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Course Description

Session 1: October 3, 2017-Fundamental Concepts, Part I

This live webinar provides an overview of basic connection types including tension, compression, framing, and moment connections. Classification of beam-to-column connections are discussed, followed by a review of limit states in the load path. Bolt related limit states and detailing are reviewed with discussions on different types of bolts and bolt connections, bolt installation, bolt shear strength, and combined shear plus tension strength. Basic weld related limit states will also be reviewed.

Learning Objectives

At the end of this program, participants will be able to:

- Identify basic structural steel connection types.
- List limit states in the load path.
- List limit states related to bolts.
- List limit states related to welded connections.

There's always a solution in steel.

Fundamentals of Connection Design

Session 1: Fundamental Concepts Part I

October 3, 2017

Presented by
Thomas M. Murray, Ph.D., P.E.
Emeritus Professor
Virginia Tech, Blacksburg, Virginia

structural STEEL

SCHEDULE

- October 03, 2017 Fundamental Concepts Part I
- October 10, 2017 Fundamental Concepts Part II
- October 17, 2017 Shear Connections Part I
- October 24, 2017 Shear Connections Part II
- November 07, 2017 Moment Connections Part I
- November 14, 2017 Moment Connections Part II
- November 28, 2017 Introduction to Seismic Connections
- December 05, 2017 Bracing Connections and More

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REFERENCE DOCUMENTS and NOMENCLATURE

VirginiaTech Invent the Future 10

SPECIFICATION AND MANUAL PROVISIONS

AISC/ANSI 360-16 *Specification for Structural Steel Buildings, 2016.*
Chapter D *Design of Members for Tension*
Chapter J *Design of Connections*

AISC *Steel Construction Manual, 15th Ed.,* 2017.

Research Council on Structural Connections (RCSC) *Specification for Structural Joints Using High Strength Bolts, 2014*

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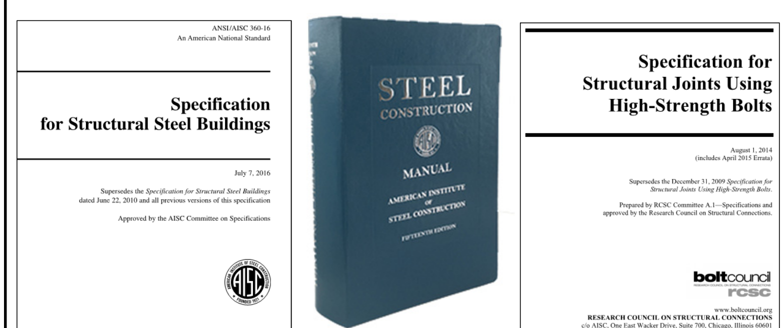
SPECIFICATION AND MANUAL PROVISIONS



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Nomenclature

LRFD: Load and Resistance Factor Design

Factored Loads and Resistance Factors, ϕ

Required Strength $\leq$ Design Strength

$$R_u \leq \phi R_n$$

where R_u = Required Strength using LRFD Load Combinations (Factored Loads)

ϕ = Resistance Factor

R_n = Nominal Strength

ϕR_n = Design Strength

Nomenclature

ASD: Allowable Strength Design

Service Loads and Factors of Safety, Ω

Service Loads $\leq$ Allowable Strength

$$R_a \leq R_n / \Omega$$

where R_a = Required Strength using ASD Load Combinations (Service Loads)

R_n = Nominal Strength

Ω = Factor of Safety

R_n / Ω = Allowable Strength

Nomenclature

NOTE: Available Strength is generic for Design Strength (LRFD) and Allowable Strength (ASD) in the *Specification*.

For the course:

AISC 360-16 *Specification for Structural Steel Buildings* → *Specification* or *Spec.*

15th Ed. *Steel Construction Manual* → *Manual*

RCSC *Specification* → *RCSC Spec.*

Nomenclature

LRFD Resistance Factors:

Ductile Limit States: $\phi = 0.9$

Example: Tension Yielding

Non-Ductile Limit States: $\phi = 0.75$

Example: Tension Rupture

Steel Properties

A36 Steel: Primarily Plates and Angles

F_y = 36 ksi (Tension Yield Stress)

F_u = 58 ksi (Tension Rupture Strength)

A992 Steel: Beams and Columns

F_y = 50 ksi

F_u = 65 ksi

Note:

Shear Yield = 0.6 F_y

Shear Rupture = 0.6 F_u

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FUNDAMENTAL CONCEPTS PART I

18

TODAY'S TOPICS

- Connections Types
- Classification of Beam-to-Column Connections
- Limit States in the Load Path
- Basic Bolt Related Limit States and Detailing
- Basic Fillet Weld Related Limit States and Detailing

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CONNECTION TYPES

- Tension Connections
- Compression Connections
- Shear (Framing) Connections

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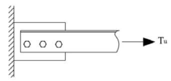
Emeritus Professor, Virginia Tech

Tension Connections



Direct Loaded

Hanger

Light and Heavy Bracing

Compression Connections

Column Splice

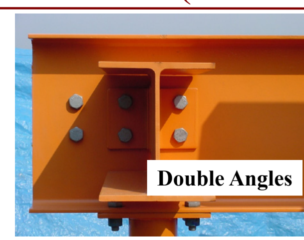
Beam Bearing

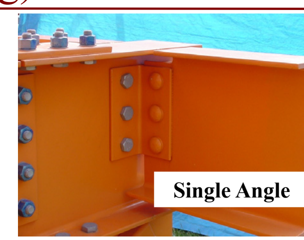
Column Base Plate

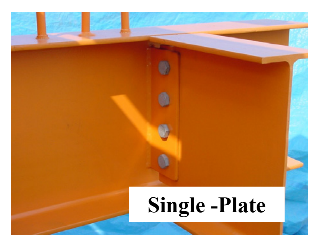
Shear (Framing) Connections

- Double Angles
- Single Angle
- Single-Plate (Shear Tab)
- Shear End-Plate
- Tee Connections
- Seated Connections

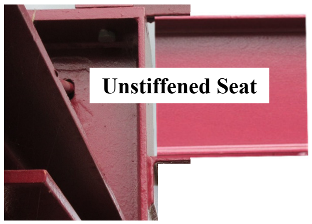
Shear (Framing) Connections







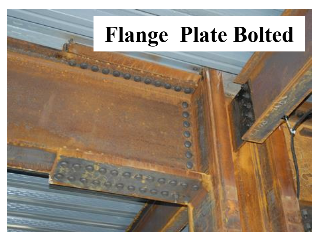
Shear (Framing) Connections

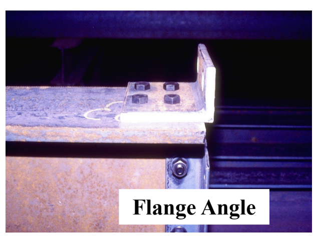


Moment Connections

- Flange Welded Moment Connection
- Flange Plate Welded Moment Connection
- Flange Plate Bolted Moment Connection
- Tee-Stub Moment Connection
- Flange Angle Moment Connection
- Moment End-Plate Connection

Moment Connections





Moment Connections

CLASSIFICATION OF CONNECTIONS

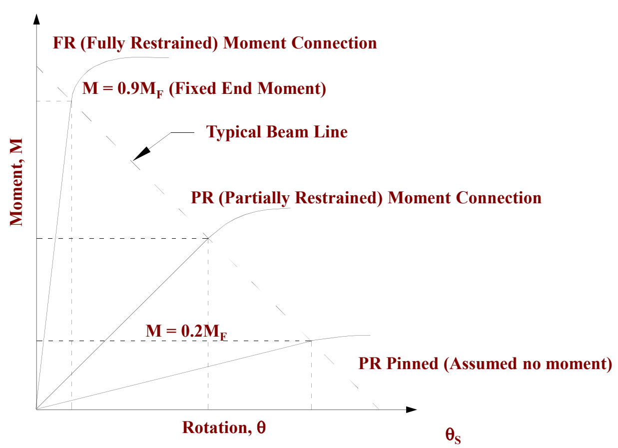
- FR - (Fully Restrained)
- PR - Partially Restrained)
- PR - Pinned (Assumed no moment restraint)

Classification of Connections

Classification: All techniques depend on member length and moment diagram/magnitude of moment.

Example: Beam Line/Connection Curve

Classification of Connections



Classification of Connections

- Fully Restrained – FR
  - Flange Welded
  - Flange Plate Welded or Bolted
  - Tee-Stub
  - Moment End-Plate

Classification of Connections

- Partially Restrained – PR
  - Flush End-Plate
  - Flange Angle
  - Double Angles

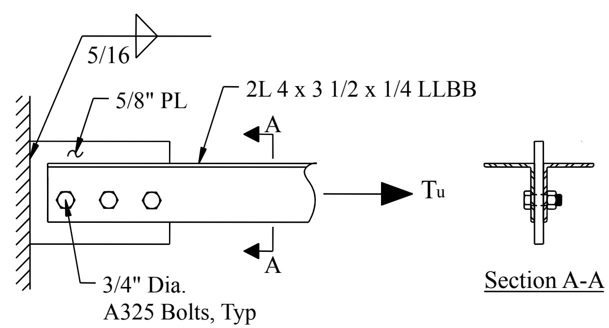
Classification of Connections

- Partially Restrained/Pinned – PR
  - Double Angles
  - Single Angle
  - Single-Plate
  - Shear End-Plate
  - Seated Connections
  - Tee Framing Connection

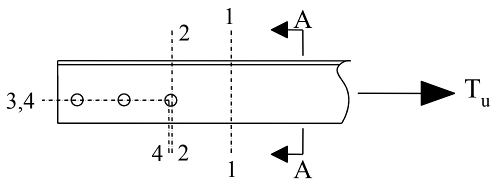
LIMIT STATES IN THE LOAD PATH

Load Paths/Limit States

Example: Tension Connection



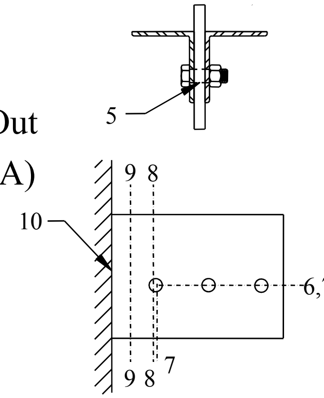
Load Paths/Limit States



1. Angle Yielding
2. Angle Rupture including Shear Lag
3. Angle Bolt Bearing/Tear Out
4. Angle Block Shear

Load Paths/Limit States

5. Bolt Shear
6. Plate Bearing / Tear-Out
7. Plate Block Shear (N/A)
8. Plate Rupture
9. Plate Yield
10. Weld Rupture

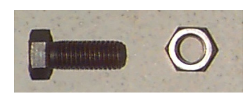


BASIC BOLT RELATED LIMIT STATES AND DETAILING

Bolt Types

A307 – Machine Bolts

F_{nt} = 45 ksi



Group A – High Strength Bolts

F_{nt} = 90 ksi

Group B – High Strength Bolts

F_{nt} = 113 ksi

Group C – High Strength Bolts

F_{nt} = 150 ksi

F_{nt} = tensile strength from *Specification* Table J3.2

Bolt Types

Group A – High Strength Bolts – F_{nt} = 90 ksi

ASTM F3125 Grades A325, A325M, F1852
ASTM A354 Grade BC

Group B – High Strength Bolts – F_{nt} = 113 ksi

ASTM F3125 Grades A490, A490M, F2280
ASTM A354 Grade BD

Group C – High Strength Bolts – F_{nt} = 150 ksi

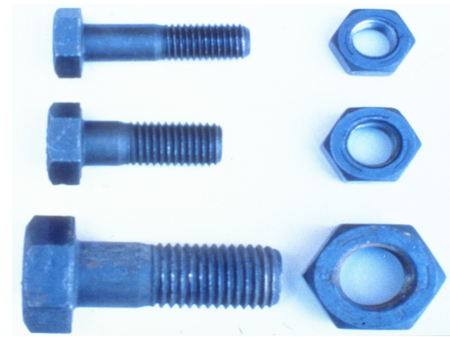
ASTM F3043 and F3111 Grades 1 and 2

Grade A325 and A490 Bolts

3/4 in. Dia.

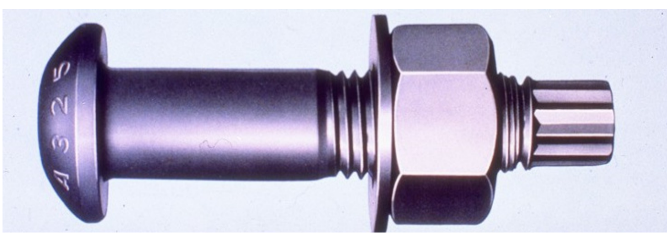
7/8 in. Dia.

1 1/4 in. Dia.



Note: Thread length is a function of bolt diameter.

Grade F1852 and F2280 Twist-Off Bolt



Note: Requires a special tightening tool.

Bolts: Connection Types

Types of Connections (Not Types of Bolts)

(a) Bearing Type

N - threads included in shear plane

X - threads excluded from shear plane

(b) Slip Critical

SC - slip critical (friction)

Example Designations: ¾ in. A325 – N

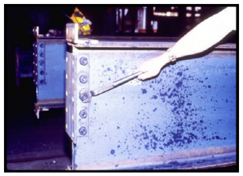
1 in. A490 – SC

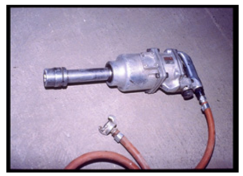
Lecturer: Tom Murray, P.E., PhD
Emeritus Professor, Virginia Tech

Bolts: Tightening

-N or -X Bearing Type Connections

Snug Tight (*RCSC Spec.* "The snug tightened condition is the tightness that is attained with a few impacts of an impact wrench or the full effort of an ironworker using an ordinary spud wrench to bring the plies into firm contact.")





Bolts: Tightening

-SC Slip Critical Type Connections

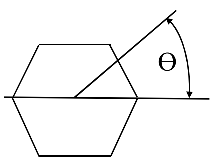
- Requires faying surface preparation and field inspection
- Pretensioning:
  - Turn of Nut Method
  - Calibrated Wrench
  - Direct Tension Indicator (DTI)
  - Twist-Off Bolt

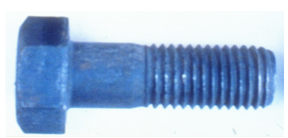
Pretensioned Bolt Connections

- Pretensioning: Same as for -SC connections
- No surface preparation or inspection required.

Bolts: Pretensioned Installation

Turn-of-Nut Tightening





θ from *Bolt Spec.* Table 8.2

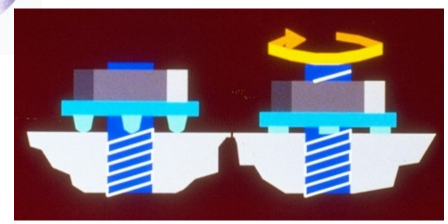
Example: Bolt Length $\leq 4d_b$, $\theta = 1/3$ Turn

Bolts: Pretensioned Installation

Calibrated Wrench Tightening


Bolts: Pretensioned Installation

Direct Tension Indicator (DTI) Tightening



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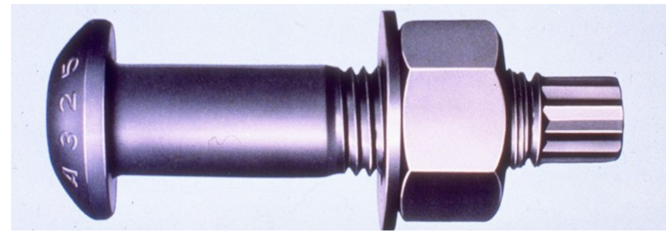
Bolts: Pretensioned Installation

Twist Off Bolt Tightening



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Bolt Holes

Hole Types and Dimensions (*Spec.* Table J3.3)

- Standard (STD) d_b + 1/16 in. for ≤ d_b = 7/8 in.
  d_b + 1/8 in. for > d_b = 7/8 in.
- Oversized (OVS) d_b + (1/8 in. to 5/16 in.)
- Short Slots (SS) STD by (OVS + 1/16 in.)
- Long Slots (LS) STD by up to 2.5 bolt diameters

(Standard Hole, STD, is Default for Course.)

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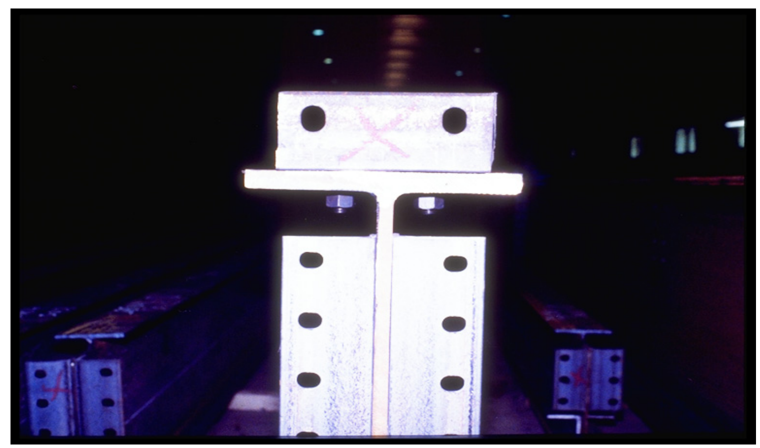
Use of Slotted Holes



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Bolt Tensile Strength

Design Tensile Strength of one Bolt, ϕr_t

(*Specification* J3.6)

$\phi = 0.75$

$r_t = F_{nt} A_b$

A_b = nominal bolt area

F_{nt} = nominal strength from *Spec.* Table J3.2

$\phi r_t = 0.75 F_{nt} A_b$ = Design Tensile Strength

Note: Tensile area is accounted for in F_{nt}

Bolt Shear Strength

Design Shear Strength of one Bolt, ϕr_v

(*Specification* J3.6)

$\phi = 0.75$

$r_v = F_{nv} A_b$

A_b = nominal bolt area

F_{nv} = nominal strength from *Spec.* Table J3.2

$\phi r_v = 0.75 F_{nv} A_b$ = Design Shear Strength

Note: Area at threads is accounted for in F_{nv}

Bolt Nominal Strengths

TABLE J3.2
Nominal Strength of Fasteners and Threaded Parts, ksi (MPa)

Description of Fasteners	Nominal Tensile Strength, F_{nt}, ksi (MPa)[a]	Nominal Shear Strength in Bearing-Type Connections, F_{nv}, ksi (MPa)[b]
A307 bolts	45 (310)	27 (188)[c] [d]
Group A (e.g., A325) bolts, when threads are not excluded from shear planes	90 (620)	54 (372)
Group A (e.g., A325) bolts, when threads are excluded from shear planes	90 (620)	68 (457)
Group B (e.g., A490) bolts, when threads are not excluded from shear planes	113 (780)	68 (457)
Group B (e.g., A490) bolts, when threads are excluded from shear planes	113 (780)	84 (579)

Bolt Nominal Strengths

Table J3.2 Continued

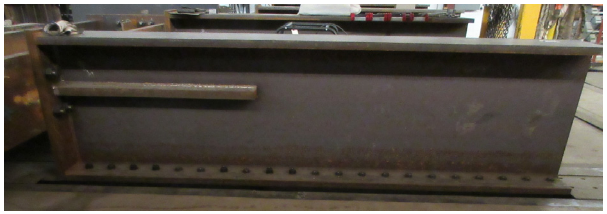
Group C (e.g., F3043) bolt assemblies, when threads and transition area of shank are excluded from the shear plane	150 (1040)	113 (779)
Threaded parts meeting the requirements of Section A3.4, when threads are not excluded from shear planes	$0.75F_u$	$0.450F_u$
Threaded parts meeting the requirements of Section A3.4, when threads are excluded from shear planes	$0.75F_u$	$0.563F_u$

[a] For high-strength bolts subject to tensile fatigue loading, see Appendix 3.
[b] For end loaded connections with a fastener pattern length greater than 38 in. (950 mm), F_{nv} shall be reduced to 83.3% of the tabulated values. Fastener pattern length is the maximum distance parallel to the line of force between the centerline of the bolts connecting two parts with one faying surface.
[c] For A307 bolts, the tabulated values shall be reduced by 1% for each 1/16 in. (2 mm) over five diameters of length in the grip.
[d] Threads permitted in shear planes.

Bolts: Connection Length Effect

Specification Table J3.2 Footnote [b]

[b] For end loaded connections with a fastener pattern length greater than 38 in. (965 mm), F_{nv} shall be reduced to 83.3% of the tabulated values. Fastener pattern length is the maximum distance parallel to the line of force between the centerline of the bolts connecting two parts with one faying surface.

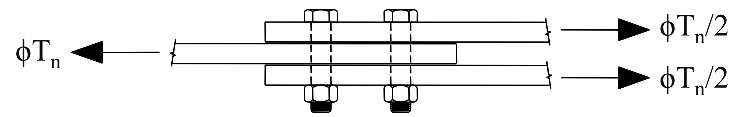


Design Bolt Shear Strength

Design Bolt Shear Strength of the Connection

$\phi R_v = 0.75\ r_v$ x Number of Bolts x Number of Shear Planes

r_v = nominal shear strength of a bolt, kips



Ex. For three bolts per row, there are twelve (3x2x2) shear planes in this connection.

Bolt Slip (-SC Connections)

Specification J3.8. *High-Strength Bolts in Slip-Critical Connections*

$$r_{sc} = \mu D_u h_f T_b n_s \qquad (\textit{Spec.}\ \text{J3-4})$$

ϕ = 1.00 for STD and SSLT (Transverse)
= 0.85 for OVS and SSLP (Parallel)
= 0.70 for LSL (Long Slots T or P)

Design Strength:

$$\phi r_{sc} = \phi \mu D_u h_f T_b n_s$$

Bolt Slip (-SC Connections)

Specification J3.8. *High-Strength Bolts in Slip-Critical Connections*

$$r_{sc} = \mu D_u h_f T_b n_s \qquad (\textit{Spec.}\ \text{J3-4})$$

μ = mean slip coefficient depending on faying surface preparation:
Class A – 0.3 Class B – 0.5

D_u=1.13, a multiplier that reflects the ratio of the mean installed pretension to the specified minimum bolt tension

Bolt Slip (-SC Connections)

Specification J3.8. *High-Strength Bolts in Slip-Critical Connections*

$$r_{sc} = \mu D_u h_f T_b n_s \qquad (\textit{Spec.}\ \text{J3-4})$$

h_f = factor for fillers
= 1.0 for no fillers or one filler
= 0.85 for two or more fillers

T_b = minimum fastener pretension, Table J3.1

n_s = number of shear planes

Bolt Slip (-SC Connections)

TABLE J3.1
Minimum Bolt Pretension, kips[a]

Bolt Size, in.	Group A[a] (e.g., A325 Bolts)	Group B[a] (e.g., A490 Bolts)	Group C, Grade 2[b] (e.g., F3043 Gr. 2 bolts)
1/2	12	15	–
5/8	19	24	–
3/4	28	35	–
7/8	39	49	–
1	51	64	90
1 1/8	64	80	113
1 1/4	81	102	143
1 3/8	97	121	–
1 1/2	118	148	–

[a] Equal to 0.70 times the minimum tensile strength of bolts as specified in ASTM F3125/F3125M for Grade A325 and Grade A490 bolts with UNC threads, rounded off to nearest kip.
[b] Equal to 0.70 times the minimum tensile strength of bolts, rounded off to nearest kip, for ASTM F3043 Grade 2 and ASTM F3111 Grade 2.

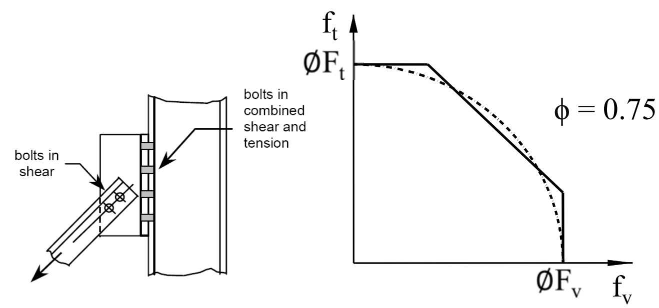
Note: Increased prestressed values indicated.

Bolt Slip (-SC Connections)

IMPORTANT:

- Slip Critical Connections are expensive because of faying surface preparation, tightening and inspection requirements.
- SC-Connections are not needed for typical framing connections and most moment connections.
- SC-Connections may be needed when dynamic or vibration loads are present or may be used to control drift in frames and are required in some moment connections.

Bearing Bolts: Combined Shear and Tension Strength



Bearing Bolt Interaction Diagram
(*Specification* Equations J3-2 and J3-3)

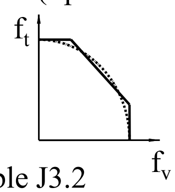
Bolts: Combined Tension and Shear Strength in Bearing

Spec. J3.7 Combined Tension and Shear Bearing

$\phi r_n = \phi F'_{nt} A_b$ $\phi = 0.75$ (Spec. J3-2)

$$F'_{nt} = 1.30F_{nt} - \frac{F_{nt}}{\phi F_{nv}} f_v \le F_{nt}$$

$f_v \le \phi F_{nv}$



F_{nt} = nominal tensile stress from Table J3.2

F_{nv} = nominal shear stress from Table J3.2

f_v = the required shear stress = V_u / A_b

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Bolt Holes in Calculations

- For all hole related limit states except tear out, the effective hole diameter used in calculations is

  $d'_h = d_h + 1/16$ in.

  The additional 1/16 in. accounts for damage from punching and drilling.

- For tear out, the actual hole diameter is used.

Note: For bearing, the bolt diameter is used.

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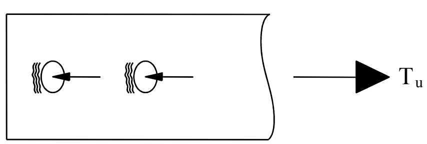
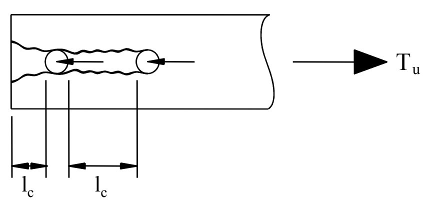
Bolt Holes: Bearing and Tearout

Bearing



Tearout



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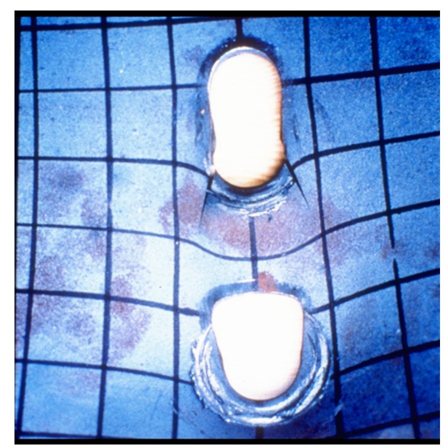
Bolt Holes: Bearing and Tearout

Tearout

Bearing



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Lecturer: Tom Murray, P.E., PhD
Emeritus Professor, Virginia Tech

Bolt Holes: Bearing and Tearout

Specification J3.10 Bearing and Tearout Strength at Bolt Holes

$\phi = 0.75$

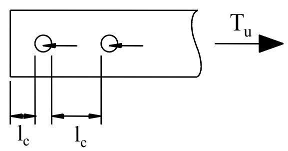
For standard, oversized, and short-slotted holes where deformation at a bolt hole is a consideration:

Bearing Strength: $2.4\ d_b\ t\ F_u$ (*Spec.* J3-6(a))

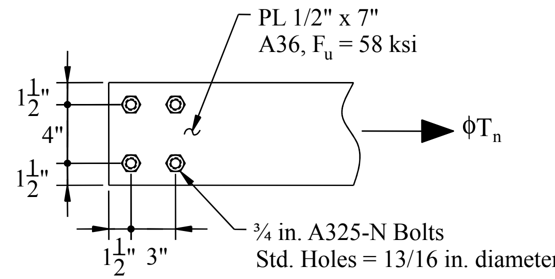
Tearout Strength: $1.2\ l_c t\ F_u$ (*Spec.* J3-6(c))

l_c = clear distance between between holes or to edge

$R_n = 1.2\ l_c t\ F_u \leq 2.4\ d_b\ t\ F_u$



Example: Bearing/Tearout Design Strength

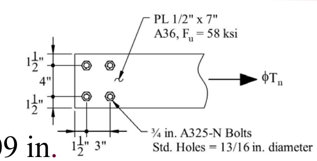


Bearing Strength at Holes

$2.4\ d_b\ t\ F_u = 2.4 \times 0.75 \times 0.5 \times 58 = 52.2$ k

Example: Bearing/Tearout Design Strength

Bearing/Tearout Strengths



Edge Bolts: $l_c = 1.5 - 13/32 = 1.09$ in.

$1.2\ l_c\ t\ F_u = 1.2 \times 1.09 \times 0.5 \times 58 = \underline{37.9\ k} < 52.2$ k

(Tearout Controls)

Other Bolts: $l_c = 3.0 - 13/16 = 2.19$ in.

$1.2\ l_c\ t\ F_u = 1.2 \times 2.19 \times 0.5 \times 58$

$= 76.2\ k > \underline{52.2\ k}$ (Bearing Controls)

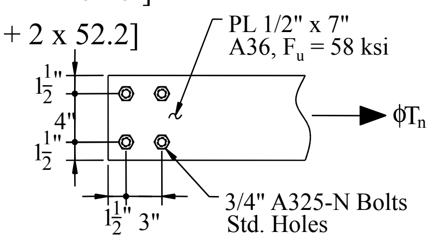
Example: Bearing/Tearout Design Strength

Design Strength

$\phi T_n = 0.75\ [2 \times \text{edge} + 2 \times \text{other}]$

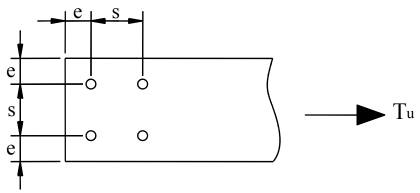
$= 0.75\ [2 \times 37.9 + 2 \times 52.2]$

$= \underline{135\ k}$



Note: For 3/4" A325-N, $r_v = 17.9$ k.
Since 17.9 k < 0.75(37.9) = 28.4 k, bolt shear ~~does not~~ controls at bolt holes for this plate.

Holes: Min. Spacing and Edge Distance



Specification J3.3 Minimum Spacing

The distance between centers of standard, oversized, or slotted holes, shall not be less than 2 2/3 times the nominal diameter of the fastener. However, the clear distance between holes or slots shall not be less than d, User Note: A *distance 3d is preferred.*

Typical spacing, s, when $d_b \leq 1$ in. is 3 in.

Holes: Min. Spacing and Edge Distance

TABLE J3.4
Minimum Edge Distance[a] from Center of Standard Hole[b] to Edge of Connected Part, in.

Bolt Diameter, in.	Minimum Edge Distance
1/2	3/4
5/8	7/8
3/4	1
7/8	1 1/8
1	1 1/4
1 1/8	1 1/2
1 1/4	1 5/8
Over 1 1/4	1 1/4 × *d*

[a] If necessary, lesser edge distances are permitted provided the appropriate provisions from Sections J3.10 and J4 are satisfied, but edge distances less than one bolt diameter are not permitted without approval from the engineer of record.
[b] For oversized or slotted holes, see Table J3.5.

BASIC FILET WELD RELATED LIMIT STATES AND DETAILING

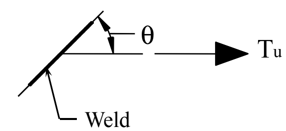
Fillet Weld Rupture

Specification J2. Welds J2.4. Strength

For Fillet Welds:

Design Strength = $\phi F_{nw} A_{we}$

$\phi = 0.75$



$F_w = 0.60 F_{EXX} (1.0 + 0.50 \sin^{1.5}\theta)$

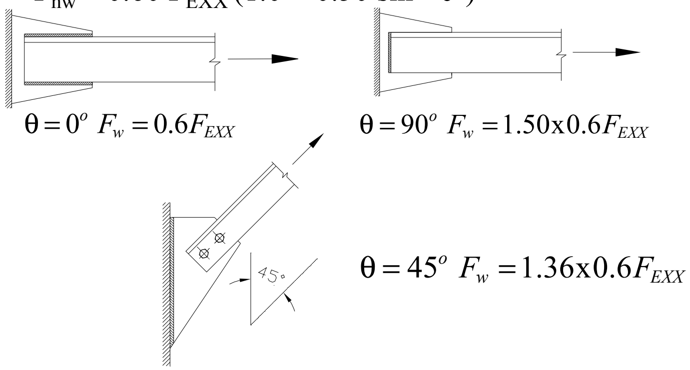
F_{EXX} = electrode strength, ksi

θ = angle of loading measured from the weld longitudinal axis, degrees = (angle of attack)

Fillet Weld Rupture

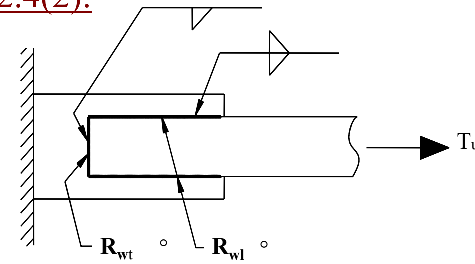
Specification J2.4:

$F_{nw} = 0.60\, F_{EXX}\, (1.0 + 0.50 \sin^{1.5}\theta^0)$



Fillet Weld Rupture – Special Case

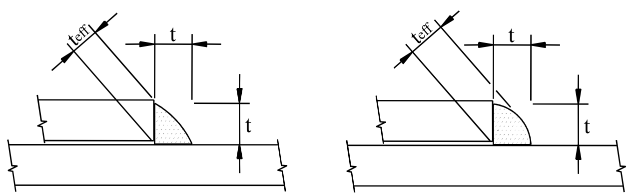
Specification J2.4(2):



$R_n = \max \left| \begin{array}{l} R_{wl} + R_{wt} \\ 0.85R_{wl} + 1.5R_{wt} \end{array} \right.$ *(Spec. J2-6a)* *(Spec. J2-6b)*

R_{wl} and R_{wt} are the weld strengths with $\theta = 0^o$.

Fillet Weld Rupture – Effective Areas



$t_{eff} = 0.707\, t$

for $t \leq 3/8"$ $t_{eff} = t$

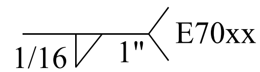
for $t > 3/8"$ $t_{eff} = t + 0.11$ in.

FCAW, GMAW, SMAW
(Manual Welding)

SAW
(Machine Welding)

Fillet Weld Rupture – SMAW Welds

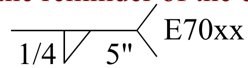
Example: $\theta = 0^0$



$\phi R_n = 0.75\,(0.6x70)(0.707x\; 1/16) =$ 1.392 k/in/(1/16)

1.392 will be used for the reminder of the course.

Example: $\theta = 90^0$



Let D = no. of 1/16's

$\phi R_n = 1.392(1.0 + 0.50 \sin^{1.5}\theta)D\, L_{weld}$

$= 1.392\; x1.5x\; 4\; x\; 5 =$ 41.8 k

Minimum Fillet Weld Sizes

TABLE J2.4
Minimum Size of Fillet Welds

Material Thickness of Thinner Part Joined, in. (mm)	Minimum Size of Fillet Weld,[a] in. (mm)
To 1/4 (6) inclusive	1/8 (3)
Over 1/4 (6) to 1/2 (13)	3/16 (5)
Over 1/2 (13) to 3/4 (19)	1/4 (6)
Over 3/4 (19)	5/16 (8)

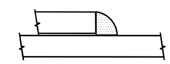
[a] Leg dimension of fillet welds. Single pass welds must be used.
Note: See Section J2.2b for maximum size of fillet welds.

Note: Thinner part controls minimum size of fillet weld.

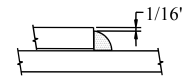
Maximum Fillet Weld Sizes

Specification J2.2b Maximum Fillet Weld Size

$t_p < ¼$ in. $t_w = t_p$

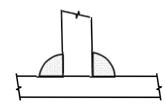


$t_p \geq ¼$ in. $t_w = t_p - 1/16$ in.



(To prevent under cutting of upper plate)

Limits apply only at edges, not:



Base Metal Strength at Fillet Welds

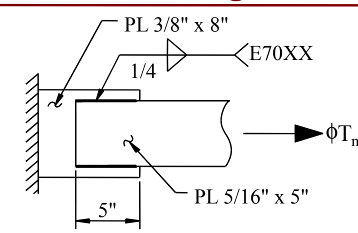
Table J2.5 and *Specification* J4.2 *Strength of Elements in Shear*

$$\phi R_n = 0.75\ (0.6\ F_u\ A_{nw})$$

A_{nw} = area of the element at the weld
F_u = tensile strength of base metal

Example: Fillet Weld Strength

Ex. Determine ϕT_n.
A36 Steel
$F_u = 58$ ksi



Weld Rupture:

$\phi T_n = (1.392\text{x}4)\ (5\text{x}2) = 55.7$ k

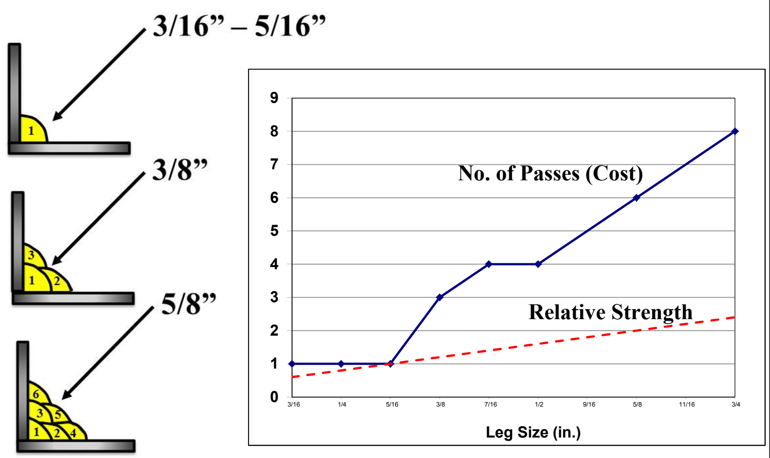
Base Metal:

$\phi T_n = 0.75\ (0.6\ F_u\ A_{nw})$

$= 0.75\ (0.6\text{x}58)\ (5/16)\ (5\text{x}2) = 81.6$ k

$\phi T_n = \underline{55.7\ k}$

Use Single Pass Welds When Possible



End of Session 1

Thank You for Attending

Next Up

Next Session

- October 10, 2017 Fundamental Concepts Part II

Topics

- Eccentric Bolted and Welded Connections
- Direct Loaded Tension Connections
- Light Bracing Connection Example
- Beam Bearing Plate Design
- Column Base Plate Design

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Access to the quiz: Information for accessing the quiz will be emailed to you by Wednesday. It will contain a link to access the quiz. EMAIL COMES FROM NIGHTSCHOOL@AISC.ORG

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Reasons for quiz:

•EEU – must take all quizzes and final to receive EEU
•CEUs/PDHS – If you watch a recorded session you must take quiz for CEUs/PDHs.
•REINFORCEMENT – Reinforce what you learned tonight. Get more out of the course.

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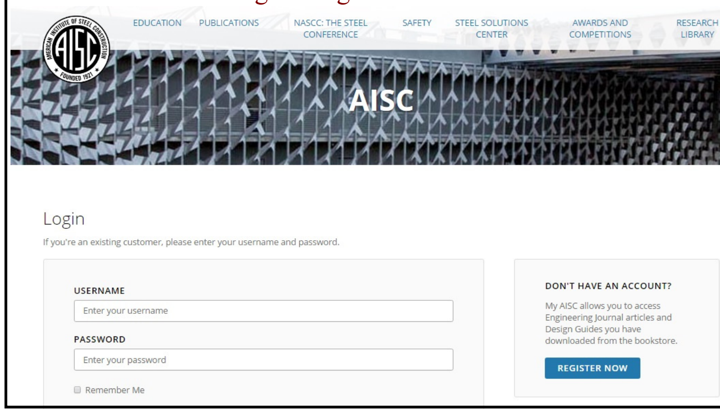

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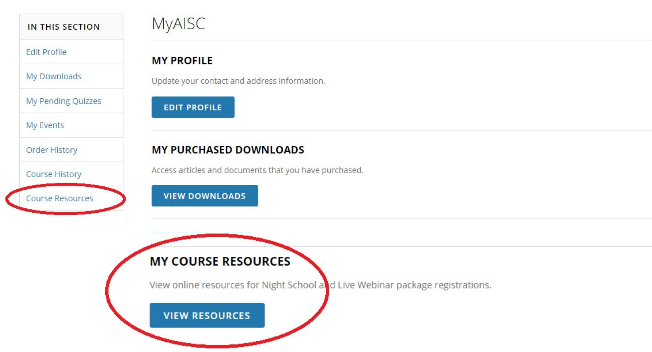

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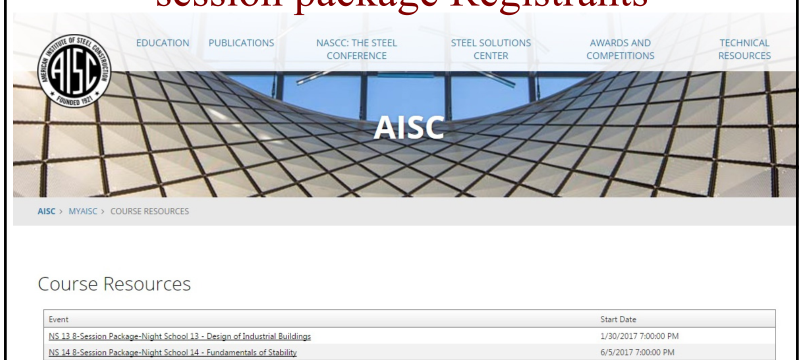

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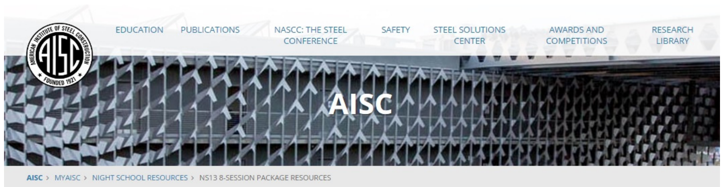

Night School 13: Design of Industrial Buildings

8-SESSION PACKAGE RESOURCES

Event	Date	Handouts	Video	Quiz	Attendance
NS13 - Design Criteria	1/30/2017 7:00:00 PM	Handouts	View Passcode: NS13DSN	Pass Score: 80	Pending
NS13 - Economic Considerations	2/6/2017 7:00:00 PM	Handouts	Available 02/08/2017 5pm EST	Available 02/08/2017 5pm EST	Pending
NS13 - Lateral Load Systems and Details	2/13/2017 7:00:00 PM	Handouts	Available 02/15/2017 5pm EST	Available 02/15/2017 5pm EST	Pending
NS13 - Preliminary Design Procedures	2/27/2017 7:00:00 PM	Handouts	Available 03/01/2017 5pm EST	Available 03/01/2017 5pm EST	Pending
NS13 - Crane Girder Design and Frame Analysis	3/6/2017 7:00:00 PM	Handouts	Available 03/08/2017 5pm EST	Available 03/08/2017 5pm EST	Pending
NS13 - Frame Member and Connection Design	3/13/2017 7:00:00 PM	Handouts	Available 03/15/2017 5pm EST	Available 03/15/2017 5pm EST	Pending
NS13 - Transfer Crane Girder & Longitudinal Bldg Bracing Dsn	3/27/2017 7:00:00 PM	Handouts	Available 03/29/2017 5pm EST	Available 03/29/2017 5pm EST	Pending
NS13 - Building Envelope and Bracing Design	4/3/2017 7:00:00 PM	Handouts	Available 04/05/2017 5pm EST	Available 04/05/2017 5pm EST	Pending
NS13 - Final Exam	4/10/2017 7:00:00 PM			Available 04/12/2017 5pm EST	

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- Weekly “quiz and recording” email.
- Weekly updates of the master Quiz and Attendance record found at www.aisc.org/nightschool. Scroll down to Quiz and Attendance records.
  - Updated on Wednesday mornings.

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  - Found in your registration confirmation/receipt.
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- Link to handouts also found here.

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Thank You

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Survey at conclusion of webinar.

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