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Course Description

Session L1: Steel Bridge Fabrication

October 12, 2017

This session will address the fabrication process of steel plate and box girders. All steps will be presented, from cutting the plates to size and fitting and welding the plates together to form the girders, to the fitting of the field splice connections. The impact of design on fabrication costs will be discussed, and recommendations will be made on design features from a fabrication standpoint. The welding processes used to join the plates including submerged arc weld, flux cored electrode, and narrow gap electroslag welding will be described. The inspection techniques and requirements used to ensure the quality of the welds will be presented. The session will conclude with a glimpse into the future of fabrication showing the virtual assembly process.

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Learning Objectives

- Become familiar with the fabrication process of steel plate and box girders.
- Gain an understanding of how design impacts fabrication costs and become familiar with constructible design recommendations.
- Become familiar with the common weld processes for joining plates including submerged arc weld, flux cored electrode, and narrow gap electroslag welding.
- Gain an understanding of weld inspection techniques and requirements used to ensure quality.

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Introduction to Steel Bridge Design

Session L1: Steel Bridge Fabrication

Presented by
Karl H. Frank
Consultant
Austin, Texas

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Introduction to Steel Bridge Design

- R1: Introduction to Bridge Engineering
- R2: Introduction and History of AASHTO LRFD Bridge Design Specifications
- R3: Steel Material Properties
- R4: Loads and Analysis

- **L1: Steel Bridge Fabrication**
- L2: Plate Girder Design and Stability
- L3: Effects of Curvature and Skew
- L4: Fatigue and Fracture Design

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Outline

- Plate Girder Design
- Building a Bridge Girder
  - How we do it now
  - How we want to do it in the future

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Modular Design

Crane and Wrenches Required for Assembly

No Post Tensioning Required

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Plate Girder

3 plates: 2 flanges plus a web

12

Strong and Ductile

Plate Girder Design

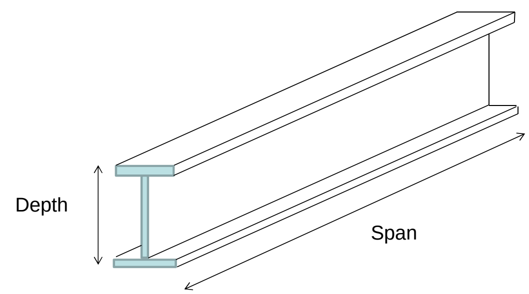
- No List of Properties Like a Rolled Beam
- Designer Starts with a Clean Sheet of Paper
  - Develop Custom Designed Section
  - Typically Deeper and Thinner Webs Than Rolled Beam
  - Deeper Sections- Stronger and Stiffer
  - Choice of Steel Strengths
  - Not Symmetric, Composite Design-Deck Used as Compression Flange

Girder Dimension Requirements Positive Moment

- **Top Compression Flange**
  - Non Composite Construction and Deck Casting Controls Design
  - Limit States
    - Lateral Torsional Buckling (flange lateral stiffness)
    - Yielding or Local Buckling of Flange ($b/2t_f$)
- **Web**
  - Shear at Pier
  - Web Bend Buckling ($2D_c/t_w$)
- **Bottom Flange- Yielding**

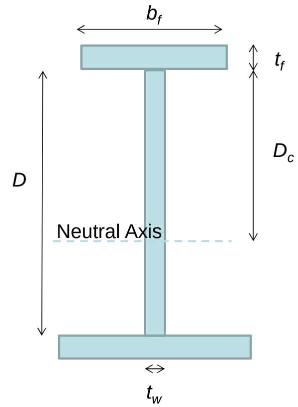
Typical Girder Proportions

- Span/Depth=25-30



Typical Girder Proportions

- $\frac{D}{t_w} \leq 120$
- $\frac{2D_c}{t_w} \leq 137$



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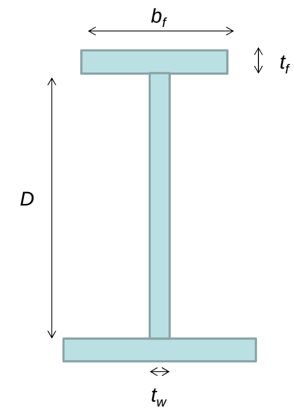
Typical Girder Proportions

- Compression Flange
  - $\frac{1}{4} > \frac{b_f}{D} > \frac{1}{6}$
  - $\frac{b_f}{2t_f} \leq 12$ and < 9.2 for 50 ksi
  - $A_{f\,top} \approx \frac{2}{3} A_{f\,bottom}$



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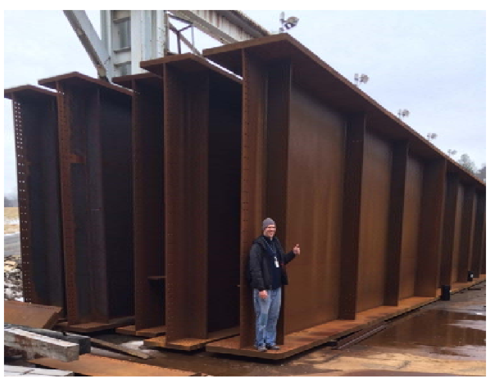
Typical Girder Proportions

- Transverse Stiffeners only as Required



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Typical Girder Proportions

200 ft. Span

- Span/Depth=25-30
- $\frac{D}{t_w} \leq 120$ $\quad \frac{2D_c}{t_w} \leq 137$
- Compression Flange
  - $\frac{1}{4} > \frac{b_f}{D} > \frac{1}{6}$
  - $\frac{b_f}{2t_f} \leq 12$ and < 9.2 for 50 ksi

$D = 8$ ft	$\frac{S}{D} \leq 25$
$t_w = 7/8$ in.	$\frac{D}{t_w} = 110 \leq 120$
$b_f = 24$ in.	$\frac{b_f}{D} \leq 0.25$
$t_f = 1.375$ in.	$\frac{b_f}{2t_f} = 8.7$

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Cross Sectional Limits

AASHTO LRFD Specifications

6.10.2.2—Flange Proportions

Compression and tension flanges shall be proportioned such that:

$\frac{b_f}{2t_f} \le 12.0,$	Too slender, 9.2 for Grade 50	(6.10.2.2-1)
$b_f \ge D/6,$	Too slender, D/4 better choice	(6.10.2.2-2)
$t_f \ge 1.1t_w,$	Should be 1.5 to 2 x web thickness	(6.10.2.2-3)
and:		
$0.1 \le \frac{I_{yc}}{I_{yt}} \le 10$	Important limit, eliminates "T" like sections	(6.10.2.2-4)

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3/8 in. Top Flange-1/2 in. Web

$$\frac{b_f}{2t_f} = \frac{16\text{ in.}}{2 \times 3/8\text{ in.}} = 21.3 > 12.0 \Rightarrow \text{NO GOOD}$$

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Flange Thickness Transition

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Building a Girder

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Raw Material

Longest Plate 80 feet Limited by Railcar

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Mill Lead Times

A572 gr. 50 & A588 = 4 to 8 weeks

HPS 70W = 4 to 10 weeks

Rolled beams = 3 to 8 weeks

Material Not Stocked by Fabricator

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Raw Material

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First Steps

- Splice Flange and Web Plates
  - Full Penetration Weld
  - Nest Flange Plates if Possible
- Trim Mill Edges
- Rip Flange Plates to Width From Wide Plates (Cut Curve Small Radius)
- Cut Curve Webs for Desired Camber

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Welding

- Fusion Welding
  - Consumable Electrode and Base Metal Melted to Form Weld
  - Arc or Resistance Heating in the Flux Provides the Heat to Melt the Base Metal
  - Shielding Gas use to Protect the Molten Metal and Spray from Electrode Melting from the Atmosphere
  - Flux to Clean Molten Weld Pool and also used to Produce Shielding Gas in SMAW
- Base Metal Chemistry Must Be Controlled

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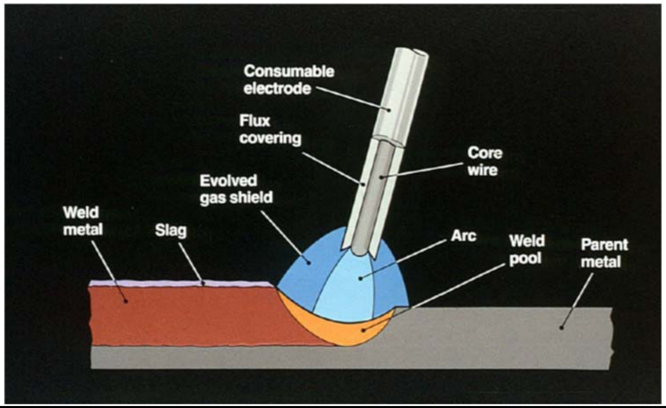
SMAW (Shielded Metal Arc Welding) Stick Welding



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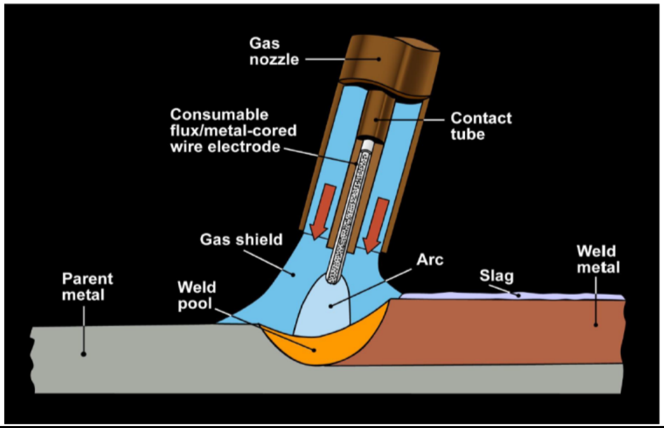
FCAW (Flux Cored Arc Welding)



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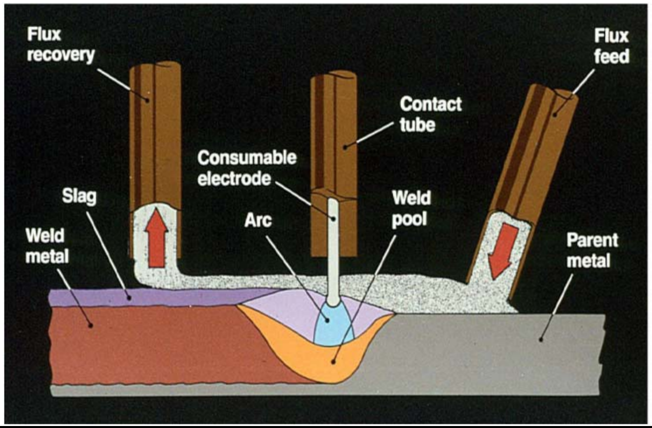
SAW (Submerged Arc Welding)



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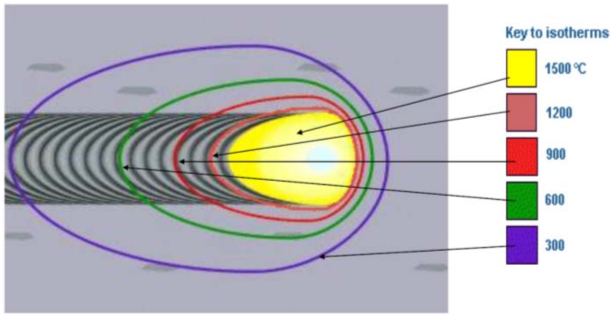
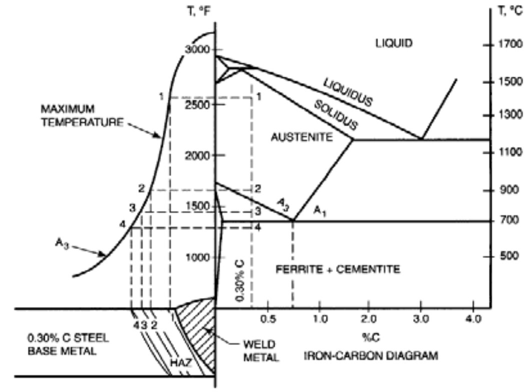
Cooling Weld by Conduction of Heat Into Plate

Thicker Plates Provide Larger Heat Sink Resulting in More Rapid Cooling



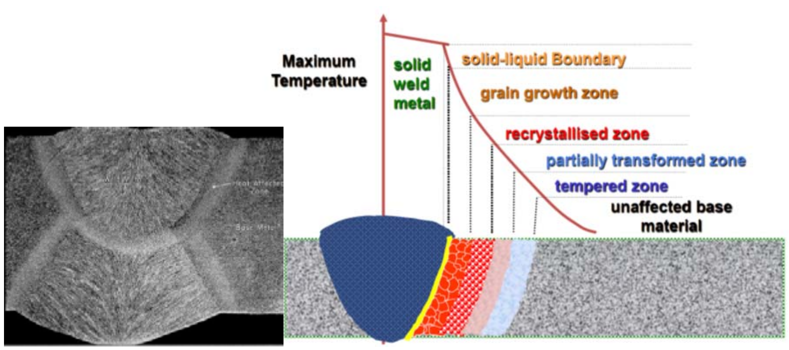
Weld and weld pool temperatures

What Happens to Base Metal During Welding



Critical That Material Heated to Austenite Temperature is Cooled Slowly Enough to Not Form Martensite

Generation of Heat Affected Zone (HAZ)



Preheat and Interpass Temperatures AWS D1.5 Chap. 4

- Preheat- Temperature before welding
- Interpass-Temperature before starting next weld pass

Steel	To ¾ in. Incl.	¾ to 1- ½ in. Incl.	1- ½ to 2- ½ in. Incl.	Over 2- ½ in.
A709 Grade 36,50,50S,50W & HPS 50W	≥50 ºF	≥70 ºF	≥150 ºF	≥225 ºF
A709 Grade HPS 70W	50 to 450 ºF	125 to 450 ºF	175 to 450 ºF	225 to 450 ºF
A709 Grade HPS 100W	50 to 400 ºF	125 to 400 ºF	175 to 450 ºF	225 to 450 ºF

Higher Preheats Slow Cooling Rate

WPS
(Welding Procedure Specification) Qualification

- Purpose- Weld Metal Meets Mechanical Properties
  - Strength
  - Ductility
  - Notch Toughness Requirements
  - Done by Welding a Test Plate
- Generates a Procedure Qualification Record (PQR)
  - Documents Welding Variables
  - Documents Physical Test Results
- Exempt (Prequalified)
  - SMAW Welds (except E100 and E110)
  - Tack Welds Remelted by Subsequent SAW Welds
  - Welds of Ancillary Products

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Heat Input

- Basis of Qualification Tests Limits
- $Heat\ Input\ \left(\frac{kJ}{in}\right) = \frac{Amperage\ x\ Voltage\ x\ 0.06}{Travel\ Speed\ (in.\ per\ minute)}$
- Each pass with +/- 10% of overall average
  - Table 5.10 Gives Min. and Max. Amperage for each Process and Electrode Diameter

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Qualification Options

- 5.12.1 Maximum Heat Input Qualification
  - Production Welds Heat Input <100% Qualification Test
  - Production Weld Heat Input> 60% Qualification Test
- 5.12.2 Maximum-Minimum Heat Input Qualification (Two Test Welds Required)
  - Production Heat Input Must be Between the Max. and Min. of Test Welds
- 5.12.4 Production Procedure Qualification
  - Multiple Pass SAW with Active Flux
  - Non Standard Joint Details
  - Matching Electrodes for HPS100W
- Most Procedures are Qualified Using 5.12.1

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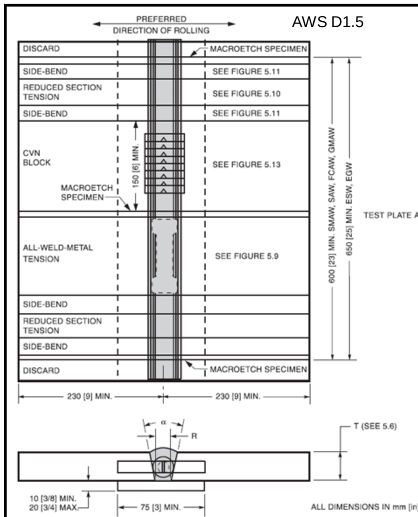
WPS Qualification Test Plate

AWS D1.5



Specimen	Number of Specimens
CVN	5 or 8 for NGESW
Side Bend	4
Reduced Section Transverse Tensile	2
All Weld Metal Tensile	1
Macro Etch	2
RT	RT+UT for NGESW

For SAW
T= 1 in.
$\alpha = 20^{o}$
R= 5/8 in.

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Test Requirements

Base Metal	Minimum Yield Strength (ksi)	Minimum Tensile Strength (ksi)	Minimum Elongation	CVN Zone I and II (ft-lbs)	CVN Zone III (ft-lbs)	Fracture Critical
Grade 36	45	60	22	20 @ 0ºF	20 @ -20ºF	25 @ -20ºF
Grade 50, 50S	50	65	22	20 @ 0ºF	20 @ -20ºF	25 @ -20ºF
Grade 50W Grade HPS 50W	50	70	22	20 @ 0ºF	20 @ -20ºF	25 @ -20ºF
Grade HPS 70W	70	90	17	25 @ -10ºF	25 @ -20ºF	30 @ -20ºF
Grade HPS 100W >2.5 in.	90	100	16	20 @ -40ºF	Engr. Approval	35 @ -30ºF
Grade HPS 100W ≤2.5 in.	100	110	20	20 @-40ºF	Engr. Approval	35 @ -30ºF

AWS D1.5

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Welding of Components

- Butt Welding of Flanges
  - SAW
  - NGESW
  - Nesting of Girder Flanges
- Welding Web to Flange
  - Plate Girders
  - Box/Tub Girders

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SAW Weld Preparation Required to Get Access to Bottom of Weld

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Prepared Plates Tacked Together Ready to Weld

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Flange Thickness Transition

Note Weld in Thinner Plate at the End of The Transition

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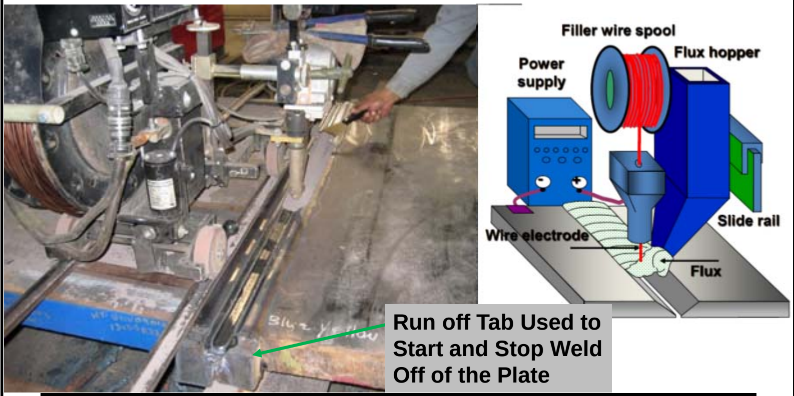
Submerged Arc Welding-SAW



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Close Up of Arc Submerged in the Flux

Multiple Pass Welds

Number of Passes Dependent Upon Plate Thickness

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Back Gouge Weld Root and Clean By Grinding Weld Back Side

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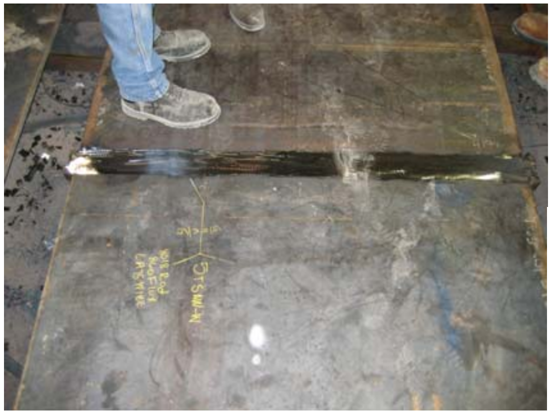
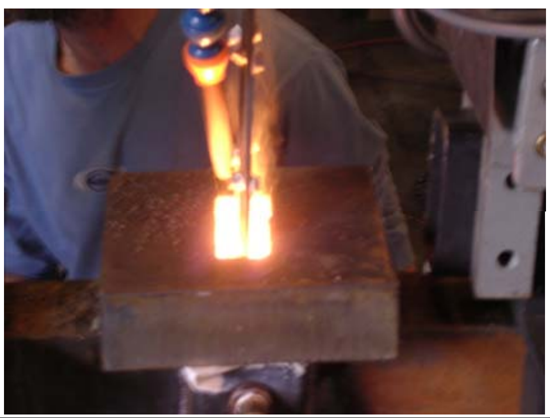
Finished Weld Ground Flush and Ready for Inspection by Radiography and Ultrasonics



Finished Flange Thickness Transition Butt Weld All Surfaces Ground Smooth

A New Way to Weld Narrow Gap Electroslag Welding



Narrow Gap Electroslag Welding NGEW

- Developed in an Extensive Research Study at the Oregon Graduate Institute by Wood and Turpin
- Based Upon Results of the Research, FHWA Lifted Moratorium March 2000
- Included in AWS D1.5 (2010)

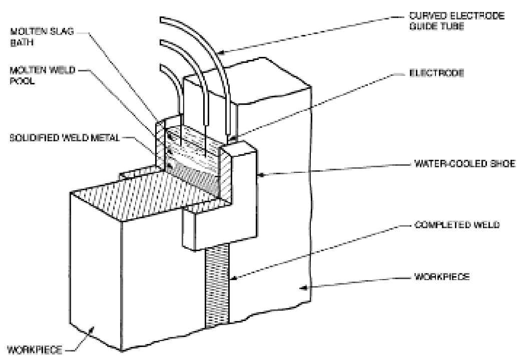
Advantages of NSW for Flange Welds

- Single Pass Vertical Weld-No turning of plate and no back gouging
- Fast- Approximately 5 to 10 increase in productivity (*2.5 to 1.5 in/minute, 3 foot long weld in about an hour*)
- Completely Automated Equipment-Computer controlled wire and flux feed as well as voltage control

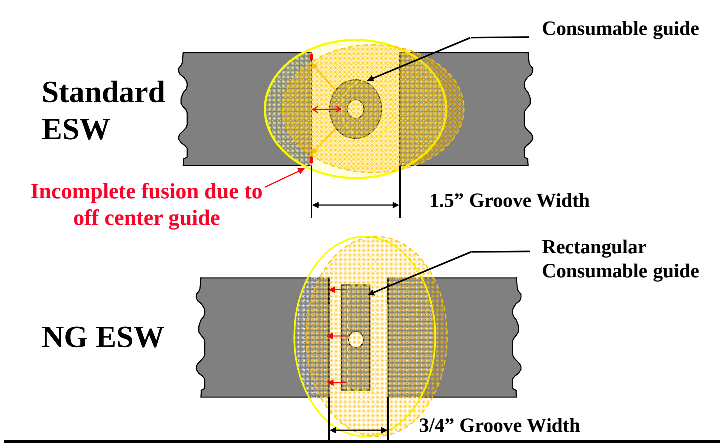
Characteristics

- Single Pass Vertical Up Weld
- Molten Weld Metal Contained by Water Cooled Copper Shoes
- Narrow Gap- 3/4 +/- 1/8 inch with square plate edge preparation
- Consumable Guide Tube to Guide Welding Wire
- Submerged Arc-Molten Flux Pool on Top of Weld Metal

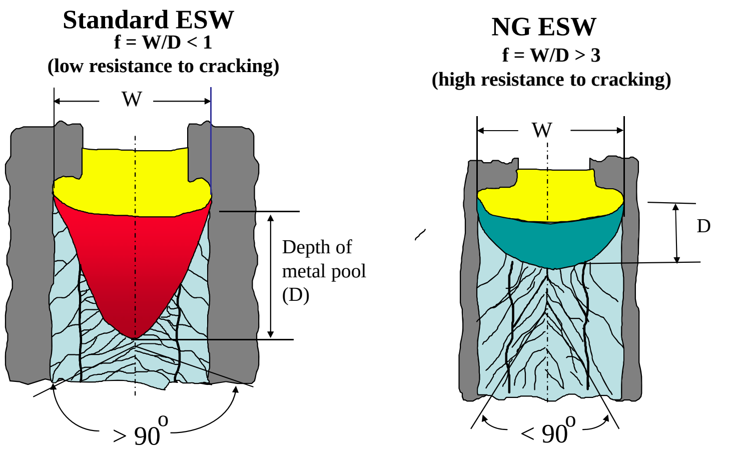
Schematic of ESW



Narrow Gap Reduces Susceptibility to Incomplete Fusion



Enhanced Weld Pool Geometry



Demonstration Weld to Show Flux Pool

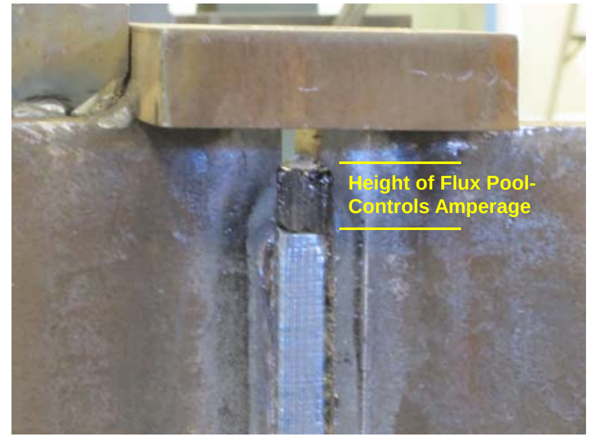
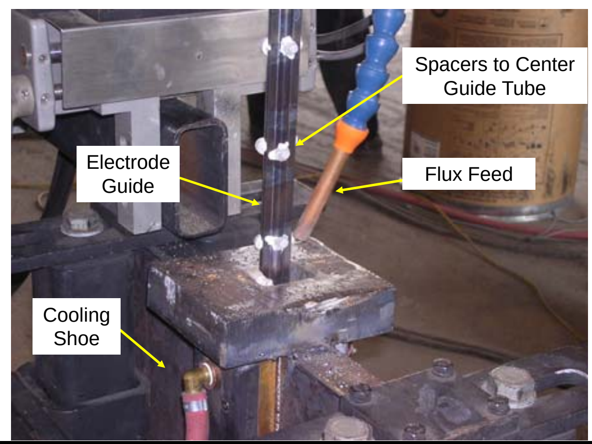


Plate Setup to Weld

- Square Preparation
- Remove Mill Scale From Fusion Zone
- Sump at Bottom to Start Weld
- No Beveling or Turning of Plate
- Cast Weld Vertically in One Pass

Starting Sump

Final Preparation



Consumable Guide and Spacers

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Plate Ready to Weld

- Water Cooled Copper Shoes to Contain Molten Weld Metal
  - Water Temperature and Flow Controlled to Produce Desired Cooling Rate
- Automatic Process
  - Computer Controlled Wire Feed
  - Computer Controlled Flux Addition

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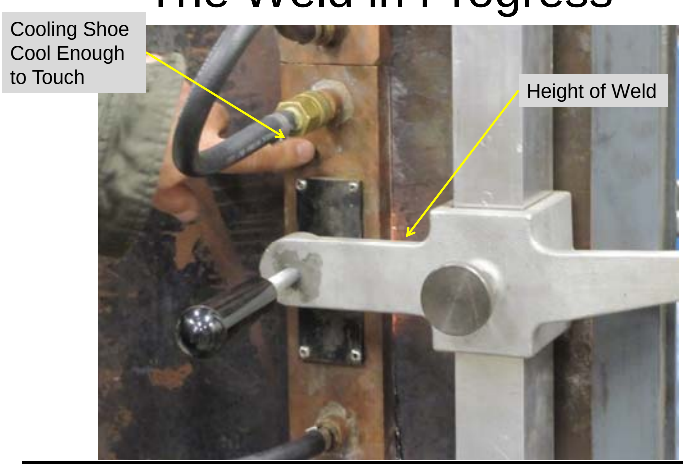
The Weld in Progress



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End of Weld

- Guide Consumed
- Note Molten Metal in Run Off Pad

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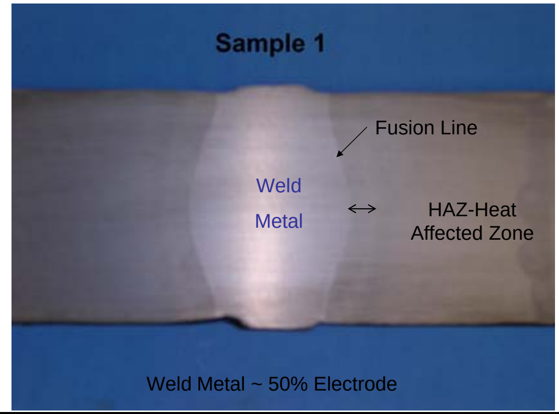
Completed Weld

Welding Time Approximately-10 to 20% of multiple pass weld
Minutes versus Hours

Weld Cross Section

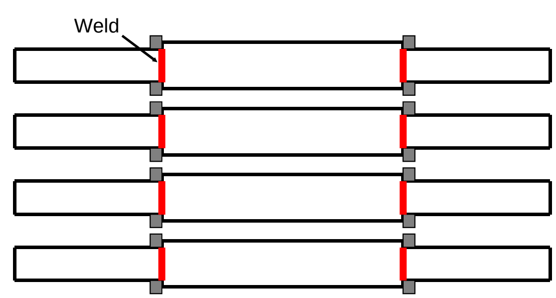


Efficient Flange Sizing

- Change Flange Width at Field Splice to Allow Welds to Be Slabbed
- Align Flange Thicknesses Transitions to Allow Slabbing
- Minimize the Number of Plate Thicknesses (plates come in 12 foot width and 80 foot lengths)
- Design it Like You are Going to Build it.

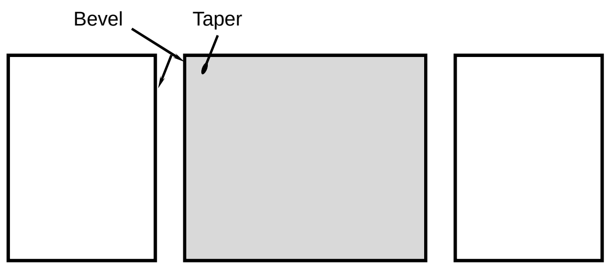
The Costly Method of Changing Flange Size by Changing Width

Weld and grind 8 splices



A Better Way- Change Flange Thickness

Bevel (4) and taper (2) plate edges



CHANGE THICKNESS

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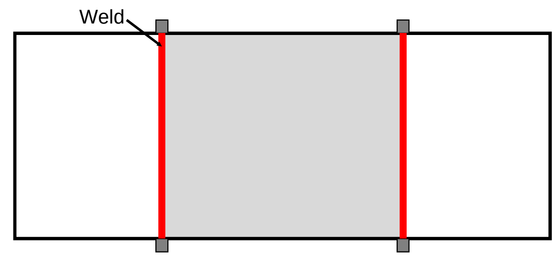
• Flange Sizing - change thickness

Weld and grind 2 splices



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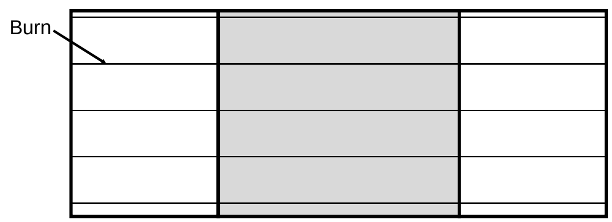
• Flange Sizing - change thickness

Burn 4 flanges from 1 assembly



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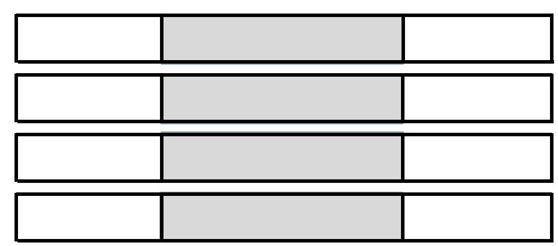
• Flange Sizing - change thickness

4 flanges from 1 assembly



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Good Practice

- Flange Sizing
  - Width transitions increase labor for flange assemblies up to 35%
  - If you must change flange width, do so at bolted field splice (do not clip corners of top flanges)
  - Allow fabricators to eliminate splices within a shipping piece by carrying thicker material through to next designed splice location

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Plate Girder Flange Sizing

- Shop butt splices within a shipping piece – when to change area?
  - No more than 2 shop splices
  - Minimum change; 1/8" (to 2 ½" thick), 1/4"
  - Maximum change; thinner piece at least 1/2 of thicker…
  - ONLY when material cost saved > labor cost spent

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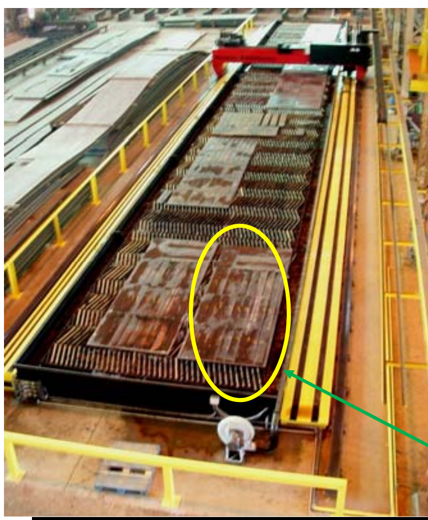

CNC Cutting and Drilling Equipment

Equipment:
16.75 ft. x 165 ft. bed

2-48 HP Drill Heads
12 tool Changer station

Plasma Automated Contour
Bevel Cutting System

6-Oxy-Fuel Torch Stations

Flanges Stripped From Wider Plate

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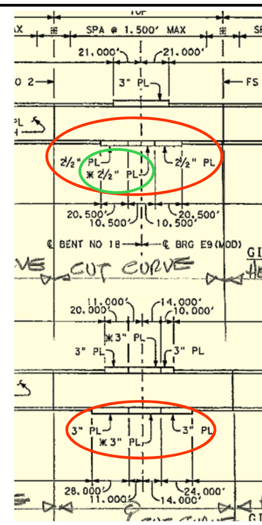
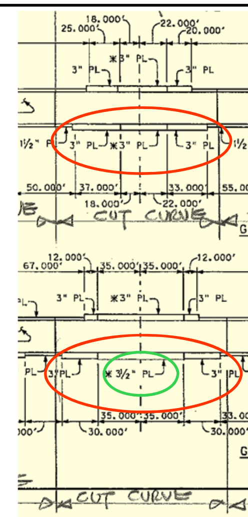


How to Prevent Slabbing of the Flanges



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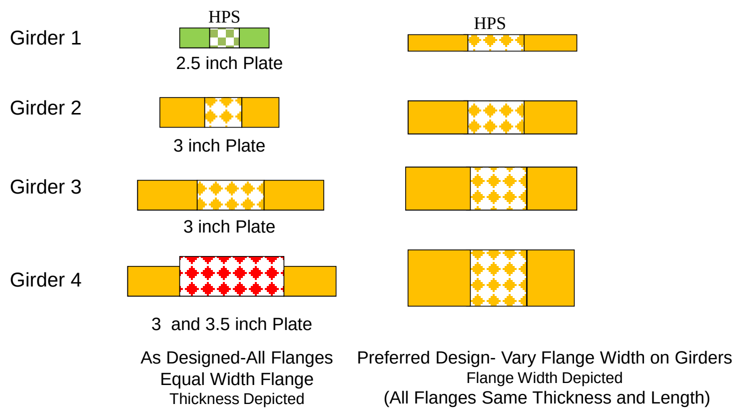
Bottom Flanges at Pier



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Attaching the Web to the Flanges

- Plate Girders
- Box Girders

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Assemble the Plates to Form Girder

Camber Cut Into Web

1. Flanges Squeezed to Fit Cambered Web
2. Tack Welds Used as Temporary Connection Between The Web and Flange

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SAW Welding the Flanges to the Web

Tack Welds Consumed by SAW Weld

Weld Both Sides at Once

Welding Head and Preheat Torches

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Stiffener Fit

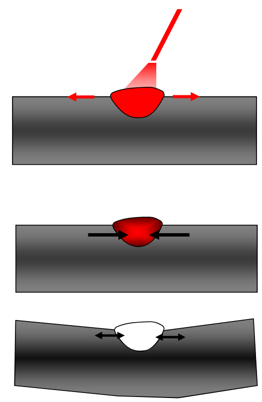
Stiffener Dart Welding SAW
Both Sides Welded at the Same Time

Tub (Box) Girders Hand Assembled

Flanges and Connection Plates Welded to Web

Cross Frames Used to Control Box Geometry

Residual Stress Due to Welding

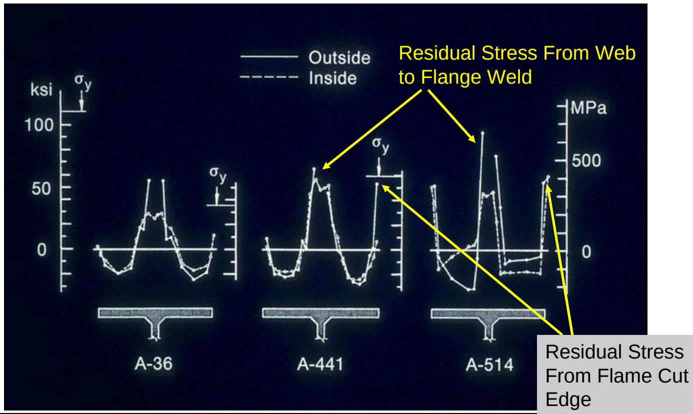


Thermal expansion due to heat input from welding

Shrinkage of beads due to cooling and solidification

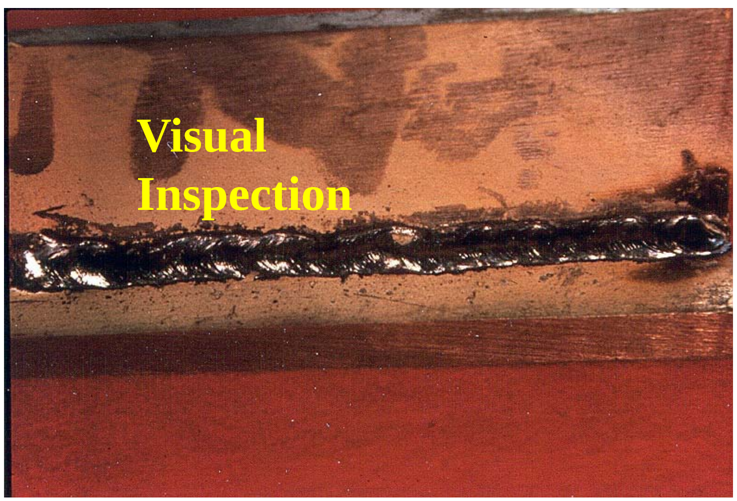
Tensile residual stress in the vicinity of weld

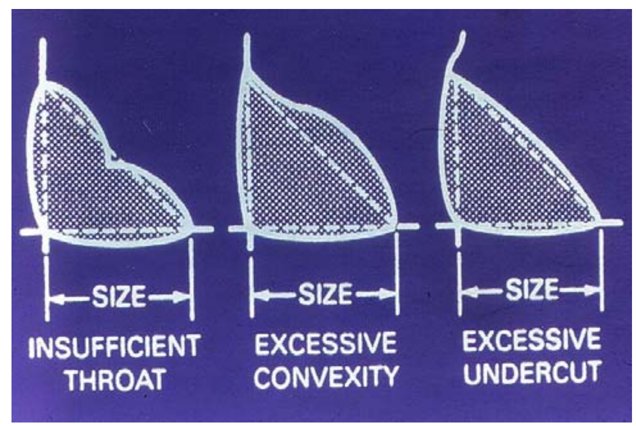
Residual Flange Stresses in Welded Shape

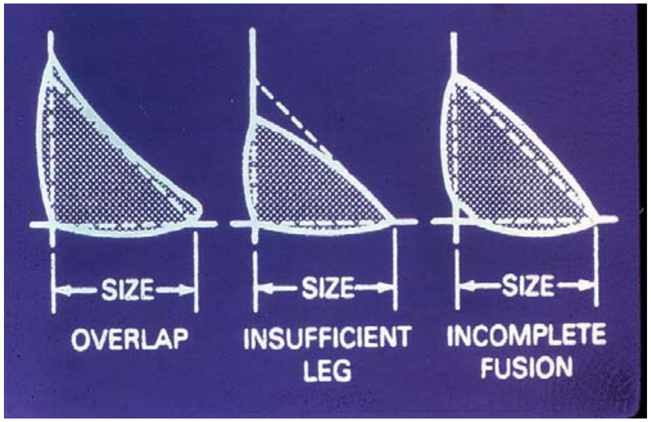


Weld Inspection

- Fillet Welds
  - Visual
  - Magnetic Particle
- Butt Welds
  - Ultrasonic
  - Radiography







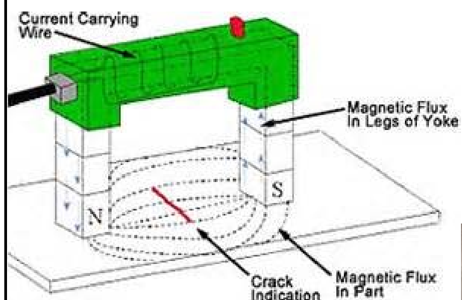
89

Magnetic Particle

- Inspection of Web to Flange Fillet Welds and Other Fillet Welds
- Surface or Near Surface Inspections

90

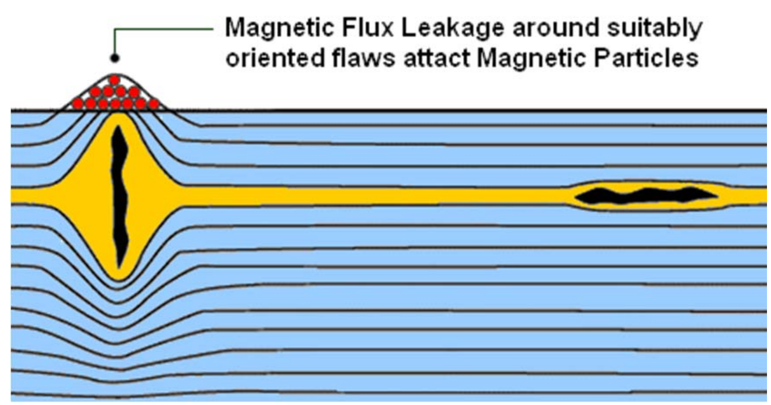
Magnetic Particle (MT)



Fish & Associates

91

Magnetic Particle (MT)



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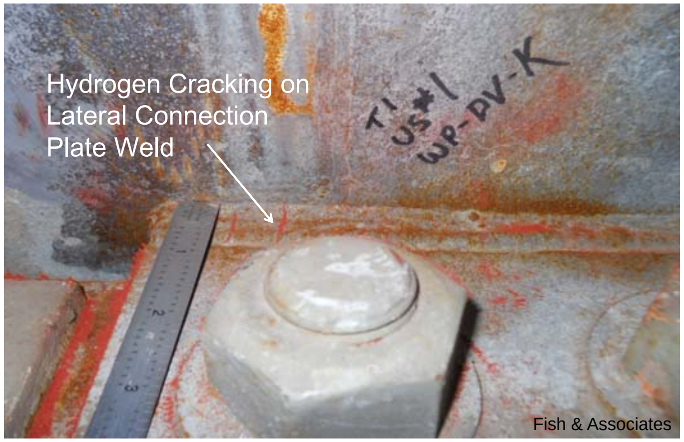
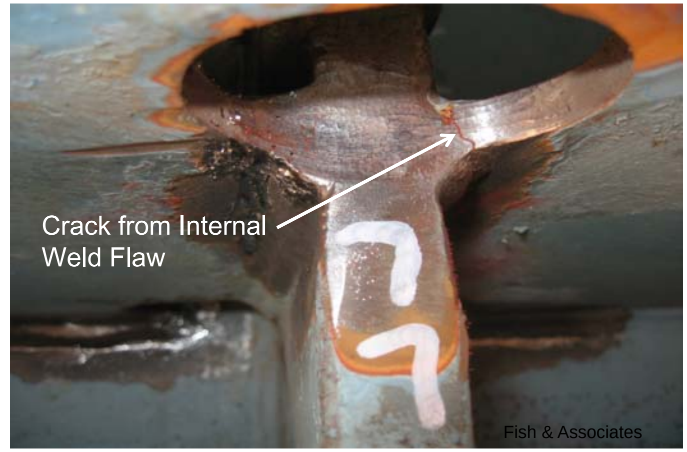
92

Magnetic Particle (MT)



93

Magnetic Particle (MT)



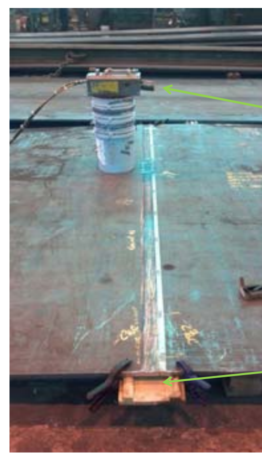
94

Radiography

- Gamma Ray (Nuclear) Source or X-Ray Source
- Internal Defects
- Very Good for Volumetric Defects
  - Slag
  - Porosity
- Provides a Visual Permanent Record on Film or Digital Record

95

Radiography



Gamma Ray Source

One Shot at a Time-
about 2 feet/per shot

Measures Density
Along Ray Path

Film Holder

96

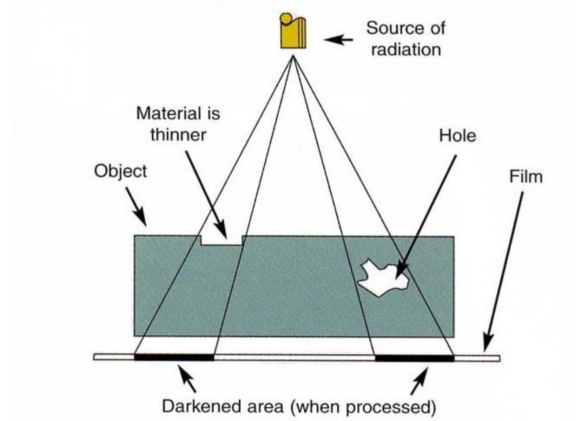
Radiation Hazard

Weld

Inspect at Night
Or Move Plate
Out of Shop

97

Radiography (RT)



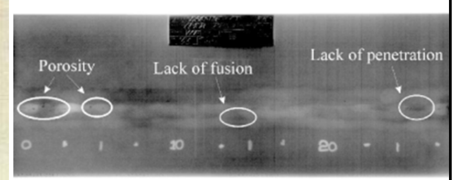
Fish & Associates

98

Approximate Thickness Limitations

Radioisotope	Thickness, in.
Iridium-192	0.5-2.5
Cesium-137	0.5-3.5
Cobalt-60	>3

99



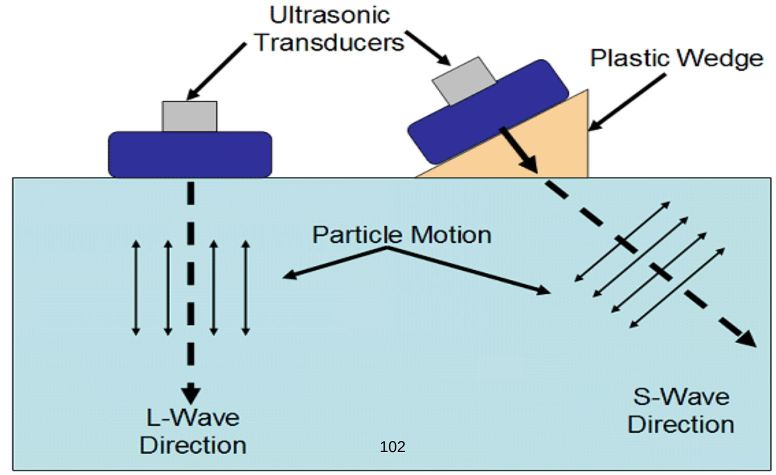
100

Ultrasonic Inspection

- Similar to Radar and Sonar
- Interrogate Weld Using High Frequency Waves (2-5 MHz)
- Sound Reflected Back to Transducer by Metal Air Interface (Defect)
- Portable and No Radiation Hazard

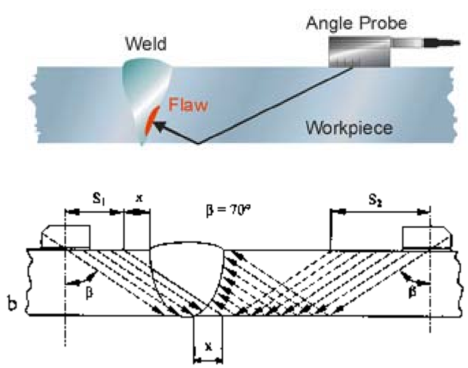
101

Conventional Ultrasonic Testing



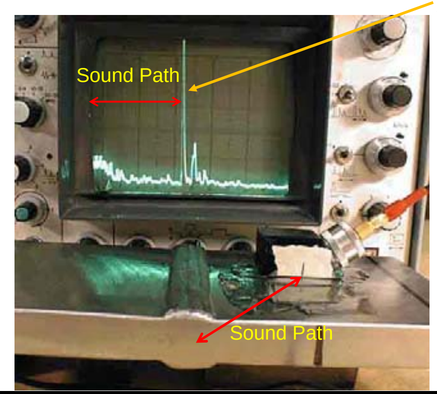
102

Ultrasonic Inspection



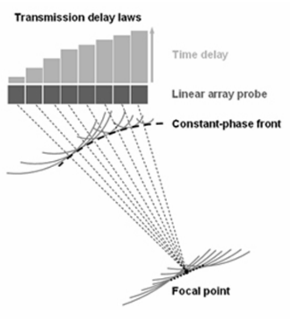
103

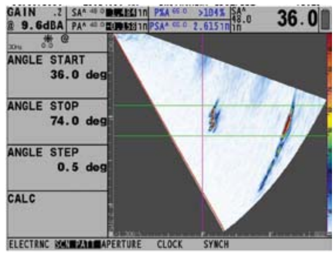
Angle Beam Testing of Weld



104

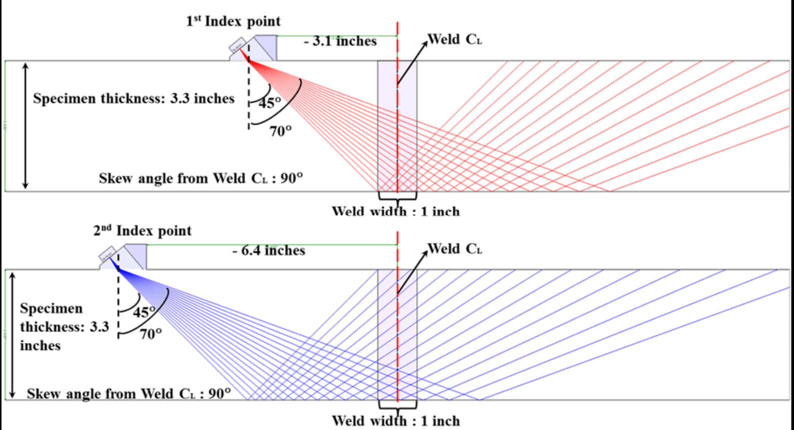
A New Technology
Phased Array Ultrasonic Inspection



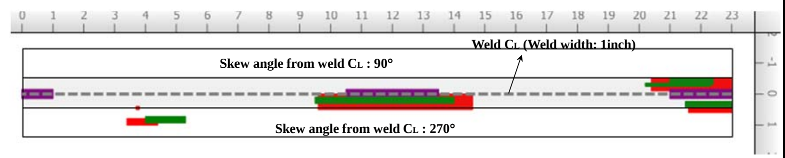


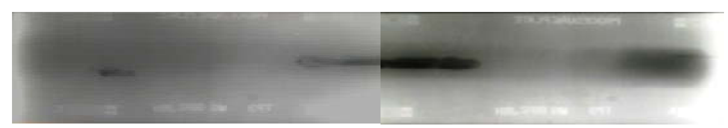
Transducer Contains Multiple Elements

Typical Scan



UT Vs RADIOGRAPHY: SPECIMEN TP3 (TOP VIEW)



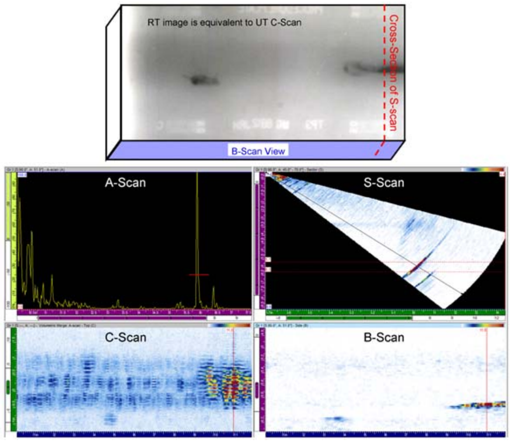


: PHASED ARRAY ULTRASONICS MEASUREMENTS AT TFHRC

: SINGLE ELEMENT ULTRASONIC TESTING IN ACCORDANCE TO AWS D1.5 AT TFHRC

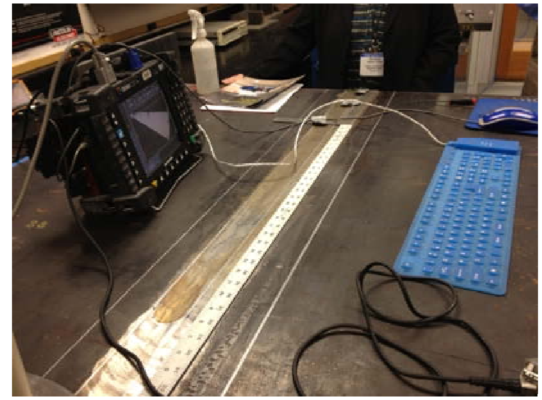
: SINGLE ELEMENT ULTRASONIC TESTING IN ACCORDANCE TO AWS D1.5 BY FABRICATOR

Ability to Change the View of the Data



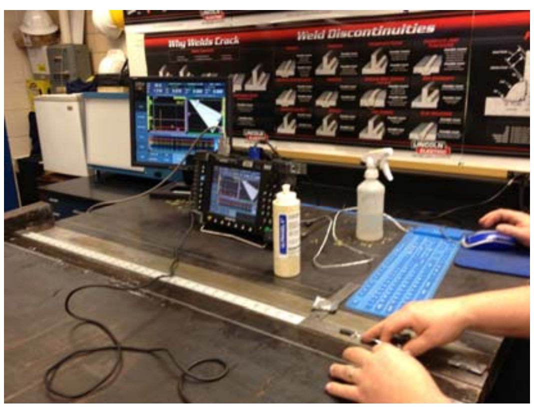
109

Set to Scan Weld



110

Scanning Weld



Position Along Weld and Returned Signal Recorded Digitally

111

PAUT

- Digital Record of Inspection-not just an OK
- Less Operator Dependent but Requires Experienced User to Set Up Equipment
- Faster Than Conventional UT
- No Radiation Hazard
- Recognized in AWS D1.5

112

In Process Inspection

113

Heat Curved to Match Road Geometry

114

Girder Lay Down to Fit Field Splices

115

Flange Splice
Splice Plate Used as Template

116

Web Splice

117

Match Drill Flanges and Webs Using Splice Plate for Template

1. Fabricate Splice Plates
2. Lay Down Girders
3. Clamp Plates to Girders
4. Match Drill

118

Completed Girder Ready for Paint

119

Tub Girder Ready For Shipping

120

New Methods (Virtual Assembly)
Eliminate Manual Drilling and Shop Assembly

Operations:

1. Cut and Drill Plates on Cutting Table
2. Assemble Girder-Weld Web to Flanges
3. Measure Girders to Determine Exact Hole Locations and Girder Geometry
4. Input Girder Geometry Into Computer
5. Assemble on Girders Virtually in Computer
6. Output Required Splice Plate Geometry to CNC Equipment

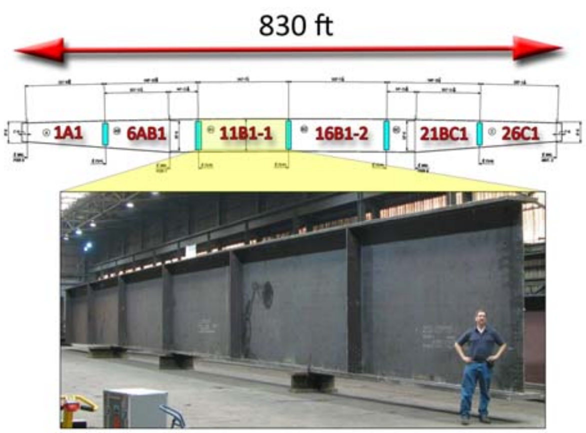
121

First Implementation

- Implemented in Virginia Sponsored Pooled Fund Study
  - Principal Investigator- Paul Fuchs (Fuchs Consulting, Inc.)
  - Tennessee DOT Bridge
  - Girder Fabrication by Hirschfeld Industries

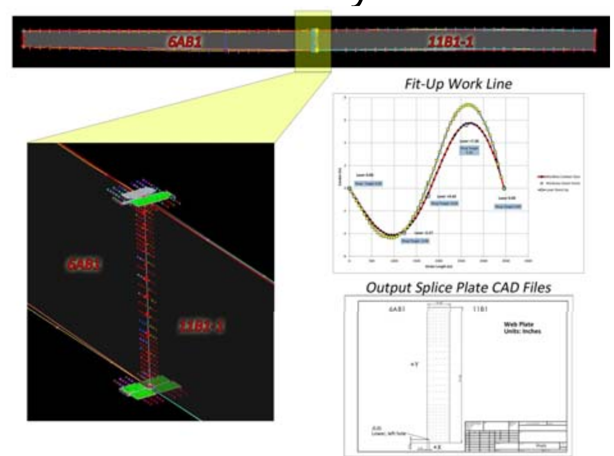
122

Tennessee DOT Bridge Job



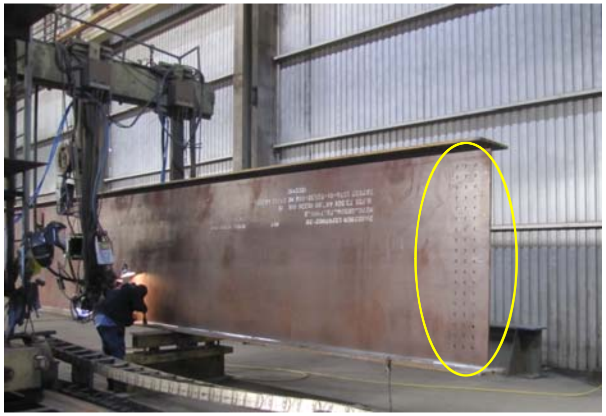
123

Virtual Assembly Software



124

Welding of Girder With Splice Holes



125

Predrilled Girders Trimmed and Adjusted for Correct Length and Camber

126

Hole Location Measurement Using Laser

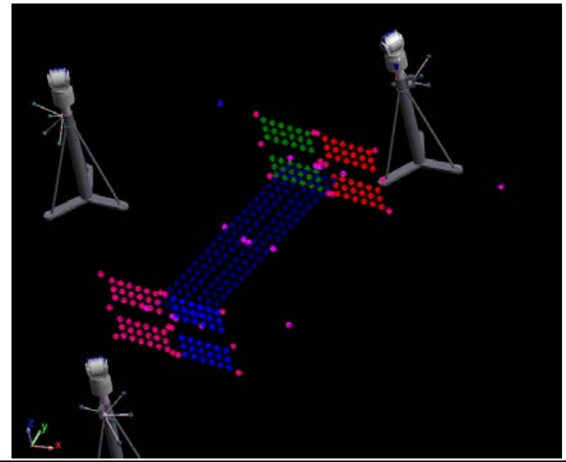
127

The Target-SMR Spherically Mounted Retroreflector

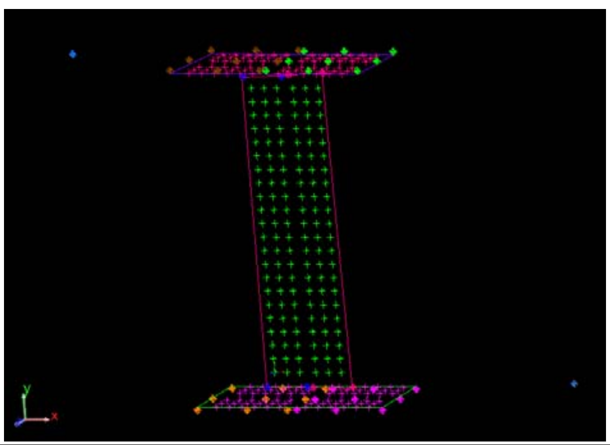
128

Measuring Connections on Curved Girder

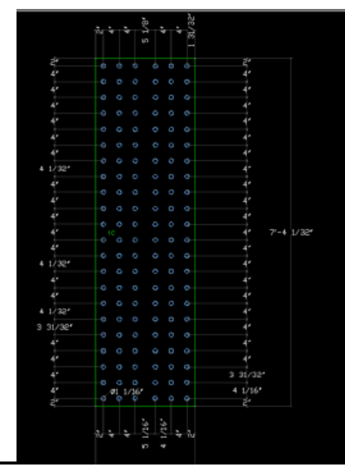
Scan Ends of Girders in Lay Down



Development of Splice Plate Geometry

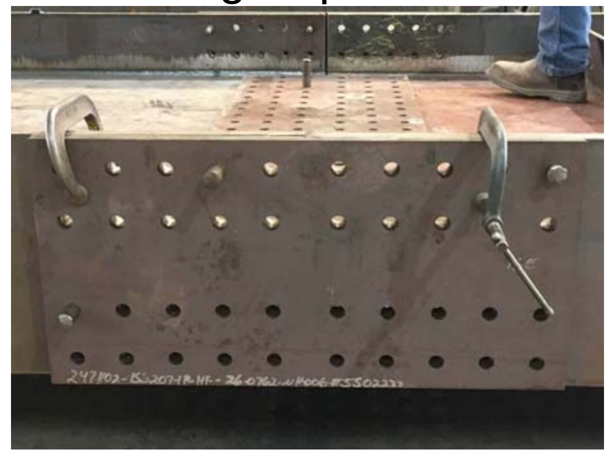


Splice Plate Detailed in Autocad



Check of Splice Plate Fitup

Flange Splice Fit



It Fits!

State of the Art

- Short Term:
  - Lay down two girders to determine splice geometry
  - Verify splice plate geometry by laser measurement
  - Verify fit up of stack up of splice plates and fillers on computer
- Long Term:
  - Full Virtual Assembly- Elimination of Lay Down of 2 Girders

The Savings

- Reduced Material Handling-Drilling and Cutting in One Operation
- Speed- Hole Drilling About 10 times faster (3 seconds a hole)
- No Girder Lay Down Required (Girders can be fabricated in separate shops)

137

Next Steps

- Painting
- Shipping

138

Girder Surface Prepared by Blasting Before Painting

139

Blasted Curved Girder

140

Painting
Often 3 Coats

141

Final Inspection

Final inspection is performed first by in-house QC department and lastly by the owner's quality representative

142

Over Road Shipping

143

Too Tall-Ship with Web Flat

144

Super Loads Require Escorts and Special Permits

145

Too Long and Too Tall-Railroad as Last Resort

146

Tappan Zee Girders Loaded On Barge For Shipment From North Carolina to Hudson River Assembly Site

147

Optimal Fabrication Capacities

Transportation Limits

Standard

Up to 120” Girders depths with parallel Flanges

Up to 144” Haunched Girders

Conditional

Up to 168” with State permission for Girder lay down during shipment

148

Shipping Permits

Annual Permit
- 12’ wide and 75’ long or less
- Travel only allowed on Non Posted Roads and Bridges – Specified Routes if over 80 kip

Single trip Permit
- 15‘ Wide, 14‘ Tall , Max. Length 120‘
- Over 14‘ tall loads require 2 more days review time
- Gross weight Limits
  - 5 Axle 112,000 Lbs
  - 6 Axle 120,000 Lbs
  - 7 Axle 132,000 Lbs

Superload Permit
- Over 120’ in length
- 10 day Minimum Review Time
- Gross weight > 132 kip requires 3 additional days for Bridge review

149

Summary

- Welding and Weld Inspection
  - D1.5 Controls
  - PQR Demonstrate Ability of Fabricator to Make the Weld
  - WPS is the Procedure Based Upon the PQR
  - Thicker Higher Strength Plates Require Higher Preheats and Greater Welding Skill
  - SAW is the Most Common Welding Process
  - NGESW Gaining Popularity
- Weld Inspection
  - RT is Slow and Dangerous, Film Record
  - UT Portable and Fast, no Record
  - PAUT Ease of UT with Digital Record

150

Summary

- Residual Stresses are Unavoidable and Not Calculated
- Virtual Assembly Field Spices on the Computer
  - Proven Technology Used in Other Industries
  - Provides a Digital Record of Fitup
- Design it Like You are Going to Build It
  - Avoid Short Lengths of Unique Plates
  - Space Welded Splice to Allow Slabbing of Welds
  - Size Field Pieces to Shipping Lengths
  - Ask the Fabricator About Any Questions

151

Good Design of Simple Bridge

152

A New Day Another Bridge

153

Polling Question 1

True or False:

Higher preheat temperatures are used in thicker plates to reduce the amount of energy input into the weld.

154

Polling Question 2

True or False:

Changing flange area by changing the flange width in the field section is preferred.

155

Questions?

156

Individual Webinar Registrants

CEU/PDH Certificates

Within 2 business days…

- You will receive an email on how to report 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!

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Individual Webinar Registrants

CEU/PDH Certificates

Within 2 business days…

- Reporting site (URL will be provided in the forthcoming email).
- Username: Same as AISC website username.
- Password: Same as AISC website password.

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8-Session Package Registrants

CEU/PDH Certificates

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

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8-Session Package Registrants

Course Resources

1. Log on to your AISC account and go to Course Resources. https://www.aisc.org/myaisc/course-resources/
2. Locate your course.
3. Access handouts, videos, quizzes, quiz scores and attendance records.

AISC › MYAISC › COURSE RESOURCES › STEEL BRIDGE DESIGN

Steel Bridge Design

8-SESSION PACKAGE RESOURCES

Event	Date	Handouts	Video	Quiz	Attendance
R1: Introduction To Bridge Engineering	N/A	Handouts	View Passcode: RZN5141	Pass Score: 80	N/A
R2: Introduction and History of AASHTO Bridge Design	N/A	Handouts	Available 9/11/2017 5:00 PM EDT	Available 9/11/2017 5:00 PM EDT	N/A
R3: Steel Material Properties	N/A	Handouts	Available 9/11/2017 5:00 PM EDT	Available 9/11/2017 5:00 PM EDT	N/A
R4: Loads and Analysis	N/A	Handouts	Available 9/11/2017 5:00 PM EDT	Available 9/11/2017 5:00 PM EDT	N/A
L1: Steel Bridge Fabrication	Oct 12 2017 1:30PM EDT	Handouts	Available 10/14/2017 5:00PM EDT	Available 10/14/2017 5:00PM EDT	Pending
L2: Plate Girder Design and Stability	Oct 19 2017 1:30PM EDT	Handouts	Available 10/21/2017 5:00PM EDT	Available 10/21/2017 5:00PM EDT	Pending
L3: Effects of Curvature and Skew	Oct 26 2017 1:30PM EDT	Handouts	Available 10/28/2017 5:00PM EDT	Available 10/28/2017 5:00PM EDT	Pending
L4: Fatigue and Fracture	Nov 2 2017 1:30PM EDT	Handouts	Available 11/04/2017 5:00PM EDT	Available 11/04/2017 5:00PM EDT	Pending
Intro To Steel Bridge Design - Final Exam	Nov 23 2017 8:00AM EST			Available 11/25/2017 5:00PM EST	

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8-Session Package Registrants
Videos and Quizzes

Videos
- For Sessions R1 – R4, find access to recordings starting September 11. Recording access expires on November 23.
- For Sessions L1 – L4, find access to recordings within two days after the live air date. Recording access expires three weeks after the live session.

Quizzes
- For Sessions R1 – R4, find access to quizzes starting September 11. Quizzes are due on November 23.
- For Sessions L1 – L4, find access to quizzes within two days after the live air date. Quizzes are due three weeks after the live session.
- A final exam will also be given.
- Quiz scores are displayed in the Course Resources table.

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8-Session Package Registrants
Course Credit

Attendance and PDH Certificates
- For Sessions R1 – R4, you must pass the quiz to receive credit for the session.
- For Sessions L1 – L4, you have two options to receive credit for the session.
  - Option 1: Watch the session live. Credit for live attendance will be displayed in the Course Resources table within two days of the session.
  - Option 2: Watch the recording and pass the quiz.

EEU Certificates – Certificate of Completion
- In addition to PDH certificates earned for each individual session, an EEU (Equivalent Education Unit) certificate of completion will be issued for participants who complete the full course. Participants must pass at least 7 of 8 quizzes and the final exam to earn the EEU.

Distribution of Certificates
- All certificates (PDH and EEU) will be issued after the final session. Only the registrant will receive certificates for the course.

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Thank You

Please give us your feedback!
Survey at conclusion of webinar.

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structural STEEL