Night School 27: Fundamentals of Welding and Bolting

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Session 2 – Principles of Welded Connections
October 4, 2021 | Curtis Decker

Smarter. Stronger. Steel.

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Course Description

NS27.2 – Welding Part 2
Principles of Welded Connections
October 4, 2021

Following the right principles can lead to better welded connections and better projects. In this session, 14 principles of welded connection design will be presented. The principles are discussed and then illustrated with examples of connections that comply and do not comply with the concepts.

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Learning Objectives

- Identify welded connection details that allow force to enter into the section that lies parallel.
- Identify when additional members are needed in a welded connection due to force changing direction.
- Identify situations where welds undergo bending.
- Identify preferred weld details to avoid material failures such as lamellar tearing.

Night School 27: Fundamentals of Welding and Bolting

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Chad Larson, LeJeune Bolt Company

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Night School 27: Fundamentals of Welding and Bolting

Welding Part 2: Principles of Welded Connections
October 4, 2021

Curtis L. Decker, PhD, PE, SE, The Lincoln Electric Company

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PRINCIPLES OF WELDED CONNECTIONS

14 Principles of Welded Connection Design

What makes a welded connection correct or proper?

PRINCIPLES OF WELDED CONNECTIONS

A correct and proper welded connection

1

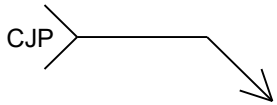
is strong enough to transfer all the applied loads through the connection.

Correct and proper = strong enough

(but not stronger than necessary)

10

PRINCIPLES OF WELDED CONNECTIONS



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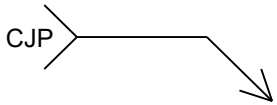
Official Definition:

A groove weld in which weld metal extends through the joint thickness.

11

PRINCIPLES OF WELDED CONNECTIONS



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Unofficial Definitions:

- A weld specified J.I.C. (just in case)
- A weld specified when loads are unknown.
- A weld specified for really important connections.
- A weld specified when NDT is desired.
- A weld specified when no one wants to calculate weld size.

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PRINCIPLES OF WELDED CONNECTIONS

A correct and proper welded connection

is strong enough to transfer all the applied loads through the connection.

1

13

PRINCIPLES OF WELDED CONNECTIONS

A correct and proper welded connection

has a clear and direct load path.

2

"Provide a path so a transverse force can enter that part of the member (section) that lies parallel to the force."

Omer W. Blodgett

14

PRINCIPLES OF WELDED CONNECTIONS

A correct and proper welded connection

has a clear and direct load path.

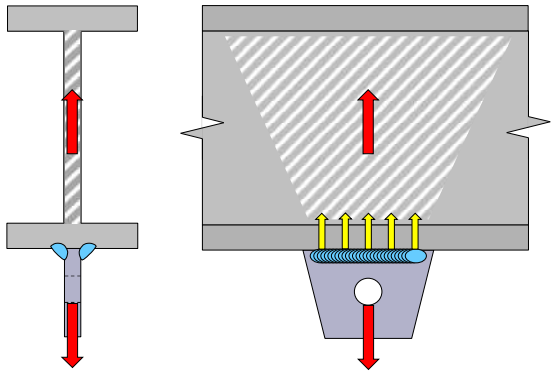
2

"The force goes to the stiff part."

William "Bill" A. Milek

15

PRINCIPLES OF WELDED CONNECTIONS



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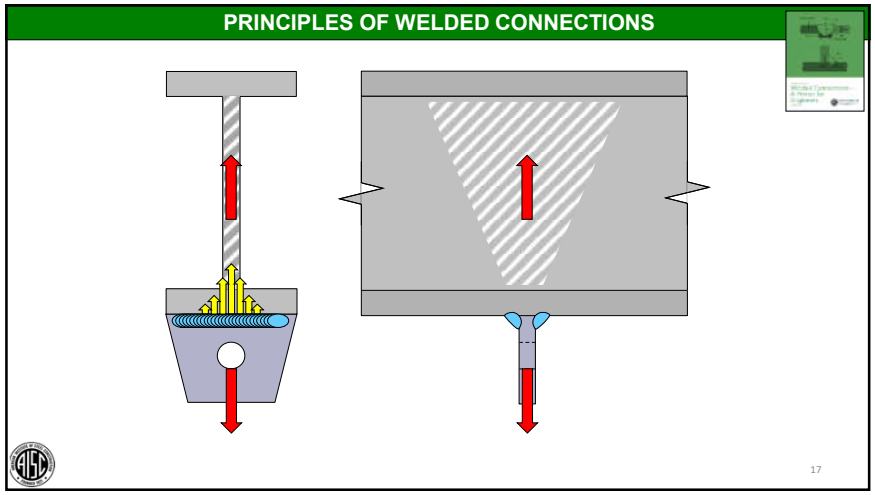

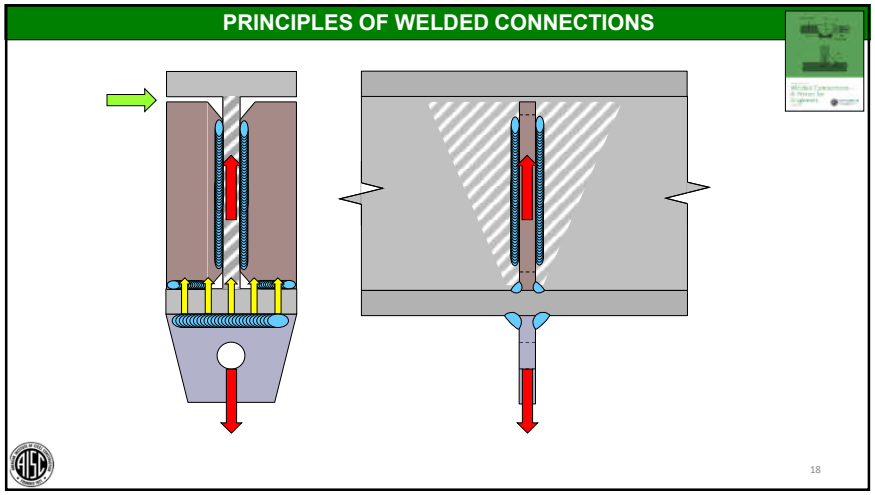

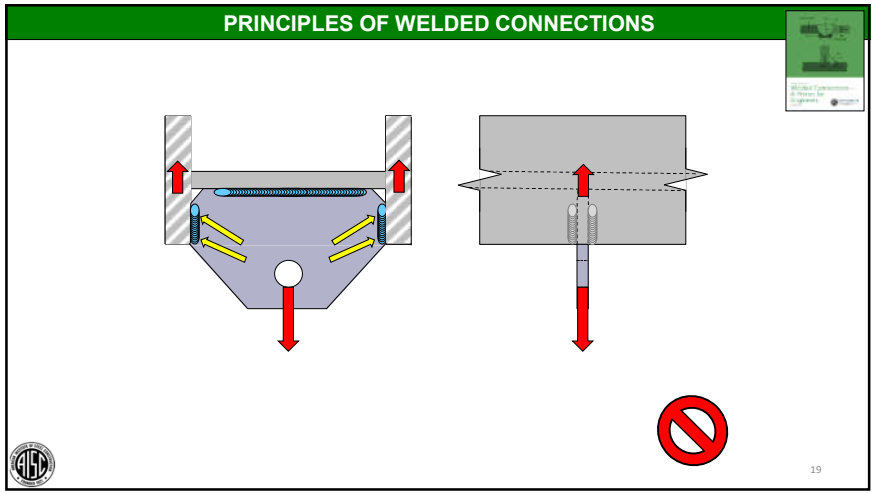

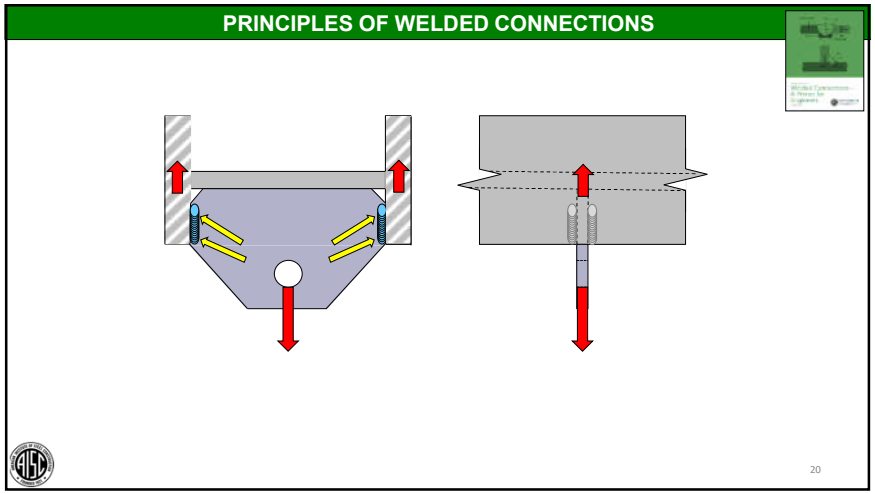

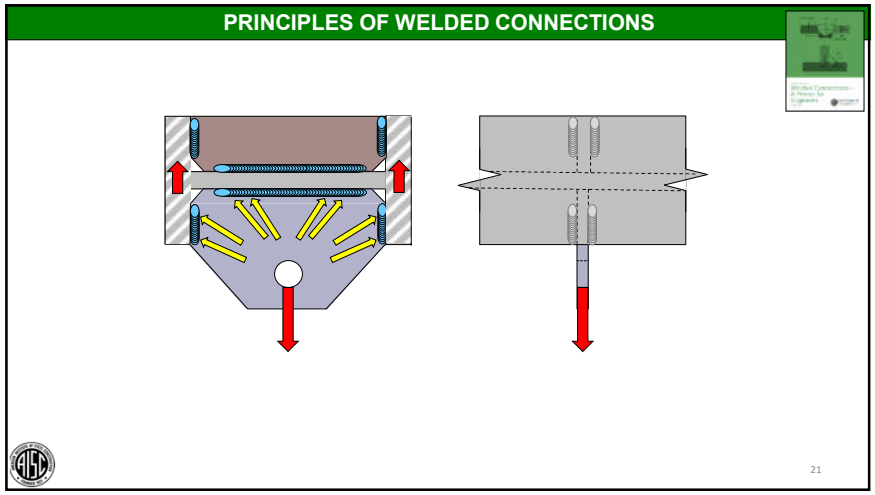

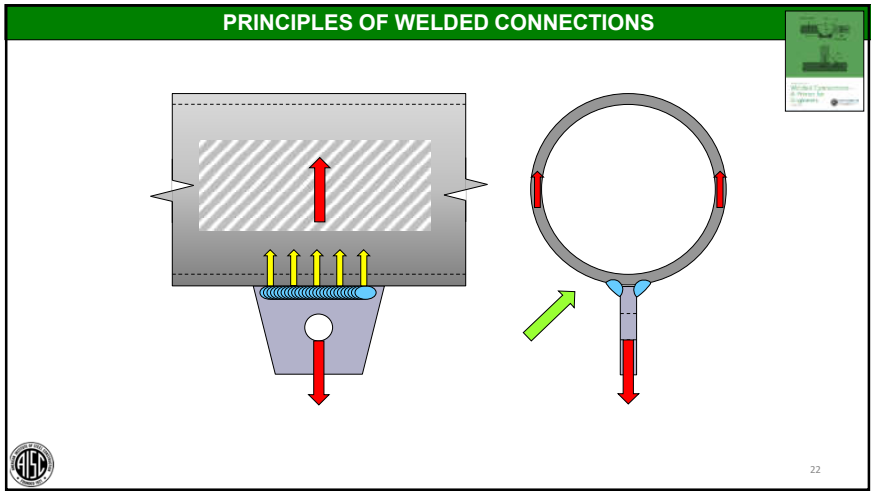

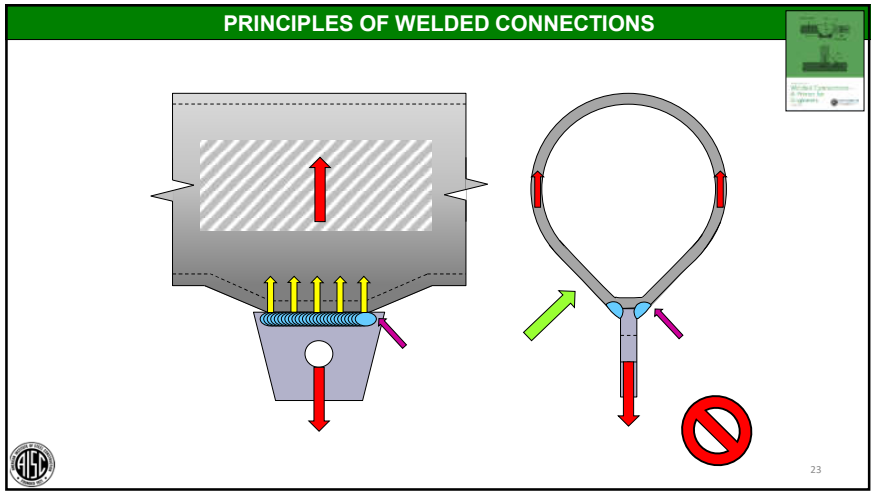

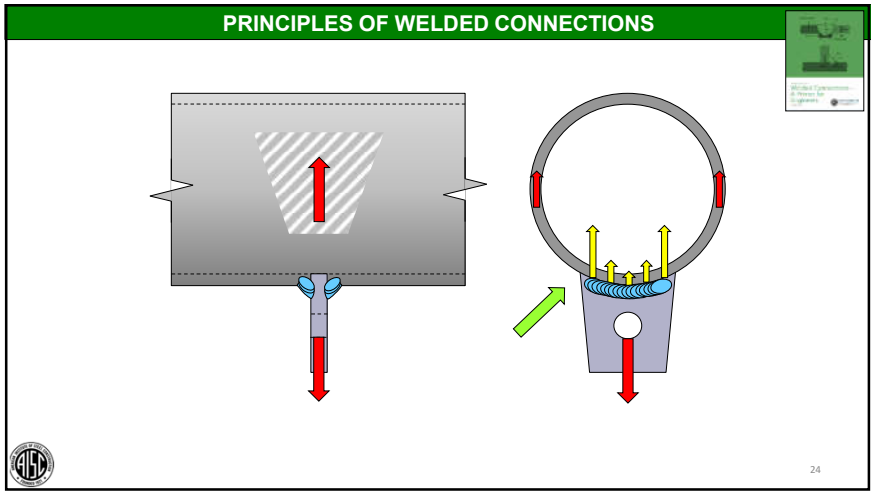

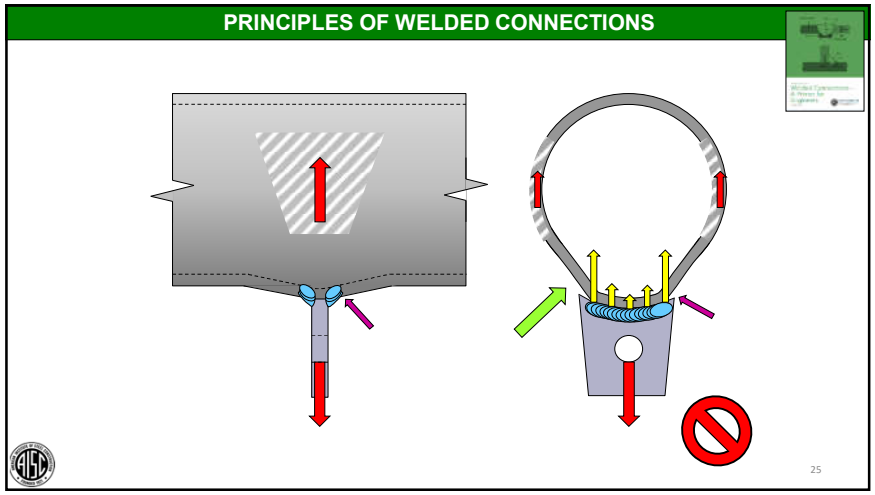

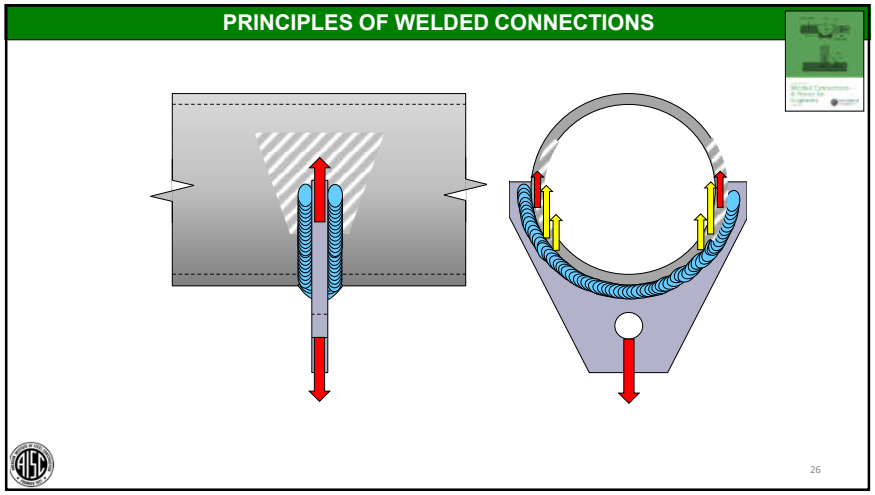

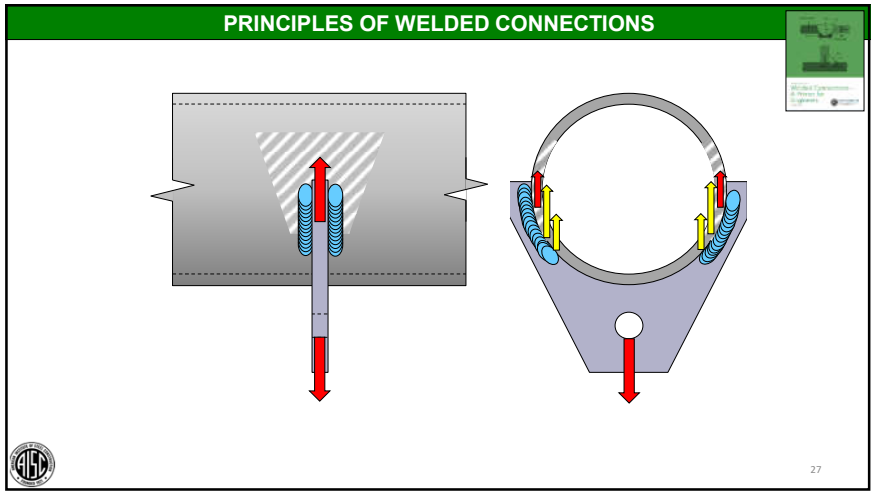

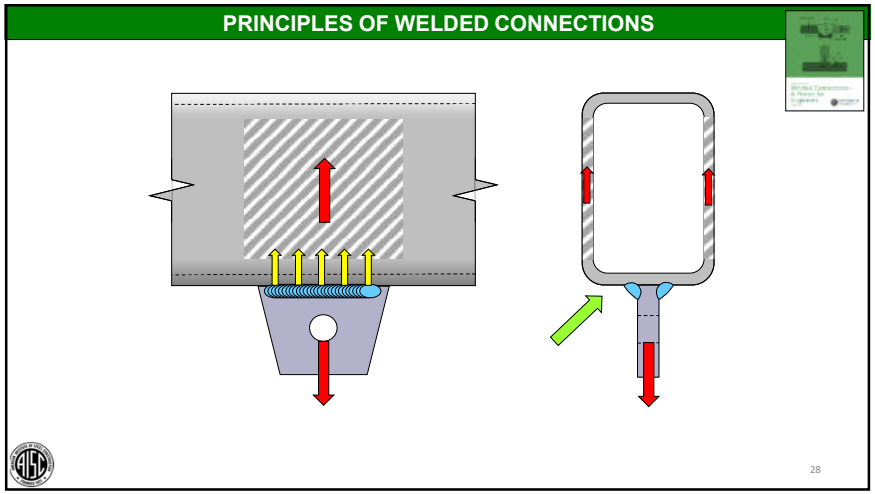

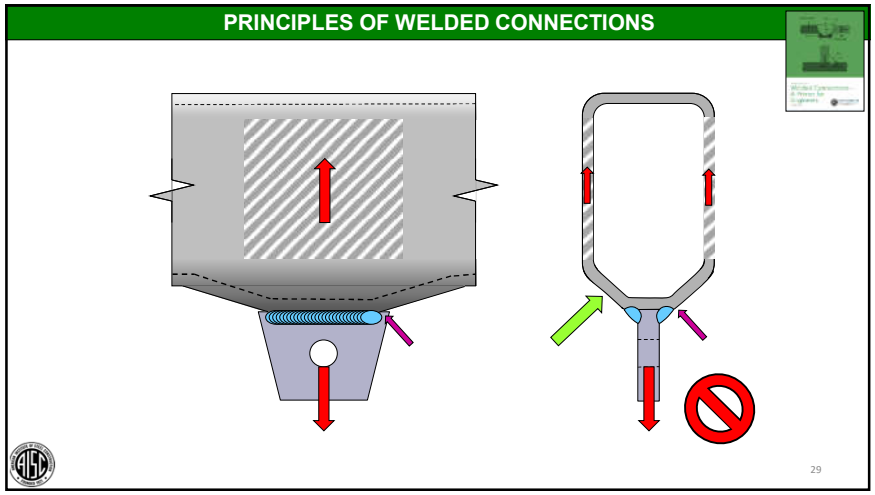

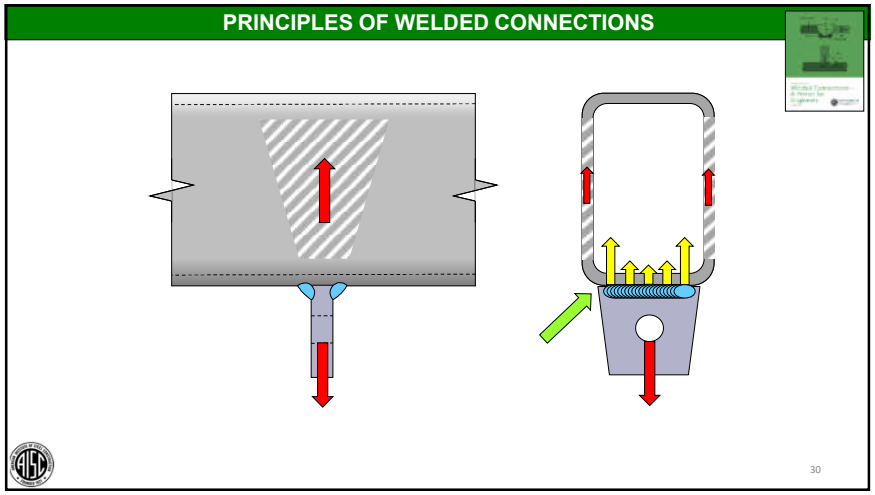

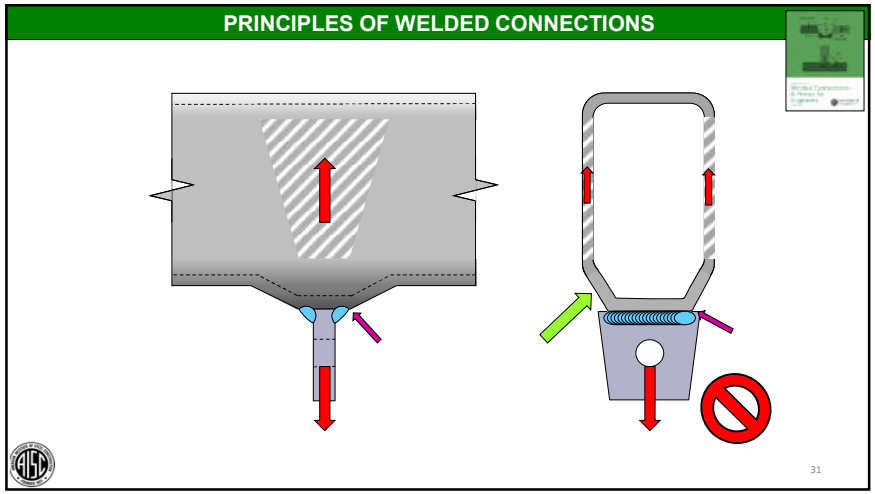

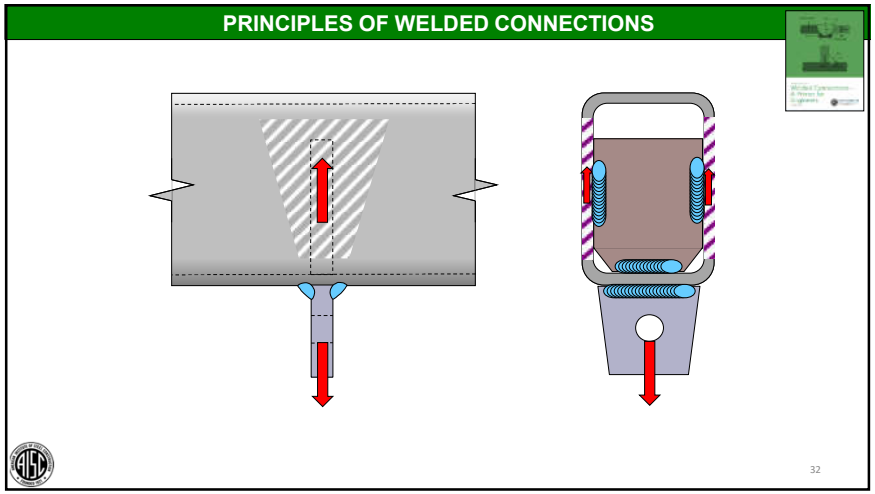

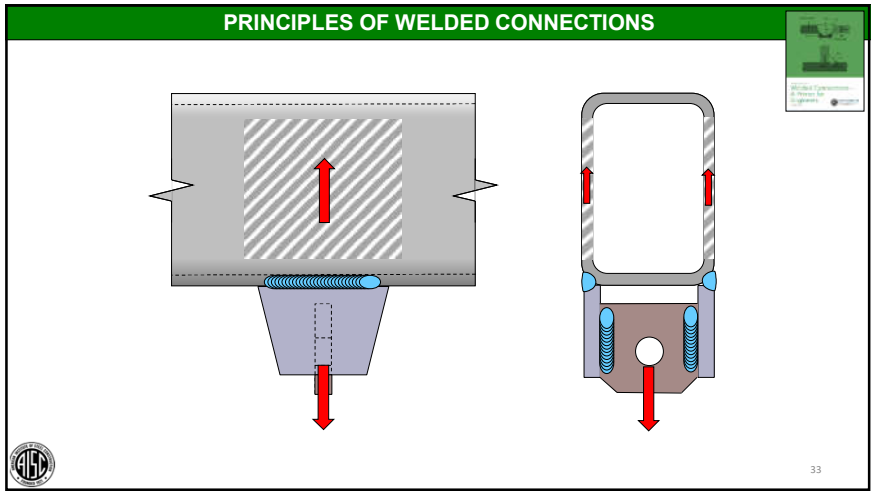

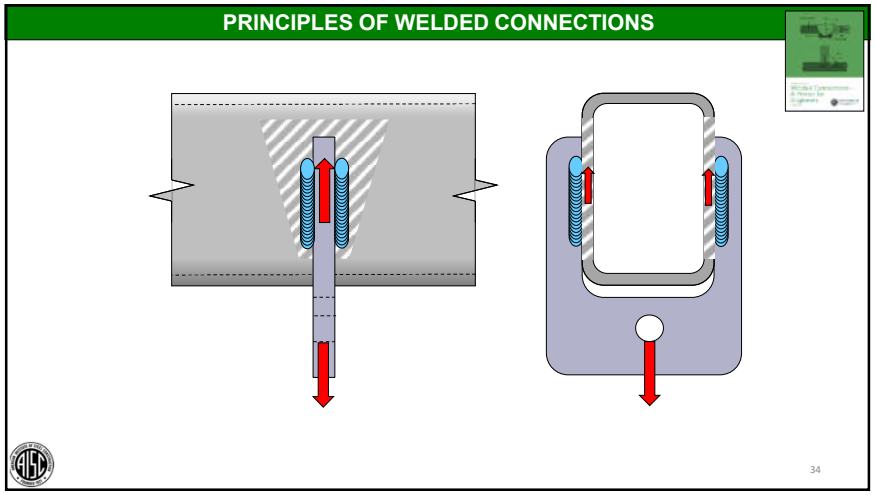

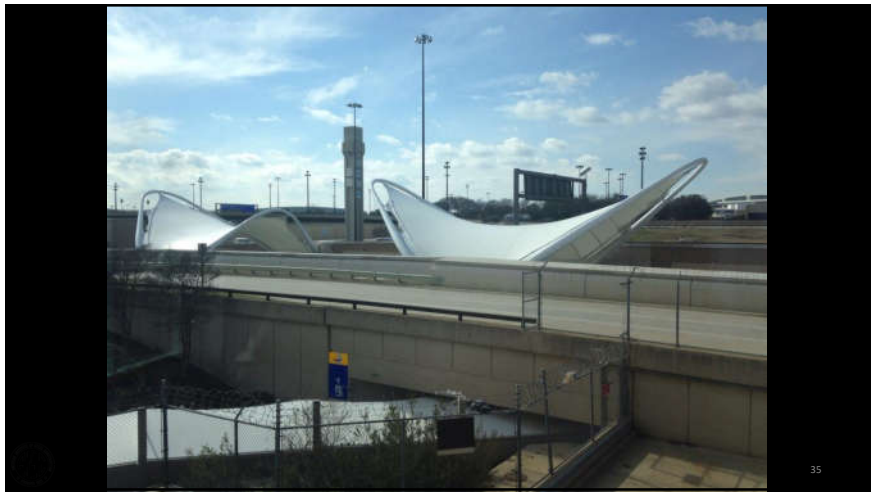

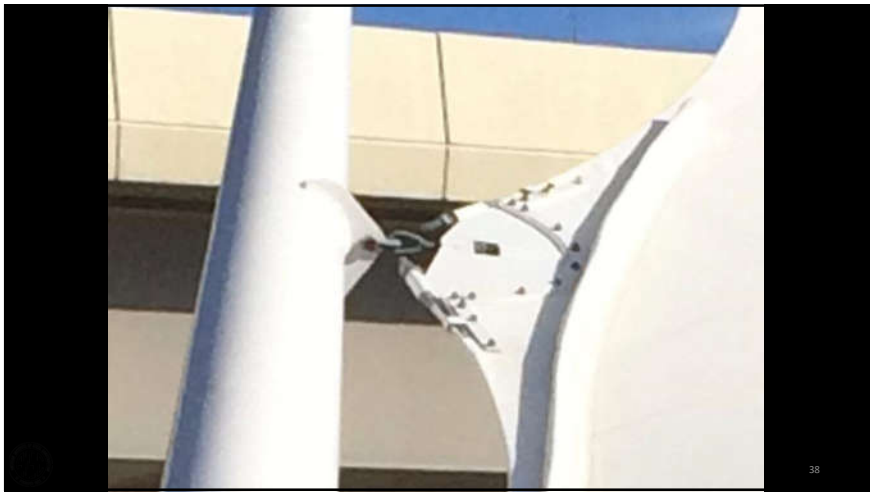

PRINCIPLES OF WELDED CONNECTIONS

A correct and proper welded connection
has a clear and direct load path. 2

Note regarding HSS: the examples cited are to illustrate the load path concept. HSS connections can be successfully made in accordance with AISC 360 Chapter K through the use of design principles that consider the unique challenges of HSS.

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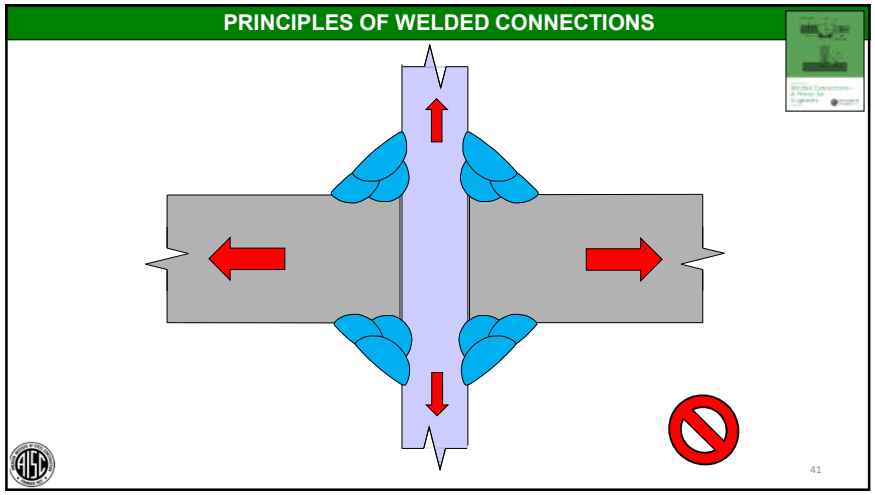
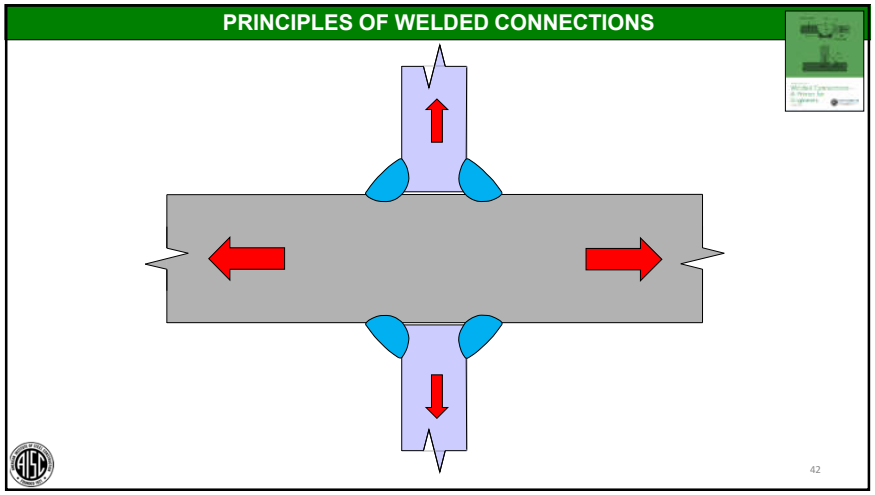
PRINCIPLES OF WELDED CONNECTIONS

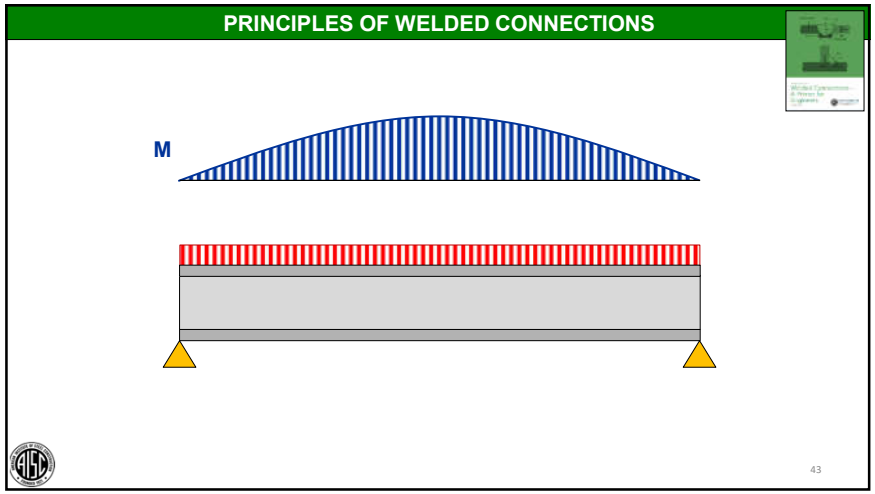
A correct and proper welded connection
places welds in regions of low stress. 3

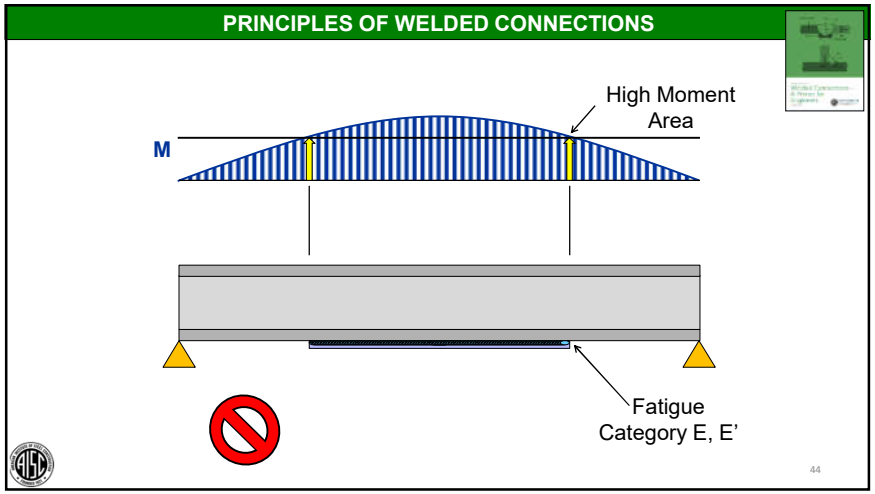
Corollary:
When possible, pass major loads through steel, not through welds

40

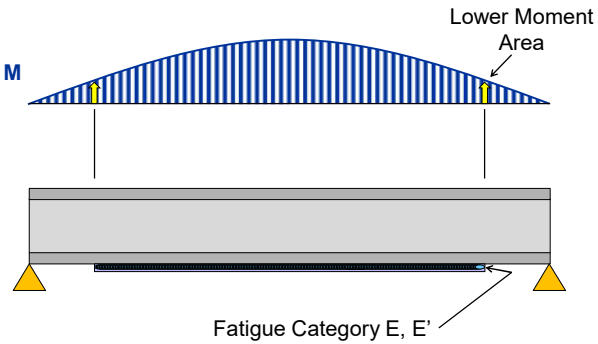








PRINCIPLES OF WELDED CONNECTIONS



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PRINCIPLES OF WELDED CONNECTIONS

A correct and proper welded connection places welds in regions of low stress. 3

46

PRINCIPLES OF WELDED CONNECTIONS

A correct and proper welded connection does not introduce stress raisers. 4

REMINDER:
Stress raisers are only stress raiser if there is a tensile stress component perpendicular to the stress raiser.

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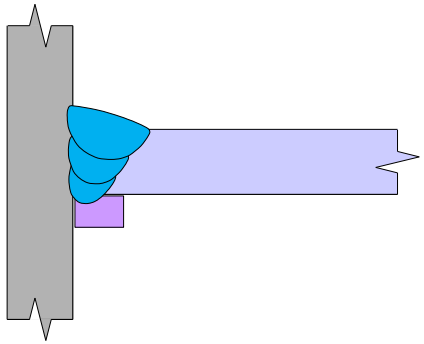
PRINCIPLES OF WELDED CONNECTIONS



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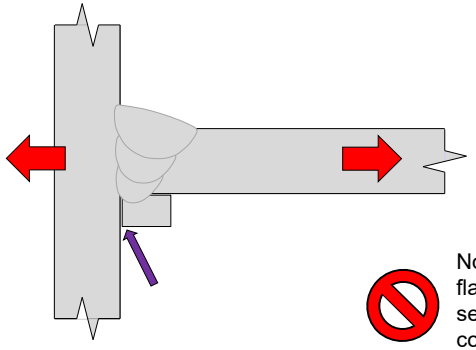
PRINCIPLES OF WELDED CONNECTIONS



Not for bottom flange of high seismic moment connections

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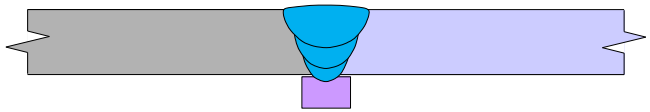
PRINCIPLES OF WELDED CONNECTIONS



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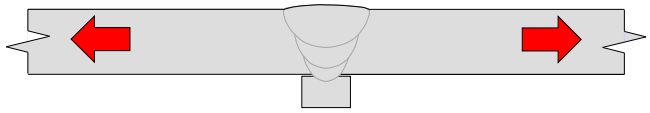
PRINCIPLES OF WELDED CONNECTIONS



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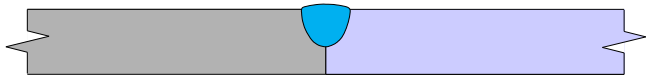
PRINCIPLES OF WELDED CONNECTIONS



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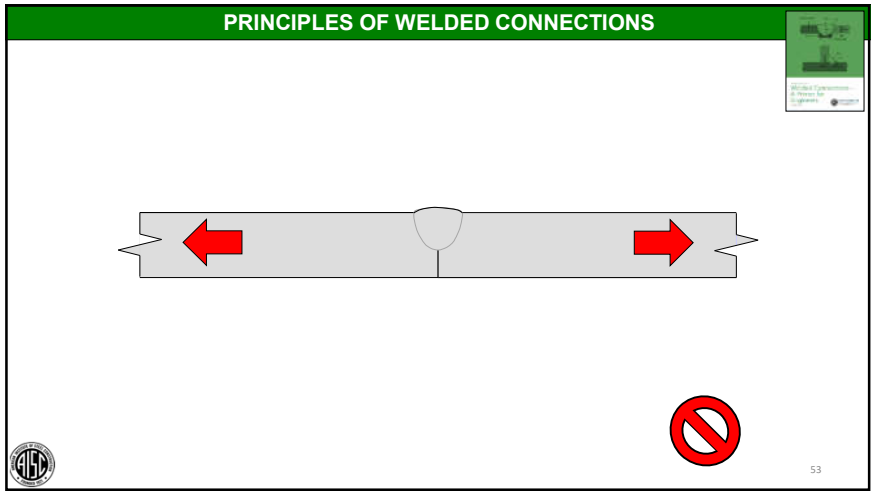
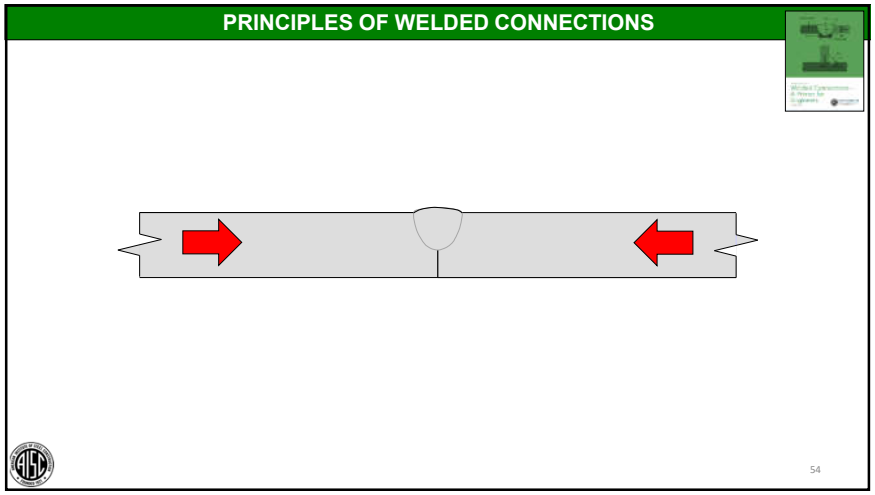
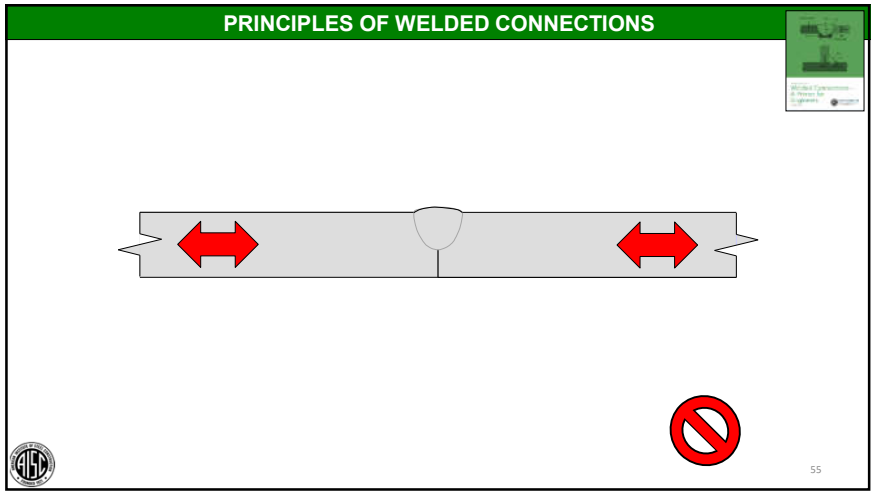
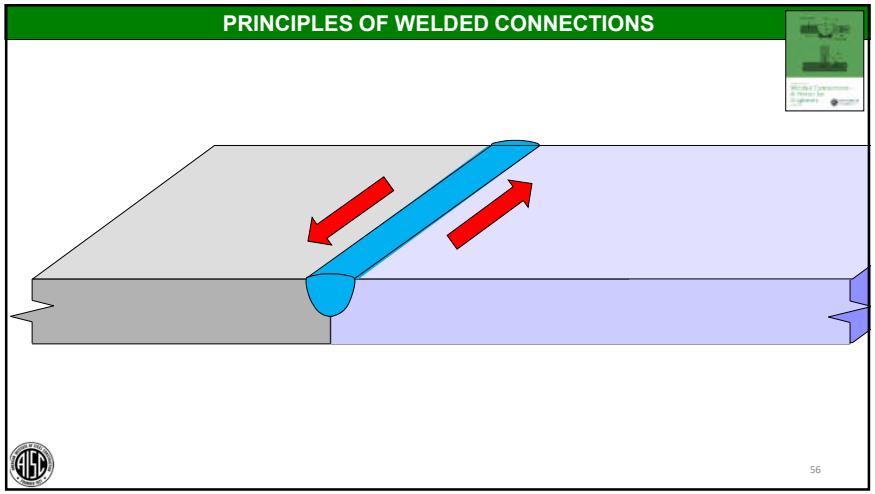
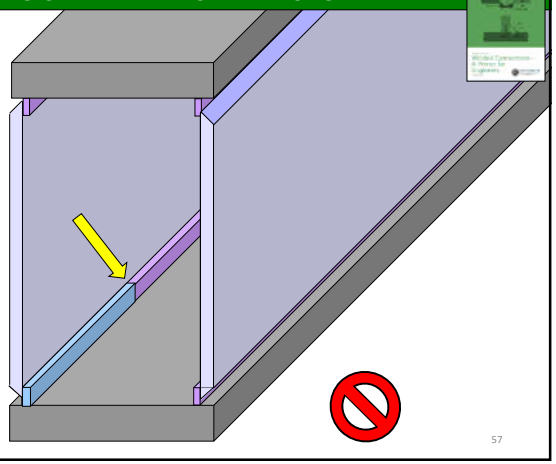








PRINCIPLES OF WELDED CONNECTIONS



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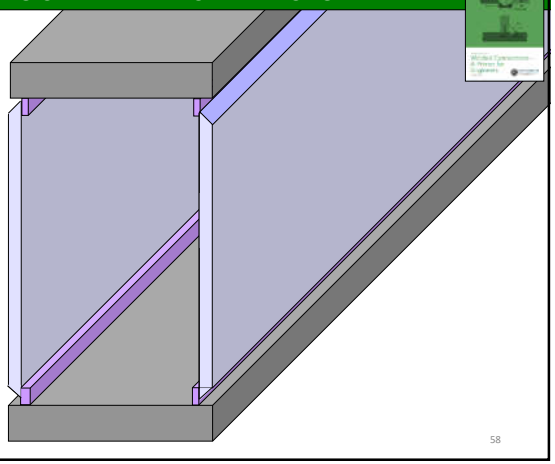
PRINCIPLES OF WELDED CONNECTIONS



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AWS D1.1: 2020 Structural Welding Code – Steel

7.9.1.2 Full-Length Backing.

Except as permitted below, steel backing shall be made continuous for the full length of the weld. All joints in the steel backing shall be CJP groove weld joints meeting all the requirements of Clause 7 of this code.

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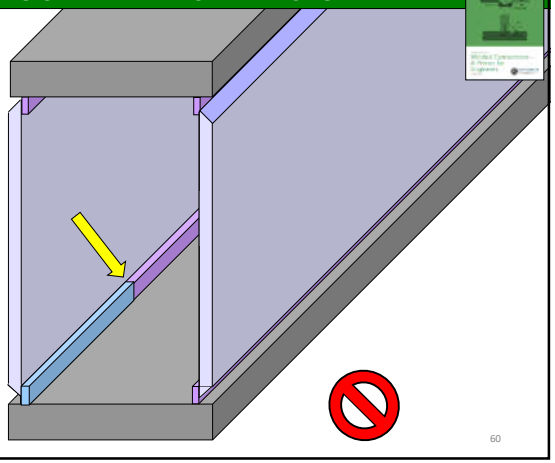
PRINCIPLES OF WELDED CONNECTIONS



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AWS D1.1: 2020 Structural Welding Code – Steel

7.9.1.2 Full-Length Backing.

Except as permitted below, steel backing shall be made continuous for the full length of the weld. All joints in the steel backing shall be CJP groove weld joints meeting all the requirements of Clause 5 of this code.

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AWS D1.1: 2020 Structural Welding Code – Steel

7.9.1.2 Full-Length Backing.

For statically loaded applications, backing for welds to the ends of closed sections, such as hollow structural sections (HSS), are permitted to be made from one or two pieces with unspliced discontinuities where all of the following conditions are met:

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PRINCIPLES OF WELDED CONNECTIONS

A correct and proper welded connection does not introduce stress raisers.

4

63

PRINCIPLES OF WELDED CONNECTIONS

A correct and proper welded connection is not constrained.

5

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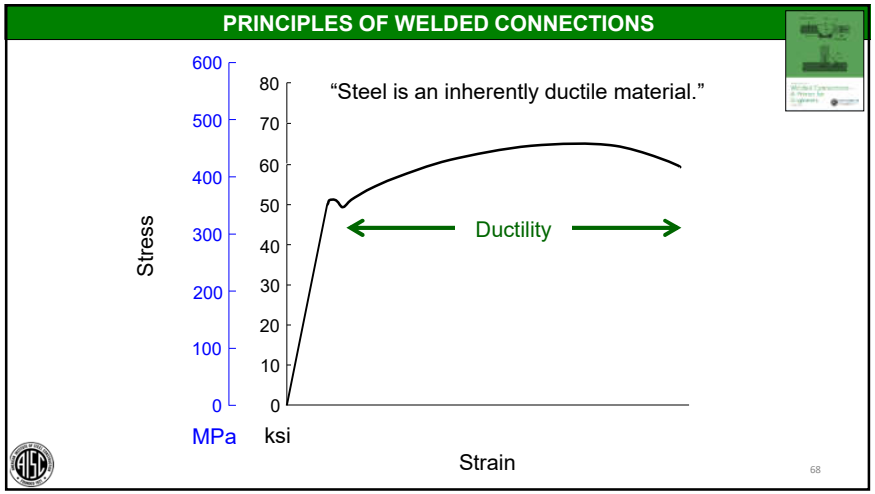
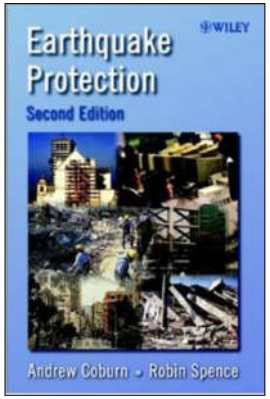


Earthquake Protection

Andrew Coburn
Robin Spence

2002



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EARTHQUAKE PROTECTION

dictated by questions of availability and cost. The essential material requirements for earthquake-resistant structures are strength and ductility, and these properties are closely interrelated. *Ductility* refers to the ability of a material to deform after its maximum strength has been reached, without losing its ability to carry load. Structures made from materials which have this property can survive short-term accidental overloads because, rather than breaking, they can deform during the overload and absorb a large amount of energy without losing strength, instead of simply breaking. Steel is an inherently ductile material, and is thus very suitable for building in earthquake areas.[16] California and Japan make extensive use of steel in large buildings of all types. Concrete and all types of masonry, without reinforcement, are brittle materials, but by means of embedment of steel

[14] There are a wide variety of techniques which have been discussed by Key (1988) and Hansen and Soong (2001).
[15] Soong and Spencer (2000).
[16] Although welded joints can be a source of weakness and have resulted in some failures in recent earthquakes.

Steel is an inherently ductile material, and is thus very suitable for building in earthquake areas.(16)

[16]Although welded joints can be a source of weakness and have resulted in some failures in recent earthquakes.

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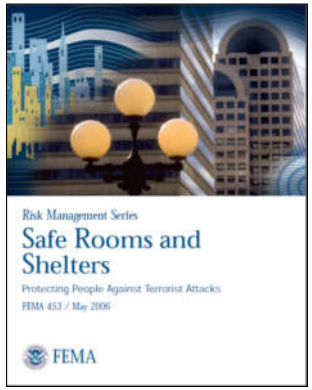
Safe Rooms and Shelters

Protecting People Against Terrorist Attacks

FEMA 453
May 2006



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SAFE ROOMS AND SHELTERS

Steelwork is generally better suited to resist relatively low intensity, but long duration effects of large stand-off explosions. Steel is an inherently ductile material that is capable of sustaining large deformations; however, the very efficient thin-flanged sections make the conventional frame construction vulnerable to localized damage. Complex stress combinations and concentrations may occur that cause localized distress and prevent the section from developing its ultimate strength. Steel buildings may experience significant rebound and must therefore be designed to support

Steel in an inherently ductile material that is capable of sustaining large deformations; however, the every efficient thin-flanged sections make the conventional frame construction vulnerable to localized damage.

detailed to tie into the concrete slabs.

72

Ductile Design of Steel Structures

Preface

"Many practicing engineers have wrongly believed for years that the ductile nature of the structural steel material directly translates into inherently ductile structures."

73

Ductile Design of Steel Structures

Chapter 1 Introduction

"However, there are many situations in which an explicit approach to the design of ductile steel structures is necessary because the inherent material ductility alone is not sufficient to provide the desired ultimate performance."

74

Ductile Design of Steel Structures

Chapter 1 Introduction

"To achieve this ductile response, one must recognize and avoid conditions that may lead to brittle failures and adopt appropriate design strategies to allow for stable and reliable hysteretic energy-dissipation mechanisms. This sort of thinking is relatively new in structural engineering."

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Fatigue and Fracture Control in Structures

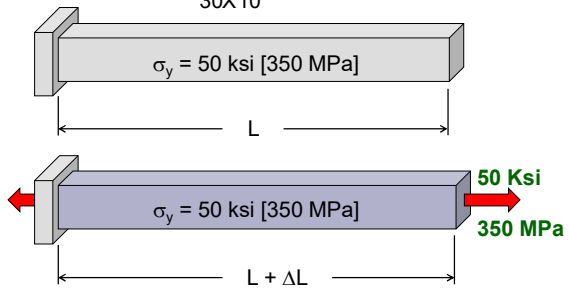
Most structural materials exhibit considerable strain (deformation) before reaching the tensile or ultimate strength….However, under conditions of low temperature, rapid loading and/or high constraint (e.g., when the principle stresses σ_1, σ_2, and σ_3 are essentially equal), even ductile materials may not exhibit any deformation before fracture.

76

PRINCIPLES OF WELDED CONNECTIONS

$$\Delta L = \frac{PL}{AE} = \frac{\sigma L}{E}$$

$$= \frac{50 \sim 10^{3}}{30X10^{3}} = 0.017 \text{ in } [1.7\%]$$



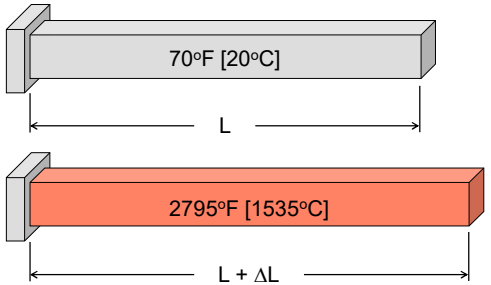
77

PRINCIPLES OF WELDED CONNECTIONS

$$\Delta L = L\,(\Delta t)(C_{exp})$$

$$= 10\,(2795 - 70)(6.6 \times 10^{-6})$$

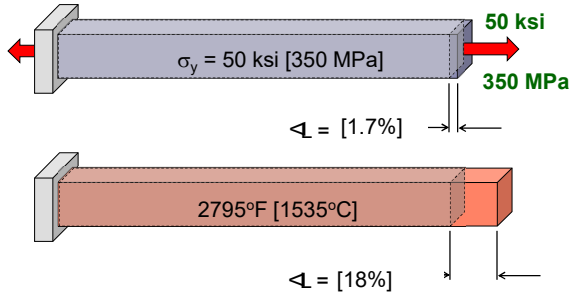
$$= 0.18 \text{ in } [18\ \%]$$



78

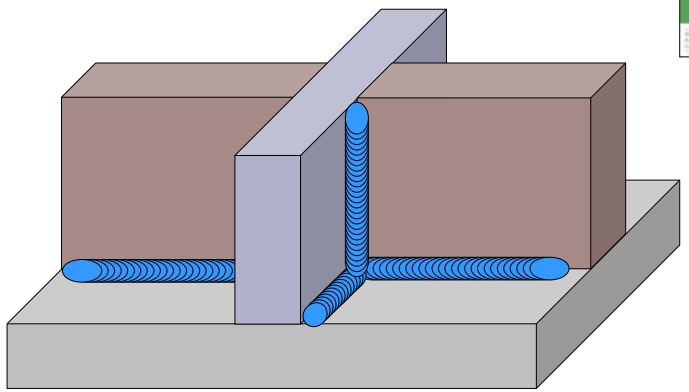
PRINCIPLES OF WELDED CONNECTIONS

Thermal expansion is approximately 10X yield elongation.



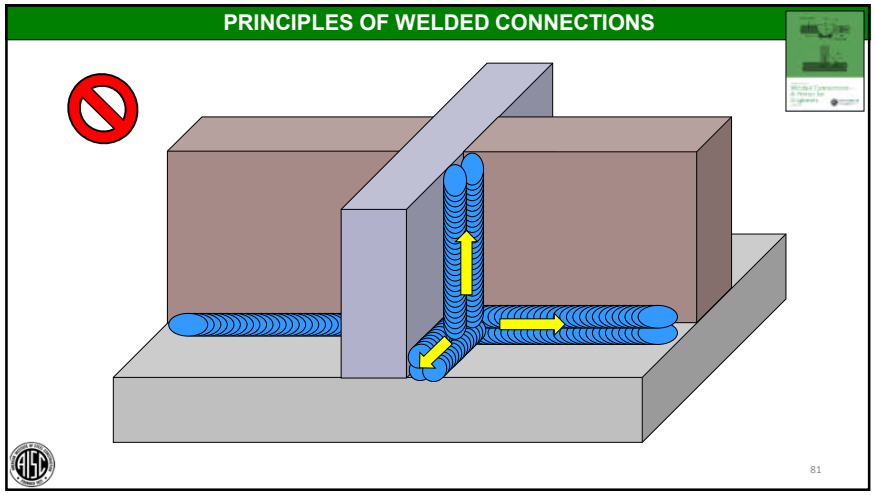
79

PRINCIPLES OF WELDED CONNECTIONS



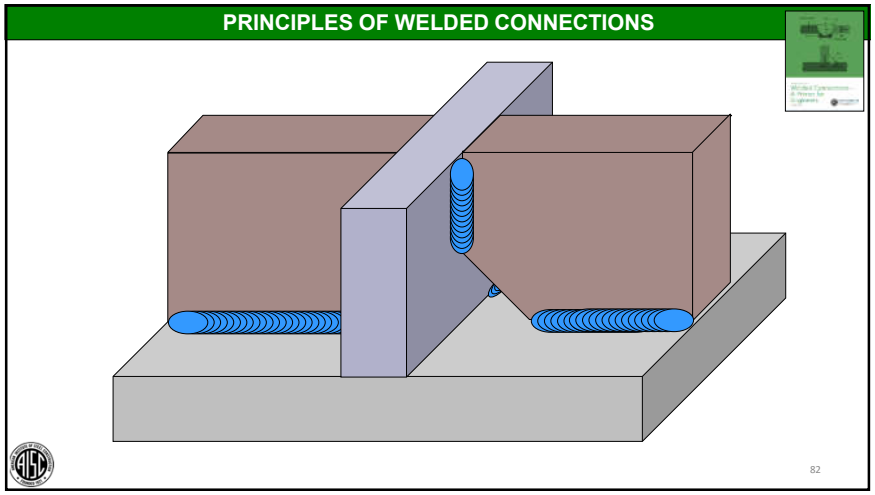
80

PRINCIPLES OF WELDED CONNECTIONS



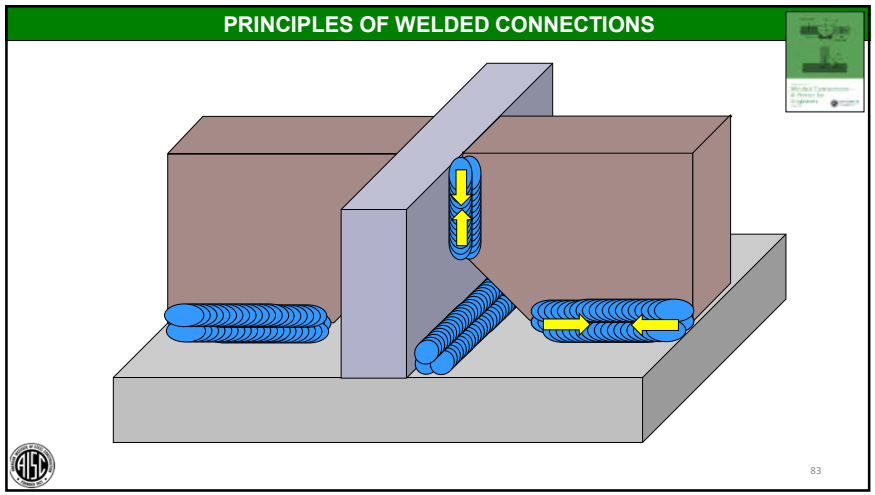
81

PRINCIPLES OF WELDED CONNECTIONS



82

PRINCIPLES OF WELDED CONNECTIONS



83

PRINCIPLES OF WELDED CONNECTIONS

A correct and proper welded connection is not constrained.

5

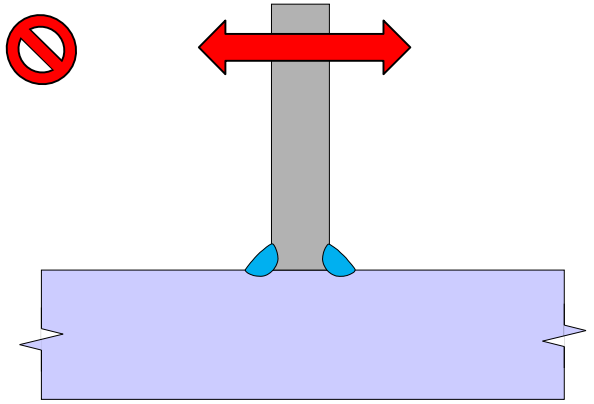
84

PRINCIPLES OF WELDED CONNECTIONS

A correct and proper welded connection
does not subject the weld to bending about the root. 6

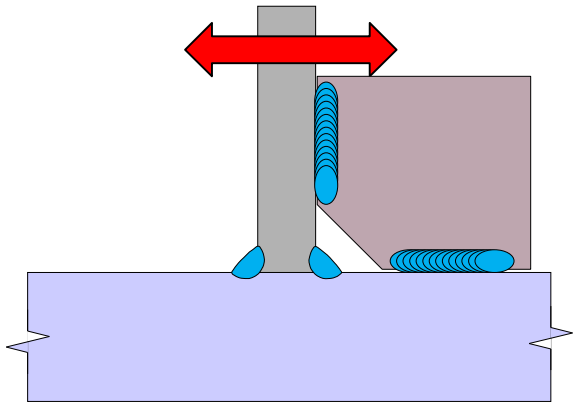
85

PRINCIPLES OF WELDED CONNECTIONS



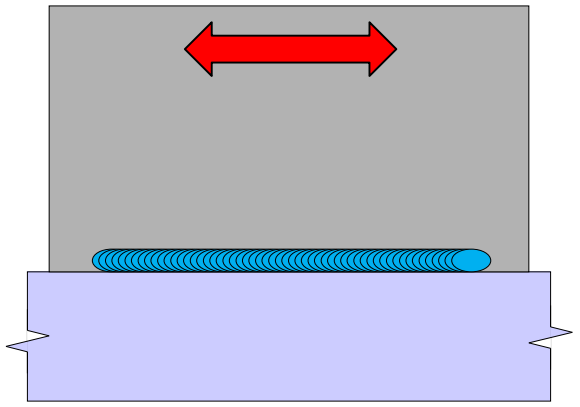
86

PRINCIPLES OF WELDED CONNECTIONS



87

PRINCIPLES OF WELDED CONNECTIONS



88

PRINCIPLES OF WELDED CONNECTIONS

A correct and proper welded connection
does not subject the weld to bending about the root. 6

89

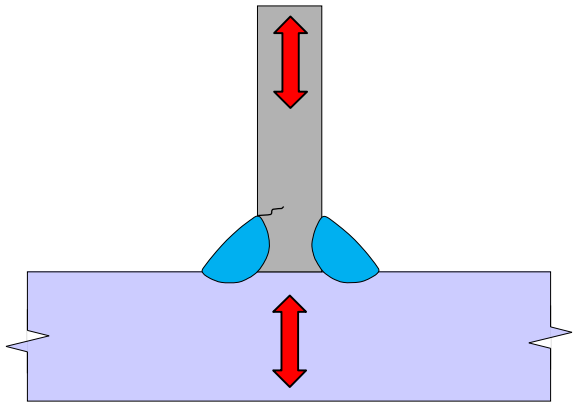
PRINCIPLES OF WELDED CONNECTIONS

A correct and proper welded connection
protects the toes and roots of the welds. 7

"Watch your toes
and
remember your roots."

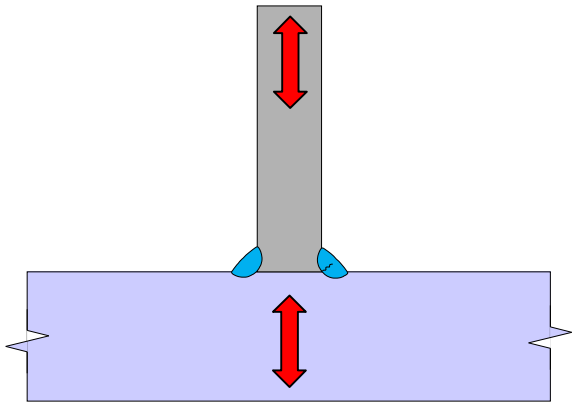
90

PRINCIPLES OF WELDED CONNECTIONS



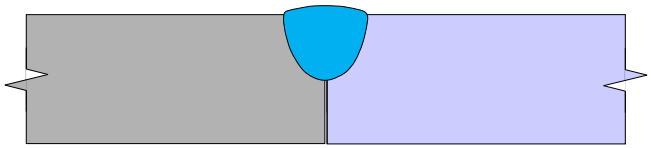
91

PRINCIPLES OF WELDED CONNECTIONS



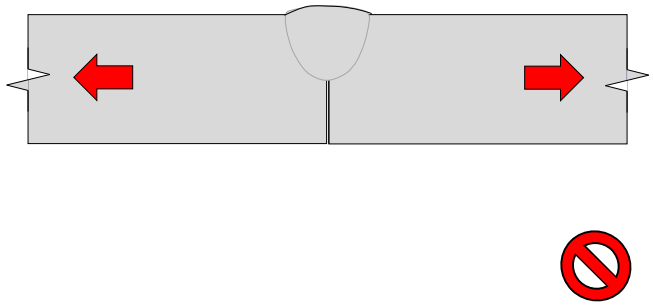
92

PRINCIPLES OF WELDED CONNECTIONS



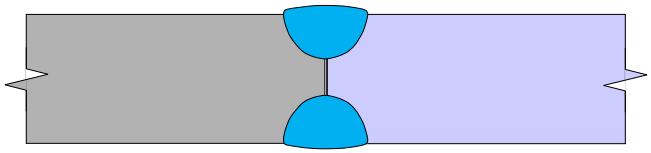
93

PRINCIPLES OF WELDED CONNECTIONS



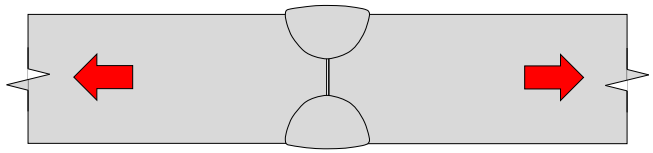
94

PRINCIPLES OF WELDED CONNECTIONS



95

PRINCIPLES OF WELDED CONNECTIONS



96

PRINCIPLES OF WELDED CONNECTIONS

A correct and proper welded connection
protects the toes and roots of the welds.

7

97

PRINCIPLES OF WELDED CONNECTIONS

A correct and proper welded connection
has a clearly defined throat.

8

"A nothin' weld ain't worth nothin' "

98

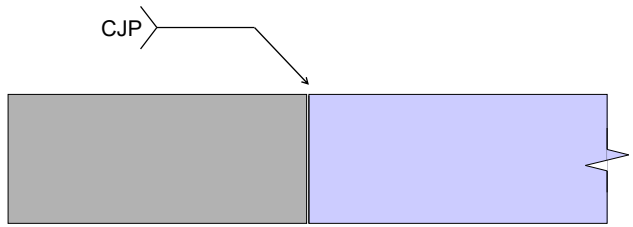
PRINCIPLES OF WELDED CONNECTIONS

nothin' weld:

A weld that looks like what you wanted, but it ain't.

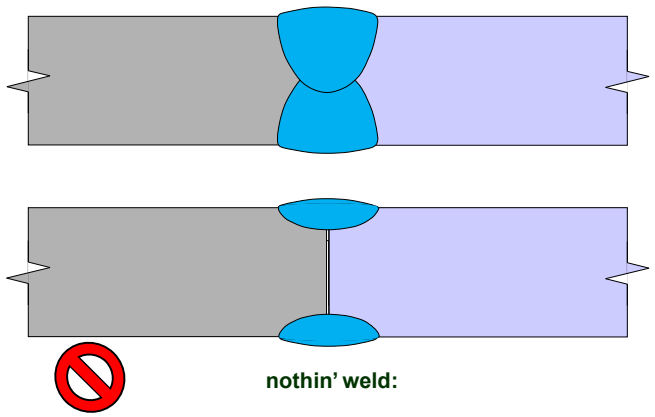
99

PRINCIPLES OF WELDED CONNECTIONS



100

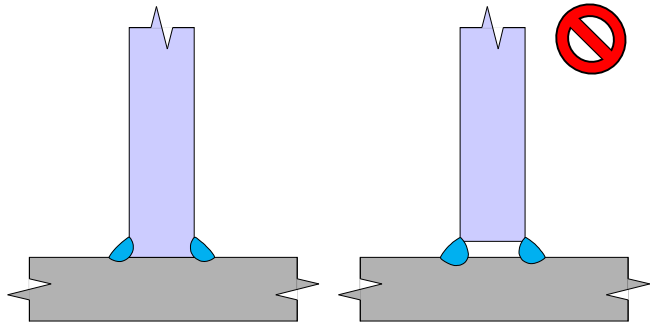
PRINCIPLES OF WELDED CONNECTIONS



nothin' weld:

101

PRINCIPLES OF WELDED CONNECTIONS



nothin' weld:

102

PRINCIPLES OF WELDED CONNECTIONS

A correct and proper welded connection
has a clearly defined throat.

8

103

PRINCIPLES OF WELDED CONNECTIONS

A correct and proper welded connection
recognizes material properties.

9

"Respect material properties."

104

PRINCIPLES OF WELDED CONNECTIONS

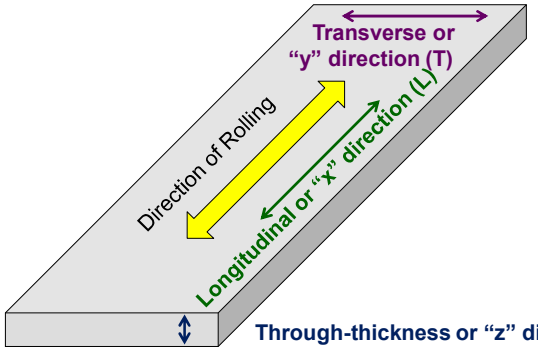
SAC Steel Project

Report No. SAC/BD-97/01 Barsom and Korvink

Through-Thickness Properties of Structural Steels

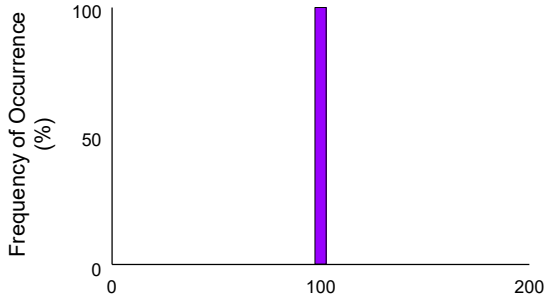
105

PRINCIPLES OF WELDED CONNECTIONS



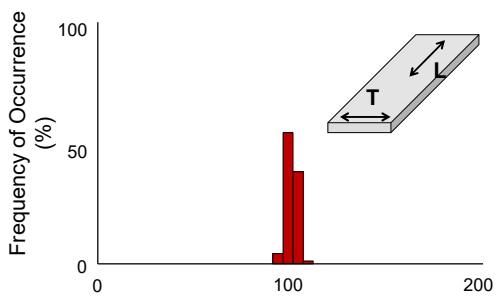
106

PRINCIPLES OF WELDED CONNECTIONS



107

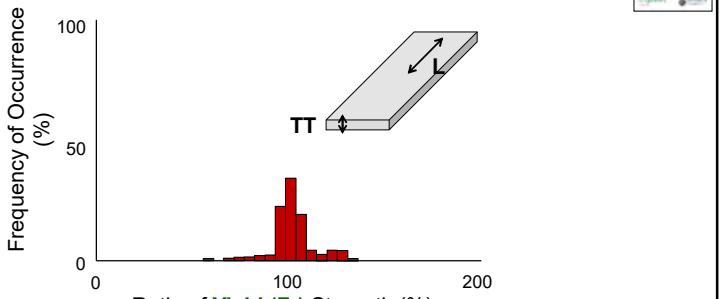
PRINCIPLES OF WELDED CONNECTIONS



Adapted from Barsom and Korvink, *Through-Thickness Properties of Structural Steels*

108

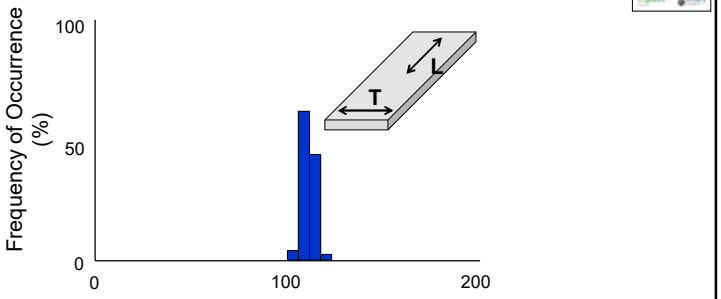
PRINCIPLES OF WELDED CONNECTIONS



Adapted from Barsom and Korvink, *Through-Thickness Properties of Structural Steels*

109

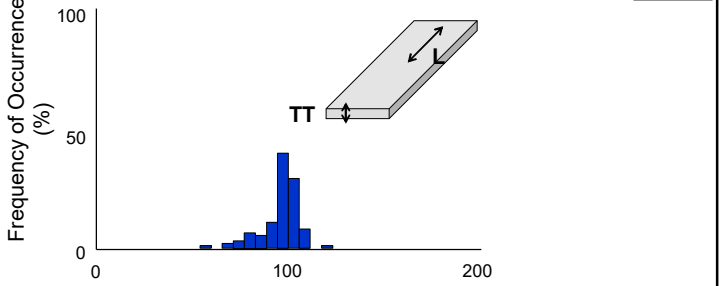
PRINCIPLES OF WELDED CONNECTIONS



Adapted from Barsom and Korvink, *Through-Thickness Properties of Structural Steels*

110

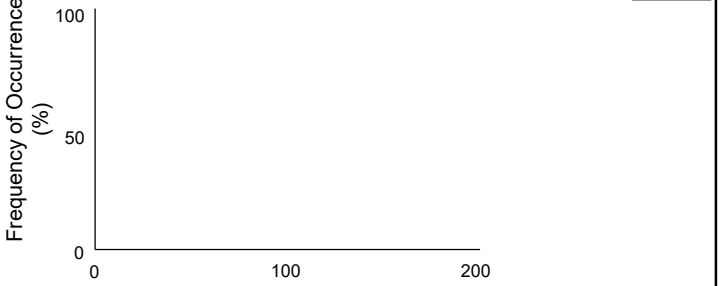
PRINCIPLES OF WELDED CONNECTIONS



Adapted from Barsom and Korvink, *Through-Thickness Properties of Structural Steels*

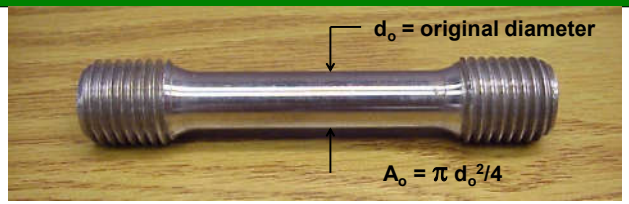
111

PRINCIPLES OF WELDED CONNECTIONS

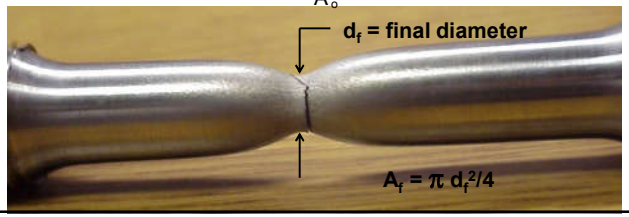


112

PRINCIPLES OF WELDED CONNECTIONS

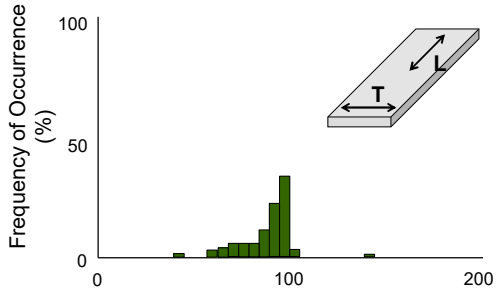


$$R.A. = \frac{A_o - A_f}{A_o} \times 100$$



113

PRINCIPLES OF WELDED CONNECTIONS

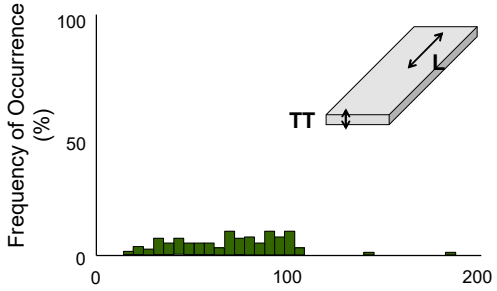


Ratio of **Reduction in Area (R.A.)** (%):
Transverse to Longitudinal (T/L)

Adapted from Barsom and Korvink, *Through-Thickness Properties of Structural Steels*

114

PRINCIPLES OF WELDED CONNECTIONS



Ratio of **Reduction in Area (R.A.)** (%):
Through-Thickness to Longitudinal (TT/L)

Adapted from Barsom and Korvink, *Through-Thickness Properties of Structural Steels*

115

PRINCIPLES OF WELDED CONNECTIONS

SAC Steel Project

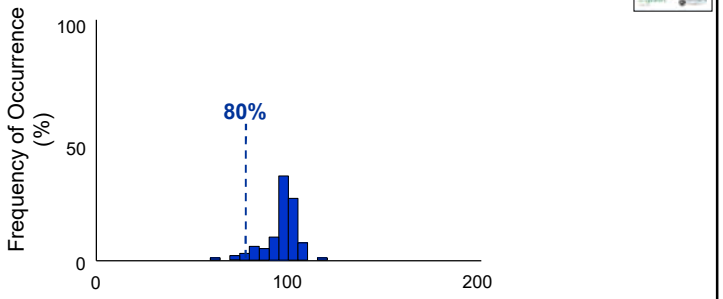
Report No. SAC/BD-97/01 Barsom and Korvink

Through-Thickness Properties of Structural Steels

A conservative through-thickness ultimate strength value can be derived from the longitudinal values and is give by the relationship of $F_u(TT) = 0.8\ F_u(L)$. Similarly, a conservative through thickness tensile yield strength value can be derived from the longitudinal values and is given by the relationship $F_y(TT) = 0.9\ F_y(L)$.

116

PRINCIPLES OF WELDED CONNECTIONS

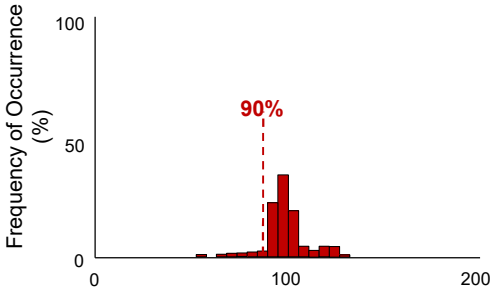


Ratio **of** **Tensile (F_u)** Strength (%):
Through Thickness to Longitudinal (TT/L)

Adapted from Barsom and Korvink, *Through-Thickness Properties of Structural Steels*

117

PRINCIPLES OF WELDED CONNECTIONS



Ratio of **Yield (F_y)** Strength (%):
Through-Thickness to Longitudinal (TT/L)

Adapted from Barsom and Korvink, *Through-Thickness Properties of Structural Steels*

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PRINCIPLES OF WELDED CONNECTIONS

SAC Steel Project

Report No. SAC/BD-97/01 Barsom and Korvink

Through-Thickness Properties of Structural Steels

Generally, a minimum twenty percent **(20%)** reduction-of-area value has been used as a good measure of lamellar tearing resistance[7,12]. However, lamellar tearing behavior of steel products is determined by a complex interaction among factors related to **material properties, detailing, welding procedure, fabrication and design.**

119

PRINCIPLES OF WELDED CONNECTIONS

A correct and proper welded connection recognizes material properties.

9

120

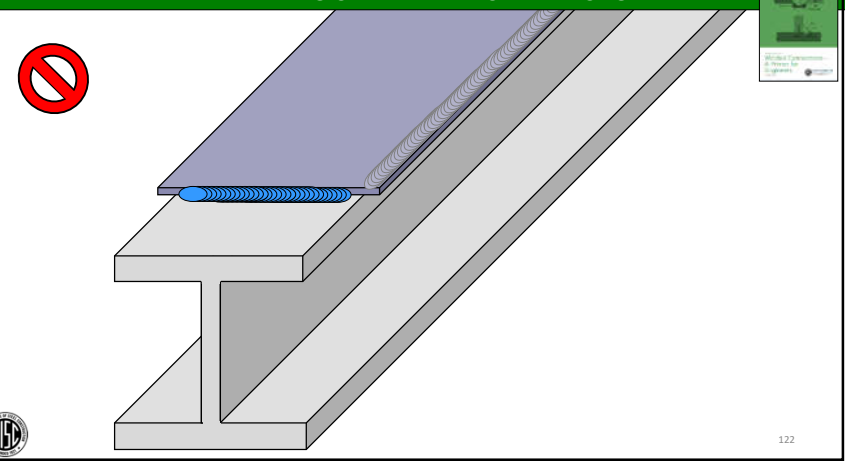
PRINCIPLES OF WELDED CONNECTIONS

A correct and proper welded connection
is easy and economical to fabricate and erect.

10

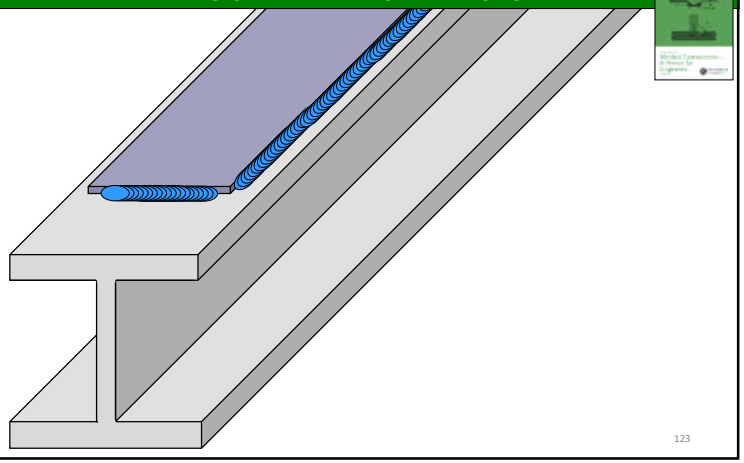
121

PRINCIPLES OF WELDED CONNECTIONS



122

PRINCIPLES OF WELDED CONNECTIONS



123

PRINCIPLES OF WELDED CONNECTIONS

A correct and proper welded connection
is easy and economical to fabricate and erect.

10

124

PRINCIPLES OF WELDED CONNECTIONS

A correct and proper welded connection is easily inspected.

11

125

PRINCIPLES OF WELDED CONNECTIONS

The issue of inspection should be considered when details are specified. Inspection includes both visual inspection as well as nondestructive testing. On complex assemblies, subsequent welding operations may preclude inspection of previously deposited welds. For such assemblies, hold points may need to be established. Left-in-place steel backing can complicate the interpretation of NDT results.

126

PRINCIPLES OF WELDED CONNECTIONS

A correct and proper welded connection is easily inspected.

11

127

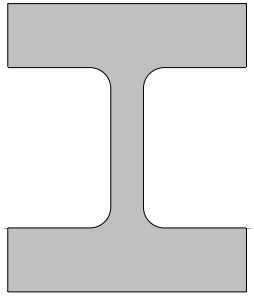
PRINCIPLES OF WELDED CONNECTIONS

A correct and proper welded connection recognizes commercial realities.

12

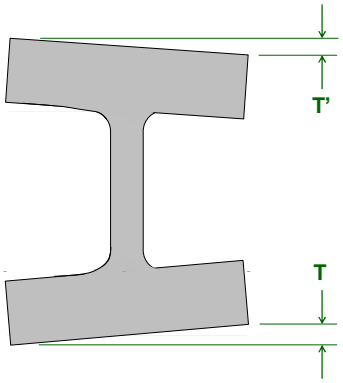
128

ASTM A6 Tolerances



129

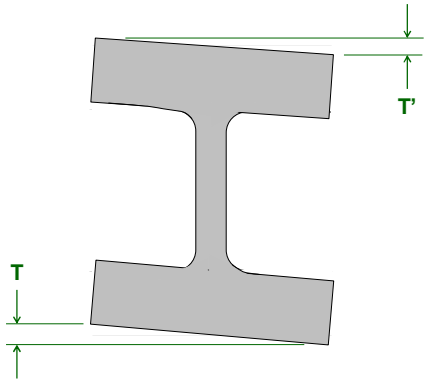
ASTM A6 Tolerances



For W over 12 in, **T + T' ≤ 5/16" [8 mm]**

130

ASTM A6 Tolerances

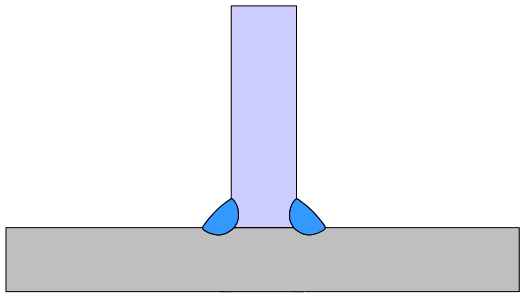


For W over 12 in, **T + T' ≤ 5/16" [8 mm]**

131

PRINCIPLES OF WELDED CONNECTIONS

Angular Distortion



132

AWS D1.1: 2015 Structural Welding Code – Steel

Δ (in) ≤ W/100 or 1/ 4 in [6 mm], whichever it greater

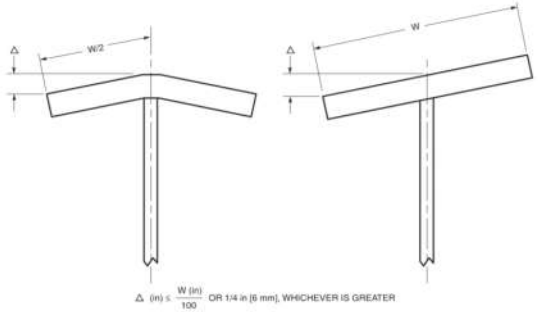
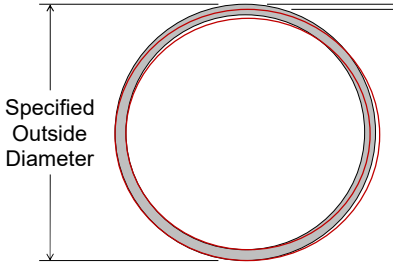


Figure C-5.7—Measurement of Flange Warpage and Tilt (see C-5.23.8)

133

ASTM A500 Tolerances

≤ ± 0.75% O.D.

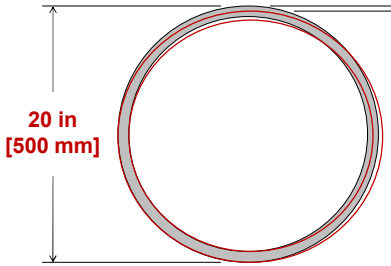


For outside diameters (O.D.) ≥ 2 in [50 mm]

134

ASTM A500 Tolerances

≤ ± 0.15 in [3.8 mm]



For outside diameters (O.D.) ≥ 2 in [50 mm]

135

AWS D1.1: 2015 Structural Welding Code – Steel

9.24.1 Girth Weld Alignment (Tubular).

….Radial offset of abutting edges of girth weld seams **shall not exceed 0.2t** (where t is the thickness of the thinner member) and the maximum allowable shall be 1/4 in [6 mm], provided that any offset exceeding 1/8 in [3 mm] is welded from both sides…..

Let t = 1/2 in [12 mm], then 0.2t = 0.10 in [2.4 mm]

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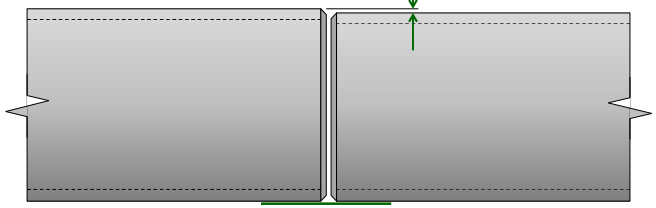
PRINCIPLES OF WELDED CONNECTIONS

AWS D1.1 Tolerance
≤ ± 0.10 in [2.4 mm]

ASTM A500 Tolerance
≤ ± 0.15 in [3.8 mm]

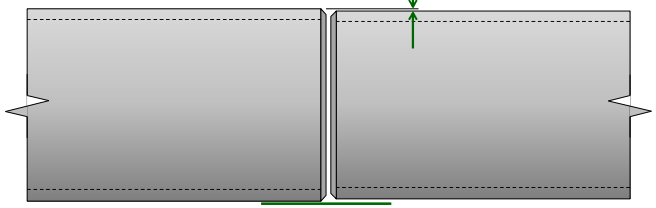


137

PRINCIPLES OF WELDED CONNECTIONS

AWS D1.1 Tolerance
≤ ± 0.10 in [2.4 mm]

ASTM A500 Tolerance
≤ ± 0.08 in [1.9 mm]



138

PRINCIPLES OF WELDED CONNECTIONS

A correct and proper welded connection
recognizes commercial realities.

12

139

PRINCIPLES OF WELDED CONNECTIONS

A correct and proper welded connection
is aesthetically pleasing.

13

Reminder:
"Beauty is in the eye of the beholder."

Reminder 2:
Sometimes, pretty doesn't really matter.

140

PRINCIPLES OF WELDED CONNECTIONS

A correct and proper welded connection
is aesthetically pleasing.

"Form follows function."

141

PRINCIPLES OF WELDED CONNECTIONS

Architectural Philosophy

Form ever follows function.

Louis Henry Sullivan
Architect
1856-1924

142

PRINCIPLES OF WELDED CONNECTIONS

Louis Henry Sullivan

It is the pervading law of all things organic and inorganic,
Of all things physical and metaphysical,
Of all things human, and all things super-human,
Of all true manifestations of the head,
Of the heart, of the soul,
That the life is recognizable in its expression,
That form ever follows function. This is the law.

143

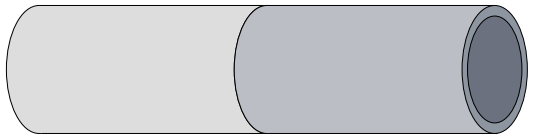
PRINCIPLES OF WELDED CONNECTIONS

Ideal

144

PRINCIPLES OF WELDED CONNECTIONS

Reality

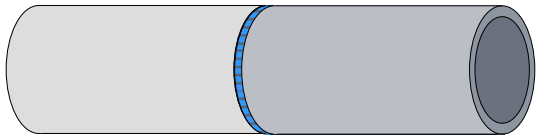


145

PRINCIPLES OF WELDED CONNECTIONS

Pretty Close to Ideal

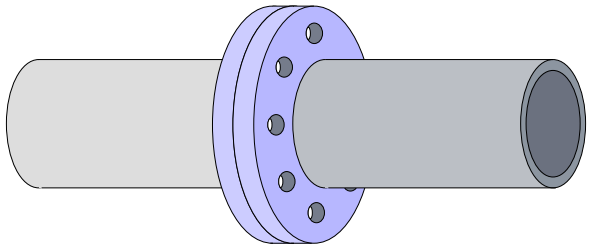
(at least in DKM's mind)



146

PRINCIPLES OF WELDED CONNECTIONS

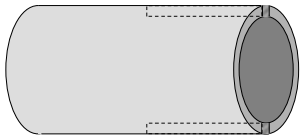
Not even close



147

PRINCIPLES OF WELDED CONNECTIONS

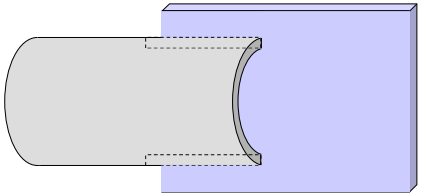
Not even close



148

PRINCIPLES OF WELDED CONNECTIONS

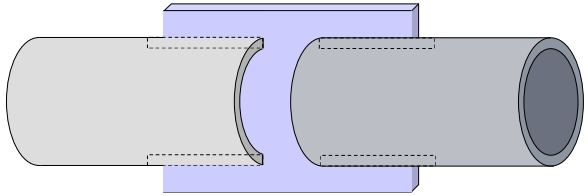
Not even close



149

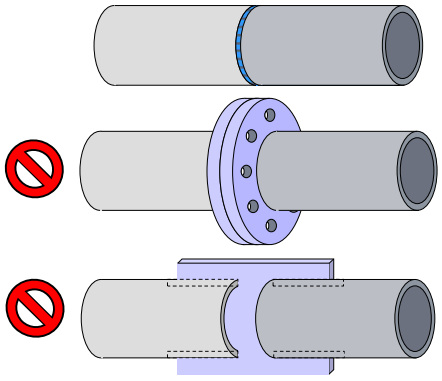
PRINCIPLES OF WELDED CONNECTIONS

Not even close



150

PRINCIPLES OF WELDED CONNECTIONS



151

PRINCIPLES OF WELDED CONNECTIONS

An aesthetically pleasing connection is:
welded, not bolted.

152

PRINCIPLES OF WELDED CONNECTIONS

An aesthetically pleasing welded connection is:

directly welded.

- no gusset plates
- no flange plates

153

PRINCIPLES OF WELDED CONNECTIONS

A correct and proper welded connection is aesthetically pleasing.

13

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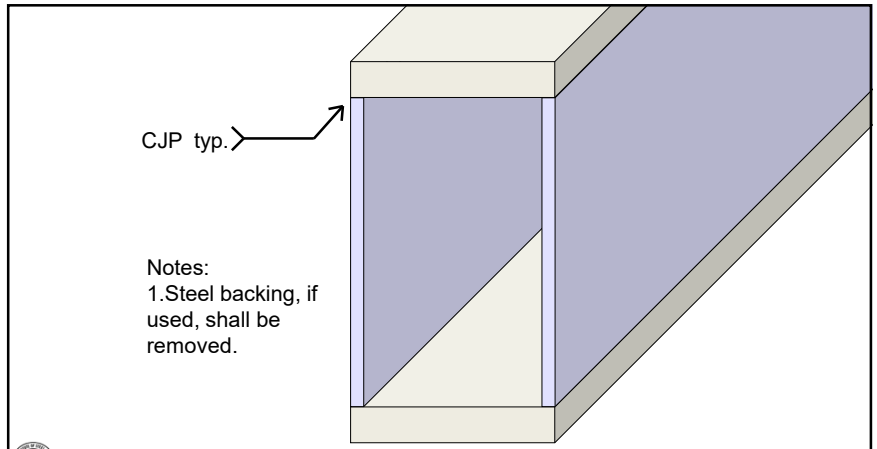
PRINCIPLES OF WELDED CONNECTIONS

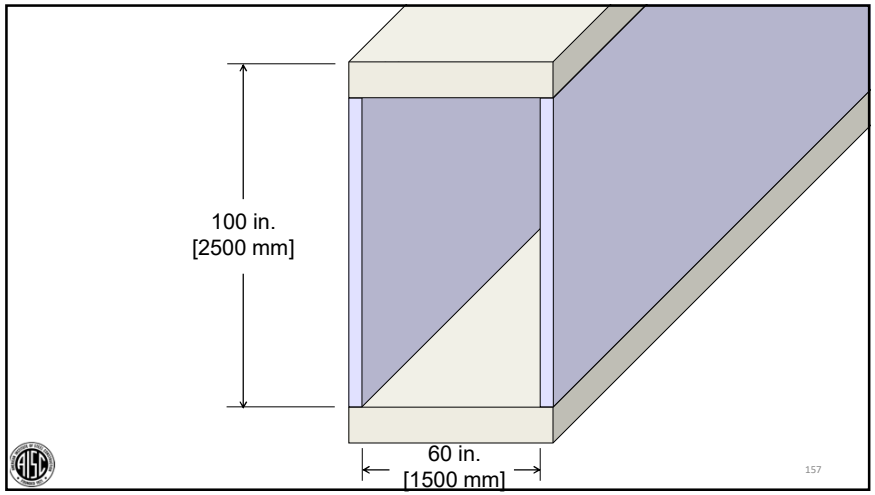
A correct and proper welded connection can be made safely.

14

155



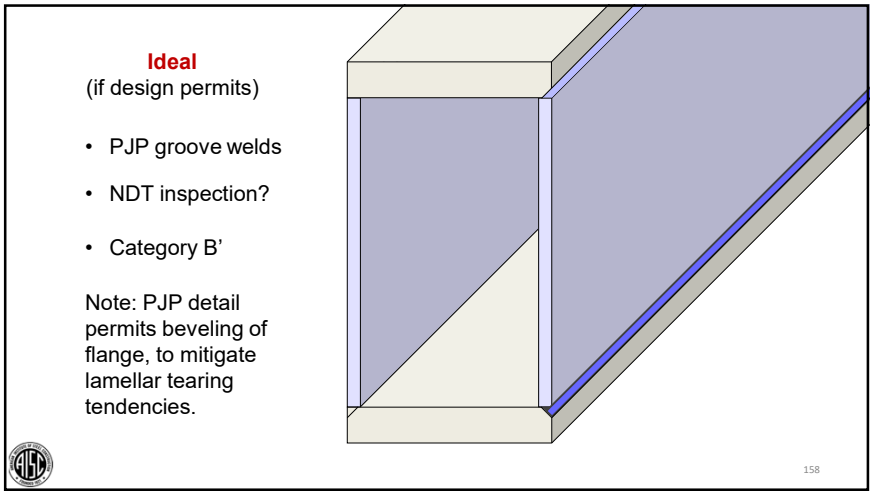
156



Ideal
(if design permits)

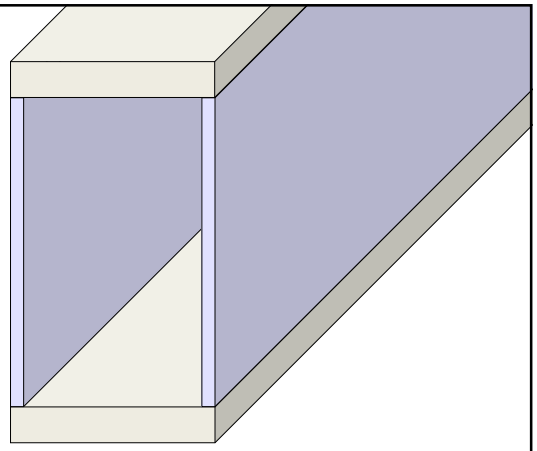
- PJP groove welds
- NDT inspection?
- Category B'

Note: PJP detail permits beveling of flange, to mitigate lamellar tearing tendencies.



Options

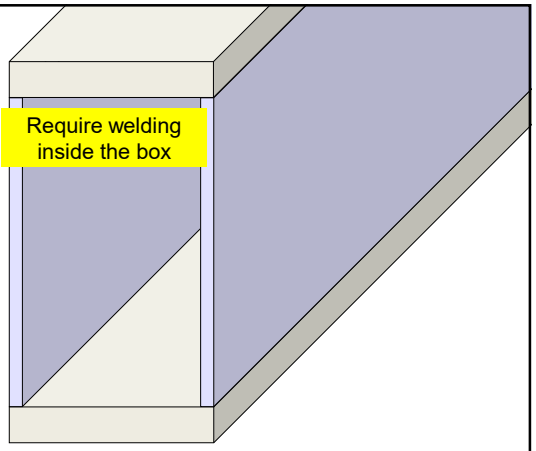
- Doubled sided CJP
- Single sided CJP with backing, then remove backing
- Non-prequalified CJP detail (open root, copper, ceramic)
- Challenge detail: use steel backing (but category B')

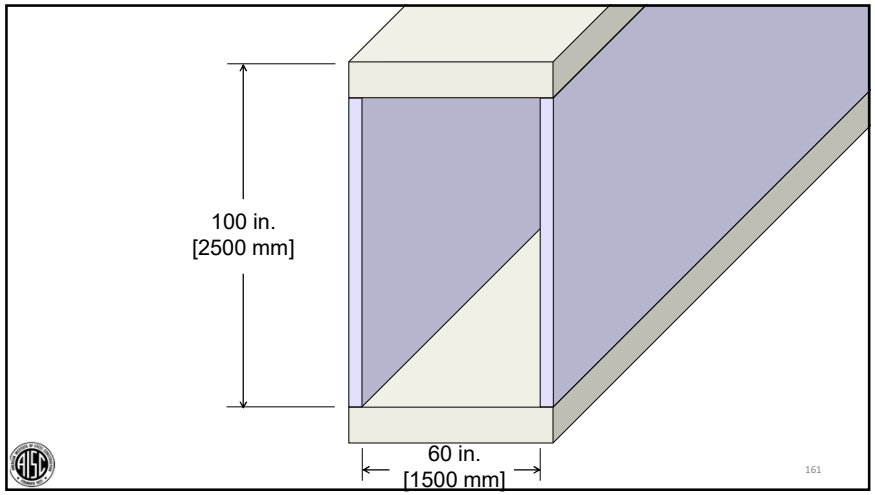


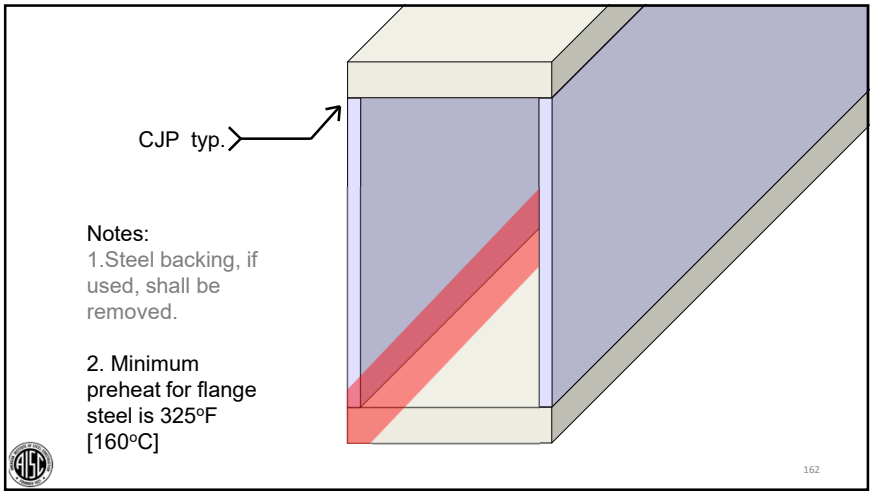
Options

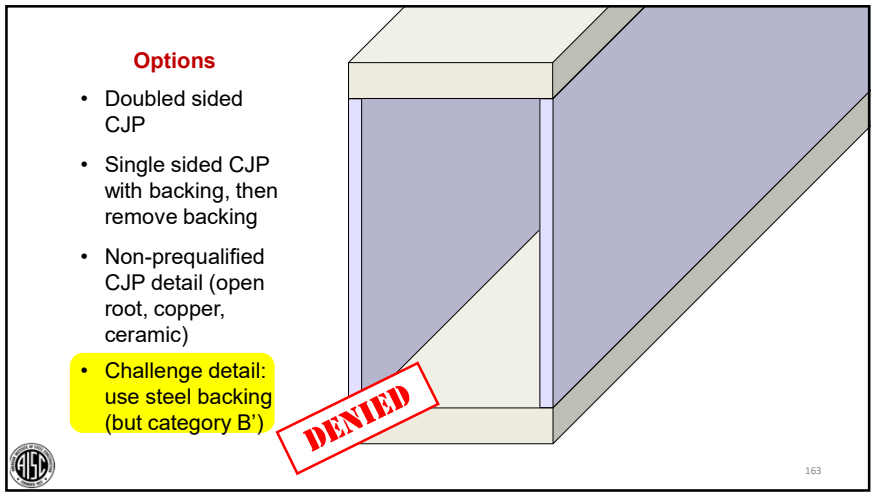
- Doubled sided CJP
- Single sided CJP with backing, then remove backing
- Non-prequalified CJP detail (open root, copper, ceramic)
- Challenge detail: use steel backing (but category B')

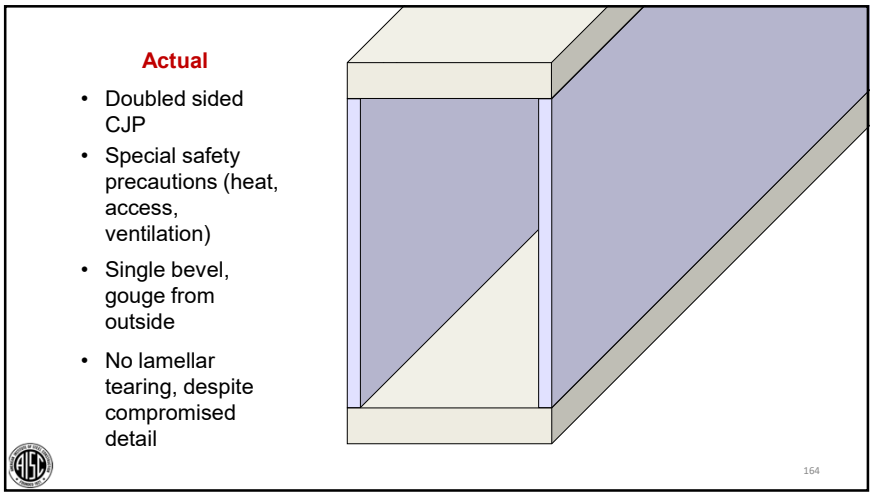
Require welding inside the box

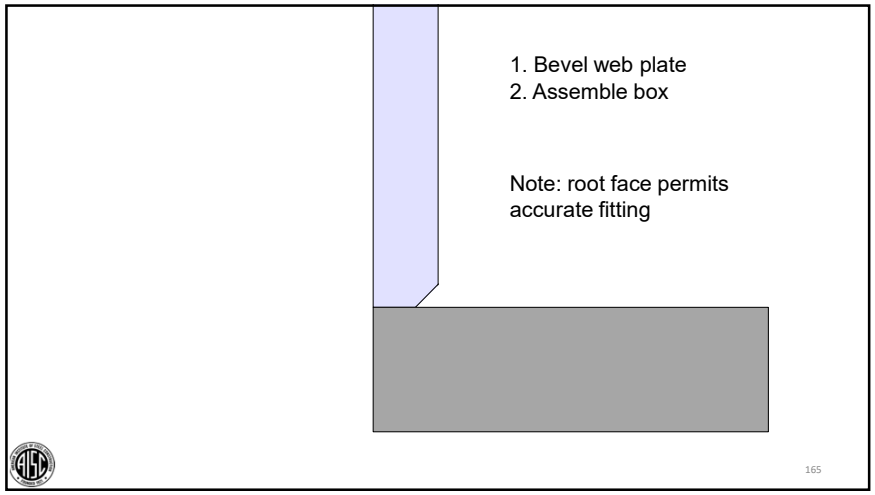


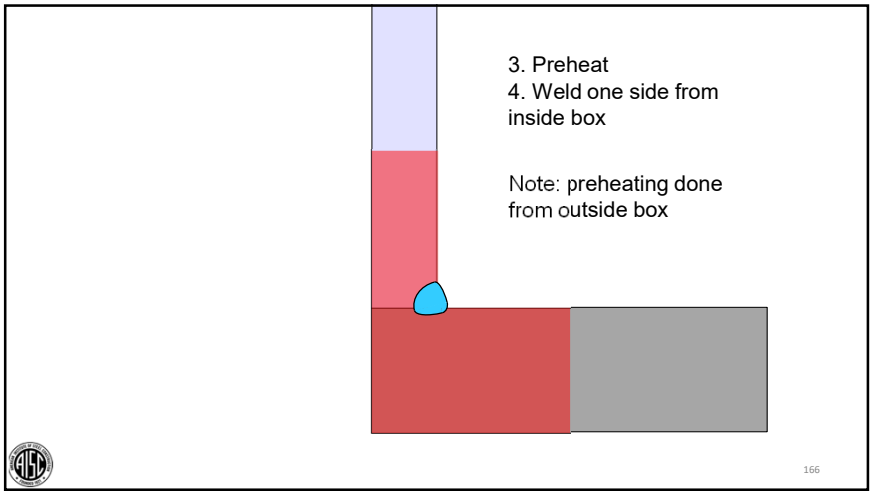


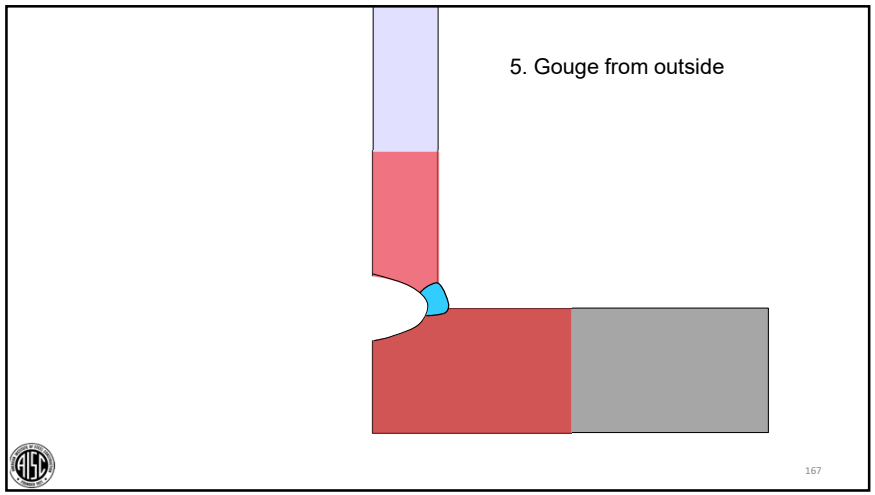


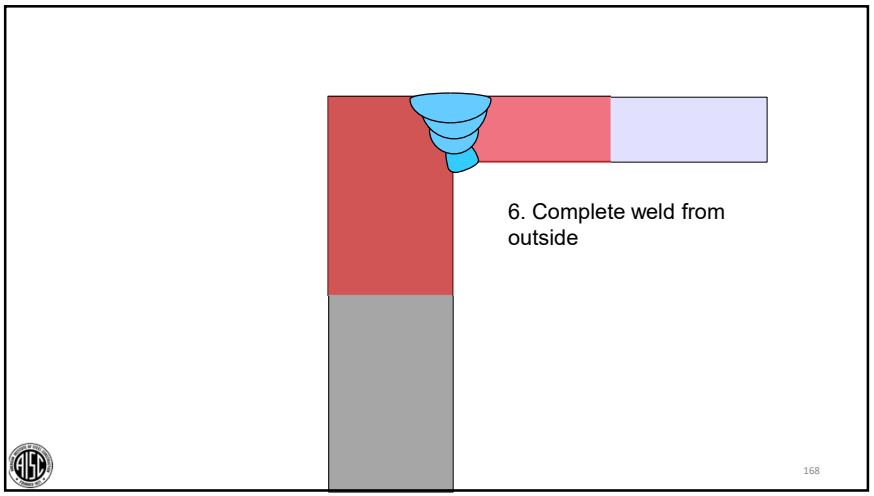












PRINCIPLES OF WELDED CONNECTIONS

A correct and proper welded connection can be made safely.

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PRINCIPLES OF WELDED CONNECTIONS

14 Principles of Welded Connection Design

What makes a welded connection correct or proper?

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Thank you!

AISC | Questions

Smarter. Stronger. Steel.

Individual Session Registrants

PDH Certificates

- All WFH individuals associated with a group registration will be issued a certificate.
- All individuals attending at your connection: you will receive an email on how to report their attendance from: registration@aisc.org.
  - Be on the lookout: Check your spam filter! Check your junk folder!
  - Completely fill out online form. Don't forget to check the boxes next to each attendee's name!

8-Session Registrants

PDH Certificates

One certificate will be issued at the conclusion of all 8 sessions.

8-Session Registrants

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.

Quiz and attendance records

Posted Friday mornings. www.aisc.org/nightschool -- Click on Current Course Details.

Reasons for quiz

- EEU – You must take all quizzes and the final exam to receive EEU.
- PDHs – If you watch a recorded session, you must pass quiz for PDHs.
- REINFORCEMENT – Reinforce what you learn tonight. Get more out of the course.

Note: If you attend the live presentation, you do not have to take the quizzes to receive PDHs

8-Session Registrants

Access to the recording

Information for accessing the recording will be emailed to you by Wednesday. The recording will be available for four weeks. (For 8-session registrants only.) EMAIL COMES FROM NIGHTSCHOOL@AISC.ORG.

PDHs via recording

If you watch a recorded session, you must take *and pass* the quiz for PDHs.

8-Session Registrants

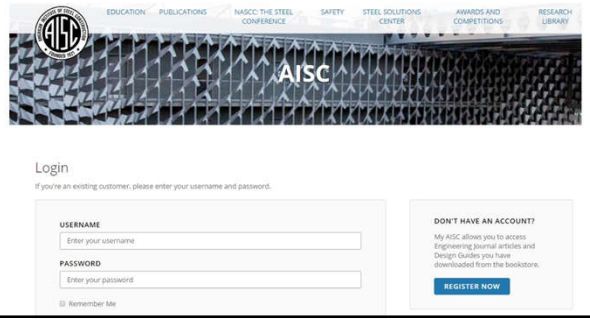
Night School Resources

Find all your handouts, quizzes and quiz scores, recording access, and attendance information all in one place!

8-Session Registrants

Night School Resources

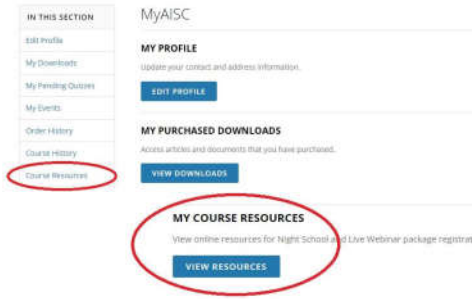
Go to www.aisc.org and sign in.



8-Session Registrants

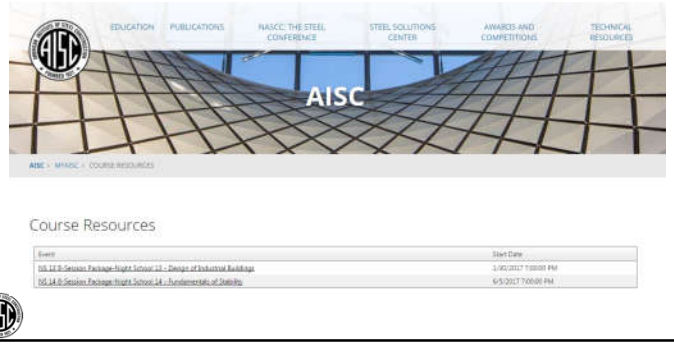
Night School Resources

Go to www.aisc.org and sign in.



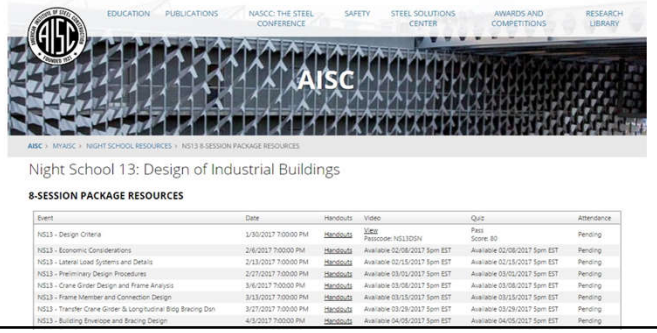
8-Session Registrants

Night School Resources



8-Session Registrants

Night School Resources



8-Session Registrants

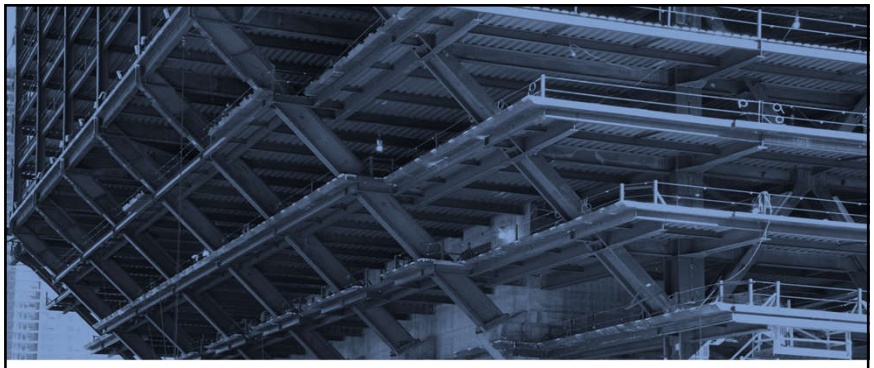
Night School Resources

- Weekly "quiz and recording" email.
- Weekly updates of the master quiz and attendance record, found at www.aisc.org/nightschool27. Scroll down to Quiz and Attendance records.
    - Updated on Friday mornings.

8-Session Registrants

Night School Resources

- Webinar connection information
    - Reminder email sent out Monday mornings
- Links to handouts also found here



AISC | Thank you

Smarter. Stronger. Steel.