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, July 2007. 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 July 2007 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 July 2007 ODOT BDM

BDM Section	Affected Pages	Revision Description
204.4	2-25	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	3-10	The wearing course for non-composite box beam has been revised to provide a more cost effective solution.
303.3.2.1	3-58	This revision corrects a typographical error that completely reversed the requirements for column confinement steel.
Figure 303.1-1		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 303.5.1-4		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.
702.10	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.k
ARN-11	Appendix-6 through Appendix-7	Retired Note [606.2-5] for battered piles was added to the appendix.

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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. The purpose for this provision is to reduce the potential for total pier failure in the event of an impact involving a large vehicle or its cargo. 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 an unsupported pile length of 20 feet [6 meters]. For unsupported pile lengths greater than 15 feet [4.5 meters], the designer should analyze the piles as columns above ground. Scour depths and the embedded depth to fixity of the driven piles shall be included in the determination of unsupported length.

B. Cap-and-column type piers.

C. Solid wall or T-type piers.

Note 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.

designed to transfer all loads.

302 SUPERSTRUCTURE

302.1 GENERAL CONCRETE REQUIREMENTS

302.1.1 CONCRETE DESIGN STRENGTHS

A. Superstructure Concrete (Class S, HP or QSC2)..4500 psi [31.0 MPa]

B. Substructure Concrete (Class C, HP or QSC1)...4000 psi [27.5 MPa]

C. Drilled Shaft Concrete (Class S Modified)..4000 psi [27.5 Mpa]

302.1.2 SUPERSTRUCTURE CONCRETE TYPES

302.1.2.1 CLASS S & HP CONCRETE, QC/QA CONCRETE FOR STRUCTURES & CONCRETE WITH WARRANTY

Class S Concrete is the Department's traditional concrete mix design for superstructures.

Class HP (High Performance) Concrete mix designs are intended to give a highly dense, very impermeable concrete resulting in a longer structure life. When Class HP Concrete is specified, the Designer shall include the bid item for Class HP Concrete Test Slab. However, the bid item for Class HP Concrete Testing is no longer required because the Department has acquired sufficient test data since the inception of High Performance Concrete.

QC/QA Concrete for Structures, SS898, is a contractor designed mix that meets minimum requirements for strength, permeability and air content. QC/QA Concrete is divided into three classes: substructure (QSC1), superstructure (QSC2) and project specific (QSC3). The contractor assumes responsibility for quality control sampling and testing. Final payment for in-place concrete includes incentives for concrete meeting or exceeding minimum requirements and disincentives for concrete not meeting minimums. QC/QA concrete should not be considered for pay items with less than 100 yd^3 [75 m^3] of concrete.

Class S Concrete for New Bridge Decks with Warranty, SS893, and Class HP Concrete for New Bridge Decks with Warranty, SS894, are standard Class S and HP mix designs that warrant the concrete for a period of seven years against scaling, spalling and cracking. Remedial measures required during the warranty period are to be performed by the original Contractor.

The mix design, curing and placing requirements for both Class S and HP concretes are defined in the CMS.

302.1.2.2 SELECTION OF CONCRETE FOR BRIDGE STRUCTURES

The following concrete types may be specified for superstructure concrete:

A. Class S Concrete
B. Class HP Concrete
C. Class S Concrete for New Bridge Decks with Warranty
D. Class HP Concrete for New Bridge Decks with Warranty
E. QC/QA Concrete Class QSC2
F. QC/QA Concrete Class QSC3

The following concrete types may be specified for substructure concrete:

A. Class C Concrete
B. Class HP Concrete
C. QC/QA Concrete Class QSC1

Contact the District to confirm the selection of concrete type to be used for a specific structure.

High performance concrete shall not be used as a replacement for the drilled shaft concrete specified in 524.

302.1.3 WEARING SURFACE

302.1.3.1 TYPES

A. 1 inch [25 mm] monolithic concrete - defined as the top one inch [25 mm] of a concrete deck slab. This one inch [25 mm] thickness shall not be considered in the structural design of the deck slab or as part of the composite section.

B. 3 inches [75 mm] asphalt concrete - defined as the minimum asphaltic concrete wearing surface to be used on only non-composite prestressed box beams. The asphalt concrete 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 on bedrock.

The minimum width of footing supported by a drilled shaft is the diameter of the shaft.

Where piling is used to support free-standing piers, the distance between centers of outside piles, measured across the footing, generally shall be not less than one-fifth the height of the pier.

Widths greater than the above shall be provided if required for proper bearing area or to accommodate the required number of piles.

The height of the pier shall be measured from the bottom of the footing to the bridge seat.

For multiple span bridges with continuity over piers, where the height of pier is more than 50 percent of the length of superstructure from the point of zero movement to such pier, it may be assumed that the pier will bend or tilt sufficiently to permit the superstructure to expand or contract without appreciable pier stress. This assumption is not permissible if the piers are skewed more than 30 degrees. The above rule does not apply to rigid frame or arch bridges.

Slender columns of either concrete or steel may be designed to bend sufficiently to permit the superimposed superstructure to expand and contract, but the resulting bending stresses shall not exceed the allowable.

During phased construction of a capped pile pier, do not design a pier phase to be supported on less than three (3) piles. For cap and column piers, do not design a phase to be supported on less than two (2) columns.

For a new or replacement structure, individual free-standing columns without a cap are not permitted.

303.3.1.1 BEARING SEAT WIDTHS

Pier bearing seat widths for reinforced concrete slab bridges should conform to Standard Bridge Drawing CPP-1-08. Also see Section 303.3.2.5 of this Manual.

Pier caps on piles, drilled shafts or on columns are normally a minimum of 3'-0" [915 mm] wide. This is the standard width used for continuous span prestressed box beams and I-beams. Bearing seat widths of 3'-0" [915 mm], while normally adequate must be verified by the designer of the structure. Large bearings, skew angle, intermediate expansion devices, AASHTO earthquake seat requirements, etc. may require additional width.

303.3.1.2 PIER PROTECTION IN WATERWAYS

See Section 200 of this Manual for piling protection requirements and Section 600 for a plan note to be added to design drawings when the Capped Pile Pier Standard Bridge Drawing is not referenced.

303.3.2 TYPES OF PIERS

303.3.2.1 CAP AND COLUMN PIERS

When designing the cantilever portions of cap and column piers, the design moments shall be calculated at the actual centerline of the column.

The uppermost layers of longitudinal reinforcing steel in the pier cap shall not be lap spliced at the centerline of a column.

Longitudinal reinforcing shall conform to AASHTO. Round columns shall be reinforced with spiral reinforcing placed directly outside the longitudinal bars.

Round columns are preferred and normally should be 36" [915 mm] diameter.

Cap dimensions should be selected to meet strength requirements and to provide necessary bridge seat widths. Caps should be cantilevered beyond the face of the end column to provide approximately balanced factored dead load moments in the cap. The end of the cantilevered caps should be formed perpendicular to the longitudinal centerline of the cap to allow for uniform development lengths for the reinforcing steel. Cantilevered pier caps may have the bottom surface of the cantilever sloped upward from the column toward the end of the cap. Cantilevered caps may be eliminated for waterway crossing where debris removal access is an issue.

Minimum column diameters of 36 in. [915 mm] are generally used with spiral reinforcing. Spirals are made up of #4 [#13M] bars at 4.5 in. [115 mm] c/c pitch with a 30 in. [765 mm] outside core diameter. Using the circumference of the spiral as the out-to-out of the reinforcing steel bar, this column size normally has a relatively large ratio of the column's axial load capacity to the axial load (e.g. more than 1.5). Therefore, while this spiral reinforcement does not conform to *LRFD 5.7.4.6* and *5.10.6.2* it is acceptable if the ratio of axial capacity to axial load is over 1.5.

For columns where the ratio of axial capacity to axial load is less than 1.5, the spiral reinforcing should conform to *LRFD 5.7.4.6* and *5.10.6.2.*.

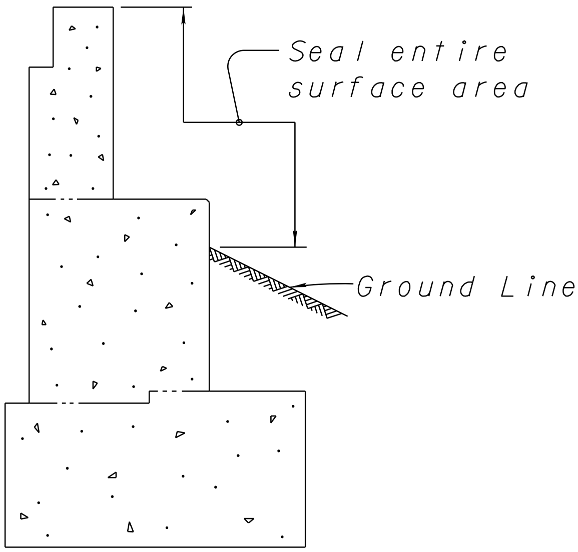
In no case shall column reinforcement not meet minimum cross section area, shrinkage and temperature requirements of AASHTO.

303.3.2.2 CAP AND COLUMN PIERS ON PILES

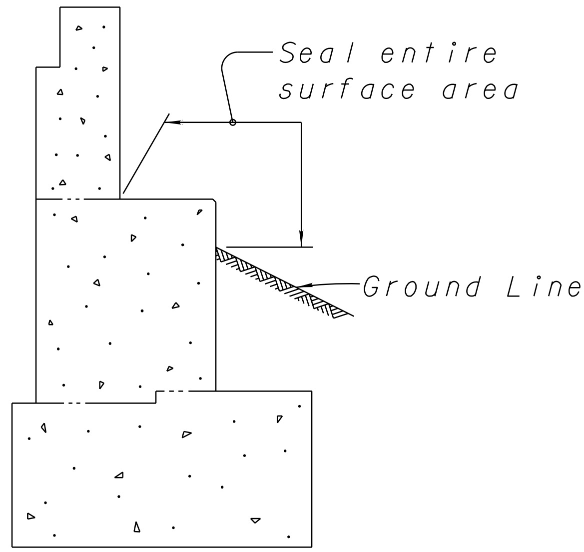
Piers supported on piles generally should have separate footings under each column.

Column piers shall have at least 4 piles per footing.

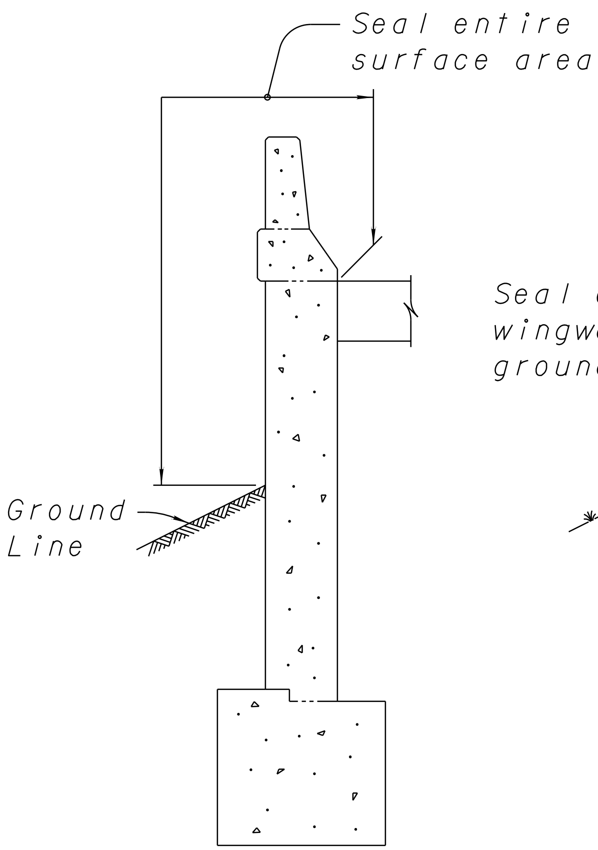
For grade separation structures, the top of the pier's footings should be a minimum of 1'-0" [300 mm] below the level of the bottom of the adjacent ditch. This applies even though the pier is



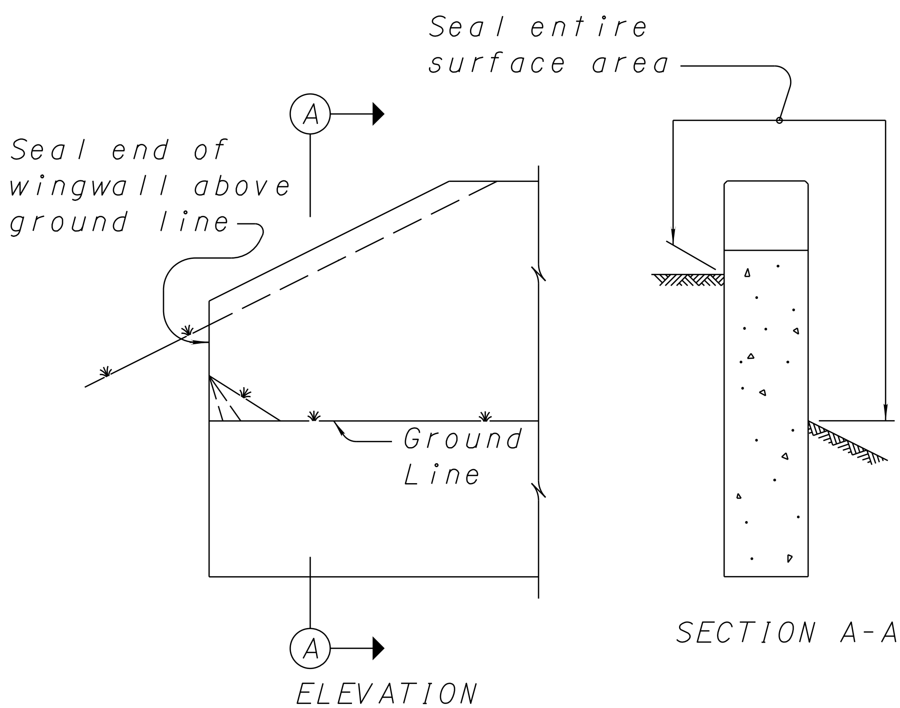
ABUTMENT SEALING LIMITS
(FOR STEEL BEAM BRIDGE)



ABUTMENT SEALING LIMITS
(FOR PRESTRESSED BOX BEAM BRIDGE)



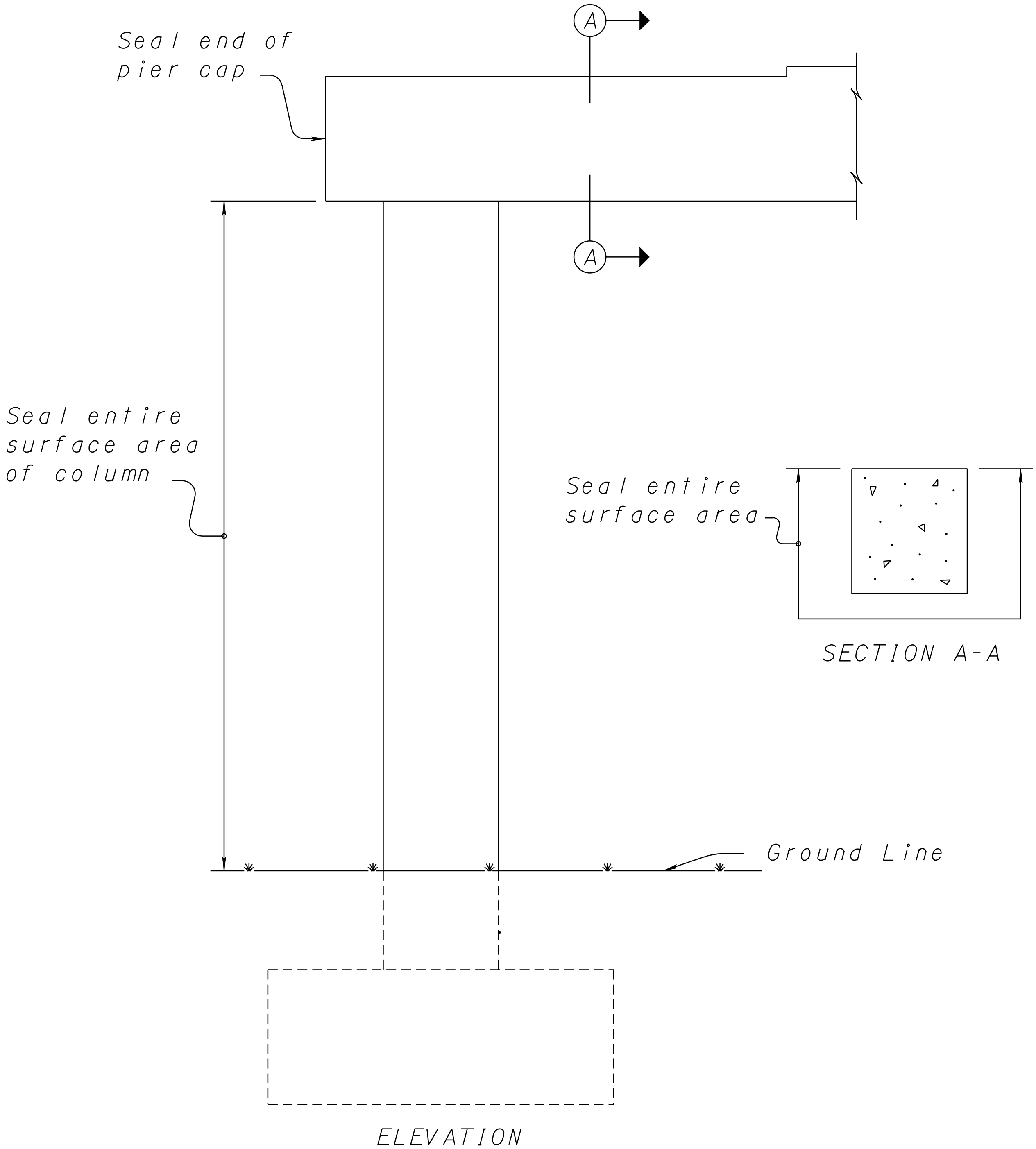
WINGWALL SEALING LIMITS
(TURNBACK WALL ON
U-TYPE ABUTMENT)



WINGWALL SEALING LIMITS
(STRAIGHT WING ABUTMENT)

SEALING OF CONCRETE SURFACES, SUBSTRUCTURE

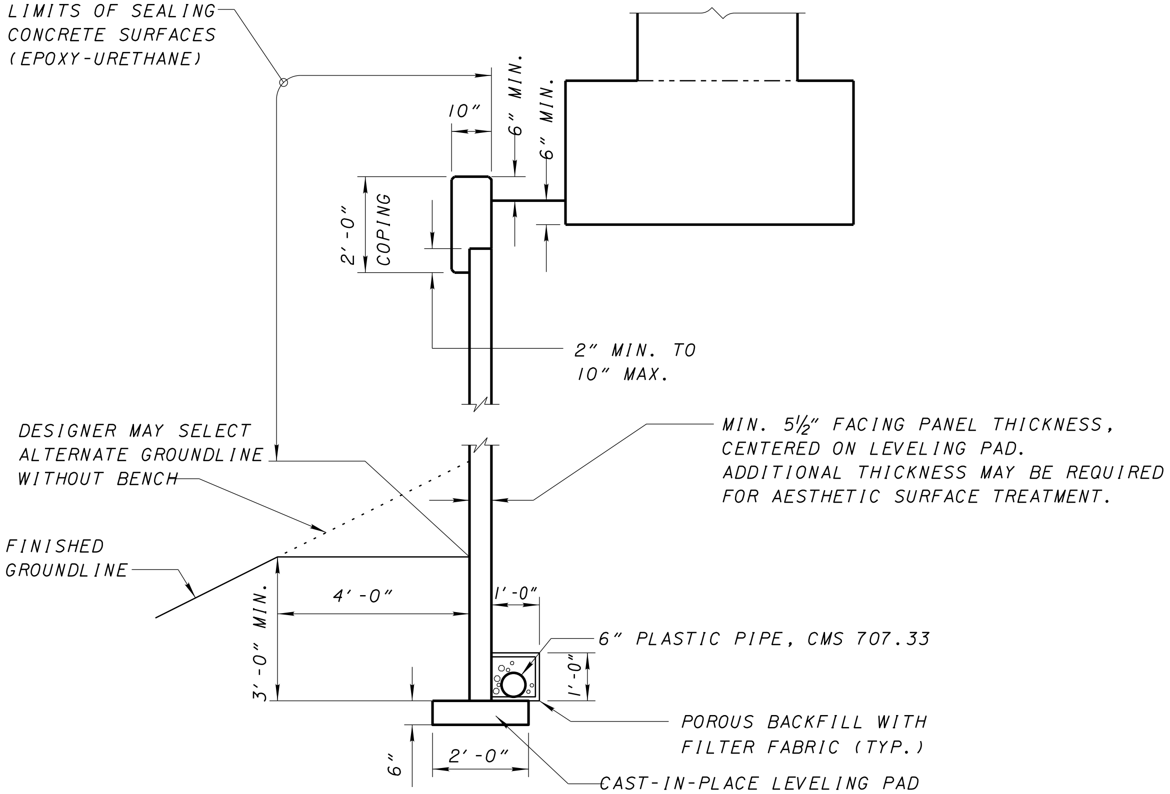
Figure 303.1-1



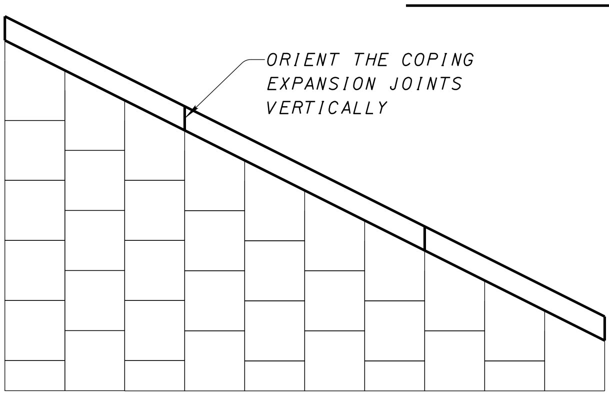
PIER SEALING LIMITS
(EXPOSED TO DEICER SPRAY)

SEALING OF CONCRETE SURFACES, SUBSTRUCTURE

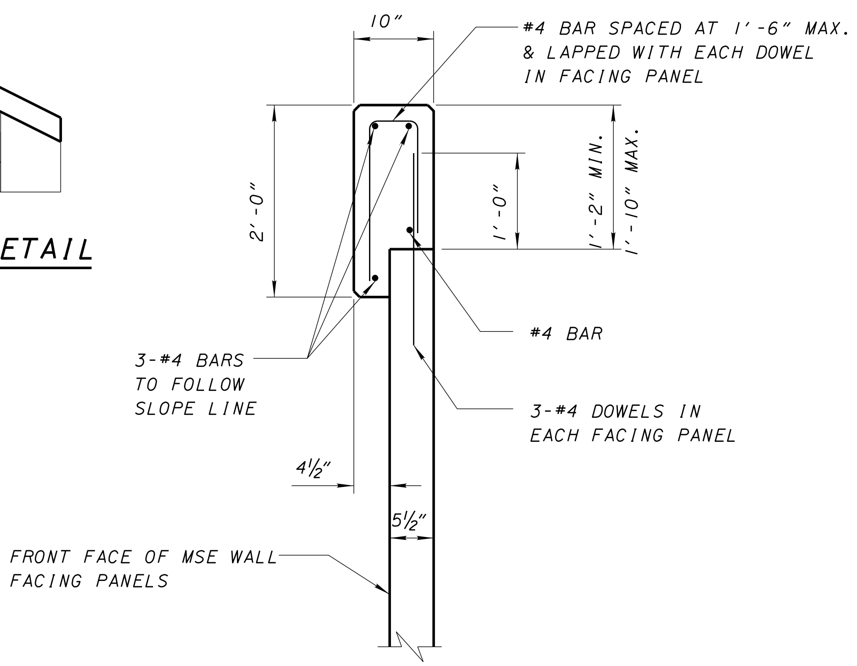
Figure 303.1-2



MSE WALL AND COPING DETAIL

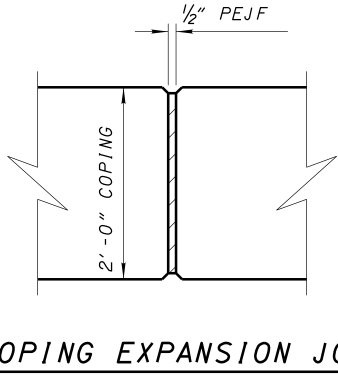


COPING JOINT ORIENTATION DETAIL



MSE WALL COPING

ALL REINFORCING STEEL TO BE EPOXY COATED



COPING EXPANSION JOINTS

FIGURE 303.5.1-4

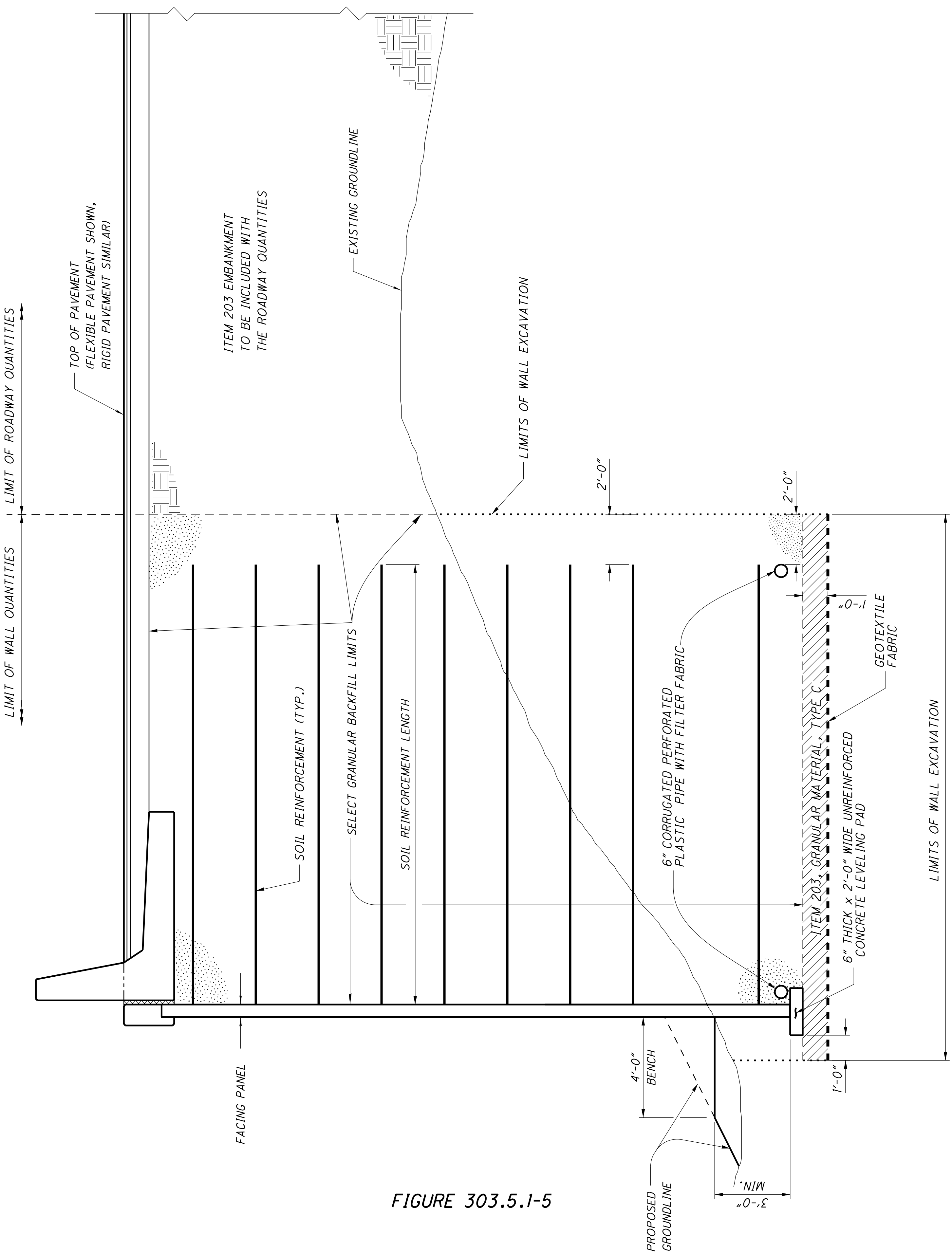


FIGURE 303.5.1-5

(5) Specify the order length according to BDM Section 202.2.3.2.c and 303.4.2.1.

(6) Specify the number of dynamic load testing items according to BDM Section 303.4.2.7.

Provide the following note when Static Load Testing is required according to Section 303.4.2.5. Modify the note as necessary to fit the specific condition.

[606.2-4] STATIC LOAD TEST: Perform dynamic testing on the first two production piles to determine the required blow count for the specified Ultimate Bearing Value. Perform the static load test on either pile. <u>Do not over-drive the selected pile</u>. Drive the third and fourth production piles to 75% and 85% of the determined blow count, respectively and perform dynamic testing on each. The test piles and the reduced capacity piles shall not be battered. After installation of the first four production piles, cease all driving operations on piling represented by the static load testing for a minimum of 7 days. After the waiting period, perform pile restrikes on the four piles (two restrike test items). The Engineer will review the results of the pile restrikes and establish the driving criteria 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 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.

The following note, modified to fit the specific conditions for the foundation required, will apply when uplift loads control the design of the pile. In this case, the piles are typically driven to a pile tip elevation and dynamic load testing of the pile is not performed.

[606.2-5] Note Retired – See Appendix

[606.2-6] PILES DRIVEN TO TIP ELEVATION FOR UPLIFT: Drive the piles to the pile tip elevation shown on the plans. Do not perform dynamic load testing on piles driven to a tip elevation. Select the hammer size to achieve the required depth. Provide plain cylindrical casings with a minimum pile wall thickness of _(1)_ inch for piles driven to a tip elevation.

Abutment piles:

_(2)_ piles _(3)_ feet long, order length

NOTE TO DESIGNER:

(1) Specify the minimum pile wall thickness for cast-in-place reinforced concrete piles. Determine the minimum pile wall thickness from a pile drivability analysis. Remove this sentence if the piles are H-piles.

(2) Specify the size of pile (e.g. HP 10 x 42 or 12 inch diameter).

(3) Specify the order length according to BDM Section 202.2.3.2.b and 303.4.2.1.

606.3 STEEL PILE POINTS

[606.3-1] Note Retired – See Appendix

606.4 PILE SPLICES

Provide the following note when H-piles are specified.

in thickness is required.

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

(3) The thickness of the intermediate asphalt course shall vary from ______ inches at each centerline of beam bearing to 1½ inches at midspan.

[702.9-2] Calculated camber at the time of release is ______ inches.

Calculated camber at time of paving is ______ inches.

Long term camber is ______ inches.

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

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

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

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

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

(3) The concrete thickness shall vary from ______ inches at each centerline of beam bearing to 6 inches 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 **[702.9-1]** 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 702.9-1 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 0.

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]:

[702.9-3] 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.

702.10 ASPHALT CONCRETE WEARING COURSE

Place note **[702.10-1]** 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.

[702.10-1] ASPHALT CONCRETE WEARING COURSE shall consist of a variable thickness of 448 asphalt concrete surface course, Type 1, PG70-22M and a second 1½" 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" uniform thickness. Feather the second portion of the course to place the surface parallel to and 1½" below final pavement surface elevation.

702.11 PAINTING OF A588/A709 GRADE 50 STEEL

Provide the following note for bridge superstructures using unpainted A588/A709 Grade 50W steel and having deck expansion joints at the abutments. Modify the note accordingly for structures with intermediate expansion joints. Bridges with an integral or semi-integral type abutment will not require painting of the beam ends.

[702.11-1] PARTIAL PAINTING OF A709 GRADE 50W STEEL : Paint the last 10 ft of each beam/girder end adjacent to the abutments including all cross frames and other steel within these limits. The prime coat shall be 708.01. The top coat color shall closely approach Federal Standard No. 595B - 20045 or 20059 (the color of weathering steel).

516.05 and the Department's Qualified Products List (QPL).

ARN-5 RETIRED NOTES 701.2-1 & 701.2-2

Provide the following porous backfill note on the appropriate detail sheets.

[701.2-1] POROUS BACKFILL WITH FILTER FABRIC, 2 feet thick shall extend up to the plane of the subgrade, to 1 foot below the embankment surface, and laterally to the ends of the wingwalls.

For use when weep holes are specified:

[701.2-2] POROUS BACKFILL WITH FILTER FABRIC, 2 feet thick shall extend up to the plane of the subgrade, to 1 foot below the embankment surface, and laterally to the ends of the wingwalls. Place two cubic feet of bagged No. 3 aggregate at each weephole. The Department will include bagged aggregate with porous backfill for payment.

HISTORY: Notes **[701.2-1]** & **[701.2-2]** were retired when the information was added to C&MS 518.05.

ARN-6 RETIRED NOTE 701.5-1

For a structure with concrete backwalls, deck joints and concrete decks supported on beams or girders, show an optional backwall construction joint at the level of the approach slab seat and provide the following note either on the appropriate abutment detail sheet or in the General Notes.

[701.5-1] BACKWALL CONCRETE: In addition to 511.10, do not place backwall concrete above the optional construction joint at the approach slab seat until after the deck concrete in the span adjacent to the abutment has been placed.

HISTORY: Note **[701.5-1]** was retired when the information was added to C&MS 511.10.

ARN-7 RETIRED NOTE 701.7-1

Provide the following note when elastomeric bearings are to be placed on substructures with beam seats sealed with an epoxy or non-epoxy sealer:

[701.7-1] SEALING OF BEAM SEATS: If the beams seats are sealed with an epoxy or non-epoxy sealer prior to setting the bearings, do not apply sealer to the concrete surfaces under the proposed bearing locations. If these locations are sealed, remove the sealer to the satisfaction of the Engineer prior to setting the bearings. The Department will not pay for this removal.

HISTORY: Note **[701.7-1]** was retired when the information was added to C&MS 516.07.

ARN-8 RETIRED NOTE 702.4-1

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:

[702.4-1] WELDING: Control welding so that the plate temperature at the elastomer bonded surface does not exceed 300° F as determined by use of pyrometric sticks or other temperature monitoring devices.

HISTORY: Note **[702.4-1]** was retired when the information was added to C&MS 516.07.

ARN-9 RETIRED NOTE 702.5-1

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

[702.5-1] BEARING REPOSITIONING: If the steel is erected at an ambient temperature higher than 80°F or lower than 40° F and the bearing shear deflection exceeds 1/6 of the bearing height at 60° F (+/-) 10° F, raise the beams or girders to allow the bearings to return to their undeformed shape at 60° F (+/-) 10° F.

HISTORY: Note **[702.5-1]** was retired when the information was added to C&MS 516.07.

ARN-10 RETIRED NOTE 702.19-1

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

[702.19-1] 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 **[702.19-1]** was retired when the information was added to C&MS 513.22.

ARN-11 RETIRED NOTE 606.2-5

Provide the following note when battered friction piles are specified.

[606.2-5] BATTERED PILES: The blow count for battered piles shall be the blow count determined for vertical piles of the same Ultimate Bearing Value divided by 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 **[606.2-5]** was retired when the information was added to C&MS 507.05.

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