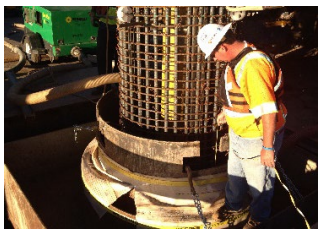
Volume 4, Issue 7 July 20, 2020

Forms

STRUCTURE BULLETIN

NCDOT Construction Unit

Website email



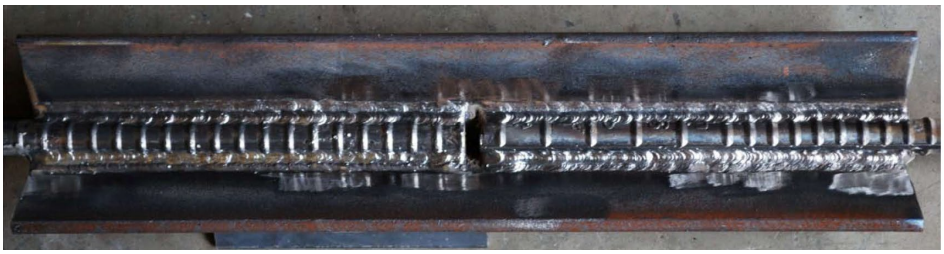
1. Shaft Inspection
2. Deck Drains Over Caps
3. Welding Reinforcing Steel
4. Training

Current Issues: Shaft Inspection

How many inspectors does it take to properly inspect a drilled shaft pour? Well, there are many factors that go into that answer, size of pour, type of pour (wet/dry), utilization of a pump, etc. Generally speaking, a minimum of two inspectors would be required. One can focus on testing the concrete, while the other inspects the placement. Larger pours could require more inspectors. Have you ever found yourself with no other available inspectors to help? With the current budget and inspector staffing issues, unfortunately, this may be more common. Testing the concrete is only one small element of an inspector's responsibilities on a shaft pour. They need to watch the initial placement of the tremie/pump hose to ensure it is on the bottom, watch to make sure it doesn't jump off the bottom when pumping begins, monitor the tremie depth, check for proper timing of raising temporary casings, look for signs of water intrusion, voids, mud/debris falling off casings, volume of concrete placed vs. theoretical, proper alignment of the cage, ensuring the cage does not float, etc……. Resident Engineers should make every effort possible to ensure at least two inspectors are present on every shaft pour. However, if this is not possible, and you are responsible for everything, setting up your concrete testing station as close as possible to the point of placement is advised. Also remember which tests are most important. Slump and cylinders are vital, while air content for a non air entrained mix placed below ground is far less critical. Once you run the required concrete tests, every effort should be made to hustle to the point of placement and inspect the actual placement operation. As always, being prepared with notes, elevations, etc. in your structure workbook will also make you better prepared for pour day.

Deck Drains Over Caps:

Properly detailed plans should avoid deck drains discharging over or near caps.
Sometimes this may be overlooked, resulting in a situation like the one above. Discharging water and salts directly onto the caps accelerates deterioration and is unsightly. Always check to make sure your drains are not over the cap, and if so, you should move them enough to miss the cap.



Welding Reinforcing Steel

Can I weld to reinforcing steel?

By and large, no. Welding to reinforcing steel can cause brittle areas to form and result in failure. Welding snap ties or other connections to reinforcing steel, welding bars together in splices for stability (think drilled shaft cages), or most other situations you can think of are not permitted. The one exception to this guidance is for rehabilitation work. If a milling machine pulls up a bar in a deck, the options for repair are limited.

In order to perform a proper lap splice, you would have to expose additional bar for the lap using a Class II repair. This could cause significant removal of otherwise sound concrete solely for the purpose of making a splice.

Another option would be for a mechanical splice. This would, however, significantly reduce the amount of cover over the bars and cause accelerated corrosion.

To avoid these two problems, we allow a butt splice with angle in this one situation. The two ends of the bar are nested in a section of steel angle and are welded in place. M&T has an approved welding procedure for this situation, and it is the only situation where we currently allow for reinforcing steel to be welded. The procedure is attached to this Bulletin.

Area Construction Engineers:

Div	Contact	Phone
1&2	Randy Hall	282-402-9957
3&4	David Candela	910-524-4931
5	Troy Brooks	336-972-4627
6&8	John Partin	336-847-1226
7	Aaron Griffith	336-215-9170
9	Vickie Davis	704-202-0945
10	Darin Waller	980-521-5176
11&12	Doug Eller	336-877-7048
13&14	Aaron Powell	828-694-7971

Videos:

Inspection training videos can be found on the Construction Unit YouTube playlist.

Training:

Structure Bulletins are now archived on the Construction Unit website under Construction Resources.

Contents of the Structure Bulletins now show up under the file link in the archive, so you no longer need to look through the index spreadsheet to look up a previous topic.

If you have a topic you would like to see addressed in a future edition of the Structure Bulletin, please email us at either acochran@ncdot.gov or aearwood@ncdot.gov

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
REBAR INDIRECT BUTT JOINT WITH SPLICE ANGLE
WELDING PROCEDURE SPECIFICATION (WPS) AWS D1.4

Specifications, Codes & Supporting Document: **NCDOT Standard Specifications/AASHTO/AWS D1.4, PQR-030**

Material Specifications: **ASTM A615 Grades 75, 60 & 40, ASTM A706 Grade 60; Bar size 4 to 18 Inclusive**

Welding Process: **SMAW** Manual or Semi- Automatic or Automatic: **Manual**

Filler Metal Specification: **AWS A5.1** Classification: **E-7018**

Manufacturer: **NCDOT Approved Electrodes** Single or Multiple Pass: **both** Position of Weld: **Flat**

Welding Current: **DC** Polarity: **Positive** Progression: **N/A**

Root Treatment: **N/A**

Preheat Temp: **Refer to preheat table below** Interpass: **1100° maximum** Post Heat: **N/A**

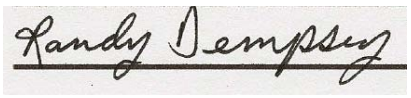
Pass Num.	Electrode Size	Welding Current Amperes	Welding Current Volts	Travel Speed	Position	Joint Details
All	**1/8”**	**90-150**	**20-23**	**6-9 ipm**	All	SEE ATTACHMENT

PREHEAT TABLE	
Rebar Size	**Min. Temp.**
#6 or less	300°
#7 or larger	500°

COMMENTS:
Remove all coating, rust, dirt and mill scale within one inch of the area to be welded.
Pre-heat shall extend 6" in each direction beyond the joint.
Remove all slag, spatter and weld discontinuities between passes.
Check interpass temperature prior to the application of each pass.
Clean the completed weld of all debris, slag and spatter.

WPS Description: **REBAR Indirect Butt Joint With Splice Angle**

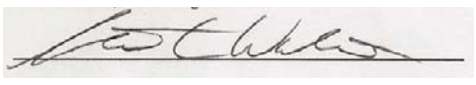
Written By: **Randy Dempsey, CWI/CWE, TT IV**

Signature: 

WPS #: **062111030**

Authorized By: **Steve Walton, Metals Engineer**

Revision #: **1**

Signature: 

Workmanship (AWS D1.4)

4.4 Quality of Welds

4.4.2 Any crack shall be unacceptable, regardless of size or location.

4.4.3 There shall be complete fusion between weld metal and base metal and between successive passes of weld.

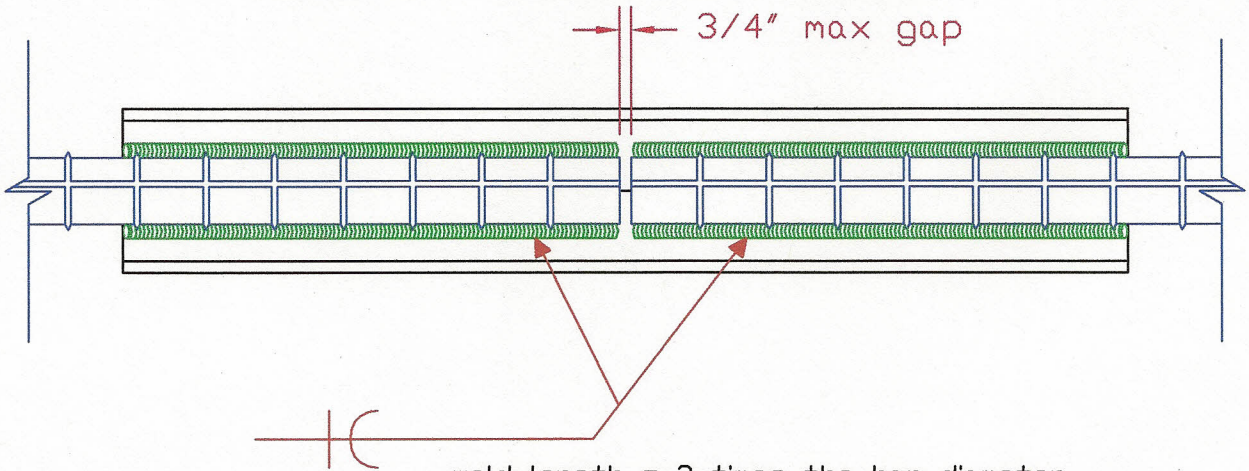
4.4.4 All weld craters shall be filled to a cross section that meets the miniimum specified weld size.

4.4.5 Welds shall be free from overlap.

4.4.6 Undercut depth greater than 1/32" in the solid section of the bar or structural member shall not be allowed.

4.4.10 The weld size shall be equal to or greater than the weld size specified. The length of weld containing this weld size shall be equal to or greater than the weld length specified. Any portion of the length, including starts or stops, that contain a smaller weld size shall not be measured in the weld length.

WPS REBAR Indirect Butt Joint with Splice Angle 062111030R1
JOINT DETAIL ATTACHMENT

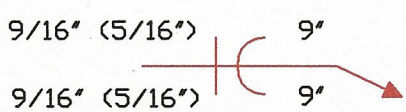


weld size = 40 percent of the bar radius (min), or as directed by the plans

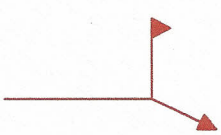
weld length = 2 times the bar diameter (min), or as directed by the plans

REBAR Indirect Butt Joint with Splice Angle
JOINT DETAILS

Weld Symbol definitions per AWS A2.4:2007



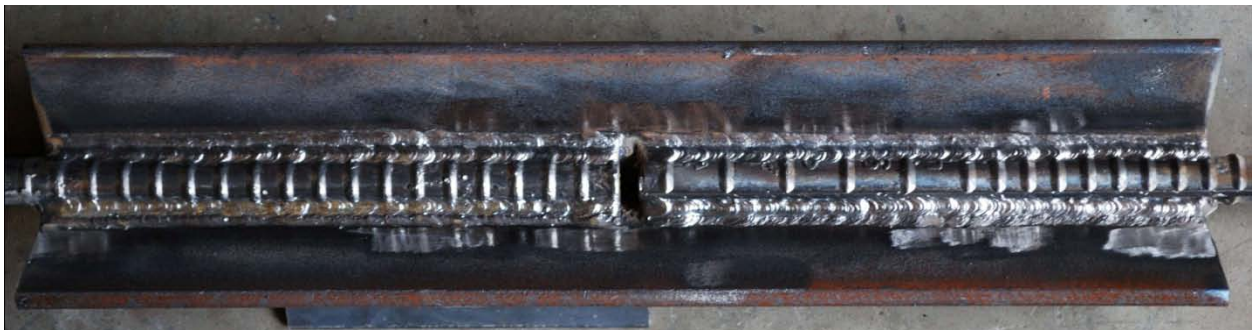
Flare Bevel, Both Sides with Groove Depth, Weld Size and Length of Weld



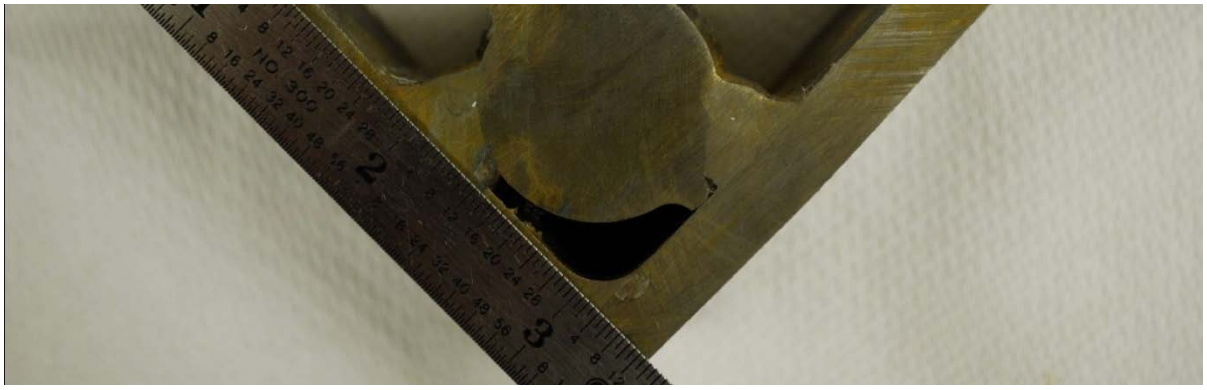
FIELD WELD SYMBOL

Illustrations for a rebar indirect butt joint with splice angle.

Joint fit-up.



Completed weld (3 passes).



A cross section was tested to verify that a 5/16" weld can be achieved with 3 passes using 1/8" E7018.

A tensile test was performed to verify that the integrity of the material was not compromised (a 500°F preheat and interpass temperature was maintained).

North Carolina Department of Transportation
Materials Tests Unit (Steel Section)

Rebar Indirect Butt Joint with Splice Angle PQR

Procedure Qualification Record No. PQR-030

Contractor: **NCDOT Materials & Tests (Steel Section)**
Authorized By: **Steve Walton** Revision No.: **1**
Welder: **Randy Dempsey, CWI/CWE** Test Date: **Monday, June 27, 2011**
Welding Process: [ ] FCAW-G [ ] FCAW-S [ ] GMAW [X] SMAW

PQR Joint Type [ ] Direct Butt [X] Indirect Butt [ ] T-Joint
Test Assembly: [ ] Figure 6.5 A [ ] Figure 6.5 B [X] Figure 6.5 C [ ] Figure 6.5 D
Position: **flat** Groove Type: **flare bevel** [ ] single bevel
Joint Opening: **3/4" max** Root Face: **n/a** [X] double bevel
Backing: [ ] yes [X] no Backing Type: **n/a**
Backgouging: [ ] yes [X] no Backgouging Method: **n/a**
Technique: [X] stringers [ ] weave Groove Angle: **n/a**

Electrical Characteristics
Current: [ ] AC [X] DCEP [ ] DCEN
Transfer Mode (GMAW): [ ] Short-circuiting [ ] Globular [ ] Spray

Base Metal Material Specification: **ASTM A615** Grade: **60**
welded to: Material Specification: **ASTM A36-08/A529-05** Grade: **60**
Carbon Equivalent (Bar): **not available** Bar Size: **#6**
Coated Bar: [ ] yes [X] no Type of Coating: **n/a**

Filler Metal
AWS Specification: **AWS A5.1** AWS Classification: **E-7018**

Shielding
Gas: [ ] single [ ] mixture Composition: **n/a** Flow Rate: **n/a**

Preheat/Interpass
Preheat/Interpass Temperature (min): **300° F**
Interpass Temperature (max): **1100° F**

Welding Parameters

Pass Number	Electrode Diameter	Type	Amperage	IPM	Volts	Joint Detail
1	**1/8"**	**E7018**	**115**	**7**	**29**	**see attachment**
2-3	**1/8"**	**E7018**	**110**	**8**	**29**	

North Carolina Department of Transportation
Materials Tests Unit (Steel Section)

Rebar Indirect Butt Joint with Splice Angle PQR

Procedure Qualification Record No. PQR-030 (continued)

TEST RESULTS

Visual Examination

Test Assembly Number One		Test Assembly Number Two	
[X] pass	[ ] fail (AWS) D1.4, Clause 4.4	[X] pass	[ ] fail (AWS) D1.4, Clause 4.4
Comments **Within tolerance of specifications.**		Comments **Within tolerance of specifications.**	

Tensile Test

Test Assembly Number One		Test Assembly Number Two	
[X] pass	[ ] fail (AWS) D1.4, Clause 6.3.7.2	[ ] pass	[ ] fail (AWS) D1.4, Clause 6.3.7.2

Specimen No.	bar size		Area	Ultimate Tensile Load (lbs)	Ultimate Unit Stress (psi)	Character of Failure and Location
1	**#6**		**0.44**	**47,954**	**108,986**	**aprox. 3" outside the heat affected zone (see photo)**

Macroetch Test

Test Assembly Number One		Test Assembly Number Two	
[ ] pass	[ ] fail (AWS) D1.4, Clause 6.3.7.3	[X] pass	[ ] fail (AWS) D1.4, Clause 6.3.7.3

Specimen No.	Results	Remarks
2	**pass**	**A 5/16" weld was achieved with the application of 3 passes.**

Welder's Name **Randy Dempsey, CWI/CWE** Welder ID No. **2659 SCW**

Visual Test Conducted By **Richard Maxon, CWI**

Tensile Test Conducted By **Dan Miller** HiCams No. **543029**

Macroetch Test Conducted By **Richard Maxon, CWI**

We certify that the statements in this record are correct and that the welds were prepared and tested in accordance with the requirements of AWS D1.4, Structural Welding Code-Reinforcing Steel.

Contractor **NCDOT Materials & Tests (Steel Section)**

Authorized by **Steve Walton** Date **Monday, June 27, 2011**

Sample Status: Meets Specs

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
MATERIALS AND TESTS UNIT
1801 BLUE RIDGE RD. RALEIGH, N.C. 27607
06/28/2011
Reinforcing Steel Test

Hicams No.: 543029
Contract No.:
County: Forsyth
Date Sampled: 06/28/2011
Sampled By: Dempsey, Randy
Sampled From: Project
Contractor:
Prod./Suppl.:
Facility:
Material: Reinforcing Steel, Plain

T.I.P. No.:
Field ID: 1
Engineer:
Received: 06/28/2011

Work Order No.:
P.O./Other No.:
Reported: 06/28/2011
Test Category: Informational
Represented Qty.: 20.000 LB

Lab No.: P367530

Test No.: ASTM A615

TENSILE TESTING

METRIC

	Results
Bar Size:	6
Nominal Area, sq. in.:	0.44
Wt. Actual % of Theoretical:	
Yield Strength, P.S.I.:	65718
Total Load, lbs.:	47954
Tensile Strength, P.S.I.:	109000
Elongation (8 in.), %:	

Comments:

V. O. Cordle

V. OWEN CORDLE
PHYSICAL TEST ENGINEER

cc:

0.44
6
ASTM A615

Page 1 of 1

Test Summary

Counter:	33967
Elapsed Time:	00:01:29
Heat Number:	
Lab:	
Procedure Name:	Rebar
Start Date:	6/28/2011
Start Time:	10:57:13 AM
End Date:	6/28/2011
End Time:	10:58:42 AM
Workstation:	N.C. DOT
Tested By:	owen

Test Results

Area:	0.4400 in²
Peak Load:	47954 lbf
Tensile Strength:	108986 psi
Halt of Force Yield:	65718.1800 psi