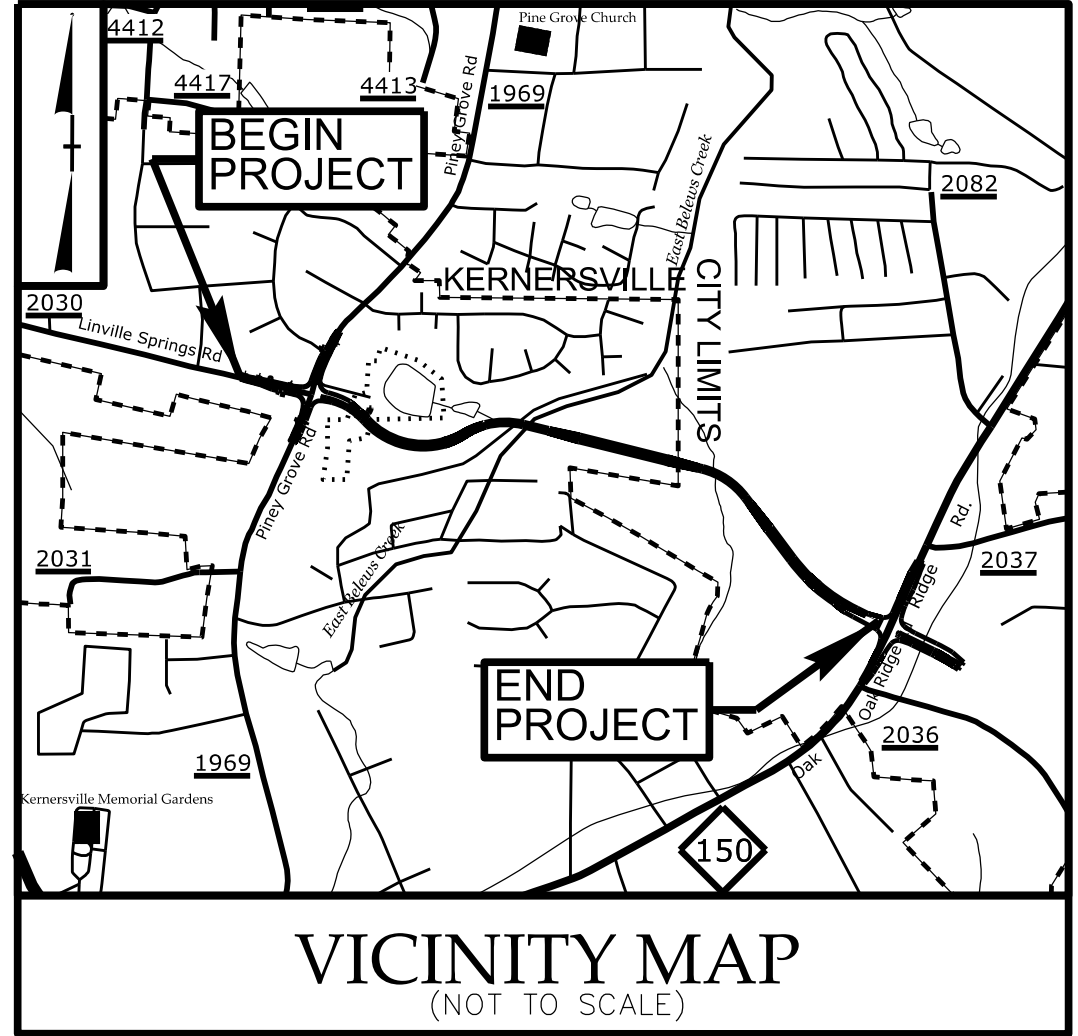


See Sheet 1A For Index of Sheets  
See Sheet 1B For Conventional Symbols

STATE OF NORTH CAROLINA  
DIVISION OF HIGHWAYS  
**FORSYTH COUNTY**

| STATE           | STATE PROJECT REFERENCE NO. | SHEET NO.   | TOTAL SHEETS |
|-----------------|-----------------------------|-------------|--------------|
| N.C.            | U-6003                      | 1           |              |
| STATE PROJ. NO. | F.A. PROJ. NO.              | DESCRIPTION |              |
| 47138.1.1       |                             | PE          |              |
| 47138.2.1       |                             | RW/UTILS    |              |
| 47138.3.1       |                             | CONST       |              |

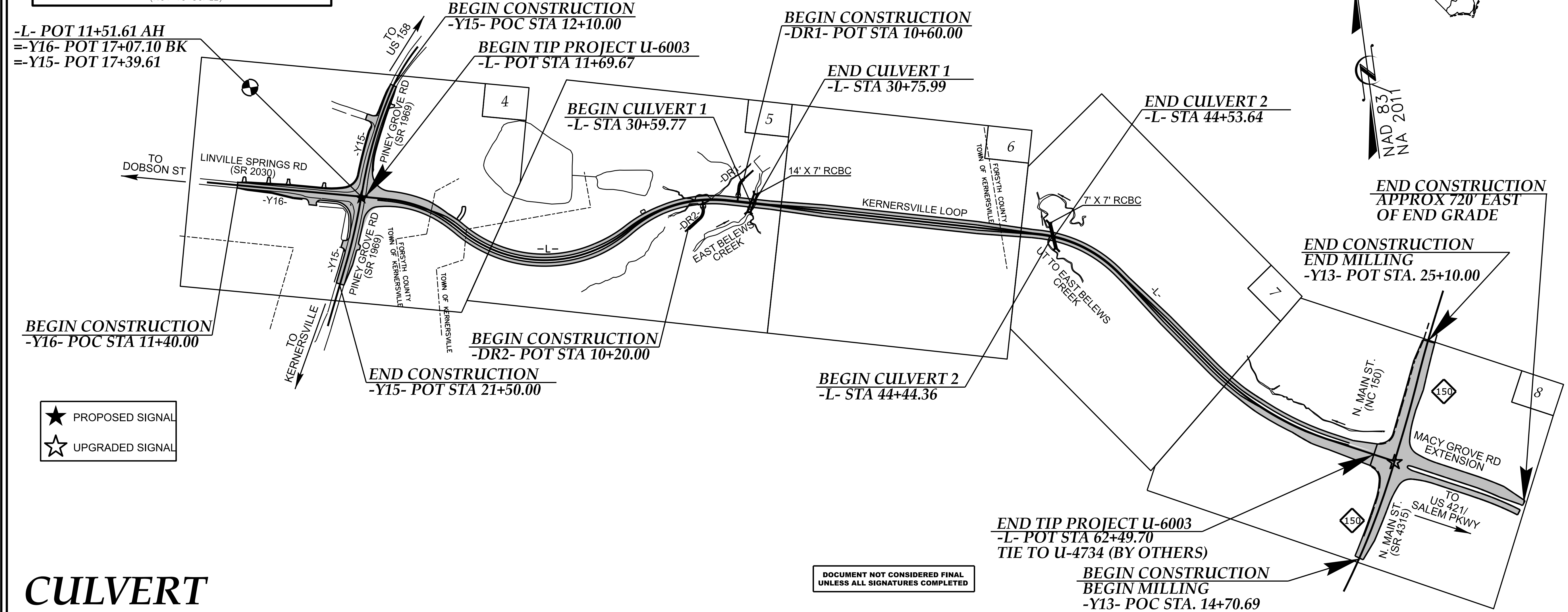
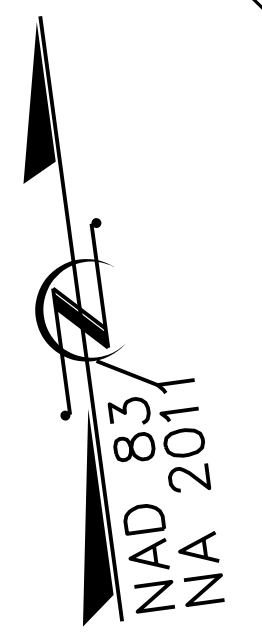
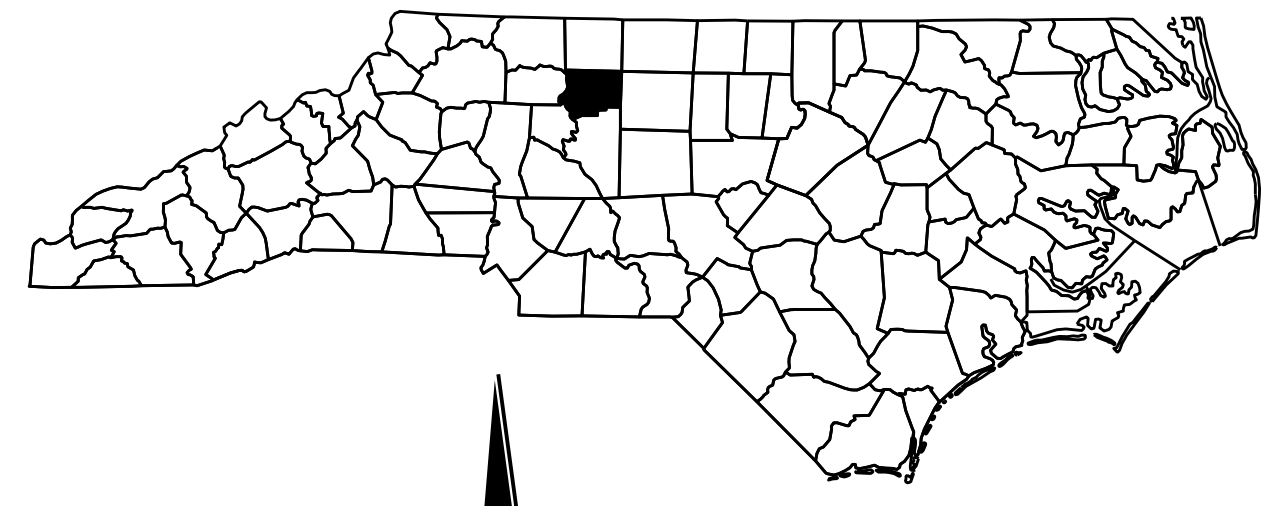
**TIP PROJECT: U-6003**



**FINAL PLANS**

**LOCATION: KERNERSVILLE - KERNERSVILLE LOOP  
FROM SR 1969 (PINEY GROVE RD) TO NC 150  
(N. MAIN ST.)**

**TYPE OF WORK: GRADING, PAVING, SIGNALS, DRAINAGE AND STRUCTURES**



-L- POT 11+51.61 AH  
=-Y16- POT 17+07.10 BK  
=-Y15- POT 17+39.61

BEGIN CONSTRUCTION  
-Y16- POC STA 11+40.00

BEGIN CONSTRUCTION  
-DR2- POT STA 10+20.00

BEGIN CONSTRUCTION  
-DR1- POT STA 10+60.00

END CULVERT 1  
-L- STA 30+75.99

END CULVERT 2  
-L- STA 44+53.64

END CONSTRUCTION  
APPROX 720' EAST  
OF END GRADE

END CONSTRUCTION  
END MILLING  
-Y13- POT STA. 25+10.00

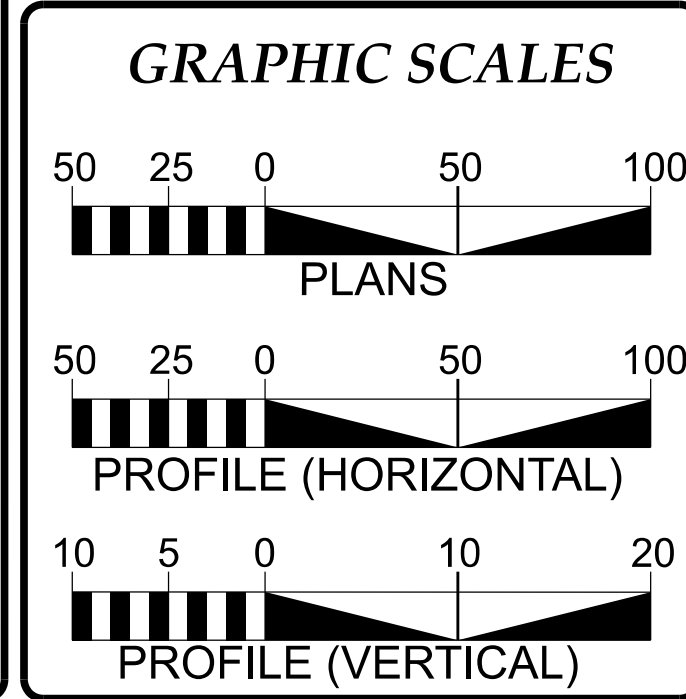
END TIP PROJECT U-6003  
-L- POT STA 62+49.70  
TIE TO U-4734 (BY OTHERS)

BEGIN CONSTRUCTION  
BEGIN MILLING  
-Y13- POC STA. 14+70.69

- ★ PROPOSED SIGNAL
- ☆ UPGRADED SIGNAL

**CULVERT**

DOCUMENT NOT CONSIDERED FINAL  
UNLESS ALL SIGNATURES COMPLETED



**DESIGN DATA**

|               |            |
|---------------|------------|
| ADT (2023)=   | 6,360      |
| ADT (2043)=   | 11,060     |
| K =           | 10 %       |
| D =           | 55 %       |
| T =           | 3 % *      |
| V =           | 40 MPH     |
| * TTST =      | 1% DUAL 2% |
| FUNC CLASS=   | ARTERIAL   |
| REGIONAL TIER |            |

**PROJECT LENGTH**

LENGTH ROADWAY TIP PROJECT U-6003 = 0.962 MILES  
TOTAL LENGTH TIP PROJECT U-6003 = 0.962 MILES

**HDR** Prepared in the Office of:  
HDR Engineering, Inc. of the Carolinas  
555 Fayetteville St. Suite 900 Raleigh, N.C. 27601  
N.C.B.E.L.S. License Number: F-0116

2018 STANDARD SPECIFICATIONS

RIGHT OF WAY DATE  
NOVEMBER 29, 2018

LETTING DATE:  
NOVEMBER 21, 2023

PHILLIP E. ROGERS, PE  
PROJECT ENGINEER

ALEXANDER D. SNIDER, PE  
PROJECT DESIGN ENGINEER

CONNIE JAMES, PE  
NCDOT CONTACT

STRUCTURE DESIGN ENGINEER

SIGNATURE: *Phillip E. Rogers* P.E.  
8/22/2023

DIVISION OF HIGHWAYS

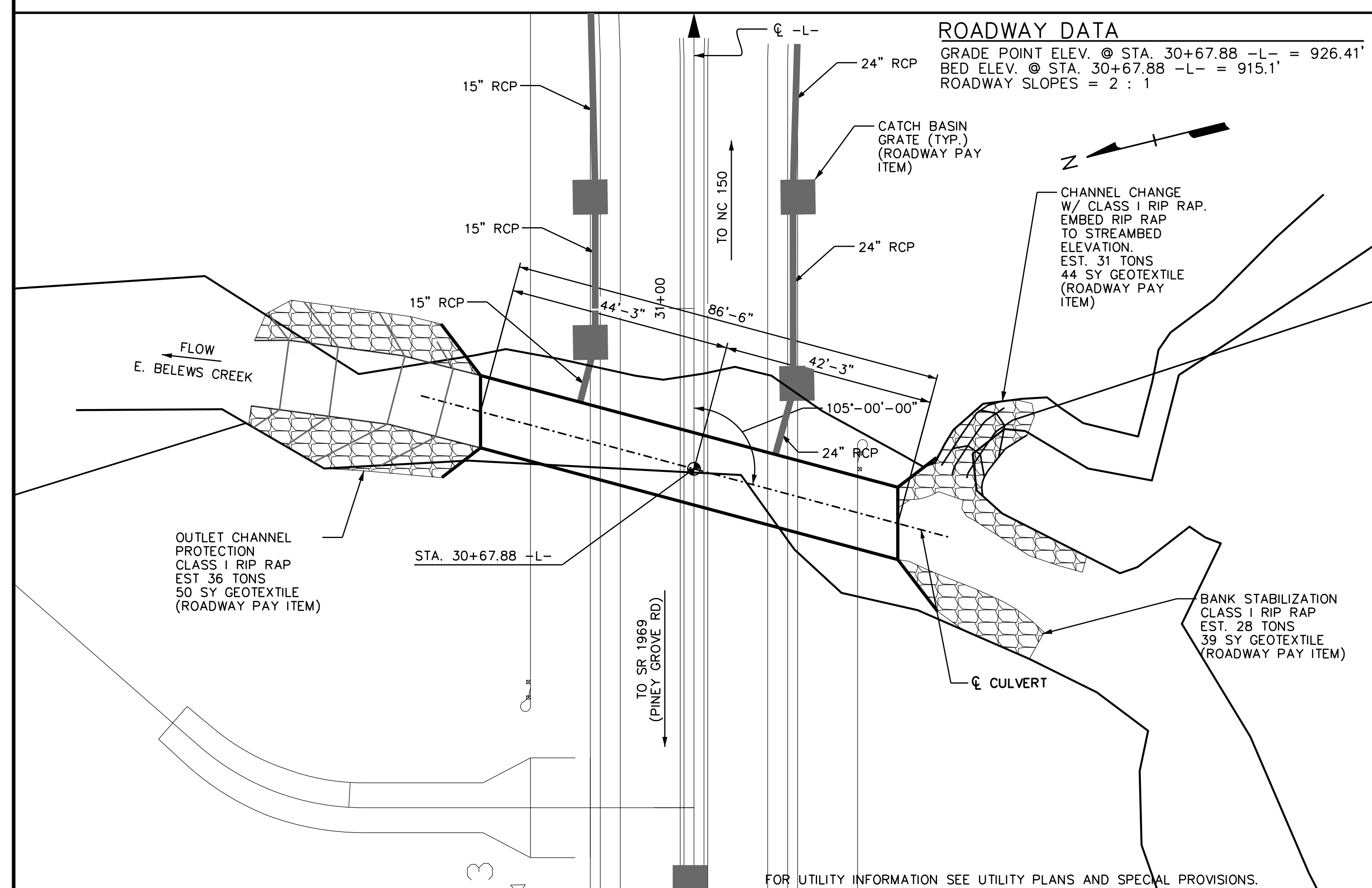
STATE OF NORTH CAROLINA

CONTRACT: C204880



BENCHMARK #2, -L- STA. 31+85, 130' LT, ELEV. : 920.69, NAVD : 88

**ROADWAY DATA**  
 GRADE POINT ELEV. @ STA. 30+67.88 -L- = 926.41'  
 BED ELEV. @ STA. 30+67.88 -L- = 915.1'  
 ROADWAY SLOPES = 2 : 1



LOCATION SKETCH

**OVERTOPPING FLOOD DATA**

OVERTOPPING DISCHARGE = 875 c.f.s.  
 FREQUENCY OF OVERTOPPING FLOOD = 500+ yr.  
 OVERTOPPING FLOOD ELEV. @ ROADWAY SAG STA. 31+22 (RT.) = 925.6 ft.

**HYDRAULIC DATA**

DESIGN DISCHARGE = 500 c.f.s.  
 FREQUENCY OF DESIGN FLOOD = 50 yr.  
 DESIGN HIGH WATER ELEVATION = 923.4 ft.  
 DRAINAGE AREA = 0.54 SQ. MI.  
 BASIC DISCHARGE (Q100) = 550 c.f.s.  
 BASIC HIGH WATER ELEVATION = 923.6 ft.

**TOTAL STRUCTURE QUANTITIES**

|   |        |            |
|---|--------|------------|
| CLASS A CONCRETE                                |        |            |
| BARREL @ 1.79                                   | CY/FT  | 154.8 C.Y. |
| WING ETC.                                       | 21.5   | C.Y.       |
| TOTAL   | 176.3  | C.Y.       |
| REINFORCING STEEL                               |        |            |
| BARREL  | 17,365 | LBS.       |
| WINGS ETC.                                      | 1,277  | LBS.       |
| TOTAL   | 18,642 | LBS.       |
| CULVERT EXCAVATION @ STA. 30+67.88 -L- LUMP SUM |        |            |
| FOUNDATION CONDITIONING MATERIAL                |        |            |
| TOTAL   | 120.0  | TONS       |

**NOTES**

ASSUMED LIVE LOAD -----HL93 OR ALTERNATE LOADING.

MAX DESIGN FILL = 3.99'

MIN DESIGN FILL = 3.37'

FOR OTHER DESIGN DATA AND NOTES SEE STANDARD NOTE SHEET.

3" ~ WEEP HOLES INDICATED TO BE IN ACCORDANCE WITH THE SPECIFICATIONS.

CONCRETE IN CULVERTS TO BE POURED IN THE FOLLOWING ORDER:

1. WING FOOTINGS AND FLOOR SLAB INCLUDING 4" OF ALL VERTICAL WALLS.
2. THE REMAINING PORTIONS OF THE WALLS AND WINGS FULL HEIGHT FOLLOWED BY ROOF SLAB AND HEADWALLS.

THE RESIDENT ENGINEER SHALL CHECK THE LENGTH OF CULVERT BEFORE STAKING IT OUT TO MAKE CERTAIN THAT IT WILL PROPERLY TAKE CARE OF THE FILL.

DIMENSIONS FOR WING LAYOUT AS WELL AS ADDITIONAL REINFORCING STEEL EMBEDDED IN BARREL ARE SHOWN ON WING SHEET.

TRANSVERSE CONSTRUCTION JOINTS SHALL BE USED IN THE BARREL, SPACED TO LIMIT THE POURS TO A MAXIMUM OF 70 FT. LOCATION OF JOINTS SHALL BE SUBJECT TO APPROVAL OF THE ENGINEER.

AT THE CONTRACTOR'S OPTION, HE MAY SPLICE THE VERTICAL REINFORCING STEEL IN THE INTERIOR FACE OF EXTERIOR WALL ABOVE LOWER WALL CONSTRUCTION JOINT. THE SPLICE LENGTH SHALL BE AS PROVIDED IN THE SPLICE LENGTH CHART SHOWN ON THE PLANS. EXTRA WEIGHT OF STEEL DUE TO THE SPLICES SHALL BE PAID FOR BY THE CONTRACTOR.

AT THE CONTRACTOR'S OPTION HE MAY SUBMIT, TO THE ENGINEER FOR APPROVAL, DESIGN AND DETAIL DRAWINGS FOR A PRECAST REINFORCED CONCRETE BOX CULVERT IN LIEU OF THE CAST-IN-PLACE CULVERT SHOWN ON THE PLANS. THE DESIGN SHALL PROVIDE THE SAME SIZE AND NUMBER OF BARRELS AS USED ON THE CAST-IN-PLACE DESIGN. FOR OPTIONAL PRECAST REINFORCED CONCRETE BOX CULVERT, SEE SPECIAL PROVISIONS.

FOR SUBMITAL OF WORKING DRAWINGS, SEE SPECIAL PROVISIONS.

FOR FALSEWORK AND FORMWORK, SEE SPECIAL PROVISIONS.

FOR CRANE SAFETY, SEE SPECIAL PROVISIONS.

FOR GROUT FOR STRUCTURES, SEE SPECIAL PROVISIONS.

FOR UTILITY INFORMATION, SEE UTILITY PLANS.

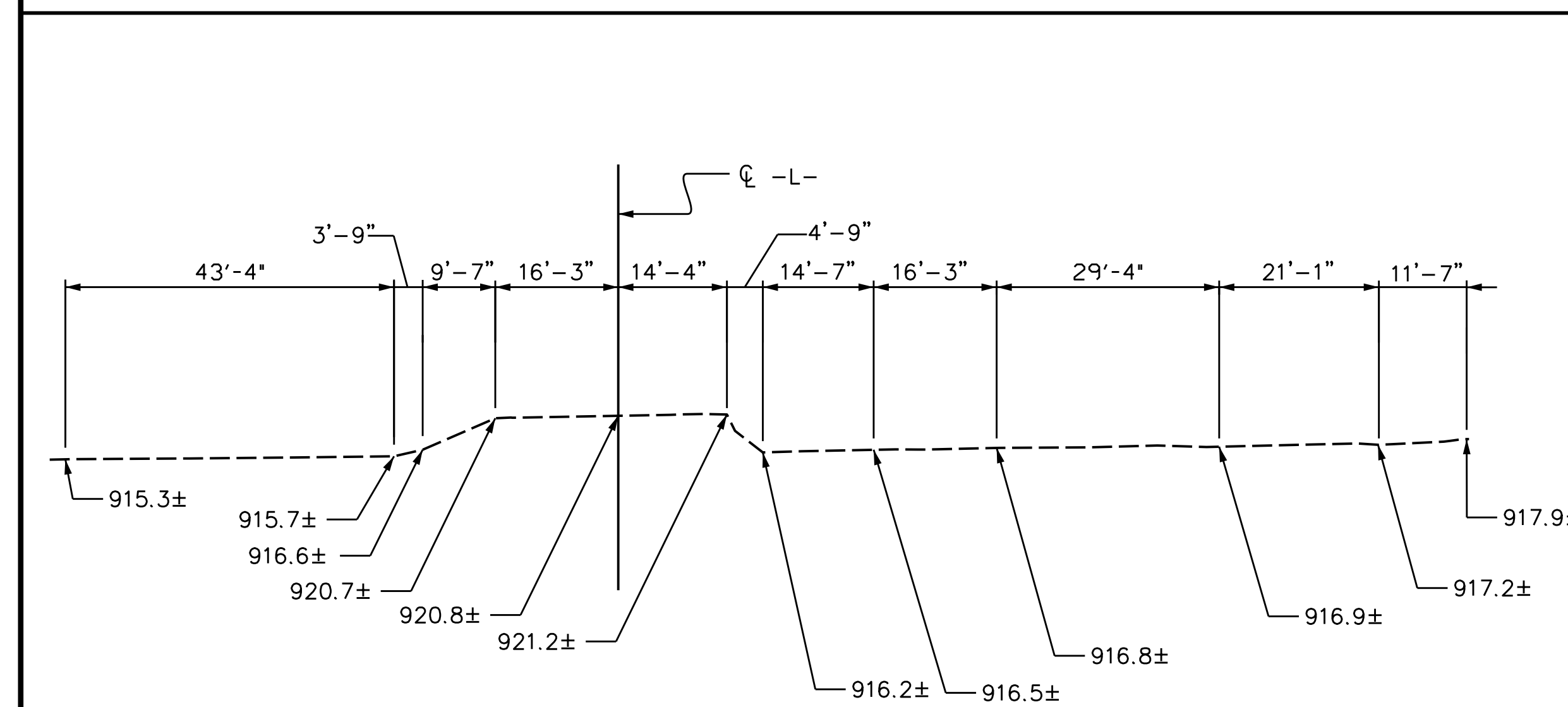
FOR CULVERT DIVERSION DETAILS AND PAY ITEM, SEE EROSION CONTROL PLANS.

THE 15", AND 24" DIA. PIPE THROUGH THE SIDEWALL OF THE CULVERT SHALL BE LOCATED BY THE ENGINEER. THE REINFORCING STEEL SHALL BE FIELD BENT AS NECESSARY TO CLEAR PIPE.

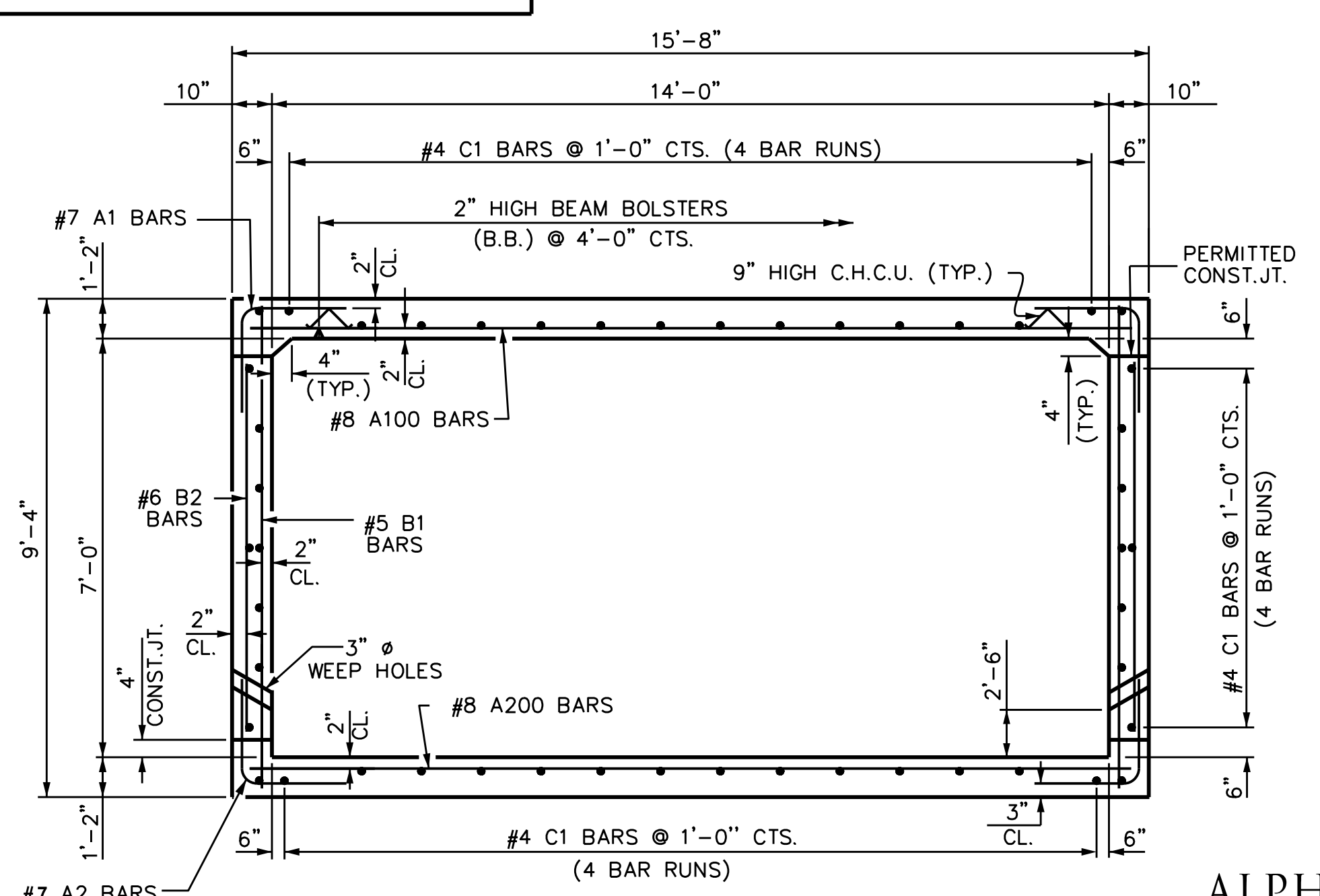
A 3 FOOT STRIP OF FILTER FABRIC SHALL BE ATTACHED TO THE FILL FACE OF THE WING COVERING THE ENTIRE LENGTH OF THE EXPANSION JOINT.

THE ENTIRE COST OF WORK REQUIRED TO PLACE EXCAVATED OR SUPPLEMENTAL MATERIAL AS SHOWN ON THE PLANS SHALL BE INCLUDED IN THE LUMP SUM PRICE FOR CULVERT EXCAVATION.

NATIVE BED MATERIAL PLACED BETWEEN SILLS IN THE CULVERT SHALL PROVIDE A CONTINUOUS LOW FLOW CHANNEL BETWEEN THE LOWER SILLS. THE MATERIAL SHALL BE NATURAL STONE WITH A GRADATION SIZE SIMILAR TO THAT OF CLASS 1 RIP RAP. STONES LARGER THAN 8 INCHES SHALL NOT BE PLACED WITHIN THE LOW FLOW CHANNEL. BED MATERIAL IS SUBJECT TO APPROVAL BY THE ENGINEER.



PROFILE ALONG CULVERT



RIGHT ANGLE SECTION OF BARREL  
 THERE ARE 48 "C" BARS IN SECTION OF BARREL



DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PLAN PREPARED BY:



**ALPHA & OMEGA GROUP**  
 CIVIL | STRUCTURAL | WATER RESOURCES

ALPHA AND OMEGA GROUP, PC  
 4601 LAKE BOONE TRAIL, SUITE 3C, RALEIGH, NC 27607  
 Firm License No. C-1684 www.aogroup.com  
 PROJECT No. 2018.014

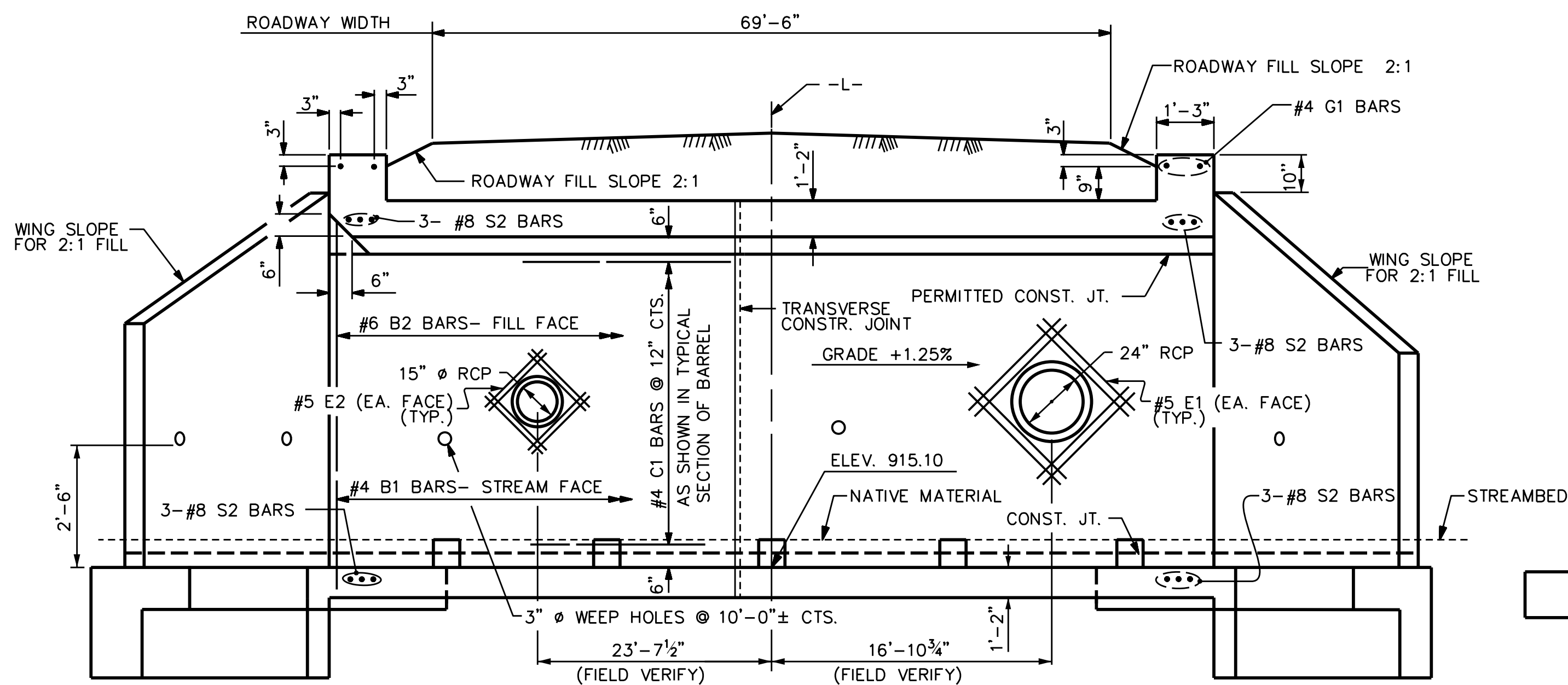
PROJECT NO. U-6003  
FORSYTH COUNTY  
 STATION: 30+67.88 -L-  
 SHEET 1 OF 4

STATE OF NORTH CAROLINA  
 DEPARTMENT OF TRANSPORTATION  
 RALEIGH  
**SINGLE 14 FT. X 7 FT. CONCRETE BOX CULVERT**

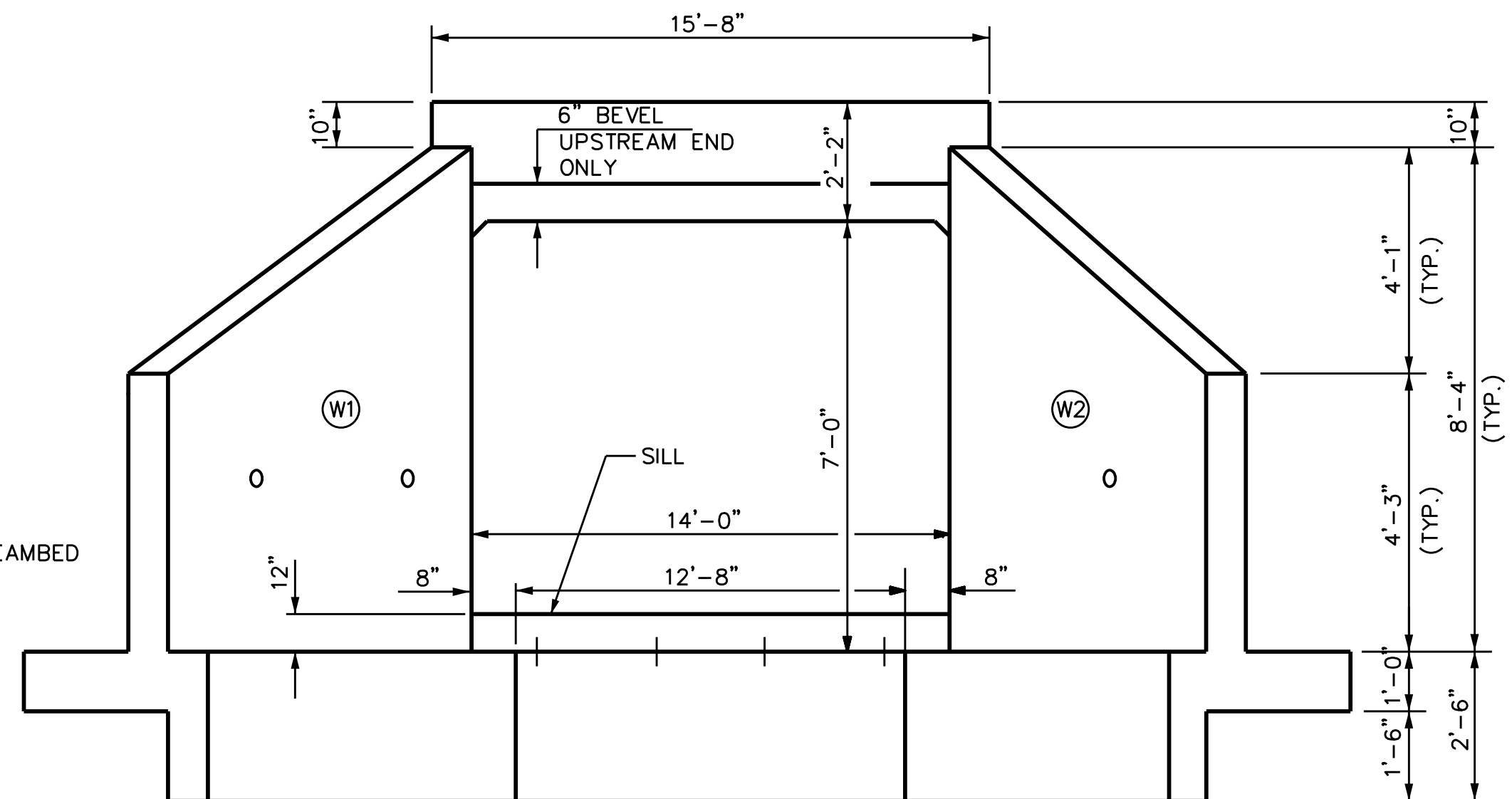
DRAWN BY : J.R.M. DATE : 3/10/2023  
 CHECKED BY : T.G.Z. DATE : 5/23/2023  
 DESIGN ENGINEER OF RECORD : I.L.B. DATE : 6/9/2023

| REVISIONS |     |       |     |     |       | TOTAL SHEETS |
|-----------|-----|-------|-----|-----|-------|--------------|
| NO.       | BY: | DATE: | NO. | BY: | DATE: | 04           |
| 1         |     |       | 3   |     |       |              |
| 2         |     |       | 4   |     |       |              |

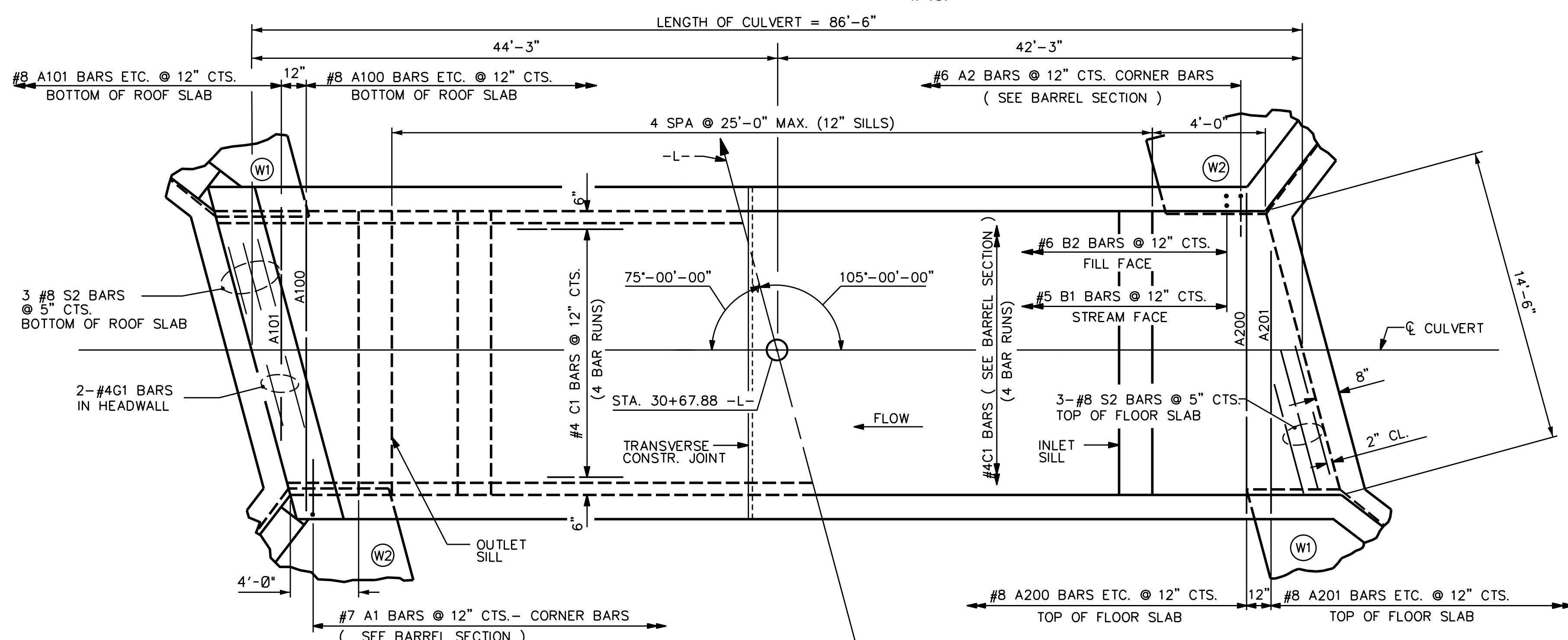




**CULVERT SECTION NORMAL TO ROADWAY**  
N.T.S.

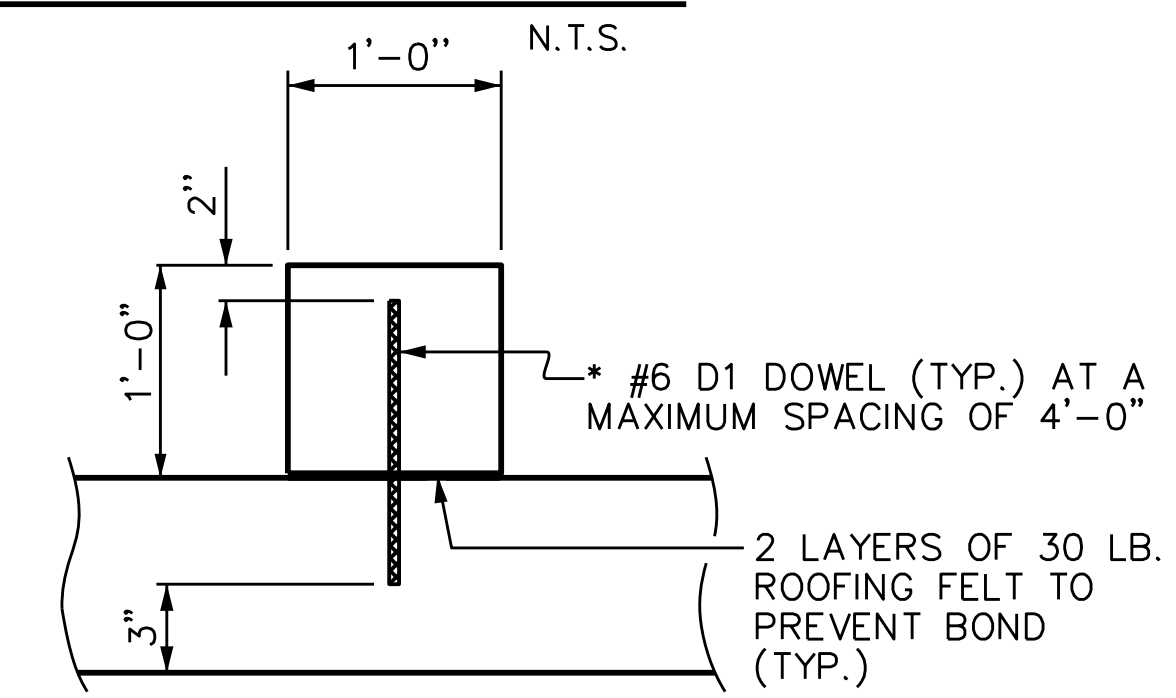


**END ELEVATION NORMAL TO SKEW**  
N.T.S.



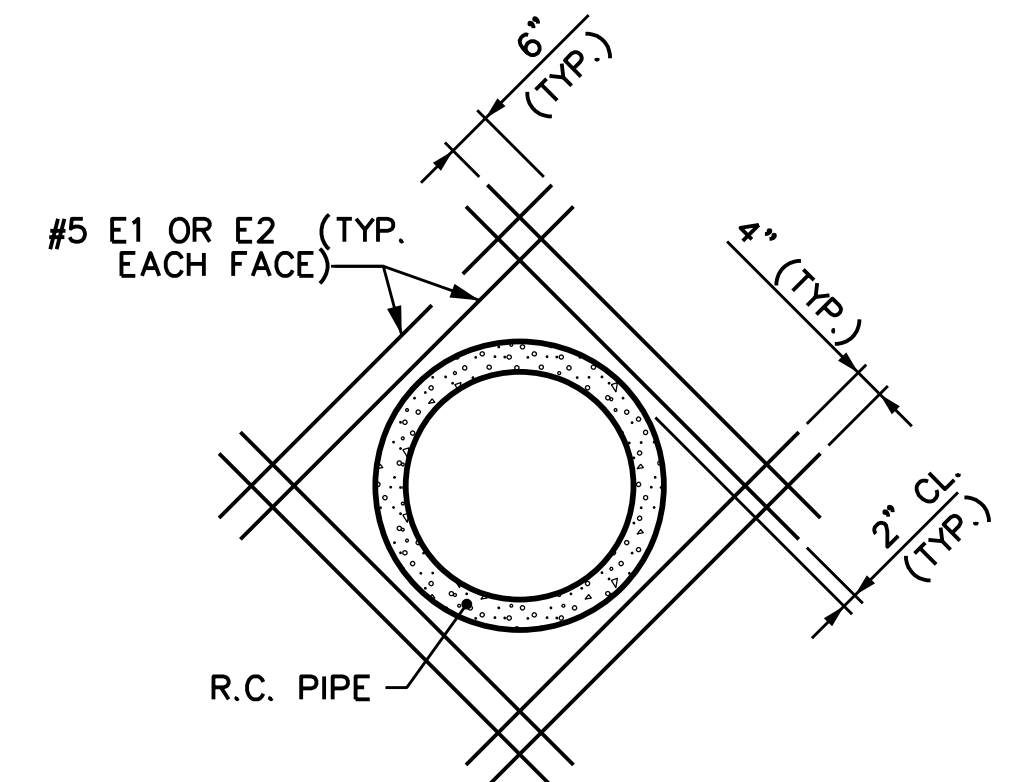
**PART PLAN - ROOF SLAB**  
N.T.S.

**PART PLAN - FLOOR SLAB**  
N.T.S.



**SECTION THROUGH SILL**  
N.T.S.

\* DOWELS MAY BE PUSHED INTO GREEN CONCRETE AFTER SLAB HAS BEEN FLOAT FINISHED.



**DETAIL OF REINFORCING AROUND PIPE**

PLAN PREPARED BY:



**ALPHA & OMEGA GROUP**  
CIVIL | STRUCTURAL | WATER RESOURCES

ALPHA AND OMEGA GROUP, PC  
4601 LAKE BOONE TRAIL, SUITE 3C, RALEIGH, NC 27607

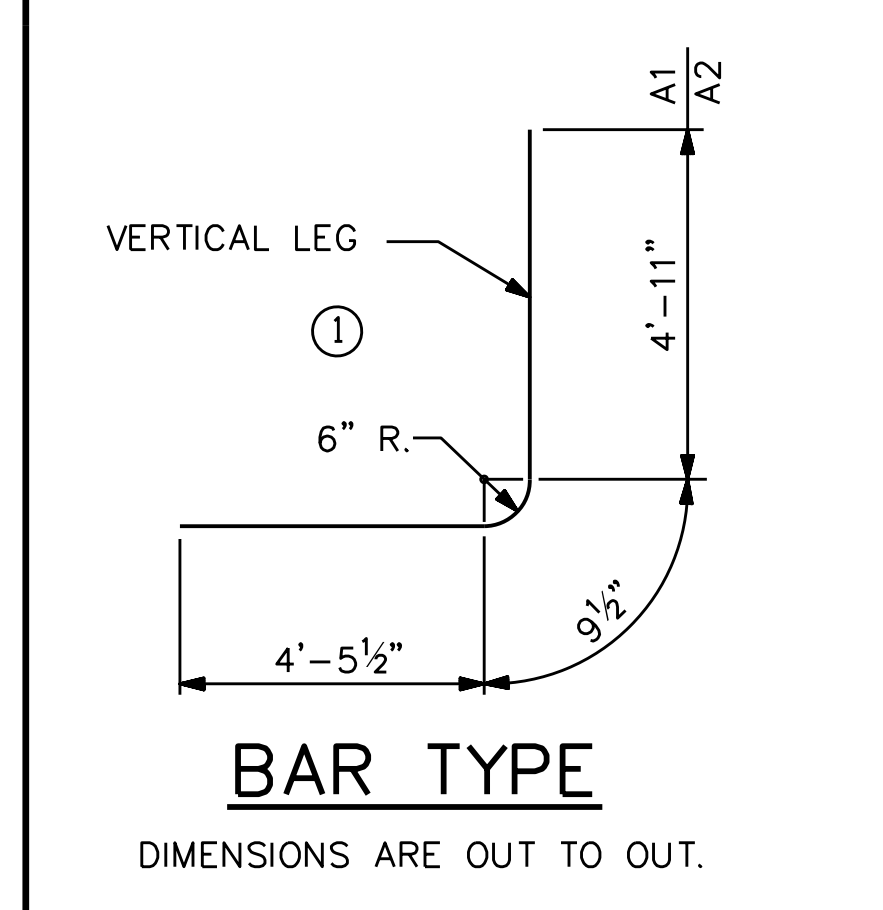
Firm License No. C-1684 www.aogroup.com

PROJECT No. 2018.014



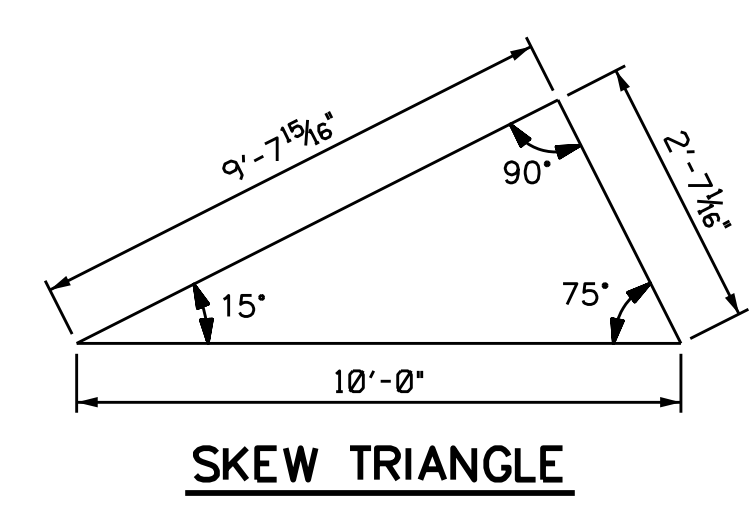
8/22/2023

| BILL OF MATERIAL        |     |      |      |         |            |
|-------------------------|-----|------|------|---------|------------|
| BAR                     | NO. | SIZE | TYPE | LENGTH  | WEIGHT     |
| A1                      | 87  | #7   | 1    | 10'-2"  | 1808       |
| A2                      | 87  | #7   | 1    | 10'-2"  | 1808       |
| A100                    | 83  | #8   | STR  | 15'-3"  | 3380       |
| A101                    | 2   | #8   | STR  | 11'-7"  | 62         |
| A102                    | 2   | #8   | STR  | 7'-10"  | 42         |
| A103                    | 4   | #8   | STR  | 4'-1"   | 44         |
| A200                    | 83  | #8   | STR  | 15'-3"  | 3380       |
| A201                    | 2   | #8   | STR  | 11'-7"  | 62         |
| A202                    | 2   | #8   | STR  | 7'-10"  | 42         |
| A203                    | 4   | #8   | STR  | 4'-1"   | 44         |
|                         |     |      |      |         |            |
| B1                      | 174 | #5   | STR  | 8'-10"  | 1602       |
| B2                      | 174 | #6   | STR  | 6'-4"   | 1650       |
|                         |     |      |      |         |            |
| C1                      | 192 | #4   | STR  | 22'-10" | 2929       |
|                         |     |      |      |         |            |
| D1                      | 20  | #6   | STR  | 1'-8"   | 75         |
|                         |     |      |      |         |            |
| E1                      | 16  | #5   | STR  | 4'-7"   | 76         |
| E2                      | 16  | #5   | STR  | 3'-8"   | 61         |
|                         |     |      |      |         |            |
| G1                      | 4   | #4   | STR  | 15'-10" | 42         |
|                         |     |      |      |         |            |
| S2                      | 6   | #8   | STR  | 15'-10" | 254        |
| TOTAL REINFORCING STEEL |     |      |      |         | 17,365 LBS |

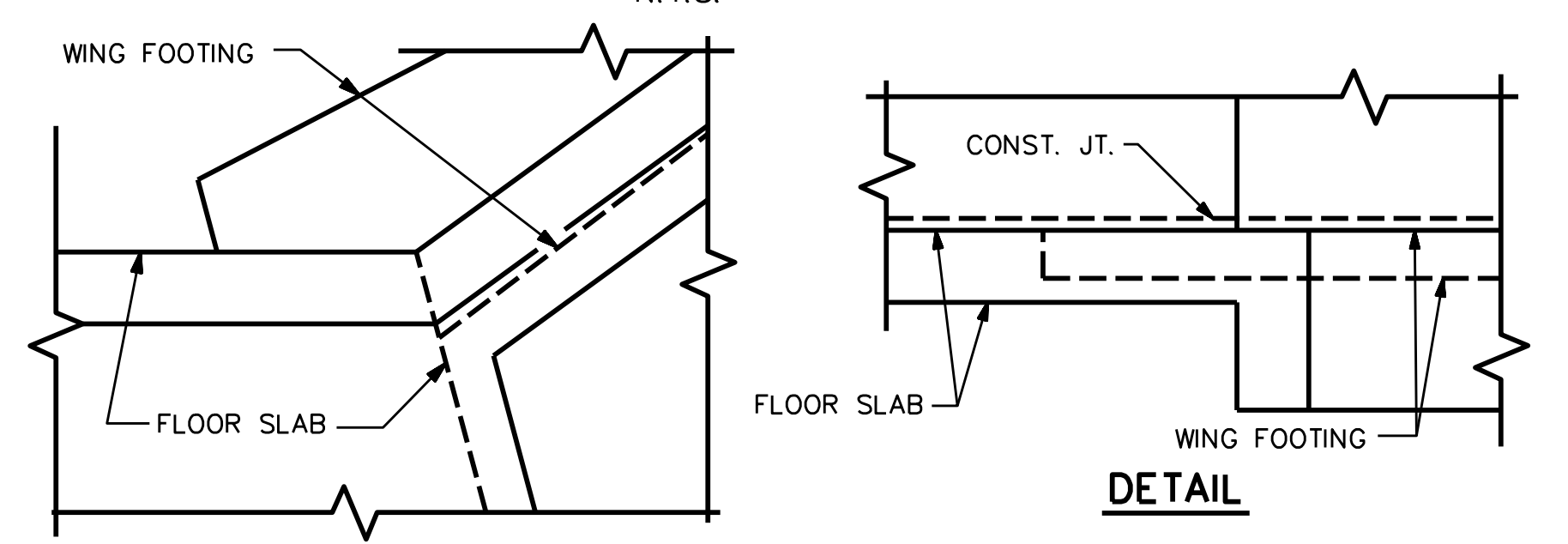


**BAR TYPE**  
DIMENSIONS ARE OUT TO OUT.

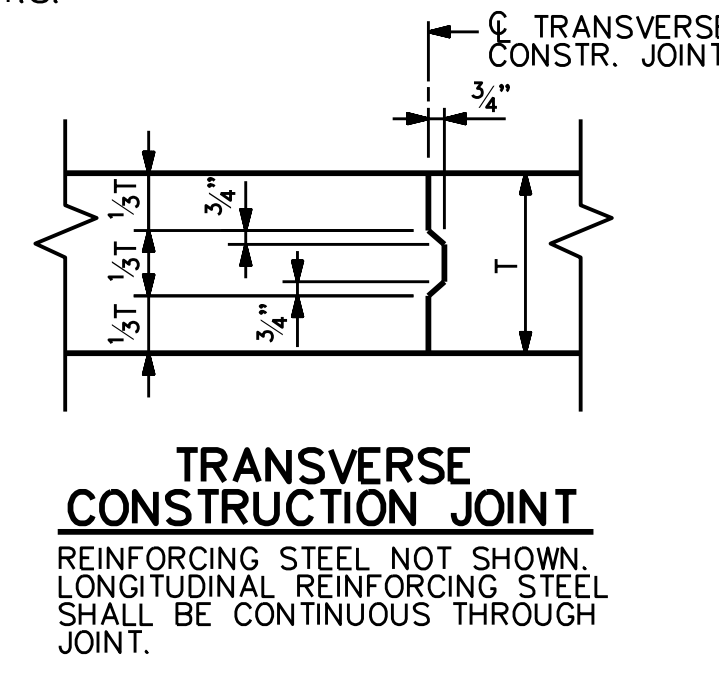
| BAR | SIZE | SPLICE LENGTH |
|-----|------|---------------|
| B1  | #4   | 1'-10"        |
| C1  | #4   | 2'-5"         |



**SKEW TRIANGLE**



**CONNECTION OF WING FOOTING AND FLOOR SLAB WHEN SLAB IS THICKER THAN FOOTING**



**TRANSVERSE CONSTRUCTION JOINT**  
REINFORCING STEEL NOT SHOWN. LONGITUDINAL REINFORCING STEEL SHALL BE CONTINUOUS THROUGH JOINT.

|                |          |           |           |
|----------------|----------|-----------|-----------|
| ASSEMBLED BY : | JRM      | DATE :    | 3/10/2023 |
| CHECKED BY :   | TGZ      | DATE :    | 5/23/2023 |
| DRAWN BY :     | RWW 8/89 | REV. 6/19 | MAA/THC   |
| CHECKED BY :   | ARB 8/89 |           |           |

\*\*\*\*\*SYSTEM\*\*\*\*\*  
\*\*\*\*\*DGN\*\*\*\*\*  
\*\*\*\*\*USERNAME\*\*\*\*\*

PROJECT NO. U-6003  
FORSYTH COUNTY  
STATION: 30+67.88 -L-  
SHEET 2 OF 4

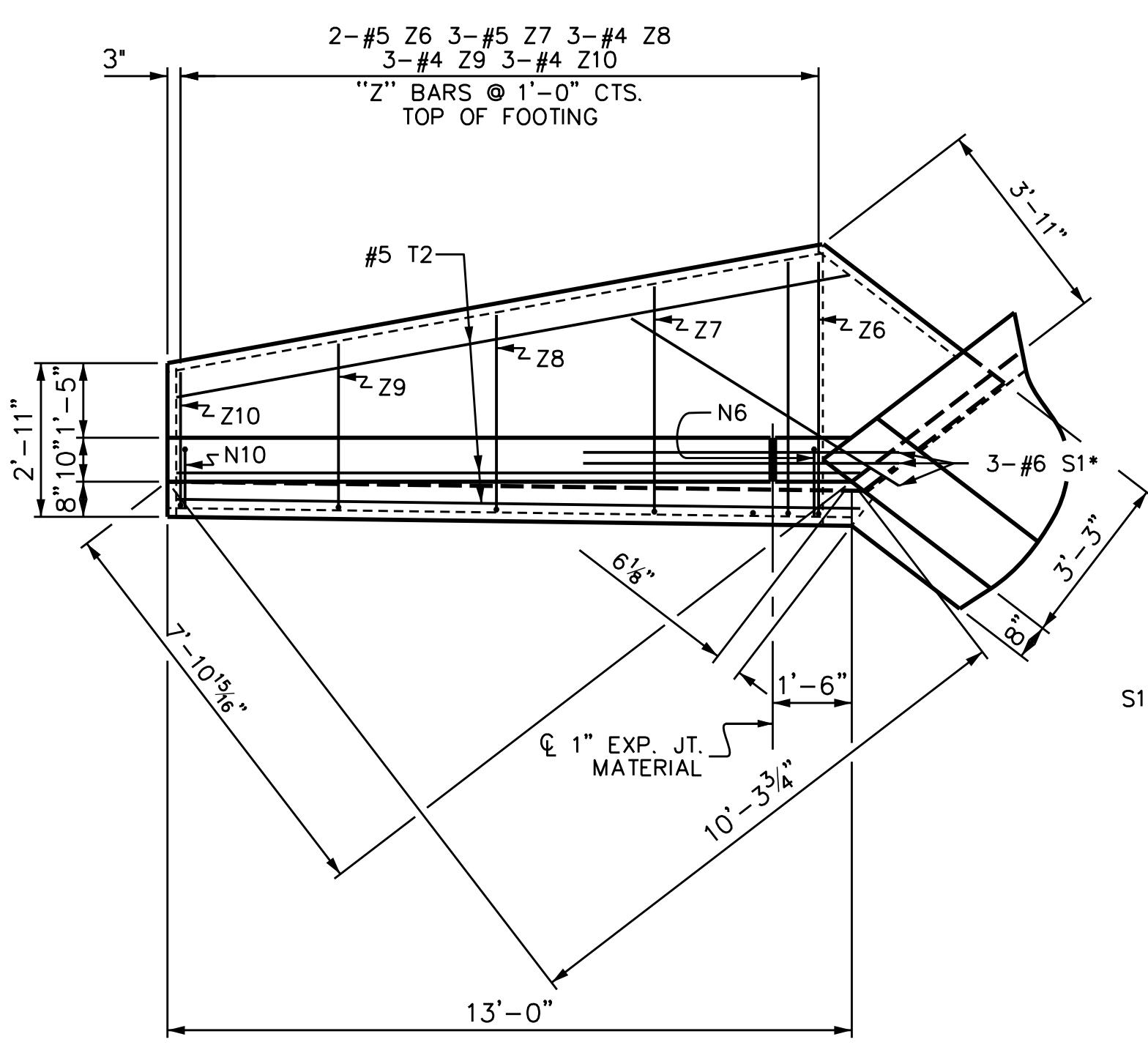
STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION  
RALEIGH  
BARREL STANDARD  
SINGLE 14 FT. X 7 FT.  
CONCRETE BOX CULVERT  
105° SKEW

| REVISIONS |     |       |     |     |       | SHEET NO.       |
|-----------|-----|-------|-----|-----|-------|-----------------|
| NO.       | BY: | DATE: | NO. | BY: | DATE: |                 |
| 1         |     |       | 3   |     |       | S1-02           |
| 2         |     |       | 4   |     |       | TOTAL SHEETS 04 |

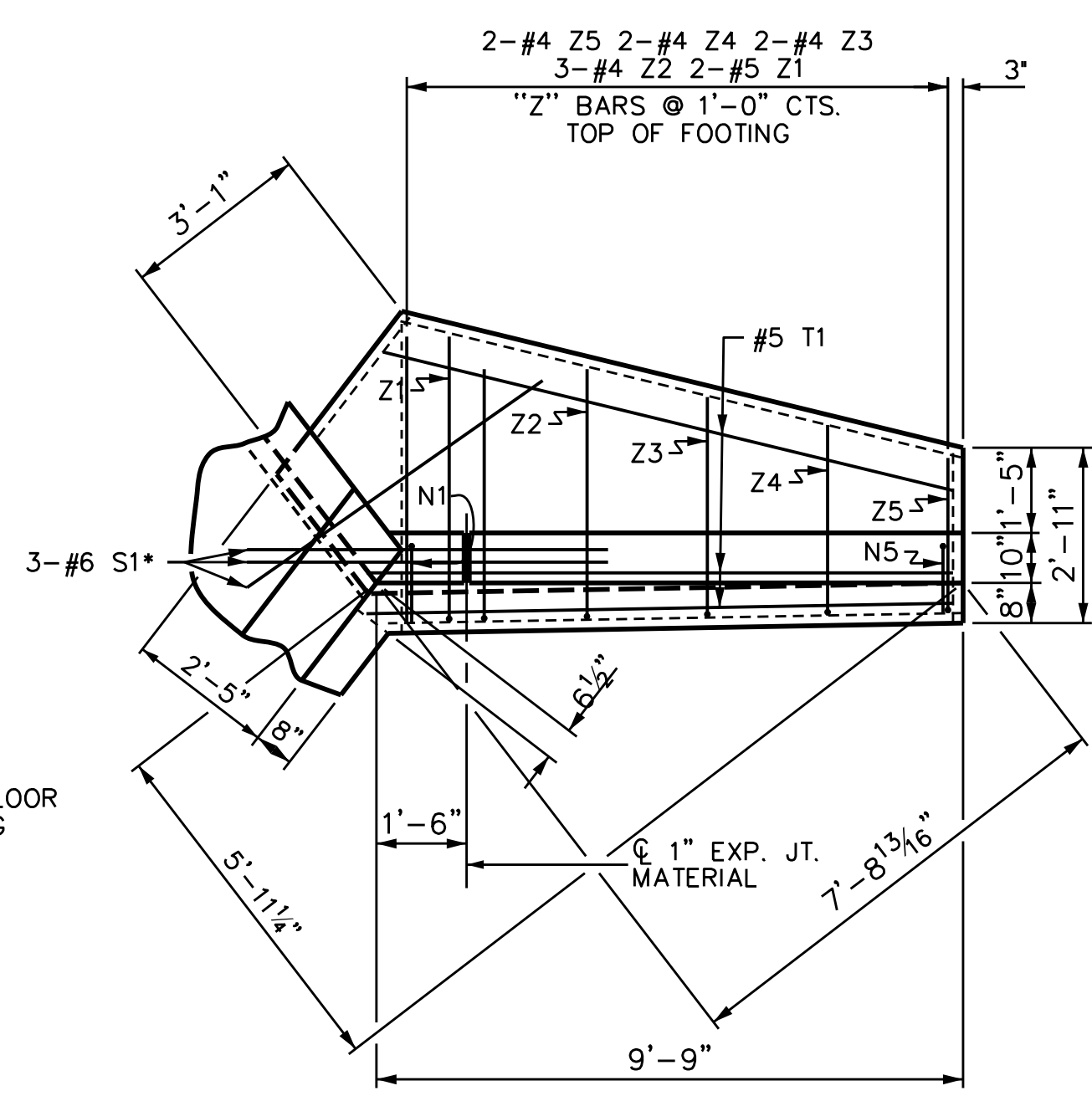
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

STD. NO. CB105.1

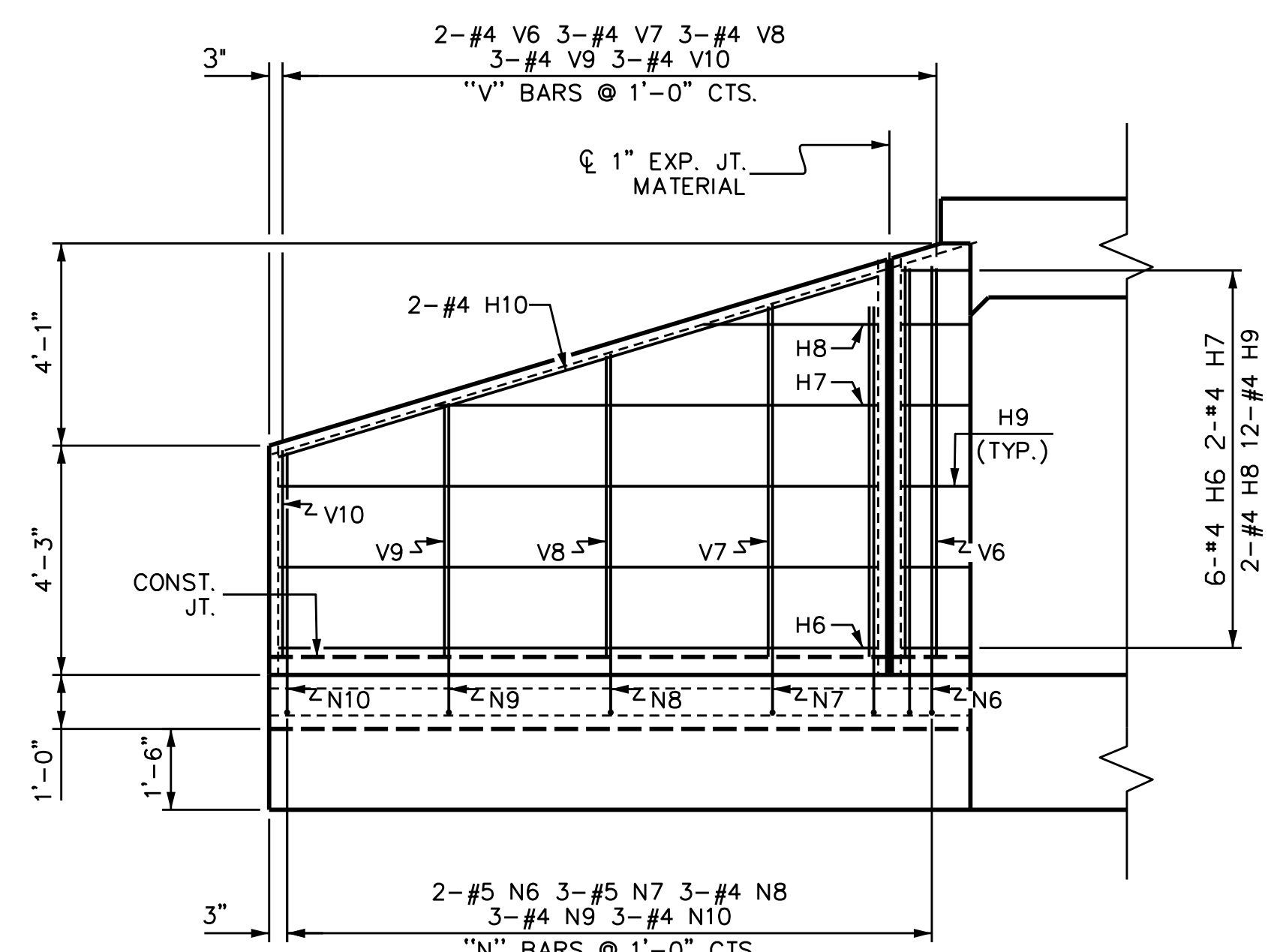




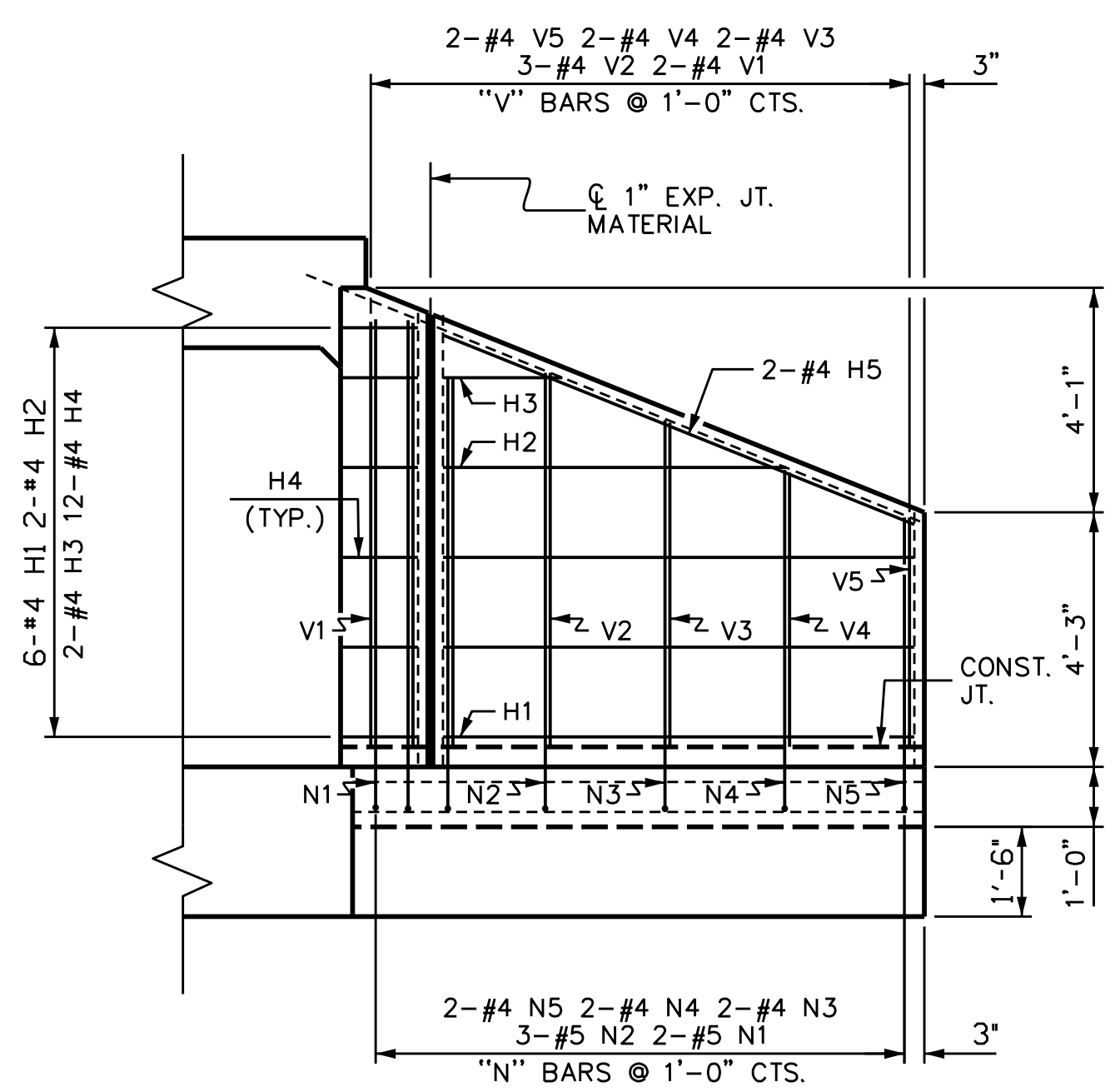
PLAN W1



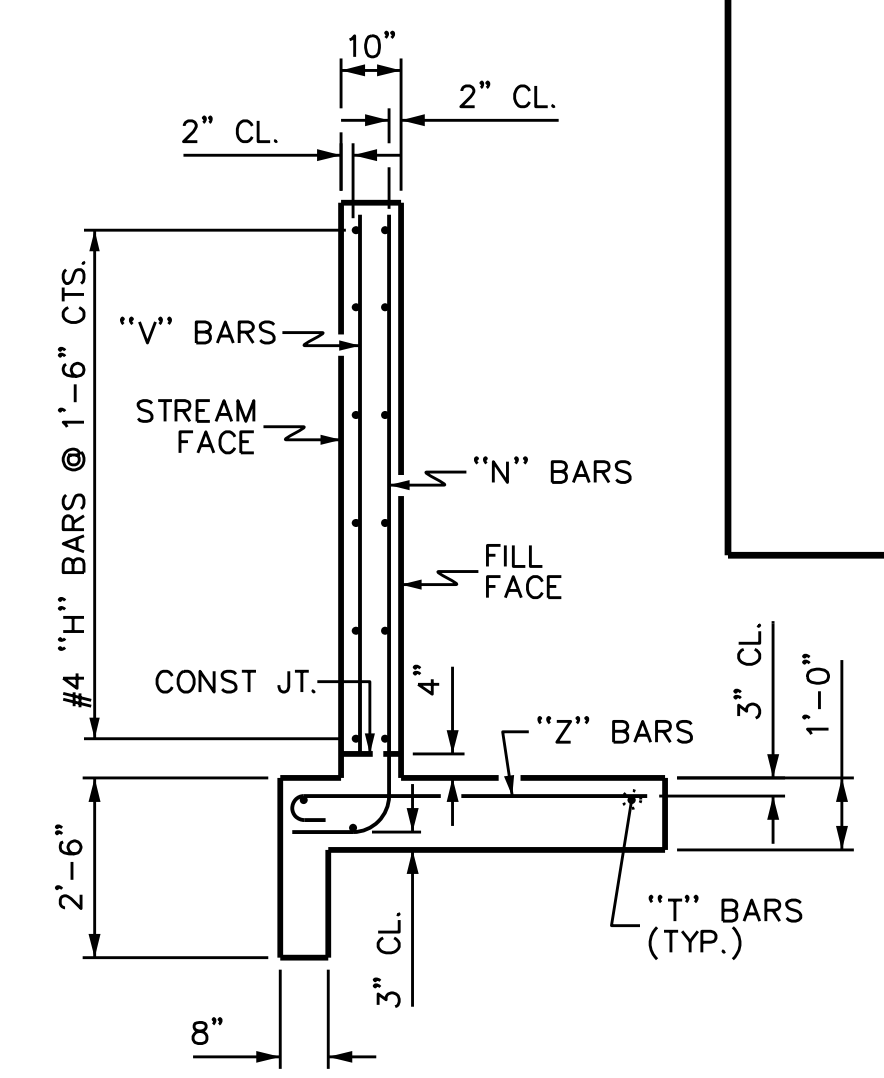
PLAN W2



ELEVATION W1



ELEVATION W2



TYPICAL WING SECTION

PLAN PREPARED BY:



ALPHA & OMEGA GROUP  
CIVIL | STRUCTURAL | WATER RESOURCES

ALPHA AND OMEGA GROUP, PC  
4601 LAKE BOONE TRAIL, SUITE 3C, RALEIGH, NC 27607

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PROJECT No. 2018.014



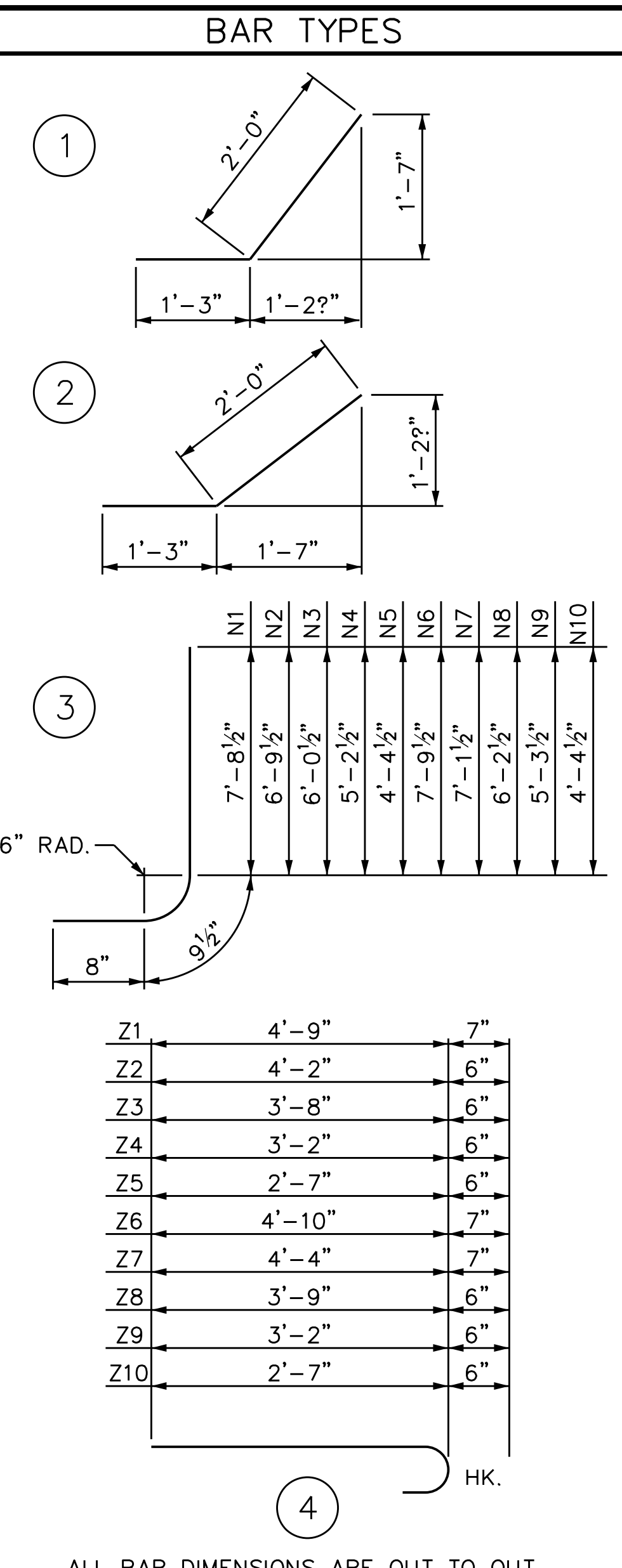
DOCUMENT NOT CONSIDERED  
FINAL UNLESS ALL  
SIGNATURES COMPLETED

REVISIONS

| NO. | BY: | DATE: | NO. | BY: | DATE: |
|-----|-----|-------|-----|-----|-------|
| 1   |     |       | 3   |     |       |
| 2   |     |       | 4   |     |       |

REVISIONS

| BILL OF MATERIAL              |     |      |      |        |           |
|-------------------------------|-----|------|------|--------|-----------|
| BAR                           | NO. | SIZE | TYPE | LENGTH | WEIGHT    |
| H1                            | 12  | #4   | STR  | 7'-10" | 63        |
| H2                            | 4   | #4   | STR  | 5'-8"  | 15        |
| H3                            | 4   | #4   | STR  | 2'-0"  | 5         |
| H4                            | 24  | #4   | 1    | 3'-3"  | 52        |
| H5                            | 4   | #4   | STR  | 8'-5"  | 22        |
| H6                            | 12  | #4   | STR  | 11'-1" | 89        |
| H7                            | 4   | #4   | STR  | 8'-2"  | 22        |
| H8                            | 4   | #4   | STR  | 3'-3"  | 9         |
| H9                            | 24  | #4   | 2    | 3'-3"  | 52        |
| H10                           | 4   | #4   | STR  | 11'-7" | 31        |
| N1                            | 4   | #5   | 3    | 9'-2"  | 38        |
| N2                            | 6   | #5   | 3    | 8'-3"  | 52        |
| N3                            | 4   | #4   | 3    | 7'-6"  | 20        |
| N4                            | 4   | #4   | 3    | 6'-8"  | 18        |
| N5                            | 4   | #4   | 3    | 5'-10" | 16        |
| N6                            | 4   | #5   | 3    | 9'-3"  | 39        |
| N7                            | 6   | #5   | 3    | 8'-7"  | 54        |
| N8                            | 6   | #4   | 3    | 7'-8"  | 31        |
| N9                            | 6   | #4   | 3    | 6'-9"  | 27        |
| N10                           | 6   | #4   | 3    | 5'-10" | 23        |
| S1                            | 12  | #6   | STR  | 6'-0"  | 108       |
| T1                            | 6   | #5   | STR  | 9'-9"  | 61        |
| T2                            | 6   | #5   | STR  | 13'-0" | 81        |
| V1                            | 4   | #4   | STR  | 7'-1"  | 19        |
| V2                            | 6   | #4   | STR  | 6'-3"  | 25        |
| V3                            | 4   | #4   | STR  | 5'-5"  | 14        |
| V4                            | 4   | #4   | STR  | 4'-7"  | 12        |
| V5                            | 4   | #4   | STR  | 3'-10" | 10        |
| V6                            | 4   | #4   | STR  | 7'-3"  | 19        |
| V7                            | 6   | #4   | STR  | 6'-6"  | 26        |
| V8                            | 6   | #4   | STR  | 5'-7"  | 22        |
| V9                            | 6   | #4   | STR  | 4'-8"  | 19        |
| V10                           | 6   | #4   | STR  | 3'-10" | 15        |
| Z1                            | 4   | #5   | 4    | 5'-4"  | 22        |
| Z2                            | 6   | #4   | 4    | 4'-8"  | 19        |
| Z3                            | 4   | #4   | 4    | 4'-2"  | 11        |
| Z4                            | 4   | #4   | 4    | 3'-8"  | 10        |
| Z5                            | 4   | #4   | 4    | 3'-1"  | 8         |
| Z6                            | 4   | #5   | 4    | 5'-5"  | 23        |
| Z7                            | 6   | #5   | 4    | 4'-11" | 31        |
| Z8                            | 6   | #4   | 4    | 4'-3"  | 17        |
| Z9                            | 6   | #4   | 4    | 3'-8"  | 15        |
| Z10                           | 6   | #4   | 4    | 3'-1"  | 12        |
| REINFORCING STEEL FOR 4 WINGS |     |      |      |        | 1,277 LBS |
| CLASS A CONCRETE              |     |      |      |        |           |
| 4 WINGS                       |     |      |      |        | 18.2 CY   |
| 2 HEADWALLS                   |     |      |      |        | 1.5 CY    |
| 2 END CURTAIN WALLS           |     |      |      |        | 1.7 CY    |
| TOTAL                         |     |      |      |        | 21.5 CY   |



ALL BAR DIMENSIONS ARE OUT TO OUT.

PROJECT NO. U-6003  
FORSYTH COUNTY  
STATION: 30+67.88 -L-

SHEET 3 OF 4

STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION  
RALEIGH  
STANDARD WINGS  
FOR  
CONCRETE BOX CULVERT  
H = 7'-0" SLOPE = 2:1  
105° SKEW

| NO. | BY: | DATE: | NO. | BY: | DATE: |
|-----|-----|-------|-----|-----|-------|
| 1   |     |       | 3   |     |       |
| 2   |     |       | 4   |     |       |

STD. NO. CW10507

|                |     |        |              |
|----------------|-----|--------|--------------|
| ASSEMBLED BY : | JRM | DATE : | 3/10/2023    |
| CHECKED BY :   | JJB | DATE : | 3/17/2023    |
| DRAWN BY :     | CCJ | REV.   | 6/19 MAA/THC |
| CHECKED BY :   | RWW | 03/00  |              |

\*\*\*\*\*SYSTEM\*\*\*\*\*  
\*\*\*\*\*DGN\*\*\*\*\*  
\*\*\*\*\*USER\*\*\*\*\*

## LOAD AND RESISTANCE FACTOR RATING (LRFR) SUMMARY FOR REINFORCED CONCRETE BOX CULVERTS

| LEVEL                  | VEHICLE                           | WEIGHT (W)<br>(TONS) | CONTROLLING LOAD RATING # | MINIMUM RATING FACTORS (RF) | TONS = W x RF | STRENGTH I LIMIT STATE |               |         |              |  |               |         |              | COMMENT NUMBER |  |  |
|------------------------|-----------------------------------|----------------------|---------------------------|-----------------------------|---------------|------------------------|---------------|---------|--------------|--|---------------|---------|--------------|----------------|--|--|
|                        |                                   |                      |                           |                             |               | MOMENT                 |               |         |              | SHEAR                                  |               |         |              |                |  |  |
|                        |                                   |                      |                           |                             |               | LIVE-LOAD FACTORS (LL) | RATING FACTOR | BOX NO. | ELEMENT TYPE | DISTANCE FROM LEFT END OF ELEMENT (ft) | RATING FACTOR | BOX NO. | ELEMENT TYPE |                | DISTANCE FROM LEFT END OF ELEMENT (ft) |  |
| DESIGN LOAD RATING     | HL-93 (INVENTORY)                 | N/A                  | 1                         | 1.09                        | --            | 1.75                   | 1.09          | 1       | MBS          | 7                                      | 2.07          | 1       | BEW          | 0              |  |  |
|                        | HL-93 (OPERATING)                 | N/A                  |                           | 1.42                        | --            | 1.35                   | 1.42          | 1       | MBS          | 7                                      | 2.69          | 1       | BEW          | 0              |  |  |
|                        | HS-20 (INVENTORY)                 | 36.000               | 2                         | 1.62                        | 58.30         | 1.75                   | 1.62          | 1       | MBS          | 7                                      | 2.95          | 1       | BEW          | 0              |  |  |
|                        | HS-20 (OPERATING)                 | 36.000               |                           | 2.20                        | 75.57         | 1.35                   | 2.20          | 1       | MBS          | 7                                      | 2.95          | 1       | BEW          | 0              |  |  |
| LEGAL LOAD RATING      | SINGLE VEHICLE (SV)               | SNSH                 |                           | 2.62                        | 35.35         | 1.40                   | 2.62          | 1       | MBS          | 7                                      | 4.52          | 1       | BEW          | 0              |  |  |
|                        |                                   | SNGARBS2             | 20.000                    |                             | 2.45          | 49.63                  | 1.40          | 2.45    | 1            | MBS                                    | 7             | 4.23    | 1            | BEW            | 0                                      |  |
|                        |                                   | SNAGRIS2             | 22.000                    |                             | 2.62          | 57.61                  | 1.40          | 2.62    | 1            | MBS                                    | 7             | 4.51    | 1            | BEW            | 0                                      |  |
|                        |                                   | SNCOTTS3             | 27.250                    |                             | 1.31          | 35.69                  | 1.40          | 1.31    | 1            | MBS                                    | 7             | 2.42    | 1            | BEW            | 0                                      |  |
|                        |                                   | SNAGGRS4             | 34.925                    |                             | 1.34          | 46.89                  | 1.40          | 1.34    | 1            | MBS                                    | 7             | 2.59    | 1            | BEW            | 0                                      |  |
|                        |                                   | SNS5A                | 35.550                    |                             | 1.32          | 46.77                  | 1.40          | 1.32    | 1            | MBS                                    | 7             | 2.47    | 1            | BEW            | 0                                      |  |
|                        |                                   | SNS6A                | 39.950                    | 3                           | 1.26          | 50.25                  | 1.40          | 1.26    | 1            | MBS                                    | 7             | 2.41    | 1            | BEW            | 0                                      |  |
|                        | SNS7B                             | 42.000               | 3                         | 1.26                        | 52.83         | 1.40                   | 1.26          | 1       | MBS          | 7                                      | 2.41          | 1       | BEW          | 0              |  |  |
|                        | TRUCK TRACTOR SEMI-TRAILER (TTST) | TNAGRIT3             | 33.000                    |                             | 1.70          | 56.20                  | 1.40          | 1.70    | 1            | MBS                                    | 7             | 3.20    | 1            | BEW            | 0                                      |  |
|                        |                                   | TNT4A                | 33.075                    |                             | 1.56          | 51.55                  | 1.40          | 1.56    | 1            | MBS                                    | 7             | 2.88    | 1            | BEW            | 0                                      |  |
|                        |                                   | TNT6A                | 41.600                    |                             | 1.43          | 59.49                  | 1.40          | 1.43    | 1            | MBS                                    | 7             | 2.64    | 1            | BEW            | 0                                      |  |
|                        |                                   | TNT7A                | 42.000                    |                             | 1.51          | 63.25                  | 1.40          | 1.51    | 1            | MBS                                    | 7             | 2.76    | 1            | BEW            | 0                                      |  |
|                        |                                   | TNT7B                | 42.000                    |                             | 1.33          | 55.84                  | 1.40          | 1.33    | 1            | MBS                                    | 7             | 2.57    | 1            | BEW            | 0                                      |  |
|                        |                                   | TNAGRIT4             | 43.000                    |                             | 1.48          | 63.80                  | 1.40          | 1.48    | 1            | MBS                                    | 7             | 2.81    | 1            | BEW            | 0                                      |  |
| TNAGT5A                |                                   | 45.000               |                           | 1.48                        | 66.79         | 1.40                   | 1.48          | 1       | MBS          | 7                                      | 2.82          | 1       | BEW          | 0              |  |  |
| TNAGT5B                | 45.000                            |                      | 1.36                      | 61.28                       | 1.40          | 1.36                   | 1             | MBS     | 7            | 2.51                                   | 1             | BEW     | 0            |                |  |  |
| EMERGENCY VEHICLE (EV) | EV2                               | 28.750               |                           | 1.72                        | 49.43         | 1.40                   | 1.72          | 1       | MBS          | 7                                      |               | 1       | BEW          | 0              |  |  |
|                        | EV3                               | 43.000               | 4                         | 1.06                        | 45.41         | 1.40                   | 1.06          | 1       | MBS          | 7                                      |               | 1       | BEW          | 0              |  |  |

**LOAD FACTORS:**

DESIGN LOAD RATING FACTORS

| LOAD TYPE | MAX FACTOR | MIN FACTOR |
|-----------|------------|------------|
| DC        | 1.25       | 0.90       |
| DW        | 1.50       | 0.65       |
| EV        | 1.30       | 0.90       |
| EH        | 1.35       | 0.90       |
| ES        | 1.35       | 0.90       |
| LS        | 1.75       | --         |
| WA        | 1.00       | --         |

**NOTE:**

RATING FACTORS ARE BASED ON THE STRENGTH I LIMIT STATE.

**COMMENTS:**

- 1.
- 2.
- 3.
- 4.

**# CONTROLLING LOAD RATING**

1 DESIGN LOAD RATING (HL-93)

2 DESIGN LOAD RATING (HS-20)

3 LEGAL LOAD RATING • •

4 EMERGENCY VEHICLE LOAD RATING • •

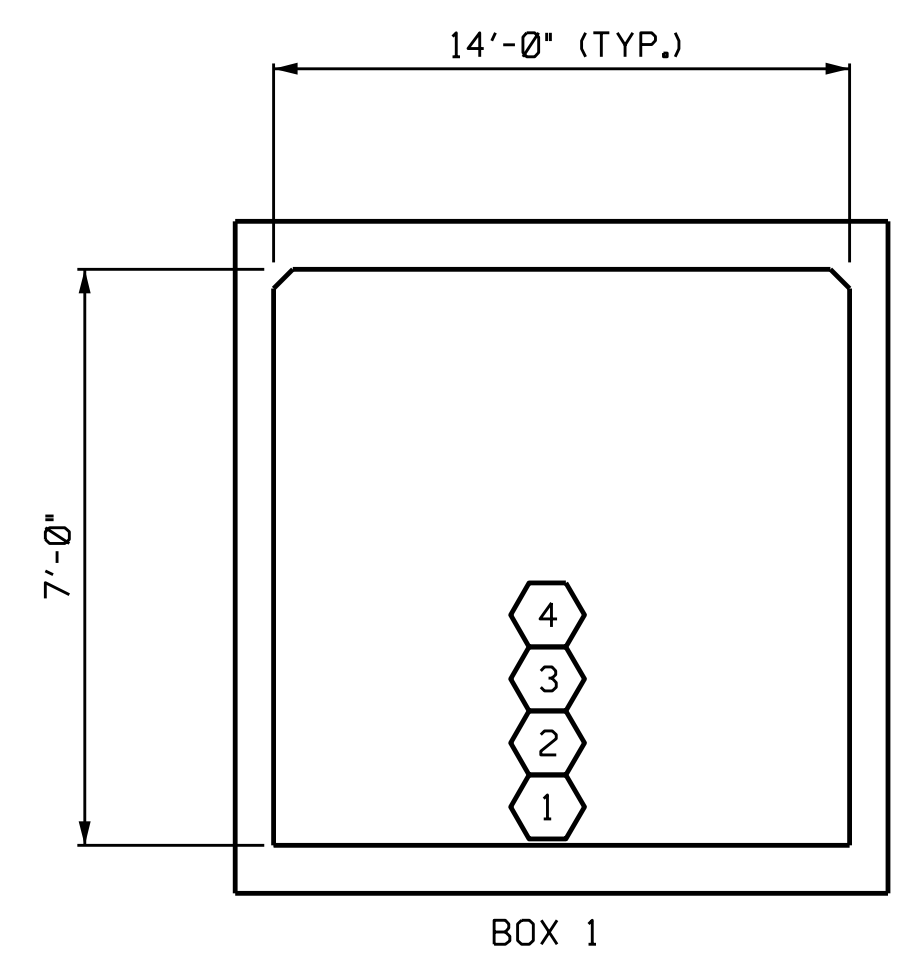
• • SEE CHART FOR VEHICLE TYPE

CULVERT LOCATION

MBS - MIDDLE BOTTOM SLAB

BEW - BOTTOM EXTERIOR WALL

TEW - TOP OF EXTERIOR WALL



**LRFR SUMMARY**  
(LOOKING DOWNSTREAM)

PROJECT NO. U-6003  
 FORSYTH COUNTY  
 STATION: 30+67.88 -L-

SHEET 4 OF 4

PLAN PREPARED BY:



**ALPHA & OMEGA GROUP**  
 CIVIL | STRUCTURAL | WATER RESOURCES  
 ALPHA AND OMEGA GROUP, PC  
 4601 LAKE BOONE TRAIL, SUITE 3C, RALEIGH, NC 27607  
 Firm License No. C-1684 www.aogroup.com  
 PROJECT No. 2018.014



STATE OF NORTH CAROLINA  
 DEPARTMENT OF TRANSPORTATION  
 RALEIGH

**LRFR SUMMARY FOR  
 REINFORCED CONCRETE  
 BOX CULVERTS  
 (NON-INTERSTATE TRAFFIC)**

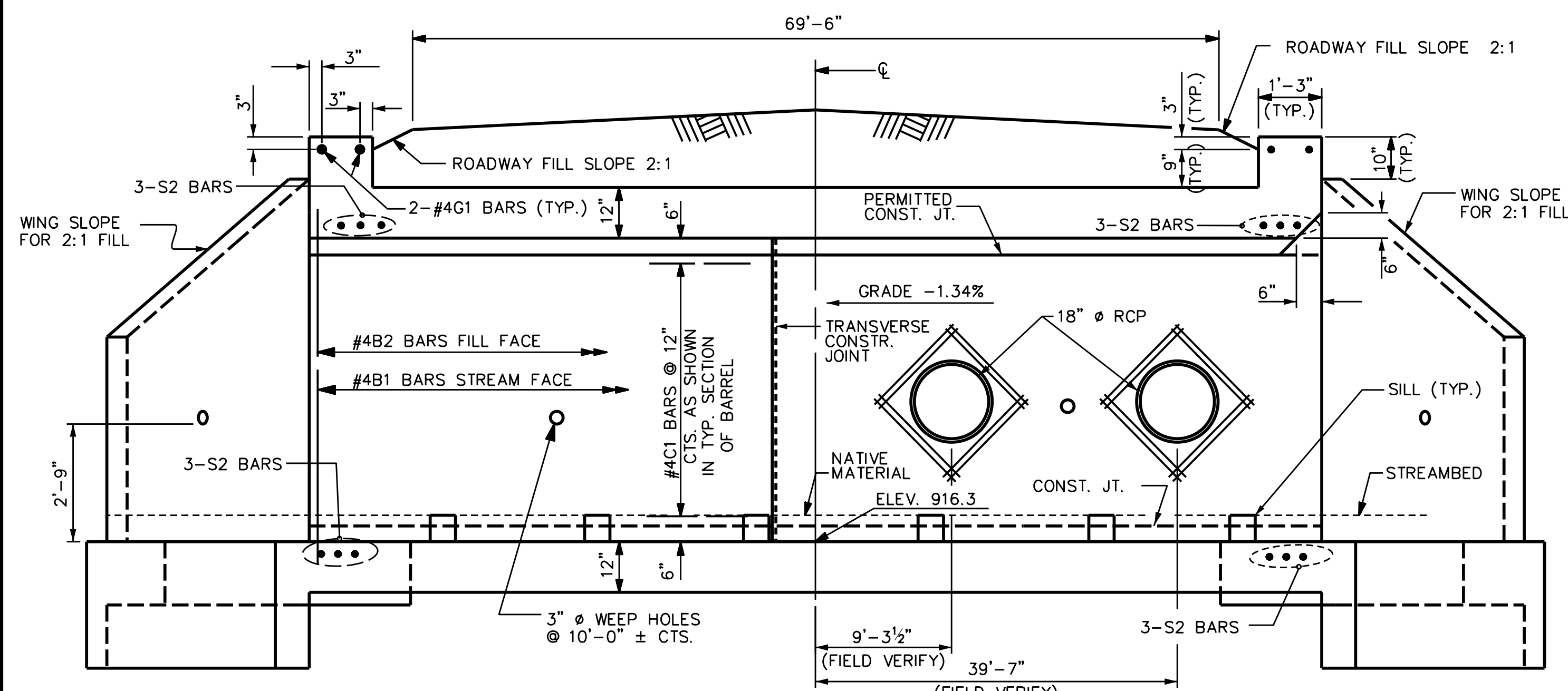
|                      |                      |
|----------------------|----------------------|
| ASSEMBLED BY : JRM   | DATE : 3/10/2023     |
| CHECKED BY : JJB     | DATE : 3/17/2023     |
| DRAWN BY : WMC 7/11  | REV. 10/11/11 MAA/GM |
| CHECKED BY : GM 7/11 | REV. 12/17 MAA/THG   |
|                      | REV. 04/23 BNB/AA    |

| REVISIONS |     |       |     |     |       | SHEET NO.       |
|-----------|-----|-------|-----|-----|-------|-----------------|
| NO.       | BY: | DATE: | NO. | BY: | DATE: | S1-04           |
| 1         |     |       | 3   |     |       | TOTAL SHEETS 04 |
| 2         |     |       | 4   |     |       |                 |

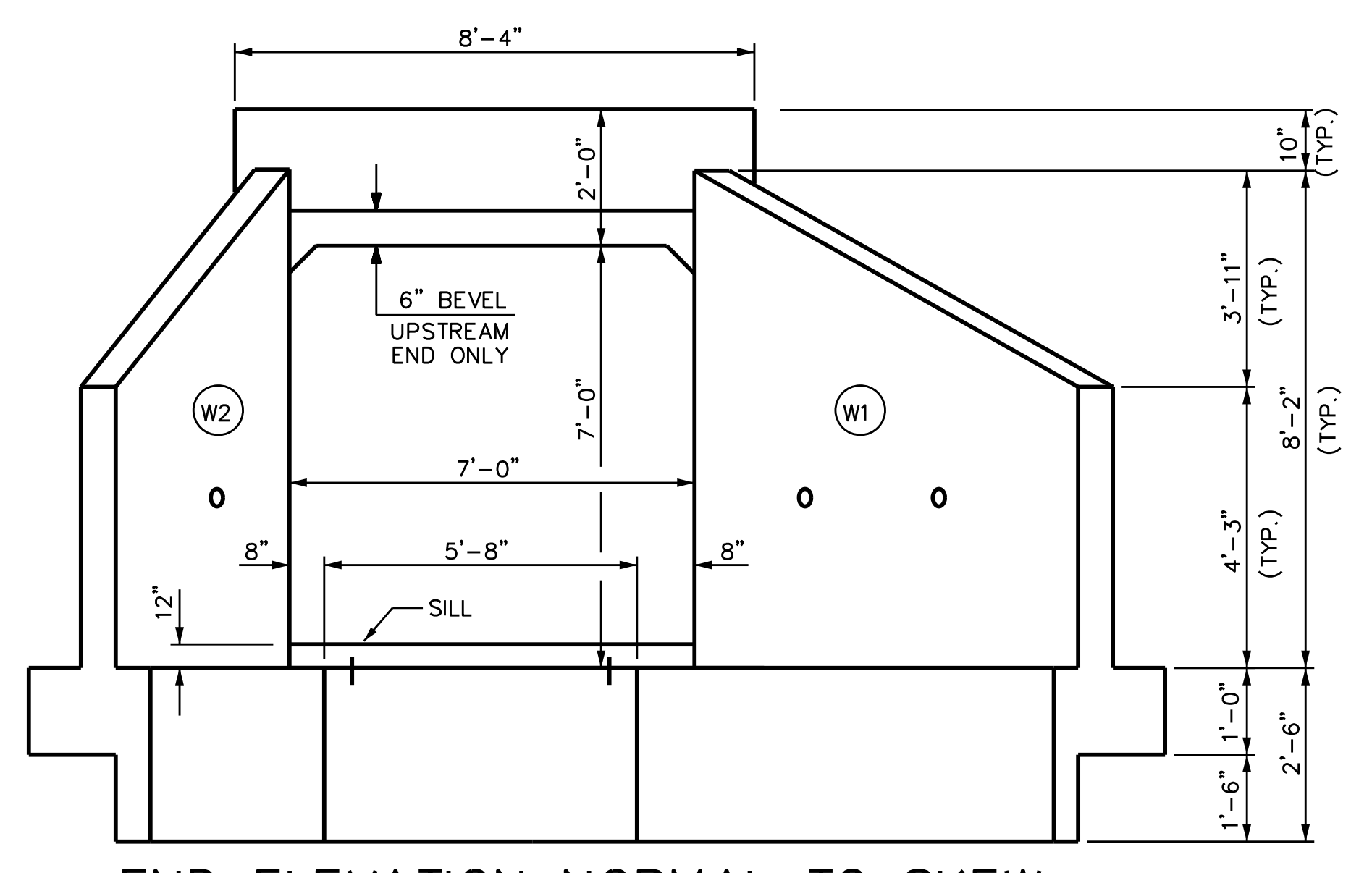






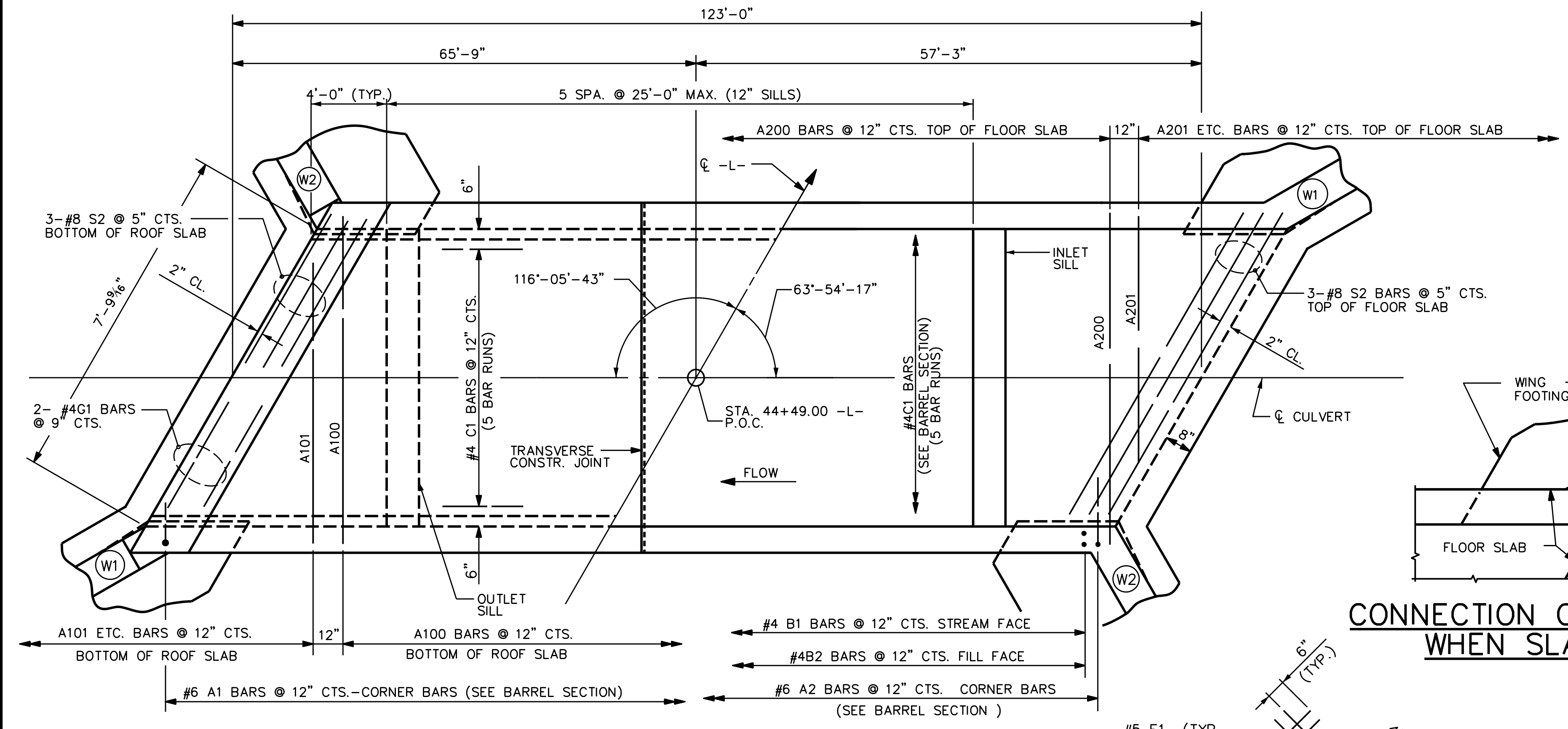


**CULVERT SECTION NORMAL TO ROADWAY**



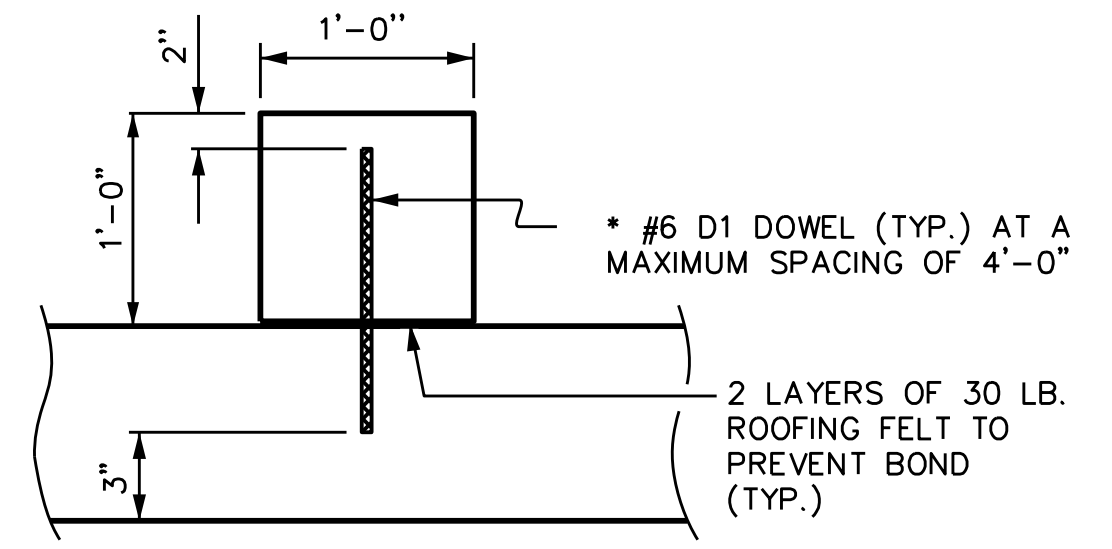
**END ELEVATION NORMAL TO SKEW**

| BILL OF MATERIAL        |     |      |      |        |            |
|-------------------------|-----|------|------|--------|------------|
| BAR                     | NO. | SIZE | TYPE | LENGTH | WEIGHT     |
| A1                      | 246 | #6   | 1    | 8'-10" | 3263       |
| A2                      | 246 | #6   | 1    | 8'-10" | 3263       |
| A100                    | 119 | #6   | STR  | 8'-0"  | 1430       |
| A101                    | 4   | #6   | STR  | 7'-2"  | 43         |
| A102                    | 4   | #6   | STR  | 5'-4"  | 32         |
| A103                    | 4   | #6   | STR  | 3'-7"  | 22         |
| A104                    | 8   | #6   | STR  | 1'-9"  | 21         |
| A200                    | 119 | #6   | STR  | 8'-0"  | 1430       |
| A201                    | 4   | #6   | STR  | 7'-2"  | 43         |
| A202                    | 4   | #6   | STR  | 5'-4"  | 32         |
| A203                    | 4   | #6   | STR  | 3'-7"  | 22         |
| A204                    | 8   | #6   | STR  | 1'-9"  | 21         |
|                         |     |      |      |        |            |
| B1                      | 246 | #4   | STR  | 8'-7"  | 1410       |
| B2                      | 246 | #4   | STR  | 6'-3"  | 1027       |
|                         |     |      |      |        |            |
| C1                      | 170 | #4   | STR  | 26'-7" | 3019       |
|                         |     |      |      |        |            |
| D1                      | 12  | #6   | STR  | 1'-6"  | 27         |
|                         |     |      |      |        |            |
| E1                      | 32  | #5   | STR  | 3'-8"  | 122        |
|                         |     |      |      |        |            |
| G1                      | 4   | #4   | STR  | 9'-1"  | 24         |
|                         |     |      |      |        |            |
| S2                      | 6   | #8   | STR  | 9'-1"  | 146        |
|                         |     |      |      |        |            |
| TOTAL REINFORCING STEEL |     |      |      |        | 15,396 LBS |



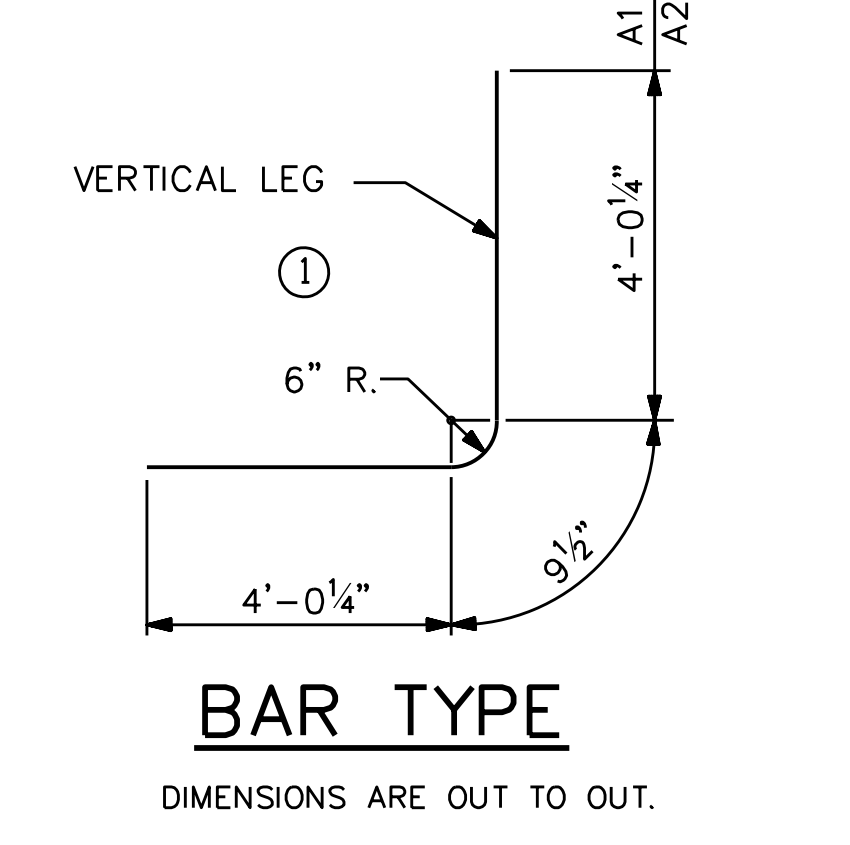
**PART PLAN - ROOF SLAB**

**PART PLAN - FLOOR SLAB**



**SECTION THROUGH SILL**

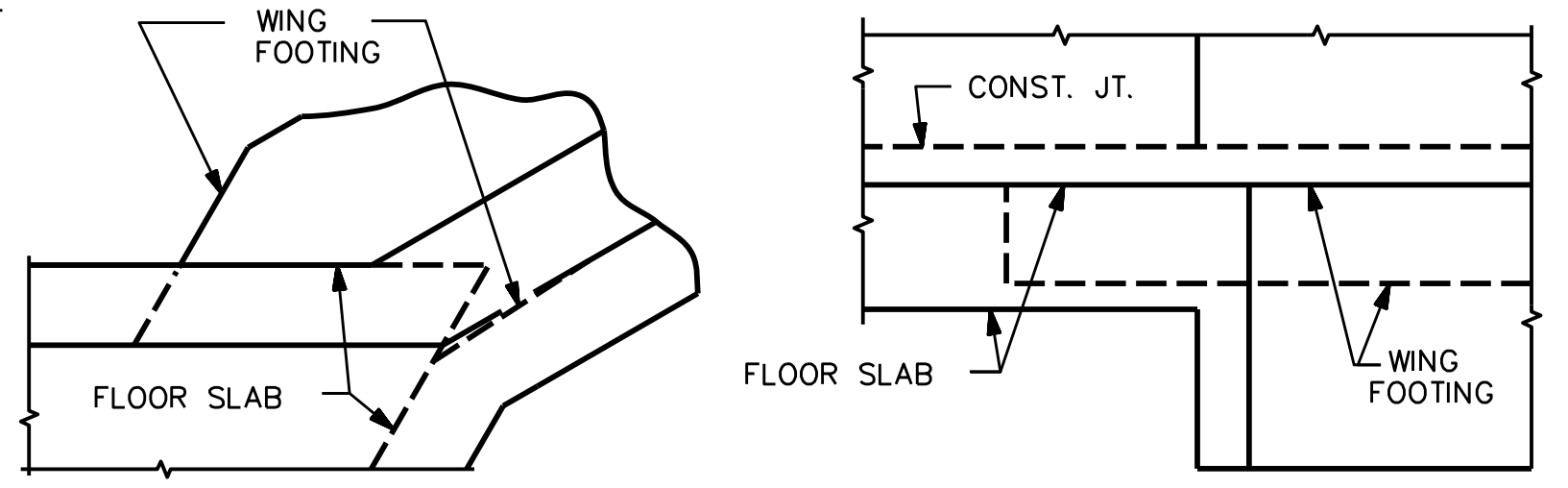
\* #6 D1 DOWEL (TYP.) AT A MAXIMUM SPACING OF 4'-0"  
2 LAYERS OF 30 LB. ROOFING FELT TO PREVENT BOND (TYP.)  
\* DOWELS MAY BE PUSHED INTO GREEN CONCRETE AFTER SLAB HAS BEEN FLOAT FINISHED.



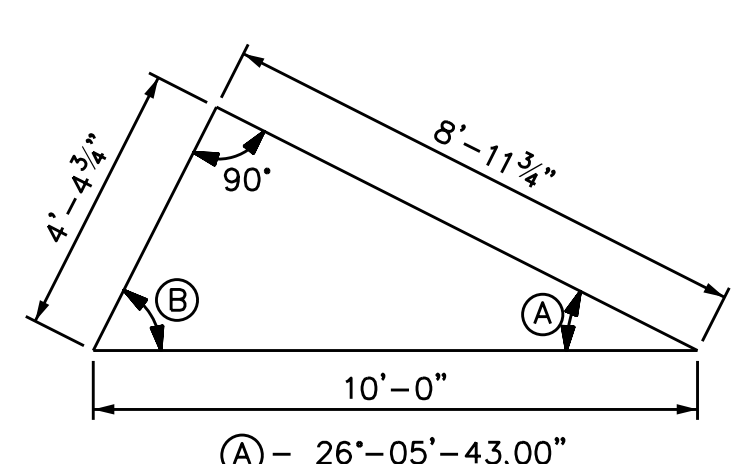
**BAR TYPE**

DIMENSIONS ARE OUT TO OUT.

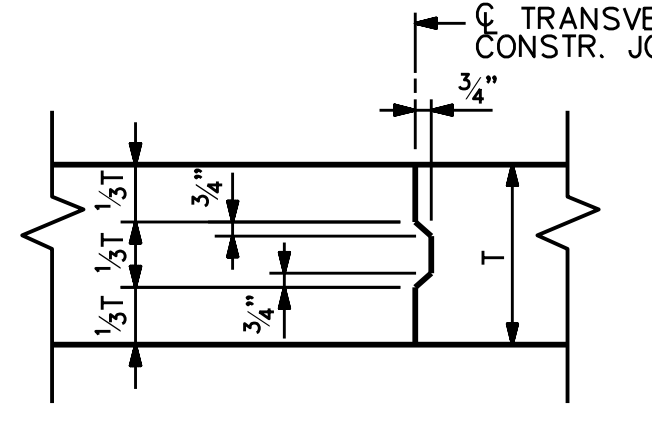
| BAR | SIZE | SPLICE LENGTH |
|-----|------|---------------|
| B1  | #4   | 1'-10"        |
| C1  | #4   | 2'-5"         |



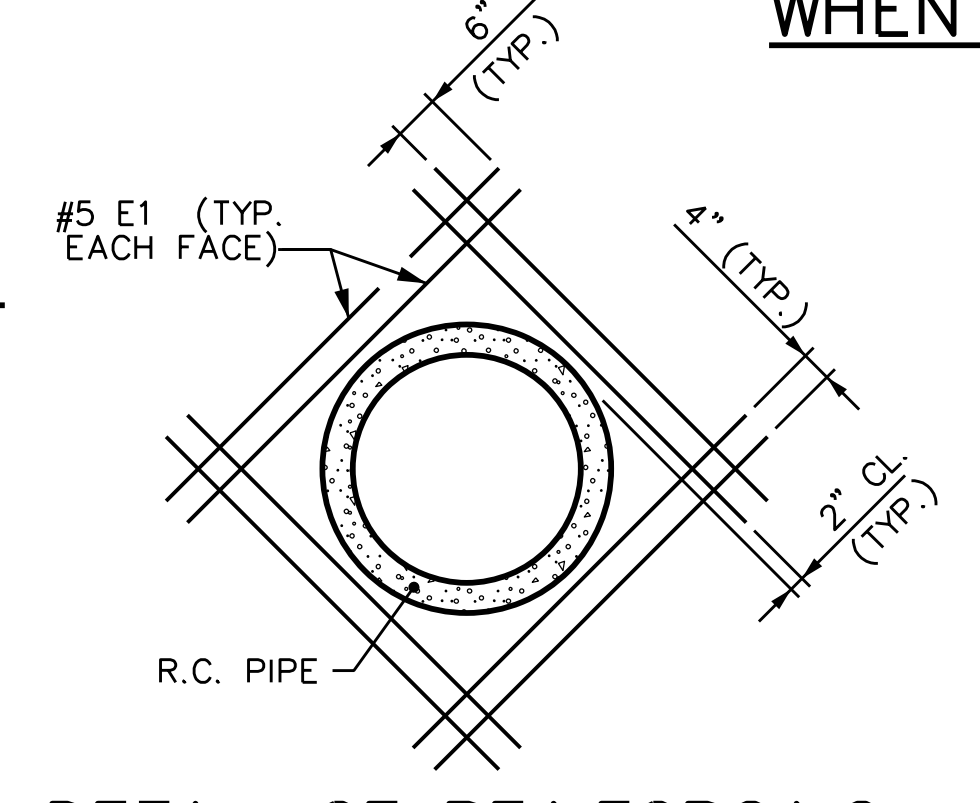
**CONNECTION OF WING FOOTING AND FLOOR SLAB WHEN SLAB IS THICKER THAN FOOTING**



**SKEW TRIANGLE**  
A - 26'-05'-43.00"  
B - 63'-54'-17.00"



**TRANSVERSE CONSTRUCTION JOINT**  
REINFORCING STEEL NOT SHOWN. LONGITUDINAL REINFORCING STEEL SHALL BE CONTINUOUS THROUGH JOINT.



**DETAIL OF REINFORCING AROUND PIPE**

|                |          |           |           |
|----------------|----------|-----------|-----------|
| ASSEMBLED BY : | JRM      | DATE :    | 3/16/2023 |
| CHECKED BY :   | TGZ      | DATE :    | 5/25/2023 |
| DRAWN BY :     | BMM 8/89 | REV. 6/19 | MAA/THC   |
| CHECKED BY :   | ARB 8/89 |           |           |

\*\*\*\*\*SYSTEM\*\*\*\*\*  
\*\*\*\*\*DGN\*\*\*\*\*  
\*\*\*\*\*USERNAME\*\*\*\*\*

PLAN PREPARED BY:



**ALPHA & OMEGA GROUP**  
CIVIL | STRUCTURAL | WATER RESOURCES

ALPHA AND OMEGA GROUP, PC  
4601 LAKE BOONE TRAIL, SUITE 3C, RALEIGH, NC 27607

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PROJECT No. 2018.014



DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PROJECT NO. U-6003  
FORSYTH COUNTY  
STATION: 44+49.00 -L-  
SHEET 2 OF 4

| REVISIONS |     |       |     |     |       | SHEET NO.       |
|-----------|-----|-------|-----|-----|-------|-----------------|
| NO.       | BY: | DATE: | NO. | BY: | DATE: |                 |
| 1         |     |       | 3   |     |       | S2-02           |
| 2         |     |       | 4   |     |       | TOTAL SHEETS 04 |

STD. NO. CB60-1







STR. #2

LOAD AND RESISTANCE FACTOR RATING (LRFR)  
SUMMARY FOR REINFORCED CONCRETE BOX CULVERTS

| LEVEL                  | VEHICLE                           | WEIGHT (W)<br>(TONS) | CONTROLLING<br>LOAD RATING | MINIMUM<br>RATING FACTORS<br>(RF) | TONS = W x RF   | STRENGTH I LIMIT STATE    |               |          |              |  |               |               |               | COMMENT NUMBER |  |  |
|------------------------|-----------------------------------|----------------------|----------------------------|-----------------------------------|---|---------------------------|---------------|----------|--------------|--|---------------|---------------|---------------|----------------|--|--|
|                        |                                   |                      |                            |                                   |   | LIVE-LOAD<br>FACTORS (LL) | MOMENT        |          |              |  | SHEAR         |               |               |                |  |  |
|                        |                                   |                      |                            |                                   |   |                           | RATING FACTOR | BOX NO.  | ELEMENT TYPE | DISTANCE FROM LEFT END OF ELEMENT (ft) | RATING FACTOR | BOX NO.       | ELEMENT TYPE  |                | DISTANCE FROM LEFT END OF ELEMENT (ft) |  |
| DESIGN LOAD RATING     | HL-93 (INVENTORY)                 | N/A                  | 1                          | N/A                               | N/A   | N/A                       | N/A           | 1        | TOP SLAB     | N/A                                    | N/A           | 1             | EXTERIOR WALL | N/A            |  |  |
|                        | HL-93 (OPERATING)                 | N/A                  |                            | N/A                               | N/A   | N/A                       | N/A           | 1        | TOP SLAB     | N/A                                    | N/A           | 1             | EXTERIOR WALL | N/A            |  |  |
|                        | HS-20 (INVENTORY)                 | 36.000               | 2                          | N/A                               | N/A   | N/A                       | N/A           | 1        | TOP SLAB     | N/A                                    | N/A           | 1             | EXTERIOR WALL | N/A            |  |  |
|                        | HS-20 (OPERATING)                 | 36.000               |                            | N/A                               | N/A   | N/A                       | N/A           | 1        | TOP SLAB     | N/A                                    | N/A           | 1             | EXTERIOR WALL | N/A            |  |  |
| LEGAL LOAD RATING      | SINGLE VEHICLE (SV)               | SNSH                 | 13.500                     |                                   | N/A   | N/A                       | N/A           | N/A      | 1            | TOP SLAB                               | N/A           | N/A           | 1             | EXTERIOR WALL  | N/A                                    |  |
|                        |                                   | SNGARBS2             | 20.000                     |                                   | N/A   | N/A                       | N/A           | N/A      | 1            | TOP SLAB                               | N/A           | N/A           | 1             | EXTERIOR WALL  | N/A                                    |  |
|                        |                                   | SNAGRIS2             | 22.000                     |                                   | N/A   | N/A                       | N/A           | N/A      | 1            | TOP SLAB                               | N/A           | N/A           | 1             | EXTERIOR WALL  | N/A                                    |  |
|                        |                                   | SNCOTTS3             | 27.250                     |                                   | N/A   | N/A                       | N/A           | N/A      | 1            | TOP SLAB                               | N/A           | N/A           | 1             | EXTERIOR WALL  | N/A                                    |  |
|                        |                                   | SNAGGRS4             | 34.925                     |                                   | N/A   | N/A                       | N/A           | N/A      | 1            | TOP SLAB                               | N/A           | N/A           | 1             | EXTERIOR WALL  | N/A                                    |  |
|                        |                                   | SNS5A                | 35.550                     |                                   | N/A   | N/A                       | N/A           | N/A      | 1            | TOP SLAB                               | N/A           | N/A           | 1             | EXTERIOR WALL  | N/A                                    |  |
|                        |                                   | SNS6A                | 39.950                     | 3                                 | N/A   | N/A                       | N/A           | N/A      | 1            | TOP SLAB                               | N/A           | N/A           | 1             | EXTERIOR WALL  | N/A                                    |  |
|                        |                                   | SNS7B                | 42.000                     | 3                                 | N/A   | N/A                       | N/A           | N/A      | 1            | TOP SLAB                               | N/A           | N/A           | 1             | EXTERIOR WALL  | N/A                                    |  |
|                        | TRUCK TRACTOR SEMI-TRAILER (TTST) | TNAGRIT3             | 33.000                     |                                   | N/A   | N/A                       | N/A           | N/A      | 1            | TOP SLAB                               | N/A           | N/A           | 1             | EXTERIOR WALL  | N/A                                    |  |
|                        |                                   | TNT4A                | 33.075                     |                                   | N/A   | N/A                       | N/A           | N/A      | 1            | TOP SLAB                               | N/A           | N/A           | 1             | EXTERIOR WALL  | N/A                                    |  |
|                        |                                   | TNT6A                | 41.600                     |                                   | N/A   | N/A                       | N/A           | N/A      | 1            | TOP SLAB                               | N/A           | N/A           | 1             | EXTERIOR WALL  | N/A                                    |  |
|                        |                                   | TNT7A                | 42.000                     |                                   | N/A   | N/A                       | N/A           | N/A      | 1            | TOP SLAB                               | N/A           | N/A           | 1             | EXTERIOR WALL  | N/A                                    |  |
|                        |                                   | TNT7B                | 42.000                     |                                   | N/A   | N/A                       | N/A           | N/A      | 1            | TOP SLAB                               | N/A           | N/A           | 1             | EXTERIOR WALL  | N/A                                    |  |
|                        |                                   | TNAGRIT4             | 43.000                     |                                   | N/A   | N/A                       | N/A           | N/A      | 1            | TOP SLAB                               | N/A           | N/A           | 1             | EXTERIOR WALL  | N/A                                    |  |
|                        |                                   | TNAGT5A              | 45.000                     |                                   | N/A   | N/A                       | N/A           | N/A      | 1            | TOP SLAB                               | N/A           | N/A           | 1             | EXTERIOR WALL  | N/A                                    |  |
| TNAGT5B                | 45.000                            |                      | N/A                        | N/A                               | N/A </td <td>N/A</td> <td>1</td> <td>TOP SLAB</td> <td>N/A</td> <td>N/A</td> <td>1</td> <td>EXTERIOR WALL</td> <td>N/A</td> <td></td> | N/A                       | 1             | TOP SLAB | N/A          | N/A                                    | 1             | EXTERIOR WALL | N/A           |                |  |  |
| EMERGENCY VEHICLE (EV) | EV2                               | 28.750               |                            | N/A                               | N/A   | N/A                       | N/A           | 1        | TOP SLAB     | N/A                                    | N/A           | 1             | EXTERIOR WALL | N/A            |  |  |
|                        | EV3                               | 43.000               | 4                          | N/A                               | N/A   | N/A                       | N/A           | 1        | TOP SLAB     | N/A                                    | N/A           | 1             | EXTERIOR WALL | N/A            |  |  |

LOAD FACTORS:

DESIGN LOAD RATING FACTORS

| LOAD TYPE | MAX FACTOR | MIN FACTOR |
|-----------|------------|------------|
| DC        | 1.25       | 0.90       |
| DW        | 1.50       | 0.65       |
| EV        | 1.30       | 0.90       |
| EH        | 1.35       | 0.90       |
| ES        | 1.35       | 0.90       |
| LS        | 1.75       | --         |
| WA        | 1.00       | --         |

NOTE:

- RATING FACTORS ARE BASED ON THE STRENGTH I LIMIT STATE.
- LRFD 3.6.1.2.6a AND MBE 6A.5.12.10.3a - NO LIVE LOADS APPLIED DUE TO DEPTH OF FILL.

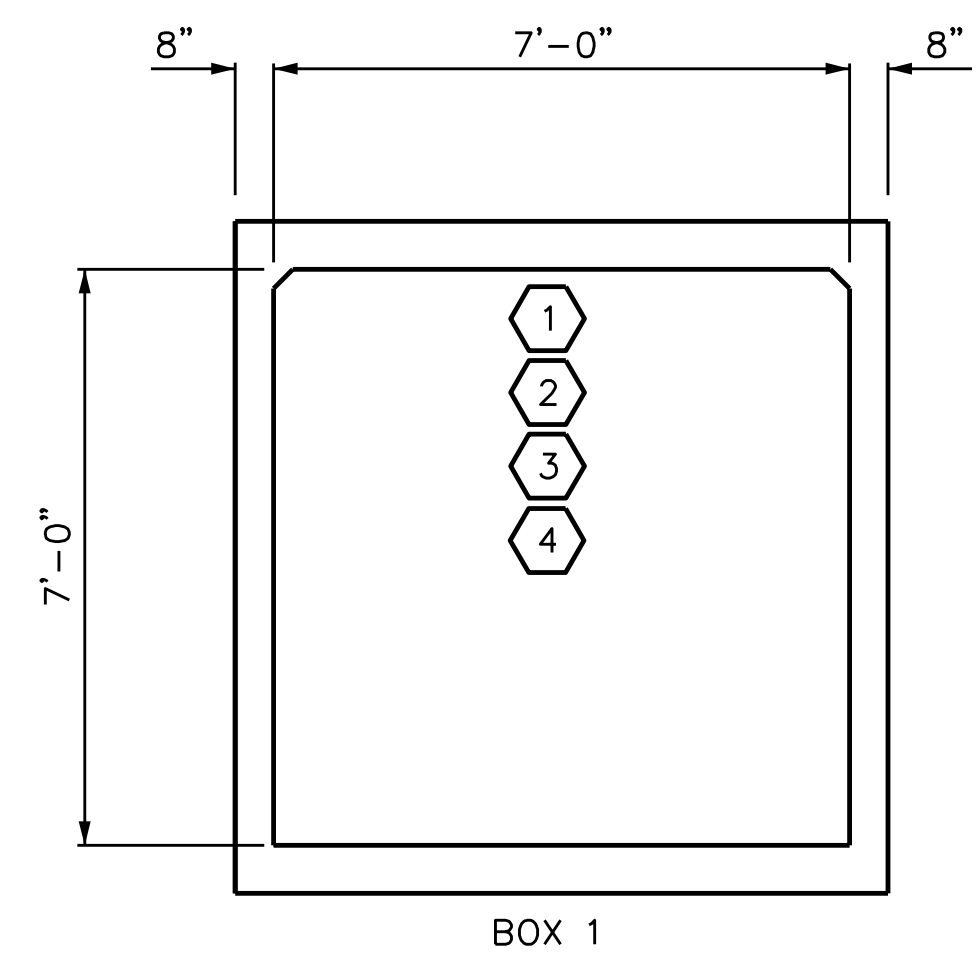
COMMENTS:

- 
- 
- 
- 

# CONTROLLING LOAD RATING

- 1 DESIGN LOAD RATING (HL-93)
- 2 DESIGN LOAD RATING (HS-20)
- 3 LEGAL LOAD RATING ••
- 4 EMERGENCY VEHICLE LOAD RATING ••

•• SEE CHART FOR VEHICLE TYPE



BOX 1  
LRFR SUMMARY  
(LOOKING DOWNSTREAM)

PROJECT NO. U-6003  
FORSYTH COUNTY  
STATION: 44+49.00 -L-

SHEET 4 OF 4

STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION  
RALEIGH

LRFR SUMMARY FOR  
REINFORCED CONCRETE  
BOX CULVERTS  
(NON-INTERSTATE TRAFFIC)

PLAN PREPARED BY:



ALPHA & OMEGA GROUP  
CIVIL | STRUCTURAL | WATER RESOURCES  
ALPHA AND OMEGA GROUP, PC  
4601 LAKE BOONE TRAIL, SUITE 3C, RALEIGH, NC 27607  
Firm License No. C-1684 www.aogroup.com  
PROJECT No. 2018.014



|                |     |        |              |
|----------------|-----|--------|--------------|
| ASSEMBLED BY : | JRM | DATE : | 3/16/2023    |
| CHECKED BY :   | JJB | DATE : | 3/16/2023    |
| DRAWN BY :     | WMC | 7/11   | REV. 10/1/11 |
| CHECKED BY :   | GM  | 7/11   | REV. 12/17   |
|                |     |        | REV. 04/23   |
|                |     |        | MAA/GM       |
|                |     |        | BNB/AA       |

| REVISIONS |     |       |     |     |       | SHEET NO.    |
|-----------|-----|-------|-----|-----|-------|--------------|
| NO.       | BY: | DATE: | NO. | BY: | DATE: | TOTAL SHEETS |
| 1         |     |       | 3   |     |       | 04           |
| 2         |     |       | 4   |     |       | 04           |

STD. NO. LRFR5



