The ORIGINAL Connector Co.

- United Steel Products
- TECO – 1933,
- Silver - TECO
- Lumberlock
- Kant Sag
- Hughes Metal
- SEMCO

- March 2013
- MiTek buys USP
- MiTek is a Berkshire Hathaway Co.
- Unites MiTek, Hardy Frames and Zone 4 with USP

Connector 101

Connectors Basics, Gravity Connections

Presented by: W. Randall Holgate

Notes to Designers and Bldg. Officials

- Please be aware that this course has been created to provide continuing education to a broad spectrum of architects, engineers, building designers and building officials and inspectors. This course is presented for Continuing Education and Professional Development of New York Building Inspectors and Code Enforcement Officers.
- Some states and enforcement jurisdictions have adopted amendments to ICC codes referenced here that address more stringent construction practices or local practices wherein the municipality has intimate knowledge and has incorporated that into the local code.
- USP urges caution to contact local code agencies for exact codes with amendments in effect for the construction site.

"USP Structural Connectors" is a Registered Provider with The American Institute of Architects Continuing Education Systems. Credit earned on completion of this program will be reported to CES Records for AIA members. Certificates of Completion for non-AIA members are available on request.

This program is registered with the AIA/CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product. Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Copyright Materials

Learning Objectives

- Understand testing and product design loads in accordance with ICC-ES AC13 and ASTM D1761, all final testing is conducted by a third-party testing laboratory.
- Listed product capacities is in accordance with NDS®, and applying Durations Factors for mechanical fastening, Live Load, Roof Snow, Construction Load and Wind/Seismic loading based on code requirements. Duration factors that apply to wood design and specifically connections
- Forces applied perpendicular to level ground surface. Dead Loads – Building Material Weight, Live Loads – Building Contents, gravity load carrying capacity must not be compromised. Selecting appropriate load carrying devices simplifies making such connections.
- Highlight sections of the IRC that discuss the use of connectors. IRC contains provisions which specify connectors in certain applications. Evaluate the applications and provide common structural connector solutions.

Summary of Discussion

- Code Evaluation Process
- How Load Values are Achieved
  - Calculation
  - Testing
- Gravity Load Carrying Devices
  - Good Installations
  - Poor Installations
- Connectors Called out in the IRC

Evaluations Services and Approvals…Why?

To determine whether a given material, product, or component complies with the building code it is being evaluated to.

ICC EVALUATION SERVICE
Ensuring that building products meet code requirements.

IAPMO ES

Code Approvals do not represent a judgment about aesthetics, design or act as an endorsement.

Product Approval Labels

Code Approvals must conform to ICC Codes ICC Adoptions

Building Product Evaluation Process

IBC currently administered statewide

Other state or local model codes administered

Source: ICC Website Updated 03/11/09

Testing and Calculation Benchmarks

Building Product Evaluation Process

ICC-ES Acceptance Criteria AC13

Last Update Effective January 1, 2007

ICC EVALUATION SERVICE, INC.

ES

ACCEPTANCE CRITERIA FOR JOIST HANGERS AND SIMILAR DEVICES

AC13

Approved October 2006

Effective January 1, 2007

(Corrected March 2007)

Previously approved October 2003, January 2003, January 2001

PREFACE

Testing and Calculation Benchmarks

Building Product Evaluation Process

ICC-ES AC155 Acceptance Criteria for Holdowns and Tension Ties

Effective March 1, 2006

ES

ACCEPTANCE CRITERIA FOR HOLD-DOWNS (TIE-DOWNS) ATTACHED TO WOOD MEMBERS

AC155

Approved October 2005

Effective March 1, 2006

PREFACE

Evaluation Process

Building Product Evaluation Process

What is required by the manufacturer:

- Complete set of plans
- Sealed calculations by engineer
- Laboratory test reports
  - Must be independent IAS accredited testing laboratory
- Data must reinforce that product complies with model building codes

Code agency actions:

- Prepare a draft report for applicant to review
- Make Final Report available to the public - Post reports on web site

ESR Report

Building Product Evaluation Process


ESR-1702

Report Sections

- Product Description
- Materials Used
- Design Criteria
- Report Findings
- Renewal Date
- Product Design Values

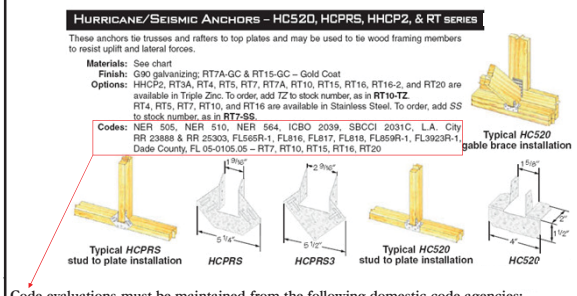
Accessing Evaluation Reports

Building Product Evaluation Process

- Reports are changing on ongoing basis.
  - Reports are changed as products and code changes.
- For the most current evaluation reports go to the one of the following websites:
  - www.icc-es.org
  - www.uspconnectors.com
- Each manufacturer in the industry provides code evaluation reports listing based on the product being approved.

Code Evaluations in Literature

Building Product Evaluation Process


HURRICANE/SEISMIC ANCHORS – HC520, HCPRS, HHCP2, & RT SERIES

These anchors tie trusses and rafters to top plates and may be used to tie wood framing members to resist uplift and lateral forces.

Materials: See chart
Finish: G90 galvanizing; RT7A-GC & RT15-GC – Gold Coat
Options: HHCP2, RT3A, RT4, RT5, RT7, RT7A, RT10, RT15, RT16, RT16-2, and RT20 are available in Triple Zinc. To order, add TZ to stock number, as in RT10-TZ. RT4, RT5, RT7, RT10, and RT16 are available in Stainless Steel. To order, add SS to stock number, as in RT7-SS.
Codes: NER 505, NER 510, NER 564, ICBO 2039, SBCCI 2031C, L.A. City RR 23888 & RR 25303, FL565R-1, FL816, FL817, FL818, FL859R-1, FL3923R-1, Dade County, FL 05-0105.05 – RT7, RT10, RT15, RT16, RT20

Typical HC520 gable brace installation

Typical HCPRS stud to plate installation

HCPRS

HCPRS3

Typical HC520 stud to plate installation

HC520

Code evaluations must be maintained from the following domestic code agencies:

ICC-ES, Dade County, FL, DSA, L.A. City, TDI, DILHR

Code Evaluations on the Product

Building Product Evaluation Process

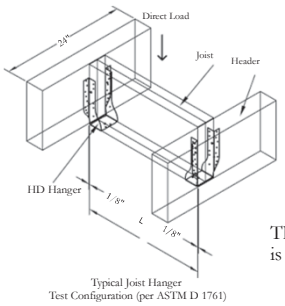
- Code Evaluation Numbers Stamped or labeled on every product
- Label or stamp in best location for inspection after product is in place

How are allowable connector loads established?

- **Calculation**
- Testing

Origin of Design Values

How Design Load Values are Established: Calculation



Typical Joist Hanger
Test Configuration (per ASTM D 1761)

1. Calculated Load Design Value
2. Tested Load Design Value
   1/8" Deflection Design Value/No Safety Factor
3. Tested Load Design Value
   Ultimate Load Value/Safety Factor of 3

The lowest of the 3 load design values is what's in the catalog.

Calculated Load Design Values

How Design Load Values are Established: Calculation

Nail & Bolt Shear

- Values calculated from NDS Yield Limit Equations.
  - Table 11.3.1A

Bearing Area

- (Net Bearing Area) x $F_{c\perp}$
  - $F_{c\perp}$ taken from NDS design tables for specific wood species

Steel Strength

- AISI NASPEC Steel Manual

Concrete Breakout

- Calculated from ACI 318 standard

Calculation: Nail Shear Design Values

How Design Load Values are Established: Calculation

Nail Specification table

Stock No.	Ref. No.	Description	Finish[4]	Wire Gauge	Nail Diameter	Length	Withdrawal Load	Nails Per Lb.	Allowable Shear per Nail (Lbs.)[1,2,3,5] Steel Gauge 3	7	10	12	14	16	18	20	22
NA11	N8	8d x 1-1/2	HDG	-- --	0.131	1-1/2	48	152	-- --	-- --	-- --	-- --	-- --	96	95	94	94
NA11SS	SSN8	8d x 1-1/2	SS	-- --	0.131	1-1/2	48	143	-- --	-- --	-- --	-- --	-- --	96	95	94	94
NA9D	N10	10d x 1-1/2	HDG	-- --	0.148	1-1/2	54	100	-- --	-- --	126	118	114	112	112	112	111
NA16D	N16	16d x 2-1/2	HDG	-- --	0.162	2-1/2	99	66	192	177	159	147	140	138	136	136	-- --
NA16D-RS	-- --	16d Ring Shank	Bright	-- --	0.148	3-1/2	140	47	181	164	147	-- --	-- --	-- --	-- --	-- --	-- --
NA21	N20A	20d x 1-3/4	HDG	-- --	0.192	1-3/4	81	65	211	194	168	159	152	-- --	-- --	-- --	-- --
NA20D	-- --	20d x 2-1/2	HDG	-- --	0.192	2-1/2	117	41	231	202	184	174	167	-- --	-- --	-- --	-- --
NA25D	N54A	1/4 x 2-1/2	HDG	-- --	0.250	2-1/2	152	27	275	241	225	216	-- --	-- --	-- --	-- --	-- --
NA25	-- --	1/4 x 3	HDG	-- --	0.250	3	183	22	275	241	225	216	-- --	-- --	-- --	-- --	-- --
8d Common	-- --	8d Common	Bright	10-1/4 ga.	0.131	2-1/2	80	126	-- --	-- --	-- --	-- --	98	96	95	94	94
10d Common	-- --	10d Common	Bright	9 ga.	0.148	3	108	70	-- --	154	136	125	118	115	114	113	112
16d Sinker	-- --	16d Sinker	Bright	9 ga.	0.148	3-1/4	117	60	160	154	136	125	118	115	114	113	-- --
16d Common	-- --	16d Common	Bright	8 ga.	0.162	3-1/2	136	48	192	177	159	147	140	138	136	136	-- --
20d Common	-- --	20d Common	Bright	-- --	0.192	4	167	29	231	202	184	174	167	-- --	-- --	-- --	-- --

1) Loads are calculated according to specifications of Part II of the National Design Specifications for Wood Construction (NDS®), 2001 Edition.
2) Loads apply to Douglas Fir-Larch (G=0.50) and Southern Pine (G=0.55). For Spruce-Pine-Fir (G=0.42) multiply above values by 0.86, for other wood types refer to NDS® or consult USP.
3) Value assumes full penetration of at least 10 nail diameters.
4) HDG = Hot-Dip Galvanized, SS = Stainless Steel, Bright = No Finish.
5) For steel with Fu=45,000 psi, and gage minimum bare metal thickness.
New products or updated product information are designated in red.

Important

Calculation: Load Duration Factors

How Design Load Values are Established: Calculation

Table 2.3.2 Frequently Used Load Duration Factors, C_D[1]

Load Duration	C_D	Typical Design Loads
Permanent	0.9	Dead Load
Ten years	1.0	Occupancy Live Load
Two months	1.15	Snow Load
Seven days	1.25	Construction Load
Ten minutes	1.6	Wind/Earthquake Load
Impact[2]	2.0	Impact Load

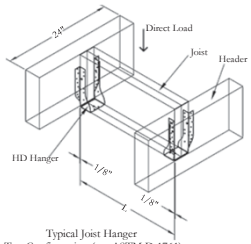
1. Load duration factors shall not apply to reference modulus of elasticity, E, reference modulus of elasticity for beam and column stability, E_{min}, nor to reference compression perpendicular to grain design values, $F_{c\perp}$, based on a deformation limit.
2. Load duration factors greater than 1.6 shall not apply to structural members pressure-treated with water-borne preservatives (see Reference 30), or fire retardant chemicals. The impact load duration factor shall not apply to connections.

Taken from the National Design Specification for Wood Construction - NDS 2005

Origin of Design Values Hanger Example

How Design Load Values are Established: Calculation

Example:



Typical Joist Hanger
Test Configuration (per ASTM D 1761)

- Calculated Load Design Values
  16d common nail in 14 ga. steel = 136#
  18 nails x 136 #/nail x 1.0 = **2,448#**
  2,488 lbs x 1.15 load duration = **2,815#**
  2,488 lbs x 1.25 load duration = **3,060#**
- Tested Load Deflection Values
  Test 1 – Left = 12,500, Right = 14,780
  Test 2 – Left = 13,290, Right = 11,980
  Test 3 – Left = 9,940, Right = 12,570
  Lowest Deflection Value is 9,940/2 = **4,970#**
- Tested Load Ultimate Value
  Test 1 – 32,210
  Test 2 – 27,420
  Test 3 – 29,370
  Lowest Ultimate Value is 27,420/2 = 13,710#
  13,710/safety factor of 3 = **4,570#.**

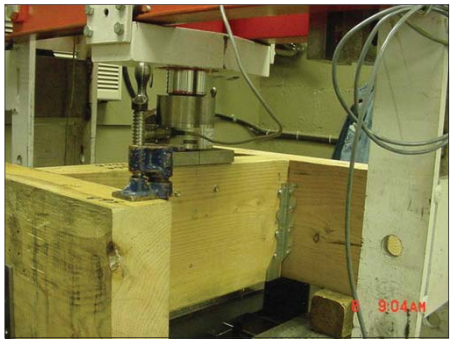
Published values for HD210-2 are (Assuming Douglas Fir Lumber):
2,450 @ 100%; 2,815 @ 115%; 3,060 @ 125%

How are allowable connector loads established?

- Calculation
- **Testing**

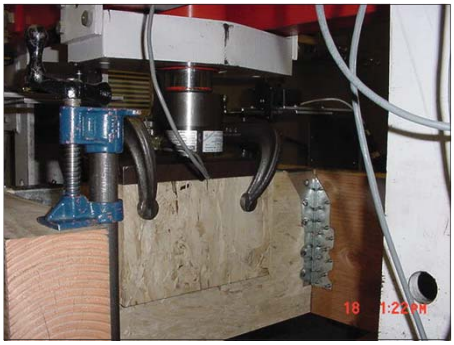
Typical Face Mount Hanger Test

How Design Load Values are Established: Testing



Typical Face Mount Hanger Test for Uplift

How Design Load Values are Established: Testing



Typical Face Mount Hanger Failures

How Design Load Values are Established: Testing

Nail withdrawal / overturning failure

Joist failure

Light capacity hangers

Heavy capacity hangers

Typical Top Mount Hanger Failures

How Design Load Values are Established: Testing

overturning failure

Top flange failure

Light capacity top flange hangers

Typical Top Mount Hanger Failures

How Design Load Values are Established: Testing

Crushing failures

overturning failure

Heavy capacity top flange hangers

Typical Hanger Failures

How Design Load Values are Established: Testing

Face Mount failure

Top flange failure

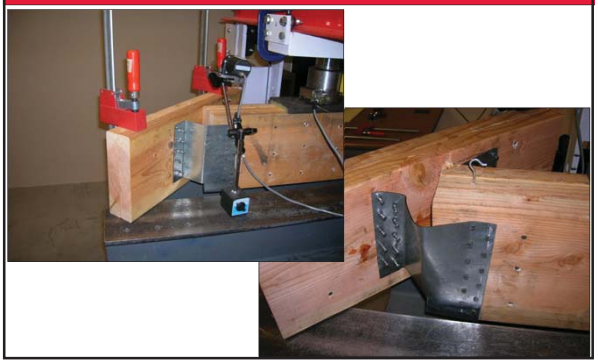
Typical Adjustable Hanger Failure

Steel buckling failure

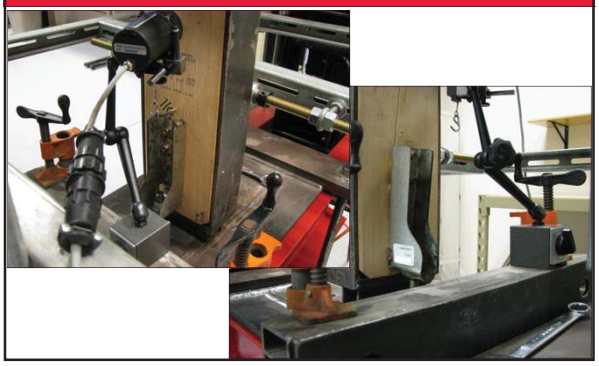
Welded Face Mount Skewed 45°

Welded Face Mount Skewed 45°

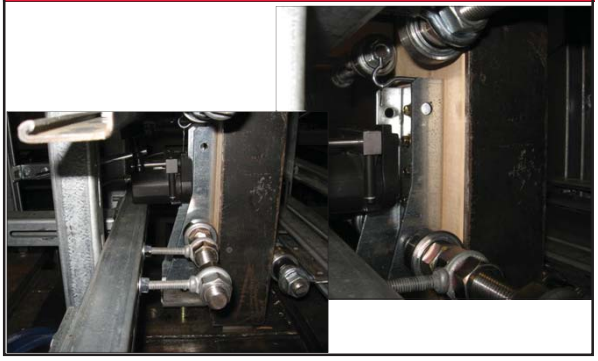
Formed Face Mount Skewed 45°



Deck Tie Back Testing



PHD Holdown Test Setup

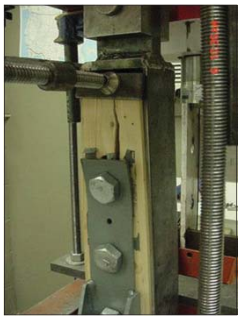


Typical Pre-Deflected Holdown Failure

How Design Load Values are Established: Testing

Typical Bolted Holdown Failure

How Design Load Values are Established: Testing



Front View

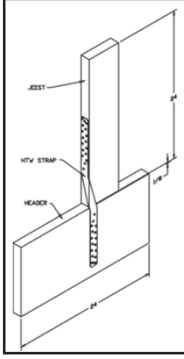
Back side of Post

Lateral Load Connector Setup

How Design Load Values are Established: Testing

Typical Hurricane Tie and Twist Strap Failure Modes

How Design Load Values are Established: Testing



Twist strap
Lateral Test

Hurricane Gusset Angle Fastened to concrete

Hurricane Anchor attached to Masonry

How Design Load Values are Established: Testing

Miscellaneous Testing

Published Loads

How Design Load Values are Established: Calculation

- **Each catalog chart contains the following information:**

Joist Size	Stock No.	Ref. No.	Steel Gauge	Dimensions W	H	D	A	Fastener Schedule[1,2] Header	Joist	Allowable Loads (Lbs.) Floor 100%	Roof 115%	125%	Uplift[3] 133%	160%
(2) 2 x 4 - 6	HUS24-2	-- --	14	3-1/8	3-1/2	2	1	(4) 16d	(2) 16d	780	895	970	495	495
(2) 2 x 6 - 8	HUS26-2	HUS26-2	14	3-1/8	5-1/4	2	1	(4) 16d	(4) 16d	1015	1165	1265	1115	1115
(2) 2 x 8 - 10	HUS28-2	HUS28-2	14	3-1/8	7-1/4	2	1	(6) 16d	(6) 16d	1520	1745	1900	1810	1810
(2) 2 x 10 - 12	HUS210-2	HUS210-2	14	3-1/8	9-1/4	2	1	(8) 16d	(8) 16d	2025	2330	2530	2210	2210
(2) 2 x 12 - 14	HUS212-2	HUS212-2	14	3-1/8	11-1/4	2	1	(10) 16d	(10) 16d	2530	2910	3165	3060	3060
(2) 2 x 14 - 16	HUS214-2	-- --	14	3-1/8	13-1/4	2	1	(12) 16d	(12) 16d	3040	3495	3800	3060	3060

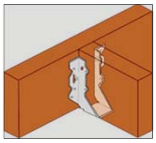
1) 16d sinkers (9 gauge x 3-1/4" long) may be used where 10d commons are specified with no reduction in load. Where 16d commons are specified, 10d commons or 16 sinkers (9 gauge x 3-1/4" long) may be used at 0.84 of the table load.

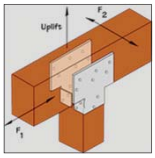
2) Nails must be driven at a 45° angle through the joist or truss into the header to achieve the table loads.

3) Uplift loads have been increased 33-1/3% or 60% for wind or seismic loads; no further increase shall be permitted.

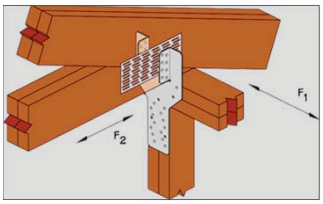
Load Direction Conventions

How Design Load Values are Established: Calculation



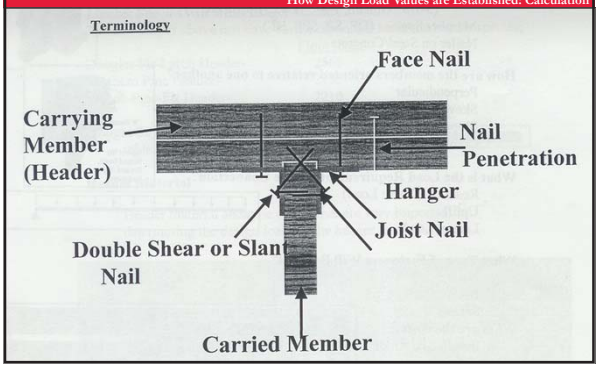


See Catalog Page 13



Terminology

How Design Load Values are Established: Calculation

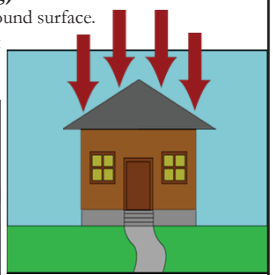


Steel Used in USP Products

- Material
  Quality steel which meets ASTM A 653 requirements for galvanized steel, and ASTM A 36 or ASTM A 570 for hot-rolled steel
- Common Material Strengths
  Grade 33 (Fy=33,000psi, Fu=45,000psi)
  Grade 40 Sp. (Fy=42,000psi, Fu=56,000psi)
  Grade 50 Cl. 1 (Fy=50,000psi, Fu=65,000psi)
- Finish
  All galvanized products have a zinc coating as specified in ASTM A 653
  Hot-dip galvanized parts are galvanized after fabrication per ASTM A 153 with a minimum of one ounce of zinc per square foot of surface
  Non-galvanized steel products are prime coated for corrosion protection

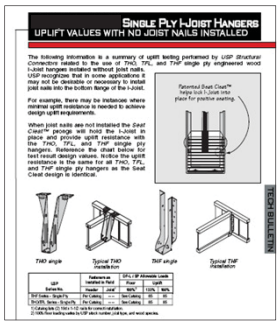
Devices for Carrying Gravity Loads

Gravity / Snow / Rain (Ponding) Loads:
Forces applied perpendicular to level ground surface.
•Dead Loads – Building Material Weight
•Live Loads – Building Contents



Proper Installation?

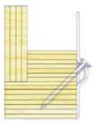
Gravity Load Carrying Devices


SINGLE PLY I-JOIST HANGERS
UPLIFT VALUES WITH NO JOIST NAILS INSTALLED

Bulletin Addresses installations without joist nails.

Proper Installation?

Gravity Load Carrying Devices


Yes


No

Carried Truss Not Fully Bearing on Hanger Seat

Gravity Load Carrying Devices

Two-ply hanger

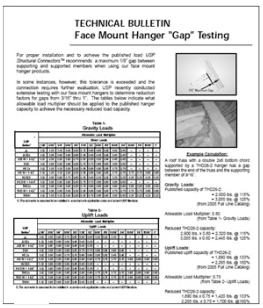
Gravity Load Carrying Devices

Technical Bulletin

Gravity Load Carrying Devices

Bulletin Provides Guidelines for instances where greater than 1/8" Gap is Present

- Multipliers are given for both uplift and Gravity loadings
- Multipliers for gaps up to 1" in certain products


TECHNICAL BULLETIN
Face Mount Hanger "Gap" Testing

Hanger Improperly Sized Nails Missing

Gravity Load Carrying Devices

Nail Shear Reductions for Field Installations

How Design Load Values are Established: Calculation

Reduced Load = $\frac{\text{Published Load x Actual Penetration}}{\text{Nail Diameter x 10}}$

Minimum Fastener Penetration table

Nail Penny	Wire Gauge	Shank Diameter (inches)	Minimum Penetration for Full Load (inches)	Minimum Penetration for Reduced Load[2] (inches)
6d	11-1/2 ga.	.113	1.13	0.68
8d	10-1/4 ga.	.131	1.31	0.79
10d/16d Sinker	9 ga.	.148	1.48	0.89
12d	9 ga.	.148	1.48	0.89
16d	8 ga.	.162	1.62	0.97
20d	6 ga.	.192	1.92	1.15

1) Less than the specified nail penetration shall be multiplied by the applicable adjustment factor.
2) For penetration less than this distance, the nail has no value.
New products or updated product information are designated in red.

Reduced Fastener Penetration Example:

HD210 – listed load is 1680 lbs. @ 100% for 16d common nails.

Reduced HD210 capacity if using 2x DF-L or SP header:

$\frac{\text{1680 lbs. x 1.5}}{\text{1.62}}$ = 1115 lbs. @ 100%

Hanger Overlap

Gravity Load Carrying Devices

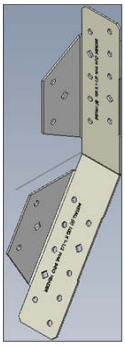
Truss Layout Problem

Gravity Load Carrying Devices

Also notice gap problem in hanger connection.

Stair Stringer Connection

Gravity Load Carrying Devices



Textbook HUS Glulam Beam Hanger Application

Gravity Load Carrying Devices

Strap Hanger

Gravity Load Carrying Devices

!@#$% What? Slight load reduction

Strap Hanger

Framing Angle

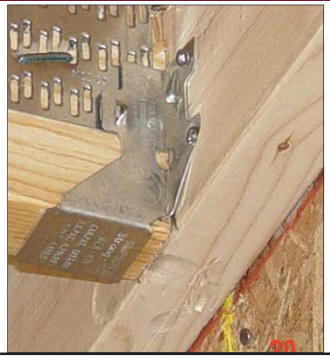
Nailing reductions to Match Field Installations

- Load values for 8d, 10d, 16d, and 20d designations in the fastener schedules in manufactures published literature refer to common wire nails, unless noted otherwise
- All manufacturers catalogs include optional nail load adjustment charts:

Catalog Nail	Replacement Nail	Allowable Load Adjustment Factor			
		DF-L	SYP	S-P-F	LVL
16d common	8d common	0.69	0.69	0.60	0.69
16d common	10d common/12d common	0.84	0.84	0.72	0.84
16d common	10d x 1-1/2	0.67	0.67	0.59	0.67
16d common	10d Sinker	0.58	0.58	0.50	0.58
16d common	16d Sinker	0.84	0.84	0.72	0.84
16d common	16d x 2-1/2	1.00	1.00	0.86	1.00

Roofing nails shall not to be substituted for any nail size or type

What's the problem?

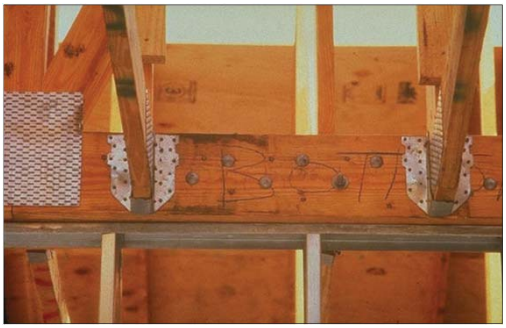


Adjustments for Wood Species

Allowable Load Adjustment Factor		
Wood Species	**Specific Gravity**	**Adjustment Factor**
Douglas Fir-Larch (DF-L)	0.50	1.00
Southern Yellow Pine (SYP)	0.55	1.00
Douglas Fir (S) Hem Fir (N)	0.45	0.88
Spruce-Pine-Fir (S-P-F)	0.42	0.86

1) Allowable loads must be adjusted according to the applicable wood species

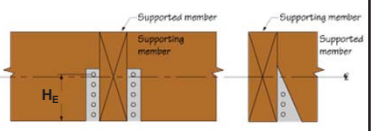
Truss to Truss Application



For Severe Skews

Correct?

ANSI/TPI



Connections meeting the following criteria are unaffected:

- Less than 800 lbs loading
- H_E greater than 85% of supporting member depth.

Is this hanger affected?

Girder Truss Application

Hip/Jack Truss Application

Low Profile Hanger

No double shear nails. Reduced downward load.
No Uplift resistance at all.

60% Rule

Gravity Load Carrying Devices

Stair Stringer

Gravity Load Carrying Devices

Glulam Hanger Installation

Gravity Load Carrying Devices

Concealed Flange Header Application

Gravity Load Carrying Devices

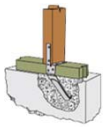
Welding Requires the specifier to provide design verification

Gravity Load Carrying Devices

Prescribed Connectors in the Building Codes

IRC

Prescribed Connectors in the Building Codes

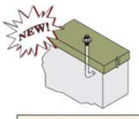


Typical foundation anchor installation to mudsill and stud

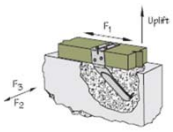
R403.1.6 Foundation Anchorage. …The wood sole plate at exterior walls on monolithic slabs and wood sill plate shall be anchored to the foundation with anchor bolts spaced a maximum of 6 feet on center. There shall be a minimum of two bolts per plate section with one bolt located not more than 12 inches or less than 7 bolt diameters from each end of the plate section...Bolts shall be at least ½" in diameter and shall extend a minimum of 7 inches into masonry or concrete.

Exceptions:

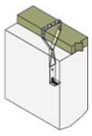
Foundation anchor straps, spaced as required to provide equivalent anchorage to ½ diameter anchor bolts.



The codes specify a minimum diameter and embedment into masonry or concrete for anchor bolts used in foundation plates or sills. IRC R403.1.6, IBC 2308.6, UBC 1806.6.



Typical foundation anchor installation in concrete



Typical foundation anchor installation in concrete

Alternate Foundation Connections

Prescribed Connectors in the Building Codes

IRC

Prescribed Connectors in the Building Codes

R602.6.1 Drilling and notching of top plate.

.054" – 16 gauge

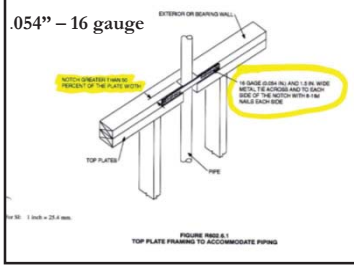
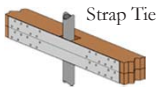


FIGURE R602.6.1
TOP PLATE FRAMING TO ACCOMMODATE PIPING

Is this correct?

Strap Tie



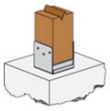
IBC, IRC

Prescribed Connectors in the Building Codes

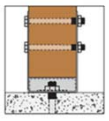
IRC R319.1.4, IBC 2304.11.2.6 Wood Columns. Wood columns shall be approved wood of natural decay resistance or approved pressure preservative treated wood.

Exceptions:

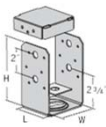
Posts or columns which are either exposed to the weather or located in basements or cellars, supported by piers or metal pedestals projecting 1 inch (25.4 mm) above the floor or finished grade and 6 inches (152 mm) above exposed earth, and are separated there by an approved impervious moisture barrier.



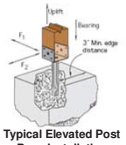
Typical Post Anchor Installation



Post Anchor cross section



Post Anchor

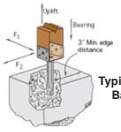


Typical Elevated Post Base Installation

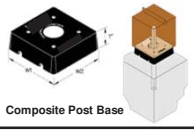
IBC, IRC

Prescribed Connectors in the Building Codes

IBC 2304.9.7, IRC R407.3 The codes specify that structural columns shall be fastened to resist net induced uplift forces and prevent lateral displacement at the bottom end.



Typical Elevated Post Base Installation



Composite Post Base

Duct Tape?

Prescribed Connectors in the Building Codes

- Nice Try…….

  Check with your local building official

Thank you

Questions?

This concludes The American Institute of Architects Continuing Education Systems Course

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Quiz

1. The purpose code approvals are obtained on structural connectors is:
   a. To act as an endorsement
   b. Make sure they are designed with aesthetics in mind
   c. Point out the features and benefits of one product as compared with another
   d. Ensure that connectors serving the same function are tested and evaluated the same way
2. The ultimate load value obtained through testing is applied a safety factor of three before being considered in the allowable load determination. (T or F)
   - True
   - False
3. Nail shear values are determined according to the:
   a. National Design Specification for Wood (NDS)
   b. ASCE 7
   c. Wood Frame Construction Manual
   d. USP Catalog

Quiz

4. Factors affecting nail shear values include all of the following EXCEPT:
   a. Steel Grade (Strength)
   b. Steel Gauge
   c. Wood Species
   d. Nail Penetration
   e. Steel Finish
5. A duration factor of 1.6 may be applied to the allowable load of a connection if affected by:
   a. Construction
   b. Snow
   c. Impact Loading
   d. Dead Loading
   e. Wind or earthquakes
6. One of the parameters of joist hanger testing require that the manufacturer record the load when the deflection in the hanger reaches:
   a. ¼"
   b. 3/8"
   c. 1/8"
   d. 1/16"

Quiz

7. As a rule of thumb in the connector industry, the joist hanger should be at least __% of the joist height.
   a. 30
   b. 45
   c. 60
   d. 75
8. When the gap between the carried member and the carrying member exceeds __, the allowable capacity of the hanger must be reduced.
   a. 1/16"
   b. 1/32"
   c. 1/64"
   d. 1/8"
9. In order for the nails to have their FULL shear capacity, they must penetrate the wood at least:
   a. 8 nail diameters
   b. 6 nail diameters
   c. 12 nail diameters
   d. 10 nail diameters
10. In order for the nails to have ANY shear capacity, they must penetrate the wood at least:
    a. 8 nail diameters
    b. 6 nail diameters
    c. 12 nail diameters
    d. 10 nail diameters