OHIO DEPARTMENT OF TRANSPORTATION

CENTRAL OFFICE, 1980 W. BROAD ST., COLUMBUS, OHIO 43216-0899

January 20, 2012

To: Users of the Bridge Design Manual

From: Tim Keller, Administrator, Office of Structural Engineering

By: Sean Meddles, Bridge Standards Engineer

Re: 2012 First Quarter Revisions

Revisions have been made to the ODOT Bridge Design Manual, January 2004. These revisions shall be implemented on all Department projects with a Stage 1 plan submission date after January 20, 2012. Implementation of some or all of these revisions for projects further along the development process should be considered on a project-by-project basis.

This package contains the revised pages. The revised pages have been designed to replace the corresponding pages in the book and are numbered accordingly. Revisions, additions, and deletions are marked in the revised pages by the use of one vertical line in the right margin. The header of the revised pages is dated accordingly.

To keep your Manual correct and up-to-date, please replace the appropriate pages in the book with the pages in this package.

To ensure proper printing, make sure your printer is set to print in the 2-sided mode.

The January 2004 edition of the Bridge Design Manual may be downloaded at no cost using the following link:

http://www.dot.state.oh.us/Divisions/HighwayOps/Structures/standard/Pages/default.aspx

Attached is a brief description of each revision.

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Summary of Revisions to the January 2004 ODOT BDM

BDM Section	Affected Pages	Revision Description
204.4	2-22 through 2-23	The use of MSE Wall supported abutments has been restricted to pile supported foundations only. Additional information has also been added for situations where rock is in close proximity to the MSE Wall foundation.
302.1.3.1	3-11	The wearing course for non-composite box beam has been revised to provide a more cost effective solution.
Figure 321		This revision removes the 9-inch width of sealing on the bridge deck surface consistent with the October 2011 revisions to BDM Section 302.1.4.3.
Figure 332		A view of the coping has been added to emphasize the orientation of the coping joints. Also, the reinforcement in the coping and the width of the coping expansion joint have been modified.
606.2	6-15	Note [606.2-5] was retired when the information was added to C&MS 507.05.
702.12	7-10	This revised plan note accommodates the changes made to the asphalt wearing course for non-composite box beams in BDM Section 302.1.3.1.
ARN-36	Appendix-109.18 through Appendix-110	Retired Note [606.2-5] for battered piles was added to the appendix.

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$D = T + 0.50Y$

Where:
T = Thickness of footing in feet [meters]
Y = distance from bottom of stream bed to surface of bedrock in feet [meters]

The footing depth from the above formula shall place the footing not less than 3 inches [75 mm] into the bedrock.

204.2 EARTH BENCHES AND SLOPES

A bench at the face of abutment shall not be used. Rehabilitation projects may require special slope considerations.

Spill thru slopes should be 2:1, except where soil analysis or existing slopes dictates flatter slopes. The slope is measured normal to the face of the abutment.

For superelevated bridges over waterways, the intersection of the top of slope with the face of abutment shall be on a level line. For other superelevated structures the top of slope shall generally be made approximately parallel to the bridge seat. For structures over streets and roads having steep grades, the intersection of earth slope and face of abutment may be either level or sloping dependent upon which method fits local conditions and gives the most economical and aesthetically pleasing structure.

The spill-thru slope should intersect the face of abutment a minimum of one foot [300 mm], or as specified in a standard bridge drawing, below the bridge seat for stringer type bridges. For concrete slab and prestressed box beam bridges this distance should be 1'-6" [450 mm].

204.3 ABUTMENT TYPES

Preference should be given to the use of spill-thru type abutments. Generally for stub abutments on piling or drilled shafts the shortest distance from the surface of the embankment to the bottom of the toe of the footing should be at least 4'-0" [1200 mm]. For stub abutments on spread footing on soil, the minimum dimension shall be 5'-0" [1525 mm]. For any type of abutment, integral design shall be used where possible, see Section 205.8 for additional information.

Wall type abutments should be used only where site conditions dictate their use.

204.4 ABUTMENTS SUPPORTED ON MSE WALLS

When conditions are appropriate, the use of MSE walls to shorten bridge spans and eliminate embankment slopes is acceptable. MSE wall supported abutments shall be supported on piling regardless of the proximity of bedrock to the MSE wall foundation. The Department will not permit

the use of spread footing supported abutments on MSE walls because of their susceptibility to loss of bearing caused by erosion during the service life of the structure. Piles require a minimum 15-foot embedment below the MSE wall. If rock exists within the minimum embedment depth, the piles shall be placed in pre-bored holes that extend a minimum of 5-ft into bedrock. The pre-bored holes shall be backfilled with Class C concrete up to the top of the leveling pad elevation after pile installation.

Refer to Sections 201.2.6, 202.2.3 and 204.6.2 for the staged review requirements for MSE walls. Consult the Office of Structural Engineering for additional design recommendations.

204.5 PIER TYPES

For highway grade separations, the pier type should generally be cap-and-column piers supported on a minimum of 3 columns. (This requirement may be waived for temporary conditions that require caps supported on less than 3 columns.) Typically the pier cap ends should be cantilevered and have squared ends.

For bridges over railroads generally the pier type should be T-type, wall type or cap and column piers. Preference should be given to T-type piers. Where a cap and column pier is located within 25 feet [7.6 meters] from the centerline of tracks, crash walls will be required.

For waterway bridges the following pier type should be used:

A. Capped pile type piers; generally limited to a maximum height of 20 feet [6 meters]. For heights greater than 15 feet [4.5 meters], the designer should analyze the piles as columns above ground. Scour depths shall be considered.

B. Cap-and-column type piers.

C. Solid wall or T-type piers.

Note that the use of T-type piers, or other pier types with large overhangs, makes the removal of debris at the pier face difficult to perform from the bridge deck. For low stream crossings with debris flow problems and where access to the piers from the stream is limited, T-type piers, or other similar pier types, should not be used.

For unusual conditions, other types may be acceptable. In the design of piers which are readily visible to the public, appearance should be given consideration if it does not add appreciably to the cost of the pier.

204.6 RETAINING WALLS

In conformance with Section 1400 of the ODOT Location and Design Manual, Volume Three, a Retaining Wall Justification shall be included in the Preferred Alternative Verification Review Submission for a Major Project or in the Minor Project Preliminary Engineering Study Review Submission. A description of the Retaining Wall Justification is provided in Section 1404 of the ODOT Location and Design Manual, Volume Three. Generally, the justification compares the

practicality, constructability and economics of the various types of retailing walls listed below:

A. Cast-in-place reinforced concrete
B. Precast concrete
C. Tied-back
D. Adjacent drilled shafts
E. Sheet piling
F. H-piling with lagging
G. Cellular (Block, Bin or Crib)
H. Soil nail
I. Mechanically Stabilized Earth (MSE)

Refer to SS840 for accredited MSE wall systems. Contact the Office of Structural Engineering for modular block wall systems. For wall systems that utilize geogrid reinforcements, the wall height shall be limited to 30 ft.

204.6.1 DESIGN CONSTRAINTS

Below are some design constraints to consider in the wall justification study to establish acceptable wall types:

A. Future use of the site (future excavations cannot be made in Mechanically Stabilized Embankments)
B. Deflection and/or differential settlements
C. Accessibility to the construction site
D. Aesthetics, including wall textures
E. Right-of-way (or other physical constraints)
F. Cost (approximate cost analysis)
G. Stage construction
H. Stability (long-term and during construction)
I. Railroad policies

204.6.2 STAGE 1 DETAIL DESIGN SUBMISSION FOR RETAINING WALLS

When a justification study has determined that a retaining wall is required, generally the wall will be a cast-in-place reinforced concrete wall or some type of proprietary wall system. The use of proprietary wall systems should be considered when the wall quantity for the project exceeds 5000 ft^2 [450 m^2].

wearing surface shall be composed as follows:

1. Two separate 1½ inch [38 mm] minimum lifts of Item 448 Asphalt Concrete Surface Course, Type 1, PG70-22M. The first lift shall be variable thickness to accommodate beam camber. The second lift shall be a uniform 1½ inch [38 mm] thickness.

2. Two applications of Item 407 Tack Coat - one prior to placement of the first lift of surface course and one prior to placement of the second lift of surface course. Refer to the ODOT Pavement Design & Rehabilitation Manual, Section 404.11 for application rates.

C. 6 inches [155 mm] cast-in-place composite deck - defined as the minimum thickness of concrete slab for composite prestressed box beams. The top 1 inch [25 mm] shall be considered monolithic as defined above. Also see Section 302.5.1.3.

302.1.3.2 FUTURE WEARING SURFACE

All bridges shall be designed for a future wearing surface (FWS) of 60 psf [2.87 kPa].

The future wearing surface is considered non-structural and shall not be used in design to increase the strength of the superstructure. The presence of a future wearing surface does not exclude the use of the 1 inch [25 mm] monolithic wearing surface as defined above.

302.1.4 CONCRETE DECK PROTECTION

302.1.4.1 TYPES

A. Epoxy Coated Reinforcing Steel - CMS 709.00

B. Minimum concrete cover of 2½ inches [65 mm]

C. Class S Concrete

D. Class HP Concrete

E. Drip Strips

F. CMS 512, Type D, Waterproofing or CMS 512 Type 3 Waterproofing

G. Asphaltic concrete wearing surface

302.1.4.2 WHEN TO USE

All reinforcing steel shall be epoxy coated.

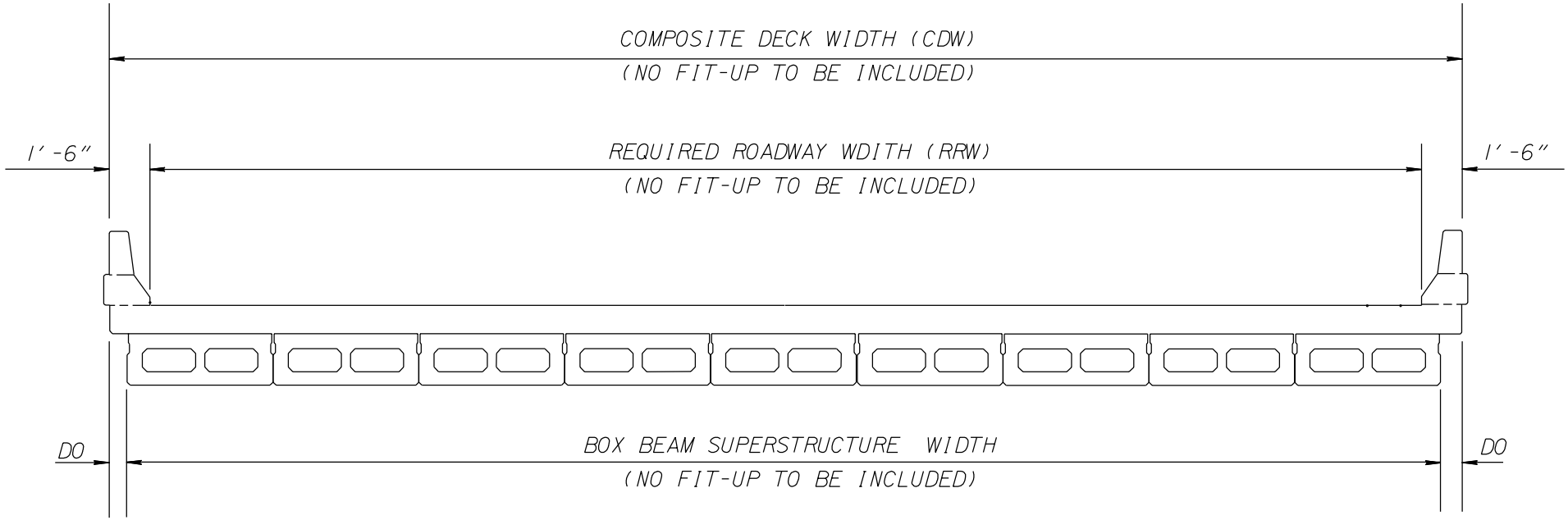
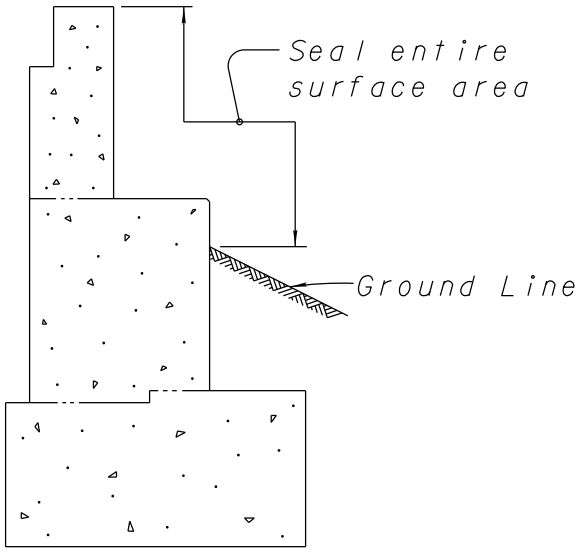


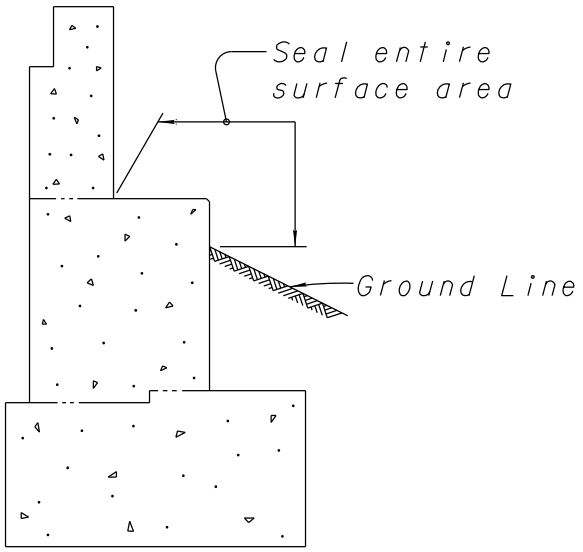
Figure 320

FIT-UP SHOULD NOT BE INCLUDED IN ESTABLISHING THE NUMBER OF BEAMS.
IN ACTUAL CONSTRUCTION FIT-UP WILL BE ABSORBED IN THE OVERHANG

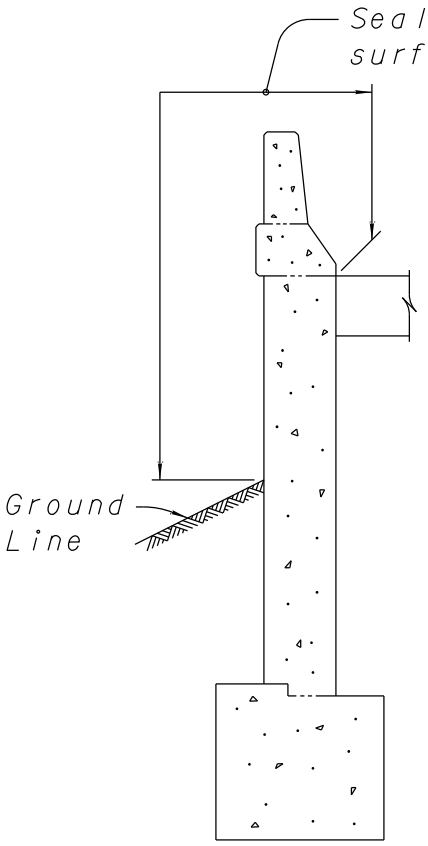
DO = DESIGN OVERHANG (MINIMUM 2", MAXIMUM 8") BOX BEAM DESIGN WIDTH SHOULD BE SELECTED SO DO STAYS WITHIN ACCEPTABLE RANGE.



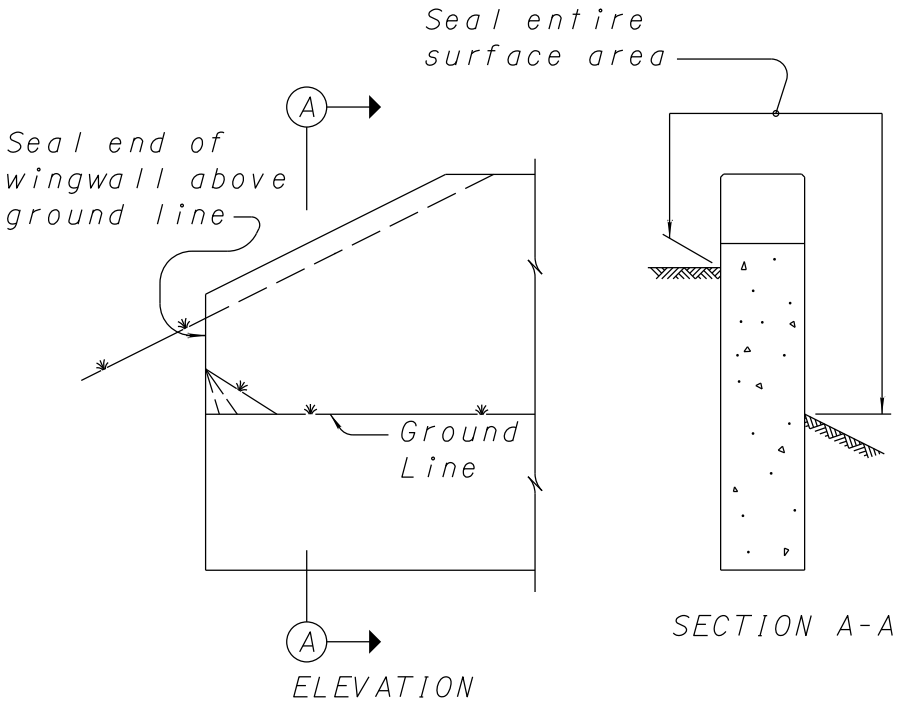
ABUTMENT SEALING LIMITS
(FOR STEEL BEAM BRIDGE)



ABUTMENT SEALING LIMITS
(FOR PRESTRESSED BOX BEAM BRIDGE)



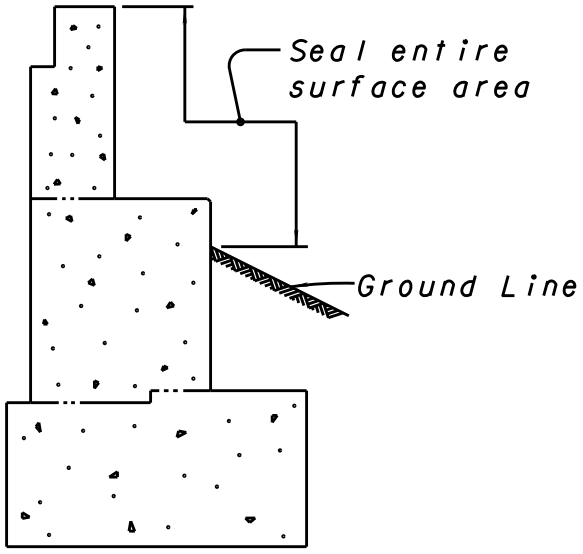
WINGWALL SEALING LIMITS
(TURNBACK WALL ON
U-TYPE ABUTMENT)



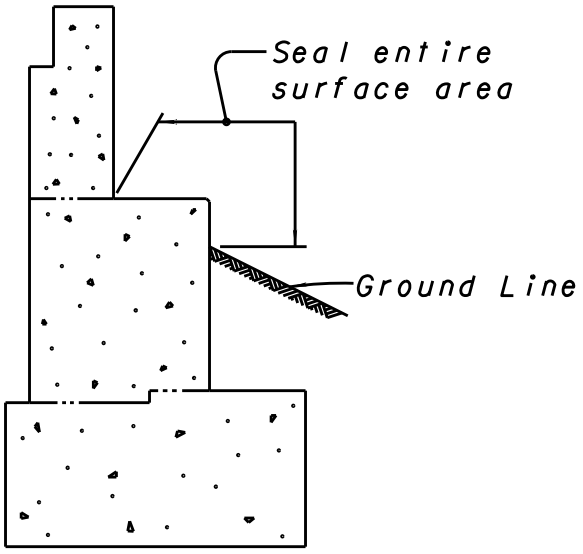
WINGWALL SEALING LIMITS
(STRAIGHT WING ABUTMENT)

SEALING OF CONCRETE SURFACES, SUBSTRUCTURE

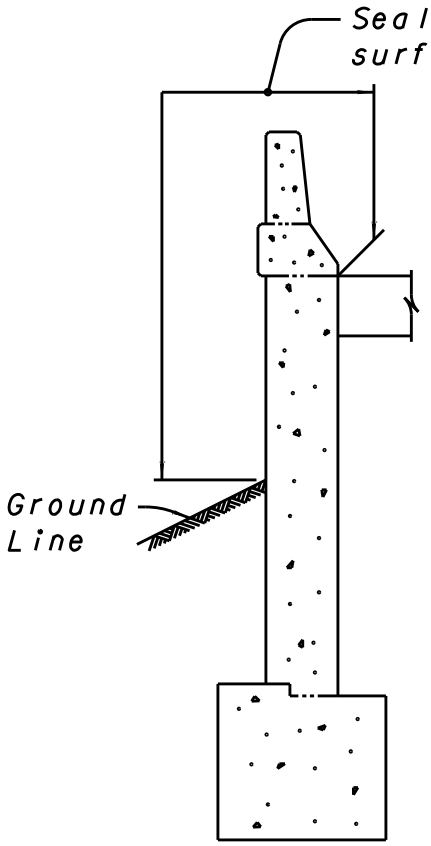
Figure 321



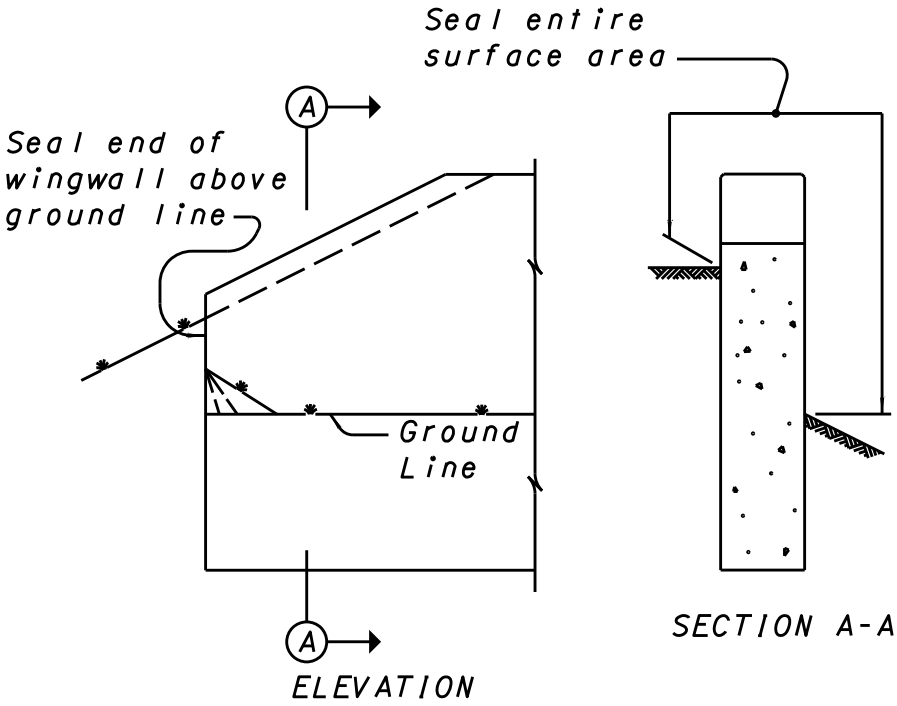
ABUTMENT SEALING LIMITS
(FOR STEEL BEAM BRIDGE)



ABUTMENT SEALING LIMITS
(FOR PRESTRESSED BOX BEAM BRIDGE)



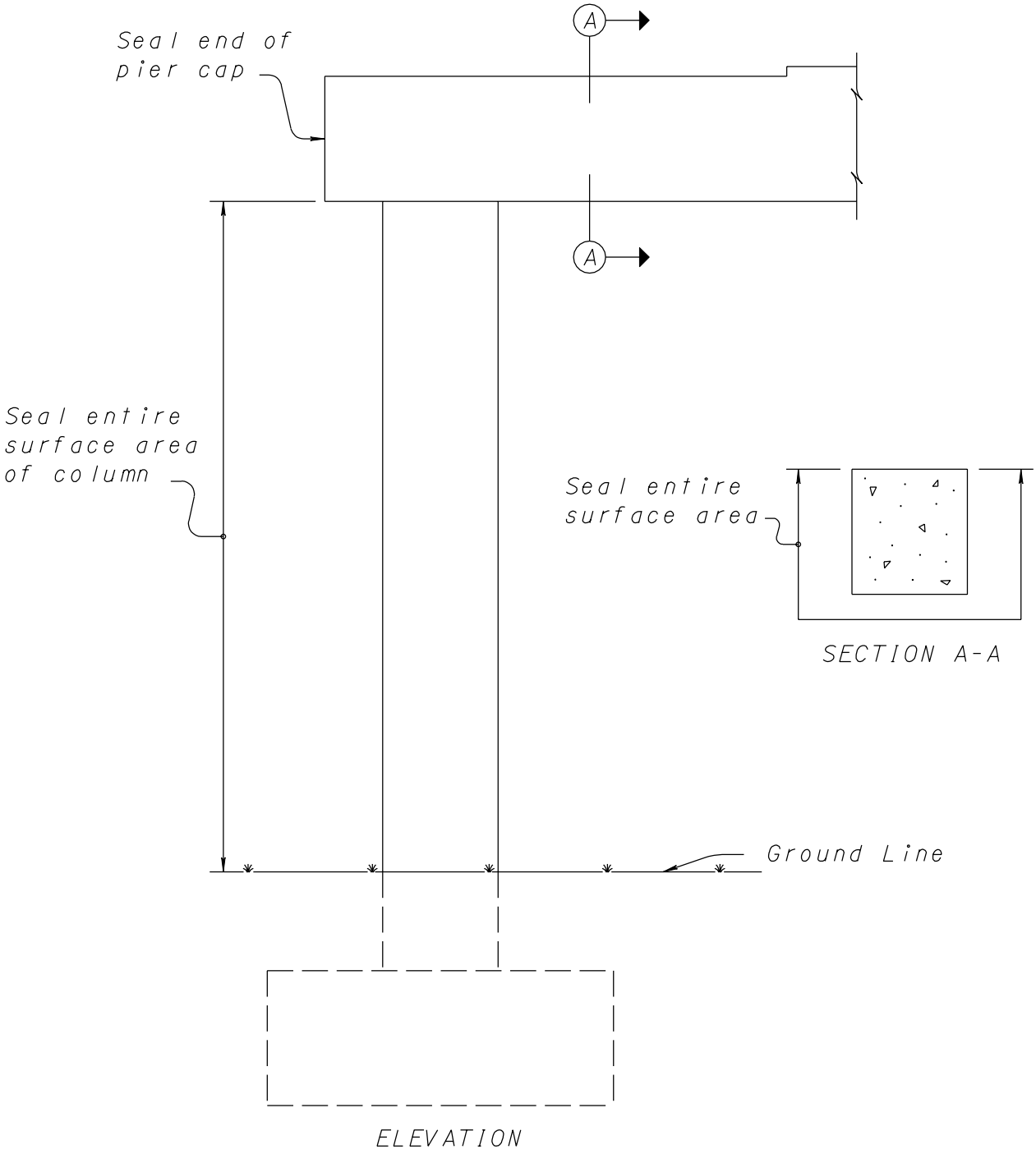
WINGWALL SEALING LIMITS
(TURNBACK WALL ON
U-TYPE ABUTMENT)



WINGWALL SEALING LIMITS
(STRAIGHT WING ABUTMENT)

SEALING OF CONCRETE SURFACES, SUBSTRUCTURE

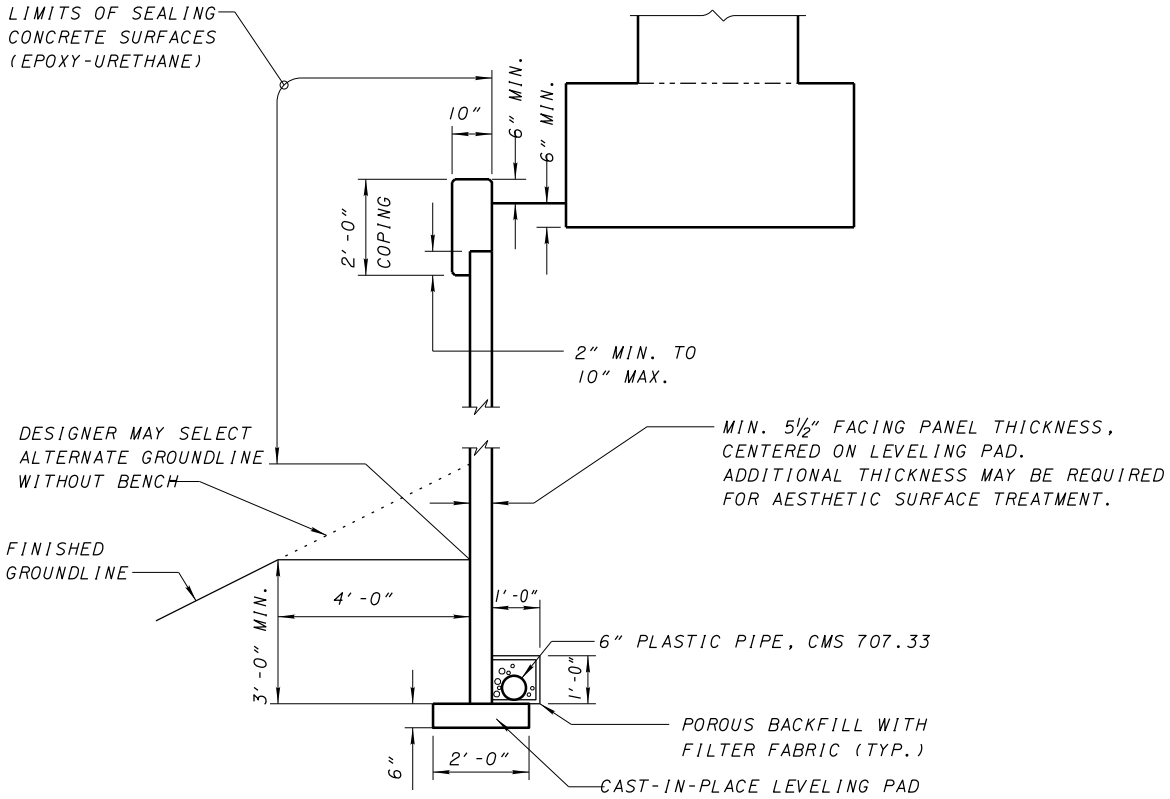
Figure 321M



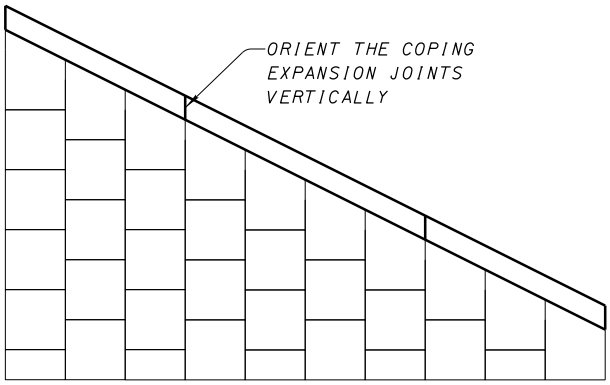
PIER SEALING LIMITS
(EXPOSED TO DEICER SPRAY)

SEALING OF CONCRETE SURFACES, SUBSTRUCTURE

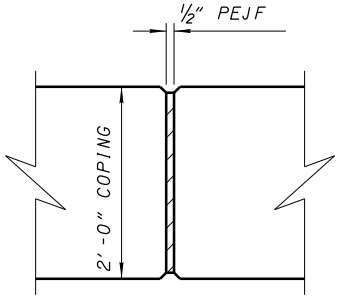
Figure 322M



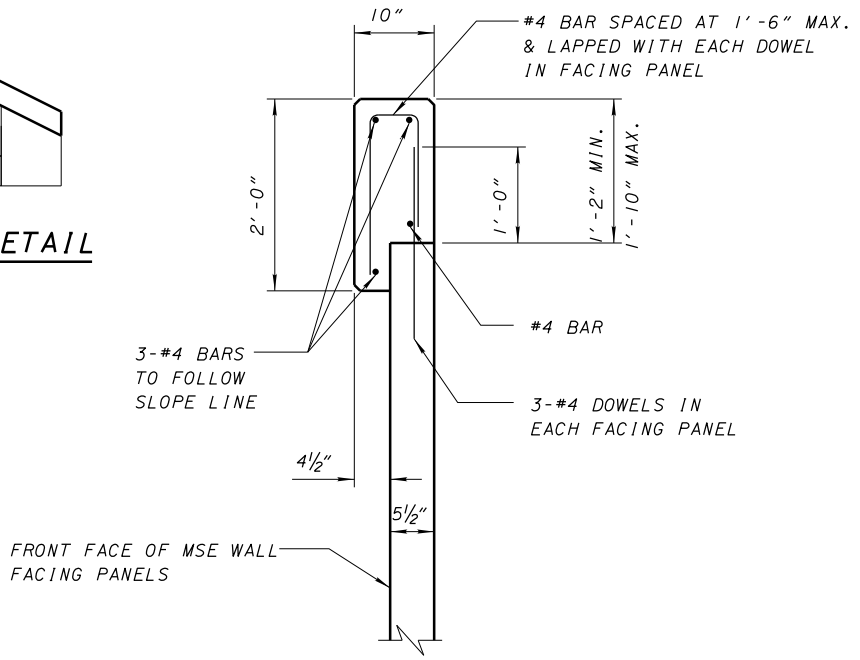
MSE WALL AND COPING DETAIL



COPING JOINT ORIENTATION DETAIL



COPING EXPANSION JOINTS



MSE WALL COPING

ALL REINFORCING STEEL TO BE EPOXY COATED

FIGURE 332

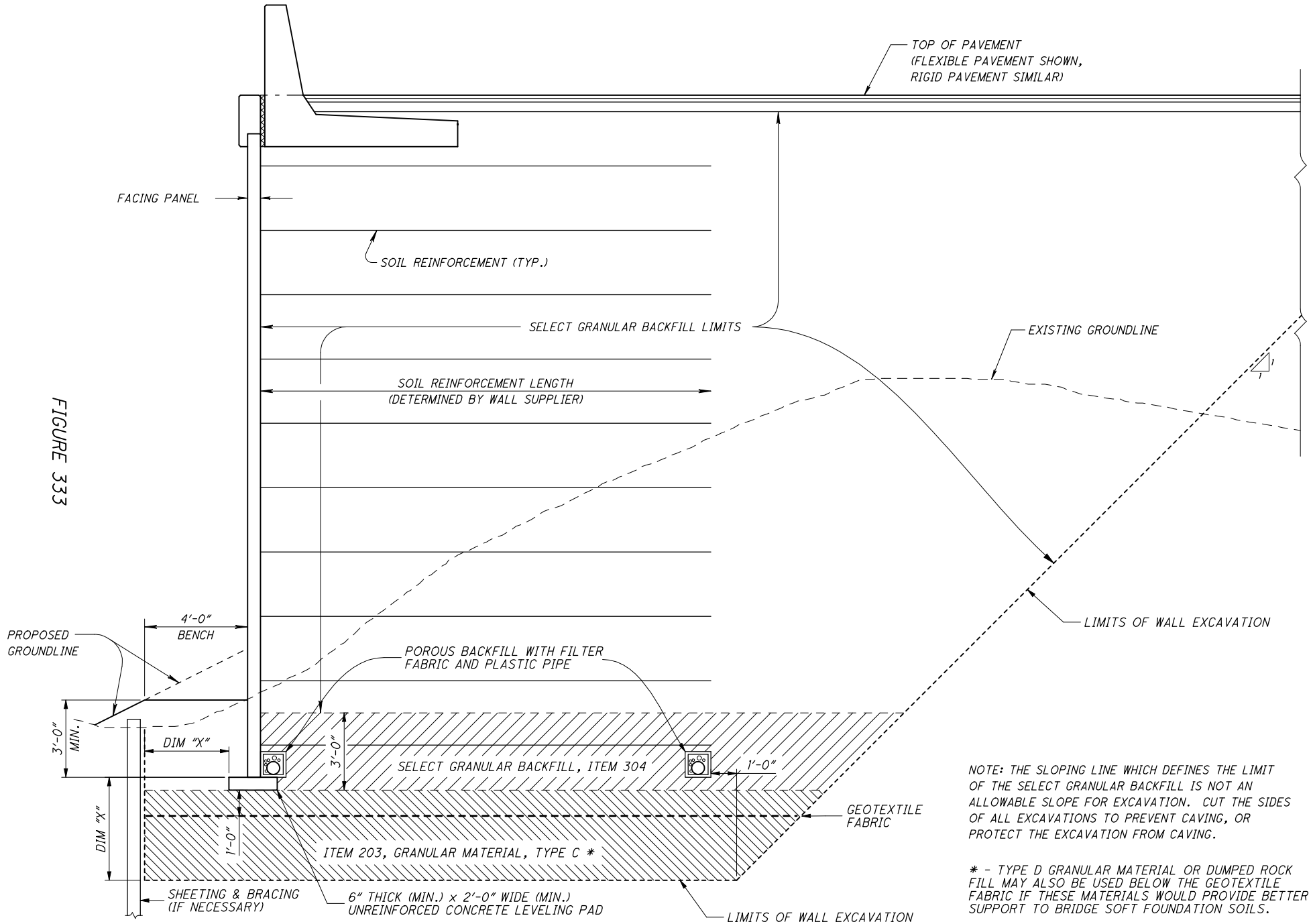


FIGURE 333

NOTE: THE SLOPING LINE WHICH DEFINES THE LIMIT OF THE SELECT GRANULAR BACKFILL IS NOT AN ALLOWABLE SLOPE FOR EXCAVATION. CUT THE SIDES OF ALL EXCAVATIONS TO PREVENT CAVING, OR PROTECT THE EXCAVATION FROM CAVING.

* - TYPE D GRANULAR MATERIAL OR DUMPED ROCK FILL MAY ALSO BE USED BELOW THE GEOTEXTILE FABRIC IF THESE MATERIALS WOULD PROVIDE BETTER SUPPORT TO BRIDGE SOFT FOUNDATION SOILS.

for the remaining piling represented by the testing. Submit all test results to the Office of Structural Engineering.

For subsequent static load tests, upon completion of a 10,000 ft [3000 m] increment of driven length, repeat the above procedure for the initial static load test. If necessary, the Engineer will revise the driving criteria for the remaining piling accordingly.

When performing the restrike, if the pile has not reached the blow count determined for the plan specified Ultimate Bearing Value, continue driving the pile until this capacity is achieved.

[30d] Note retired - see appendix

606.3 STEEL PILE POINTS

Use the following note where steel points are required, and see Section 202.2.3.2.a.

[31] ITEM 507, STEEL POINTS, AS PER PLAN: Use steel pile points to protect the tips of the proposed steel "H" piling. Furnish steel points from the following manufactures/suppliers: Associated Pile and Fitting Corporation, 262 Rutherford Blvd., Clifton, New Jersey 07014, phone: (973)773-8400, (800)526-9047, fax: (973)773-8442; International Construction Equipment, Inc., 301 Warehouse Drive, Matthews, North Carolina 28015, phone: (704)821-8200, (888)423-8721, fax: (704)821-8201; Dougherty Foundation Products, Inc., P.O. Box 688, Franklin Lakes, New Jersey 07417, phone: (201)337-5748, fax: (201)337-9022; Versa Steel Inc., 1618 N.E. First Ave., Portland, Oregon 97232, phone: (503)287-9822, (800)678-0814, fax: (503)287-7483; Versabite Piling Accessories, 1704 Tower Industrial Dr., Monroe, North Carolina 28110, phone: (800)280-9950, (704)225-1566, fax: (704)225-1567; or by a manufacturer that can furnish a steel point that is acceptable to Director. The material used for the manufacturing of pile points shall conform to ASTM A27/A27M 65/35 [450/240] – Class 2 – Heat Treated or AASHTO M103/M103M 65/35 [450/240] – Heat Treated. Weld the

pile points to the pile in accordance with AWS D1.5 or the manufacturer's written welding procedure supplied to the engineer before the welding is performed. Submit a notarized copy of the mill test report to the Engineer.

606.4 PILE SPLICES

Provide the following note when H-piles are specified.

[100] PILE SPLICES: In lieu of using the full penetration butt welds specified in CMS 507.09 to splice steel H-piles, the Contractor may use a manufactured H-pile splicer. Furnish splicers from the following manufacturer:

Associated Pile and Fitting Corporation

8 Wood Hollow Rd. Plaza 1

Parsippany, New Jersey 07054

Install and weld the splicer to the pile sections in accordance with the manufacturer's written assembly procedure supplied to the Engineer before the welding is performed.

606.5 MINIMUM HAMMER SIZE

[33] Note retired - see appendix

606.6 PILE ENCASEMENT

The following note shall be used where capped pile piers and steel "H" piles are being used for a bridge structure crossing a waterway. The exposed steel piling corrodes at the waterline, or near there. The note should not be used if the capped pile pier standard drawing is being used as standard drawing already specifies pile encasement methods.

[34] ITEM SPECIAL - PILE ENCASEMENT

Encase all steel H-piles for the capped pile piers in Class C concrete. Provide a concrete slump between 6 to 8 inches with the use of a superplasticizer. Place the concrete within a form that consists of polyethylene pipe (707.33), or PVC pipe (707.42). The encasement shall extend from 3 feet [1 meter] below the finished ground surface up to the concrete pier cap. Position pipe so that at least 3 inches [75 mm] of concrete cover is provided around the exterior of the pile.

In lieu of encasing the pile in concrete, galvanize the piles according to 711.02. The galvanizing shall be continuous from a minimum of 3 feet below the finish ground surface up to the concrete pier cap. The galvanized coating thickness shall be a minimum of 4 mils [100 μm]. Repair all gouges, scrapes, scratches or other surface imperfections caused by the handling or the driving of the pile to the satisfaction of the Engineer.

The Department will measure pile encasement by the number of feet. The Department will determine the sum as the length measured along the axis of each pile from the

Calculated deflection due to dead load applied after the beams are set (weight of surface course, railings, sidewalks, etc.) is ____ inches [mm].
The vertical curve adjustment to the topping thickness at midspan is _____ inches [mm] upward.

The vertical curve adjustment to the topping thickness at each bearing is _____ inches [mm] upward/downward.

(1) The thickness of the intermediate asphalt course shall be 1½ inches [38 mm]. No variation in thickness is required.

(2) The thickness of the intermediate asphalt course shall vary from 1½ inches [38 mm] at each centerline of beam bearing to _____ inches [mm] at midspan.

(3) The thickness of the intermediate asphalt course shall vary from _____ inches [mm] at each centerline of beam bearing to 1½ inches [38 mm] at midspan.

[76a] Calculated camber at the time of release is _____ inches [mm].

Calculated camber at time of paving is _____ inches [mm].

Long term camber is _____ inches [mm].

Calculated deflection due to dead load applied after the beams are set (weight of surface course, railings, sidewalks, etc.) is ____ inches [mm].

The vertical curve adjustment to the topping thickness at midspan is _____ inches [mm] upward.

The vertical curve adjustment to the topping thickness at each bearing is _____ inches [mm] upward/downward.

(1) The concrete thickness shall be 6 inches [150 mm]. No variation in thickness of concrete is required.

(2) The concrete thickness shall vary from 6 inches [150 mm] at each centerline of beam bearing to _____ inches [mm] at midspan.

(3) The concrete thickness shall vary from _____ inches [mm] at each centerline of beam bearing to 6 inches [150 mm] at midspan.

NOTE TO DESIGNER: The calculated camber at the time of release is (B – C), at the time of paving is (1.8B - 1.85C), and long term is (2.45B – 2.40C). The calculated deflection due to dead load applied after the beams are set is (D + E). The vertical curve adjustment at midspan is (F) when F > 1.8B - 1.85C - D - E. The vertical curve adjustment at each bearing is (F) when F

< 1.8B - 1.85C - D - E and may be upward for sag curves or downward for crest curves. Remove the reference to the vertical curve adjustment that does not apply.

Conclude note **[76]** with note (1), (2) or (3) as appropriate. Note (1) should be used when after placement of the topping, the top surface of the beam parallels the profile grade. Note (2) should be used when F > 1.8B - 1.85C - D - E. Note (3) should be used for all other cases.

For non-composite designs, include in the bridge plans a diagram similar to Figure 702 showing the thickness of the Item 448 Intermediate course and the Item 448 surface course at each centerline of bearing and at midspan.

For composite design, show a longitudinal superstructure cross section in the plans detailing the total Topping Thickness at each centerline of bearings and at midspan. Also show screed elevation tables similar to 701.1.

Use the following note when the length of the box beam, measured along the grade, differs from the length, measured horizontally, by more than 3/8" [10mm]:

[95] NOTE TO FABRICATOR: The dimensions measured along the length of the beam, marked with a _*_, do not contain an allowance for the effect of the longitudinal grade. Include the proper allowance for these dimensions in the shop drawings.

NOTE TO DESIGNER: Indicate the dimensions that require a grade adjustment with an asterisk or some other easily recognizable symbol and include that symbol in the note above.

702.12 ASPHALT CONCRETE WEARING COURSE

Place note **[77]** on the plans for prestressed concrete box beam bridges having an asphalt concrete wearing course. If the nominal thickness of 448 varies from the 1½" [38 mm] shown, revise the note accordingly.

While this note specifies how to place only the two 448 bid items, the designer should recognize that two Item 407 tack coat items are also required. One tack coat is applied before the first surface course. The other tack coat is applied between the first and second surface courses.

[77] ASPHALT CONCRETE WEARING COURSE shall consist of a variable thickness of 448 asphalt concrete surface course, Type 1, PG70-22M and a second 1½" [38 mm] thickness of 448 asphalt concrete surface course, Type 1, PG70-22M. Place the first 448 surface course in two operations. The first portion of the course shall be of 1½" [38 mm] uniform thickness. Feather the second portion of the course to place the surface parallel to and 1 ½" [38 mm] below final pavement surface elevation.

satisfaction of the Engineer prior to setting the bearings. The Department will not pay for this removal.

HISTORY: Note **[92]** was retired when the information was added to C&MS 516.07.

ARN-33 RETIRED NOTE 69

Where the load plate of an elastomeric bearing is to be connected to the structure by welding, provide the following note with the pertinent bearing details:

[69] WELDING: Control welding so that the plate temperature at the elastomer bonded surface does not exceed 300º F [150º C] as determined by use of pyrometric sticks or other temperature monitoring devices.

HISTORY: Note **[69]** was retired when the information was added to C&MS 516.07.

ARN-34 RETIRED NOTE 70

Where elastomeric bearing repositioning is required for a steel beam or girder superstructure, provide the following plan note.

[70] BEARING REPOSITIONING: If the steel is erected at an ambient temperature higher than 80ºF [26º C] or lower than 40º F [4º C] and the bearing shear deflection exceeds 1/6 of the bearing height at 60º F (+/-) 10º F [15º C +/- 5º], raise the beams or girders to allow the bearings to return to their undeformed shape at 60º F (+/-) 10º F [15º C +/- 5º].

HISTORY: Note **[70]** was retired when the information was added to C&MS 516.07.

ARN-35 RETIRED NOTE 91

For galvanized structures with welded shear connectors, place the following note on the same plan sheet as the shear connector spacing.

[91] WELDED SHEAR CONNECTORS: Install shear connectors after the decking or other walking/working surface, has been installed. Remove the galvanic coating by grinding at each connector location prior to welding.

HISTORY: Note **[91]** was retired when the information was added to C&MS 513.22.

ARN-36 RETIRED NOTE 30d

Provide the following note when battered piles are specified.

[30d] BATTERED PILES: The blow count for battered piles shall be the blow count determined for vertical piles of the same Ultimate Bearing Value divided an efficiency factor (D). Compute the efficiency factor (D) as follows:

$$D = \frac{1 - UG}{\sqrt{\left(1 + G^2\right)}}$$

U = Coefficient of friction, which is estimated at 0.05 for double-acting air operated or diesel hammers; 0.1 for single-acting air operated or diesel hammers; and 0.2 for drop hammers.

G = Rate of batter (1/3, 1/4, etc.)

HISTORY: Note **[30d]** was retired when the information was added to C&MS 507.05.