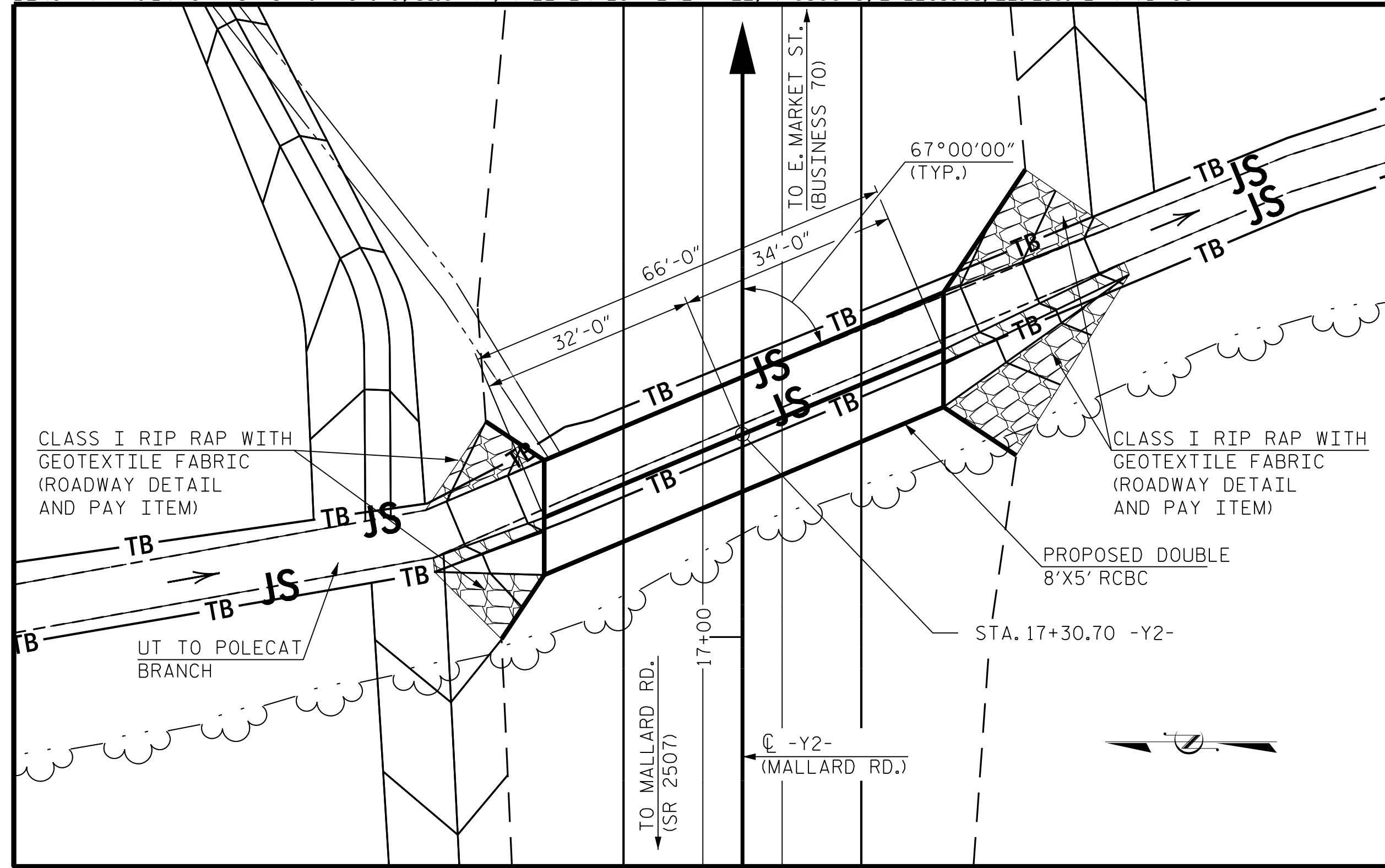


BENCH MARK: BM\*8 -Y3- STA. 7+84.70, 31.6' RT, NAIL IN 29" PINE TREE, N 636673, E 2201901, EL. 216.42 NAVD 88



**LOCATION SKETCH**

FOR UTILITY INFORMATION, SEE UTILITY PLANS AND SPECIAL PROVISIONS  
 GRADE POINT ELEVATION AT STA. 17+30.70 -Y2- = 149.7  
 BED ELEVATION AT STA. 17+30.70 -Y2- = 141.55  
 ROADWAY SLOPES = 3:1

**TOTAL STRUCTURE QUANTITIES**

<b>CLASS A CONCRETE</b>		
BARREL @ 1.83	CY/FT	121.0 C.Y.
WING ETC.		22.6 C.Y.
SILLS/BAFFLES		2.0 C.Y.
<b>TOTAL</b>		<b>145.6 C.Y.</b>
<b>REINFORCING STEEL</b>		
BARREL		18,387 LBS.
WINGS ETC.		1,448 LBS.
<b>TOTAL</b>		<b>19,835 LBS.</b>
<b>CULVERT EXCAVATION ----- LUMP SUM</b>		
<b>FOUNDATION CONDITIONING MATERIAL --- 102 TONS</b>		

**HYDRAULIC DATA**

DESIGN DISCHARGE-----200 C.F.S.  
 FREQUENCY OF DESIGN FLOOD-----25 YR.  
 DESIGN HIGH WATER ELEVATION-----145.4  
 DRAINAGE AREA-----0.23 SQ. MI.  
 BASE DISCHARGE (Q100)-----260 C.F.S.  
 BASE HIGH WATER ELEVATION-----145.8

**OVERTOPPING FLOOD DATA**

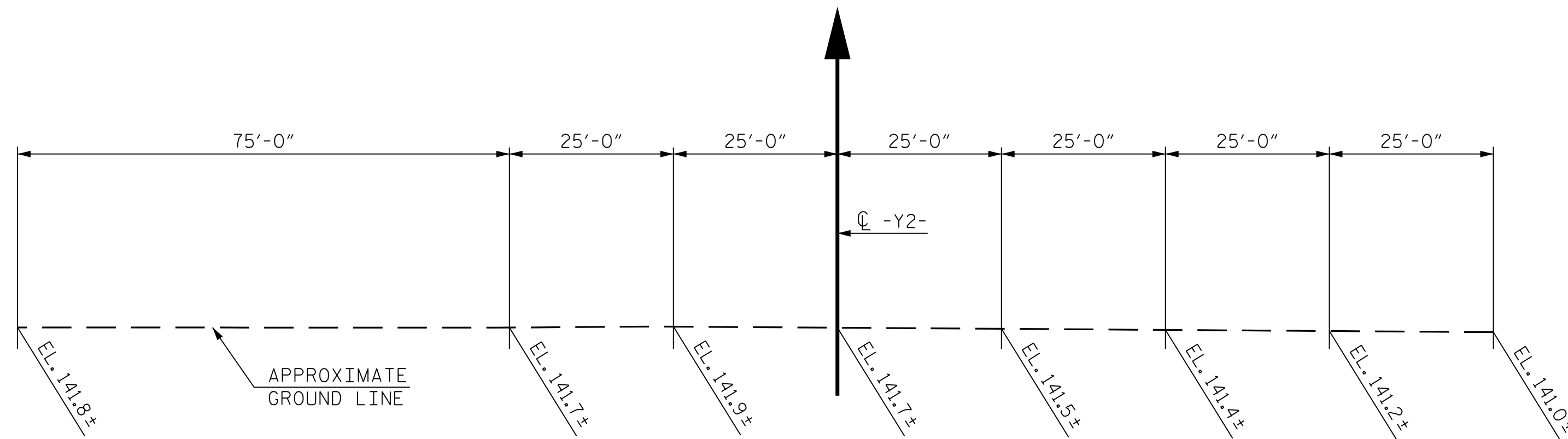
OVERTOPPING DISCHARGE-----650 C.F.S.  
 FREQUENCY OF OVERTOPPING FLOOD-----500+ YR  
 OVERTOPPING FLOOD ELEVATION-----149.7  
 OVERTOPPING OCCURS AT STA. 17+05 -Y2-

**NOTES:**

- ASSUMED LIVE LOAD -----HL-93 OR ALTERNATE LOADING
- DESIGN FILL-----3.0 FT. (MIN.), 4.2 FT. (MAX.)
- FOR OTHER DESIGN DATA AND NOTES SEE STANDARD NOTES SHEET.
- 3"Ø WEEP HOLES INDICATED TO BE IN ACCORDANCE WITH THE SPECIFICATIONS.
- CONCRETE IN CULVERT 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, SILLS 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 THE BARREL ARE SHOWN ON WING SHEET.
- 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 WINGS COVERING THE ENTIRE LENGTH OF THE EXPANSION JOINT.
- STEEL IN THE BOTTOM SLAB MAY BE SPLICED AT THE PERMITTED CONSTRUCTION JOINT AT THE CONTRACTOR'S OPTION. EXTRA WEIGHT OF STEEL DUE TO THE SPLICES WILL BE PAID FOR BY THE CONTRACTOR.
- THE CONTRACTOR SHALL PROVIDE INDEPENDENT ASSURANCE SAMPLES OF REINFORCING STEEL AS FOLLOWS: FOR PROJECTS REQUIRING UP TO 400 TONS OF REINFORCING STEEL, ONE 30 INCH SAMPLE OF EACH SIZE BAR USED, AND FOR PROJECTS REQUIRING OVER 400 TONS OF REINFORCING STEEL, TWO 30 INCH SAMPLES OF EACH SIZE BAR USED. THE SAMPLE BARS SHOULD COME FROM STEEL ACTUALLY USED IN THE PROJECT AND THE SAMPLE BARS SHOULD BE REPLACED BY SPLICED BARS AS SPECIFIED IN THE SAMPLE BAR REPLACEMENT CHART. PAYMENT FOR THE SAMPLE BARS AND REPLACEMENT REINFORCING STEEL SHALL BE CONSIDERED INCIDENTAL TO VARIOUS PAY ITEMS.
- EXCAVATE 1-FT BELOW CULVERT BEARING ELEVATION AND REPLACE WITH FOUNDATION CONDITIONING MATERIAL (SELECT MATERIAL CLASS VI).
- UNDERCUT ANY SOFT/LOOSE ALLUVIAL SOILS THAT MAY BE ENCOUNTERED BENEATH THE BOTTOM OF THE FOUNDATION CONDITIONING MATERIAL. BACKFILL UNDERCUT AREA WITH FOUNDATION CONDITIONING MATERIAL.
- FOR CULVERT DIVERSION DETAILS AND PAY ITEM, SEE EROSION CONTROL PLANS
- FOR GROUT FOR STRUCTURES, SEE SPECIAL PROVISIONS.
- FOR SUBMITTAL OF WORKING DRAWINGS, SEE SPECIAL PROVISIONS.
- FOR FALSEWORK AND FORMWORK, SEE SPECIAL PROVISIONS.
- FOR CRANE SAFETY, SEE SPECIAL PROVISIONS.
- FOR CONSTRUCTION SEQUENCE, SEE EROSION CONTROL PLANS.
- NO PRECAST REINFORCED BOX CULVERT OPTION WILL BE ALLOWED.

SAMPLE BAR REPLACEMENT	
SIZE	LENGTH
#3	6'-2"
#4	7'-4"
#5	8'-6"
#6	9'-8"
#7	10'-10"
#8	12'-0"
#9	13'-2"
#10	14'-6"
#11	15'-10"

NOTE:  
 SAMPLE BAR REPLACEMENT LENGTHS BASED ON 30" (SAMPLE LENGTH) PLUS TWO SPLICE LENGTHS AND  $f_y = 60\text{ksi}$ .



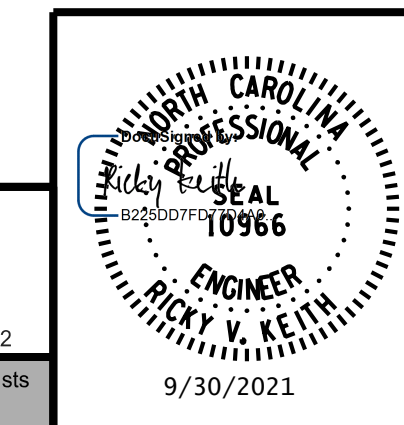
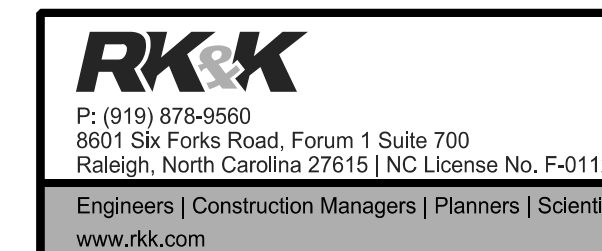
**PROFILE ALONG CULVERT**

PROJECT NO. I-5972  
JOHNSTON COUNTY  
 STATION: 17+30.70 -Y2-

SHEET 1 OF 6

STATE OF NORTH CAROLINA  
 DEPARTMENT OF TRANSPORTATION  
 RALEIGH

**DOUBLE 8 FT. X 5 FT.  
 CONCRETE BOX CULVERT  
 67°00'00" SKEW**



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

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9/30/2021  
 DRAWN BY : J. BOXLEY DATE : JUL. 2021  
 CHECKED BY : A. L. STROUD DATE : JUL. 2021  
 DESIGN ENGINEER OF RECORD : R. V. KEITH DATE : JUL. 2021

## 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 (%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	1.18	--	1.75	1.81	2	BOT SLAB	0.1	1.18	1	TOP SLAB	8		
	HL-93 (OPERATING)	N/A		1.52	--	1.35	2.34	2	BOT SLAB	0.1	1.52	1	TOP SLAB	8		
	HS-20 (INVENTORY)	36.000	2	1.33	47.88	1.75	1.81	2	BOT SLAB	0.1	1.33	2	BOT SLAB	0.1		
	HS-20 (OPERATING)	36.000		1.73	62.28	1.35	2.34	2	BOT SLAB	0.1	1.73	2	BOT SLAB	0.1		
LEGAL LOAD RATING	SINGLE VEHICLE (SV)	SNSH	13.500		3.56	48.06	1.40	4.2	1	TOP SLAB	4	3.56	1	TOP SLAB	8	
		SNGARBS2	20.000		3.12	62.40	1.40	3.6	2	BOT SLAB	0.1	3.12	2	BOT SLAB	0.1	
		SNAGRIS2	22.000		2.84	62.48	1.40	3.33	2	BOT SLAB	0.1	2.84	2	BOT SLAB	0.1	
		SNCOTTS3	27.250		1.62	44.15	1.40	2.57	2	BOT SLAB	0.1	1.62	1	TOP SLAB	8	
		SNAGGRS4	34.925		1.75	61.12	1.40	2.7	2	BOT SLAB	0.1	1.75	2	BOT SLAB	0.1	
		SNS5A	35.550		1.95	69.32	1.40	2.45	1	BOT SLAB	8	1.95	2	BOT SLAB	0.1	
		SNS6A	39.950		1.71	68.31	1.40	2.23	2	BOT SLAB	0.1	1.71	2	BOT SLAB	0.1	
		SNS7B	42.000		1.71	71.82	1.40	2.22	2	BOT SLAB	0.1	1.71	2	BOT SLAB	0.1	
	TRUCK TRACTOR SEMI-TRAILER (TTST)	TNAGRIT3	33.000		2.81	92.73	1.40	3.45	2	BOT SLAB	0.1	2.81	2	BOT SLAB	0.1	
		TNT4A	33.075		2.08	68.80	1.40	2.67	2	BOT SLAB	0.1	2.08	1	TOP SLAB	8	
		TNT6A	41.600		1.91	79.46	1.40	2.43	2	BOT SLAB	0.1	1.91	2	BOT SLAB	0.1	
		TNT7A	42.000		1.84	77.28	1.40	2.35	2	BOT SLAB	0.1	1.84	2	BOT SLAB	0.1	
		TNT7B	42.000		2.02	84.84	1.40	2.49	2	BOT SLAB	0.1	2.02	1	TOP SLAB	8	
		TNAGRIT4	43.000		1.83	78.69	1.40	2.31	2	BOT SLAB	0.1	1.83	2	BOT SLAB	0.1	
TNAGT5A	45.000		1.73	77.85	1.40	2.30	1	BOT SLAB	8	1.73	2	BOT SLAB	0.1			
TNAGT5B	45.000		3	1.27	57.15	1.40	1.86	2	BOT SLAB	0.1	1.27	2	BOT SLAB	0.1		

### 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	--

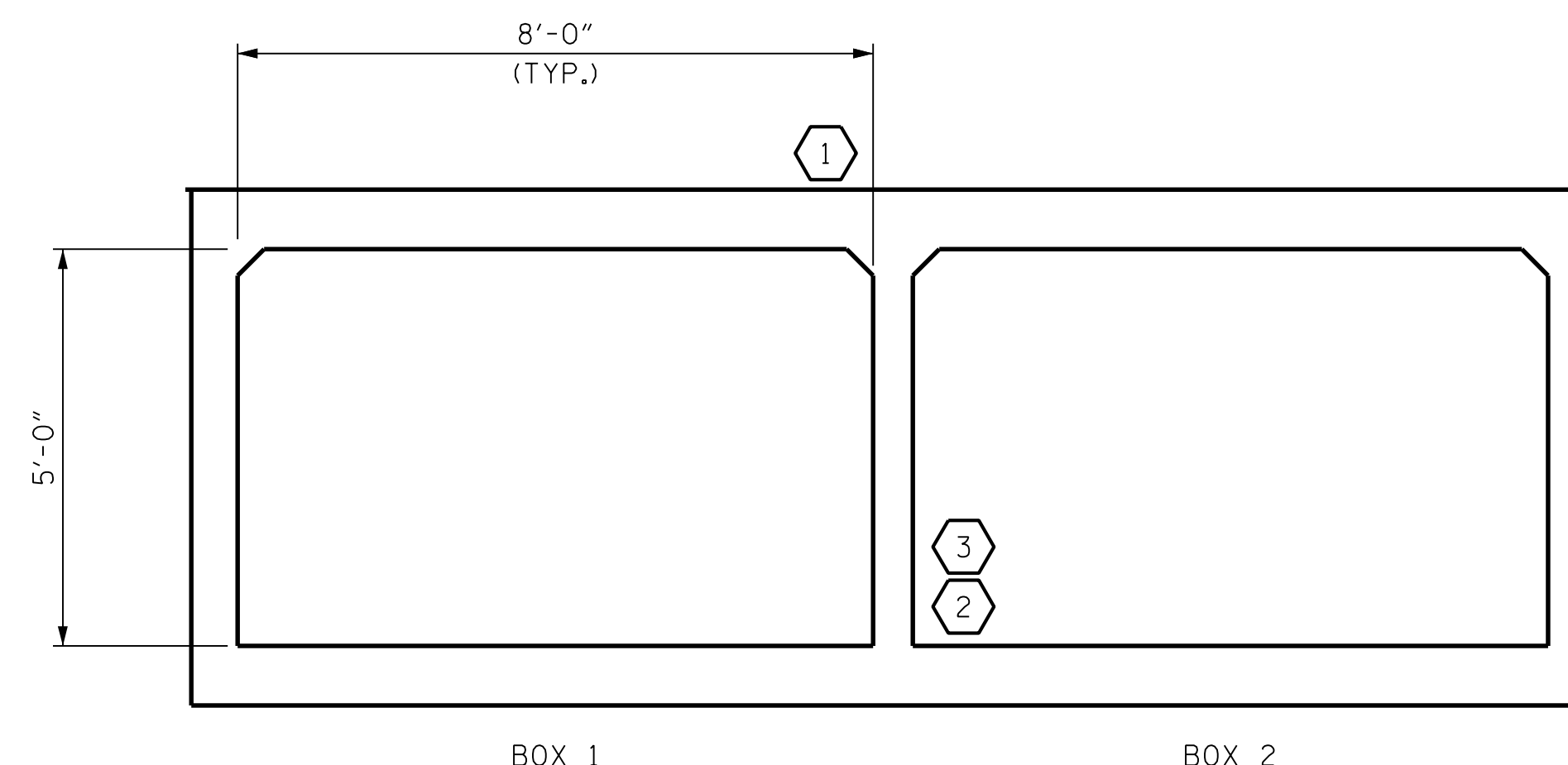
### NOTE:

RATING FACTORS ARE BASED ON THE STRENGTH I LIMIT STATE.

### COMMENTS:

CULVERT RATING AT 17+30.70 -Y2-

#	CONTROLLING LOAD RATING
1	DESIGN LOAD RATING (HL-93)
2	DESIGN LOAD RATING (HS-20)
3	LEGAL LOAD RATING **
** SEE CHART FOR VEHICLE TYPE	

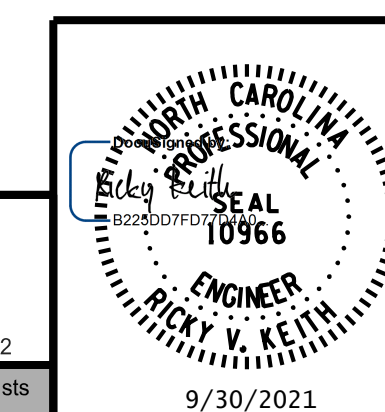


**LRFR SUMMARY**  
(LOOKING DOWNSTREAM)

PROJECT NO. I-5972  
JOHNSTON COUNTY  
STATION: 17+30.70 -Y2-

SHEET 2 OF 6

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

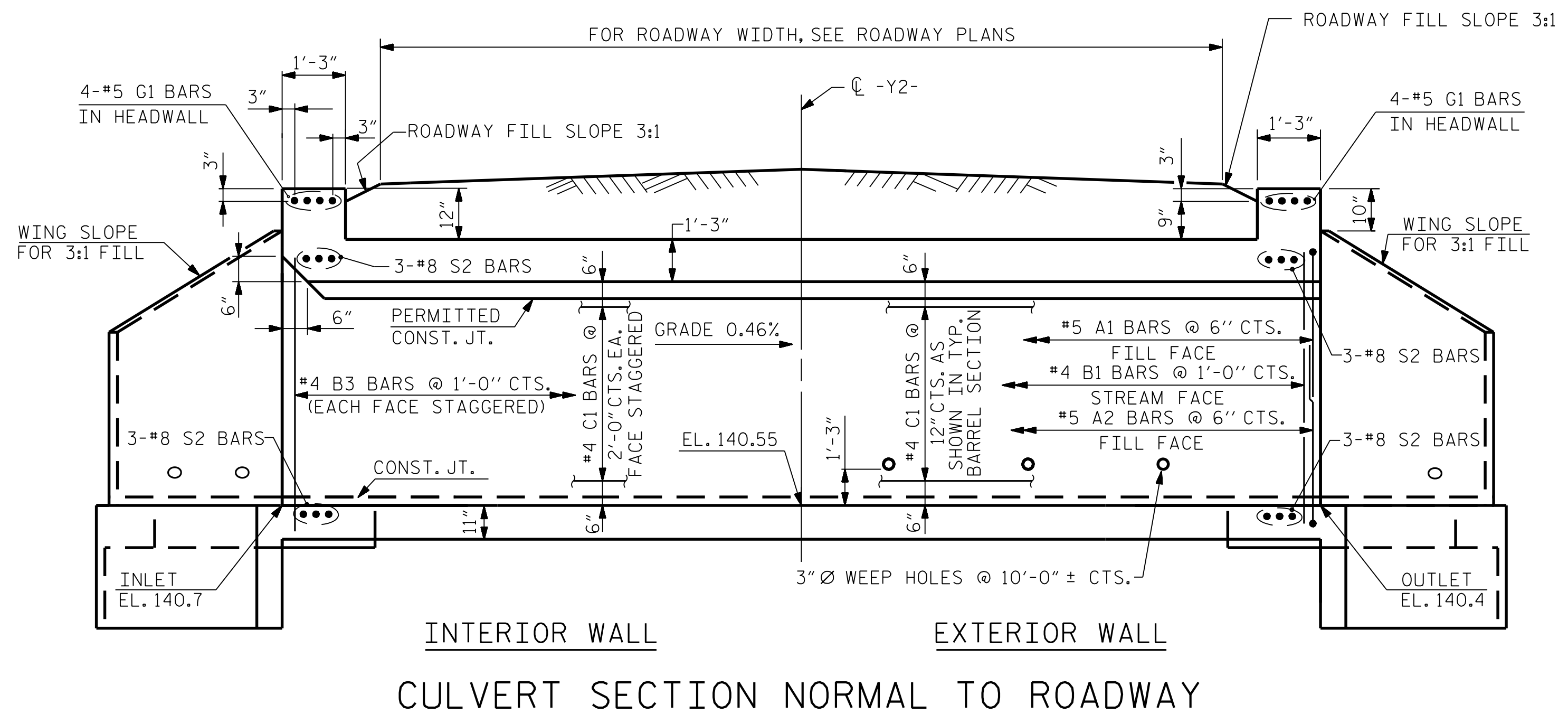


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1			3			TOTAL SHEETS
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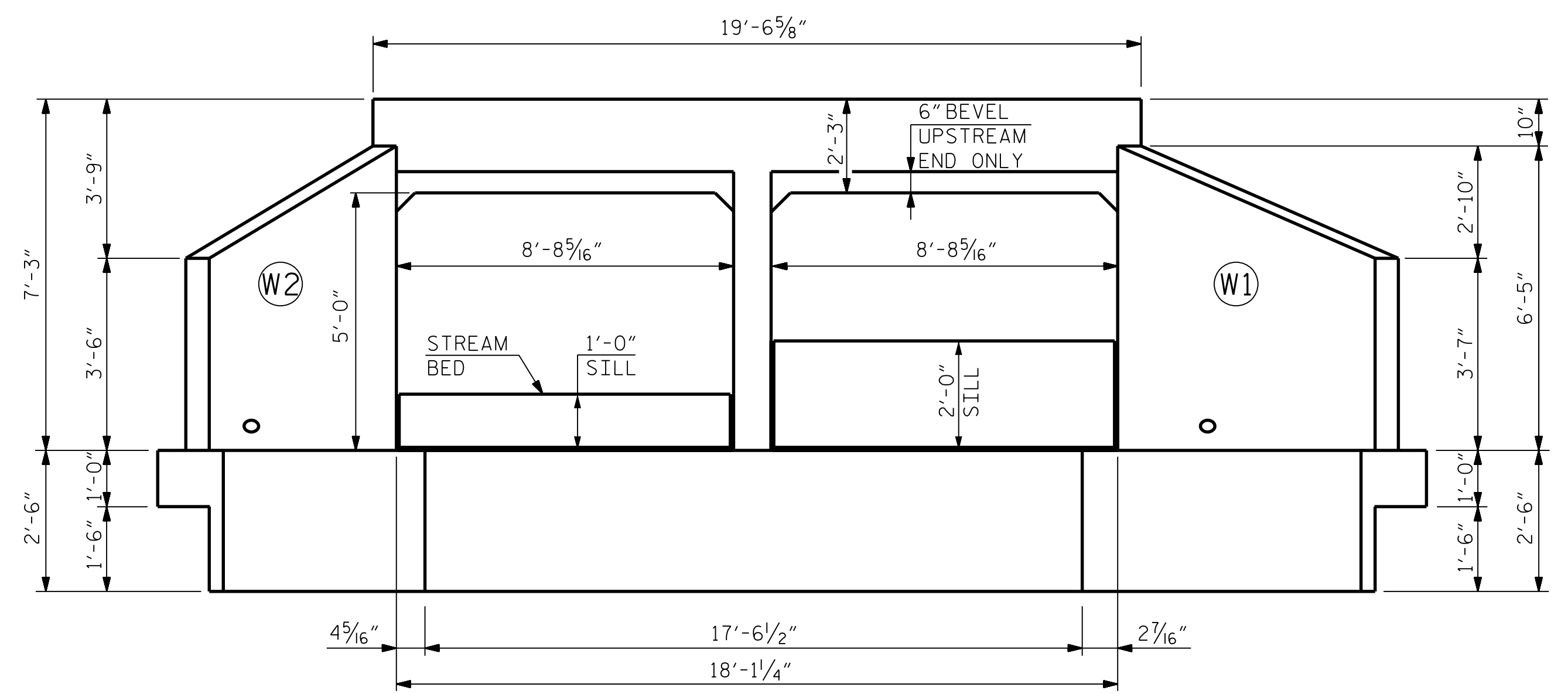
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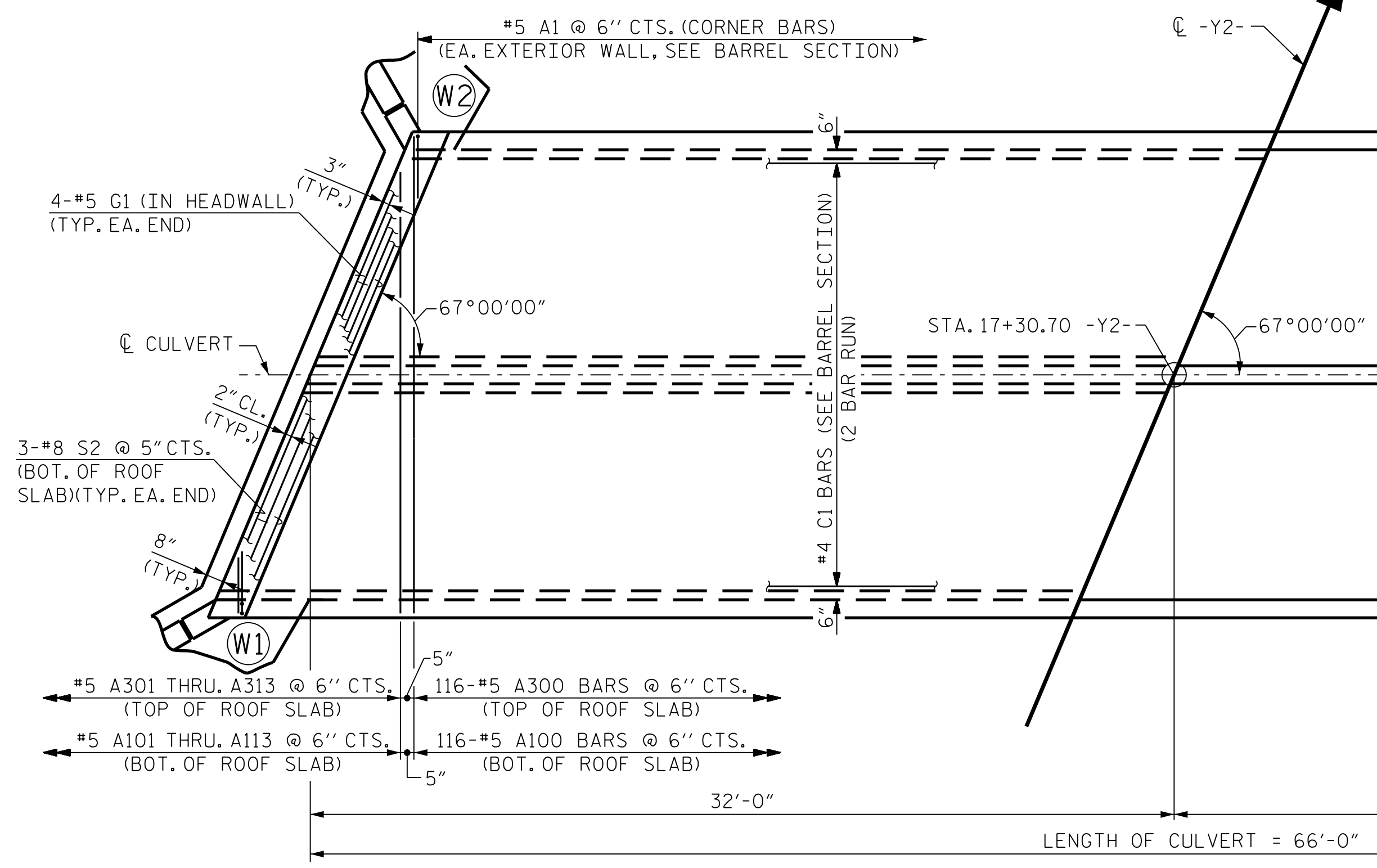
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DESIGN ENGINEER OF RECORD : R. V. KEITH DATE : JUL. 2021



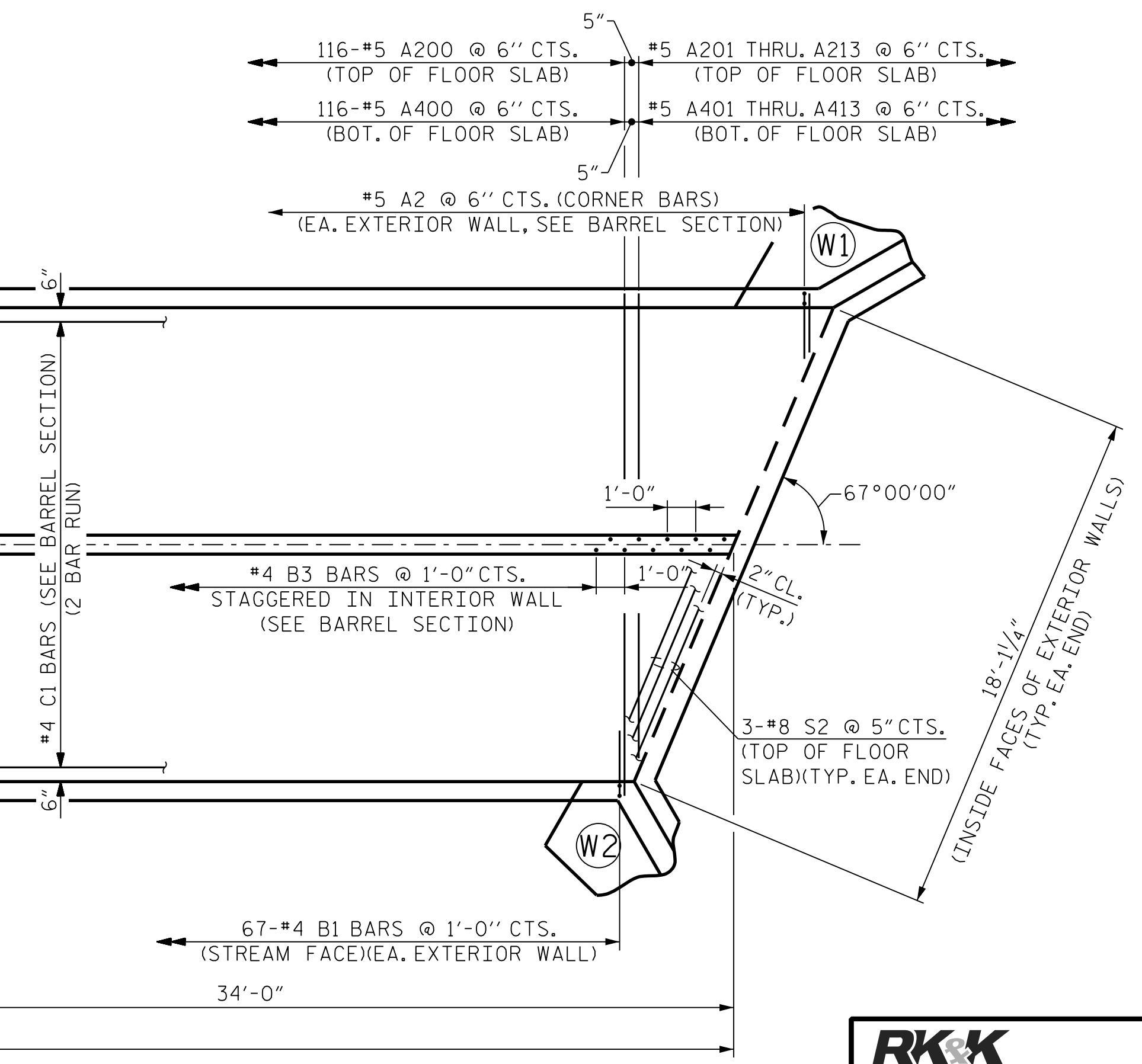
INTERIOR WALL EXTERIOR WALL  
CULVERT SECTION NORMAL TO ROADWAY



END ELEVATION NORMAL TO SKEW  
(LOOKING DOWNSTREAM)  
(INLET)



PART PLAN - ROOF SLAB



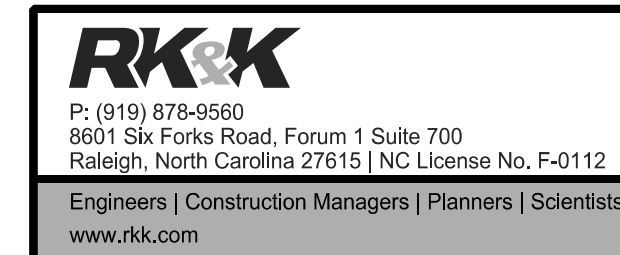
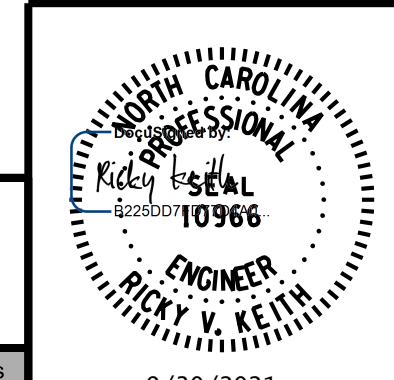
PART PLAN - FLOOR SLAB

PROJECT NO. I-5972  
JOHNSTON COUNTY  
STATION: 17+30.70 -Y2-

SHEET 3 OF 6

STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION  
RALEIGH

DOUBLE 8 FT. X 5 FT.  
CONCRETE BOX CULVERT  
DETAILS



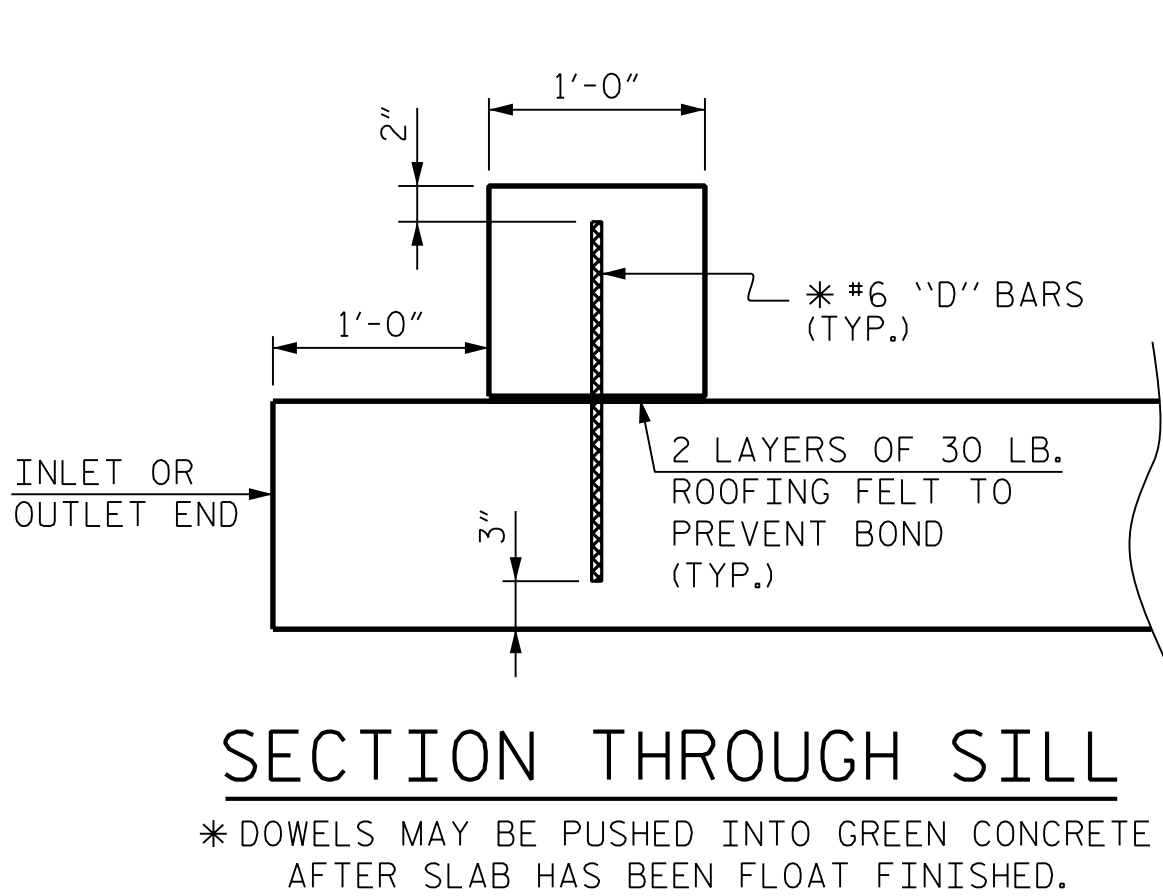
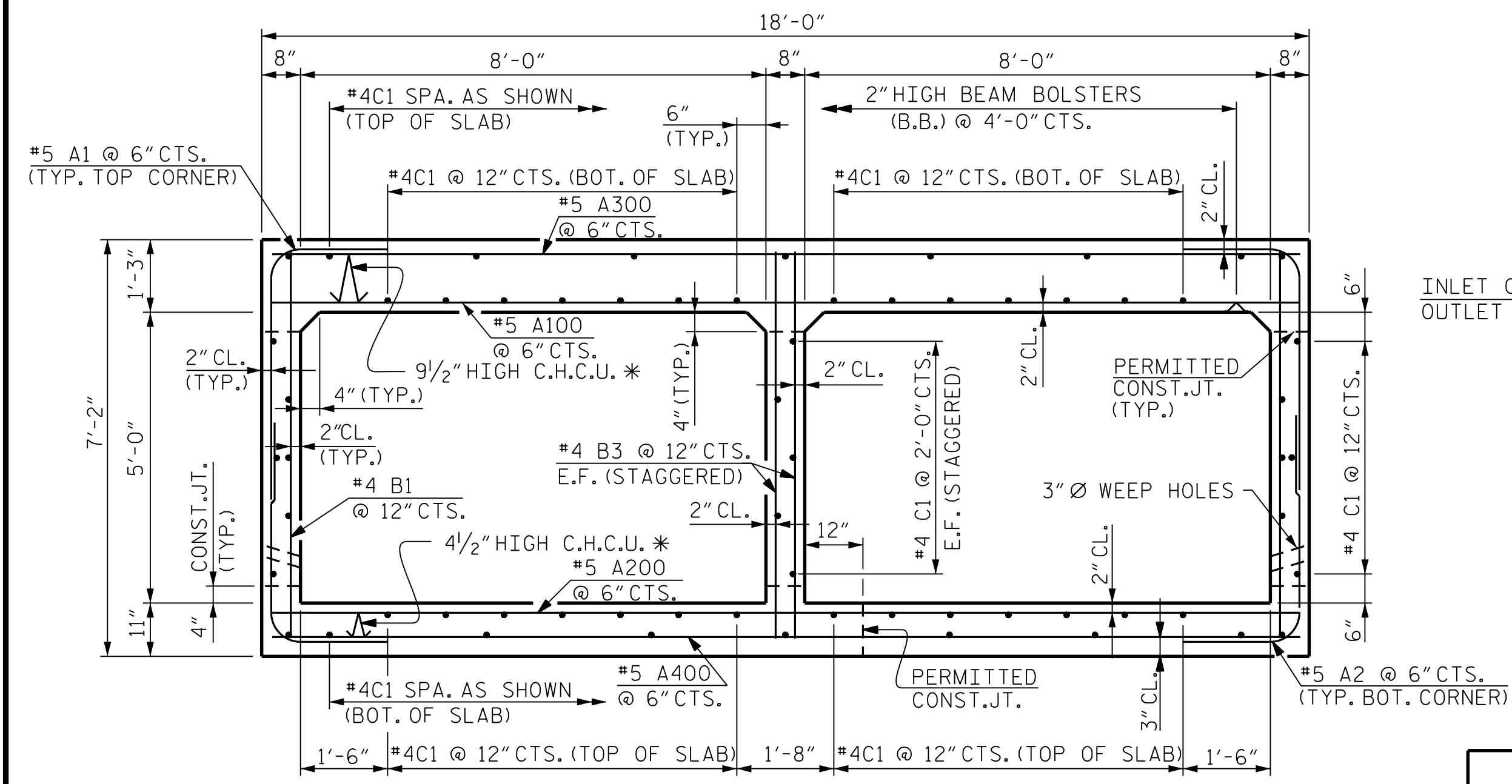
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CULVERT  
TOTAL SHEETS  
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DRAWN BY : J. BOXLEY DATE : JUL. 2021  
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DESIGN ENGINEER OF RECORD : R. V. KEITH DATE : JUL. 2021



BAR TYPE		
A1	A2	(Diagram showing vertical leg dimensions: 4'-3", 3'-10", 6" RAD., 2'-4 1/2", 9/2", 2'-4 1/2")
SPLICE LENGTHS		
BAR	SIZE	SPLICE LENGTHS
A1, A2	#5	2'-4"
C1	#4	2'-5"

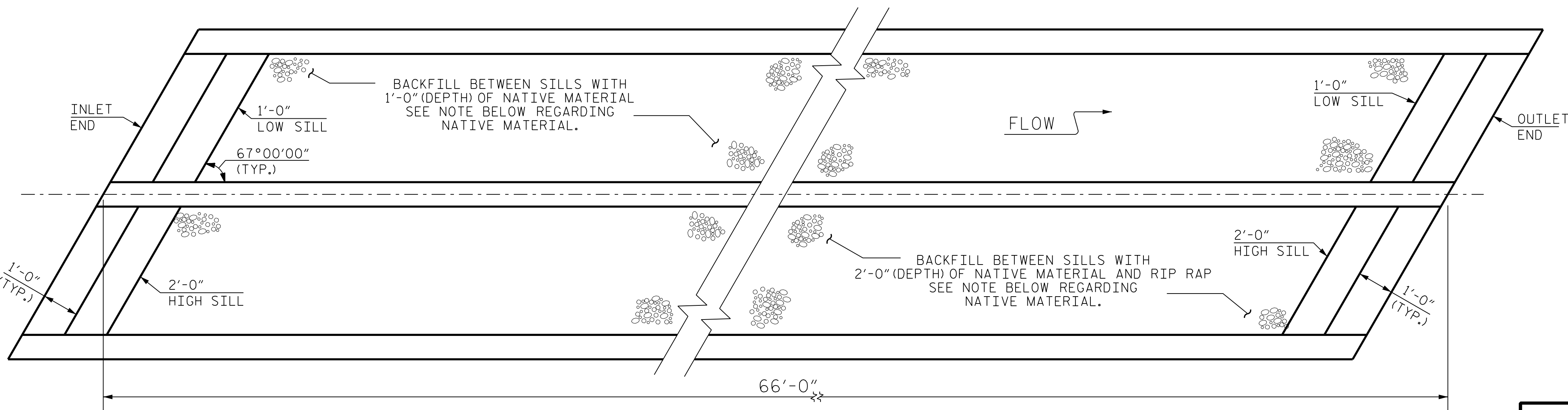
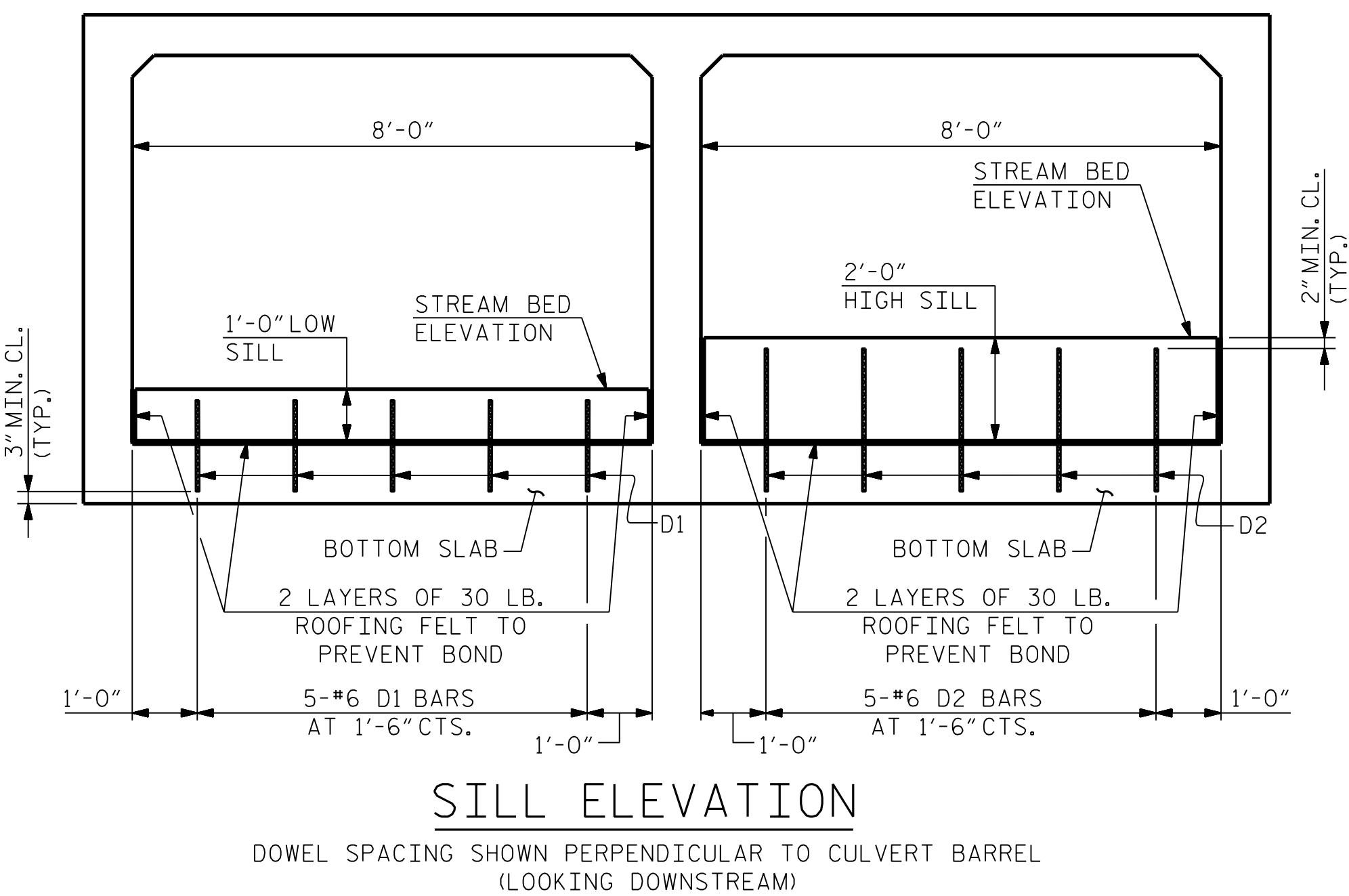
BILL OF MATERIAL					BILL OF MATERIAL						
BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT	BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
A1	258	#5	1	7'-5"	1,996	A300	116	#5	STR.	17'-8"	2,137
A2	258	#5	1	7'-0"	1,884	A301	2	#5	STR.	17'-4"	36
						A302	2	#5	STR.	16'-2"	34
A100	116	#5	STR.	17'-8"	2,137	A303	2	#5	STR.	15'-0"	31
A101	2	#5	STR.	17'-4"	36	A304	2	#5	STR.	13'-10"	29
A102	2	#5	STR.	16'-2"	34	A305	2	#5	STR.	12'-7"	26
A103	2	#5	STR.	15'-0"	31	A306	2	#5	STR.	11'-5"	24
A104	2	#5	STR.	13'-10"	29	A307	2	#5	STR.	10'-3"	21
A105	2	#5	STR.	12'-7"	26	A308	2	#5	STR.	9'-1"	19
A106	2	#5	STR.	11'-5"	24	A309	2	#5	STR.	7'-10"	16
A107	2	#5	STR.	10'-3"	21	A310	2	#5	STR.	6'-8"	14
A108	2	#5	STR.	9'-1"	19	A311	2	#5	STR.	5'-6"	11
A109	2	#5	STR.	7'-10"	16	A312	2	#5	STR.	4'-4"	9
A110	2	#5	STR.	6'-8"	14	A313	2	#5	STR.	3'-2"	7
A111	2	#5	STR.	5'-6"	11						
A112	2	#5	STR.	4'-4"	9	A400	116	#5	STR.	17'-8"	2,137
A113	2	#5	STR.	3'-2"	7	A401	2	#5	STR.	17'-4"	36
A200	116	#5	STR.	17'-8"	2,137	A402	2	#5	STR.	16'-2"	34
A201	2	#5	STR.	17'-4"	36	A403	2	#5	STR.	15'-0"	31
A202	2	#5	STR.	16'-2"	34	A404	2	#5	STR.	13'-10"	29
A203	2	#5	STR.	15'-0"	31	A405	2	#5	STR.	12'-7"	26
A204	2	#5	STR.	13'-10"	29	A406	2	#5	STR.	11'-5"	24
A205	2	#5	STR.	12'-7"	26	A407	2	#5	STR.	10'-3"	21
A206	2	#5	STR.	11'-5"	24	A408	2	#5	STR.	9'-1"	19
A207	2	#5	STR.	10'-3"	21	A409	2	#5	STR.	7'-10"	16
A208	2	#5	STR.	9'-1"	19	A410	2	#5	STR.	6'-8"	14
A209	2	#5	STR.	7'-10"	16	A411	2	#5	STR.	5'-6"	11
A210	2	#5	STR.	6'-8"	14	A412	2	#5	STR.	4'-4"	9
A211	2	#5	STR.	5'-6"	11	A413	2	#5	STR.	3'-2"	7
A212	2	#5	STR.	4'-4"	9	B1	134	#4	STR.	6'-9"	604
A213	2	#5	STR.	3'-2"	7	B3	134	#4	STR.	6'-9"	604
						C1	126	#4	STR.	34'-1"	2,869
						D1	10	#6	STR.	1'-6"	23
						D2	10	#6	STR.	2'-6"	38
						G1	8	#5	STR.	19'-2"	160
						S2	12	#8	STR.	19'-2"	614
REINFORCING STEEL										18,387	LBS.

### RIGHT ANGLE SECTION OF BARREL

THERE ARE 63 "C" BARS IN SECTION OF BARREL.  
 \* ALL CONTINUOUS HIGH CHAIR UPPER (C.H.C.U.) @ 3'-0"

#### NOTE:

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

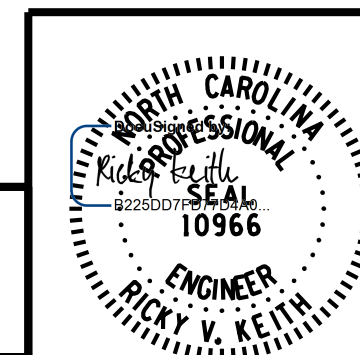


PROJECT NO. I-5972  
JOHNSTON COUNTY  
 STATION: 17+30.70 -Y2-

SHEET 4 OF 6

STATE OF NORTH CAROLINA  
 DEPARTMENT OF TRANSPORTATION  
 RALEIGH

DOUBLE 8 FT. X 5 FT.  
 CONCRETE BOX CULVERT  
 67°00'00"



**RK&K**  
 P: (919) 878-9560  
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#### REVISIONS

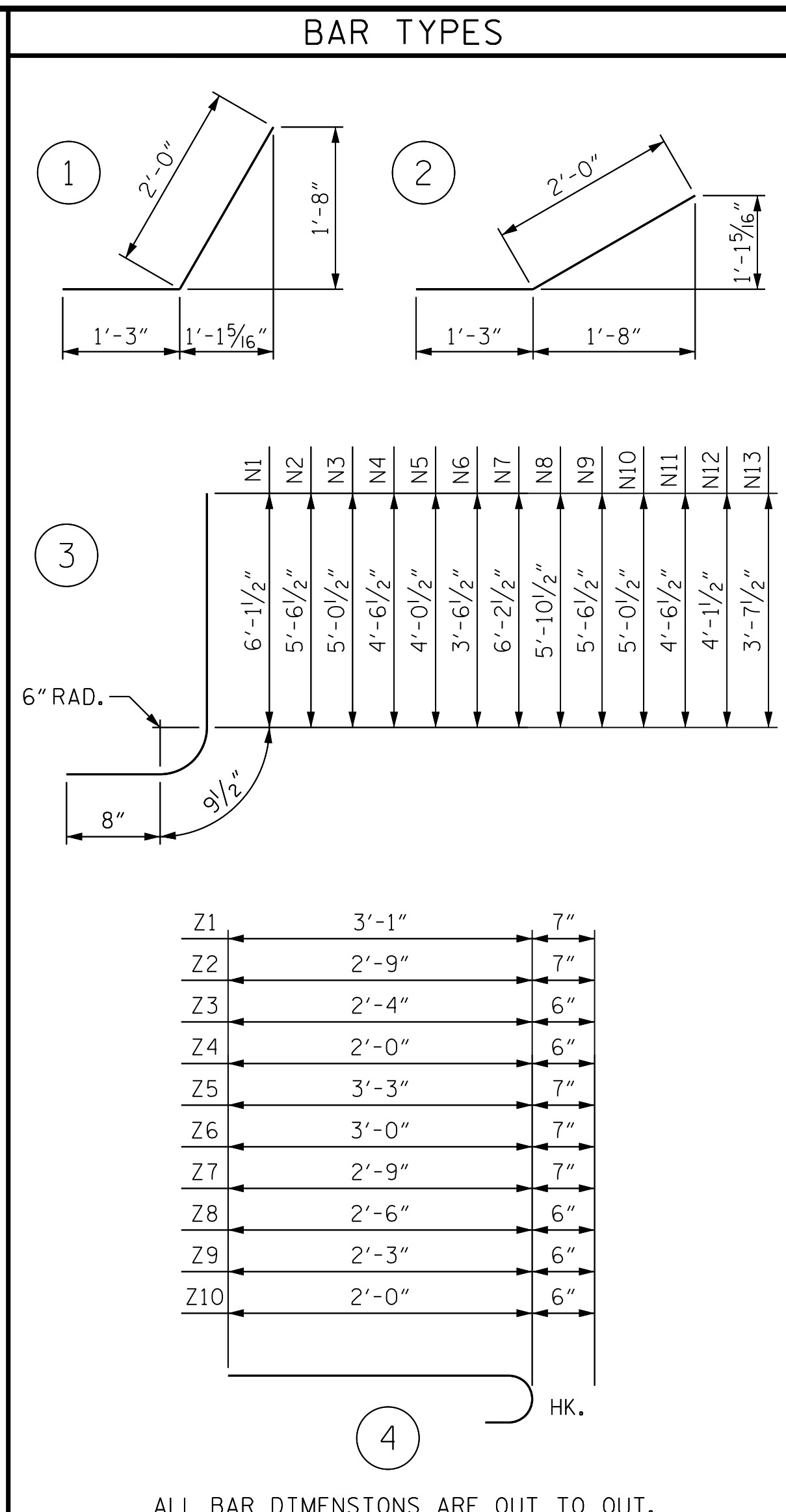
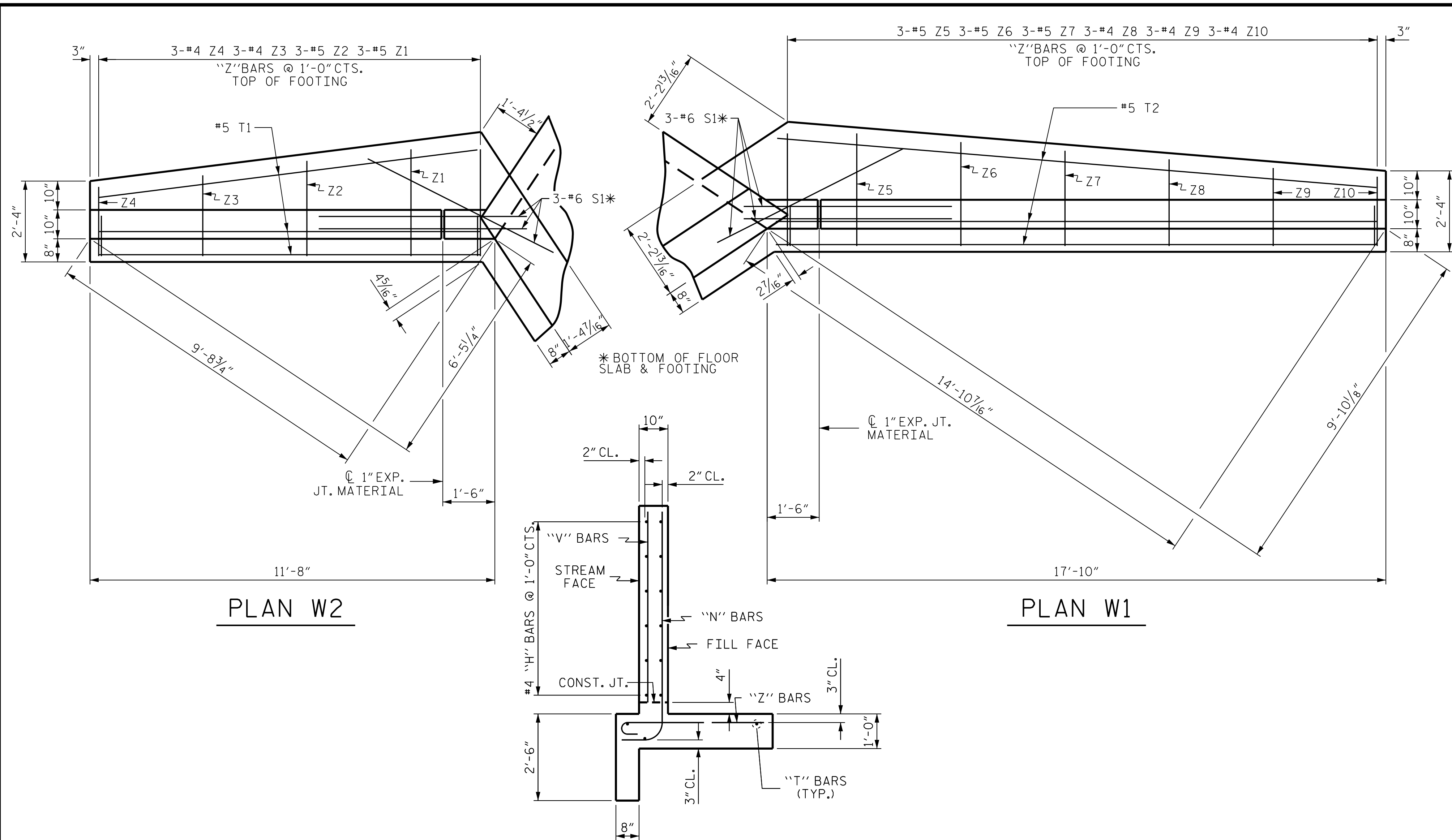
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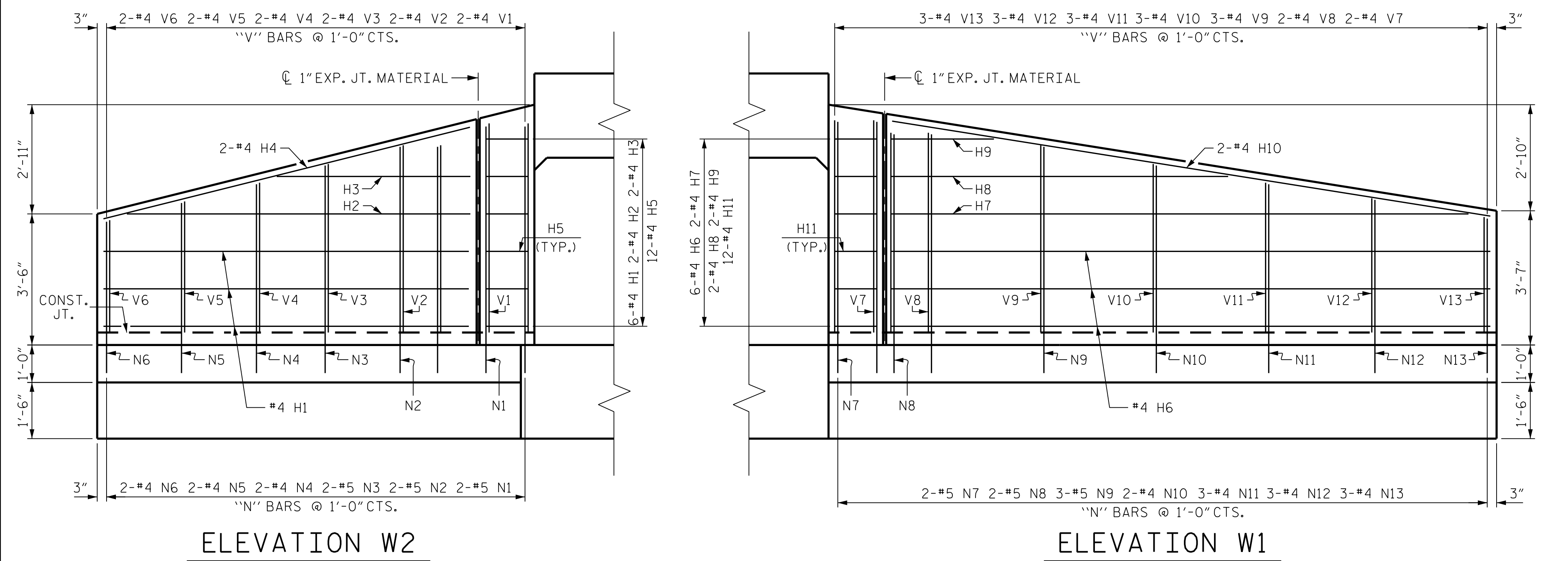
DRAWN BY: J. BOXTLEY DATE: JUL. 2021  
 CHECKED BY: A. L. STROUD DATE: JUL. 2021  
 DESIGN ENGINEER OF RECORD: R. V. KEITH DATE: JUL. 2021

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BILL OF MATERIAL					
BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
H1	12	#4	STR.	9'-9"	78
H2	4	#4	STR.	9'-2"	24
H3	4	#4	STR.	5'-2"	14
H4	4	#4	STR.	10'-1"	27
H5	24	#4	1	3'-3"	52
H6	12	#4	STR.	16'-0"	128
H7	4	#4	STR.	15'-5"	41
H8	4	#4	STR.	9'-0"	24
H9	4	#4	STR.	2'-9"	7
H10	4	#4	STR.	16'-2"	43
H11	24	#4	2	3'-3"	52
N1	4	#5	3	7'-7"	32
N2	4	#5	3	7'-0"	29
N3	4	#5	3	6'-6"	27
N4	4	#4	3	6'-0"	16
N5	4	#4	3	5'-6"	15
N6	4	#4	3	5'-0"	13
N7	4	#5	3	7'-8"	32
N8	4	#5	3	7'-4"	31
N9	6	#5	3	7'-0"	44
N10	6	#4	3	6'-6"	26
N11	6	#4	3	6'-0"	24
N12	6	#4	3	5'-7"	22
N13	6	#4	3	5'-1"	20
S1	12	#6	STR.	6'-0"	108
T1	6	#5	STR.	11'-0"	69
T2	6	#5	STR.	17'-4"	108
V1	4	#4	STR.	5'-7"	15
V2	4	#4	STR.	5'-0"	13
V3	4	#4	STR.	4'-6"	12
V4	4	#4	STR.	4'-0"	11
V5	4	#4	STR.	3'-6"	9
V6	4	#4	STR.	3'-0"	8
V7	4	#4	STR.	5'-8"	15
V8	4	#4	STR.	5'-4"	14
V9	6	#4	STR.	5'-0"	20
V10	6	#4	STR.	4'-6"	18
V11	6	#4	STR.	4'-0"	16
V12	6	#4	STR.	3'-7"	14
V13	6	#4	STR.	3'-1"	12
Z1	6	#5	4	3'-8"	23
Z2	6	#5	4	3'-4"	21
Z3	6	#4	4	2'-10"	11
Z4	6	#4	4	2'-6"	10
Z5	6	#5	4	3'-10"	24
Z6	6	#5	4	3'-7"	22
Z7	6	#5	4	3'-4"	21
Z8	6	#4	4	3'-0"	12
Z9	6	#4	4	2'-9"	11
Z10	6	#4	4	2'-6"	10

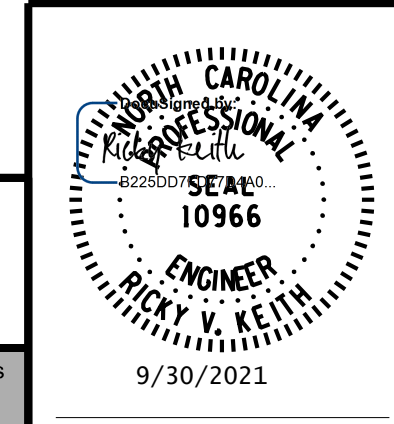
REINFORCING STEEL FOR 4 WINGS	1,448 LBS
CLASS A CONCRETE	
4 WINGS	18.4 CY
2 HEADWALLS	2.0 CY
2 END CURTAIN WALLS	2.2 CY
TOTAL	22.6 CY



PROJECT NO. I-5972  
 JOHNSTON COUNTY  
 STATION: 17+30.70 -Y2-

SHEET 5 OF 6

STATE OF NORTH CAROLINA  
 DEPARTMENT OF TRANSPORTATION  
 RALEIGH  
 WINGS FOR CONCRETE BOX CULVERT  
 H = 5'-0" SLOPE = 3:1  
 67° SKEW



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

DOCUMENT NOT CONSIDERED FINAL  
 UNLESS ALL SIGNATURES COMPLETED

9/30/2021 R:\Structures\Drawings\Final\I5972\_SMU\_CU.1-5\_500410.dgn  
 bhooq

DRAWN BY : J. BOXLEY DATE : JUL. 2021  
 CHECKED BY : A. L. STROUD DATE : JUL. 2021  
 DESIGN ENGINEER OF RECORD : R. V. KEITH DATE : JUL. 2021