOCKED		NC		LOCKED	
30		min	NC		NC		NC		LOCKED		NC		LOCKED	
31	N57	max	NC		NC		NC		LOCKED		NC		LOCKED	
32		min	NC		NC		NC		LOCKED		NC		LOCKED	
33	N40	max	NC		NC		NC		LOCKED		NC		LOCKED	
34		min	NC		NC		NC		LOCKED		NC		LOCKED	
35	N46	max	NC		NC		NC		LOCKED		NC		LOCKED	
36		min	NC		NC		NC		LOCKED		NC		LOCKED	
37	N52	max	NC		NC		NC		LOCKED		NC		LOCKED	
38		min	NC		NC		NC		LOCKED		NC		LOCKED	
39	N58	max	NC		NC		NC		LOCKED		NC		LOCKED	
40		min	NC		NC		NC		LOCKED		NC		LOCKED	
41	N47	max	NC		NC		NC		LOCKED		NC		LOCKED	
42		min	NC		NC		NC		LOCKED		NC		LOCKED	
43	N41	max	NC		NC		NC		LOCKED		NC		LOCKED	
44		min	NC		NC		NC		LOCKED		NC		LOCKED	
45	N53	max	NC		NC		NC		LOCKED		NC		LOCKED	
46		min	NC		NC		NC		LOCKED		NC		LOCKED	
47	N59	max	NC		NC		NC		LOCKED		NC		LOCKED	
48		min	NC		NC		NC		LOCKED		NC		LOCKED	
49	N48	max	NC		NC		NC		LOCKED		NC		LOCKED	
50		min	NC		NC		NC		LOCKED		NC		LOCKED	
51	N54	max	NC		NC		NC		LOCKED		NC		LOCKED	
52		min	NC		NC		NC		LOCKED		NC		LOCKED	
53	N42	max	NC		NC		NC		LOCKED		NC		LOCKED	
54		min	NC		NC		NC		LOCKED		NC		LOCKED	
55	N60	max	NC		NC		NC		LOCKED		NC		LOCKED	
56		min	NC		NC		NC		LOCKED		NC		LOCKED	
57	Totals:	max	0.514	10	391.092	3	-0.136	1						
58		min	-8.805	9	51.012	1	-14.412	11						

Envelope Maximum Member Section Forces

	Member		Axial[lb]	Loc[in]	LCy	Shear[lb]	Loc[in]	LCz	Shear[lb]	Loc[in]	LC	Torque[lb-ft]	Loc[in]	LCy	y-y Moment[lb-ft]	Loc[in]	LCz	z-z Moment[lb-ft]	Loc[in]	LC
1	M12	max	108.925	6	10	0.359	6	9	-1.49	6	1	0	6	12	0	0	12	0.012	6	10
2		min	14.165	0	1	-0.025	0	10	-14.571	0	11	0	0	1	-7.286	6	11	-0.179	6	9
3	M11	max	109.267	6	10	0.36	6	9	-1.479	6	1	0	6	12	0	0	12	0.012	6	10
4		min	14.21	0	1	-0.023	0	10	-14.469	0	11	0	0	1	-7.235	6	11	-0.18	6	9
5	M1	max	159.2	13.75	3	10.95	5.5	3	2.879	13.75	9	0.313	13.75	10	0.126	35.75	3	0.515	107.25	8
6		min	-0.562	107.25	3	-7.087	20.625	11	-4.058	0	9	-4.574	23.375	9	-2.003	6.875	9	-132.072	6.875	10
7	M2	max	155.286	13.75	3	10.772	5.5	3	2.767	13.75	9	0.316	24.75	10	0.225	45.375	3	0.001	107.25	3
8		min	-0.58	107.25	3	-6.851	20.625	11	-4.028	0	9	-4.573	6.875	9	-1.987	6.875	9	-131.463	6.875	10
9	M15	max	0	22	12	0	22	12	0.134	22	3	0.005	22	7	0	22	12	0	22	12
10		min	0	0	1	0	0	1	-0.134	0	3	-0.005	0	10	-0.123	11	3	0	0	1
11	M14	max	0	22	12	0	22	12	0.067	4.125	8	0.001	4.125	8	0.025	4.354	8	0	22	12
12		min	0	0	1	0	0	1	-0.06	17.875	3	-0.001	17.875	3	-0.003	17.646	9	0	4.125	10
13	M13	max	-0.013	10.771	1	0	22	3	0.002	11	3	0	11	8	0.002	11	3	0.281	11	8
14		min	-0.101	11	3	-0.307	0	8	-0.002	11.229	3	0	11.229	3	0	0	1	-0.275	11.229	9
15	M3	max	0	15.704	12	32.591	0	3	0	15.704	12	0	15.704	12	0	15.704	12	21.325	0	3
16		min	0	0	1	0	15.704	9	0	0	1	0	0	1	0	0	1	0	15.704	1
17	M4	max	0	15.704	12	32.591	0	3	0	15.704	12	0	15.704	12	0	15.704	12	21.325	0	3
18		min	0	0	1	0	15.704	1	0	0	1	0	0	1	0	0	1	0	15.704	1
19	M5	max	0	15.704	12	32.591	0	3	0	15.704	12	0	15.704	12	0	15.704	12	21.325	0	3
20		min	0	0	1	0	15.704	9	0	0	1	0	0	1	0	0	1	0	15.704	1
21	M6	max	0	15.704	12	32.591	0	3	0	15.704	12	0	15.704	12	0	15.704	12	21.325	0	3
22		min	0	0	1	0	15.704	1	0	0	1	0	0	1	0	0	1	0	15.704	1
23	M7	max	0	15.704	12	32.591	0	3	0	15.704	12	0	15.704	12	0	15.704	12	21.325	0	3
24		min	0	0	1	0	15.704	9	0	0	1	0	0	1	0	0	1	0	15.704	1
25	M8	max	0	15.704	12	32.591	0	3	0	15.704	12	0	15.704	12	0	15.704	12	21.325	0	3
26		min	0	0	1	0	15.704	1	0	0	1	0	0	1	0	0	1	0	15.704	1
27	M9	max	0	15.704	12	-9.959	0	1	0	15.704	12	0.18	15.704	9	0	15.704	12	7.235	15.704	11
28		min	0	0	1	-109.267	15.704	10	0	0	1	-0.012	0	10	0	0	1	-119.191	0	10
29	M10	max	0	15.704	12	-9.914	0	1	0	15.704	12	0.179	15.704	9	0	15.704	12	7.286	15.704	11
30		min	0	0	1	-108.925	15.704	10	0	0	1	-0.012	0	10	0	0	1	-118.692	0	10
31	M16	max	0	15.704	12	32.591	0	3	0	15.704	12	0	15.704	12	0	15.704	12	21.325	0	3
32		min	0	0	1	0	15.704	9	0	0	1	0	0	1	0	0	1	0	15.704	1
33	M17	max	0	15.704	12	32.591	0	3	0	15.704	12	0	15.704	12	0	15.704	12	21.325	0	3
34		min	0	0	1	0	15.704	1	0	0	1	0	0	1	0	0	1	0	15.704	1
35	M18	max	0	15.704	12	32.591	0	3	0	15.704	12	0	15.704	12	0	15.704	12	21.325	0	3
36		min	0	0	1	0	15.704	9	0	0	1	0	0	1	0	0	1	0	15.704	1
37	M19	max	0	15.704	12	32.591	0	3	0	15.704	12	0	15.704	12	0	15.704	12	21.325	0	3
38		min	0	0	1	0	15.704	1	0	0	1	0	0	1	0	0	1	0	15.704	1

Material Take-Off

	Material	Size	Pieces	Length[in]	Weight[K]
1	General Members				
2	RIGID		2	12	0
3	General Walls			Volume (yds^3)	
4	gen-cf		2	0	0.01
5	Total General		4	12	0.01
6					
7	Hot Rolled Steel				
8	A1008_50	TMB-RAIL-L	3	66	0.005
9	A1011_50	HD BASE SECTION-N_HRA	2	31.4	0.006
10	A1011_50	LOZIER-SHLF-STD-BRK	10	157	0.01
11	Total HR Steel		15	254.4	0.021
12					
13	Cold Formed Steel				
14	A607 C1 Gr.55	UP-STD-LOZ	2	264	0.057
15	Total CF Steel		2	264	0.057
16					
17	Plate Elements	Thickness (in)		Volume (yds^3)	
18	STL	0	6	0	0.015
19	Total Plates		6	0	0.015

Frame B

Lozier Battery Rack

30"B x 50"L x 96"H - Wide Span (2 Levels)

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

SEISMIC DESIGN FRAME B 30"B x 50"L x 96"H Battery

SEISMIC FORCES

Code Refrence

Seismic Code : **ASCE 7-10**
EQUIVALENT LATERAL FORCE PROCEDURE FOR SHELVING
& RMI (AS IT APPLIES)

Dimension

Frame :	**B**		Max. Shelving Height :	**96**	in
Width :	**30**	in	Levels :	**5**	
Length :	**50**	in	Shelf type :	**Battery**	

Site parameters (ASCE 7 section 11.4)

Site class	**D (Default)**				
Mapped acceleration parameters					
at short periods	Ss =	**0.206**	at 1 sec. period	S_1 =	**0.106**
Site coefficient at short periods	Fa =	**1.600**	at 1 sec. period	Fv =	**2.376**

Spectral response accelaration parameters (ASCE 7 section 11.4)

at short periods		**0.071**			**0.050**
	Calc. SMS =	**0.330**	at 1 sec. period	Calc. SM1 =	**0.252**

Design spectral acceleration parameters (ASCE 7 section 11.4)

at short periods	S_{DS} =	**0.220**	at 1 sec. period	S_{D1} =	**0.168**

Seismic design category (ASCE 7 section 11.6)

Risk Category	**II**
Seismic design category	**C**

Approximate fundamental period (ASCE 7 section 12.8.2.1)

Height above base to highest level	hn =	**8.00**	ft
Structure Type		**4**	
Long-period transition	TL =	**12**	Figs. 22-14 thru 22-17
Building period parameter Ct	Ct =	**0.020**	
Building period parameter x	x =	**0.75**	
Building fundamental period	T = Ta =	**0.095**	sec.
Exponent related to structure period	k =	**1**	since Ta ≤ 0.50 sec

Seismic response coefficient (ASCE 7 section 15.5 & RMI 2.6.3)

Response modification factor (Transverse)	R =	**4**	
Response modification factor (Longitudinal)	R =	**6**	
Seismic importance factor	Ie =	**1.5**	(ASCE 7 15.5.3,RMI Sec. 2.6.2)
Redundancy factor	ρ =	**1.0**	RMI Sec. 2.6.2.1; ASCE7 Sec.12.4.2.1
	Cd =	**3.5**	

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

Operating Weight (RMI 2.1 & ASCE 7 section 15.5)

Loads

DL : **5** psf

LEVEL	Height/LVL (in)	Input Shelf Load (PL) (lbs.)	Calculated (lbs.)
5	**28**	**500**	500
4	**16**	**500**	500
3	**16**	**500**	500
2	**16**	**500**	500
1	**10**	**500**	500
		Total PL :	2,500

DL = 5 PSF x 2.5 FT x 4.17 FT x 5 SHELVES = 260.42 lbs
PL app = 2,500 LBS x 0.67 = 1,675.00 lbs
PL (top shelf) = 500.00 lbs

Ws = DL+67%PL+0.25LL (Per Storage Rack Section)
67%PL (every shelf loaded 67% of its rated load)(PL app)
100%PL (top shelf only loaded 100% of its rated load)
V_{BASE} = Cs Ws

Seismic base shear (ASCE 7 section 12.8)

		Transverse	Longitudinal
Seismic response coefficient	Cs =	**0.082**	**0.055**
Seismic response coefficient max.	$Cs_{, MAX}$ =	**0.662**	**0.441**
Seismic response coefficient min.	$Cs_{, MIN}$ =	**0.015**	**0.015**
Seismic response coefficient (Governs)	Cs =	**0.082**	**0.055**

LOAD COMBINATION ASD (RMI 2.1)	W_{LC}	Ws	E (factor)	V_{BASE} Transverse	V_{BASE} Longitudinal	
DL+0.67PL+0.75(0.7ρE)	1,935.42	1,935.42	0.525	84	56	
(1+0.105S_{DS})DL+0.75[(1.4+0.14S_{DS})0.7PL+0.7ρE]	2,144.30	1,935.42	0.525	84	56	
(1+0.14S_{DS})DL+(0.85+0.14S_{DS})0.7PL+0.7ρE	1,809.76	1,935.42	0.700	112	74	**CONTROLS**
(0.6 - 0.14S_{DS})DL+(0.6 - 0.14S_{DS})0.67PL+0.7ρE	1,101.71	1,935.42	0.700	112	74	
Seismic base shear			$V_{BASE\ MAX.\ CONTROL}$	112	74	

$W_{s\ CONTROL}$= 1,809.76 LBS

Anchors in accordance with ACI318 Sec.17 Ωo = 2.0 (ACI318 Sec.17; ASCE7 Table 15.4-1)

	Transverse	Longitudinal	
$V_{BASE\ 67\%PL}$ =	**112**	**74**	lbs
$V_{BASE\ 100\%PL\ TOP}$ x 0.7ρ=	**44**	**30**	lbs

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

SEISMIC LATERAL FORCE DISTRIBUTION - FRAME B (CONTINUED)

LEVEL	W (lbs.)	h (ft)	$W_x h_x^k$ (lbs-ft)	$C_v x$	Transverse F_x (lbs)	Longitudinal F_x (lbs)
5	361.95	7.17	2593.99	0.39	43.25	28.83
4	361.95	4.83	1749.44	0.26	29.17	19.44
3	361.95	3.50	1266.83	0.19	21.12	14.08
2	361.95	2.17	784.23	0.12	13.07	8.72
1	361.95	0.83	301.63	0.05	5.03	3.35
Σ	1809.76	Σ	6696.12	Base :	111.63	74.42
P_{STATIC} =	904.88	lbs per post		$COMP._{MAX}$ =	1380	lbs per post

$V_{BASE\ 67\%PL}$ (Transverse): 112 lbs

$V_{BASE\ 67\%PL}$ (Longitudinal): 74 lbs

Σ (F_X * h) (Transverse) : 6,688 lbs-in

Σ (F_X * h) (Longitudinal) : 4,459 lbs-in

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

SEISMIC LATERAL FORCE DISTRIBUTION TOP SHELF LOADED - FRAME B (CONTINUED)

					Transverse	Longitudinal
LEVEL	W (lbs.)	h (ft)	$W_x h_x^k$ (lbs-ft)	$C_v x$	F_x (lbs)	F_x (lbs)
3	52.08	3.50	182.29	0.04	1.76	1.20
2	52.08	2.17	112.85	0.02	1.09	0.74
1	52.08	0.83	43.40	0.01	0.42	0.29
	Σ 760.42		Σ 4546.88	Base :	44.00	30.00

$V_{BASE\ 100\%PL\ TOP}$ (Transverse): 44 LBS Σ (F_X * h) (Transverse) : 3,541 lbs-in

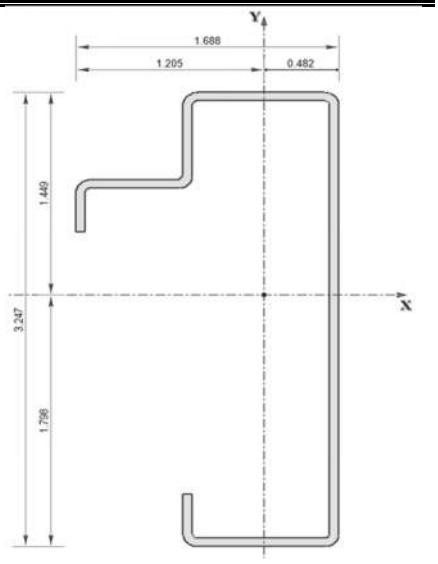
$V_{BASE\ 100\%PL\ TOP}$ (Longitudinal): 30 LBS Σ (F_X * h) (Longitudinal) : 2,414 lbs-in

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

BEAM DESIGN FOR FRAME B

SECTION PROPERTIES:

MAX L :	50	in			
Size :	3.25"x16ga				
H :	3.25	IN			
t :	16	GA	Fy :	45,000	PSI
Area :	0.413	IN^2	E :	29,500	KSI
Ix :	0.572	IN^4	Iy :	0.116	IN^4
Sx :	0.318	IN^3	Sy :	0.096	IN^3
rx :	1.176	IN	ry :	0.529	IN



BEAM SECTION

MAX ALLOWABLE LOAD - BENDING: (AISI Sec. C3.1.3)

Mn (MAX) = 0.6 * Sx * Fy = 8586 LBS-IN

CAPACITY = 2(8 * M / L) = 2747.52 LBS

MAX ALLOWABLE LOAD - DEFLECTION (L/180): (RMI Sec. 5.3)

ALLOW DEFLECTION = 5 wL^4 / 384 E I

CAPACITY = 2 [(384 E I) / (5*180*L^2)] = 5759.66 LBS

MAXIMUM STATIC ALLOWABLE LOAD PER LEVEL= 2747.52 LBS

ALLOWABLE AND ACTUAL BENDING MOMENT PER LEVEL (RMI Sec.2.1.5 & 2.3)

MAX BENDING MOMENT

Wstatic = (DL + LL + 0.88PL) / 50" = 9.84 LBS/IN

$M_{STATIC\ (DL + LL + 0.88PL)} = W_{STATIC}\ L^2$ / 8 = 3075.52 LBS-IN

$P_{VERTICAL\ IMPACT}$ = Wstatic x 25% = 29.53 LBS

$M_{VERTICAL\ IMPACT} = P_{VERTICAL\ IMPACT}$ x L / 4 = 369.06 LBS-IN

$M_{STATIC+IMPACT}$ = 3444.58 LBS-IN

ALLOWABLE BENDING MOMENT

$M_{ALLOW(STATIC)}$ = 17172.00 LBS-IN

$M_{STATIC+IMPACT}$ < $M_{ALLOW(STATIC)}$ OK

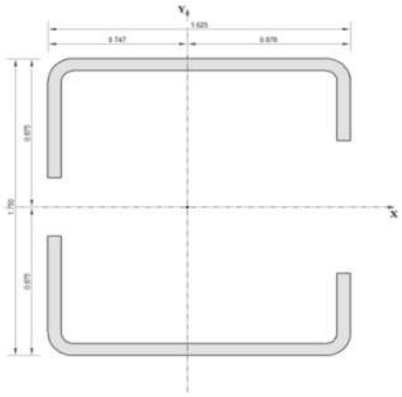
JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

WS STD UPRITE DESIGN FOR FRAME - B

SECTION PROPERTIES

MAX HT = 96 IN

SIZE =	1.625x1.75x14ga		Fy =	45	ksi
t =	14	GA	E =	29500	ksi
AREA =	0.372	in^2	Iy =	0.133	in^4
Ix =	0.202	in^4	Sy =	0.151	in^3
Sx =	0.231	in^3	ry =	0.597	in
rx =	0.738	in	Ωc=	1.80	
C_{mx}=	1.00		Ωb=	1.67	
Unbrace Lx-x =	25	in	Kx =	1.7	
Unbrace Ly-y =	30	in	Ky =	1.0	
δ_{SE} =	0.04	IN			
δ_X =	0.09	IN < 5% Structural Height OK			



COLUMN SECTION

P_{static} = 951 lbs

$\frac{kLx}{rx}$	=	$\frac{(1.7)(24.75)}{0.738in}$	=	57.01		$\frac{kLy}{ry}$	=	$\frac{(1)(30)}{0.597in}$	=	50.25	
Fax	=	$\frac{\pi^2 * E}{(Klx/rx)^2}$	=	89575	PSI	Fay	=	$\frac{\pi^2 * E}{(Kly/ry)^2}$	=	115300	psi
λc	=	$(Fy / Fax)^{1/2}$	=	0.71	<1.5	λc	=	$(Fy / Fay)^{1/2}$	=	0.62	<1.5
Fn	=	λc < 1.5 $(0.658^{\lambda c2})Fy$ λc > 1.5 $(0.877/\lambda c^2)Fy$	=	36467	psi	Fn	=	λc < 1.5 $(0.658^{\lambda c2})Fy$ λc > 1.5 $(0.877/\lambda c^2)Fy$	=	38218	psi
Pn	=	AREA * F_n	=	13566	lbs	Pn	=	AREA * F_n	=	14217	lbs
P_{EX}	=	$(\pi^2 E I_X) / (K_X L_X)^2$	=	33222	lbs	P_{EY}	=	$(\pi^2 E I_Y) / (K_Y L_Y)^2$	=	43026	lbs
α_x	=	$1 - (\Omega_c Px/Pex)$	=	0.95		α_y	=	$1 - (\Omega_c Px/Pey)$	=	0.96	

MAX MOMENT IN COLUMN

Mx = M_{STATIC} + $M_{SEISMIC}$ =	0.01	lbs-ft	M_{nx} = Sx * Fy =	866.25	lbs-ft
My = M_{STATIC} + $M_{SEISMIC}$ =	58.32	lbs-ft	M_{ny} = Sy * Fy =	566.25	lbs-ft

COMBINED STRESS (fa/Fa + fb/Fb)

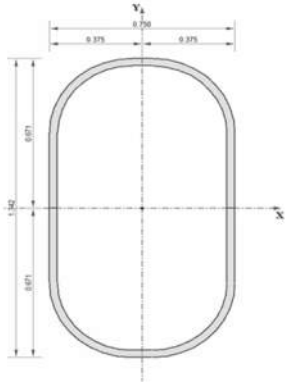
RISA3D Lateral Load X-Direction

$(\Omega c Px/P_n) + (\Omega_b C_{mx} M_x/M_n \alpha_{x1}) + (\Omega_b C_{my} M_y/M_{ny} \alpha_{y1})$ = 0.31 < 1.0 **THEREFORE UPRITE IS OK**

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

TRANSVERSE BRACING - FRAME B

SECTION PROPERTIES:



P_{MEMBER} = 180 LBS - WORST CASE

HORIZONTAL BRACINGS:

AREA = 0.115 IN^2
r_x = 0.453 IN
d = 30 IN

$$\frac{kl_x}{r_x} = \frac{(0.8)(30IN)}{0.453IN} = 52.98$$

$$\frac{kl_x}{r_x} < 200 \quad \textbf{OK}$$

$$Fa = \frac{\pi^2 E}{(kl/r)2} = 101970 \text{ PSI}$$

$$\frac{fa}{Fa} = \frac{V_{BASE}}{AREA \times Fa}$$
$$= 0.015 < 1.0 \quad \textbf{OK}$$

DIAGONAL BRACING:

AREA = 0.115 IN^2
r_x = 0.453 IN
d = 30 IN
l = 38 IN

THE LENGTH OF THE BRACE:

$L = (d^2 + l^2)^{0.5}$ = 4.03 FT
L = 48.41 IN

$V_{DIAG} = V_{BASE}$ * (LENGTH OF THE BRACE/ DEPTH)
= 290 LBS

$$\frac{kl_x}{r_x} = \frac{(1)(48.41IN)}{0.453IN} = 106.88$$

$$\frac{kl_x}{r_x} < 200 \quad \textbf{OK}$$

$$Fa = \frac{\pi^2 E}{(kl/r)2} \quad 25057 \text{ PSI}$$

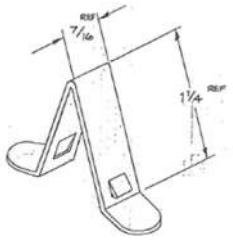
$$\frac{fa}{Fa} = \frac{V_{DIAG}}{AREA \times Fa}$$
$$= 0.101 < 1.0 \quad \textbf{OK}$$

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

BEAM TO COLUMN CONNX - FRAME B

BEAM TO COLUMN CONNECTION PROVIDE ADEQUATE MOMENT CAPACITY TO STABLIZE THIS SYSTEM, ALTHOGH IT DOES NOT PROVIDE 100% FIXITY. THUS, THE BEAMS WILL BE ANALYSED ASSUMING THEY HAVE PINNED ENDS. FOR THE COMPUTATION OF BEAM TO COL. MOMENT CAPACITY, THE PARTIAL FIXITY OF THE BEAM,(ASSUMED AT AN ARBITRARY 25% OF THE FIXED END MOMENT OR 2000 IN-LB WHICH EVER IS SMALLER) WILL BE ADDED

CAPACITY OF CONNECTOR:



BEAM LOCKING DEVICE (TWO CLIPS) (RMI 7.1.2)

AREA = 7/16 * 0.03 *2 = 0.026 IN^2

Fy = 50000 PSI

Fv = 2 * 0.4 * A * Fy

V_{MAX} = 1050 LBS >1000 LBS OK

BEAM TO BRACKET WELD CAPACITY

1/8" * 14.84 KSI = 1855 LBS/IN <--- CONTROLS

0.061" * 26 KSI * 1.33 = 2109 LBS/IN

L_{WELD} = 3 IN

CAPACITY = 5565 LBS

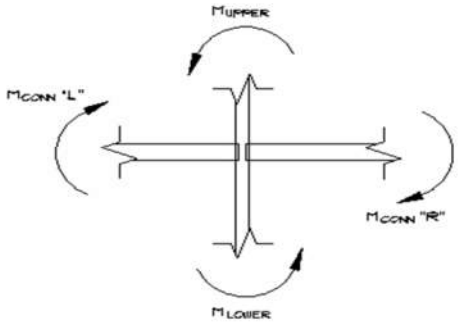
a) SHEAR CAPACITY OF 1/2" TAB

AREA = 0.105" * 1/2" = 0.053 IN^2

Fy = 50000 PSI

Fv = 0.4 * A * Fy

V_{MAX} = 1050 LBS



b) BEARING ON COLUMN

D = 0.420 IN

t = 0.072 IN

BEARING AREA = t * D = 0.030 IN^2

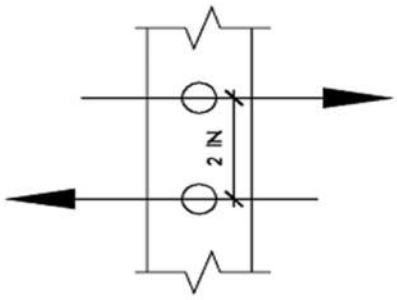
Fy = 50000 PSI

$P_{MAX\ BEARING}$ = BRG AREA * 1.2 * Fy = 1814 LBS

SINCE SHEAR GOVERNS P1 = 1050 LBS

$M_{CONN\ CAPACITY}$ = (P1 * 2") = 2100 LBS-IN

$M_{CONN\ SEISMIC}$ = 1.33 * $M_{CONN\ CAPACITY}$ = 2793 LBS-IN



FROM MODEL RISA $M_{MAX\ BEAM}$ = 1,382 LBS-IN

FROM MODEL RISA $M_{MAX\ BEAM\ 25\%}$ = 345 LBS-IN < $M_{CONN\ SEISMIC}$

OK

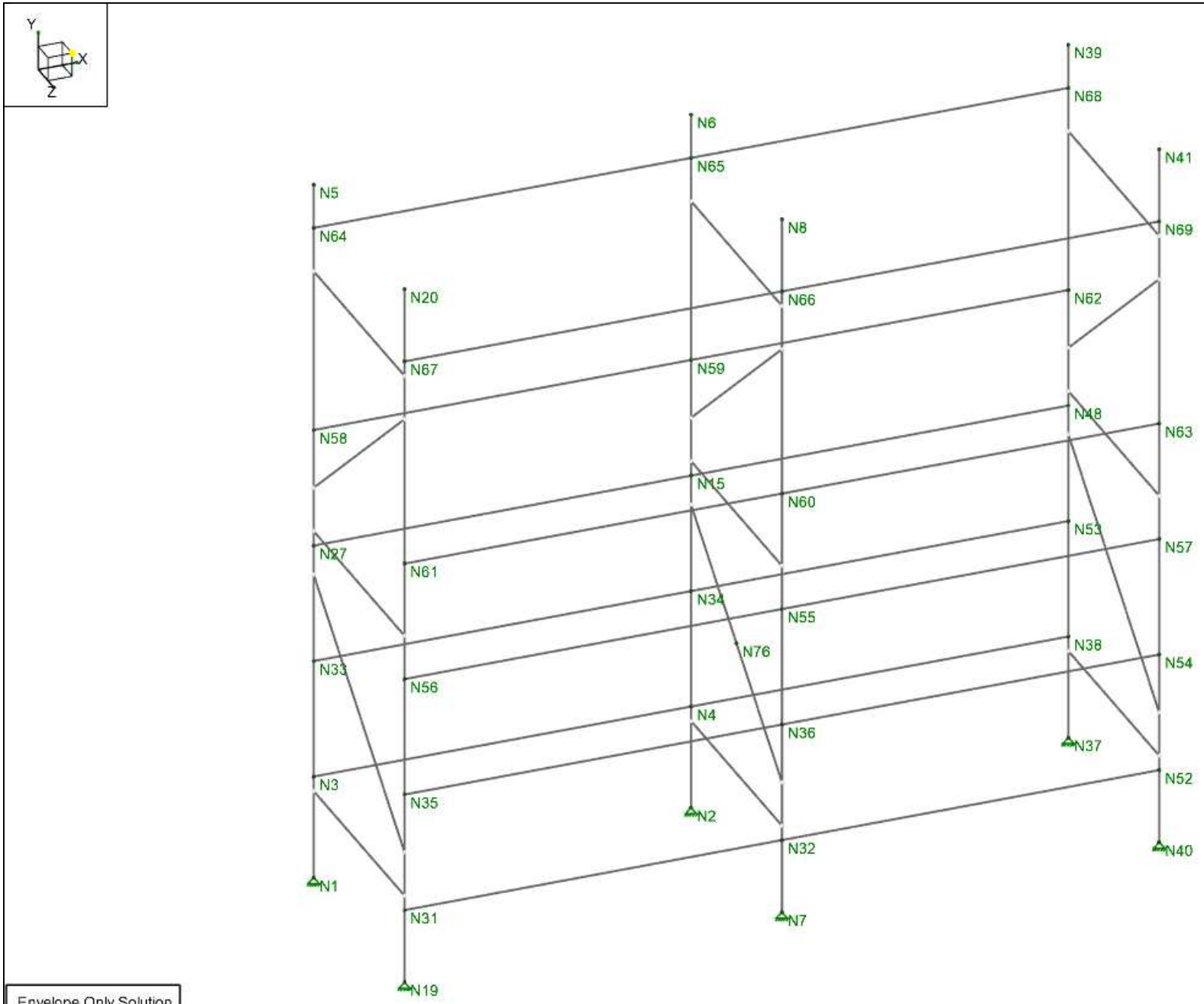
JPH & CLARK, INC.

CONSULTING STRUCTURAL ENGINEERING

1801 N. HAMPTON RD., SUITE 440

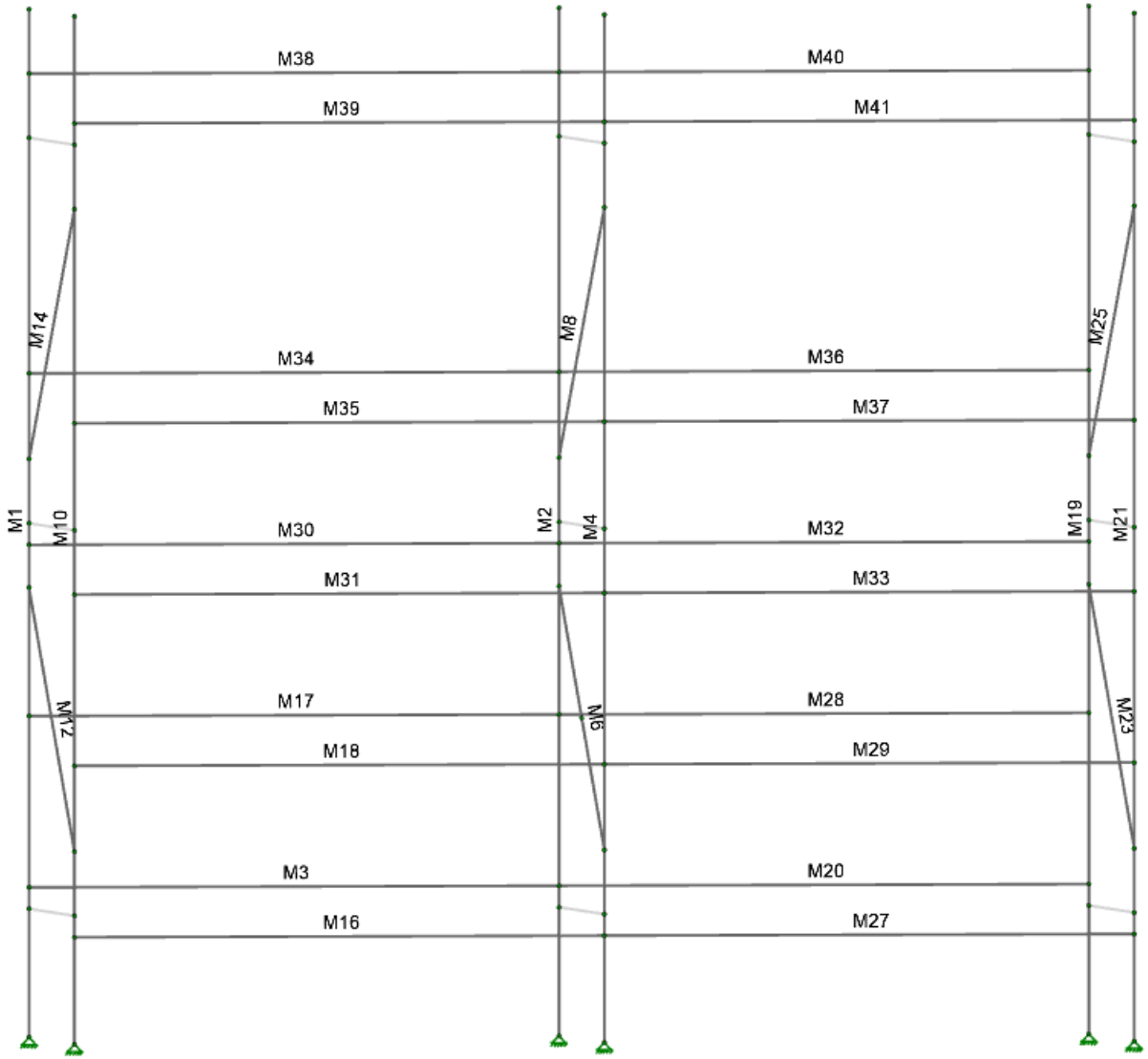
DESOTO, TX 75115-2399

(972) 283-5111



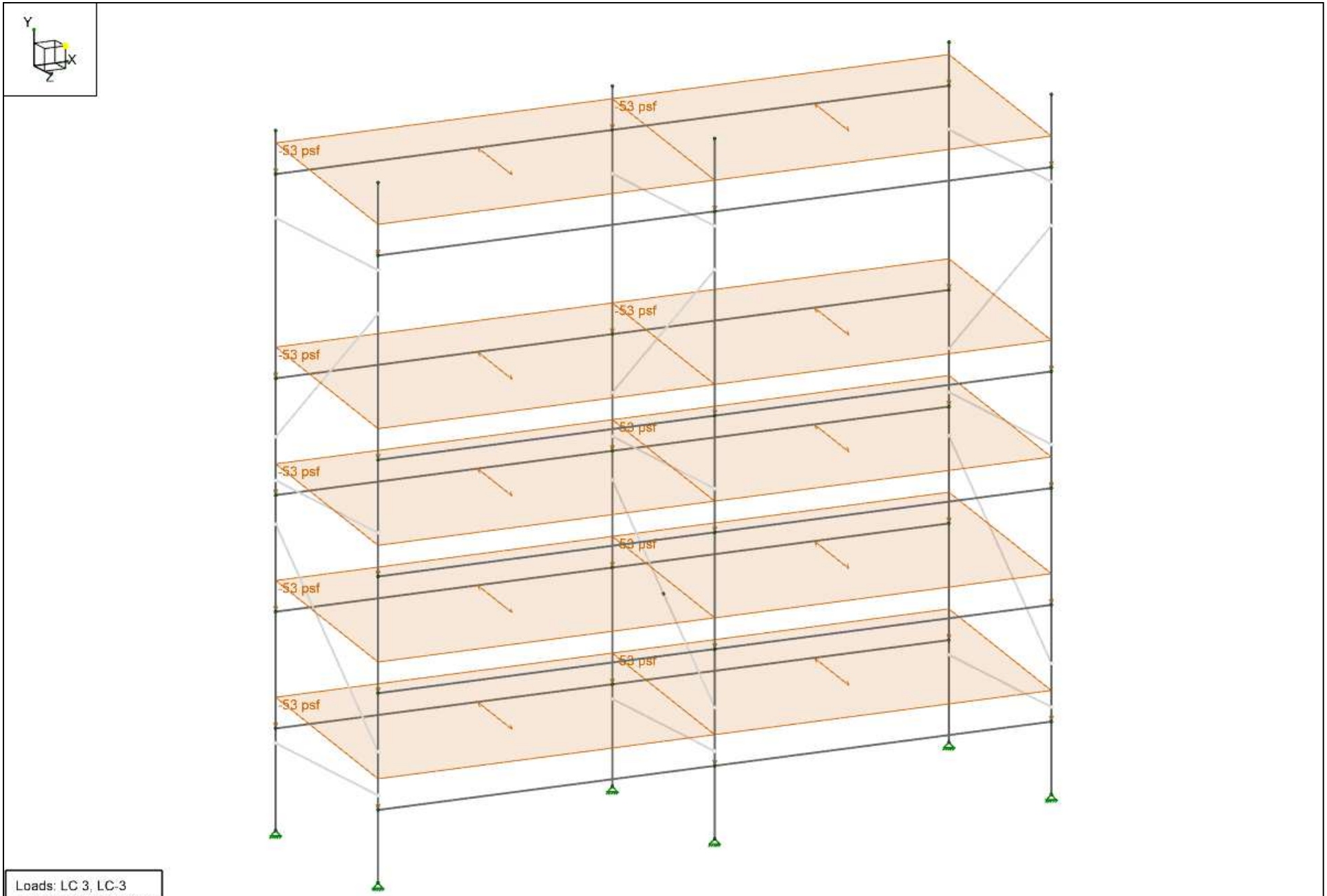
Envelope Only Solution

Joh & CLARK	JPH & CLARK, Inc	Frame B - (30"Bx50"Lx96"H) - Battery Rack	SK-2
	AA		Aug 28, 2026 at 03:36 PM
	26-460 Advanced Auto Parts	Nodes Layout	AAP_B0 -30x50x96 -5Lvls - 2Bays - WS.r3d



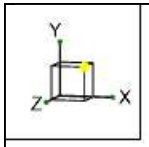
Envelope Only Solution

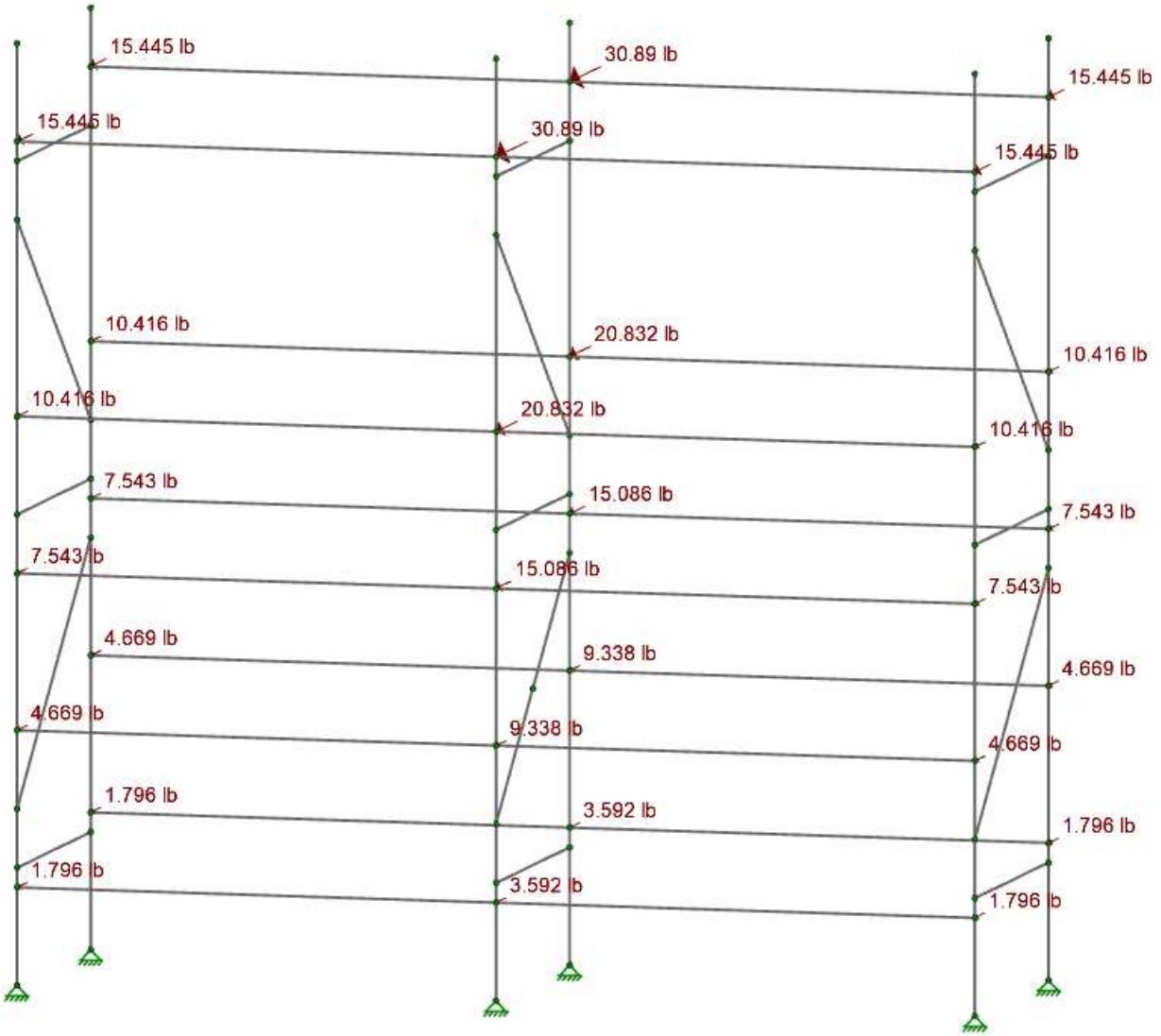
JPH & CLARK, Inc		Frame B - (30"Bx50"Lx96"H) - Battery Rack	SK-7
AA			Aug 28, 2026 at 04:02 PM
26-460 Advanced Auto Parts		Members Label	AAP_B0 -30x50x96 -5Lvls - 2Bays - WS.r3d



Loads: LC 3, LC-3
Envelope Only Solution

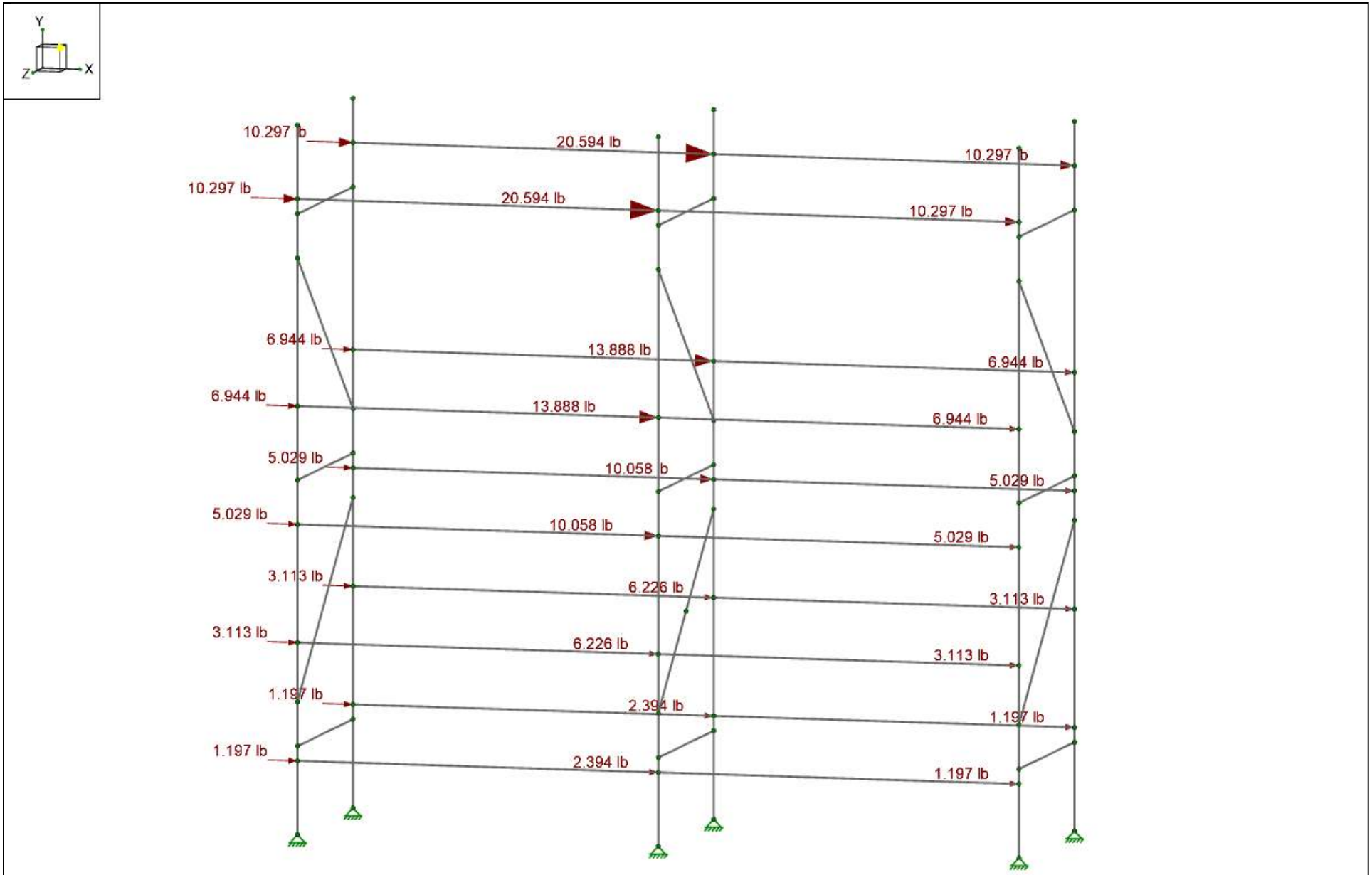
JPH & CLARK, Inc	Frame B - (30"Bx50"Lx96"H) - Battery Rack	SK-3
AA		Aug 28, 2026 at 03:40 PM
26-460 Advanced Auto Parts	DL + LL	AAP_B0 -30x50x96 -5Lvls - 2Bays - WS.r3d





Loads: BLC 3, ELZ
Envelope Only Solution

JPH & CLARK, Inc	Frame B - (30"Bx50"Lx96"H) - Battery Rack	SK-1
AA		Aug 31, 2026 at 03:41 PM
26-460 Advanced Auto Parts	ELZ	B- Battery Rack -30x50x96 -5Lvls - 2Bays



Loads: BLC 4, ELX
Envelope Only Solution

JPH & CLARK, Inc	Frame B - (30"Bx50"Lx96"H) - Battery Rack	SK-2
AA		Aug 31, 2026 at 03:41 PM
26-460 Advanced Auto Parts	ELX	B- Battery Rack -30x50x96 -5Lvls - 2Bays

Node Boundary Conditions

	Node Label	X [k/in]	Y [k/in]	Z [k/in]
1	N1	Reaction	Reaction	Reaction
2	N2	Reaction	Reaction	Reaction
3	N7	Reaction	Reaction	Reaction
4	N19	Reaction	Reaction	Reaction
5	N37	Reaction	Reaction	Reaction
6	N40	Reaction	Reaction	Reaction

Hot Rolled Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm. Coeff. [1e⁵°F⁻¹]	Density [k/ft³]	Yield [ksi]	Ry	Fu [ksi]	Rt
1	A36 Gr.36	29000	11154	0.3	0.65	0.49	36	1.5	58	1.2
2	A572 Gr.50	29000	11154	0.3	0.65	0.49	50	1.1	65	1.1
3	A992	29000	11154	0.3	0.65	0.49	50	1.1	65	1.1
4	A500 Gr.42	29000	11154	0.3	0.65	0.49	42	1.4	58	1.3
5	A500 Gr.46	29000	11154	0.3	0.65	0.49	46	1.4	58	1.3
6	45	29000	11154	0.3	0.65	0.49	45	1.5	58	1.2

Hot Rolled Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rule	Area [in²]	Iyy [in⁴]	Izz [in⁴]	J [in⁴]
1	BM	WS BEAM SECTION 16GA (0.061")CA	Beam	Channel	A36 Gr.36	Typical	0.439	0.128	0.621	0.000533

Cold Formed Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm. Coeff. [1e⁵°F⁻¹]	Density [k/ft³]	Yield [ksi]	Fu [ksi]
1	A570 Gr.33	29500	11346	0.3	0.65	0.49	33	52
2	A607 C1 Gr.55	29500	11346	0.3	0.65	0.49	55	70
3	A653 SS Gr33	29500	11346	0.3	0.65	0.49	33	45
4	A653 SS Gr50/1	29500	11346	0.3	0.65	0.49	50	65
5	Gr45	29500	11346	0.3	0.65	0.49	45	57

Cold Formed Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rule	Area [in²]	Iyy [in⁴]	Izz [in⁴]	J [in⁴]
1	WS-UP	-WS-COL1.625X1.75X14GA	Column	CS	Gr45	Typical	0.372	0.133	0.202	0.000657
2	WS-BM	-WS-BM3.25X16GA	Beam	CS	Gr45	Typical	0.413	0.116	0.572	0.001
3	WS-BRC	-WS-BRC-1.34X0.75X20GA	HBrace	None	Gr45	Typical	0.115	0.01	0.024	0.055

Basic Load Cases

	BLC Description	Category	Nodal	Distributed	Area(Member)
1	DL	DL			10
2	PLL	LL			10
3	ELZ	ELZ	40		
4	ELX	ELX	40		
5	BLC 1 Transient Area Loads	None		20	
6	BLC 2 Transient Area Loads	None		20	

Load Combinations

	Description	Solve	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
1	LC-1	Yes	DL	1								
2	LC-2	Yes	LL	1								
3	LC-3	Yes	DL	1	LL	1						
4	LC-4-AEL	Yes	DL	1	LL	0.67						
5	LC-5	Yes	DL	1	LL	0.67	ELX	0.525				
6	LC-6	Yes	DL	1	LL	0.67	ELZ	0.525				
7	LC-7	Yes	DL	1	Sds*DL	0.105	LL	0.735	LL	0.016	Rho*ELX	0.525

Load Combinations (Continued)

	Description	Solve	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
8	LC-8	Yes	DL	1	Sds*DL	0.14	LL	0.595	LL	0.021	Rho*ELX	0.7
9	LC-9	Yes	DL	0.6	Sds*DL	-0.14	LL	0.402	LL	-0.02	Rho*ELX	0.7
10	LC-10	Yes	DL	1	Sds*DL	0.105	LL	0.735	LL	0.016	Rho*ELZ	0.525
11	LC-11	Yes	DL	1	Sds*DL	0.14	LL	0.595	LL	0.021	Rho*ELZ	0.7
12	LC-12	Yes	DL	0.6	Sds*DL	-0.14	LL	0.402	LL	-0.02	Rho*ELZ	0.7
13												
14	AB-FLC5-1	Yes	DL	1.2	Sds*DL	0.2	LL	0.84	LL	0.03	Om*ELX	1
15	AB-FLC5-2	Yes	DL	1.2	Sds*DL	0.2	LL	0.84	LL	0.03	Om*ELZ	1
16	AB-FLC5-3	Yes	DL	1.2	Sds*DL	0.2	LL	0.84	LL	0.03	Om*ELX	-1
17	AB-FLC5-4	Yes	DL	1.2	Sds*DL	0.2	LL	0.84	LL	0.03	Om*ELZ	-1
18	AB-FLC7-5	Yes	DL	0.9	Sds*DL	-0.2	LL	0.603	LL	-0.029	Om*ELX	1
19	AB-FLC7-6	Yes	DL	0.9	Sds*DL	-0.2	LL	0.603	LL	-0.029	Om*ELZ	1
20	AB-FLC7-7	Yes	DL	0.9	Sds*DL	-0.2	LL	0.603	LL	-0.029	Om*ELX	-1
21	AB-FLC7-8	Yes	DL	0.9	Sds*DL	-0.2	LL	0.603	LL	-0.029	Om*ELZ	-1

Node Loads and Enforced Displacements (BLC 3 : ELZ)

	Node Label	L, D, M	Direction	Magnitude [(lb, lb-ft), (in, rad), (lb*s²/in, lb*s²*in)]
1	N64	L	Z	15.445
2	N67	L	Z	15.445
3	N65	L	Z	15.445
4	N65	L	Z	15.445
5	N66	L	Z	15.445
6	N66	L	Z	15.445
7	N69	L	Z	15.445
8	N68	L	Z	15.445
9	N63	L	Z	10.416
10	N62	L	Z	10.416
11	N60	L	Z	10.416
12	N60	L	Z	10.416
13	N59	L	Z	10.416
14	N59	L	Z	10.416
15	N61	L	Z	10.416
16	N58	L	Z	10.416
17	N55	L	Z	7.543
18	N55	L	Z	7.543
19	N15	L	Z	7.543
20	N15	L	Z	7.543
21	N56	L	Z	7.543
22	N27	L	Z	7.543
23	N48	L	Z	7.543
24	N57	L	Z	7.543
25	N36	L	Z	4.669
26	N36	L	Z	4.669
27	N34	L	Z	4.669
28	N34	L	Z	4.669
29	N35	L	Z	4.669
30	N33	L	Z	4.669
31	N54	L	Z	4.669
32	N53	L	Z	4.669
33	N3	L	Z	1.796
34	N31	L	Z	1.796
35	N52	L	Z	1.796
36	N4	L	Z	1.796
37	N32	L	Z	1.796
38	N32	L	Z	1.796
39	N38	L	Z	1.796
40	N4	L	Z	1.796

Node Loads and Enforced Displacements (BLC 4 : ELX)

	Node Label	L, D, M	Direction	Magnitude [(lb, lb-ft), (in, rad), (lb*s²/in, lb*s²*in)]
1	N64	L	X	10.297
2	N67	L	X	10.297
3	N65	L	X	10.297
4	N65	L	X	10.297
5	N66	L	X	10.297
6	N66	L	X	10.297
7	N69	L	X	10.297
8	N68	L	X	10.297
9	N63	L	X	6.944
10	N62	L	X	6.944
11	N60	L	X	6.944
12	N60	L	X	6.944
13	N59	L	X	6.944
14	N59	L	X	6.944
15	N61	L	X	6.944
16	N58	L	X	6.944
17	N55	L	X	5.029
18	N55	L	X	5.029
19	N15	L	X	5.029
20	N15	L	X	5.029
21	N56	L	X	5.029
22	N27	L	X	5.029
23	N48	L	X	5.029
24	N57	L	X	5.029
25	N36	L	X	3.113
26	N36	L	X	3.113
27	N34	L	X	3.113
28	N34	L	X	3.113
29	N35	L	X	3.113
30	N33	L	X	3.113
31	N54	L	X	3.113
32	N53	L	X	3.113
33	N3	L	X	1.197
34	N31	L	X	1.197
35	N52	L	X	1.197
36	N4	L	X	1.197
37	N32	L	X	1.197
38	N32	L	X	1.197
39	N38	L	X	1.197
40	N4	L	X	1.197

Member Area Loads (BLC 1 : DL)

	Node A	Node B	Node C	Node D	Direction	Load Direction	A Magnitude [psf]	B Magnitude [psf]	C Magnitude [psf]	D Magnitude [psf]	Exclude Braces
1	N3	N31	N32	N4	Y	A-B	-5	-5	-5	-5	Yes
2	N4	N32	N52	N38	Y	A-B	-5	-5	-5	-5	Yes
3	N33	N35	N36	N34	Y	A-B	-5	-5	-5	-5	Yes
4	N34	N36	N54	N53	Y	A-B	-5	-5	-5	-5	Yes
5	N27	N56	N55	N15	Y	A-B	-5	-5	-5	-5	Yes
6	N15	N55	N57	N48	Y	A-B	-5	-5	-5	-5	Yes
7	N58	N61	N60	N59	Y	A-B	-5	-5	-5	-5	Yes
8	N59	N60	N63	N62	Y	A-B	-5	-5	-5	-5	Yes
9	N64	N67	N66	N65	Y	A-B	-5	-5	-5	-5	Yes
10	N65	N66	N69	N68	Y	A-B	-5	-5	-5	-5	Yes

Member Area Loads (BLC 2 : PLL)

	Node A	Node B	Node C	Node D	Direction	Load Direction	A Magnitude [psf]	B Magnitude [psf]	C Magnitude [psf]	D Magnitude [psf]	Exclude Braces
1	N3	N31	N32	N4	Y	A-B	-48	-48	-48	-48	Yes
2	N4	N32	N52	N38	Y	A-B	-48	-48	-48	-48	Yes

Member Area Loads (BLC 2 : PLL) (Continued)

	Node A	Node B	Node C	Node D	Direction	Load Direction	A Magnitude [psf]	B Magnitude [psf]	C Magnitude [psf]	D Magnitude [psf]	Exclude Braces
3	N33	N35	N36	N34	Y	A-B	-48	-48	-48	-48	Yes
4	N34	N36	N54	N53	Y	A-B	-48	-48	-48	-48	Yes
5	N27	N56	N55	N15	Y	A-B	-48	-48	-48	-48	Yes
6	N15	N55	N57	N48	Y	A-B	-48	-48	-48	-48	Yes
7	N58	N61	N60	N59	Y	A-B	-48	-48	-48	-48	Yes
8	N59	N60	N63	N62	Y	A-B	-48	-48	-48	-48	Yes
9	N64	N67	N66	N65	Y	A-B	-48	-48	-48	-48	Yes
10	N65	N66	N69	N68	Y	A-B	-48	-48	-48	-48	Yes

Envelope Node Reactions

	Node Label		X [lb]	LC	Y [lb]	LC	Z [lb]	LC	MX [lb-ft]	LC	MY [lb-ft]	LC	MZ [lb-ft]	LC
1	N1	max	24.961	3	652.184	3	0.244	3	0	12	0	12	0	12
2		min	-11.855	9	61.527	1	-49.5	12	0	1	0	1	0	1
3	N2	max	-0.001	1	1480.553	3	-0.085	1	0	12	0	12	0	12
4		min	-30.552	8	139.675	1	-67.551	11	0	1	0	1	0	1
5	N7	max	-0.002	1	1485.281	3	-0.001	1	0	12	0	12	0	12
6		min	-32.777	8	140.121	1	-22.315	11	0	1	0	1	0	1
7	N19	max	40.42	3	649.821	3	0.213	3	0	12	0	12	0	12
8		min	-4.783	9	61.304	1	-17.316	12	0	1	0	1	0	1
9	N37	max	-2.354	1	652.007	3	0.244	3	0	12	0	12	0	12
10		min	-38.177	8	61.51	1	-49.502	12	0	1	0	1	0	1
11	N40	max	-3.811	1	649.642	3	0.213	3	0	12	0	12	0	12
12		min	-47.407	8	61.287	1	-17.316	12	0	1	0	1	0	1
13	Totals:	max	0	3	5569.488	3	0	1						
14		min	-148.848	9	525.423	1	-223.266	11						

Envelope Maximum Member Section Forces

	Member		Axial[lb]	Loc[in]	LCy	Shear[lb]	Loc[in]	LCz	Shear[lb]	Loc[in]	LC	Torque[lb-ft]	Loc[in]	LCy	y-y Moment[lb-ft]	Loc[in]	LCz	z-z Moment[lb-ft]	Loc[in]	LC
1	M1	max	652.184	12	3	11.871	14	9	25.781	41	11	0.072	14	11	30.243	42	11	46.485	90	3
2		min	0	91	1	-58.238	46	3	-71.234	42	12	-0.103	46	12	-49.5	12	12	-38.412	46	3
3	M2	max	1480.553	12	3	35.146	30	8	35.458	41	11	0.031	48	9	43.128	42	11	19.533	15	8
4		min	0	91	1	0	91	1	-100.551	42	11	-0.027	12	8	-67.551	12	11	-35.518	14	8
5	M3	max	-3.071	50.004	1	129.659	0	3	0.008	50.004	9	0	50.004	3	0.069	0	11	108.523	50.004	3
6		min	-32.547	0	3	-148.857	50.004	3	-0.684	0	11	-0.006	0	12	-2.781	50.004	11	-57.232	23.439	3
7	M4	max	1485.281	9	3	0	96	12	117.868	18	11	0.027	12	8	58.323	18	11	24.582	9	8
8		min	0	87	1	-33.613	10	8	-30.801	42	11	-0.032	84	8	-20.93	78	12	-21.944	10	8
9	M5	max	-0.193	30	1	0.371	30	3	0	30	12	0	30	3	0.027	0	8	22.779	30	12
10		min	-96.97	0	11	-17.202	0	12	-0.02	0	8	-0.129	0	9	-0.025	30	8	-20.226	0	12
11	M6	max	179.588	38.419	11	6.765	19.209	11	0	38.419	12	0.06	38.419	8	0	38.419	1	12.207	0	11
12		min	0.404	19.61	1	0.016	19.61	1	-0.011	0	9	0	19.61	1	-0.069	38.419	8	-9.451	38.419	11
13	M7	max	-0.21	30	1	3.986	30	12	0	30	12	0.098	30	8	0.018	0	9	2.469	0	12
14		min	-38.951	0	11	-0.136	0	3	-0.019	0	9	0	0	1	-0.03	30	8	-7.496	30	12
15	M8	max	1.244	38.419	3	0.043	38.419	3	0	38.419	12	0.004	38.419	8	0.007	0	9	6.777	38.419	12
16		min	-72.782	0	12	-4.342	0	12	-0.004	0	9	0	0	1	-0.007	38.419	9	-7.125	0	12
17	M9	max	31.207	30	12	4.299	30	11	0	30	12	0	30	1	0.032	0	8	7.081	0	11
18		min	-0.311	0	3	0.025	0	1	-0.019	0	8	-0.15	0	8	-0.015	30	8	-3.667	30	11
19	M10	max	649.821	9	3	58.172	57	3	84.701	18	12	0.155	86	11	42.446	18	11	37.995	42	3
20		min	0	87	1	-4.783	0	9	-23.111	42	11	-0.059	10	11	-14.091	78	12	-46.424	86	3
21	M11	max	0.088	30	8	0.332	30	3	0.052	30	11	-0.008	30	1	0.059	30	11	16.953	30	12
22		min	-69.19	0	12	-12.831	0	12	-0.016	0	9	-0.228	0	8	-0.072	0	11	-15.125	0	12
23	M12	max	128.075	38.419	11	4.84	38.419	11	0.038	38.419	12	0.026	38.419	9	0.097	38.419	11	8.82	0	12
24		min	-0.115	0	9	-0.002	0	9	-0.012	0	8	-0.057	0	3	-0.045	38.419	9	-6.675	38.419	11
25	M13	max	-0.045	30	1	2.692	30	12	0.068	30	12	-0.024	30	1	0.104	30	12	1.584	0	12
26		min	-28.963	0	11	-0.096	0	3	-0.022	0	8	-0.258	0	3	-0.065	0	12	-5.147	30	12
27	M14	max	0.93	38.419	3	0.049	38.419	3	0.02	38.419	12	0.037	38.419	3	0.015	38.419	12	4.691	38.419	12
28		min	-48.65	0	12	-3.012	0	12	-0.009	0	8	0.003	0	1	-0.053	0	11	-4.952	0	12
29	M15	max	21.109	30	12	2.849	30	11	0.09	30	11	0.467	30	3	0.071	30	11	4.749	0	11
30		min	-0.318	0	3	0.009	0	1	-0.017	0	9	0.044	0	1	-0.154	0	11	-2.374	30	11
31	M16	max	-1.416	50.004	1	148.218	0	3	0.006	50.004	9	0	50.004	1	2.227	0	11	107.991	0	3

Envelope Maximum Member Section Forces (Continued)

	Member		Axial[lb]	Loc[in]	LCy	Shear[lb]	Loc[in]	LCz	Shear[lb]	Loc[in]	LC	Torque[lb-ft]	Loc[in]	LCy-y Moment[lb-ft]	Loc[in]	LCz-z Moment[lb-ft]	Loc[in]	LC
32		min	-15.01	0	3	-130.299	50.004	3	-0.549	0	11	-0.011	0	11	-0.059	50.004	11	-56.349	26.565	3
33	M17	max	1.582	50.004	8	132.349	0	3	0.046	50.004	3	0.001	50.004	3	0.192	50.004	3	103.783	50.004	3
34		min	0.065	0	1	-146.153	50.004	3	-0.833	0	12	-0.001	0	12	-3.457	50.004	12	-56.009	23.96	3
35	M18	max	-0.101	50.004	1	146.547	0	3	0.013	50.004	3	0.001	50.004	3	4.54	0	12	104.636	0	3
36		min	-1.067	0	3	-131.955	50.004	3	-1.096	0	12	-0.003	0	12	-0.057	0	3	-56.013	26.565	3
37	M19	max	652.007	12	3	58.21	48	3	25.781	41	11	0.103	48	12	30.244	42	11	38.393	46	3
38		min	0	91	1	0	91	1	-71.237	42	12	-0.072	12	11	-49.502	12	12	-46.459	90	3
39	M20	max	-3.069	49.992	1	148.826	0	3	0.684	49.992	11	0.006	49.992	12	0.069	49.992	11	108.488	0	3
40		min	-32.531	0	3	-129.623	49.992	3	0	0	1	0	0	3	-2.781	0	11	-57.198	26.558	3
41	M21	max	649.642	9	3	0	96	12	84.704	18	12	0.059	12	11	42.447	18	11	46.398	86	3
42		min	0	87	1	-58.144	48	3	-23.112	42	11	-0.155	84	11	-14.092	78	12	-37.976	42	3
43	M22	max	0.012	30	3	0.332	30	3	-0.001	30	1	0.085	30	3	0.072	0	11	16.953	30	12
44		min	-69.192	0	12	-12.832	0	12	-0.052	0	11	-0.138	0	9	-0.059	30	11	-15.126	0	12
45	M23	max	128.08	38.419	11	4.84	38.419	11	0.002	38.419	3	0.086	38.419	8	0.034	0	12	8.821	0	12
46		min	0.011	0	1	0.001	0	1	-0.038	0	12	0.005	0	12	-0.097	38.419	11	-6.675	38.419	11
47	M24	max	-0.045	30	1	2.692	30	12	0.004	30	3	0.258	30	3	0.065	0	12	1.584	0	12
48		min	-28.964	0	11	-0.096	0	3	-0.068	0	12	0.024	0	1	-0.104	30	12	-5.147	30	12
49	M25	max	0.93	38.419	3	0.049	38.419	3	0.007	38.419	3	-0.003	38.419	1	0.053	0	11	4.691	38.419	12
50		min	-48.651	0	12	-3.012	0	12	-0.02	0	12	-0.037	0	3	-0.015	38.419	12	-4.952	0	12
51	M26	max	21.11	30	12	2.849	30	11	0	30	1	-0.044	30	1	0.154	0	11	4.749	0	11
52		min	-0.318	0	3	0.009	0	1	-0.09	0	11	-0.467	0	3	-0.071	30	11	-2.374	30	11
53	M27	max	-1.415	49.992	1	130.263	0	3	0.549	49.992	11	0.011	49.992	11	2.227	49.992	11	107.954	49.992	3
54		min	-15.002	0	3	-148.187	49.992	3	0.001	0	1	0	0	1	-0.059	0	11	-56.316	23.434	3
55	M28	max	0.688	49.992	3	146.121	0	3	0.834	49.992	12	0.001	49.992	12	0.192	0	3	103.745	0	3
56		min	-0.854	0	9	-132.314	49.992	3	-0.046	0	3	-0.001	0	3	-3.457	0	12	-55.977	26.037	3
57	M29	max	-0.101	49.992	1	131.92	0	3	1.097	49.992	12	0.003	49.992	12	4.54	49.992	12	104.599	49.992	3
58		min	-1.067	0	3	-146.515	49.992	3	-0.013	0	3	-0.001	0	3	-0.057	49.992	3	-55.981	23.434	3
59	M30	max	-0.134	50.004	1	133.196	0	3	0.086	50.004	3	0	50.004	3	0.345	50.004	3	101.814	50.004	3
60		min	-1.746	0	8	-145.306	50.004	3	-1.092	0	12	-0.006	0	12	-4.395	50.004	12	-56.141	23.96	3
61	M31	max	-0.158	50.004	1	145.674	0	3	0.067	50.004	3	0.001	50.004	11	4.718	0	12	102.624	0	3
62		min	-1.91	0	7	-132.828	50.004	3	-1.142	0	12	0	0	1	-0.278	0	3	-56.128	26.044	3
63	M32	max	0.253	49.992	9	145.274	0	3	1.092	49.992	12	0.006	49.992	12	0.345	0	3	101.777	0	3
64		min	-1.415	0	3	-133.161	49.992	3	-0.086	0	3	0	0	3	-4.395	0	12	-56.109	26.037	3
65	M33	max	0.142	49.992	9	132.793	0	3	1.142	49.992	12	0	49.992	1	4.718	49.992	12	102.587	49.992	3
66		min	-1.676	0	3	-145.642	49.992	3	-0.067	0	3	-0.001	0	11	-0.278	49.992	3	-56.096	23.954	3
67	M34	max	22.424	50.004	3	133.213	0	3	0.075	50.004	3	0	50.004	1	0.309	50.004	3	101.238	50.004	3
68		min	2.115	0	1	-145.303	50.004	3	-1.406	0	12	-0.003	0	11	-5.809	50.004	12	-56.702	23.96	3
69	M35	max	23.053	50.004	3	145.664	0	3	0.085	50.004	3	0	50.004	1	4.636	0	12	102.036	0	3
70		min	2.175	0	1	-132.853	50.004	3	-1.121	0	12	-0.001	0	11	-0.35	0	3	-56.686	26.044	3
71	M36	max	22.414	49.992	3	145.271	0	3	1.406	49.992	12	0.003	49.992	11	0.309	0	3	101.2	0	3
72		min	2.115	0	1	-133.179	49.992	3	-0.075	0	3	0	0	1	-5.809	0	12	-56.669	26.037	3
73	M37	max	23.043	49.992	3	132.819	0	3	1.122	49.992	12	0.001	49.992	11	4.636	49.992	12	101.998	49.992	3
74		min	2.174	0	1	-145.631	49.992	3	-0.085	0	3	0	0	1	-0.35	49.992	3	-56.653	23.954	3
75	M38	max	35.807	50.004	3	122.89	0	3	0.046	50.004	3	0	50.004	1	0.192	50.004	3	114.661	50.004	3
76		min	3.378	0	1	-155.612	50.004	3	-1.513	0	12	-0.001	0	11	-6.25	50.004	12	-66.486	21.877	3
77	M39	max	35.123	50.004	3	155.739	0	3	0.048	50.004	3	0	50.004	1	6.363	0	12	115.141	0	3
78		min	3.313	0	1	-122.763	50.004	3	-1.564	0	12	-0.006	0	11	-0.204	0	3	-66.304	28.127	3
79	M40	max	35.789	49.992	3	155.583	0	3	1.514	49.992	12	0.001	49.992	11	0.192	0	3	114.637	0	3
80		min	3.376	0	1	-122.852	49.992	3	-0.046	0	3	0	0	1	-6.25	0	12	-66.443	28.12	3
81	M41	max	35.105	49.992	3	122.725	0	3	1.564	49.992	12	0.006	49.992	11	6.363	49.992	12	115.118	49.992	3
82		min	3.312	0	1	-155.71	49.992	3	-0.048	0	3	0	0	1	-0.204	49.992	3	-66.26	21.871	3

Material Take-Off

	Material	Size	Pieces	Length[in]	Weight[K]
1	Cold Formed Steel				
2	Gr45	-WS-BM3.25X16GA	20	1000	0.117
3	Gr45	-WS-BRC-1.34X0.75X20GA	15	500.5	0.016
4	Gr45	-WS-COL1.625X1.75X14GA	6	576	0.061
5	Total CF Steel		41	2076.5	0.194

Frame C

Lozier Oil Rack

30"B x 50"L x 96"H - Wide Span (2 Levels)

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

SEISMIC DESIGN FRAME C 30"B x 50"L x 96"H Oil Rack

SEISMIC FORCES

Code Refrence

Seismic Code : **ASCE 7-10**
EQUIVALENT LATERAL FORCE PROCEDURE FOR SHELVING
& RMI (AS IT APPLIES)

Dimension

Frame :	**C**		Max. Shelving Height :	**96**	in
Width :	**30**	in	Levels :	**5**	
Length :	**50**	in	Shelf type :	**Oil Rack**	

Site parameters (ASCE 7 section 11.4)

Site class	**D (Default)**				
Mapped acceleration parameters					
at short periods	Ss =	**0.206**	at 1 sec. period	S_1 =	**0.106**
Site coefficient at short periods	Fa =	**1.600**	at 1 sec. period	Fv =	**2.376**

Spectral response accelaration parameters (ASCE 7 section 11.4)

at short periods		**0.071**			**0.050**
	Calc. SMS =	**0.330**	at 1 sec. period	Calc. SM1 =	**0.252**

Design spectral acceleration parameters (ASCE 7 section 11.4)

at short periods	S_{DS} =	**0.220**	at 1 sec. period	S_{D1} =	**0.168**

Seismic design category (ASCE 7 section 11.6)

Risk Category	**II**
Seismic design category	**C**

Approximate fundamental period (ASCE 7 section 12.8.2.1)

Height above base to highest level	hn =	**8.00**	ft
Structure Type		**4**	
Long-period transition	TL =	**12**	Figs. 22-14 thru 22-17
Building period parameter Ct	Ct =	**0.020**	
Building period parameter x	x =	**0.75**	
Building fundamental period	T = Ta =	**0.095**	sec.
Exponent related to structure period	k =	**1**	since Ta ≤ 0.50 sec

Seismic response coefficient (ASCE 7 section 15.5 & RMI 2.6.3)

Response modification factor (Transverse)	R =	**4**	
Response modification factor (Longitudinal)	R =	**6**	
Seismic importance factor	Ie =	**1.5**	(ASCE 7 15.5.3,RMI Sec. 2.6.2)
Redundancy factor	ρ =	**1.0**	RMI Sec. 2.6.2.1; ASCE7 Sec.12.4.2.1
	Cd =	**3.5**	

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

Operating Weight (RMI 2.1 & ASCE 7 section 15.5)

Loads

DL : **5** psf

LEVEL	Height/LVL (in)	Input Shelf Load (PL) (lbs.)	Calculated (lbs.)
5	**28**	**680**	680
4	**16**	**680**	680
3	**16**	**680**	680
2	**16**	**680**	680
1	**10**	**680**	680
		Total PL :	3,400

DL = 5 PSF x 2.5 FT x 4.17 FT x 5 SHELVES = 260.42 lbs

PL app = 3,400 LBS x 0.67 = 2,278.00 lbs

PL (top shelf) = 680.00 lbs

Ws = DL+67%PL+0.25LL (Per Storage Rack Section)
67%PL (every shelf loaded 67% of its rated load)(PL app)
100%PL (top shelf only loaded 100% of its rated load)
V_{BASE} = Cs Ws

Seismic base shear (ASCE 7 section 12.8)

		Transverse	Longitudinal
Seismic response coefficient	Cs =	**0.082**	**0.055**
Seismic response coefficient max.	$Cs_{, MAX}$ =	**0.662**	**0.441**
Seismic response coefficient min.	$Cs_{, MIN}$ =	**0.015**	**0.015**
Seismic response coefficient (Governs)	Cs =	**0.082**	**0.055**

LOAD COMBINATION ASD (RMI 2.1)	**W_{LC}**	**Ws**	**E (factor)**	**V_{BASE} Transverse**	**V_{BASE} Longitudinal**	
DL+0.67PL+0.75(0.7ρE)	2,538.42	2,538.42	0.525	110	73	
$(1+0.105S_{DS})DL+0.75[(1.4+0.14S_{DS})0.7PL+0.7\rho E]$	2,820.34	2,538.42	0.525	110	73	
$(1+0.14S_{DS})DL+(0.85+0.14S_{DS})0.7PL+0.7\rho E$	2,364.64	2,538.42	0.700	146	98	**CONTROLS**
$(0.6 - 0.14S_{DS})DL+(0.6 - 0.14S_{DS})0.67PL+0.7\rho E$	1,444.96	2,538.42	0.700	146	98	
Seismic base shear			$V_{BASE\ MAX.\ CONTROL}$	146	98	

$W_{s\ CONTROL}$= 2,364.64 LBS

Anchors in accordance with ACI318 Sec.17 Ωo = 2.0 (ACI318 Sec.17; ASCE7 Table 15.4-1)

	Transverse	Longitudinal	
$V_{BASE\ 67\%PL}$ =	**146**	**98**	lbs
$V_{BASE\ 100\%PL\ TOP}$ x 0.7ρ=	**55**	**37**	lbs

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

SEISMIC LATERAL FORCE DISTRIBUTION - FRAME C (CONTINUED)

LEVEL	W (lbs.)	h (ft)	$W_x h_x^k$ (lbs-ft)	$C_v x$	Transverse F_x (lbs)	Longitudinal F_x (lbs)
5	472.93	7.17	3389.32	0.39	56.72	37.81
4	472.93	4.83	2285.82	0.26	38.25	25.50
3	472.93	3.50	1655.25	0.19	27.70	18.47
2	472.93	2.17	1024.68	0.12	17.15	11.43
1	472.93	0.83	394.11	0.05	6.60	4.40
Σ	2364.64	Σ	8749.18	Base :	146.42	97.61
P_{STATIC} =	1182.32	lbs per post		$COMP._{MAX}$ =	1830	lbs per post

$V_{BASE\ 67\%PL}$ (Transverse): 146 lbs

$V_{BASE\ 67\%PL}$ (Longitudinal): 98 lbs

Σ (F_X * h) (Transverse) : 8,772 lbs-in

Σ (F_X * h) (Longitudinal) : 5,848 lbs-in

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

SEISMIC LATERAL FORCE DISTRIBUTION TOP SHELF LOADED - FRAME C (CONTINUED)

					Transverse	Longitudinal
LEVEL	W (lbs.)	h (ft)	$W_x h_x^k$ (lbs-ft)	$C_v x$	F_x (lbs)	F_x (lbs)
5	732.08	7.17	5246.60	0.90	49.44	33.26
4	52.08	4.83	251.74	0.04	2.37	1.60
3	52.08	3.50	182.29	0.03	1.72	1.16
2	52.08	2.17	112.85	0.02	1.06	0.72
1	52.08	0.83	43.40	0.01	0.41	0.28
Σ	940.42	Σ	5836.88	Base :	55.00	37.00

$V_{BASE\ 100\%PL\ TOP}$ (Transverse): 55 LBS Σ (F_X * h) (Transverse) : 4,493 lbs-in

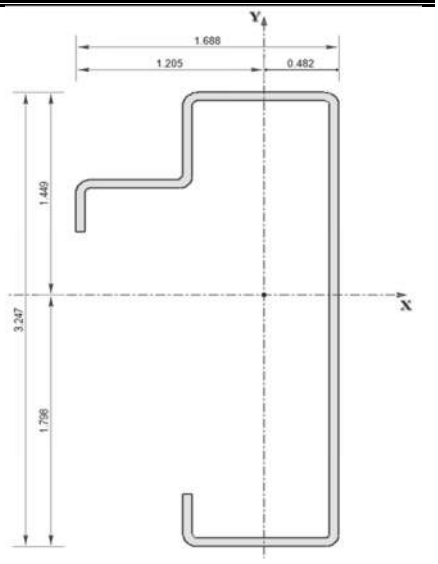
$V_{BASE\ 100\%PL\ TOP}$ (Longitudinal): 37 LBS Σ (F_X * h) (Longitudinal) : 3,023 lbs-in

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

BEAM DESIGN FOR FRAME C

SECTION PROPERTIES:

MAX L :	50	in			
Size :	3.25"x16ga				
H :	3.25	IN			
t :	16	GA	Fy :	45,000	PSI
Area :	0.413	IN^2	E :	29,500	KSI
Ix :	0.572	IN^4	Iy :	0.116	IN^4
Sx :	0.318	IN^3	Sy :	0.096	IN^3
rx :	1.176	IN	ry :	0.529	IN



BEAM SECTION

MAX ALLOWABLE LOAD - BENDING: (AISI Sec. C3.1.3)

Mn (MAX) = 0.6 * Sx * Fy = 8586 LBS-IN

CAPACITY = 2(8 * M / L) = 2747.52 LBS

MAX ALLOWABLE LOAD - DEFLECTION (L/180): (RMI Sec. 5.3)

ALLOW DEFLECTION = 5 wL^4 / 384 E I

CAPACITY = 2 [(384 E I) / (5*180*L^2)] = 5759.66 LBS

MAXIMUM STATIC ALLOWABLE LOAD PER LEVEL= 2747.52 LBS

ALLOWABLE AND ACTUAL BENDING MOMENT PER LEVEL (RMI Sec.2.1.5 & 2.3)

MAX BENDING MOMENT

Wstatic = (DL + LL + 0.88PL) / 50" = 13.01 LBS/IN

$M_{STATIC\ (DL + LL + 0.88PL)} = W_{STATIC}\ L^2$ / 8 = 4065.52 LBS-IN

$P_{VERTICAL\ IMPACT}$ = Wstatic x 25% = 39.03 LBS

$M_{VERTICAL\ IMPACT} = P_{VERTICAL\ IMPACT}$ x L / 4 = 487.86 LBS-IN

$M_{STATIC+IMPACT}$ = 4553.38 LBS-IN

ALLOWABLE BENDING MOMENT

$M_{ALLOW(STATIC)}$ = 17172.00 LBS-IN

$M_{STATIC+IMPACT}$ < $M_{ALLOW(STATIC)}$ OK

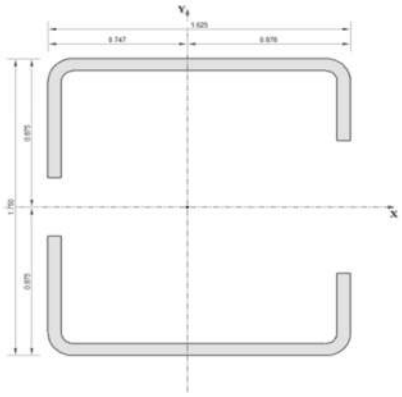
JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

WS STD UPRITE DESIGN FOR FRAME - C

SECTION PROPERTIES

MAX HT = 96 IN

SIZE =	1.625x1.75x14ga		Fy =	45	ksi
t =	14	GA	E =	29500	ksi
AREA =	0.372	in^2	Iy =	0.133	in^4
Ix =	0.202	in^4	Sy =	0.151	in^3
Sx =	0.231	in^3	ry =	0.597	in
rx =	0.738	in	Ωc=	1.80	
C_{mx}=	1.00		Ωb=	1.67	
Unbrace Lx-x =	25	in	Kx =	1.7	
Unbrace Ly-y =	30	in	Ky =	1.0	
δ_{SE} =	0.04	IN			
δ_X =	0.09	IN < 5% Structural Height OK			



COLUMN SECTION

P_{static} = 1,243 lbs

$\frac{kLx}{rx}$	=	$\frac{(1.7)(24.75)}{0.738in}$	=	57.01		$\frac{kLy}{ry}$	=	$\frac{(1)(30)}{0.597in}$	=	50.25	
Fax	=	$\frac{\pi^2 * E}{(Klx/rx)^2}$	=	89575	PSI	Fay	=	$\frac{\pi^2 * E}{(Kly/ry)^2}$	=	115300	psi
λc	=	$(Fy / Fax)^{1/2}$	=	0.71	<1.5	λc	=	$(Fy / Fay)^{1/2}$	=	0.62	<1.5
Fn	=	λc < 1.5 $(0.658^{\lambda c2})Fy$ λc > 1.5 $(0.877/\lambda c^2)Fy$	=	36467	psi	Fn	=	λc < 1.5 $(0.658^{\lambda c2})Fy$ λc > 1.5 $(0.877/\lambda c^2)Fy$	=	38218	psi
Pn	=	AREA * F_n	=	13566	lbs	Pn	=	AREA * F_n	=	14217	lbs
P_{EX}	=	$(\pi^2 E I_X) / (K_X L_X)^2$	=	33222	lbs	P_{EY}	=	$(\pi^2 E I_Y) / (K_Y L_Y)^2$	=	43026	lbs
α_x	=	$1 - (\Omega_c Px/Pex)$	=	0.93		α_y	=	$1 - (\Omega_c Px/Pey)$	=	0.95	

MAX MOMENT IN COLUMN

Mx = M_{STATIC} + $M_{SEISMIC}$ =	0.01	lbs-ft	M_{nx} = Sx * Fy =	866.25	lbs-ft
My = M_{STATIC} + $M_{SEISMIC}$ =	76.49	lbs-ft	M_{ny} = Sy * Fy =	566.25	lbs-ft

COMBINED STRESS (fa/Fa + fb/Fb)

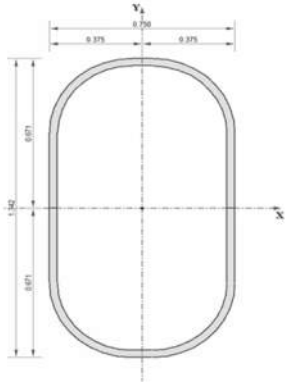
RISA3D Lateral Load X-Direction

$(\Omega c Px/P_n) + (\Omega_b C_{mx} M_x/M_n \alpha_{x1}) + (\Omega_b C_{my} M_y/M_{ny} \alpha_{y1})$ = 0.40 < 1.0 **THEREFORE UPRITE IS OK**

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

TRANSVERSE BRACING - FRAME C

SECTION PROPERTIES:



P_{MEMBER} = 236 LBS - WORST CASE

HORIZONTAL BRACINGS:

AREA = 0.115 IN^2
r_x = 0.453 IN
d = 30 IN

$$\frac{kl_x}{r_x} = \frac{(0.8)(30IN)}{0.453IN} = 52.98$$

$$\frac{kl_x}{r_x} < 200 \quad \textbf{OK}$$

$$Fa = \frac{\pi^2 E}{(kl/r)2} = 101970 \text{ PSI}$$

$$\frac{fa}{Fa} = \frac{V_{BASE}}{AREA \times Fa}$$
$$= 0.020 < 1.0 \quad \textbf{OK}$$

DIAGONAL BRACING:

AREA = 0.115 IN^2
r_x = 0.453 IN
d = 30 IN
l = 38 IN

THE LENGTH OF THE BRACE:

$L = (d^2 + l^2)^{0.5}$ = 4.03 FT
L = 48.41 IN

$V_{DIAG} = V_{BASE}$ * (LENGTH OF THE BRACE/ DEPTH)
= 380 LBS

$$\frac{kl_x}{r_x} = \frac{(1)(48.41IN)}{0.453IN} = 106.88$$

$$\frac{kl_x}{r_x} < 200 \quad \textbf{OK}$$

$$Fa = \frac{\pi^2 E}{(kl/r)2} \quad 25057 \text{ PSI}$$

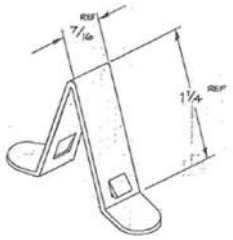
$$\frac{fa}{Fa} = \frac{V_{DIAG}}{AREA \times Fa}$$
$$= 0.132 < 1.0 \quad \textbf{OK}$$

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

BEAM TO COLUMN CONNX - FRAME C

BEAM TO COLUMN CONNECTION PROVIDE ADEQUATE MOMENT CAPACITY TO STABLIZE THIS SYSTEM, ALTHOGH IT DOES NOT PROVIDE 100% FIXITY. THUS, THE BEAMS WILL BE ANALYSED ASSUMING THEY HAVE PINNED ENDS. FOR THE COMPUTATION OF BEAM TO COL. MOMENT CAPACITY, THE PARTIAL FIXITY OF THE BEAM,(ASSUMED AT AN ARBITRARY 25% OF THE FIXED END MOMENT OR 2000 IN-LB WHICH EVER IS SMALLER) WILL BE ADDED

CAPACITY OF CONNECTOR:



BEAM LOCKING DEVICE (TWO CLIPS) (RMI 7.1.2)

AREA = 7/16 * 0.03 *2 = 0.026 IN^2

Fy = 50000 PSI

Fv = 2 * 0.4 * A * Fy

V_{MAX} = 1050 LBS >1000 LBS OK

BEAM TO BRACKET WELD CAPACITY

1/8" * 14.84 KSI = 1855 LBS/IN <--- CONTROLS

0.061" * 26 KSI * 1.33 = 2109 LBS/IN

L_{WELD} = 3 IN

CAPACITY = 5565 LBS

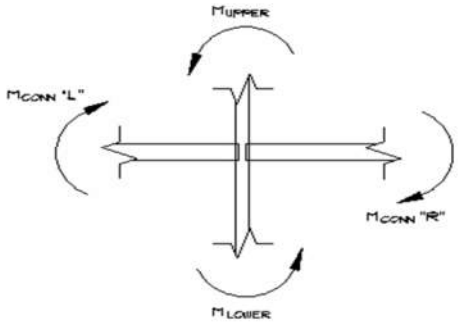
a) SHEAR CAPACITY OF 1/2" TAB

AREA = 0.105" * 1/2" = 0.053 IN^2

Fy = 50000 PSI

Fv = 0.4 * A * Fy

V_{MAX} = 1050 LBS



b) BEARING ON COLUMN

D = 0.420 IN

t = 0.072 IN

BEARING AREA = t * D = 0.030 IN^2

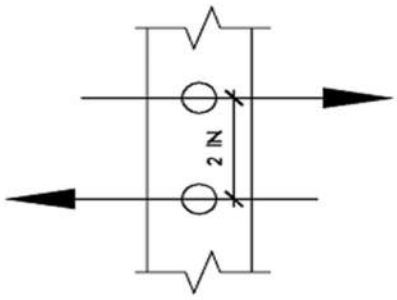
Fy = 50000 PSI

$P_{MAX\ BEARING}$ = BRG AREA * 1.2 * Fy = 1814 LBS

SINCE SHEAR GOVERNS P1 = 1050 LBS

$M_{CONN\ CAPACITY}$ = (P1 * 2") = 2100 LBS-IN

$M_{CONN\ SEISMIC}$ = 1.33 * $M_{CONN\ CAPACITY}$ = 2793 LBS-IN



FROM MODEL RISA $M_{MAX\ BEAM}$ = 1,832 LBS-IN

FROM MODEL RISA $M_{MAX\ BEAM\ 25\%}$ = 458 LBS-IN < $M_{CONN\ SEISMIC}$

OK

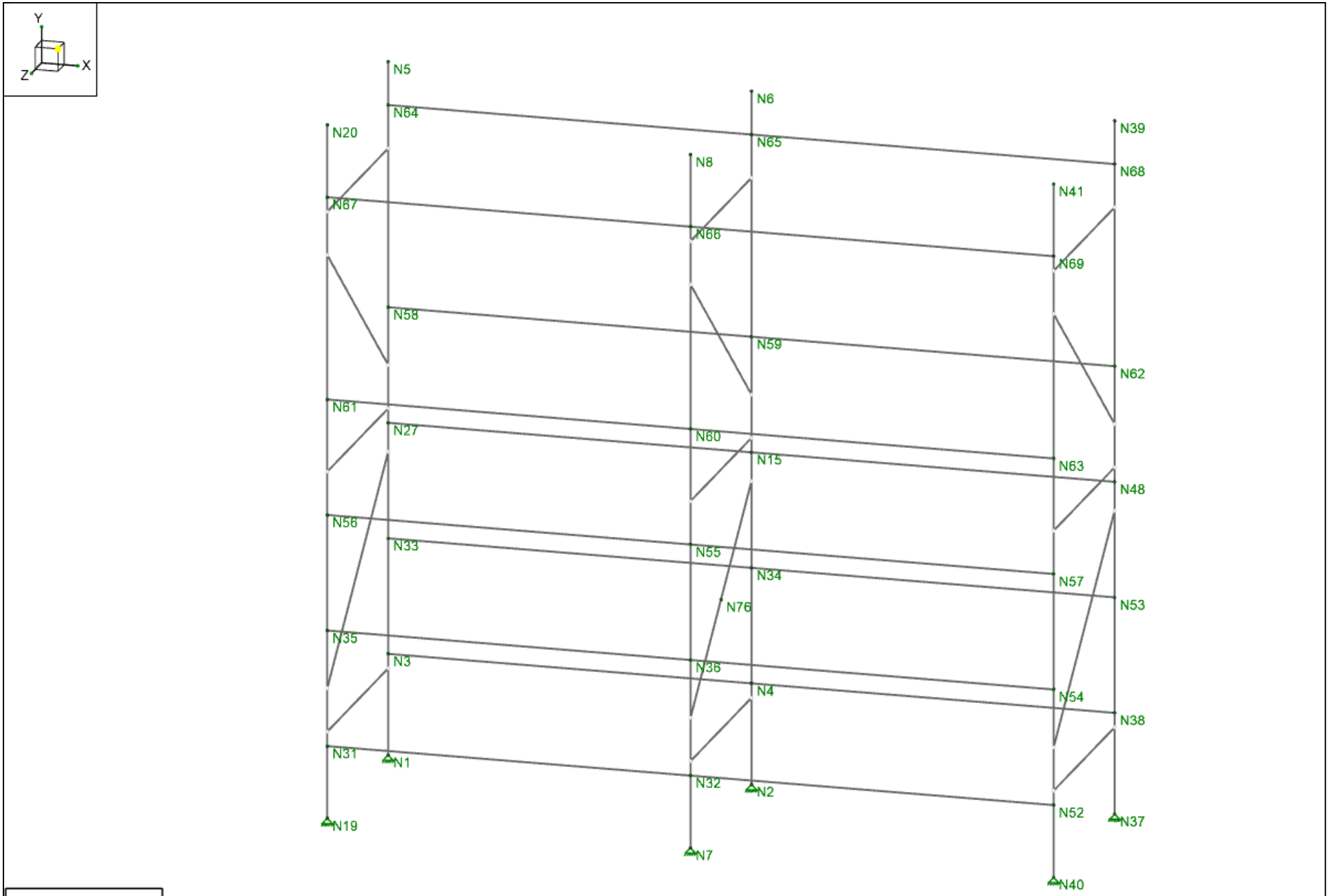
JPH & CLARK, INC.

CONSULTING STRUCTURAL ENGINEERING

1801 N. HAMPTON RD., SUITE 440

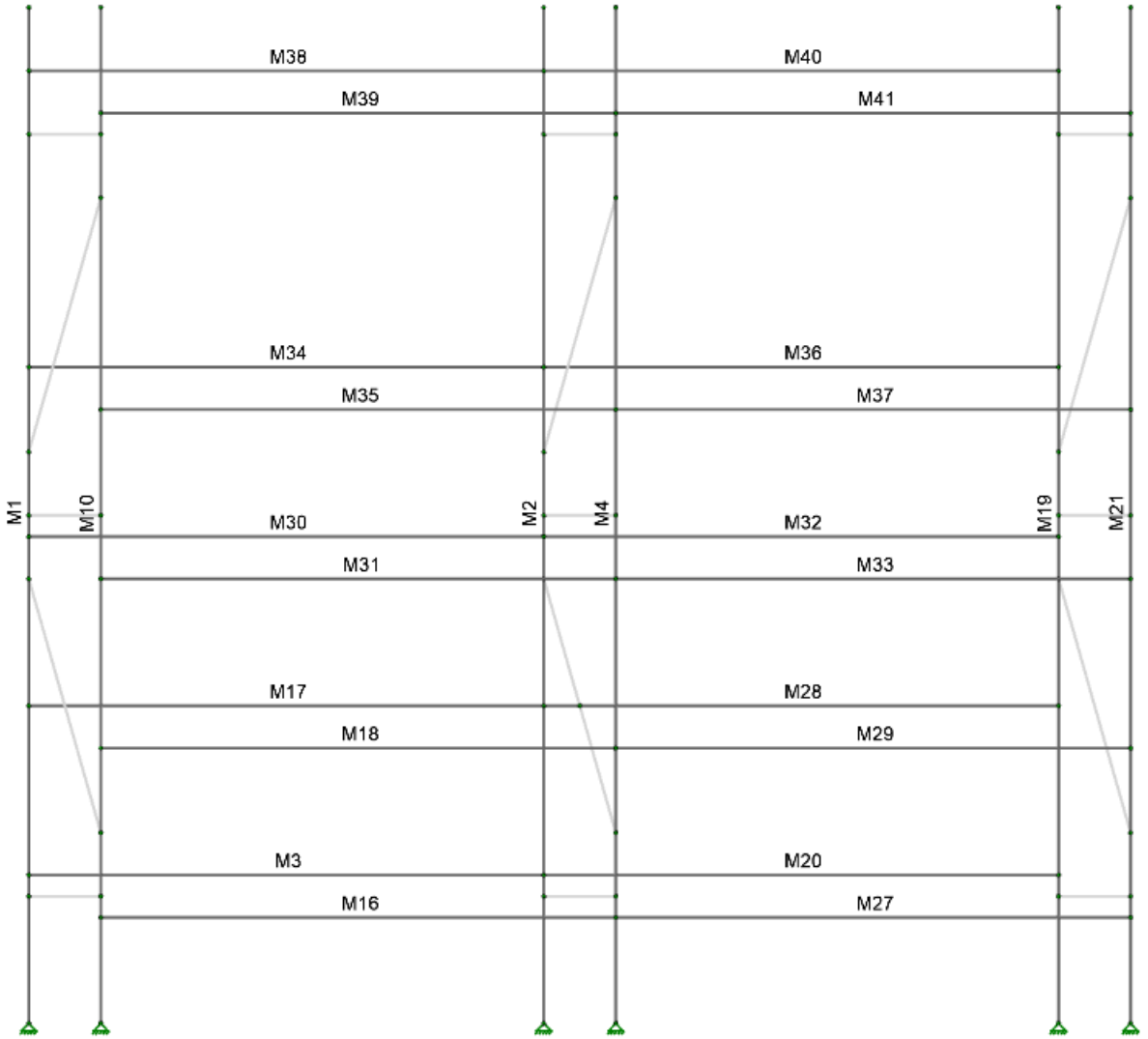
DESOTO, TX 75115-2399

(972) 283-5111



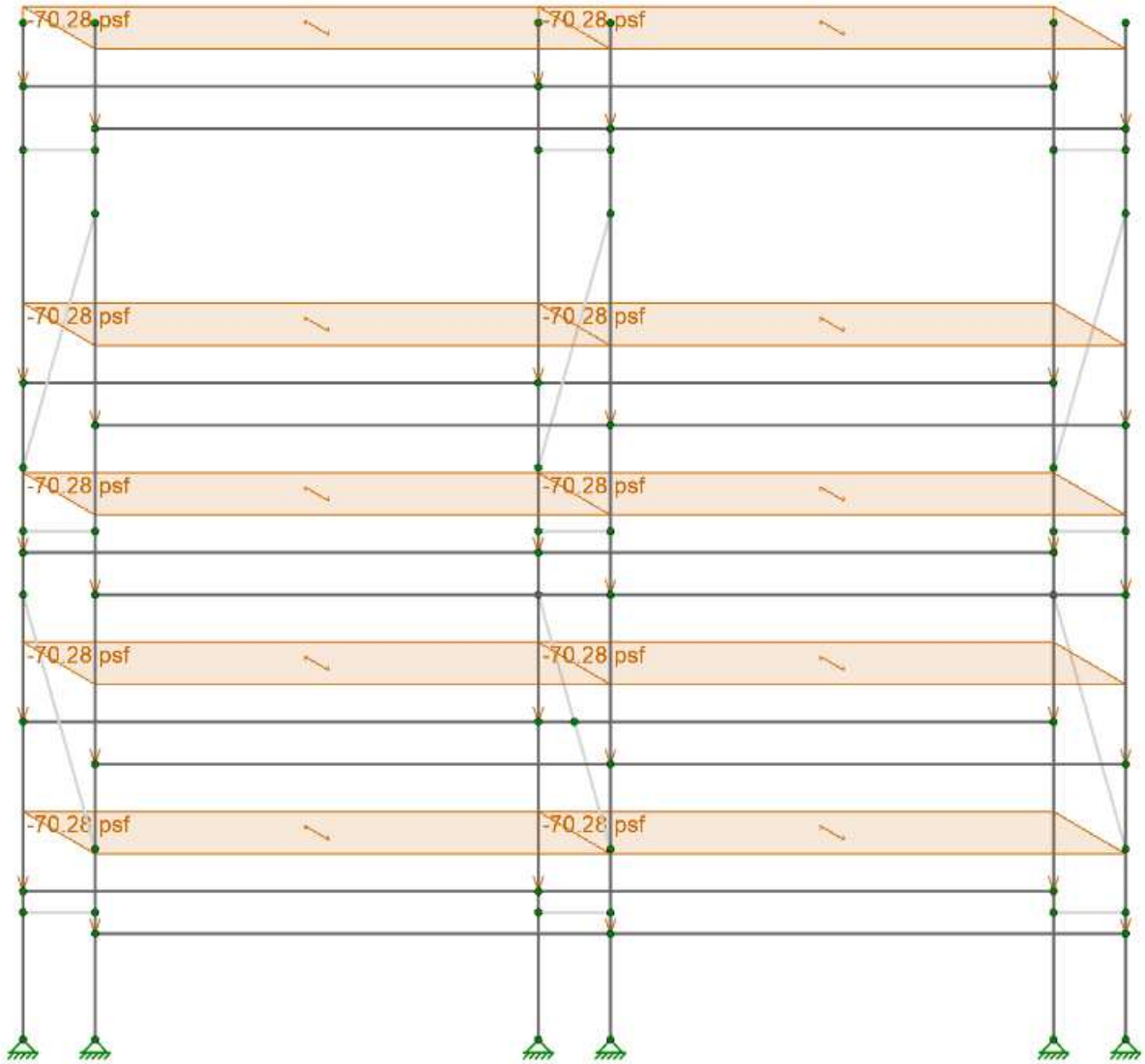
Envelope Only Solution

JPH & CLARK, Inc	Frame C - (30"Bx50"Lx96"H) - Oil Rack	SK-1
AA		Aug 28, 2026 at 05:30 PM
26-460 Advanced Auto Parts	Nodes Layout	C - Oil Rack -30x50x96 -5Lvls - 2Bays - WS



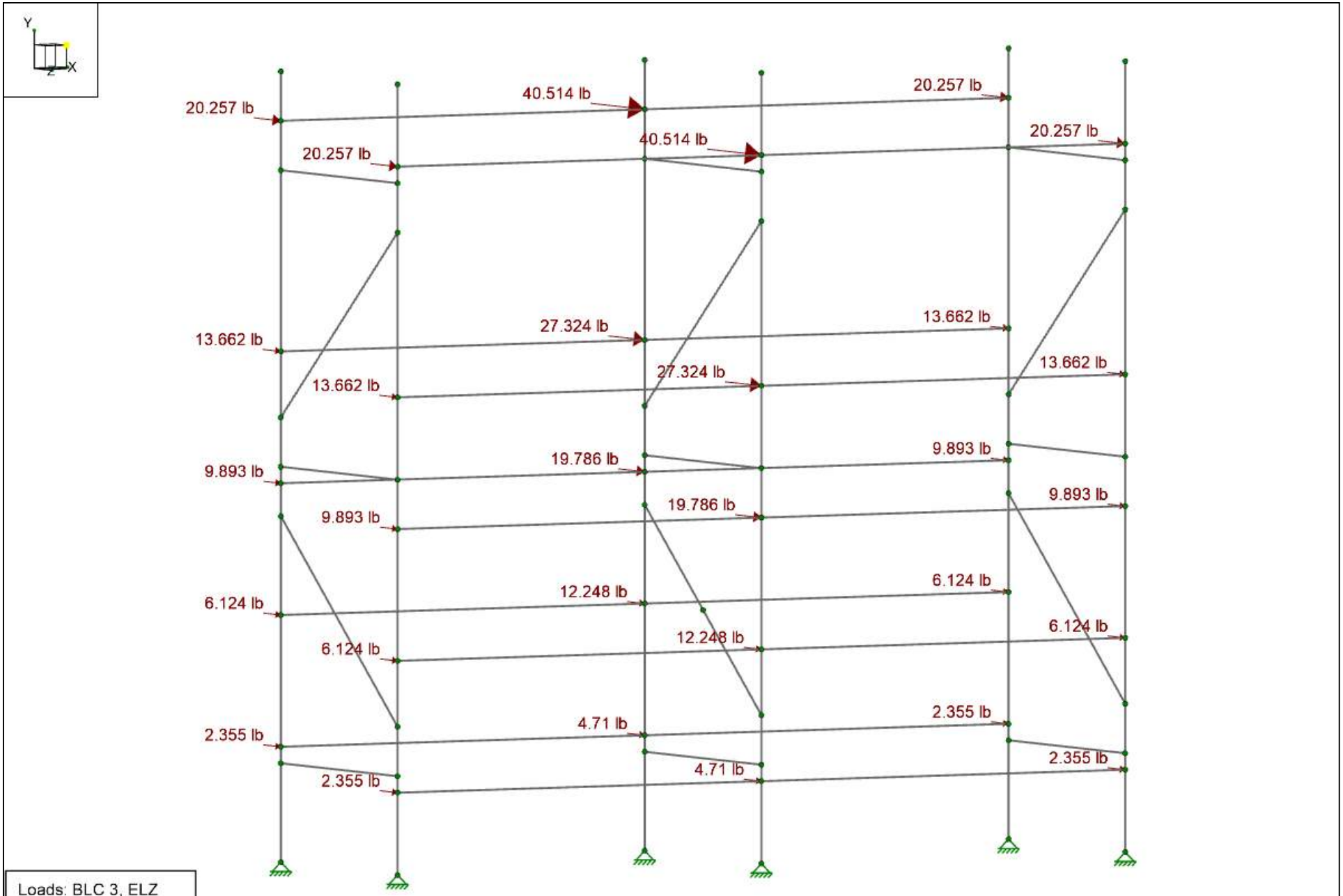
Envelope Only Solution

JPH & CLARK, Inc	Frame C - (30"Bx50"Lx96"H) - Oil Rack		SK-2
AA			Aug 28, 2026 at 05:32 PM
26-460 Advanced Auto Parts	Members Label		C - Oil Rack -30x50x96 -5Lvls - 2Bays - WS



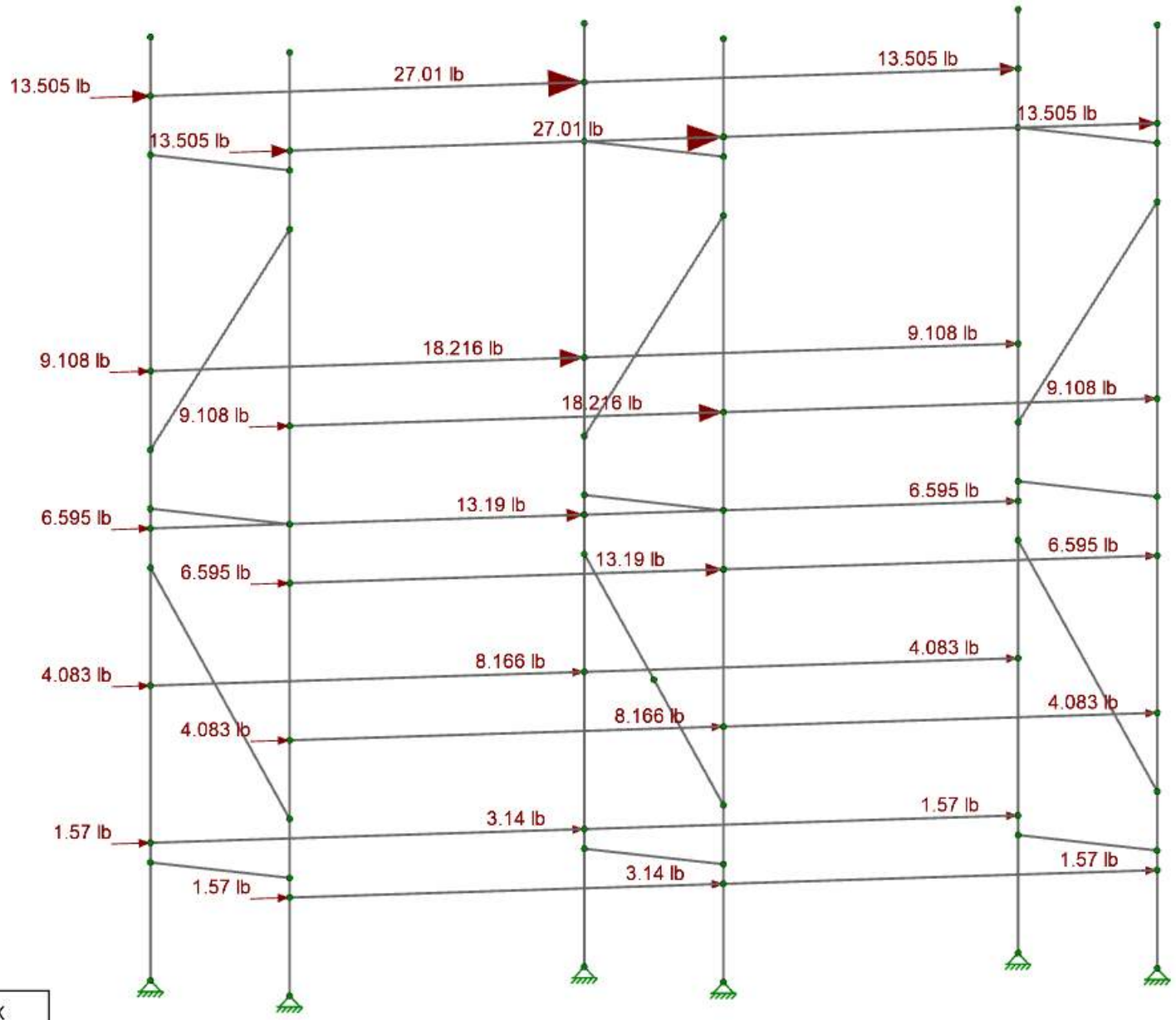
Loads: LC 3, LC-3
Envelope Only Solution

JPH & CLARK, Inc	Frame C - (30"Bx50"Lx96"H) - Oil Rack		SK-3
AA			Aug 28, 2026 at 05:33 PM
26-460 Advanced Auto Parts	DL + LL		C - Oil Rack -30x50x96 -5Lvls - 2Bays - WS



Loads: BLC 3, ELZ
Envelope Only Solution

JPH & CLARK, Inc	Frame C - (30"Bx50"Lx96"H) - Oil Rack	SK-1
AA		Aug 31, 2026 at 05:17 PM
26-460 Advanced Auto Parts	ELZ	C - Oil Rack -30x50x96 -5Lvls - 2Bays - WS



Loads: BLC 4, ELX
Envelope Only Solution

JPH & CLARK, Inc	Frame C - (30"Bx50"Lx96"H) - Oil Rack		SK-2
AA			Aug 31, 2026 at 05:18 PM
26-460 Advanced Auto Parts	ELX		C - Oil Rack -30x50x96 -5Lvls - 2Bays - WS

Cold Formed Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm. Coeff. [1e5°F⁻¹]	Density [k/ft³]	Yield [ksi]	Fu [ksi]
1	A570 Gr.33	29500	11346	0.3	0.65	0.49	33	52
2	A607 C1 Gr.55	29500	11346	0.3	0.65	0.49	55	70
3	A653 SS Gr33	29500	11346	0.3	0.65	0.49	33	45
4	A653 SS Gr50/1	29500	11346	0.3	0.65	0.49	50	65
5	Gr45	29500	11346	0.3	0.65	0.49	45	57

Cold Formed Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rule	Area [in²]	Iyy [in⁴]	Izz [in⁴]	J [in⁴]
1	WS-UP	-WS-COL1.625X1.75X14GA	Column	CS	Gr45	Typical	0.372	0.133	0.202	0.000657
2	WS-BM	-WS-BM3.25X16GA	Beam	CS	Gr45	Typical	0.413	0.116	0.572	0.001
3	WS-BRC	-WS-BRC-1.34X0.75X20GA	HBrace	None	Gr45	Typical	0.115	0.01	0.024	0.055

Basic Load Cases

	BLC Description	Category	Nodal	Distributed	Area(Member)
1	DL	DL			10
2	PLL	LL			10
3	ELZ	ELZ	40		
4	ELX	ELX	40		
5	BLC 1 Transient Area Loads	None		20	
6	BLC 2 Transient Area Loads	None		20	

Load Combinations

	Description	Solve	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
1	LC-1	Yes	DL	1								
2	LC-2	Yes	LL	1								
3	LC-3	Yes	DL	1	LL	1						
4	LC-4-AEL	Yes	DL	1	LL	0.67						
5	LC-5	Yes	DL	1	LL	0.67	ELX	0.525				
6	LC-6	Yes	DL	1	LL	0.67	ELZ	0.525				
7	LC-7	Yes	DL	1	Sds*DL	0.105	LL	0.735	LL	0.016	Rho*ELX	0.525
8	LC-8	Yes	DL	1	Sds*DL	0.14	LL	0.595	LL	0.021	Rho*ELX	0.7
9	LC-9	Yes	DL	0.6	Sds*DL	-0.14	LL	0.402	LL	-0.02	Rho*ELX	0.7
10	LC-10	Yes	DL	1	Sds*DL	0.105	LL	0.735	LL	0.016	Rho*ELZ	0.525
11	LC-11	Yes	DL	1	Sds*DL	0.14	LL	0.595	LL	0.021	Rho*ELZ	0.7
12	LC-12	Yes	DL	0.6	Sds*DL	-0.14	LL	0.402	LL	-0.02	Rho*ELZ	0.7
13												
14	AB-FLC5-1	Yes	DL	1.2	Sds*DL	0.2	LL	0.84	LL	0.03	Om*ELX	1
15	AB-FLC5-2	Yes	DL	1.2	Sds*DL	0.2	LL	0.84	LL	0.03	Om*ELZ	1
16	AB-FLC5-3	Yes	DL	1.2	Sds*DL	0.2	LL	0.84	LL	0.03	Om*ELX	-1
17	AB-FLC5-4	Yes	DL	1.2	Sds*DL	0.2	LL	0.84	LL	0.03	Om*ELZ	-1
18	AB-FLC7-5	Yes	DL	0.9	Sds*DL	-0.2	LL	0.603	LL	-0.029	Om*ELX	1
19	AB-FLC7-6	Yes	DL	0.9	Sds*DL	-0.2	LL	0.603	LL	-0.029	Om*ELZ	1
20	AB-FLC7-7	Yes	DL	0.9	Sds*DL	-0.2	LL	0.603	LL	-0.029	Om*ELX	-1
21	AB-FLC7-8	Yes	DL	0.9	Sds*DL	-0.2	LL	0.603	LL	-0.029	Om*ELZ	-1

Node Loads and Enforced Displacements (BLC 3 : ELZ)

	Node Label	L, D, M	Direction	Magnitude [(lb, lb-ft), (in, rad), (lb*s²/in, lb*s²*in)]
1	N64	L	Z	20.257
2	N67	L	Z	20.257
3	N65	L	Z	20.257
4	N65	L	Z	20.257
5	N66	L	Z	20.257
6	N66	L	Z	20.257
7	N69	L	Z	20.257
8	N68	L	Z	20.257

Node Loads and Enforced Displacements (BLC 3 : ELZ) (Continued)

	Node Label	L, D, M	Direction	Magnitude [(lb, lb-ft), (in, rad), (lb*s²/in, lb*s²*in)]
9	N63	L	Z	13.662
10	N62	L	Z	13.662
11	N60	L	Z	13.662
12	N60	L	Z	13.662
13	N59	L	Z	13.662
14	N61	L	Z	13.662
15	N58	L	Z	13.662
16	N59	L	Z	13.662
17	N48	L	Z	9.893
18	N57	L	Z	9.893
19	N15	L	Z	9.893
20	N15	L	Z	9.893
21	N55	L	Z	9.893
22	N55	L	Z	9.893
23	N56	L	Z	9.893
24	N27	L	Z	9.893
25	N34	L	Z	6.124
26	N34	L	Z	6.124
27	N36	L	Z	6.124
28	N36	L	Z	6.124
29	N35	L	Z	6.124
30	N33	L	Z	6.124
31	N53	L	Z	6.124
32	N54	L	Z	6.124
33	N3	L	Z	2.355
34	N31	L	Z	2.355
35	N4	L	Z	2.355
36	N4	L	Z	2.355
37	N32	L	Z	2.355
38	N38	L	Z	2.355
39	N52	L	Z	2.355
40	N32	L	Z	2.355

Node Loads and Enforced Displacements (BLC 4 : ELX)

	Node Label	L, D, M	Direction	Magnitude [(lb, lb-ft), (in, rad), (lb*s²/in, lb*s²*in)]
1	N64	L	X	13.505
2	N67	L	X	13.505
3	N65	L	X	13.505
4	N65	L	X	13.505
5	N66	L	X	13.505
6	N66	L	X	13.505
7	N69	L	X	13.505
8	N68	L	X	13.505
9	N63	L	X	9.108
10	N62	L	X	9.108
11	N60	L	X	9.108
12	N60	L	X	9.108
13	N59	L	X	9.108
14	N61	L	X	9.108
15	N58	L	X	9.108
16	N59	L	X	9.108
17	N48	L	X	6.595
18	N57	L	X	6.595
19	N15	L	X	6.595
20	N15	L	X	6.595
21	N55	L	X	6.595
22	N55	L	X	6.595
23	N56	L	X	6.595
24	N27	L	X	6.595
25	N34	L	X	4.083
26	N34	L	X	4.083

Node Loads and Enforced Displacements (BLC 4 : ELX) (Continued)

	Node Label	L, D, M	Direction	Magnitude [(lb, lb-ft), (in, rad), (lb*s²/in, lb*s²*in)]
27	N36	L	X	4.083
28	N36	L	X	4.083
29	N35	L	X	4.083
30	N33	L	X	4.083
31	N53	L	X	4.083
32	N54	L	X	4.083
33	N3	L	X	1.57
34	N31	L	X	1.57
35	N4	L	X	1.57
36	N4	L	X	1.57
37	N32	L	X	1.57
38	N38	L	X	1.57
39	N52	L	X	1.57
40	N32	L	X	1.57

Member Distributed Loads (BLC 5 : BLC 1 Transient Area Loads)

	Member Label	Direction	Start Magnitude [lb/ft, F, psf, lb-ft/in]	End Magnitude [lb/ft, F, psf, lb-ft/in]	Start Location [(in, %)]	End Location [(in, %)]
1	M3	Y	-6.306	-6.306	0	50.004
2	M16	Y	-6.306	-6.306	4.441e-15	50.004
3	M20	Y	-6.306	-6.306	9.77e-15	49.992
4	M27	Y	-6.306	-6.306	1.865e-14	49.992
5	M17	Y	-6.305	-6.305	0	50.004
6	M18	Y	-6.305	-6.305	6.217e-15	50.004
7	M28	Y	-6.305	-6.305	7.105e-15	49.992
8	M29	Y	-6.305	-6.305	1.421e-14	49.992
9	M30	Y	-6.305	-6.305	0	50.004
10	M31	Y	-6.305	-6.305	6.217e-15	50.004
11	M32	Y	-6.305	-6.305	7.105e-15	49.992
12	M33	Y	-6.305	-6.305	1.688e-14	49.992
13	M34	Y	-6.306	-6.306	0	50.004
14	M35	Y	-6.306	-6.306	8.882e-16	50.004
15	M36	Y	-6.306	-6.306	9.77e-15	49.992
16	M37	Y	-6.306	-6.306	1.51e-14	49.992
17	M38	Y	-6.305	-6.305	0	50.004
18	M39	Y	-6.305	-6.305	4.441e-15	50.004
19	M40	Y	-6.305	-6.305	5.329e-15	49.992
20	M41	Y	-6.305	-6.305	1.421e-14	49.992

Member Distributed Loads (BLC 6 : BLC 2 Transient Area Loads)

	Member Label	Direction	Start Magnitude [lb/ft, F, psf, lb-ft/in]	End Magnitude [lb/ft, F, psf, lb-ft/in]	Start Location [(in, %)]	End Location [(in, %)]
1	M33	Y	-82.321	-82.321	1.688e-14	49.992
2	M34	Y	-82.325	-82.325	0	50.004
3	M35	Y	-82.325	-82.325	8.882e-16	50.004
4	M36	Y	-82.325	-82.325	9.77e-15	49.992
5	M37	Y	-82.325	-82.325	1.51e-14	49.992
6	M38	Y	-82.321	-82.321	0	50.004
7	M39	Y	-82.321	-82.321	4.441e-15	50.004
8	M40	Y	-82.321	-82.321	5.329e-15	49.992
9	M41	Y	-82.321	-82.321	1.421e-14	49.992
10	M3	Y	-82.325	-82.325	0	50.004
11	M16	Y	-82.325	-82.325	4.441e-15	50.004
12	M20	Y	-82.325	-82.325	9.77e-15	49.992
13	M27	Y	-82.325	-82.325	1.865e-14	49.992
14	M17	Y	-82.321	-82.321	0	50.004
15	M18	Y	-82.321	-82.321	6.217e-15	50.004
16	M28	Y	-82.321	-82.321	7.105e-15	49.992
17	M29	Y	-82.321	-82.321	1.421e-14	49.992
18	M30	Y	-82.321	-82.321	0	50.004
19	M31	Y	-82.321	-82.321	6.217e-15	50.004

Member Distributed Loads (BLC 6 : BLC 2 Transient Area Loads) (Continued)

	Member Label	Direction	Start Magnitude [lb/ft, F, psf, lb-ft/in]	End Magnitude [lb/ft, F, psf, lb-ft/in]	Start Location [(in, %)]	End Location [(in, %)]
20	M32	Y	-82.321	-82.321	7.105e-15	49.992

Envelope Node Reactions

	Node Label		X [lb]	LC	Y [lb]	LC	Z [lb]	LC	MX [lb-ft]	LC	MY [lb-ft]	LC	MZ [lb-ft]	LC
1	N1	max	33.099	3	864.821	3	0.324	3	0	12	0	12	0	12
2		min	-15.548	9	61.527	1	-64.923	12	0	1	0	1	0	1
3	N2	max	-0.001	1	1963.269	3	-0.085	1	0	12	0	12	0	12
4		min	-40.07	8	139.675	1	-88.595	11	0	1	0	1	0	1
5	N7	max	-0.002	1	1969.539	3	-0.001	1	0	12	0	12	0	12
6		min	-42.988	8	140.121	1	-29.268	11	0	1	0	1	0	1
7	N19	max	53.599	3	861.687	3	0.283	3	0	12	0	12	0	12
8		min	-6.272	9	61.304	1	-22.71	12	0	1	0	1	0	1
9	N37	max	-2.354	1	864.586	3	0.324	3	0	12	0	12	0	12
10		min	-49.99	8	61.51	1	-64.925	12	0	1	0	1	0	1
11	N40	max	-3.811	1	861.45	3	0.283	3	0	12	0	12	0	12
12		min	-62.045	8	61.287	1	-22.711	12	0	1	0	1	0	1
13	Totals:	max	0	3	7385.351	3	0	1						
14		min	-195.222	9	525.423	1	-292.83	12						

Envelope Maximum Member Section Forces

	Member		Axial[lb]	Loc[in]	LC	y Shear[lb]	Loc[in]	LC	z Shear[lb]	Loc[in]	LC	Torque[lb-ft]	Loc[in]	LC	y-y Moment[lb-ft]	Loc[in]	LC	z-z Moment[lb-ft]	Loc[in]	LC
1	M1	max	864.821	12	3	15.569	14	9	33.813	41	11	0.094	14	11	39.664	42	11	61.641	90	3
2		min	0	91	1	-77.226	46	3	-93.429	42	12	-0.136	46	12	-64.923	12	12	-50.936	46	3
3	M2	max	1963.269	12	3	46.095	30	8	46.502	41	11	0.04	48	9	56.56	42	11	25.618	15	8
4		min	0	91	1	0	91	1	-131.874	42	11	-0.035	12	8	-88.595	12	11	-46.584	14	8
5	M3	max	-3.071	50.004	1	171.933	0	3	0.01	50.004	9	0	50.004	3	0.091	0	11	143.906	50.004	3
6		min	-43.159	0	3	-197.39	50.004	3	-0.897	0	11	-0.008	0	12	-3.648	50.004	11	-75.891	23.439	3
7	M4	max	1969.539	9	3	0	96	12	154.587	18	11	0.036	12	8	76.49	18	11	32.241	9	8
8		min	0	87	1	-44.086	10	8	-40.393	42	11	-0.042	84	8	-27.451	78	12	-28.78	10	8
9	M5	max	-0.193	30	1	0.491	30	3	0	30	12	0	30	3	0.035	0	8	29.877	30	12
10		min	-127.177	0	11	-22.562	0	12	-0.027	0	8	-0.17	0	9	-0.032	30	8	-26.528	0	12
11	M6	max	235.53	19.209	11	8.872	19.209	11	0	38.419	12	0.079	38.419	8	0	38.419	1	16.009	0	11
12		min	0.404	19.61	1	0.016	19.61	1	-0.014	19.209	9	0	19.61	1	-0.09	38.419	8	-12.395	38.419	11
13	M7	max	-0.21	30	1	5.228	30	12	0	30	12	0.129	30	8	0.023	0	9	3.239	0	12
14		min	-51.081	0	11	-0.181	0	3	-0.025	0	9	0	0	1	-0.04	30	8	-9.832	30	12
15	M8	max	1.649	38.419	3	0.058	38.419	3	0	38.419	12	0.006	38.419	8	0.009	0	9	8.889	38.419	12
16		min	-95.459	0	12	-5.695	0	12	-0.006	0	9	0	0	1	-0.01	38.419	9	-9.345	0	12
17	M9	max	40.93	30	12	5.638	30	11	0	30	12	0	30	1	0.042	0	8	9.286	0	11
18		min	-0.412	0	3	0.025	0	1	-0.025	0	8	-0.197	0	8	-0.02	30	8	-4.808	30	11
19	M10	max	861.687	9	3	77.139	57	3	111.093	18	12	0.203	86	11	55.67	18	11	50.383	42	3
20		min	0	87	1	-6.272	0	9	-30.311	42	11	-0.077	10	11	-18.481	78	12	-61.56	86	3
21	M11	max	0.115	30	8	0.44	30	3	0.069	30	11	-0.008	30	1	0.078	30	11	22.235	30	12
22		min	-90.748	0	12	-16.829	0	12	-0.021	0	9	-0.299	0	8	-0.094	0	11	-19.838	0	12
23	M12	max	167.981	38.419	11	6.348	38.419	11	0.05	38.419	12	0.035	38.419	9	0.128	38.419	11	11.569	0	12
24		min	-0.151	0	9	-0.002	0	9	-0.016	0	8	-0.075	0	3	-0.059	38.419	9	-8.755	38.419	11
25	M13	max	-0.045	30	1	3.531	30	12	0.089	30	12	-0.024	30	1	0.136	30	12	2.077	0	12
26		min	-37.986	0	11	-0.127	0	3	-0.028	0	8	-0.342	0	3	-0.085	0	12	-6.75	30	12
27	M14	max	1.234	38.419	3	0.065	38.419	3	0.026	38.419	12	0.049	38.419	3	0.019	38.419	12	6.152	38.419	12
28		min	-63.807	0	12	-3.95	0	12	-0.012	0	8	0.003	0	1	-0.07	0	11	-6.495	0	12
29	M15	max	27.686	30	12	3.736	30	11	0.118	30	11	0.619	30	3	0.093	30	11	6.228	0	11
30		min	-0.422	0	3	0.009	0	1	-0.022	0	9	0.044	0	1	-0.201	0	11	-3.113	30	11
31	M16	max	-1.416	50.004	1	196.542	0	3	0.008	50.004	9	0	50.004	1	2.921	0	11	143.2	0	3
32		min	-19.903	0	3	-172.781	50.004	3	-0.72	0	11	-0.015	0	11	-0.077	50.004	11	-74.72	26.565	3
33	M17	max	2.072	50.004	8	175.5	0	3	0.062	50.004	3	0.001	50.004	3	0.254	50.004	3	137.62	50.004	3
34		min	0.065	0	1	-193.804	50.004	3	-1.093	0	12	-0.001	0	12	-4.534	50.004	12	-74.271	23.96	3
35	M18	max	-0.101	50.004	1	194.327	0	3	0.017	50.004	3	0.001	50.004	3	5.954	0	12	138.752	0	3
36		min	-1.414	0	3	-174.977	50.004	3	-1.438	0	12	-0.005	0	12	-0.075	0	3	-74.276	26.565	3
37	M19	max	864.586	12	3	77.189	48	3	33.814	41	11	0.136	48	12	39.665	42	11	50.911	46	3
38		min	0	91	1	0	91	1	-93.433	42	12	-0.094	12	11	-64.925	12	12	-61.606	90	3

Envelope Maximum Member Section Forces (Continued)

	Member		Axial[lb]	Loc[in]	LC	y Shear[lb]	Loc[in]	LC	z Shear[lb]	Loc[in]	LC	Torque[lb-ft]	Loc[in]	LC	y-y Moment[lb-ft]	Loc[in]	LC	z-z Moment[lb-ft]	Loc[in]	LC
39	M20	max	-3.069	49.992	1	197.349	0	3	0.897	49.992	11	0.008	49.992	12	0.091	49.992	11	143.86	0	3
40		min	-43.137	0	3	-171.885	49.992	3	0	0	1	0	0	3	-3.648	0	11	-75.847	26.558	3
41	M21	max	861.45	9	3	0	96	12	111.097	18	12	0.077	12	11	55.672	18	11	61.526	86	3
42		min	0	87	1	-77.101	48	3	-30.312	42	11	-0.203	84	11	-18.482	78	12	-50.358	42	3
43	M22	max	0.016	30	3	0.44	30	3	-0.001	30	1	0.113	30	3	0.094	0	11	22.236	30	12
44		min	-90.751	0	12	-16.83	0	12	-0.069	0	11	-0.18	0	9	-0.078	30	11	-19.839	0	12
45	M23	max	167.986	38.419	11	6.348	38.419	11	0.002	38.419	3	0.113	38.419	8	0.045	0	12	11.569	0	12
46		min	0.011	0	1	0.001	0	1	-0.05	0	12	0.005	0	1	-0.128	38.419	11	-8.755	38.419	11
47	M24	max	-0.045	30	1	3.531	30	12	0.005	30	3	0.342	30	3	0.085	0	12	2.077	0	12
48		min	-37.988	0	11	-0.127	0	3	-0.089	0	12	0.024	0	1	-0.136	30	12	-6.75	30	12
49	M25	max	1.234	38.419	3	0.065	38.419	3	0.01	38.419	3	-0.003	38.419	1	0.07	0	11	6.153	38.419	12
50		min	-63.809	0	12	-3.95	0	12	-0.026	0	12	-0.049	0	3	-0.019	38.419	12	-6.495	0	12
51	M26	max	27.687	30	12	3.736	30	11	0	30	1	-0.044	30	1	0.201	0	11	6.228	0	11
52		min	-0.422	0	3	0.009	0	1	-0.118	0	11	-0.619	0	3	-0.093	30	11	-3.113	30	11
53	M27	max	-1.415	49.992	1	172.734	0	3	0.72	49.992	11	0.015	49.992	11	2.921	49.992	11	143.152	49.992	3
54		min	-19.893	0	3	-196.501	49.992	3	0.001	0	1	0	0	1	-0.077	0	11	-74.677	23.434	3
55	M28	max	0.912	49.992	3	193.762	0	3	1.093	49.992	12	0.001	49.992	12	0.254	0	3	137.57	0	3
56		min	-1.12	0	9	-175.454	49.992	3	-0.062	0	3	-0.001	0	3	-4.534	0	12	-74.228	26.037	3
57	M29	max	-0.101	49.992	1	174.931	0	3	1.438	49.992	12	0.005	49.992	12	5.954	49.992	12	138.702	49.992	3
58		min	-1.415	0	3	-194.285	49.992	3	-0.017	0	3	-0.001	0	3	-0.075	49.992	3	-74.233	23.434	3
59	M30	max	-0.134	50.004	1	176.622	0	3	0.114	50.004	3	0	50.004	3	0.457	50.004	3	135.01	50.004	3
60		min	-2.285	0	8	-192.682	50.004	3	-1.432	0	12	-0.008	0	12	-5.764	50.004	12	-74.445	23.96	3
61	M31	max	-0.158	50.004	1	193.169	0	3	0.089	50.004	3	0.001	50.004	11	6.188	0	12	136.084	0	3
62		min	-2.51	0	7	-176.135	50.004	3	-1.498	0	12	0	0	1	-0.368	0	3	-74.428	26.044	3
63	M32	max	0.332	49.992	9	192.639	0	3	1.432	49.992	12	0.008	49.992	12	0.457	0	3	134.96	0	3
64		min	-1.876	0	3	-176.576	49.992	3	-0.114	0	3	0	0	3	-5.764	0	12	-74.402	26.037	3
65	M33	max	0.186	49.992	9	176.089	0	3	1.498	49.992	12	0	49.992	1	6.188	49.992	12	136.034	49.992	3
66		min	-2.223	0	3	-193.127	49.992	3	-0.089	0	3	-0.001	0	11	-0.368	49.992	3	-74.386	23.954	3
67	M34	max	29.735	50.004	3	176.646	0	3	0.1	50.004	3	0	50.004	1	0.409	50.004	3	134.245	50.004	3
68		min	2.115	0	1	-192.678	50.004	3	-1.844	0	12	-0.004	0	11	-7.619	50.004	12	-75.189	23.96	3
69	M35	max	30.569	50.004	3	193.155	0	3	0.113	50.004	3	0	50.004	1	6.081	0	12	135.304	0	3
70		min	2.175	0	1	-176.168	50.004	3	-1.471	0	12	-0.001	0	11	-0.465	0	3	-75.167	26.044	3
71	M36	max	29.722	49.992	3	192.634	0	3	1.845	49.992	12	0.004	49.992	11	0.409	0	3	134.195	0	3
72		min	2.115	0	1	-176.6	49.992	3	-0.1	0	3	0	0	1	-7.619	0	12	-75.146	26.037	3
73	M37	max	30.556	49.992	3	176.122	0	3	1.471	49.992	12	0.001	49.992	11	6.081	49.992	12	135.254	49.992	3
74		min	2.174	0	1	-193.112	49.992	3	-0.113	0	3	0	0	1	-0.465	49.992	3	-75.124	23.954	3
75	M38	max	47.482	50.004	3	162.957	0	3	0.061	50.004	3	0	50.004	1	0.255	50.004	3	152.044	50.004	3
76		min	3.378	0	1	-206.347	50.004	3	-1.985	0	12	-0.002	0	11	-8.198	50.004	12	-88.163	21.877	3
77	M39	max	46.574	50.004	3	206.516	0	3	0.064	50.004	3	0	50.004	1	8.346	0	12	152.682	0	3
78		min	3.313	0	1	-162.788	50.004	3	-2.051	0	12	-0.007	0	11	-0.27	0	3	-87.921	28.127	3
79	M40	max	47.457	49.992	3	206.309	0	3	1.986	49.992	12	0.002	49.992	11	0.255	0	3	152.013	0	3
80		min	3.376	0	1	-162.907	49.992	3	-0.061	0	3	0	0	1	-8.198	0	12	-88.105	28.12	3
81	M41	max	46.55	49.992	3	162.738	0	3	2.052	49.992	12	0.007	49.992	11	8.346	49.992	12	152.651	49.992	3
82		min	3.312	0	1	-206.477	49.992	3	-0.064	0	3	0	0	1	-0.27	49.992	3	-87.863	21.871	3

Material Take-Off

	Material	Size	Pieces	Length[in]	Weight[K]
1	Cold Formed Steel				
2	Gr45	-WS-BM3.25X16GA	20	1000	0.117
3	Gr45	-WS-BRC-1.34X0.75X20GA	15	500.5	0.016
4	Gr45	-WS-COL1.625X1.75X14GA	6	576	0.061
5	Total CF Steel		41	2076.5	0.194

Frame E

Storage Shelving

12/12"B x 48"L x 144"H - S-series

(14 Levels)

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

SEISMIC DESIGN FRAME E0 12"/12"B x 48"L x 144"H S-Series Storage Shelving

SEISMIC FORCES

Code Refrence

Seismic Code : **ASCE 7-10**
EQUIVALENT LATERAL FORCE PROCEDURE FOR SHELVING
& RMI (AS IT APPLIES)

Dimension

Frame :	**E0**		Max. Shelving Height :	**144**	in
Width :	**24**	in	Levels :	**14**	
Length :	**48**	in	Shelf type :	**S-Series Storage Shelving** Double Fixture	

Site parameters (ASCE 7 section 11.4)

Site class	**D (Default)**				
Mapped acceleration parameters					
at short periods	Ss =	**0.206**	at 1 sec. period	S_1 =	**0.106**
Site coefficient at short period	Fa =	**1.600**	at 1 sec. period	Fv =	**2.376**

Spectral response accelaration parameters (ASCE 7 section 11.4)

at short periods		**0.071**			**0.050**
	Calc. SMS =	**0.330**	at 1 sec. period	Calc. SM1 =	**0.252**

Design spectral acceleration parameters (ASCE 7 section 11.4)

at short periods	S_{DS} =	**0.220**	at 1 sec. period	S_{D1} =	**0.168**

Seismic design category (ASCE 7 section 11.6)

Risk Category	**II**
Seismic design category	**C**

Approximate fundamental period (ASCE 7 section 12.8.2.1)

Height above base to highest level	hn =	**12.00**	ft
Structure Type		**4**	
Long-period transition	TL =	**12**	Figs. 22-14 thru 22-17
Building period parameter Ct	Ct =	**0.020**	
Building period parameter x	x =	**0.75**	
Building fundamental period	T = Ta =	**0.129**	sec.
Exponent related to structure period	k =	**1**	since Ta ≤ 0.50 sec

Seismic response coefficient (ASCE 7 section 15.5 & RMI 2.6.3)

Response modification factor (Transverse)	R =	**4**	
Response modification factor (Longitudinal)	R =	**6**	
Seismic importance factor	Ie =	**1.5**	(ASCE 7 15.5.3,RMI Sec. 2.6.2)
Redundancy factor	ρ =	**1.0**	RMI Sec. 2.6.2.1; ASCE7 Sec.12.4.2.1
	Cd =	**3.5**	

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

Operating Weight (RMI 2.1 & ASCE 7 section 15.5)

Loads

DL : **5** psf

LEVEL	Height/LVL (in)	Input Shelf Load (PL) (lbs.)	Calculated (lbs.)
14	**10.25**	**80**	80
13	**10.25**	**80**	80
12	**10.25**	**80**	80
11	**10.25**	**80**	80
10	**10.25**	**80**	80
9	**10.25**	**80**	80
8	**10.25**	**80**	80
7	**10.25**	**80**	80
6	**10.25**	**80**	80
5	**10.25**	**80**	80
4	**10.25**	**80**	80
3	**10.25**	**80**	80
2	**10.25**	**80**	80
1	**4.00**	**80**	80
		Total PL :	1,120

DL = 5 PSF x 2 FT x 4 FT x 14 SHELVES = 560.00 lbs
PL app = 1,120 LBS x 0.67 = 750.40 lbs
PL (top shelf) = 80.00 lbs

Ws = DL+67%PL+0.25LL (Per Storage Rack Section)
67%PL (every shelf loaded 67% of its rated load)(PL app)
100%PL (top shelf only loaded 100% of its rated load)
V_{BASE} = Cs Ws

Seismic base shear (ASCE 7 section 12.8)

		Transverse	Longitudinal
Seismic response coefficient	Cs =	**0.082**	**0.055**
Seismic response coefficient max.	$Cs_{, MAX}$ =	**0.488**	**0.326**
Seismic response coefficient min.	$Cs_{, MIN}$ =	**0.015**	**0.015**
Seismic response coefficient (Governs)	Cs =	**0.082**	**0.055**

LOAD COMBINATION ASD (RMI 2.1)

	W_{LC}	Ws	E (factor)	V_{BASE} Transverse	V_{BASE} Longitudinal	
DL+0.67PL+0.75(0.7ρE)	1,310.40	1,310.40	0.525	57	38	
$(1+0.105S_{DS})$DL+0.75[$(1.4+0.14S_{DS})$0.7PL+0.7ρE]	1,414.21	1,310.40	0.525	57	38	
$(1+0.14S_{DS})$DL+$(0.85+0.14S_{DS})$0.7PL+0.7ρE	1,267.75	1,310.40	0.700	76	50	**CONTROLS**
$(0.6 - 0.14S_{DS})$DL+$(0.6 - 0.14S_{DS})$0.67PL+0.7ρE	745.93	1,310.40	0.700	76	50	
Seismic base shear			$V_{BASE\ MAX.\ CONTROL}$	76	50	

$W_{s\ CONTROL}$= 1,267.75 LBS

Anchors in accordance with ACI318 Sec.17 Ωo = 2.0 (ACI318 Sec.17; ASCE7 Table 15.4-1)

	Transverse	Longitudinal	
$V_{BASE\ 67\%PL}$ =	**76**	**50**	lbs
$V_{BASE\ 100\%PL\ TOP}$ x 0.7ρ=	**37**	**25**	lbs

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

SEISMIC LATERAL FORCE DISTRIBUTION - FRAME E0 (CONTINUED)

					Transverse	Longitudinal
LEVEL	W (lbs.)	h (ft)	$W_x h_x^k$ (lbs-ft)	$C_v x$	F_x (lbs)	F_x (lbs)
14	90.55	11.44	1035.70	0.14	10.49	6.99
13	90.55	10.58	958.35	0.13	9.71	6.47
12	90.55	9.73	881.01	0.12	8.92	5.95
11	90.55	8.88	803.66	0.11	8.14	5.43
10	90.55	8.02	726.31	0.10	7.36	4.91
9	90.55	7.17	648.96	0.09	6.57	4.38
8	90.55	6.31	571.62	0.08	5.79	3.86
7	90.55	5.46	494.27	0.07	5.01	3.34
6	90.55	4.60	416.92	0.06	4.22	2.82
5	90.55	3.75	339.57	0.05	3.44	2.29
4	90.55	2.90	262.23	0.04	2.66	1.77
3	90.55	2.04	184.88	0.02	1.87	1.25
2	90.55	1.19	107.53	0.01	1.09	0.73
1	90.55	0.33	30.18	0.00	0.31	0.20
Σ	1267.75	Σ	7461.21	Base :	75.58	50.39
P_{STATIC} =	316.94	lbs per post		$COMP._{MAX}$ =	420	lbs per post

$V_{BASE\ 67\%PL}$ (Transverse): 76 lbs

$V_{BASE\ 67\%PL}$ (Longitudinal): 50 lbs

Σ (F_X * h) (Transverse) : 7,165 lbs-in

Σ (F_X * h) (Longitudinal) : 4,777 lbs-in

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

SEISMIC LATERAL FORCE DISTRIBUTION TOP SHELF LOADED - FRAME E0 (CONTINUED)

					Transverse	Longitudinal
LEVEL	W (lbs.)	h (ft)	$W_x h_x^k$ (lbs-ft)	$C_v x$	F_x (lbs)	F_x (lbs)
14	120.00	11.44	1372.50	0.33	12.06	8.15
13	40.00	10.58	423.33	0.10	3.72	2.51
12	40.00	9.73	389.17	0.09	3.42	2.31
11	40.00	8.88	355.00	0.08	3.12	2.11
10	40.00	8.02	320.83	0.08	2.82	1.90
9	40.00	7.17	286.67	0.07	2.52	1.70
8	40.00	6.31	252.50	0.06	2.22	1.50
7	40.00	5.46	218.33	0.05	1.92	1.30
6	40.00	4.60	184.17	0.04	1.62	1.09
5	40.00	3.75	150.00	0.04	1.32	0.89
4	40.00	2.90	115.83	0.03	1.02	0.69
3	40.00	2.04	81.67	0.02	0.72	0.48
2	40.00	1.19	47.50	0.01	0.42	0.28
1	40.00	0.33	13.33	0.00	0.12	0.08
Σ	640.00	Σ	4210.83	Base :	37.00	25.00

$V_{BASE\ 100\%PL\ TOP}$ (Transverse): 37 LBS Σ (F_X * h) (Transverse) : 3,849 lbs-in

$V_{BASE\ 100\%PL\ TOP}$ (Longitudinal): 25 LBS Σ (F_X * h) (Longitudinal) : 2,601 lbs-in

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

COMPONENT DESIGN FOR PROFILE E0

CROSS BRACE DESIGN:

MAX. FORCE IN CROSS BRACE IN LONGITUDINAL DIRECTION

Fy = 30,000 PSI

CROSS BRACE AT EVERY 4 RACKS

(RISA3D) T_{MAX} = 160.218 LBS

A_{REQD} = 160.22 / (0.6 x 30000 PSI) = 0.009 IN^2

A_{ACTUAL} = 3/4" x 0.06" = 0.045 IN^2 OK

USE CROSS BRACE AT EVERY 4 RACKS.

SHEAR CAPACITY OF #8X5/8" SCREWS (AISI 2002 TABLE IV 8a)

(16 GA BRACE IN CONTACT & 16 GA UPRITE NOT IN CONTACT)

P_{nS} = 1.62 No. of Screws = 1

V_{ALLOW} = P_{nS} / Ω where, Ω = 3

V_{ALLOW} = 1 x 1.62 /3 = 0.54 KIPS = 540 LBS

V_{ALLOW} (SEISMIC) = 1.0 * V_{ALLOW} = 540 > $V_{MAX.}$ = 160 LBS OK

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

TRANSVERSE DIRECTION HORIZONTAL BRACE DESIGN:

(RISA3D) $P_{MAX.}$:	33	LBS
Unbrace Lx :	12	IN
Unbrace Ly :	12	IN

AREA =	0.269	IN^2	Fy =	30,000	PSI
Ix =	0.628	IN^4	Iy =	0.005	IN^4
Sx =	0.279	IN^3	Sy =	0.010	IN^3
rx =	1.527	IN	ry =	0.140	IN
C_{mx}=	1.00		Kx =	1.7	
			Ky =	1.0	

$$\frac{kLx}{rx} = \frac{(1.7)(12)}{1.527} = 13.36$$

$$\frac{kLy}{ry} = \frac{(1)(12)}{0.14} = 85.71 \quad \text{<-- CONTROLS}$$

$$Fa = \frac{\pi^2 * E}{(Kl/r)^2} = 38958 \text{ PSI}$$

$$\lambda c = (Fy / Fa)^{1/2} = 0.88 \quad <1.5$$

$$Fn = \begin{cases} \lambda c < 1.5 & (0.658^{\lambda c2})Fy \\ \lambda c > 1.5 & (0.877/\lambda c^2)Fy \end{cases} = 21734 \text{ PSI}$$

$$Pn = A_{eff} \times F_n = 5846 \text{ LBS}$$

$$P = P_n / \Omega$$

where, Ω_c = 1.80

P = 3248 LBS

$P_{MAX.} / P$ = 0.01 (1) <----------

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

(RISA3D) M_{MAX} =	38.10	LBS-FT
$M_n = S_x \times Fy$ =	8370.00	LBS-IN
M =	M_n/Ω	
where, Ω_b =	1.67	
M =	5012	LBS-IN
M_{MAX} / M =	0.09	(2) <----------
(1) + (2) =	0.10	< 1.0 OK

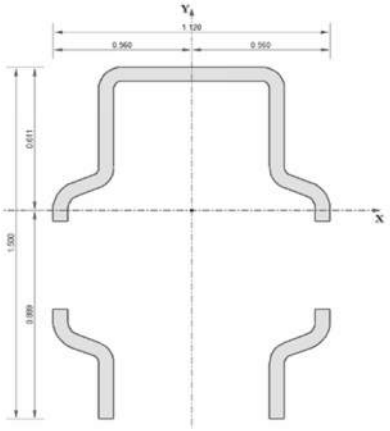
JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

COLUMN DESIGN FOR FRAME - E0

SECTION PROPERTIES

MAX HT = 144 IN

SIZE =	1.12"x1.5"x16ga		Fy =	30	ksi
t =	16	GA	E =	29,500	ksi
AREA =	0.194	in^2	Iy =	0.027	in^4
Ix =	0.050	in^4	Sy =	0.048	in^3
Sx =	0.056	in^3	ry =	0.374	in
rx =	0.508	in	Ωc=	1.80	
C_{mx}=	1.00		Ωb=	1.67	
Unbrace Lx-x =	10.25	in	Kx =	1.0	(RMI Sec. 6.3.1.2)
Unbrace Ly-y =	10.25	in	Ky =	1.7	(RMI Sec. 6.3.1.1)
δ_{SE} =	0.14	IN			
δ_X =	0.33	IN < 5% Structural Height OK			



COLUMN SECTION

P = 511 lbs

$\frac{kLx}{rx}$	=	$\frac{(1)(10.25)}{0.508in}$	=	20.18		$\frac{kLy}{ry}$	=	$\frac{(1.7)(10.25)}{0.374in}$	=	46.59	
Fax	=	$\frac{\pi^2 * E}{(Klx/rx)^2}$	=	715157	PSI	Fay	=	$\frac{\pi^2 * E}{(Kly/ry)^2}$	=	134128	psi
λc	=	$(Fy / Fax)^{1/2}$	=	0.20	<1.5	λc	=	$(Fy / Fay)^{1/2}$	=	0.47	<1.5
Fn =	λc < 1.5	$(0.658^{\lambda c2})Fy$	=	29478	psi	Fn =	λc < 1.5	$(0.658^{\lambda c2})Fy$	=	27319	psi
	λc > 1.5	$(0.877/\lambda c^2)Fy$					λc > 1.5	$(0.877/\lambda c^2)Fy$			
Pn	=	AREA * F_n	=	5719	lbs	Pn	=	AREA * F_n	=	5300	lbs
P_{EX}	=	$(\pi^2 E I_X) / (K_X L_X)^2$	=	138562	lbs	P_{EY}	=	$(\pi^2 E I_Y) / (K_Y L_Y)^2$	=	25890	lbs
α_x	=	$1 - (\Omega_c Px/Pex)$	=	0.99		α_y	=	$1 - (\Omega_c Px/Pey)$	=	0.96	

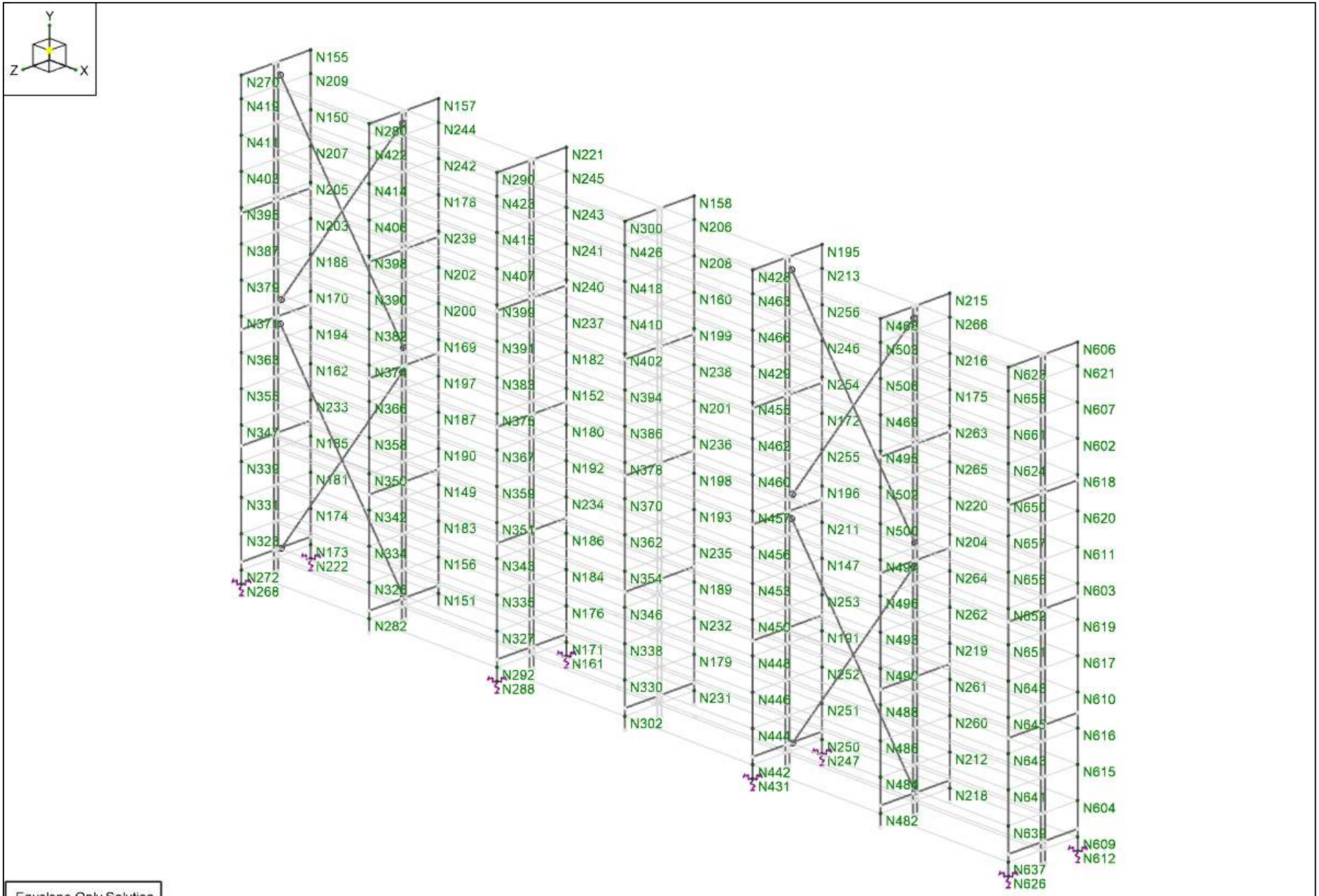
MAX MOMENT IN COLUMN

$Mx = M_{STATIC} + M_{SEISMIC}$ =	0.01	lbs-ft	$M_{nx} = Sx * Fy$ =	140.00	lbs-ft
$My = M_{STATIC} + M_{SEISMIC}$ =	19.69	lbs-ft	$M_{ny} = Sy * Fy$ =	120.00	lbs-ft

COMBINED STRESS (fa/Fa + fb/Fb)

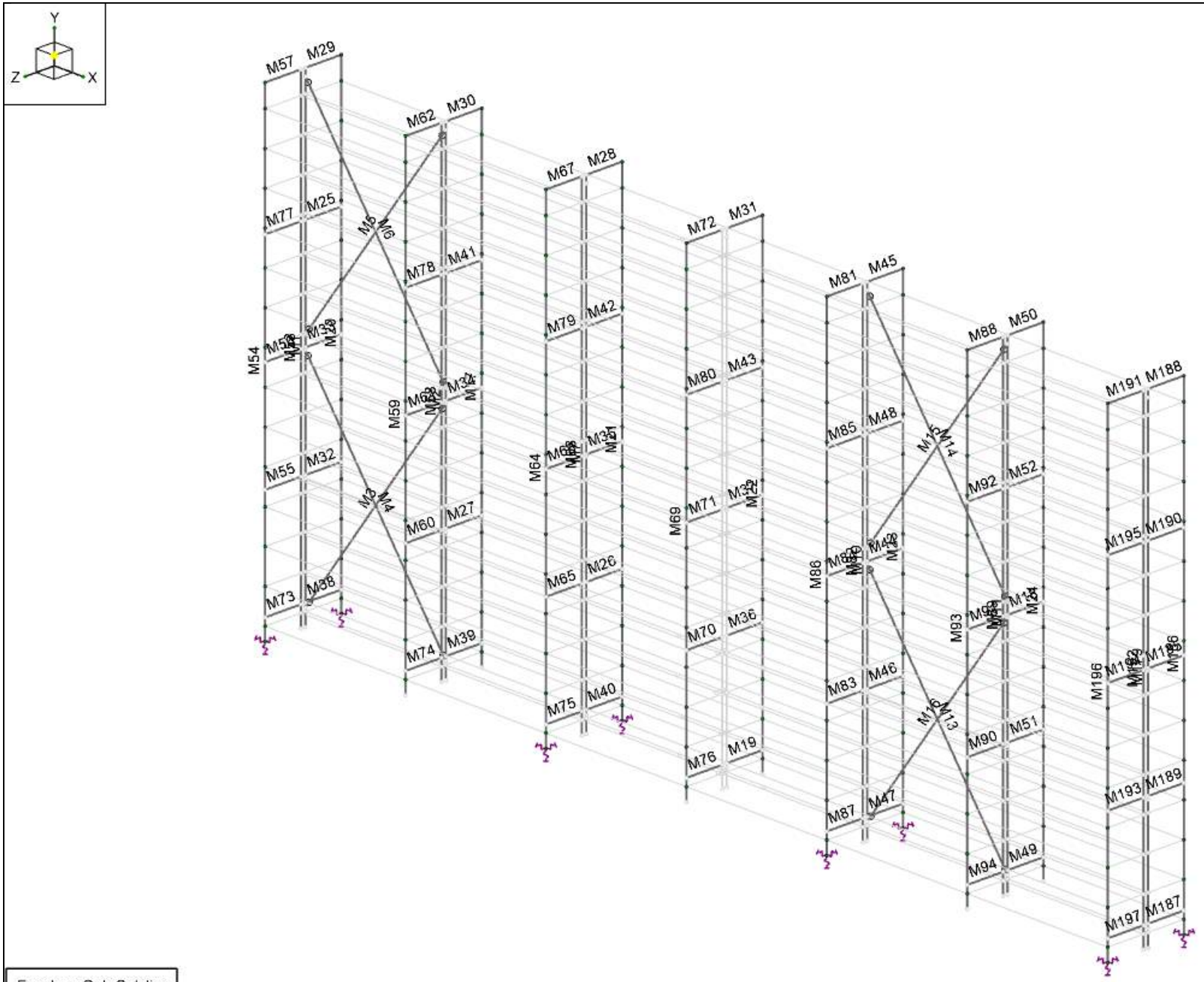
$(\Omega cP/P_n) + (\Omega_b C_{mx} M_x/M_n \alpha_x) + (\Omega_b C_{my} M_y/M_{ny} \alpha_y)$ = 0.46 < 1.0 **THEREFORE UPRITE IS OK**

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111



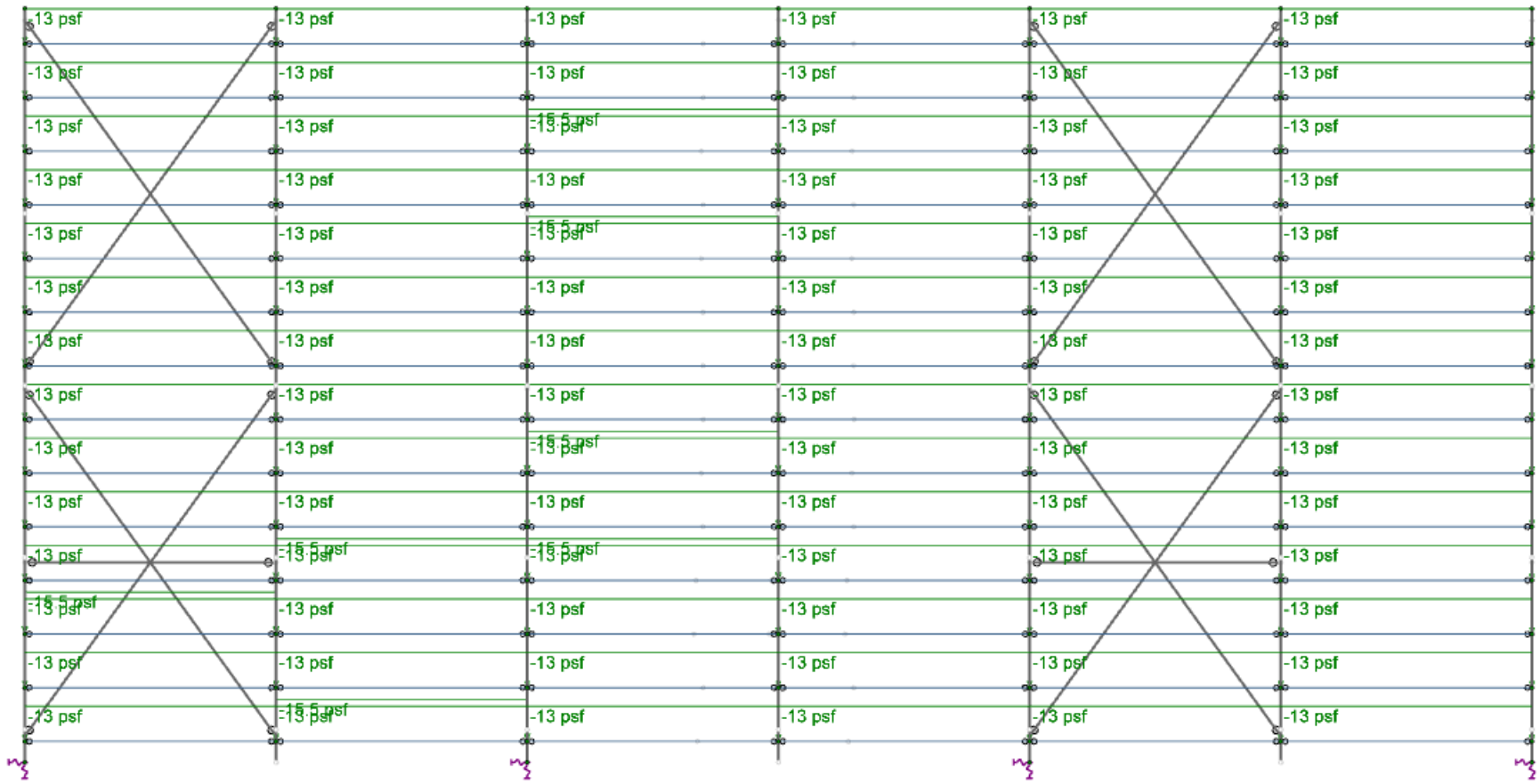
Envelope Only Solution

JPH & CLARK, Inc		Frame E (12"/12"Bx48"Lx144"H) - Sseries	SK-2
AA			Sep 01, 2026 at 03:51 PM
26-460 Advanced Auto Parts		Nodes Layout	E0 Storage Rack-12-12x48x144 - 14lvls - 5



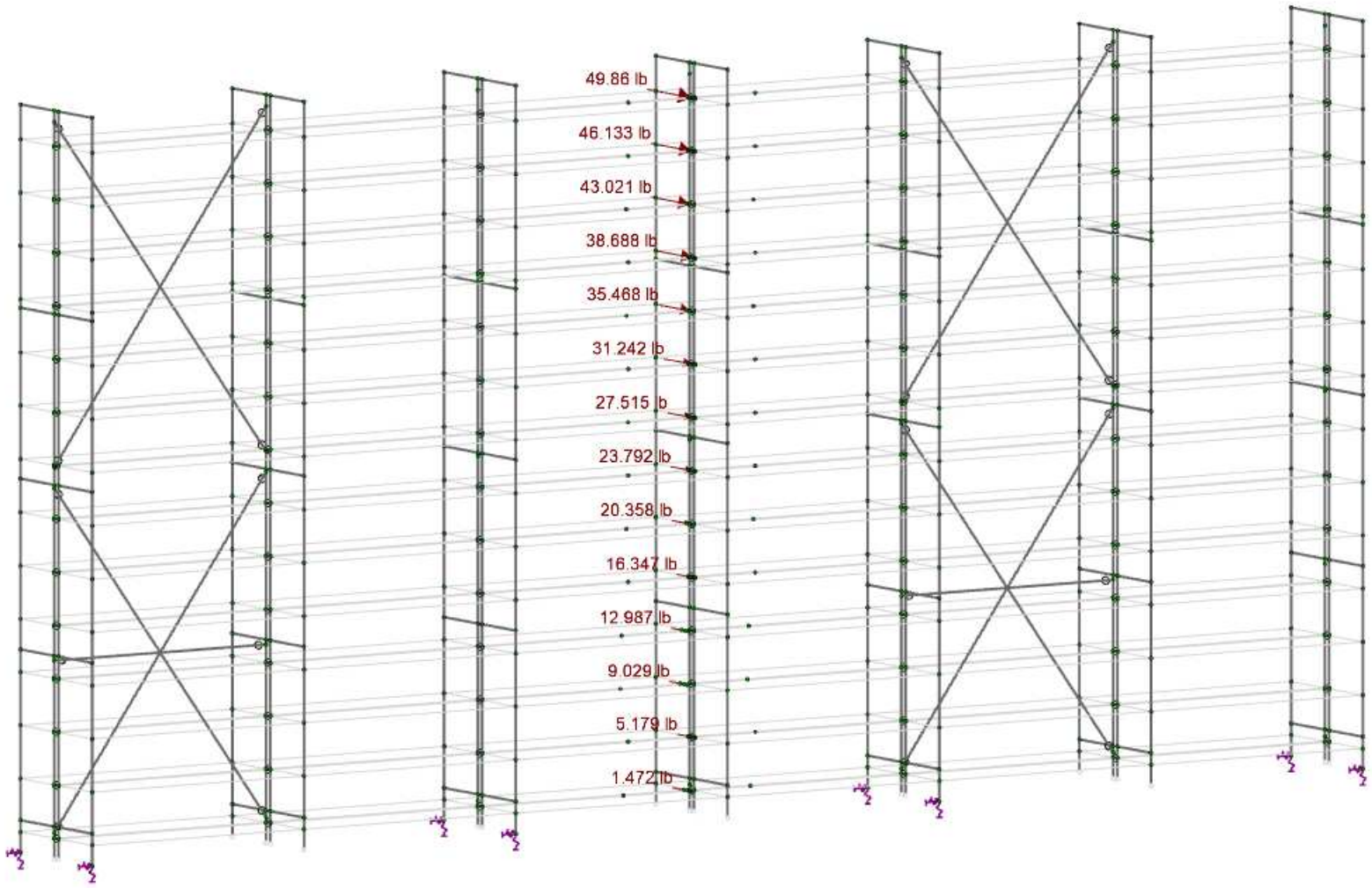
Envelope Only Solution

JPH & CLARK, Inc		Frame E (12"/12"Bx48"Lx144"H) - Sseries	SK-5
AA			Sep 01, 2026 at 03:52 PM
26-460 Advanced Auto Parts		Members Label	E0 Storage Rack-12-12x48x144 - 14lvls - 5...



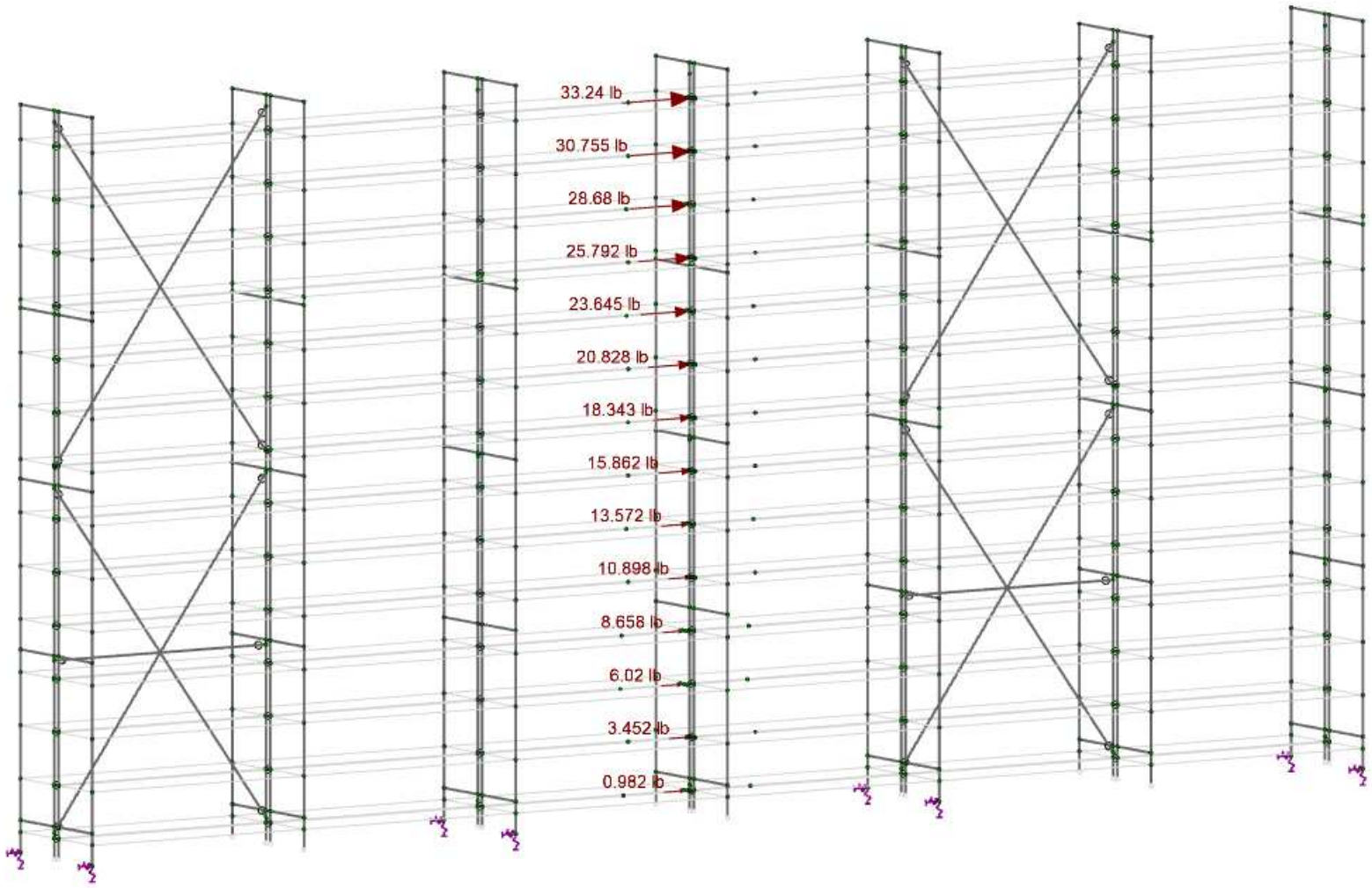
Loads: LC 3, LC-3
Envelope Only Solution

JPH & CLARK, Inc	Frame E (12"/12"Bx48"Lx144"H) - Sseries	SK-6
AA		Sep 01, 2026 at 03:55 PM
26-460 Advanced Auto Parts	DL + LL	E0 Storage Rack-12-12x48x144 - 14lvls - 5



Loads: BLC 3, Earthquake Load Z

JPH & CLARK, Inc	Frame E (12"/12"Bx48"Lx144"H) - Sseries		SK-7
AA			Sep 01, 2026 at 03:58 PM
26-460 Advanced Auto Parts	ELZ		E0 Storage Rack-12-12x48x144 - 14lvls - 5...



Loads: BLC 4, Earthquake Load X

JPH & CLARK, Inc	Frame E (12"/12"Bx48"Lx144"H) - Sseries	SK-8
AA		Sep 01, 2026 at 03:58 PM
26-460 Advanced Auto Parts	ELX	E0 Storage Rack-12-12x48x144 - 14lvls - 5...

Cold Formed Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm. Coeff. [1e5°F⁻¹]	Density [k/ft³]	Yield [ksi]	Fu [ksi]
1	A570 Gr.33	29500	11346	0.3	0.65	0.49	33	52
2	A607 C1 Gr.55	29500	11346	0.3	0.65	0.49	55	70
3	A653 SS Gr33	29500	11346	0.3	0.65	0.49	33	45
4	A653 SS Gr50/1	29500	11346	0.3	0.65	0.49	50	65
5	Gr45	29500	11346	0.3	0.65	0.49	45	57
6	Gr30	29000	11346	0.3	0.65	0.49	30	38

Cold Formed Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rule	Area [in²]	Iyy [in⁴]	Izz [in⁴]	J [in⁴]
1	SS-UP	S-SERIES-UP_1.5X1.12X16GA	Column	CU	Gr30	Typical	0.194	0.05	0.027	0.000279
2	SS-BRC	S-SERIES-BRC_0.625X4.5X18GA	HBrace	CU	Gr30	Typical	0.269	0.005	0.628	0.000205

Basic Load Cases

	BLC Description	Category	Nodal	Surface(Plate/Wall)
1	DL	DL		168
2	LL	LL		168
3	ELZ	ELZ	14	
4	ELX	ELX	14	

Load Combinations

	Description	Solve	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
1	LC-1	Yes	DL	1								
2	LC-2	Yes	LL	1								
3	LC-3	Yes	DL	1	LL	1						
4	LC-4-AEL	Yes	DL	1	LL	0.67						
5	LC-5	Yes	DL	1	LL	0.67	ELX	0.525				
6	LC-6	Yes	DL	1	LL	0.67	ELZ	0.525				
7	LC-7	Yes	DL	1	Sds*DL	0.105	LL	0.735	LL	0.016	Rho*ELX	0.525
8	LC-8	Yes	DL	1	Sds*DL	0.14	LL	0.595	LL	0.022	Rho*ELX	0.7
9	LC-9	Yes	DL	0.6	Sds*DL	-0.14	LL	0.402	LL	-0.021	Rho*ELX	0.7
10	LC-10	Yes	DL	1	Sds*DL	0.105	LL	0.735	LL	0.016	Rho*ELZ	0.525
11	LC-11	Yes	DL	1	Sds*DL	0.14	LL	0.595	LL	0.022	Rho*ELZ	0.7
12	LC-12	Yes	DL	0.6	Sds*DL	-0.14	LL	0.402	LL	-0.021	Rho*ELZ	0.7
13												
14	AB-FLC5-1	Yes	DL	1.2	Sds*DL	0.2	LL	0.84	LL	0.031	Om*ELX	1
15	AB-FLC5-2	Yes	DL	1.2	Sds*DL	0.2	LL	0.84	LL	0.031	Om*ELZ	1
16	AB-FLC5-3	Yes	DL	1.2	Sds*DL	0.2	LL	0.84	LL	0.031	Om*ELX	-1
17	AB-FLC5-4	Yes	DL	1.2	Sds*DL	0.2	LL	0.84	LL	0.031	Om*ELZ	-1
18	AB-FLC7-5	Yes	DL	0.9	Sds*DL	-0.2	LL	0.603	LL	-0.029	Om*ELX	1
19	AB-FLC7-6	Yes	DL	0.9	Sds*DL	-0.2	LL	0.603	LL	-0.029	Om*ELZ	1
20	AB-FLC7-7	Yes	DL	0.9	Sds*DL	-0.2	LL	0.603	LL	-0.029	Om*ELX	-1
21	AB-FLC7-8	Yes	DL	0.9	Sds*DL	-0.2	LL	0.603	LL	-0.029	Om*ELZ	-1

Node Loads and Enforced Displacements (BLC 3 : ELZ)

	Node Label	L, D, M	Direction	Magnitude [(lb, lb-ft), (in, rad), (lb*s²/in, lb*s²*in)]
1	N592A	L	Z	49.86
2	N593A	L	Z	46.133
3	N594A	L	Z	43.021
4	N595A	L	Z	38.688
5	N596A	L	Z	35.468
6	N597A	L	Z	31.242
7	N598A	L	Z	27.515
8	N599A	L	Z	23.792
9	N600A	L	Z	20.358
10	N601A	L	Z	16.347

Node Loads and Enforced Displacements (BLC 3 : ELZ) (Continued)

	Node Label	L, D, M	Direction	Magnitude [(lb, lb-ft), (in, rad), (lb*s²/in, lb*s²*in)]
11	N602A	L	Z	12.987
12	N603A	L	Z	9.029
13	N604A	L	Z	5.179
14	N605A	L	Z	1.472

Node Loads and Enforced Displacements (BLC 4 : ELX)

	Node Label	L, D, M	Direction	Magnitude [(lb, lb-ft), (in, rad), (lb*s²/in, lb*s²*in)]
1	N592A	L	X	33.24
2	N593A	L	X	30.755
3	N594A	L	X	28.68
4	N595A	L	X	25.792
5	N596A	L	X	23.645
6	N597A	L	X	20.828
7	N598A	L	X	18.343
8	N599A	L	X	15.862
9	N600A	L	X	13.572
10	N601A	L	X	10.898
11	N602A	L	X	8.658
12	N603A	L	X	6.02
13	N604A	L	X	3.452
14	N605A	L	X	0.982

Envelope Node Reactions

	Node Label		X [lb]	LC	Y [lb]	LC	Z [lb]	LC	MX [lb-ft]	LC	MY [lb-ft]	LC	MZ [lb-ft]	LC
1	N1	max	0	12	308.033	10	0	12	0	12	0	12	0	12
2		min	0	1	0	9	0	1	0	1	0	1	0	1
3	N10	max	0	12	480.228	11	0	12	0	12	0	12	0	12
4		min	0	1	82.483	1	0	1	0	1	0	1	0	1
5	N19	max	0	12	612.364	3	0	12	0	12	0	12	0	12
6		min	0	1	135.858	1	0	1	0	1	0	1	0	1
7	N27	max	0	12	482.48	11	0	12	0	12	0	12	0	12
8		min	0	1	82.645	1	0	1	0	1	0	1	0	1
9	N99	max	0	12	585.97	3	0	12	0	12	0	12	0	12
10		min	0	1	85.008	9	0	1	0	1	0	1	0	1
11	N124	max	0	12	479.233	11	0	12	0	12	0	12	0	12
12		min	0	1	83.456	1	0	1	0	1	0	1	0	1
13	N161	max	0	1	145.635	3	-3.544	1	0	12	0	12	0	12
14		min	-20.641	8	-80.404	12	-43.378	11	0	1	0	1	0	1
15	N163	max	0	12	381.164	3	0	12	0	12	0	12	0	12
16		min	0	1	0	12	0	1	0	1	0	1	0	1
17	N222	max	0	1	72.512	3	-1.794	1	0	12	0	12	0	12
18		min	-20.638	8	-109.787	12	-37.481	11	0	1	0	1	0	1
19	N224	max	0	12	377.45	3	0	12	0	12	0	12	0	12
20		min	0	1	0	12	0	1	0	1	0	1	0	1
21	N247	max	0	1	139.22	3	-3.539	1	0	12	0	12	0	12
22		min	-20.638	8	-84.537	12	-43.052	11	0	1	0	1	0	1
23	N257	max	0	12	369.487	3	0	12	0	12	0	12	0	12
24		min	0	1	0	12	0	1	0	1	0	1	0	1
25	N267	max	0	12	294.816	3	0	12	0	12	0	12	0	12
26		min	0	1	0	12	0	1	0	1	0	1	0	1
27	N268	max	0.001	2	154.496	12	7.928	3	0	12	0	12	0	12
28		min	-20.633	8	16.185	1	-28.054	12	0	1	0	1	0	1
29	N277	max	0	12	361.693	3	0	12	0	12	0	12	0	12
30		min	0	1	0	12	0	1	0	1	0	1	0	1
31	N278	max	0	12	482.694	11	0	12	0	12	0	12	0	12
32		min	0	1	84.999	1	0	1	0	1	0	1	0	1
33	N287	max	0	12	589.372	3	0	12	0	12	0	12	0	12
34		min	0	1	108.104	12	0	1	0	1	0	1	0	1
35	N288	max	0.001	2	200.884	12	15.482	3	0	12	0	12	0	12

Envelope Node Reactions (Continued)

	Node Label		X [lb]	LC	Y [lb]	LC	Z [lb]	LC	MX [lb-ft]	LC	MY [lb-ft]	LC	MZ [lb-ft]	LC
36		min	-20.634	8	32.133	1	-26.023	12	0	1	0	1	0	1
37	N297	max	0	12	359.268	3	0	12	0	12	0	12	0	12
38		min	0	1	0	12	0	1	0	1	0	1	0	1
39	N298	max	0	12	484.78	11	0	12	0	12	0	12	0	12
40		min	0	1	85.363	1	0	1	0	1	0	1	0	1
41	N430	max	0	12	588.996	3	0	12	0	12	0	12	0	12
42		min	0	1	106.223	12	0	1	0	1	0	1	0	1
43	N431	max	0.001	2	202.765	12	15.427	3	0	12	0	12	0	12
44		min	-20.633	8	32.144	1	-26.144	12	0	1	0	1	0	1
45	N470	max	0	12	359.733	3	0	12	0	12	0	12	0	12
46		min	0	1	0	12	0	1	0	1	0	1	0	1
47	N471	max	0	12	484.862	11	0	12	0	12	0	12	0	12
48		min	0	1	85.057	1	0	1	0	1	0	1	0	1
49	N579	max	0	12	304.973	10	0	12	0	12	0	12	0	12
50		min	0	1	67.819	1	0	1	0	1	0	1	0	1
51	N612	max	0	1	70.076	3	-1.791	1	0	12	0	12	0	12
52		min	-20.641	8	-115.769	12	-37.626	11	0	1	0	1	0	1
53	N625	max	0	12	293.682	3	0	12	0	12	0	12	0	12
54		min	0	1	0	12	0	1	0	1	0	1	0	1
55	N626	max	0.001	2	154.496	12	7.765	3	0	12	0	12	0	12
56		min	-20.634	8	16.218	1	-28.041	12	0	1	0	1	0	1
57	N623A	max	NC		NC		NC		LOCKED		NC		LOCKED	
58		min	NC		NC		NC		LOCKED		NC		LOCKED	
59	N609A	max	NC		NC		NC		LOCKED		NC		LOCKED	
60		min	NC		NC		NC		LOCKED		NC		LOCKED	
61	N622A	max	NC		NC		NC		LOCKED		NC		LOCKED	
62		min	NC		NC		NC		LOCKED		NC		LOCKED	
63	N608A	max	NC		NC		NC		LOCKED		NC		LOCKED	
64		min	NC		NC		NC		LOCKED		NC		LOCKED	
65	N637A	max	NC		NC		NC		LOCKED		NC		LOCKED	
66		min	NC		NC		NC		LOCKED		NC		LOCKED	
67	N624A	max	NC		NC		NC		LOCKED		NC		LOCKED	
68		min	NC		NC		NC		LOCKED		NC		LOCKED	
69	N610A	max	NC		NC		NC		LOCKED		NC		LOCKED	
70		min	NC		NC		NC		LOCKED		NC		LOCKED	
71	N621A	max	NC		NC		NC		LOCKED		NC		LOCKED	
72		min	NC		NC		NC		LOCKED		NC		LOCKED	
73	N607A	max	NC		NC		NC		LOCKED		NC		LOCKED	
74		min	NC		NC		NC		LOCKED		NC		LOCKED	
75	N636A	max	NC		NC		NC		LOCKED		NC		LOCKED	
76		min	NC		NC		NC		LOCKED		NC		LOCKED	
77	N651A	max	NC		NC		NC		LOCKED		NC		LOCKED	
78		min	NC		NC		NC		LOCKED		NC		LOCKED	
79	N638A	max	NC		NC		NC		LOCKED		NC		LOCKED	
80		min	NC		NC		NC		LOCKED		NC		LOCKED	
81	N625A	max	NC		NC		NC		LOCKED		NC		LOCKED	
82		min	NC		NC		NC		LOCKED		NC		LOCKED	
83	N620A	max	NC		NC		NC		LOCKED		NC		LOCKED	
84		min	NC		NC		NC		LOCKED		NC		LOCKED	
85	N606A	max	NC		NC		NC		LOCKED		NC		LOCKED	
86		min	NC		NC		NC		LOCKED		NC		LOCKED	
87	N635A	max	NC		NC		NC		LOCKED		NC		LOCKED	
88		min	NC		NC		NC		LOCKED		NC		LOCKED	
89	N650A	max	NC		NC		NC		LOCKED		NC		LOCKED	
90		min	NC		NC		NC		LOCKED		NC		LOCKED	
91	N639A	max	NC		NC		NC		LOCKED		NC		LOCKED	
92		min	NC		NC		NC		LOCKED		NC		LOCKED	
93	N652A	max	NC		NC		NC		LOCKED		NC		LOCKED	
94		min	NC		NC		NC		LOCKED		NC		LOCKED	
95	N626A	max	NC		NC		NC		LOCKED		NC		LOCKED	
96		min	NC		NC		NC		LOCKED		NC		LOCKED	

Envelope Node Reactions (Continued)

	Node Label		X [lb]	LC	Y [lb]	LC	Z [lb]	LC	MX [lb-ft]	LC	MY [lb-ft]	LC	MZ [lb-ft]	LC
97	N611A	max	NC		NC		NC		LOCKED		NC		LOCKED	
98		min	NC		NC		NC		LOCKED		NC		LOCKED	
99	N629A	max	NC		NC		NC		LOCKED		NC		LOCKED	
100		min	NC		NC		NC		LOCKED		NC		LOCKED	
101	N634A	max	NC		NC		NC		LOCKED		NC		LOCKED	
102		min	NC		NC		NC		LOCKED		NC		LOCKED	
103	N649A	max	NC		NC		NC		LOCKED		NC		LOCKED	
104		min	NC		NC		NC		LOCKED		NC		LOCKED	
105	N640A	max	NC		NC		NC		LOCKED		NC		LOCKED	
106		min	NC		NC		NC		LOCKED		NC		LOCKED	
107	N653A	max	NC		NC		NC		LOCKED		NC		LOCKED	
108		min	NC		NC		NC		LOCKED		NC		LOCKED	
109	N612A	max	NC		NC		NC		LOCKED		NC		LOCKED	
110		min	NC		NC		NC		LOCKED		NC		LOCKED	
111	N628A	max	NC		NC		NC		LOCKED		NC		LOCKED	
112		min	NC		NC		NC		LOCKED		NC		LOCKED	
113	N614A	max	NC		NC		NC		LOCKED		NC		LOCKED	
114		min	NC		NC		NC		LOCKED		NC		LOCKED	
115	N615A	max	NC		NC		NC		LOCKED		NC		LOCKED	
116		min	NC		NC		NC		LOCKED		NC		LOCKED	
117	N643A	max	NC		NC		NC		LOCKED		NC		LOCKED	
118		min	NC		NC		NC		LOCKED		NC		LOCKED	
119	N630A	max	NC		NC		NC		LOCKED		NC		LOCKED	
120		min	NC		NC		NC		LOCKED		NC		LOCKED	
121	N616A	max	NC		NC		NC		LOCKED		NC		LOCKED	
122		min	NC		NC		NC		LOCKED		NC		LOCKED	
123	N648A	max	NC		NC		NC		LOCKED		NC		LOCKED	
124		min	NC		NC		NC		LOCKED		NC		LOCKED	
125	N654A	max	NC		NC		NC		LOCKED		NC		LOCKED	
126		min	NC		NC		NC		LOCKED		NC		LOCKED	
127	N627A	max	NC		NC		NC		LOCKED		NC		LOCKED	
128		min	NC		NC		NC		LOCKED		NC		LOCKED	
129	N642A	max	NC		NC		NC		LOCKED		NC		LOCKED	
130		min	NC		NC		NC		LOCKED		NC		LOCKED	
131	N657A	max	NC		NC		NC		LOCKED		NC		LOCKED	
132		min	NC		NC		NC		LOCKED		NC		LOCKED	
133	N631A	max	NC		NC		NC		LOCKED		NC		LOCKED	
134		min	NC		NC		NC		LOCKED		NC		LOCKED	
135	N617A	max	NC		NC		NC		LOCKED		NC		LOCKED	
136		min	NC		NC		NC		LOCKED		NC		LOCKED	
137	N644A	max	NC		NC		NC		LOCKED		NC		LOCKED	
138		min	NC		NC		NC		LOCKED		NC		LOCKED	
139	N641A	max	NC		NC		NC		LOCKED		NC		LOCKED	
140		min	NC		NC		NC		LOCKED		NC		LOCKED	
141	N613A	max	NC		NC		NC		LOCKED		NC		LOCKED	
142		min	NC		NC		NC		LOCKED		NC		LOCKED	
143	N656A	max	NC		NC		NC		LOCKED		NC		LOCKED	
144		min	NC		NC		NC		LOCKED		NC		LOCKED	
145	N632A	max	NC		NC		NC		LOCKED		NC		LOCKED	
146		min	NC		NC		NC		LOCKED		NC		LOCKED	
147	N618A	max	NC		NC		NC		LOCKED		NC		LOCKED	
148		min	NC		NC		NC		LOCKED		NC		LOCKED	
149	N645A	max	NC		NC		NC		LOCKED		NC		LOCKED	
150		min	NC		NC		NC		LOCKED		NC		LOCKED	
151	N658A	max	NC		NC		NC		LOCKED		NC		LOCKED	
152		min	NC		NC		NC		LOCKED		NC		LOCKED	
153	N655A	max	NC		NC		NC		LOCKED		NC		LOCKED	
154		min	NC		NC		NC		LOCKED		NC		LOCKED	
155	N646A	max	NC		NC		NC		LOCKED		NC		LOCKED	
156		min	NC		NC		NC		LOCKED		NC		LOCKED	
157	N659A	max	NC		NC		NC		LOCKED		NC		LOCKED	

Envelope Node Reactions (Continued)

	Node Label		X [lb]	LC	Y [lb]	LC	Z [lb]	LC	MX [lb-ft]	LC	MY [lb-ft]	LC	MZ [lb-ft]	LC
158		min	NC		NC		NC		LOCKED		NC		LOCKED	
159	N633A	max	NC		NC		NC		LOCKED		NC		LOCKED	
160		min	NC		NC		NC		LOCKED		NC		LOCKED	
161	N619A	max	NC		NC		NC		LOCKED		NC		LOCKED	
162		min	NC		NC		NC		LOCKED		NC		LOCKED	
163	N660A	max	NC		NC		NC		LOCKED		NC		LOCKED	
164		min	NC		NC		NC		LOCKED		NC		LOCKED	
165	N647A	max	NC		NC		NC		LOCKED		NC		LOCKED	
166		min	NC		NC		NC		LOCKED		NC		LOCKED	
167	N661A	max	NC		NC		NC		LOCKED		NC		LOCKED	
168		min	NC		NC		NC		LOCKED		NC		LOCKED	
169	Totals:	max	-0.003	1	8806.004	3	0.012	3						
170		min	-165.092	8	2016.001	1	-258.576	12						

Envelope Maximum Member Section Forces

	Member		Axial[lb]	Loc[in]	LC	y Shear[lb]	Loc[in]	LC	z Shear[lb]	Loc[in]	LC	Torque[lb-ft]	Loc[in]	LC	y-y Moment[lb-ft]	Loc[in]	LC	z-z Moment[lb-ft]	Loc[in]	LC
1	M1	max	308.033	3	10	4	13.5	8	43.419	4.5	12	0.001	6	9	14.172	39	12	3.957	6	8
2		min	-5.696	4.5	9	-84.529	4.5	8	-4.836	15	3	-0.001	142.5	3	-14.994	7.5	12	-2.393	66	9
3	M2	max	480.228	3	11	35.145	70.5	8	27.106	13.5	11	0.013	144	8	16.748	39	11	8.073	138	8
4		min	-2.105	142.5	9	-53.382	72	8	-9.181	66	9	-0.008	72	8	-19.184	7.5	11	-10.315	70.5	8
5	M3	max	0	81.91	12	0	81.91	12	0	81.91	12	0	0	12	0	81.91	12	0	81.91	12
6		min	-151.068	0	8	0	0	1	0	0	1	0	0	7	0	0	1	0	0	1
7	M4	max	0	81.91	12	0	81.91	12	0	81.91	12	0	81.91	12	0	81.91	12	0	81.91	12
8		min	0	0	1	0	0	1	0	0	1	0	0	6	0	0	1	0	0	1
9	M5	max	0	81.92	12	0	81.92	12	0	81.92	12	0	81.92	8	0	81.92	12	0	81.92	12
10		min	-44.147	0	8	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1
11	M6	max	0	81.92	9	0	81.92	12	0	81.92	12	0	0	9	0	81.92	12	0	81.92	12
12		min	-3.436	0	3	0	0	1	0	0	1	0	0	12	0	0	1	0	0	1
13	M7	max	612.364	3	3	2.455	136.5	8	63.111	4.5	10	0.005	6	9	18.464	39	11	2.589	15	8
14		min	1.103	142.5	1	-3.133	6	8	-9.861	15	3	-0.001	7.5	8	-20.791	7.5	10	-2.312	66	9
15	M8	max	482.48	3	11	2.455	136.5	8	27.31	6	11	0	96	12	16.849	39	11	2.59	15	8
16		min	0.048	138	1	-3.127	4.5	8	-0.345	87	8	0	15	8	-19.283	7.5	11	-2.312	66	9
17	M9	max	0	48	12	0	48	12	0	48	12	0	48	11	0	48	12	0	48	12
18		min	-0.174	0	8	0	0	1	0	0	1	0	0	3	0	0	1	0	0	1
19	M10	max	585.97	3	3	4.336	13.5	9	61.399	6	10	0	6	8	18.119	39	11	4.115	6	9
20		min	1.108	138	1	-88.327	4.5	9	-9.468	15	3	0	66	8	-20.219	7.5	10	-2.422	66	9
21	M11	max	479.233	3	11	36.807	70.5	9	27.471	6	11	0.017	144	9	16.872	39	11	10.584	138	9
22		min	-2.41	142.5	9	-55.855	72	9	-9.193	73.5	9	-0.008	72	9	-19.364	7.5	11	-10.718	70.5	9
23	M12	max	0	48	12	0	48	12	0	48	12	0	48	11	0	48	12	0	48	12
24		min	-0.182	0	9	0	0	1	0	0	1	0	0	3	0	0	1	0	0	1
25	M13	max	0	81.91	12	0	81.91	12	0	81.91	12	0	81.91	12	0	81.91	12	0	81.91	12
26		min	0	0	1	0	0	1	0	0	1	0	0	6	0	0	1	0	0	1
27	M14	max	0	81.92	12	0	81.92	12	0	81.92	12	0	0	12	0	81.92	12	0	81.92	12
28		min	0	0	1	0	0	1	0	0	1	0	81.92	1	0	0	1	0	0	1
29	M15	max	-0.616	81.92	12	0	81.92	12	0	81.92	12	0	81.92	9	0	81.92	12	0	81.92	12
30		min	-57.877	0	9	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1
31	M16	max	0	81.91	12	0	81.91	12	0	81.91	12	0	0	12	0	81.91	12	0	81.91	12
32		min	-158.124	0	9	0	0	1	0	0	1	0	0	7	0	0	1	0	0	1
33	M17	max	377.45	3	3	3.132	13.5	8	9.181	75	9	0.013	144	8	19.184	7.5	11	2.313	66	9
34		min	-12.245	4.5	12	-2.419	127.5	8	-27.106	4.5	11	-0.008	72	8	-16.748	39	11	-2.592	15	8
35	M18	max	0	12	12	14.603	12	9	0	12	12	0.003	12	9	0.013	0	9	26.743	12	11
36		min	0	0	1	-53.485	0	11	-0.027	0	9	0	0	12	-0.013	12	9	-26.743	0	11
37	M19	max	0	12	11	0.22	12	2	0	12	12	0	12	8	0	0	9	27.258	12	11
38		min	0	0	1	-54.515	0	11	0	0	1	0	0	12	0	12	9	-27.258	0	11
39	M20	max	95.052	13.5	3	20.638	3	8	17.073	6	11	0.001	6	9	14.601	7.5	12	2.313	66	9
40		min	-115.239	4.5	12	-6.738	4.5	8	-37.481	0	11	-0.001	138	3	-14.175	39	12	-6.59	4.5	8
41	M21	max	190.264	13.5	3	20.641	3	8	9.723	24	3	0.005	6	9	20.384	7.5	10	2.313	66	9
42		min	-92	4.5	12	-6.746	4.5	8	-46.672	7.5	3	-0.001	7.5	8	-18.467	39	11	-6.59	4.5	8
43	M22	max	381.164	3	3	3.132	13.5	8	0.345	96	8	0	96	12	19.283	7.5	11	2.314	66	9
44		min	-11.418	4.5	12	-2.454	127.5	8	-27.31	7.5	11	0	15	8	-16.849	39	11	-2.592	15	8
45	M23	max	183.441	13.5	3	20.638	3	8	9.335	24	3	0	6	8	19.816	7.5	10	2.313	66	9

Envelope Maximum Member Section Forces (Continued)

	Member		Axial[lb]	Loc[in]	LC	y Shear[lb]	Loc[in]	LC	z Shear[lb]	Loc[in]	LC	Torque[lb-ft]	Loc[in]	LC	y-y Moment[lb-ft]	Loc[in]	LC	z-z Moment[lb-ft]	Loc[in]	LC
46		min	-95.183	4.5	12	-6.738	4.5	8	-44.814	7.5	3	0	66	8	-18.123	39	11	-6.59	4.5	8
47	M24	max	369.487	3	3	3.132	13.5	8	9.193	70.5	9	0.017	144	9	19.364	7.5	11	2.312	66	9
48		min	-11.316	4.5	12	-2.409	127.5	8	-27.471	7.5	11	-0.008	72	9	-16.872	39	11	-2.592	15	8
49	M25	max	0	12	12	28.891	12	12	0	12	12	0	12	8	0	12	3	14.446	0	12
50		min	0	0	3	3.516	0	1	0	0	1	0	0	12	0	0	3	-14.446	12	12
51	M26	max	-0.003	12	1	76.228	12	11	0	12	8	0	12	8	0	12	8	38.112	0	11
52		min	-0.034	0	11	15.023	0	1	0	0	1	0	0	12	0	0	8	-38.116	12	11
53	M27	max	0	12	3	7.669	12	9	0	12	8	0	12	8	0	12	8	34.287	12	11
54		min	0	0	1	-68.574	0	11	0	0	1	0	0	12	0	0	8	-34.287	0	11
55	M28	max	0	12	12	6.808	12	11	0	12	11	0	12	1	0	0	12	3.404	0	11
56		min	0	0	1	1.103	0	1	0	0	12	0	0	12	0	12	12	-3.404	12	11
57	M29	max	0	12	10	5.395	12	12	0.002	12	3	0.001	12	3	0.001	12	3	2.697	0	12
58		min	0	0	12	0.551	0	1	0	0	9	0	0	9	-0.001	0	3	-2.697	12	12
59	M30	max	0	12	12	2.105	12	9	0	12	11	0	12	1	0.013	0	8	3.123	12	11
60		min	0	0	8	-6.246	0	11	-0.026	0	8	-0.01	0	8	-0.013	12	8	-3.123	0	11
61	M31	max	0	12	12	-0.048	12	1	0	12	11	0	12	1	0	0	12	3.146	12	11
62		min	0	0	1	-6.292	0	11	0	0	12	0	0	12	0	12	12	-3.146	0	11
63	M32	max	-0.001	12	1	57.281	12	12	0	12	9	0	12	8	0	12	9	28.639	0	12
64		min	-0.03	0	11	7.627	0	1	0	0	1	0	0	12	0	0	9	-28.642	12	12
65	M33	max	0	12	12	45.017	12	12	0.001	12	8	0	12	8	0	12	8	22.509	0	12
66		min	0	0	8	5.371	0	1	0	0	1	0	0	12	0	0	8	-22.509	12	12
67	M34	max	0	12	9	14.323	12	9	0	12	12	0.003	12	8	0.013	0	8	26.582	12	11
68		min	0	0	12	-53.164	0	11	-0.026	0	8	0	0	12	-0.013	12	8	-26.582	0	11
69	M35	max	0	12	12	58.552	12	11	0	12	12	0	12	1	0	12	12	29.276	0	11
70		min	0	0	1	10.586	0	1	0	0	1	0	0	12	0	0	1	-29.276	12	11
71	M36	max	0	12	12	-0.214	12	1	0	12	12	0	12	8	0	12	12	34.504	12	11
72		min	0	0	1	-69.009	0	11	0	0	1	0	0	12	0	0	1	-34.504	0	11
73	M37	max	0	12	12	-0.285	12	1	0	12	12	0	12	1	0	12	9	26.776	12	11
74		min	0	0	1	-53.552	0	11	0	0	1	0	0	12	0	0	9	-26.776	0	11
75	M38	max	28.182	12	11	50.845	12	12	0	12	12	0	12	1	0.001	0	9	24.878	0	12
76		min	1.349	0	1	8.094	0	1	-0.002	0	9	-0.001	0	9	-0.001	12	9	-25.967	12	12
77	M39	max	0	12	9	1.444	12	9	0	12	12	0	12	8	0	0	9	27.099	12	11
78		min	0	0	11	-54.198	0	11	0	0	1	0	0	12	0	12	9	-27.099	0	11
79	M40	max	32.616	12	11	73.784	12	10	0	12	12	0	12	1	0.006	0	8	36.329	0	10
80		min	2.665	0	1	15.979	0	1	-0.013	0	8	-0.002	0	9	-0.006	12	8	-37.456	12	10
81	M41	max	0	12	12	11.035	12	9	0	12	8	0	12	1	0	12	8	17.138	12	11
82		min	0	0	1	-34.275	0	11	0	0	1	0	0	9	0	0	8	-17.138	0	11
83	M42	max	0	12	12	37.826	12	11	0	12	12	0	12	1	0	12	12	18.913	0	11
84		min	0	0	1	6.961	0	1	0	0	1	0	0	9	0	0	1	-18.913	12	11
85	M43	max	0	12	12	-0.265	12	1	0	12	12	0	12	1	0	12	12	17.282	12	11
86		min	0	0	1	-34.565	0	11	0	0	1	0	0	9	0	0	1	-17.282	0	11
87	M44	max	0	12	4	57.588	12	11	0.001	12	9	0	12	8	0	12	9	28.794	0	11
88		min	0	0	9	10.634	0	1	0	0	1	0	0	12	0	0	9	-28.794	12	11
89	M45	max	0	12	12	6.701	12	11	0	12	11	0	12	1	0	0	12	3.35	0	11
90		min	0	0	1	1.108	0	1	0	0	12	0	0	12	0	12	12	-3.35	12	11
91	M46	max	-0.003	12	1	74.704	12	11	0	12	8	0	12	8	0	12	8	37.35	0	11
92		min	-0.034	0	11	15.029	0	1	0	0	1	0	0	12	0	0	8	-37.354	12	11
93	M47	max	32.371	12	11	71.692	12	10	0	12	12	0	12	1	0.001	0	8	35.289	0	10
94		min	2.661	0	1	15.953	0	1	-0.001	0	8	-0.001	0	8	-0.001	12	8	-36.403	12	10
95	M48	max	0	12	12	37.18	12	11	0	12	12	0	12	8	0	0	8	18.59	0	11
96		min	0	0	1	6.995	0	1	0	0	1	0	0	12	0	12	8	-18.59	12	11
97	M49	max	0	12	11	-0.02	12	2	0	12	12	0	12	8	0	0	9	27.386	12	11
98		min	0	0	1	-54.772	0	11	0	0	1	0	0	12	0	12	9	-27.386	0	11
99	M50	max	0	12	10	2.41	12	9	0	12	12	0	12	12	0.017	0	9	3.12	12	11
100		min	0	0	9	-6.24	0	11	-0.034	0	9	-0.013	0	9	-0.017	12	9	-3.12	0	11
101	M51	max	0	12	3	6.755	12	8	0	12	9	0	12	8	0	12	9	34.551	12	11
102		min	0	0	1	-69.102	0	11	0	0	1	0	0	12	0	0	9	-34.551	0	11
103	M52	max	0	12	12	11.788	12	9	0	12	12	0	12	4	0	12	9	17.19	12	11
104		min	0	0	1	-34.381	0	11	0	0	1	0	0	9	0	0	9	-17.19	0	11
105	M53	max	294.816	3	3	2.786	85.5	8	29.089	6	3	0.001	13.5	9	10.103	15	11	2.316	66	9
106		min	-6.619	36	12	-2.458	127.5	9	-15.299	15	11	-0.003	4.5	9	-9.658	7.5	3	-2.786	4.5	8

Envelope Maximum Member Section Forces (Continued)

	Member		Axial[lb]	Loc[in]	LC	y Shear[lb]	Loc[in]	LC	z Shear[lb]	Loc[in]	LC	Torque[lb-ft]	Loc[in]	LC	y-y Moment[lb-ft]	Loc[in]	LC	z-z Moment[lb-ft]	Loc[in]	LC
107	M54	max	154.496	3	12	6.747	6	8	28.054	3	12	0.001	13.5	9	9.571	7.5	3	6.587	4.5	8
108		min	-2.473	138	3	-20.633	0	8	-41.261	4.5	11	-0.003	4.5	9	-10.245	15	11	-2.305	66	9
109	M55	max	0.022	12	12	24.488	12	12	0	12	12	0	12	8	0	0	9	16.689	12	3
110		min	-0.006	0	3	-33.379	0	3	0	0	9	0	0	12	0	12	9	-16.69	0	3
111	M56	max	0	12	12	21.767	12	12	0	12	12	0	12	8	0	0	8	11.84	12	3
112		min	0	0	1	-23.679	0	3	0	0	8	0	0	12	0	12	8	-11.84	0	3
113	M57	max	0	12	12	2.962	12	12	0	12	8	0	12	8	0	0	3	1.481	0	12
114		min	0	0	1	-2.473	0	3	-0.001	0	3	0	0	3	0	12	3	-1.481	12	12
115	M58	max	361.693	3	3	4.486	136.5	8	0.885	75	3	0.002	75	8	19.129	7.5	11	3.844	75	8
116		min	-10.515	4.5	12	-1.883	45	8	-26.975	4.5	11	-0.006	138	8	-16.51	39	11	-4.549	136.5	8
117	M59	max	482.694	3	11	2.441	136.5	8	26.975	13.5	11	0.002	75	8	16.51	39	11	2.586	15	8
118		min	-0.192	138	3	-3.124	4.5	8	-0.885	66	3	-0.006	138	8	-19.129	7.5	11	-2.306	66	9
119	M60	max	0	12	12	1.349	12	3	0	12	12	0	12	1	0	0	8	33.754	12	11
120		min	0	0	1	-67.508	0	11	0	0	8	0	0	9	0	12	8	-33.754	0	11
121	M61	max	0	12	12	1.396	12	3	0.007	12	8	0	12	1	0.003	12	8	25.857	12	11
122		min	0	0	1	-51.715	0	11	0	0	1	-0.001	0	8	-0.003	0	8	-25.857	0	11
123	M62	max	0	12	12	0.192	12	3	0.012	12	8	0.004	12	8	0.006	12	8	3.007	12	11
124		min	0	0	1	-6.015	0	11	0	0	12	0	0	12	-0.006	0	8	-3.007	0	11
125	M63	max	589.372	3	3	3.134	6	8	57.182	6	3	0.001	13.5	9	14.829	39	3	2.307	66	9
126		min	-2.366	138	12	-2.458	127.5	9	-18.606	15	11	-0.005	4.5	8	-19.017	7.5	3	-2.588	15	8
127	M64	max	200.884	3	12	6.751	6	8	26.023	3	12	0.001	13.5	9	18.846	7.5	3	6.588	4.5	8
128		min	-4.782	138	3	-20.634	0	8	-52.868	4.5	11	-0.005	4.5	8	-14.83	39	3	-2.305	66	9
129	M65	max	0.021	12	12	16.037	12	12	0	12	12	0	12	8	0	0	8	32.658	12	3
130		min	-0.012	0	3	-65.317	0	3	0	0	8	0	0	12	0	12	8	-32.659	0	3
131	M66	max	0	12	12	15.996	12	12	0	12	12	0	12	1	0	12	9	23.018	12	3
132		min	0	0	1	-46.036	0	3	0	0	1	0	0	12	0	0	9	-23.018	0	3
133	M67	max	0	12	12	2.366	12	12	0	12	11	0	12	1	0	0	12	2.391	12	3
134		min	0	0	1	-4.782	0	3	0	0	12	0	0	12	0	12	12	-2.391	0	3
135	M68	max	359.268	3	3	3.128	13.5	8	0.944	70.5	3	0	96	12	19.213	7.5	11	2.307	66	9
136		min	-10.444	4.5	12	-2.458	127.5	9	-27.143	7.5	11	0	15	8	-16.549	39	11	-2.589	15	8
137	M69	max	484.78	3	11	2.456	136.5	8	27.143	6	11	0	96	12	16.549	39	11	2.586	15	8
138		min	-0.221	138	3	-3.124	4.5	8	-0.944	72	3	0	15	8	-19.213	7.5	11	-2.306	66	9
139	M70	max	0	12	12	1.282	12	3	0	12	12	0	12	8	0	12	12	33.836	12	11
140		min	0	0	1	-67.672	0	11	0	0	1	0	0	12	0	0	1	-33.836	0	11
141	M71	max	0	12	12	1.489	12	3	0	12	12	0	12	1	0	12	9	25.887	12	11
142		min	0	0	1	-51.773	0	11	0	0	1	0	0	12	0	0	9	-25.887	0	11
143	M72	max	0	12	12	0.221	12	3	0	12	11	0	12	1	0	0	12	3.001	12	11
144		min	0	0	1	-6.001	0	11	0	0	12	0	0	12	0	12	12	-3.001	0	11
145	M73	max	5.961	12	3	16.173	12	12	0.007	12	9	0.001	12	9	0.004	12	9	17.532	12	3
146		min	-21.094	0	12	-35.307	0	3	0	0	1	0	0	12	-0.004	0	9	-17.774	0	3
147	M74	max	0	12	12	0.772	12	3	0	12	12	0	12	8	0	12	12	27.006	12	11
148		min	0	0	1	-54.012	0	11	0	0	1	0	0	12	0	0	1	-27.006	0	11
149	M75	max	11.641	12	3	6.994	12	12	0.013	12	8	0.002	12	8	0.006	12	8	34.503	12	3
150		min	-19.567	0	12	-69.479	0	3	0	0	1	0	0	12	-0.006	0	8	-34.975	0	3
151	M76	max	0	12	12	0.516	12	3	0	12	12	0	12	8	0	0	9	27.139	12	11
152		min	0	0	1	-54.278	0	11	0	0	1	0	0	12	0	12	9	-27.139	0	11
153	M77	max	0	12	12	13.544	12	12	0	12	12	0	12	4	0	12	9	7.807	12	3
154		min	0	0	1	-15.615	0	3	0	0	1	0	0	9	0	0	9	-7.807	0	3
155	M78	max	0	12	12	1.134	12	3	0	12	12	0	12	8	0	0	8	16.485	12	11
156		min	0	0	1	-32.97	0	11	0	0	8	0	0	12	0	12	8	-16.485	0	11
157	M79	max	0	12	12	9.8	12	12	0	12	12	0	12	1	0	12	12	15.113	12	3
158		min	0	0	1	-30.227	0	3	0	0	1	0	0	9	0	0	1	-15.113	0	3
159	M80	max	0	12	12	1.277	12	3	0	12	12	0	12	1	0	12	12	16.469	12	11
160		min	0	0	1	-32.938	0	11	0	0	1	0	0	9	0	0	1	-16.469	0	11
161	M81	max	0	12	12	2.402	12	12	0	12	11	0	12	1	0	0	12	2.387	12	3
162		min	0	0	1	-4.774	0	3	0	0	12	0	0	12	0	12	12	-2.387	0	3
163	M82	max	588.996	3	3	2.861	85.5	9	57.061	6	3	0.001	13.5	8	14.801	39	3	2.319	66	9
164		min	-2.402	138	12	-2.458	127.5	9	-18.616	15	11	-0.003	4.5	8	-18.984	7.5	3	-2.911	4.5	9
165	M83	max	0.021	12	12	16.561	12	12	0	12	12	0	12	8	0	0	8	32.597	12	3
166		min	-0.012	0	3	-65.196	0	3	0	0	8	0	0	12	0	12	8	-32.599	0	3
167	M84	max	0	12	12	16.436	12	12	0	12	12	0	12	8	0	0	9	22.974	12	3

Envelope Maximum Member Section Forces (Continued)

	Member		Axial[lb]	Loc[in]	LC	y Shear[lb]	Loc[in]	LC	z Shear[lb]	Loc[in]	LC	Torque[lb-ft]	Loc[in]	LC	y-y Moment[lb-ft]	Loc[in]	LC	z-z Moment[lb-ft]	Loc[in]	LC
168		min	0	0	1	-45.947	0	3	0	0	9	0	0	12	0	12	9	-22.974	0	3
169	M85	max	0	12	12	10.074	12	12	0	12	12	0	12	1	0	12	9	15.086	12	3
170		min	0	0	1	-30.172	0	3	0	0	1	0	0	9	0	0	9	-15.086	0	3
171	M86	max	202.765	3	12	6.747	6	8	26.144	3	12	0.001	13.5	8	18.814	7.5	3	6.587	4.5	8
172		min	-4.774	138	3	-20.633	0	8	-52.884	4.5	11	-0.003	4.5	8	-14.803	39	3	-2.305	66	9
173	M87	max	11.6	12	3	7.521	12	12	0.007	12	8	0.001	12	8	0.004	12	8	34.439	12	3
174		min	-19.658	0	12	-69.348	0	3	0	0	1	0	0	12	-0.004	0	8	-34.909	0	3
175	M88	max	0	12	12	0.152	12	3	0.015	12	9	0.006	12	9	0.008	12	9	3.027	12	11
176		min	0	0	1	-6.055	0	11	0	0	12	0	0	12	-0.008	0	9	-3.027	0	11
177	M89	max	359.733	3	3	6.643	136.5	9	0.62	70.5	3	0.002	75	9	19.314	7.5	11	3.958	75	9
178		min	-10.521	4.5	12	-2.372	117	9	-27.35	7.5	11	-0.008	138	9	-16.659	39	11	-5.914	136.5	9
179	M90	max	0	12	12	0.759	12	3	0	12	12	0	12	1	0	0	9	34.074	12	11
180		min	0	0	1	-68.149	0	11	0	0	9	0	0	9	0	12	9	-34.074	0	11
181	M91	max	0	12	12	0.978	12	3	0.007	12	9	0	12	1	0.004	12	9	26.122	12	11
182		min	0	0	1	-52.245	0	11	0	0	1	-0.001	0	9	-0.004	0	9	-26.122	0	11
183	M92	max	0	12	12	0.868	12	3	0	12	12	0	12	8	0	12	3	16.641	12	11
184		min	0	0	1	-33.282	0	11	0	0	1	0	0	12	0	0	3	-16.641	0	11
185	M93	max	484.862	3	11	2.437	136.5	8	27.35	6	11	0.002	75	9	16.659	39	11	2.586	15	8
186		min	-0.152	138	3	-3.124	4.5	8	-0.62	72	3	-0.008	138	9	-19.314	7.5	11	-2.306	66	9
187	M94	max	0	12	12	0.179	12	3	0	12	12	0	12	8	0	12	12	27.3	12	11
188		min	0	0	1	-54.6	0	11	0	0	1	0	0	12	0	0	1	-27.3	0	11
189	M95	max	15.683	1.5	11	0	1.5	11	0	1.5	12	0	1.5	8	0	1.5	12	0	1.5	12
190		min	-1.849	0	9	0	0	12	0	0	1	-0.003	0	12	0	0	1	0	0	1
191	M96	max	7.383	1.5	3	0	1.5	9	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	12
192		min	-5.777	0	11	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
193	M97	max	1.427	1.5	11	0	1.5	4	0	1.5	12	0.002	1.5	8	0	1.5	12	0	1.5	12
194		min	-1.978	0	3	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
195	M98	max	3.201	1.5	11	0	1.5	4	0	1.5	12	0.011	1.5	8	0	1.5	12	0	1.5	12
196		min	-7.205	0	3	-0.001	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
197	M99	max	0.465	1.5	9	0	1.5	4	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
198		min	-5.016	0	11	-0.001	0	12	0	0	1	-0.01	0	9	0	0	1	0	0	1
199	M100	max	5.962	1.5	8	0	1.5	4	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
200		min	-2.769	0	11	-0.001	0	12	0	0	1	-5.444	0	9	0	0	1	0	0	1
201	M101	max	0.282	1.5	11	0	1.5	4	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	12
202		min	-0.218	0	3	-0.001	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
203	M102	max	1.213	1.5	11	0	1.5	4	0	1.5	12	4.231	1.5	9	0	1.5	12	0	1.5	12
204		min	-8.572	0	7	-0.001	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
205	M103	max	1.267	1.5	8	0	1.5	4	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
206		min	0.031	0	11	-0.001	0	12	0	0	1	-0.007	0	12	0	0	1	0	0	1
207	M104	max	0.892	1.5	9	0	1.5	4	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
208		min	-1.144	0	11	-0.001	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
209	M105	max	1.572	1.5	11	0	1.5	4	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
210		min	-6.693	0	8	-0.001	0	12	0	0	1	-0.007	0	12	0	0	1	0	0	1
211	M106	max	2.264	1.5	8	0	1.5	4	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
212		min	-0.13	0	11	-0.001	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
213	M107	max	1.495	1.5	11	0	1.5	4	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
214		min	-1.786	0	9	-0.001	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
215	M108	max	1.661	1.5	8	0	1.5	4	0	1.5	12	6.347	1.5	9	0	1.5	12	0	1.5	12
216		min	0.17	0	1	-0.001	0	12	0	0	1	0.065	0	12	0	0	1	0	0	1
217	M109	max	-1.447	1.5	1	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
218		min	-6.307	0	3	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	1.5	9
219	M110	max	-4.44	1.5	1	0	1.5	9	0	1.5	12	0.446	1.5	9	0	1.5	12	0	1.5	12
220		min	-19.449	0	3	0	0	12	0	0	1	-0.002	0	12	0	0	1	0	1.5	9
221	M111	max	31.913	1.5	3	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
222		min	7.316	0	1	0	0	12	0	0	1	-0.015	0	9	0	0	1	0	1.5	9
223	M112	max	22.419	1.5	3	0	1.5	12	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
224		min	1.634	0	12	0	0	1	0	0	1	-2.945	0	9	0	0	1	0	0	1
225	M113	max	-8.167	1.5	1	0	1.5	11	0	1.5	12	0.563	1.5	9	0	1.5	12	0	1.5	12
226		min	-35.624	0	3	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
227	M114	max	8.592	1.5	3	0	1.5	9	0	1.5	12	0.002	1.5	8	0	1.5	12	0	1.5	12
228		min	1.969	0	1	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1

Envelope Maximum Member Section Forces (Continued)

	Member		Axial[lb]	Loc[in]	LC	y Shear[lb]	Loc[in]	LC	z Shear[lb]	Loc[in]	LC	Torque[lb-ft]	Loc[in]	LC	y-y Moment[lb-ft]	Loc[in]	LC	z-z Moment[lb-ft]	Loc[in]	LC
229	M115	max	-4.197	1.5	1	0	1.5	9	0	1.5	12	0.007	1.5	8	0	1.5	12	0	1.5	12
230		min	-18.253	0	10	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	1.5	9
231	M116	max	0.724	1.5	3	0	1.5	9	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	12
232		min	-0.74	0	12	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	1.5	9
233	M117	max	27.204	1.5	3	0	1.5	9	0	1.5	12	-0.001	1.5	1	0	1.5	12	0	1.5	12
234		min	6.215	0	1	0	0	12	0	0	1	-0.06	0	9	0	0	1	0	1.5	9
235	M118	max	-1.008	1.5	1	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
236		min	-4.415	0	3	0	0	12	0	0	1	-0.007	0	12	0	0	1	0	1.5	9
237	M119	max	19.639	1.5	3	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
238		min	4.508	0	1	0	0	12	0	0	1	-0.007	0	12	0	0	1	0	1.5	9
239	M120	max	-0.857	1.5	1	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
240		min	-5.63	0	11	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	1.5	9
241	M121	max	3.12	1.5	3	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
242		min	0.718	0	1	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	1.5	9
243	M122	max	-0.665	1.5	1	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
244		min	-2.914	0	10	0	0	12	0	0	1	-0.003	0	12	0	0	1	0	1.5	9
245	M123	max	17.838	1.5	11	0	0.75	3	24.312	0.75	7	0	1.5	1	1.721	0.75	11	0	1.5	12
246		min	-16.891	0	11	-0.002	0	12	-27.536	0.75	11	-0.006	0	12	-0.456	0.734	12	0	0.75	3
247	M124	max	26.642	1.5	11	0	0.75	5	168.895	0.75	11	0	1.5	1	10.556	0.75	11	0	1.5	12
248		min	-18.402	0	11	-0.001	0	12	-164.037	0.766	11	-0.006	0.75	12	0	1.5	5	0	0.75	2
249	M125	max	-0.782	1.5	1	0	1.5	9	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	12
250		min	-5.493	0	11	-0.001	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
251	M126	max	-0.229	1.5	1	0	1.5	11	0	1.5	12	0	1.5	8	0	1.5	12	0	1.5	12
252		min	-3.693	0	11	0	0	12	0	0	1	-0.003	0	12	0	0	1	0	0	1
253	M127	max	40.432	1.5	11	0	0.734	4	436.238	0.75	11	0.001	1.5	8	27.265	0.75	11	0	1.5	12
254		min	-22.541	0	11	-0.001	0	12	-353.705	0.766	11	-0.006	0	12	0	1.5	5	0	0.75	2
255	M128	max	-0.226	1.5	1	0	1.5	9	0	1.5	12	0.002	1.5	8	0	1.5	12	0	1.5	12
256		min	-1.743	0	11	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
257	M129	max	35.484	1.5	11	0	0.734	3	316.023	0.75	11	0.001	1.5	8	19.751	0.75	11	0	1.5	12
258		min	-21.66	0	11	-0.001	0	12	-281.212	0.766	11	-0.006	0	12	0	1.5	5	0	0.75	3
259	M130	max	-0.016	1.5	1	0	1.5	9	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	12
260		min	-0.183	0	11	-0.001	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
261	M131	max	11.041	0.734	3	0	0.75	5	172.704	1.5	11	0	0.75	8	0.309	0.766	9	0	1.5	12
262		min	-16.641	0.75	3	-0.001	0	12	-277.848	0	11	-0.006	0.75	12	-17.366	0.75	11	0	0.75	3
263	M132	max	14.297	1.5	11	0	0.75	2	23.76	0.75	3	0	0.734	1	2.022	0.75	11	0	1.5	12
264		min	-11.658	0	11	-0.001	0.75	12	-32.348	0.75	11	-0.007	0.75	12	-0.477	0.734	12	0	0.75	8
265	M133	max	-0.038	1.5	9	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
266		min	-2.472	0	11	-0.001	0	12	0	0	1	-0.007	0	12	0	0	1	0	0	1
267	M134	max	1.282	1.5	11	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
268		min	0.196	0	1	-0.001	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
269	M135	max	13.397	1.5	12	0	0.734	4	40.11	1.5	11	0	1.5	1	0.435	0.75	9	0	1.5	12
270		min	-12.512	0	12	-0.001	0	12	-84.395	0	11	-0.006	0	12	-5.275	0.75	11	0	0.75	7
271	M136	max	19.135	1.5	11	0	0.75	5	25.813	0.75	8	0	0.734	1	1.613	0.75	8	0	1.5	12
272		min	-16.571	0	11	-0.001	0.766	12	-30.232	0	12	-0.003	0	12	-1.89	0.75	12	0	0.75	2
273	M137	max	-1.215	1.5	1	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
274		min	-5.47	0	10	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
275	M138	max	-3.333	1.5	1	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
276		min	-14.977	0	10	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
277	M139	max	21.384	1.5	3	0	1.5	9	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	12
278		min	4.901	0	1	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
279	M140	max	25.273	1.5	11	0	1.5	12	0	1.5	12	0	1.5	8	0	1.5	12	0	1.5	12
280		min	4.026	0	1	0	0	1	0	0	1	-0.003	0	12	0	0	1	0	0	1
281	M141	max	-7.288	1.5	1	0	1.5	11	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	12
282		min	-31.78	0	3	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
283	M142	max	5.896	1.5	10	0	1.5	9	0	1.5	12	0.002	1.5	8	0	1.5	12	0	1.5	12
284		min	1.346	0	1	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
285	M143	max	-7.044	1.5	1	0	1.5	9	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	12
286		min	-30.784	0	3	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
287	M144	max	0.61	1.5	11	0	1.5	9	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	12
288		min	0.072	0	1	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
289	M145	max	16.899	1.5	3	0	1.5	9	0	1.5	12	0	1.5	8	0	1.5	12	0	1.5	12

Envelope Maximum Member Section Forces (Continued)

	Member		Axial[lb]	Loc[in]	LCy	Shear[lb]	Loc[in]	LCz	Shear[lb]	Loc[in]	LC	Torque[lb-ft]	Loc[in]	LCy-y Moment[lb-ft]	Loc[in]	LCz-z Moment[lb-ft]	Loc[in]	LC
290		min	3.884	0	1	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
291	M146	max	-0.74	1.5	1	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
292		min	-3.769	0	11	0	0	12	0	0	1	-0.007	0	12	0	0	1	0	0	1
293	M147	max	9.102	1.5	10	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
294		min	1.916	0	1	0	0	12	0	0	1	-0.007	0	12	0	0	1	0	0	1
295	M148	max	-1.216	1.5	1	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
296		min	-5.316	0	3	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
297	M149	max	3.821	1.5	3	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
298		min	0.488	0	12	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
299	M150	max	-0.388	1.5	9	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
300		min	-2.914	0	11	0	0	12	0	0	1	-0.003	0	12	0	0	1	0	0	1
301	M151	max	5.623	1.5	11	0	1.5	4	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
302		min	0.94	0	1	-0.001	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
303	M152	max	12.428	1.5	11	0	1.5	4	0	1.5	12	-0.006	1.5	1	0	1.5	12	0	1.5	12
304		min	1.847	0	1	-0.001	0	12	0	0	1	-5.196	0	8	0	0	1	0	0	1
305	M153	max	-4.2	1.5	1	0	1.5	4	0	1.5	12	0.011	1.5	8	0	1.5	12	0	1.5	12
306		min	-19.756	0	10	-0.001	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
307	M154	max	-0.346	1.5	1	0	1.5	11	0	1.5	12	0	1.5	8	0	1.5	12	0	1.5	12
308		min	-26.749	0	11	0	0	12	0	0	1	-0.003	0	12	0	0	1	0	0	1
309	M155	max	27.478	1.5	11	0	1.5	9	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	12
310		min	5.259	0	1	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
311	M156	max	-1.167	1.5	1	0	1.5	7	0	1.5	12	0.002	1.5	8	0	1.5	12	0	1.5	12
312		min	-5.581	0	10	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
313	M157	max	26.199	1.5	3	0	1.5	4	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
314		min	6.032	0	1	-0.001	0	12	0	0	1	-0.01	0	9	0	0	1	0	0	1
315	M158	max	1.404	1.5	12	0	1.5	4	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	12
316		min	-0.342	0	8	-0.001	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
317	M159	max	-2.471	1.5	1	0	1.5	4	0	1.5	12	4.047	1.5	8	0	1.5	12	0	1.5	12
318		min	-13.382	0	11	-0.001	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
319	M160	max	3.769	1.5	11	0	1.5	4	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
320		min	0.461	0	1	-0.001	0	12	0	0	1	-0.007	0	12	0	0	1	0	0	1
321	M161	max	-0.29	1.5	12	0	1.5	4	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
322		min	-5.554	0	11	-0.001	0	12	0	0	1	-0.007	0	12	0	0	1	0	0	1
323	M162	max	6.378	1.5	11	0	1.5	4	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
324		min	1.143	0	1	-0.001	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
325	M163	max	0.443	1.5	12	0	1.5	4	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
326		min	-3.093	0	3	-0.001	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
327	M164	max	3.342	1.5	11	0	1.5	4	0	1.5	12	4.843	1.5	8	0	1.5	12	0	1.5	12
328		min	0.209	0	9	-0.001	0	12	0	0	1	-0.003	0	12	0	0	1	0	0	1
329	M165	max	-0.861	1.5	1	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
330		min	-3.906	0	10	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	1.5	9
331	M166	max	-1.834	1.5	1	0	1.5	9	0	1.5	12	0.344	1.5	8	0	1.5	12	0	1.5	12
332		min	-9.209	0	11	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	1.5	9
333	M167	max	15.995	1.5	10	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
334		min	3.524	0	1	0	0	12	0	0	1	-0.014	0	9	0	0	1	0	1.5	9
335	M168	max	38.063	1.5	11	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
336		min	1.78	0	1	0	0	12	0	0	1	-2.811	0	8	0	0	1	0	1.5	9
337	M169	max	-4.405	1.5	1	0	1.5	9	0	1.5	12	0.542	1.5	8	0	1.5	12	0	1.5	12
338		min	-21.604	0	11	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	1.5	9
339	M170	max	4.644	1.5	10	0	1.5	9	0	1.5	12	0.002	1.5	8	0	1.5	12	0	1.5	12
340		min	0.969	0	1	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	1.5	9
341	M171	max	-4.136	1.5	1	0	1.5	9	0	1.5	12	0.007	1.5	8	0	1.5	12	0	1.5	12
342		min	-17.971	0	3	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	1.5	9
343	M172	max	0.294	1.5	8	0	1.5	9	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	12
344		min	-0.16	0	12	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	1.5	9
345	M173	max	12.264	1.5	10	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
346		min	2.566	0	1	0	0	12	0	0	1	-0.045	0	9	0	0	1	0	1.5	9
347	M174	max	-0.446	1.5	1	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
348		min	-2.19	0	11	0	0	12	0	0	1	-0.007	0	12	0	0	1	0	1.5	9
349	M175	max	6.607	1.5	10	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
350		min	1.382	0	1	0	0	12	0	0	1	-0.007	0	12	0	0	1	0	1.5	9

Envelope Maximum Member Section Forces (Continued)

	Member		Axial[lb]	Loc[in]	LC	y Shear[lb]	Loc[in]	LC	z Shear[lb]	Loc[in]	LC	Torque[lb-ft]	Loc[in]	LC	y-y Moment[lb-ft]	Loc[in]	LC	z-z Moment[lb-ft]	Loc[in]	LC
351	M176	max	-0.741	1.5	1	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
352		min	-3.221	0	3	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	1.5	9
353	M177	max	2.342	1.5	10	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
354		min	0.532	0	1	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	1.5	9
355	M178	max	-0.309	1.5	1	0	1.5	9	0	1.5	12	0	1.5	8	0	1.5	12	0	1.5	12
356		min	-1.465	0	10	0	0	12	0	0	1	-0.378	0	3	0	0	1	0	1.5	9
357	M179	max	304.973	3	10	2.455	136.5	8	44.525	6	12	0.005	4.5	9	14.504	39	12	2.589	15	8
358		min	0.568	142.5	1	-3.133	6	8	-4.798	15	3	-0.001	7.5	8	-15.4	7.5	12	-2.312	66	9
359	M185	max	0	12	12	-5.411	12	1	0	12	12	0	12	1	0	12	12	23.14	12	12
360		min	0	0	1	-46.281	0	12	0	0	1	0	0	12	0	0	1	-23.14	0	12
361	M186	max	92.362	13.5	3	20.641	3	8	17.288	6	11	0.005	6	9	15.002	7.5	12	2.313	66	9
362		min	-121.214	4.5	12	-6.746	4.5	8	-37.626	0	11	-0.001	7.5	8	-14.507	39	12	-6.59	4.5	8
363	M187	max	28.291	12	11	-8.071	12	1	0	12	12	0	12	1	0.006	0	8	25.58	12	12
364		min	1.347	0	1	-52.261	0	12	-0.013	0	8	-0.002	0	9	-0.006	12	8	-26.68	0	12
365	M188	max	0	12	12	-0.568	12	1	0	12	11	0	12	1	0	0	12	2.752	12	12
366		min	0	0	1	-5.505	0	12	0	0	12	0	0	12	0	12	12	-2.752	0	12
367	M189	max	-0.001	12	1	-7.632	12	1	0	12	8	0	12	8	0	12	8	29.363	12	12
368		min	-0.03	0	11	-58.73	0	12	0	0	1	0	0	12	0	0	8	-29.367	0	12
369	M190	max	0	12	12	-3.577	12	1	0	12	12	0	12	1	0	12	12	14.85	12	12
370		min	0	0	1	-29.701	0	12	0	0	1	0	0	9	0	0	1	-14.85	0	12
371	M191	max	0	12	12	2.45	12	3	0	12	11	0	12	1	0	0	12	1.479	12	12
372		min	0	0	1	-2.958	0	12	0	0	12	0	0	12	0	12	12	-1.479	0	12
373	M192	max	293.682	3	3	3.134	6	8	28.73	6	3	0.001	13.5	9	10.126	15	11	2.307	66	9
374		min	-6.796	36	12	-2.458	127.5	9	-15.33	15	11	-0.005	4.5	8	-9.559	7.5	3	-2.588	15	8
375	M193	max	0.022	12	12	33.021	12	3	0	12	12	0	12	8	0	0	8	16.51	0	3
376		min	-0.006	0	3	-24.479	0	12	0	0	8	0	0	12	0	12	8	-16.511	12	3
377	M194	max	0	12	12	23.418	12	3	0	12	12	0	12	1	0	12	9	11.709	0	3
378		min	0	0	1	-21.987	0	12	0	0	1	0	0	12	0	0	9	-11.709	12	3
379	M195	max	0	12	12	15.454	12	3	0	12	12	0	12	1	0	12	12	7.727	0	3
380		min	0	0	1	-13.653	0	12	0	0	1	0	0	9	0	0	1	-7.727	12	3
381	M196	max	154.496	3	12	6.751	6	8	28.041	3	12	0.001	13.5	9	9.473	7.5	3	6.588	4.5	8
382		min	-2.45	138	3	-20.634	0	8	-41.308	4.5	11	-0.005	4.5	8	-10.269	15	11	-2.305	66	9
383	M197	max	5.839	12	3	34.918	12	3	0.013	12	8	0.002	12	8	0.006	12	8	17.341	0	3
384		min	-21.084	0	12	-16.051	0	12	0	0	1	0	0	12	-0.006	0	8	-17.577	12	3
385	M198	max	18.023	1.5	11	0	1.5	11	0	1.5	12	0	1.5	8	0	1.5	12	0	1.5	12
386		min	1.406	0	1	0	0	12	0	0	1	-0.003	0	12	0	0	1	0	0	1
387	M199	max	-0.752	1.5	1	0	1.5	11	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	12
388		min	-7.285	0	11	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
389	M200	max	2.323	1.5	11	0	1.5	9	0	1.5	12	0.002	1.5	8	0	1.5	12	0	1.5	12
390		min	0.35	0	1	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
391	M201	max	8.427	1.5	11	0	1.5	9	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	12
392		min	1.292	0	1	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
393	M202	max	-0.647	1.5	1	0	1.5	9	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	12
394		min	-5.63	0	11	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
395	M203	max	-0.299	1.5	9	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
396		min	-3.227	0	11	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
397	M204	max	0.13	1.5	8	0	1.5	9	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	12
398		min	-0.977	0	12	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
399	M205	max	4.059	1.5	11	0	1.5	9	0	1.5	12	0	1.5	8	0	1.5	12	0	1.5	12
400		min	0.28	0	9	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
401	M206	max	-0.046	1.5	9	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
402		min	-0.58	0	11	0	0	12	0	0	1	-0.007	0	12	0	0	1	0	0	1
403	M207	max	-0.208	1.5	9	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
404		min	-4.181	0	11	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
405	M208	max	2.877	1.5	3	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
406		min	0.275	0	12	0	0	12	0	0	1	-0.007	0	12	0	0	1	0	0	1
407	M209	max	-0.022	1.5	9	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
408		min	-1.045	0	11	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
409	M210	max	0.992	1.5	11	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
410		min	0.004	0	9	0	0	12	0	0	1	-0.006	0	12	0	0	1	0	0	1
411	M211	max	0.076	1.5	12	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12

Envelope Maximum Member Section Forces (Continued)

	Member		Axial[lb]	Loc[in]	LC	y Shear[lb]	Loc[in]	LC	z Shear[lb]	Loc[in]	LC	Torque[lb-ft]	Loc[in]	LC	y-y Moment[lb-ft]	Loc[in]	LC	z-z Moment[lb-ft]	Loc[in]	LC
412		min	-0.218	0	3	0	0	12	0	0	1	-0.003	0	12	0	0	1	0	0	1

Material Take-Off

	Material	Size	Pieces	Length[in]	Weight[K]
1	General Members				
2	RIGID		98	147	0
3	Total General		98	147	0
4					
5	Hot Rolled Steel				
6	Gr-30	0.06X0.75FLAT	10	751.3	0.01
7	Total HR Steel		10	751.3	0.01
8					
9	Cold Formed Steel				
10	Gr30	S-SERIES-BRC_0.625X4.5X18GA	70	840	0.064
11	Gr30	S-SERIES-UP_1.5X1.12X16GA	28	4032	0.222
12	Total CF Steel		98	4872	0.286

Frame E1

Storage Shelving

18/18"B x 48"L x 144"H - S-series

(17 Levels)

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

SEISMIC DESIGN FRAME E1 18"/18"B x 48"L x 144"H S-Series Storage Shelving

SEISMIC FORCES

Code Refrence

Seismic Code : **ASCE 7-10**
EQUIVALENT LATERAL FORCE PROCEDURE FOR SHELVING
& RMI (AS IT APPLIES)

Dimension

Frame :	**E1**		Max. Shelving Height :	**144**	in
Width :	**36**	in	Levels :	**17**	
Length :	**48**	in	Shelf type :	**S-Series Storage Shelving** Double Fixture	

Site parameters (ASCE 7 section 11.4)

Site class	**D (Default)**				
Mapped acceleration parameters					
at short periods	Ss =	**0.206**	at 1 sec. period	S_1 =	**0.106**
Site coefficient at short periods	Fa =	**1.600**	at 1 sec. period	Fv =	**2.376**

Spectral response accelaration parameters (ASCE 7 section 11.4)

at short periods		**0.071**			**0.050**
	Calc. SMS =	**0.330**	at 1 sec. period	Calc. SM1 =	**0.252**

Design spectral acceleration parameters (ASCE 7 section 11.4)

at short periods	S_{DS} =	**0.220**	at 1 sec. period	S_{D1} =	**0.168**

Seismic design category (ASCE 7 section 11.6)

Risk Category	**II**
Seismic design category	**C**

Approximate fundamental period (ASCE 7 section 12.8.2.1)

Height above base to highest level	hn =	**12.00**	ft
Structure Type		**4**	
Long-period transition	TL =	**12**	Figs. 22-14 thru 22-17
Building period parameter Ct	Ct =	**0.020**	
Building period parameter x	x =	**0.75**	
Building fundamental period	T = Ta =	**0.129**	sec.
Exponent related to structure period	k =	**1**	since Ta ≤ 0.50 sec

Seismic response coefficient (ASCE 7 section 15.5 & RMI 2.6.3)

Response modification factor (Transverse)	R =	**4**	
Response modification factor (Longitudinal)	R =	**6**	
Seismic importance factor	Ie =	**1.5**	(ASCE 7 15.5.3,RMI Sec. 2.6.2)
Redundancy factor	ρ =	**1.0**	RMI Sec. 2.6.2.1; ASCE7 Sec.12.4.2.1
	Cd =	**3.5**	

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

Operating Weight (RMI 2.1 & ASCE 7 section 15.5)

Loads

DL : **5** psf

LEVEL	Height/LVL **8.38**	Input Shelf Load (PL) (lbs.)	Calculated (lbs.)
17	**8.38**	**150**	150
16	**8.38**	**150**	150
15	**8.38**	**150**	150
14	**8.38**	**150**	150
13	**8.38**	**150**	150
12	**8.38**	**150**	150
11	**8.38**	**150**	150
10	**8.38**	**150**	150
9	**8.38**	**150**	150
8	**8.38**	**150**	150
7	**8.38**	**150**	150
6	**8.38**	**150**	150
5	**8.38**	**150**	150
4	**8.38**	**150**	150
3	**8.38**	**150**	150
2	**8.38**	**150**	150
1	**4.00**	**150**	150
		Total PL :	2,550

DL = 5 PSF x 3 FT x 4 FT x 17 SHELVES = 1,020.00 lbs
PL app = 2,550 LBS x 0.67 = 1,708.50 lbs
PL (top shelf) = 150.00 lbs

Ws = DL+67%PL+0.25LL (Per Storage Rack Section)
67%PL (every shelf loaded 67% of its rated load)(PL app)
100%PL (top shelf only loaded 100% of its rated load)
V_{BASE} = Cs Ws

Seismic base shear (ASCE 7 section 12.8)

		Transverse	Longitudinal
Seismic response coefficient	Cs =	**0.082**	**0.055**
Seismic response coefficient max.	$Cs_{,MAX}$ =	**0.488**	**0.326**
Seismic response coefficient min.	$Cs_{,MIN}$ =	**0.015**	**0.015**
Seismic response coefficient (Governs)	Cs =	**0.082**	**0.055**

LOAD COMBINATION ASD (RMI 2.1)	W_{LC}	Ws	E (factor)	V_{BASE} Transverse	V_{BASE} Longitudinal	
DL+0.67PL+0.75(0.7ρE)	2,728.50	2,728.50	0.525	118	79	
$(1+0.105S_{DS})DL+0.75[(1.4+0.14S_{DS})0.7PL+0.7\rho E]$	2,958.97	2,728.50	0.525	118	79	
$(1+0.14S_{DS})DL+(0.85+0.14S_{DS})0.7PL+0.7\rho E$	2,623.54	2,728.50	0.700	157	105	**CONTROLS**
$(0.6 - 0.14S_{DS})DL+(0.6 - 0.14S_{DS})0.67PL+0.7\rho E$	1,553.16	2,728.50	0.700	157	105	
Seismic base shear			$V_{BASE\ MAX.\ CONTROL}$	157	105	

$W_{s\ CONTROL}$= 2,623.54 LBS

Anchors in accordance with ACI318 Sec.17 Ωo = 2.0 (ACI318 Sec.17; ASCE7 Table 15.4-1)

	Transverse	Longitudinal	
$V_{BASE\ 67\%PL}$ =	**157**	**105**	lbs
$V_{BASE\ 100\%PL\ TOP}$ x 0.7ρ=	**68**	**45**	lbs

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

SEISMIC LATERAL FORCE DISTRIBUTION - FRAME E1 (CONTINUED)

					Transverse	Longitudinal
LEVEL	W (lbs.)	h (ft)	$W_x h_x^k$ (lbs-ft)	$C_v x$	F_x (lbs)	F_x (lbs)
17	154.33	11.50	1774.88	0.11	17.99	12.00
16	154.33	10.80	1667.10	0.11	16.90	11.27
15	154.33	10.10	1559.33	0.10	15.81	10.54
14	154.33	9.41	1451.63	0.09	14.72	9.81
13	154.33	8.71	1343.92	0.09	13.63	9.08
12	154.33	8.01	1236.21	0.08	12.53	8.36
11	154.33	7.31	1128.51	0.07	11.44	7.63
10	154.33	6.61	1020.80	0.07	10.35	6.90
9	154.33	5.92	913.09	0.06	9.26	6.17
8	154.33	5.22	805.39	0.05	8.17	5.44
7	154.33	4.52	697.68	0.04	7.07	4.72
6	154.33	3.82	589.97	0.04	5.98	3.99
5	154.33	3.13	482.27	0.03	4.89	3.26
4	154.33	2.43	374.56	0.02	3.80	2.53
3	154.33	1.73	266.86	0.02	2.71	1.80
2	154.33	1.03	159.15	0.01	1.61	1.08
1	154.33	0.33	51.44	0.00	0.52	0.35
Σ	2623.54	Σ	15522.80	Base :	157.38	104.92
P_{STATIC} =	655.88	lbs per post		$COMP._{MAX}$ =	893	lbs per post

$V_{BASE\ 67\%PL}$ (Transverse): 157 lbs

$V_{BASE\ 67\%PL}$ (Longitudinal): 105 lbs

$\Sigma (F_X * h)$ (Transverse) : 14,906 lbs-in

$\Sigma (F_X * h)$ (Longitudinal) : 9,937 lbs-in

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

SEISMIC LATERAL FORCE DISTRIBUTION TOP SHELF LOADED - FRAME E1 (CONTINUED)

					Transverse	Longitudinal
LEVEL	W (lbs.)	h (ft)	$W_x h_x^k$ (lbs-ft)	$C_v x$	F_x (lbs)	F_x (lbs)
17	210.00	11.50	2415.18	0.31	21.16	14.01
16	60.00	10.80	648.15	0.08	5.68	3.76
15	60.00	10.10	606.25	0.08	5.31	3.52
14	60.00	9.41	564.38	0.07	4.95	3.27
13	60.00	8.71	522.50	0.07	4.58	3.03
12	60.00	8.01	480.63	0.06	4.21	2.79
11	60.00	7.31	438.75	0.06	3.84	2.54
10	60.00	6.61	396.88	0.05	3.48	2.30
9	60.00	5.92	355.00	0.05	3.11	2.06
8	60.00	5.22	313.13	0.04	2.74	1.82
7	60.00	4.52	271.25	0.03	2.38	1.57
6	60.00	3.82	229.38	0.03	2.01	1.33
5	60.00	3.13	187.50	0.02	1.64	1.09
4	60.00	2.43	145.63	0.02	1.28	0.84
3	60.00	1.73	103.75	0.01	0.91	0.60
2	60.00	1.03	61.88	0.01	0.54	0.36
1	60.00	0.33	20.00	0.00	0.18	0.12
Σ	1170.00	Σ	7760.20	Base :	68.00	45.00

$V_{BASE\ 100\%PL\ TOP}$ (Transverse): 68 LBS Σ (F_X * h) (Transverse) : 7,095 lbs-in

$V_{BASE\ 100\%PL\ TOP}$ (Longitudinal): 45 LBS Σ (F_X * h) (Longitudinal) : 4,695 lbs-in

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

COMPONENT DESIGN FOR PROFILE E1

CROSS BRACE DESIGN:

MAX. FORCE IN CROSS BRACE IN LONGITUDINAL DIRECTION

Fy = 30,000 PSI

CROSS BRACE AT EVERY 4 RACKS

(RISA3D) T_{MAX} = 369.131 LBS

A_{REQD} = 369.13 / (0.6 x 30000 PSI) = 0.021 IN^2

A_{ACTUAL} = 3/4" x 0.06" = 0.045 IN^2 OK

USE CROSS BRACE AT EVERY 4 RACKS.

SHEAR CAPACITY OF #8X5/8" SCREWS (AISI 2002 TABLE IV 8a)

(16 GA BRACE IN CONTACT & 16 GA UPRITE NOT IN CONTACT)

P_{nS} = 1.62 No. of Screws = 1

V_{ALLOW} = P_{nS} / Ω where, Ω = 3

V_{ALLOW} = 1 x 1.62 /3 = 0.54 KIPS = 540 LBS

V_{ALLOW} (SEISMIC) = 1.0 * V_{ALLOW} = 540 > $V_{MAX.}$ = 369 LBS OK

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

TRANSVERSE DIRECTION HORIZONTAL BRACE DESIGN:

(RISA3D) $P_{MAX.}$:	58	LBS
Unbrace Lx :	18	IN
Unbrace Ly :	18	IN

AREA =	0.269	IN^2	Fy =	30,000	PSI
Ix =	0.628	IN^4	Iy =	0.005	IN^4
Sx =	0.279	IN^3	Sy =	0.010	IN^3
rx =	1.527	IN	ry =	0.140	IN
C_{mx}=	1.00		Kx =	1.7	
			Ky =	1.0	

$$\frac{kLx}{rx} = \frac{(1.7)(18)}{1.527} = 20.04$$

$$\frac{kLy}{ry} = \frac{(1)(18)}{0.14} = 128.57 \quad \text{<-- CONTROLS}$$

$$Fa = \frac{\pi^2 * E}{(Kl/r)^2} = 17314 \text{ PSI}$$

$$\lambda c = (Fy / Fa)^{1/2} = 1.32 \quad <1.5$$

$$Fn = \begin{cases} \lambda c < 1.5 & (0.658^{\lambda c2})Fy \\ \lambda c > 1.5 & (0.877/\lambda c^2)Fy \end{cases} = 14527 \text{ PSI}$$

$$Pn = A_{eff} \times F_n = 3908 \text{ LBS}$$

$$P = P_n / \Omega$$

where, Ω_c = 1.80

P = 2171 LBS

$P_{MAX.} / P$ = 0.03 (1) <----------

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

(RISA3D) M_{MAX} =	89.35	LBS-FT
$M_n = S_x \times Fy$ =	8370.00	LBS-IN
M =	M_n/Ω	
where, Ω_b =	1.67	
M =	5012	LBS-IN
M_{MAX} / M =	0.21	(2) <----------
(1) + (2) =	0.24	< 1.0 OK

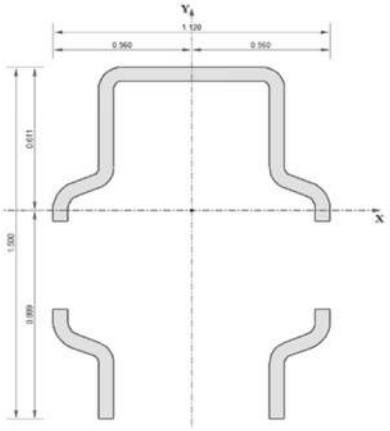
JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

COLUMN DESIGN FOR FRAME - E1

SECTION PROPERTIES

MAX HT = 144 IN

SIZE =	1.12"x1.5"x16ga		Fy =	30	ksi
t =	16	GA	E =	29,500	ksi
AREA =	0.194	in^2	Iy =	0.027	in^4
Ix =	0.050	in^4	Sy =	0.048	in^3
Sx =	0.056	in^3	ry =	0.374	in
rx =	0.508	in	Ωc=	1.80	
C_{mx}=	1.00		Ωb=	1.67	
Unbrace Lx-x =	8.38	in	Kx =	1.0	(RMI Sec. 6.3.1.2)
Unbrace Ly-y =	10.25	in	Ky =	1.7	(RMI Sec. 6.3.1.1)
δ_{SE} =	0.14	IN			
δ_X =	0.33	IN < 5% Structural Height OK			



COLUMN SECTION

P = 885 lbs

$\frac{kLx}{rx}$	=	$\frac{(1)(8.38)}{0.508in}$	=	16.50		$\frac{kLy}{ry}$	=	$\frac{(1.7)(10.25)}{0.374in}$	=	46.59	
Fax	=	$\frac{\pi^2 * E}{(Klx/rx)^2}$	=	1069944	PSI	Fay	=	$\frac{\pi^2 * E}{(Kly/ry)^2}$	=	134128	psi
λc	=	$(Fy / Fax)^{1/2}$	=	0.17	<1.5	λc	=	$(Fy / Fay)^{1/2}$	=	0.47	<1.5
Fn =	λc < 1.5	$(0.658^{\lambda c2})Fy$	=	29650	psi	Fn =	λc < 1.5	$(0.658^{\lambda c2})Fy$	=	27319	psi
	λc > 1.5	$(0.877/\lambda c^2)Fy$					λc > 1.5	$(0.877/\lambda c^2)Fy$			
Pn	=	AREA * F_n	=	5752	lbs	Pn	=	AREA * F_n	=	5300	lbs
P_{EX}	=	$(\pi^2 E I_X) / (K_X L_X)^2$	=	207302	lbs	P_{EY}	=	$(\pi^2 E I_Y) / (K_Y L_Y)^2$	=	25890	lbs
α_x	=	$1 - (\Omega_c Px/Pex)$	=	0.99		α_y	=	$1 - (\Omega_c Px/Pey)$	=	0.94	

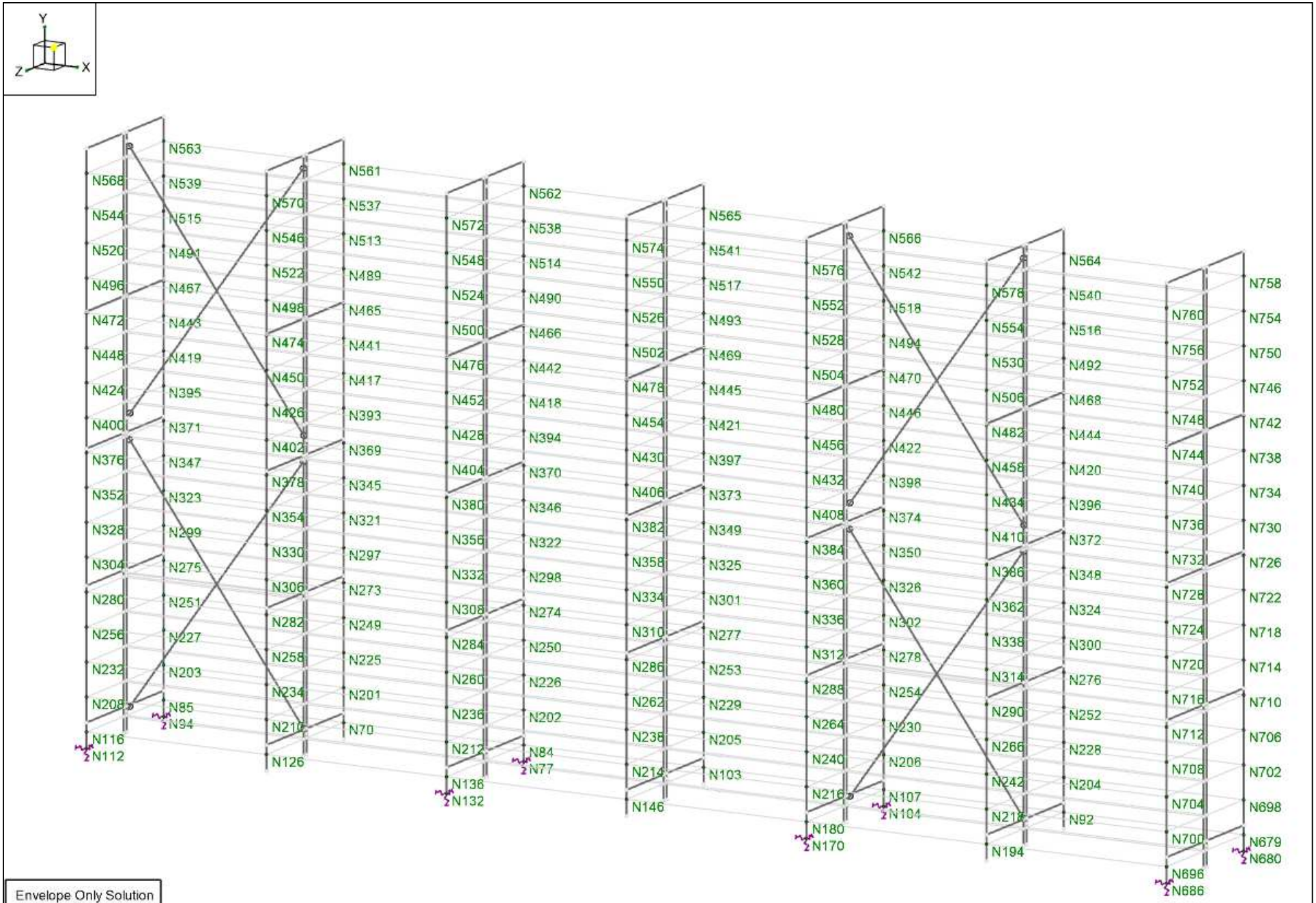
MAX MOMENT IN COLUMN

$Mx = M_{STATIC} + M_{SEISMIC}$ =	0.02	lbs-ft	$M_{nx} = Sx * Fy$ =	140.00	lbs-ft
$My = M_{STATIC} + M_{SEISMIC}$ =	46.68	lbs-ft	$M_{ny} = Sy * Fy$ =	120.00	lbs-ft

COMBINED STRESS (fa/Fa + fb/Fb)

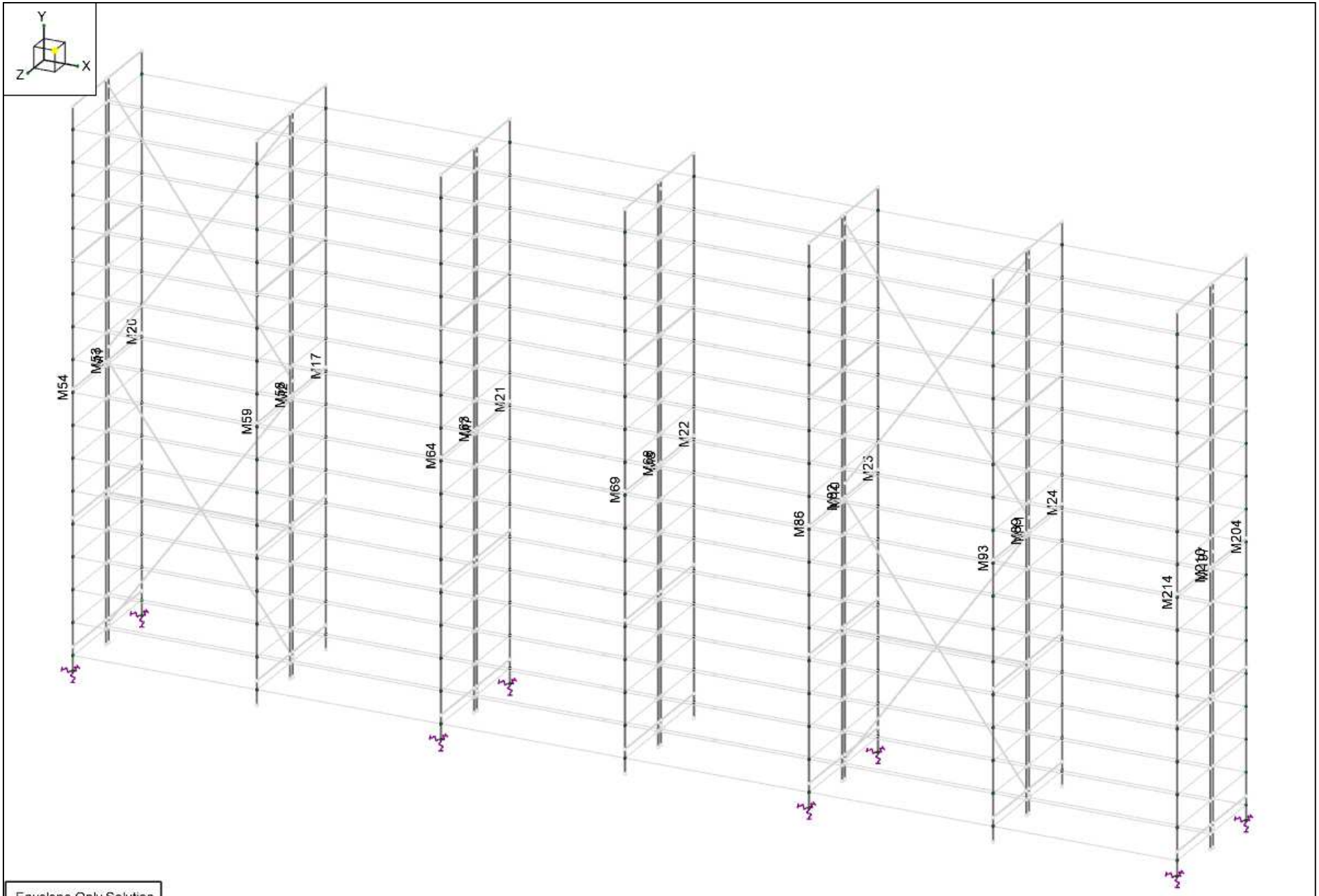
$(\Omega cP/P_n) + (\Omega_b C_{mx} M_x/M_n \alpha_x) + (\Omega_b C_{my} M_y/M_{ny} \alpha_y)$ = 0.99 < 1.0 **THEREFORE UPRITE IS OK**

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111



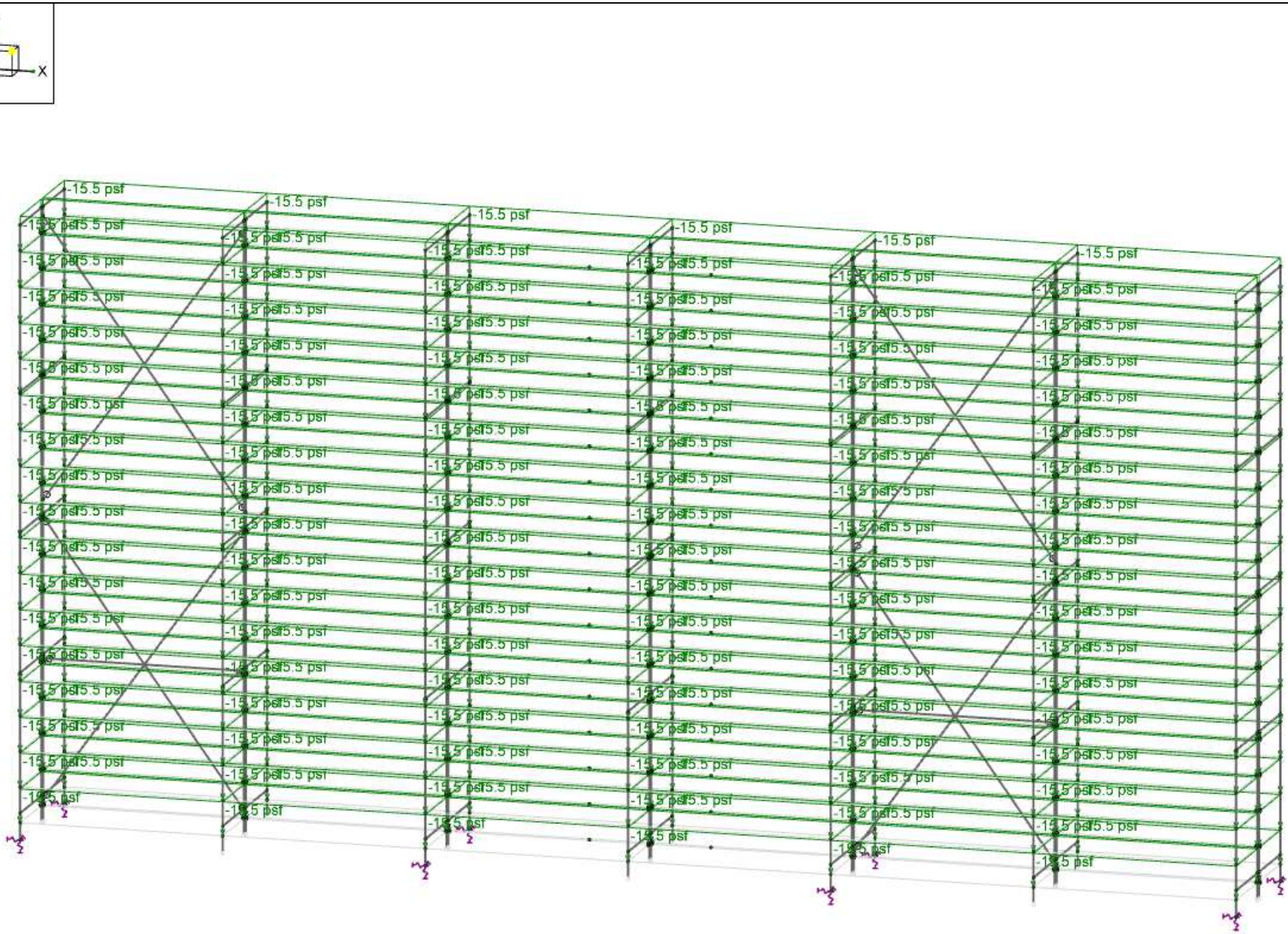
Envelope Only Solution

JPH & CLARK, Inc		Frame E1 (18"/18"Bx48"Lx144"H) - Sseries	SK-1
AA			Sep 01, 2026 at 05:37 PM
26-460 Advanced Auto Parts		Nodes Layout	E1 Storage Rack-18-18x48x144 - 17lvls - 5



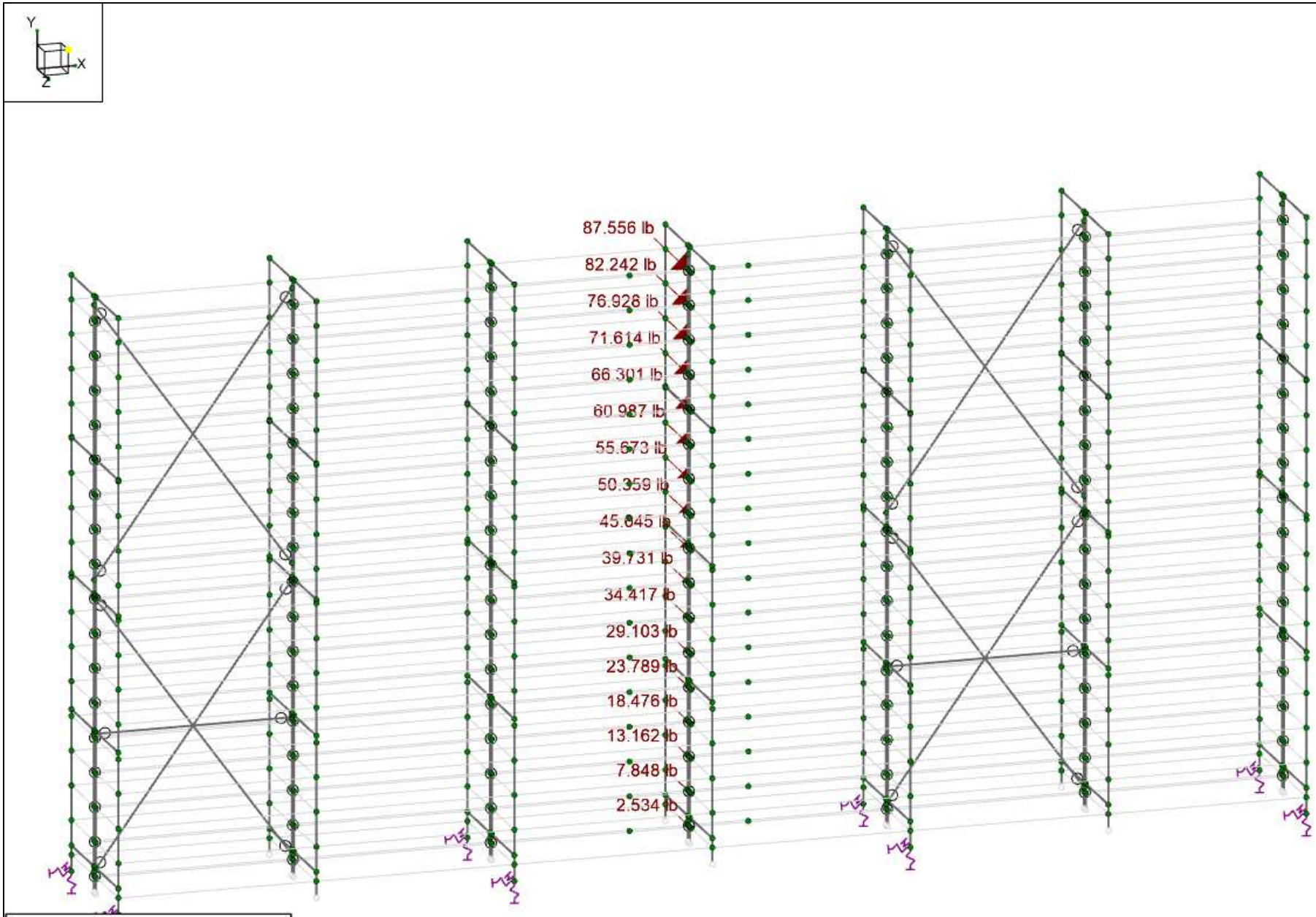
Envelope Only Solution

JPH & CLARK	JPH & CLARK, Inc	Frame E1 (18"/18"Bx48"Lx144"H) - Sseries	SK-2
	AA		Sep 01, 2026 at 05:39 PM
	26-460 Advanced Auto Parts	Column Labels	E1 Storage Rack-18-18x48x144 - 17lvls, 5...



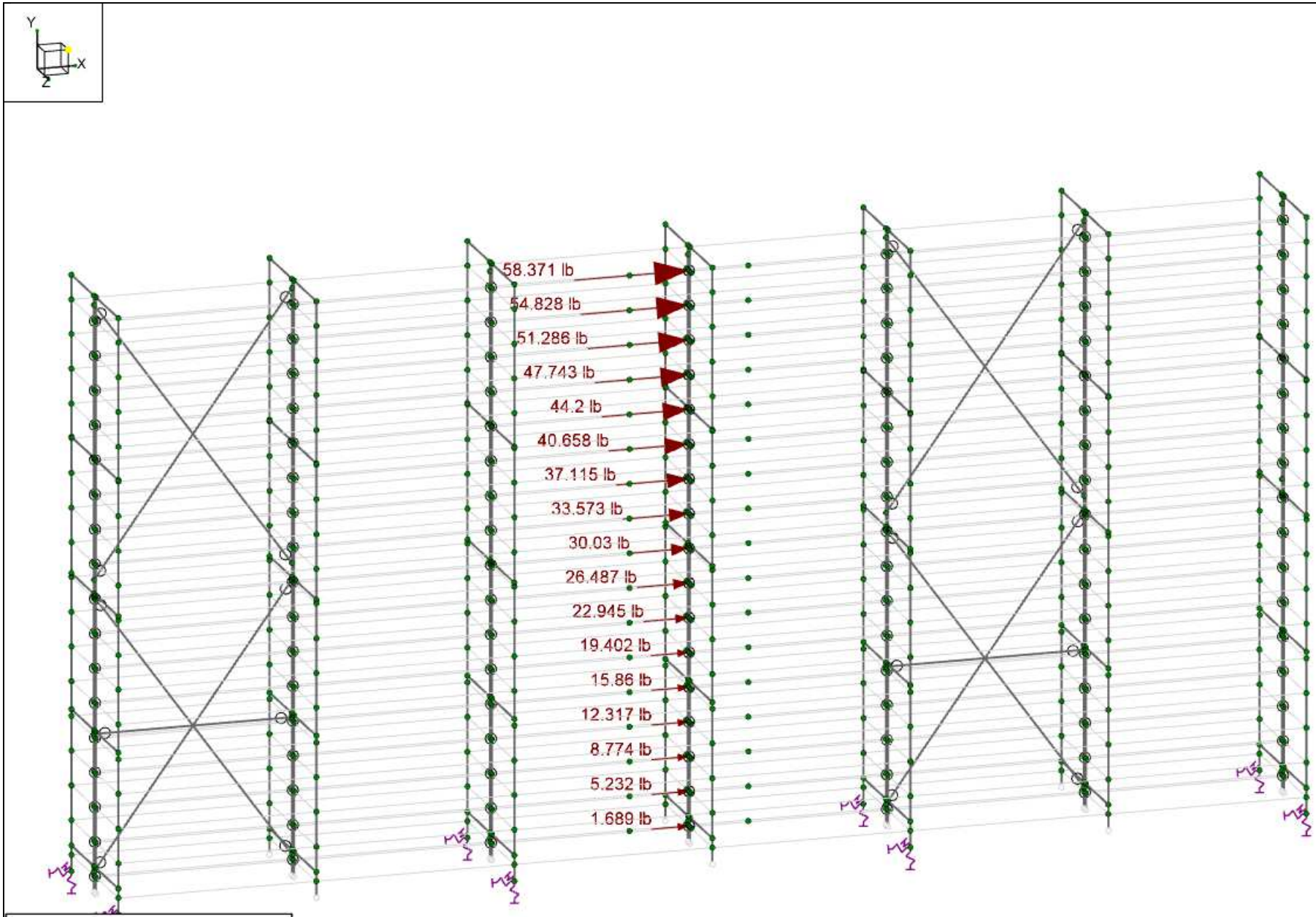
Loads: LC 3, LC-3
Envelope Only Solution

JPH & CLARK, Inc	Frame E1 (18"/18"Bx48"Lx144"H) - Sseries	SK-3
AA		Sep 01, 2026 at 05:41 PM
26-460 Advanced Auto Parts	DL + LL	E1 Storage Rack-18-18x48x144 - 17lvls - 5...



Loads: BLC 3, Earthquake Load Z
Envelope Only Solution

JPH & CLARK, Inc	Frame E1 (18"/18"Bx48"Lx144"H) - Sseries	SK-4
AA		Sep 01, 2026 at 05:42 PM
26-460 Advanced Auto Parts	ELZ	E1 Storage Rack-18-18x48x144 - 17lvls, 5...



Loads: BLC 4, Earthquake Load X
Envelope Only Solution

JPH & CLARK, Inc	Frame E1 (18"/18"Bx48"Lx144"H) - Sseries		SK-5
AA			Sep 01, 2026 at 05:42 PM
26-460 Advanced Auto Parts	ELX		E1 Storage Rack-18-18x48x144 - 17lvls, 5...

Cold Formed Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm. Coeff. [1e5°F⁻¹]	Density [k/ft³]	Yield [ksi]	Fu [ksi]
1	A570 Gr.33	29500	11346	0.3	0.65	0.49	33	52
2	A607 C1 Gr.55	29500	11346	0.3	0.65	0.49	55	70
3	A653 SS Gr33	29500	11346	0.3	0.65	0.49	33	45
4	A653 SS Gr50/1	29500	11346	0.3	0.65	0.49	50	65
5	Gr45	29500	11346	0.3	0.65	0.49	45	57
6	Gr30	29000	11346	0.3	0.65	0.49	30	38

Cold Formed Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rule	Area [in²]	Iyy [in⁴]	Izz [in⁴]	J [in⁴]
1	SS-UP	S-SERIES-UP_1.5X1.12X16GA	Column	CU	Gr30	Typical	0.194	0.05	0.027	0.000279
2	SS-BRC	S-SERIES-BRC_0.625X4.5X18GA	HBrace	CU	Gr30	Typical	0.269	0.005	0.628	0.000205

Basic Load Cases

	BLC Description	Category	Nodal	Surface(Plate/Wall)
1	DL	DL		204
2	PL	LL		204
3	Earthquake Load Z	ELZ	17	
4	Earthquake Load X	ELX	17	
5	Earthquake Load Z Plus X Eccentr	ELZ+X	17	
6	Earthquake Load Z Minus X Eccent	ELZ-X	17	
7	Earthquake Load X Plus Z Eccentr	ELX+Z	17	
8	Earthquake Load X Minus Z Eccent	ELX-Z	17	

Load Combinations

	Description	Solve	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
1	LC-1	Yes	DL	1								
2	LC-2	Yes	LL	1								
3	LC-3	Yes	DL	1	LL	1						
4	LC-4-AEL	Yes	DL	1	LL	0.67						
5	LC-5	Yes	DL	1	LL	0.67	ELX	0.525				
6	LC-6	Yes	DL	1	LL	0.67	ELZ	0.525				
7	LC-7		DL	1	Sds*DL	0.105	LL	0.735	LL	0.008	Rho*ELX	0.525
8	LC-8	Yes	DL	1	Sds*DL	0.14	LL	0.595	LL	0.01	Rho*ELX	0.7
9	LC-9	Yes	DL	0.6	Sds*DL	-0.14	LL	0.402	LL	-0.01	Rho*ELX	0.7
10	LC-10	Yes	DL	1	Sds*DL	0.105	LL	0.735	LL	0.008	Rho*ELZ	0.525
11	LC-11	Yes	DL	1	Sds*DL	0.14	LL	0.595	LL	0.01	Rho*ELZ	0.7
12	LC-12	Yes	DL	0.6	Sds*DL	-0.14	LL	0.402	LL	-0.01	Rho*ELZ	0.7
13												
14	AB-FLC5-1	Yes	DL	1.2	Sds*DL	0.2	LL	0.84	LL	0.015	Om*ELX	1
15	AB-FLC5-2	Yes	DL	1.2	Sds*DL	0.2	LL	0.84	LL	0.015	Om*ELZ	1
16	AB-FLC5-3	Yes	DL	1.2	Sds*DL	0.2	LL	0.84	LL	0.015	Om*ELX	-1
17	AB-FLC5-4	Yes	DL	1.2	Sds*DL	0.2	LL	0.84	LL	0.015	Om*ELZ	-1
18	AB-FLC7-5	Yes	DL	0.9	Sds*DL	-0.2	LL	0.603	LL	-0.014	Om*ELX	1
19	AB-FLC7-6	Yes	DL	0.9	Sds*DL	-0.2	LL	0.603	LL	-0.014	Om*ELZ	1
20	AB-FLC7-7		DL	0.9	Sds*DL	-0.2	LL	0.603	LL	-0.014	Om*ELX	-1
21	AB-FLC7-8	Yes	DL	0.9	Sds*DL	-0.2	LL	0.603	LL	-0.014	Om*ELZ	-1

Node Loads and Enforced Displacements (BLC 3 : Earthquake Load Z)

	Node Label	L, D, M	Direction	Magnitude [(lb, lb-ft), (in, rad), (lb*s²/in, lb*s²*in)]
1	N676A	L	Z	87.556
2	N677A	L	Z	82.242
3	N678A	L	Z	76.928
4	N679A	L	Z	71.614
5	N680A	L	Z	66.301
6	N681A	L	Z	60.987

Node Loads and Enforced Displacements (BLC 3 : Earthquake Load Z) (Continued)

	Node Label	L, D, M	Direction	Magnitude [(lb, lb-ft), (in, rad), (lb*s²/in, lb*s²*in)]
7	N682A	L	Z	55.673
8	N683A	L	Z	50.359
9	N684A	L	Z	45.045
10	N685A	L	Z	39.731
11	N686A	L	Z	34.417
12	N687A	L	Z	29.103
13	N688A	L	Z	23.789
14	N689A	L	Z	18.476
15	N690A	L	Z	13.162
16	N691A	L	Z	7.848
17	N692A	L	Z	2.534

Node Loads and Enforced Displacements (BLC 4 : Earthquake Load X)

	Node Label	L, D, M	Direction	Magnitude [(lb, lb-ft), (in, rad), (lb*s²/in, lb*s²*in)]
1	N676A	L	X	58.371
2	N677A	L	X	54.828
3	N678A	L	X	51.286
4	N679A	L	X	47.743
5	N680A	L	X	44.2
6	N681A	L	X	40.658
7	N682A	L	X	37.115
8	N683A	L	X	33.573
9	N684A	L	X	30.03
10	N685A	L	X	26.487
11	N686A	L	X	22.945
12	N687A	L	X	19.402
13	N688A	L	X	15.86
14	N689A	L	X	12.317
15	N690A	L	X	8.774
16	N691A	L	X	5.232
17	N692A	L	X	1.689

Node Loads and Enforced Displacements (BLC 5 : Earthquake Load Z Plus X Eccentr)

	Node Label	L, D, M	Direction	Magnitude [(lb, lb-ft), (in, rad), (lb*s²/in, lb*s²*in)]
1	N693A	L	Z	87.556
2	N694A	L	Z	82.242
3	N695A	L	Z	76.928
4	N696A	L	Z	71.614
5	N697A	L	Z	66.301
6	N698A	L	Z	60.987
7	N699A	L	Z	55.673
8	N700A	L	Z	50.359
9	N701A	L	Z	45.045
10	N702A	L	Z	39.731
11	N703A	L	Z	34.417
12	N704A	L	Z	29.103
13	N705A	L	Z	23.789
14	N706A	L	Z	18.476
15	N707A	L	Z	13.162
16	N708A	L	Z	7.848
17	N709A	L	Z	2.534

Node Loads and Enforced Displacements (BLC 6 : Earthquake Load Z Minus X Eccent)

	Node Label	L, D, M	Direction	Magnitude [(lb, lb-ft), (in, rad), (lb*s²/in, lb*s²*in)]
1	N710A	L	Z	87.556
2	N711A	L	Z	82.242
3	N712A	L	Z	76.928
4	N713A	L	Z	71.614

Node Loads and Enforced Displacements (BLC 6 : Earthquake Load Z Minus X Eccent) (Continued)

	Node Label	L, D, M	Direction	Magnitude [(lb, lb-ft), (in, rad), (lb*s²/in, lb*s²*in)]
5	N714A	L	Z	66.301
6	N715A	L	Z	60.987
7	N716A	L	Z	55.673
8	N717A	L	Z	50.359
9	N718A	L	Z	45.045
10	N719A	L	Z	39.731
11	N720A	L	Z	34.417
12	N721A	L	Z	29.103
13	N722A	L	Z	23.789
14	N723A	L	Z	18.476
15	N724A	L	Z	13.162
16	N725A	L	Z	7.848
17	N726A	L	Z	2.534

Node Loads and Enforced Displacements (BLC 7 : Earthquake Load X Plus Z Eccentr)

	Node Label	L, D, M	Direction	Magnitude [(lb, lb-ft), (in, rad), (lb*s²/in, lb*s²*in)]
1	N727A	L	X	58.371
2	N728A	L	X	54.828
3	N729A	L	X	51.286
4	N730A	L	X	47.743
5	N731A	L	X	44.2
6	N732A	L	X	40.658
7	N733A	L	X	37.115
8	N734A	L	X	33.573
9	N735A	L	X	30.03
10	N736A	L	X	26.487
11	N737A	L	X	22.945
12	N738A	L	X	19.402
13	N739A	L	X	15.86
14	N740A	L	X	12.317
15	N741A	L	X	8.774
16	N742A	L	X	5.232
17	N743A	L	X	1.689

Node Loads and Enforced Displacements (BLC 8 : Earthquake Load X Minus Z Eccent)

	Node Label	L, D, M	Direction	Magnitude [(lb, lb-ft), (in, rad), (lb*s²/in, lb*s²*in)]
1	N744A	L	X	58.371
2	N745A	L	X	54.828
3	N746A	L	X	51.286
4	N747A	L	X	47.743
5	N748A	L	X	44.2
6	N749A	L	X	40.658
7	N750A	L	X	37.115
8	N751A	L	X	33.573
9	N752A	L	X	30.03
10	N753A	L	X	26.487
11	N754A	L	X	22.945
12	N755A	L	X	19.402
13	N756A	L	X	15.86
14	N757A	L	X	12.317
15	N758A	L	X	8.774
16	N759A	L	X	5.232
17	N760A	L	X	1.689

Envelope Node Reactions

	Node Label		X [lb]	LC	Y [lb]	LC	Z [lb]	LC	MX [lb-ft]	LC	MY [lb-ft]	LC	MZ [lb-ft]	LC
1	N1	max	0	12	588.171	3	0	12	0	12	0	12	0	12
2		min	0	1	0	9	0	1	0	1	0	1	0	1
3	N10	max	0	12	834.712	8	0	12	0	12	0	12	0	12
4		min	0	1	148.756	1	0	1	0	1	0	1	0	1
5	N19	max	0	12	1172.294	3	0	12	0	12	0	12	0	12
6		min	0	1	226.896	1	0	1	0	1	0	1	0	1
7	N27	max	0	12	821.461	10	0	12	0	12	0	12	0	12
8		min	0	1	148.613	1	0	1	0	1	0	1	0	1
9	N47	max	0	12	1167.271	3	0	12	0	12	0	12	0	12
10		min	0	1	107.857	9	0	1	0	1	0	1	0	1
11	N59	max	0	12	852.176	8	0	12	0	12	0	12	0	12
12		min	0	1	150.571	1	0	1	0	1	0	1	0	1
13	N77	max	0.177	11	408.706	3	-4.681	1	0	12	0	12	0	12
14		min	-46.515	9	30.346	12	-83.9	11	0	1	0	1	0	1
15	N78	max	0	12	813.176	3	0	12	0	12	0	12	0	12
16		min	0	1	67.538	12	0	1	0	1	0	1	0	1
17	N94	max	0.177	11	207.966	3	-2.382	1	0	12	0	12	0	12
18		min	-46.514	9	-56.248	12	-75.205	11	0	1	0	1	0	1
19	N96	max	0	12	806.789	3	0	12	0	12	0	12	0	12
20		min	0	1	66.9	12	0	1	0	1	0	1	0	1
21	N104	max	0.177	11	408.142	3	-4.677	1	0	12	0	12	0	12
22		min	-46.514	9	29.258	12	-84.294	11	0	1	0	1	0	1
23	N108	max	0	12	808.638	3	0	12	0	12	0	12	0	12
24		min	0	1	63.009	12	0	1	0	1	0	1	0	1
25	N111	max	0	12	583.237	3	0	12	0	12	0	12	0	12
26		min	0	1	103.74	12	0	1	0	1	0	1	0	1
27	N112	max	0.256	11	287.326	11	12.298	3	0	12	0	12	0	12
28		min	-46.447	9	40.115	1	-61.522	12	0	1	0	1	0	1
29	N121	max	0	12	773.413	3	0	12	0	12	0	12	0	12
30		min	0	1	52.538	12	0	1	0	1	0	1	0	1
31	N122	max	0	12	851.652	10	0	12	0	12	0	12	0	12
32		min	0	1	156.307	1	0	1	0	1	0	1	0	1
33	N131	max	0	12	1172.336	3	0	12	0	12	0	12	0	12
34		min	0	1	226.904	1	0	1	0	1	0	1	0	1
35	N132	max	0.256	11	433.69	10	24.188	3	0	12	0	12	0	12
36		min	-46.448	9	79.096	1	-56.978	12	0	1	0	1	0	1
37	N141	max	0	12	767.795	3	0	12	0	12	0	12	0	12
38		min	0	1	48.197	12	0	1	0	1	0	1	0	1
39	N142	max	0	12	857.63	10	0	12	0	12	0	12	0	12
40		min	0	1	157.396	1	0	1	0	1	0	1	0	1
41	N169	max	0	12	1172.284	3	0	12	0	12	0	12	0	12
42		min	0	1	226.894	1	0	1	0	1	0	1	0	1
43	N170	max	0.256	11	434.542	10	24.182	3	0	12	0	12	0	12
44		min	-46.447	9	79.106	1	-57.368	12	0	1	0	1	0	1
45	N183	max	0	12	773.208	3	0	12	0	12	0	12	0	12
46		min	0	1	48.359	12	0	1	0	1	0	1	0	1
47	N184	max	0	12	854.964	10	0	12	0	12	0	12	0	12
48		min	0	1	156.347	1	0	1	0	1	0	1	0	1
49	N666	max	0	12	583.283	3	0	12	0	12	0	12	0	12
50		min	0	1	112.893	1	0	1	0	1	0	1	0	1
51	N680	max	0.177	11	207.217	3	-2.38	1	0	12	0	12	0	12
52		min	-46.515	9	-59.741	12	-76.384	11	0	1	0	1	0	1
53	N685	max	0	12	583.079	3	0	12	0	12	0	12	0	12
54		min	0	1	100.482	12	0	1	0	1	0	1	0	1
55	N686	max	0.256	11	290.702	11	12.281	3	0	12	0	12	0	12
56		min	-46.448	9	40.146	1	-62.691	12	0	1	0	1	0	1
57	N366	max	NC		NC		NC		NC		NC		LOCKED	
58		min	NC		NC		NC		NC		NC		LOCKED	
59	N12	max	NC		NC		NC		NC		NC		NC	
60		min	NC		NC		NC		NC		NC		NC	
61	Totals:	max	1.732	11	18972.014	3	0.682	8						

Envelope Node Reactions (Continued)

	Node Label		X [lb]	LC	Y [lb]	LC	Z [lb]	LC	MX [lb-ft]	LC	MY [lb-ft]	LC	MZ [lb-ft]	LC
62		min	-371.848	9	3672.003	1	-539.326	12						

Envelope Maximum Member Section Forces

	Member		Axial[lb]	Loc[in]	LC	y Shear[lb]	Loc[in]	LC	z Shear[lb]	Loc[in]	LC	Torque[lb-ft]	Loc[in]	LC	y-y Moment[lb-ft]	Loc[in]	LC	z-z Moment[lb-ft]	Loc[in]	LC
1	M1	max	588.171	3	3	22.988	78	8	95.886	4.5	11	0.001	6	9	29.558	39	11	8.858	6	8
2		min	-10.415	4.5	9	-186.331	4.5	8	-12.452	13.5	3	-0.002	72	8	-31.843	7.5	11	-7.401	70.5	8
3	M2	max	834.712	3	8	57.164	141	8	53.54	12	11	0.013	144	8	29.949	39	11	10.733	139.5	8
4		min	-3.255	142.5	9	-11.044	72	8	-14.985	73.5	9	0	73.5	8	-34.288	7.5	11	-7.419	72	8
5	M3	max	0	81.91	12	0	81.91	12	0	81.91	12	0	0	12	0	81.91	12	0	81.91	12
6		min	-337.846	0	8	0	0	1	0	0	1	0	0	9	0	0	1	0	0	1
7	M4	max	0	81.91	9	0	81.91	12	0	81.91	12	0	81.91	12	0	81.91	12	0	81.91	12
8		min	-1.611	0	11	0	0	1	0	0	1	0	81.91	1	0	0	1	0	0	1
9	M5	max	0	81.92	12	0	81.92	12	0	81.92	12	0	81.92	8	0	81.92	12	0	81.92	12
10		min	-97.59	0	8	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1
11	M6	max	0	81.92	9	0	81.92	12	0	81.92	12	0	0	9	0	81.92	12	0	81.92	12
12		min	-6.956	0	3	0	0	1	0	0	1	0	0	11	0	0	1	0	0	1
13	M7	max	1172.294	3	3	5.657	138	8	155.926	6	10	0.006	4.5	9	38.786	39	11	5.889	12	9
14		min	2.184	142.5	1	-8.845	6	9	-24.467	13.5	3	-0.002	7.5	8	-46.581	7.5	10	-6.062	70.5	9
15	M8	max	821.461	3	10	5.657	138	8	54.072	12	11	0	141	9	30.236	39	11	5.89	12	9
16		min	0.098	142.5	1	-8.842	6	9	-0.793	7.5	9	0	21	8	-34.583	7.5	11	-6.062	70.5	9
17	M9	max	0	48	12	0	48	12	0	48	12	0	48	12	0	48	12	0	48	12
18		min	0	0	1	0	0	1	0	0	1	0	0	11	0	0	1	0	0	1
19	M10	max	1167.271	3	3	35.089	78	9	156.114	4.5	10	0.001	75	9	38.953	39	11	9.537	6	9
20		min	2.19	139.5	1	-202.799	4.5	9	-24.445	13.5	3	-0.003	72	9	-46.681	7.5	10	-8.102	72	9
21	M11	max	852.176	3	8	80.404	141	9	54.469	4.5	11	0.019	144	9	30.377	39	11	15.097	139.5	9
22		min	-3.766	142.5	9	-15.706	130.5	9	-14.645	73.5	9	0	73.5	8	-34.837	7.5	11	-7.625	72	9
23	M12	max	0	48	12	0	48	12	0	48	12	0	0	11	0	48	12	0	48	12
24		min	0	0	1	0	0	1	0	0	1	0	0	12	0	0	1	0	0	1
25	M13	max	0	81.91	12	0	81.91	12	0	81.91	12	0	81.91	12	0	81.91	12	0	81.91	12
26		min	0	0	1	0	0	1	0	0	1	0	0	6	0	0	1	0	0	1
27	M14	max	0	81.92	12	0	81.92	12	0	81.92	12	0	0	12	0	81.92	12	0	81.92	12
28		min	0	0	1	0	0	1	0	0	1	0	81.92	1	0	0	1	0	0	1
29	M15	max	-0.132	81.92	12	0	81.92	12	0	81.92	12	0	81.92	11	0	81.92	12	0	81.92	12
30		min	-137.265	0	9	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1
31	M16	max	0	81.91	12	0	81.91	12	0	81.91	12	0	0	12	0	81.91	12	0	81.91	12
32		min	-369.131	0	9	0	0	1	0	0	1	0	0	8	0	0	1	0	0	1
33	M17	max	806.789	3	3	8.839	12	9	14.985	78	9	0.013	144	8	34.288	7.5	11	6.079	70.5	9
34		min	-8.716	139.5	11	-5.62	130.5	9	-53.54	4.5	11	0	73.5	8	-29.949	39	11	-5.896	12	9
35	M18	max	0	18	8	17.073	18	9	0	18	12	0	18	4	0.003	0	9	50.652	18	11
36		min	0	0	1	-67.536	0	11	-0.005	0	9	-0.001	0	9	-0.003	18	9	-50.652	0	11
37	M19	max	0	18	12	0.586	18	9	0	18	12	0	18	8	0	0	9	50.372	18	11
38		min	0	0	1	-67.163	0	11	0	0	1	0	0	9	0	18	9	-50.372	0	11
39	M20	max	243.648	12	3	46.514	3	9	29.743	6	12	0.001	6	9	30.291	7.5	11	6.079	70.5	9
40		min	-66.326	4.5	12	-17.995	4.5	9	-75.205	0	11	-0.002	72	8	-29.565	39	11	-14.733	4.5	9
41	M21	max	479.179	12	3	46.515	3	9	23.958	19.5	3	0.006	6	9	45.142	7.5	10	6.079	70.5	9
42		min	-12.487	139.5	10	-18	4.5	9	-136.846	7.5	3	-0.002	7.5	8	-38.794	39	11	-14.734	4.5	9
43	M22	max	813.176	3	3	8.839	12	9	0.793	6	9	0	144	9	34.583	7.5	11	6.079	70.5	9
44		min	-8.847	139.5	11	-5.652	130.5	8	-54.072	4.5	11	0	21	8	-30.236	39	11	-5.896	12	9
45	M23	max	478.519	12	3	46.514	3	9	23.936	19.5	3	0	78	9	45.235	7.5	10	6.079	70.5	9
46		min	-12.534	139.5	10	-17.994	7.5	9	-136.733	7.5	3	-0.003	72	9	-38.961	39	11	-14.733	4.5	9
47	M24	max	808.638	3	3	8.839	12	9	14.645	78	9	0.019	144	9	34.837	7.5	11	6.078	70.5	9
48		min	-8.807	139.5	11	-5.61	130.5	8	-54.469	7.5	11	0	73.5	8	-30.377	39	11	-5.896	12	9
49	M25	max	0	18	12	44.769	18	11	0	18	12	0	18	8	0	18	8	33.577	0	11
50		min	0	0	1	6.297	0	1	0	0	1	0	0	9	0	0	8	-33.577	18	11
51	M26	max	0.035	18	11	112.574	18	11	0	18	12	0	18	8	0	0	9	84.428	0	11
52		min	0.002	0	1	17.462	0	1	0	0	1	0	0	9	0	18	9	-84.433	18	11
53	M27	max	0	18	12	11.15	18	9	0	18	12	0	18	8	0	0	9	61.819	18	11
54		min	0	0	1	-82.426	0	11	0	0	1	0	0	9	0	18	9	-61.819	0	11
55	M28	max	0	18	12	12.487	18	10	0	18	12	0	18	8	0	0	9	9.365	0	10
56		min	0	0	1	2.184	0	1	0	0	9	0	0	9	0	18	9	-9.365	18	10
57	M29	max	0	18	9	8.434	18	11	0.001	18	3	0.001	18	3	0.001	18	3	6.326	0	11

Envelope Maximum Member Section Forces (Continued)

	Member		Axial[lb]	Loc[in]	LC	y Shear[lb]	Loc[in]	LC	z Shear[lb]	Loc[in]	LC	Torque[lb-ft]	Loc[in]	LC	y-y Moment[lb-ft]	Loc[in]	LC	z-z Moment[lb-ft]	Loc[in]	LC
58		min	0	0	11	1.115	0	1	0	0	9	0	0	9	-0.001	0	3	-6.326	18	11
59	M30	max	0	18	12	3.255	18	9	0	18	12	0	18	4	0.013	0	8	6.537	18	11
60		min	0	0	1	-8.716	0	11	-0.018	0	8	-0.01	0	8	-0.013	18	8	-6.537	0	11
61	M31	max	0	18	12	-0.098	18	1	0	18	12	0	18	8	0	0	9	6.635	18	11
62		min	0	0	1	-8.847	0	11	0	0	9	0	0	9	0	18	9	-6.635	0	11
63	M32	max	0.032	18	11	81.11	18	11	0	18	12	0	18	8	0	0	9	60.83	0	11
64		min	0.001	0	1	8.927	0	1	0	0	1	0	0	9	0	18	9	-60.835	18	11
65	M33	max	0	18	12	65.354	18	11	0.003	18	8	0.001	18	8	0.002	18	8	49.015	0	11
66		min	0	0	1	7.167	0	1	0	0	1	0	0	11	-0.002	0	8	-49.015	18	11
67	M34	max	0	18	9	16.898	18	9	0	18	1	0	18	1	0.003	0	8	50.083	18	11
68		min	0	0	11	-66.777	0	11	-0.004	0	8	0	0	9	-0.003	18	8	-50.083	0	11
69	M35	max	0	18	12	90.65	18	11	0	18	12	0	18	8	0	18	8	67.987	0	11
70		min	0	0	1	13.987	0	1	0	0	1	0	0	9	0	0	8	-67.987	18	11
71	M36	max	0	18	12	-0.31	18	1	0	18	12	0	18	8	0	18	12	62.444	18	11
72		min	0	0	1	-83.259	0	11	0	0	1	0	0	9	0	0	1	-62.444	0	11
73	M37	max	0	18	12	-0.43	18	1	0	18	3	0	18	3	0	18	3	50.618	18	11
74		min	0	0	1	-67.491	0	11	0	0	1	0	0	9	0	0	3	-50.618	0	11
75	M38	max	51.806	18	11	74.108	18	11	0	18	11	0	18	10	0.001	0	9	54.454	0	11
76		min	1.641	0	1	11.288	0	1	-0.001	0	9	-0.002	0	9	-0.001	18	9	-56.707	18	11
77	M39	max	0	18	9	5.434	18	9	0	18	12	0	18	8	0	0	11	49.922	18	11
78		min	0	0	12	-66.562	0	11	0	0	1	0	0	9	0	18	10	-49.922	0	11
79	M40	max	57.795	18	11	117.547	18	10	0	18	11	0	18	10	0.008	0	9	87.116	0	10
80		min	3.224	0	1	22.175	0	1	-0.01	0	9	-0.002	0	9	-0.008	18	9	-89.205	18	10
81	M41	max	0	18	12	16.379	18	9	0	18	12	0	18	4	0	0	9	34.608	18	11
82		min	0	0	1	-46.144	0	11	0	0	1	0	0	9	0	18	9	-34.608	0	11
83	M42	max	0	18	12	68.078	18	10	0	18	12	0	18	4	0	0	9	51.059	0	10
84		min	0	0	1	12.287	0	1	0	0	1	0	0	9	0	18	9	-51.059	18	10
85	M43	max	0	18	12	-0.498	18	1	0	18	12	0	18	4	0	0	9	35.043	18	11
86		min	0	0	1	-46.723	0	11	0	0	1	0	0	9	0	18	9	-35.043	0	11
87	M44	max	0	18	12	91.005	18	11	0.005	18	9	0.002	18	9	0.003	18	9	68.254	0	11
88		min	0	0	1	14.028	0	1	0	0	1	0	0	12	-0.003	0	9	-68.254	18	11
89	M45	max	0	18	12	12.534	18	10	0	18	12	0	18	8	0	0	9	9.401	0	10
90		min	0	0	1	2.19	0	1	0	0	9	0	0	9	0	18	9	-9.401	18	10
91	M46	max	0.036	18	11	112.999	18	11	0	18	12	0	18	8	0	18	12	84.747	0	11
92		min	0.002	0	1	17.475	0	1	0	0	1	0	0	9	0	0	1	-84.752	18	11
93	M47	max	58.067	18	11	117.731	18	10	0.001	18	9	0	18	10	0	18	9	87.249	0	10
94		min	3.222	0	1	22.156	0	1	0	0	8	-0.001	0	8	0	0	9	-89.347	18	10
95	M48	max	0	18	12	68.258	18	10	0	18	12	0	18	8	0	18	8	51.194	0	10
96		min	0	0	1	12.325	0	1	0	0	1	0	0	9	0	0	8	-51.194	18	10
97	M49	max	0	18	12	0.936	18	8	0	18	12	0	18	8	0	0	9	50.742	18	11
98		min	0	0	1	-67.656	0	11	0	0	1	0	0	9	0	18	9	-50.742	0	11
99	M50	max	0	18	4	3.766	18	9	0	18	12	0	18	12	0.019	0	9	6.605	18	11
100		min	0	0	11	-8.807	0	11	-0.025	0	9	-0.015	0	9	-0.019	18	9	-6.605	0	11
101	M51	max	0	18	12	8.942	18	9	0	18	12	0	18	8	0	0	9	62.7	18	11
102		min	0	0	1	-83.6	0	11	0	0	1	0	0	9	0	18	9	-62.7	0	11
103	M52	max	0	18	12	17.466	18	9	0	18	12	0	18	4	0	0	9	34.857	18	11
104		min	0	0	1	-46.477	0	11	0	0	9	0	0	9	0	18	9	-34.857	0	11
105	M53	max	583.237	3	3	6.987	78	8	79.035	6	3	0.001	12	9	22.402	12	11	7.399	70.5	8
106		min	-1.978	139.5	12	-6.371	63	8	-31.738	13.5	11	-0.003	4.5	9	-21.308	7.5	3	-5.816	4.5	8
107	M54	max	287.326	3	11	17.999	6	8	61.522	3	12	0.001	12	9	21.054	7.5	3	14.711	4.5	9
108		min	-5.84	139.5	3	-46.447	0	9	-97.815	4.5	11	-0.003	4.5	9	-22.949	12	11	-6.059	70.5	9
109	M55	max	0.005	18	3	29.741	18	12	0	18	12	0	18	8	0	18	12	34.657	18	3
110		min	-0.026	0	12	-46.21	0	3	0	0	1	0	0	9	0	0	1	-34.658	0	3
111	M56	max	0	18	12	24.051	18	12	0	18	12	0	18	4	0.001	0	8	27.942	18	3
112		min	0	0	1	-37.255	0	3	-0.001	0	8	-0.001	0	8	-0.001	18	8	-27.942	0	3
113	M57	max	0	18	12	1.978	18	12	0	18	8	0	18	8	0	0	3	4.38	18	3
114		min	0	0	1	-5.84	0	3	-0.001	0	3	0	0	3	0	18	3	-4.38	0	3
115	M58	max	773.413	3	3	9.511	138	8	5.248	6	9	0	78	9	34.174	7.5	12	6.634	72	8
116		min	-8.267	139.5	12	-4.421	121.5	8	-53.152	4.5	12	-0.006	139.5	8	-29.535	39	12	-8.694	138	8
117	M59	max	851.652	3	10	5.648	138	9	53.152	12	12	0	78	9	29.535	39	12	5.87	12	9
118		min	-0.371	139.5	3	-8.8	4.5	9	-5.248	7.5	9	-0.006	139.5	8	-34.174	7.5	12	-6.059	70.5	9

Envelope Maximum Member Section Forces (Continued)

	Member		Axial[lb]	Loc[in]	LC	y Shear[lb]	Loc[in]	LC	z Shear[lb]	Loc[in]	LC	Torque[lb-ft]	Loc[in]	LC	y-y Moment[lb-ft]	Loc[in]	LC	z-z Moment[lb-ft]	Loc[in]	LC
119	M60	max	0	18	12	2.682	18	9	0	18	12	0	18	8	0	18	12	60.755	18	12
120		min	0	0	1	-81.006	0	12	0	0	1	0	0	9	0	0	1	-60.755	0	12
121	M61	max	0	18	12	1.709	18	3	0.001	18	8	0	18	8	0.001	18	8	48.565	18	12
122		min	0	0	1	-64.753	0	12	0	0	1	0	0	12	-0.001	0	8	-48.565	0	12
123	M62	max	0	18	12	0.371	18	3	0.008	18	8	0.004	18	8	0.006	18	8	6.2	18	12
124		min	0	0	1	-8.267	0	12	0	0	1	0	0	11	-0.006	0	8	-6.2	0	12
125	M63	max	1172.336	3	3	8.821	6	8	155.47	6	3	0.002	12	9	26.342	39	3	6.076	70.5	9
126		min	0.148	139.5	12	-5.682	130.5	9	-40.037	13.5	11	-0.006	4.5	8	-41.915	7.5	3	-5.88	12	8
127	M64	max	479.158	12	3	18.001	6	8	56.978	3	12	0.002	12	9	41.416	7.5	3	14.711	4.5	9
128		min	-11.268	139.5	3	-46.448	0	9	-138.032	4.5	11	-0.006	4.5	8	-28.129	6	3	-6.059	70.5	9
129	M65	max	0.01	18	3	12.098	18	12	0	18	12	0	18	8	0	18	8	67.677	18	3
130		min	-0.024	0	12	-90.237	0	3	0	0	1	0	0	9	0	0	8	-67.679	0	3
131	M66	max	0	18	12	10.165	18	12	0	18	12	0	18	8	0	18	8	54.21	18	3
132		min	0	0	1	-72.28	0	3	0	0	1	0	0	9	0	0	8	-54.21	0	3
133	M67	max	0	18	12	-0.148	18	12	0	18	12	0	18	8	0	0	9	8.451	18	3
134		min	0	0	1	-11.268	0	3	0	0	9	0	0	9	0	18	9	-8.451	0	3
135	M68	max	767.795	3	3	8.818	12	8	1.948	78	3	0	144	9	34.432	7.5	12	6.076	70.5	9
136		min	-8.291	139.5	12	-5.682	130.5	9	-53.57	7.5	12	0	21	8	-29.715	39	12	-5.881	12	8
137	M69	max	857.63	3	10	5.662	138	8	53.57	6	12	0	144	9	29.715	39	12	5.87	12	9
138		min	-0.49	139.5	3	-8.8	4.5	9	-1.948	72	3	0	21	8	-34.432	7.5	12	-6.059	70.5	9
139	M70	max	0	18	12	1.604	18	3	0	18	12	0	18	8	0	18	12	61.107	18	12
140		min	0	0	1	-81.476	0	12	0	0	1	0	0	9	0	0	1	-61.107	0	12
141	M71	max	0	18	12	2.225	18	3	0	18	12	0	18	8	0	0	3	48.761	18	12
142		min	0	0	1	-65.015	0	12	0	0	3	0	0	9	0	18	3	-48.761	0	12
143	M72	max	0	18	12	0.49	18	3	0	18	12	0	18	8	0	0	9	6.218	18	12
144		min	0	0	1	-8.291	0	12	0	0	9	0	0	9	0	18	9	-6.218	0	12
145	M73	max	8.472	18	3	9.198	18	12	0.006	18	9	0.001	18	9	0.005	18	9	43.506	18	3
146		min	-42.38	0	12	-58.253	0	3	0	0	11	0	0	11	-0.005	0	9	-43.874	0	3
147	M74	max	0	18	12	3.96	18	9	0	18	12	0	18	8	0	18	11	49.695	18	12
148		min	0	0	1	-66.26	0	12	0	0	1	0	0	9	0	0	11	-49.695	0	12
149	M75	max	16.662	18	3	-13.889	18	12	0.01	18	9	0.002	18	8	0.008	18	9	85.579	18	3
150		min	-39.25	0	12	-114.589	0	3	0	0	11	0	0	11	-0.008	0	9	-86.304	0	3
151	M76	max	0	18	12	0.9	18	9	0	18	12	0	18	8	0	0	9	50.074	18	12
152		min	0	0	1	-66.766	0	12	0	0	1	0	0	9	0	18	9	-50.074	0	12
153	M77	max	0	18	12	8.4	18	12	0	18	12	0	18	4	0	0	9	24.629	18	3
154		min	0	0	1	-32.839	0	3	0	0	1	0	0	9	0	18	9	-24.629	0	3
155	M78	max	0	18	12	1.928	18	3	0	18	12	0	18	8	0	18	8	32.879	18	12
156		min	0	0	1	-43.839	0	12	0	0	1	0	0	9	0	0	8	-32.879	0	12
157	M79	max	0	18	12	-3.755	18	12	0	18	12	0	18	4	0	0	9	47.585	18	3
158		min	0	0	1	-63.446	0	3	0	0	1	0	0	9	0	18	9	-47.585	0	3
159	M80	max	0	18	12	2.531	18	3	0	18	12	0	18	4	0	0	9	32.908	18	12
160		min	0	0	1	-43.878	0	12	0	0	1	0	0	9	0	18	9	-32.908	0	12
161	M81	max	0	18	12	-0.104	18	12	0	18	12	0	18	8	0	0	9	8.451	18	3
162		min	0	0	1	-11.268	0	3	0	0	9	0	0	9	0	18	9	-8.451	0	3
163	M82	max	1172.284	3	3	7.379	87	9	155.443	6	3	0.001	72	9	26.337	39	3	7.998	70.5	9
164		min	0.104	139.5	12	-7.447	63	9	-40.193	13.5	11	-0.003	4.5	8	-41.908	7.5	3	-6.329	4.5	9
165	M83	max	0.01	18	3	12.492	18	12	0	18	12	0	18	8	0	18	12	67.665	18	3
166		min	-0.024	0	12	-90.221	0	3	0	0	1	0	0	9	0	0	1	-67.667	0	3
167	M84	max	0	18	12	10.46	18	12	0	18	12	0	18	1	0.001	0	9	54.2	18	3
168		min	0	0	1	-72.266	0	3	-0.002	0	9	-0.001	0	9	-0.001	18	9	-54.2	0	3
169	M85	max	0	18	12	-3.627	18	12	0	18	12	0	18	4	0	0	9	47.58	18	3
170		min	0	0	1	-63.439	0	3	0	0	1	0	0	9	0	18	9	-47.58	0	3
171	M86	max	479.19	12	3	17.999	6	8	57.368	3	12	0.001	72	9	41.409	7.5	3	14.711	4.5	9
172		min	-11.268	139.5	3	-46.447	0	9	-138.284	4.5	11	-0.003	4.5	8	-28.124	6	3	-6.059	70.5	9
173	M87	max	16.658	18	3	-13.596	18	12	0.006	18	8	0.001	18	8	0.004	18	8	85.565	18	3
174		min	-39.519	0	12	-114.569	0	3	0	0	11	0	0	11	-0.004	0	8	-86.289	0	3
175	M88	max	0	18	12	0.368	18	3	0.011	18	9	0.006	18	9	0.008	18	9	6.308	18	12
176		min	0	0	1	-8.411	0	12	0	0	12	0	0	12	-0.008	0	9	-6.308	0	12
177	M89	max	773.208	3	3	15.652	138	9	1.457	78	3	0	78	9	34.717	7.5	12	6.752	72	9
178		min	-8.411	139.5	12	-5.739	121.5	9	-54.078	7.5	12	-0.008	139.5	9	-29.988	39	12	-12.205	138	9
179	M90	max	0	18	12	1.188	18	3	0	18	12	0	18	8	0	18	12	61.696	18	12

Envelope Maximum Member Section Forces (Continued)

	Member		Axial[lb]	Loc[in]	LC	y Shear[lb]	Loc[in]	LC	z Shear[lb]	Loc[in]	LC	Torque[lb-ft]	Loc[in]	LC	y-y Moment[lb-ft]	Loc[in]	LC	z-z Moment[lb-ft]	Loc[in]	LC
180		min	0	0	1	-82.261	0	12	0	0	1	0	0	9	0	0	1	-61.696	0	12
181	M91	max	0	18	12	1.664	18	3	0.001	18	9	0	18	8	0.001	18	9	49.284	18	12
182		min	0	0	1	-65.713	0	12	0	0	1	0	0	11	-0.001	0	9	-49.284	0	12
183	M92	max	0	18	12	1.899	18	3	0	18	12	0	18	8	0	18	8	33.311	18	12
184		min	0	0	1	-44.415	0	12	0	0	1	0	0	9	0	0	8	-33.311	0	12
185	M93	max	854.964	3	10	5.643	138	8	54.078	6	12	0	78	9	29.988	39	12	5.87	12	9
186		min	-0.368	139.5	3	-8.8	4.5	9	-1.457	73.5	3	-0.008	139.5	9	-34.717	7.5	12	-6.059	70.5	9
187	M94	max	0	18	12	0.241	18	3	0	18	12	0	18	8	0	0	9	50.508	18	12
188		min	0	0	1	-67.344	0	12	0	0	1	0	0	9	0	18	9	-50.508	0	12
189	M95	max	30.546	1.5	11	0	1.5	10	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	11
190		min	-0.992	0	9	0	0	11	0	0	1	-0.008	0	9	0	0	1	0	0	1
191	M96	max	56.692	1.5	3	0	1.5	12	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
192		min	10.973	0	1	0	0	1	0	0	1	-6.376	0	9	0	0	1	0	1.5	9
193	M97	max	-0.233	1.5	12	0	0.734	10	124.39	1.5	3	0.001	1.5	8	20.875	0.75	12	0	0.75	12
194		min	-19.087	0	11	0	0.75	5	-334.007	0.75	12	-0.008	0	9	-11.288	0.734	12	0	0.75	5
195	M98	max	60.107	1.5	10	0	1.5	12	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	12
196		min	10.349	0	1	0	0	1	0	0	1	-0.008	0	9	0	0	1	0	0	1
197	M99	max	-0.868	1.5	1	0	1.5	10	0	1.5	12	0.026	1.5	11	0	1.5	12	0	1.5	12
198		min	-16.095	0	11	0	0	12	0	0	1	-0.008	0	9	0	0	1	0	0	1
199	M100	max	26.818	1.5	3	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
200		min	5.191	0	1	0	0	1	0	0	1	-5.827	0	8	0	0	1	0	1.5	9
201	M101	max	-4.11	1.5	1	0	1.5	4	0	1.5	12	0.004	1.5	8	0	1.5	12	0	1.5	11
202		min	-39.225	0	11	0	0	11	0	0	1	-0.014	0	9	0	0	1	0	0	1
203	M102	max	-13.464	1.5	1	0	1.5	9	0	1.5	12	1.61	1.5	9	0	1.5	12	0	1.5	12
204		min	-69.563	0	3	0	0	12	0	0	1	-0.006	0	11	0	0	1	0	1.5	9
205	M103	max	18.158	0.75	11	0	1.5	12	127.032	1.5	12	0.004	0.75	8	12.993	0.75	3	0	0.75	12
206		min	0.488	0.766	1	0	0.75	5	-207.894	0.75	3	-0.014	0	9	-7.939	0.75	12	0	0.75	5
207	M104	max	-12.419	1.5	1	0	1.5	10	0	1.5	12	0.004	1.5	8	0	1.5	12	0	1.5	12
208		min	-64.165	0	3	0	0	12	0	0	1	-0.014	0	9	0	0	1	0	0	1
209	M105	max	18.324	1.5	11	0	1.5	4	0	1.5	12	0.004	1.5	8	0	1.5	12	0	1.5	12
210		min	1.476	0	1	0	0	12	0	0	1	-0.014	0	9	0	0	1	0	0	1
211	M106	max	-6.193	1.5	1	0	1.5	9	0	1.5	12	1.49	1.5	8	0	1.5	12	0	1.5	11
212		min	-31.997	0	3	0	0	11	0	0	1	-0.006	0	11	0	0	1	0	1.5	9
213	M107	max	6.504	1.5	11	0	1.5	4	0	1.5	12	0.006	1.5	8	0	1.5	12	0	1.5	11
214		min	0.591	0	1	0	0	11	0	0	1	-0.012	0	9	0	0	1	0	0	1
215	M108	max	10.25	1.5	3	0	1.5	9	0	1.5	12	0.006	1.5	8	0	1.5	12	0	1.5	12
216		min	1.984	0	1	0	0	12	0	0	1	-0.012	0	9	0	0	1	0	1.5	9
217	M109	max	4.112	1.5	12	0	0.734	6	30.317	1.5	3	0.006	1.5	8	2.056	0.75	12	0	0.75	11
218		min	-7.98	0	11	0	0.75	2	-32.892	0.75	12	-0.012	0	9	-1.895	0.75	3	0	0.75	2
219	M110	max	9.462	1.5	3	0	1.5	9	0	1.5	12	0.006	1.5	8	0	1.5	12	0	1.5	12
220		min	1.831	0	1	0	0	12	0	0	1	-0.012	0	9	0	0	1	0	0	1
221	M111	max	-0.221	1.5	1	0	1.5	4	0	1.5	12	0.006	1.5	8	0	1.5	12	0	1.5	12
222		min	-2.968	0	11	0	0	12	0	0	1	-0.012	0	9	0	0	1	0	0	1
223	M112	max	4.717	1.5	3	0	1.5	9	0	1.5	12	0.006	1.5	8	0	1.5	12	0	1.5	11
224		min	0.913	0	1	0	0	11	0	0	1	-0.012	0	9	0	0	1	0	1.5	9
225	M113	max	5.821	1.5	11	0	1.5	4	0	1.5	12	0.005	1.5	8	0	1.5	12	0	1.5	11
226		min	-0.164	0	9	0	0	11	0	0	1	-0.013	0	9	0	0	1	0	0	1
227	M114	max	11.236	1.5	3	0	1.5	9	0	1.5	12	0.005	1.5	8	0	1.5	12	0	1.5	12
228		min	2.175	0	1	0	0	12	0	0	1	-0.013	0	9	0	0	1	0	1.5	9
229	M115	max	6.119	1.5	12	0	1.5	10	34.485	1.5	3	0.005	0.75	8	1.321	0.75	12	0	0.75	12
230		min	-8.911	0	11	0	0.75	3	-21.13	0.75	12	-0.013	0.75	9	-2.155	0.75	3	0	0.75	3
231	M116	max	10.347	1.5	3	0	1.5	9	0	1.5	12	0.005	1.5	8	0	1.5	12	0	1.5	12
232		min	2.003	0	1	0	0	12	0	0	1	-0.013	0	9	0	0	1	0	0	1
233	M117	max	-0.218	1.5	1	0	1.5	4	0	1.5	12	0.005	1.5	8	0	1.5	12	0	1.5	12
234		min	-2.197	0	11	0	0	12	0	0	1	-0.013	0	9	0	0	1	0	0	1
235	M118	max	5.166	1.5	3	0	1.5	9	0	1.5	12	0.005	1.5	8	0	1.5	12	0	1.5	11
236		min	1	0	1	0	0	11	0	0	1	-0.013	0	9	0	0	1	0	1.5	9
237	M119	max	14.488	1.5	11	0	1.5	4	0	1.5	12	0.003	1.5	8	0	1.5	12	0	1.5	11
238		min	0.287	0	9	0	0	11	0	0	1	-0.015	0	9	0	0	1	0	0	1
239	M120	max	27.352	1.5	3	0	1.5	9	0	1.5	12	0.003	1.5	8	0	1.5	12	0	1.5	12
240		min	5.294	0	1	0	0	12	0	0	1	-0.015	0	9	0	0	1	0	1.5	9

Envelope Maximum Member Section Forces (Continued)

	Member		Axial[lb]	Loc[in]	LC	y Shear[lb]	Loc[in]	LC	z Shear[lb]	Loc[in]	LC	Torque[lb-ft]	Loc[in]	LC	y-y Moment[lb-ft]	Loc[in]	LC	z-z Moment[lb-ft]	Loc[in]	LC
241	M121	max	7.523	1.5	12	0	0.734	12	83.332	1.5	3	0.003	1.5	8	2.968	0.75	12	0	0.75	11
242		min	-15.045	0	11	-0.001	0.75	3	-47.493	0.75	12	-0.015	0.75	9	-5.208	0.75	3	0	0.734	12
243	M122	max	25.2	1.5	3	0	1.5	9	0	1.5	12	0.003	1.5	8	0	1.5	12	0	1.5	12
244		min	4.877	0	1	0	0	12	0	0	1	-0.015	0	9	0	0	1	0	0	1
245	M123	max	-0.543	1.5	1	0	1.5	4	0	1.5	12	0.003	1.5	8	0	1.5	12	0	1.5	12
246		min	-5.966	0	11	0	0	12	0	0	1	-0.015	0	9	0	0	1	0	0	1
247	M124	max	12.578	1.5	3	0	1.5	9	0	1.5	12	0.003	1.5	8	0	1.5	12	0	1.5	11
248		min	2.434	0	1	0	0	11	0	0	1	-0.015	0	9	0	0	1	0	1.5	9
249	M125	max	-0.644	1.5	9	0	1.5	4	0	1.5	12	0.004	1.5	8	0	1.5	12	0	1.5	11
250		min	-23.064	0	11	0	0	11	0	0	1	-0.015	0	9	0	0	1	0	0	1
251	M126	max	-8.829	1.5	1	0	1.5	9	0	1.5	12	0.004	1.5	8	0	1.5	12	0	1.5	12
252		min	-45.616	0	3	0	0	12	0	0	1	-0.015	0	9	0	0	1	0	1.5	9
253	M127	max	11.505	1.5	11	0	0.734	10	38.203	1.5	12	0.004	1.5	8	8.692	0.75	3	0	0.75	11
254		min	0.061	0	12	0	0.75	3	-139.07	0.75	3	-0.015	0	9	-4.666	0.734	3	0	0.75	3
255	M128	max	-8.134	1.5	1	0	1.5	9	0	1.5	12	0.004	1.5	8	0	1.5	12	0	1.5	12
256		min	-42.026	0	3	0	0	12	0	0	1	-0.015	0	9	0	0	1	0	0	1
257	M129	max	10.239	1.5	11	0	1.5	4	0	1.5	12	0.004	1.5	8	0	1.5	12	0	1.5	12
258		min	0.905	0	1	0	0	12	0	0	1	-0.015	0	9	0	0	1	0	0	1
259	M130	max	-4.06	1.5	1	0	1.5	9	0	1.5	12	0.004	1.5	8	0	1.5	12	0	1.5	11
260		min	-20.977	0	3	0	0	11	0	0	1	-0.015	0	9	0	0	1	0	1.5	9
261	M131	max	3.448	1.5	11	0	1.5	4	0	1.5	12	0.005	1.5	8	0	1.5	12	0	1.5	11
262		min	0.358	0	1	0	0	11	0	0	1	-0.013	0	9	0	0	1	0	0	1
263	M132	max	5.872	1.5	3	0	1.5	9	0	1.5	12	0.005	1.5	8	0	1.5	12	0	1.5	12
264		min	1.137	0	1	0	0	12	0	0	1	-0.013	0	9	0	0	1	0	1.5	9
265	M133	max	11.703	1.5	12	0	0.734	12	17.812	1.5	3	0.005	1.5	8	1.657	0.75	12	0	1.5	11
266		min	-13.306	0	11	0	0.75	4	-26.505	0.75	12	-0.013	0.75	9	-1.113	0.75	3	0	1.5	5
267	M134	max	5.413	1.5	3	0	1.5	9	0	1.5	12	0.005	1.5	8	0	1.5	12	0	1.5	12
268		min	1.048	0	1	0	0	12	0	0	1	-0.013	0	9	0	0	1	0	0	1
269	M135	max	-0.122	1.5	1	0	1.5	4	0	1.5	12	0.005	1.5	8	0	1.5	12	0	1.5	12
270		min	-1.152	0	11	0	0	12	0	0	1	-0.013	0	9	0	0	1	0	0	1
271	M136	max	2.703	1.5	3	0	1.5	9	0	1.5	12	0.005	1.5	8	0	1.5	12	0	1.5	11
272		min	0.523	0	1	0	0	11	0	0	1	-0.013	0	9	0	0	1	0	1.5	9
273	M137	max	8.148	1.5	11	0	1.5	4	0	1.5	12	0.004	1.5	8	0	1.5	12	0	1.5	11
274		min	-1.863	0	9	0	0	11	0	0	1	-0.015	0	9	0	0	1	0	0	1
275	M138	max	14.363	1.5	3	0	1.5	9	0	1.5	12	0.004	1.5	8	0	1.5	12	0	1.5	12
276		min	2.78	0	1	0	0	12	0	0	1	-0.015	0	9	0	0	1	0	1.5	9
277	M139	max	13.458	1.5	12	0.001	0.734	6	44.188	1.5	3	0.004	1.5	8	2.511	0.75	12	0	0.75	11
278		min	-17.059	0	11	0	0.75	2	-40.175	0.75	12	-0.015	0.75	9	-2.762	0.75	3	0	0.75	3
279	M140	max	13.22	1.5	3	0	1.5	9	0	1.5	12	0.004	1.5	8	0	1.5	12	0	1.5	12
280		min	2.559	0	1	0	0	12	0	0	1	-0.015	0	9	0	0	1	0	0	1
281	M141	max	-0.259	1.5	1	0	1.5	4	0	1.5	12	0.004	1.5	8	0	1.5	12	0	1.5	12
282		min	-2.884	0	11	0	0	12	0	0	1	-0.015	0	9	0	0	1	0	0	1
283	M142	max	6.593	1.5	3	0	1.5	9	0	1.5	12	0.004	1.5	8	0	1.5	12	0	1.5	11
284		min	1.276	0	1	0	0	11	0	0	1	-0.015	0	9	0	0	1	0	1.5	9
285	M143	max	8.041	1.5	11	0	1.5	4	0	1.5	12	2.508	1.5	9	0	1.5	12	0	1.5	9
286		min	0.078	0	9	0	0	9	0	0	1	-0.005	0	11	0	0	1	0	0	1
287	M144	max	14.137	1.5	3	0	1.5	9	0	1.5	12	-0.008	1.5	12	0	1.5	12	0	1.5	12
288		min	2.736	0	1	0	0	12	0	0	1	-3.428	0	9	0	0	1	0	1.5	9
289	M145	max	15.228	1.5	12	0	0.734	2	44.314	0.75	8	0.001	0.75	8	2.77	0.75	8	0	0.75	11
290		min	-18.921	0	11	-0.001	0	3	-43.102	0.75	12	-0.126	0	3	-2.715	0.75	3	0	1.5	2
291	M146	max	13.014	1.5	3	0	1.5	9	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	12
292		min	2.519	0	1	0	0	12	0	0	1	-0.018	0	9	0	0	1	0	0	1
293	M147	max	-0.259	1.5	1	0	1.5	4	0	1.5	12	2.313	1.5	8	0	1.5	12	0	1.5	12
294		min	-2.853	0	11	0	0	12	0	0	1	0.033	0	1	0	0	1	0	0	1
295	M148	max	6.49	1.5	3	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	11
296		min	1.256	0	1	0	0	11	0	0	1	-2.423	0	8	0	0	1	0	1.5	9
297	M149	max	2.947	1.5	9	0	1.5	4	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	9
298		min	-16.357	0	11	0	0	9	0	0	1	-0.433	0	9	0	0	1	0	0	1
299	M150	max	-6.276	1.5	1	0	1.5	9	0	1.5	12	3.583	1.5	9	0	1.5	12	0	1.5	12
300		min	-32.427	0	3	0	0	12	0	0	1	-0.001	0	12	0	0	1	0	1.5	9
301	M151	max	18.097	1.5	11	0.001	0.734	8	10.002	1.5	12	0	1.5	8	6.226	0.75	3	0	0.75	12

Envelope Maximum Member Section Forces (Continued)

	Member		Axial[lb]	Loc[in]	LC	y Shear[lb]	Loc[in]	LC	z Shear[lb]	Loc[in]	LC	Torque[lb-ft]	Loc[in]	LC	y-y Moment[lb-ft]	Loc[in]	LC	z-z Moment[lb-ft]	Loc[in]	LC
302		min	-10.406	0	12	0	0.75	2	-99.622	0.75	3	-0.018	0	9	-3.359	0.734	3	0	0.75	4
303	M152	max	-5.778	1.5	1	0	1.5	9	0	1.5	12	0	1.5	8	0	1.5	12	0	1.5	12
304		min	-29.851	0	3	0	0	12	0	0	1	-0.018	0	9	0	0	1	0	0	1
305	M153	max	7.217	1.5	11	0	1.5	4	0	1.5	12	-0.035	1.5	1	0	1.5	12	0	1.5	12
306		min	0.593	0	1	0	0	12	0	0	1	-0.379	0	8	0	0	1	0	0	1
307	M154	max	-2.882	1.5	1	0	1.5	9	0	1.5	12	2.561	1.5	8	0	1.5	12	0	1.5	11
308		min	-14.89	0	3	0	0	11	0	0	1	-0.003	0	12	0	0	1	0	1.5	9
309	M155	max	2.319	1.5	11	0	1.5	4	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	11
310		min	-0.197	0	9	0	0	11	0	0	1	-0.018	0	9	0	0	1	0	0	1
311	M156	max	2.944	1.5	3	0	1.5	9	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	12
312		min	0.57	0	1	0	0	12	0	0	1	-0.018	0	9	0	0	1	0	1.5	9
313	M157	max	19.135	1.5	12	0	0.734	11	15.691	0.75	8	0.001	1.5	8	2.223	0.75	12	0	0.75	12
314		min	-19.836	0	11	-0.001	0.75	3	-35.565	0.75	12	-0.018	0	9	-1.475	0.734	12	0	0.75	2
315	M158	max	3.143	1.5	11	0	1.5	9	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	12
316		min	0.525	0	1	0	0	12	0	0	1	-0.018	0	9	0	0	1	0	0	1
317	M159	max	-0.059	1.5	1	0	1.5	4	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	12
318		min	-0.397	0	11	0	0	12	0	0	1	-0.018	0	9	0	0	1	0	0	1
319	M160	max	1.357	1.5	3	0	1.5	9	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	11
320		min	0.263	0	1	0	0	11	0	0	1	-0.018	0	9	0	0	1	0	1.5	9
321	M161	max	10.284	1.5	11	0	1.5	4	0	1.5	12	0	1.5	8	0	1.5	12	0	1.5	11
322		min	-2.812	0	9	0	0	11	0	0	1	-0.018	0	9	0	0	1	0	0	1
323	M162	max	17.804	1.5	3	0	1.5	9	0	1.5	12	0	1.5	8	0	1.5	12	0	1.5	12
324		min	3.446	0	1	0	0	12	0	0	1	-0.018	0	9	0	0	1	0	1.5	9
325	M163	max	20.874	1.5	12	0.001	0.734	11	55.063	1.5	3	0	1.5	8	3.495	0.75	12	0	1.5	12
326		min	-25.177	0	11	-0.001	0	6	-55.928	0.75	12	-0.018	0.75	9	-3.441	0.75	3	0	0.75	4
327	M164	max	16.381	1.5	3	0	1.5	9	0	1.5	12	0	1.5	8	0	1.5	12	0	1.5	12
328		min	3.17	0	1	0	0	12	0	0	1	-0.018	0	9	0	0	1	0	0	1
329	M165	max	-0.304	1.5	1	0	1.5	4	0	1.5	12	0	1.5	8	0	1.5	12	0	1.5	12
330		min	-3.418	0	11	0	0	12	0	0	1	-0.018	0	9	0	0	1	0	0	1
331	M166	max	8.153	1.5	3	0	1.5	9	0	1.5	12	0	1.5	8	0	1.5	12	0	1.5	11
332		min	1.578	0	1	0	0	11	0	0	1	-0.018	0	9	0	0	1	0	1.5	9
333	M167	max	3.54	1.5	11	0	1.5	4	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	11
334		min	-0.811	0	9	0	0	11	0	0	1	-0.019	0	9	0	0	1	0	0	1
335	M168	max	4.679	1.5	3	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
336		min	0.906	0	1	0	0	12	0	0	1	-0.019	0	9	0	0	1	0	1.5	9
337	M169	max	22.919	1.5	11	0	0.75	8	19.381	0.75	8	0	1.5	1	2.805	0.75	12	0	0.75	11
338		min	-23.895	0	11	-0.001	0.766	8	-44.883	0.75	12	-0.019	0	9	-1.828	0.734	12	0	0.75	8
339	M170	max	4.562	1.5	10	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
340		min	0.833	0	1	0	0	12	0	0	1	-0.019	0	9	0	0	1	0	0	1
341	M171	max	-0.081	1.5	1	0	1.5	4	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	12
342		min	-0.717	0	11	0	0	12	0	0	1	-0.019	0	9	0	0	1	0	0	1
343	M172	max	2.144	1.5	3	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	11
344		min	0.415	0	1	0	0	11	0	0	1	-0.019	0	9	0	0	1	0	1.5	9
345	M173	max	3.358	1.5	9	0	1.5	4	0	1.5	12	0	1.5	8	0	1.5	12	0	1.5	9
346		min	-12.085	0	11	0	0	9	0	0	1	-0.019	0	9	0	0	1	0	0	1
347	M174	max	-4.756	1.5	1	0	1.5	9	0	1.5	12	0	1.5	8	0	1.5	12	0	1.5	12
348		min	-24.573	0	3	0	0	12	0	0	1	-0.019	0	9	0	0	1	0	1.5	9
349	M175	max	25.177	1.5	11	0.001	0.734	8	-7.704	0.734	9	0	1.5	8	4.747	0.75	3	0	0.75	12
350		min	-19.409	0	12	-0.001	0.75	3	-75.956	0.75	3	-0.019	0.75	9	-2.569	0.734	3	0	0.75	2
351	M176	max	-4.376	1.5	1	0	1.5	9	0	1.5	12	0	1.5	8	0	1.5	12	0	1.5	12
352		min	-22.61	0	3	0	0	12	0	0	1	-0.019	0	9	0	0	1	0	0	1
353	M177	max	5.493	1.5	11	0	1.5	4	0	1.5	12	0	1.5	8	0	1.5	12	0	1.5	12
354		min	0.423	0	1	0	0	12	0	0	1	-0.019	0	9	0	0	1	0	0	1
355	M178	max	-2.179	1.5	1	0	1.5	9	0	1.5	12	0	1.5	8	0	1.5	12	0	1.5	11
356		min	-11.257	0	3	0	0	11	0	0	1	-0.019	0	9	0	0	1	0	1.5	9
357	M179	max	3.342	1.5	11	0	1.5	4	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	9
358		min	-0.545	0	9	0	0	9	0	0	1	-0.018	0	9	0	0	1	0	0	1
359	M180	max	3.974	1.5	3	0	1.5	9	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	12
360		min	0.763	0	12	0	0	12	0	0	1	-0.018	0	9	0	0	1	0	1.5	9
361	M181	max	26.428	1.5	12	0.001	0.734	3	21.856	0.75	8	0.001	0.75	8	3.115	0.75	12	0	0.75	12
362		min	-27.222	0	11	-0.001	0.75	2	-49.845	0.75	12	-0.018	0	9	-2.05	0.734	12	0	0.75	2

Envelope Maximum Member Section Forces (Continued)

	Member		Axial[lb]	Loc[in]	LCy	Shear[lb]	Loc[in]	LCz	Shear[lb]	Loc[in]	LC	Torque[lb-ft]	Loc[in]	LCy-y Moment[lb-ft]	Loc[in]	LCz-z Moment[lb-ft]	Loc[in]	LC
363	M182	max	4.242	1.5	11	0	1.5	9	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	12
364		min	0.708	0	1	0	0	12	0	0	1	-0.018	0	9	0	0	1	0	0	1
365	M183	max	-0.069	1.5	1	0	1.5	4	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	12
366		min	-0.56	0	8	0	0	12	0	0	1	-0.018	0	9	0	0	1	0	0	1
367	M184	max	1.825	1.5	3	0	1.5	9	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	11
368		min	0.353	0	1	0	0	11	0	0	1	-0.018	0	9	0	0	1	0	1.5	9
369	M185	max	4.761	1.5	11	0	1.5	4	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	9
370		min	-2.044	0	9	0	0	9	0	0	1	-0.018	0	9	0	0	1	0	0	1
371	M186	max	6.618	1.5	3	0	1.5	9	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	12
372		min	1.281	0	1	0	0	12	0	0	1	-0.018	0	9	0	0	1	0	1.5	9
373	M187	max	28.259	1.5	11	0.001	0.734	3	20.383	1.5	3	0.001	1.5	8	3.461	0.75	12	0	0.75	12
374		min	-29.602	0	11	-0.001	0.75	3	-55.382	0.75	12	-0.018	0.75	9	-2.267	0.734	12	0	0.75	3
375	M188	max	6.363	1.5	10	0	1.5	9	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	12
376		min	1.177	0	1	0	0	12	0	0	1	-0.018	0	9	0	0	1	0	0	1
377	M189	max	-0.11	1.5	1	0	1.5	4	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	12
378		min	-1.038	0	11	0	0	12	0	0	1	-0.018	0	9	0	0	1	0	0	1
379	M190	max	3.01	1.5	3	0	1.5	9	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	11
380		min	0.583	0	1	0	0	11	0	0	1	-0.018	0	9	0	0	1	0	1.5	9
381	M191	max	2.093	1.5	9	0	1.5	4	0	1.5	12	12.315	1.5	9	0	1.5	12	0	1.5	9
382		min	-2.166	0	3	0	0	9	0	0	1	0.01	0	12	0	0	1	0	0	1
383	M192	max	-1.202	1.5	1	0	1.5	9	0	1.5	12	0	1.5	8	0	1.5	12	0	1.5	12
384		min	-6.213	0	3	0	0	12	0	0	1	-0.01	0	9	0	0	1	0	1.5	9
385	M193	max	30.457	1.5	12	0	1.5	11	24.078	0.734	9	0	1.5	8	3.002	0.75	11	0	0.75	12
386		min	-28.839	0	12	-0.001	0.75	5	-48.036	0.75	11	-0.01	0	9	-2.049	0.734	11	0	0.75	4
387	M194	max	-1.105	1.5	1	0	1.5	9	0	1.5	12	0	1.5	8	0	1.5	12	0	1.5	12
388		min	-5.708	0	3	0	0	12	0	0	1	-0.01	0	9	0	0	1	0	0	1
389	M195	max	1.709	1.5	11	0	1.5	4	0	1.5	12	8.763	1.5	8	0	1.5	12	0	1.5	12
390		min	0.103	0	1	0	0	12	0	0	1	-0.002	0	11	0	0	1	0	0	1
391	M196	max	-0.547	1.5	1	0	1.5	9	0	1.5	12	0	1.5	8	0	1.5	12	0	1.5	11
392		min	-2.826	0	3	0	0	11	0	0	1	-0.625	0	3	0	0	1	0	1.5	9
393	M197	max	583.283	3	3	5.657	138	8	96.737	6	11	0.006	4.5	9	30.054	39	11	5.889	12	9
394		min	1.133	139.5	1	-8.845	4.5	9	-12.432	13.5	3	-0.002	7.5	8	-32.268	7.5	11	-6.062	70.5	9
395	M203	max	0	18	12	-7.207	18	1	0	18	12	0	18	8	0	18	8	49.802	18	11
396		min	0	0	1	-66.402	0	11	0	0	1	0	0	9	0	0	8	-49.802	0	11
397	M204	max	242.818	12	3	46.515	3	9	30.566	6	12	0.006	6	9	30.691	7.5	11	6.079	70.5	9
398		min	-69.83	4.5	12	-18	4.5	9	-76.384	0	11	-0.002	7.5	8	-30.061	39	11	-14.734	4.5	9
399	M205	max	52.618	18	11	-11.272	18	1	0	18	11	0	18	10	0.008	0	9	55.043	18	11
400		min	1.64	0	1	-74.915	0	11	-0.01	0	9	-0.002	0	9	-0.008	18	9	-57.331	0	11
401	M206	max	0	18	12	-1.133	18	1	0	18	12	0	18	8	0	0	9	6.465	18	11
402		min	0	0	1	-8.62	0	11	0	0	9	0	0	9	0	18	9	-6.465	0	11
403	M207	max	0.032	18	11	-8.941	18	1	0	18	12	0	18	8	0	0	9	61.775	18	11
404		min	0.001	0	1	-82.37	0	11	0	0	1	0	0	9	0	18	9	-61.78	0	11
405	M208	max	0	18	12	-6.361	18	1	0	18	12	0	18	4	0	0	9	34.017	18	11
406		min	0	0	1	-45.356	0	11	0	0	1	0	0	9	0	18	9	-34.017	0	11
407	M209	max	0	18	12	5.84	18	3	0	18	12	0	18	8	0	0	9	4.38	0	3
408		min	0	0	1	-2.107	0	12	0	0	9	0	0	9	0	18	9	-4.38	18	3
409	M210	max	583.079	3	3	8.821	6	8	78.955	6	3	0.002	12	9	22.804	12	11	6.076	70.5	9
410		min	-2.107	139.5	12	-5.682	130.5	9	-32.208	13.5	11	-0.006	4.5	8	-21.288	7.5	3	-5.88	12	8
411	M211	max	0.005	18	3	46.163	18	3	0	18	12	0	18	8	0	18	8	34.622	0	3
412		min	-0.027	0	12	-30.911	0	12	0	0	1	0	0	9	0	0	8	-34.622	18	3
413	M212	max	0	18	12	37.216	18	3	0	18	12	0	18	8	0	18	8	27.912	0	3
414		min	0	0	1	-24.924	0	12	0	0	1	0	0	9	0	0	8	-27.912	18	3
415	M213	max	0	18	12	32.82	18	3	0	18	12	0	18	4	0	0	9	24.615	0	3
416		min	0	0	1	-8.771	0	12	0	0	1	0	0	9	0	18	9	-24.615	18	3
417	M214	max	290.702	3	11	18.001	6	8	62.691	3	12	0.002	12	9	21.034	7.5	3	14.711	4.5	9
418		min	-5.84	139.5	3	-46.448	0	9	-98.583	4.5	11	-0.006	4.5	8	-23.362	12	11	-6.059	70.5	9
419	M215	max	8.46	18	3	58.195	18	3	0.01	18	9	0.002	18	8	0.008	18	9	43.463	0	3
420		min	-43.185	0	12	-10.065	0	12	0	0	11	0	0	11	-0.008	0	9	-43.831	18	3
421	M216	max	38.902	1.5	11	0	1.5	12	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	12
422		min	3.622	0	1	0	0	1	0	0	1	-0.008	0	9	0	0	1	0	0	1
423	M217	max	-4.387	1.5	1	0	1.5	9	0	1.5	12	0.004	1.5	8	0	1.5	12	0	1.5	11

Envelope Maximum Member Section Forces (Continued)

	Member		Axial[lb]	Loc[in]	LC	y Shear[lb]	Loc[in]	LC	z Shear[lb]	Loc[in]	LC	Torque[lb-ft]	Loc[in]	LC	y-y Moment[lb-ft]	Loc[in]	LC	z-z Moment[lb-ft]	Loc[in]	LC
424		min	-30.577	0	11	0	0	11	0	0	1	-0.014	0	9	0	0	1	0	0	1
425	M218	max	5.043	1.5	11	0	1.5	9	0	1.5	12	0.006	1.5	8	0	1.5	12	0	1.5	11
426		min	0.645	0	1	0	0	11	0	0	1	-0.012	0	9	0	0	1	0	0	1
427	M219	max	4.425	1.5	11	0	1.5	9	0	1.5	12	0.005	1.5	8	0	1.5	12	0	1.5	11
428		min	0.716	0	1	0	0	11	0	0	1	-0.013	0	9	0	0	1	0	0	1
429	M220	max	11.108	1.5	11	0	1.5	9	0	1.5	12	0.003	1.5	8	0	1.5	12	0	1.5	11
430		min	1.738	0	1	0	0	11	0	0	1	-0.015	0	9	0	0	1	0	0	1
431	M221	max	-2.899	1.5	1	0	1.5	9	0	1.5	12	0.004	1.5	8	0	1.5	12	0	1.5	11
432		min	-17.807	0	11	0	0	11	0	0	1	-0.015	0	9	0	0	1	0	0	1
433	M222	max	2.632	1.5	11	0	1.5	9	0	1.5	12	0.005	1.5	8	0	1.5	12	0	1.5	11
434		min	0.371	0	1	0	0	11	0	0	1	-0.013	0	9	0	0	1	0	0	1
435	M223	max	6.042	1.5	11	0	1.5	9	0	1.5	12	0.004	1.5	8	0	1.5	12	0	1.5	11
436		min	0.92	0	1	0	0	11	0	0	1	-0.015	0	9	0	0	1	0	0	1
437	M224	max	6.027	1.5	11	0	1.5	9	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	11
438		min	0.904	0	1	0	0	11	0	0	1	-0.018	0	9	0	0	1	0	0	1
439	M225	max	-2.074	1.5	1	0	1.5	9	0	1.5	12	0	1.5	8	0	1.5	12	0	1.5	11
440		min	-12.421	0	11	0	0	11	0	0	1	-0.018	0	9	0	0	1	0	0	1
441	M226	max	1.709	1.5	11	0	1.5	9	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	11
442		min	0.187	0	1	0	0	11	0	0	1	-0.018	0	9	0	0	1	0	0	1
443	M227	max	7.629	1.5	11	0	1.5	9	0	1.5	12	0	1.5	8	0	1.5	12	0	1.5	11
444		min	1.144	0	1	0	0	11	0	0	1	-0.018	0	9	0	0	1	0	0	1
445	M228	max	2.548	1.5	11	0	1.5	9	0	1.5	12	0	1.5	1	0	1.5	12	0	1.5	11
446		min	0.301	0	1	0	0	11	0	0	1	-0.019	0	9	0	0	1	0	0	1
447	M229	max	-1.579	1.5	1	0	1.5	9	0	1.5	12	0	1.5	8	0	1.5	12	0	1.5	11
448		min	-9.125	0	10	0	0	11	0	0	1	-0.019	0	9	0	0	1	0	0	1
449	M230	max	2.335	1.5	11	0	1.5	9	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	11
450		min	0.255	0	1	0	0	11	0	0	1	-0.018	0	9	0	0	1	0	0	1
451	M231	max	3.464	1.5	11	0	1.5	9	0	1.5	12	0.001	1.5	8	0	1.5	12	0	1.5	11
452		min	0.354	0	9	0	0	11	0	0	1	-0.018	0	9	0	0	1	0	0	1
453	M232	max	-0.371	1.5	9	0	1.5	9	0	1.5	12	0	1.5	8	0	1.5	12	0	1.5	11
454		min	-2.063	0	3	0	0	11	0	0	1	-0.01	0	9	0	0	1	0	0	1

Material Take-Off

	Material	Size	Pieces	Length[in]	Weight[K]
1	General Members				
2	RIGID		119	178.5	0
3	Total General		119	178.5	0
4					
5	Hot Rolled Steel				
6	Gr-30	0.06X0.75FLAT	10	751.3	0.01
7	Total HR Steel		10	751.3	0.01
8					
9	Cold Formed Steel				
10	Gr30	S-SERIES-BRC_0.625X4.5X18GA	70	1260	0.096
11	Gr30	S-SERIES-UP_1.5X1.12X16GA	28	4032	0.222
12	Total CF Steel		98	5292	0.318

Frame E4

Tail Pipe Shelving

20"B x 96"L x 120"H - Wide Span

(2 Levels)

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

SEISMIC DESIGN FRAME E4 20"B x 96"L x 120"H Tail Pipe

SEISMIC FORCES

Code Refrence

Seismic Code : **ASCE 7-10**

EQUIVALENT LATERAL FORCE PROCEDURE FOR SHELVING & RMI (AS IT APPLIES)

Dimension

Frame :	**E4**		Max. Shelving Height :	**120**	in
Width :	**20**	in	Levels :	**2**	
Length :	**96**	in	Shelf type :	**Tail Pipe**	

Site parameters (ASCE 7 section 11.4)

Site class	**D (Default)**				
Mapped acceleration parameters					
at short periods	Ss =	**0.206**	at 1 sec. period	S_1 =	**0.106**
Site coefficient at short periods	Fa =	**1.600**	at 1 sec. period	Fv =	**2.376**

Spectral response accelaration parameters (ASCE 7 section 11.4)

at short periods		**0.071**			**0.050**
	Calc. SMS =	**0.330**	at 1 sec. period	Calc. SM1 =	**0.252**

Design spectral acceleration parameters (ASCE 7 section 11.4)

at short periods	S_{DS} =	**0.220**	at 1 sec. period	S_{D1} =	**0.168**

Seismic design category (ASCE 7 section 11.6)

Risk Category	**II**
Seismic design category	**C**

Approximate fundamental period (ASCE 7 section 12.8.2.1)

Height above base to highest level	hn =	**10.00**	ft
Structure Type		**4**	
Long-period transition	TL =	**12**	Figs. 22-14 thru 22-17
Building period parameter Ct	Ct =	**0.020**	
Building period parameter x	x =	**0.75**	
Building fundamental period	T = Ta =	**0.112**	sec.
Exponent related to structure period	k =	**1**	since Ta ≤ 0.50 sec

Seismic response coefficient (ASCE 7 section 15.5 & RMI 2.6.3)

Response modification factor (Transverse)	R =	**4**	
Response modification factor (Longitudinal)	R =	**6**	
Seismic importance factor	Ie =	**1.5**	(ASCE 7 15.5.3,RMI Sec. 2.6.2)
Redundancy factor	ρ =	**1.0**	RMI Sec. 2.6.2.1; ASCE7 Sec.12.4.2.1
	Cd =	**3.5**	

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

Operating Weight (RMI 2.1 & ASCE 7 section 15.5)

Loads

DL : **5** psf

LEVEL	Height/LVL (in)	Input Shelf Load (PL) (lbs.)	Calculated (lbs.)
2	**60**	**500**	500
1	**60**	**500**	500
		Total PL :	1,000

DL = 5 PSF x 1.67 FT x 8 FT x 2 SHELVES = 133.33 lbs
PL app = 1,000 LBS x 0.67 = 670.00 lbs
PL (top shelf) = 500.00 lbs

Ws = DL+67%PL+0.25LL (Per Storage Rack Section)
67%PL (every shelf loaded 67% of its rated load)(PL app)
100%PL (top shelf only loaded 100% of its rated load)
V_{BASE} = Cs Ws

Seismic base shear (ASCE 7 section 12.8)

		Transverse	Longitudinal
Seismic response coefficient	Cs =	**0.082**	**0.055**
Seismic response coefficient max.	$Cs_{,MAX}$ =	**0.560**	**0.373**
Seismic response coefficient min.	$Cs_{,MIN}$ =	**0.015**	**0.015**
Seismic response coefficient (Governs)	Cs =	**0.082**	**0.055**

LOAD COMBINATION ASD (RMI 2.1)

	W_{LC}	Ws	E (factor)	V_{BASE} Transverse	V_{BASE} Longitudinal	
DL+0.67PL+0.75(0.7ρE)	803.33	803.33	0.525	35	23	
$(1+0.105S_{DS})DL+0.75[(1.4+0.14S_{DS})0.7PL+0.7\rho E]$	887.56	803.33	0.525	35	23	
$(1+0.14S_{DS})DL+(0.85+0.14S_{DS})0.7PL+0.7\rho E$	753.97	803.33	0.700	46	31	**CONTROLS**
$(0.6 - 0.14S_{DS})DL+(0.6 - 0.14S_{DS})0.67PL+0.7\rho E$	457.29	803.33	0.700	46	31	
Seismic base shear			$V_{BASE\ MAX.\ CONTROL}$	46	31	

$W_{s\ CONTROL}$ = 753.97 LBS

Anchors in accordance with ACI318 Sec.17 Ω_o = 2.0 (ACI318 Sec.17; ASCE7 Table 15.4-1)

	Transverse	Longitudinal	
$V_{BASE\ 67\%PL}$ =	**46**	**31**	lbs
$V_{BASE\ 100\%PL\ TOP}$ x 0.7ρ=	**37**	**25**	lbs

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

SEISMIC LATERAL FORCE DISTRIBUTION - FRAME E4 (CONTINUED)

					Transverse	Longitudinal
LEVEL	W (lbs.)	h (ft)	$W_x h_x^k$ (lbs-ft)	$C_v x$	F_x (lbs)	F_x (lbs)
2	376.98	10.00	3769.84	0.67	30.89	20.59
1	376.98	5.00	1884.92	0.33	15.45	10.30
Σ	753.97	Σ	5654.77	Base :	46.34	30.89
P_{STATIC} =	376.98	lbs per post		$COMP._{MAX}$ =	567	lbs per post

$V_{BASE\ 67\%PL}$ (Transverse): 46 lbs Σ (F_X * h) (Transverse) : 4,634 lbs-in

$V_{BASE\ 67\%PL}$ (Longitudinal): 31 lbs Σ (F_X * h) (Longitudinal) : 3,089 lbs-in

UPLIFT FORCES (RMI Sec. 2.1.9 Seismic Uplift)

L_W = 20 in

L_L = 96 in

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

SEISMIC LATERAL FORCE DISTRIBUTION TOP SHELF LOADED - FRAME E4 (CONTINUED)

LEVEL	W (lbs.)	h (ft)	$W_x h_x^k$ (lbs-ft)	$C_v x$	Transverse F_x (lbs)	Longitudinal F_x (lbs)
2	566.67	10.00	5666.67	0.94	34.94	23.61
1	66.67	5.00	333.33	0.06	2.06	1.39
	Σ 633.33		Σ 6000.00	Base :	37.00	25.00

$V_{BASE\ 100\%PL\ TOP}$ (Transverse): 37 LBS Σ (F_X * h) (Transverse) : 4,317 lbs-in

$V_{BASE\ 100\%PL\ TOP}$ (Longitudinal): 25 LBS Σ (F_X * h) (Longitudinal) : 2,917 lbs-in

UPLIFT FORCES FOR ANCHORS

UPLIFT FORCES (RMI Sec. 2.1.9 Seismic Uplift)

L_W = 20 in

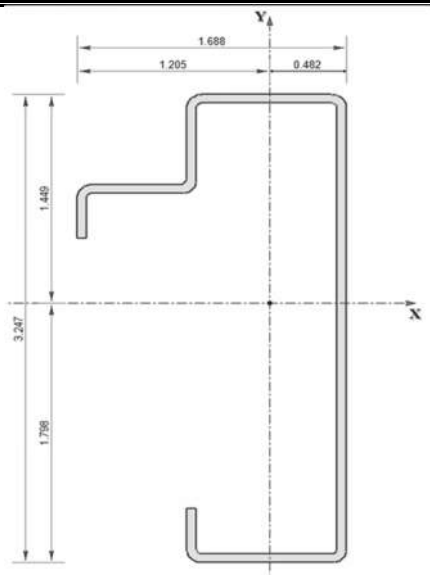
L_L = 96 in

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

BEAM DESIGN FOR FRAME E4

SECTION PROPERTIES:

MAX L :	96	in			
Size :	3.25"x16ga				
H :	3.25	IN			
t :	16	GA	Fy :	45,000	PSI
Area :	0.413	IN^2	E :	29,500	KSI
Ix :	0.572	IN^4	Iy :	0.116	IN^4
Sx :	0.318	IN^3	Sy :	0.096	IN^3
rx :	1.176	IN	ry :	0.529	IN



BEAM SECTION

MAX ALLOWABLE LOAD - BENDING: (AISI Sec. C3.1.3)

Mn (MAX) = 0.6 * Sx * Fy = 8586 LBS-IN

CAPACITY = 2(8 * M / L) = 1431.00 LBS

MAX ALLOWABLE LOAD - DEFLECTION (L/180): (RMI Sec. 5.3)

ALLOW DEFLECTION = 5 wL^4 / 384 E I

CAPACITY = 2 [(384 E I) / (5*180*L^2)] = 1562.41 LBS

MAXIMUM STATIC ALLOWABLE LOAD PER LEVEL= 1431.00 LBS

ALLOWABLE AND ACTUAL BENDING MOMENT PER LEVEL (RMI Sec.2.1.5 & 2.3)

MAX BENDING MOMENT

Wstatic = (DL + LL + 0.88PL) / 96" = 5.28 LBS/IN

$M_{STATIC\ (DL + LL + 0.88PL)} = W_{STATIC}\ L^2$ / 8 = 6080.00 LBS-IN

$P_{VERTICAL\ IMPACT}$ = Wstatic x 25% = 15.83 LBS

$M_{VERTICAL\ IMPACT} = P_{VERTICAL\ IMPACT}$ x L / 4 = 380.00 LBS-IN

$M_{STATIC+IMPACT}$ = 6460.00 LBS-IN

ALLOWABLE BENDING MOMENT

$M_{ALLOW(STATIC)}$ = 17172.00 LBS-IN

$M_{STATIC+IMPACT}$ < $M_{ALLOW(STATIC)}$ OK

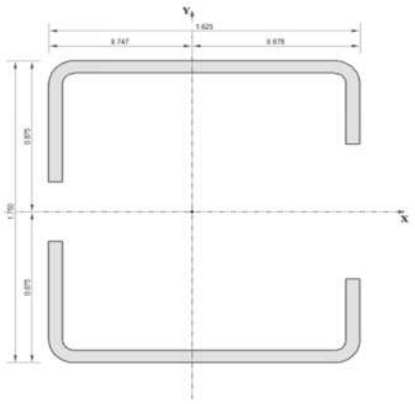
JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

WS STD UPRITE DESIGN FOR FRAME - E4

SECTION PROPERTIES

MAX HT = 120 IN

SIZE =	1.625x1.75x14ga		Fy =	45	ksi
t =	14	GA	E =	29500	ksi
AREA =	0.372	in^2	Iy =	0.133	in^4
Ix =	0.202	in^4	Sy =	0.151	in^3
Sx =	0.231	in^3	ry =	0.597	in
rx =	0.738	in	Ωc=	1.80	
C_{mx}=	1.00		Ωb=	1.67	
Unbrace Lx-x =	57	in	Kx =	1.7	
Unbrace Ly-y =	36	in	Ky =	1.0	
δ_{SE} =	0.24	IN			
δ_X =	0.56	IN < 5% Structural Height OK			



COLUMN SECTION

P_{static} = 634 lbs

$\frac{kLx}{rx}$	=	$\frac{(1.7)(56.75)}{0.738in}$	=	130.72		$\frac{kLy}{ry}$	=	$\frac{(1)(36)}{0.597in}$	=	60.30	
Fax	=	$\frac{\pi^2 * E}{(Klx/rx)^2}$	=	17037	PSI	Fay	=	$\frac{\pi^2 * E}{(Kly/ry)^2}$	=	80069	psi
λc	=	$(Fy / Fax)^{1/2}$	=	1.63	>1.5	λc	=	$(Fy / Fay)^{1/2}$	=	0.75	<1.5
Fn	=	λc < 1.5 $(0.658^{\lambda c2})Fy$ λc > 1.5 $(0.877/\lambda c^2)Fy$	=	14942	psi	Fn	=	λc < 1.5 $(0.658^{\lambda c2})Fy$ λc > 1.5 $(0.877/\lambda c^2)Fy$	=	35567	psi
Pn	=	AREA * F_n	=	5558	lbs	Pn	=	AREA * F_n	=	13231	lbs
P_{EX}	=	$(\pi^2 E I_X) / (K_X L_X)^2$	=	6319	lbs	P_{EY}	=	$(\pi^2 E I_Y) / (K_Y L_Y)^2$	=	29879	lbs
α_x	=	$1 - (\Omega_c Px/Pex)$	=	0.82		α_y	=	$1 - (\Omega_c Px/Pey)$	=	0.96	

MAX MOMENT IN COLUMN

$Mx = M_{STATIC} + M_{SEISMIC}$ =	0.01	lbs-ft	$M_{nx} = Sx * Fy$ =	866.25	lbs-ft
$My = M_{STATIC} + M_{SEISMIC}$ =	12.36	lbs-ft	$M_{ny} = Sy * Fy$ =	566.25	lbs-ft

COMBINED STRESS (fa/Fa + fb/Fb)

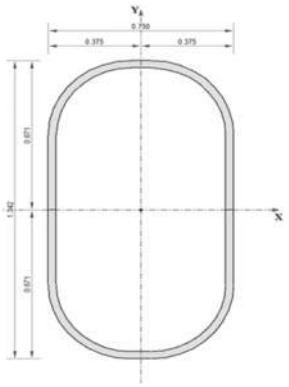
RISA3D Lateral Load X-Direction

$(\Omega cPx/P_n) + (\Omega_b C_{mx} M_x/M_n \alpha_{x1}) + (\Omega_b C_{my} M_y/M_{ny} \alpha_{y1})$ = 0.24 < 1.0 **THEREFORE UPRITE IS OK**

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

TRANSVERSE BRACING - FRAME E4

SECTION PROPERTIES:



P_{MEMBER} = 123 LBS - WORST CASE

HORIZONTAL BRACINGS:

AREA = 0.115 IN^2
r_x = 0.453 IN
d = 20 IN

$$\frac{kl_x}{r_x} = \frac{(0.8)(20IN)}{0.453IN} = 35.32$$

$$\frac{kl_x}{r_x} < 200 \quad \textbf{OK}$$

$$Fa = \frac{\pi^2 E}{(kl/r)2} = 229432 \text{ PSI}$$

$$\frac{fa}{Fa} = \frac{V_{BASE}}{AREA \times Fa}$$

$$= 0.005 < 1.0 \quad \textbf{OK}$$

DIAGONAL BRACING:

AREA = 0.115 IN^2
r_x = 0.453 IN
d = 20 IN
l = 38 IN

THE LENGTH OF THE BRACE:

$L = (d^2 + l^2)^{0.5}$ = 3.58 FT
L = 42.94 IN

$V_{DIAG} = V_{BASE}$ * (LENGTH OF THE BRACE/ DEPTH)
= 264 LBS

$$\frac{kl_x}{r_x} = \frac{(1)(42.94IN)}{0.453IN} = 94.79$$

$$\frac{kl_x}{r_x} < 200 \quad \textbf{OK}$$

$$Fa = \frac{\pi^2 E}{(kl/r)2} \quad 31852 \text{ PSI}$$

$$\frac{fa}{Fa} = \frac{V_{DIAG}}{AREA \times Fa}$$

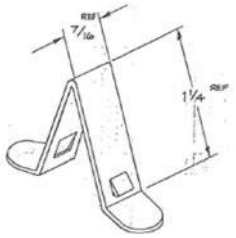
$$= 0.072 < 1.0 \quad \textbf{OK}$$

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

BEAM TO COLUMN CONNX - FRAME E4

BEAM TO COLUMN CONNECTION PROVIDE ADEQUATE MOMENT CAPACITY TO STABLIZE THIS SYSTEM, ALTHOGH IT DOES NOT PROVIDE 100% FIXITY. THUS, THE BEAMS WILL BE ANALYSED ASSUMING THEY HAVE PINNED ENDS. FOR THE COMPUTATION OF BEAM TO COL. MOMENT CAPACITY, THE PARTIAL FIXITY OF THE BEAM,(ASSUMED AT AN ARBITRARY 25% OF THE FIXED END MOMENT OR 2000 IN-LB WHICH EVER IS SMALLER) WILL BE ADDED

CAPACITY OF CONNECTOR:



BEAM LOCKING DEVICE (TWO CLIPS) (RMI 7.1.2)

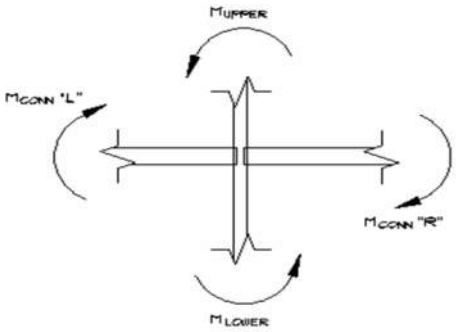
AREA = 7/16 * 0.03 *2 = 0.026 IN^2
Fy = 50000 PSI
Fv = 2 * 0.4 * A * Fy

V_{MAX} = 1050 LBS >1000 LBS OK

BEAM TO BRACKET WELD CAPACITY

1/8" * 14.84 KSI = 1855 LBS/IN <--- CONTROLS
0.061" * 26 KSI * 1.33 = 2109 LBS/IN
L_{WELD} = 3 IN
CAPACITY = 5565 LBS

a) SHEAR CAPACITY OF 1/2" TAB



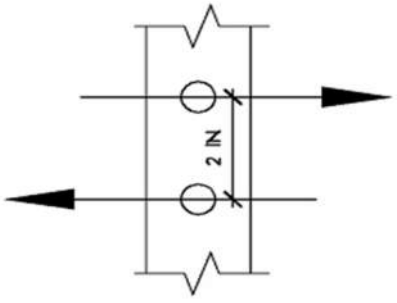
AREA = 0.105" * 1/2" = 0.053 IN^2
Fy = 50000 PSI
Fv = 0.4 * A * Fy

V_{MAX} = 1050 LBS

b) BEARING ON COLUMN

D = 0.420 IN
t = 0.072 IN
BEARING AREA = t * D = 0.030 IN^2

Fy = 50000 PSI



$P_{MAX\ BEARING}$ = BRG AREA * 1.2 * Fy = 1814 LBS

SINCE SHEAR GOVERNS P1 = 1050 LBS

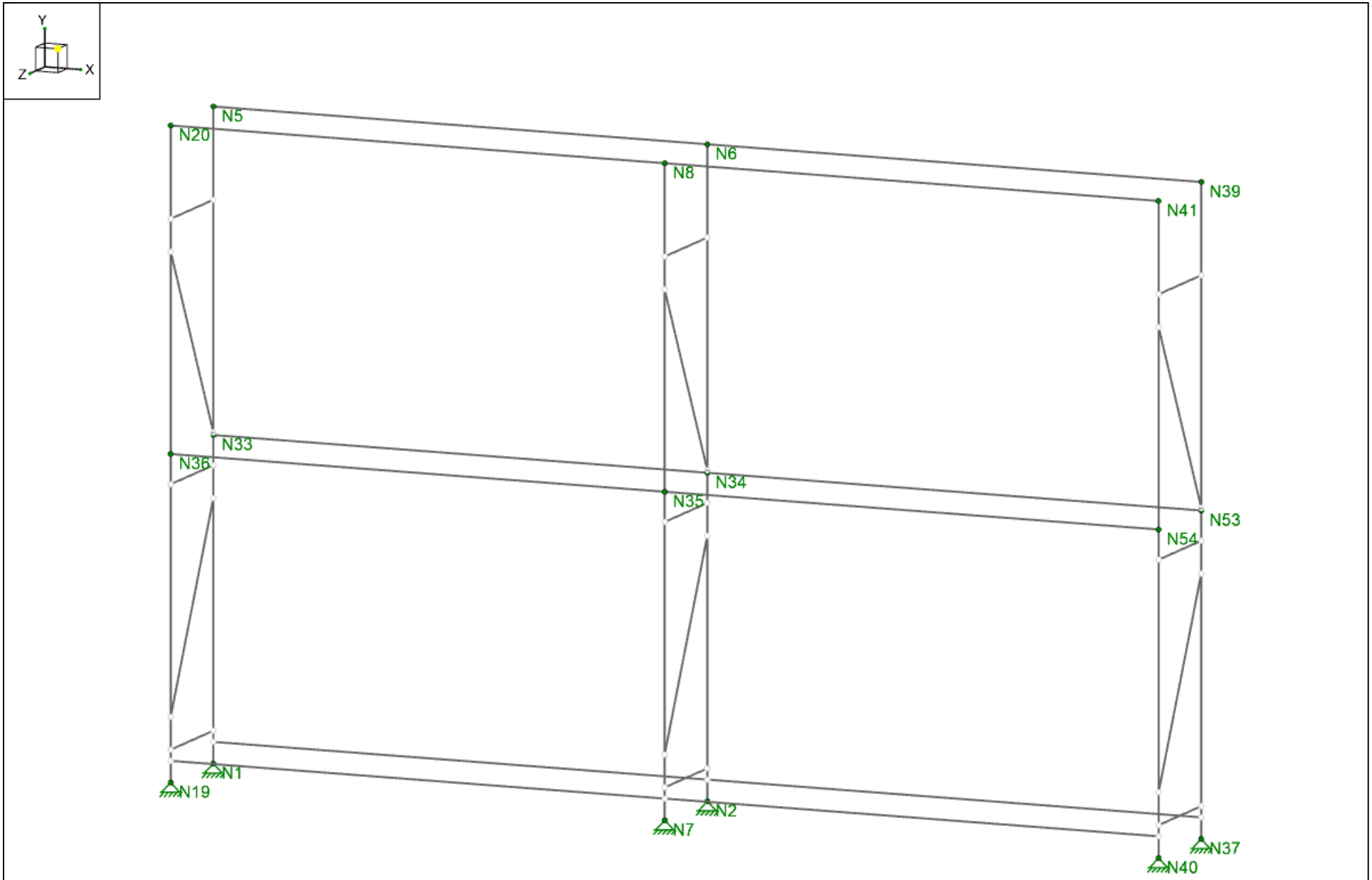
$M_{CONN\ CAPACITY}$ = (P1 * 2") = 2100 LBS-IN

$M_{CONN\ SEISMIC}$ = 1.33 * $M_{CONN\ CAPACITY}$ = 2793 LBS-IN

FROM MODEL RISA $M_{MAX\ BEAM}$ = 2,885 LBS-IN
FROM MODEL RISA $M_{MAX\ BEAM\ 25\%}$ = 721 LBS-IN < $M_{CONN\ SEISMIC}$

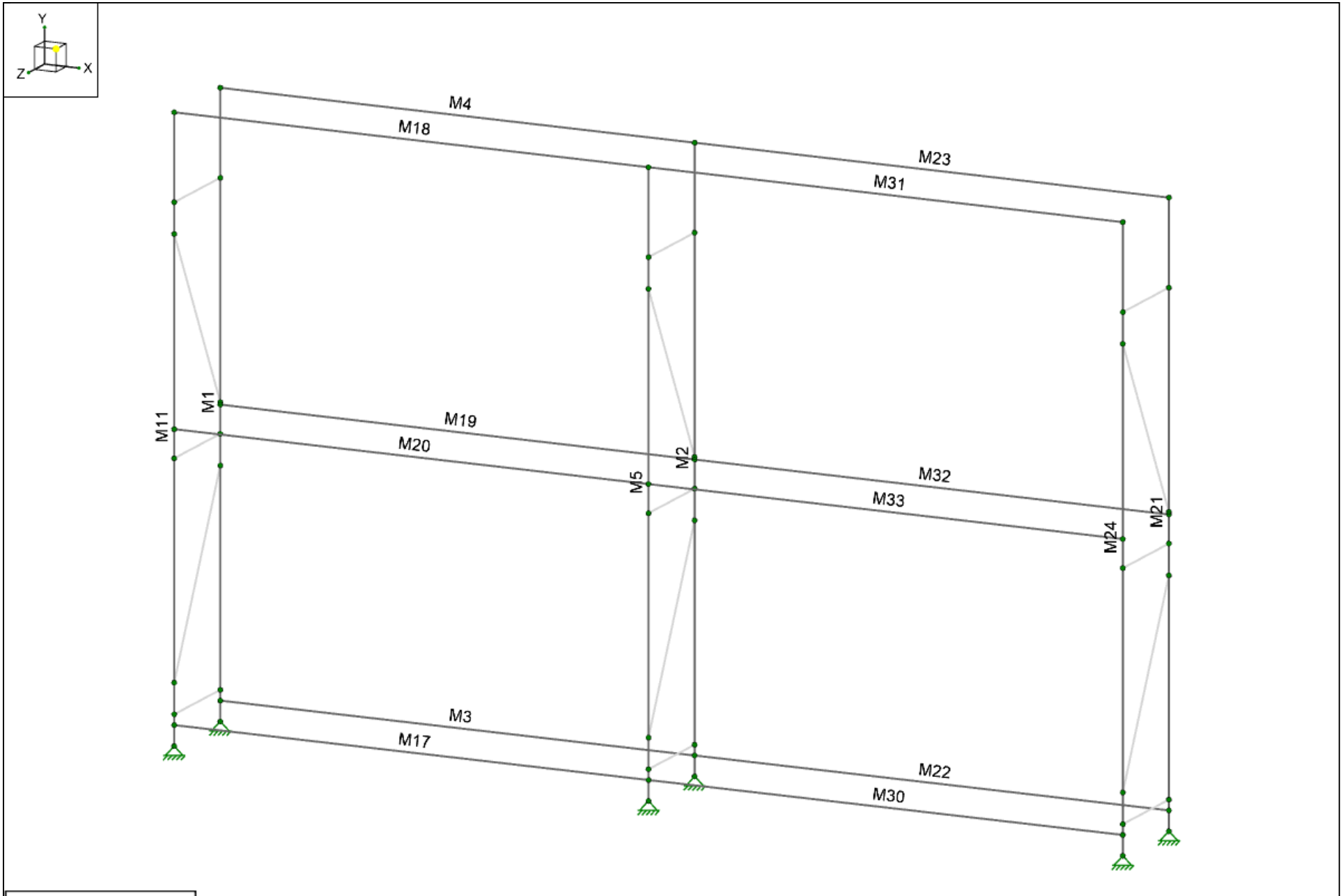
OK

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111



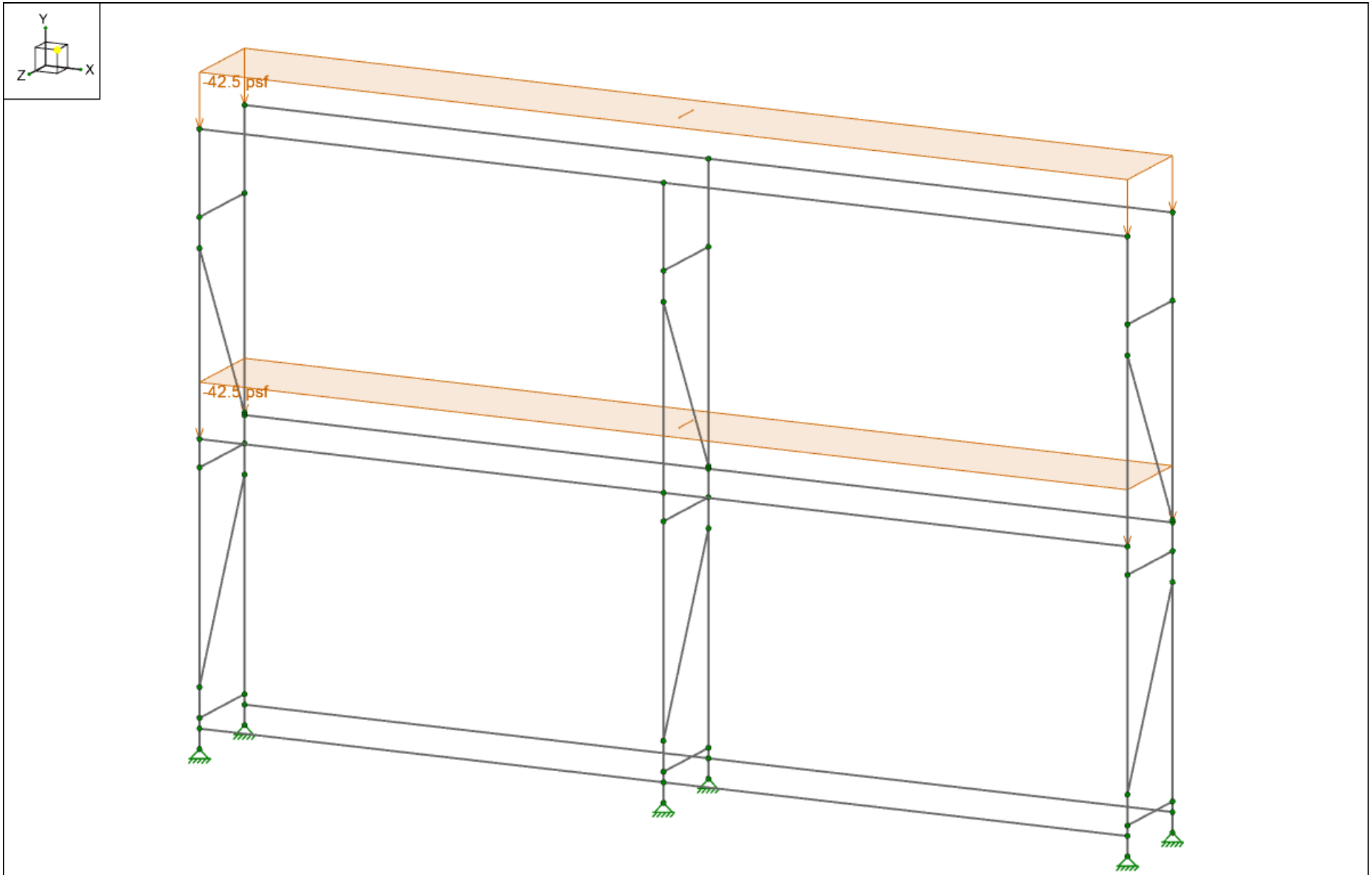
Envelope Only Solution

JPH & CLARK, Inc	Frame E4 (20"Bx96"Lx120"H) - Tail Pipe	SK-2
AA		Aug 31, 2026 at 10:19 PM
26-460 - Advanced Auto Parts	Nodes Layout	E4-Tail Pipe Rack -20x96x120 - 2Lvls - 2Ba



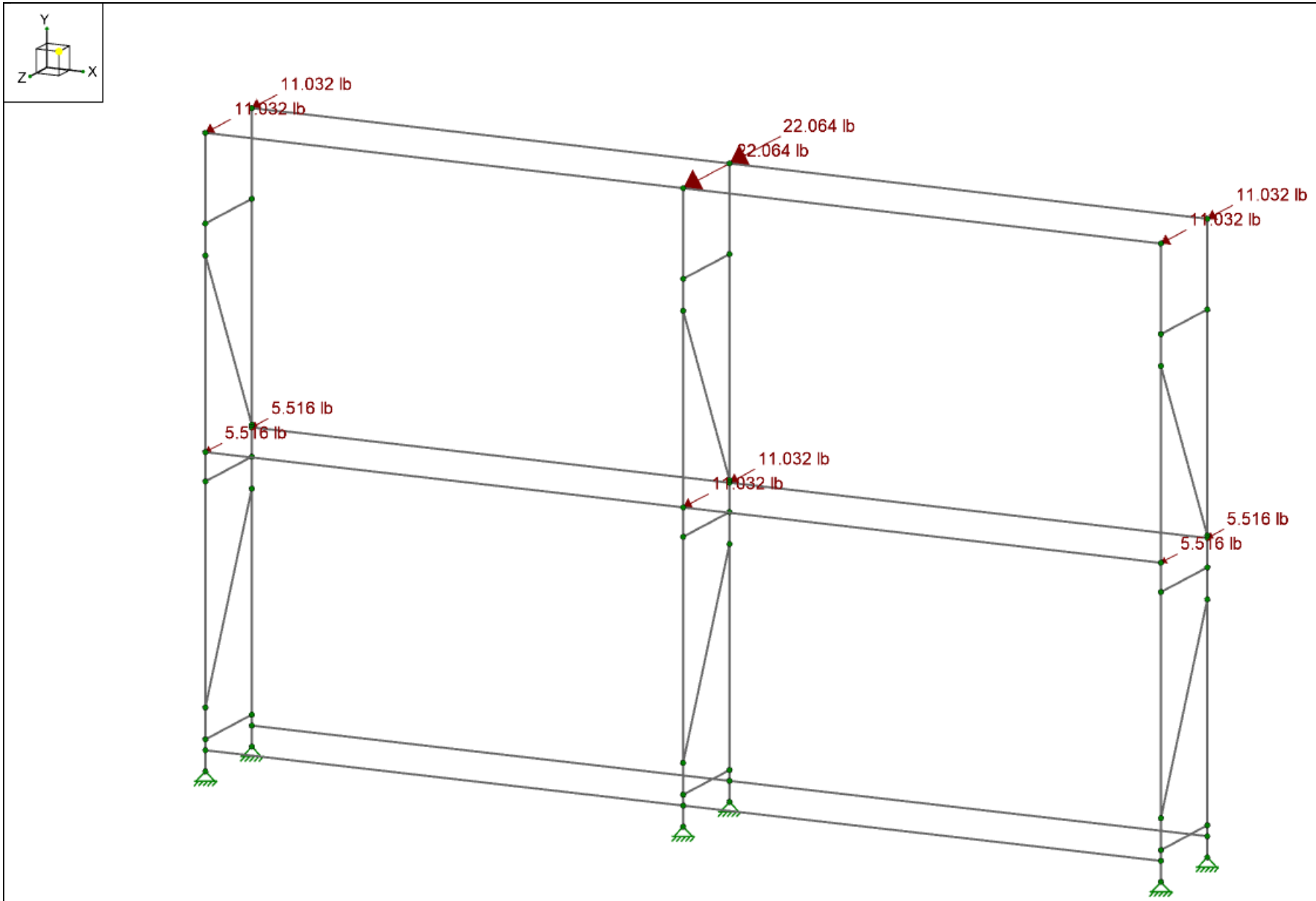
Envelope Only Solution

JPH & CLARK	JPH & CLARK, Inc	Frame E4 (20"Bx96"Lx120"H) - Tail Pipe	SK-3
	AA		Aug 31, 2026 at 10:20 PM
	26-460 - Advanced Auto Parts	Members Label	E4-Tail Pipe Rack -20x96x120 - 2Lvls - 2Ba



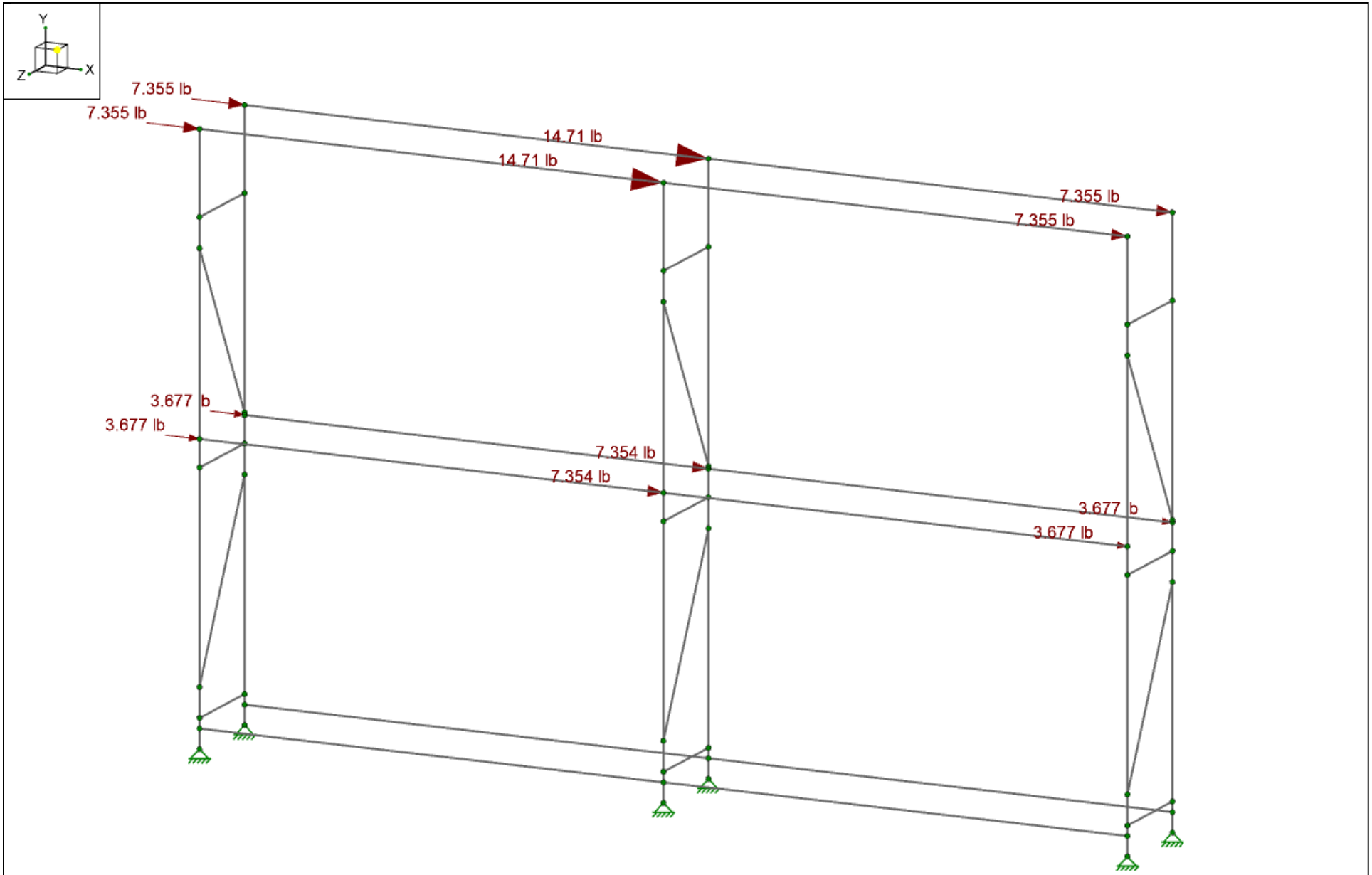
Loads: LC 3, LC-3
Envelope Only Solution

JPH & CLARK, Inc	Frame E4 (20"Bx96"Lx120"H) - Tail Pipe	SK-4
AA		Aug 31, 2026 at 10:21 PM
26-460 - Advanced Auto Parts	DL + LL	E4-Tail Pipe Rack -20x96x120 - 2Lvls - 2Ba



Loads: BLC 3, ELZ
Envelope Only Solution

JPH & CLARK, Inc	Frame E4 (20"Bx96"Lx120"H) - Tail Pipe		SK-5
AA			Aug 31, 2026 at 10:21 PM
26-460 - Advanced Auto Parts	ELZ		E4-Tail Pipe Rack -20x96x120 - 2Lvls - 2Ba



Loads: BLC 4, ELX
Envelope Only Solution

JPH & CLARK, Inc	Frame E4 (20"Bx96"Lx120"H) - Tail Pipe	SK-6
AA		Aug 31, 2026 at 10:21 PM
26-460 - Advanced Auto Parts	ELX	E4-Tail Pipe Rack -20x96x120 - 2Lvls - 2Ba

Node Boundary Conditions

	Node Label	X [k/in]	Y [k/in]	Z [k/in]
1	N1	Reaction	Reaction	Reaction
2	N2	Reaction	Reaction	Reaction
3	N7	Reaction	Reaction	Reaction
4	N19	Reaction	Reaction	Reaction
5	N37	Reaction	Reaction	Reaction
6	N40	Reaction	Reaction	Reaction

Cold Formed Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm. Coeff. [1e^{5}°F^{-1}]	Density [k/ft^{3}]	Yield [ksi]	Fu [ksi]
1	A570 Gr.33	29500	11346	0.3	0.65	0.49	33	52
2	A607 C1 Gr.55	29500	11346	0.3	0.65	0.49	55	70

Cold Formed Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rule	Area [in^{2}]	Iyy [in^{4}]	Izz [in^{4}]	J [in^{4}]
1	WS-UP	WS-COL1.625X1.75X14GA	Beam	CS	A570 Gr.33	Typical	0.372	0.133	0.202	0.000657
2	WS-BM	WS-BM3.25X16GA	Beam	CS	A570 Gr.33	Typical	0.413	0.116	0.572	0.001
3	WS-BRC	-WS-BRC-1.34X0.75X20GA	Beam	CU	A570 Gr.33	Typical	0.115	0.01	0.024	0.055

Basic Load Cases

	BLC Description	Category	Nodal	Distributed	Area(Member)
1	DL	DL			2
2	LL	LL			2
3	ELZ	ELZ	16		
4	ELX	ELX	16		
5	BLC 1 Transient Area Loads	None		8	
6	BLC 2 Transient Area Loads	None		8	

Load Combinations

	Description	Solve	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
1	LC-1	Yes	DL	1								
2	LC-2	Yes	LL	1								
3	LC-3	Yes	DL	1	LL	1						
4	LC-4-AEL	Yes	DL	1	LL	0.67						
5	LC-5	Yes	DL	1	LL	0.67	ELX	0.525				
6	LC-6	Yes	DL	1	LL	0.67	ELZ	0.525				
7	LC-7	Yes	DL	1	Sds*DL	0.105	LL	0.735	LL	0.016	Rho*ELX	0.525
8	LC-8	Yes	DL	1	Sds*DL	0.14	LL	0.595	LL	0.022	Rho*ELX	0.7
9	LC-9	Yes	DL	0.6	Sds*DL	-0.14	LL	0.402	LL	-0.021	Rho*ELX	0.7
10	LC-10	Yes	DL	1	Sds*DL	0.105	LL	0.735	LL	0.016	Rho*ELZ	0.525
11	LC-11	Yes	DL	1	Sds*DL	0.14	LL	0.595	LL	0.022	Rho*ELZ	0.7
12	LC-12	Yes	DL	0.6	Sds*DL	-0.14	LL	0.402	LL	-0.021	Rho*ELZ	0.7
13												
14	AB-FLC5-1	Yes	DL	1.2	Sds*DL	0.2	LL	0.84	LL	0.031	Om*ELX	1
15	AB-FLC5-2	Yes	DL	1.2	Sds*DL	0.2	LL	0.84	LL	0.031	Om*ELZ	1
16	AB-FLC5-3	Yes	DL	1.2	Sds*DL	0.2	LL	0.84	LL	0.031	Om*ELX	-1
17	AB-FLC5-4	Yes	DL	1.2	Sds*DL	0.2	LL	0.84	LL	0.031	Om*ELZ	-1
18	AB-FLC7-5	Yes	DL	0.9	Sds*DL	-0.2	LL	0.603	LL	-0.029	Om*ELX	1
19	AB-FLC7-6	Yes	DL	0.9	Sds*DL	-0.2	LL	0.603	LL	-0.029	Om*ELZ	1
20	AB-FLC7-7	Yes	DL	0.9	Sds*DL	-0.2	LL	0.603	LL	-0.029	Om*ELX	-1
21	AB-FLC7-8	Yes	DL	0.9	Sds*DL	-0.2	LL	0.603	LL	-0.029	Om*ELZ	-1

Member Area Loads (BLC 1 : DL)

	Node A	Node B	Node C	Node D	Direction	Load Direction	A Magnitude [psf]	B Magnitude [psf]	C Magnitude [psf]	D Magnitude [psf]	Exclude Braces
1	N20	N5	N39	N41	Y	A-B	-5	-5	-5	-5	Yes
2	N36	N33	N53	N54	Y	A-B	-5	-5	-5	-5	Yes

Member Area Loads (BLC 2 : LL)

	Node A	Node B	Node C	Node D	Direction	Load Direction	A Magnitude [psf]	B Magnitude [psf]	C Magnitude [psf]	D Magnitude [psf]	Exclude Braces
1	N20	N5	N39	N41	Y	A-B	-37.5	-37.5	-37.5	-37.5	Yes
2	N36	N33	N53	N54	Y	A-B	-37.5	-37.5	-37.5	-37.5	Yes

Node Loads and Enforced Displacements (BLC 3 : ELZ)

	Node Label	L, D, M	Direction	Magnitude [(lb, lb-ft), (in, rad), (lb*s²/in, lb*s²*in)]
1	N20	L	Z	11.032
2	N5	L	Z	11.032
3	N8	L	Z	11.032
4	N8	L	Z	11.032
5	N6	L	Z	11.032
6	N6	L	Z	11.032
7	N41	L	Z	11.032
8	N39	L	Z	11.032
9	N33	L	Z	5.516
10	N36	L	Z	5.516
11	N35	L	Z	5.516
12	N35	L	Z	5.516
13	N34	L	Z	5.516
14	N34	L	Z	5.516
15	N54	L	Z	5.516
16	N53	L	Z	5.516

Node Loads and Enforced Displacements (BLC 4 : ELX)

	Node Label	L, D, M	Direction	Magnitude [(lb, lb-ft), (in, rad), (lb*s²/in, lb*s²*in)]
1	N20	L	X	7.355
2	N5	L	X	7.355
3	N8	L	X	7.355
4	N8	L	X	7.355
5	N6	L	X	7.355
6	N6	L	X	7.355
7	N41	L	X	7.355
8	N39	L	X	7.355
9	N33	L	X	3.677
10	N36	L	X	3.677
11	N35	L	X	3.677
12	N35	L	X	3.677
13	N34	L	X	3.677
14	N34	L	X	3.677
15	N54	L	X	3.677
16	N53	L	X	3.677

Member Distributed Loads (BLC 5 : BLC 1 Transient Area Loads)

	Member Label	Direction	Start Magnitude [lb/ft, F, psf, lb-ft/in]	End Magnitude [lb/ft, F, psf, lb-ft/in]	Start Location [(in, %)]	End Location [(in, %)]
1	M4	Y	-4.167	-4.167	0	96
2	M18	Y	-4.167	-4.167	0	96
3	M23	Y	-4.167	-4.167	0	96
4	M31	Y	-4.168	-4.168	0	96
5	M19	Y	-4.167	-4.167	0	96
6	M20	Y	-4.167	-4.167	0	96
7	M32	Y	-4.167	-4.167	0	96

Member Distributed Loads (BLC 5 : BLC 1 Transient Area Loads) (Continued)

	Member Label	Direction	Start Magnitude [lb/ft, F, psf, lb-ft/in]	End Magnitude [lb/ft, F, psf, lb-ft/in]	Start Location [(in, %)]	End Location [(in, %)]
8	M33	Y	-4.168	-4.168	0	96

Member Distributed Loads (BLC 6 : BLC 2 Transient Area Loads)

	Member Label	Direction	Start Magnitude [lb/ft, F, psf, lb-ft/in]	End Magnitude [lb/ft, F, psf, lb-ft/in]	Start Location [(in, %)]	End Location [(in, %)]
1	M4	Y	-31.256	-31.256	0	96
2	M18	Y	-31.256	-31.256	0	96
3	M23	Y	-31.256	-31.256	0	96
4	M31	Y	-31.256	-31.256	0	96
5	M19	Y	-31.256	-31.256	0	96
6	M20	Y	-31.256	-31.256	0	96
7	M32	Y	-31.256	-31.256	0	96
8	M33	Y	-31.256	-31.256	0	96

Envelope Node Reactions

	Node Label		X [lb]	LC	Y [lb]	LC	Z [lb]	LC	MX [lb-ft]	LC	MY [lb-ft]	LC	MZ [lb-ft]	LC
1	N1	max	-3.304	1	252.18	3	-0.002	1	0	12	0	12	0	12
2		min	-28.081	3	-18.769	12	-25.012	11	0	1	0	1	0	1
3	N2	max	0	1	629.2	3	-0.1	1	0	12	0	12	0	12
4		min	-32.656	8	31.272	12	-46.862	11	0	1	0	1	0	1
5	N7	max	0	1	661.477	10	2.084	11	0	12	0	12	0	12
6		min	-32.462	8	74.319	1	0.058	1	0	1	0	1	0	1
7	N19	max	-3.326	1	287.434	11	1.067	11	0	12	0	12	0	12
8		min	-28.27	3	29.521	1	0.023	1	0	1	0	1	0	1
9	N37	max	28.081	3	252.18	3	0.002	9	0	12	0	12	0	12
10		min	3.304	1	-18.769	12	-25.012	11	0	1	0	1	0	1
11	N40	max	28.27	3	287.434	11	1.067	11	0	12	0	12	0	12
12		min	3.326	1	29.521	1	0.023	1	0	1	0	1	0	1
13	Totals:	max	0	1	2267.12	3	0	1						
14		min	-61.779	9	266.72	1	-92.669	11						

Envelope Maximum Member Section Forces

	Member		Axial[lb]	Loc[in]	LC	y Shear[lb]	Loc[in]	LC	z Shear[lb]	Loc[in]	LC	Torque[lb-ft]	Loc[in]	LC	y-y Moment[lb-ft]	Loc[in]	LC	z-z Moment[lb-ft]	Loc[in]	LC
1	M1	max	252.18	3.75	3	28.081	3.75	3	4.665	47.5	11	0.469	60	3	10.831	103.75	12	82.067	120	3
2		min	-19.353	5	12	-31.141	60	3	-25.46	48.75	11	-0.02	48.75	9	-10.423	5	11	-73.657	60	3
3	M2	max	635.356	53.75	3	32.656	3.75	8	8.876	47.5	11	0.007	47.5	8	20.286	48.75	11	28.549	5	8
4		min	31.272	0	12	0	0	1	-47.94	48.75	11	-0.123	60	8	-19.523	5	11	-29.341	60	8
5	M3	max	-4.794	96	1	1.47	96	3	0.002	96	3	0	96	3	0.013	96	3	18.624	96	9
6		min	-40.749	0	3	-4.758	0	9	-0.015	0	12	-0.003	0	12	-0.117	96	12	-19.438	0	9
7	M4	max	30.847	96	3	121.901	0	3	0.01	96	3	0	96	1	0.077	96	3	240.422	96	3
8		min	3.629	0	1	-161.489	96	3	-0.272	0	12	-0.005	0	11	-2.163	96	12	-127.665	41	3
9	M5	max	663.814	5	10	0	120	12	53.716	11.25	11	0.04	11.25	8	12.358	11.25	11	29.163	60	9
10		min	37.787	61.25	1	-32.462	0	8	-5.5	60	12	-0.006	12.5	8	-21.919	97.5	12	-28.472	5	8
11	M6	max	-0.213	20.004	1	1.335	20.004	3	0.026	20.004	8	0	20.004	12	0.036	20.004	8	10.386	20.004	12
12		min	-55.768	0	11	-11.652	0	12	0	0	1	-0.003	0	8	-0.007	0	9	-9.038	0	12
13	M7	max	123.124	41.605	11	2.718	41.605	11	0	41.605	12	0	41.605	12	0.187	0	8	4.79	0	11
14		min	0.6	0	1	0.02	0	1	-0.057	0	8	-0.05	0	9	-0.011	41.605	8	-4.632	41.605	11
15	M8	max	-0.212	20.004	1	5.489	20.004	12	0.026	20.004	8	0	20.004	12	0.039	20.004	8	2.153	0	12
16		min	-5.361	0	11	-0.368	0	3	0	0	1	-0.017	0	8	-0.004	0	8	-6.997	20.004	12
17	M9	max	2.811	41.605	3	0.105	41.605	3	0.099	41.605	8	0.136	41.605	9	0	41.605	12	5.919	41.605	12
18		min	-91.953	0	12	-3.124	0	12	0	0	1	0	0	1	-0.509	0	8	-4.913	0	12
19	M10	max	21.203	20.004	12	16.046	20.004	11	0	20.004	12	0	20.004	12	0.035	0	9	15.578	0	11
20		min	-0.536	0	3	0.099	0	1	-0.023	0	8	-0.015	0	9	-0.003	20.004	8	-11.171	20.004	11
21	M11	max	287.434	3.75	11	31.328	102.5	3	28.579	11.25	11	0.019	96.25	3	6.463	11.25	11	72.454	60	3
22		min	14.252	61.25	1	-28.27	0	3	-3.038	60	12	-0.107	97.5	3	-11.985	97.5	12	-82.367	120	3
23	M12	max	-0.04	20.004	1	0.61	20.004	3	0.005	20.004	9	-0.001	20.004	1	0.006	0	3	5.641	20.004	12
24		min	-29.662	0	11	-6.334	0	12	-0.033	0	3	-0.007	0	8	-0.049	20.004	3	-4.919	0	12
25	M13	max	65.28	41.605	11	1.44	41.605	11	0.058	41.605	3	-0.032	41.605	1	0.563	41.605	3	2.543	0	11
26		min	0.135	0	1	0.006	0	1	-0.018	0	9	-0.269	0	3	0.043	0	1	-2.449	41.605	11

Envelope Maximum Member Section Forces (Continued)

	Member		Axial[lb]	Loc[in]	LCy	Shear[lb]	Loc[in]	LCz	Shear[lb]	Loc[in]	LC	Torque[lb-ft]	Loc[in]	LCy-y Moment[lb-ft]	Loc[in]	LCz-z Moment[lb-ft]	Loc[in]	LC
27	M14	max	-0.072	20.004	1	2.959	20.004	12	0.01	20.004	12	0.031	20.004	3	0.016	20.004	9	1.16	0	12
28		min	-2.523	0	11	-0.197	0	3	-0.026	0	3	-0.006	0	9	-0.03	20.004	3	-3.773	20.004	12
29	M15	max	1.245	41.605	3	0.052	41.605	3	-0.042	41.605	1	-0.047	41.605	1	1.716	0	3	3.222	41.605	12
30		min	-49.888	0	12	-1.701	0	12	-0.36	0	3	-0.399	0	3	0.055	41.605	1	-2.675	0	12
31	M16	max	11.397	20.004	12	8.608	20.004	11	0.069	20.004	10	-0.002	20.004	1	0.019	20.004	11	8.384	0	11
32		min	-0.251	0	3	0.036	0	1	0.008	0	1	-0.024	0	8	-0.105	0	3	-5.965	20.004	11
33	M17	max	-4.854	96	1	1.485	96	3	0.001	96	8	0	96	3	0.01	96	3	18.533	96	9
34		min	-41.263	0	3	-4.732	0	9	-0.016	0	12	-0.003	0	12	-0.12	96	12	-19.321	0	9
35	M18	max	31.262	96	3	121.957	0	3	0.011	96	3	0	96	1	0.083	96	3	240.27	96	3
36		min	3.678	0	1	-161.433	96	3	-0.338	0	12	-0.009	0	11	-2.686	96	12	-127.558	41	3
37	M19	max	-2.173	96	1	128.223	0	3	0.119	96	3	0	96	1	0.484	96	3	223.999	96	3
38		min	-18.474	0	3	-155.167	96	3	-0.096	0	12	-0.003	0	11	-0.84	96	12	-115.817	43	3
39	M20	max	-2.115	96	1	128.071	0	3	0.036	96	3	0	96	12	0.264	96	3	224.4	96	3
40		min	-17.974	0	3	-155.319	96	3	-0.088	0	12	0	0	3	-0.693	96	12	-116.089	43	3
41	M21	max	252.18	3.75	3	31.141	60	3	4.665	47.5	11	0.008	47.5	8	10.831	103.75	12	73.657	60	3
42		min	-19.353	5	12	-28.081	0	3	-25.46	48.75	11	-0.469	60	3	-10.423	5	11	-82.067	120	3
43	M22	max	-4.794	96	1	-0.173	96	1	0.015	96	12	0.003	96	12	0.013	0	3	27.797	96	8
44		min	-40.749	0	3	-6.329	0	8	-0.002	0	3	0	0	3	-0.117	0	12	-22.832	0	8
45	M23	max	30.847	96	3	161.489	0	3	0.272	96	12	0.005	96	11	0.077	0	3	240.422	0	3
46		min	3.629	0	1	-121.901	96	3	-0.01	0	3	0	0	1	-2.163	0	12	-127.665	55	3
47	M24	max	287.434	3.75	11	28.27	3.75	3	28.579	11.25	11	0.107	102.5	3	6.463	11.25	11	82.367	120	3
48		min	14.252	61.25	1	-31.328	97.5	3	-3.038	60	12	-0.019	60	3	-11.985	97.5	12	-72.454	60	3
49	M25	max	-0.04	20.004	1	0.61	20.004	3	0.04	20.004	8	0.005	20.004	3	0.058	20.004	8	5.641	20.004	12
50		min	-29.662	0	11	-6.334	0	12	0.004	0	1	-0.002	0	9	-0.009	0	8	-4.919	0	12
51	M26	max	65.28	41.605	11	1.44	41.605	11	-0.007	41.605	1	0.269	41.605	3	0.047	0	9	2.543	0	11
52		min	0.135	0	1	0.006	0	1	-0.08	0	8	0.032	0	1	-0.563	41.605	3	-2.449	41.605	11
53	M27	max	-0.072	20.004	1	2.959	20.004	12	0.036	20.004	8	-0.004	20.004	1	0.049	20.004	8	1.16	0	12
54		min	-2.523	0	11	-0.197	0	3	-0.01	0	12	-0.039	0	8	-0.013	0	3	-3.773	20.004	12
55	M28	max	1.245	41.605	3	0.052	41.605	3	0.36	41.605	3	0.399	41.605	3	-0.055	41.605	1	3.222	41.605	12
56		min	-49.888	0	12	-1.701	0	12	0.042	0	1	0.047	0	1	-1.716	0	3	-2.675	0	12
57	M29	max	11.397	20.004	12	8.608	20.004	11	-0.008	20.004	1	0.015	20.004	3	0.105	0	3	8.384	0	11
58		min	-0.251	0	3	0.036	0	1	-0.069	0	10	-0.008	0	9	-0.019	20.004	11	-5.965	20.004	11
59	M30	max	-4.854	96	1	-0.175	96	1	0.016	96	12	0.003	96	12	0.01	0	3	27.766	96	8
60		min	-41.263	0	3	-6.319	0	8	-0.001	0	3	0	0	3	-0.12	0	12	-22.784	0	8
61	M31	max	31.262	96	3	161.433	0	3	0.338	96	12	0.009	96	11	0.083	0	3	240.27	0	3
62		min	3.678	0	1	-121.957	96	3	-0.011	0	3	0	0	1	-2.686	0	12	-127.558	55	3
63	M32	max	-2.173	96	1	155.167	0	3	0.096	96	12	0.003	96	11	0.484	0	3	223.999	0	3
64		min	-18.474	0	3	-128.223	96	3	-0.119	0	3	0	0	1	-0.84	0	12	-115.817	53	3
65	M33	max	-2.115	96	1	155.319	0	3	0.088	96	12	0	96	3	0.264	0	3	224.4	0	3
66		min	-17.974	0	3	-128.071	96	3	-0.036	0	3	0	0	12	-0.693	0	12	-116.089	53	3

Material Take-Off

	Material	Size	Pieces	Length[in]	Weight[K]
1	Cold Formed Steel				
2	A570 Gr.33	-WS-BRC-1.34X0.75X20GA	15	429.7	0.014
3	A570 Gr.33	WS-BM3.25X16GA	12	1152	0.135
4	A570 Gr.33	WS-COL1.625X1.75X14GA	6	720	0.076
5	Total CF Steel		33	2301.7	0.225

Base Plate Design & Punching Shear

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

ANCHOR PLATE DESIGN OF FRAMES (A,A1,A2)

FRAME	MAX. SHEAR (LBS)	MAX. UPLIFT PLATE CONN. (LBS)	MAX. COMP. (LBS)
A	13	1	521
A1	4	1	299
-	-	-	-
-	-	-	-
-	-	-	-
MAX. LOADS	50	4	521
	EVERY 4th FRAME		

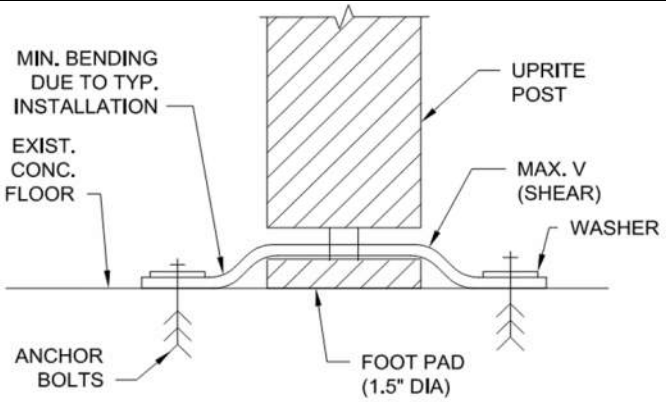
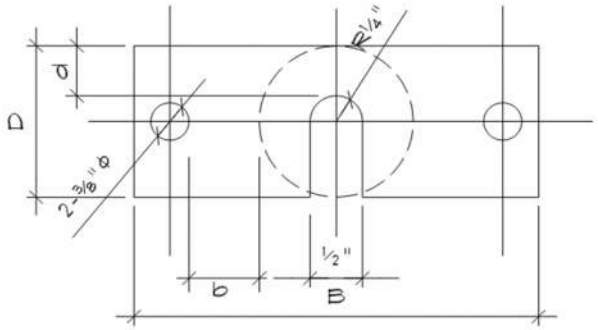


PLATE DIMENSIONS :

B:	3 1/2	in
D:	1 1/2	in
t_1 :	12	GA

UPRITE POST PAD DIM. :

DIAM. :	1.5	in



ANCHOR PLATE SHEAR CHECK :

Fy :	38	ksi	
d :	0.56	in	
t_1 :	0.105	in	
$V_{Allow} = 0.6Fy\ L_1\ t_1/1.67$:	802	lbs	**OK**

BEARING ON CONCRERTE :

f'c :	2,500	psi	
F'p :	1,750	psi	
Aeff. :	1.77	in2	
P_{Allow} :	3,092	lbs	**OK**

ANCHOR PLATE UPLIFT CHECK :

b :	0.3125	in	
S :	0.0010	in3	
Mallow = 0.6 x38ksi x S =	22.8	lbs-in	
Uplift $_{ALLOW}$ = (Mallow / b) x 2 =	146	lbs	**OK**

SPEC'ED MATERIAL MUST BEND 180° FLAT ON ITSELF IN ANY DIRECTION WITHOUT CRACKING OUTSIDE MATERIAL.

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

ANCHOR PLATE DESIGN OF FRAMES (B,C,E4)

FRAME	MAX. SHEAR (LBS)	MAX. UPLIFT PLATE CONN. (LBS)	MAX. COMP. (LBS)
B	68	0	1485
C	89	0	1970
E4	47	0	661
-	-	-	-
MAX. LOADS	354	0	1970
	EVERY 4th FRAME		

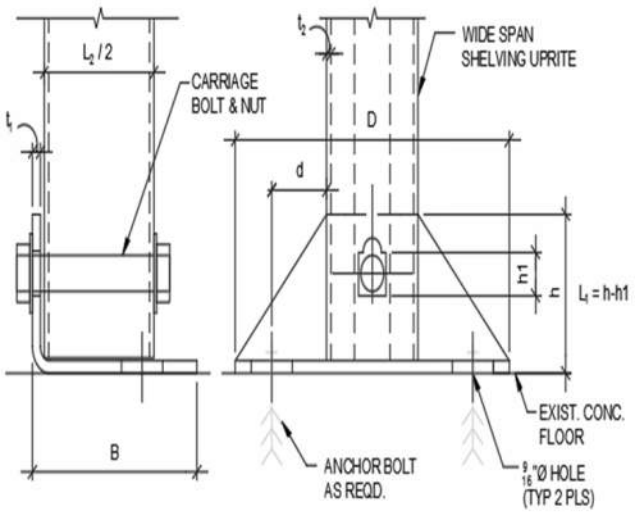


PLATE DIMENSIONS :

B:	2.25	in
D:	3.75	in
h :	1.375	in
h1 :	0.5	in
t_1 :	12	GA

ANCHOR PLATE SHEAR CHECK :

Fy :	30	ksi	
L_1:	0.875	in	
t_1 :	0.105	in	
$V_{Allow} = 0.6Fy\ L_1\ t_1/1.67$:	990	lbs	**OK**

UPLIFT/TENSION FORCE CHECK:

b :	0.75	in	
S :	0.0069	in3	
Mallow = 0.6 x30ksi x S =	126.0	lbs-in	
Uplift $_{ALLOW}$ = (Mallow / b) =	168	lbs	**OK**

BEARING ON CONCRERTE :

f'c :	2,500	psi	
F'p :	1,750	psi	
Aeff. :	8.44	in2	(2.25in x 3.75in)
P_{Allow} :	14,765	lbs	**OK**

UPRITE SHEAR CHECK :

Fy :	30	ksi	
t_2 :	14	GA	
	0.072	in	
L_2:	6	in	
$V_{Allow} = 0.6Fy\ L_2\ t_2 / 1.67$:	4,656	lbs	**OK**

CONNECTION SCREW/BOLT SHEAR CHECK :

METAL SCREW :	5/16	in ASTM A449
Fu1 :	47	ksi (12 GA MATL. IN CONTACT WITH SCREW HEAD)
Fu2 :	47	ksi (14 GA MATL. NOT IN CONTACT WITH SCREW HEAD)
Dia. :	5/16	in
t2/t1:	1.46	

AISI S100-16; J4.3 Ω : 3.0

FOR t2/t1 ≤ 1.0, Pnv (kips)		FOR t2/t1 ≥ 2.5, Pnv (kips)		FOR 1.0 < t2/t1 < 2.5, Pnv (kips)
Pnv :	3.75	Pnv :	4.16	Pnv : 2.86
Pnv :	4.16	Pnv :	2.86	
Pnv :	2.86			
MIN.	2.86	MIN.	2.86	

Pnv / 3 :	951.75	lbs	**OK**

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

ANCHOR PLATE DESIGN OF FRAMES (E,E1)

FRAME	MAX. SHEAR (LBS)	MAX. UPLIFT PLATE CONN. (LBS)	MAX. COMP. (LBS)
E	20	58	420
E1	39	30	893
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
MAX. LOADS	78	116	893
	EVERY 2nd FRAME		

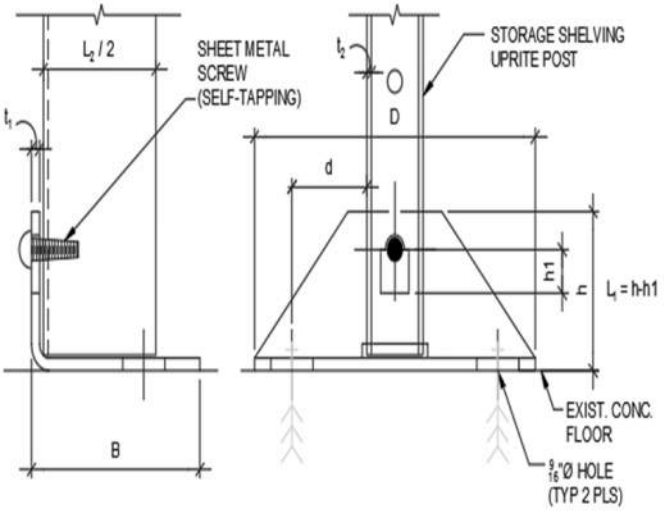


PLATE DIMENSIONS :

B :	2.25	in
D :	3.75	in
h :	1.375	in
h1 :	0.5	in
t_1 :	12	GA

ANCHOR PLATE SHEAR CHECK :

Fy :	30	ksi	
L_1:	0.875	in	
t_1 :	0.105	in	
V_{Allow} :	990	lbs	**OK**

UPLIFT/TENSION FORCE :

d :	1.00	in	
S :	0.058	in3	
Anchorage :	1	side	
M_{Allow} :	1,052	lbs-in	
$Uplift_{Allow}$:	2,103	lbs	**OK**

BEARING ON CONCRERTE :

f'c :	2,500	psi	
F'p :	1,750	psi	
Aeff. :	8.44	in2	(2.25in x 3.75in)
P_{Allow} :	14,765	lbs	**OK**

UPRITE SHEAR CHECK :

Fy :	30	ksi	
t_2 :	16	GA	
	0.061	in	
L_2:	1.5	in	
V_{Allow} :	986	lbs	**OK**

CONNECTION SCREW SHEAR CHECK :

METAL SCREW :	#10	
Fu1 :	45	ksi (12 GA MATL. IN CONTACT WITH SCREW HEAD)
Fu2 :	45	ksi (16 GA MATL. NOT IN CONTACT WITH SCREW HEAD)
Dia. :	15/79	in
t2/t1:	1.72	

AISI S100-16; J4.3 Ω : 3.0

FOR t2/t1 ≤ 1.0, Pnv (kips)		FOR t2/t1 ≥ 2.5, Pnv (kips)		FOR 1.0 < t2/t1 < 2.5, Pnv (kips)	
Pnv :	2.80	Pnv :	2.42	Pnv :	1.41
Pnv :	2.42	Pnv :	1.41		
Pnv :	1.41				
MIN.	1.41	MIN.	1.41		

Pnv / 3 : 469.40 lbs **OK**

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

SLAB PUNCH SHEAR FOR FRAME A, A1

ASSUME CONCRETE IS AS FOLLOW

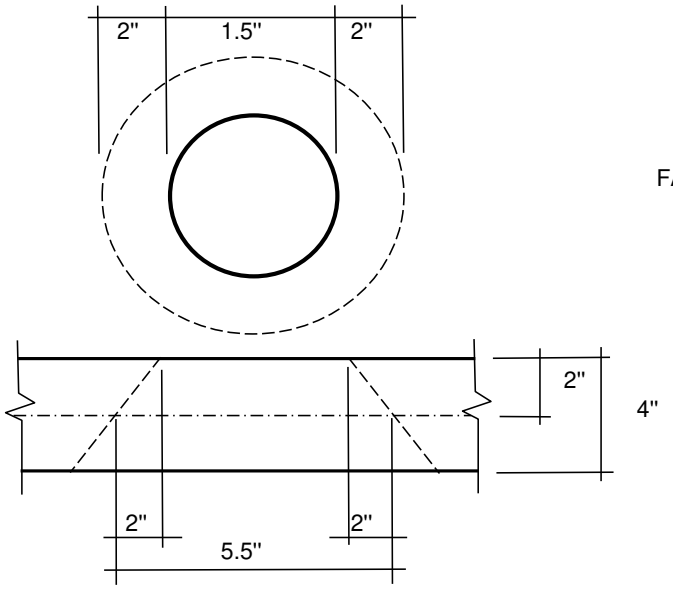
THICK CONCRETE SLAB (t) = 4.0 in d = 2 in

f'c = 2,500 PSI MIN (NO INSPECTION)

ALLOWABLE SOIL BEARING PRESSURE = 750 PSF

Pmax (DL+LL+SEISMIC) < P = 521 LBS AREA REQ'D = 521.33 / 750 = 0.7 FT^2

BEARING PLATE = 1.50 in TYP. AREA = 1.77 in^2



AREA USED			BEARING PRESSURE
FT	FT	(FT^2)	(LBS/FT^2)
1.67	1.67	2.79	186.93

FACTOR OF SAFETY = 750 PSF / 186.93 PSF = 4.01 **OK**

FOR TWO WAY DIAGONAL TENSION ACTION

SHEAR

Vu = 2 x TLmax x (EFFECTIVE AREA)

Vu = 2 x 186.9 PSF x (2.79 FT^2 - 0.165 FT^2)

Vu = 981 LBS

d = 2.00 IN

bo = (2 x PI x 2.75")

bo = 17.28 IN

Vallow = 0.85 x 2 x sqrt(2500 PSI) x 17.28 x 2"

= 2938 LBS

Vallow > v_u **OK**

LENGTH = (2 x PI x 2.75") = 17.28"

AREA = L x d = 17.28" x 2"

= 34.56 IN^2

v_u = 981 LBS / 34.56 IN^2

= 28.38 PSI

Vallow = 0.85 x 2 x sqrt(2500 PSI)

= 85.00 PSI

Vallow > v_u **OK**

JPH & CLARK, INC.

CONSULTING STRUCTURAL ENGINEERING

1801 N. HAMPTON RD., SUITE 440

DESOTO, TX 75115-2399

(972) 283-5111

SLAB PUNCH SHEAR FOR FRAME B, C, E, E1, E4

ASSUME CONCRETE IS AS FOLLOW

THICK CONCRETE SLAB (t) = 4.0 in d = 4 in

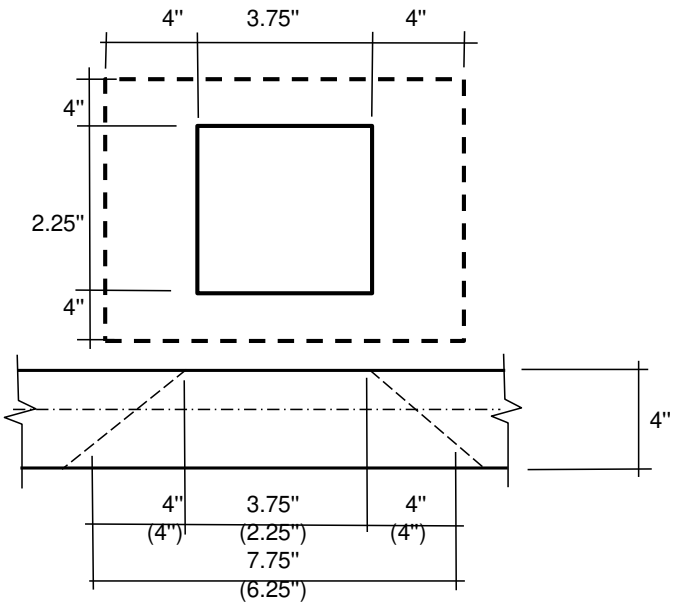
f'c = 2,500 PSI MIN (NO INSPECTION)

ALLOWABLE SOIL BEARING PRESSURE = 750 PSF

Pmax (DL+LL+SEISMIC) < P = 1,970 LBS AREA REQ'D = 1969.539 / 750 = 2.63 FT^2

BEARING PLATE 3.75 x 2.25 in TYP. AREA = 8.44 in^2

AREA USED			BEARING PRESSURE
FT	FT	(FT^2)	(LBS/FT^2)
2	1.75	3.50	562.73



FACTOR OF SAFETY = 750 PSF / 562.73 PSF = 1.33 **OK**

FOR TWO WAY DIAGONAL TENSION ACTION

SHEAR

Vu = 1.7 x TLmax x (EFFECTIVE AREA)

Vu = 1.7 x 562.7 PSF x (3.5 FT^2 - 0.8364 FT^2)

Vu = 2548 LBS

d = 4.00 IN

bo = [2 (2.25" +8")] + [2 (3.75" +8")]

bo = 44.00 IN

Vallow = 0.85 x 2 x sqrt(2500 PSI) x 44 x 4"

= 14960 LBS

Vallow > v_u **OK**

LENGTH = (11.75" x 2) + (10.25" x 2) = 44

AREA = L x d = 44" x 4"

= 176.00 IN^2

v_u = 2548 LBS / 176 IN^2

= 14.48 PSI

Vallow = 0.85 x 2 x sqrt(2500 PSI)

= 85.00 PSI

Vallow > v_u **OK**

JPH & CLARK, INC.

CONSULTING STRUCTURAL ENGINEERING

1801 N. HAMPTON RD., SUITE 440

DESOTO, TX 75115-2399

(972) 283-5111

Project Title:
Engineer:
Project ID:
Project Descr:

Point Load on Slab

Project File: SLAB-ON-GRADE.ec6

LIC# : KW-06014565, Build:20.24.12.17 JOE P. HILL, PE INC (c) ENERCALC, LLC 1982-2026

DESCRIPTION: SLAB ON GRADE FOR ALL FRAMES

Code References

Calculations per IBC 2021
Load Combinations Used : ASCE 7-22 / IBC 2024

Analytical Values

d - Slab Thickness	4.0 in	Ks - Soil Modulus of Subgrade Reac	50.0 pci
FS - Req'd Factor of Safety	3.0 : 1	Ec - Concrete Elastic Modulus	3,122.02 ksi
		f'c - Concrete Compressive Strength	2.50 ksi
		μ - Poisson's Ratio	0.150
		ϕ - LRFD Reduction Factor	0.850
		Min. Adjacent Load Distance	36.239 in

Analysis Formulas

Pn = 1.72 [(Ks R1 / Ec) 10,000 + 3.6] Fr d²

Ks = Soil modulus of subgrade reaction
R1 = 50% plate average dimension = sqrt(PlWid * PlLe
Ec = Concrete elastic modulus
Fr - Concrete modulus of rupture = 7.5 * sqrt(f'c)
d - Slab Thickness

Min Adjacent Column Distance = 1.5 * ([Ec d^3 / (12 * (1- u^2) Ks] ^ .

Ec = Concrete elastic modulus
d - Slab Thickness
u - Poisson's ratio
Ks = Soil modulus of subgrade reaction

Load & Capacity Table

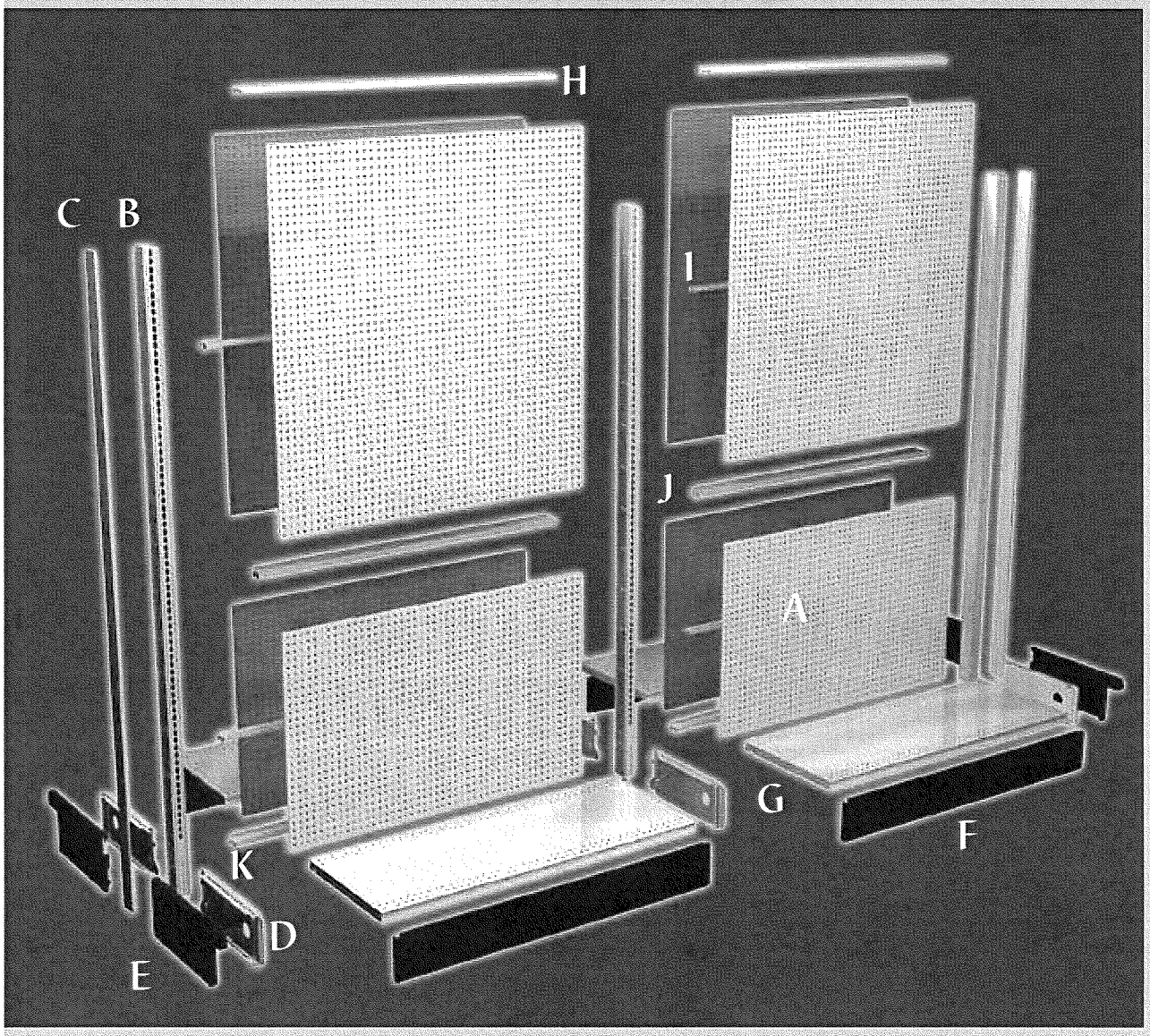
Load ID	Plate (in) Wid	Len	R1 (in)	Applied Concentrated Load on Plate - (kip) D	Lr	L	S	W	E	Governing Ld Comb	Pu (kip)	Phi*Pn (kip)	Check
A	1.50	1.50	0.75			0.52				+1.60L	0.8	32.6	Pass, FS=39.15 >= 3
, C,E,E1,E	3.75	2.25	1.45			1.98				+1.60L	3.2	33.6	Pass, FS=10.62 >= 3

Appendix A

Typical Lozier Technical Specifications

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

Island Section Exploded



Components:

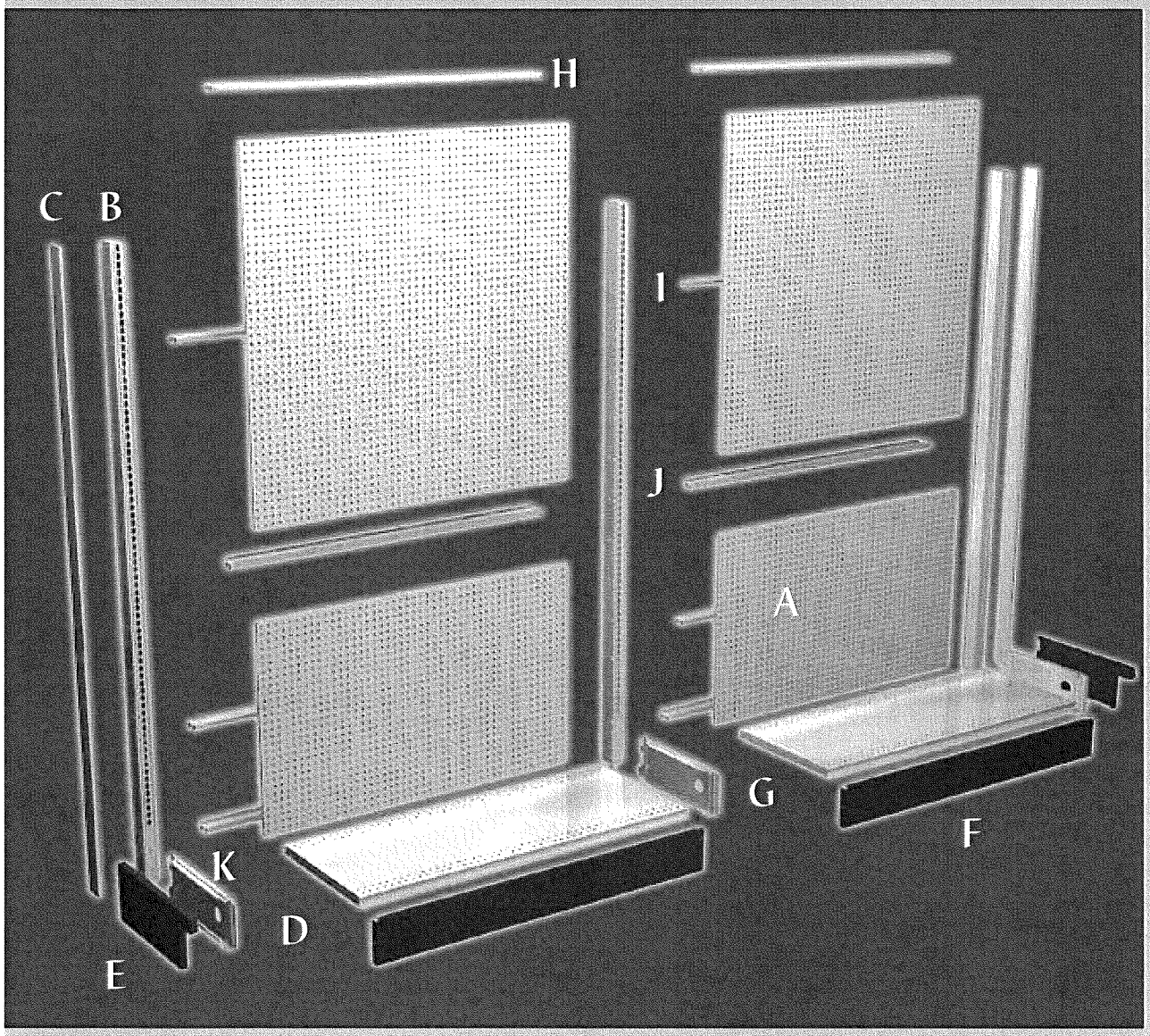
A	=	Back	G	=	Base Deck
B	=	Uprite	H	=	Top Rail
C	=	Uprite End Trim	I	=	Center Rail
D	=	Base Brackets	J	=	Splicer Rail
E	=	Base End Trim	K	=	Bottom Rail
F	=	Closed Base Front			

LOZIER®
© 2005 Lozier® Corporation

P.O. BOX 3448 • OMAHA, NEBRASKA 68103-0448 • (800) 228-9882

This is a copyrighted work of Lozier Corporation. Any unauthorized reproduction, distribution or use is expressly prohibited.

Wall Section Exploded



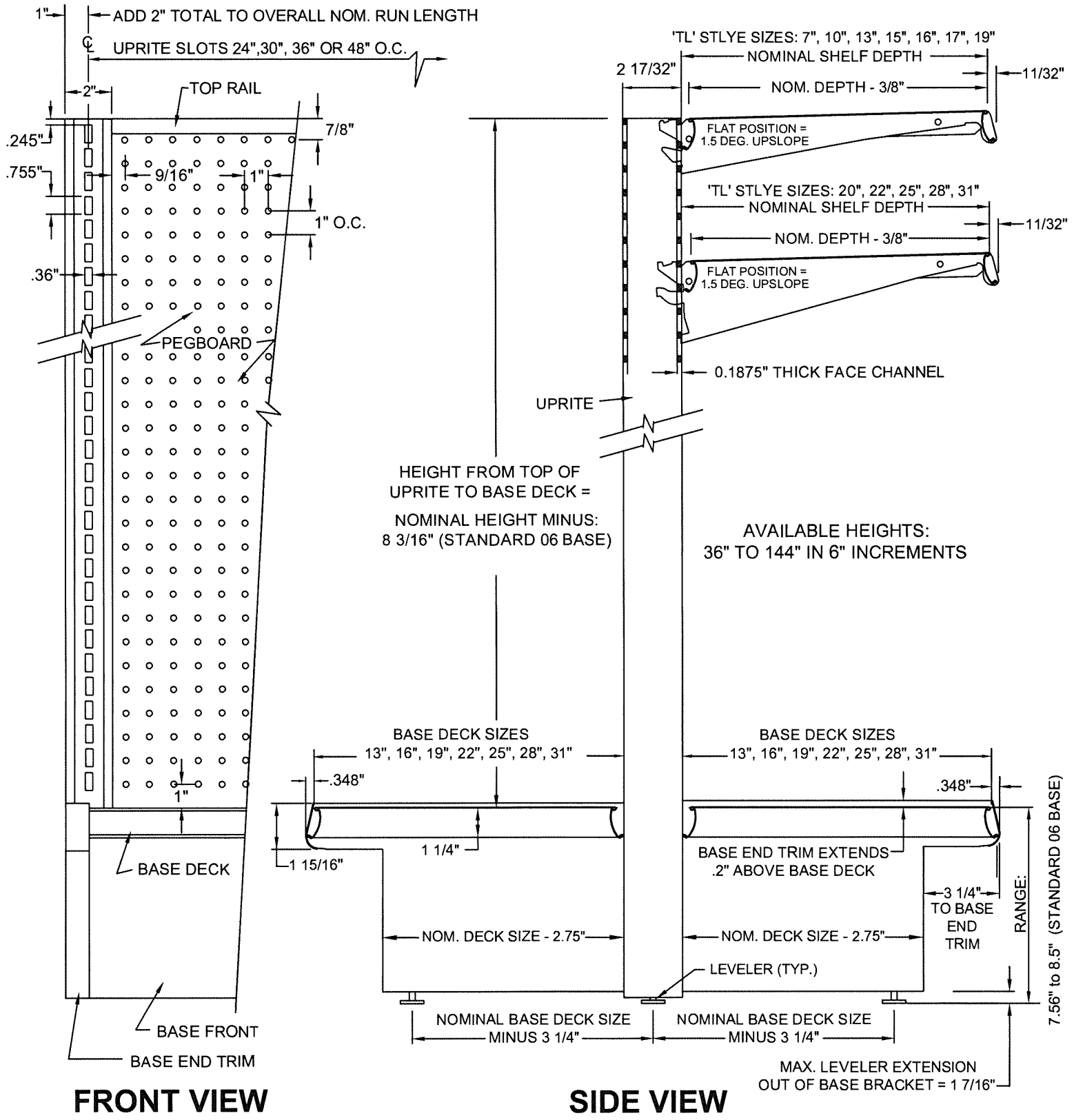
Components:					
A	=	Back	G	=	Base Deck
B	=	Uprite	H	=	Top Rail
C	=	Uprite End Trim	I	=	Center Rail
D	=	Base Brackets	J	=	Splicer Rail
E	=	Base End Trim	K	=	Bottom Rail
F	=	Closed Base Front			

LOZIER®
© 2005 Lozier® Corporation

P.O. BOX 3448 • OMAHA, NEBRASKA 68103-0448 • (800) 228-9882

This is a copyrighted work of Lozier Corporation. Any unauthorized reproduction, distribution or use is expressly prohibited.

BASIC SHELVING SYSTEM DIMENSIONS



FRONT VIEW **SIDE VIEW**

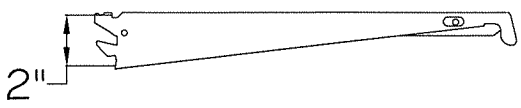
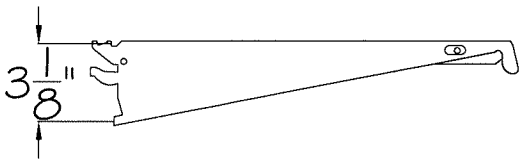
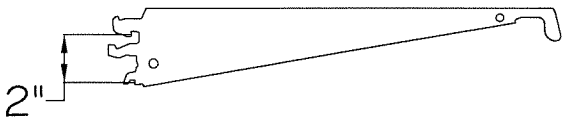
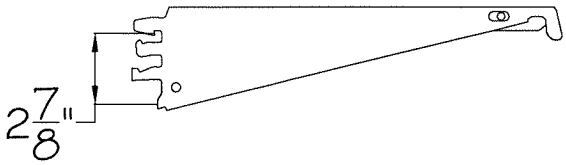
©2001 LOZIER CORP.

6336 PERSHING DR. OMAHA, NE 68110 1-800-228-9882

This drawing and its contents are the exclusive and confidential property of Lozier Corporation and its affiliated companies. The drawing is provided only for the purposes intended and shall at all times be kept confidential by the customer or supplier, who shall not, without the prior written consent of Lozier, diclose, use or disseminate, in whole or in part, this drawing, its contents, or concepts, and shall promptly return the drawing upon request without retaining any copies thereof.

RECOMMENDED LOAD CAPACITIES SHOWN ARE BASED ON EVENLY DISTRIBUTED STATIC LOAD. ALL SHELVES AND DECKS ARE FINISHED WITH A DURABLE WEAR RESISTANT FINISH. CAPACITIES SHOWN ARE REDUCED BY 30% WHEN FRONT HALF ONLY IS LOADED.

LOAD CAPACITIES

BRACKET PROFILE	STYLE	DEPTH	MAX. EVENLY DISTRIBUTED STATIC LOAD CAPACITY **FLAT** (IN LBS.)
	**TL STYLE**	7" THRU 19"	300 500
	**TL STYLE**	22" THRU 31"	500 400
	**DL STYLE**	7" THRU 19'	300 500
	**DL STYLE**	22", 25" 28", 31"	500 400

MATERIAL: 11 GA CRS BRACKET STEEL
COLD ROLLED STEEL SPECIFICATIONS:
COLD ROLLED STEEL SHEET, SAE #1022
FULL HARD TEMPER
107,000 PSI MINIMUM TENSILE STRENGTH (ANY DIRECTION)
SURFACE: MATTE FINISH OR SMOOTHER, LIGHTLY OILED
CARBON: .25% MAXIMUM
SILICON: .15% TO .30%

©2000 LOZIER CORP.

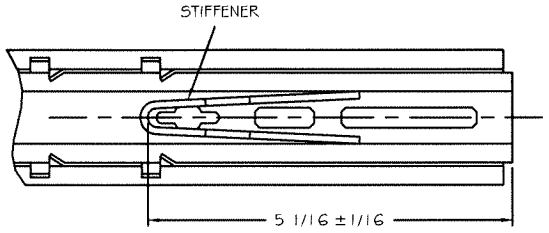
LOZIER
6336 PERSHING DR.
OMAHA, NE 68110
1-800-228-9882

DL & TL STYLE SHELF BRACKETS

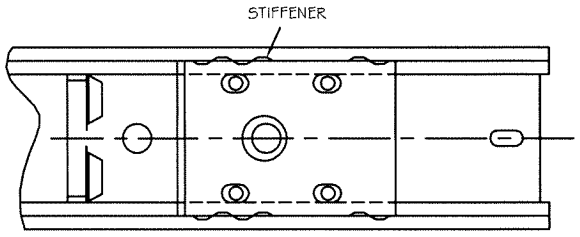
This drawing and its contents are the exclusive and confidential property of Lozier Corporation and its affiliated companies. The drawing is provided only for the purposes intended and shall at all times be kept confidential by the customer or supplier, who shall not, without the prior written consent of Lozier, diclose, use or disseminate, in whole or in part, this drawing, its contents, or concepts, and shall promptly return the drawing upon request without retaining any copies thereof.

NO. OF SLOTS	A	NOM
135	142 7/8	144
129	136 7/8	138
123	130 7/8	132
117	124 7/8	126
111	118 7/8	120
105	112 7/8	114
99	106 7/8	108
93	100 7/8	102
87	94 7/8	96
81	88 7/8	90

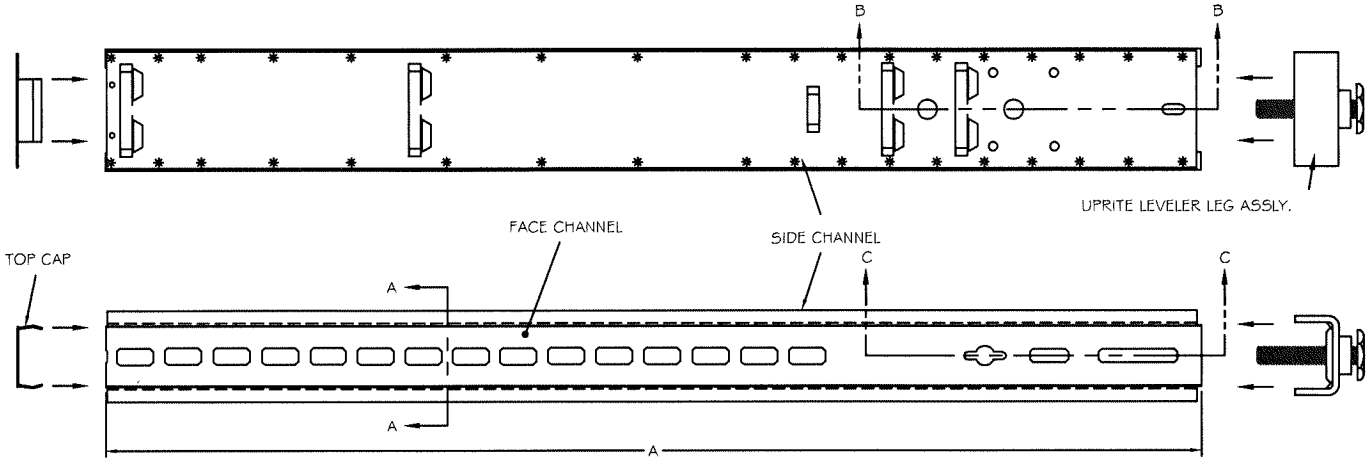
NO. OF SLOTS	A	NOM
75	82 7/8	84
69	76 7/8	78
63	70 7/8	72
57	64 7/8	66
51	58 7/8	60
45	52 7/8	54
39	46 7/8	48
33	40 7/8	42
27	34 7/8	36
21	28 7/8	30
15	22 7/8	24

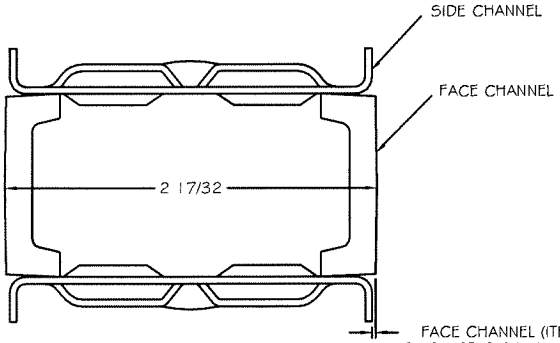


SECTION B-B
LEVELING LEG ASSEMBLY NOT SHOWN



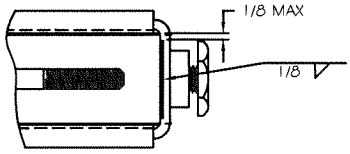
SECTION C-C
LEVELING LEG ASSEMBLY NOT SHOWN





SECTION A-A

FACE CHANNEL (ITEM 1) FLUSH TO 3/64 MAX EXTENDED OR 1/32 MAX RECESSED (EXCEPT TOP 1")



DETAIL OF FACE SHOWING WELD

©2000 LOZIER CORP.

LOZIER
6336 PERSHING DR.
OMAHA, NE 68110
1-800-228-9882

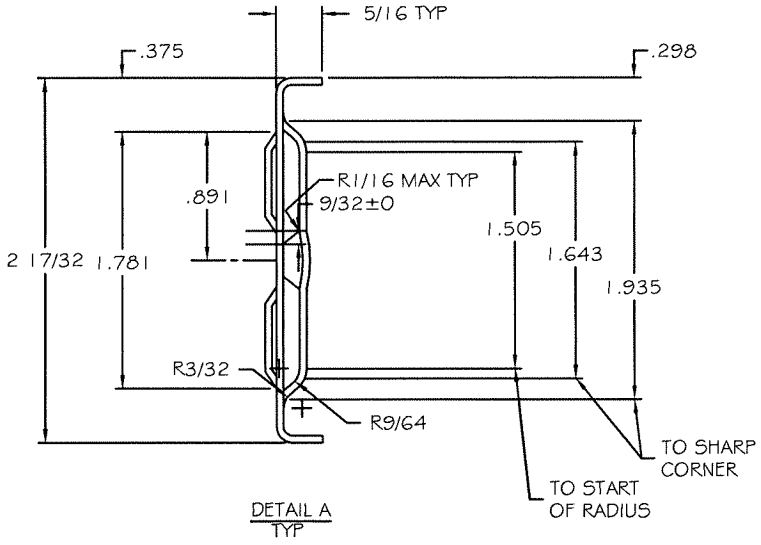
UPRITE DETAILS

This drawing and its contents are the exclusive and confidential property of Lozier Corporation and its affiliated companies. The drawing is provided only for the purposes intended and shall at all times be kept confidential by the customer or supplier, who shall not, without the prior written consent of Lozier, diclose, use or disseminate, in whole or in part, this drawing, its contents, or concepts, and shall promptly return the drawing upon request without retaining any copies thereof.

18 GA. SIDE CHANNEL MATERIAL SPECIFICATION

COLD ROLLED HIGH STRENGTH, LOW ALLOY (HSLA) GRADE 45 CLASS II STEEL.
MATERIAL TO MEET ASTM SPECIFICATION A607.
LIMITED TO 57000 PSI MAX YIELD, 22% MIN ELONGATION EXCEPT
24% NATIONAL AND US STEEL.
LIMITED TO 55000 PSI MIN TENSILE

ORDER THICKNESS: .043 MINIMUM.

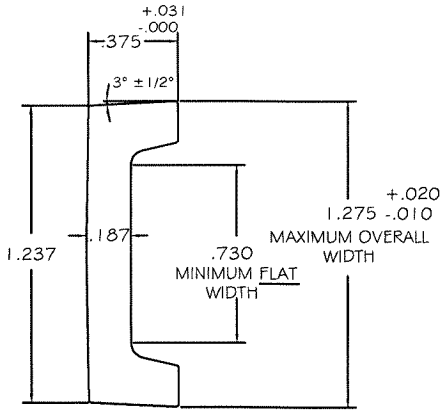


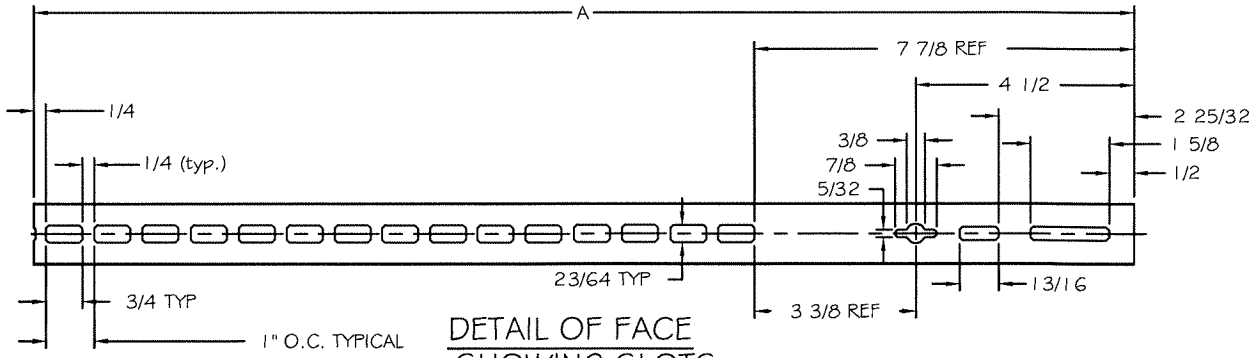
DETAIL A
TYP

FACE CHANNEL MATERIAL SPECIFICATION

VENDOR SPECIFICATIONS: 1 1/4 X 3/8 X LENGTH,
ASTM 1044 SPECIAL HOT ROLLED STEEL
WITH .60% TO .90% MAGANESE (CALUMET)
OR
ASTM A572-60 HOT ROLLED STEEL (COURTICE)

YIELD: 60,000 PSI MINIMUM





DETAIL OF FACE
SHOWING SLOTS

©2000 LOZIER CORP.

LOZIER
6336 PERSHING DR.
OMAHA, NE 68110
1-800-228-9882

UPRITE DETAILS

This drawing and its contents are the exclusive and confidential property of Lozier Corporation and its affiliated companies. The drawing is provided only for the purposes intended and shall at all times be kept confidential by the customer or supplier, who shall not, without the prior written consent of Lozier, diclose, use or disseminate, in whole or in part, this drawing, its contents, or concepts, and shall promptly return the drawing upon request without retaining any copies thereof.

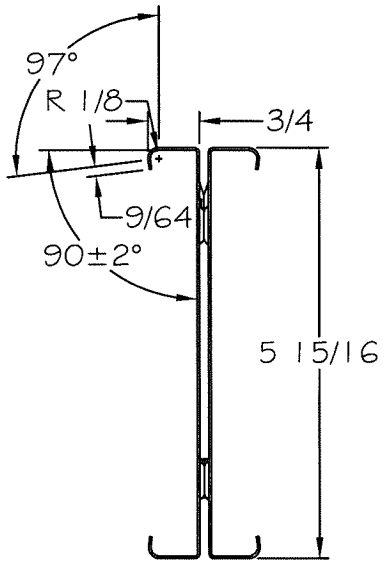
20 GA. MATERIAL SPECIFICATION

SPECIFICATIONS: COLD ROLLED COMMERCIAL QUALITY CLASS 1 STEEL.
MATERIAL TO MEET ASTM SPECIFICATION A366.

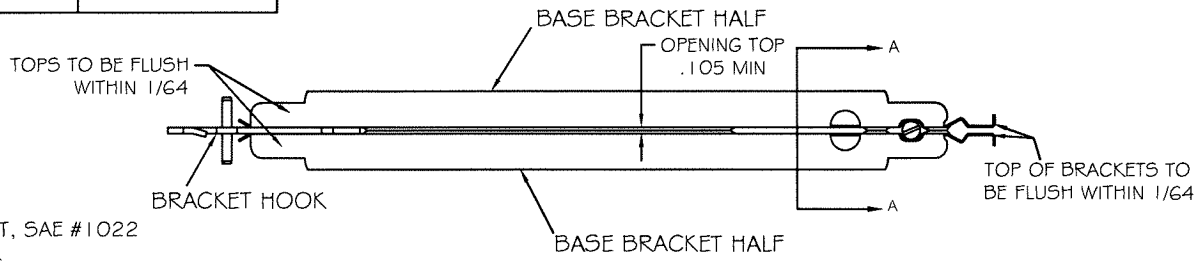
ORDER THICKNESS: .0329 MINIMUM.

HARDNESS: RB 60 MAX (RF 91 MAX)
AIM FOR LOW SIDE RB 40 TO 50 RANGE.

C	NOM	PART NUMBER
28 3/16	31	BB3106
25 3/16	28	BB2806
22 3/16	25	BB2506
19 3/16	22	BB2206
16 3/16	19	BB1906
13 3/16	16	BB1606
10 3/16	13	BB1306

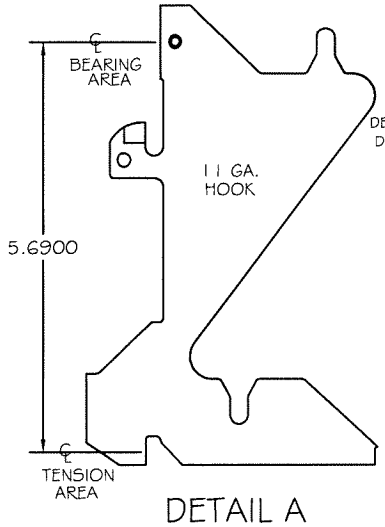


SECTION A-A

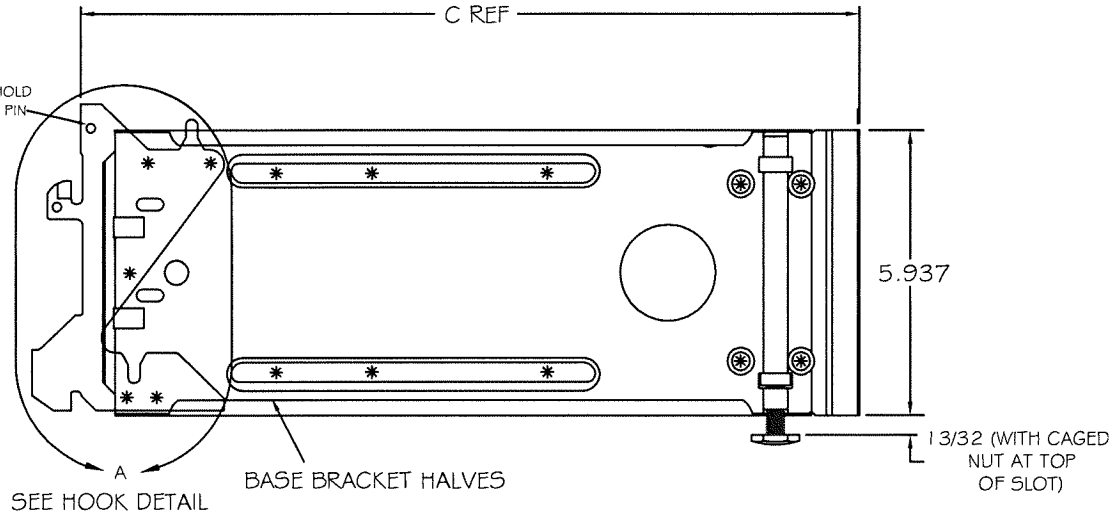


COLD ROLLED STEEL SHEET, SAE #1022
FULL HARD TEMPER
107,000 PSI MINIMUM TENSILE STRENGTH

TOP VIEW



DETAIL A



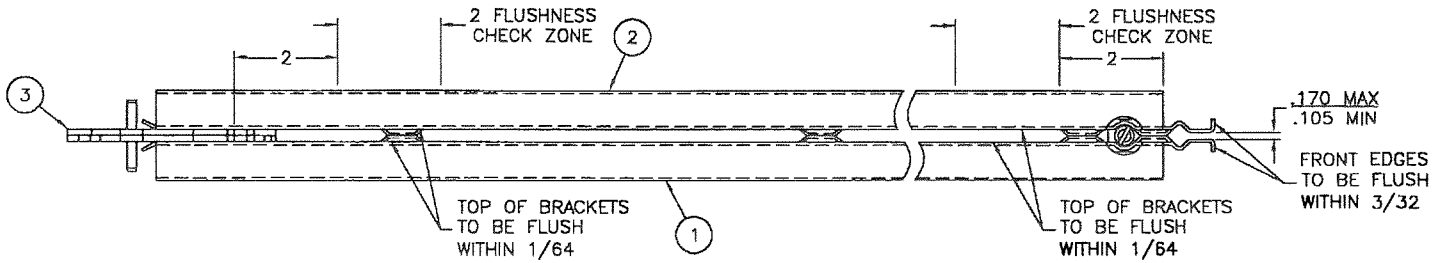
SIDE VIEW

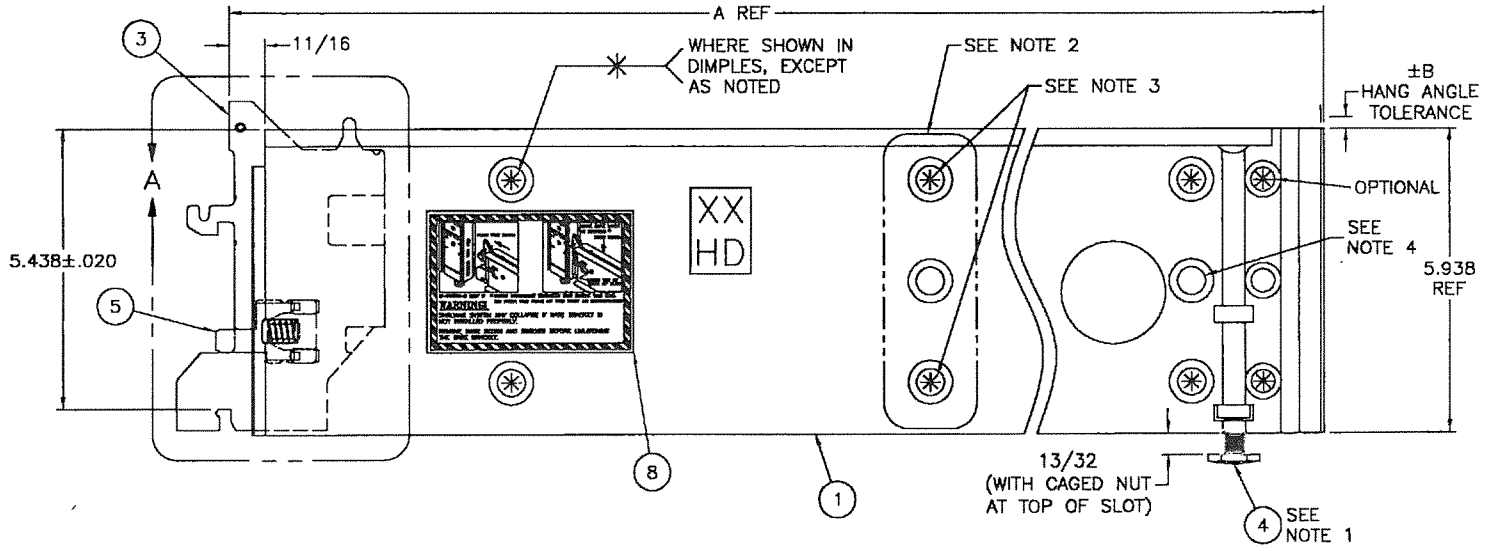
©2000 LOZIER CORP.

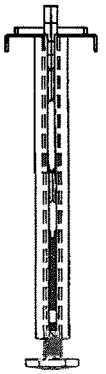
LOZIER
6336 PERSHING DR.
OMAHA, NE 68110
1-800-228-9882

06 BASE BRACKET DETAILS

05-0525	N
DRAWING NO.	REV
PAGE 2 OF 2	





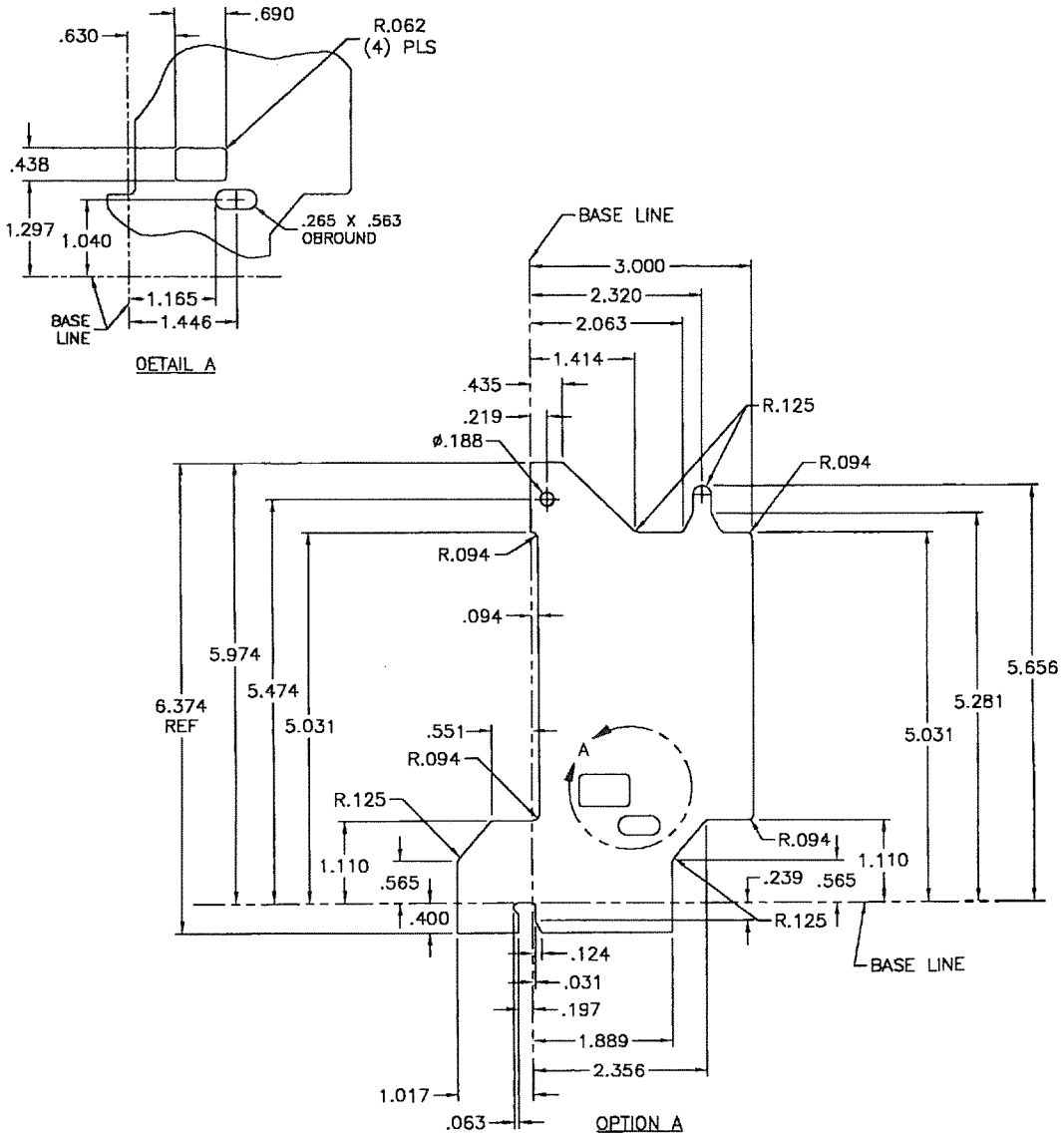


THIS DRAWING IS THE EXCLUSIVE PROPERTY OF THE LOZIER CORP. AND IS FOR THE SOLE USE OF THE CUSTOMER FOR WHOM IT IS INTENDED.

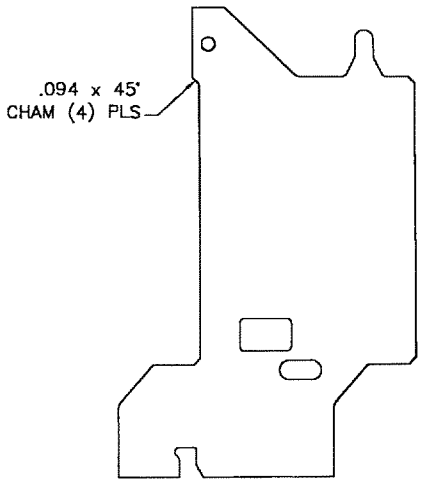
TITLE: BASE BRACKET - LTOE36, 06HD, REMOVABLE

©2007 LOZIER CORPORATION

TOLERANCES UNLESS SPECIFIED:
DECIMALS: XXX = ± .010 XX = ± .03
ENGLISH: ANGULAR ± 2° ± 1/64" ± 1/32"
METRIC: ± 1 MM



NOTES:
1. MATERIAL: 11 GA (63040)
   OPTIONAL: 12 GA (63040).
2. LASER, OPTION A: 25.5154
3. AREA, OPTION A: 16.2743
4. ALL RADII ARE .063 UNLESS OTHERWISE SPECIFIED.
5. .094 X 45° CHAMFERS MAY BE USED IN PLACE OF .094 RADII, AS SHOWN AT OPTION B.
   LASER, OPTION B: 25.4567
   AREA, OPTION B: 16.2743



OPTION B
(ALL OTHER
FEATURES SAME)

S-65250-1 | F
DRAWING NO. | REV
PAGE 1 OF 1

PCO	REV	REVISION DESCRIPTION	DRAFTER	CHKR	APPVD
58156	E	REMOVED GRAIN DIRECTION	AJC 12-05-08	DF	JAD
60047	F	ADDED MATERIAL OPTION TO NOTES	ALC 10-15-97	DF	JD

SUPERSEDES S-64818-1

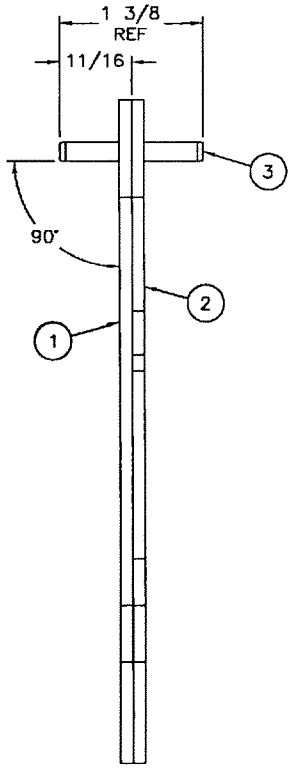
SUPERSEDED BY:

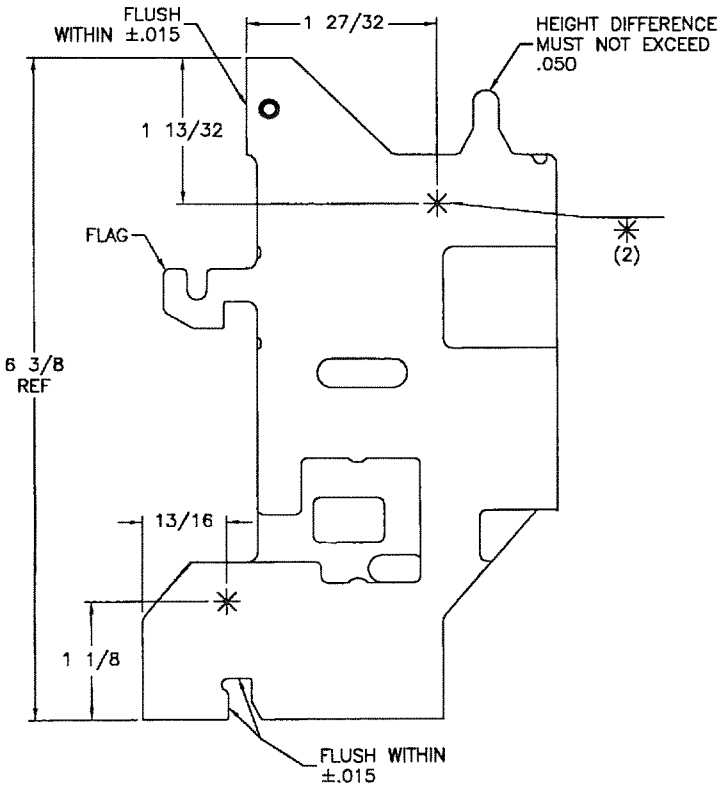
TITLE: HOOK - BASE BRACKET, 06HD, RH

© 2007 LOZIER CORPORATION
THIS DRAWING IS THE EXCLUSIVE PROPERTY OF THE LOZIER CORP. AND IS FOR THE SOLE USE OF THE CUSTOMER FOR WHOM IT IS INTENDED.

TOLERANCES UNLESS SPECIFIED:
DECIMALS XXX = ± .010
DECIMALS XX = ± .03
ENGLISH ± 1/32"
ANGULAR ± 2°
METRIC ± 1 MM
△ RUNOUT
○ HOLD ± 1/64"
→ GRAIN DIRECTION

NOTES:
1. SERVICES RENDEREO NUMBER IS REQUIRED TO INSERT PIN.
2. HOOK WITH "FLAG" (HOOK, LH) MUST ALWAYS BE ON THE LEFT SIDE OF THE HOOK PAIR, AS SHOWN.





ITEM	PART NUMBER	QTY	DESCRIPTION
3	23242	1	HOLD-DOWN PIN
2	S-64605-1	1	HOOK - LH
1	S-65250-1	1	HOOK - RH

PARTS LIST

S-65249-1 D
DRAWING NO. REV
PAGE 1 OF 1

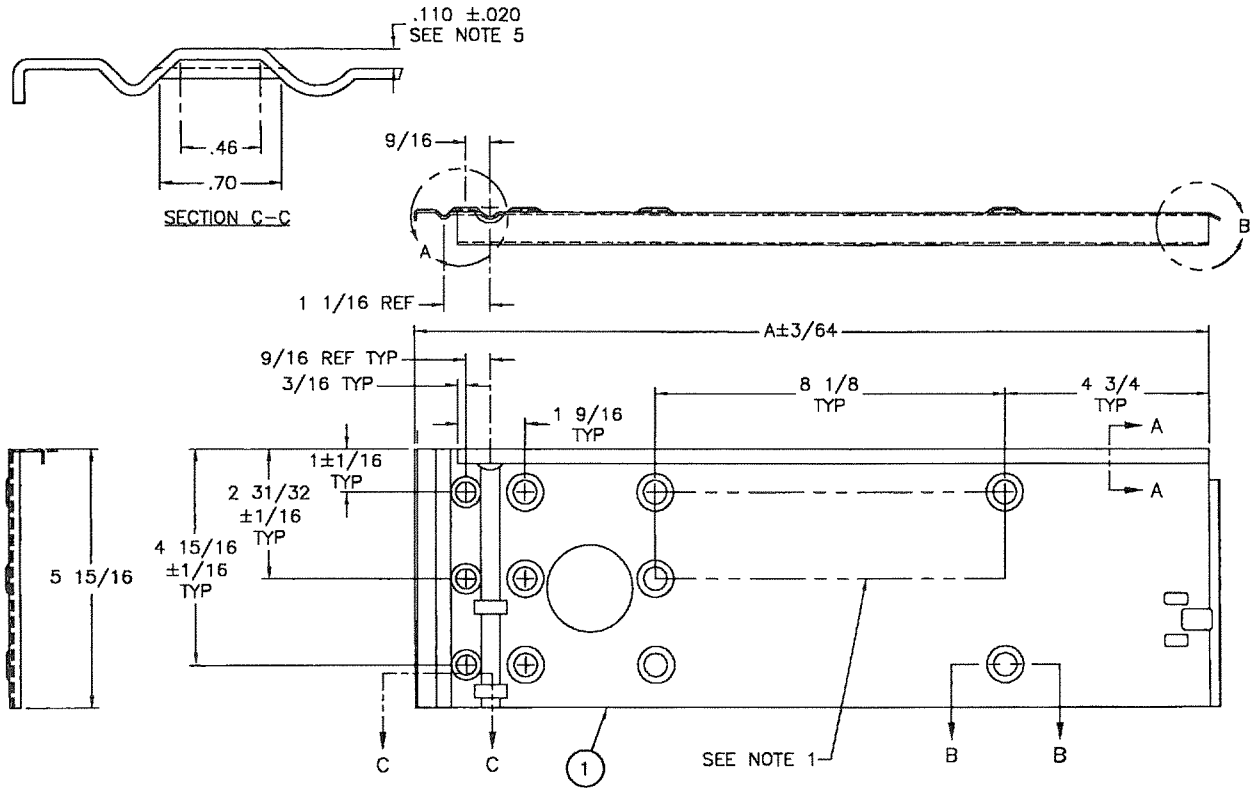
PCO	REV	REVISION DESCRIPTION	DRAFTER	CHKR	APPVD
59565	D	UPDATED PICTURE PER COMPONENT CHANGE	RJP 07/27/07	DAF	JAD
49097	C	WELD LOCATION WAS 1 5/32 X 1 27/32	AJG 4-11-03	KLE	JAD
48831	B	UPDATED DWG TO MATCH NEW PROFILE FROM S-65250-1	AJG 4-3-03	DF	JAD
47282-1	A	RELEASED, LIKE S-64472-1, SUPERSEDES S-64472-1	RJP 08/22/02	ROC	JAD

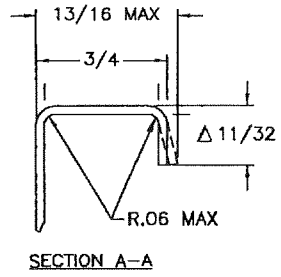
TITLE: ASSEMBLY - BASE BRACKET HOOK, 06HD

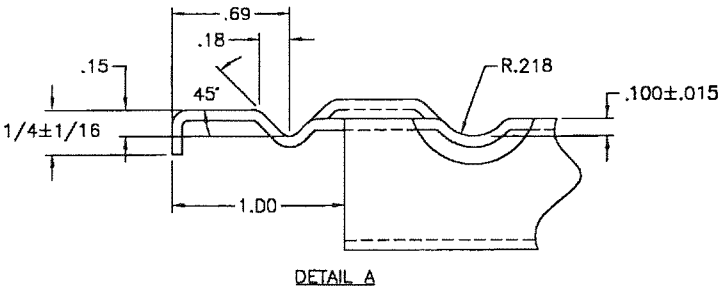
SUPERSEDES S-64472-1
SUPERSEDED BY:

© 2007 LODER CORPORATION
THIS DRAWING IS THE EXCLUSIVE PROPERTY OF THE LODER CORP. AND IS FOR THE SOLE USE OF THE CUSTOMER FOR WHOM IT IS INTENDED.

TOLERANCES UNLESS SPECIFIED:
DECIMALS XXX = ± .010
DECIMALS XX = ± .03
ANGULAR ± 1/2°
METRIC ± 1 MM
△ RUNOUT
○ HOLD ± 1/64"
GRAIN DIRECTION

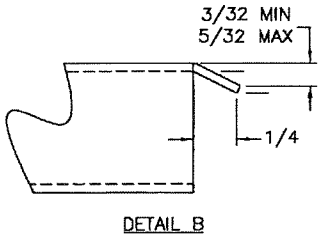


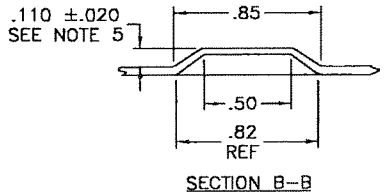




NOTES:

1. CENTERLINE OF HEAVY DUTY STAMP (H0) AND NUMERIC SIZE STAMP (XX) TO LIE WITHIN THIS REGION. CHARACTER HEIGHT TO BE 1/4" TO 1/2" AND EMBOSSING OEPTH TO BE .005" TO .020". EMBOSSING MAY BE IN EITHER DIRECTION.
2. WHEN ADJUSTMENTS TO DIMPLE HEIGHT ARE MAOE A WELDEO BASE BRACKET MUST BE INSPECTED FOR CONFORMANCE TO FRONT GAP SEPECIFICATION AND LEVELING LEG MOVEMENT.





QTY	ITEM 1 BRACKET BLANK	A	NOM	PART NUMBER
1	S-69019-8	15 15/32	19	S-65234-8
1	S-69019-7	28 15/32	32	S-65234-7
1	S-69019-6	21 15/32	25	S-65234-6
1	S-69019-5	32 15/32	36	S-65234-5
1	S-69019-4	30 15/32	34	S-65234-4
1	S-69019-3	27 15/32	31	S-65234-3
1	S-69019-2	24 15/32	28	S-65234-2
1	S-69019-1	18 15/32	22	S-65234-1

S-65234 | L
DRAWING NO. | REV
PAGE 1 OF 1

PCO	REV	REVISION DESCRIPTION	DRAFTER	CHKR	APPVD
56298	L	ADDED +/-3/64 TO FORMED LENGTH	JAD 02-06-05	DF	JAD
56101	K	ADDED -8 NOM 19, SUPERSEDES S-65244/S-65245	JAD REF 7/07/08	DF	JAD
55837	J	DIMPLE HEIGHT WAS 1.120 ADDED NOTE 2, " WHEN ADJUSTMENTS TO DIMPLE HEIGHT..... UPDATED ALL VIEWS ACCORDINGLY	JAD 12-06-05	DF	JAD
55712	J	ADDED TWO FRONT DIMPLES & SECTION C-C; UPDATED DETAIL A	JAD REF 8/29/05	DF	JAD
54480	H	ADDED TWO FRONT DIMPLES & SECTION C-C; UPDATED DETAIL A	JAD REF 8/29/05	DF	JAD
55218	G	REMOVED BLANK AND LASER AREA TABULATION, DIM "A" WAS "B" REMOVED "B" TABULATION, REMOVED NOTE 1 WAS MATERIAL IS CR STEEL (S1152-05), OPTIONAL 16 GA STEEL (S1170-12), ADDED ITEM 1 TABULATION	LW 8-17-05	DF	MLN

TITLE: BLANK - BASE BRACKET, LTOE36, 06, RH

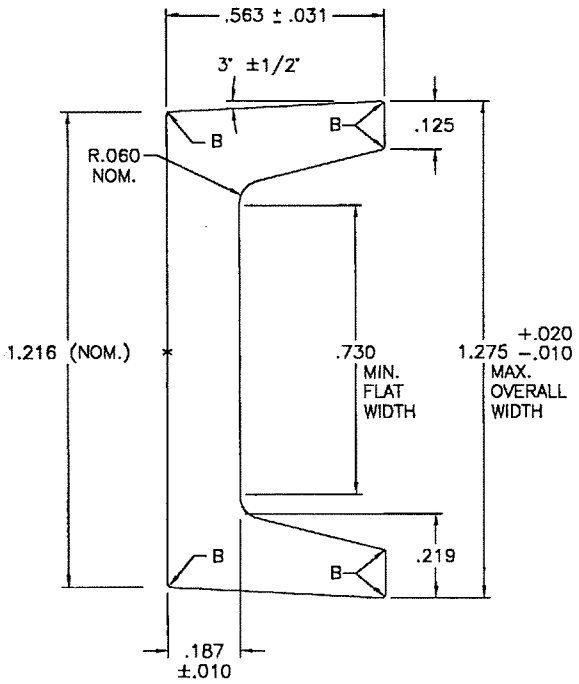
SUPERSEDES S-65244/S-65245

SUPERSEDED BY

LOZIER
© 2006 LOZIER CORPORATION
THIS DRAWING IS THE EXCLUSIVE PROPERTY OF THE LOZIER CORP. AND IS FOR THE SOLE USE OF THE CUSTOMER FOR WHOM IT IS INTENDED.

TOLERANCES UNLESS SPECIFIED:
DECIMALS XXX = ± .010
DECIMALS XX = ± .05
ENGLISH: ± 1/32"
ANGULAR: ± 2°
METRIC: ± 1 MM
△ RUNOUT
○ HOLD ± 1/64"
——— GRAIN DIRECTION

PROCURMENT SPECIFICATIONS



"B" CORNERS WILL VARY FROM SHARP TO SLIGHTLY ROUNDED.

"CALUMET"

NOTES:

1. MATERIAL: 1 1/4 X 9/16 X LENGTH, ASTM 1044 SPECIAL HRS. WITH .60 TO .90% MANGANESE (CALUMET)
2. FINISH: AS ROLLED.
3. SURFACES MARKED * MUST BE FLAT.
4. CHANNEL MUST BE BALANCED IN RESPECT TO WEIGHT ON EITHER SIDE OF CENTER LINE.
5. UNLESS OTHERWISE SPECIFIED ASTM A-29-67 WILL APPLY.
6. AREA=.352 SQ. IN. FT. WGT.=1.197 LBS.
7. CUT ENDS MUST BE SQUARE WITHIN 1/32.
8. BUNDLES ARE NOT TO EXCEED 8000# MAX
9. LENGTH OPTIONS: 252" & 288"
10. TOLERANCE FOR ALL LENGTHS IS +3 -0

63777 E-2

PAGE 1 OF 1 REV

PCO	REV	REVISION DESCRIPTION	DFTR	CHKR	APPVD
39115	E-2	ON .563 DIMENSION CHANGED TOLERANCE FROM +.031 -0 TO +- .031	WP 1/29/98	ROC	ARS
37928	E-1	REMOVED "OF 20" CHANNEL" FROM NOTE 9. REMOVED NOTE 8 "PACKING INSTRUCTIONS FOR..... AND RENUMBERED NOTE 9 TO 8.	TDS 11-5-97	AH	DKH
37940	E	NOTE WAS 1 1/4 X 3/8 X 3/16 X LENGTH, ASTM 1044 HRS. WITH .60 TO .90% MANGANESE" REMOVED TABULATION ADDED, NOTES 10 & 11 ADDED, DWG NO. WAS 63777-01	LJ 12-27-96	AH	DKH
36780	D	REMOVED DETAIL "A" AND NUCOR SPECS	HP 8-8-96	JF	RAH
36859	C	MATERIAL WAS ASTM 1045 HRS	AH 4-4-96	JF	RAH
35570	B-1	REDRAWN ON CAD	TBM 11-14-95	JJ	RAH
28289	A	REDRAWN AND NUCOR SPECS ADDED	GJJ 03-22-92	PJB	RAH

SUPERSEDES:

SUPERSEDED BY:

TITLE: STEEL, UPRITE CHANNEL

DRAWING NO. 63777

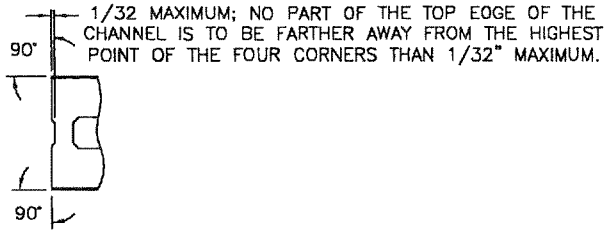
REV E-2

PAGE 1 OF 1

©1998 LOZIER CORPORATION

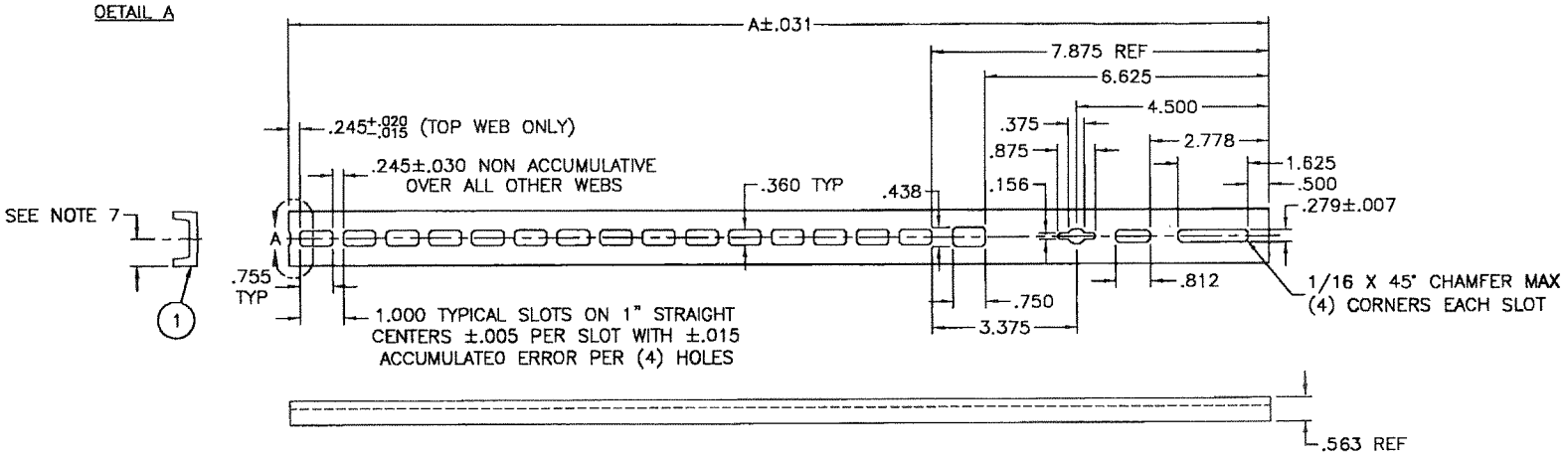
THIS DRAWING IS THE EXCLUSIVE PROPERTY OF THE LOZIER CORP. AND IS FOR THE SOLE USE OF THE CUSTOMER FOR WHOM IT IS INTENDED.

TOLERANCES UNLESS SPECIFIED: DECIMAL ± .010 ANGULAR: ± 1 DEG. RUNOUT △ HOLD ± 1/64 ○ HOLD ± 1/64 ——— GRAIN DIRECTION



DETAIL A

NOTES:
1. MAXIMUM TOLERANCE ACCEPTABLE FOR BOWED CHANNEL IS 1/4 (.250) IN 60".
2. EVERY 5TH SLOT CANNOT BE OUT OF LINE FROM THE PREVIOUS SLOT MORE THAN ±.021.
3. EACH SLOT MUST BE PARALLEL TO THE EDGE OF THE CHANNEL WITHIN .008
4. AREA OF AVERAGE SECTION FOR (63777) IS .352 SQ IN.
5. WEIGHT PER LINEAR FOOT FOR (63777) IS 1.197 LBS.
6. STRAIGHTNESS (BOW) OF THE CHANNEL IN THE BOTTOM 12" CAN NOT EXCEED 1/64" (.016") FROM THE TRUE PLANE OF THE CHANNEL FACE.
7. SLOTS TO BE CENTERED ON FACE OF CHANNEL ±.020.



QTY	ITEM 1 CHANNEL	C NO. OF SLOTS	A	NOM	PART NO
1	63777	135	142 7/8	144	S-64303-21
1	63777	129	136 7/8	138	S-64303-20
1	63777	123	130 7/8	132	S-64303-19
1	63777	117	124 7/8	126	S-64303-18
1	63777	111	118 7/8	120	S-64303-17
1	63777	105	112 7/8	114	S-64303-16
1	63777	99	106 7/8	108	S-64303-15
1	63777	93	100 7/8	102	S-64303-14
1	63777	87	94 7/8	96	S-64303-13
1	63777	81	88 7/8	90	S-64303-12

QTY	ITEM 1 CHANNEL	C NO. OF SLOTS	A	NOM	PART NO
1	63777	75	82 7/8	84	S-64303-11
1	63777	69	76 7/8	78	S-64303-10
1	63777	63	70 7/8	72	S-64303-9
1	63777	57	64 7/8	66	S-64303-8
1	63777	51	58 7/8	60	S-64303-7
1	63777	45	52 7/8	54	S-64303-6
1	63777	39	46 7/8	48	S-64303-5
1	63777	33	40 7/8	42	S-64303-4
1	63777	27	34 7/8	36	S-64303-3
1	63777	21	28 7/8	30	S-64303-2
1	63777	15	22 7/8	24	S-64303-1

S-64303 D
DRAWING NO. REV
PAGE 1 OF 1

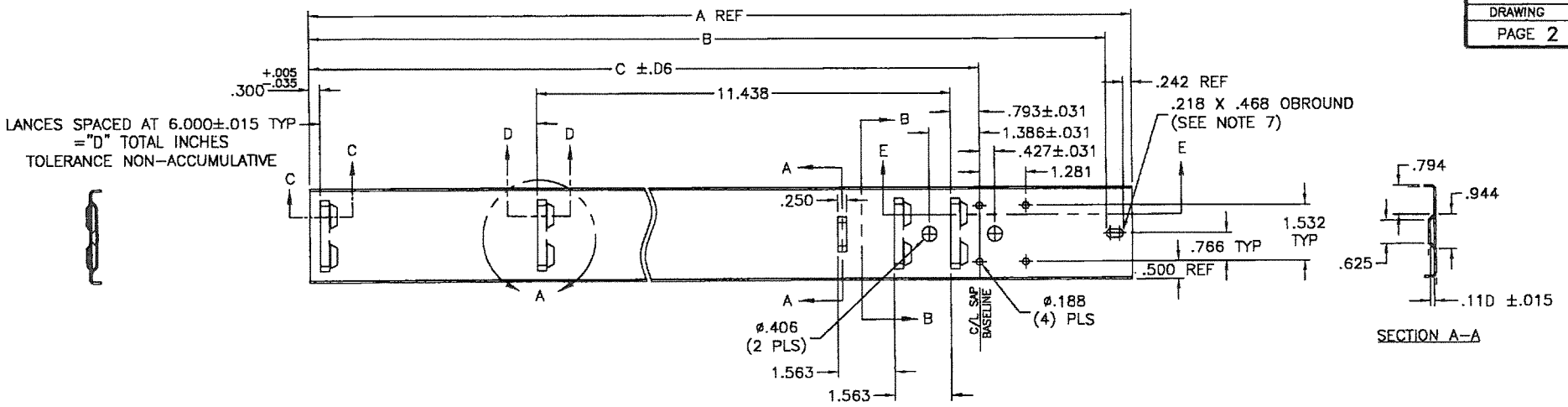
PCO	REV	REVISION DESCRIPTION	DRAFTER	CHKR	APPVD
55661	D	2.778 DIM WAS 2.750 DIM	ATL 10-17-05	DF	JAD
46704	C	REMOVED SAP NOTCHES FROM BTM VIEW	TDS 4-18-02	DF	JJ
46151	B	ADDED SAP NOTCHES TO BTM VIEW W/ R.188; PER PCR 46050, ADDED KEYHOLE	REF 1/15/02	DF	RAH
	A	RELEASED QT#21163	LOZIER 1-12-01	DF	JJ

SUPERSEDES
SUPERSEDED BY

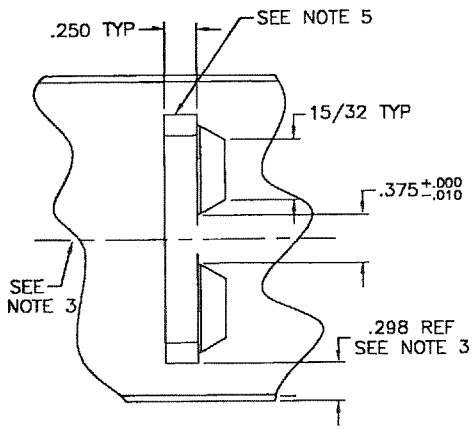
TITLE: FACE CHANNEL, HEAVY DUTY, 06/LB

LOZIER
© 2005 LOZIER CORPORATION
THIS DRAWING IS THE EXCLUSIVE PROPERTY OF THE LOZIER CORP. AND IS FOR THE SOLE USE OF THE CUSTOMER FOR WHOM IT IS INTENDED.

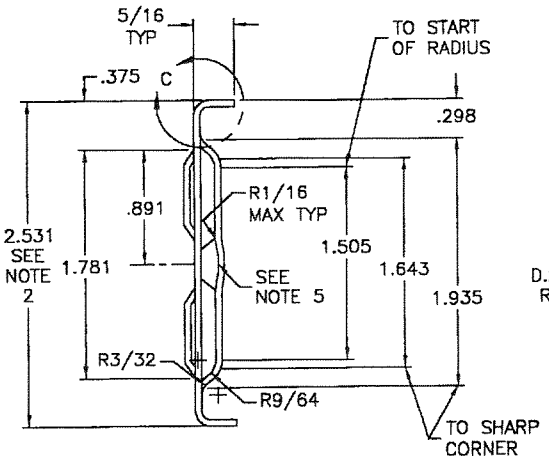
TOLERANCES UNLESS SPECIFIED:
DECIMAL 3DP = ± .010
DECIMAL 2P = ± .03
ENGLISH ± 1/32"
ANGULAR ± 2°
METRIC ± 1 MM
△ RUNOUT
○ HOLD ± 1/64"
GRAIN DIRECTION



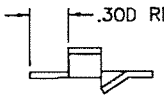
DIE FORMED



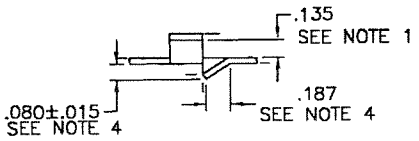
DETAIL A
TYP



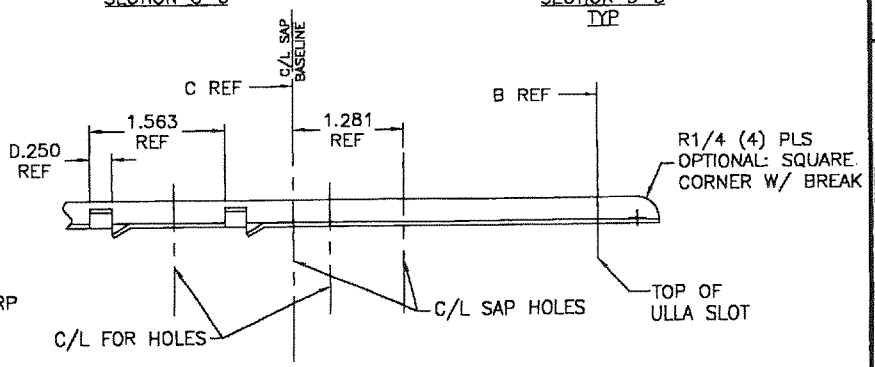
SECTION B-B
TYP



SECTION C-C



SECTION D-D
TYP

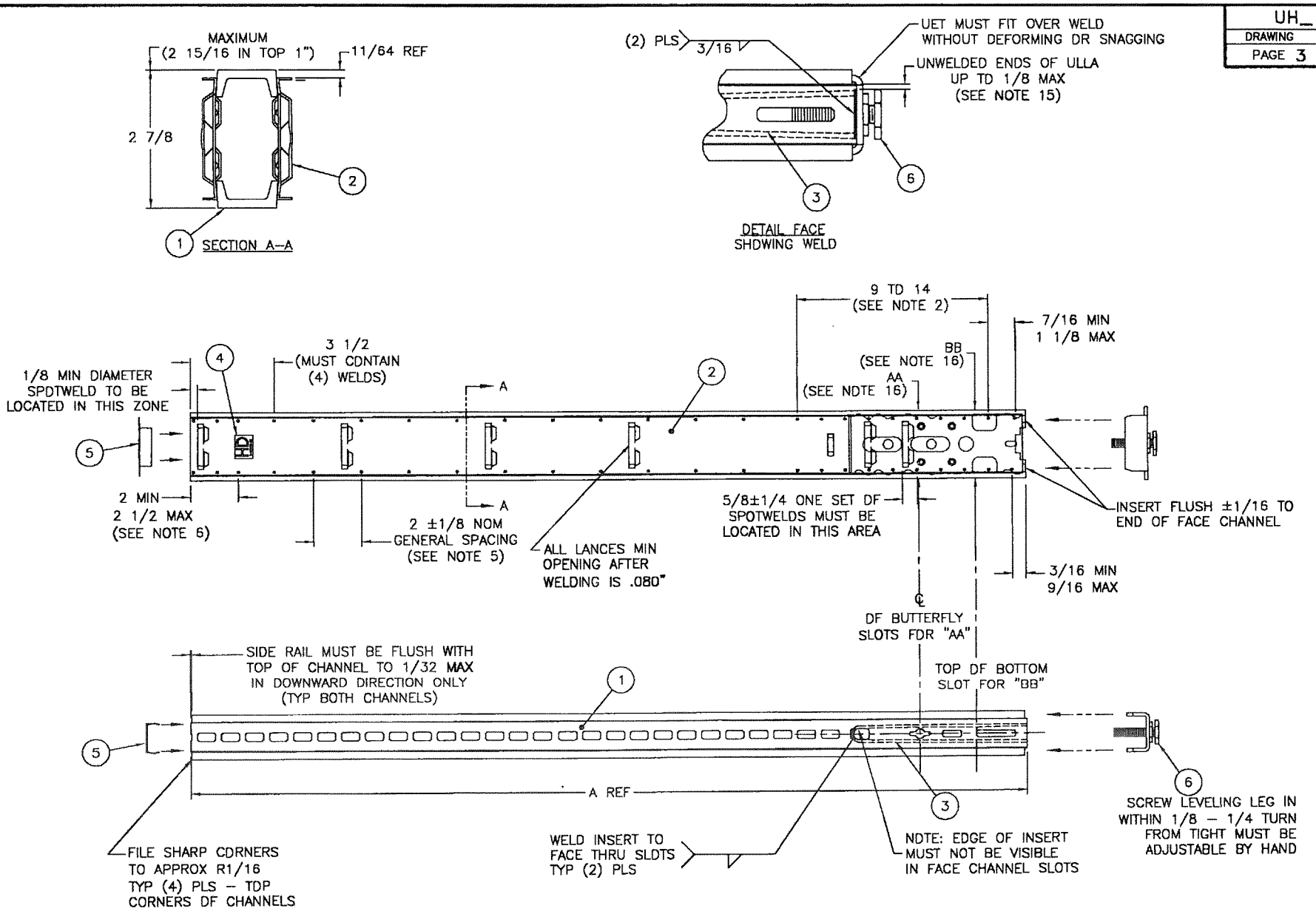


SECTION E-E

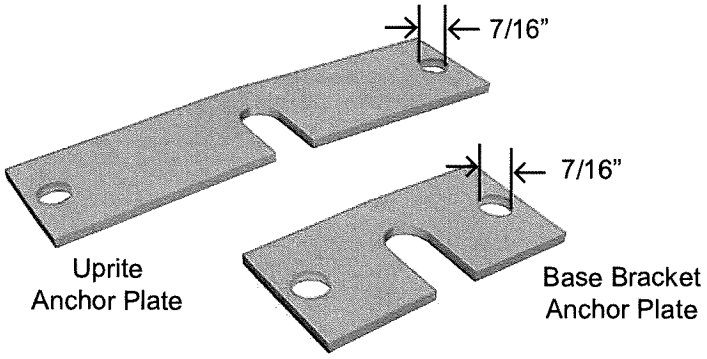
THIS DRAWING IS THE EXCLUSIVE PROPERTY OF THE LOZIER CORP. AND IS FOR THE SOLE USE OF THE CUSTOMER FOR WHOM IT IS INTENDED.
© 2006 LOZIER CORPORATION

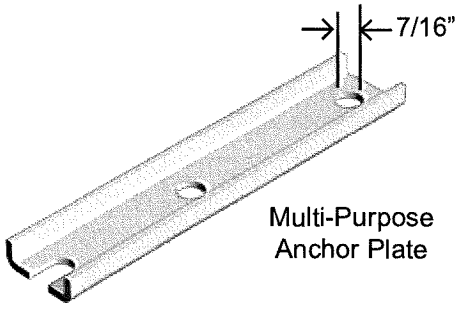
TITLE: SIDERAIL, UPRITE

TOLERANCES UNLESS SPECIFIED:
WIRE PRODUCTS USING ES-38
DECIMALS .XXX = ±.010
DECIMALS .XX = ±.03
ENGLISH: ±1/32"
METRIC: ±1MM
ANGULAR: .X° (DEGREES) ±1° (OTHERS)
△ RUNOUT
○ HOLD ±1/64"
GRAIN DIRECTION
ASPECT EXCEPTIONS
DECIMALS .XX = ±.02
ANGULAR: ±1°


MAXIMUM
(2 15/16 IN TOP 1")
11/64 REF
2 7/8
2
1
SECTION A-A
(2) PLS
3/16
UET MUST FIT OVER WELD
WITHOUT DEFORMING DR SNAGGING
UNWELDED ENDS OF ULLA
UP TD 1/8 MAX
(SEE NOTE 15)
3
6
DETAIL FACE
SHDWING WELD
9 TD 14
(SEE NDTE 2)
7/16 MIN
1 1/8 MAX
BB
(SEE NOTE 16)
AA
(SEE NDTE 16)
3 1/2
(MUST CDNTAIN
(4) WELDS)
1/8 MIN DIAMETER
SPDTWELD TO BE
LOCATED IN THIS ZONE
4
2
A
5
2 MIN
2 1/2 MAX
(SEE NOTE 6)
2 ±1/8 NOM
GENERAL SPACING
(SEE NOTE 5)
ALL LANCES MIN
OPENING AFTER
WELDING IS .080"
5/8±1/4 ONE SET DF
SPOTWELDS MUST BE
LOCATED IN THIS AREA
INSERT FLUSH ±1/16 TO
END OF FACE CHANNEL
3/16 MIN
9/16 MAX
℄
DF BUTTERFLY
SLOTS FDR "AA"
TOP DF BOTTOM
SLOT FOR "BB"
SIDE RAIL MUST BE FLUSH WITH
TOP OF CHANNEL TO 1/32 MAX
IN DOWNWARD DIRECTION ONLY
(TYP BOTH CHANNELS)
1
5
A REF
3
6
SCREW LEVELING LEG IN
WITHIN 1/8 – 1/4 TURN
FROM TIGHT MUST BE
ADJUSTABLE BY HAND
FILE SHARP CDRNERS
TO APPROX R1/16
TYP (4) PLS – TDP
CORNERS DF CHANNELS
WELD INSERT TO
FACE THRU SLDTS
TYP (2) PLS
NDTE: EDGE OF INSERT
MUST NOT BE VISIBLE
IN FACE CHANNEL SLOTS
UH_
U
DRAWING NO.
REV
PAGE 3 OF 3
THIS DRAWING IS THE EXCLUSIVE PROPERTY OF THE LOZIER CORP. AND IS FOR THE SOLE USE OF THE CUSTOMER FOR WHOM IT IS INTENDED.
TITLE:
UPRITE, HEAVY DUTY, 06/LB
© 2007 LOZIER CORPORATION
TOLERANCES UNLESS SPECIFIED
DECIMALS .XXX = ± .010
DECIMALS .XX = ± .03
ENGLISH ± 1/64"
ANGULAR ± 2°
METRIC ± 1 MM
RUNOUT
HOLD ± 1/64"
DRAW DIRECTION

Uprite/Base Bracket Anchor Plates





Anchor Plates

- Anchor Plates used when Shelving Unit exceeds height to depth ratio limits
- Required for Shelving over 5'H in certain seismic zones (Contact local building officials for fastener requirements)
- Accepts 1/4" or 3/8" dia. anchor bolts
- Secures Leveling Leg to floor using anchor bolts (not included)
- Multi-Purpose Anchor for end of run, Wall End Display or limited access applications
- **For pricing see section 100, pg 88**

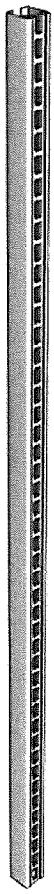
DESCRIPTION	PART NO.
Uprite Anchor Plate	DC1241
Base Bracket Anchor Plate	DC1242
Multi-Purpose Anchor Plate	DC1248

STANDARD FINISH:

GLV

- Galvanized

Wall-Mount Uprite



Wall-Mount Uprite:

- Slotted 1" on center
- Attaching hardware not included
- WMU actual size is 1" shorter than nominal size
- **For pricing see section 100, pg 88**

EXAMPLE PART NO.

WMU | 48

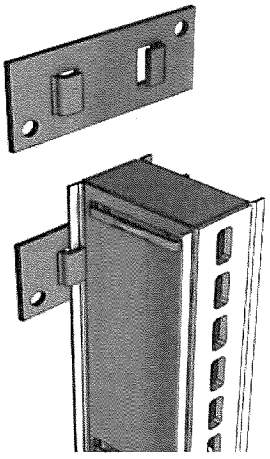
WMU = Wall Mounted Uprite
48 = Height: 48", 60", 72", 84", 90"

STANDARD FINISH:

PLT

- Optional Tier I & II colors

Wall-Mount Bracket



Wall-Mount Bracket:

- Connect standard Uprites to building walls
- Two Brackets are required for Uprites to 96"H
  Three Brackets for one piece Uprites over 96"H
- Extension Uprites require one Bracket for Uprites to 36"H; two for Extensions over 36"
- Fasteners not included
- **For pricing see section 100, pg 88**

PART NO.
DC2191

STANDARD FINISH:

GLV

- Galvanized

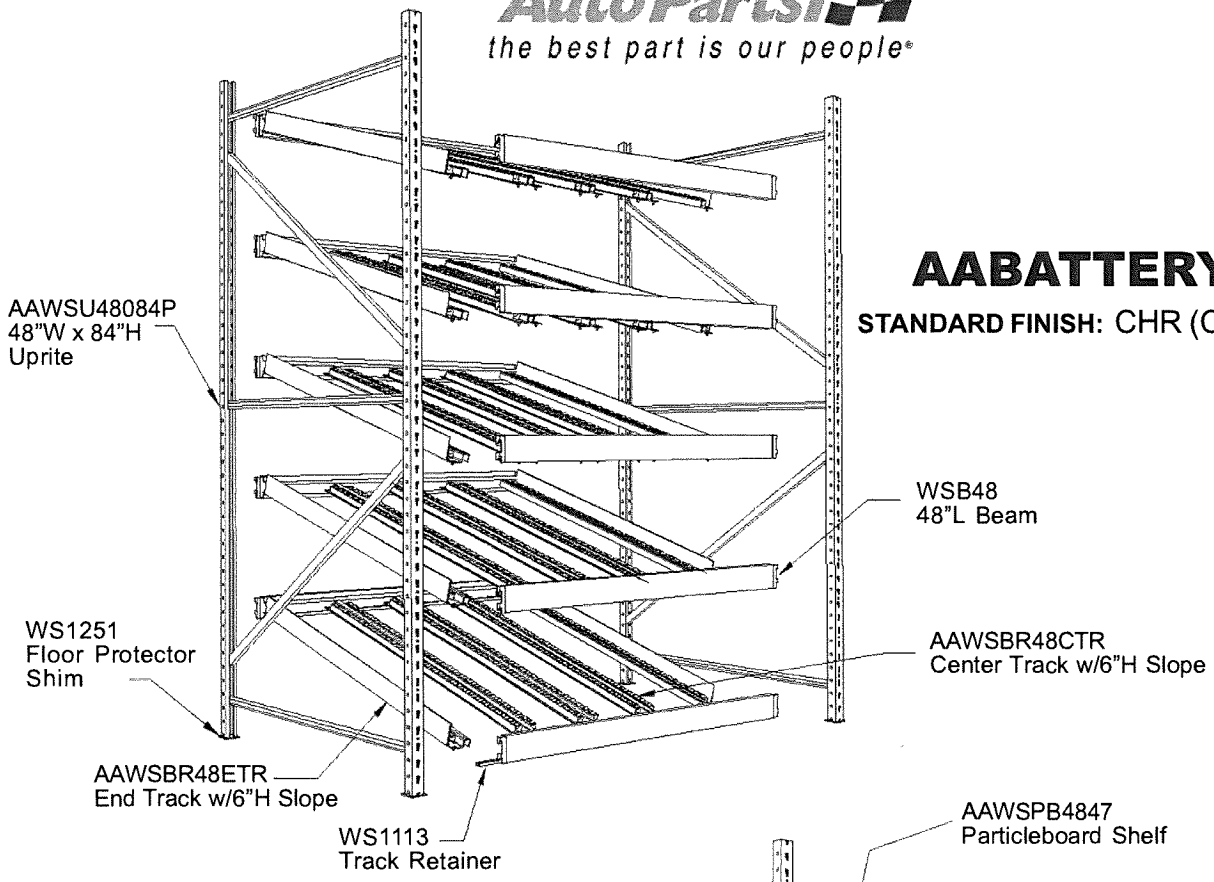
LOZIER®
© 2005 Lozier® Corporation

P.O. BOX 3448 • OMAHA, NEBRASKA 68103-0448 • (800) 228-9882

This is a copyrighted work of Lozier Corporation. Any unauthorized reproduction, distribution or use is expressly prohibited.

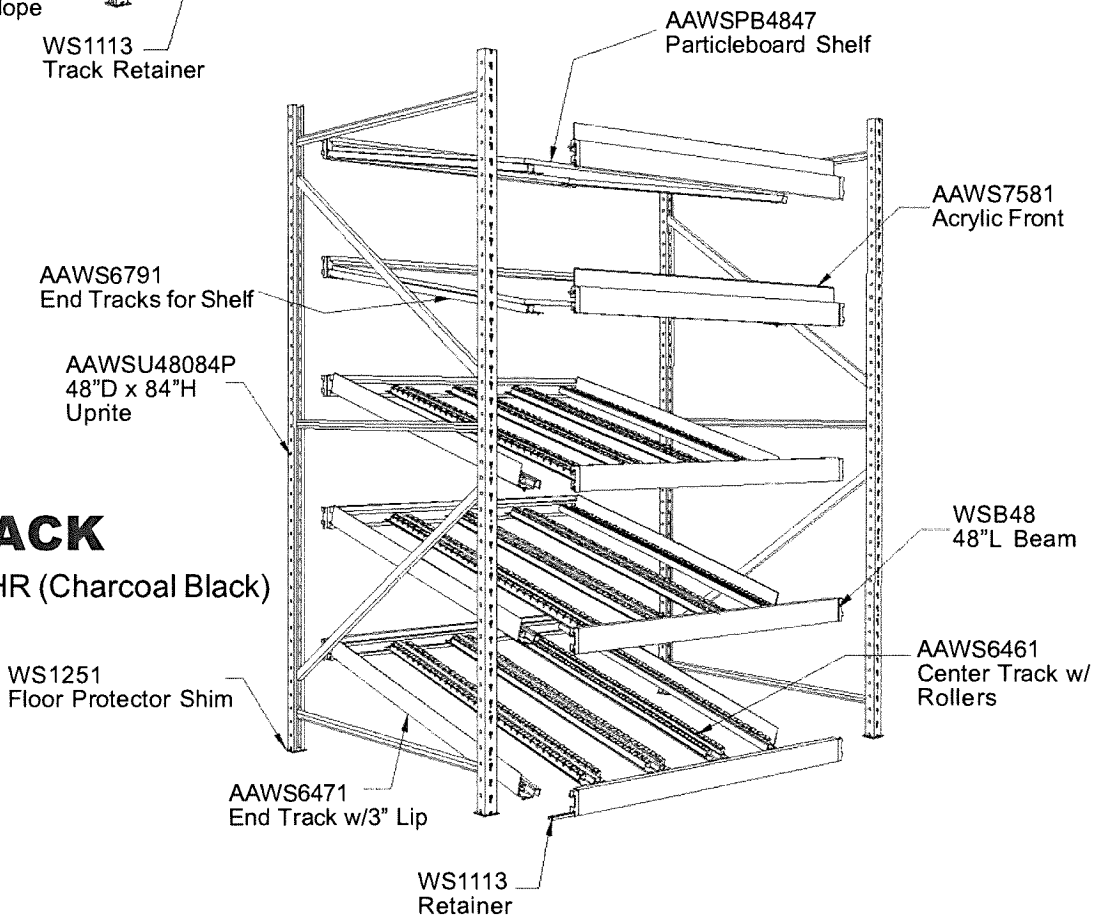
AABATTERYRACK

STANDARD FINISH: CHR (Charcoal Black)



AAOILRACK

STANDARD FINISH: CHR (Charcoal Black)



© 2000 Lozier® Corporation

Widespan:

- Includes four basic components:
  Uprite Frames
  Beams
  Shelf Supports
  Shelves



Dimensional Information:

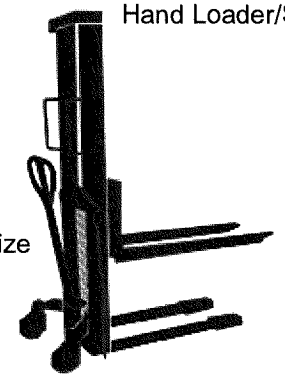
- Clear opening between posts:
  Nominal shelf width plus 1/2"
- Overall length:
  (Nominal section width + 1/2") times the number of sections, + 1 3/4" for each post in the run
- Overall depth:
  2 1/4" greater than the nominal depth of the unit
- Vertical clearance between shelves:
  Regular Duty Beam:
  3 1/4" less than the center-to-center shelf spacing
  Heavy Duty Beam:
  4 3/4" less than the center-to-center shelf spacing
- Shelves adjustable 2" on center
- No cross bracing required
- Welded Uprite Frame

WARNING: Multi-Function Beams are intended to be used with Multi-Function Shelf Supports. If Shelf Supports are not installed then the beams MUST utilize a Widespan Multi-Function Beam Locking Clip (WS1291 or WS9111 pg.706) depending on the beam location. Failure to do this could allow the Beam to become disengaged causing product damage or personal injury.

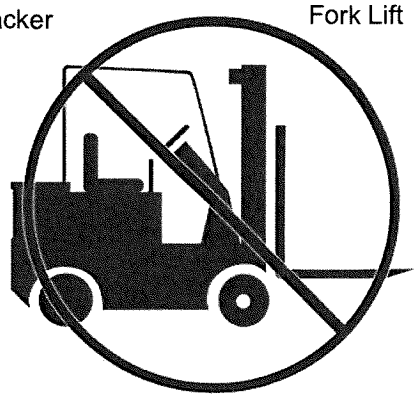
Pallet Loaded Widespan Considerations:

- **WARNING**:
- Forklifts must not be used,
- Only hand loader/stacker can be safely used
- Order "RE" Reinforced Uprite Frames when using hand loader/stacker
- Shelf supports are required for all applications to stabilize beam, if not used then beam locking clip is required
- Aisle side Uprite posts must be anchored to floor
- Total weight of palletized goods MUST NOT exceed one half of uniformly distributed Beam capacity
- Allow at least 3" clearance between pallet & Uprite Frame, at least 4" clearance between pallets
- Pallets should overhang both Beams by at least 2", otherwise Particleboard or Wiregrid Shelves must be used

Hand Loader/Stacker



Fork Lift

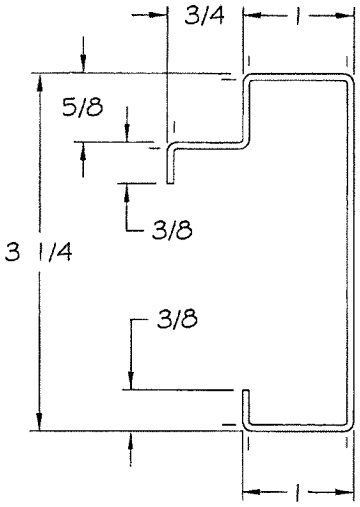


P.O. BOX 3448 • OMAHA, NEBRASKA 68103-0448 • (800) 228-9882
This is a copyrighted work of Lozier Corporation. Any unauthorized reproduction, distribution or use is expressly prohibited.

© 2013 Lozier® Corporation

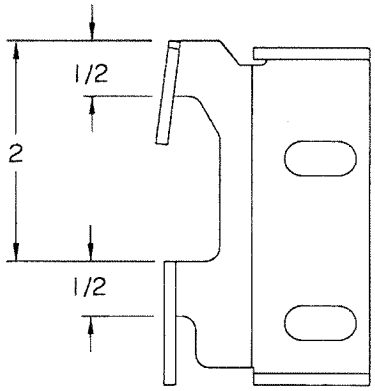
This drawing and its contents are the exclusive and confidential property of Lozier Corporation and its affiliated companies. The drawing is provided only for the purposes intended and shall at all times be kept confidential by the customer or supplier, who shall not, without the prior written consent of Lozier, diclose, use or disseminate, in whole or in part, this drawing, its contents, or concepts, and shall promptly return the drawing upon request without retaining any copies thereof.

B	A	PART NO.
96 1/8	96 1/2	WSB96
94 1/8	94 1/2	WSB94
92 1/8	92 1/2	WSB92
84 1/8	84 1/2	WSB84
79 1/8	79 1/2	WSB79
78 1/8	78 1/2	WSB78
77 1/8	77 1/2	WSB77
74 1/8	74 1/2	WSB74
72 1/8	72 1/2	WSB72
70 1/8	70 1/2	WSB70
68 1/8	68 1/2	WSB68
66 1/8	66 1/2	WSB66
64 1/8	64 1/2	WSB64
60 1/8	60 1/2	WSB60
59 1/8	59 1/2	WSB59
56 1/8	56 1/2	WSB56
54 1/8	54 1/2	WSB54
48 1/8	48 1/2	WSB48
44 1/8	44 1/2	WSB44
42 1/8	42 1/2	WSB42
41 1/8	41 1/2	WSB41
34 1/8	34 1/2	WSB34
28 1/8	28 1/2	WSB28
22 1/8	22 1/2	WSB22



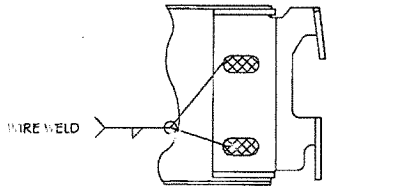
SECTION A-A

16 GA. HOT ROLLED STEEL
ASTM A607 GR 45, CLASS 2, OR
SAE J 1392 045X
45,000 PSI MIN YIELD

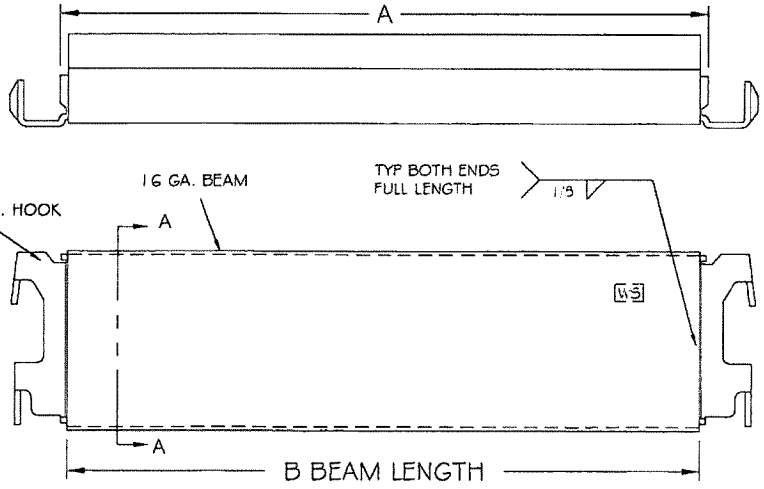


HOOK DETAIL

12 GA. HOT ROLLED STEEL
HSLA GRADE 50 PER ASTM SPECIFICATION A715
50,000 PSI MINIMUM YIELD STRENGTH



ALTERNATE WELDMENT OPTION
TYP BOTH ENDS



©2000 LOZIER CORP.

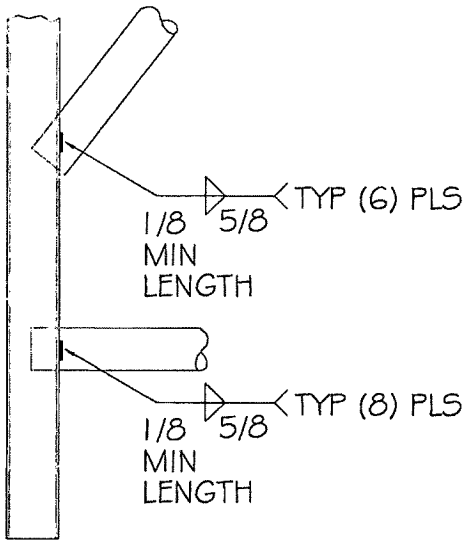
STANDARD DUTY BEAM

LOZIER
6336 PERSHING DR.
OMAHA, NE 68110
1-800-228-9882

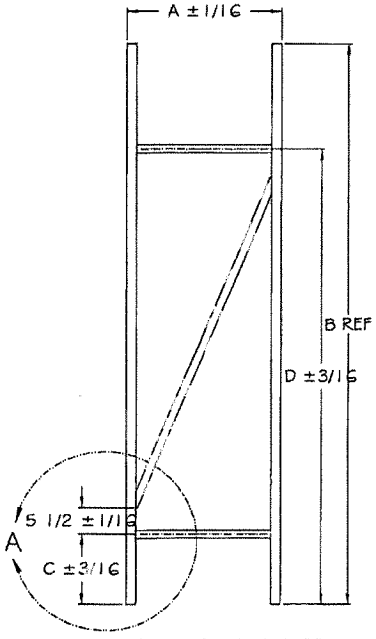
WIDESPAN BEAM DETAILS

SHEET 1 OF 1

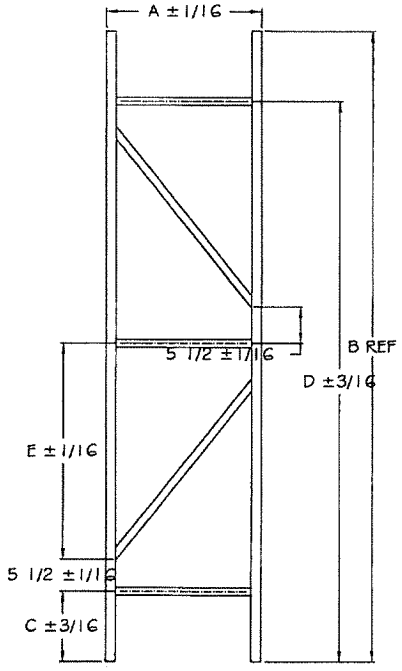
This drawing and its contents are the exclusive and confidential property of Lozier Corporation and its affiliated companies. The drawing is provided only for the purposes intended and shall at all times be kept confidential by the customer or supplier, who shall not, without the prior written consent of Lozier, diclose, use or disseminate, in whole or in part, this drawing, its contents, or concepts, and shall promptly return the drawing upon request without retaining any copies thereof.



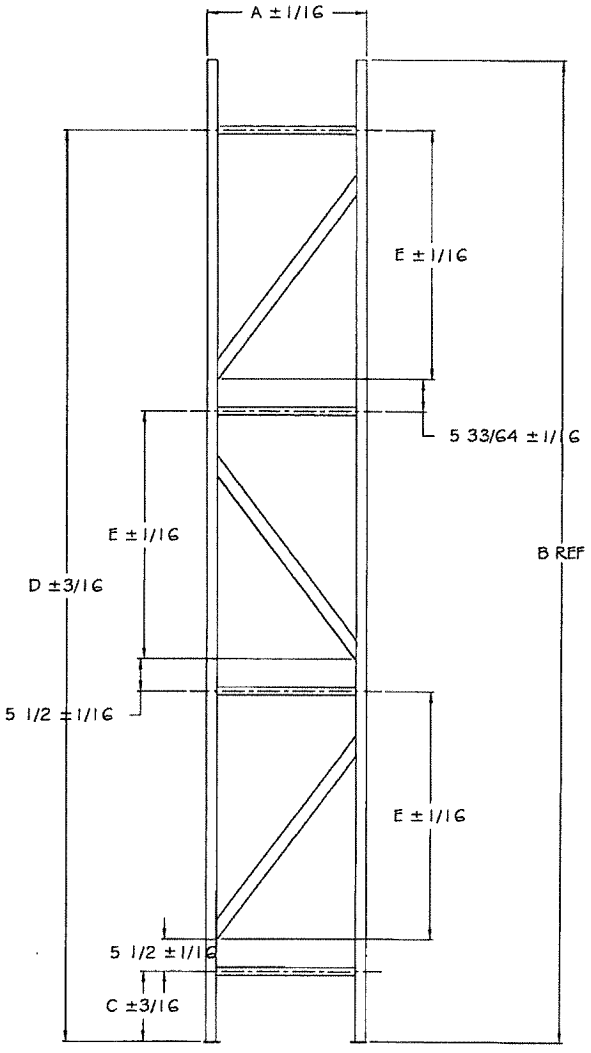
DETAIL A



THIS WELDMENT IS FOR
UPRITES TO 8'H.



THIS WELDMENT IS FOR
UPRITES 9'H THROUGH 12'H.



THIS WELDMENT IS
FOR URITES ABOVE 12'

WELDMENT DETAILS

©2000 LOZIER CORP.

LOZIER
6336 PERSHING DR.
OMAHA, NE 68110
1-800-228-9882

WIDESPAN UPRITE

This drawing and its contents are the exclusive and confidential property of Lozier Corporation and its affiliated companies. The drawing is provided only for the purposes intended and shall at all times be kept confidential by the customer or supplier, who shall not, without the prior written consent of Lozier, diclose, use or disseminate, in whole or in part, this drawing, its contents, or concepts, and shall promptly return the drawing upon request without retaining any copies thereof.

E	D	C	B NOM HEIGHT	A	PART NUMBER
---	36	6	42	32 1/8	WSU30042
---	36	6	42	26 1/8	WSU24042
---	36	6	42	20 1/8	WSU18042
---	36	6	42	10 1/8	WSU08042
---	34	6	40	50 1/8	WSU48040
---	32	6	38	32 1/8	WSU30038
---	30	6	36	60 1/8	WSU58036
---	30	6	36	50 1/8	WSU48036
---	30	6	36	44 1/8	WSU42036
---	30	6	36	38 1/8	WSU36036
---	30	6	36	32 1/8	WSU30036
---	30	6	36	26 1/8	WSU24036
---	30	6	36	20 1/8	WSU18036
---	30	6	36	17 1/8	WSU15036
---	26	6	32	14 1/8	WSU12032
---	24	6	30	50 1/8	WSU48030
---	24	6	30	44 1/8	WSU42030
---	24	6	30	38 1/8	WSU36030
---	24	6	30	32 1/8	WSU30030
---	24	6	30	26 1/8	WSU24030
---	24	6	30	20 1/8	WSU18030
---	22	6	28	50 1/8	WSU48028
---	18	6	24	50 1/8	WSU48024
---	18	6	24	44 1/8	WSU42024
---	18	6	24	38 1/8	WSU36024
---	18	6	24	32 1/8	WSU30024
---	18	6	24	30 1/8	WSU28024
---	18	6	24	26 1/8	WSU24024
---	18	6	24	23 1/8	WSU21024
---	18	6	24	20 1/8	WSU18024
---	18	6	24	17 1/8	WSU15024
---	12	6	18	20 1/8	WSU18018

E	D	C	B NOM HEIGHT	A	PART NUMBER
---	54	6	66	38 1/8	WSU36066
---	54	6	66	26 1/8	WSU24066
---	60	6	66	17 1/8	WSU15066
---	54	6	66	14 1/8	WSU12066
---	54	6	60	60 1/8	WSU58060
---	54	6	60	50 1/8	WSU48060
---	54	6	60	44 1/8	WSU42060
---	54	6	60	38 1/8	WSU36060
---	54	6	60	32 1/8	WSU30060
---	54	6	60	26 1/8	WSU24060
---	54	6	60	24 1/8	WSU22060
---	54	6	60	22 1/8	WSU20060
---	54	6	60	20 1/8	WSU18060
---	54	6	60	17 1/8	WSU15060
---	54	6	60	14 1/8	WSU12060
---	48	6	54	50 1/8	WSU48054
---	48	6	54	44 1/8	WSU42054
---	48	6	54	38 1/8	WSU36054
---	48	6	54	32 1/8	WSU30054
---	48	6	54	26 1/8	WSU24054
---	42	6	48	50 1/8	WSU48048
---	42	6	48	44 1/8	WSU42048
---	42	6	48	38 1/8	WSU36048
---	42	6	48	36 1/8	WSU34048
---	42	6	48	35 1/8	WSU33048
---	42	6	48	32 1/8	WSU30048
---	42	6	48	26 1/8	WSU24048
---	42	6	48	22 1/8	WSU20048
---	42	6	48	20 1/8	WSU18048
---	42	6	48	18 1/8	WSU16048
---	42	6	48	17 1/8	WSU15048
---	42	6	48	14 1/8	WSU12048
---	36	6	42	50 1/8	WSU48042
---	36	6	42	44 1/8	WSU42042
---	36	6	42	38 1/8	WSU36042

©2000 LOZIER CORP.

LOZIER
6336 PERSHING DR.
OMAHA, NE 68110
1-800-228-9882

WIDESPAN UPRITE

This drawing and its contents are the exclusive and confidential property of Lozier Corporation and its affiliated companies. The drawing is provided only for the purposes intended and shall at all times be kept confidential by the customer or supplier, who shall not, without the prior written consent of Lozier, diclose, use or disseminate, in whole or in part, this drawing, its contents, or concepts, and shall promptly return the drawing upon request without retaining any copies thereof.

---	78	12	96	32 1/8	WSU30096
---	78	12	96	26 1/8	WSU24096
---	78	12	96	20 1/8	WSU18096
---	78	12	96	17 1/8	WSU15096
---	78	12	96	14 1/8	WSU12096
---	78	12	90	50 1/8	WSU48090
---	78	12	90	44 1/8	WSU42090
---	78	12	90	38 1/8	WSU36090
---	72	12	84	60 1/8	WSU58084
---	72	12	84	50 1/8	WSU48084
---	72	12	84	46 1/8	WSU44084
---	72	12	84	44 1/8	WSU42084
---	72	12	84	38 1/8	WSU36084
---	72	12	84	32 1/8	WSU30084
---	72	12	84	26 1/8	WSU24084
---	72	12	84	20 1/8	WSU18084
---	72	12	84	18 1/8	WSU16084
---	72	12	84	17 1/8	WSU15084
---	72	12	84	14 1/8	WSU12084
---	66 1/4	12	78 1/4	38 1/8	WSU36078.25
---	66 1/4	12	78 1/4	32 1/8	WSU30078.25
---	66 1/4	12	78 1/4	26 1/8	WSU24078.25
---	66	12	78	60 1/8	WSU58078
---	66	12	78	38 1/8	WSU36078
---	66	12	78	32 1/8	WSU30078
---	60	12	72	50 1/8	WSU48072
---	60	12	72	46 1/8	WSU44072
---	60	12	72	44 1/8	WSU42072
---	60	12	72	38 1/8	WSU36072
---	60	12	72	32 1/8	WSU30072
---	60	12	72	26 1/8	WSU24072
---	60	12	72	22 1/8	WSU20072
---	60	12	72	20 1/8	WSU18072
---	60	12	72	17 1/8	WSU15072
---	60	12	72	14 1/8	WSU12072
E	D	C	B NOM HEIGHT	A	PART NUMBER

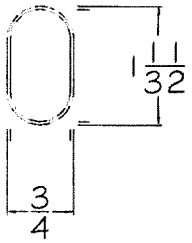
46 1/2	168	12	180	50 1/8	WSU48180
42 1/2	150	6	156	54 1/8	WSU52156
54 1/2	132	12	144	60 1/8	WSU58144
54 1/2	132	12	144	50 1/8	WSU48144
54 1/2	132	12	144	46 1/8	WSU44144
54 1/2	132	12	144	44 1/8	WSU42144
54 1/2	132	12	144	38 1/8	WSU36144
54 1/2	132	12	144	32 1/8	WSU30144
54 1/2	132	12	144	30 1/8	WSU28144
54 1/2	132	12	144	26 1/8	WSU24144
48 1/2	114	6	126	20 1/8	WSU18126
42 1/2	108	12	120	60 1/8	WSU58120
42 1/2	108	12	120	50 1/8	WSU48120
42 1/2	108	12	120	44 1/8	WSU42120
42 1/2	108	12	120	38 1/8	WSU36120
42 1/2	108	12	120	32 1/8	WSU30120
42 1/2	108	12	120	30 1/8	WSU28120
42 1/2	108	12	120	26 1/8	WSU24120
42 1/2	108	12	120	20 1/8	WSU18120
42 1/2	108	12	120	14 1/8	WSU12120
42 1/2	102	6	114	32 1/8	WSU30114
42 1/2	102	6	108	54 1/8	WSU52108
42 1/2	102	6	108	50 1/8	WSU48108
42 1/2	102	6	108	44 1/8	WSU42108
42 1/2	102	6	108	38 1/8	WSU36108
42 1/2	102	6	108	32 1/8	WSU30108
42 1/2	102	6	108	30 1/8	WSU28108
42 1/2	102	6	108	27 1/8	WSU25108
42 1/2	102	6	108	26 1/8	WSU24108
42 1/2	102	6	108	20 1/8	WSU18108
42 1/2	102	6	108	17 1/8	WSU15108
39 1/2	96	6	102	26 1/8	WSU24102
---	78	12	96	60 1/8	WSU58096
---	78	12	96	50 1/8	WSU48096
---	78	12	96	44 1/8	WSU42096
---	78	12	96	38 1/8	WSU36096
E	D	C	B NOM HEIGHT	A	PART NUMBER

©2000 LOZIER CORP.

LOZIER
6336 PERSHING DR.
OMAHA, NE 68110
1-800-228-9882

WIDESPAN UPRITE

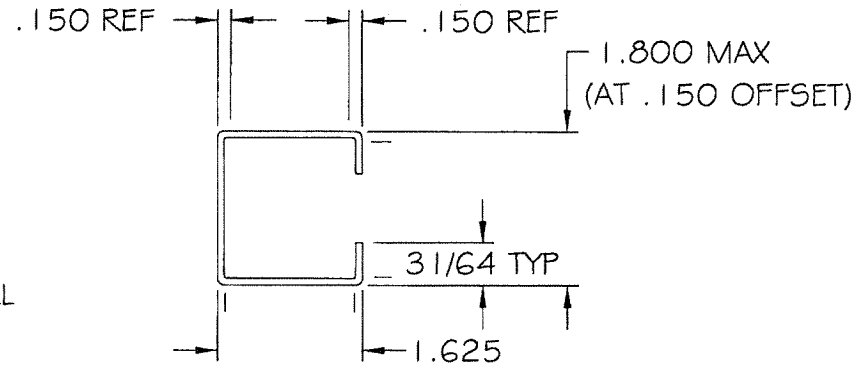
This drawing and its contents are the exclusive and confidential property of Lozier Corporation and its affiliated companies. The drawing is provided only for the purposes intended and shall at all times be kept confidential by the customer or supplier, who shall not, without the prior written consent of Lozier, diclose, use or disseminate, in whole or in part, this drawing, its contents, or concepts, and shall promptly return the drawing upon request without retaining any copies thereof.



HORIZ. AND DIAG. BRACE MATERIAL

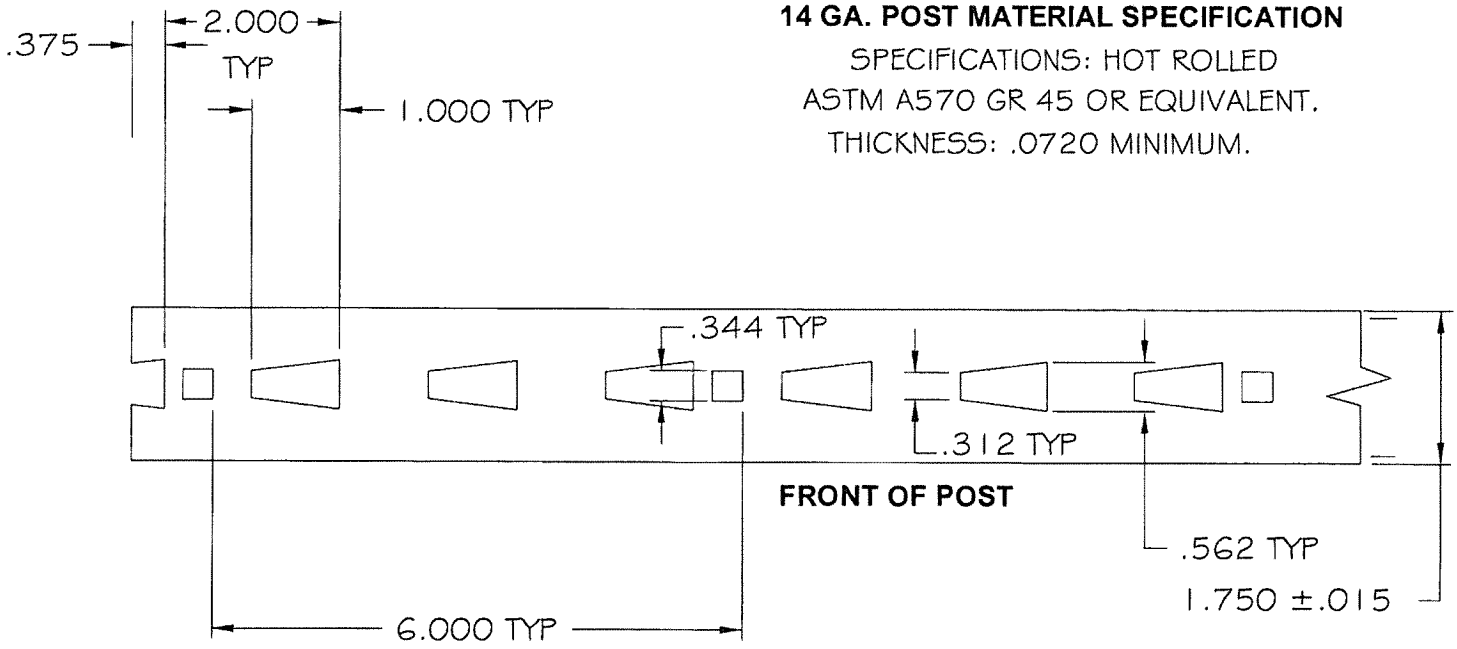
SPECIFICATIONS:

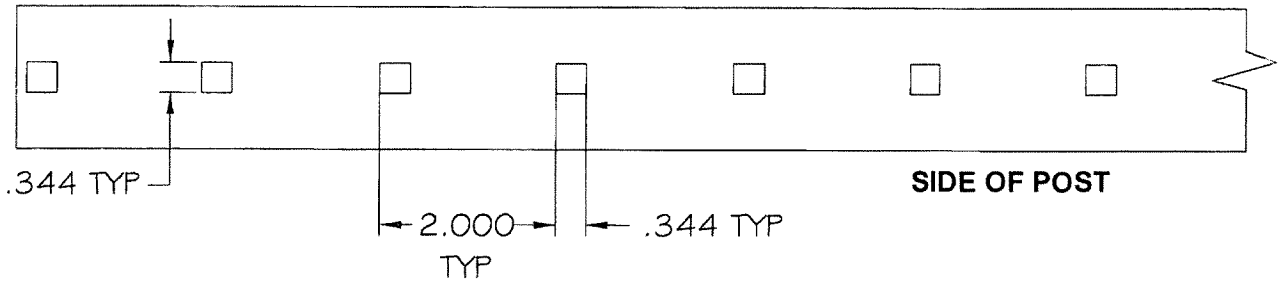
1. 3/4 X 1 11/32 X 20 GA. WALL STEEL TUBING.



14 GA. POST MATERIAL SPECIFICATION

SPECIFICATIONS: HOT ROLLED ASTM A570 GR 45 OR EQUIVALENT.
THICKNESS: .0720 MINIMUM.



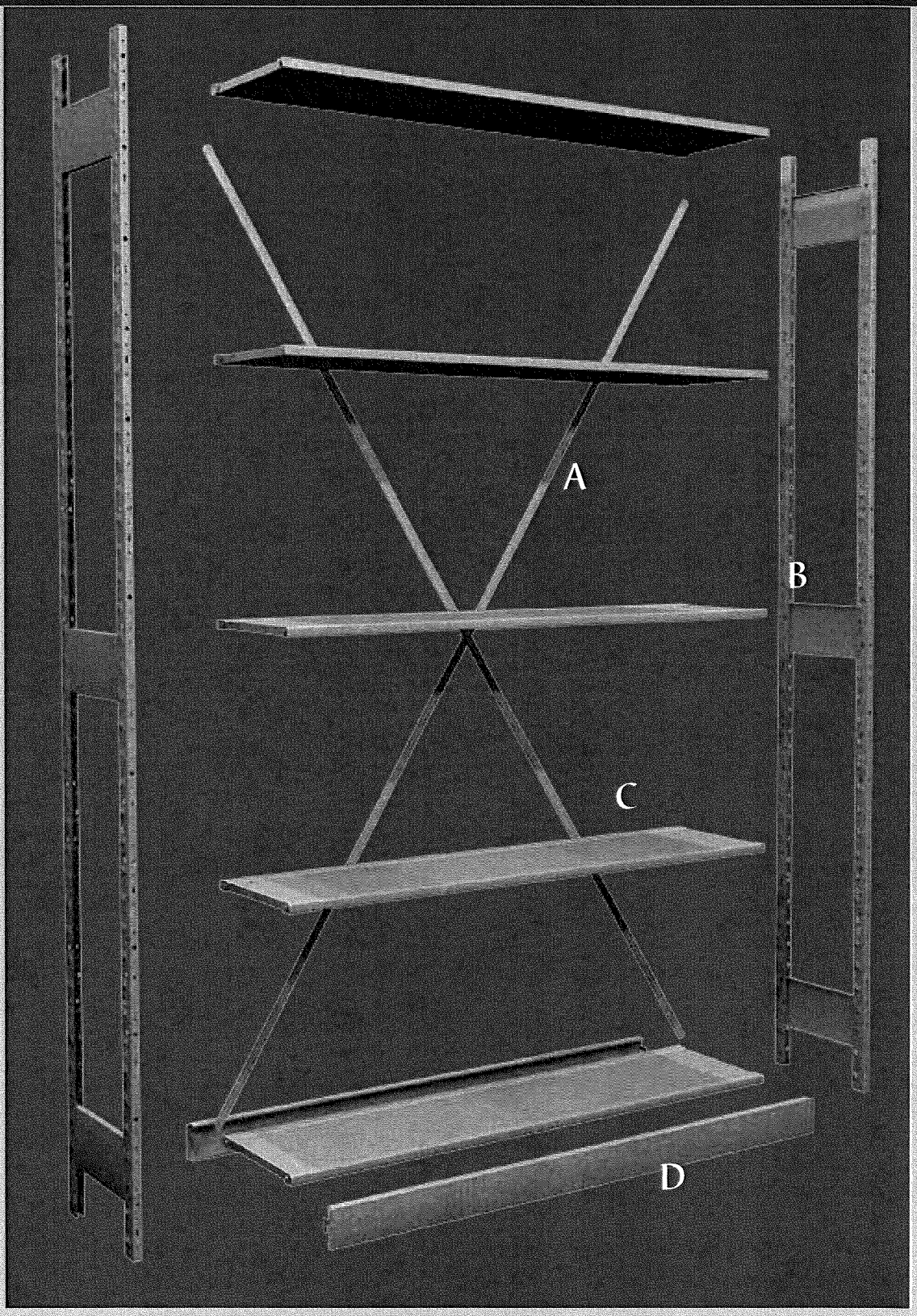


©2000 LOZIER CORP.

LOZIER
6336 PERSHING DR.
OMAHA, NE 68110
1-800-228-9882

WIDESPAN UPRITE

S Series Storage Shelving Components



Components:

A	=	Crossbrace	C	=	Shelf
B	=	Uprite	D	=	Shelf Front

LOZIER®

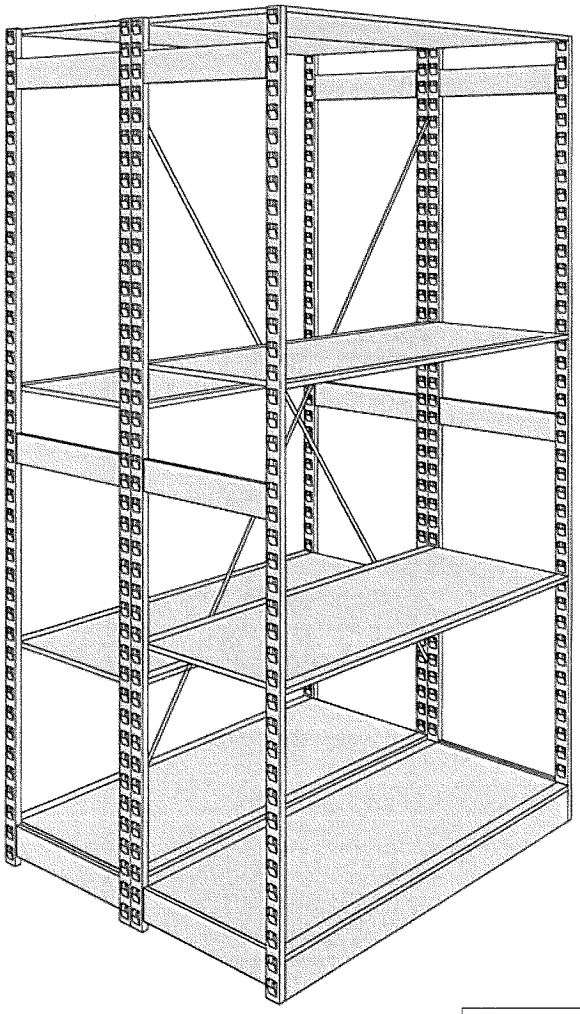
© 2005 Lozier® Corporation

P.O. BOX 3448 • OMAHA, NEBRASKA 68103-0448 • (800) 228-9882

This is a copyrighted work of Lozier Corporation. Any unauthorized reproduction, distribution or use is expressly prohibited.

Advance Auto Parts™
the best part is our people®

S SERIES STORAGE SHELVING



The wood and steel construction of Lozier S Series Storage Shelving offers economy without sacrificing strength. Installation time is reduced through the use of pre-assembled uprites, one piece shelves, and cross braces. Shelves are reinforced with a steel front and back to resist deflection and protect the edges. Accessories are available for garment hanging and open files.

PLEASE NOTE:

1. Personnel must be provided with safe access to all elevations of storage equipment or display fixtures via ladders, stairways, or other means in accordance with applicable OSHA regulations. In no case should anyone be allowed to climb or stand on storage or display equipment.
2. Some shelving installations may be subject to various local codes involving fire regulations, sanitation regulations, etc. Please check with local building departments before ordering shelving to determine which codes may apply.
3. Shelving installations in high-risk seismic zones (primarily California) may need to be "certified" by a structural engineer licensed in the state where the installation is located. Local authorities should be consulted in advance. Needed modifications must be quoted before the order is entered.

WARNING: Shelving must be anchored to a suitable building wall, to the floor, or otherwise braced to prevent overturning when merchandising tall or heavy items which lean against the shelving. The weight and force of leaning items on unanchored or unbraced shelving may cause the shelving to overturn or collapse.

SIZE INFORMATION

Clear Opening Between Posts:
- Nominal shelf width **minus** 1-1/4".

Overall Length:
- Length of continuous run is the sum of the nominal section widths **plus** 1-1/4" to account for end posts.

Overall Depth:
- Equals the nominal depth.

Vertical clearance between shelves:
- Equals the center-to-center shelf spacing **minus** 3/4".

Vertical Adjustment:
- All shelves are adjustable on 2" centers.

LOZIER®

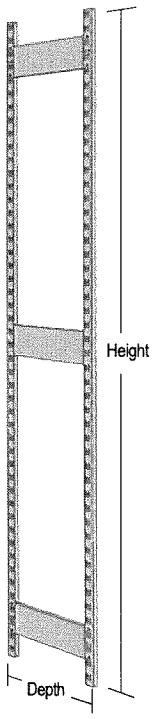
6336 Pershing Drive • Omaha, NE 68110 U.S.A. • TOLL FREE 1-800-228-9882

Prices and Specifications subject to change without notice.

© 2000 Lozier® Corporation

Advance Auto Parts™
the best part is our people®

S SERIES STORAGE SHELVING
UPRITE ASSEMBLIES



DEPTH	HEIGHT	CAT. NO.
12"	48"	SSU12048N
12"	96"	SSU12096N
12"	108"	SSU12108N
12"	120"	SSU12120N
12"	144"	SSU12144N
18"	84"	SSU18084N
18"	96"	SSU18096N
18"	108"	SSU18108N
18"	120"	SSU18120N
18"	144"	SSU18144N

OPEN UPRITE ASSEMBLIES

All storage shelving uprites have 16 ga. steel posts with shelf lances 2" on center. Open uprite assemblies are spaced with 18 ga. galvanized steel braces; closed uprite assemblies have a 5/8" particle board panel.

One assembly required for each 3' or 4' section and one at the end of each storage shelving run. Nominal depths and heights listed are actual dimensions.

STANDARD FINISH:
GLV (Galvanized) **only**, Code B

S SERIES CROSSBRACES

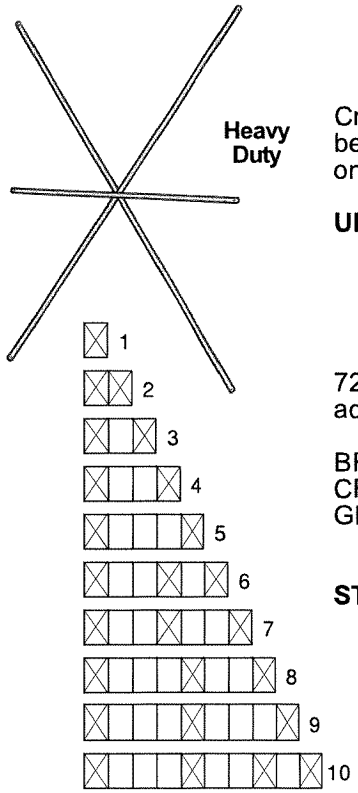


FIGURE 1

X - indicates brace(s) required in this section.

Crossbraces are required on the first and last sections of runs and on every fourth section between (see Figure 1). The unit catalog numbers below call out braces and hardware for one braced section of the width and height indicated. "Heavy Duty" brace forms an "X".

UPRITE CAPACITIES (IN RUNS BRACED WITH THE CROSSBRACE UNITS BELOW):

48"-96"High :1,200 lb./uprite assembly
108"-144"High :2,400 lb./uprite assembly

72", 84", and 96"H uprites can be upgraded to 2,400 lbs. by specifying "heavy duty" braces; add "HD" onto the 72", 84", or 96"H Crossbrace Unit numbers .

BRACE ALL ARCHIVE RECORD STORAGE INSTALLATIONS OVER 96"H WITH THE CROSSBRACE UNITS LISTED BELOW. IF THE ARCHIVE UNITS ARE 72"-96"H, UPGRADE THE CROSSBRACE UNITS TO "HD".

STANDARD FINISH: GLV (Galvanized) **only**

INDIVIDUAL BRACES

TYPE	SEC.	CAT. NO.	USED ON
Heavy Duty	48"	SSX472HD	72"-144" Uprite Hts.

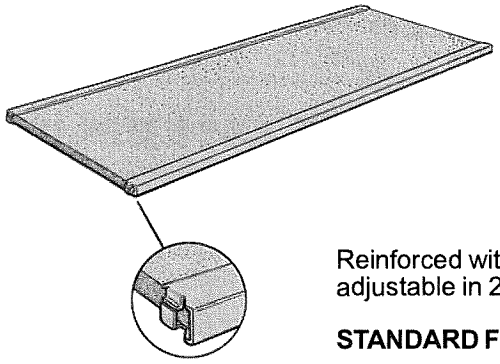
LOZIER®

6336 Pershing Drive • Omaha, NE 68110 U.S.A. • TOLL FREE 1-800-228-9882
Prices and Specifications subject to change without notice.
© 2000 Lozier® Corporation

Advance Auto Parts™

the best part is our people®

S SERIES STORAGE SHELVES



HEAVY DUTY

All Lozier S Series Storage Shelves are completely preassembled — no loose hardware needed. Shelves are made of 5/8" particleboard. Front and rear edges are steel reinforced to add strength and resist damage. Shelves are easily installed and repositioned to handle changing storage needs.

LOAD CAPACITIES: Heavy Duty: 600 lb./shelf

HEAVY DUTY

Reinforced with 1-1/4" deep x 3/4" high 16 ga. steel channels; adjustable in 2" vertical increments.

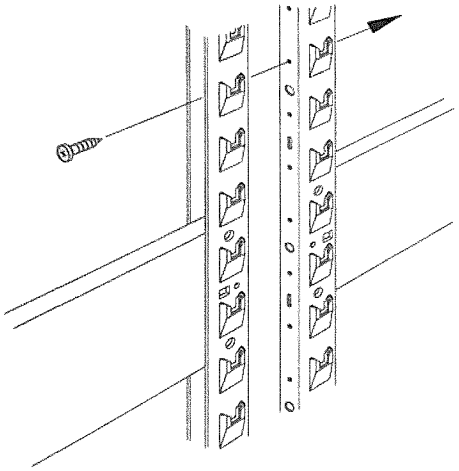
STANDARD FINISH: GLV (Galvanized) Channels **only**

IMPORTANT! TWO SHELVES MINIMUM PER SECTION, AND CROSSBRACES ARE REQUIRED FOR LATERAL STABILITY.

SHELF WIDTH	SHELF DEPTH	CAT. NO.
36"	12"	SS312H
36"	18"	SS318H
36"	24"	SS324H
48"	12"	SS412H
48"	18"	SS418H
48"	24"	SS424H

S SERIES BACK-TO-BACK STORAGE SHELVING

Two storage shelving runs can be connected back-to-back creating a double-entry island. When connecting two Open Uprite Assemblies, or an Open and a Closed Uprite Assembly, sheet metal screws are recommended.



BACK-TO-BACK HARDWARE

These #8 x 3/4" Phillips Head Sheet Metal Screws are used to connect two uprite assemblies back-to-back through the pilot holes punched in the uprite post face. Number of screws per pair of uprites required varies with uprite height — see table below.

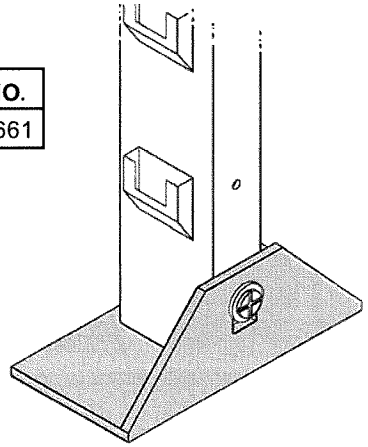
STANDARD FINISH: N/A (No Finish Option),

WT.	CAT.NO.❶
2.0	SS2221PK500

❶ **Available in packs of 500 only.**

FLOOR ANCHOR

CAT. NO.
A2553661



FLOOR ANCHORS ARE REQUIRED:

1. On all uprite posts where the bottom shelf is not within 6" of the floor.
2. On all shelving runs where the height to depth ratio exceeds 6 to 1. If two sections are connected back-to-back according to the specifications above, use the overall depth to calculate the 6 to 1 ratio.
3. To meet seismic anchoring requirements as specified by seismic engineer.

Post mounting hardware included.

STANDARD FINISH: GLV (Galvanized) **only**

LOZIER®

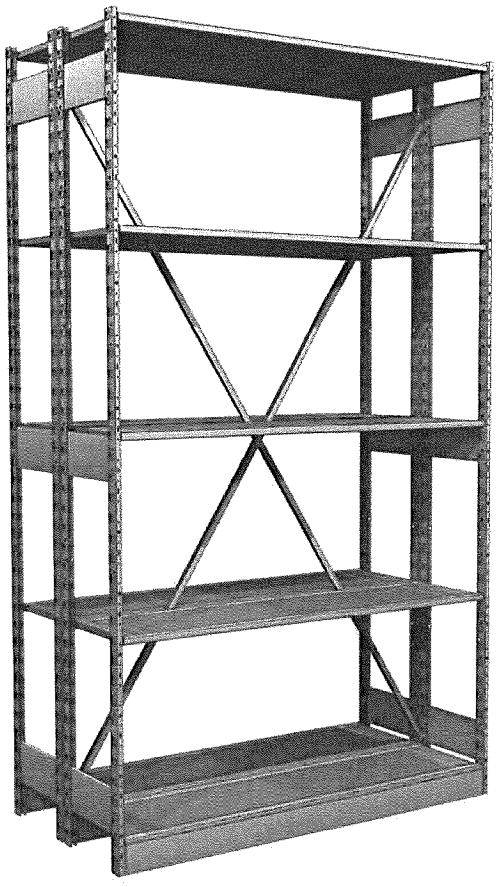
6336 Pershing Drive • Omaha, NE 68110 U.S.A. • TOLL FREE 1-800-228-9882

Prices and Specifications subject to change without notice.

© 2000 Lozier® Corporation

S Series Storage Shelving:

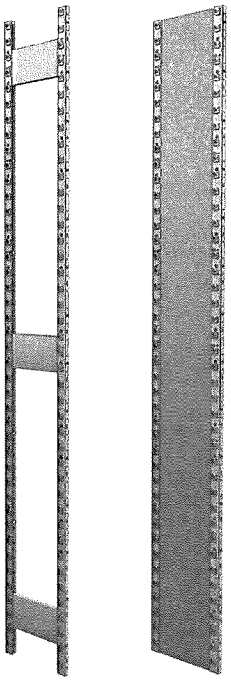
- Integrated wood & steel construction for strength & economy
- Pre-assembled all steel Uprites, one piece Shelves, & Cross Braces for installation ease (Open Uprite Pat. # 6,085,918)
- Particleboard Shelves reinforced with steel channels front & back
- Accessories available
- Standard Finish: GLV (Galvanized) unless otherwise noted



Size Information:

- Clear opening between posts: Nominal shelf width minus 1 1/4"
- Overall length: Length of continuous run is the sum of the nominal section widths plus 1 1/4" to account for end posts
- Overall depth equals the nominal depth
- Vertical clearance between shelves: Equals the center-to-center shelf spacing minus 3/4"
- Vertical adjustment 2" on centers

Assembled Uprite



Assembled Uprite:

- Galvanized steel posts
- Two Styles: Open: Galvanized steel Uprite braces (Pat. # 6,085,918) Closed: 5/8" unfinished particleboard panel
- Shelf lances 2" on center
- One assembly required for each 3' or 4' Section & one at the end of each run
- **For pricing see section 800, pg 15**

EXAMPLE PART NO.

SSU	12	048	N

STANDARD FINISH:

GLV

SSU = S Series Storage Uprite
12 = Shelf Depth: 12", 18", 24", 30"
048 = Section Height: 48", 60", 72", 84", 96", 108", 120", 144
N = "N" Open or "P" Closed

P.O. BOX 3448 • OMAHA, NEBRASKA 68103-0448 • (800) 228-9882
This is a copyrighted work of Lozier Corporation. Any unauthorized reproduction, distribution or use is expressly prohibited.

© 2011 Lozier® Corporation

S Series Backs & Crossbraces:

- All sections must be stabilized per the minimum recommendation on the diagram mid page: Lateral stability obtained in one of three ways:
  1. Order Crossbrace below
  2. Order Back Panel below
  3. Order braced sections on (pg. 804)

Crossbrace:

- See chart on pg. 804 for system load rating
- Required on ends of each section & every fourth section in between (see diagram below)
- Back-to-back runs can share Crossbraces if posts are securely connected with Back-to-Back Screws
- Part number below includes two Crossbraces when section height is over 96"
- **For pricing see section 800, pg 16**

EXAMPLE PART NO.

SSX	4	48	R

SSX = S Series Crossbrace
4 = Section Width: 3' or 4'
48 = Section Height: 36", 48", 60", 72", 84", 96", 108", 120", 144
R = "R" Regular Duty: (48"H - 96"H) "H" Heavy Duty: (72"H - 144"H)

STANDARD FINISH:

GLV

Number of continuous sections									
1	X								
2	X	X							
3	X		X						
4	X			X					
5	X				X				
6	X			X		X			
7	X			X			X		
8	X				X			X	
9	X				X				X

X = denotes braced section

Back Panels:

- Can be used on back of each section to create a closed or "closet" section
- 1/8" Hardboard, unfinished
- Required on ends of each section & every fourth section in between for stabilization
- In back-to-back closed sections, supplement an additional Back or Crossbrace in all sections requiring a brace
- Notched to accept Back-to-Back Connectors
- 108" - 144" Backs are two-pieces with an "H" Splicer
- Uniformly distributed load of 2,400 lb. per Section
- **For pricing see section 800, pg 16**

EXAMPLE PART NO.

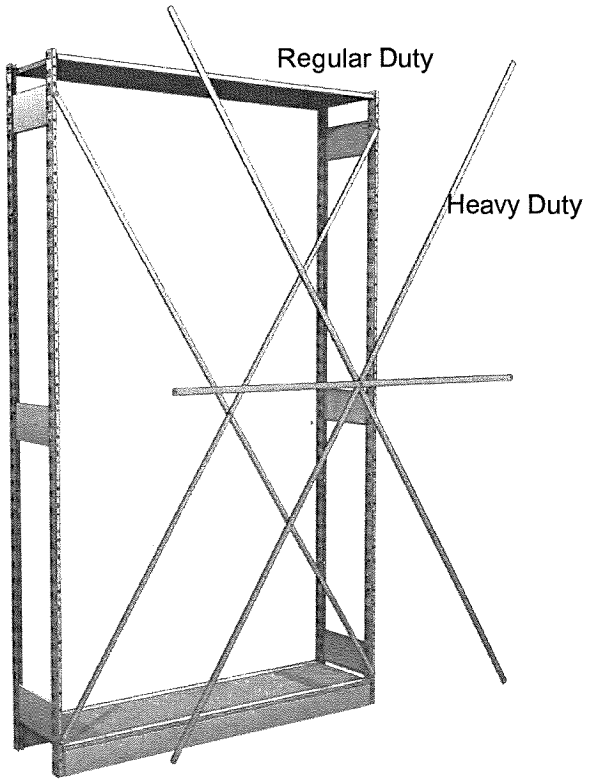
SSBP	48	048	U

SSBP = S Series Back Panel
48 = Section Width: 36" or 48"
048 = Section Height: 48", 60", 72", 84", 96", 108", 120", 144"
U = Unit (includes: screws, washers, & "H" Splicer)

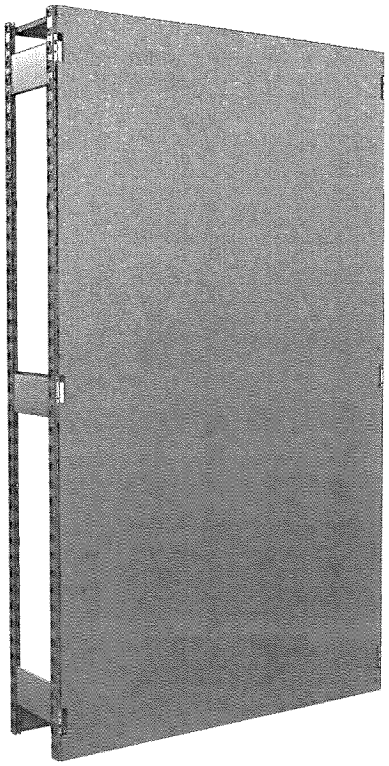
STANDARD FINISH:

N/A

Crossbrace



Back Panels

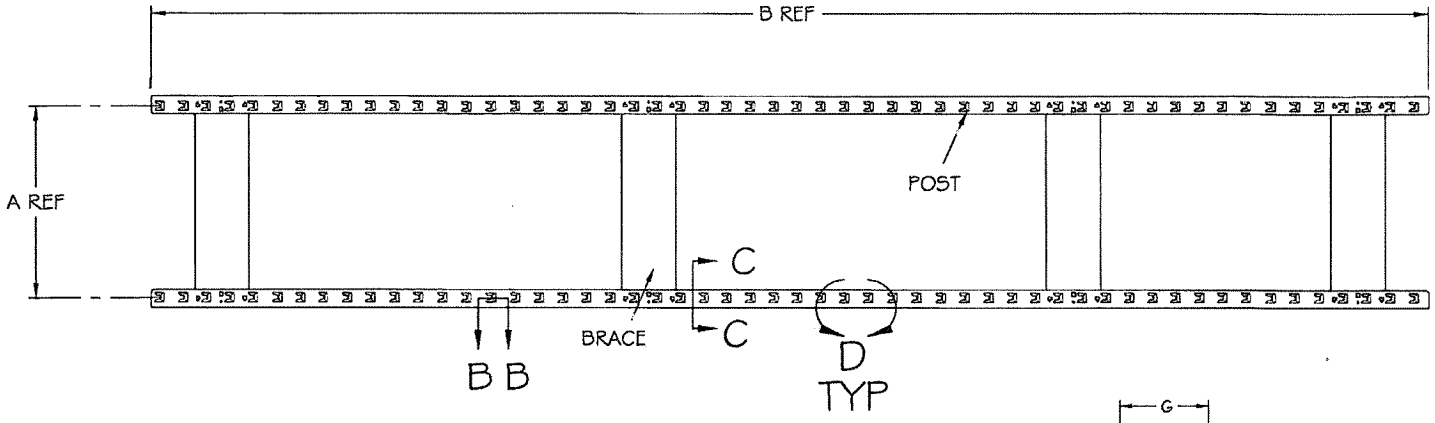


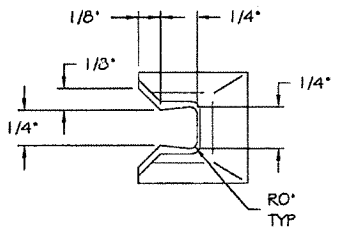
P.O. BOX 3448 • OMAHA, NEBRASKA 68103-0448 • (800) 228-9882
This is a copyrighted work of Lozier Corporation. Any unauthorized reproduction, distribution or use is expressly prohibited.
© 2011 Lozier® Corporation

This drawing and its contents are the exclusive and confidential property of Lozier Corporation and its affiliated companies. The drawing is provided only for the purposes intended and shall at all times be kept confidential by the customer or supplier, who shall not, without the prior written consent of Lozier, diclose, use or disseminate, in whole or in part, this drawing, its contents, or concepts, and shall promptly return the drawing upon request without retaining any copies thereof.

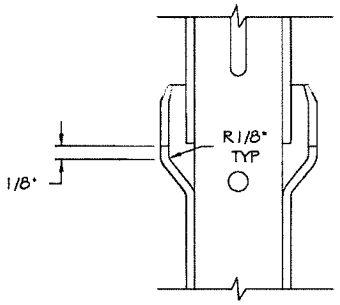
16 GA. GALVANIZED MATERIAL

STEEL, COMMERCIAL QUALITY, 30 KSI MINIMUM YIELD STRENGTH, HOT DIP GALVANIZED PER ASTM A653, GRADE G30 OR BETTER. THICKNESS: .060 MINIMUM.

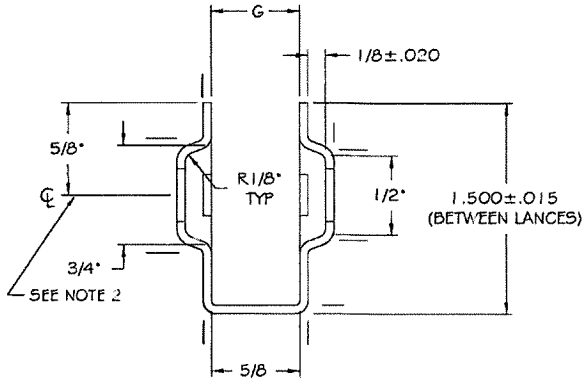




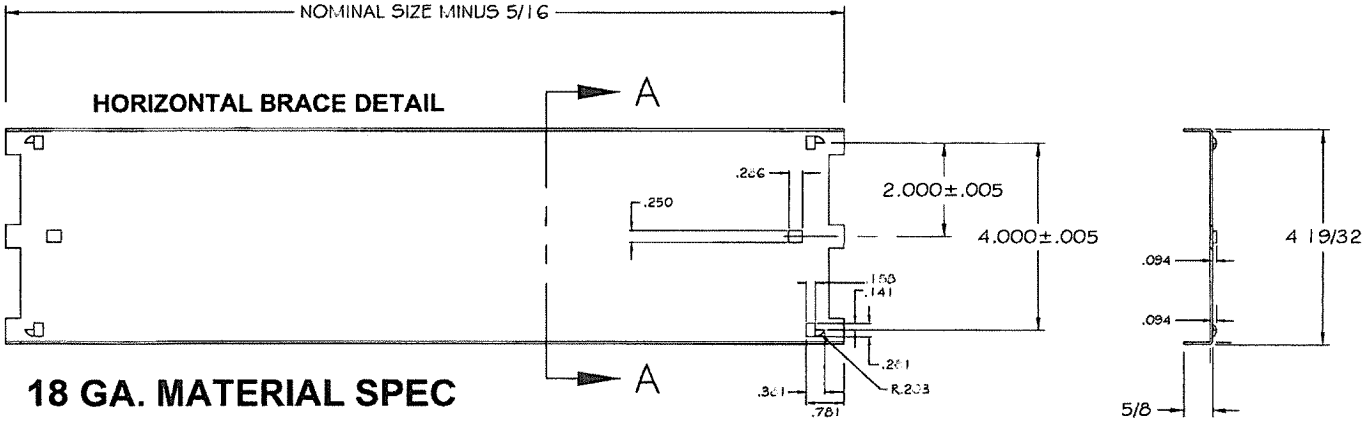
DETAIL D



SECTION B-B



SECTION C-C



SECTION A-A

18 GA. MATERIAL SPEC

18 GA STEEL SLIT COIL, ZINC-COATED (GALVANIZED), HOT DIP COMMERCIAL QUALITY, 30 KSI YIELD STRENGTH, MIN.
ASTM A 653 G30-G90

©2000 LOZIER CORP.

UPRITE ASSEMBLY DETAILS

LOZIER
6336 PERSHING DR.
OMAHA, NE 68110
1-800-228-9882

S-SERIES STORAGE SHELVING

US PATENT NO. 6,085,918

This drawing and its contents are the exclusive and confidential property of Lozier Corporation and its affiliated companies. The drawing is provided only for the purposes intended and shall at all times be kept confidential by the customer or supplier, who shall not, without the prior written consent of Lozier, disclose, use or disseminate, in whole or in part, this drawing, its contents, or concepts, and shall promptly return the drawing upon request without retaining any copies thereof.

BRACE QTY	B	A	PART NUMBER
6	192	28 1/4	SSU30192N
6	186	28 1/4	SSU30186N
5	180	28 1/4	SSU30180N
5	174	28 1/4	SSU30174N
5	168	28 1/4	SSU30168N
5	162	28 1/4	SSU30162N
5	156	28 1/4	SSU30156N
5	150	28 1/4	SSU30150N
5	144	28 1/4	SSU30144N
5	138	28 1/4	SSU30138N
4	132	28 1/4	SSU30132N
4	126	28 1/4	SSU30126N
4	120	28 1/4	SSU30120N
4	114	28 1/4	SSU30114N
4	108	28 1/4	SSU30108N
4	102	28 1/4	SSU30102N
3	96	28 1/4	SSU30096N
3	90	28 1/4	SSU30090N
3	84	28 1/4	SSU30084N
3	78	28 1/4	SSU30078N
3	72	28 1/4	SSU30072N
3	66	28 1/4	SSU30066N
3	60	28 1/4	SSU30060N
3	54	28 1/4	SSU30054N
2	48	28 1/4	SSU30048N
2	42	28 1/4	SSU30042N
2	40	28 1/4	SSU30040N
2	36	28 1/4	SSU30036N
2	30	28 1/4	SSU30030N
2	24	28 1/4	SSU30024N
2	18	28 1/4	SSU30018N
1	12	28 1/4	SSU30012N
6	192	22 1/4	SSU24192N
6	186	22 1/4	SSU24186N
5	180	22 1/4	SSU24180N
5	174	22 1/4	SSU24174N
5	168	22 1/4	SSU24168N
5	162	22 1/4	SSU24162N
5	156	22 1/4	SSU24156N
5	150	22 1/4	SSU24150N
5	144	22 1/4	SSU24144N
5	138	22 1/4	SSU24138N
4	132	22 1/4	SSU24132N
4	126	22 1/4	SSU24126N
4	120	22 1/4	SSU24120N
4	114	22 1/4	SSU24114N
4	108	22 1/4	SSU24108N
4	102	22 1/4	SSU24102N
3	96	22 1/4	SSU24096N
3	90	22 1/4	SSU24090N
3	84	22 1/4	SSU24084N
3	78	22 1/4	SSU24078N
3	72	22 1/4	SSU24072N

BRACE QTY	B	A	PART NUMBER
3	66	22 1/4	SSU24066N
3	60	22 1/4	SSU24060N
3	54	22 1/4	SSU24054N
2	48	22 1/4	SSU24048N
2	42	22 1/4	SSU24042N
2	40	22 1/4	SSU24040N
2	36	22 1/4	SSU24036N
2	30	22 1/4	SSU24030N
2	24	22 1/4	SSU24024N
2	18	22 1/4	SSU24018N
1	12	22 1/4	SSU24012N
6	192	16 1/4	SSU18192N
6	186	16 1/4	SSU18186N
5	180	16 1/4	SSU18180N
5	174	16 1/4	SSU18174N
5	168	16 1/4	SSU18168N
5	162	16 1/4	SSU18162N
5	156	16 1/4	SSU18156N
5	150	16 1/4	SSU18150N
5	144	16 1/4	SSU18144N
5	138	16 1/4	SSU18138N
4	132	16 1/4	SSU18132N
4	126	16 1/4	SSU18126N
4	120	16 1/4	SSU18120N
4	114	16 1/4	SSU18114N
4	108	16 1/4	SSU18108N
4	102	16 1/4	SSU18102N
3	96	16 1/4	SSU18096N
3	90	16 1/4	SSU18090N
3	84	16 1/4	SSU18084N
3	78	16 1/4	SSU18078N
3	72	16 1/4	SSU18072N
3	66	16 1/4	SSU18066N
3	60	16 1/4	SSU18060N
3	54	16 1/4	SSU18054N
2	48	16 1/4	SSU18048N
2	42	16 1/4	SSU18042N
2	40	16 1/4	SSU18040N
2	36	16 1/4	SSU18036N
2	30	16 1/4	SSU18030N
2	24	16 1/4	SSU18024N
2	18	16 1/4	SSU18018N
1	12	16 1/4	SSU18012N
6	192	14 1/4	SSU16192N
4	120	14 1/4	SSU16120N
4	102	14 1/4	SSU16102N
3	96	14 1/4	SSU16096N
3	84	14 1/4	SSU16084N

BRACE QTY	B	A	PART NUMBER
3	96	12 1/4	SSU14096N
6	192	10 1/4	SSU12192N
6	186	10 1/4	SSU12186N
5	180	10 1/4	SSU12180N
5	174	10 1/4	SSU12174N
5	168	10 1/4	SSU12168N
5	162	10 1/4	SSU12162N
5	156	10 1/4	SSU12156N
5	150	10 1/4	SSU12150N
5	144	10 1/4	SSU12144N
5	138	10 1/4	SSU12138N
4	132	10 1/4	SSU12132N
4	126	10 1/4	SSU12126N
4	120	10 1/4	SSU12120N
4	114	10 1/4	SSU12114N
4	108	10 1/4	SSU12108N
4	102	10 1/4	SSU12102N
3	96	10 1/4	SSU12096N
3	90	10 1/4	SSU12090N
3	84	10 1/4	SSU12084N
3	78	10 1/4	SSU12078N
3	72	10 1/4	SSU12072N
3	66	10 1/4	SSU12066N
3	60	10 1/4	SSU12060N
3	54	10 1/4	SSU12054N
2	48	10 1/4	SSU12048N
2	42	10 1/4	SSU12042N
2	40	10 1/4	SSU12040N
2	36	10 1/4	SSU12036N
2	30	10 1/4	SSU12030N
2	24	10 1/4	SSU12024N
2	18	10 1/4	SSU12018N
1	12	10 1/4	SSU12012N

©2000 LOZIER CORP.

UPRITE ASSEMBLY DETAILS

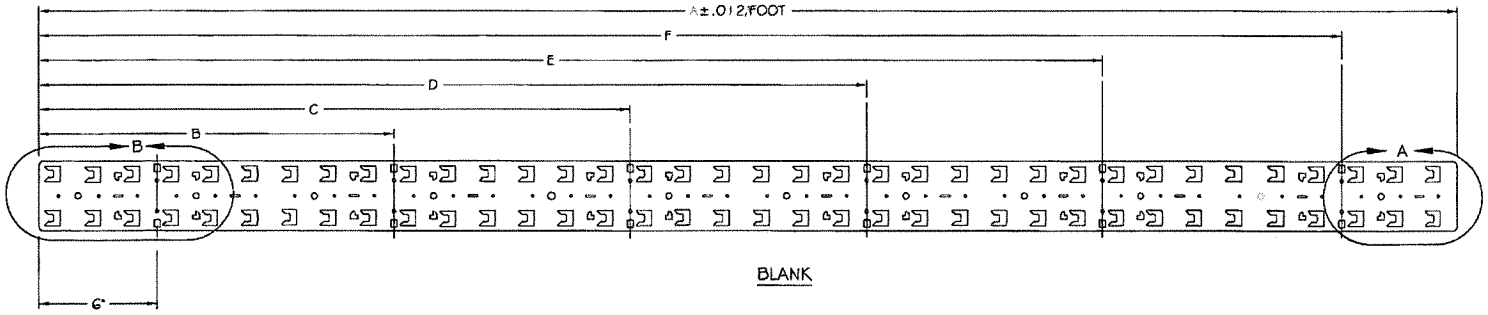
LOZIER
6336 PERSHING DR.
OMAHA, NE 68110
1-800-228-9882

S-SERIES STORAGE SHELVING

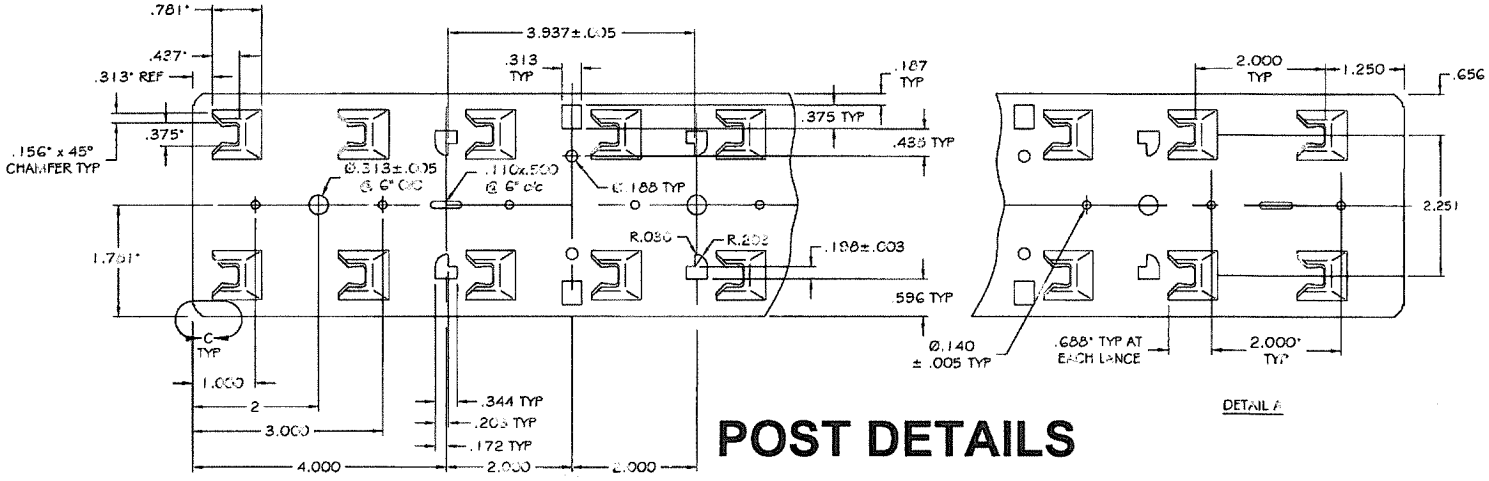
US PATENT NO. 6,085,918

This drawing and its contents are the exclusive and confidential property of Lozier Corporation and its affiliated companies. The drawing is provided only for the purposes intended and shall at all times be kept confidential by the customer or supplier, who shall not, without the prior written consent of Lozier, diclose, use or disseminate, in whole or in part, this drawing, its contents, or concepts, and shall promptly return the drawing upon request without retaining any copies thereof.

BRACE LOCATIONS

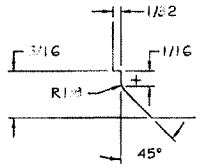


BLANK



DETAIL A

POST DETAILS



DETAIL C

DETAIL B

186	162	126	90	54	192
180	156	120	84	48	186
---	174	138	102	54	180
---	168	132	96	54	174
---	162	126	90	54	168
F	E	D	C	B	A

---	156	120	84	48	162
---	150	114	78	42	156
---	144	114	78	42	150
---	138	108	78	42	144
---	132	102	72	42	138
---	---	126	90	54	132
---	---	120	84	48	126
---	---	114	78	42	120
---	---	108	78	42	114
---	---	102	72	42	108
---	---	96	66	36	102
---	---	---	90	54	96
---	---	---	84	48	90
F	E	D	C	B	A

---	---	---	78	42	84
---	---	---	72	42	78
---	---	---	66	42	72
---	---	---	60	36	66
---	---	---	54	30	60
---	---	---	48	30	54
---	---	---	---	42	48
---	---	---	---	36	42
---	---	---	---	30	36
---	---	---	---	24	30
---	---	---	---	18	24
---	---	---	---	12	18
---	---	---	---	---	12
F	E	D	C	B	A

©2000 LOZIER CORP.

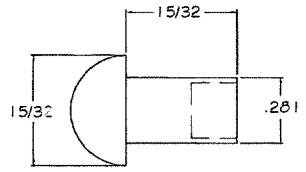
LOZIER
6336 PERSHING DR.
OMAHA, NE 68110
1-800-228-9882

S-SERIES STORAGE SHELVING

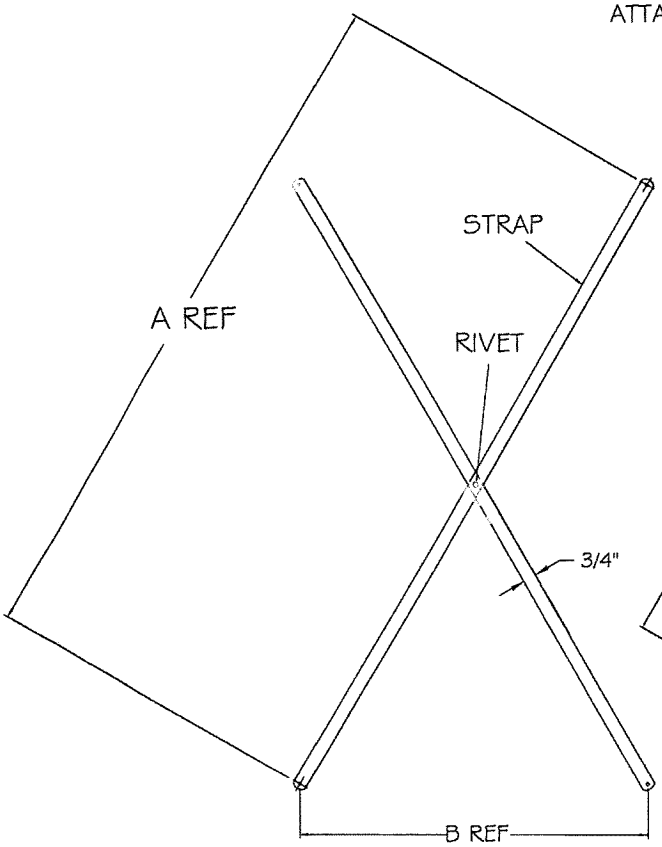
US PATENT NO. 6,085,918

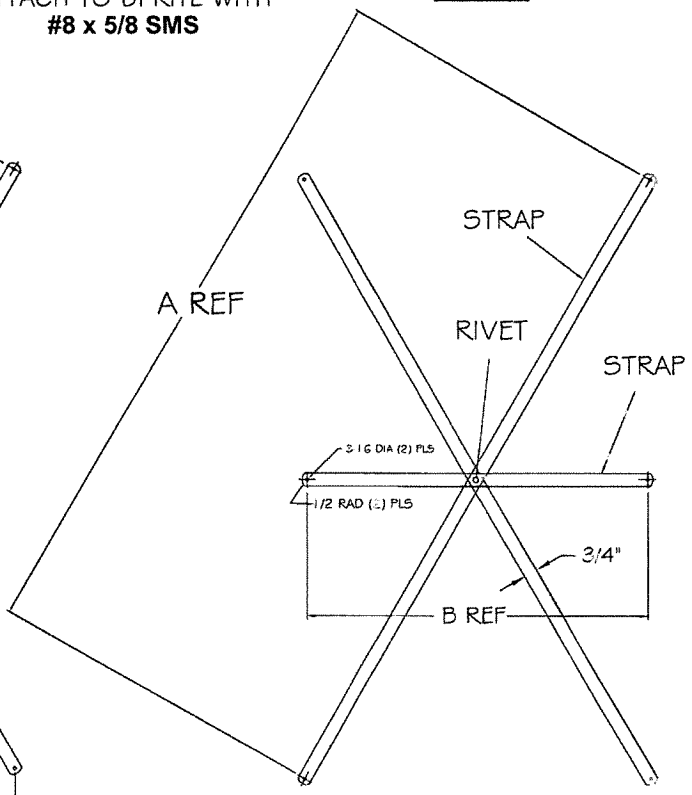
This drawing and its contents are the exclusive and confidential property of Lozier Corporation and its affiliated companies. The drawing is provided only for the purposes intended and shall at all times be kept confidential by the customer or supplier, who shall not, without the prior written consent of Lozier, disclose, use or disseminate, in whole or in part, this drawing, its contents, or concepts, and shall promptly return the drawing upon request without retaining any copies thereof.

RIVET DETAIL



ATTACH TO UPRITE WITH
#8 x 5/8 SMS





REGULAR DUTY

48	80	SSX472RD
48	55 19/32	SSX436RD
48	51 1/4	SSX424RD
48	48 3/4	SSX412RD
48	78 1/4	SSX4572RD
48	76 1/2	SSX4272RD
48	51 5/8	SSX4236RD
48	45 11/16	SSX4224RD
36	73 7/16	SSX372RD
36	46 7/8	SSX336RD
30	40 1/4	SSX324RD
24	38 13/32	SSX236RD
12	18 3/8	SSX118RD
B	A	DWG NO

HEAVY DUTY

48	100 1/4	SSX48120HD
48	80	SSX472HD
45	78 1/4	SSX4572HD
42	76 1/2	SSX4272HD
36	95 1/16	SSX36120HD
36	73 7/16	SSX372HD
30	72 1/2	SSX3072HD
24	70 7/32	SSX272HD
B	A	PART NUMBER

16 G. GALVANIZED MATERIAL

STEEL, COMMERCIAL QUALITY, 30 KSI MINIMUM YIELD STRENGTH, AIM FOR 60 MAXIMUM HARDNESS ON ROCKWELL "B" SCALE.
HOT DIP GALVANIZED PER ASTM A653, GRADE G30 OR BETTER.
THICKNESS: .060 MINIMUM.

©2000 LOZIER CORP.

CROSSBRACE DETAILS

LOZIER
6336 PERSHING DR.
OMAHA, NE 68110
1-800-228-9882

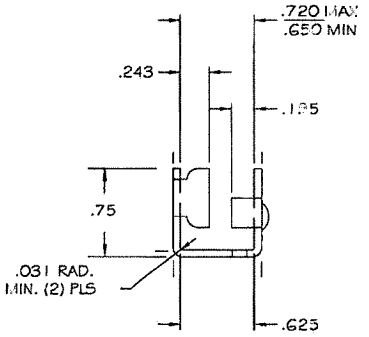
S-SERIES STORAGE SHELVING

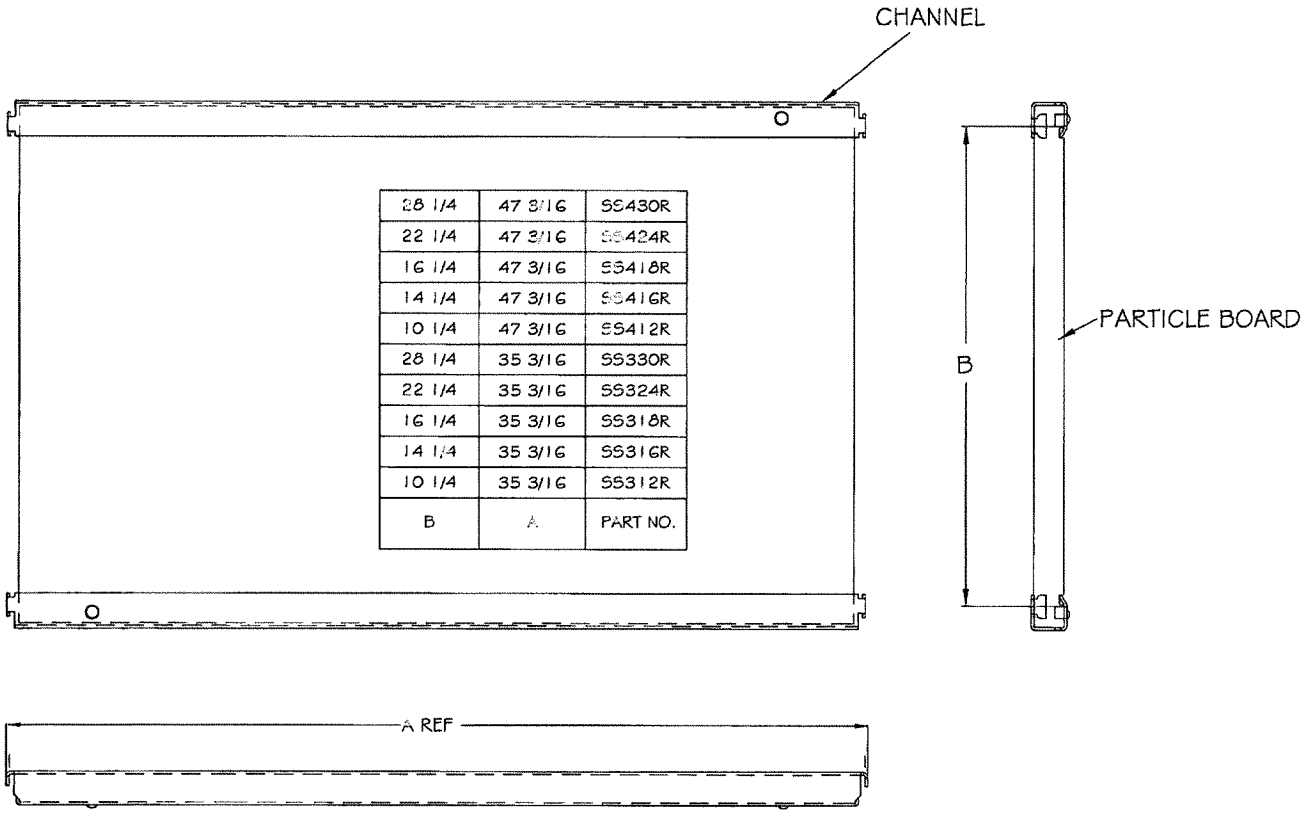
This drawing and its contents are the exclusive and confidential property of Lozier Corporation and its affiliated companies. The drawing is provided only for the purposes intended and shall at all times be kept confidential by the customer or supplier, who shall not, without the prior written consent of Lozier, diclose, use or disseminate, in whole or in part, this drawing, its contents, or concepts, and shall promptly return the drawing upon request without retaining any copies thereof.

16 GA SHELF CHANNEL

Hot dip galvinized coil steel (grade G30 or better.)

Material to meet ASTM spec. A525
Thickness: .062" min. 2.65 lb/sq. ft.
Hardness: RB60 Max.





B	A	PART NO.
28 1/4	47 3/16	SS430R
22 1/4	47 3/16	SS424R
16 1/4	47 3/16	SS418R
14 1/4	47 3/16	SS416R
10 1/4	47 3/16	SS412R
28 1/4	35 3/16	SS330R
22 1/4	35 3/16	SS324R
16 1/4	35 3/16	SS318R
14 1/4	35 3/16	SS316R
10 1/4	35 3/16	SS312R

©2000 LOZIER CORP.

REGULAR DUTY SHELF DETAILS

LOZIER
6336 PERSHING DR.
OMAHA, NE 68110
1-800-228-9882

S-SERIES STORAGE SHELVING

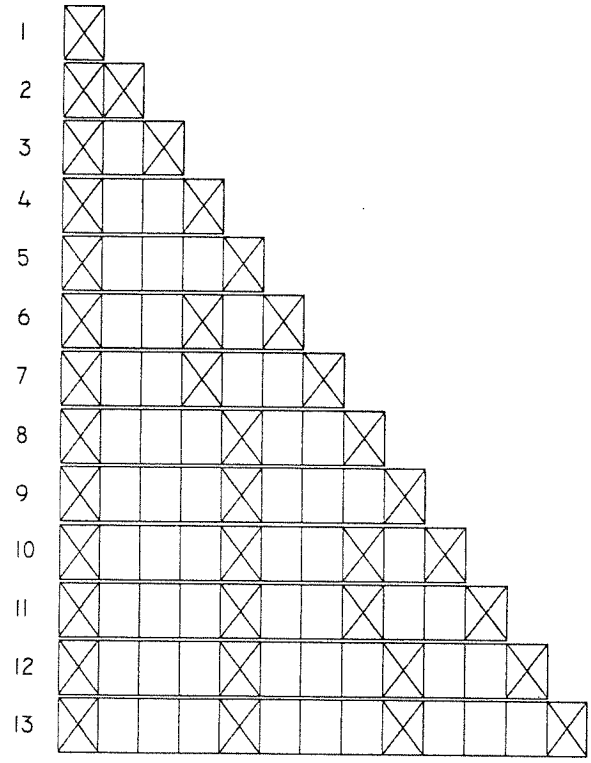
INSTALLATION INSTRUCTIONS

S-SERIES STORAGE SHELVING

WARNING! ALL RUNS OF STORAGE SHELVING MUST HAVE AT LEAST TWO SECTIONS (EXCEPT A SINGLE FREE STANDING SECTION) CROSS-BRACED, AS SHOWN BELOW. RUNS MUST HAVE CROSS-BRACES ON THE END, OR STARTER SECTION, AND CROSS-BRACES ON EVERY FOURTH SECTION THEREAFTER, PLUS A CROSS-BRACE ON THE LAST SECTION. FAILURE TO DO THIS MAY RESULT IN PERSONAL INJURY AND PROPERTY DAMAGE.

EXAMPLES OF CROSS BRACE LOCATIONS:

NUMBER OF SECTIONS

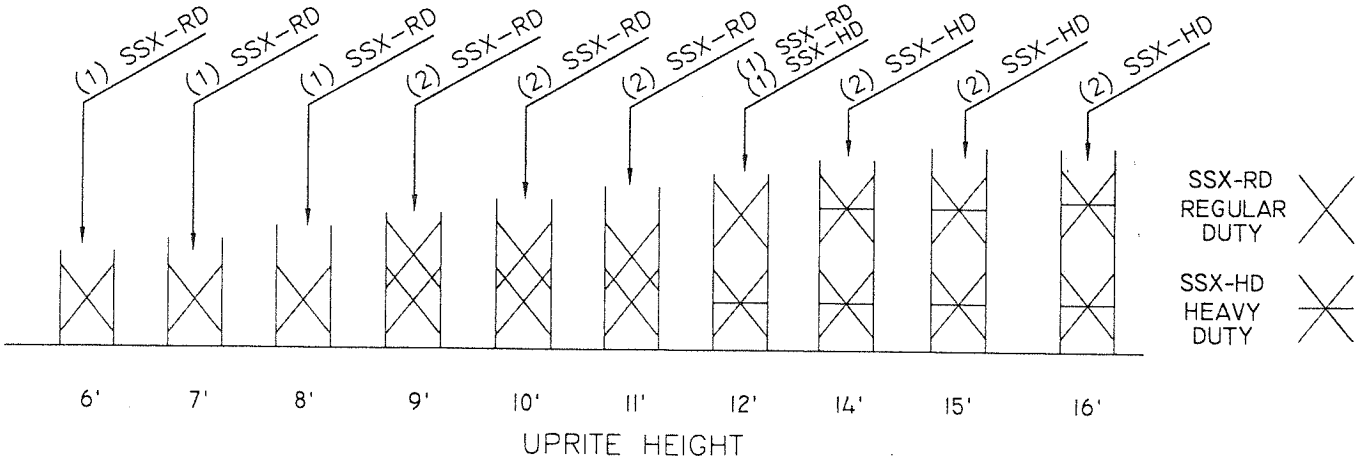


FASTENING
Cross-braces must be fastened into the small hole in the face of the uprite post with #8 x 3/4" sheet metal screws. Start at the bottom as shown on the next page. Where adjacent sections have braces, offset the braces (1) hole on the common uprite post

BACK-TO-BACK RUN BRACING
These runs may share common cross-braces only if the back-to-back Uprite posts are securely fastened together with screws or with back-to-back connectors. (See Page 9)

SOLID BACKS
Solid back panels may be used in place of cross-braces. If solid back panels are used in back-to-back runs, the posts on the other side must have cross-braces. (See Page 8)

NOTE: The style and quantity of cross-braces in each braced section depends on the height of the uprites, as shown below.



LOZIER
6336 PERSHING DRIVE
OMAHA, NEBRASKA 68110
(800) 228-9882

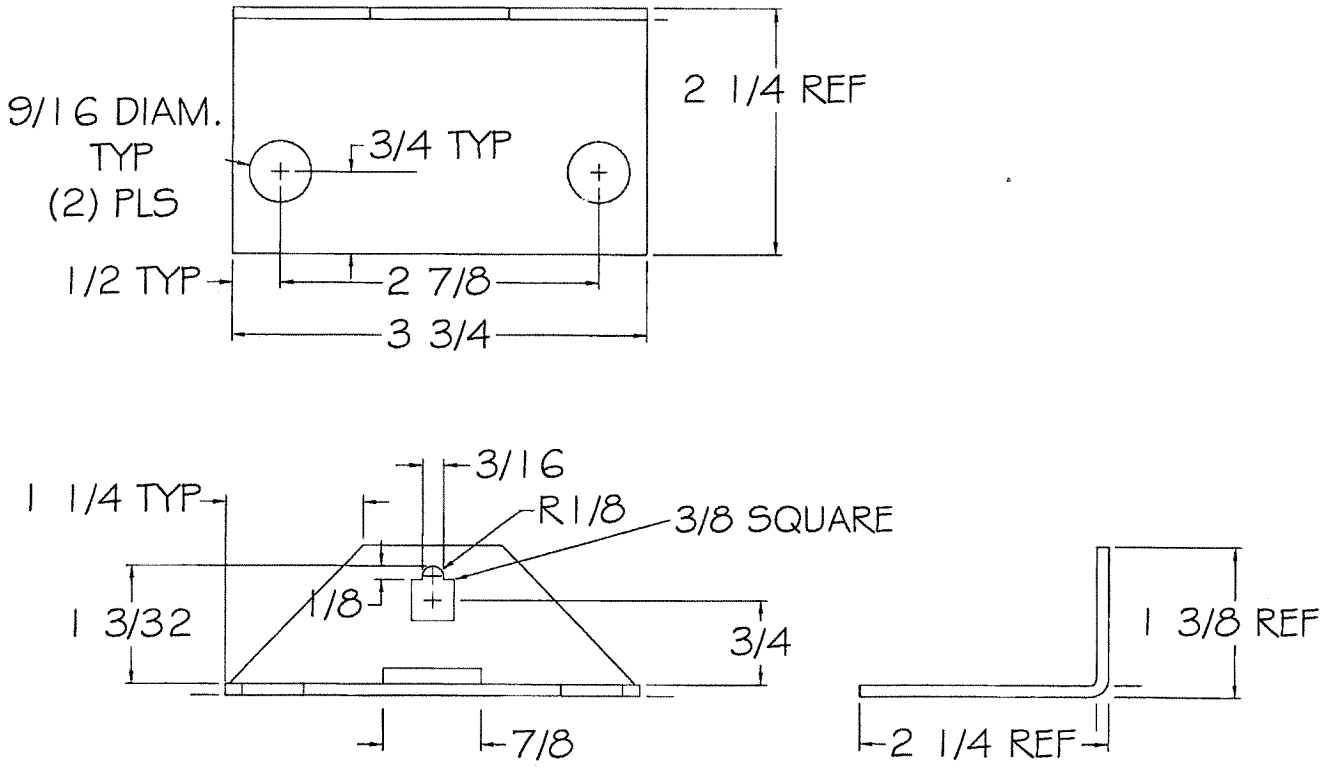
© 1998 LOZIER CORPORATION

This drawing and its contents are the exclusive and confidential property of Lozier Corporation and its affiliated companies. The drawing is provided only for the purposes intended and shall at all times be kept confidential by the customer or supplier, who shall not, without the prior written consent of Lozier, diclose, use or disseminate, in whole or in part, this drawing, its contents, or concepts, and shall promptly return the drawing upon request without retaining any copies thereof.

MATERIAL:

12 GA. ASTM A526 COMMERCIAL QUALITY GALVANIZED SHEET OR

12 GA. HOT ROLLED COMMERCIAL QUALITY SHEET PICKLED AND OILED



©2000 LOZIER CORP.

WIDE SPAN AND STORAGE SHELVING

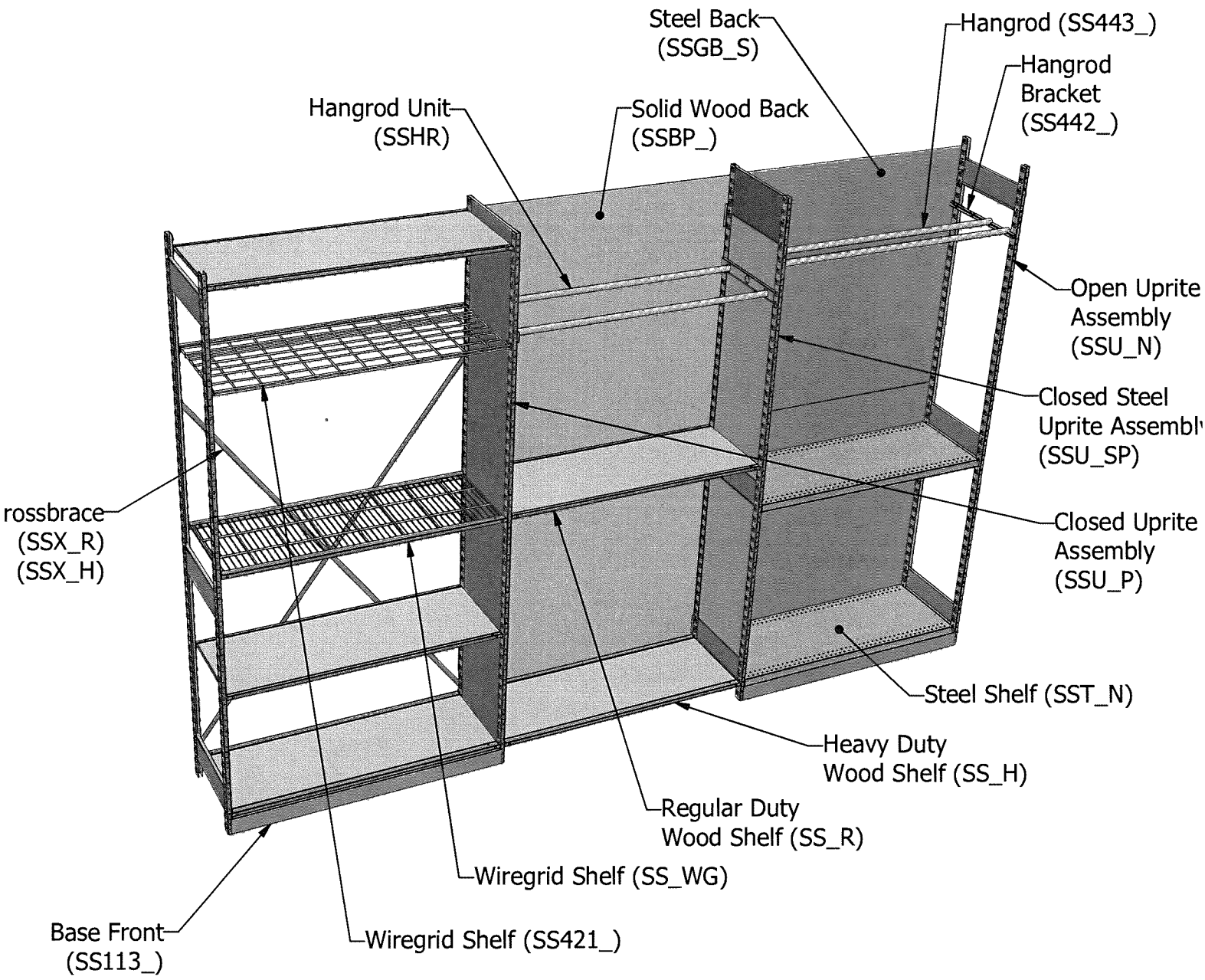
LOZIER
6336 PERSHING DR.
OMAHA, NE 68110
1-800-228-9882

ANCHOR PLATE DETAILS

SHEET 1 OF 1

INSTALLATION INSTRUCTIONS

S-SERIES STORAGE SHELVING



INSTALLATION INSTRUCTIONS

S-SERIES STORAGE SHELVING

SYSTEM ASSEMBLY INSTRUCTIONS

Basic Storage Shelving.....Pages 3 thru 7

Open Uprites
Crossbrace stabilizing
Wood storage shelves
Back-to-Back run instructions

Closed Wood Storage Shelving.....Pages 8 thru 11

Closed Uprites
Solid Wood Backs
Wood storage shelves
Back-to-Back run instructions

Steel Storage Shelving (Open and Closed).....Pages 12 thru 15

All Steel Uprites, Open or Closed
Steel storage shelves
Crossbraced or Steel Backs
Back-to-Back run instructions

SYSTEM & SHELF LOAD CAPACITIES.....Pages 16 & 17

Shelf Options
Regular duty wood storage shelf
Heavy duty wood storage shelf
Steel storage shelf
Wiregrid storage shelf(s)

ACCESSORIES.....Page 18

! **SYSTEM STABILIZING REQUIREMENTS.....Pages 19 & 20**

! **PRODUCT SAFETY INFORMATION.....Page 21**

INSTALLATION INSTRUCTIONS

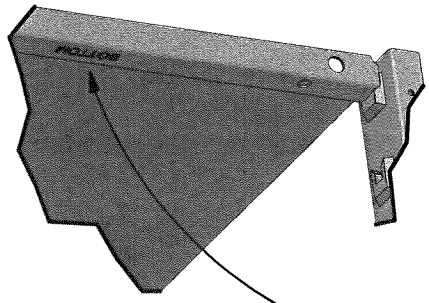
S-SERIES STORAGE SHELVING

BASIC SYSTEM ASSEMBLY INSTRUCTIONS

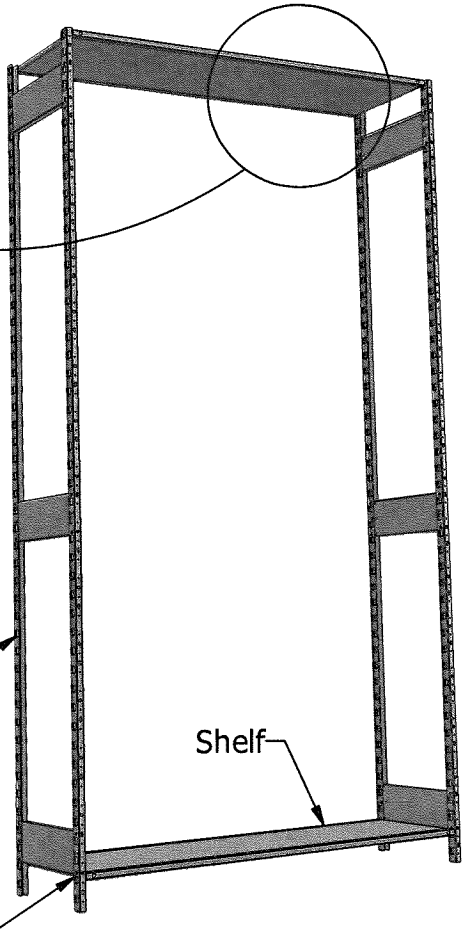
STARTER SECTION

CAUTION: **AT LEAST TWO PEOPLE ARE REQUIRED TO STABILIZE THE SYSTEM DURING ASSEMBLY.**

WARNING!: **REFERENCE PAGE 21 FOR *PRODUCT SAFETY INFORMATION.***



Note: The bottom side of the cross channels of the regular duty (SS_R) shelves are stamped "**BOTTOM**" and should be facing downward when installed

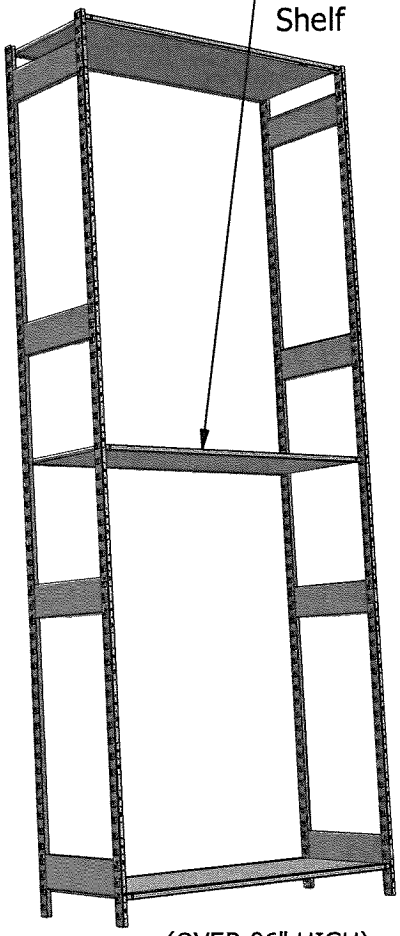


Uprite Assembly

Shelf

Shelf hooked in 2nd pocket from the bottom

(UP TO 96" HIGH)



Intermediate Shelf

(OVER 96" HIGH)

1. Hold two (2) Uprite assemblies vertical and hook tabs of a shelf into the 2nd pocket from the floor.
2. Install a shelf near the top of the Uprites and install an intermediate shelf on taller uprites. (Over 96" high) This will help stabilize the section. Reference pages 16 & 17 for shelf styles and for proper shelf orientation.

WARNING! TO STABILIZE THE FINISHED SYSTEM, A BOTTOM SHELF SHOULD BE INSTALLED WITHIN 6" OF THE FLOOR (UNLESS FLOOR ANCHORS ARE USED. SEE PAGE 7) AND A TOP SHELF WITHIN 12" OF THE TOP OF THE UPRITE, AND SHELVES SPACED NO MORE THAN 48" IN EACH SECTION ON THE RUN TO MAINTAIN THE RATED LOAD CARRYING CAPACITY OF THE SYSTEM. SEE **SYSTEM & SHELF LOAD CAPACITIES** PAGES 16 & 17.

INSTALLATION INSTRUCTIONS

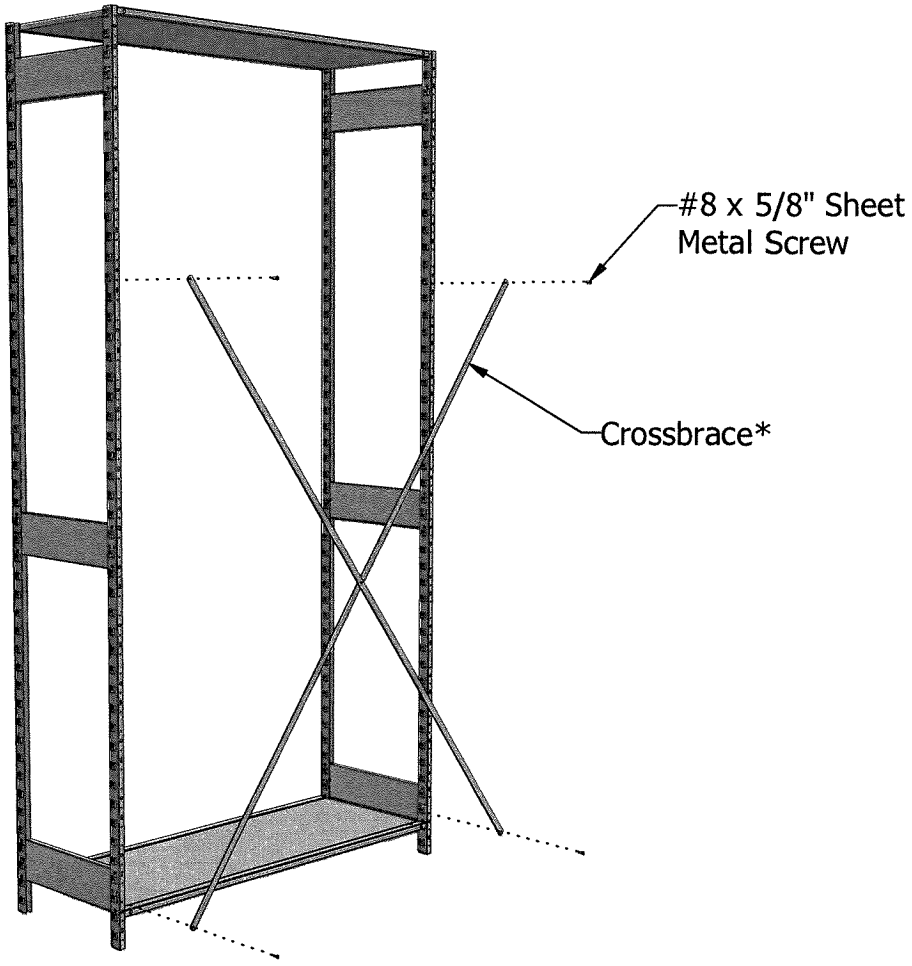
S-SERIES STORAGE SHELVING

BASIC SYSTEM ASSEMBLY INSTRUCTIONS

STABILIZATION WITH CROSSBRACES

3. All shelving runs should be stabilized on the first section, last section, and every fourth section between. With the #8 x 5/8" sheet metal screws provided, attach the crossbrace to the Uprites using the small holes on the face of the Uprite. On Uprites higher than 8', two crossbraces are required, one above the other. See **SYSTEM STABILIZING REQUIREMENTS pages 19 & 20** for specific style and quantities for your specific uprite height.

WARNING! DO NOT USE POP RIVETS TO FASTEN CROSSBRACES TO UPRITES. ALWAYS USE #8 SHEET METAL SCREWS OR UPRITES MAY BECOME SEPARATED UNDER LOAD, CAUSING A POTENTIAL HAZARD. (BRACES MUST BE LOCATED AS SHOWN BY **SYSTEM STABILIZING REQUIREMENTS** PAGES 19 & 20.)



TO DETERMINE THE CORRECT CROSSBRACE TO USE
MEASURE THE LENGTH OF THE CROSSBRACE AND USE THE FOLLOWING CHART:

*ACTUAL LENGTH OF CROSSBRACE				
Section Width	36", 48 ", 60" Uprites	72", 84 ", 96" Uprites	108" & Higher	
			Lower Brace	Upper Brace
36"	47 1/2"	74 1/16"	74 1/16"	74 1/16"
48"	57 3/16"	80 5/8"	80 5/8"	80 5/8"

INSTALLATION INSTRUCTIONS

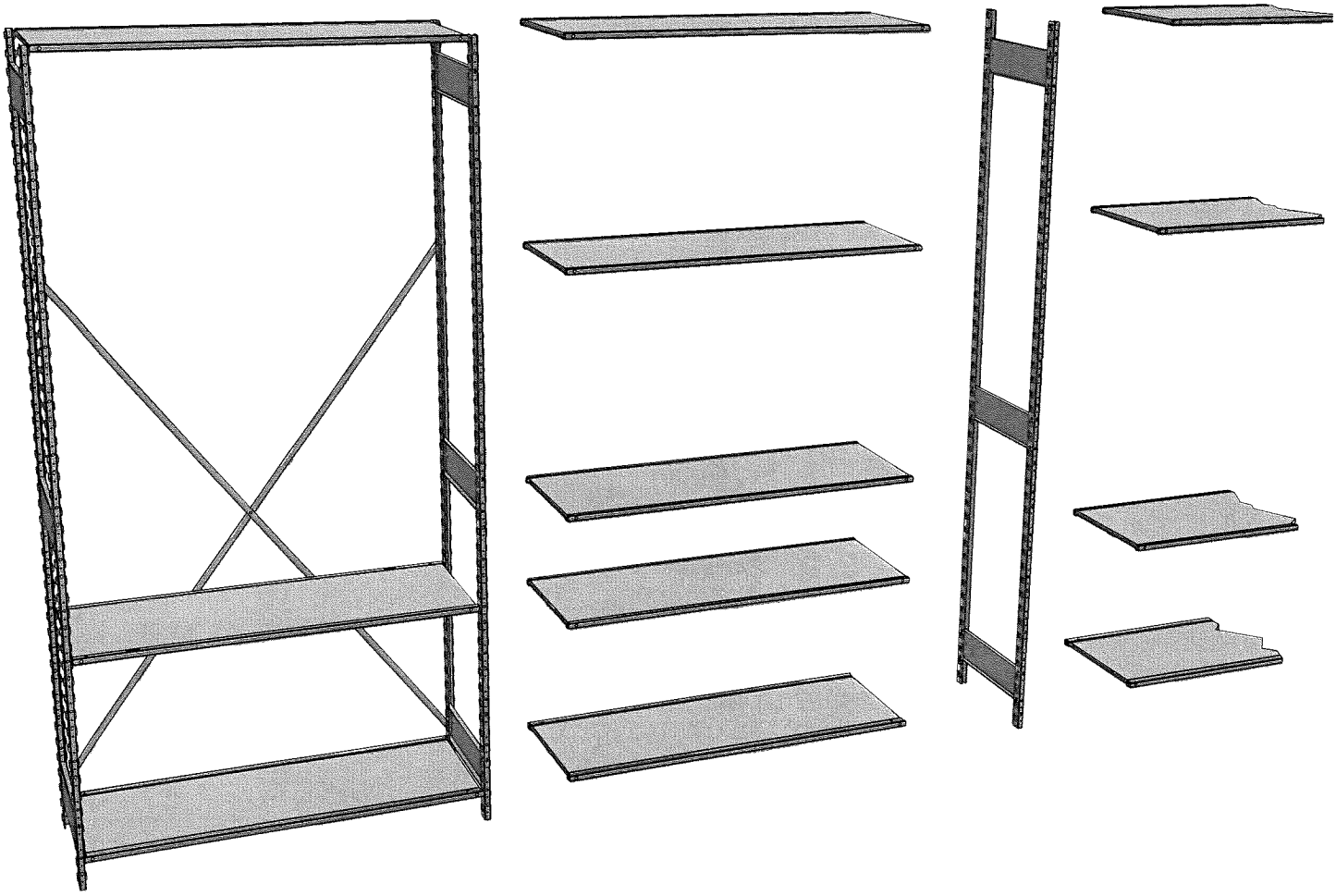
S-SERIES STORAGE SHELVING

BASIC SYSTEM ASSEMBLY INSTRUCTIONS

ADDING SECTIONS:

4. Hook shelf tabs into pockets in line with one of the center shelves of the starter section. Hook tabs at other end of shelf into pockets of free uprite. Install remainder of shelves at required positions. Crossbraces should be attached as instructed by **SYSTEM STABILIZING REQUIREMENTS** Pages 19 & 20.

WARNING! **THE SHELVES MUST BE LEVEL AND EACH CORNER MUST FULLY ENGAGE THE UPRITE POCKET.**



S-SERIES STORAGE SHELVING

BASIC SYSTEM ASSEMBLY INSTRUCTIONS

BACK-TO-BACK RUNS WITH CROSSBRACES

5. The sections in the back-to-back runs must be fastened to one another. There are two ways to do this:

   (1) Install cross-braces on one run first and then screw the uprites of the second run to the first;

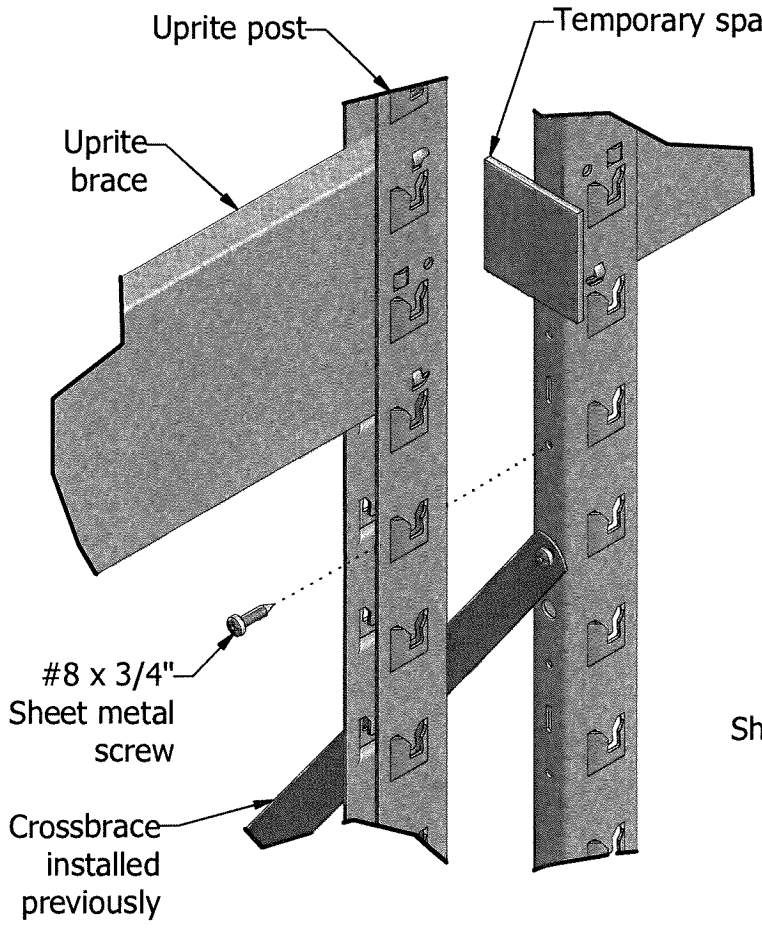
   (2) Install cross-braces at the same time that the back-to-back uprites are screwed together.

(See illustrations of the methods)

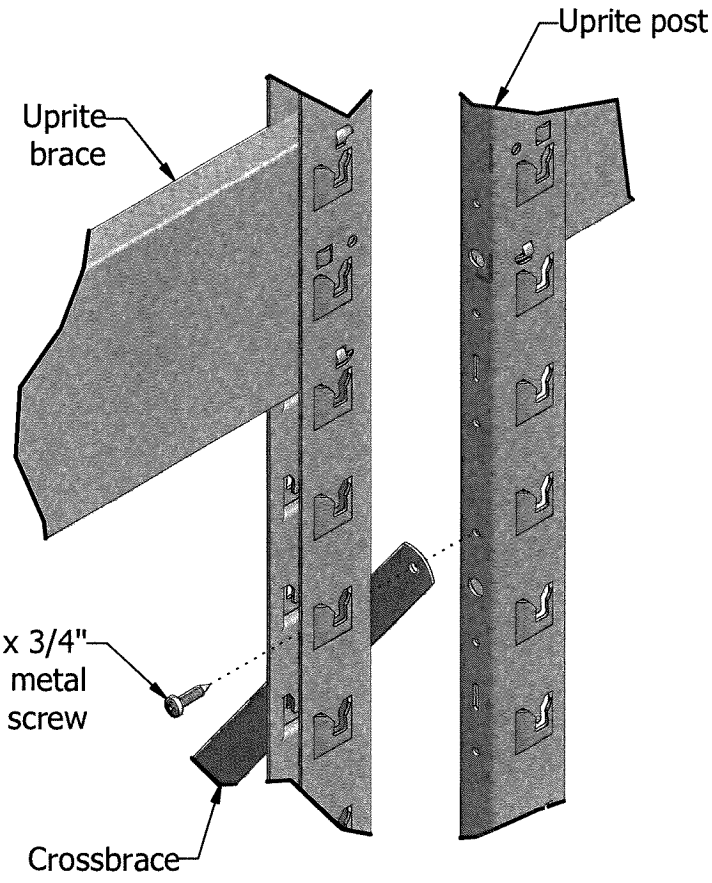
CAUTION: When (2) Uprites are secured together, a #8 x 3/4" screw should be used. (See page 18)

6. Fasten the back to back runs together with #8 x 3/4" sheet metal screws. If method (1) above is used, hold an 1/8" thick, temporary spacer between the uprite posts (except where the crossbrace screws are located) to maintain post spacing while they are being fastened together. Remove and re-use spacer. If method (2) above is used, the screw must go through one post, then the crossbrace, then the other back-to-back post, as shown.

IMPORTANT: All back to back posts must have one screw within 18" of the top of the uprite, one within 18" of the bottom, and intermediate screws no more than 36" apart.



(METHOD 1)



(METHOD 2)

INSTALLATION INSTRUCTIONS

S-SERIES STORAGE SHELVING

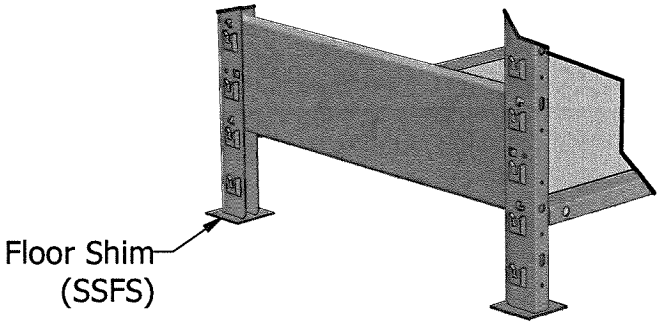
BASIC SYSTEM ASSEMBLY INSTRUCTIONS

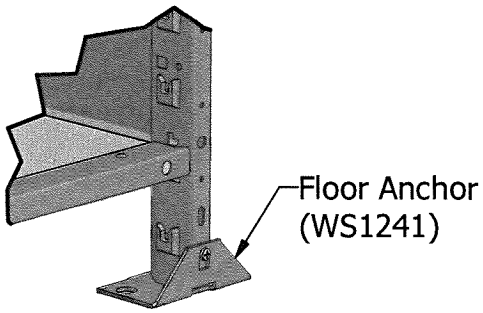
FLOOR PROTECTORS/SHIMS

7. Floor protectors/shims are used to protect floors when required by the customer and to aid in leveling the system (by stacking the shims) when required. Install shims after assembly of the Starter Section by using 4' long level or plumb bob. Upon determining which side needs to be raised, lift one uprite at a time and then position shim(s) as shown.

WARNING: **DO NOT STACK MORE THAN (5) SHIMS UNDER AN UPRITE POST. ALWAYS CENTER SHIM(S) UNDER THE POST.**

NOTE: FLOOR PROTECTORS/SHIMS CANNOT BE USED IN CONJUNCTION WITH FLOOR ANCHORS.





FLOOR ANCHORS

8. Place the floor anchor under the uprite post.
   Attach the anchor to the uprite post with a #8 x 5/8" long washer head screw. (the floor anchor is designed to be used with commonly available anchor studs. Follow the installation instruction provided with the anchor studs or the recommendations a structural engineer to satisfy building code requirements.)

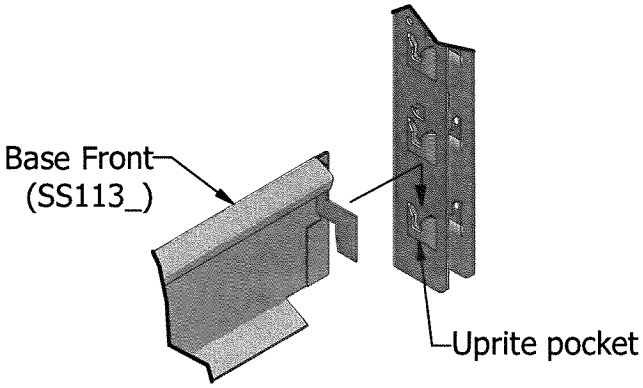
WARNING: **FLOOR ANCHORS MUST BE USED WHEN:**

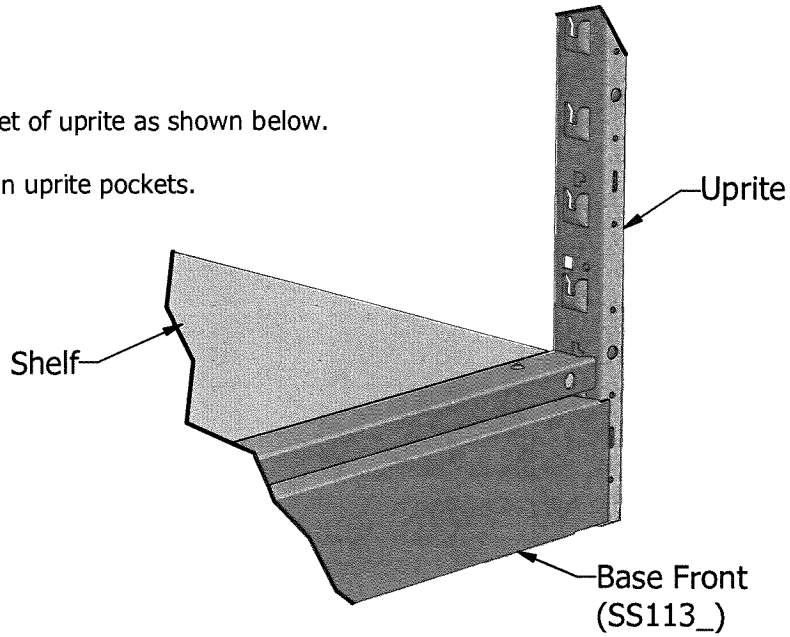
(1) THE UPRITES HEIGHT TO DEPTH RATIO EXCEEDS 6:1. (IF THE TWO SECTIONS ARE CONNECTED BACK-TO-BACK, USE THEIR COMBINED DEPTH TO CALCULATE THE HEIGHT TO DEPTH RATIO.)
(2) THE BOTTOM SHELF IS NOT WITHIN 6" OF THE FLOOR.
(3) ON ALL UPRITE POSTS AND SUPPORT POSTS THAT SUPPORT A 2ND LEVEL CATWALK SYSTEM.
(4) LOCAL BUILDING CODES REQUIRE THEM.
(5) SHELVING MUST BE ANCHORED TO THE FLOOR, TO A SUITABLE BUILDING WALL, OR OTHERWISE BRACED TO PREVENT OVERTURNING IN THE EVENT TALL OR HEAVY ITEMS ARE LEANED AGAINST THE SHELVING.

BASE FRONTS

If base fronts are to be used, install with hooks in bottom pocket of uprite as shown below.

9. Install bottom shelf above base front with shelf tabs seated in uprite pockets.





INSTALLATION INSTRUCTIONS

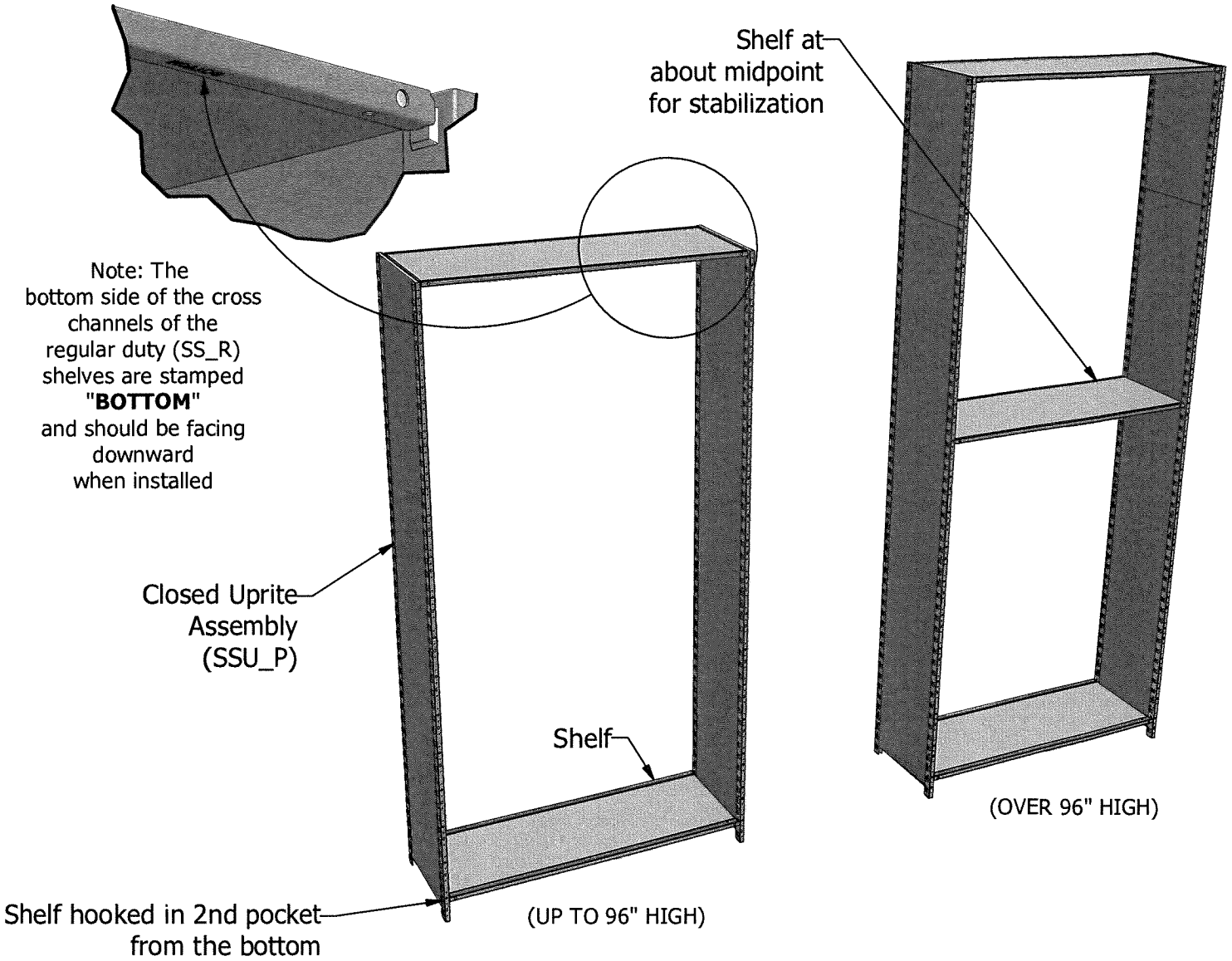
S-SERIES STORAGE SHELVING

CLOSED WOOD STORAGE SHELVING ASSEMBLY INSTRUCTIONS

STARTER SECTION

CAUTION: **AT LEAST TWO PEOPLE ARE REQUIRED TO STABILIZE THE SYSTEM DURING ASSEMBLY.**

WARNING!: **REFERENCE PAGE 21 FOR *PRODUCT SAFETY INFORMATION***



1. Hold two (2) Uprite assemblies vertical and hook tabs of a shelf into the 2nd pocket from the floor.
2. Install a shelf near the top of the Uprites and install an intermediate shelf on taller uprites. (Over 96" high) This will help stabilize the section. Reference pages 16 & 17 for shelf styles and for proper shelf orientation.

WARNING! TO STABILIZE THE FINISHED SYSTEM, A BOTTOM SHELF SHOULD BE INSTALLED WITHIN 6" OF THE FLOOR (UNLESS FLOOR ANCHORS ARE USED. SEE PAGE 7) AND A TOP SHELF WITHIN 12" OF THE TOP OF THE UPRITE, AND SHELVES SPACED NO MORE THAN 48" IN EACH SECTION OF THE RUN TO MAINTAIN THE RATED LOAD CARRYING CAPACITY OF THE SYSTEM. SEE **SYSTEM & SHELF LOAD CAPACITIES** PAGES 16 & 17 FOR MORE INFORMATION.

INSTALLATION INSTRUCTIONS

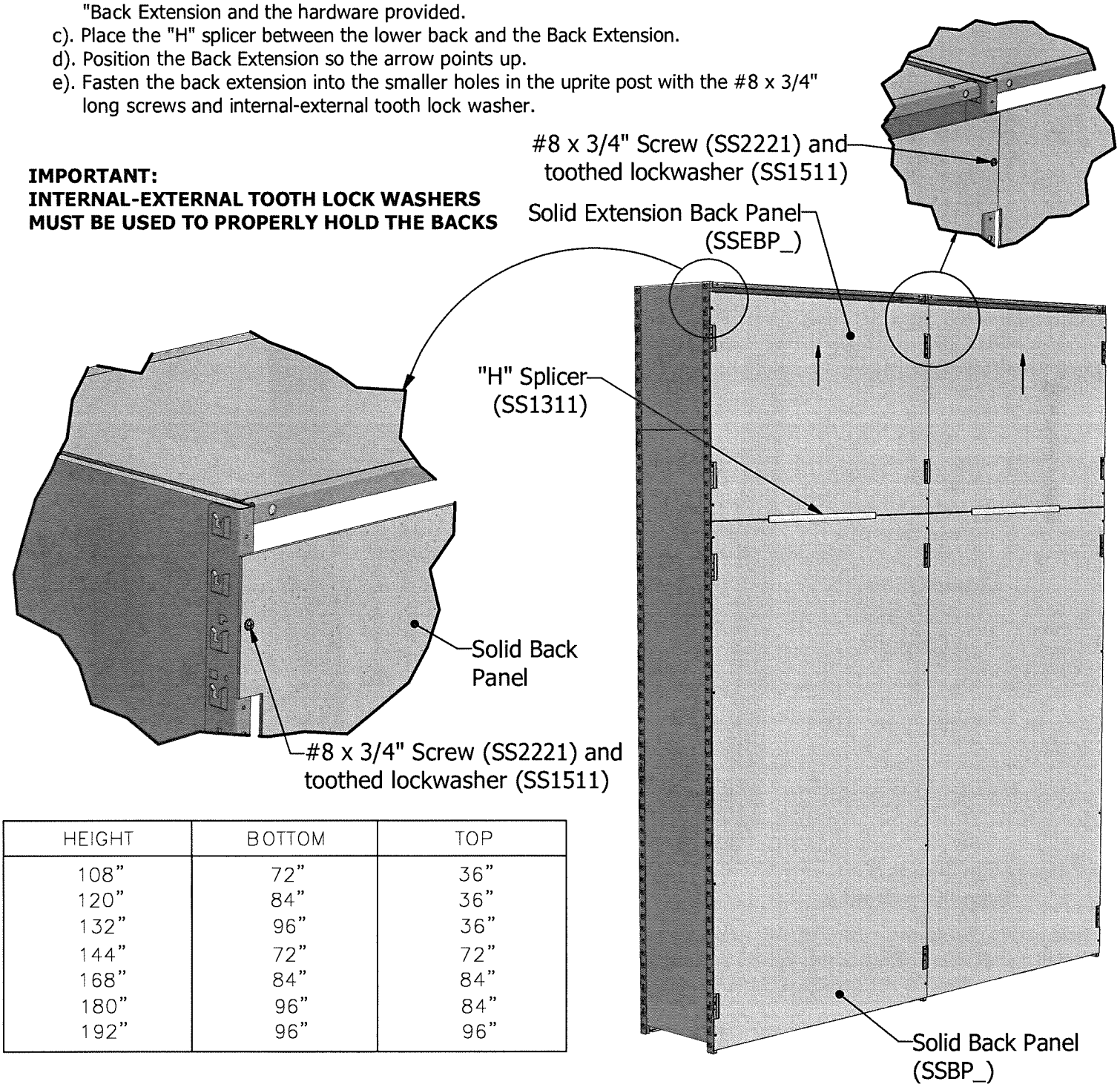
S-SERIES STORAGE SHELVING

CLOSED WOOD STORAGE SHELVING ASSEMBLY INSTRUCTIONS

SOLID WOOD BACK PANEL APPLICATIONS

3. Attach solid wood backs to the uprite using the hardware provided.
   a). Place the back against the rear of the shelving section. (NOTE: The bottom edge of the back will be approximately 1/2" above the floor.
   b). Fasten the backs into the smaller holes in the uprite posts with the #8 x 3/4" long screws and internal-external tooth lock washer. If "back extension" is to be used (uprites more than 8' tall) use the hardboard backs marked "Back Extension and the hardware provided.
   c). Place the "H" splicer between the lower back and the Back Extension.
   d). Position the Back Extension so the arrow points up.
   e). Fasten the back extension into the smaller holes in the uprite post with the #8 x 3/4" long screws and internal-external tooth lock washer.

IMPORTANT:
INTERNAL-EXTERNAL TOOTH LOCK WASHERS MUST BE USED TO PROPERLY HOLD THE BACKS



HEIGHT	BOTTOM	TOP
108"	72"	36"
120"	84"	36"
132"	96"	36"
144"	72"	72"
168"	84"	84"
180"	96"	84"
192"	96"	96"

INSTALLATION INSTRUCTIONS

S-SERIES STORAGE SHELVING

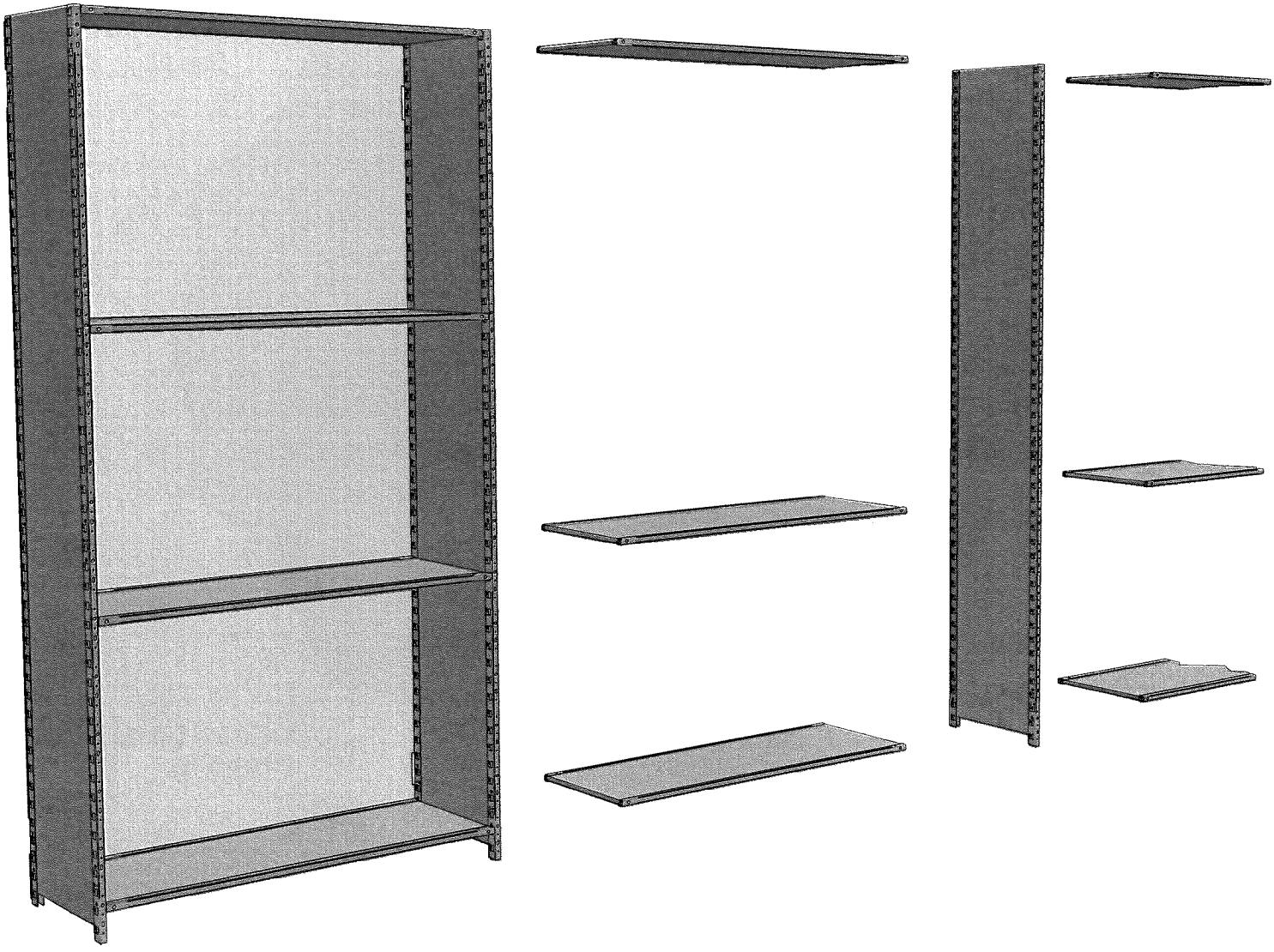
CLOSED WOOD STORAGE SHELVING ASSEMBLY INSTRUCTIONS

ADDING SECTIONS:

4. Hook shelf tabs into pockets in line with one of the center shelves of the starter section. Hook tabs at other end of shelf into pockets of free uprite. Install remainder of shelves at required positions. Solid wood backs should be attached as instructed by **SYSTEM STABILIZING REQUIREMENTS** Pages 19 & 20.

WARNING! SOLID WOOD BACKS MUST BE LOCATED, AT A MINIMUM, AS SHOWN BY **SYSTEM STABILIZING REQUIREMENTS** PAGES 19 & 20.

WARNING! **THE SHELVES MUST BE LEVEL AND EACH CORNER MUST FULLY ENGAGE THE UPRITE POCKET.**



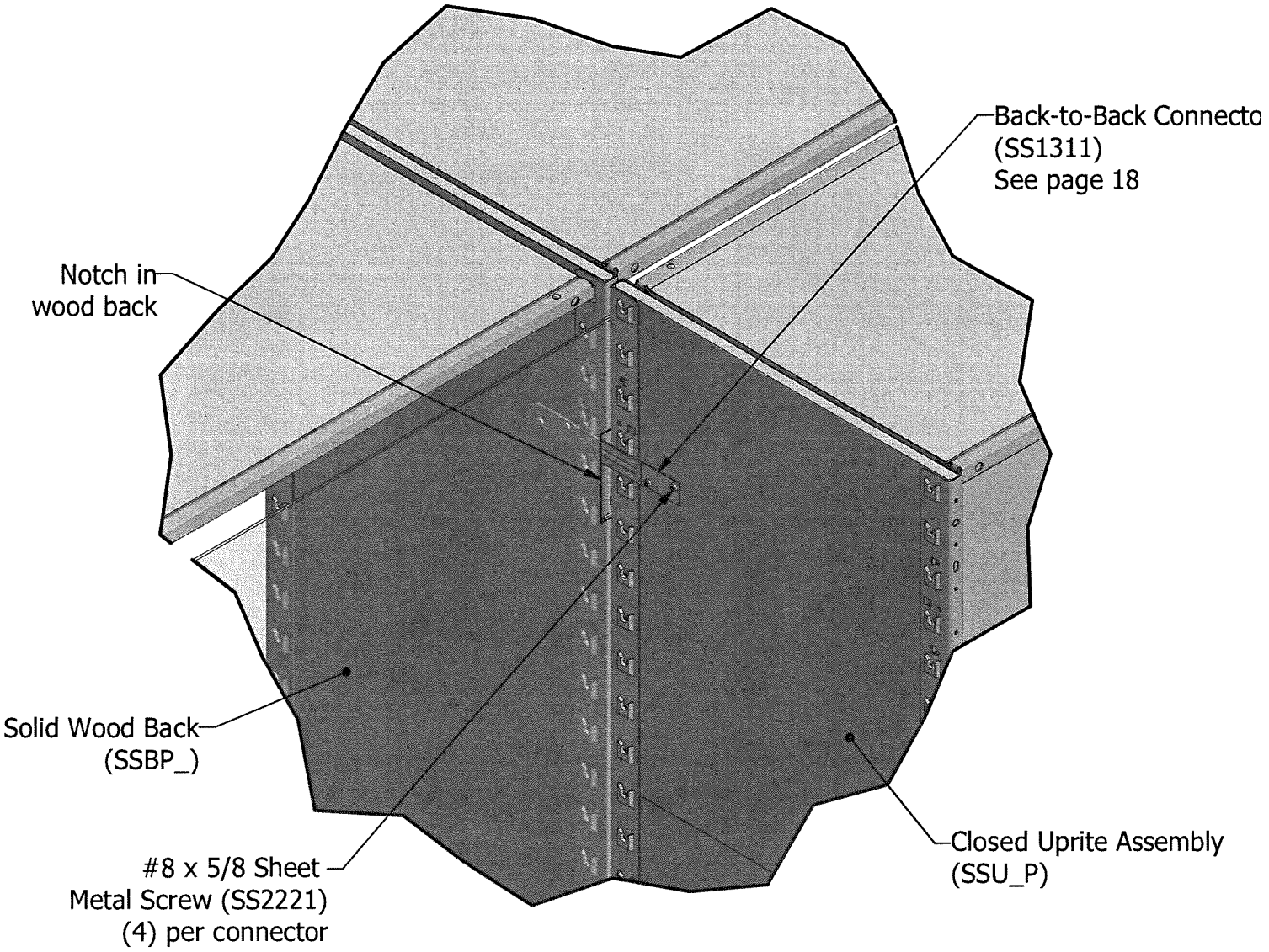
S-SERIES STORAGE SHELVING

CLOSED WOOD STORAGE SHELVING ASSEMBLY INSTRUCTIONS

BACK-TO-BACK RUNS WITH SOLID WOOD BACKS

5. If closed uprites or soild wood backs or both are used back-to-back, use back-to-back connectors to join the uprites. The connector fits through the slots in the backs and fasten to the wood panels that are part of the uprites.

IMPORTANT: ALL BACK-TO-BACK POSTS MUST HAVE ONE CONNECTOR WITHIN 18" OF THE TOP OF THE UPRITE, ONE WITHIN 18" OF THE BOTTOM, AND INTERMEDIATE CONNECTORS NO MORE THAN 36" APART.



FLOOR PROTECTOR/SHIMS OR FLOOR ANCHORS

Reference page 7 of **BASIC SYSTEM ASSEMBLY INSTRUCTIONS.**

BASE FRONTS

Reference page 7 of **BASIC SYSTEM ASSEMBLY INSTRUCTIONS.**

INSTALLATION INSTRUCTIONS

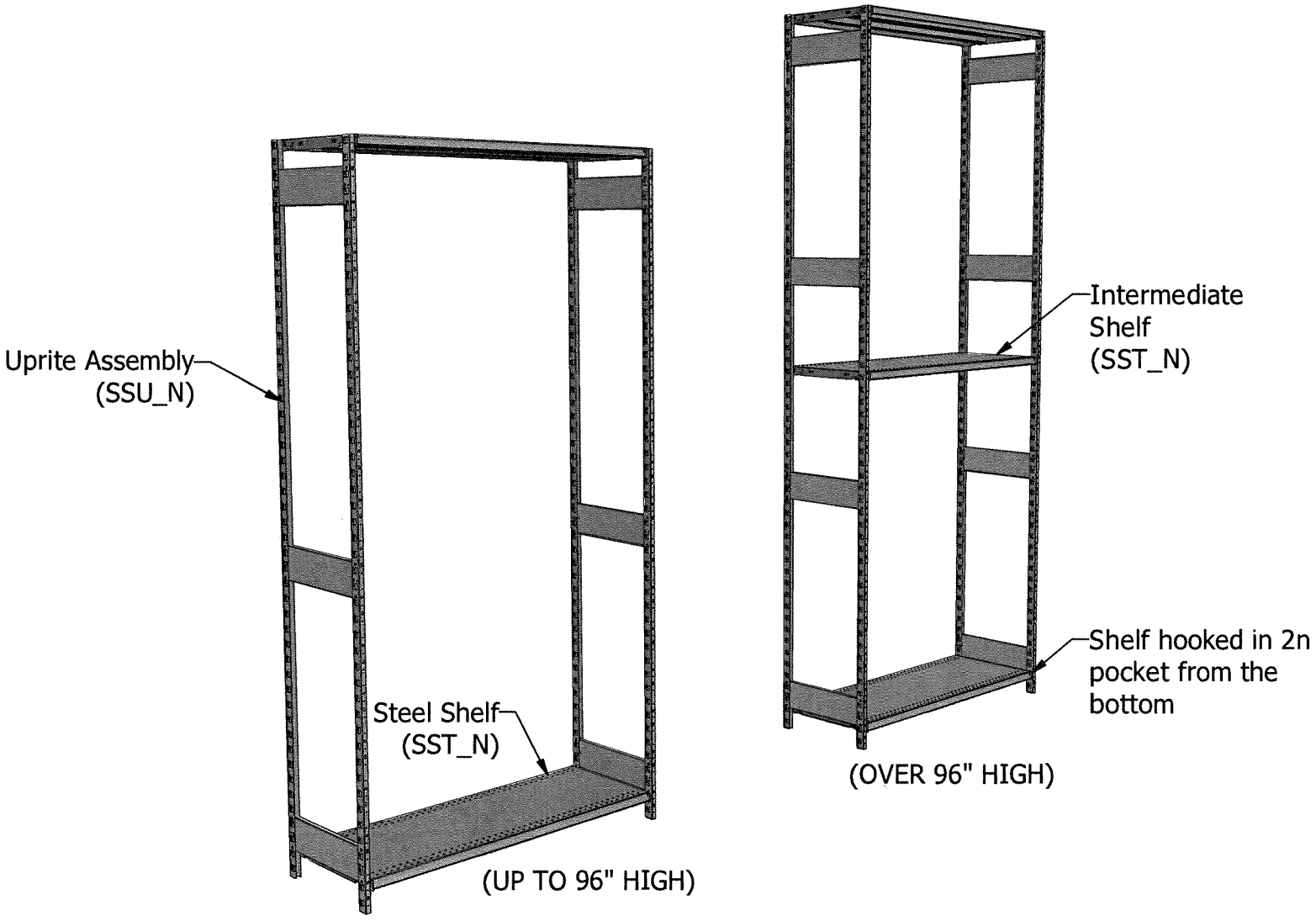
S-SERIES STORAGE SHELVING

STEEL STORAGE SHELVING ASSEMBLY INSTRUCTIONS

STARTER SECTION

CAUTION: **AT LEAST TWO PEOPLE ARE REQUIRED TO STABILIZE THE SYSTEM DURING ASSEMBLY.**

WARNING!: **REFERENCE PAGE 21 FOR *PRODUCT SAFETY INFORMATION*.**



1. Hold two (2) Uprite assemblies vertical and hook tabs of a shelf into the 2nd pocket from the floor.
2. Install a shelf near the top of the Uprites and install an intermediate shelf on taller Uprites. (Over 96" high) This will help stabilize the section. Reference pages 16 & 17 for shelf styles and for proper shelf orientation.

WARNING! TO STABILIZE THE FINISHED SYSTEM, A BOTTOM SHELF SHOULD BE INSTALLED WITHIN 6" OF THE FLOOR (UNLESS FLOOR ANCHORS ARE USED. SEE PAGE 7) AND A TOP SHELF WITHIN 12" OF THE TOP OF THE UPRITE, AND SHELVES SPACED NO MORE THAN 48" IN EACH SECTION OF THE RUN TO MAINTAIN THE RATED LOAD CARRYING CAPACITY OF THE SYSTEM. SEE **SYSTEM & SHELF LOAD CAPACITIES** PAGES 16 & 17 FOR MORE INFORMATION.

INSTALLATION INSTRUCTIONS

S-SERIES STORAGE SHELVING

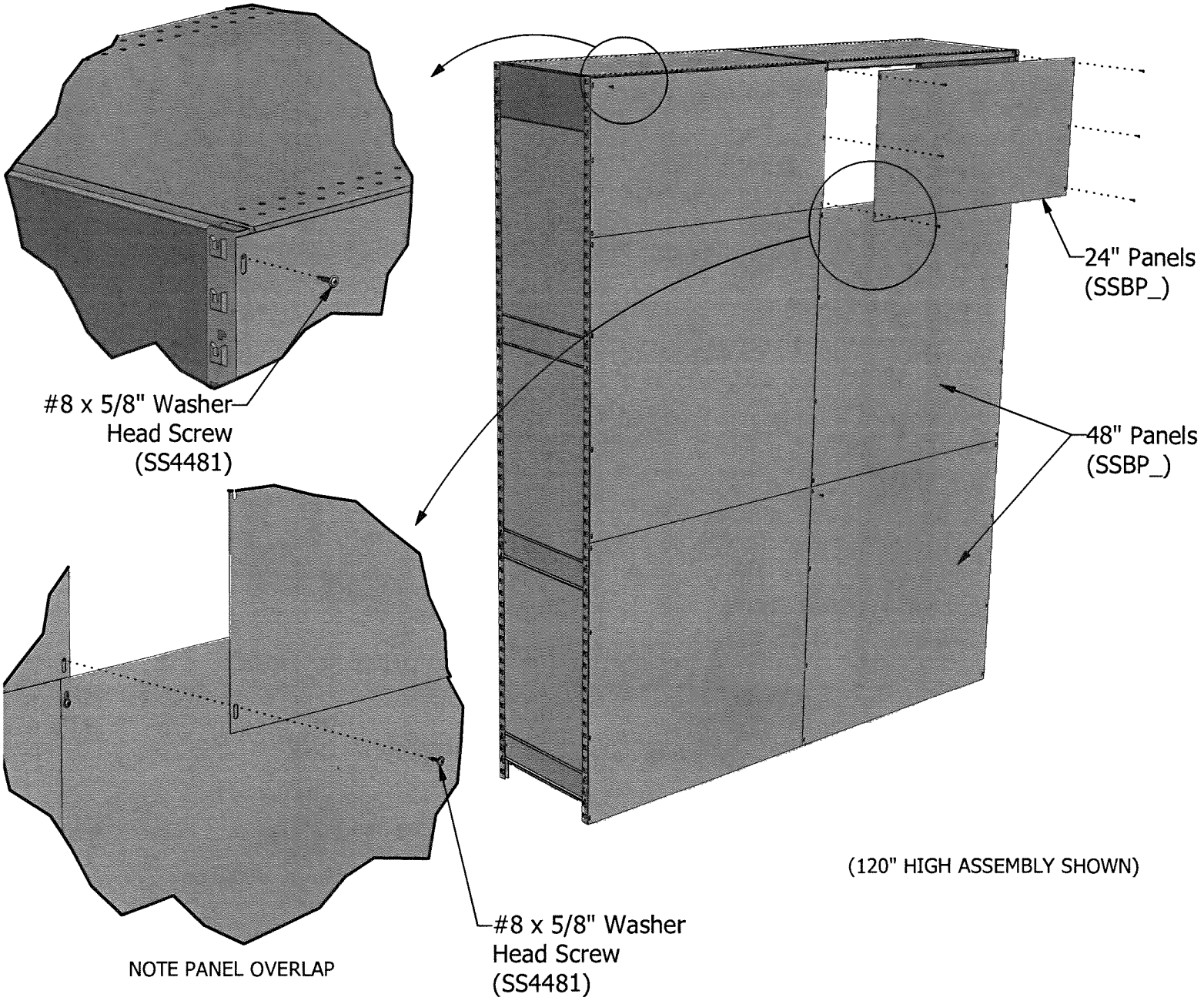
STEEL STORAGE SHELVING ASSEMBLY INSTRUCTIONS

STEEL BACK PANEL APPLICATIONS

3. Attach steel backs to the uprite using #8 x 5/8" (5/8" minimun length, up to 1" OK) long washer head sheet metal screws.
   a). Place the back against the rear of the shelving section, OK to set on floor. Holes in back panels are slotted to account for unlevel floors.
   b). Fasten the backs into the small holes in the uprite posts with the #8 x 5/8" long washer head sheet metal screws.

IMPORTANT:

- **WASHER HEAD SHEET METAL SCREWS MUST BE USED TO PROPERLY HOLD THE BACKS.**
- **SCREWS MUST BE INSTALLED AT ALL SLOT LOCATIONS**



INSTALLATION INSTRUCTIONS

S-SERIES STORAGE SHELVING

STEEL STORAGE SHELVING ASSEMBLY INSTRUCTIONS

ADDING SECTIONS:

4. Hook shelf tabs into pockets in line with one of the center shelves of the starter section. Hook tabs at other end of shelf into pockets of free uprite. Install remainder of shelves at required positions. Crossbraces or steel backs should be attached as instructed by **SYSTEM STABILIZING REQUIREMENTS** Pages 19 & 20.

WARNING! DO NOT USE POP RIVETS TO FASTEN CROSSBRACES OR BACKS TO UPRITES. ALWAYS USE #8 SHEET METAL SCREWS. (BRACES MUST BE LOCATED AS SHOWN BY **SYSTEM STABILIZING REQUIREMENTS** PAGES 19 & 20.

WARNING! **THE SHELVES MUST BE LEVEL AND EACH CORNER MUST ENGAGE THE UPRITE POCKET.**



S-SERIES STORAGE SHELVING

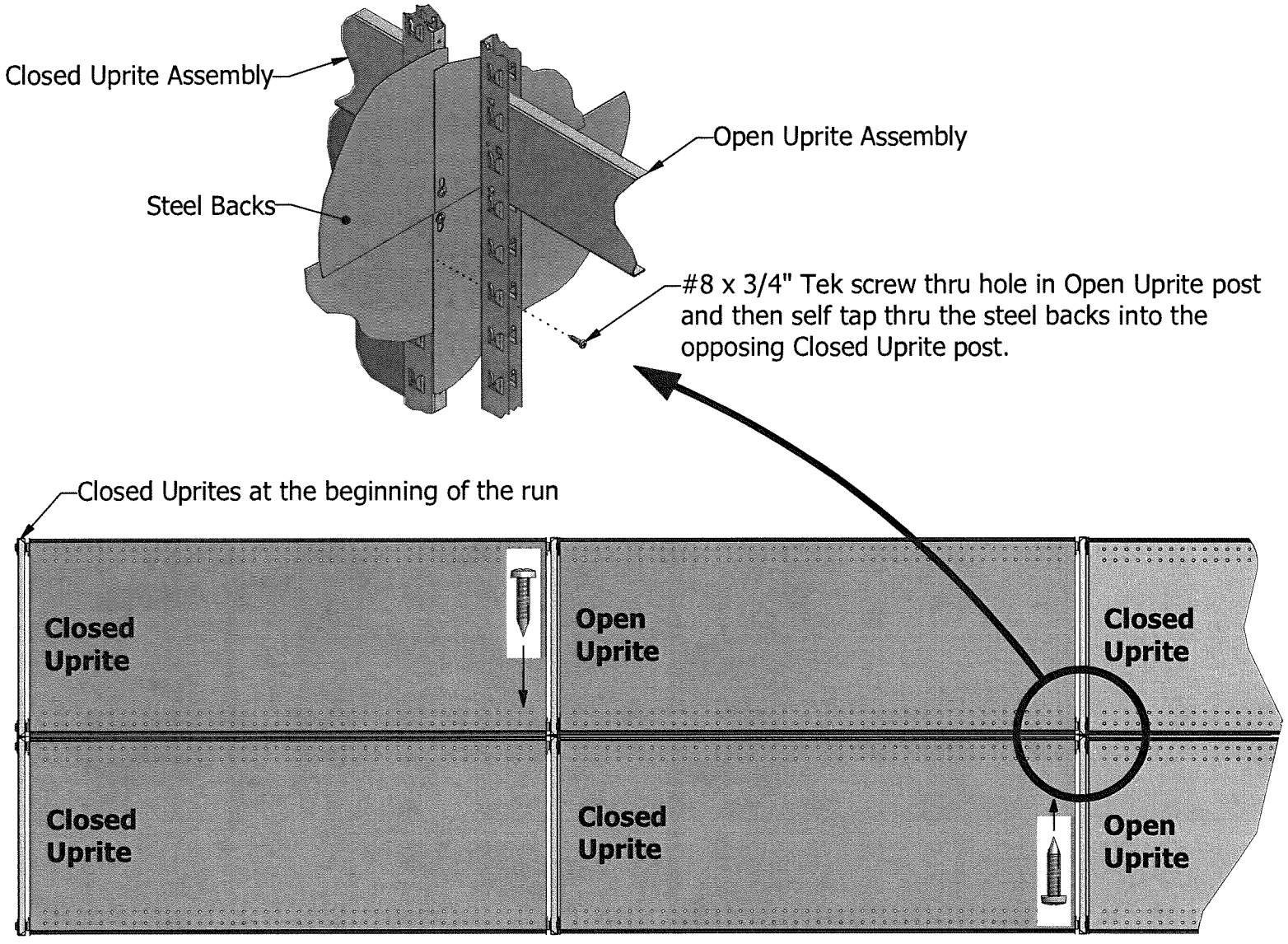
STEEL STORAGE SHELVING ASSEMBLY INSTRUCTIONS

BACK-TO-BACK RUNS WITH STEEL BACKS

5. The sections in the back-to-back runs must be fastened to one another.
   a. Install steel backs on one run first and then screw the uprites of the second run to the first. (When securing two closed steel uprites together, a screwdriver extension bit must be used)
   b. When using both open uprites and closed uprites, see suggested uprite arrangement below.

6. Fasten the back-to-back runs together with #8 x 3/4" Tek screws. The screw must go through one post, then self drill through the steel backs and into the other back-to-back post, as shown.

IMPORTANT: All back-to-back posts must have one screw within 18" of the top of the uprite, one within 18" of the bottom, and intermediate screws no more than 36" apart.



SUGGESTED UPRITE ARRANGEMENT AND FASTENING:
When closed Uprite assemblies are used within a run, alternate between open and closed uprite assemblies for the remainder of the run. Screw the open uprites to the opposing closed uprite. See top view illustration above.

FLOOR ANCHORS OR BASE FRONTS

Reference page 7 of **BASIC SYSTEM ASSEMBLY INSTRUCTIONS.**

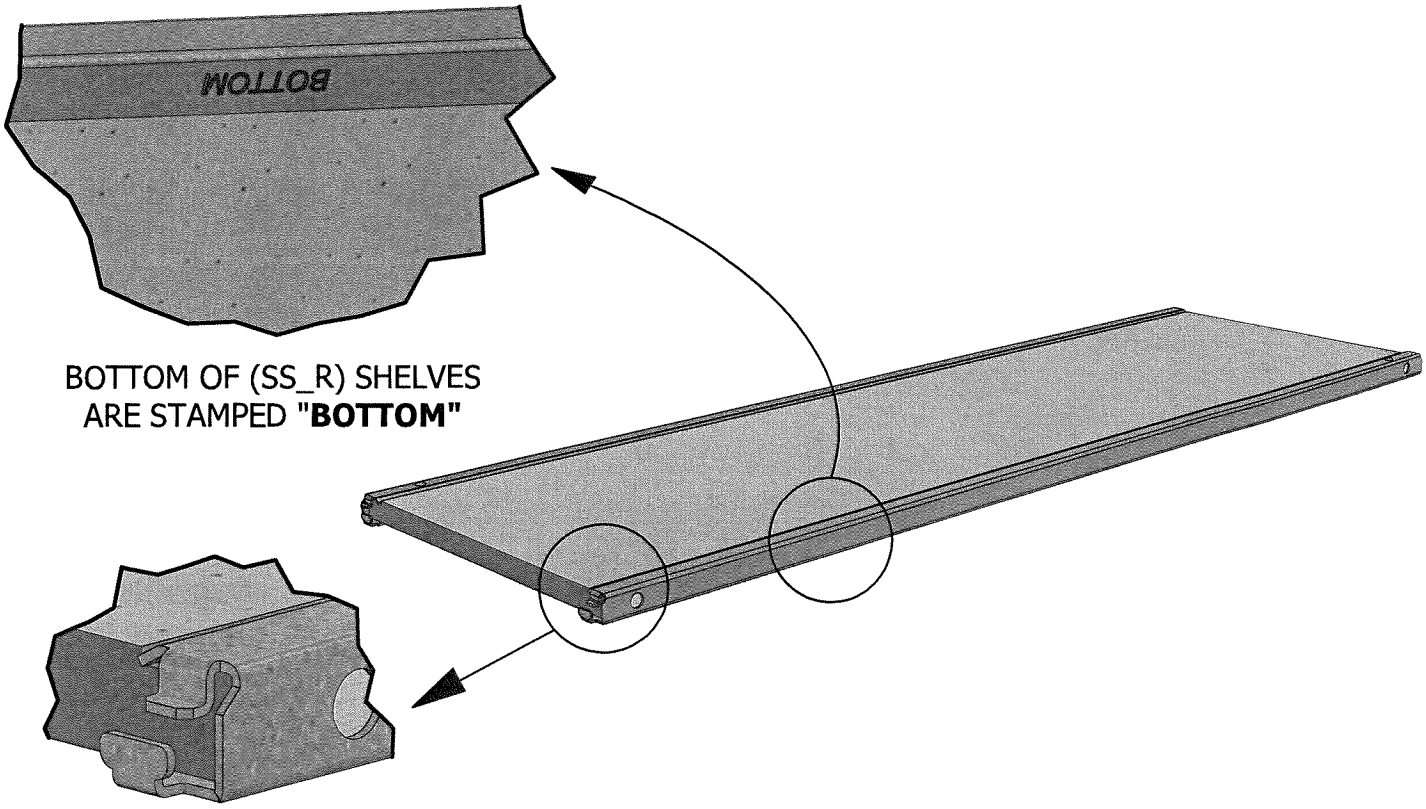
INSTALLATION INSTRUCTIONS

S-SERIES STORAGE SHELVING

SHELF OPTIONS AND SYSTEM LOAD CAPACITIES

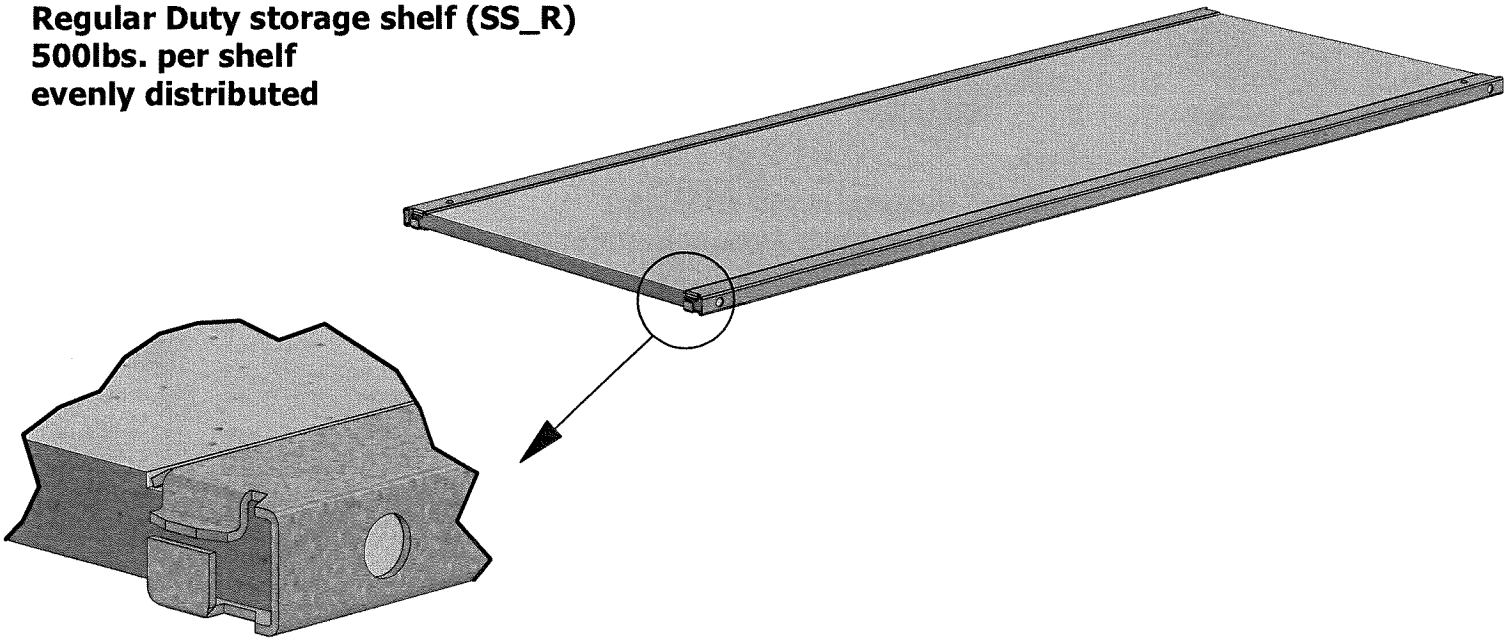
WARNING!: **REFERENCE PAGE 21 FOR *PRODUCT SAFETY INFORMATION***

NOTE STYLE AND PROPER ORIENTAION OF SHELF HOOKS



BOTTOM OF (SS_R) SHELVES
ARE STAMPED "**BOTTOM**"

Regular Duty storage shelf (SS_R)
500lbs. per shelf
evenly distributed



Heavy Duty storage shelf (SS_H)
600lbs. per shelf
evenly distributed

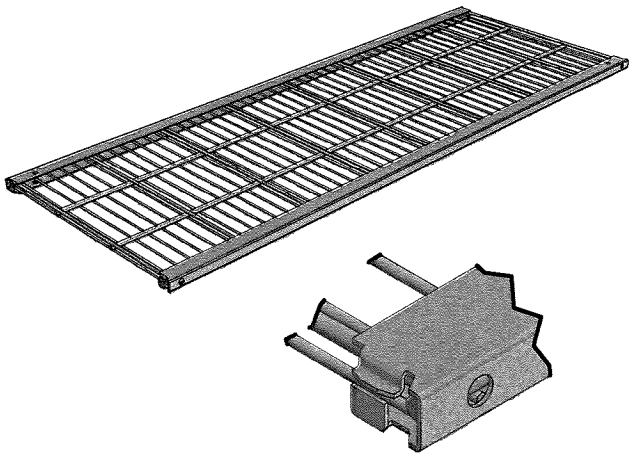
INSTALLATION INSTRUCTIONS

S-SERIES STORAGE SHELVING

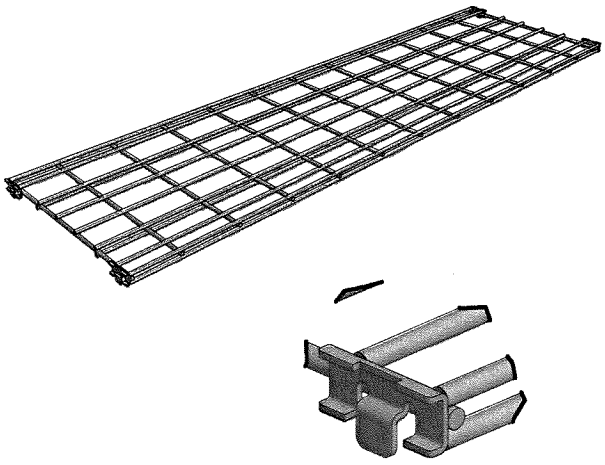
SHELF OPTIONS AND SYSTEM LOAD CAPACITIES

WARNING!: **REFERENCE PAGE 21 FOR *PRODUCT SAFETY INFORMATION***

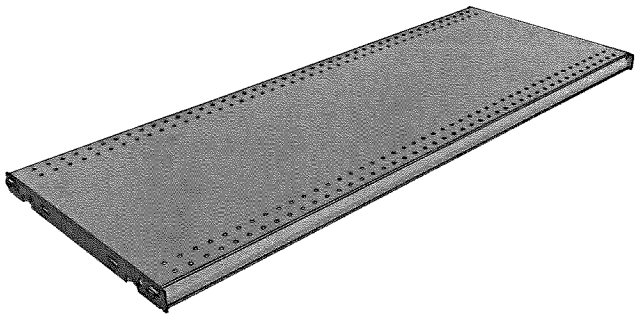
NOTE STYLE AND PROPER ORIENTAION OF SHELF HOOKS



Wiregrid storage shelf (SS_WG)
500lbs. per shelf evenly distributed



Wire storage shelf (SS421_)
12" - 18" depth 400lbs. per shelf evenly distributed
Greater then 18" 300lbs. per shelf evenly distributed



Steel storage shelf (SST_N)
500lb. per shelf evenly distributed

UPRITE STATIC LOAD CAPACITY -MAXIMUM			
Vertical Shelf Spacing	Regular Duty Cross Bracing (1) SSX_RD 36"-96" High	Regular Duty Cross Bracing (2) SSX_RD 108"-132"High	Heavy Duty Cross Bracing (2) SSX_HD 144"-192" High
<24"	1,200 lbs	3,000 lbs.	3,000 lbs.
24"-36"	1,200 lbs.	2,500 lbs.	2,500 lbs.
36"-48"	1,200 lbs.	2,000 lbs.	2,000 lbs.
48"-60"	1,200 lbs.	1,500 lbs.	1,500 lbs.
>60"	Not Recommeded	Not Recommended	Not Recommeded

INSTALLATION INSTRUCTIONS

S-SERIES STORAGE SHELVING

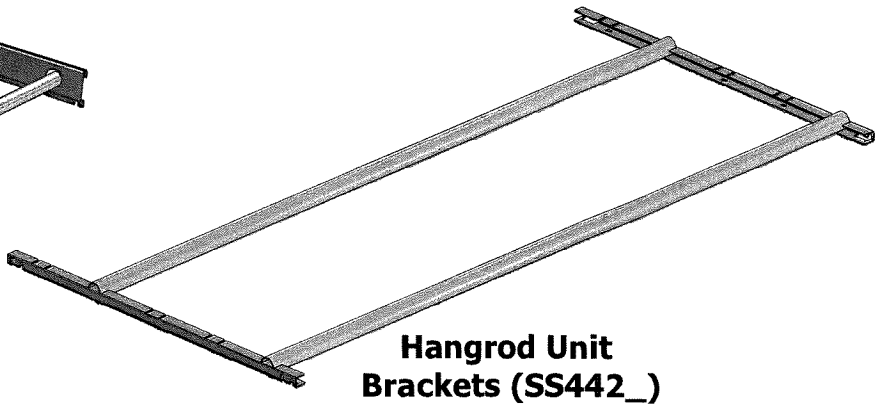
ACCESSORIES

WARNING!: **REFERENCE PAGE 21 FOR *PRODUCT SAFETY INFORMATION***



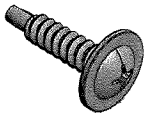
Hangrod Unit
Brackets (SS111_)
Hangrod (SS112_)

LOAD CAPACITY:
' wide section - 350 lb. evenly distributed
' wide section - 250 lb.evenly distributed



Hangrod Unit
Brackets (SS442_)
Hangrod (SS444_)

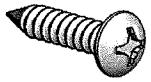
LOAD CAPACITY:
30" deep section - 50 lb. evenly distributed
24" deep section - 75 lb.evenly distributed
18" & Less deep section - 100 lb.evenly distributed



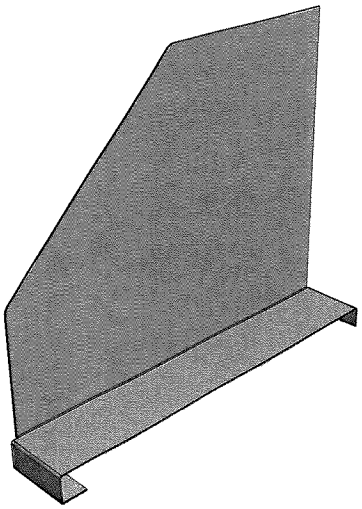
Steel Back
Panel Screw
(SS4481)



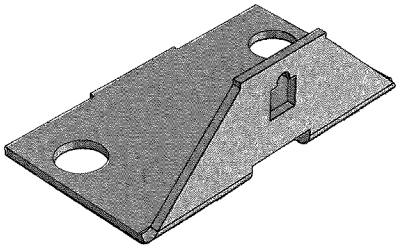
Wood Back Screw & Washer
Screw (SS2221)
Washer (SS1511)



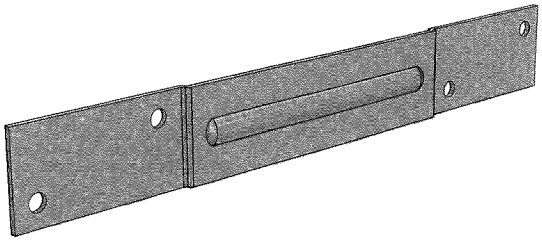
Back-to-Back Screw
(SS2221)



Sliding Shelf Divider
SS127_) For Regular Duty Shelves
SS125_) For Heavy Duty Shelves



Floor Anchor
(WS1241)



Back-to-Back Connector
(SS1311)

INSTALLATION INSTRUCTIONS

S-SERIES STORAGE SHELVING

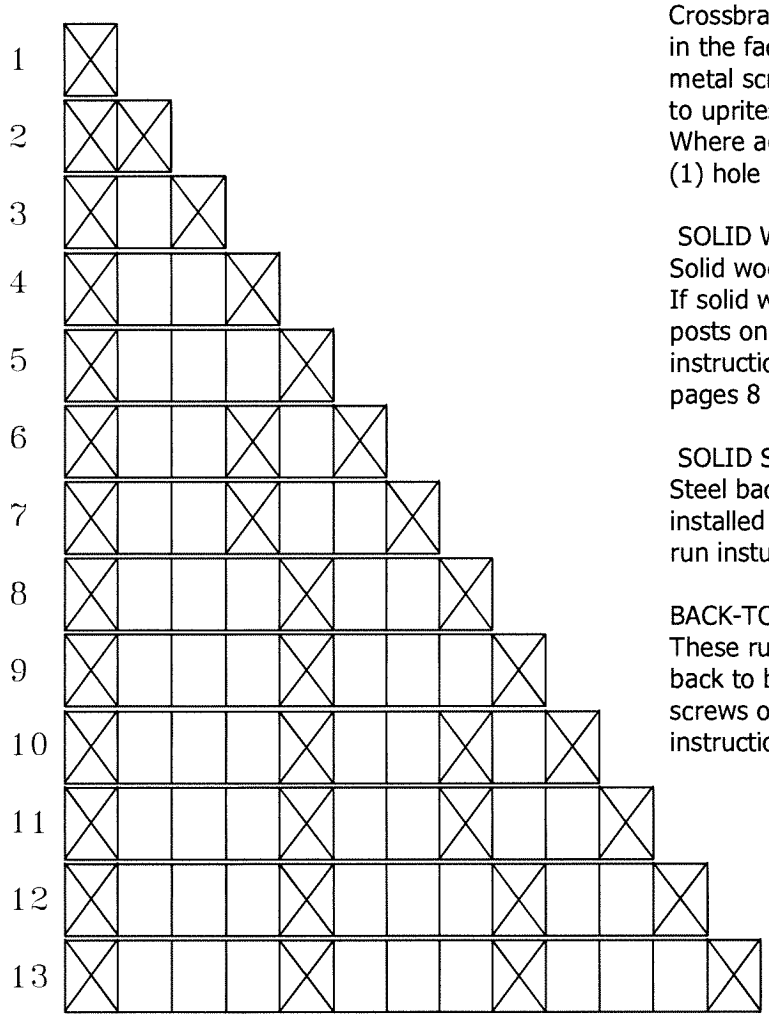
SYSTEM STABILIZING REQUIREMENTS

WARNING! **ALL RUNS OF STORAGE SHELVING MUST HAVE AT LEAST TWO SECTIONS LATERALLY STABILIZED, AS SHOWN BELOW. (EXCEPT A SINGLE FREE STANDING SECTION)**

RUNS MUST BE STABILIZED ON THE END OR STARTER SECTION, AND STABILIZED, AT MINIMUM, ON EVERY FOURTH SECTION THEREAFTER, PLUS STABILIZED ON THE LAST SECTION.
FAILURE TO DO THIS MAY RESULT IN PERSONAL INJURY AND PROPERTY DAMAGE.

EXAMPLES OF STABILIZER LOCATIONS:

NUMBER OF SECTIONS



CROSSBRACE
Crossbraces must be fastened into the small hole in the face of the uprite post with #8 x 5/8" sheet metal screws. DO NOT use pop rivets to fasten crossbraces to uprites. Start at the bottom as shown on page 20. Where adjacent sections have braces, offset the braces (1) hole on the common uprite post.

SOLID WOOD BACKS
Solid wood back panels may be used in place of crossbraces. If solid wood back panels are used in back-to-back runs, the posts on the other side must have crossbraces. Back-to-back instructions for **CLOSED WOOD STORAGE SHELVING** pages 8 thru 11.

SOLID STEEL BACKS
Steel back panels may be used in place of crossbraces. Screws must be installed in all slot locations of the steel back panels. See back-to-back run instuctions for **STEEL STORAGE SHELVING** pages 12 thru 15.

BACK-TO-BACK RUN BRACING
These runs may share common bracing only if the back to back uprite posts are securely fastened together with screws or with back-to-back connectors. See back to back instructions for individual styles of storage shelving.

NOTE: The style and quantity of cross-braces in each braced section depends on the height of the uprites, as shown on page 20.

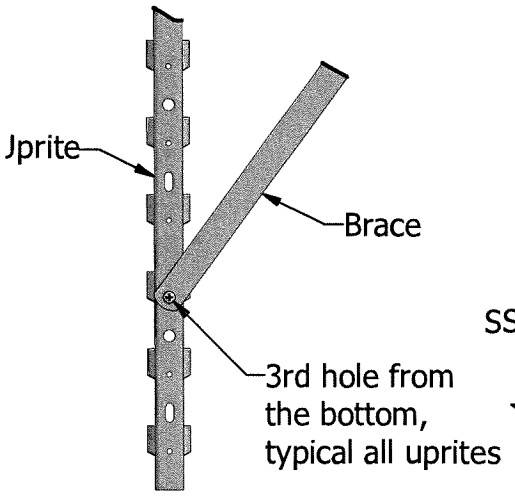
INSTALLATION INSTRUCTIONS

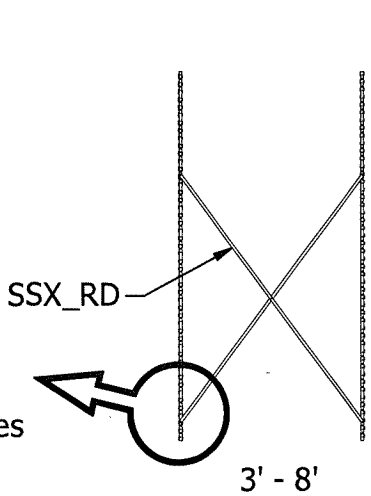
S-SERIES STORAGE SHELVING

SYSTEM STABILIZING REQUIREMENTS

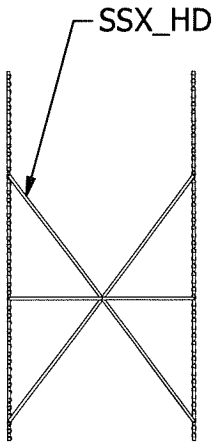
Uprite heights and crossbrace requirements

HEIGHT	A
9'	44"
10'	34"
11'	22"

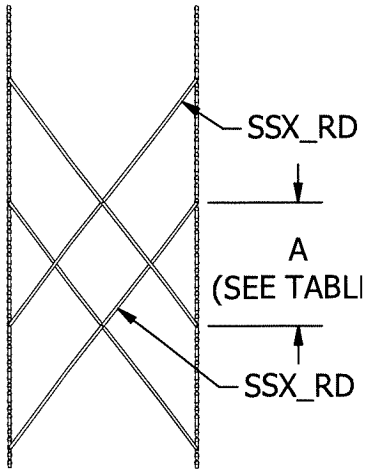




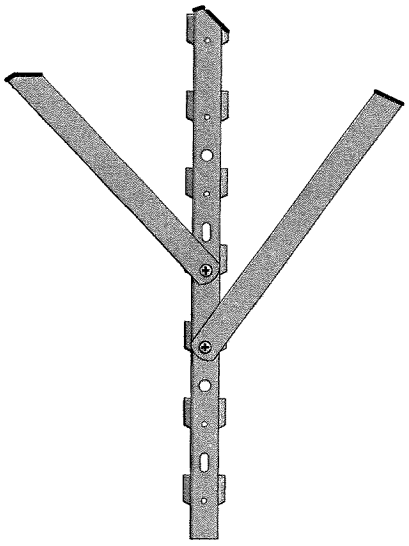
3' - 8'
(1)
SSX_RD



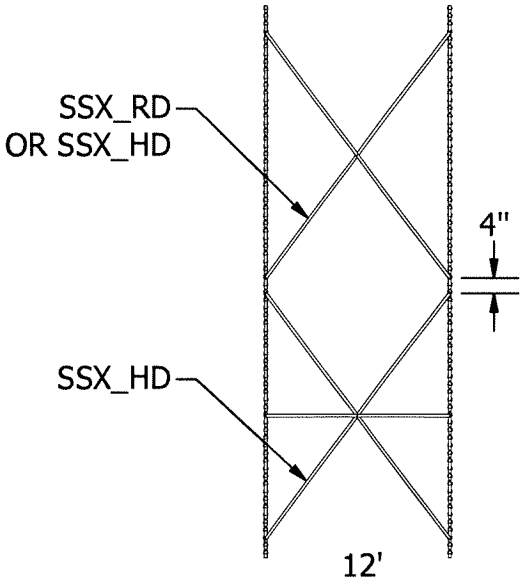
6' - 8'
(1)
SSX_HD



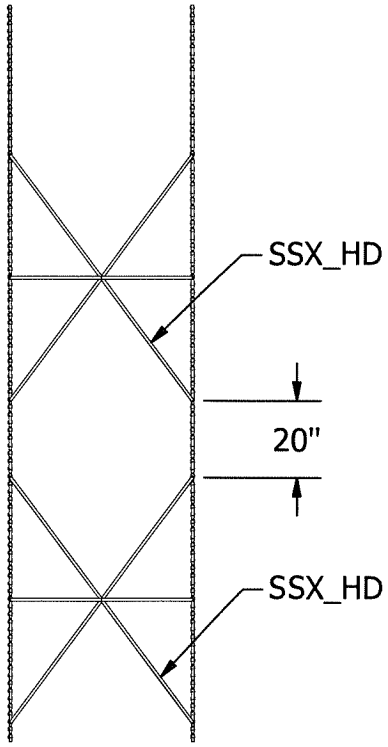
9' - 11'
(2)
SSX_RD



Where adjacent sections have braces, offset the braces (1) hole on the common uprite



12'
(1)
SSX_RD
(1)
SSX_HD



13' - 16'
(2)
SSX_HD

INSTALLATION INSTRUCTIONS

S-SERIES STORAGE SHELVING

PRODUCT SAFETY INFORMATION

WARNING

FOR YOUR SAFETY

* Install all shelving according to installation instructions and use components only as instructed. Shelving and components should only be installed or rearranged by trained personnel who have read and understand the instructions and warnings. Additional copies of the installation instructions are available upon request.

* Local codes and regulations concerning building, fire, sanitation, or seismic requirements may apply to some installations. It is the responsibility of the owner of the fixtures to check with local building authorities to determine what codes or regulations, if any, apply, and always install the shelving in compliance with any such requirements.

* When installing or rearranging shelving, never move assembled shelving.

* Do not combine Lozier products with non-Lozier products.

* Never use damaged parts. Damaged parts may cause shelving to be structurally unsafe or create exposure to sharp or pointed edges. If parts were damaged in shipping, do not use and contact your Lozier Customer Service Representative. If parts are damaged after shipment, discontinue use immediately and order replacement parts.

* Do not exceed Allowable Load Limits. Exceeding allowable loads may cause the shelving to tip over or collapse.

* To avoid store personnel or customers accidentally coming in contact with display fixtures, never allow any display to protrude into an aisle or to extend beyond the edge of the fixtures.

* Do not lean tall or heavy items against shelving unless shelving is anchored to a suitable building wall, to the floor, or is otherwise braced to prevent overturning. The weight and force of leaning items on unanchored or unbraced shelving may cause the shelving to overturn or collapse.

* Provide safe access to all levels of storage & display shelving in accordance with applicable OSHA regulations. Never allow anyone to climb, walk, or stand on shelving. These shelves were not designed to withstand the extra weight and impact of climbing, walking, and standing, and the added weight and impact of such actions may cause the fixtures to collapse.

* Never alter, modify or otherwise structurally change the shelving or any of its component parts.Modifications or alteration may cause the shelving or component part to become structurally unsafe resulting in tipping, collapse or other failure of the fixture.

* Inspect the shelving system periodically for damage. Parts that are bent, buckled, dented, cracked, or otherwise damaged should be replaced. Tighten or replace loose or missing fasteners.

* Shelving (or racks) that are leaning or bending when loaded may indicate a dangerous overload or impending collapse. Loads should be immediately reduced, and the cause for this condition should be corrected, before reloading. Refer to appropriate installation instructions to assure shelving (or racks) are properly assembled, replace any damaged components or parts, and do not exceed recommended maximum loads or engage in any other unsafe use of the shelving (racks).

IMPORTANT: FAILURE TO FOLLOW THESE INSTRUCTIONS AND WARNINGS MAY RESULT IN PERSONAL INJURY TO YOUR EMPLOYEES OR CUSTOMERS, DAMAGE TO PROPERTY, OR DAMAGE TO THE FIXTURE ITSELF.

Appendix B

Typical Component

Section Properties for Lozier

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

Section Properties: BASE SECTION

Section Information:

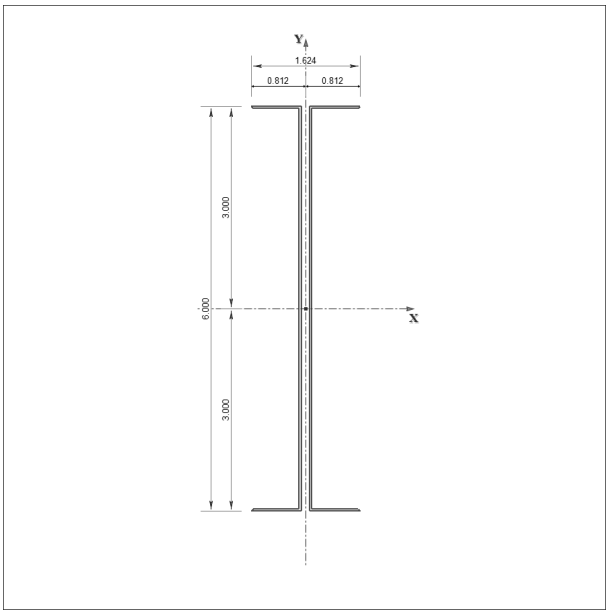
Material Type	=	General
Shape Type	=	Arbitrary
Number of Shapes	=	2

Basic Properties:

Total Width	=	1.624	in
Total Height	=	6.000	in
Centroid, Xo	=	0.148	in
Centroid, Yo	=	-0.000	in
X-Bar (Right)	=	0.812	in
X-Bar (Left)	=	0.812	in
Y-Bar (Top)	=	3.000	in
Y-Bar (Bot)	=	3.000	in
Max Thick	=	0.033	in

Equivalent Properties:

Area, Ax	=	0.488	in^2
Inertia, Ixx	=	2.011	in^4
Inertia, Iyy	=	0.025	in^4
Inertia, Ixy	=	0.000	in^4
Sx (Top)	=	0.670	in^3
Sx (Bot)	=	0.670	in^3
Sy (Left)	=	0.030	in^3
Sy (Right)	=	0.030	in^3
rx	=	2.029	in
ry	=	0.224	in
Plastic Zx	=	0.870	in^3
Plastic Zy	=	0.072	in^3
Torsional J	=	0.000	in^4
As-xx Def	=	1.000	
As-yy Def	=	1.000	
As-xx Stress	=	1.000	
As-yy Stress	=	1.000	



Section Diagram

Section Properties: 13-shelf-N

Section Information:

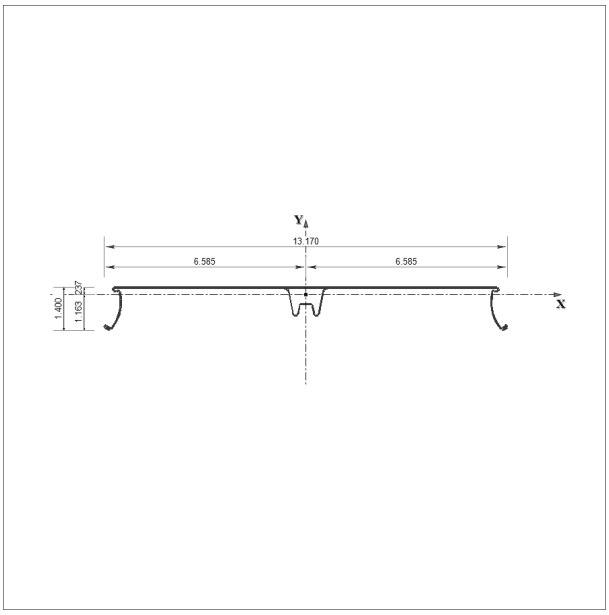
Material Type	=	General
Shape Type	=	Arbitrary
Number of Shapes	=	2

Basic Properties:

Total Width	=	13.170	in
Total Height	=	1.400	in
Centroid, Xo	=	6.615	in
Centroid, Yo	=	1.208	in
X-Bar (Right)	=	6.585	in
X-Bar (Left)	=	6.585	in
Y-Bar (Top)	=	0.237	in
Y-Bar (Bot)	=	1.163	in
Max Thick	=	0.030	in

Equivalent Properties:

Area, Ax	=	0.600	in^2
Inertia, Ixx	=	0.096	in^4
Inertia, Iyy	=	10.198	in^4
Inertia, Ixy	=	-0.000	in^4
Sx (Top)	=	0.405	in^3
Sx (Bot)	=	0.082	in^3
Sy (Left)	=	1.549	in^3
Sy (Right)	=	1.549	in^3
rx	=	0.400	in
ry	=	4.124	in
Plastic Zx	=	0.135	in^3
Plastic Zy	=	2.078	in^3
Torsional J	=	0.000	in^4
As-xx Def	=	1.000	
As-yy Def	=	1.000	
As-xx Stress	=	1.000	
As-yy Stress	=	1.000	



Section Diagram

Section Properties: 16-shelf-N

Section Information:

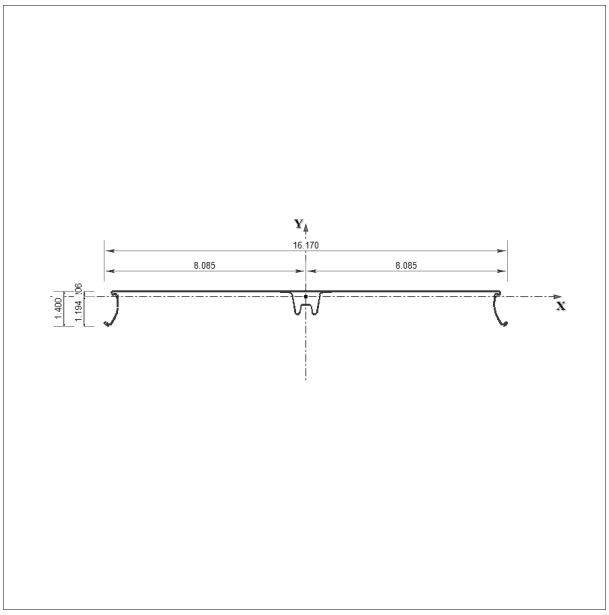
Material Type	=	General
Shape Type	=	Arbitrary
Number of Shapes	=	2

Basic Properties:

Total Width	=	16.170	in
Total Height	=	1.400	in
Centroid, Xo	=	8.125	in
Centroid, Yo	=	1.249	in
X-Bar (Right)	=	8.085	in
X-Bar (Left)	=	8.085	in
Y-Bar (Top)	=	0.206	in
Y-Bar (Bot)	=	1.194	in
Max Thick	=	0.030	in

Equivalent Properties:

Area, Ax	=	0.695	in^2
Inertia, Ixx	=	0.100	in^4
Inertia, Iyy	=	17.586	in^4
Inertia, Ixy	=	-0.000	in^4
Sx (Top)	=	0.484	in^3
Sx (Bot)	=	0.084	in^3
Sy (Left)	=	2.175	in^3
Sy (Right)	=	2.175	in^3
rx	=	0.379	in
ry	=	5.031	in
Plastic Zx	=	0.136	in^3
Plastic Zy	=	2.937	in^3
Torsional J	=	0.000	in^4
As-xx Def	=	1.000	
As-yy Def	=	1.000	
As-xx Stress	=	1.000	
As-yy Stress	=	1.000	



Section Diagram

Section Properties: 17-shelf-N

Section Information:

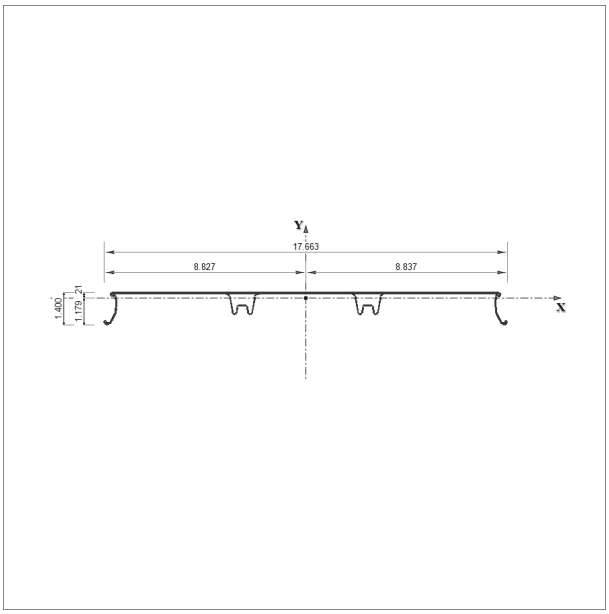
Material Type	=	General
Shape Type	=	Arbitrary
Number of Shapes	=	3

Basic Properties:

Total Width	=	17.663	in
Total Height	=	1.400	in
Centroid, Xo	=	8.827	in
Centroid, Yo	=	1.179	in
X-Bar (Right)	=	8.837	in
X-Bar (Left)	=	8.827	in
Y-Bar (Top)	=	0.221	in
Y-Bar (Bot)	=	1.179	in
Max Thick	=	17.663	in

Equivalent Properties:

Area, Ax	=	0.816	in^2
Inertia, Ixx	=	0.114	in^4
Inertia, Iyy	=	23.414	in^4
Inertia, Ixy	=	0.001	in^4
Sx (Top)	=	0.517	in^3
Sx (Bot)	=	0.097	in^3
Sy (Left)	=	2.653	in^3
Sy (Right)	=	2.650	in^3
rx	=	0.374	in
ry	=	5.357	in
Plastic Zx	=	0.170	in^3
Plastic Zy	=	3.795	in^3
Torsional J	=	0.000	in^4
As-xx Def	=	1.000	
As-yy Def	=	1.000	
As-xx Stress	=	1.000	
As-yy Stress	=	1.000	



Section Diagram

Section Properties: 19-shelf

Section Information:

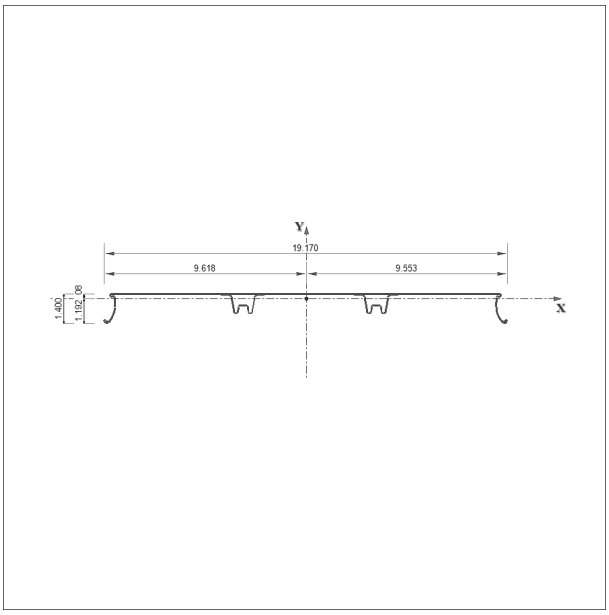
Material Type	=	General
Shape Type	=	Arbitrary
Number of Shapes	=	3

Basic Properties:

Total Width	=	19.170	in
Total Height	=	1.400	in
Centroid, Xo	=	9.646	in
Centroid, Yo	=	1.226	in
X-Bar (Right)	=	9.553	in
X-Bar (Left)	=	9.618	in
Y-Bar (Top)	=	0.208	in
Y-Bar (Bot)	=	1.192	in
Max Thick	=	0.030	in

Equivalent Properties:

Area, Ax	=	0.864	in^2
Inertia, Ixx	=	0.115	in^4
Inertia, Iyy	=	29.272	in^4
Inertia, Ixy	=	-0.007	in^4
Sx (Top)	=	0.555	in^3
Sx (Bot)	=	0.097	in^3
Sy (Left)	=	3.044	in^3
Sy (Right)	=	3.064	in^3
rx	=	0.365	in
ry	=	5.822	in
Plastic Zx	=	0.169	in^3
Plastic Zy	=	4.377	in^3
Torsional J	=	0.000	in^4
As-xx Def	=	1.000	
As-yy Def	=	1.000	
As-xx Stress	=	1.000	
As-yy Stress	=	1.000	



Section Diagram

Section Properties: HD GONDOLA UPRIGHT OPN

Section Information:

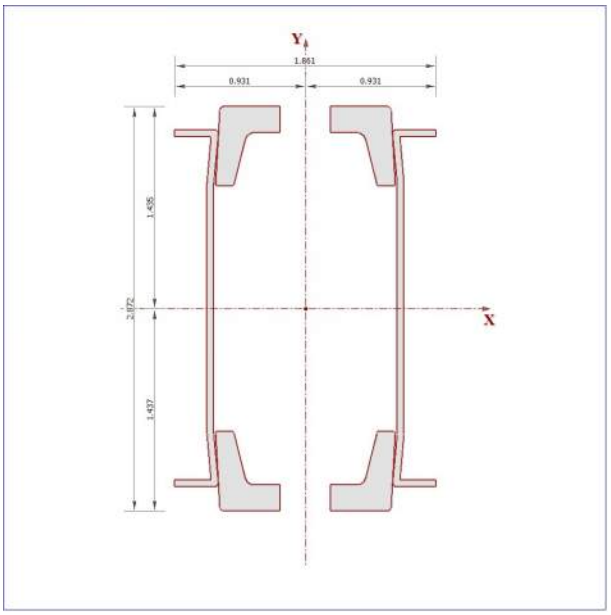
Material Type	=	General
Shape Type	=	Arbitrary
Number of Shapes	=	6

Basic Properties:

Total Width	=	1.861	in
Total Height	=	2.872	in
Centroid, Xo	=	1.870	in
Centroid, Yo	=	0.839	in
X-Bar (Right)	=	0.931	in
X-Bar (Left)	=	0.931	in
Y-Bar (Top)	=	1.435	in
Y-Bar (Bot)	=	1.437	in
Max Thick	=	2.531	in

Equivalent Properties:

Area, Ax	=	0.866	in^2
Inertia, Ixx	=	1.083	in^4
Inertia, Iyy	=	0.273	in^4
Inertia, Ixy	=	0.000	in^4
Sx (Top)	=	0.754	in^3
Sx (Bot)	=	0.753	in^3
Sy (Left)	=	0.293	in^3
Sy (Right)	=	0.293	in^3
rx	=	1.118	in
ry	=	0.561	in
Plastic Zx	=	0.919	in^3
Plastic Zy	=	0.468	in^3
Torsional J	=	0.006	in^4
As-xx Def	=	1.000	
As-yy Def	=	1.000	
As-xx Stress	=	1.000	
As-yy Stress	=	1.000	



Section Diagram

Section Properties: GONDOLA UPRIGHT OPN

Section Information:

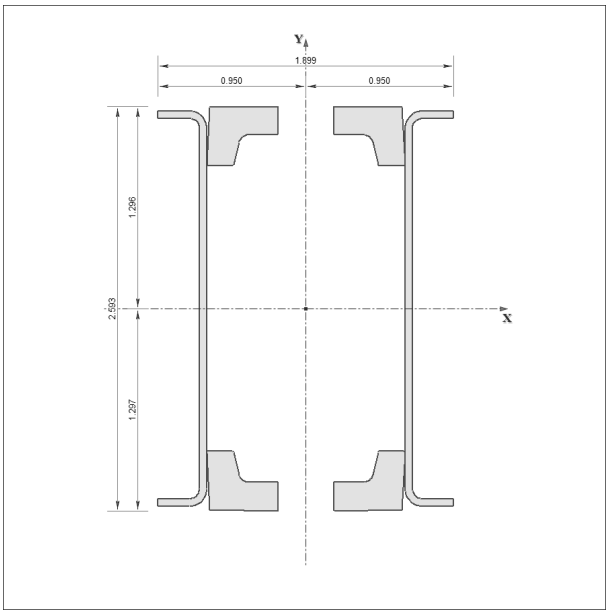
Material Type	=	General
Shape Type	=	Arbitrary
Number of Shapes	=	6

Basic Properties:

Total Width	=	1.899	in
Total Height	=	2.593	in
Centroid, Xo	=	0.990	in
Centroid, Yo	=	1.372	in
X-Bar (Right)	=	0.950	in
X-Bar (Left)	=	0.950	in
Y-Bar (Top)	=	1.296	in
Y-Bar (Bot)	=	1.297	in
Max Thick	=	2.531	in

Equivalent Properties:

Area, Ax	=	0.757	in^2
Inertia, Ixx	=	0.817	in^4
Inertia, Iyy	=	0.237	in^4
Inertia, Ixy	=	0.000	in^4
Sx (Top)	=	0.630	in^3
Sx (Bot)	=	0.630	in^3
Sy (Left)	=	0.250	in^3
Sy (Right)	=	0.250	in^3
rx	=	1.039	in
ry	=	0.560	in
Plastic Zx	=	0.746	in^3
Plastic Zy	=	0.406	in^3
Torsional J	=	0.005	in^4
As-xx Def	=	1.000	
As-yy Def	=	1.000	
As-xx Stress	=	1.000	
As-yy Stress	=	1.000	



Section Diagram

Section Properties: WS BEAM 3.25x16GA (0.061")

Section Information:

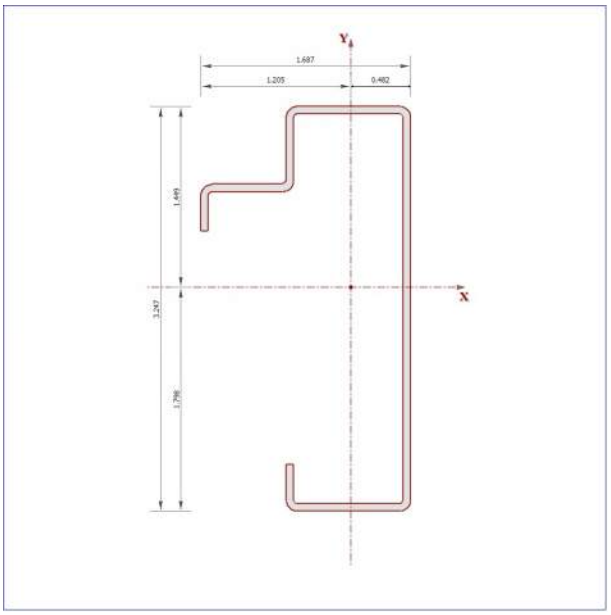
Material Type	=	General
Shape Type	=	Arbitrary
Number of Shapes	=	1

Basic Properties:

Total Width	=	1.688	in
Total Height	=	3.247	in
Centroid, Xo	=	1.205	in
Centroid, Yo	=	1.798	in
X-Bar (Right)	=	0.482	in
X-Bar (Left)	=	1.205	in
Y-Bar (Top)	=	1.449	in
Y-Bar (Bot)	=	1.798	in
Max Thick	=	0.061	in

Equivalent Properties:

Area, Ax	=	0.413	in^2
Inertia, Ixx	=	0.572	in^4
Inertia, Iyy	=	0.116	in^4
Inertia, Ixy	=	-0.059	in^4
Sx (Top)	=	0.394	in^3
Sx (Bot)	=	0.318	in^3
Sy (Left)	=	0.096	in^3
Sy (Right)	=	0.240	in^3
rx	=	1.176	in
ry	=	0.529	in
Plastic Zx	=	0.428	in^3
Plastic Zy	=	0.184	in^3
Torsional J	=	0.001	in^4
As-xx Def	=	1.000	
As-yy Def	=	1.000	
As-xx Stress	=	1.000	
As-yy Stress	=	1.000	



Section Diagram

Section Properties: WS BRACINGS 20GA

Section Information:

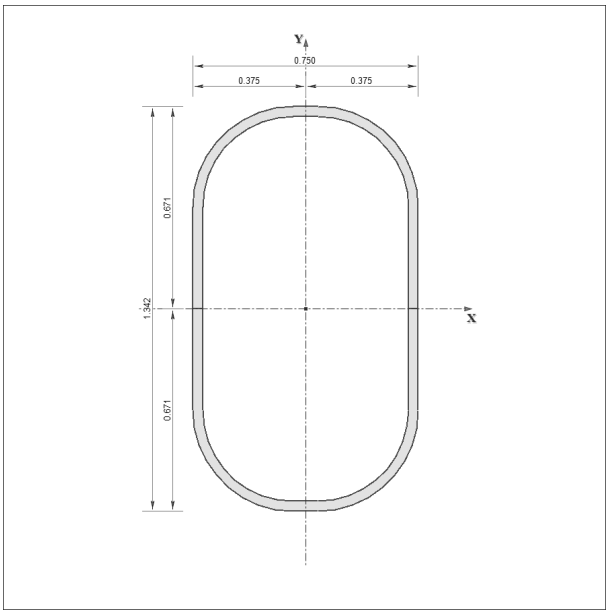
Material Type	=	General
Shape Type	=	Arbitrary
Number of Shapes	=	2

Basic Properties:

Total Width	=	0.750	in
Total Height	=	1.342	in
Centroid, Xo	=	2.804	in
Centroid, Yo	=	0.557	in
X-Bar (Right)	=	0.375	in
X-Bar (Left)	=	0.375	in
Y-Bar (Top)	=	0.671	in
Y-Bar (Bot)	=	0.671	in
Max Thick	=	0.033	in

Equivalent Properties:

Area, Ax	=	0.115	in^2
Inertia, Ixx	=	0.024	in^4
Inertia, Iyy	=	0.010	in^4
Inertia, Ixy	=	0.000	in^4
Sx (Top)	=	0.035	in^3
Sx (Bot)	=	0.035	in^3
Sy (Left)	=	0.027	in^3
Sy (Right)	=	0.027	in^3
rx	=	0.453	in
ry	=	0.298	in
Plastic Zx	=	0.046	in^3
Plastic Zy	=	0.032	in^3
Torsional J	=	0.000	in^4
As-xx Def	=	1.000	
As-yy Def	=	1.000	
As-xx Stress	=	1.000	
As-yy Stress	=	1.000	



Section Diagram

Section Properties: WS UPRITE 14GA (0.072")

Section Information:

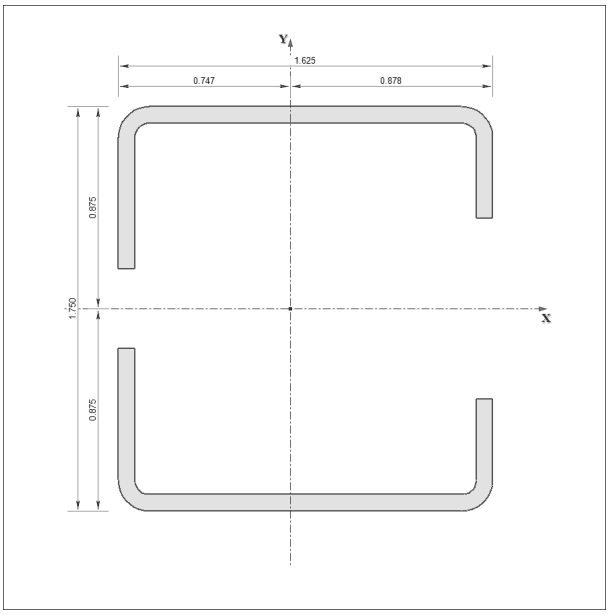
Material Type	=	General
Shape Type	=	Arbitrary
Number of Shapes	=	2

Basic Properties:

Total Width	=	1.625	in
Total Height	=	1.750	in
Centroid, Xo	=	1.176	in
Centroid, Yo	=	0.446	in
X-Bar (Right)	=	0.878	in
X-Bar (Left)	=	0.747	in
Y-Bar (Top)	=	0.875	in
Y-Bar (Bot)	=	0.875	in
Max Thick	=	1.625	in

Equivalent Properties:

Area, Ax	=	0.372	in^2
Inertia, Ixx	=	0.202	in^4
Inertia, Iyy	=	0.133	in^4
Inertia, Ixy	=	-0.000	in^4
Sx (Top)	=	0.231	in^3
Sx (Bot)	=	0.231	in^3
Sy (Left)	=	0.178	in^3
Sy (Right)	=	0.151	in^3
rx	=	0.738	in
ry	=	0.597	in
Plastic Zx	=	0.265	in^3
Plastic Zy	=	0.200	in^3
Torsional J	=	0.001	in^4
As-xx Def	=	1.000	
As-yy Def	=	1.000	
As-xx Stress	=	1.000	
As-yy Stress	=	1.000	



Section Diagram

Section Properties: S-SERIES UPRITE-EXT 16GA

Section Information:

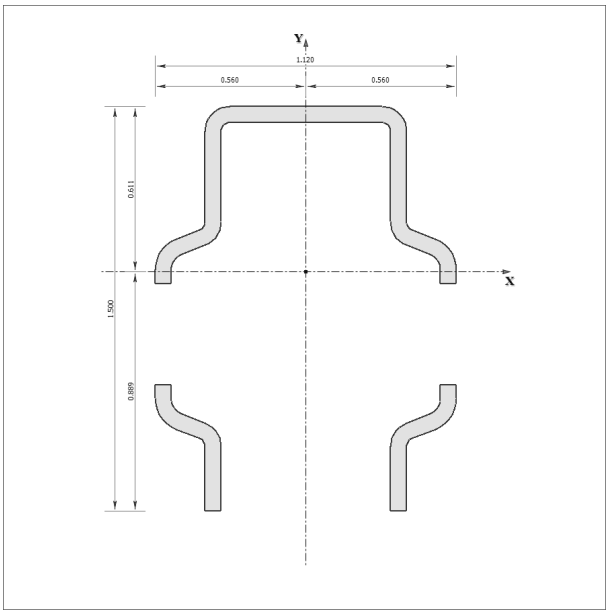
Material Type	=	General
Shape Type	=	Arbitrary
Number of Shapes	=	3

Basic Properties:

Total Width	=	1.120	in
Total Height	=	1.500	in
Centroid, Xo	=	0.000	in
Centroid, Yo	=	0.139	in
X-Bar (Right)	=	0.560	in
X-Bar (Left)	=	0.560	in
Y-Bar (Top)	=	0.611	in
Y-Bar (Bot)	=	0.889	in
Max Thick	=	0.060	in

Equivalent Properties:

Area, Ax	=	0.194	in^2
Inertia, Ixx	=	0.050	in^4
Inertia, Iyy	=	0.027	in^4
Inertia, Ixy	=	0.000	in^4
Sx (Top)	=	0.082	in^3
Sx (Bot)	=	0.056	in^3
Sy (Left)	=	0.048	in^3
Sy (Right)	=	0.048	in^3
rx	=	0.508	in
ry	=	0.374	in
Plastic Zx	=	0.084	in^3
Plastic Zy	=	0.068	in^3
Torsional J	=	0.000	in^4
As-xx Def	=	1.000	
As-yy Def	=	1.000	
As-xx Stress	=	1.000	
As-yy Stress	=	1.000	



Section Diagram

Section Properties: S-SERIES UPRITE-INT 16GA

Section Information:

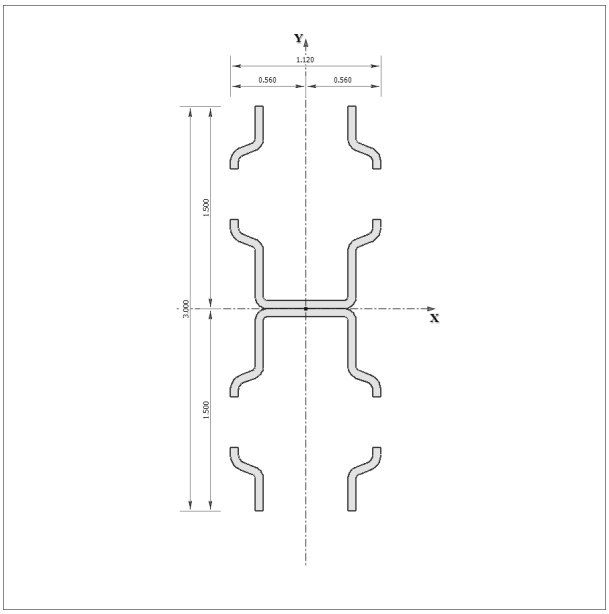
Material Type	=	General
Shape Type	=	Arbitrary
Number of Shapes	=	6

Basic Properties:

Total Width	=	1.120	in
Total Height	=	3.000	in
Centroid, Xo	=	0.429	in
Centroid, Yo	=	0.321	in
X-Bar (Right)	=	0.560	in
X-Bar (Left)	=	0.560	in
Y-Bar (Top)	=	1.500	in
Y-Bar (Bot)	=	1.500	in
Max Thick	=	0.061	in

Equivalent Properties:

Area, Ax	=	0.387	in^2
Inertia, Ixx	=	0.245	in^4
Inertia, Iyy	=	0.054	in^4
Inertia, Ixy	=	-0.000	in^4
Sx (Top)	=	0.163	in^3
Sx (Bot)	=	0.163	in^3
Sy (Left)	=	0.097	in^3
Sy (Right)	=	0.097	in^3
rx	=	0.795	in
ry	=	0.374	in
Plastic Zx	=	0.237	in^3
Plastic Zy	=	0.137	in^3
Torsional J	=	0.000	in^4
As-xx Def	=	1.000	
As-yy Def	=	1.000	
As-xx Stress	=	1.000	
As-yy Stress	=	1.000	



Section Diagram

Section Properties: S-SERIES BRACE

Section Information:

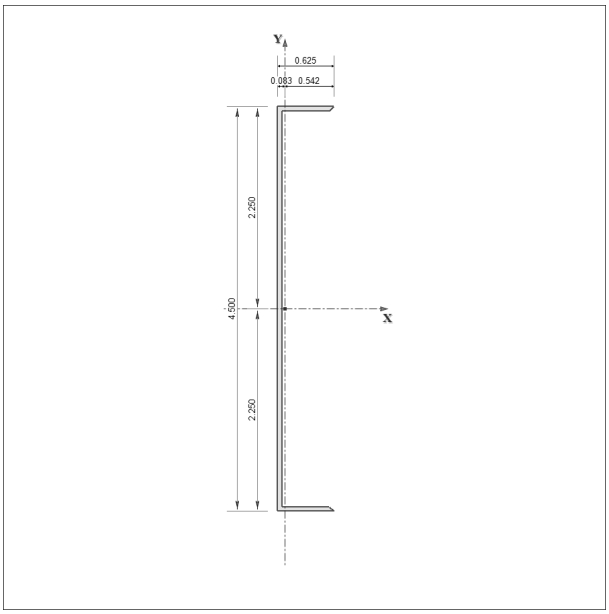
Material Type	=	General
Shape Type	=	Arbitrary
Number of Shapes	=	1

Basic Properties:

Total Width	=	0.625	in
Total Height	=	4.500	in
Centroid, Xo	=	2.966	in
Centroid, Yo	=	0.524	in
X-Bar (Right)	=	0.542	in
X-Bar (Left)	=	0.083	in
Y-Bar (Top)	=	2.250	in
Y-Bar (Bot)	=	2.250	in
Max Thick	=	0.048	in

Equivalent Properties:

Area, Ax	=	0.269	in^2
Inertia, Ixx	=	0.628	in^4
Inertia, Iyy	=	0.005	in^4
Inertia, Ixy	=	-0.000	in^4
Sx (Top)	=	0.279	in^3
Sx (Bot)	=	0.279	in^3
Sy (Left)	=	0.063	in^3
Sy (Right)	=	0.010	in^3
rx	=	1.527	in
ry	=	0.140	in
Plastic Zx	=	0.361	in^3
Plastic Zy	=	0.018	in^3
Torsional J	=	0.000	in^4
As-xx Def	=	1.000	
As-yy Def	=	1.000	
As-xx Stress	=	1.000	
As-yy Stress	=	1.000	



Section Diagram

Appendix C

Anchor Bolt Design
ICC ESR Report

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

ANCHOR BOLT DESIGN OF FRAMES (A,A1,A2)

Assume

FRAME	MAX. SHEAR (LBS)*	MAX. UPLIFT (LBS)*	SLAB THK. (IN)
A	22	12	4
A1	8	1	4

EVERY 4th FRAME

	MAX. SHEAR (LBS)	MAX. UPLIFT (LBS)
MAX. LOADS	22	12
LRFD - FACTORED LOADS	92	48

ANCHOR BRAND : HILTI
No. OF ANCHORS : 2
DIAMETER OF ANCHOR : 1/4 in
MIN. EMBEDMENT : 2 in
PRODUCT : HILTI KWIK HUS-EZ (KH-EZ) SCREW ANCHOR, CARBON STEEL, INSTALLATION PER ESR-3027.

ADD STANDARD WASHERS.

ACCEPTABLE ALTERNATIVES LISTED BELOW (1/4" DIAMETER, 2.5" MIN. EMBEDMENT)

SIMPSON-TIE CARBON STEEL TITEN HD SCREW, INSTALLATION PER ESR-2713.

DEWALT POWER SCREW-BOLT+ ANCHOR, INSTALLATION PER ESR-3889.

SEE NEXT PAGES FOR ANCHOR BOLT DESIGN BASED ON WORST CASE LOADING

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

Company:		Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	A - Wall Frame - Anchor Design	Date:	9/2/2026
Fastening point:			

Specifier's comments:

1 Input data



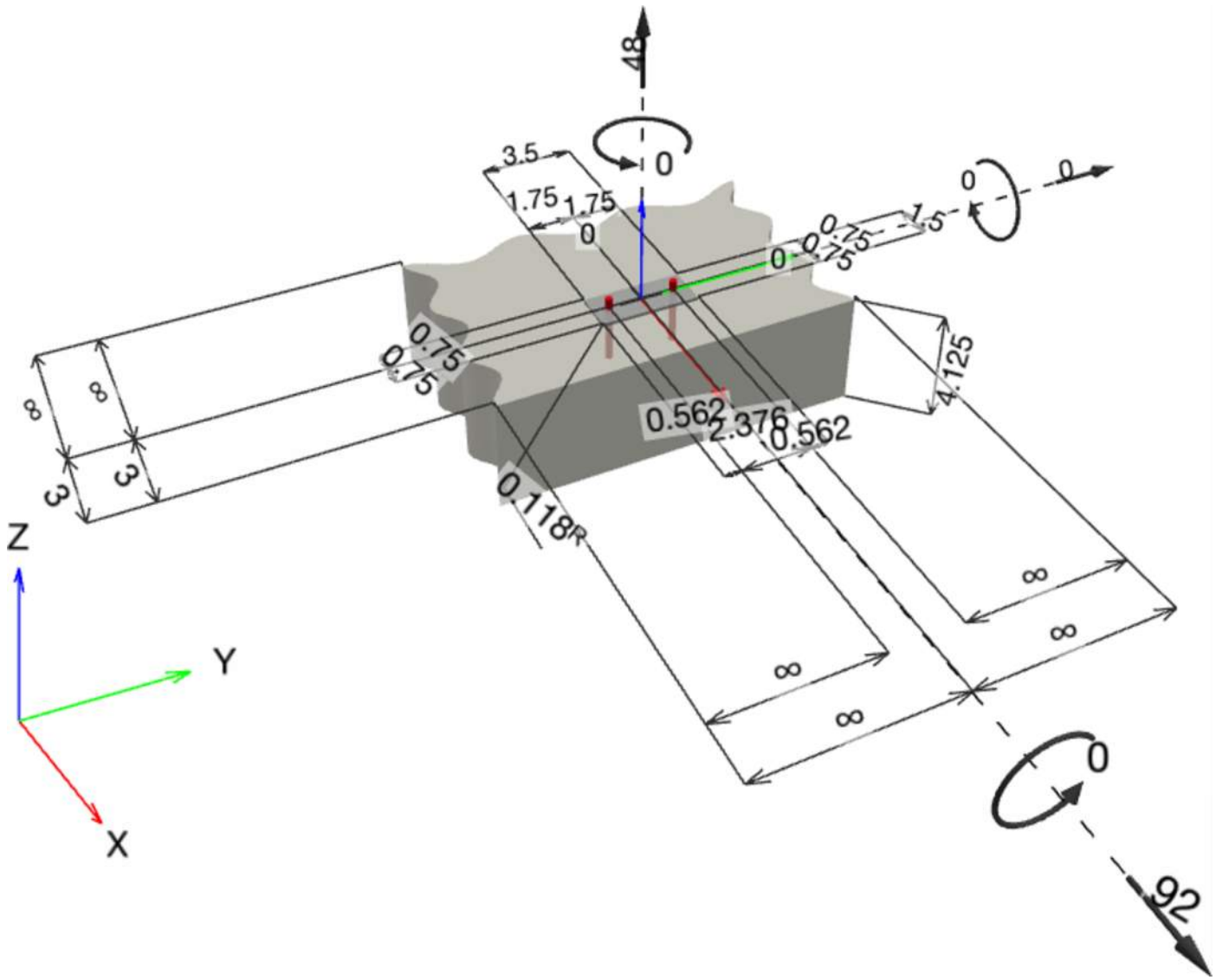
Anchor type and diameter:	**KWIK HUS-EZ (KH-EZ) (Carbon Steel) 1/4 (2 1/2)**
Item number:	418045 KH-EZ 1/4"x2 5/8"
Specification text:	HILTI ∅ 1/4 IN KWIK HUS-EZ (KH-EZ) (CARBON STEEL) WITH 2.5 IN NOMINAL EMBEDMENT DEPTH PER ICC-ES ESR-3027 , HAMMER DRILL BIT INSTALLATION PER MPII
Effective embedment depth:	$h_{ef,act}$ = 1.920 in., h_{nom} = 2.500 in.
Material:	Carbon Steel
Evaluation Service Report:	ESR-3027
Issued I Valid:	3/1/2026 | 12/1/2027
Proof:	Design Method ACI 318-19 / Mech
Shear edge breakout verification:	Row closest to edge (Case 3 only from ACI 318-19 Fig. R.17.7.2.1b)
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.118 in.
Anchor plate[R] :	l_x x l_y x t = 1.500 in. x 3.500 in. x 0.118 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, 2500, f_c' = 2,500 psi; h = 4.125 in.
Installation:	**Hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: not present, shear: not present; no supplemental splitting reinforcement present edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	Tension load: yes (17.10.5.3 (d)) Shear load: yes (17.10.6.3 (c))

[R] - The anchor calculation is based on a rigid anchor plate assumption.

Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

Company:		Page:	2
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	A - Wall Frame - Anchor Design	Date:	9/2/2026
Fastening point:			

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



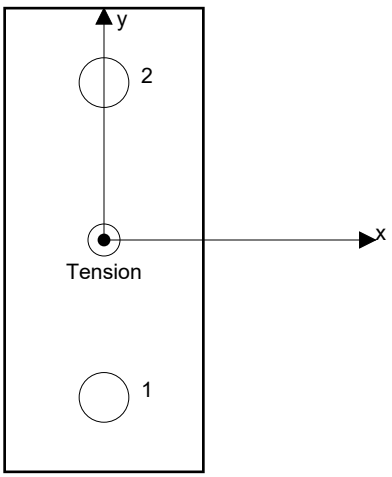
Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

Company:		Page:	3
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	A - Wall Frame - Anchor Design	Date:	9/2/2026
Fastening point:			

1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 48; V_x = 92; V_y = 0; M_x = 0; M_y = 0; M_z = 0;	yes	8

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	24	46	46	0
2	24	46	46	0

Max. concrete compressive strain: - [‰]
Max. concrete compressive stress: - [psi]
Resulting tension force in (x/y)=(0.000/0.000): 48 [lb]
Resulting compression force in (x/y)=(-/-): 0 [lb]

Anchor forces are calculated based on the assumption of a rigid anchor plate.

3 Tension load

	Load N_{ua} [lb]	Capacity ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi$ N_n	Status
Steel Strength*	24	3,679	1	OK
Pullout Strength*	24	568	5	OK
Concrete Breakout Failure**	48	1,557	4	OK

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

Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

Company:		Page:	4
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	A - Wall Frame - Anchor Design	Date:	9/2/2026
Fastening point:			

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]
0.05	125,000

Calculations

N_{sa} [lb]
5,660

Results

N_{sa} [lb]	ϕ_{steel}	$\phi_{nonductile}$	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
5,660	0.650	1.000	3,679	24

3.2 Pullout Strength

$N_{pn,f_c'} = N_{p,2500}\ \lambda_a\ (f_c'/2500)^{0.5}$ — refer to ICC-ES ESR-3027
$\phi\ N_{pn,f_c'} \geq N_{ua}$ — ACI 318-19 Table 17.5.2

Variables

f_c' [psi]	λ_a	$N_{p,2500}$ [lb]
2,500	1.000	1,166

Calculations

$(f_c'/2500)^{0.5}$
1.000

Results

$N_{pn,f_c'}$ [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ N_{pn,f_c'}$ [lb]	N_{ua} [lb]
1,166	0.650	0.750	1.000	568	24

Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

Company:		Page:	5
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	A - Wall Frame - Anchor Design	Date:	9/2/2026
Fastening point:			

3.3 Concrete Breakout Failure

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

$\phi\ N_{cbg} \geq N_{ua}$ — 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)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e'_N}{3\ h_{ef}}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.3.1)

$\psi_{ed,N} = 0.7 + 0.3\left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ — 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.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
1.920	0.000	0.000	3.000	1.000

c_{ac} [in.]	k_c	λ_a	f'_c [psi]
2.780	17	1.000	2,500

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
46.86	33.18	1.000	1.000	1.000	1.000	2,261

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
3,194	0.650	0.750	1.000	1,557	48

Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

Company:		Page:	6
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	A - Wall Frame - Anchor Design	Date:	9/2/2026
Fastening point:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi$ V_n	Status
Steel Strength*	46	837	6	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	92	2,236	5	OK
Concrete edge failure in direction x+**	92	1,158	8	OK

* highest loaded anchor **anchor group (relevant anchors)
When the input edge distance is set to "infinity", edge breakout verification is not performed in that direction

4.1 Steel Strength

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

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]	$\alpha_{V,seis}$
0.05	125,000	0.900

Calculations

$V_{sa,eq}$ [lb]
1,395

Results

$V_{sa,eq}$ [lb]	ϕ_{steel}	$\phi_{nonductile}$	ϕ $V_{sa,eq}$ [lb]	V_{ua} [lb]
1,395	0.600	1.000	837	46

Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

Company:		Page:	7
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	A - Wall Frame - Anchor Design	Date:	9/2/2026
Fastening point:			

4.2 Pryout Strength

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

$\phi V_{cpg} \geq V_{ua}$ 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)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2 e'_N}{3 h_{ef}}} \right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.3.1)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0$ 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.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
1	1.920	0.000	0.000	3.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f'_c [psi]
1.000	2.780	17	1.000	2,500

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
46.86	33.18	1.000	1.000	1.000	1.000	2,261

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	ϕV_{cpg} [lb]	V_{ua} [lb]
3,194	0.700	1.000	1.000	2,236	92

Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

4.3 Concrete edge failure in direction x+

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

$\phi V_{cbg} \geq V_{ua}$ 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)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{e'_v}{1.5c_{a1}}}\right) \leq 1.0$ ACI 318-19 Eq. (17.7.2.3.1)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ 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.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
3.000	-	0.000	1.000	4.125

l_e [in.]	λ_a	d_a [in.]	f'_c [psi]	$\psi_{parallel,V}$
1.920	1.000	0.250	2,500	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
46.93	40.50	1.000	1.000	1.044	1,367

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	ϕV_{cbg} [lb]	V_{ua} [lb]
1,654	0.700	1.000	1.000	1,158	92

*Anchor row defined by: Anchor 1, 2; Case 3 controls

When the input edge distance is set to "infinity", edge breakout verification is not performed in that direction

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

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.042	0.079	5/3	2	OK

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

Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (EN1992-4, AS5216, 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 FEM 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!
- The equations presented in this report are based on imperial units. When inputs are displayed in metric units, the user should be aware that the equations remain in their imperial format.
- 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://viewer.joomag.com/profis-design-guide-us-en-summer-2021/0841849001625154758?short&/
- "An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-19, Chapter 17, Section 17.10.5.3 (a) that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, the connection design (tension) shall satisfy the provisions of Section 17.10.5.3 (b), Section 17.10.5.3 (c), or Section 17.10.5.3 (d). The connection design (shear) shall satisfy the provisions of Section 17.10.6.3 (a), Section 17.10.6.3 (b), or Section 17.10.6.3 (c)."
- Section 17.10.5.3 (b) / Section 17.10.6.3 (a) require the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Section 17.10.5.3 (c) / Section 17.10.6.3 (b) waive the ductility requirements and require the anchors to be designed for the maximum tension / shear that can be transmitted to the anchors by a non-yielding attachment. Section 17.10.5.3 (d) / Section 17.10.6.3 (c) waive the ductility requirements and require the design strength of the anchors to equal or exceed the maximum tension / shear obtained from design load combinations that include E, with E increased by ω_0.
- 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!

PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

7 Installation data

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

Profile: no profile

Item number: 418045 KH-EZ 1/4"x2 5/8"

Hole diameter in the fixture: d_f = 0.375 in.

Maximum installation torque: 216 in.lb

Plate thickness (input): 0.118 in.

Hole diameter in the base material: 0.250 in.

Recommended plate thickness: not calculated

Hole depth in the base material: 2.875 in.

Drilling method: Hammer drilled

Minimum thickness of the base material: 4.125 in.

Cleaning: Manual cleaning of the drilled hole according to instructions for use is required.

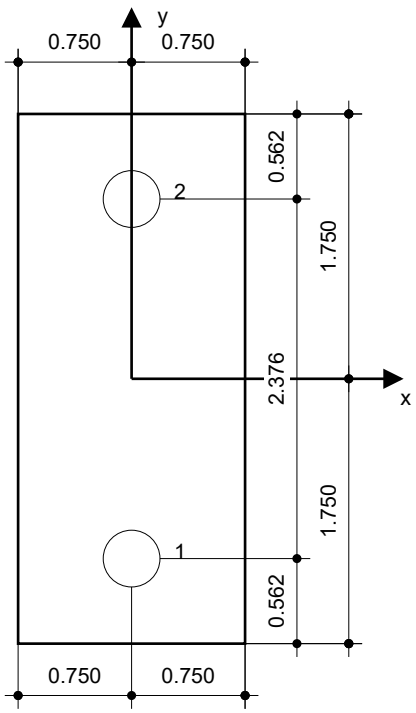
Hilti ∅ 1/4 in KWIK HUS-EZ (KH-EZ) (Carbon Steel) with 2.5 in nominal embedment depth per ICC-ES ESR-3027 , Hammer drill bit installation per MPII

7.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• Manual blow-out pump	• Torque wrench

Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

Company:		Page:	11
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	A - Wall Frame - Anchor Design	Date:	9/2/2026
Fastening point:			



Coordinates Anchor [in.]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-0.000	-1.188	-	3.000	-	-
2	-0.000	1.188	-	3.000	-	-

Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

Company:		Page:	12
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	A - Wall Frame - Anchor Design	Date:	9/2/2026
Fastening point:			

8 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

Wall Frame A - Lozier DC1242 - DeWalt Anchor
Design Report

9/1/2026

1.Project Information

Company:	JPH & CLARK
Project Engineer:	AA/KRC
Address:	DESOTO, TEXAS
Phone:	972-283-5111
Email:	krishna@jphpe.com
Project Name:	26-460 Advanced Auto Parts
Project Address:	Louisville, KY
Notes:	

2.Selected Anchor Information

Selected Anchor :	Screw-Bolt+
Brand:	DEWALT
Material:	1/4" Ø Low Carbon Steel
Embedment:	h_{ef} 1.94 in h_{nom} 2.5 in
Approval:	ICC-ES ESR-3889
Issued/Revision:	Nov,2025 Feb,2026
Drill method:	Hammer Drilled



3.Design Principles

Design Method:	ACI 318-19
Load Combinations:	Section 5.3 User Defined Loads
Seismic Loading:	Tension 17.10.5.3(d) Shear 17.10.6.3(c) Ω_o= 2.5

4.Base Material Information

Concrete:

Type:	Cracked Normal Weight Concrete
Strength	2500 psi

Reinforcement:

Edge Reinforcement	None or < #4 Rebar
Spacing	Tension No (Condition B) Shear No (Condition B)
Controls Breakout	Tension True Shear True

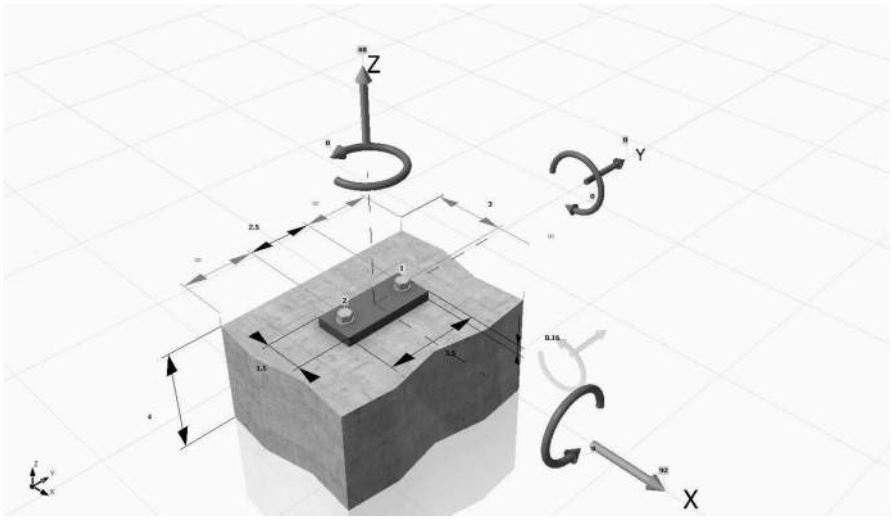
Base Plate:

Sizing	Thickness 0.16 in Length 3.5 in Width 1.5 in
Standoff	None Height 0 in
Strength	36000 psi

Profile: None

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

5.Geometric Conditions



h_{slab}	4	in	h_{min}	4.000	in
Edge Cx-	3	in	c_{min}	1.500	in
Edge Cx+	∞	in	c_{ac}	6.100	in
Edge Cy-	∞	in	s_{min}	1.500	in
Edge Cy+	∞	in			

6.Summary Results

Tension Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength:	24.00	2948.00	0.008	OK	
Concrete Breakout Strength:	48.00	1601.00	0.030	OK	
Pullout Strength:	24.00	570.00	0.042	OK	Controls

Shear Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength	46.00	1020.00	0.045	OK	
Concrete Breakout Strength:	92.00	1155.00	0.080	OK	Controls
Pryout Strength	92.00	2298.00	0.040	OK	

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

7.Warnings and Remarks

ANCHOR DESIGN CRITERIA IS SATISFIED

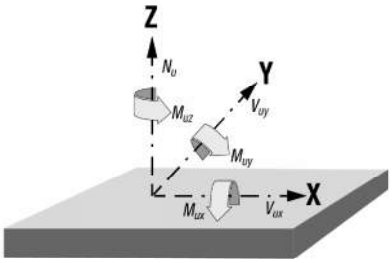
- The results of the calculations carried out by means of the DDA Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an design professional/engineer, particularly with regard to compliance with applicable standards, norms and permits, prior to using them for your specific project. The DDA Software serves only as an aid to interpret standards, norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- Calculations including seismic design requirements in accordance with ACI 318 are required for anchors in structures assigned to seismic design categories C, D, E and F.
- Under these seismic conditions, the direction of shear may not be predictable. In accordance with ACI 318 the full shear force should be assumed also in reverse direction for a safe design. Load reversal may influence the direction of the controlling concrete breakout strength.

8.Load Condition

Design Loads / Actions

Nu	48.0	lb	Vux	-92.0	lb	Vuy	0.0	lb
Muz	0.0	in-lb	Mux	0.0	in-lb	Muy	0.0	in-lb

Consider Load Reversal X Direction 100% Y Direction 100%



9.Load Distribution

Max. concrete compressive strain:	0.000	%	Anchor Eccentricity					
Max. concrete compressive stress:	0.000	psi	ex	0	in	ey	0	in
Resulting tension force:	48.000	lb	Profile Eccentricity					
Resulting compression force:	0.000	lb	ex	0	in	ey	0	in

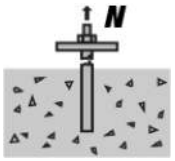
Resulting anchor forces / Load distribution

Anchor	Tension Load (lb)	Shear Load (lb)	Component Shear Load (lb)		Anchor Coordinates (in)	
			Shear X	Shear Y	X	Y
1	24.00	46.0	-46.0	0.0	0.000	1.250
2	24.00	46.0	-46.0	0.0	0.000	-1.250

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

10.Design Proof Tension Loading

Steel Strength



ACI 318-19 17.6.1

Variables

N_{sa} (lb)	φ
4535.000	0.65

Results

φN_{sa}	=	2948.0	lb	Table 17.5.2
N_{ua}	=	24.0	lb	
Utilization	=	0.8%		

Concrete Breakout Strength



ACI 318-19 17.6.2

Equations

$N_{cbg} = (A_{Nc} / A_{Nc0}) \cdot \Psi_{ec,N} \cdot \Psi_{ed,N} \cdot \Psi_{c,N} \cdot \Psi_{cp,N} \cdot N_b$ Eqn. 17.6.2.1b

$N_b = k_c \cdot \lambda_a \cdot (f'_c)^{0.5} \cdot h_{ef}^{1.5}$ Eqn. 17.6.2.2.1

Variables

A_{Nc} (in²)	A_{Nc0} (in²)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$
48.422	33.872	1.000	1.000	1.000	1.000

c_{ac} (in)	k_c	λ_a	f'_c (psi)	h_{ef} (in)	C_{amin} (in)
6.100	17.000	1.000	2500	1.94	3

N_b (lb)	φ	φs_{eis}
2296.790	0.65	0.750

Results

φN_{cbg}	=	1601	lb	Table 17.5.2
N_{ua}	=	48.0	lb	
Utilization	=	3.0%		

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

Pullout Strength:



ACI 318-19 17.6.3

Equations

$N_{pn} = \Psi_{c,P} \cdot N_p \cdot (f'_c / 2500)^n$ Eqn. 17.6.3.1

Variables

$\Psi_{c,P}$	$N_{p,eq}$ (lb)	f'_c (psi)	n	φ
1.000	1170.000	2500	0.300	0.65

φs_{eis}
0.750

Results

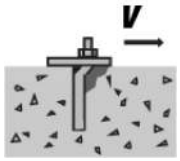
φN_{pn}	=	570	lb	
N_{ua}	=	24	lb	Table 17.5.2
Utilization	=	4.2%		

11.Design Proof Shear Loading

Reference

Steel Strength

ACI 318-19 17.7.1



Variables

V_{sa} (lb)	φ	$\alpha_{V,Seismic}$
1700.00	0.60	1

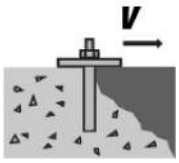
Results

$\varphi V_{sa,eq}$	=	1020	lb
V_{ua}	=	46	lb
Utilization	=	4.5%	

Table 17.5.2

Concrete Breakout Strength

ACI 318-19 17.7.2



Equations

$$V_{cbg} = (A_{Vc} / A_{Vc0}) \cdot \Psi_{ec,V} \cdot \Psi_{ed,V} \cdot \Psi_{c,V} \cdot \Psi_{h,v} \cdot V_b$$

Eqn. 17.7.2.1b

$$V_b = (7 \cdot (l_e / d_a)^{0.2} \cdot (d_a)^{0.5}) \cdot \lambda_a \cdot (f'_c)^{0.5} \cdot (c_{a1})^{1.5}$$

Eqn. 17.7.2.2.1a

Variables

A_{Vc} (in²)	A_{Vc0} (in²)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$
46.000	40.500	1.000	1.000	1.000	1.061

$\Psi_{\alpha,V}$	l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)
1.000	1.940	0.250	1.000	2500.000	3.000

V_b (lb)	φ	φs_{eis}	V_{cbg} (lb)
1369.911	0.70	0.750	1650.332

Results

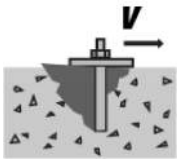
φV_{cbg}	=	1155	lb
Direction	=	X-	
V_{ua}	=	92	lb
Utilization	=	8.0%	

Table 17.5.2

Shear Breakout Case 2 Controls

Pryout Strength

ACI 318-19 17.7.3



Equations

$V_{cpg} = k_{cp} \cdot N_{cpg}$ Eqn. 17.7.3.1b

$N_{cbg} = (A_{Nc} / A_{Nc0}) \cdot \Psi_{ec,N} \cdot \Psi_{ed,N} \cdot \Psi_{c,N} \cdot \Psi_{cp,N} \cdot N_b$ Eqn. 17.6.2.1b

$N_b = k_c \cdot \lambda_a \cdot (f'_c)^{0.5} \cdot h_{ef}^{1.5}$ Eqn. 17.6.2.2.1

Variables

A_{Nc} (in²)	A_{Nc0} (in²)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$
48.422	33.872	1.000	1.000	1.000	1.000

c_{ac} (in)	k_c	λ_a	h_{ef} (in)	f'_c (psi)	C_{amin} (in)
6.100	17.000	1.000	1.94	2500.000	3.000

N_b (lb)	k_{cp}	N_{cpg} (lb)	φ
2296.791	1.000	3283.385	0.70

Results

φV_{cpg}	=	2298.00	lb	Table 17.5.2
V_{ua}	=	92	lb	
Utilization	=	4.0%		

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

12.Interaction of Tension and Shear Loads

Reference

ACI 318-19 17.8

Equations

$$(N_{ua} / \varphi \cdot N_n)^{5/3} + (V_{ua} / \varphi \cdot V_n)^{5/3} <= 1.0$$ Eqn. 17.8.3

Variables

$N_{ua} / \varphi \cdot N_n$	$V_{ua} / \varphi \cdot V_n$
0.042	0.080

Results

0.020	≤	1.0
Status	:	OK

ANCHOR DESIGN CRITERIA IS SATISFIED

ANCHOR BOLT DESIGN OF FRAMES (B,C,E4)

FRAME	MAX. SHEAR (LBS)*	MAX. UPLIFT (LBS)*	Assume SLAB THK. (IN)
B	192	0	4
C	252	0	4
E4	133	0	4

*Includes Ωo = 2 and are factored loads

EVERY 4th FRAME

	MAX. SHEAR (LBS)	MAX. UPLIFT (LBS)
MAX. LOADS	252	0
LRFD - FACTORED LOADS	1,008	4

ANCHOR BRAND : DEWALT POWERS
No. OF ANCHORS : 1
DIAMETER OF ANCHOR : 3/8 in
MIN. EMBEDMENT : 2 1/2 in
PRODUCT : HILTI KWIK HUS-EZ (KH-EZ) SCREW ANCHOR, CARBON STEEL, INSTALLATION PER ESR-3027.

ACCEPTABLE ALTERNATIVES LISTED BELOW (3/8" DIAMETER, 2.5" MIN. EMBEDMENT)

SIMPSON-TIE CARBON STEEL TITEN HD SCREW, INSTALLATION PER ESR-2713.

DEWALT POWER SCREW-BOLT+ ANCHOR, INSTALLATION PER ESR-3889.

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

Company:		Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	B, C, E4 - Wide Span Racks - Anchor Design	Date:	9/2/2026
Fastening point:			

Specifier's comments:

1 Input data



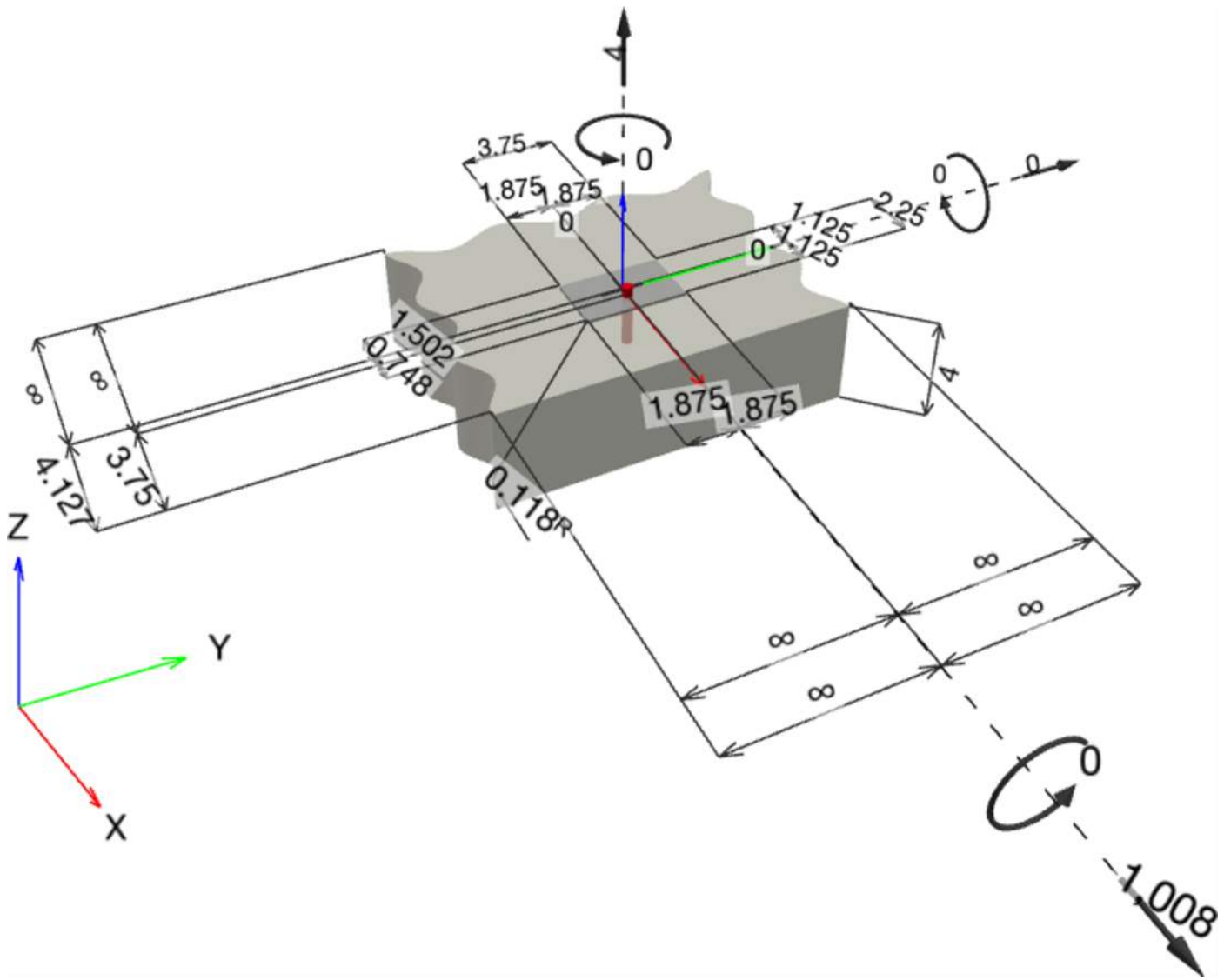
Anchor type and diameter:	**KWIK HUS-EZ (KH-EZ) (Carbon Steel) 3/8 (2 1/2)**
Item number:	418057 KH-EZ 3/8"x3"
Specification text:	HILTI ∅ 3/8 IN KWIK HUS-EZ (KH-EZ) (CARBON STEEL) WITH 2.5 IN NOMINAL EMBEDMENT DEPTH PER ICC-ES ESR-3027 , HAMMER DRILL BIT INSTALLATION PER MPII
Effective embedment depth:	$h_{ef,act}$ = 1.860 in., h_{nom} = 2.500 in.
Material:	Carbon Steel
Evaluation Service Report:	ESR-3027
Issued I Valid:	3/1/2026 | 12/1/2027
Proof:	Design Method ACI 318-19 / Mech
Shear edge breakout verification:	Row closest to edge (Case 3 only from ACI 318-19 Fig. R.17.7.2.1b)
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.118 in.
Anchor plate[R] :	l_x x l_y x t = 2.250 in. x 3.750 in. x 0.118 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, 2500, f_c' = 2,500 psi; h = 4.000 in.
Installation:	**Hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: not present, shear: not present; no supplemental splitting reinforcement present edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	Tension load: yes (17.10.5.3 (d)) Shear load: yes (17.10.6.3 (c))

[R] - The anchor calculation is based on a rigid anchor plate assumption.

Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

Company:		Page:	2
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	B, C, E4 - Wide Span Racks - Anchor Design	Date:	9/2/2026
Fastening point:			

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



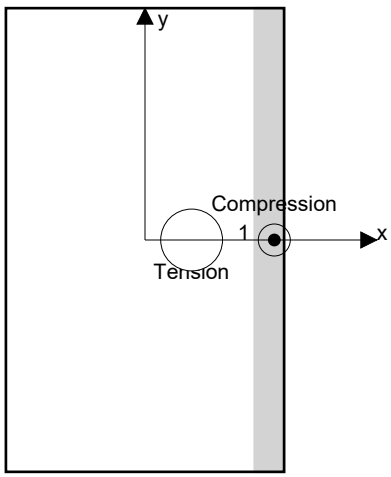
Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

Company:		Page:	3
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	B, C, E4 - Wide Span Racks - Anchor Design	Date:	9/2/2026
Fastening point:			

1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 4; V_x = 1,008; V_y = 0; M_x = 0; M_y = 0; M_z = 0;	yes	80

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	6	1,008	1,008	0

Max. concrete compressive strain: 0.00 [‰]
Max. concrete compressive stress: 5 [psi]
Resulting tension force in (x/y)=(0.377/0.000): 6 [lb]
Resulting compression force in (x/y)=(1.046/0.000): 2 [lb]

Anchor forces are calculated based on the assumption of a rigid anchor plate.

3 Tension load

	Load N_{ua} [lb]	Capacity ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi$ N_n	Status
Steel Strength*	6	6,718	1	OK
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	6	1,051	1	OK

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

Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

Company:		Page:	4
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	B, C, E4 - Wide Span Racks - Anchor Design	Date:	9/2/2026
Fastening point:			

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]
0.09	120,300

Calculations

N_{sa} [lb]
10,335

Results

N_{sa} [lb]	ϕ_{steel}	$\phi_{nonductile}$	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
10,335	0.650	1.000	6,718	6

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]
1.860	3.750	1.000	2.920	17	1.000	2,500

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
31.14	31.14	1.000	1.000	2,156

Results

N_{cb} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ N_{cb}$ [lb]	N_{ua} [lb]
2,156	0.650	0.750	1.000	1,051	6

Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

Company:		Page:	5
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	B, C, E4 - Wide Span Racks - Anchor Design	Date:	9/2/2026
Fastening point:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi$ V_n	Status
Steel Strength*	1,008	1,866	55	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	1,008	1,509	67	OK
Concrete edge failure in direction x+**	1,008	1,266	80	OK

* highest loaded anchor **anchor group (relevant anchors)
When the input edge distance is set to "infinity", edge breakout verification is not performed in that direction

4.1 Steel Strength

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

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]	$\alpha_{V,seis}$
0.09	120,300	0.600

Calculations

$V_{sa,eq}$ [lb]
3,110

Results

$V_{sa,eq}$ [lb]	ϕ_{steel}	$\phi_{nonductile}$	ϕ $V_{sa,eq}$ [lb]	V_{ua} [lb]
3,110	0.600	1.000	1,866	1,008

Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

Company:		Page:	6
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	B, C, E4 - Wide Span Racks - Anchor Design	Date:	9/2/2026
Fastening point:			

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)

$\psi_{cp,N} = MAX\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0$ 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	1.860	3.750	1.000

c_{ac} [in.]	k_c	λ_a	f'_c [psi]
2.920	17	1.000	2,500

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
31.14	31.14	1.000	1.000	2,156

Results

V_{cp} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	ϕV_{cp} [lb]	V_{ua} [lb]
2,156	0.700	1.000	1.000	1,509	1,008

Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

Company:		Page:	7
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	B, C, E4 - Wide Span Racks - Anchor Design	Date:	9/2/2026
Fastening point:			

4.3 Concrete edge failure in direction x+

$V_{cb} = \left(\frac{A_{Vc}}{A_{Vc0}}\right) \psi_{ed,V} \psi_{c,V} \psi_{h,V} \psi_{parallel,V} V_b$ — 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.]
3.750	-	1.000	4.000	1.860

λ_a	d_a [in.]	f'_c [psi]	$\psi_{parallel,V}$
1.000	0.375	2,500	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
45.00	63.28	1.000	1.186	2,144

Results

V_{cb} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	ϕV_{cb} [lb]	V_{ua} [lb]
1,808	0.700	1.000	1.000	1,266	1,008

*Anchor row defined by: Anchor 1; Case 3 controls

When the input edge distance is set to "infinity", edge breakout verification is not performed in that direction

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

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.006	0.796	1.000	67	OK

$\beta_{NV} = (\beta_N + \beta_V) / 1.2 <= 1$

Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

Company:		Page:	8
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	B, C, E4 - Wide Span Racks - Anchor Design	Date:	9/2/2026
Fastening point:			

6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (EN1992-4, AS5216, 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 FEM 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!
- The equations presented in this report are based on imperial units. When inputs are displayed in metric units, the user should be aware that the equations remain in their imperial format.
- 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://viewer.joomag.com/profis-design-guide-us-en-summer-2021/0841849001625154758?short&/
- "An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-19, Chapter 17, Section 17.10.5.3 (a) that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, the connection design (tension) shall satisfy the provisions of Section 17.10.5.3 (b), Section 17.10.5.3 (c), or Section 17.10.5.3 (d). The connection design (shear) shall satisfy the provisions of Section 17.10.6.3 (a), Section 17.10.6.3 (b), or Section 17.10.6.3 (c)."
- Section 17.10.5.3 (b) / Section 17.10.6.3 (a) require the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Section 17.10.5.3 (c) / Section 17.10.6.3 (b) waive the ductility requirements and require the anchors to be designed for the maximum tension / shear that can be transmitted to the anchors by a non-yielding attachment. Section 17.10.5.3 (d) / Section 17.10.6.3 (c) waive the ductility requirements and require the design strength of the anchors to equal or exceed the maximum tension / shear obtained from design load combinations that include E, with E increased by ω_0.
- 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!

PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

Company:		Page:	9
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	B, C, E4 - Wide Span Racks - Anchor Design	Date:	9/2/2026
Fastening point:			

7 Installation data

Anchor type and diameter: KWIK HUS-EZ (KH-EZ) (Carbon Steel) 3/8 (2 1/2)

Profile: no profile

Item number: 418057 KH-EZ 3/8"x3"

Hole diameter in the fixture: d_f = 0.500 in.

Maximum installation torque: 480 in.lb

Plate thickness (input): 0.118 in.

Hole diameter in the base material: 0.375 in.

Recommended plate thickness: not calculated

Hole depth in the base material: 2.750 in.

Drilling method: Hammer drilled

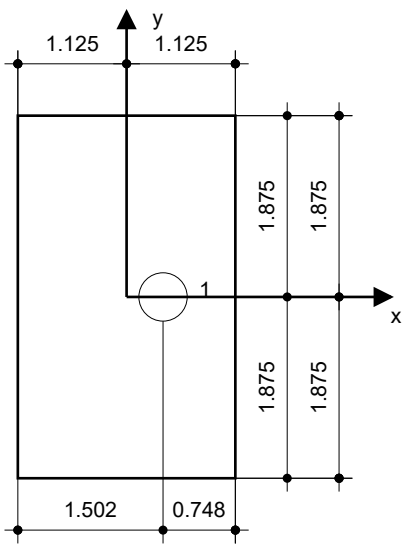
Minimum thickness of the base material: 4.000 in.

Cleaning: Manual cleaning of the drilled hole according to instructions for use is required.

Hilti ∅ 3/8 in KWIK HUS-EZ (KH-EZ) (Carbon Steel) with 2.5 in nominal embedment depth per ICC-ES ESR-3027 , Hammer drill bit installation per MPII

7.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• Manual blow-out pump	• Torque controlled cordless impact tool • Torque wrench



Coordinates Anchor [in.]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	0.377	0.000	-	3.750	-	-

Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

8 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

B,C,E4 Rack - DeWalt Anchor Design Report

9/1/2026

1.Project Information

Company:	JPH & CLARK
Project Engineer:	AA/KRC
Address:	DESOTO, TEXAS
Phone:	972-283-5111
Email:	kristine@jphpe.com
Project Name:	26-460 Advanced Auto Parts
Project Address:	Louisville, KY
Notes:	

2.Selected Anchor Information

Selected Anchor :	Screw-Bolt+
Brand:	DEWALT
Material:	3/8" Ø Low Carbon Steel
Embedment:	h_{ef} 1.75 in h_{nom} 2.5 in
Approval:	ICC-ES ESR-3889
Issued/Revision:	Nov,2025 Feb,2026
Drill method:	Hammer Drilled



3.Design Principles

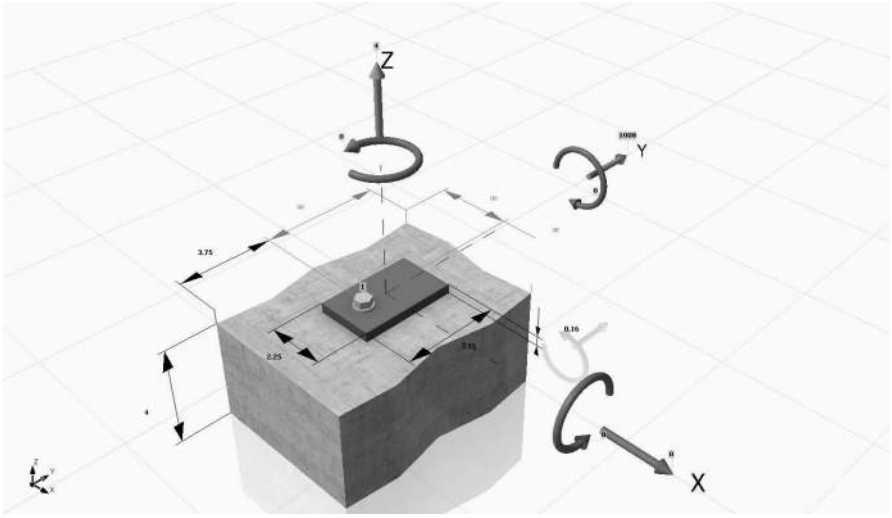
Design Method:	ACI 318-19
Load Combinations:	Section 5.3 User Defined Loads
Seismic Loading:	Tension 17.10.5.3(d) Shear 17.10.6.3(c) Ω_o= 2.5

4.Base Material Information

Concrete:								
Type:	Cracked	Normal Weight Concrete						
Strength	2500 psi							
Reinforcement:								
Edge Reinforcement	None or < #4 Rebar							
Spacing	Tension	No (Condition B)	Shear	No (Condition B)				
Controls Breakout	Tension	True	Shear	True				
Base Plate:								
Sizing	Thickness	0.16 in	Length	3.75 in	Width	2.25 in		
Standoff	None		Height	0 in				
Strength	36000 psi							
Profile:	None							

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

5.Geometric Conditions



h_{slab}	4	in	h_{min}	4.000	in
Edge Cx-	∞	in	c_{min}	1.500	in
Edge Cx+	∞	in	c_{ac}	6.300	in
Edge Cy-	3.75	in	s_{min}	2.000	in
Edge Cy+	∞	in			

6.Summary Results

Tension Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength:	9.46	5674.00	0.002	OK	
Concrete Breakout Strength:	9.00	959.00	0.010	OK	
Pullout Strength:	9.00	802.00	0.011	OK	Controls

Shear Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength	1008.00	1449.00	0.696	OK	
Concrete Breakout Strength:	1008.00	1250.00	0.806	OK	Controls
Pryout Strength	1008.00	1377.00	0.732	OK	

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

7.Warnings and Remarks

ANCHOR DESIGN CRITERIA IS SATISFIED

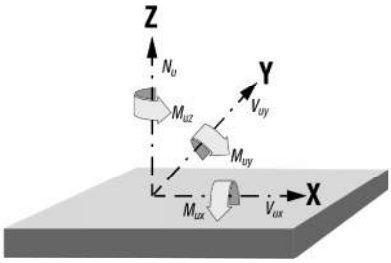
- The results of the calculations carried out by means of the DDA Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an design professional/engineer, particularly with regard to compliance with applicable standards, norms and permits, prior to using them for your specific project. The DDA Software serves only as an aid to interpret standards, norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- Calculations including seismic design requirements in accordance with ACI 318 are required for anchors in structures assigned to seismic design categories C, D, E and F.
- Under these seismic conditions, the direction of shear may not be predictable. In accordance with ACI 318 the full shear force should be assumed also in reverse direction for a safe design. Load reversal may influence the direction of the controlling concrete breakout strength.

8.Load Condition

Design Loads / Actions

Nu	4.0	lb	Vux	0.0	lb	Vuy	-1008.0	lb
Muz	0.0	in-lb	Mux	0.0	in-lb	Muy	0.0	in-lb

Consider Load Reversal X Direction 100% Y Direction 100%



9.Load Distribution

Max. concrete compressive strain:	0.003	%	Anchor Eccentricity					
Max. concrete compressive stress:	12.019	psi	ex	0	in	ey	-1	in
Resulting tension force:	9.458	lb	Profile Eccentricity					
Resulting compression force:	5.388	lb	ex	0	in	ey	0	in

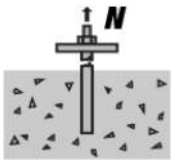
Resulting anchor forces / Load distribution

Anchor	Tension Load (lb)	Shear Load (lb)	Component Shear Load (lb)		Anchor Coordinates (in)	
			Shear X	Shear Y	X	Y
1	9.46	1008.0	0.0	-1008.0	0.000	-1.000

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

10.Design Proof Tension Loading

Steel Strength



ACI 318-19 17.6.1

Variables

N_{sa} (lb)	φ
8730.000	0.65

Results

φN_{sa}	=	5674.0	lb	Table 17.5.2
N_{ua}	=	9.5	lb	
Utilization	=	0.2%		

Concrete Breakout Strength



ACI 318-19 17.6.2

Equations

$N_{cb} = (A_{Nc} / A_{Nc0}) . \Psi_{ed,N} . \Psi_{c,N} . \Psi_{cp,N} . N_b$ Eqn. 17.6.2.1a

$N_b = k_c . \lambda_a . (f'_c)^{0.5} . h_{ef}^{1.5}$ Eqn. 17.6.2.2.1

Variables

A_{Nc} (in²)	A_{Nc0} (in²)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$
27.562	27.562	1.000	1.000	1.000	1.000

c_{ac} (in)	k_c	λ_a	f'_c (psi)	h_{ef} (in)	C_{amin} (in)
6.300	17.000	1.000	2500	1.75	3.75

N_b (lb)	φ	φs_{eis}
1967.780	0.65	0.750

Results

φN_{cb}	=	959	lb	Table 17.5.2
N_{ua}	=	9.0	lb	
Utilization	=	1.0%		

Pullout Strength:



ACI 318-19 17.6.3

Equations

$N_{pn} = \Psi_{c,P} \cdot N_p \cdot (f'_c / 2500)^n$ Eqn. 17.6.3.1

Variables

$\Psi_{c,P}$	$N_{p,eq}$ (lb)	f'_c (psi)	n	φ
1.000	1645.000	2500	0.500	0.65

φs_{eis}
0.750

Results

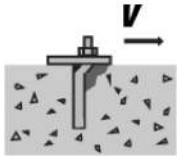
φN_{pn}	=	802	lb	
N_{ua}	=	9	lb	Table 17.5.2
Utilization	=	1.1%		

11.Design Proof Shear Loading

Reference

Steel Strength

ACI 318-19 17.7.1



Variables

V_{sa} (lb)	φ	$\alpha_{V,Seismic}$
2415.00	0.60	1

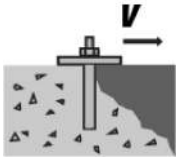
Results

$\varphi V_{sa,eq}$	=	1449	lb
V_{ua}	=	1008	lb
Utilization	=	69.6%	

Table 17.5.2

Concrete Breakout Strength

ACI 318-19 17.7.2



Equations

$$V_{cb} = (A_{Vc} / A_{Vc0}) \cdot \Psi_{ed,V} \cdot \Psi_{c,V} \cdot \Psi_{h,V} \cdot V_b$$

Eqn. 17.7.2.1a

$$V_b = (7 \cdot (l_e / d_a)^{0.2} \cdot (d_a)^{0.5}) \cdot \lambda_a \cdot (f'_c)^{0.5} \cdot (c_{a1})^{1.5}$$

Eqn. 17.7.2.2.1a

Variables

A_{Vc} (in²)	A_{Vc0} (in²)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$
45.000	63.281	1.000	1.000	1.000	1.186

$\Psi_{\alpha,V}$	l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)
1.000	1.750	0.375	1.000	2500.000	3.750

V_b (lb)	φ	φs_{eis}	V_{cb} (lb)
2118.029	0.70	0.750	1786.079

Results

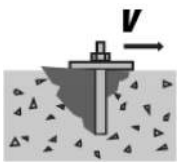
φV_{cb}	=	1250	lb
Direction	=	Y-	
V_{ua}	=	1008	lb
Utilization	=	80.6%	

Table 17.5.2

Shear Breakout Case 2 Controls

Pryout Strength

ACI 318-19 17.7.3



Equations

$V_{cp} = k_{cp} \cdot N_{cp}$ Eqn. 17.7.3.1a

$N_{cb} = (A_{Nc} / A_{Nc0}) \cdot \Psi_{ed,N} \cdot \Psi_{c,N} \cdot \Psi_{cp,N} \cdot N_b$ Eqn. 17.6.2.1a

$N_b = k_c \cdot \lambda_a \cdot (f'_c)^{0.5} \cdot h_{ef}^{1.5}$ Eqn. 17.6.2.2.1

Variables

A_{Nc} (in²)	A_{Nc0} (in²)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$
27.563	27.563	1.000	1.000	1.000	1.000

c_{ac} (in)	k_c	λ_a	h_{ef} (in)	f'_c (psi)	C_{amin} (in)
6.300	17.000	1.000	1.75	2500.000	3.750

N_b (lb)	k_{cp}	N_{cp} (lb)	φ
1967.778	1.000	1967.778	0.70

Results

φV_{cp}	=	1377.00	lb
V_{ua}	=	1008	lb
Utilization	=	73.2%	

Table 17.5.2

12.Interaction of Tension and Shear Loads

Reference

ACI 318-19 17.8

Equations

$$(N_{ua} / \varphi \cdot N_n)^{5/3} + (V_{ua} / \varphi \cdot V_n)^{5/3} <= 1.0$$ Eqn. 17.8.3

Variables

$N_{ua} / \varphi \cdot N_n$	$V_{ua} / \varphi \cdot V_n$
0.011	0.806

Results

0.699	≤	1.0
Status	:	OK

ANCHOR DESIGN CRITERIA IS SATISFIED



ANCHOR BOLT DESIGN OF FRAMES (E,E1)

Assume

FRAME	MAX. SHEAR (LBS)*	MAX. UPLIFT (LBS)*	SLAB THK. (IN)
E	62	407	4
E1	108	303	4

EVERY OTHER FRAME

	MAX. SHEAR (LBS)	MAX. UPLIFT (LBS)
MAX. LOADS	108	407
LRFD - FACTORED LOADS	216	816

ANCHOR BRAND : DEWALT POWERS
No. OF ANCHORS : 2
DIAMETER OF ANCHOR : 3/8 in
MIN. EMBEDMENT : 2 1/2 in
PRODUCT : HILTI KWIK HUS-EZ (KH-EZ) SCREW ANCHOR, CARBON STEEL, INSTALLATION PER ESR-3027.

ACCEPTABLE ALTERNATIVES LISTED BELOW (3/8" DIAMETER, 2.5" MIN. EMBEDMENT)

SIMPSON-TIE CARBON STEEL TITEN HD SCREW, INSTALLATION PER ESR-2713.

DEWALT POWER SCREW-BOLT+ ANCHOR, INSTALLATION PER ESR-3889.

JPH & CLARK, INC.
CONSULTING STRUCTURAL ENGINEERING
1801 N. HAMPTON RD., SUITE 440
DESOTO, TX 75115-2399
(972) 283-5111

Company:		Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	E, E1 Storage Rack - Anchor Design	Date:	9/2/2026
Fastening point:			

Specifier's comments:

1 Input data



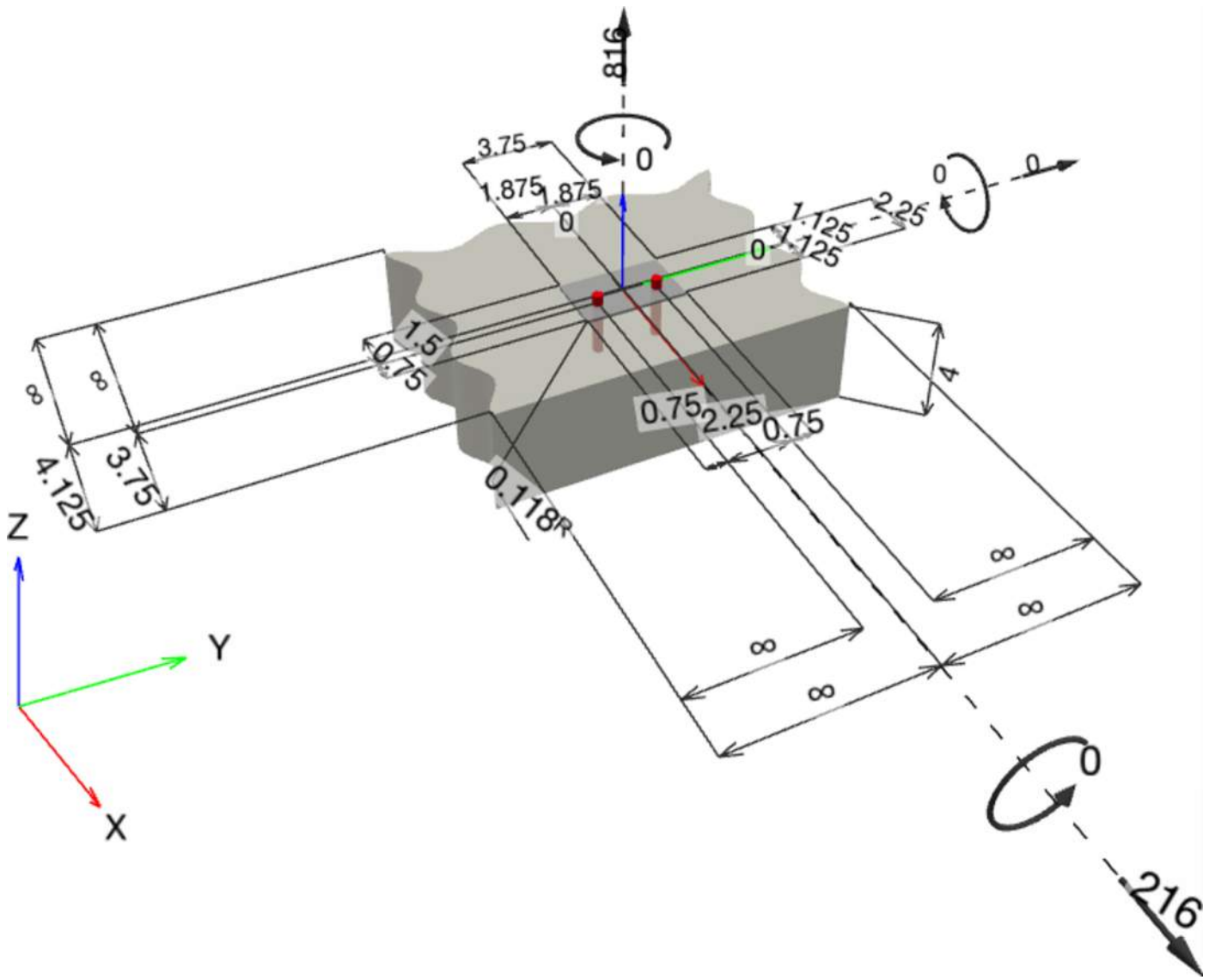
Anchor type and diameter:	**KWIK HUS-EZ (KH-EZ) (Carbon Steel) 3/8 (2 1/2)**
Item number:	418057 KH-EZ 3/8"x3"
Specification text:	HILTI ∅ 3/8 IN KWIK HUS-EZ (KH-EZ) (CARBON STEEL) WITH 2.5 IN NOMINAL EMBEDMENT DEPTH PER ICC-ES ESR-3027 , HAMMER DRILL BIT INSTALLATION PER MPII
Effective embedment depth:	$h_{ef,act}$ = 1.860 in., h_{nom} = 2.500 in.
Material:	Carbon Steel
Evaluation Service Report:	ESR-3027
Issued I Valid:	3/1/2026 | 12/1/2027
Proof:	Design Method ACI 318-19 / Mech
Shear edge breakout verification:	Row closest to edge (Case 3 only from ACI 318-19 Fig. R.17.7.2.1b)
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.118 in.
Anchor plate[R] :	l_x x l_y x t = 2.250 in. x 3.750 in. x 0.118 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, 2500, f_c' = 2,500 psi; h = 4.000 in.
Installation:	**Hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: not present, shear: not present; no supplemental splitting reinforcement present edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	Tension load: yes (17.10.5.3 (d)) Shear load: yes (17.10.6.3 (c))

[R] - The anchor calculation is based on a rigid anchor plate assumption.

Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

Company:		Page:	2
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	E, E1 Storage Rack - Anchor Design	Date:	9/2/2026
Fastening point:			

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



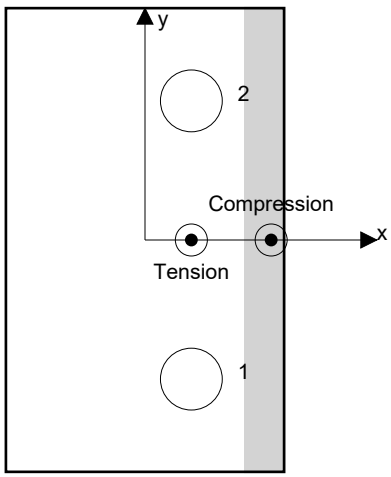
Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

Company:		Page:	3
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	E, E1 Storage Rack - Anchor Design	Date:	9/2/2026
Fastening point:			

1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = 816; V_x = 216; V_y = 0; M_x = 0; M_y = 0; M_z = 0;	yes	88

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	645	108	108	0
2	645	108	108	0

Max. concrete compressive strain: 0.19 [‰]
Max. concrete compressive stress: 807 [psi]
Resulting tension force in (x/y)=(0.375/0.000): 1,290 [lb]
Resulting compression force in (x/y)=(1.021/0.000): 474 [lb]

Anchor forces are calculated based on the assumption of a rigid anchor plate.

3 Tension load

	Load N_{ua} [lb]	Capacity ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi$ N_n	Status
Steel Strength*	645	6,718	10	OK
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	1,290	1,475	88	OK

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

Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

Company:		Page:	4
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	E, E1 Storage Rack - Anchor Design	Date:	9/2/2026
Fastening point:			

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]
0.09	120,300

Calculations

N_{sa} [lb]
10,335

Results

N_{sa} [lb]	ϕ_{steel}	$\phi_{nonductile}$	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
10,335	0.650	1.000	6,718	645

3.2 Concrete Breakout Failure

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

$\phi\ N_{cbg} \geq N_{ua}$ — 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)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e'_N}{3\ h_{ef}}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.3.1)

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

$\psi_{cp,N} = MAX\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}}\right) \leq 1.0$ — 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

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
1.860	0.000	0.000	3.750	1.000

c_{ac} [in.]	k_c	λ_a	f'_c [psi]
2.920	17	1.000	2,500

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
43.69	31.14	1.000	1.000	1.000	1.000	2,156

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
3,026	0.650	0.750	1.000	1,475	1,290

Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

Company:		Page:	5
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	E, E1 Storage Rack - Anchor Design	Date:	9/2/2026
Fastening point:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi$ V_n	Status
Steel Strength*	108	1,866	6	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	216	2,118	11	OK
Concrete edge failure in direction x+**	216	1,519	15	OK

* highest loaded anchor **anchor group (relevant anchors)
When the input edge distance is set to "infinity", edge breakout verification is not performed in that direction

4.1 Steel Strength

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

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]	$\alpha_{V,seis}$
0.09	120,300	0.600

Calculations

$V_{sa,eq}$ [lb]
3,110

Results

$V_{sa,eq}$ [lb]	ϕ_{steel}	$\phi_{nonductile}$	ϕ $V_{sa,eq}$ [lb]	V_{ua} [lb]
3,110	0.600	1.000	1,866	108

Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

4.2 Pryout Strength

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

$\phi V_{cpg} \geq V_{ua}$ 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)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2 e'_N}{3 h_{ef}}} \right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.3.1)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0$ 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.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
1	1.860	0.000	0.000	3.750

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f'_c [psi]
1.000	2.920	17	1.000	2,500

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
43.69	31.14	1.000	1.000	1.000	1.000	2,156

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	ϕV_{cpg} [lb]	V_{ua} [lb]
3,026	0.700	1.000	1.000	2,118	216

Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

4.3 Concrete edge failure in direction x+

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

$\phi V_{cbg} \geq V_{ua}$ 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)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{e'_v}{1.5c_{a1}}}\right) \leq 1.0$ ACI 318-19 Eq. (17.7.2.3.1)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ 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.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
3.750	-	0.000	1.000	4.000

l_e [in.]	λ_a	d_a [in.]	f'_c [psi]	$\psi_{parallel,V}$
1.860	1.000	0.375	2,500	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
54.00	63.28	1.000	1.000	1.186	2,144

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	ϕV_{cbg} [lb]	V_{ua} [lb]
2,170	0.700	1.000	1.000	1,519	216

*Anchor row defined by: Anchor 1, 2; Case 3 controls

When the input edge distance is set to "infinity", edge breakout verification is not performed in that direction

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

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.875	0.142	5/3	84	OK

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

Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

Company:		Page:	8
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	E, E1 Storage Rack - Anchor Design	Date:	9/2/2026
Fastening point:			

6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (EN1992-4, AS5216, 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 FEM 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!
- The equations presented in this report are based on imperial units. When inputs are displayed in metric units, the user should be aware that the equations remain in their imperial format.
- 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://viewer.joomag.com/profis-design-guide-us-en-summer-2021/0841849001625154758?short&/
- "An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-19, Chapter 17, Section 17.10.5.3 (a) that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, the connection design (tension) shall satisfy the provisions of Section 17.10.5.3 (b), Section 17.10.5.3 (c), or Section 17.10.5.3 (d). The connection design (shear) shall satisfy the provisions of Section 17.10.6.3 (a), Section 17.10.6.3 (b), or Section 17.10.6.3 (c)."
- Section 17.10.5.3 (b) / Section 17.10.6.3 (a) require the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Section 17.10.5.3 (c) / Section 17.10.6.3 (b) waive the ductility requirements and require the anchors to be designed for the maximum tension / shear that can be transmitted to the anchors by a non-yielding attachment. Section 17.10.5.3 (d) / Section 17.10.6.3 (c) waive the ductility requirements and require the design strength of the anchors to equal or exceed the maximum tension / shear obtained from design load combinations that include E, with E increased by ω_0.
- 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!

PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

7 Installation data

Anchor type and diameter: KWIK HUS-EZ (KH-EZ) (Carbon Steel) 3/8 (2 1/2)

Profile: no profile

Item number: 418057 KH-EZ 3/8"x3"

Hole diameter in the fixture: d_f = 0.500 in.

Maximum installation torque: 480 in.lb

Plate thickness (input): 0.118 in.

Hole diameter in the base material: 0.375 in.

Recommended plate thickness: not calculated

Hole depth in the base material: 2.750 in.

Drilling method: Hammer drilled

Minimum thickness of the base material: 4.000 in.

Cleaning: Manual cleaning of the drilled hole according to instructions for use is required.

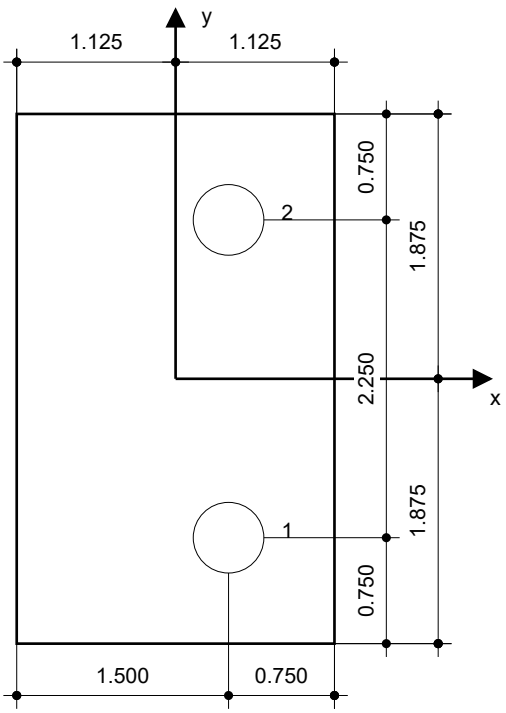
Hilti ∅ 3/8 in KWIK HUS-EZ (KH-EZ) (Carbon Steel) with 2.5 in nominal embedment depth per ICC-ES ESR-3027 , Hammer drill bit installation per MPII

7.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• Manual blow-out pump	• Torque controlled cordless impact tool • Torque wrench

Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

Company:		Page:	10
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	E, E1 Storage Rack - Anchor Design	Date:	9/2/2026
Fastening point:			



Coordinates Anchor [in.]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	0.375	-1.125	-	3.750	-	-
2	0.375	1.125	-	3.750	-	-

Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

8 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

Input data and results must be checked for conformity with the existing conditions and for plausibility!
PROFIS Engineering (c) 2003-2026 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

DEWALT

E,E1 Storage Rack -DeWalt Anchor Design Report

9/1/2026

1.Project Information

Company:	JPH & CLARK
Project Engineer:	AA/KRC
Address:	DESOTO, TEXAS
Phone:	972-283-5111
Email:	krishna@jphpe.com
Project Name:	26-460 Advanced Auto Part
Project Address:	Loisville, KY
Notes:	

2.Selected Anchor Information

Selected Anchor :	Screw-Bolt+
Brand:	DEWALT
Material:	3/8" Ø Low Carbon Steel
Embedment:	h_{ef} 1.75 in h_{nom} 2.5 in
Approval:	ICC-ES ESR-3889
Issued/Revision:	Nov,2025 Feb,2026
Drill method:	Hammer Drilled



3.Design Principles

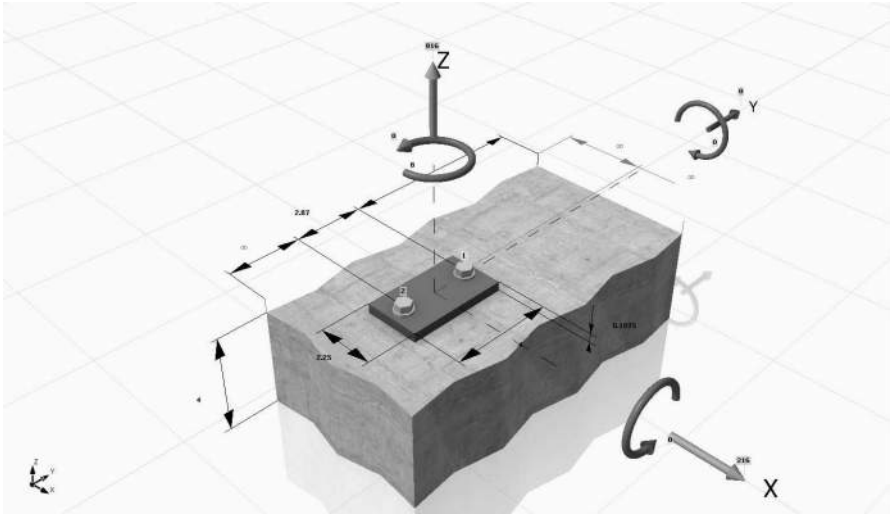
Design Method:	ACI 318-19				
Load Combinations:	Section 5.3		User Defined Loads		
Seismic Loading:	Tension	17.10.5.3(d)	Shear	17.10.6.3(c)	Ω_o= 2.5

4.Base Material Information

Concrete:								
Type:	Cracked		Normal Weight Concrete					
Strength	2500	psi						
Reinforcement:								
Edge Reinforcement	None or < #4 Rebar							
Spacing	Tension	No (Condition B)	Shear	No (Condition B)				
Controls Breakout	Tension	True	Shear	True				
Base Plate:								
Sizing	Thickness	0.1875 in	Length	4 in	Width	2.25 in		
Standoff	None		Height	0 in				
Strength	36000	psi						
Profile:	None							

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

5.Geometric Conditions



h_{slab}	4	in	h_{min}	4.000	in
Edge Cx-	∞	in	c_{min}	1.500	in
Edge Cx+	∞	in	c_{ac}	6.300	in
Edge Cy-	∞	in	s_{min}	2.000	in
Edge Cy+	8	in			

6.Summary Results

Tension Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength:	408.00	5674.00	0.072	OK	
Concrete Breakout Strength:	816.00	1484.00	0.550	OK	Controls
Pullout Strength:	408.00	802.00	0.509	OK	

Shear Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength	108.00	1449.00	0.075	OK	
Concrete Breakout Strength:	216.00	5334.00	0.041	OK	
Pryout Strength	216.00	2130.00	0.101	OK	Controls

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

7.Warnings and Remarks

ANCHOR DESIGN CRITERIA IS SATISFIED

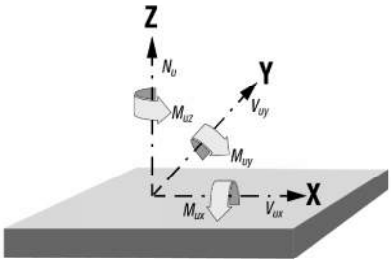
- The results of the calculations carried out by means of the DDA Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an design professional/engineer, particularly with regard to compliance with applicable standards, norms and permits, prior to using them for your specific project. The DDA Software serves only as an aid to interpret standards, norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- Calculations including seismic design requirements in accordance with ACI 318 are required for anchors in structures assigned to seismic design categories C, D, E and F.
- Under these seismic conditions, the direction of shear may not be predictable. In accordance with ACI 318 the full shear force should be assumed also in reverse direction for a safe design. Load reversal may influence the direction of the controlling concrete breakout strength.

8.Load Condition

Design Loads / Actions

Nu	816.0	lb	Vux	216.0	lb	Vuy	0.0	lb
Muz	0.0	in-lb	Mux	0.0	in-lb	Muy	0.0	in-lb

Consider Load Reversal X Direction 100% Y Direction 100%



9.Load Distribution

Max. concrete compressive strain:	0.000	%	Anchor Eccentricity				
Max. concrete compressive stress:	0.000	psi	ex	0	in	ey 0	in
Resulting tension force:	816.000	lb	Profile Eccentricity				
Resulting compression force:	0.000	lb	ex	0	in	ey 0	in

Resulting anchor forces / Load distribution

Anchor	Tension Load (lb)	Shear Load (lb)	Component Shear Load (lb)		Anchor Coordinates (in)	
			Shear X	Shear Y	X	Y
1	408.00	108.0	108.0	0.0	0.000	1.435
2	408.00	108.0	108.0	0.0	0.000	-1.435

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

10.Design Proof Tension Loading

Steel Strength



ACI 318-19 17.6.1

Variables

N_{sa} (lb)	φ
8730.000	0.65

Results

φN_{sa}	=	5674.0	lb	Table 17.5.2
N_{ua}	=	408.0	lb	
Utilization	=	7.2%		

Concrete Breakout Strength



ACI 318-19 17.6.2

Equations

$N_{cbg} = (A_{Nc} / A_{Nc0}) \cdot \Psi_{ec,N} \cdot \Psi_{ed,N} \cdot \Psi_{c,N} \cdot \Psi_{cp,N} \cdot N_b$ Eqn. 17.6.2.1b

$N_b = k_c \cdot \lambda_a \cdot (f'_c)^{0.5} \cdot h_{ef}^{1.5}$ Eqn. 17.6.2.2.1

Variables

A_{Nc} (in²)	A_{Nc0} (in²)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$
42.630	27.562	1.000	1.000	1.000	1.000

c_{ac} (in)	k_c	λ_a	f'_c (psi)	h_{ef} (in)	C_{amin} (in)
6.300	17.000	1.000	2500	1.75	8

N_b (lb)	φ	φs_{eis}
1967.780	0.65	0.750

Results

φN_{cbg}	=	1484	lb	Table 17.5.2
N_{ua}	=	816.0	lb	
Utilization	=	55.0%		

Pullout Strength:



ACI 318-19 17.6.3

Equations

$N_{pn} = \Psi_{c,P} \cdot N_p \cdot (f'_c / 2500)^n$ Eqn. 17.6.3.1

Variables

$\Psi_{c,P}$	$N_{p,eq}$ (lb)	f'_c (psi)	n	φ
1.000	1645.000	2500	0.500	0.65

φs_{eis}
0.750

Results

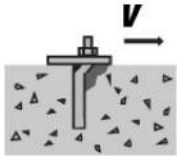
φN_{pn}	=	802	lb	
N_{ua}	=	408	lb	Table 17.5.2
Utilization	=	50.9%		

11.Design Proof Shear Loading

Reference

Steel Strength

ACI 318-19 17.7.1



Variables

V_{sa} (lb)	φ	$\alpha_{V,Seismic}$
2415.00	0.60	1

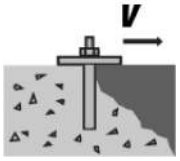
Results

$\varphi V_{sa,eq}$	=	1449	lb
V_{ua}	=	108	lb
Utilization	=	7.5%	

Table 17.5.2

Concrete Breakout Strength

ACI 318-19 17.7.2



Equations

$$V_{cbg} = (A_{Vc} / A_{Vc0}) \cdot \Psi_{ec,V} \cdot \Psi_{ed,V} \cdot \Psi_{c,V} \cdot \Psi_{h,v} \cdot V_b$$

Eqn. 17.7.2.1b

$$V_b = (7 \cdot (l_e / d_a)^{0.2} \cdot (d_a)^{0.5}) \cdot \lambda_a \cdot (f'_c)^{0.5} \cdot (c_{a1})^{1.5}$$

Eqn. 17.7.2.2.1a

Variables

A_{Vc} (in²)	A_{Vc0} (in²)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$
96.000	288.000	1.000	1.000	1.000	1.732

$\Psi_{\alpha,V}$	l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)
2.000	1.750	0.375	1.000	2500.000	8.000

V_b (lb)	φ	φs_{eis}	V_{cbg} (lb)
6599.636	0.70	0.750	7620.604

Results

φV_{cbg}	=	5334	lb
Direction	=	Y+	
V_{ua}	=	216	lb
Utilization	=	4.1%	

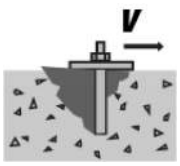
Table 17.5.2

Shear Breakout Case 3 Controls

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

Pryout Strength

ACI 318-19 17.7.3



Equations

$V_{cpg} = k_{cp} \cdot N_{cpg}$ Eqn. 17.7.3.1b

$N_{cbg} = (A_{Nc} / A_{Nc0}) \cdot \Psi_{ec,N} \cdot \Psi_{ed,N} \cdot \Psi_{c,N} \cdot \Psi_{cp,N} \cdot N_b$ Eqn. 17.6.2.1b

$N_b = k_c \cdot \lambda_a \cdot (f'_c)^{0.5} \cdot h_{ef}^{1.5}$ Eqn. 17.6.2.2.1

Variables

A_{Nc} (in²)	A_{Nc0} (in²)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$
42.630	27.563	1.000	1.000	1.000	1.000

c_{ac} (in)	k_c	λ_a	h_{ef} (in)	f'_c (psi)	C_{amin} (in)
6.300	17.000	1.000	1.75	2500.000	8.000

N_b (lb)	k_{cp}	N_{cpg} (lb)	φ
1967.778	1.000	3043.496	0.70

Results

φV_{cpg}	=	2130.00	lb	Table 17.5.2
V_{ua}	=	216	lb	
Utilization	=	10.1%		

12.Interaction of Tension and Shear Loads

Reference

ACI 318-19 17.8

Equations

$$(N_{ua} / \varphi \cdot N_n)^{5/3} + (V_{ua} / \varphi \cdot V_n)^{5/3} <= 1.0$$ Eqn. 17.8.3

Variables

$N_{ua} / \varphi \cdot N_n$	$V_{ua} / \varphi \cdot V_n$
0.550	0.101

Results

0.391	≤	1.0
Status	:	OK

ANCHOR DESIGN CRITERIA IS SATISFIED



ICC-ES Evaluation Report

ESR-3027

Reissued December 2025

Subject to renewal December 2027

This report also contains:

- City of LA Supplement
- FL Supplement w/ HVHZ

ICC-ES Evaluation Reports are not to be construed as representing aesthetics or any other attributes not specifically addressed, nor are they to be construed as an endorsement of the subject of the report or a recommendation for its use. There is no warranty by ICC Evaluation Service, LLC, express or implied, as to any finding or other matter in this report, or as to any product covered by the report.

Copyright © 2025 ICC Evaluation Service, LLC. All rights reserved.

DIVISION: 03 00 00—CONCRETE **Section: 03 16 00—Concrete Anchors** **DIVISION: 05 00 00—METALS** **Section: 05 05 19—Post-Installed Concrete Anchors**	**REPORT HOLDER:** **HILTI, INC.**	**EVALUATION SUBJECT:** **HILTI KH-EZ, KH-EZ P, KH-EZ PM, KH-EZ PL, KH-EZ C, KH-EZ E, KH-EZ I, AND KH-EZ CRC CARBON STEEL SCREW ANCHORS AND KH-EZ SS316 AND KH-EZ C SS316 STAINLESS STEEL SCREW ANCHORS FOR USE IN CRACKED AND UNCRACKED CONCRETE**	

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2024, 2021, 2018, and 2015 *International Building Code*® (IBC)
- 2024, 2021, 2018, and 2015 *International Residential Code*® (IRC)

Main references of this report are for the 2024 IBC and IRC. See Table 10 and Table 11 for applicable sections of the code for previous IBC and IRC editions.

Property evaluated:

Structural

2.0 USES

The Hilti KH-EZ, KH-EZ SS316, KH-EZ P, KH-EZ PM, KH-EZ PL, KH-EZ C, KH-EZ C SS316, KH-EZ E, KH-EZ I and KH-EZ CRC screw anchors are used as anchorage in cracked and uncracked normal-weight and lightweight concrete having a specified strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa); and cracked and uncracked normal-weight or sand-lightweight concrete over steel deck having a minimum specified compressive strength, f'_c, of 3,000 psi (20.7 MPa) to resist static, wind and seismic (Seismic Design Categories A through F) tension and shear loads.

The Hilti KH-EZ, KH-EZ SS316, KH-EZ P, KH-EZ PM, KH-EZ PL, KH-EZ C, KH-EZ C SS316, KH-EZ E, KH-EZ I and KH-EZ CRC screw anchors are an alternative to anchors described in Section 1901.3 of the 2024 IBC. The anchors may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

3.0 DESCRIPTION

3.1 KH-EZ:

The KH-EZ anchors are comprised of a body with hex washer head. The anchor is manufactured from carbon steel and is heat-treated. It has a minimum 0.0003-inch-thick (8 µm) zinc coating in accordance with DIN EN

ISO 4042. The anchoring system is available in a variety of lengths with nominal diameters of $^1/_4$-inch, $^3/_8$-inch,$^1/_2$-inch, $^5/_8$-inch and $^3/_4$-inch. The KH-EZ is illustrated in Figure 2.

The hex head is larger than the diameter of the anchor and is formed with serrations on the underside. The anchor body is formed with threads running most of the length of the anchor body. The anchor is installed in a predrilled hole with a powered impact wrench or torque wrench. The anchor threads cut into the concrete on the sides of the hole and interlock with the base material during installation.

3.2 KH-EZ I:

The KH-EZ I anchors are comprised of a body with a long internal thread ($^1/_4$-inch, $^3/_8$-inch, or $^1/_2$-inch internal thread) hex washer head. The anchor is manufactured from carbon steel and is heat-treated. It has a minimum 0.0003-inch-thick (8 µm) zinc coating in accordance with DIN EN ISO 4042. The KH-EZ I is illustrated in Figure 3.

The over-sized hex head is larger than the diameter of the anchor and is formed with serrations on the underside. The anchor body is formed with threads running most of the length of the anchor body. The anchor is installed in a predrilled hole with a powered impact wrench or torque wrench directly to the supporting member surface. The anchor threads cut into the concrete on the sides of the hole and interlock with the base material during installation.

Shear design values in this report for the KH-EZ I are for threaded inserts with F_u equal to or greater than 125 ksi. For use with inserts with F_u less than 125 ksi, the shear values are multiplied by the ratio of F_u of insert and 125 ksi.

3.3 KH-EZ P, KH-EZ PM and KH-EZ PL:

The KH-EZ P, KH-EZ PM and KH-EZ PL anchors are comprised of a body with round pan style head with an indented area in the top of the head with a six point star configuration. The KH-EZ P, KH-EZ PM and KH-EZ PL have different size pan style heads: small (P), medium (PM) and Large (PL). The anchor is manufactured from carbon steel and is heat-treated. It has a minimum 0.0003-inch-thick (8 µm) zinc coating in accordance with DIN EN ISO 4042. The KH-EZ P, KH-EZ PM and KH-EZ PL are available in $^1/_4$-inch diameter. The KH-EZ P, KH-EZ PM and KH-EZ PL are illustrated in Figure 4.

3.4 KH-EZ E:

The KH-EZ E anchors are comprised of a body with a long externally threaded ($^3/_8$-inch external thread) head. The anchor is manufactured from carbon steel and is heat-treated. It has a minimum 0.0003-inch-thick (8 µm) zinc coating in accordance with DIN EN ISO 4042. The KH-EZ E is available in $^1/_4$-inch diameter. The KH-EZ E is illustrated in Figure 5.

3.5 KH-EZ C:

The KH-EZ C anchors are comprised of the same thread profile as the hex head but with a countersunk head. The anchor is manufactured from carbon steel and is heat-treated. It has a minimum 0.0003-inch-thick (8 µm) zinc coating in accordance with DIN EN ISO 4042. The KH-EZ C is available in $^1/_4$-inch and $^3/_8$-inch diameter. The KH-EZ C is illustrated in Figure 7.

3.6 KH-EZ CRC:

The KH-EZ CRC anchors are comprised of a body with hex washer head. The anchor is manufactured from carbon steel and is heat-treated. It has a minimum of 0.0021-inch-thick (53 µm) mechanically deposited zinc coating in accordance with ASTM B695, Class 55. The anchoring system is available in a variety of lengths with nominal diameters of $^3/_8$-inch, $^1/_2$-inch, $^5/_8$-inch and $^3/_4$-inch. The KH-EZ CRC is illustrated in Figure 6.

3.7 KH-EZ SS316:

The KH-EZ SS316 anchors are comprised of a body with hex washer head. The anchor is manufactured from AISI Type 316 stainless steel material. The anchoring system is available in a variety of lengths with nominal diameters of ¼-inch, $^3/_8$-inch and $^1/_2$-inch. The KH-EZ SS316 is illustrated in Figure 8.

The hex head is larger than the diameter of the anchor and is formed with serrations on the underside. The anchor body is formed with threads running most of the length of the anchor body. The anchor is installed in a predrilled hole with a powered impact wrench. The anchor threads cut into the concrete on the sides of the hole and interlock with the base material during installation.

3.8 KH-EZ C SS316:

The KH-EZ C SS316 anchors are comprised of the same thread profile as the stainless steel hex head but with a countersunk head. The anchor is manufactured from AISI Type 316 stainless steel material. The KH-EZ C SS316 is available in $^1/_4$-inch and $^3/_8$-inch diameter. The KH-EZ C SS316 is illustrated in Figure 9.

3.9 Concrete:

Normal-weight and lightweight concrete must conform to Sections 1903 and 1905 of the 2024 IBC.

3.10 Steel Deck Panels:

Steel deck panels must comply with the configurations in Figure 12 and have a minimum base steel thickness of 0.035 inch (0.889 mm). Steel must comply with ASTM A653/A653M SS Grade 50 and have a minimum yield strength of 50,000 psi (345 MPa).

4.0 DESIGN AND INSTALLATION

4.1 Strength Design:

4.1.1 General: Design strength of anchors complying with the 2024 IBC as well as Section R301.1.3 of the 2024 IRC must be determined in accordance with ACI 318-19 Chapter 17 and this report.

Design parameters provided in Table 1 through Table 9 of this report are based on the 2024 IBC (ACI 318-19) unless noted otherwise in Sections 4.1.1 through 4.1.12.

The strength design of anchors must comply with ACI 318-19 Section 17.5.1.2 except as required in ACI 318-19 Section 17.10. Strength reduction factors, ϕ, as given in ACI 318-19 Section 17.5.3, and noted in Tables 3, 4 and 7 of this report, must be used for load combinations calculated in accordance with Section 1605.1 of the 2024 IBC and Section 5.3 of ACI 318-19.

The value of f'_c used in the calculations must be limited to a maximum of 8,000 psi (55.2 MPa), in accordance with ACI 318-19 Section 17.3.1

4.1.2 Requirements for Static Steel Strength in Tension, N_{sa}: The nominal static steel strength, N_{sa}, of a single anchor in tension calculated in accordance with ACI 318-19 Section 17.6.1.2, is given in Tables 3, 4 and 7 of this report. Strength reduction factors, ϕ, corresponding to brittle steel elements must be used.

4.1.3 Requirements for Static Concrete Breakout Strength in Tension, N_{cb} or N_{cbg}: The nominal concrete breakout strength of a single anchor or a group of anchors in tension, N_{cb} and N_{cbg}, respectively, must be calculated in accordance with ACI 318-19 Section 17.6.2 with modifications as described in this section. The basic concrete breakout strength of a single anchor in tension, N_b, must be calculated in accordance with ACI 318-19 Section 17.6.2.2 using the values of h_{ef} and k_{cr} as given in Tables 3, 4 and 7 of this report. The nominal concrete breakout strength in tension in regions where analysis indicates no cracking in accordance with ACI 318-19 Section 17.6.2.5 must be calculated with the value of k_{uncr} as given in Tables 3, 4 and 7 with $\psi_{c,N} = 1.0$.

For anchors installed in the lower or upper flute of the soffit of sand-lightweight or normal-weight concrete-filled steel deck floor and roof assemblies, as shown in Figure 12, calculation of the concrete breakout strength in accordance with ACI 318-19 Section 17.6.2 is not required.

4.1.4 Requirements for Static Pullout Strength in Tension, N_p: The nominal pullout strength of a single anchor in accordance with ACI 318-19 Sections 17.6.3.1 and 17.6.3.2.1 in cracked and uncracked concrete, $N_{p,cr}$, and $N_{p,uncr}$, respectively, is given in Tables 3, 4 and 7. In lieu of ACI 318-19 Section 17.6.3.3, $\psi_{c,P} = 1.0$ for all design cases. In accordance with ACI 318-19 Section 17.6.3, the nominal pullout strength in cracked concrete may be adjusted according to Eq.-1:

$$N_{p,f'_c} = N_{p,cr}\left(\frac{f'_c}{2{,}500}\right)^n \qquad \text{(lb, psi)} \quad \text{(Eq-1)}$$

$$N_{p,f'_c} = N_{p,cr}\left(\frac{f'_c}{17.2}\right)^n \qquad \text{(N, MPa)}$$

where f'_c is the specified concrete compressive strength and n is the factor defining the influence of concrete compressive strength on the pullout strength. For the $^1/_4$-inch-diameter anchor at $1^5/_8$ inches nominal embedment in cracked concrete, n is 0.3. For all other cases, n is 0.5.

In regions where analysis indicates no cracking in accordance with ACI 318-19 Section 17.6.3.3, the nominal pullout strength in tension may be adjusted according to Eq-2:

$$N_{p,f'_c} = N_{p,uncr}\left(\frac{f'_c}{2{,}500}\right)^n \quad \text{(lb, psi)} \quad \text{(Eq-2)}$$

$$N_{p,f'_c} = N_{p,uncr}\left(\frac{f'_c}{17.2}\right)^n \quad \text{(N, MPa)}$$

where f'_c is the specified concrete compressive strength and n is the factor defining the influence of concrete compressive strength on the pullout strength. For the $^1/_4$-inch-diameter anchor at a nominal embedment of $1^5/_8$ inches in uncracked concrete, n is 0.3. For all other cases, n is 0.5.

Where values for $N_{p,cr}$ or $N_{p,uncr}$ are not provided in Tables 3, 4 or Table 7 of this report, the pullout strength in tension need not be considered.

The nominal pullout strength in tension of the anchors installed in the soffit of sand-lightweight or normal-weight concrete filled steel deck floor and roof assemblies, as shown in Figure 12, is provided in Table 5 for KH-EZ, KH-EZ P, KH-EZ PM, KH-EZ PL, KH-EZ C and KH-EZ CRC and Table 8 for KH-EZ I and KH-EZ E. In accordance with ACI 318-19 Section 17.6.3.2.1, the nominal pullout strength in cracked concrete must be calculated according to Eq-1, whereby the value of $N_{p,deck,cr}$ must be substituted for $N_{p,cr}$ and the value of 3,000 psi (20.7 MPa) must be substituted for the value of 2,500 psi (17.2 MPa) in the denominator. In regions where analysis indicates no cracking in accordance with ACI 318-19 Section 17.6.3.3, the nominal strength in uncracked concrete must be calculated according to Eq-2, whereby the value of $N_{p,deck,uncr}$ must be substituted for $N_{p,uncr}$ and the value of 3,000 psi (20.7 MPa) must be substituted for the value of 2,500 psi (17.2 MPa) in the denominator.

4.1.5 Requirements for Static Steel Shear Capacity, V_{sa}: The nominal steel strength in shear, V_{sa}, of a single anchor in accordance with ACI 318-19 Section 17.7.1.2 is given in Tables 3, 4 and 7 of this report and must be used in lieu of the values derived by calculation from ACI 318-19 Eq. 17.7.1.2b. The strength reduction factor, ϕ, corresponding to brittle steel elements must be used. The nominal shear strength $V_{sa,deck}$, of anchors installed in the soffit of sand-lightweight or normal-weight concrete filled steel deck floor and roof assemblies, as shown in Figure 12, is given in Table 5 for KH-EZ, KH-EZ P, KH-EZ PM, KH-EZ PL, KH-EZ C and KH-EZ CRC and Table 8 for KH-EZ I and KH-EZ E. Shear values for KH-EZ I are for threaded inserts with $F_u \geq 125$ ksi. For use with inserts with F_u less than 125 ksi, the shear values are multiplied by the ratio of F_u of insert and 125 ksi.

4.1.6 Requirements for Static Concrete Breakout Strength in Shear, V_{cb} or V_{cbg}: The nominal concrete breakout strength of a single anchor or group of anchors in shear, V_{cb} or V_{cbg}, respectively, must be calculated in accordance with ACI 318-19 Section 17.7.2 with modifications as described in this section. The basic concrete breakout strength in shear, V_b, must be calculated in accordance with ACI 318-19 Section 17.7.2.2.1 using the values of ℓ_e and d_a given in Tables 3, 4 and 7.

For anchors installed in the lower or upper flute of the soffit of sand-lightweight or normal-weight concrete-filled steel deck floor and roof assemblies, as shown in Figure 12, calculation of the concrete breakout strength in accordance with ACI 318-19 Section 17.7.2 is not required.

4.1.7 Requirements for Static Concrete Pryout Strength in Shear, V_{cp} or V_{cpg}: The nominal concrete pryout strength of a single anchor or group of anchors, V_{cp} or V_{cpg}, respectively, must be calculated in accordance with ACI 318-19 Section 17.7.3 using the coefficient for pryout strength, k_{cp} provided in Tables 3, 4 and 7 and the value of N_{cb} or N_{cbg} as calculated in Section 4.1.3 of this report.

For anchors installed in the lower or upper flute of the soffit of sand-lightweight or normal-weight concrete-filled steel deck floor and roof assemblies, as shown in Figure 12, calculation of the concrete pryout strength in accordance with ACI 318-19 Section 17.7.3 is not required.

4.1.8 Requirements for Seismic Design:

4.1.8.1 General: For load combinations including seismic, the design must be in accordance with ACI 318-19 Section 17.10. Modifications to ACI 318-19 Section 17.10 shall be applied under Section 1905.7 of the 2024 IBC, as applicable.

The anchors comply with ACI 318-19 Section 2.3 as brittle steel elements and must be designed in accordance with ACI 318-19 Sections 17.10.5 or 17.10.6.

4.1.8.2 Seismic Tension: The nominal steel strength and nominal concrete breakout strength for anchors in tension must be calculated in accordance with ACI 318-19 Sections 17.6.1 and 17.6.2, as described in Sections 4.1.2 and 4.1.3 of this report. In accordance with ACI 318-19 Section17.6.3.2.1, the appropriate value for pullout strength in tension for seismic loads, $N_{p,eq}$ or $N_{p,deck,cr}$ described in Tables 3, 4 and 5 for KH-EZ,

KH-EZ SS316, KH-EZ C, KH-EZ C SS316, KH-EZ P, KH-EZ PM, KH-EZ PL and KH-EZ CRC; and in Tables 7 and 8 for KH-EZ I and KH-EZ E, must be used in lieu of N_p. $N_{p,eq}$ or $N_{p,deck,cr}$ may be adjusted by calculations for concrete compressive strength in accordance with Eq-1 of this report in addition for concrete-filled steel deck floor and roof assemblies the value of 3,000 psi (20.7 MPa) must be substituted for the value of 2,500 psi (17.2 MPa) in the denominator. Where values for $N_{p,eq}$ are not provided in Tables 3, 4 or 7 of this report, the pullout strength in tension for seismic loads need not be evaluated.

4.1.8.3 Seismic Shear: The nominal concrete breakout strength and pryout strength in shear must be calculated in accordance with ACI 318-19 Sections 17.7.2 and 17.7.3, as described in Sections 4.1.6 and 4.1.7 of this report. In accordance with ACI 318-19 Section 17.7.1.2, the appropriate value for nominal steel strength for seismic loads, $V_{sa,eq}$ or $V_{sa,deck,eq}$ described in Tables 3, 4 and 5 for KH-EZ, KH-EZ SS316, KH-EZ C, KH-EZ C SS316, KH-EZ P, KH-EZ PM, KH-EZ PL and KH-EZ CRC, and in Tables 7 and 8 for KH-EZ I and KH-EZ E, must be used in lieu of V_{sa}.

4.1.9 Requirements for Interaction of Tensile and Shear Forces: For anchors or groups of anchors that are subject to the effects of combined tensile and shear forces, the design must be determined in accordance with ACI 318-19 Section 17.8.

4.1.10 Requirements for Minimum Member Thickness, Minimum Anchor Spacing and Minimum Edge Distance: In lieu of ACI 318-19 Section 17.9.2, values of s_{min} and c_{min}, respectively, as given in Tables 1, 2 and 6 of this report must be used. In lieu of ACI 318-19 Section 17.9.4, minimum member thicknesses, h_{min} as given in Tables 1, 2 and 6 must be used. Additional combinations for minimum edge distance, c_{min}, and minimum spacing distance, s_{min}, may be derived by linear interpolation between the given boundary values as defined in Tables 1, 2 and 6 of this report.

For anchors installed through the lower flute of the soffit of steel deck assemblies, the anchors must be installed in accordance with Figure 12 and shall have an axial spacing along the flute equal to the greater of $3h_{ef}$ or 1.5 times the flute width. For installations in the upper flute of the soffit of steel deck assemblies the anchors shall have an axial spacing along the flute equal to or greater than $3h_{ef}$.

For ¼-inch, $^3/_8$-inch and $^1/_2$-inch KH-EZ, KH-EZ P, KH-EZ PM, KH-EZ PL and KH-EZ C anchors installed on the top of steel deck assemblies, values of $c_{ac,deck,top}$, $s_{min,deck,top}$, and $c_{min,deck,top}$, as given in Table 9 of this report must be used.

4.1.11 Requirements for Critical Edge Distance, c_{ac}: In applications where $c < c_{ac}$ and supplemental reinforcement to control splitting of the concrete is not present, the concrete breakout strength in tension for uncracked concrete, calculated in accordance with ACI 318-19 Section 17.6.2, must be further multiplied by the factor $\Psi_{cp,N}$ as given by Eq-3:

$$\Psi_{cp,N} = \frac{c}{c_{ac}} \qquad \text{(Eq-3)}$$

where the factor $\Psi_{cp,N}$ need not be taken as less than $\frac{1.5h_{ef}}{c_{ac}}$. For all other cases, $\Psi_{cp,N} = 1.0$. In lieu of using ACI 318-19 Section 17.9.5, values of c_{ac} must comply with Tables 3, 4 and 7.

4.1.12 Lightweight Concrete: For the use of anchors in lightweight concrete, the modification factor λ_a equal to 0.8λ is applied to all values of $\sqrt{f'_c}$ affecting N_n and V_n.

The value of λ must be determined in accordance with the corresponding version of ACI 318.

For anchors installed in the soffit of sand-lightweight concrete-filled steel deck and floor and roof assemblies, further reduction of the pullout values provided in this report is not required.

4.2 Allowable Stress Design (ASD):

4.2.1 General: Design values for use with allowable stress design load combinations calculated in accordance with Section 1605.1 of the 2024 IBC must be established using the following equations:

$$T_{allowable,ASD} = \frac{\phi N_n}{\alpha} \qquad \text{(Eq-4)}$$

$$V_{allowable,ASD} = \frac{\phi V_n}{\alpha} \qquad \text{(Eq-5)}$$

where:

$T_{allowable,ASD}$ = Allowable tension load (lb, N)

$V_{allowable\ ASD}$ = Allowable shear load (lb, N)

ϕN_n = Lowest design strength of an anchor or anchor group in tension as determined in accordance with ACI 318-19 Chapter 17 and 2024 IBC Section 1905.7, and Section 4.1 of this report, as applicable.

ϕV_n = Lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318-19 Chapter 17 and 2024 IBC Section 1905.7, and Section 4.1 of this report, as applicable.

α = Conversion factor calculated as a weighted average of the load factors for the controlling load combination. In addition, α must include all applicable factors to account for nonductile failure modes and required over-strength.

Limits on edge distance, anchor spacing and member thickness as given in Tables 1, 2 and 6 of this report must apply.

4.2.2 Interaction of Tensile and Shear Forces: The interaction must be calculated and consistent with ACI 318-19 Section 17.8 as follows:

For shear loads $V_{applied} \leq 0.2V_{allowable,ASD}$, the full allowable load in tension $T_{allowable,ASD}$ shall be permitted.

For tension loads $T_{applied} \leq 0.2T_{allowable,ASD}$, the full allowable load in shear $V_{allowable,ASD}$ shall be permitted.

For all other cases:

$$\frac{T_{applied}}{T_{allowable,ASD}} + \frac{V_{applied}}{V_{allowable,ASD}} \leq 1.2 \qquad \text{(Eq-6)}$$

4.3 Installation:

Installation parameters are provided in Tables 1, 2, 6 and 9 and Figures 1, 11A, 11B, 11C, 11D, 11E and 12. Anchor locations must comply with this report and plans and specifications approved by the code official. The Hilti KH-EZ, KH-EZ SS316, KH-EZ P, KH-EZ PM, KH-EZ PL, KH-EZ C, KH-EZ C SS316, KH-EZ E, KH-EZ I and KH-EZ CRC must be installed in accordance with the manufacturer's published instructions and this report. In case of conflict, this report governs. Anchors must be installed in holes drilled into concrete perpendicular to the surface using carbide-tipped masonry drill bits complying with ANSI B212.15-1994 or using the Hilti SafeSet System™. The Hilti SafeSet System™ is comprised of Hilti TE-YD or TE-CD Hollow Drill Bits with a Hilti vacuum with a minimum value for the maximum volumetric flow rate of 129 CFM (61 ℓ/s). The Hollow Drill Bits are not permitted for use with the $^1/_4$-inch- and $^3/_8$-inch-diameter anchors. The nominal drill bit diameter must be equal to that of the anchor. The minimum drilled hole depth, h_0, is given in Tables 1, 2, 6 and 8. When drilling dust is not removed after hole drilling, make sure to drill deep enough to achieve h_{nom}, taking into account the depth of debris remaining in the hole. If dust and debris is removed from the drilled hole with the Hilti TE-YD or TE-CD Hollow Drill Bits or compressed air, vacuum, or a manual pump, h_{nom} is achieved at the specified value of h_0. The anchor must be installed into the predrilled hole using a powered impact wrench or installed with a torque wrench until the proper nominal embedment depth is obtained. The maximum impact wrench torque, $T_{impact,max}$ and maximum installation torque, $T_{inst,max}$ for the manual torque wrench must be in accordance with Tables 1, 2 and 6. The KH-EZ, KH-EZ SS316, KH-EZ P, KH-EZ PM, KH-EZ PL, KH-EZ C, KH-EZ C SS316, KH-EZ E, KH-EZ I and KH-EZ CRC may be loosened by a maximum of one turn and retightened with a torque wrench or powered impact wrench to facilitate fixture attachment or realignment. Complete removal and reinstallation of the anchor is not allowed.

For installation in the soffit of concrete on steel deck assemblies, the hole diameter in the steel deck must not exceed the diameter of the hole in the concrete by more the $^1/_8$ inch (3.2 mm). For member thickness and edge distance restrictions for installations into the soffit of concrete on steel deck assemblies, see Figure 12.

For installation of $^1/_4$-inch, $^3/_8$-inch and $^1/_2$-inch KH-EZ KH-EZ P, KH-EZ PM, KH-EZ PL and KH-EZ C, anchors on the top of steel deck assemblies, see Table 9 for installation setting information.

4.4 Special Inspection:

Periodic special inspection is required, in accordance with Section 1705.1.1 and Table 1705.3 of the 2024 IBC. The special inspector must be on the site periodically during anchor installation to verify anchor type, anchor dimensions, hole dimensions, concrete type, concrete compressive strength, drill bit type and size, hole dimensions, hole cleaning procedures, anchor spacing(s), edge distance(s), concrete member thickness, anchor embedment, installation torque, impact wrench power and adherence to the manufacturer's printed installation instructions and the conditions of this report (in case of conflict, this report governs). The special inspector must be present as often as required in accordance with the "statement of special inspection." Under

the IBC, additional requirements as set forth in Sections 1705, 1706 and 1707 must be observed, where applicable.

5.0 CONDITIONS OF USE:

Hilti KH-EZ, KH-EZ SS316, KH-EZ P, KH-EZ PM, KH-EZ PL, KH-EZ C, KH-EZ C SS316, KH-EZ E, KH-EZ I and KH-EZ CRC concrete anchors described in this report are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The anchors must be installed in accordance with the manufacturer's published installation instructions and this report. In case of conflict, this report governs.

5.2 Anchor sizes, dimensions, and minimum embedment depths are as set forth in this report.

5.3 Anchors must be installed in accordance with Section 4.3 of this report in uncracked or cracked normal-weight concrete and lightweight concrete having a specified compressive strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa), and cracked and uncracked normal-weight or sand-lightweight concrete over metal deck having a minimum specified compressive strength, f'_c, of 3,000 psi (20.7 MPa).

5.4 The value of f'_c used for calculation purposes must not exceed 8,000 psi (55.2 MPa).

5.5 The concrete must have attained its minimum design strength prior to installation of the anchors.

5.6 Strength design values must be established in accordance with Section 4.1 of this report.

5.7 Allowable stress design values must be established in accordance with Section 4.2 of this report.

5.8 Anchor spacing(s) and edge distance(s), and minimum member thickness, must comply with Tables 1, 2 and 6 and Figure 12 of this report.

5.9 Reported values for the KH-EZ I with an internally threaded hex washer head do not consider the steel insert element which must be verified by the design professional. Shear design values in this report for the KH-EZ I are for threaded inserts with F_u equal to or greater than 125 ksi. For use with inserts with F_u less than 125 ksi, the shear values are multiplied by the ratio of F_u of insert and 125 ksi.

5.10 Prior to installation, calculations and details demonstrating compliance with this report must be submitted to the code official. The calculations and details must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

5.11 Since an ICC-ES acceptance criteria for evaluating data to determine the performance of anchors subjected to fatigue or shock loading is unavailable at this time, the use of these anchors under such conditions is beyond the scope of this report.

5.12 Anchors may be installed in regions of concrete where cracking has occurred or where analysis indicates cracking may occur ($f_t > f_r$), subject to the conditions of this report.

5.13 Anchors may be used to resist short-term loading due to wind or seismic forces, subject to the conditions of this report.

5.14 Anchors are not permitted to support fire-resistance-rated construction. Where not otherwise prohibited in the code, anchors are permitted for use with fire-resistance-rated construction provided that at least one of the following conditions is fulfilled:

- Anchors are used to resist wind or seismic forces only.
- Anchors that support gravity load–bearing structural elements are within a fire-resistance-rated envelope or a fire-resistance-rated membrane, are protected by approved fire-resistance-rated materials, or have been evaluated for resistance to fire exposure in accordance with recognized standards.
- Anchors are used to support nonstructural elements.

5.15 Anchors have been evaluated for reliability against brittle failure and found to be not significantly sensitive to stress-induced hydrogen embrittlement.

5.16 Use of KH-EZ, KH-EZ P, KH-EZ PM, KH-EZ PL, KH-EZ C, KH-EZ E, and KH-EZ I carbon steel anchors are limited to dry, interior locations.

5.17 Use of KH-EZ SS316, KH-EZ C SS316 and KH-EZ CRC are permitted for exterior exposure or damp environments.

5.18 Special inspection must be provided in accordance with Sections 4.4.

5.19 KH-EZ, KH-EZ SS316, KH-EZ P, KH-EZ PM, KH-EZ PL, KH-EZ C, KH-EZ C SS316, KH-EZ E, KH-EZ I and KH-EZ CRC anchors are manufactured, under a quality control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Mechanical Anchors in Concrete Elements (AC193(24)), dated April 2025.

7.0 IDENTIFICATION

7.1 HILTI KH-EZ, KH-EZ SS316, KH-EZ P, KH-EZ PL, KH-EZ C, KH-EZ C SS316, KH-EZ E, KH-EZ I and KH-EZ CRC anchors are identified by packaging with the company name (Hilti, Inc.), anchor name, anchor size, and evaluation report number (ESR-3027). The anchors with hex washer head, pan head and countersunk head, have KH-EZ, HILTI, and anchor size and anchor length embossed on the anchor head. Identifications are visible after installation, for verification.

7.2 The report holder's contact information is the following:

HILTI INC.
7250 DALLAS PARKWAY, SUITE 1000
PLANO, TEXAS 75024
(800) 879-8000
www.hilti.com

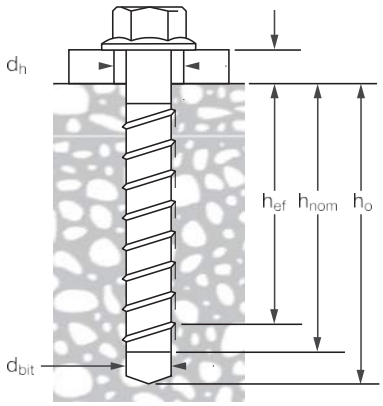


FIGURE 1—KWIK HUS EZ ANCHOR



FIGURE 2—HILTI KH-EZ CONCRETE SCREW ANCHOR



FIGURE 3—HILTI KH-EZ I SCREW ANCHOR



FIGURE 4—HILTI KH-EZ P, PM, PL SCREW ANCHORS



FIGURE 5—HILTI KH-EZ E SCREW ANCHOR



FIGURE 6—HILTI KH-EZ CRC SCREW ANCHOR



FIGURE 7—HILTI KH-EZ C SCREW ANCHOR



FIGURE 8—HILTI KH-EZ SS316 SCREW ANCHOR



FIGURE 9—HILTI KH-EZ C SS316 SCREW ANCHOR

Hilti SafeSet™ System with Hollow Drill Bit	 Hilti TE-CD or TE-YD Hollow Carbide Drill Bit with a Hilti Vacuum (per section 4.3)	
Hilti Dust Removal Systems	 Hilti Rotary Hammer Drill with DRS (Dust Removal System) Module	 Hilti TE DRS-D Dust Removal System with Hilti Vacuum

FIGURE 10—HILTI SAFESET™ AND DUST REMOVAL SYSTEMS

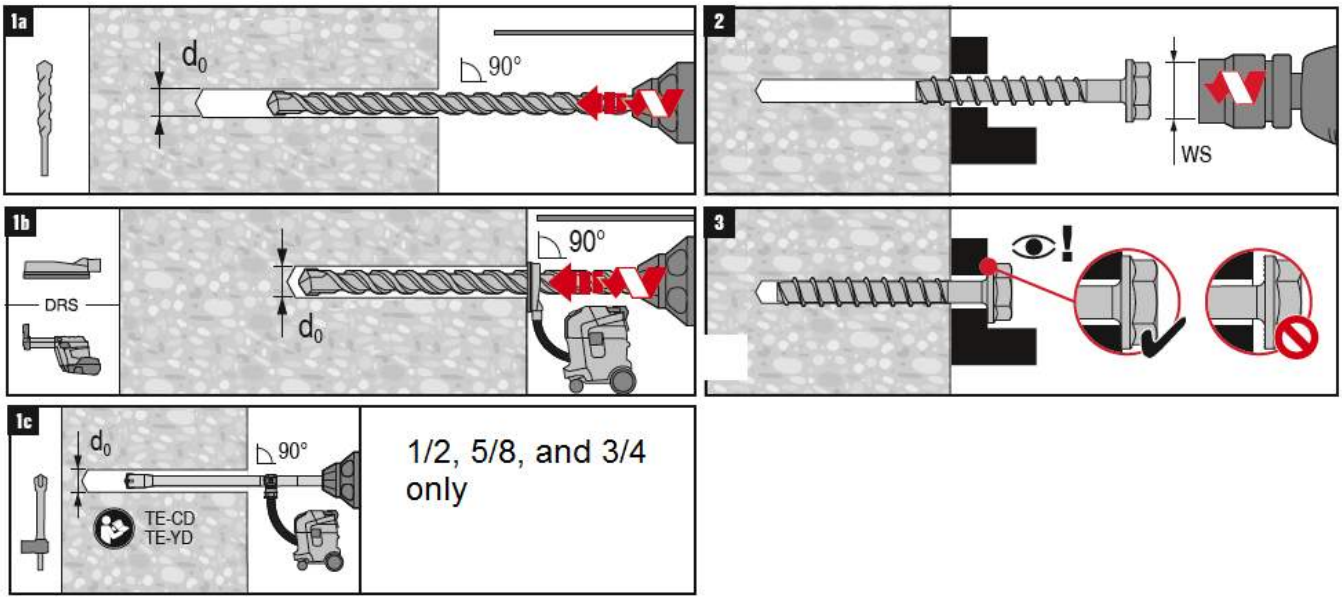


FIGURE 11A—INSTALLATION INSTRUCTIONS – HILTI KH-EZ, KH-EZ SS316 AND KH-EZ CRC SCREW ANCHORS

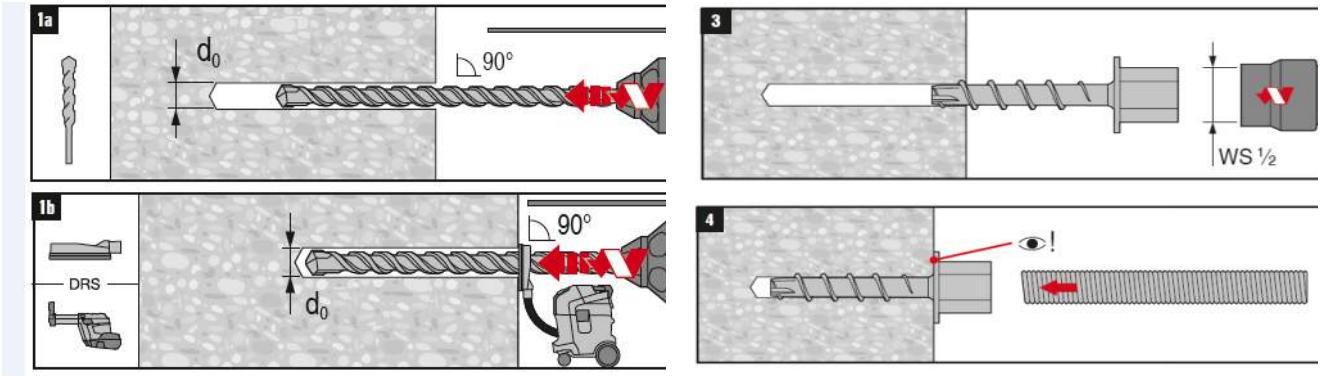


FIGURE 11B—INSTALLATION INSTRUCTIONS – HILTI KH-EZ I SCREW ANCHORS

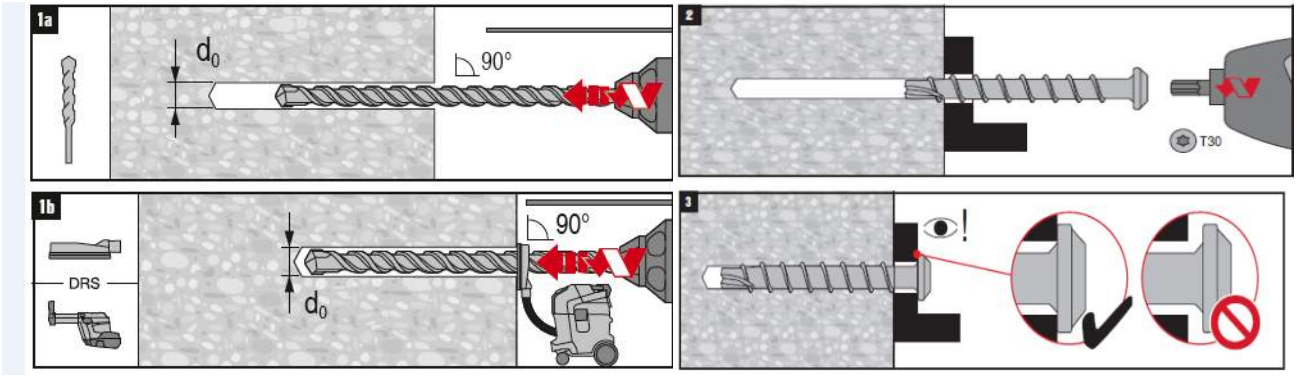


FIGURE 11C—INSTALLATION INSTRUCTIONS – HILTI KH-EZ P, PM, PL SCREW ANCHORS

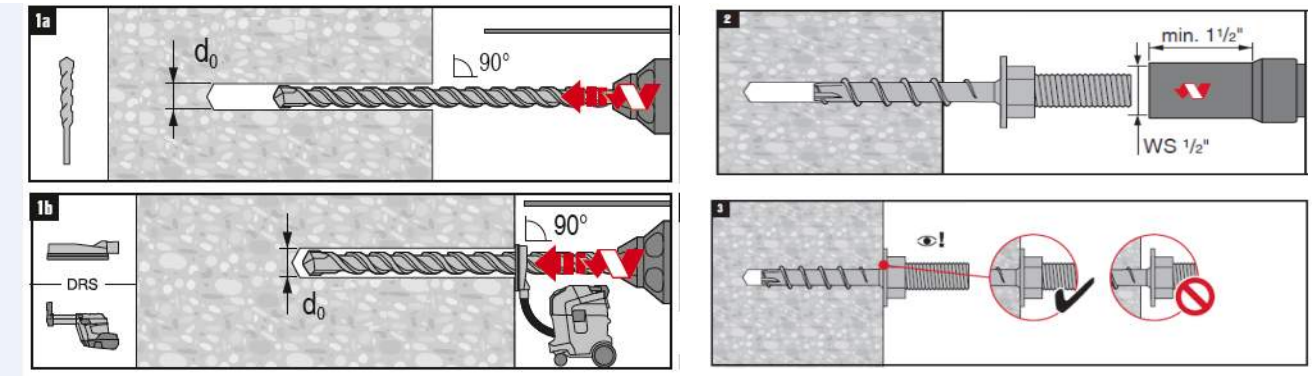


FIGURE 11D—INSTALLATION INSTRUCTIONS – HILTI KH-EZ E SCREW ANCHORS

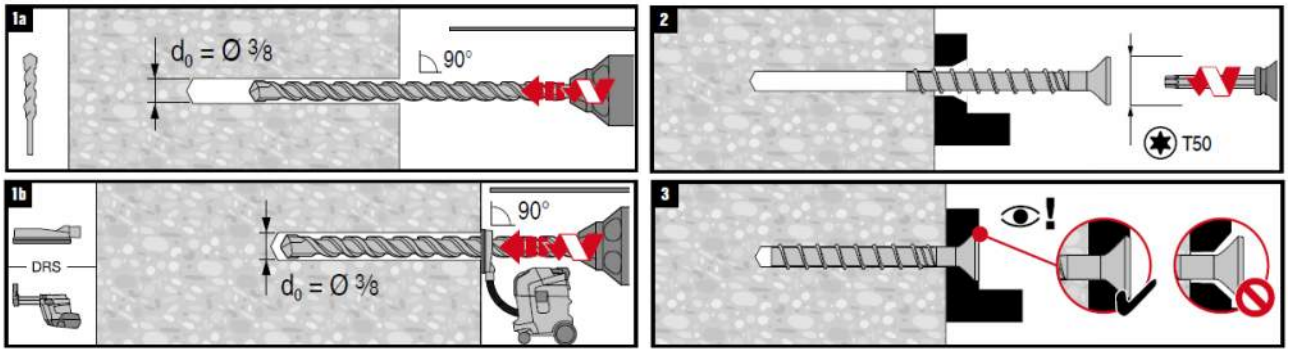


FIGURE 11E—INSTALLATION INSTRUCTIONS – HILTI KH-EZ C AND KH-EZ C SS316 SCREW ANCHORS

TABLE 1—HILTI KH-EZ, KH-EZ P, KH-EZ PL, KH-EZ C AND KH-EZ CRC INSTALLATION INFORMATION AND ANCHOR SPECIFICATION[1]

Characteristic	Symbol	Units	Nominal Anchor Diameter (inches)																			
			1/4		3/8					1/2				5/8				3/4				
Nominal drill bit diameter	d_{bit}	in.	1/4		3/8					1/2				5/8				3/4				
		(mm)	(6.4)		(9.5)					(12.7)				(15.9)				(19.1)				
Head Style and Coating	-	-	Hex, P, PM, PL, C Head		Hex, C Head		Hex, C Head (including CRC)		Hex Head (including CRC)	Hex Head (including CRC)				Hex Head (including CRC)				Hex Head (including CRC)				
Minimum Nominal Embedment depth	h_{nom}	in.	1 5/8	2 1/2	1 5/8	2 1/8	2 1/2	3 1/4	4 1/2	2 1/4	3	4 1/4	5 1/2	3 1/4	4	5	6	4	5	6 1/4	7 1/4
		(mm)	(41)	(64)	(41)	(54)	(64)	(83)	(114)	(57)	(76)	(108)	(140)	(83)	(102)	(127)	(152)	(102)	(127)	(159)	(184)
Effective Embedment (min.)	h_{ef}	in.	1.18	1.92	1.11	1.54	1.86	2.50	3.55	1.52	2.16	3.22	4.28	2.39	3.03	3.88	4.73	2.92	3.77	4.84	5.69
		(mm)	(30)	(49)	(28)	(39)	(47)	(64)	(90)	(39)	(55)	(82)	(109)	(61)	(77)	(99)	(120)	(74)	(96)	(123)	(145)
Minimum Hole Depth (min.)	h_o	in.	2	2 7/8	1 7/8	2 3/8	2 3/4	3 1/2	4 3/4	2 5/8	3 3/8	4 5/8	5 7/8	3 5/8	4 3/8	5 3/8	6 3/8	4 3/8	5 3/8	6 5/8	7 5/8
		(mm)	(51)	(73)	(48)	(60)	(70)	(89)	(121)	(67)	(86)	(117)	(149)	(92)	(111)	(137)	(162)	(111)	(137)	(168)	(194)
Minimum Baseplate Clearance Hole Diameter	d_h	in.	3/8		1/2					5/8				3/4				7/8				
		(mm)	(9.5)		(12.7)					(15.9)				(19.1)				(22.2)				
Maximum Installation Torque	$T_{inst,max}$[4]	ft-lbf	18		19	40				45			50	85				95[6]				
		(Nm)	(24)		(26)	(54)				(61)			(68)	(115)				(129)				
Maximum Impact Wrench Torque Rating[3]	$T_{impact,max}$	ft-lbf	157		157	450				137	450			590				590				
		(Nm)	(213)		(213)	(610)				(186)	(610)			(800)				(800)				
Wrench socket size	WS	in.	7/16		9/16					3/4				15/16				1 1/8				
		(mm)	(11.1)		(14.3)					(19.1)				(23.8)				(28.6)				
Minimum Concrete Thickness	h_{min}	in.	3.25	4.125	3.25	3.67	4	4.75	7.75	4.5	4.75	6.75	8.75	5	6	7	9.5	6	7	8.125	11.5
		(mm)	(83)	(105)	(83)	(93)	(102)	(121)	(197)	(114)	(121)	(171)	(222)	(127)	(152)	(178)	(241)	(152)	(178)	(206)	(292)
Minimum edge distance[2]	c_{min}	in.	1 1/2		1 1/2					1 3/4				1 3/4				1 3/4				
		(mm)	(38)		(38)					(44)				(44)				(44)				
	for s ≥	in.	3		3					3				4				4				
		(mm)	(76)		(76)					(76)				(102)				(102)				
Minimum spacing[2]	s_{min}	in.	1 1/2		2 1/4					3				3				3				
		(mm)	(38)		(57)					(76)				(76)				(76)				
	for c ≥	in.	2.00	2.78	2.63	2.75	2.92	3.75	14.2	2.75	3.75	5.25	17.1	3.63	4.57	5.82	18.9	4.41	5.69	7.28	22.8
		(mm)	(51)	(71)	(67)	(70)	(74)	(95)	(361)	(70)	(95)	(133)	(434)	(92)	(116)	(148)	(480)	(112)	(145)	(185)	(579)
Max. Head height	-	in.	0.17 (P Head) 0.24 (Hex Head)		0.35					0.49				0.57				0.70				
		(mm)	(4.3) P Head (6.1) Hex Head		(8.9)					(12.4)				(14.5)				(17.8)				

For **SI:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 psi = 6.89 kPa, 1 in^2 = 645 mm^2, 1 lb/in = 0.175 N/mm.

[1]The data presented in this table is to be used in conjunction with the design criteria of ACI 318-19 Chapter 17.
[2]Linear interpolation permitted for minimum spacing and edge distance.
[3] Because of variability in measurement procedures, the published torque of an impact tool may not correlate properly with the above setting torques. Over-torqueing can damage the anchor and/or reduce its holding capacity.
[4]$T_{inst,max}$ applies to installations using a calibrated torque wrench.
[5]Additional combinations for minimum edge distance, c_{min}, and minimum spacing distance, s_{min} or $s_{min,cac}$, may be derived by linear interpolation between the given boundary values.
[6] Maximum installation torque for 3/4-in diameter KH-EZ CRC is 85 ft-lbs (115 Nm).

TABLE 2—HILTI KH-EZ SS316 AND KH-EZ C SS316 INSTALLATION INFORMATION AND ANCHOR SPECIFICATION[1]

Characteristic	Symbol	Units	Nominal anchor diameter (in)							
			1/4		3/8			1/2		
Nominal drill bit diameter	d_{bit}	in.	1/4		3/8			1/2		
Head style	-	-	Hex and C		Hex and C			Hex		
Effective embedment (min.)	h_{ef}	in.	1.19	1.93	1.49	1.92	2.55	1.56	2.20	3.26
		(mm)	(30)	(49)	(38)	(49)	(65)	(40)	(56)	(83)
Nominal embedment	h_{nom}	in.	1 5/8	2 1/2	2	2 1/2	3 1/4	2 1/4	3	4 1/4
		(mm)	(41)	(64)	(51)	(64)	(83)	(57)	(76)	(108)
Hole depth in concrete (min.)	h_0	in.	2	2 7/8	2 1/4	2 3/4	3 1/2	2 5/8	3 3/8	4 5/8
		(mm)	(51)	(73)	(57)	(70)	(89)	(67)	(86)	(117)
Fixture hole diameter	d_h	in.	3/8		1/2			5/8		
		(mm)	(9.5)		(12.7)			(15.9)		
Maximum impact wrench[2] torque rating	$T_{impact,max}$	ft-lb	100		157			332		
		(Nm)	(136)		(213)			(450)		
Wrench socket size	*WS*	in.	7/16		9/16			3/4		
Minimum concrete thickness	h_{min}	in.	3 1/4	4 1/8	3 1/2	4	4 3/4	4 1/2	4 3/4	6 3/4
		(mm)	(83)	(105)	(89)	(102)	(121)	(114)	(121)	(171)
Minimum edge distance[3]	c_{min}	in.	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 3/4	1 3/4	1 3/4
		(mm)	(38)	(38)	(38)	(38)	(38)	(44)	(44)	(44)
	for s ≥	in.	3	3	3	3	3	3	3	3
		(mm)	(76)	(76)	(76)	(76)	(76)	(76)	(76)	(76)
Minimum anchor spacing[3]	s_{min}	in.	1 1/2	1 1/2	2 1/4	2 1/4	2 1/4	3	3	3
		(mm)	(38)	(38)	(57)	(57)	(57)	(76)	(76)	(76)
	for c ≥	in.	2	2	3	3	3	1 3/4	1 3/4	1 3/4
		(mm)	(51)	(51)	(76)	(76)	(76)	(44)	(44)	(44)

or **SI**: 1 inch = 25.4mm, 1 ft-lb = 1.3558 Nm

[1]The data presented in this table is to be used in conjunction with the design criteria of ACI 318-19 Chapter 17.

[2]Because of variability in measurement procedures, the published torque of an impact tool may not correlate properly with the above setting torques. Over-torquing can damage the anchor and/or reduce its holding capacity.

[3]Linear interpolation permitted for minimum spacing and edge distance.

TABLE 3—HILTI KH-EZ, KH-EZ P, KH-EZ PM, KH-EZ PL, KH-EZ C AND KH-EZ CRC TENSION AND SHEAR STRENGTH DESIGN DATA[1,2,3,6]

Characteristic	Symbol	Units	Nominal Anchor Diameter (inches)																			
			1/4		3/8					1/2				5/8				3/4				
Head style and coating	-	-	Hex, P, PM, PL, C Head		Hex, C Head		Hex, C Head (including CRC)		Hex Head (including CRC)	Hex Head (including CRC)				Hex Head (including CRC)				Hex Head (including CRC)				
Nominal diameter	d_a	in. (mm)	0.250 (6.4)		0.375 (9.5)					0.500 (12.7)				0.625 (15.9)				0.750 (19.1)				
Effective embedment	h_{ef}	in. (mm)	1.18 (30)	1.92 (49)	1.11 (28)	1.54 (39)	1.86 (47)	2.50 (64)	3.55 (90)	1.52 (39)	2.16 (55)	3.22 (82)	4.28 (109)	2.39 (61)	3.03 (77)	3.88 (99)	4.73 (120)	2.92 (74)	3.77 (96)	4.84 (123)	5.69 (145)	
Nominal embedment	h_{nom}	in. (mm)	1 5/8 (41)	2 1/2 (64)	1 5/8 (41)	2 1/8 (54)	2 1/2 (64)	3 1/4 (83)	4 1/2 (114)	2 1/4 (57)	3 (76)	4 1/4 (108)	5 1/2 (140)	3 1/4 (83)	4 (102)	5 (127)	6 (127)	4 (102)	5 (127)	6 1/4 (159)	7 1/4 (184)	
Strength reduction factor for steel in tension [2,7]	ϕ_{sa}	-	0.65		0.65					0.65				0.65				0.65				
Effective tensile stress area	A_{se}	in.^{2} (mm^2)	0.045 (29.0)		0.086 (55.5)					0.161 (103.9)				0.268 (172.9)				0.392 (252.9)				
Minimum specified ultimate strength	f_{uta}	psi (MPa)	125,000 (862)		106,975 (738)		120,300 (829)			112,540 (776)				90,180 (622)				81,600 (563)				
Tension resistance of steel	N_{sa}	lbf. (kN)	5,660 (25)		9,200 (41)		10,335 (46)			18,120 (81)				24,210 (108)				32,015 (142)				
Anchor category	-	-	3	1	1					1				1			2	1				
Strength reduction factor for concrete failure modes in tension[2]	$\phi_{c,N}$	-	0.45	0.65	0.65					0.65				0.65			0.55	0.65				
Effectiveness factor – uncracked concrete	k_{uncr}	-	24		24					27			24	27			24	27			24	
Effectiveness factor – cracked concrete	k_{cr}	-	17		17					17				17				17				
Modification factor for cracked and uncracked concrete[6]	$\Psi_{c,N}$	-	1.0		1.0					1.0				1.0				1.0				
Critical edge distance	c_{ac}	in. (mm)	2.00 (51)	2.78 (71)	2.63 (67)	2.75 (70)	2.92 (74)	3.75 (95)	14.2 (361)	2.75 (70)	3.75 (95)	5.25 (133)	17.1 (434)	3.63 (92)	4.57 (116)	5.82 (148)	18.9 (480)	4.41 (112)	5.69 (145)	7.28 (185)	22.8 (578)	
Pullout strength in uncracked concrete	$N_{p,uncr}$[6]	lbf. (kN)	1,305[5] (5.8)	2,350[4] (10.5)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Pullout strength in cracked concrete	$N_{p,cr}$[6]	lbf. (kN)	665[5] (3.0)	1,165[4] (5.2)	725[4] (3.2)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Pullout strength in cracked concrete, seismic	$N_{p,eq}$[6]	lbf. (kN)	535[5] (2.4)	1,165[4] (5.2)	725[4] (3.2)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Strength reduction factor for steel in shear [2,7]	ϕ_{sa}	-	0.60		0.60					0.60				0.60				0.60				
Nominal steel strength in shear [8]	V_{sa}	lbf. (kN)	1,550 (6.9)		3,670 (16.3)		5,185 (23.1)			9,245 (41.1)				11,220 (49.9)				16,660 (74.1)				
Nominal steel strength in shear, seismic [8]	$V_{sa,eq}$	lbf. (kN)	1,395 (6.2)		3,670 (16.3)		3,110 (13.8)			5,545 (24.7)				6,735 (30.0)				11,555 (51.4)				
Load bearing length of anchor	ℓ_e	in. (mm)	1.18 (30)	1.92 (49)	1.11 (28)	1.54 (39)	1.86 (47)	2.50 (64)	3 (76)	1.52 (39)	2.16 (55)	3.22 (82)	4 (102)	2.39 (61)	3.03 (77)	3.88 (99)	4.73 (120)	2.92 (74)	3.77 (96)	4.84 (123)	5.69 (145)	
Strength reduction factor for concrete failure modes in shear [2]	$\phi_{c,V}$	-	0.70		0.70					0.70				0.70				0.70				
Effectiveness factor for pryout	k_{cp}	-	1.0	1.0	1.0	1.0	1.0	2.0	2.0	1.0	1.0	2.0	2.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Mean axial stiffness, uncracked concrete	β_{uncr}	lb/in.	437,000		540,000					835,000				819,000				261,000				
Mean axial stiffness, cracked concrete	β_{cr}		284,000		239,000					272,000				332,000				252,000				

For **SI:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 psi = 6.89 kPa, 1 in^2 = 645 mm^2, 1 lb/in = 0.175 N/mm.

[1]The data in this table is intended for use with the design provisions of ACI 318-19 Chapter 17 for anchors resisting seismic load combinations the additional requirements of ACI 318-19 Section 17.10 shall apply.

[2]The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 Section 17.5.3

[3]In this report, N/A denotes that pullout resistance does not govern and does not need to be considered.

[4]The characteristic pullout resistance for concrete compressive strengths greater than 2,500 psi may be increased by multiplying the value in the table by $(f'_c/2{,}500)^{0.5}$ for psi or $(f'_c/17.2)^{0.5}$ for MPa.

[5]The characteristic pullout resistance for concrete compressive strengths greater than 2,500 psi may be increased by multiplying the value in the table by $(f'_c/2{,}500)^{0.3}$ for psi or $(f'_c/17.2)^{0.3}$ for MPa.

[6]For lightweight concrete, calculate values according to Section 4.1.12 of this report.

[7]The KH-EZ**,** KH-EZ P, PM, PL and KH-EZ CRC are considered brittle steel elements as defined by ACI 318-19 Section 2.3.

[8]Reported values for steel strength in shear are based on test results per ACI 355.2, Section 9.4 and must be used for design in lieu of calculated results using equation 17.7.1.2b of ACI 318-19.

TABLE 4—HILTI KH-EZ SS316 AND KH-EZ C SS316 TENSION AND SHEAR STRENGTH DESIGN DATA[1]

Characteristic	Symbol	Units	Nominal anchor diameter (in)							
			1/41		3/8			1/2		
Head style	-	-	Hex and C		Hex and C			Hex		
Anchor O.D.	d_a	in. (mm)	0.250 (6.4)		0.375 (9.5)			0.5 (12.7)		
Effective embedment	h_{ef}	in. (mm)	1.19 (30)	1.93 (49)	1.49 (38)	1.92 (49)	2.55 (65)	1.56 (40)	2.20 (56)	3.26 (83)
Nominal embedment	h_{nom}	in. (mm)	$1^5/_8$ (41)	$2^1/_2$ (64)	2 (51)	$2^1/_2$ (64)	$3^1/_4$ (83)	$2^1/_4$ (57)	3 (76)	$4^1/_4$ (108)
Strength reduction factor for steel in tension[1,2]	$\phi_{sa,N}$	-	0.75		0.75			0.75		
Min. specified yield strength	f_{ya}	psi (N/mm^2)	135,600 (935)		125,000 (862)			101,400 (699)		
Min. specified ult. strength	f_{uta}	psi (N/mm^2)	153,000 (1055)		139,300 (961)			120,100 (828)		
Effective-cross sectional steel area in tension	$A_{se,N}$	in^2 (mm^2)	0.040 (25.5)		0.094 (60.8)			0.172 (111.2)		
Nominal steel strength in tension[4]	N_{sa}	lb (kN)	6,120 (27.2)		13,095 (58.2)			20,655 (91.9)		
Anchor category	-	-	2	3	1			2		
Strength reduction factor for concrete failure modes in tension[2]	$\phi_{c,N}$	-	0.55	0.45	0.65			0.55		
Effectiveness factor for uncracked concrete	k_{uncr}	in-lb (SI)	24 (10.0)		27 (11.3)			27 (11.3)		
Effectiveness factor for cracked concrete	k_{cr}	in-lb (SI)	17 (7.1)		17 (7.1)			21 (8.8)		
Modification factor for anchor resistance, tension, uncracked conc.[3]	$\psi_{c,N}$	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Critical edge distance	c_{ac}	in. (mm)	4.76 (121)	7.72 (196)	5.96 (151)	7.68 (195)	10.20 (259)	6.24 (158)	8.80 (224)	7.50 (191)
Pullout strength in uncracked concrete	$N_{p,uncr}$	lb (kN)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pullout strength in cracked concrete[4]	$N_{p,cr}$	lb (kN)	570 (2.5)	1,100 (4.9)	1,510 (6.7)	2,215 (9.9)	N/A	N/A	N/A	N/A
Pullout strength in cracked concrete, seismic[4]	$N_{p,eq}$	lb (kN)	390 (1.7)	1,100 (4.9)	1,510 (6.7)	2,215 (9.9)	N/A	N/A	N/A	N/A
Strength reduction factor for steel in shear[1,2]	$\phi_{sa,V}$	-	0.65		0.65			0.65		
Nominal steel strength in shear	V_{sa}	lb (kN)	1,830 (8.1)	1,830 (8.1)	4,355 (19.4)	4,355 (19.4)	4,355 (19.4)	4,790 (21.3)	4,790 (21.3)	4,790 (21.3)
Nominal steel strength in shear, seismic	$V_{sa,eq}$	lb (kN)	1,200 (5.3)	1,200 (5.3)	4,355 (19.4)	4,355 (19.4)	4,355 (19.4)	4,790 (21.3)	4,790 (21.3)	4,790 (21.3)
Strength reduction factor for concrete failure modes in shear[2]	$\phi_{c,V}$	-	0.70		0.70			0.70		
Effectiveness factor for pryout	k_{cp}	-	1.0	1.0	1.0	1.0	2.0	1.0	1.0	2.0
Mean axial stiffness, uncracked concrete[5]	β_{uncr}	lbf/in	519,400		770,900			1,244,000		
Mean axial stiffness, cracked concrete[5]	β_{cr}	lbf/in	341,600		452,600			757,000		

For **SI:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 psi = 6.89 kPa, 1 in^2 = 645 mm^2, 1 lb/in = 0.175 N/mm.

[1] The KH-EZ SS is considered a ductile steel element as defined by ICC-ES AC193 Section 6.3.6.

[2] The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 Section 17.5.3 are met.

[3] For all design cases, $\psi_{c,N}$ = 1.0. The appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) must be used.

[4] For all design cases, $\psi_{c,P}$ = 1.0. Tabular value for pullout strength is for a concrete compressive strength of 2,500 psi (17.2 MPa). Pullout strength for concrete compressive strength greater than 2,500 psi (17.2 MPa) may be increased by multiplying the tabular pullout strength by $(f'_c / 2{,}500)^n$ for psi or $(f'_c / 17.2)^n$ for MPa where n=0.15 for 1/4" x 1-5/8" and n=0.35 for 1/4" x 2-1/2". NA (not applicable) denotes that pullout strength does not need to be considered for design.

[5] Mean values shown. Actual stiffness varies considerably depending on concrete strength, loading, and geometry of application.

TABLE 5—HILTI KH-EZ, KH-EZ P, KH-EZ PM, KH-EZ PL, KH-EZ C AND KH-EZ CRC TENSION AND SHEAR DESIGN DATA FOR INSTALLATION IN THE UNDERSIDE OF CONCRETE-FILLED PROFILE STEEL DECK ASSEMBLIES[1,5,6,7]

Characteristic	Symbol	Units	Lower Flute											Upper Flute				
			Anchor Diameter															
			1/4		3/8		1/2			5/8		3/4		1/4		3/8		1/2
Head Style and Coating	-	-	Hex, P, PM, PL, C Head		Hex, C Head	Hex Head (including CRC)								Same as previous				
Embedment	h_{nom}	in.	1 5/8	2 1/2	1 5/8	2 1/2	3 1/4	2 1/4	3	4 1/4	3 1/4	5	4	1 5/8	2 1/2	1 5/8	2 1/2	2 1/4
		(mm)	(41)	(64)	(41)	(64)	(83)	(57)	(76)	(108)	(83)	(127)	(102)	(41)	(64)	(41)	(64)	(57)
Minimum Hole Depth	h_o	in.	2	2 7/8	1 7/8	2 3/4	3 1/2	2 5/8	3 3/8	4 5/8	3 5/8	5 3/8	4 3/8	2	2 7/8	1 7/8	2 7/8	2 5/8
		(mm)	(51)	(73)	(47)	(70)	(83)	(67)	(86)	(117)	(92)	(137)	(111)	(51)	(73)	(48)	(73)	(67)
Effective Embedment Depth	h_{ef}	in.	1.18	1.92	1.11	1.86	2.50	1.52	2.16	3.22	2.39	3.88	2.92	1.18	1.92	1.11	1.86	1.52
		(mm)	(30)	(49)	(28)	(47)	(64)	(39)	(55)	(82)	(61)	(99)	(74)	(30)	(49)	(28)	(47)	(39)
Pullout Resistance, (uncracked concrete)[2]	$N_{p,deck,uncr}$	lbf.	1,210	1,875	1,300	2,240	3,920	1,305	3,060	5,360	4,180	9,495	4,180	1,490	1,960	1,490	2,920	1,395
		(kN)	(5.4)	(8.3)	(5.8)	(10.0)	(17.4)	(5.8)	(13.6)	(23.8)	(18.6)	(42.2)	(18.6)	(6.6)	(8.7)	(6.6)	(13.0)	(6.2)
Pullout Resistance (cracked conc. / seismic loads)[3]	$N_{p,deck,cr}$	lbf.	620	930	810	1,590	2,780	820	1,930	3,375	2,630	5,980	2,630	760	975	1,185	2,070	985
		(kN)	(2.8)	(4.1)	(3.6)	(7.1)	(12.4)	(3.6)	(8.6)	(15.0)	(11.7)	(26.6)	(11.7)	(3.4)	(4.3)	(5.3)	(9.2)	(4.4)
Steel Strength in Shear[4]	$V_{sa,deck}$	lbf.	1,205	2,210	1,510	1,510	3,605	1,605	2,920	3,590	3,470	4,190	3,760	1,205	3,265	3,670	6,090	7,850
		(kN)	(5.4)	(9.8)	(6.7)	(6.7)	(16.0)	(7.1)	(13.0)	(16.0)	(15.4)	(18.6)	(16.7)	(5.4)	(14.5)	(16.3)	(27.1)	(34.9)
Steel Strength in Shear, Seismic	$V_{sa,deck,eq}$	lbf.	905	1,990	905	905	2,165	965	1,750	2,155	2,080	2,515	2,610	1,080	2,940	3,670	3,650	4,710
		(kN)	(4.0)	(8.9)	(4.0)	(4.0)	(9.6)	(4.3)	(7.8)	(9.6)	(9.3)	(11.2)	(11.6)	(4.8)	(13.1)	(16.3)	(16.2)	(21.0)

For **SI:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 psi = 6.89 kPa, 1 in^2 = 645 mm^2, 1 lb/in = 0.175 N/mm.

[1]Installation must comply with Sections 4.1.10 and 4.3 and Figure 12 of this report.
[2]The values listed must be used in accordance with Section 4.1.4 of this report.
[3]The values listed must be used in accordance with Section 4.1.4 and 4.1.8.2 of this report.
[4]The values listed must be used in accordance with Section 4.1.5 and 4.1.8.3 of this report.
[5]The values for ϕ_p in tension and the values for ϕ_{sa} in shear can be found in Table 3 of this report.
[6]For the 1/4-inch-diameter (KH-EZ) at 2 1/2-inch nominal embedment and the 3/8-inch- through 3/4-inch-diameter anchors the characteristic pullout resistance for concrete compressive strengths greater than 3,000 psi may be increased by multiplying the value in the table by $(f'_c/3{,}000)^{1/2}$ for psi or $(f'_c/20.7)^{1/2}$ for MPa.
[7]For the 1/4-inch-diameter anchors (KH-EZ and KH-EZ P, PM, PL) at 1 5/8-inch nominal embedment characteristic pullout resistance for concrete compressive strengths greater than 3,000 psi may be increased by multiplying the value in the table by $(f'_c/3{,}000)^{0.3}$ for psi or $(f'_c/20.7)^{0.3}$ for MPa.

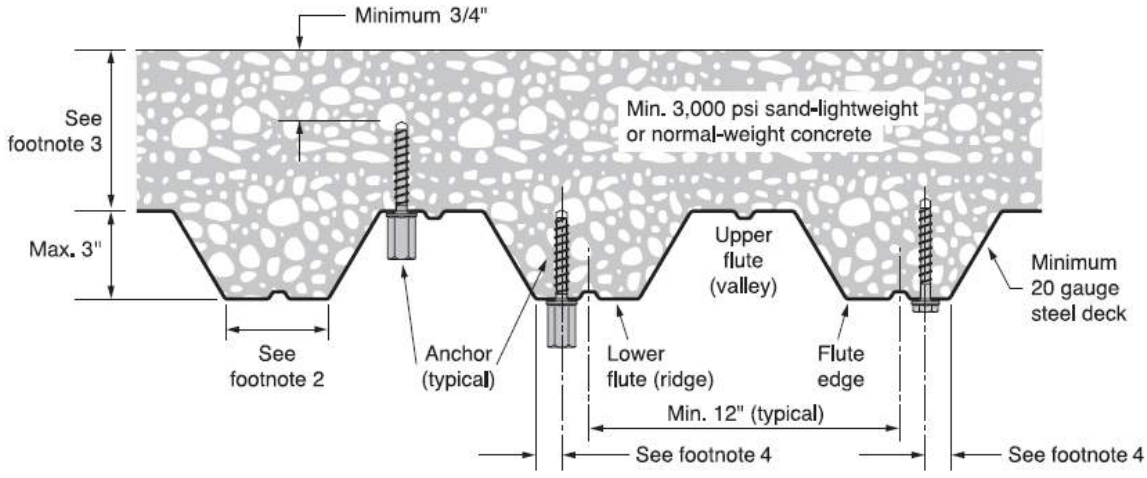


FIGURE 12—INSTALLATION OF KH-EZ, KH-EZ CRC AND KH-EZ I IN SOFFIT OF CONCRETE OVER STEEL DECK FLOOR AND ROOF ASSEMBLIES[1]

[1]Anchors may be placed in the upper or lower flute of the steel deck profile provided the minimum hole clearance is satisfied. Anchors in the lower flute may be installed with a maximum 1-inch offset in either direction from the center of the flute. The offset distance may be increased proportionally for profiles with lower flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied.
[2]Minimum flute width for 1/4-inch diameter KH-EZ and KH-EZ I and 3/8-inch diameter KH-EZ I is 3 7/8 inches. Minimum flute width for KH-EZ 3/8-, 1/2-, 5/8- and 3/4-inch diameters is 4 1/2 inches.
[3]Minimum concrete thickness above upper flute for 1/4-inch diameter KH-EZ and 3/8-inch KH-EZ I is 2 1/2 inches. Minimum concrete thickness above upper flute for KH-EZ 3/8-, 1/2-, 5/8- and 3/4-inch diameter is 3-1/4 inches.
[4]Minimum distance from edge of flute to centerline of anchor for KH-EZ and KH-EZ I 1/4-inch diameter is 1-inch. Minimum distance from edge of flute to centerline of anchor for KH-EZ 3/8-, 1/2-, 5/8- and 3/4-inch diameter is 1 1/4 inches.

TABLE 6—HILTI KH-EZ E AND KH-EZ I, INSTALLATION INFORMATION AND ANCHOR SPECIFICATION[1]

Characteristic	Symbol	Units	Nominal Anchor Diameter (inches)		
			1/4 (KH-EZ I and KH-EZ E)		3/8 (KH-EZ I)
Nominal drill bit diameter	d_{bit}	in.	1/4		3/8
Head style	-	-	Internally (I) or Externally (E) Threaded		Internally (I)
Effective embedment	h_{ef}	in.	1.18	1.92	1.54
		(mm)	(30)	(49)	(39)
Nominal embedment	h_{nom}	in.	1 5/8	2 1/2	2 1/8
		(mm)	(41)	(64)	(54)
Hole depth in concreteHole depth in concrete (min.)	h_o	in.	2	2 7/8	2 3/8
		(mm)	(51)	(73)	(60)
Maximum installation torque	$T_{inst,max}$[4]	ft-lbf	18		40
		(Nm)	(24)		(54)
Maximum impact wrench torque rating [3]	$T_{impact,max}$	ft-lbf	114	137	450
		(Nm)	(155)	(186)	(610)
Wrench socket size – KH-EZ I	1/4″ Internal Thread	in.	3/8		N/A
		(mm)	(9.5)		
	3/8″ Internal Thread	in.	1/2		N/A
		(mm)	(12.7)		
	1/2″ Internal Thread	in.	N/A		3/4
		(mm)			(19.1)
Wrench socket size – KH-EZ E	*WS*	in.	1/2		N/A
		(mm)	(12.7)		
Minimum concrete thickness	h_{min}	in.	3 1/4	4 1/8	3 5/8
		(mm)	(83)	(105)	(92)
Minimum edge distance [2]	c_{min}[6]	in.	1 1/2		1 1/2
		(mm)	(38)		(38)
	for s ≥ [6]	in.	3		3
		(mm)	(76)		(76)
Minimum anchor spacing	s_{min}[6]	in.	1 1/2		2 1/4
		(mm)	(38)		(57)
	for c ≥ [6]	in.	2.00	2.78	2.75
		(mm)	(51)	(71)	(70)
Max. head height – KH-EZ I	1/4″ Internal Thread	in.	5/8		N/A
		(mm)	(15.9)		
	3/8″ Internal Thread	in.	11/16		N/A
		(mm)	(17.5)		
	½” Internal Thread	in.	N/A		3/4
		(mm)			(19.1)
Max. head height KH-EZ E	3/8” External thread	in.	1 3/8		N/A
		(mm)	(35)		

For **SI:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 psi = 6.89 kPa, 1 in^2 = 645 mm^2, 1 lb/in = 0.175 N/mm.

[1]The data presented in this table is to be used in conjunction with the design criteria of ACI 318-19 Chapter 17.
[2]For installations through the soffit of steel deck into concrete (see Figure 12) anchors installed in the lower flute may be installed with a maximum 1 inch offset in either direction from the center of the flute.
[3]Because of variability in measurement procedures, the published torque of an impact tool may not correlate properly with the above setting torques. Over-torqueing can damage the anchor and/or reduce its holding capacity.
[4]$T_{inst,max}$ applies to installations using a calibrated torque wrench.
[5]The KH-EZ I and KH-EZ E versions are driven directly to the supporting member surface.
[6]Additional combinations for minimum edge distance, c_{min}, and minimum spacing distance, s_{min}, may be derived by linear interpolation between the given boundary values.

TABLE 7—HILTI KH-EZ E AND KH-EZ I TENSION AND SHEAR STRENGTH DESIGN DATA[1,2,3,6]

Characteristic	Symbol	Units	Nominal Anchor Dimension		
			1/4 (KH-EZ I and KH-EZ E)		3/8 (KH-EZ I)
Head style	-	-	Internally (I) or Externally (E) Threaded		Internally (I)
Nominal diameter	d_a	in. (mm)	0.250 (6.4)		0.375 (9.5)
Effective embedment	h_{ef}	in. (mm)	1.18 (30)	1.92 (49)	1.54 (39)
Nominal embedment	h_{nom}	in. (mm)	$1^5/_8$ (41)	$2^1/_2$ (64)	$2^1/_8$ (54)
Strength reduction factor for steel in tension [2,7]	ϕ_{sa}	-	0.65		0.65
Min. specified ult. strength	A_{se}	in.^{2} (mm^2)	0.045 (29.0)		0.086 (55.5)
Effective-cross sectional steel area in tension	f_{uta}	psi (MPa)	125,000 (862)		106,975 (738)
Nominal steel strength in tension	N_{sa}	lbf. (kN)	5,660 (25)		9,200 (41)
Anchor category 1, 2 or 3	-	-	3	1	1
Strength reduction factor for concrete failure modes in tension [2]	$\phi_{c,N}$	-	0.45	0.65	0.65
Effectiveness factor for uncracked oncrete	k_{uncr}	-	24		24
Effectiveness factor for cracked concrete	k_{cr}	-	17		17
Modification factor for anchor resistance, tension, uncracked concrete	$\Psi_{c,N}$	-	1.0		1.0
Critical edge distance	c_{ac}	in. (mm)	2.00 (51)	2.78 (71)	2.75 (70)
Pullout strength in uncracked concrete	$N_{p,uncr}$[6]	lbf. (kN)	1,305[5] (5.8)	2,350[4] (10.5)	N/A
Pullout strength in cracked concrete	$N_{p,cr}$[6]	lbf. (kN)	665[5] (3.0)	1,165[4] (5.2)	N/A
Pullout strength in cracked concrete, seismic	$N_{p,eq}$[6]	lbf. (kN)	535[5] (2.4)	1,165[4] (5.2)	N/A
Strength reduction factor for steel in shear [2]	$\phi_{sa,V}$	-	0.60		0.60
Nominal steel strength in shear[8]	V_{sa}	lbf. (mm)	1,360 (6.4)	1,315 (9.5)	1,885 (12.7)
Nominal steel strength in shear, seismic[8]	$V_{sa,eq}$	lbf. (kN)	605 (2.7)	1,120 (5.0)	1,885 (8.4)
Load bearing length of anchor	ℓ_e	in. (mm)	1.18 (30)	1.92 (49)	1.54 (39)
Strength reduction factor for concrete failure modes in shear [2]	$\phi_{c,V}$	-	0.70		0.70
Coefficient for Pryout Strength	k_{cp}	-	1.0	1.0	1.0
Mean axial stiffness, uncracked concrete	β_{uncr}	lb/in. (N/mm)	760,000 (133,000)		
Mean axial stiffness, cracked concrete	β_{cr}	lb/in. (N/mm)	293,000 (51,275)		

For **SI:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 psi = 6.89 kPa, 1 in^2 = 645 mm^2, 1 lb/in = 0.175 N/mm.

[1]The data in this table is intended for use with the design provisions of ACI 318-19 Chapter 17 for anchors resisting seismic load combinations the additional requirements of ACI 318-19 Section 17.10 shall apply.
[2]The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 Section 17.5.3 are met.
[3]In this report, N/A denotes that pullout resistance does not govern and does not need to be considered.
[4]The characteristic pullout resistance for concrete compressive strengths greater than 2,500 psi may be increased by multiplying the value in the table by $(f'_c/2{,}500)^{0.5}$ for psi or $(f'_c/17.2)^{0.5}$ for MPa.
[5]The characteristic pullout resistance for concrete compressive strengths greater than 2,500 psi may be increased by multiplying the value in the table by $(f'_c/2{,}500)^{0.3}$ for psi or $(f'_c/17.2)^{0.3}$ for MPa.
[6]For lightweight concrete, calculate values according to Section 4.1.12 of this report.
[7]The KH-EZ E and KH-EZ I are considered brittle steel elements as defined by ACI 318-19 Section 2.3.
[8]Reported values for steel strength in shear are based on test results per ACI 355.2, Section 9.4 and must be used for design in lieu of calculated results using equation 17.7.1.2b of ACI 318-19.

TABLE 8—HILTI KH-EZ I AND KH-EZ E TENSION AND SHEAR DESIGN DATA FOR INSTALLATION IN THE UNDERSIDE OF CONCRETE-FILLED PROFILE STEEL DECK ASSEMBLIES[1,6,7]

Characteristic	Symbol	Units	Lower Flute					Upper Flute				
			Nominal Anchor Diameter									
			1/4				3/8	1/4				3/8
Head Style	-	-	Internally (I) Threaded and Externally (E) Threaded				Internally Threaded	Internally (I) Threaded and Externally (E) Threaded				Internally Threaded
Embedment	h_{nom}	in.	1 5/8	2 1/2	1 5/8	2 1/2	2 1/8	1 5/8	2 1/2	1 5/8	2 1/2	2 1/8
		(mm)	(41)	(64)	(41)	(64)	(54)	(41)	(64)	(41)	(64)	(54)
Minimum Hole Depth	h_o	in.	2	2 7/8	2	2 7/8	2 3/8	2	2 7/8	2	2 7/8	2 3/8
		(mm)	(51)	(73)	(51)	(73)	(60)	(51)	(73)	(51)	(73)	(60)
Internal Thread Diameter	-	in.	1/4		3/8		1/2	1/4		3/8		1/2
		(mm)	(6.4)		(9.5)		(12.7)	(6.4)		(9.5)		(12.7)
Effective Embedment Depth	h_{ef}	in.	1.18	1.92	1.18	1.92	1.54	1.18	1.92	1.18	1.92	1.54
		(mm)	(30)	(49)	(30)	(49)	(39)	(30)	(49)	(30)	(49)	(39)
Pullout Resistance, (uncracked concrete)[2]	$N_{p,deck,uncr}$	lbf.	1,210	1,875	1,210	1,875	1,720	1,490	1,960	1,490	1,960	2,660
		(kN)	(5.4)	(8.3)	(5.4)	(8.3)	(7.7)	(6.6)	(8.7)	(6.6)	(8.7)	(11.8)
Pullout Resistance (cracked concrete and seismic loads)[3]	$N_{p,deck,cr}$	lbf.	620	930	620	930	1,220	730	975	730	975	1,885
		(kN)	(2.8)	(4.1)	(2.8)	(4.1)	(5.4)	(3.2)	(4.3)	(3.2)	(4.3)	(8.4)
Steel Strength in Shear[4]	$V_{sa,deck}$	lbf.	860		1,025		2,380	1,015		1,525		3,650
		(kN)	(3.8)		(4.6)		(10.6)	(4.5)		(6.8)		(16.2)
Steel Strength in Shear, Seismic	$V_{sa,deck,eq}$	lbf.	385		875		2,380	445		1,295		3,650
		(kN)	(1.7)		(3.9)		(10.6)	(2.0)		(5.8)		(16.2)

For **SI:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 psi = 6.89 kPa, 1 in^2 = 645 mm^2, 1 lb/in = 0.175 N/mm.

[1]Installation must comply with Sections 4.1.10 and 4.3 and Figures 11B, 11D, and 12 of this report.
[2]The values listed must be used in accordance with Section 4.1.4 of this report.
[3]The values listed must be used in accordance with Section 4.1.4 and 4.1.8.2 of this report.
[4]The values listed must be used in accordance with Section 4.1.5 and 4.1.8.3 of this report.
[5]The values for ϕ_p in tension and the values for ϕ_{sa} in shear can be found in Table 3 of this report.
[6]For the 1/4-inch-diameter (KH-EZ I) at 2-1/2 inch nominal embedment the characteristic pullout resistance for concrete compressive strengths greater than 3,000 psi may be increased by multiplying the value in the table by $(f'_c/3{,}000)^{1/2}$ for psi or $(f'_c/20.7)^{1/2}$ for MPa.
[7]For the 1/4-inch-diameter anchors (KH-EZ I and KH-EZ E) at 1 5/8-inch nominal embedment characteristic pullout resistance for concrete compressive strengths greater than 3,000 psi may be increased by multiplying the value in the table by $(f'_c/3{,}000)^{0.3}$ for psi or $(f'_c/20.7)^{0.3}$ for MPa.

TABLE 9—HILTI KH-EZ, KH-EZ P, KH-EZ PM, KH-EZ PL, KH-EZ C AND KH-EZ E, SETTING INFORMATION FOR INSTALLATION ON THE TOP OF CONCRETE-FILLED PROFILE STEEL DECK ASSEMBLIES.[1,2,3,4,5,6,7]

DESIGN INFORMATION	Symbol	Units	Nominal Anchor Diameter						
			1/4		3/8			1/2	
Effective Embedment Depth	h_{ef}	in.	1.18	1.92	1.11	1.86	2.50	1.52	2.16
		(mm)	(30)	(49)	(28)	(47)	(64)	(39)	(55)
Nominal Embedment Depth	h_{nom}	in.	1 5/8	2 1/2	1 5/8	2 1/2	3 1/4	2 1/4	3
		(mm)	(41)	(64)	(41)	(64)	(83)	(57)	(76)
Minimum concrete thickness	$h_{min,deck}$	in.	2 1/2	2 1/2	2 1/2	2 1/2	3 1/4	2 1/2	3 1/4
		(mm)	(64)	(64)	(64)	(64)	(83)	(64)	(83)
Critical edge distance	$c_{ac,deck,top}$	in.	4	7 1/2	3	7 1/2	4 1/4	6	8 3/4
		(mm)	(104)	(191)	(76)	(191)	(108)	(152)	(83)
Minimum edge distance	$c_{min,deck,top}$	in.	1 3/4	1 3/4	1 3/4	3	1 3/4	3	1 3/4
		(mm)	(44)	(44)	(44)	(76)	(44)	(76)	(222)
Minimum spacing	$s_{min,deck,top}$	in.	3	3	3	3	3	3	3
		(mm)	(76)	(76)	(76)	(76)	(76)	(76)	(76)

For **SI:** 1 inch = 25.4 mm.

[1]Installation must comply with Sections 4.1.10 and 4.3 of this report.
[2]For all other anchor diameters and embedment depths refer to Table 1 for values of h_{min},c_{min} and s_{min}.
[3]Design capacity must be based on calculations according to values in Tables 3 and 6 of this report.
[4]Applicable for 2½-inch ≤ $h_{min,deck}$ <3 1/4-inch. For $h_{min,deck}$ ≥ 3 1/4-inch, use setting information in Tables 3 and 6 of this report.
[5]Minimum concrete thickness ($h_{min,deck}$) refers to concrete thickness above upper flute.
[6]Minimum flute depth (distance from top of flute to bottom of flute) is 3 inches.
[7]Steel deck thickness must be minimum 20 gauge.

TABLE 10— APPLICABLE SECTIONS OF THE IBC UNDER EACH EDITION OF THE IBC

2024 IBC	2021 IBC	2018 IBC	2015 IBC
Section 1605.1		Section 1605.2 or 1605.3	
1705			
Section 1705.1.1 and Table 1705.3			
1706			
1707			
Section 1901.3			
Sections 1903 and 1905			
Section 1905.7	Section 1905.1.8		

TABLE 11— APPLICABLE SECTIONS OF ACI 318 UNDER EACH EDITION OF THE IBC

2024 IBC	2021 IBC	2018 IBC	2015 IBC
ACI 318-19		**ACI 318-14**	
2.3		2.3	
5.3		5.3	
Chapter 17		Chapter 17	
17.3.1		17.2.7	
17.5.1.2		17.3.1	
17.5.3		17.3.3	
17.6.1		17.4.1	
17.6.1.2		17.4.1.2	
17.6.2		17.4.2	
17.6.2.1		17.4.2.1	
17.6.2.2		17.4.2.2	
17.6.2.3.1		17.4.2.4	
17.6.2.4.1		17.4.2.5	
17.6.2.5		17.4.2.6	
17.6.3		17.4.3	
17.6.3.1		17.4.3.1	
17.6.3.2.1		17.4.3.2	
17.6.3.3		17.4.3.6	
17.7.1.2		17.5.1.2	
Eq. 17.7.1.2b		Eq. 17.5.1.2b	
17.7.2		17.5.2	
17.7.2.2.1		17.5.2.2	
17.7.3		17.5.3	
17.8		17.6	
17.9		17.7	
17.9.2		17.7.1 and 17.7.3	
17.9.4		17.7.5	
17.9.5		17.7.6	
17.10		17.2.3	
17.10.5		17.2.3.4	
17.10.6		17.2.3.5	

DIVISION: 03 00 00—CONCRETE
Section: 03 16 00—Concrete Anchors

DIVISION: 05 00 00—METALS
Section: 05 05 19—Post-Installed Concrete Anchors

REPORT HOLDER:

HILTI, INC.

EVALUATION SUBJECT:

HILTI KH-EZ, KH-EZ P, KH-EZ PM, KH-EZ PL, KH-EZ C, KH-EZ E, KH-EZ I, AND KH-EZ CRC CARBON STEEL SCREW ANCHORS AND KH-EZ SS316 AND KH-EZ C SS316 STAINLESS STEEL SCREW ANCHORS FOR USE IN CRACKED AND UNCRACKED CONCRETE

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the Hilti KH-EZ, KH-EZ P, KH-EZ PM, KH-EZ PL, KH-EZ C, KH-EZ E, KH-EZ I, and KH-EZ CRC carbon steel screw anchors and KH-EZ SS316 and KH-EZ C SS316 stainless steel screw anchors in cracked and uncracked concrete, described in ICC-ES evaluation report ESR-3027, have also been evaluated for compliance with the codes noted below as adopted by Los Angeles Department of Building and Safety (LADBS).

Applicable code editions:

- 2023 *City of Los Angeles Building Code* (LABC)
- 2023 *City of Los Angeles Residential Code* (LARC)

2.0 CONCLUSIONS

The Hilti KH-EZ, KH-EZ P, KH-EZ PM, KH-EZ PL, KH-EZ C, KH-EZ E, KH-EZ I, and KH-EZ CRC carbon steel screw anchors and KH-EZ SS316 and KH-EZ C SS316 stainless steel screw anchors in cracked and uncracked concrete, described in Sections 2.0 through 7.0 of the evaluation report ESR-3027, comply with the LABC Chapter 19, and the LARC, and are subject to the conditions of use described in this supplement.

3.0 CONDITIONS OF USE

The Hilti KH-EZ, KH-EZ P, KH-EZ PM, KH-EZ PL, KH-EZ C, KH-EZ E, KH-EZ I, and KH-EZ CRC carbon steel screw anchors and KH-EZ SS316 and KH-EZ C SS316 stainless steel screw anchors described in this evaluation report supplement must comply with all of the following conditions:

- All applicable sections in the evaluation report ESR-3027.
- The design, installation, conditions of use and identification of the anchors are in accordance with the 2021 *International Building Code*® (IBC) and 2021 *International Residential Code*® (IRC) provisions, as applicable, noted in the evaluation report ESR-3027.
- The design, installation and inspection are in accordance with additional requirements of LABC Chapters 16 and 17, as applicable.
- Under the LARC, an engineered design in accordance with LARC Section R301.1.3 must be submitted.
- The allowable and strength design values established with the evaluation report and tables are for the connection of the anchors to the concrete. The connection between the anchors and the connected members shall be checked for capacity (which may govern).
- For use in wall anchorage assemblies to flexible diaphragm applications, anchors shall be designed per the requirements of City of Los Angeles Information Bulletin P/BC 2023-071.

This supplement expires concurrently with the evaluation report, reissued December 2025.

ICC-ES Evaluation Reports are not to be construed as representing aesthetics or any other attributes not specifically addressed, nor are they to be construed as an endorsement of the subject of the report or a recommendation for its use. There is no warranty by ICC Evaluation Service, LLC, express or implied, as to any finding or other matter in this report, or as to any product covered by the report.

Copyright © 2025 ICC Evaluation Service, LLC. All rights reserved.

DIVISION: 03 00 00—CONCRETE
Section: 03 16 00—Concrete Anchors

DIVISION: 05 00 00—METALS
Section: 05 05 19—Post-Installed Concrete Anchors

REPORT HOLDER:

HILTI, INC.

EVALUATION SUBJECT:

HILTI KH-EZ, KH-EZ P, KH-EZ PM, KH-EZ PL, KH-EZ C, KH-EZ E, KH-EZ I, AND KH-EZ CRC CARBON STEEL SCREW ANCHORS AND KH-EZ SS316 AND KH-EZ C SS316 STAINLESS STEEL SCREW ANCHORS FOR USE IN CRACKED AND UNCRACKED CONCRETE

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that Hilti KH-EZ, KH-EZ P, KH-EZ PM, KH-EZ PL, KH-EZ C, KH-EZ E, KH-EZ I, and KH-EZ CRC carbon steel screw anchors and KH-EZ SS316 and KH-EZ C SS316 stainless steel screw anchors in cracked and uncracked concrete, described in ICC-ES evaluation report ESR-3027, have also been evaluated for compliance with the codes noted below:

Compliance with the following codes:

- 2023 *Florida Building Code—Building*
- 2023 *Florida Building Code—Residential*

2.0 CONCLUSIONS

The Hilti KH-EZ, KH-EZ P, KH-EZ PM, KH-EZ PL, KH-EZ C, KH-EZ E, KH-EZ I, and KH-EZ CRC carbon steel screw anchors and KH-EZ SS316 and KH-EZ C SS316 stainless steel screw anchors, described in Sections 2.0 through 7.0 of the evaluation report ESR-3027, comply with the *Florida Building Code—Building* and the *Florida Building Code—Residential*, provided the design requirements are determined in accordance with the *Florida Building Code—Building* or the *Florida Building Code—Residential*, as applicable. The installation requirements noted in ICC-ES evaluation report ESR-3027 for the 2021 *International Building Code®* meet the requirements of the *Florida Building Code—Building* or the *Florida Building Code—Residential*, as applicable.

Use of the Hilti KH-EZ, KH-EZ P, KH-EZ PM, KH-EZ PL, KH-EZ C, KH-EZ E, KH-EZ I, and KH-EZ CRC carbon steel screw anchors, and KH-EZ SS316 and KH-EZ C SS316 stainless steel screw anchors in cracked and uncracked concrete have also been found to be in compliance with the High-Velocity Hurricane Zone provisions of the *Florida Building Code—Building* and the *Florida Building Code—Residential*, with the following condition:

a) For anchorage of wood members, the connection subject to uplift must be designed for no less than 700 pounds (3114 N).

For products falling under Florida Rule 61G20-3, verification that the report holder's quality assurance program is audited by a quality assurance entity approved by the Florida Building Commission for the type of inspections being conducted is the responsibility of an approved validation entity (or the code official, when the report holder does not possess an approval by the Commission). Florida Rule 61G20-3 is applicable to products and/or systems which comprise the building envelope and structural frame for compliance with the structural requirements of the Florida Building Code.

This supplement expires concurrently with the evaluation report, reissued December 2025.

ICC-ES Evaluation Reports are not to be construed as representing aesthetics or any other attributes not specifically addressed, nor are they to be construed as an endorsement of the subject of the report or a recommendation for its use. There is no warranty by ICC Evaluation Service, LLC, express or implied, as to any finding or other matter in this report, or as to any product covered by the report.

Copyright © 2025 ICC Evaluation Service, LLC. All rights reserved.

ICC-ES Evaluation Report

ESR-2502

Reissued May 2026

Subject to renewal May 2027

This report also contains:

- City of LA Supplement
- FL Supplement w/ HVHZ

For references to other reports.
See ELC-2502 for *National Building Code of Canada*® (NBCC)

ICC-ES Evaluation Reports are not to be construed as representing aesthetics or any other attributes not specifically addressed, nor are they to be construed as an endorsement of the subject of the report or a recommendation for its use. There is no warranty by ICC Evaluation Service, LLC, express or implied, as to any finding or other matter in this report, or as to any product covered by the report.

Copyright © 2026 ICC Evaluation Service, LLC. All rights reserved.

DIVISION: 03 00 00—CONCRETE **Section: 03 16 00—Concrete Anchors** **DIVISION: 05 00 00—METALS** **Section: 05 05 19—Post-installed Concrete Anchors**	**REPORT HOLDER:** **DEWALT** **ADDITIONAL LISTEE:** **THE HILLMAN GROUP**	**EVALUATION SUBJECT:** **POWER-STUD®+ SD2 CARBON STEEL ANCHORS, POWER-STUD®+ SD4 AND POWER-STUD®+ SD6 STAINLESS STEEL ANCHORS IN CRACKED AND UNCRACKED CONCRETE (DEWALT)**	

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2024, 2021, 2018, and 2015 *International Building Code*® (IBC)
- 2024, 2021, 2018, and 2015 *International Residential Code*® (IRC)

Main references of this report are for the 2024 IBC and IRC. See Table 10 and Table 11 for applicable sections of the code for previous IBC and IRC editions.

Property evaluated:

- Structural

2.0 USES

The Power-Stud+ SD2 carbon steel anchors and Power-Stud+ SD4 and SD6 stainless steel anchors are used to anchor building components to cracked and uncracked normal-weight and lightweight concrete having a specified compressive strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa) to resist static, wind and seismic tension and shear loads.

The $^3/_8$-inch- and $^1/_2$-inch diameter (9.5 mm and 12.7 mm) Power-Stud+ SD2 carbon steel anchors may be installed in the topside of cracked and uncracked normal-weight or sand-lightweight concrete over steel deck having a minimum specified compressive strength, f'_c, of 2,500 psi (17.2 MPa).

The $^3/_8$-inch through $^3/_4$-inch diameter (9.5 mm through 19.1 mm) Power-Stud+ SD2 carbon steel anchors may be installed in the soffit of cracked and uncracked normal-weight or sand-lightweight concrete over steel deck having a minimum specified compressive strength, f'_c, of 3,000 psi (20.7 MPa).

The anchors comply with Section 1901.3 of the 2024 IBC. The anchors may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

3.0 DESCRIPTION

3.1 General:

The anchors are torque-controlled, mechanical expansion anchors comprised of an anchor body, expansion wedge (clip), washer and hex nut.

The anchor body is comprised of a high-strength carbon or stainless steel rod threaded at one end and having a tapered mandrel at the other end. The tapered mandrel is enclosed by a three-section expansion clip which freely moves around the mandrel. The expansion clip movement is restrained by the mandrel taper and by a collar. On the stainless steel anchors, the mandrel taper has a knurling with the exception of the $^1/_4$-inch-diameter (6.4 mm) anchors.

The anchors are installed in a predrilled hole with a hammer. When torque is applied to the nut of the installed anchor on the threaded end of the anchor body, the mandrel at the other end of the anchor is drawn into the expansion clip, forcing it outward into the sides of the predrilled hole in the base material. Installation instructions and related information are set forth in Section 4.3, Tables 1, 2 and 6, and Figures A, 1, 3, 5A, 5B, 5C and 5D.

3.2 Power-Stud+ SD2 Carbon Steel Anchors:

The anchor body is manufactured from medium carbon steel and has minimum 0.0002-inch (5 µm) zinc plating in accordance with ASTM B633. The expansion clip is manufactured from AISI Type 316 stainless steel. The washer conforms to ASTM F844. The hex nuts conform to ASTM A563, Grade A. The Power-Stud+ SD2 anchor is illustrated in Figure 2. Installation instructions and related information are set forth in Section 4.3, Tables 1 and 2, and Figures A, 1, 3, 5A, 5B, 5C and 5D.

3.3 Power-Stud+ SD4 and Power-Stud+ SD6 Stainless Steel Anchors:

The Power-Stud+ SD4 anchor body is manufactured from Type 304 stainless steel and the Power-Stud+ SD6 is manufactured from Type 316 stainless steel. The expansion clips and hex nuts are manufactured from Type 316 stainless steel. Washers are manufactured from 300 series stainless steel for the Power-Stud+ SD4 and Type 316 stainless steel for the Power-Stud+ SD6. The Power-Stud+ SD4 and Power-Stud+ SD6 anchors are illustrated in Figure 2. Installation instructions and related information are set forth in Section 4.3, Table 6, and Figures A, 1 and 3.

Power-Stud+ SD4 and Power-Stud+ SD6 anchor names for the report holder and for the additional listees are presented in the following table.

COMPANY NAME	PRODUCT NAME	
DEWALT	Power-Stud+ SD4	Power-Stud+ SD6
The Hillman Group	Power Pro SD4 Wedge Anchor	Power Pro SD6 Wedge Anchor

3.4 Concrete:

Normal-weight and lightweight concrete must conform to Sections 1903 and 1905 of the 2024 IBC.

3.5 Steel Deck Panels (for SD2 anchors only):

Steel deck panels must comply with the configurations in Figure 5A and 5C of this report and have a minimum base-metal thickness of 0.035 inch (0.899 mm) [20 gauge]. Steel deck must comply with the requirements of ASTM A653/A653M SS Grade 33, and have a minimum yield strength of 33 ksi (228 MPa) for Figures 5A and 5C.

Steel deck panels must comply with the configurations in Figure 5B of this report and have a minimum base-metal thickness of 0.035 inch (0.899 mm) [20 gauge].Steel deck must comply with requirements of ASTM A653/A653M SS Grade 50, and have a minimum yield strength of 50 ksi (345 MPa) for Figure 5B.

4.0 DESIGN AND INSTALLATION

4.1 Strength Design:

4.1.1 General: Design strength of anchors complying with the 2024 IBC, as well as Section R301.1.3 of the 2024 IRC must be determined in accordance with ACI 318-19 Chapter 17 and this report.

A design example in accordance with the 2024 IBC is shown in Figure 6 of this report.

Design parameters are based on the 2024 IBC (ACI 318-19), unless noted otherwise in Sections 4.1.1 through 4.1.12 of this report. The strength design of anchors must comply with ACI 318-19 Section 17.5.1.2, except as required in ACI 318-19 Section 17.10. Strength reduction factors, ϕ, as given in ACI 318-19 Section 17.5.3, and noted in Tables 3, 4, 5, 7 and 8 of this report, must be used for load combinations calculated in

accordance with Section 1605.1 of the 2024 IBC or Section 5.3 of ACI 318-19. The value of f'_c must be limited to 8,000 psi (55.2 MPa), in accordance with ACI 318-19 Section 17.3.1.

4.1.2 Requirements for Static Steel Strength in Tension, N_{sa}: The nominal steel strength of a single anchor in tension, N_{sa}, is given in Tables 3 and 7 of this report. The values of N_{sa} for single anchors given in Tables 3 and 7 must be used and not be derived by calculation. For installation in the soffit of steel deck, the steel strength in tension is not decisive and need not be calculated.

4.1.3 Requirements for Static Concrete Breakout Strength in Tension, N_{cb} or N_{cbg}: The nominal concrete breakout strength of a single anchor or group of anchors in tension, N_{cb} and N_{cbg}, respectively, must be calculated in accordance with ACI 318-19 Section 17.6.2, with modifications as described in this section. The basic concrete breakout strength of a single anchor in tension, N_b, must be calculated according to ACI 318-19 Section 17.6.2.2, using the values of h_{ef} and k_{cr} as given in Tables 3 and 7 of this report. The nominal concrete breakout strength in tension in regions where analysis indicates no cracking in accordance with ACI 318-19 Section 17.6.2.5.1(a), must be calculated, with $\psi_{c,N} = 1.0$ and using the value of k_{uncr} as given in Tables 3 and 7. The value of f'_c must be limited to 8,000 psi (55.2 MPa), in accordance with ACI 318-19 Section 17.3.1.

For anchors installed in the soffit of sand-lightweight or normal-weight concrete filled steel deck floor and roof assemblies, as shown in Figures 5A, 5B and 5C, calculation of the concrete breakout strength in accordance with ACI 318-19 Section 17.6.2 is not required.

4.1.4 Requirements for Static Pullout Strength in Tension, N_{pn}: The nominal pullout strength of a single anchor in tension in accordance with ACI 318-19 Sections 17.6.3.1 and 17.6.3.2.1, in cracked and uncracked concrete, $N_{p,cr}$ and $N_{p,uncr}$, respectively, is given in Tables 3 and 7 of this report. In lieu of ACI 318-19 Section 17.6.3.3, $\psi_{c,P} = 1.0$ for all design cases. In accordance with ACI 318-19 Section 17.6.3.2.1, the nominal pullout strength in cracked concrete must be adjusted by calculation according to Eq-1:

$$N_{pn,f'_c} = N_{p,cr}\left(\frac{f'_c}{2{,}500}\right)^n \text{ (lb, psi)} \qquad \text{(Eq-1)}$$

$$N_{pn,f'_c} = N_{p,cr}\left(\frac{f'_c}{17.2}\right)^n \text{ (N, MPa)}$$

where f'_c is the specified concrete compressive strength and whereby the exponent $n = {}^1/_2$ for all anchor diameters with the exception of the ${}^3/_8$-inch-diameter (9.5 mm) Power-Stud+ SD2 anchor size, where $n = {}^1/_3$.

In regions where analysis indicates no cracking in accordance with ACI 318-19 Section 17.6.3.3, the nominal pullout strength in tension must be adjusted by calculation according to Eq-2:

$$N_{pn,f'_c} = N_{p,uncr}\left(\frac{f'_c}{2{,}500}\right)^n \text{ (lb, psi)} \qquad \text{(Eq-2)}$$

$$N_{pn,f'_c} = N_{p,uncr}\left(\frac{f'_c}{17.2}\right)^n \text{ (N, MPa)}$$

where f'_c is the specified concrete compressive strength and whereby the exponent $n = {}^1/_2$ for all anchors.

Where values for $N_{p,cr}$ or $N_{p,uncr}$ are not provided in Tables 3 or 7, the pullout strength in tension need not be evaluated.

The nominal pullout strength in tension of the anchors installed in the soffit of sand-lightweight or normal-weight concrete filled steel deck floor and roof assemblies, as shown in Figures 5A, 5B and 5C, is provided in Table 5. In accordance with ACI 318-19 Section 17.6.3.2.1, the nominal pullout strength in cracked concrete must be calculated according to Eq-1, whereby the value of $N_{p,deck,cr}$ must be substituted for $N_{p,cr}$ and the values of 3,000 psi or 20.7 MPa must substitute for 2,500 psi or 17.2 MPa in the denominator. In regions where analysis indicates no cracking in accordance with ACI 318-19 Section 17.6.3.3, the nominal strength in uncracked concrete must be calculated according to Eq-2, whereby the value of $N_{p,deck,uncr}$ must be substituted for $N_{p,uncr}$ and the values of 3,000 psi or 20.7 MPa must substitute for 2,500 psi or 17.2 MPa in the denominator.

4.1.5 Requirements for Static Steel Shear Capacity, V_{sa}: The nominal steel strength in shear, $V_{sa,}$ of a single anchor in accordance with ACI 318-19 Section 17.7.1.2, is given in Tables 4 and 8 of this report and must be used in lieu of the values derived by calculation from ACI 318-19 Eq. 17.7.1.2b. The shear strength $V_{sa,deck}$ of anchors installed in the soffit of sand-lightweight or normal weight concrete filled steel deck floor and roof assemblies, as shown in Figures 5A, 5B and 5C, is given in Table 5.

4.1.6 Requirements for Static Concrete Breakout Strength in Shear, V_{cb} or V_{cbg}: The nominal concrete breakout strength of a single anchor or group of anchors in shear, V_{cb} or V_{cbg}, respectively, must be calculated in accordance with ACI 318-19 Section 17.7.2, with modifications as described in this section.

The basic concrete breakout strength of a single anchor in shear, V_b, must be calculated in accordance with ACI 318-19 Section 17.7.2.2.1, using the values of ℓ_e and d_a given in Tables 4 and 8. The value of f'_c must be limited to 8,000 psi (55.2 MPa), in accordance with ACI 318-19 Section 17.3.1.

For anchors installed in the soffit of sand-lightweight or normal-weight concrete on steel deck floor and roof assemblies, as shown in Figures 5A, 5B and 5C, calculation of the concrete breakout strength in accordance with ACI 318-19 Section 17.7.2 is not required.

4.1.7 Requirements for Static Concrete Pryout Strength in Shear, V_{cp} or V_{cpg}: The nominal concrete pryout strength of a single anchor or a group of anchors in shear, V_{cp} or V_{cpg}, must be calculated in accordance with ACI 318-19 Section 17.7.3, using the value of k_{cp} provided in Tables 4 and 8 and the value of N_{cb} or N_{cbg} as calculated in accordance with Section 4.1.3 of this report.

For anchors installed in the soffit of sand-lightweight or normal-weight concrete on steel deck floor and roof assemblies, as shown in Figures 5A, 5B and 5C, calculation of the concrete pryout strength in accordance with ACI 318-19 Section 17.7.3 is not required.

4.1.8 Requirements for Seismic Design:

4.1.8.1 General: For load combinations including seismic loads, the design must be performed in accordance with ACI 318-19 Section 17.10. Modifications to ACI 318-19 Section 17.10 must be applied under Section 1905.7 of the 2024 IBC.

The anchors comply with ACI 318-19 Section 2.3 as ductile steel elements and must be designed in accordance with ACI 318-19 Sections 17.10.4, 17.10.5, 17.10.6, and 17.10.7. Strength reduction factors, ϕ, are given in Tables 3, 4, 5, 7 and 8. The anchors, except for the $^1/_4$-inch-diameter (6.4 mm) stainless steel anchors, may be installed in regions designed as IBC Seismic Design Category A through F.

4.1.8.2 Seismic Tension: The nominal steel strength and nominal concrete breakout strength for anchors in tension must be calculated according to ACI 318-19 Sections 17.6.1 and 17.6.2, respectively, as described in Sections 4.1.2 and 4.1.3 of this report. In accordance with ACI 318-19 Section 17.6.3.2.1, the appropriate value for pullout strength in tension for seismic loads, $N_{p,eq}$ or $N_{p,deck,cr}$, described in Tables 3, 5 and 7 of this report, must be used in lieu of N_p. The values of $N_{p,eq}$ or $N_{p,deck,cr}$ can be adjusted for concrete strength as follows:

$$N_{eq,f'_c} = N_{eq}\left(\frac{f'_c}{2{,}500}\right)^n \quad \text{(lb, psi)} \qquad \text{(Eq-3)}$$

$$N_{eq,f'_c} = N_{eq}\left(\frac{f'_c}{17.2}\right)^n \quad \text{(N, MPa)}$$

where f'_c is the specified concrete compressive strength and whereby the exponent $n = {}^1/_2$ for all anchor diameters with the exception of the $^3/_8$-inch-diameter (9.5 mm) Power-Stud+ SD2 anchor size where $n = {}^1/_3$. In addition, for sand-lightweight or normal-weight concrete filled steel deck floor and roof assemblies, the value of 3,000 psi or 20.7 MPa must be substituted for the value of 2,500 psi or 17.2 MPa in the denominator.

Where values of $N_{p,eq}$ are not provided in Tables 3 and 7 of this report, the pullout strength in tension for seismic loads does not govern and need not be evaluated.

4.1.8.3 Seismic Shear: The nominal concrete breakout strength and pryout strength for anchors in shear must be calculated according to ACI 318-19 Sections 17.7.2 and 17.7.3, respectively, as described in Sections 4.1.6 and 4.1.7 of this report. In accordance with ACI 318-19 Section 17.7.1.2, the appropriate value for nominal steel strength in shear for seismic loads, $V_{sa,eq}$ or $V_{sa,deck,eq}$, described in Tables 4, 5 and 8 of this report must be used in lieu of V_{sa}.

4.1.9 Interaction of Tensile and Shear Forces: For anchors or groups of anchors that are subject to the effects of combined tension and shear forces, the design must be performed in accordance with ACI 318-19 Section 17.8.

4.1.10 Requirements for Critical Edge Distance: In applications where $c < c_{ac}$ and supplemental reinforcement to control splitting of the concrete is not present, the concrete breakout strength in tension for uncracked concrete, calculated according to ACI 318-19 Section 17.6.2, must be further multiplied by the factor $\psi_{cp,N}$ given by the following equation:

$$\psi_{cp,N} = \frac{c}{c_{ac}} \qquad \text{(Eq-4)}$$

whereby the factor $\psi_{cp,N}$ need not be taken as less than $\frac{1.5h_{ef}}{c_{ac}}$. For all other cases $\psi_{cp,N} = 1.0$. In lieu of ACI 318-19 Section 17.9.5, values of c_{ac} provided in Tables 1, 2 and 6 of this report must be used.

4.1.11 Requirements for Minimum Member Thickness, Minimum Anchor Spacing and Minimum Edge Distance: In lieu of ACI 318-19 Section 17.9.2, values of c_{min} and s_{min} as given in Tables 1, 2 and 6 of this report must be used. In lieu of ACI 318-19 Section 17.9.4, minimum member thicknesses, h_{min} as given in Tables 1, 2 and 6 must be used. Additional combinations for minimum edge distance, c_{min}, and spacing, s_{min}, may be derived from linear interpolation between the given boundary values as described in Figure 4.

For anchors installed through the soffit of steel deck assemblies, the anchors must be installed in accordance with Figure 5A, 5B or 5C, as applicable, and must have an axial spacing along the flute equal to the greater of $3h_{ef}$ or 1.5 times the flute width.

For anchors installed in the top of concrete over steel deck assemblies, the anchors must be installed in accordance with Figure 5D.

4.1.12 Lightweight Concrete: For the use of anchors in lightweight concrete, the modification factor λ_a equal to 0.8λ is applied to all values of $\sqrt{f'_c}$ affecting N_n and V_n.

The value of λ must be determined in accordance with ACI 318-19.

For anchors installed in the soffit of sand-lightweight concrete-filled steel deck and floor and roof assemblies, further reduction of the pullout values provided in this report is not required.

4.2 Allowable Stress Design (ASD):

4.2.1 General: Where design values for use with allowable stress design (working stress design) load combinations in accordance with Section 1605.1 of the 2024 IBC are required, these are calculated using Eq-5 and Eq-6 as follows:

$$T_{allowable,ASD} = \frac{\phi N_n}{\alpha} \quad \text{(Eq-5)}$$

$$V_{allowable,ASD} = \frac{\phi V_n}{\alpha} \quad \text{(Eq-6)}$$

where:

$T_{allowable,ASD}$ = Allowable tension load (lbf or kN)

$V_{allowable,ASD}$ = Allowable shear load (lbf or kN)

ϕN_n = Lowest design strength of an anchor or anchor group in tension as determined in accordance with ACI 318-19 Chapter 17 and 2024 IBC Section 1905.7, and Section 4.1 of this report as applicable (lbf or N).

ϕVn = Lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318-19 Chapter 17 and 2024 IBC Section 1905.7, and Section 4.1 of this report as applicable (lbf or N).

α = Conversion factor calculated as a weighted average of the load factors for the controlling load combination. In addition, α must include all applicable factors to account for non-ductile failure modes and required over-strength.

The requirements for member thickness, edge distance and spacing, as described in this report, must apply. An example of allowable stress design values for illustrative purposes is shown in Table 9 and Figure 6 of this report.

4.2.2 Interaction of Tensile and Shear Forces: The interaction must be calculated and consistent with ACI 318-19 Section 17.8, as follows:

For shear loads $V \le 0.2V_{allowable,ASD}$, the full allowable load in tension must be permitted.

For tension loads $T \le 0.2T_{allowable,ASD}$, the full allowable load in shear must be permitted.

For all other cases: $\frac{T}{T_{allowable}} + \frac{V}{V_{allowable}} \le 1.2$ (Eq-7)

4.3 Installation:

Installation parameters are provided in Tables 1, 2 and 6, and Figures A, 1, 3, 5A, 5B, 5C and 5D. Anchor locations must comply with this report and the plans and specifications approved by the code official. The

Power-Stud+ SD2 carbon steel anchors and Power-Stud+ SD4 and Power-Stud+ SD6 stainless steel anchors must be installed according to manufacturer's printed installation instructions and this report. Anchors must be installed in holes drilled into the concrete using carbide-tipped masonry drill bits complying with ANSI B212.15-1994. The nominal drill bit diameter must be equal to that of the anchor size. The minimum drilled hole depths are given in Tables 1, 2 and 6. Remove dust and debris from the hole during drilling (e.g. dust extractor, hollow bit) or following drilling (e.g. suction, forced air) to extract loose particles created by drilling (see Figures A and 3). The anchor must be hammered into the predrilled hole until the proper nominal embedment depth is achieved. The nut must be tightened against the washer until the torque values specified in Tables 1, 2 and 6 are achieved.

For installation of SD2 anchors in the soffit of concrete on steel deck assemblies, the hole diameter in the steel deck must not exceed the diameter of the hole in the concrete by more than $^1/_8$ inch (3.2 mm). For member thickness and edge distance requirements for installations into the soffit of concrete on steel deck assemblies, see Figure 5A, 5B and 5C.

4.4 Special Inspection:

Periodic special inspection is required, in accordance with Section 1705.1.1 and Table 1705.3 of the 2024 IBC. The special inspector must make periodic inspections during anchor installation to verify anchor type, anchor dimensions, concrete type, concrete compressive strength, hole dimensions, hole cleaning procedure, anchor spacing, edge distances, concrete member thickness, anchor embedment, tightening torque and adherence to the manufacturer's installation instructions. The special inspector must be present as often as required in accordance with the "statement of special inspection".

5.0 CONDITIONS OF USE:

The anchors described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The anchors must be installed in accordance with the manufacturer's printed installation instructions and this report. In case of a conflict, this report governs.

5.2 Anchor sizes, dimensions, and minimum embedment depths are as set forth in this report.

5.3 The 1/4-inch-diameter (6.4 mm) anchors must be installed in uncracked normal-weight or lightweight concrete; 3/8-inch- to 3/4-inch-diameter (9.5 mm to 19.1 mm) anchors must be installed in cracked and uncracked normal-weight concrete and lightweight concrete having a specified compressive strength, f'c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa); and installed in the soffit or in the top of cracked and uncracked normal weight or sand-lightweight concrete over steel deck profiles having a minimum specified compressive strength, f'c, of 3,000 psi (20.7 MPa).

5.4 The values of f'c used for calculation purposes must not exceed 8,000 psi (55.2 MPa).

5.5 The concrete must have attained its minimum design strength prior to installation of the anchors.

5.6 Strength Design values must be established in accordance with Section 4.1 of this report.

5.7 Allowable Stress Design values must be established in accordance with Section 4.2 of this report.

5.8 Anchor spacing(s) and edge distance(s), as well as minimum member thickness, must comply with Tables 1, 2 and 6, and Figures 5A, 5B, 5C and 5D.

5.9 Prior to installation, calculations and details demonstrating compliance with this report must be submitted to the code official. The calculations and details must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

5.10 Since an ICC-ES acceptance criteria for evaluating data to determine the performance of anchors subjected to fatigue or shock loading is unavailable at this time, the use of these anchors under such conditions is beyond the scope of this report.

5.11 Anchors may be installed in regions of concrete where cracking has occurred or where analysis indicates cracking may occur (ft > fr), subject to the conditions of this report.

5.12 The 3/8-inch-diameter to 3/4-inch-diameter (9.5 mm to 19.1 mm) anchors may be used to resist short-term loading due to wind or seismic forces in locations designated as Seismic Design Categories A through F under the IBC, subject to the conditions of this report. The 1/4-inch-diameter (6.4 mm) anchors may be used to resist short-term loading due to wind forces, and for seismic load combinations limited to structures assigned to Seismic Design Categories A and B under the IBC, subject to the conditions of this report.

5.13 Where not otherwise prohibited in the code, the anchors are permitted for use with fire-resistance-rated construction provided that at least one of the following conditions is fulfilled:

- Anchors are used to resist wind or seismic forces only.
- Anchors that support a fire-resistance-rated envelope or a fire-resistance-rated membrane are protected by approved fire-resistance-rated materials, or have been evaluated for resistance to fire exposure in accordance with recognized standards.
- Anchors are used to support nonstructural elements.

5.14 Use of zinc-coated carbon steel anchors is limited to dry, interior locations.

5.15 Use of anchors made of stainless steel as specified in this report are permitted for exterior exposure or damp environments.

5.16 Use of anchors made of stainless steel as specified in this report are permitted for contact with preservative-treated and fire-retardant-treated wood.

5.17 Special inspection must be provided in accordance with Section 4.4 of this report.

5.18 Anchors are manufactured under an approved quality-control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Mechanical Anchors in Concrete Elements AC193 (24a), published April 2025, which incorporates requirements in ACI 355.2 (-19 and -07), for use in cracked and uncracked concrete; including optional service-condition Test No. 18 and Test No. 19 (AC193, Annex 1, Table 4.2) for seismic tension and shear, respectively; and quality control documentation.

7.0 IDENTIFICATION

7.1 The ICC-ES mark of conformity, electronic labeling, or the evaluation report number (ICC-ES ESR-2502) along with the name, registered trademark, or registered logo of the report holder and/or listee must be included in the product label.

7.2 In addition, the anchors are identified by dimensional characteristics and packaging. A length letter code head marking is stamped on each anchor on the exposed threaded stud end which is visible after installation. Table B shows the length code identification system. For the Power-Stud+ SD2 anchors, a plus sign "+" and the number "2" are also visible after installation. For the Power-Stud+ SD4 and Power-Stud+ SD6 anchors, a plus sign "+" is also marked with a number on all anchors with the exception of the $^1/_4$-inch-diameter (6.4 mm) anchors. The number "4" designates the Power-Stud+ SD4 and the number "6" designates the Power-Stud+ SD6. Packages are identified with the anchor name, type and size and the company name as set forth in Table A.

7.3 The report holder's contact information is the following:

DEWALT
701 EAST JOPPA ROAD
TOWSON, MARYLAND 21286
(800) 524-3244
www.DEWALT.com
anchors@DEWALT.com

7.4 The additional listee's contact information is the following:

THE HILLMAN GROUP
1280 KEMPER MEADOW DRIVE
CINCINNATI, OHIO 45240
info@hillmangroup.com

TABLE A—PRODUCT AND DESIGN INDEX

Product Name	Installation Specifications	Tesion Design Data			Shear Design Data		
		Concrete	Top of Concrete Over Steel Deck	Steel Deck Soffit	Concrete	Top of Concrete Over Steel Deck	Steel Deck Soffit
Power-Stud+ SD2	Tables 1 and 2	Table 3	Table 3	Table 5	Table 4	Table 4	Table 5
Power-Stud+ SD4 and Power-Stud+ SD6	Table 6	Table 7	Table 7	Not applicable	Table 8	Table 8	Not applicable

TABLE B—POWER-STUD+ SD2, POWER-STUD+ SD4 AND POWER-STUD+ SD6 ANCHOR LENGTH CODE IDENTIFICATION SYSTEM

Length ID marking on threaded stud head		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
Overall anchor length, ℓ_{anch}, (inches)	From	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7	7 1/2	8	8 1/2	9	9 1/2	10
	Up to but not including	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7	7 1/2	8	8 1/2	9	9 1/2	10	11

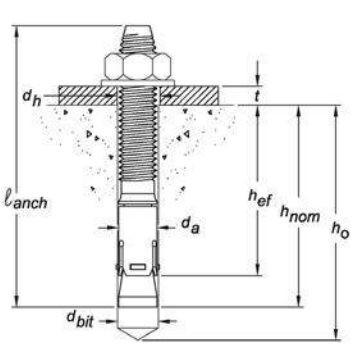


FIGURE 1—POWER-STUD+ SD2, POWER-STUD+ SD4 AND POWER-STUD+ SD6 ANCHOR DETAIL Before (Left Picture) and After (Right Picture) Application of Installation Torque

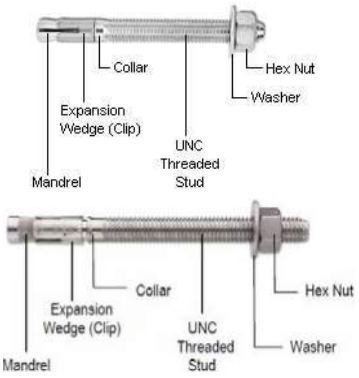
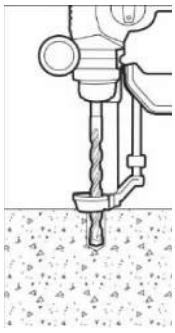
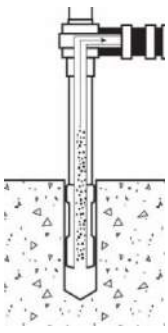


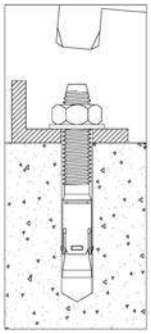
FIGURE 2—POWER-STUD+ SD2 (Top Picture), POWER-STUD+ SD4 AND POWER-STUD+ SD6 (Bottom Picture), ANCHOR ASSEMBLY



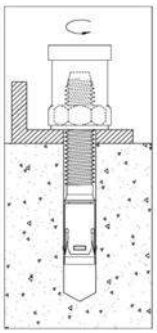
1.) Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.



2.) Remove dust and debris from the hole during drilling (e.g., dust extractor, hollow bit) or following drilling (e.g., suction, forced air) to extract loose particles created by drilling.

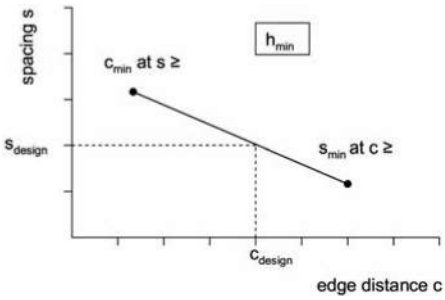


3.) Position the washer on the anchor and thread on the nut. If installing through a fixture, drive the anchor through the fixture into the hole. Be sure the anchor is driven to the minimum required embedment depth, h_{nom}.



4.) Tighten the anchor with a torque wrench by applying the required installation torque, T_{inst}. Note: the threaded stud will draw up during tightening of the nut; the expansion wedge (clip) remains in original position.

FIGURE 3— POWER-STUD+ SD2, POWER-STUD+ SD4 AND POWER-STUD+ SD6 INSTALLATION INSTRUCTIONS



[1]This interpolation applies to the cases when two sets of minimum edge distances, c_{min}, and minimum spacing distances, s_{min}, are given in Tables 1, 2, and 6 for a given anchor diameter under the same effective embedment depth, h_{ef}, and corresponding minimum member thickness, h_{min}.

FIGURE 4—INTERPOLATION OF MINIMUM EDGE DISTANCE AND MINIMUM ANCHOR SPACING[1]

TABLE 1—POWER-STUD+ SD2 ANCHOR INSTALLATION SPECIFICATIONS

ANCHOR PROPERTY / SETTING INFORMATION	NOTATION	UNITS	NOMINAL ANCHOR SIZE (inch)									
			3/8	1/2				5/8			3/4	
Outside diameter of anchor	d_a	in. (mm)	0.375 (9.5)	0.500 (12.7)				0.625 (15.9)			0.750 (19.1)	
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	7/16 (11.1)	9/16 (14.3)				11/16 (17.5)			13/16 (20.6)	
Nominal drill bit diameter (ANSI)	d_{bit}	in.	3/8	1/2				5/8			3/4	
Minimum nominal embedment depth[1]	h_{nom}	in. (mm)	2 3/8 (60)	2 1/2 (64)		3 3/4 (83)		3 7/8 (98)	4 7/8 (124)		4 1/2 (114)	5 3/4 (146)
Effective embedment	h_{ef}	in. (mm)	2.00 (51)	2.00 (51)		3.25 (83)		3.25 (83)	4.25 (108)		3.75 (95)	5.00 (127)
Minimum concrete member thickness[2,3]	h_{min}	in. (mm)	4 (102)	4 1/2 (114)	6 (152)	5 3/4 (146)	5 3/4 (146)	5 3/4 (146)	6 1/2 (165)	8 (203)	7 (178)	10 (254)
Critical edge distance[3] (uncracked concrete)	c_{ac}	in. (mm)	6 1/2 (165)	8 (203)		10 (254)		8 (203)	15 3/4 (400)	10 (254)	12 (305)	12 (305)
Minimum edge distance[3,4]	c_{min}	in. (mm)	2 1/2 (64)	4 (102)	2 3/4 (70)	4 (102)	2 3/4 (70)	4 1/4 (108)	4 1/4 (108)		5 (127)	4 1/2 (114)
Minimum spacing distance[3,4]	s_{min}	in. (mm)	3 1/2 (89)	6 (152)	6 (152)	4 (102)	6 (152)	4 1/4 (108)	4 1/4 (108)		6 (152)	6 (152)
Minimum hole depth[3]	h_o	in. (mm)	2 5/8 (67)	2 3/4 (70)		4 (102)		4 1/4 (108)	5 1/4 (133)		5 (127)	6 1/4 (159)
Minimum overall anchor length[5]	ℓ_{anch}	in.	3	3 3/4		4 1/2		4 3/4	6		5 1/2	7
Installation torque	T_{inst}	ft.-lb. (N-m)	20 (27)	40 (54)				60 (81)			110 (149)	
Torque wrench / socket size	-	in.	9/16	3/4				15/16			1 1/8	
Hex nut height	-	In.	21/64	7/16				35/64			41/64	

For **SI:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m.

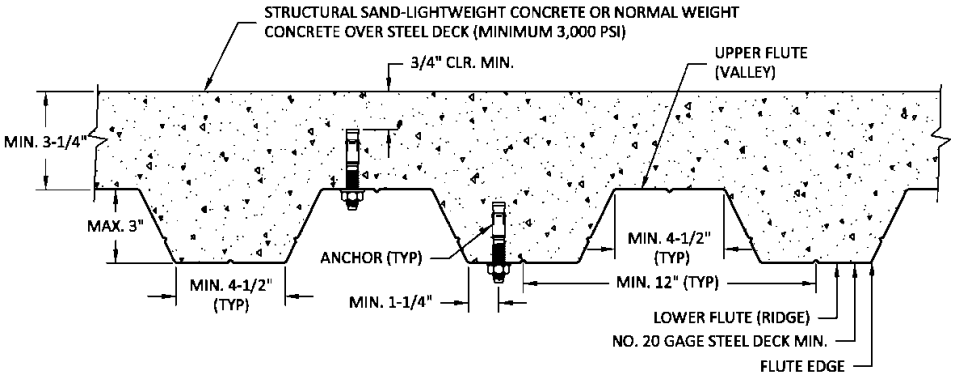
[1]The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor prior to tightening.
[2]The anchors may be installed in the topside of concrete-filled steel deck floor and roof assemblies in accordance with Section 4.3 of this report, provided the concrete thickness above the upper flute meets the minimum thicknesses as specified in Table 2 and Figure 5D of this report.
[3]For installations through the soffit of steel deck into concrete see the installation details in Figures 5A, 5B and 5C of this report. In addition, anchors must have an axial spacing along the flute soffit equal to the greater of $3h_{ef}$ or 1.5 times the flute width.
[4]Additional combinations for minimum edge distance, c_{min}, and minimum spacing distance, s_{min}, may be derived by linear interpolation between the given boundary values for the anchors, See Figure 4.
[5]The listed minimum overall anchor length is based on anchor sizes commercially available at the time of publication compared with the requirements to achieve the minimum nominal embedment depth and possible fixture attachment, as applicable.

TABLE 2—POWER-STUD+ SD2 ANCHORS SETTING INFORMATION FOR INSTALLATION ON THE TOP OF CONCRETE-FILLED STEEL DECK ASSEMBLIES (ACCORDING TO FIGURE 5D)

ANCHOR PROPERTY / SETTING INFORMATION	NOTATION	UNITS	NOMINAL ANCHOR SIZE (inch)			
			3/8		1/2	
Nominal drill bit diameter (ANSI)	d_{bit}	in.	3/8		1/2	
Minimum nominal embedment depth[1]	h_{nom}	in. (mm)	2 3/8 (60)		2 1/2 (64)	
Effective embedment	h_{ef}	in. (mm)	2.00 (51)		2.00 (51)	
Minimum concrete member thickness[2,3]	$h_{min,deck}$	in. (mm)	2 1/2 (64)		2 1/2 (64)	
Critical edge distance for topside of concrete-filled steel decks with minimum topping thickness (uncracked concrete)[3]	$c_{ac,deck,top}$	in. (mm)	8 (203)		9 (229)	
Minimum edge distance[3,4]	$c_{min,deck,top}$	in. (mm)	4 (102)	2 3/4 (70)	4 (102)	8 (203)
Minimum spacing distance[3,4]	$s_{min,deck,top}$	in. (mm)	3 1/2 (89)	6 (152)	8 (203)	4 (102)
Minimum hole depth	h_o	in. (mm)	2 1/2 (64)		2 1/2 (64)	
Minimum overall anchor length[5]	ℓ_{anch}	in.	3		3 3/4	
Installation torque	T_{inst}	ft.-lb. (N-m)	20 (27)		40 (54)	
Torque wrench / socket size	-	in.	9/16		3/4	
Hex nut height	-	in.	21/64		7/16	

For **SI:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m.

[1]The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor prior to tightening.
[2]The anchors may be installed in the topside of concrete-filled steel deck floor and roof assemblies in accordance with Section 4.3 of this report provided the concrete thickness above the upper flute meets the minimum thicknesses specified in this table. Minimum concrete member thickness refers to the concrete thickness above the upper flute (topping thickness). See Figure 5D of this report.
[3]For all other anchor diameters and embedment depths, refer to Table 1 for applicable values of h_{min}, c_{min} and s_{min}.
[4]Additional combinations for minimum design distance, c_{min}, and minimum spacing distance, s_{min}, may be derived by linear interpolation between the given boundary values for the anchors. See Figure 4.
[5]The listed minimum overall anchor length is based on anchor sizes commercially available at the time of publication compared with the requirements to achieve the minimum nominal embedment depth and possible fixture attachment, as applicable.

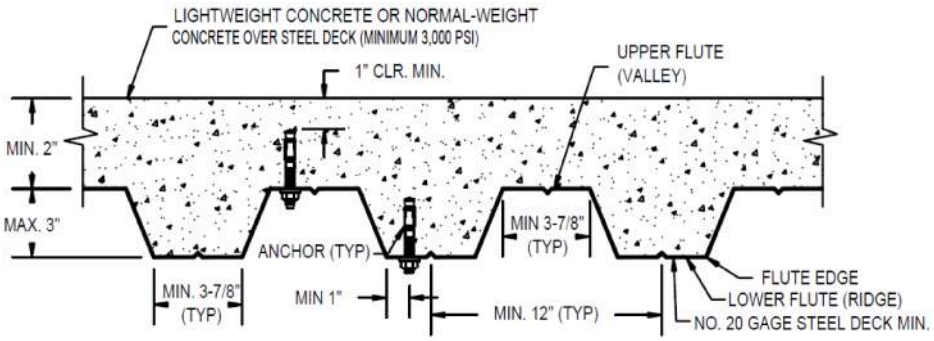


[1] SD2 anchors may be placed in the upper flute or lower flute of the steel deck profiles in accordance with Figure 5A provided the minimum hole clearance is satisfied.

Anchors in the lower flute of Figure 5A profiles may be installed with a maximum 1-inch offset in either direction from the center of the flute. The offset distance may be increased proportionally for profiles with lower flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied.

[2] See Table 5 of this report for design data.

FIGURE 5A—POWER-STUD+ SD2 INSTALLATION DETAIL FOR ANCHORS IN THE SOFFIT OF CONCRETE OVER STEEL DECK FLOOR AND ROOF ASSEMBLIES (SEE DIMENSIONAL PROFILE REQUIREMENTS)[1,2]

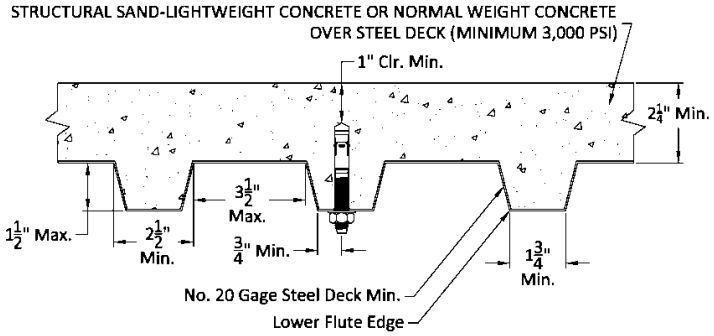


[1] SD2 anchors may be placed in the upper flute or lower flute of the steel deck profiles in accordance with Figure 5B provided the minimum hole clearance is satisfied.

Anchors in the lower flute of Figure 5B profiles may be installed with a maximum $^{15}/_{16}$-inch offset in either direction from the center of the flute. The offset distance may be increased proportionally for profiles with lower flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied.

[2] See Table 5 of this report for design data.

FIGURE 5B—POWER-STUD+ SD2 INSTALLATION DETAIL FOR ANCHORS IN THE SOFFIT OF CONCRETE OVER STEEL DECK FLOOR AND ROOF ASSEMBLIES (SEE DIMENSIONAL PROFILE REQUIREMENTS)[1,2]



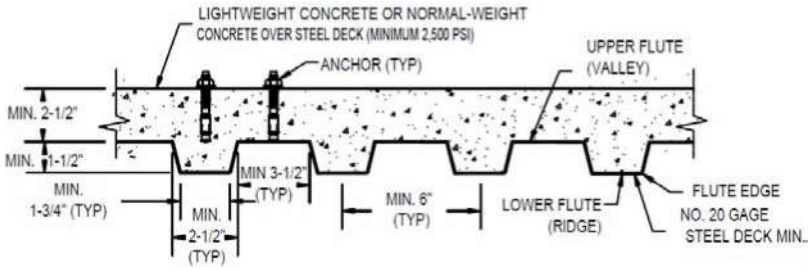
[1] SD2 anchors may be placed in the lower flute of the steel deck profiles in accordance with Figure 5C provided the minimum hole clearance is satisfied.

Anchors in the lower flute of Figure 5C profiles may be installed with a maximum $^{1}/_{8}$-inch offset in either direction from the center of the flute. The offset distance may be increased proportionally for profiles with lower flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied.

[2] Anchors may be placed in the upper flute of the steel deck profiles in accordance with Figure 5C provided the concrete thickness above the upper flute is minimum $3^{1}/_{4}$-inch and a minimum hole clearance of $^{3}/_{4}$-inch is satisfied.

[3] See Table 5 of this report for design data.

FIGURE 5C—POWER-STUD+ SD2 INSTALLATION DETAIL FOR ANCHORS IN THE SOFFIT OF CONCRETE OVER STEEL DECK FLOOR AND ROOF ASSEMBLIES (SEE DIMENSIONAL PROFILE REQUIREMENTS)[1,2,3]



[1] Anchors may be placed in the top side of concrete over steel deck profiles in accordance with Figure 5D provided the minimum concrete thickness above the upper flute (topping thickness) is as illustrated the and minimum spacing distance and minimum edge distances are satisfied as given in Table 2 of this report.

[2] For anchors installed in the top of concrete over steel deck profiles with concrete thickness above the upper flute (topping thickness) greater than or equal to the minimum concrete member thicknesses specified in Table 1 the minimum spacing distance and minimum edge distances may be used from those tables, as applicable.

[3] See Tables 3 and 4 of this report for design data.

FIGURE 5D—INSTALLATION DETAIL FOR ANCHORS IN THE TOP OF CONCRETE OVER STEEL DECK FLOOR AND ROOF ASSEMBLIES (SEE DIMENSIONAL PROFILE REQUIREMENTS)[1,2]

TABLE 3—TENSION DESIGN INFORMATION FOR POWER-STUD+ SD2 ANCHORS IN CONCRETE[1,2,12]

Design Characteristic	Notation	Units	Nominal Anchor Size (inch)						
			3/8	1/2		5/8		3/4	
Anchor category	1, 2 or 3	-	1	1		1		1	
Effective embedment	h_{ef}	in. (mm)	2.00 (51)	2.00 (51)	3.25 (83)	3.25 (83)	4.25 (108)	3.75 (95)	5.00 (127)
STEEL STRENGTH IN TENSION (ACI 318-19 Section 17.6.1)[4]									
Minimum specified yield strength (neck)	f_y	ksi (N/mm^2)	96.0 (662)	85.0 (586)		85.0 (586)		70.0 (483)	
Minimum specified ultimate strength (neck)	f_{uta}	ksi (N/mm^2)	120.0 (827)	106.0 (731)		106.0 (731)		90.0 (620)	
Effective tensile stress area (neck)	$A_{se,N}$	in^2 (mm^2)	0.0552 (35.6)	0.1007 (65.0)		0.1619 (104.5)		0.2359 (153.2)	
Steel strength in tension[5]	N_{sa}	lbf (kN)	6,625 (29.5)	10,445 (46.5)		13,080 (58.2)		21,230 (94.4)	
Reduction factor for steel strength[3]	ϕ	-	0.75						
CONCRETE BREAKOUT STRENGTH IN TENSION (ACI 318-19 Section 17.6.2)[9]									
Effectiveness factor for uncracked concrete	k_{uncr}	-	24	24		24		24	
Effectiveness factor for cracked concrete	k_{cr}	-	17	17		17		17	
Modification factor for cracked and uncracked concrete[6]	$\Psi_{c,N}$	-	1.0 See note 6	1.0 See note 6		1.0 See note 6		1.0 See note 6	
Critical edge distance (uncracked concrete)	c_{ac}	in. (mm)	See Table 1						
Critical edge distance for topside of concrete-filled steel decks with minimum topping thickness (uncracked concrete)[13]	$c_{ac,deck,top}$	in. (mm)	See Table 2						
Reduction factor for concrete breakout strength in tension[3]	ϕ	-	0.65 (Condition B, supplementary reinforcement not present)						
PULLOUT STRENGTH IN TENSION (ACI 318-19 Section 17.6.3)[9]									
Characteristic pullout strength, uncracked concrete (2,500 psi)[7]	$N_{p,uncr}$	lbf (kN)	2,775 (12.3)	See note 8	6,615 (29.4)	See note 8	See note 8	See note 8	See note 8
Characteristic pullout strength, cracked concrete (2,500 psi)[7]	$N_{p,cr}$	lbf (kN)	2,165 (9.6)	See note 8	4,375 (19.5)	See note 8	See note 8	See note 8	7,795 (35.1)
Reduction factor for pullout strength[3]	ϕ	-	0.65 (Condition B, supplementary reinforcement not present)						
PULLOUT STRENGTH IN TENSION FOR SEISMIC APPLICATIONS (ACI 318-19 Section 17.10.3)[9]									
Characteristic pullout strength, seismic (2,500 psi)[7,10]	$N_{p,eq}$	lbf (kN)	2,165 (9.6)	See note 8	4,375 (19.5)	See note 8	See Note 8	See note 8	7,795 (35.1)
Reduction factor for pullout strength[3]	ϕ	-	0.65 (Condition B, supplementary reinforcement not present)						
Mean axial stiffness values service load range[11] — Uncracked concrete	β_{uncr}	lbf/in. (kN/mm)	865,000 (1517)		717,000 (1258)		569,000 (998)		420,000 (747)
Mean axial stiffness values service load range[11] — Cracked concrete	β_{cr}	lbf/in. (kN/mm)	49,500 (87)		57,000 (100)		64,500 (113)		72,000 (126)

For **SI:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 ksi = 6.895 N/mm^2, 1 lbf = 0.0044 kN.

[1]The data in this table is intended to be used with the design provisions of ACI 318-19 Chapter 17; for anchors resisting seismic load combinations the additional requirements of ACI 318-19 Section 17.10 must apply.
[2]Installation must comply with printed instructions and details.
[3]The strength reduction factor applies when the load combinations from the IBC or ACI 318-19 are used and the requirements of ACI 318-19 Section 17.5.3 are met.
[4]The Power-Stud+ SD2 is considered a ductile steel element in tension as defined by ACI 318-19 Section 2.3.
[5]Tabulated values for steel strength in tension are based on test results per ACI 355.2 and must be used for design in lieu of calculation.
[6]For all design cases $\Psi_{c,N}$=1.0. The appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) must be used.
[7]For all design cases $\Psi_{c,P}$=1.0. For the calculation of N_{pn}, including adjustment for specified concrete compressive strength, see Section 4.1.4 of this report.
[8]Pullout strength does not control design of indicated anchors. Do not calculate pullout strength for indicated anchor size and embedment.
[9]Anchors are permitted to be used in lightweight concrete in accordance with Section 4.1.12 of this report.
[10]Tabulated values for characteristic pullout strength in tension are for seismic applications are based on test results per ACI 355.2, Section 9.5.
[11]Actual stiffness of the mean value varies considerably depending on concrete strength, loading and geometry of application.
[12]Anchors are permitted for use in concrete-filled steel deck floor and roof assemblies, see Section 4.1 and Figures 5A, 5B, 5C and 5D of this report.
[13]Tabulated critical edge distance values, $c_{ac,deck,top}$, are for anchors installed in the top of concrete over steel deck profiles with a minimum concrete thickness, $h_{min,deck}$, of 2.5 inches above the upper flute (topping thickness). For minimum topping thickness greater than or equal to the minimum concrete member thicknesses, h_{min}, given in Table 1, the associated critical edge distance, c_{ac}, for indicated anchor diameters and embedment depths may be used in the calculation of $\Psi_{cp,N}$, in accordance with Section 4.1.10 of this report, as applicable.

TABLE 4—SHEAR DESIGN INFORMATION FOR POWER-STUD+ SD2 ANCHORS IN CONCRETE[1,2,8]

Design Characteristic	Notation	Units	Nominal Anchor Diameter (inch)						
			3/8	1/2		5/8		3/4	
Anchor category	1, 2 or 3	-	1	1		1		1	
Effective embedment	h_{ef}	in. (mm)	2.00 (51)	2.00 (51)	3.25 (83)	3.25 (83)	4.25 (108)	3.75 (95)	5.00 (127)
STEEL STRENGTH IN SHEAR (ACI 318-19 Section 17.7.1)[4]									
Minimum specified yield strength (threads)	f_y	ksi (N/mm^2)	76.8 (530)	68.0 (469)		68.0 (469)		56.0 (386)	
Minimum specified ultimate strength (threads)	f_{uta}	ksi (N/mm^2)	100.0 (690)	88.0 (607)		88.0 (607)		80.0 (551)	
Effective tensile stress area (threads)	$A_{se,V}$	in^2 (mm^2)	0.0775 (50.0)	0.1419 (91.6)		0.2260 (145.8)		0.3345 (215.8)	
Steel strength in shear[5]	V_{sa}	lbf (kN)	3,115 (13.9)	4,815 (21.4)		10,170 (45.2)		12,610 (56.1)	
Reduction factor for steel strength[3]	ϕ	-	0.65						
STEEL STRENGTH IN SHEAR FOR SEISMIC APPLICATIONS (ACI 318-19 Section 17.10.3)									
Steel strength in shear, seismic[7]	$V_{sa,eq}$	lbf (kN)	2,460 (11.0)	4,815 (21.4)		6,770 (30.1)		8,060 (35.9)	
Reduction factor for steel strength in shear, seismic[3]	ϕ	-	0.65						
CONCRETE BREAKOUT STRENGTH IN SHEAR (ACI 318-19 Section 17.7.2)[6]									
Load-bearing length of anchor	ℓ_e	in. (mm)	2.00 (51)	2.00 (51)	3.25 (83)	3.25 (83)	4.25 (108)	3.75 (95)	5.00 (127)
Nominal anchor diameter	d_a	in. (mm)	0.375 (9.5)	0.500 (12.7)		0.625 (15.9)		0.750 (19.1)	
Reduction factor for concrete breakout strength in shear[3]	ϕ	-	0.70 (Condition B, supplementary reinforcement not present)						
PRYOUT STRENGTH IN SHEAR (ACI 318-19 Section 17.7.3)[6]									
Coefficient for pryout strength	k_{cp}	-	1.0	1.0	2.0	2.0	2.0	2.0	2.0
Reduction factor for pryout strength[3]	ϕ	-	0.70 (Condition B, supplementary reinforcement not present)						

For **SI:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 ksi = 6.895 N/mm^2, 1 lbf = 0.0044 kN.

[1]The data in this table is intended to be used with the design provisions of ACI 318-19 Chapter 17; for anchors resisting seismic load combinations the additional requirements of ACI 318-19 Section 17.10 must apply.
[2]Installation must comply with printed instructions and details.
[3]The strength reduction factor applies when the load combinations from the IBC or ACI 318-19 are used and the requirements of ACI 318-19 Section 17.5.3 are met.
[4]The Power-Stud+ SD2 is considered a ductile steel element as defined by ACI 318-19 Section 2.3.
[5]Tabulated values for steel strength in shear are based on test results per ACI 355.2, Section 9.4 and must be used for design.
[6]Anchors are permitted to be used in lightweight concrete in accordance with Section 4.1.12 of this report.
[7]Tabulated values for steel strength in shear are for seismic applications are based on test results per ACI 355.2, Section 9.6.
[8]Anchors are permitted for use in concrete-filled steel deck floor and roof assemblies, see Section 4.1 and Figures 5A, 5B, 5C and 5D of this report.

TABLE 5—TENSION AND SHEAR DESIGN DATA FOR POWER-STUD+ SD2 ANCHORS IN THE SOFFIT OF CONCRETE-FILLED STEEL DECK ASSEMBLIES[1,2,7,8]

Design Characteristic		Notation	Units	Nominal Anchor Size (inch)					
				3/8	1/2		5/8		3/4
Anchor category		1, 2 or 3	-	1	1		1		1
Effective embedment		h_{ef}	in. (mm)	2.00 (51)	2.00 (51)	3.25 (83)	3.25 (83)	4.25 (108)	3.75 (95)
Minimum nominal embedment depth		h_{nom}	in. (mm)	2 3/8 (60)	2 1/2 (64)	3 3/4 (83)	3 7/8 (98)	4 7/8 (124)	4 1/2 (114)
Minimum hole depth		h_o	in. (mm)	2 5/8 (67)	2 3/4 (70)	4 (102)	4 1/4 (108)	5 1/4 (133)	5 (127)
PULLOUT STRENGTH IN TENSION FOR ANCHORS IN SOFFIT OF SAND-LIGHTWEIGHT AND NORMAL-WEIGHT CONCRETE OVER STEEL DECK[1]									
According to Figure 5A 4 1/2-inch-wide deck flute	Characteristic pullout strength, uncracked concrete over steel deck[2]	$N_{p,deck,uncr}$	lbf (kN)	1,855 (8.3)	2,065 (9.2)	3,930 (17.5)	4,665 (20.8)	7,365 (32.8)	4,900 (21.8)
	Characteristic pullout strength, cracked concrete over steel deck[2,3]	$N_{p,deck,cr}$ ($N_{p,deck,eq}$)	lbf (kN)	1,445 (6.4)	1,465 (6.5)	2,600 (11.6)	3,305 (14.7)	5,215 (23.2)	3,470 (15.4)
According to Figure 5B 3 7/8-inch-wide deck flute	Characteristic pullout strength, uncracked concrete over steel deck[2]	$N_{p,deck,uncr}$	lbf (kN)	2,235 (9.9)	2,785 (12.4)	5,600 (24.9)	4,480 (19.9)	7,265 (32.3)	Not Applicable
	Characteristic pullout strength, cracked concrete over steel deck[2,3]	$N_{p,deck,cr}$ ($N_{p,deck,eq}$)	lbf (kN)	1,745 (7.8)	1,975 (8.8)	3,695 (16.4)	3,175 (14.1)	5,145 (22.9)	
According to Figure 5C 1 3/4-inch-wide deck flute	Characteristic pullout strength, uncracked concrete over steel deck[2]	$N_{p,deck,uncr}$	lbf (kN)	1,600 (7.1)	2,025 (9.0)	Not Applicable	Not Applicable	Not Applicable	Not Applicable
	Characteristic pullout strength, cracked concrete over steel deck[2,3]	$N_{p,deck,cr}$ ($N_{p,deck,eq}$)	lbf (kN)	1,250 (5.6)	1,435 (6.4)				
Reduction factor for pullout strength[6]		ϕ	-	0.65 (Condition B)					
STEEL STRENGTH IN SHEAR FOR ANCHORS IN SOFFIT OF SAND-LIGHTWEIGHT AND NORMAL-WEIGHT CONCRETE OVER STEEL DECK[4]									
According to Figure 5A 4 1/2-inch-wide deck flute	Steel strength in shear, concrete over steel deck[5]	$V_{sa,deck}$	lbf (kN)	2,170 (9.7)	3,815 (17.0)	5,040 (22.4)	4,015 (17.9)	6,670 (29.7)	4,325 (19.2)
	Steel strength in shear, seismic, concrete over steel deck[5]	$V_{sa,deck,eq}$	lbf (kN)	1,715 (7.6)	3,815 (17.0)	5,040 (22.4)	2,675 (11.9)	4,445 (19.8)	2,820 (12.5)
According to Figure 5B 3 7/8-inch-wide deck flute	Steel strength in shear, concrete over steel deck[5]	$V_{sa,deck}$	lbf (kN)	3,040 (13.5)	2,675 (11.9)	4,930 (21.9)	5,370 (23.9)	6,070 (27.0)	Not Applicable
	Steel strength in shear, seismic, concrete over steel deck[5]	$V_{sa,deck,eq}$	lbf (kN)	2,400 (10.6)	2,675 (11.9)	4,930 (21.9)	3,580 (15.9)	4,045 (18.0)	
According to Figure 5C 1 3/4-inch-wide deck flute	Steel strength in shear, concrete over steel deck[5]	$V_{sa,deck}$	lbf (kN)	2,170 (9.7)	2,880 (12.8)	Not Applicable	Not Applicable	Not Applicable	Not Applicable
	Steel strength in shear, seismic, concrete over steel deck[5]	$V_{sa,deck,eq}$	lbf (kN)	1,715 (7.6)	2,880 (12.8)				
Reduction factor for steel strength in shear, concrete over steel deck[6]		ϕ	-	0.65					

For **SI:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 ksi = 6.895 N/mm^2, 1 lbf = 0.0044 kN.

[1]For all design cases $\Psi_{c,P}$ = 1.0. For the calculation of N_{pn}, including adjustment for specified concrete compressive strength, see Section 4.1.4 of this report. see Section 4.1.4 of this report.

[2]Values for $N_{p,deck}$ are for sand-lightweight concrete ($f'_{c,\ min}$ = 3,000 psi) and additional lightweight concrete reduction factors need not be applied. In addition, evaluation for the concrete breakout capacity in accordance with ACI 318-19 Section 17.6.2 is not required for anchors installed in the deck soffit (flute).

[3]Values for $N_{p,deck,cr}$ are applicable for seismic loading; see Section 4.1.8.2 of this report.

[4]Shear loads for anchors installed through steel deck into concrete may be applied in any direction.

[5]Values for $V_{sa,deck}$ and $V_{sa,deck,eq}$ are for sand-lightweight concrete ($f'_{c,\ min}$ = 3,000 psi) and additional lightweight concrete reduction factors need not be applied. In addition, evaluation for the concrete breakout capacity in accordance with ACI 318-19 Section 17.7.2 and the pryout capacity in accordance with ACI 318-19 Section 17.7.3 is not required for anchors installed in the deck soffit (flute).

[6]The strength reduction factor applies when the load combinations from the IBC or ACI 318-19 are used and the requirements of ACI 318-19 Section 17.5.3 are met.

[7]Installations must comply with Sections 4.1.11 and 4.3 and Figures 5A, 5B and 5C of this report.

[8]Anchors must have an axial spacing along the flute soffit equal to the greater of 3h_{ef} or 1.5 times the flute width.



The DEWALT drilling systems shown collect and remove dust with a HEPA dust extractor during the hole drilling operation in dry base materials using hammer-drills (see manufacturer's printed installation instructions).

FIGURE A—EXAMPLES OF DEWALT DUST REMOVAL DRILLING SYSTEMS WITH HEPA DUST EXTRACTORS FOR ILLUSTRATION

TABLE 6—POWER-STUD+ SD4 AND POWER-STUD+ SD6 STAINLESS STEEL ANCHOR INSTALLATION SPECIFICATIONS

ANCHOR PROPERTY / SETTING INFORMATION	NOTATION	UNITS	NOMINAL ANCHOR SIZE (inch)									
			1/4	3/8		1/2		5/8		3/4	
Outside diameter of anchor	d_a	in. (mm)	0.250 (6.4)	0.375 (9.5)		0.500 (12.7)		0.625 (15.9)		0.750 (19.1)	
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	5/16 (7.9)	7/16 (11.1)		9/16 (14.3)		11/16 (17.5)		13/16 (20.6)	
Nominal drill bit diameter (ANSI)	d_{bit}	in.	1/4	3/8		1/2		5/8		3/4	
Minimum nominal embedment depth[1]	h_{nom}	in. (mm)	1 3/4 (44)	1 7/8 (48)		2 1/2 (64)		3 1/4 (83)		4 1/2 (114)	
Effective embedment	h_{ef}	in. (mm)	1.50 (38)	1.50 (38)		2.00 (51)		2.75 (70)		3.75 (95)	
Minimum concrete member thickness[2]	h_{min}	in. (mm)	3 1/4 (83)	3 1/4 (83)	4 (102)	4 (102)		5 (127)		6 (152)	
Critical edge distance (uncracked concrete)	c_{ac}	in. (mm)	5 (127)	5 (127)		7 1/2 (191)		9 1/2 (241)		9 (229)	
Minimum edge distance[3]	c_{min}	in. (mm)	1 3/4 (45)	3 (76)	3 1/2 (89)	6 (152)	3 (76)	4 1/2 (114)	8 1/2 (216)	5 (127)	9 (229)
Minimum spacing distance[3]	s_{min}	in. (mm)	2 (51)	5 1/2 (140)	3 (76)	3 (76)	6 (152)	8 1/2 (216)	5 (127)	9 (229)	5 (127)
Minimum hole depth	h_o	in. (mm)	1 7/8 (48)	2 (51)		2 5/8 (67)		3 1/2 (89)		4 3/4 (121)	
Minimum overall anchor length[4]	ℓ_{anch}	in.	2 1/4	2 3/4		3 3/4		4 1/2		5 1/2	
Installation torque	T_{inst}	ft.-lb. (N-m)	6 (8)	25 (34)		40 (54)		60 (81)		110 (149)	
Torque wrench / socket size	-	in.	7/16	9/16		3/4		15/16		1 1/8	
Nut height	-	In.	7/32	21/64		7/16		35/64		41/64	

For **SI:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m.

[1]The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor prior to tightening.
[2]The anchors may be installed in the top of concrete-filled steel deck floor and roof assemblies in accordance with Section 4.3 of this report provided the concrete thickness above the upper flute meets the minimum thickness specified in this table.
[3]Additional combinations for minimum edge distance, c_{min}, and minimum spacing distance, s_{min}, may be derived by linear interpolation between the given boundary values for the anchors. See Figure 4.
[4]The listed minimum overall anchor length is based on anchor sizes commercially available at the time of publication compared with the requirements to achieve the minimum nominal embedment depth and possible fixture attachment, as applicable.

TABLE 7—TENSION DESIGN INFORMATION FOR POWER-STUD+ SD4 AND POWER-STUD+ SD6 STAINLESS STEEL ANCHORS IN CONCRETE[1,7]

Design Characteristic		Notation	Units	Nominal Anchor Size (inch)				
				1/4	3/8	1/2	5/8	3/4
Anchor category		1, 2 or 3	-	1	1	1	1	1
Effective embedment		h_{ef}	in. (mm)	1.50 (38)	1.50 (38)	2.00 (51)	2.75 (70)	3.75 (95)
STEEL STRENGTH IN TENSION (ACI 318-19 Section 17.6.1)								
Minimum specified yield strength (neck)		f_y	ksi (N/mm^2)	60.0 (414)	60.0 (414)	60.0 (414)	60.0 (414)	60.0 (414)
Minimum specified ultimate strength (neck)		f_{uta}	ksi (N/mm^2)	90.0 (621)	90.0 (621)	90.0 (621)	90.0 (621)	90.0 621)
Effective tensile stress area (neck)		$A_{se,N}$	in^2 (mm^2)	0.0249 (16.1)	0.0530 (34.2)	0.1020 (65.8)	0.1630 (105.2)	0.238 (151)
Steel strength in tension		N_{sa}	lbf (kN)	2,240 (10.0)	4,780 (21.3)	9,160 (40.8)	14,635 (65.1)	21,380 (95.1)
Reduction factor for steel strength[2,3]		ϕ	-	0.75				
CONCRETE BREAKOUT STRENGTH IN TENSION (ACI 318-19 Section 17.6.2)[6]								
Effectiveness factor for uncracked concrete		k_{uncr}	-	24	24	24	24	24
Effectiveness factor for cracked concrete		k_{cr}	-	Not applicable	17	21	21	21
Modification factor for cracked and uncracked concrete		$\Psi_{c,N}$	-	1.0 See note 4	1.0 See note 4	1.0 See note 4	1.0 See note 4	1.0 See note 4
Critical edge distance (uncracked concrete)		c_{ac}	in. (mm)	See Table 6				
Reduction factor for concrete breakout strength in tension[2]		ϕ	-	0.65 (Condition B, supplementary reinforcement not present)				
PULLOUT STRENGTH IN TENSION (ACI 318-19 Section 17.6.3)[7]								
Characteristic pullout strength, uncracked concrete (2,500 psi)[5]		$N_{p,uncr}$	lbf (kN)	1,510 (6.7)	See note 6	See note 6	See note 6	8,520 (37.8)
Characteristic pullout strength, cracked concrete (2,500 psi)[5]		$N_{p,cr}$	lbf (kN)	Not applicable	1,645 (7.3)	See note 6	See note 6	See note 6
Reduction factor for pullout strength[2]		ϕ	-	0.65 (Condition B, supplementary reinforcement not present)				
PULLOUT STRENGTH IN TENSION FOR SEISMIC APPLICATIONS (ACI 318-19 Section 17.10.3)[7]								
Characteristic pullout strength, seismic (2,500 psi)[5,8]		$N_{p,eq}$	lbf (kN)	Not applicable	1,645 (7.3)	See note 6	See note 6	See note 6
Reduction factor for pullout strength[2]		ϕ	-	0.65 (Condition B, supplementary reinforcement not present)				
Mean axial stiffness values for service load range[9]	Uncracked concrete	β	lbf/in (kN/mm)	171,400 (30,060)	490,000 (86,000)	459,000 (80,500)	234,000 (41,000)	395,000 (69,300)
	Cracked concrete	β	lbf/in (kN/mm)	Not applicable	228,000 (40,000)	392,000 (68,800)	193,000 (33,800)	76,600 (13,400)

For **SI:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 ksi = 6.895 N/mm^2, 1 lbf = 0.0044 kN.

[1]The data in this table is intended to be used with the design provisions of ACI 318-19 Chapter 17; for anchors resisting seismic load combinations the additional requirements of ACI 318-19 Section 17.10, must apply.
[2] The strength reduction factor applies when the load combinations from the IBC or ACI 318-19 are used and the requirements of ACI 318-19 Section 17.5.3 are met.
[3]The anchors are ductile steel elements as defined in ACI 318-19 Section 2.3.
[4]For all design cases $\Psi_{c,N}$=1.0. The appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) must be used.
[5]For all design cases $\Psi_{c,P}$=1.0. For the calculation of N_{pn}, including adjustment for specified concrete compressive strength, see Section 4.1.4 of this report.
[6]Pullout strength does not control design of indicated anchors. Do not calculate pullout strength for indicated anchor size and embedment.
[7]Anchors are permitted to be used in lightweight concrete in accordance with Section 4.1.12 of this report.
[8]Tabulated values for characteristic pullout strength in tension are for seismic applications are based on test results per ACI 355.2, Section 9.5.
[9]Actual stiffness of the mean value varies depending on concrete strength, loading and geometry of application.

TABLE 8—SHEAR DESIGN INFORMATION FOR POWER-STUD+ SD4 AND POWER-STUD+ SD6 STAINLESS STEEL ANCHORS IN CONCRETE[1,5]

Design Characteristic	Notation	Units	Nominal Anchor Diameter				
			1/4	3/8	1/2	5/8	3/4
Anchor category	1, 2 or 3	-	1	1	1	1	1
Effective embedment	h_{ef}	in. (mm)	1.50 (38)	1.50 (38)	2.00 (51)	2.75 (70)	3 3/4 (95)
STEEL STRENGTH IN SHEAR (ACI 318-19 Section 17.7.1)[2]							
Minimum specified yield strength (threads)	f_y	ksi (N/mm^2)	60.0 (414)	60.0 (414)	60.0 (414)	60.0 (414)	60.0 (414)
Minimum specified ultimate strength (threads)	f_{uta}	ksi (N/mm^2)	90.0 (621)	90.0 (621)	90.0 (621)	90.0 (621)	90.0 (621)
Effective shear stress area (threads)	$A_{se,V}$	in^2 (mm^2)	0.0318 (20.5)	0.0780 (50.3)	0.142 (91.6)	0.226 (145.8)	0.334 (212)
Steel strength in shear[4]	V_{sa}	lbf (kN)	1,115 (5.0)	1,470 (6.6)	3,170 (14.1)	7,455 (33.2)	11,955 (53.2)
Reduction factor for steel strength[2,3]	ϕ	-	0.65				
STEEL STRENGTH IN SHEAR FOR SEISMIC APPLICATIONS (ACI 318-19 Section 17.10.3)							
Steel strength in shear, seismic[6]	$V_{sa,eq}$	lbf (kN)	Not applicable	1,305 (5.8)	2,765 (12.3)	5,240 (23.3)	7,745 (34.45)
Reduction factor for steel strength in shear, seismic[2]	ϕ	-	0.65				
CONCRETE BREAKOUT STRENGTH IN SHEAR (ACI 318-19 Section 17.7.2)[5]							
Load-bearing length of anchor	ℓ_e	in. (mm)	1.50 (38)	1.50 (38)	2.00 (51)	2.75 (70)	3.75 (95)
Nominal anchor diameter	d_a	in. (mm)	0.250 (6.4)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)
Reduction factor for concrete breakout strength in shear[2]	ϕ	-	0.70 (Condition B, supplementary reinforcement not present)				
PRYOUT STRENGTH IN SHEAR (ACI 318-19 Section 17.7.3)[5]							
Coefficient for pryout strength	k_{cp}	-	1.0	1.0	1.0	2.0	2.0
Reduction factor for pryout strength[2]	ϕ	-	0.70 (Condition B, supplementary reinforcement not present)				

For **SI:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 ksi = 6.895 N/mm^2, 1 lbf = 0.0044 kN.

[1]The data in this table is intended to be used with the design provisions of ACI 318-19 Chapter 17; for anchors resisting seismic load combinations the additional requirements of ACI 318-19 Section 17.10 must apply.
[2] The strength reduction factor applies when the load combinations from the IBC or ACI 318-19 are used and the requirements of ACI 318-19 Section 17.5.3 are met.
[3]The anchors are ductile steel elements as defined in ACI 318-19 Section 2.3.
[4]Tabulated values for steel strength in shear are based on test results per ACI 355.2, Section 9.4 and must be used for design.
[5]Anchors are permitted to be used in lightweight concrete in accordance with Section 4.1.12 of this report.
[6]Tabulated values for steel strength in shear are for seismic applications are based on test results per ACI 355.2, Section 9.6.

TABLE 9—EXAMPLE ALLOWABLE STRESS DESIGN VALUES FOR ILLUSTRATIVE PURPOSES[1,2,3,4,5,6,7,8,9]

Nominal Anchor Diameter (in.)	Product	Nominal Embedment Depth (in.)	Effective Embedment (in.)	Allowable Tension Load (pounds)
1/4	Power-Stud+ SD4 and Power-Stud+ SD6	1 3/4	1.50	665
3/8	Power-Stud+ SD2	2 3/8	2.00	1,220
	Power-Stud+ SD4 and Power-Stud+ SD6	1 7/8	1.50	970
1/2	Power-Stud+ SD2	2 1/2	2.00	1,490
	Power-Stud+ SD4 and Power-Stud+ SD6	2 1/2	2.00	1,865
	Power-Stud+ SD2	3 3/4	3.25	2,905
5/8	Power-Stud+ SD4 and Power-Stud+ SD6	3 1/4	2.75	2,405
	Power-Stud+ SD2	3 7/8	3.25	3,090
		4 7/8	4.25	4,615
3/4	Power-Stud+ SD4 and Power-Stud+ SD6	4 1/2	3.75	3,740
	Power-Stud+ SD2	4 1/2	3.75	3,825
		5 3/4	5.00	5,890

For **SI:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m.
[1]Single anchor with static tension load only.
[2]Concrete determined to remain uncracked for the life of the anchorage.
[3]Load combinations from ACI 318-19 Section 5.3 (no seismic loading considered).
[4]30% dead load and 70% live load, controlling load combination 1.2*D* + 1.6*L*.
[5]Calculation of weighted average for α = 1.2(0.3) + 1.6(0.7) = 1.48.
[6]f'_c = 2,500 psi (normal weight concrete).
[7]$c_{a1} = c_{a2} \geq c_{ac}$.
[8]$h \geq h_{min}$.
[9]Values are for Condition B where supplementary reinforcement in accordance with ACI 318-19 Section 17.5.3 is not provided.

Given: Calculate the factored strength design resistance in tension, $\boldsymbol{\phi N_n}$, and the allowable stress design value, $\boldsymbol{T_{allowable,ASD}}$, for a 3/8-inch diameter Power-Stud+ SD2 anchor assuming the given conditions in Table 7.

Calculation in accordance with ACI 318-19 Chapter 17 and this report:	ACI 318-19 Ref.	Report Ref.
Step 1. Calculate steel strength of a single anchor in tension: $\boldsymbol{\phi N_{sa}} = (0.75)(6{,}625) = 4{,}969\ lbs.$	17.6.1.2	Table 3
Step 2. Calculate concrete breakout strength of a single anchor in tension: $\phi N_{cb} = \phi \frac{A_{Nc}}{A_{Nc0}} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b$ $N_b = k_c \lambda_a \sqrt{f'_c} (h_{ef})^{1.5}$ $N_b = (24)(1.0)\sqrt{2{,}500}(2.0)^{1.5} = 3{,}394\ lbs.$ $\boldsymbol{\phi N_{cb}} = (0.65)\frac{(36.0)}{(36.0)}(1.0)(1.0)(1.0)(3{,}394) = 2{,}206\ lbs.$	17.6.2.1	Table 3
Step 3. Calculate pullout strength of a single anchor: $\phi N_{pn} = \phi N_{p,uncr} \psi_{c,P} \left(\frac{f'_c}{2{,}500}\right)^n$ $\boldsymbol{\phi N_{pn}}$ = (0.65)(2,775)(1.0)(1.0)$^{0.5}$ = 1804 *lbs.*	17.6.2.2	Table 3
Step 4. Determine controlling factored resistance strength in tension: $\boldsymbol{\phi N_n} = \min\left\|\phi N_{sa}, \phi N_{cb}, \phi N_{pn}\right\| = \phi N_{pn} = 1{,}804\ lbs.$	17.5.1.3	-
Step 5. Calculate allowable stress design conversion factor for loading condition: Controlling load combination: 1.2*D* + 1.6*L* $\boldsymbol{\alpha}$ = 1.2(30%) + 1.6(70%) = 1.48	5.3	-
Step 6. Calculate allowable stress design value: $\boldsymbol{T_{allowable,ASD}} = \frac{\boldsymbol{\phi N_n}}{\boldsymbol{\alpha}} = \frac{\mathbf{1{,}804}}{\mathbf{1.48}} = \mathbf{1{,}220\ lbs.}$	-	§ 4.2

FIGURE 6—EXAMPLE STRENGTH DESIGN CALCULATION INCLUDING ASD CONVERSION FOR ILLUSTRATIVE PURPOSES

TABLE 10— APPLICABLE SECTIONS OF THE IBC UNDER EACH EDITION OF THE IBC

2024 IBC	2021 IBC	2018 IBC	2015 IBC
Section 1605.1		Section 1605.2 or 1605.3	
Section 1705.1.1 and Table 1705.3			
Section 1901.3			
Sections 1903 and 1905			
Section 1905.7	Section 1905.1.8		

TABLE 11— APPLICABLE SECTIONS OF ACI 318 UNDER EACH EDITION OF THE IBC

2024 IBC	2021 IBC	2018 IBC	2015 IBC
ACI 318-19		ACI 318-14	
2.3		2.3	
5.3		5.3	
Chapter 17		Chapter 17	
17.3.1		17.2.7	
17.5.1.2		17.3.1	
17.5.1.3		17.3.1.1	
17.5.3		17.3.3	
17.6.1		17.4.1	
17.6.1.2		17.4.1.2	
17.6.2		17.4.2	
17.6.2.1		17.4.2.1	
17.6.2.2		17.4.2.2	
17.6.2.5.1(a)		17.4.2.6	
17.6.3		17.4.3	
17.6.3.1		17.4.3.1	
17.6.3.2.1		17.4.3.2	
17.6.3.3		17.4.3.6	
17.7.1		17.5.1	
17.7.1.2		17.5.1.2	
Eq. 17.7.1.2b		Eq. 17.5.1.2b	
17.7.2		17.5.2	
17.7.2.2.1		17.5.2.2	
17.7.3		17.5.3	
17.8		17.6	
17.9.2		17.7.1 and 17.7.3	
17.9.4		17.7.5	
17.9.5		17.7.6	
17.10		17.2.3	
17.10.3		17.2.3.3	
17.10.4, 17.10.5, 17.10.6, 17.10.7		17.2.3.4, 17.2.3.5, 17.2.3.6, 17.2.3.7	

ICC-ES Evaluation Report

ESR-2502 City of LA Supplement

Reissued May 2026

This report is subject to renewal May 2027.

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

DIVISION: 03 00 00—CONCRETE
Section: 03 16 00—Concrete Anchors

DIVISION: 05 00 00—METALS
Section: 05 05 19—Post-installed Concrete Anchors

REPORT HOLDER:

DEWALT

EVALUATION SUBJECT:

POWER-STUD®+ SD2 CARBON STEEL ANCHORS, POWER-STUD®+ SD4 AND POWER-STUD®+ SD6 STAINLESS STEEL ANCHORS IN CRACKED AND UNCRACKED CONCRETE (DEWALT)

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that Power-Stud®+ SD2 carbon steel anchors, Power-Stud®+ SD4 stainless steel anchors and Power-Stud®+ SD6 stainless steel anchors in cracked and uncracked concrete, described in ICC-ES evaluation report ESR-2502, have also been evaluated for compliance with the codes noted below as adopted by Los Angeles Department of Building and Safety (LADBS).

Applicable code editions:

- 2023 *City of Los Angeles Building Code* (LABC)
- 2023 *City of Los Angeles Residential Code* (LARC)

2.0 CONCLUSIONS

The Power-Stud®+ SD2 carbon steel anchors, Power-Stud®+ SD4 stainless steel anchors and Power-Stud®+ SD6 stainless steel anchors in cracked and uncracked concrete, described in Sections 2.0 through 7.0 of the evaluation report ESR-2502, comply with LABC Chapter 19, and LARC, and are subject to the conditions of use described in this report.

3.0 CONDITIONS OF USE

The Power-Stud®+ SD2 carbon steel anchors, Power-Stud®+ SD4 stainless steel anchors and Power-Stud®+ SD6 stainless steel anchors described in this evaluation report supplement must comply with all of the following conditions:

- All applicable sections in the evaluation report ESR-2502.
- The design, installation, conditions of use and labeling of the anchors are in accordance with the 2021 *International Building Code®* (IBC) provisions noted in the evaluation report ESR-2502.
- The design, installation and inspection are in accordance with additional requirements of LABC Chapters 16 and 17, as applicable.
- Under the LARC, an engineered design in accordance with LARC Section R301.1.3 must be submitted.
- The allowable and strength design values listed in the evaluation report and tables, are for the connection of the anchors to the concrete. The connection between the anchors and the connected members shall be checked for capacity (which may govern).
- For use in wall anchorage assemblies to flexible diaphragm applications, anchors shall be designed per the requirements of City of Los Angeles Information Bulletin P/BC 2023-071.

This supplement expires concurrently with the evaluation report, reissued May 2026.

ICC-ES Evaluation Reports are not to be construed as representing aesthetics or any other attributes not specifically addressed, nor are they to be construed as an endorsement of the subject of the report or a recommendation for its use. There is no warranty by ICC Evaluation Service, LLC, express or implied, as to any finding or other matter in this report, or as to any product covered by the report.

Copyright © 2026 ICC Evaluation Service, LLC. All rights reserved.

DIVISION: 03 00 00—CONCRETE
Section: 03 16 00—Concrete Anchors

DIVISION: 05 00 00—METALS
Section: 05 05 19—Post-Installed Concrete Anchors

REPORT HOLDER:

DEWALT

EVALUATION SUBJECT:

POWER-STUD®+ SD2 CARBON STEEL ANCHORS, POWER-STUD®+ SD4 AND POWER-STUD®+ SD6 STAINLESS STEEL ANCHORS IN CRACKED AND UNCRACKED CONCRETE (DEWALT)

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that Power-Stud+ SD2 Carbon Steel Anchors, Power-Stud+ SD4 Stainless Steel Anchors and Power-Stud+ SD6 Stainless Steel Anchors in Cracked and Uncracked Concrete, described in ICC-ES evaluation report ESR-2502, have also been evaluated for compliance with the codes noted below:

Compliance with the following codes:

- 2023 *Florida Building Code—Building*
- 2023 *Florida Building Code—Residential*

2.0 PURPOSE OF THIS SUPPLEMENT

The Power-Stud+ SD2 Carbon Steel Anchors, Power-Stud+ SD4 Stainless Steel Anchors and Power-Stud+ SD6 Stainless Steel Anchors in Cracked and Uncracked Concrete, described in Sections 2.0 through 7.0 of the evaluation report ESR-2502, comply with the *Florida Building Code—Building* and the *Florida Building Code—Residential*. The design requirements must be in accordance with the *Florida Building Code—Building* or the *Florida Building Code—Residential,* as applicable. The installation noted in ICC-ES evaluation report ESR-2502 for the 2021 *International Building Code®* meet the requirements of the *Florida Building Code—Building* or the *Florida Building Code—Residential*.

Use of the Power-Stud+ SD2 Carbon Steel Anchors, Power-Stud+ SD4 Stainless Steel Anchors and Power-Stud+ SD6 Stainless Steel Anchors in cracked and uncracked concrete has also been found to be in compliance with the High-Velocity Hurricane Zone provisions of the *Florida Building Code—Building* and the *Florida Building Code—Residential* with the following condition:

a) For anchorage to wood members, the connection subject to uplift, must be designed for no less than 700 pounds (3114 N).

For products falling under Florida Rule 61G20-3, verification that the report holder's quality assurance program is audited by a quality assurance entity approved by the Florida Building Commission for the type of inspections being conducted is the responsibility of an approved validation entity (or the code official, when the report holder does not possess an approval by the Commission). Florida Rule 61G20-3 is applicable to products and/or systems which comprise the building envelope and structural frame for compliance with the structural requirements of the *Florida Building Code*.

This supplement expires concurrently with the evaluation report, reissued May 2026.

ICC-ES Evaluation Reports are not to be construed as representing aesthetics or any other attributes not specifically addressed, nor are they to be construed as an endorsement of the subject of the report or a recommendation for its use. There is no warranty by ICC Evaluation Service, LLC, express or implied, as to any finding or other matter in this report, or as to any product covered by the report.

Copyright © 2026 ICC Evaluation Service, LLC. All rights reserved.