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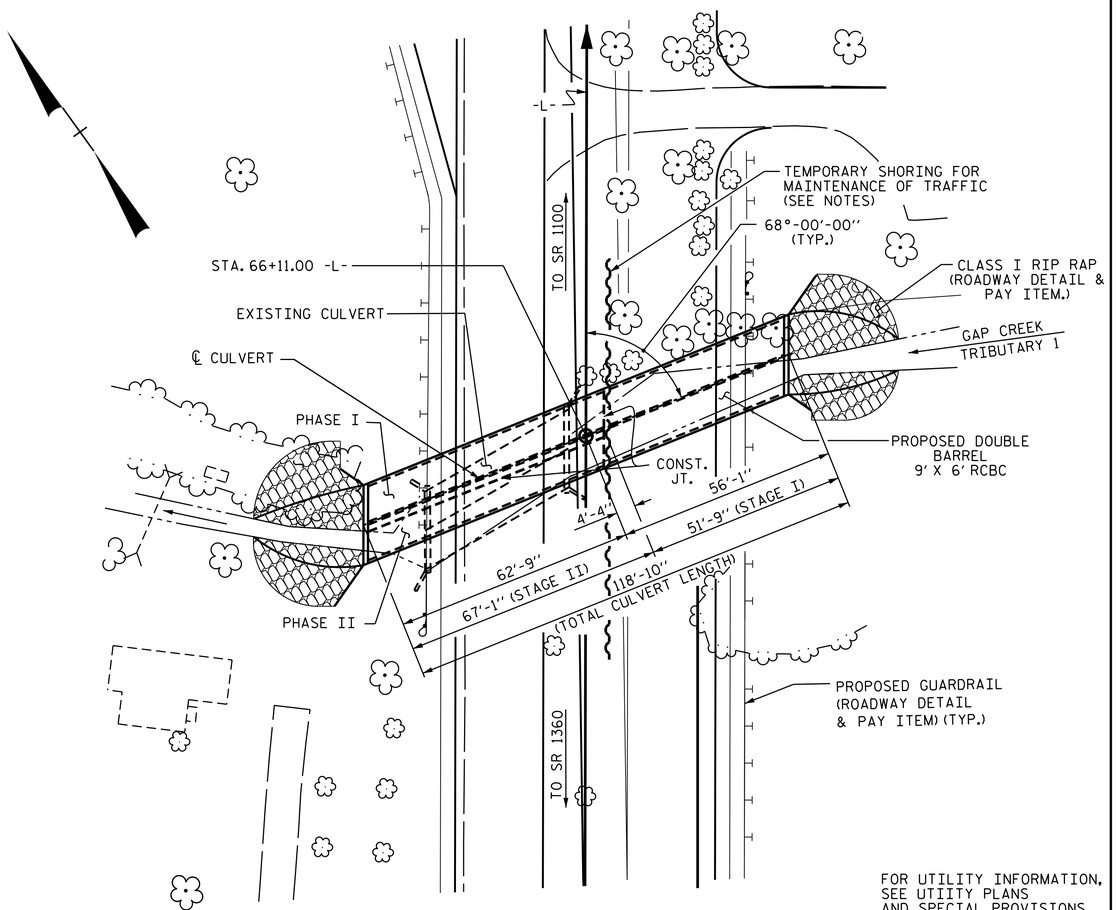
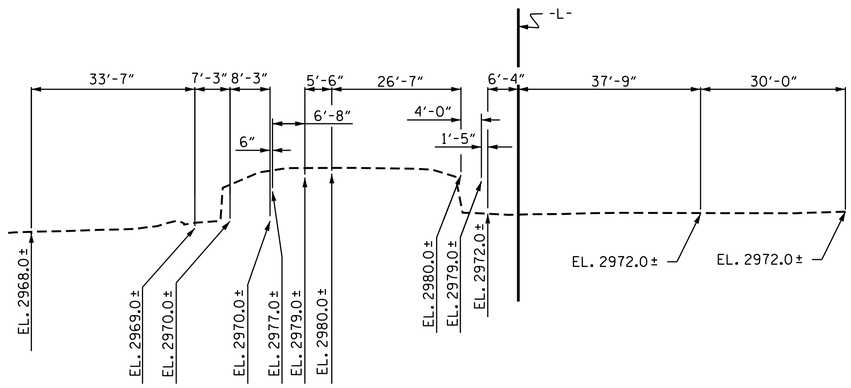
F.A. PROJECT NO. STP-0221 (39)

B.M. #3 - RAILROAD SPIKE IN BASE OF POWER POLE,
291.00 FT. LT. OF STA. 69+00.00 -L-, EL. 2962.09', N 919454, E 1261861



FOR UTILITY INFORMATION, SEE UTIITY PLANS AND SPECIAL PROVISIONS.

LOCATION SKETCH



PROFILE ALONG ℄ CULVERT

NOTES

ASSUMED LIVE LOAD ----- = HL-93 OR ALTERNATE LOADING.

DESIGN FILL _____ 3.10 FT. (MIN.), 6.46 FT. (MAX.)

FOR OTHER DESIGN DATA AND NOTES, SEE STANDARD NOTE SHEET.

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

CONCRETE IN STAGE I CULVERT TO BE POURED IN THE FOLLOWING ORDER:

1. WING FOOTING, EDGE BEAM AND FLOOR SLAB INCLUDING 4" OF ALL VERTICAL WALLS.
2. THE REMAINING PORTIONS OF THE WALLS AND WINGS FULL HEIGHT FOLLOWED BY ROOF SLAB, EDGE BEAM AND HEADWALL.

CONCRETE IN STAGE II CULVERT TO BE POURED IN THE FOLLOWING ORDER:

1. PHASE I WING FOOTING, EDGE BEAM AND FLOOR SLAB TO CONSTRUCTION JOINT INCLUDING 4" OF PHASE I VERTICAL WALLS.
2. THE REMAINING PORTIONS OF PHASE I WALLS AND PHASE I WING FULL HEIGHT.
3. PHASE II WING FOOTING, EDGE BEAM AND FLOOR SLAB TO CONSTRUCTION JOINT INCLUDING 4" OF PHASE II VERTICAL WALL.
4. THE REMAINING PORTIONS OF PHASE II WALL AND PHASE II WING FULL HEIGHT.
5. ROOF SLAB, HEADWALL AND EDGE BEAM.

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.

AT THE CONTRACTOR'S OPTION, HE MAY SPLICE THE VERTICAL REINFORCING STEEL IN THE INTERIOR FACES OF THE EXTERIOR WALLS AND BOTH FACES OF INTERIOR 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 MAINTENANCE OF TRAFFIC, SEE TRAFFIC CONTROL PLANS.

FOR LIMITS OF TEMPORARY SHORING FOR MAINTENANCE OF TRAFFIC, SEE TRAFFIC CONTROL PLANS. FOR PAY ITEM FOR TEMPORARY SHORING FOR MAINTENANCE OF TRAFFIC, SEE ROADWAY PLANS.

FOR CONSTRUCTION SEQUENCE, SEE EROSION CONTROL PLANS.

FOR FALSEWORK AND FORMWORK, SEE SPECIAL PROVISIONS.

FOR GROUT FOR STRUCTURES, SEE SPECIAL PROVISIONS.

FOR SUBMITTAL OF WORKING DRAWINGS, SEE SPECIAL PROVISIONS.

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

FOR CRANE SAFETY, SEE SPECIAL PROVISIONS.

FOR EROSION CONTROL MEASURES, SEE EROSION CONTROL PLANS.

AFTER SERVING AS A TEMPORARY STRUCTURE, THE EXISTING DOUBLE 9' X 6' REINFORCED CONCRETE BOX CULVERT SHALL BE REMOVED.

TRAFFIC ON US 221 SHALL BE MAINTAINED. IN ORDER TO MAINTAIN TRAFFIC THE CULVERT SHALL BE CONSTRUCTED IN SECTIONS AS DIRECTED BY THE ENGINEER.

STEEL IN THE BOTTOM SLAB MAY BE SPLICED AT THE PERMITTED CONSTRUCTION JOINT AT THE CONTRACTOR'S OPTION. EXTRA WEIGHT OF STEEL DUE TO THE SPLICES WILL BE PAID FOR BY THE CONTRACTOR.

THE CONTRACTOR SHALL PROVIDE INDEPENDENT ASSURANCE SAMPLES OF REINFORCING STEEL AS FOLLOWS: FOR PROJECTS REQUIRING UP TO 400 TONS OF REINFORCING STEEL, ONE 30 INCH SAMPLE OF EACH SIZE BAR USED, AND FOR PROJECTS REQUIRING OVER 400 TONS OF REINFORCING STEEL, TWO 30 INCH SAMPLES OF EACH SIZE BAR USED. THE BARS FROM WHICH THE SAMPLES ARE TAKEN MUST THEN BE SPLICED WITH REPLACEMENT BARS OF THE SIZE AND LENGTH OF THE SAMPLE, PLUS A MINIMUM LAP SPLICE OF THIRTY BAR DIAMETERS. PAYMENT FOR THE SAMPLES OF REINFORCING STEEL SHALL BE CONSIDERED INCIDENTAL TO VARIOUS PAY ITEMS.

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.

FOR EROSION CONTROL MEASURES, SEE EROSION CONTROL PLANS.

TOTAL STRUCTURE QUANTITIES

CLASS A CONCRETE	
STAGE I	104.5 C.Y.
STAGE II	132.3 C.Y.
TOTAL	236.8 C.Y.
REINFORCING STEEL	
STAGE I	11,889 LBS.
STAGE II	15,736 LBS.
TOTAL	27,625 LBS.
CULVERT EXCAVATION	LUMP SUM
FOUNDATION COND. MAT'L	
STAGE I	88 TONS
STAGE II	114 TONS
TOTAL	202 TONS
REMOVAL OF EXISTING STRUCTURE	LUMP SUM

ROADWAY DATA

GRADE POINT ELEV. @ STATION 66+11.00 -L- = 2981.02
BED ELEV. @ STATION 66+11.00 -L- = 2969.45
ROADWAY SLOPES = 2:1

HYDRAULIC DATA

DESIGN DISCHARGE _____ = 430 C.F.S.
FREQUENCY OF DESIGN FLOOD_____= 50 YR.
DESIGN HIGH WATER ELEVATION = 2976.10
DRAINAGE AREA = _____ = 0.81 SQ. MI.
BASE DISCHARGE (Q100) _____ = 500 C.F.S.
BASE HIGH WATER ELEVATION = 2976.38

OVERTOPPING FLOOD DATA

OVERTOPPING DISCHARGE --------- = 915 C.F.S.
FREQUENCY OF OVERTOPPING FLOOD ----- = 500+ YR.
OVERTOPPING FLOOD ELEVATION = 2980.70

NORTH CAROLINA PROFESSIONAL SEAL 14855 ENGINEER DOUGLAS R. CALHOUN
DocuSigned by: Douglas R. Calhoun 430196F9D5E0429...
7/23/2015

NORTH CAROLINA PROFESSIONAL SEAL 17230 ENGINEER WAEL S. ARAFAT
DocuSigned by: Wael Arafat 4139C12A32AB406...
7/23/2015

PROJECT NO. R-2915A
WATAUGA/ASHE COUNTY
STATION: 66+11.00 -L-

SHEET 1 OF 9 REPLACES BRIDGE No. 374

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

DOUBLE 9'-0" X 6'-0" CONCRETE BOX CULVERT

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C-1
1			3			TOTAL SHEETS
2			4			20

STR. #2

DRAWN BY : V.X. NGUYEN DATE : 1-26-15
CHECKED BY : H.T. BARBOUR DATE : 5-1-15
DESIGN ENGINEER OF RECORD: J.P. McCARTHA DATE : 6-15

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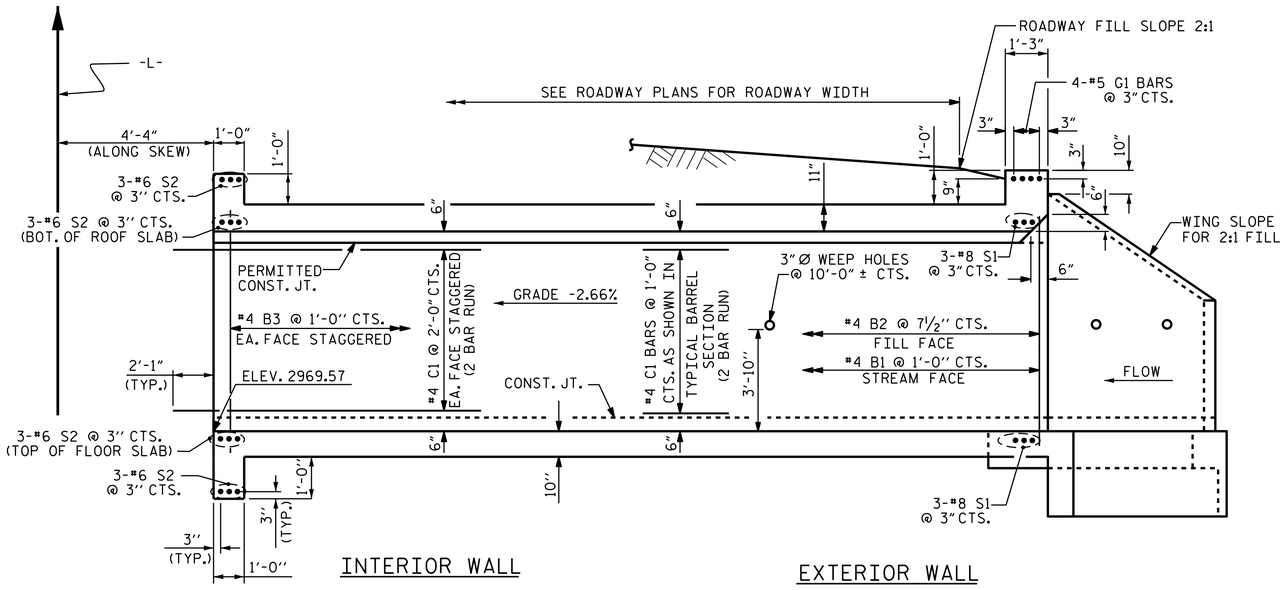
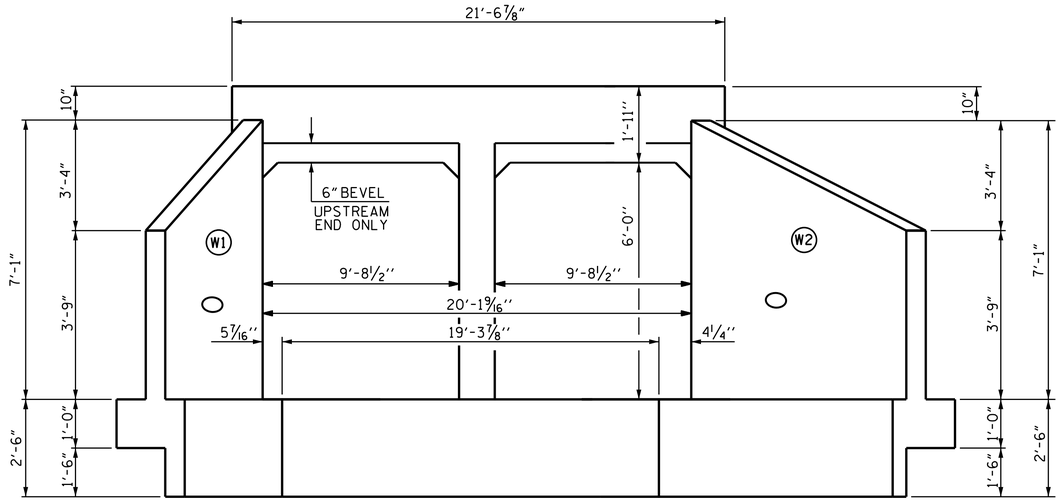


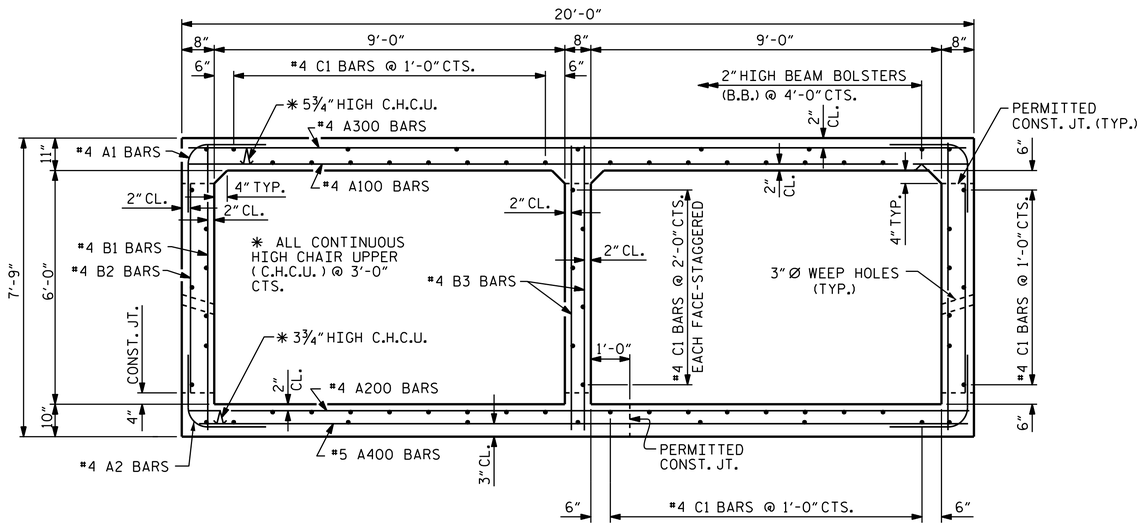
CULVERT SECTION NORMAL TO ROADWAY

(STAGE I)



END ELEVATION NORMAL TO SKEW

(STAGE I)
(LOOKING DOWNSTREAM)



RIGHT ANGLE SECTION OF BARREL

THERE ARE 70 C1 BARS IN SECTION OF BARREL
(STAGE I)
(LOOKING DOWNSTREAM)

PROJECT NO. R-2915A
WATAUGA/ASHE COUNTY
STATION: 66+11.00 -L-

SHEET 2 OF 9

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

DOUBLE 9'-0" X 6'-0" CONCRETE BOX CULVERT 68°-00'-00" SKEW STAGE I

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C-2
1			3			TOTAL SHEETS
2			4			20

NORTH CAROLINA PROFESSIONAL SEAL 17230 ENGINEER WAEL S. ARAFAT
Digitally signed by: Wael Arafat
DN: cn=4139C12A32AB406...
7/28/2015

STR. #2

DRAWN BY : V.X. NGUYEN DATE : 1-26-15
CHECKED BY : H.T. BARBOUR DATE : 5-1-15
DESIGN ENGINEER OF RECORD: J.P. McCARTHA DATE : 6-15

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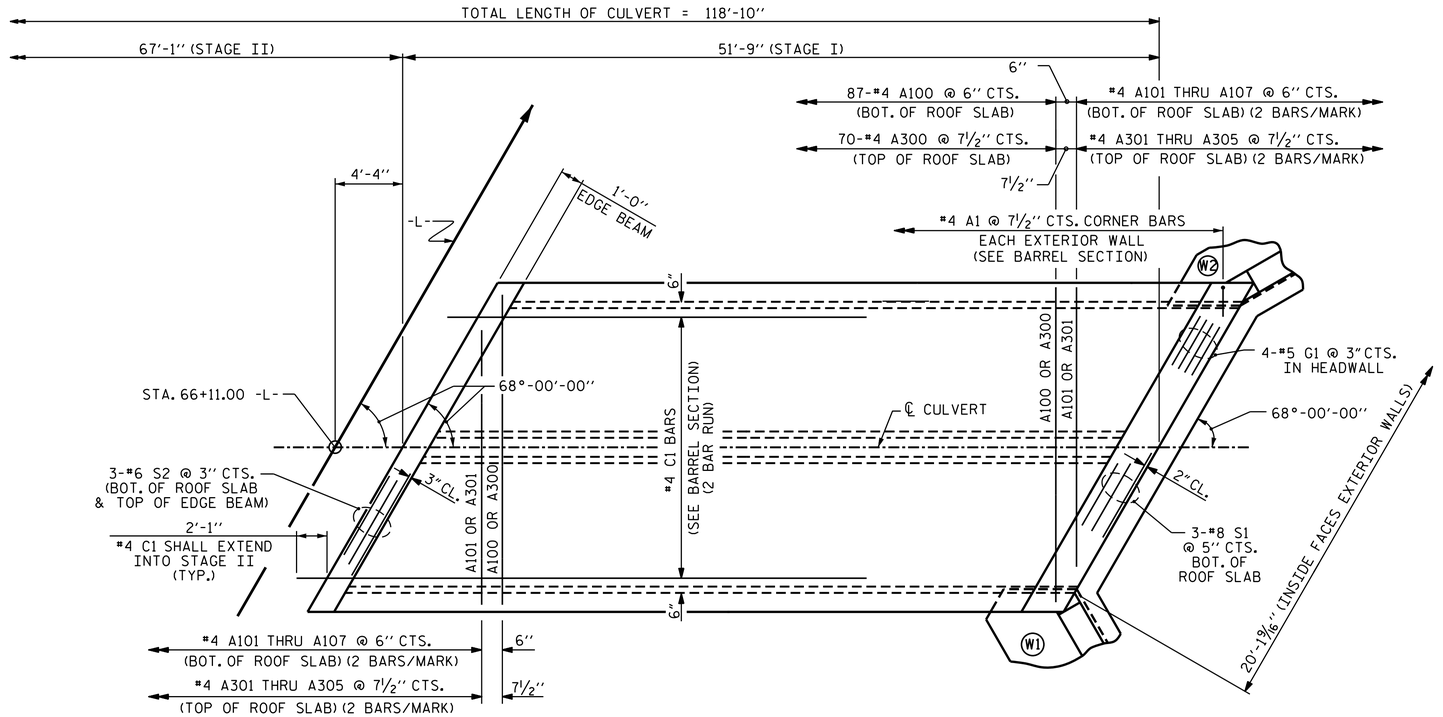
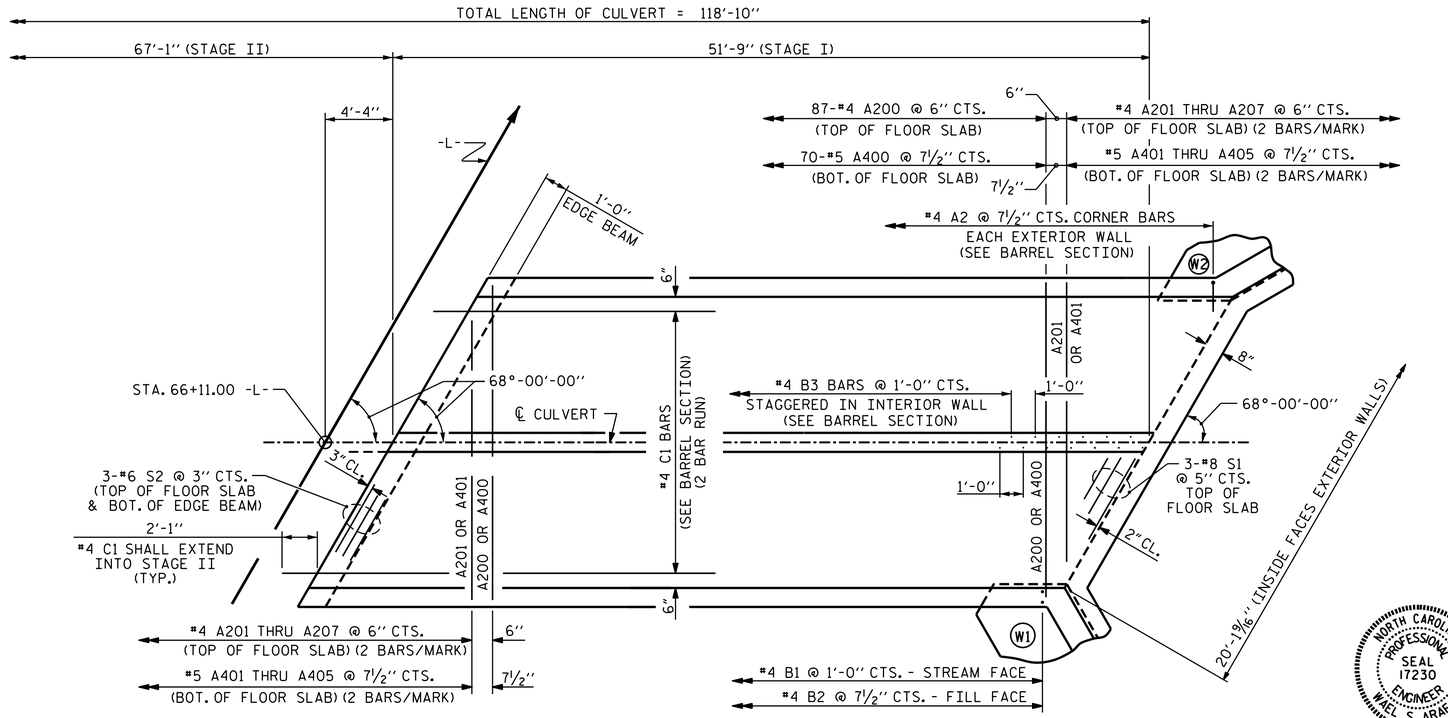


PLAN OF ROOF SLAB

(STAGE I)



PLAN OF FLOOR SLAB

(STAGE I)

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4139C12A32AB406...
7/28/2015

PROJECT NO. R-2915A
WATAUGA/ASHE COUNTY
STATION: 66+11.00 -L-

SHEET 3 OF 9

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

DOUBLE 9'-0" X 6'-0" CONCRETE BOX CULVERT 68°-00'-00" SKEW STAGE I

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1			3			TOTAL SHEETS
2			4			20

STR. #2

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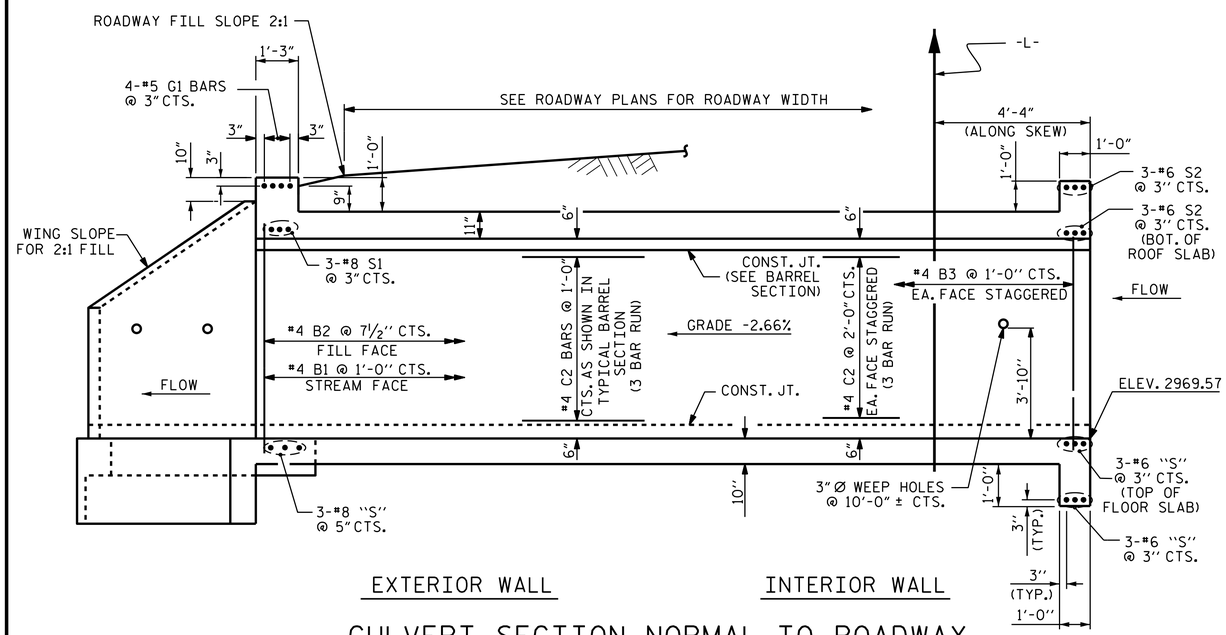
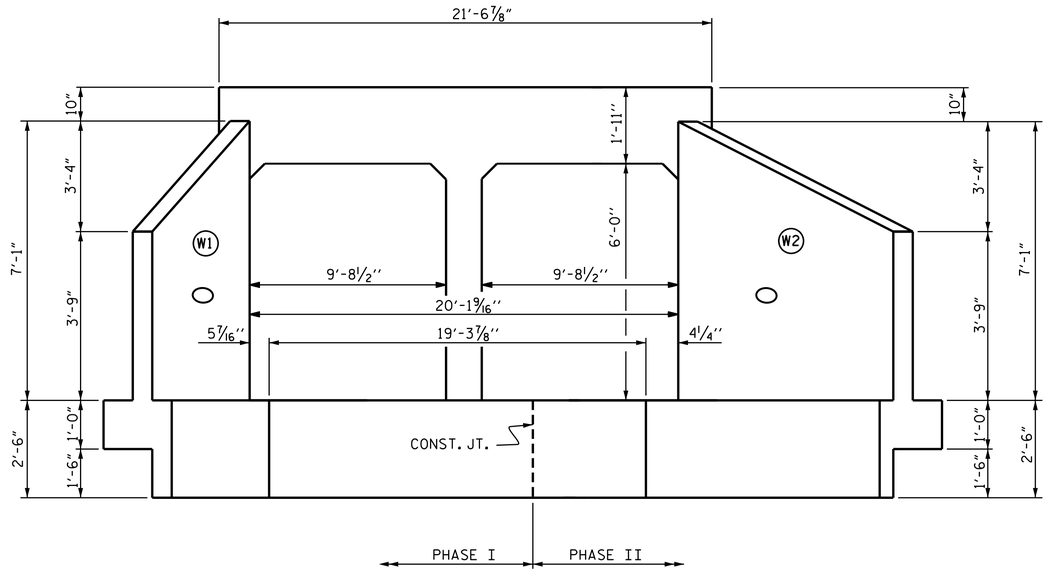


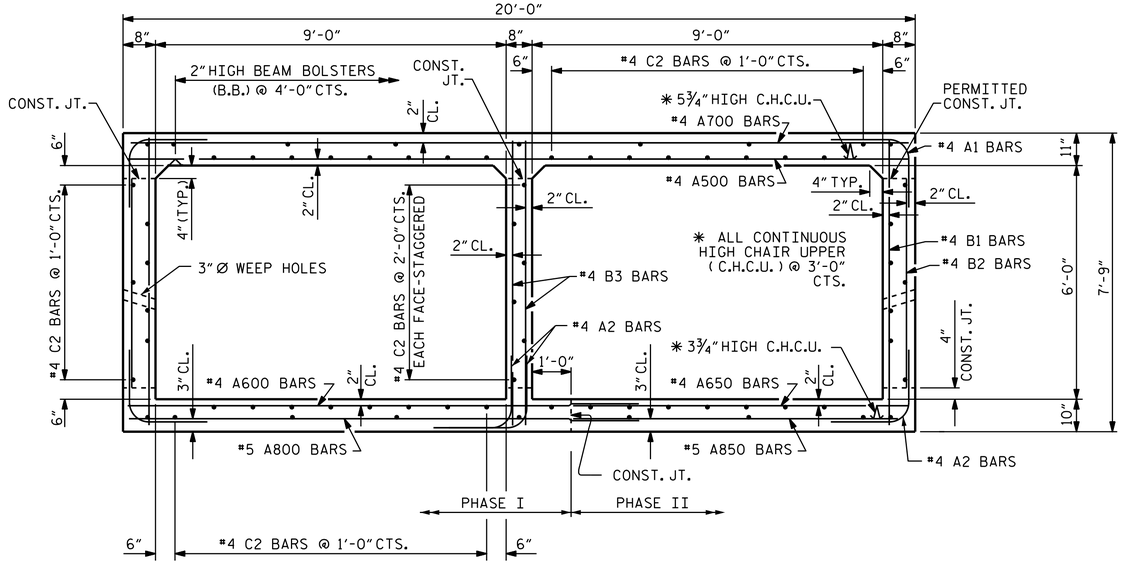
CULVERT SECTION NORMAL TO ROADWAY

(STAGE II) (PHASES 1 & 2)



END ELEVATION NORMAL TO SKEW

(STAGE II) (PHASES 1 & 2)
(LOOKING UPSTREAM)



RIGHT ANGLE SECTION OF BARREL

THERE ARE 70 C2 BARS IN SECTION OF BARREL.
(STAGE II) (PHASES 1 & 2)
(LOOKING UPSTREAM)

PROJECT NO. R-2915A
WATAUGA/ASHE COUNTY
STATION: 66+11.00 -L-

SHEET 4 OF 9

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

DOUBLE 9'-0" X 6'-0" CONCRETE BOX CULVERT 68°-00'-00" SKEW STAGE II

REVISIONS						SHEET NO.
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1			3			TOTAL SHEETS
2			4			20

STR. #2

NORTH CAROLINA PROFESSIONAL SEAL 17230 ENGINEER WAEL S. ARAFAT

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4139C12A32ABA06...
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DRAWN BY : V.X. NGUYEN DATE : 1-26-15
CHECKED BY : H.T. BARBOUR DATE : 5-1-15
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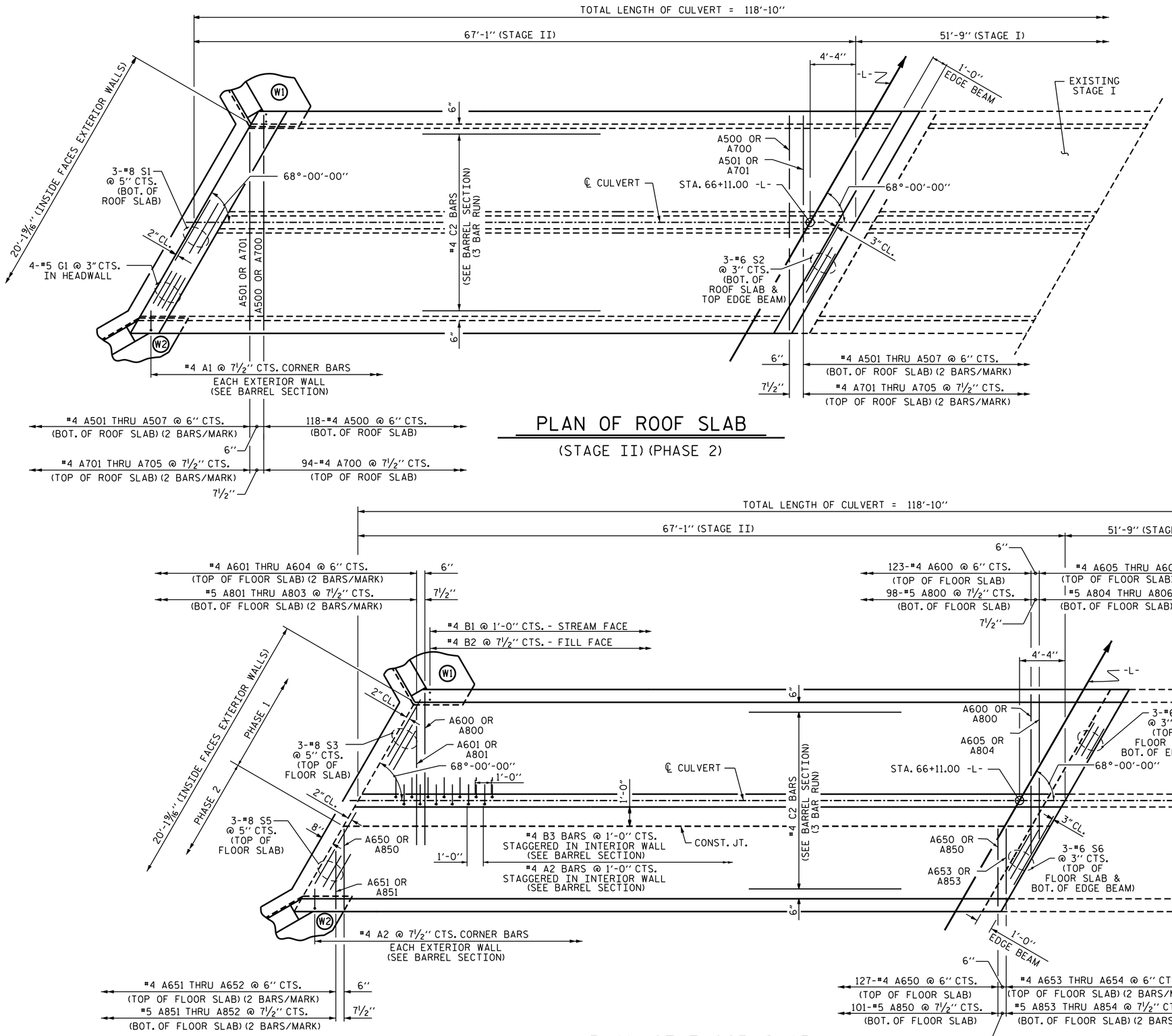

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WATAUGA/ASHE COUNTY
STATION: 66+11.00 -L-

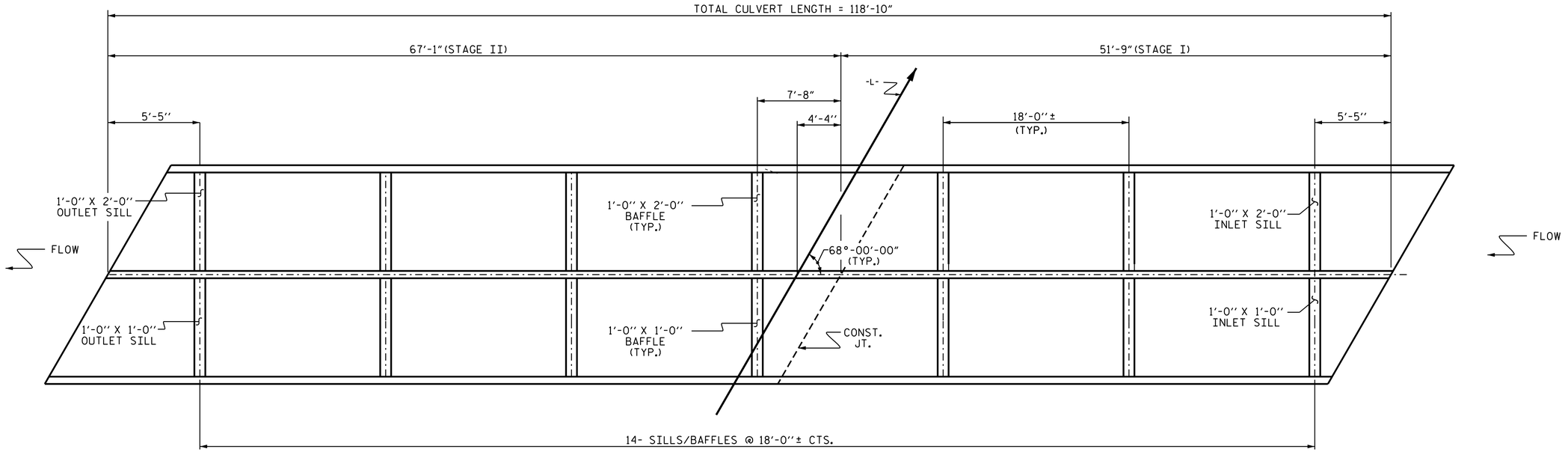
SHEET 5 OF 9

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

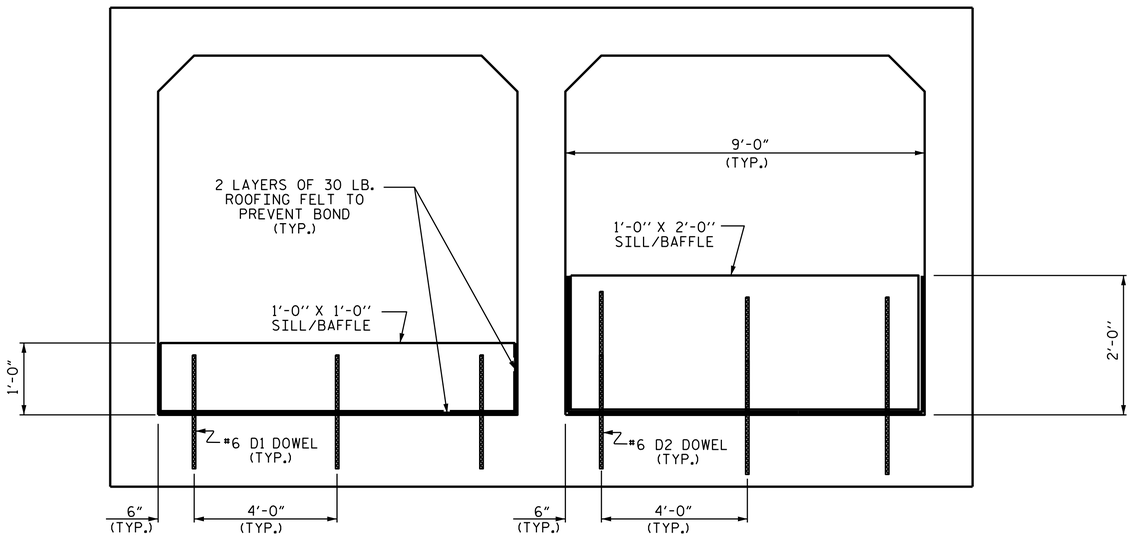
DOUBLE 9'-0" X 6'-0" CONCRETE BOX CULVERT 68°-00'-00" SKEW STAGE II

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C-5
1			3			TOTAL SHEETS
2			4			20

STR. #2

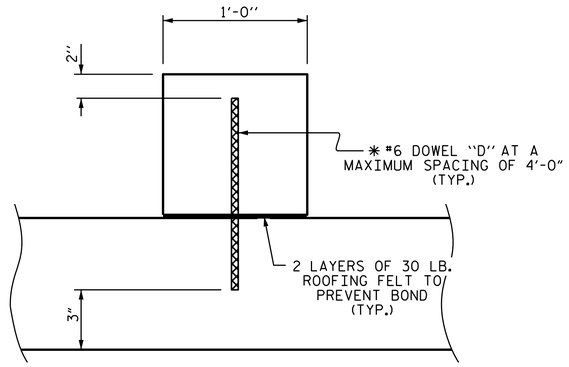


PLAN VIEW SHOWING SILL/BAFFLE LOCATIONS



ELEVATION

LOOKING DOWNSTREAM



SECTION THROUGH SILL/BAFFLE

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

NOTES

MATERIAL EXCAVATED FROM THE EXISTING BED SHALL BE STOCKPILED FOR USE IN THE PROPOSED CULVERT AND SHALL PROVIDE A CONTINUOUS LOW FLOW CHANNEL AS SHOWN. THE MATERIAL SHALL BE NATURAL STONE WITH A GRADATION SIZE SIMILAR TO THAT OF CLASS B RIP RAP. STONES LARGER THAN 6 INCHES SHALL NOT BE PLACED WITHIN THE LOW FLOW CHANNEL. BED MATERIAL SHALL BE SUBJECT TO APPROVAL BY THE ENGINEER.

THE STOCKPILED MATERIAL SHALL BE PLACED TO PROVIDE A 1 FOOT DEPTH IN THE LOW FLOW CULVERT BARREL, AND SHALL BE PLACED TO THE LEVEL OF 2 FEET BETWEEN THE HIGH FLOW SILLS.

THE TOP OF BED MATERIAL IN THE LOW FLOW CULVERT BARREL SHOULD MATCH THE STREAM BED ELEVATION.

BED MATERIAL SHALL BE SUPPLEMENTED BY CLASS B RIP RAP AS NECESSARY IN THE HIGH FLOW BARREL ONLY.

BED MATERIAL SHALL BE PLACED ON TOP OF THE SUPPLEMENTAL FILL, IF USED, TO PROVIDE A FLAT SURFACE FOR ANIMAL PASSAGE.

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

THE ENTIRE COST OF WORK REQUIRED TO CONSTRUCT THE SILLS SHALL BE INCLUDED IN THE VARIOUS PAY ITEMS.

PROJECT NO. R-2915A

WATAUGA/ASHE COUNTY

STATION: 66+11.00 -L-

SHEET 6 OF 9

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

DOUBLE 9'-0" X 6'-0" CONCRETE BOX CULVERT

NORTH CAROLINA PROFESSIONAL SEAL 17230 ENGINEER WAEL S. ARAFAT

Wael Arafat
4139C12A32AB406...
7/28/2015

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1			3			TOTAL SHEETS
2			4			20

STR. #2

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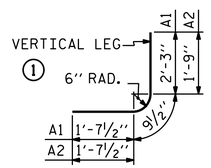
CULVERT SILL/BAFFLE DETAILS

REINFORCING BAR SCHEDULE

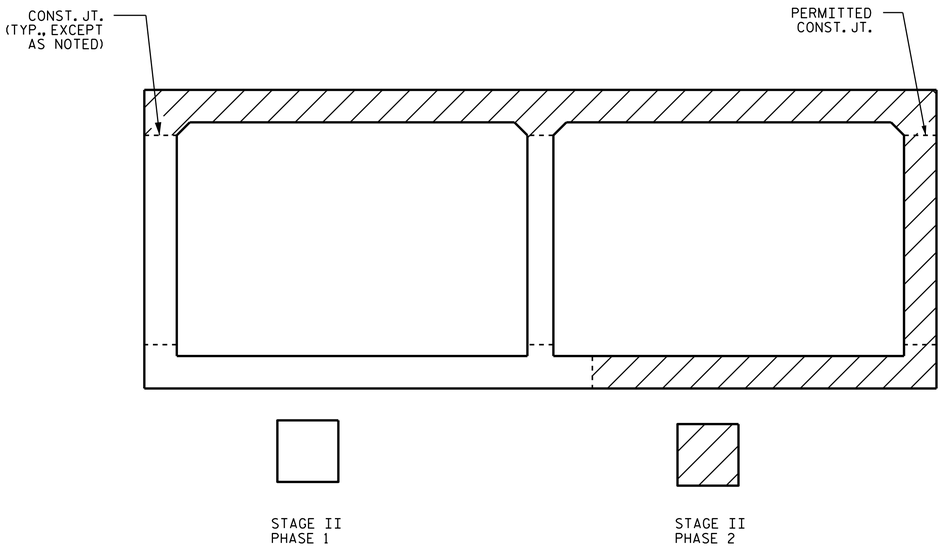
STAGE I

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT	BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT	BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
A1	166	#4	1	4'-8''	517	A300	70	#4	STR	19'-7''	916	D1	9	#6	STR	1'-5''	19
A2	166	#4	1	4'-2''	462	A301	4	#4	STR	16'-11''	45	D2	9	#6	STR	2'-5''	33
						A302	4	#4	STR	13'-10''	37						
A100	87	#4	STR	19'-7''	1138	A303	4	#4	STR	10'-9''	29	G1	4	#5	STR	21'-2''	88
A101	4	#4	STR	17'-8''	47	A304	4	#4	STR	7'-8''	20						
A102	4	#4	STR	15'-3''	41	A305	4	#4	STR	4'-7''	12	S1	6	#8	STR	21'-2''	339
A103	4	#4	STR	12'-9''	34							S2	12	#6	STR	21'-2''	382
A104	4	#4	STR	10'-3''	27	A400	70	#5	STR	19'-7''	1430						
A105	4	#4	STR	7'-10''	21	A401	4	#5	STR	16'-11''	71	REINFORCING STEEL = 11,424 LBS.					
A106	4	#4	STR	5'-4''	14	A402	4	#5	STR	13'-10''	58						
A107	4	#4	STR	2'-10''	8	A403	4	#5	STR	10'-9''	45						
						A404	4	#5	STR	7'-8''	32						
A200	87	#4	STR	19'-7''	1138	A405	4	#5	STR	4'-7''	19						
A201	4	#4	STR	17'-8''	47												
A202	4	#4	STR	15'-3''	41	B1	104	#4	STR	7'-3''	504						
A203	4	#4	STR	12'-9''	34	B2	166	#4	STR	5'-4''	591						
A204	4	#4	STR	10'-3''	27	B3	104	#4	STR	7'-3''	504						
A205	4	#4	STR	7'-10''	21												
A206	4	#4	STR	5'-4''	14	C1	140	#4	STR	27'-11''	2611						
A207	4	#4	STR	2'-10''	8												

BAR TYPE



BAR DIMENSIONS ARE OUT TO OUT



PHASING SEQUENCE

STAGE II
LOOKING UPSTREAM

REINFORCING BAR SCHEDULE

STAGE II - PHASE 1

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
A1	107	#4	1	4'-8''	334
A2	241	#4	1	4'-2''	671
A600	123	#4	STR	12'-9''	1048
A601	2	#4	STR	10'-8''	14
A602	2	#4	STR	8'-2''	11
A603	2	#4	STR	5'-8''	8
A604	2	#4	STR	3'-3''	4
A605	2	#4	STR	11'-4''	15
A606	2	#4	STR	8'-10''	12
A607	2	#4	STR	6'-4''	8
A608	2	#4	STR	3'-11''	5
A800	98	#5	STR	13'-1''	1337
A801	2	#5	STR	10'-10''	23
A802	2	#5	STR	7'-9''	16
A803	2	#5	STR	4'-8''	10
A804	2	#5	STR	11'-2''	23
A805	2	#5	STR	8'-1''	17
A806	2	#5	STR	5'-0''	10
B1	67	#4	STR	7'-3''	324
B2	107	#4	STR	5'-4''	381
B3	134	#4	STR	7'-3''	649
C2	81	#4	STR	23'-7''	1276
D2	12	#6	STR	2'-5''	44
S3	3	#8	STR	17'-2''	138
S4	6	#6	STR	15'-0''	135
REINFORCING STEEL = 6,513 LBS.					

STAGE II - PHASE 2

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
A1	107	#4	1	4'-8''	334
A2	107	#4	1	4'-2''	298
A500	118	#4	STR	19'-7''	1544
A501	4	#4	STR	17'-6''	47
A502	4	#4	STR	15'-0''	40
A503	4	#4	STR	12'-7''	34
A504	4	#4	STR	10'-1''	27
A505	4	#4	STR	7'-7''	20
A506	4	#4	STR	5'-1''	14
A507	4	#4	STR	2'-8''	7
A650	127	#4	STR	8'-4''	707
A651	2	#4	STR	6'-4''	8
A652	2	#4	STR	3'-11''	5
A653	2	#4	STR	6'-2''	8
A654	2	#4	STR	3'-8''	5
A700	94	#4	STR	19'-7''	1230
A701	4	#4	STR	17'-4''	46
A702	4	#4	STR	14'-3''	38
A703	4	#4	STR	11'-2''	30
A704	4	#4	STR	8'-1''	22
A705	4	#4	STR	5'-0''	13

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
A850	101	#5	STR	8'-4''	878
A851	2	#5	STR	6'-6''	14
A852	2	#5	STR	3'-5''	7
A853	2	#5	STR	6'-0''	13
A854	2	#5	STR	2'-11''	6
B1	67	#4	STR	7'-3''	324
B2	107	#4	STR	5'-4''	381
C2	129	#4	STR	23'-7''	2032
D1	12	#6	STR	1'-5''	26
G1	4	#5	STR	21'-2''	88
S1	3	#8	STR	21'-2''	170
S2	6	#6	STR	21'-2''	191
S5	3	#8	STR	8'-11''	71
S6	6	#6	STR	8'-11''	80

REINFORCING STEEL = 8,758 LBS.

STAGE I QUANTITIES

CLASS A CONCRETE
- BARREL @ 1.749 CY/FT — 90.5 C.Y.
- WINGS, ETC. — 11.0 C.Y.
- SILLS/BAFFLES — 3.0 C.Y.
- TOTAL — 104.5 C.Y.

REINFORCING STEEL
- BARREL & SILLS — 11,424
- WINGS, ETC. — 465 LBS.
- TOTAL — 11,889 LBS.

CULVERT EXCAVATION ---------- LUMP SUM
FOUNDATION COND. MAT'L -------- 88 TONS

STAGE II QUANTITIES

CLASS A CONCRETE
- BARREL @ 1.749 CY/FT — 117.3 C.Y.
- WINGS, ETC. — 11.0 C.Y.
- SILLS/BAFFLES — 4.0 C.Y.
- TOTAL — 132.3 C.Y.

REINFORCING STEEL
- BARREL & SILLS — 15,271 LBS.
- WINGS, ETC. — 465 LBS.
- TOTAL — 15,736 LBS.

CULVERT EXCAVATION ---------- LUMP SUM
FOUNDATION COND. MAT'L -------- 114 TONS

SPLICE LENGTH CHART

BAR	SIZE	SPLICE LENGTH
A200, A600	#4	1'-5''
A400, A800	#5	1'-9''
B1	#4	1'-5''
B3	#4	1'-5''
''C''	#4	1'-11''
S3	#8	4'-11''
S4	#6	2'-9''

DRAWN BY : V.X. NGUYEN DATE : 2-3-15
CHECKED BY : H.T. BARBOUR DATE : 5-1-15
DESIGN ENGINEER OF RECORD: J.P. McCARTHA DATE : 6-15

24-JUL-2015 13:58
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wardfat

NORTH CAROLINA PROFESSIONAL SEAL 17230 ENGINEER WAEL S. ARAFAT
Digitally signed by: Wael Arafat 4139C12A32AB406...
7/28/2015

PROJECT NO. R-2915A
WATAUGA/ASHE COUNTY
STATION: 66+11.00 -L-

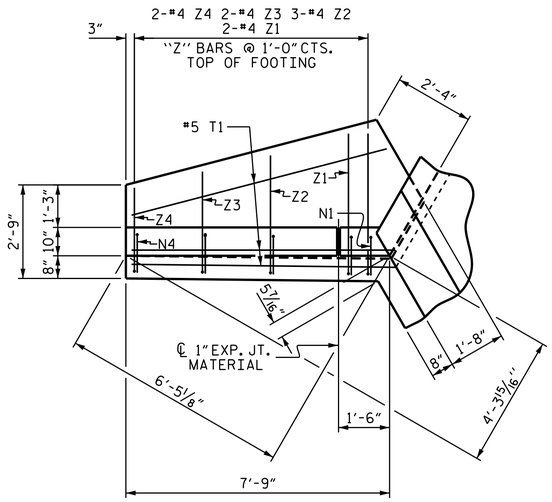
SHEET 7 OF 9

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

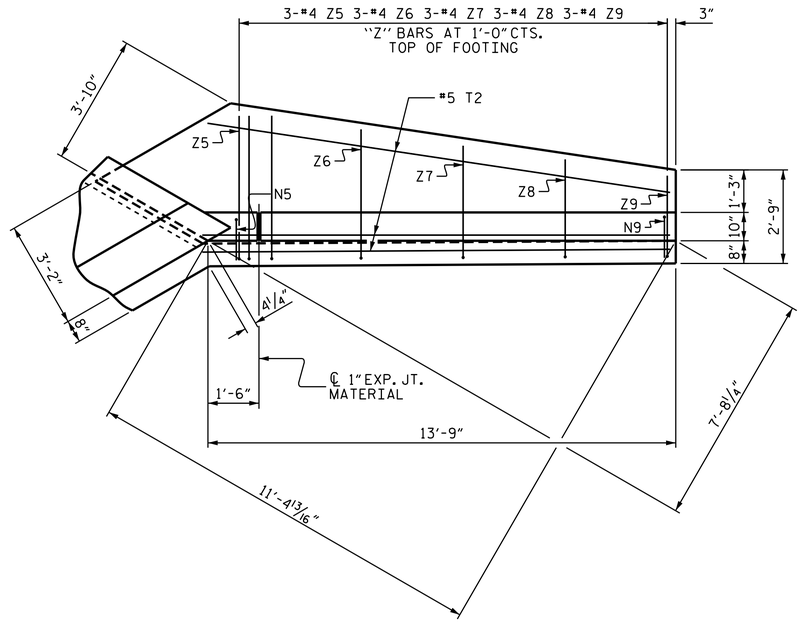
DOUBLE 9'-0'' X 6'-0'' CONCRETE BOX CULVERT STAGES I & II

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C-7
1			3			TOTAL SHEETS
2			4			20

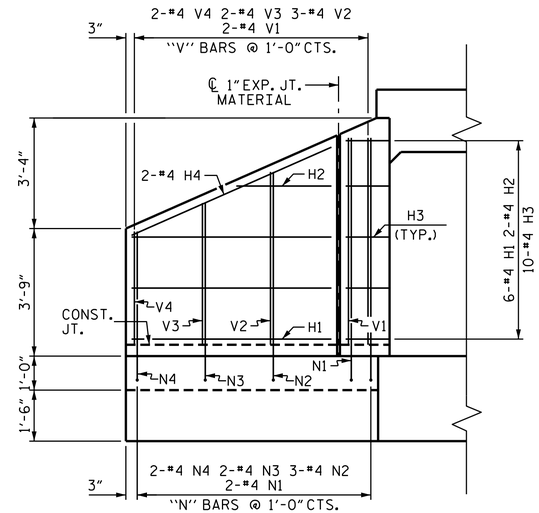
STR. #2



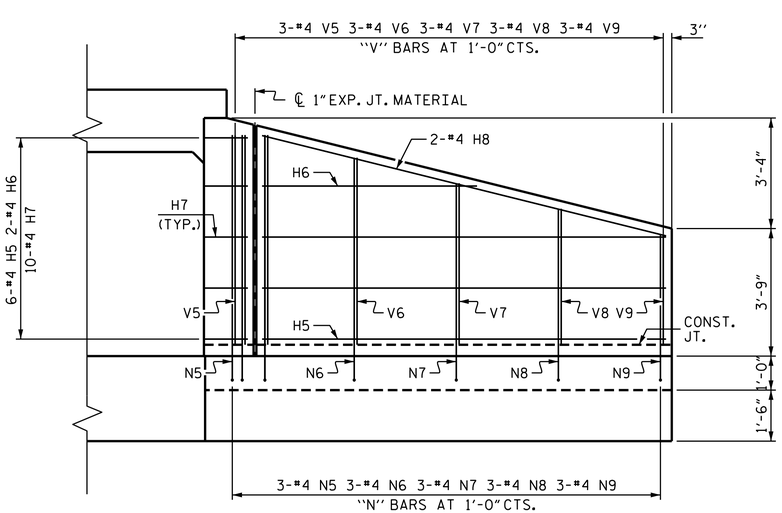
PLAN W1



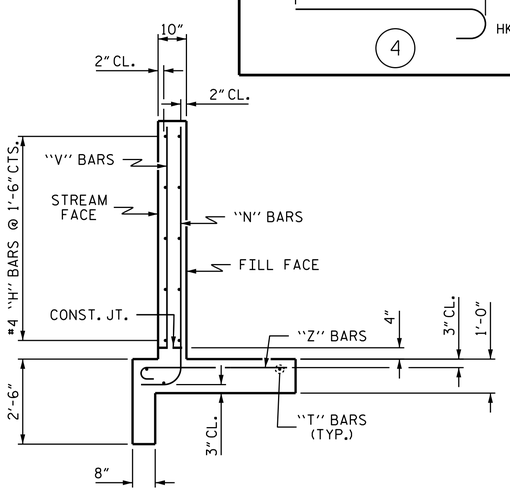
PLAN W2



ELEVATION W1



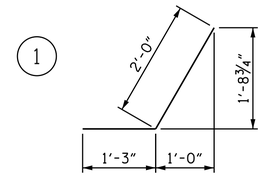
ELEVATION W2

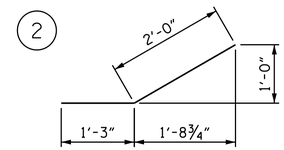


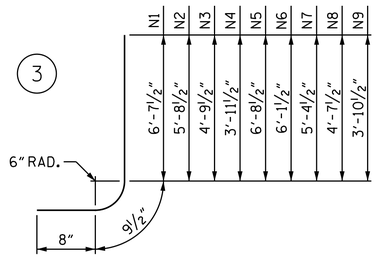
TYPICAL WING SECTION

BAR TYPES

ALL BAR DIMENSIONS ARE OUT TO OUT.







Z1	4'-2"	6"
Z2	3'-6"	6"
Z3	3'-0"	6"
Z4	2'-6"	6"
Z5	4'-3"	6"
Z6	3'-10"	6"
Z7	3'-4"	6"
Z8	2'-11"	6"
Z9	2'-5"	6"

HK.

4

BILL OF MATERIAL

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
H1	6	#4	STR	5'-10"	23
H2	2	#4	STR	2'-9"	4
H3	10	#4	1	3'-3"	22
H4	2	#4	STR	6'-5"	9
H5	6	#4	STR	11'-10"	47
H6	2	#4	STR	6'-3"	8
H7	10	#4	2	3'-3"	22
H8	2	#4	STR	12'-2"	16
N1	2	#4	3	8'-1"	11
N2	3	#4	3	7'-2"	14
N3	2	#4	3	6'-3"	8
N4	2	#4	3	5'-5"	7
N5	3	#4	3	8'-2"	16
N6	3	#4	3	7'-7"	15
N7	3	#4	3	6'-10"	14
N8	3	#4	3	6'-1"	12
N9	3	#4	3	5'-4"	11
T1	3	#5	STR	7'-9"	24
T2	3	#5	STR	13'-9"	43
V1	2	#4	STR	6'-1"	8
V2	3	#4	STR	5'-1"	10
V3	2	#4	STR	4'-2"	6
V4	2	#4	STR	3'-4"	4
V5	3	#4	STR	6'-2"	12
V6	3	#4	STR	5'-6"	11
V7	3	#4	STR	4'-9"	10
V8	3	#4	STR	4'-0"	8
V9	3	#4	STR	3'-3"	7
Z1	2	#4	4	4'-8"	6
Z2	3	#4	4	4'-0"	8
Z3	2	#4	4	3'-6"	5
Z4	2	#4	4	3'-0"	4
Z5	3	#4	4	4'-9"	10
Z6	3	#4	4	4'-4"	9
Z7	3	#4	4	3'-10"	8
Z8	3	#4	4	3'-5"	7
Z9	3	#4	4	2'-11"	6

REINFORCING STEEL FOR 2 WINGS 465 LBS

CLASS A CONCRETE

2 WINGS	7.2	CY
1 HEADWALL	1.0	CY
1 END CURTAIN WALL	1.2	CY
2 EDGE BEAMS	1.6	CY
TOTAL	11.0	CY

PROJECT NO. R-2915A

WATAUGA/ASHE COUNTY

STATION: 66+11.00 -L-

SHEET 8 OF 9

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

STANDARD WINGS FOR CONCRETE BOX CULVERT

H = 6'-0" SLOPE = 2:1

STAGE I OR II

68°-00'-00" SKEW

NORTH CAROLINA PROFESSIONAL SEAL 17230 ENGINEER WAEL S. ARAFAT

Designed by: Wael Arafat 4139C12A32AB406...

7/28/2015

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C-8
1			3			TOTAL SHEETS
2			4			20

ASSEMBLED BY :	V.X. NGUYEN	DATE :	1-26-15
CHECKED BY :	H.T. BARBOUR	DATE :	5-1-15
DRAWN BY :	CCJ		11/99
CHECKED BY :	RWW		03/00

24-JUL-2015 14:02
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STR. #2

STD. NO. CW6006

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 × RF	STRENGTH I LIMIT STATE									COMMENT NUMBER
							LIVE-LOAD FACTORS $\gamma_{(LL)}$	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	1.06	--	1.75	1.06	1	TOP SLAB	4.11	1.13	1	TOP SLAB	8.67	
		HL-93 (OPERATING)	N/A		1.38	--	1.35	1.38	1	TOP SLAB	4.11	1.46	1	TOP SLAB	8.67	
		HS-20 (INVENTORY)	36.000	2	1.10	39.42	1.75	1.10	1	TOP SLAB	4.11	1.26	1	TOP SLAB	8.67	
		HS-20 (OPERATING)	36.000		1.42	51.10	1.35	1.42	1	TOP SLAB	4.11	1.64	1	TOP SLAB	8.67	
LEGAL LOAD RATING	SINGLE VEHICLE (SV)	SNSH	13.500		2.00	27.02	1.40	2.00	1	TOP SLAB	4.11	2.30	1	TOP SLAB	8.67	
		SNGARBS2	20.000		1.87	37.48	1.40	1.87	1	TOP SLAB	4.11	2.15	1	TOP SLAB	8.67	
		SNAGRIS2	22.000		2.00	44.03	1.40	2.00	1	TOP SLAB	4.11	2.30	1	TOP SLAB	8.67	
		SNCOTTS3	27.250	3	1.33	36.24	1.40	1.33	1	TOP SLAB	4.11	1.41	1	TOP SLAB	8.67	
		SNAGGRS4	34.925		1.58	55.35	1.40	1.73	1	TOP SLAB	4.35	1.58	1	BOTTOM SLAB	8.73	
		SNS5A	35.550		1.57	55.78	1.40	1.62	1	TOP SLAB	4.11	1.57	1	TOP SLAB	8.67	
		SNS6A	39.950		1.48	58.96	1.40	1.62	1	TOP SLAB	4.11	1.48	1	BOTTOM SLAB	8.73	
		SNS7B	42.000		1.53	64.37	1.40	1.69	1	TOP SLAB	3.87	1.53	1	BOTTOM SLAB	8.73	
	TRUCK TRACTOR SEMI-TRAILER (TTST)	TNAGRIT3	33.000		1.98	65.36	1.40	2.00	1	TOP SLAB	4.11	1.98	1	BOTTOM SLAB	8.73	
		TNT4A	33.075		1.60	52.78	1.40	1.60	1	TOP SLAB	4.11	1.68	1	TOP SLAB	8.67	
		TNT6A	41.600		1.63	67.77	1.40	1.63	1	TOP SLAB	4.11	1.63	1	TOP SLAB	8.67	
		TNT7A	42.000		1.63	68.33	1.40	1.66	1	TOP SLAB	4.11	1.63	1	TOP SLAB	8.67	
		TNT7B	42.000		1.60	67.02	1.40	1.60	1	TOP SLAB	4.11	1.68	1	TOP SLAB	8.67	
		TNAGRIT4	43.000		1.52	65.47	1.40	1.52	1	TOP SLAB	4.11	1.57	1	BOTTOM SLAB	8.73	
		TNAGT5A	45.000		1.41	63.43	1.40	1.56	1	TOP SLAB	4.11	1.41	1	BOTTOM SLAB	8.73	
		TNAGT5B	45.000		1.33	59.89	1.40	1.60	1	TOP SLAB	4.11	1.33	1	BOTTOM SLAB	8.73	

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.

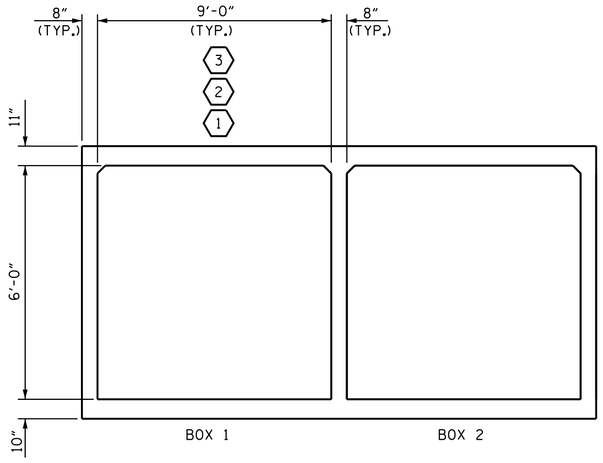
(#) CONTROLLING LOAD RATING

(1) DESIGN LOAD RATING (HL-93)

(2) DESIGN LOAD RATING (HS-20)

(3) LEGAL LOAD RATING **

** SEE CHART FOR VEHICLE TYPE



LRFR SUMMARY

(LOOKING UPSTREAM)

PROJECT NO. R-2915A

WATAUGA/ASHE COUNTY

STATION: 66+11.00 -L-

SHEET 9 OF 9

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

STANDARD

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

NORTH CAROLINA PROFESSIONAL SEAL 17230 ENGINEER WAEL S. ARAFAT

Digitally signed by Wael Orafat
4139C12A32AB406...
7/28/2015

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C-9
1			3			TOTAL SHEETS
2			4			20

STR. #2 STD. NO. LRFR5

ASSEMBLED BY : V.X. NGUYEN DATE : 5-11-15
CHECKED BY : H.T. BARBOUR DATE : 5-15

DRAWN BY : WMC 7/11
CHECKED BY : GM 7/11

REV. 10/1/11 MAA/GM

24-JUL-2015 14:03
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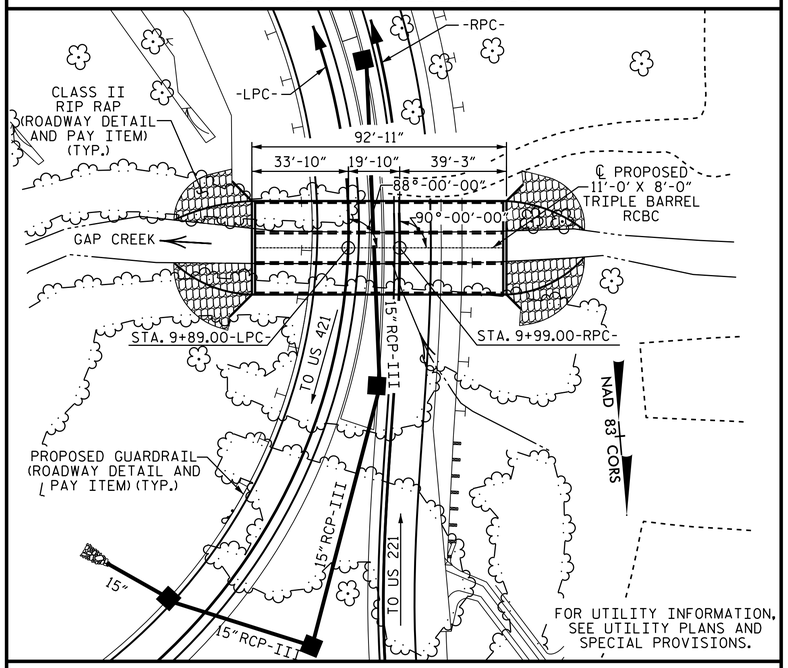
B. M. #1: CHISLED SQUARE ON TOP OF HEADWALL
STA. 13+20.00-L-, 287 FT. LEFT, EL. 2986.63
N 914470 E1259917



LOCATION SKETCH

ROADWAY DATA

GRADE POINT EL. @ STA. 9+89-LPC- = 2993.64
BED EL. @ STA. 9+89-LPC- --------- = 2980.11

GRADE POINT EL. @ STA. 9+99-RPC- = 2994.82
BED EL. @ STA. 9+99-RPC- --------- = 2980.17

ROADWAY SLOPES ---------- = 2:1

HYDRAULIC DATA

DESIGN DISCHARGE ---------- = 900 C.F.S.

FREQUENCY OF DESIGN FLOOD ----- = 50 YEARS

DESIGN HIGH WATER ELEVATION --- = 2987.10

DRAINAGE AREA ---------- = 2.35 SQ. MI.

BASE DISCHARGE (Q100) ---------- = 1100 C.F.S.

BASE HIGH WATER ELEVATION ------ = 2987.66

OVERTOPPING FLOOD DATA

OVERTOPPING DISCHARGE ---------- = 1130 C.F.S.

FREQUENCY OF OVERTOPPING FLOOD -= 100+ YEARS

OVERTOPPING FLOOD ELEVATION ----= 2989.20

NOTES

ASSUMED LIVE LOAD ----------HL-93 OR ALTERNATE LOADING.

DESIGN FILL----------MAX. = 7.93 FT., MIN. = 3.6 FT.

FOR OTHER DESIGN DATA AND NOTES SEE STANDARD NOTE SHEET.

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

CONCRETE IN CULVERTS TO BE POURED IN THE FOLLOWING ORDER:

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

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.

STEEL IN THE BOTTOM SLAB MAY BE SPLICED AT THE PERMITTED CONSTRUCTION JOINT AT THE CONTRACTOR'S OPTION. EXTRA WEIGHT OF STEEL DUE TO THE SPLICES SHALL BE PAID FOR BY THE CONTRACTOR.

AT THE CONTRACTOR'S OPTION, HE MAY SPLICE THE VERTICAL REINFORCING STEEL IN THE INTERIOR FACE OF EXTERIOR WALL AND BOTH FACES OF INTERIOR WALLS 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.

THE CONTRACTOR SHALL PROVIDE INDEPENDENT ASSURANCE SAMPLES OF REINFORCING STEEL AS FOLLOWS: FOR PROJECTS REQUIRING UP TO 400 TONS OF REINFORCING STEEL, ONE 30 INCH SAMPLE OF EACH SIZE BAR USED, AND FOR PROJECTS REQUIRING OVER 400 TONS OF REINFORCING STEEL, TWO 30 INCH SAMPLES OF EACH SIZE BAR USED. THE BARS FROM WHICH THE SAMPLES ARE TAKEN MUST THEN BE SPLICED WITH REPLACEMENT BARS OF THE SIZE AND LENGTH OF THE SAMPLE, PLUS A MINIMUM LAP SPLICE OF THIRTY BAR DIAMETERS. PAYMENT FOR THE SAMPLES OF REINFORCING STEEL SHALL BE CONSIDERED INCIDENTAL TO VARIOUS PAY ITEMS.

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

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.

FOR SUBMITTAL 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.

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

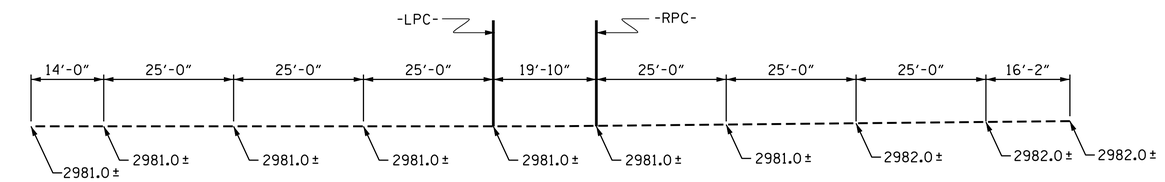
FOR EROSION CONTROL MEASURES, SEE EROSION CONTROL PLANS.

F. A. PROJECT No.: STP-0221 (39)

TOTAL STRUCTURE QUANTITIES

CLASS A CONCRETE	
BARREL @ 3.389 CY/FT	314.9 C.Y.
WING ETC.	28.7 C.Y.
SILLS	3.3 C.Y.
TOTAL	346.9 C.Y.
REINFORCING STEEL	
BARREL	39863 LBS.
WINGS ETC.	1453 LBS.
TOTAL	41316.0 LBS.
CULVERT EXCAVATION	LUMP SUM
FOUNDATION COND. MAT'L.	260 TONS

I HEREBY CERTIFY THESE PLANS ARE THE AS BUILT PLANS



PROFILE ALONG ℄ CULVERT

NORTH CAROLINA PROFESSIONAL SEAL 14855 ENGINEER DOUGLAS R. CALHOUN
DocuSigned by: Douglas R. Calhoun 430196F9D5E0429...
7/23/2015

NORTH CAROLINA PROFESSIONAL SEAL 17230 ENGINEER WAEL S. ARAFAT
DocuSigned by: Wael Arafat 4139C12A32AB406...
7/23/2015

PROJECT NO. R-2915A
WATAUGA/ASHE COUNTY
STATION: 9+89.00-LPC-/
9+99.00-RPC-

SHEET 1 OF 6 CULVERT NO. 387

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

TRIPLE 11 FT. X 8 FT. CONCRETE BOX CULVERT

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C-10
1			3			TOTAL SHEETS
2			4			20

STR. #3

DRAWN BY : H. T. BARBOUR DATE : 2-12-15
CHECKED BY : M. K. BEARD DATE : 3-16-15
DESIGN ENGINEER OF RECORD: J. P. McCARTHA DATE : 4-15

23-JUL-2015 12:45
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24-JUL-2015 14:11
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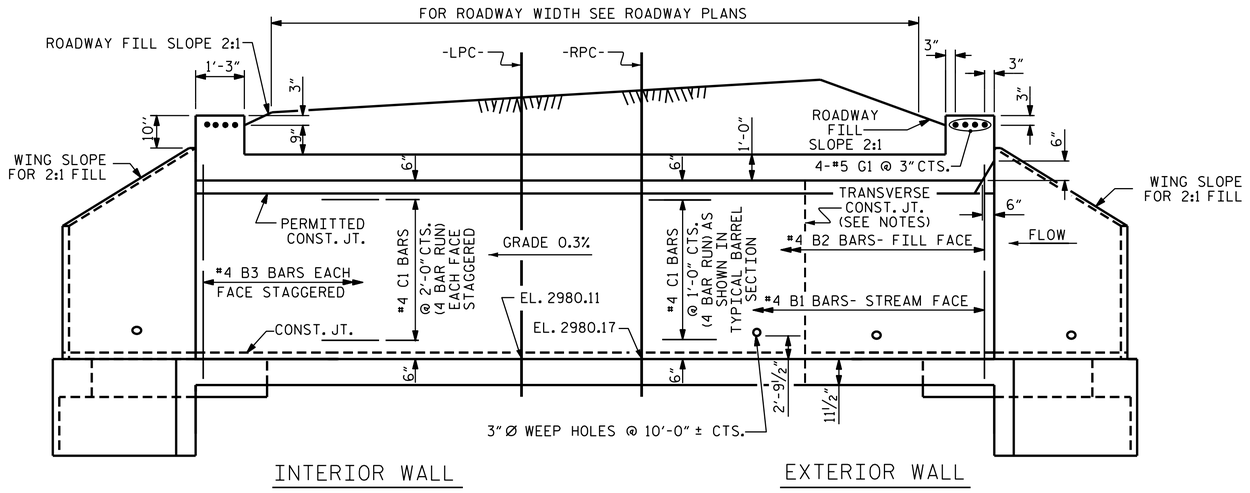
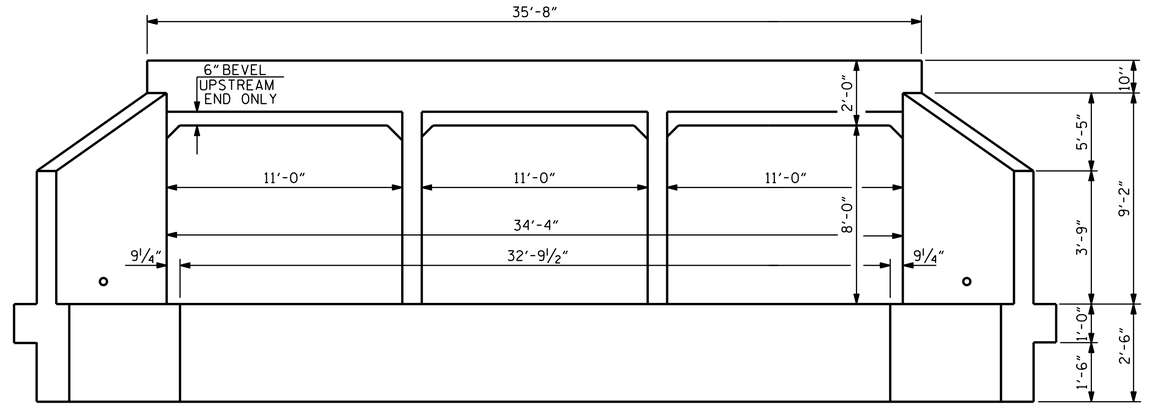
warafat

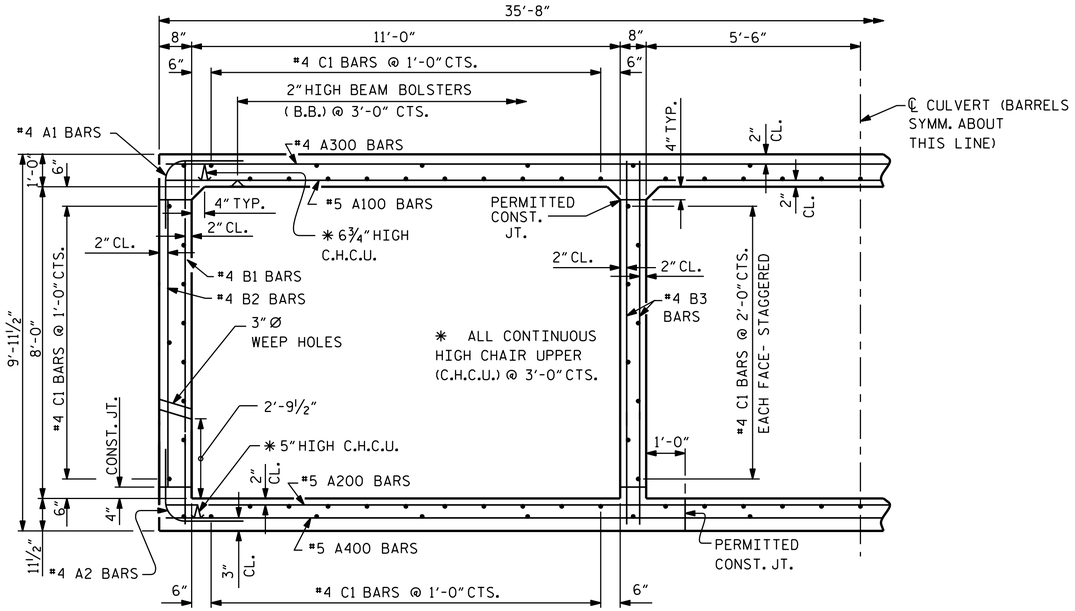


CULVERT SECTION NORMAL TO ROADWAY



END ELEVATION

CULVERT SILLS NOT SHOWN FOR CLARITY, SEE CULVERT SILL DETAILS FOR LOCATION AND DIMENSIONS.



RIGHT ANGLE SECTION OF BARREL

THERE ARE 126 "C" BARS IN SECTION OF BARREL.

I HEREBY CERTIFY THESE PLANS ARE THE AS BUILT PLANS

PROJECT NO. R-2915A
WATAUGA/ASHE COUNTY
STATION: 9+89.00-LPC-/ 9+99.00-RPC-
SHEET 2 OF 6

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

TRIPLE 11 FT. X 8 FT. CONCRETE BOX CULVERT

NORTH CAROLINA PROFESSIONAL SEAL 17230 ENGINEER WAEL S. ARAFAT

DocuSigned by: Wael Arafat 7/28/2015

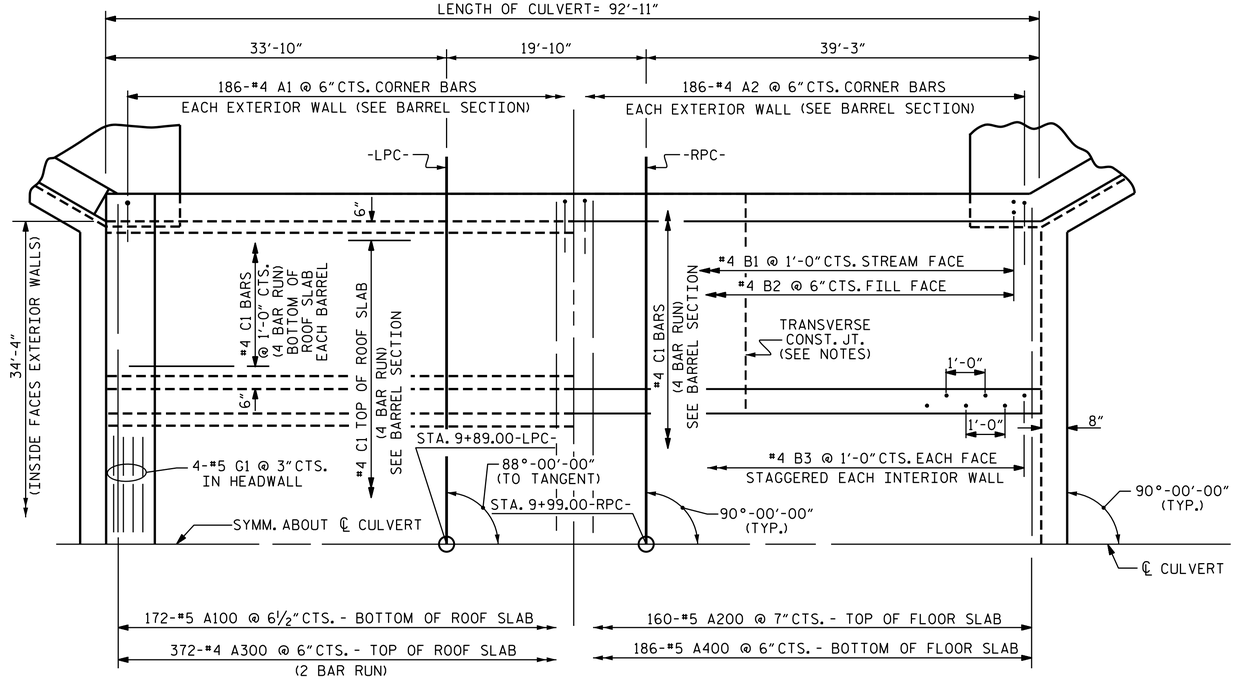
REVISIONS					
NO.	BY:	DATE:	NO.	BY:	DATE:
1			3		
2			4		

SHEET NO. C-11
TOTAL SHEETS 20

ASSEMBLED BY : H. T. BARBOUR DATE : 2-16-15
CHECKED BY : M. K. BEARD DATE : 3-16-15
DRAWN BY : JOEL JOHNSON DATE : MAR. 1971
CHECKED BY : GARY BROOME DATE : MAR. 1971
SPECIAL
STANDARD
DESIGN ENGINEER OF RECORD: J. P. McCARTHA DATE : 4-15

REVISED 8-28-92 BY E.L.R. CHECKED BY G.R.P.
REDRAWN NOV. 1990 BY TSS. CHECKED BY ARB
REVISED 11-9-99 BY M.M. CHECKED BY R.W.W.

STR. #3

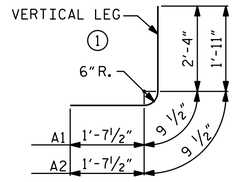


PART PLAN - ROOF SLAB

PART PLAN - FLOOR SLAB

REINFORCING BAR SCHEDULE

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
A1	372	#4	1	4'-9"	1180
A2	372	#4	1	4'-4"	1077
A100	172	#5	STR.	35'-3"	6324
A200	160	#5	STR.	35'-3"	5883
A300	372	#4	STR.	18'-4"	4556
A400	186	#5	STR.	35'-3"	6838
B1	186	#4	STR.	9'-5"	1170
B2	372	#4	STR.	7'-4"	1822
B3	372	#4	STR.	9'-5"	2340
C1	504	#4	STR.	24'-9"	8333
D1	12	#6	STR.	2'-6"	45
G1	8	#5	STR.	35'-4"	295
TOTAL REINFORCING STEEL					39863

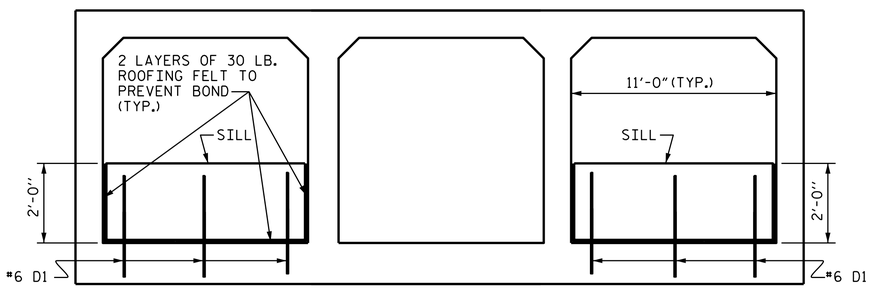


BAR TYPES

BAR DIMENSIONS ARE OUT TO OUT.

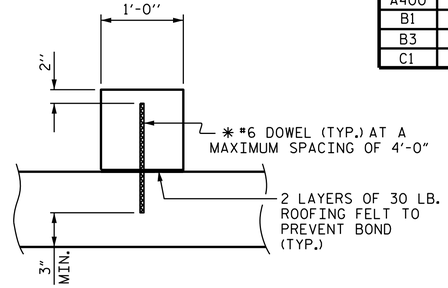
SPLICE CHART

BAR	SIZE	SPLICE LENGTH
A200	5	1'-9"
A300	4	1'-5"
A400	5	1'-9"
B1	4	1'-5"
B3	4	1'-5"
C1	4	1'-11"



ELEVATION

SILLS TYP. INLET AND OUTLET ENDS



SECTION THROUGH SILL

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

CULVERT SILL DETAILS

MATERIAL EXCAVATED FROM THE EXISTING BED SHALL BE STOCKPILED FOR USE IN THE PROPOSED CULVERT AND SHALL PROVIDE A CONTINUOUS LOW FLOW CHANNEL AS SHOWN. THE MATERIAL SHALL BE NATURAL STONE WITH A GRADATION SIZE SIMILAR TO THAT OF CLASS B RIP RAP. STONES LARGER THAN 6 INCHES SHALL NOT BE PLACED WITHIN THE LOW FLOW CHANNEL. BED MATERIAL SHALL BE SUBJECT TO APPROVAL BY THE ENGINEER.

THE STOCKPILED MATERIAL SHALL BE PLACED TO PROVIDE A 1 FOOT DEPTH LOW FLOW CHANNEL, AND SHALL BE PLACED TO THE LEVEL OF 2' BETWEEN THE HIGH FLOW SILLS.

THE TOP OF BED MATERIAL SHOULD MATCH THE STREAM BED ELEVATION IN THE LOW FLOW CHANNEL OF THE STREAM.

BED MATERIAL SHALL BE SUPPLEMENTED BY CLASS B RIP RAP AS NECESSARY IN THE LEFT AND RIGHT BARRELS ONLY.

BED MATERIAL SHALL BE PLACED ON TOP OF THE SUPPLEMENTAL FILL, IF USED, TO PROVIDE A FLAT SURFACE FOR ANIMAL PASSAGE.

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

THE ENTIRE COST OF WORK REQUIRED TO CONSTRUCT THE SILLS SHALL BE INCLUDED IN THE VARIOUS PAY ITEMS.

DRAWN BY : H. T. BARBOUR DATE : 2-12-15
CHECKED BY : M. K. BEARD DATE : 3-16-15
DESIGN ENGINEER OF RECORD: J. P. McCARTHA DATE : 4-15

24-JUL-2015 14:13
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warafat

NORTH CAROLINA PROFESSIONAL SEAL 17230 ENGINEER WAEL S. ARAFAT

DocuSigned by: Wael Arafat 4139C12A32AB406... 7/28/2015

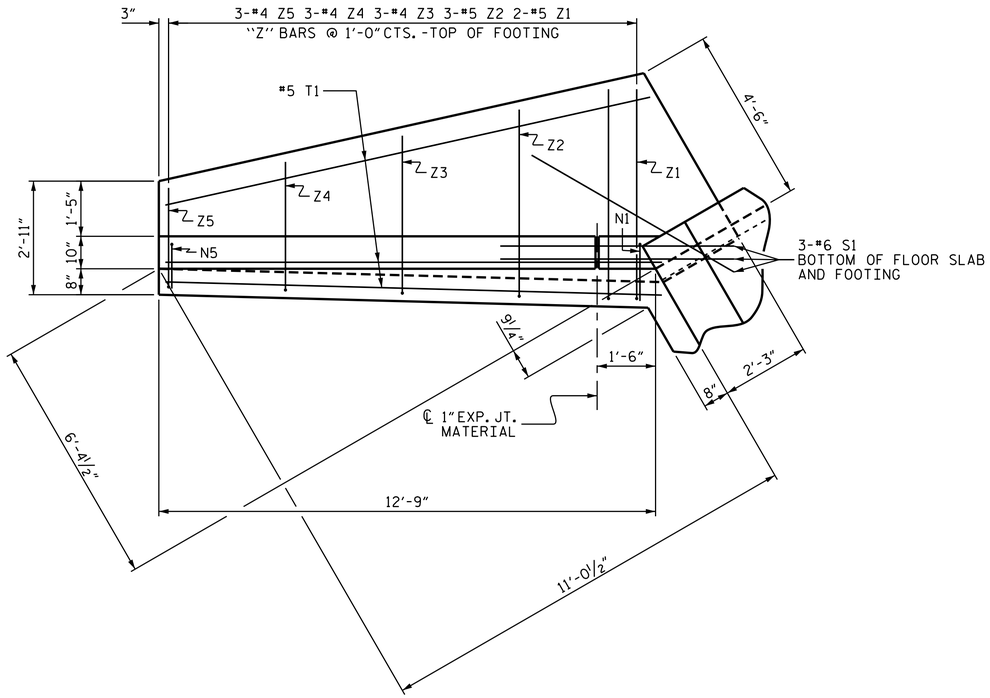
PROJECT NO. R-2915A
WATAUGA/ASHE COUNTY
STATION: 9+89.00-LPC-/ 9+99.00-RPC-
SHEET 3 OF 6

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

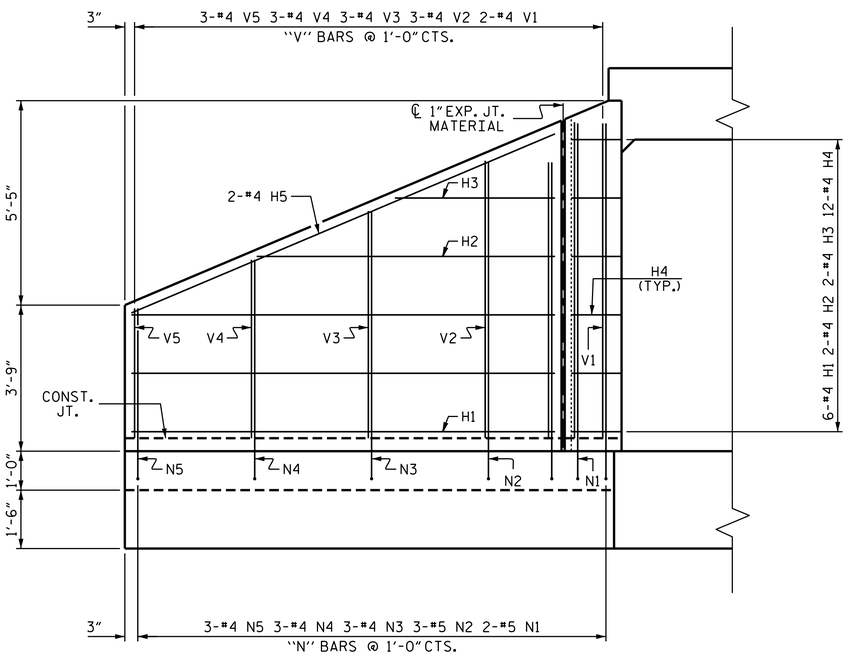
TRIPLE 11 FT. X 8 FT. CONCRETE BOX CULVERT

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C-12
1			3			TOTAL SHEETS
2			4			20

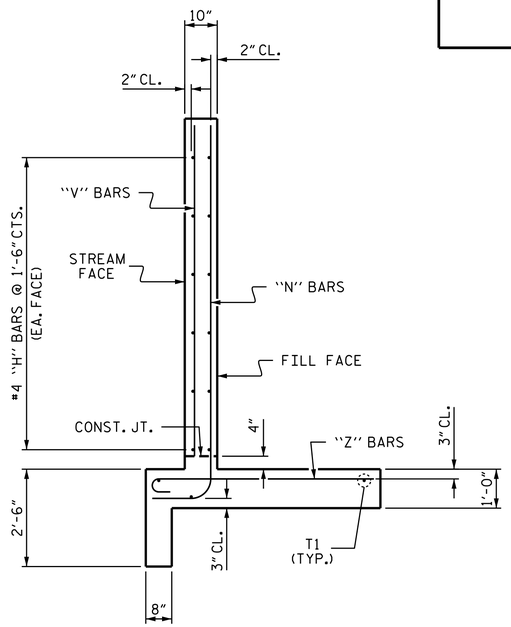
STR. #3



PLAN



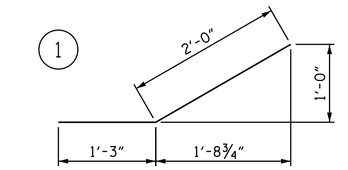
ELEVATION

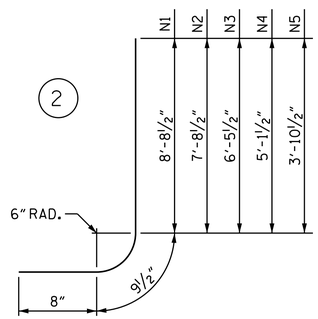


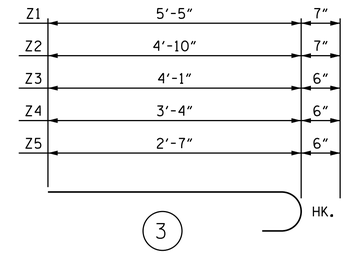
TYPICAL WING SECTION

BAR TYPES

ALL BAR DIMENSIONS ARE OUT TO OUT.







BILL OF MATERIAL

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
H1	24	#4	STR	10'-10"	174
H2	8	#4	STR	7'-8"	41
H3	8	#4	STR	4'-1"	22
H4	48	#4	1	3'-3"	104
H5	8	#4	STR	11'-9"	63
N1	8	#5	2	10'-2"	85
N2	12	#5	2	9'-2"	115
N3	12	#4	2	7'-11"	63
N4	12	#4	2	6'-7"	53
N5	12	#4	2	5'-4"	43
S1	12	#6	STR	6'-0"	108
T1	12	#5	STR	12'-9"	160
V1	8	#4	STR	8'-1"	43
V2	12	#4	STR	7'-1"	57
V3	12	#4	STR	5'-10"	47
V4	12	#4	STR	4'-7"	37
V5	12	#4	STR	3'-4"	27
Z1	8	#5	3	6'-0"	50
Z2	12	#5	3	5'-5"	68
Z3	12	#4	3	4'-7"	37
Z4	12	#4	3	3'-10"	31
Z5	12	#4	3	3'-1"	25

REINFORCING STEEL
FOR 4 WINGS 1453 LBS

CLASS A CONCRETE
4 WINGS 21.4 CY
2 HEADWALLS 3.3 CY
2 END CURTAIN WALLS 4.0 CY
TOTAL 28.7 CY

PROJECT NO. R-2915A
WATAUGA/ASHE COUNTY
STATION: 9+89.00-LPC-/
9+99.00-RPC-
SHEET 4 OF 6

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

STANDARD WINGS FOR CONCRETE BOX CULVERT

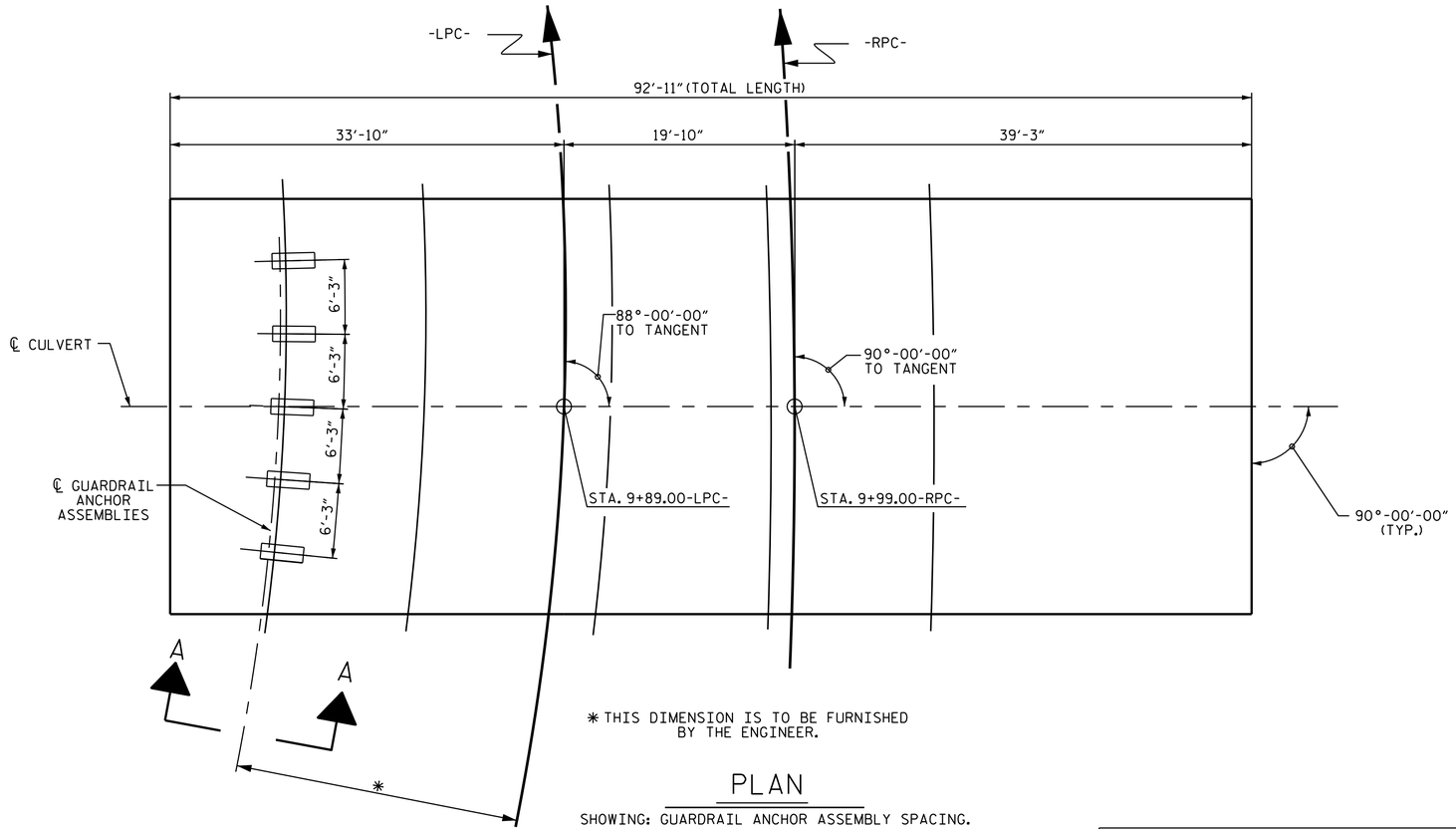
H = 8'-0" SLOPE = 2:1
90° SKEW

NORTH CAROLINA PROFESSIONAL SEAL 17230 ENGINEER WAEL S. ARAFAT
Docusigned by: Wael Arafat 8395C124A52AB406... 7/28/2015

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C-13
1			3			TOTAL SHEETS
2			4			20

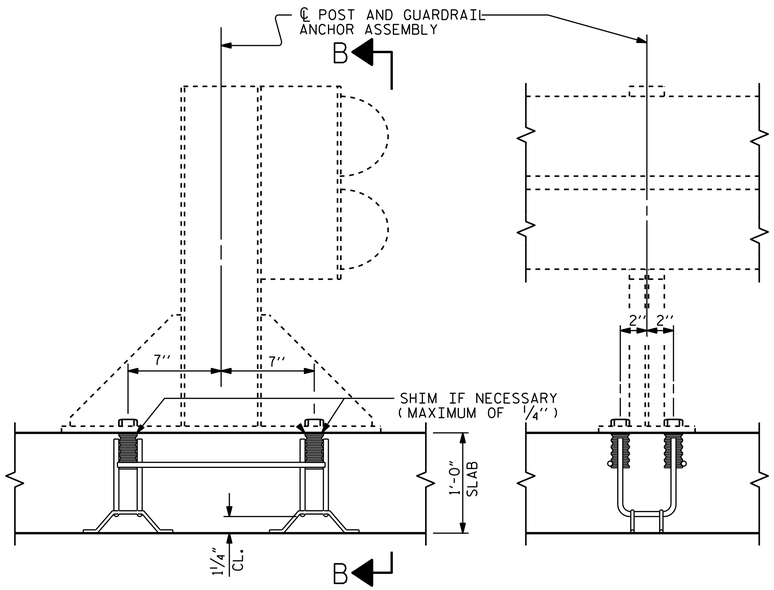
ASSEMBLED BY :	H. T. BARBOUR	DATE :	2-16-15
CHECKED BY :	M. K. BEARD	DATE :	3-16-15
DRAWN BY :	CCJ		10/99
CHECKED BY :	RWW		03/00

STR. #3 STD. NO. CW9008



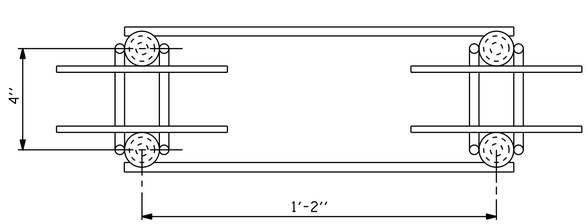
PLAN

SHOWING: GUARDRAIL ANCHOR ASSEMBLY SPACING.



SECTION A-A

SECTION B-B



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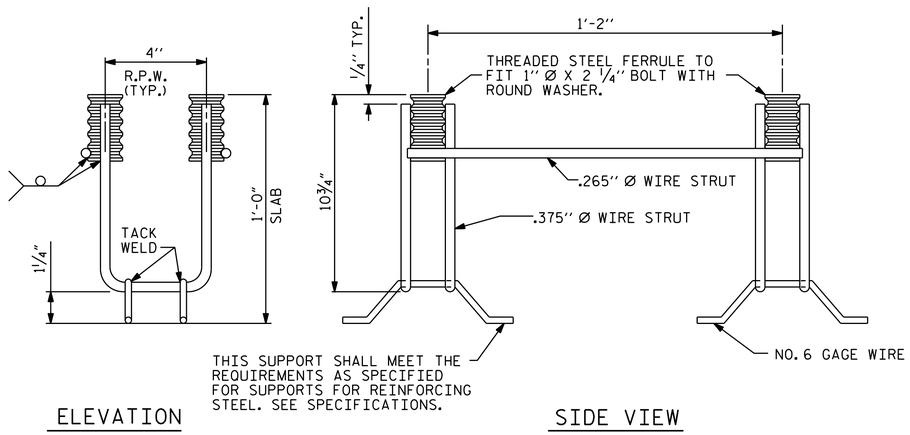

ELEVATION

SIDE VIEW

GUARDRAIL ANCHOR ASSEMBLY FOR CULVERTS

NOTES

THE GUARDRAIL ANCHOR ASSEMBLY FOR CULVERTS SHALL CONSIST OF THE FOLLOWING COMPONENTS :

A. FERRULES SHALL BE MADE FROM STEEL MEETING THE REQUIREMENTS OF AASHTO M169, GRADE 12L14 AND SHALL HAVE A MINIMUM LENGTH OF THREADS OF 2½".

B. 4 - 1" Ø X 2 ¼" BOLTS WITH WASHERS, BOLTS SHALL CONFORM TO THE REQUIREMENTS OF ASTM A307. BOLTS AND WASHERS SHALL BE GALVANIZED. (AT THE CONTRACTOR'S OPTION, STAINLESS STEEL BOLTS AND WASHERS MAY BE USED AS AN ALTERNATE FOR THE 1" Ø X 2¼" GALVANIZED BOLTS AND WASHERS. THEY SHALL CONFORM TO OR EXCEED THE MECHANICAL REQUIREMENTS OF ASTM A307. THE USE OF THIS ALTERNATE SHALL BE APPROVED BY THE ENGINEER.)

C. WIRE STRUTS SHOWN IN THE GUARDRAIL ANCHOR ASSEMBLY FOR CULVERTS DETAIL ARE MINIMUM ALLOWABLE SIZE AND SHALL HAVE A MINIMUM TENSILE STRENGTH OF 100,000 P.S.I. AS AN OPTION, A 7/16" Ø WIRE STRUT WITH A MINIMUM TENSILE STRENGTH OF 90,000 PSI IS ACCEPTABLE.

GUARDRAIL ANCHOR ASSEMBLY WITH BOLTS SHALL BE ASSEMBLED IN THE SHOP. BOLT THREADS MAY BE RECUT AS NECESSARY TO INSURE FIT.

THE COST OF THE GUARDRAIL ANCHOR ASSEMBLY FOR CULVERTS COMPLETE IN PLACE, SHALL BE INCLUDED IN THE UNIT CONTRACT PRICE BID FOR CLASS "A" CONCRETE.

FERRULES TO BE PLUGGED DURING POURING OF SLAB AS RECOMMENDED BY THE MANUFACTURER.

AT THE CONTRACTOR'S OPTION, FERRULES WITH OPEN OR CLOSED ENDS MAY BE USED.

PAYMENT FOR GUARDRAIL, POSTS, AND POST BASE PLATES IS INCLUDED IN ROADWAY PAY ITEMS.

SLAB REINFORCING STEEL MAY BE SHIFTED AS NECESSARY TO CLEAR GUARDRAIL ANCHOR ASSEMBLY. CARE SHOULD BE TAKEN TO KEEP THE SHIFTING OF REINFORCING STEEL TO A MINIMUM.

THE CONTRACTOR MAY USE ADHESIVELY ANCHORED ANCHOR BOLTS IN PLACE OF GUARDRAIL ANCHOR ASSEMBLY. LEVEL TWO FIELD TESTING IS REQUIRED, AND THE YIELD LOAD OF THE 1" Ø BOLT IS 21.8 KIPS. FOR ADHESIVELY ANCHORED ANCHOR BOLTS OR DOWELS, SEE STANDARD SPECIFICATIONS.

ASSEMBLED BY :	H. T. BARBOUR	DATE :	2-18-15
CHECKED BY :	M. K. BEARD	DATE :	3-16-15
DRAWN BY : FCJ	6/88	REV. 5/7/03	RWW/JTE
CHECKED BY : ARB	6/88	REV. 5/1/06R	KMM/GM
		REV. 10/1/11	MAA/GM

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warafat

NORTH CAROLINA PROFESSIONAL SEAL 17230 ENGINEER WAEL S. ARAFAT

DocuSigned by: Wael Arafat 4139C12A32AB406... 7/28/2015

PROJECT NO. R-2915A

WATAUGA/ASHE COUNTY

STATION: 9+89.00-LPC-/ 9+99.00-RPC-

SHEET 5 OF 6

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

STANDARD

ANCHORAGE DETAILS FOR GUARDRAIL ANCHOR ASSEMBLY FOR CULVERTS

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C-14
1			3			TOTAL SHEETS
2			4			20

STR. #3 STD. NO. GRA1

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 × RF	STRENGTH I LIMIT STATE									COMMENT NUMBER
								MOMENT				SHEAR				
							LIVE-LOAD FACTORS γ_{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	TOP SLAB	4.96	1.14	1	TOP SLAB	10.60	
		HL-93 (OPERATING)	N/A		1.42	--	1.35	1.42	1	TOP SLAB	4.96	1.47	1	TOP SLAB	10.60	
		HS-20 (INVENTORY)	36.00	⟨2⟩	1.28	46.24	1.75	1.28	1	TOP SLAB	4.96	1.36	1	TOP SLAB	10.60	
		HS-20 (OPERATING)	36.00		1.67	59.94	1.35	1.67	1	TOP SLAB	4.96	1.76	1	TOP SLAB	10.60	
LEGAL LOAD RATING	SINGLE VEHICLE (SV)	SNSH	13.50		2.33	31.45	1.40	2.33	1	TOP SLAB	5.25	2.51	1	TOP SLAB	10.60	
		SNGARBS2	20.00		2.18	43.66	1.40	2.18	1	TOP SLAB	5.25	2.35	1	TOP SLAB	10.60	
		SNAGRIS2	22.00		2.33	51.26	1.40	2.33	1	TOP SLAB	5.25	2.51	1	TOP SLAB	10.60	
		SNCOTTS3	27.25	⟨3⟩	1.37	37.31	1.40	1.37	1	TOP SLAB	4.96	1.42	1	TOP SLAB	10.60	
		SNAGGRS4	34.93		1.71	59.65	1.40	1.71	1	TOP SLAB	5.25	1.75	1	TOP SLAB	10.60	
		SNS5A	35.55		1.58	56.10	1.40	1.59	1	TOP SLAB	5.25	1.58	1	TOP SLAB	10.60	
		SNS6A	39.95		1.55	62.11	1.40	1.59	1	TOP SLAB	5.25	1.55	1	TOP SLAB	10.60	
		SNS7B	42.00		1.52	63.92	1.40	1.65	1	TOP SLAB	4.96	1.52	1	TOP SLAB	10.60	
	TRUCK TRACTOR SEMI-TRAILER (TTST)	TNAGRIT3	33.00		2.22	73.37	1.40	2.33	1	TOP SLAB	5.25	2.22	1	TOP SLAB	10.60	
		TNT4A	33.08		1.63	54.05	1.40	1.63	1	TOP SLAB	4.96	1.69	1	TOP SLAB	10.60	
		TNT6A	41.60		1.55	64.49	1.40	1.68	1	TOP SLAB	4.96	1.55	1	TOP SLAB	10.60	
		TNT7A	42.00		1.57	66.14	1.40	1.74	1	TOP SLAB	4.96	1.57	1	TOP SLAB	10.60	
		TNT7B	42.00		1.61	67.80	1.40	1.61	1	TOP SLAB	5.25	1.64	1	TOP SLAB	10.60	
		TNAGRIT4	43.00		1.56	67.03	1.40	1.56	1	TOP SLAB	4.96	1.61	1	TOP SLAB	10.60	
		TNAGT5A	45.00		1.57	70.57	1.40	1.59	1	TOP SLAB	5.25	1.57	1	TOP SLAB	10.60	
		TNAGT5B	45.00		1.51	67.82	1.40	1.63	1	TOP SLAB	4.96	1.51	1	TOP SLAB	10.60	

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	0.00
WA	1.00	0.00

NOTE:

RATING FACTORS ARE BASED ON THE STRENGTH I LIMIT STATE.

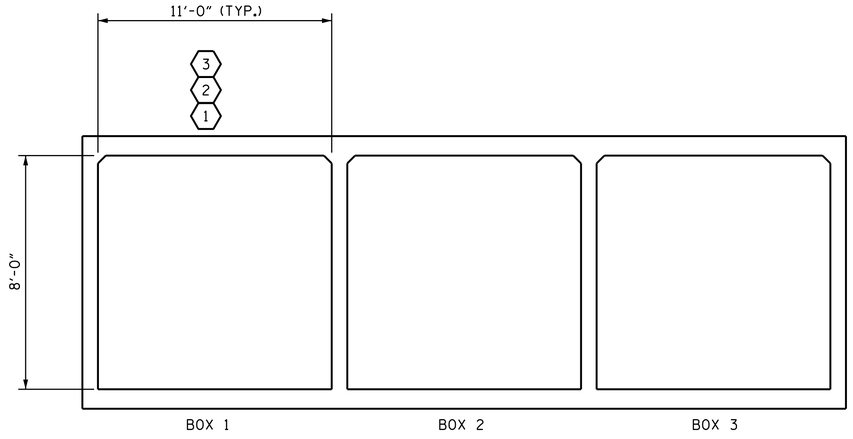
⟨#⟩ CONTROLLING LOAD RATING

⟨1⟩ DESIGN LOAD RATING (HL-93)

⟨2⟩ DESIGN LOAD RATING (HS-20)

⟨3⟩ LEGAL LOAD RATING **

** SEE CHART FOR VEHICLE TYPE



LRFR SUMMARY

(LOOKING DOWNSTREAM)

PROJECT NO. R-2915A

WATAUGA/ASHE COUNTY

STATION: 9+89.00-LPC-/ 9+99.00-RPC-

SHEET 6 OF 6

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

STANDARD

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

NORTH CAROLINA PROFESSIONAL SEAL 17230 ENGINEER WAEL S. ARAFAT

DocuSigned by: Wael Arafat 4139C12A32AB406... 7/28/2015

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C-15
1			3			TOTAL SHEETS
2			4			20

DRAWN BY : H. T. BARBOUR DATE : 3-19-15
CHECKED BY : M. K. BEARD DATE : 3-20-15
DESIGN ENGINEER OF RECORD: J. P. McCARTHA DATE : 4-15

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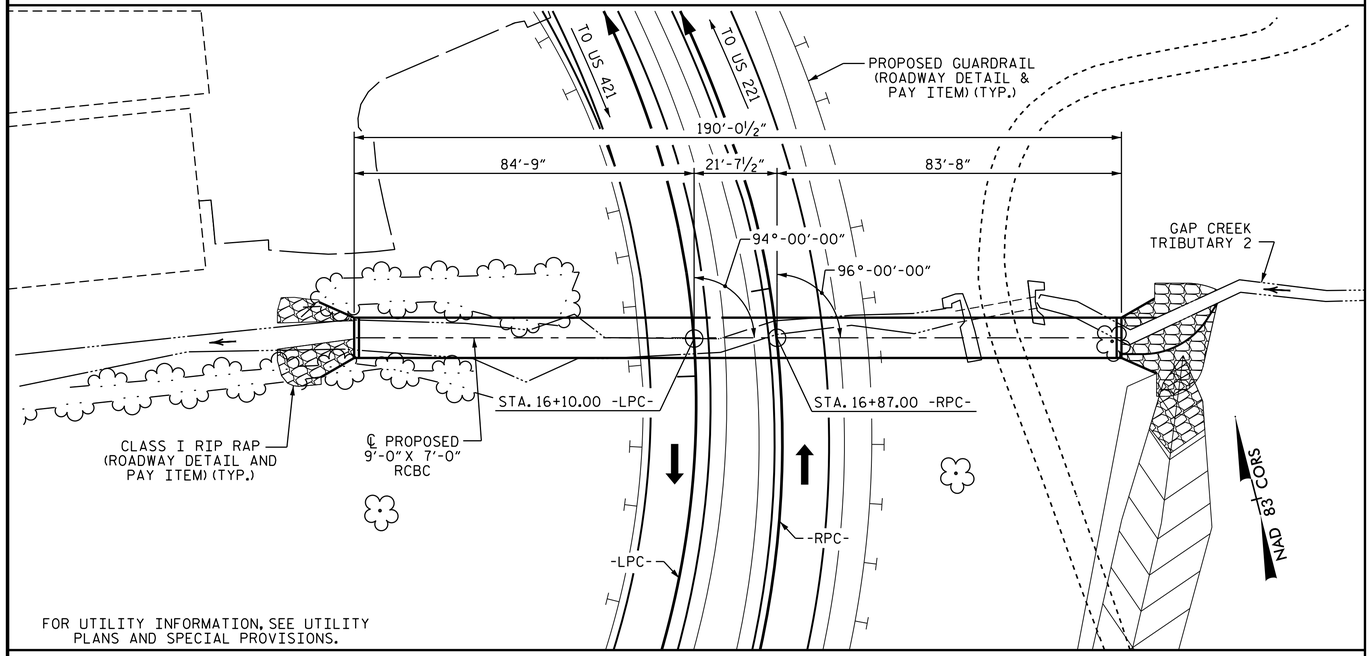
warafat

STR. #3

STD. NO. LRFR5

B.M. #1: CHISELED SQUARE ON TOP OF HEADWALL STA. 13+20.00 -L-, 287 FT. LEFT, EL. 2986.63 N. 914470 E. 1259917



LOCATION SKETCH

ROADWAY DATA

GRADE POINT EL. @ STA. 16+10.00 -LPC- ---= 3022.68
BED EL. @ STA. 16+10.00 -LPC- ---------- = 2986.29
GRADE POINT EL. @ STA. 16+87.00 -RPC- ---= 3024.63
BED EL. @ STA. 16+87.00 -RPC- ---------- = 2986.72
ROADWAY SLOPES ---------- = 2:1

HYDRAULIC DATA

DESIGN DISCHARGE ---------- = 380 C.F.S.
FREQUENCY OF DESIGN FLOOD ---------- = 50 YEARS
DESIGN HIGH WATER ELEVATION --------- = 2995.80
DRAINAGE AREA ---------- = 0.44 SQ.Mi.
BASE DISCHARGE (Q100) ---------- = 450 C.F.S.
BASE HIGH WATER ELEVATION ---------- = 2996.56

OVERTOPPING FLOOD DATA

OVERTOPPING DISCHARGE ---------- = 780 C.F.S.
FREQUENCY OF OVERTOPPING FLOOD ------= 500+ YEARS
OVERTOPPING FLOOD ELEVATION --------- = 3003.8 *

* OVERTOPPING ELEVATION WAS SET TO THE ℄ ELEVATION OF SR 1675 DEEP GAP DRIVE. THIS IS @ STA. 35+96.00 -Y1- OFFSET 150' RT.

TOTAL STRUCTURE QUANTITIES

CLASS A CONCRETE		
BARREL @	1.462 CY/FT	277.8 C.Y.
WING ETC.		19.1 C.Y.
SILLS/BAFFLES		7.5 C.Y.
TOTAL		304.4 C.Y.
REINFORCING STEEL		
BARREL		30,391 LBS.
WINGS ETC.		1,151 LBS.
TOTAL		31,542 LBS.
CULVERT EXCAVATION		LUMP SUM
FOUNDATION COND. MAT'L.		195 TONS

NOTES

ASSUMED LIVE LOAD------HL-93 OR ALTERNATE LOADING.

DESIGN FILL------MAX. = 31.79 FT., MIN. = 28.25 FT.

FOR OTHER DESIGN DATA AND NOTES SEE STANDARD NOTE SHEET.

3"Ø 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.

THE CONTRACTOR SHALL PROVIDE INDEPENDENT ASSURANCE SAMPLES OF REINFORCING STEEL AS FOLLOWS: FOR PROJECTS REQUIRING UP TO 400 TONS OF REINFORCING STEEL, ONE 30 INCH SAMPLE OF EACH SIZE BAR USED, AND FOR PROJECTS REQUIRING OVER 400 TONS OF REINFORCING STEEL, TWO 30 INCH SAMPLES OF EACH SIZE BAR USED. THE BARS FROM WHICH THE SAMPLES ARE TAKEN MUST THEN BE SPLICED WITH REPLACEMENT BARS OF THE SIZE AND LENGTH OF THE SAMPLE, PLUS A MINIMUM LAP SPLICE OF THIRTY BAR DIAMETERS. PAYMENT FOR THE SAMPLES OF REINFORCING STEEL SHALL BE CONSIDERED INCIDENTAL TO VARIOUS PAY ITEMS.

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

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.

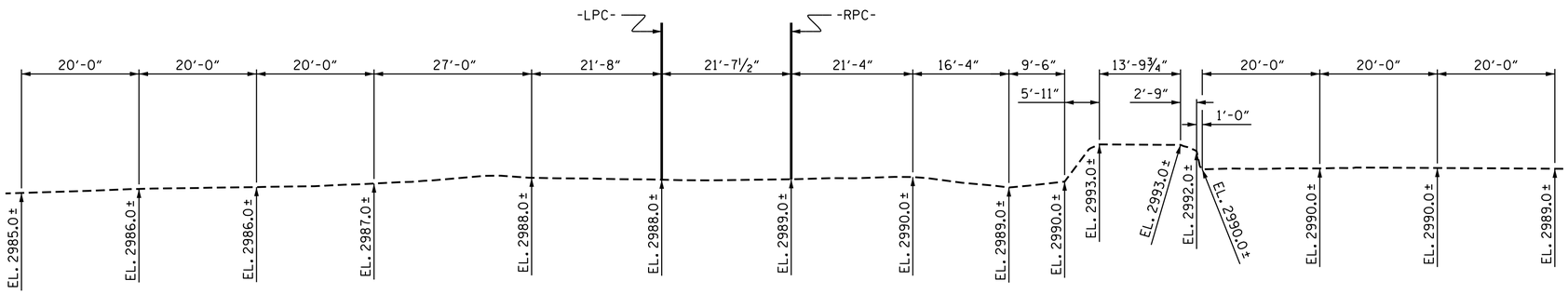
FOR SUBMITTAL OF WORKING DRAWINGS, SEE SPECIAL PROVISIONS.

FOR FALSEWORK AND FRAMEWORK, SEE SPECIAL PROVISIONS.

FOR CRANE SAFETY, SEE SPECIAL PROVISIONS.

FOR GROUT FOR STRUCTURES, SEE SPECIAL PROVISIONS.

FOR EROSION CONTROL MEASURES, SEE EROSION CONTROL PLANS.



PROFILE ALONG ℄ CULVERT

NORTH CAROLINA PROFESSIONAL SEAL 14855 ENGINEER DOUGLAS R. CALHOUN
DocuSigned by: Douglas R. Calhoun 430196F8D5E0429...
7/23/2015

NORTH CAROLINA PROFESSIONAL SEAL 17230 ENGINEER WAEL S. ARAFAT
DocuSigned by: Wael Arafat 4139C12A32AB406...
7/23/2015

F.A. PROJECT NO.: STP-0221 (39)

PROJECT NO. R-2915A
WATAUGA/ASHE COUNTY
STATION: 16+10.00 -LPC-/ 16+87.00 -RPC-
SHEET 1 OF 5

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

SINGLE 9 FT. X 7 FT. CONCRETE BOX CULVERT

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C-16
1			3			TOTAL SHEETS
2			4			20

STR. #4

DRAWN BY : M.K. BEARD DATE : 2/23/15
CHECKED BY : H.T. BARBOUR DATE : 3/2015
DESIGN ENGINEER OF RECORD: J.P. McCARTHA DATE : 4/14/15

23-JUL-2015 12:48
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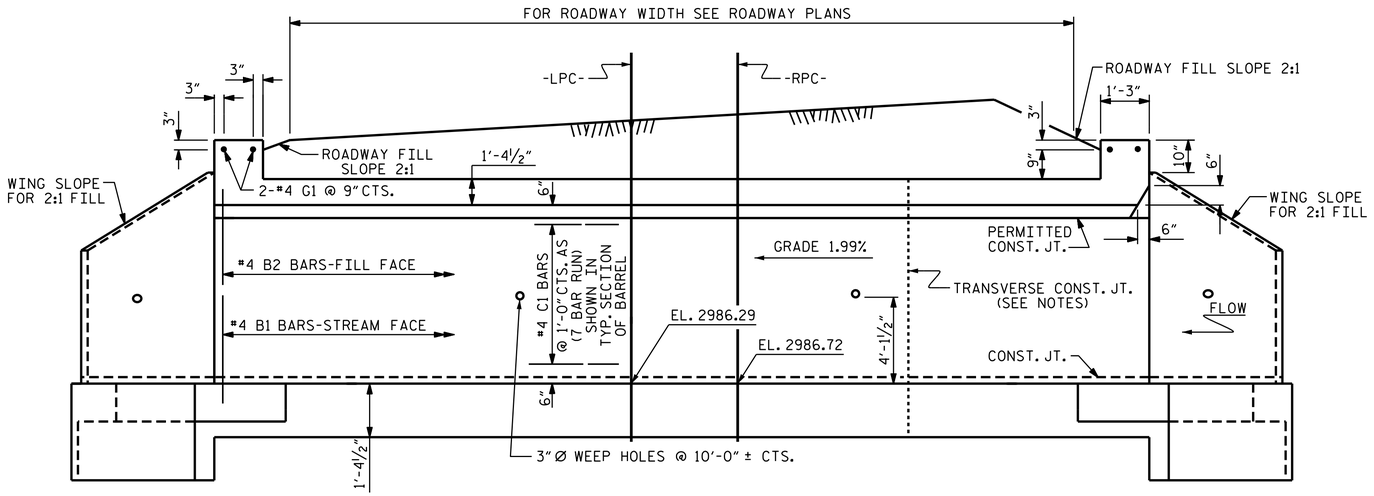
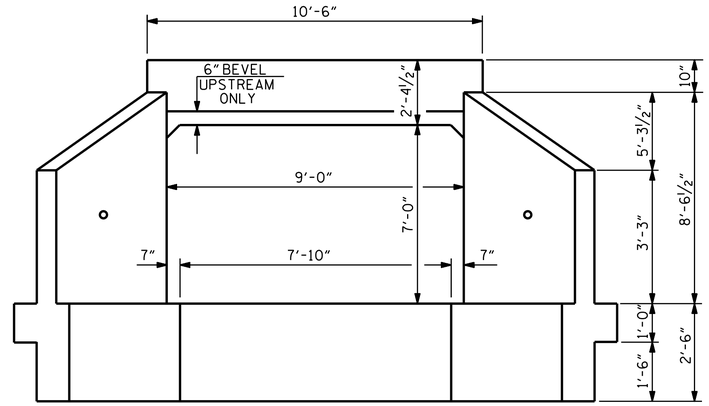
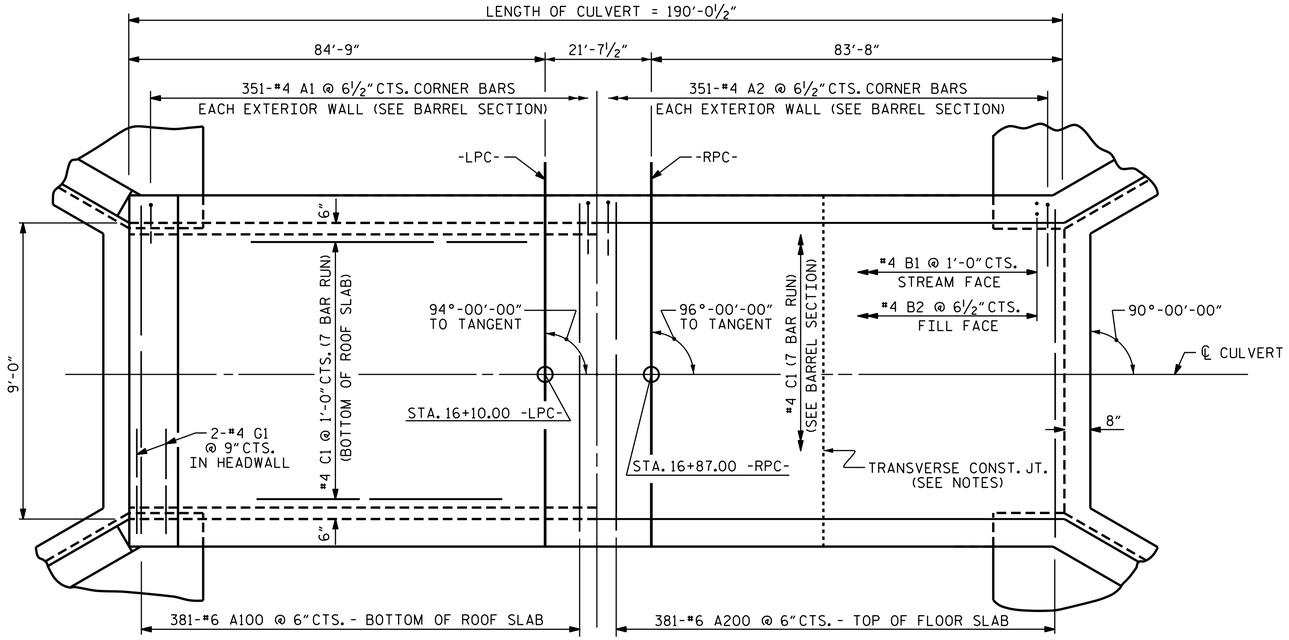


CULVERT SECTION NORMAL TO ROADWAY

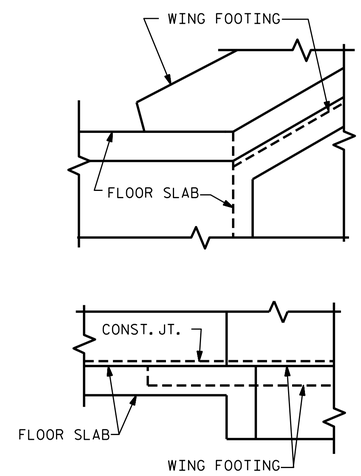


END ELEVATION



PART PLAN - ROOF SLAB

PART PLAN - FLOOR SLAB



DETAIL

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

REVISED 8-28-92 BY E.L.R. CHECKED BY G.R.P.
REVISED 8-22-89 BY A.R.B. CHECKED BY C.R.K.
REDRAWN 8-22-1989
REVISED 11-19-99 BY M.M. CHECKED BY R.W.W.

ASSEMBLED BY : M.K. BEARD DATE : 2/23/15
CHECKED BY : H.T. BARBOUR DATE : 3/2015
DRAWN BY : R. WRIGHT DATE : AUG. 1989
CHECKED BY : A.R. BISSETTE DATE : AUG. 1989
SPECIAL
STANDARD
DESIGN ENGINEER OF RECORD: J.P. McCARTHA DATE : 4/14/15

24-JUL-2015 14:27
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warafat

DocuSigned by: Wael Arafat 7/28/2015

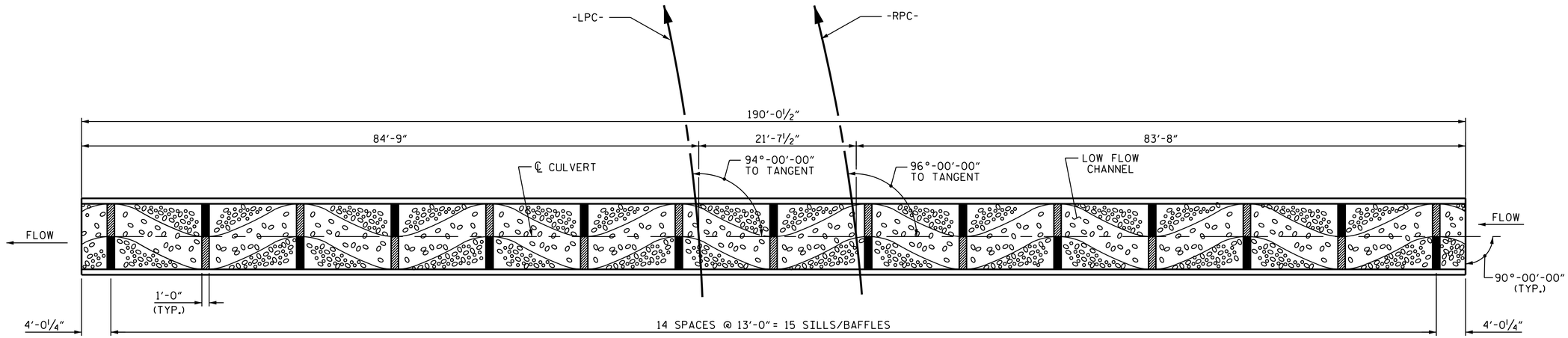
PROJECT NO. R-2915A
WATAUGA/ASHE COUNTY
STATION: 16+10.00 -LPC-/ 16+87.00 -RPC-
SHEET 2 OF 5

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

SINGLE 9 FT. X 7 FT. CONCRETE BOX CULVERT

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C-17
1			3			TOTAL SHEETS
2			4			20

STR. #4



PLAN OF FLOOR SILL/BAFFLE LAYOUT

1'-0" HIGH SILL/BAFFLE

2'-0" HIGH SILL/BAFFLE

MATERIAL EXCAVATED FROM THE EXISTING BED SHALL BE STOCKPILED FOR USE IN THE PROPOSED CULVERT AND SHALL PROVIDE A CONTINUOUS LOW FLOW CHANNEL BETWEEN THE SILLS AS SHOWN. THE MATERIAL SHALL BE NATURAL STONE WITH A GRADATION SIZE SIMILAR TO THAT OF CLASS B RIP RAP. STONES LARGER THAN 6 INCHES SHALL NOT BE PLACED WITHIN THE LOW FLOW CHANNEL. BED MATERIAL SHALL BE SUBJECT TO APPROVAL BY THE ENGINEER.

BED MATERIAL SHALL BE SUPPLEMENTED BY CLASS B RIP RAP AS NECESSARY.

THE TOP OF LOW FLOW SILLS SHOULD MATCH THE STREAM BED ELEVATION IN THE LOW FLOW CHANNEL OF THE STREAM.

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

THE ENTIRE COST OF WORK REQUIRED TO CONSTRUCT THE SILLS SHALL BE INCLUDED IN THE VARIOUS PAY ITEMS.

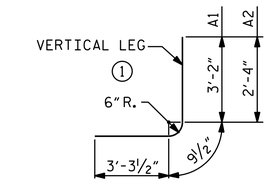
THE STOCKPILED MATERIAL SHALL BE PLACED TO PROVIDE A 1 FOOT DEPTH LOW FLOW CHANNEL BETWEEN THE LOW FLOW SILLS, AND SHALL BE PLACED TO THE LEVEL OF 2'-0" BETWEEN THE HIGH FLOW SILLS.

REINFORCING BAR SCHEDULE

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
A1	702	#4	1	7'-3"	3400
A2	702	#4	1	6'-5"	3009
A100	381	#6	STR	10'-1"	5770
A200	381	#6	STR	10'-1"	5770
B1	380	#4	STR	9'-3"	2348
B2	702	#4	STR	6'-4"	2970
C1	350	#4	STR	28'-11"	6761
D1	30	#6	STR	2'-11"	131
D2	30	#6	STR	1'-11"	86
F1	39	#4	STR	4'-7"	119
G1	4	#4	STR	10'-2"	27

REINFORCING STEEL 30,391 LBS.

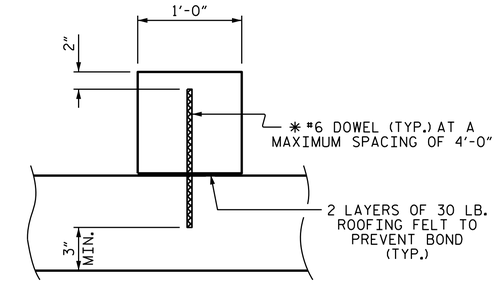
BAR TYPE



DIMENSIONS ARE OUT TO OUT

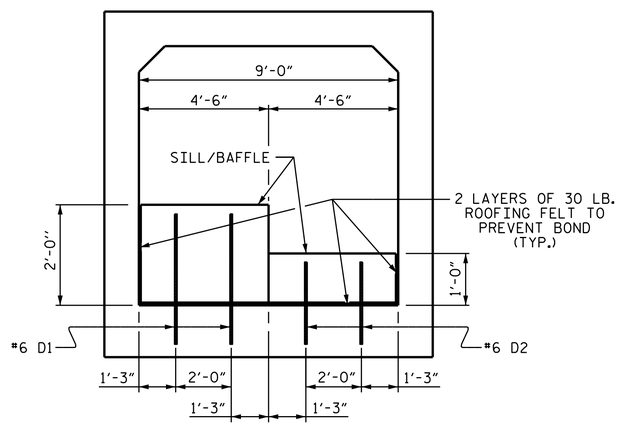
SPLICE CHART

BAR	SIZE	SPLICE LENGTH
B1	#4	1'-5"
C1	#4	1'-11"



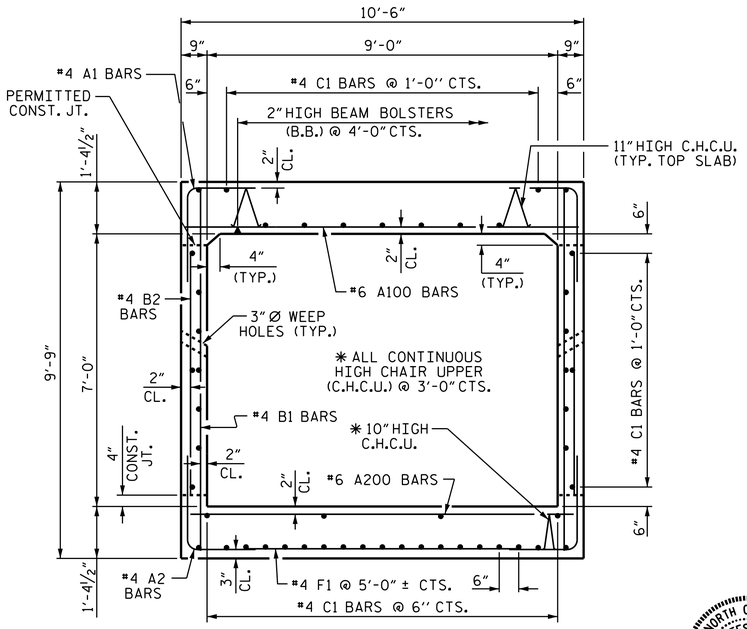
SECTION THROUGH SILL/BAFFLE

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



ELEVATION

(LOOKING UPSTREAM OR DOWNSTREAM)



RIGHT ANGLE SECTION OF BARREL

THERE ARE 50 "C" BARS IN SECTION OF BARREL

CULVERT SILL/BAFFLE DETAILS

NORTH CAROLINA PROFESSIONAL SEAL 17230 ENGINEER WAEL S. ARAFAT

DocuSigned by: Wael Arafat 4139C1232424406... 7/28/2015

PROJECT NO. R-2915A

WATAUGA/ASHE COUNTY

STATION: 16+10.00 -LPC-/ 16+87.00 -RPC-

SHEET 3 OF 5

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

SINGLE 9 FT. X 7 FT. CONCRETE BOX CULVERT

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C-18
1			3			TOTAL SHEETS
2			4			20

STR. #4

DRAWN BY : M.K. BEARD DATE : 2/23/15
CHECKED BY : H.T. BARBOUR DATE : 3/2015
DESIGN ENGINEER OF RECORD: J.P. McCARTHA DATE : 4/14/15

24-JUL-2015 14:30
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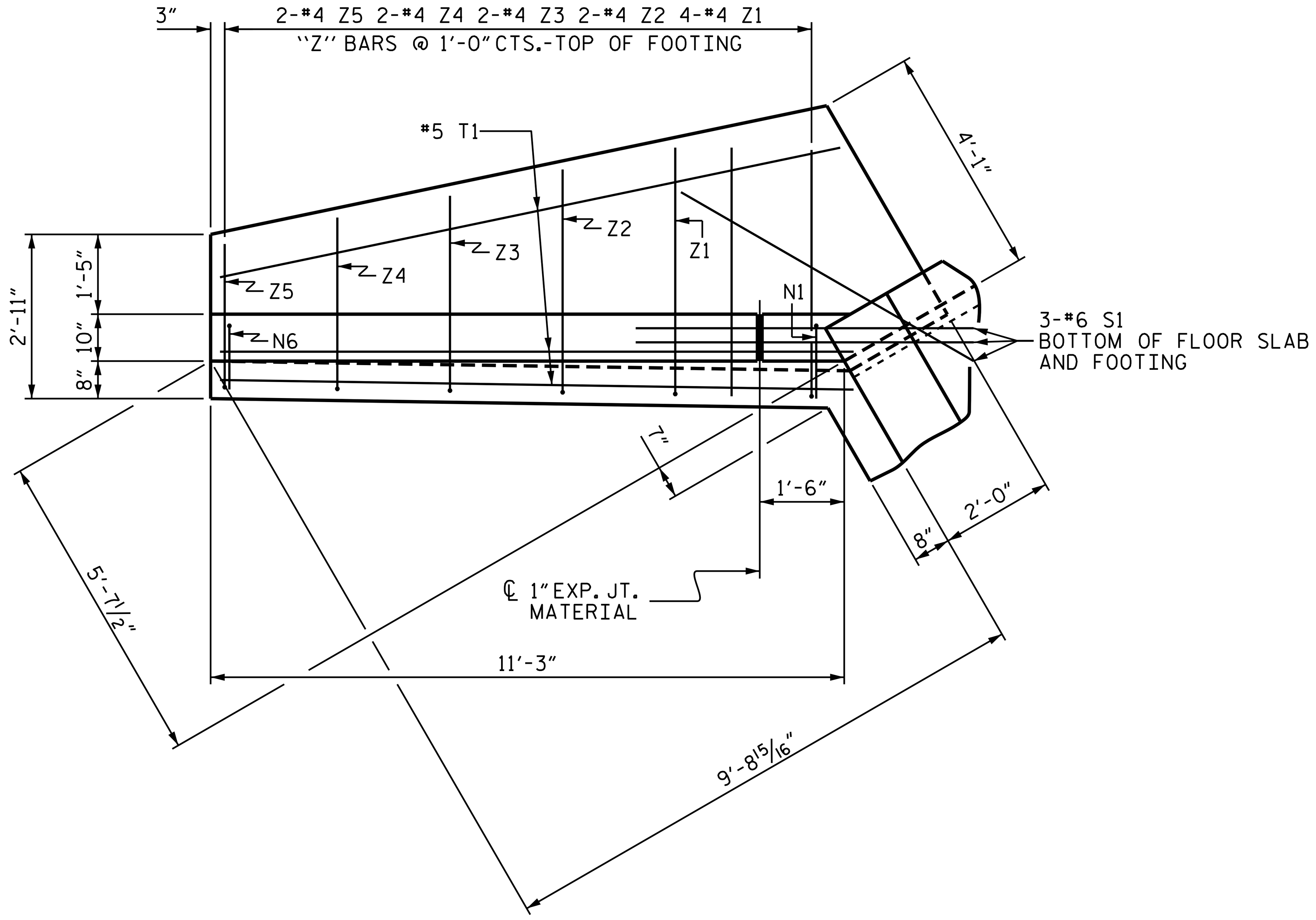
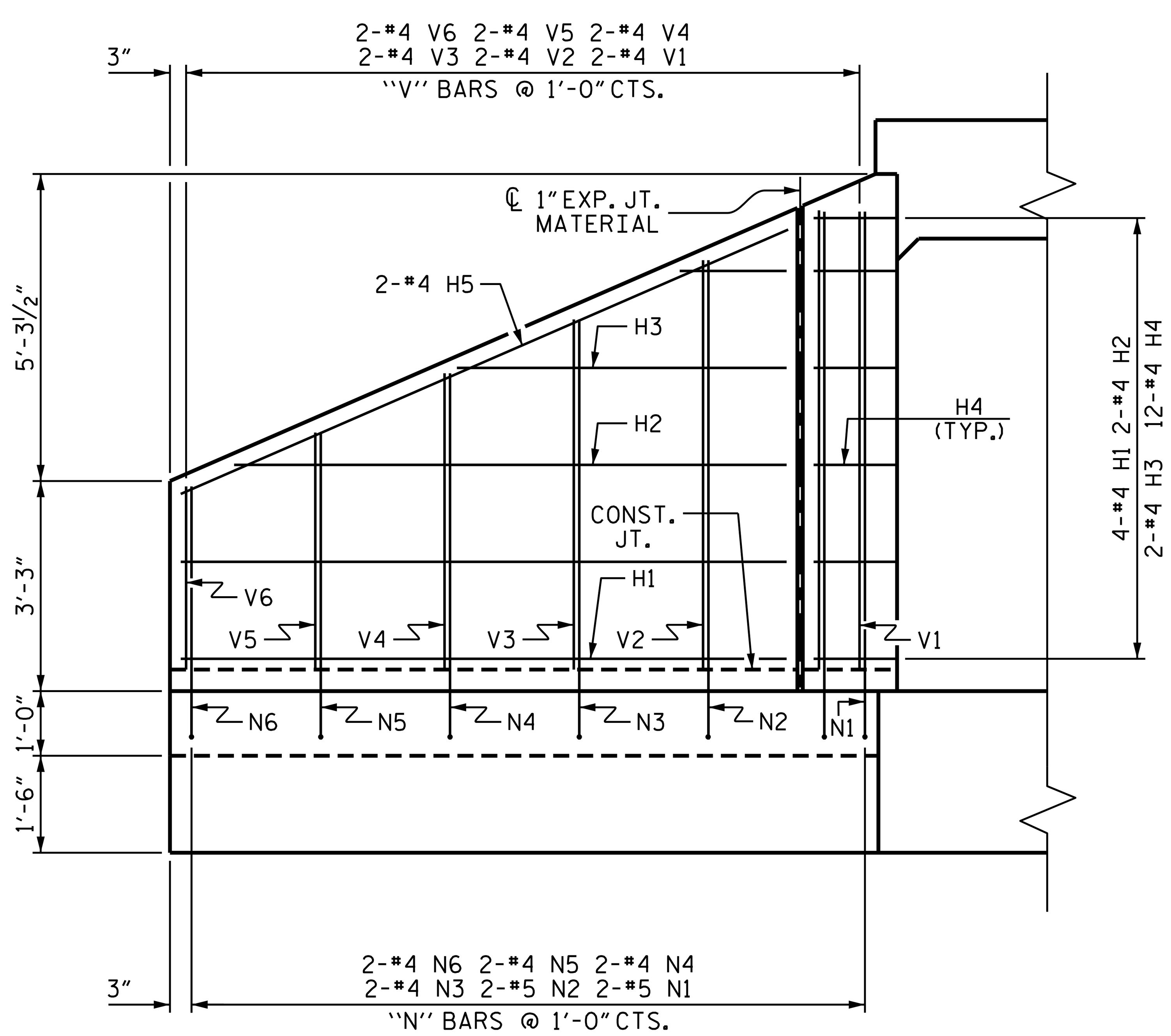
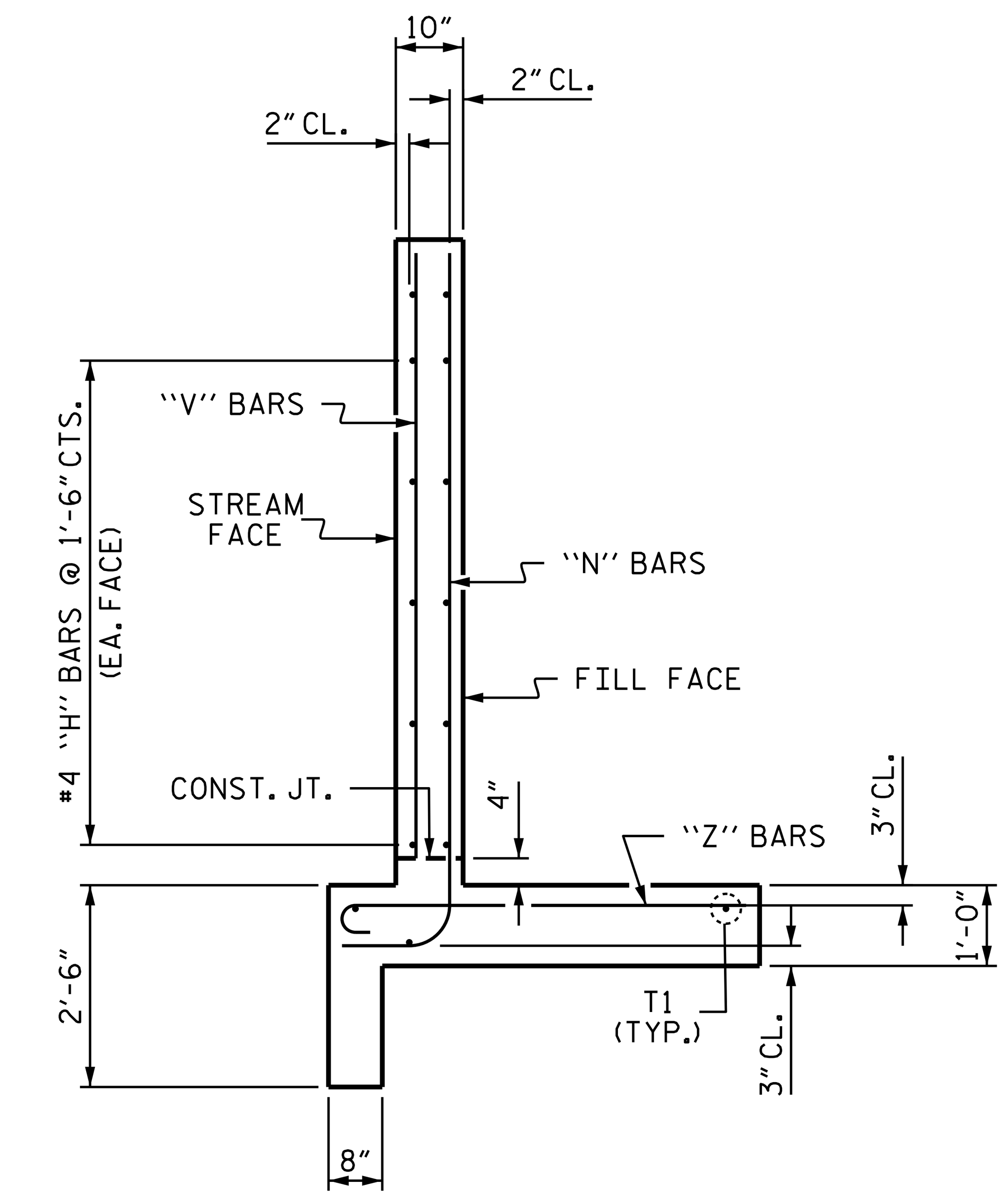


PLAN



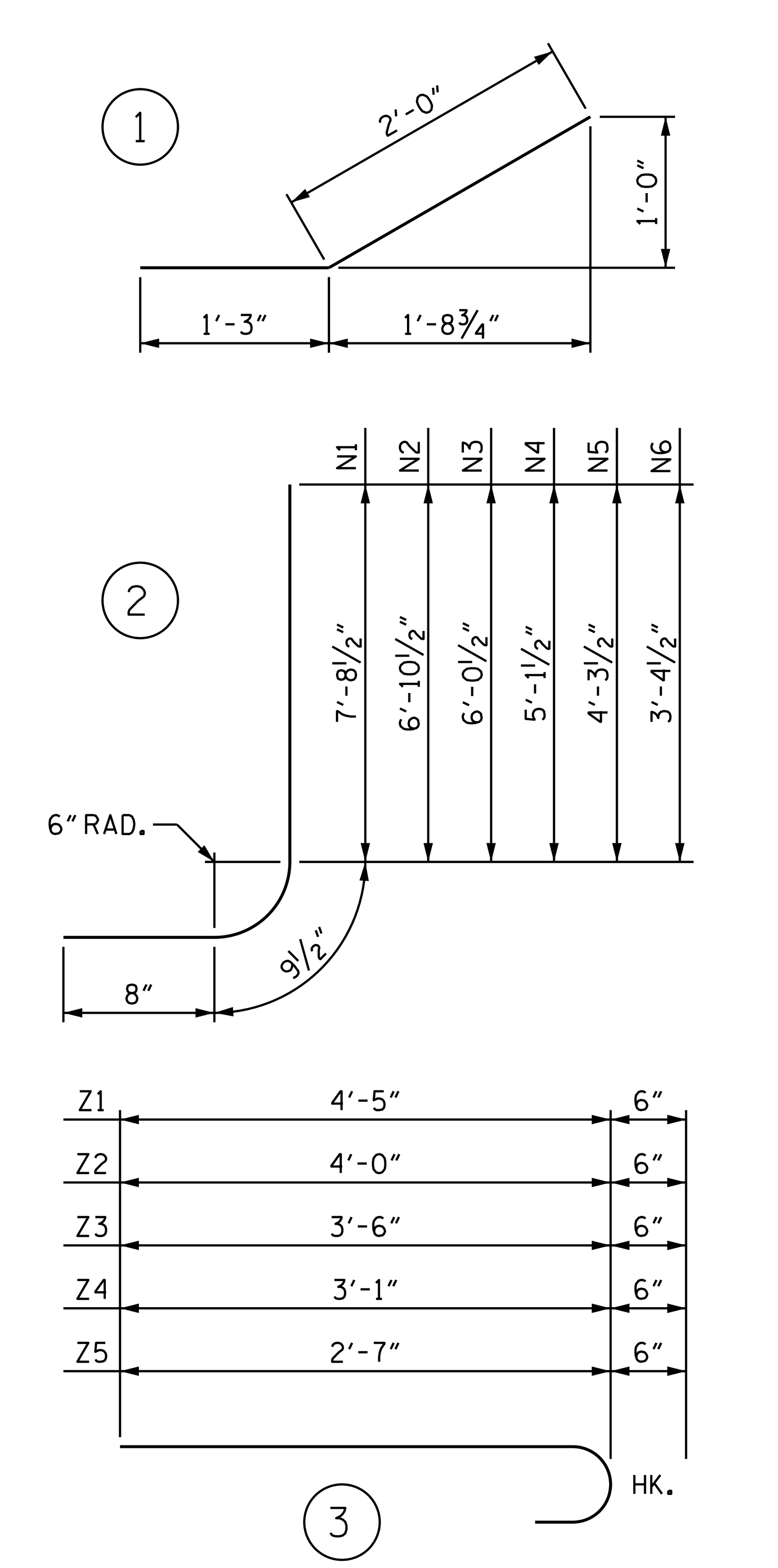
ELEVATION



TYPICAL WING SECTION

BAR TYPES

ALL BAR DIMENSIONS ARE OUT TO OUT.



BILL OF MATERIAL

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
H1	16	#4	STR	9'-4"	100
H2	8	#4	STR	8'-6"	45
H3	8	#4	STR	5'-1"	27
H4	48	#4	1	3'-3"	104
H5	8	#4	STR	10'-3"	55
N1	8	#5	2	9'-2"	76
N2	8	#5	2	8'-4"	70
N3	8	#4	2	7'-6"	40
N4	8	#4	2	6'-7"	35
N5	8	#4	2	5'-9"	31
N6	8	#4	2	4'-10"	26
S1	12	#6	STR	6'-0"	108
T1	12	#5	STR	11'-3"	141
V1	8	#4	STR	7'-1"	38
V2	8	#4	STR	6'-4"	34
V3	8	#4	STR	5'-5"	29
V4	8	#4	STR	4'-7"	24
V5	8	#4	STR	3'-8"	20
V6	8	#4	STR	2'-10"	15
Z1	16	#4	3	4'-11"	53
Z2	8	#4	3	4'-6"	24
Z3	8	#4	3	4'-0"	21
Z4	8	#4	3	3'-7"	19
Z5	8	#4	3	3'-1"	16

TOTAL REINFORCING STEEL
FOR 4 WINGS 1,151 LBS

CLASS A CONCRETE
4 WINGS 17.1 CY
2 HEADWALLS 1.0 CY
2 END CURTAIN WALLS 1.0 CY
TOTAL 19.1 CY

PROJECT NO. R-2915A
WATAUGA/ASHE COUNTY
STATION: 16+10.00 -LPC-/ 16+87.00 -RPC-
SHEET 4 OF 5

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

STANDARD WINGS FOR CONCRETE BOX CULVERT

H = 7'-0" SLOPE = 2:1
90° SKEW

NORTH CAROLINA PROFESSIONAL SEAL 17230 ENGINEER WAEL S. ARAFAT

DocuSigned by: Wael Arafat
7/28/2015

REVISIONS							SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:		C-19
1			3				TOTAL SHEETS
2			4				20

STR. #4 STD. NO. CW9007

ASSEMBLED BY : M.K. BEARD DATE : 2/23/15
CHECKED BY : H.T. BARBOUR DATE : 3/2015

DRAWN BY : CCJ 10/99
CHECKED BY : RWW 03/00

24-JUL-2015 14:32
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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 × RF	STRENGTH I LIMIT STATE									COMMENT NUMBER
							LIVE-LOAD FACTORS $\gamma_{(LL)}$	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	4.39	--	1.75	7.14	1	BOT. CORNER WALL	7.75	4.39	1	EXTERIOR WALL	7.15	
		HL-93 (OPERATING)	N/A		5.69	--	1.35	9.26	1	BOT. CORNER WALL	7.75	5.69	1	EXTERIOR WALL	7.15	
		HS-20 (INVENTORY)	36.00	2	4.39	158.03	1.75	7.14	1	BOT. CORNER WALL	7.75	4.39	1	EXTERIOR WALL	7.15	
		HS-20 (OPERATING)	36.00		5.69	204.86	1.35	9.26	1	BOT. CORNER WALL	7.75	5.69	1	EXTERIOR WALL	7.15	
LEGAL LOAD RATING	SINGLE VEHICLE (SV)	SNSH	13.50	3	5.49	74.08	1.40	8.93	1	BOT. CORNER WALL	7.75	5.49	1	EXTERIOR WALL	7.15	
		SNGARBS2	20.00		5.49	109.74	1.40	8.93	1	BOT. CORNER WALL	7.75	5.49	1	EXTERIOR WALL	7.15	
		SNAGRIS2	22.00		5.49	120.72	1.40	8.93	1	BOT. CORNER WALL	7.75	5.49	1	EXTERIOR WALL	7.15	
		SNCOTTS3	27.25		5.49	149.53	1.40	8.93	1	BOT. CORNER WALL	7.75	5.49	1	EXTERIOR WALL	7.15	
		SNAGGRS4	34.93		5.49	191.64	1.40	8.93	1	BOT. CORNER WALL	7.75	5.49	1	EXTERIOR WALL	7.15	
		SNS5A	35.55		5.49	195.07	1.40	8.93	1	BOT. CORNER WALL	7.75	5.49	1	EXTERIOR WALL	7.15	
		SNS6A	39.95		5.49	219.21	1.40	8.93	1	BOT. CORNER WALL	7.75	5.49	1	EXTERIOR WALL	7.15	
		SNS7B	42.00		5.49	230.46	1.40	8.93	1	BOT. CORNER WALL	7.75	5.49	1	EXTERIOR WALL	7.15	
	TRUCK TRACTOR SEMI-TRAILER (TTST)	TNAGRIT3	33.00		5.49	181.08	1.40	8.93	1	BOT. CORNER WALL	7.75	5.49	1	EXTERIOR WALL	7.15	
		TNT4A	33.08		5.49	181.49	1.40	8.93	1	BOT. CORNER WALL	7.75	5.49	1	EXTERIOR WALL	7.15	
		TNT6A	41.60		5.49	228.27	1.40	8.93	1	BOT. CORNER WALL	7.75	5.49	1	EXTERIOR WALL	7.15	
		TNT7A	42.00		5.49	230.46	1.40	8.93	1	BOT. CORNER WALL	7.75	5.49	1	EXTERIOR WALL	7.15	
		TNT7B	42.00		5.49	230.46	1.40	8.93	1	BOT. CORNER WALL	7.75	5.49	1	EXTERIOR WALL	7.15	
		TNAGRIT4	43.00		5.49	235.95	1.40	8.93	1	BOT. CORNER WALL	7.75	5.49	1	EXTERIOR WALL	7.15	
		TNAGT5A	45.00		5.49	246.93	1.40	8.93	1	BOT. CORNER WALL	7.75	5.49	1	EXTERIOR WALL	7.15	
		TNAGT5B	45.00		5.49	246.93	1.40	8.93	1	BOT. CORNER WALL	7.75	5.49	1	EXTERIOR WALL	7.15	

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	0.00
WA	1.00	0.00

NOTE:

RATING FACTORS ARE BASED ON THE STRENGTH I LIMIT STATE.

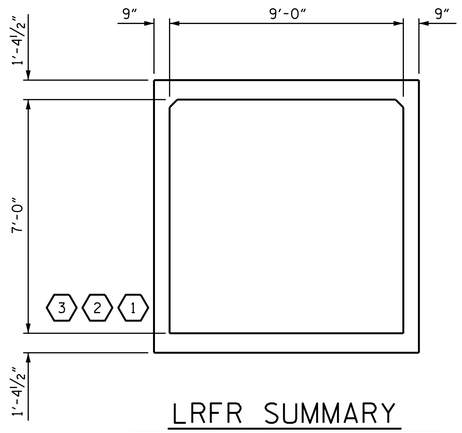
(#) CONTROLLING LOAD RATING

(1) DESIGN LOAD RATING (HL-93)

(2) DESIGN LOAD RATING (HS-20)

(3) LEGAL LOAD RATING **

** SEE CHART FOR VEHICLE TYPE



LRFR SUMMARY

(LOOKING DOWNSTREAM)

PROJECT NO. R-2915A

WATAUGA/ASHE COUNTY

STATION: 16+10.00 -LPC-/ 16+87.00 -RPC-

SHEET 5 OF 5

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

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

NORTH CAROLINA PROFESSIONAL SEAL 17230 ENGINEER WAEL S. ARAFAT

Docusigned by: Wael Arafat 7/28/2015

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C-20
1			3			TOTAL SHEETS
2			4			20

STR. #4 STD. NO. LRFR5

ASSEMBLED BY : M.K. BEARD DATE : 3/6/15
CHECKED BY : H.T. BARBOUR DATE : 3/2015

DRAWN BY : WMC 7/11
CHECKED BY : GM 7/11

REV. 10/1/11 MAA/GM

DESIGN ENGINEER OF RECORD: J.P. McCARTHA DATE : 4/14/15

24-JUL-2015 14:33
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