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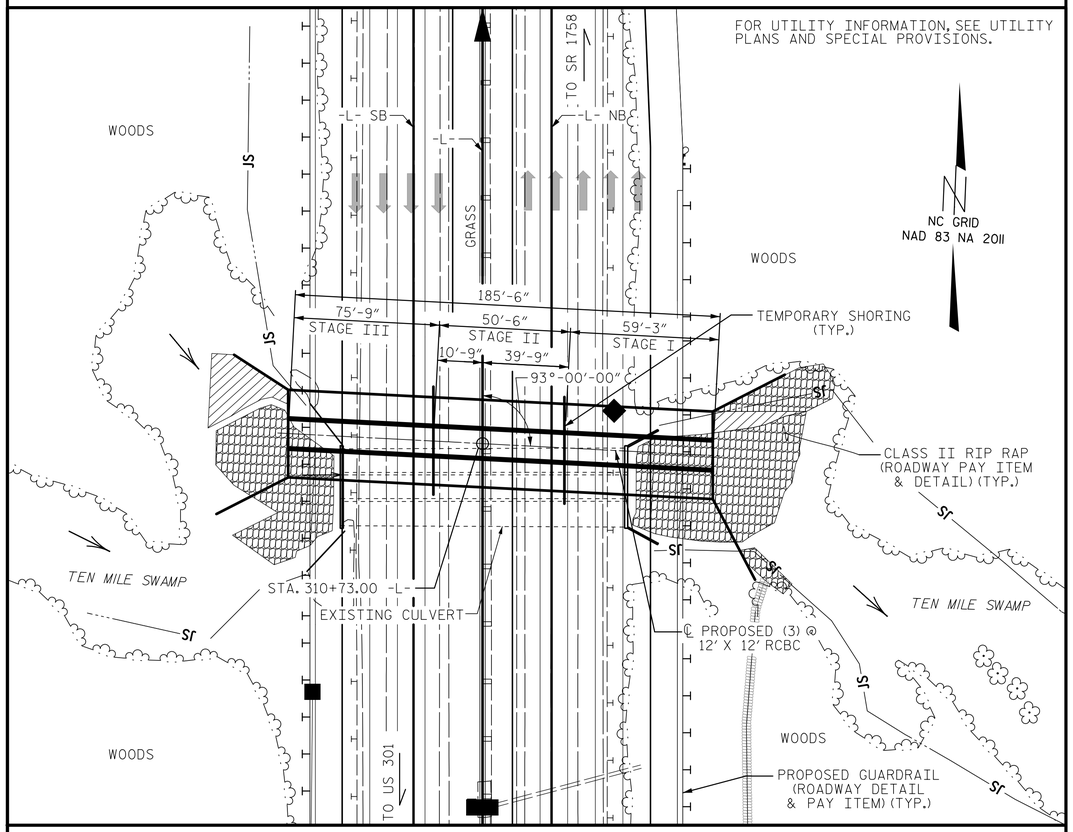
BENCH MARK #16: RR SPIKE SET IN 12" PINE; STA. 326+77 -L-; 357' RT.; ELEV. 155.96'

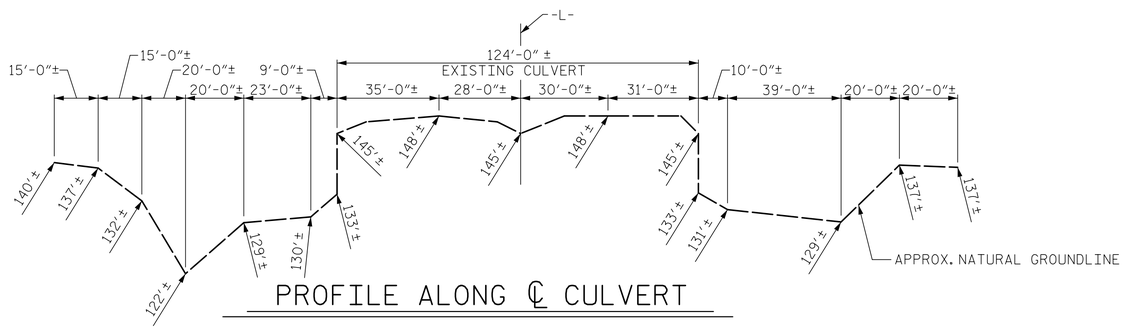


LOCATION SKETCH

TOTAL STRUCTURE QUANTITIES

CLASS A CONCRETE		REINFORCING STEEL		FOUNDATION COND. MAT'L.	
STAGE I	288.0 C.Y.	STAGE I	38,425 LBS.	STAGE I	180 TONS
STAGE II	201.5 C.Y.	STAGE II	29,493 LBS.	STAGE II	153 TONS
STAGE III	348.6 C.Y.	STAGE III	47,815 LBS.	STAGE III	230 TONS
TOTAL	838.1 C.Y.	TOTAL	115,733 LBS.	TOTAL	563 TONS

REMOVAL OF EXISTING STRUCTURE	LUMP SUM	CULVERT EXCAVATION	LUMP SUM



PROFILE ALONG ℄ CULVERT

DRAWN BY : ZCS DATE : 10/21
CHECKED BY : MGC DATE : 1/22
DESIGN ENGINEER OF RECORD: ZCS DATE : 1/22

NOTES:

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

DESIGN FILL---------- 5.0 FT.

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

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

CONCRETE IN EACH STAGE 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.

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

FOR CRANE SAFETY, SEE SPECIAL PROVISIONS.

FOR SUBMITTAL OF WORKING DRAWINGS, SEE SPECIAL PROVISIONS.

FOR FALSEWORK AND FORMWORK, SEE SPECIAL PROVISIONS.

FOR GROUT FOR STRUCTURES, SEE SPECIAL PROVISIONS.

FOR EROSION CONTROL MEASURES, SEE EROSION CONTROL PLANS.

FOR CONSTRUCTION SEQUENCE, SEE EROSION CONTROL PLANS.

FOR TRAFFIC PHASING, SEE TRAFFIC CONTROL PLANS.

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.

SEE SECTION 414 OF THE STANDARD SPECIFICATIONS FOR CULVERT EXCAVATION AND BACKFILLING. EXCAVATE 1 FOOT BELOW CULVERT FOOTING AND REPLACE WITH FOUNDATION CONDITIONING MATERIAL IN ACCORDANCE WITH ARTICLE 414-4 OF THE STANDARD SPECIFICATIONS.

BACKFILL WITH SELECT MATERIAL, CLASS VI MEETING THE REQUIREMENTS OF SECTION 1016 OF THE STANDARD SPECIFICATIONS.

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.

DOWELS SHALL BE USED TO CONNECT THE STAGE II CULVERT TO STAGE I AND STAGE III TO II AS SHOWN. FOR NOTE REGARDING SETTING OF DOWELS, SEE SHEET SN.

ROADWAY DATA

G.P. ELEV. @ STA. 310+73.00 -L- SB	= 149.58'
G.P. ELEV. @ STA. 310+73.00 -L- NB	= 149.74'
BED ELEV. @ STA. 310+73.00 -L-	= 132.0'
ROADWAY SLOPES	= 3 : 1

HYDRAULIC DATA

DESIGN DISCHARGE	= 2600 CFS
FREQUENCY OF DESIGN FLOOD	= 100 YRS
DESIGN HIGH WATER ELEVATION	= 144.3'
DRAINAGE AREA	= 17.5 SQ. MI.
BASE DISCHARGE (Q100)	= 2600 CFS
BASE HIGH WATER ELEVATION	= 144.3'

OVERTOPPING FLOOD DATA

OVERTOPPING DISCHARGE	= 4915 CFS
FREQUENCY OF OVERTOPPING FLOOD	= 500+ YRS
OVERTOPPING FLOOD ELEVATION	= 148.6' ✳

✳ OVERTOPPING OCCURS AT LOW POINT AT STA. 314+65 -L- SB

PROJECT NO. I-5987A
ROBESON COUNTY
STATION: 310+73.00 -L-

SHEET 1 OF 14 REPLACES CULVERT #511

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL G. CLECK, JR.
DocuSigned by: Marshall G. Cleck, Jr.
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5/10/2022 | 10:02 AM EDT

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TGS ENGINEERS
706 HILLSBOROUGH STREET
SUITE 200
RALEIGH, NC 27603
PH (919) 773-8887
CORP. LICENSE NO.: C-0275

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

TRIPLE 12 FT. X 12 FT. CONCRETE BOX CULVERT 93° SKEW

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C11-1
1			3			TOTAL SHEETS
2			4			14

FILE NAME: 413_001_I-5987A_Site_11_SMU_CU_001.dgn SITE 11

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	LIVE-LOAD FACTORS (γ_{LL})	STRENGTH I LIMIT STATE — MOMENT: RATING FACTOR	BOX NO.	ELEMENT TYPE	DISTANCE FROM LEFT END OF ELEMENT (ft)	SHEAR: RATING FACTOR	BOX NO.	ELEMENT TYPE	DISTANCE FROM LEFT END OF ELEMENT (ft)	COMMENT NUMBER
DESIGN LOAD RATING		HL-93 (INVENTORY)	N/A	1	1.16	--	1.75	1.29	1	TOP SLAB	6.83	1.16	1	TOP SLAB	12.5	
		HL-93 (OPERATING)	N/A		1.50	--	1.35	1.67	1	TOP SLAB	6.83	1.50	1	TOP SLAB	12.5	
		HS-20 (INVENTORY)	36.000	2	1.21	43.56	1.75	1.26	1	EXT. WALL	0.42	1.21	1	TOP SLAB	12.5	
		HS-20 (OPERATING)	36.000		1.57	56.52	1.35	1.63	1	EXT. WALL	0.42	1.57	1	TOP SLAB	12.5	
LEGAL LOAD RATING	SINGLE VEHICLE (SV)	SH	12.500		2.09	26.13	1.40	2.43	1	BOTT SLAB	1.25	2.09	1	EXT. WALL	0.42	
		S3C	21.500		1.88	40.42	1.40	2.12	1	TOP SLAB	6.83	1.88	1	TOP SLAB	12.5	
		S3A	22.750		1.85	42.09	1.40	2.12	1	BOTT SLAB	1.25	1.85	1	TOP SLAB	12.5	
		S4A	26.750		1.84	49.22	1.40	2.09	1	BOTT SLAB	1.25	1.84	1	TOP SLAB	12.5	
		S5A	30.500		1.98	60.39	1.40	2.04	1	BOTT SLAB	1.25	1.98	1	EXT. WALL	0.42	
		S6A	34.500		1.80	62.10	1.40	1.89	2	BOTT SLAB	14.0	1.80	1	TOP SLAB	12.5	
		S7B	38.500		1.72	66.22	1.40	1.72	1	BOTT SLAB	12.5	1.74	1	TOP SLAB	12.5	
		S7A	40.000	3	1.70	68.00	1.40	1.70	1	BOTT SLAB	12.5	1.76	1	TOP SLAB	12.5	
	TRUCK TRACTOR SEMI-TRAILER (TTST)	T4A	28.250		1.86	52.55	1.40	2.09	1	BOTT SLAB	1.25	1.86	1	TOP SLAB	12.5	
		T5B	32.000		1.80	57.60	1.40	1.90	1	TOP SLAB	12.5	1.80	1	TOP SLAB	12.5	
		T6A	36.000		1.82	65.52	1.40	1.82	1	BOTT SLAB	12.5	1.84	1	TOP SLAB	12.5	
		T7A	40.000		1.71	68.40	1.40	1.71	1	BOTT SLAB	12.5	1.84	1	TOP SLAB	12.5	
		T7B	40.000		1.73	69.20	1.40	1.73	2	BOTT SLAB	14.0	1.84	1	TOP SLAB	12.5	

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:

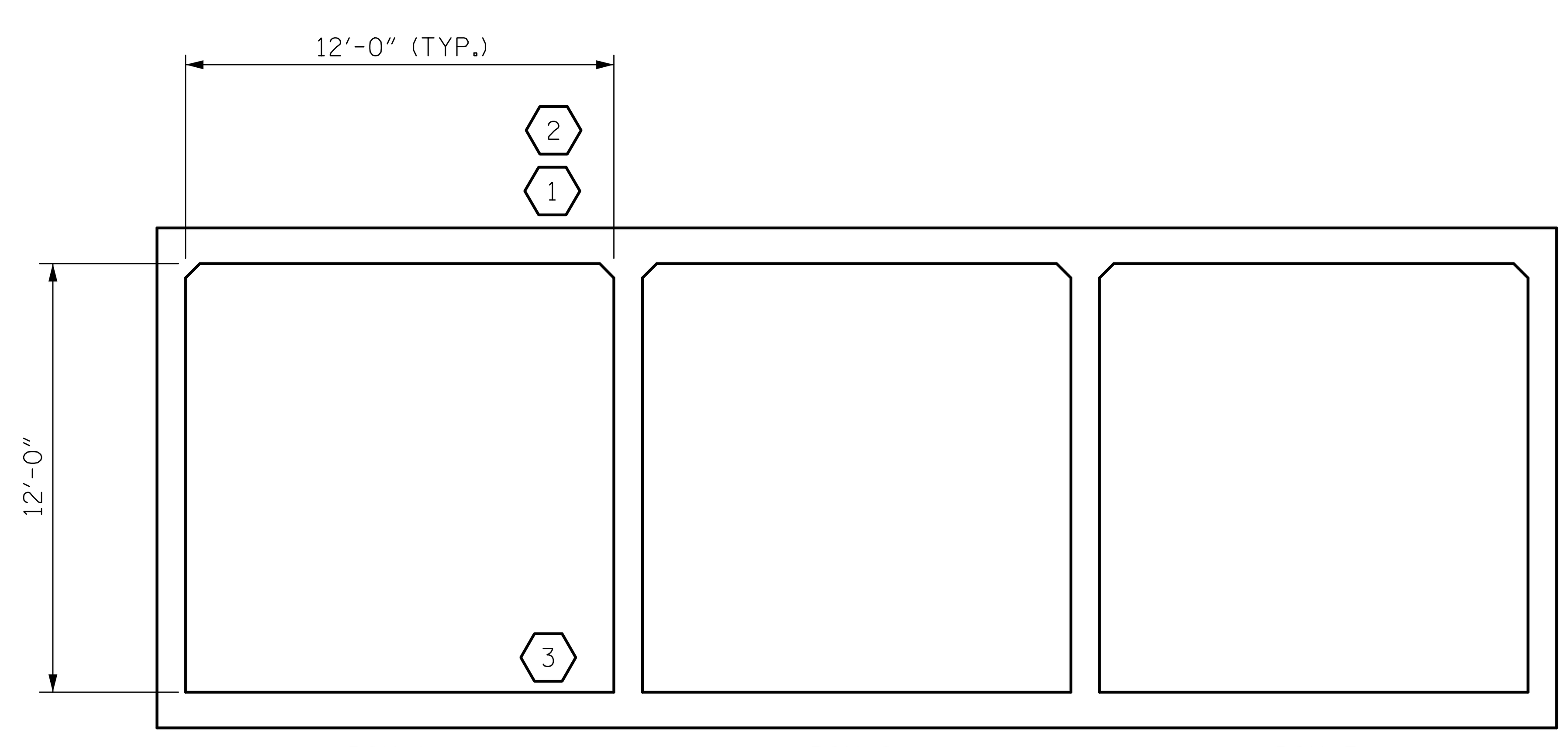
RATING FACTORS ARE BASED ON THE STRENGTH I LIMIT STATE.

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



LRFR SUMMARY

(LOOKING DOWNSTREAM)

PROJECT NO. I-5987A
ROBESON COUNTY
STATION: 310+73.00 -L-

SHEET 2 OF 14

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL G. CHEEK, JR.
5/10/2022 | 10:02 AM EDT

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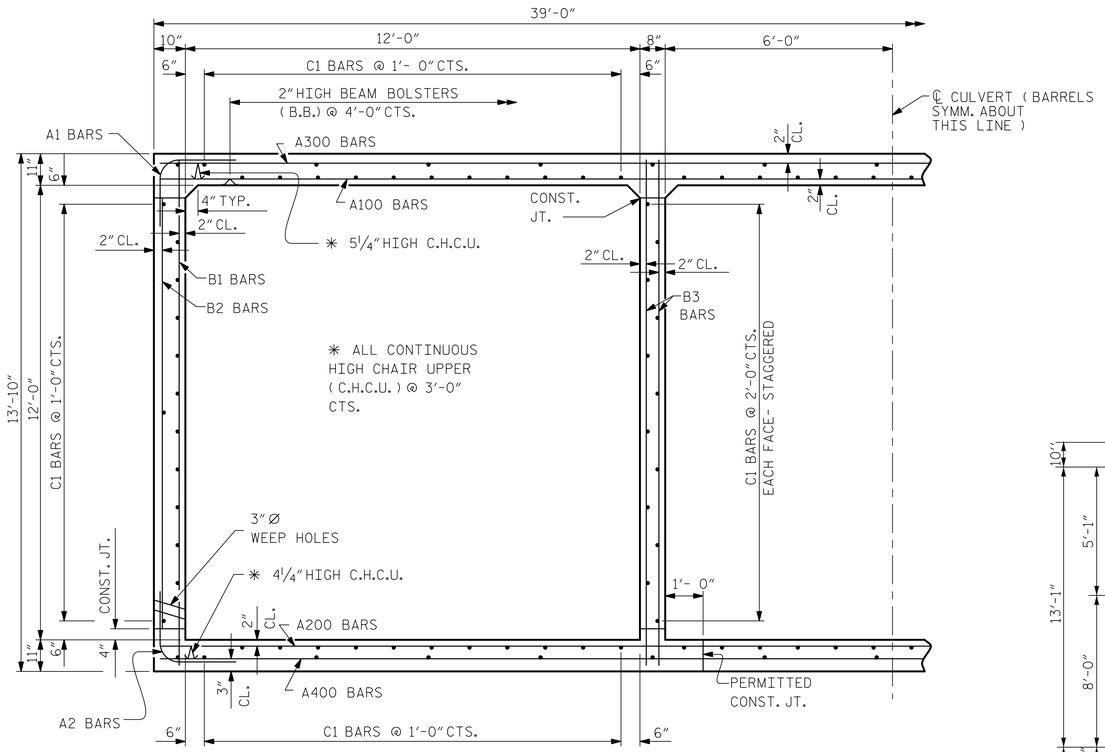
706 HILLSBOROUGH STREET SUITE 200
RALEIGH, NC 27603
PH (919) 773-8887
CORP. LICENSE NO.: C-0275

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

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

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C11-2
1			3			TOTAL SHEETS 14
2			4			

ASSEMBLED BY :	ZCS	DATE :	1/22
CHECKED BY :	MGC	DATE :	1/22
DRAWN BY : WMC 7/11	REV. 10/1/11	MAA/GM	
CHECKED BY : GM 7/11	REV. 12/17	MAA/THC	



RIGHT ANGLE SECTION OF BARREL

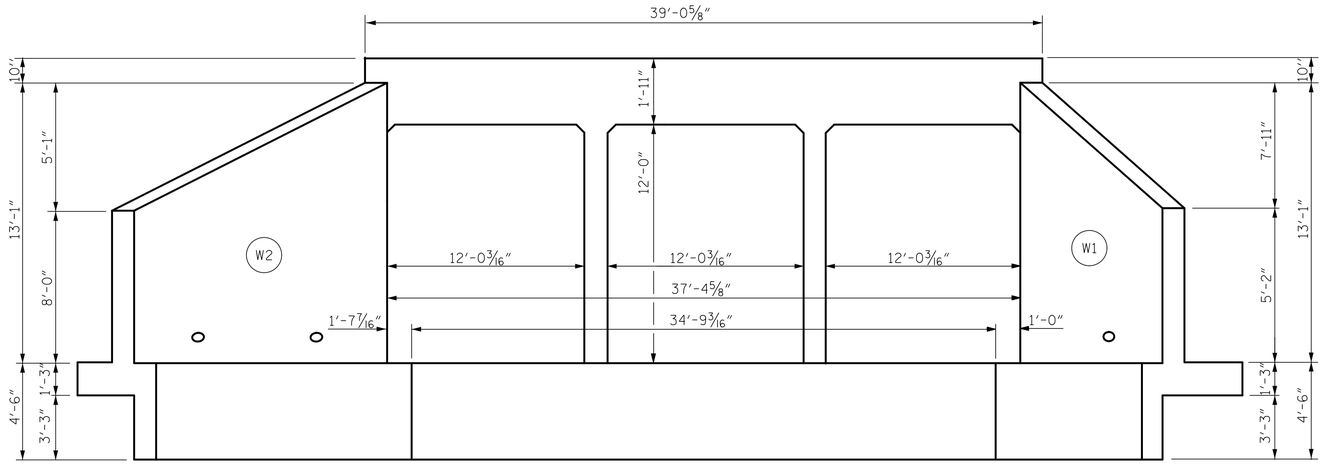
THERE ARE 148 "C" BARS IN SECTION OF BARREL.

STAGE I QUANTITIES

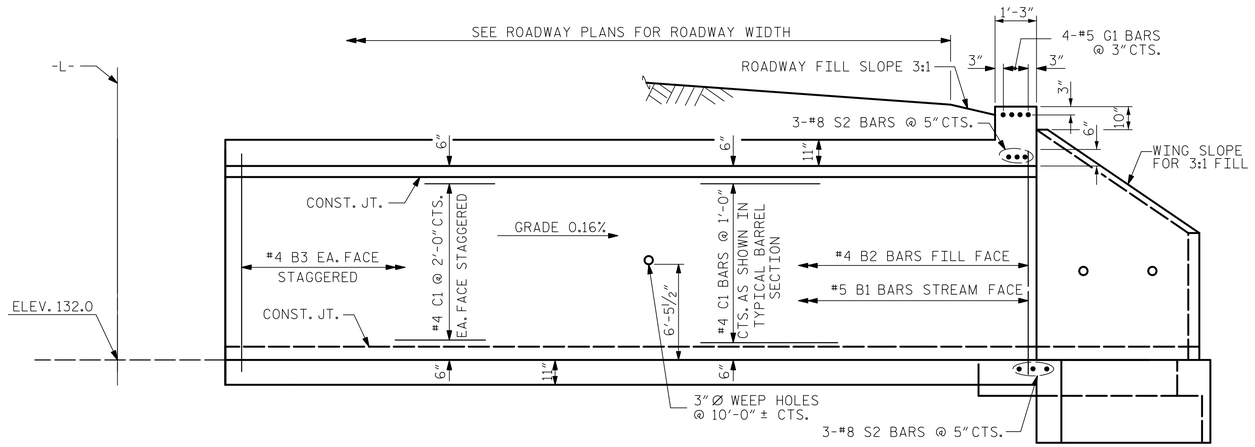
CLASS A CONCRETE			
BARREL @ 3.99 CY/FT	236.4	C.Y.	
WINGS, ETC.	50.3	C.Y.	
SILLS	1.3	C.Y.	
TOTAL	288.0	C.Y.	
REINFORCING STEEL			
BARREL & SILLS	35,062	LBS.	
WINGS, ETC.	3,363	LBS.	
TOTAL	38,425	LBS.	
CULVERT EXCAVATION	LUMP SUM		
FOUNDATION COND. MAT'L.	180 TONS		

STAGE I BAR SCHEDULE

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT	BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
A100	87	#6	STR	38'-7"	5042	A1	177	#6	1	7'-1"	1883
A101	1	#6	STR	35'-2"	53	A2	177	#5	1	5'-10"	1077
A102	1	#6	STR	22'-5"	34						
A103	1	#6	STR	9'-9"	15	B1	120	#5	STR	13'-4"	1669
						B2	177	#4	STR	11'-4"	1340
A200	87	#5	STR	38'-7"	3501	B3	356	#4	STR	13'-4"	3171
A201	1	#5	STR	35'-2"	37						
A202	1	#5	STR	22'-5"	23	C1	296	#4	STR	30'-11"	6113
A203	1	#5	STR	9'-9"	10						
						D2	12	#6	STR	1'-6"	27
A300	87	#6	STR	38'-7"	5042						
A301	1	#6	STR	35'-2"	53	G1	4	#5	STR	38'-7"	161
A302	1	#6	STR	22'-5"	34						
A303	1	#6	STR	9'-9"	15	S2	6	#8	STR	38'-7"	618
A400	87	#6	STR	38'-7"	5042						
A401	1	#6	STR	35'-2"	53						
A402	1	#6	STR	22'-5"	34						
A403	1	#6	STR	9'-9"	15						
						REINFORCING STEEL				35,062 LBS	



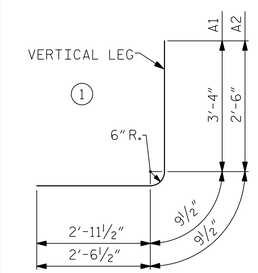
OUTLET END ELEVATION NORMAL TO SKEW



INTERIOR WALL EXTERIOR WALL

STAGE I - CULVERT SECTION NORMAL TO ROADWAY

BAR TYPE



DIMENSIONS ARE OUT TO OUT

SPLICE LENGTHS CHART

BAR	SIZE	SPLICE LENGTH
"B"	#4	1'-10"
"B"	#5	2'-4"
C1	#4	1'-10"
A200	#5	2'-4"
A400	#6	2'-9"
S2	#8	3'-8"

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 310+73.00 -L-

SHEET 3 OF 14

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL G. CHEEK, JR.
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SUITE 200
RALEIGH, NC 27603
PH (919) 773-8887
CORP. LICENSE NO.: C-0275

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

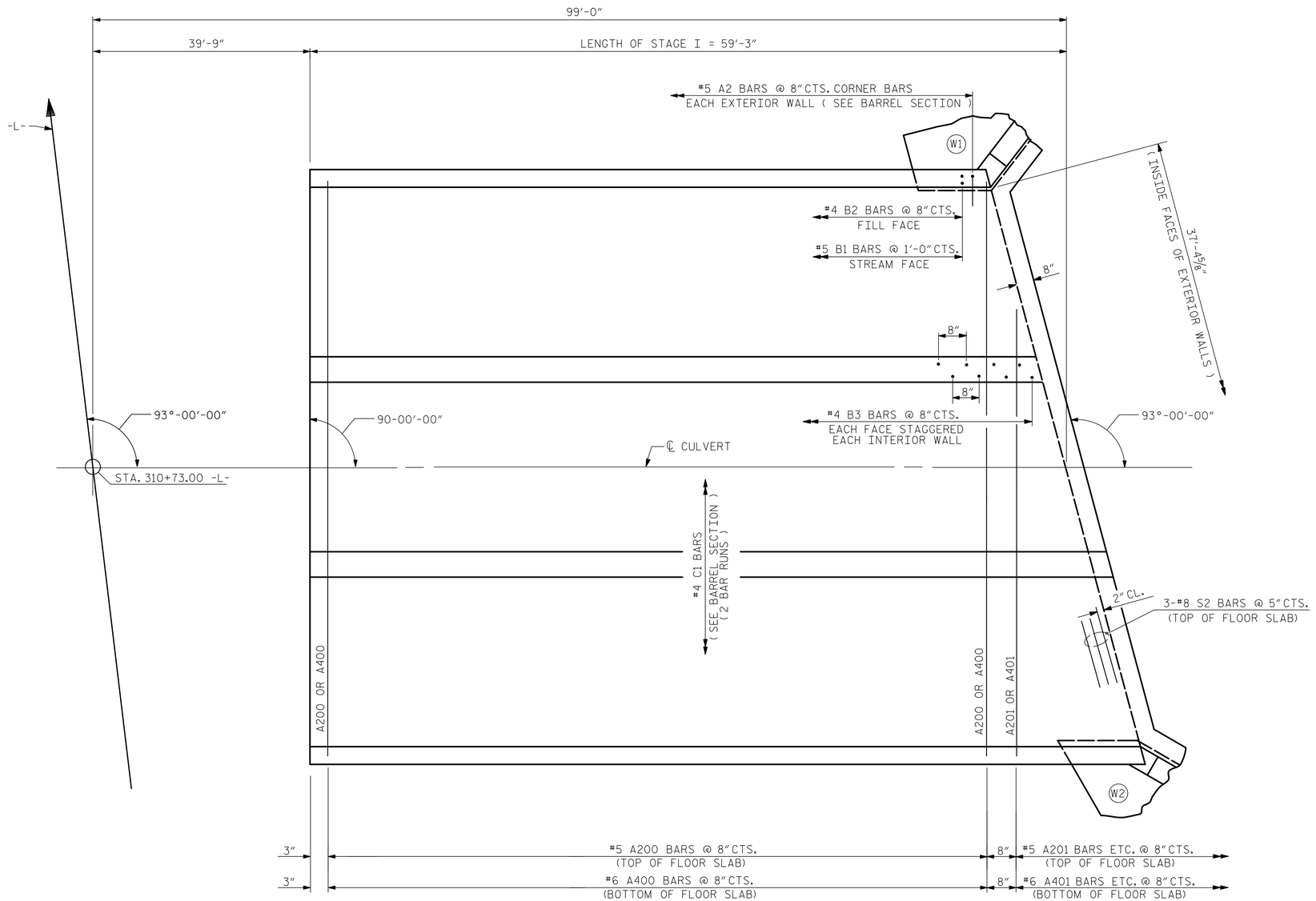
TRIPLE 12 FT. X 12 FT. CONCRETE BOX CULVERT STAGE I

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C11-3
1			3			TOTAL SHEETS
2			4			14

DRAWN BY : ZCS DATE : 10/21
CHECKED BY : MGC DATE : 1/22
DESIGN ENGINEER OF RECORD: ZCS DATE : 1/22

FILE NAME: 413_005_I-5987A_SIte_11_SMU_CU_003.dgn

SITE 11



PLAN - FLOOR SLAB

NOTE: FOR S1 BARS IN FLOOR SLAB & WING FOOTINGS, SEE WING SHEET.

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 310+73.00 -L-

SHEET 4 OF 14

DRAWN BY : ZCS DATE : 10/21

CHECKED BY : MGC DATE : 1/22

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NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL G. CHEEK, JR.

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CORP. LICENSE NO.: C-0275

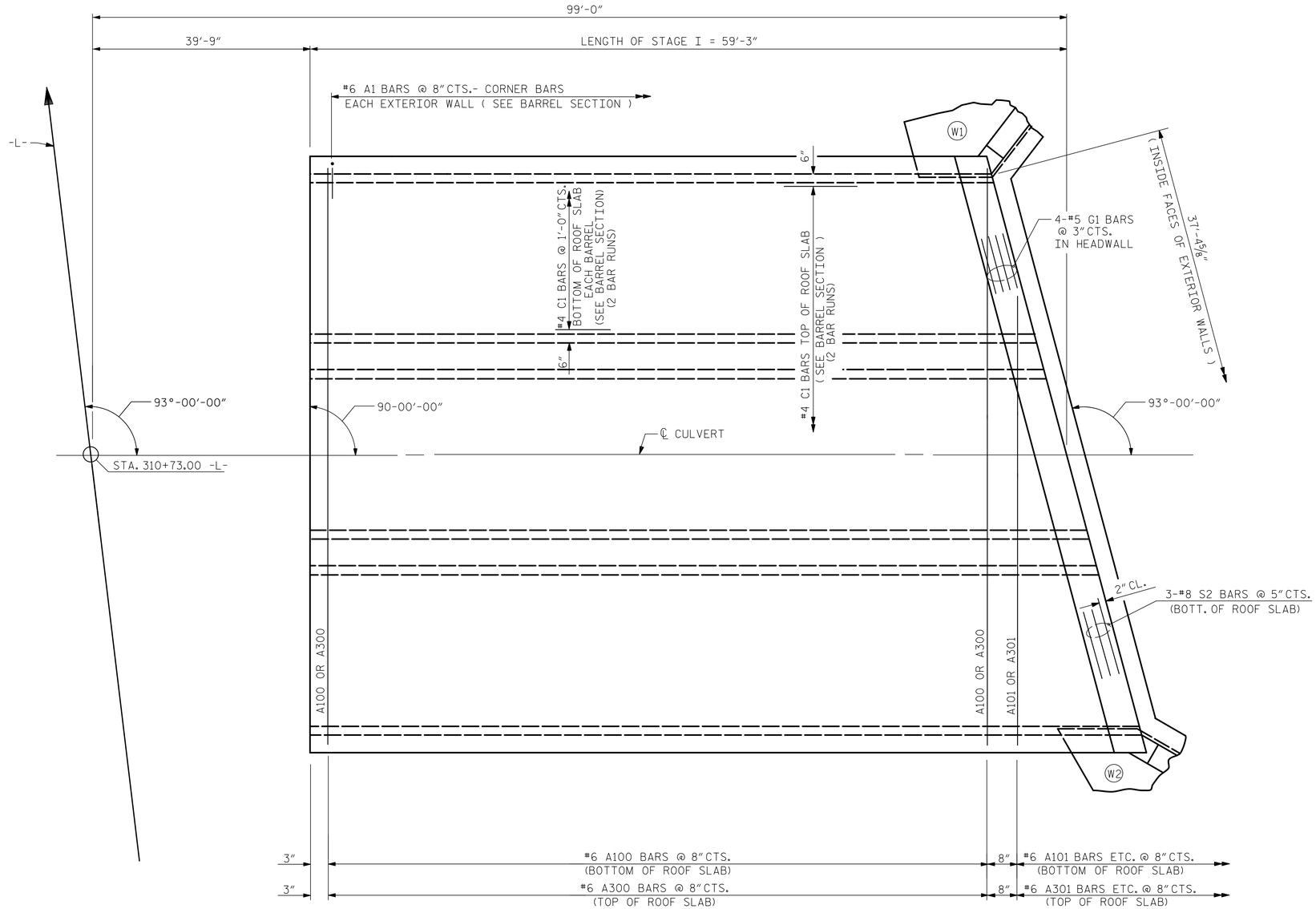
STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

TRIPLE 12 FT. X 12 FT. CONCRETE BOX CULVERT STAGE I

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C11-4
1			3			TOTAL SHEETS
2			4			14

FILE NAME: 413_007_I-5987A_Site_11_SMU_CU_004.dgn

SITE 11



PLAN - ROOF SLAB

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 310+73.00 -L-

SHEET 5 OF 14

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL G. CLARK, JR.
Documents signed by: Marshall G. Clark, Jr.
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PH (919) 773-8887
CORP. LICENSE NO.: C-0275

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

TRIPLE 12 FT. X 12 FT. CONCRETE BOX CULVERT STAGE I

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C11-5
1			3			TOTAL SHEETS
2			4			14

DRAWN BY : ZCS DATE : 10/21
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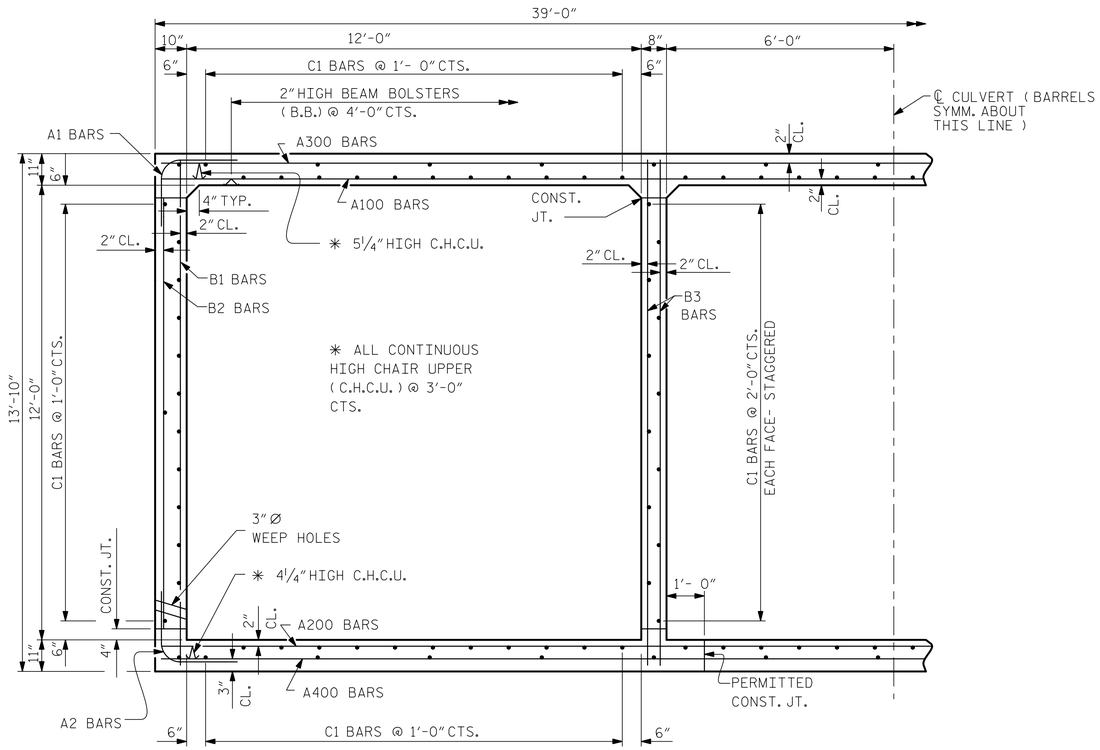
DESIGN ENGINEER OF RECORD: ZCS DATE : 1/22

FILE NAME: 413_009_I-5987A_Site_11_SMU_CU_005.dgn

SITE 11



RIGHT ANGLE SECTION OF BARREL

THERE ARE 148 "C" BARS IN SECTION OF BARREL.

STAGE II QUANTITIES

CLASS A CONCRETE

BARREL @ 3.99 CY/FT 201.5 C.Y.

TOTAL 201.5 C.Y.

REINFORCING STEEL

BARREL 29,493 LBS.

TOTAL 29,493 LBS.

CULVERT EXCAVATION LUMP SUM

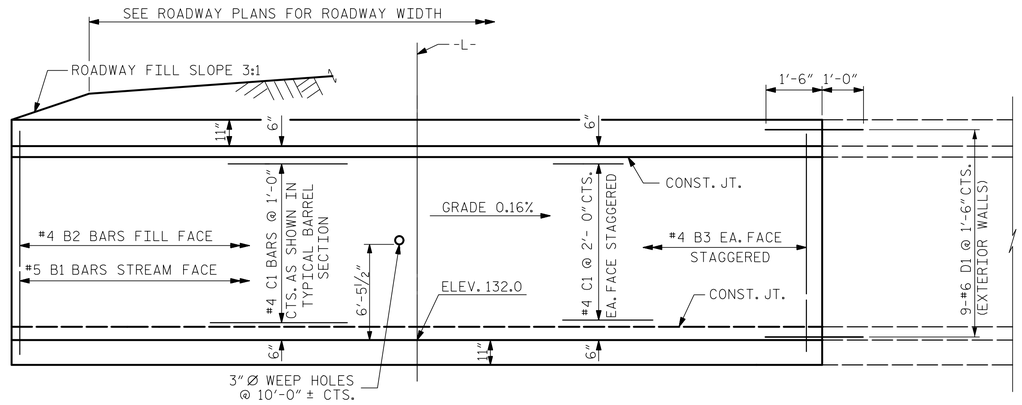
FOUNDATION COND. MAT'L. 153 TONS

STAGE II BAR SCHEDULE

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
A100	76	#6	STR	38'-7"	4404
A200	76	#5	STR	38'-7"	3058
A300	76	#6	STR	38'-7"	4404
A400	76	#6	STR	38'-7"	4404

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
A1	152	#6	1	7'-1"	1617
A2	152	#5	1	5'-10"	925
B1	102	#5	STR	13'-4"	1418
B2	152	#4	STR	11'-4"	1151
B3	304	#4	STR	13'-4"	2708
C1	296	#4	STR	26'-0"	5141
D1	70	#6	STR	2'-6"	263

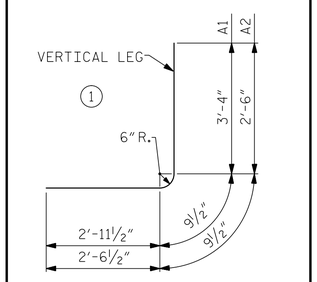
REINFORCING STEEL 29,493 LBS



EXTERIOR WALL INTERIOR WALL

STAGE II - CULVERT SECTION NORMAL TO ROADWAY

BAR TYPE



DIMENSIONS ARE OUT TO OUT

SPLICE LENGTHS CHART

BAR	SIZE	SPLICE LENGTH
"B"	#4	1'-10"
"B"	#5	2'-4"
C1	#4	1'-10"
A200	#5	2'-4"
A400	#6	2'-9"

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 310+73.00 -L-

SHEET 6 OF 14

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL G. CHEEK, JR.

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TGS ENGINEERS
706 HILLSBOROUGH STREET
SUITE 200
RALEIGH, NC 27603
PH (919) 773-8887
CORP. LICENSE NO.: C-0275

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

TRIPLE 12 FT. X 12 FT. CONCRETE BOX CULVERT STAGE II

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

SHEET NO. C11-6

TOTAL SHEETS 14

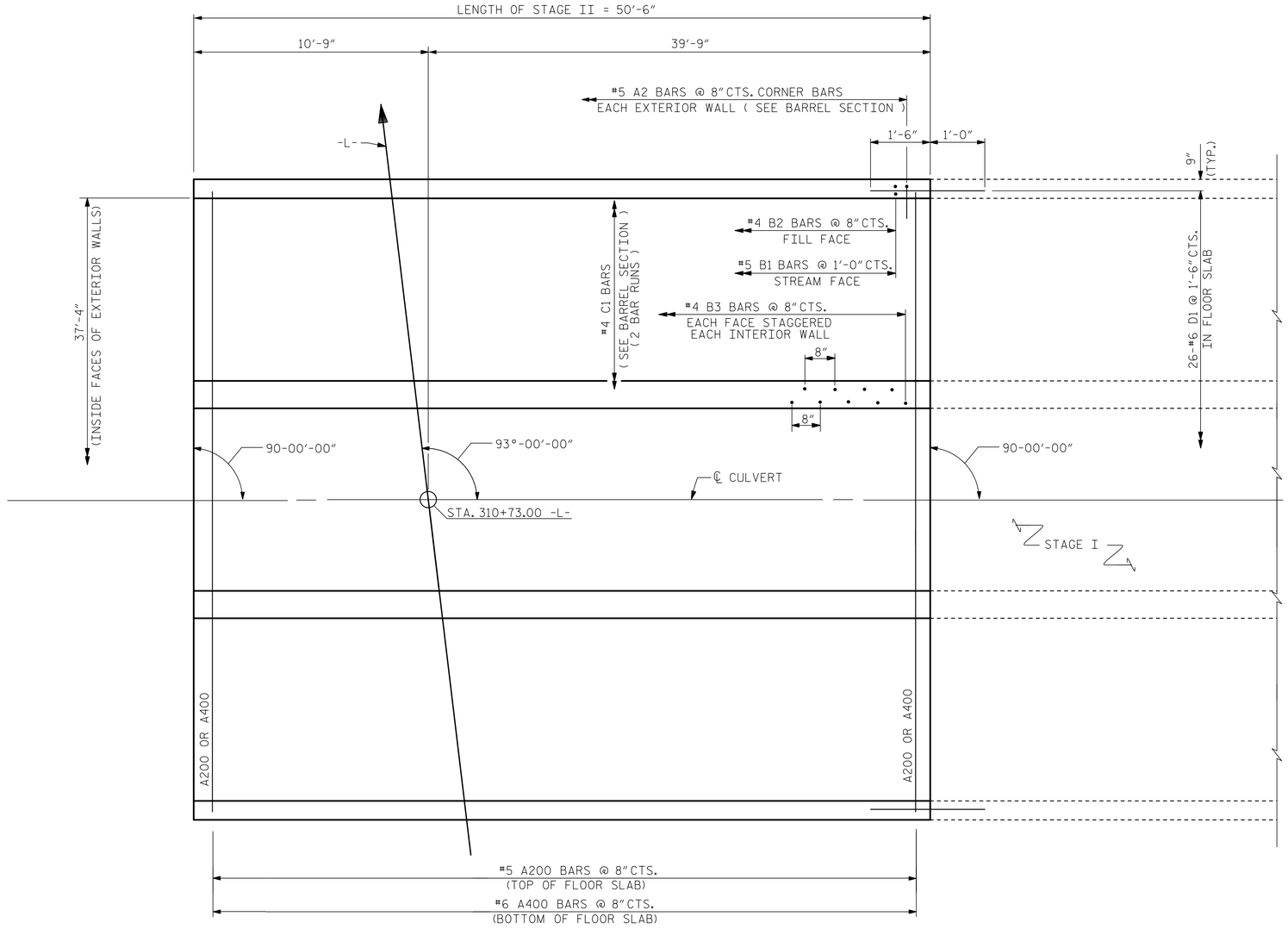
DRAWN BY : ZCS DATE : 10/21

CHECKED BY : MGC DATE : 1/22

DESIGN ENGINEER OF RECORD: ZCS DATE : 1/22

FILE NAME: 413_011_I-5987A_Site_11_SMU_CU_006.dgn

SITE 11



PLAN - FLOOR SLAB

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 310+73.00 -L-

SHEET 7 OF 14

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL G. CHEEK, JR.

DocuSigned by: Marshall G. Cheek, Jr. 5FBCC2F3A4DC413...

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TGS ENGINEERS
706 HILLSBOROUGH STREET
SUITE 200
RALEIGH, NC 27603
PH (919) 773-8887
CORP. LICENSE NO.: C-0275

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

TRIPLE 12 FT. X 12 FT. CONCRETE BOX CULVERT STAGE II

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C11-7
1			3			TOTAL SHEETS
2			4			14

DRAWN BY : ZCS DATE : 10/21
CHECKED BY : MGC DATE : 1/22
DESIGN ENGINEER OF RECORD: ZCS DATE : 1/22

FILE NAME: 413_013_I-5987A_Site_11_SMU_CU_007.dgn

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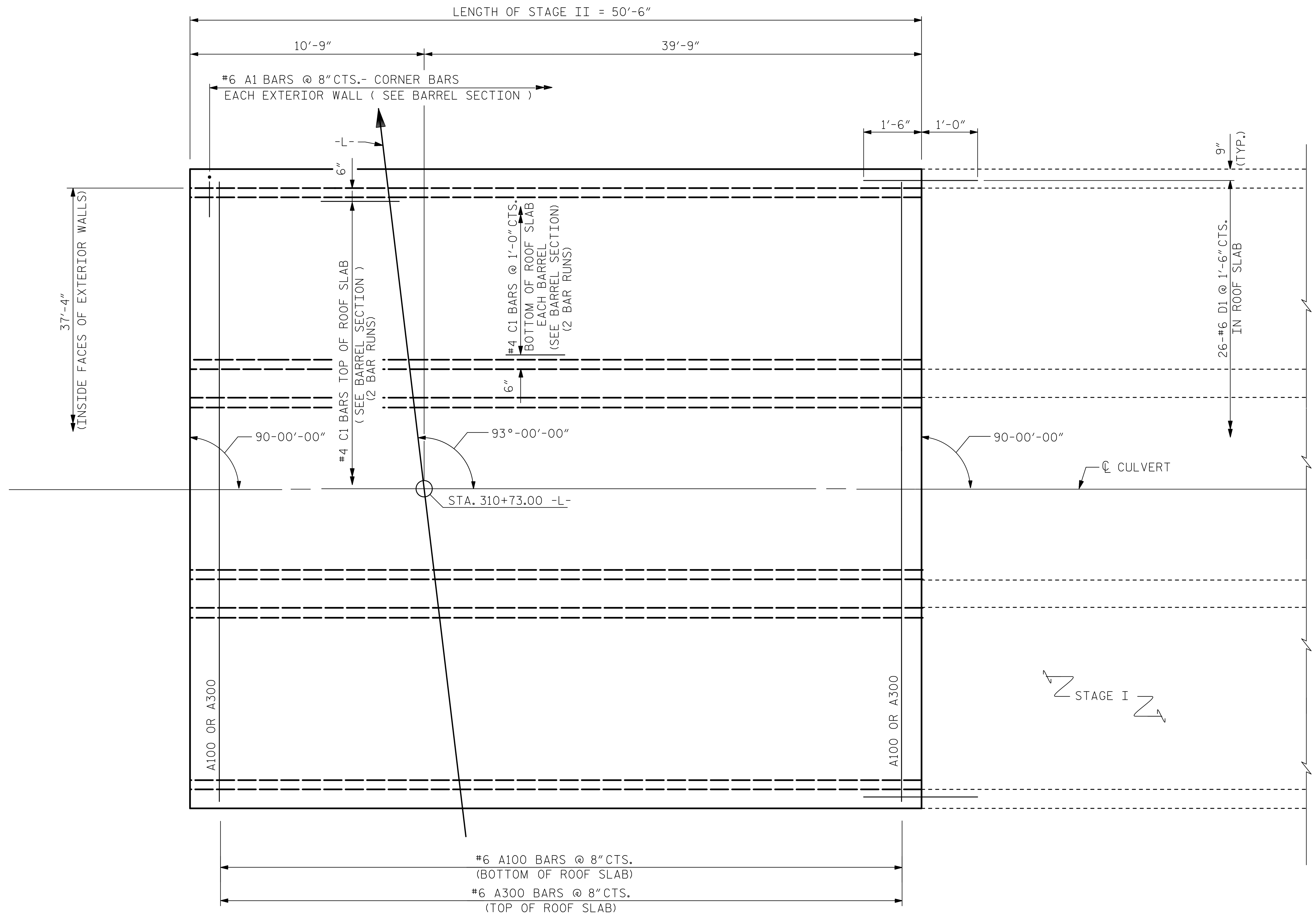

PLAN - ROOF SLAB

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 310+73.00 -L-

SHEET 8 OF 14

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL G. CHEEK, JR.

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SUITE 200
RALEIGH, NC 27603
PH (919) 773-8887
CORP. LICENSE NO.: C-0275

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

TRIPLE 12 FT. X 12 FT.
CONCRETE BOX CULVERT
STAGE II

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C11-8
1			3			TOTAL SHEETS
2			4			14

DRAWN BY : ZCS DATE : 10/21
CHECKED BY : MGC DATE : 1/22
DESIGN ENGINEER OF RECORD: ZCS DATE : 1/22

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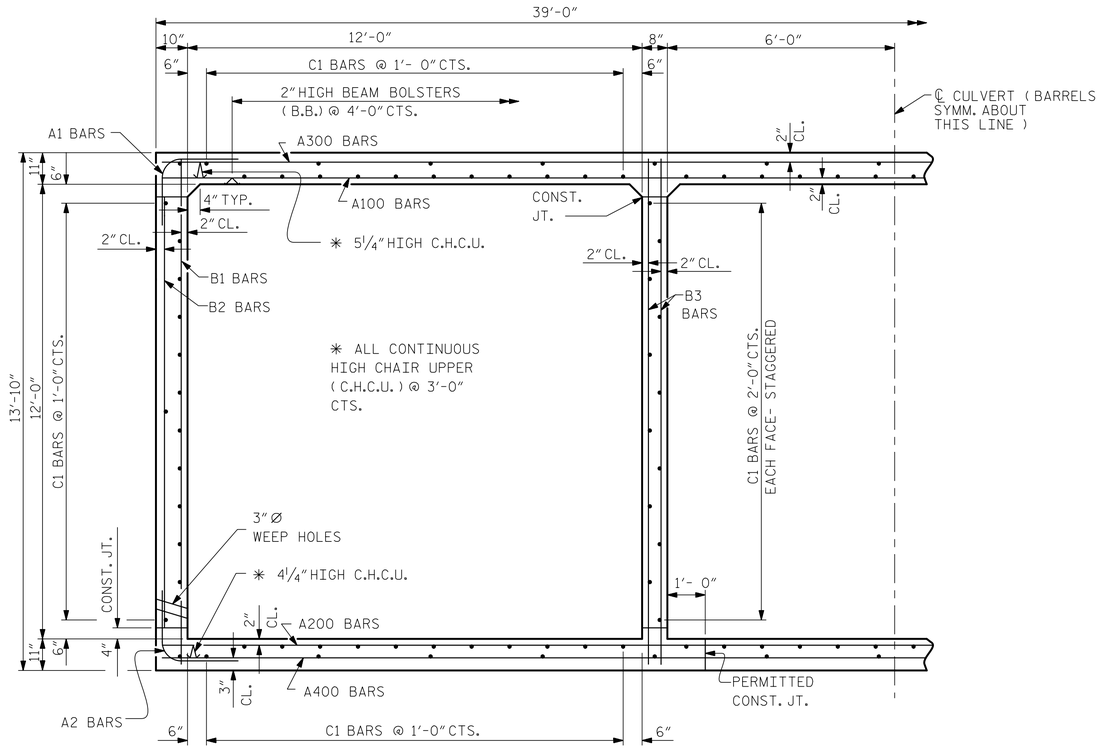


RIGHT ANGLE SECTION OF BARREL

THERE ARE 148 "C" BARS IN SECTION OF BARREL.

STAGE III QUANTITIES

CLASS A CONCRETE

BARREL @ 3.99 CY/FT	302.2	C.Y.
WINGS, ETC.	45.1	C.Y.
SILLS	1.3	C.Y.
TOTAL	348.6	C.Y.

REINFORCING STEEL

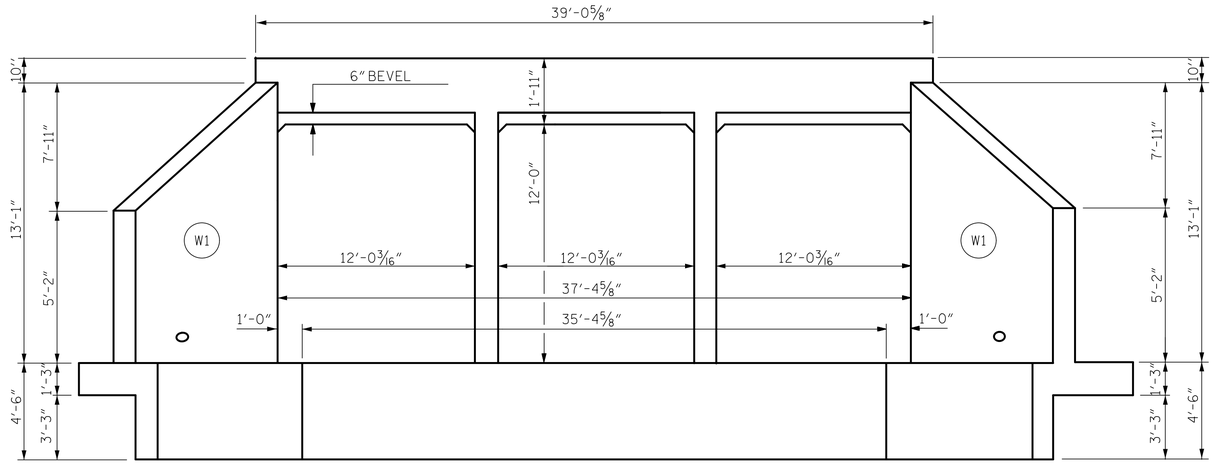
BARREL & SILLS	44,787	LBS.
WINGS, ETC.	3,028	LBS.
TOTAL	47,815	LBS.

CULVERT EXCAVATION	LUMP SUM
FOUNDATION COND. MAT'L.	230 TONS

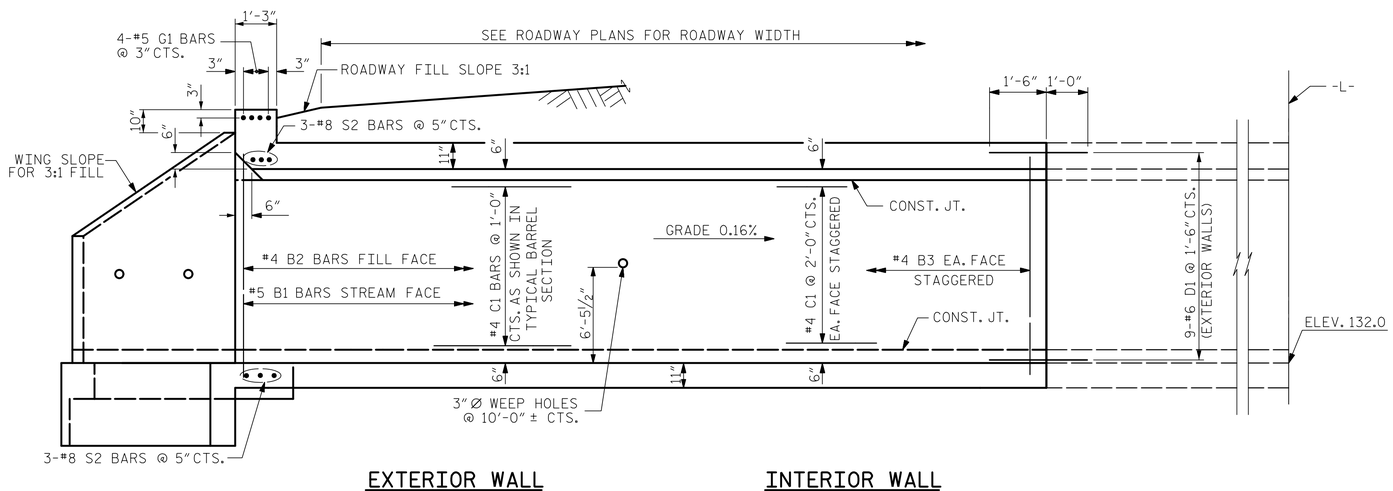
STAGE III BAR SCHEDULE

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT	BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
A100	112	#6	STR	38'-7"	6491	A1	227	#6	1	7'-1"	2415
A101	1	#6	STR	32'-0"	48	A2	227	#5	1	5'-10"	1381
A102	1	#6	STR	19'-3"	29						
A103	1	#6	STR	6'-6"	10	B1	152	#5	STR	13'-4"	2114
						B2	227	#4	STR	11'-4"	1719
A200	112	#5	STR	38'-7"	4507	B3	454	#4	STR	13'-4"	4044
A201	1	#5	STR	32'-0"	33						
A202	1	#5	STR	19'-3"	20	C1	296	#4	STR	39'-2"	7744
A203	1	#5	STR	6'-6"	7						
						D1	70	#6	STR	2'-6"	263
A300	112	#6	STR	38'-7"	6491	D2	12	#6	STR	1'-6"	27
A301	1	#6	STR	32'-0"	48						
A302	1	#6	STR	19'-3"	29	G1	4	#5	STR	38'-7"	161
A303	1	#6	STR	6'-6"	10						
						S2	6	#8	STR	38'-7"	618
A400	112	#6	STR	38'-7"	6491						
A401	1	#6	STR	32'-0"	48						
A402	1	#6	STR	19'-3"	29						
A403	1	#6	STR	6'-6"	10						

REINFORCING STEEL 44,787 LBS



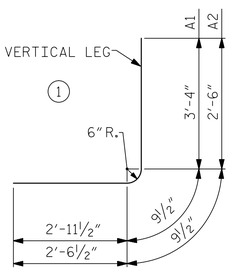
INLET END ELEVATION NORMAL TO SKEW



EXTERIOR WALL INTERIOR WALL

STAGE III - CULVERT SECTION NORMAL TO ROADWAY

BAR TYPE



DIMENSIONS ARE OUT TO OUT

SPLICE LENGTHS CHART

BAR	SIZE	SPLICE LENGTH
"B"	#4	1'-10"
"B"	#5	2'-4"
C1	#4	1'-10"
A200	#5	2'-4"
A400	#6	2'-9"
S2	#8	3'-8"

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 310+73.00 -L-

SHEET 9 OF 14

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARCUS G. CHENEY, JR.

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SUITE 200
RALEIGH, NC 27603
PH (919) 773-8887
CORP. LICENSE NO.: C-0275

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

TRIPLE 12 FT. X 12 FT. CONCRETE BOX CULVERT STAGE III

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

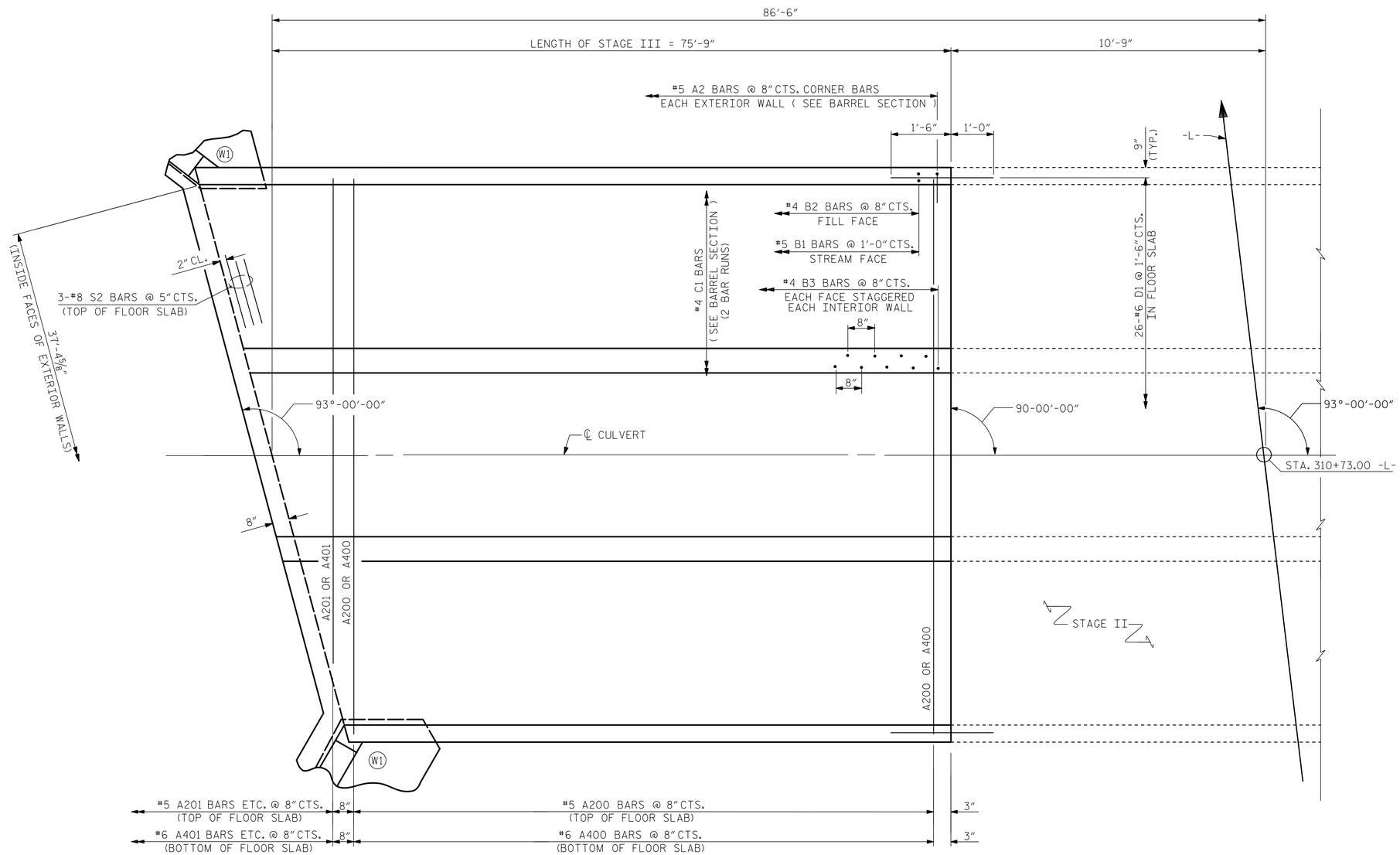
SHEET NO. C11-9

TOTAL SHEETS 14

DRAWN BY : ZCS DATE : 10/21
CHECKED BY : MGC DATE : 1/22
DESIGN ENGINEER OF RECORD: ZCS DATE : 1/22

FILE NAME: 413_017_I-5987A_Site_11_SMU_CU_009.dgn

SITE 11



PLAN - FLOOR SLAB

NOTE: FOR S1 BARS IN FLOOR SLAB & WING FOOTINGS, SEE WING SHEET.

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 310+73.00 -L-

SHEET 10 OF 14

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

TRIPLE 12 FT. X 12 FT. CONCRETE BOX CULVERT STAGE III

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARCUS G. CHEEK, JR.
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RALEIGH, NC 27603
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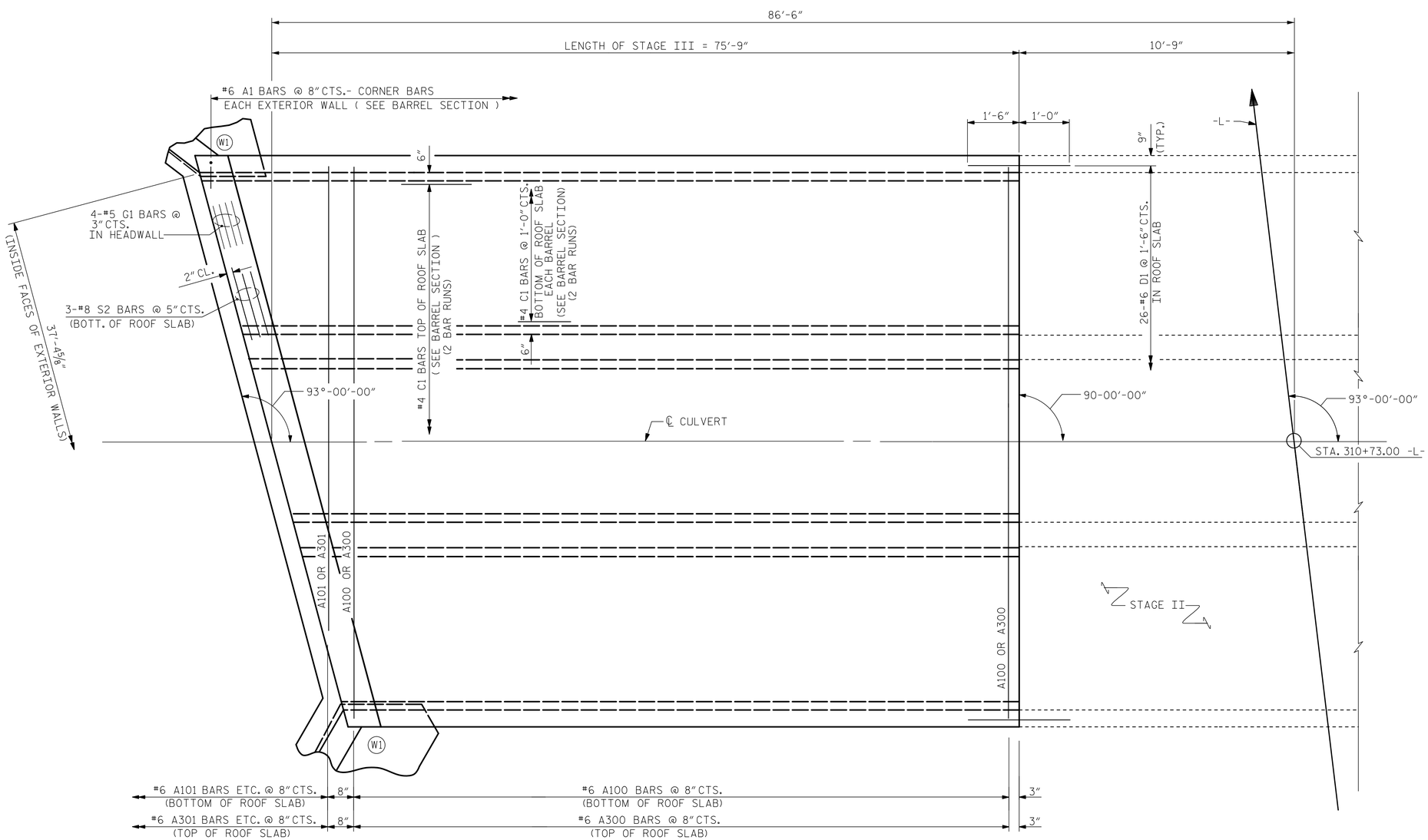
REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C11-10
1			3			TOTAL SHEETS
2			4			14

DRAWN BY : ZCS DATE : 10/21
CHECKED BY : MGC DATE : 1/22
DESIGN ENGINEER OF RECORD: ZCS DATE : 1/22

FILE NAME: 413_019_I-5987A_Site_11_SMU_CU_010.dgn

SITE 11



PLAN - ROOF SLAB

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 310+73.00 -L-

SHEET 11 OF 14

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL G. CHEEK, JR.

Marshall G. Cheek, Jr.

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SUITE 200
RALEIGH, NC 27603
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CORP. LICENSE NO.: C-0275

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

TRIPLE 12 FT. X 12 FT. CONCRETE BOX CULVERT STAGE III

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C11-11
1			3			TOTAL SHEETS
2			4			14

DRAWN BY : ZCS DATE : 10/21
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DESIGN ENGINEER OF RECORD: ZCS DATE : 1/22

FILE NAME: 413_021_I-5987A_Site_11_SMU_CU_011.dgn

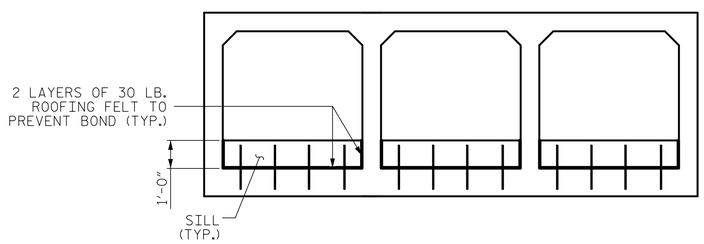
SITE 11

NOTES

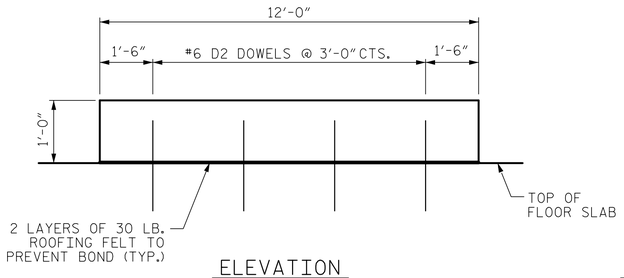
MATERIAL EXCAVATED FROM THE EXISTING BED SHALL BE STOCKPILED FOR USE IN THE PROPOSED CULVERT. BED MATERIAL MAY BE SUPPLEMENTED WITH CLASS B RIP RAP AS NECESSARY. NATIVE MATERIAL SHOULD BE PLACED ON TOP TO PROVIDE A FLAT SURFACE FOR ANIMAL PASSAGE. BED MATERIAL IS SUBJECT TO THE APPROVAL BY THE ENGINEER AND MAY BE SUBJECT TO PERMIT CONDITIONS.

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.

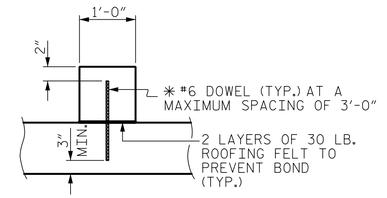
THE ENTIRE COST OF WORK REQUIRED TO CONSTRUCT THE SILLS SHALL BE INCLUDED IN THE VARIOUS PAY ITEMS.



INLET ELEVATION



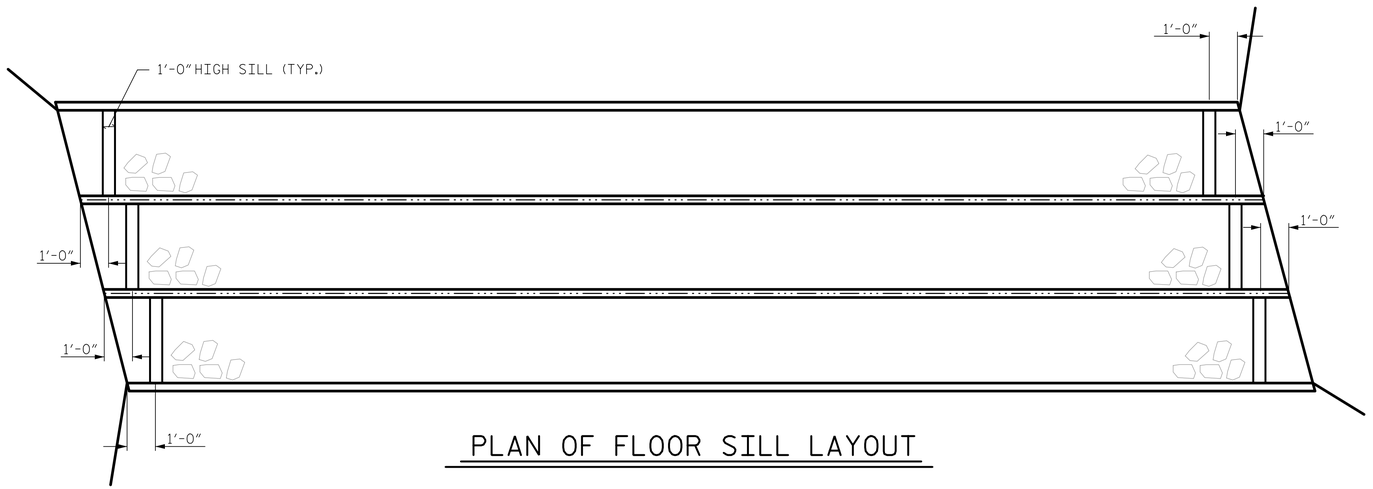
ELEVATION



SECTION THROUGH SILL

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

SILL DETAILS



PLAN OF FLOOR SILL LAYOUT

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 310+73.00 -L-

SHEET 12 OF 14

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER WASHINGTON B. GREEK, JR.

5/10/2022 | 10:02 AM EDT

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706 HILLSBOROUGH STREET
SUITE 200
RALEIGH, NC 27603
PH (919) 773-8887
CORP. LICENSE NO.: C-0275

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

TRIPLE 12 FT. X 12 FT. CONCRETE BOX CULVERT

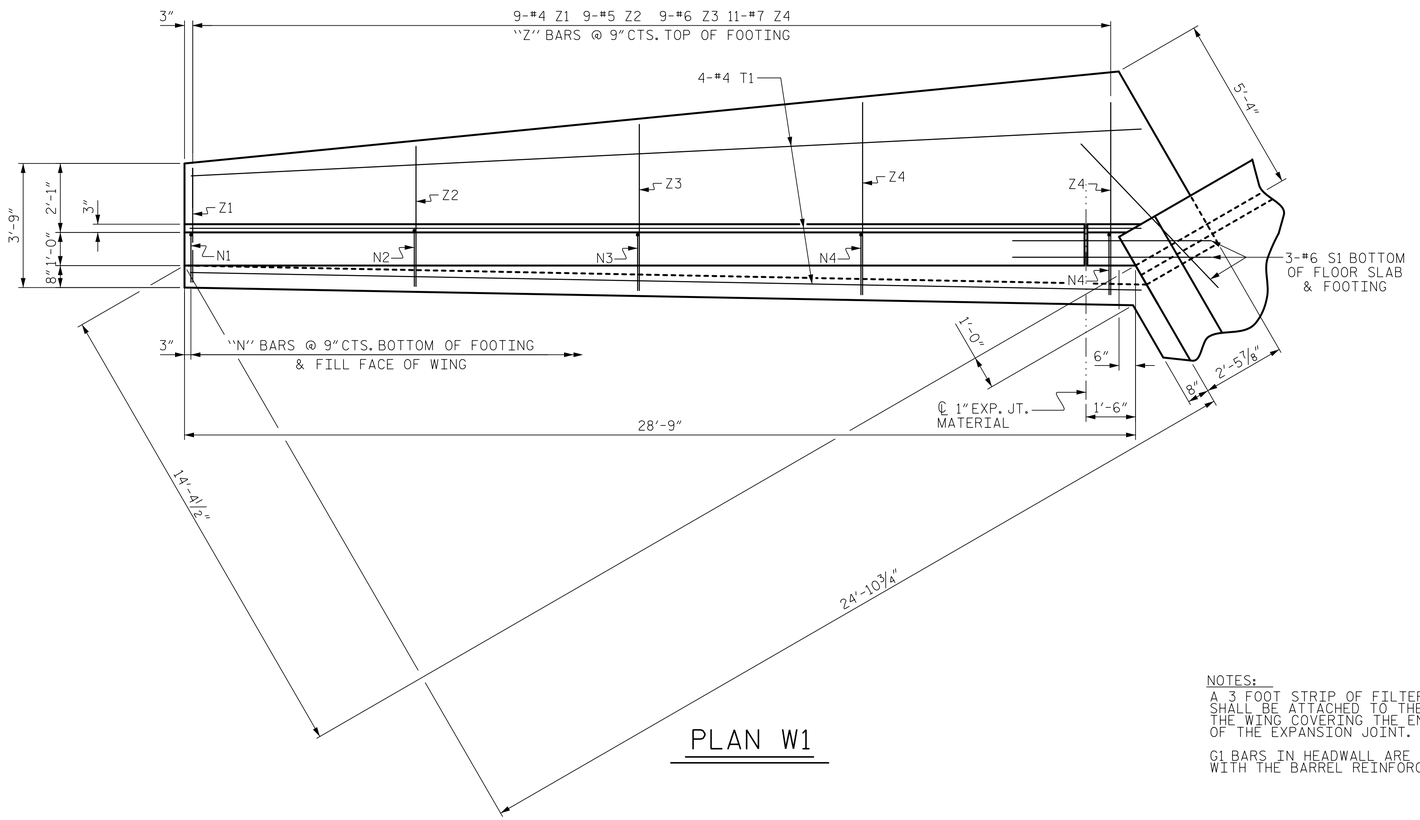
REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C11-12
1			3			TOTAL SHEETS
2			4			14

DRAWN BY : ZCS DATE : 10/21

CHECKED BY : MGC DATE : 1/22

FILE NAME: 413_023_I-5987A_Site_11_SMU_CU_012.dgn

SITE 11



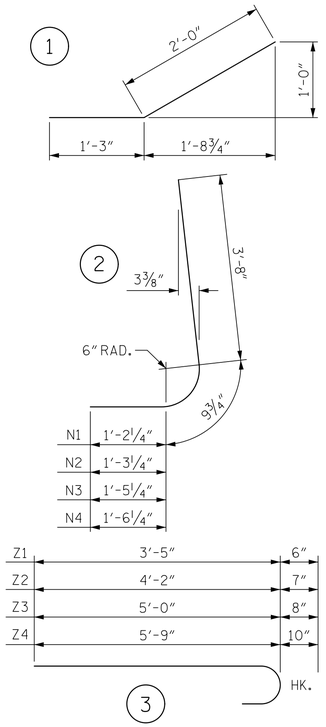
PLAN W1

NOTES:

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.

G1 BARS IN HEADWALL ARE INCLUDED WITH THE BARREL REINFORCING STEEL.

BAR TYPES



ALL BAR DIMENSIONS ARE OUT TO OUT.

BILL OF MATERIAL

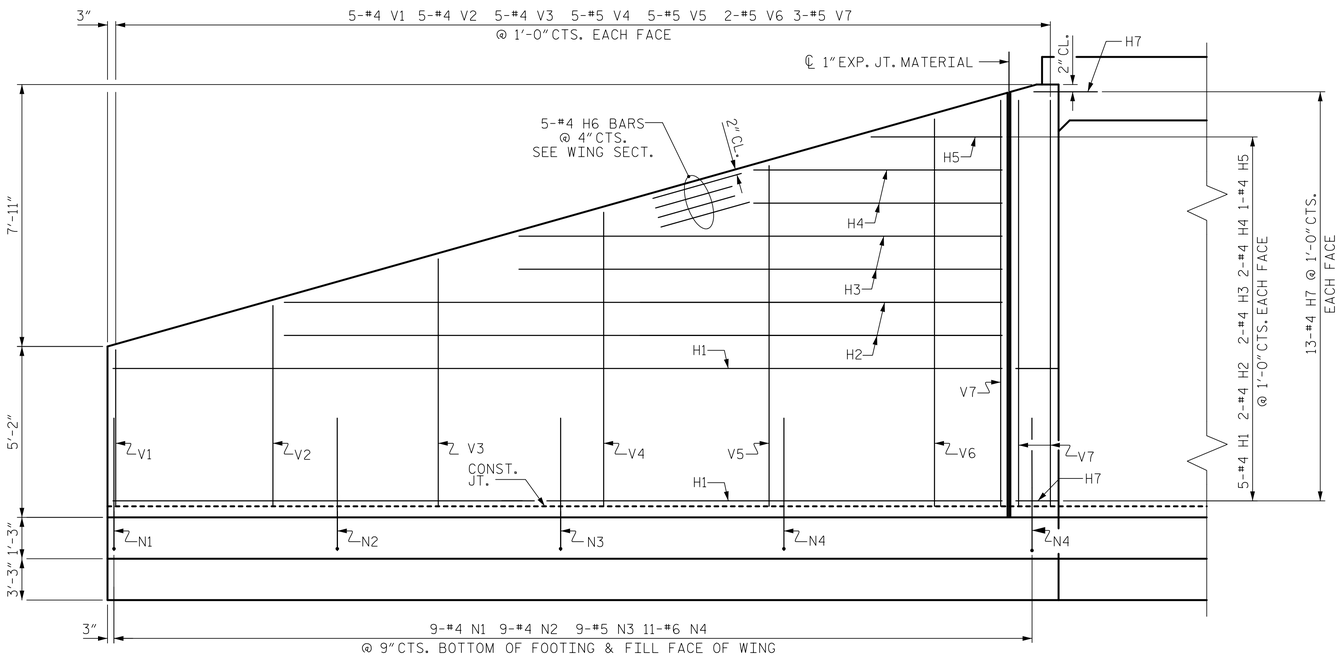
BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
H1	30	#4	STR	26'-10"	538
H2	12	#4	STR	21'-8"	174
H3	12	#4	STR	14'-7"	117
H4	12	#4	STR	7'-6"	60
H5	6	#4	STR	3'-11"	16
H6	15	#4	STR	27'-10"	279
H7	78	#4	1	3'-3"	169
N1	27	#4	2	5'-8"	102
N2	27	#4	2	5'-9"	104
N3	27	#5	2	5'-11"	167
N4	33	#6	2	6'-0"	297
S1	9	#6	STR	6'-0"	81
T1	12	#4	STR	28'-9"	230
V1	30	#4	STR	4'-8"	93
V2	30	#4	STR	6'-0"	120
V3	30	#4	STR	7'-5"	148
V4	30	#5	STR	8'-10"	276
V5	30	#5	STR	10'-3"	321
V6	12	#5	STR	11'-6"	144
V7	18	#5	STR	12'-1"	227
Z1	27	#4	3	3'-11"	71
Z2	27	#5	3	4'-9"	134
Z3	27	#6	3	5'-8"	230
Z4	33	#7	3	6'-7"	444

REINFORCING STEEL FOR 3 WINGS 4542 LBS

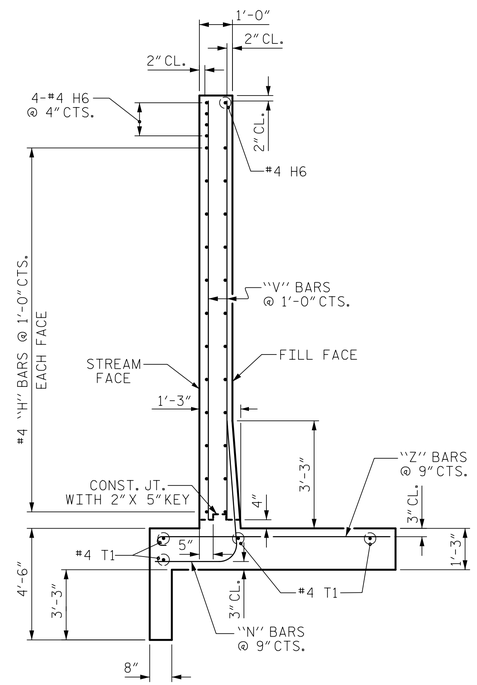
CLASS A CONCRETE

STAGE I		
1 WING	19.7	CY
1 HEADWALL	1.8	CY
1 END CURTAIN WALL	3.9	CY
TOTAL	25.4	CY

STAGE III		
2 WINGS	39.4	CY
1 HEADWALL	1.8	CY
1 END CURTAIN WALL	3.9	CY
TOTAL	45.1	CY



ELEVATION W1



TYPICAL WING SECTION

DRAWN BY : ZCS DATE : 10/21
CHECKED BY : MGC DATE : 1/22
DESIGN ENGINEER OF RECORD: ZCS DATE : 1/22

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL G. CREEK, JR.
Docusigned by: Marshall G. Creek, Jr.
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706 HILLSBOROUGH STREET
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RALEIGH, NC 27603
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CORP. LICENSE NO.: C-0275

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 310+73.00 -L-

SHEET 13 OF 14

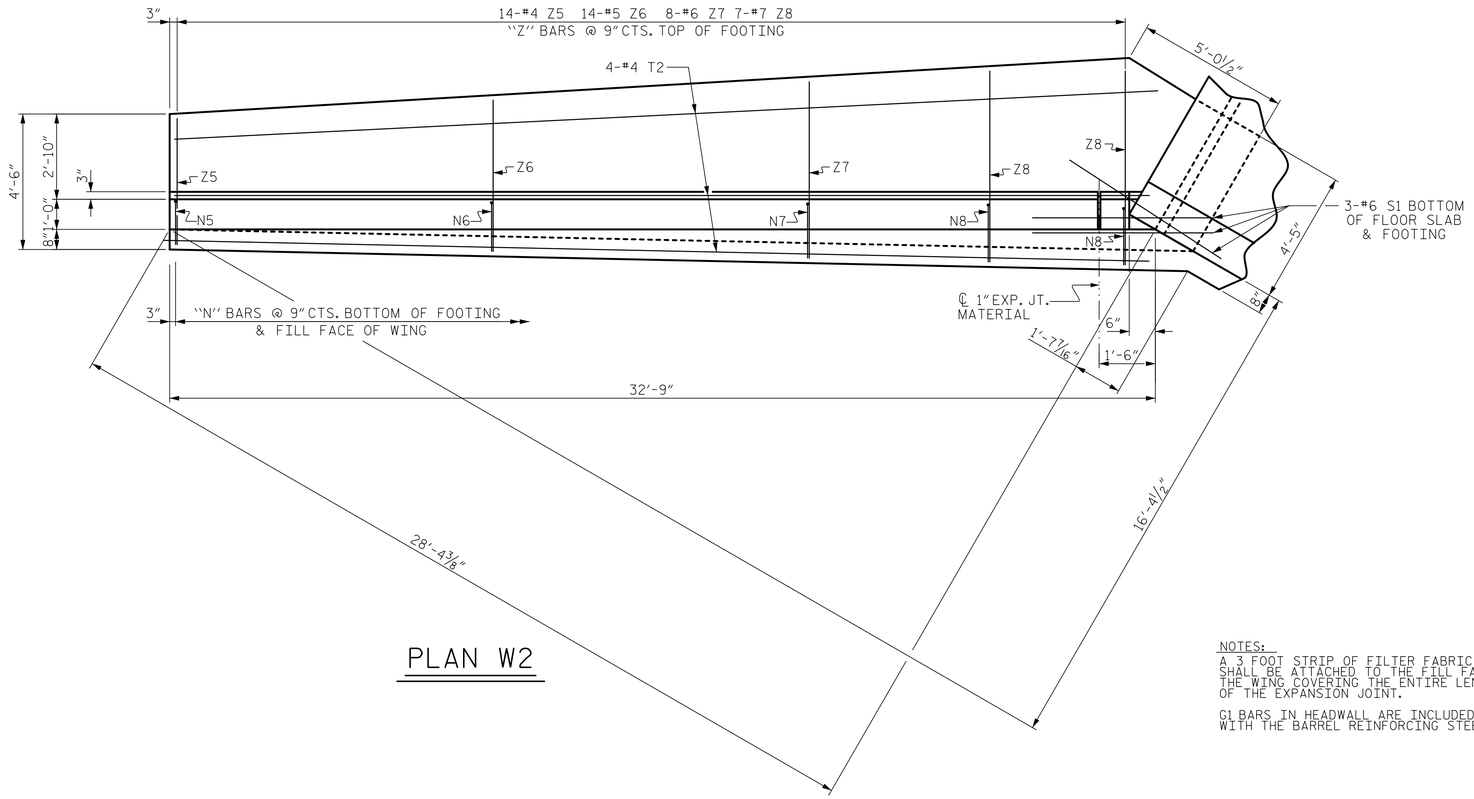
STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

WING 1 FOR CONCRETE BOX CULVERT

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C11-13
1			3			TOTAL SHEETS
2			4			14

FILE NAME: 413_025_I-5987A_Site_11_SMU_CU_013.dgn

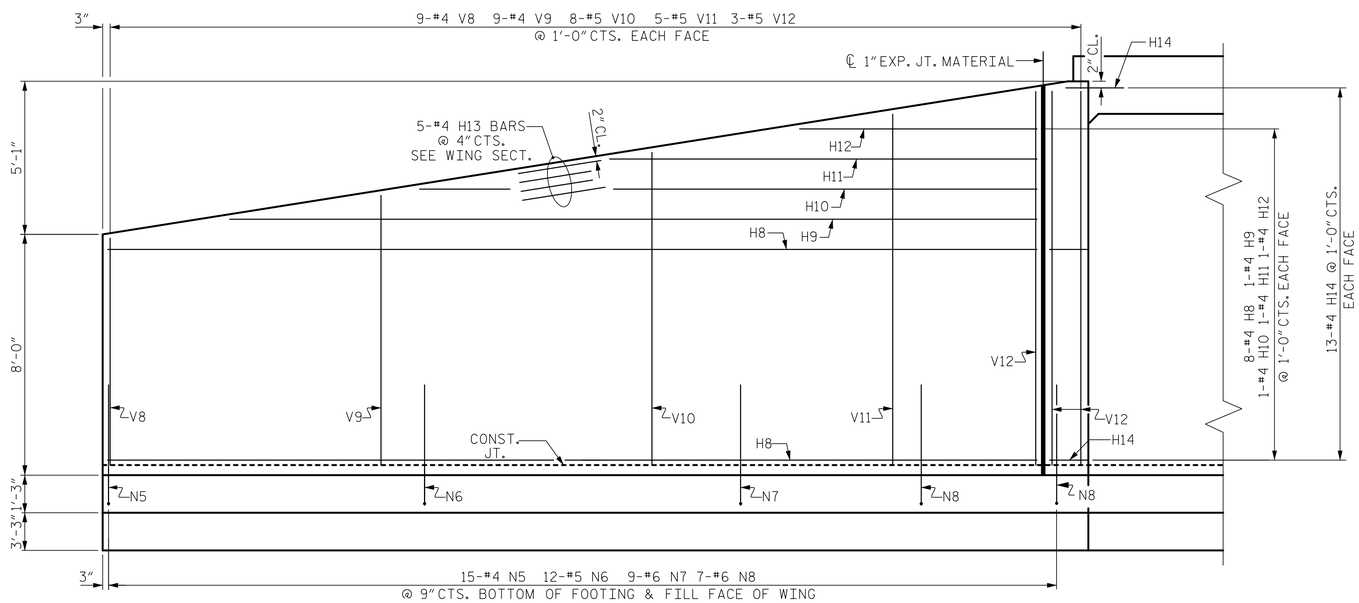
SITE 11



PLAN W2

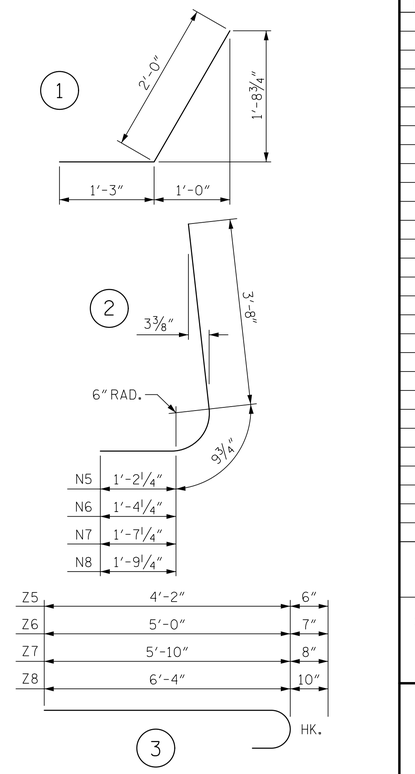
NOTES:
A 3 FOOT STRIP OF FILTER FABRIC SHALL BE ATTACHED TO THE FILL FACE OF THE WING COVERING THE ENTIRE LENGTH OF THE EXPANSION JOINT.

G1 BARS IN HEADWALL ARE INCLUDED WITH THE BARREL REINFORCING STEEL.



ELEVATION W2

BAR TYPES



ALL BAR DIMENSIONS ARE OUT TO OUT.

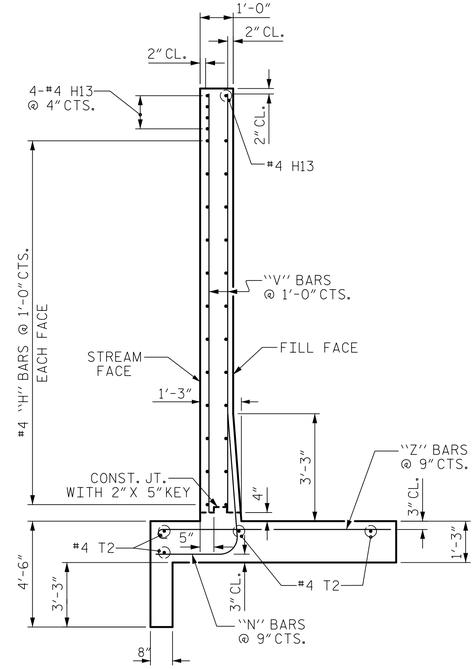
BILL OF MATERIAL

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
H8	16	#4	STR	30'-10"	330
H9	2	#4	STR	26'-9"	36
H10	2	#4	STR	20'-6"	27
H11	2	#4	STR	14'-2"	19
H12	2	#4	STR	7'-10"	10
H13	5	#4	STR	31'-3"	104
H14	26	#4	1	3'-3"	56
N5	15	#4	2	5'-8"	57
N6	12	#5	2	5'-10"	73
N7	9	#6	2	6'-1"	82
N8	7	#6	2	6'-3"	66
S1	3	#6	STR	6'-0"	27
T2	4	#4	STR	32'-9"	88
V8	18	#4	STR	7'-6"	90
V9	18	#4	STR	8'-11"	107
V10	16	#5	STR	10'-4"	172
V11	10	#5	STR	11'-7"	121
V12	6	#5	STR	12'-4"	77
Z5	14	#4	3	4'-8"	44
Z6	14	#5	3	5'-7"	82
Z7	8	#6	3	6'-6"	78
Z8	7	#7	3	7'-2"	103

REINFORCING STEEL FOR 1 WING 1849 LBS

CLASS A CONCRETE 1 WING 24.9 CY

TOTAL 24.9 CY



TYPICAL WING SECTION

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL G. CHEEK, JR.
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TGS ENGINEERS
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SUITE 200
RALEIGH, NC 27603
PH (919) 773-8887
CORP. LICENSE NO.: C-0275

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 310+73.00 -L-

SHEET 14 OF 14

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

WING 2 FOR CONCRETE BOX CULVERT

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C11-14
1			3			TOTAL SHEETS
2			4			14

DRAWN BY : ZCS DATE : 10/21
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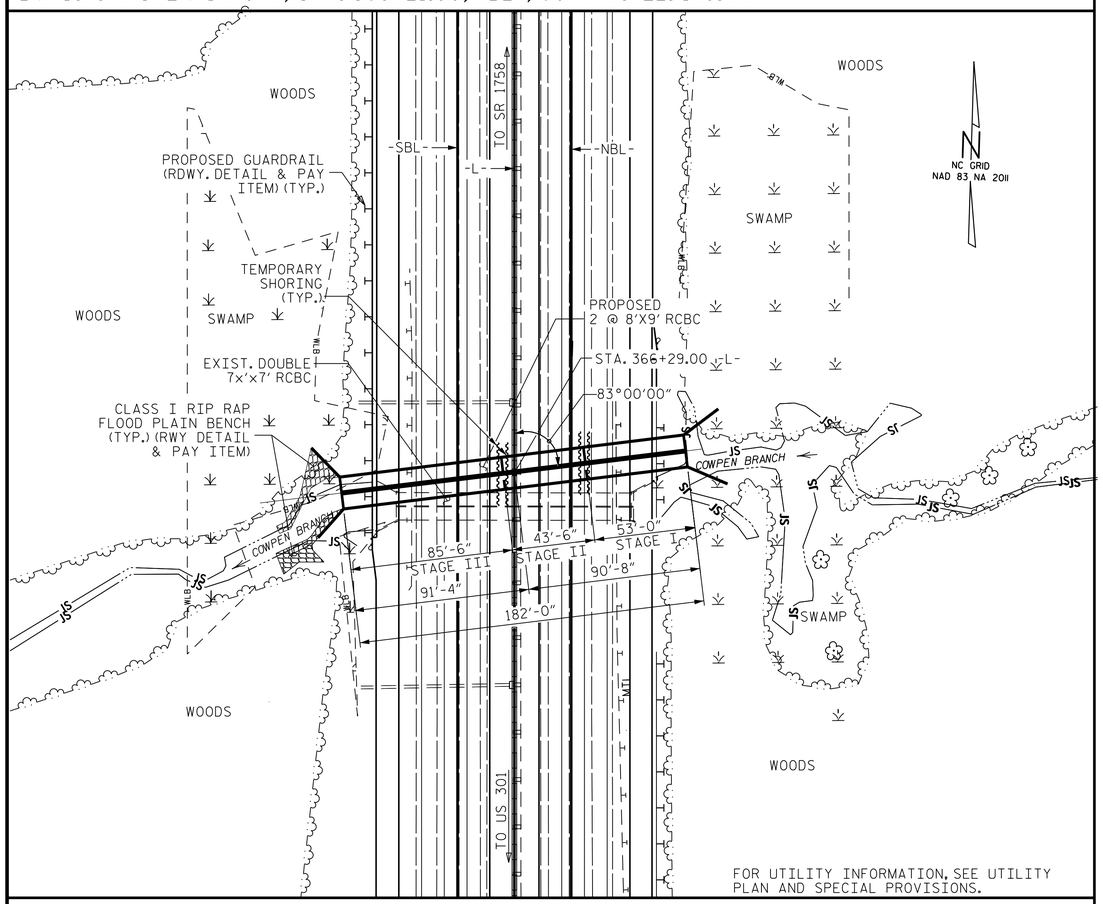
DESIGN ENGINEER OF RECORD: ZCS DATE : 1/22

FILE NAME: 413_027_I-5987A_Site_11_SMU_CU_014.dgn

SITE 11

DocuSign Envelope ID: 393D30DF-962F-4A3C-A7BA-D77EDF01A525

BM 18 : RRS IN 14" OAK, STA. 369+21.00, -BL-, 604' RT. EL. 149.74



LOCATION SKETCH

ROADWAY DATA

GRADE PT. EL. @ STA. 366+29.00 -L-	= 152.6'
BED ELEV. @ STA. 366+29.00 -L-	= 137.4'
ROADWAY SLOPE	= 3 : 1

HYDRAULIC DATA

DESIGN DISCHARGE	= 750 CFS
FREQUENCY OF DESIGN FLOOD	= 100 YRS.
DESIGN HIGH WATER ELEVATION	= 147.4'
DRAINAGE AREA	= 2.70 SQ. MI.
BASE DISCHARGE (Q100)	= 750 CFS
BASE HIGH WATER ELEVATION	= 147.4'

OVERTOPPING FLOOD DATA

OVERTOPPING DISCHARGE	= 550 CFS
FREQUENCY OF OVERTOPPING FLOOD	= 10+ YRS.
OVERTOPPING FLOOD ELEVATION	= 146.5' ✳

✳ OT AT DRAINAGE DIVIDE @ STA. 351+50.00 -L- RT. ELEV. = 146.5'

TOTAL STRUCTURE QUANTITIES

CULVERT EXCAVATION	LUMP SUM
FOUNDATION COND. MATERIAL	
STAGE I	82 TONS
STAGE II	68 TONS
STAGE III	133 TONS
TOTAL	283 TONS
CLASS A CONCRETE	
STAGE I	125.3 C.Y.
STAGE II	85.6 C.Y.
STAGE III	188.8 C.Y.
TOTAL	399.7 C.Y.
REINFORCING STEEL	
STAGE I	16,748 LBS.
STAGE II	12,783 LBS.
STAGE III	25,565 LBS.
TOTAL	55,096 LBS.

NOTES

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

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

FOR CONSTRUCTION SEQUENCE, EROSION CONTROL AND MEASURES, SEE EROSION CONTROL PLANS.

DESIGN FILL---------- 5.26'

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:

STAGES I - CONSTRUCT RCBC SECTION AT INLET END.
STAGES III - CONSTRUCT RCBC SECTION AT OUTLET END.

1. WING FOOTINGS AND FLOOR SLAB INCLUDING 4" OF ALL VERTICAL WALLS.
2. SILLS WITH NATIVE MATERIAL BACKFILL IN BOTH BARRELS.
3. FOLLOWED BY THE WING WALLS FULL HEIGHT. ROOF SLAB AND HEADWALL.

STAGE II - CONSTRUCT RCBC INTERMEDIATE SECTION.

1. FLOOR SLAB INCLUDING 4" OF ALL VERTICAL WALLS.
2. FOLLOWED BY NATIVE MATERIAL BACKFILL AND ROOF SLAB.

THE CONTRACTOR 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 BARRELS ARE SHOWN ON WING SHEET.

TRANSVERSE CONSTRUCTION JOINTS SHALL BE USED IN THE BARRELS, SPACED TO LIMIT THE POURS TO A MAXIMUM OF 70 FEET. LOCATION OF JOINTS SHALL BE SUBJECT TO APPROVAL OF 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 SHALL BE PAID FOR BY CONTRACTOR.

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.

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.

NO PRECAST REINFORCED BOX CULVERT OPTION WILL BE ALLOWED.

FOR SUBMITTAL OF WORKING DRAWINGS, SEE SPECIAL PROVISIONS.

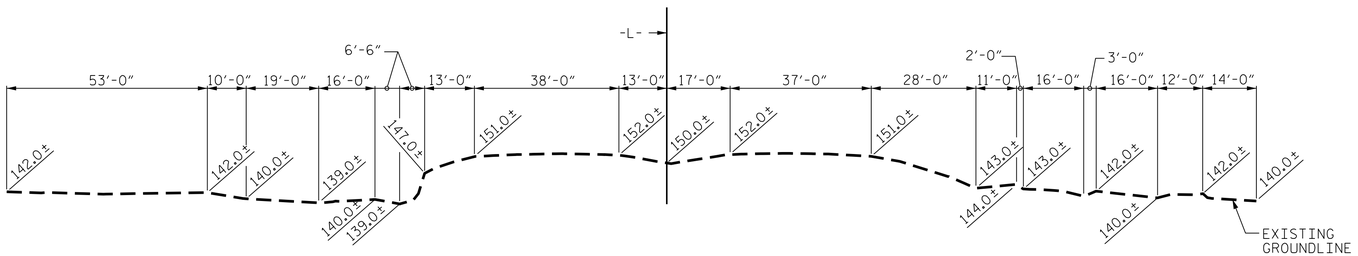
FOR FALSEWORK AND FORMWORK, SEE SPECIAL PROVISIONS.

FOR CRANE SAFETY, SEE SPECIAL PROVISIONS.

FOR GROUT FOR STRUCTURES, SEE SPECIAL PROVISIONS.

FOR TRAFFIC PHASING, LIMITS OF TEMPORARY SHORING, SEE TRAFFIC CONTROL PLANS.

FOR PAY ITEM FOR TEMPORARY SHORING, SEE ROADWAY PLANS.



PROFILE ALONG ℄ CULVERT

FOUNDATION NOTES

BACKFILL WITH SELECT MATERIAL, CLASS VI MEETING THE REQUIREMENTS OF SECTION 1016 OF THE STANDARD SPECIFICATIONS.

SEE SECTION 414 OF THE STANDARD SPECIFICATIONS FOR CULVERT EXCAVATION AND BACKFILLING. EXCAVATE 1 FOOT BELOW CULVERT AND FOOTING AND REPLACE WITH FOUNDATION CONDITIONING MATERIAL IN ACCORDANCE WITH ARTICLE 414-4 OF THE STANDARD SPECIFICATIONS.

I HEREBY CERTIFY THESE PLANS ARE THE AS-BUILT PLANS

PROJECT NO. I-5987A
ROBESON COUNTY
STATION: 366+29.00 -L-

SHEET 1 OF 8 STRUCTURE NO. 504

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NC COA No. F-1255

DRAWN BY : JJR DATE : 9/21
CHECKED BY : THF DATE : 12/21
DESIGN ENGINEER : VDK DATE : 12/21

DWG. No.

NORTH CAROLINA PROFESSIONAL SEAL 16301 ENGINEER TING HSIUNG FANG
Ting Hsiung Fang
3/18/2022

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH
BARREL STANDARD

DOUBLE 8 FT. X 9 FT. CONCRETE BOX CULVERT 83° SKEW

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2			4			8

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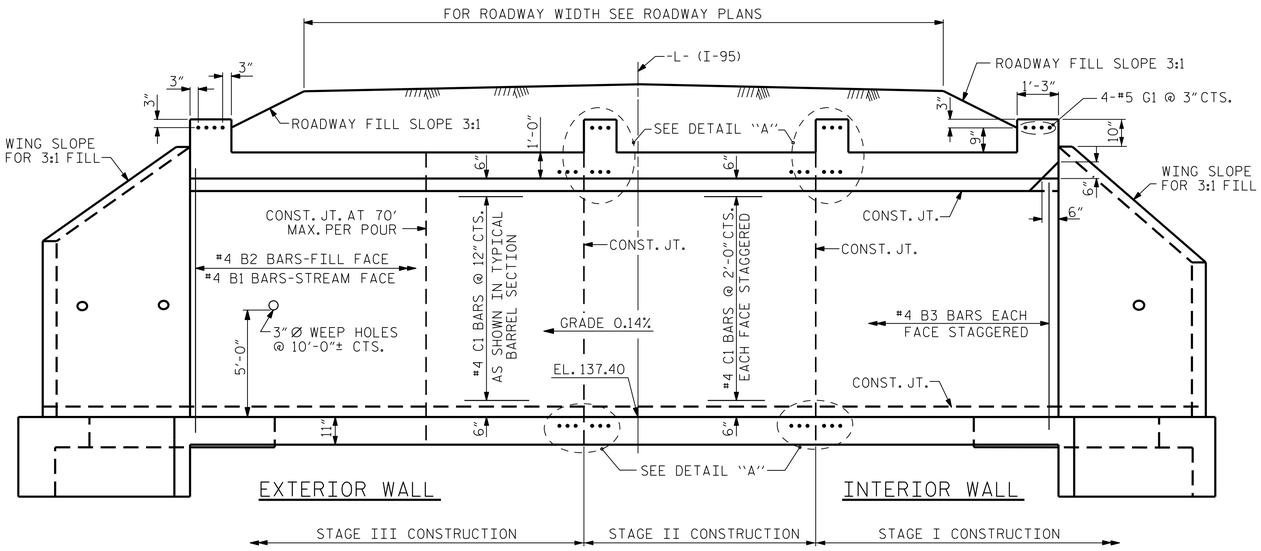
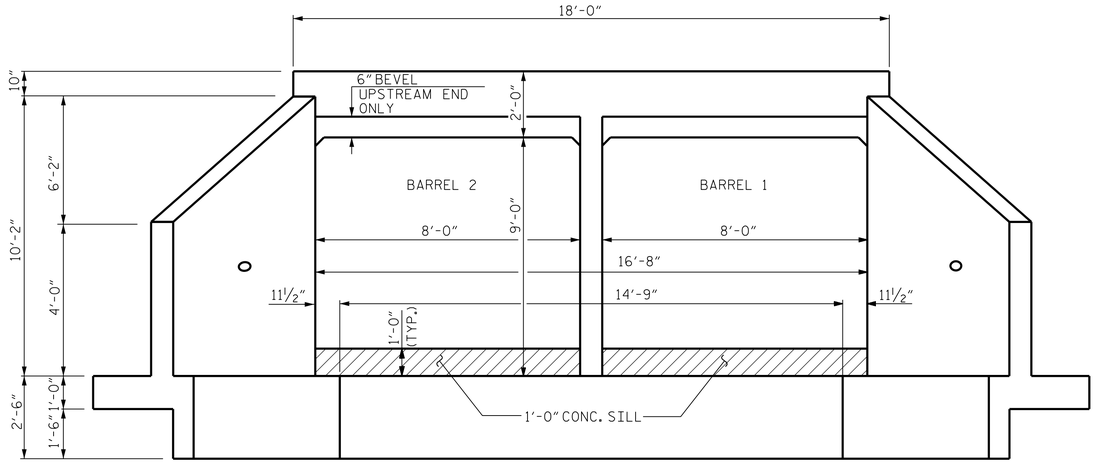
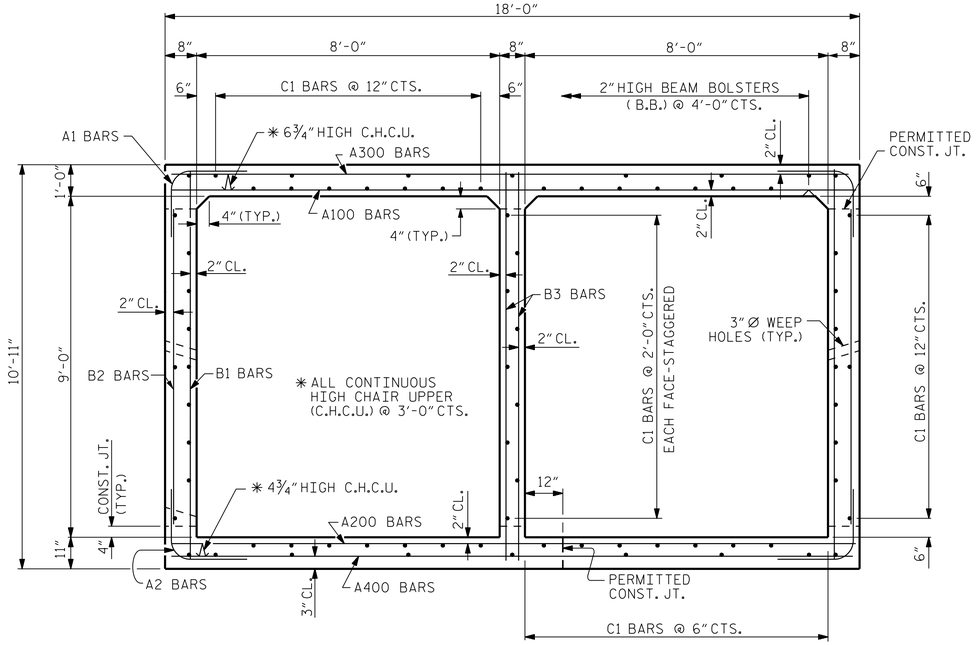


CULVERT SECTION NORMAL TO ROADWAY



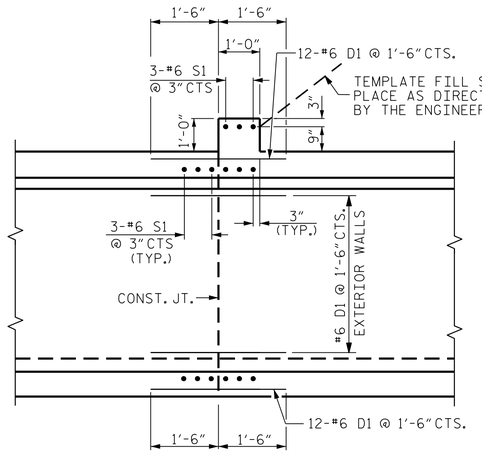
INLET END ELEVATION NORMAL TO SKEW

OUTLET END ELEVATION SIMILAR BY ROTATION



RIGHT ANGLE SECTION OF BARREL

THERE ARE 75 C1 BARS IN SECTION OF BARREL.



DETAIL "A"

I HEREBY CERTIFY THESE PLANS ARE THE AS-BUILT PLANS

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 366+29.00 -L-

SHEET 2 OF 8

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

BARREL STANDARD

DOUBLE 8 FT. X 9 FT. CONCRETE BOX CULVERT

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DWG. No.

NORTH CAROLINA PROFESSIONAL SEAL 16301 ENGINEER TING HSIUNG FANG
Ting Fang
405E43C9AEA60462...
3/18/2022

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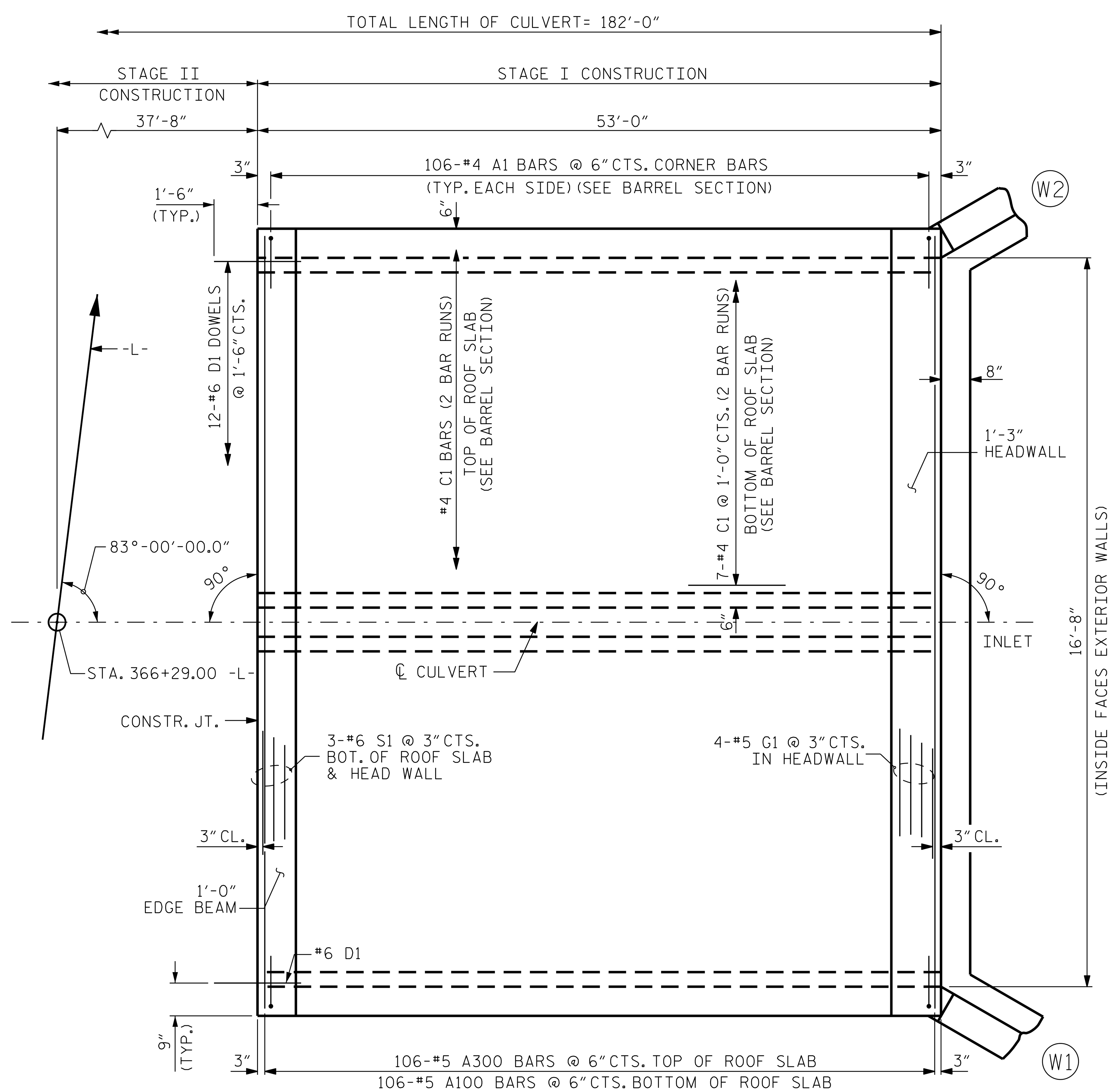
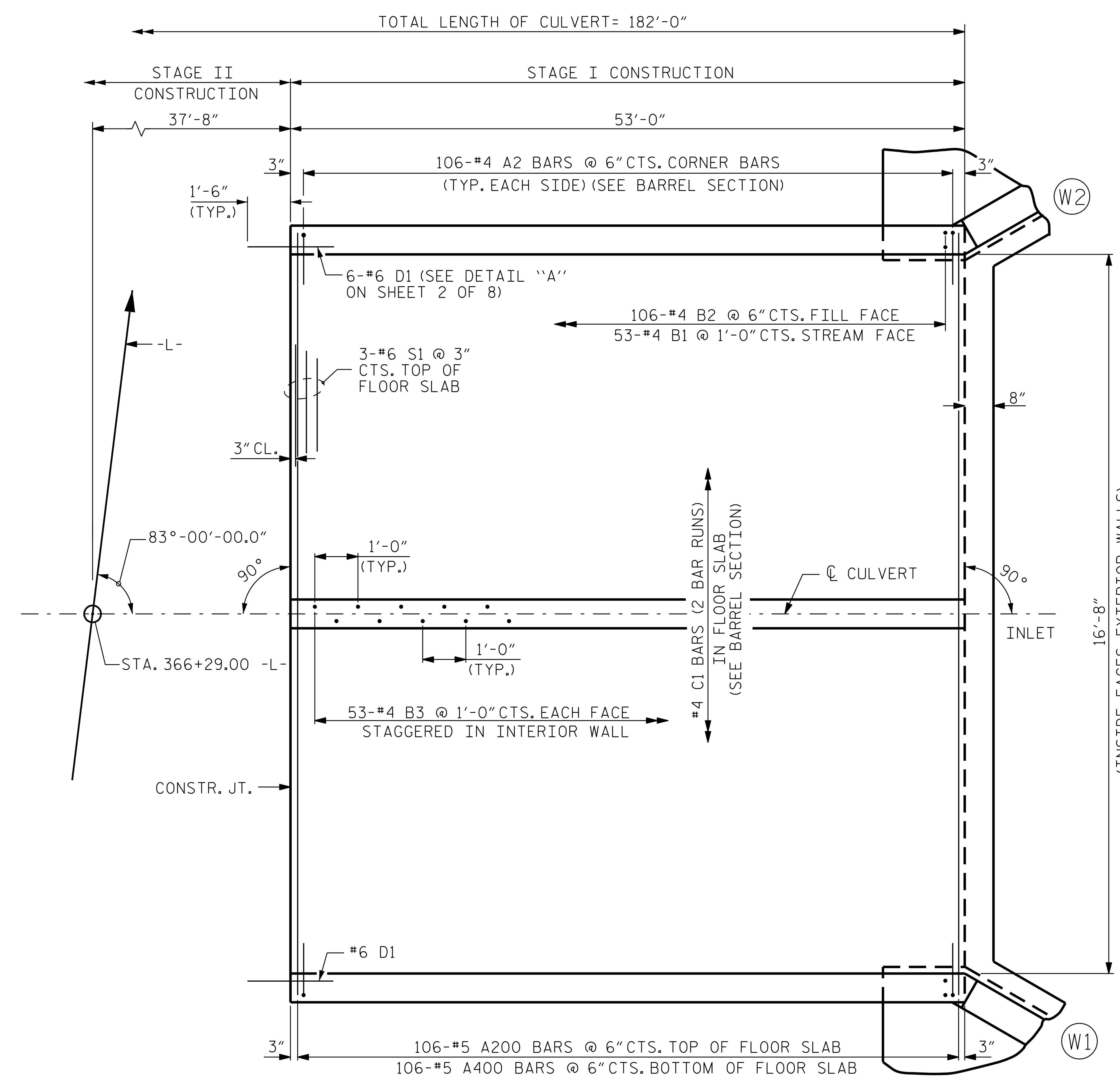


STAGE I - PLAN OF ROOF SLAB



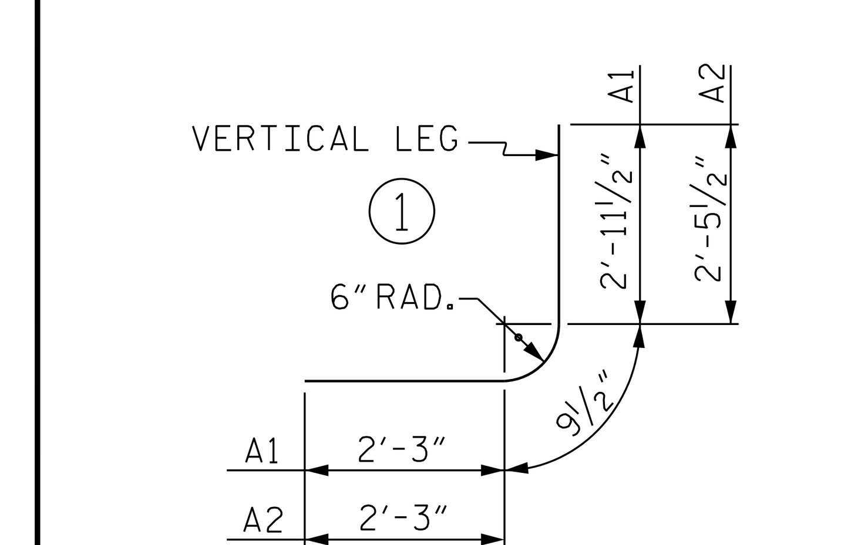
STAGE I - PLAN OF FLOOR SLAB

REINFORCING BAR SCHEDULE

STAGE I

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
A1	212	#4	1	6'-0"	850
A2	212	#4	1	5'-6"	779
B1	106	#4	STR	10'-6"	743
B2	212	#4	STR	8'-4"	1180
B3	106	#4	STR	10'-6"	743
A100	106	#5	STR	17'-8"	1953
A200	106	#5	STR	17'-8"	1953
A300	106	#5	STR	17'-8"	1953
A400	106	#5	STR	17'-8"	1953
C1	150	#4	STR	28'-4"	2839
D1	36	#6	STR	3'-0"	162
D2	8	#6	STR	1'-6"	18
G1	4	#5	STR	17'-8"	74
S1	9	#6	STR	17'-8"	239
REINFORCING STEEL				LBS.	15,440

BAR TYPE



BAR DIMENSIONS ARE OUT TO OUT

SPLICE LENGTHS CHART

BAR	SIZE	SPLICE LENGTH
C1	#4	1'-10"

STRUCTURE QUANTITIES STAGE I

FOUNDATION COND. MAT'L	82 TONS
CULVERT EXCAVATION	LUMP SUM
CLASS A CONCRETE	
BARREL @ 1.953 CY/FT	103.5 C.Y.
WINGS ETC.	21.2 C.Y.
SILLS	0.6 C.Y.
TOTAL	125.3 C.Y.
REINFORCING STEEL	
BARRELS & SILLS	15,440 LBS.
WINGS ETC.	1,308 LBS.
TOTAL	16,748 LBS.

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DWG. No.

NORTH CAROLINA PROFESSIONAL SEAL 16301 ENGINEER TING HSIUNG FANG
Ting Fang
3/18/2022

PROJECT NO. I-5987A
ROBESON COUNTY
STATION: 366+29.00 -L-

SHEET 3 OF 8

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH
BARREL STANDARD

DOUBLE 8 FT. X 9 FT. CONCRETE BOX CULVERT

STAGE I

REVISIONS

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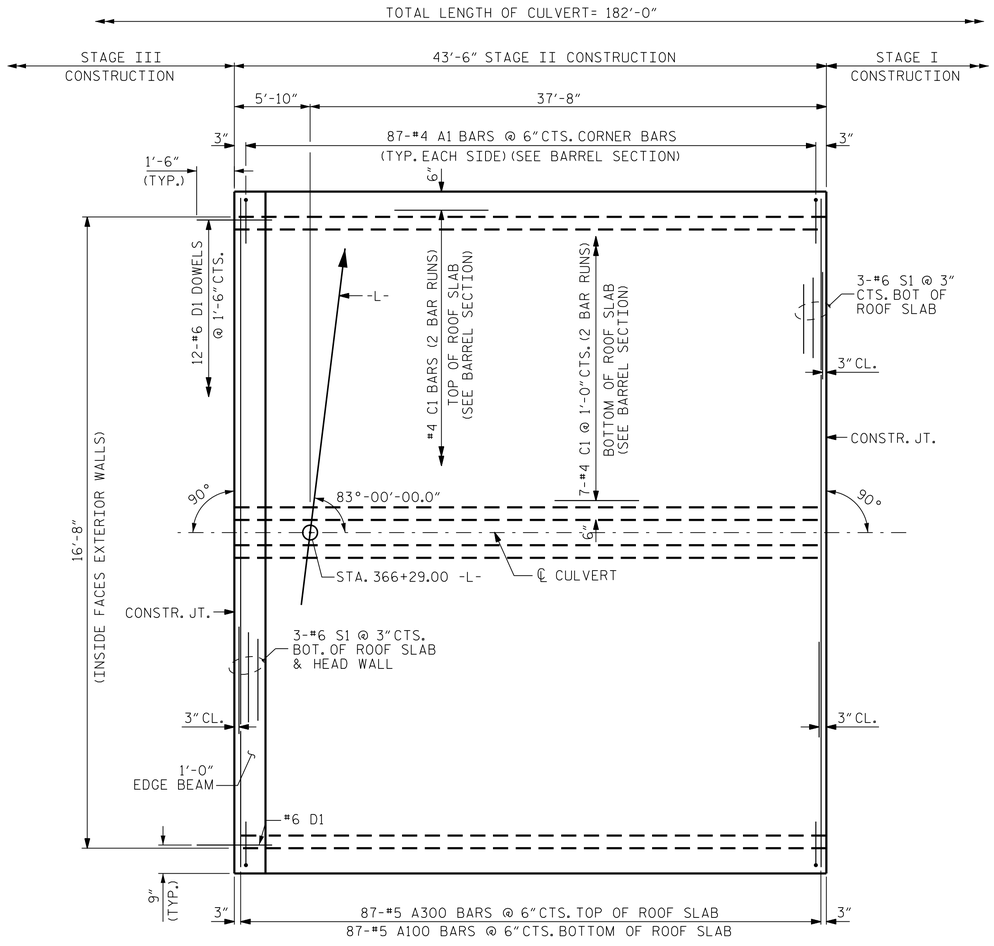
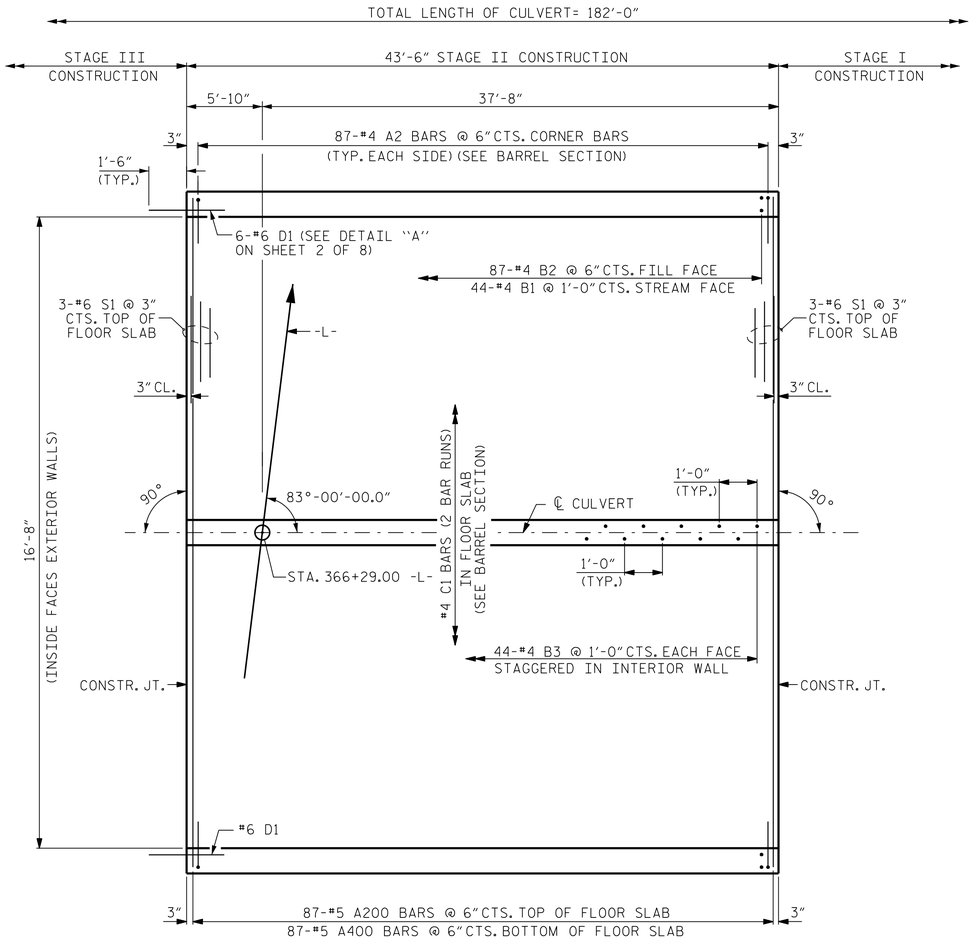


STAGE II - PLAN OF ROOF SLAB



STAGE II - PLAN OF FLOOR SLAB

STRUCTURE QUANTITIES STAGE II		
FOUNDATION COND. MAT'L	68	TONS
CULVERT EXCAVATION	LUMP SUM	
CLASS A CONCRETE		
BARREL @ 1.953 CY/FT	84.9	C.Y.
EDGE BEAM	0.7	C.Y.
TOTAL	85.6	C.Y.
REINFORCING STEEL		
BARRELS	12,783	LBS.
TOTAL	12,783	LBS.

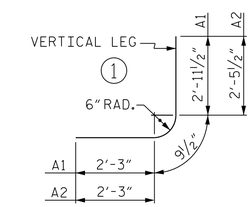
REINFORCING BAR SCHEDULE

STAGE II

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
A1	174	#4	1	6'-0"	697
A2	174	#4	1	5'-6"	639
B1	88	#4	STR	10'-6"	617
B2	174	#4	STR	8'-4"	969
B3	88	#4	STR	10'-6"	617
A100	87	#5	STR	17'-8"	1603
A200	87	#5	STR	17'-8"	1603
A300	87	#5	STR	17'-8"	1603
A400	87	#5	STR	17'-8"	1603
C1	150	#4	STR	22'-8"	2270
D1	36	#6	STR	3'-0"	162
S1	15	#6	STR	17'-8"	398

REINFORCING STEEL LBS. 12,783

BAR TYPE



BAR DIMENSIONS ARE OUT TO OUT

SPLICE LENGTHS CHART

BAR	SIZE	SPLICE LENGTH
C1	#4	1'-10"

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 366+29.00 -L-

SHEET 4 OF 8

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH
BARREL STANDARD

DOUBLE 8 FT. X 9 FT. CONCRETE BOX CULVERT

STAGE II

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Ting Fang
60E43C8AEA80482...
3/18/2022

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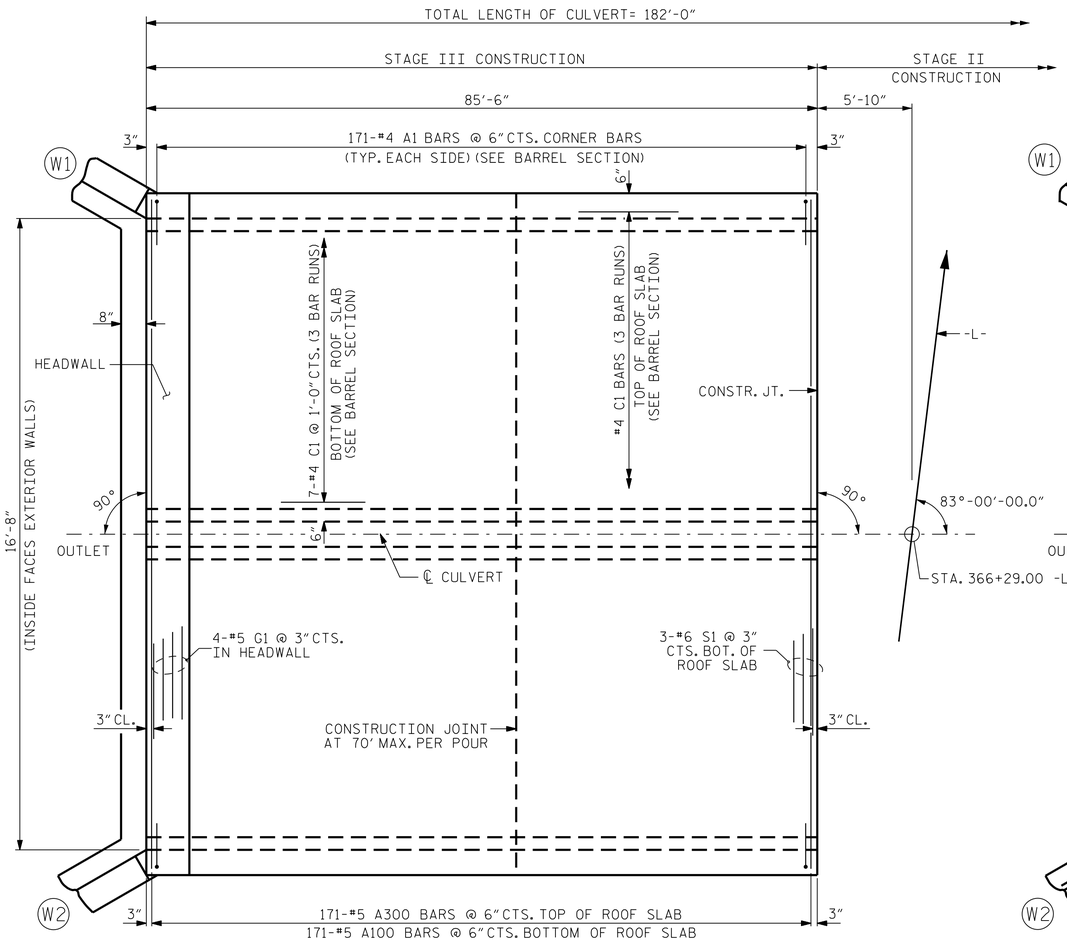
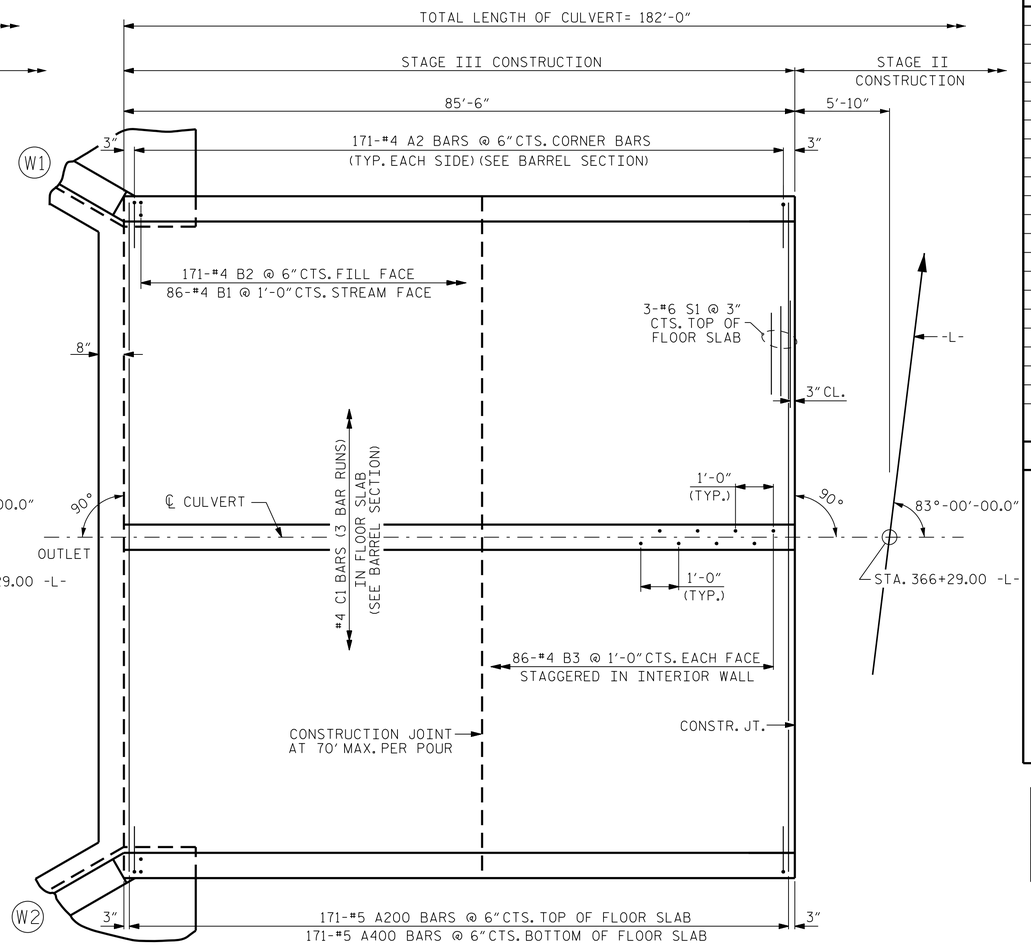


STAGE III - PLAN OF ROOF SLAB



STAGE III - PLAN OF FLOOR SLAB

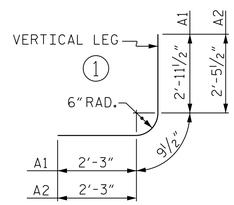
REINFORCING BAR SCHEDULE

STAGE III

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
A1	342	#4	1	6'-0"	1371
A2	342	#4	1	5'-6"	1257
B1	172	#4	STR	10'-6"	1206
B2	342	#4	STR	8'-4"	1904
B3	172	#4	STR	10'-6"	1206
A100	171	#5	STR	17'-8"	3151
A200	171	#5	STR	17'-8"	3151
A300	171	#5	STR	17'-8"	3151
A400	171	#5	STR	17'-8"	3151
C1	225	#4	STR	29'-8"	4459
D2	8	#6	STR	1'-6"	18
G1	4	#5	STR	17'-8"	74
S1	6	#6	STR	17'-8"	159

REINFORCING STEEL LBS. 24,257

BAR TYPE



BAR DIMENSIONS ARE OUT TO OUT

SPLICE LENGTHS CHART

BAR	SIZE	SPLICE LENGTH
C1	#4	1'-10"

STRUCTURE QUANTITIES
STAGE III

FOUNDATION COND. MAT'L	133 TONS
CULVERT EXCAVATION	LUMP SUM
CLASS A CONCRETE	
BARREL @ 1.953 CY/FT	167.0 C.Y.
WINGS ETC.	21.2 C.Y.
SILLS	0.6 C.Y.
TOTAL	188.8 C.Y.
REINFORCING STEEL	
BARRELS & SILLS	24,257 LBS.
WINGS ETC.	1,308 LBS.
TOTAL	25,565 LBS.

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3/18/2022

PROJECT NO. I-5987A
ROBESON COUNTY
STATION: 366+29.00 -L-

SHEET 5 OF 8

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH
BARREL STANDARD

DOUBLE 8 FT. X 9 FT. CONCRETE BOX CULVERT
STAGE III

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STIMES

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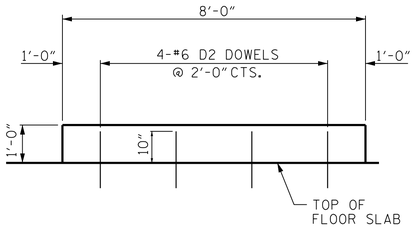
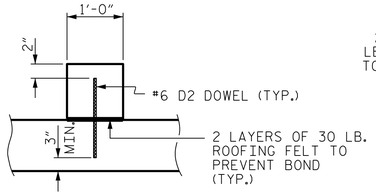
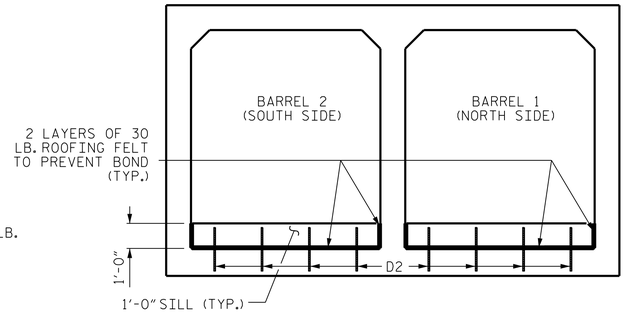


CONCRETE SILL DETAILS



SECTION THROUGH SILL

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



INLET ELEVATION

(LOOKING DOWNSTREAM)

THE CONTRACTOR'S ATTENTION IS CALLED TO THE FACT THAT THE NATIVE MATERIAL BACKFILL SHALL BE PLACED PRIOR TO THE CASTING OF THE ROOF SLAB.

NOTES:

CULVERT FLOOR SLAB IS BURIED 1 FOOT BELOW EXISTING STREAM BED. BACKFILL WITH NATIVE MATERIAL TO SILL HEIGHT IN ALL BARRELS.

NATIVE MATERIAL BETWEEN SILLS IN THE CULVERT SHALL PROVIDE A CONTINUOUS FLOW CHANNEL.

NATIVE MATERIAL CONSISTS OF MATERIAL THAT IS EXCAVATED FROM THE STREAM OR FLOODPLAIN AT THE PROJECT SITE DURING CONSTRUCTION. ONLY MATERIAL THAT IS EXCAVATED FROM THE STREAM BED MAY BE USED TO LINE CULVERT BARRELS. RIP RAP MAY BE USED TO SUPPLEMENT THE NATIVE MATERIAL IN THE FLOW BARRELS.

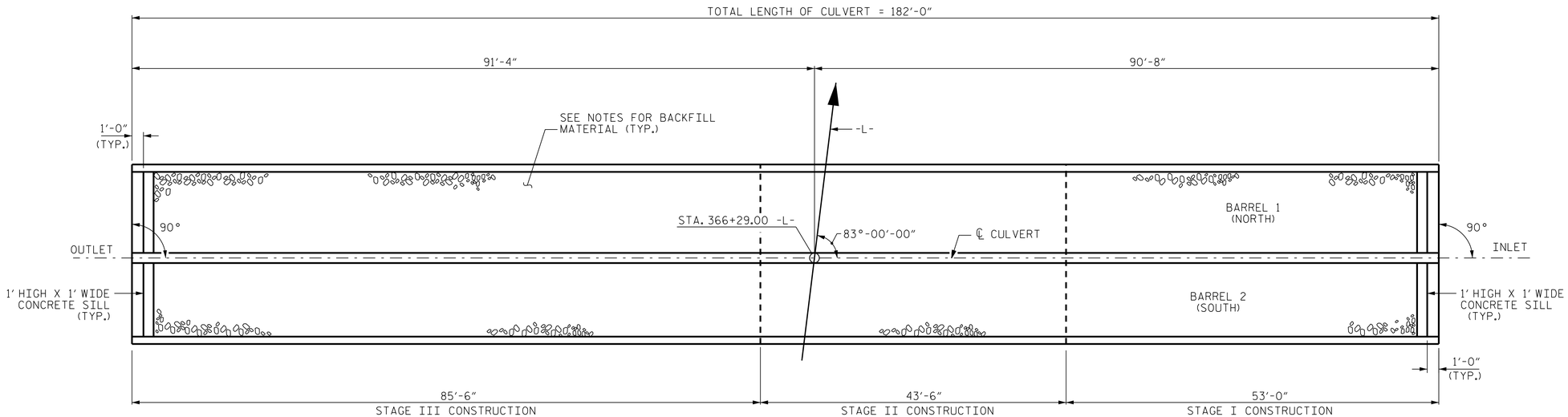
IF RIP RAP IS USED TO LINE THE FLOW CULVERT BARRELS, NATIVE MATERIAL SHOULD BE PLACED ON TOP TO FILL VOIDS AND PROVIDE A FLAT SURFACE FOR ANIMAL PASSAGE.

NATIVE MATERIAL IS SUBJECT TO APPROVAL BY THE ENGINEER AND MAY BE SUBJECT TO PERMIT CONDITIONS.

SILLS ARE TO BE 1 FOOT, CAST SEPARATELY AND ATTACHED BY DOWELS.

TOP OF SILLS SHOULD MATCH STREAM BED ELEVATION.

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.



PLAN

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 366+29.00 -L-

SHEET 6 OF 8

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

DETAILS OF SILLS FOR CONCRETE BOX CULVERT

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Ting Fang
60E43C9AEA80462...
3/18/2022

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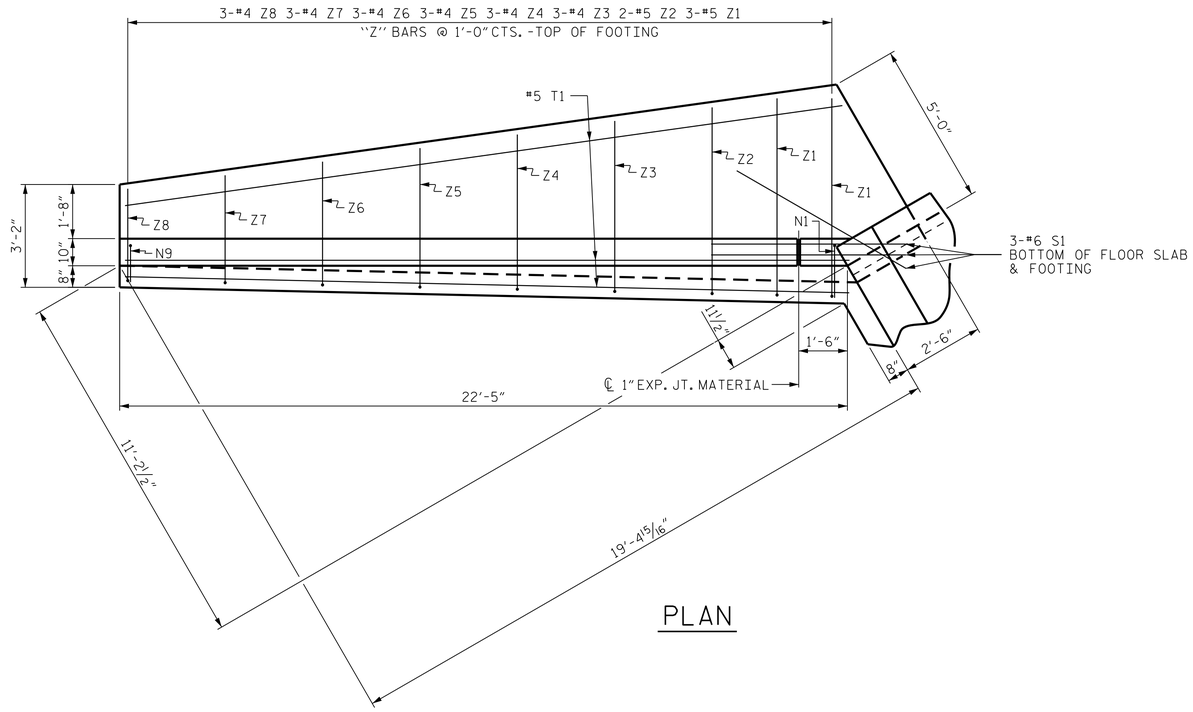
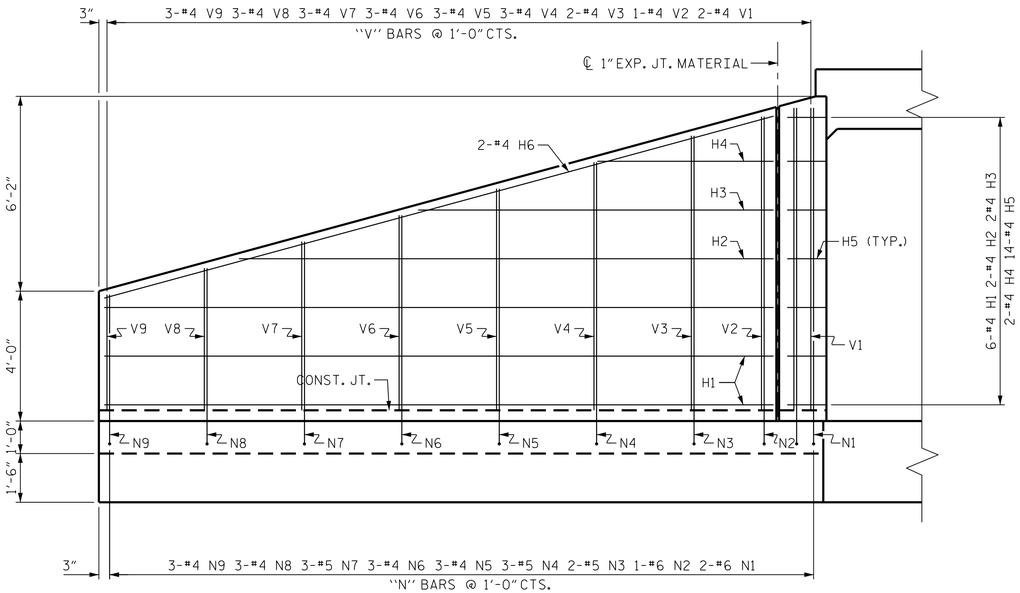
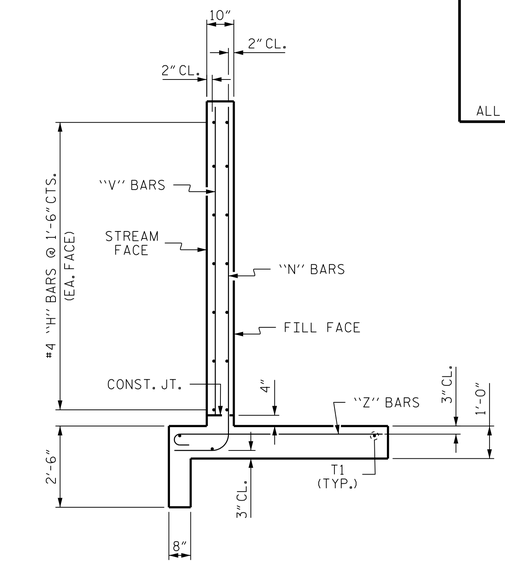


PLAN

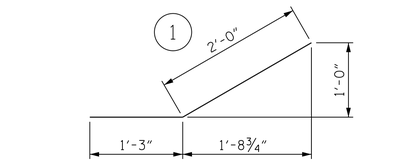


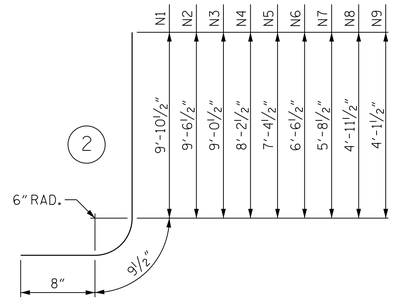
ELEVATION

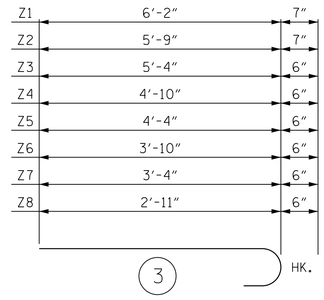


TYPICAL WING SECTION

BAR TYPES







ALL BAR DIMENSIONS ARE OUT TO OUT.

BILL OF MATERIAL

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
H1	24	#4	STR	20'-7"	330
H2	8	#4	STR	16'-6"	88
H3	8	#4	STR	10'-11"	58
H4	8	#4	STR	5'-5"	29
H5	56	#4	1	3'-3"	122
H6	8	#4	STR	21'-4"	114
N1	8	#6	2	11'-4"	136
N2	4	#6	2	11'-0"	66
N3	12	#5	2	10'-6"	88
N4	12	#5	2	9'-8"	121
N5	12	#4	2	8'-10"	111
N6	12	#4	2	8'-0"	64
N7	12	#5	2	7'-2"	57
N8	12	#4	2	6'-5"	51
N9	12	#4	2	5'-7"	45
S1	12	#6	STR	6'-0"	108
T1	12	#5	STR	22'-4"	280
V1	8	#4	STR	9'-4"	50
V2	4	#4	STR	9'-0"	24
V3	12	#4	STR	8'-6"	45
V4	12	#4	STR	7'-8"	61
V5	12	#4	STR	6'-10"	55
V6	12	#4	STR	6'-0"	48
V7	12	#4	STR	5'-2"	41
V8	12	#4	STR	4'-5"	35
V9	12	#4	STR	3'-7"	29
Z1	12	#5	3	6'-9"	84
Z2	8	#5	3	6'-4"	53
Z3	12	#4	3	5'-10"	47
Z4	12	#4	3	5'-4"	43
Z5	12	#4	3	4'-10"	39
Z6	12	#4	3	4'-4"	35
Z7	12	#4	3	3'-10"	31
Z8	12	#4	3	3'-5"	27

REINFORCING STEEL
FOR 4 WINGS 2,616 LBS

CLASS A CONCRETE
4 WINGS 38.9 CY
2 HEADWALLS 1.7 CY
2 END CURTAIN WALLS 1.8 CY
TOTAL 42.4 CY

PROJECT NO. I-5987A
ROBESON COUNTY
STATION: 366+29.00 -L-

SHEET 7 OF 8

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CDM Smith
CDM SMITH
5400 Glenwood Avenue, Suite 400
Raleigh, NC 27612-3228
NC COA No. F-1255

DRAWN BY : JJR DATE : 9/21
CHECKED BY : THF DATE : 12/21
DESIGN ENGINEER : VDK DATE : 12/21

DWG. No.

NORTH CAROLINA PROFESSIONAL SEAL 16301 ENGINEER TING HSIUNG FANG
Ting Fang
60E43C0AEA80462...
3/18/2022

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

WINGS FOR CONCRETE BOX CULVERT

H = 9'-0" SLOPE = 3:1
90° SKEW

REVISIONS						SHEET NO.
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SITE 12

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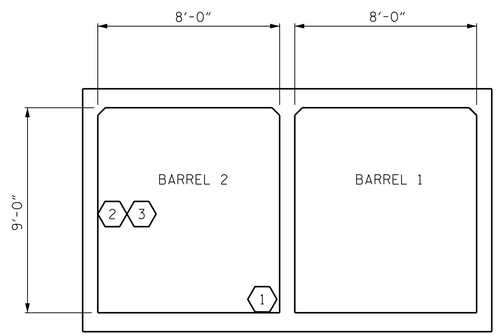
LOAD AND RESISTANCE FACTOR RATING (LRFR) SUMMARY FOR REINFORCED CONCRETE BOX CULVERTS

LEVEL		VEHICLE	WEIGHT (W) (TONS)	CONTROLLING LOAD RATING (#)	MINIMUM RATING FACTORS (RF)	TONS = W x RF	STRENGTH I LIMIT STATE									COMMENT NUMBER
								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)	1.41	--	1.75	1.71	1	BOTTOM SLAB	8.00	1.41	1	BOTTOM SLAB	8.00	
		HL-93 (OPERATING)	N/A		1.83	--	1.35	2.21	1	BOTTOM SLAB	8.00	1.83	1	BOTTOM SLAB	8.00	
		HS-20 (INVENTORY)	36.000	(2)	1.38	49.68	1.75	1.38	1	EXTERIOR WALL	4.50	1.88	1	BOTTOM SLAB	8.00	
		HS-20 (OPERATING)	36.000		1.79	64.44	1.35	1.79	1	EXTERIOR WALL	4.50	2.44	1	BOTTOM SLAB	8.00	
LEGAL LOAD RATING	SINGLE VEHICLE (SV)	SH	12.500	(3)	1.73	21.63	1.40	1.73	1	EXTERIOR WALL	4.50	2.48	1	BOTTOM SLAB	8.00	
		S3C	21.500		1.73	37.20	1.40	1.73	1	EXTERIOR WALL	4.50	2.60	1	BOTTOM SLAB	8.00	
		S3A	22.750		1.73	39.36	1.40	1.73	1	EXTERIOR WALL	4.50	2.60	1	BOTTOM SLAB	8.00	
		S4A	26.750		1.73	46.28	1.40	1.73	1	EXTERIOR WALL	4.50	2.60	1	BOTTOM SLAB	8.00	
		S5A	30.500		1.73	52.77	1.40	1.73	1	EXTERIOR WALL	4.50	2.60	1	BOTTOM SLAB	8.00	
		S6A	34.500		1.73	59.69	1.40	1.73	1	EXTERIOR WALL	4.50	2.60	1	BOTTOM SLAB	8.00	
		S7B	38.500		1.73	66.61	1.40	1.73	1	EXTERIOR WALL	4.50	2.60	1	BOTTOM SLAB	8.00	
		S7A	40.000		1.73	69.20	1.40	1.73	1	EXTERIOR WALL	4.50	2.60	1	BOTTOM SLAB	8.00	
	TRUCK TRACTOR SEMI-TRAILER (TTST)	T4A	28.250		1.73	48.87	1.40	1.73	1	EXTERIOR WALL	4.50	2.60	1	BOTTOM SLAB	8.00	
		T5B	32.000		1.73	55.36	1.40	1.73	1	EXTERIOR WALL	4.50	2.60	1	BOTTOM SLAB	8.00	
		T6A	36.000		1.73	62.28	1.40	1.73	1	EXTERIOR WALL	4.50	2.60	1	BOTTOM SLAB	8.00	
		T7A	40.000		1.73	69.20	1.40	1.73	1	EXTERIOR WALL	4.50	2.60	1	BOTTOM SLAB	8.00	
		T7B	40.000		1.73	69.20	1.40	1.73	1	EXTERIOR WALL	4.50	2.60	1	BOTTOM SLAB	8.00	



LRFR SUMMARY
(LOOKING DOWNSTREAM)

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

PROJECT NO. I-5987A
ROBESON COUNTY
STATION: 366+29.00 -L-

SHEET 8 OF 8

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH
STANDARD

LRFR SUMMARY FOR REINFORCED CONCRETE BOX CULVERTS
(INTERSTATE TRAFFIC)

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

CDM Smith
CDM SMITH
5400 Glenwood Avenue, Suite 400
Raleigh, NC 27612-3228
NC COA No. F-1255

DRAWN BY : JJR DATE : 9/21
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DESIGN ENGINEER : VDK DATE : 12/21

DWG. No.

NORTH CAROLINA PROFESSIONAL SEAL 16301 ENGINEER TING HSIUNG FANG
Ting Fang
3/18/2022

REVISIONS						SHEET NO.
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STD. NO. LRFR5 SITE 12

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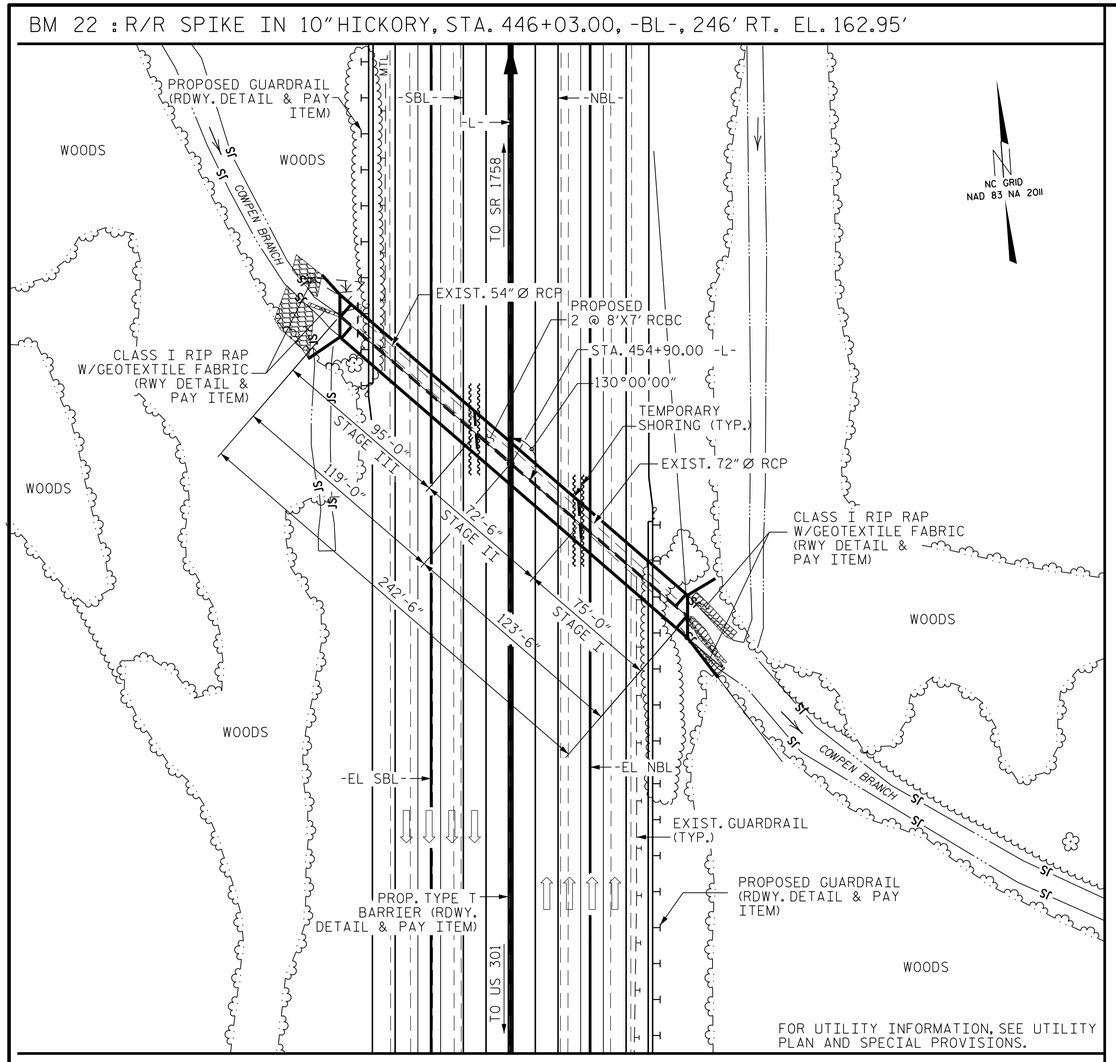


ROADWAY DATA

GRADE PT. EL. @ STA. 454+90.00 -NBL-	= 168.30'
BED ELEV. @ STA. 454+90.00 -L-	= 154.40'
ROADWAY SLOPE	= 3 : 1

HYDRAULIC DATA

DESIGN DISCHARGE	= 550 CFS
FREQUENCY OF DESIGN FLOOD	= 100 YRS.
DESIGN HIGH WATER ELEVATION	= 164.5'
DRAINAGE AREA	= 1.66 SQ. MI.
BASE DISCHARGE (Q100)	= 550 CFS
BASE HIGH WATER ELEVATION	= 164.5'

OVERTOPPING FLOOD DATA

OVERTOPPING DISCHARGE	= 330± CFS
FREQUENCY OF OVERTOPPING FLOOD	= 10 YRS.
OVERTOPPING FLOOD ELEVATION	= 162.9' ✳

✳ OT AT DRAINAGE DIVIDE @ STA. 444+50.00 -L- LT. ELEV. = 162.9'

TOTAL STRUCTURE QUANTITIES

CULVERT EXCAVATION	LUMP SUM
FOUNDATION COND. MATERIAL	
STAGE I	116 TONS
STAGE II	113 TONS
STAGE III	147 TONS
TOTAL	376 TONS
CLASS A CONCRETE	
STAGE I	148.1 C.Y.
STAGE II	123.7 C.Y.
STAGE III	181.1 C.Y.
TOTAL	452.9 C.Y.
REINFORCING STEEL	
STAGE I	21,805 LBS.
STAGE II	19,756 LBS.
STAGE III	26,878 LBS.
TOTAL	68,439 LBS.

NOTES

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

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

FOR CONSTRUCTION SEQUENCE, EROSION CONTROL AND MEASURES, SEE EROSION CONTROL PLANS.

DESIGN FILL---------- 6.28'

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:

STAGES I - CONSTRUCT RCBC SECTION AT OUTLET END.
STAGES III - CONSTRUCT RCBC SECTION AT INLET END.

1. WING FOOTINGS AND FLOOR SLAB INCLUDING 4" OF ALL VERTICAL WALLS.
2. SILLS WITH NATIVE MATERIAL BACKFILL IN BOTH BARRELS.
3. FOLLOWED BY THE WING WALLS FULL HEIGHT. ROOF SLAB AND HEADWALL.

STAGE II - CONSTRUCT RCBC INTERMEDIATE SECTION.

1. FLOOR SLAB INCLUDING 4" OF ALL VERTICAL WALLS.
2. FOLLOWED BY NATIVE MATERIAL BACKFILL AND ROOF SLAB.

THE CONTRACTOR 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 BARRELS ARE SHOWN ON WING SHEET.

TRANSVERSE CONSTRUCTION JOINTS SHALL BE USED IN THE BARRELS, SPACED TO LIMIT THE POURS TO A MAXIMUM OF 70 FEET. LOCATION OF JOINTS SHALL BE SUBJECT TO APPROVAL OF 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 SHALL BE PAID FOR BY CONTRACTOR.

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.

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.

NO PRECAST REINFORCED BOX CULVERT OPTION WILL BE ALLOWED.

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.

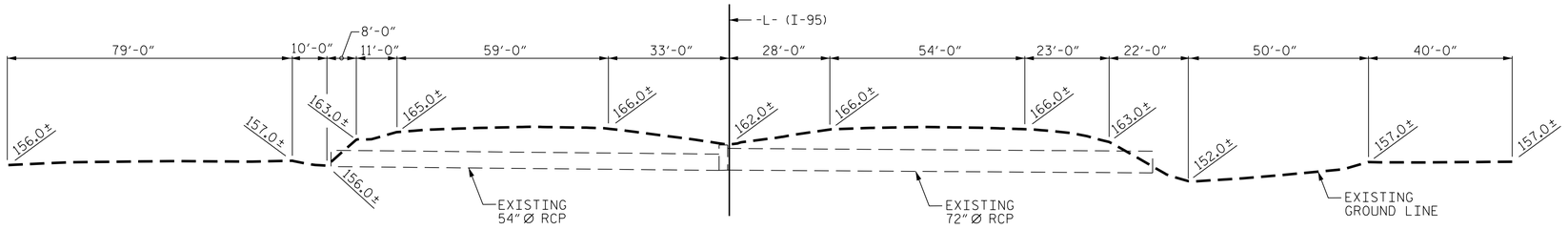
FOR TRAFFIC PHASING, LIMITS OF TEMPORARY SHORING, SEE TRAFFIC CONTROL PLANS.

FOR PAY ITEM FOR TEMPORARY SHORING, SEE ROADWAY PLANS.

FOUNDATION NOTES

BACKFILL WITH SELECT MATERIAL, CLASS VI MEETING THE REQUIREMENTS OF SECTION 1016 OF THE STANDARD SPECIFICATIONS.

SEE SECTION 414 OF THE STANDARD SPECIFICATIONS FOR CULVERT EXCAVATION AND BACKFILLING. EXCAVATE 1 FOOT BELOW CULVERT AND FOOTING AND REPLACE WITH FOUNDATION CONDITIONING MATERIAL IN ACCORDANCE WITH ARTICLE 414-4 OF THE STANDARD SPECIFICATIONS.



PROFILE ALONG ℄ CULVERT

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 454+90.00 -L-

SHEET 1 OF 8 STRUCTURE NO. E27

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

BARREL STANDARD

DOUBLE 8 FT. X 7 FT. CONCRETE BOX CULVERT 130° SKEW

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

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5400 Glenwood Avenue, Suite 400
Raleigh, NC 27612-3228
NC COA No. F-1255

DRAWN BY : JJR DATE : 10/21
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DWG. No.

NORTH CAROLINA PROFESSIONAL SEAL 16301 ENGINEER TING HSIUNG FANG
Ting Fang
60E43C9AEA60462...
3/17/2022

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SITE 13

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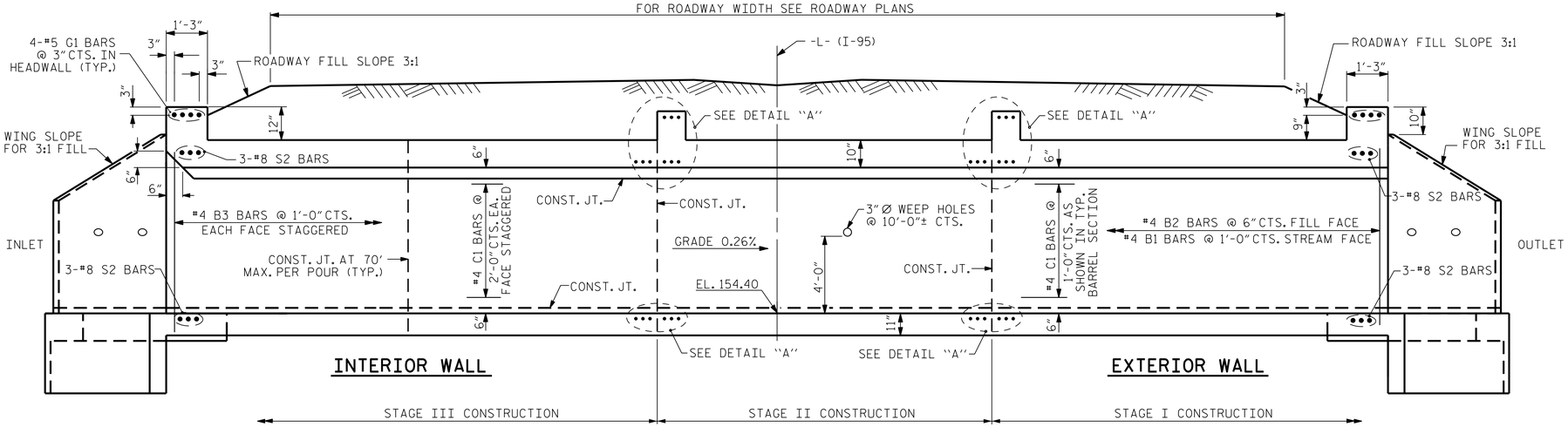
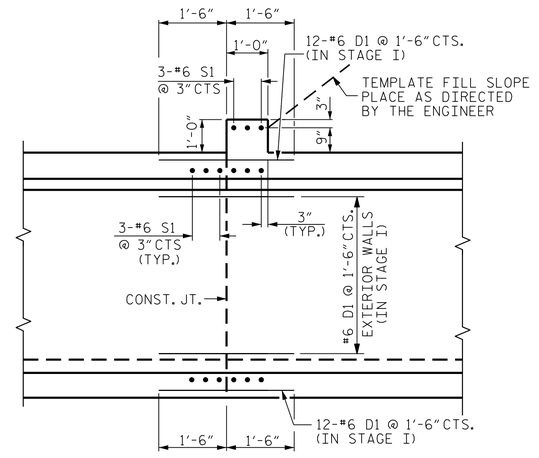
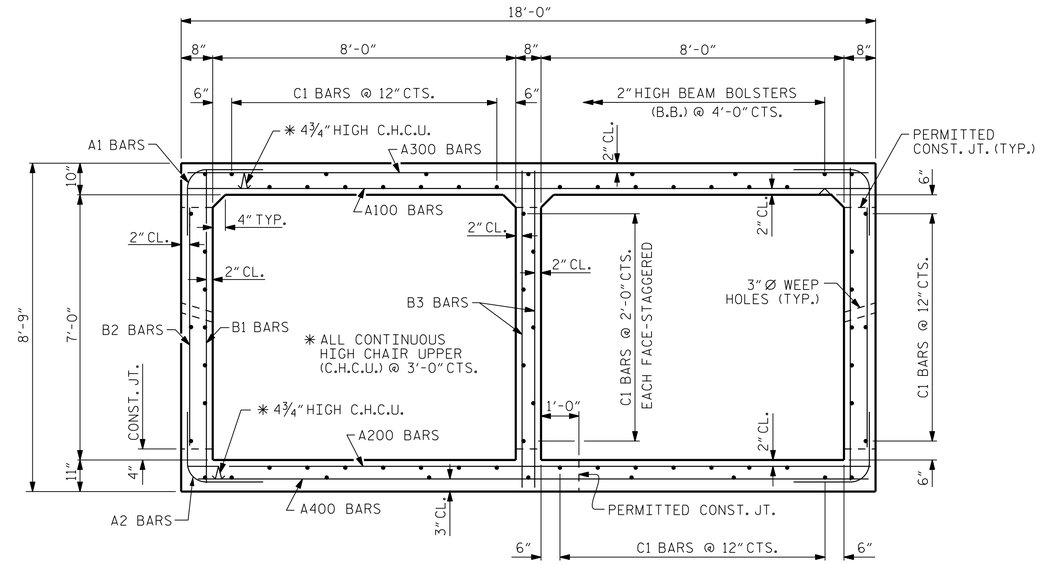


CULVERT SECTION NORMAL TO ROADWAY

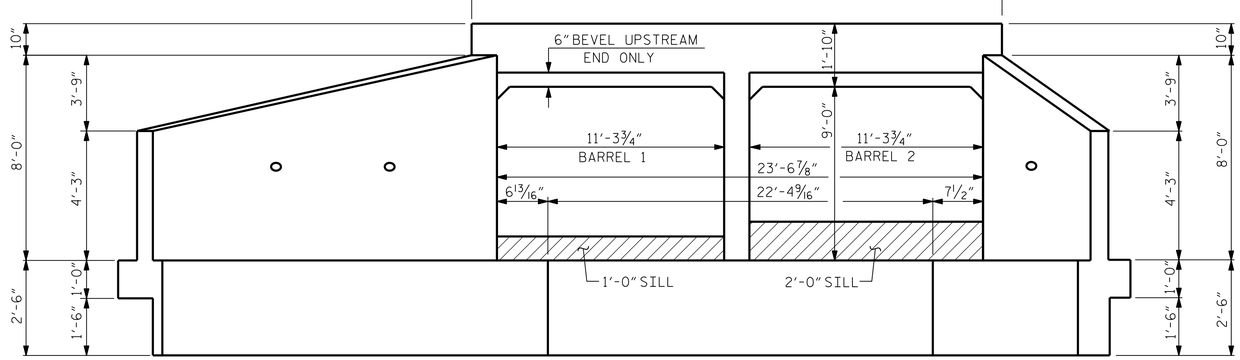


DETAIL "A"



RIGHT ANGLE SECTION OF BARREL

THERE ARE 69 C1 BARS IN SECTION OF BARREL.



INLET END ELEVATION NORMAL TO SKEW

OUTLET END ELEVATION SIMILAR BY ROTATION

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 454+90.00 -L-

SHEET 2 OF 8

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

BARREL STANDARD

DOUBLE 8 FT. X 7 FT. CONCRETE BOX CULVERT

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NORTH CAROLINA PROFESSIONAL SEAL 16301 ENGINEER TING HSILING FANG
Ting Fang
DocuSigned by: 3/17/2022

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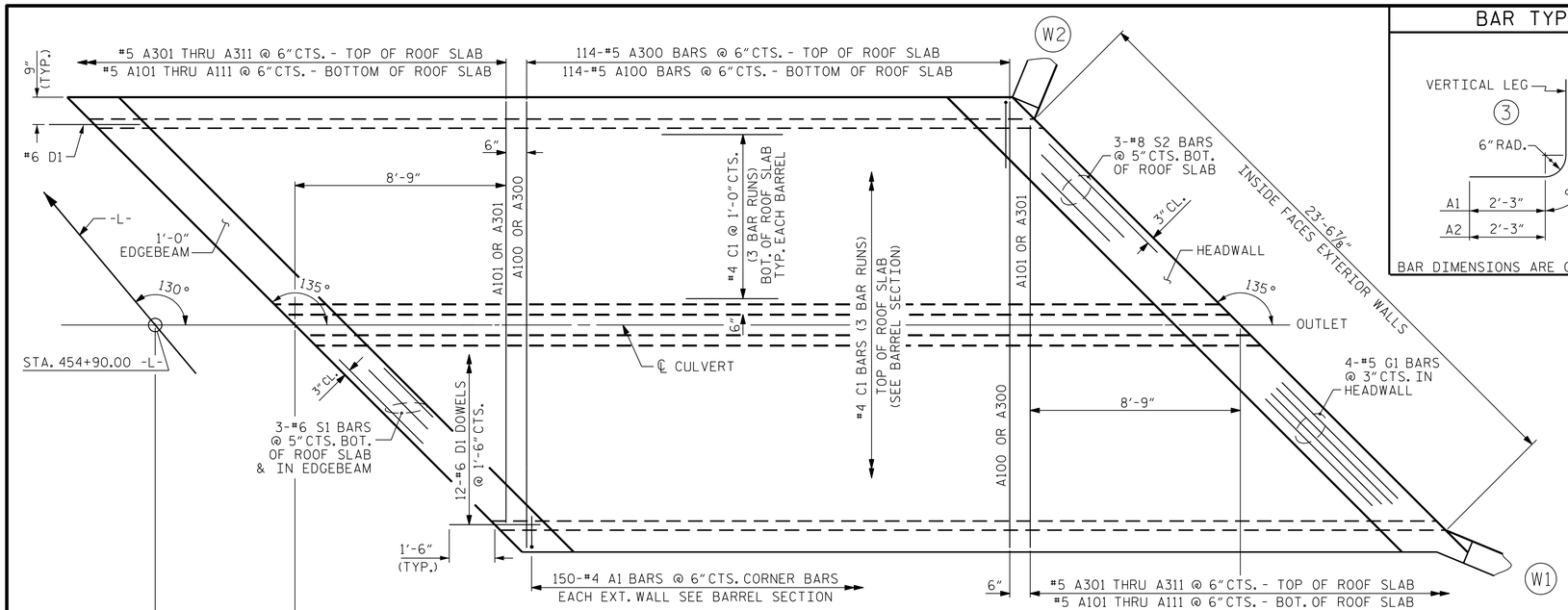
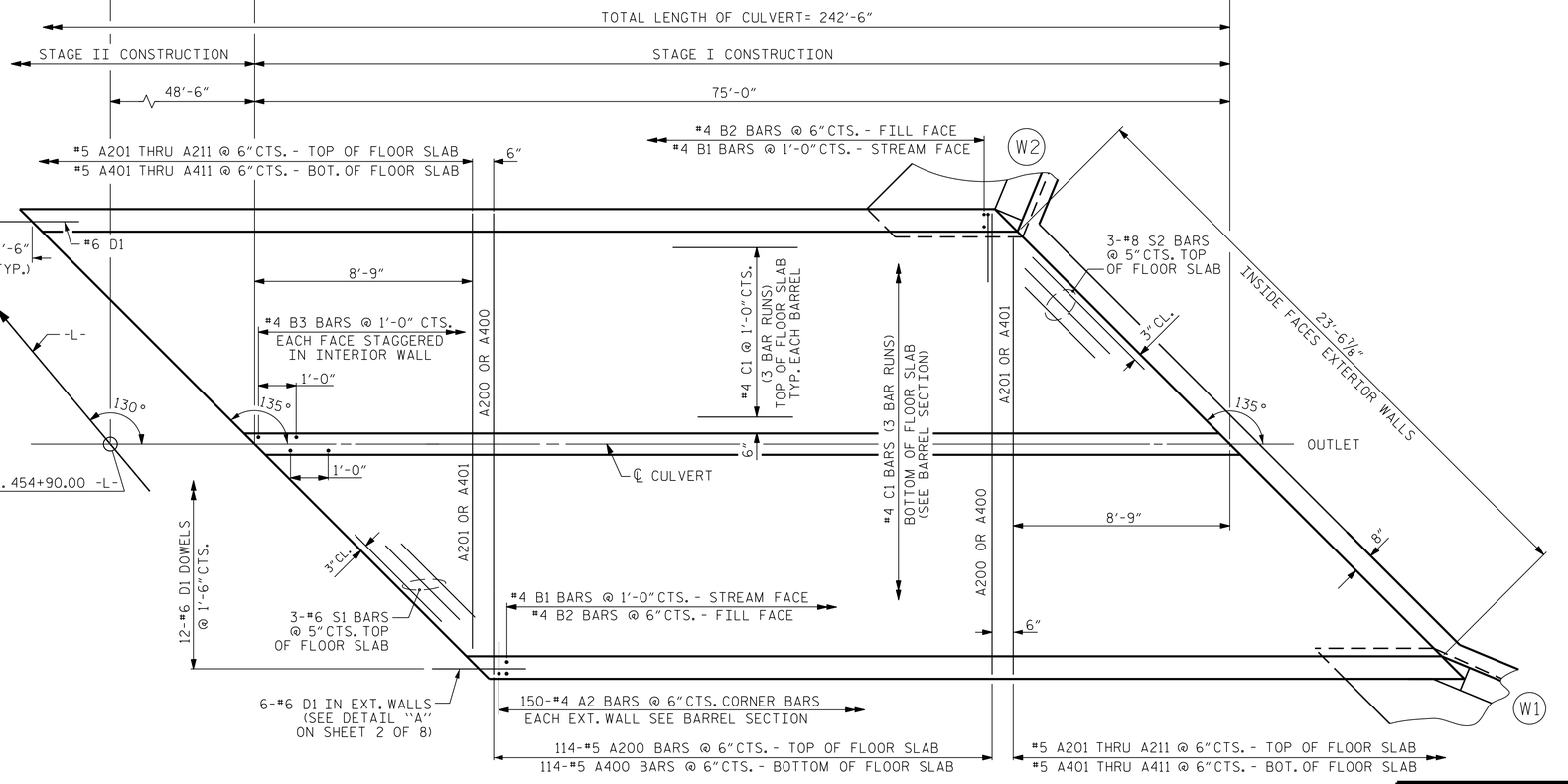


STAGE I - PLAN OF ROOF SLAB



STAGE I - PLAN OF FLOOR SLAB

STMHS

BAR TYPE

BAR DIMENSIONS ARE OUT TO OUT

REINFORCING BAR SCHEDULE

STAGE I

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT	BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
A1	300	#4	3	5'-10"	1169	A303	6	#5	STR	13'-4"	83
A2	300	#4	3	5'-6"	1102	A304	6	#5	STR	11'-10"	74
						A305	6	#5	STR	10'-4"	65
A100	114	#5	STR	17'-8"	2101	A306	6	#5	STR	8'-10"	55
A101	6	#5	STR	16'-4"	102	A307	6	#5	STR	7'-4"	46
A102	6	#5	STR	14'-10"	93	A308	6	#5	STR	5'-10"	37
A103	6	#5	STR	13'-4"	83	A309	6	#5	STR	4'-4"	27
A104	6	#5	STR	11'-10"	74	A310	6	#5	STR	2'-10"	18
A105	6	#5	STR	10'-4"	65	A311	6	#5	STR	1'-4"	8
A106	6	#5	STR	8'-10"	55						
A107	6	#5	STR	7'-4"	46	A400	114	#5	STR	17'-8"	2101
A108	6	#5	STR	5'-10"	37	A401	6	#5	STR	16'-4"	102
A109	6	#5	STR	4'-4"	27	A402	6	#5	STR	14'-10"	93
A110	6	#5	STR	2'-10"	18	A403	6	#5	STR	13'-4"	83
A111	6	#5	STR	1'-4"	8	A404	6	#5	STR	11'-10"	74
						A405	6	#5	STR	10'-4"	65
A200	114	#5	STR	17'-8"	2101	A406	6	#5	STR	8'-10"	55
A201	6	#5	STR	16'-4"	102	A407	6	#5	STR	7'-4"	46
A202	6	#5	STR	14'-10"	93	A408	6	#5	STR	5'-10"	37
A203	6	#5	STR	13'-4"	83	A409	6	#5	STR	4'-4"	27
A204	6	#5	STR	11'-10"	74	A410	6	#5	STR	2'-10"	18
A205	6	#5	STR	10'-4"	65	A411	6	#5	STR	1'-4"	8
A206	6	#5	STR	8'-10"	55						
A207	6	#5	STR	7'-4"	46	B1	150	#4	STR	8'-5"	843
A208	6	#5	STR	5'-10"	37	B2	298	#4	STR	6'-4"	1261
A209	6	#5	STR	4'-4"	27	B3	150	#4	STR	8'-5"	843
A210	6	#5	STR	2'-10"	18						
A211	6	#5	STR	1'-4"	8	C1	207	#6	STR	26'-2"	3618
A300	114	#5	STR	17'-8"	2101	D1	36	#6	STR	3'-0"	162
A301	6	#5	STR	16'-4"	102	D2	3	#6	STR	1'-6"	7
A302	6	#5	STR	14'-10"	93	D3	3	#6	STR	2'-3"	10
						G1	4	#5	STR	25'-0"	104
						S1	9	#6	STR	25'-0"	338
						S2	6	#8	STR	25'-0"	401

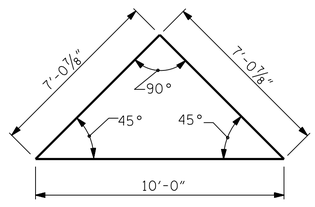
REINFORCING STEEL LBS. 20,695

SPLICE LENGTHS CHART

BAR	SIZE	SPLICE LENGTH
C1	#4	1'-10"

TOTAL STRUCTURE QUANTITIES STAGE I

FOUNDATION COND. MAT'L	116	TONS
CULVERT EXCAVATION	LUMP SUM	
CLASS A CONCRETE		
BARREL @ 1.693 CY/FT	127.0	C.Y.
WINGS ETC.	19.3	C.Y.
SILLS	0.9	C.Y.
EDGE BEAM	0.9	C.Y.
TOTAL	148.1	C.Y.
REINFORCING STEEL		
BARREL & SILLS	20,695	LBS.
WINGS ETC.	1,110	LBS.
TOTAL	21,805	LBS.



SKEW TRIANGLE

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 454+90.00 -L-

SHEET 3 OF 8

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NC COA No. F-1255

DRAWN BY : JJR DATE : 10/21
CHECKED BY : THF DATE : 11/21
DESIGN ENGINEER : VDK DATE : 12/21

DWG. No.

NORTH CAROLINA PROFESSIONAL SEAL 16301 ENGINEER TING-HSIUNG FANG
Ting Fang
60E43C9AEA604A2...
3/17/2022

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH
BARREL STANDARD

DOUBLE 8 FT. X 7 FT. CONCRETE BOX CULVERT

STAGE I

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C13-3
1			3			TOTAL SHEETS
2			4			8

SITE 13

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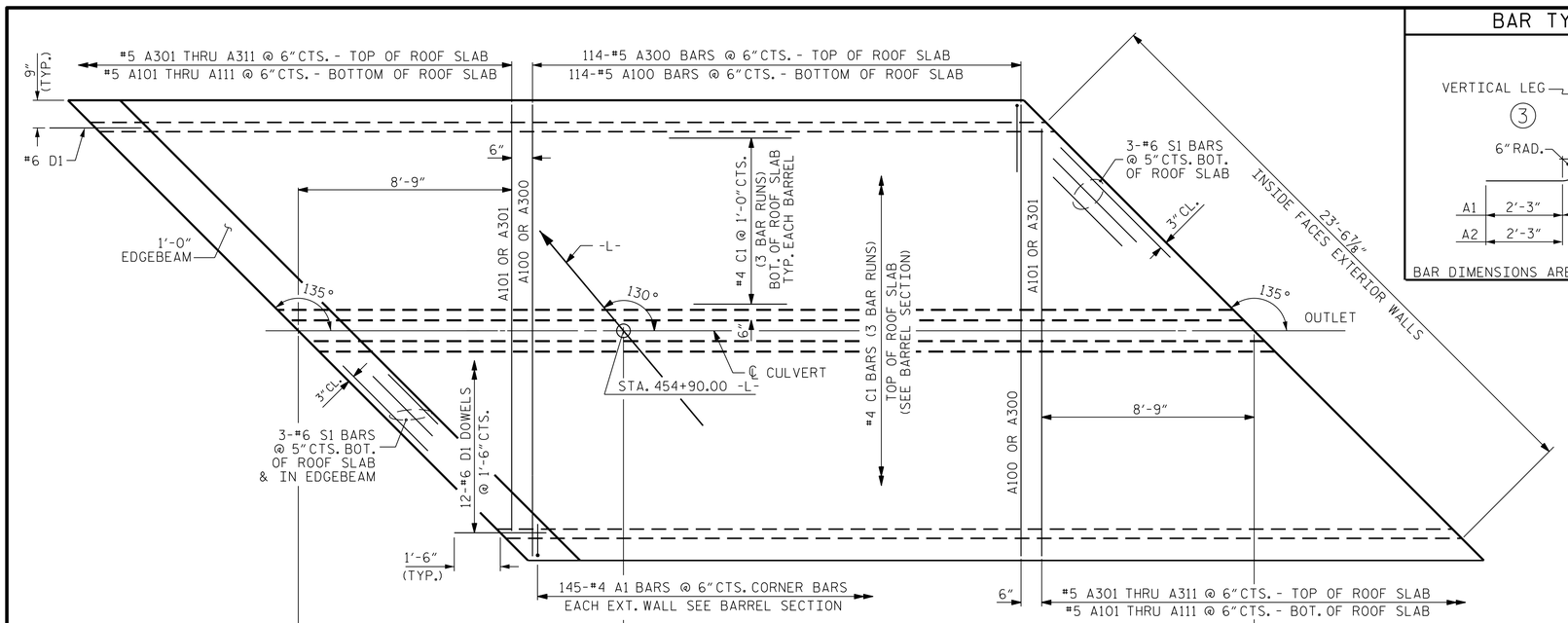
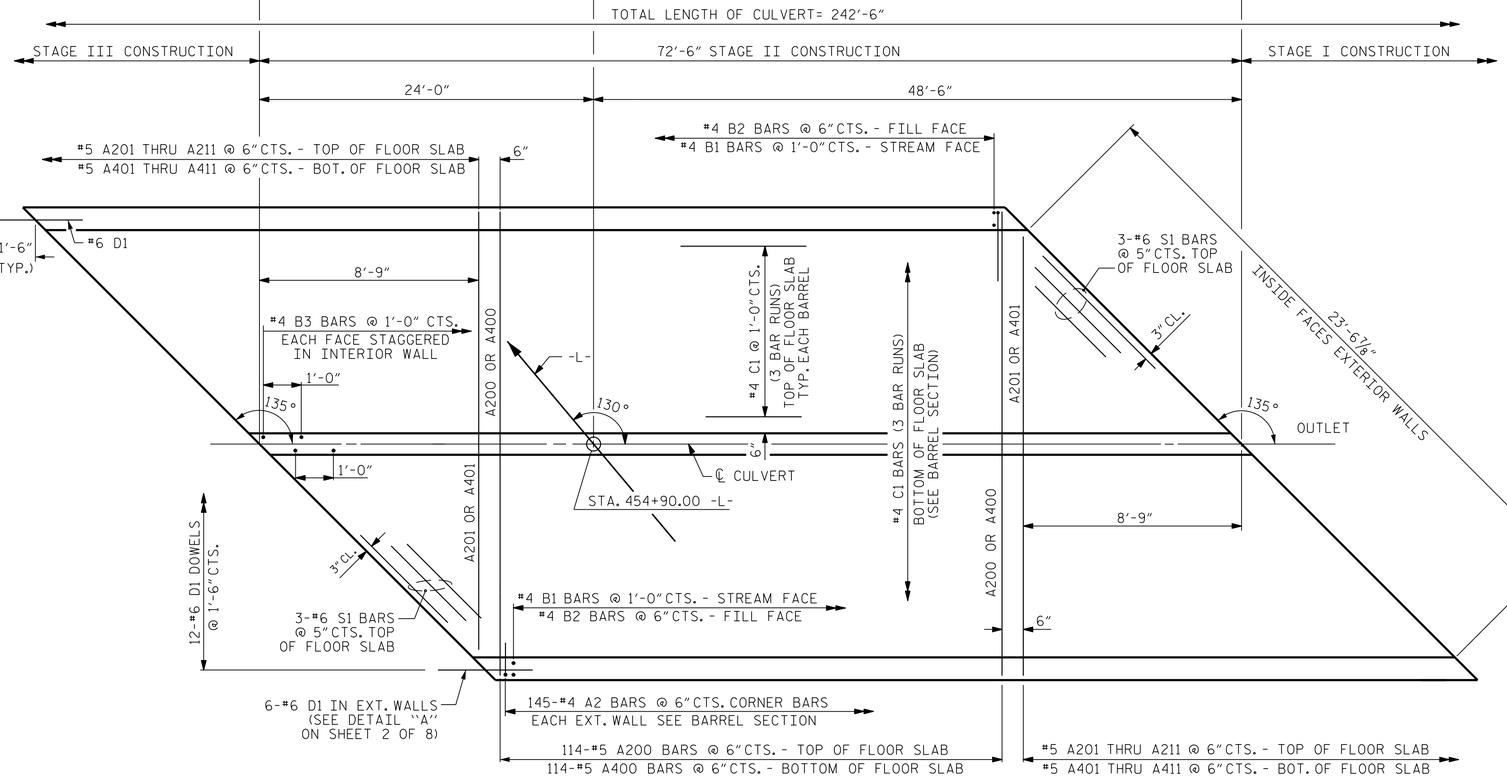


STAGE II - PLAN OF ROOF SLAB



STAGE II - PLAN OF FLOOR SLAB

BAR TYPE

BAR DIMENSIONS ARE OUT TO OUT

REINFORCING BAR SCHEDULE

STAGE II

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT	BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
A1	290	#4	3	5'-10"	1130	A303	6	#5	STR	13'-4"	83
A2	290	#4	3	5'-6"	1065	A304	6	#5	STR	11'-10"	74
						A305	6	#5	STR	10'-4"	65
A100	109	#5	STR	17'-8"	2008	A306	6	#5	STR	8'-10"	55
A101	6	#5	STR	16'-4"	102	A307	6	#5	STR	7'-4"	46
A102	6	#5	STR	14'-10"	93	A308	6	#5	STR	5'-10"	37
A103	6	#5	STR	13'-4"	83	A309	6	#5	STR	4'-4"	27
A104	6	#5	STR	11'-10"	74	A310	6	#5	STR	2'-10"	18
A105	6	#5	STR	10'-4"	65	A311	6	#5	STR	1'-4"	8
A106	6	#5	STR	8'-10"	55						
A107	6	#5	STR	7'-4"	46	A400	109	#5	STR	17'-8"	2008
A108	6	#5	STR	5'-10"	37	A401	6	#5	STR	16'-4"	102
A109	6	#5	STR	4'-4"	27	A402	6	#5	STR	14'-10"	93
A110	6	#5	STR	2'-10"	18	A403	6	#5	STR	13'-4"	83
A111	6	#5	STR	1'-4"	8	A404	6	#5	STR	11'-10"	74
						A405	6	#5	STR	10'-4"	65
A200	109	#5	STR	17'-8"	2008	A406	6	#5	STR	8'-10"	55
A201	6	#5	STR	16'-4"	102	A407	6	#5	STR	7'-4"	46
A202	6	#5	STR	14'-10"	93	A408	6	#5	STR	5'-10"	37
A203	6	#5	STR	13'-4"	83	A409	6	#5	STR	4'-4"	27
A204	6	#5	STR	11'-10"	74	A410	6	#5	STR	2'-10"	18
A205	6	#5	STR	10'-4"	65	A411	6	#5	STR	1'-4"	8
A206	6	#5	STR	8'-10"	55						
A207	6	#5	STR	7'-4"	46	B1	146	#4	STR	8'-5"	821
A208	6	#5	STR	5'-10"	37	B2	290	#4	STR	6'-4"	1227
A209	6	#5	STR	4'-4"	27	B3	146	#4	STR	8'-5"	821
A210	6	#5	STR	2'-10"	18						
A211	6	#5	STR	1'-4"	8	C1	207	#6	STR	25'-4"	3503
A300	109	#5	STR	17'-8"	2008	D1	36	#6	STR	3'-0"	162
A301	6	#5	STR	16'-4"	102						
A302	6	#5	STR	14'-10"	93	S1	15	#6	STR	25'-0"	563

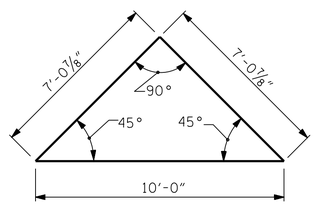
REINFORCING STEEL LBS. 19,756

SPLICE LENGTHS CHART

BAR	SIZE	SPLICE LENGTH
C1	#4	1'-10"

TOTAL STRUCTURE QUANTITIES STAGE II

FOUNDATION COND. MAT'L	113	TONS
CULVERT EXCAVATION	LUMP SUM	
CLASS A CONCRETE		
BARREL @ 1.693 CY/FT	122.8	C.Y.
EDGE BEAM	0.9	C.Y.
TOTAL	123.7	C.Y.
REINFORCING STEEL		
BARREL & EDGE BEAM	19,756	LBS.
TOTAL	19,756	LBS.



SKEW TRIANGLE

PROJECT NO. I-5987A
ROBESON COUNTY
STATION: 454+90.00 -L-

SHEET 4 OF 8

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NORTH CAROLINA PROFESSIONAL SEAL 16301 ENGINEER TING-HSILING FANG
Ting Fang
60E43C9AEA60462...
3/17/2022

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH
BARREL STANDARD

DOUBLE 8 FT. X 7 FT. CONCRETE BOX CULVERT

STAGE II

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C13-4
1			3			TOTAL SHEETS
2			4			8

SITE 13

STIKES

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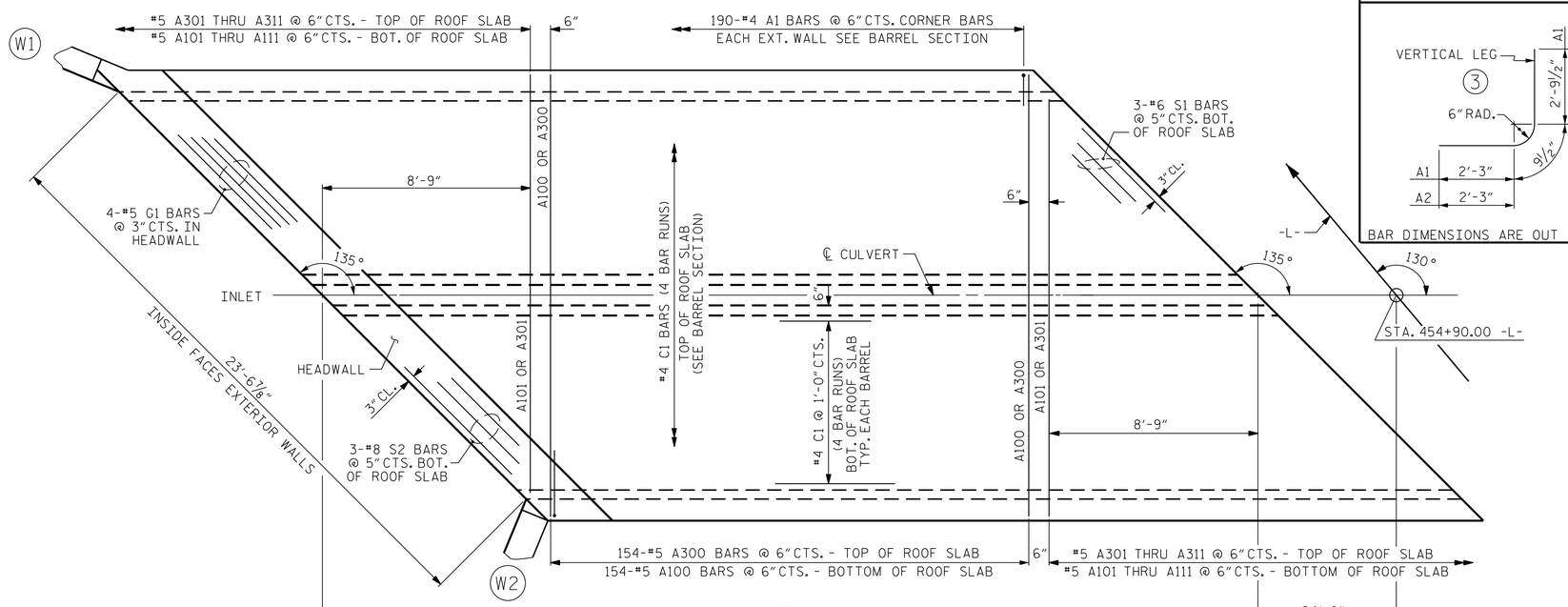
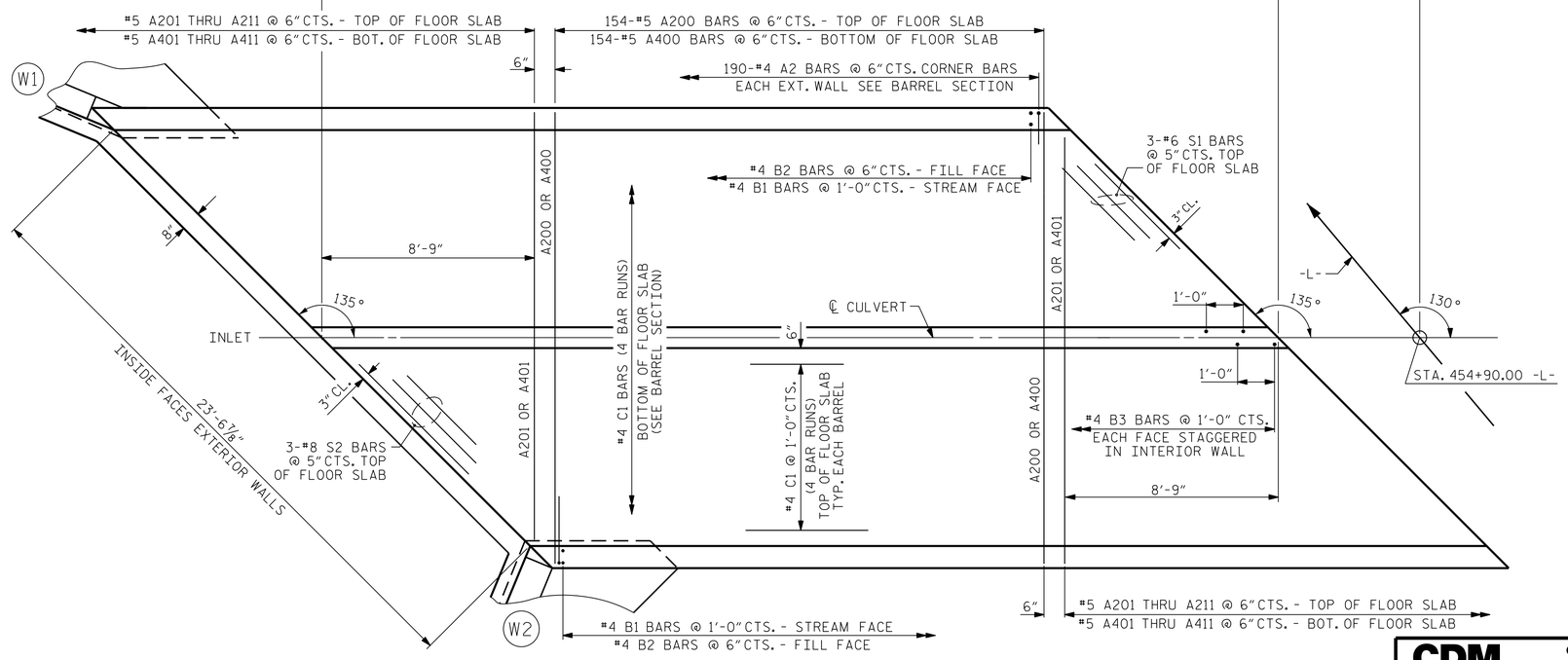


STAGE III - PLAN OF ROOF SLAB



STAGE III - PLAN OF FLOOR SLAB

BAR TYPE

BAR DIMENSIONS ARE OUT TO OUT

REINFORCING BAR SCHEDULE

STAGE III

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT	BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
A1	380	#4	3	5'-10"	1481	A303	6	#5	STR	13'-4"	83
A2	380	#4	3	5'-6"	1396	A304	6	#5	STR	11'-10"	74
						A305	6	#5	STR	10'-4"	65
A100	154	#5	STR	17'-8"	2838	A306	6	#5	STR	8'-10"	55
A101	6	#5	STR	16'-4"	102	A307	6	#5	STR	7'-4"	46
A102	6	#5	STR	14'-10"	93	A308	6	#5	STR	5'-10"	37
A103	6	#5	STR	13'-4"	83	A309	6	#5	STR	4'-4"	27
A104	6	#5	STR	11'-10"	74	A310	6	#5	STR	2'-10"	18
A105	6	#5	STR	10'-4"	65	A311	6	#5	STR	1'-4"	8
A106	6	#5	STR	8'-10"	55						
A107	6	#5	STR	7'-4"	46	A400	154	#5	STR	17'-8"	2838
A108	6	#5	STR	5'-10"	37	A401	6	#5	STR	16'-4"	102
A109	6	#5	STR	4'-4"	27	A402	6	#5	STR	14'-10"	93
A110	6	#5	STR	2'-10"	18	A403	6	#5	STR	13'-4"	83
A111	6	#5	STR	1'-4"	8	A404	6	#5	STR	11'-10"	74
						A405	6	#5	STR	10'-4"	65
A200	154	#5	STR	17'-8"	2838	A406	6	#5	STR	8'-10"	55
A201	6	#5	STR	16'-4"	102	A407	6	#5	STR	7'-4"	46
A202	6	#5	STR	14'-10"	93	A408	6	#5	STR	5'-10"	37
A203	6	#5	STR	13'-4"	83	A409	6	#5	STR	4'-4"	27
A204	6	#5	STR	11'-10"	74	A410	6	#5	STR	2'-10"	18
A205	6	#5	STR	10'-4"	65	A411	6	#5	STR	1'-4"	8
A206	6	#5	STR	8'-10"	55						
A207	6	#5	STR	7'-4"	46	B1	190	#4	STR	8'-5"	1068
A208	6	#5	STR	5'-10"	37	B2	378	#4	STR	6'-4"	1599
A209	6	#5	STR	4'-4"	27	B3	190	#4	STR	8'-5"	1068
A210	6	#5	STR	2'-10"	18						
A211	6	#5	STR	1'-4"	8	C1	276	#6	STR	25'-1"	4625
A300	154	#5	STR	17'-8"	2838	D2	3	#6	STR	1'-6"	7
A301	6	#5	STR	16'-4"	102	D3	3	#6	STR	2'-3"	10
A302	6	#5	STR	14'-10"	93						
						G1	4	#5	STR	25'-0"	104
						S1	6	#6	STR	25'-0"	225
						S2	6	#8	STR	25'-0"	401

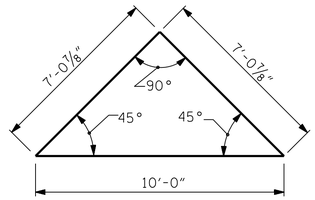
REINFORCING STEEL LBS. 25,768

SPLICE LENGTHS CHART

BAR	SIZE	SPLICE LENGTH
C1	#4	1'-10"

TOTAL STRUCTURE QUANTITIES STAGE III

FOUNDATION COND. MAT'L	147	TONS
CULVERT EXCAVATION	LUMP SUM	
CLASS A CONCRETE		
BARREL @ 1.693 CY/FT	160.9	C.Y.
WINGS ETC.	19.3	C.Y.
SILLS	0.9	C.Y.
TOTAL	181.1	C.Y.
REINFORCING STEEL		
BARREL & SILLS	25,768	LBS.
WINGS ETC.	1,110	LBS.
TOTAL	26,878	LBS.



SKEW TRIANGLE

PROJECT NO. I-5987A
ROBESON COUNTY
STATION: 454+90.00 -L-

SHEET 5 OF 8

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DESIGN ENGINEER : VDK DATE : 12/21
DWG. No.

NORTH CAROLINA PROFESSIONAL SEAL 16301 ENGINEER JING HSILING FANG
Ting Fang
80E43C9AEA60462...
3/17/2022

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH
BARREL STANDARD

DOUBLE 8 FT. X 7 FT. CONCRETE BOX CULVERT
STAGE III

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C13-5
1			3			TOTAL SHEETS
2			4			8

SITE 13

STINES

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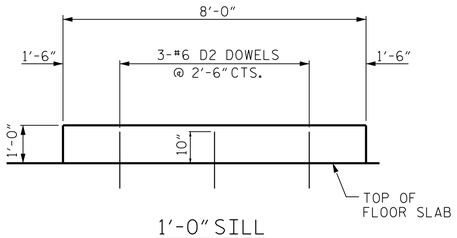
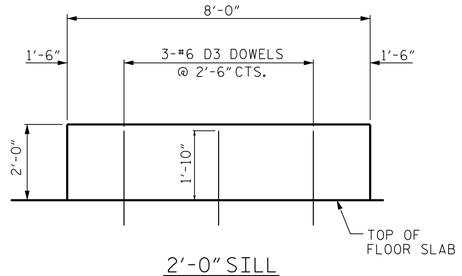
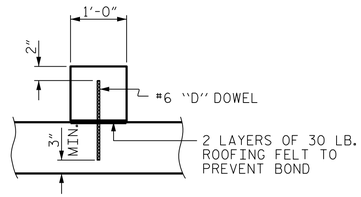


1'-0" SILL
IN BARREL 1



2'-0" SILL
IN BARREL 2



SECTION THROUGH SILL

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

CONCRETE SILL DETAILS

THE CONTRACTOR'S ATTENTION IS CALLED TO THE FACT THAT THE NATIVE MATERIAL BACKFILL SHALL BE PLACED PRIOR TO THE CASTING OF THE ROOF SLAB.

NOTES:

CULVERT FLOOR SLAB IS BURIED 1.0' BELOW EXISTING STREAM BED. BACKFILL WITH NATIVE MATERIAL TO SILL HEIGHT IN BOTH BARRELS.

NATIVE MATERIAL BETWEEN SILLS IN THE CULVERT SHALL PROVIDE A CONTINUOUS LOW FLOW CHANNEL.

NATIVE MATERIAL CONSISTS OF MATERIAL THAT IS EXCAVATED FROM THE STREAM OR FLOODPLAIN AT THE PROJECT SITE DURING CONSTRUCTION. ONLY MATERIAL THAT IS EXCAVATED FROM THE STREAM BED MAY BE USED TO LINE THE CULVERT BARRELS. RIP RAP MAY BE USED TO SUPPLEMENT THE NATIVE MATERIAL IN THE HIGH FLOW CULVERT BARREL 2.

IF RIP RAP IS USED TO LINE THE HIGH FLOW CULVERT BARREL 2, NATIVE MATERIAL IS TO BE PLACED ON TOP TO FILL VOIDS AND PROVIDE A FLAT SURFACE FOR ANIMAL PASSAGE.

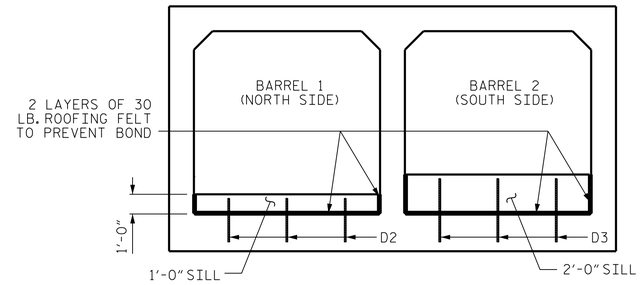
NATIVE MATERIAL IS SUBJECT TO APPROVAL BY THE ENGINEER AND MAY BE SUBJECT TO PERMIT CONDITIONS.

SILLS ARE TO BE 1 FOOT WIDE, CAST SEPARATELY AND ATTACHED BY DOWELS.

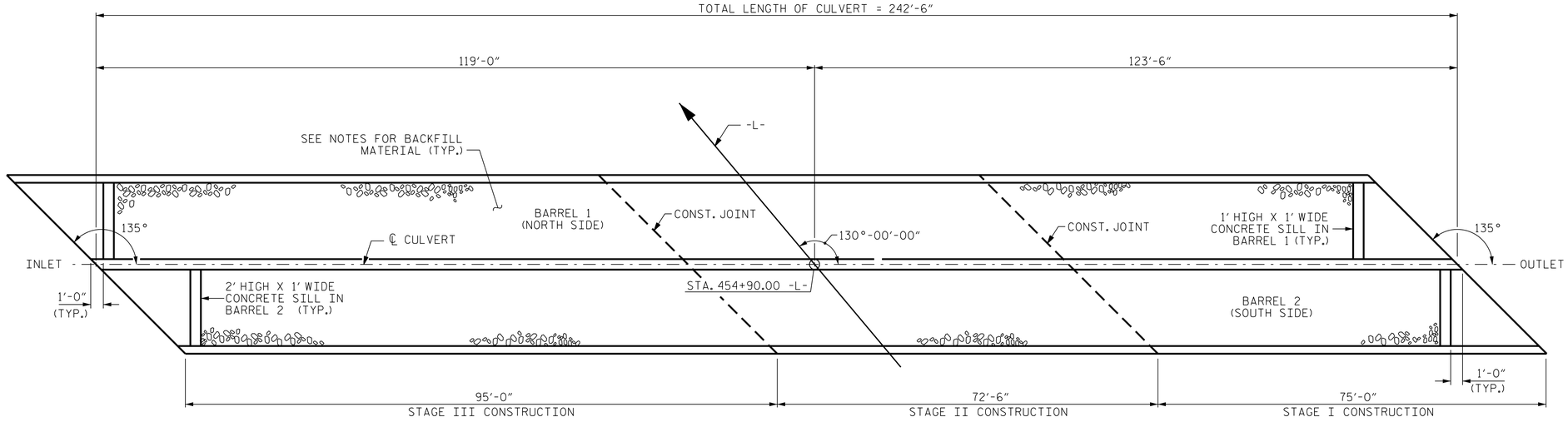
TOP OF LOW FLOW SILLS SHOULD MATCH STREAM BED ELEVATION IN LOW FLOW CHANNEL OF STREAM. (THALWEG)

DO NOT SET ELEVATION OF HIGH SILLS ABOVE BANK FILL.

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.



INLET ELEVATION
(LOOKING DOWNSTREAM)



PLAN

PROJECT NO. I-5987A
ROBESON COUNTY
STATION: 454+90.00 -L-

SHEET 6 OF 8

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

DETAILS OF SILLS FOR CONCRETE BOX CULVERT

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NC COA No. F-1255

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CHECKED BY :	THF	DATE :	11/21
DESIGN ENGINEER :	VDK	DATE :	12/21

DWG. No.

NORTH CAROLINA PROFESSIONAL SEAL 16301 ENGINEER TING HSILUNG FANG
Ting Fang
60E43C9AEA60462...
3/17/2022

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C13-6
1			3			TOTAL SHEETS
2			4			8

SITE 13

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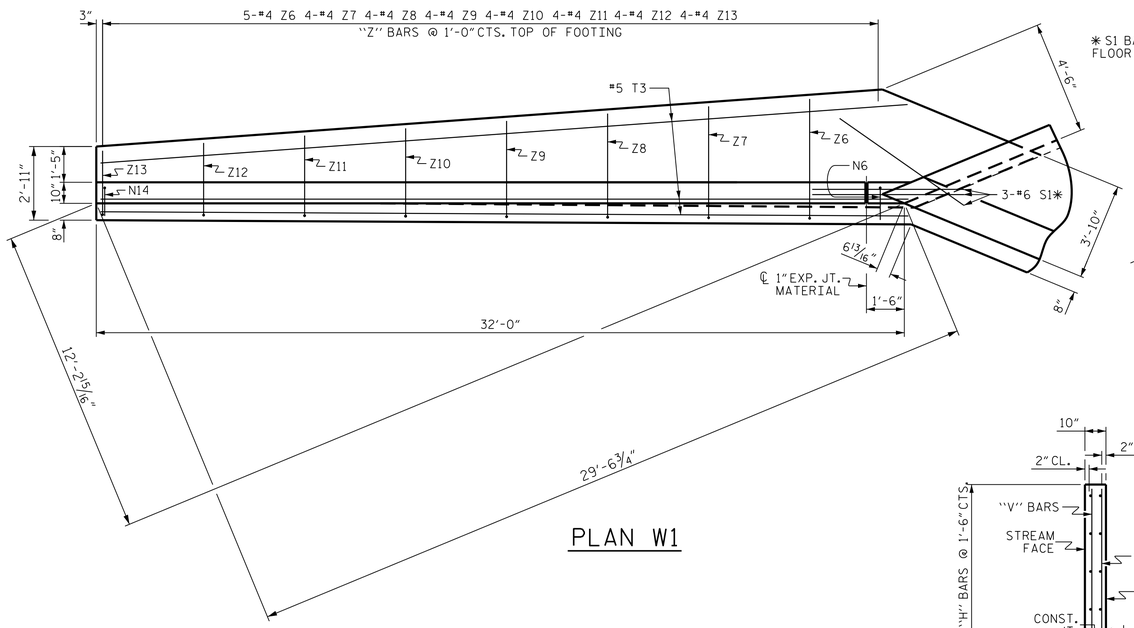
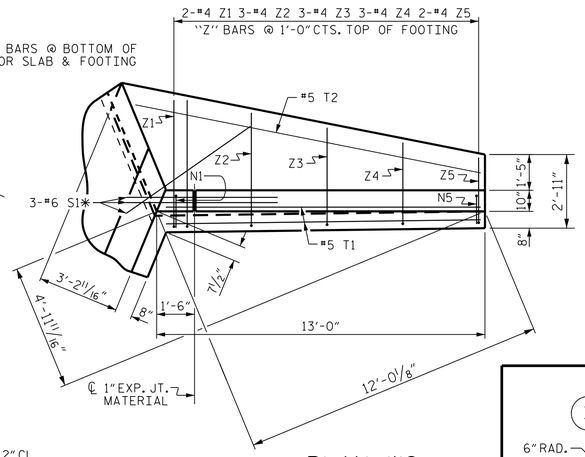
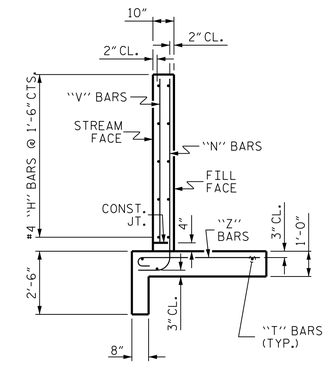


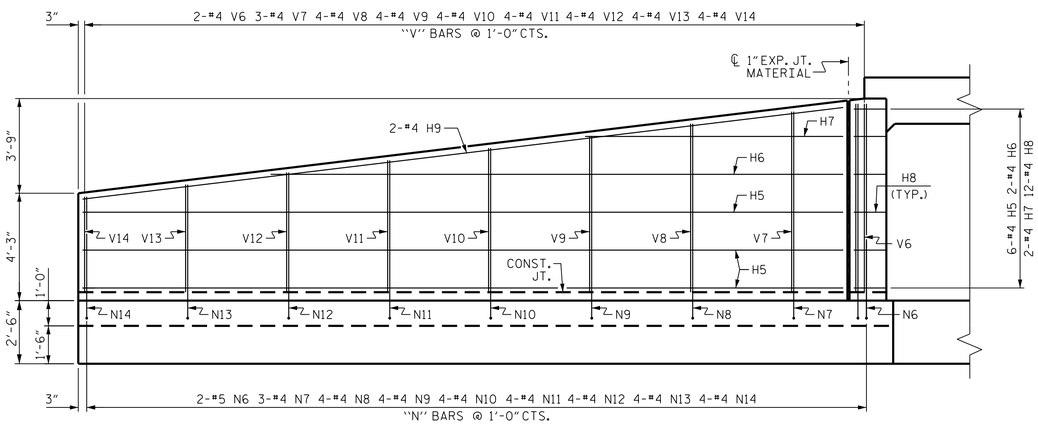
PLAN W1



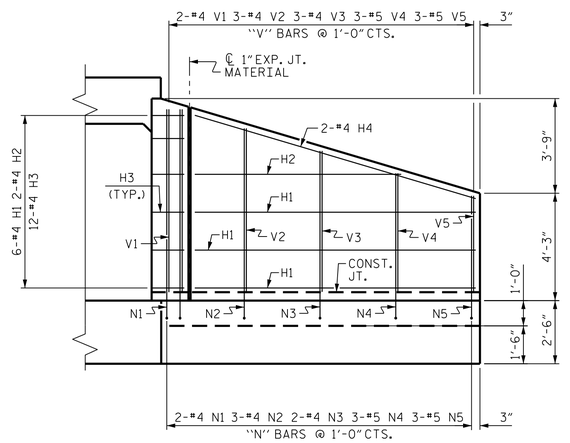
PLAN W2



TYPICAL WING SECTION

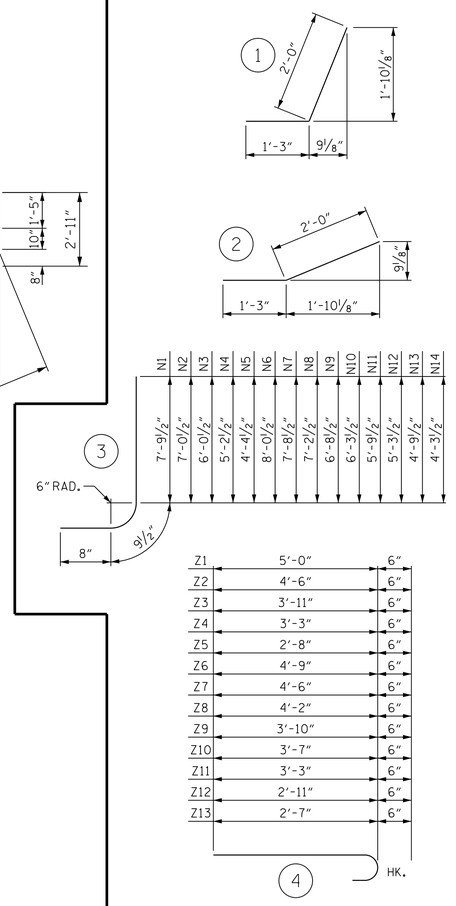


ELEVATION W1



ELEVATION W2

BAR TYPES



ALL BAR DIMENSIONS ARE OUT TO OUT.

CLASS A CONCRETE

4 WINGS	33.39	CY
2 HEADWALLS	2.36	CY
2 END CURTAIN WALLS	2.76	CY
TOTAL	38.51	CY

REINFORCING BAR SCHEDULE

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
H1	12	#4	STR	11'-1"	89
H2	4	#4	STR	8'-2"	22
H3	24	#4	1	3'-3"	52
H4	4	#4	STR	11'-7"	31
H5	12	#4	STR	30'-1"	241
H6	4	#4	STR	22'-8"	61
H7	4	#4	STR	10'-3"	27
H8	24	#4	2	3'-3"	52
H9	4	#4	STR	33'-4"	81
N1	4	#5	3	9'-3"	39
N2	6	#5	3	8'-6"	53
N3	6	#4	3	7'-7"	30
N4	6	#4	3	6'-8"	27
N5	6	#4	3	5'-10"	23
N6	4	#5	3	9'-6"	40
N7	6	#5	3	9'-2"	57
N8	8	#5	3	8'-8"	72
N9	8	#4	3	8'-2"	44
N10	8	#4	3	7'-9"	41
N11	8	#5	3	7'-3"	39
N12	8	#5	3	6'-9"	36
N13	8	#4	3	6'-3"	33
N14	8	#4	3	5'-9"	31
S1	12	#6	STR	6'-0"	108
T1	4	#5	STR	12'-6"	52
T2	2	#5	STR	13'-11"	29
T3	6	#5	STR	32'-0"	200
V1	4	#4	STR	7'-3"	19
V2	6	#4	STR	6'-6"	26
V3	6	#4	STR	5'-7"	22
V4	6	#4	STR	4'-8"	19
V5	6	#4	STR	3'-10"	15
V6	4	#4	STR	7'-6"	20
V7	6	#4	STR	7'-2"	29
V8	8	#4	STR	6'-8"	36
V9	8	#4	STR	6'-2"	33
V10	8	#4	STR	5'-9"	31
V11	8	#4	STR	5'-3"	28
V12	8	#4	STR	4'-9"	25
V13	8	#4	STR	4'-3"	23
V14	8	#4	STR	3'-9"	20
Z1	4	#4	4	5'-6"	15
Z2	6	#4	4	5'-0"	20
Z3	6	#4	4	4'-5"	18
Z4	6	#4	4	3'-9"	15
Z5	4	#4	4	3'-2"	8
Z6	10	#4	4	5'-3"	35
Z7	8	#4	4	5'-0"	27
Z8	8	#4	4	4'-8"	25
Z9	8	#4	4	4'-4"	23
Z10	8	#4	4	4'-1"	22
Z11	8	#4	4	3'-9"	20
Z12	8	#4	4	3'-5"	18
Z13	8	#4	4	3'-1"	16

REINFORCING STEEL FOR 4 WINGS 2220 LBS

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 454+90.00 -L-

SHEET 7 OF 8

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

WINGS FOR CONCRETE BOX CULVERT

H = 7'-0" SLOPE = 3:1

135° SKEW

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

CDM Smith
CDM SMITH
5400 Glenwood Avenue, Suite 400
Raleigh, NC 27612-3228
NC COA No. F-1255

DRAWN BY : JJR DATE : 10/21
CHECKED BY : THF DATE : 11/21
DESIGN ENGINEER : VDK DATE : 12/21

DWG. No.

NORTH CAROLINA PROFESSIONAL SEAL 16301 ENGINEER JING-HSING FANG
Ting Fang
3/17/2022

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C13-7
1			3			TOTAL SHEETS
2			4			8

STD. NO. CW13507

SITE 13

DocuSign Envelope ID: C1896D66-826A-4468-8D5C-ACB671339B27

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
								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	**1.24**	--	1.75	1.54	1	TOP SLAB	8.00	**1.24**	1	TOP SLAB	8.00	
		HL-93 (OPERATING)	N/A		1.60	--	1.35	1.99	1	TOP SLAB	8.00	1.60	1	TOP SLAB	8.00	
		HS-20 (INVENTORY)	36.000	2	**1.65**	59.4	1.75	2.05	1	TOP SLAB	8.00	**1.65**	1	TOP SLAB	8.00	
		HS-20 (OPERATING)	36.000		2.14	77.04	1.35	2.65	1	TOP SLAB	8.00	2.14	1	TOP SLAB	8.00	
LEGAL LOAD RATING	SINGLE VEHICLE (SV)	SH	12.500	3	**2.22**	27.75	1.40	2.72	1	TOP SLAB	8.00	**2.22**	1	TOP SLAB	8.00	
		S3C	21.500		2.33	50.01	1.40	2.85	1	TOP SLAB	8.00	2.33	1	TOP SLAB	8.00	
		S3A	22.750		2.33	53.01	1.40	2.85	1	TOP SLAB	8.00	2.33	1	TOP SLAB	8.00	
		S4A	26.750		2.33	62.33	1.40	2.85	1	TOP SLAB	8.00	2.33	1	TOP SLAB	8.00	
		S5A	30.500		2.33	71.07	1.40	2.85	1	TOP SLAB	8.00	2.33	1	TOP SLAB	8.00	
		S6A	34.500		2.33	80.39	1.40	2.85	1	TOP SLAB	8.00	2.33	1	TOP SLAB	8.00	
		S7B	38.500		2.33	89.71	1.40	2.85	1	TOP SLAB	8.00	2.33	1	TOP SLAB	8.00	
		S7A	40.000		2.33	93.20	1.40	2.85	1	TOP SLAB	8.00	2.33	1	TOP SLAB	8.00	
	TRUCK TRACTOR SEMI-TRAILER (TTST)	T4A	28.250		2.33	65.82	1.40	2.85	1	TOP SLAB	8.00	2.33	1	TOP SLAB	8.00	
		T5B	32.000		2.33	74.56	1.40	2.85	1	TOP SLAB	8.00	2.33	1	TOP SLAB	8.00	
		T6A	36.000		2.33	83.88	1.40	2.85	1	TOP SLAB	8.00	2.33	1	TOP SLAB	8.00	
		T7A	40.000		2.33	93.20	1.40	2.85	1	TOP SLAB	8.00	2.33	1	TOP SLAB	8.00	
		T7B	40.000		2.33	93.20	1.40	2.85	1	TOP SLAB	8.00	2.33	1	TOP SLAB	8.00	

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.

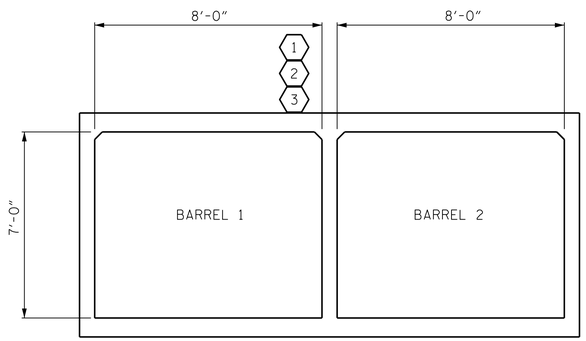
(#) CONTROLLING LOAD RATING

(1) DESIGN LOAD RATING (HL-93)

(2) DESIGN LOAD RATING (HS-20)

(3) LEGAL LOAD RATING **

** SEE CHART FOR VEHICLE TYPE



LRFR SUMMARY

(LOOKING DOWNSTREAM)

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 454+90.00 -L-

SHEET 8 OF 8

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

STANDARD

LRFR SUMMARY FOR REINFORCED CONCRETE BOX CULVERTS

(INTERSTATE TRAFFIC)

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

CDM Smith
CDM SMITH
5400 Glenwood Avenue, Suite 400
Raleigh, NC 27612-3228
NC COA No. F-1255

DRAWN BY : JJR DATE : 10/21
CHECKED BY : THF DATE : 11/21
DESIGN ENGINEER : VDK DATE : 12/21

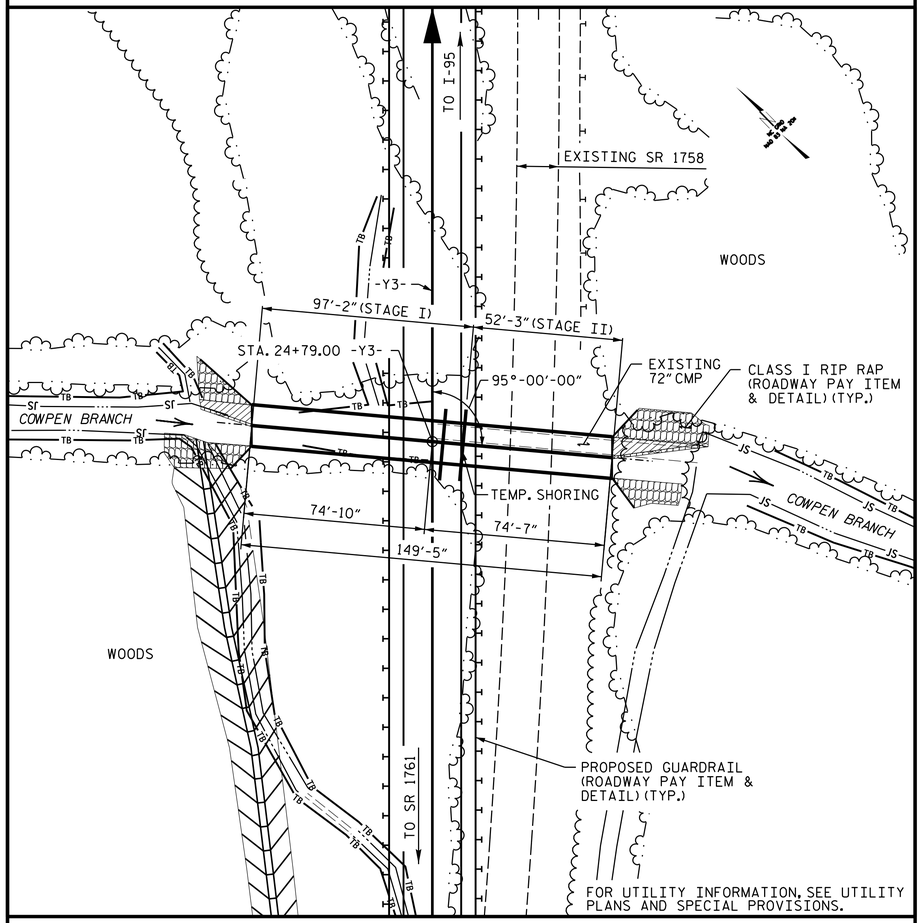
DWG. No.

NORTH CAROLINA PROFESSIONAL SEAL 16301 ENGINEER TING HSILING FANG
Ting Fang
80E43C8AEA80462...
3/17/2022

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C13-8
1			3			TOTAL SHEETS
2			4			8

STD. NO. LRFR5 SITE 13

BENCH MARK #22: RAILROAD SPIKE SET IN 10" HICKORY TREE
246' RT OF STA. 446+03 -L-; ELEV. 162.95



LOCATION SKETCH

ROADWAY DATA

GRADE POINT ELEV. @ STA. 24+79.00 -Y3-	= 182.75'
BED ELEV. @ STA. 24+79.00 -Y3-	= 155.80'
ROADWAY SLOPES	= 3 : 1

HYDROGRAPHIC DATA

DESIGN DISCHARGE	= 420 CFS
FREQUENCY OF DESIGN FLOOD	= 25 YRS
DESIGN HIGH WATER ELEVATION	= 164.8'
DRAINAGE AREA	= 1.64 SQ. MI.
BASE DISCHARGE (Q100)	= 550 CFS
BASE HIGH WATER ELEVATION	= 165.8'

OVERTOPPING FLOOD DATA

OVERTOPPING DISCHARGE	= 570 CFS
FREQUENCY OF OVERTOPPING FLOOD	= 100 YRS
OVERTOPPING FLOOD ELEVATION	= 165.9' *

* OVERTOPPING OCCURS AT STA. 16+50 -Y3-

TOTAL STRUCTURE QUANTITIES

CLASS A CONCRETE		
STAGE I	229.3	C.Y.
STAGE II	130.8	C.Y.
TOTAL	360.1	C.Y.
REINFORCING STEEL		
STAGE I	24,639	LBS.
STAGE II	14,018	LBS.
TOTAL	38,657	LBS.
CULVERT EXCAVATION	LUMP SUM	
FOUNDATION COND. MAT'L.		
STAGE I	151	TONS
STAGE II	81	TONS
TOTAL	232	TONS

NOTES:

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

DESIGN FILL---------- 19.1 FT.

FOR OTHER DESIGN DATA AND NOTES, SEE STANDARD NOTES 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.

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

FOR CRANE SAFETY, SEE SPECIAL PROVISIONS.

FOR SUBMITTAL OF WORKING DRAWINGS, SEE SPECIAL PROVISIONS.

FOR FALSEWORK AND FORMWORK, SEE SPECIAL PROVISIONS.

FOR GROUT FOR STRUCTURES, SEE SPECIAL PROVISIONS.

FOR EROSION CONTROL MEASURES, SEE EROSION CONTROL PLANS.

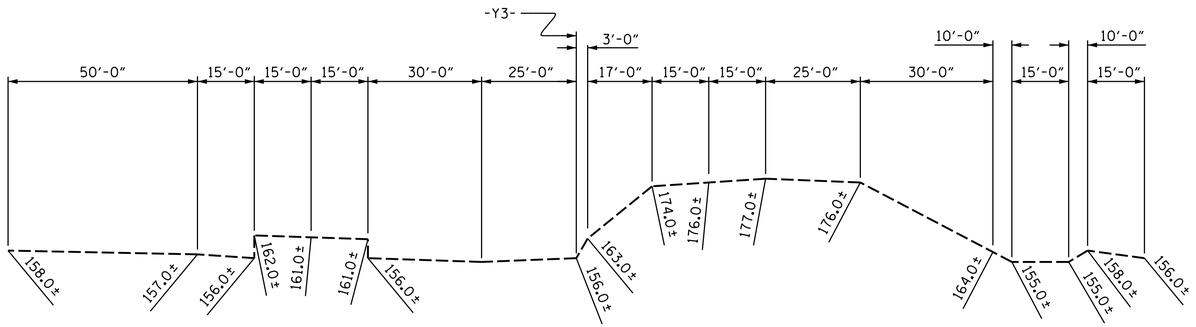
CONSTRUCT THE REINFORCED CONCRETE BOX CULVERT WITH 3.5" OF CAMBER TO ACCOUNT FOR ANTICIPATED SETTLEMENT.

BACKFILL WITH SELECT MATERIAL, CLASS VI MEETING THE REQUIREMENTS OF SECTION 1016 OF THE STANDARD SPECIFICATIONS.

SEE SECTION 414 OF THE STANDARD SPECIFICATIONS FOR CULVERT EXCAVATION AND BACKFILLING. EXCAVATE 1 FOOT BELOW CULVERT AND REPLACE WITH FOUNDATION CONDITIONING MATERIAL IN ACCORDANCE WITH ARTICLE 414-4 OF THE STANDARD SPECIFICATIONS.

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.

DOWELS SHALL BE USED TO CONNECT THE STAGE II CULVERT TO STAGE I AS SHOWN. FOR NOTE REGARDING SETTING OF DOWELS, SEE SHEET SN.



PROFILE ALONG ℄ CULVERT

PROJECT NO. I-5987A
ROBESON COUNTY
STATION: 24+79.00 -Y3-

SHEET 1 OF 10

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL G. CHEEK, JR.
SFBCC2F3A4DC413...
5/10/2022 | 10:06 AM EDT

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

TGS ENGINEERS
706 HILLSBOROUGH STREET
SUITE 200
RALEIGH, NC 27603
PH (919) 773-8887
CORP. LICENSE NO.: C-0275

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

DOUBLE 8 FT. X 7 FT. CONCRETE BOX CULVERT 95°-00'-00" SKEW

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C14-1
1			3			TOTAL SHEETS
2			4			10

DRAWN BY :	STM	DATE :	10/21
CHECKED BY :	MGC	DATE :	12/21
DESIGN ENGINEER OF RECORD:	STM	DATE :	10/21

3/16/2022
X:\NCDOT\I-5987A\Structures\Site 14 - 24+79 -Y3-\Final Plans\DGNs\417_001_I-5987A_Site 14_SMU_CU_001.dgn
User:smassinople

FILE NAME: 417_001_I-5987A_Site 14_SMU_CU_001.dgn

SITE 14

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 (γ_{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	1.63	1	EXTERIOR WALL	0.33	1.06	1	EXTERIOR WALL	0.33	
		HL-93 (OPERATING)	N/A		1.37	--	1.35	2.12	1	EXTERIOR WALL	0.33	1.37	1	EXTERIOR WALL	0.33	
		HS-20 (INVENTORY)	36.000	(2)	1.06	38.16	1.75	1.65	1	EXTERIOR WALL	0.33	1.06	1	EXTERIOR WALL	0.33	
		HS-20 (OPERATING)	36.000		1.37	49.32	1.35	2.14	1	EXTERIOR WALL	0.33	1.37	1	EXTERIOR WALL	0.33	
LEGAL LOAD RATING	SINGLE VEHICLE (SV)	SNSH	13.500		1.35	18.23	1.40	2.19	1	EXTERIOR WALL	0.33	1.35	1	EXTERIOR WALL	0.33	
		SNGARBS2	20.000		1.34	26.80	1.40	2.15	1	EXTERIOR WALL	0.33	1.34	1	EXTERIOR WALL	0.33	
		SNAGRIS2	22.000		1.34	29.48	1.40	2.13	1	EXTERIOR WALL	0.33	1.34	1	EXTERIOR WALL	0.33	
		SNCOTTS3	27.250		1.32	35.97	1.40	2.04	1	EXTERIOR WALL	0.33	1.32	1	EXTERIOR WALL	0.33	
		SNAGGRS4	34.925		1.32	46.10	1.40	2.05	1	EXTERIOR WALL	0.33	1.32	1	EXTERIOR WALL	0.33	
		SNS5A	35.550		1.32	46.93	1.40	2.04	1	EXTERIOR WALL	0.33	1.32	1	EXTERIOR WALL	0.33	
		SNS6A	39.950		1.32	52.73	1.40	2.02	1	EXTERIOR WALL	0.33	1.32	1	EXTERIOR WALL	0.33	
		SNS7B	42.000		1.32	55.44	1.40	2.03	1	EXTERIOR WALL	0.33	1.32	1	EXTERIOR WALL	0.33	
	TRUCK TRACTOR SEMI-TRAILER (TTST)	TNAGRIT3	33.000		1.32	43.56	1.40	2.04	1	EXTERIOR WALL	0.33	1.32	1	EXTERIOR WALL	0.33	
		TNT4A	33.075		1.32	43.66	1.40	2.04	1	EXTERIOR WALL	0.33	1.32	1	EXTERIOR WALL	0.33	
		TNT6A	41.600		1.31	54.50	1.40	2.01	1	EXTERIOR WALL	0.33	1.31	1	EXTERIOR WALL	0.33	
		TNT7A	42.000		1.32	55.44	1.40	2.02	1	EXTERIOR WALL	0.33	1.32	1	EXTERIOR WALL	0.33	
		TNT7B	42.000		1.31	55.02	1.40	2.01	1	EXTERIOR WALL	0.33	1.31	1	EXTERIOR WALL	0.33	
		TNAGRIT4	43.000		1.31	56.33	1.40	2.00	1	EXTERIOR WALL	0.33	1.31	1	EXTERIOR WALL	0.33	
		TNAGT5A	45.000		1.32	59.40	1.40	2.03	1	EXTERIOR WALL	0.33	1.32	1	EXTERIOR WALL	0.33	
		TNAGT5B	45.000	(3)	1.31	58.95	1.40	1.99	1	EXTERIOR WALL	0.33	1.31	1	EXTERIOR WALL	0.33	

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.

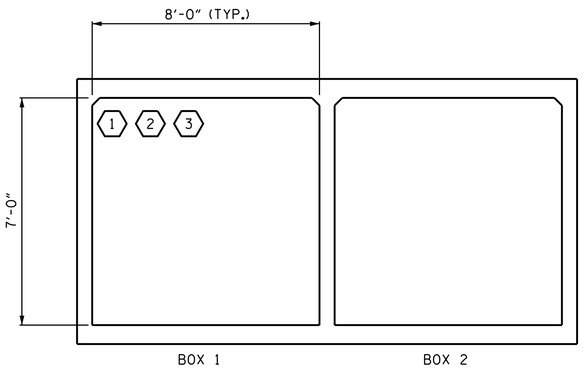
(#) CONTROLLING LOAD RATING

(1) DESIGN LOAD RATING (HL-93)

(2) DESIGN LOAD RATING (HS-20)

(3) LEGAL LOAD RATING **

** SEE CHART FOR VEHICLE TYPE



LRFR SUMMARY

(LOOKING DOWNSTREAM)

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 24+79.00 -Y3-

SHEET 2 OF 10

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL G. CHEEK, JR.

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5/10/2022 | 10:06 AM EDT

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

TGS ENGINEERS
706 HILLSBOROUGH STREET
SUITE 200
RALEIGH, NC 27603
PH (919) 773-8887
CORP. LICENSE NO.: C-0275

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

STANDARD

LRFR SUMMARY FOR REINFORCED CONCRETE BOX CULVERTS

(NON-INTERSTATE TRAFFIC)

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C14-2
1			3			TOTAL SHEETS
2			4			10

ASSEMBLED BY :	STM	DATE :	10/21
CHECKED BY :	MGC	DATE :	12/21
DRAWN BY : WMC	7/11	REV. 10/1/11	MAA/GM
CHECKED BY : GM	7/11	REV. 12/17	MAA/THC

3/16/2022
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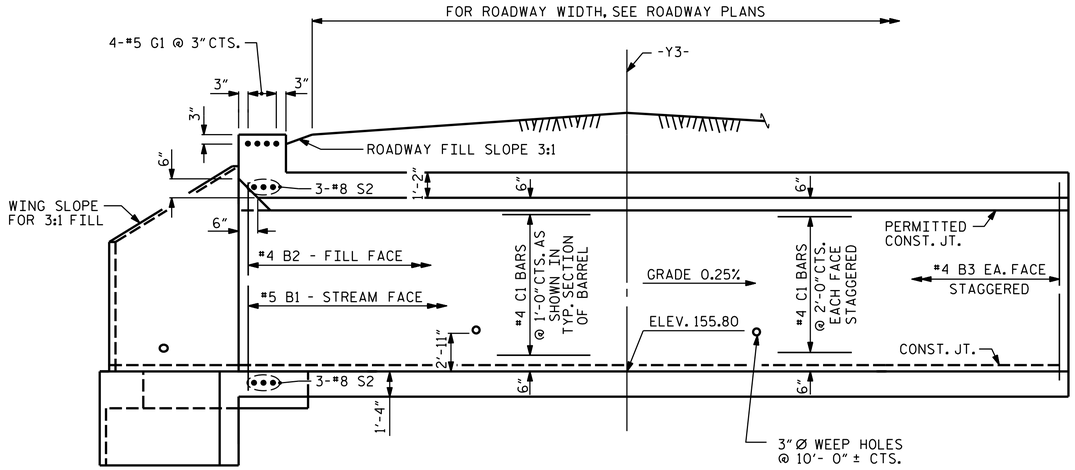
User:smassinople

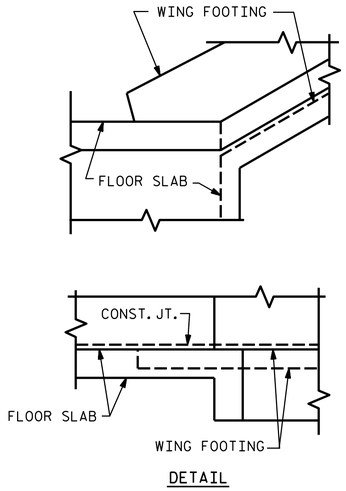
STD. NO. LRFR5

FILE NAME: 417_003_I-5987A_Site 14_SMU_CU_002.dgn

SITE 14



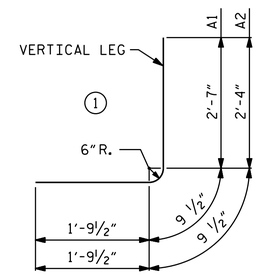
CULVERT SECTION NORMAL TO ROADWAY



DETAIL

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

BAR TYPE



DIMENSIONS ARE OUT TO OUT

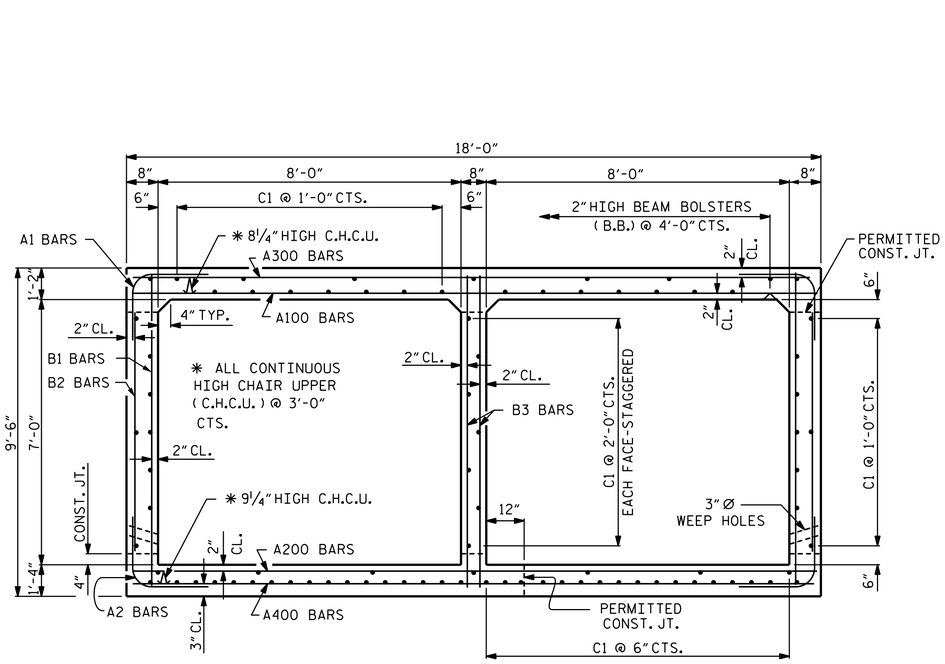
SPLICE LENGTHS CHART

BAR	SIZE	SPLICE LENGTH
C1	#4	1'-10"
A200	#5	3'-0"
A400	#6	2'-9"
S2	#8	3'-8"

BAR SCHEDULE

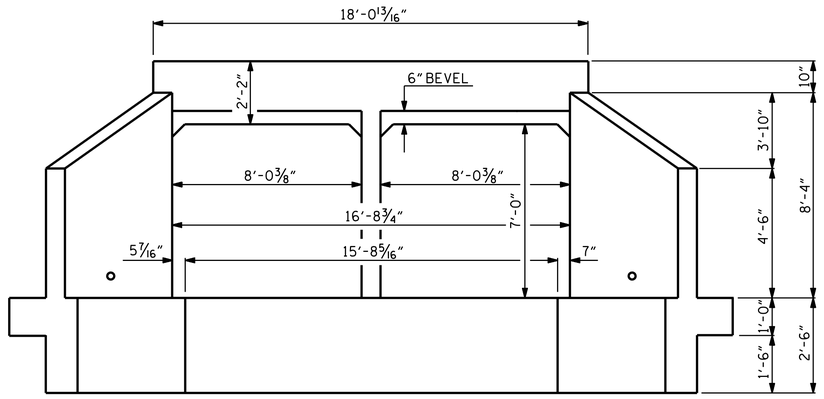
BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
A100	128	#5	STR	17'-7"	2347
A101	1	#5	STR	15'-11"	17
A102	1	#5	STR	7'-4"	8
A200	128	#5	STR	17'-7"	2347
A201	1	#5	STR	15'-11"	17
A202	1	#5	STR	7'-4"	8
A300	128	#6	STR	17'-7"	3380
A301	1	#6	STR	15'-11"	24
A302	1	#6	STR	7'-4"	11
A400	128	#6	STR	17'-7"	3380
A401	1	#6	STR	15'-11"	24
A402	1	#6	STR	7'-4"	11
A1	258	#4	1	5'-2"	890
A2	258	#4	1	4'-11"	847
B1	195	#5	STR	9'-1"	1847
B2	258	#4	STR	6'-4"	1092
B3	195	#4	STR	9'-1"	1183
C1	261	#4	STR	33'-10"	5899
D2	3	#6	STR	1'-11"	9
D3	3	#6	STR	2'-11"	13
G1	4	#5	STR	17'-7"	73
S2	6	#8	STR	17'-7"	282

REINFORCING STEEL 23,709 LBS

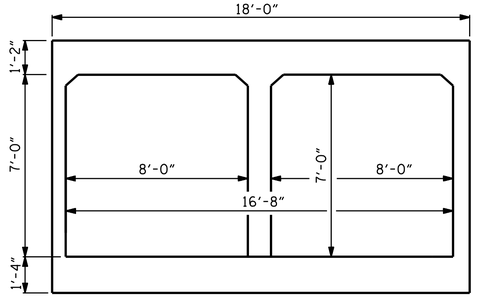


RIGHT ANGLE SECTION OF BARREL

THERE ARE 87 "C" IN SECTION OF BARREL.



INLET END ELEVATION



RIGHT END ELEVATION

STAGE I QUANTITIES

CLASS A CONCRETE

BARREL	2.193 CY/FT	213.1	C.Y.
WINGS, ETC.		15.3	C.Y.
SILLS		0.9	C.Y.
TOTAL		229.3	C.Y.

REINFORCING STEEL

BARREL & SILLS	23,709	LBS.
WINGS, ETC.	930	LBS.
TOTAL	24,639	LBS.

CULVERT EXCAVATION	LUMP SUM
FOUNDATION COND. MAT'L.	151 TONS

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 24+79.00 -Y3-

SHEET 3 OF 10

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL G. CHEEK, JR.

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706 HILLSBOROUGH STREET
SUITE 200
RALEIGH, NC 27603
PH (919) 773-8887
CORP. LICENSE NO.: C-0275

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

DOUBLE 8 FT. X 7 FT. CONCRETE BOX CULVERT 95°-00'-00" SKEW STAGE I

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C14-3
1			3			TOTAL SHEETS
2			4			10

ASSEMBLED BY : STM DATE : 10/21
CHECKED BY : MGC DATE : 12/21

3/16/2022
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Username

FILE NAME: 417_005_I-5987A_Site 14_SMU_CU_003.dgn

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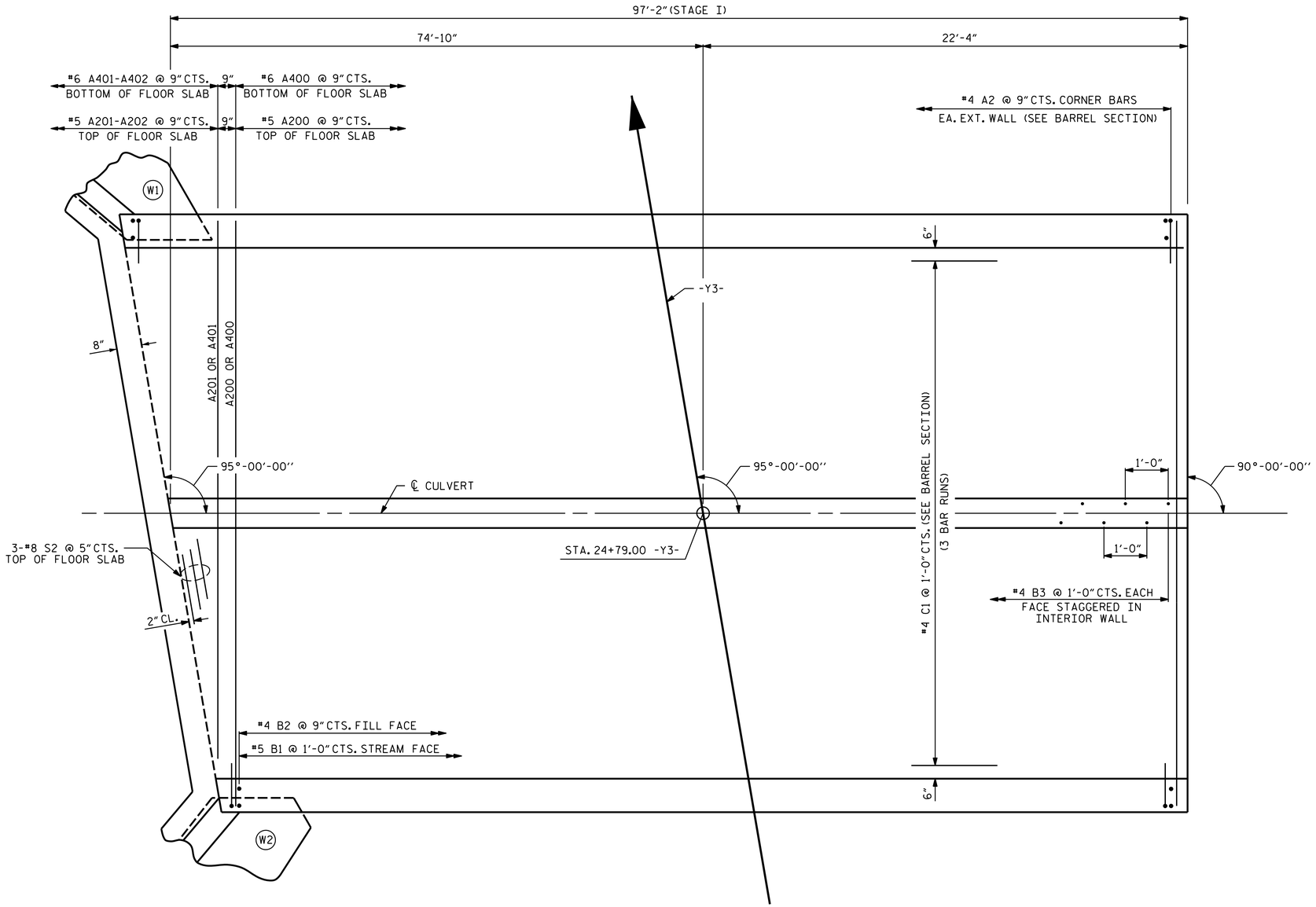

PLAN - FLOOR SLAB

STAGE I
FOR S1 BARS IN FLOOR SLAB & FOOTING, SEE WING SHEET.

PROJECT NO. I-5987A
ROBESON COUNTY
STATION: 24+79.00 -Y3-

SHEET 4 OF 10

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL G. CHEEK, JR.
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CORP. LICENSE NO.: C-0275

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

DOUBLE 8 FT. X 7 FT. CONCRETE BOX CULVERT 95°-00'-00" SKEW STAGE I

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C14-4
1			3			TOTAL SHEETS
2			4			10

DRAWN BY :	STM	DATE : 09/21
CHECKED BY :	MGC	DATE : 12/21
DESIGN ENGINEER OF RECORD:	STM	DATE : 09/21

3/16/2022
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User:smossinople

FILE NAME: 417_007_I-5987A_Site 14_SMU_CU_004.dgn

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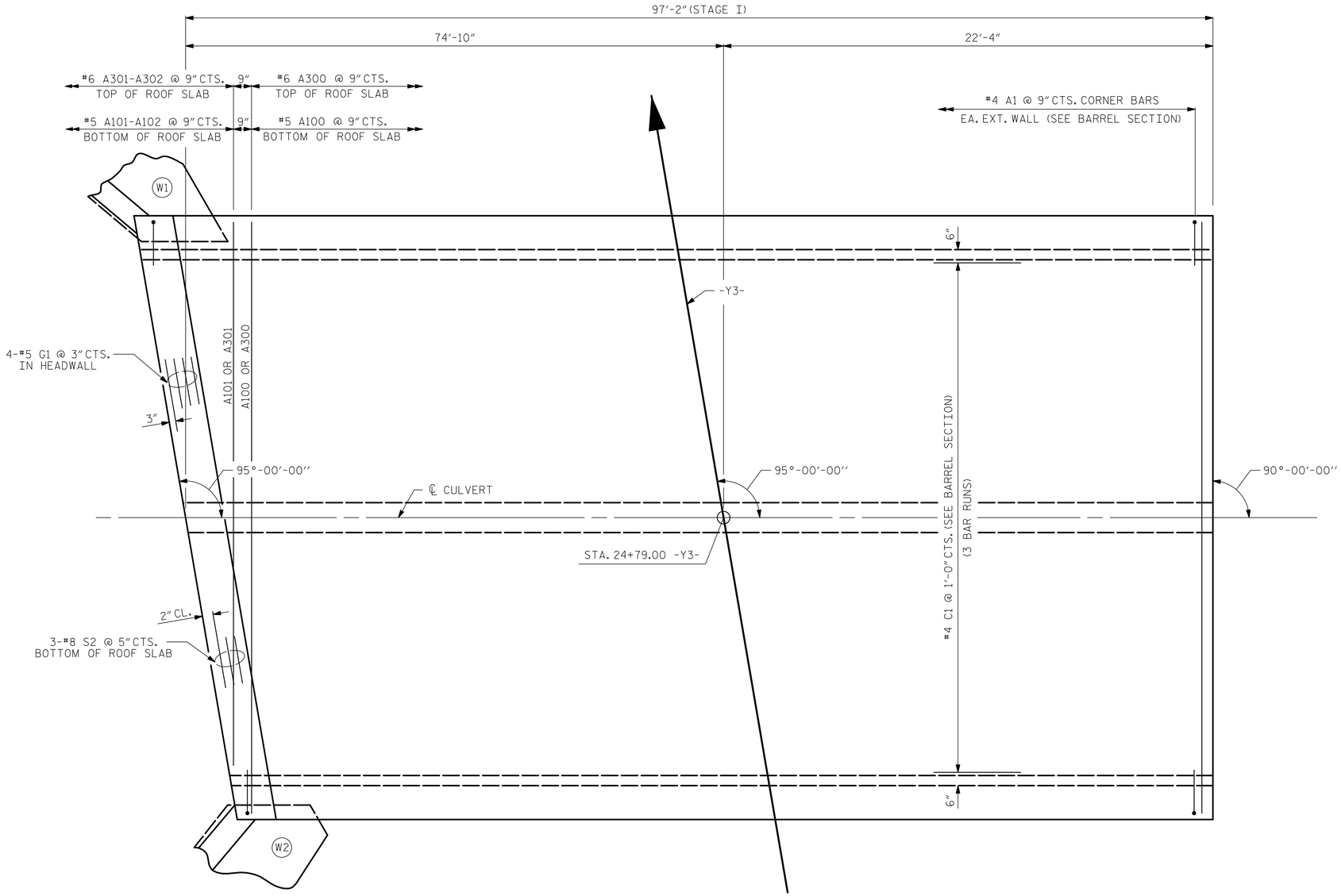

PLAN - ROOF SLAB

STAGE I

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 24+79.00 -Y3-

SHEET 5 OF 10

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL G. CHEEK, JR.

Marshall G. Cheek, Jr.

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STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

DOUBLE 8 FT. X 7 FT. CONCRETE BOX CULVERT 95°-00'-00" SKEW STAGE I

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C14-5
1			3			TOTAL SHEETS
2			4			10

DRAWN BY :	STM	DATE :	09/21
CHECKED BY :	MGC	DATE :	12/21
DESIGN ENGINEER OF RECORD:	STM	DATE :	09/21

3/17/2022
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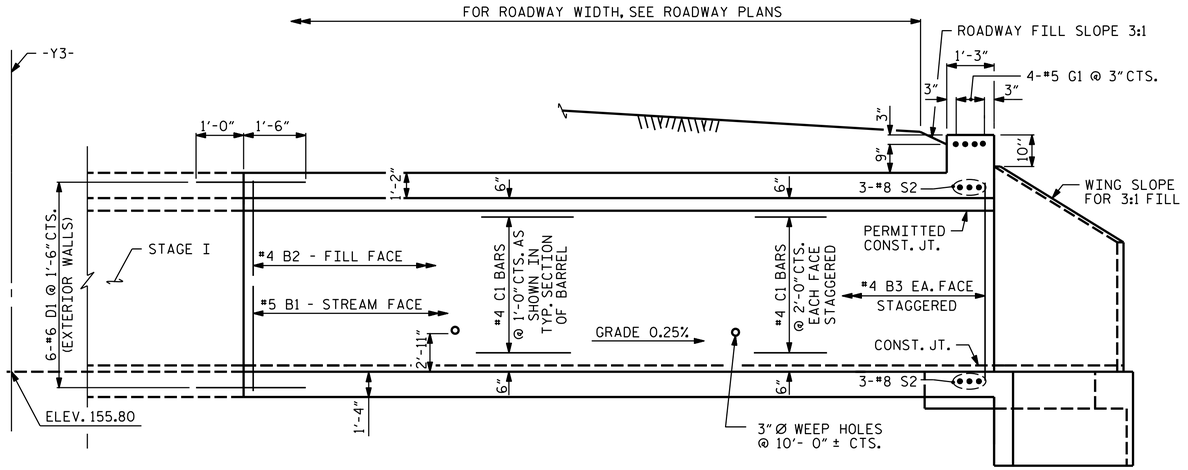
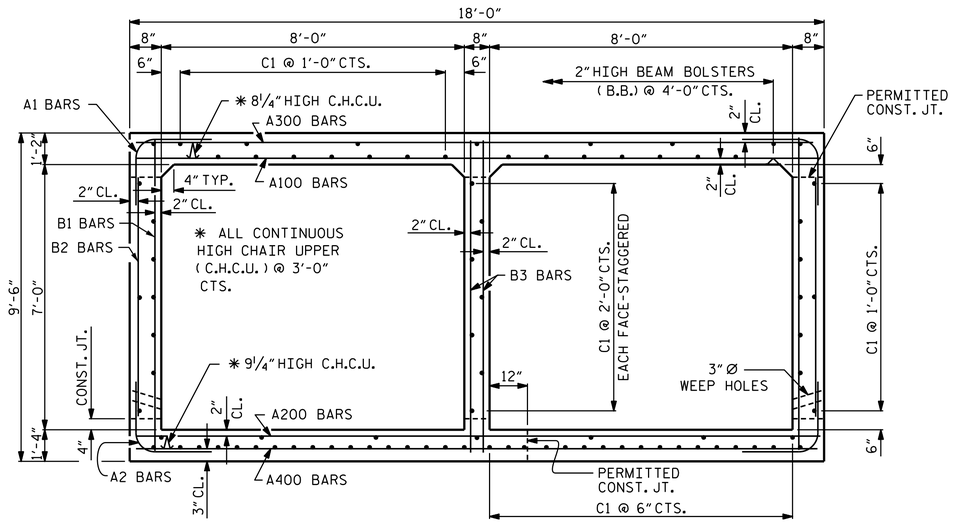
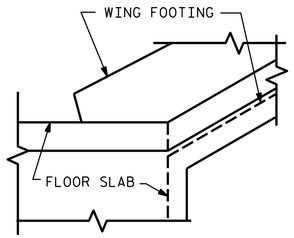


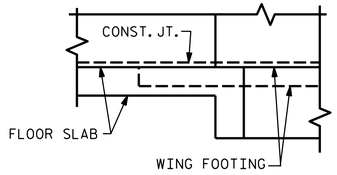
CULVERT SECTION NORMAL TO ROADWAY



RIGHT ANGLE SECTION OF BARREL

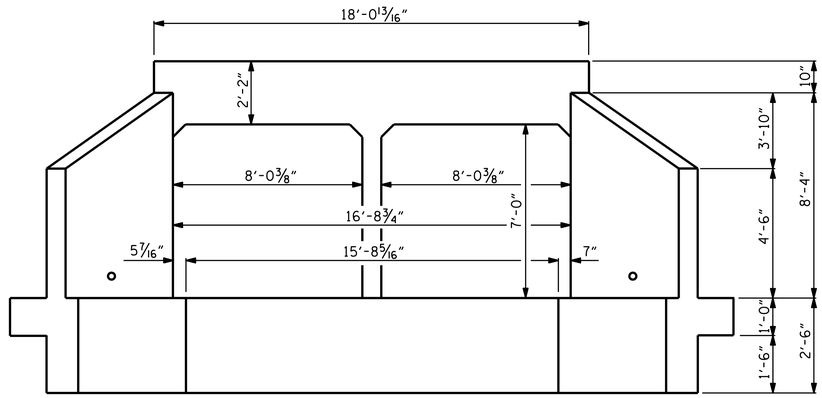
THERE ARE 87 "C" IN SECTION OF BARREL.





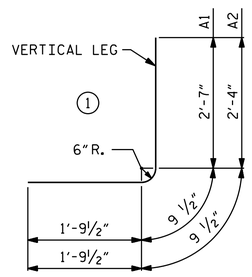
DETAIL

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



OUTLET END ELEVATION

BAR TYPE



DIMENSIONS ARE OUT TO OUT

SPLICE LENGTHS CHART

BAR	SIZE	SPLICE LENGTH
C1	#4	1'-10"
A200	#5	3'-0"
A400	#6	2'-9"
S2	#8	3'-8"

BAR SCHEDULE

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
A100	69	#5	STR	17'-7"	1265
A101	1	#5	STR	9'-4"	10
A200	69	#5	STR	17'-7"	1265
A201	1	#5	STR	9'-4"	10
A300	69	#6	STR	17'-7"	1822
A301	1	#6	STR	9'-4"	14
A400	69	#6	STR	17'-7"	1822
A401	1	#6	STR	9'-4"	14
A1	140	#4	1	5'-2"	483
A2	140	#4	1	4'-11"	460
B1	105	#5	STR	9'-1"	995
B2	140	#4	STR	6'-4"	592
B3	105	#4	STR	9'-1"	637
C1	174	#4	STR	27'-5"	3187
D1	36	#6	STR	2'-6"	135
D2	3	#6	STR	1'-11"	9
D3	3	#6	STR	2'-11"	13
G1	4	#5	STR	17'-7"	73
S2	6	#8	STR	17'-7"	282

REINFORCING STEEL 13,088 LBS

STAGE II QUANTITIES

CLASS A CONCRETE

BARREL	2.193 CY/FT	114.6	C.Y.
WINGS, ETC.		15.3	C.Y.
SILLS		0.9	C.Y.
TOTAL		130.8	C.Y.

REINFORCING STEEL

BARREL & SILLS	13,088	LBS.
WINGS, ETC.	930	LBS.
TOTAL	14,018	LBS.

CULVERT EXCAVATION	LUMP SUM	
FOUNDATION COND. MAT'L.	81	TONS

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 24+79.00 -Y3-

SHEET 6 OF 10

ASSEMBLED BY : STM DATE : 10/21
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User:smassinople

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SUITE 200
RALEIGH, NC 27603
PH (919) 773-8887
CORP. LICENSE NO.: C-0275

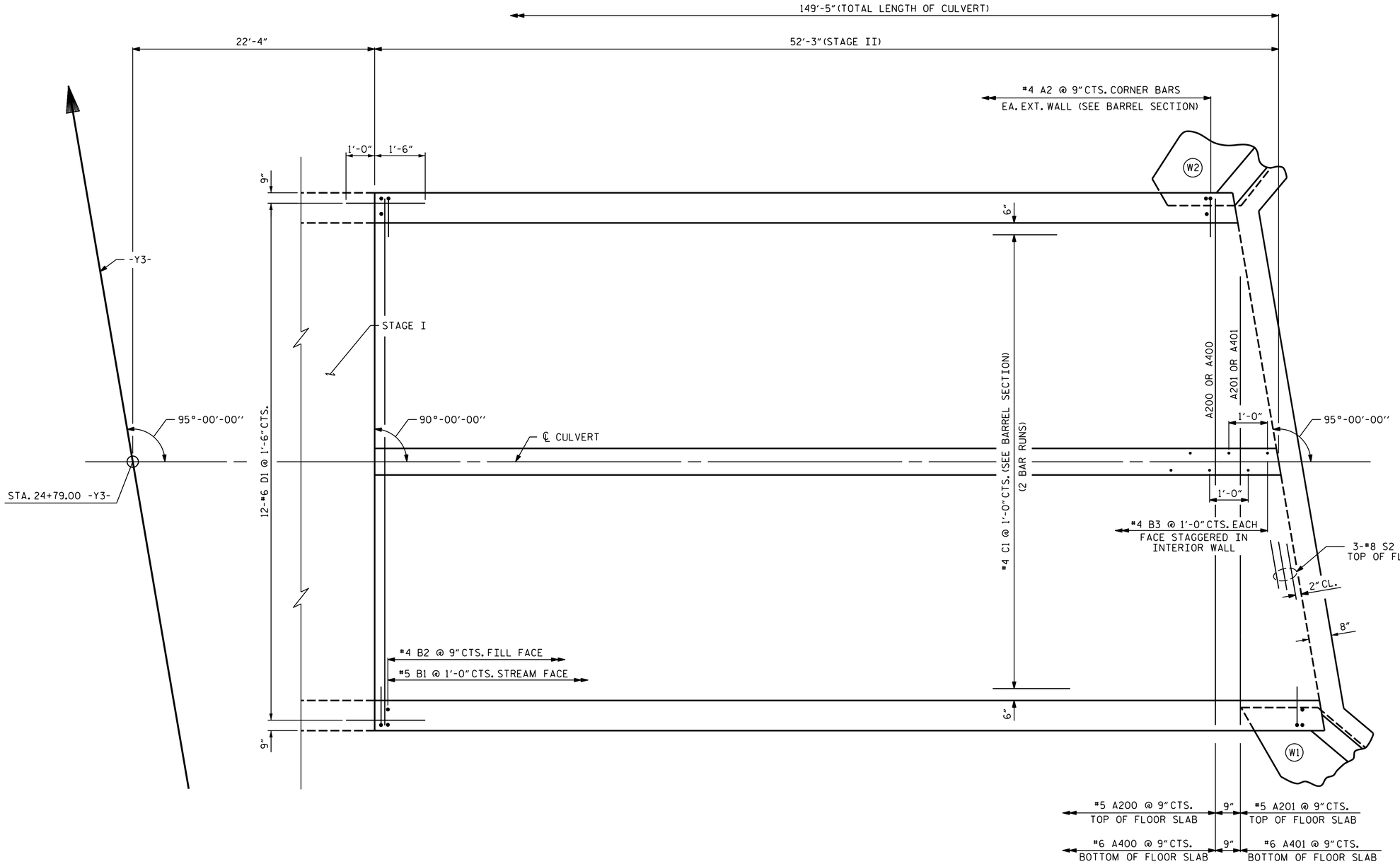
STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

DOUBLE 8 FT. X 7 FT. CONCRETE BOX CULVERT 95°-00'-00" SKEW STAGE II

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C14-6
1			3			TOTAL SHEETS
2			4			10

FILE NAME: 417_011_I-5987A_Site 14_SMU_CU_006.dgn

SITE 14



PLAN - FLOOR SLAB

STAGE II
FOR S1 BARS IN FLOOR SLAB & FOOTING, SEE WING SHEET.

PROJECT NO. I-5987A
ROBESON COUNTY
STATION: 24+79.00 -Y3-

SHEET 7 OF 10

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER
MARSHALEY G. CHEEK, JR.
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STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

DOUBLE 8 FT. X 7 FT. CONCRETE BOX CULVERT 95°-00'-00" SKEW STAGE II

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C14-7
1			3			TOTAL SHEETS
2			4			10

DRAWN BY : STM DATE : 10/21
CHECKED BY : MGC DATE : 12/21
DESIGN ENGINEER OF RECORD: STM DATE : 10/21

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User:smassinople

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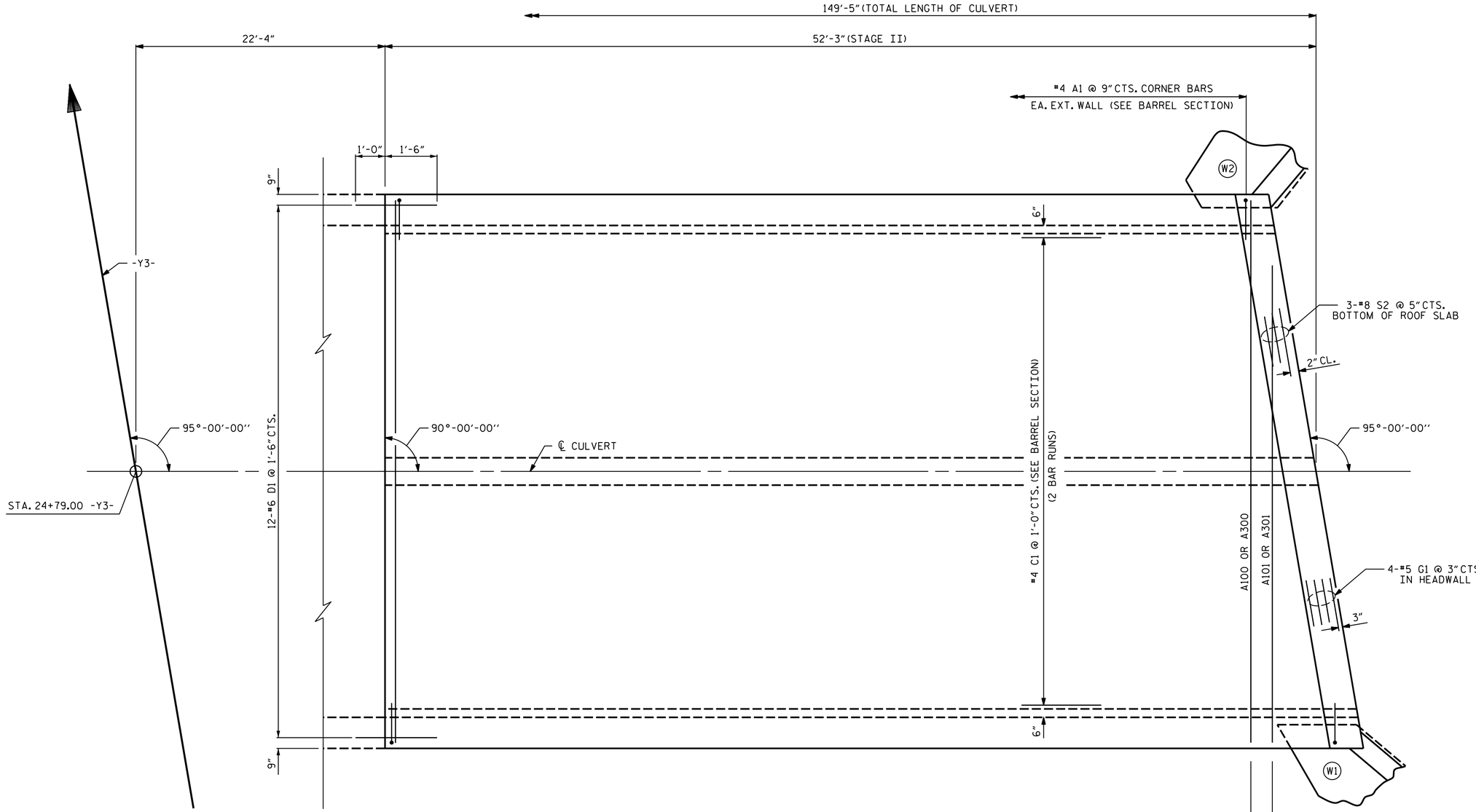

PLAN - ROOF SLAB

STAGE II

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 24+79.00 -Y3-

SHEET 8 OF 10

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL G. CHEEK, JR.

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SUITE 200
RALEIGH, NC 27603
PH (919) 773-8887
CORP. LICENSE NO.: C-0275

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

DOUBLE 8 FT. X 7 FT. CONCRETE BOX CULVERT 95°-00'-00" SKEW STAGE II

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C14-8
1			3			TOTAL SHEETS
2			4			10

DRAWN BY : STM DATE : 10/21
CHECKED BY : MGC DATE : 12/21
DESIGN ENGINEER OF RECORD: STM DATE : 10/21

3/16/2022
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User:smassinople

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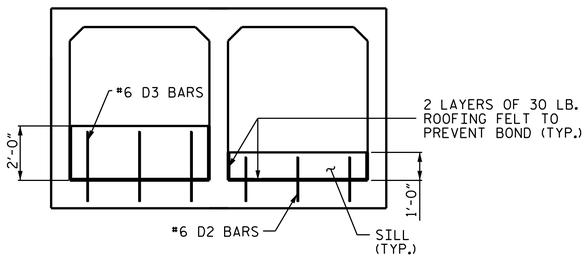
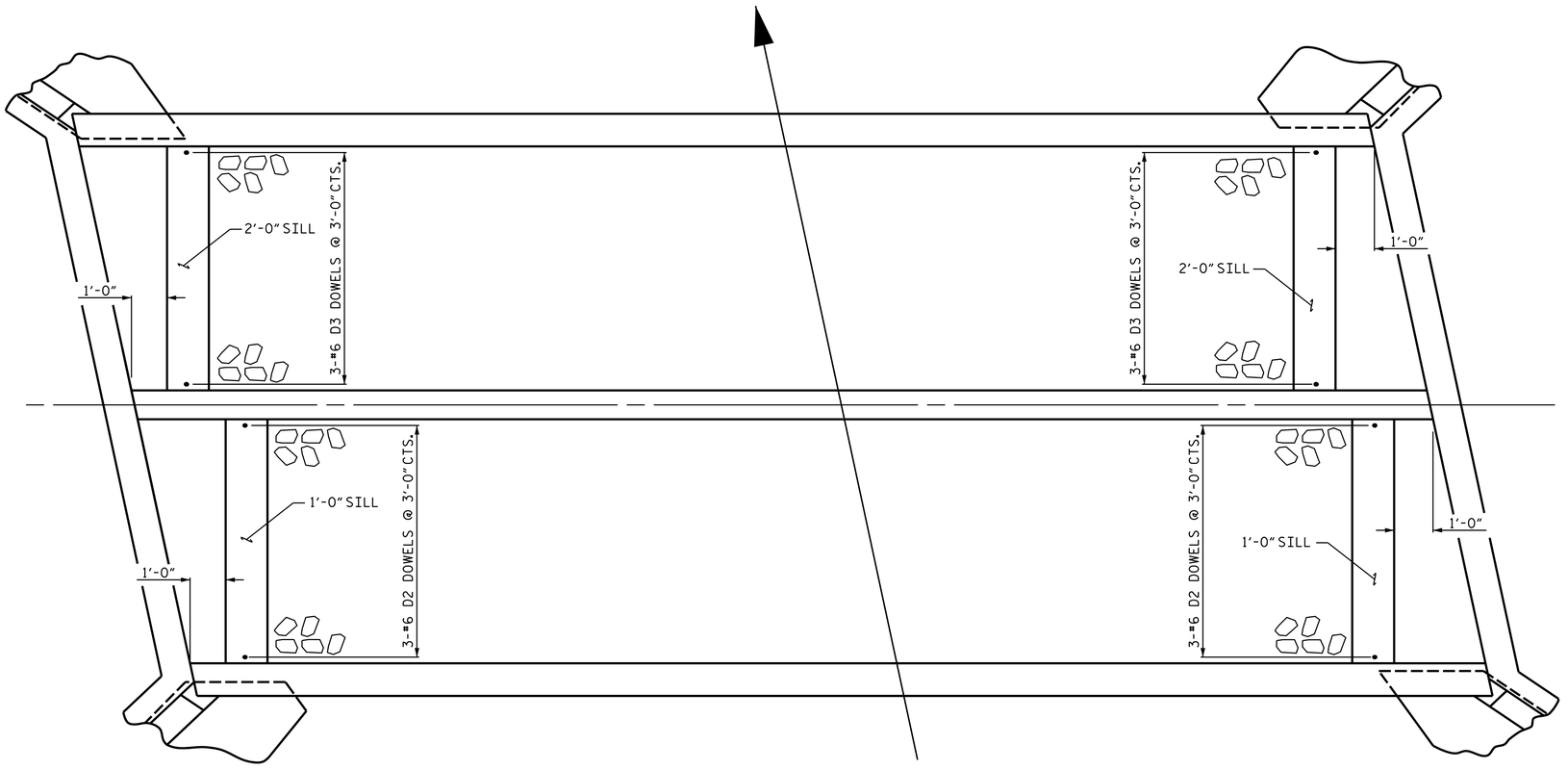
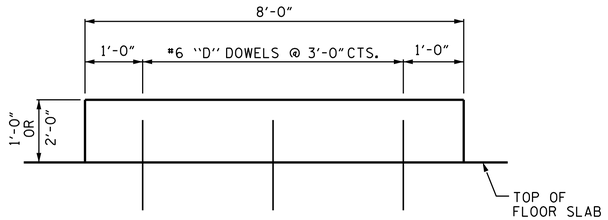


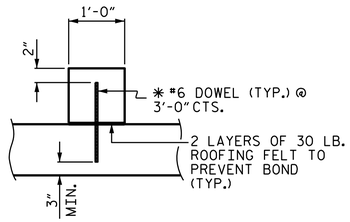
INLET ELEVATION
(LOOKING DOWNSTREAM)



PLAN OF FLOOR SILL LAYOUT



ELEVATION



SECTION THROUGH SILL

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

SILL DETAILS

NOTES

MATERIAL EXCAVATED FROM THE EXISTING BED SHALL BE STOCKPILED FOR USE IN THE PROPOSED CULVERT. BED MATERIAL IN THE HIGH FLOW BARREL MAY BE SUPPLEMENTED WITH CLASS B RIP RAP AS NECESSARY. NATIVE MATERIAL SHOULD BE PLACED ON TOP TO PROVIDE A FLAT SURFACE FOR ANIMAL PASSAGE. BED MATERIAL IS SUBJECT TO THE APPROVAL BY THE ENGINEER AND MAY BE SUBJECT TO PERMIT CONDITIONS.

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.

PROJECT NO. I-5987A
ROBESON COUNTY
STATION: 24+79.00 -Y3-

SHEET 9 OF 10

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL G. CHEEK, JR.
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706 HILLSBOROUGH STREET
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CORP. LICENSE NO.: C-0275

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

DOUBLE 8 FT. X 7 FT. CONCRETE BOX CULVERT 95°-00'-00" SKEW

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C14-9
1			3			TOTAL SHEETS
2			4			10

DRAWN BY : STM DATE : 12/21
CHECKED BY : MGC DATE : 12/21
DESIGN ENGINEER OF RECORD: STM DATE : 10/21

3/16/2022
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User:smassinople

FILE NAME: 417_017_I-5987A_Site 14_SMU_CU_009.dgn

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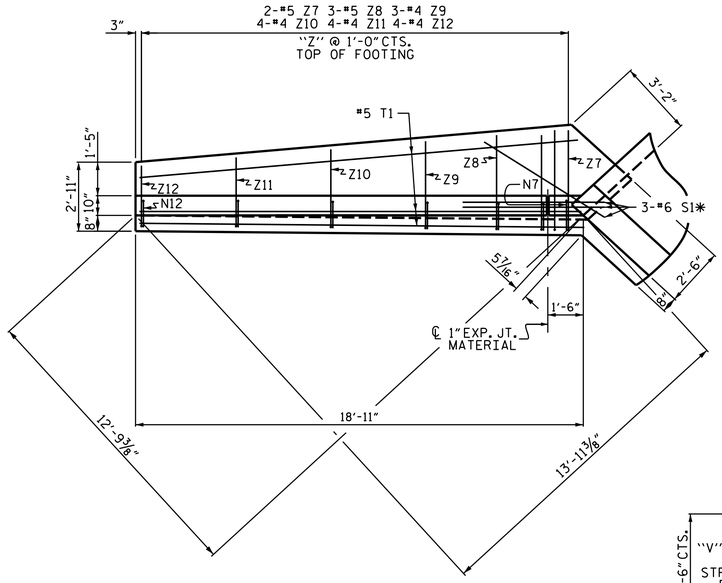
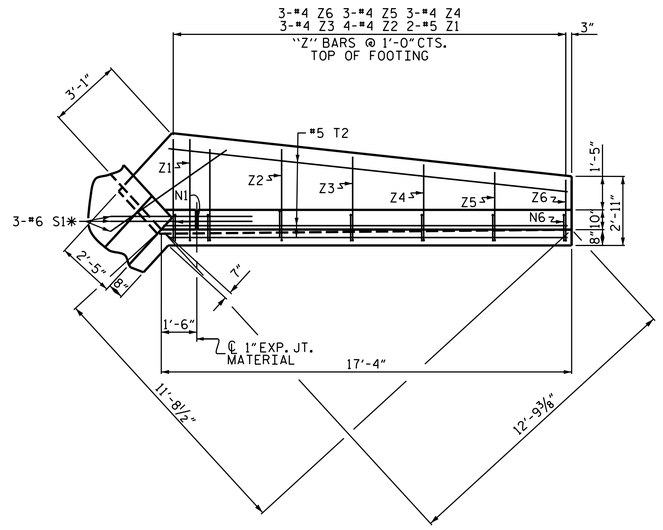
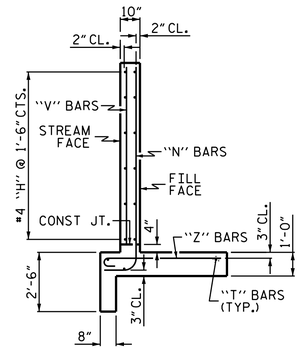


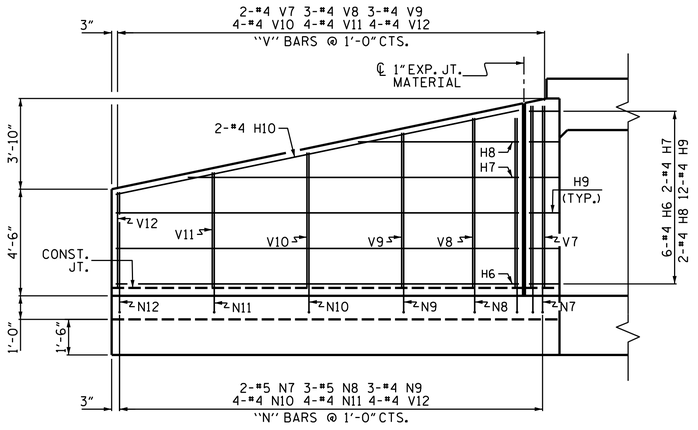
PLAN W1



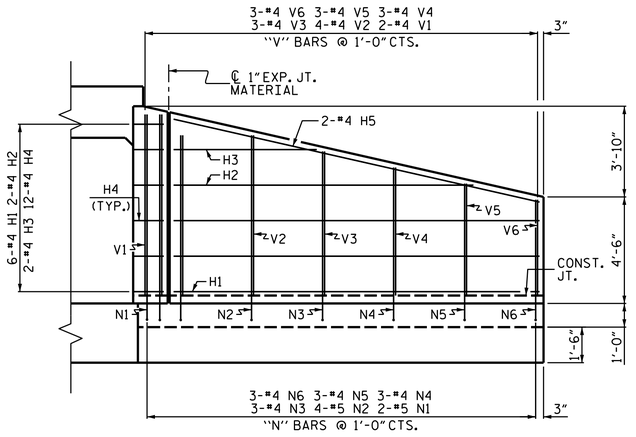
PLAN W2



TYPICAL WING SECTION

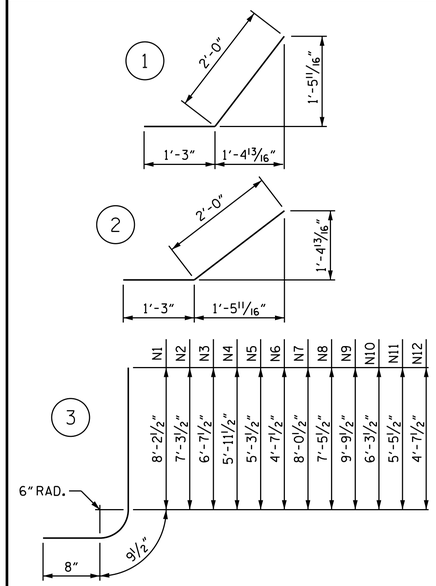


ELEVATION W1



ELEVATION W2

BAR TYPES



Z1	4'-3"	7"
Z2	3'-10"	6"
Z3	3'-7"	6"
Z4	3'-3"	6"
Z5	2'-11"	6"
Z6	2'-7"	6"
Z7	4'-3"	7"
Z8	4'-0"	7"
Z9	3'-9"	6"
Z10	3'-4"	6"
Z11	2'-11"	6"
Z12	2'-7"	6"

HK.

4

ALL BAR DIMENSIONS ARE OUT TO OUT.

NOTES

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.

G1 BARS IN HEADWALL ARE INCLUDED WITH THE BARREL REINFORCING STEEL.

BILL OF MATERIAL

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
H1	12	#4	STR	15'-5"	124
H2	4	#4	STR	12'-8"	34
H3	4	#4	STR	6'-0"	16
H4	24	#4	1	3'-3"	52
H5	4	#4	STR	15'-10"	42
H6	12	#4	STR	17'-0"	136
H7	4	#4	STR	14'-0"	37
H8	4	#4	STR	6'-9"	18
H9	24	#4	2	3'-3"	52
H10	4	#4	STR	17'-4"	46
N1	4	#5	3	9'-8"	40
N2	8	#5	3	8'-9"	73
N3	6	#4	3	8'-1"	32
N4	6	#4	3	7'-5"	30
N5	6	#4	3	6'-9"	27
N6	6	#4	3	6'-1"	24
N7	4	#5	3	9'-6"	40
N8	6	#5	3	8'-11"	56
N9	6	#4	3	8'-3"	33
N10	8	#4	3	7'-9"	41
N11	8	#4	3	6'-11"	37
N12	8	#4	3	6'-1"	33
S1	12	#6	STR	6'-0"	108
T1	6	#5	STR	18'-11"	118
T2	6	#5	STR	17'-4"	108
V1	4	#4	STR	7'-5"	20
V2	8	#4	STR	6'-6"	35
V3	6	#4	STR	5'-10"	23
V4	6	#4	STR	5'-2"	21
V5	6	#4	STR	4'-7"	18
V6	6	#4	STR	4'-0"	16
V7	4	#4	STR	7'-5"	20
V8	6	#4	STR	6'-9"	27
V9	6	#4	STR	6'-2"	25
V10	8	#4	STR	5'-8"	30
V11	8	#4	STR	4'-10"	26
V12	8	#4	STR	4'-0"	21
Z1	4	#5	4	4'-10"	20
Z2	8	#4	4	4'-4"	23
Z3	6	#4	4	4'-1"	16
Z4	6	#4	4	3'-9"	15
Z5	6	#4	4	3'-5"	14
Z6	6	#4	4	3'-1"	12
Z7	4	#5	4	4'-10"	20
Z8	6	#5	4	4'-7"	29
Z9	6	#4	4	4'-3"	17
Z10	8	#4	4	3'-10"	21
Z11	8	#4	4	3'-5"	18
Z12	8	#4	4	3'-1"	16

REINFORCING STEEL FOR 4 WINGS	1860 LBS
CLASS A CONCRETE	
4 WINGS	27.0 CY
2 HEADWALLS	1.7 CY
2 END CURTAIN WALLS	1.9 CY
TOTAL	30.6 CY

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 24+79.00 -Y3-

SHEET 10 OF 10

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL G. CHEEK, JR.

Docusigned by: Marshall G. Cheek, Jr. 5FBCC2F3A4DC413...

5/10/2022 | 10:06 AM EDT

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TGS ENGINEERS
706 HILLSBOROUGH STREET
SUITE 200
RALEIGH, NC 27603
PH (919) 773-8887
CORP. LICENSE NO.: C-0275

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

WINGS FOR CONCRETE BOX CULVERT

H = 7'-0" SLOPE = 3:1

95°-00'-00" SKEW

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C14-10
1			3			TOTAL SHEETS
2			4			10

DRAWN BY :	STM	DATE : 10/21
CHECKED BY :	MGC	DATE : 12/21
DESIGN ENGINEER OF RECORD:	STM	DATE : 10/21

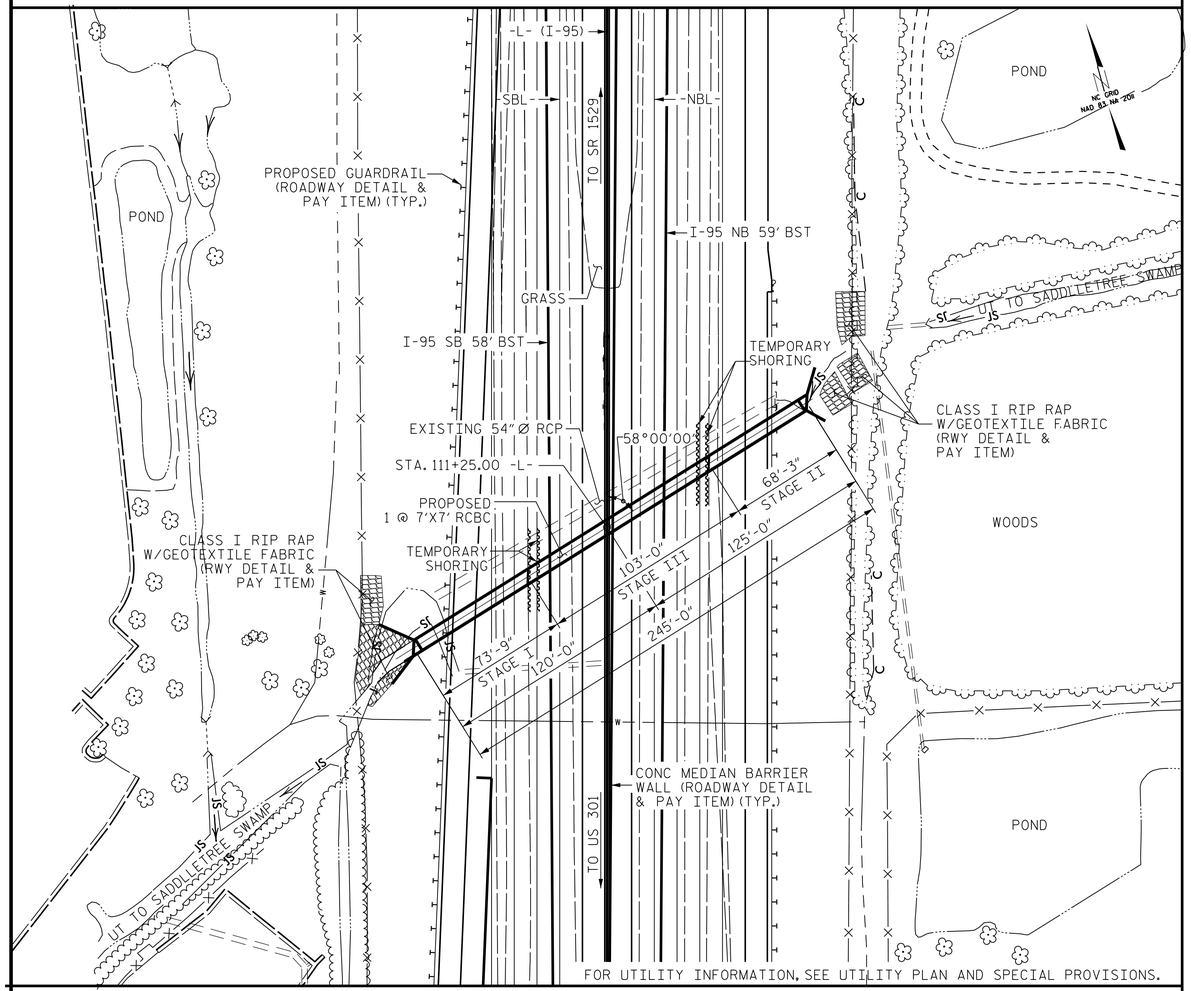
3/16/2022
X:\NCDOT\I-5987A\Structures\Site 14 - 24+79 -Y3-\Final Plans\DGNs\417_019_I-5987A_Site 14_SMU_CU_010.dgn
Users\mossinople

FILE NAME: 417_019_I-5987A_Site 14_SMU_CU_010.dgn

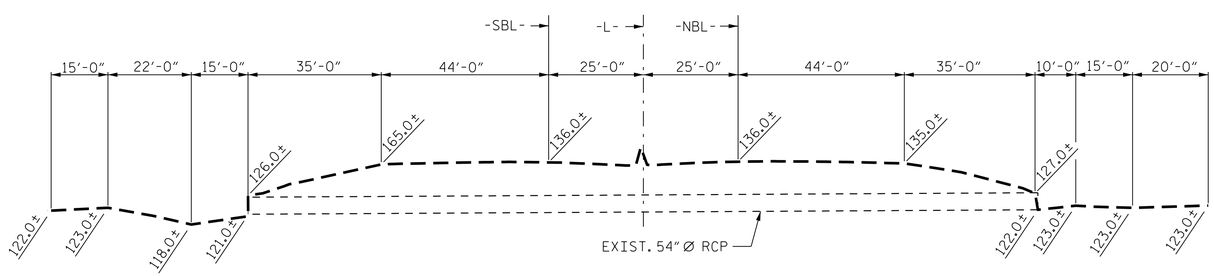
SITE 14

DocuSign Envelope ID: 35D1B21E-94F7-4BEF-9940-A25C69C41949

BM5: BENCH NAIL SET IN BASE OF 24" OAK, BL STA. 118+42.00; 57' RT.; EL. 134.06'



LOCATION SKETCH



PROFILE ALONG ℄ CULVERT

ROADWAY DATA

GRADE PT. EL. @ STA. 111+25.00 -L-	= 136.10'
BED ELEV. @ STA. 111+25.00 -L-	= 120.90'
ROADWAY SLOPE (LEFT)	= 3 : 1
ROADWAY SLOPE (RIGHT)	= 3 : 1

HYDRAULIC DATA

DESIGN DISCHARGE	= 270 CFS
FREQUENCY OF DESIGN FLOOD	= 100 YRS.
DESIGN HIGH WATER ELEVATION	= 128.5'
DRAINAGE AREA	= 0.42 SQ. MI.
BASE DISCHARGE (Q100)	= 270 CFS
BASE HIGH WATER ELEVATION	= 128.5'

OVERTOPPING FLOOD DATA

OVERTOPPING DISCHARGE	= 320+ CFS
FREQUENCY OF OVERTOPPING FLOOD	= 500+ YRS.
OVERTOPPING FLOOD ELEVATION	= 129.1' ✱

✱ AT ROADWAY LOW POINT STA. 13+79.00 -Y1RPD- GP ELEV. =132.5', SHOULDER ELEV = 130.4'

TOTAL STRUCTURE QUANTITIES

CULVERT EXCAVATION	LUMP SUM
FOUNDATION COND. MATERIAL	
STAGE I	64 TONS
STAGE II	60 TONS
STAGE III	90 TONS
TOTAL	214 TONS
CLASS A CONCRETE	
STAGE I	79.1 C.Y.
STAGE II	74.3 C.Y.
STAGE III	89.0 C.Y.
TOTAL	242.4 C.Y.
REINFORCING STEEL	
STAGE I	7,929 LBS.
STAGE II	7,435 LBS.
STAGE III	9,592 LBS.
TOTAL	24,956 LBS.

NOTES

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

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

FOR CONSTRUCTION SEQUENCE, EROSION CONTROL AND MEASURES, SEE EROSION CONTROL PLANS.

DESIGN FILL---------- 7.76' (MAX. FILL), 5.37' (MIN. FILL),

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:

STAGES I & II - CONSTRUCT RCBC SECTION AT BOTH OUTLET AND INLET ENDS.

1. WING FOOTINGS AND FLOOR SLAB INCLUDING 4" OF BOTH VERTICAL WALLS.
2. SILL WITH NATIVE MATERIAL BACKFILL.
3. FOLLOWED BY THE WING WALLS FULL HEIGHT. ROOF SLAB AND HEADWALL.

STAGE III - CONSTRUCT RCBC INTERMEDIATE SECTION.

1. FLOOR SLAB INCLUDING 4" OF BOTH VERTICAL WALLS.
2. FOLLOWED BY NATIVE MATERIAL BACKFILL AND ROOF SLAB.

THE CONTRACTOR 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 FEET. LOCATION OF JOINTS SHALL BE SUBJECT TO APPROVAL OF 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 SHALL BE PAID FOR BY CONTRACTOR.

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.

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.

NO PRECAST REINFORCED BOX CULVERT OPTION WILL BE ALLOWED.

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.

FOR TRAFFIC PHASING, LIMITS OF TEMPORARY SHORING, SEE TRAFFIC CONTROL PLANS.

FOR PAY ITEM FOR TEMPORARY SHORING, SEE ROADWAY PLANS.

FOUNDATION NOTES

BACKFILL WITH SELECT MATERIAL, CLASS VI MEETING THE REQUIREMENTS OF SECTION 1016 OF THE STANDARD SPECIFICATIONS.

SEE SECTION 414 OF THE STANDARD SPECIFICATIONS FOR CULVERT EXCAVATION AND BACKFILLING. EXCAVATE 1 FOOT BELOW CULVERT AND FOOTING AND REPLACE WITH FOUNDATION CONDITIONING MATERIAL IN ACCORDANCE WITH ARTICLE 414-4 OF THE STANDARD SPECIFICATIONS.

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 111+25.00 -L-

SHEET 1 OF 8

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

BARREL STANDARD

SINGLE 7 FT. X 7 FT. CONCRETE BOX CULVERT 58°SKEW

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

CDM Smith
CDM SMITH
5400 Glenwood Avenue, Suite 400
Raleigh, NC 27612-3228
NC COA No. F-1255

DRAWN BY : JJR DATE : 8/21
CHECKED BY : THF DATE : 8/21
DESIGN ENGINEER : VDK DATE : 9/21

DWG. No.

NORTH CAROLINA PROFESSIONAL SEAL 16301 ENGINEER TING-HSUING FANG
Ting Fang
05E43C9AEA80462...
3/19/2022

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C19-1
1			3			TOTAL SHEETS
2			4			8

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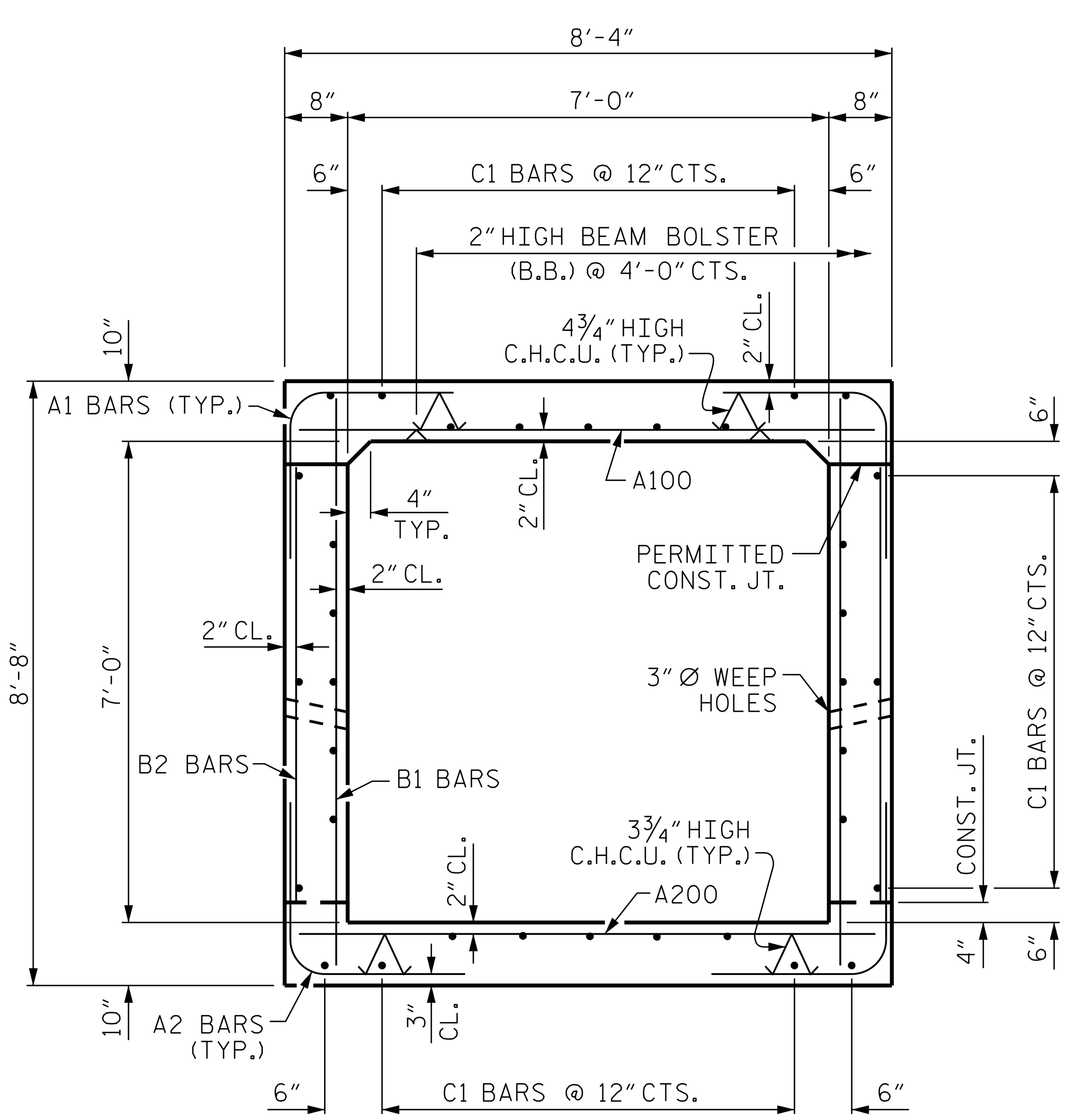
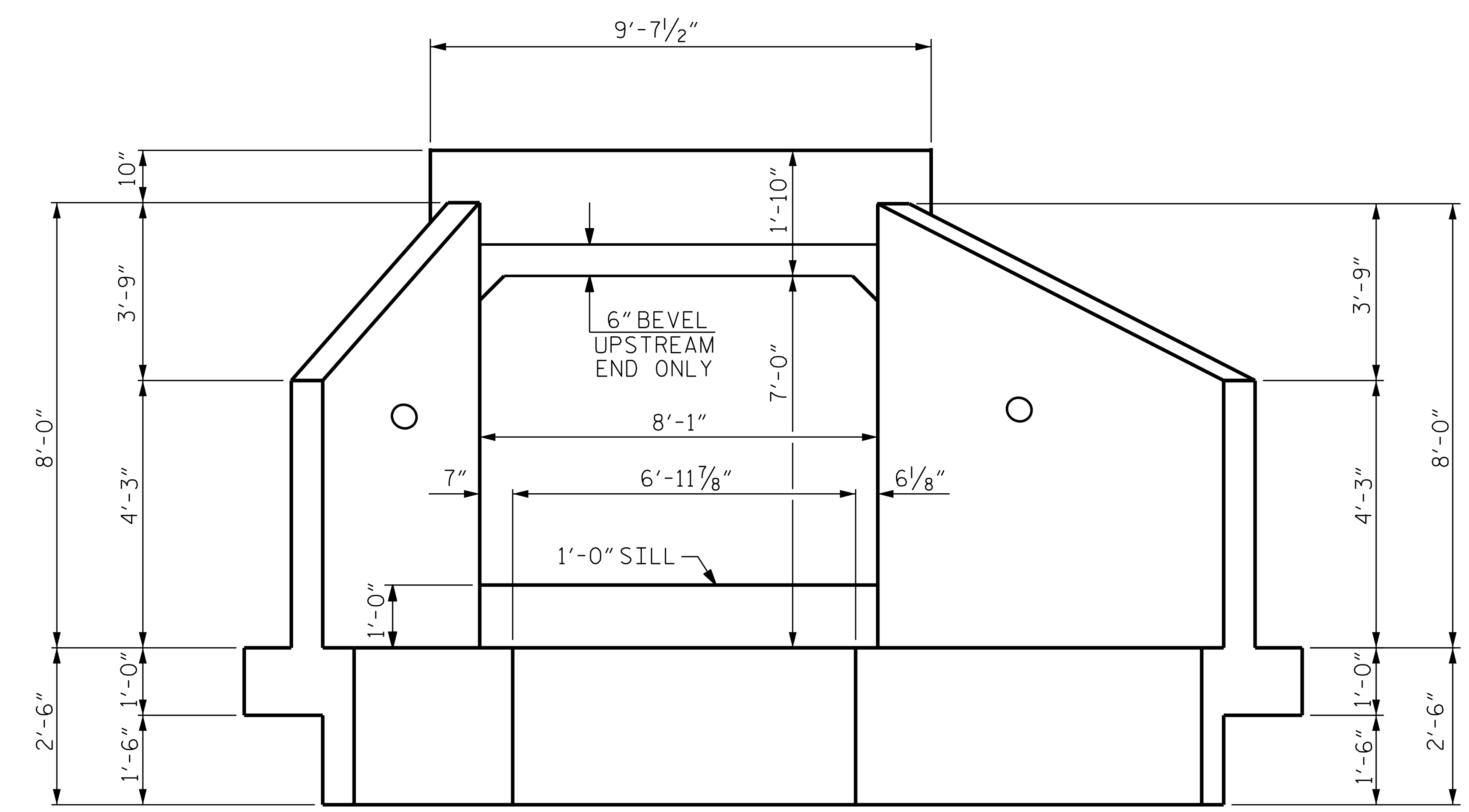
CULVERT SECTION NORMAL TO ROADWAY



RIGHT ANGLE SECTION OF BARREL

THERE ARE 34 C1 BARS IN SECTION OF BARREL



INLET END ELEVATION

NORMAL TO SKEW

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 111+25.00 -L-

SHEET 2 OF 8

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

BARREL STANDARD

SINGLE 7 FT. X 7 FT. CONCRETE BOX CULVERT

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NORTH CAROLINA PROFESSIONAL SEAL 16301 ENGINEER TING HSIUNG FANG

Ting Fang
3/19/2022

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SHEET NO. C19-2

TOTAL SHEETS 8

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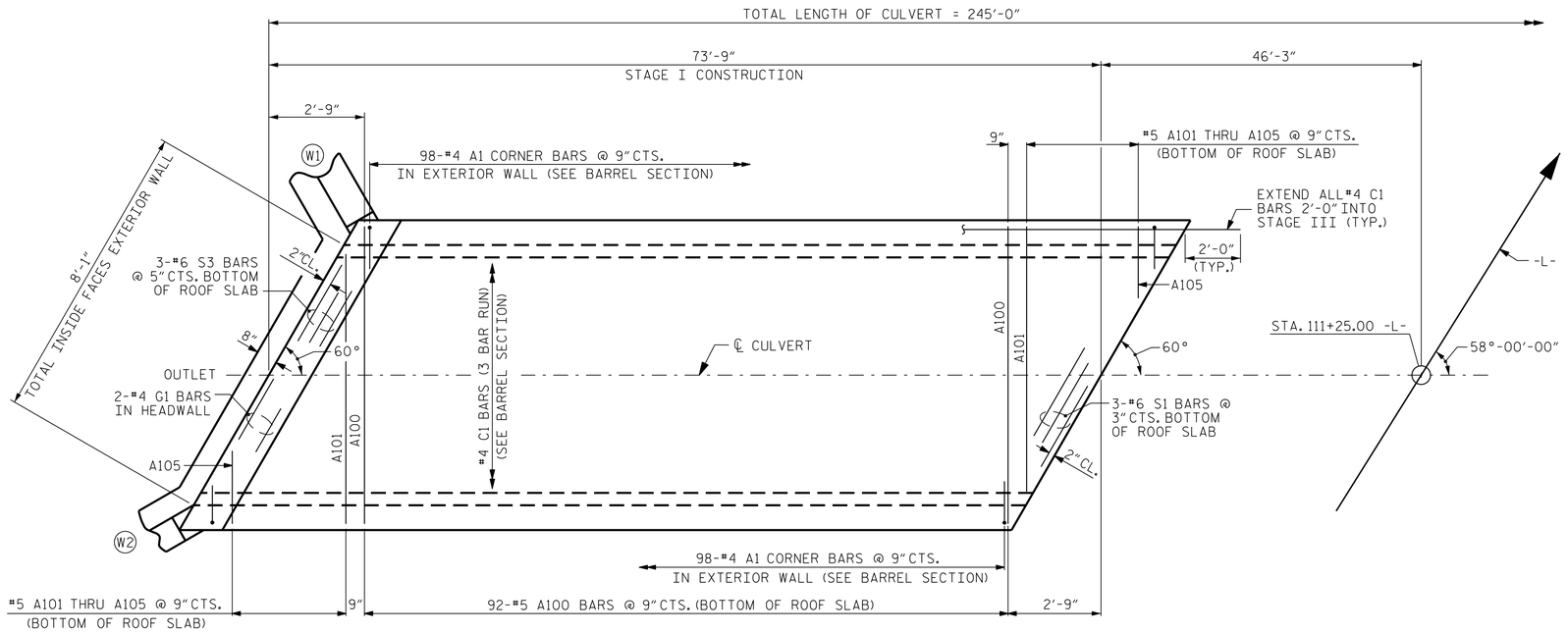
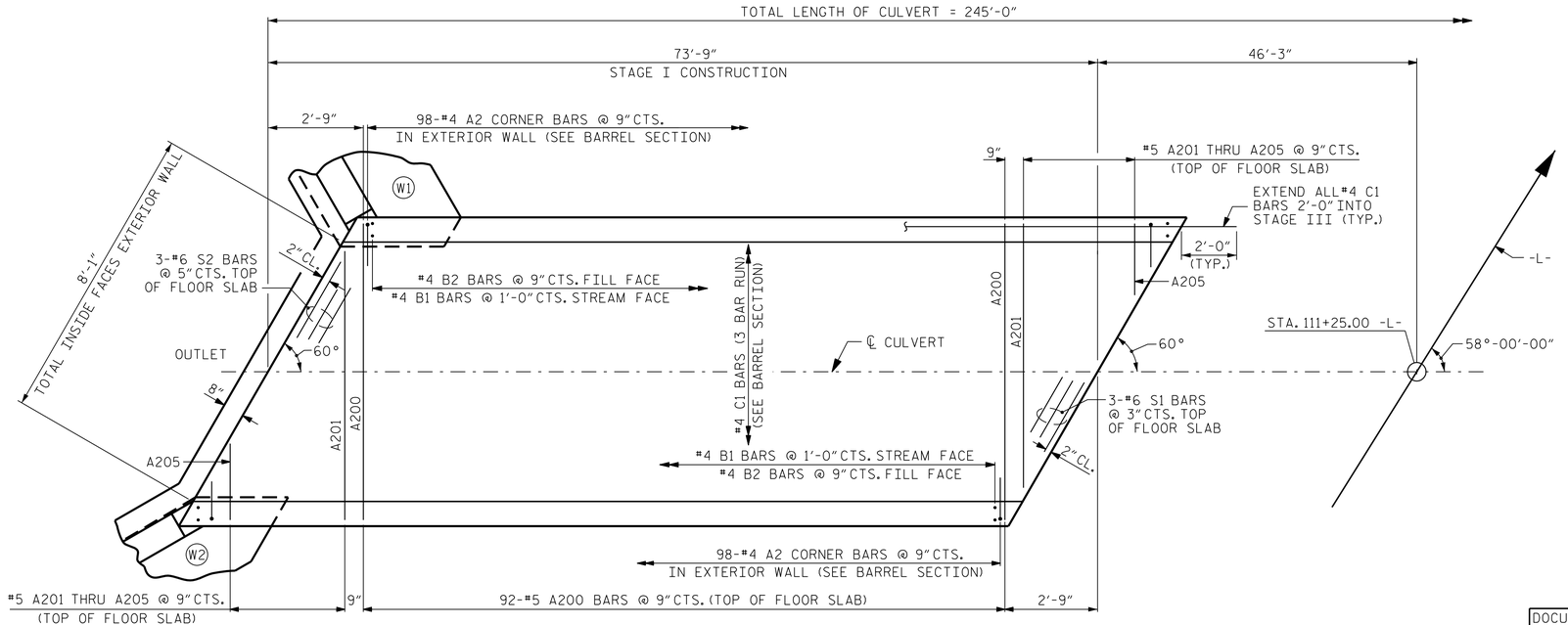
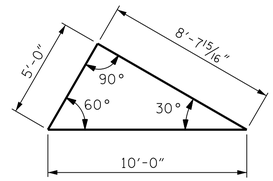


STAGE I - PLAN OF ROOF SLAB



STAGE I - PLAN OF FLOOR SLAB



SKEW TRIANGLE

REINFORCING BAR SCHEDULE

STAGE I

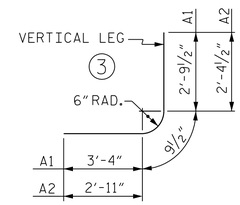
BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
A1	196	#4	3	6'-11"	906
A2	196	#4	3	6'-1"	796
A100	92	#5	STR	8'-0"	768
A101	2	#5	STR	7'-2"	15
A102	2	#5	STR	5'-10"	12
A103	2	#5	STR	4'-6"	9
A104	2	#5	STR	3'-3"	7
A105	2	#5	STR	1'-11"	4
A200	92	#5	STR	8'-0"	768
A201	2	#5	STR	7'-2"	15
A202	2	#5	STR	5'-10"	12
A203	2	#5	STR	4'-6"	9
A204	2	#5	STR	3'-3"	7
A205	2	#5	STR	1'-11"	4
B1	148	#4	STR	8'-4"	821
B2	196	#4	STR	6'-4"	829
C1	102	#4	STR	26'-5"	1800
D1	3	#6	STR	1'-5"	6
G1	2	#4	STR	9'-3"	12
S1	12	#6	STR	9'-3"	167
REINFORCING STEEL				LBS.	6,970

STRUCTURE QUANTITIES

STAGE I

FOUNDATION COND. MAT'L	64	TONS
CULVERT EXCAVATION	LUMP SUM	
CLASS A CONCRETE		
BARREL @ 0.864 CY/FT	63.8	C.Y.
HEADWALL	0.5	C.Y.
WINGS & CURTAIN WALL	14.5	C.Y.
SILL	0.3	C.Y.
TOTAL	79.1	C.Y.
REINFORCING STEEL		
BARREL, SILL & HEADWALL	6,970	LBS.
2 WINGS	959	LBS.
TOTAL	7,929	LBS.

BAR TYPE



BAR DIMENSIONS ARE OUT TO OUT

SPLICE LENGTHS CHART

BAR	SIZE	SPLICE LENGTH
C1	#4	1'-10"

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 111+25.00 -L-

SHEET 3 OF 8

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Ting Fang
60E43C9AEA0046...
3/19/2022

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH
BARREL STANDARD

SINGLE 7 FT. X 7 FT. CONCRETE BOX CULVERT
STAGE I

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

SHEET NO. C19-3

TOTAL SHEETS 8

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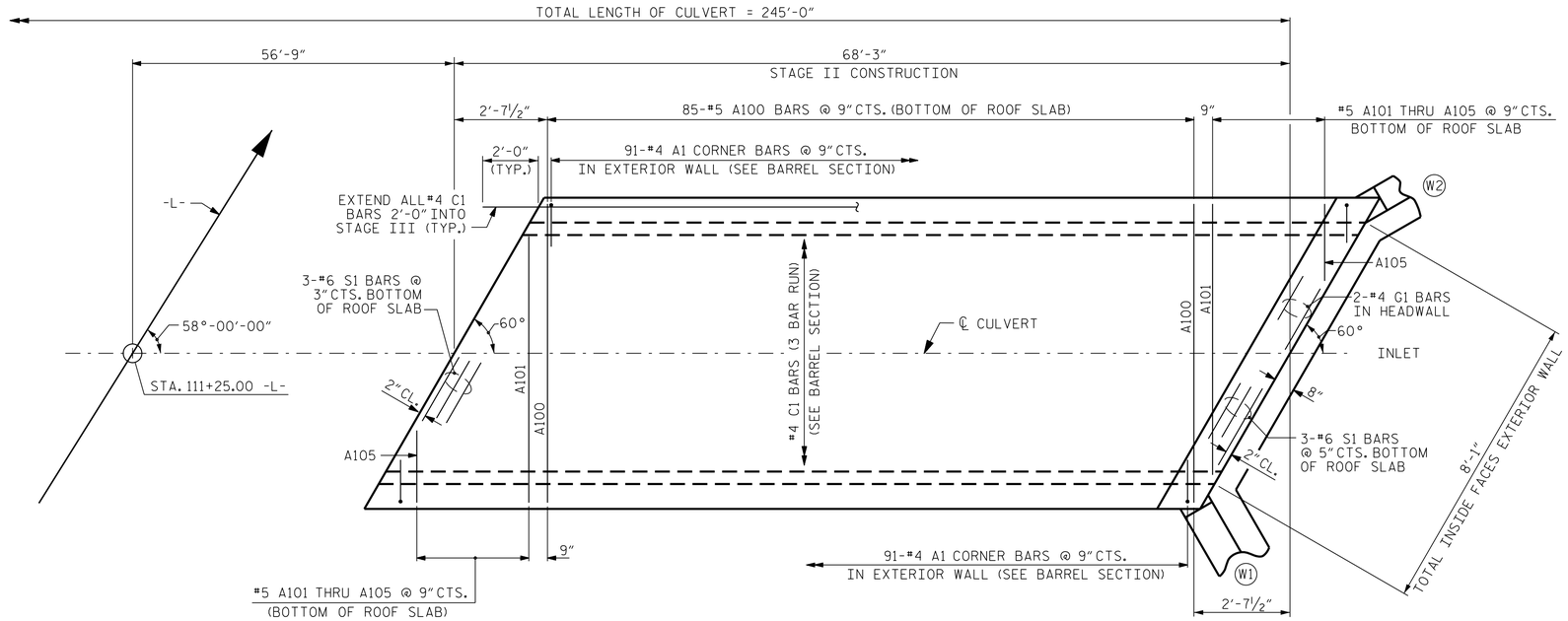
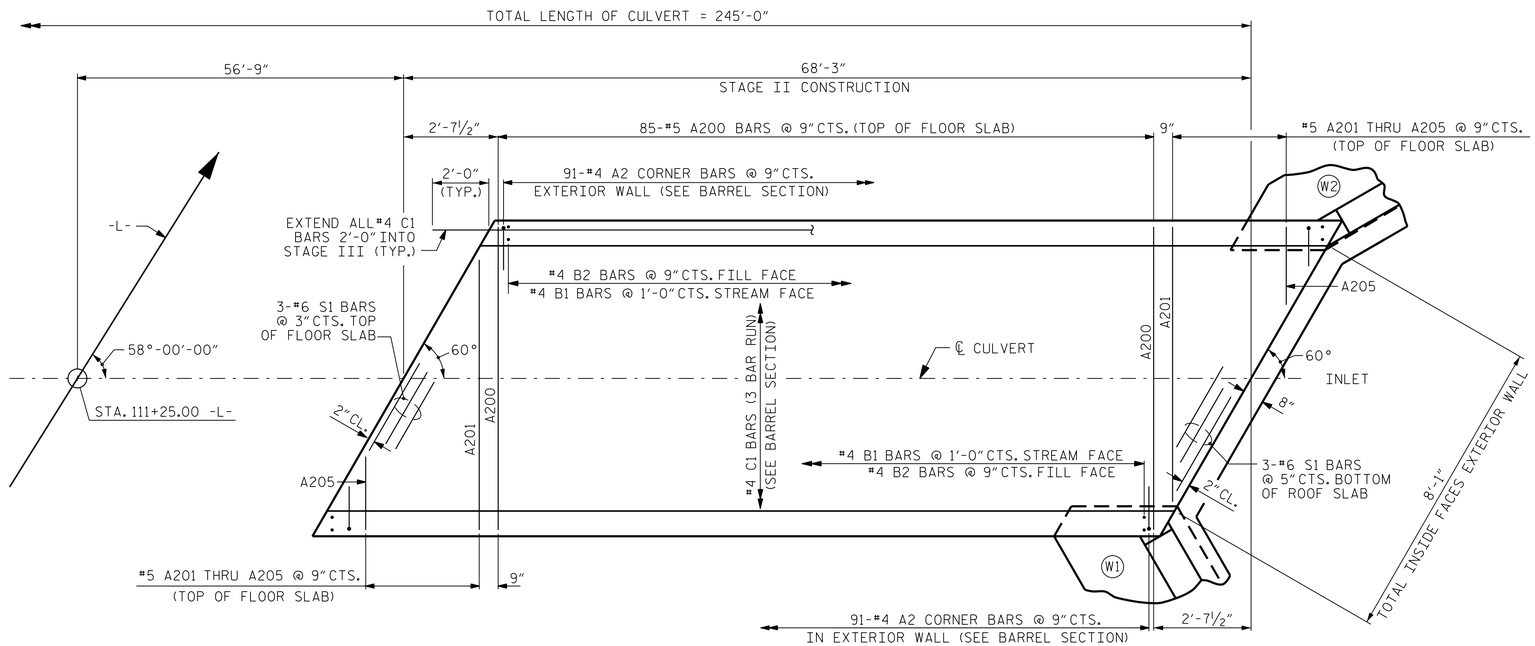


STAGE II - PLAN OF ROOF SLAB

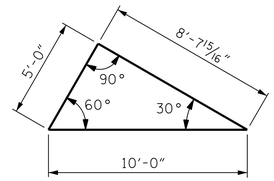


STAGE II - PLAN OF FLOOR SLAB

STRUCTURE QUANTITIES

STAGE II

FOUNDATION COND. MAT'L	60	TONS
CULVERT EXCAVATION	LUMP SUM	
CLASS A CONCRETE		
BARREL @ 0.864 CY/FT	59.0	C.Y.
HEADWALL	0.5	C.Y.
WINGS & CURTAIN WALL	14.5	C.Y.
SILL	0.3	C.Y.
TOTAL	74.3	C.Y.
REINFORCING STEEL		
BARREL, SILL & HEADWALL	6,476	LBS.
2 WINGS	959	LBS.
TOTAL	7,435	LBS.



SKEW TRIANGLE

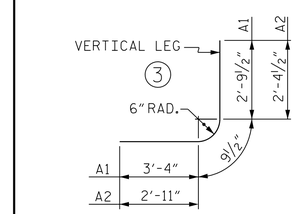
REINFORCING BAR SCHEDULE

STAGE II

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
A1	182	#4	3	6'-11"	841
A2	182	#4	3	6'-1"	740
A100	85	#5	STR	8'-0"	709
A101	2	#5	STR	6'-11"	14
A102	2	#5	STR	5'-7"	12
A103	2	#5	STR	4'-4"	9
A104	2	#5	STR	3'-0"	6
A105	2	#5	STR	1'-9"	4
A200	85	#5	STR	8'-0"	709
A201	2	#5	STR	6'-11"	14
A202	2	#5	STR	5'-7"	12
A203	2	#5	STR	4'-4"	9
A204	2	#5	STR	3'-0"	6
A205	2	#5	STR	1'-9"	4
B1	136	#4	STR	8'-4"	757
B2	182	#4	STR	6'-4"	770
C1	102	#4	STR	24'-7"	1675
D1	3	#6	STR	1'-5"	6
G1	2	#4	STR	9'-3"	12
S1	12	#6	STR	9'-3"	167

REINFORCING STEEL LBS. 6,476

BAR TYPE



BAR DIMENSIONS ARE OUT TO OUT

SPLICE LENGTHS CHART

BAR	SIZE	SPLICE LENGTH
C1	#4	1'-10"

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 111+25.00 -L-

SHEET 4 OF 8

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NORTH CAROLINA PROFESSIONAL SEAL 16301 ENGINEER TING-HSIUNG FANG
Ting Fang
60E43C9AEA60462...

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

BARREL STANDARD

SINGLE 7 FT. X 7 FT. CONCRETE BOX CULVERT

STAGE II

REVISIONS						SHEET NO.
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1			3			TOTAL SHEETS
2			4			8

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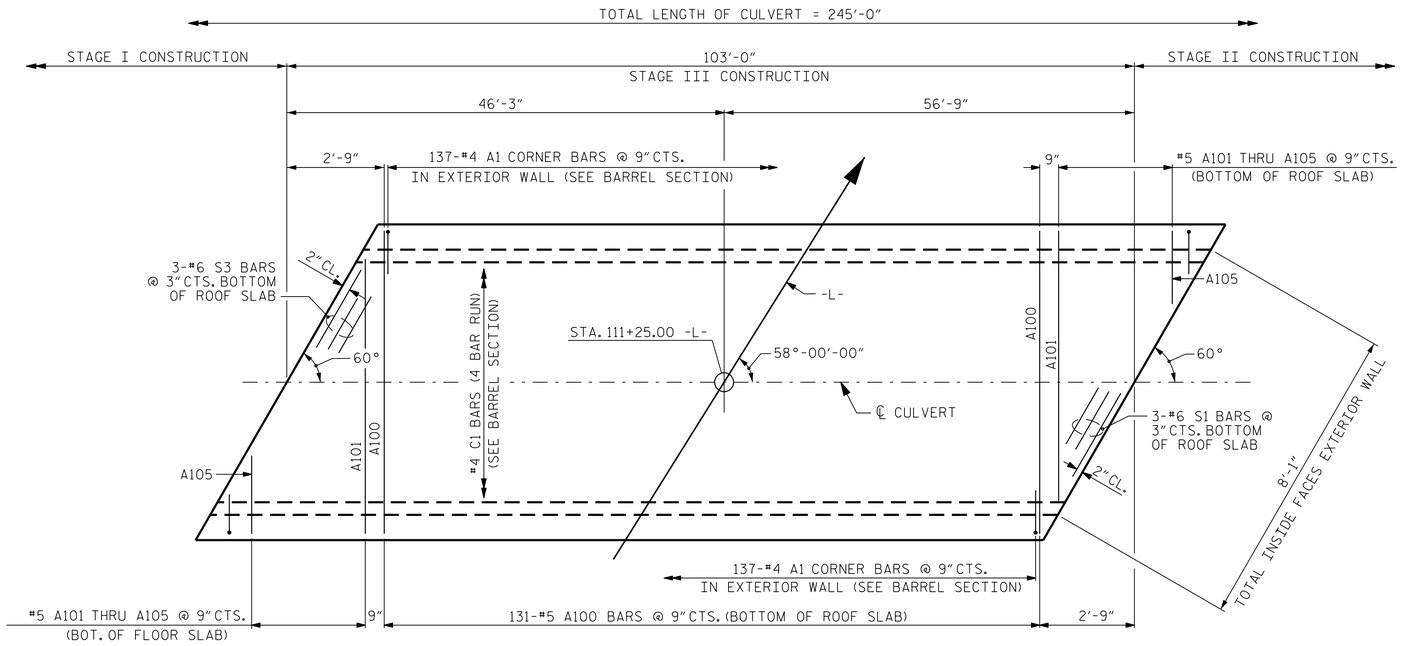
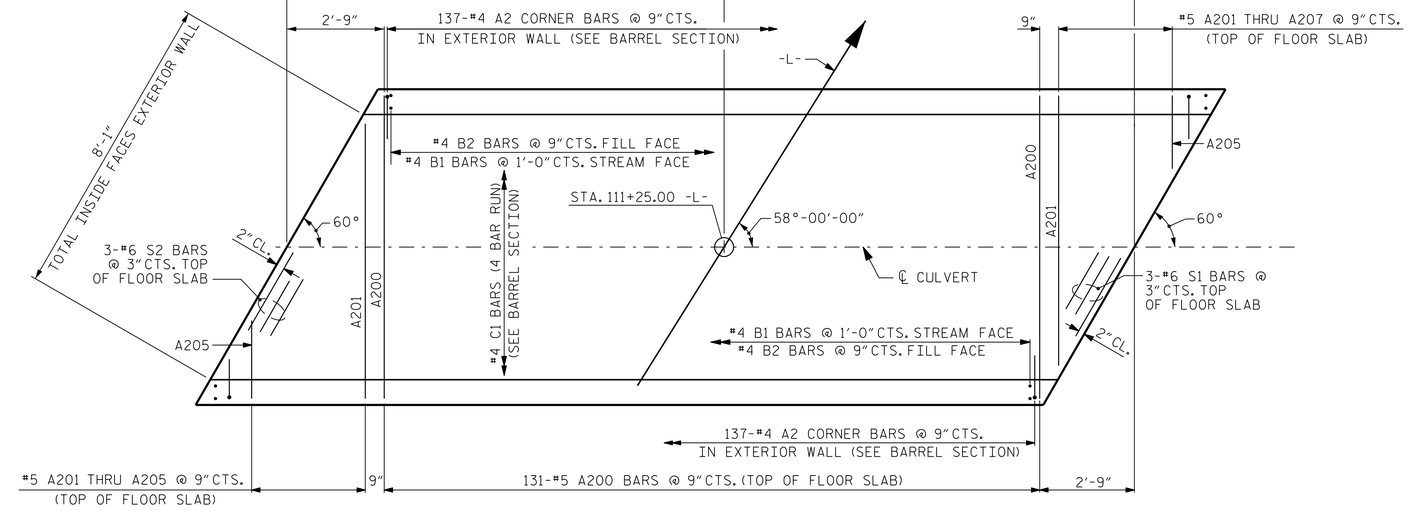


STAGE III - PLAN OF ROOF SLAB

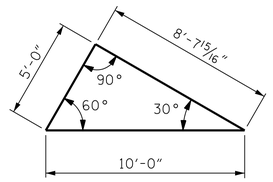


STAGE III - PLAN OF FLOOR SLAB

STRUCTURE QUANTITIES

STAGE III

FOUNDATION COND. MAT'L	90 TONS
CULVERT EXCAVATION	LUMP SUM
CLASS A CONCRETE	
BARREL @ 0.864 CY/FT	89.0 C.Y.
TOTAL	89.0 C.Y.
REINFORCING STEEL	
BARREL	9,592 LBS.
TOTAL	9,592 LBS.



SKEW TRIANGLE

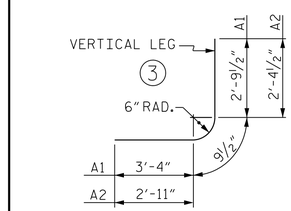
REINFORCING BAR SCHEDULE

STAGE III

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
A1	274	#4	3	6'-11"	1266
A2	274	#4	3	6'-1"	1113
A100	131	#5	STR	8'-0"	1093
A101	2	#5	STR	7'-2"	15
A102	2	#5	STR	5'-10"	12
A103	2	#5	STR	4'-6"	9
A104	2	#5	STR	3'-3"	7
A105	2	#5	STR	1'-11"	4
A200	131	#5	STR	8'-0"	1093
A201	2	#5	STR	7'-2"	15
A202	2	#5	STR	5'-10"	12
A203	2	#5	STR	4'-6"	9
A204	2	#5	STR	3'-3"	7
A205	2	#5	STR	1'-11"	4
B1	206	#4	STR	8'-4"	1147
B2	274	#4	STR	6'-4"	1159
C1	136	#4	STR	27'-1"	2460
S1	12	#6	STR	9'-3"	167

REINFORCING STEEL LBS. 9,592

BAR TYPE



BAR DIMENSIONS ARE OUT TO OUT

SPLICE LENGTHS CHART

BAR	SIZE	SPLICE LENGTH
C1	#4	1'-10"

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 111+25.00 -L-

SHEET 5 OF 8

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Ting Fang
3/19/2022

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

BARREL STANDARD

SINGLE 7 FT. X 7 FT. CONCRETE BOX CULVERT

STAGE III

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C19-5
1			3			TOTAL SHEETS
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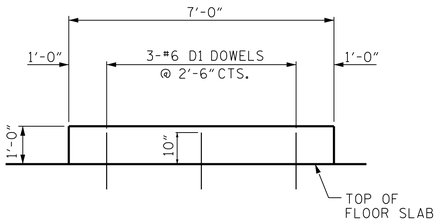
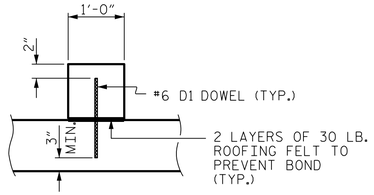


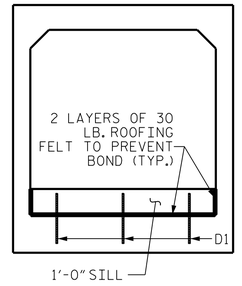
CONCRETE SILL DETAIL



SECTION THROUGH SILL

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

THE CONTRACTOR'S ATTENTION IS CALLED TO THE FACT THAT THE NATIVE MATERIAL BACKFILL SHALL BE PLACED PRIOR TO THE CASTING OF THE ROOF SLAB.



ELEVATION

SILLS AT INLET & OUTLET ENDS

NOTES:

CULVERT FLOOR SLAB IS BURIED 1 FOOT BELOW EXISTING STREAM BED. BACKFILL WITH NATIVE MATERIAL TO SILL HEIGHT IN ALL BARRELS.

NATIVE MATERIAL BETWEEN SILLS IN THE CULVERT SHALL PROVIDE A CONTINUOUS FLOW CHANNEL.

NATIVE MATERIAL CONSISTS OF MATERIAL THAT IS EXCAVATED FROM THE STREAM OR FLOODPLAIN AT THE PROJECT SITE DURING CONSTRUCTION. ONLY MATERIAL THAT IS EXCAVATED FROM THE STREAM BED MAY BE USED TO LINE CULVERT BARRELS. AT THE CONTRACTOR'S OPTION, RIP RAP MAY BE USED TO SUPPLEMENT THE NATIVE MATERIAL IN THE BARREL.

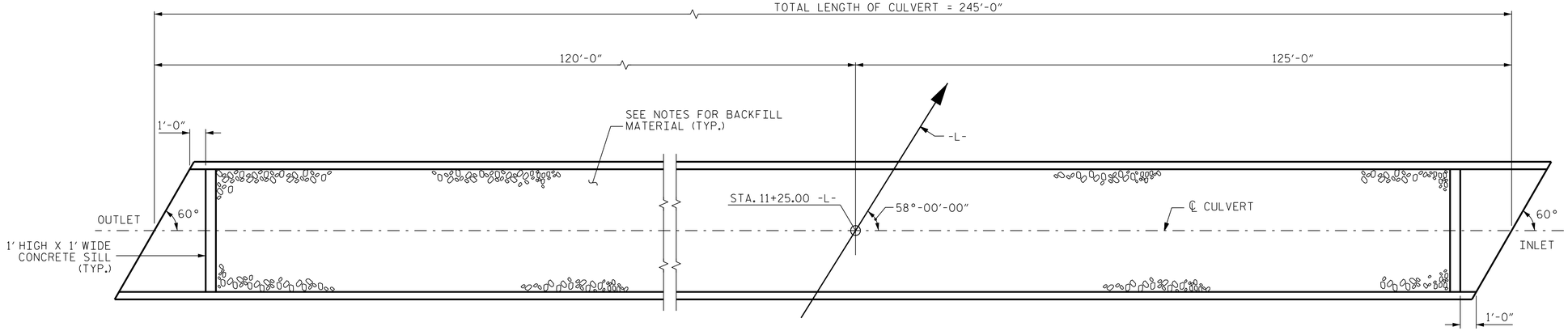
IF RIP RAP IS USED TO LINE THE FLOW CULVERT BARREL, NATIVE MATERIAL SHOULD BE PLACED ON TOP TO FILL VOIDS AND PROVIDE A FLAT SURFACE FOR ANIMAL PASSAGE.

NATIVE MATERIAL IS SUBJECT TO APPROVAL BY THE ENGINEER AND MAY BE SUBJECT TO PERMIT CONDITIONS.

SILLS ARE TO BE 1 FOOT, CAST SEPARATELY AND ATTACHED BY DOWELS.

TOP OF SILLS SHOULD MATCH STREAM BED ELEVATION.

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.



PLAN

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 111+25.00 -L-

SHEET 6 OF 8

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NC COA No. F-1255

DRAWN BY :	JJR	DATE : 8/21
CHECKED BY :	THF	DATE : 8/21
DESIGN ENGINEER :	VDK	DATE : 9/21

DWG. No.

NORTH CAROLINA PROFESSIONAL SEAL 16301 ENGINEER TING-HSIUNG FANG
Ting Fang
3/19/2022

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

DETAILS OF SILLS FOR CONCRETE BOX CULVERT

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C19-6
1			3			TOTAL SHEETS
2			4			8

SITE 19

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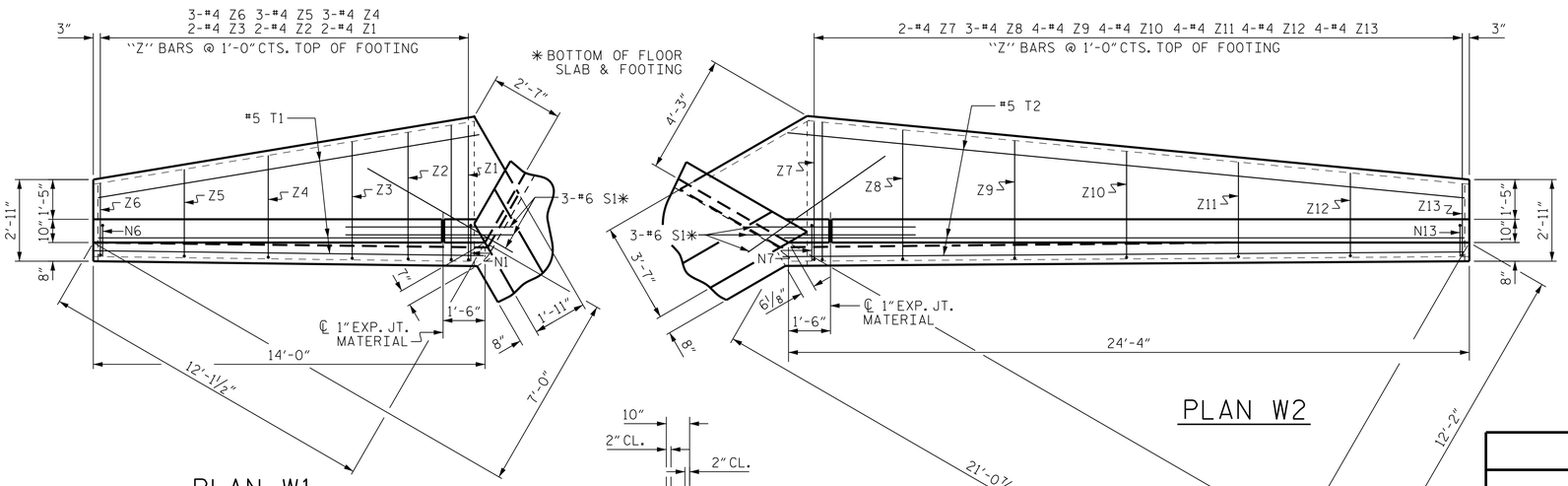
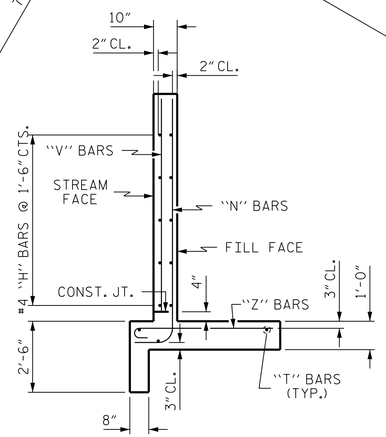
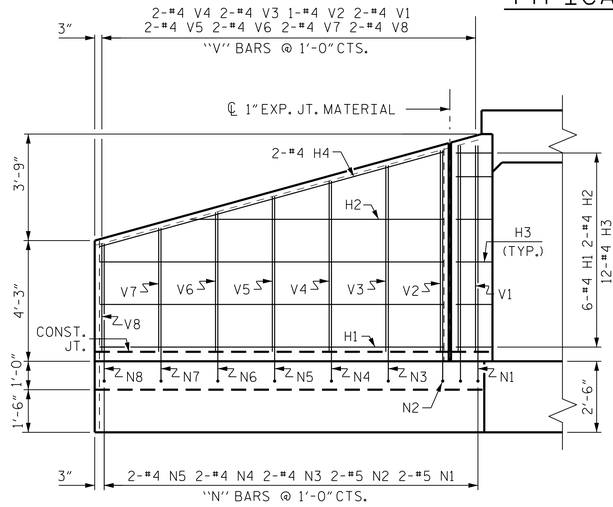


PLAN W1

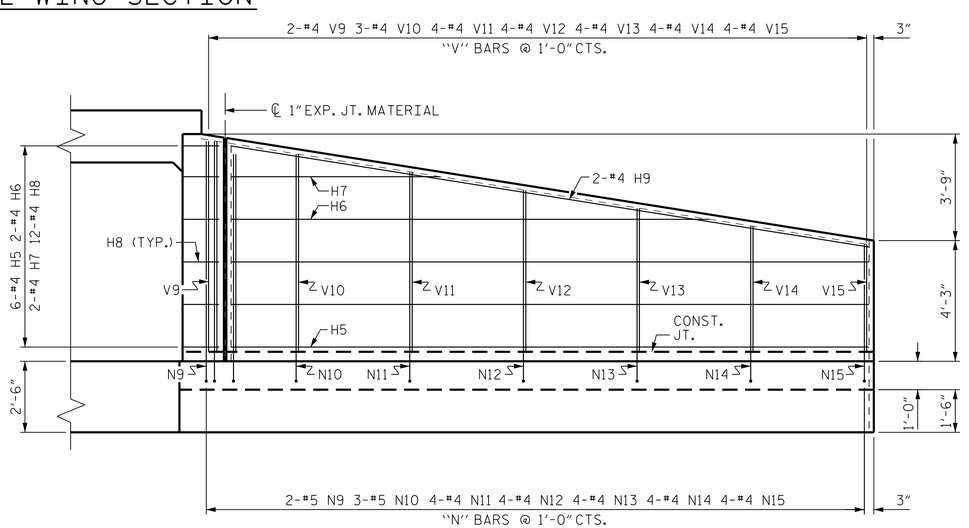
PLAN W2



TYPICAL WING SECTION



ELEVATION W1



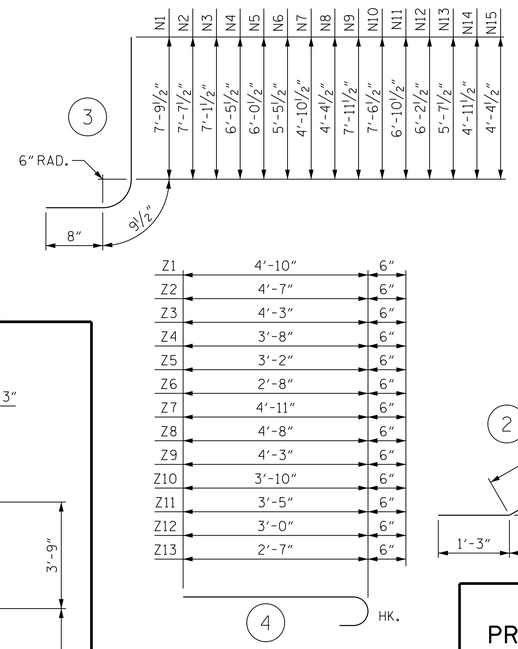
ELEVATION W2

BILL OF MATERIAL

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
Z1	4	#4	4	5'-4"	14
Z2	4	#4	4	5'-1"	14
Z3	4	#4	4	4'-9"	13
Z4	6	#4	4	4'-2"	17
Z5	6	#4	4	3'-8"	15
Z6	6	#4	4	3'-2"	13
Z7	4	#4	4	5'-5"	14
Z8	6	#4	4	5'-2"	21
Z9	8	#4	4	4'-9"	25
Z10	8	#4	4	4'-4"	23
Z11	8	#4	4	3'-11"	21
Z12	8	#4	4	3'-6"	19
Z13	8	#4	4	3'-1"	16
REINFORCING STEEL FOR 4 WINGS					1918 LBS
CLASS A CONCRETE					
4 WINGS					28.1 CY
2 HEADWALLS					0.9 CY
2 END CURTAIN WALLS					0.9 CY
TOTAL					29.9 CY

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
H1	12	#4	STR	12'-1"	97
H2	4	#4	STR	8-11"	24
H3	24	#4	1	3'-3"	52
H4	4	#4	STR	12'-7"	34
H5	12	#4	STR	22'-5"	180
H6	4	#4	STR	16'-10"	45
H7	4	#4	STR	7'-4"	20
H8	24	#4	2	3'-3"	52
H9	4	#4	STR	22'-9"	61
N1	4	#5	3	9'-3"	39
N2	4	#5	3	9'-1"	19
N3	4	#4	3	8'-7"	23
N4	4	#4	3	8'-0"	21
N5	4	#4	3	7'-6"	20
N6	4	#5	3	6'-11"	18
N7	6	#5	3	6'-4"	17
N8	8	#4	3	5'-10"	16
N9	8	#4	3	9'-5"	59
N10	8	#4	3	9'-0"	56
N11	4	#5	3	8'-4"	45
N12	6	#5	3	7'-8"	41
N13	8	#4	3	7'-1"	38
N14	8	#4	3	6'-5"	34
N15	8	#4	3	5'-10"	31
S1	12	#6	STR	6'-0"	108
T1	6	#5	STR	13'-10"	87
T2	6	#5	STR	24'-4"	152
V1	4	#4	STR	7'-3"	19
V2	2	#4	STR	7'-1"	9
V3	4	#4	STR	6'-7"	18
V4	4	#4	STR	6'-0"	16
V5	4	#4	STR	5'-6"	15
V6	4	#4	STR	4'-11"	13
V7	4	#4	STR	4'-4"	12
V8	4	#4	STR	3'-10"	10
V9	6	#4	STR	7'-5"	30
V10	6	#4	STR	7'-0"	28
V11	8	#4	STR	6'-4"	34
V12	8	#4	STR	5'-8"	30
V13	8	#4	STR	5'-1"	27
V14	8	#4	STR	4'-5"	24
V15	8	#4	STR	3'-10"	20

BAR TYPES



ALL BAR DIMENSIONS ARE OUT TO OUT.

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 111+25.00 -L-

SHEET 7 OF 8

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

WINGS FOR CONCRETE BOX CULVERT

H = 7'-0" SLOPE = 3:1

60° SKEW

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NC COA No. F-1255

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DESIGN ENGINEER : VDK DATE : 9/21

DWG. No.

NORTH CAROLINA PROFESSIONAL SEAL 16301 ENGINEER TING-HSIUNG FANG
Ting Fang
80E43C0AEA60462...
3/19/2022

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2			4			8

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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
								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	**1.33**	--	1.75	**1.33**	1	BOTTOM SLAB	3.50	2.91	1	BOTTOM SLAB	0.00	
		HL-93 (OPERATING)	N/A		1.72	--	1.35	1.72	1	BOTTOM SLAB	3.50	3.77	1	BOTTOM SLAB	0.00	
		HS-20 (INVENTORY)	36.000	2	**1.77**	63.72	1.75	**1.77**	1	BOTTOM SLAB	3.50	3.88	1	BOTTOM SLAB	0.00	
		HS-20 (OPERATING)	36.000		2.29	82.44	1.35	2.29	1	BOTTOM SLAB	3.50	5.03	1	BOTTOM SLAB	0.00	
LEGAL LOAD RATING	SINGLE VEHICLE (SV)	SH	12.500	3	2.25	28.13	1.40	2.25	1	BOTTOM SLAB	3.50	5.10	1	BOTTOM SLAB	0.00	
		S3C	21.500		2.35	50.53	1.40	2.35	1	BOTTOM SLAB	3.50	5.33	1	BOTTOM SLAB	0.00	
		S3A	22.750		2.35	53.46	1.40	2.35	1	BOTTOM SLAB	3.50	5.33	1	BOTTOM SLAB	0.00	
		S4A	26.750		2.35	62.86	1.40	2.35	1	BOTTOM SLAB	3.50	5.33	1	BOTTOM SLAB	0.00	
		S5A	30.500		2.35	71.68	1.40	2.35	1	BOTTOM SLAB	3.50	5.33	1	BOTTOM SLAB	0.00	
		S6A	34.500		2.35	81.08	1.40	2.35	1	BOTTOM SLAB	3.50	5.33	1	BOTTOM SLAB	0.00	
		S7B	38.500		2.35	90.48	1.40	2.35	1	BOTTOM SLAB	3.50	5.33	1	BOTTOM SLAB	0.00	
		S7A	40.000		2.35	94.00	1.40	2.35	1	BOTTOM SLAB	3.50	5.33	1	BOTTOM SLAB	0.00	
	TRUCK TRACTOR SEMI-TRAILER (TTST)	T4A	28.250		2.35	66.39	1.40	2.35	1	BOTTOM SLAB	3.50	5.33	1	BOTTOM SLAB	0.00	
		T5B	32.000		2.35	75.20	1.40	2.35	1	BOTTOM SLAB	3.50	5.33	1	BOTTOM SLAB	0.00	
		T6A	36.000		2.35	84.60	1.40	2.35	1	BOTTOM SLAB	3.50	5.33	1	BOTTOM SLAB	0.00	
		T7A	40.000		2.35	94.00	1.40	2.35	1	BOTTOM SLAB	3.50	5.33	1	BOTTOM SLAB	0.00	
		T7B	40.000		2.35	94.00	1.40	2.35	1	BOTTOM SLAB	3.50	5.33	1	BOTTOM SLAB	0.00	

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.

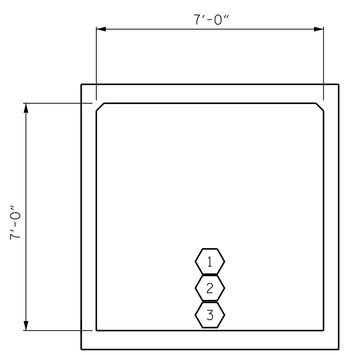
(#) CONTROLLING LOAD RATING

(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)

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NC COA No. F-1255

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DESIGN ENGINEER : VDK DATE : 9/21

DWG. No.

NORTH CAROLINA PROFESSIONAL SEAL 16301 ENGINEER TING HSIUNG FANG
Ting Fang
6DE43C8AEA80462...
3/19/2022

PROJECT NO. I-5987A
ROBESON COUNTY
STATION: 111+25.00 -L-

SHEET 8 OF 8

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH
STANDARD

LRFR SUMMARY FOR REINFORCED CONCRETE BOX CULVERTS
(INTERSTATE TRAFFIC)

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C19-8
1			3			TOTAL SHEETS
2			4			8

STD. NO. LRFR5

SITE 19

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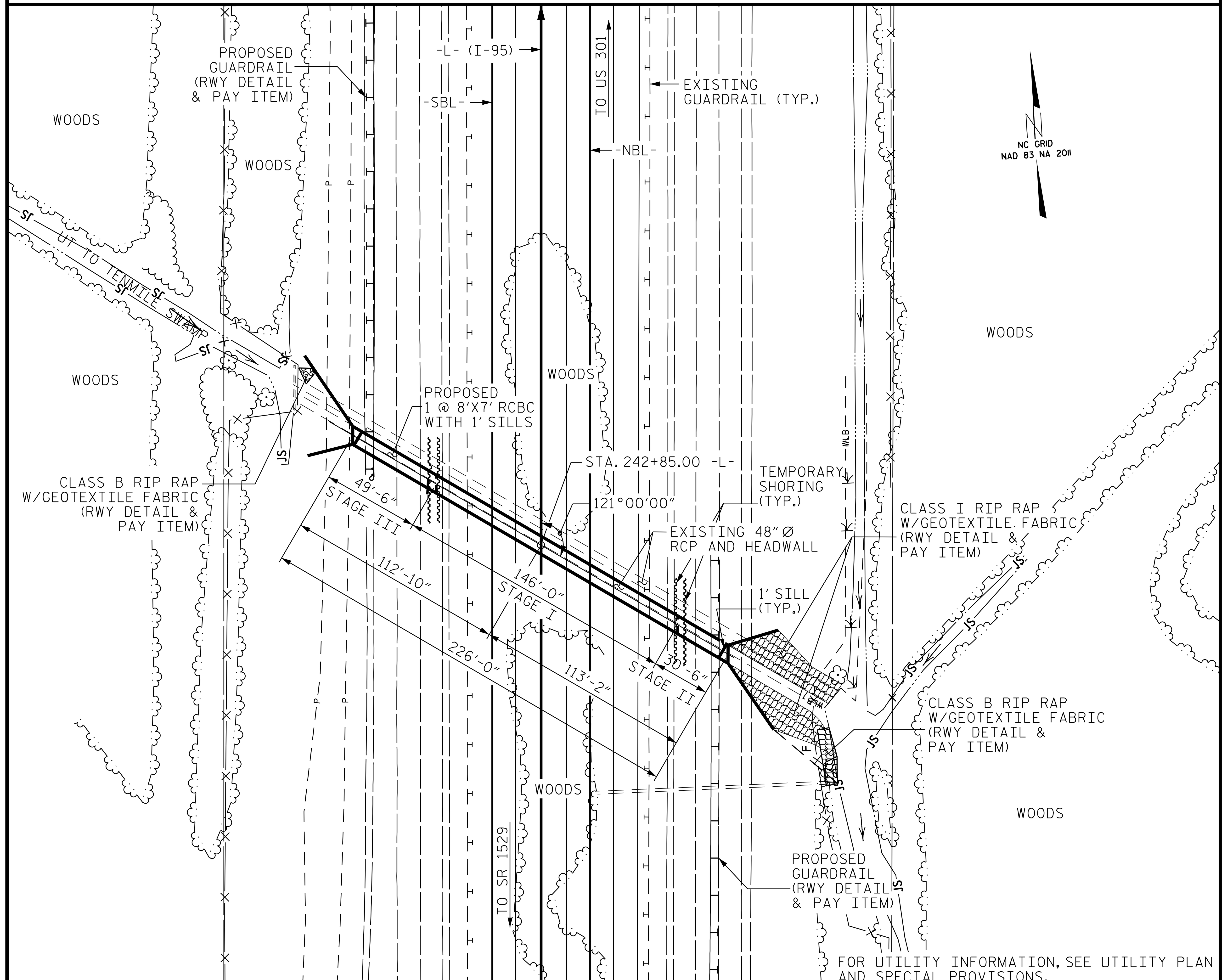
BM 10: BENCH NAIL SET IN BASE OF 24" PINE, -BL- STA. 236+77.00, 28' RT., EL. 148.49'



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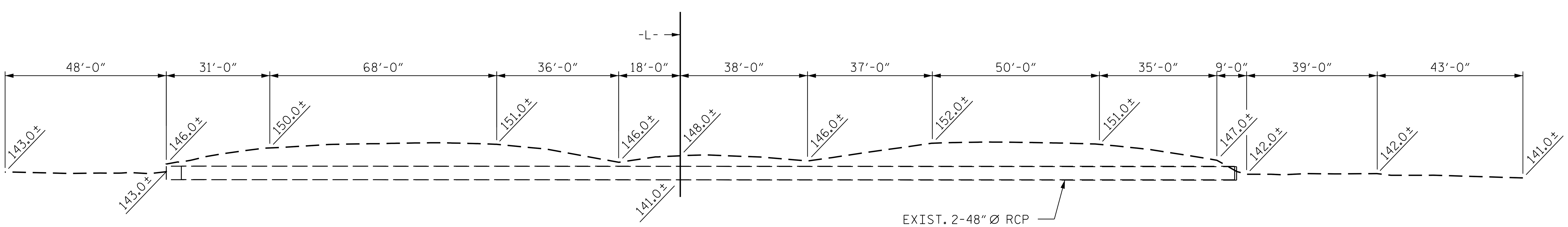

PROFILE ALONG ℄ CULVERT

ROADWAY DATA

GRADE PT. EL. @ STA. 242+85.00 -L-	= 152.68'±
BED ELEV. @ STA. 242+85.00 -L-	= 141.30'
ROADWAY SLOPE (LEFT)	= 3 : 1
ROADWAY SLOPE (RIGHT)	= 3 : 1

HYDRAULIC DATA

DESIGN DISCHARGE	= 340 CFS
FREQUENCY OF DESIGN FLOOD	= 100 YRS.
DESIGN HIGH WATER ELEVATION	= 149.4'
DRAINAGE AREA	= 0.64 SQ. MI.
BASE DISCHARGE (Q100)	= 340 CFS
BASE HIGH WATER ELEVATION	= 149.4'

OVERTOPPING FLOOD DATA

OVERTOPPING DISCHARGE	= 130 CFS
FREQUENCY OF OVERTOPPING FLOOD	< 10 YRS.
OVERTOPPING FLOOD ELEVATION	= 147.0' *

*OT AT DRAINAGE AREA DIVIDE @ STA. 235+85.00 -L- LT. ELEV. =147.0'

TOTAL STRUCTURE QUANTITIES

CULVERT EXCAVATION	LUMP SUM
FOUNDATION COND. MATERIAL	
STAGE I	137 TONS
STAGE II	29 TONS
STAGE III	47 TONS
TOTAL	213 TONS
CLASS A CONCRETE	
STAGE I	139.4 C.Y.
STAGE II	44.5 C.Y.
STAGE III	62.7 C.Y.
TOTAL	246.6 C.Y.
REINFORCING STEEL	
STAGE I	18,558 LBS.
STAGE II	4,918 LBS.
STAGE III	7,396 LBS.
TOTAL	30,872 LBS.

NOTES

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

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

FOR CONSTRUCTION SEQUENCE, EROSION CONTROL AND MEASURES, SEE EROSION CONTROL PLANS.

DESIGN FILL----------------- 4.74 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:

STAGE I - CONSTRUCT RCBC INTERMEDIATE SECTION.

1. FLOOR SLAB INCLUDING 4" OF BOTH VERTICAL WALLS.
2. FOLLOWED BY NATIVE MATERIAL BACKFILL AND ROOF SLAB.

STAGES II & III - CONSTRUCT RCBC SECTION AT BOTH OUTLET AND INLET ENDS.

1. WING FOOTINGS AND FLOOR SLAB INCLUDING 4" OF BOTH VERTICAL WALLS.
2. SILL WITH NATIVE MATERIAL BACKFILL.
3. FOLLOWED BY THE WING WALLS FULL HEIGHT. ROOF SLAB AND HEADWALL.

THE CONTRACTOR 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 FEET. LOCATION OF JOINTS SHALL BE SUBJECT TO APPROVAL OF 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 SHALL BE PAID FOR BY CONTRACTOR.

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.

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.

NO PRECAST REINFORCED BOX CULVERT OPTION WILL BE ALLOWED.

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.

FOR TRAFFIC PHASING, LIMITS OF TEMPORARY SHORING, SEE TRAFFIC CONTROL PLANS.

FOR PAY ITEM FOR TEMPORARY SHORING, SEE ROADWAY PLANS.

FOUNDATION NOTES

BACKFILL WITH SELECT MATERIAL, CLASS VI MEETING THE REQUIREMENTS OF SECTION 1016 OF THE STANDARD SPECIFICATIONS.

SEE SECTION 414 OF THE STANDARD SPECIFICATIONS FOR CULVERT EXCAVATION AND BACKFILLING. EXCAVATE 1 FOOT BELOW CULVERT AND FOOTING AND REPLACE WITH FOUNDATION CONDITIONING MATERIAL IN ACCORDANCE WITH ARTICLE 414-4 OF THE STANDARD SPECIFICATIONS.

PROJECT NO. I-5987A
ROBESON COUNTY
STATION: 242+85.00 -L-

SHEET 1 OF 8

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NC COA No. F-1255

DRAWN BY : JJR	DATE : 9/21	DWG. No.
CHECKED BY : THF	DATE : 11/21	
DESIGN ENGINEER : VDK	DATE : 12/21	

NORTH CAROLINA PROFESSIONAL SEAL 16301 ENGINEER TING HSIUNG FANG
DocuSigned by: Ting Fang
60E43C9AEA60462...
3/18/2022

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH
BARREL STANDARD

SINGLE 8 FT. X 7 FT.
CONCRETE BOX CULVERT
121° SKEW

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

SHEET NO. C20-1
TOTAL SHEETS 8

SITE 20

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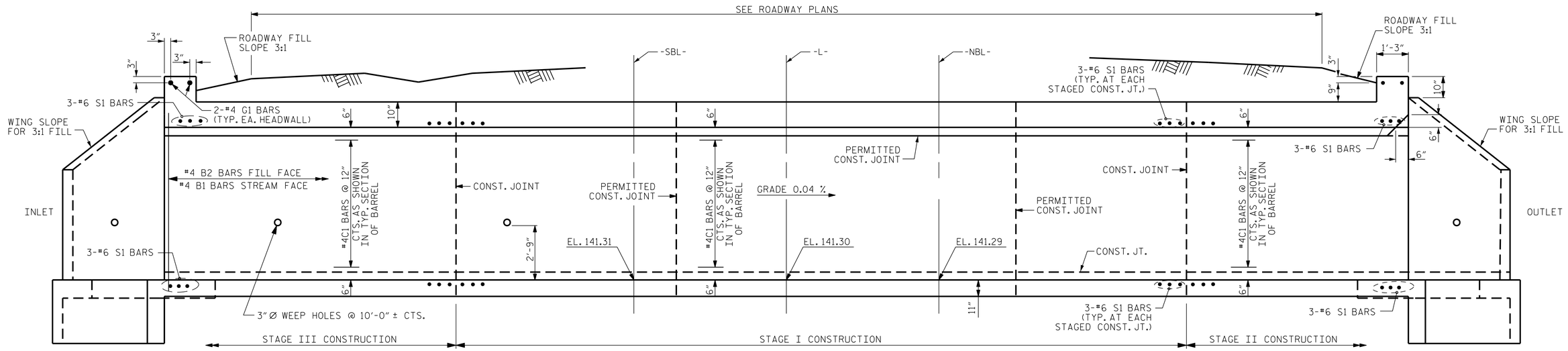
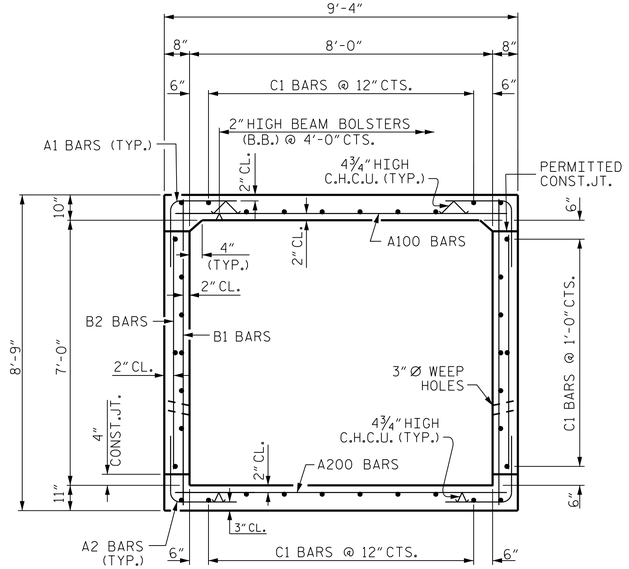
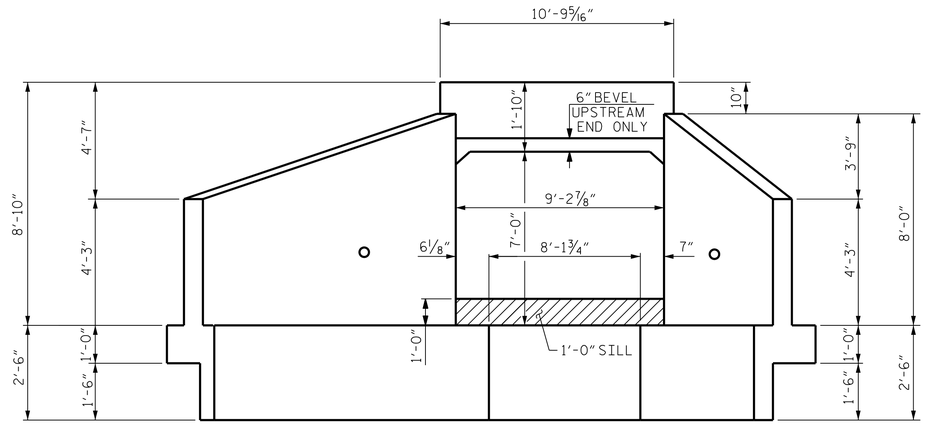


CULVERT SECTION NORMAL TO ROADWAY



RIGHT ANGLE SECTION OF BARREL

THERE ARE 36 "C" BARS IN SECTION OF BARREL



INLET END ELEVATION NORMAL TO SKEW

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 242+85.00 -L-

SHEET 2 OF 8

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

BARREL STANDARD

SINGLE 8 FT. X 7 FT. CONCRETE BOX CULVERT

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3/18/2022

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SITE 20

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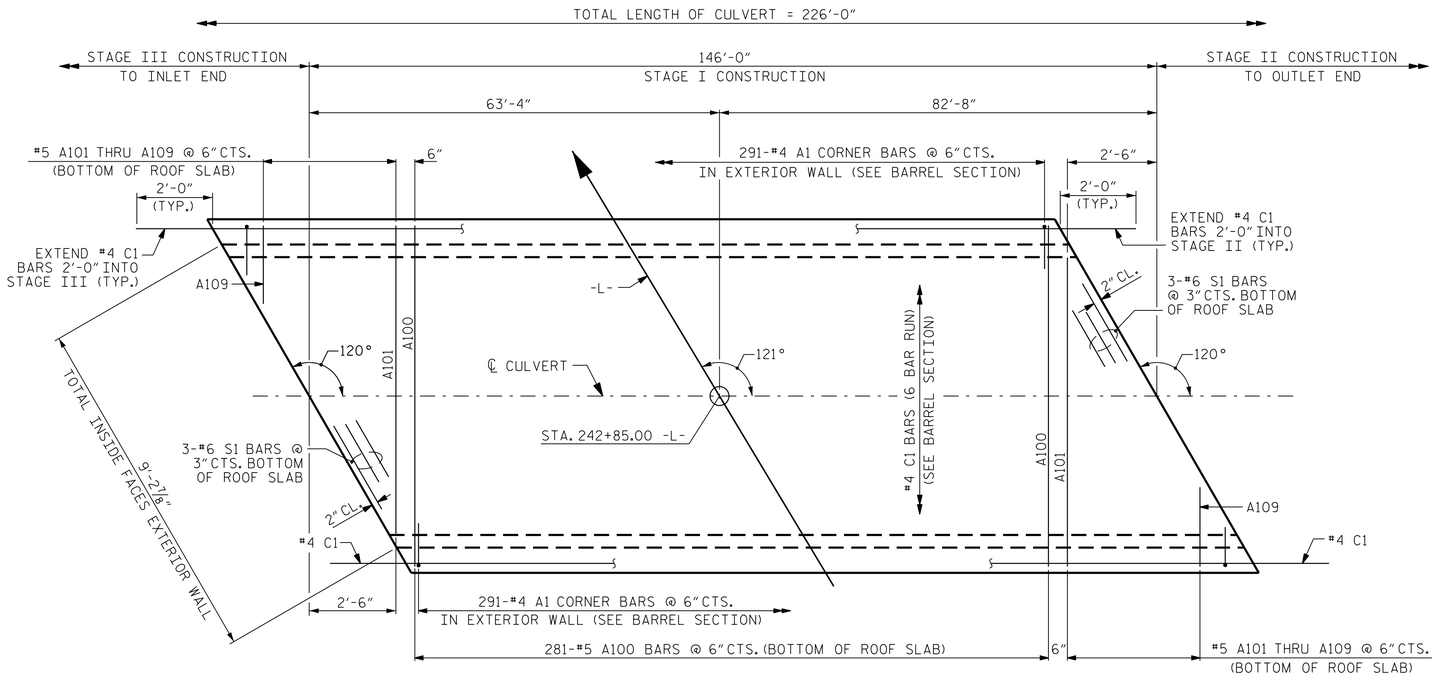
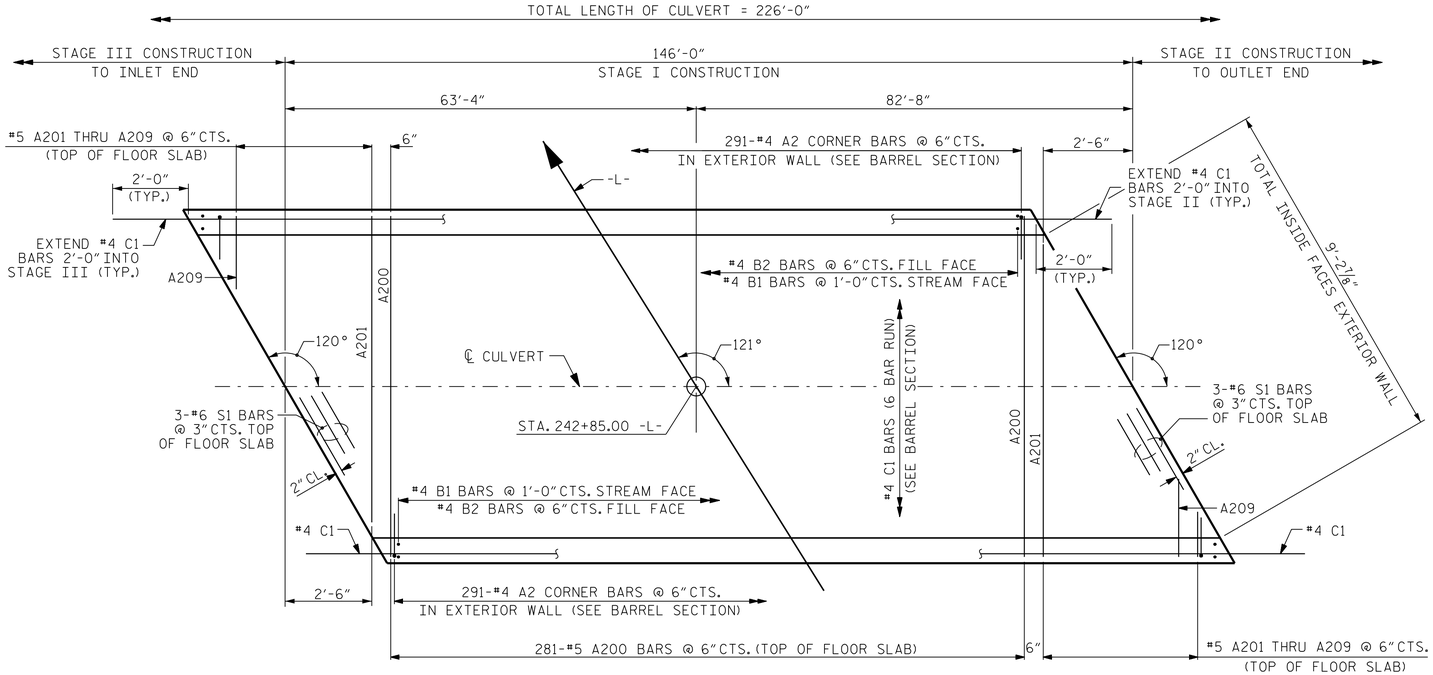


STAGE I - PLAN OF ROOF SLAB

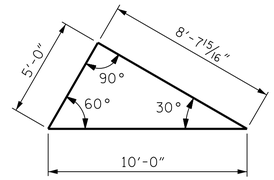


STAGE I - PLAN OF FLOOR SLAB

STRUCTURE QUANTITIES

STAGE I

FOUNDATION COND. MAT'L	137	TONS
CULVERT EXCAVATION	LUMP SUM	
CLASS A CONCRETE		
BARREL @ 0.955 CY/FT	139.4	C.Y.
TOTAL	139.4	C.Y.
REINFORCING STEEL		
BARREL	18,558	LBS.
TOTAL	18,558	LBS.



SKEW TRIANGLE

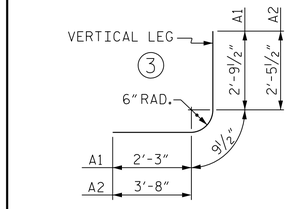
REINFORCING BAR SCHEDULE

STAGE I

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
A1	582	#4	3	5'-10"	2268
A2	582	#4	3	6'-11"	2689
A100	281	#5	STR	9'-0"	2638
A101	2	#5	STR	8'-6"	18
A102	2	#5	STR	7'-8"	16
A103	2	#5	STR	6'-9"	14
A104	2	#5	STR	5'-11"	12
A105	2	#5	STR	5'-0"	10
A106	2	#5	STR	4'-2"	9
A107	2	#5	STR	3'-4"	7
A108	2	#5	STR	2'-6"	5
A109	2	#5	STR	1'-7"	3
A200	281	#5	STR	9'-0"	2638
A201	2	#5	STR	8'-6"	18
A202	2	#5	STR	7'-8"	16
A203	2	#5	STR	6'-9"	14
A204	2	#5	STR	5'-11"	12
A205	2	#5	STR	5'-0"	10
A206	2	#5	STR	4'-2"	9
A207	2	#5	STR	3'-4"	7
A208	2	#5	STR	2'-6"	5
A209	2	#5	STR	1'-7"	3
B1	292	#4	STR	8'-5"	1642
B2	584	#4	STR	6'-4"	2471
C1	216	#4	STR	26'-7"	3836
S1	12	#6	STR	10'-5"	188

REINFORCING STEEL LBS. 18,558

BAR TYPE



BAR DIMENSIONS ARE OUT TO OUT

SPLICE LENGTHS CHART

BAR	SIZE	SPLICE LENGTH
C1	#4	1'-10"

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 242+85.00 -L-

SHEET 3 OF 8

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

BARREL STANDARD

SINGLE 8 FT. X 7 FT. CONCRETE BOX CULVERT

STAGE I

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

CDM Smith
CDM SMITH
5400 Glenwood Ave, Suite 400
Raleigh, NC 27612-3228
NC COA No. F-1255

DRAWN BY :	JJR	DATE : 9/21
CHECKED BY :	THF	DATE : 11/21
DESIGN ENGINEER :	VDK	DATE : 12/21

DWG. No.

NORTH CAROLINA PROFESSIONAL SEAL 16301 ENGINEER TING-HSIUNG FANG
Ting Fang
3/18/2022

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C20-3
1			3			TOTAL SHEETS
2			4			8

SITE 20

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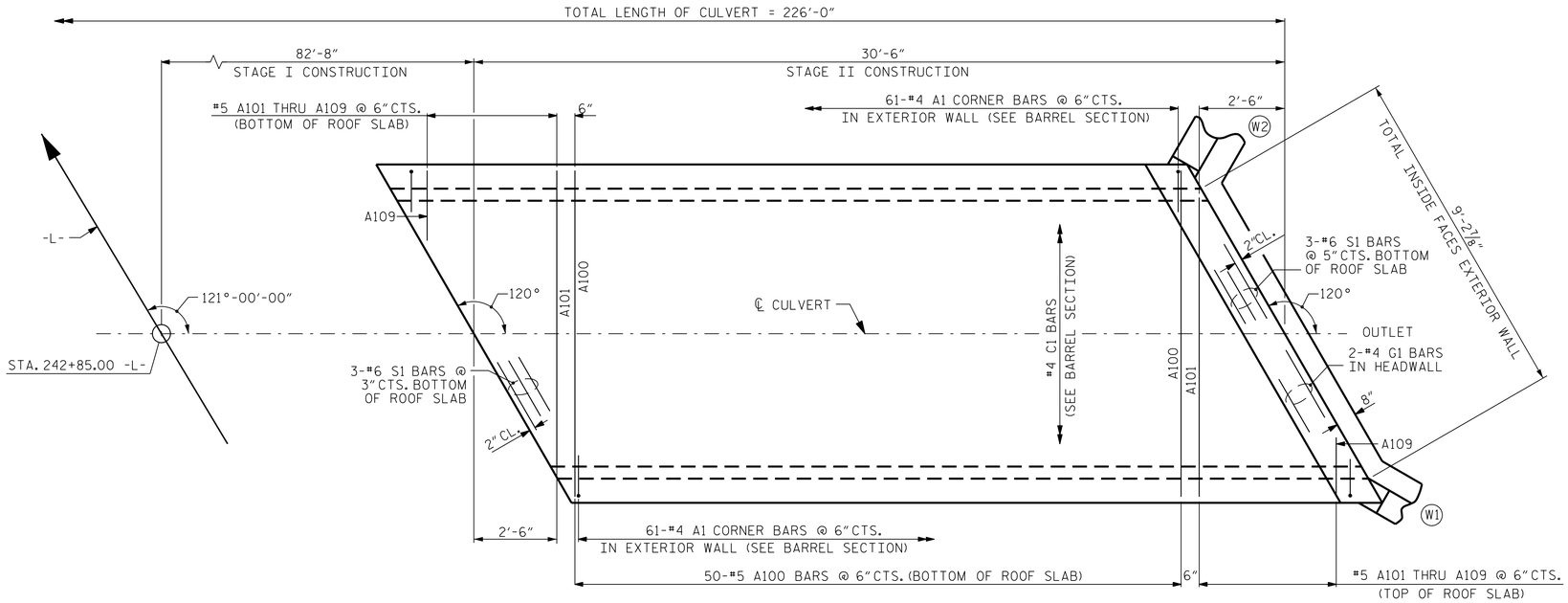
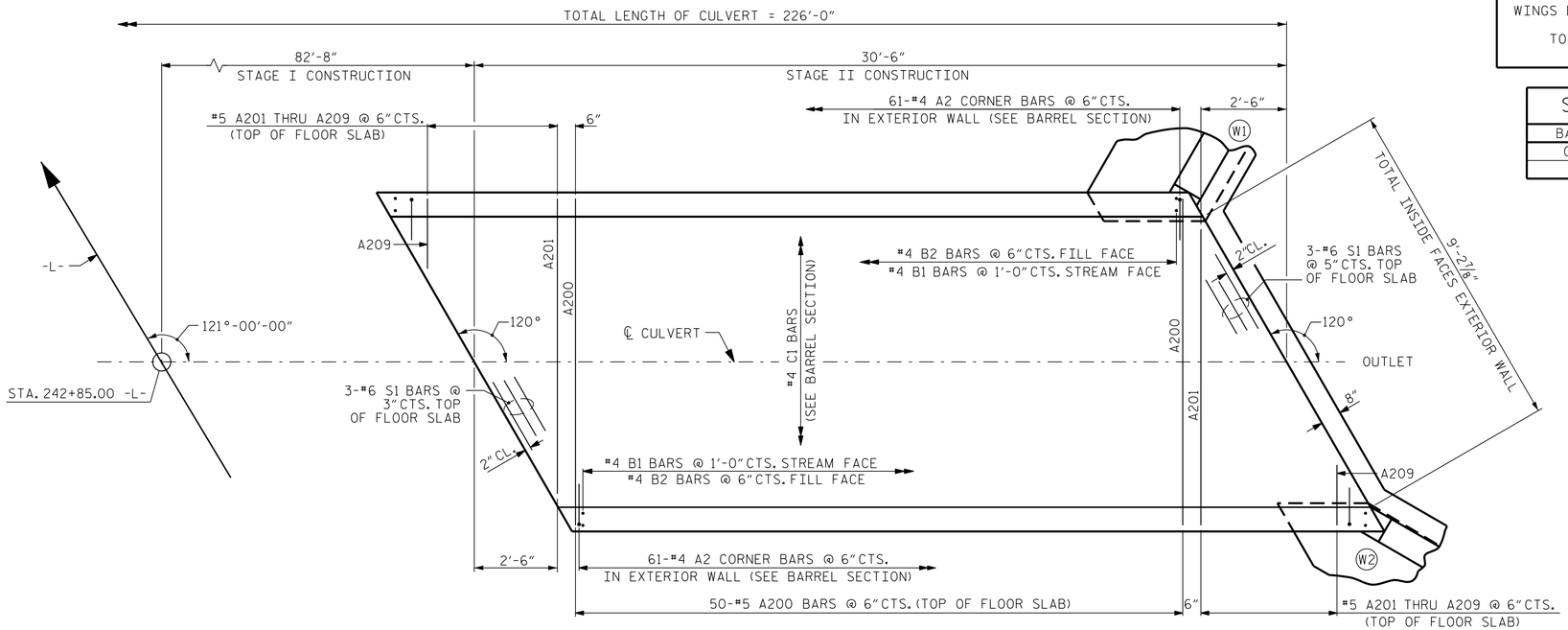
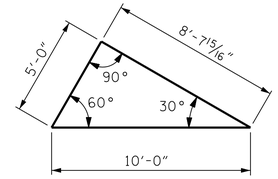


STAGE II - PLAN OF ROOF SLAB



STAGE II - PLAN OF FLOOR SLAB



SKEW TRIANGLE

TOTAL STRUCTURE QUANTITIES
STAGE II

FOUNDATION COND. MAT'L	29	TONS
CULVERT EXCAVATION	LUMP SUM	
CLASS A CONCRETE		
BARREL @ 0.955 CY/FT	29.1	C.Y.
WINGS ETC.	14.6	C.Y.
SILL	0.3	C.Y.
HEADWALL	0.5	C.Y.
TOTAL	44.5	C.Y.
REINFORCING STEEL		
BARREL & SILL	3,959	LBS.
WINGS ETC.	959	LBS.
TOTAL	4,918	LBS.

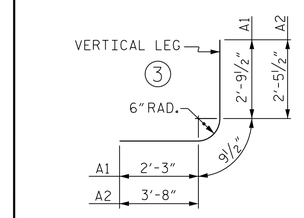
SPLICE LENGTHS CHART

BAR	SIZE	SPLICE LENGTH
C1	#4	1'-10"

REINFORCING BAR SCHEDULE
STAGE II

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
A1	122	#4	3	5'-10"	475
A2	122	#4	3	6'-11"	564
A100	50	#5	STR	9'-0"	469
A101	2	#5	STR	8'-6"	18
A102	2	#5	STR	7'-8"	16
A103	2	#5	STR	6'-9"	14
A104	2	#5	STR	5'-11"	12
A105	2	#5	STR	5'-0"	10
A106	2	#5	STR	4'-2"	9
A107	2	#5	STR	3'-4"	7
A108	2	#5	STR	2'-6"	5
A109	2	#5	STR	1'-7"	3
A200	50	#5	STR	9'-0"	469
A201	2	#5	STR	8'-6"	18
A202	2	#5	STR	7'-8"	16
A203	2	#5	STR	6'-9"	14
A204	2	#5	STR	5'-11"	12
A205	2	#5	STR	5'-0"	10
A206	2	#5	STR	4'-2"	9
A207	2	#5	STR	3'-4"	7
A208	2	#5	STR	2'-6"	5
A209	2	#5	STR	1'-7"	3
B1	62	#4	STR	8'-5"	349
B2	122	#4	STR	6'-4"	516
C1	36	#4	STR	30'-4"	729
D1	3	#6	STR	1'-6"	7
G1	2	#4	STR	10'-5"	14
S1	12	#6	STR	10'-5"	188
REINFORCING STEEL				LBS.	3,959

BAR TYPE



BAR DIMENSIONS ARE OUT TO OUT

PROJECT NO. I-5987A
ROBESON COUNTY
STATION: 242+85.00 -L-

SHEET 4 OF 8

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

CDM Smith
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Raleigh, NC 27612-3228
NC COA No. F-1255

DRAWN BY : JJR DATE : 9/21
CHECKED BY : THF DATE : 11/21
DESIGN ENGINEER : VDK DATE : 12/21

DWG. No.

NORTH CAROLINA PROFESSIONAL SEAL 16301 ENGINEER TING HSIUNG FANG
Ting Fang
80E43C8AEA80462...
3/18/2022

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH
BARREL STANDARD

SINGLE 8 FT. X 7 FT. CONCRETE BOX CULVERT
STAGE II

REVISIONS						SHEET NO.
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1			3			TOTAL SHEETS
2			4			8

SITE 20

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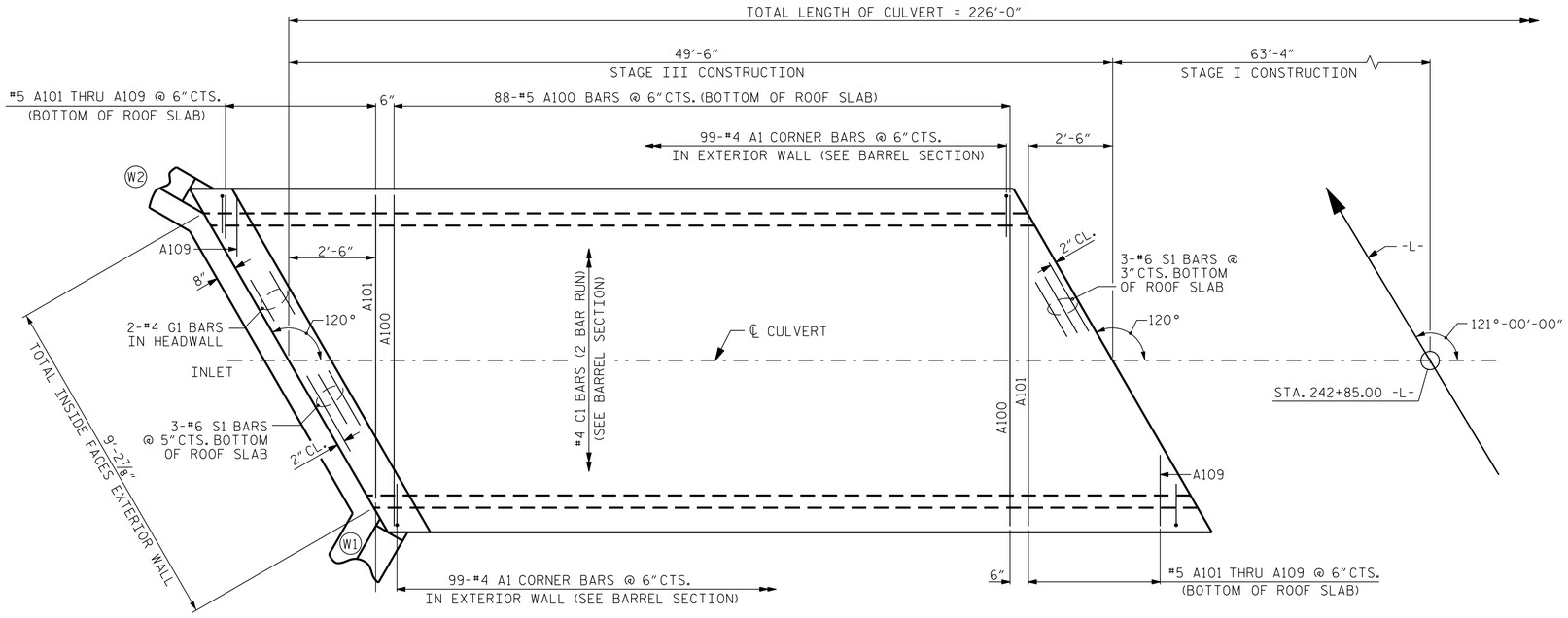
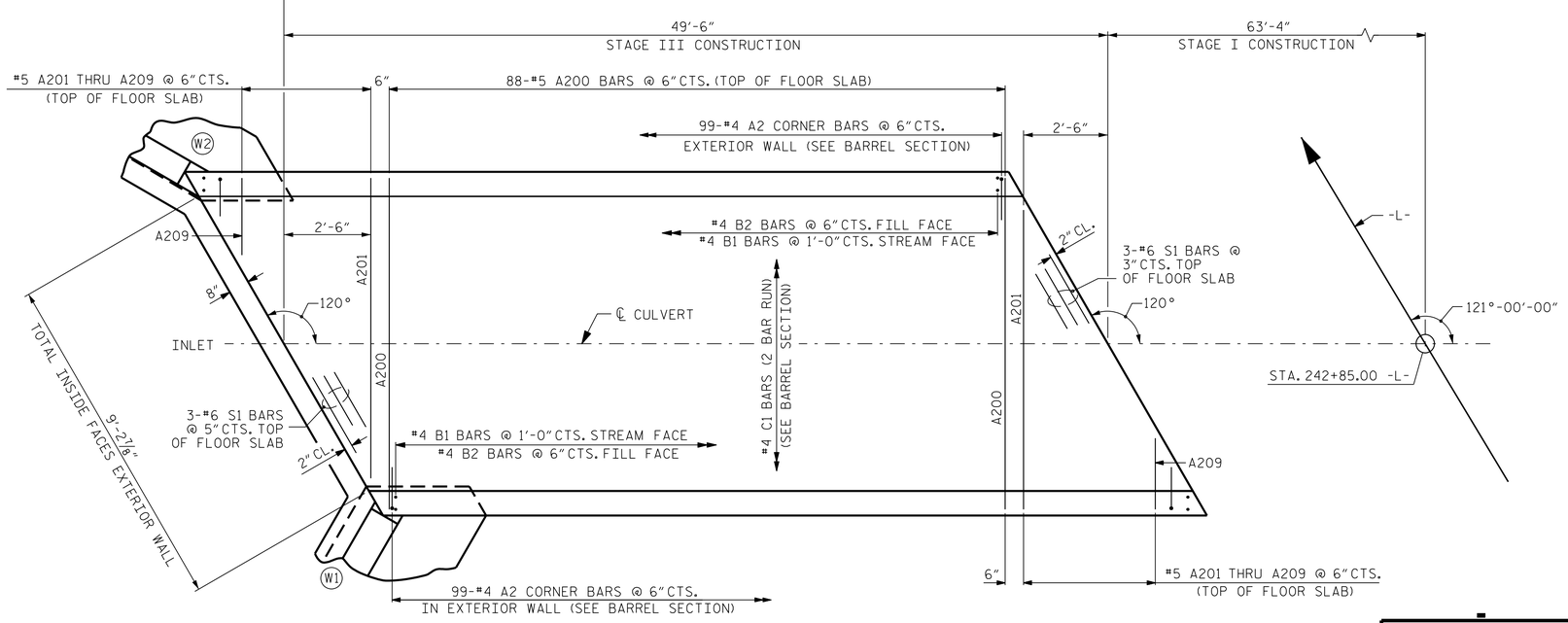
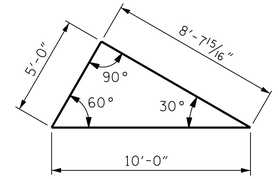


STAGE III - PLAN OF ROOF SLAB



STAGE III - PLAN OF FLOOR SLAB



SKEW TRIANGLE

TOTAL STRUCTURE QUANTITIES STAGE III

FOUNDATION COND. MAT'L	47	TONS
CULVERT EXCAVATION	LUMP SUM	
CLASS A CONCRETE		
BARREL @ 0.955 CY/FT	47.3	C.Y.
WINGS ETC.	14.6	C.Y.
SILL	0.3	C.Y.
HEADWALL	0.5	C.Y.
TOTAL	62.7	C.Y.
REINFORCING STEEL		
BARREL & SILL	6,437	LBS.
WINGS ETC.	959	LBS.
TOTAL	7,396	LBS.

SPLICE LENGTHS CHART

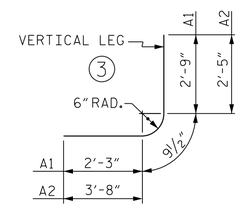
BAR	SIZE	SPLICE LENGTH
C1	#4	1'-10"

REINFORCING BAR SCHEDULE STAGE III

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
A1	198	#4	3	5'-10"	772
A2	198	#4	3	6'-11"	915
A100	88	#5	STR	9'-0"	826
A101	2	#5	STR	8'-6"	18
A102	2	#5	STR	7'-8"	16
A103	2	#5	STR	6'-9"	14
A104	2	#5	STR	5'-11"	12
A105	2	#5	STR	5'-0"	10
A106	2	#5	STR	4'-2"	9
A107	2	#5	STR	3'-4"	7
A108	2	#5	STR	2'-6"	5
A109	2	#5	STR	1'-7"	3
A200	88	#5	STR	9'-0"	826
A201	2	#5	STR	8'-6"	18
A202	2	#5	STR	7'-8"	16
A203	2	#5	STR	6'-9"	14
A204	2	#5	STR	5'-11"	12
A205	2	#5	STR	5'-0"	10
A206	2	#5	STR	4'-2"	9
A207	2	#5	STR	3'-4"	7
A208	2	#5	STR	2'-6"	5
A209	2	#5	STR	1'-7"	3
B1	100	#4	STR	8'-5"	562
B2	198	#4	STR	6'-4"	838
C1	72	#4	STR	25'-7"	1230
D1	3	#6	STR	1'-6"	7
G1	2	#4	STR	10'-5"	14
S1	12	#6	STR	10'-5"	188

REINFORCING STEEL LBS. 6,437

BAR TYPE



BAR DIMENSIONS ARE OUT TO OUT

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 242+85.00 -L-

SHEET 5 OF 8

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

BARREL STANDARD

SINGLE 8 FT. X 7 FT. CONCRETE BOX CULVERT STAGE III

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

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5400 Glenwood Ave, Suite 400
Raleigh, NC 27612-3228
NC COA No. F-1255

DRAWN BY : JJR DATE : 9/21
CHECKED BY : THF DATE : 10/221
DESIGN ENGINEER : VDK DATE : 12/21

DWG. No.

NORTH CAROLINA PROFESSIONAL SEAL 16301 ENGINEER TING HSIUNG FANG
Ting Fang
3/18/2022

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C20-5
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2			4			8

FILE: SFILES
DATE: SDATES
STAKES

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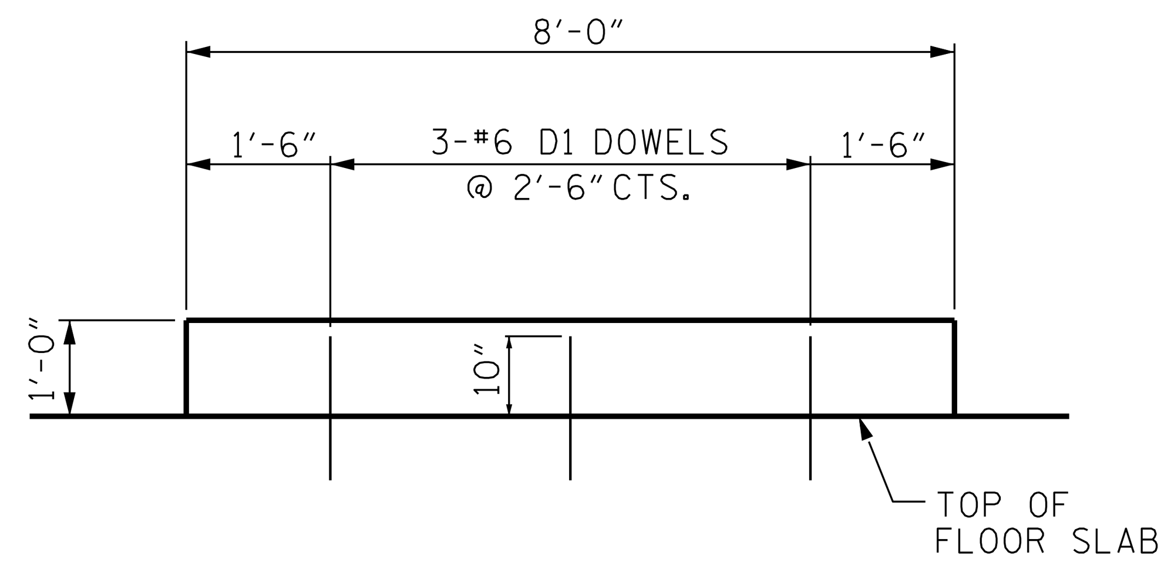
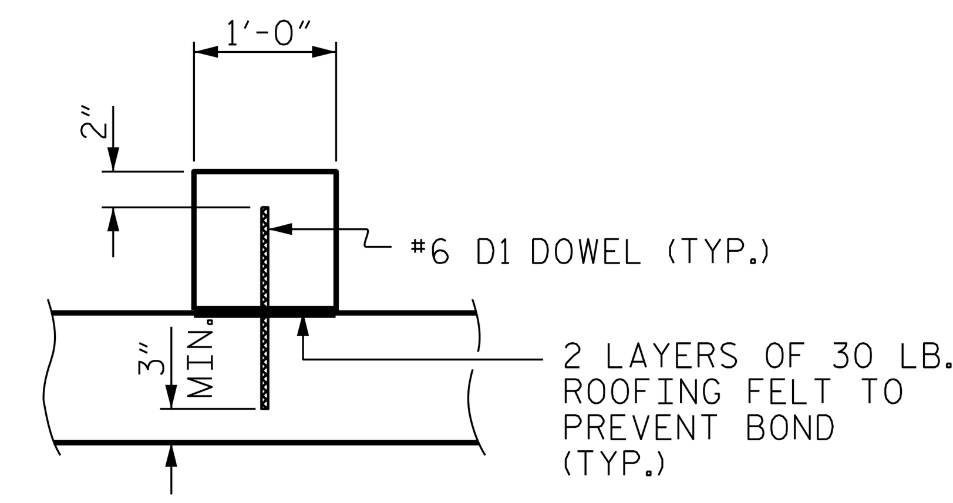


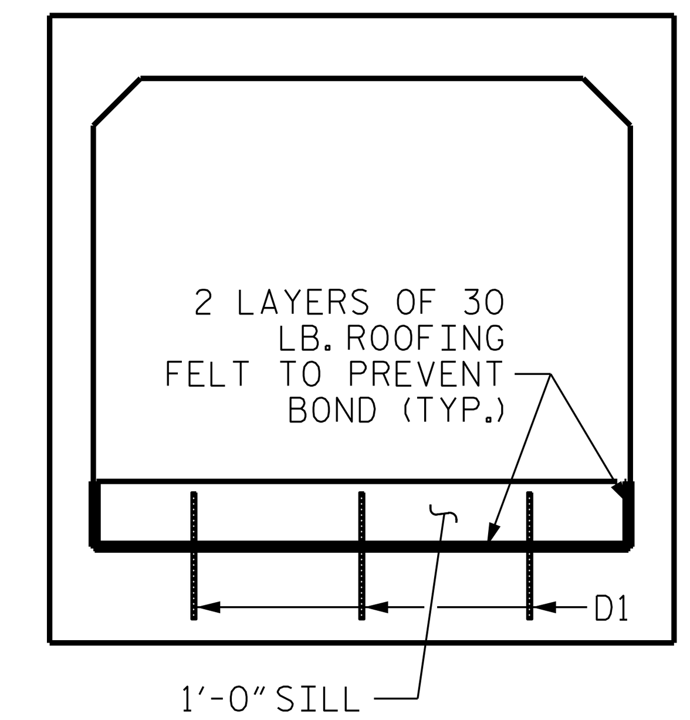
CONCRETE SILL DETAIL



SECTION THROUGH SILL

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

THE CONTRACTOR'S ATTENTION IS CALLED TO THE FACT THAT THE NATIVE MATERIAL BACKFILL SHALL BE PLACED PRIOR TO THE CASTING OF THE ROOF SLAB.



ELEVATION

SILLS AT INLET & OUTLET ENDS

NOTES:

CULVERT FLOOR SLAB IS BURIED 1 FOOT BELOW EXISTING STREAM BED. BACKFILL WITH NATIVE MATERIAL TO SILL HEIGHT IN ALL BARRELS.

NATIVE MATERIAL BETWEEN SILLS IN THE CULVERT SHALL PROVIDE A CONTINUOUS FLOW CHANNEL.

NATIVE MATERIAL CONSISTS OF MATERIAL THAT IS EXCAVATED FROM THE STREAM OR FLOODPLAIN AT THE PROJECT SITE DURING CONSTRUCTION. ONLY MATERIAL THAT IS EXCAVATED FROM THE STREAM BED MAY BE USED TO LINE CULVERT BARRELS. AT THE CONTRACTOR'S OPTION, RIP RAP MAY BE USED TO SUPPLEMENT THE NATIVE MATERIAL IN THE BARREL.

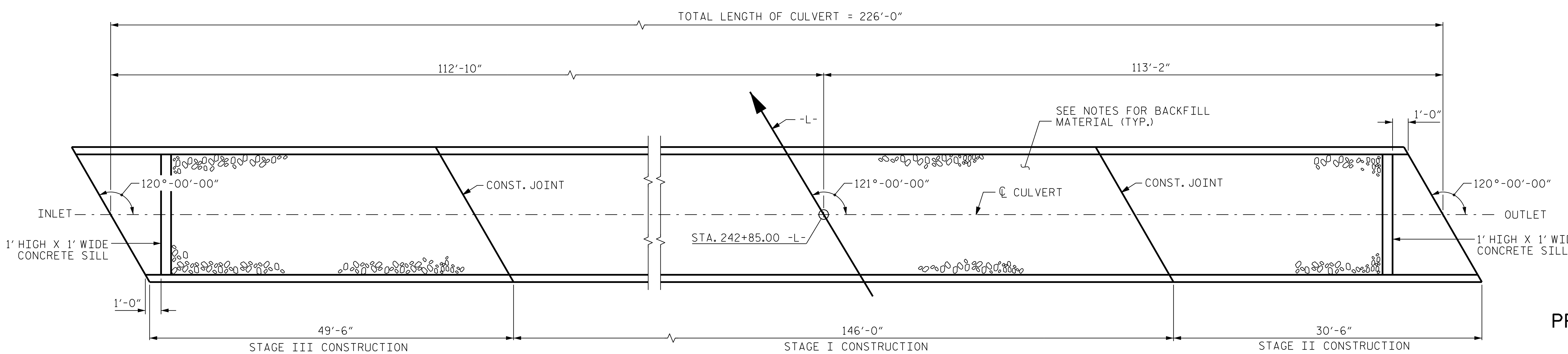
IF RIP RAP IS USED TO LINE THE FLOW CULVERT BARREL, NATIVE MATERIAL SHOULD BE PLACED ON TOP TO FILL VOIDS AND PROVIDE A FLAT SURFACE FOR ANIMAL PASSAGE.

NATIVE MATERIAL IS SUBJECT TO APPROVAL BY THE ENGINEER AND MAY BE SUBJECT TO PERMIT CONDITIONS.

SILLS ARE TO BE 1 FOOT, CAST SEPARATELY AND ATTACHED BY DOWELS.

TOP OF SILLS SHOULD MATCH STREAM BED ELEVATION.

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.



PLAN

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 242+85.00 -L-

SHEET 6 OF 8

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

DETAILS OF SILLS FOR CONCRETE BOX CULVERT

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

SHEET NO. C20-6

TOTAL SHEETS 8

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

CDM Smith

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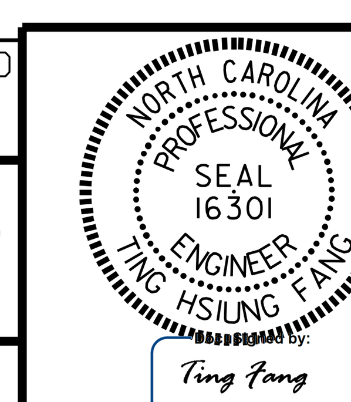
NC COA No. F-1255

DRAWN BY : JJR DATE : 9/21
CHECKED BY : THF DATE : 11/21
DESIGN ENGINEER : VDK DATE : 12/21

DWG. No.



SITE 20

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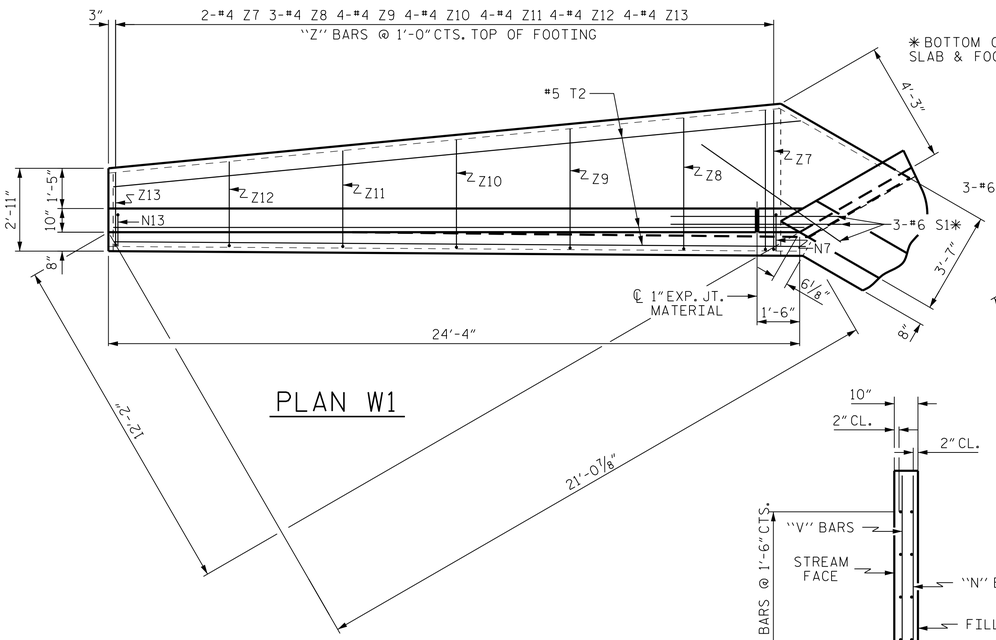
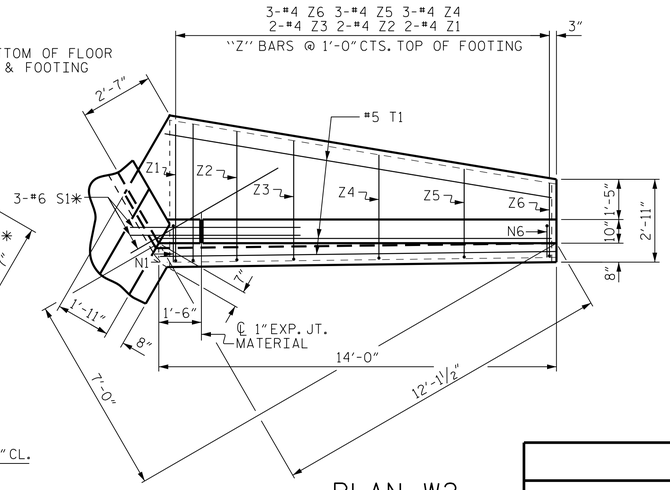
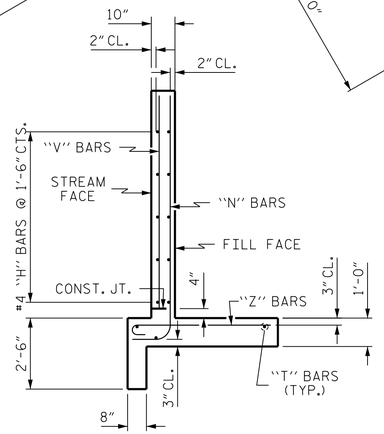


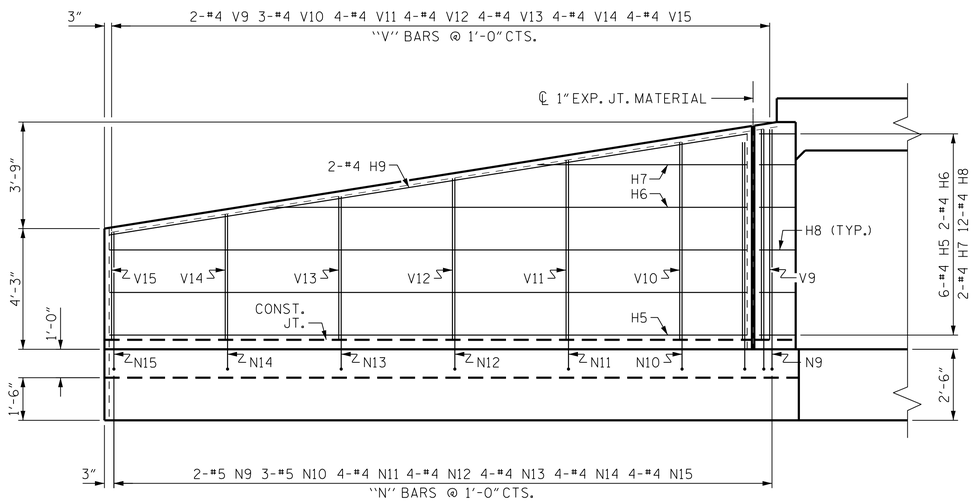
PLAN W1



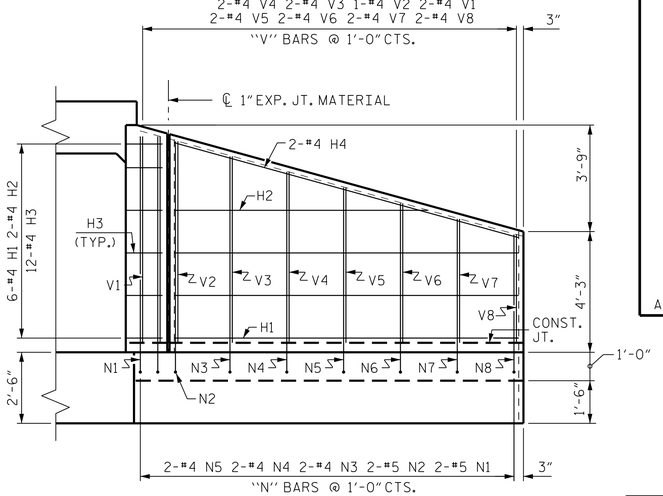
PLAN W2



TYPICAL WING SECTION

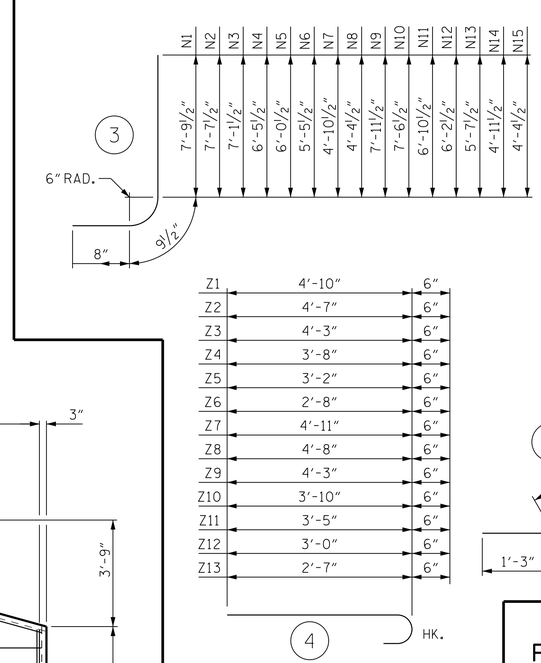


ELEVATION W1



ELEVATION W2

BAR TYPES



ALL BAR DIMENSIONS ARE OUT TO OUT.

BILL OF MATERIAL

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
Z1	4	#4	4	5'-4"	14
Z2	4	#4	4	5'-1"	14
Z3	4	#4	4	4'-9"	13
Z4	6	#4	4	4'-2"	17
Z5	6	#4	4	3'-8"	15
Z6	6	#4	4	3'-2"	13
Z7	4	#4	4	5'-5"	14
Z8	6	#4	4	5'-2"	21
Z9	8	#4	4	4'-9"	25
Z10	8	#4	4	4'-4"	23
Z11	8	#4	4	3'-11"	21
Z12	8	#4	4	3'-6"	19
Z13	8	#4	4	3'-1"	16
REINFORCING STEEL FOR 4 WINGS					1918 LBS
CLASS A CONCRETE					
4 WINGS					28.1 CY
2 HEADWALLS					1.0 CY
2 END CURTAIN WALLS					1.0 CY
TOTAL					30.1 CY

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
H1	12	#4	STR	12'-1"	97
H2	4	#4	STR	8-11"	24
H3	24	#4	1	3'-3"	52
H4	4	#4	STR	12'-7"	34
H5	12	#4	STR	22'-5"	180
H6	4	#4	STR	16'-10"	45
H7	4	#4	STR	7'-4"	20
H8	24	#4	2	3'-3"	52
H9	4	#4	STR	22'-9"	61
N1	4	#5	3	9'-3"	39
N2	4	#5	3	9'-1"	19
N3	4	#4	3	8'-7"	23
N4	4	#4	3	8'-0"	21
N5	4	#4	3	7'-6"	20
N6	4	#5	3	6'-11"	18
N7	6	#5	3	6'-4"	17
N8	8	#4	3	5'-10"	16
N9	8	#4	3	9'-5"	59
N10	8	#4	3	9'-0"	56
N11	4	#5	3	8'-4"	45
N12	6	#5	3	7'-8"	41
N13	8	#4	3	7'-1"	38
N14	8	#4	3	6'-5"	34
N15	8	#4	3	5'-10"	31
S1	12	#6	STR	6'-0"	108
T1	6	#5	STR	13'-10"	87
T2	6	#5	STR	24'-4"	152
V1	4	#4	STR	7'-3"	19
V2	2	#4	STR	7'-1"	9
V3	4	#4	STR	6'-7"	18
V4	4	#4	STR	6'-0"	16
V5	4	#4	STR	5'-6"	15
V6	4	#4	STR	4'-11"	13
V7	4	#4	STR	4'-4"	12
V8	4	#4	STR	3'-10"	10
V9	6	#4	STR	7'-5"	30
V10	6	#4	STR	7'-0"	28
V11	8	#4	STR	6'-4"	34
V12	8	#4	STR	5'-8"	30
V13	8	#4	STR	5'-1"	27
V14	8	#4	STR	4'-5"	24
V15	8	#4	STR	3'-10"	20

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 242+85.00 -L-

SHEET 7 OF 8

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

STANDARD WINGS FOR CONCRETE BOX CULVERT

H = 7'-0" SLOPE = 3:1

120° SKEW

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

SHEET NO. C20-7

TOTAL SHEETS 8

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

CDM Smith
CDM SMITH
5400 Glenwood Ave, Suite 400
Raleigh, NC 27612-3228
NC COA No. F-1255

DRAWN BY : JJR DATE : 9/21
CHECKED BY : THF DATE : 11/21
DESIGN ENGINEER : VDK DATE : 12/21

DWG. No.

NORTH CAROLINA PROFESSIONAL SEAL 16301 ENGINEER TING HSIUNG FANG
Ting Fang
80E43C8AEA80462...
3/18/2022

SITE 20

DocuSign Envelope ID: 38081D23-159F-4D30-BF4A-59136E210271

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
								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	**1.30**	--	1.75	**1.30**	1	TOP SLAB	4.00	1.68	1	TOP SLAB	8.00	
		HL-93 (OPERATING)	N/A		1.68	--	1.35	1.68	1	TOP SLAB	4.00	2.18	1	TOP SLAB	8.00	
		HS-20 (INVENTORY)	36.000	2	**1.35**	48.60	1.75	**1.35**	1	TOP SLAB	4.00	1.93	1	TOP SLAB	0.00	
		HS-20 (OPERATING)	36.000		1.76	63.36	1.35	1.76	1	TOP SLAB	4.00	2.50	1	TOP SLAB	0.00	
LEGAL LOAD RATING	SINGLE VEHICLE (SV)	SH	12.500		2.57	32.13	1.40	2.57	1	BOTTOM SLAB	4.00	3.11	1	TOP SLAB	8.00	
		S3C	21.500	3	1.99	42.79	1.40	1.99	1	TOP SLAB	4.00	2.83	1	TOP SLAB	0.00	
		S3A	22.750		1.99	45.27	1.40	1.99	1	TOP SLAB	4.00	2.83	1	TOP SLAB	0.00	
		S4A	26.750		1.99	53.23	1.40	1.99	1	TOP SLAB	4.00	2.83	1	TOP SLAB	0.00	
		S5A	30.500		1.99	60.70	1.40	1.99	1	TOP SLAB	4.00	2.83	1	TOP SLAB	0.00	
		S6A	34.500		1.99	68.66	1.40	1.99	1	TOP SLAB	4.00	2.83	1	TOP SLAB	0.00	
		S7B	38.500		1.99	76.62	1.40	1.99	1	TOP SLAB	4.00	2.83	1	TOP SLAB	0.00	
		S7A	40.000		1.99	79.60	1.40	1.99	1	TOP SLAB	4.00	2.83	1	TOP SLAB	0.00	
	TRUCK TRACTOR SEMI-TRAILER (TTST)	T4A	28.250		1.99	56.22	1.40	1.99	1	TOP SLAB	4.00	2.83	1	TOP SLAB	0.00	
		T5B	32.000		1.99	63.68	1.40	1.99	1	TOP SLAB	4.00	2.83	1	TOP SLAB	0.00	
		T6A	36.000		1.99	71.64	1.40	1.99	1	TOP SLAB	4.00	2.83	1	TOP SLAB	0.00	
		T7A	40.000		1.99	79.60	1.40	1.99	1	TOP SLAB	4.00	2.83	1	TOP SLAB	0.00	
		T7B	40.000		1.99	79.60	1.40	1.99	1	TOP SLAB	4.00	2.83	1	TOP SLAB	0.00	

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.

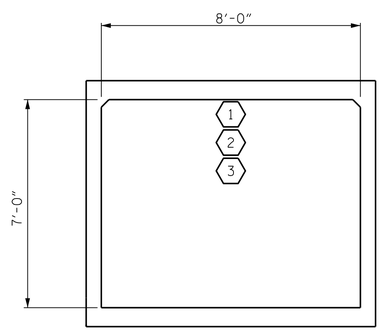
(#) CONTROLLING LOAD RATING

(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)

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

CDM Smith

CDM SMITH
5400 Glenwood Ave, Suite 400
Raleigh, NC 27612-3228
NC COA No. F-1255

DRAWN BY : JJR DATE : 9/21
CHECKED BY : THF DATE : 11/21
DESIGN ENGINEER : VDK DATE : 12/21

DWG. No.

NORTH CAROLINA PROFESSIONAL SEAL 16301 ENGINEER TING-HSIUNG FANG
Ting Hsiung Fang
60E43C9AEA60462...
3/18/2022

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 242+85.00 -L-

SHEET 8 OF 8

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

STANDARD

LRFR SUMMARY FOR REINFORCED CONCRETE BOX CULVERTS

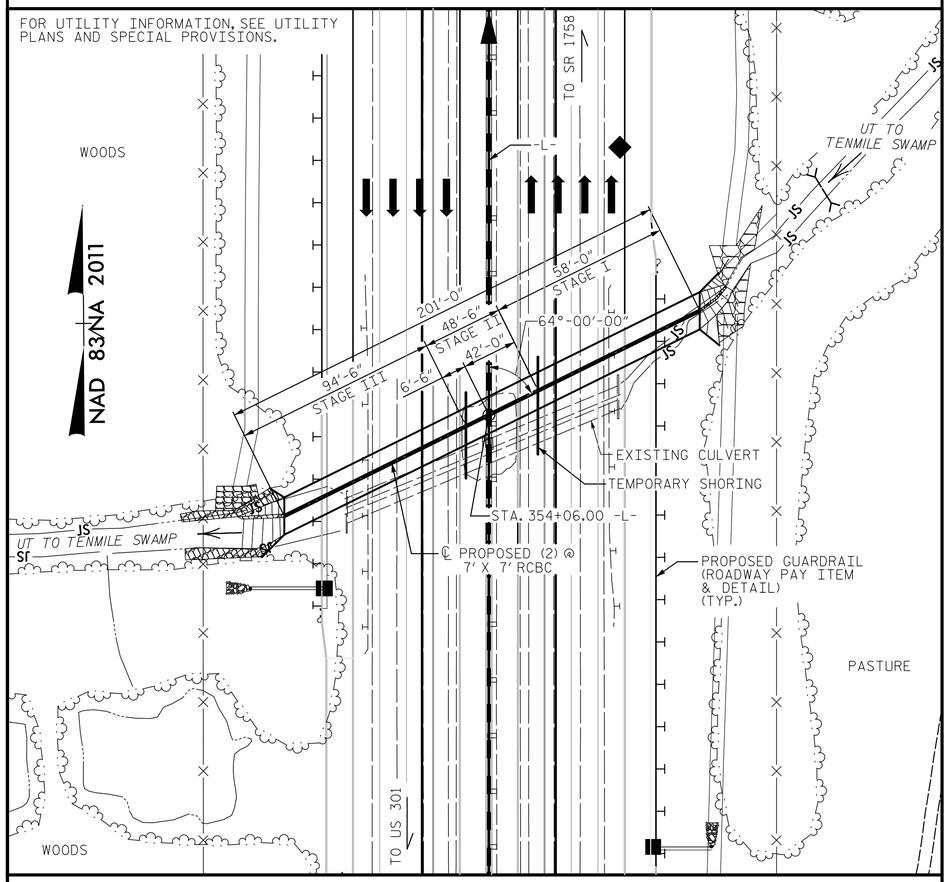
(INTERSTATE TRAFFIC)

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C20-8
1			3			TOTAL SHEETS
2			4			8

STD. NO. LRFR5

SITE 20

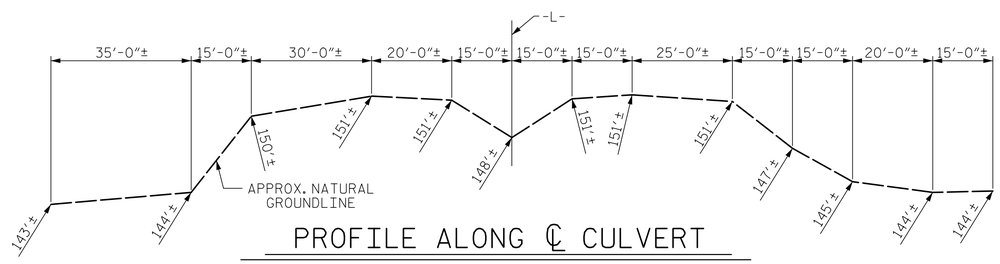
BENCH MARK #17: RRS IN 24" PINE; STA. 346+92.0 -L-; 258' RT.; ELEV. 152.37'



LOCATION SKETCH

TOTAL STRUCTURE QUANTITIES

CLASS A CONCRETE		REINFORCING STEEL		FOUNDATION COND. MAT'L.	
STAGE I	105.4 C.Y.	STAGE I	11,546 LBS.	STAGE I	83 TONS
STAGE II	75.0 C.Y.	STAGE II	9,068 LBS.	STAGE II	69 TONS
STAGE III	159.8 C.Y.	STAGE III	18,010 LBS.	STAGE III	135 TONS
TOTAL	340.2 C.Y.	TOTAL	38,624 LBS.	TOTAL	287 TONS
REMOVAL OF EXISTING STRUCTURE	LUMP SUM	CULVERT EXCAVATION	LUMP SUM		



PROFILE ALONG ℄ CULVERT

DRAWN BY : ZCS DATE : 11/21
CHECKED BY : MGC DATE : 12/21
DESIGN ENGINEER OF RECORD: ZCS DATE : 2/22

NOTES:

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

DESIGN FILL---------- 6.5 FT.

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

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

CONCRETE IN EACH STAGE 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 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.

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

FOR CRANE SAFETY, SEE SPECIAL PROVISIONS.

FOR SUBMITTAL OF WORKING DRAWINGS, SEE SPECIAL PROVISIONS.

FOR FALSEWORK AND FORMWORK, SEE SPECIAL PROVISIONS.

FOR GROUT FOR STRUCTURES, SEE SPECIAL PROVISIONS.

FOR EROSION CONTROL MEASURES, SEE EROSION CONTROL PLANS.

FOR CONSTRUCTION SEQUENCE, SEE EROSION CONTROL PLANS.

FOR TRAFFIC PHASING, SEE TRAFFIC CONTROL PLANS.

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 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.

DOWELS SHALL BE USED TO CONNECT THE STAGE II CULVERT TO STAGE I AND STAGE III TO STAGE II AS SHOWN. FOR NOTE REGARDING SETTING OF DOWELS, SEE SHEET SN.

BACKFILL WITH SELECT MATERIAL, CLASS VI MEETING THE REQUIREMENTS OF SECTION 1016 OF THE STANDARD SPECIFICATIONS.

SEE SECTION 414 OF THE STANDARD SPECIFICATIONS FOR CULVERT EXCAVATION AND BACKFILLING. EXCAVATE 1 FOOT BELOW CULVERT AND FOOTING AND REPLACE WITH FOUNDATION CONDITIONING MATERIAL IN ACCORDANCE WITH ARTICLE 414-4 OF THE STANDARD SPECIFICATIONS.

ROADWAY DATA

G.P. ELEV. @ STA. 354+06.00 -L- SB _____ = 155.45'
G.P. ELEV. @ STA. 354+06.00 -L- NB _____ = 155.56'
BED ELEV. @ STA. 354+06.00 -L-_____ = 142.1'
ROADWAY SLOPES _____ = 3 : 1

HYDRAULIC DATA

DESIGN DISCHARGE _____ = 370 CFS
FREQUENCY OF DESIGN FLOOD _____ = 100 YRS
DESIGN HIGH WATER ELEVATION _____ = 148.4'
DRAINAGE AREA _____ = 0.85 SQ. MI.
BASE DISCHARGE (Q100) _____ = 370 CFS
BASE HIGH WATER ELEVATION _____ = 148.4'

OVERTOPPING FLOOD DATA

OVERTOPPING DISCHARGE _____ = 120 CFS
FREQUENCY OF OVERTOPPING FLOOD _ = <10 YRS
OVERTOPPING FLOOD ELEVATION _____ = 146.5' ✱

✱ OVERTOPPING OCCURS AT DRAINAGE DIVIDE @ STATION 351+50 RT.

I HEREBY CERTIFY THESE PLANS ARE THE AS-BUILT PLANS.

SEAL

PROJECT NO. I-5987A
ROBESON COUNTY
STATION: 354+06.00 -L-

SHEET 1 OF 13

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL G. CHEEK, JR.
Docusigned by: Marshall G. Cheek, Jr. 5FBCC2F3A4DC413...
5/10/2022 | 10:32 AM EDT

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

TGS ENGINEERS
706 HILLSBOROUGH STREET
SUITE 200
RALEIGH NC 27603
PH (919) 773-8887
CORP. LICENSE NO.: C-0275

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

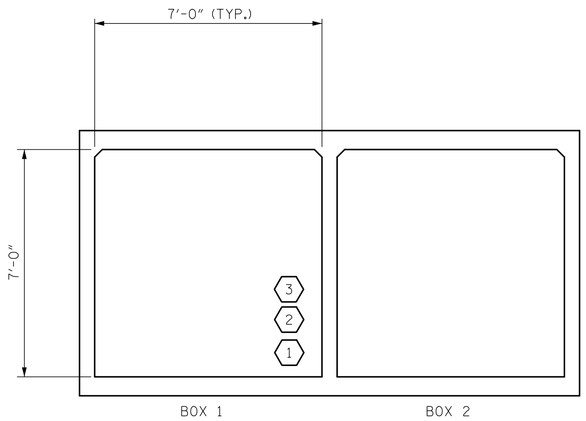
DOUBLE 7 FT. X 7 FT. CONCRETE BOX CULVERT 64° SKEW

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C21-1
1			3			TOTAL SHEETS
2			4			13

FILE NAME: 414_001_I-5987A_Site_21_SMU_CU_001.dgn SITE 21

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 (γ_{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⟩	1.04	--	1.75	1.08	1	BOTT SLAB	7.75	1.04	1	BOTT SLAB	7.75	
		HL-93 (OPERATING)	N/A		1.35	--	1.35	1.40	1	BOTT SLAB	7.75	1.35	1	BOTT SLAB	7.75	
		HS-20 (INVENTORY)	36.000	⟨2⟩	1.13	40.68	1.75	1.17	1	BOTT SLAB	7.75	1.13	1	BOTT SLAB	7.75	
		HS-20 (OPERATING)	36.000		1.46	52.56	1.35	1.52	1	BOTT SLAB	7.75	1.46	1	BOTT SLAB	7.75	
LEGAL LOAD RATING	SINGLE VEHICLE (SV)	SH	12.500	⟨3⟩	2.26	28.25	1.40	2.34	1	BOTT SLAB	7.75	2.26	1	BOTT SLAB	7.75	
		S3C	21.500		2.38	51.17	1.40	2.46	1	BOTT SLAB	7.75	2.38	1	BOTT SLAB	7.75	
		S3A	22.750		2.38	54.15	1.40	2.46	1	BOTT SLAB	7.75	2.38	1	BOTT SLAB	7.75	
		S4A	26.750		2.38	63.67	1.40	2.46	1	BOTT SLAB	7.75	2.38	1	BOTT SLAB	7.75	
		S5A	30.500		2.38	72.59	1.40	2.46	1	BOTT SLAB	7.75	2.38	1	BOTT SLAB	7.75	
		S6A	34.500		2.38	82.11	1.40	2.46	1	BOTT SLAB	7.75	2.38	1	BOTT SLAB	7.75	
		S7B	38.500		2.38	91.63	1.40	2.46	1	BOTT SLAB	7.75	2.38	1	BOTT SLAB	7.75	
		S7A	40.000		2.38	95.20	1.40	2.46	1	BOTT SLAB	7.75	2.38	1	BOTT SLAB	7.75	
	TRUCK TRACTOR SEMI-TRAILER (TTST)	T4A	28.250		2.38	67.24	1.40	2.46	1	BOTT SLAB	7.75	2.38	1	BOTT SLAB	7.75	
		T5B	32.000		2.38	76.16	1.40	2.46	1	BOTT SLAB	7.75	2.38	1	BOTT SLAB	7.75	
		T6A	36.000		2.38	85.68	1.40	2.46	1	BOTT SLAB	7.75	2.38	1	BOTT SLAB	7.75	
		T7A	40.000		2.38	95.20	1.40	2.46	1	BOTT SLAB	7.75	2.38	1	BOTT SLAB	7.75	
		T7B	40.000		2.38	95.20	1.40	2.46	1	BOTT SLAB	7.75	2.38	1	BOTT SLAB	7.75	



LRFR SUMMARY

(LOOKING DOWNSTREAM)

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

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 354+06.00 -L-

ASSEMBLED BY :	ZCS	DATE :	11/21
CHECKED BY :	MGC	DATE :	12/21
DRAWN BY : WMC	7/11	REV. 10/1/11	MAA/GM
CHECKED BY : GM	7/11	REV. 12/17	MAA/THC

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL G. CHEEK, JR.

Marshall G. Cheek, Jr.

5FBCC2F3A4DC413...

5/10/2022 | 10:32 AM EDT

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TGS ENGINEERS
706 HILLSBOROUGH STREET
SUITE 200
RALEIGH, NC 27603
PH (919) 773-8887
CORP. LICENSE NO.: C-0275

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

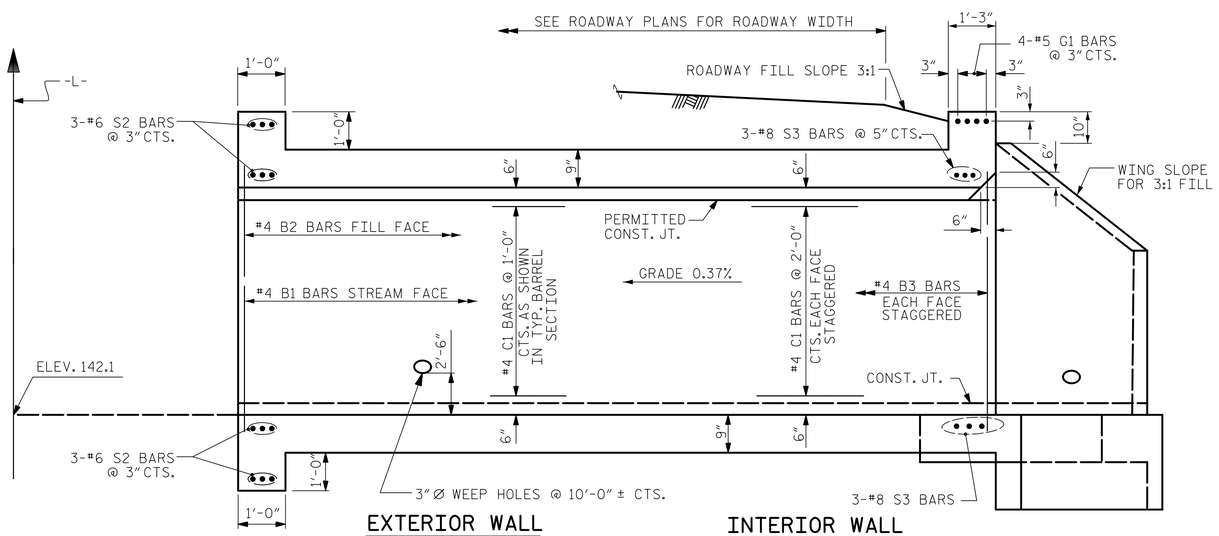
STANDARD

LRFR SUMMARY FOR REINFORCED CONCRETE BOX CULVERTS
(INTERSTATE TRAFFIC)

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C21-2
1			3			TOTAL SHEETS
2			4			13

FILE NAME: 414_003_I-5987A_Site_21_SMU_CU_002.dgn

SITE 21

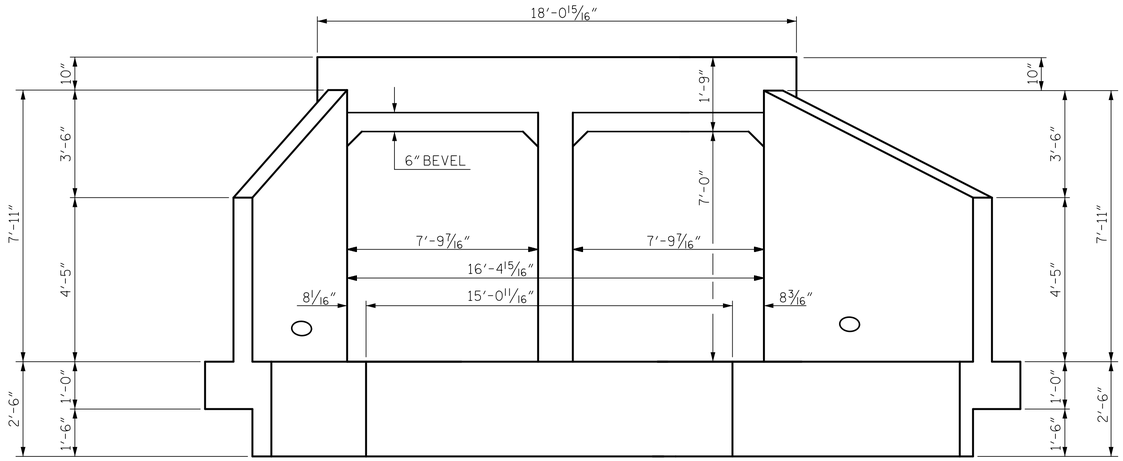


CULVERT SECTION NORMAL TO ROADWAY

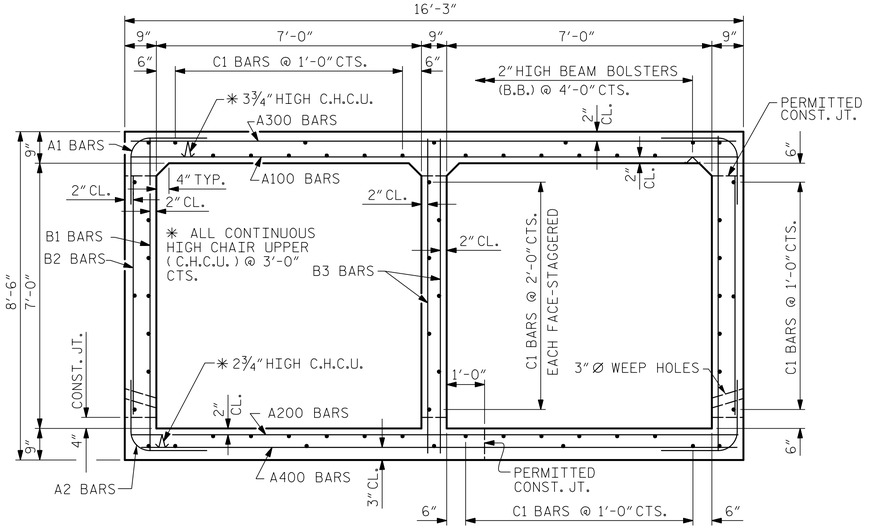
STAGE I BAR SCHEDULE

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT	BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT	BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
A100	75	#4	STR	15'-10"	793	A300	75	#5	STR	15'-10"	1239	A1	170	#4	1	4'-10"	549
A101	2	#4	STR	14'-10"	20	A301	2	#5	STR	14'-10"	31	A2	170	#4	1	4'-5"	502
A102	2	#4	STR	13'-6"	18	A302	2	#5	STR	13'-6"	28						
A103	2	#4	STR	12'-2"	16	A303	2	#5	STR	12'-2"	25	B1	116	#4	STR	8'-0"	620
A104	2	#4	STR	10'-9"	14	A304	2	#5	STR	10'-9"	22	B2	170	#4	STR	6'-4"	719
A105	2	#4	STR	9'-5"	13	A305	2	#5	STR	9'-5"	20	B3	78	#4	STR	8'-0"	417
A106	2	#4	STR	8'-1"	11	A306	2	#5	STR	8'-1"	17						
A107	2	#4	STR	6'-9"	9	A307	2	#5	STR	6'-9"	14	C1	122	#4	STR	29'-9"	2425
A108	2	#4	STR	5'-5"	7	A308	2	#5	STR	5'-5"	11						
A109	2	#4	STR	4'-0"	5	A309	2	#5	STR	4'-0"	8	S2	12	#6	STR	17'-8"	318
A110	2	#4	STR	2'-8"	4	A310	2	#5	STR	2'-8"	6	S3	6	#8	STR	17'-8"	283
A200	75	#4	STR	15'-10"	793	A400	75	#5	STR	15'-10"	1239	G1	4	#5	STR	17'-8"	74
A201	2	#4	STR	14'-10"	20	A401	2	#5	STR	14'-10"	31						
A202	2	#4	STR	13'-6"	18	A402	2	#5	STR	13'-6"	28	D2	6	#6	STR	1'-4"	12
A203	2	#4	STR	12'-2"	16	A403	2	#5	STR	12'-2"	25	D3	6	#6	STR	2'-4"	21
A204	2	#4	STR	10'-9"	14	A404	2	#5	STR	10'-9"	22						
A205	2	#4	STR	9'-5"	13	A405	2	#5	STR	9'-5"	20						
A206	2	#4	STR	8'-1"	11	A406	2	#5	STR	8'-1"	17						
A207	2	#4	STR	6'-9"	9	A407	2	#5	STR	6'-9"	14						
A208	2	#4	STR	5'-5"	7	A408	2	#5	STR	5'-5"	11						
A209	2	#4	STR	4'-0"	5	A409	2	#5	STR	4'-0"	8						
A210	2	#4	STR	2'-8"	4	A410	2	#5	STR	2'-8"	6						

REINFORCING STEEL 10,602 LBS



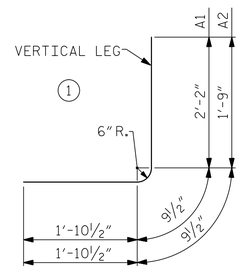
INLET END ELEVATION NORMAL TO SKEW



RIGHT ANGLE SECTION OF BARREL

THERE ARE 61 "C" BARS IN SECTION OF BARREL.

BAR TYPE



DIMENSIONS ARE OUT TO OUT

SPLICE LENGTHS CHART

BAR	SIZE	SPLICE LENGTH
B1	#4	1'-10"
C1	#4	1'-10"
A200	#4	1'-10"
A400	#5	2'-4"
S2	#6	2'-9"
S3	#8	3'-8"

STAGE I QUANTITIES

CLASS A CONCRETE		
BARREL @ 1.49 CY/FT	86.4	C.Y.
WINGS, ETC.	16.9	C.Y.
EDGE BEAMS	1.3	C.Y.
SILLS	0.8	C.Y.
TOTAL	105.4	C.Y.
REINFORCING STEEL		
BARREL & SILLS	10,602	LBS.
WINGS, ETC.	944	LBS.
TOTAL	11,546	LBS.
CULVERT EXCAVATION	LUMP SUM	
FOUNDATION COND. MAT'L.	83 TONS	

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 354+06.00 -L-

SHEET 3 OF 13

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL G. CHEEK, JR.

5/10/2022 | 10:32 AM EDT

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

DOUBLE 7 FT. X 7 FT.
CONCRETE BOX CULVERT
64° SKEW
STAGE I

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

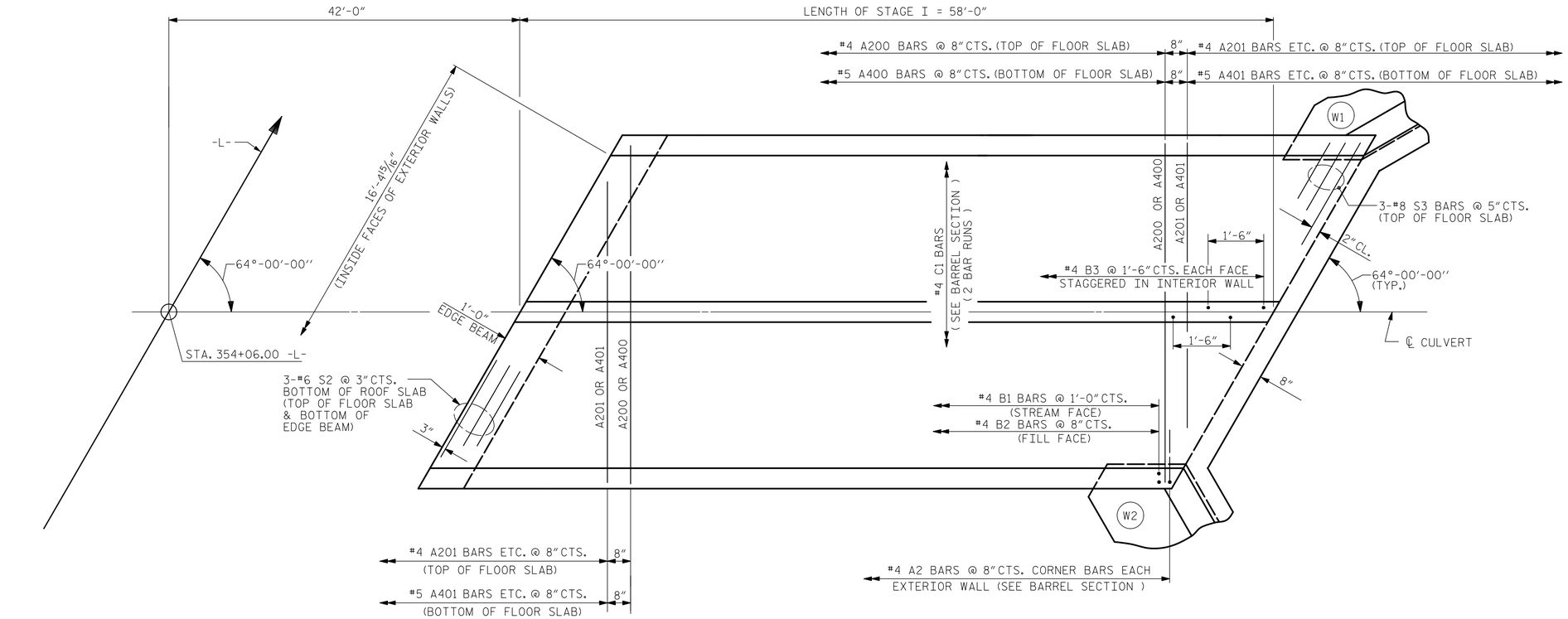
TGS ENGINEERS
706 HILLSBOROUGH STREET
SUITE 200
RALEIGH, NC 27603
PH (919) 773-8887
CORP. LICENSE NO.: C-0275

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C21-3
1			3			TOTAL SHEETS
2			4			13

ASSEMBLED BY :	ZCS	DATE :	11/21
CHECKED BY :	MGC	DATE :	12/21
DRAWN BY : PD	10/90	REV. 6/19	MAA/THC
CHECKED BY : ARB	10/90		

FILE NAME: 414_005_I-5987A_Site_21_SMU_CU_003.dgn

SITE 21



PLAN - FLOOR SLAB

NOTE: FOR S1 BARS IN FLOOR SLAB & WING FOOTING, SEE WING SHEET.

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 354+06.00 -L-

SHEET 4 OF 13

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL G. SHEEK, JR.

5/10/2022 | 10:32 AM EDT

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TGS ENGINEERS
706 HILLSBOROUGH STREET
SUITE 200
RALEIGH, NC 27603
PH (919) 773-8887
CORP. LICENSE NO.: C-0275

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

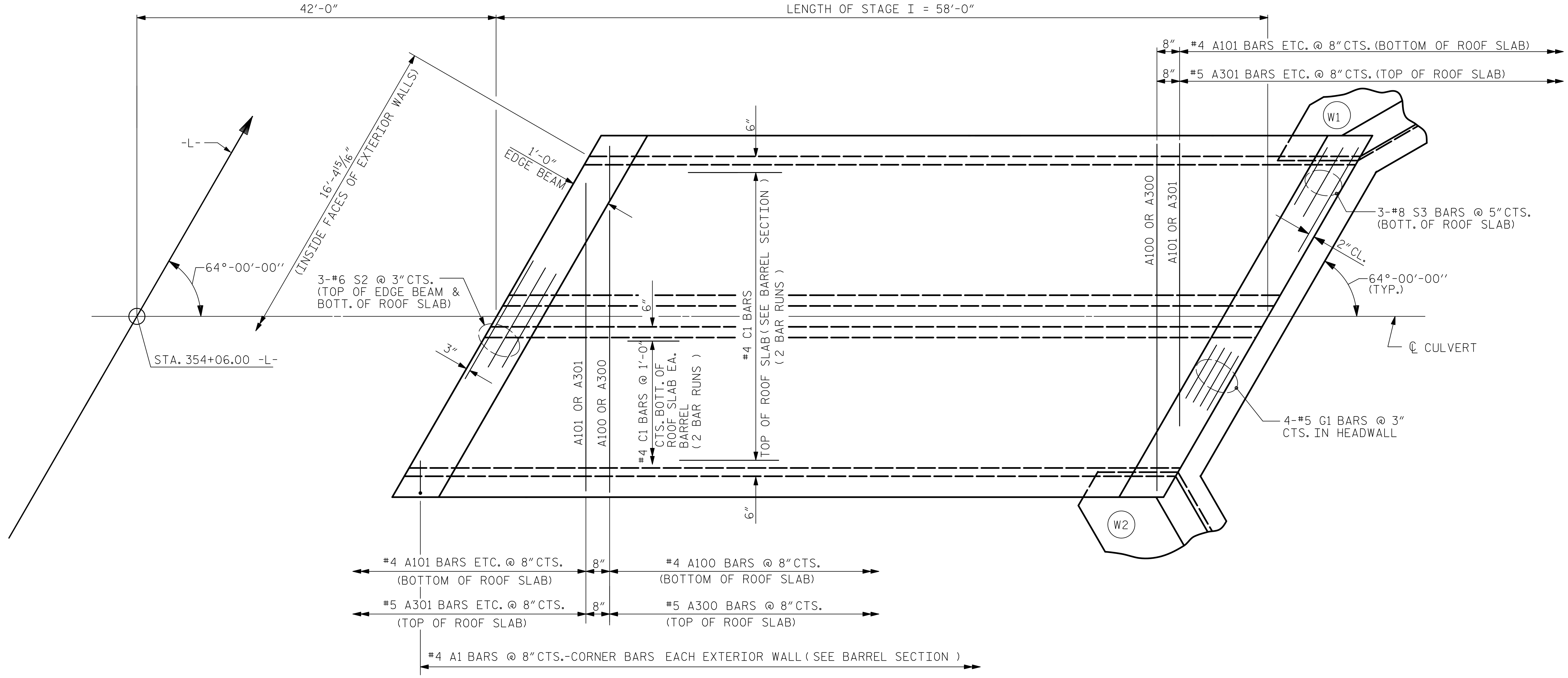
DOUBLE 7 FT. X 7 FT.
CONCRETE BOX CULVERT
64° SKEW
STAGE I

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C21-4
1			3			TOTAL SHEETS
2			4			13

DRAWN BY : ZCS DATE : 11/21
CHECKED BY : MGC DATE : 12/21
DESIGN ENGINEER OF RECORD: ZCS DATE : 2/22

FILE NAME: 414_007_I-5987A_Site_21_SMU_CU_004.dgn

SITE 21



PLAN - ROOF SLAB

PROJECT NO. I-5987A
ROBESON COUNTY
STATION: 354+06.00 -L-

SHEET 5 OF 13

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

DOUBLE 7 FT. X 7 FT.
CONCRETE BOX CULVERT
64° SKEW
STAGE I

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL C. CHEEK, JR.
5/10/2022 | 10:32 AM EDT

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TGS ENGINEERS
706 HILLSBOROUGH STREET
SUITE 200
RALEIGH, NC 27603
PH (919) 773-8887
CORP. LICENSE NO.: C-0275

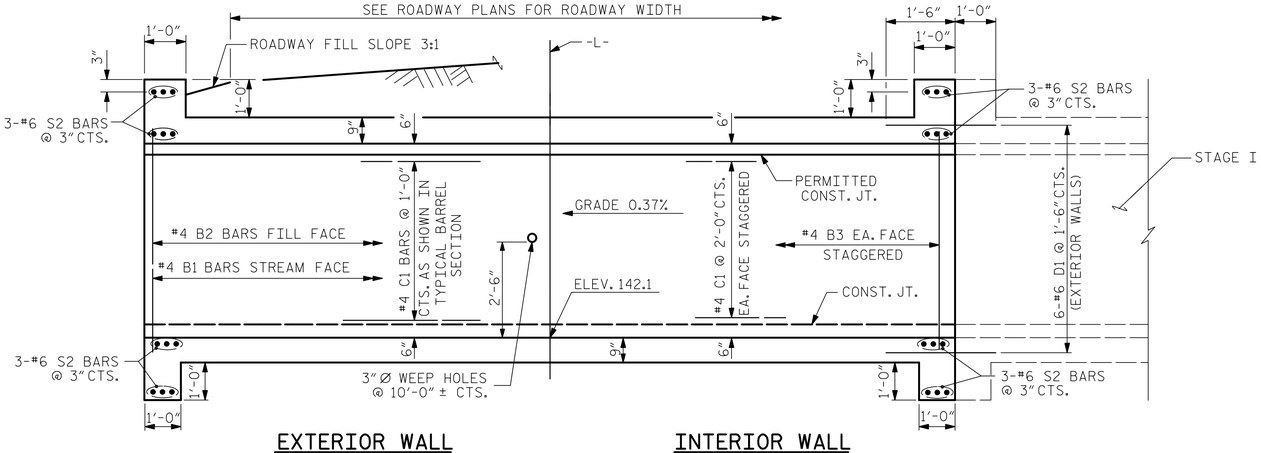
REVISIONS					
NO.	BY:	DATE:	NO.	BY:	DATE:
1			3		
2			4		

SHEET NO. C21-5
TOTAL SHEETS 13

DRAWN BY : ZCS DATE : 11/21
CHECKED BY : MGC DATE : 12/21
DESIGN ENGINEER OF RECORD: ZCS DATE : 2/22

FILE NAME: 414_009_I-5987A_Site_21_SMU_CU_005.dgn

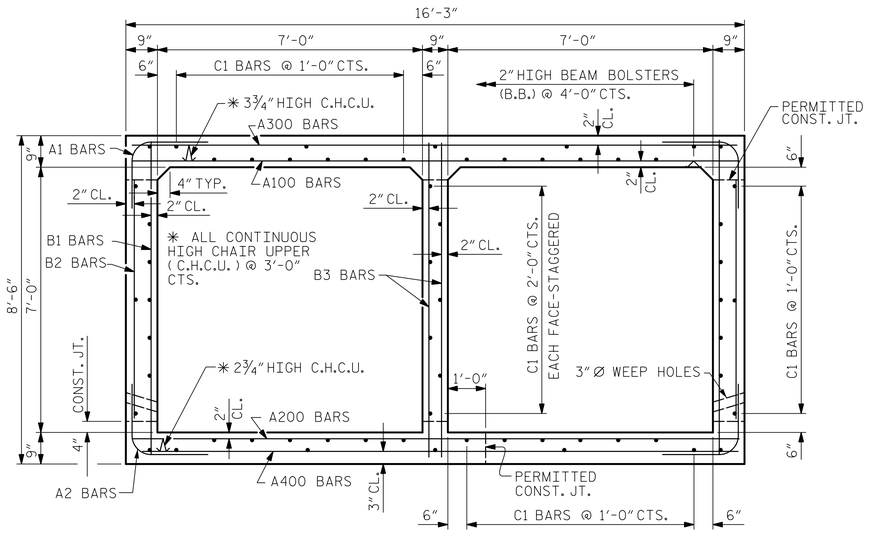
SITE 21



CULVERT SECTION NORMAL TO ROADWAY

STAGE II BAR SCHEDULE

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT	BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT	BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
A100	61	#4	STR	15'-10"	645	A300	61	#5	STR	15'-10"	1007	A1	142	#4	1	4'-10"	458
A101	2	#4	STR	14'-8"	20	A301	2	#5	STR	14'-8"	31	A2	142	#4	1	4'-5"	419
A102	2	#4	STR	13'-4"	18	A302	2	#5	STR	13'-4"	28						
A103	2	#4	STR	12'-0"	16	A303	2	#5	STR	12'-0"	25	B1	98	#4	STR	8'-0"	524
A104	2	#4	STR	10'-7"	14	A304	2	#5	STR	10'-7"	22	B2	146	#4	STR	6'-4"	618
A105	2	#4	STR	9'-3"	12	A305	2	#5	STR	9'-3"	19	B3	66	#4	STR	8'-0"	353
A106	2	#4	STR	7'-11"	11	A306	2	#5	STR	7'-11"	17						
A107	2	#4	STR	6'-7"	9	A307	2	#5	STR	6'-7"	14	C1	122	#4	STR	25'-0"	2037
A108	2	#4	STR	5'-3"	7	A308	2	#5	STR	5'-3"	11						
A109	2	#4	STR	3'-10"	5	A309	2	#5	STR	3'-10"	8	S2	24	#6	STR	17'-8"	637
A110	2	#4	STR	2'-6"	3	A310	2	#5	STR	2'-6"	5						
												D1	34	#6	STR	2'-6"	128
A200	61	#4	STR	15'-10"	645	A400	61	#5	STR	15'-10"	1007						
A201	2	#4	STR	14'-8"	20	A401	2	#5	STR	14'-8"	31						
A202	2	#4	STR	13'-4"	18	A402	2	#5	STR	13'-4"	28						
A203	2	#4	STR	12'-0"	16	A403	2	#5	STR	12'-0"	25						
A204	2	#4	STR	10'-7"	14	A404	2	#5	STR	10'-7"	22						
A205	2	#4	STR	9'-3"	12	A405	2	#5	STR	9'-3"	19						
A206	2	#4	STR	7'-11"	11	A406	2	#5	STR	7'-11"	17						
A207	2	#4	STR	6'-7"	9	A407	2	#5	STR	6'-7"	14						
A208	2	#4	STR	5'-3"	7	A408	2	#5	STR	5'-3"	11						
A209	2	#4	STR	3'-10"	5	A409	2	#5	STR	3'-10"	8						
A210	2	#4	STR	2'-6"	3	A410	2	#5	STR	2'-6"	5						
												REINFORCING STEEL					9,068 LBS



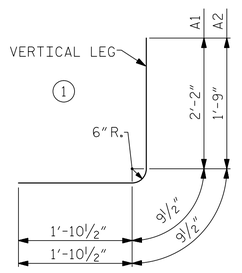
RIGHT ANGLE SECTION OF BARREL

THERE ARE 61 "C" BARS IN SECTION OF BARREL.

STAGE II QUANTITIES

CLASS A CONCRETE		
BARREL @ 1.49 CY/FT	72.3	C.Y.
4 EDGE BEAMS	2.7	C.Y.
TOTAL	75.0	C.Y.
REINFORCING STEEL		
BARREL	9,068	LBS.
TOTAL	9,068	LBS.
CULVERT EXCAVATION	LUMP SUM	
FOUNDATION COND. MAT'L.	69 TONS	

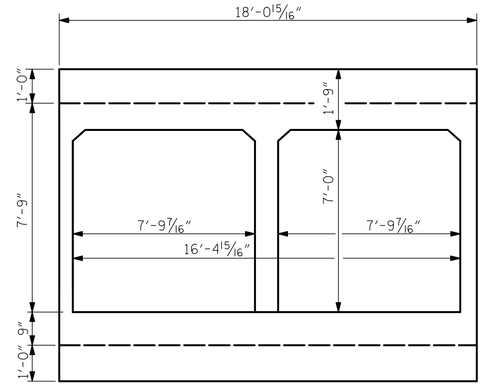
BAR TYPE



DIMENSIONS ARE OUT TO OUT

SPLICE LENGTHS CHART

BAR	SIZE	SPLICE LENGTH
B1	#4	1'-10"
C1	#4	1'-10"
A200	#4	1'-10"
A400	#5	2'-4"
S2	#6	2'-9"



LEFT END ELEVATION NORMAL TO SKEW

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 354+06.00 -L-

SHEET 6 OF 13

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL A. CHICK, JR.

Document ID: 5FBCC2F3A4DC413...

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TGS ENGINEERS
706 HILLSBOROUGH STREET
SUITE 200
RALEIGH, NC 27603
PH (919) 773-8887
CORP. LICENSE NO.: C-0275

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

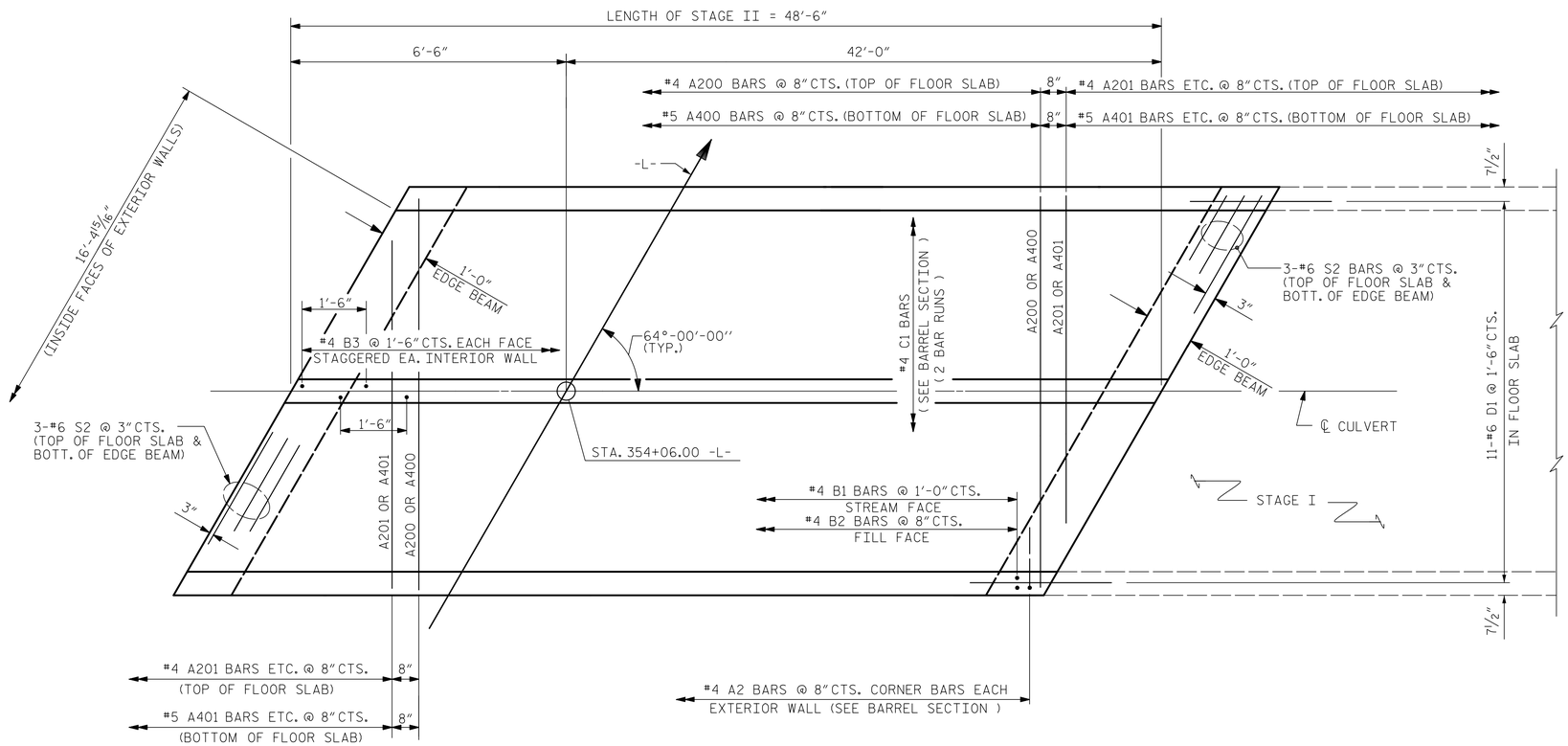
DOUBLE 7 FT. X 7 FT. CONCRETE BOX CULVERT 64° SKEW STAGE II

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C21-6
1			3			TOTAL SHEETS
2			4			13

ASSEMBLED BY :	ZCS	DATE :	11/21
CHECKED BY :	MGC	DATE :	12/21
DRAWN BY : PD	10/90	REV. 6/19	MAA/THC
CHECKED BY : ARB	10/90		

FILE NAME: 414_011_I-5987A_Site_21_SMU_CU_006.dgn

SITE 21



PLAN - FLOOR SLAB

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 354+06.00 -L-

SHEET 7 OF 13

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL G. CHEEK, JR.

Document Id: 5FBCC2F3A4DC413...

5/10/2022 | 10:32 AM EDT

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706 HILLSBOROUGH STREET
SUITE 200
RALEIGH, NC 27603
PH (919) 773-8887
CORP. LICENSE NO.: C-0275

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

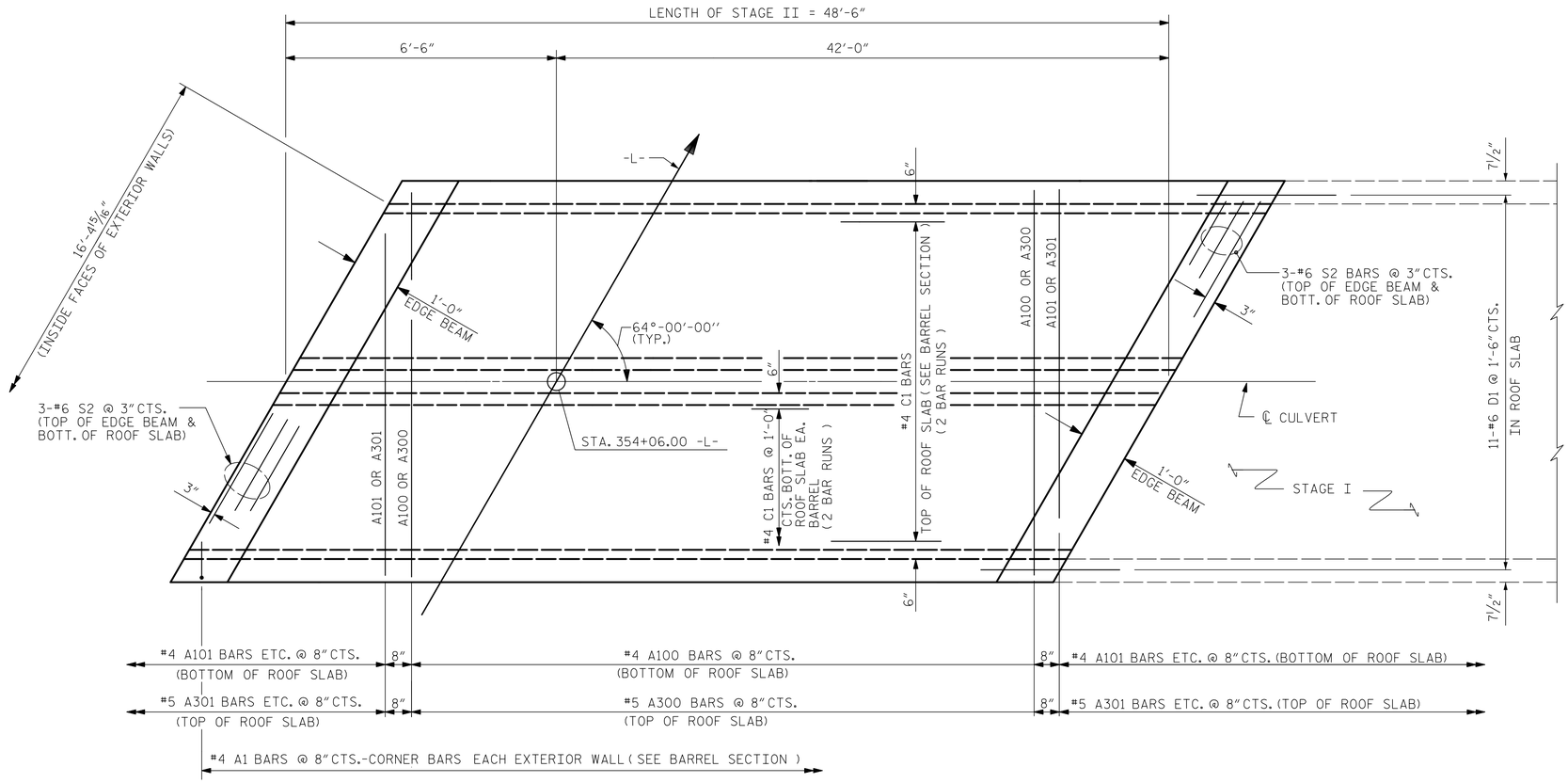
DOUBLE 7 FT. X 7 FT.
CONCRETE BOX CULVERT
64° SKEW
STAGE II

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C21-7
1			3			TOTAL SHEETS
2			4			13

DRAWN BY :	ZCS	DATE :	11/21
CHECKED BY :	MGC	DATE :	12/21
DESIGN ENGINEER OF RECORD:	ZCS	DATE :	2/22

FILE NAME: 414_013_I-5987A_Site_21_SMU_CU_007.dgn

SITE 21



PLAN - ROOF SLAB

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 354+06.00 -L-

SHEET 8 OF 13

DRAWN BY : ZCS DATE : 11/21
CHECKED BY : MGC DATE : 12/21
DESIGN ENGINEER OF RECORD: ZCS DATE : 2/22

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER Marshall G. Cheek, Jr.

Docusigned by: Marshall G. Cheek, Jr. 5FBCC2F3A4DC413...

5/10/2022 | 10:32 AM EDT

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

TGS ENGINEERS
706 HILLSBOROUGH STREET
SUITE 200
RALEIGH, NC 27603
PH (919) 773-8887
CORP. LICENSE NO.: C-0275

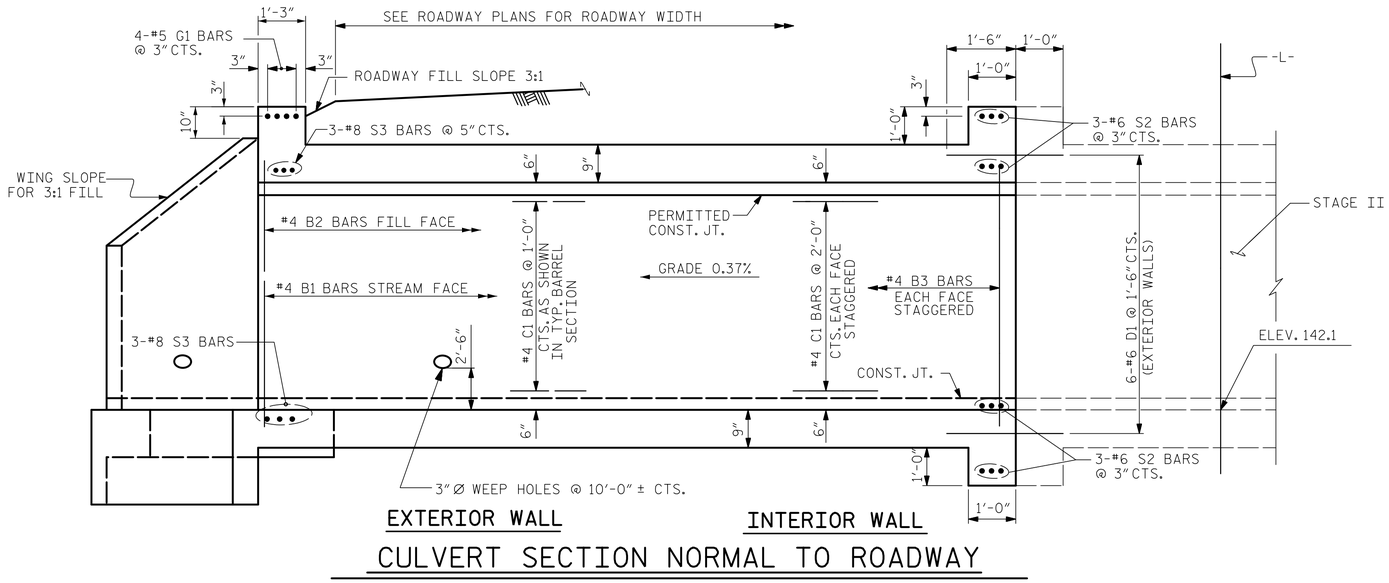
STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

DOUBLE 7 FT. X 7 FT.
CONCRETE BOX CULVERT
64° SKEW
STAGE II

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C21-8
1			3			TOTAL SHEETS
2			4			13

FILE NAME: 414_015_I-5987A_Site_21_SMU_CU_008.dgn

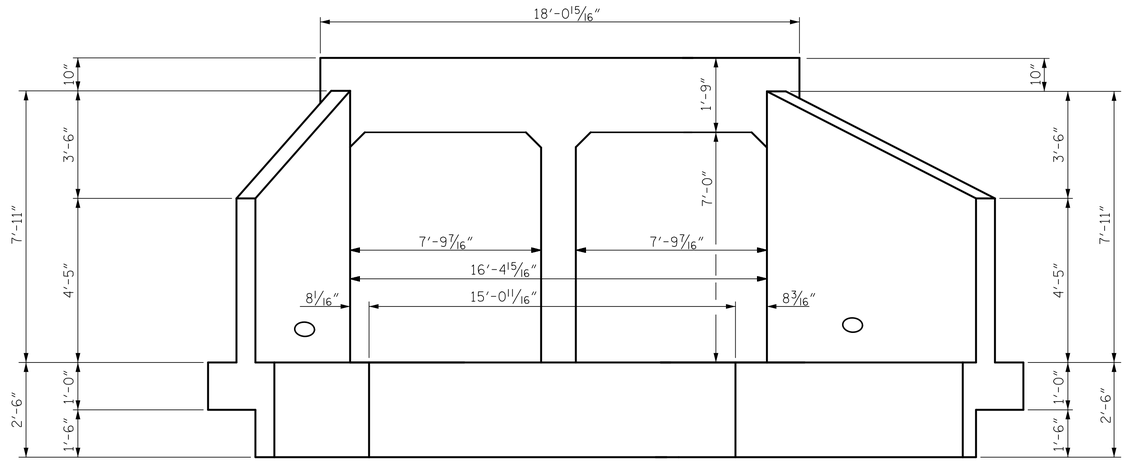
SITE 21



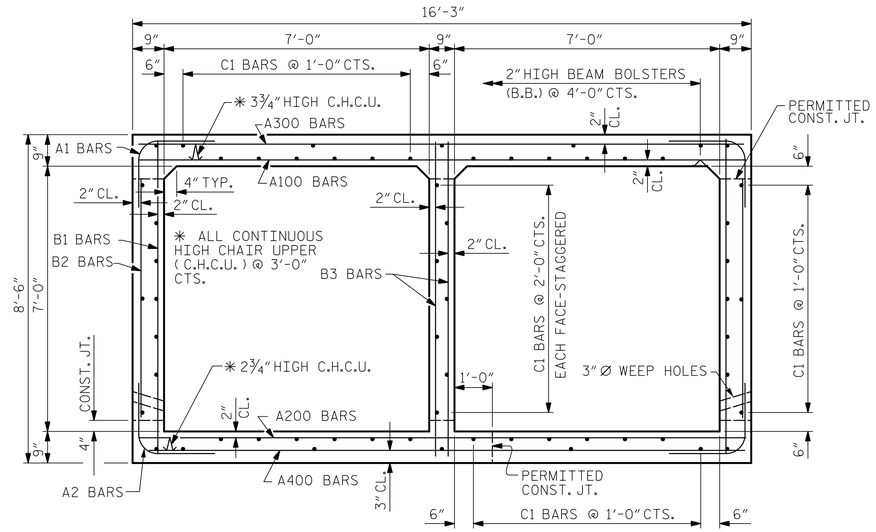
CULVERT SECTION NORMAL TO ROADWAY

STAGE III BAR SCHEDULE

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT	BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT	BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
A100	130	#4	STR	15'-10"	1375	A300	130	#5	STR	15'-10"	2147	A1	280	#4	1	4'-10"	904
A101	2	#4	STR	14'-8"	20	A301	2	#5	STR	14'-8"	31	A2	280	#4	1	4'-5"	826
A102	2	#4	STR	13'-4"	18	A302	2	#5	STR	13'-4"	28						
A103	2	#4	STR	12'-0"	16	A303	2	#5	STR	12'-0"	25	B1	190	#4	STR	8'-0"	1015
A104	2	#4	STR	10'-7"	14	A304	2	#5	STR	10'-7"	22	B2	280	#4	STR	6'-4"	1185
A105	2	#4	STR	9'-3"	12	A305	2	#5	STR	9'-3"	19	B3	126	#4	STR	8'-0"	673
A106	2	#4	STR	7'-11"	11	A306	2	#5	STR	7'-11"	17						
A107	2	#4	STR	6'-7"	9	A307	2	#5	STR	6'-7"	14	C1	183	#4	STR	32'-8"	3993
A108	2	#4	STR	5'-3"	7	A308	2	#5	STR	5'-3"	11						
A109	2	#4	STR	3'-10"	5	A309	2	#5	STR	3'-10"	8	S2	12	#6	STR	17'-8"	318
A110	2	#4	STR	2'-6"	3	A310	2	#5	STR	2'-6"	5	S3	6	#8	STR	17'-8"	283
A200	130	#4	STR	15'-10"	1375	A400	130	#5	STR	15'-10"	2147	G1	4	#5	STR	17'-8"	74
A201	2	#4	STR	14'-8"	20	A401	2	#5	STR	14'-8"	31						
A202	2	#4	STR	13'-4"	18	A402	2	#5	STR	13'-4"	28	D1	34	#6	STR	2'-6"	128
A203	2	#4	STR	12'-0"	16	A403	2	#5	STR	12'-0"	25	D2	6	#6	STR	1'-4"	12
A204	2	#4	STR	10'-7"	14	A404	2	#5	STR	10'-7"	22	D3	6	#6	STR	2'-4"	21
A205	2	#4	STR	9'-3"	12	A405	2	#5	STR	9'-3"	19						
A206	2	#4	STR	7'-11"	11	A406	2	#5	STR	7'-11"	17						
A207	2	#4	STR	6'-7"	9	A407	2	#5	STR	6'-7"	14						
A208	2	#4	STR	5'-3"	7	A408	2	#5	STR	5'-3"	11						
A209	2	#4	STR	3'-10"	5	A409	2	#5	STR	3'-10"	8						
A210	2	#4	STR	2'-6"	3	A410	2	#5	STR	2'-6"	5						
												REINFORCING STEEL				17,066 LBS	



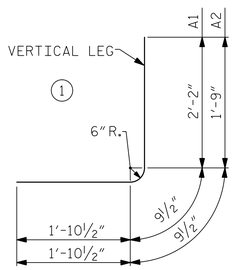
OUTLET END ELEVATION NORMAL TO SKEW



RIGHT ANGLE SECTION OF BARREL

THERE ARE 61 "C" BARS IN SECTION OF BARREL.

BAR TYPE



DIMENSIONS ARE OUT TO OUT

SPLICE LENGTHS CHART

BAR	SIZE	SPLICE LENGTH
B1	#4	1'-10"
C1	#4	1'-10"
A200	#4	1'-10"
A400	#5	2'-4"
S2	#6	2'-9"
S3	#8	3'-8"

STAGE III QUANTITIES

CLASS A CONCRETE		
BARREL @ 1.49 CY/FT	140.8	C.Y.
WINGS, ETC.	16.9	C.Y.
EDGE BEAMS	1.3	C.Y.
SILLS	0.8	C.Y.
TOTAL	159.8	C.Y.
REINFORCING STEEL		
BARREL & SILLS	17,066	LBS.
WINGS, ETC.	944	LBS.
TOTAL	18,008	LBS.
CULVERT EXCAVATION	LUMP SUM	
FOUNDATION COND. MAT'L.	135 TONS	

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 354+06.00 -L-

SHEET 9 OF 13

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL A. CHEEK, JR.

Docusigned by: Marshall A. Cheek, Jr. SFBCC2F3A4DC413...

5/10/2022 | 10:32 AM EDT

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TGS ENGINEERS
706 HILLSBOROUGH STREET
SUITE 200
RALEIGH, NC 27603
PH. (919) 773-8887
CORP. LICENSE NO.: C-0275

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

DOUBLE 7 FT. X 7 FT.
CONCRETE BOX CULVERT
64° SKEW
STAGE III

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

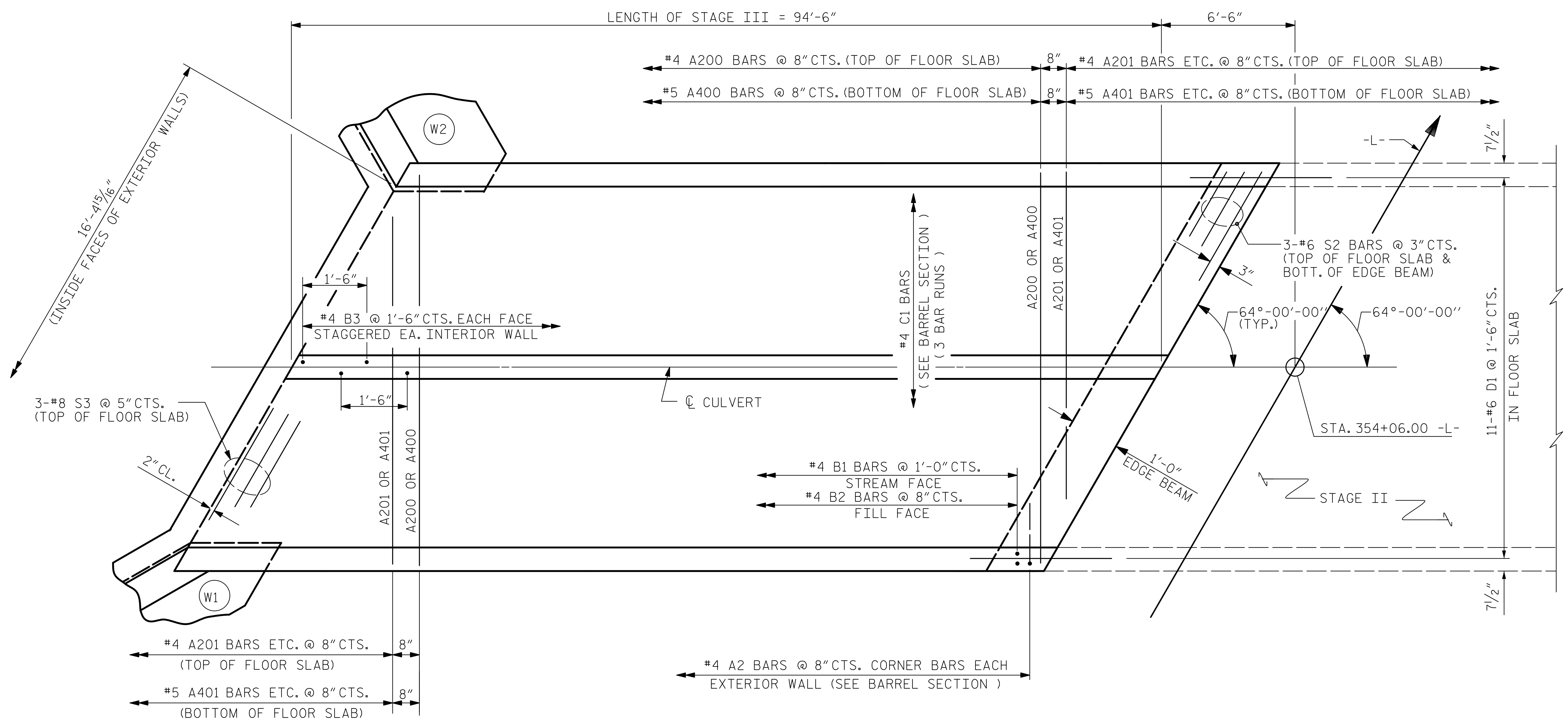
SHEET NO. C21-9

TOTAL SHEETS 13

ASSEMBLED BY :	ZCS	DATE :	11/21
CHECKED BY :	MGC	DATE :	12/21
DRAWN BY : PD	10/90	REV. 6/19	MAA/THC
CHECKED BY : ARB	10/90		

FILE NAME: 414_011_I-5987A_Site_21_SMU_CU_006.dgn

SITE 21



PLAN - FLOOR SLAB

NOTE: FOR S1 BARS IN FLOOR SLAB & WING FOOTING, SEE WING SHEET.

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 354+06.00 -L-

SHEET 10 OF 13

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL G. CHEEK, JR.

5/10/2022 | 10:32 AM EDT

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TGS ENGINEERS
706 HILLSBOROUGH STREET
SUITE 200
RALEIGH, NC 27603
PH (919) 773-8887
CORP. LICENSE NO.: C-0275

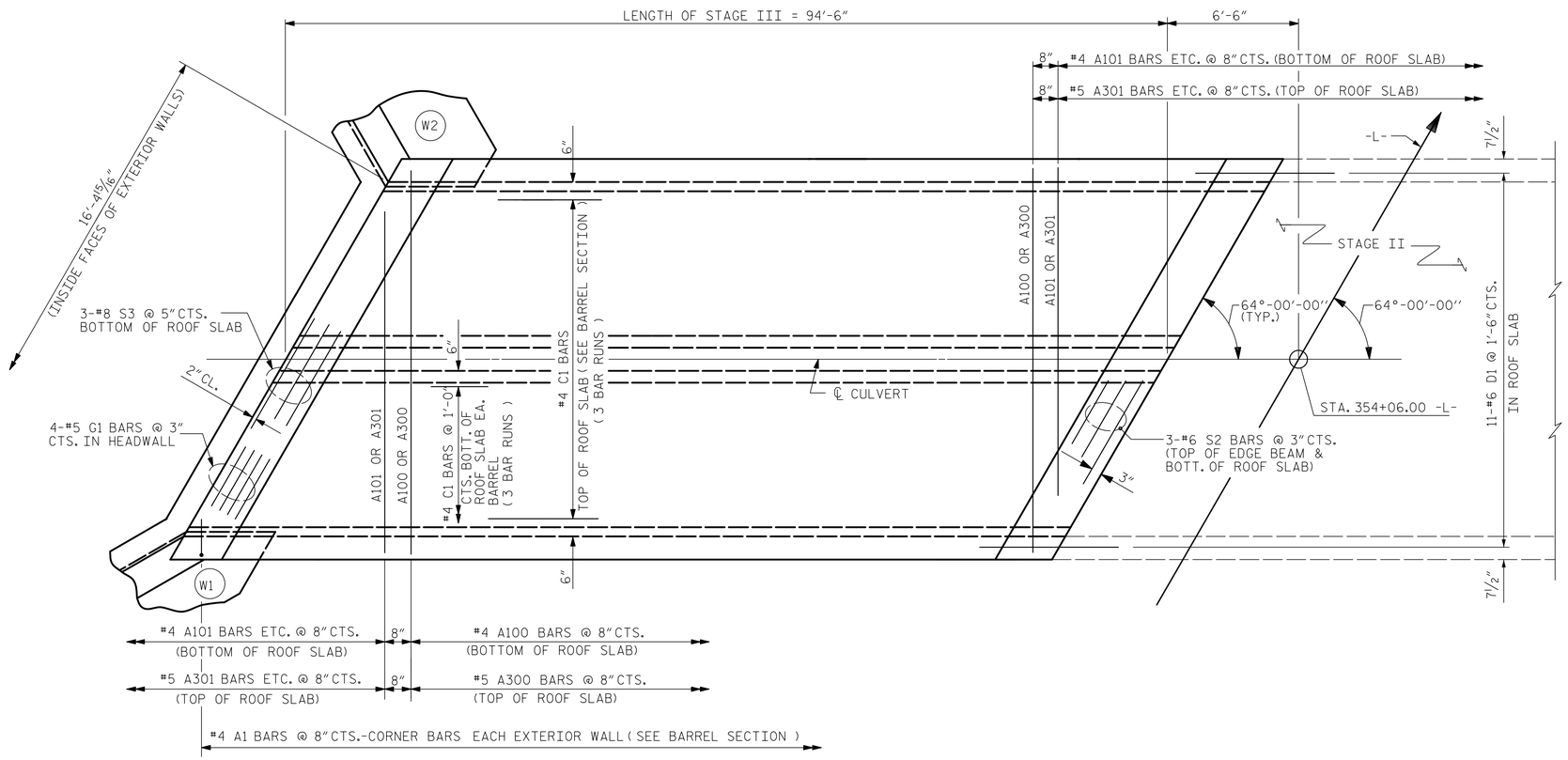
STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

DOUBLE 7 FT. X 7 FT.
CONCRETE BOX CULVERT
64° SKEW
STAGE III

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C21-10
1			3			TOTAL SHEETS
2			4			13

DRAWN BY : ZCS DATE : 11/21
CHECKED BY : MGC DATE : 12/21
DESIGN ENGINEER OF RECORD: ZCS DATE : 2/22

FILE NAME: 414_013_I-5987A_Site_21_SMU_CU_007.dgn



PLAN - ROOF SLAB

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 354+06.00 -L-

SHEET 11 OF 13

DRAWN BY : ZCS DATE : 11/21

CHECKED BY : MGC DATE : 12/21

DESIGN ENGINEER OF RECORD: ZCS DATE : 2/22

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL G. CHEEK, JR.

Docusigned by: Marshall G. Cheek, Jr.

5FBCC2F3A4DC413 5/10/2022 | 10:32 AM EDT

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

TGS ENGINEERS
706 HILLSBOROUGH STREET
SUITE 200
RALEIGH, NC 27603
PH (919) 773-8887
CORP. LICENSE NO.: C-0275

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

DOUBLE 7 FT. X 7 FT. CONCRETE BOX CULVERT 64° SKEW STAGE III

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C21-11
1			3			TOTAL SHEETS
2			4			13

FILE NAME: 414_015_I-5987A_Site_21_SMU_CU_008.dgn

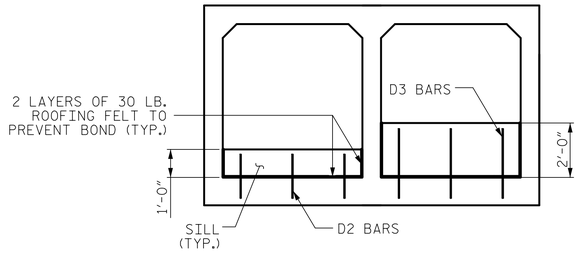
SITE 21

NOTES

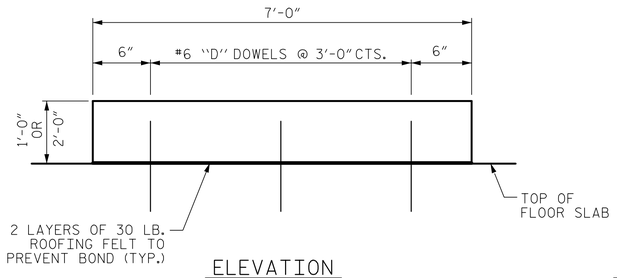
MATERIAL EXCAVATED FROM THE EXISTING BED SHALL BE STOCKPILED FOR USE IN THE PROPOSED CULVERT. BED MATERIAL IN THE HIGH FLOW BARREL MAY BE SUPPLEMENTED WITH CLASS B RIP RAP AS NECESSARY. NATIVE MATERIAL SHOULD BE PLACED ON TOP TO PROVIDE A FLAT SURFACE FOR ANIMAL PASSAGE. BED MATERIAL IS SUBJECT TO THE APPROVAL BY THE ENGINEER AND MAY BE SUBJECT TO PERMIT CONDITIONS.

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.

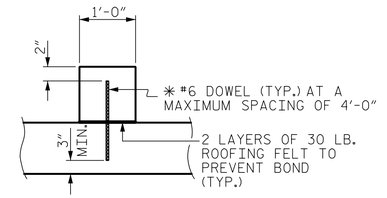
THE ENTIRE COST OF WORK REQUIRED TO CONSTRUCT THE SILLS SHALL BE INCLUDED IN THE VARIOUS PAY ITEMS.



INLET ELEVATION
(LOOKING DOWNSTREAM)



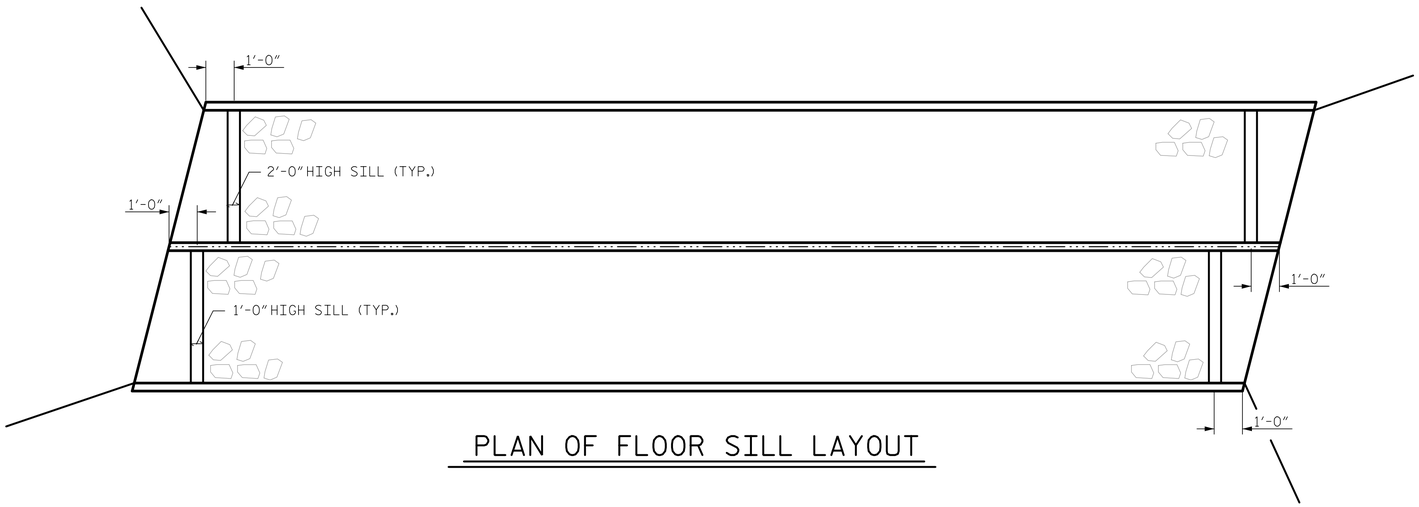
ELEVATION



SECTION THROUGH SILL

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

SILL DETAILS



PLAN OF FLOOR SILL LAYOUT

PROJECT NO. I-5987A
ROBESON COUNTY
STATION: 354+06.00 -L-

SHEET 12 OF 13

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER
Digitally signed by Marshall G. Cheek, Jr.
5FBCC2F3A4DC413...
5/10/2022 | 10:32 AM EDT

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

TGS ENGINEERS
706 HILLSBOROUGH STREET
SUITE 200
RALEIGH, NC 27603
PH (919) 773-8887
CORP. LICENSE NO.: C-0275

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

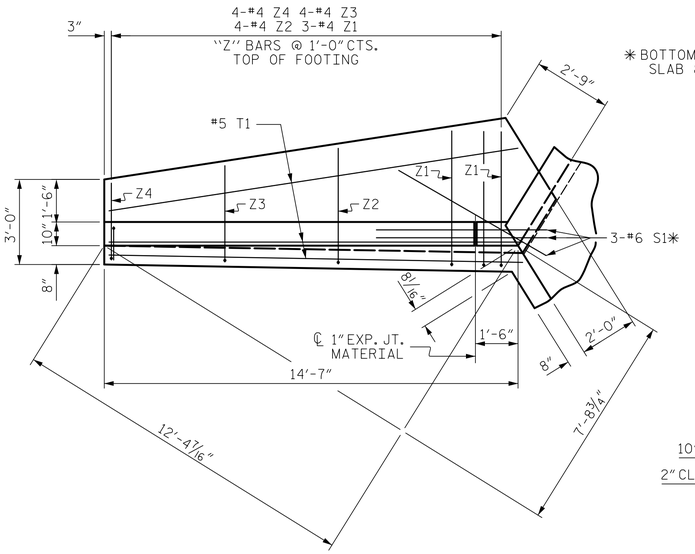
DOUBLE 7 FT. X 7 FT. CONCRETE BOX CULVERT

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C21-12
1			3			TOTAL SHEETS
2			4			13

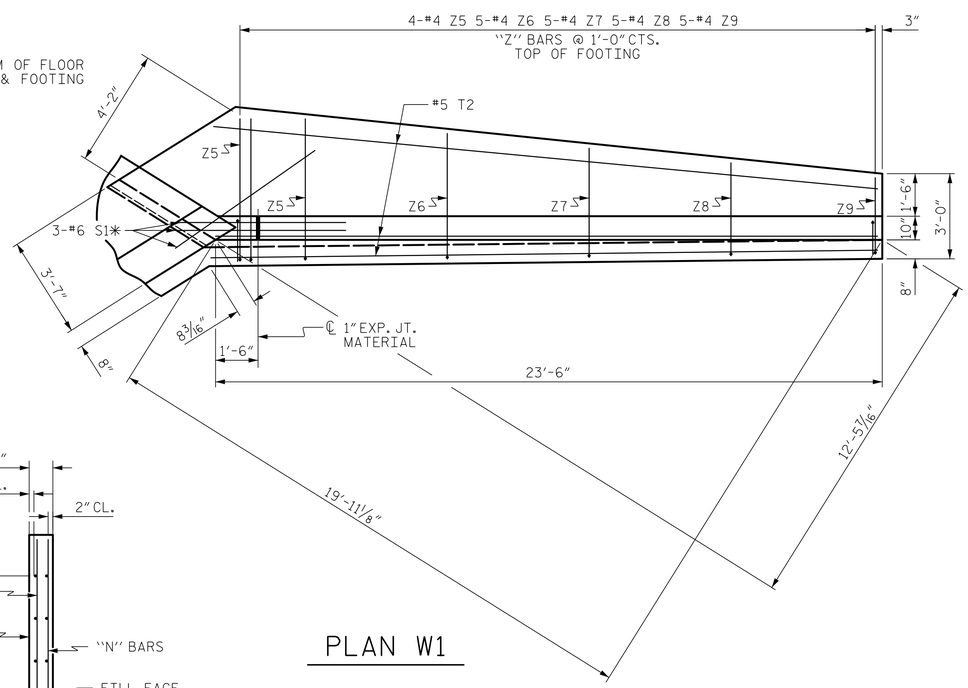
DRAWN BY : ZCS DATE : 11/21
CHECKED BY : MGC DATE : 12/21

FILE NAME: 414_017_I-5987A_Site_21_SMU_CU_009.dgn

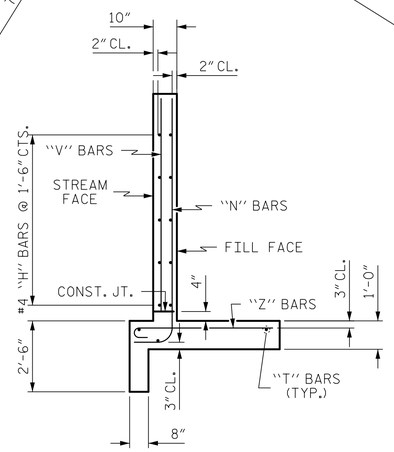
SITE 21



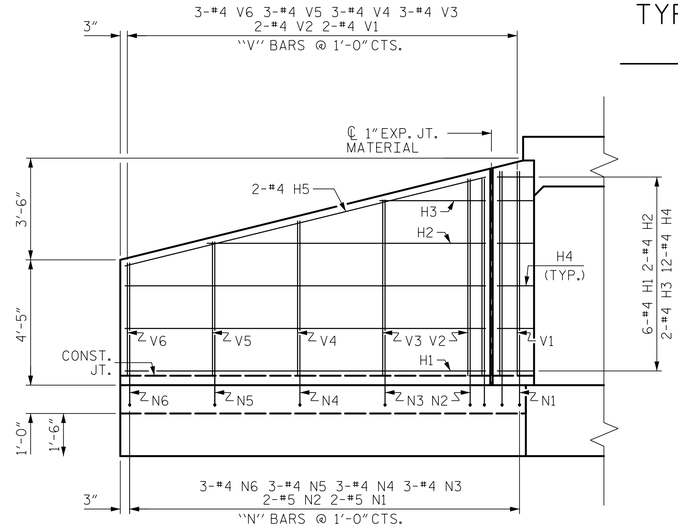
PLAN W2



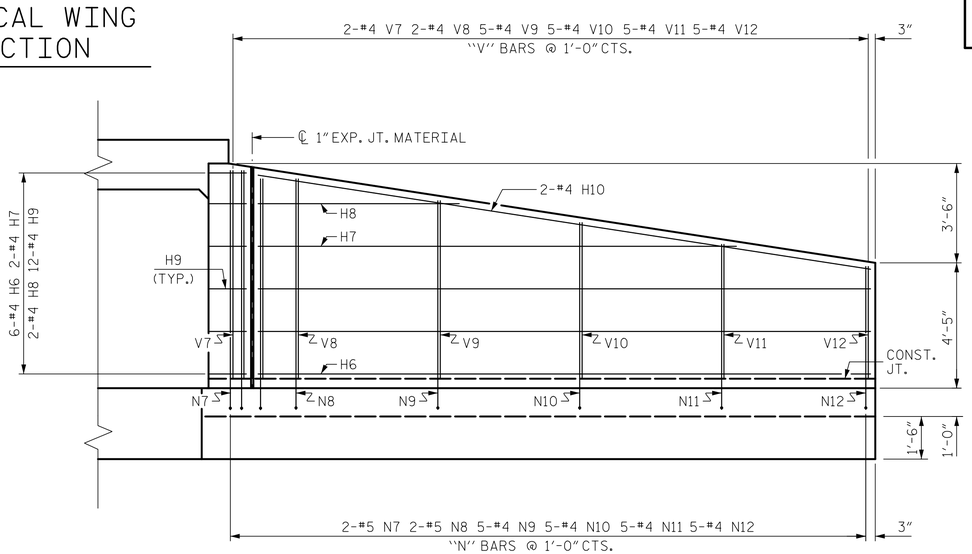
PLAN W1



TYPICAL WING SECTION

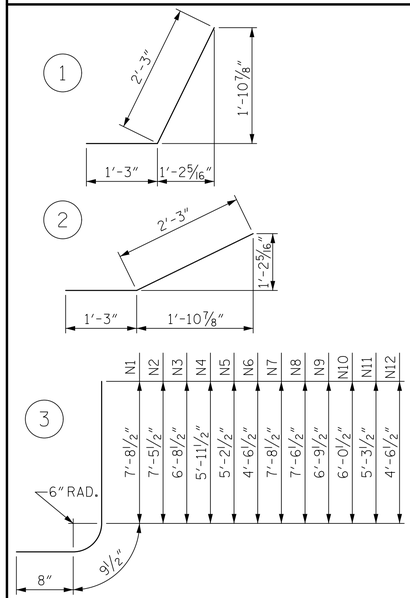


ELEVATION W2



ELEVATION W1

BAR TYPES



ALL BAR DIMENSIONS ARE OUT TO OUT.

BILL OF MATERIAL

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
H1	12	#4	STR	12'-8"	102
H2	4	#4	STR	9'-9"	26
H3	4	#4	STR	3'-8"	10
H4	24	#4	1	3'-6"	56
H5	4	#4	STR	13'-1"	35
H6	12	#4	STR	21'-7"	173
H7	4	#4	STR	16'-10"	45
H8	4	#4	STR	7'-1"	19
H9	24	#4	2	3'-6"	56
H10	4	#4	STR	21'-10"	58
N1	4	#5	3	9'-2"	38
N2	4	#5	3	8'-11"	37
N3	6	#4	3	8'-2"	33
N4	6	#4	3	7'-5"	30
N5	6	#4	3	6'-8"	27
N6	6	#4	3	6'-0"	24
N7	4	#5	3	9'-2"	38
N8	4	#5	3	9'-0"	38
N9	10	#4	3	8'-3"	55
N10	10	#4	3	7'-6"	50
N11	10	#4	3	6'-9"	45
N12	10	#4	3	6'-0"	40
S1	12	#6	STR	6'-0"	108
T1	6	#5	STR	14'-7"	91
T2	6	#5	STR	23'-6"	147
V1	4	#4	STR	7'-2"	19
V2	4	#4	STR	6'-11"	18
V3	6	#4	STR	6'-2"	25
V4	6	#4	STR	5'-5"	22
V5	6	#4	STR	4'-8"	19
V6	6	#4	STR	3'-11"	16
V7	4	#4	STR	7'-2"	19
V8	4	#4	STR	6'-10"	18
V9	10	#4	STR	6'-1"	41
V10	10	#4	STR	5'-4"	36
V11	10	#4	STR	4'-7"	31
V12	10	#4	STR	3'-11"	26
Z1	6	#4	4	5'-3"	21
Z2	8	#4	4	4'-6"	24
Z3	8	#4	4	3'-10"	20
Z4	8	#4	4	3'-2"	17
Z5	8	#4	4	5'-5"	29
Z6	10	#4	4	4'-10"	32
Z7	10	#4	4	4'-3"	28
Z8	10	#4	4	3'-9"	25
Z9	10	#4	4	3'-2"	21

REINFORCING STEEL FOR 4 WINGS	1,888 LBS
CLASS A CONCRETE	
4 WINGS	30.2 CY
2 HEADWALLS	1.7 CY
2 END CURTAIN WALLS	1.9 CY
TOTAL	33.8 CY

NOTES:

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.

G1 BARS IN HEADWALL ARE INCLUDED WITH THE BARREL REINFORCING STEEL.

PROJECT NO. I-5987A

ROBESON COUNTY

STATION: 354+06.00 -L-

SHEET 13 OF 13

DRAWN BY :	ZCS	DATE :	11/21
CHECKED BY :	MGC	DATE :	12/21
DESIGN ENGINEER OF RECORD:	ZCS	DATE :	2/22

NORTH CAROLINA PROFESSIONAL SEAL 20125 ENGINEER MARSHALL G. CHEEK, JR. DocuSigned by: SFBCC2F3A4DC413...

5/10/2022 | 10:32 AM EDT

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

TGS ENGINEERS
706 HILLSBOROUGH STREET
SUITE 200
RALEIGH, NC 27603
PH (919) 773-8887
CORP. LICENSE NO.: C-0275

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

WINGS FOR CONCRETE BOX CULVERT

H = 7'-0" SLOPE = 3:1
64° SKEW

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	C21-13
1			3			TOTAL SHEETS
2			4			13

3/17/2022
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User:ZSmith

FILE NAME: 414_019_I-5987A_Site_21_SMU_CU_010.dgn

SITE 21

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 ¾" WITH THE FOLLOWING EXCEPTIONS: TOP CORNERS OF CURBS MAY BE ROUNDED TO 1½" RADIUS WHICH IS BUILT INTO CURB FORMS; CORNERS OF TRANSVERSE FLOOR EXPANSION JOINTS SHALL BE ROUNDED WITH A ¼" 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 ¼" 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 ⅞" Ø SHEAR STUDS FOR THE ¾" Ø STUDS SPECIFIED ON THE PLANS. THIS SUBSTITUTION SHALL BE MADE AT THE RATE OF 3 - ⅞" Ø STUDS FOR 4 - ¾" Ø STUDS, AND STUD SPACING CHANGES SHALL BE MADE AS NECESSARY TO PROVIDE THE SAME EQUIVALENT NUMBER OF ⅞" Ø STUDS ALONG THE BEAM AS SHOWN FOR ¾" Ø STUDS BASED ON THE RATIO OF 3 - ⅞" Ø STUDS FOR 4 - ¾" Ø 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 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 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. FINS 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

REV. 6-16-95 EEM (c) RGW REV. 5-7-03 RWW (c) JTE REV. 10-1-11 MAA (c) GM
REV. 8-16-99 RWW (c) LES REV. 5-1-06 TLA (c) GM REV. 12-17 MAA (c) THC
21-FEB-2019 11:17
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