Stephan & Brady Balcony

1850 Hoffman St
Madison, WI 53704

Structural Calculations

Balcony Members & Connections

Prepared For

OpeningDesign
Madison, WI

WISCONSIN
STEVEN
UECKE
41886-6
CHICAGO
IL.
PROFESSIONAL ENGINEER

NTRIVE
INNOVATIVE ENGINEERING

Ntrive Engineering

280 Shuman Blvd Ste 270

Naperville, IL 60563

Stephan & Brady Balcony
1850 Hoffman St
Madison, WI 53704

Structural Calculations
Balcony Members & Connections

Table of Contents

WISCONSIN COA 3615-11

Stephan & Brady Balcony
Madison, WI

Design Criteria

PURPOSE:
DESIGN BALCONY FRAMING AND ITS ATTACHMENT TO EXISTING BUILDING

MATERIALS:
STRUCTURAL STEEL:
WIDE FLANGES - ASTM A992
PLATES - ASTM A36 (Fy=36 ksi)
RECTANGULAR TUBES - ASTM A500C (Fy=50 ksi)

CODES. SPECS, REFERENCES, ETC.:
BUILDING CODE - 2011 WISCONSIN BUILDING CODE (REFERENCES 2009 IBC)
STEEL DESIGN - AISC 13TH EDITION ASD

STRUCTURAL LOADS:
DEAD LOAD: 20 PSF
LIVE LOAD: BALCONY - 80 PSF
WIND LOAD: PER ASCE 7-05 (UPLIFT ONLY)
$q_z=0.00256K_zK_{zt}K_dV^2I=0.00256*0.85*1.0*0.85*90^2*1.0=14.98$ PSF
Kz=0.85 (TABLE 6-3)
Kzt=1.0 (SECTION 6.5.7.2)
Kd=0.85 (TABLE 6-4)
V=90 MPH (FIGURE 6-1)
I=1.0 (TABLE 6-1)
$p=q_z(GCp \pm GCpi)=14.98$ PSF$*(-1.3\pm0)=-19.47$ PSF
GCp=-1.3 (FIGURE 6-14A)

Stephan & Brady Balcony
Madison, WI

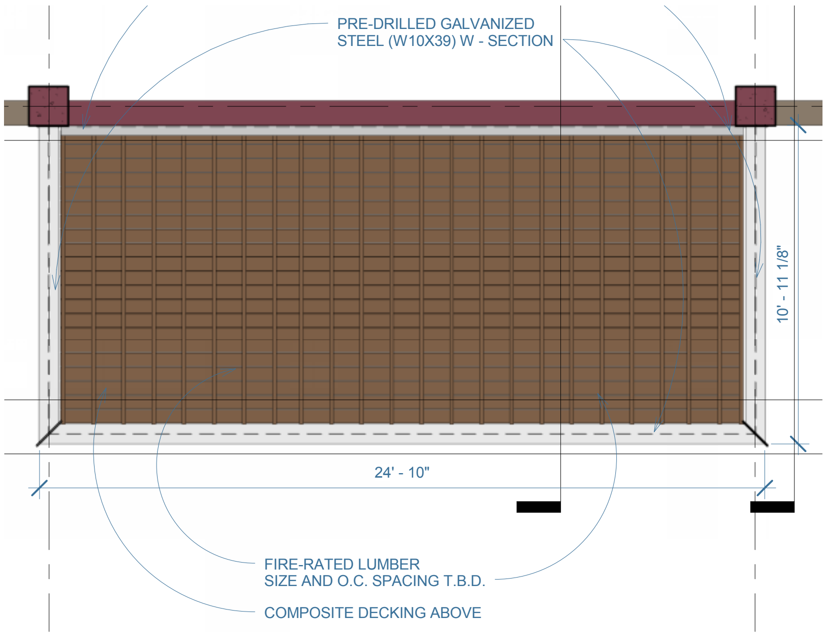
Member Analysis

Ntrive Engineering

280 Shuman Blvd Ste 270

Naperville, IL 60563

JOB	S & B BALCONY	NO.	20150103
SHEET NO.	201	OF	
CALCULATED BY	KZZ	DATE	6/8/15
CHECKED BY		DATE	
DESCRIPTION	BALCONY BEAM ANALYSIS		



CHECK BENDING STRENGTH OF WIDE FLANGE BEAM:

Wd=20 PSF*11'/2=110 PLF

Wl=80 PSF*11'/2=440 PLF

Wt=110 PLF+440 PLF=550 PLF

Mact=Wt*L^2/8=550 PLF* (21'-2")^2/8=30.8 FT*K

Mall=117 FT*K > 30.8 FT*K, **OK** (AISC TABLE 3-6)

CHECK DEFLECTION OF WIDE FLANGE BEAM:

Δ=(5*Wt*L^4)/(384*E*I)=(5*550 PLF*(21'-2")^4*1728)/(384*29E6*209 IN^4)=0.409"

Δall=L/240=21'-2"/240=1.058" > 0.409", **OK**

PROVIDE W10x39

JOIST SPACING CHECK:
2X8 HF SELECT STRUCTURAL

MATERIAL PROPERTIES (NDS SUPPLEMENT 2005)
Fb = 1400 PSI
Fv = 150 PSI
E = 1600 KSI
Emin = 580 KSI
A = 10.88 IN^2
d = 7.25 IN
B = 1.5 IN
Sx = 13.14 IN^3
I = 47.63 IN^4

SPACING = 12 IN O.C.
LENGTH = 10.5 FT = 126 IN

WD = 20 PSF*1 FT = 20 PLF
WL = 80 PSF*1 FT = 80 PLF

SHEAR, MOMENT, AND DEFLECTION
Vmax = (20+80) PLF*10.5 FT/2 = 525.0 LB
Mmax = (20+80) PLF*$(10.5\ FT)^2/8$ = 1378.13 FT-LB
Δ_D = [5*20 PLF*126 IN^4]/[384*1600 KSI*47.63 IN^4] = 0.072"
Δ_L = [5*80 PLF*126 IN^4]/[384*1600 KSI*47.63 IN^4] = 0.287"
Δ_T = 2*0.072" + 0.287" = 0.431" (K=2, NDS 2005)
Δall = 126"/240 = 0.525" > 0.431" **OK**

CAPACITY CHECK
CD = Ct = Cfu = Ci = CL = 1
CM = 0.85
CF = 1.2
Cr = 1.15
F'b = 1400 PSI*0.85*1.2*1.15 = 1642 PSI
M'n = 1642 PSI*13.14 IN^3/12 IN/FT = 1798 FT-LB > 1378.13 FT-LB **OK**

SHEAR CHECK
CD = Ct = CF = Ci = 1
CM = 0.97
F'v = 150 PSI*0.97 = 145.5 PSI
DEMAND = 1.5*525 LB/10.88 IN^2 = 72.4 PSI < 145.5 PSI **OK**

USE (1) 2X8 HF SELECT STRUCTURAL @ 12" OC OR

JOIST SPACING CHECK:
2X8 HF NO. 2

MATERIAL PROPERTIES (NDS SUPPLEMENT 2005)
Fb = 850 PSI
Fv = 150 PSI
E = 1300 KSI
Emin = 470 KSI
A = 10.88 IN^2
d = 7.25 IN
B = 1.5 IN
Sx = 13.14 IN^3
I = 47.63 IN^4

SPACING = 12 IN O.C.
LENGTH = 10.5 FT = 126 IN

WD = 20 PSF*1 FT = 20 PLF
WL = 80 PSF*1 FT = 80 PLF

SHEAR, MOMENT, AND DEFLECTION
Vmax = (20+80) PLF*10.5 FT/2 = 525.0 LB
Mmax = (20+80) PLF*$(10.5 FT)^2$/8 = 1378.13 FT-LB
Δ_D = [5*20 PLF*126 IN^4]/[384*1300 KSI*47.63 IN^4] = 0.088"
Δ_L = [5*80 PLF*126 IN^4]/[384*1300 KSI*47.63 IN^4] = 0.353"
Δ_T = (2*0.088" + 0.353")/2 = 0.265" (K=2, NDS 2005)
Δall = 126"/240 = 0.525" > 0.265" **OK**

CAPACITY CHECK
CD = CM = Ct = Cfu = Ci = CL = 1
CF=1.2
Cr = 1.15
F'b = 850 PSI*1.2*1.15 = 1173 PSI
M'n = 2*1173 PSI*13.14 IN^3/12 IN/FT = 2569 FT-LB > 1378.13 FT-LB **OK**

SHEAR CHECK
CD = Ct = Ci = 1
CM = 0.97
F'v = 150 PSI*0.97 = 145.5 PSI
DEMAND = 1.5*525 LB/2*10.88 IN^2 = 36.2 PSI < 145.5 PSI **OK**

USE (2) 2X8 HF NO.2 OR BETTER @ 12" OC

Ntrive Engineering

280 Shuman Blvd Ste 270

Naperville, IL 60563

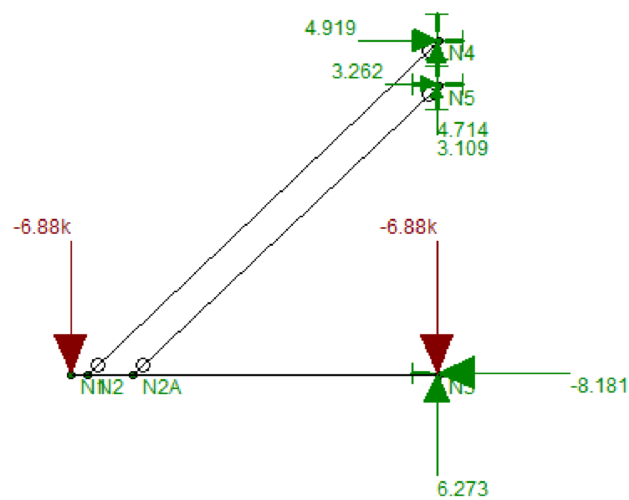
JOB S & B BALCONY NO. 20150103

SHEET NO. 204 OF

CALCULATED BY KZZ DATE 6/9/15

CHECKED BY DATE

DESCRIPTION HANGER ANALYSIS



CHECK AXIAL CAPACITY OF HANGER MEMBERS:

Tmax=6.813 K

Pmax=0.784 K

Tall=min(FyAg/Ω, FuAe/Ω)=min(46 KSI*1.57 IN^2/1.67, 62 KSI*1.57 IN^2/2.00)

Tall=min(43.25 K, 48.67 K)=43.25 K > 6.813 K, **OK**

kL/r=1.0*(14'-6")/0.762"=228.3

4.71*SQRT(E/Fy)=4.71*SQRT(29E6/46E3)=118.3 < kL/r, Fcr=0.877Fe

Fe=π^2E/$(kL/r)^2$=π^2*29E6/$(228.3)^2$=5491 PSI

Fcr=0.877Fe=0.877*5.491 KSI=4.816 KSI

Pall=FcrAg/Ω=4.816 KSI*1.57 IN^2/1.67=4.528 K > 0.784 K, **OK**

PROVIDE HSS2.375x0.25

CHECK CAPACITY OF WIDE FLANGE BEAM:

Pact=8.181 K

Pall=248 K > 8.181 K, **OK** (AISC TABLE 4-1)

Mact=6.448 FT*K

Mall=107 FT*K > 6.448 FT*K, **OK** (AISC TABLE 3-10)

INT=(Pact/Pall)+(Mact/Mall)=(8.181/248)+(6.448/107)=0.09 < 1.0, **OK**

PROVIDE W10x39

Ntrive Engineering

280 Shuman Blvd Ste 270

Naperville, IL 60563

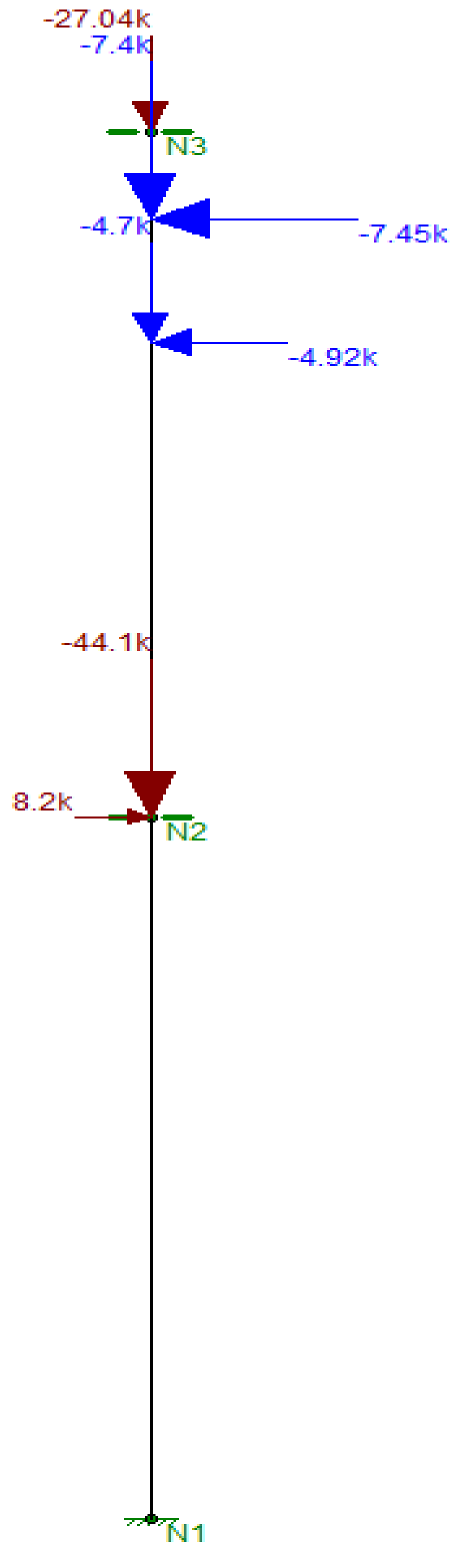
JOB S & B BALCONY NO. 20150103

SHEET NO. 205 OF

CALCULATED BY KZZ DATE 6/9/15

CHECKED BY DATE

DESCRIPTION EXISTING CONC ANALYSIS



CHECK EXIST CONCRETE COLUMN:
12"x16" Conc, conservatively assume f'c=3,000 psi and (4) #5 longitudinal and #3 ties at 12" oc

Mmax=16.4 k-ft / Pmax=83.24 k / V max=9.26 k
b=16" d=10"

check bending
a=(As*Fy)/(.85*f'c*d)=0.91
øMn=øAs*Fy(d-(a/2))=26.6 k-ft > Mu OK

check shear
øVc=ø2*SQRT(f'c)*b*d=13.15 k
øVc/2=6.57K < V max therefore reinforcing is req. Incorporate ties into the design
øVs=ø*Fy*Av*d/s=15k
øVc+øVs=28.14k > 9.26k OK

check axial
øPn=0.8ø[.85*f'c(Ag-Ast)+Fy*Ast]=290k > Pu OK

CHECK EXIST CONCRETE BEAM:
12"x18" Conc, conservatively assume f'c=3,000 psi and (3) #5 longitudinal and #3 ties at 12" oc

the floor structure spans parallel to this beam and is supported by beams at the column lines.

Span = 23'-7.5", Trib Area = 10'-3"
w=(10'-3'/2)(1.2*20+1.6*80) + 10'*7 psf*1.2=863 #/ft
Mu=60.0 k-ft
b=12", d=16"
a=1.82
øMn=øAs*Fy(d-(a/2))=63.1 k-ft > Mu OK

check shear
øVc=ø2*SQRT(f'c)*b*d=15.8 k
øVc/2=7.9K < V max therefore reinforcing is req. Incorporate shear into the design
øVs=ø*Fy*Av*d/s=24k
øVc+øVs=39.8 k > 10.1 k OK

Stephan & Brady Balcony
Madison, WI

Connection Analysis

NTRIVE
INNOVATIVE ENGINEERING

Ntrive Engineering

280 Shuman Blvd Ste 270

Naperville, IL 60563

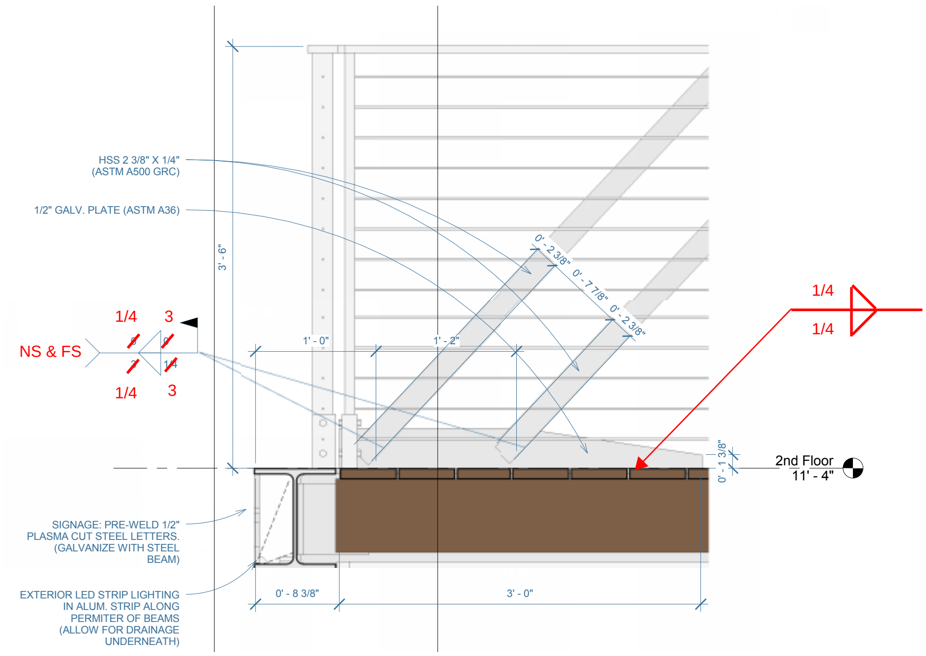
JOB S & B BALCONY NO. 20150103

SHEET NO. 301 OF

CALCULATED BY KZZ DATE 6/8/15

CHECKED BY DATE

DESCRIPTION HANGER CONN ANALYSIS



CHECK CONNECTION OF HANGER TO PLATE:

Tmax=6.813 K

Rn/Ω=0.928*D*l=0.928*4*3"*4=44.544 K > 6.813 K, **OK**

PROVIDE 1/4" FILLET WELD 3" LONG (4) SIDES

CHECK CONNECTION OF PLATE TO BEAM:

Tact=4.714 K

Vact=4.919 K

Mact=Vact*e=4.919*3"=14.757 IN*K

Aw=d*2=6"*2=12" (USE d=6" CONSERVATIVELY)

$Sw=d^2/3=6^2/3=12\ IN^2$

$fw=SQRT[(Vact/Aw)^2+(Tact/Aw+Mact/Sw)^2]$

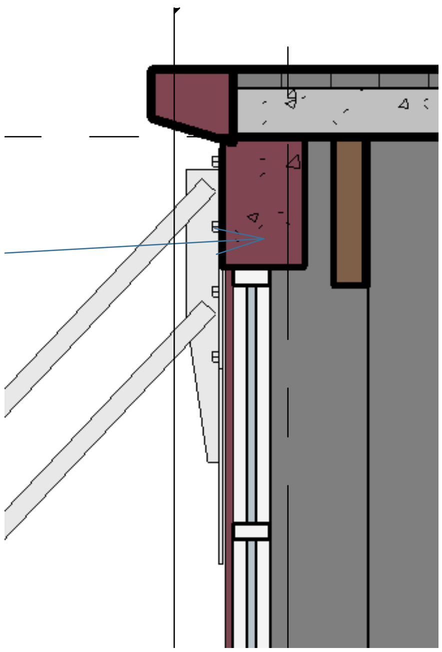
$fw=SQRT[(4.919/12)^2+(4.714/12+14.757/12)^2]=1.674\ K/IN$

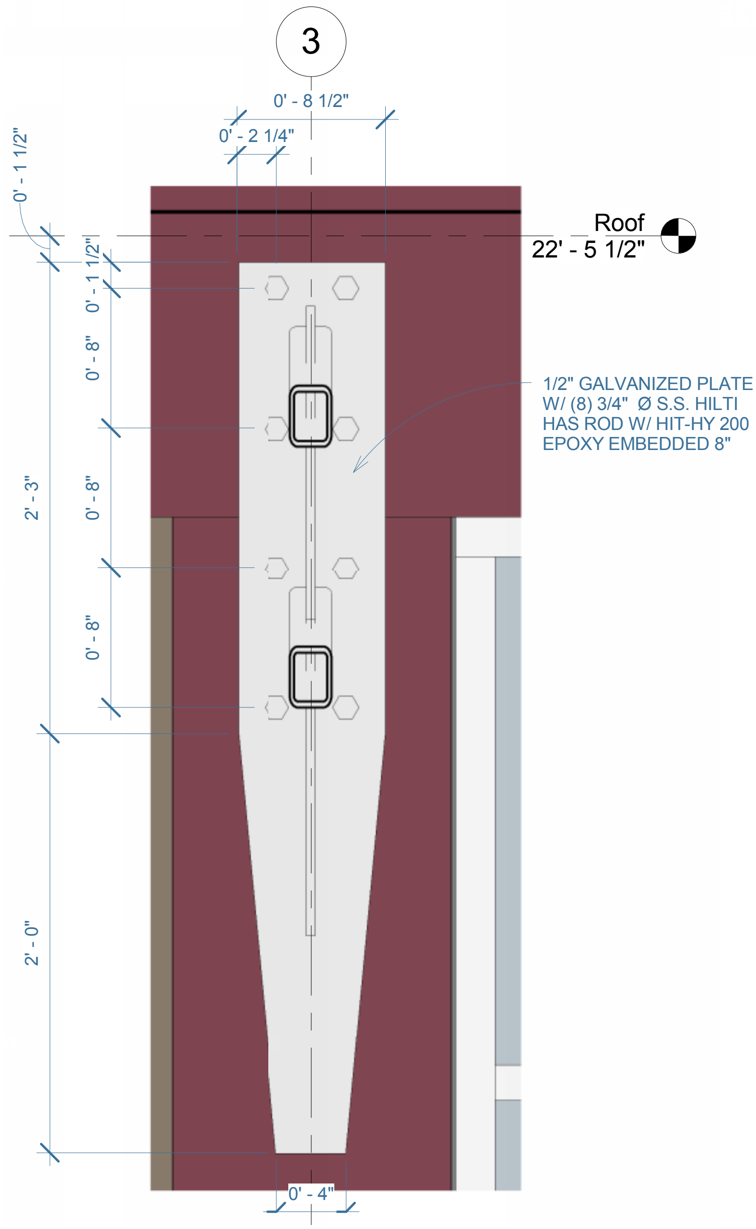
Fw=0.928*D=0.928*3=2.784 K/IN > 1.674 K/IN, **OK**

PROVIDE CONTINUOUS 3/16" FILLET WELD EACH SIDE

Ntrive Engineering
280 Shuman Blvd Ste 270
Naperville, IL 60563

JOB S & B BALCONY NO. 20150103
SHEET NO. 302 OF
CALCULATED BY KZZ DATE 6/8/15
CHECKED BY DATE
DESCRIPTION HANGER CONN ANALYSIS





CHECK CONNECTION OF PLATE TO EXISTING CONCRETE COLUMN:

Tu_{top}=7.453 K

Vu_{top}=7.139 K

Tu_{bot}=4.917 K

Vu_{bot}=4.682 K

PROVIDE (8) 3/4"Ø 316 SS HAS RODS W/ HILTI HIT-HY 200+ EPOXY W/ EMBED=8".
SEE FOLLOWING HILTI PROFIS OUTPUT FOR ANALYSIS

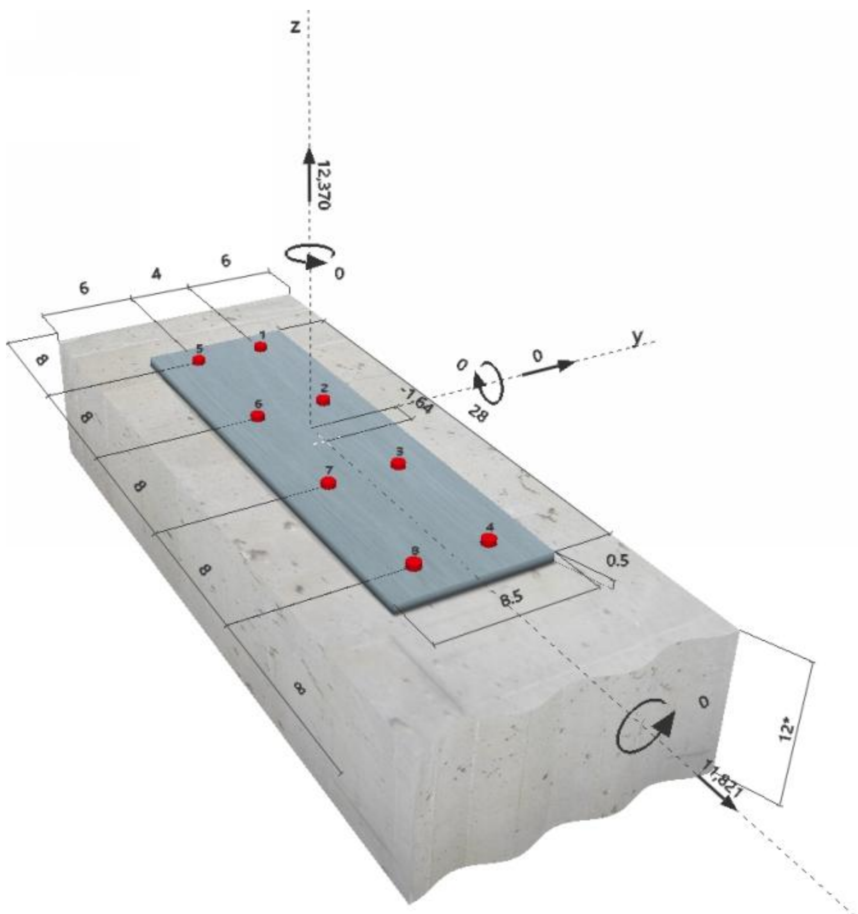
Company:	Ntrive	Page:	1
Specifier:	KZZ	Project:	20150103
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/8/2015
E-Mail:			

Specifier's comments:

1 Input data

Anchor type and diameter:	**HIT-HY 200 + HAS-R 316 3/4**
Effective embedment depth:	$h_{ef,act}$ = 8.000 in. ($h_{ef,limit}$ = - in.)
Material:	ASTM F 593
Evaluation Service Report:	ESR-3187
Issued I Valid:	1/1/2015 | 3/1/2016
Proof:	Design method ACI 318-08 / Chem
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate:	l_x x l_y x t = 28.000 in. x 8.500 in. x 0.500 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, , f_c' = 3500 psi; h = 12.000 in., Temp. short/long: 32/32 °F
Installation:	hammer drilled hole, Installation condition: Dry
Reinforcement:	tension: condition B, shear: condition B; no supplemental splitting reinforcement present edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

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



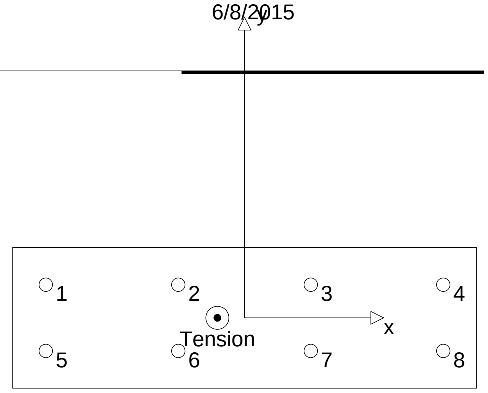
Company:	Ntrive	Page:	2
Specifier:	KZZ	Project:	20150103
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/8/2015
E-Mail:			

2 Load case/Resulting anchor forces

Load case: Design loads

Anchor reactions [lb]

Tension force: (+Tension, -Compression)



Anchor	Tension force	Shear force	Shear force x	Shear force y
1	1927	1478	1478	0
2	1673	1478	1478	0
3	1419	1478	1478	0
4	1166	1478	1478	0
5	1927	1478	1478	0
6	1673	1478	1478	0
7	1419	1478	1478	0
8	1166	1478	1478	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-1.640/0.000): 12370 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

3 Tension load

	Load N_{ua} [lb]	**Capacity ϕN_n [lb]**	**Utilization $\beta_N = N_{ua}/\phi N_n$**	**Status**
Steel Strength*	1927	18479	11	OK
Bond Strength**	12370	17184	72	OK
Sustained Tension Load Bond Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Strength**	12370	15452	81	OK

* anchor having the highest loading **anchor group (anchors in tension)

3.1 Steel Strength

N_{sa} = ESR value refer to ICC-ES ESR-3187
$\phi\ N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.33	85000

Calculations

N_{sa} [lb]
28430

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
28430	0.650	18479	1927

Company: Ntrive
Specifier: KZZ
Address:
Phone I Fax: |
E-Mail:

3.2 Bond Strength

$N_{ag} = \left(\frac{A_{Na}}{A_{Na0}}\right) \psi_{ec1,Na}\ \psi_{ec2,Na}\ \psi_{ed,Na}\ \psi_{cp,Na}\ N_{ba}$ — ACI 318-11 Eq. (D-19)

$\phi\ N_{ag} \geq N_{ua}$ — ACI 318-11 Table D.4.1.1

A_{Na} = see ACI 318-11, Part D.5.5.1, Fig. RD.5.5.1(b)

$A_{Na0} = (2\ c_{Na})^2$ — ACI 318-11 Eq. (D-20)

$c_{Na} = 10\ d_a \sqrt{\frac{\tau_{uncr}}{1100}}$ — ACI 318-11 Eq. (D-21)

$\psi_{ec,Na} = \left(\frac{1}{1 + \frac{e'_N}{c_{Na}}}\right) \leq 1.0$ — ACI 318-11 Eq. (D-23)

$\psi_{ed,Na} = 0.7 + 0.3 \left(\frac{c_{a,min}}{c_{Na}}\right) \leq 1.0$ — ACI 318-11 Eq. (D-25)

$\psi_{cp,Na} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{c_{Na}}{c_{ac}}\right) \leq 1.0$ — ACI 318-11 Eq. (D-27)

$N_{ba} = \lambda_a \cdot \tau_{k,c} \cdot \kappa_{bond} \cdot \pi \cdot d_a \cdot h_{ef}$ — ACI 318-11 Eq. (D-22)

Variables

$\tau_{k,c,uncr}$ [psi]	d_a [in.]	h_{ef} [in.]	$c_{a,min}$ [in.]	$\tau_{k,c}$ [psi]
1727	0.750	8.000	6.000	977

$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	c_{ac} [in.]	κ_{bond}	λ_a
1.640	0.000	19.129	1.00	1.000

Calculations

c_{Na} [in.]	A_{Na} [in.^{2}]	A_{Na0} [in.^{2}]	$\psi_{ed,Na}$
9.355	661.69	350.10	0.892

$\psi_{ec1,Na}$	$\psi_{ec2,Na}$	$\psi_{cp,Na}$	N_{ba} [lb]
0.851	1.000	1.000	18422

Results

N_{ag} [lb]	ϕ_{bond}	$\phi\ N_{ag}$ [lb]	N_{ua} [lb]
26438	0.650	17184	12370

Company:	Ntrive	Page:	4
Specifier:	KZZ	Project:	20150103
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/8/2015
E-Mail:			

3.3 Concrete Breakout Strength

$N_{cbg} = \left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ec,N}\ \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b$ ACI 318-08 Eq. (D-5)

$\phi\ N_{cbg} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3\left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
5.333	1.640	0.000	6.000	1.000

c_{ac} [in.]	k_c	λ	f_c' [psi]
19.129	17	1	3500

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
640.00	256.00	0.830	1.000	0.925	1.000	12387

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
23773	0.650	15452	12370

Company:	Ntrive	Page:	5
Specifier:	KZZ	Project:	20150103
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/8/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	1478	10236	15	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength (Concrete Breakout Strength controls)**	11821	40104	30	OK
Concrete edge failure in direction y+**	11821	25477	47	OK

* anchor having the highest loading **anchor group (relevant anchors)

4.1 Steel Strength

$V_{sa} = (n\ 0.6\ A_{se,V}\ f_{uta})$ refer to ICC-ES ESR-3187

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]	$(n\ 0.6\ A_{se,V}\ f_{uta})$ [lb]
1	0.33	85000	17060

Calculations

V_{sa} [lb]
17060

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
17060	0.600	10236	1478

4.2 Pryout Strength (Concrete Breakout Strength controls)

$V_{cpg} = k_{cp} \left[\left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ec,N}\ \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b\right]$ ACI 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	5.333	0.000	0.000	6.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.000	19.129	17	1	3500

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
640.00	256.00	1.000	1.000	0.925	1.000	12387

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
57292	0.700	40104	11821

4.3 Concrete edge failure in direction y+

$V_{cbg} = \left(\frac{A_{Vc}}{A_{Vc0}}\right) \psi_{ec,V}\ \psi_{ed,V}\ \psi_{c,V}\ \psi_{h,V}\ \psi_{parallel,V}\ V_b$ ACI 318-08 Eq. (D-22)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f_c'}\ c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
6.000	8.000	0.000	1.000	12.000

l_e [in.]	λ	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
6.000	1.000	0.750	3500	2.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
369.00	162.00	1.000	1.000	1.000	7989

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
36396	0.700	25477	11821

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.801	0.464	5/3	97	OK

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

6 Warnings

- Load re-distributions 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 loading! Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies when supplementary reinforcement is used. The Φ factor is increased for non-steel Design Strengths except Pullout Strength and Pryout strength. Condition B applies when supplementary reinforcement is not used and for Pullout Strength and Pryout Strength. Refer to your local standard.
- Design Strengths of adhesive anchor systems are influenced by the cleaning method. Refer to the INSTRUCTIONS FOR USE given in the Evaluation Service Report for cleaning and installation instructions
- The ACI 318-08 version of the software does not account for adhesive anchor special design provisions corresponding to overhead applications.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

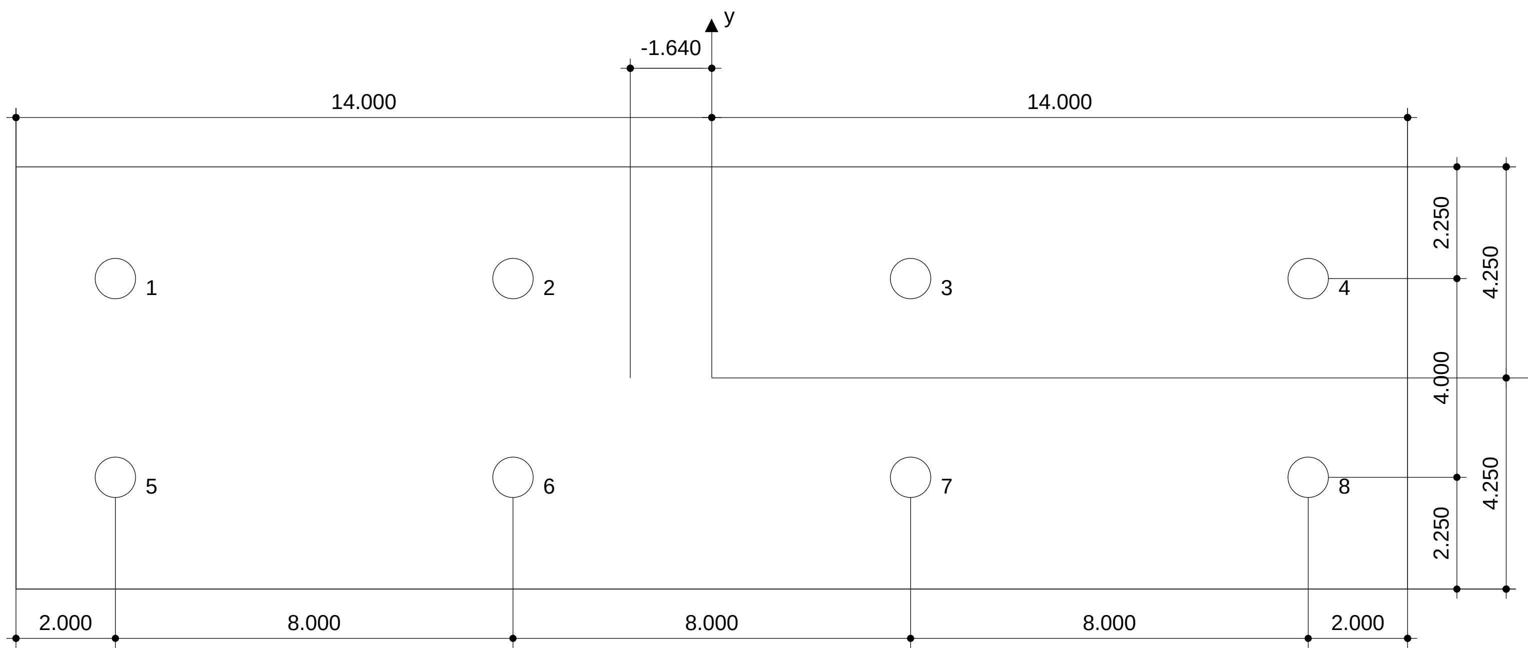
Fastening meets the design criteria!

Company:	Ntrive	Page:	7
Specifier:	KZZ	Project:	20150103
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/8/2015
E-Mail:			

7 Installation data

Anchor plate, steel: -
Profile: no profile; 0.000 x 0.000 x 0.000 in.
Hole diameter in the fixture: d_f = 0.813 in.
Plate thickness (input): 0.500 in.
Recommended plate thickness: not calculated
Cleaning: Premium cleaning of the drilled hole is required

Anchor type and diameter: HIT-HY 200 + HAS-R 316 3/4
Installation torque: 1200.002 in.lb
Hole diameter in the base material: 0.875 in.
Hole depth in the base material: 8.000 in.
Minimum thickness of the base material: 9.750 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-12.000	2.000	8.000	-	10.000	6.000
2	-4.000	2.000	16.000	-	10.000	6.000
3	4.000	2.000	24.000	-	10.000	6.000
4	12.000	2.000	32.000	-	10.000	6.000

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
5	-12.000	-2.000	8.000	-	6.000	10.000
6	-4.000	-2.000	16.000	-	6.000	10.000
7	4.000	-2.000	24.000	-	6.000	10.000
8	12.000	-2.000	32.000	-	6.000	10.000

Company:	Ntrive	Page:	8
Specifier:	KZZ	Project:	20150103
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/8/2015
E-Mail:			

8 Remarks; Your Cooperation Duties

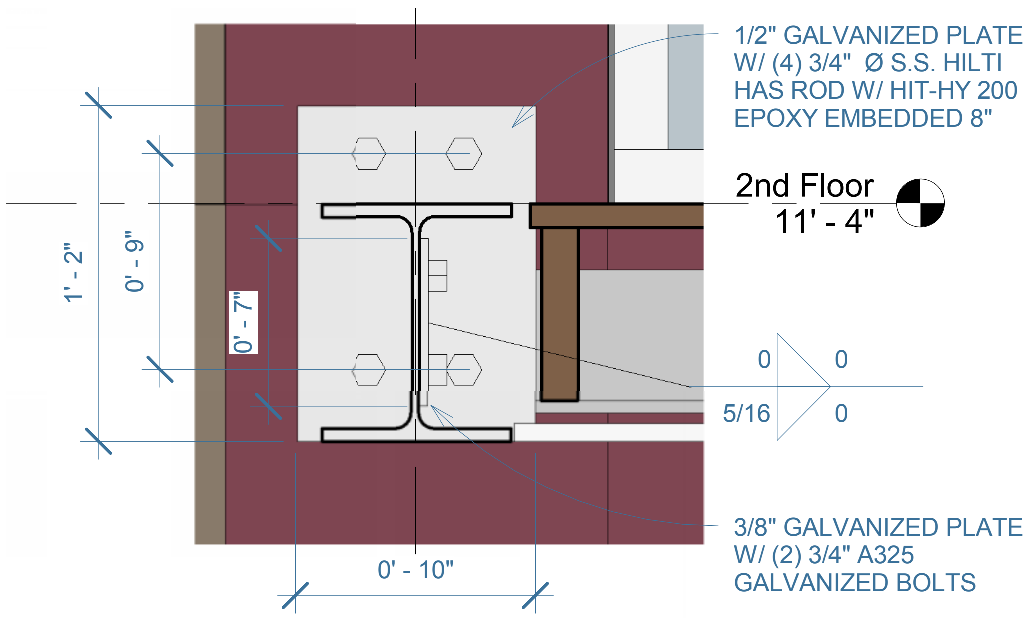
- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied 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.

Ntrive Engineering

280 Shuman Blvd Ste 270

Naperville, IL 60563

JOB S & B BALCONY	NO. 20150103
SHEET NO. 311	OF
CALCULATED BY KZZ	DATE 6/8/15
CHECKED BY	DATE
DESCRIPTION BEAM CONN ANALYSIS	



CHECK CONNECTION OF PLATE TO EXISTING CONCRETE COLUMN:

Vu=9.5 K

PROVIDE (4) 3/4"Ø 316 SS HAS RODS W/ HILTI HIT-HY 200+ EPOXY W/ EMBED=8".

SEE FOLLOWING HILTI PROFIS OUTPUT FOR ANALYSIS

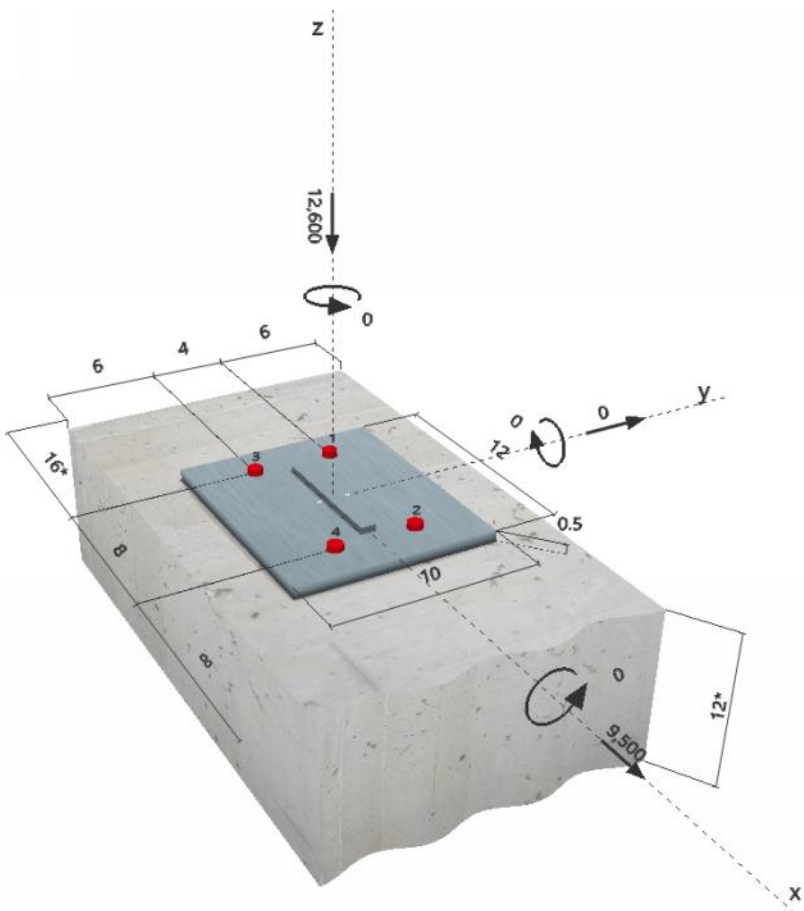
Company:	Ntrive	Page:	1
Specifier:	KZZ	Project:	20150103
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/8/2015
E-Mail:			

Specifier's comments:

1 Input data

Anchor type and diameter:	**HIT-HY 200 + HAS-R 316 3/4**
Effective embedment depth:	$h_{ef,act}$ = 8.000 in. ($h_{ef,limit}$ = - in.)
Material:	ASTM F 593
Evaluation Service Report:	ESR-3187
Issued I Valid:	1/1/2015 | 3/1/2016
Proof:	Design method ACI 318-08 / Chem
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate:	l_x x l_y x t = 12.000 in. x 10.000 in. x 0.500 in.; (Recommended plate thickness: not calculated)
Profile:	Rectangular plates and bars (AISC); (L x W x T) = 6.750 in. x 0.750 in. x 0.000 in.
Base material:	cracked concrete, , f_c' = 3500 psi; h = 12.000 in., Temp. short/long: 32/32 °F
Installation:	hammer drilled hole, Installation condition: Dry
Reinforcement:	tension: condition B, shear: condition B; no supplemental splitting reinforcement present edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

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



Company:	Ntrive	Page:	2
Specifier:	KZZ	Project:	20150103
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/8/2015
E-Mail:			

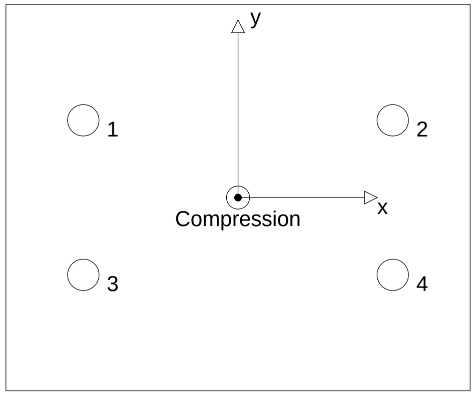
2 Load case/Resulting anchor forces

Load case: Design loads

Anchor reactions [lb]
Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0	2375	2375	0
2	0	2375	2375	0
3	0	2375	2375	0
4	0	2375	2375	0

max. concrete compressive strain: 0.02 [‰]
max. concrete compressive stress: 105 [psi]
resulting tension force in (x/y)=(0.000/0.000): 0 [lb]
resulting compression force in (x/y)=(0.000/0.000): 12600 [lb]



3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	N/A	N/A	N/A	N/A
Bond Strength**	N/A	N/A	N/A	N/A
Sustained Tension Load Bond Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Strength**	N/A	N/A	N/A	N/A

* anchor having the highest loading **anchor group (anchors in tension)

Company:	Ntrive	Page:	3
Specifier:	KZZ	Project:	20150103
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/8/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	2375	10236	24	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength (Concrete Breakout Strength controls)**	9500	24072	40	OK
Concrete edge failure in direction y-**	9500	16156	59	OK

* anchor having the highest loading **anchor group (relevant anchors)

4.1 Steel Strength

$V_{sa} = (n\ 0.6\ A_{se,V}\ f_{uta})$ refer to ICC-ES ESR-3187

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]	$(n\ 0.6\ A_{se,V}\ f_{uta})$ [lb]
1	0.33	85000	17060

Calculations

V_{sa} [lb]
17060

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
17060	0.600	10236	2375

4.2 Pryout Strength (Concrete Breakout Strength controls)

$$V_{cpg} = k_{cp}\left[\left(\frac{A_{Nc}}{A_{Nc0}}\right)\psi_{ec,N}\ \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b\right]$$ ACI 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$$ ACI 318-08 Eq. (D-9)

$$\psi_{ed,N} = 0.7 + 0.3\left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$$ ACI 318-08 Eq. (D-11)

$$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	8.000	0.000	0.000	6.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.000	19.129	17	1	3500

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
512.00	576.00	1.000	1.000	0.850	1.000	22757

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
34389	0.700	24072	9500

Company:	Ntrive	Page:	4
Specifier:	KZZ	Project:	20150103
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/8/2015
E-Mail:			

4.3 Concrete edge failure in direction y-

$V_{cbg} = \left(\frac{A_{Vc}}{A_{Vc0}}\right) \psi_{ec,V}\ \psi_{ed,V}\ \psi_{c,V}\ \psi_{h,V}\ \psi_{parallel,V}\ V_b$ ACI 318-08 Eq. (D-22)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e'_V}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f'_c}\ c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
6.000	16.000	0.000	1.000	12.000

l_e [in.]	λ	d_a [in.]	f'_c [psi]	$\psi_{parallel,V}$
6.000	1.000	0.750	3500	2.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
234.00	162.00	1.000	1.000	1.000	7989

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
23080	0.700	16156	9500

5 Warnings

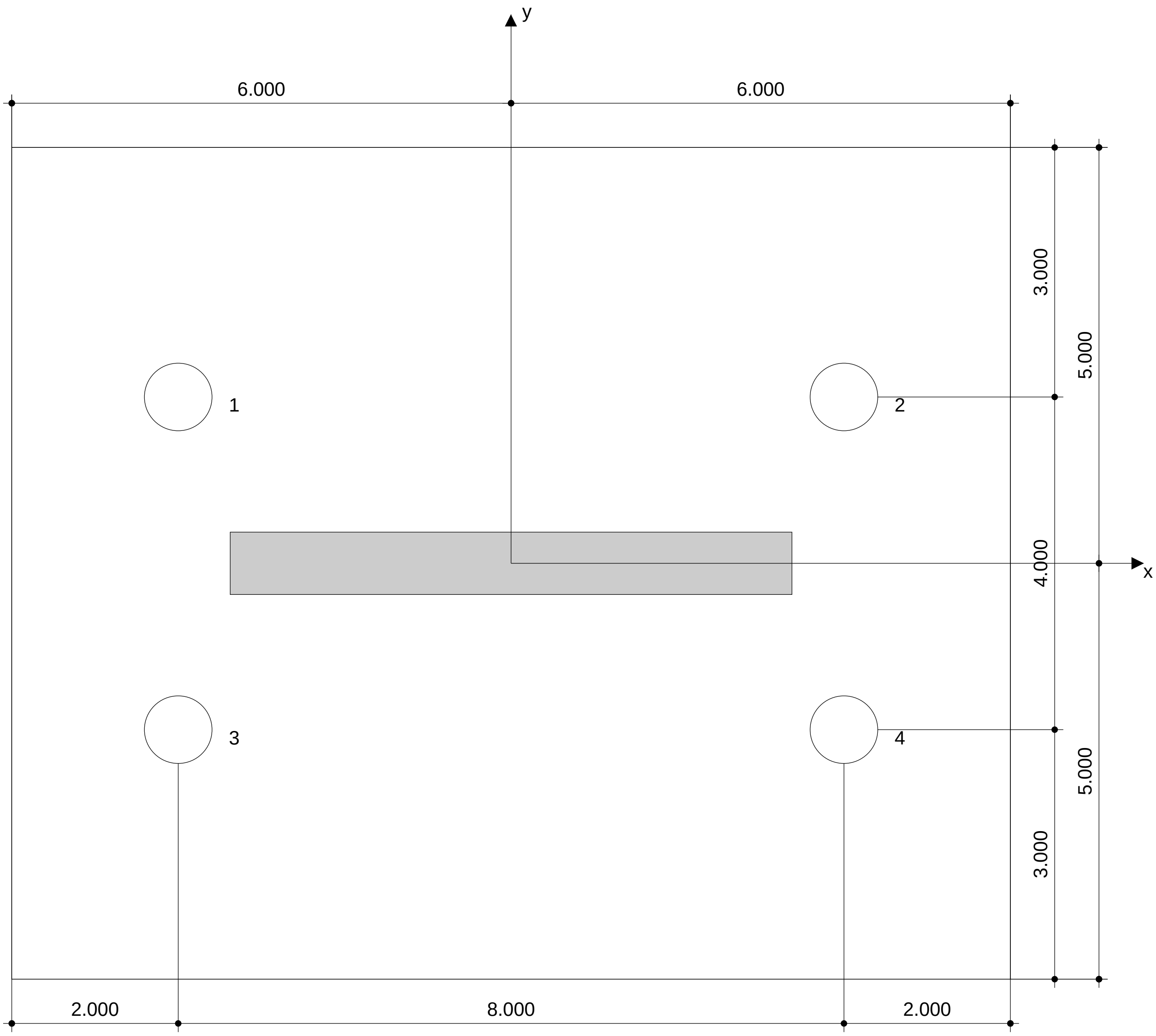
- Load re-distributions on the anchors due to elastic deformations of the anchor plate are not considered. The anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the loading! Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies when supplementary reinforcement is used. The Φ factor is increased for non-steel Design Strengths except Pullout Strength and Pryout strength. Condition B applies when supplementary reinforcement is not used and for Pullout Strength and Pryout Strength. Refer to your local standard.
- Design Strengths of adhesive anchor systems are influenced by the cleaning method. Refer to the INSTRUCTIONS FOR USE given in the Evaluation Service Report for cleaning and installation instructions
- The ACI 318-08 version of the software does not account for adhesive anchor special design provisions corresponding to overhead applications.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

Fastening meets the design criteria!

6 Installation data

Anchor plate, steel: -
Profile: Rectangular plates and bars (AISC); 6.750 x 0.750 x 0.000 in.
Hole diameter in the fixture: d_f = 0.813 in.
Plate thickness (input): 0.500 in.
Recommended plate thickness: not calculated
Cleaning: Premium cleaning of the drilled hole is required

Anchor type and diameter: HIT-HY 200 + HAS-R 316 3/4
Installation torque: 1200.002 in.lb
Hole diameter in the base material: 0.875 in.
Hole depth in the base material: 8.000 in.
Minimum thickness of the base material: 9.750 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-4.000	2.000	16.000	-	10.000	6.000
2	4.000	2.000	24.000	-	10.000	6.000
3	-4.000	-2.000	16.000	-	6.000	10.000
4	4.000	-2.000	24.000	-	6.000	10.000

Company:	Ntrive	Page:	6
Specifier:	KZZ	Project:	20150103
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/8/2015
E-Mail:			

7 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.

Ntrive Engineering

280 Shuman Blvd Ste 270

Naperville, IL 60563

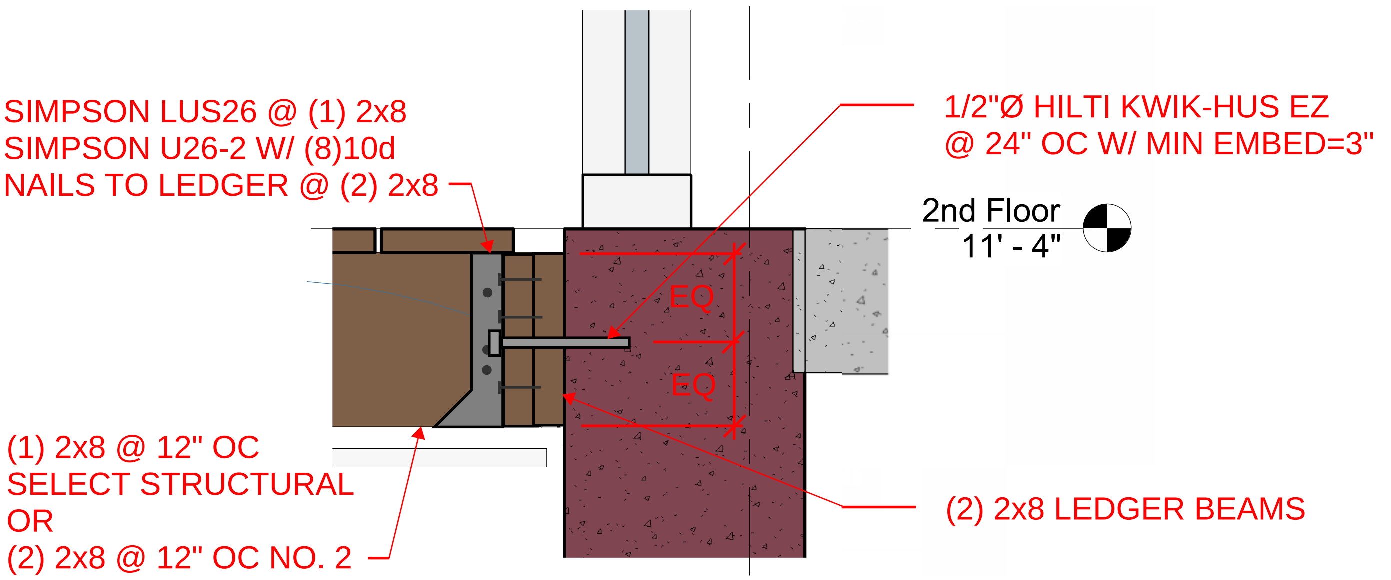
JOB S & B BALCONY NO. 20150103

SHEET NO. 318 OF

CALCULATED BY KZZ DATE 6/9/15

CHECKED BY DATE

DESCRIPTION JOIST CONN ANALYSIS



CHECK CONNECTION OF JOIST TO LEDGER BEAM:
Vact=100 PSF*12"*(10'-6")/2=525 LB
$Vall_{LUS26}$=1100 LB > 525 LB, **OK**
$Vall_{U26\text{-}2}$=975 LB > 525 LB, **OK**
PROVIDE SIMPSON LUS26 OR SIMPSON U26-2

CHECK CONNECTION OF LEDGER BEAM TO CONCRETE:
Vu=1.6*2'*525 PLF=1680 LB
PROVIDE 1/2"Ø HILTI KWIK-HUS EZ @ 24" OC W/ EMBED=3".
SEE FOLLOWING HILTI PROFIS OUTPUT FOR ANALYSIS

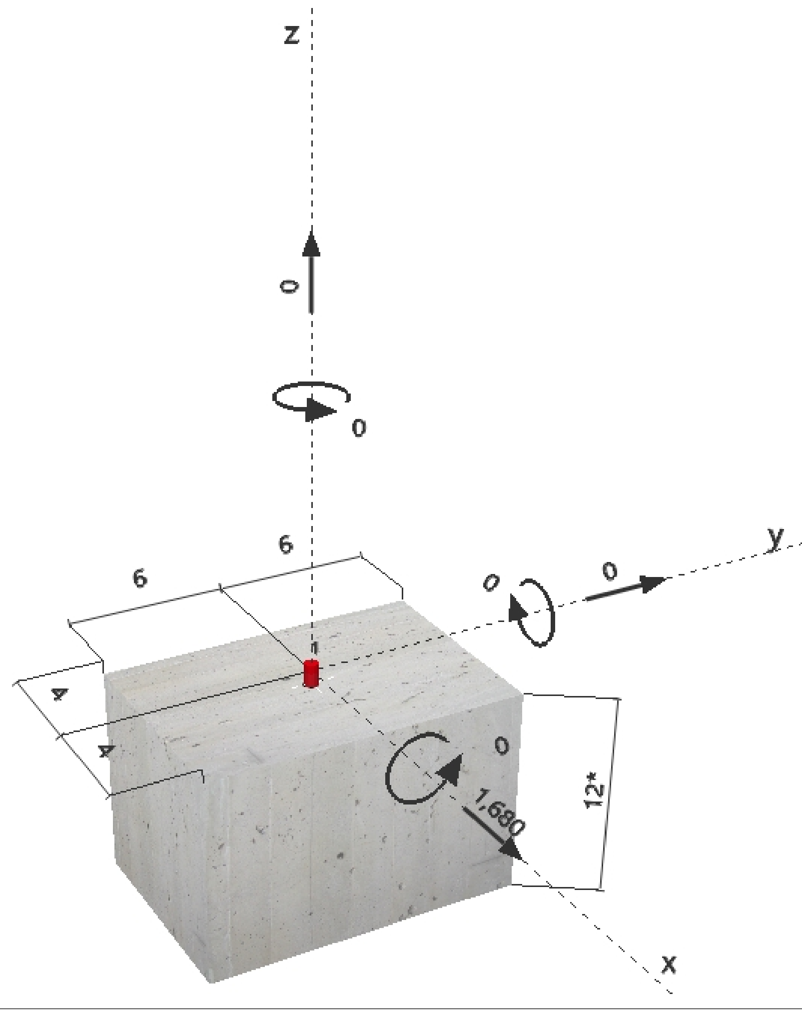
Company:	Ntrive	Page:	1
Specifier:	KZZ	Project:	20150103
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/9/2015
E-Mail:			

Specifier's comments:

1 Input data

Anchor type and diameter:	**KWIK HUS-EZ (KH-EZ) 1/2 (3)**
Effective embedment depth:	h_{ef} = 2.160 in., h_{nom} = 3.000 in.
Material:	Carbon Steel
Evaluation Service Report:	ESR-3027
Issued I Valid:	6/1/2014 | 12/1/2015
Proof:	Design method ACI 318 / AC193
Stand-off installation:	- (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, 2500, f_c' = 2500 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition B; no supplemental splitting reinforcement present edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

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



Company:	Ntrive	Page:	2
Specifier:	KZZ	Project:	20150103
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/9/2015
E-Mail:			

2 Load case/Resulting anchor forces

Load case: Design loads

Anchor reactions [lb]
Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0	1680	1680	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(0.000/0.000): 0 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	N/A	N/A	N/A	N/A
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Strength**	N/A	N/A	N/A	N/A

* anchor having the highest loading **anchor group (anchors in tension)

Company:	Ntrive	Page:	3
Specifier:	KZZ	Project:	20150103
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/9/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	1680	5547	31	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	1680	1889	89	OK
Concrete edge failure in direction x+**	1680	1857	91	OK

* anchor having the highest loading **anchor group (relevant anchors)

4.1 Steel Strength

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

$\phi\, V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.16	112540

Calculations

V_{sa} [lb]
9245

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\, V_{sa}$ [lb]	V_{ua} [lb]
9245	0.600	5547	1680

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 318-08 Eq. (D-30)

$\phi\, V_{cp} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\, h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\, e'_N}{3\, h_{ef}}} \right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\, \lambda\, \sqrt{f'_c}\, h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
1	2.160	0.000	0.000	4.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f'_c [psi]
1.000	3.750	17	1	2500

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
41.99	41.99	1.000	1.000	1.000	1.000	2698

Results

V_{cp} [lb]	$\phi_{concrete}$	$\phi\, V_{cp}$ [lb]	V_{ua} [lb]
2698	0.700	1889	1680

Company:	Ntrive	Page:	4
Specifier:	KZZ	Project:	20150103
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/9/2015
E-Mail:			

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 318-08 Eq. (D-21)

$\phi\, V_{cb} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\, c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e'_V}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f'_c}\, c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
4.000	6.000	0.000	1.000	12.000

l_e [in.]	λ	d_a [in.]	f'_c [psi]	$\psi_{parallel,V}$
2.160	1.000	0.500	2500	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
72.00	72.00	1.000	1.000	1.000	2653

Results

V_{cb} [lb]	$\phi_{concrete}$	$\phi\, V_{cb}$ [lb]	V_{ua} [lb]
2653	0.700	1857	1680

5 Warnings

- Load re-distributions 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 loading! Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies when supplementary reinforcement is used. The Φ factor is increased for non-steel Design Strengths except Pullout Strength and Pryout strength. Condition B applies when supplementary reinforcement is not used and for Pullout Strength and Pryout Strength. Refer to your local standard.
- Refer to the manufacturer's product literature for cleaning and installation instructions.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

Fastening meets the design criteria!

6 Installation data

Anchor plate, steel: -
Profile: -
Hole diameter in the fixture: -
Plate thickness (input): -
Recommended plate thickness: -

Anchor type and diameter: KWIK HUS-EZ (KH-EZ) 1/2 (3)
Installation torque: 540.001 in.lb
Hole diameter in the base material: 0.500 in.
Hole depth in the base material: 3.375 in.
Minimum thickness of the base material: 4.750 in.

Cleaning: Manual cleaning of the drilled hole according to instructions for use is required.

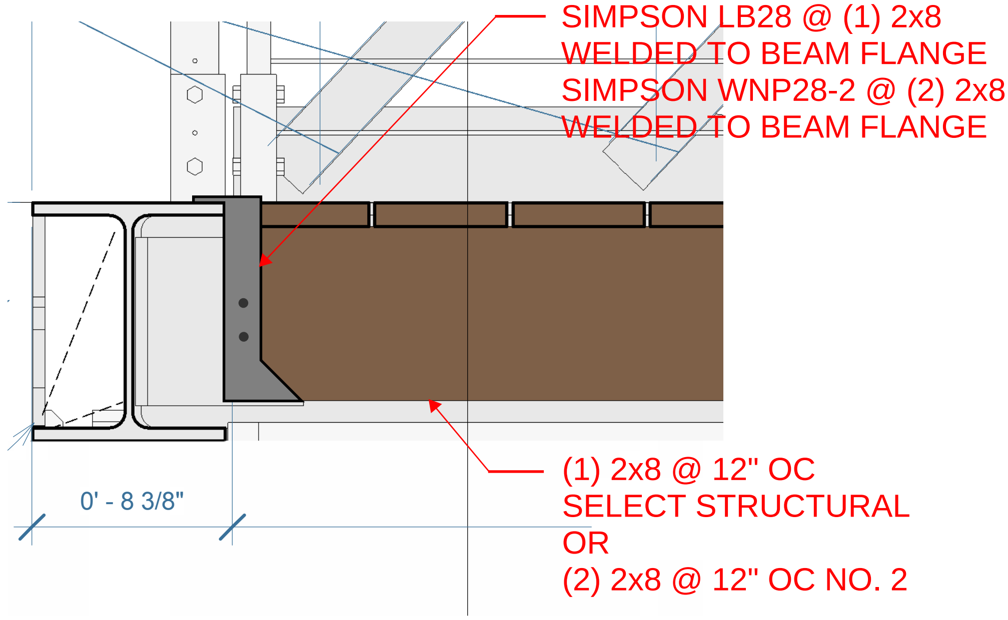
Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	0.000	0.000	4.000	4.000	6.000	6.000

7 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.

Ntrive Engineering	JOB S & B BALCONY	NO. 20150103
280 Shuman Blvd Ste 270	SHEET NO. 324	OF
Naperville, IL 60563	CALCULATED BY KZZ	DATE 6/9/15
	CHECKED BY	DATE
	DESCRIPTION JOIST CONN ANALYSIS	



CHECK CONNECTION OF JOIST TO LEDGER BEAM:

Vact=100 PSF*12"*(10'-6")/2=525 LB

$V_{all,LB28}$=1270 LB > 525 LB, **OK**

$V_{all,WNP28\text{-}2}$=3255 LB > 525 LB, **OK**

PROVIDE SIMPSON LB28 OR SIMPSON WNP28-2

Stephan & Brady Balcony
Madison, WI

Appenix A:
Technical Information

LUS/HUS/HHUS/HGUS *Double Shear Joist Hangers*

SIMPSON Strong-Tie®

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

See Hanger tables on pages 77-82. See Hanger Options on pages 233-243 for hanger modifications, which may result in reduced loads.

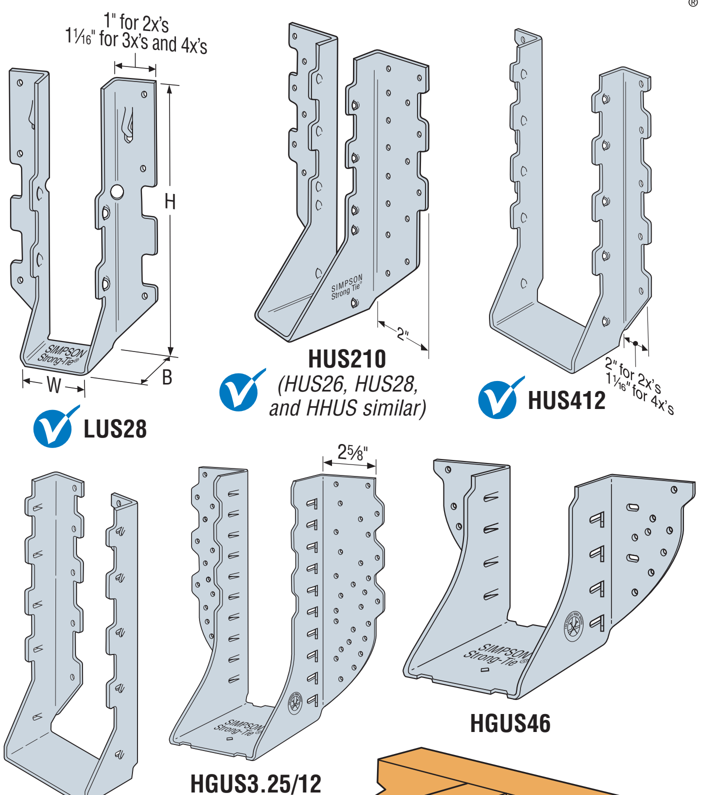
All hangers in this series have double shear nailing. This innovation distributes the load through two points on each joist nail for greater strength. It also allows the use of fewer nails, faster installation, and the use of standard nails for all connections. *(Do not bend or remove tabs.)*

MATERIAL: See tables, pages 77-82.

FINISH: Galvanized. Some products available in stainless steel or ZMAX® coating; see Corrosion Information, pages 13-15.

INSTALLATION • Use all specified fasteners. See General Notes.
- Nails must be driven at an angle through the joist or truss into the header to achieve the table loads.
- Not designed for welded or nailer applications.
- 16d sinkers (0.148" dia. x 3¼" long) may be used where 10d commons are specified with no reduction in load. Where 16d commons are specified, 10d commons or 16d sinkers (0.148" dia. x 3¼" long) may be used at 0.85 of the table load.
- With 3x carrying members, use 16dx2½" nails into the header and 16d commons into the joist with no load reduction.
- With 2x carrying members, use 10dx1½" nails into the header and 10d commons into the joist, reduce the load to 0.64 of the table value.
- Use stainless-steel (SS) nails with stainless-steel (SS) hangers.

OPTIONS: • LUS hangers cannot be modified.
- HUS hangers available with the header flanges turned in for 2-2x (3⅛") and 4x only, with no load reduction. See the HUSC Concealed Flange illustration.



LUS28

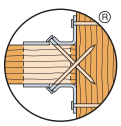
HUS210 *(HUS26, HUS28, and HHUS similar)*

HUS412

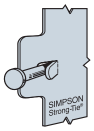
HUSC Concealed Flanges *(not available for HHUS, HGUS and HUS2x)*

HGUS3.25/12

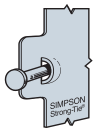
HGUS46



Double-Shear Nailing Top View

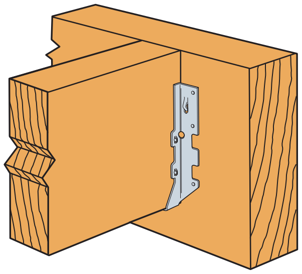


Double-Shear Nailing Side View Do not bend tab



Dome Double-Shear Nailing Side View *(available on some models)*

U.S. Patent 5,603,580



Typical LUS28 Installation
use 0.148x3" (10d common) or 0.148x3¼" (16d sinker) nail

FACE MOUNT HANGERS – SOLID SAWN LUMBER (DF/SP)

These products are available with additional corrosion protection. Additional products on this page may also be available with this option, check with Simpson Strong-Tie for details.

These products are approved for installation with the Strong-Drive® SD Connector screw. See page 27 for more information.

Joist Size	Model No.	Ga	Dimensions (in.) W	H	B	Min/Max	Fasteners Header	Fasteners Joist	DF/SP Allowable Loads Uplift (160)	Floor (100)	Snow (115)	Roof (125)	Installed Cost Index (ICI)	Code Ref.
SAWN LUMBER SIZES														
2X4	LU24	20	1⁹⁄₁₆	3⅛	1½	—	4-16d	2-10dx1½	265	555	635	685	Lowest	I7, I27, F6, L5, L17
	LUS24	18	1⁹⁄₁₆	3⅛	1¾	—	4-10d	2-10d	490	670	765	825	+3%	
	U24	16	1⁹⁄₁₆	3⅛	1½	—	4-16d	2-10dx1½	265	575	655	705	+67%	I7, F6, L17
	HU26	14	1⁹⁄₁₆	3¹⁄₁₆	2¼	—	4-16d	2-10dx1½	335	595	670	720	+295%	
DBL 2X4	LUS24-2	18	3⅛	3⅛	2	—	4-16d	2-16d	440	800	910	985	Lowest	I7, I27, F6, L5, L17
	U24-2	16	3⅛	3	2	—	4-16d	2-10d	370	575	655	705	+33%	I7, F6, L17
	HU24-2/HUC24-2	14	3⅛	3¹⁄₁₆	2½	—	4-16d	2-10d	380	380	595	720	+240%	
2x6	LUS26	18	1⁹⁄₁₆	4¾	1¾	—	4-10d	4-10d	1165	865	990	1070	Lowest	I7, I27, F6, L5, L17
	LU26	20	1⁹⁄₁₆	4¾	1½	—	6-16d	4-10dx1½	565	835	950	1030	+6%	
	U26	16	1⁹⁄₁₆	4¾	2	—	6-16d	4-10dx1½	585	865	980	1055	+43%	I7, F6, L17
	LUC26Z	18	1⁹⁄₁₆	4¾	1¾	—	6-16d	4-10dx1½	730	845	965	1040	+160%	
	HU26	14	1⁹⁄₁₆	3¹⁄₁₆	2¼	—	4-16d	2-10dx1½	335	335	595	720	+179%	
	HUS26	16	1⅝	5⅜	3	—	14-16d	6-16d	1550	2720	3095	3335	+276%	I7, I27, F6, L5, L17
DBL 2X6	LUS26-2	18	3⅛	4⅞	2	—	4-16d	4-16d	1165	1030	1180	1280	Lowest	
	U26-2	16	3⅛	5	2	—	8-16d	4-10d	740	1150	1305	1410	+65%	I7, F6, L17
	HUS26-2/HUSC26-2	14	3⅛	5³⁄₁₆	2	—	4-16d	4-16d	1235	1065	1210	1305	+172%	
	HU26-2/HUC26-2	14	3⅛	5⅜	2½	Min	8-16d	4-10d	760	1190	1345	1445	+233%	I7, I27, F6, L5, L17
		14	3⅛	5⅜	2½	Max	12-16d	6-10d	1135	1785	2015	2165	+254%	I7, F6, L17

See footnotes on page 79.

CODES: See page xx for Code Reference Key Chart.

FACE MOUNT HANGERS – SOLID SAWN LUMBER (DF/SP)

SIMPSON Strong-Tie®

These products are available with additional corrosion protection. Additional products on this page may also be available with this option, check with Simpson Strong-Tie for details.

These products are approved for installation with the Strong-Drive® SD Connector screw. See page 27 for more information.

Joist Size	Model No.	Ga	Dimensions (in.) W	H	B	Min/ Max	Fasteners Header	Joist	DF/SP Allowable Loads Uplift (160)	Floor (100)	Snow (115)	Roof (125)	Installed Cost Index (ICI)	Code Ref.
SAWN LUMBER SIZES														
TPL 2x6	LUS26-3	18	4⅝	4⅛	2		4-16d	4-16d	1165	1030	1180	1280	*	160
	U26-3	16	4⅝	4¼	2		8-16d	4-10d	740	1150	1305	1410	*	
	HU26-3/HUC26-3	14	4 11/16	5½	2½	Min	8-16d	4-10d	760	1190	1345	1445	*	
		14	4 11/16	5½	2½	Max	12-16d	6-10d	1135	1785	2015	2165	*	
2x8	LUS26	18	1 9/16	4¾	1¾	—	4-10d	4-10d	1165	865	990	1070	Lowest	I7, I27, F6, L5, L17
	LU26	20	1 9/16	4¾	1½	—	6-16d	4-10dx1½	565	835	950	1030	+6%	
	LUS28	18	1 9/16	6⅝	1¾	—	6-10d	4-10d	1165	1100	1255	1360	+23%	
	LU28	20	1 9/16	6⅝	1½	—	8-16d	6-10dx1½	850	1110	1270	1335	+39%	
	U26	16	1 9/16	4¾	2	—	6-16d	4-10dx1½	585	865	980	1055	+43%	I7, F6, L17
	LUC26Z	18	1 9/16	4¾	1¾	—	6-16d	4-10dx1½	730	845	965	1040	+160%	
	HU28	14	1 9/16	5¼	2¼	—	6-16d	4-10dx1½	610	895	1005	1085	+251%	
	HUS26	16	1⅝	5⅜	3	—	14-16d	6-16d	1550	2720	3095	3335	+276%	I7, I27, F6, L5, L17
	HUS28	16	1⅝	7	3	—	22-16d	8-16d	2000	3965	4120	4220	+409%	
DBL 2x8	LUS26-2	18	3⅛	4⅞	2	—	4-16d	4-16d	1165	1030	1180	1280	Lowest	
	LUS28-2	18	3⅛	7	2	—	6-16d	4-16d	1165	1315	1500	1625	+8%	
	U26-2	16	3⅛	5	2	—	8-16d	4-10d	740	1150	1305	1410	+65%	I7, F6, L17
	HUS28-2/HUSC28-2	14	3⅛	7 3/16	2	—	6-16d	6-16d	1550	1595	1815	1960	+188%	
	HU28-2/HUC28-2	14	3⅛	7	2½	Min	10-16d	4-10d	760	1490	1680	1805	+397%	
		14	3⅛	7	2½	Min	14-16d	6-10d	1135	2085	2350	2530	+418%	
TPL 2X8	LUS28-3	18	4⅝	6¼	2	—	6-16d	4-16d	1165	1315	1500	1625	*	160
	U26-3	16	4⅝	4¼	2	—	8-16d	4-10d	740	1150	1305	1410	*	
	HU26-3/HUC26-3	14	4 11/16	5½	2½	Min	8-16d	4-10d	760	1190	1345	1445	*	
		14	4 11/16	5½	2½	Max	12-16d	6-10d	1135	1785	2015	2165	*	
QUAD 2X8	HU28-4/HUC28-4	14	14	6⅛	6⅝	Min	10-16d	4-16d	900	1490	1680	1805	*	
		14	14	6⅛	6⅝	Max	14-16d	6-16d	1345	2085	2350	2530	*	
2x10	LUS28	18	1 9/16	6⅝	1¾	—	6-10d	4-10d	1165	1100	1255	1360	Lowest	I7, I27, F6, L5, L17
	LU28	20	1 9/16	6⅜	1½	—	8-16d	6-10dx1½	850	1110	1270	1335	+13%	
	LUS210	18	1 9/16	7 13/16	1¾	—	8-10d	4-10d	1165	1340	1525	1650	+15%	
	LU210	20	1 9/16	7 13/16	1½	—	10-16d	6-10dx1½	850	1390	1585	1715	+28%	I7, F6, L17
	U210	16	1 9/16	7 13/16	2	—	10-16d	6-10dx1½	1110	1440	1635	1685	+76%	
	LUC210Z	18	1 9/16	7¾	1¾	—	10-16d	6-10dx1½	1100	1410	1605	1735	+180%	
	HU210	14	1 9/16	7⅛	2¼	—	8-16d	4-10dx1½	610	1190	1345	1445	+225%	
	HUS210	16	1⅝	9	3	—	30-16d	10-16d	3000	4255	4445	4575	+450%	
DBL 2X10	LUS28-2	18	3⅛	7	2	—	6-16d	4-16d	1165	1315	1500	1625	Lowest	I7, I27, F6, L5, L17
	LUS210-2	18	3⅛	9	2	—	8-16d	6-16d	1745	1830	2090	2265	+34%	
	U210-2	16	3⅛	8½	2	—	14-16d	6-10d	1110	2015	2285	2465	+88%	I7, F6, L17
	HUS210-2/HUSC210-2	14	3⅛	9 3/16	2	—	8-16d	8-16d	3295	2125	2420	2615	+217%	I7, F23, L17
	HU210-2/HUC210-2	14	3⅛	8 13/16	2½	Min	14-16d	6-10d	1135	2085	2350	2530	+441%	I7, F6, L17
		14	3⅛	8 13/16	2½	Max	18-16d	10-10d	1895	2680	3020	3250	+467%	
	HUCQ210-2-SDS	14	2 9/16	9	3	—	12-¼"x2½" SDS	6-¼"x2½" SDS	2510	4680	4955	4955	*	F23
	HHUS210-2	14	3 5/16	9 5/32	3	—	30-16d	10-16d	4000	5635	6380	6880	*	F23
TPL 2X10	LUS28-3	18	4⅝	6¼	2	—	6-16d	4-16d	1165	1315	1500	1625	*	160
	LUS210-3	18	4⅝	8 3/16	2	—	8-16d	6-16d	1745	1830	2090	2265	*	
	U210-3	16	4⅝	7¾	2	—	14-16d	6-10d	1110	2015	2285	2465	*	I7, F6, L17
	HU210-3/HUC210-3	14	4 11/16	8 9/16	2½	Min	14-16d	6-10d	1135	2085	2350	2530	*	
		14	4 11/16	8 9/16	2½	Max	18-16d	10-10d	1895	2680	3020	3250	*	
	HHUS210-3	14	4 11/16	8⅞	3	—	30-16d	10-16d	4000	5635	6380	6880	*	
	HGUS210-3	12	4 15/16	9⅛	4	—	46-16d	16-16d	4095	9100	9100	9100	*	I7, F23
	HUCQ210-3-SDS	14	4⅝	9	3	—	8-¼"x2½" SDS	4-¼"x2½" SDS	2510	4680	4955	4955	*	F23
QUAD 2x10	HU210-4/HUC210-4	14	6⅛	8⅜	2½	Min	14-16d	6-16d	1345	2085	2350	2530	*	160
		14	6⅛	8⅜	2½	Max	18-16d	8-16d	1795	2680	3020	3250	*	
	HHUS210-4	14	6⅛	8⅞	3	—	30-16d	10-16d	4000	5635	6380	6880	*	F23, 160
	HGUS210-4	12	6 9/16	9⅛	4	—	46-16d	16-16d	4095	9100	9100	9100	*	
2x12	LUS210	18	1 9/16	7 13/16	1¾	—	8-10d	4-10d	1165	1340	1525	1650	Lowest	I7, I27, F6, L5, L17
	LU210	20	1 9/16	7 13/16	1½	—	10-16d	6-10dx1½	850	1390	1585	1715	+11%	
	U210	16	1 9/16	7 13/16	2	—	10-16d	6-10dx1½	1110	1440	1635	1685	+53%	I7, F6, L17
	LUC210Z	18	1 9/16	7¾	1¾	—	10-16d	6-10dx1½	1100	1410	1605	1735	+180%	I7, I27, F6, L5, L17
	HU212	14	1 9/16	9	2¼	—	10-16d	6-10dx1½	1135	1490	1680	1805	+347%	I7, F6, L17
	HUS210	16	1⅝	9	3	—	30-16d	10-16d	3000	4255	4445	4575	+378%	
DBL 2x12	LUS210-2	18	3⅛	9	2	—	8-16d	6-16d	1745	1830	2090	2265	Lowest	I7, I27, F6, L5, L17
	U210-2	16	3⅛	8½	2	—	14-16d	6-10d	1110	2015	2285	2465	+40%	I7, F6, L17
	LUS214-2	18	3⅛	10 15/16	2	—	10-16d	6-16d	1745	2110	2410	2610	+56%	
	HUS210-2	14	3⅛	9 3/16	2	—	8-16d	8-16d	3295	2125	2420	2615	*	
	HUS212-2/HUSC212-2	14	3⅛	10¾	2	—	10-16d	10-16d	3635	2660	3025	3265	*	
	HU212-2/HUC212-2	14	3⅛	10 9/16	2½	Min	16-16d	6-10d	1135	2380	2685	2890	*	
		14	3⅛	10 9/16	2½	Max	2 2-16d	10-10d	1895	3275	3695	3970	+411%	
	HUCQ210-2-SDS	14	2 9/16	9	3	—	12-¼"x2½" SDS	6-¼"x2½" SDS	2510	5460	5560	5560	*	F23

See footnotes on page 79.

CODES: See page 12 for Code Reference Key Chart.

TOP FLANGE HANGERS JB/JBA/LB/LBAZ/BA/B/HHB *Joist, Beam and Purlin Hangers*

SIMPSON Strong-Tie®

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

The new, next-generation LBAZ and JBA hangers provide higher loads for 2x10, 2x12 and 2x14 members in 14 gauge and 18 gauge steel, respectively. The new nail locations on the JBA enable effective use with nailers.

The B and BA hangers are cost effective hangers featuring min/max joist nailing option. Min Nailing featuring Positive Angle Nailing targets moderate load conditions whereas the Max Nailing generates capacities for higher loads. The unique two level embossment provides added stiffness to the top flange.

See tables on pages 87-91. See Hanger Options on pages 233-243
for hanger modifications, which may result in reduced loads.

MATERIAL: See tables, pages 87-91.

FINISH: BA, JB, JBA, LB, LBAZ and B—Galvanized; HHB–all saddle hangers and all welded sloped and special hangers—Simpson Strong-Tie® gray paint. BA, LB, B and HHB may be ordered hot-dip galvanized, specify HDG.

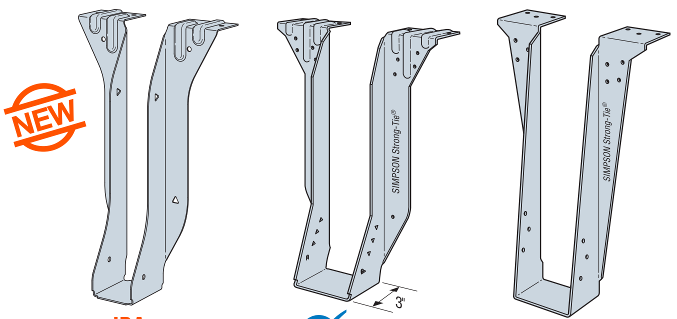
INSTALLATION: • Use specified fasteners. See General Notes and nailer table notes.

- LBAZ, BA, B and HHB may also be welded to steel headers with weld size to match material thickness *(approximate thickness shown)*. The minimum required weld to the top flanges is 1/8" x 2" *(1/8" x 1 7/16" for LBAZ)* fillet weld to each side of each top flange tab for 14 and 12 gauge and 3/16" x 2" fillet weld to each side of each top flange tab for 7 gauge. Distribute the weld equally on both top flanges. Welding cancels the top and face nailing requirements. Consult the code for special considerations when welding galvanized steel. The area should be well-ventilated *(see page 17 for welding information)*. Weld on applications produce the maximum allowable down load listed. For uplift loads refer to technical bulletin T-WELDUPLFT.
- Ledgers must be evaluated for each application separately. Check TF dimension, nail length and nail location on ledger.
- Refer to technical bulletin T-SLOPEJST for information regarding load reductions on selected hangers which can be used without modification to support joists which have shallow slopes (≤3/4:12).

OPTIONS: **B and HHB**

- Other widths are available; specify W dimension *(the minimum W dimension is 1 9/16" for B and 3 1/4" for HHB)*.
- See Hanger Options, pages 233-243. BA, JB, JBA, LB and LBAZ hangers cannot be modified. Use LBV as an alternative for the JBA/LBAZ.

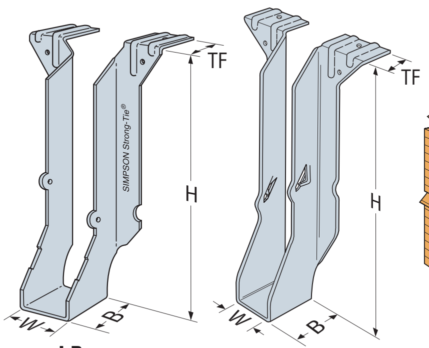
CODES: See page 12 for Code Reference Key Chart.



JBA
(LBAZ similar)

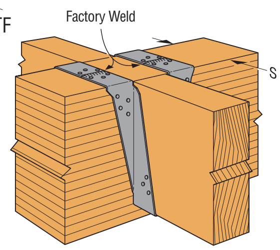
BA
U.S. Patent 7,334,372

B
(HHB similar)

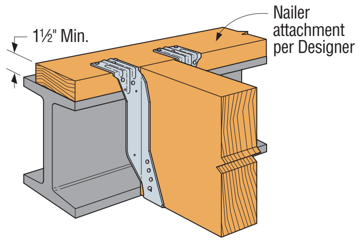


LB

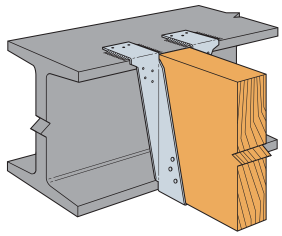
JB



Typical BD Saddle Installation



Typical BA Installation on Wood Nailer
(LB, B similar)



LB, BA, B and HHB are acceptable for weld-on applications. See Installation Information.

Nailer Table[5]

Model No.	Nailer	Top Flange Nailing	Joist Nailing	Allowable Loads		
				Uplift[1] (160)	DF/SP	SPF/HF
JB210A JB212A JB214A	2x	6-10dx1½	2-10dx1½	315	1265	965
	3x	6-16dx2½	2-10dx1½	315	1290	—
LB26	2x	4-10dx1½	2-10dx1½	—	850	—
LB28	2x	4-10dx1½	2-10dx1½	—	915	—
LB210AZ LB212AZ LB214AZ	2x	6-10dx1½	2-10dx1½	375	1265	1065
	3x	6-16dx2½	2-10dx1½	375	1290	—
LB216	2x	4-10dx1½	2-10dx1½	—	1150	—
BA	2x	10-10dx1½	2-10dx1½	265[3]	2220	1755
	2-2x	14-10d	2-10dx1½	265[3]	2695	2235
	3x	14-16dx2½	2-10dx1½	265[3]	3230	—
	4x	14-16d	2-10dx1½	265[3]	3230	—
B	2-2x	14-10d	6-10dx1½	710[4]	3615	2770
	3x	14-16dx2½	6-10dx1½	830[4]	3725	—
	4x	14-16d	6-10dx1½	830[4]	3800	—

1. Uplift values are for DF/SP nailers only. Refer to technical bulletin T-NAILERUPLFT for SPF values.
2. For joist members 2½" or wider, 16dx2½" joist nails should be installed for additional uplift loads on the 3x and 4x nailer applications of 970 lbs. and 1010 lbs. respectively.
3. If joist nailing is increased to (8)-10dx1½, higher uplift loads are allowed. See technical bulletin T-NAILERUPLFT.
4. If joist nailing is increased to (6)-16dx2½, higher uplift loads are allowed for joist members at least 2½" wide. See technical bulletin T-NAILERUPLFT.
5. Attachment of nailer to supporting member is by the Designer.

TOP FLANGE HANGERS W/WPU/WNP/WM/WMU/HW/HWU/GLT/HGLT

The W, WPU, HWU and HW series purlin hangers offer the greatest design flexibility and versatility. WMs are designed for use on standard 8" grouted masonry block wall construction.

MATERIAL: See tables on pages 87-91.

FINISH: Simpson Strong-Tie® gray paint; hot-dip galvanized available: specify HDG, contact Simpson Strong-Tie.

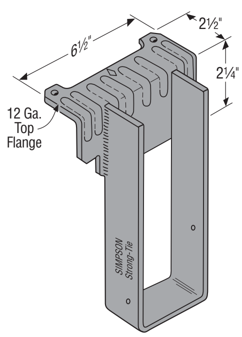
INSTALLATION: • Use all specified fasteners.

- H dimensions are sized to account for normal joist shrinkage. W dimensions are for dressed timber widths.
- Hangers may be welded to steel headers with weld size to match material thickness *(approximate thickness shown)* ⅛" for W, 3⁄16" for WNP/WPU and ¼" for HW/HWU, by 1½" fillet welds located at each end of the top flange *(see page 17 for welding information)*. Weld-on applications produce maximum allowable load listed. For uplift loads refer to technical bulletin T-WELDUPLFT *(HWU and WPU hangers only)*.
- GLT/HGLT may be welded to steel headers, see page 104 for requirements.
- Hangers can support multi-ply carried members; the individual members must be secured together to work as a single unit before installation into the hanger.
- WM—two 16d duplex nails must be installed into the top flange and embedded into the grouted wall. Verify that the grouted wall can take the required fasteners specified in the table.
- Embed WM into block with a minimum of one course above and one course below the top flange with one #5 vertical rebar minimum 24" long in each cell. Minimum grout strength is 2000 psi.

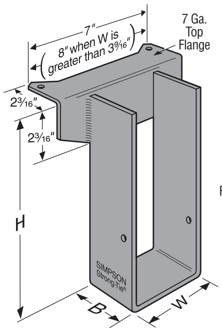
OPTIONS: • Refer to technical bulletin T-SLOPEJST for information regarding load reductions on selected hangers which can be used without modification to support joists which have shallow slopes (≤¾:12).

- See Hanger Options, pages 233-243 for hanger modifications and associated load reductions.
- Some model configurations may differ from those shown. Contact Simpson Strong-Tie for details.

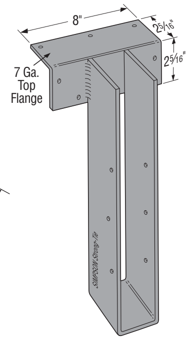
CODES: See page 12 for Code Reference Key Chart.



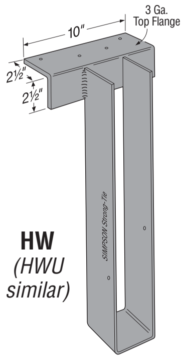
W



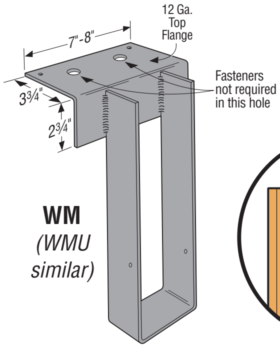
WP/WNP



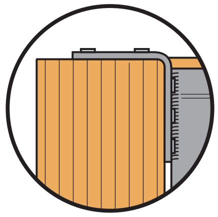
WPU



HW
(HWU similar)



WM
(WMU similar)

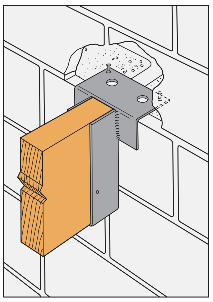

Eased Edge
Flatten edge of header to match top flange radius.

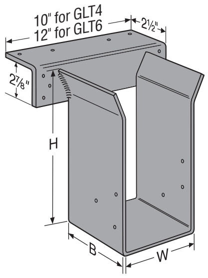
Model	Nailer	Top Flange Nailing	Uplift[1] (160)	Allowable Down Loads		
				DF/SP	SPF/HF	LSL
W	2x	2-10dx1½	—	1600	1600	—
	2-2x	2-10d	—	1665	1665	—
	3x	2-16dx2½	—	1765	—	—
	4x	2-10d	—	2200	—	—
WP and WNP	2x	2-10dx1½	—	2525	2500	3375
	2-2x	2-10d	—	3255	3255	—
	3x	2-16dx2½	—	3000	2510	3375
	4x	2-10d	—	3255	3255	—
WPU	2-2x	7-10d	700	3255	—	—
	3x	7-16dx2½	970	3000	—	—
	4x	7-16d	1095	3255	—	—
HW	2-2x	4-10d	—	4860	—	—
	3x	4-16dx2½	—	4845	—	—
	4x	4-16d	—	5285	—	—
HWU	2-2x	8-16dx2½	710	5430	—	—
	3x	8-16dx2½	970	5430	—	—
	4x	8-16d	1160	5430	—	—

NAILER TABLE

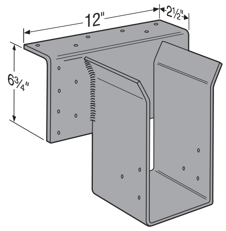
The table indicates the maximum allowable loads for W, WNP and HW hangers used on wood nailers. Nailers are wood members attached to the top of a steel I-beam, concrete or masonry wall.

1. Uplift value for the HWU hanger is for depths ≤18" and are for DF/SP values only. Refer to uplift values in table below for taller depths.
2. Attachment of nailer to supporting member is the responsibility of the Designer.


Typical WM Mid-Wall Installation
See pages 173-174 for models and information.



GLT
(fasteners included)

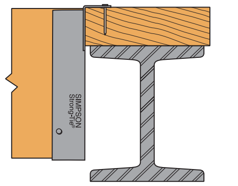


HGLT
(fasteners included)

See pages 104-105 for GLT and HGLT information.

W SERIES WITH VARIOUS HEADER APPLICATIONS

Model	Joist		Fasteners			Allowable Loads Header Type								Code Ref.
	Width	Depth	Top	Face	Joist	Uplift (160)	LVL	PSL	LSL	DF/SP	SPF/HF	I-Joist	Masonry	
W	1½ to 4	3½ to 30	2-10dx1½	—	2-10dx1½	—	1635	1740	—	1600	1415	—	—	170
	1½ to 4	3½ to 30	2-10d	—	2-10dx1½	—	2150	2020	—	2200	1435	—	—	I10, F9, L14
	1½ to 4	3½ to 30	2-16d	—	2-10dx1½	—	2335	1950	2335	1765	1435	—	—	
WM	1½ to 7½	3½ to 30	2-16d DPLX	—	2-10dx1½	—	MID-WALL INSTALLATION[4]						4175	L16
	1½ to 7½	3½ to 30	2-¼x1¾ Titens	—	2-10dx1½	—	TOP OF WALL INSTALLATION						3380	L11
WMU	1½ to 7½	9 to 28	2-16d DPLX	4-¼x1¾ Titens	6-10dx1½	625	MID-WALL INSTALLATION[4]						4175	170
	1½ to 7½	9 to 28	2-¼x1¾ Titens	4-¼x1¾ Titens	6-10dx1½	545	TOP OF WALL INSTALLATION						3380	
WP/ WNP	1½ to 7½	3½ to 30	2-10dx1½	—	2-10dx1½	—	2865	3250	—	2500	2000	2030	—	
	1½ to 7½	3½ to 30	2-10d	—	2-10dx1½	—	2525	3250	3650	3255	2525	—	—	I10, I19, F9, F18, L11, L14
	1½ to 7½	3½ to 30	2-16d	—	2-10dx1½	—	3635	3320	3650	3255	2600	—	—	
WPU/ WNPU	1½ to 5½	7¼ to 18	3-16d	4-16d	6-10dx1½	1095	4700	4880	3650	4165	4165	—	—	
	1½ to 5½	18½ to 28	3-16d	4-16d	6-10dx1½	390	4700	4880	3650	4165	4165	—	—	
HW	1½ to 7½	3½ to 32	4-10d	—	2-10dx1½	—	3100	4000	—	5285	3100	—	—	I10, I19, F9, F18, L11, L14
	1½ to 7½	3½ to 32	4-16d	—	2-10dx1½	—	5100	4000	4500	5285	3665	—	—	
HWU	1½ to 3½	9 to 18	4-16d	4-16d	6-10dx1½	1160	6335	5500	5535	6335	5415	—	—	
	1½ to 3½	18½ to 28	4-16d	4-16d	6-10dx1½	965	6335	5500	5535	6335	5415	—	—	
	1½ to 3½	28½ to 32	4-16d	4-16d	8-10dx1½	985	6335	5500	5535	6335	5415	—	—	
	4½ to 7	9 to 18	4-16d	4-16d	6-10dx1½	1160	6000	5500	5535	6000	5415	—	—	
	4½ to 7	18½ to 28	4-16d	4-16d	6-10dx1½	965	6000	5500	5535	6000	5415	—	—	
	4½ to 7	28½ to 32	4-16d	4-16d	8-10dx1½	985	6000	5500	5535	6000	5415	—	—	


Installation on Wood Nailer

1. Code values are based on DF/SP header species.
2. WMU, WPU and HWU uplift loads have been increased for wind or earthquake loading with no further increase allowed. Reduce where other loads govern.
3. For hanger heights exceeding the joist height, the allowable load is 0.50 of the table load.
4. Mid-wall Installation requires minimum of one grouted course above and below the hanger.
5. **NAILS:** 16d = 0.162" dia. x 3½" long, 10d = 0.148" dia. x 3" long, 10dx1½ = 0.148" dia. x 1½" long. See pages 22-23 for other nail sizes and information.

TOP FLANGE HANGERS – SOLID SAWN LUMBER (DF/SP)

SIMPSON Strong-Tie®

DON'T FEEL LIKE SIFTING THROUGH THIS TABLE? Visit ***www.strongtie.com/software*** to learn more about our new Joist Hanger Selector software.

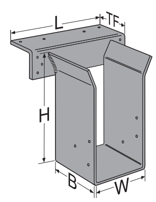
These products are available with additional corrosion protection. Additional products on this page may also be available with this option, check with Simpson Strong-Tie for details.

Joist or Purlin Size	Model No.	Ga	Dimensions				Fasteners		DF/SP Allowable Loads				Installed Cost Index (ICI)	Code Ref.
			W	H	B	TF	Header	Joist	Uplift (160)	Floor (100)	Snow (115)	Roof (125)		
SAWN LUMBER SIZES														
2x4	HU24TF	12	1 9/16	3 7/16	2¼	2½	6-16d	2-10dx1½	295	2090	2100	2100	Lowest	I10, F9, L11
DBL 2x4	HU24-2TF	12	3⅛	3 7/16	2½	2½	8-16d	2-10d	375	2600	2600	2600	Lowest	
2x6	JB26	18	1 9/16	5⅜	1½	1 9/16	4-10d	2 PRONG	—	1040	1040	1040	Lowest	
	LB26	14	1 9/16	5⅜	1½	1½	4-16d	2-10dx1½	290	1380	1380	1380	+117%	
	HU26TF	12	1 9/16	5⅜	2¼	2½	10-16d	4-10dx1½	590	2275	2330	2335	+568%	
	W26	12	1 9/16	5⅜	2½	2½	2-10d	2-10dx1½	—	2200	2200	2200	+890%	
DBL 2x6	HUS26-2TF	14	3⅛	5⅜	2	1¾	6-16d	4-16d	1235	2820	3000	3000	Lowest	
	WNP26-2	12	3⅛	5⅜	2½	2 3/16	2-10d	2-10d	—	3255	3255	3255	+33%	
	HU26-2TF	12	3⅛	5⅜	2½	2½	10-16d	4-10d	750	3725	3900	3900	+87%	
2x8	JB28	18	1 9/16	7¼	1½	1 9/16	4-10d	2 PRONG	—	1050	1050	1050	Lowest	
	LB28	14	1 9/16	7¼	1½	1½	4-16d	2-10dx1½	290	1270	1270	1270	+98%	
	HU28TF	12	1 9/16	7⅛	2¼	2½	10-16d	4-10dx1½	590	2335	2335	2335	+563%	
	W28	12	1 9/16	7⅛	2½	2½	2-10d	2-10dx1½	—	2200	2200	2200	+570%	
DBL 2x8	HUS28-2TF	14	3⅛	7¼	2	1⅞	8-16d	6-16d	1550	3455	3720	3895	Lowest	
	WNP28-2	12	3⅛	7⅛	2½	2 3/16	2-10d	2-10d	—	3255	3255	3255	+16%	
	HU28-2TF	12	3⅛	7⅛	2½	2½	12-16d	4-10d	750	3900	3900	3900	+75%	
2x10	JB210A	18	1 9/16	9 3/16	2	1 7/16	6-16d	2-10dx1½	315	1685	1685	1685	—	160
	LB210AZ	14	1 9/16	9 3/16	2	1 7/16	6-16d	2-10dx1½	380	1865	1865	1865	—	170
	HU210TF	12	1 9/16	9⅛	2¼	2½	12-16d	4-10dx1½	590	2335	2335	2335	+359%	I10, F9, L11
	W210	12	1 9/16	9⅛	2½	2½	2-10d	2-10dx1½	—	2200	2200	2200	+360%	
DBL 2x10	HUS210-2TF	14	3⅛	9¼	2	1½	10-16d	8-16d	2590	3585	3925	4155	Lowest	
	WNP210-2	12	3⅛	9⅛	2½	2 3/16	2-10d	2-10d	—	3255	3255	3255	+9%	
	HU210-2TF	12	3⅛	9⅛	2½	2½	14-16d	6-10d	1125	4170	4170	4170	+67%	
TPL 2x10	HU210-3TF	12	4 11/16	9⅛	2½	2½	14-16d	6-16d	1325	4150	4150	4150	Lowest	
2x12	JB212A	18	1 9/16	11⅛	2	1 7/16	6-16d	2-10dx1½	315	1685	1685	1685	—	160
	LB212AZ	14	1 9/16	11⅛	2	1 7/16	6-16d	2-10dx1½	380	1865	1865	1865	—	170
	W212	12	1 9/16	11	2½	2½	2-10d	2-10dx1½	—	2200	2200	2200	+317%	I10, F9, L11
	HU212TF	12	1 9/16	11	2¼	2½	14-16d	6-10dx1½	885	2335	2335	2335	+339%	
DBL 2x12	HUS212-2TF	14	3⅛	11⅛	2	2¼	10-16d	8-16d	2000	4435	4535	4605	Lowest	I10, F9
	WNP212-2	12	3⅛	11	2½	2 3/16	2-10d	2-10d	—	3255	3255	3255	+12%	I10, F9, L11
	HU212-2TF	12	3⅛	11	2½	2½	16-16d	6-10d	1125	4325	4660	4880	+48%	
TPL 2x12	HU212-3TF	12	4 11/16	11	2½	2½	16-16d	6-16d	1325	4550	4885	5105	Lowest	
2x14	JB214A	18	1 9/16	13⅛	2	1 7/16	6-16d	2-10dx1½	315	1685	1685	1685	—	160
	LB214AZ	14	1 9/16	13⅛	2	1 7/16	6-16d	2-10dx1½	380	1865	1865	1865	—	170
	W214	12	1 9/16	13	2½	2½	2-10d	2-10dx1½	—	2200	2200	2200	+188%	I10, F9, L11
	HU214TF	12	1 9/16	13	2¼	2½	16-16d	6-10dx1½	885	2660	2745	2800	+189%	
DBL 2x14	HUS214-2TF	14	3⅛	13⅛	2	2¼	12-16d	8-16d	2590	4435	4535	4605	Lowest	
	WNP214-2	12	3⅛	13	2½	2 3/16	2-10d	2-10d	—	3255	3255	3255	+2%	
	HU214-2TF	12	3⅛	13	2½	2½	18-16d	8-10d	1500	4335	4335	4335	+33%	
TPL 2x14	HU214-3TF	12	4 11/16	13	2½	2½	18-16d	8-16d	1765	4835	5050	5050	Lowest	
2x16	LB216	14	1 9/16	15⅛	2	1½	4-16d	2-10dx1½	290	1425	1425	1425	Lowest	
	W216	12	1 9/16	15	2½	2½	2-10d	2-10dx1½	—	2200	2200	2200	+122%	
	HU216TF	12	1 9/16	15	2¼	2½	18-16d	8-10dx1½	1180	2845	2955	3030	+199%	
DBL 2x16	WNP216-2	12	3⅛	15	2½	2 3/16	2-10d	2-10d	—	3255	3255	3255	Lowest	
	HU216-2TF	12	3⅛	15	2½	2½	20-16d	8-10d	1500	4335	4335	4335	+34%	

1. N54A fasteners are supplied with hangers.
2. 16d sinkers may be used where 10d commons are called out with no load reduction.
3. Uplift loads are based on DF/SP lumber and have been increased for wind or earthquake loading with no further increase allowed. For normal loading applications such as cantilever construction refer to Simpson Strong-Tie® Connector Selector™ software or conservatively divide the uplift load by 1.6. For SPF use 0.86 x DF/SP uplift load.
4. **NAILS:** 16d = 0.162" dia. x 3½" long, 10d = 0.148" dia. x 3" long, 10dx1½ = 0.148" dia. x 1½" long. See pages 22-23 for other nail sizes and information.

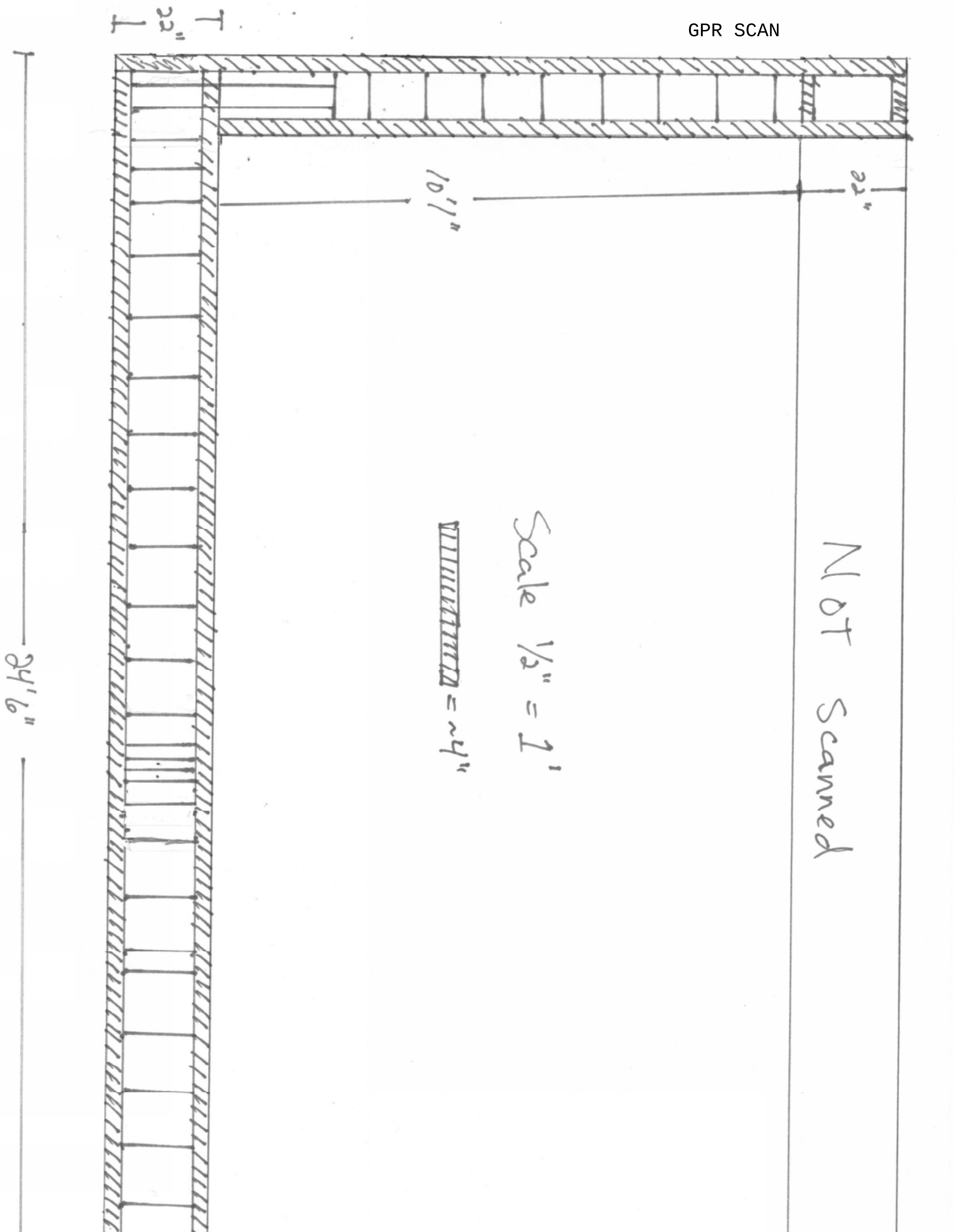
CODES: See page 12 for Code Reference Key Chart.

**Installed Cost Index not available on these models.*

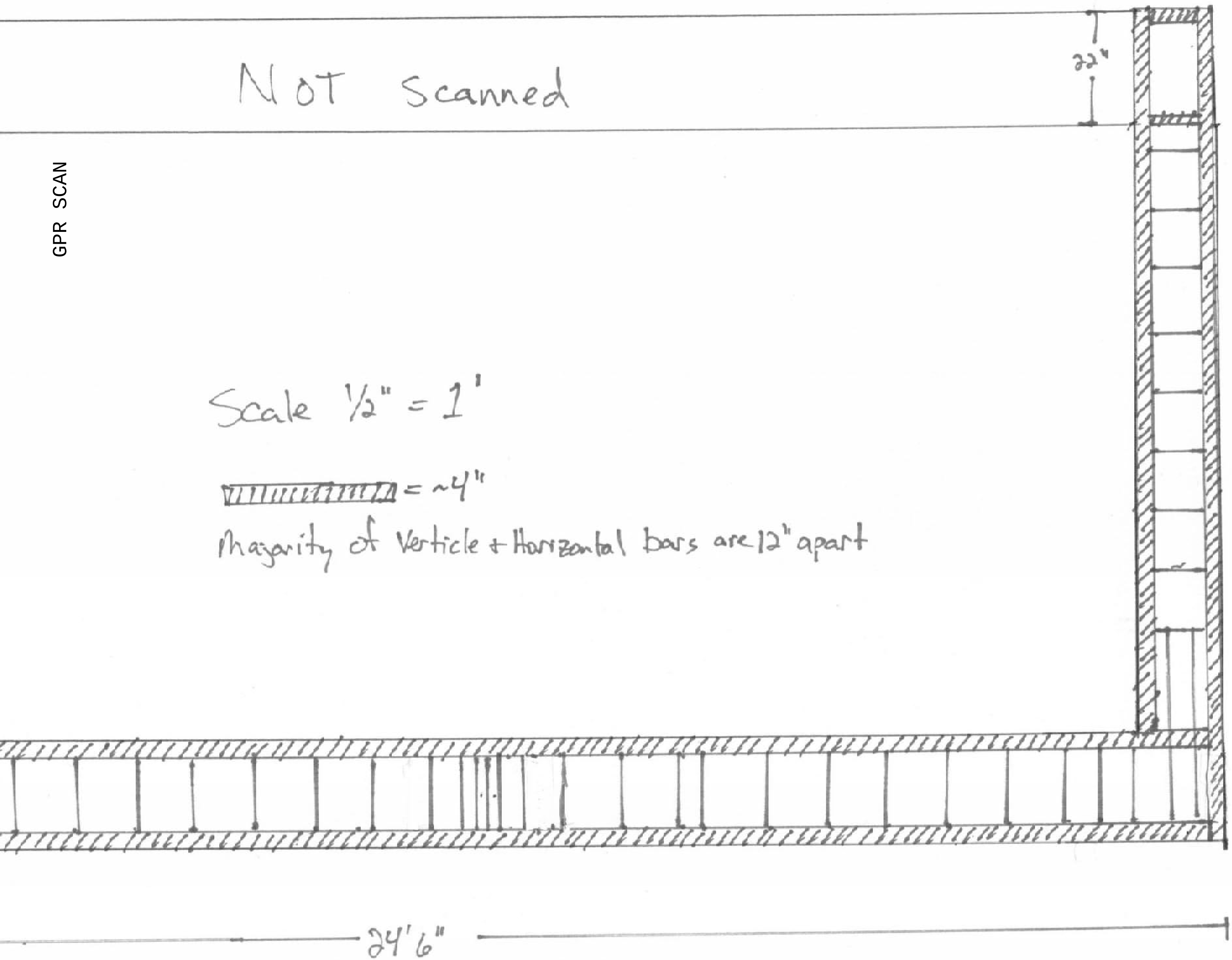


Solid Sawn Joist Hangers

GPR SCAN



GPR SCAN


Not Scanned
22"
Scale 1/2" = 1'
= ~4"
Majority of Verticle + Horrizontal bars are 12" apart
24'6"