OHIO DEPARTMENT OF TRANSPORTATION

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

October 19, 2007

To: Users of the Bridge Design Manual

From: Tim Keller, Administrator, Office of Structural Engineering

By: Sean Meddles, Bridge Standards Engineer

Re: 2007 Fourth Quarter Revisions

Revisions have been made to the ODOT Bridge Design Manual, January 2004. This package contains the revised pages. The revised pages have been designed to replace the corresponding pages in the book and are numbered accordingly. Revisions, additions, and deletions are marked in the revised pages by the use of one vertical line in the right margin. The header of the revised pages is dated accordingly.

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

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

The January 2004 edition of the Bridge Design Manual may be downloaded at no cost using the following link: http://www.dot.state.oh.us/se/BDM/BDM2004/bdm2004.htm

Attached is a brief description of each revision.

Summary of Revisions to the January 2004 ODOT BDM

BDM Section	Affected Pages	Revision Description
105	1-14	This revision adds the location of non-standard approach slab details to the list for bridge plan sheet order.
201.2.2	2-3	This revision emphasizes the need to label the roadway width to provide consistency and clarity for review, inventory and rating purposes.
201.2.7	2-8	This revision corrects an improper reference attributed to the L&D Manual in lieu of the Traffic Engineering Manual.
202.2.3.2.a	2-13	This revision increases the maximum allowable design loads for H-piles driven to refusal to take advantage of the Grade 50 steel.
203.1	2-17	This revision introduces StreamStats, an on-line resource for determining unregulated stream statistics and basin characteristics, which replaces USGS Report 89-4126.
203.4	2-21 through 2-22	This new section addresses the various stake holder responsibilities in the bridge and waterway permit process.
204.6.2.1	2-25 through 2-28	The first revision, item B, has been made to clarify the determination of an MSE wall strap length. The second revision, item K, has been made to improve compaction effort between piles and pile sleeves in MSE wall supported abutments.
209.5	2-40 through 2-40.2	This revision provides additional information required for approach slabs located in vertical curves or superelevated sections.
209.13	2-44	This new section address research findings for fatigue damage to overhead sign supports attached to bridges. The new section also addresses sign supports attached to the fascia of overpass bridges.
302.1.3.1	3-11 through 3-11.2	This revision provides a resource for determining the estimated quantity of tack coat.
302.1.4.3	3-13 through 3-13.2	The revision provides information for when to consider the use of graffiti protection sealers.
302.4.2.3	3-30	A section that required slotted holes in cross frame members and final member connections after completion of the deck placement to accommodate differential deflection was removed. In order to reduce the potential for unanticipated girder deflection during deck placement, all cross frames and lateral bracing shall be permanently fastened before deck placement begins.
302.5.1.3	3-40	This revision clarifies the layout of the composite deck slab reinforcement for prestressed box beams.

BDM Section	Affected Pages	Revision Description
303.1.1	3-52 through 3-52.2	The revision provides information for when to consider the use of graffiti protection sealers.
303.4.2.4	3-72	This revision increases the maximum allowable design loads for H-piles driven to refusal to take advantage of the Grade 50 steel.
Fig. 329		The print quality for the July 2006 revision of this figure was poor. This figure has only been re-printed to improve the print quality. No revisions have been made.
Fig. 330		This figure has been revised to reflect design and detailing changes now required for MSE walls. Revisions include: lengthening approach slab; quantity pay limits; 3 ft. layer of Item 304 in select granular fill zone; material above select granular fill; material used for undercut replacement; placement of geotextile fabric beneath wall; and sample location for undercut sheeting and bracing.
Fig. 331		This figure has been revised to reflect design and detailing changes now required for MSE walls. Revisions include: lengthening approach slab; quantity pay limits; 3 ft. layer of Item 304 in select granular fill zone; material above select granular fill; material used for wall foundation; and placement of geotextile fabric beneath wall.
Fig. 332		The print quality for the July 2006 revision of this figure was poor. This figure has only been re-printed to improve the print quality. No revisions have been made.
Fig. 333		This figure has been revised to reflect design and detailing changes now required for MSE walls. Revisions include: 3 ft. layer of Item 304 in select granular fill zone; material used for undercut replacement; and placement of geotextile fabric beneath wall.
403.3	4-7	This revision update a reference to the C&MS.
602.6	6-9 through 6-9.2	This new section provides plan notes for graffiti protection sealers.
605.5	6-16	This revision updates the MSE wall note to include reference to SS840 in lieu of the former Special Provisions.
606.3	6-19 through 6-20	This revision updates the contact information for suppliers of steel points for H-piles.
606.4	6-20 through 6-20.2	This new section has been added to provide contractors with an alternative to full penetration welds for H-pile splices.
610.7	6-29	This revision adds concrete sealers and curing compounds to the list of items to be removed during surface preparation for concrete parapet refacing.

BDM Section	Affected Pages	Revision Description
611.9	6-33 through 6-34	This new section addresses construction submittal requirements for shoring designs provided in the plans.
702.14	7-11	Note [81] has been retired. In order to reduce the potential for unanticipated girder deflection during deck placement, all cross frames and lateral bracing shall be permanently fastened before deck placement begins.
904.3.2.2	9-3	Bullet (A) was revised from “actual thickness” to “actual dimensions” for better definition of the information requirements.
904.5	9-4	The preparation requirements were changed. The Department now requires a rater and a checker. The rater should be a graduate engineer, but does not need to be registered. The checker shall be an engineer and shall seal the load rating report. The content of load rating report has been more clearly defined.
905.2	9-5	The Department will now require pre-approval for use of software other than AASHTO BARS-PC. Web addresses have been updated for listed software. LARSA 4D has been added as an approved finite element software. SAP 90 and STAAD III/Pro were removed from the approved list. This change reflects software availability within the Department.
905.4.1	9-6 through 9-6.2	This revision clarifies the application of the monolithic wearing surface for rating.
905.5.1	9-8	This revision clarifies the application of the monolithic wearing surface for rating.
905.6.1	9-11	This revision clarifies the application of the monolithic wearing surface for rating.
907	9-12	This revision changes the traffic lane definition for rating. Previously, ODOT allowed the number of lanes for rating to represent the actual marked lanes.
909.3	9-14	Input for single lane distribution factors is no longer required for rating purposes.
909.4	9-15	The content of load rating report has been more clearly defined.
910.3	9-17	The content of load rating report has been more clearly defined.
911	9-18	A new reference has been included.
AN-10	Appendix 95 through Appendix 96	Several references were updated for the HPS70W plan note.
ARN-26	Appendix 109.14 through Appendix 110	Retired note [81] has been added to the Appendix repository.

103.1 GEOMETRIC PROGRAMS

A. COGO - Coordinate Geometry (MF)
B. GEOPAK COGO - Roadway Design Software (PC)

103.2 DESIGN PROGRAMS

A. GAD - Girder Automated Design (MF)
B. BDS - Bridge Design Systems (MF) & (PC)
C. BRASS - Bridge Rating and Analysis of Structural Systems (MF) & (PC)
D. BOXCAR - Box Culvert Structural Analysis (PC)
E. MERLIN DASH - Beam and Girder Analysis and Design (PC)
F. DESCUS I - Curved Girder (PC)
G. CONSPAN – Prestressed Concrete Beams (PC)
H. PCA COLUMN - concrete column design (PC)
I. SIMON SYSTEMS (PC)
J. RISA3D - Structural Analysis (PC)
K. VANCK - curved steel bridge structures (PC)
L. RC-PIER - Concrete Substructure Analysis and Design (PC)
M. OPIS - Beam and Girder Analysis and Design (PC)
N. PSBEAM – Prestressed Concrete Beams (PC)

103.3 HYDRAULIC ENGINEERING PROGRAMS

A. HEC-2 or HEC-RAS - Computations of Water Surface Profiles in Open Channels (PC)
B. HY7 - (WSPRO) Water Surface Profiles (PC)
C. HY8 - Culvert Hydraulics (PC)
D. HEC-12 - Pavement Drainage (PC)
E. HYDRA V3.2 (PC)
    1. Universal Culvert
    2. Special Culvert
    3. Long Span Culvert
    4. Storm Sewer Design
    5. Inlet Spacing
    6. Ditch Analysis

103.4 GEOTECHNICAL ENGINEERING PROGRAMS

A. PICAP - Pile Capacity (PC)
B. SHAFT - Drilled Shafts (PC)
C. COM624P - Lateral Loading of Piles and Drilled Shafts (PC)
D. WEAP - Wave Equation Analysis of Pile Driving (PC)

E. STABL - Slope Stability Analysis (PC)
F. SPW911 - Sheet Pile Design and Analysis (PC)
G. Driven - Pile Capacity (PC)

103.5 BRIDGE RATING PROGRAM

Refer to Section 900 for Bridge Rating Programs.

104 OHIO REVISED CODE SUBMITTALS

The Ohio Revised Code has been changed so that Section 5543.02 no longer requires county financed bridge projects to be submitted to the Department for approval. The Code does require the Department to review and comment on the plans for conformance with State and Federal requirements if requested to do so by the County.

105 BRIDGE PLAN SHEET ORDER

A set of completed bridge plans should conform to the following order:

A. Site Plan
B. General Plan & General Notes
C. Estimated Quantities Phase Construction Details
D. Abutments
E. Piers
F. Superstructure
G. Railing Details
H. Expansion device details
I. Non-standard approach slab details
J. Reinforcing Steel List

The General Plan sheet no longer requires an elevation view. The General Plan sheet is only required for:

A. Deck overlay projects
B. Deck replacement projects where the bridge deck is variable width or curved.
C. New bridge of variable width or curved alignment.
D. New or rehabilitated structure requiring staged construction

If no General Plan sheet is furnished, the bridge plans may require a line diagram to show stationing and bridge layout dimensions that would not be practical to show on the site plan due to the site plan's scale. Other details may be required to adequately present information needed to construct the bridge.

E. In the existing structure block, provide a brief description of existing bridge. This should include type, length of spans and how measured (c/c of bearings, f/f of abutments), roadway width (t/t of barrier, t/t of curb, or f/f of railing), skew angle, original design loading or upgraded loading, type of deck and type of substructure, date when built, Structure File Number (SFN), approach slabs and wearing surface.

F. In the proposed structure block provide a brief description of proposed bridge. This should include type, length of spans and how measured (c/c of bearings), roadway width (t/t of barrier, t/t of curb, or f/f of railing), width of sidewalks, design loading, future wearing surface loading, skew angle, wearing surface, approach slabs, alignment, superelevation or crown and latitude and longitude bridge coordinates.

G. A cross section of the proposed superstructure, including an elevation of the proposed pier type(s) if applicable.

H. The design and current average daily traffic (ADT) and the design average daily truck traffic (ADTT).

I. For each substructure unit where a bearing is to be used, the bearing condition (fixed or expansion) shall be designated in the profile view (FIX or EXP). Semi-integral substructures shall be designated as expansion (EXP) and integral shall be designated as integral (INT).

J. Horizontal and vertical clearances and their locations shall be provided for navigable waterway crossings.

K. A cross section sketch at the abutments shall be submitted to provide information to help verify bridge limits.

For all waterway crossings, Designers shall reference Supplemental Specification 832 and determine the anticipated area impacted by the potential placement of temporary construction access fills (i.e. temporary causeways or workpads) into the "Waters of the United States". "Waters of the United States" are defined by ODOT CMS 101.03 as waters that are under the jurisdiction of the Corps of Engineers and include: rivers, streams, lakes and wetlands. For rivers and streams, the jurisdiction begins below the Ordinary High Water Mark (OHWM). The OHWM is defined as the elevation on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas. Placement of fill material into the "Waters of the U.S." will require a 404 permit from the U.S Army Corps of Engineers and a 401 permit from the Ohio EPA.

To facilitate the permit process, the Preliminary Structure Site Plan shall show the OHWM and shall include quantities for: (1) the plan area representing the footprint of the temporary fill and (2) the total volume of temporary fill material placed in the waterway below OHWM. To determine these quantities, the Designer should first calculate the surface area of the waterway bounded by the proposed right-of-way lines on each side of the bridge and the OHWM on each bank. (Use existing ROW lines where no right-of-way will be purchased.)

A. If the resulting area does not exceed 1/3 acres [1350 m^2], then include the result as the quantity for (1) above and calculate the total fill volume assuming the flow line as the bottom elevation and the OHWM as the top elevation with 1.5 to 1 (Horz. to Vert.) side slopes. Refer to Figure 208 for more information.

B. If the resulting area exceeds 1/3 acres [1350 m^2], then the site plan quantities should represent a causeway from bank to bank and independent workpads for each pier located in the "Waters of the U.S.". Assume the causeway to be bounded by the flow line at the bottom and the OHWM at the top; and to be trapezoidal in shape, 20'-0" [6 m] wide at the top with 1.5 to 1 (Horz. to Vert.) side slopes. Assume the pier workpads to be bounded by the flow line at the bottom and the OHWM at the top; and to be trapezoidal in shape with at least 10'-0" [3 m] of work area on all sides of the pier with 1.5 to 1 (Horz. to Vert.) side slopes. Refer to Figures 209 for more information.

Unless environmental documentation provides specific areas where placement of temporary construction fills is prohibited, the project plans shall not include a prescribed location for causeways and work pads. Figures 208 and 209 are only to aid in the determination of temporary fill quantities. The actual location, shape and size of causeways and pier work pads may differ.

201.2.3 HYDRAULIC REPORT

The Structure Type Study shall include a Hydraulic Report that includes the following information:

A. Supplemental Site Plan showing information necessary for the determination of the waterway opening. Information shown on the Supplemental Site Plan should not be repeated on the Structure Site Plan. The following information should be include on the Supplemental Site Plan:

1. A small scale area plan showing: approximate location of all stream cross sections used for the hydraulic analysis; an accurate waterway alignment at least 500 feet [150 meters] each way from the structure; and the alignment of the proposed and present highways, taken from actual surveys. Note location of dams or other regulatory work on the waterway above the site, and the pool level, if the bridge is in a pool area above a dam.

2. A stream profile at least 500 feet [150 meters] each way from the bridge showing waterway flow line elevations and low water profile (where materially different) and high water profile if such is obtainable. If a high water profile cannot be obtained, high water elevations, with their locations marked or described, should be shown both above and below the bridge. Show high water elevations with dates and location of reading with relation to the existing structure. The source of high water data should be noted on the Supplemental Site Plan. High water data should preferably be collected from at least two locations and preferably verified by interviewing two local residents.

3. A profile along the centerline of highway so that the overflow section may be computed. This profile should extend along the approach fill to an elevation well above high water. If

analysis should include the initial construction cost and all major future rehabilitation/maintenance costs, converted to present dollars. Sufficient preliminary design must be performed for an accurate cost estimate. Cost data information may be obtained from “Summary of Contracts Awarded”. This publication is available from the Office of Contracts.

When a rehabilitation alternate involves salvaging existing concrete members, cost overruns should be anticipated and included in the cost analysis. See Section 400 of this Manual for additional rehabilitation information.

201.2.6 FOUNDATION RECOMMENDATION

The Structure Type Study shall include a Foundation Recommendation that consists of:

A. General foundation type (i.e. Drilled Shafts, Friction Piles, Bearing Piles or Spread Footings)
B. Typed boring logs
C. Laboratory test results as follows:
   1. Soil: Water content, particle size analysis, liquid limit, plastic limit
   2. Rock: RQD

For the scour evaluation, Section 203.3(D), provide D_{50} values from the particle size analysis.

When the foundation recommendation for the preferred alternative includes MSE wall supported abutments, the Designer shall provide estimates for bearing pressure and allowable bearing capacity for the in-situ material below the MSE wall and an estimate for settlement of the MSE wall. Refer to Section 204.4 for additional considerations.

When unique subsurface conditions arise, include a brief narrative in the Foundation Recommendation for justification to obtain extra soils borings.

201.2.7 PRELIMINARY MAINTENANCE OF TRAFFIC PLAN

The various components of the bridge stage construction shall match those of the approach roadway, and the nomenclature used to identify the various stages (phases) of construction shall be the same for the roadway and the bridge (Stage 1 and Stage 2 or Phase 1 and Phase 2).

The Preliminary Maintenance of Traffic Plan shall include a transverse section(s) defining all stages of removal and construction. The following information should be provided:

A. The existing superstructure and substructure layout with overall dimensions (field verified) and color photographs.

B. Type of temporary railing or barrier.

C. Proposed temporary lane widths, measured as the clear distance between temporary barriers, shall be shown. A temporary single lane width of 11'-0" [3350 mm] or greater is preferred; 10'-0" [3000 mm] is the minimum allowable. Minimum preferred lateral clearance from edge of lane to barrier is 1'-6" [500 mm] (ODOT's Traffic Engineering Manual Section 640-2) but Section 605-11.2 of the Traffic Engineering Manual, allows this lateral distance to be amended for specific sites and conditions. The designer should ensure that lane and lateral clearance requirements are evaluated versus effects of phased construction on a bridge structure.

D. Location of cut lines. The existing structure should be evaluated to determine where the cut-line can be made to provide structural adequacy. Cut lines through stone substructures should be carefully evaluated to maintain structural integrity through staged removals. Temporary shoring may be required and should be considered.

E. Temporary modifications to superelevated sections (existing and/or proposed) on the deck and/or shoulder in order to accommodate the traffic from the phase construction.

F. Width of closure pour. When determining the closure pour width (see Section 300 of this Manual), the designer should investigate the economics of using the lap splices versus using mechanical connectors. Any necessary structure modifications should be included in the cost estimate. Lap splices are preferred and recommended. A reduced closure width may cause transition problems in the finishing of the bridge deck surface when bringing the various phases of construction together.

G. Profile grade, alignment, approximate location and width of temporary structures

H. Location of temporary shoring

201.3 UTILITIES

All utilities should be accurately located and identified on the Preliminary Structure Site Plan. A note should state whether they are to remain in place, be relocated or be removed, and for the latter two, by whom.

Utilities should not be placed on bridges whenever possible.

The type of superstructure selected for a site may be dependent upon the number of utilities supported on the bridge. The request to allow utilities on the bridge shall be made through the ODOT District Utilities Coordinator. Refer to the ODOT Utilities Manual. Utilities shall be installed in substantial ducts or enclosures adequate to protect the lines from future bridge repair and maintenance operations. Utilities shall not be placed inside of prestressed concrete box beams. For some specific detail issues with utilities on bridges refer to Section 300 of this Manual.

H Pile Size	Design Load	Ultimate Bearing Value
HP10X42	75 tons	150 tons
HP12X53	95 tons	190 tons
HP14X73	130 tons	260 tons

H Pile Size	Design Load	Ultimate Bearing Value
HP250X62	650 kN	1300 kN
HP310X79	850 kN	1700 kN
HP360X108	1150 kN	2300 kN

Ultimate Bearing load is equal to the actual unfactored design load multiplied by a safety factor of two (2). Design load values for H piles are based on a maximum service load stress of 12.5 ksi [86 MPa] for Grade 50 steel.

The actual value listed in the structure general notes should not be the Ultimate Bearing Value of the H pile size selected but the calculated Ultimate Bearing Value load of the substructure unit or units.

For the piers, other than capped pile piers, HP10X42 [HP250X62] should be used if the calculated design load is less than 75 tons [650 kN] per pile.

In order to protect the tips of the steel "H" piling, steel pile points shall be used when the piles are driven to refusal onto hard bedrock. When the depth of overburden is more than 50 feet [15 meters] and the soils are cohesive in nature, piles driven to hard bedrock generally should not have steel points. Steel points should not be used when the piles are driven to bear on shale.

For projects where steel points are to be used, include the plan note entitled "Item 507, Steel Points, As Per Plan" with the Structure General Notes (Section 600 of this Manual).

For capped pile piers with steel H piles, pile encasement is required.

202.2.3.2.b CAST-IN-PLACE REINFORCED CONCRETE PILES

For piles not driven to bear on the bedrock, cast-in-place reinforced concrete piles should be used. This type of pile achieves its design load resistance through a combination of side friction and end bearing. The commonly used pile sizes are:

Pipe Pile Diameter	Design Load	Ultimate Bearing Value
12 inch	50 tons	100 tons
14 inch	70 tons	140 tons
16 inch	90 tons	180 tons

Pipe Pile Diameter	Design Load	Ultimate Bearing Value
300 mm	450 kN	900 kN
350 mm	650 kN	1300 kN
400 mm	800 kN	1600 kN

Ultimate Bearing load is equal to the actual unfactored design load multiplied by a safety factor of two (2). The design values for pipe piles are based on a maximum allowable service load stress on the pile wall thickness of roughly 10 ksi [69 MPa] for ASTM A 252 Grade 2 steel, Fy = 35 ksi [Fy = 240 MPa].

The actual value listed in the structure general notes should not be the Ultimate Bearing Value of the Pipe pile size selected but the calculated Ultimate Bearing Value load of the substructure unit or units.

For capped-pile piers with cast-in-place piles, 16 inch [400 mm] diameter piles shall be used. 16 inch [400 mm] diameter piles with additional reinforcing steel are preferred because the need for pile encasement is eliminated. Additional reinforcing steel which consists of 8 - #6 [19M] epoxy coated reinforcing bars with #4 [13M] spiral at 12 inch [300 mm] pitch should be provided for 16 inch [400 mm] diameter piles. Reinforcing steel shall be detailed on the plans, included in the reinforcing steel list, and be paid for under Item 507, 16 Inch [400 mm] Cast-In-Place Piles Furnished, As Per Plan. The reinforcing steel cage should extend 15 feet [5 meters] below the flow line and into the pier cap. Pile encasement is not used when additional reinforcement is provided. Painting of the cast-in-place reinforced concrete pile is not required.

For capped-pile piers where the exposed length of the piles is more than 20 feet [6 meters], 18 inch [450 mm] diameter piles can be used. Consult the Office of Structural Engineering before recommending the use of 18 inch [450 mm] diameter piles.

202.2.3.2.c DOWN DRAG FORCES ON PILES

When a significant height of new embankment is constructed over a compressible layer of soil and long term settlement is anticipated, the possibility of down drag forces on the piles should be considered. The extra load that the pile receives due to the down drag force should be computed and accounted for by driving the piles to a higher design load capacity. For example, the total design load for the piles should be equal to Dead Load + Live Load + Down Drag Force. See Section 600 of this Manual for note.

D. In case a highway underpass type of separation is at all possible, the submitted information should show the line and profile of the nearest or best outlet for drainage.

E. Intersection angle between highway centerline and railroad centerline.

F. Highway stationing and railroad mile post stationing at intersection.

G. Railroad right-of-way lines.

H. Railroad pole lines, signal control boxes, communications relay houses, signal standards and drainage structures.

I. Centerlines of all tracks and location of switch points.

J. Location of buildings or other structures within the railroad right-of-way.

K. Railroad traffic counts including type of movements and speed.

L. Location of all utilities occupying railroad right-of-way and the names of the owners of these utilities.

203 BRIDGE WATERWAY

203.1 HYDROLOGY

A. Discharges shall be estimated using StreamStats, a USGS web based application for estimating stream flow statistics and basin characteristics on unregulated streams. StreamStats supersedes USGS Report 89-4126 and is available at: http://water.usgs.gov/osw/streamstats/ohio.html. Just click on the link labeled: “Interactive Map”. First-time users should familiarize themselves with the on-line StreamStats Limitations, Definitions and User Instructions.

For urban drainage areas less than 4 square miles [10.4 km^2] discharges shall be estimated by the method described in USGS Water-Resources Investigations Report 93-135, “Estimation of Peak Frequency Relations, Flood Hydrographs, and Volume-Duration-Frequency Relations of Ungaged Small Urban Streams in Ohio”.

B. Discharge estimates may be calculated by other methods for comparison with StreamStats against verified flood elevations and other known river data to ensure that the most realistic discharge for the area is used for the design of the waterway opening. Calculations and comparisons shall be submitted for review.

C. Federal Emergency Management Agency (FEMA), National Flood Insurance Program (NFIP) Flood Insurance Studies; U.S. Corps of Engineer Flood Studies; U.S. Soils Conservation Studies; U.S. Water Resources Data and other reliable sources may be used as reference information in estimating discharges and flood elevations. However, for waterway crossings located in a NFIP study area, the base discharge (Q_{100}) from the NFIP study takes precedence over all other calculated discharges.

D. Where a U.S. Geological Survey estimate is in conflict with that of another agency, the agencies should be contacted in order that the discrepancy can be resolved. In general, the U.S. Geological Survey estimate shall be given preference.

E. Proposed structures upstream or downstream from a flood control facility shall be designed for discharges as supplied by the U.S. Corps of Engineers, Ohio Department of Natural Resources or the agency responsible for the flood control facility.

203.2 HYDRAULIC ANALYSIS

A. The design flood frequency shall be based on the importance of the highway and the design average daily traffic (ADT) as follows:

1.Freeways or other multi-lane facilities with limited or controlled access .... 50 years

2.Other Highways (2000 design ADT and over) and freeway ramps............................ 25 years

3.Other Highways (under 2000 design ADT).. 10 years

B. The total backwater produced for the design flood should be calculated by WSPRO (HY-7), HEC-2, HEC-RAS or other comparable backwater calculation methods.

C. The allowable backwater depth shall generally be governed by the nature of the upstream area at the structure location and/or the induced mean velocity through the structure.

D. Local Flood Plain Coordinators will need to be contacted so they may be made aware of planned waterway crossings and proposed backwater effects. A listing of Local Flood Plain Coordinators is maintained by the Ohio Department of Natural Resources (ODNR) and may be obtained by calling (614) 265-6750 or visiting ODNR's, Division of Water website: http://www.dnr.state.oh.us/water/.

The Local Flood Plain Coordinator may require a permit for any proposed waterway crossing regardless of the drainage area size. The District Production Administrator should be contacted, by the responsible governmental agency which initiated the project, as to how they wish to coordinate the permit process. The granted permit becomes a record which is kept by ODOT, at the appropriate District office. The governmental agency will be required to make application for the permit and to secure a granted permit prior to the initiation of any detail plan preparation.

E. In areas where the topography is flat, backwater should not be permitted to flood unreasonably large areas of usable land, if possible.

F. In urban areas the waterway opening for proposed structures shall be designed so that the accordance with the requirements of Section 204.1, except in laminated bedrock such as interbedded shale and limestone, in which case drilled shaft foundations with sufficient embedment into the bedrock are preferred.

D. A scour evaluation shall be performed for all bridges not founded on scour resistant shale or bedrock. All major rehabilitation work requires a scour evaluation. The scour evaluation may simply consist of determining what the bridge is founded on. For example, on a bridge rehabilitation, noting that the bridge is founded on scour resistant bedrock or deep foundations to bedrock, would constitute the scour evaluation. As a minimum, piles shall be embedded 15 ft [4.5 m] below the streambed elevation.

   When evaluating a structure for scour, review all inspection reports for evidence of stream degradation (lowering of stream bed), scour or previous scour countermeasures. For existing footings founded on shale, test probe the shale to determine its resistance to weathering and note the relationship of the bottom of the footing to the stream bed elevation.

   When it is necessary to calculate scour depths, they are to be calculated by the equations in HEC-18 (Hydraulic Engineering Circular No. 18, Pub. No. FHWA NHI 01-001), “Evaluating Scour at Bridges”. The text of HEC-18 should be read in order to understand scour and river mechanics. The references cited in Chapter 3 of HEC-18 are also helpful in understanding the concepts of scour and river mechanics. Scour depths should be considered in the design of the substructures and the location of the bottom of footings and minimum tip elevations for piles and drilled shafts.

A value of Q500 should be used as the super flood is to be estimated by 1.3 x Q100.

203.4 BRIDGE AND WATERWAY PERMITS

Impacts to bridges or waterways may require legal authorization in the form of permits or certifications issued by various regulatory agencies, including:

A. U.S. Army Corps of Engineers .... 404 Permit and/or Section 10 Permit
B. U.S. Coast Guard .... Section 9 Bridge Permit
C. Ohio EPA .... 401 Certification and/or Isolated Wetland Permit

The designer and project manager shall coordinate with the ODOT District Environmental Coordinator and the ODOT Office of Environmental Services – Waterway Permits Unit throughout the permit determination process to ensure that the final waterway permit applications are indicative of the final project design. For more information refer to the Waterway Permits Manual available from the ODOT Office of Environmental Services.

Special Provisions are the method ODOT uses to attach the waterway permits and certifications to the project construction plans. The waterway permits Special Provisions Package (SPP) is prepared by the Office of Environmental Services – Waterway Permits Unit and may contain the following:

A. All pertinent waterway permits, certifications and related conditions
B. Drawings and/or mapping submitted with a permit application
C. Specialized plan notes associated with the waterway permits

The designer and the project manager shall confirm that the bridge design plans (e.g. the navigational clearances shown on the site plan, BDM Section 201.2.2.J; the amount of fill placed below ordinary high water, BDM Section 201.2.2; etc.) meet the requirements in the project waterway SPP (e.g. U.S. Coast Guard Section 9 Bridge Permit; U.S.A.C.E. 404 Permit; etc.) and shall ensure the project waterway SPP are submitted with the Final Plan Package.

204 SUBSTRUCTURE INFORMATION

204.1 FOOTING ELEVATIONS

Substructure footing elevations should be shown on the Final Structure Site Plan. The top of footing should be a minimum of one foot [0.3 meters] below the finished ground line. The top of footing should be at least one foot [0.3 meters] below the bottom of any adjacent drainage ditch. The bottom of footing shall not be less than four feet [1.2 meters] below and measured normal to the finished groundline.

Due to possible stream meander, pier footings for waterway crossings in the overflow section should not be higher than the footings within the stream unless the channel slopes are well protected against scour. Founding pier footings at or above the flow line elevation is strongly discouraged.

Where footings are founded on bedrock (note that undisturbed shale is bedrock) the minimum depth of the bottom of the footing below the stream bed, D, in feet [meters], shall be as computed by the following:

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D = T + 0.50Y

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

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

204.2 EARTH BENCHES AND SLOPES

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

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

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

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

204.3 ABUTMENT TYPES

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

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

204.4 ABUTMENTS SUPPORTED ON MSE WALLS

When conditions are appropriate, the designer may consider stub type abutments with piling or spread footings supported on MSE walls. Use spread footings to support the abutment if the MSE wall is on bedrock or shale. If the MSE wall is on soil, then the selection of spread footings or piles design height not more than 25 ft [7.6 m]. MSE wall types that are approved for supporting abutments on are Tricon Retained Soil, Reinforced Earth, Retained Earth, and Tensar Ares. However, the Tensar Ares wall shall be limited to pile supported abutments only. The Tensar Ares wall is limited to a maximum height of 30 ft [9.15 m] for all applications.

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 can not 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; allowable bearing pressure 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 17th Edition of the "AASHTO Standard Specifications for Highway Bridges" and the following:

A. Determine the height of the wall (h) for minimum soil reinforcement lengths as follows:

    1. When the surface of the retained soil is level, measure (h) from the top of the concrete leveling pad to the top of the concrete coping.

    2. When the surface of the retained soil is sloping, measure (h) as shown in AASHTO Figure 5.8.2B.

    3. If the wall will be located at an abutment, measure (h) from the top of the concrete leveling pad to the profile grade elevation at the face of the wall.

B. Determine the minimum soil reinforcement length to meet external stability requirements (sliding, bearing resistance, overturning, overall global stability). However, the minimum soil reinforcement length shall not be less than 70% of the wall height (h) or 8'-0" [2.5 m], whichever is greater. Generally, the soil reinforcement length should not be greater than 150% of the wall height (h).

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 202 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. The following factors of safety shall apply:

Factor of Safety	
Sliding	> 1.5
Overturning	> 2.0
Bearing Capacity	>2.5
Overall Stability	>1.5 (for walls supporting spread footing abutments)
	>1.30 (for all other walls)

G. 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]	34°	0
Retained Soil	On-site soil varying from sandy lean clay to silty sand	120 lb/ft^3 [18.9 kN/m^3]	30°	0

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

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

I. 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.

J. For MSE walls supporting abutments on spread footings, the minimum distance between the back face of the MSE wall panels and the toe of the bridge abutment footing shall be 3’-0” [915 mm] and the minimum distance between the back face of the MSE wall panels and the centerline of the abutment bearings shall be 5’-0” [1525 mm].

K. 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.

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

M. The maximum allowable bearing pressure for a spread footing abutment placed on an MSE wall embankment shall be 4 ksf [190 kPa].

N. 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 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.

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 on the basis of economy as well as appearance. For special conditions where other types of super-structures may be considered, consult the Office of Structural Engineering for recommendations prior to initiating the design.

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205.2 SPAN ARRANGEMENTS

The length of a bridge will be determined by the requirements for horizontal clearance at grade (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 sub-structure 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.

Standard bridge drawings are available for the design of single span and three span continuous concrete slabs. The Standard Bridge Drawing for single span concrete slab bridges is SB-1-03. The spans range from 11 to 38 feet [3350 to 11 580 mm] with a maximum skew angle of 30 degrees. The Standard Bridge Drawing for three span continuous concrete slabs is CS-1-03. The spans range from 14’ - 17.5’ - 14’ [4260 mm - 5334 mm - 4260 mm] to 46’ - 57.5’ - 46’ [14 020 mm - 17 530 mm - 14 020 mm] with a maximum skew angle of 30 degrees. The drawings are based on a 60 lb/ft^2 future wearing surface and a live load of an HS25 truck and the alternate military vehicle. The edge beam is designed to support live load according to AASHTO 3.24.8 and the weight of the 42” BR-1 deflector parapet.

placed on each side of the flume. On grade separation structures with 2:1 approach embankment slopes and where the pavement flow from the deck exceeds 0.75 ft^3/s [0.021 m^3/s], an integral curb shall be provided on the approach slab with a standard catch basin located off the approach slab in lieu of the sodded flume. At the trailing end of bridge barriers, a bridge terminal assembly is required to protect this curb. The catch basin should be a Catch Basin No. 3A, as shown on Standard Construction Drawing CB-2.2. A properly sized conduit (Type F, 707.05 Type C) shall be used to provide an outlet down the embankment slope and the outlet shall be armored to prevent erosion.

Control of drainage is especially critical at abutments with MSE walls. On structures with MSE walls at the abutments, a barrier shall be provided on the approach slab with a standard catch basin to collect the drainage. Where possible, the catch basin shall be located at least 25 ft [7.6 m] beyond the limits of the MSE wall soil reinforcement. Continue the barrier 10 ft [3.0 m] past the catch basin. Use the same type of catch basin and conduit as described above.

For bridges that have deck joints consisting of finger joints or sliding plates with a trough collector system scuppers should be considered near the joint to minimize the amount of deck drainage flow across the joint.

For bridges that have over the side drainage a stainless steel drip strip should be provided to protect the deck edge and beam fascia from the deck surface run-off.

209.4 SLOPE PROTECTION

For structures of the spill-thru type where pedestrian traffic adjacent to the toe of the slope is anticipated or the structure is located in an urban area within an incorporated city limit, the slope under the structure shall be paved with Concrete slope protection, CMS 601.07. Consideration of slope protection should be given to all areas under freeway bridges over city streets not covered by pavement or sidewalk. Drainage discharge from the bridge should be checked to ensure that discharge is not crossing sidewalks, etc. so that ice, dirt and debris build-ups are prevented.

On spill-thru slopes under grade separation structures, areas that are not protected by concrete slope protection, shall be protected by crushed aggregate material as provided in CMS 601.06.

The slope protection, either concrete or rock, shall extend from the face of the abutment down to the toe of the slope and shall extend in width to 3 feet [1 meter] beyond the outer edges of the superstructure, except that at the acute corners of a skewed bridge the outside edge of the slope protection shall intersect the actual or projected face of the abutment 3 feet [1 meter] beyond the outer edge of the superstructure and shall extend down the slope, normal to the face of the abutment, to the toe of the slope. The base of the slope protection shall be toed in. Note that the natural vegetation on the slopes when shaded by a new structure will die out. For this case additional slope protection should be considered.

209.5 APPROACH SLABS

Approach slabs should be used for all ODOT bridges. Determine the length of the approach slab using the following formula:

$L = [1.5(H + h + 1.5)]$) Cos θ # 30 ft
$L = [1.5(H + h + 0.45)]$) Cos θ # 9.15 m

Where:

Where:	L	=	Length of the approach slab measured along the centerline of the roadway rounded up to the nearest 5 ft [1.5 m]
	H	=	Height of the embankment measured from the bottom of the footing to the bottom of the approach slab (ft) [m]
	h	=	Width of the footing heel (ft) [m]
	θ	=	Skew angle

For four lane divided highways on new embankment, the minimum approach slab length shall be 25 ft [7.6 m] (measured along the roadway centerline). For structures with MSE walls at the abutments, the minimum approach slab length shall be 30 ft [9.1 m]. For all other structures the minimum length shall be 15 ft [4.6 m]. Refer to the approach slab standard bridge drawing for details.

Provide detail drawings for approach slabs which differ from the standard approach slabs. Examples include approach slabs that are a non-standard length, tapered, have a non-uniform width, or other such variation. When an approach slab falls within the limits of a vertical curve 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.

On structure rehabilitation plans, 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

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.

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measured
from centerline of tracks, and 22’-0” [6.7 meters] vertical, measured six feet [1.8 meters] from centerline of tracks, wherever possible.

209.9 BICYCLE BRIDGES

Reference should be made to ODOT’s most current design guidelines and Section 300 of this Manual. The current design guidelines can be obtained from ODOT’s Office of Local Projects, (614)644-7095. For new structures generally the minimum bridge width should be the same as the width of the paved bicycle path and approach shoulders. A minimum transverse slope of 1/4 inch per foot [0.021] sloped in one direction should generally be used. Bicycle railings should be a minimum of 4’-6” [1370 mm] high. A smooth rub rail should be provided at a height of 3’-6” [1065 mm]. For the design of the railing refer to AASHTO Section 2.7.2. If an occasional maintenance vehicle is going to use the bridge, the railing should only be designed as a bicycle railing. The type of bridge deck joints used should be bicycle safe.

If a timber deck is used, a 1½ inch [38 mm] minimum thickness of Item 448, Asphalt Concrete Surface Course, Type 1, PG64-22, shall be applied in order to provide an abrasive skid resistant surface. Consult the Office of Structural Engineering for recommendations before specifying other alternative surfaces.

209.10 PEDESTRIAN BRIDGES

Pedestrian facilities shall meet the grade and cross slope requirements specified in Volume One, Section 306.2.5 of the ODOT Location & Design Manual. For pedestrian bridges over highways an additional one foot [300 mm] of vertical clearance shall be provided. The current AASHTO design guide for pedestrian bridges should be followed.

If a timber deck is used, a 1½ inch [38 mm] minimum thickness of Item 448, Asphalt Concrete Surface Course, Type 1, PG64-22, shall be applied in order to provide an abrasive skid resistant surface. Other alternative surfaces may be used if approved by the Department.

209.11 SIDEWALKS ON BRIDGES

Sidewalks should be provided where significant pedestrian traffic is anticipated and/or the approach roadway has sidewalks or requires provisions for future sidewalks. Refer to Volume One, Section 306.4 of the ODOT Location & Design Manual for specific pedestrian traffic requirements. The width of the bridge sidewalk is generally the width of the approach sidewalk plus 12 inches [300 mm], with the widths typically between 5 and 6 feet [1500 and 1800 mm] wide.

An 1/4 inch per foot [0.02] cross slope should be provided to drain the sidewalk towards the curbline. The sidewalk height shall be 8 inches [203 mm] on the bridge, tapering down to the approach curb height within the length of the approach slab.

A detail of the standard curb (height, face slope, and corner rounding) should be given. Refer to Section 300 of this Manual for vandal protection fencing requirements.

209.12 MAINTENANCE AND INSPECTION ACCESS

Maintenance and inspection access requirements should be included in the Structure Type Study, Narrative of Bridge Alternatives. For multiple span bridges with 8 feet [2400 mm] or deeper girders, an inspection handrail located on the girders should be provided. Also catwalks should be considered. Safety cables and other fall arrest systems should be considered in addition to handrails and catwalks. Provisions for maintenance and inspection access should be provided for fracture critical girders, cross girders and bents that cannot be inspected from a snooper. The use of fracture critical members is strongly discouraged. For these types of structures, consult the Office of Structural Engineering for details and recommendations. Additional information is provided in "FHWA Guidelines for Providing Access to Bridges for Inspections", dated November 1985.

209.13 SIGN SUPPORTS

Research has shown that overhead sign supports located on bridges are highly susceptible to fatigue damage. Every effort shall be made to locate overhead sign supports off of bridge structures. When this is not possible, only two locations on the structure are acceptable and are listed below in order of preference:

A. Mounted directly to the substructure unit.

B. Mounted to the superstructure directly over a substructure unit.

Sign supports attached to the fascia of overpass bridges, as shown on Standard Construction Drawings TC-18.24 and TC-18.26, should also be avoided. Consult with the District Bridge Engineer before specifying their use.

wearing surface shall be composed as follows:

1. 1½ inches [38 mm] of Item 448 Asphalt Concrete Surface Course, Type 1H.

2. 1½ inches [38 mm] minimum thickness of Item 448 Asphalt Concrete Intermediate Course, Type 2, PG64-28.

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

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

302.1.3.2 FUTURE WEARING SURFACE

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

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

302.1.4 CONCRETE DECK PROTECTION

302.1.4.1 TYPES

A. Epoxy Coated Reinforcing Steel - CMS 709.00

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

C. Class S Concrete

D. Class HP Concrete

E. Drip Strips

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

G. Asphaltic concrete wearing surface

302.1.4.2 WHEN TO USE

All reinforcing steel shall be epoxy coated.

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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 310 & 311)

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

The exterior 9 inch [230 mm] width on the top of the deck, 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:

A 9 inch [230 mm] width of the roadway along the curbline; 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:

A 9 inch [230 mm] width of the roadway along the face of parapet; 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 exterior 9 inch [230 mm] width on the top of the deck; 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:

A 9 inch [230 mm] width of the roadway along the curbline; 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:

A 9 inch [230 mm] width of the roadway along the face of parapet; 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.

Concrete surfaces that include patches should be sealed with an epoxy-urethane sealer so the concrete color will remain uniform.

The designer should include in the plans actual details showing the position, location and area required to be sealed. A plan note should not be used to describe the location 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 may also use a bid item for sealer, with no preference, and allow the contractor to choose based on cost.

Due to poor performance, epoxy-only sealers shall not be used.

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.

302.2 REINFORCED CONCRETE DECK ON STRINGERS

302.2.1 DECK THICKNESS

Bridge deck concrete thickness shall meet the requirements of AASHTO, this Manual and Standards.

For reinforced concrete decks on steel or concrete stringers the deck thickness shall be computed by the following formula:

Tmin (inches) = (S + 17)(12) ÷ 36 $ 8½0

Tmin (mm) = (S + 5200) ÷ 36 $ 215 mm

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Where S is the effective span length in feet [millimeters]. Tmin shall be rounded up to the nearest one-quarter inch [5 mm].

The one inch [25 mm] wearing thickness, Section 302.1.3.1, is included in the calculations for minimum concrete deck thickness but not in the calculations during actual structural design of the deck slab.

For transversely reinforced concrete deck slabs supported on steel stringers the effective span length "S" shall be considered equal to the distance center-to-center of stringers minus 6 inches [150 mm].

For concrete I-beam stringers the effective span length shall meet the requirements of AASHTO 3.24.1.2.

302.2.2 CONCRETE DECK DESIGN

The concrete deck design shall be in conformance with AASHTO, latest edition, and additional requirements in this Manual. The design live load shall be HS25 for decks on new superstructures and HS20 for decks on existing superstructures.

For continuous slabs on three or more supports a continuity factor of 0.80 shall be applied to the simple span bending moments for both live load and dead load.

See Figures 312 & 313 for an illustration of a method of design for a reinforced concrete deck slab. Design data tables for HS25 (Fig. 314A) and HS20-44 (Fig. 314B) live loads are also provided.

Upon completing the concrete deck design from the example shown in Figure 312 & 313, or similar method, the designer should assure any cantilevered deck overhang will not over stress the initial deck design due to the dead load and the greater live load of either the vehicle wheel loads or the railing live loads. See relevant AASHTO sections for live load application requirements. See example Figures 315 & 316.

Transverse spacing of the top and bottom reinforcing in a deck design shall meet section 302.2.4.2.

302.2.3 SCREED ELEVATIONS

Screed elevations shall be furnished to ensure that the bridge deck, including the gutters or deck edges, is completed at its correct elevation.

The bridge plans shall include a diagram or table showing the elevations at the top of the concrete deck that are required before the concrete is placed. Elevations should be shown for all

Stiffener plates shall have corners in contact with both web and flange clipped. The clip dimensions shall be one inch [25 mm] horizontally and 2½ inches [65 mm] vertically. Dimensions are shown on the Standard Bridge Drawing.

Both sides of the stiffener shall be fillet welded to the beam web and both flanges.

302.4.2.3 INTERMEDIATE CROSS FRAMES

For structures with the stringers placed on tangent alignments, detail cross frames as follows:

A. Cross frames for rolled beams shall be connected directly to the web or to intermediate web stiffeners.

B. Cross frames shall be perpendicular to stringers and be in line across the total width of the structure.

C. Cross frame spacings between points of dead load contraflexure in the positive moment regions shall not exceed 25 ft [7.6 m].

D. Cross frame spacings between points of dead load contraflexure in the negative moment regions shall not exceed 15 ft [4.6 m].

E. Horizontal legs of cross frame angles shall align on both sides of the stringer.

F. The AASHTO 10.20.1 requirement for cross frames at each support should be waived.

See the General Steel Details Standard Bridge Drawing for standard cross frame configurations.

For structures with flared stringers, the following exceptions apply:

A. If the differential angle between individual stringers is 5 degrees or less, the cross frames shall be perpendicular to one stringer and in line across the total width of the structure.

B. If the differential angle between individual stringers is greater than 5 degrees, the differential angle shall be divided evenly between connections to both stringers.

The design plans shall show:

A. The maximum cross frame spacing for each region along the length of the stringer. Actual spacing of the cross frames should be left to the steel fabricator's detailer .

B. The typical cross frame details or reference to the General Steel Details Standard Bridge Drawing for standard cross frame configurations. If a design requires a specific location of cross frames, clearly show the cross frame locations that cannot be adjusted.

A detail showing a completely bolted connection for cross frame to the steel member is shown in the Standard Bridge Drawing.

Holes for erection bolts are normally provided in the connection of cross frames to stiffeners. Refer to the Standard Bridge Drawing for details.

In phased construction of new steel structures cross frames should not be permanently attached between phases until all deadload (deck, parapet, etc.) has been applied to the members. The crossframes can then be permanently attached and a deck closure pour can be completed to finish the superstructure. See Section 302.2.9.

For curved or flared bridges with "dog-legged" stringers, cross frames should be placed near the bend points. The cross frames should be located approximately 1 foot [300 mm] from the bend point but not interfere with the splice material. The cross frame should be placed normal to the stringer used to set the 1 foot [300 mm] clearance dimension and should be connected to the adjacent stringer only on the same side of the centerline of the splice. The cross frame units should be similar to standard cross frames but should have an additional horizontal angle near the top flange of the stringers.

See Figure 319 for plan view layout of cross frames for dog-legged stringers.

Cross frames for curved stringers may be one of the types shown on the Standard Bridge Drawing with an additional top strut. The designer shall confirm that the standard cross frames and their connections meet the additional loading developed in a curved member design. Since cross frame components in a curved structure share the live loading, Charpy V-notch (CVN) testing shall be specified. If specially designed cross frames are used, they should be bolted to stiffeners with oversized holes. The designer shall recognize the reduction in allowable capacity associated with oversized holes. If the capacity reduction is too much to allow for oversized holes and standard holes are required, the designer shall denote on the plans that shop assembly of the specially designed cross frames and adjacent curved member is required.

Both doglegged stringer cross frames at the dogleg or curved stringer cross frames shall be connected to the main member by use of welded stiffeners.

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.

> Low-relaxation 12.7 mm diameter (A_S = 99 mm^2) seven wire uncoated strands, ASTM A416M, Grade 270.

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

> Low-relaxation 12.7 mm diameter (A_S = 108 mm^2) seven wire uncoated strands, ASTM A416M, Grade 270.

C. Low-relaxation 0.6 inch diameter (A_S = 0.217 in^2) seven wire uncoated strands, ASTM A416, Grade 270.

> Low-relaxation 15.24 mm diameter (A_S = 140 mm^2) seven wire uncoated strands, ASTM A416M, Grade 270.

Consult the Office of Structural Engineering and the Ohio/Indiana/Kentucky Prestressed Concrete Institute prior to specifying 0.6 inch [15.244 mm] diameter or larger strand sizes.

302.5.1.2.b SPACING

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

The location of the centerline of the first row of strands shall be 2 inches [50 mm] from the bottom of the beam. If possible, all strands shall be completely enclosed by the #4 [#13M] stirrup bars. For designs that cannot meet this requirement, the minimum distance from the side of the beam to the centerline of the first strand shall be 2 inches [50 mm]. 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 [1400 MPa]
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 ($A_S = 108\ mm^2$)

The estimated stress in the prestressing tendon immediately after transfer shall be $0.69\ f'_s$ = 186,300 psi [1285 Mpa] for loss calculation purposes.

Total losses shall be calculated with 70% relative humidity (RH) and a modulus of elasticity of prestensioning reinforcement (E_S) equal to 28,500 ksi [196 500 Mpa]. Total losses may be expressed by:

$$F_S = SH + ES + CR_C + CR_S$$
$$F_S = 11{,}175 + [25{,}650/E_{ci} + 11.4]f_{cir} - 6.65\ f_{cds}$$
$$F_S = 77.0 + [176\ 850/E_{ci} + 11.4]f_{cir} - 6.65\ f_{cds}$$

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 AASHTO 8.24.3.3. The pier bars should be placed longitudinally and approximately centered on the pier but with a 3 foot [1000 mm] stagger.

303 SUBSTRUCTURE

303.1 GENERAL

If a pier column, wall or other structural member is located in the sloped portion of an embankment, the design active earth pressure shall be applied to an effective width (S) of the member as defined in the following table. The effective width accounts for the earth pressure due to the embankment directly in back of the member and the earth pressure due to the adjacent embankment on each side.

Type of Member		S
Single Column or Wall		a + H
Interior Columns	c $ H	a + H
	c < H	$a+H-(H-c)^2/H$
Exterior Columns	c $ H	a + H
	c < H	$a+H-(H-c)^2/2H$

Where: c = One-half of the distance between adjacent members measured face to face.
H = Height of the active earth fill measured at the face of the footing.
a = Width of the member.

The minimum design earth pressure shall be 40 psf [2.0 kPa] unless granular backfill is provided.

303.1.1 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 <u>before</u> 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 321, 322 & 323.

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 front face 1/16" for each foot [5 mm for each 1000 mm] of abutment height. Height is measured from bottom of footing to the roadway surface.

303.2.1.1 PRESSURE RELIEF JOINTS FOR RIGID PAVEMENT

If rigid concrete pavement or base is to be used adjacent to the structure, the designer shall confirm that the roadway plans require installation of type A pressure relief joints, as per Standard Construction Drawing BP-2.3.

Pressure relief joints are required to alleviate backwall pressures on abutments with expansion devices and to allow freedom of movement for integral and semi-integral abutments.

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Include in the table of Estimated Quantities.

303.4.2.2 PILES, NUMBER & SPACING

The designer shall comply with the following maximum center-to-center spacing of piles:

A. In capped pile piers, 7.5 feet [2300 mm].

B. In capped pile abutments, 8 feet [2500 mm].

C. In stub abutments, front row, 8 feet [2500 mm].

D. In wall type abutments and retaining walls, front row, 7 feet [2100 mm].

E. Cap and column piers should have at least 4 piles per individual footing.

303.4.2.3 PILES BATTERED

The path of battered piles should be checked to see that the piles remain within the right-of-way and do not interfere with piles from adjacent and existing substructure units nor conflict with portions of staged construction.

In general, a batter of 1:4 is considered desirable, but in cases where sufficient resistance is not otherwise attainable, a batter of 1:3 may be specified.

Piles should be battered to resist the stream forces. Battered piles also should be provided where necessary to avoid settlement due to group action by increasing the periphery of the soil mass.

Abutment piles should be battered normal to the centerline of bearings.

Piles fewer than 15 feet [5 meters] in length should not be battered.

When friction battered piles are specified, include note **[30d]** from Section 600 in the plans.

303.4.2.4 PILES, DESIGN LOADS

The pile's Ultimate Bearing Value, based on calculation of dead and live load transferred to the piles shall be given in the structure General Notes.

Ultimate Bearing Value load is equal to the actual unfactored design load multiplied by a safety factor of two (2).

The largest of these calculated individual pile Ultimate Bearing Value loads for each substructure unit should be used as the Ultimate Bearing Value for that substructure unit. This value for each substructure shall be listed in the structure General Notes.

The following table for H-piles should be used for selecting the required pile size based on the calculated Ultimate Bearing Value load for each substructure unit.

H Pile Size	Maximum Design Load	Ultimate bearing Value
HP10x42 [HP250X62]	75 Tons [650 kN]	150 Tons [1300 kN]
HP12x53 [HP310X79]	95 Tons [850 kN]	190 Tons [1700 kN]
HP14x73 [HP360X108]	130 Tons [1150 kN]	260 Tons [2300 kN]

Design load values for H piles are based on a maximum service load stress of 12.5 ksi [86 MPa] for Grade 50 steel.

The following table for pipe piles should be used for selecting the required pile size based on the calculated Ultimate Bearing Value load for each substructure unit.

Pipe Pile Diameter	Maximum Design Load	Ultimate bearing Value
12" [300 mm]	50 Tons [450 kN]	100 Tons [900 kN]
14" [350 mm]	70 Tons [650 kN]	140 Tons [1300 kN]
16" [400 mm]	90 Tons [800 kN]	180 Tons [1600 kN]

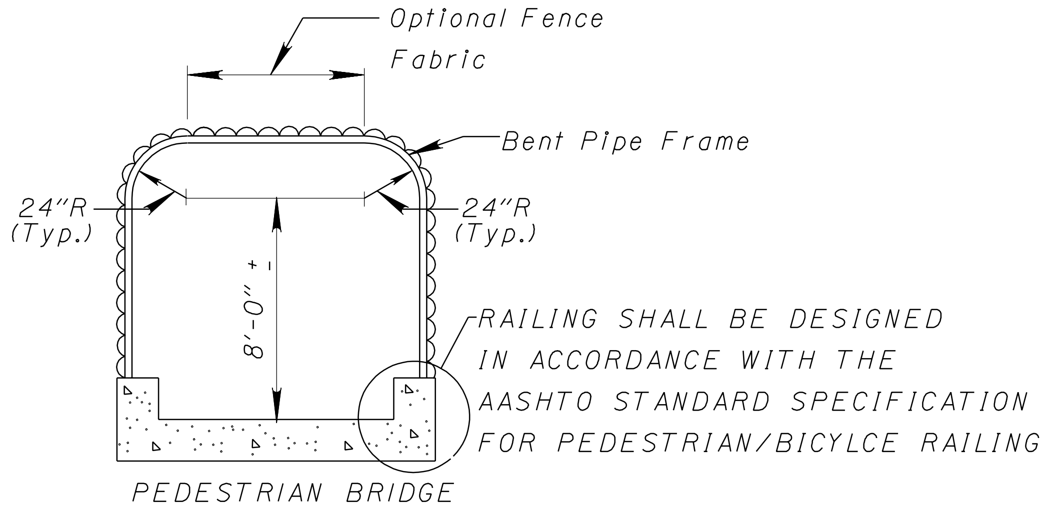
The actual value listed in the structure general notes should not be the Ultimate Bearing Value of the pile size selected, whether H pile or Pipe pile, but the calculated Ultimate Bearing Value load of the substructure unit or units.

Maximum specified pile spacings and maximum allowable Ultimate Bearing loads should be utilized to minimize the number of piles.

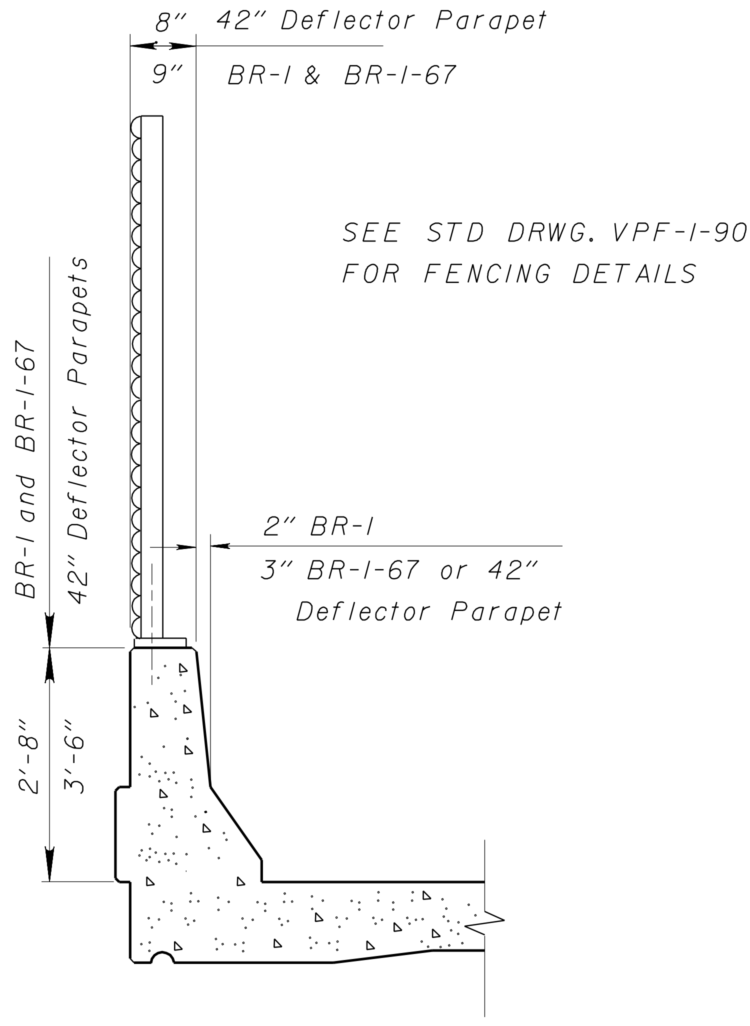
303.4.2.5 PILES, STATIC LOAD TEST

The Designer shall specify a Static Load Test when the total estimated pile length for an individual structure exceeds 10,000 ft [3000 m] for piling of the same size and Ultimate Bearing Value. Static load testing is not required for piling driven to refusal on bedrock.

The Designer shall specify one subsequent static load test for each additional 10,000 ft [3000 m] increment of estimated pile length. Each static load test requires one dynamic testing item and three restrike items. Restrikes are a useful tool to determine if a driven pile gains or loses capacity over time.

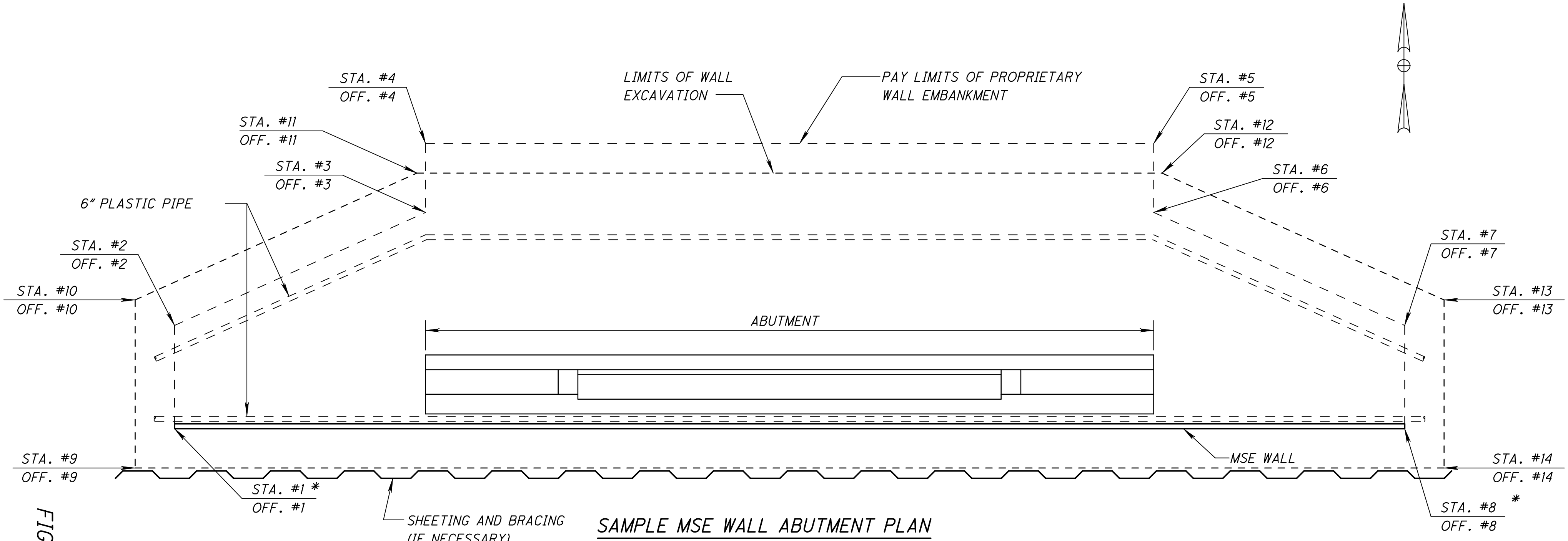


PEDESTRIAN FENCING ON STRUCTURES



DEFLECTOR PARAPET WITH FENCING

Figure 328

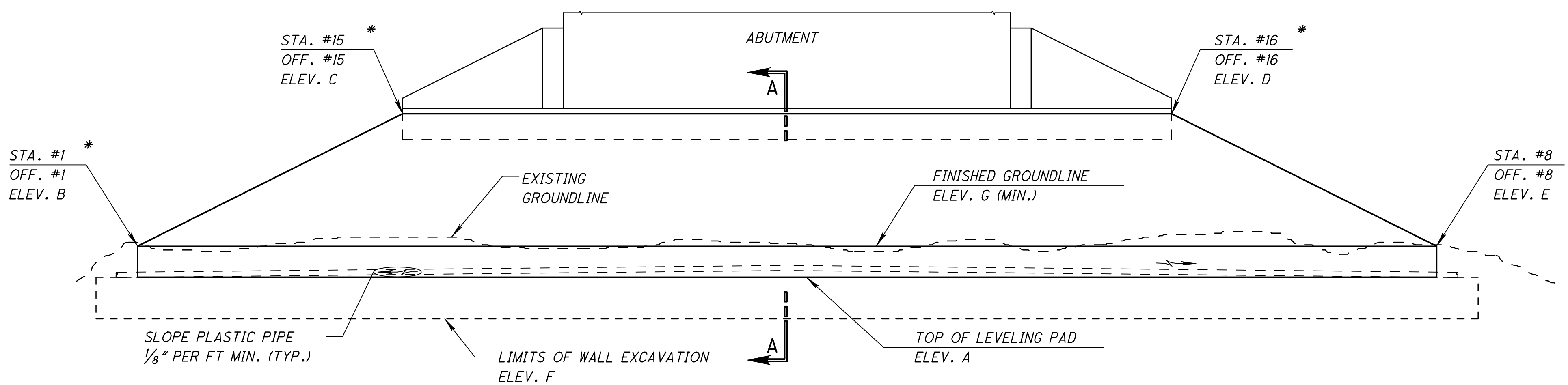


SAMPLE MSE WALL ABUTMENT PLAN

* - MEASURED TO FRONT FACE OF MSE WALL FACING PANELS

FIGURE 329

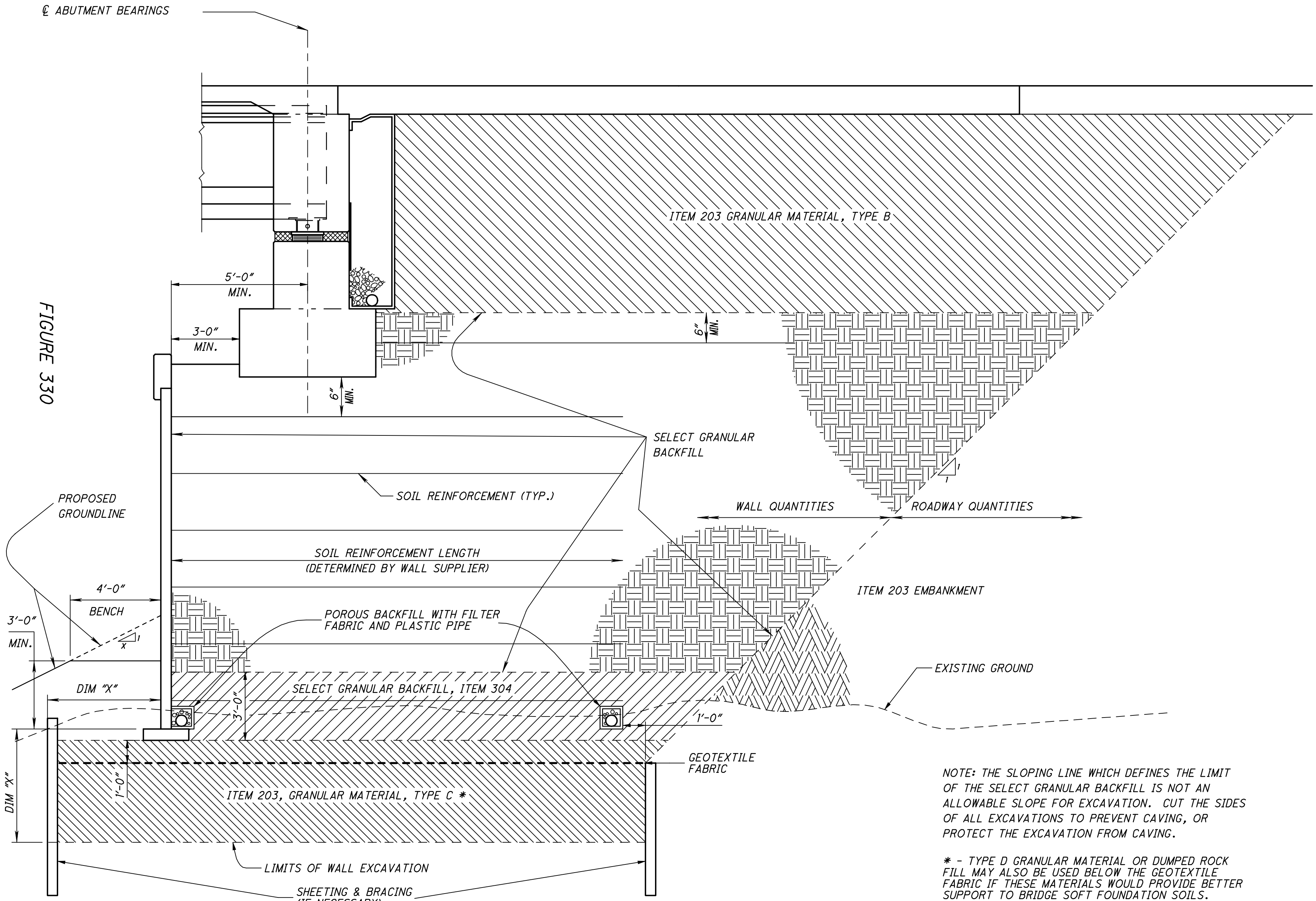
SEE FIGURE 330 FOR SECTION A-A (WITH ABUTMENT SUPPORTED ON SPREAD FOOTING AND ADDITIONAL WALL EXCAVATION)
SEE FIGURE 331 FOR SECTION A-A (WITH ABUTMENT SUPPORTED ON PILES)



SAMPLE MSE WALL ABUTMENT ELEVATION

* - MEASURED TO FRONT FACE OF MSE WALL FACING PANELS

FIGURE 330

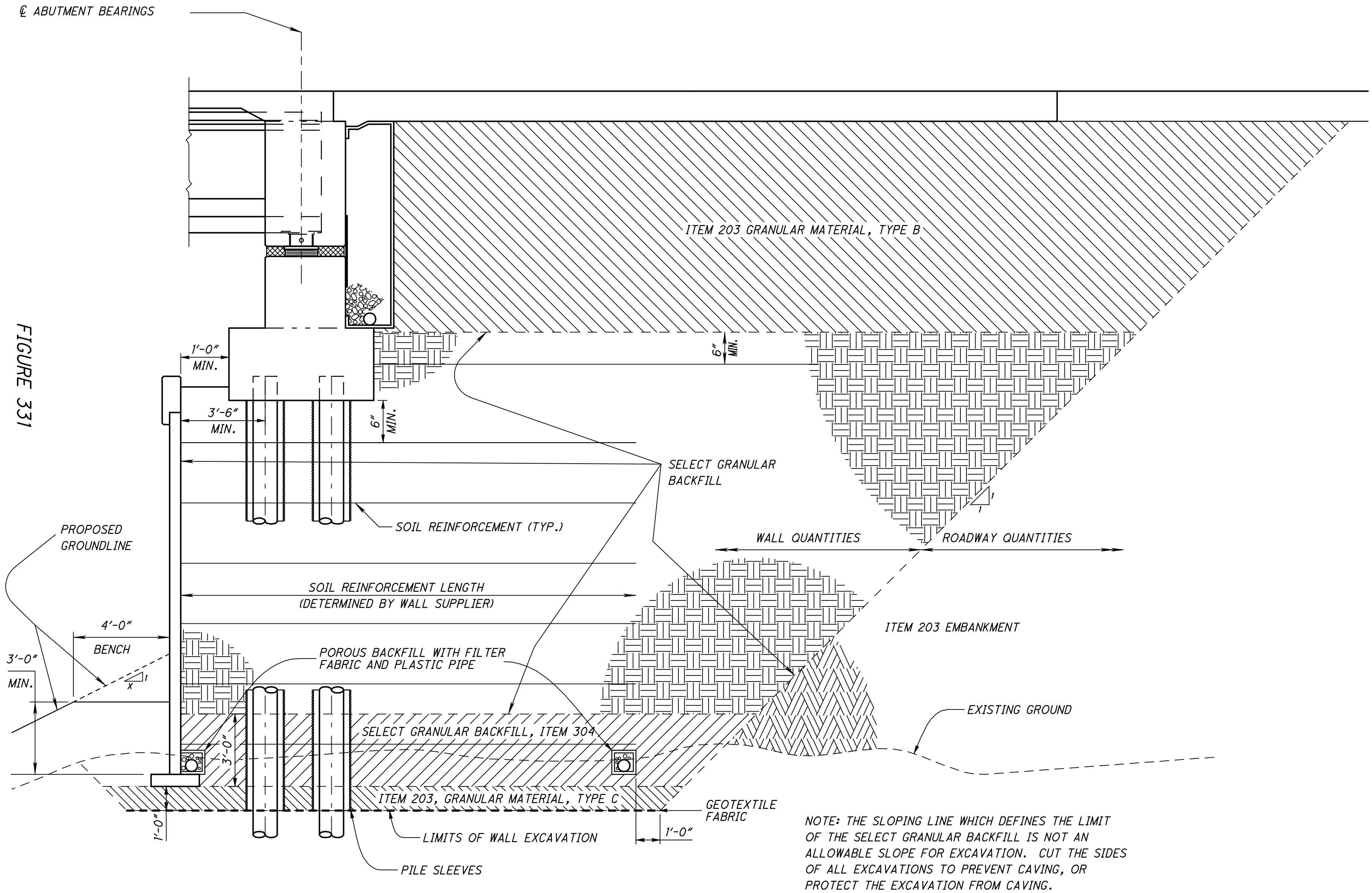


NOTE: THE SLOPING LINE WHICH DEFINES THE LIMIT OF THE SELECT GRANULAR BACKFILL IS NOT AN ALLOWABLE SLOPE FOR EXCAVATION. CUT THE SIDES OF ALL EXCAVATIONS TO PREVENT CAVING, OR PROTECT THE EXCAVATION FROM CAVING.

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

SECTION A-A

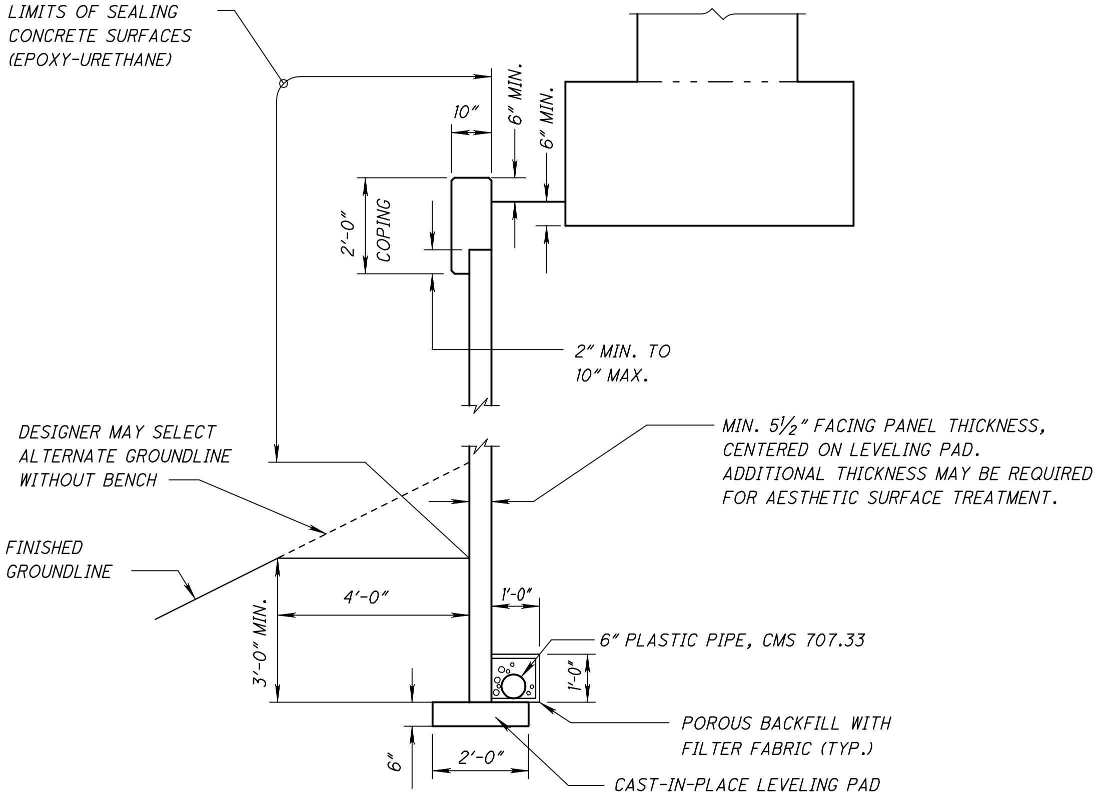
(ALL DIMENSIONS PERPENDICULAR TO MSE WALL)



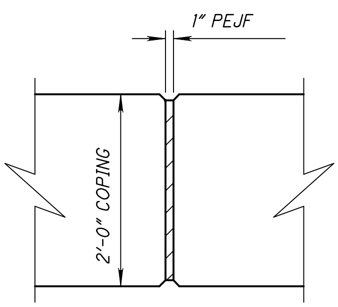
SECTION A-A

(ALL DIMENSIONS PERPENDICULAR TO MSE WALL)

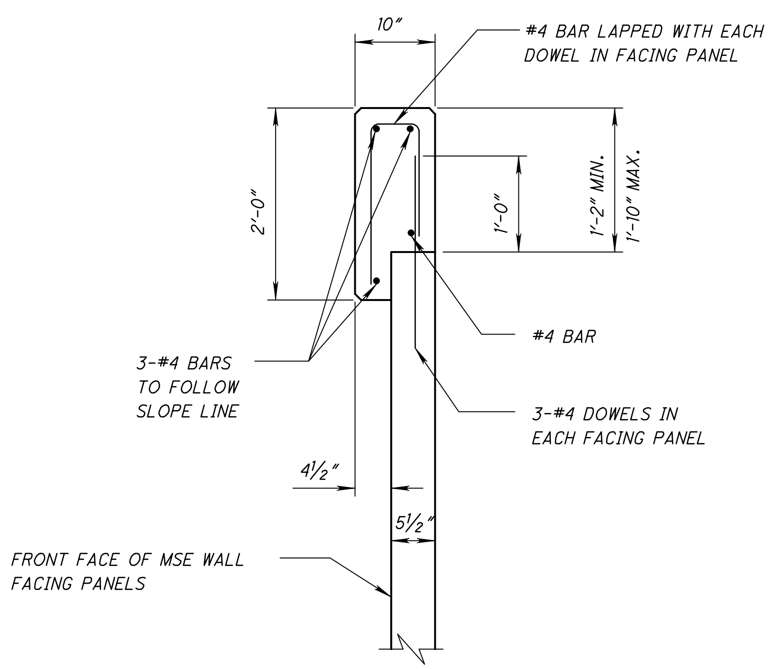
FIGURE 331



MSE WALL AND COPING DETAIL



COPING EXPANSION JOINTS



MSE WALL COPING

ALL REINFORCING STEEL TO BE EPOXY COATED

FIGURE 332

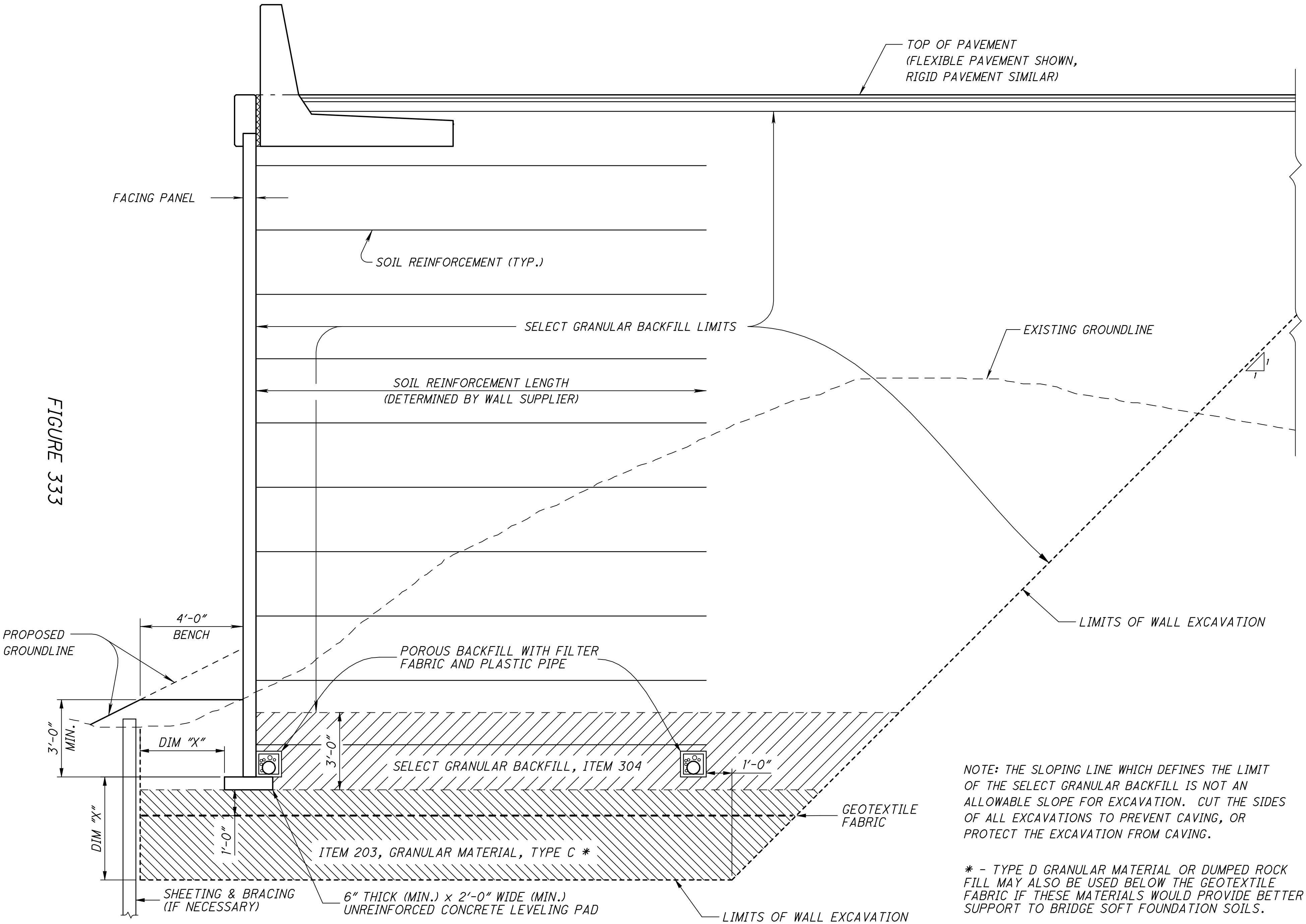

TOP OF PAVEMENT
(FLEXIBLE PAVEMENT SHOWN,
RIGID PAVEMENT SIMILAR)
FACING PANEL
SOIL REINFORCEMENT (TYP.)
SELECT GRANULAR BACKFILL LIMITS
EXISTING GROUNDLINE
SOIL REINFORCEMENT LENGTH
(DETERMINED BY WALL SUPPLIER)
LIMITS OF WALL EXCAVATION
PROPOSED
GROUNDLINE
4'-0"
BENCH
POROUS BACKFILL WITH FILTER
FABRIC AND PLASTIC PIPE
3'-0"
MIN.
DIM "X"
3'-0"
SELECT GRANULAR BACKFILL, ITEM 304
1'-0"
GEOTEXTILE
FABRIC
DIM "X"
1'-0"
ITEM 203, GRANULAR MATERIAL, TYPE C *
SHEETING & BRACING
(IF NECESSARY)
6" THICK (MIN.) x 2'-0" WIDE (MIN.)
UNREINFORCED CONCRETE LEVELING PAD
LIMITS OF WALL EXCAVATION
NOTE: THE SLOPING LINE WHICH DEFINES THE LIMIT OF THE SELECT GRANULAR BACKFILL IS NOT AN ALLOWABLE SLOPE FOR EXCAVATION. CUT THE SIDES OF ALL EXCAVATIONS TO PREVENT CAVING, OR PROTECT THE EXCAVATION FROM CAVING.
* - TYPE D GRANULAR MATERIAL OR DUMPED ROCK FILL MAY ALSO BE USED BELOW THE GEOTEXTILE FABRIC IF THESE MATERIALS WOULD PROVIDE BETTER SUPPORT TO BRIDGE SOFT FOUNDATION SOILS.

FIGURE 333

Item 520, Pneumatically Placed Mortar, should generally be used where the repair surface cannot be readily formed and concrete placed, where the depth of repair is between 1 and 6 inches [25 and 150 mm], and where at least 150 square feet [15 m^2] of repair area is involved.

The detail plans shall show and detail the locations of the areas that require patching repairs. Additionally, Item 519 needs a plan note requiring the surfaces to be patched and the exposed reinforcing steel to be abrasively cleaned within 24 hours of application of patching material (or erection of forms if the forms would render the area inaccessible to blasting). See the note in Section 600 of this Manual.

Trowelable mortar should generally be specified when the repair depth is less than 1½ inches [40 mm] deep, and the repair area is less than 150 square feet [15 m^2]. Trowelable mortar should also be specified in lieu of pneumatically placed mortar for the case where the depth of patch is equal to or less than 3 inches [75 mm] and the quantity is less than 150 square feet [15 m^2]. 3 inches [75 mm] is the maximum depth of patch that should be attempted with this type of mortar.

A pay item, Item 843, Patching Concrete Structures with Trowelable Mortar, should be used and reference should be made to a Supplemental Specification 843.

The designer shall outline the areas to be repaired on the structure and also show where these areas are on details in the plans.

403.3 CRACK REPAIR

Cracks can be repaired by epoxy injection, C&MS 512.07. The location of the cracks shall be shown in the plans and marked in the field.

404 BRIDGE DECK REPAIR

404.1 OVERLAYS ON AN OVERLAY

In no case should a new asphalt or concrete overlay be placed over an already present overlay on a bridge deck. Removal of any existing overlay is required before a new overlay is placed.

404.2 OVERLAYS

The following types of overlays may be used in the repair of an existing reinforced concrete deck:

A. 1¼ inches [32 mm] minimum micro-silica modified concrete (MSC) per either Supplemental Specification 847 or 848. Micro-silica is state of the art and is recommended because it provides greater permeability resistance than the same thickness of other types of overlay materials.

B. 1¼ inches [32 mm] minimum latex modified concrete (LMC) per Supplemental Specification 847 or 848.

C. 1¾ inches [45 mm] minimum superplasticized dense concrete (SDC) per Supplemental Specification 847 or 848.

D. ¼ inch [6 mm] Epoxy Waterproofing Overlay for Bridge Decks are not normally recommended except for in the case where a concrete overlay would sufficiently lower the bridge's load rating. A proposal note is available.

Be aware that the minimum overlay thicknesses indicated provide the maximum protection against chloride penetration. Increased thicknesses do not proportionally increase protection. Minimum thicknesses should be used if at all possible. The maximum thickness should be limited to 2½ inches [65 mm].

Overlays are not intended to be used for grade adjustments.

Overlays shall not be used on new decks .

A deck condition survey shall be performed in accordance with Section 412 of this Manual. This survey is required for all overlay projects in order to determine reasonably accurate variable thickness quantities.

Hydrodemolition is a recommended option for projects where uniform removal depth across an entire bridge deck is required. It is recommended that hydrodemolition be specified for any bridge overlay project where the total square yardage {square meters] of the bridge decks to be overlayed is 500 square yards [400 square meters] or greater. The normal depth of uniform removal of the original deck concrete called for shall be 1 inch [25 mm]. Plan removal depths should not be set up to go below the top mat of deck reinforcing.

404.3 UNDER DECK REPAIR

For under deck spalls up to 1 inch [25 mm] deep, use trowelable mortar (Supplemental Specification 843). For more severe underside deterioration, full depth repairs or Item 519 will be necessary. No spalls over traffic or other safety sensitive areas should be patched because potential debonding of the patch creates a hazard to the public. In these areas, remove loose concrete and provide a concrete sealer.

Low-pressure epoxy injection has also been tried as a remedy for delaminations detected in the bottom portion of the deck. However, there are no indications of how well this method of repair works and its usage should be scrutinized.

2½" [65 mm] concrete cover

Superplasticized dense, Micro-silica, Epoxy, or Latex modified concrete overlay (Only applicable for existing decks)

Waterproofing and asphalt concrete overlay

Steel drip strip

Other (Specify)

602.5 MONOLITHIC WEARING SURFACE

Furnish the following note for concrete bridge decks.

[12] MONOLITHIC WEARING SURFACE is assumed, for design purposes, to be 1 inch [25 mm] thick.

602.6 SEALING OF CONCRETE SURFACES

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

[13a] 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:

[13b] 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.

603 EXISTING STRUCTURE REMOVAL NOTES

The following sample notes will serve as a guide in composing the note(s) for the removal of the existing structure. Modify the notes as required to fit the conditions. Use the following note if it is the desire of the owner to salvage any portion of the bridge.

[14] REMOVAL OF EXISTING STRUCTURE: Carefully dismantle the _________ and store along the right-of-way for disposal by the State's forces.

Describe the degree of care to be exercised in the removal in sufficient detail to allow accurate bidding. For example, for a truss bridge where the stringers and floor beams are to be salvaged for reuse but it is permissible to flame cut the truss members, state that clearly along with any other restrictions or allowances. If this option is used, the pay item shall be "as per plan".

Use the following note when removal of structure to 1 foot [300 mm] below ground line as specified in CMS 202 will not fill the specific requirements of the project.

[15] ITEM 202, PORTIONS OF STRUCTURE REMOVED, AS PER PLAN: Remove abutments to Elev.____. Remove piers to Elev.____.

Use the following note when special protection of an existing structure to be incorporated into a

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new structure is required.

[16] ITEM 202, PORTIONS OF STRUCTURE REMOVED, AS PER PLAN: This item shall include the elements indicated in the plans and general notes and that are not separately listed for payment, except for wearing course removal. Items to be removed include all existing materials being replaced by new construction and miscellaneous items that are not shown to be incorporated into the final construction and are directed to be removed by the Engineer. The use of explosives, headache balls and/or hoe-rams will not be permitted. The method of removal and the weight of hammer shall be approved by the Engineer. Perform all work in a manner that will not cut, elongate or damage the existing reinforcing steel to be preserved. Chipping hammers shall not be heavier than the nominal 90-pound [41 kilogram] class. Pneumatic hammers shall not be placed in direct contact with reinforcing steel that is to be retained in the rebuilt structure. Submit construction plans according to CMS 501.05.

[17] Note Retired – see Appendix

603.1 CONCRETE DECK REMOVAL PROJECTS

Use the following removal note for concrete deck removal projects, where the existing superstructure is to remain. Delete the portions in the note that are not appropriate for the specific project.

[18] ITEM 202, PORTIONS OF STRUCTURE REMOVED, AS PER PLAN DESCRIPTION: This work consists of the removal of concrete decks including sidewalks, parapets, railings, deck joints and other appurtenances from steel supporting systems (beams, girders, cross frames, etc.). The provisions of Item 202 apply except as specified by the following notes. Perform work carefully during deck removals to protect portions of such systems that are to be salvaged and incorporated into the proposed structure. The use of explosives, headache balls and/or hoe ram type of equipment is prohibited. Submit construction plans according to CMS 501.05.

PROTECTION OF STEEL SUPPORT SYSTEMS: Before deck slab cutting is permitted, draw the outline of primary steel members in contact with the bottom of the deck on the surface of deck. Drill small diameter pilot holes 2 inches [50 mm] outside these lines to confirm the location of flange edges. Deck cuts over or within 2 inches [50 mm] of flange edges shall not extend lower than the bottom layer of deck slab reinforcing steel. Cuts made outside 2 inches [50 mm] of flange edges may extend the full depth of the deck. Perform work carefully during cutting of the deck slab to avoid damaging steel members that are to be incorporated into the proposed structure. Replace or repair steel members damaged by the deck slab cutting operations at no cost to the project. At least 7 days before performing repair work, submit a proposed repair plan, developed by an Ohio registered professional engineer to the Director. Obtain the Director’s approval before performing repair.

For wall type abutments on spread footings with no new embankment provide note **[26]** or **[27]** and the following note:

[25] 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.

<u>Note that Item 203 is a roadway quantity and coordination with the roadway plans is necessary.</u>

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.

[26] ITEM 203 EMBANKMENT, AS PER PLAN: Place and compact embankment material in 6 inch [150 mm] lifts for the construction of the approach embankment between stations _**_ to _**_.

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

[27] ITEM 203 EMBANKMENT, AS PER PLAN: Place and compact embankment material in 6 inch [150 mm] 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

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

[98] PROPRIETARY RETAINING WALL DATA:
The proprietary wall supplier shall design the internal stability of a mechanically stabilized earth (MSE) wall in accordance with the SS840 to support the abutment loads provided in the table below. All loads in the table represent unfactored service loads applied to the reinforced soil mass at the base of the concrete footing. DL represents a vertical spread footing strip load that includes the dead load of the approach slab; the dead load of the abutment; and the dead load from the superstructure. LL represents a vertical spread footing strip load that includes only the live load from the superstructure. H represents a horizontal strip load from the superstructure applied perpendicular to the face of wall. Ecc. represents the distance between the geometrical center of the strip footing and the resultant of all loads applied to the footing.

Wall Location	DL (k/ft)	LL (k/ft)	H (k/ft)	Ecc. (ft)	Bearing Pressure (k/ft^2)
#1					
#2					
#3					

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

[99] PROPRIETARY RETAINING WALL DATA:
The proprietary wall supplier shall design the internal stability of a mechanically stabilized earth (MSE) wall in accordance with the SS840 to support the

of the pile restrikes and establish the driving criteria for the remaining piling represented by the testing.

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

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

Provide the following note when battered piles are specified.

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

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

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

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

606.3 STEEL PILE POINTS

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

[31] ITEM 507, STEEL POINTS, AS PER PLAN: Use steel pile points to protect the tips of the proposed steel “H” piling. Furnish steel points from the following manufactures/suppliers: Associated Pile and Fitting Corporation, 262 Rutherford Blvd., Clifton, New Jersey 07014, phone: (973)773-8400, (800)526-9047, fax: (973)773-8442; International Construction Equipment, Inc., 301 Warehouse Drive, Matthews, North Carolina 28015, phone: (704)821-8200, (888)423-8721, fax: (704)821-8201; Dougherty Foundation Products, Inc., P.O. Box 688, Franklin Lakes, New Jersey 07417, phone: (201)337-5748, fax: (201)337-9022; Versa Steel Inc., 1618 N.E. First Ave., Portland, Oregon 97232, phone: (503)287-9822, (800)678-0814, fax: (503)287-7483; Versabite Piling Accessories, 1704 Tower Industrial Dr., Monroe, North Carolina 28110, phone: (800)280-9950, (704)225-1566, fax: (704)225-1567; or by a manufacturer that can furnish a steel point that is acceptable to Director. The material used for the manufacturing of pile points shall conform to ASTM A27/A27M 65/35 [450/240] – Class 2 – Heat Treated or AASHTO M103/M103M 65/35 [450/240] – Heat Treated. Weld the pile points to the pile in accordance with AWS D1.5 or the manufacturer's written welding procedure supplied to the engineer before the welding is performed. Submit a notarized copy of the mill test report to the Engineer.

606.4 PILE SPLICES

Provide the following note when H-piles are specified.

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

Associated Pile and Fitting Corporation

262 Rutherford Blvd.

Clifton, New Jersey 07014

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

606.5 MINIMUM HAMMER SIZE

[33] Note retired - see appendix

606.6 PILE ENCASEMENT

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

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

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

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

606.7 FOUNDATION BEARING PRESSURE

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. Show the actual calculated maximum bearing pressure under the footing.

[35] FOUNDATION BEARING PRESSURE: _______ footings, as designed, produce a maximum bearing pressure of ______ tons per square foot [Mpa]. The allowable bearing

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610.7 RAILING

Use the following note where the existing parapet is to be refaced. Modify the note accordingly for each specific project.

[48] ITEM 517 - RAILING FACED, AS PER PLAN

DESCRIPTION: This work consists of facing curb style parapets, using cast in place concrete, to obtain the deflector shape as shown in the plans.

REMOVAL: Carefully remove the existing aluminum railing, posts, curb plates, existing concrete curb and bulb angle gutter. Remove all loose or unsound concrete. Remove sound concrete, as necessary, to obtain a minimum 4 inch [100 mm] thickness of new concrete.

NOTE TO DESIGNER: Modify the list of items in the above removal portion of this note as necessary to fit the actual conditions of your particular project.

DOWEL HOLES AND REINFORCING STEEL: Drill dowel holes where shown in the plans. Install reinforcing steel according to Item 510 using epoxy grout, 705.20. Prior to drilling dowel holes, locate all existing reinforcing steel bars in the area of the hole with the aid of a reinforcing steel bar locator (pachometer). If an existing bar is encountered at the same location as a proposed dowel hole, move the dowel hole to either side of the existing bar. The Department will pay for all reinforcing steel, dowel holes and grouting with Item 517.

SURFACE PREPARATION: Thoroughly clean the parapet surface in contact with the refacing with detergent to remove surface contaminants. After detergent cleaning and within 24 hours of placing concrete, blast clean and air broom or power sweep all surfaces in contact with the refacing to remove all spalls, laitance, curing compounds, concrete sealers and other contaminants detrimental to the achievement of an adequate bond. Acceptable blast cleaning methods are high-pressure water blasting with or without abrasives in water, abrasive blasting with containment or vacuum abrasive blasting. Use hand tools as necessary to remove scale from any exposed reinforcing steel. Materials: Concrete shall be Class _*_ (S or HP) with a compressive strength of 4500 psi [31 MPa]. Furnish reinforcing steel according to 709.00, grade 60 [420], with a minimum yield strength of 60,000 psi [420 MPa].

CONTROL JOINTS: Sawcut 1 1/4 inch [32 mm] deep control joints along the perimeter of the parapet as soon as the saw can be operated without damaging the concrete. Place the joint saw cuts at the same location as the existing deflection joints. Use an edge guide, fence or jig to ensure that the cut joint is straight, true and aligned on all faces of the parapet. The joint width shall be the width of the saw blade, a nominal width of 1/4 inch [6 mm]. Seal the perimeter of the control joint to a minimum depth of one inch [25 mm] with a polyurethane or polymeric material conforming to ASTM C920, Type S. Leave the bottom one-half inch [12 mm] of both the inside and outside faces of the parapet unsealed to allow any water which may enter the joint to escape.

METHOD OF MEASUREMENT: The Department will measure this item in feet by the actual length of railing faced between the ends of the existing concrete parapet.

BASIS OF PAYMENT: Payment for this item includes all costs of removal, dowel holes, reinforcing steel, concrete, shrinkage control joints, epoxy injection and inspection platforms. The Department will pay for accepted quantities at the contract price for Item 517, Railing Faced, As Per Plan.

NOTE TO DESIGNER: Include the reinforcing steel in the bar list with appropriate bending diagrams, as necessary, even though the reinforcing steel is included with item 517 for payment. Modify the method of measurement and items of work included in this pay item as necessary to fit your specific project.

611 MISCELLANEOUS GENERAL NOTES

611.1 DOWEL HOLES

[49] Note Retired - See appendix

611.2 APPROACH SLABS

[50] Note retired - see appendix

[50A] Note Retired - See appendix

Item 526, Reinforced Concrete Approach Slabs was developed such that the concrete used in the superstructure would also be used for the approach slabs. The new supplemental specification for QC/QA concrete is not included in Item 526.

Provide both of the following notes on projects that specify SS898, QC/QA Concrete for Structures:

[93A] ITEM 898 - QC/QA CONCRETE, CLASS QSC2, SUPERSTRUCTURE (APPROACH SLAB), AS PER PLAN
Furnish approach slabs conforming to CMS 526 except concrete shall be in accordance with Supplemental Specification 898, QC/QA Concrete, Class QSC2. The accepted quantities shall include: concrete, curbs, reinforcing steel, joint fillers, joint sealers, joint seals, and waterproofing. The Department will measure approach slabs by the number of square yards. The Department will initially pay the full bid price to the Contractor upon

proper bearing. Furnish two shims per beam. The Department will measure this item by the total number supplied. The Department will pay for accepted quantities at the contract price for Item 516 - 1/8" [3 mm] Preformed Bearing Pads. Any unused shims will become the property of the State.

NOTE TO DESIGNER: The plan area of the shim pad shall be the same as the elastomeric bearing.

611.7 CLEANING STEEL IN PATCHES

Use this note with all concrete patching bid items that refer to the cleaning requirements specified in 519.04

[55a] ITEM 519 - PATCHING CONCRETE STRUCTURES, AS PER PLAN: Prior to the surface cleaning specified in 519.04 and within 24 hours of placing patching material, blast clean all surfaces to be patched including the exposed reinforcing steel. Acceptable methods include high-pressure water blasting with or without abrasives in the water, abrasive blasting with containment, or vacuum abrasive blasting.

611.8 CONVERSION OF STANDARD BRIDGE DRAWINGS

The Department's Standard Bridge Drawings are available in English units only. If the project scope has established that Contract Documents will be prepared in metric units, the Designer has two options:

A. Convert the English drawings to metric units. This means removing the standard title blocks and using the converted drawings as plan insert sheets directly in the project plans. In doing so, the Designer assumes responsibility for the accuracy to the converted drawings. CADD files may be downloaded from the ODOT, Office of Structural Engineering web site.

B. Specify the English Standard Bridge Drawings in the Plans and use the following note:

[55b] CONVERSION OF STANDARD BRIDGE DRAWINGS: The Standard Bridge Drawings referenced in this plan are in English units. Any conversion of dimensions required to construct the items shown on the standards is the responsibility of the Contractor. Refer to 109.02 for a listing of Conversion Factors. Conversions shall be appropriately precise and shall reflect standard industry metric values where suitable.

611.9 COFFERDAMS, CRIBS AND SHEETING

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

[101] ITEM 503, COFFERDAMS, CRIBS, AND SHEETING, 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, Cribs, and Sheeting. No additional payment will be made for providing an alternate design.

702.13 PAINTING OF A588/A709 GRADE 50 STEEL

[78] Note retired - see appendix

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

[79] PARTIAL PAINTING OF A709 GRADE 50W STEEL : Paint the last 10 ft [3 m] of each beam/girder end adjacent to the abutments including all cross frames and other steel within these limits. The prime coat shall be 708.01. The top coat color shall closely approach Federal Standard No. 595B - 20045 or 20059 (the color of weathering steel).

702.14 ERECTION BOLTS

Where erection bolts are specified for attaching crossframes on steel girder or rolled beam bridges, and the expected dead load differential deflection at each end of the crossframes is less than or equal to ½" [13 mm] provide the following note. (Do not use the note if standard drawing GSD-1-96 is being referenced.)

[80] ERECTION BOLTS: The hole diameter in the cross frames and girder stiffeners shall be 3/16" [4 mm] larger than the diameter of the erection bolts. Erection bolts shall be high strength bolts and shall remain in place. Supply two hardened washers with each high strength bolt. Fully torque the bolts or use a lock washer in addition to the two hardened washers. Furnish erection bolts as part of Item 513.

[81] Note Retired – See Appendix

702.15 WELDED ATTACHMENTS

Provide the following note on plans for steel beam or girder bridges:

[82] WELD ATTACHMENT of supports for concrete deck finishing machine to areas of the fascia stringer flanges designated "Compression". Do not weld attachments to areas designated "Tension". Fillet welds to compression flanges shall be at least 1" [25 mm] from edge of flange, be no more than 2" [50 mm] long, and be at least 1/4" [6 mm] for thicknesses up to 3/4" [19 mm] or 5/16" [8 mm] for greater than 3/4" [19 mm] thick.

702.16 SCREED ELEVATION TABLES

Screed elevation tables are required for concrete decks on structural steel beams, structural steel girders, prestressed I-beams and composite deck box beams. General criteria for screed elevation tables are defined in section 302.2.3. Refer to Figure 703 for an example screed table for structural steel members and Figure 704 for an example screed table for composite box beams.

702.16.1 SCREED ELEVATION TABLES – STRUCTURAL STEEL MEMBERS

In lieu of a table format, the designer may supply screed elevations through the use of a deck plan view showing elevations and stations of the points required in section 302.2.3.

In addition to the screed elevation table or diagram, provide a screed elevation note similar to the one below to describe the elevations that are given.

[83] SCREED ELEVATIONS shown are for the deck slab surface prior to concrete placement. Allowance has been made for anticipated calculated dead load deflections.

702.16.2 SCREED ELEVATION TABLES – PRESTRESSED I-BEAM MEMBERS

See the requirements of 702.16.1 for example tables, notes and format.

702.16.3 SCREED ELEVATION TABLES – COMPOSITE BOX BEAM MEMBERS

In lieu of a table format, the designer may supply screed elevations through the use of a deck plan view showing elevations and stations of the points required in section 302.2.3.

In addition to the screed elevation table or diagram, provide a screed elevation note similar to **[83]** to describe the elevations that are given.

904.2.2.2 PRECAST BOXES OF SPAN EQUAL TO OR LESS THAN 12’ [3.6 m]

A. Manufacturer shall submit the actual information about the dimensions and reinforcing bars/cage to the OSE along with the shop drawings before the placement of structure.
B. The load rating analysis will be performed by the OSE.

904.2.3 PRECAST FRAMES, ARCHES, AND CONSPANS & BEBO TYPE STRUCTURES

A. The load rating analysis will be performed by the manufacturer.
B. Load rating report shall be submitted along with the shop drawings before the placement of the precast units.
C. Use the design software to load rate the structure.

904.3 LOAD RATING OF BURIED BRIDGES TO BE REHABILITATED

904.3.1 CAST-IN-PLACE STRUCTURES

A. Cast-in-place bridges shall be load rated by the designer of the bridge.
B. BRASS-Culvert program shall be used to load rate the structure. For the BRASS-Culvert Analysis, see Section 910.

904.3.2 PRECAST BOXES

904.3.2.1 PRECAST BOXES OF SPAN GREATER THAN 12’ [3.6 m]

A. The load rating analysis will be performed by the OSE.
B. BRASS-Culvert program shall be used to load rate the structure. For the BRASS-Culvert Analysis, see Section 910.

904.3.2.2 PRECAST BOXES OF SPAN EQUAL TO OR LESS THAN 12’ [3.6 m]

A. Manufacturer shall submit information about the actual dimensions and reinforcing bars/cage to the OSE along with the shop drawings before the placement of precast structure.
B. The load rating analysis will be performed by the OSE.

904.3.3 PRECAST FRAMES, ARCHES, AND CONSPANS & BEBO TYPE STRUCTURES

A. The load rating analysis for any new or replacement precast sections will be performed by the manufacturer, otherwise the load rating analysis will be performed as per the scope of services.

B. Load rating report shall be submitted along with the shop drawings before the placement of the units.
C. Use the design software to load rate the structure.

904.4 LOAD RATING OF EXISTING BURIED BRIDGES

A. The load rating analysis will be performed as per the Scope of Services.
B. Unless specified otherwise, structure shall be load rated for the Loads as per Section 902.

904.5 LOAD RATING REPORT SUBMISSION

The load rating report shall be submitted to the District office(s). The submission shall include two (2) printed copies and one electronic copy of the Load Rating Report. The Load Rating Reports shall be prepared and signed by a registered or non-registered engineer and checked, signed, sealed and dated by an Ohio Registered Engineer.

The District Bridge Engineer will send one printed copy, an electronic copy of the report, the electronic data files and a copy of the final bridge plans to the OSE. The electronic data files from the District may be sent together with a copy of the report on a PC compatible computer disk, CD-ROM or separate from the report as an attachment to an E-mail message.

The report must list final inventory and operating ratings of the buried structure summarized in a tabular form. The ratings of each member and the overall ratings of the structure shall be presented for each live load truck given in Figure 901.

An example of a Load Rating Report Summary is given as Figure 908.

The inventory and operating ratings for the AASHTO HS20-44 loading shall be expressed in terms of the AASHTO HS20-44 loading (English Units), rounded off to the nearest single decimal point. The operating ratings for each of the Ohio Legal Loads shall be expressed in terms of the gross tonnage of the respective legal load. The summary rating for all of the Ohio Legal Loads shall be the smallest rating factor of the four vehicles expressed as a percentage (i.e. multiplied by 100).

For existing bridges, the report shall state how the material properties were determined. Any specific details about the current conditions and bridge geometry shall be listed.

All calculations related to the load rating should be a part of the load rating report.

905 LOAD RATING OF NON-BURIED STRUCTURES

905.1 GENERAL

All structures including flat slabs, arch structures, frames, box sections, etc., having a fill or pavement material of less than 2'-0" [600 mm] on top of the structures shall be load rated according to the provisions of this Section.

All main structural members of the superstructure affected by live load shall be analyzed.

Superstructure shall be load rated for the Loads as per Section 902.

905.2 SOFTWARE TO BE USED FOR LOAD RATING

Use only the AASHTO BARS-PC (BARS-PC) computer program to load rate all bridges listed in Figures 902 and 903. The Department will not accept load ratings performed using other rating software products for bridges listed in Figures 902 and 903.

For analysis requirements using BARS-PC see Section 909.

BRASS-Culvert software shall be used for the analysis of concrete box sections and three sided concrete frames. For analysis requirements using BRASS-Culvert see Section 910.

Contact the OSE prior to using any computer program other than AASHTO BARS-PC or BRASS-Culvert. The Deparment will not accept load rating performed using any software not pre-approved for that bridge.

For the analysis of arches and other special structures that cannot be modeled using BARS-PC, the current version of one of the following computer programs shall be used. Contact the OSE prior to using any of these computer programs for load rating purpose.

A. AASHTO Virtis - A load rating and analysis product developed by AASHTO (http://aashto.bakerprojects.com/virtis/).

B. BRASS - A bridge rating and design analysis program developed by the Wyoming Department of Transportation: (http://www.dot.state.wy.us/Default.jsp?sCode=hwyba).

C. DESCUS I - Design and Analysis of Curved I-girder Bridge Systems, marketed by OPTI-MATE, Inc. (www.opti-mate.com)

D. LARSA 4D – Finite element analysis programs by LARSA, Inc., 105 Maxess Road, Melville Corporate Center, Suite 115N, Melville, NY 11474 (http://www.larsausa.com).

905.3 ANALYSIS OF CONCRETE BOX SECTIONS & FRAMES

Unless more accurate soil data exits, calculate the rating based on a lateral pressure of 60 lb/ft^2 [2.9 kPa].

2 ft [600 mm] of earth fill shall be assumed as live load surcharge on all structures as per AASHTO 3.20.3 unless the provisions of AASHTO 3.20.4 apply.

Effect of soil-structure interaction shall be taken into account as per AASHTO 16.6.4.2

Assume hinged connections between the walls and the top and bottom slabs unless there is adequate reinforcing steel continuous between the slab and the walls at the joint. In that case continuity between the slab and the walls can be assumed.

Perform load rating of new structures according to Section 904.2.

Perform load rating of structures to be rehabilitated according to Section 904.3.

Perform load rating of existing structures according to Section 904.4.

905.4 LOAD RATING OF NEW BRIDGES

905.4.1 HOW THE LOAD RATING SHALL BE DONE

The designer shall analyze and load rate all spans which are designed to carry vehicular traffic.

The load rating analysis shall be based on the final design plans. At the inventory level, the load rating shall be equal to or greater than the design loading.

All members shall have actual net section and current conditions incorporated into the member's analysis.

Bridge members designed as non-composite with the deck slab should be analyzed as non-composite.

All dead loads are to be calculated based on the actual field conditions. Future dead loads shall not be applied, unless directed otherwise.

Total thickness of the composite concrete slab shall be used in load rating for the calculations of section properties. Do not subtract for the monolithic wearing surface.

Live load distribution factors, as defined in the current AASHTO Standard Specifications for Highway Bridges, shall be used.

Continuous reinforced concrete slabs shall be rated using the live load distribution factor for the shortest span.

All analyses shall be performed using the Load Factor or Strength Design (LF) method. The load factors as defined in AASHTO shall be applied.

All bridges shall be rated for Inventory and Operating conditions. The inventory load rating condition refers to the stresses at the design level and reflects the customary conditions under normal operation. The operating load rating condition generally defines the maximum

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permissible live load to which the structure may be subjected (AASHTO Manual for Condition Evaluation of Bridges).

Refer to ODOT Procedure No.: 518-001 (P), “Rating of Bridges and Posting for Reduced Load Limits,” in the Appendix (AP-1, Rating of Bridges and Posted Loads) and at Structure Rating web site (http://www.dot.state.oh.us/srg/) for rating procedures.

905.4.2 WHEN THE BRIDGE LOAD RATING SHALL BE DONE

The load rating of new bridges shall be done as per following:

905.4.2.1 BRIDGES DESIGNED UNDER MAJOR OR MINOR PLAN DEVELOPMENT PROCESS

For bridges designed under the Major or Minor Plan Development Process (PDP), perform the load rating and include the load rating report in the Stage 2 Detail Design Submission. When design modifications that affect the previously submitted load rating analysis occur after Stage 2 and prior to contract sale, revise and resubmit the load rating report to the District Project Manager. The District Project Manager will forward the final load rating report to the District Bridge Engineer.

905.4.2.2 BRIDGES DESIGNED UNDER MINIMAL PLAN DEVELOPMENT PROCESS

For bridges designed under the Minimal Plan Development Process (PDP), perform the load rating and include the load rating report in the Stage 3 Detail Design Submission. When design modifications that affect the previously submitted load rating analysis occur after Stage 3 and prior to contract sale, revise and resubmit the load rating report to the District Project Manager. The District Project Manager will forward the final load rating report to the District Bridge Engineer.

905.4.2.3 BRIDGES DESIGNED UNDER MINOR DESIGN-BUILD PROCESS

For bridges designed as part of a Minor Design-Build project, perform the load rating and include the load rating report in the Stage 2 Detail Design Submission. When design modifications that affect the previously submitted load rating analysis occur after Stage 2, revise and resubmit the load rating report to the District Project Manager. The District Project Manager will forward the final load rating report to the District Bridge Engineer.

905.4.2.4 BRIDGES DESIGNED UNDER MINIMAL DESIGN-BUILD PROCESS

For bridges designed as part of a Minimal Design-Build project, perform the load rating and include the load rating report in the Stage 3 Detail Design Submission. When design modifications that affect the previously submitted load rating analysis occur after Stage 3, revise and resubmit the load rating report to the District Project Manager. The District Project Manager will forward the final load rating report to the District Bridge Engineer.

905.4.2.5 BRIDGES DESIGNED UNDER VALUE ENGINEERING CHANGE PROPOSAL

For bridges re-designed under a Value Engineering Change Proposal (VECP), perform a load rating of the altered bridge design and submit the load rating report to the District Construction Engineer (DCE) with the Final VECP submission. The DCE will supply this information to the District Bridge Engineer.

905.5 LOAD RATING OF BRIDGES TO BE REHABILITATED

905.5.1 HOW THE LOAD RATING SHALL BE DONE

The designer shall analyze and load rate all spans which are designed to carry vehicular traffic.

The load rating analysis shall be based on the final design plans. At the inventory level, the load rating shall be equal to or greater than the design loading.

All members shall have actual net section and current conditions incorporated into the member's analysis. Any known section losses, defects or damage to the existing structural members shall be considered in the rating analysis.

Bridge members designed as non-composite with the deck slab should be analyzed as non-composite.

Structures to be rehabilitated shall be analyzed using the original design plans, the actual field conditions, and all major changes in the final rehabilitation plans.

A complete review of all the available inspection information as well as a thorough site inspection of the existing bridge must be performed to establish the current conditions prior to proceeding with the analysis.

Future wearing surface dead loads shall not be applied, unless directed otherwise.

Total thickness of the composite concrete slab shall be used in load rating for the calculations of section properties. Do not subtract for the monolithic wearing surface.

Live load distribution factors, as defined in the current AASHTO Standard Specifications for Highway Bridges, shall be used.

Continuous reinforced concrete slabs shall be rated using the live load distribution factor for the shortest span.

District Bridge Engineer.

905.6 LOAD RATING OF EXISTING BRIDGES

905.6.1 HOW THE LOAD RATING SHALL BE DONE

The rater shall analyze and load rate all spans which are designed to carry vehicular traffic.

Existing structures shall be analyzed using the information from the original design plans and the actual field conditions.

A complete review of all the available inspection information as well as a thorough site inspection of the existing bridge must be performed to establish the current conditions prior to proceeding with the analysis.

The bridges rated using design plans shall be noted as such in the load rating report.

Allowable stresses for the working stress and the ultimate or yield strengths of materials for Load Factor ratings shall be as specified on the original design plans, unless it is required in the scope of services to conduct specific tests to determine the material strengths.

For existing bridges, the rater should review the original design plans as the first source of information for material strengths and stresses. If the material strengths are not explicitly stated on the design plans, ODOT Construction and Material Specifications (CMS) applicable at the time of the bridge construction shall be reviewed. This may require investigations into old ASTM or AASHTO Material Specifications active at the time of construction.

Total thickness of the composite concrete slab shall be used in load rating for the calculations of section properties. Do not subtract for the monolithic wearing surface.

Figures 904 and 905 provide general information about ODOT Allowable Stresses in bending and shear and material strengths based on the year of construction.

The rater is cautioned to pay extra attention to the design plans and the year of construction, when determining material strengths for structures built during transition years of Figures 904 and 905 (e.g., for member type SS, years 1964-68, or 1988-93, etc.), as materials may have been substituted.

Any material stresses and specifications specified on the design plans shall supersede the values given in Figures 904 and 905.

Refer to ODOT Procedure No.: 518-001 (P), "Rating of Bridges and Posting for Reduced Load Limits," in the Appendix (AP-1, Rating of Bridges and Posted Loads) and at Structure Rating web site (http://www.dot.state.oh.us/srg/) for rating procedures.

905.6.2 WHEN THE BRIDGE LOAD RATING SHALL BE DONE

The load rating of existing bridges shall be done as per the Scope of Services.

906 ANALYSIS OF BRIDGES WITH SIDEWALKS

Sidewalks shall have AASHTO live loads applied, but reduced by 50% to reflect the actual service conditions.

907 ANALYSIS OF MULTILANE LOADING

Traffic lanes to be used for rating purposes shall be in accordance with AASHTO Section 3.6.

AASHTO reduction factors for multiple lane loadings shall be applied where appropriate.

For rating analysis of floor beams, trusses, non-redundant girders or other non-redundant main structural members, position identical rating vehicles in one or more of the through traffic lanes on the bridge, spaced and shifted laterally on the deck, within the traffic lanes, so as to produce the maximum stress in the member under consideration.

908 ANALYSIS FOR SPECIAL OR SUPERLOAD

When a structure is required, in the Scope of Services, to be analyzed for special or Superload vehicle, a second analysis shall be performed for a single lane loading of the special or Superload vehicle condition. The special or Superload vehicle shall be placed laterally on the structure to produce maximum stresses in the critical member under consideration.

The analysis for special or Superload vehicle shall be performed at the operating level only.

909 LOAD RATING ANALYSIS USING BARS-PC

909.1 GENERAL

The BARS-PC is the PC version of the AASHTO BARS (Bridge Analysis and Rating System) program that can analyze and load rate structures based on the AASHTO Specifications.

BARS-PC program installation disks and User Manuals are available for use on ODOT Projects, from the OSE.

The OSE will provide limited technical support to install and execute the program.

The types of material, methods of construction and types of section that can be handled by BARS-PC are provided in Figure 902.

The types of bridge member that can be analyzed and rated by the BARS-PC are provided in Figure 903.

The BARS-PC program operates using English units. Input values taken from metric plans will have to be converted to English units.

Figures 904 and 905 provide general information about ODOT Allowable Stresses in bending and shear and material strengths based on the year of construction. These material properties are different from those given in AASHTO BARS Manual 2, Appendix A. However, they are used as default values in the BARS-PC customization file prepared by ODOT, which is available from Structure Rating website. Any material stresses and specifications specified on the design plans shall supersede the values given in Figures 904 and 905.

The rater is cautioned to pay extra attention to the design plans and the year of construction, when determining material strengths for structures built during transition years of Figures 904 and 905 (e.g., for member type SS, years 1964-68, or 1988-93, etc.), as materials may have been substituted.

909.2 SYSTEM REQUIREMENTS

Hardware Requirements:

A. Minimum Configuration
   386 - 12 MHz with math co-processor
   6 MB RAM
   60MB disk drive (uncompressed)
   3.5" high-density diskette drive
   EGA display adapter
   Keyboard
   Mouse

B. Optimum Configuration
   Pentium or compatible CPU
   32 MB RAM
   150 MB free space on hard drive (uncompressed)
   3.5" disk drive & CD-ROM Drive
   VGA or SVGA display adapter
   Keyboard
   Mouse

Software Requirements: (any of the following)

A. Windows 3.11 (with MS-DOS 5.0 or higher)

B. Windows 9X
C. Windows NT 3.51 and NT 4.0
D. Windows 2000
E. Windows XP PRO

909.3 BARS-PC ANALYSIS – GENERAL GUIDELINES

All information in a BARS-PC input data file shall be entered in uppercase with “Caps Lock ON.”

The first six digits from left of the Structural File Number (SFN) of the bridge with prefix “R” and extension “dat” shall be used as the input data file name. The same first six digits of the SFN shall be used as Structure Group ID No. on all BARS-PC data input cards. For example, if the SFN of a bridge is 4729854, the input file name should be named as “R472985.DAT” and the Structure Group ID No. will be “472985.”

If a SFN has not been assigned to a new structure, contact Structure Inventory Section in the OSE to get a SFN for the structure.

All BARS-PC input files shall have the word “NEW” in columns 9-11 and the letter “X” in column 17 of card type AA.

All BARS-PC input files shall have the bridge rater’s initials and company/office abbreviations in the columns 15-22 of card type 01 and columns 9-16 of card type 02.

All structures rated by BARS-PC using LF method shall have letter “L” in column 65 of card type 05.

All structures rated by BARS-PC shall have letter “F” in column 66 of card type 05.

All structures rated using BARS program shall have a three-digit Structure Type Code in columns 41-46 of card type 02. The three-digit code shall be selected based on the material, type and the description of the main members according to Figure 906. For example, Concrete Slab Continuous shall be coded as “112" and Steel Beam Simple Span shall be coded as “321.”

The complete seven digit SFN shall be entered in columns 9-16 of card type 05.

The original loading used for the design of the bridge shall be stated on card type 06.

The assumptions made to model a structural member or unit for computer analysis shall also be stated on card type 06.

If space on card type 06 (maximum of six cards of type 06) is not sufficient, additional information can be included with the load rating report for ODOT review.

BARS (mainframe) and BARS-PC programs do not recognize standard steel rolled beams, Prestressed I-girder or Prestressed box beam sections. Standard rolled beams shall be coded on card type 12 in terms of flange and web plates. Prestressed I-girders and box beams shall be coded on card type 15 with special attention given to the type, area and strength of the prestressing strands.

When using BARS-PC to load rate multi-span prestressed structures, each member shall be analyzed as a simply supported member.

909.4 BARS-PC LOAD RATING REPORT SUBMISSION

The load rating report shall be submitted to the District office(s). The submission shall include two (2) printed copies and one electronic copy of the Load Rating Report and one electronic copy of the input data files. The Load Rating Reports shall be signed, sealed and dated by an Ohio Registered Engineer.

The District Bridge Engineer will send one printed copy, an electronic copy of the report, the electronic data files and a copy of the final bridge plans to the OSE. The electronic data files from the District may be sent together with a copy of the report on a PC compatible computer disk, CD-ROM or separate from the report as an attachment to an E-mail message.

The report must list final inventory and operating ratings of each main bridge member, overall ratings of each structure unit (mainline, ramps, etc.), and the final ratings of the entire bridge summarized in a tabular form. The ratings of each member and the overall ratings of the structure shall be presented for each live load truck given in Figure 901.

An example of a Load Rating Report Summary is given as Figure 908.

The inventory and operating ratings for the AASHTO HS20-44 loading shall be expressed in terms of the AASHTO HS20-44 loading (English Units), rounded off to the nearest single decimal point. The operating ratings for each of the Ohio Legal Loads shall be expressed in terms of the gross tonnage of the respective legal load. The summary rating for all of the Ohio Legal Loads shall be the smallest rating factor of the four vehicles expressed as a percentage (i.e. multiplied by 100).

For existing bridges, the report shall state how the material properties were determined. Any specific details about the current conditions and bridge geometry shall be listed.

All calculations related to the load rating should be a part of the load rating report.

909.5 BARS-PC COMPUTER INPUT AND OUTPUT FILES

In addition to the electronic input data file, each copy of the rating report shall also include hard (printed) copies of the computer input and output files.

Some computer programs generate several output files during the process of analysis. Include those files that contain information. For example, the load rating analysis report of a steel beam bridge using BARS-PC shall contain printed copies of the following files:

A. lista.lis
B. rate2.lis
C. report.lis
D. flex.lis

910 LOAD ANALYSIS USING BRASS-CULVERT PROGRAM

910.1 GENERAL

BRASS (Bridge Rating and Analysis System) is a family of several structural analysis modules, such as BRASS-Culvert, BRASS-Girder, BRASS-Pole, etc. BRASS-Culvert program can be used to analyze reinforced concrete three-sided flat-topped frames and four-sided box sections.

If haunch dimensions are different, use the smallest dimension in the analysis.

BRASS can run on any Microsoft Windows compatible machine.

BRASS data files should use the same naming convention as the BARS-PC data files.

BRASS Vehicle library can be customized to include ODOT Legal Loads (See Figure 909).

910.2 BRASS CAPABILITIES

BRASS program can analyze single-cell and multi-cell reinforced concrete box structures and frames.

Technical support on BRASS program is available to the BRASS licensed users from the Wyoming Department of Transportation.

910.3 BRASS LOAD RATING REPORT SUBMISSION

The load rating report shall be submitted to the District office. The submission shall include two (2) printed copies and one electronic copy of the Load Rating Report and one copy of the electronic input data files. The Load Rating Reports shall be signed, sealed and dated by an Ohio Registered Engineer.

The District Bridge Engineer will send one printed copy, an electronic copy of the report, the electronic data files and a copy of the final bridge plans to the OSE. The electronic data files from the District may be sent together with a copy of the report on a PC compatible computer disk, CD-ROM or separate from the report as an attachment to an E-mail message.

The report must list final inventory and operating ratings of each main bridge member, overall ratings of each structure unit (mainline, ramps, etc.), and the final ratings of the entire bridge summarized in a tabular form. The ratings of each member and the overall ratings of the structure shall be presented for each live load vehicle according to Figure 901.

An example of a Load Rating Report Summary is given as Figure 908.

The inventory and operating ratings for the AASHTO HS20-44 loading shall be expressed in terms of the AASHTO HS20-44 loading (English Units), rounded off to the nearest single decimal point. The operating ratings for each of the Ohio Legal Loads shall be expressed in terms of the gross tonnage of the respective legal load. The summary rating for all of the Ohio Legal Loads shall be the smallest rating factor of the four vehicles expressed as a percentage (i.e. multiplied by 100).

For existing bridges, the report shall state how the material properties were determined. Any specific details about the current conditions and bridge geometry shall be listed.

All calculations related to the load rating should be a part of the load rating report.

910.4 BRASS COMPUTER INPUT AND OUTPUT FILES

Submit electronic copies of the input & output files with extensions "dat," "cus" and "xml."

In addition to the electronic input data file, each copy of the rating report shall also include hard (printed) copies of the computer input and output files.

911 REFERENCES

A. AASHTO, 1978, "Guide Specifications for Fracture Critical Non-Redundant Steel Bridge Members," and all subsequent Interims.

B. AASHTO, 1983, "Manual for Maintenance Inspection of Bridges."

C. AASHTO, 1989, "Guide Specifications for Strength Evaluation of Existing Steel and Concrete Bridges."

D. AASHTO, 1990, "Guide Specifications for Fatigue Evaluation of Existing Steel Bridges," and all subsequent Interims.

E. AASHTO, 2000, "Manual for Condition Evaluation of Bridges," and all subsequent Interims.

F. BRASS-Culvert software developed by the Wyoming Department of Transportation (PO Box 1708, Cheyenne, WY 82003).

G. Duncan, J.M., 1979, “Design Studies For Aluminum Structural Plate Box Culverts,” Kaiser Aluminum and Chemical Sales, Inc.

H. NCSPA, “Load Rating & Structural Evaluation of In-Service Corrugated Steel Structures,” & Design Data Sheet No. 19, National Corrugated Steel Pipe Association (NCSPA, 202-452-1700).

I. SRG, Structure Rating Group Website http://www.dot.state.oh.us/srg/

J. AASHTO, 2003, “Manual for Condition Evaluation and Load Resistance Factor Rating (LRFR) of Bridges,” and all subsequent Interims.

AN-10 HIGH PERFORMANCE STEEL (GRADE 70)

The following plan note establishes specification requirements for the fabrication of hybrid girders using high performance, grade 70, steel. Provide this note in the structures General Notes.

Item 513, Structural Steel Members, Hybrid Girder, Level Six Fabrication, As Per Plan:

1. DESCRIPTION:

1.01 This work consist of furnishing all necessary labor, materials and equipment to furnish and erect structural steel members, designed as a hybrid/ mix of steel materials consisting of: ASTM A709, High Performance grade HSP70W in combination with Grade 50W steel.

1.02 This work shall be performed per Item 513 Structural Steel Member, level six(6) except as modified by the June, 2003 2nd edition of the "Guide for Highway Bridge Fabrication with HPS70W Steel (HPS485W), A supplement to ANSI/AASHTO AWS D1.5" and as modified by these plan notes.

2. MATERIALS:

2.01 Steel for girder webs and flanges shall be a combination of ASTM A709 grade HPS70W manufactured by the Thermo-Mechanical Controlled Processing (TMCP) or Quenched and Tempered Heat Treatment Processing along with ASTM A588/709 Grade 50W. All other steel shall be ASTM A709 grade 50W.

2.02 Steel designated CVN shall be impact tested to exceed the test values of ASTM A709 table S1.2 "Non-Fracture Critical Impact Test Requirements" for zone 2, temperature range.

3. ADDITIONAL FABRICATION RESTRICTIONS / WARNINGS:

3.01 Application of heat for curving and straightening applications, camber and sweep adjustment, or other reason heating is limited to 1100º F/590 C maximum, and must be done by procedures approved by the director or his authorized representative.

3.02 The matching submerged arc welding consumables ESAB ENI4 electrode in combination with Lincoln MIL800H, recommended in appendix A of the AASHTO guide for highway bridge fabrication with HPS70W steel, has produced weldment containing unacceptable discontinuities in a substantial number of complete penetration groove welds in one structure, based on the parameters used and experience of one fabricator. Extreme caution should be exercised when using this electrode/flux combination.

3.03 Consideration will be given to other welding processes if a written request is submitted to the Office of Materials Management in accordance with CMS

108.05. Other welding processes must be qualified and tested as required by the referenced specifications and these notes.

3.04 In addition to the requirements of ANSI/AASHTO/AWS D1.5 section 5.17. All procedure qualification tests must be ultrasonically tested in conformance with the requirements of AWS D1.5, section 6, part c. Evaluation must be in accordance with AWS D1.5, Table 6.3, ultrasonic acceptance – rejection criteria – tensile stress. Indications found at the interface of the backing bar may be disregarded, regardless of the defect rating.

3.05 Whenever magnetic particle testing is done, only the yoke technique will be allowed, as described in section 6.7.6.2 of the ANSI/AASHTO/ AWS D1.5 Bridge Welding Code, modified to test using alternating current only. The prod technique will not be allowed.

4. BASIS OF PAYMENT:

Payment for the above completed and accepted quantities will be made at the contract bid price for:

Item	**Ext**	**Units**	**Description**
513	10151	LUMP	Structural Steel Members, Hybrid Girder, Level Six Fabrication, As Per Plan:
513	10401	POUND	Structural Steel Members, Hybrid Girder, Level Six Fabrication, As Per Plan:

In addition to the above General Plan note, include the following provisions:

1. Include the following note on the detail plan sheet showing girder elevations:

Where a Shape or plate is designated (CVN) the material shall meet requirements as specified in the general notes on sheet ___/___.

2. Provide a note on the detail plan sheets showing girder elevations indicating where undermatched fillet welding is acceptable. See section 3.3 of Guide Specification for Highway Bridge Fabrication with HPS70W Steel.

All costs associated with this traffic protection will be included with Item 202 for payment.

HISTORY: Note **[17]** was retired by the release of the 2005 Construction and Material Specifications. The information contained in Note **[17]** is entirely contained in CMS 501.05.

ARN-26 RETIRED NOTE 81

If the differential dead load deflection at each end of the crossframes is greater than ½" [13 mm], provide the following note. (Note - if part of a structure's crossframes have a differential deflection of greater than ½" [13 mm] and part of the structure does not, use the following ERECTION BOLT note.)

[81] ERECTION BOLTS AND CROSS FRAME FIELD WELDING: The hole diameter in the girder stiffeners shall be 3/16" [4 mm] larger than the diameter of the erection bolts. The cross frame members shall have slotted holes, 3/4" [19 mm] longer than the bolt diameter and 1/16" [2 mm] wider than the erection bolt diameter. The slot shall be parallel to the longitudinal dimension of the cross frame member. Erection bolts shall be high strength bolts and shall remain in place. Supply two hardened washers with each high strength bolt. Fully torque the bolts or use a lock washer in addition to the two hardened washers. Furnish erection bolts as part of Item 513.

Do not weld the cross frame members to the stiffeners until the concrete deck has been placed.

HISTORY: Note **[81]** was retired in order to reduce the potential for unanticipated girder deflection during deck placement. All crossframes and lateral bracing shall be permanently fastened before deck placement begins.

AP-1 RATING OF BRIDGES AND POSTED LOADS

RATING OF BRIDGES AND POSTING FOR REDUCED LOAD LIMITS

I. PURPOSE

This Standard Operating Procedure outlines the procedures to be performed for rating the relative strength of bridges and for posting warnings of bridge strength deficiencies.

II. REFERENCE

Ohio Revised Code, Section 5591.42:

****or the Director of Transportation, may ascertain the safe carrying capacity of the bridges on roads or highways under their jurisdiction. Where the safe carrying capacity of any such bridge is ascertained and found to be less than the load limit prescribed by sections 5577.01to 5577.12, of the Ohio Revised Code, warning notice shall be conspicuously posted near each end of the bridge as per section IV.C.

Supersedes Standard Operating Procedure OPS-116, dated July 1, 1993.

III. PROCEDURE FOR RATING

A. The relative strength ratings for each bridge shall be determined in the following manner:

1. A careful field inspection of the bridge shall be made by the District Bridge Engineer and/or other qualified structural engineer to determine its condition, and the percent of effectiveness of the various members for carrying load. All information shown in the Bridge Inventory and Inspection Records shall also be carefully checked and revised as necessary to show the current condition of the bridge.

2. Using pertinent current information, the District Bridge Engineer shall determine the Inventory, Operating, and Ohio Legal Load Ratings for the structure as follows:

   a. The Inventory Rating shall be determined by Load Factor Methods and shall be expressed in tons, in terms of the AASHTO-HS Loading.

   b. The Operating Rating shall be determined by Load Factor Methods and shall be expressed in tons, in terms of the AASHTO-HS Loading.

   c. The Ohio Legal Load shall be determined by Load Factor Methods and shall be expressed in terms of the Percent of Ohio Legal Loads.