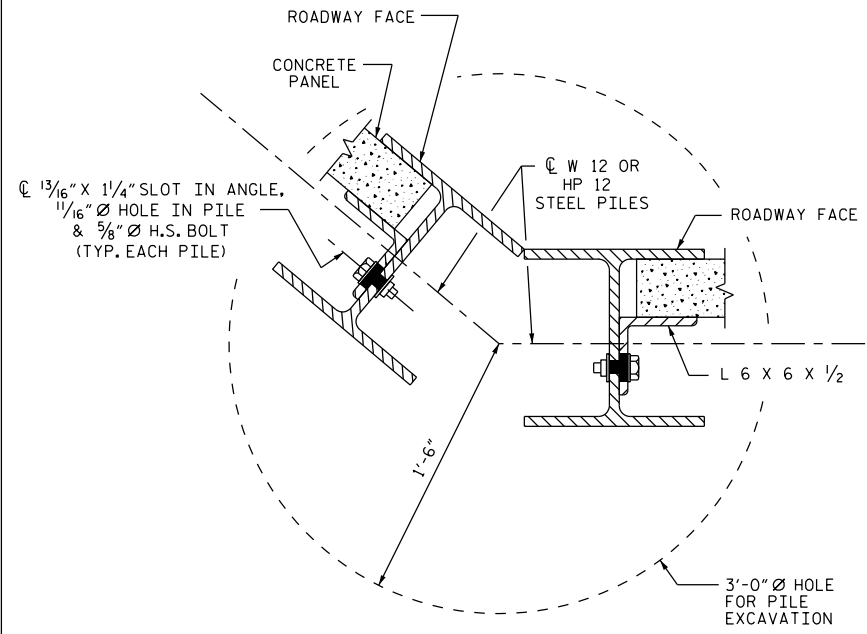
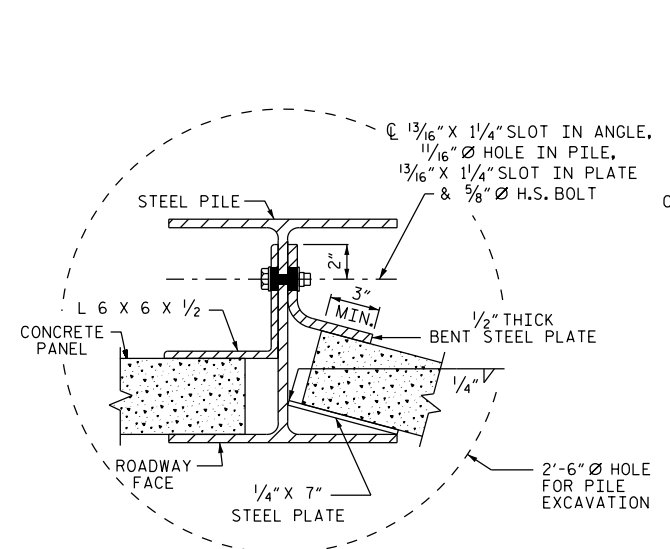


APPENDIX J

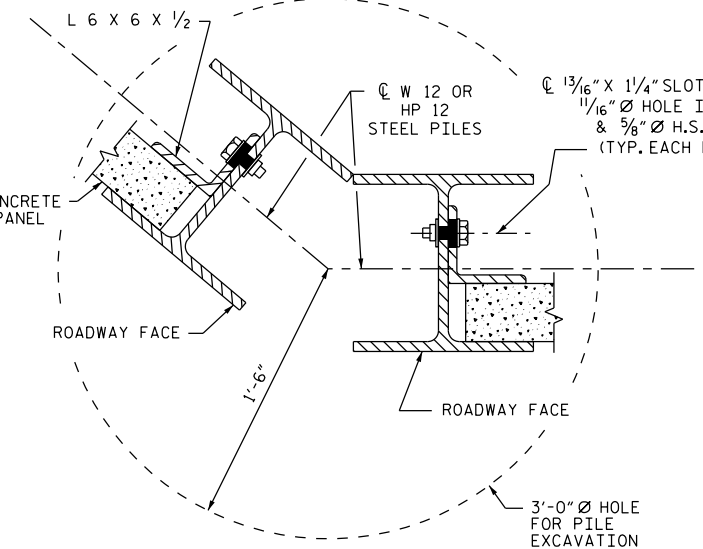
NOISE WALL STANDARD DRAWINGS AND SPECIAL PROVISIONS



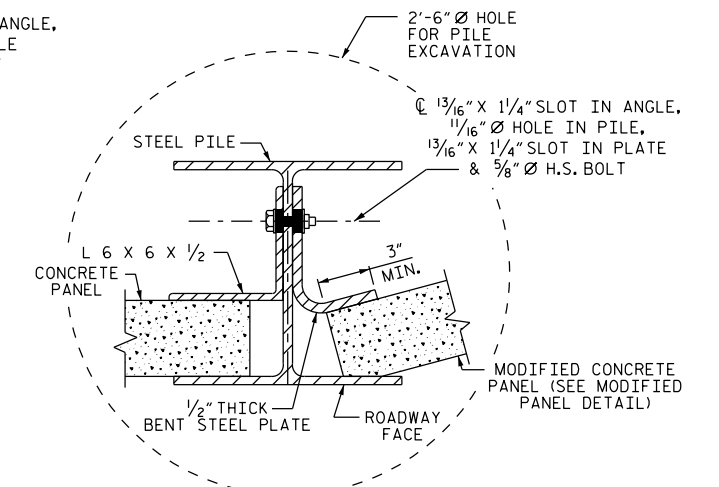
TYPICAL WALL TURN DETAIL
(FOR GREATER THAN 15° TURNS, CONCAVE TOWARD ROADWAY)



TYPICAL WALL TURN DETAIL
(USE ONLY FOR TURNS 15° OR LESS, CONCAVE TOWARD ROADWAY)

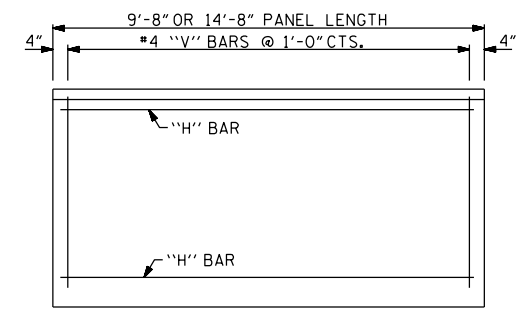


TYPICAL WALL TURN DETAIL
(FOR GREATER THAN 15° TURNS, CONVEX TOWARD ROADWAY)

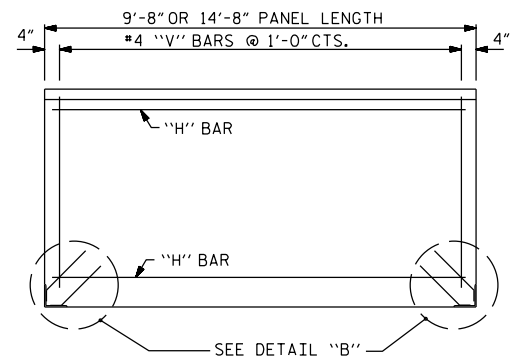


TYPICAL WALL TURN DETAIL
(USE ONLY FOR TURNS 15° OR LESS, CONVEX TOWARD ROADWAY)

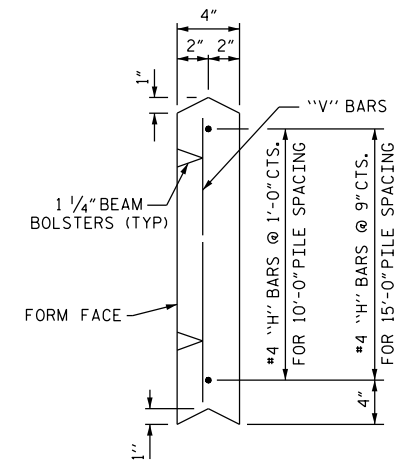
BILL OF MATERIAL	
SOUND BARRIER WALL	S.F.
QUANTITIES PROVIDED ARE APPROXIMATE AND ARE FOR BID PURPOSES ONLY.	



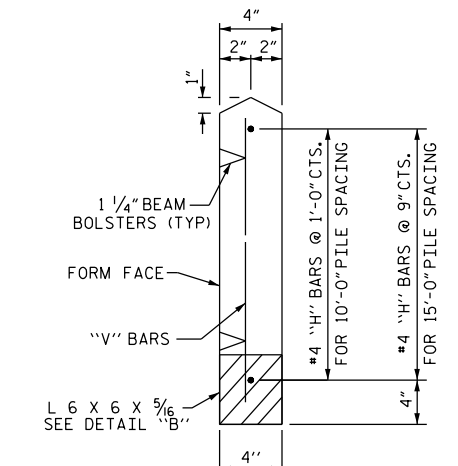
FRONT ELEVATION OF UPPER PRECAST PANELS



FRONT ELEVATION OF BOTTOM PRECAST PANEL

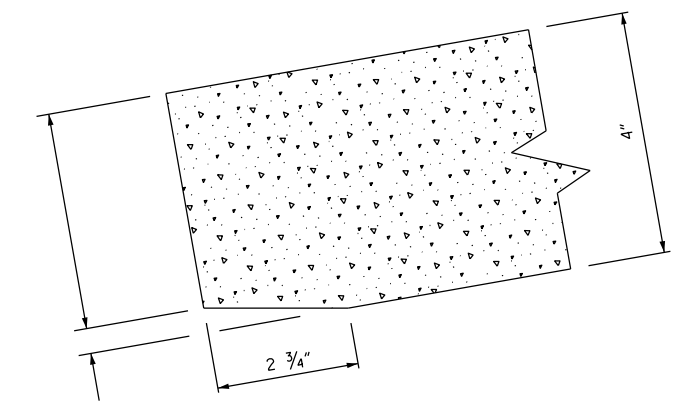


UPPER PANEL

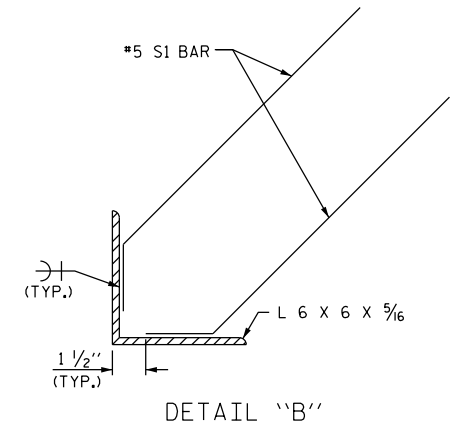


BOTTOM PANEL

SECTION THROUGH PRECAST PANELS



MODIFIED PANEL DETAIL
(USE ONLY FOR TURNS 15° OR LESS, CONVEX TOWARD ROADWAY)



DETAIL "B"

ADDITIONAL BARS FOR ONE BOTTOM PANEL					
NO.	BAR SIZE	TYPE	LENGTH	WEIGHT (lb)	
4	S1	#5	1'-6"	6	

BAR TYPE	
①	10 5/8" x 1'-3" x 3"

QUANTITIES FOR ONE PRECAST PANEL (FOR 10'-0" PILE SPACING)													
PANEL HEIGHT	CLASS AA CONCRETE C.Y.	HORIZONTAL BAR TYPES						VERTICAL					
		NO.	BAR SIZE	TYPE	LENGTH	WEIGHT (lb)	NO.	BAR SIZE	TYPE	LENGTH	WEIGHT (lb)		
2'-0"	0.24	3	H1	#4	STR	9'-4"	19	10	V1	#4	STR	1'-8"	11
3'-0"	0.36	4	H2	#4	STR	9'-4"	25	10	V2	#4	STR	2'-8"	18
4'-0"	0.48	5	H3	#4	STR	9'-4"	31	10	V3	#4	STR	3'-8"	24

QUANTITIES FOR ONE PRECAST PANEL (FOR 15'-0" PILE SPACING)													
PANEL HEIGHT	CLASS AA CONCRETE C.Y.	HORIZONTAL BAR TYPES						VERTICAL					
		NO.	BAR SIZE	TYPE	LENGTH	WEIGHT (lb)	NO.	BAR SIZE	TYPE	LENGTH	WEIGHT (lb)		
3'-0"	0.54	5	H1	#4	STR	14'-4"	48	15	V1	#4	STR	2'-8"	27
4'-0"	0.72	6	H2	#4	STR	14'-4"	57	15	V2	#4	STR	3'-8"	37
5'-0"	0.91	7	H3	#4	STR	14'-4"	67	15	V3	#4	STR	4'-8"	47
6'-0"	1.09	8	H4	#4	STR	14'-4"	77	15	V4	#4	STR	5'-8"	57

ASSEMBLED BY : _____ DATE : _____
 CHECKED BY : _____ DATE : _____
 DRAWN BY : JAD 5/01 REV. 5/1/06R KMM/GM
 CHECKED BY : RDR 5/01 REV. 10/1/11 MAA/GM
 REV. 1/15/14 RWW/TMG

PROJECT NO. _____
 COUNTY _____
 STATION: _____

SHEET OF _____
 STATE OF NORTH CAROLINA
 DEPARTMENT OF TRANSPORTATION
 RALEIGH
 STANDARD
 SOUND BARRIER WALL
 DETAILS
 (STEEL PILES)

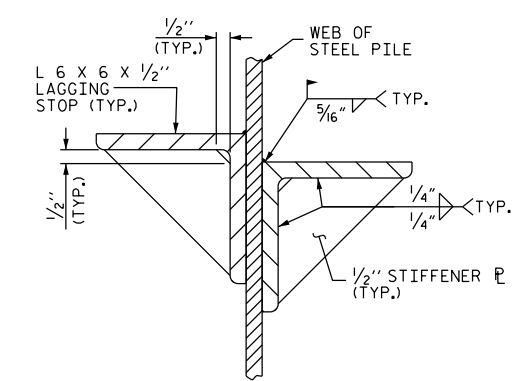
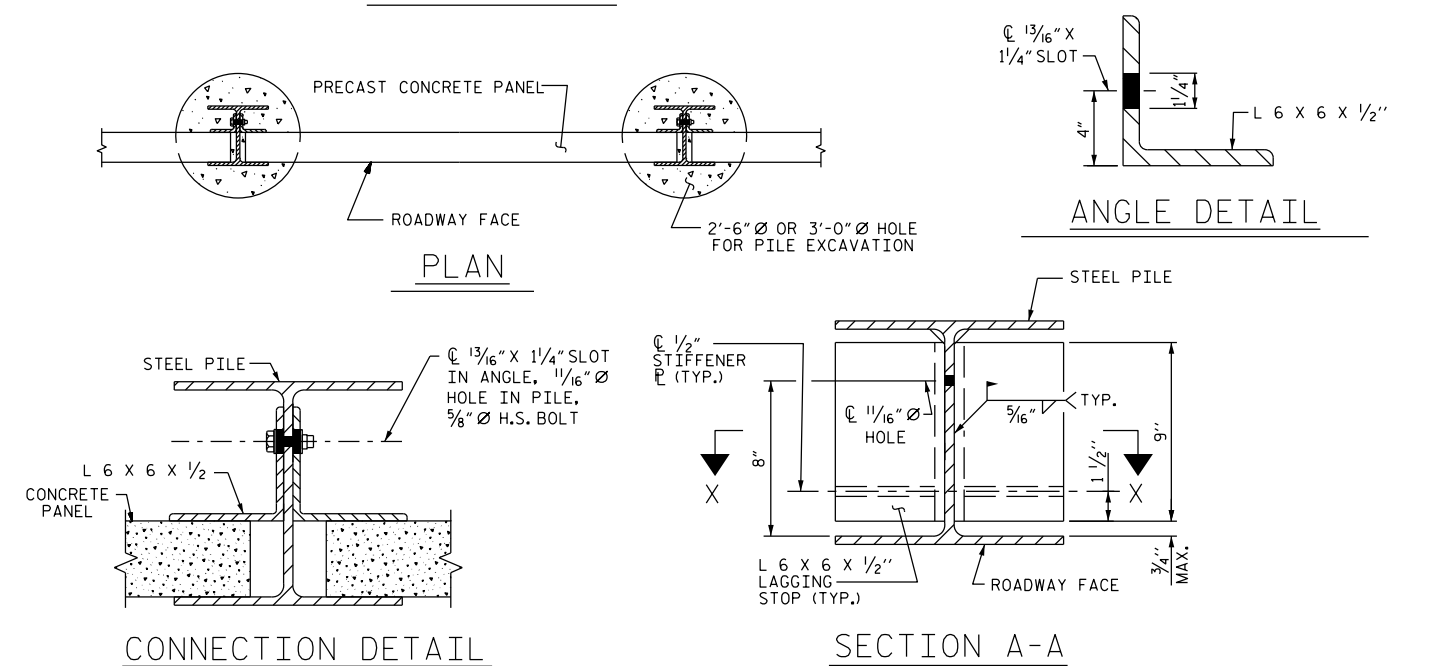
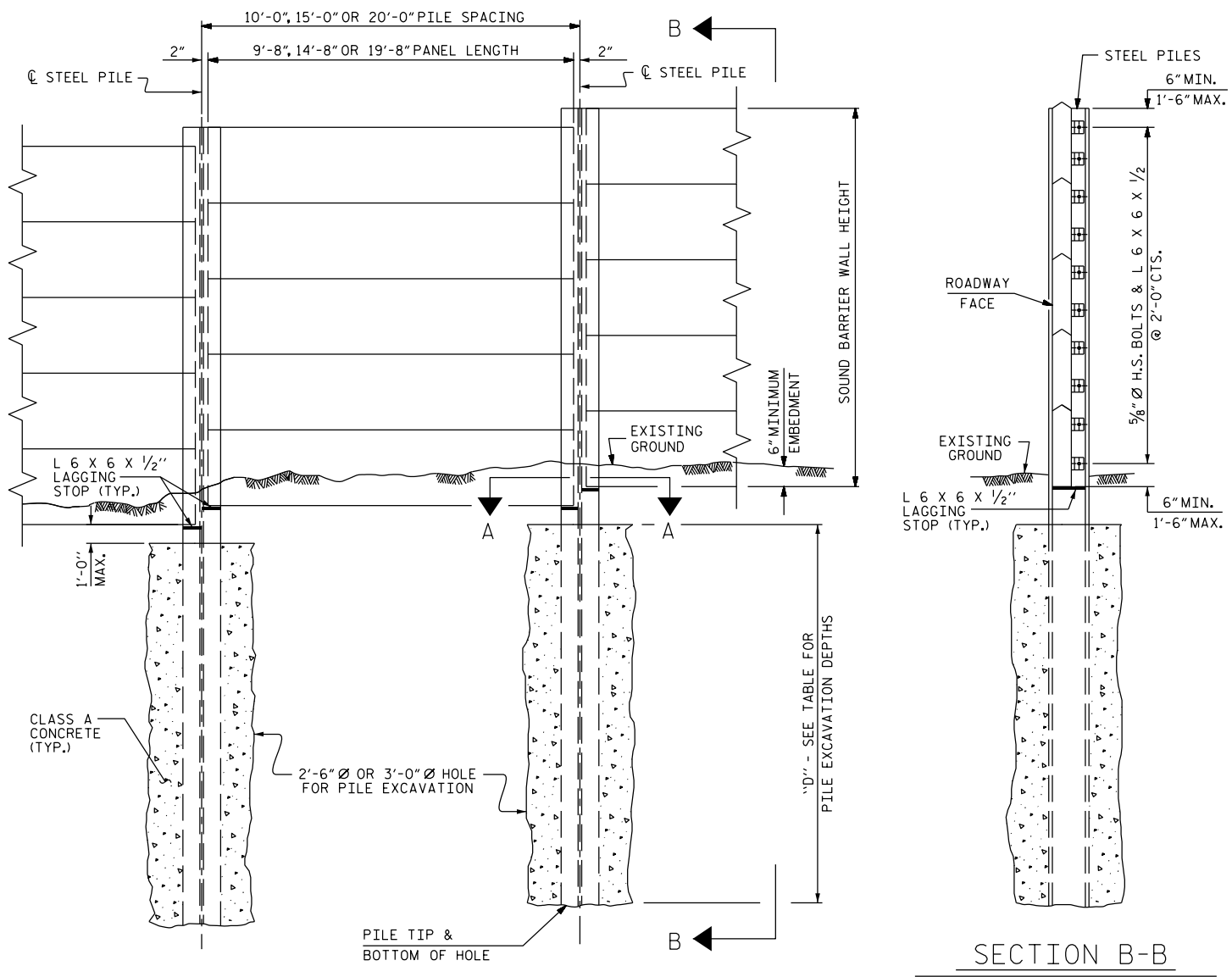
REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	
1			3			TOTAL SHEETS
2			4			

NOTES

- FOR SOUND BARRIER WALL, SEE SPECIAL PROVISIONS.
- CONSTRUCT SOUND BARRIER WALL TO LINES AND GRADES SHOWN ON THE ROADWAY PLANS.
- PROVIDE PANELS WITH A FLAT BOTTOM.
- USE STEEL PILES, ANGLES, AND LAGGING STOPS MEETING THE REQUIREMENTS OF AASHTO M270, GRADE 50. GALVANIZE ALL STEEL COMPONENTS INCLUDING PILES, ANGLES, LAGGING STOPS, BOLTS, NUTS, AND WASHERS IN ACCORDANCE WITH SECTION 1076 OF THE STANDARD SPECIFICATIONS. REPAIR ANY DAMAGED GALVANIZATION IN ACCORDANCE WITH ARTICLE 1076-7 OF THE STANDARD SPECIFICATIONS.
- VERIFY THE LOCATION OF UNDERGROUND UTILITIES BEFORE DRILLING HOLES TO ENSURE SUFFICIENT CLEARANCE IS AVAILABLE.
- AT THE CONTRACTOR'S OPTION, USE AN APPROVED NON-SHRINK NON-METALLIC GROUT BETWEEN THE FLANGES OF THE STEEL PILES TO SUPPORT THE BOTTOM PANEL IN LIEU OF LAGGING STOPS.
- ADJUST PILE EXCAVATION ELEVATIONS TO MAINTAIN 6" MINIMUM EMBEDMENT OF THE BOTTOM PANEL.
- USE CLASS AA FOR PANELS AND CLASS A CONCRETE PILE EXCAVATION BACKFILL, IN ACCORDANCE WITH ARTICLE 1000-4 OF THE STANDARD SPECIFICATIONS.
- PROVIDE PLATES AND ANGLES TO SECURE PANELS 6" LONG AS MEASURED ALONG THE STEEL PILE.
- AT THE CONTRACTOR'S OPTION, USE EITHER 'W' OR 'HP' PILES THAT SATISFY THE MINIMUM PILE SIZE REQUIRED IN THE "STEEL PILES" TABLE. PILES SMALLER THAN W12 OR HP12 ARE NOT PERMITTED. AT TURNS WITH A 3'-0" DIAMETER HOLE FOR PILE EXCAVATION, USE ONLY W12 OR HP12 PILES, AS SHOWN.
- AT THE CONTRACTOR'S OPTION, USE 10'-0", 15'-0", OR 20'-0" PILE SPACINGS, AND EITHER 2'-6" OR 3'-0" DIAMETER HOLES FOR PILE EXCAVATION. STANDARD PRECAST CONCRETE PANELS MAY BE USED WITH THE 10'-0" AND 15'-0" PILE SPACING. FOR 20'-0" PILE SPACING, PANELS DESIGNED AND MANUFACTURED BY A THIRD PARTY VENDOR SHALL BE USED.
- DO NOT SPLICE STEEL PILES.
- FOR SOUND BARRIER WALL STATIONS, OFFSETS, AND WALL ENVELOPE, SEE ROADWAY PLANS.

PILE EXCAVATION DEPTH "D"

WALL #	FROM : STA.	TO : STA.	WALL HEIGHT		
2'-6" Ø HOLE	PILE SPACING		H ≤ 15'	15' < H ≤ 20'	20' < H ≤ 25'
			10'-0"	-	-
			15'-0"	-	-
			20'-0"	-	-
3'-0" Ø HOLE	PILE SPACING		H ≤ 15'	15' < H ≤ 20'	20' < H ≤ 25'
			10'-0"	-	-
			15'-0"	-	-
			20'-0"	-	-
WALL #	FROM : STA.	TO : STA.	WALL HEIGHT		
2'-6" Ø HOLE	PILE SPACING		H ≤ 15'	15' < H ≤ 20'	20' < H ≤ 25'
			10'-0"	-	-
			15'-0"	-	-
			20'-0"	-	-
3'-0" Ø HOLE	PILE SPACING		H ≤ 15'	15' < H ≤ 20'	20' < H ≤ 25'
			10'-0"	-	-
			15'-0"	-	-
			20'-0"	-	-
WALL #	FROM : STA.	TO : STA.	WALL HEIGHT		
2'-6" Ø HOLE	PILE SPACING		H ≤ 15'	15' < H ≤ 20'	20' < H ≤ 25'
			10'-0"	-	-
			15'-0"	-	-
			20'-0"	-	-
3'-0" Ø HOLE	PILE SPACING		H ≤ 15'	15' < H ≤ 20'	20' < H ≤ 25'
			10'-0"	-	-
			15'-0"	-	-
			20'-0"	-	-



STEEL PILES
DESIGN WIND PRESSURE = 40 PSF

PILE SPACING	MAXIMUM WALL HEIGHT (H)	MINIMUM W SIZE STEEL PILES	MINIMUM HP SIZE STEEL PILES
10'-0"	H ≤ 15'	W 12 X 40 W 14 X 48	HP 12 X 53 HP 14 X 73
	15' < H ≤ 20'	W 12 X 45 W 14 X 48	HP 12 X 53 HP 14 X 73
	20' < H ≤ 25'	W 12 X 65 W 14 X 61	HP 12 X 53 HP 14 X 73
	25' < H ≤ 29'	W 12 X 87 W 14 X 90	HP 14 X 73
	H ≤ 15'	W 12 X 40 W 14 X 48	HP 12 X 53 HP 14 X 73
15'-0"	15' < H ≤ 20'	W 12 X 53 W 14 X 61	HP 12 X 53 HP 14 X 73
	20' < H ≤ 25'	W 12 X 72 W 14 X 90	HP 12 X 74 HP 14 X 73
	25' < H ≤ 29'	W 12 X 120 W 14 X 90	HP 14 X 89
20'-0"	H ≤ 15'	W 12 X 40 W 14 X 48	HP 12 X 53 HP 14 X 73
	15' < H ≤ 20'	W 12 X 58 W 14 X 61	HP 12 X 63 HP 14 X 73
	20' < H ≤ 25'	W 12 X 96 W 14 X 90	HP 14 X 89
	25' < H ≤ 29'	W 12 X 152 W 14 X 109	HP 14 X 117

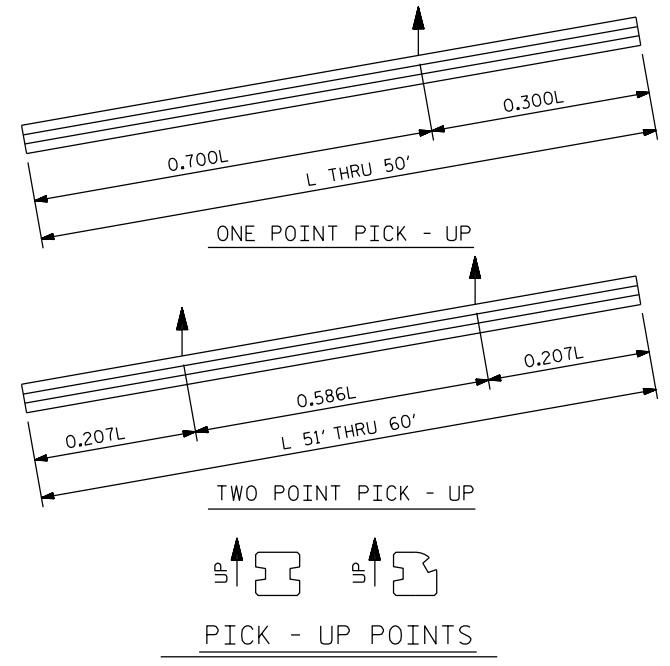
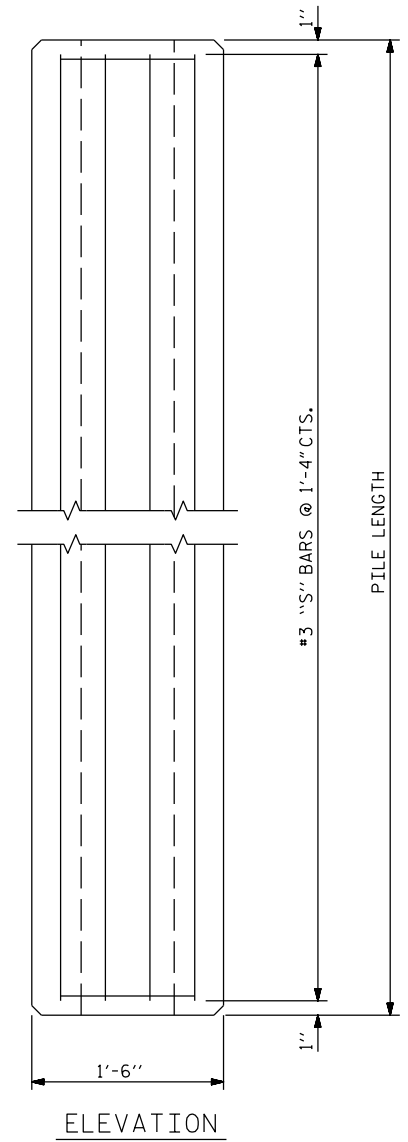
PROJECT NO. _____
 COUNTY _____
 STATION: _____
 SHEET _ OF _

STATE OF NORTH CAROLINA
 DEPARTMENT OF TRANSPORTATION
 RALEIGH
 STANDARD
 SOUND BARRIER WALL
 (STEEL PILES)

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

ASSEMBLED BY : _____ DATE : _____
 CHECKED BY : _____ DATE : _____
 DRAWN BY : JAD 5/01 REV. 10/1/11 MAA/GM
 CHECKED BY : RDR 5/01 REV. 1/15/14 RWW/TMG
 REV. 9/26/14 MAA/TMG

DOCUMENT NOT CONSIDERED
 FINAL UNLESS ALL
 SIGNATURES COMPLETED



QUANTITIES FOR ONE PRECAST CONCRETE PILE

LENGTH	APPROX. PILE WT. TONS	ONE PICK-UP POINT		TWO PICK-UP POINT	
		0.300L	0.700L	0.207L	0.586L
10'-0"	1.56	3'-0"	7'-0"		
15'-0"	2.35	4'-6"	10'-6"		
20'-0"	3.14	6'-0"	14'-0"		
25'-0"	3.93	7'-6"	17'-6"		
30'-0"	4.70	9'-0"	21'-0"		
35'-0"	5.49	10'-6"	24'-6"		
40'-0"	6.28	12'-0"	28'-0"		
45'-0"	7.05	13'-6"	31'-6"		
50'-0"	7.84	15'-0"	35'-0"		
55'-0"	8.63			11'-4 1/2"	32'-3"
60'-0"	9.42			12'-5"	35'-2"

NOTES

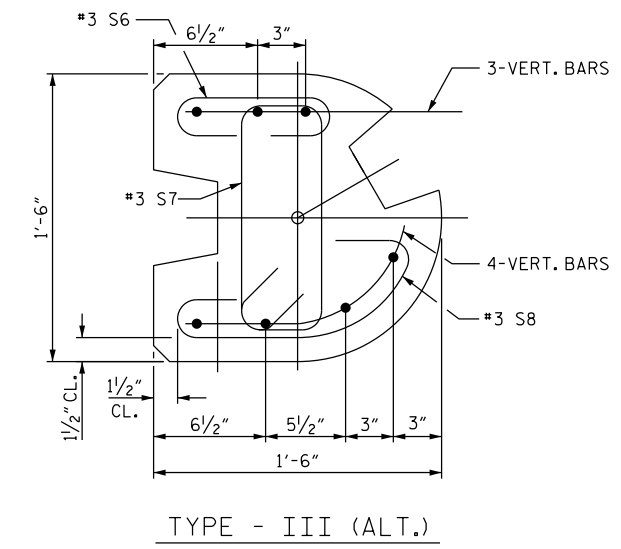
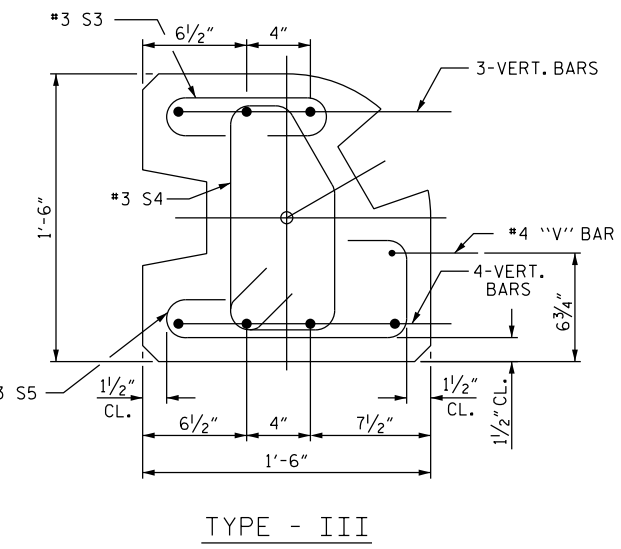
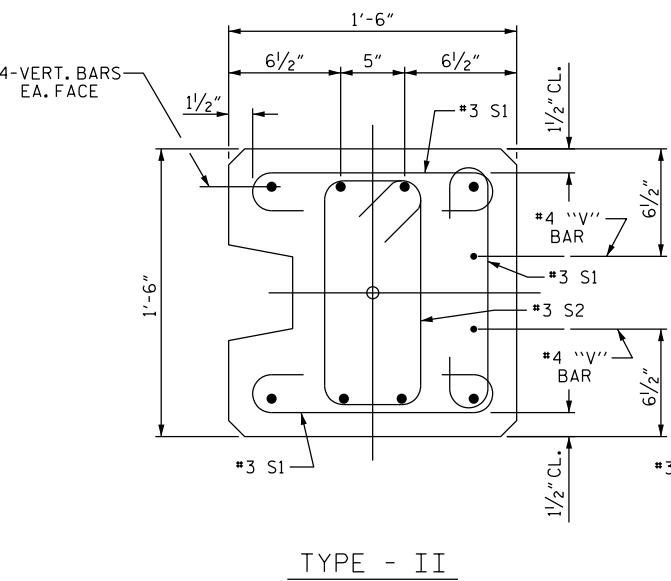
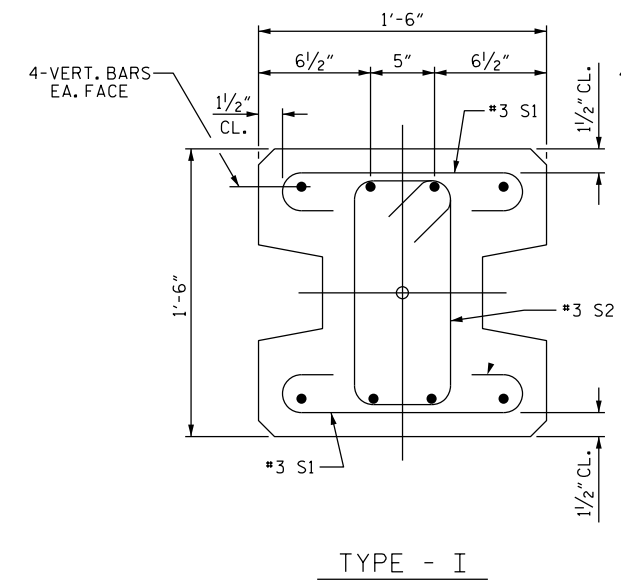
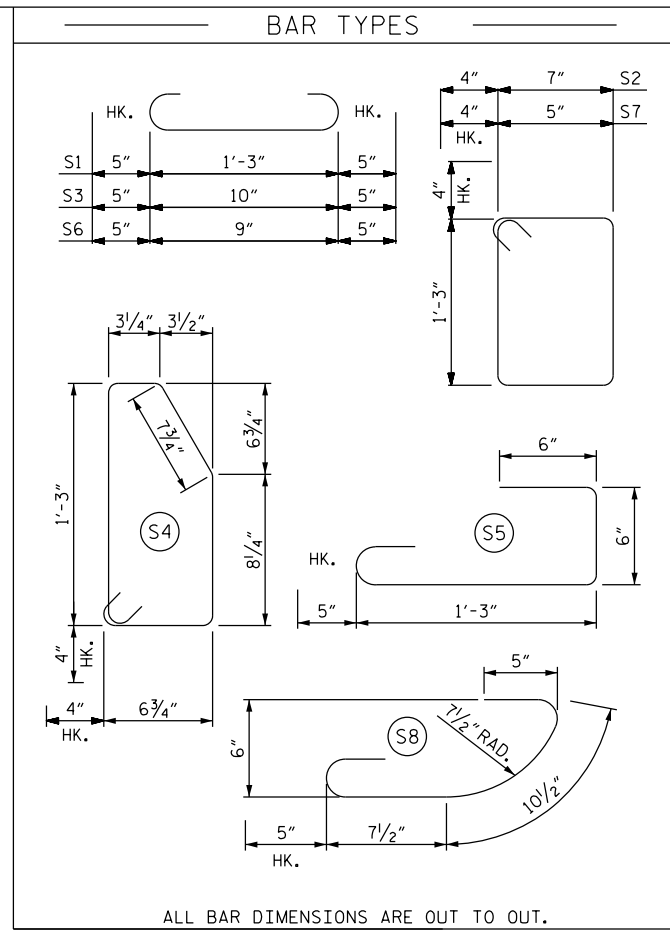
CONCRETE DESIGN DATA : $f'_c = 5,000$ PSI

PROPOSED DEVICES FOR LIFTING PILES, RECESS DETAILS, AND PATCHING MATERIAL SHALL BE DETAILED IN SHOP DRAWINGS. AFTER ATTACHMENTS HAVE BEEN REMOVED, OPENINGS SHALL BE REPAIRED SUCH THAT THE APPEARANCE OF THE PILE IS UNIFORM.

WHERE CAST-IN-PLACE LIFTING DEVICES ARE NOT USED, PICK-UP POINTS TO BE INDICATED WITH A BLACK MARK 2" WIDE.

THE SLIP-FORM METHOD OF CASTING PILES WILL NOT BE PERMITTED.

ALL CORNERS TO BE CHAMFERED 1".



PILE DETAIL

FOR VERTICAL BAR PILE REINFORCING, SEE SHEET 1 OF 3

ASSEMBLED BY :	DATE :
CHECKED BY :	DATE :
DRAWN BY : MAA 6/11	ADDED 8/31/11
CHECKED BY : GM 6/11	REV. 1/15/14 RWW/TMG

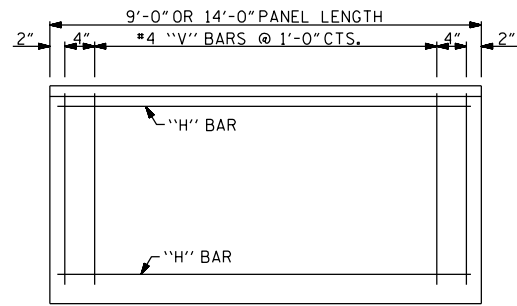
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PROJECT NO. _____ COUNTY _____

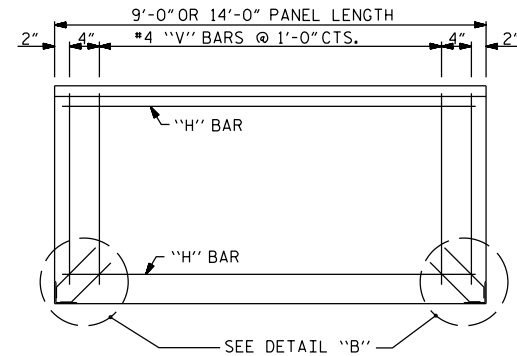
STATION: _____

SHEET _ OF _

STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION RALEIGH						SHEET NO.
STANDARD SOUND BARRIER WALL DETAILS						TOTAL SHEETS
REVISIONS						
NO.	BY:	DATE:	NO.	BY:	DATE:	
1			3			
2			4			



FRONT ELEVATION OF UPPER PRECAST PANELS



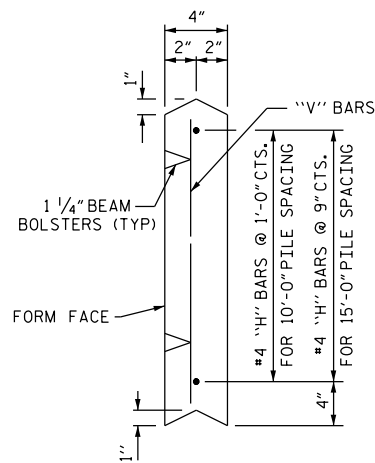
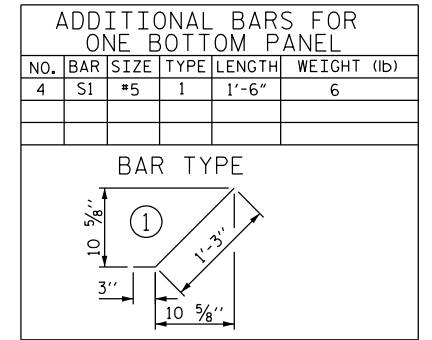
FRONT ELEVATION OF BOTTOM PRECAST PANEL

QUANTITIES FOR ONE PRECAST PANEL (FOR 10'-0" PILE SPACING)

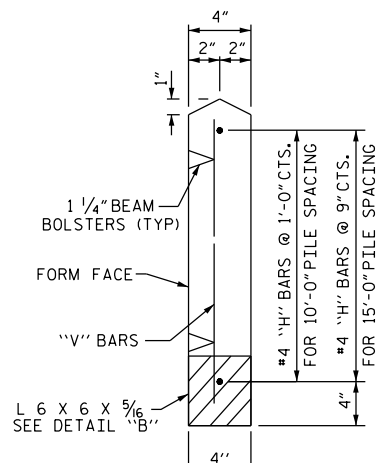
PANEL HEIGHT	CLASS AA CONCRETE	BAR TYPES											
		HORIZONTAL						VERTICAL					
C.Y.	NO.	BAR	SIZE	TYPE	LENGTH	WEIGHT (lb)	NO.	BAR	SIZE	TYPE	LENGTH	WEIGHT (lb)	
2'-0"	0.22	3	H1	#4	STR	8'-8"	17	11	V1	#4	STR	1'-8"	12
3'-0"	0.33	4	H2	#4	STR	8'-8"	23	11	V2	#4	STR	2'-8"	20
4'-0"	0.44	5	H3	#4	STR	8'-8"	29	11	V3	#4	STR	3'-8"	27

QUANTITIES FOR ONE PRECAST PANEL (FOR 15'-0" PILE SPACING)

PANEL HEIGHT	CLASS AA CONCRETE	BAR TYPES											
		HORIZONTAL						VERTICAL					
C.Y.	NO.	BAR	SIZE	TYPE	LENGTH	WEIGHT (lb)	NO.	BAR	SIZE	TYPE	LENGTH	WEIGHT (lb)	
3'-0"	0.52	5	H1	#4	STR	13'-8"	46	16	V1	#4	STR	2'-8"	29
4'-0"	0.69	6	H2	#4	STR	13'-8"	55	16	V2	#4	STR	3'-8"	39
5'-0"	0.86	7	H3	#4	STR	13'-8"	64	16	V3	#4	STR	4'-8"	50
6'-0"	1.04	8	H4	#4	STR	13'-8"	73	16	V4	#4	STR	5'-8"	61

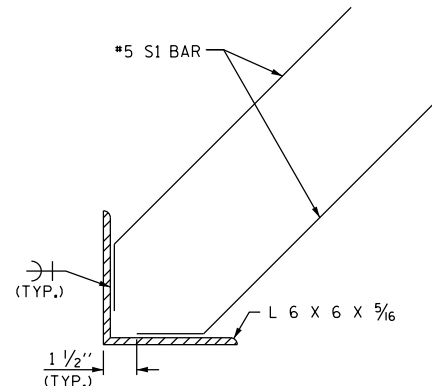


UPPER PANEL

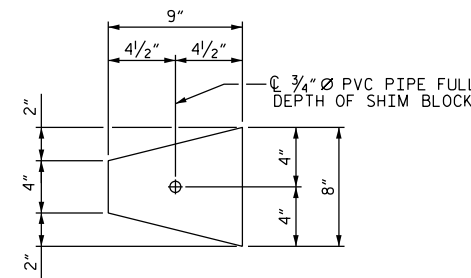


BOTTOM PANEL

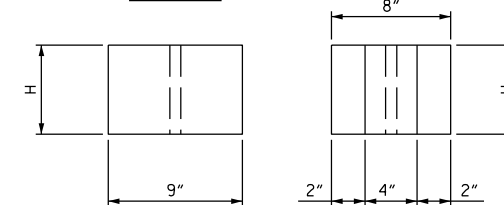
SECTION THROUGH PRECAST PANELS



DETAIL 'B'



PLAN

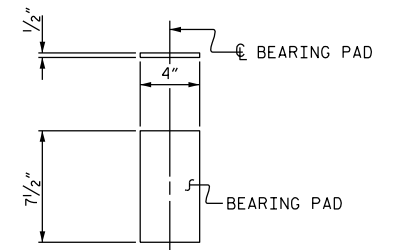


ELEVATION

END

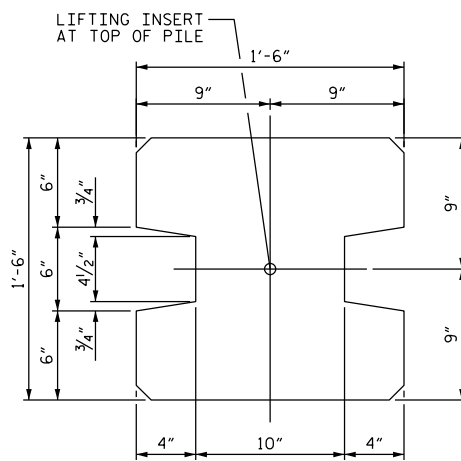
CONCRETE SHIM BLOCK

H = 3', 6" or 1'-0"

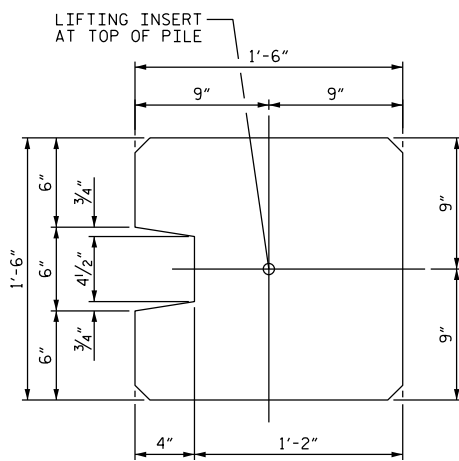


ELASTOMERIC BEARING DETAILS

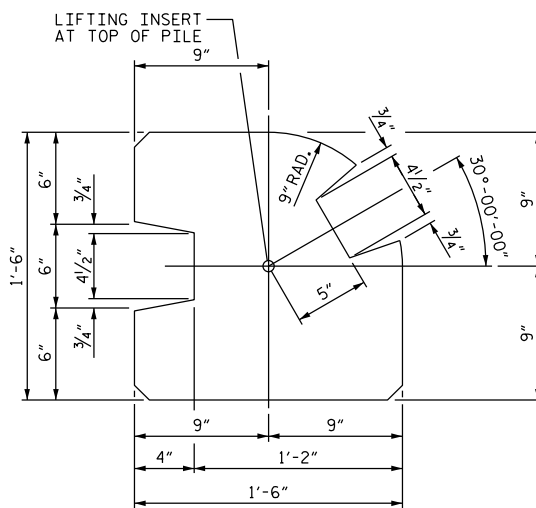
ELASTOMER IN BEARINGS SHALL BE 50 DUROMETER HARDNESS.



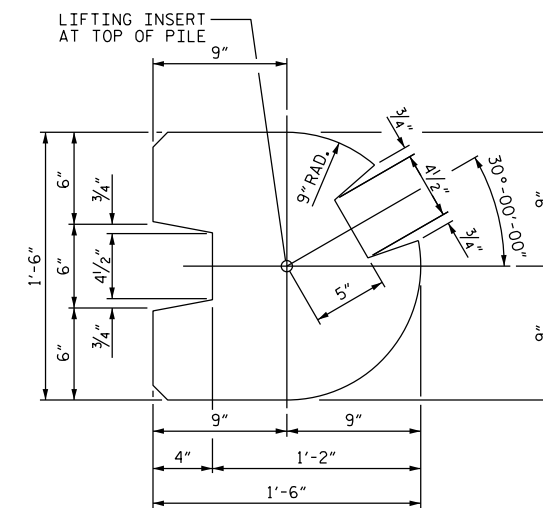
TYPE - I
(AREA = 1.9444 SQ. FT.)



TYPE - II
(AREA = 2.0903 SQ. FT.)



TYPE - III
(AREA = 1.8336 SQ. FT.)



TYPE - III (ALT.)
(AREA = 1.7163 SQ. FT.)

PILE DETAIL

(ALL CORNERS TO BE CHAMFERED 1")

ASSEMBLED BY :	DATE :
CHECKED BY :	DATE :
DRAWN BY : MAA 6/11	ADDED 8/31/11
CHECKED BY : CM 6/11	REV. 1/15/14 RWW/TMG

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PROJECT NO. _____

_____ COUNTY

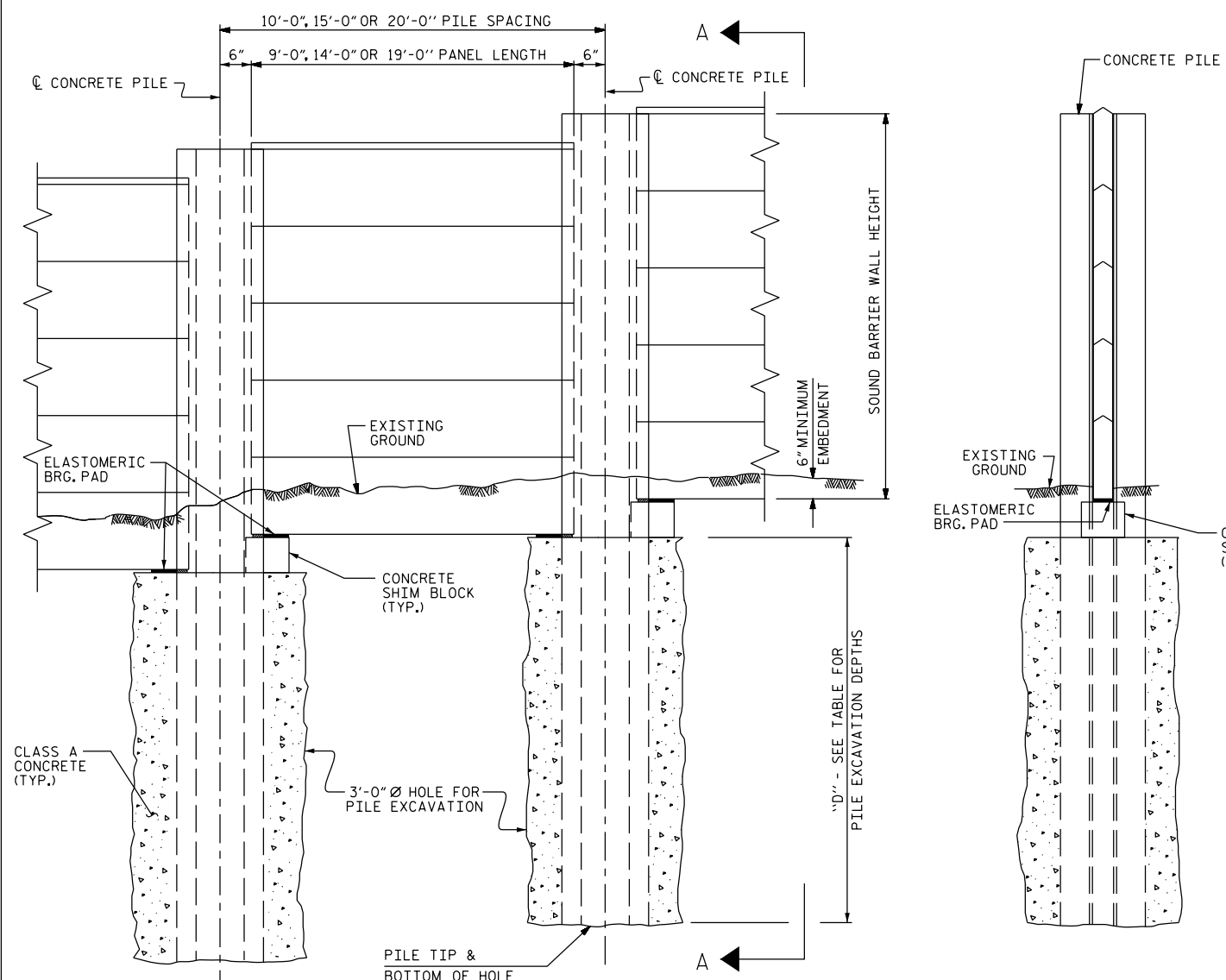
STATION: _____

SHEET OF _____

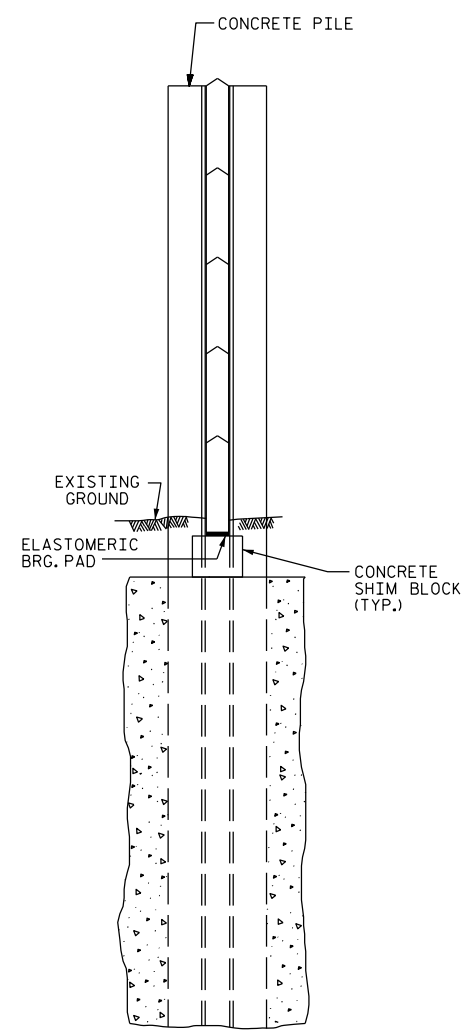
STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH
STANDARD
SOUND BARRIER WALL
DETAILS

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

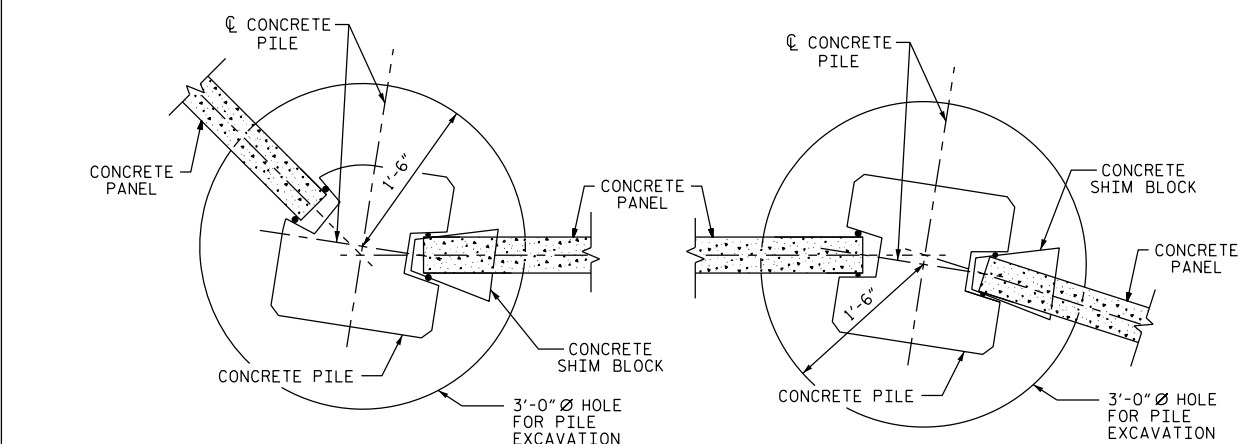
STD. NO. SBW2



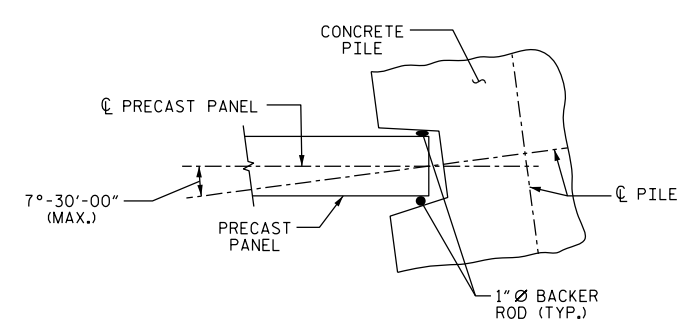
ELEVATION



SECTION A-A



TYPICAL WALL TURN DETAILS



PILE ROTATION LIMIT FOR WALL TURN

(ROTATE THE CONCRETE PILE ±7°-30'-00" TO ACCOMMODATE WALL TURN.)

PILE EXCAVATION DEPTHS "D"				
WALL #	FROM : STA. TO : STA.	WALL HEIGHT		
3'-0" Ø HOLE	PILE SPACING	H ≤ 15'	15' < H ≤ 20'	20' < H ≤ 25'
		10'-0"	-	-
		15'-0"	-	-
		20'-0"	-	-
3'-0" Ø HOLE	PILE SPACING	H ≤ 15'	15' < H ≤ 20'	20' < H ≤ 25'
		10'-0"	-	-
		15'-0"	-	-
		20'-0"	-	-
3'-0" Ø HOLE	PILE SPACING	H ≤ 15'	15' < H ≤ 20'	20' < H ≤ 25'
		10'-0"	-	-
		15'-0"	-	-
		20'-0"	-	-

PILE REINFORCING STEEL DESIGN WIND PRESSURE = 40 PSF							
PILE TYPE I				PILE TYPE III			
PILE SPACING	MAXIMUM WALL HEIGHT (H)	VERTICAL REINFORCING STEEL	TIES	PILE SPACING	MAXIMUM WALL HEIGHT (H)	VERTICAL REINFORCING STEEL	TIES
10'-0"	H ≤ 25'	4 - #8 EA. FACE	#3 @ 1'-4"CTS.	10'-0"	H ≤ 25'	3 - #9 SHORT FACE 4 - #9 LONG FACE	#3 @ 1'-4"CTS.
	20' < H ≤ 25'	4 - #10 EA. FACE	#3 @ 1'-4"CTS.		15'-0"	H ≤ 20'	3 - #9 SHORT FACE 4 - #9 LONG FACE
15'-0"	H ≤ 20'	4 - #8 EA. FACE	#3 @ 1'-4"CTS.	15'-0"		20' < H ≤ 25'	3 - #11 SHORT FACE 4 - #11 LONG FACE
	20' < H ≤ 25'	4 - #9 EA. FACE	#3 @ 1'-4"CTS.		20'-0"	H ≤ 20'	3 - #10 SHORT FACE 4 - #10 LONG FACE
20'-0"	H ≤ 20'	4 - #9 EA. FACE	#3 @ 1'-4"CTS.	20'-0"		H ≤ 20'	3 - #10 SHORT FACE 4 - #10 LONG FACE
	20' < H ≤ 25'	4 - #11 EA. FACE	#3 @ 1'-4"CTS.				
PILE TYPE II				PILE TYPE III ALT.			
PILE SPACING	MAXIMUM WALL HEIGHT (H)	VERTICAL REINFORCING STEEL	TIES	PILE SPACING	MAXIMUM WALL HEIGHT (H)	VERTICAL REINFORCING STEEL	TIES
10'-0"	H ≤ 25'	4 - #6 EA. FACE	#3 @ 1'-4"CTS.	10'-0"	H ≤ 25'	3 - #9 SHORT FACE 4 - #9 LONG FACE	#3 @ 1'-4"CTS.
	20' < H ≤ 25'	4 - #7 EA. FACE	#3 @ 1'-4"CTS.		15'-0"	H ≤ 20'	3 - #9 SHORT FACE 4 - #9 LONG FACE
15'-0"	H ≤ 20'	4 - #6 EA. FACE	#3 @ 1'-4"CTS.	15'-0"		20' < H ≤ 25'	3 - #11 SHORT FACE 4 - #11 LONG FACE
	20' < H ≤ 25'	4 - #8 EA. FACE	#3 @ 1'-4"CTS.		20'-0"	H ≤ 20'	3 - #10 SHORT FACE 4 - #10 LONG FACE
20'-0"	H ≤ 20'	4 - #6 EA. FACE	#3 @ 1'-4"CTS.	20'-0"		H ≤ 20'	3 - #10 SHORT FACE 4 - #10 LONG FACE
	20' < H ≤ 25'	4 - #8 EA. FACE	#3 @ 1'-4"CTS.				

BILL OF MATERIAL	
SOUND BARRIER WALL	S.F.
QUANTITIES PROVIDED ARE APPROXIMATE AND ARE FOR BID PURPOSES ONLY.	

NOTES

- FOR SOUND BARRIER WALL, SEE SPECIAL PROVISIONS.
- CONSTRUCT SOUND BARRIER WALL TO LINES AND GRADES SHOWN ON THE ROADWAY PLANS.
- PROVIDE PANELS WITH A FLAT BOTTOM.
- VERIFY THE LOCATION OF UNDERGROUND UTILITIES BEFORE DRILLING HOLES TO ENSURE SUFFICIENT CLEARANCE IS AVAILABLE.
- ADJUST PILE EXCAVATION ELEVATIONS TO MAINTAIN 6" MINIMUM EMBEDMENT OF THE BOTTOM PANEL.
- USE CLASS AA FOR PANELS AND CLASS A CONCRETE PILE EXCAVATION BACKFILL, IN ACCORDANCE WITH ARTICLE 1000-4 OF THE STANDARD SPECIFICATIONS.
- AT THE CONTRACTOR'S OPTION, USE 10'-0", 15'-0", OR 20'-0" PILE SPACINGS. STANDARD PRECAST CONCRETE PANELS MAY BE USED WITH THE 10'-0" AND 15'-0" PILE SPACING. FOR 20'-0" PILE SPACING, PANELS DESIGNED AND MANUFACTURED BY A THIRD PARTY VENDOR SHALL BE USED.
- FOR SOUND BARRIER WALL STATIONS, OFFSETS, AND WALL ENVELOPE, SEE ROADWAY PLANS.
- PLACE 1" Ø BACKER RODS FULL HEIGHT ON EACH SIDE OF THE PRECAST PANELS. SET AND SEAL THE BACKER ROD IN PLACE WITH SEALANT THAT CONFORMS WITH ARTICLE 1028-3 OF THE STANDARD SPECIFICATIONS.
- FOR SUBMITTAL OF WORKING DRAWINGS, SEE SPECIAL PROVISIONS.
- FOR FALSEWORK AND FORMWORK, SEE SPECIAL PROVISIONS.

ASSEMBLED BY :	DATE :
CHECKED BY :	DATE :
DRAWN BY : MAA 6/11	ADDED 10/1/11
CHECKED BY : GM 6/11	REV. 1/15/14 RWW/TMG
	REV. 9/26/14 MAA/TMG

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

PROJECT NO. _____
 COUNTY _____
 STATION: _____
 SHEET _ OF _

STATE OF NORTH CAROLINA
 DEPARTMENT OF TRANSPORTATION
 RALEIGH
 STANDARD
 SOUND BARRIER WALL

FIGURE 12 - 37

Pile Panel Sound Barrier Wall Design						
Exposure Category	Wall Height (ft)	Wind Pressure (psf)	"H" Bar Requirements	Soil Loads		
				P(D.L.+ I.L.) (kips)	V(W.L.) (kips)	M(W.L.) (k-ft)
A	0 < h <= 14	12	#4 @ 1'-0"	0.056 hs	0.012 hs	0.012 hs(h/2+d)
	14 < h <= 29	17		0.056 hs	0.168 s + 0.017 s(h-14)	0.168 s(d+7) + 0.017 s(h-14)(h/2+d+7)
B	0 < h <= 14	20	#4 @ 1'-0"	0.056 hs	0.020 hs	0.020 hs(h/2+d)
	14 < h <= 29	25		0.056 hs	0.280 s + 0.025 s(h-14)	0.280 s(d+7) + 0.025 s(h-14)(h/2+d+7)
C	0 < h <= 14	34	#4 @ 1'-0" (10' pile spacing)	0.056 hs	0.034 hs	0.034 hs(h/2+d)
	14 < h <= 29	42	#4 @ 9" (15' pile spacing)	0.056 hs	0.476 s + 0.042 s(h-14)	0.476 s(d+7) + 0.042 s(h-14)(h/2+d+7)
D	0 < h <= 14	62	#4 @ 1'-0" (10' pile spacing)	0.056 hs	0.062 hs	0.062 hs(h/2+d)
	14 < h <= 29	71	#4 @ 6" (15' pile spacing)	0.056 hs	0.868 s + 0.071 s(h-14)	0.868 s(d+7) + 0.071 s(h-14)(h/2+d+7)

D. L. = weight of 4" precast concrete panels

h = maximum wall height (ft)

I. L. = ice and snow loads for panels (3 psf)

s = pile spacing (ft)

W. L. = wind loads

d = distance from the top of the drilled pier concrete to the elevation required to support the bottom panel (ft)

FIGURE 12 - 37 M

Pile Panel Sound Barrier Wall Design						
Exposure Category	Wall Height (m)	Wind Pressure (kpa)	"H" Bar Requirements	Soil Loads		
				P(D.L. + I.L) (KN)	V(W.L.) (KN)	M(W.L.) (KN-m)
A	0 < h ≤ 4.270	0.575	#13 @ 300mm	2.681 hs	0.575 hs	0.575 hs(h/2+d)
	4.270 < h ≤ 8.840	0.814		2.681 hs	2.454 s + 0.814 s(h-4.267)	2.454 s(d+2.134) + 0.814 s(h-4.267)(h/2+d+2.134)
B	0 < h ≤ 4.270	0.958	#13 @ 300mm	2.681 hs	0.958 hs	0.958 hs(h/2+d)
	4.270 < h ≤ 8.840	1.197		2.681 hs	4.088 s + 1.197 s(h-4.267)	4.088 s(d+2.134) + 1.197 s(h-4.267)(h/2+d+2.134)
C	0 < h ≤ 4.270	1.628	#13 @ 300mm (3.1m pile spacing)	2.681 hs	1.628 hs	1.628 hs(h/2+d)
	4.270 < h ≤ 8.840	2.011	#13 @ 225mm (4.6m pile spacing)	2.681 hs	6.947 s + 2.011 s(h-4.267)	6.947 s(d+2.134) + 2.011 s(h-4.267)(h/2+d+2.134)
D	0 < h ≤ 4.270	2.969	#13 @ 300mm (3.1m pile spacing)	2.681 hs	2.969 hs	2.969 hs(h/2+d)
	4.270 < h ≤ 8.840	3.400	#13 @ 150mm (4.6m pile spacing)	2.681 hs	12.669 s + 3.400 s(h-4.267)	12.669 s(d+2.134) + 3.400 s(h-4.267)(h/2+d+2.134)

D. L. = weight of 102mm precast concrete panels

h = maximum wall height (m)

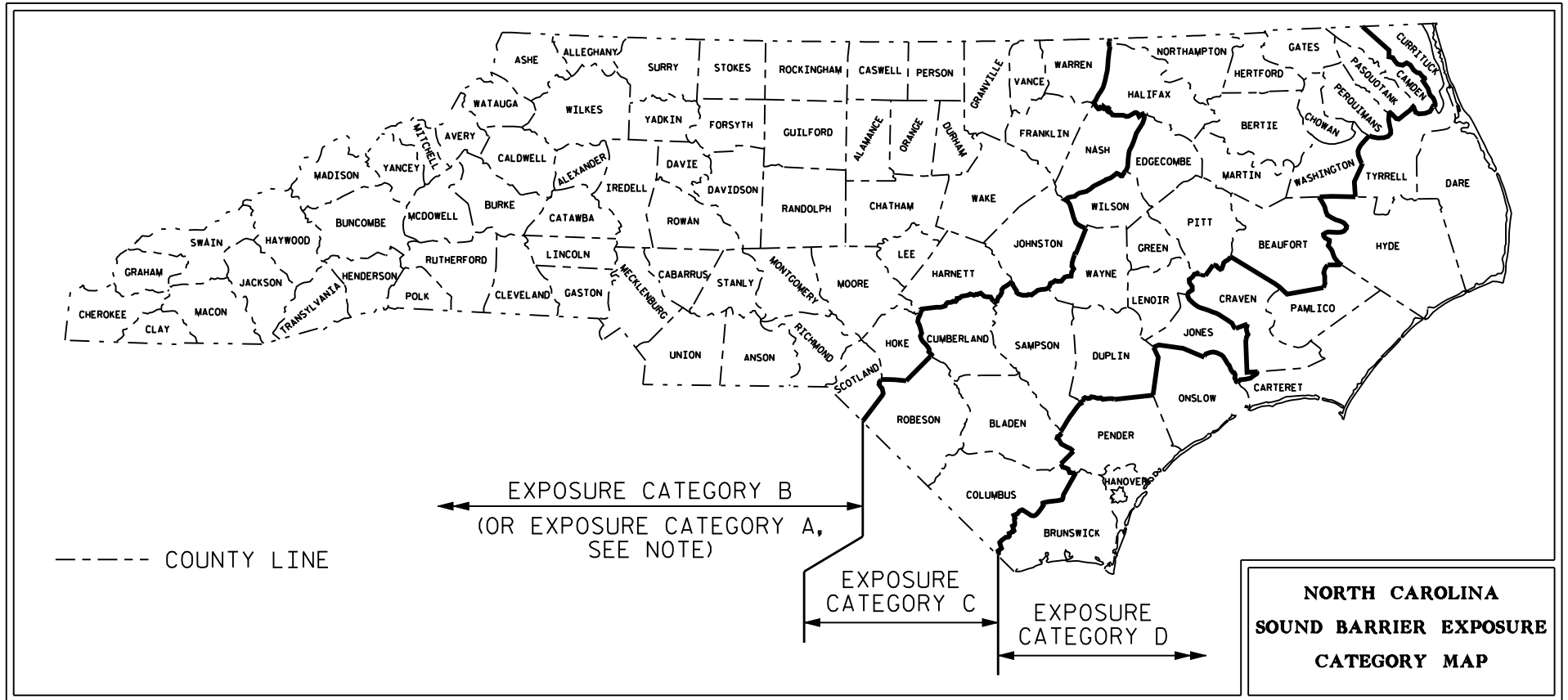
I. L. = ice and snow loads for panels (0.144 kpa)

s = pile spacing (m)

W. L. = wind loads

d = distance from the top of the drilled pier concrete to the elevation required to support the bottom panel (m)

FIGURE 12 - 36

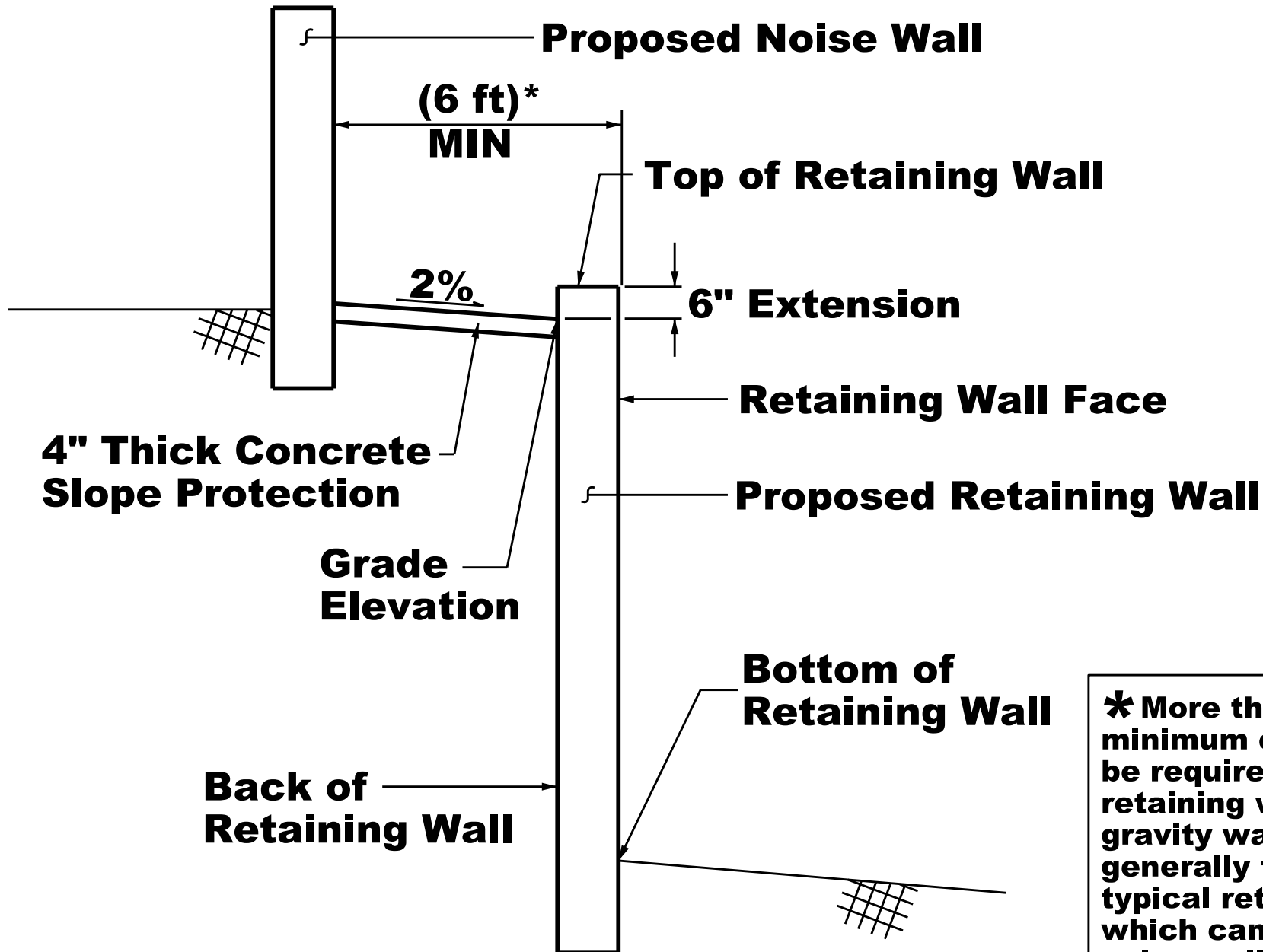


EXPOSURE CATERGORIES FOR SOUND BARRIER WALL

NOTE: EXPOSURE CATEGORY A PERTAINS TO URBAN AREAS WITH MULTIPLE OBSTRUCTIONS

Noise Wall/Retaining Wall Clearance Requirement

(May not apply to cantilever concrete retaining walls due to potential for interference between cantilever wall and noise wall foundations.)



*** More than a 6 ft minimum clearance may be required for gravity retaining walls because gravity walls are generally thicker than typical retaining walls which can interfere with noise wall foundations.**

If a junction box is required to accept the drainage from the system, coordinate with the Roadway Design Unit to locate the junction box. Place the following note on the plans:

See Roadway Plans for details and pay item for junction box at approximate Station _____.

12-15 Sound Barrier Walls

Pile panel sound barrier walls shall be in accordance with Standards SBW1 and SBW2 and the Special Provisions. The wall components shall be designed for the wind pressure as determined by the Exposure Category map of Figure 12-36. Options and details shall be provided on the standard drawings to allow the use of either a 10 foot (3.1 m), or 15 foot (4.6 m) panel.

The appropriate pile selection table from Standard SBW1 should be placed on the plans. The dead load, ice load, and wind loads have been considered in the panel and pile design. For walls subject to any additional loadings, the pile and panel shall be designed on a case by case basis. In addition, walls exceeding 29 feet (8.840 m) in height shall be designed on a case by case basis.

The Geotechnical Engineering Unit will determine the drilled pier lengths to be shown on Standard SBW1. Calculate the soil loads based on Figure 12-37, excluding the weight of the pile and drilled pier. Submit the loads and a copy of the Roadway Plan sheet that locates the wall to the Soils and Foundation Unit.

The required horizontal reinforcement in the precast panels, as determined by Figure 12-37, should be detailed on Standard SBW2 and the quantity tables for one precast panel shall be completed. The number and size of panels does not need to be computed; however, the estimated area, as computed from the Roadway plans, of the wall should be reported on Standard SBW2.

The completed standard drawings for the wall shall be transmitted to the Roadway Design Unit for inclusion with the wall layout and envelope in the Roadway plans.

12-16 Electrical Conduit System

The design of the Electrical Conduit System is categorized by its attachment to the superstructure. The three options are attachment to SIP forms, precast deck panels, or overhangs. Use the overhang option only when designing a stream crossing or a railroad crossing.

Every structure designed with an electrical conduit system shall use a conduit Expansion Joint Fitting and a Transition Adapter at each end bent and an Expansion Joint Fitting at each expansion joint in the deck. A Stabilizer should

Substructure sheets show the layout of the end bents and bents in plan and elevation. See Section 7 for detailed information.

1.3.6 Culverts

Culverts are structures typically used for short span stream crossings.

Culvert sheets show the culvert layout, plan and elevation views and a section through the culvert barrel showing the reinforcing steel. Standard culvert wing walls are used whenever possible. See Chapter 9 for detailed information.

1.3.7 Walls

Walls are typically designed to function as earth retaining structures or sound barriers.

1.3.7.1 Earth Retaining

The Roadway Design Unit establishes the location and limits of retaining walls. The Geotechnical Engineering Unit recommends the earth retaining system which will be employed and prepares the retaining wall plans. The plans typically show a plan view, typical sections, details, notes and an elevation or profile view (wall envelope) of each wall.

Coordinate with the Geotechnical Engineering Unit to include retaining wall plans in the structure plans, except when walls are the only structures on the project. In that case, the Geotechnical Unit will coordinate with the Roadway Design Unit to include retaining wall plans in the roadway plans.

1.3.7.2 Sound Barrier

The Roadway Design Unit establishes the location and limits of sound barrier walls. The Structures Management Unit is responsible for preparing sound barrier wall plans. Use the Sound Barrier Wall (SBW) standard drawings to prepare the plans. The Roadway Design Unit will prepare the wall envelope, which is similar to that for retaining walls. The Geotechnical Engineering Unit will provide sound barrier wall foundation recommendations.

Coordinate with the Roadway Design and Geotechnical Engineering Units to include sound barrier wall plans in the structure plans, except when walls are the only structures on the project. In that case, coordinate with the Roadway Design Unit to include wall plans in the roadway plans.



STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

BEVERLY EAVES PERDUE
GOVERNOR

EUGENE A. CONTI, JR.
SECRETARY

August 23, 2012

MEMORANDUM TO: Allen Raynor, P.E.
Assistant State Structures Engineer

Mohammed Mulla, P.E., C.P.M.
Contracts and Statewide Services Manager

K. J. Kim, Ph.D., P.E.
Eastern Regional Geotechnical Manager

John Pilipchuk, L.G., P.E.
Western Regional Geotechnical Manager

FROM: Njoroge Wainaina, P.E.
State Geotechnical Engineer

SUBJECT: Standard Sound Barrier Wall Foundations

The Technical Support Group of the Support Services Section of the Geotechnical Engineering Unit (GEU) has completed the new standard sound barrier wall foundations based on the 6th Edition of the *AASHTO LRFD Bridge Design Specifications*. These standard foundations update the current sound barrier wall foundation design from ASD to LRFD in accordance with new Section 15 entitled "Design of Sound Barriers" of the AASHTO LRFD specifications. Even though the Structures Management Unit (SMU) standard sound barrier wall panels are designed for 10 ft and 15 ft pile spacing, the standard sound barrier wall foundations are designed for variable pile spacing to allow for alternate panel types. The new standard sound barrier wall foundation tables are based on the following soil parameters, groundwater elevation and geometry.

- Friction angle (ϕ) = 30° or 34°, cohesion (c) = 0 psf and unit weight (γ) = 120 pcf,
- Groundwater elevation below finished grade,
- Front slope/finished grade 2:1 (H:V) or flatter,
- Pile spacing \leq 20 ft,
- Wall height \leq 25 ft and
- Hole diameter = 36" or 30".

The standard foundation tables are also based on an assumed wind pressure of 40 psf per SMU.

The SMU should incorporate the standard foundation tables into sound barrier wall plans as recommended by the GEU unless the standard sound barrier wall foundations are not applicable

MAILING ADDRESS:
NC DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING UNIT
1589 MAIL SERVICE CENTER
RALEIGH NC 27699-1589

TELEPHONE: 919-707-6850
Fax: 919-250-4237

www.ncdot.gov/doh/preconstruct/highway/geotech

LOCATION:
CENTURY CENTER COMPLEX
ENTRANCE B-2
1020 BIRCH RIDGE DRIVE
RALEIGH NC 27610

August 23, 2012
Allen Raynor, P.E.
Mohammed Mulla, P.E., C.P.M.
K. J. Kim, Ph.D., P.E.
John Pilipchuk, L.G., P.E.
Page 2

and a site specific foundation design is required. The new standard sound barrier wall foundation tables and sound barrier wall foundation recommendations form memo are attached to this memorandum for your reference. If there are any questions, please contact Scott Hidden, P.E. at (919) 707-6856.

Attachments: Standard Sound Barrier Wall Foundation Tables
 Sound Barrier Wall Foundation Recommendations Form Memo

cc: Greg Smith, P.E., Traffic Noise & Air Quality Group Leader
 Rodger Rochelle, P.E., Transportation Program Management Director
 Mike Robinson, P.E., State Bridge Construction Engineer



STANDARD SOUND BARRIER WALL FOUNDATION TABLES
(Pile Excavation Depths, "D" (ft) for 36" Dia. Hole; Add 1 ft to D for 30" Dia. Hole)

Sound Barrier Wall Foundation Table No. 1 ($\phi = 30^\circ$, $c = 0$ psf, $\gamma = 120$ pcf, groundwater between finished grade and bottom of hole with front slope/finished grade 6:1 or flatter or groundwater below bottom of hole with front slope/finished grade 2:1 or flatter and steeper than 3:1) –

Pile Spacing (S)	Wall Height (H)		
	$H \leq 15$ ft	15 ft $< H \leq 20$ ft	20 ft $< H \leq 25$ ft
$S \leq 10$ ft	10	12	13
10 ft $< S \leq 15$ ft	11	13	16
15 ft $< S \leq 20$ ft	12	15	18

Sound Barrier Wall Foundation Table No. 2 ($\phi = 30^\circ$, $c = 0$ psf, $\gamma = 120$ pcf, groundwater below bottom of hole with front slope/finished grade 3:1 or flatter and steeper than 6:1) –

Pile Spacing (S)	Wall Height (H)		
	$H \leq 15$ ft	15 ft $< H \leq 20$ ft	20 ft $< H \leq 25$ ft
$S \leq 10$ ft	8	10	11
10 ft $< S \leq 15$ ft	9	11	13
15 ft $< S \leq 20$ ft	10	13	15

Sound Barrier Wall Foundation Table No. 3 ($\phi = 30^\circ$, $c = 0$ psf, $\gamma = 120$ pcf, groundwater below bottom of hole with front slope/finished grade 6:1 or flatter) –

Pile Spacing (S)	Wall Height (H)		
	$H \leq 15$ ft	15 ft $< H \leq 20$ ft	20 ft $< H \leq 25$ ft
$S \leq 10$ ft	7	9	10
10 ft $< S \leq 15$ ft	8	10	12
15 ft $< S \leq 20$ ft	9	11	13

Sound Barrier Wall Foundation Table No. 4 ($\phi = 34^\circ$, $c = 0$ psf, $\gamma = 120$ pcf, groundwater between finished grade and bottom of hole with front slope/finished grade 6:1 or flatter or groundwater below bottom of hole with front slope/finished grade 2:1 or flatter and steeper than 3:1) –

Pile Spacing (S)	Wall Height (H)		
	$H \leq 15$ ft	15 ft $< H \leq 20$ ft	20 ft $< H \leq 25$ ft
$S \leq 10$ ft	9	11	12
10 ft $< S \leq 15$ ft	10	12	14
15 ft $< S \leq 20$ ft	11	13	16

Sound Barrier Wall Foundation Table No. 5 ($\phi = 34^\circ$, $c = 0$ psf, $\gamma = 120$ pcf, groundwater below bottom of hole with front slope/finished grade 3:1 or flatter and steeper than 6:1) –

Pile Spacing (S)	Wall Height (H)		
	$H \leq 15$ ft	15 ft $< H \leq 20$ ft	20 ft $< H \leq 25$ ft
$S \leq 10$ ft	8	9	10
10 ft $< S \leq 15$ ft	8	10	12
15 ft $< S \leq 20$ ft	9	11	13

Sound Barrier Wall Foundation Table No. 6 ($\phi = 34^\circ$, $c = 0$ psf, $\gamma = 120$ pcf, groundwater below bottom of hole with front slope/finished grade 6:1 or flatter) –

Pile Spacing (S)	Wall Height (H)		
	$H \leq 15$ ft	15 ft $< H \leq 20$ ft	20 ft $< H \leq 25$ ft
$S \leq 10$ ft	7	8	9
10 ft $< S \leq 15$ ft	7	9	11
15 ft $< S \leq 20$ ft	8	10	12



PAT McCrory
Governor

NICHOLAS J. TENNYSON
Secretary

November 9, 2015

MEMORANDUM TO: Rick Nelson, P.E.
Assistant State Structures Engineer

ATTENTION: Structures Project Engineer, P.E.
Structures Management Project Engineer

FROM: John L. Pilipchuk, L.G., P.E.
State Geotechnical Engineer

STATE PROJECT: WBS El. # (TIP #)
F. A. PROJECT: N/A
COUNTY: County
DESCRIPTION: Description

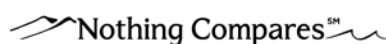
SUBJECT: Sound Barrier Wall Foundation Recommendations

The Geotechnical Engineering Unit (GEU) has received the following proposed sound barrier wall locations for the referenced project and recommends the following standard sound barrier wall foundation tables as shown:

Sound Barrier Wall No.	Begin Station & Offset	End Station & Offset	Standard Sound Barrier Wall Foundation Table No.
No. 1, 2, etc.			1, 2, 3, 4, 5 or 6
No. 1, 2, etc.			1, 2, 3, 4, 5 or 6

(List all sound barrier wall locations in table. Break up sound barrier walls into sections by station as needed for variable subsurface conditions and geometry. The standard sound barrier wall foundation tables are based on 36" dia. holes. For 30" dia. holes, add 1 ft to pile excavation depths (D) in standard foundation tables.

The GEU recommends including the Continuous Flight Auger Piles for Sound Barrier Walls provision in the contract for the referenced project. (Optional) Please contact Primary Contact Name or Secondary Contact Name at Contact Telephone # if there are any questions concerning this memorandum.





Design Engineer Name
Design Engineer Title

JLP/Design Engineer Initials

Attachment: Continuous Flight Auger Piles for Sound Barrier Walls Provision (Optional)

SOUND BARRIER WALL

(6-19-15)

1.0 DESCRIPTION

This work consists of furnishing precast panels, structural steel, concrete, and all other materials; handling, transporting, fabricating, galvanizing, and storing materials; furnishing erection drawings, pile excavation, backfilling, erecting and installing the sound barrier wall members and all other materials as required by the plans, Standard Specifications and this Special Provision.

The Standard Plans allow a pile spacing of 10, 15 or 20 feet. Pile spacing greater than 15 feet will not be allowed for standard precast concrete panels. Provide consistent pile spacing the entire length of the wall. Use odd pile spacing, if necessary, only at the ends of the wall and at turning points as approved by the Engineer.

A maximum one foot drop or rise in elevation between wall sections is permitted. Elevation changes greater than one foot, if necessary, will be allowed only at the end of the wall. Top of wall elevation changes that result in a jagged appearance will not be allowed.

2.0 ALTERNATE PILE SPACING FOR STANDARD PRECAST PANELS

As an alternate, the Contractor may submit plans for pile spacing greater than 10 feet and less than 15 feet for review and approval. The excavated diameter, excavation depth and reinforcing steel shall be equal to the amount shown on the existing plans for the 15 feet pile spacing. A variance in the reinforcing steel will be allowed for the length of horizontal and number of vertical reinforcement bars in the precast panel for the alternate pile spacing.

Submit two sets of detailed plans for review. Include all details in the plans, including the size and spacing of required reinforcement necessary to fabricate the precast panels. Have a North Carolina Registered Professional Engineer check, seal and date the plans. After the plans are reviewed and, if necessary, the corrections made, submit one set of reproducible tracings on 22" x 34" sheets to become part of the contract plans.

3.0 ALTERNATE WALL TYPE

Walls that have been assigned "Approved" or "Approved for Provisional Use" status by the Product Evaluation Program will be considered for substitution to the detailed Standard Sound Barrier Wall only when noted on the plans. Alternate wall types, piles and pile spacing must meet the design and construction requirements of the project. Pile spacing greater than 20 feet will not be permitted. Alternate pile and wall structural stability and connection details shall conform to the current edition of the AASHTO LRFD Bridge Design Specifications.

Prior to submittal of Working Drawings, as described herein, submit a copy of the signed NCDOT Product Status Notification Letter and two sets of preliminary plans for review and approval. Include material specifications for all components. Once preliminary plans

are approved, submit Working Drawings in accordance with all applicable portions of the requirements herein, including details necessary to fabricate and construct the proposed alternate.

Have a North Carolina Registered Professional Engineer check, seal and date the plans and, when requested, calculations. After the plans are reviewed and, if necessary, corrections made, submit one set of reproducible tracings on 22" x 34" sheets to become part of the contract plans.

4.0 MATERIALS AND FABRICATION OF STANDARD PRECAST PANELS

Provide materials and fabricate members in accordance with the requirements of Division 10 of the Standard Specifications for Roads and Structures.

Provide precast panels that are 4 inches \pm 1/4 inch thick with an exposed aggregate finish on one face. The panel face with the aggregate finish shall be installed facing the roadway. The depth of the exposure is required to range from 0 to 1/4 inch. Furnish three 12" x 12" samples for approval which establish the acceptable variations in color, texture, and uniformity. After the color, texture, and uniformity of the furnished samples are approved, produce a full scale panel unit meeting design requirements. This mock-up and the furnished samples establish the standard quality for determining acceptance of the panels. When producing the final installed panels, use fine and coarse aggregate, retarder, and cement from the same source as those used in the approved sample panels.

5.0 CONSTRUCTION METHODS

Complete the final survey of existing ground profile after clearing the wall area but prior to submitting any working drawings. Submit the final groundline survey with the working drawings.

If the Department is responsible for the survey, the Engineer field verifies the existing ground profile along the sound barrier wall. Contact the Engineer to obtain the survey information. Otherwise, complete the existing ground survey prior to submittal of working drawings.

Excavate holes with the diameters shown on the plans. Perform pile excavation to the depths shown on the plans and install piles as shown on the plans or in the accepted submittals with a tolerance of 1/2 inch per foot from vertical. Backfill excavations with concrete after placing piles.

A. Pile Excavation

Use equipment of adequate capacity and capable of drilling through soil and non-soil including rock, boulders, debris, man-made objects and any other materials encountered. Blasting is not permitted to advance the excavation. Blasting for core removal is only permitted when approved by the Engineer. Dispose of drilling spoils in accordance with Section 802 of the Standard Specifications and as directed by the

Engineer. Drilling spoils consist of all excavated material including water removed from the excavation either by pumping or drilling tools.

If unstable, caving or sloughing soils are anticipated or encountered, stabilize excavations with either slurry or steel casing. When using slurry, submit slurry details including product information, manufacturer's recommendations for use, slurry equipment information and written approval from the slurry supplier that the mixing water is acceptable before beginning drilling. When using steel casing, use either the sectional type or one continuous corrugated or non-corrugated piece. Steel casings should consist of clean watertight steel of ample strength to withstand handling and driving stresses and the pressures imposed by concrete, earth or backfill. Use steel casings with an outside diameter equal to the hole size and a minimum wall thickness of 1/4 inch.

B. Concrete Placement

Before placing concrete, center and support the pile in the excavation and check the water inflow rate in the excavation after any pumps have been removed. If the inflow rate is less than 6 inches per half hour, remove any water and free fall the concrete into the excavation. Ensure that concrete flows completely around the pile. If the water inflow rate is greater than 6 inches per half hour, propose a concrete placement procedure to the Engineer. The Engineer shall approve the concrete placement procedure before placing concrete.

Fill the excavation with Class A concrete in accordance with Section 1000 of the Standard Specifications except as modified herein. Provide concrete with a slump of 6 to 8 inches. Use an approved high-range water reducer to achieve this slump. Place concrete in a continuous manner and remove all casings.

6.0 WORKING DRAWINGS

Submit casting drawings for the precast face panels for approval in accordance with Article 1077-2 of the Standard Specifications prior to casting. Show the inserts, method of handling, and support details used for transportation on casting drawings. Submit metalwork fabrication drawings for approval prior to fabrication of steel wall components. Submit an erection plan and concrete face panel placing plan, including location of various heights of panels, for review and acceptance prior to fabrication of metalwork. Submit five sets of detail drawings.

7.0 METHOD OF MEASUREMENT

The quantity of sound barrier wall to be paid will be the actual square feet of completed and accepted wall. In any individual section of sound barrier wall or in comparably dimensioned sections, the wall height is from the bottom of the bottom panel to the top of the top panel and the width is the distance between the centerline of the piles at the ends of the section. Include the full width of the piles at the ends of the wall.

8.0 BASIS OF PAYMENT

The quantity of sound barrier wall, measured as provided above, will be paid for at the contract unit price bid per square foot for “Sound Barrier Wall”.

The unit price bid per square foot will be full compensation for all work covered by this Special Provision including, but not limited to, furnishing precast panels, steel or concrete piles, miscellaneous structural steel, concrete, and all other materials; handling, transporting, fabricating, galvanizing, and storing materials; furnishing erection drawings, backfilling, pile excavation including any casing or slurry, and erecting and installing the sound barrier wall members.

Payment will be made under:

Sound Barrier Wall..... Square Foot