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

January 18, 2013

To: Users of the Bridge Design Manual

From: Tim Keller, Administrator, Office of Structural Engineering

By: Sean Meddles, Assistant Administrator, Office of Structural Engineering

Re: 2013 First Quarter Revisions

Revisions have been made to the ODOT Bridge Design Manual, July 2007. These revisions shall be implemented on all Department projects begin Stage 2 plan development date after January 18, 2013. 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 change in this section reflects the changes to Items 499 & 511 in the 2013 C&MS.
204.6.2.1	2-28 through 2-29	Information related to the use of spread footings on MSE walls was deleted because the Department discontinued the use of spread footing abutments on MSE walls in January 2012. Additional information regarding the use of spread footings on MSE walls is available in BDM Section 204.4.
205.4	2-30	Reference is made to BDM Section 205.5 for deviations from ODOT standard practice for prestressed beams.
205.5	2-31	Release of PSID-1-13 necessitates the revision to the preliminary engineering information related to prestressed I-beams.
209.7	2-41 through 2-42.2	Information related to the placing aesthetic logos or lettering on bridges and noise wall has been added.
301.7	3-8	Added restriction for attaching utilities directly to decks. Utilities attached directly to the bottom of the deck will be affected by future deck replacements.
302.1.1	3-9	The classes of concrete in this section were updated to reflect the changes to Items 499 & 511 in the 2013 C&MS.
302.1.2	3-9 through 3-10	The changes in this section reflect the changes to Items 499 & 511 in the 2013 C&MS.
302.1.4.1	3-11	The changes in this section reflect the changes to Items 499 & 511 in the 2013 C&MS.
302.5	3-35	The design model for multi-span composite prestressed beams has been modified. The positive moment connection created by extending strands into a pier diaphragm does not have sufficient capacity to resist creep caused by the prestressing force. Once the beams have deflected under creep, the loads applied to the structure act on a simple span until the creep deflection is overcome. Therefore, the new design model applies all loads to a simple span to design the beams. If there is any remaining load actually carried by a continuous structure the deck reinforcing steel does this work. Conservatively, this steel is designed for full continuity.

BDM Section	Affected Pages	Revision Description
302.5.1	3-35	This change reflects the modified design model specified in BDM Section 302.5.
302.5.1.2.a	3-37	The 0.6-inch strand has been removed as a standard practice for box beams. The use of this strand size shall be addressed with the industry as noted in BDM Section 205.4.
302.5.1.2.b	3-37	This change is consistent with the beam strand locations identified in PSBD-2-07.
302.5.1.3	3-38	This change reflects the modified design model specified in BDM Section 302.5.
302.5.1.7	3-40	The changes in this section reflect the changes to Items 499 & 511 in the 2013 C&MS.
302.5.2	3-41	These changes reflect the release of PSID-1-13 and the modified design model specified in BDM Section 302.5.
302.5.2.2	3-41	The preference for relieving excessive tensile stresses in the beam ends at release has been revised. Designers shall debond up to the LRFD 5.11.4.3 maximum limits before specifying draping. Research indicates that reduced draping forces helps reduce potential for web cracking.
302.5.2.2.a	3-41 through 3-42	PSID-1-13 utilizes only the 0.6-inch strand diameter. The use of the larger strand diameter increases efficiency of the I-beam shape and helps account for the loss of draped strand locations available in previous version of the I-beam standard.
302.5.2.2.c	3-42	This change reflects the use of the 0.6-inch strand diameter.
302.5.2.2.d	3-42	This change reflects the elimination of extending strands into the pier diaphragms in PSID-1-13 as well as the change in preferences mention in BDM Section 302.5.2.2 above.
302.5.2.4	3-45	This change in fixed pier anchorage reflects the modification of the pier diaphragm in PSID-1-13.
302.5.2.5	3-45	The change in this section reflects the changes to Items 499 & 511 in the 2013 C&MS.
302.5.2.6	3-46	A revision to PSID-1-13 requires cast-in-place intermediate diaphragms for all beams less than 60” deep. PSID-1-13 also modified the location of the bottom of the end diaphragm.

BDM Section	Affected Pages	Revision Description
302.5.2.7	3-46	A reference to PSID-1-99 has been removed.
302.5.2.8	3-47	The change in this section reflects the changes to Items 499 & 511 in the 2013 C&MS.
302.5.2.9	3-47	PSID-1-13 now utilizes uncoated reinforcing steel bars and welded wire fabric. Only the bars extending from the beams shall be epoxy coated.
Figure 303.5.1-2		Figure 303.5.1-2 has been deleted because the use of spread footing abutments on MSE walls was discontinued in January 2012.
Figure 303.5.1-3		The Geotextile fabric has been removed from the detail because this item was removed from SS840 in October 2012. Undercut dimension “X” has been added for illustration purposes with the removal of Figure 303.5.1-2.
Figure 303.5.1-5		The Geotextile fabric has been removed from the detail because this item was removed from SS840 in October 2012.
Figure 303.5.1-6		The Geotextile fabric has been removed from the detail because this item was removed from SS840 in October 2012.
Figure 303.5.1-7		The Geotextile fabric has been removed from the detail because this item was removed from SS840 in October 2012.
504	5-3	The change in this section reflects the changes to Items 499 & 511 in the 2013 C&MS.
602.3	6-4 through 6-5	The first change in this section reflects the changes to Items 499 & 511 in the 2013 C&MS. The second change in this section results from the use of WWR in prestressed I-beams according to PSID-1-13.
605.5	6-10	BDM Note 605.5-1 was retired. This note addressed the General Plan information associated with spread footing abutments supported on MSE walls which was discontinued in January 2012.
606.5	6-17	The change in this section reflects the changes to Items 499 & 511 in the 2013 C&MS.
610.7.1	6-25	The change in this section reflects the changes to Items 499 & 511 in the 2013 C&MS.

BDM Section	Affected Pages	Revision Description
702.6.1	7-4	The change in this section reflects the changes to Items 499 & 511 in the 2013 C&MS.
S5.10.3.1.1	10-13 through 10-14	The changes in this section reflect the changes to Items 499 & 511 in the 2013 C&MS.
S11.10.11	10-26	Deleted “The bearing pressure at the service limit state for a spread footing abutment placed on an MSE wall embankment shall be less than or equal to 4 ksf [190 kPa].” This change
ARN-11	Appendix-7	Archived note [605.5-1].

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 QC Misc. 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.

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].

204.6.2.1 PROPRIETARY WALLS

If a proprietary wall is justified, the Design Agency shall include the following information in the Stage 1 Detailed Design Submission: wall alignment; footing elevations; factored bearing resistance at the leveling pad elevation; a global stability analysis; the effect of settlement and settlement calculations; and any construction constraints, such as soil improvement methods, that may be required. Refer to Section 303.5 for plan requirements for Detail Design.

The alignment of proprietary retaining walls should be straight and with as few corners or curves as is practical. When changes in wall alignment are required, use gradual curves or corners with an interior angle of at least 135 degrees whenever possible. Do not use corners with interior angles of less than 90 degrees (acute corners).

The design of the wall shall be in conformance with the 4th Edition of the *AASHTO LRFD Bridge Design Specifications* and the following:

A. Determine the height of the wall (H) as follows:

1. If the wall is not located at an abutment, measure (H) as the elevation difference between the top of the coping and the top of the leveling pad.
2. If the wall is located at an abutment, measure (H) as the elevation difference between the profile grade at the face of the wall and the top of the leveling pad.

B. The soil reinforcement length shall not be less than 70% of the wall height (H) or 8'-0" [2.5 m], whichever is greater. Only increase this minimum soil reinforcement length as necessary to meet external stability requirements (sliding, bearing resistance, overturning, overall global stability). Generally, the soil reinforcement length should not be greater than 150% of the wall height (H). Provide calculations with the Foundation Report, BDM Section 202.2.3, that justify soil reinforcement lengths exceeding 0.70H.

C. The thickness of the unreinforced concrete leveling pad shall not be less than 6 inches [150 mm]. The minimum distance from the top of the leveling pad the ground surface at a point located 4'-0" [1.2 m] from the face of the wall shall be the larger of 3'-0" [900 mm] or the frost depth. Refer to Figure 303.5.1-4 for more information.

D. The minimum thickness of the precast reinforced concrete face panels may be assumed to be 5½ inches [140 mm].

E. The maximum allowable differential settlement in the longitudinal direction (regardless of the size of panels) is one (1) percent. Provide slip joints if the estimated differential settlement is greater than one (1) percent.

F. Use the following soil parameters for design:

Fill Zone	Type of Soil	Soil Unit Weight	Friction Angle	Cohesion
Reinforced Zone	Select Granular Embankment Material	120 lb/ft^3 [18.9 kN/m^3]	34º	0
Retained Soil	On-site soil varying from sandy lean clay to silty sand	120 lb/ft^3 [18.9 kN/m^3]	30º	0

Determine soil parameters for the foundation soils based on the soils encountered by the soil borings.

G. Compute the coefficient of lateral earth pressure, k_a, using the Coulomb equation.

H. MSE walls located within 25'-0" [7.6 m] of the centerline of tracks, or other distance as specified by an individual railroad, shall be protected by a crash wall as specified in Section 209.8 and the AREMA Manual for Railway Engineering. The MSE wall system does not meet the definition of a crash wall as defined by the AREMA Manual for Railway Engineering.

I. For MSE walls supporting abutments on piles, the minimum distance between the back face of the MSE wall panels and the toe of the bridge abutment footing shall be 1'-0" [305 mm] and the minimum distance between the back face of the MSE wall panels and the centerline of the closest row of piles shall be 3’-6” [1065 mm]. The distance between the centerlines of adjacent rows of piles shall be 3’-6” [1065 mm] to allow compaction of the fill between the pile sleeves.

J. Integral abutment designs placed on MSE wall embankments are prohibited. Semi-integral abutment designs are allowed.

K. When detailing the pile layout and the design of the abutments and/or wingwalls, consider that 100% of the ground reinforcement shall be connect to the facing elements and the Department will not allow field cutting of reinforcement systems to avoid piles or other obstacles.

204.6.2.2 CAST-IN-PLACE WALLS

If a cast-in-place wall is justified, the design agency will be responsible for providing the complete wall design in the detail plans. The design of the wall shall be in conformance with the current edition of the *AASHTO LRFD Bridge Design Specifications.* The Stage 1 Detailed Design Submission shall include: footing elevations; allowable bearing pressures; a global stability analysis; settlement calculations, if necessary; and any construction constraints that may be required.

204.6.2.3 OTHER WALLS

The other wall types listed in Section 204.6 are for use with special project conditions such as top-down construction and other excavation methods. Contact the Office of Structural Engineering for recommendations when considering these other wall types. Typically only one wall type design shall be prepared for these methods. The design of the wall shall be in conformance with the current edition of the *AASHTO LRFD Bridge Design Specifications.*

205 SUPERSTRUCTURE INFORMATION

205.1 TYPE OF STRUCTURES

The types of superstructure generally used in Ohio consist of cast-in-place concrete slabs, prestressed concrete box or I-beams, and steel beams or welded plate girders. Normally shallow abutments and spill-thru slopes will be used. The type of superstructure used should be selected (highway or railway) separations or by the requirements for waterway opening at stream crossings. Typically for any given bridge, there are a number of combinations of spans and lengths of spans that can be utilized. Generally a preferred span arrangement that minimizes the number of substructure units should be used (i.e. fewer piers with longer spans).

For grade separation structures spanning any divided highway a two-span bridge with spill-thru slopes is preferred.

For waterway crossings, one or three span bridges are typically used. This span arrangement is preferred so that a pier is not located in the middle of the waterway. If a series of precast, three-sided structures are used to produce a multiple span structure over a waterway, spread footings on soil shall not be used to support any of the precast structures.

When a multiple span arrangement (4 spans or more) is required, the Cost Analysis should examine the most economical number of spans required based on total bridge costs, including a substructure and superstructure cost optimization study. Site conditions will govern the location of substructure units with respect to required horizontal clearances, foundation conditions and appearance.

On structures with steep grades, the designer should account for the load effects of the grade on the substructure units.

205.3 CONCRETE SLABS

Cast-in-place concrete slabs are normally used where site geometry dictates a curved alignment or variable superelevation and the use of prestressed concrete box beams is impractical. Since concrete slabs will generally yield the least superstructure depth they should be considered when vertical clearance is limited. For stream crossings where flood waters often inundate the structure, a concrete slab should be considered. When using cast-in-place concrete slabs the construction clearance requirements of the falsework should be considered.

205.4 PRESTRESSED CONCRETE BOX BEAMS

The span limits for prestressed, side by side, concrete box beams generally range from 15 to 100 feet. These span limits are based on designs with 0.167 in^2 low relaxation strands, a concrete 28-day compressive strength of 7.0 ksi, and a release strength of 5.0 ksi. Prestressed box beams of up to 120 foot spans have been designed using 10.0 ksi concrete and larger diameter strands. Concrete compressive strengths should be limited to 5.0 ksi at release and 7.0 ksi at 28-days. Refer to BDM Section 205.5 when considering a deviation from standard prestressed practice in Ohio.

The skew angle should be limited to a maximum of 30 degrees. Consult the Office of Structural Engineering for recommendations prior to designing a box beam structure with a higher degree of skew. For all four lane divided highways or where the design ADTT (one way) is greater than

2500 prestressed box beam superstructures shall not be used. Box beams may be used on curved alignment where the mid-ordinate is 6 inches [150 mm] or less, as long as the required bridge width is provided. The maximum asphalt wearing surface thickness for a non-composite designed box beam bridge shall be 8 inches [200 mm]. For multiple span bridges, individual span lengths may vary but the proposed box beam depth should be constant.

The Designer shall consider the site limitations for practical hauling. While weight of a precast bridge member is not typically a limiting factor, its length and ability to reach the jobsite may be a restriction. Maximum lengths are normally dictated by the smallest turning radius enroute to the project site. For beams 100 ft [30 m] long or more, the Designer should contact at least two approved fabricators of precast bridge members to obtain a written agreement stating that the member can be shipped to the project site. The agreements should be included in the Structure Type Study, Narrative of Bridge Alternatives.

Non-composite boxbeam designs should be used where over the side drainage is provided and where the combined deck grade is less than 4 percent. The combined deck grade, Cg, should be computed by the following equation:

$$Cg = [\text{transverse deck grade}^2 + \text{roadway grade}^2]^{1/2}$$

For a normal transverse deck grade horizontal to vertical of 3/16 inch per foot [1 to 64 (1.56 percent)], the maximum roadway grade would be 3.68 percent or less for non-composite design. Where the combined deck grade is greater than 4 percent or the deck drainage is confined to the bridge deck by a parapet, curb, etc., a composite design should be used.

205.5 PRESTRESSED CONCRETE I-BEAMS

The Bridge Design Manual and Standard Bridge Drawings represent standard practice for the prestressed industry in Ohio. When considering design deviations from these publications, contact the Ohio Prestressers Association and/or the PCI Central Region to request documentation that the deviation is acceptable and can be produced within the project timeframe by at least two independent producers prequalified under Supplement 1079. ODOT may request verification of this documentation during project reviews. These industry organizations are also valuable resources for preliminary pricing and practical hauling limitations to specific project locations. The transportation and weight issues listed for box beams also apply for I-beams

The standard bridge drawing allows 28-day concrete strengths up to 7.0 ksi and release strengths up to 5.0 ksi. Refer to BDM Section 300 for the preferred methods to relieve excessive tensile stresses.

Prestressed I-beam highway bridges should have a minimum of 4 stringer lines.

Prestressed I-beam bridges that meet the vertical clearance specified in Section 207 are acceptable over highway crossings.

205.6 STEEL BEAMS AND GIRDERS

For spans greater than 60 feet [18 meters], rolled beams, up to and including the 40 inch [1000 mm] depth, or welded plate girders should be considered. Continuous spans shall be used for multiple span bridges. The ratio of the length of the end spans to the intermediate spans usually should be 0.7 to 0.8. The latter ratio is preferred because it nearly equalizes the maximum positive moment of all spans. Integrally designed structures may have end span ratios of as low as 0.6 if prevention of uplift is considered. For multi-span, composite designed, rolled beams, the maximum intermediate span is generally around 115 feet [35 meters]. For single span, composite designed, rolled beams, the maximum span is generally around 100 feet [30 meters].

While constant depth plate girders can be used in the same range as rolled beams, they are generally not as cost effective as rolled beams for the same span lengths. Haunched girders over the intermediate substructure units should be considered for spans greater than 350'-0" [105 meters] or where economics warrant their use. Selections of any steel members should be based on an overall cost analysis of the structure.

Stringer type	**Span length**
Rolled beam	up to 115' [35 m]
Constant Depth Girder	100' - 350' [30 - 105 m]
Haunched Girder	> 350' [105 m]

Generally the minimum economical beam spacing for rolled beams is 8'-0" [2450 mm]. For plate girders a minimum spacing of 9'-0" [2750 mm] is generally recommended.

In order to facilitate forming, deck slab overhangs should not exceed 4'-0" [1200 mm]. On over the side drainage structures, the minimum overhang shall be 2'-3" [700 mm]. Where scuppers are required for bridge deck drainage, the overhang shall be 1'-6" [450 mm].

Steel rolled beam or girder highway bridges should have a minimum of 4 stringer lines.

ASTM A588[M]/A709[M] 50W should be selected wherever possible as it eliminates the need for a coating system and the maintenance associated with a coating system. See Section 300 of this Manual.

If a steel structure requires a coating system, the steel should be ASTM A572[M]/A709[M] 50. A coating shall be specified. See Section 300 of this Manual.

For more information on steel materials, see Section 300 of this Manual.

For bridges with significant substructure costs, the difference in dead loads between the steel superstructure versus a concrete superstructure should be considered in the Structure Type Study, Cost Analysis for choosing the most economical structure type.

or superelevated section, the elevations at the edges of the approach slab shall be provided. Include these detail drawings in the structure plans for review during the detail design review stage. Approach slabs are paid for under Item 526.

For bridge replacement projects, when the existing approach slab is to be removed, the Designer shall include Item 202 - Approach Slab Removed in the structures estimated quantities.

209.6 PRESSURE RELIEF JOINTS

Type A pressure relief joints shall be specified when the approach roadway pavement is rigid concrete and shall be placed at the end of the approach slab.

The pressure relief joints are detailed on Standard Construction Drawing BP-2.3 (Revised 7/28/00), "Pressure Relief Joint Type A".

209.7 AESTHETICS

209.7.1 GENERAL

Each structure should be evaluated for aesthetics. Normally it is not practical to provide cost premium aesthetic treatments without a specific demand; however careful attention to the details of the structure lines and forms will generally result in a pleasing structure appearance.

Some basic guidelines that should be considered are as follows:

A. Avoid mixing structural elements, for example concrete slab and steel beam superstructures or cap and column piers with wall type piers.

B. In general, continuous superstructures shall be provided for multiple span bridges. Where intermediate joints cannot be avoided, the depth of spans adjacent to the joints preferably should be the same. Avoid the use of very slender superstructures over massive piers.

C. Abrupt changes in beam depth should be avoided when possible. Whenever sudden changes in the depth of the beams in adjacent spans are required, care should be taken in the development of details at the pier.

D. The lines of the structure should be simple and without excessive curves and abrupt changes.

E. All structures should blend in with their surroundings.

One of the most significant design factors contributing to the aesthetic quality of the structure is unity, consistency, or continuity. These qualities will give the structure an appearance of a design process that was carefully thought out.

The aesthetics of the structure can generally be accomplished within the guidelines of design requiring only minimum special designs and minor project cost increase. As special situations arise preliminary concepts and details should be developed and coordinated with the Office of Structural Engineering.

If formliners are being considered, the depth of the projections should be as deep as possible in order to have the desired visual effect. Using shallow depths, such as 3" to 2" [6 to 13 mm], provides very little, if any, visual effect (relief) when viewed from a distance. The depth of the formliner shall not be included in the measurement of the concrete clear cover.

The use of colored concrete, where the color is integral with the concrete mix, should generally not be used since the final visual appearance of the concrete is not uniform. The color varies greatly due to the aggregate, cement type, cement content and the curing of the concrete. None of these items are reasonably controlled in the field to a sufficient enough degree to insure a uniform final appearance. If color is required, a concrete coating should be used which will not only produce the required color but will also provide the necessary sealing of the concrete as required in Section 300 of this Manual.

The use of formliners and/or coloring of the concrete should be evaluated on a cost basis and submitted as part of the Structure Type Study, Cost Analysis.

For additional guidance, refer to the Department's document entitled "Aesthetic Design Guidelines" available at the Design Reference Resource Center on the Department's website.

209.7.2 LOGO AND LETTERING POLICY

The following criteria applies to logos and lettering proposed for use on Bridges and Noise Walls.

A. The Department will permit City logos and City names when the bridge or noise wall is located within the territorial jurisdiction of that City.

B. The Department will permit displaying the names of Public Streets or Paths on bridges carrying those same Public Streets or Paths. Private street names or private path names are not permissible.

C. A request for using logos and/or lettering shall be submitted during preliminary engineering to ODOT for approval. The request shall include:

   1. The logo or lettering size, location, color and style.

   2. A rendering of the proposal.

D. The Department may require the local agency requesting the logo or lettering to fund the costs exceeding those necessary for standard ODOT practice as defined in the Bridge Design Manual or Standard Bridge Drawings.

209.8 RAILWAY BRIDGES

For railway overpasses the specific requirements of the railway company involved need to be addressed. The design and operational requirements of the railway companies will vary from railway line to railway line and between companies. Some of the common railway concerns are as follows:

A. Horizontal and vertical clearances for both the proposed design and during construction,

B. The constructability of the substructure units adjacent to their tracks,

C. Allowing adequate clearances for drainage ditches and access roads that are parallel to their tracks,

D. Location of railway utilities, and

E. Provisions for crash walls on piers.

Consideration for providing future tracks and the possibility of track abandonment should be investigated. All submissions are to be made in accordance with the Department's review process. Railway submissions shall be made as directed by the District planning administrator. The guidelines of the individual railway company may be requested thru the District's designated rail transportation coordinator.

Generally if a steel superstructure is proposed over the railway the type of steel should be ASTM A588[M]/A709[M] 50W steel. Bridges located in urban areas or which have sidewalks located on the bridge should include protective fencing. Preferably drainage from the bridge should be collected in drain pipes and drained away from the railway right of way. No drains shall be allowed to drain on the railroad tracks or roadbed.

Where piers are located within 25'-0" [7.6 meters] of the centerline of tracks or if required by an

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301.5.7 MINIMUM CONCRETE COVER FOR REINFORCING

The minimum concrete cover shall be as follows:

A. Bridge decks*, slab bridges* and sidewalks (top surface)..................................2½ in. [65 mm]

B. Bridge decks and slab bridges (bottom surface)..1½ in. [40 mm]

C. Footings (bottom surface)...3 in. [75 mm]

D. Approach slabs (top & bottom surfaces) ....3 in. [75 mm]

E. Column ties or spirals ....3 in. [75 mm]

F. Drilled shaft ties or spirals (diameter ≤ 4.0 ft.)...3 in. [75 mm]

G. Drilled shaft ties or spirals (diameter > 4.0 ft.)...6 in. [150 mm]

H. Prestressed concrete I-beams & Box beams (side & bottom surfaces) ....1.25 in. [32 mm]

I. Prestressed concrete Box beams (inside surfaces)..1 in. [25 mm]

J. All other concrete surfaces ....2 in. [50 mm]

* - The 1.0 in. monolithic wearing surface is included in the minimum cover shown

Clearances not given in C&MS 509.04, C&MS 524 or referenced Standard Bridge Drawing shall be shown in the detail plans.

301.5.8 MINIMUM REINFORCING STEEL

Minimum reinforcing steel requirements shall conform to AASHTO requirements for shrinkage and temperature reinforcement. Reinforcement for shrinkage and temperature stresses shall be provided near exposed surfaces of walls and slabs not otherwise reinforced.

301.6 REFERENCE LINE

For structures on a horizontal curve a reference line, usually a chord of the curve shall be provided. This reference line should be shown on the General Plan/Site Plan view with a brief description, including, for example, "Reference Line (centerline bearing to bearing)," and the stations of the points where the reference line intersects the curve. Skews, dimensions of substructure elements and superstructure elements should be given from this Reference Line, both on the General Plan /Site Plan and on the individual detail sheets. Dimensions from the curve generally should be avoided. The distance between the curve and reference line should be dimensioned at the substructure units. In this manner a check is available to the contractor.

The reference tangent can be used if appropriate.

301.7 UTILITIES

Utilities should not be supported on the fascia of bridge decks.

Utilities, other than gas and water, may be run through sidewalk sections or parapets of bridges but shall be encased in a protective conduit.

Placing utilities through or underneath MSE walls should be avoided when possible. When it is necessary to place a utility through or beneath an MSE wall, it shall be encased in a protective conduit or casing pipe that extends ten feet [3.0 m] beyond the limits of the select granular backfill for the MSE wall. Placing pipe culverts through MSE walls should be avoided. Water and sewer lines within ten feet [3.0 m] of an MSE wall shall also be encased in a protective conduit or casing pipe.

Utility conduits embedded in concrete should be shown and dimensioned so as to clear construction joints by a minimum of one inch [25 mm] and other conduits by a minimum of 2 inches [50 mm].

No utilities shall be embedded in the actual vehicular traffic carrying section of a concrete deck.

Utilities shall not be suspended below the bottom of the bridge superstructure nor attached directly to the deck.

For approval procedures for installation of utilities on bridges, please refer to ODOT's “Utilities Manual.”

301.7.1 UTILITIES ATTACHED TO BEAMS AND GIRDERS

All utility lines placed between the stringers of grade separation structures should not be located in the floor panel behind the fascia stringer. This is to protect the lines from collisions.

Critical utility lines (gas, etc.) that could contribute to the severity of a collision should be located well above the bottom of the superstructure or be otherwise protected.

If the bridge design is a composite deck on prestressed box beams, the design may either eliminate an interior box beam or provide a space between two interior box beams to provide utility access in this space. This alternative will require a special design for both the boxbeams and the deck.

No utilities shall be placed inside of box beams.

301.8 CONSTRUCTION JOINTS, NEW CONSTRUCTION

Construction joints should be anticipated and provided for in the detail plans. Joint locations should be selected such that they are aesthetically least objectionable, allow construction to be properly performed and are at locations of minimum stress. Construction joints shall be designed to transfer all loads.

302 SUPERSTRUCTURE

302.1 GENERAL CONCRETE REQUIREMENTS

302.1.1 CONCRETE DESIGN STRENGTHS

The following concrete strengths (f'c) shall be assumed for design purposes:

A. Substructure Concrete (Class QC1) .... 4.0 ksi

B. Superstructure Concrete (Class QC2) .... 4.5 ksi

C. Drilled Shaft Concrete (Class QC2) .... 4.0 ksi

302.1.2 SELECTION OF CONCRETE FOR BRIDGE STRUCTURES

The following concrete types may be specified for substructure concrete:

A. Class QC1 Concrete

B. Class QC1 Concrete with QC/QA

C. Class QC3 Special Concrete

D. Class QC4 Mass Concrete

The following concrete types may be specified for superstructure concrete:

A. Class QC2 Concrete

B. Class QC2 Concrete with QC/QA

C. Class QC3 Special Concrete

D. Class QC4 Mass Concrete

Concrete with QC/QA shall be specified for the class of concrete when the total concrete quantity for that class exceeds 150 yd^3.

Class QC3 Special Concrete shall be specified when concrete strengths and/or permeability other than the QC1 or QC2 are necessary.

Class QC4 Mass Concrete shall be specified when the minimum dimension for a concrete component is 5-ft or greater or the diameter of a drilled shaft is 7-ft or greater.

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 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

C. Class QC2 Concrete

D. Drip Strips

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

F. Asphaltic concrete wearing surface

302.1.4.2 WHEN TO USE

All reinforcing steel shall be epoxy coated.

All cast-in-place concrete decks shall have minimum concrete top cover of 2½ inches [65 mm].

A drip strip may be used on decks with over the side drainage.

Non-composite box beam bridges, with over the side drainage, shall have an asphalt concrete overlay. The overlay shall be placed over either Type D Waterproofing, CMS 512 or Type 3 Waterproofing, CMS 512. Minimum thickness of overlay is 3 inches [75 mm] - See Section 302.1.3.1.

302.1.4.3 SEALING OF CONCRETE SURFACES SUPERSTRUCTURE

Specifications for sealing material are defined in CMS 512. Concrete surfaces shall be sealed with an approved concrete sealer as follows: (See Figures 302.1.4.3-1 & 302.1.4.3-2)

A. Concrete slabs or concrete decks on steel superstructures with over-the-side drainage:

The deck fascia and a 6 inch [150 mm] (minimum) width under the deck shall be sealed with either an epoxy-urethane or non-epoxy sealer.

B. Concrete slabs, composite prestressed box beam superstructures or concrete decks on steel superstructures with sidewalks:

The vertical face of curb; the top of the curb/sidewalk; the inside face, top and outside face of the parapet; the deck fascia; and a 6 inch [150 mm] (minimum) width under the deck shall be sealed with either an epoxy -urethane or non-epoxy sealer.

C. Concrete slabs, composite prestressed box beam superstructures or concrete decks on steel superstructures with deflector parapets:

The inside face, top and outside face of parapet; the deck fascia; and a 6 inch [150 mm] (minimum) width under the deck shall be sealed with either an epoxy-urethane, or non-epoxy sealer.

D. Non-composite prestressed concrete box beam decks with over-the-side drainage:

The fascia of the outside beams and a minimum 6 inch [150 mm] width under the beam shall be sealed with an epoxy-urethane or a non-epoxy sealer.

E. Concrete decks on prestressed I-beam superstructures with over-the-side drainage:

The deck fascia; the underside of the deck to the edge of the top flange; the exterior fascia of the beam; the underside of the bottom flange; and the inside face of the bottom flange shall be sealed with an epoxy-urethane sealer.

F. Concrete decks on prestressed I-beam superstructures with sidewalks:

The vertical face of curb; the top of the curb/sidewalk; the inside face, top and outside face of the parapet; the deck fascia; the underside of the deck to the edge of the top flange; the exterior fascia of the beam; the underside of the bottom flange; and the inside face of the bottom flange shall be sealed with an epoxy-urethane sealer.

G. Concrete decks on prestressed I-beam superstructures with deflector parapets:

The inside face, top and outside face of parapet; the deck fascia; the underside of the deck to the edge of the top flange; the exterior fascia of the beam; the underside of the bottom flange; and the inside face of the bottom flange shall be sealed with either an epoxy-urethane sealer.

predict stresses and deflections in all girders and diaphragms and to ensure that the structure is stable during all construction stages and loading conditions.

The Designer shall supply basic erection data on the contract plans. As a minimum, include the following information:

A. If temporary supports are required, provide the location of the assumed temporary support points, reactions and deflections for each construction stage and loading condition.
B. Instructions to the Contractor as to when and how to fasten connections for cross frames or diaphragms to assure stability during all temporary conditions.

Further design information for curved structures is contained in the "Guide Specifications for Horizontally Curved Highway Bridges", published by the American Association of State Highway and Transportation Officials.

302.5 PRESTRESSED CONCRETE BEAMS

Model multi-span, non-composite members as simple-span for all loading conditions. The live load and future wearing surface shall be as defined in Section 301.4.

Model multi-span, composite members using the two loading conditions that follow:

A. The beams shall be designed as simple-span for all loading conditions. The live load and future wearing surface shall be as defined in Section 301.4.
B. The deck reinforcing shall be designed for beams acting as simple-span for non-composite dead loads and as continuous span for live load and composite dead loads. The live load and future wearing surface shall be as defined in Section 301.4.

302.5.1 BOX BEAMS

Physical dimensions and section properties of box beam cross sections shall be as shown on the Prestressed Concrete Box Beam Bridge Details, Standard Bridge Drawing.

Box beams should be limited to a maximum skew of 30 degrees.

Multiple span box beam bridges shall be joined over the piers with a T-joint as shown in the Standard Bridge Drawing. Structurally, beams shall be designed as simple spans. The decks of composite beams shall be designed as continuous for live loads and composite dead loads.

Expansion at the piers shall be accommodated by elastomeric expansion bearings or by flexibility of the piers for integral designs.

The length of abutment seats of prestressed concrete box beam bridges should be long enough to accommodate the total width out-to-out of all beams including a fit-up allowance of ½ inch [12 mm] per joint between beams.

In order to keep the beam seat from extending beyond the fascia of any pier of a box beam bridge, the length of the pier seat should only include a fit-up allowance for the joints between

302.5.1.2 STRANDS

Debonding of strands, by an approved plastic sheath, shall be done to control stresses at the ends of the beams. Refer to Section 302.5.2.2.d for debonding limits.

Deflecting of strands in box beams to limit stresses shall not be allowed.

The designer shall show on the plans the number, spacing and length of debonding. The box beam fabricator may have the option to change the position of debonding as long as the change is still symmetrical.

All strands extended from a beam to develop positive moment resistance shall not be debonded strands.

302.5.1.2.a TYPE, SIZE OF STRANDS

A. Low-relaxation ½ inch diameter (A_S = 0.153 in^2) seven wire uncoated strands, ASTM A416, Grade 270.

B. Low-relaxation ½ inch diameter (A_S = 0.167 in^2) seven wire uncoated strands, ASTM A416, Grade 270.

302.5.1.2.b SPACING

Strands shall be spaced at increments or multiples of 2 inches.

The location of the centerline of the first row of strands shall be 2 inches from the bottom of the beam. All strands shall be completely enclosed by the #4 stirrup bars. Strands near the top flange shall be placed below all transverse and longitudinal reinforcing steel and to the left and right of the void.

302.5.1.2.c STRESSES

Initial prestressing loads for low-relaxation strand shall be according to AASHTO requirements and shall be detailed on the plans.

Initial stress .... 0.75 f'_s = 202,500 psi

Initial tension load ....30,982 lb/strand (A_S = 0.153 in^2)

33,818 lb/strand (A_S = 0.167 in^2)

Initial stress ....0.75 f'_s = 1400 Mpa

Initial tension load ....138 600 N/strand (A_S = 99 mm^2)

151 200 N/strand (A_S = 108 mm^2)

302.5.1.3 COMPOSITE

Composite reinforced deck slabs on prestressed box beams shall be a minimum of 6 inches [155 mm] thick and shall be reinforced with #6 [#19M] bars. The longitudinal bars shall be spaced at 18" [450 mm] and the transverse bars spaced at 9" [225 mm]. For ease of placement on skewed structures, the transverse bars may be placed parallel to the substructure units with spacing measured parallel to the longitudinal axis of the structure.

On multiple span composite box beam bridges additional longitudinal reinforcing steel over the piers is required. The additional bars shall be alternately spaced with the standard longitudinal reinforcement and the pier bar's length shall be equal to the larger of: 40 percent of the length of the longer adjacent stringer span or a length that meets the requirements of *LRFD 5.11.1.2.3*. The pier bars should be placed longitudinally and approximately centered on the pier but with a 3 foot [1000 mm] stagger.

When designing the deck reinforcement for a multiple span structure, unless a more precise method of analysis is performed, the composite structure shall be conservatively modeled as a continuous beam on a single support centered on the pier.

Composite box beam structures with concrete parapets or sidewalks should not incorporate fit-up tolerances in the finished roadway width. To compensate for fit-up tolerances the composite deck and barrier and/or sidewalk should be designed to cantilever or overhang the boxbeam units by 2" [50 mm] to 8" [200 mm] each side with the fit-up being absorbed in the overhang. A mixture of 48" [1220 mm] and 36" [915 mm] boxbeam units may be necessary to meet this requirement.

See Figure 302.5.1.3-1 for a sketch of the cross-section of the composite deck superstructure.

302.5.1.4 NON-COMPOSITE WEARING SURFACE

Non-composite box beam bridges with asphalt overlays shall have either Type D Waterproofing or Type 3 Waterproofing as specified in CMS 512 placed on the boxes before the 1½ inch [38 mm] minimum layers of CMS type 448 asphaltic concrete is applied. See section 302.1.3.1. The Type 3 Waterproofing is preferred.

Non-composite box beam bridges with asphalt overlays shall be limited to a 4 percent combined grade. Combined grades greater than 4 percent require a composite deck design. Combined grade includes both the longitudinal and transverse structure grades calculated as follows:

Combined Grade (Cg) = $([\text{deck slope}]^2 + [\text{transverse grade}]^2)^{1/2}$

302.5.1.5 CAMBER

In establishing bridge seat elevations and assuring a minimum design slab or overlay thickness, allowance shall be made for camber due to prestressing according to the following:

A = Minimum topping thickness

B = Anticipated total mid-span camber due to the design prestressing force at time of release

C = Mid-span deflection due to the self weight of the beam (including diaphragms)

D = Mid-span deflection due to dead load of the topping and other non-composite loads

E = Mid-span deflection due to dead load of railing, sidewalk and other composite dead loads not including future wearing surface

F = Adjustment for vertical curve (Positive for crest vertical curves)

G = Total topping thickness at beam bearings = A + 1.8B - 1.85C - D - E - F. If F > 1.8B - 1.85C - (D + E) then G = A.

H = Total topping thickness at mid-span = A. If F > 1.8B - 1.85C - (D + E) then H = A - (1.8B - 1.85C) + D + E + F.

Use the gross moment of inertia for the non-composite beam to calculate the camber and deflection values B, C, and D. For E, use the moment of inertia for the composite section when designing a composite box beam otherwise use the non-composite section. Note that with the exception of when F > 1.8B - 1.85C - (D + E), the dead load deflection adjustment (D + E) is made by adjusting the beam seat elevations upward.

The designer shall provide the camber at the time of release (B–C), the camber at the time of erection (1.8B – 1.85C), long term camber (2.45B – 2.40C), and a longitudinal superstructure cross section in the plans. For non-composite beams, show the thickness of the Item 448 Intermediate course and the Item 448 surface course at each centerline of bearing and at mid-span points. For composite beams, show the total topping thickness at each centerline of bearing and at mid-span points and provide a screed elevation table.

302.5.1.6 ANCHORAGE

In a box beam design, all beams shall be anchored at abutments and piers. The anchor shall be in the center of the cross section of the box beam and shall conform to details presented in the Standard Bridge Drawing.

Fixed end anchor dowels shall be installed with a non-shrinking grout (mortar). Expansion end anchor dowel holes shall be filled with joint sealer, CMS 705.04.

Preformed expansion joint filler, 705.03, the same thickness as the elastomeric bearing, shall be installed under the box beam, around the anchor dowel, to halt the grout or sealer from leaking through to the beam seat.

302.5.1.7 CONCRETE MATERIALS FOR BOX BEAMS

The designer has a choice of 28-day compressive strengths ranging from 5500 psi [38 Mpa] to 7000 psi [48 Mpa]. The 28-day compressive strength chosen for design shall be listed in the contract plan General Notes.

The designer has a choice of compressive strength at the time of release ranging from 4000 psi [27.5 Mpa] to 5000 psi [34.5 Mpa]. The release strength chosen for design shall be listed in the contract plan General Notes.

Cast-in-place concrete for composite decks, pier "T" sections, etc., shall be superstructure concrete – 4.5 ksi [31.0 MPa] at 28 days.

For concrete in composite decks see Section 301.1.1.

302.5.1.8 REINFORCING

Epoxy coated reinforcing steel shall be used in composite deck slabs and shall be Grade 60 [420], Fy = 60 ksi [420 MPa].

Reinforcing steel used in the standard design box beams is Grade 60, Fy = 60 ksi.

The fabricator, by specification, is required to use a corrosion-inhibiting admixture in the concrete. Reinforcing bars projecting from the prestressed members shall be epoxy coated.

302.5.1.9 TIE RODS

Tie rods shall be provided and installed according to the Prestressed Concrete Box Beam Bridge standard bridge drawing.

Diaphragms and transverse tie rods for prestressed concrete box beam spans shall be provided at mid-span for spans up to 50 feet [15 000 mm], at third points for spans from 50 feet [15 000 mm] to 75 feet [23 000 mm] and at quarter points for spans greater than 75 feet [23 000 mm].

302.5.2 I-BEAMS

AASHTO standard prestressed I-beam shapes, type II through type IV; modified type IV and WF36-49 through WF72-49 as shown in the standard bridge drawing, shall be used.

In designing prestressed I-beams, the non-composite section shall be used for computing stresses due to the beam and deck slab. The composite section shall be used for computing stresses due to the superimposed dead, railing and live loads. When designing the deck reinforcement for a multiple span structure, unless a more precise method of analysis is performed, the composite structure shall be conservatively modeled as a continuous beam on a single support centered on the pier.

Aside from access for shipping strands and clipped flanges as shown in the standard drawing, abrupt changes or discontinuities in the beam cross-section shall be avoided. If not, a refined analysis that accounts for section loss, resulting stress concentrations, and time dependent loading is required. Examples include providing breaks in the top flange to locate a utility or scupper for deck drainage.

302.5.2.1 DESIGN REQUIREMENTS

In order to prevent fabrication mistakes for beam length, the effect that the longitudinal grade has on dimensions measured along a beam's length should be addressed in the plans. When the beam length measured along the grade differs from the beam length measured horizontally by more than 3/8" [10 mm], all affected dimensions measured along the length of the beam should be clearly labeled so that the fabricator can make the necessary allowances in the shop drawings. A Typical Detail note is available in Section 700.

When detailing beam elevations, dimension the locations of all inserts, hold-downs, etc. to the ends of the beam rather than the centerlines of bearing.

302.5.2.2 STRANDS

The preferred strand pattern is straight, parallel strands with no debonding. However, excessive tensile stresses may develop in the beam ends during the release of the prestressing force. To relieve these excessive stresses, the following strand patterns are allowed: (listed in order of preference)

A. Partially debonded bottom flange strands up to the limits specified in *LRFD 5.11.4.3*.

B. Combination of the maximum partially debonded bottom flange strands permitted by *LRFD 5.11.4.3* and draped strands.

Transforming strand area in order to increase section properties is not allowed.

302.5.2.2.a TYPE, SIZE

Use low-relaxation, 0.6-inch diameter (A_S = 0.217 in^2) seven wire uncoated strands, ASTM A416, Grade 270. The prestressing strand type and size shall be listed in the contract plan General Notes.

302.5.2.2.b SPACING

Strands shall be spaced at increments of 2 inches [50 mm].

A minimum 2 inch [50 mm] dimension from bottom of beam to centerline of the first row of strands and any exterior beam surface shall also be maintained.

302.5.2.2.c STRESSES

Initial prestressing loads for low-relaxation strand shall be as per AASHTO requirements and shall be detailed on the plans.

Initial stress .... 0.75 f'_s = 202,500 psi

Initial tension load..43,943 lb/strand (A_S = 0.217 in^2)

302.5.2.2.d DEBONDING

Debonding or shielding of the strands, with an approved plastic sheath, may be done at the beam ends to relieve excessive stresses. The following guidelines shall be followed for debonded strand designs:

A. The maximum debonded length at each end shall not be greater than 0.16L - 40". Where L equals the span length in inches.
B. A minimum of one-half the number of debonded strands shall have a debonded length equal to one-half times the maximum debonded length.
C. No more than 25% of the total number of strands in the I-beam shall be debonded.
D. No more than 40% of the strands in any row shall be debonded.
E. Debonded strands shall be symmetrical about the centerline of the beam.

The designer shall show on the detail plans the number, spacing and the length of required debonding per strand.

D = Mid-span deflection due to dead load of the slab, diaphragms and other non-composite loads.

E = Mid-span deflection due to dead load of railing, sidewalk and other composite dead loads not including future wearing surface.

F = Adjustment for vertical curve. Positive for crest vertical curves.

G = Sacrificial haunch depth (2" [50 mm]).

H = Total topping thickness at beam bearings = A + 1.8B - 1.85C - D - E - F + G. If F > 1.8B - 1.85C - (D + E) then H = A + G

I = Total topping thickness at mid-span = A + G. If F > 1.8B - 1.85C - (D + E) then I = A - (1.8B - 1.85C) + D + E + F + G.

The gross moment of inertia for the non-composite beam shall be used to calculate the camber and deflection values for B, C and D. The moment of inertia for the composite section should be used to calculate value E.

The designer shall show a longitudinal superstructure cross section in the plans detailing the total topping thickness, including the design slab thickness and the haunch thickness at the centerline of spans and bearings. Provide the camber at the time of release (B-C), camber at the time of erection (1.8B – 1.85C), long term camber (2.45B – 2.40C), and a screed elevation table according to Section 302.2.3.

302.5.2.4 ANCHORAGE

One inch diameter anchors shall be provided at each fixed pier as shown on the standard bridge drawing.

The number of anchors required shall be determined by analysis. These anchors shall be designed to transfer superstructure loads to the substructure at the Strength Limit States and resist seismic loads at the Extreme Event Limit State.

The anchors shall be a minimum of 2'-0" long. Anchors shall be embedded a minimum of 1'-0" into the pier cap. The anchors should be drilled in place at the centerline of the pier. The designer should confirm the pier cap has reinforcing steel clearance to accept these anchors.

302.5.2.5 DECK SUPERSTRUCTURE AND PRECAST DECK PANEL

Only cast-in-place concrete decks shall be designed and used.

The precast panel alternative, previously used, has shown cracking problems at the joints between the panels and there are questions on the transfer of stresses in the finished deck sections.

302.5.2.6 DIAPHRAGMS

Maximum spacing of intermediate diaphragms shall be 40'-0".

Intermediate diaphragms for 60” and deeper beams may be either cast-in-place concrete or galvanized steel. The contractor shall choose the type. Intermediate diaphragms for less than 60” deep beams shall be cast-in-place concrete. Details for each type are provided in the standard bridge drawing. The design plans shall show the centerline location of each intermediate diaphragm. Payment for the intermediate diaphragms shall be made at the contract price for item 515, each, Intermediate Diaphragms.

Cast-in-place intermediate diaphragms should not make contact with the underside of the deck because they could act as a support to the deck, causing cracking and possible over stressing of the deck. The top of the cast-in-place intermediate diaphragm should start at the bottom vertical edge of the top flange and end at the top of the vertical edge of the bottom flange.

If the Standard Bridge Drawing for I-beams is not referenced by the contract plans, the designer shall add a note to the plans for prestressed I-beam designs requiring cast-in-place intermediate diaphragms to be placed and cured at least 48 hours before deck placement.

Threaded inserts shall be used to connect the cast-in-place diaphragm reinforcing steel to the I-beam. The threaded inserts and the threaded rods shall be galvanized according to C&MS 711.02.

End diaphragms shall be provided. Diaphragms shall be cast-in-place. The top of the end diaphragm shall make complete contact with the deck. The bottom of the end diaphragm shall end at the top of the elastomeric bearing. Refer to the standard bridge drawing for typical diaphragm details.

302.5.2.7 DECK POURING SEQUENCE

A deck pour sequence is required for all multiple span prestressed I-beam designs made continuous at pier locations. The standard drawing establishes one sequence that allows the beams to deflect without stressing pre-placed diaphragms. The designer shall either accept the standard drawing sequence or detail an alternative.

302.5.2.8 CONCRETE MATERIALS FOR I-BEAMS

The designer has a choice of 28-day compressive strengths ranging from 5500 psi [38 Mpa] to 7000 psi [48 Mpa]. The 28-day compressive strength chosen for design shall be listed in the contract plan General Notes.

The designer has a choice of compressive strength at the time of release ranging from 4000 psi [27.5 Mpa] to 5000 psi [34.5 Mpa]. The release strength chosen for design shall be listed in the contract plan General Notes.

Cast-in-place concrete, (composite decks, pier diaphragms, intermediate diaphragms, etc.) Shall be superstructure concrete - 4500 psi at 28 days.

Consult the Office of Structural Engineering for recommendations prior to designing a structure with concrete strengths higher than those shown above.

302.5.2.9 REINFORCING

The fabricator, by specification, is required to use a corrosion-inhibiting admixture to the concrete.

Reinforcing bars projecting from the prestressed members shall be epoxy coated. All other beam reinforcement shall be uncoated. Reinforcing steel shall be Grade 60, F_y = 60 ksi. Welded wire fabric shall be Grade 70, F_y = 70 ksi.

302.5.2.10 TRANSPORTATION & HANDLING CONSIDERATIONS

In order to prevent damaging the beams during transit and erection, fabricators may require additional strands to be placed in the top flange. These shipping strands keep the top flange in compression until the beams are set into final position. Once set, the shipping strands are cut to release their prestressing force and allow the beams to reach their design ultimate capacity.

303 SUBSTRUCTURE

303.1 SEALING OF CONCRETE SURFACES, SUBSTRUCTURE

Specifications for the sealer are defined in CMS 512. Concrete surfaces shall be sealed with a concrete sealer as follows:

A. The front face of abutment backwalls, from top to bridge seat, the bridge seat and the breastwall down to the groundline shall be sealed with an epoxy-urethane or non-epoxy sealer. (Note: Sealing of the backwall shall not be required on prestressed box beam bridges because the beams are installed before the backwall is placed.)

B. The exposed surfaces of all wingwalls and retaining walls, exclusive of abutment type, that are within 30 feet [10 000 mm] of any pavement edge shall be sealed with an epoxy-urethane sealer.

C. Ends and sides of piers exposed to traffic-induced deicer spray, from any direction, shall be sealed with either an epoxy-urethane or non-epoxy sealer. Top of pier caps need only be sealed if there is an expansion joint or the tops are subject to exposure to deicer-laden water.

D. The total vertical surface of piers which are adjacent to traffic lanes shall be sealed with either an epoxy-urethane or non-epoxy sealer. Structures with A588[M] weathering steel superstructures shall also have their piers sealed as stated above with either an epoxy-urethane or non-epoxy sealer.

The designer should include in the plans actual details showing the position, location and area required to be sealed. A plan note to describe the position should not be used as there can be both description and interpretation problems.

The designer has the option to select a specific type of sealer, epoxy-urethane or non-epoxy. The designer also has the alternative to just use a bid item for sealer, with no preference, and allows the contractor to choose based on cost.

See Figures 303.1-1, 303.1-2 & 303.1-3.

In areas where concrete surfaces have a history of graffiti vandalism, the designer may add a sacrificial or permanent graffiti coating meeting the requirements of Supplement 1083 on top of the epoxy-urethane or non-epoxy sealer. A plan note is available in BDM Section 600. The designer should limit the concrete surfaces that are treated with sacrificial or permanent graffiti coatings to those reachable by easy climbing and visible to the traveling public.

303.2 ABUTMENTS

303.2.1 GENERAL

Abutments should be provided with backwalls to protect the superstructure from contact with the approach fill and to assist in preventing water from reaching the bridge seat.

For members designed to retain earth embankments and restrained from deflecting freely at their tops, the computed backfill pressure shall be determined by using at-rest pressure. Examples include: rigid frame bridges, abutment walls keyed to the superstructure, and some types of U-abutments.

For abutment walls of structures designed without provision for expansion between superstructure and substructure and where an appreciable amount of superstructure expansion is anticipated, passive earth pressure should be considered in the design.

To allow for slight tilting of wall type abutments after the backfill has been placed, batter the

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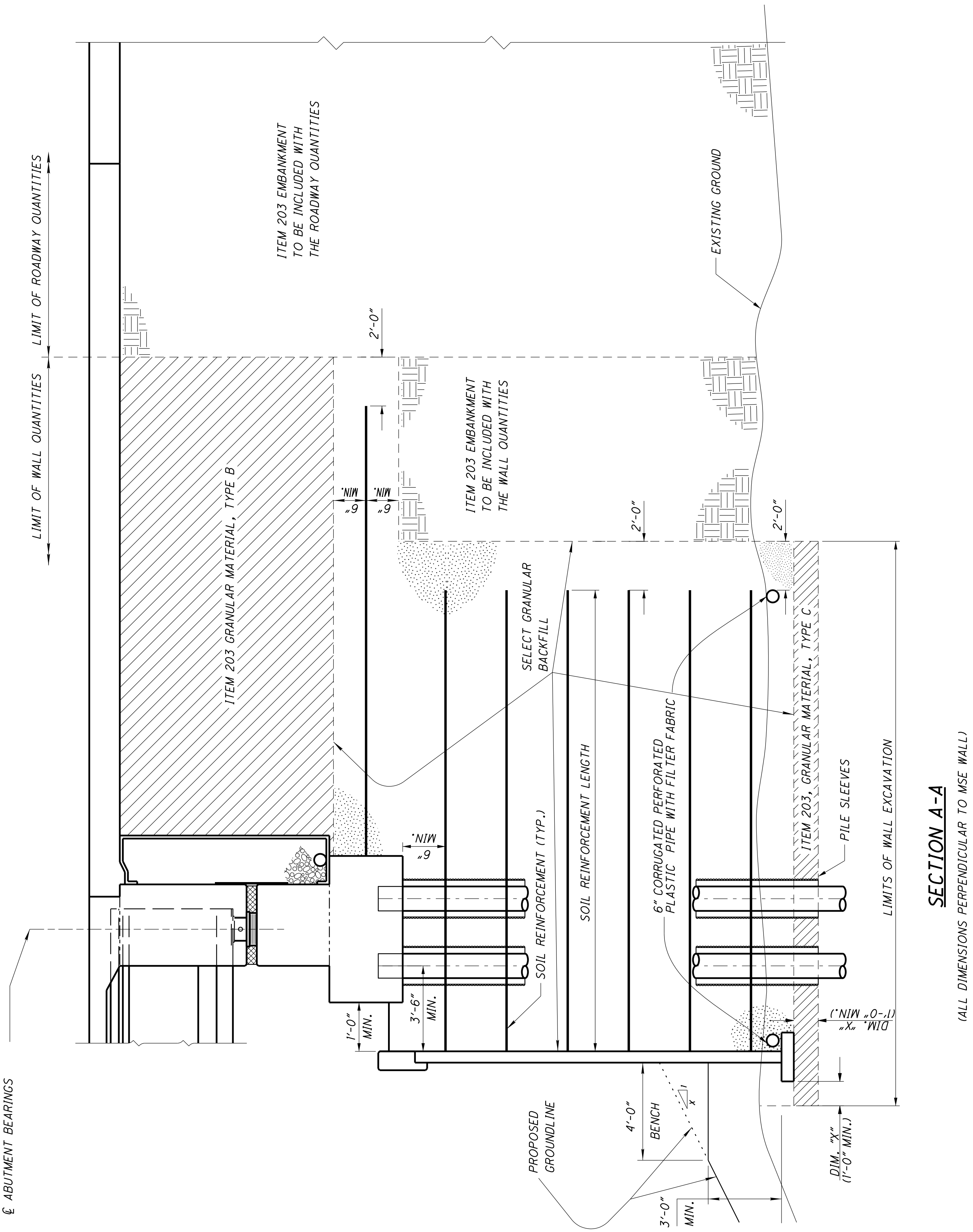
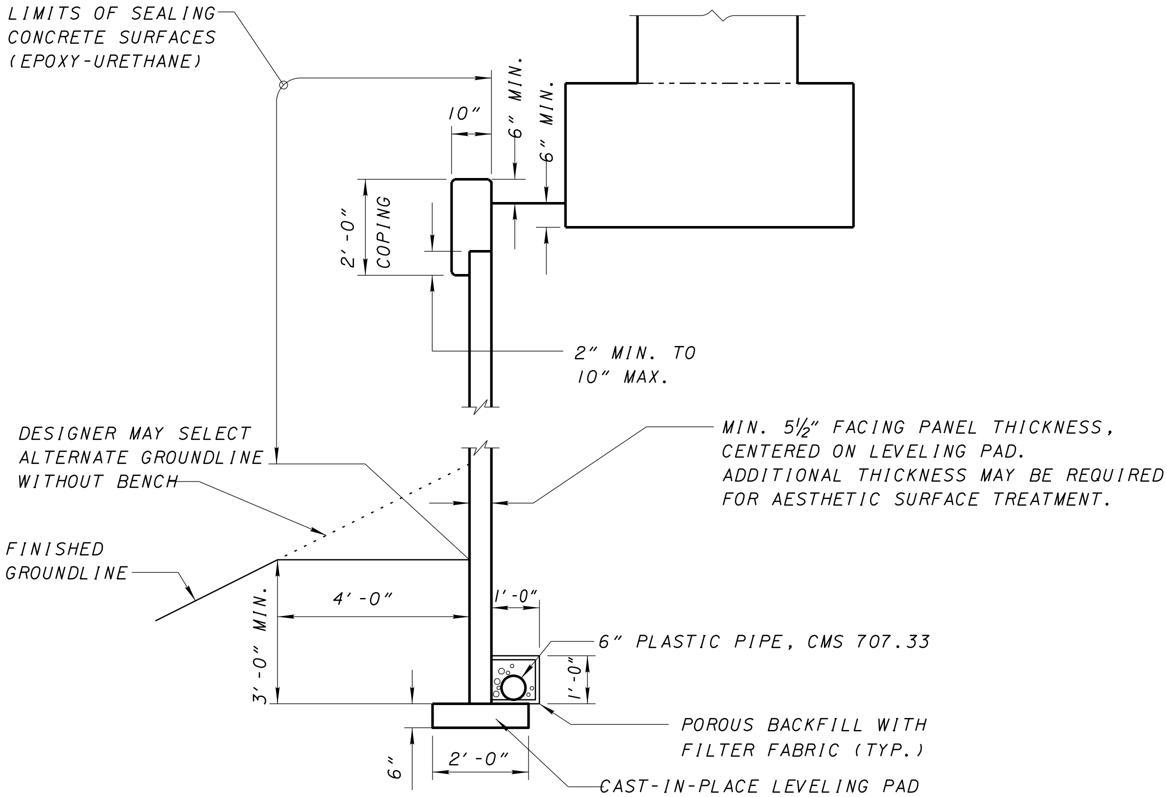
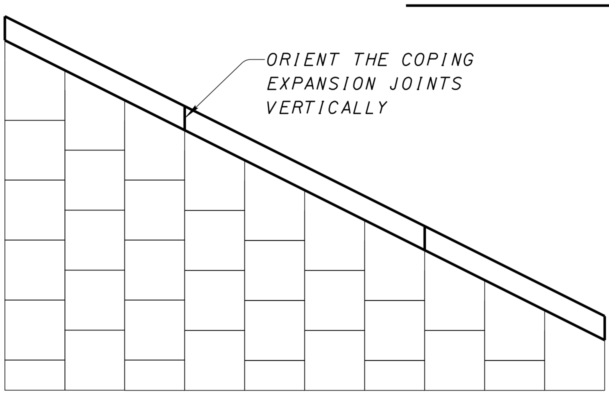


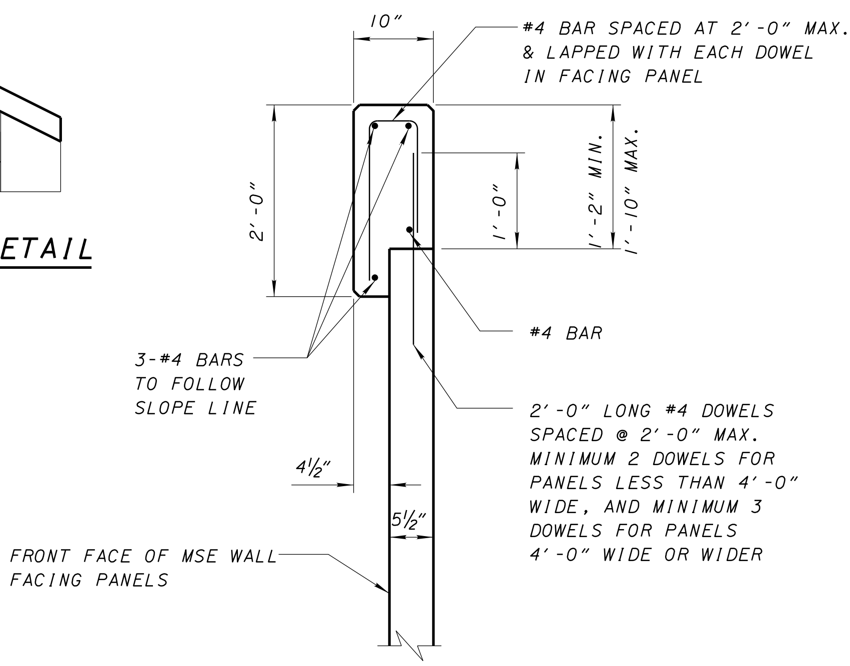
FIGURE 303.5.1-3



MSE WALL AND COPING DETAIL

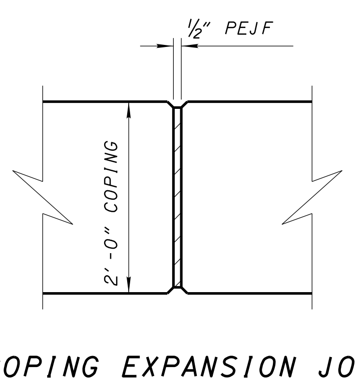


COPING JOINT ORIENTATION DETAIL



MSE WALL COPING

ALL REINFORCING STEEL TO BE EPOXY COATED



COPING EXPANSION JOINTS

FIGURE 303.5.1-4

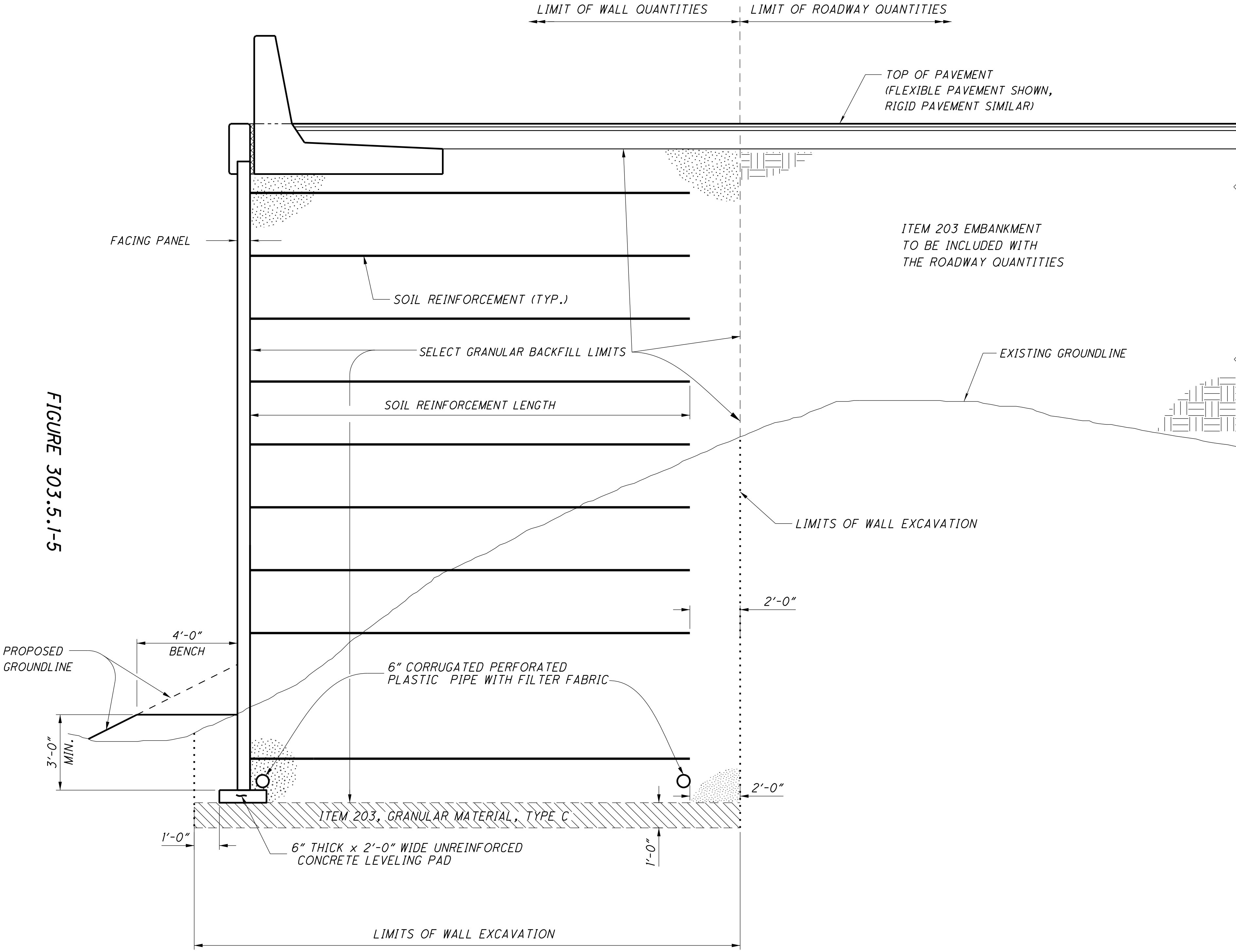


FIGURE 303.5.1-5

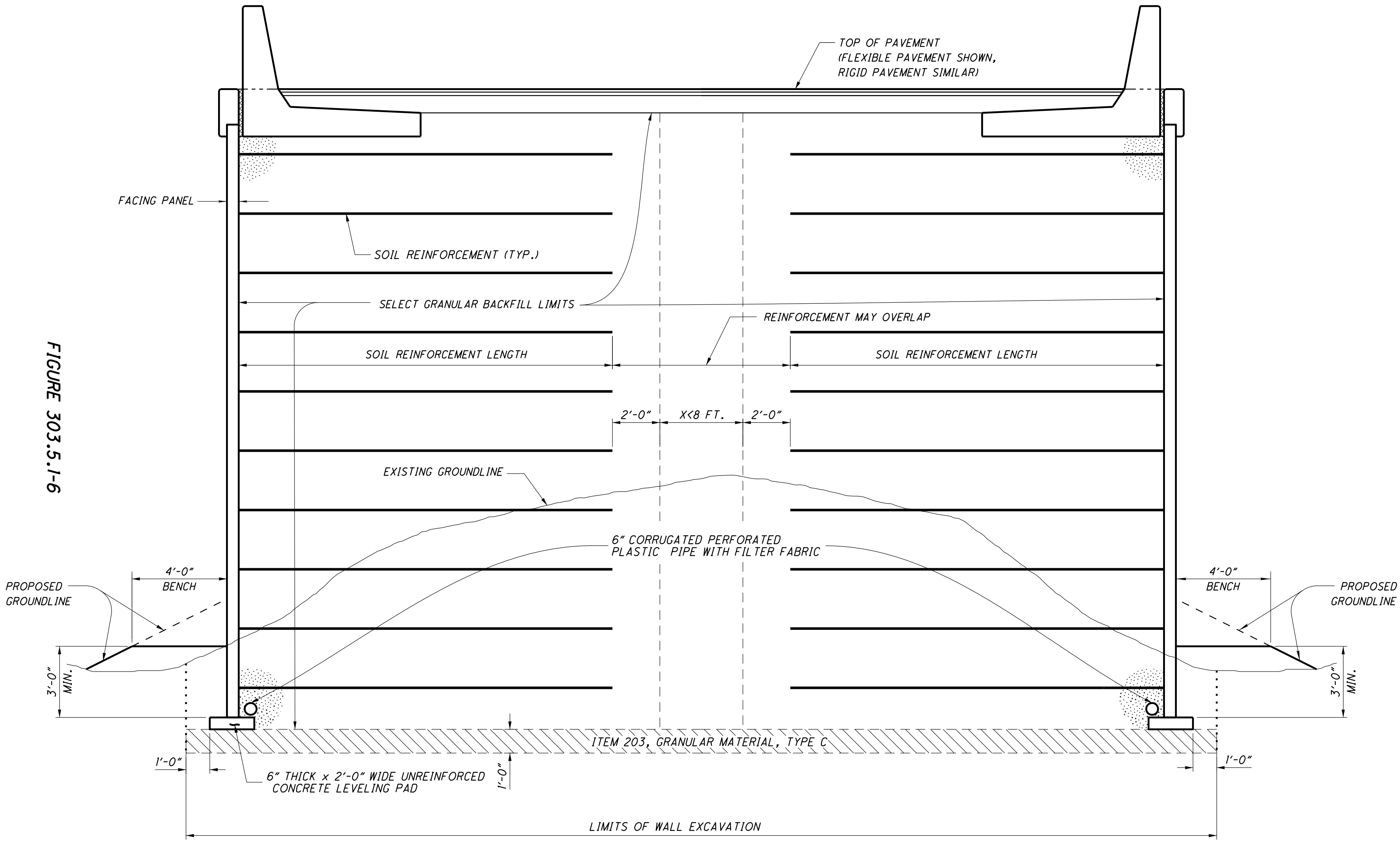
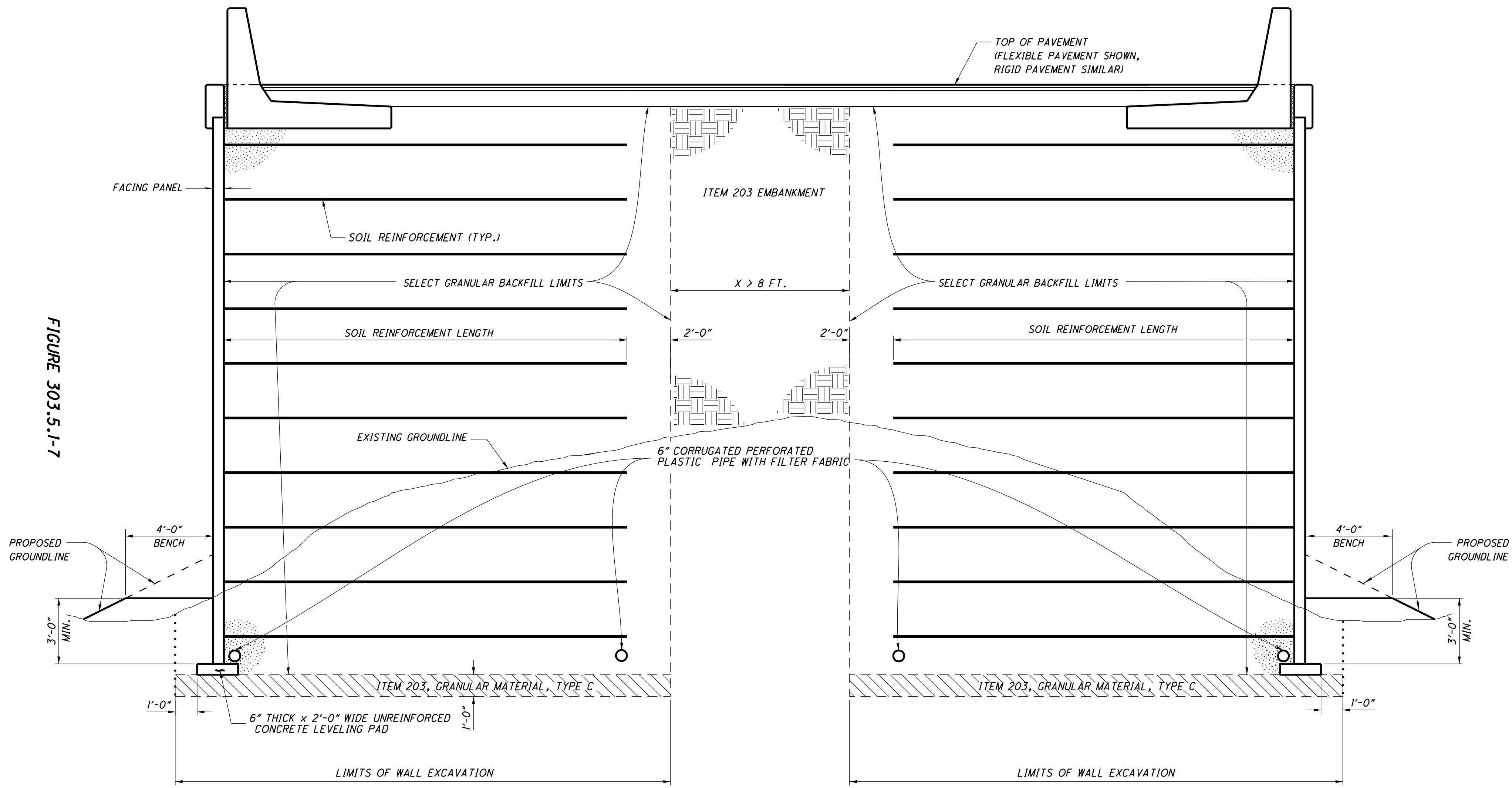


FIGURE 303.5.1-6

IF X IS LESS THAN 8 FT., USE SELECT GRANULAR BACKFILL MATERIAL BETWEEN SOIL REINFORCEMENT.

SEE ROADWAY PLANS FOR PAVEMENT BUILD UP



IF X IS MORE THAN 8 FT., USE ITEM 203 EMBANKMENT BETWEEN SOIL REINFORCEMENT.

SEE ROADWAY PLANS FOR PAVEMENT BUILD UP

FIGURE 303.5.1-7

equal to or greater than the original member. Maintain waterway opening size and required clearances. Submit calculations for the substitute or alternate member according to 502. Use only new bolts.

B. Structural steel need not be painted.

The following instructions are provided to assist in developing the necessary general notes.

When 513 Structural Steel is specified in the plans, only the following CMS descriptions shall apply:

A. Straightening....................513.11

B. Holes for High Strength and Bearing Bolts....................513.19

C. High Strength Steel Bolts, Nuts and Washers....................513.20

D. Welding....................513.21

E. Nondestructive Testing....................513.25

F. Shipping, Storage and Erection....................513.26

When Item 511 is specified in the plans, the C&MS 511 surface finish requirements shall be waived.

The following notes shall be included in the Structure General Notes. In the roadway plans the pay item description "614 Maintenance of Traffic" shall include an "as per Plan." Coordination with the roadway plans for this item is required.

A. MAINTENANCE: Maintain all portions of the temporary structure in good condition with regard to strength, safety and ridability. The Department will consider this maintenance to be incidental to Item 614, Maintaining Traffic. Maintain the waterway opening shown on the plans at all times. If debris accumulates within the waterway opening or on any part of the structure promptly remove the debris. The Department will compensate for debris removal according to 109.05.

B. CLOSING OF THE TEMPORARY STRUCTURE: If for any reason or at any time the temporary structure's ability to safely carry traffic is in question, immediately take the actions necessary to protect traffic, repair and reopen the temporary structure. When closing a temporary structure for this purpose, immediately notify the Engineer and the appropriate law enforcement agency. Water elevations exceeding the design (5) year highwater elevation or an excessive accumulation of debris within the waterway opening shall be sufficient reasons to close the temporary structure. Mark the design (5) year highwater elevation with fluorescent paint on the temporary structure, at a visible location. The Department will consider the costs associated with closing the temporary structure to be incidental to Item 614, Maintaining Traffic.

5-4

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602.1 LRFD LOAD MODIFIERS

For bridges with non-redundant components, the following note shall be included:

[602.1-1] REDUNDANCY: The following item(s) were considered non-redundant for design and include a load modifier equal to 1.05 in accordance with the AASHTO LRFD Bridge Design Specifications, Article 1.3.4:

NOTE TO DESIGNER:
Include a list of all items considered non-redundant for design in accordance with BDM Section S*1.3.4*.

For bridges with non-redundant foundation components, the following notes shall be included:

[602.1-2] REDUNDANCY: The piles supporting the following substructure(s) were considered non-redundant for design and include a modified resistance factor equal to __(1)__ in accordance with the AASHTO LRFD Bridge Design Specifications, Article 10.5.5.2.3:

[602.1-3] REDUNDANCY: The drilled shafts supporting the following substructure(s) were considered non-redundant for design and include a modified resistance factor equal to __(1)__ in accordance with the AASHTO LRFD Bridge Design Specifications, Article 10.5.5.2.4:

NOTE TO DESIGNER:
Include a list of all substructures with pile foundations or drilled shafts considered non-redundant for design in accordance with *AASHTO LRFD 10.5.5.2.3* & *10.5.5.2.4*.

(1) Provide the modified resistance factor value. This should be equal to 80% of the resistance factor used for design on redundant pile foundations.

For all bridges the following note shall be included:

[602.1-4] OPERATIONAL IMPORTANCE: A load modifier of ___ has been assumed for the design of this structure in accordance with the AASHTO LRFD Bridge Design Specifications, Article 1.3.5 and the ODOT Bridge Design Manual, 2007.

NOTE TO DESIGNER:
Refer to BDM Section S*1.3.5* for guidance.

602.2 DESIGN LOADING

For bridges designed for highway loads, the design loading shall be:

[602.2-1] DESIGN LOADING: HL-93

Future Wearing Surface (FWS) of 0.060 kips/ft ^{2}.

For bikeway/pedestrian bridges that will not accommodate vehicular traffic the design loading shall be:

[602.2-2] DESIGN LOADING**:** 0.090 kips/ ft^2

For bikeway/pedestrian bridges subject to vehicular traffic the design loading shall be:

[602.2-3] DESIGN LOADING**:** 0.090 kips/ft^2 and H15-44 vehicle

602.3 DESIGN STRESSES

A. General Design Data:

[602.3-1] DESIGN DATA :

Concrete Class (1) - compressive strength 4.5 ksi (superstructure)

Concrete Class (2) - compressive strength 4.0 ksi (substructure)

Concrete Class QC2 - compressive strength 4.0 ksi (drilled shaft)

Reinforcing steel - minimum yield strength 60 ksi

Structural Steel - ASTM A709 Grade (3) - yield strength (3) ksi

Steel H-piles - ASTM A572 - yield strength 50 ksi

NOTE TO DESIGNER:

Modify note **[602.3-1]** as necessary. Delete references that are not applicable to project.

(1) Class QC2 Concrete for superstructure

(2) Class QC1 Concrete for substructure

(3) Grade 50 - yield strength 50 ksi, or

Grade 50W - yield strength 50 ksi, or

Grade HPS70W - yield strength 70 ksi, or

Grade 36 - yield strength 36 ksi

If more than one grade of steel is selected, the description shall clearly indicate where the different grades are used in the structure.

B. Additional Design Data for Prestressed Concrete Members:

Provide the following note in addition to note **[602.2-1]**.

[602.3-2] DESIGN DATA:

Concrete for prestressed beams:

Compressive Strength (final) - (1) ksi

Compressive Strength (release) - (2) ksi

Welded Wire Fabric:

Yield Strength – 70 ksi (4)

Prestressing strand:

Area = (3) in^2

Ultimate Strength = 270 ksi

Initial stress = 202.5 ksi (Low relaxation strands)

NOTE TO DESIGNER:

(1) Specify 28-day compressive strength from the following range: 5.5 – 7.0 ksi

(2) Specify compressive strength at release from the following range: 4.0 – 5.0 ksi

(3) Specify prestressing strand area from the following: 0.153 in^2, 0.167 in^2, or 0.217 in^2

(4) Reference to Welded Wire Fabric applies to I-beams only.

602.4 FOR RAILWAY PROJECTS

For structures carrying railroad traffic, provide notes **[602.3-1]; [602.3-2]** (if necessary); and the following notes on the project plans:

[602.4-1] DESIGN SPECIFICATIONS: This structure conforms to the requirements of the "Manual for Railway Engineering" by the American Railway Engineering and Maintenance-of -way Association, XXXX * Edition.

CONSTRUCTION AND MATERIAL SPECIFICATIONS: State of Ohio, Department of Transportation, dated January 1, XXXX. *

NOTE TO DESIGNER: Note **[601.3-2]** may be required if special criteria or distributions have been used for the design of this rail structure. See **[601.3-2]** and determine if a modified note is required for inclusion. Fill-in items above marked "*" with current edition and latest interims.

Provide the following note, modified as necessary to meet AREMA and/or a specific railroad criterion, with all railroad structures.

[602.4-2] DESIGN LOADING: Cooper E-80 with diesel impact

602.5 DECK PROTECTION METHOD

If any of the following deck protection methods have been specified in the plans, include the following note, modified as necessary for the specific structure, in the Design Data section of the Structure General Notes:

[602.5-1] DECK PROTECTION METHOD:

Epoxy coated reinforcing steel

2½" concrete cover

Superplasticized dense, Micro-silica, Epoxy, or Latex modified concrete overlay

Waterproofing and asphalt concrete overlay

Steel drip strip

Other (Specify)

602.6 MONOLITHIC WEARING SURFACE

Furnish the following note for concrete bridge decks.

[602.6-1] MONOLITHIC WEARING SURFACE is assumed, for design purposes, to be 1 inch thick.

602.7 SEALING OF CONCRETE SURFACES

Use the following notes when permanent anti-graffiti coatings are required:

[602.7-1] ITEM 512 SEALING OF CONCRETE SURFACES, AS PER PLAN, (PERMANENT GRAFFITI PROTECTION):
Apply a permanent graffiti coating qualified according to Supplement 1083 that is compatible with the concrete sealer over which it is applied. Apply the graffiti coating in accordance with the manufacturer's printed instructions.

Use the following notes when sacrificial anti-graffiti coatings are required:

[602.7-2] ITEM 512 SEALING OF CONCRETE SURFACES, AS PER PLAN, (SACRIFICIAL GRAFFITI PROTECTION):
Apply a permanent graffiti coating qualified according to Supplement 1083 that is compatible with the concrete sealer over which it is applied. Apply the graffiti coating in accordance with the manufacturer's printed instructions.

[605.2-2] CONSTRUCTION CONSTRAINTS: Fill the void created by excavating for the abutment footings with Type B granular material, 703.16.C. After the footing and the breastwall have been constructed, fill the void behind each abutment up to the beam seat elevation and from the beam seat up on a 1:1 slope to the subgrade elevation prior to constructing the backwall and setting the beams on the abutment.

605.3 EMBANKMENT CONSTRUCTION NOTE

In an attempt to reduce settlements of the roadway approaches, specify the placement of embankment materials in 6 inch [150 mm] lifts. Include one of the following plan notes in the Project General Notes and make reference to the work defined below at the appropriate locations within the plans.

Note that Item 203 is a roadway quantity and coordination with the roadway plans is necessary.

To define the limits of measured pay quantities for bridges with wall-type abutments, provide excavation, backfill, and embankment diagrams (or a composite diagram, where suitable), using schematic abutment cross-sections, showing the boundaries between structure and roadway excavation, and between structure backfill and roadway embankment.

[605.3-1] ITEM 203 EMBANKMENT, AS PER PLAN: Place and compact embankment material in 6 inch lifts for the construction of the approach embankment between stations _**_ to _**_.

NOTE TO DESIGNER:

** The approximate limits should be 100 feet behind each abutment

[605.3-2] ITEM 203 EMBANKMENT, AS PER PLAN: Place and compact embankment material in 6 inch lifts for the construction of the approach embankment.

605.4 UNCLASSIFIED EXCAVATION

Compute and use pay items for Item 503 as follows:

When an excavation includes 10 yd^3 [m^3] or more of rock (or shale), itemize the quantity of rock excavation separately under:

Item 503 - Rock (or Shale) Excavation

When the rock (or shale) excavation is under 10 yd^3 [m^3], do not itemize the rock (or shale) excavation separately. Provide the following pay item:

Item 503 - Unclassified excavation, including rock (and/or shale)

When excavation includes no rock (or shale), provide the following pay item:

Item 503 - Unclassified excavation

In computing the quantity of Item 503 excavation, the designer should confirm that all removals under items 201, 202 or 203 have been excluded, according to CMS 503.01. Generally, the basis of payment for Item 503 should be yd^3 [m^3]. Lump sum quantities may be used if authorized by the District and with the understanding that cost may be higher than when specific quantities are used.

605.5 PROPRIETARY RETAINING WALLS

[605.5-1] Note Retired – See Appendix

For projects with proprietary retaining wall systems supporting bridge abutments on pile foundations, provide the following note:

[605.5-2] PROPRIETARY RETAINING WALL DATA:

The proprietary wall supplier shall design the internal stability of a mechanically stabilized earth (MSE) wall in accordance with SS840 to support the abutment. The design for internal stability shall include a nominal (i.e. unfactored) horizontal strip load due to friction (FR) from the superstructure of _____ k/ft applied perpendicular to the face of wall at the base of the concrete footing. This

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 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.

[606.5-1] ITEM SPECIAL - PILE ENCASEMENT

Encase all steel H-piles for the capped pile piers in Class QC1 concrete. Provide a concrete slump between 6 to 8 inches with the use of a superplasticizer. Place the concrete wit hin a form that consists of polyethylene pipe (707.33), or PVC pipe (707.42). The encasement shall extend from 3 feet below the finished ground surface up to the concrete pier cap. Position the pipe so that at least 3 inches 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. 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 bottom of the encasement to the bottom of the pier cap. The Department will not pay for galvanizing provided beyond the project requirements. The Department will pay for accepted quantities at the contract price for Item - Special, Pile Encasement.

606.6 SPREAD FOOTING FOUNDATIONS

Provide the following note, with the blanks filled in as appropriate for each individual project, if there are abutments or piers which are supported by spread footings.

[606.6-1] FOUNDATION BEARING RESISTANCE: __(1)__ footings, as designed, produce a maximum Service Load pressure of __(2)__ kips per square foot and a maximum Strength Load pressure of __(2)__ kips per square foot. The factored bearing resistance is __(3)__ kips per square foot.

NOTE TO DESIGNER:

(1) Specify the location of the spread footing.

(2) Specify the maximum factored bearing pressures.

(3) Specify the factored bearing resistance according to *LRFD 10.6.3* and BDM Section 202.2.3.1.

When abutments or piers are supported by spread footings on soil, include the following note to require that reference monuments be constructed in each footing. The purpose of the reference monuments is to document the performance of the spread footings, both short and long term.

[606.6-2] ITEM 511, CLASS __*__ CONCRETE, __*__ , AS PER PLAN : * In addition to the requirements of Item 511*, install a reference monument at each end of each spread footing. The reference monument shall consist of a #8, or larger, epoxy coated rebar embedded at least 6" into the footing and extended vertically 4 to 6 inches above the top of the footing. Install a six inch diameter, schedule 40, plastic pipe around the reference monument. Center the pipe on the reference monument and place the pipe vertical with its top at the finished grade. The pipe shall have a removable, schedule 40, plastic cap. Permanently attach the bottom of the pipe to the top of the footing.

Establish a benchmark to determine the elevations of the reference monuments at various monitoring periods throughout the length of the construction project. The benchmark shall be the same throughout the project and shall be independent of all structures.

Record the elevation of each reference monument at each monitoring period shown in the table below.

The original completed tables will become part of the District’s project plan records. Send a copy of the completed tables to the Office of Structural Engineering.

610.6 COFFERDAMS AND EXCAVATION BRACING

Use this note when the plans include detail designs for temporary shoring.

[610.6-1] ITEM 503, COFFERDAMS AND EXCAVATION BRACING, AS PER PLAN: The design shown on the plans for temporary support of excavation is one representative design that may be used to construct the project. The Contractor may construct the design shown on the plans or prepare an alternate design to support the sides of excavations. If constructing an alternate design for temporary support of excavation, prepare and provide plans in accordance with C&MS 501.05. The Department will pay for the temporary support of excavation at the contract lump sum price for Cofferdams and Excavation Bracing. No additional payment will be made for providing an alternate design.

610.7 DECK PLACEMENT NOTES

610.7.1 FALSEWORK AND FORMS

Use the following note when web depths greater than 84 in. are specified.

[610.7.1-1] ITEM 511, CLASS QC2 CONCRETE, SUPERSTRUCTURE, AS PER PLAN *

Locate the lower contact point of the overhang falsework at least _**_ inches ± 2 in. above the top of the girder's bottom flange. The bracket contact point location requirements of C&MS 508 do not apply.

NOTE TO DESIGNER:

* Modify the pay item description to fit the specific project requirements.

** The minimum dimension for the location for the lower point of contact should be 76 in. below the bottom of the top flange. Designers should verify the acceptability of the design within the range of tolerance specified.

610.7.2 DECK PLACEMENT DESIGN ASSUMPTIONS

Use the following note on all projects requiring mechanized finishing machines to place deck concrete.

[610.7.2] DECK PLACEMENT DESIGN ASSUMPTIONS:

The following assumptions of construction means and methods were made for the analysis and design of the superstructure. The Contractor is responsible for the design of the falsework support system within these parameters and will assume responsibility for superstructure analysis for deviation from these design assumptions.

An eight wheel finishing machine with a maximum wheel load of _____ kips for a total machine load of _____ kips.

A minimum out-to-out wheel spacing at each end of the machine of 103”.

A maximum spacing of overhang falsework brackets of 48 in.

A maximum distance from the centerline of the fascia girder to the face of the safety handrail of 65”.

NOTE TO DESIGNER:

Refer to BDM Section 302.2.7.2.c for design information regarding finishing machine loads.

701.7 SEALING OF BEAM SEATS

[701.7-1] Note Retired – See Appendix

702 SUPERSTRUCTURE DETAILS

702.1 STEEL BEAM DEFLECTION AND CAMBER

For steel beam or built-up girder bridges provide a table similar to Figure 702.1-1 on a structural steel detail sheet. Tabulation is required regardless of the amount of deflection and is required for all beams or girders, if the deflection is different.

Show the deflection and camber data as described in Section 302.4.1.8. The table is to include bearing points, quarter points, center of span, splice points, and maximum 30 foot [10.0 meter] increments. Unique geometry may require an even closer spacing.

702.2 STEEL NOTCH TOUGHNESS REQUIREMENT (CHARPY V-NOTCH)

CVN material is a requirement to help assure fracture toughness of main material. Designers using this note should understand not only why CVN is specified but what is a main member. Section 302.4.1.10 helps with the definition of main members and specially highlights that crossframes of curved steel structures, because they are actual designed members carrying liveload forces, are also main members. Designers are reminded they must indicate specific pieces, members, shapes, etc. that are main members.

Place the following note on a structural steel detail sheet for bridges having main load-carrying members that must meet minimum notch toughness requirements:

[702.2-1] CVN: Where a shape or plate is designated (CVN), furnish material that meets the minimum notch toughness requirements as specified in 711.01.

702.3 HIGH STRENGTH BOLTS

For all structural steel superstructures, place the following note on the structural detail sheet:

[702.3-1] HIGH STRENGTH BOLTS shall be ____________ diameter A325 unless otherwise noted.

702.4 ELASTOMERIC BEARING LOAD PLATE

[702.4-1] Note Retired – See Appendix

702.5 BEARING REPOSITIONING

[702.5-1] Note Retired – See Appendix

702.6 CONCRETE PLACEMENT SEQUENCE NOTES

Also see section 701.5 notes.

702.6.1 CONCRETE INTERMEDIATE DIAPHRAGM FOR PRESTRESSED CONCRETE I-BEAMS

If the design plans do not reference Standard Bridge Drawing PSID-1-13, provide the following note.

[702.6.1-1] INTERMEDIATE DIAPHRAGMS: Do not place the deck concrete until all intermediate diaphragms have been properly installed. If concrete diaphragms are used, complete the installation of the intermediate diaphragms at least 48 hours before deck placement begins. Concrete shall conform to C&MS 511 with a design strength of 4.5 ksi.

702.6.2 SEMI-INTEGRAL OR INTEGRAL ABUTMENT CONCRETE PLACEMENT FOR DIAPHRAGMS

Hardened concrete end diaphragms restrain the movement and rotation of beam/girder ends that occur during deck placement. This restraint will increase stress in both the beam/girder and diaphragm. Factors that can contribute to detrimental stress increases include large structure skew and phased construction. When these factors exist, hardened diaphragms should be avoided during the deck placement. The following table provides guidelines for concrete diaphragm placement options.

S*5.9.4.2.2* *TENSION STRESSES*

Designers shall assume a severe corrosive environment to determine the tensile stress limit for components with bonded prestressing tendons in non-segmentally constructed bridges.

S*5.9.5.3* *APPROXIMATE ESTIMATE OF TIME-DEPENDENT LOSSES*

Approximate methods to determine time-dependent losses utilizing *Eq. 5.9.5.3-l* should be used for the detail design of prestressed members without post-tensioning. Values from *Table 5.9.5.3-1* may be used for preliminary design purposes only.

S*5.9.5.4* *REFINED ESTIMATES OF TIME-DEPENDENT LOSSES*

The refined estimates for time-dependent losses presented in this article may be used for detail design of prestressed members without post-tensioning.

In the absence of more precise data, for prestressed members without post-tensioning, designers may assume the following ages:

A. Age at transfer (t_i) .... 0.75 days

B. Age at deck placement (t_d) .... 45 days

C. Final age (t_f) .... 10,000 days

S*5.10.3.1.1* *CAST-IN-PLACE CONCRETE*

The maximum aggregate size permitted for structural concrete according to C&MS 499 is 1-inch. When a maximum aggregate size required for design purposes differs from C&MS 499, the Designer shall provide a plan note and specify the concrete pay item “As Per Plan”.

S*5.10.3.1.2* *PRECAST CONCRETE*

For prestressed concrete mixes, C&MS 515 allows the use of the following aggregate gradations: No. 57, 6, 67, 68, 7, 78 or 8. Unless more precise data is provided, assume the maximum aggregate size according to the No. 57 gradation shown in *Table* S*5.10.3.1.1-2*.

When a maximum aggregate size required for design purposes differs from the gradations specified in C&MS 515, the Designer shall provide a plan note and specify the prestressed concrete pay item “As Per Plan”.

S5.10.3.3.1 *PRETENSIONING STRAND*

The minimum spacing of pretensioning strand shall be 2.0 in. measured center-to-center of the strands.

S5.10.6.2 *SPIRALS*

If the ratio of axial column capacity to axial column load is 1.5 or greater at the Strength Limit States, the center-to-center spacing between spirals (i.e. pitch) shall be 4.5 in as specified in BDM Section 303.3.2.1. Otherwise, the spacing limitation in *Article 5.10.6.2* applies.

S5.10.6.3 *TIES*

Ties are also required for T-type and wall-type piers. Refer to BDM Section 303.3.2.8 for more information.

S5.11.4.3 *PARTIALLY DEBONDED STRANDS*

Refer to BDM Section 302.5.2.2.d for additional debonded strand requirements.

S5.12.3 *CONCRETE COVER*

The minimum concrete cover for reinforcing steel shall be provided according to BDM Section 301.5.7. No modification for W/C ratio shall be made.

1011 LRFD SECTION 11 – ABUTMENTS, PIERS, AND WALLS

S11.5.1 GENERAL

The design life for MSE walls shall be 100 years.

S11.6.1.3 INTEGRAL ABUTMENTS

The maximum structure length for integral abutments shall be in accordance with BDM Section 205.8.

S11.6.1.6 EXPANSION AND CONTRACTION JOINTS

BDM Section 303.2.5 does not require contraction joints in abutments.

S11.7.2.2 COLLISION WALLS

Refer to BDM Section 209.8 for more information.

S11.10 MECHANICALLY STABILIZED EARTH WALLS

Refer to BDM Sections 204.6 and 303.5 for more information.

S11.10.2.1 MINIMUM LENGTH OF SOIL REINFORCEMENT

BDM Section 204.6.2.1 further defines the minimum length of soil reinforcement as the larger of: 70% of the wall height or 8′-0″. The reinforcement length shall be uniform for the entire height of the wall facing.

S11.10.2.2 MINIMUM FRONT FACE EMBEDMENT

The minimum depth shall be as defined in BDM Section 204.6.2.1. *Table C11.10.2.2-1* does not apply.

S11.10.8 DRAINAGE

Impervious membranes shall not be used.

S11.10.11 MSE ABUTMENTS

The minimum distances from facing panels to abutments and footings do not apply. Refer to BDM Section 204.6.2.1 for more information.

Refer to BDM Sections 204.4 and 204.6.2.1 for additional information.

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

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.

ARN-12 RETIRED NOTE 605.5-1

For projects with proprietary retaining wall systems supporting bridge abutments on spread footings, provide the following note and table:

[605.5-1] PROPRIETARY RETAINING WALL DATA:

The proprietary wall supplier shall design the internal stability of a mechanically stabilized earth (MSE) wall in accordance with SS840 to support loads from the abutment provided in the table below. All loads in the table are nominal (i.e. unfactored) applied to the reinforced soil mass at the base of the concrete footing. The loads in the table do not include earth pressure loads from the abutment backfill. However, the proprietary wall supplier shall include earth pressure loads from the abutment backfill in the design calculations. Refer to AASHTO LRFD Bridge Design Specifications, Section 3, for load definitions.

Wall Location	DC (k/ft)	DW (k/ft)	LL (k/ft)	PL (k/ft)	FR (k/ft)
#1					
#2					
#3					

HISTORY: Note **[605.5-1]** was retired because spread footings were no longer permitted to be used for MSE wall supported abutments.

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