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

| LEVEL | VEHICLE | WEIGHT (W) (TONS) | CONTROLLING LOAD RATING # | MINIMUM RATING FACTORS (RF) | TONS = W x RF | STRENGTH I LIMIT STATE | | | | | | | | COMMENT NUMBER | | |
|--------------------|-----------------------------------|----------------------|---------------------------------|-----------------------------------|---------------|----------------------------|---------------|-----------|--------------|---------------------------------------|---------------|-----------|--------------|----------------|---------------------------------------|--|
| | | | | | | LIVE-LOAD FACTORS (%LL) | MOMENT | | | | SHEAR | | | | | |
| | | | | | | | RATING FACTOR | BOX NO. | ELEMENT TYPE | DISTANCE FROM LEFT END OF ELEMENT (±) | RATING FACTOR | BOX NO. | ELEMENT TYPE | | DISTANCE FROM LEFT END OF ELEMENT (±) | |
| DESIGN LOAD RATING | HL-93 (INVENTORY) | N/A | ① | 1.06 | -- | 1.75 | 1.06 | 1 & 2 | ROOF SLAB | 5.46' | 1.18 | 1 & 2 | ROOF SLAB | 12.00' | | |
| | HL-93 (OPERATING) | N/A | | 1.38 | -- | 1.35 | 1.38 | 1 & 2 | ROOF SLAB | 5.46' | 1.53 | 1 & 2 | ROOF SLAB | 12.00' | | |
| | HS-20 (INVENTORY) | 36.000 | ② | 1.07 | 38.520 | 1.75 | 1.07 | 1 & 2 | ROOF SLAB | 5.46' | 1.49 | 1 & 2 | ROOF SLAB | 12.00' | | |
| | HS-20 (OPERATING) | 36.000 | | 1.38 | 49.680 | 1.35 | 1.38 | 1 & 2 | ROOF SLAB | 5.46' | 1.94 | 1 & 2 | ROOF SLAB | 12.00' | | |
| LEGAL LOAD RATING | SINGLE VEHICLE (SV) | SNSH | 13.500 | | 1.95 | 26.325 | 1.40 | 1.95 | 1 & 2 | ROOF SLAB | 5.46' | 2.79 | 1 & 2 | ROOF SLAB | 12.00' | |
| | | SNGARBS2 | 20.000 | | 1.82 | 36.400 | 1.40 | 1.82 | 1 & 2 | ROOF SLAB | 5.46' | 2.57 | 1 & 2 | ROOF SLAB | 12.00' | |
| | | SNAGRIS2 | 22.000 | | 1.95 | 42.900 | 1.40 | 1.95 | 1 & 2 | ROOF SLAB | 5.46' | 2.71 | 1 & 2 | ROOF SLAB | 12.00' | |
| | | SNCOTTS3 | 27.250 | ③ | 1.33 | 36.243 | 1.40 | 1.33 | 1 & 2 | ROOF SLAB | 5.46' | 1.50 | 1 & 2 | ROOF SLAB | 12.00' | |
| | | SNAGGRS4 | 34.925 | | 1.55 | 54.134 | 1.40 | 1.55 | 1 & 2 | ROOF SLAB | 5.46' | 1.71 | 1 & 2 | ROOF SLAB | 12.00' | |
| | | SNS5A | 35.550 | | 1.47 | 52.259 | 1.40 | 1.47 | 1 & 2 | EXTERIOR WALL | 0.88' | 1.67 | 1 & 2 | ROOF SLAB | 12.00' | |
| | | SNS6A | 39.950 | | 1.49 | 59.526 | 1.40 | 1.49 | 1 & 2 | ROOF SLAB | 5.46' | 1.61 | 1 & 2 | ROOF SLAB | 12.00' | |
| | | SNS7B | 42.000 | | 1.54 | 64.680 | 1.40 | 1.54 | 1 & 2 | ROOF SLAB | 5.46' | 1.61 | 1 & 2 | ROOF SLAB | 12.00' | |
| | TRUCK TRACTOR SEMI-TRAILER (TTST) | TNAGRIT3 | 33.000 | | 1.95 | 64.350 | 1.40 | 1.95 | 1 & 2 | ROOF SLAB | 5.46' | 2.15 | 1 & 2 | FLOOR SLAB | 12.09' | |
| | | TNT4A | 33.075 | | 1.58 | 52.259 | 1.40 | 1.58 | 1 & 2 | EXTERIOR WALL | 0.88' | 1.72 | 1 & 2 | ROOF SLAB | 12.00' | |
| | | TNT6A | 41.600 | | 1.58 | 65.728 | 1.40 | 1.58 | 1 & 2 | EXTERIOR WALL | 0.88' | 1.62 | 1 & 2 | ROOF SLAB | 12.00' | |
| | | TNT7A | 42.000 | | 1.57 | 65.940 | 1.40 | 1.57 | 1 & 2 | EXTERIOR WALL | 0.88' | 1.65 | 1 & 2 | ROOF SLAB | 12.00' | |
| | | TNT7B | 42.000 | | 1.51 | 63.420 | 1.40 | 1.51 | 1 & 2 | ROOF SLAB | 5.46' | 1.67 | 1 & 2 | ROOF SLAB | 12.00' | |
| | | TNAGRIT4 | 43.000 | | 1.58 | 67.940 | 1.40 | 1.58 | 1 & 2 | EXTERIOR WALL | 0.88' | 1.67 | 1 & 2 | ROOF SLAB | 12.00' | |
| | | TNACT5A | 45.000 | | 1.67 | 75.150 | 1.40 | 1.72 | 1 & 2 | ROOF SLAB | 5.46' | 1.67 | 1 & 2 | ROOF SLAB | 12.00' | |
| TNACT5B | 45.000 | | 1.56 | 70.200 | 1.40 | 1.56 | 1 & 2 | ROOF SLAB | 12.75' | 1.64 | 1 & 2 | ROOF SLAB | 12.00' | | | |

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 | -- |

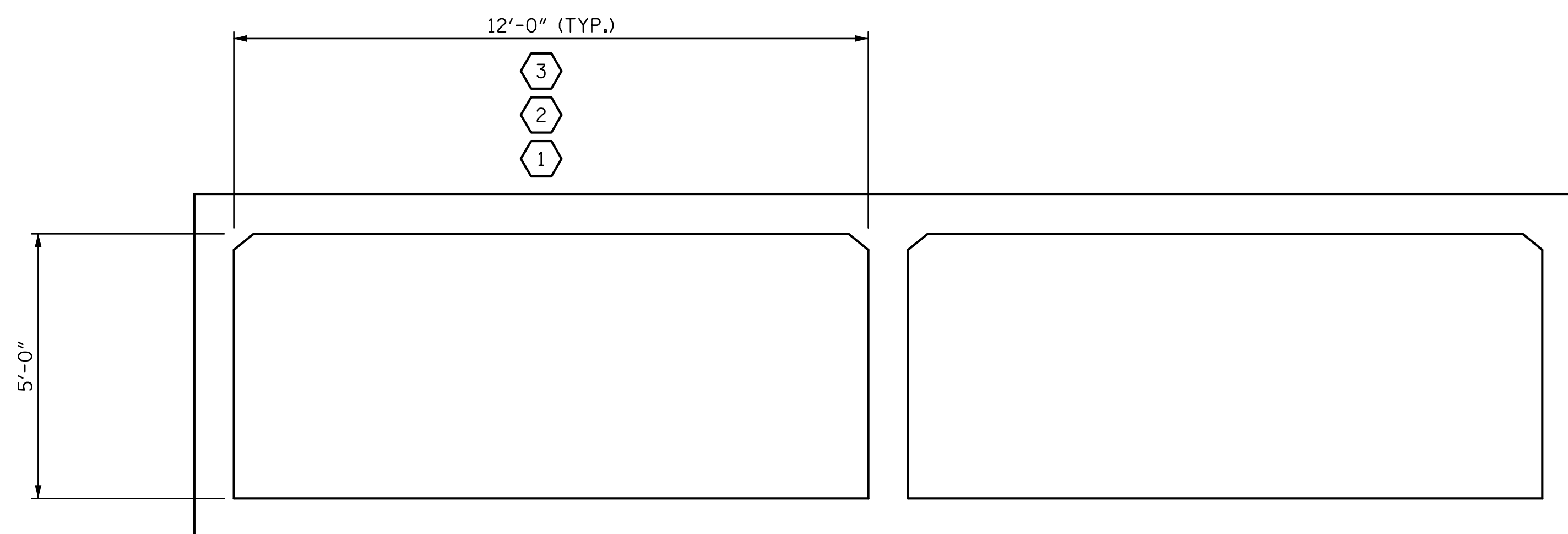
NOTE:

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 ** |
| | ** SEE CHART FOR VEHICLE TYPE |



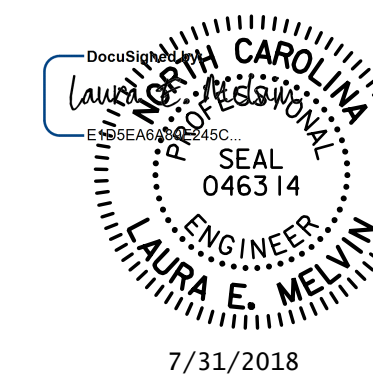
BOX 1

BOX 2

LRFR SUMMARY

(LOOKING DOWNSTREAM)

PROJECT NO. 17BP.10.R.128
ANSON COUNTY
 STATION: 13+03.00 -L-



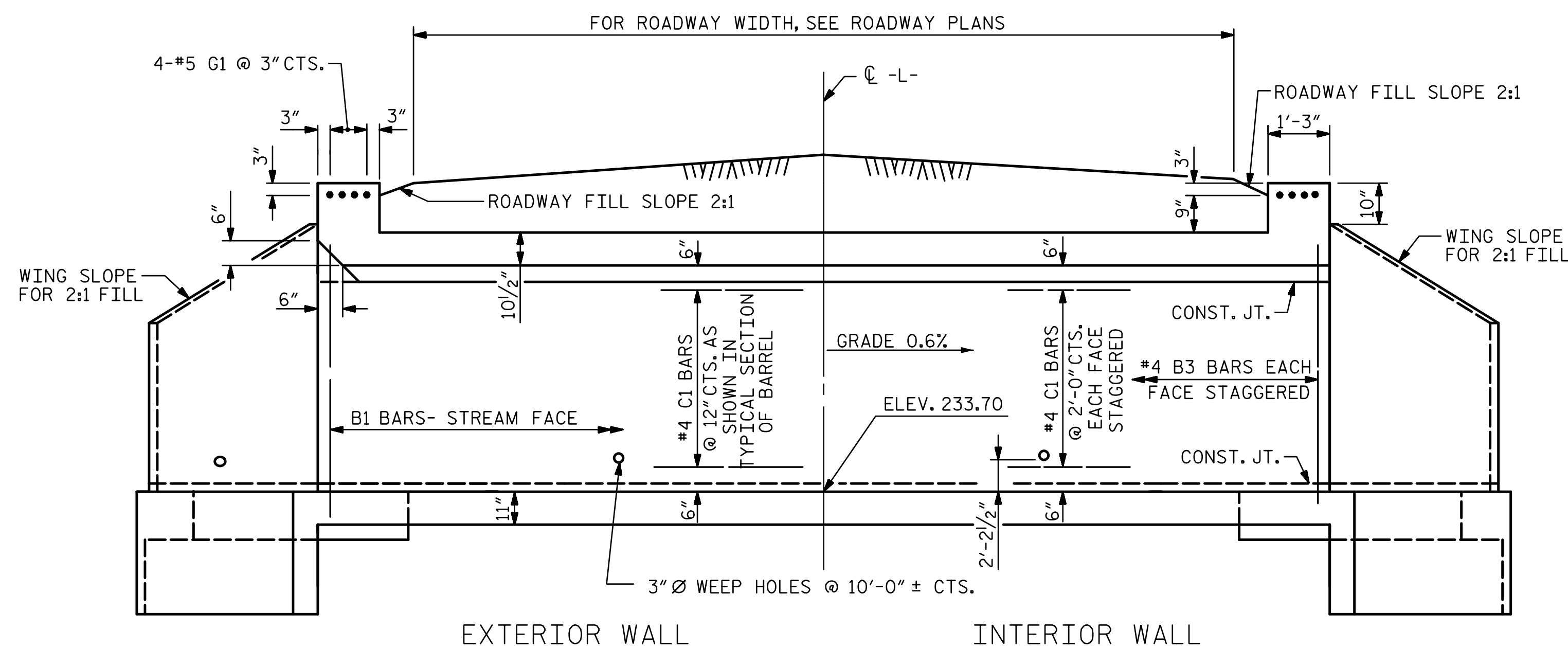
STV 100 YEARS
 STV ENGINEERS, INC.
 900 West Trade St., Suite 715
 Charlotte, NC 28202
 NC License Number F-0991

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 SIGNATURES COMPLETED

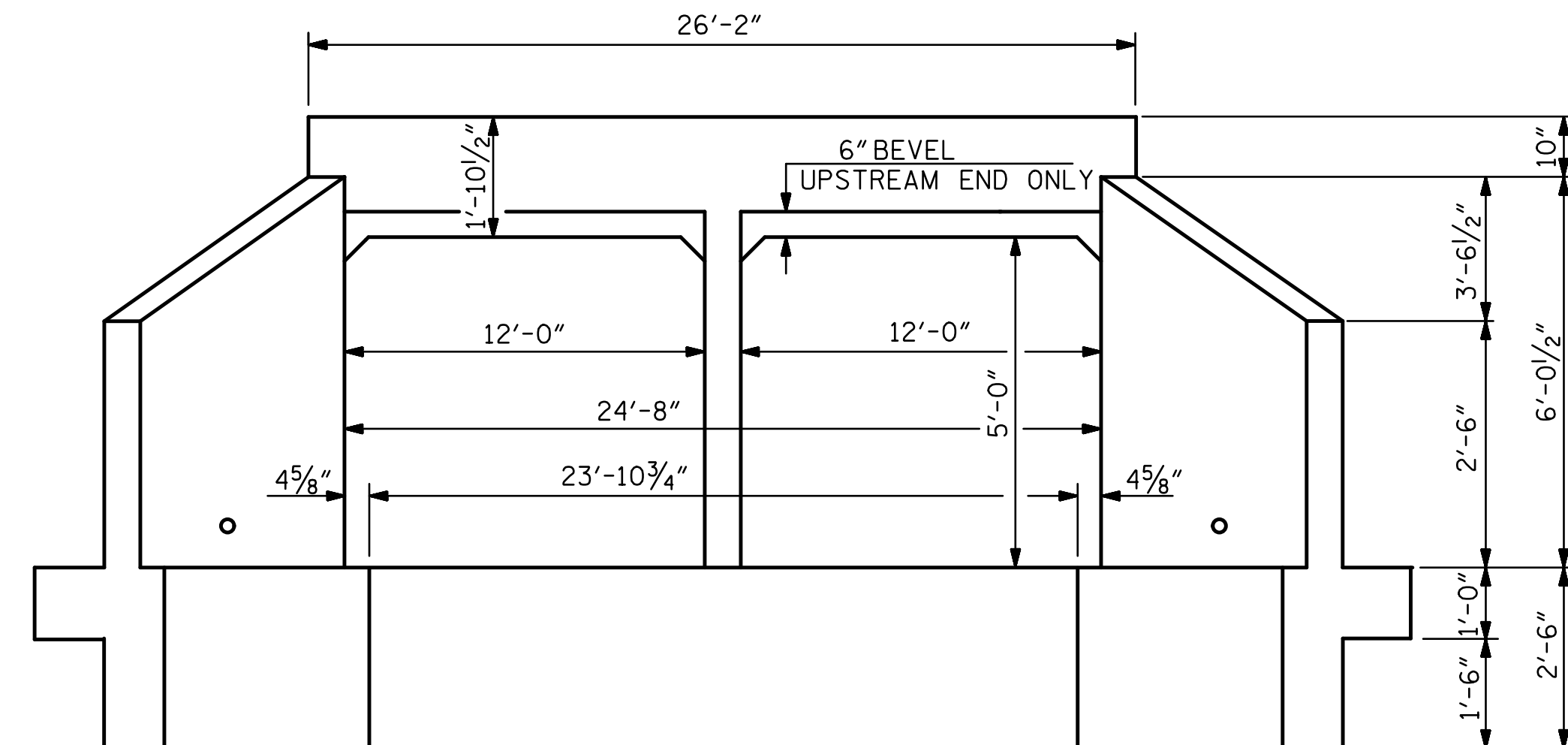
STATE OF NORTH CAROLINA
 DEPARTMENT OF TRANSPORTATION
 RALEIGH
**LRFR SUMMARY FOR
 REINFORCED CONCRETE
 BOX CULVERTS
 (NON-INTERSTATE TRAFFIC)**

| REVISIONS | | | | SHEET NO. | | |
|-----------|-----|-------|-----|-----------|-------|--------------|
| NO. | BY: | DATE: | NO. | BY: | DATE: | C-2 |
| 1 | | | 3 | | | TOTAL SHEETS |
| 2 | | | 4 | | | 5 |

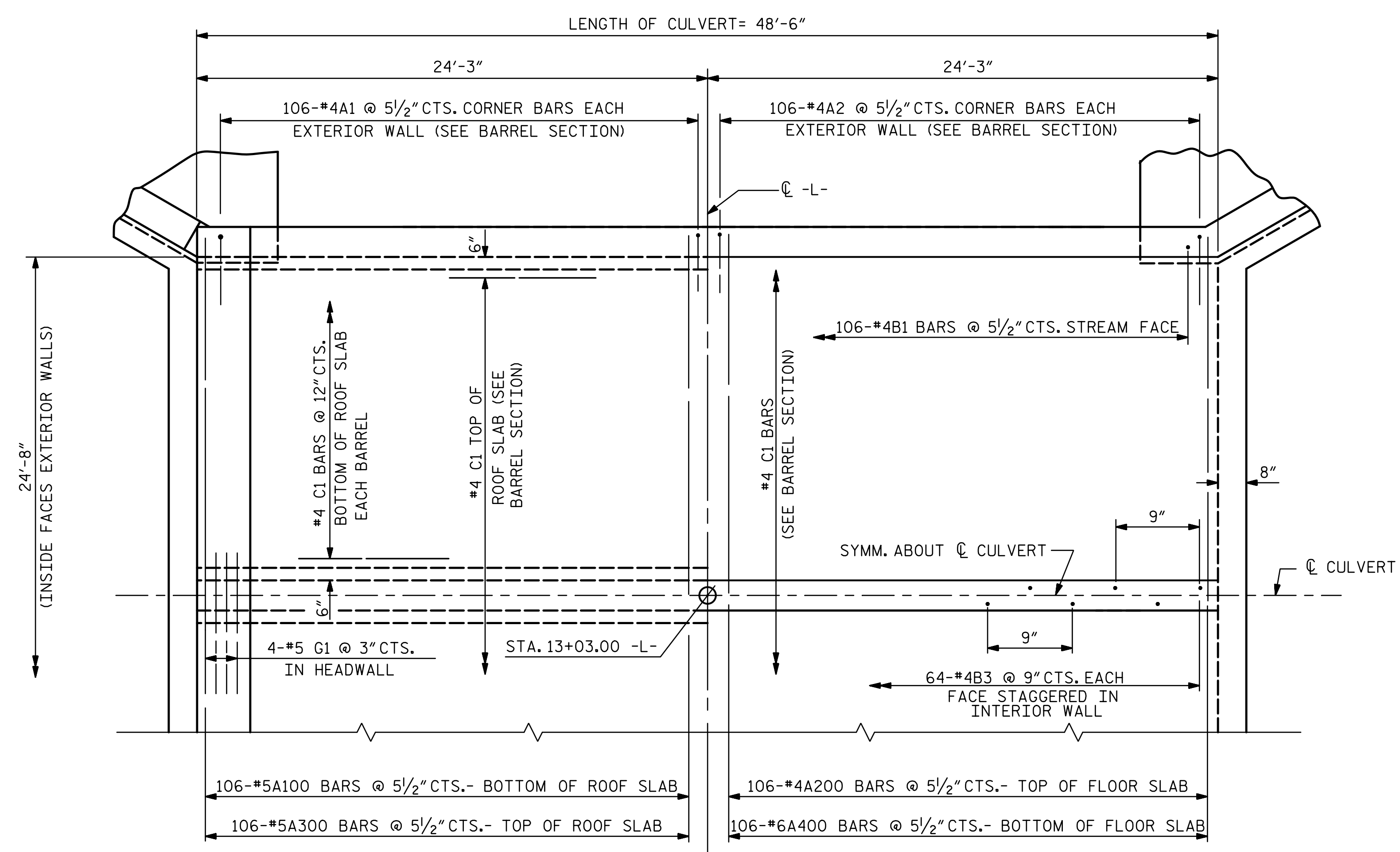
DRAWN BY : CL DATE : 6-18
 CHECKED BY : JWJ DATE : 7-18
 DESIGN ENGINEER OF RECORD : LEM DATE : 7-18



CULVERT SECTION NORMAL TO ROADWAY



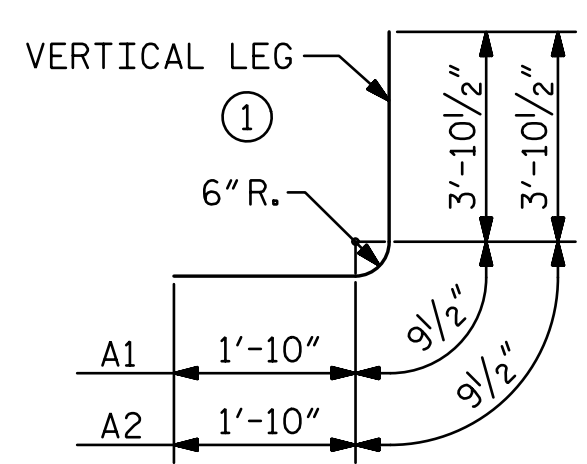
END ELEVATION



PART PLAN-ROOF SLAB

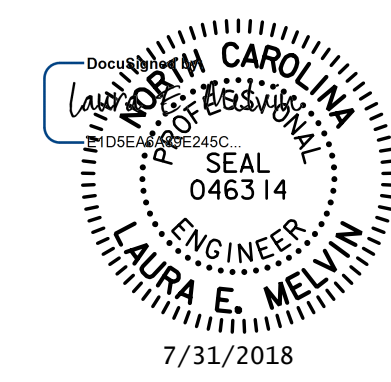
PART PLAN-FLOOR SLAB

| BAR TYPES | | BILL OF REINFORCING FOR BARREL | | | | |
|----------------------------------|-----|--------------------------------|------|---------|-------------|--|
| MARK | NO. | SIZE | TYPE | LENGTH | WEIGHT | |
| A1 | 212 | #4 | (1) | 6'-6" | 921 | |
| A2 | 212 | #4 | (1) | 6'-6" | 921 | |
| A100 | 106 | #5 | STR | 25'-10" | 2,856 | |
| A200 | 106 | #4 | STR | 25'-10" | 1,829 | |
| A300 | 106 | #5 | STR | 25'-10" | 2,856 | |
| A400 | 106 | #6 | STR | 25'-10" | 4,113 | |
| B1 | 212 | #4 | STR | 6'-4" | 897 | |
| B3 | 128 | #4 | STR | 6'-4" | 542 | |
| C1 | 166 | #4 | STR | 25'-0" | 2,772 | |
| G1 | 8 | #5 | STR | 25'-10" | 216 | |
| D1 | 8 | #6 | STR | 2'-6" | 30 | |
| D2 | 8 | #6 | STR | 1'-6" | 18 | |
| TOTAL BARREL REINFORCING STEEL = | | | | | 17,971 LBS. | |



ALL BAR DIMENSIONS ARE OUT TO OUT.

PROJECT NO. 17BP.10.R.128
ANSON COUNTY
 STATION: 13+03.00 -L-



STV 100 STV ENGINEERS, INC.
 900 West Trade St., Suite 715
 Charlotte, NC 28202
 NC License Number F-0991

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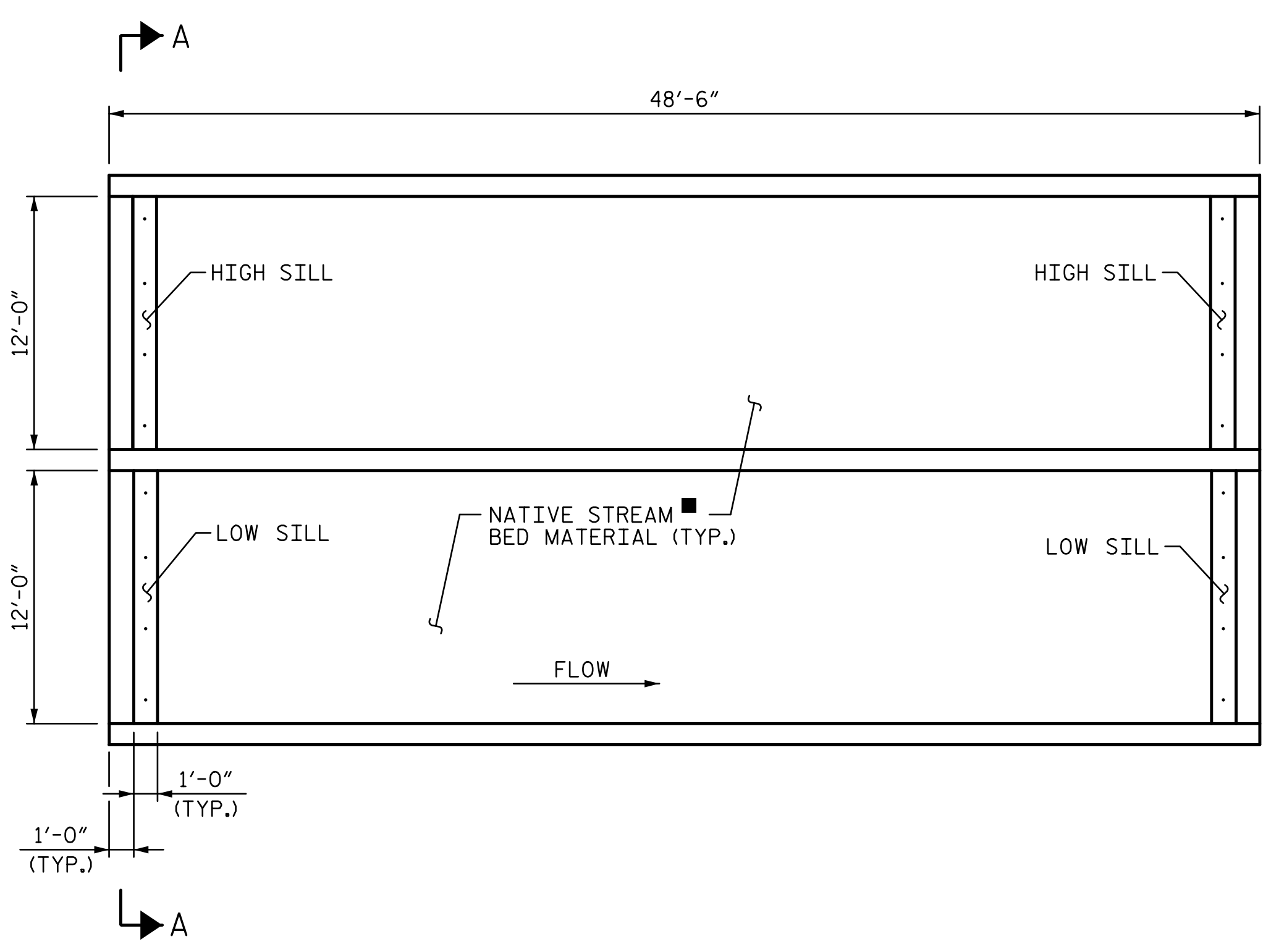
STATE OF NORTH CAROLINA
 DEPARTMENT OF TRANSPORTATION
 RALEIGH
 DOUBLE 12'-0" X 5'-0"
 CONCRETE BOX CULVERT
 90°-00'-00" SKEW

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

C-3
 TOTAL SHEETS 5

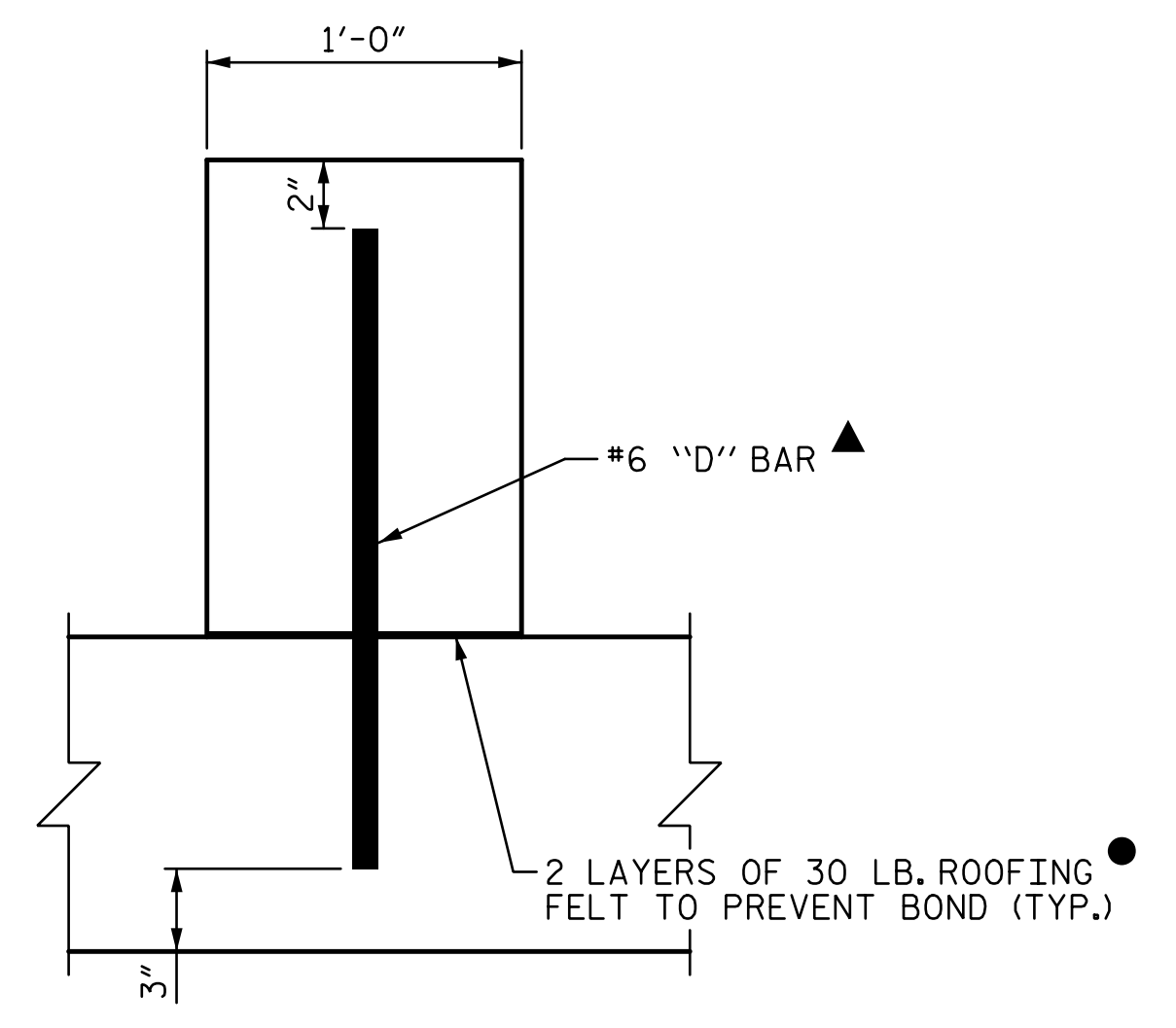
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DRAWN BY : CL DATE : 6-18
 CHECKED BY : JWJ DATE : 7-18
 DESIGN ENGINEER OF RECORD : LEM DATE : 7-18



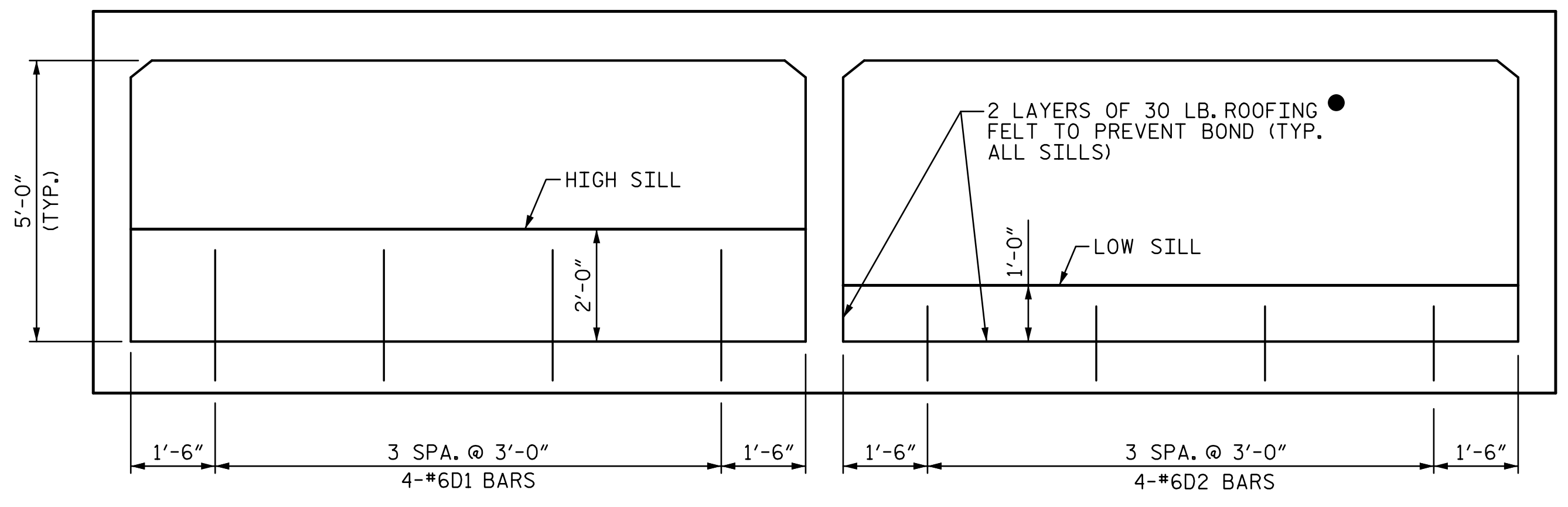
PLAN VIEW - LOCATION OF SILLS

■ NATIVE STREAM BED MATERIAL SHALL BE USED TO BACKFILL THE CULVERT BETWEEN SILLS. (SEE NOTE ON SHEET C-1)



SECTION THROUGH SILL

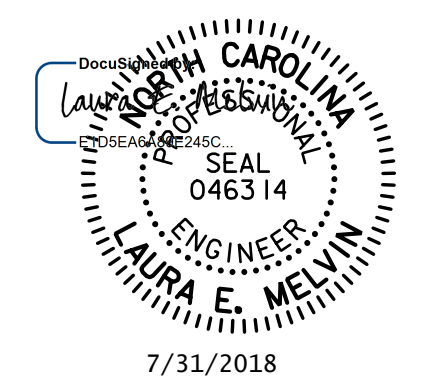
▲ DOWELS MAY BE PUSHED INTO GREEN CONCRETE AFTER SLAB HAS BEEN FLOAT FINISHED.



SECTION A-A

SECTION AT INLET SHOWN. SECTION AT OUTLET SIMILAR.
● THE COST OF THE ROOFING FELT IS INCIDENTAL AND SHALL BE INCLUDED IN THE VARIOUS PAY ITEMS.

PROJECT NO. 17BP.10.R.128
ANSON COUNTY
STATION: 13+03.00 -L-



STV 100 Years
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Charlotte, NC 28202
NC License Number F-0991

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| | | | | | |
|--|-----|-------|-----|-----|-------------------|
| STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION RALEIGH | | | | | |
| SILL DETAILS | | | | | |
| REVISIONS | | | | | SHEET NO. |
| NO. | BY: | DATE: | NO. | BY: | DATE: |
| 1 | | | 3 | | |
| 2 | | | 4 | | |
| | | | | | C-4 |
| | | | | | TOTAL SHEETS 5 |

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| | | | |
|-----------------------------|-----|--------|------|
| DRAWN BY : | CL | DATE : | 6-18 |
| CHECKED BY : | JWJ | DATE : | 7-18 |
| DESIGN ENGINEER OF RECORD : | LEM | DATE : | 7-18 |

STANDARD NOTES

DESIGN DATA:

| | | |
|---|-------|----------------------------------|
| SPECIFICATIONS | ----- | A.A.S.H.T.O. (CURRENT) |
| LIVE LOAD | ----- | SEE PLANS |
| IMPACT ALLOWANCE | ----- | SEE A.A.S.H.T.O. |
| STRESS IN EXTREME FIBER OF STRUCTURAL STEEL - AASHTO M270 GRADE 36 | -- | 20,000 LBS. PER SQ. IN. |
| - AASHTO M270 GRADE 50W | -- | 27,000 LBS. PER SQ. IN. |
| - AASHTO M270 GRADE 50 | -- | 27,000 LBS. PER SQ. IN. |
| REINFORCING STEEL IN TENSION - GRADE 60 | ---- | 24,000 LBS. PER SQ. IN. |
| CONCRETE IN COMPRESSION | ----- | 1,200 LBS. PER SQ. IN. |
| CONCRETE IN SHEAR | ----- | SEE A.A.S.H.T.O. |
| STRUCTURAL TIMBER - TREATED OR UNTREATED EXTREME FIBER STRESS | ---- | 1,800 LBS. PER SQ. IN. |
| COMPRESSION PERPENDICULAR TO GRAIN OF TIMBER | ----- | 375 LBS. PER SQ. IN. |
| EQUIVALENT FLUID PRESSURE OF EARTH | ----- | 30 LBS. PER CU. FT. (MINIMUM) |

MATERIAL AND WORKMANSHIP:

EXCEPT AS MAY OTHERWISE BE SPECIFIED ON PLANS OR IN THE SPECIAL PROVISIONS, ALL MATERIAL AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH THE 2018 "STANDARD SPECIFICATIONS FOR ROADS AND STRUCTURES" OF THE N.C. DEPARTMENT OF TRANSPORTATION.

STEEL SHEET PILING FOR PERMANENT OR TEMPORARY APPLICATIONS SHALL BE HOT ROLLED.

CONCRETE:

UNLESS OTHERWISE REQUIRED ON PLANS, CLASS A CONCRETE SHALL BE USED FOR ALL PORTIONS OF ALL STRUCTURES WITH THE EXCEPTION THAT: CLASS AA CONCRETE SHALL BE USED IN BRIDGE SUPERSTRUCTURES, ABUTMENT BACKWALLS, AND APPROACH SLABS; AND CLASS B CONCRETE SHALL BE USED FOR SLOPE PROTECTION AND RIP RAP.

CONCRETE CHAMFERS:

UNLESS OTHERWISE NOTED ON THE PLANS, ALL EXPOSED CORNERS ON STRUCTURES SHALL BE CHAMFERED $\frac{3}{4}$ " WITH THE FOLLOWING EXCEPTIONS: TOP CORNERS OF CURBS MAY BE ROUNDED TO $\frac{1}{2}$ " RADIUS WHICH IS BUILT INTO CURB FORMS; CORNERS OF TRANSVERSE FLOOR EXPANSION JOINTS SHALL BE ROUNDED WITH A $\frac{1}{4}$ " FINISHING TOOL UNLESS OTHERWISE REQUIRED ON PLANS; AND CORNERS OF EXPANSION JOINTS IN THE ROADWAY FACES AND TOPS OF CURBS AND SIDEWALKS SHALL BE ROUNDED TO A $\frac{1}{4}$ " RADIUS WITH A FINISHING STONE OR TOOL UNLESS OTHERWISE REQUIRED ON PLANS.

DOWELS:

DOWELS WHEN INDICATED ON PLANS AS FOR CULVERT EXTENSIONS, SHALL BE EMBEDDED AT LEAST 12" INTO THE OLD CONCRETE AND GROUTED INTO PLACE WITH 1:2 CEMENT MORTAR.

ALLOWANCE FOR DEAD LOAD DEFLECTION, SETTLEMENT, ETC. IN CASTING SUPERSTRUCTURES:

BRIDGES SHALL BE BUILT ON THE GRADE OR VERTICAL CURVE SHOWN ON PLANS. SLABS, CURBS AND PARAPETS SHALL CONFORM TO THE GRADE OR CURVE.

ALL DIMENSIONS WHICH ARE GIVEN IN SECTION AND ARE AFFECTED BY DEAD LOAD DEFLECTIONS ARE DIMENSIONS AT CENTER LINE OF BEARING UNLESS OTHERWISE NOTED ON PLANS. IN SETTING FORMS FOR STEEL BEAM BRIDGES AND PRESTRESSED CONCRETE GIRDER BRIDGES, ADJUSTMENTS SHALL BE MADE DUE TO THE DEAD LOAD DEFLECTIONS FOR THE ELEVATIONS SHOWN. WHERE BLOCKS ARE SHOWN OVER BEAMS FOR BUILDING UP TO THE SLAB, THE VERTICAL DIMENSIONS OF THE BLOCKS SHALL BE ADJUSTED BETWEEN BEARINGS TO COMPENSATE FOR DEAD LOAD DEFLECTIONS, VERTICAL CURVE ORDINATE, AND ACTUAL BEAM CAMBER. WHERE BOTTOM OF SLAB IS IN LINE WITH BOTTOM OF TOP FLANGES, DEPTH OF SLAB BETWEEN BEARINGS SHALL BE ADJUSTED TO COMPENSATE FOR DEAD LOAD DEFLECTION, VERTICAL CURVE ORDINATE, AND ACTUAL BEAM CAMBER.

IN SETTING FALSEWORK AND FORMS FOR REINFORCED CONCRETE SPANS, AN ALLOWANCE SHALL BE MADE FOR DEAD LOAD DEFLECTIONS, SETTLEMENT OF FALSEWORK, AND PERMANENT CAMBER WHICH SHALL BE PROVIDED FOR IN ADDITION TO THE ELEVATIONS SHOWN. AFTER REMOVAL OF THE FALSEWORK, THE FINISHED STRUCTURES SHALL CONFORM TO THE PROFILE AND ELEVATIONS SHOWN ON THE PLANS AND CONSTRUCTION ELEVATIONS FURNISHED BY THE ENGINEER.

DETAILED DRAWINGS FOR FALSEWORK OR FORMS FOR BRIDGE SUPERSTRUCTURE AND ANY STRUCTURE OR PARTS OF A STRUCTURE AS NOTED ON THE PLANS SHALL BE SUBMITTED TO THE ENGINEER FOR APPROVAL BEFORE CONSTRUCTION OF THE FALSEWORK OR FORMS IS STARTED.

REINFORCING STEEL:

ALL REINFORCING STEEL SHALL BE DEFORMED. DIMENSIONS RELATIVE TO PLACEMENT OF REINFORCING ARE TO CENTERS OF BARS UNLESS OTHERWISE INDICATED IN THE PLANS. DIMENSIONS ON BAR DETAILS ARE TO CENTERS OF BARS OR ARE OUT TO OUT AS INDICATED ON PLANS.

WIRE BAR SUPPORTS SHALL BE PROVIDED FOR REINFORCING STEEL WHERE INDICATED ON THE PLANS. WHEN BAR SUPPORT PIECES ARE PLACED IN CONTINUOUS LINES, THEY SHALL BE SO PLACED THAT THE ENDS OF THE SUPPORTING WIRES SHALL BE LAPPED TO LOCK LEGS ON ADJOINING PIECES.

STRUCTURAL STEEL:

AT THE CONTRACTOR'S OPTION, HE MAY SUBSTITUTE $\frac{7}{8}$ " \emptyset SHEAR STUDS FOR THE $\frac{3}{4}$ " \emptyset STUDS SPECIFIED ON THE PLANS. THIS SUBSTITUTION SHALL BE MADE AT THE RATE OF 3 - $\frac{7}{8}$ " \emptyset STUDS FOR 4 - $\frac{3}{4}$ " \emptyset STUDS, AND STUD SPACING CHANGES SHALL BE MADE AS NECESSARY TO PROVIDE THE SAME EQUIVALENT NUMBER OF $\frac{7}{8}$ " \emptyset STUDS ALONG THE BEAM AS SHOWN FOR $\frac{3}{4}$ " \emptyset STUDS BASED ON THE RATIO OF 3 - $\frac{7}{8}$ " \emptyset STUDS FOR 4 - $\frac{3}{4}$ " \emptyset STUDS. STUDS OF THE LENGTH SPECIFIED ON THE PLANS MUST BE PROVIDED. THE MAXIMUM SPACING SHALL BE 2'-0".

EXCEPT AT THE INTERIOR SUPPORTS OF CONTINUOUS BEAMS WHERE THE COVER PLATE IS IN CONTACT WITH BEARING PLATE, THE CONTRACTOR MAY, AT HIS OPTION, SUBSTITUTE FOR THE COVER PLATES DESIGNATED ON THE PLANS COVER PLATES OF THE EQUIVALENT AREA PROVIDED THESE PLATES ARE AT LEAST $\frac{5}{16}$ " IN THICKNESS AND DO NOT EXCEED A WIDTH EQUAL TO THE FLANGE WIDTH LESS 2" OR A THICKNESS EQUAL TO 2 TIMES THE FLANGE THICKNESS. THE SIZE OF FILLET WELDS SHALL CONFORM TO THE REQUIREMENTS OF THE CURRENT ANSI/AASHTO/AWS "BRIDGE WELDING CODE". ELECTROSLAG WELDING WILL NOT BE PERMITTED.

WITH THE SOLE EXCEPTION OF EDGES AT SURFACES WHICH BEAR ON OTHER SURFACES, ALL SHARP EDGES AND ENDS OF SHAPES AND PLATES SHALL BE SLIGHTLY ROUNDED BY SUITABLE MEANS TO A RADIUS OF APPROXIMATELY $\frac{1}{16}$ " INCH OR EQUIVALENT FLAT SURFACE AT A SUITABLE ANGLE PRIOR TO PAINTING, GALVANIZING, OR METALLIZING.

HANDRAILS AND POSTS:

METAL STANDARDS AND FACES OF THE CONCRETE END POSTS FOR THE METAL RAIL SHALL BE SET NORMAL TO THE GRADE OF THE CURB, UNLESS OTHERWISE SHOWN ON PLANS. THE METAL RAIL AND TOPS OF CONCRETE POSTS USED WITH THE ALUMINUM RAIL SHALL BE BUILT PARALLEL TO THE GRADE OF THE CURB.

METAL HANDRAILS SHALL BE IN ACCORDANCE WITH THE PLANS. RAILS SHALL BE AS MANUFACTURED FOR BRIDGE RAILING. CASTINGS SHALL BE OF A UNIFORM APPEARANCE. FINIS AND OTHER DEFORMATIONS RESULTING FROM CASTING OR OTHERWISE SHALL BE REMOVED IN A MANNER SO THAT A UNIFORM COLORING OF THE COMPLETED CASTING SHALL BE OBTAINED. CASTINGS WITH DISCOLORATIONS OR OF NON-UNIFORM COLORING WILL NOT BE ACCEPTED. CERTIFIED MILL REPORTS ARE REQUIRED FOR METAL RAILS AND POSTS.

SPECIAL NOTES:

GENERALLY, IN CASE OF DISCREPANCY, THIS STANDARD SHEET OF NOTES SHALL GOVERN OVER THE SPECIFICATIONS, BUT THE REMAINDER OF THE PLANS SHALL GOVERN OVER NOTES HEREON, AND SPECIAL PROVISIONS SHALL GOVERN OVER ALL. SEE SPECIFICATIONS ARTICLE 105-4.

ENGLISH

JANUARY, 1990

STD. NO. SN