



Long Island Rail Road
East Side Access



CONTRACT DOCUMENT

DRAWINGS

Contract CM009 (Re-Bid)
Manhattan Tunnels Excavation
Supplemental Tunnel Lining & Intersecting Structures


BOOK 4A of 5
May 2006

CONFORMED, Addenda 1-10 Incorporated




Metropolitan Transportation Authority
Capital Construction
State of New York

SHEET No.	DWG No.	REVISION No.	DESCRIPTION	SHEET No.	DWG No.	REVISION No.	DESCRIPTION
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22	CM009-ST-1206		REINFORCEMENT DETAILS - GCT 5 WYE CAVERN END WALLS				
23	CM009-ST-1208		REINFORCEMENT DETAILS - CROSS PASSAGES				
24	CM009-ST-1209		REINFORCEMENT DETAILS - SUMP PUMP CHAMBER				
25	CM009-ST-1210		REINFORCEMENT DETAILS - CROSS FLUE - SHEET 1				
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5/26/06

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M. CAPONE

CHECKED BY:
M. DELLA POSTA

COORDINATED BY:
M. DELLA POSTA

APPROVED BY:
J. SCHABIB

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License No. _____

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SIGNED
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SEALED

DATE: _____

MANHATTAN TUNNELS EXCAVATION

INDEX OF DRAWINGS
SHEET 5

SCALE:
NONE

DRAWING NUMBER:
CM009-IN-0006

DATE:
3-24-06

REVISION NUMBER:
0

CONTRACT No.
CM009

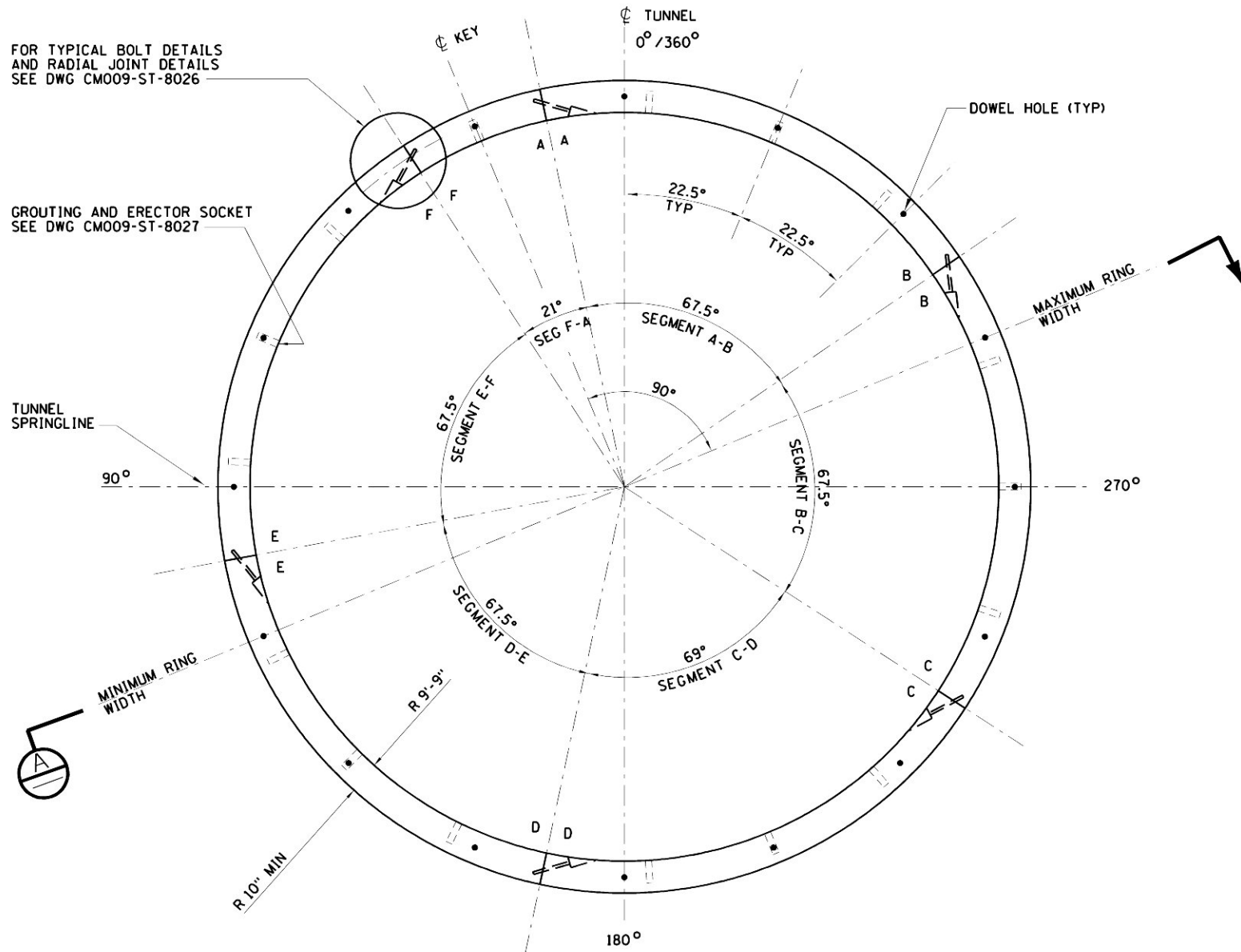
ISSUE

SHEET No.
1 of 28

\$PRNAME\$

\$PLOTDRW\$

\$REF6\$
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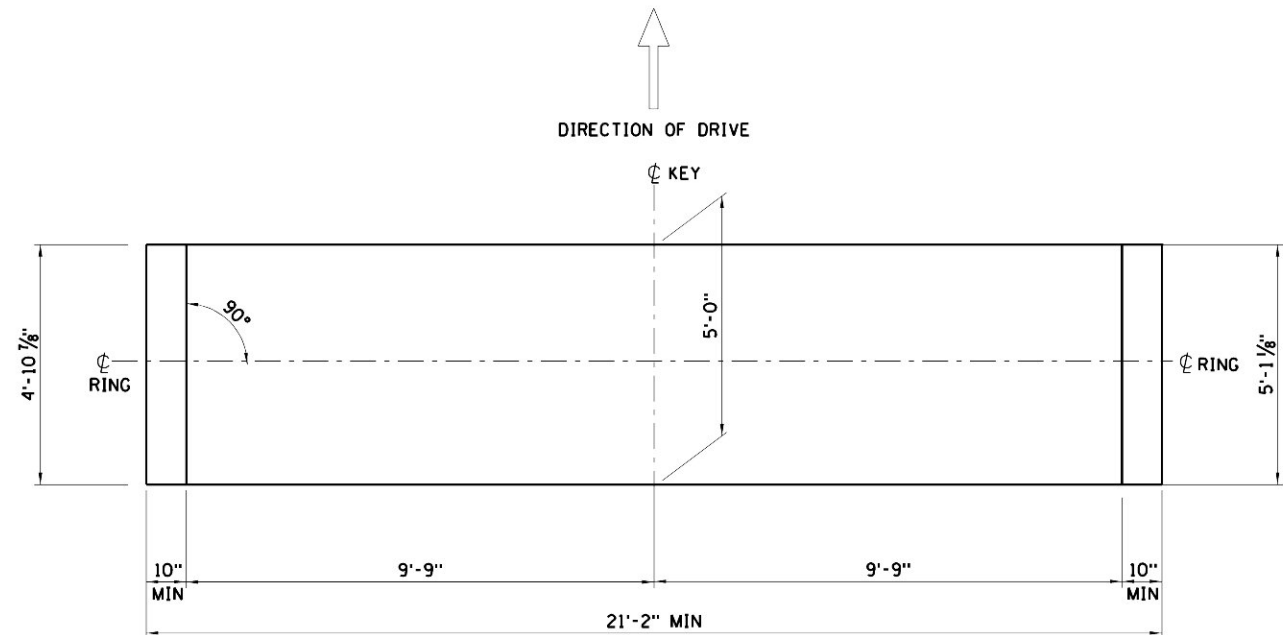


TYPICAL SECTION (IN DIRECTION OF DRIVE)
SUGGESTED RING ARRANGEMENT

THE ARC DIMENSIONS ARE MEASURED AT THE RING CENTERLINE
(GASKETS AND CAULKING GROOVES OMITTED FOR CLARITY)

TBM TUNNEL LINING GENERAL NOTES:

1. CONTRACT DRAWINGS CM009-ST-1001 THROUGH CM009-ST-1003; CM009-ST-1008 THROUGH CM009-ST-1014; CM009-ST-1101 THROUGH CM009-ST-1103 AND CM009-ST-1107 THROUGH CM009-ST-1110 INDICATE THE LIMITS OF THE TBM TUNNELS FINAL LINING INSTALLATION.
2. THE CONTRACTOR SHALL SELECT THE TBM TUNNEL BORE SIZE TO SUIT THE PRECAST CONCRETE LINING INSTALLATION FOR THE TUNNEL SIZE INDICATED ON THE CONTRACT DRAWINGS.
3. DEPENDING UPON THE TYPE OF TBM(S) CHOSEN BY THE CONTRACTOR, THE MACHINES SHALL BE CAPABLE OF INSTALLING PRECAST CONCRETE LINING WHERE INITIAL SUPPORT IS REQUIRED AND HAVE BEEN INSTALLED.
4. PRECAST CONCRETE LINING SHALL HAVE A MINIMUM THICKNESS OF 10 INCHES.
5. CONTRACT DRAWINGS CM009-ST-8022 THROUGH CM009-ST-8025 AND CM009-ST-8033 SHOW A SUGGESTED LAYOUT AND ARRANGEMENT OF THE PRECAST CONCRETE SEGMENTS.
6. THE CONTRACTOR SHALL DESIGN AND DETAIL THE PRECAST CONCRETE LINER SEGMENT REINFORCEMENT BASED ON THE DESIGN LOAD CRITERIA PRESENTED ON DRAWING CM009-ST-8034 AND THE CONTRACTOR'S HANDLING, TRANSPORTATION AND ERECTION LOADS.
7. THE CONTRACTOR SHALL SUBMIT, FOR REVIEW BY THE RESIDENT ENGINEER, PRECAST CONCRETE LINING DRAWINGS AND DESIGN CALCULATIONS, SIGNED AND STAMPED BY A PROFESSIONAL ENGINEER REGISTERED IN THE STATE OF NEW YORK.
8. THE CONTRACTOR SHALL SUBMIT FOR REVIEW BY THE RESIDENT ENGINEER, THE CONTRACTOR'S METHOD FOR PROTECTING THE PREVIOUSLY INSTALLED PRECAST CONCRETE LINING FROM ADJACENT DRILL-AND-BLAST EXCAVATION ACTIVITIES.
9. AT THE LOCATIONS OF STRUCTURAL INTERFACE BETWEEN THE LINED TUNNELS AND THE SUMP PUMP CHAMBER, CROSS FLUE AND CAVERNS, THE PERMANENT LINING SHALL BE REINFORCED CAST-IN-PLACE CONCRETE WITH WATERPROOFING MEMBRANE, AS SHOWN ON THE CONTRACT DRAWINGS.
10. AT THE TUNNEL SECTIONS WHERE THE FINAL LINING IS OMITTED, THE CONTRACTOR SHALL PROVIDE THE NECESSARY TEMPORARY INVERT FILL FOR THE INSTALLATION OF THE CONTRACTOR'S REQUIRED INFRASTRUCTURE FOR MATERIAL DELIVERY, MUCK REMOVAL AND TBM HAULING.
11. THE CONTRACTOR IS RESPONSIBLE FOR DEVELOPING MEANS AND METHODS FOR GROUNDWATER CONTROL DURING TBM EXCAVATION. WHEN MINING IN PRECAST CONCRETE LINING DESIGNATED AREAS AND WHERE THE CONTRACTOR IS HAVING DIFFICULTY CONTROLLING THE GROUNDWATER FLOW IN THE ANNULUS, THE MTA WILL CONSIDER ALLOWING THE CONTRACTOR, AT ITS REQUEST, TO OMIT THE PRECAST CONCRETE LINING AND REPLACE IT WITH CIP CONCRETE LINING.
12. THE CONTRACTOR IS FREE TO CHOOSE THE MEANS AND METHODS FOR INSTALLING THE PRECAST CONCRETE LINING. THE ONLY REQUIREMENT IS THAT NO TUNNEL SECTION CAN BE LEFT UNSUPPORTED DURING TUNNEL BORING.



SECTION



SCALE IN FEET
2' 1' 0' 2' 4'

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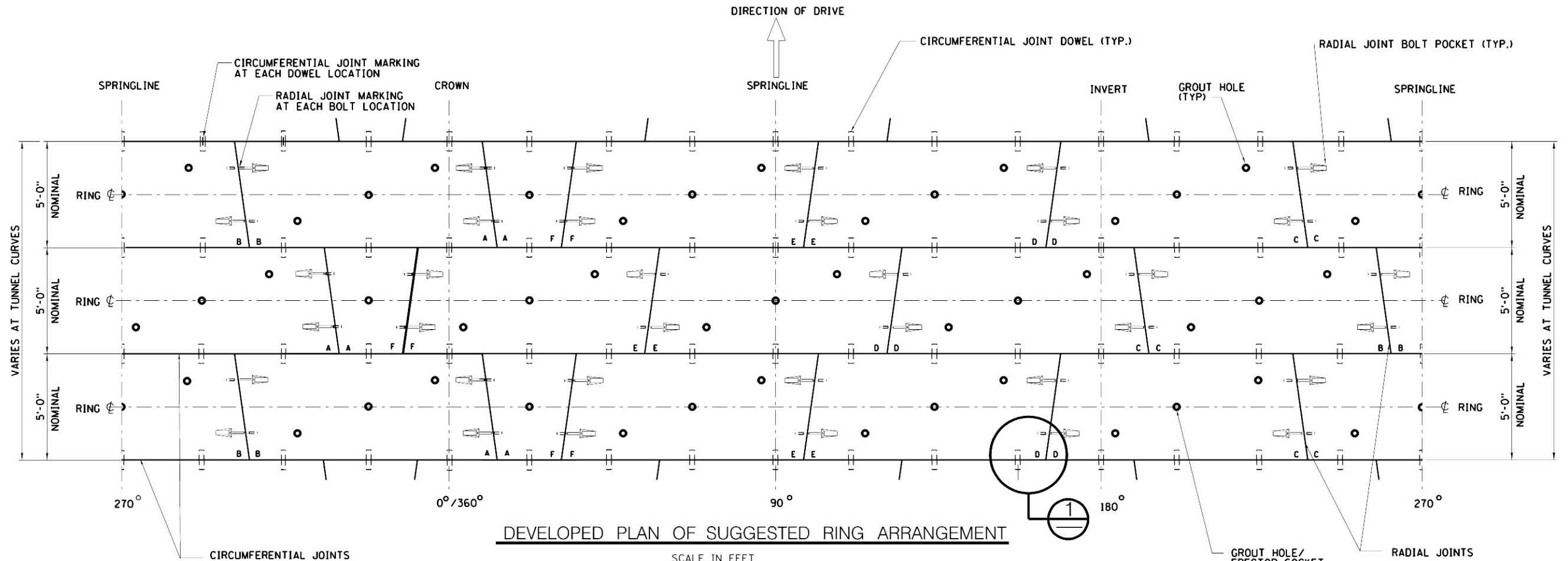
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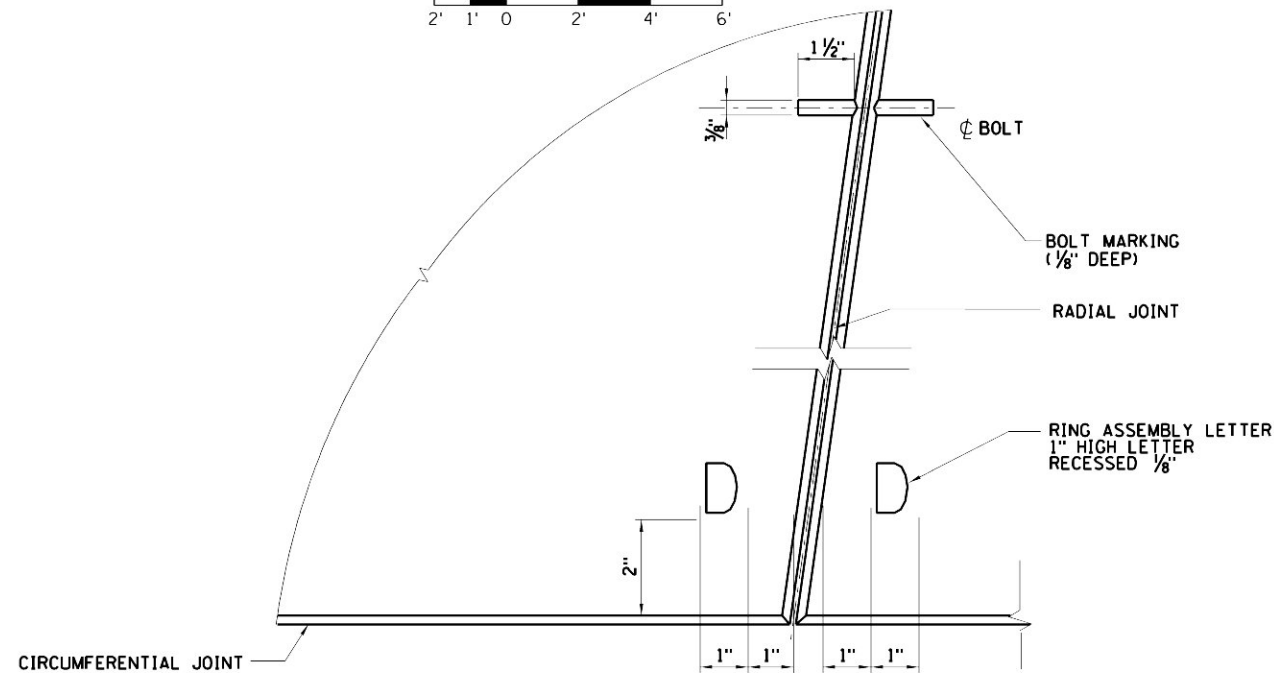
DESIGNED BY: D. SMITH	NY PROFESSIONAL License No.
DRAWN BY: D. SMITH	
CHECKED BY: J. SCHABIB	
COORDINATED BY: M. DELLA POSTA	
APPROVED BY: J. SCHABIB	
DATE: 5/26/06	
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REVISIONS	

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MANHATTAN TUNNELS EXCAVATION		CONTRACT No. CM009
PRECAST CONCRETE TUNNEL LINING GENERAL NOTES AND TYPICAL SECTION		ISSUE
SCALE AS NOTED		SHEET No. 2 OF 28
DRAWING NUMBER CM009-ST-8021		
DATE: 3-24-06		
REVISION NUMBER: 0		



DEVELOPED PLAN OF SUGGESTED RING ARRANGEMENT



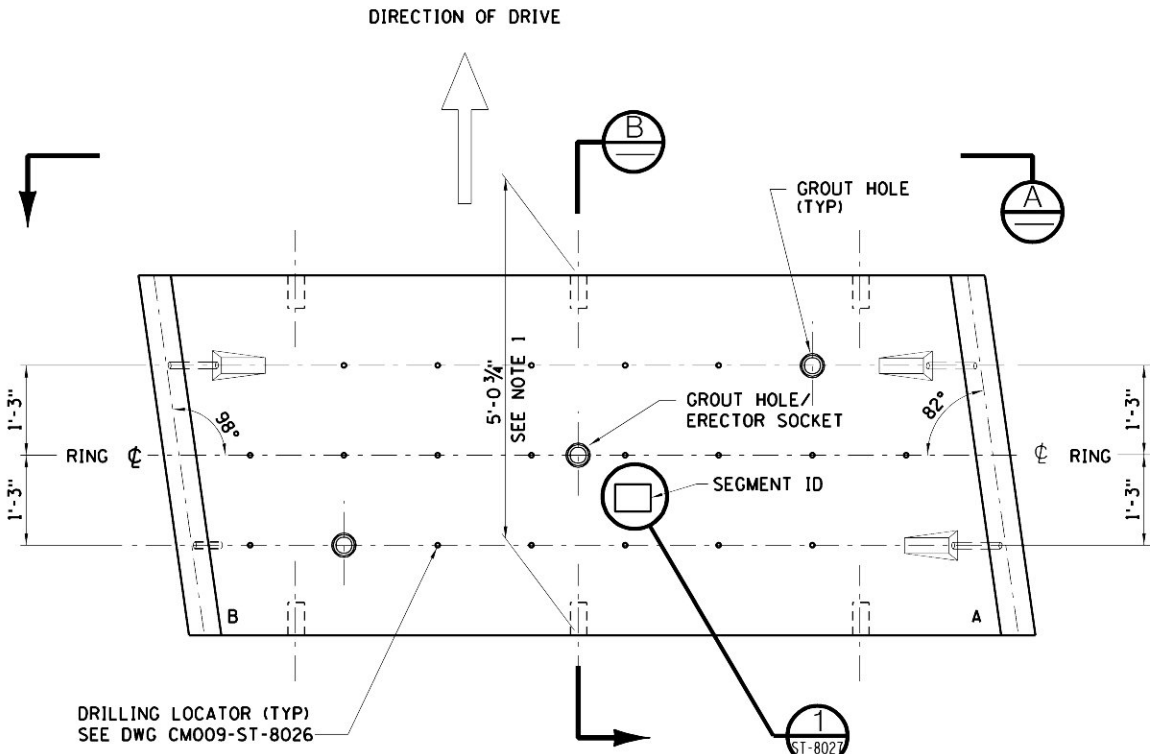
DETAIL
RING ASSEMBLY MARKINGS



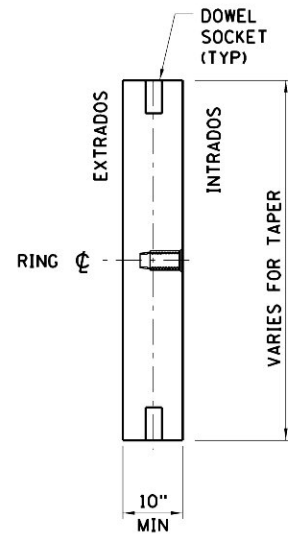
NOTE:
THE DEVELOPED PLAN SHOWN ON THIS
DRAWING PRESENTS A TYPICAL SEGMENT
ARRANGEMENT FOR A COMPLETE LINING RING.
FOR DIFFERENT COMBINATIONS OF RING
ARRANGEMENTS SEE DWG CM009-ST-8033.

\$PRFNAME\$
\$PLOTDIR\$

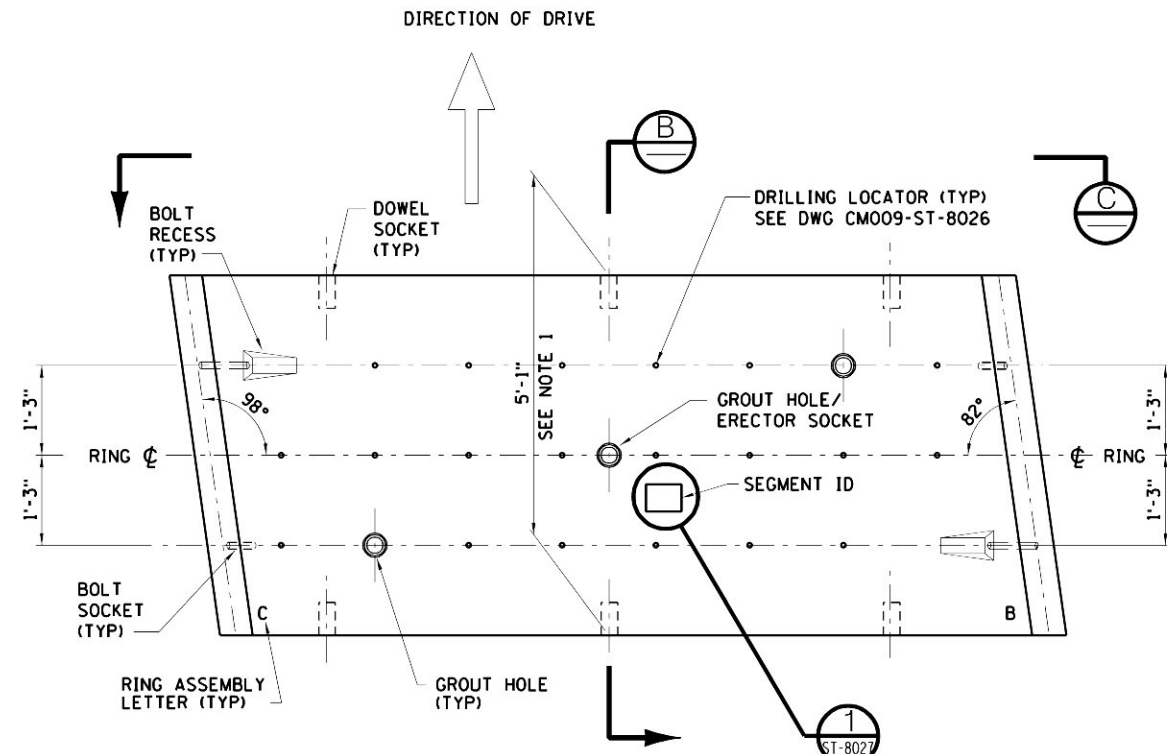
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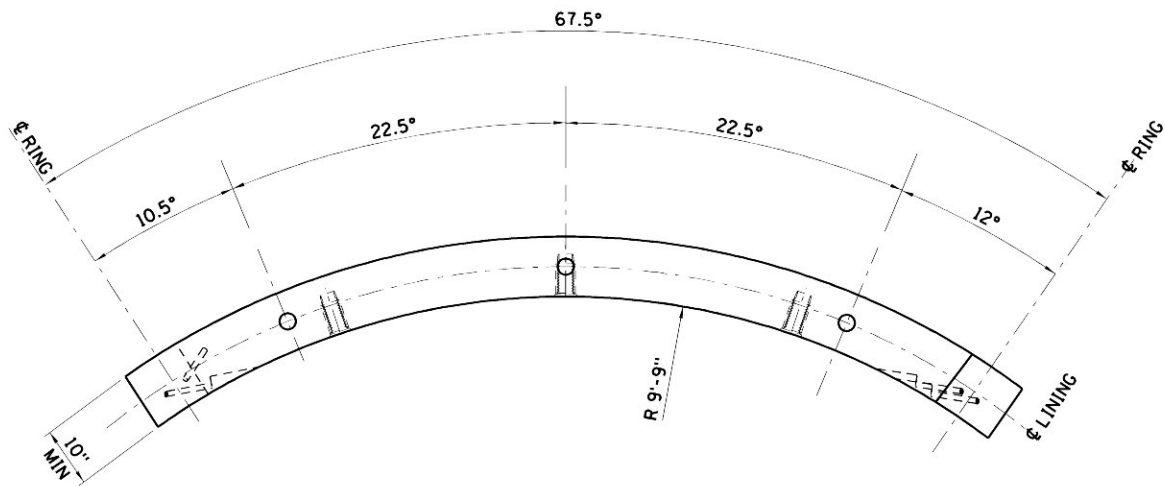
SUGGESTED SEGMENT TYPE A-B



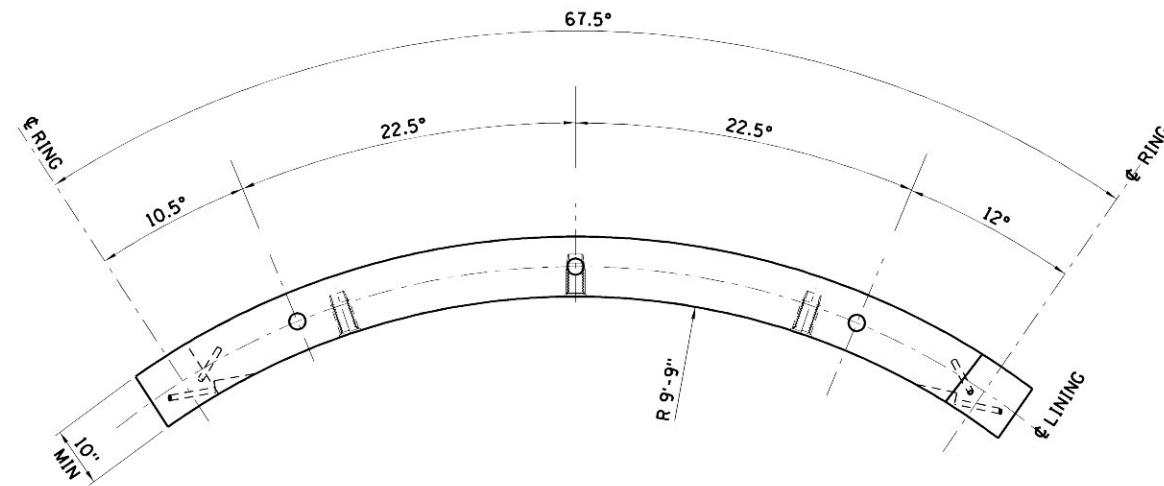
SECTION



SUGGESTED SEGMENT TYPE B-C



SECTION



SECTION

NOTE:
1. SEGMENT WIDTHS SHOWN ARE APPROXIMATE.
PRECISE VALUES SHALL BE CALCULATED
FROM GEOMETRY OF TAPERED RING.



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MANHATTAN TUNNELS EXCAVATION

PRECAST CONCRETE TUNNEL LINING
SEGMENT TYPES A-B AND B-C

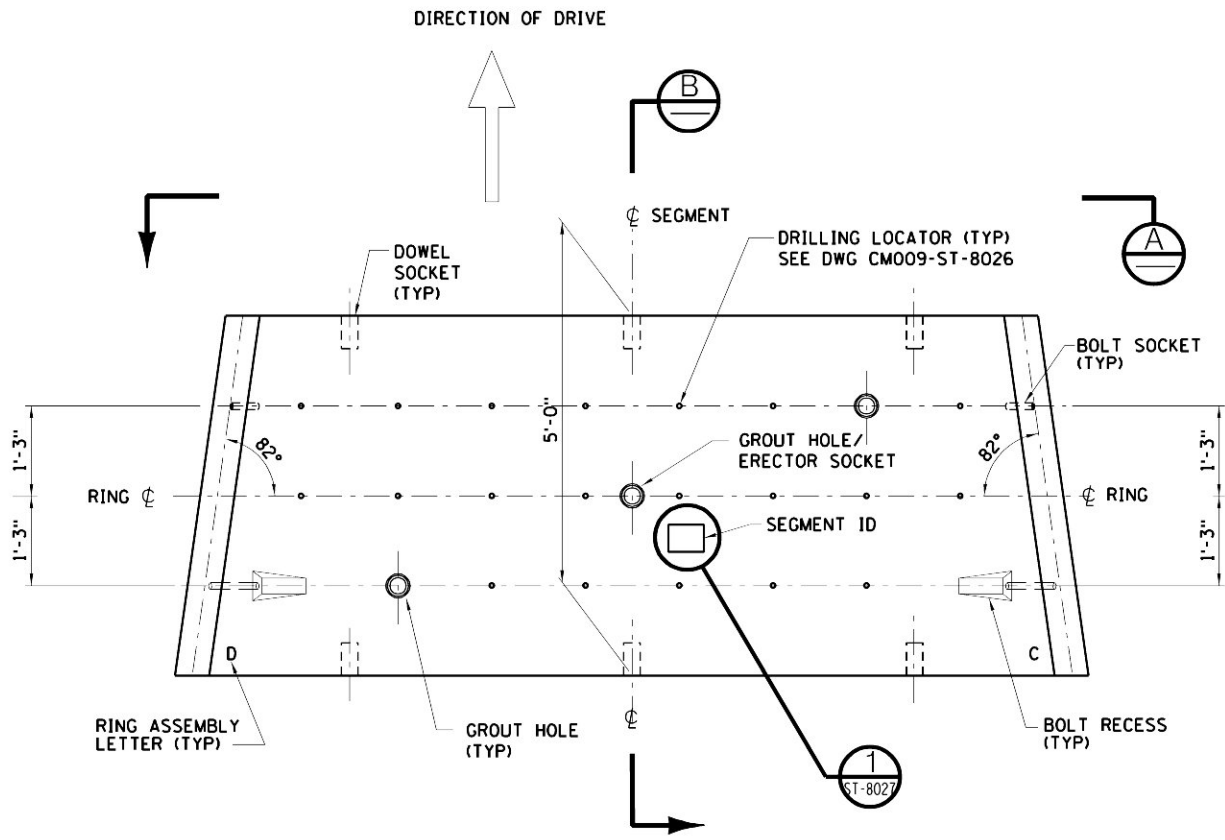
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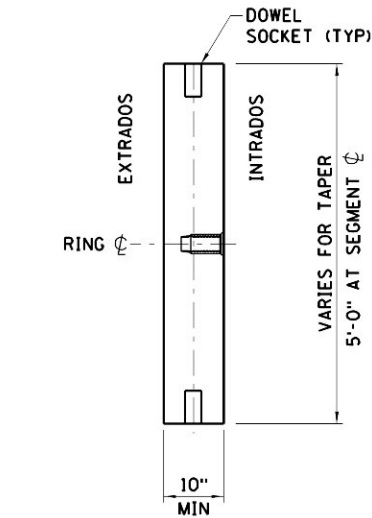
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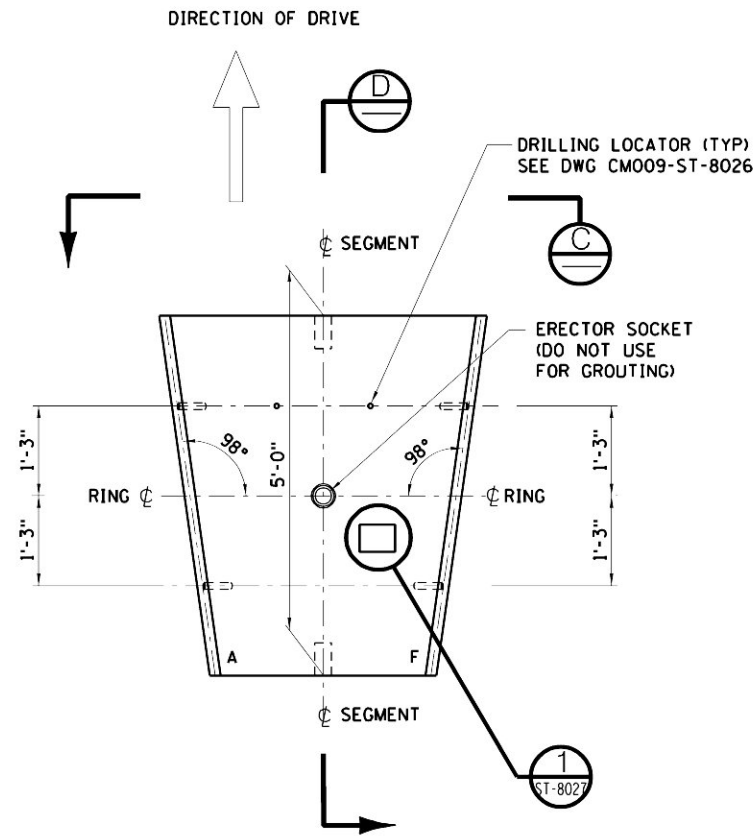
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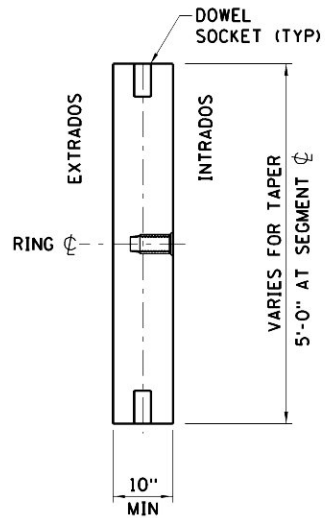
SUGGESTED SEGMENT TYPE C-D



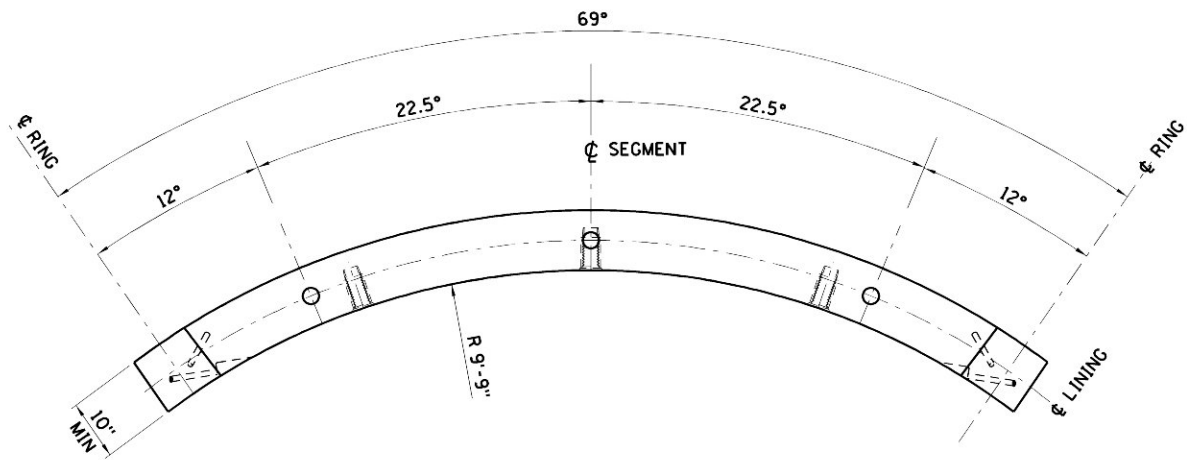
SECTION B



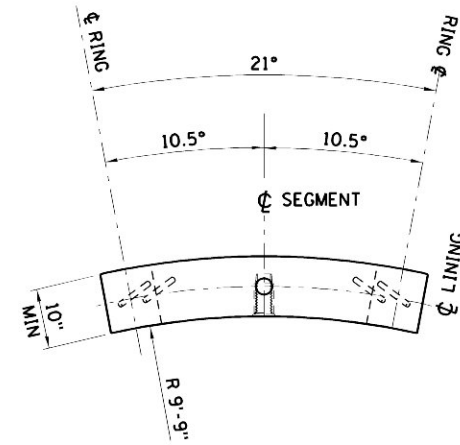
SUGGESTED SEGMENT TYPE F-A



SECTION D



SECTION A



SECTION C

SCALE IN FEET

1' .5' 0' 1' 2' 3'

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MANHATTAN TUNNELS EXCAVATION

PRECAST CONCRETE TUNNEL LINING
SEGMENT TYPES C-D AND F-A

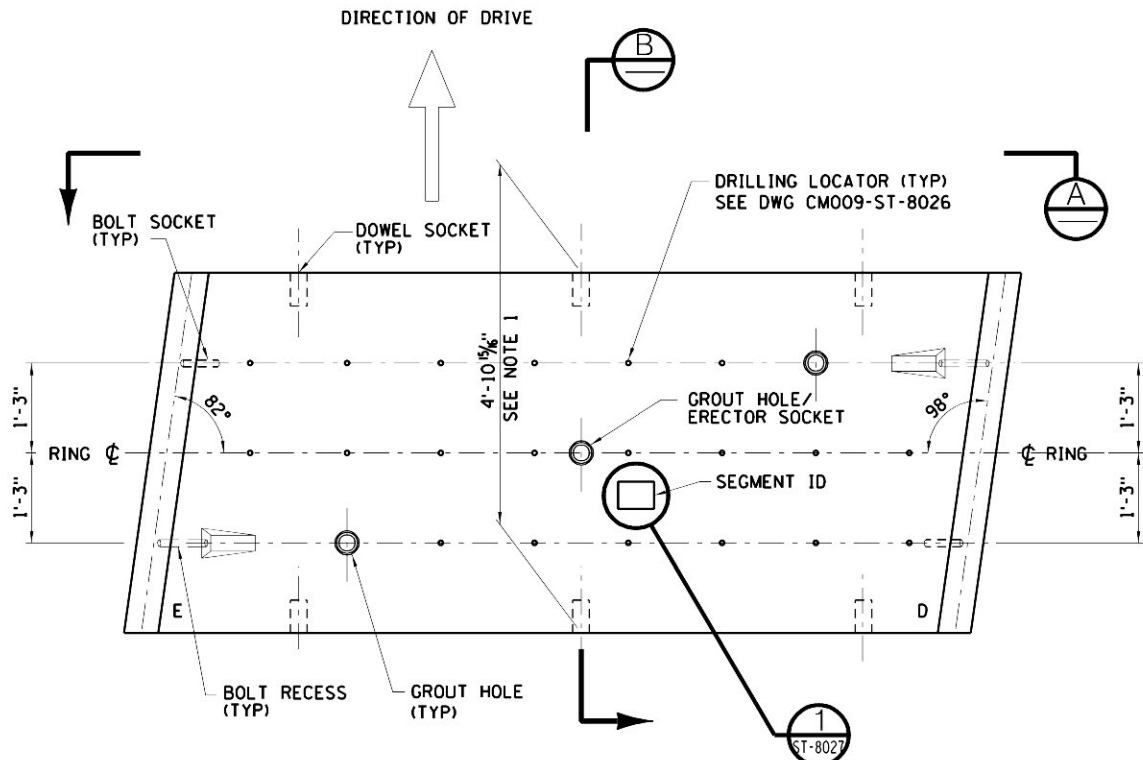
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DRAWING NUMBER
CM009-ST-8024
DATE:
3-24-06
REVISION NUMBER:
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CONTRACT No.
CM009
ISSUE
SHEET No.
5 OF 28

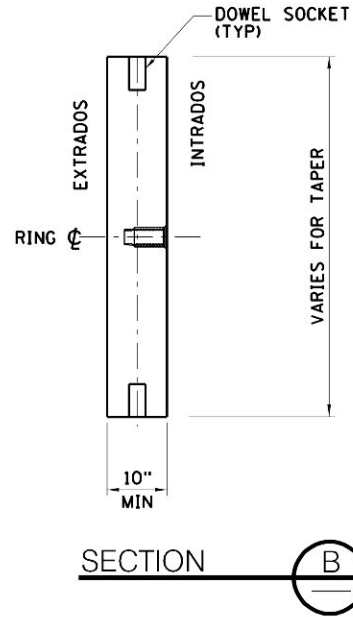
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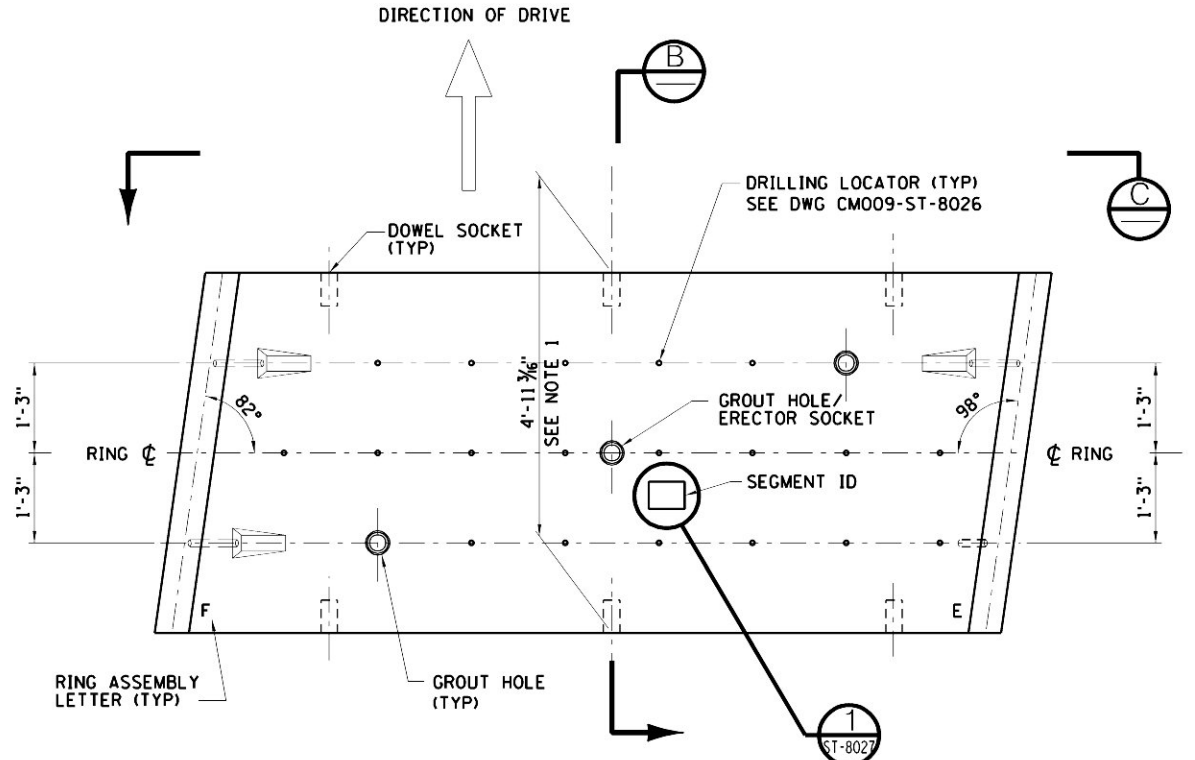
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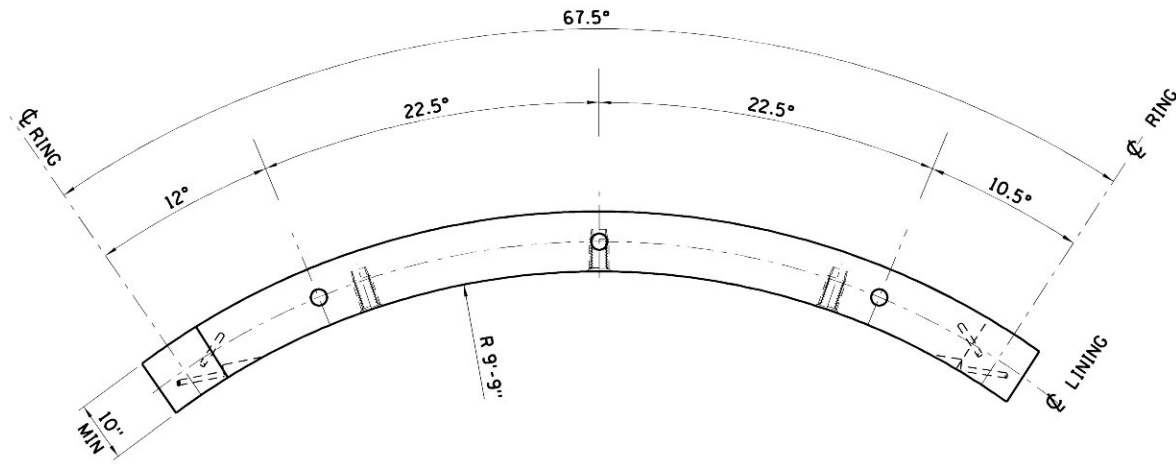
SUGGESTED SEGMENT TYPE D-E



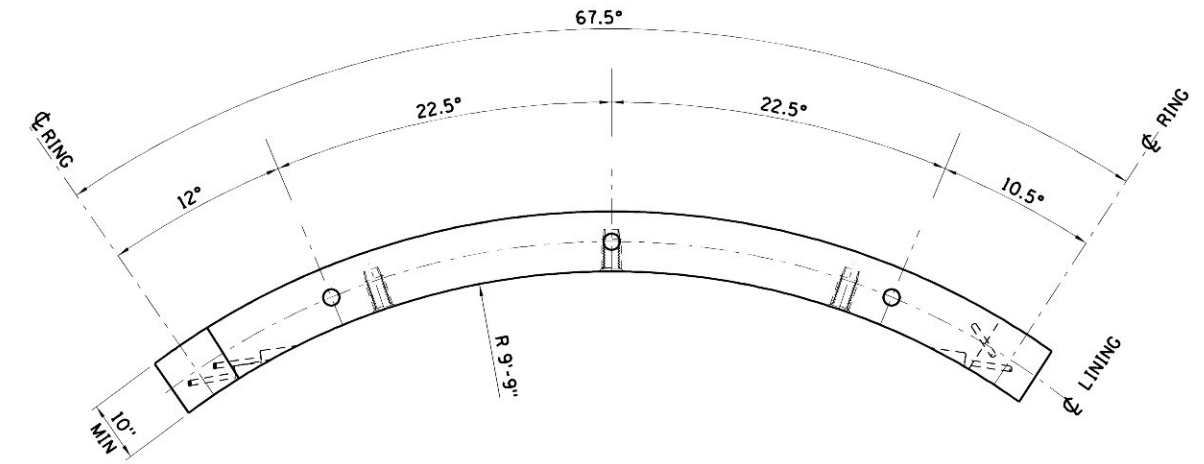
SECTION



SUGGESTED SEGMENT TYPE E-F



SECTION



SECTION

NOTE:

1. SEGMENT WIDTHS SHOWN ARE APPROXIMATE. PRECISE VALUES SHALL BE CALCULATED FROM GEOMETRY OF TAPERED RING.

SCALE IN FEET
1' .5' 0 1' 2' 3'

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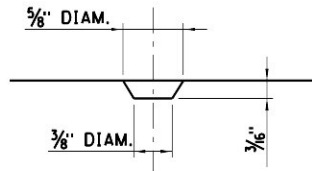
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MANHATTAN TUNNELS EXCAVATION

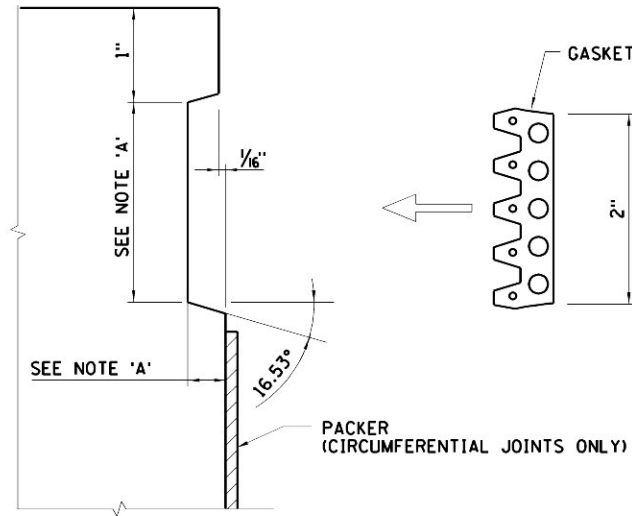
PRECAST CONCRETE TUNNEL LINING
SEGMENT TYPES D-E AND E-F

SCALE
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CM009-ST-8025
DATE:
3-24-06
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CONTRACT No.
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SHEET No.
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DETAIL OF DRILLING LOCATOR



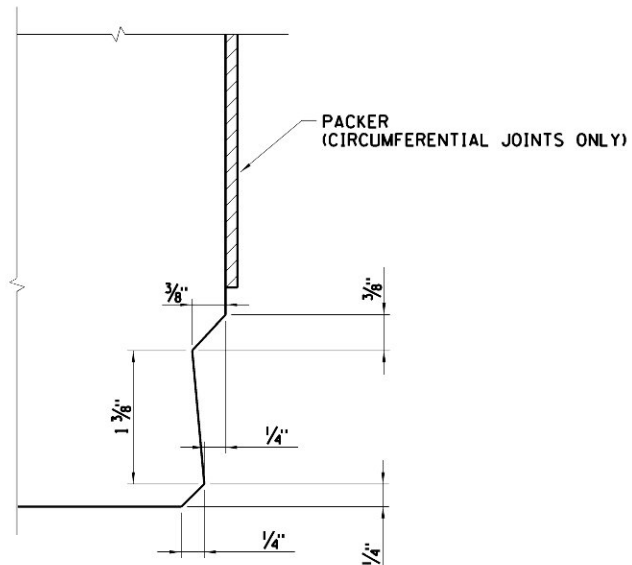
GASKET GROOVE DETAIL (SEE NOTE 'A' BELOW)
(RADIAL & CIRCUMFERENTIAL JOINTS)



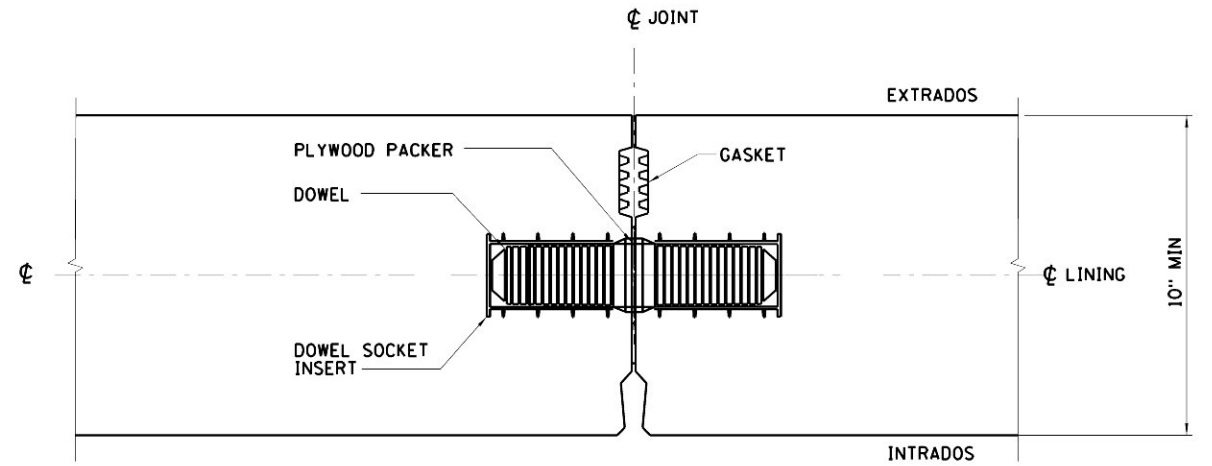
NOTE A:
DIMENSIONS OF THE GASKET GROOVE DETAIL
ARE TO BE DETERMINED IN ACCORDANCE WITH
SECTION 02427 OF THE SPECIFICATIONS.

NOTES:

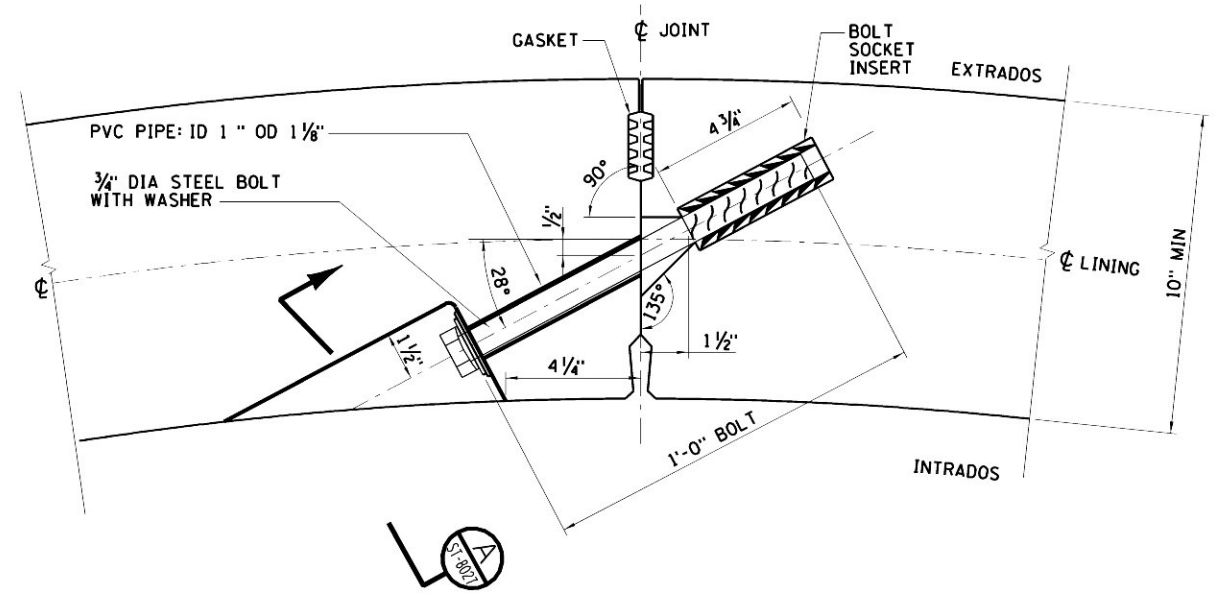
1. DRILLING LOCATOR SHALL BE PROVIDED
CAST INTO THE INTERIOR SURFACE OF
SEGMENT AND LOCATED MIDWAY BETWEEN
REINFORCING BARS.
2. FOR APPROXIMATE LOCATION AND QUANTITY OF DRILLING LOCATORS,
DOWELS AND BOLTS, SEE DWG CM009-ST-8023 THROUGH CM009-ST-8025.
ACTUAL LOCATIONS TO SUIT CONTRACTOR'S DETAILED
REINFORCING BAR LAYOUTS.



CAULKING GROOVE DETAIL
(RADIAL & CIRCUMFERENTIAL JOINTS)

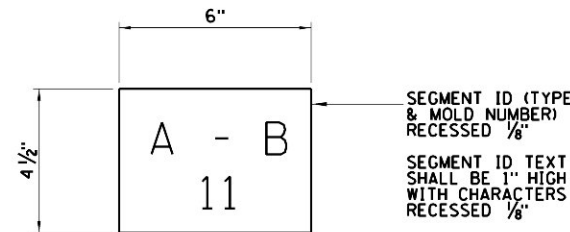
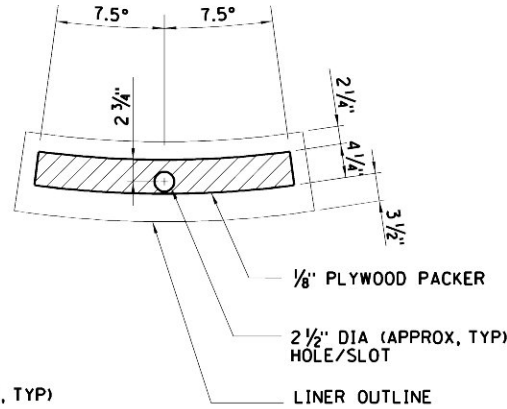
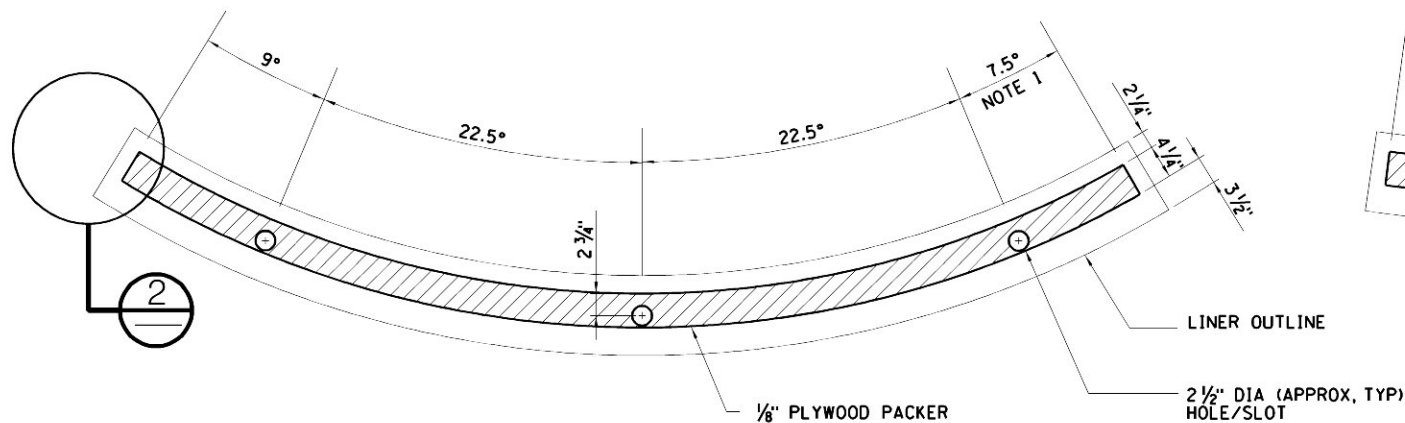


TYPICAL DOWEL DETAIL (CIRCUMFERENTIAL JOINT)



TYPICAL BOLT DETAIL (RADIAL JOINT)





CIRCUMFERENTIAL JOINT PACKER – SEGMENT TYPES D-E AND E-F

- NOTES:
1. PACKER FOR SEGMENT TYPE C-D SIMILAR, BUT EXTENDS 9° BEYOND DOWEL HOLE AT BOTH ENDS.
 2. PACKER FOR SEGMENT TYPES A-B AND B-C SIMILAR, BUT MIRRORED LEFT TO RIGHT.
 3. PACKER TO BE INSTALLED ON THE TRAILING EDGE OF SEGMENT.



CIRCUMFERENTIAL JOINT PACKER

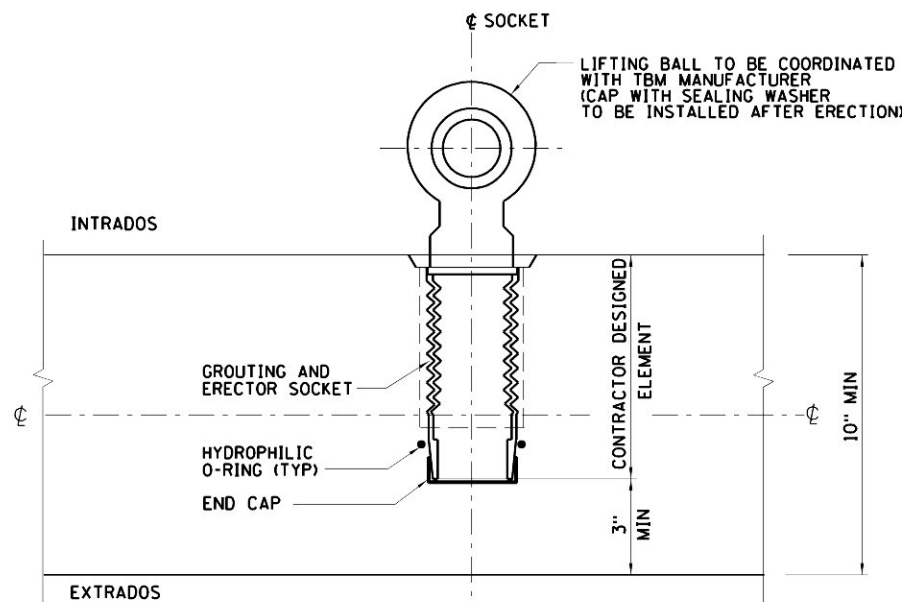
SEGMENT TYPE F-A

PACKER TO BE INSTALLED ON THE TRAILING EDGE OF SEGMENT



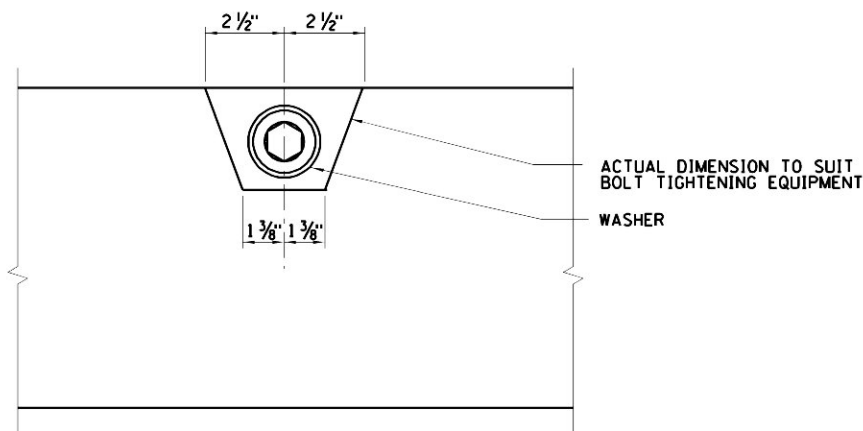
DETAIL 1

SEGMENT ID



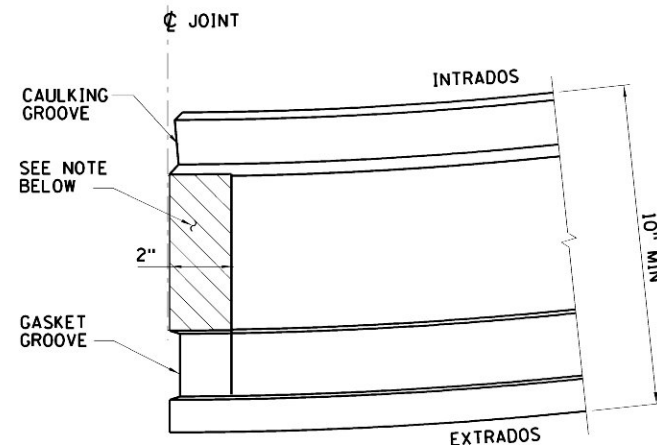
THREADED GROUT HOLE / ERECTOR SOCKET

GROUT HOLE AND ERECTOR SOCKET DESIGNS CAN BE THE SAME (AS SHOWN)



SECTION A

BOLT RECESS



NOTE:
A 2" STRIP ON BOTH SIDES OF EVERY RADIAL AND CIRCUMFERENTIAL CORNER SHALL BE RECESSED 1/16".

DETAIL 2



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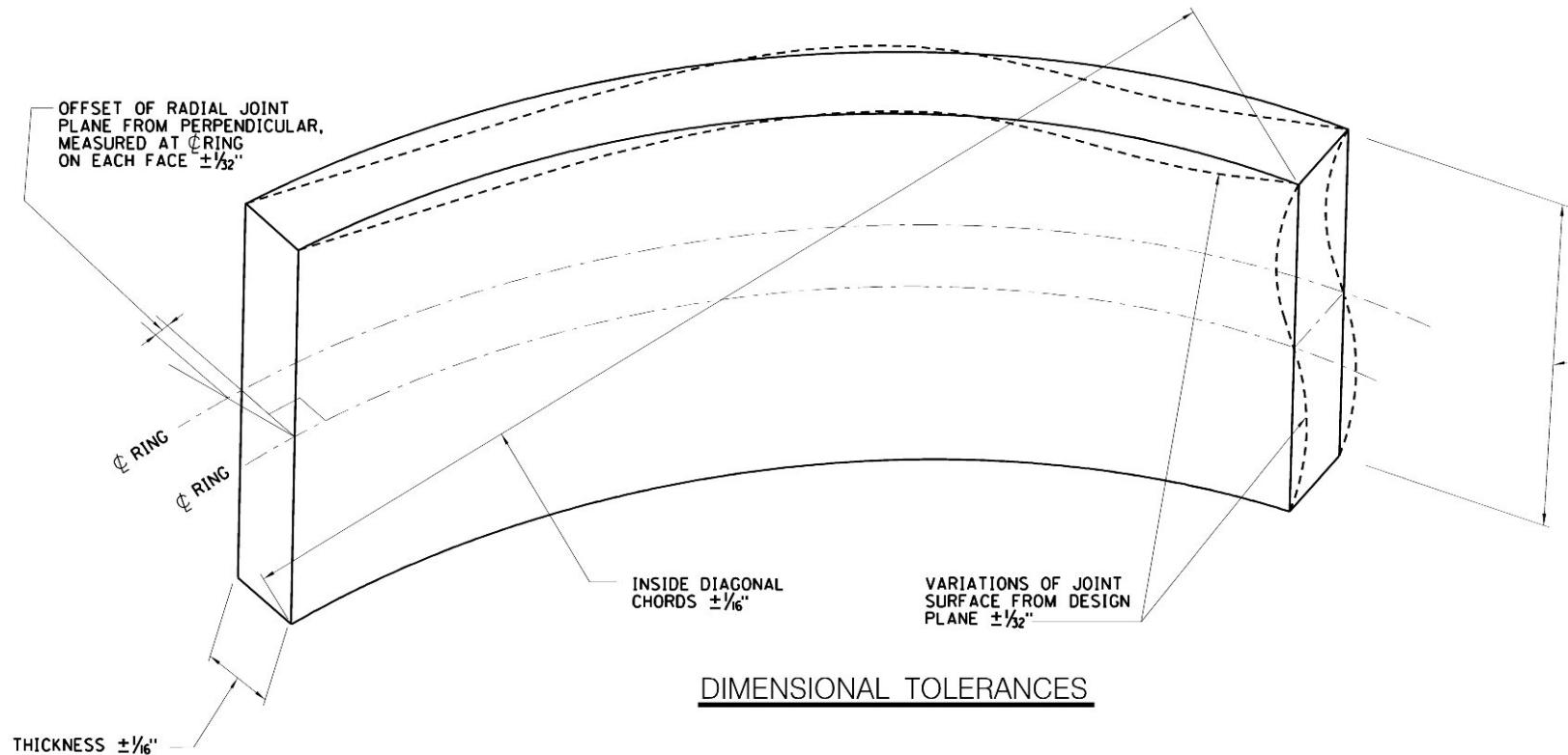
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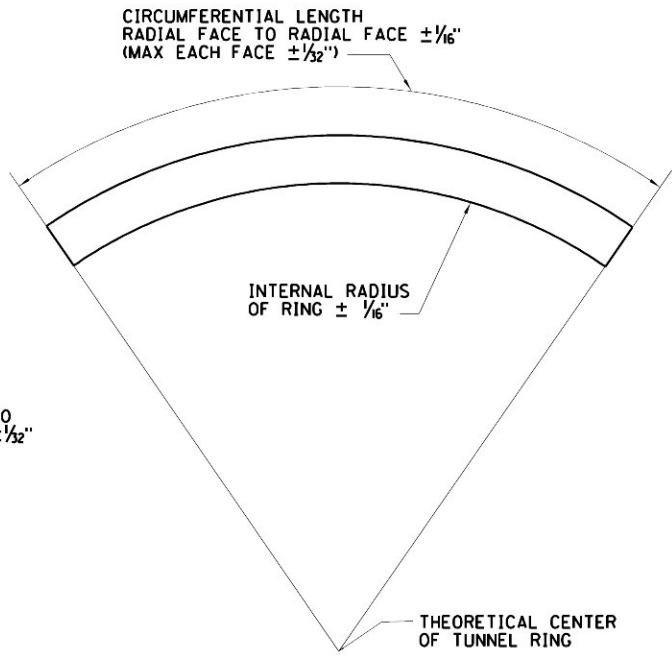
MANHATTAN TUNNELS EXCAVATION

PRECAST CONCRETE TUNNEL LINING
SOCKET, PACKER AND MARKING DETAILS

SCALE: AS NOTED	CONTRACT No. CM009
DRAWING NUMBER: CM009-ST-8027	ISSUE
DATE: 3-24-06	SHEET No. 8 OF 28
REVISION NUMBER: 0	

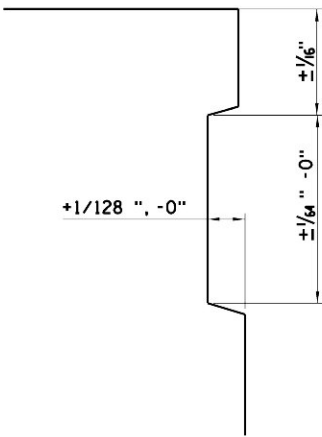


DIMENSIONAL TOLERANCES





RADIAL TOLERANCE

OTHER TOLERANCES: POSITION OF BOLT HOLES AND DOWEL INSERTS $\pm \frac{1}{32}$ "



GASKET GROOVE TOLERANCE

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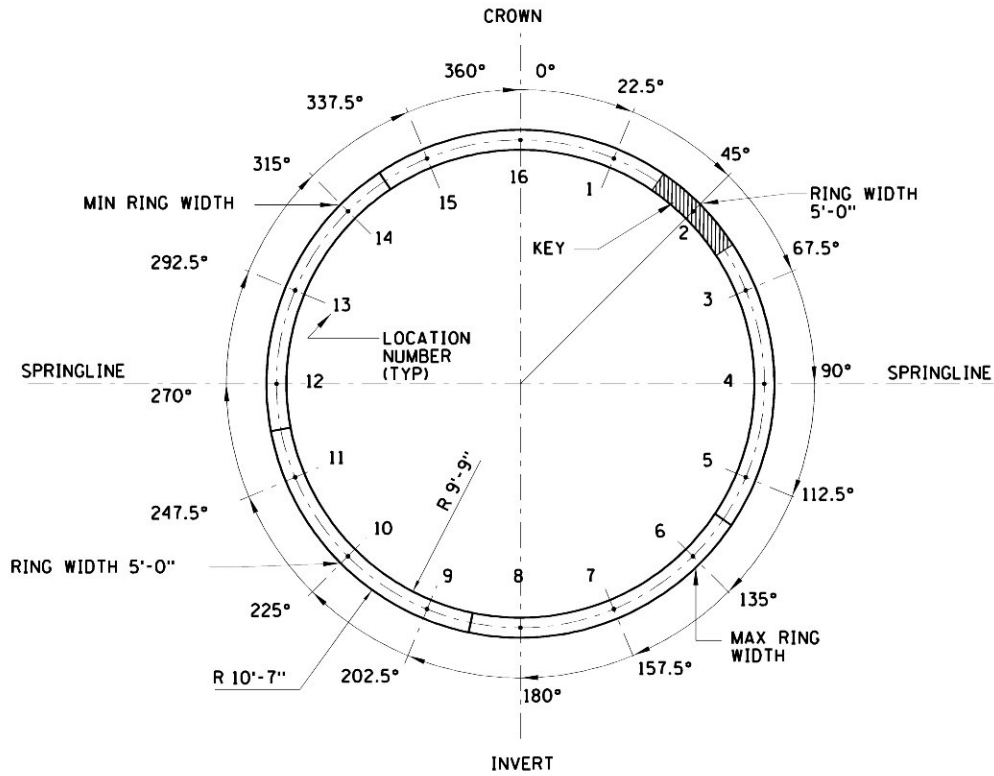
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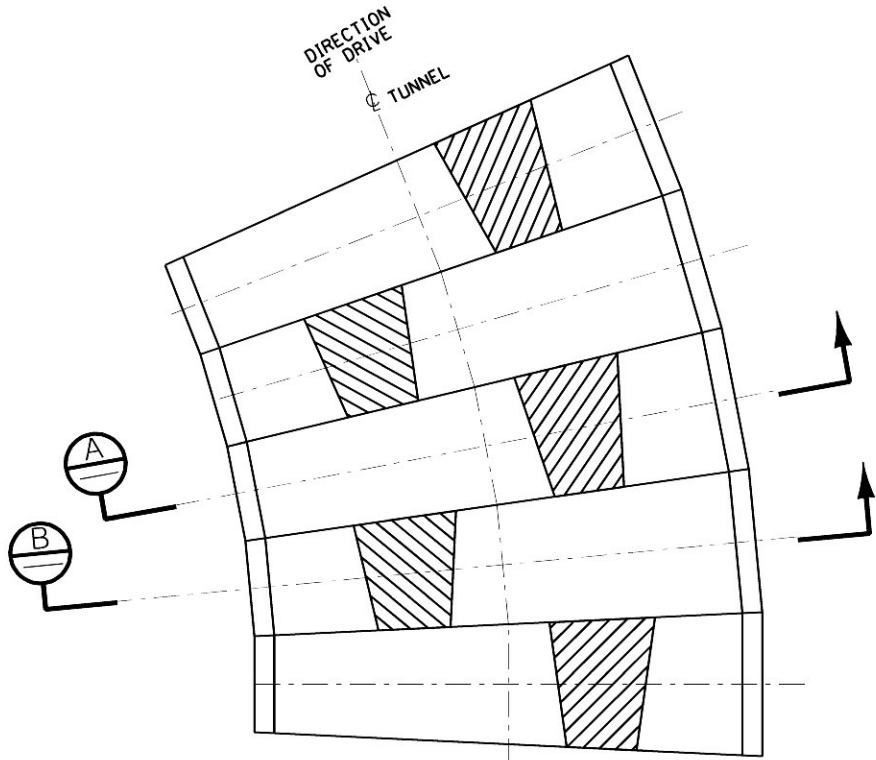
MANHATTAN TUNNELS EXCAVATION

PRECAST CONCRETE TUNNEL LINING
TUNNEL LINING FABRICATION TOLERANCES

SCALE: NOT TO SCALE	CONTRACT No. CM009
DRAWING NUMBER: CM009-ST-8032	ISSUE
DATE: 3-24-06	SHEET No.
REVISION NUMBER: 0	<u>9</u> OF <u>28</u>



SUGGESTED KEY LOCATION - DOWEL HOLE NUMBERS
FACING THE DIRECTION OF TBM DRIVE. KEY SHOWN AT LOCATION NUMBER 2.
SCALE: NTS

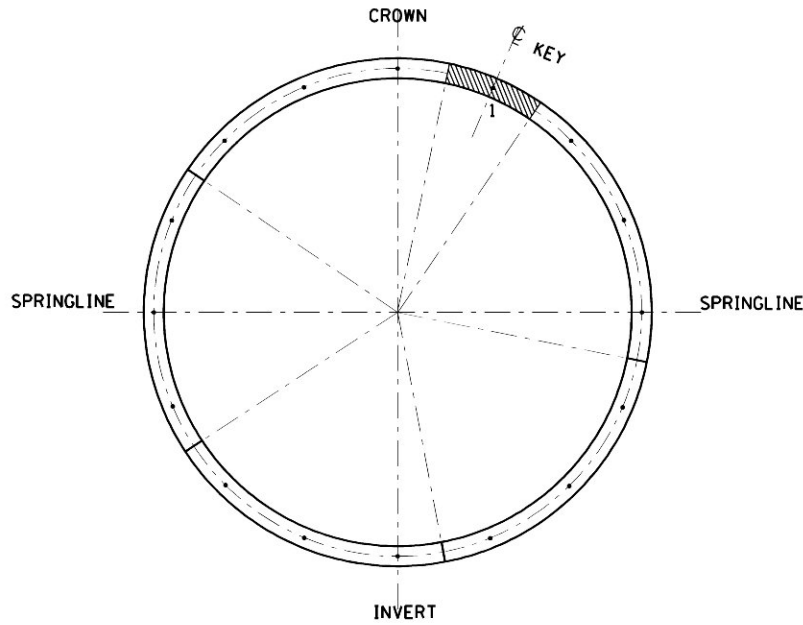


PLAN
(EXAGGERATED TAPER)
SCALE: NTS

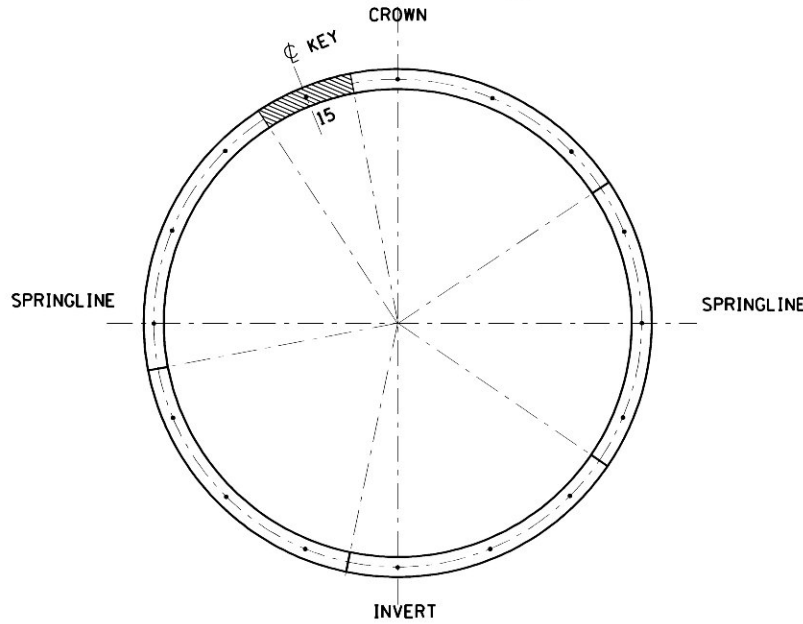
KEY AT DOWEL HOLE NUMBER	KEY AT α DEGREES FROM CROWN (NOTE 1)	EQUIVALENT HORIZONTAL TAPER (INCHES)	HORIZONTAL DIRECTION OF TUNNEL (NOTE 1)	EQUIVALENT VERTICAL TAPER (INCHES)	VERTICAL DIRECTION OF TUNNEL (NOTE 1)
1	22.5	2.08	LEFT	0.86	UP
2	45	1.59		1.59	
3	67.5	0.86		2.08	
4 (SPRINGLINE)	90	0.00	STRAIGHT	2.25	UP
5	112.5	0.86	RIGHT	2.08	
6	135	1.59		1.59	
7	157.5	2.08		0.86	
8 (INVERT)	180	2.25	RIGHT	0	STRAIGHT
9	202.5	2.08		0.86	DOWN
10	225	1.59	1.59		
11	247.5	0.86	2.08		
12 (SPRINGLINE)	270	0	STRAIGHT	2.25	DOWN
13	292.5	0.86	2.08		
14	315	1.59	1.59		
15	337.5	2.08	0.86	DOWN	DOWN
16 (CROWN)	360	2.25	0		

ALTERNATING KEY LOCATIONS	KEY AT ALTERNATING DEGREES FROM CROWN (NOTE 1)		HORIZONTAL CURVE RADIUS (FEET) (NOTE 3)	HORIZONTAL DIRECTION OF TUNNEL (NOTE 1)
16	0	0	564	LEFT
1 AND 15	22.5	337.5	611	
2 AND 14	45	315	798	
3 AND 13	67.5	292.5	1475	STRAIGHT
4 AND 12	90	270	(NOTE 4)	
5 AND 11	112.5	247.5	1475	
6 AND 10	135	225	798	RIGHT
7 AND 9	157.5	202.5	611	
8	180	180	564	

- NOTES:
1. TABLE ASSUMES RING VIEW IS FACING THE DIRECTION OF TBM DRIVE.
 2. SUGGESTED RING TAPER OF 2 1/4 INCHES TO BE SPLIT EQUALLY BETWEEN LEADING AND TRAILING EDGES.
 3. RING ORIENTATIONS TO FOLLOW VERTICAL CURVES ARE NOT TABULATED.
 4. ALTERNATING THE KEY BETWEEN ANY OPPOSING LOCATIONS CREATES STRAIGHT ALIGNMENTS.

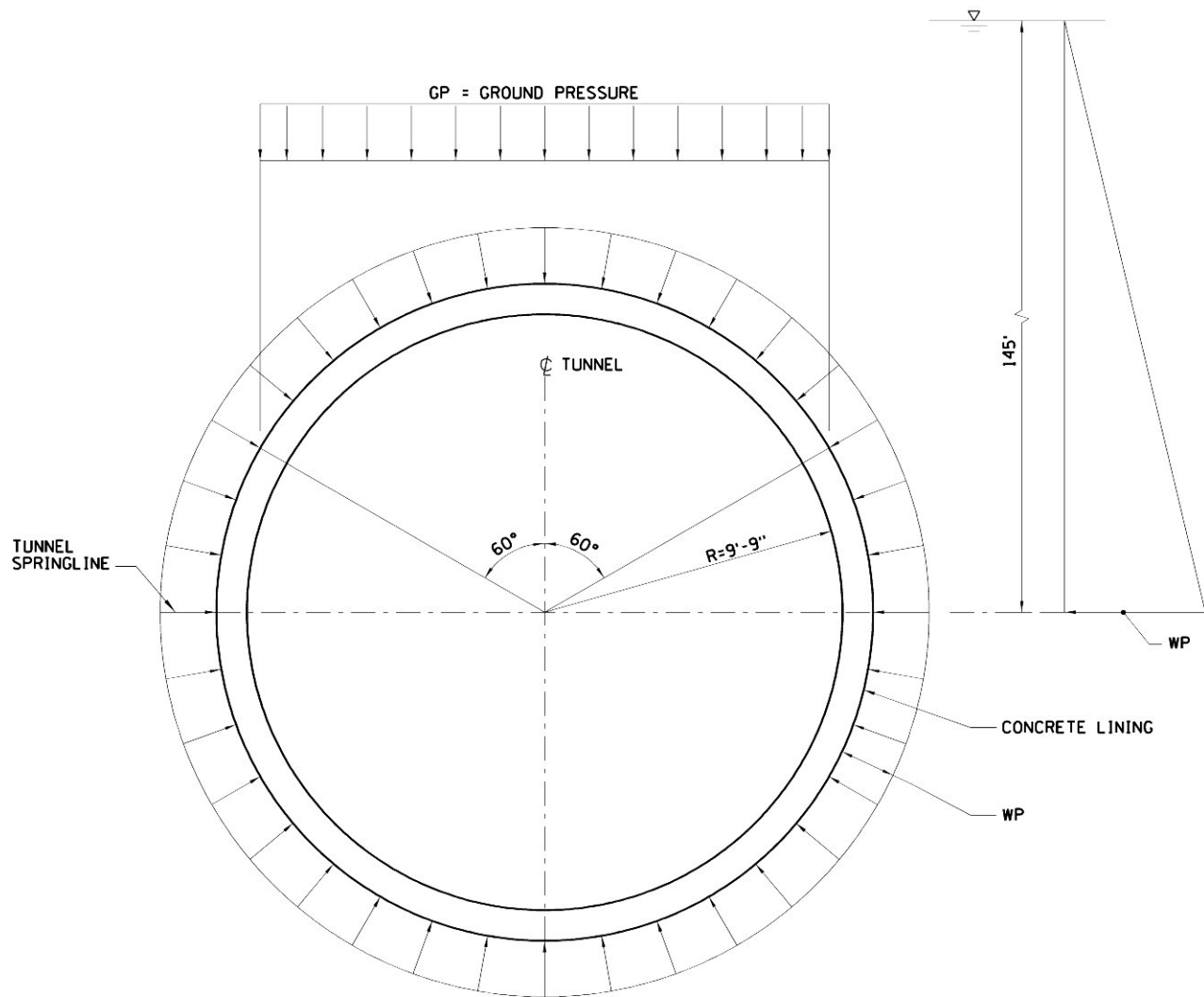


SECTION A
SCALE: NTS



SECTION B
SCALE: NTS

EXAMPLE OF HORIZONTAL CURVE TO LEFT (621FT RADIUS)
SCALE: NTS



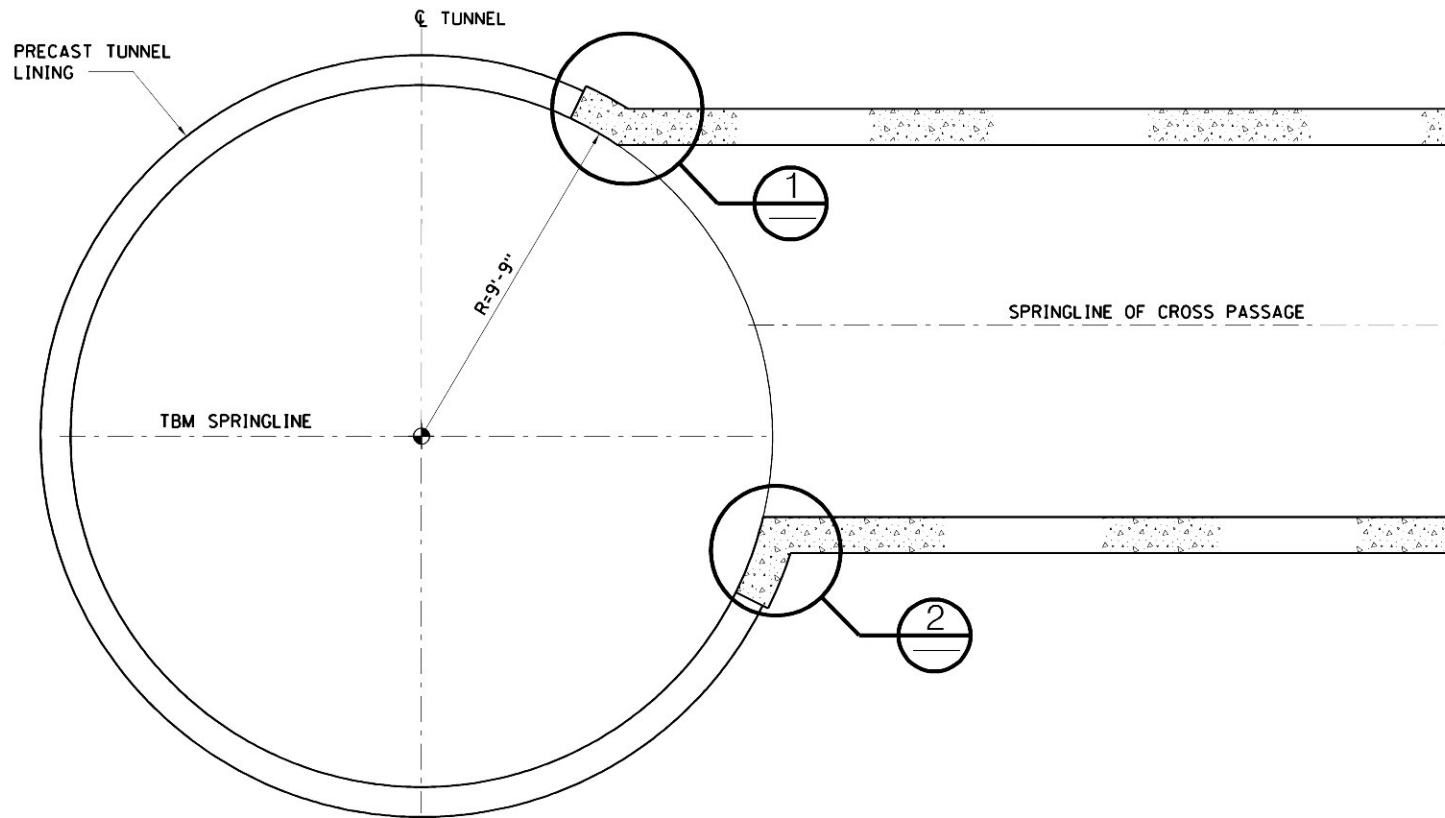
LOADING DIAGRAM

- DESIGN CRITERIA NOTES:
- THE FINAL LINING OF THE TBM TUNNELS SHALL BE DESIGNED FOR THE FOLLOWING LOADS:

D = SELFWEIGHT OF CONCRETE LINER = 145 PCF
GP = GROUND PRESSURE AS FOLLOWS:
CASE I: 750 PSF, EXCEPT AT LOCATIONS INDICATED IN CASE II
CASE II: 2600 PSF IN SUPPORT CLASS SC III DESIGNATED AREAS AND WITHIN THE LIMITS FROM STA WB1/WB3/EB2/EB4 1051+80 TO 1054+20
WP = WATER PRESSURE. THE DESIGN GROUNDWATER LEVEL IS 145 FT ABOVE THE TUNNEL SPRINGLINE. WATER DENSITY = 62.4 PCF.
EQ: SEISMIC LOADING SHALL BE BASED ON ESA DESIGN CRITERIA AND BUILDING CODE OF NEW YORK STATE.
 - DESIGN SHALL BE BASED ON THE LOAD FACTOR DESIGN METHOD.
 - THE FOLLOWING FACTORED LOAD COMBINATIONS SHALL BE INVESTIGATED TO DETERMINE THE GOVERNING LOADING CONDITIONS:
I. $1.4(D+WP) + 1.7GP$
II. $1.4D + 1.7GP$
III. $1.0(D+WP) + 1.0GP + EQ$
IV. $1.0D + 1.0GP + EQ$
 - CONCRETE STRENGTH:
PRECAST LINER: $f'_c = 6,000$ PSI
CAST-IN-PLACE LINER: $f'_c = 4,000$ PSI
 - CONCRETE REINFORCEMENT:
REINFORCEMENT FOR CONCRETE LINING SHALL BE AS SPECIFIED ON DWG CM009-GP-0055.
 - FIBER REINFORCED CAST-IN-PLACE CONCRETE LINER SHALL BE AS SPECIFIED IN SECTION 03305 OF THE SPECIFICATIONS. FIBER REINFORCEMENT IS FOR SHRINKAGE CONTROL AND SHALL NOT BE TAKEN INTO ACCOUNT FOR DETERMINING THE CAPACITY OF FINAL LINING.
 - THE ANALYSIS OF THE TUNNEL LINING SHALL BE BASED ON THE LINING IN ITS FINAL POSITION. FOR THIS PURPOSE, THE ROCK MASS ELASTIC MODULUS, E_m , SHALL BE AS FOLLOWS:

 $E_m = 500$ KSI IN SUPPORT CLASS SC III DESIGNATED AREAS

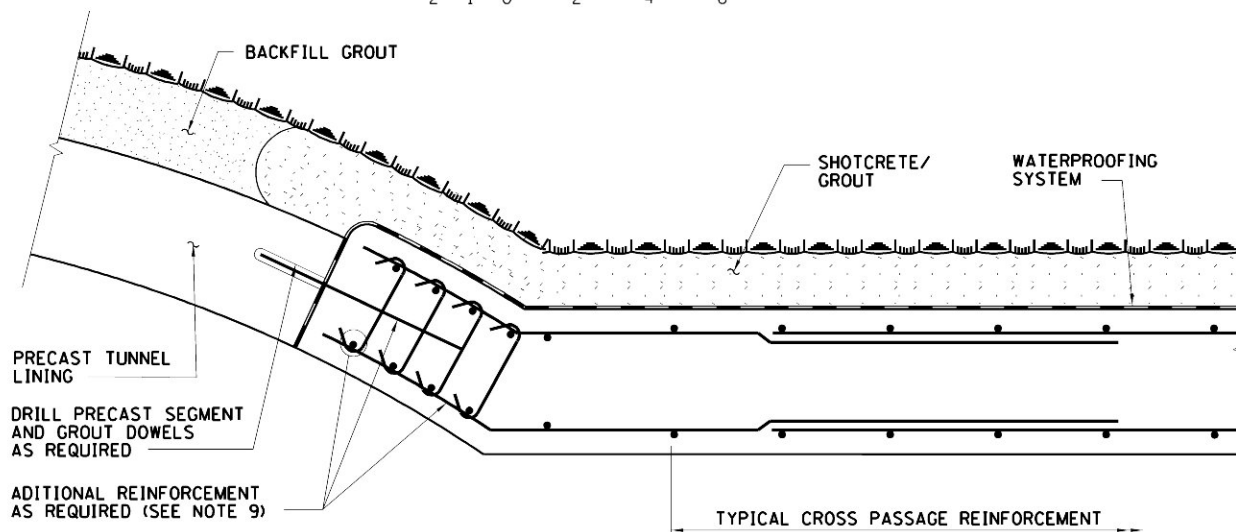
 $E_m = 4000$ KSI IN ALL OTHER AREAS
 - THE CONTRACTOR SHALL INCORPORATE IN THE LINER DESIGN ANY ADDITIONAL REINFORCEMENT REQUIRED FOR HANDLING, TRANSPORTATION AND ERECTION LOADS.



TYPICAL SECTION AT CROSS PASSAGE

SCALE IN FEET

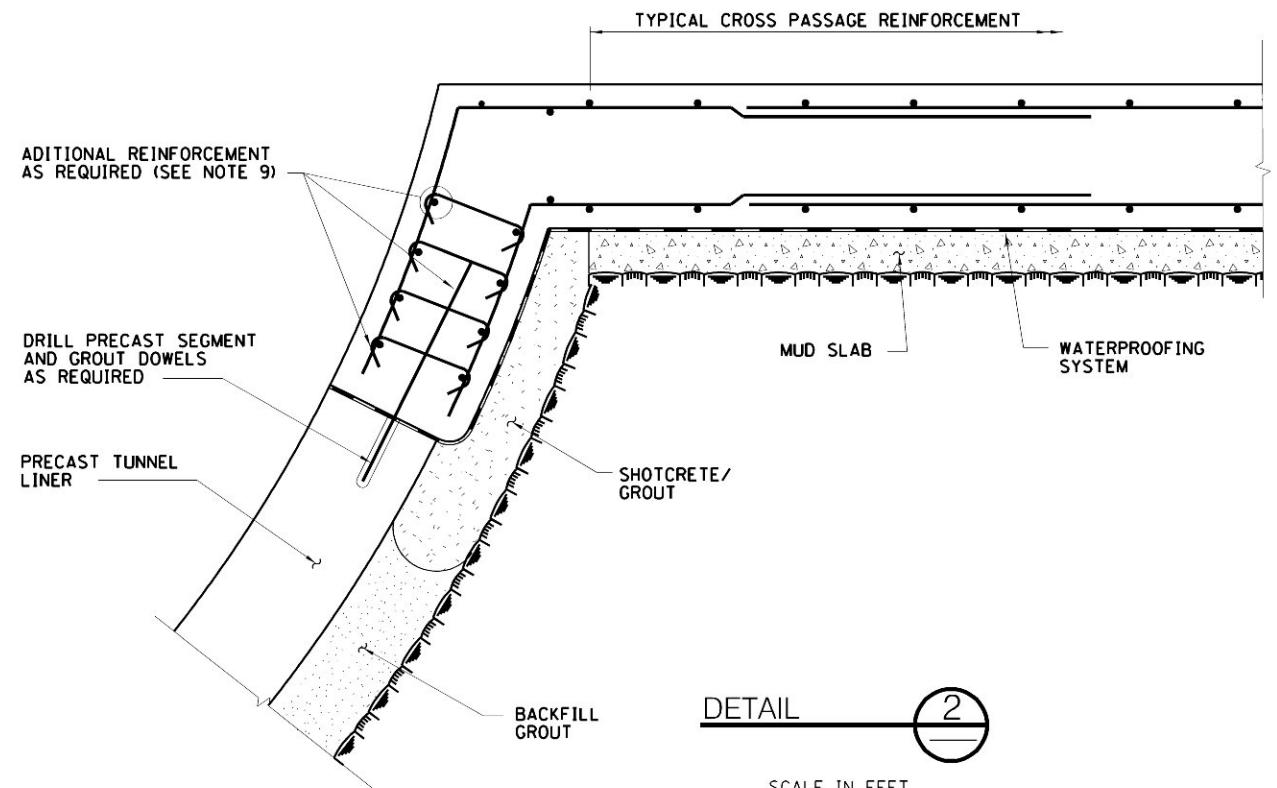
2' 1' 0 2' 4' 6'



DETAIL 1

SCALE IN FEET

1/2 1/4 0 1/2 1' 1 1/2'



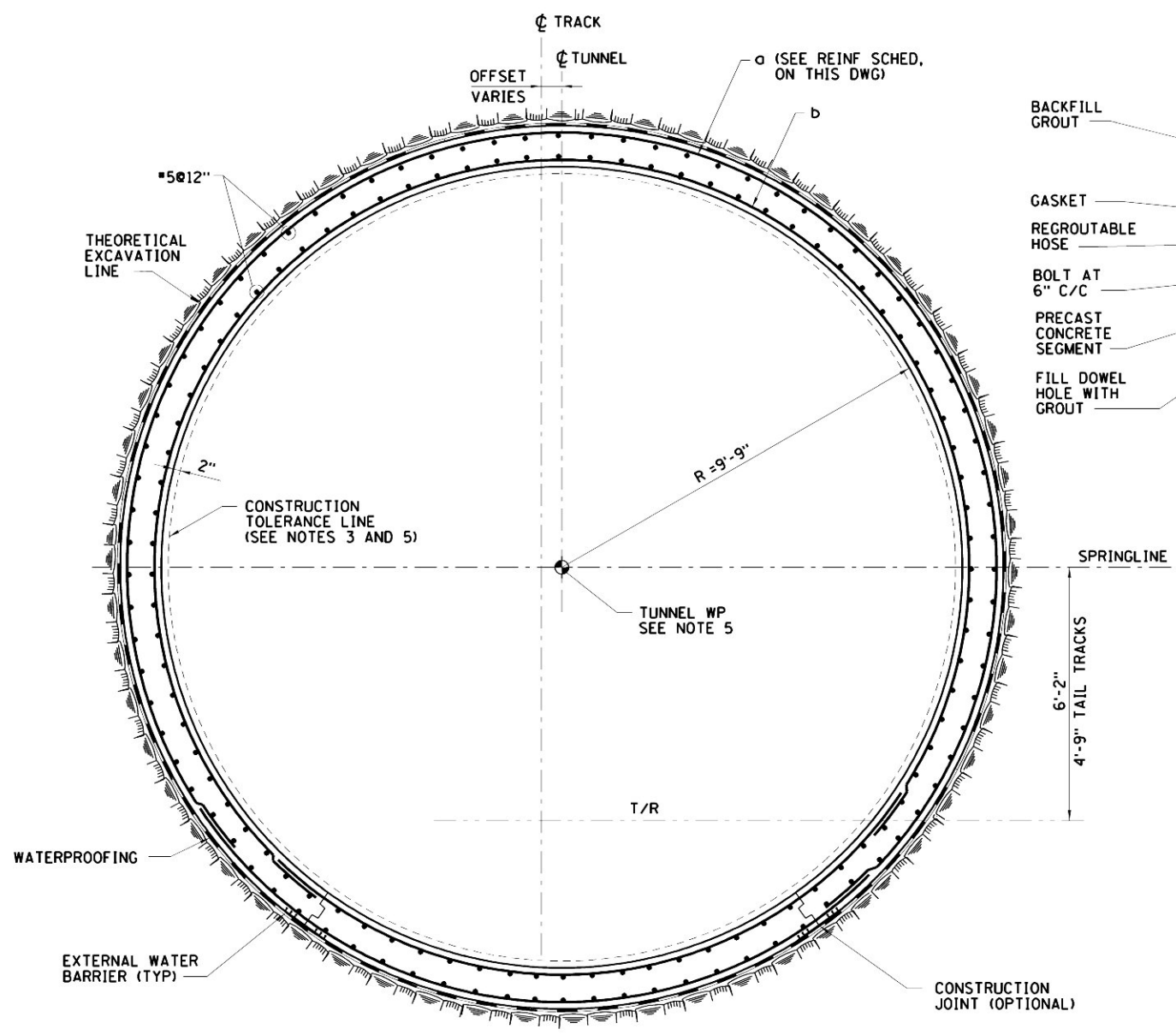
DETAIL 2

SCALE IN FEET

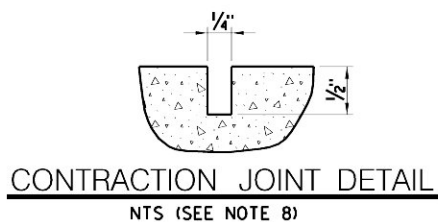
1/2 1/4 0 1/2 1' 1 1/2'

NOTES:

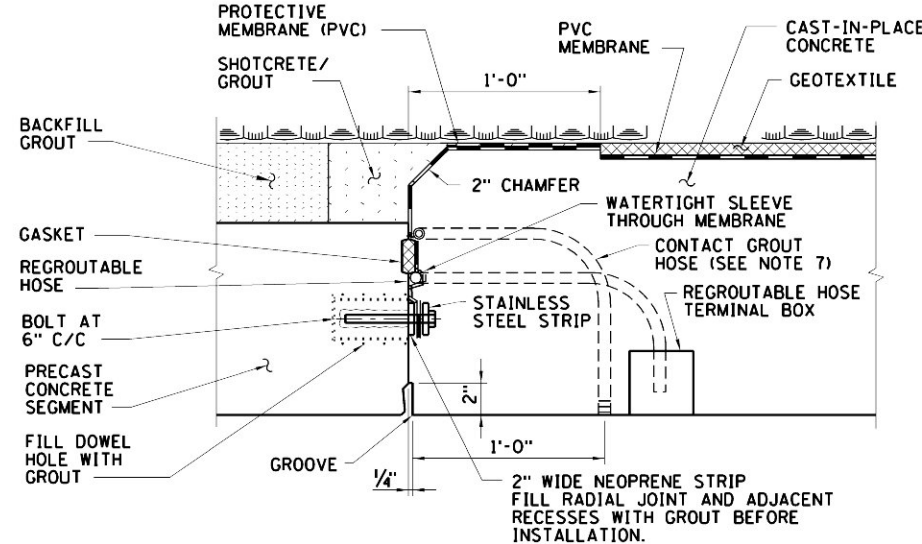
1. DETAILS SHOWN IN THIS DRAWING APPLY TO TYPICAL APPROACH TUNNEL CROSS PASSAGES. TAIL TRACK CROSS PASSAGES ARE SIMILAR.
2. FINAL JOINT LOCATION TO BE ADJUSTED BASED ON FIELD CONDITIONS.
3. ALL VOIDS BEHIND THE LINER SHALL BE FILLED WITH CONCRETE OR GROUT.
4. CONNECTION SHALL BE DESIGNED PER LOADING CRITERIA SHOWN ON DWG CM009-ST-8034.
5. LIMITS OF OPENING IN SEGMENTAL LINER SHALL COINCIDE WITH JOINTS BETWEEN SEGMENTAL RINGS.
6. MINIMUM LENGTH OF REMAINING PARTIAL SEGMENT WITHIN A RING SHALL BE 3'-0".
7. DAMAGED SEGMENTS SHALL BE REMOVED.
8. STABILITY OF THE LINING AND GROUND SHALL BE MAINTAINED AT ALL TIMES USING STEEL STRUTS, SPREADER BEAMS OR SIMILAR.
9. FINAL DESIGN SHALL ACCOUNT FOR OVERALL STABILITY, STRUCTURAL ADEQUACY AND WATERTIGHTNESS OF THE PERMANENT LINER. DESIGN SHALL BE SIGNED BY A PROFESSIONAL ENGINEER LICENSED IN THE STATE OF NEW YORK. SUBMIT DESIGN FOR REVIEW BY RESIDENT ENGINEER WITHIN 90 DAYS OF NOTICE TO PROCEED.



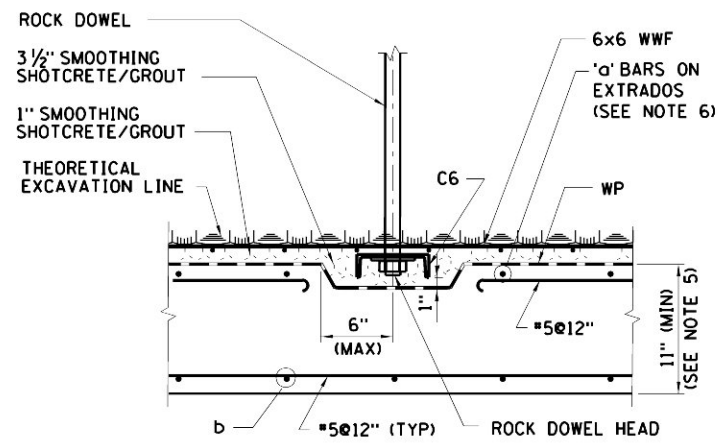
TYPICAL REINFORCED CAST-IN-PLACE LINER SECTION
UNREINFORCED LINER SIMILAR, SEE NOTE 2



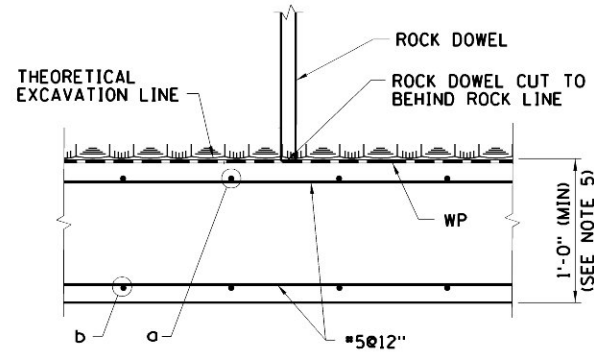
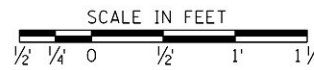
MAIN CIRCUMFERENTIAL REINFORCING SCHEDULE					
CASE	LIMITS	CLASS SUPPORT TYPE	REINF BAR 'a'	REINF BAR 'b'	
1	WITHIN LIMITS OF TUNNEL INTERSECTION AREAS SHOWN AS 'CIP LINING' (ONLY) ON DWGS CM009-ST-1001 THROUGH CM009-ST-1110. EXCEPT AS INDICATED IN CASE 2 BELOW	SC I AND SC II	*7 @ 9"	*7 @ 9"	
2	WITHIN LIMITS FROM STA WB1/WB3/EB2/EB4 1051+80 TO 1054+20	SC II	*9 @ 9"	*7 @ 9"	
3	WITHIN ALL LIMITS OF SUPPORT CLASS III DESIGNATED AREAS	SC III	*9 @ 6"	*7 @ 6"	
4	ALL OTHER AREAS		FIBER REINF CIP CONC	FIBER REINF CIP CONC	



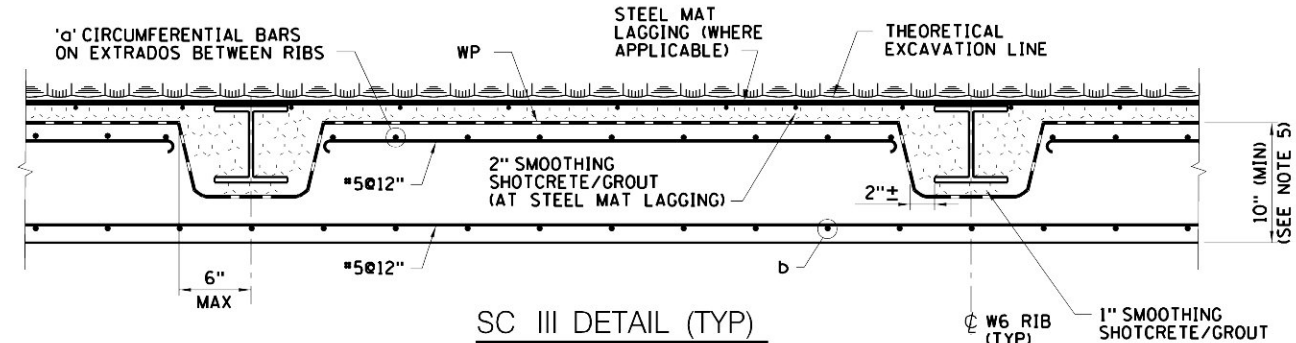
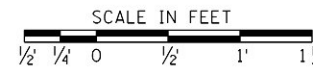
WATERPROOFING DETAIL AT PRECAST LINING



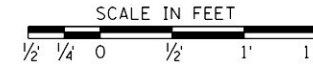
SC II DETAIL (TYP)



SC I DETAIL (TYP)



SC III DETAIL (TYP)

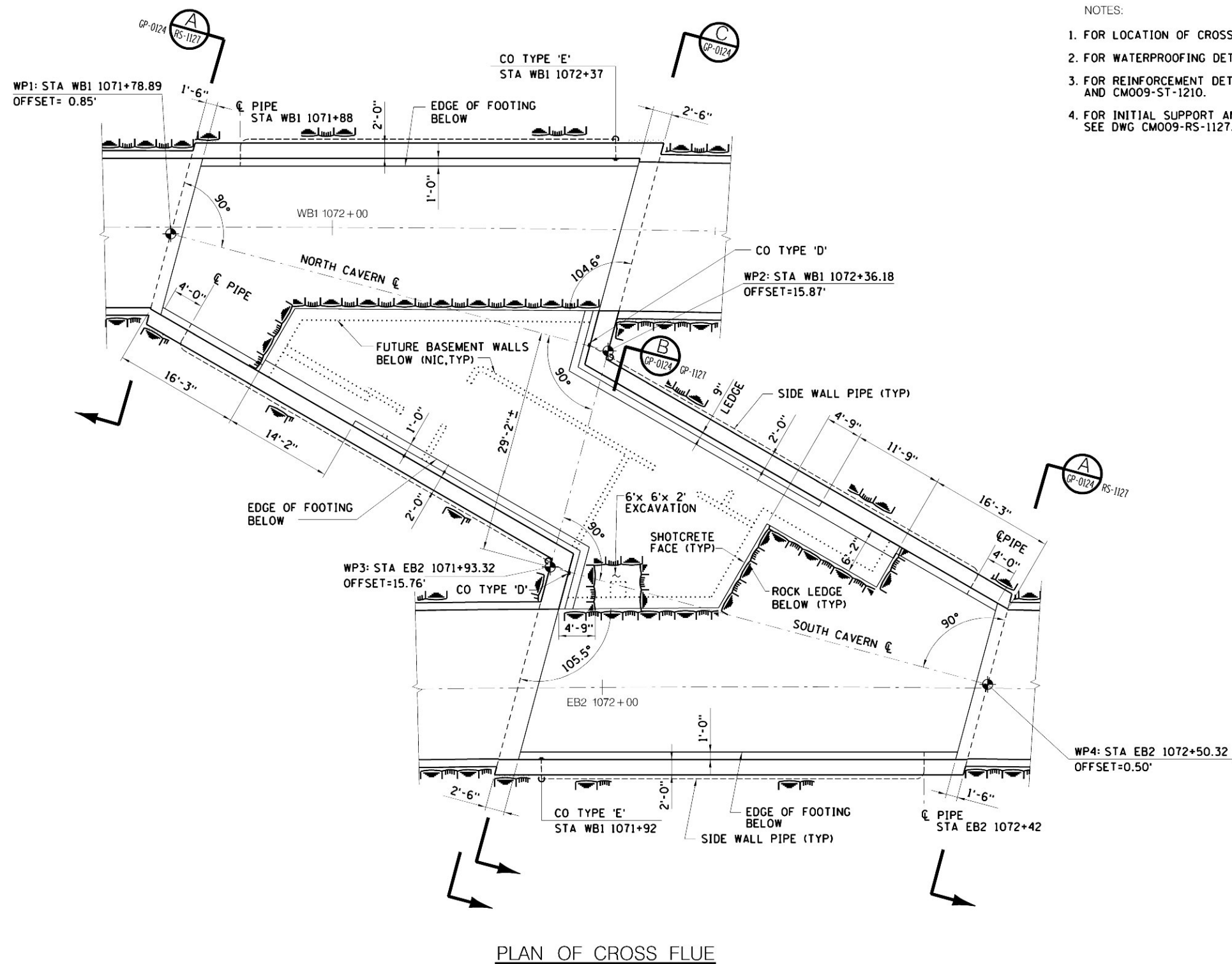


- NOTES:
1. REINFORCEMENT SHOWN ON THIS DRAWING SHALL APPLY TO CAST-IN-PLACE CONCRETE WITHIN THE TUNNEL LIMITS INDICATED IN REINFORCING SCHEDULE SHOWN ON THIS DWG.
 2. EXCEPT WHERE REINFORCEMENT IS REQUIRED IN ACCORDANCE WITH NOTE 1, CAST IN PLACE TBM TUNNEL LINING DOES NOT REQUIRE REINFORCING BARS. INSTEAD CONCRETE SHALL CONTAIN FIBER REINFORCEMENT IN ACCORDANCE WITH SPECIFICATION SECTION 03305.
 3. FOR GENERAL ARRANGEMENT OF TBM TUNNELS, SEE DWGS CM009-GP-0111 THROUGH CM009-GP-0113.
 4. TRANSVERSE CONSTRUCTION JOINTS SHALL BE SPACED NO FURTHER THAN 60 FEET. FOR DETAIL OF TYPICAL CONSTRUCTION JOINT, SEE DWG CM009-WS-0101. WITHIN BORED TUNNEL, SHEAR KEY AND HYDROPHILIC WATER STOP MAY BE OMITTED.
 5. THE INTERNAL DIAMETER SHALL BE AS INDICATED. THE LINER SHALL NOT ENCRATCH INSIDE THE CONSTRUCTION TOLERANCE LINE, EXCEPT IN CURVED TUNNELS BY UP TO ONE ADDITIONAL INCH NEAR THE SPRINGLINE TO ALLOW FOR CHORDED FORMWORK. THE MINIMUM LINER THICKNESS INDICATED SHALL NOT BE REDUCED IN ANY CASE. CHORD LENGTHS SHALL NOT EXCEED 30 FT.
 6. AT SUPPORT CLASS II LOCATIONS, ADDITIONAL BARS 'a' SHALL BE ADDED FOR EVERY BAR OMITTED AT THE CHANNEL LOCATIONS.
 7. EXTEND REGROUTABLE HOSE AROUND FULL CIRCUMFERENCE OF TUNNEL.
 8. IN AREAS OF FIBER REINFORCED CONC TUNNEL LINING, DISCRETE LENGTH OF CONC POURS NOT EXCEEDING 60 FT SHALL BE USED. INTERMEDIATE CONTRACTION JOINTS SPACED NOT LARGER THAN 30 FT SHALL BE ADDED (SEE DETAIL THIS DWG). WATER BARRIER SHALL BE USED AT THE CONTRACTION JOINT LOCATIONS.



NOTES:

1. FOR LOCATION OF CROSS FLUE, SEE DWG CM009-ST-1012.
2. FOR WATERPROOFING DETAILS, SEE DWG CM009-WS-0106.
3. FOR REINFORCEMENT DETAILS, SEE DWG CM009-ST-1209 AND CM009-ST-1210.
4. FOR INITIAL SUPPORT AND EXCAVATION SEQUENCE, SEE DWG CM009-RS-1127.



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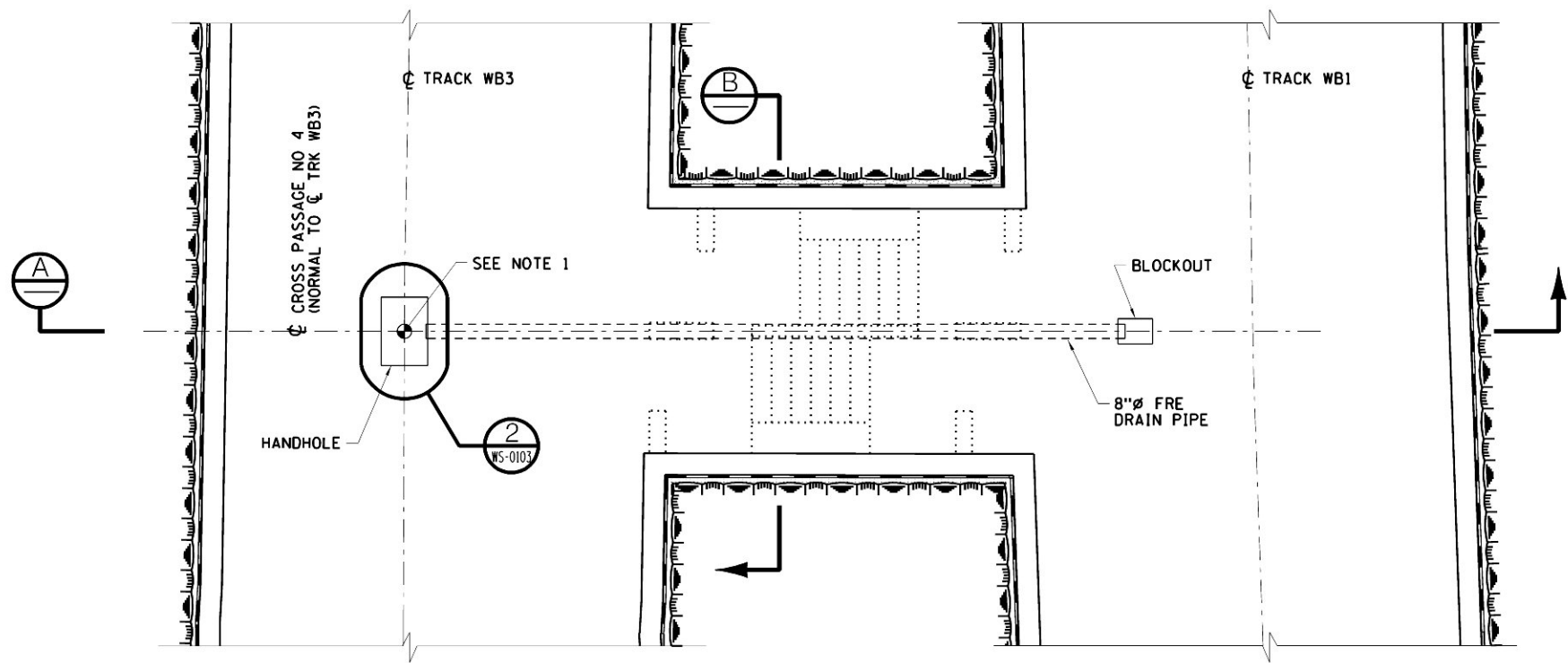
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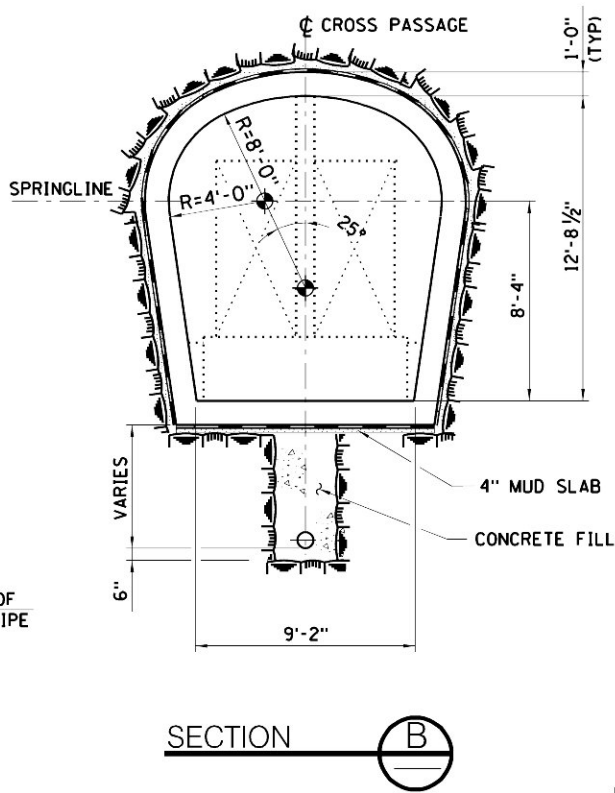
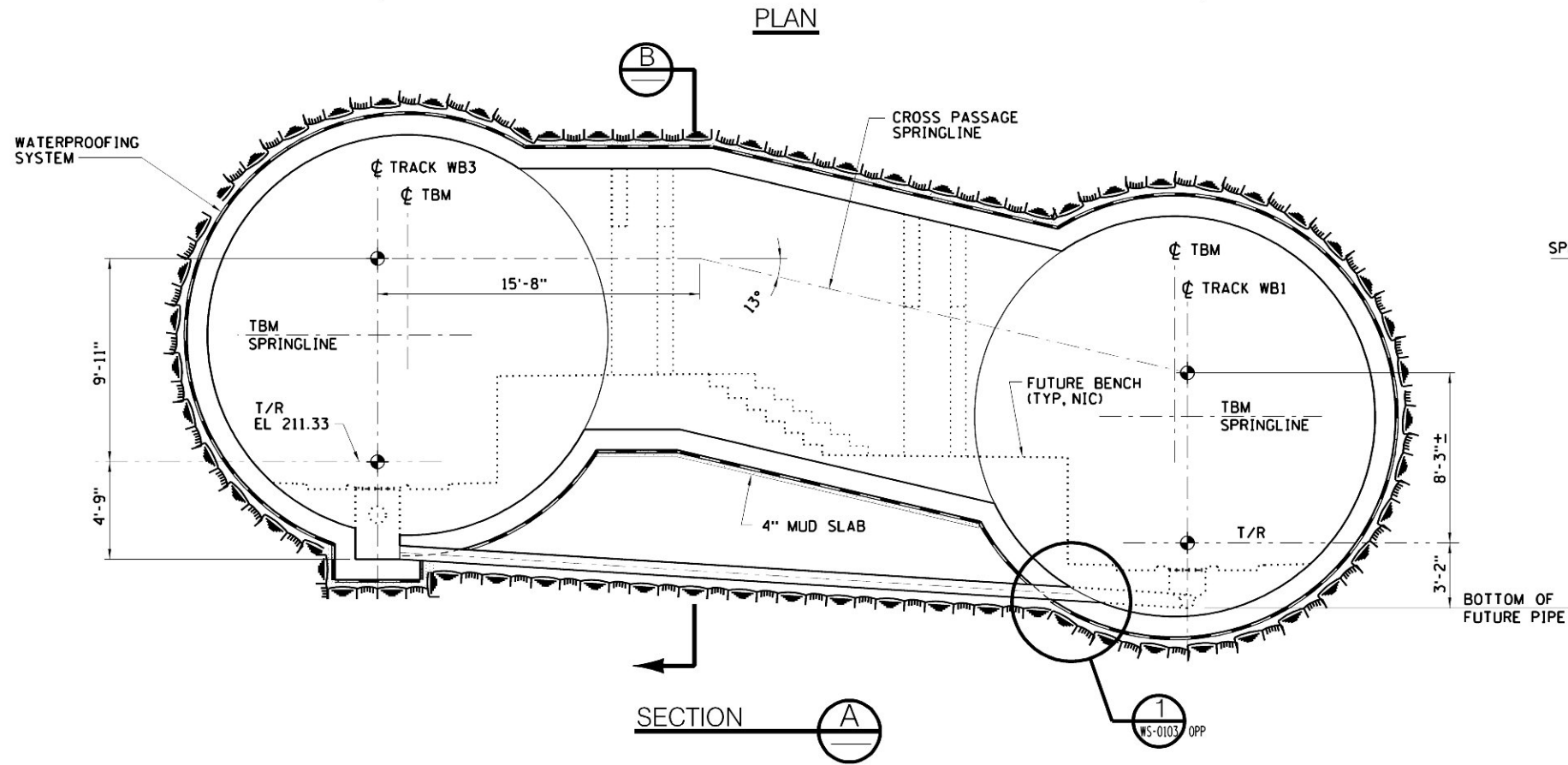
MANHATTAN TUNNELS EXCAVATION
GENERAL ARRANGEMENT
CROSS FLUE PLAN

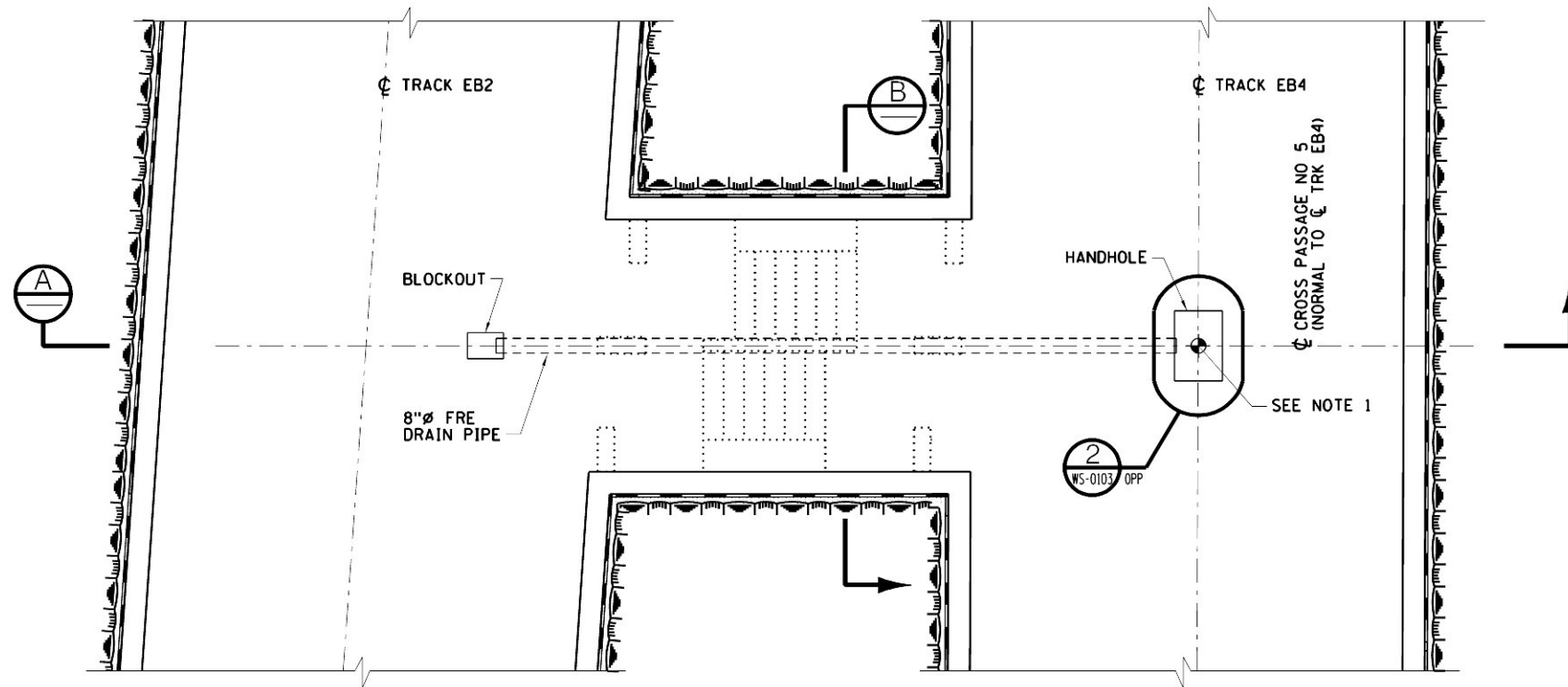
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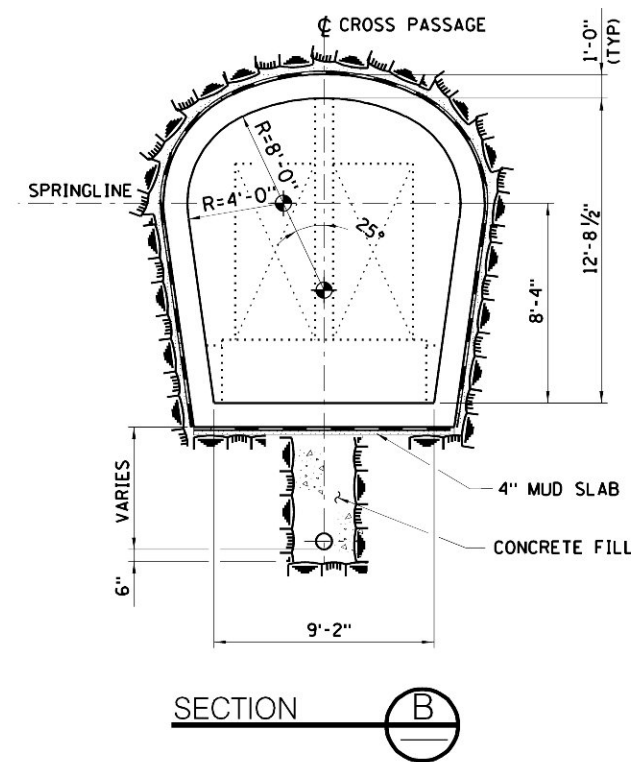
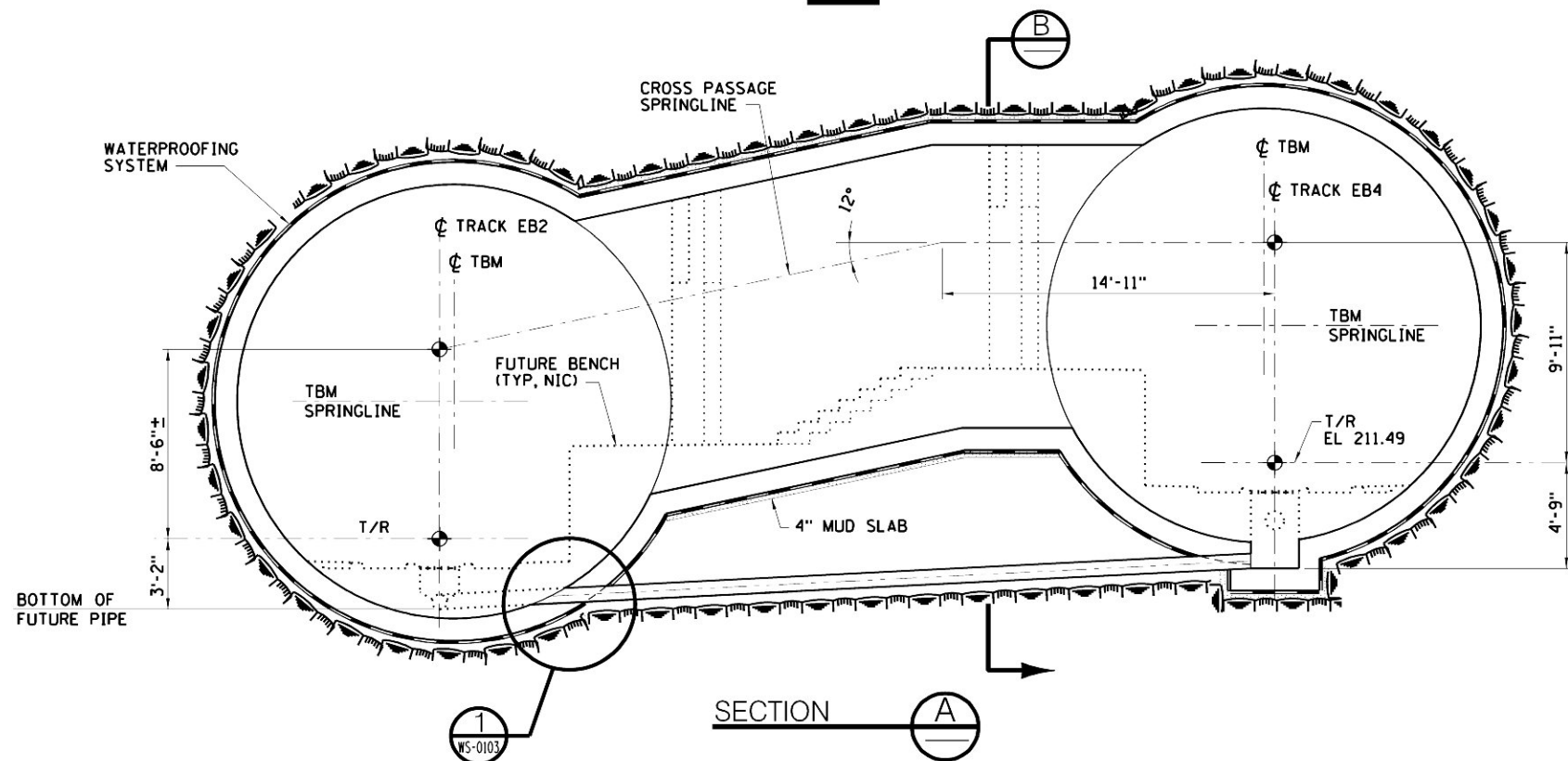


- NOTES:
1. FOR LOCATION OF CROSS PASSAGE, SEE DWGS CM009-ST-1010 AND CM009-ST-1110.
 2. INITIAL SUPPORT NOT SHOWN. SEE DWG CM009-RS-1070 FOR DETAILS.





- NOTES:
1. FOR LOCATION OF CROSS PASSAGE, SEE DWG CM009-ST-1011.
 2. INITIAL SUPPORT NOT SHOWN. SEE DWG CM009-RS-1070 FOR DETAILS.



SCALE IN FEET

4' 2' 0' 4' 8'

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MANHATTAN TUNNELS EXCAVATION
GENERAL ARRANGEMENT
INCLINED CROSS PASSAGE 5
FINAL LINER

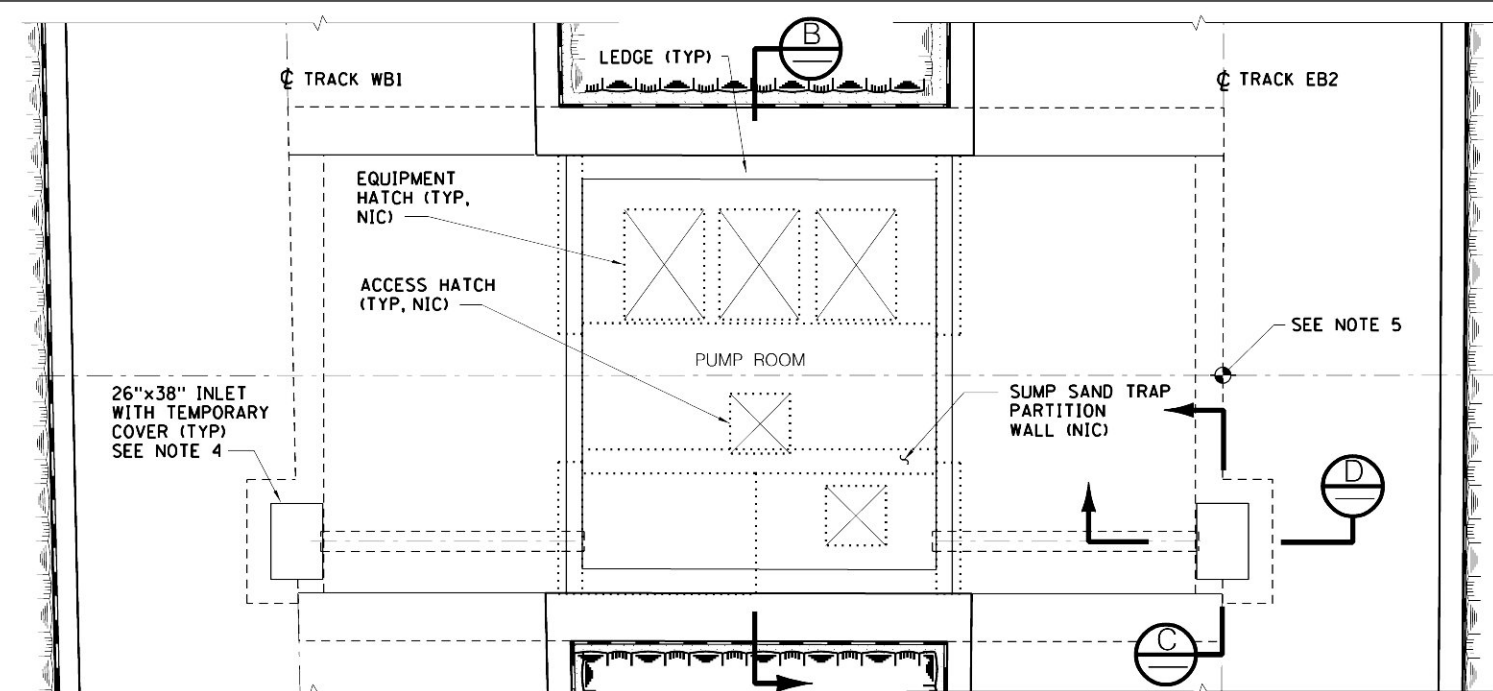
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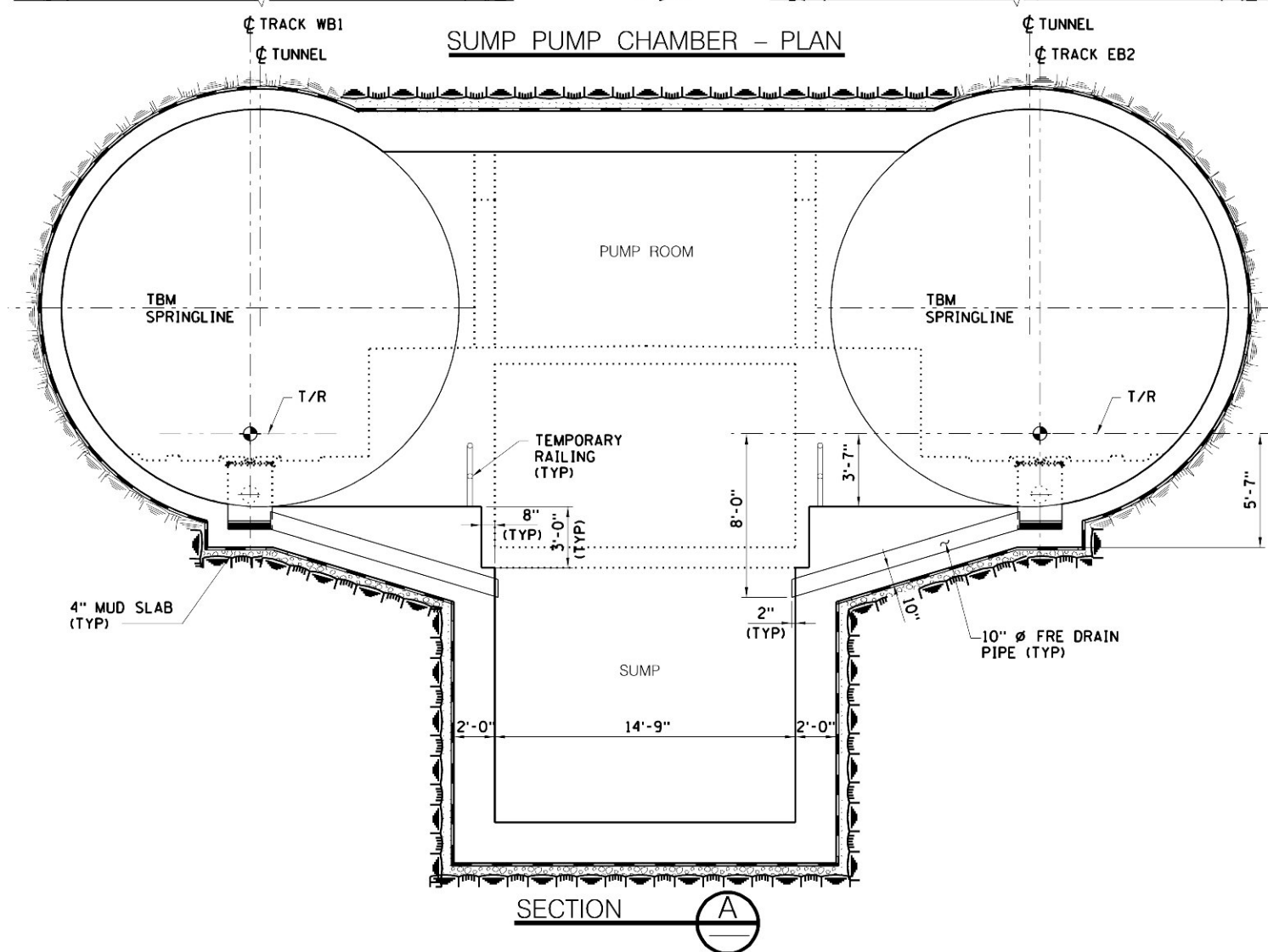
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SUMP PUMP CHAMBER - PLAN

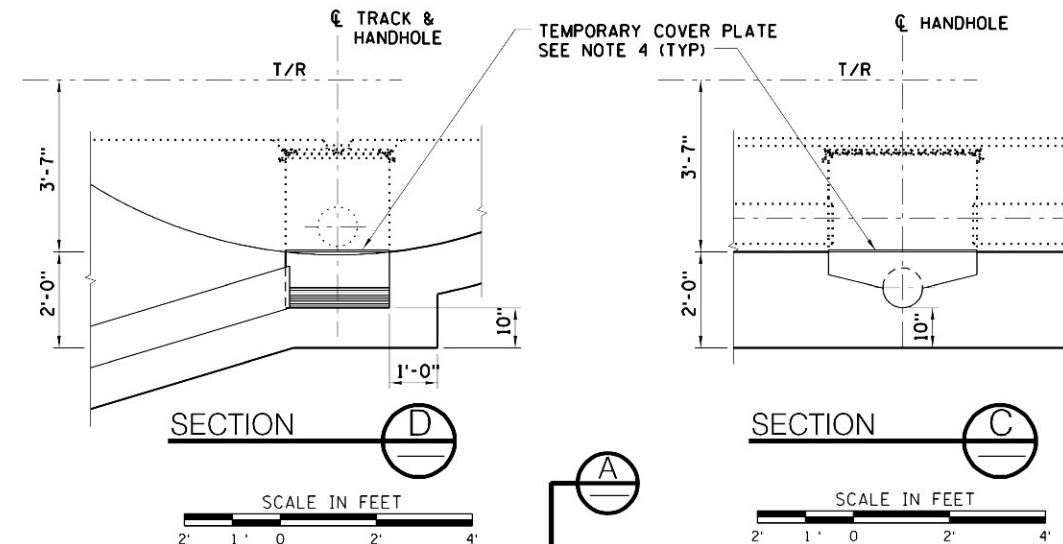


SECTION A-A

NOTES:

1. FOR WATERPROOFING DETAILS SEE CM009-WS-0105.
2. FOR REINFORCEMENT DETAILS SEE CM009-ST-1208.
3. FOR INITIAL SUPPORT AND EXCAVATION SEQUENCE SEE CM009-RS-1071.

4. INLET SHALL BE COVERED BY A TEMPORARY PERFORATED STEEL PLATE $\frac{1}{2}$ " THICK FASTENED TO TUNNEL INVERT WITH 4-1/2" DIA EXPANSION ANCHORS.
5. FOR LOCATION OF SUMP PUMP CHAMBER, SEE DWG CM009-ST-1008.

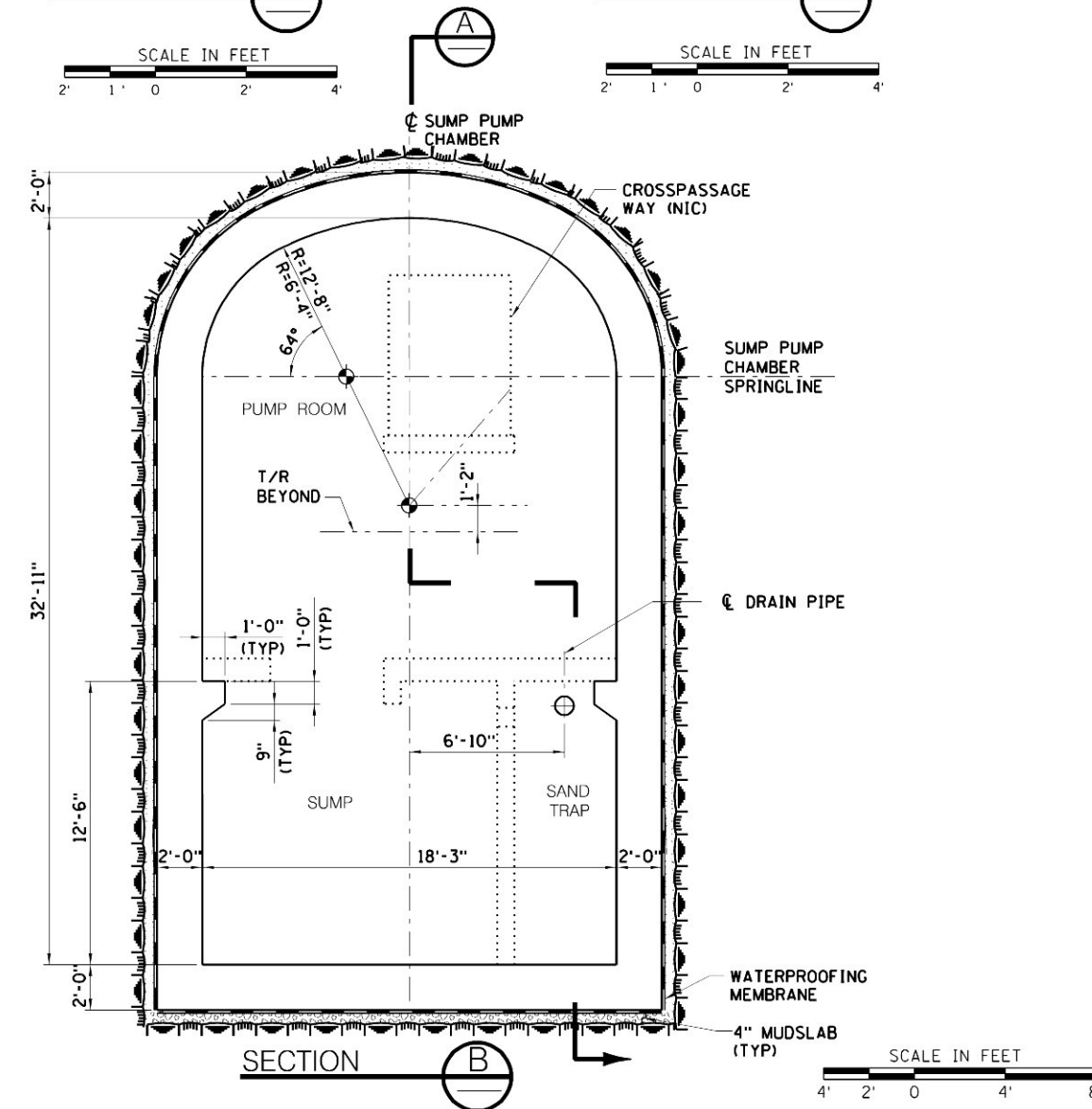


SECTION D-D

SECTION C-C

SCALE IN FEET

SCALE IN FEET



SECTION B-B

SCALE IN FEET

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APPROVED BY: J. SCHABIB	

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MANHATTAN TUNNELS EXCAVATION

GENERAL ARRANGEMENT
SUMP PUMP CHAMBER
FINAL LINER

SCALE AS NOTED
DRAWING NUMBER CM009-GP-0128
DATE: 3-24-06
REVISION NUMBER: 0

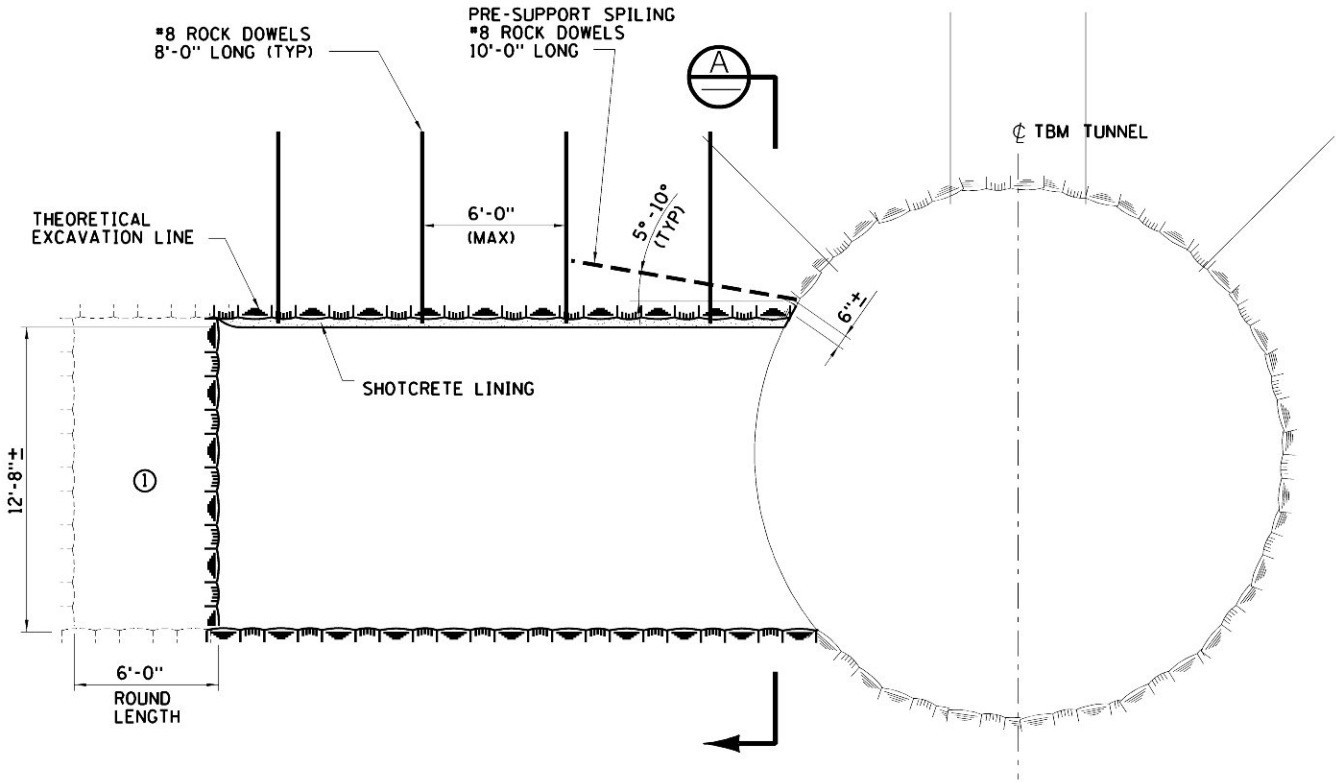
CONTRACT No. CM009
ISSUE
SHEET No. 17 OF 28

EXCAVATION SEQUENCE

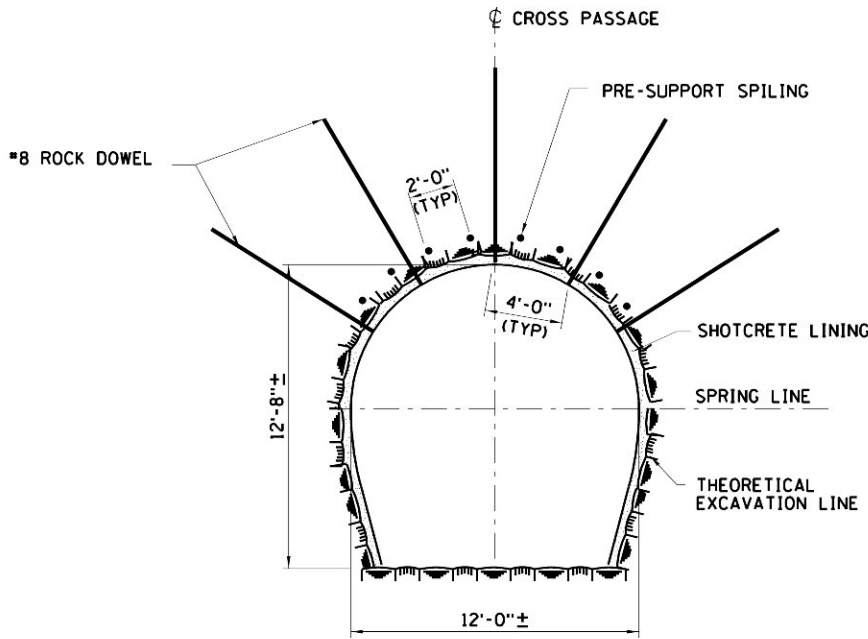
- STEP 1 - EXCAVATE ROUND ①
- STEP 2 - INSTALL ROCK DOWELS
- STEP 3 - APPLY INITIAL SHOTCRETE LAYER 2" (MIN)
- STEP 4 - INSTALL WWF
- STEP 5 - INSTALL SHOTCRETE TO 4" (MIN)
- STEP 6 - REPEAT STEPS 1-5 FOR NEXT ROUND

NOTES:

1. FOR SETTING OUT OF CROSS PASSAGE, SEE DWG CM009-GP-0121.
2. FOR CONFIGURATION OF INVER SLAB REFER TO WATERPROOFING DRAWINGS.
3. FOR SHOTCRETE LINING DETAILS AND SHOTCRETE SMOOTHNESS CRITERIA SEE DWGS CM009-RS-1100 AND CM009-RS-1102.



LONGITUDINAL SECTION



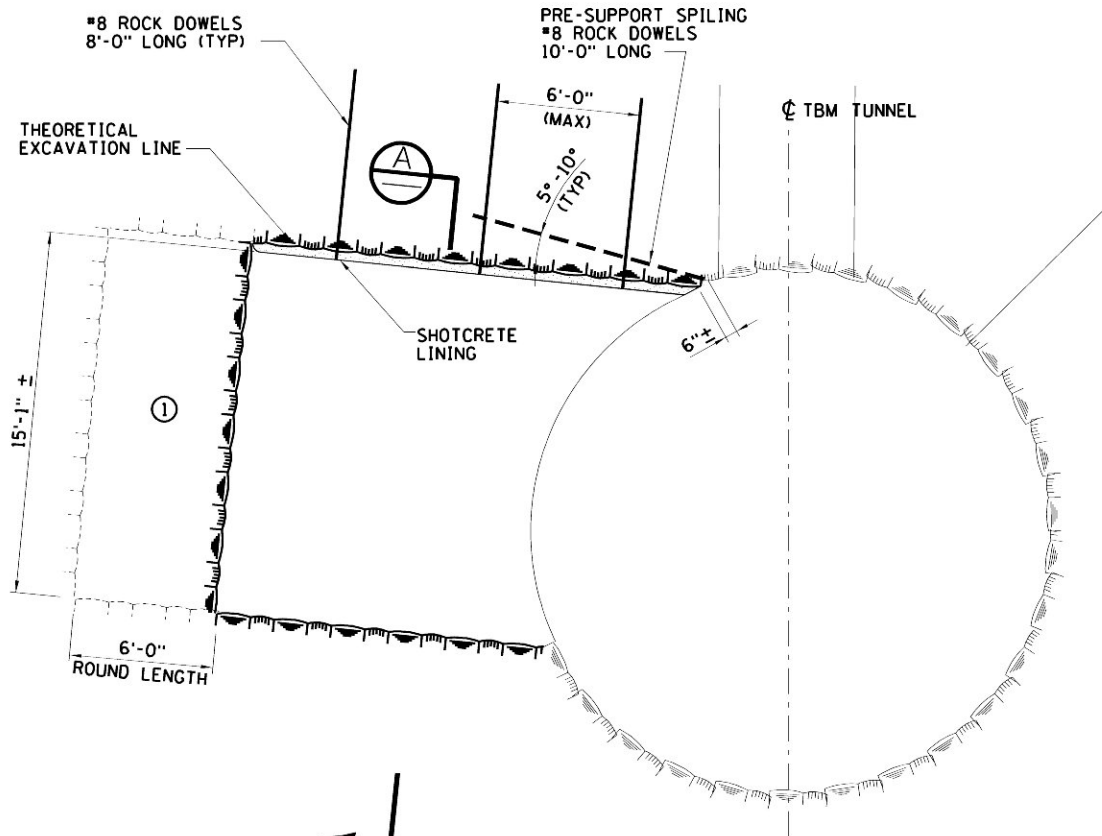
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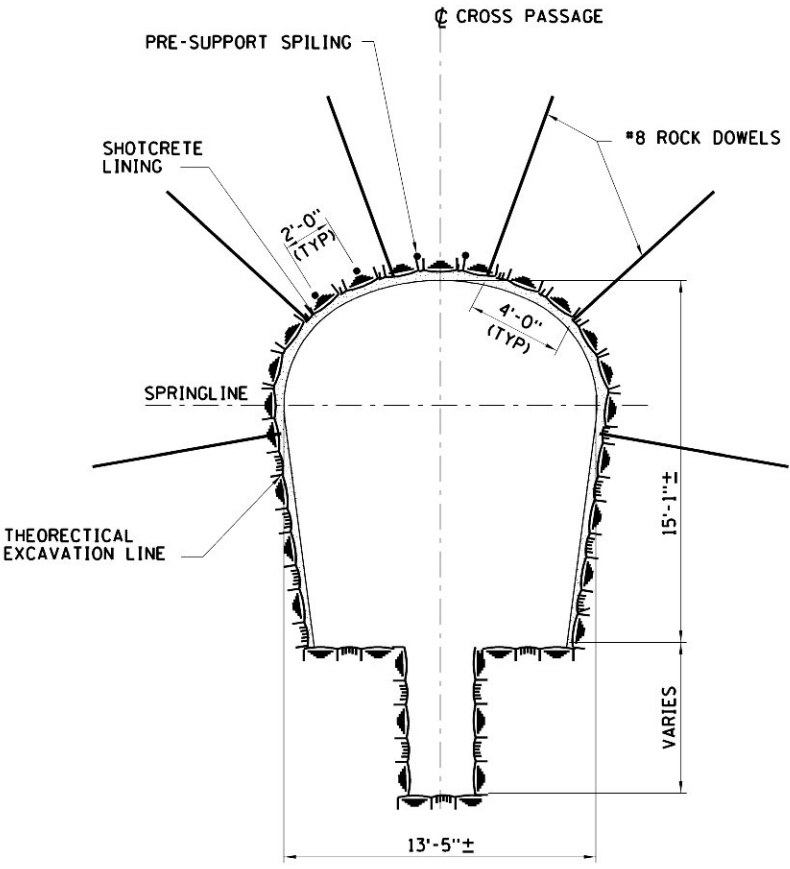
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- STEP 1 - EXCAVATE ROUND ①
STEP 2 - INSTALL ROCK DOWELS
STEP 3 - APPLY INITIAL SHOTCRETE LAYER 2" (MIN)
STEP 4 - INSTALL WWF
STEP 5 - INSTALL SHOTCRETE TO 4" (MIN)
STEP 6 - REPEAT STEPS 1-5 FOR NEXT ROUND

- NOTE:
1. FOR SETTING OUT AND GEOMETRY OF CROSS PASSAGES, REFER TO CM009-GP-0126 AND CM009-GP-0127.
 2. FOR CONFIGURATION OF INVERT SLAB REFER TO WATERPROOFING DWGS.
 3. FOR SHOTCRETE LINING DETAILS AND SHOTCRETE SMOOTHNESS CRITERIA SEE DWGS CM009-RS-1100 AND CM009-RS-1102.



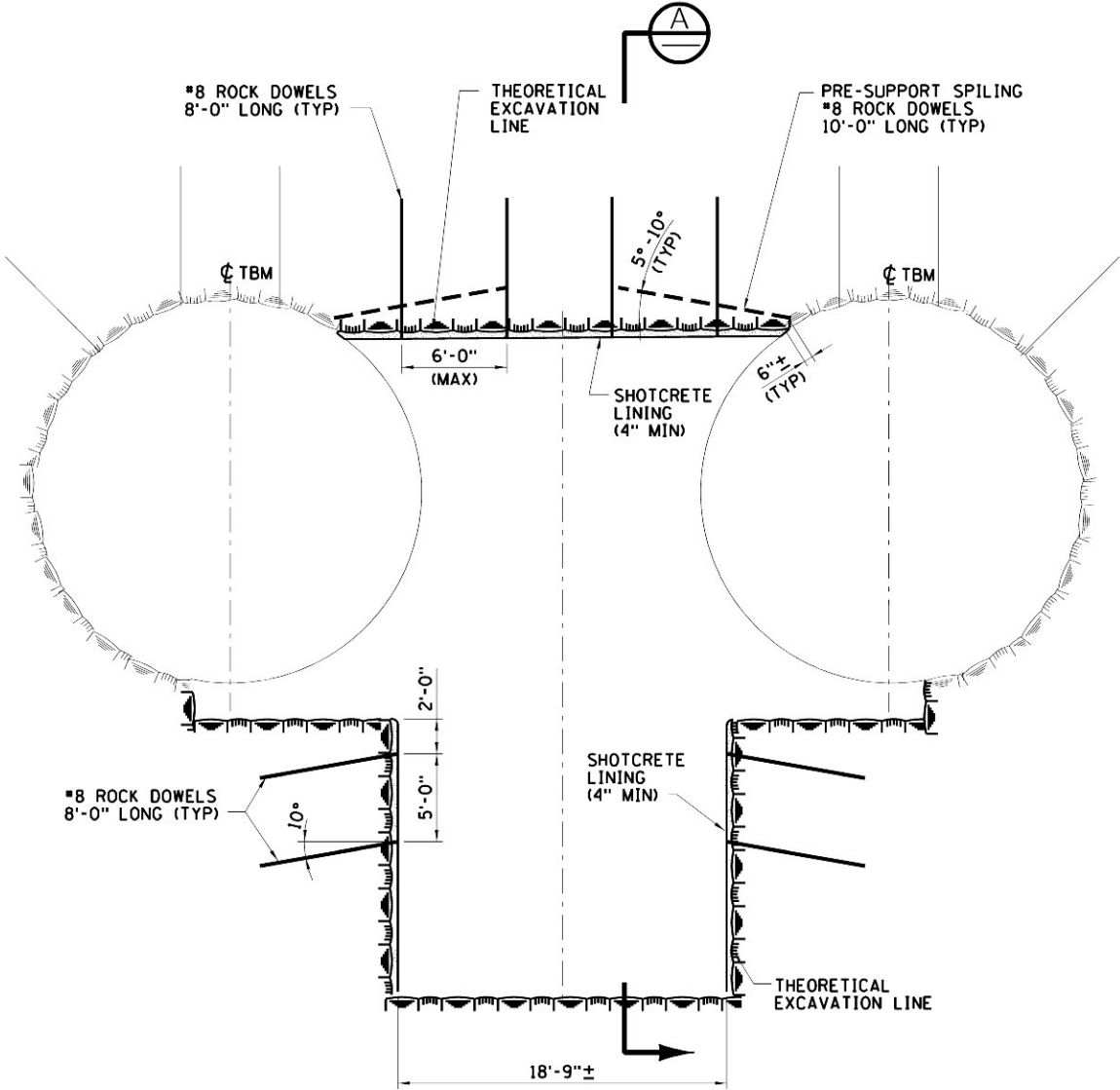
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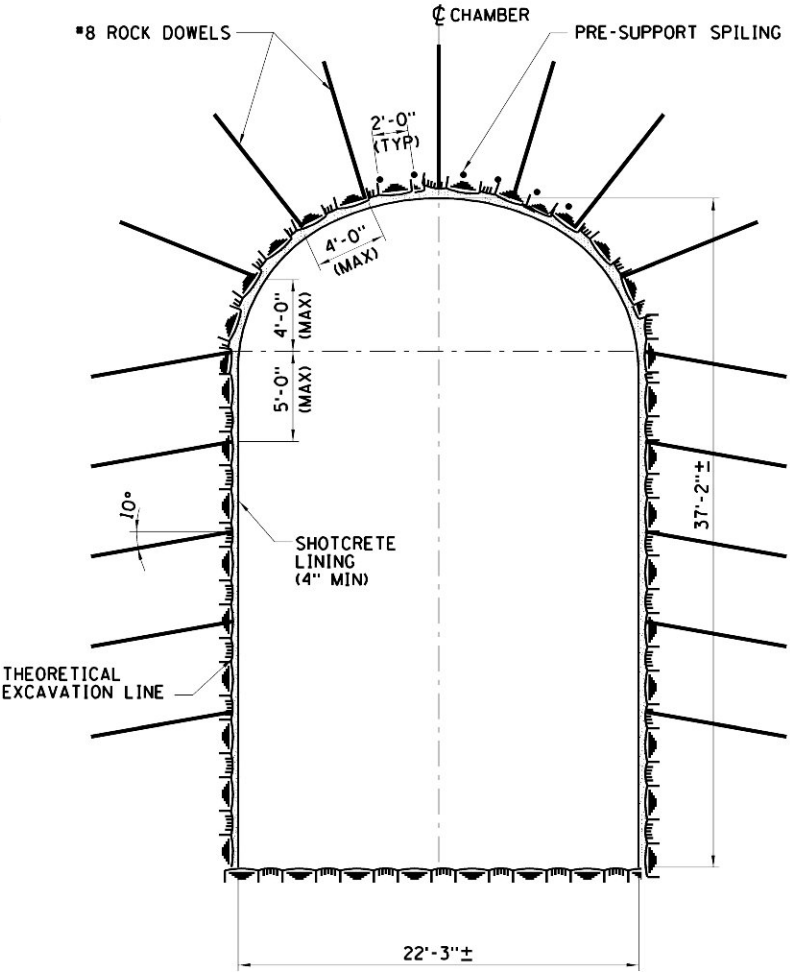
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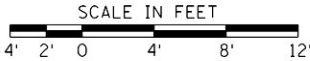
- NOTES:
1. FOR SETTING OUT AND GEOMETRY OF SUMP PUMP CHAMBER, SEE CM009-GP-0128.
 2. FOR CONFIGURATION OF INVERT SLAB SEE WATERPROOFING DRAWINGS.
 3. FOR SHOTCRETE LINING DETAILS AND SHOTCRETE SMOOTHNESS CRITERIA SEE DWG CM009-RS-1100 AND CM009-RS-1102.



LONGITUDINAL-SECTION



SECTION A-A



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MANHATTAN TUNNELS EXCAVATION

INITIAL SUPPORT AND EXCAVATION SEQUENCE
SUMP PUMP CHAMBER

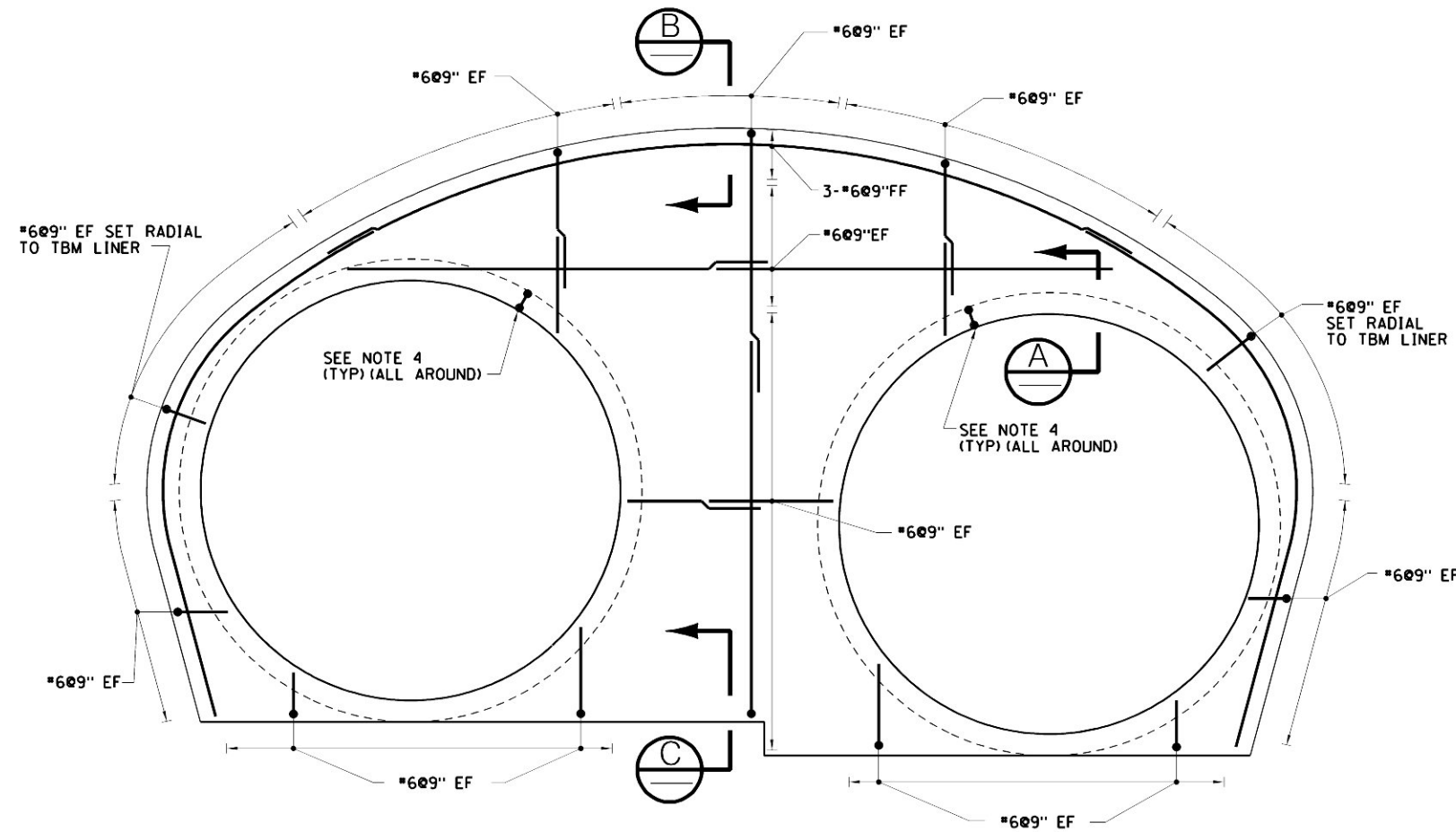
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DRAWING NUMBER:
CM009-RS-1071
DATE:
3-24-06
REVISION NUMBER:
0

CONTRACT No.
CM009
ISSUE
SHEET No.
20 OF 28

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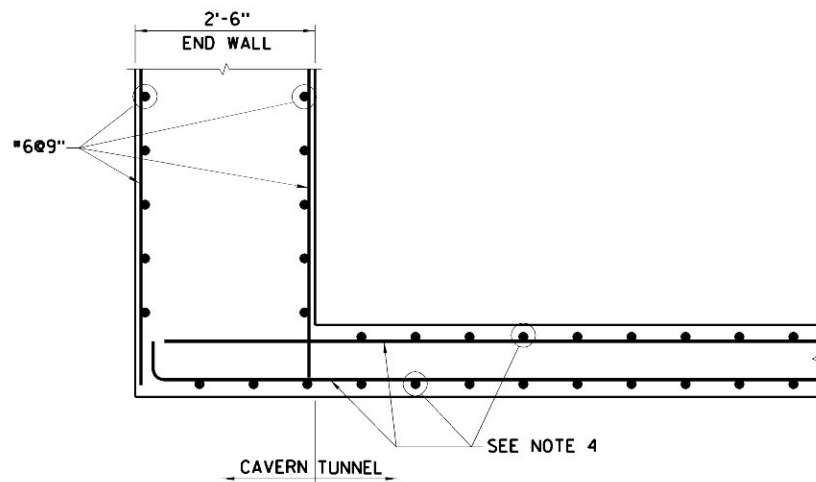
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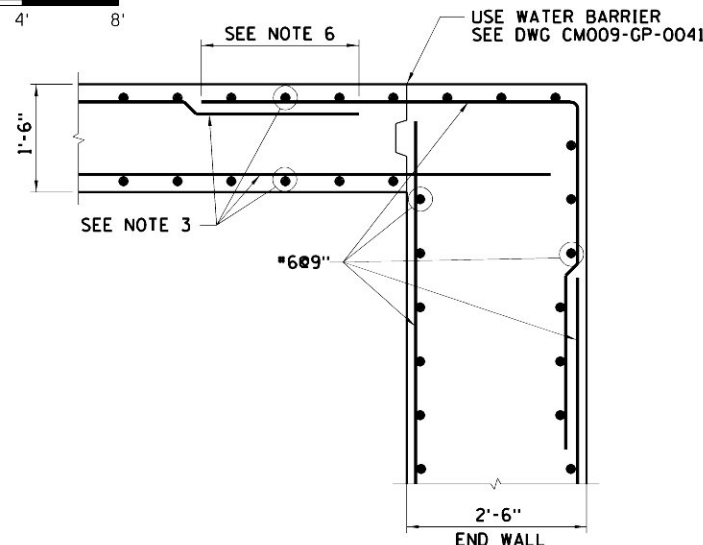


GCT 5 WYE CAVERN
SOUTH END WALL REINFORCEMENT DETAILS
EAST CAVERN SHOWN, WEST OPPOSITE HAND

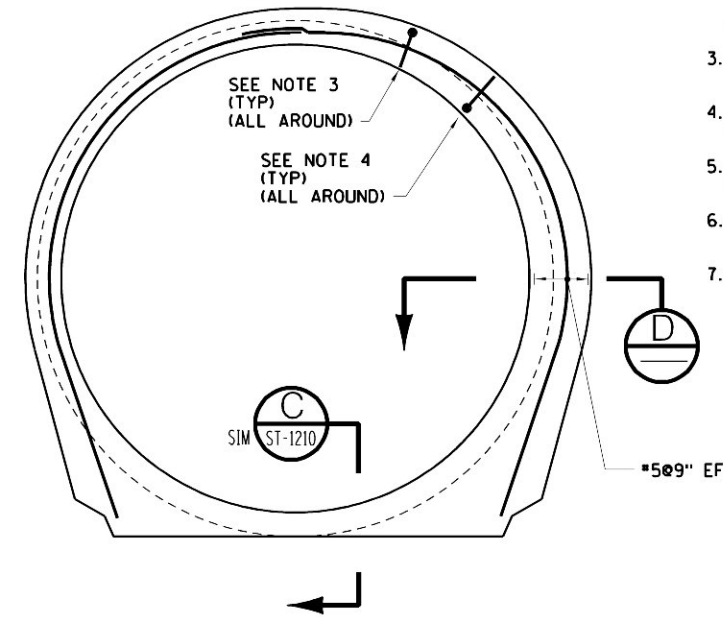
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SECTION A
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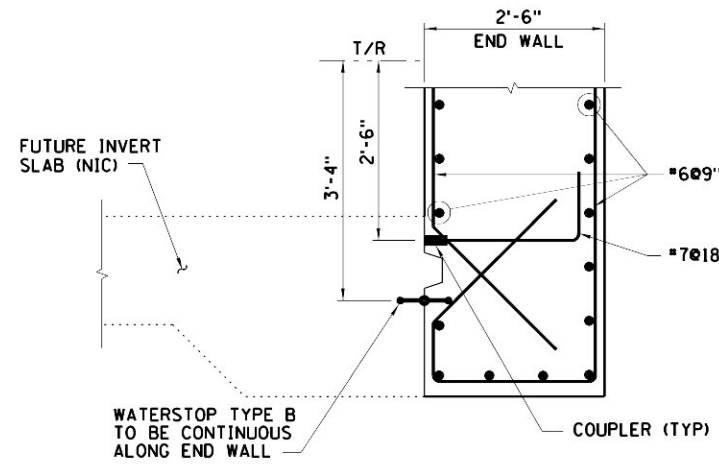


SECTION B
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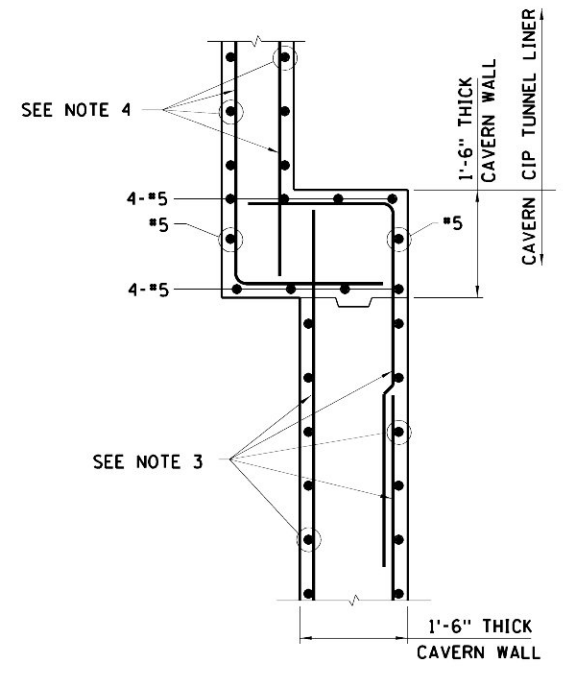


GCT 5 WYE CAVERN
NORTH END WALL REINFORCEMENT DETAILS
EAST CAVERN SHOWN, WEST OPPOSITE HAND

SCALE IN FEET
4' 2' 0 4' 8'



SECTION C
SCALE IN FEET
1' .5' 0 1' 2' 3'



SECTION D
SCALE IN FEET
1' .5' 0 1' 2' 3'

NOTES:

1. SEE DWG CM009-ST-1011 FOR CAVERN GENERAL ARRANGEMENT AND LIMITS.
2. LOCATIONS OF CONSTRUCTION JOINTS ARE SUGGESTED. THEY SHALL BE COORDINATED WITH THE WATERPROOFING SYSTEM SHOWN ON DWG CM012-WS-0101. FOR SECTION A, THE CONTRACTOR MAY PROPOSE CONSTRUCTION JOINT FOR END WALL AND TUNNEL LINING INTERFACE.
3. FOR GCT 5 WYE CAVERN LINER REINFORCEMENT, SEE DWG CM009-ST-1203.
4. FOR TBM CAST-IN-PLACE TUNNEL LINER REINFORCEMENT, SEE DWG CM009-ST-1211.
5. FOR SETTING OUT OF WYE CAVERNS AND WORKING POINTS, SEE DWG CM009-GP-0120.
6. FOR MINIMUM CONCRETE COVER, LAP SPLICE AND DEVELOPMENT LENGTHS SEE DWG STD-SS-1004.
7. FOR TYPICAL CONSTRUCTION JOINT DETAILS SEE DWG STD-SS-0101.

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DRAWN BY: A. BEKKER	
CHECKED BY: K. ONCU	
COORDINATED BY: M. DELLA POSTA	
APPROVED BY: J. SCHABIB	

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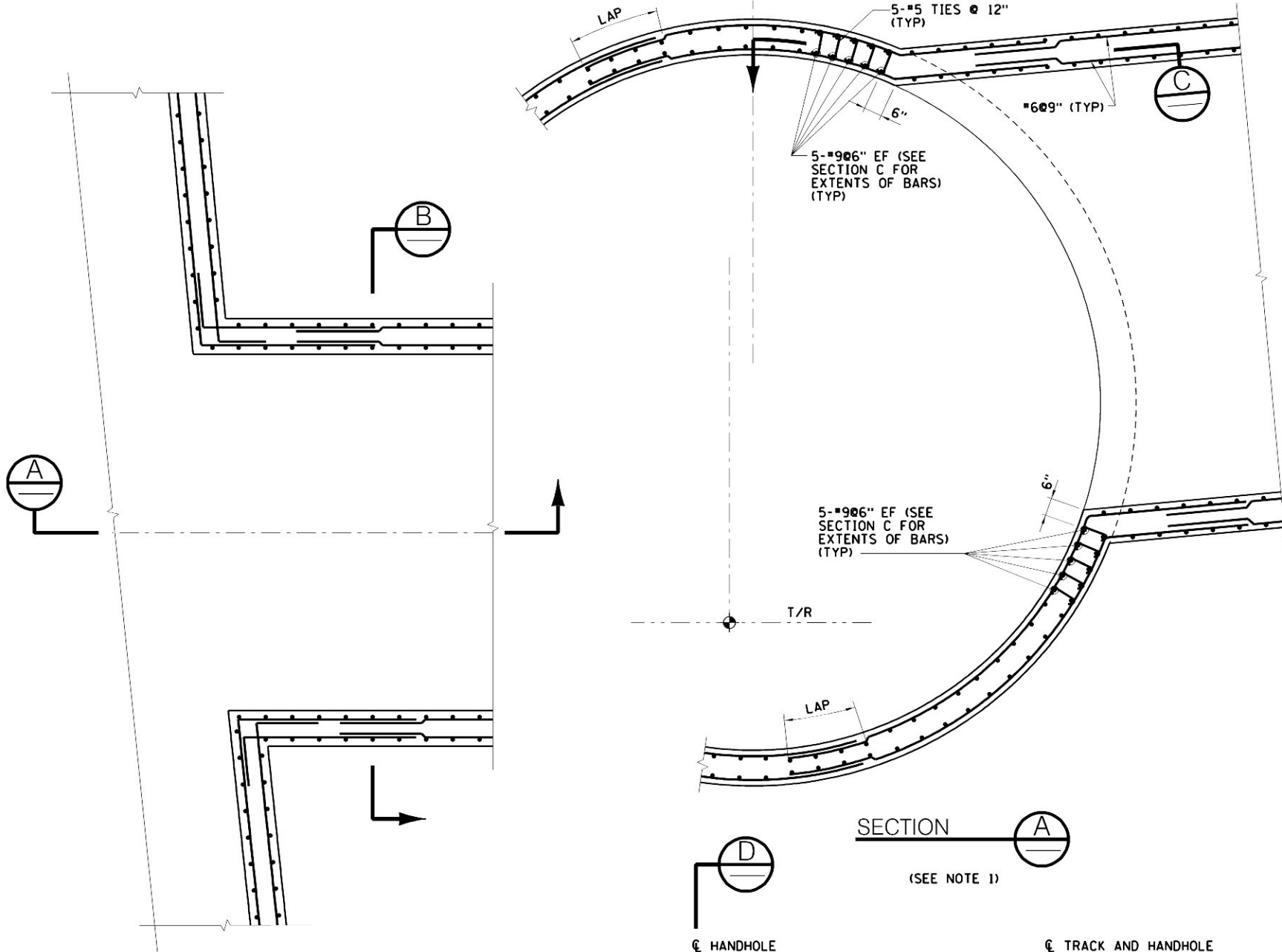
MANHATTAN TUNNELS EXCAVATION
REINFORCEMENT DETAILS
GCT 5 WYE CAVERN END WALLS

SCALE AS NOTED	CONTRACT No. CM009
DRAWING NUMBER CM009-ST-1205	ISSUE
DATE: 3-24-06	SHEET No. 21 OF 28
REVISION NUMBER: 0	

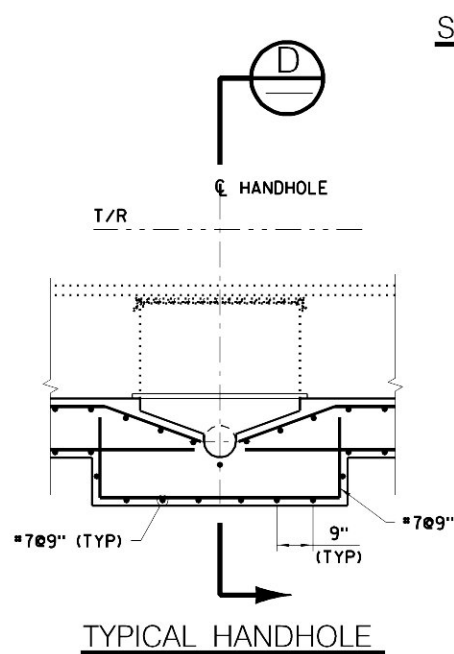
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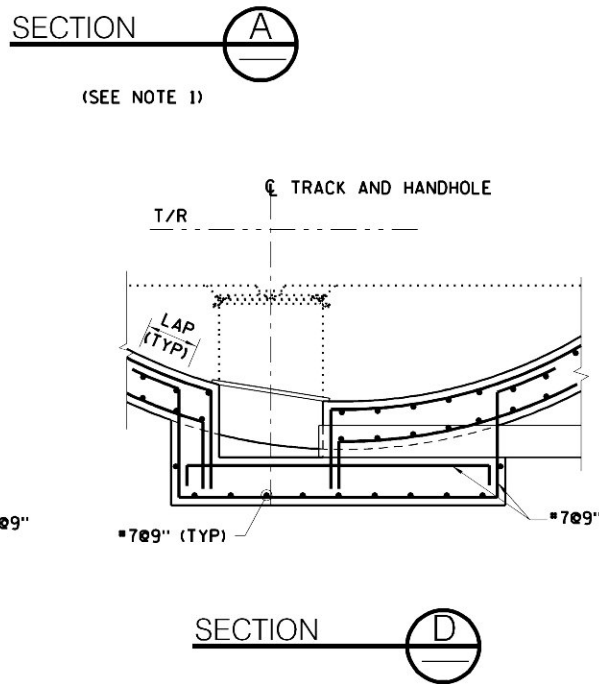
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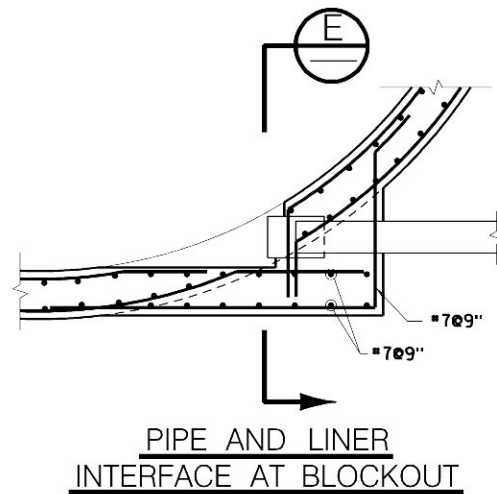
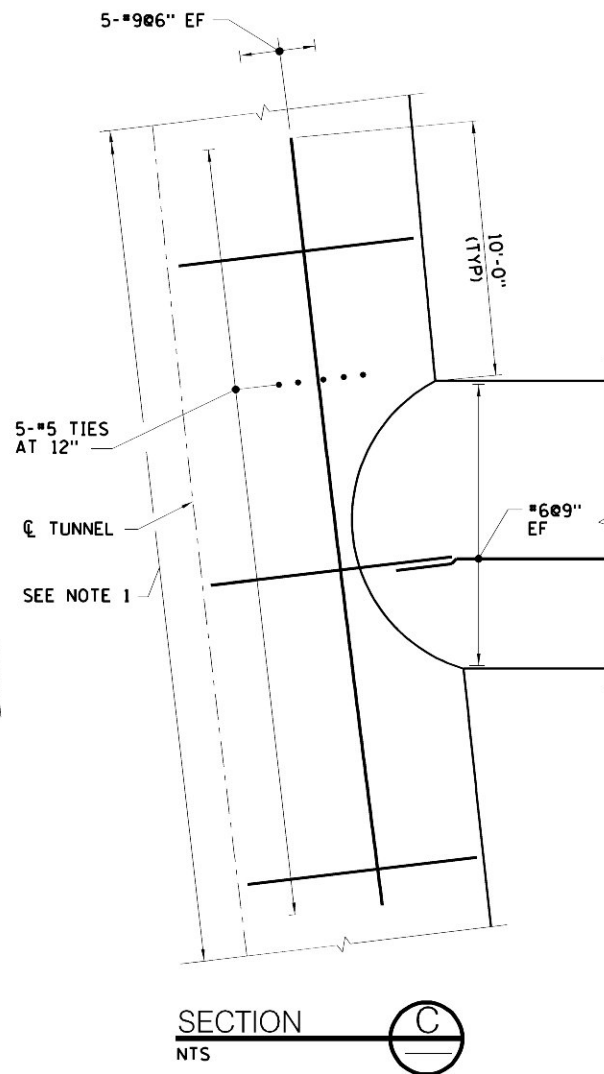
CROSS PASSAGE AND
TUNNEL INTERFACE – PLAN
(SEE NOTE 1)



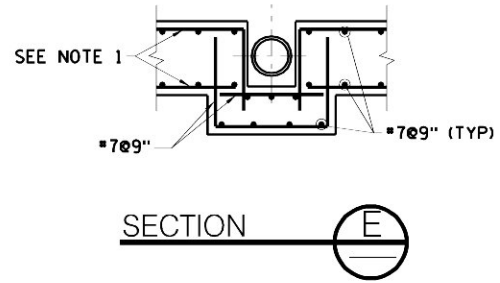
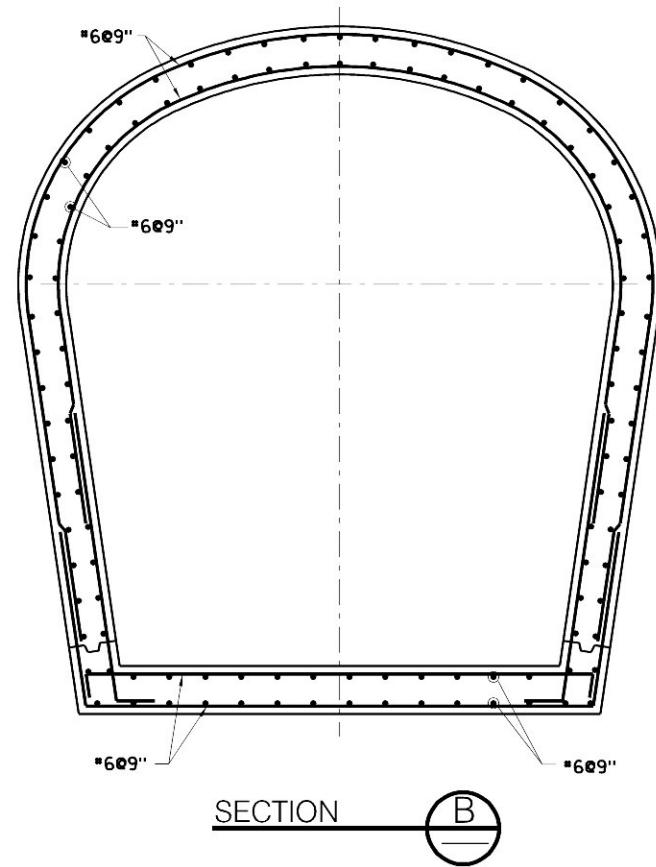
TYPICAL HANDHOLE



SECTION D-D



PIPE AND LINER
INTERFACE AT BLOCKOUT



- NOTES:
1. FOR CAST-IN-PLACE LINER REINFORCEMENT DETAILS, SEE DWG CM009-ST-1211.
 2. INCLINED CROSS PASSAGE #5 SHOWN, OTHERS SIMILAR.

SCALE IN FEET
2' 1' 0' 2' 4'

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DRAWN BY:
J. RICCARDI
CHECKED BY:
M. ELLWOOD
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M. DELLA POSTA
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J. SCHABIB

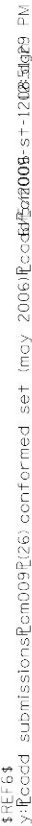
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MANHATTAN TUNNELS EXCAVATION
REINFORCEMENT DETAILS
CROSS PASSAGES

SCALE
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DRAWING NUMBER:
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DATE:
3-24-06
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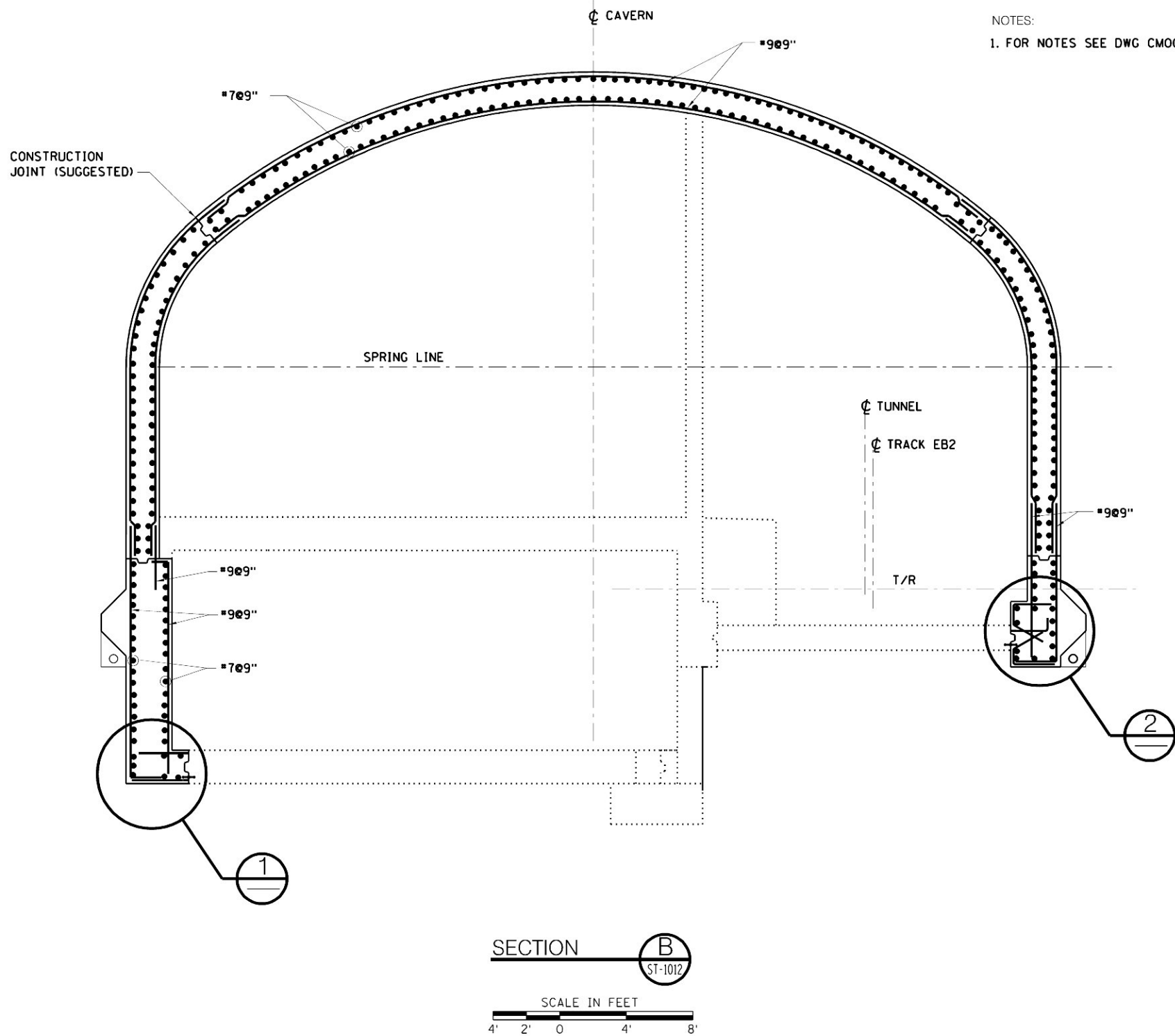
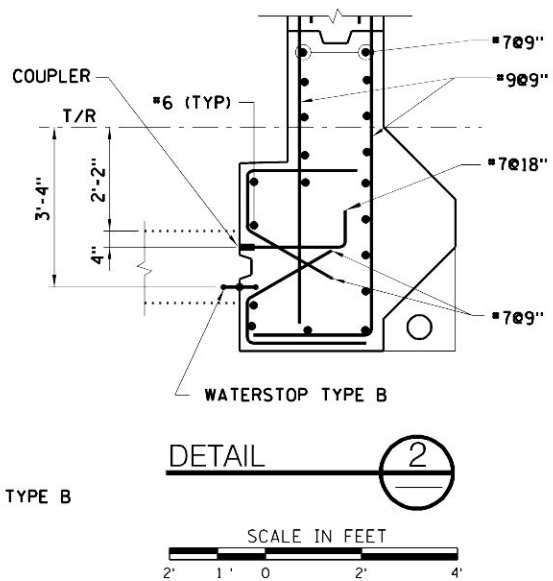
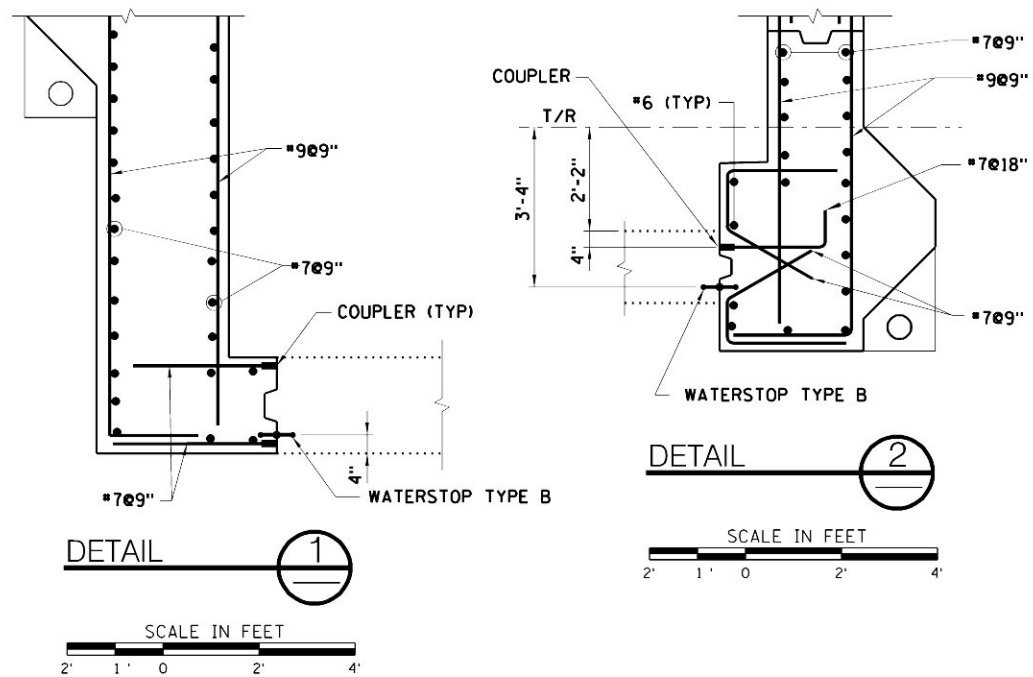
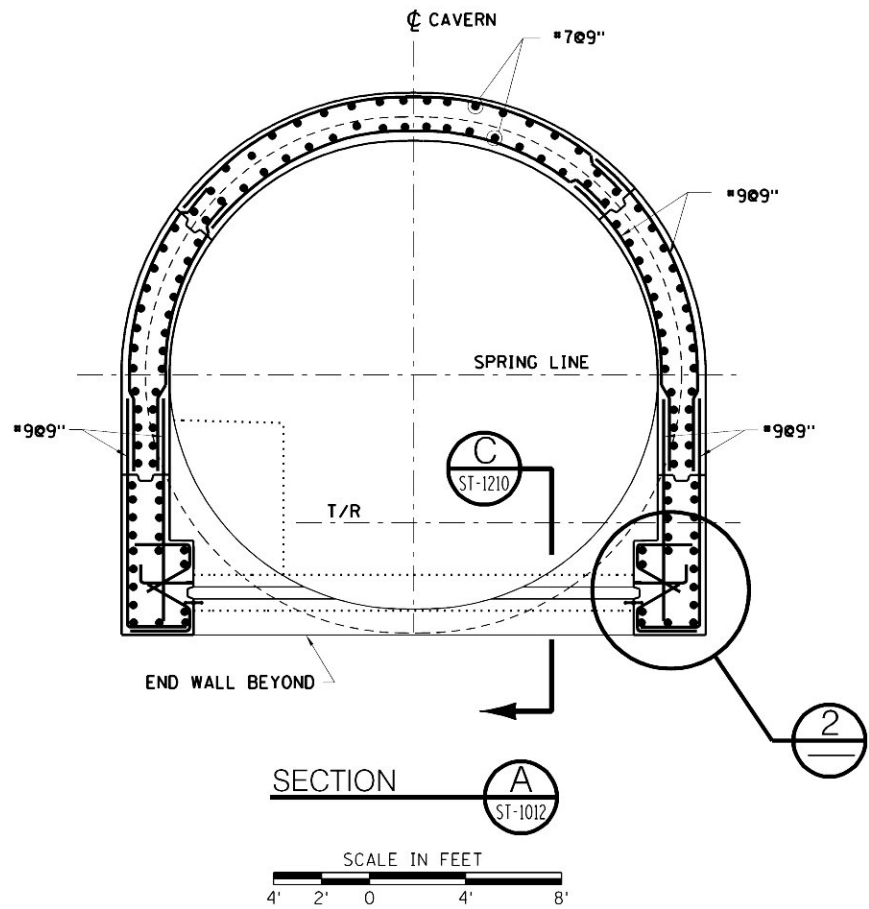
CONTRACT No.
CM009
ISSUE
SHEET No.
22 OF 28

1. SEE DWG CMO09-ST-1008 FOR LIMITS OF CAST IN PLACE LINER.
2. REFER TO GENERAL NOTES ON DWG STD-SS-1004 FOR MINIMUM REINFORCEMENT COVER MINIMUM SPLICE AND MINIMUM DEVELOPMENT LENGTHS.
3. REFER TO DWG STD-SS-0201 FOR CONSTRUCTION JOINT AND WATERSTOP DETAILS.
4. FOR REINFORCEMENT DETAILS AT THE TUNNEL LINING WITH THE SUMP PUMP CHAMBER, SEE DWG CMO09-ST-1206.
5. FOR REINFORCEMENT DETAILS AT MANHOLE LOCATIONS, SEE CMO09-ST-1206.
6. FOR GENERAL ARRANGEMENT, SEE DWG CMO09-GP-0128.



\$PRFNAME\$
s(PLOTDRW)

\$REF\$3
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NOTES:
1. FOR NOTES SEE DWG CM009-ST-1210.

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DATE:	REVISIONS	No.

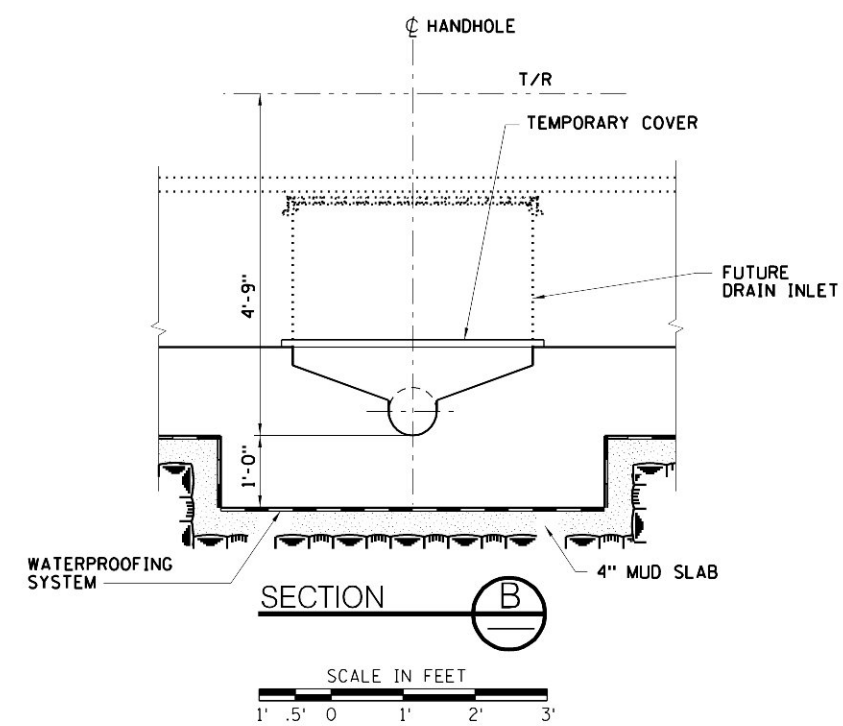
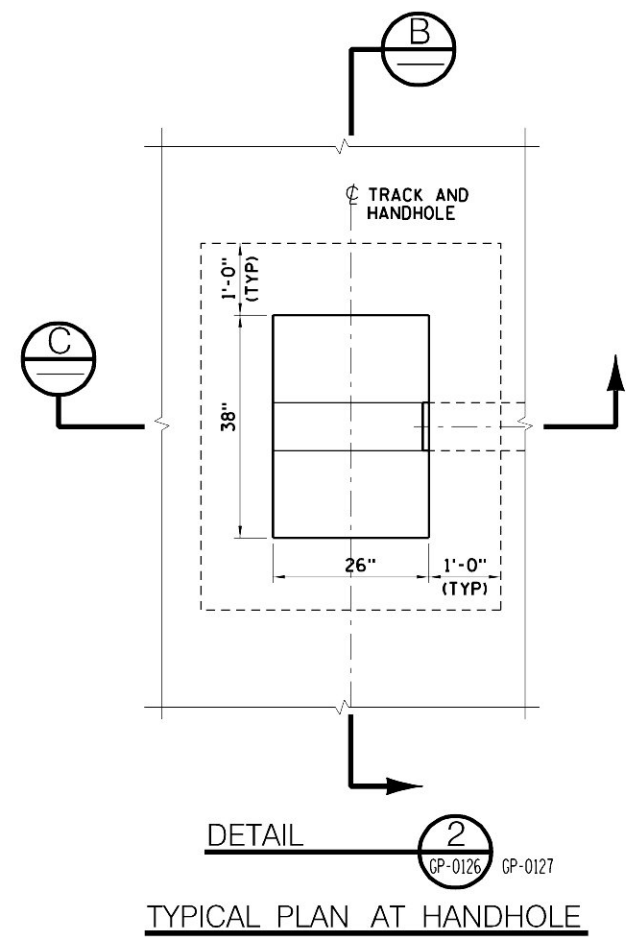
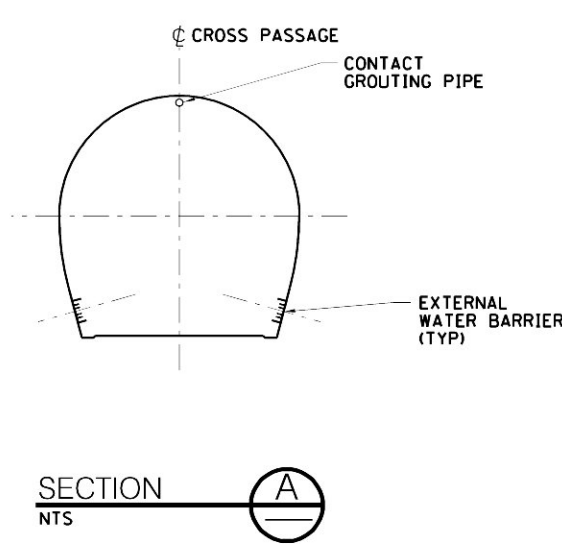
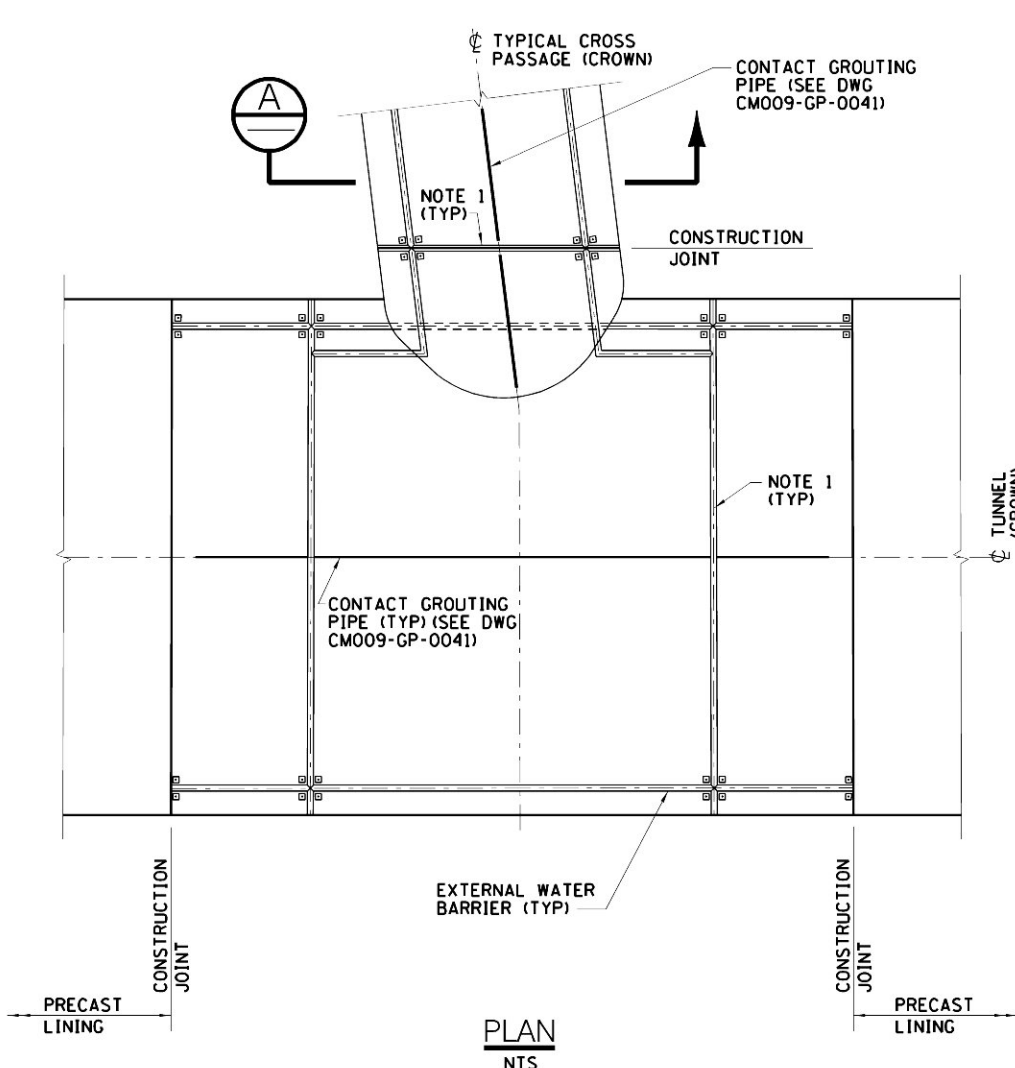
DESIGNED BY:
H. REZAEI
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CHECKED BY:
O. DORWAY
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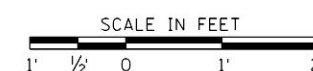
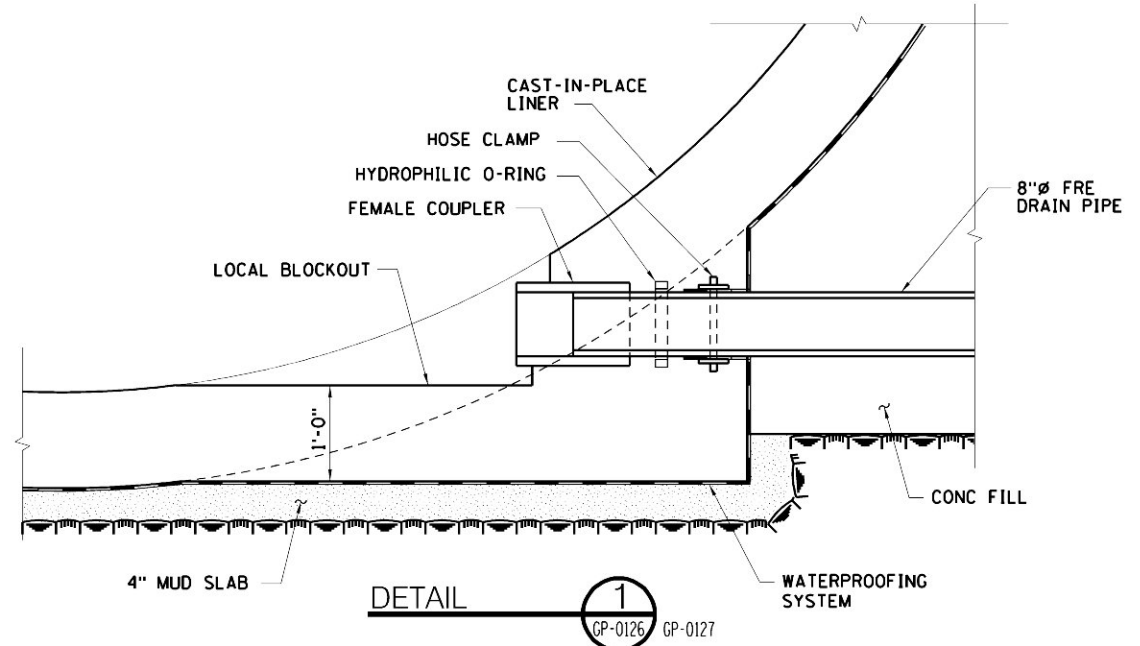
MANHATTAN TUNNELS EXCAVATION
REINFORCEMENT DETAILS
CROSS FLUE
SHEET 1

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DRAWING NUMBER
CM009-ST-1209
DATE:
3-24-06
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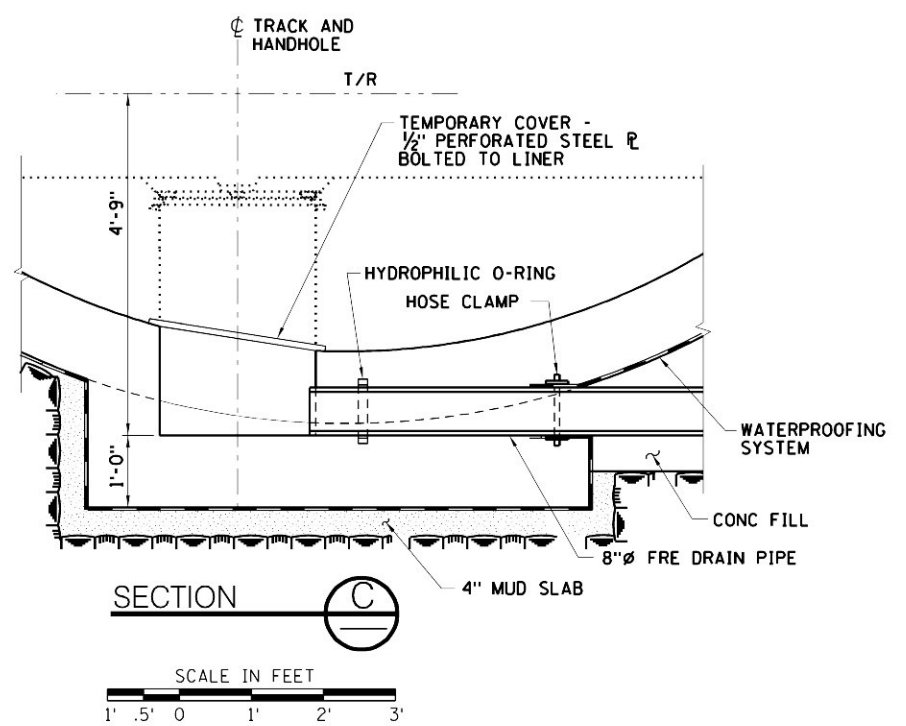
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ISSUE
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24 OF 28

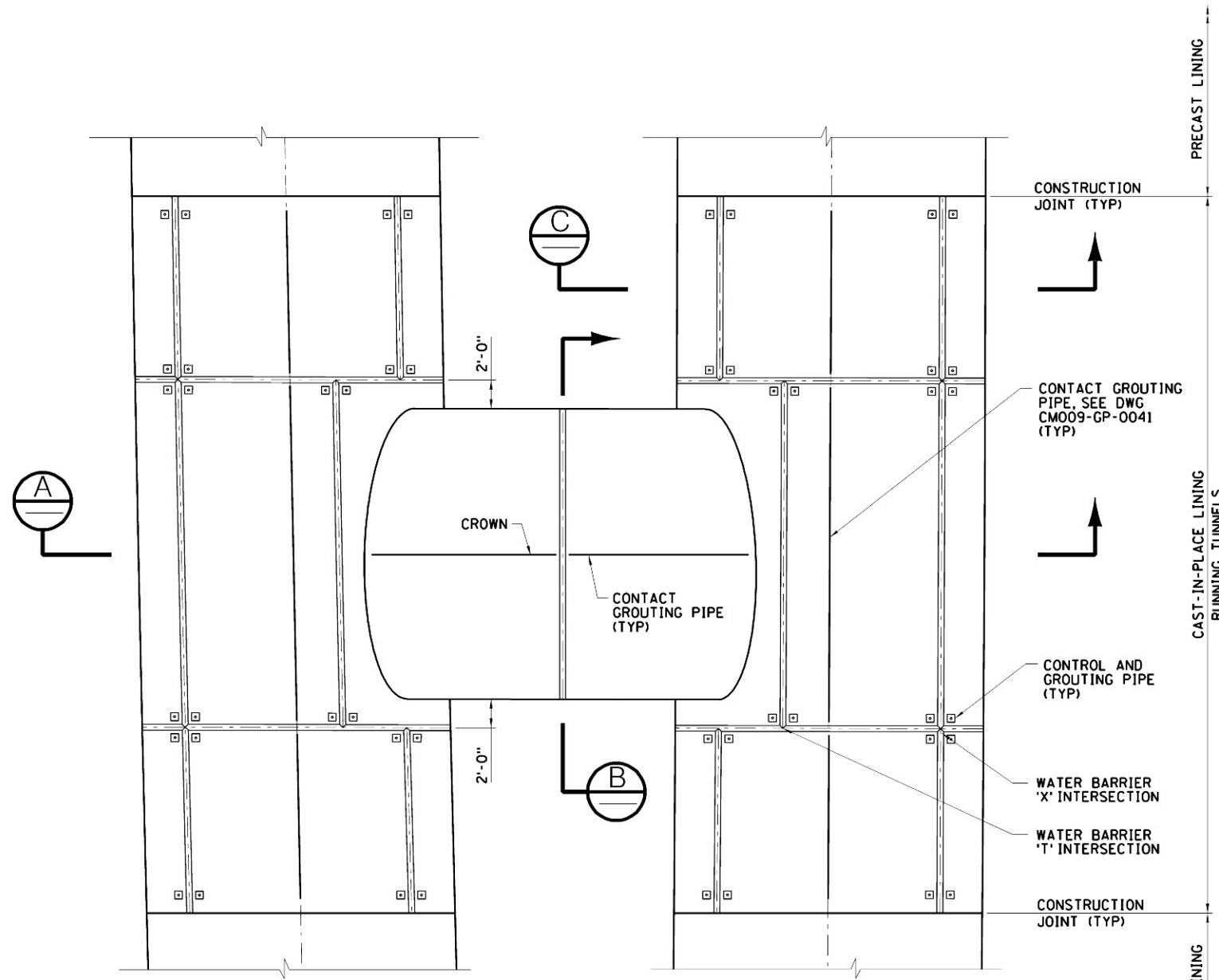


- NOTES:
1. VERTICAL EXTERNAL WATER BARRIER EXTENDS 360° AROUND PERIMETER OF TUNNEL.
 2. LOCATIONS OF WATER BARRIERS SHOWN ARE SUGGESTED. EXACT LOCATIONS ARE TO BE COORDINATED WITH CONSTRUCTION JOINTS. MAXIMUM SPACING OF WATER BARRIERS IS 40-FT.
 3. FOR ADDITIONAL WATERPROOFING DETAILS SEE DWG CM009-WS-0101.
 4. WHERE PIPE PENETRATES THE WATERPROOFING MEMBRANE, PROVIDE PVC MEMBRANE SLEEVE WELDED TO MAIN PVC MEMBRANE SHEET. INSTALL STAINLESS STEEL HOSE CLAMP CLEAR OF BENDS AND TAPERS. APPLY SILICON PASTE OR APPROVED EQUAL, BETWEEN PIPE AND SLEEVE AT CLAMP LOCATION.
 5. FOR HANDHOLE AND BLOCKOUT REINFORCEMENT DETAILS, SEE DWG CM009-ST-1206.

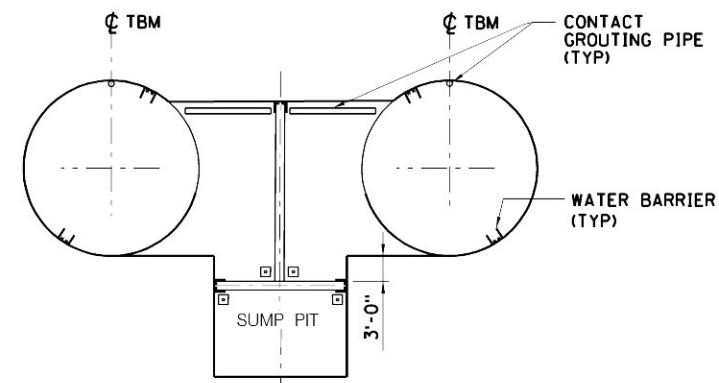


PIPE AND LINER INTERFACE AT BLOCKOUT

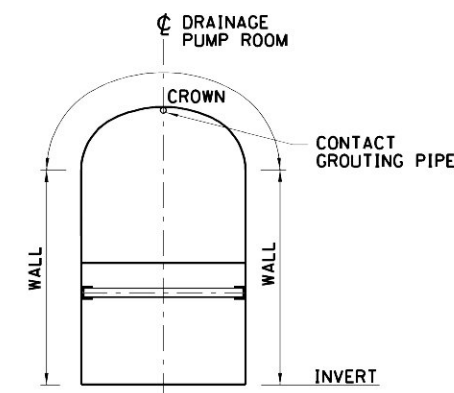




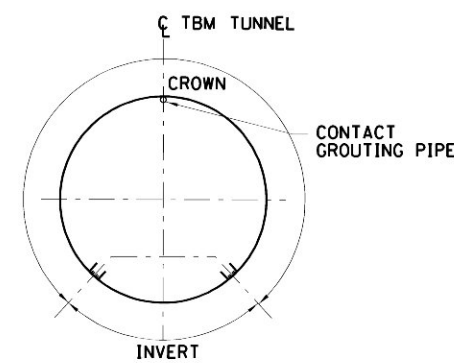
SUMP PUMP CHAMBER PLAN



SECTION A



SECTION B



SECTION C

- NOTES:
1. THIS DRAWING DEPICTS THE SUBDIVISION OF WATERPROOFING INTO INDIVIDUAL SECTIONS BY WATER BARRIERS, THE LOCATION OF CONTROL AND GROUTING PIPES AND THE LOCATION OF CONTACT GROUTING PIPES. SEE SPECIFICATION SECTIONS 07122 AND 02425.
 2. SEE DRAWINGS CM009-ST-1008 AND CM009-GP-0128 FOR LOCATION AND GENERAL ARRANGEMENT OF SUMP PUMP CHAMBER.
 3. FOR ADDITIONAL NOTES AND DETAILS, SEE DWG CM009-WS-0101.

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F. BUDAY
DRAWN BY:
J. RICCARDI
CHECKED BY:
D. SMITH
COORDINATED BY:
M. DELLA POSTA
APPROVED BY:
J. SCHABIB

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MANHATTAN TUNNELS EXCAVATION

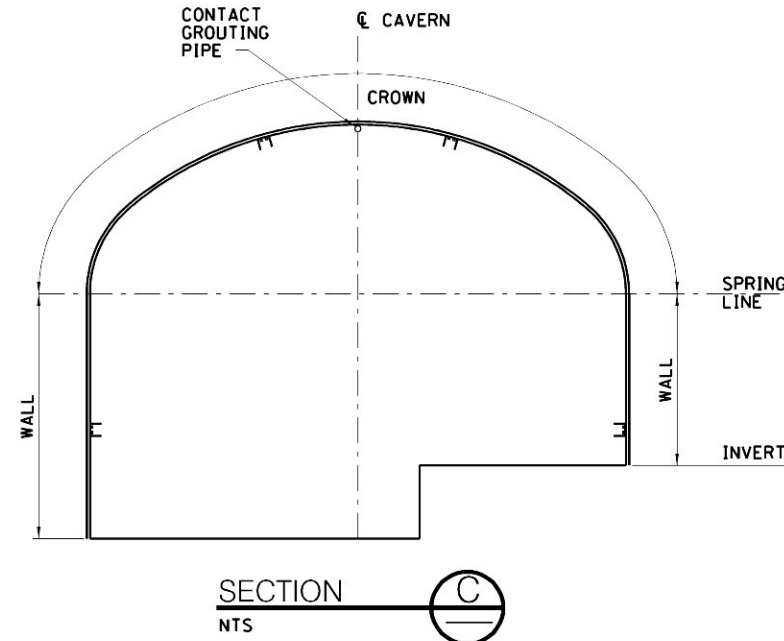
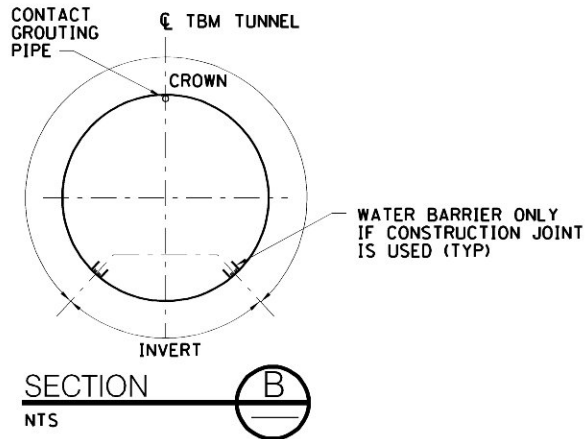
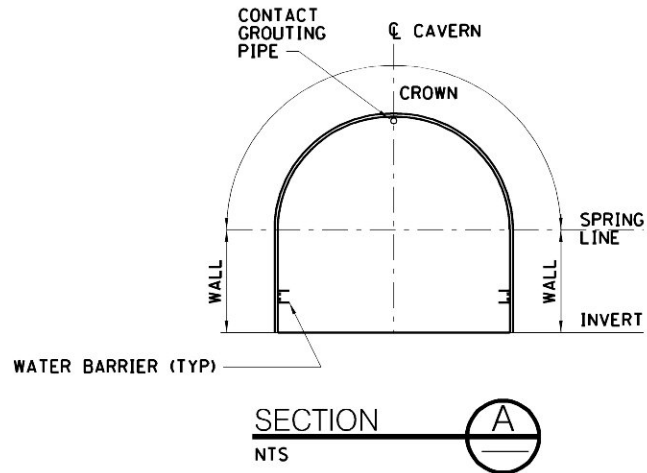
WATERPROOFING DETAILS
SUMP PUMP CHAMBER

SCALE: NOT TO SCALE
DRAWING NUMBER: CM009-WS-0105
DATE: 3-24-06
REVISION NUMBER: 0

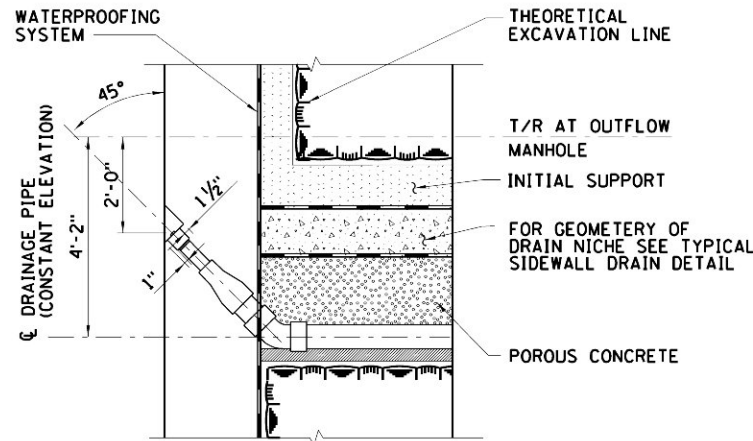
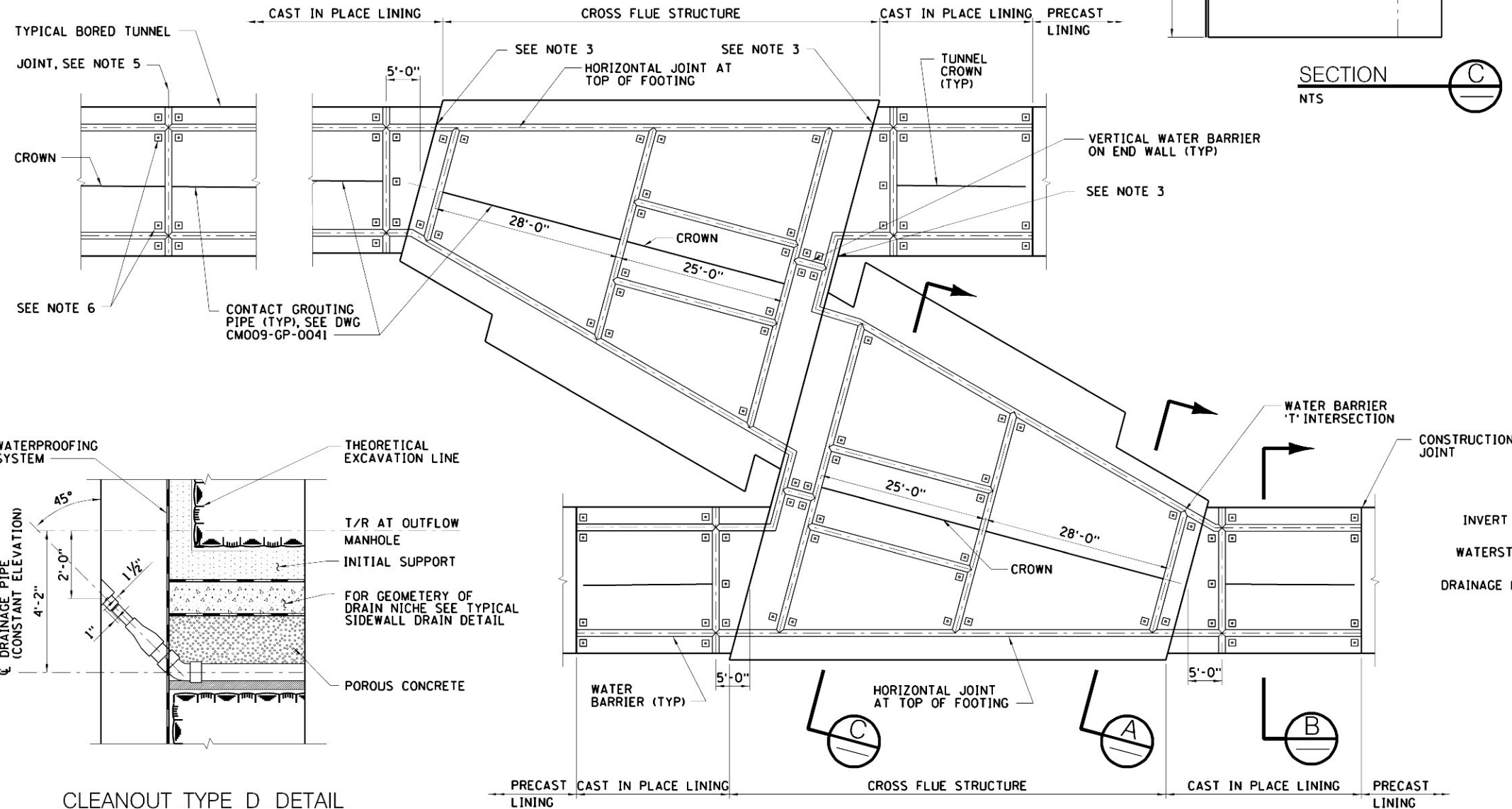
CONTRACT No. CM009
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SHEET No. 27 OF 28

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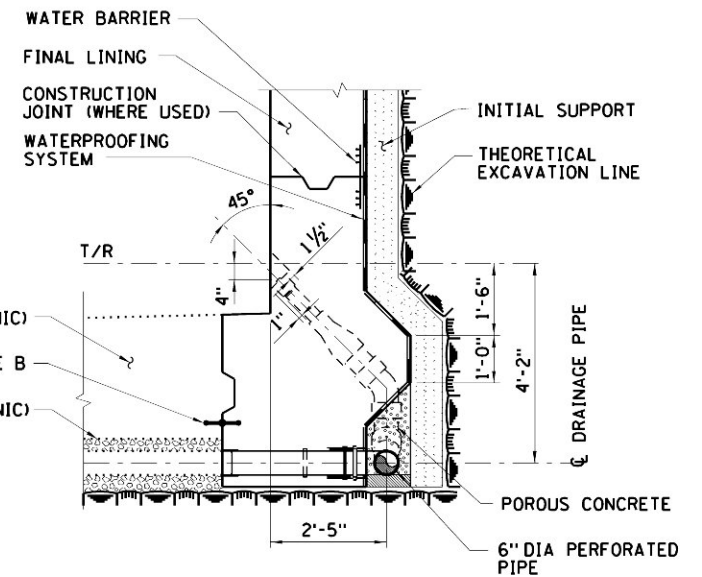


- NOTES:
1. THIS DRAWING DEPICTS THE SUBDIVISION OF WATERPROOFING INTO INDIVIDUAL SECTIONS BY WATER BARRIERS, THE LOCATION OF CONTROL-AND-GROUTING PIPES AND THE LOCATION OF CONTACT GROUTING PIPES. SEE SPECIFICATION SECTIONS 07122 AND 02425.
 2. SEE DWGS CM009-ST-1012 AND CM009-GP-0125 FOR LOCATION AND GENERAL ARRANGEMENT OF CROSS FLUE.
 3. ENSURE CONTINUITY OF EXTERNAL WATER BARRIER BETWEEN TUNNELS AND CAVERN BY INTRODUCING SPLICED JOINTS, AS REQUIRED.
 4. FOR ADDITIONAL DETAILS AND NOTES, SEE DWG CM009-WS-0101 AND CM009-GP-0040.
 5. LOCATE WATER BARRIERS AT ALL CONSTRUCTION AND CONTRACTION JOINTS WITHIN THE BORED TUNNELS. SEE DWG CM009-ST-1211.
 6. WITHIN CAST IN PLACE TUNNELS LOCATE UPPER CONTROL-AND-GROUTING PIPES AT SPRINGLINE ON WALLS WITH FUTURE BENCHES AND 1'-0" ABOVE TOP OF RAIL ON WALLS WITHOUT FUTURE BENCHES. FOR EACH ZONE ENCLOSED BY EXTERNAL BARRIERS PROVIDE FOUR CONTROL AND GROUTING PIPES.



CLEANOUT TYPE D DETAIL

SCALE IN FEET
2' 1' 0' 2' 4'



TYPICAL SIDEWALL DRAIN DETAIL
SHOWN AT FOOTING WITH CLEANOUT TYPE E

SCALE IN FEET
2' 1' 0' 2' 4'

CROSS FLUE CAVERN SCHEMATIC VIEW
NTS

MTA Metropolitan Transportation Authority
Capital Construction

Long Island Rail Road
East Side Access

GEC PB
STV PARSONS
General Engineering Consultant

PARSONS BRINCKERHOFF
STV INCORPORATED
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MANHATTAN TUNNELS EXCAVATION

WATERPROOFING DETAILS
CROSS FLUE AND BORED TUNNELS

SCALE AS NOTED	CONTRACT No. CM009
DRAWING NUMBER CM009-WS-0106	ISSUE
DATE: 3-24-06	SHEET No. 28 OF 28
REVISION NUMBER: 0	