JOISTREPAIR
A Skyline Brands Company
Structural Plates, Brackets and Devices

Technical Bulletin

Updated 23-03-25

Skyline Modular Joist Reinforcer System (Patents Pending)

Skyline Joist Repair
Roanoke, VA | 540-589-9669
www.JoistRepair.com

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Table of Contents

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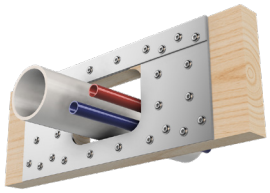
Joist Reinforcer Guide (Patents Pending)

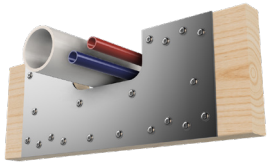
Hole Reinforcers

Model No	Joist Size	Gauge	Dimensions (in)		Maximum Hole Size (in)		Fastener Qty	No of Components
			H	W	H	W		
2x10 HR	2” x 10” Nominal	10	9.00”	15.75”	7.50”	6.0”	33	3
2x8 HR	2” x 8” Nominal	10	7.00”	15.75”	6.00”	6.0”	31	3
2x6 HR	2” x 6” Nominal	10	5.50”	15.75”	2.50”	6.0”	29	3



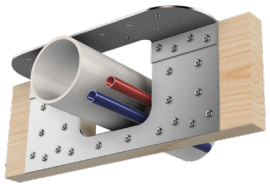
Shallow Notch Reinforcers

Model No	Joist Size	Gauge	Dimensions (in)		Maximum Notch Size (in)		Fastener Qty	No of Components
			H	W	H	W		
2x10 SNR	2” x 10” Nominal	10	9.0”	15.75”	3.0”	6.0”	22	1
2x8 SNR	2” x 8” Nominal	10	7.0”	15.75”	3.0”	6.0”	26	1



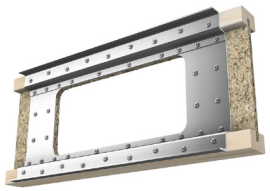
Deep Notch Reinforcers

Model No	Joist Size	Gauge	Dimensions (in)		Maximum Notch Size (in)		Fastener Qty	No of Components
			H	W	H	W		
2x10 DNR	2” x 10” Nominal	10	9.00”	15.75”	7.50”	6.00”	36	2
2x8 DNR	2” x 8” Nominal	10	7.00”	15.75”	5.50”	6.00”	36	2
2x6 DNR	2” x 6” Nominal	10	5.50”	15.75”	4.00”	6.00”	36	2



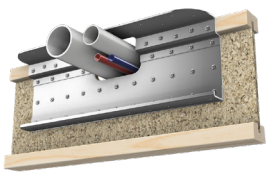
iJoist Web Reinforcers

Model No	Approximate Flange Width (in)	Overall iJoist Height (in)	Gauge	Dimensions (in)		Maximum Opening (in)		Fastener Qty	No of Components
				H	W	H	W		
150 WR 95	1.50”	9.50”	10	9.50”	23.75”	4.75”	16”	42	6
150 WR 11		11.875	10	11.875”	23.75”	7.125”	16”	42	6
150 WR 14		14.00”	10	14.00”	23.75”	9.25”	16”	48	6
150 WR 16		16.00”	10	16.00”	23.75”	11.25”	16”	48	6
250 WR 95	2.50”	9.50”	10	9.50”	23.75”	4.75”	16”	42	6
250 WR 11		11.875”	10	11.875”	23.75”	7.125”	16”	42	6
250 WR 14		14.00”	10	14.00”	23.75”	9.25”	16”	48	6
250 WR 16		16.00”	10	16.00”	23.75”	11.25”	16”	48	6
350 WR 95	3.50”	9.50”	10	9.50”	23.75”	4.75”	16”	42	6
350 WR 11		11.875”	10	11.875”	23.75”	7.125”	16”	42	6
350 WR 14		14.00	10	14.00”	23.75”	9.25”	16”	48	6
350 WR 16		16.00”	10	6.00”	23.75”	11.25”	16”	48	6



iJoist Notch Reinforcers

Model No	Application	Gauge	Dimensions (in)		Maximum Notch Size (in)		Fastener Qty	No of Components
			H	W	H	W		
150 NR	150 Flange x 9.5, 11 7/8”, 14”, 16”	10	7.875”	23.75”	3.5”	6”	36	2
250 NR	250 Flange x 9.5, 11 7/8”, 14”, 16”	10	7.875”	23.75”	3.5”	6”	36	2
350 NR	350 Flange x 9.5, 11 7/8”, 14”, 16”	10	7.875”	23.75”	3.5”	6”	36	2



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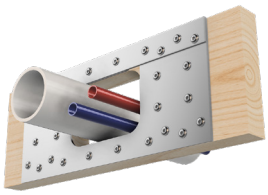
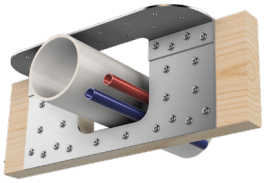
Structural Plates, Brackets and Devices

Metallurgical Information

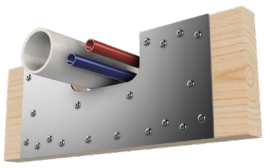
Metallurgical information below purtain to all Skyline Brands, LLC Joist Reinforcer Modular and Component products (Patents Pending).



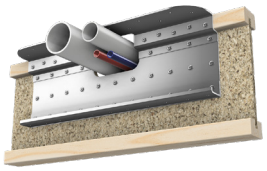
Hole Reinforcers
2x6, 2x8, 2x10



Deep Notch Reinforcers
2x6, 2x8, 2x10



Shallow Notch Reinforcers
2x8, 2x10



iJoist Flange Reinforcers
Flange widths 1.5”, 2.5”, 3.5”
Joist Heights 9.5”, 11 7/8”, 14”, 16”

iJoist Web Reinforcers
Flange widths: 1.5”, 2.5”, 3.5”
Joist Heights: 9.5”, 11 7/8”, 14”, 16”

Typical Ranges of Mechanical Properties [A, B] (Non-mandatory)					
Designation	(Longitudinal Direction)				
	Yield Strength		Elongation in 2 in [50mm], %	r_m Value[C]	n Value[D]
	ksi	[MPa]			
CS Type B	30/55	205/380	20	*E*	*E*
Fy = 30 ksi yield strength					
Ft = 55 ksi tensile strength					

Steel Dynamics®
Flat Roll Group

1945 Airport Road
Columbus, MS 39701
Phone: 662-245-4200
Fax: 662-245-4297

Metallurgical Certification

Order Number: 528429-1
Order Dimensions: 0.1300 x 60.0000 (in) (MIN)
Sold To:
Ship To:

Ordered Product: A653 CS Type B - 20
PRIME GALV HOT ROLLED SHEET
Part Number: 324329
Customer PO Number: 0101623-1
Cert Number: 2198942
Alt Part#:
Load Number: S1345590
Ship Date: 2/15/2023

Chemical Analysis

Coil Number	Coil Weight	Heat	C	Mn	P	S	Si	Cu	Sn	Ni	Cr	Mo	Al	N	V	Nb	Ti	B	Ca	C(eq)
23J702559A	24,087 lb.	A302073	.02	.17	.010	.004	.03	.11	.0070	.05	.06	.010	.036	.0066	< .001	.001	.002	.0001	.0017	.082

	Test		Test 1	
Mechanical Properties	English	Metric	English	Metric
Yield Strength			Not Reported	Not Reported
Tensile Strength			Not Reported	Not Reported
Elongation			Not Reported	Not Reported
N-Value			Not Reported	Not Reported
Hardness - HRBW			Not Reported	Not Reported
Direction				
Linear Footage			856 ft	261 m
Gauge Length	2 inch			
Test Standard	ASTME			
Actual gauge			.1325 in	3.37 mm
Coating ROHS			RoHS CHEM TREAT	
Coating Weight			G90UL	

We hereby certify the above is correct as contained in the records of the company. All tests performed according to ASTM standards: E8, A370, E18, E415, E1019, E646, E517 or JIS Z2241 or ISO 6892 as required. All Heats are Al Killed and Ca Treated. Melted and Manufactured in the USA in compliance to the American Iron and Steel Step Certification, Buy America Act Title 23 CFR § 635.410, and the Buy American Act Title 46 CFR § 381.2 (B) requirements.

Certified by: Makade Archibald

Certificated Date: 02/22/2023

Makade Archibald
Gal/Paint Line Metallurgical Engineer

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Steel Dynamics Rev Level 1.95 [5143]
Page 1 of 1

Engineering Properties of Structural Lumber

Douglas-Fir-Larch, Hem-Fir, Spruce-Pine-Fir

Stress-graded structural lumber is produced under two systems: visual grading and machine grading. Visual structural grading is the oldest stress grading system. It is based on the premise that the mechanical properties of lumber differ from those of clear wood because many growth characteristics of lumber affect its properties; these characteristics can be seen and judged by eye (ASTM D245). The principal growth features affecting lumber properties are the size and location of knots, sloping grain, and density.

Grading rules for lumber nominally 2 x 4 in (standard 38 x 89 mm) thick (dimension lumber) are published by grading agencies (listing and addresses are given in “National Design Specification,” American Forest & Paper Association, 1992 and later). For most species, allowable properties are based on test results from full-size specimens graded by agency rules, sampled according to ASTM D2915, and tested according to ASTM D4761. Procedures for deriving allowable properties from these tests are given in ASTM D1990. Allowable properties for visually graded hardwoods and a few softwoods are derived from clear-wood data following principles given in ASTM D2555.

Design values, (lb/in^2)								
Species and Commercial Grade	**Size Classification, in**	**Bending Fb**	**Tension Parallel to grain Ft**	**Shear parallel to grain Fv**	**Compression perpendicular to grain Fc.L.**	**Compression perpendicular to grain Fc.L.**	**Modulus of Elasticity**	**Grading Rules Agency**
Dougls-Fir-Larch								
Select Structural	-	1,000	1,000	95	625	1,700	1,900,000	
#1 and Better	2-4 Thick	1,150	775	95	625	1,500	1,800,000	WCLIB WWPA
#1	-	1,000	675	95	625	1,450	1,700,000	
#2	2 and wider	875	575	95	625	1,300	1,600,000	
#3	-	500	325	95	625	750	1,400,00	
Stud	-	675	450	95	625	825	1,400,000	
Construction	2 - 4 Thick	1,000	650	95	625	1,600	1,500,000	
Standard	-	550	375	95	625	1,350	1,400,000	
Utility	2-4 Wide	275	175	95	625	875	1,300,000	
Hem-Fir								
Select Structural	-	1,400	900	75	405	1,500	1,600,000	WCLIB WWPA
#1 and Better	2-4 Thick	1,050	700	75	405	1,350	1,500,000	
#1	-	950	600	75	405	1,300	1,500,000	
#2	2 and Wider	850	500	75	405	1,250	1,300,000	
#3	-	500	300	75	405	725	1,200,000	
Stud	-	675	400	75	405	800	1,200,000	
Construction	2-4 Thick	975	575	75	405	1,500	1,300,000	
Standard	-	550	325	75	405	1,300	1,200,000	
Utility	2-4 Wide	250	150	75	405	850	1,100,000	
Spruce-Pine-Fir								
Select Structural	-	1,250	675	70	425	1,400	1,500,000	NLGA
#1, #2	2-4 Thick	875	425	70	425	110	1,400,000	
#3	2 and Wider	500	250	70	425	625	1,200,000	
Stud	-	675	325	70	425	675	1,200,000	
Construction	2-4 Thick	975	475	70	425	1,350	1,300,000	
Standard	-	550	275	70	425	1,100	1,200,000	
Utility	2-4 Wide	250	125	70	425	725	1,100,000	
Reference: Reproduced with permission of the American Forest and Paper Association								

Fastener Technical Values

ConnexTite™ Flange Head Structural Wood Screw 1/4" x 1.5" with T25 Torx Drive (See attached TER) Fasteners details included below purtain to all Skyline Brands, LLC Reinforcer modular and component products (Patents Pending). See attached SFS TER doc for additional product data.

Dimensions and strength details

Fastener Name	Nominal Fastener Diameter	Head		Shank Diameter[1] (in.)	Thread Diameter (in.)		Nominal Bending Yield (f_{yb}, psi)		Allowable Fastener Strength[3]	
		Diameter (in.)	Height (in.)		Minor[2]	Major	Transition Zone	Shank	Tensile (lbs)	Shear (lbs)
Flange Head	1/4"	0.552	0.094	0.173	0.148	0.244	201,611	237,010	970	485

For SI: 1" = 25.4 mm, 1 lbf = 4.45 N, 1 psi = 6.895 kPa.

1. Shank diameter based on manufactured thickness. Finished dimensions are larger in the coated condition due to the proprietary coatings added.
2. Minor thread diameter value is calculated as the average of the upper and lower tolerances.

Withdrawal design values/face grain applications

Allowable Withdrawal Design Values by Species (Specific Gravity) (lbs.)

Nominal Fastener Diameter (in.)	Face Grain Applications		
	SPF (.42)	DF (.50)	SP (.55)
1/4"	95	135	220

1. Values are stated in lbf/in of thread engagement.
2. Values shall be adjusted by all applicable adjustment factors per NDS Section 10.3 for wood screws.
3. Fastener penetration is that threaded length embedded in the main member, including the tip.

Head pull-through design values

Min. Side Member Thickness (in.)	Nominal Fastener Diameter (in.)	Flange Head Diameter (in.)	Counter-sunk Head Diameter (in.)	SPF (.42)		DF (.50)		SP (.55)	
				Flange	Counter-sunk	Flange	Counter-sunk	Flange	Counter-sunk
3/4"	1/4"	0.552	0.457	155	130	220	185	265	225
	5/16"	0.705	0.583	195	165	275	235	335	280
1–1/2"	1/4"	0.552	0.457	310	265	440	370	535	450
	5/16"	0.705	0.583	390	330	550	465	670	565

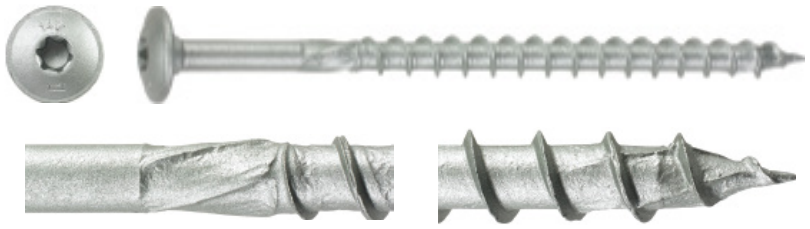
1. Values shall be adjusted by all applicable adjustment factors per NDS Section 10.3 for withdrawal of wood screws.

Lateral design values using dimensional lumber

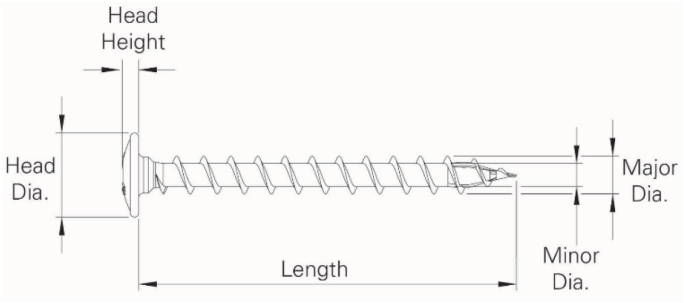
Fastener Head Type	Nominal Fastener Diameter (in.)	Fastener Length (in.)	Side Member Thickness (in.)	Min. Penetration into Main Member (in.)	Lateral Design Values (lbs.) by Species (Specific Gravity) & Load Orientation					
					SPF (.42)		DF (.50)		SP (.55)	
					Z Para	Z Perp	Z Para	Z Perp	Z Para	Z Perp
Flange	**1/4"**	2-3/8"	1-1/2"	7/8"	115	90	140	110	160	125
		2-3/4"		1-1/4"	130	105	165	135	190	155
		3-1/8"		1-1/2"	145	115	175	140	190	155
		4"		2-1/2"	145	115	175	140	190	155

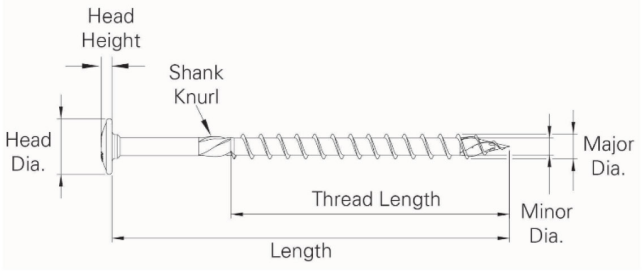
1. Reference lateral design values apply to two-member single shear connections where both members are of the same specific gravity, and the fastener is oriented perpendicular to grain. Where the members are of different specific gravities, use the lower of the two.
2. Values shall be adjusted by all applicable adjustment factors per NDS.

Fastener Details



ConnexTite™ Flange Head Detail





Engineering Example

Subject: Test Results for Stiffened Floor Joist Products
By J. Leroy Hulsey, PhD, PE, SE

Tests by a Test Lab are used for verifying calculated deformations, and calculated states of stress (flexure & shear stress).

1) Consider a timber floor joist that is stiffened using CS (commercial steel) shapes that are made to be a composite system that is a combination of both the timber floor joist and steel. The CS steel must be fastened to the timber floor joists to insure the steel will not buckle and will resist load as the timber is trying to deform.

2) The cold form steel (CFS) product satisfies current steel specifications, Code loading and NDS timber specifications.

Material	Yield Stress (ksi)	Tensile Strength (ksi)	Grade
A653 CS B	30	55	G90
A653 SS Grade 50/1	50	65	G90
A653 SS Grade 50/1	50	70	G90
A653 SS Grade 50/1	50	60	G90
A653 SS Grade 50/1	55	70	G90
A653 SS Grade 50/1	60	70	G90
A653 SS Grade 50/1	60	61.5	G90

Material Thickness	
Gauge	Thickness
20	0.0346
18	0.0451
16	0.0556
14	0.0712
12	0.1017
10	0.1242

a) ASTM - American Society for Testing & Materials
b) ASTM A653
Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process 1. This standard is issued under the fixed designation A 653/A 653M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last re-approval. A superscript epsilon (e) indicates an editorial change since the last revision or re-approval.
(c) ASTM A653 CS B - CS Type B (also known as Commercial Steel Type B) is the most common form of commercial steel. It is designated by chemical requirements, not mechanical properties, with a slightly higher max range of carbon content (0.15%) than other types.
(d) ASTM A653 SS (this is known as Structural Steel)
Link: https://www.cosasteel.com/wp-content/uploads/2020/11/astm-a653_.pdf

V1 Undamaged 2x10 (see fig 1)										
1) Un-damaged 2x10 - #2 Douglas Fir, 2' OC with 9.5' span length										
Fbx = 0.875 ksi; Fv (parallel) = 0.095 ksi; E - 1,600 ksi										
I = bh^3/12 = 1.5*(9.25^3)/12		98.93164063 in⁴		Sx = 21.390 cu in						
Examined using ASD (Allowable Stress Design Method):										
3. NDS code loading is:										
	a) Dead Load			b) Live Load:	50 psf					
	Finished floor 4 psf:	4 psf								
	3/4" sub-floor:	3 psf								
	2x10 @ 24" OC:	6 psf								
	2x10 @ 24" OC:	6 psf								
	Total Dead Load =	13 psf		Total Live Load =	50 psf					
	c) Total DL + LL =	63 psf								
4) Load acting on each floor joist		126 plf								
	a) Moment (in-k) =(max)									
	M = 12*w*(L^2)/8)	18.711 in-k		fb = 0.8747 ksi	(OK)					
	b) Reaction/Shear V(max) = w*L/2									
	R = V(max) =	1.01 kips		fv = 0.0727 ksi	(OK)					
5) Maximum Deflection (center line)										
	a) Def = 5wL4/(384EI)									
	0.1755 in			0.3316 L/360						

Engineering Example

Hole Reinforcer Stiffener
Plate and Flange

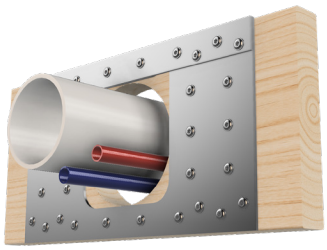
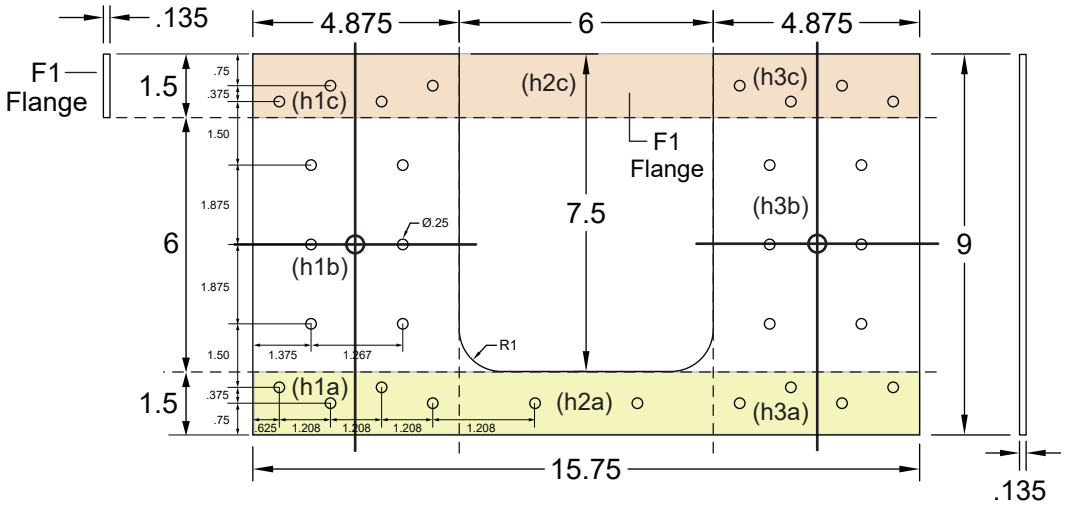


Fig. 1



Notch Reinforcer Stiffener
Plate and Flange

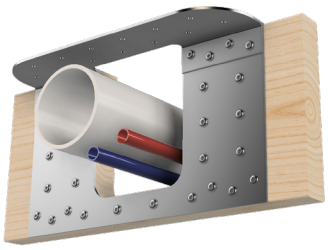
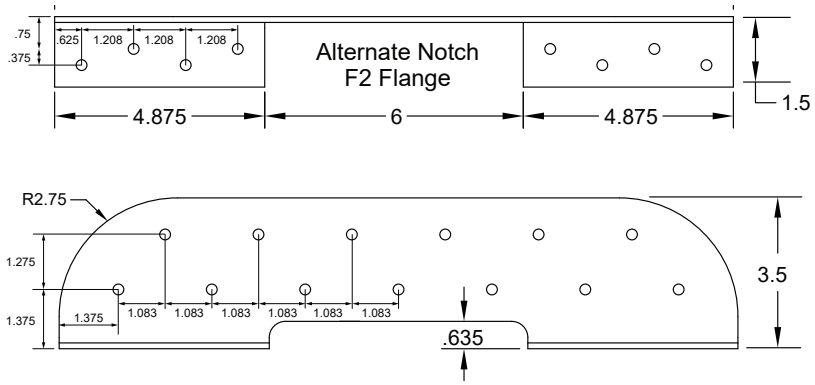


Fig. 2



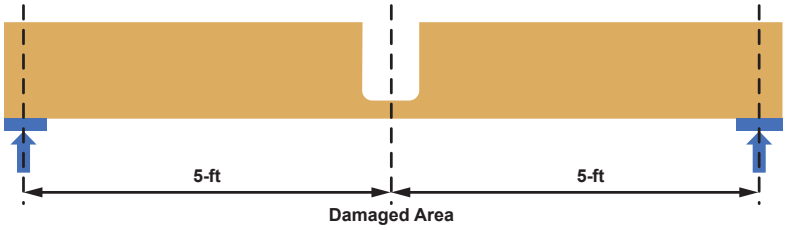
Engineering Example

V2 Damaged 2x10
1 Solve - Centroid of sections 1, 2 & 3 (Fig. 1 & 2)
Steel thickness = 0.135”
Ix = bh^3/12

(i)	bi	A1	yi	Aiyi	di	di^2	Aidi^2	Ix0	1xi
1a	0.135	.658125	0.75	0.49359375	4.636363636	21.49586777	14.14696798	0.03796875	0.03796875
1b	0.135	0.81	4.5	3.645	0.8863636364	0.7856404959	0.6363688017	4.74609375	4.74609375
1c	.127	1.31625	0.75	10.8590625	2.863636364	8.200413223	10.7937939	0.0759375	0.0759375
Sum		2.784375		14.99765625					30.43713068
y(bar = sum(Aiyi)/Sum(Ai) =		**5.386363636 (in)**							
di = ybar - yi =		4.636363636							
(i)	**bi**	**A1**	**yi**	**Aiyi**	**di**	**di^2**	**Aidi^2**	**Ix0**	**1xi**
2a	.135	0.81	0.75	0.6075	3.75	14.0625	11.390625	0.03796875	11.42859375
2b	.135	0.81	4.5	3.645	0	0	0	4.74609375	4.74609375
2c	.135	0.81	8.25	6.6825	-3.75	14.0625	11.390625	0.0759375	11.42859375
Sum		2.43		10.935					27.60328125
y(bar = sum(Aiyi)/Sum(Ai) =		**4.50 (in)**							
di = ybar - yi =		3.75							
(i)	**bi**	**A1**	**yi**	**Aiyi**	**di**	**di^2**	**Aidi^2**	**Ix0**	**Ixi**
3a	.135	0.658125	0.75	0.49359375	4.636363636	21.49586777	14.14696798	0.03796875	14.18493673
3b	.135	0.81	4.5	3.645	0.8863636364	0.7856404959	0.6363688017	4.74609375	5.382462552
3c	.27	1.31625	8.25	10.8590625	-2.863636364	8.200413223	10.7937939	0.0759375	10.8697314
Sum		2.784375		14.99765625					30.43713068
y(bar = sum(Aiyi)/Sum(Ai) =		**5.386363636 (in)**							
di = ybar - yi =		4.636363636							
2 Solve - Convert to Douglas Fir: n=18.125									
Sections 1 & 3									
t = 0.135*18.125 =		0.37584	in						
A (1) = 18.125*2.784		50.46	sq in						
Ix (in4) =		551.725	in4						
Sx = Ix/ (9.25/2)		119.2918919	cu in						
Section 2									
t = 0.135*18.125 =		0.37584	inches						
A(2) =		44.04375	sq in						
Ix(in4) =		500.25	in4						
Sx = Ix/(9.25/2)		216.3243243	cu in						
3 Solve Maximum Bending Stress									
M(max) = wL^2/8		10.5(lbs/in) * ((9.95*12)^2)/8 in-lbs							
M(max) = 0.5 * (9.95*12)^2/8 =		18711.4725c in-lbs							
fbx = (18711/(Sx) =		86.625 psi							
Fbx (allowable) = 875 psi		**875 psi**							

Damaged 2x10 - Fig 3.

Limit centerline live load deflection to L/360

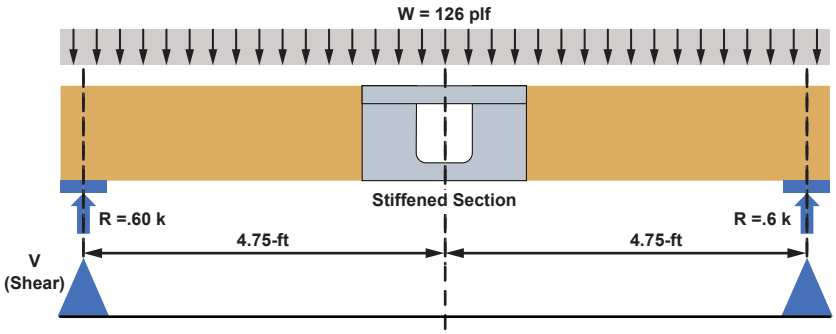


Engineering Example

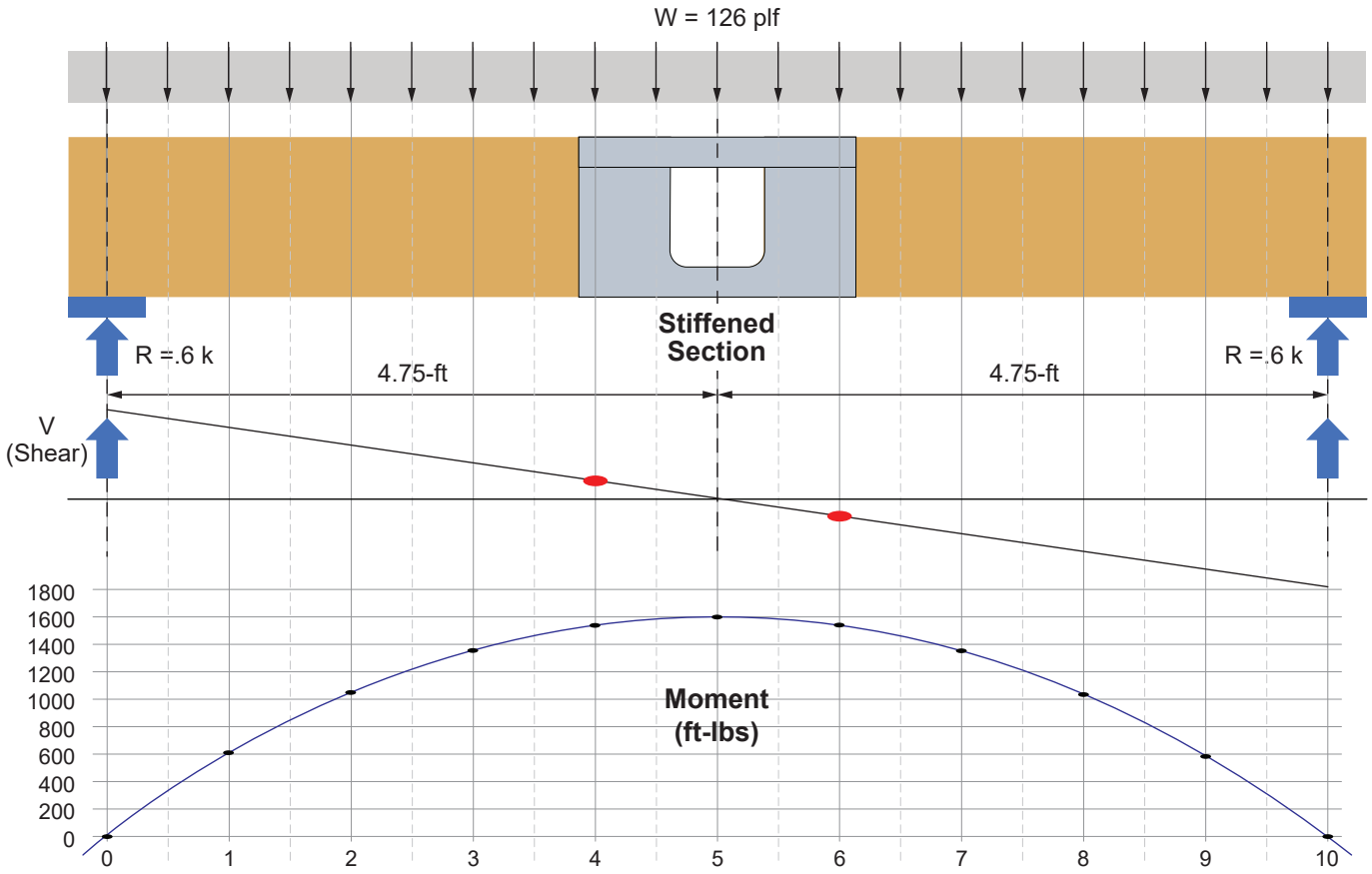
Stiffened 2x10 - Fig 4.

Note: ASTM A653 CS-B
• Modulus of Elasticity for the Douglas Fir is 1600 ksi
• Modulus of Elasticity for the steel plates are 29,000 ksi
Modular ratio Is n = Es/Ew = 29000/1600 = 18.125

Converting to Douglas Fir:
Stiffened section will be: ts = 0.135*18.125 = 2.45 inches.
Add the Stiffened to existing douglas fir section = 1.5” thick
the Stiffened section becomes: t= 2*2.45 + 1.5 = 6.4” thick.
Stiffened flange section + web becomes: tf = 11.3” thick.



Title - Fig 5.



It is the purpose of this example to show the reader how to improve the performance for a damaged 2x10 floor joist. In this case, damage is at mid-span. A 10 gauge CS-B metal stiffener is installed at mid-span to strength the floor joist. This is a combination of a #2 grade DF 2x10 and a steel stiffener. Bending stress for both wood and steel are check to be within allowable. In addition, the centerline deflection is kept within allowable live load deflection. - Dr. J. Leroy Hulsey, Ph.D., P. E., S.E.

JOISTREPAIR
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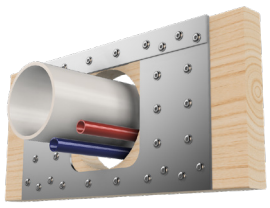
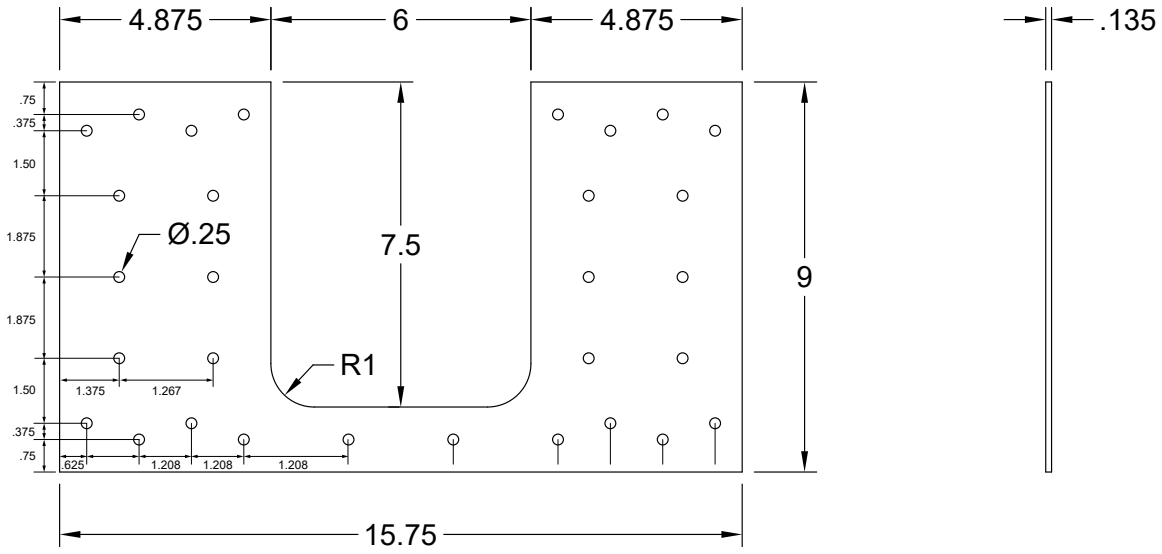
Structural Plates, Brackets and Devices

Technical Drawings

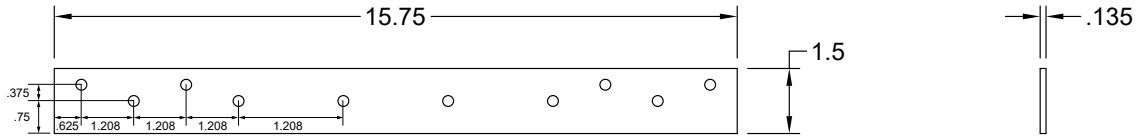


2x10 HR Hole Reinforcer (Patents Pending)

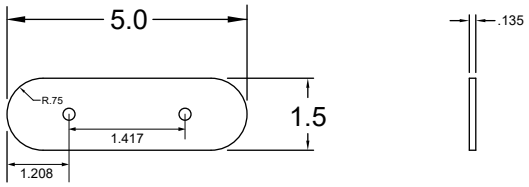
Component 1 : 2x10 HNR Web Plate



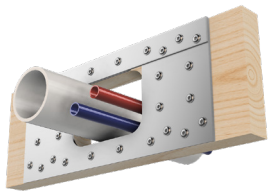
Component 2: F1 Flange



Component 3: S1 Spacer

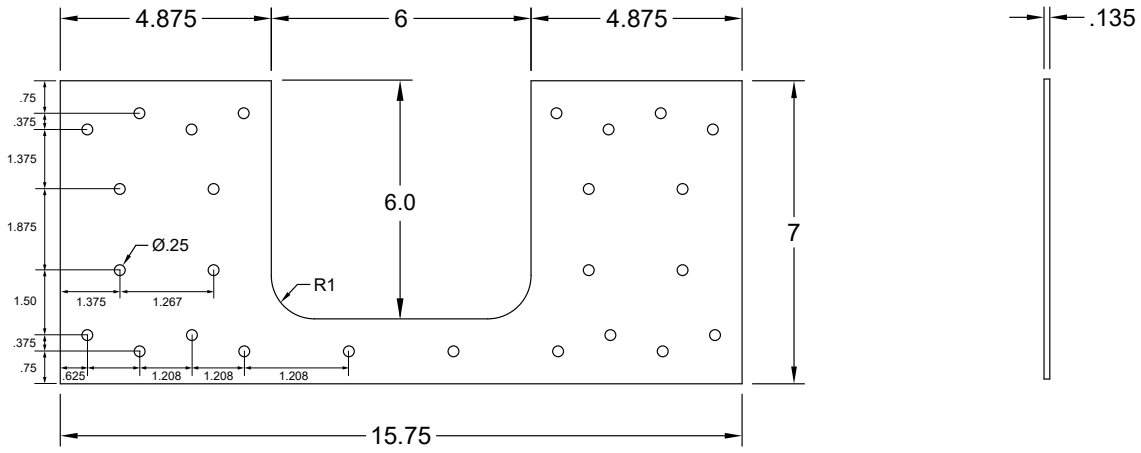


Technical Drawings

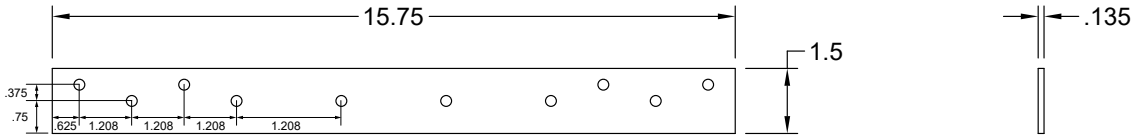


2x8 HR Hole Reinforcer (Patents Pending)

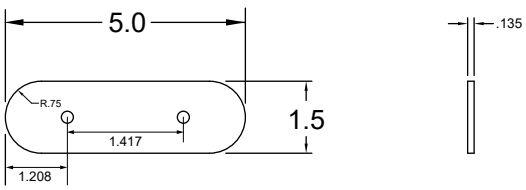
Component 1: 2x8 HNR Web Plate



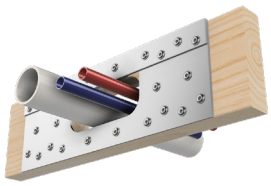
Component 2: F1 Flange



Component 3: S1 Spacer

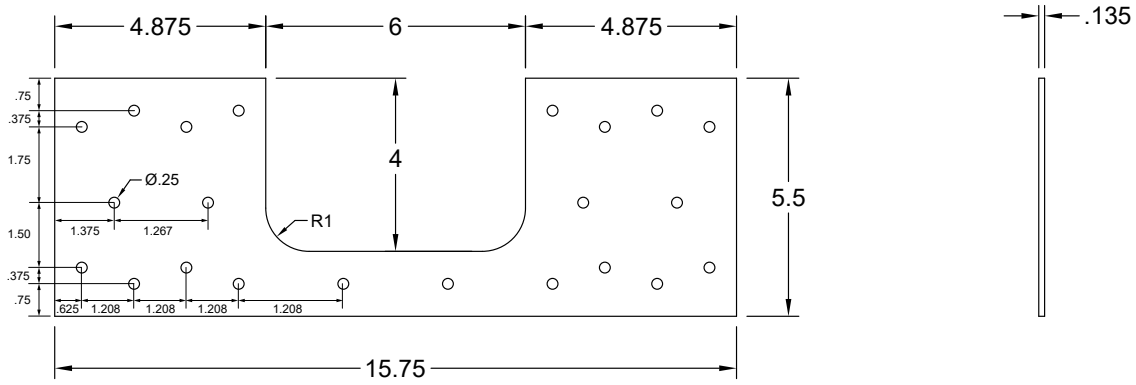


Technical Drawings

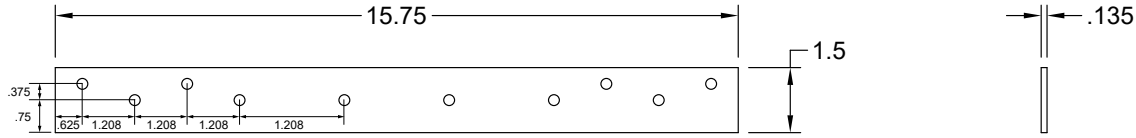


2x6 HR Hole Reinforcer (Patents Pending)

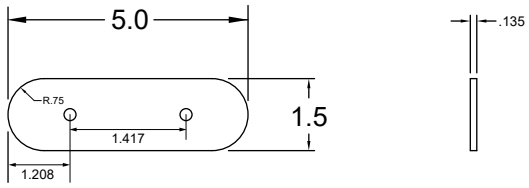
Component 1: 2x6 HNR Web Plate



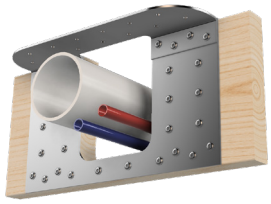
Component 2: F1 Flange



Component 2: S1 Spacer

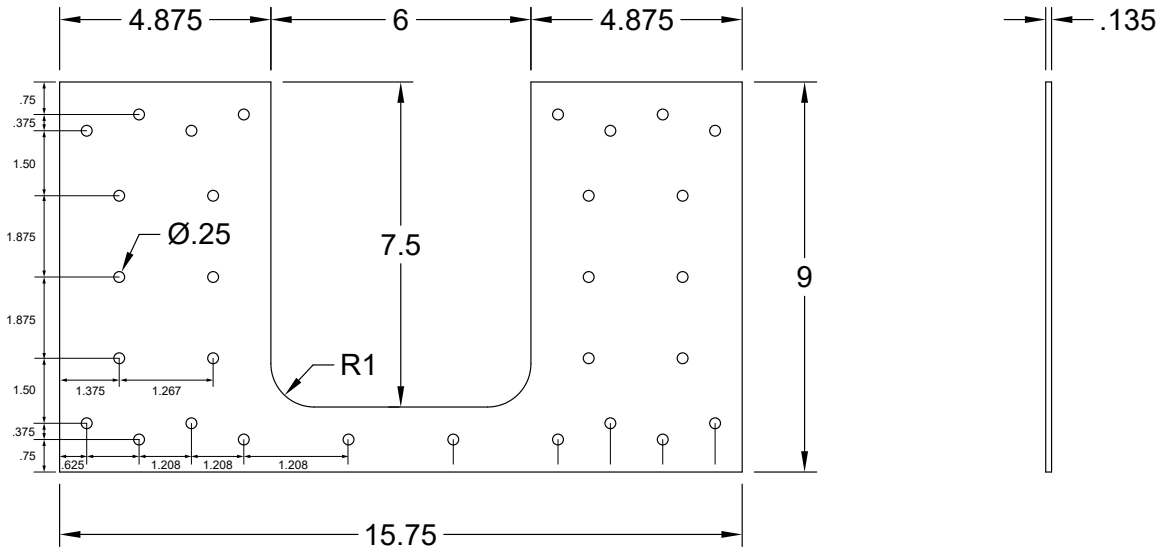


Technical Drawings

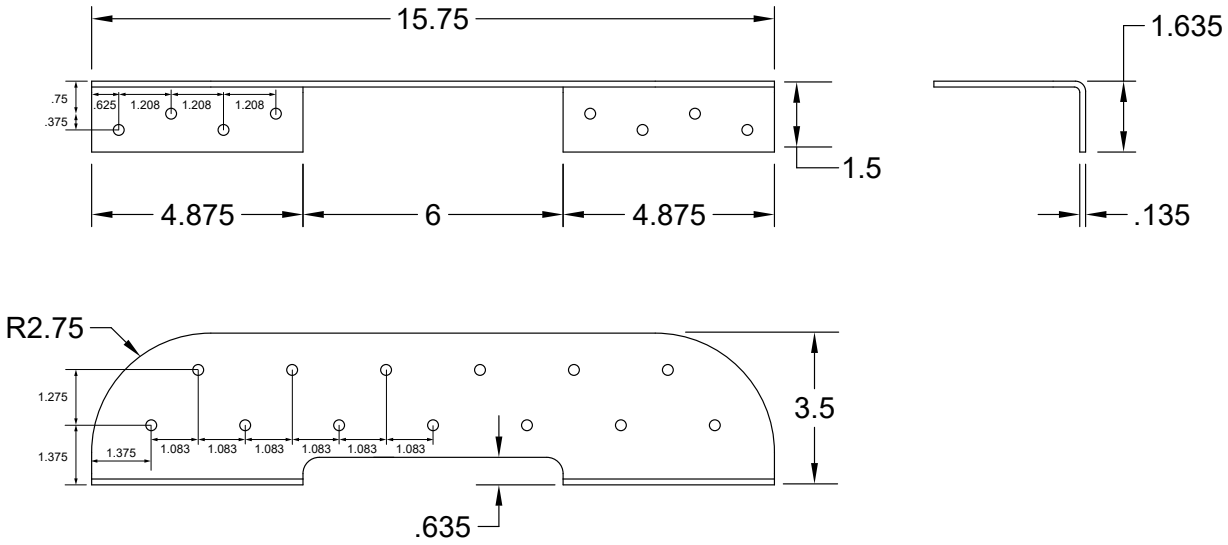


2x10 DNR Deep Notch Reinforcer (Patents Pending)

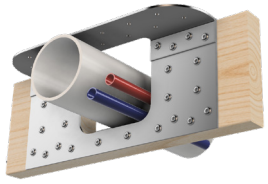
Component 1: 2x10 HNR Web Plate



Component 2: F2 Notch Flange

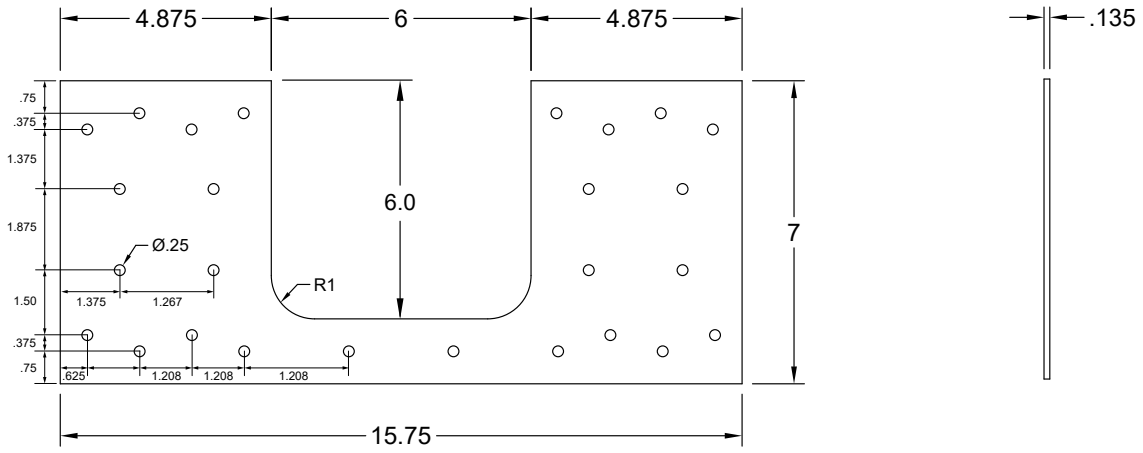


Technical Drawings

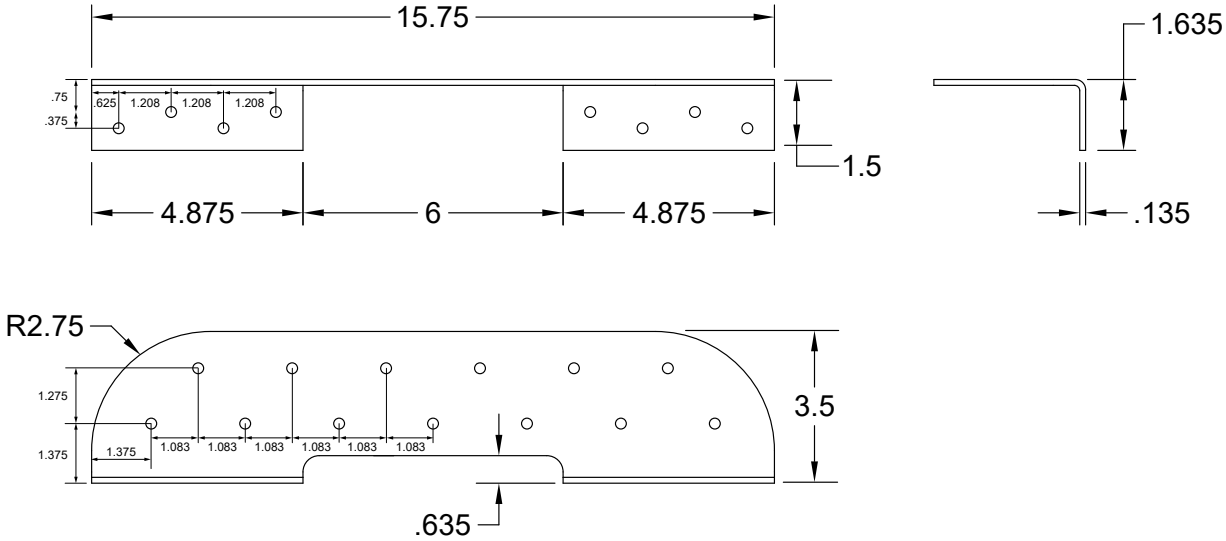


2x8 DNR Deep Notch Reinforcer (Patents Pending)

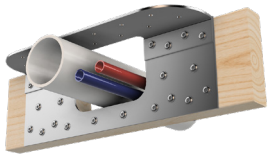
Component 1: 2x8 HNR Web Plate



Component 2: F2 Notch Flange

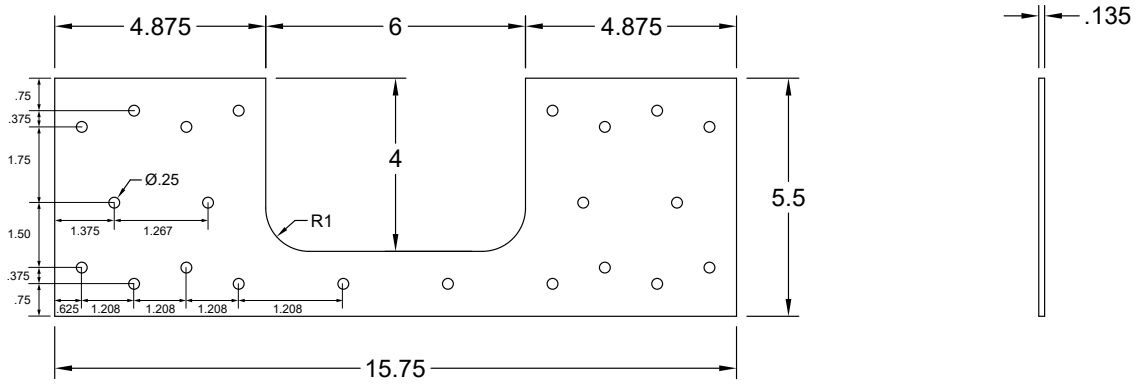


Technical Drawings

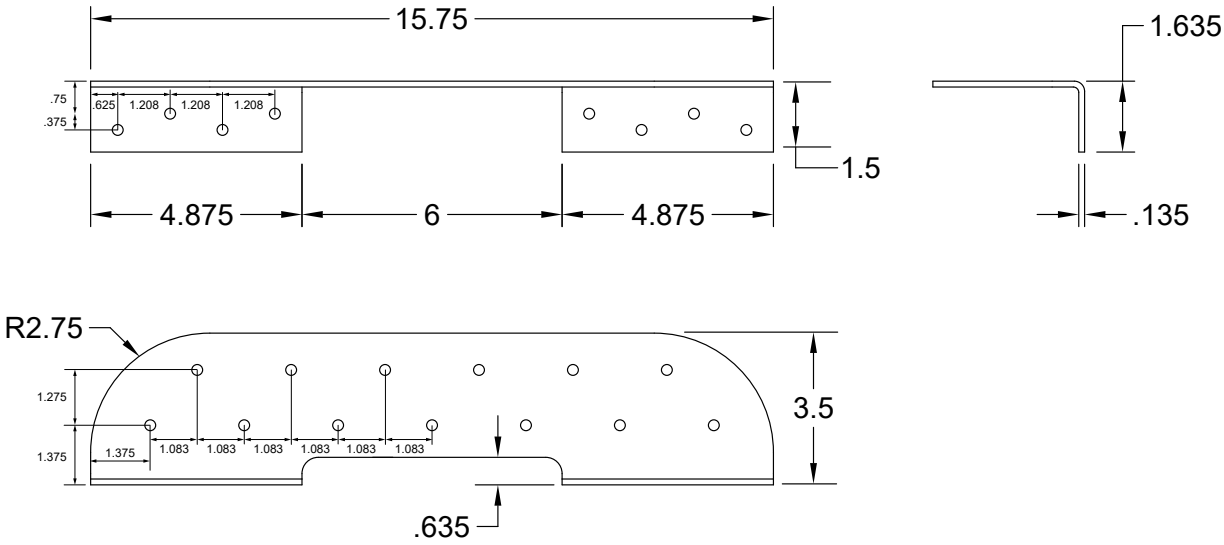


2x6 DNR Deep Notch Reinforcer (Patents Pending)

Component 1: 2x6 HNR Web Plate



Component 2: F2 Notch Flange



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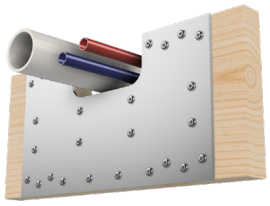
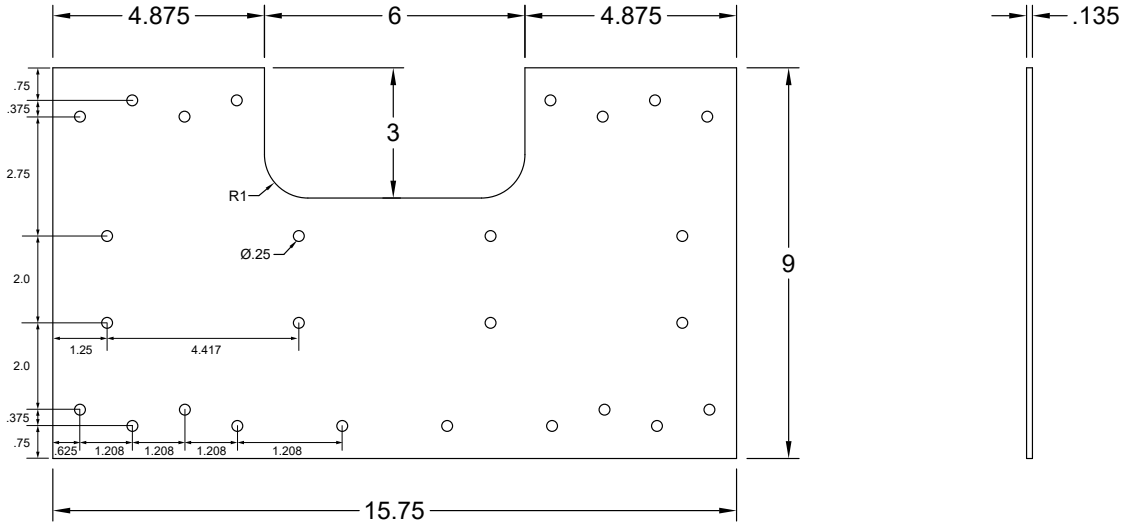
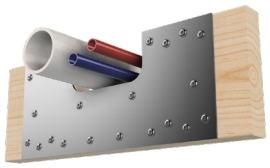


2x10 SNR Shallow Notch Reinforcer (Patents Pending)

Component 1: 2x10 SNR Web Plate



Technical Drawings



2x8 SNR Shallow Notch Reinforcer (Patents Pending)

Component 1: 2x8 SNR Web Plate