



# HIGH PERFORMANCE STEEL

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A Brief Overview of the  
use of HPS from the  
NCDOT Perspective

Jeff Vones, PE  
and  
Allen Raynor, PE





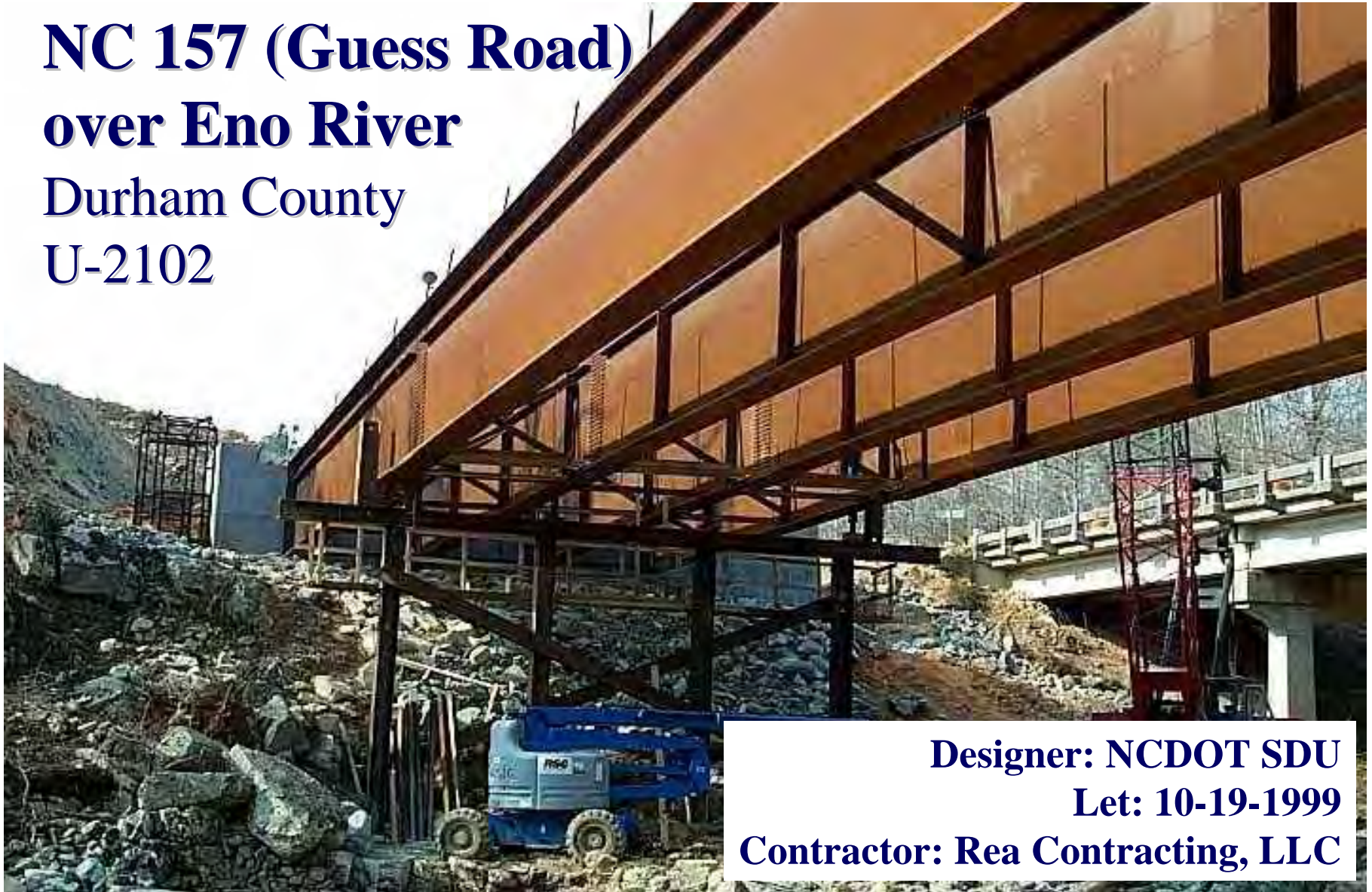
## A Look at Three Projects

- NC 157 (Guess Road) over Eno River
  - U-2102 Durham County
- U.S. 64 over Hiwassee River & Martin Creek
  - R-0977A Cherokee County
- SR 1102 (Langtree Road) over I-77
  - I-4411 Iredell County



STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION

# **NC 157 (Guess Road) over Eno River Durham County U-2102**



**Designer: NCDOT SDU  
Let: 10-19-1999  
Contractor: Rea Contracting, LLC**



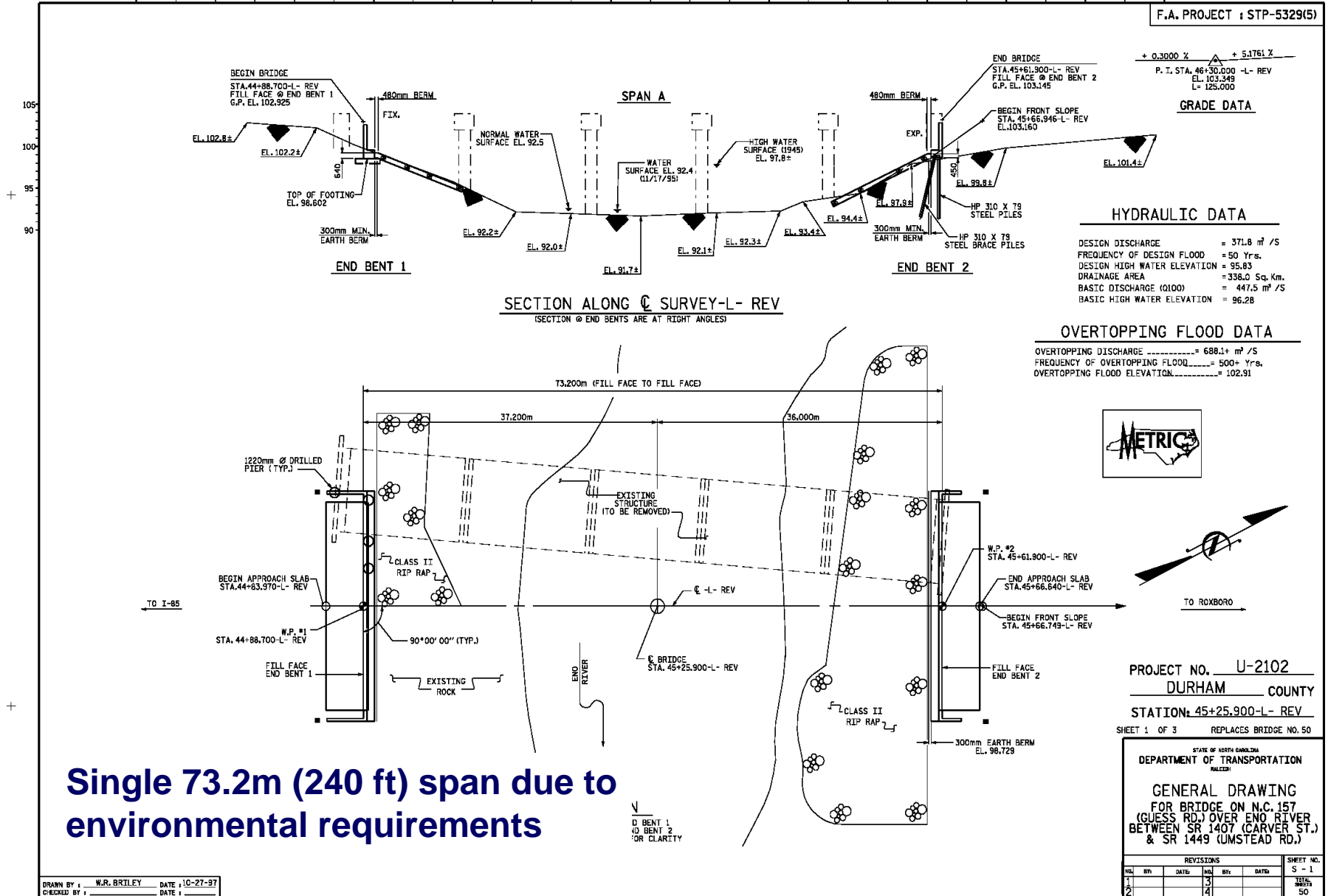


## Project Data

- Single Span of 73.2m (240')
- Clear Roadway Width of 21.6m (70'-10")
  - w/ two 1.5m (5') Sidewalks
- Girder Spacing
  - Stage I: 3.24m (10'-7 1/2")
  - Stage II: 2.94m (9'-7 3/4")
- Girder Depth of 2.64m (8'-8")
- First use of HPS485W (70ksi) in NC



F.A. PROJECT : STP-5329(5)



## Single 73.2m (240 ft) span due to environmental requirements

DRAWN BY : W.R. BRILEY DATE : 10-27-97  
CHECKED BY : \_\_\_\_\_ DATE : \_\_\_\_\_

REVISIONS						SHEET NO. S - 1
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2			4			

STR.#1



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DEPARTMENT OF TRANSPORTATION







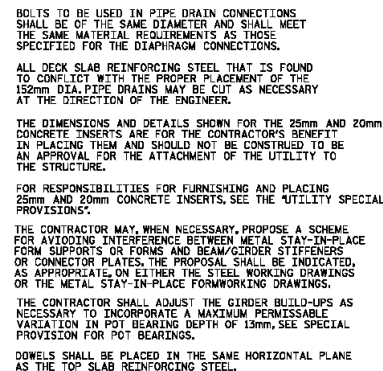
The diagram illustrates the details of a drain connector assembly. It includes two cross-sectional views:

- SECTION A-A**: Shows a side view of the connector. Key dimensions include a total width of 100mm, a central slot width of 50mm, and a height of 200mm. The top flange has a thickness of 10mm. The bottom flange has a thickness of 10mm. The central slot is labeled "E".
- SECTION B-B**: Shows a front view of the connector. Key dimensions include a total width of 76mm, a central slot width of 30mm, and a height of 48mm. The top flange has a thickness of 10mm. The bottom flange has a thickness of 10mm. The central slot is labeled "F".

Additional notes and labels include:

- "PROVIDE SLOTS AS NECESSARY TO ALLOW ADJUSTMENTS Laterally & LONGITUDINALLY"
- "STAINLESS STEEL WORM DRIVE HOSE CLAMP"
- "27mm x 100mm E"
- "50mm TO 200mm"
- "30 (TYP.)"
- "27mm x 76mm SLOT"
- "27mm x 48mm SLOT"

## Staged Construction



SHEET 1 OF 4

STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION  
RAILROAD

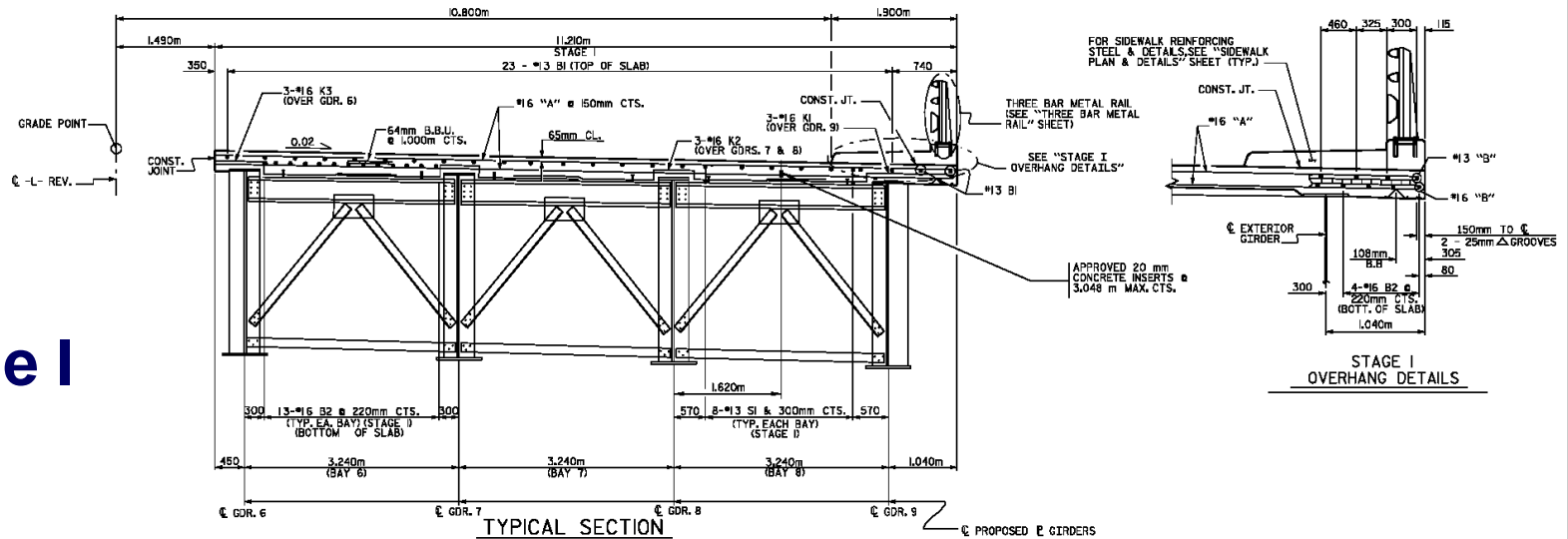
SUPERSTRUCTURE  
TYPICAL SECTION

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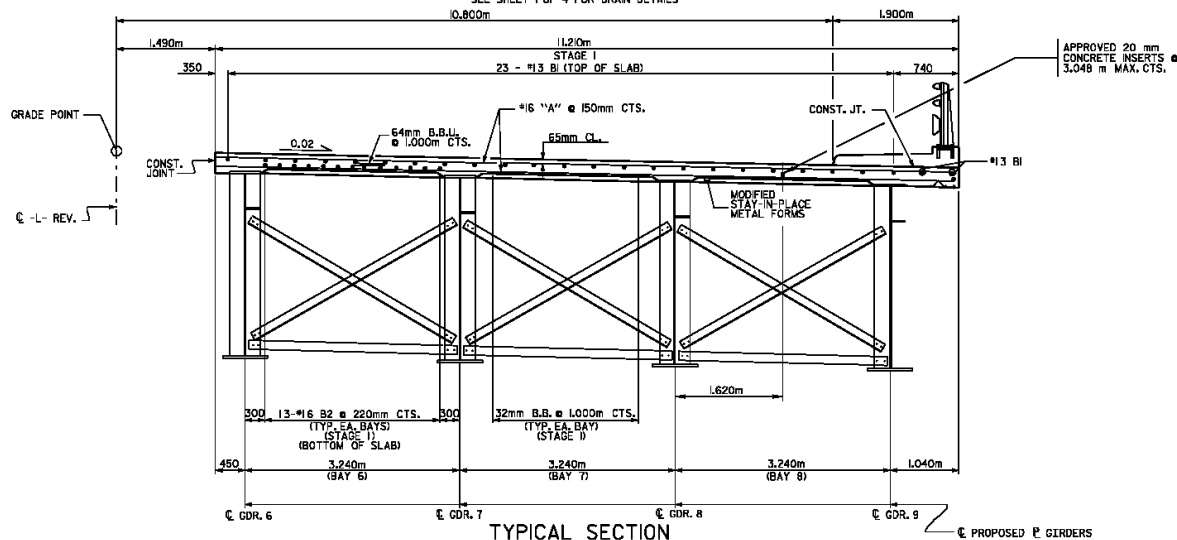


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TYPICAL SECTION

(SHOWING END BENT DIAPHRAGMS)  
DECK DRAIN NOT SHOWN FOR CLARITY  
SEE SHEET 1 OF 4 FOR DRAIN DETAILS



TYPICAL SECTION

(SHOWING INTERMEDIATE DIAPHRAGMS)  
DECK DRAINS NOT SHOWN FOR CLARITY  
SEE SHEET 1 OF 4 FOR DRAIN DETAILS

FOR SIDEWALK REINFORCING  
STEEL & DETAILS, SEE "SIDEWALK  
PLAN & DETAILS" SHEET (TYP.) -

CONST. JT. —

THREE BAR METAL RAIL  
(SEE "THREE BAR METAL  
RAIL" SHEET)

SEE "STAGE 1  
OVERHANG DETAILS"

APPROVED 20 mm  
CONCRETE INSERTS  
3.048 m MAX. CTS.

EXTERIOR

### STAGE I OVERHANG DETAILS

PROJECT NO. U-2102  
DURHAM COUNTY  
 STATION: 45+25.900 -L- REV.

SHEET 2 OF 4

STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION  
PLAN 1000

SUPERSTRUCTURE  
 TYPICAL SECTION  
 STAGE I

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	
1			3			TOTAL SHEETS
2			4			50

DRAWN BY : M. E. POOLE DATE : 8/21/98  
CHECKED BY : \_\_\_\_\_ DATE : \_\_\_\_\_





The figure contains several technical drawings for a bridge superstructure:

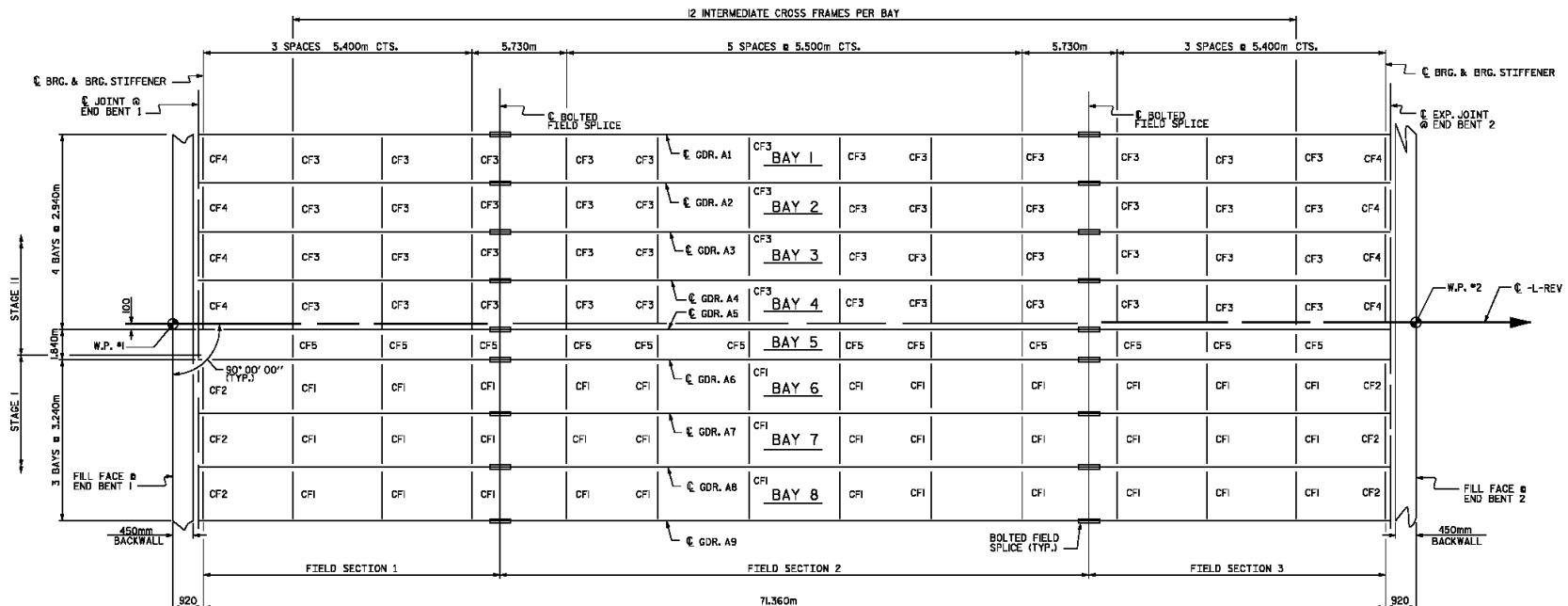
- TYPICAL SECTION (Top):** A cross-section of the bridge deck showing a total width of 10.800m. It includes details for the top slab (14.190m wide), reinforcement (3-#16 K5 over GDRs 2, 3, & 4), and various girders (GDR. 1 to GDR. 5). It also shows a "CONST. JOINT" and "GRADE POINT".
- TYPICAL SECTION (Bottom):** A cross-section showing the bottom of the slab and reinforcement details (260 #12-#16 B2 @ 220mm CTS.). It includes a "CONST. JOINT" and "GRADE POINT".
- STAGE II OVERHANG DETAILS (Top Right):** A detailed view of the overhang showing reinforcement (3-#16 K4 over GDR. 5) and a "CONST. JOINT".
- CLOSURE POUR DETAILS (Bottom Right):** A detailed view of the closure pour showing reinforcement (4-#16 B2 @ 220mm CTS.) and a "CONST. JOINT".

Other labels include: "APPROVED 25 mm GALV. HANGER ROD", "FOR WATER MAIN LATERAL BRACE ASSEMBLY, SEE 'UTILITY ATTACHMENTS DETAIL SHEET'", "APPROVED GALV. CLEVIS TYPE HANGER FOR 400 mm D.I. RESTRAINED JOINT WATER PIPE", "APPROVED 25 mm GALV. CONCRETE INSERTS @ 2.438 MAX. CTS.", "MODIFIED METAL STAY-IN-PLACE FORMS", "MIN. PROJECTION", "TYP.", "L.840m", "920", "470", "100", "2.940m", "2.840m", "1.040m", "1.470m", "1.900m", "10.800m", "14.190m", "STAGE II", "GDR. 1", "GDR. 2", "GDR. 3", "GDR. 4", "GDR. 5", "CLOSURE POUR", "CONST. JOINT", "GRADE POINT", "SEE 'CLOSURE POUR DETAILS'", "SEE 'STAGE II OVERHANG DETAILS'", "FOR SIDEWALK REINFORCING STEEL & DETAILS, SEE 'SIDEWALK PLAN & DETAILS' SHEET (TYP.)", "EXTERIOR GIRDER", "L.400m", "150mm TO C", "2 - 25mm Δ GROOVES", "305", "108mm S.B.", "4-#16 B2 @ 220mm CTS. (BOTT. OF SLAB)", "L.040m", "300", "470", "920", "1.840m", "50", "670mm", "770mm", "MIN. PROJECTION", "4-#16 'B' @ 220mm CTS.", "130", "19 D1", "50 CL.", "450", "920", "470", "1.840m", "CLOSURE POUR", "CONST. JOINT", "SEE 'CLOSURE POUR DETAILS'", "SEE 'STAGE II OVERHANG DETAILS'", "FOR WATER MAIN LATERAL BRACE ASSEMBLY, SEE 'UTILITY ATTACHMENTS DETAIL SHEET'", "APPROVED GALV. CLEVIS TYPE HANGER FOR 400 mm D.I. RESTRAINED JOINT WATER PIPE", "APPROVED 25 mm GALV. CONCRETE INSERTS @ 2.438 MAX. CTS.", "MODIFIED METAL STAY-IN-PLACE FORMS", "MIN. PROJECTION", "TYP.", "L.840m", "920", "470", "100", "2.940m", "2.840m", "1.040m", "1.470m", "1.900m", "10.800m", "14.190m", "STAGE II", "GDR. 1", "GDR. 2", "GDR. 3", "GDR. 4", "GDR. 5", "CLOSURE POUR", "CONST. JOINT", "GRADE POINT", "SEE 'CLOSURE POUR DETAILS'", "SEE 'STAGE II OVERHANG DETAILS'", "FOR SIDEWALK REINFORCING STEEL & DETAILS, SEE 'SIDEWALK PLAN & DETAILS' SHEET (TYP.)", "EXTERIOR GIRDER", "L.400m", "150mm TO C", "2 - 25mm Δ GROOVES", "305", "108mm S.B.", "4-#16 B2 @ 220mm CTS. (BOTT. 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# STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

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## FRAMING PLAN

### NOTES

ALL GIRDER WEB PLATES, FLANGE PLATES, AND BOLTED FIELD SPICE PLATES SHALL BE HP5485W STEEL AND PAINTED IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS FOR WEATHERING STEEL.

ALL OTHER STRUCTURAL STEEL SHALL BE AASHTO M270 GRADE 450MM STEEL AND PAINTED IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS UNLESS OTHERWISE NOTED ON THE PLANS.

FOR HIGH PERFORMANCE STEEL, SEE SPECIAL PROVISIONS.

CAMBERED GIRDER LENGTHS SHALL BE ADJUSTED AND BEARINGS ARE TO BE PLACED ON THE CAMBERED GIRDERS AS TO BE ALIGNED WITH THE ANCHORS AFTER THE DEAD LOAD DEFLECTION HAS OCCURRED. SHOP PLANS SHALL BE PREPARED ACCORDINGLY.

STUDS ON GIRDERS MAY BE SHIFTED UP TO 25mm IF NECESSARY TO CLEAR FLANGE SPICE WELD.

ENDS OF GIRDERS SHALL BE PLUMB.

SHEAR STUDS ARE TO BE SHOP WELDED ON TOP OF SPICE PLATE BEFORE FIELD ASSEMBLY.

FOR RADIOGRAPHIC TESTING OF BUTT WELDS SEE SPECIAL PROVISIONS.

FOR PROTECTION OF PAINTED STEEL, SEE SPECIAL PROVISIONS.

FOR SURFACE PREPARATION OF UNPAINTED STRUCTURAL STEEL, SEE SPECIAL PROVISIONS.

SHOP SPICES ARE PERMITTED TO LIMIT THE MAXIMUM REQUIRED FLANGE PIECE LENGTHS TO 18 METERS AND WEB PIECE LENGTHS TO 14 METERS PERMITTED FLANGE AND WEB SHOP SPICES SHALL NOT BE LOCATED WITHIN 4.5 METERS OF MAXIMUM DEAD LOAD DEFLECTION. KEEP 800mm MINIMUM BETWEEN WEB AND FLANGE SHOP SPICES. KEEP 150mm MINIMUM BETWEEN CONNECTOR PLATE OR TRANSVERSE STIFFENER WELDS AND WEB OR FLANGE SHOP SPICES.

A CHARTER V-NOTCH TEST IS REQUIRED FOR WEB PLATES, BOTTOM FLANGE PLATES, BOTTOM FLANGE SPICE PLATES AND WEB FLANGE PLATES FOR ALL GIRDERS. SEE SPECIAL PROVISION FOR CHARTER V-NOTCH TESTS.

LONGITUDINAL STIFFENERS SHALL BE LOCATED ON THE OUTSIDE OF THE EXTERIOR GIRDERS AS INDICATED ON THE SUPERSTRUCTURE TYPICAL SECTIONS.

HOLES IN CONNECTOR PLATES FOR CROSSFRAME CF5 MAY BE FIELD DRILLED FOLLOWING THE COMPLETION OF STAGE AND STAGE IIPOURS AT THE DISCRETION OF THE CONTRACTOR.

INTERMEDIATE STIFFENERS AND INTERMEDIATE CROSSFRAME CONNECTOR PLATES SHALL BE OMITTED ON THE OUTSIDE OF EXTERIOR GIRDERS.

BEARING STIFFENERS ARE TO BE PLACED NORMAL TO THE WEB OF THE GIRDER AND SHALL BE PLUMB.

IN LIEU OF THE TURN OF THE NUT METHOD, TENSION ON A325W BOLTS MAY BE CALIBRATED USING DIRECT TENSION INDICATOR WASHERS. FOR DIRECT TENSION INDICATORS, SEE SPECIAL PROVISIONS.

ALL DIMENSIONS SHOWN ARE HORIZONTAL OR VERTICAL, UNLESS OTHERWISE NOTED.

ALL FIELD CONNECTIONS TO BE 22.23mm HIGH STRENGTH BOLTS UNLESS NOTED.

FOR SHEAR STUDS, SEE SPECIAL PROVISIONS.

DURING THE ERECTION PROCEDURE THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING TEMPORARY LATERAL BRACING AND OTHER NECESSARY MEANS OF SUPPORT TO ENSURE THE STABILITY OF THE GIRDERS AND MAINTAIN PLUMBNESS OF THE GIRDER WEBS.

THE STRUCTURAL STEEL SHALL BE SUPPORTED DURING ERECTION IN ITS CAMBERED POSITION. ONE TEMPORARY BENT SHALL BE PLACED ADJACENT TO EACH FIELD SPICE TO SUPPORT THE END SECTIONS OF EACH GIRDER DURING THE ERECTION PROCEDURE.

TEMPORARY BENTS SHALL BE DESIGNED BY A PROFESSIONAL ENGINEER REGISTERED IN THE STATE OF NORTH CAROLINA. SEE SPECIAL PROVISION FOR FALSEWORK AND FORMWORK.

PLANS FOR TEMPORARY BENTS, ERECTION SEQUENCE, AND TEMPORARY BENT REMOVAL SHALL BE SUBMITTED TO THE ENGINEER FOR REVIEW.

TEMPORARY BENTS SHALL REMAIN IN PLACE UNTIL ALL DIAPHRAGMS ARE IN PLACE AND HIGH STRENGTH BOLTS ARE TIGHTENED WITH THE EXCEPTION OF THOSE LOCATED IN BAY 5 (CF5).

THE CONTRACTOR'S ERECTION PLAN SHALL INCLUDE A METHOD OF REMOVAL OF THE TEMPORARY BENTS THAT WILL UNIFORMLY APPLY THE WEIGHT OF THE STRUCTURAL STEEL TO THE BRIDGE DIAPHRAGMS.

TEMPORARY BENTS SHALL BE REMOVED PRIOR TO PLACEMENT OF THE DECK FORMS AND FALSEWORK.

THE CONTRACTOR MAY SUBMIT ALTERNATE ERECTION METHODS. PLANS FOR SUCH ERECTION METHODS SHALL BE APPROVED BY THE ENGINEER.

PAYMENT FOR TEMPORARY BENTS SHALL BE INCLUDED IN THE CONTRACT PRICE BID FOR "STRUCTURAL STEEL".

PROJECT NO. U-2102  
DURHAM COUNTY  
STATION: 45+25.900 -L-REV.

SHEET 1 OF 9

STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION  
(L-REV)

SUPERSTRUCTURE  
STRUCTURAL STEEL  
DETAILS  
FRAMING PLAN

REVISIONS						SHEET NO. 5 - 15
NO.	BY	DATE	NO.	BY	DATE	
1			3			50
2			4			

DRAWN BY: M. E. POOLE DATE: 8/20/98  
CHECKED BY: DATE:



# STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

## FRAMING PLAN

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ALL OTHER STRUCTURAL STEEL SHALL BE AASHTO M270 GRADE 345(W) STEEL AND PAINTED IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS UNLESS OTHERWISE NOTED ON THE PLANS.

FOR HIGH PERFORMANCE STEEL, SEE SPECIAL PROVISIONS.

CAMBERED GIRDER LENGTHS SHALL BE ADJUSTED AND BEARINGS ARE TO BE PLACED ON THE CAMBERED GIRDER SO AS TO BE ALIGNED WITH THE ANCHORS AFTER THE DEAD LOAD DEFLECTION HAS OCCURRED. SHOP PLANS SHALL BE PREPARED ACCORDINGLY.

STUDS ON GIRDERS MAY BE SHIFTED UP TO 25mm IF NECESSARY TO CLEAR FLANGE SPLICE WELD.

ENDS OF GIRDERS SHALL BE PLUMB.

SHEAR STUDS ARE TO BE SHOP WELDED ON TOP OF SPLICE PLATE BEFORE FIELD ASSEMBLY.

FOR RADIOGRAPHIC TESTING OF BUTT WELDS SEE SPECIAL PROVISIONS.

FOR PROTECTION OF PAINTED STEEL, SEE SPECIAL PROVISIONS.

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ALL DIMENSIONS SHOWN ARE HORIZONTAL OR VERTICAL, UNLESS OTHERWISE NOTED.

ALL FIELD CONNECTIONS TO BE 22.23mm HIGH STRENGTH BOLTS UNLESS NOTED.

FOR SHEAR STUDS, SEE SPECIAL PROVISIONS.





STR. #1



## Lessons Learned

- More efficient to use in a “hybrid” configuration
- Design to eliminate transverse and longitudinal stiffeners
- Carefully evaluate the material premium to ensure the most economical design



STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION

# U.S. 64 over Hiwassee River & Martin Creek Cherokee County R-0977A

**Designer: NCDOT SDU**

**Let: 3-15-2005**

**Contractor: Simpson Construction  
Company (Structures)**





# STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

CONTRACT: C201114 TIP PROJECT: R-977A

## STATE OF NORTH CAROLINA DIVISION OF HIGHWAYS

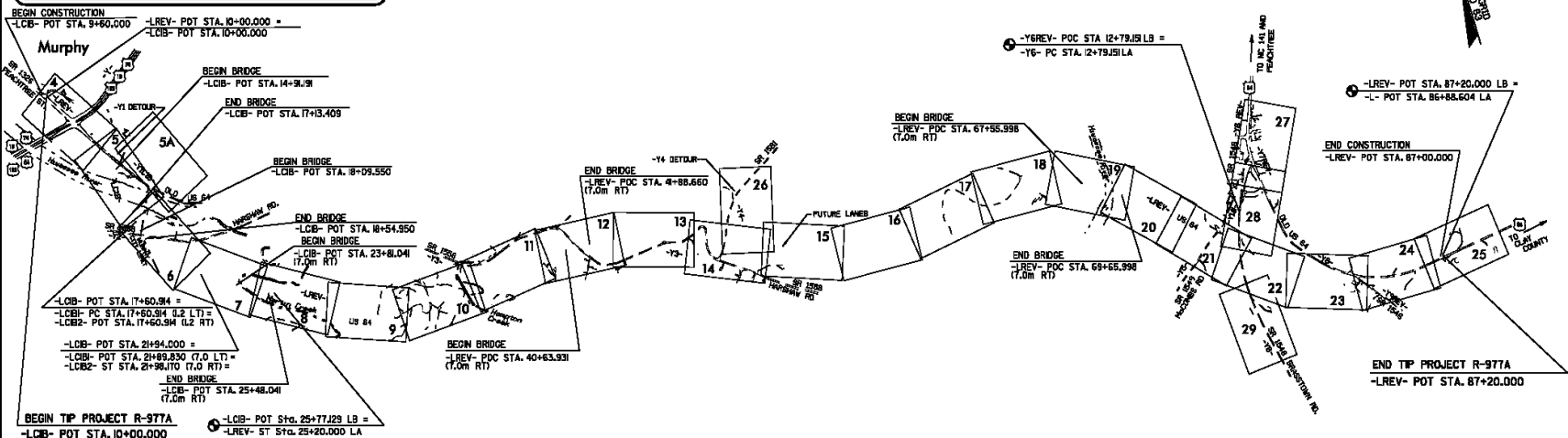
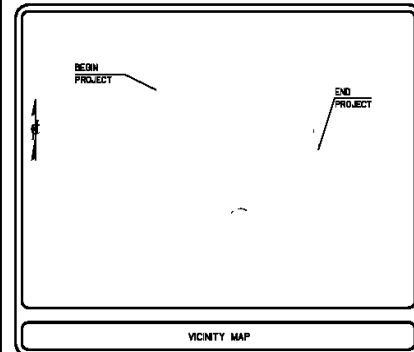
### CHEROKEE COUNTY

LOCATION: US 64, FROM US 19-74-129 IN MURPHY  
TO EAST OF NC 141 IN PEACHTREE

TYPE OF WORK: GRADING, DRAINAGE, PAVING, GUARDRAIL,  
LONGLIFE PAVEMENT MARKINGS & SNOWPLOWABLE  
MARKERS, SIGNALS, STRUCTURES AND CULVERTS

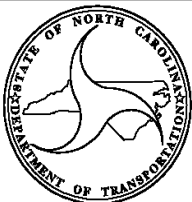
STATE	STATE PROJECT NUMBER	PROJECT	SECTION
N.C.	R-977A		
ROUTE NUMBER	PLAN NUMBER	P.E.	
34357.1.1	PR-14-110		
34357.2.1	STP-44(21)	P.E., R.W. & UTIL.	
34357.3.6	STP-44(79)	CONST.	

ALL DIMENSIONS IN THESE  
PLANS ARE IN METERS AND  
FOR MILLIMETERS UNLESS  
OTHERWISE NOTED



### STRUCTURES

NOTE: THIS IS A PARTIAL CONTROLLED-ACCESS PROJECT WITH  
ACCESS BEING LIMITED TO POINTS SHOWN ON PLANS.



#### DESIGN DATA

ADT 2004 = 6900 - 9900  
ADT 2024 = 11900 - 17200  
DHV = 11%  
D = 60%  
T = 4% (1% T1ST + 3% DUALS)  
V = 80 km/h (-LC1B-)  
V = 100 km/h (-LREV-)

#### PROJECT LENGTH

LENGTH ROADWAY TIP PROJECT R-977A = 7.008 km  
LENGTH STRUCTURE TIP PROJECT R-977A = 0.769 km  
TOTAL LENGTH TIP PROJECT R-977A = 7.777 km

#### Prepared in the Office of: DIVISION OF HIGHWAYS

THE STANDARD SPECIFICATIONS

LETTING DATE:  
MARCH 15, 2005

R.M. GIROLAMI, P.E.  
Project Engineer

L.E. SUTTON, P.E.  
Project Engineer

#### STRUCTURE DESIGN UNIT AND DESIGN REVIEW UNIT SECTION 705.00

#### DIVISION OF HIGHWAYS STATE OF NORTH CAROLINA

P.E.  
STATE HIGHWAY ENGINEER - DESIGN  
DEPARTMENT OF TRANSPORTATION  
FEDERAL HIGHWAY ADMINISTRATION

APPROVED FOR  
SECTION ADMINISTRATION



## Project Data - Hiwassee River Span

- 3 Span Continuous Hybrid Steel Girders
  - 101m (331') main with 60.6m (199') end spans
- Clear Roadway Width of 13.2m (43'-3")
- Girder Spacing of 3.660m (12')
- Girder Depth of 3m (9'-10")
- HPS485W (70 ksi) used in key locations to economize design



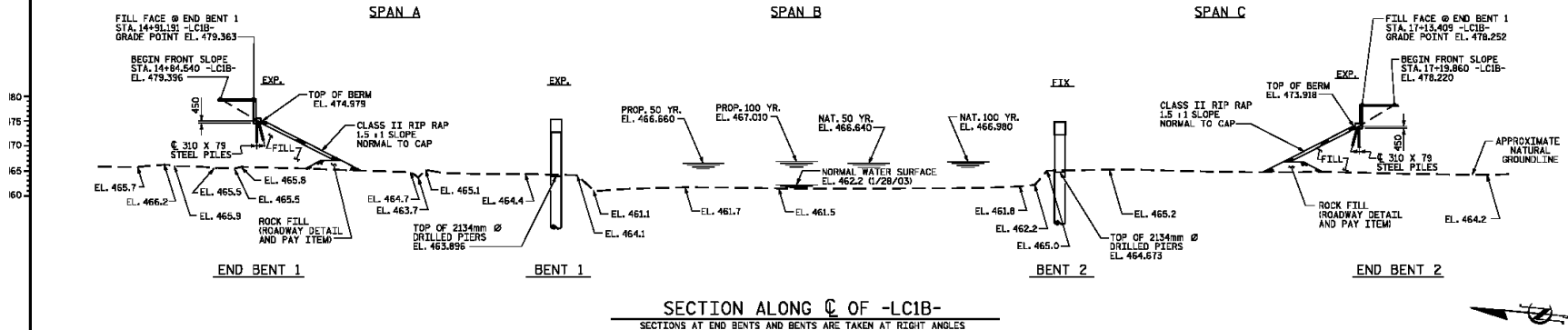
# STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

14+60 14+80 15+00 15+20 15+40 15+60 15+80 16+00 16+20 16+40 16+60 16+80 17+00 17+20

F. A. PROJECT NO. STP-64(79)

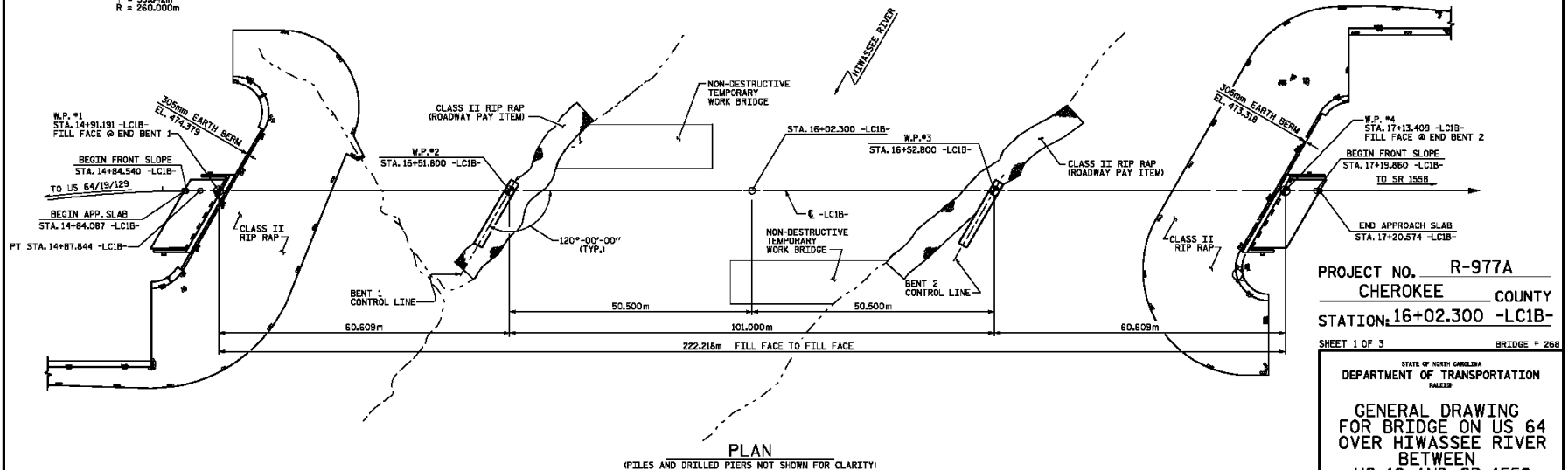


GRADE DATA  
PI = 14+00.000 L-  
EL. = 479.819  
VC = 140m



## HORIZONTAL CURVE DATA

PT STA. = 14+54.381 -LC1B-  
Δ = 14° 49' 54.6 (RT)  
L = 67.305m  
T = 33.842m  
R = 260.000m



PROJECT NO. R-977A  
CHEROKEE COUNTY  
STATION 16+02.300 -LC1B-

SHEET 1 OF 3 BRIDGE # 268

STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION  
RAILROAD

GENERAL DRAWING  
FOR BRIDGE ON US 64  
OVER HIWASSEE RIVER  
BETWEEN  
US 19 AND SR 1558

REVISED				SHEET NO.			
NO.	BY	DATE	NO.	BY	DATE	S-1	
1		3				200	
2		4				230	

STR. #1

DRAWN BY: B.N.D. / TAW DATE: 10-25-04  
CHECKED BY: L.P. SUTTON DATE: 11-08-04

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pgo977a





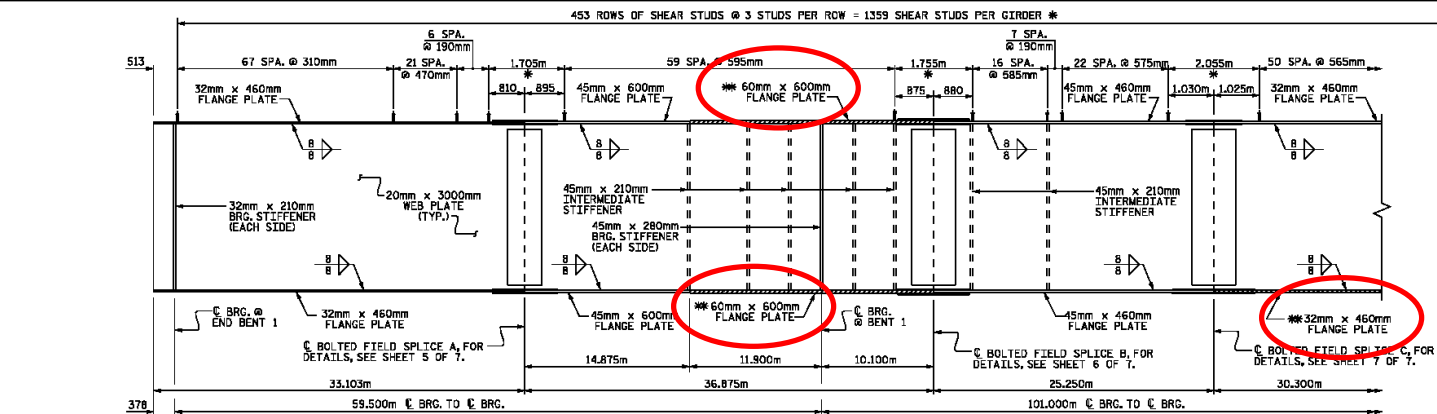
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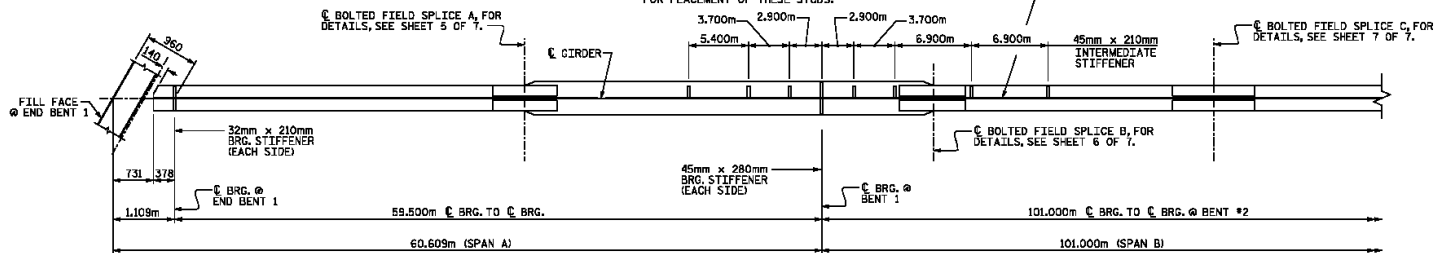
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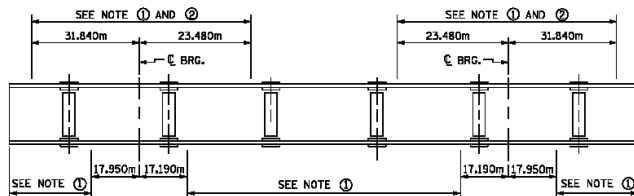
## GIRDER ELEVATION

\* ADDITIONAL SHEAR STUDS ARE LOCATED ON THE TOP OF THE BOLTED FIELD SPLICE, SEE "BOLTED FIELD SPLICE" SHEETS 5 OF 7, 6 OF 7 & 7 OF 7 FOR PLACEMENT OF THESE STUDS.

INTERMEDIATE STIFFENERS SHALL BE PLACED ON THE INTERIOR FACING SIDE OF THE WEB.



## BOTTOM FLANGE DETAIL



## GIRDER MAKE UP

NOTE ①: CHARRY V-NOTCH TESTS ARE REQUIRED FOR ALL TOP OR BOTTOM FLANGE PLATES WHICH FALL WITHIN THESE LIMITS, ALL WEB PLATES, AND ALL SPLICE PLATES. IF A PERMITTED SHOP FLANGE SPLICE IS NOT USED, CHARRY V-NOTCH TESTS WILL BE REQUIRED FOR THE ENTIRE FLANGE PLATE. FOR CHARRY V-NOTCH TESTS, SEE ARTICLE 1072-9 OF THE STANDARD SPECIFICATIONS.

NOTE ②: NO WELDING OF FORMS OR FALSEWORK TO THE TOP FLANGE WILL BE PERMITTED IN THIS REGION.

## CHARRY V-NOTCH TESTS FOR CONTINUOUS PLATE GIRDERS

NOTE:  
\*\* USE GRADE HPS 485W STEEL FOR FLANGES AS SHOWN IN GIRDER ELEVATION.  
FOR ALL OTHER PARTS OF GIRDER, USE AASHTO M270 GRADE 345W.

PROJECT NO. R-0977A  
CHEROKEE COUNTY  
STATION: 16+02.300-LC1B-

SHEET 1 OF 7

STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION  
HAZEL

SUPERSTRUCTURE  
STRUCTURAL STEEL  
DETAILS

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
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2			3			250

DRAWN BY: A.S. CALLAWAY DATE: 3/8/04  
CHECKED BY: B.N. BARNOWAL DATE: 6/17/04

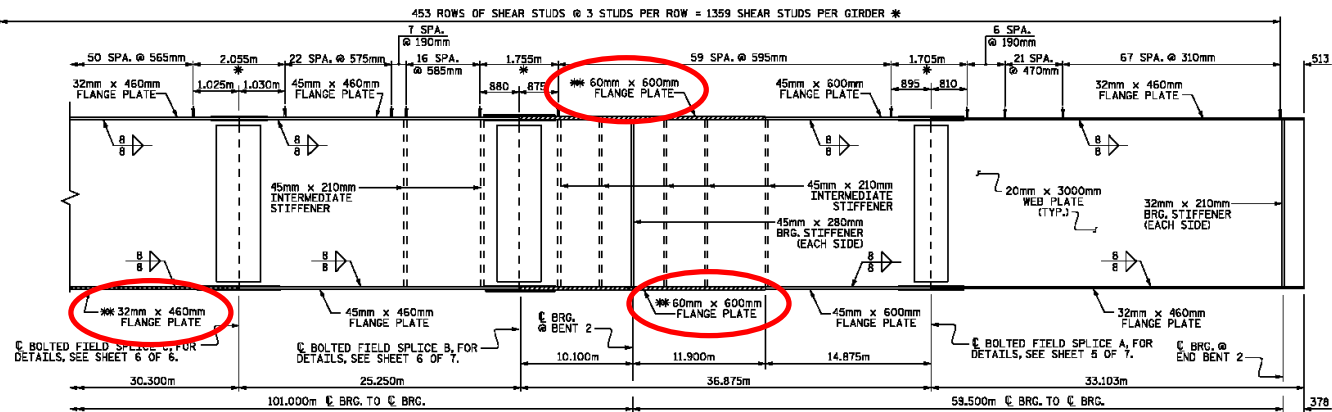
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STR. #1

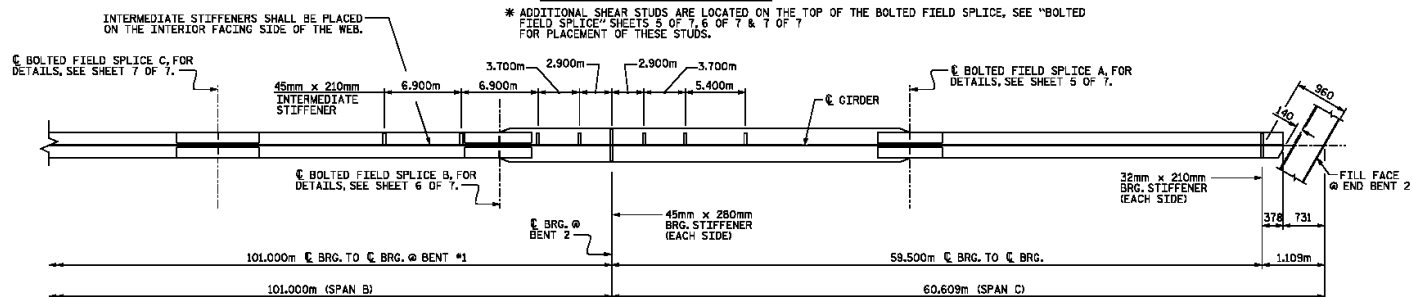




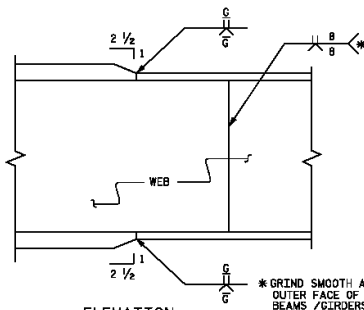
# STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION



## GIRDER ELEVATION

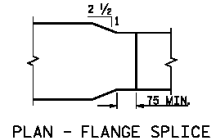


## BOTTOM FLANGE DETAIL

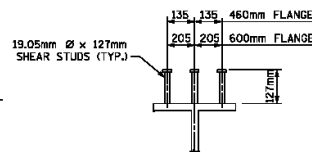


## ELEVATION

## TYPICAL FLANGE AND WEB BUTT JOINT



## PLAN - FLANGE SPLICE



## SHEAR STUD DETAILS

NOTE:  
\*\* // USE GRADE HPS 485W STEEL FOR FLANGES AS SHOWN IN GIRDER ELEVATION.  
FOR ALL OTHER PARTS OF GIRDER, USE AASHTO M270 GRADE 345W.

PROJECT NO. R-0977A  
CHEROKEE COUNTY  
STATION: 16+02.300-LC1B-

SHEET 2 OF 7

STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION  
RALEIGH

SUPERSTRUCTURE  
STRUCTURAL STEEL  
DETAILS

REVISIONS				SHEET NO.	
NO.	BY	DATE	NO.	BY	DATE
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2			2		

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STR. #1



# STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION





# STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION





# STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION





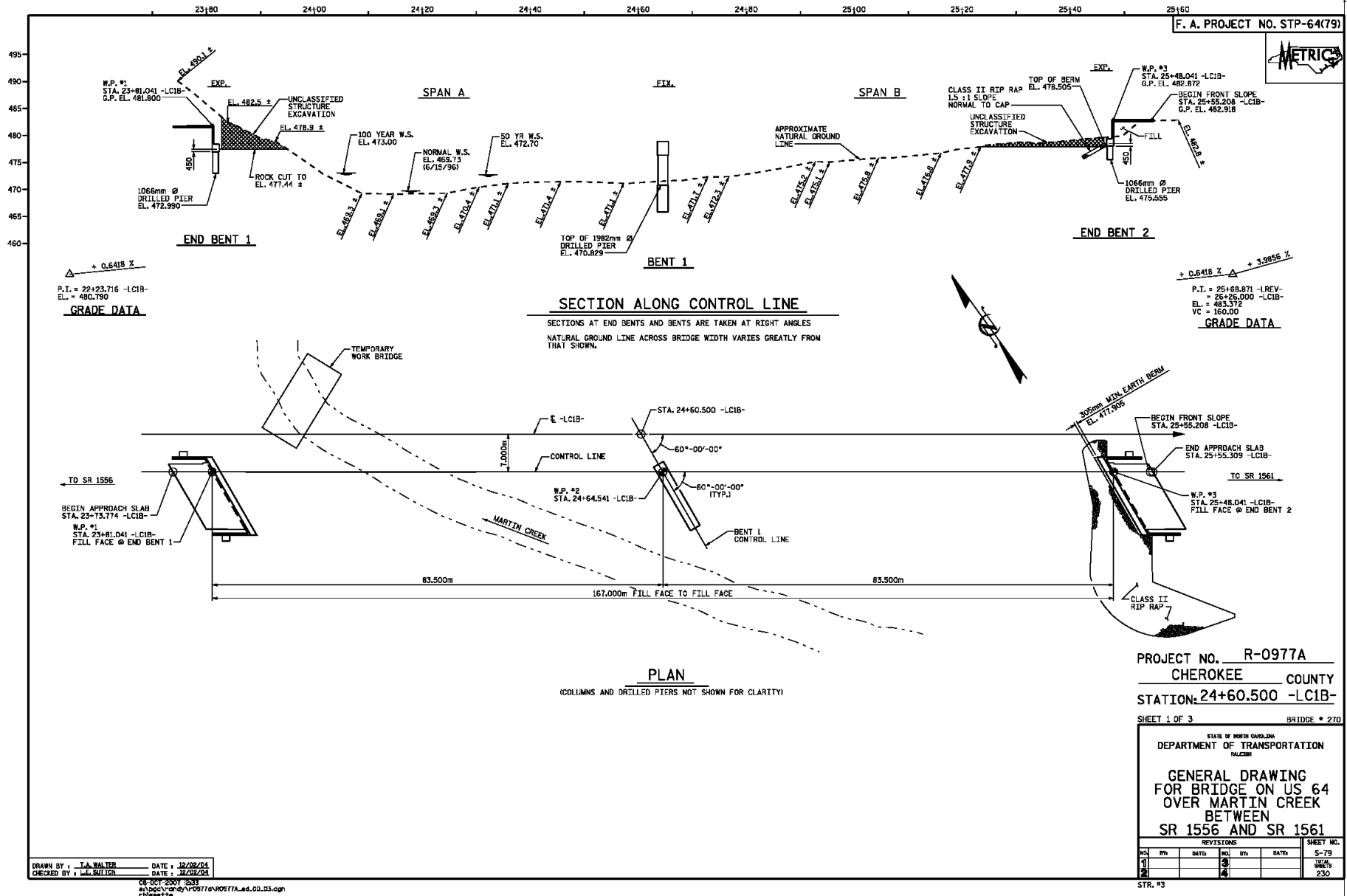


## Project Data - Martin Creek Span

- 2 Span Continuous Hybrid Steel Girders
  - Equal 83.5m (274') spans
- Clear Roadway Width of 11.5m (37'-9")
- Girder Spacing of 3.36m (11')
- Girder Depth of 2.72m (8'-11")
- HPS485W (70 ksi) used in key locations to economize design



# STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION



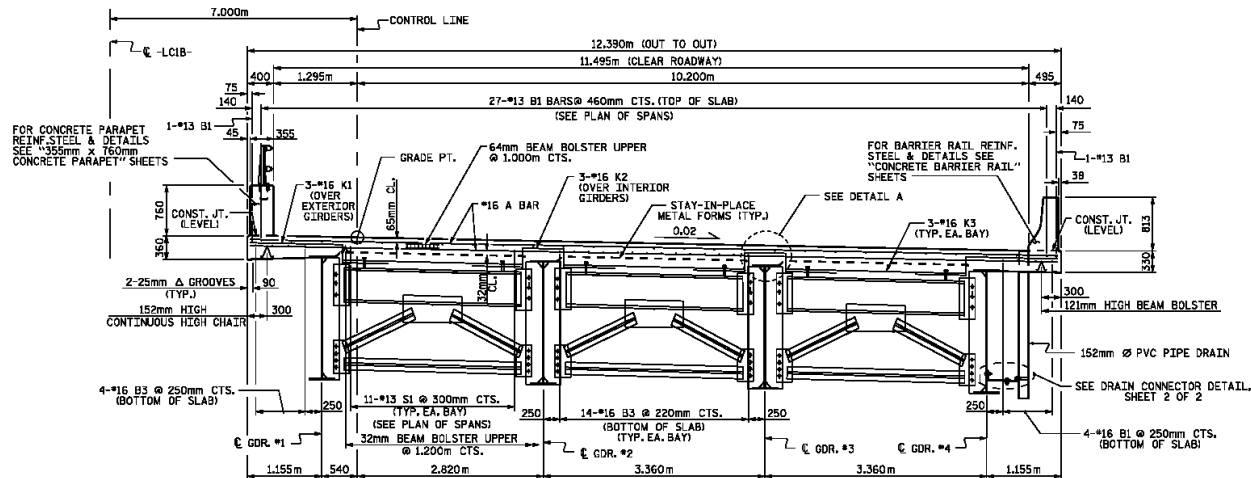


# STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION



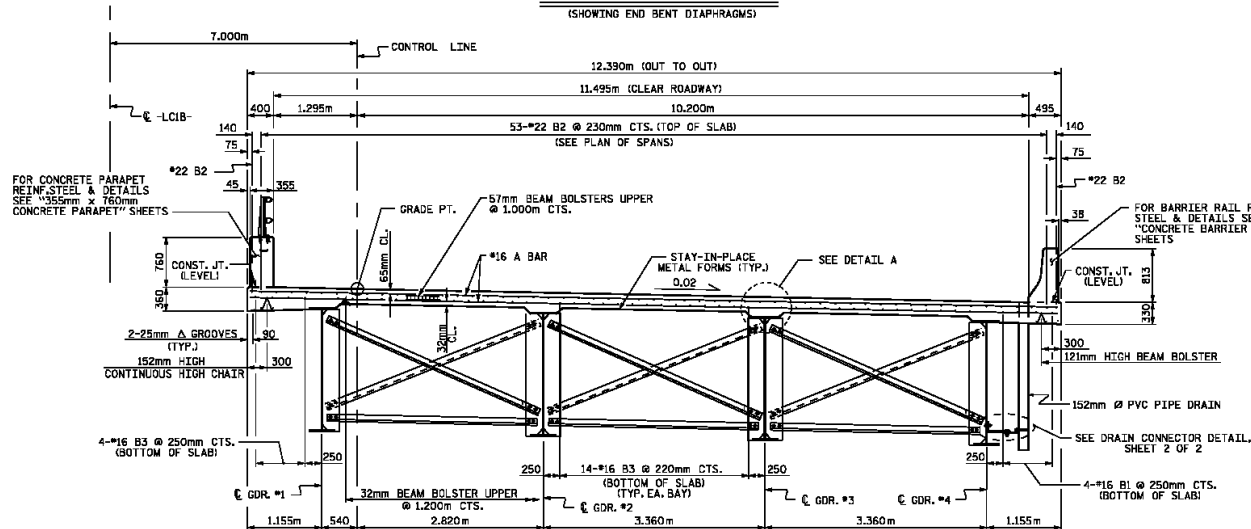


# STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION



TYPICAL SECTION

(SHOWING END BENT DIAPHRAGMS)



TYPICAL SECTION

(SHOWING BENT DIAPHRAGMS AND INTERMEDIATE DIAPHRAGMS)

## NOTES

PROVIDE 32mm HIGH BEAM BOLSTERS UPPER AT 1.2m CTS. ATOP THE METAL STAY-IN-PLACE FORMS TO SUPPORT THE BOTTOM MAT OF 'A' BARS. WHEN USING REMOVABLE FORMS, PROVIDE CONTINUOUS HIGH CHAIRS FOR METAL DECK (C.H.C.H.) @ 1.2m CTS WITH A HEIGHT TO SUPPORT THE BOTTOM MAT OF 'A' BARS A CLEAR DISTANCE OF 60mm ABOVE THE TOP OF THE REMOVABLE FORM.

METAL STAY-IN-PLACE FORMS SHALL NOT BE WELDED TO BEAM OR GIRDER FLANGES IN THE ZONES SURROUNDING CHAIRY V-NOTCH TEST. SEE STRUCTURAL STEEL DETAIL SHEETS.

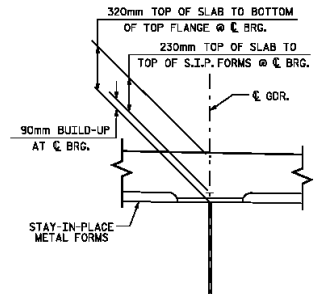
PREVIOUSLY CAST CONCRETE IN A CONTINUOUS UNIT SHALL HAVE ATTAINED A MINIMUM COMPRESSIVE STRENGTH OF 20.7 MPa BEFORE ADDITIONAL CONCRETE IS CAST IN THE UNIT.

BARRIER RAIL AND PARAPET IN A CONTINUOUS UNIT SHALL NOT BE CAST UNTIL ALL SLAB CONCRETE IN THE UNIT HAS BEEN CAST AND HAS REACHED A MINIMUM COMPRESSIVE STRENGTH OF 20.7 MPa.

STRUCTURAL STEEL ERECTION IN A CONTINUOUS UNIT SHALL BE COMPLETE BEFORE FALSEWORK OR FORMS ARE PLACED ON THE UNIT.

THE CONTRACTOR MAY, WHEN NECESSARY, PROPOSE A SCHEME FOR AVOIDING INTERFERENCE BETWEEN METAL STAY-IN-PLACE FORM SUPPORTS OR FORMS AND GIRDER STIFFENERS OR SUPPORT PLATES. THE PROPOSAL SHALL BE INDICATED, IF APPROPRIATE, ON EITHER THE STEEL WORKING DRAWINGS OR THE METAL STAY-IN-PLACE FORM WORKING DRAWINGS.

USE SAND LIGHTWEIGHT CONCRETE IN THE DECK SLAB. SEE SPECIAL PROVISIONS FOR REINFORCED CONCRETE DECK SLAB (SAND LIGHTWEIGHT CONCRETE). CONCRETE SHALL BE EXCLUDED FROM THE METAL STAY-IN-PLACE FORM WORKING DRAWINGS FOR FABRICATED METAL STAY-IN-PLACE FORMS.



DETAIL A

PROJECT NO. R-0977A  
CHEROKEE COUNTY  
STATION: 24+60.500-LC1B-

SHEET 1 OF 2

STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION  
BUREAU

SUPERSTRUCTURE  
TYPICAL SECTIONS  
SPANS A & B

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			2			S-82
						230

STR,3

DRAWN BY: B.N.BARODAWALA DATE: 10-9-03  
CHECKED BY: MIKE ALLAN DATE: 10-04


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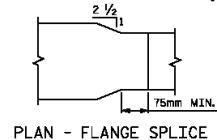




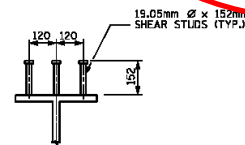
NOTE:

\*\*  USE GRADE HPS 485W STEEL FOR FLANGES  
AS SHOWN IN GIRDER ELEVATION.

FOR ALL OTHER PARTS OF GIRDER, USE AASHTO M270  
GRADE 345W.



PLAN - FLANGE SPLICE



## SHEAR STUD DETAILS

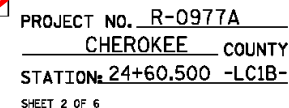
### FOR 460mm & 680mm FLANGES

ELEVATION

### TYPICAL FLANGE AND WEB BUTT JOINT

\*GRIND SMOOTH AND FLUSH ON  
OUTER FACE OF EXTERIOR  
GIRDERS

USE .0014 X  
FOR PE SEAL



STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION  
RAILROAD  
SUPERSTRUCTURE  
STRUCTURAL STEEL  
DETAILS  
SPAN B

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	
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2			4			TOTAL 230

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CHECKED BY : B.N. BARODAWALA DATE : 8-10-04

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STR. 03



# STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION





## Lessons Learned

- Efficient use of “hybrid” configuration  
HPS70W & Grade 50W flange plates and  
Grade 50W web plate
- Design eliminates use of most transverse  
and all longitudinal stiffeners
- Economical section design
- Ideal situation





STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION

# **SR 1102 (Langtree Road) over I-77**

**Iredell County I-4411**



**Designer: NCDOT SDU**

**Let: 1-16-07**

**Contractor: Rea Contracting, LLC**

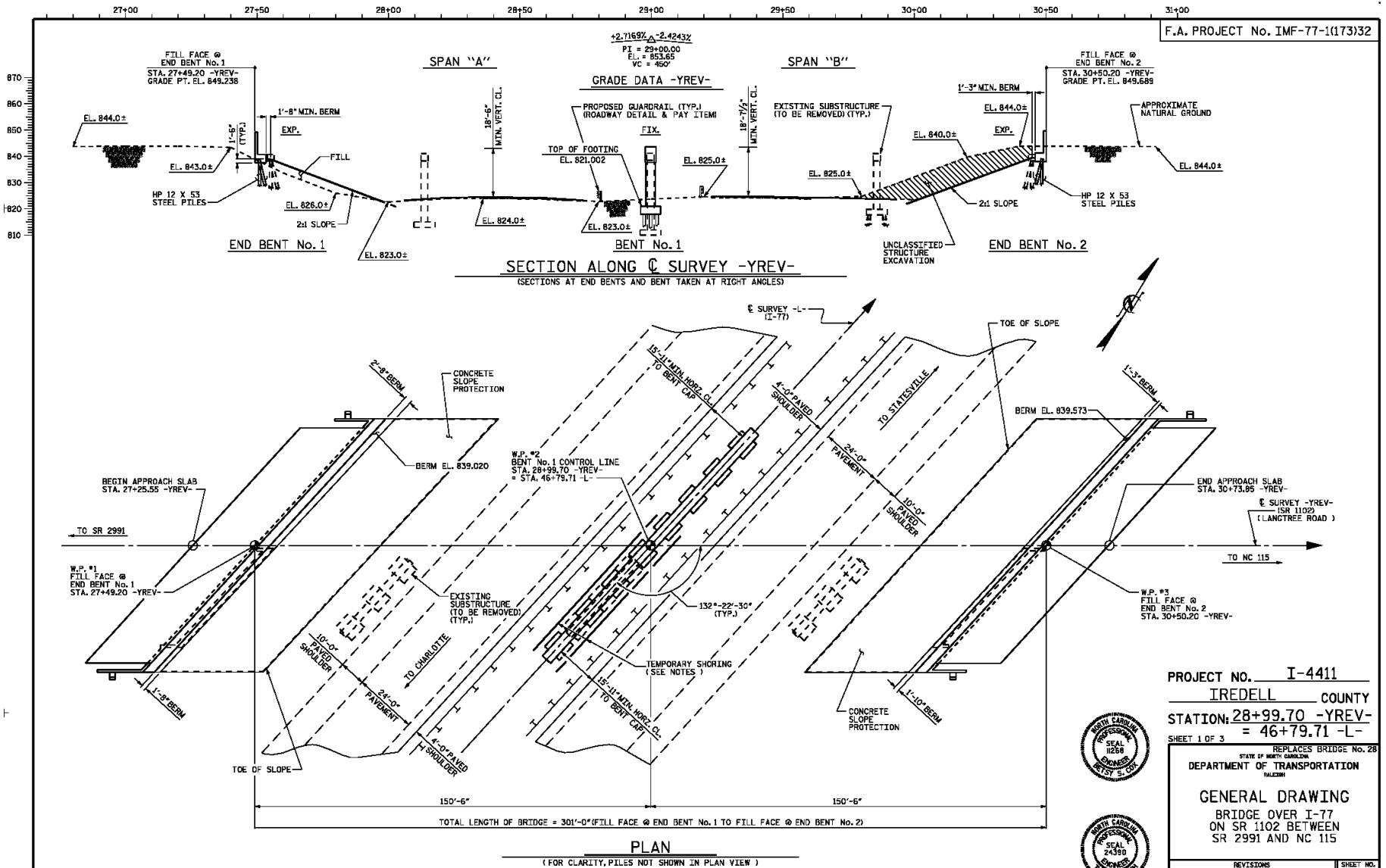


## Project Data

- 2 Span Continuous Hybrid Steel Girders
  - Equal 150'-6" (45.9m) spans
- Clear Roadway Width of 88' (26.8m)
- Girder Spacing of 11'-6" (3.5m)
- Girder Depth of 5'-4" (1.6m)
- IBRD Funded project to evaluate use of HPS100W in NC



# STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

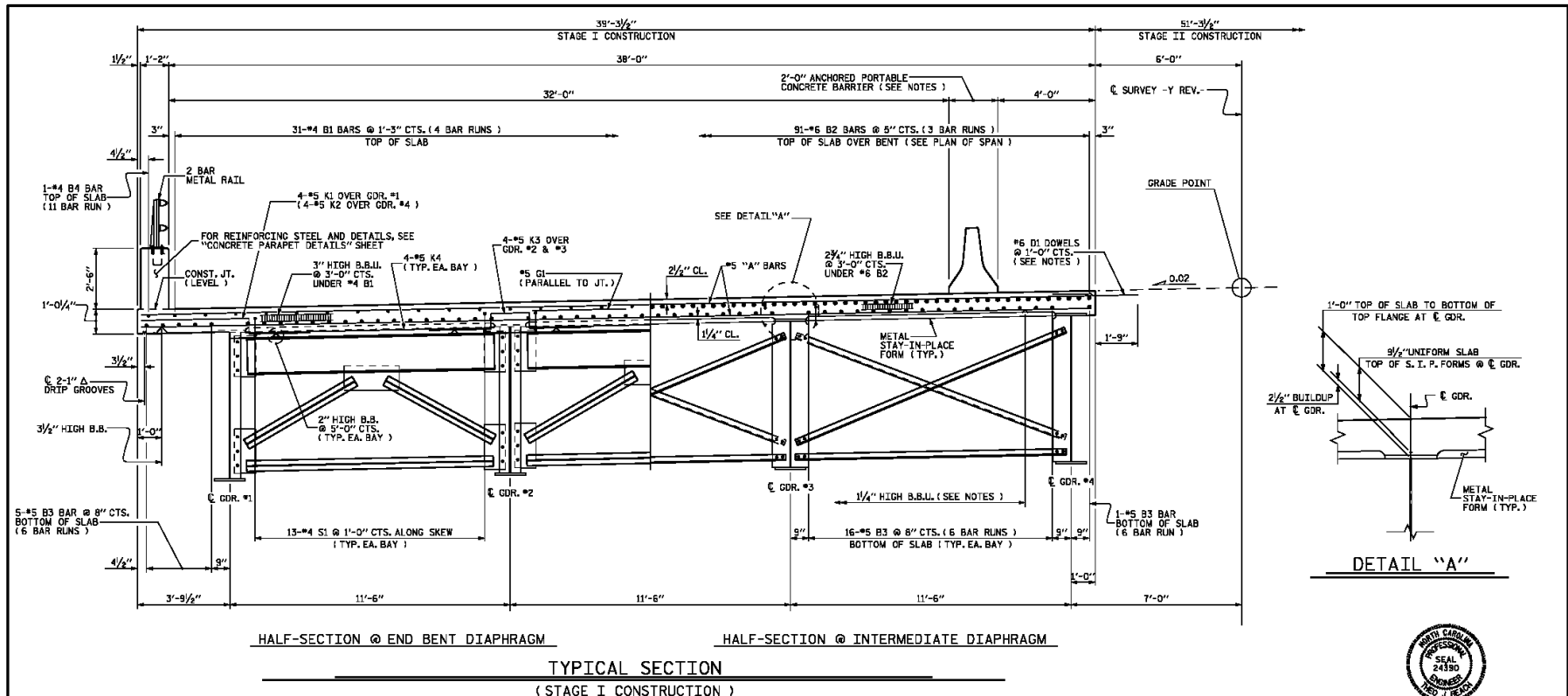


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01/1/07



# STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION



## NOTES

PROVIDE 1/4" HIGH BEAM BOLSTERS UPPER AT 4'-0" CTS. ATOP THE METAL STAY-IN-PLACE FORMS TO SUPPORT THE BOTTOM MAT OF 'A' BARS. WHEN USING REMOVABLE FORMS, PROVIDE CONTINUOUS HIGH CHAIRS FOR METAL DECK (CH.C.W.) @ 4'-0" CTS. WITH A HEIGHT TO SUPPORT THE BOTTOM MAT OF 'A' BARS A CLEAR DISTANCE OF 2/2" ABOVE THE TOP OF THE REMOVABLE FORM.

#6 D1 DOWELS SHALL BE PLACED IN THE SAME HORIZONTAL PLANE AS THE TOP SLAB REINFORCING STEEL.

METAL STAY-IN-PLACE FORMS SHALL NOT BE WELDED TO GIRDER FLANGES IN THE ZONES REQUIRING CHARPY V-NOTCH TEST. SEE STRUCTURAL STEEL DETAIL SHEETS.

PREVIOUSLY CAST CONCRETE IN A CONTINUOUS UNIT SHALL HAVE ATTAINED A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI BEFORE ADDITIONAL CONCRETE IS CAST IN THE UNIT.

PARAPET IN A CONTINUOUS UNIT SHALL NOT BE CAST UNTIL ALL SLAB CONCRETE IN THE UNIT HAS BEEN CAST AND HAS REACHED A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI.

STRUCTURAL STEEL ERECTION IN A CONTINUOUS UNIT SHALL BE COMPLETE BEFORE FALSEWORK OR FORMS ARE PLACED ON THE UNIT.

'G' BARS MAY BE SHIFTED SLIGHTLY, AS NECESSARY, TO CLEAR REINFORCING STEEL AND STIRRUPS.

SEE TRAFFIC CONTROL PLANS FOR LOCATION AND PAY LIMITS OF THE ANCHORED PORTABLE CONCRETE BARRIER.

THE CONTRACTOR MAY, WHEN NECESSARY, PROPOSE A SCHEME FOR AVOIDING INTERFERENCE BETWEEN METAL STAY-IN-PLACE FORM SUPPORTS OR FORMS AND BEAM/GIRDER STIFFENERS OR CONNECTOR PLATES. THE PROPOSAL SHALL BE INDICATED, AS APPROPRIATE, ON EITHER THE STEEL WORKING DRAWINGS OR THE METAL STAY-IN-PLACE FORM WORKING DRAWINGS.

ALL REINFORCING STEEL IN PARAPETS SHALL BE EPOXY COATED.

THE NOMINAL UNCOMPRESSED SEAL WIDTH OF THE EVAZOTE JOINT SEAL SHALL BE 2/4" AT END RENTS. FOR EVAZOTE JOINT SEALS, SEE SPECIAL PROVISIONS.

THE CONTRACTOR SHALL ADJUST THE GIRDER BUILDUPS AS NECESSARY TO INCORPORATE A MAXIMUM PERMISSIBLE VARIATION IN POT BEARING DEPTH OF 1/2". SEE SPECIAL PROVISION FOR POT BEARINGS.



PROJECT NO. I-4411  
IREDELL COUNTY  
STATION: 46+79.71 -L-

SHEET 1 OF 2

STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION  
RAILROAD  
SUPERSTRUCTURE  
TYPICAL SECTIONS

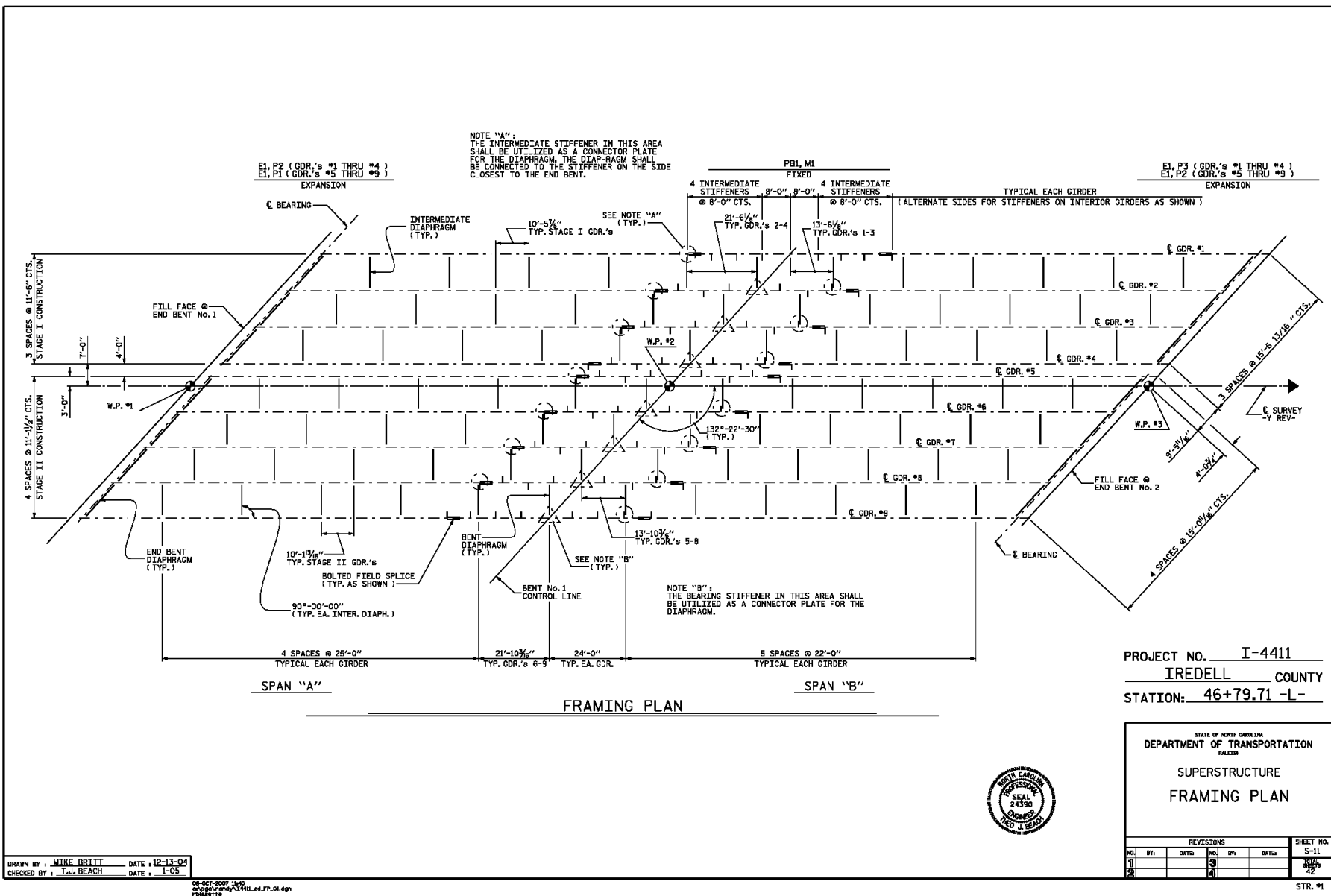
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CHECKED BY: T.J. BEACH DATE: 1-05

08-307-2007 15-10  
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NO.	BY	DATE	REV.	DATE		
1			3			5-5
2			4			42

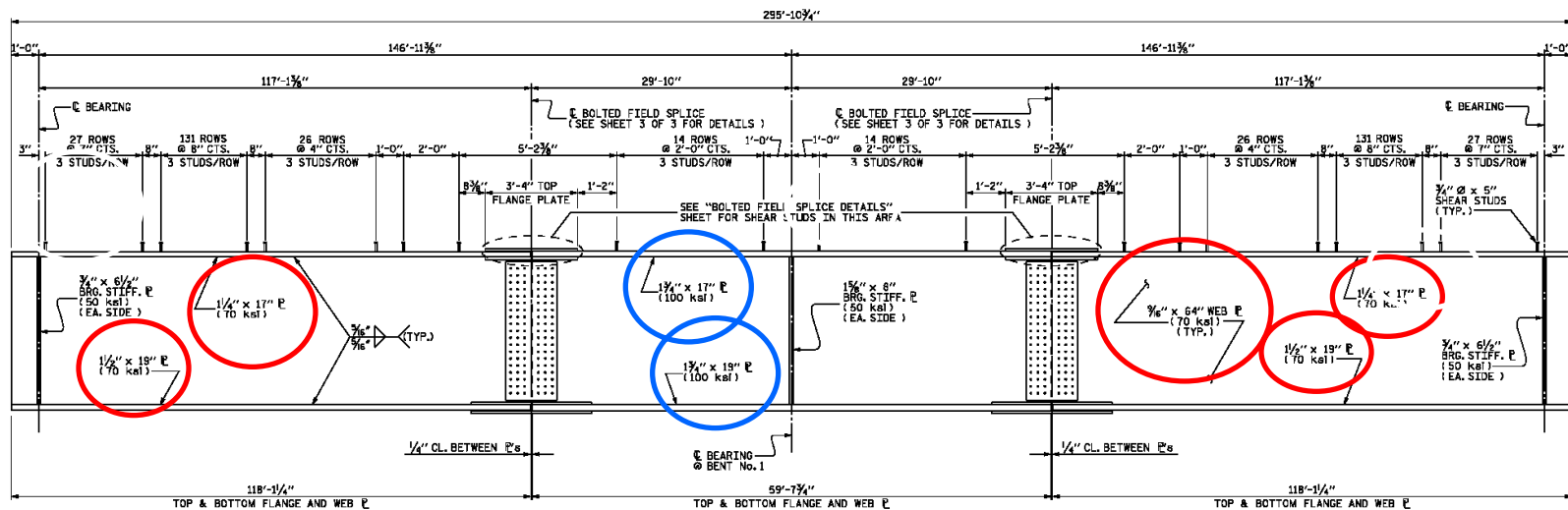
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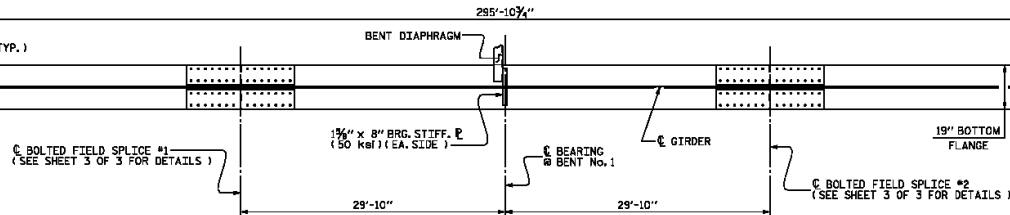
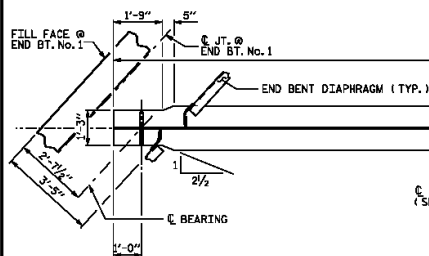
# STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION



## ELEVATION OF GIRDER

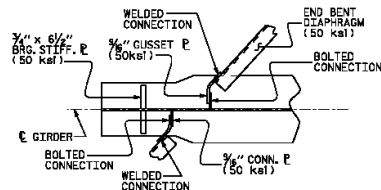
(FOR VARYING STEEL GRADES, SEE NOTES ON SHEET 3 OF 3)

NOTE:  
CONNECTOR & INTERMEDIATE STIFFENER E'S NOT SHOWN.  
FOR PLACEMENT, SEE "FRAMING PLAN" SHEET.



## BOTTOM FLANGE DETAIL

(INTERMEDIATE DIAPHRAGMS NOT SHOWN)



## CONNECTOR E DETAIL

(EACH END SIMILAR)

## SHEAR STUD DETAIL

TYPICAL EXCEPT AT TOP FLANGE SPLICE E  
SEE "BOLTED FIELD SPLICE DETAILS" SHEET  
FOR SHEAR STUDS IN THIS AREA

PROJECT NO. I-4411  
IREDELL COUNTY  
STATION: 46+79.71 -L-

SHEET 1 OF 3

STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION

SUPERSTRUCTURE  
STRUCTURAL STEEL  
DETAILS

REVISIONS					SHEET NO. S-12
NO.	BY	DATE	REASON	DATE	
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DRAWN BY: MIKE BRITT DATE: 12-14-04  
CHECKED BY: T.W. BEACH DATE: 1-05

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01/05/05





## Lessons Learned

- IBRD Funded Project using HPS100W/HPS70W hybrid section with Grade 50W miscellaneous plates
- Likely not ideal application of HPS100W, but used as trial material
- Further applications pending results of trial project



## **NCDOT HPS “Guidelines”**

- No formal policy at present
- Use in hybrid configuration on long spans
- Strategically locate to economize steel sections
- Must result in overall cost savings especially on project with multiple structures





# Questions?