OHIO DEPARTMENT OF TRANSPORTATION

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

October 15, 2010

To: Users of the Bridge Design Manual

From: Tim Keller, Administrator, Office of Structural Engineering

By: Sean Meddles, Bridge Standards Engineer

Re: 2010 Fourth Quarter Revisions

Revisions have been made to the ODOT Bridge Design Manual, July 2007. These revisions shall be implemented on all Department projects with a Stage 1 plan submission date after October 15, 2010.

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

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

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

The July 2007 edition of the Bridge Design Manual may be downloaded at no cost using the following link:

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

Attached is a brief description of each revision.

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Summary of Revisions to the July 2007 ODOT BDM

BDM Section	Affected Pages	Revision Description
204.6.2.2	2-29 through 2-29.2	A reference to the LRFD Bridge Design Specifications has been added to ensure compliance with FHWA policy.
204.6.2.3	2-29 through 2-29.2	A reference to the LRFD Bridge Design Specifications has been added to ensure compliance with FHWA policy.
209.9	2-43	The required height for bicycle railing on bridges has been revised to be consistent with the AASHTO LRFD Bridge Design Specifications, Section 13.9.2 and the AASHTO Guide for the Development of Bicycle Facilities.
209.10	2-44	The reference to BDM Section 301.4.2 has been corrected.
302.5	3-35 through 3-35.2	This change results from a change in load rating policy for new bridges. Previously, per BDM Section 1004, S4.4, all superstructure types required a PC-BARS load rating factor of 1.25 on the HS20-44 truck at inventory levels. Since PC-BARS analyzed all multi-span prestressed beams as simple spans, the rating provided assurance that simple spans made continuous met a minimum design loading in the event of continuity loss. With this quarterly release, load rating for new bridges shall be in compliance with the Load & Resistance Factor Rating Method (LRFR) which uses a different live load, HL-93. To ensure a minimum design for individual spans in the event of continuity loss, a second design criterion has been added enabling the use of a consistent governing specification (i.e. AASHTO LRFD).
304.3.3	3-76	This change came as a request from the fabricators. Failure to show a dimensional reference from the TST-1-99 post spacing to the beam ends, often results in project delays while the fabricator requests information in order to finalize the shop drawings.
305.2	3-78 through 3-78.2	This revision clarifies when designers should investigate the need for bridge fencing.
305.5	3-80 through 3-80.2	This revision introduces an optional mesh for vandal fencing in lieu of chain-link.
503	5-2	This revision eliminates conflicts with ODOT reference documents.
602.4	6-5	This revision eliminates conflicts between governing specifications for the design of bridges carrying rail traffic.
605.1	6-8 through 6-8.2	This new note addresses the installation of piling for MSE wall supported abutments.

BDM Section	**Affected Pages**	**Revision Description**
702.10	7-10	This section was revised to eliminate confusion between “surface” course and “wearing” course.
1004, *S4.4*	10-10	See BDM Section 302.5 above for detailed explanation.
1006, *S6.6.1.2.3*	10-16	This BDM revision resulted from an AASHTO revision for fatigue resistance which introduced two fatigue load combinations.
1006, *S6.6.1.2.5*	10-16	This BDM revision resulted from an AASHTO revision for fatigue resistance which introduced two fatigue load combinations.

[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].

J. 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.

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

L. The bearing pressure at the service limit state for a spread footing abutment placed on an MSE wall embankment shall be less than or equal to 4 ksf [190 kPa]..

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

204.6.2.2 CAST-IN-PLACE WALLS

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

204.6.2.3 OTHER WALLS

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

205 SUPERSTRUCTURE INFORMATION

205.1 TYPE OF STRUCTURES

The types of superstructure generally used in Ohio consist of cast-in-place concrete slabs, prestressed concrete box or I-beams, and steel beams or welded plate girders. Normally shallow abutments and spill-thru slopes will be used. The type of superstructure used should be selected on the basis of economy as well as appearance. For special conditions where other types of superstructures may be considered, consult the Office of Structural Engineering for recommendations prior to initiating the design.

205.2 SPAN ARRANGEMENTS

The length of a bridge will be determined by the requirements for horizontal clearance at grade

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(highway or railway) separations or by the requirements for waterway opening at stream crossings. Typically for any given bridge, there are a number of combinations of spans and lengths of spans that can be utilized. Generally a preferred span arrangement that minimizes the number of substructure units should be used (i.e. fewer piers with longer spans).

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

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

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

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

205.3 CONCRETE SLABS

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

205.4 PRESTRESSED CONCRETE BOX BEAMS

The span limits for prestressed, side by side, concrete box beams generally range from 15 to 100 feet [5 to 30 meters]. These span limits are based on designs with 0.167 in^2 [108 mm^2] low relaxation strands, a concrete 28-day compressive strength of 7000 psi [48.3 MPa], and a release strength of 5000 psi [34.5 MPa]. Prestressed box beams of up to 120 foot spans [36 meters] have been designed using 10,000 psi [68.9 MPa] concrete and larger diameter strands. Concrete compressive strengths should be limited to 5000 psi [34.5 Mpa] at release and 7000 psi [48.3 Mpa] at 28-days. Consult the Office of Structural Engineering for recommendations prior to designing a structure with higher compressive strengths.

The skew angle should be limited to a maximum of 30 degrees. Consult the Office of Structural Engineering for recommendations prior to designing a box beam structure with a higher degree individual railroad, a crash wall shall be provided unless a T-type or wall type pier is used. Crash walls should have a minimum height of 10 feet [3.1 meters] above the top of rail, except where a pier is located within 12 feet [3.6 meters] of the centerline of tracks and in that instance the minimum height should be 12 feet [3.6 meters] above the top of rail. The crash wall shall be at least 2’-6” [760 mm] thick. For a cap and column pier the face of the wall shall extend 12 inches [300 mm] beyond the face of the columns on the track side. The designer should note that this requirement does not automatically require a crash wall thickness greater than the minimum. The crash wall should be anchored to the footings and columns.

When temporary shoring details are required for construction of substructure units adjacent to railway tracks, details shall be included in the plans. When considering excavation for substructure units, address whether sheet piling can be driven (avoid existing footing, clear any battered piles, elevation of bedrock, etc.) and whether the proper lengths can be provided to retain the railway tracks. The design should be such that no settlement of the tracks is allowed. Interlocking sheet piling of cantilever design is preferred. It may be appropriate to leave the temporary shoring in place after construction.

The minimum vertical clearance from the top of rail should be 23’-0” [7.0 meters]. The point of minimum vertical clearance should be measured (calculated) from a point six feet [1.8 meters], measured horizontally, from the centerline of tracks measured level with the top of the high rail. The horizontal clearances vary between railway companies and need to be addressed for each specific site. Minimum construction clearances shall at least be 14’-0” [4.25 meters] horizontal, 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 found on ODOT’s Office of Local Projects web page, www.dot.state.oh.us/local/. 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 3’-6” [1065 mm] high. For the design of the railing refer to AASHTO LRFD Article 13.9. 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. Refer to BDM Section 301.4.2 for additional design guidance.

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

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

A. If temporary supports are required, provide the location of the assumed temporary support points, reactions and deflections for each construction stage and loading condition.

B. Instructions to the Contractor as to when and how to fasten connections for cross frames or diaphragms to assure stability during all temporary conditions.

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

302.5 PRESTRESSED CONCRETE BEAMS

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

Model multi-span, composite members using the two loading conditions that follow. The loading condition that produces the largest load effects shall govern.

A. Simple-span for non-composite dead loads; continuous span for live load and composite dead loads. The live load and future wearing surface shall be as defined in Section 301.4.

B. Simple-span for all loading conditions. Do not include future wearing surface. The live load shall be as defined in Section 301.4.

302.5.1 BOX BEAMS

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

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

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

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

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

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

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the beams of 1/4 inch [6 mm] per joint.

For box beam bridges that have skew combined with grade or which have variable superelevation, beam seats shall be designed and dimensioned to provide support for the full width of the box beams.

If a bridge structure's geometry causes a bridge deck in an individual span to have a different cross slope at one bearing than at the other bearing, the difference should be evenly divided so that the box beam seat cross slopes at both bearings are made to be the same. This adjustment gives the box beam full support at the seat without creating any twist or torsion on the box beam. Any elevation differences created by this beam seat adjustment should be adjusted for in the overlay, whether asphaltic or concrete.

Prestressed box beam members shall be supported by two bearings at each support.

Abutment wingwalls above the bridge seat and backwalls should not be cast until after box beams have been erected. The cast in place wingwall and box beam should normally be separated by one inch [25 mm] joint filler, CMS 705.03. The designer should show both requirements in the plans. Casting the backwall and wingwalls after the box beams are erected eliminates installation problems associated with the actual physical dimensions of the box beam and the joint filler. Cracking and spalling of backwall and wingwall concrete due to movements of the elastomeric bearings is also alleviated.

For box beam bridges with steel railing, the post spacing and position of post anchorage shall be detailed on the plans. The dimensioning for the post spacing shall be referenced to each prestressed beam end. The designer shall check that the post anchor spacing does not interfere with tierod locations or the "T" joint over the pier. The designer should confirm that post anchors at the ends of skewed box beams have both adequate concrete cover and do not interfere with the tierods. If the designer finds that no post spacing option can comply with the above requirements, the option of relocating the tie rods may be chosen. See standard drawings for maximum allowable spacing of tie rods.

When the box beam ends are not completely encased in concrete, the Standard Bridge Drawing requires Type B waterproofing on the ends. When required, Designers shall include a pay item for Item 512, Type B Waterproofing, in the estimated quantities.

302.5.1.1 DESIGN REQUIREMENTS

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

The 36" barrier section is for use on structures located on two (2) lane routes with an ADTT in one direction less than 2500.

The 42" barrier sections are for use on structures located on interstates, divided highways of four (4) lanes or more, and two (2) lane routes with an ADTT in one direction of 2500 or more. Final decision of which section to use rests with the districts and should be finalized during the preliminary structural design review. The single slope barrier section is unaffected by the placement of future overlays, but weighs 23% more than the 42" New Jersey type parapet.

A 50" deflector type median barrier and a 57" single slope median barrier are for use on structures where protection against oncoming headlight glare is required. The structure's barrier height and type shall match the design of the adjoining roadway median barrier.

For each of the above listed barrier types, designers are required to confirm the structural adequacy of the concrete deck slab as described in the "Concrete Deck Design" Section 302.2 of this manual.

All concrete parapet type barriers shall be designed and detailed as follows:

A. All horizontal reinforcing steel shall be detailed as continuous for the total length of the structure.
B. Crack control joints shall be sawed into the concrete parapets. The distance between the saw-cut joints on the structure shall be between 6'-0" and 10'-0". The detailed locations of the crack control joints and vertical reinforcing bars shall be shown in the contract plans for all parapet types.
C. The saw-cut crack control joint shall be detailed as 1 ¼ inch deep and shall be filled with a polyurethane or polymeric material conforming to ASTM C920, Type S. The bottom one-half inch of both the inside and outside face shall be left unsealed to allow any water that enters the joint to escape. This requirement is established in the Standard Bridge Drawings; however, a plan note is required for special designs. See Section 600.

304.3.2 DEEP BEAM BRIDGE GUARDRAIL (DBR-2-73)

This railing configuration does not meet the Department's minimum NCHRP 350 acceptance criteria (i.e. TL-3) for use on any project unless supported by the selection procedures described in Section 304.1 of this manual. In no case, shall this railing system be used on an overpass structure or a project where the finished deck surface is greater than 25 feet above the normal water surface elevation or final ground line.

The standard configuration for this rail type does not meet the minimum requirements specified by AASHTO for pedestrian and bicycle railings and shall not be used where pedestrian or bicycle traffic is expected. A modified railing design meeting these requirements and using the Type 1 post design may be justified.

Use of Type A anchors, as detailed on the Standard Bridge Drawing, is not recommended. The Type B alternative is recommended because they are easier to install in a deck or box beam and easier to replace if damaged in a collision.

Designers should recognize that variable post lengths may be required along the length of a structure due to beam camber. A design data sheet is available from the Office of Structural Engineering to address these concerns.

304.3.3 TWIN STEL TUBE BRIDGE RAILING (TST-1-99)

This railing configuration was developed as a replacement to the Deep Beam Bridge Guardrail system on projects requiring a higher NCHRP acceptance level. The Twin Steel Tube Bridge Railing is for use over rural stream crossings on two (2) lane routes with an ADTT in one direction less than 2500 where the finished deck surface is less than 25 feet above the normal water surface elevation or final ground line. This system shall not be used on an overpass structure.

The standard configuration for this rail type does not meet the minimum requirements specified by AASHTO for pedestrian and bicycle railings and shall not be used where pedestrian or bicycle traffic is expected. A modified railing design meeting these requirements may be justified.

The required bridge terminal assembly section used to transition from Type 5 or 5A approach roadway guardrail to the bridge railing is detailed on Standard Construction Drawing GR-3.6.

The typical post spacing is 6'-3". The standard drawing enables the designer to reduce the first, last and one additional post spacing per span on each side of the bridge to account for construction clearances. The designer should carefully review the position of the posts that are near the corner of a structure for possible interference with wingwalls, tie rods, etc. For box beam bridge types, post spacing dimensions shall be referenced to each box beam end.

The site plan shall show the station of the center of the first inlet-mounted post on each corner of the bridge.

304.3.4 PORTABLE CONCRETE BARRIER (PCB-91)

This system is for use on construction projects to protect project personnel and to provide a temporary barrier system when a permanent bridge railing system does not exist. Application guidelines for PCB-91 are provided in Design Data Sheet, PCB-DD, available at the Office of Structural Engineering web site.

The designer is required to detail the installation requirements, including the number of anchor bolts per barrier, in the bridge plans. The pay item for this barrier system is Item 622 - Portable Concrete Barrier, 32 inch, Bridge Mounted. Although temporary railing is to be specified and completely described in the bridge plans, temporary railing is a roadway item and shall be included in the roadway quantities.

On projects where maintaining minimum lane widths during a construction phase is not possible due to limited bridge width, the use of a top mounted steel post and tubular steel rail system, similar to the Twin Steel Tube bridge guardrail, may be justified. The railing, post and anchorage designs of these systems are to be in accordance with the *AASHTO LRFD Bridge Design Specifications, Sections A13.1-3*.

304.3.5 BRIDGE SIDEWALK RAILING WITH CONCRETE PARAPETS (BR-2-98)

This railing system is for use on bridges with sidewalks at least 5'-0" wide and a curb height of 8 inches. Although this system is essentially a combination railing system, it may also be used without a sidewalk in applications where pedestrian traffic is not a concern.

Where Vandal Protection Fencing is required, the fencing shall be installed behind the steel tubing as shown in Figure 305.3-2. However, the steel tubing may be omitted if the concrete parapet height is 32" or greater. See Figure 305.3-1. If the tubing is omitted, the fencing should extend the full length of the concrete parapet and the additional 18" parapet height at each end, as detailed in the standard, is not required.

The concrete parapet shall be designed and detailed as follows:

A. All horizontal reinforcing steel shall be detailed as continuous for the total length of the structure.

B. Crack control joints shall be sawed into the concrete parapets. The distance between the saw-cut joints on the structure shall be between 6'-0" and 10'-0". The detailed locations of the crack control joints and vertical reinforcing bars shall be shown in the contract plans.

C. The saw-cut crack control joint shall be detailed as 1 ¼ inch deep and shall be filled with a polyurethane or polymeric material conforming to ASTM C920, Type S. The bottom one-half inch of both the inside and outside face shall be left unsealed to allow any water that enters the joint to escape. This requirement is established in the Standard Bridge Drawing; however, a plan note is required for special designs. See Section 600.

305 FENCING

305.1 GENERAL

The primary purposes of protective fencing are to provide for the security of pedestrians and to discourage the throwing or dropping of objects from bridges onto lower roadways, railroads, boat lanes or occupied property. In addition, fence may be needed on high level bridges where wind may threaten to blow pedestrians or occasional stranded motorists off the bridge and on bridges where there is a danger that the outside parapet may be mistaken for a median barrier, causing persons to jump over the parapet in emergency situations in periods of darkness. These situations should be treated on a case-by-case basis.

Since a falling object problem could occur at any bridge accessible to pedestrians, it is necessary to consider installation of protective fencing at such locations.

Generally, fencing attached to bridge structures for the protection of traffic and pedestrians should conform to the Vandal Protection Fencing Standard Bridge Drawing. The designer may need to enhance this standard to deal with requirements for the specific structure.

305.2 WHEN TO USE

Designers shall investigate the need for fencing on all new overpass bridges during the Red Flag Summary. Pedestrian Fencing may be required when a total of 10 points or greater is achieved for a structure according to the following criteria. The designer should use this procedure as a general guide as to the need for fencing. The affected district should also be consulted for their input. The list is not to be construed as all-inclusive. Other rationale may be used on a case-by-case basis. Similarly, retrofitting of bridges that qualify according to the total index number is not mandatory if adequate justification for not doing so can be documented.

	JUSTIFICATION ITEM	INDEX POINTS
A.	Overpass within an urbanized area of 50,000 or more population	2
B.	Overpass with sidewalks but not in an urbanized area as defined in (A) (“Sidewalk” does not include safety curbs 2'-3" [685 mm] or less in width)	2
C.	Overpass which is unlighted	2
D.	Overpass not a main thoroughfare, i.e., on collectors or local streets	2
E.	Overpass within ½ mile [0.8 km] of another overpass exclusive of pedestrian bridges, having or requiring protection	2
F.	Overpass within ½ mile [0.8 km] of another overpass having previous reports of falling objects	4
G.	Overpass within 1 mile [1.6 km] of a school, playground or other pedestrian attraction	4
H.	Bridges over any feature which has a high count of boat, rail, vehicular or pedestrian traffic, or includes damage-sensitive property	4
I.	Overpass which has had prior reported incident of falling objects	6
J.	Overpass which is used exclusively by pedestrians	10

“OVERPASS” is a bridge over a highway or a railroad.

Justification Items (E), (F) and (G) do not apply to overpasses carrying Freeway routes, as defined in ORC 4511.01, where pedestrians are prohibited per ORC 4511.051.

305.3 FENCING CONFIGURATIONS

For structures with sidewalks, the top of fence should be a minimum height of 8 feet [2450 mm] above the sidewalk. For a greater degree of protection against objects being thrown from the

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bridge, the fence may be curved to overhang the sidewalk. For curved fence the posts should be vertical for approximately 8 feet [2450 mm] above the sidewalk before curving inward over the sidewalk. The overhang should be at least 1 foot [300 mm] less than the width of the sidewalk, with a maximum overhang of 3'-7" [1100 mm]. The slope of the straight overhanging portion should be 1 vertical to 4 horizontal. The radius of the connecting arc should be 32 inches [815 mm]. See Figures 305.3-1 & 305.3-2.

For narrow pedestrian bridges, bent pipe frames are generally used with pipe bend radii of 24" [600 mm] at the upper corners and the start of the radii about 8 feet [2450 mm] above the sidewalk surface. The fabric should start at the deck line, top of curb or parapet and may stop at the upper end of the bent portion of the frame.

Fabric on the top horizontal area of the frame is sometimes not installed because adventurous youngsters tend to walk on the top of the enclosure. See Figure 305.3-3 for an illustration of this configuration. To try to eliminate the adventurous youngster problem, some pedestrian bridges have used a frame design that comes to a peak at the center of the structure, similar to a house roofline.

Chain link fabric should not have an opening at the bottom through which large objects could be pushed. A detail to close the bottom of a fencing section is included on the standard bridge drawing. The closure plate detail is required for all fence configurations that have tension wire at the bottom of the fence fabric.

Posts and frames may be either plumb or perpendicular to the longitudinal grade of the bridge, subject to considerations of aesthetics or practicality of construction. Complete details of base plates, pipe inserts or other types of base anchorage shall be provided on the plans. If applicable to the specific project, details from the standard bridge drawing may be referred to in the project plans.

305.4 SPECIAL DESIGNS

The following information is given the designer as a basis for specialized designs. It is not intended for designers to develop their own requirements in lieu of the standard bridge drawing.

For fence installation projects on new structures, the installation of a traffic railing (steel tubing) is not required if the top concrete parapet or concrete wall is 32" [813 mm] above roadway for structures without sidewalks or 32" [813 mm] above the top of sidewalk for structures with sidewalks. See Figure 305.3-1.

For special fence designs, plan notes shall be required to define materials, traffic maintenance, construction procedures and other requirements. The designer should follow the example of standard bridge drawing for development of required notes.

305.5 FENCE DESIGN GENERAL REQUIREMENTS

Fencing mesh should consist of either of the following materials:

A. Chain-link wire mesh with one inch [25 mm] diamonds. The core wire shall be 11 gage [3.05 mm] with a Polyvinyl chloride coating. (C&MS 710.03)

B. Welded wire fabric with ½" x 3" [12 mm x 75 mm] opening size. The core wire shall be 10.5 gage [3.25 mm]; galvanized after welding (1.2 oz zinc/ft^2), and PVC coated (10 mil [0.25 mm]).

Brace and bottom rails shall be clamped to posts or post frames.

The top rail, if any, of a free-standing fence should be continuous over two or more posts and suitable cap fittings provided.

Bent pipe frames for narrow pedestrian bridges are permitted. Bent pipe frames for narrow pedestrian bridges should be fabricated in two or more sections and field spliced at the top with sleeves bolted to the frame sections.

To prevent pipe blow-ups during galvanizing, both ends of pipe should be open. Therefore base plates should have holes in them almost equal to the pipes' inside diameter.

305.5.1 WIND LOADS

The design wind pressure (P) in lb/ft^2 [kPa] shall be calculated using:

$P = 27.69C_h$, derived from the formula:

$P = 0.00256(1.3V)^2C_sC_hC_i$ (1)

Where:

V = 50 yr. mean wind vel. (2) = 80 mph

1.3 = 30% Wind Gust Factor

C_s = Shape Coefficient = 1.0

C_h = Height Coefficient (See table)

C_i = Ice Coefficient = 1.0

$P = 1.326C_h$, derived from the formula:

$P = 0.0471(1.3V)^2C_sC_hC_i/1000$ (1)

Where:

V = 50 yr. mean wind vel. (2) = 129 km/h

1.3 = 30% Wind Gust Factor

C_s = Shape Coefficient = 1.0

C_h = Height Coefficient (See table)

C_i = Ice Coefficient = 1.0

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SECTION 500 – TEMPORARY STRUCTURES

501 GENERAL

This section is a supplement to CMS 502, Structures For Maintaining Traffic. All design guidelines of CMS 502 apply.

502 PRELIMINARY DESIGN

For the Structure Type Study, the Designer shall show the grade, alignment, approximate location and width of the temporary structure on the Preliminary Structure Site Plan.

For the Preliminary Design Report, the Designer shall show the grade and the alignment of the temporary structure on the Site Plan. The Designer shall also determine the roadway width, hydraulic design , clearance requirements, and all other design parameters in conjunction with the development of the preliminary design . When the temporary structure can adequately be shown on the Site Plan for the permanent bridge, a Site Plan for the temporary structure is not required. The required Site Plan information shall be as detailed in Section 200. The Designer shall submit the preliminary design of the temporary structure concurrently with the Preliminary Design Report at the Stage 1 Detailed Design Review Submission for the permanent structure.

502.1 HYDRAULICS

The design year and other hydraulic requirements for temporary structures are defined in CMS 502.02. In addition to those requirements, scour depths for the design year discharge shall be calculated and accounted for in the design of the temporary bridge and its foundation.

With the owner’s approval, the design year may be reduced for low volume roads with an ADT less than 200.

The designer shall show the water surface elevation (“high water”) and velocity of the design year discharge on the temporary structure plans. The lowest portion of the superstructure of the temporary bridge shall clear the design year discharge.

Culvert pipes may be used in lieu of a bridge structure provided controls specified in Section 1006 of the ODOT Location and Design Manual are not exceeded for the design year discharge.

503 DETAIL DESIGN

The temporary structure detail plans shall be complete and independent of the permanent structure plans. The temporary structure detail plans shall include general plan and elevation views, general notes, a table of estimated quantities, a reinforcing steel bar list and all necessary detail plan sheets. The Designer should clearly indicate that the temporary structure will be paid for under one Lump Sum bid item - Item 502, Structure for Maintaining Traffic, and the table provided for estimated quantities is “For Estimating Purposes Only”.

Temporary bridge structures shall be designed as permanent structures in accordance with the *AASHTO LRFD Bridge Design Specifications* and this Manual except that the design live loading, HL-93, may be reduced by 25 percent. The temporary bridge plans shall include Design Data in the General Notes as defined in BDM Section 600.

For ice pressure loads, the thickness of ice shall be assumed to be 6 inches [150 mm], with a 200 psi [1.4 MPa] effective ice strength. The force shall be assumed to act at the level of the design year highwater elevation.

The bridge railing for the temporary structures shall meet the requirements of Section 304 of this Manual. If the Designer elects to use standard Type 5 or 5A guardrail or standard portable concrete barrier, the Designer should account for the deflection characteristics of the barrier.

Generally a temporary structure should be designed to be easily constructed and removed with minimal cost. The following items should be considered when designing a temporary bridge:

A. Timber decks, H pile bents, and simple spans are commonly used.

B. Locally available lumber should be specified. The allowable design unit stresses of the lumber used in the design shall be specified in the plans . State whether timber sizes are full sawn or standard dressed sizes.

C. The nominal thickness of wood plank or strip floor shall be 3 inches [75 mm] minimum.

D. Timber floors shall be securely fastened to the stringers and stringers shall be securely fastened to the pier and abutment caps.

E. When circumstances permit, all or part of the existing bridge may be used for the run-around.

F. Field welded connections shall require nondestructive testing as per 513. Bolted connections are preferred and generally are more economical.

G. Designs that minimize debris accumulation should be considered.

H. Shop drawings are not required. Adequate plan details need to be provided.

I. The road surface on the temporary structure shall have antiskid characteristics, crown, drainage and superelevation in accordance with all ODOT and AASHTO publications.

504 GENERAL NOTES

The designer should provide plan note(s) with the Temporary Structure plans similar to the following:

A. The Contractor may substitute used or alternate members for the members shown on the Temporary Structure Plans, provided that the strength of the substitute or alternate member is

[602.3-2] DESIGN DATA:

Concrete for prestressed beams:

Compressive Strength (final) - (1) ksi

Compressive Strength (release) - (2) ksi

Prestressing strand:

Area = (3) in^2

Ultimate Strength = 270 ksi

Initial stress = 202.5 ksi (Low relaxation strands)

NOTE TO DESIGNER:

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

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

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

602.4 FOR RAILWAY PROJECTS

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

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

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

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

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

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

602.5 DECK PROTECTION METHOD

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

[602.5-1] DECK PROTECTION METHOD:

Epoxy coated reinforcing steel

2½" concrete cover

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

Waterproofing and asphalt concrete overlay

Steel drip strip

Other (Specify)

602.6 MONOLITHIC WEARING SURFACE

Furnish the following note for concrete bridge decks.

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

602.7 SEALING OF CONCRETE SURFACES

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

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

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

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

Remove abutments to Elev.____. Remove piers to Elev.____.

604 TEMPORARY STRUCTURE CONSTRUCTION

Include the applicable portions of the following temporary structure note on the plans if the bridge roadway width is other than 23 feet [7 meters], or if the use of the existing structure is part of the temporary road. See Section 500 for additional information.

[604-1] TEMPORARY STRUCTURE roadway width shall be ______ feet. The existing structure may be moved and used for the temporary structure without strengthening.

605 EMBANKMENT CONSTRUCTION

For all substructure units where embankment construction is involved, provide appropriate embankment construction notes in the Structure General Notes. Consult the Office of Structural Engineering for the recommended notes to use at a specific project site.

605.1 FOUNDATIONS ON PILES IN NEW EMBANKMENTS

The following construction method should minimize the effect of lateral forces acting on substructure units and their piles.

For structures with abutments on piles placed in new embankments use the following note:

[605.1-1] PILE DRIVING CONSTRAINTS: Prior to driving piles, construct the spill through slopes and the bridge approach embankment behind the abutments up to the level of the subgrade elevation for a minimum distance of _*_ behind each abutment. Do not begin the excavation for the abutment footings and the installation of the abutment piles until after the above required embankment has been constructed.

NOTE TO DESIGNER:

* Generally 200 feet [60 meters]. Optionally, this distance may be defined by station-to-station dimensions.

For structures with abutments and piers on piles placed in new embankments use the following note:

[605.1-2] PILE DRIVING CONSTRAINTS: Prior to driving piles, construct the spill through slopes and the bridge approach embankment behind the abutments up to the level of the subgrade elevation for a minimum distance of _(1)_ behind each abutment. Do not begin the excavation for the abutment footings and the installation of the abutment and pier piles, for pier(s): _(2)_, until after the above required embankment has been constructed.

NOTE TO DESIGNER:

(1) Generally 200 feet [60 meters]. Optionally, this distance may be defined by station-to-station dimensions.

(2) Identify specific piers.

For structures with wall type abutments on piles placed in new embankment use the following note:

[605.1-3] PILE DRIVING CONSTRAINTS: Prior to driving piles at the abutments, construct the bridge approach embankment behind the abutments up at a 1:1 slope from the top of the heel of the footing* to the subgrade elevation and for a minimum distance of 250 feet behind the abutments. Do not begin the installation of the abutment piles until after the above required embankment has been constructed. After the footing and the breastwall have been constructed, construct the embankment immediately behind the abutments up to the beam seat elevation and on a 1:1 slope up to the subgrade elevation prior to setting the beams on the abutments.

NOTE TO DESIGNER:

* In some cases the bottom of the heel may be used.

For MSE wall supported abutments with driven piles use the following note:

[605.1-4] PILE DRIVING CONSTRAINTS: Prior to driving abutment piles to the Ultimate Bearing Value (UBV) or to refusal on bedrock, construct the MSE wall and the bridge approach embankment behind the abutment up to the bottom of the footing for a minimum distance of _*_ behind each abutment. The Contractor may pre-drive abutment piles before constructing MSE walls. Pre-driving consists of installing the abutment piles into the soil only as far as necessary so that the pile will remain vertical during MSE wall construction. If pre-driving piles, install pile sleeves around piles before constructing the MSE wall. At least three feet of pile must extend above the top of the pile sleeve to meet the requirements of CMS 507.09 regarding splices. Do not drive abutment piles to the UBV or to refusal on bedrock until after the above required MSE wall and embankment have been constructed and a _**_ calendar day waiting period has elapsed. The Engineer may adjust the length of the waiting period based on settlement platform readings. After the specified waiting period has elapsed, drive abutment piles to the UBV or to refusal on bedrock. In order to remove any negative skin friction that has developed during the waiting period, drive each abutment pile a distance of at least 0.5 inch.

If not pre-driving abutment piles, install the abutment piles through pile sleeves after the above required MSE wall and embankment have been constructed and the specified waiting period has elapsed.

NOTE TO DESIGNER:

* Generally 200 feet [60 meters]. May be defined by station-to-station dimensions.

** Estimate the length of the waiting period by determining the time required for 90% of primary settlement to occur.

605.2 FOUNDATIONS ON SPREAD FOOTINGS IN NEW EMBANKMENTS

The following construction method helps to eliminate any lateral forces on the foundation due to the construction of the embankment and/or settlement of the subgrade under the embankment. For stub abutments on spread footings being constructed in new embankments provide note **[605.3-1]** or **[605.3-2]** and the following note:

[605.2-1] CONSTRUCTION CONSTRAINTS: Prior to constructing the spread footing foundations, construct the bridge approach embankments behind the abutment up at a 1:1 slope from the bottom of the heel of the footing to the subgrade elevation and for a minimum distance of 250 feet behind the abutments. After the abutment footing and breastwall are completed and prior to setting superstructure members, construct the embankment immediately behind the abutment up to the beam seat elevation and on a 1:1 slope up to the subgrade elevation, with Type B granular material conforming to 703.16.C.

NOTE TO DESIGNER: Modify the note, as appropriate, for piers constructed on a spread footing foundation.

For wall type abutments on spread footings with no new embankment provide note **[605.3-1]** or **[605.3-2]** and the following note:

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in thickness is required.

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

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

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

Calculated camber at time of paving is ______ inches.

Long term camber is ______ inches.

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

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

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

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

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

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

NOTE TO DESIGNER: The calculated camber at the time of release is (B – C), at the time of paving is (1.8B - 1.85C), and long term is (2.45B – 2.40C). The calculated deflection due to dead load applied after the beams are set is (D + E). The vertical curve adjustment at midspan is (F) when F > 1.8B - 1.85C - D - E. The vertical curve adjustment at each bearing is (F) when F < 1.8B - 1.85C - D - E and may be upward for sag curves or downward for crest curves. Remove the reference to the vertical curve adjustment that does not apply.

Conclude note **[702.9-1]** with note (1), (2) or (3) as appropriate. Note (1) should be used when after placement of the topping, the top surface of the beam parallels the profile grade. Note (2) should be used when F > 1.8B - 1.85C - D - E. Note (3) should be used for all other cases.

For non-composite designs, include in the bridge plans a diagram similar to Figure 702.9-1 showing the thickness of the Item 448 Intermediate course and the Item 448 surface course at each centerline of bearing and at midspan.

For composite design, show a longitudinal superstructure cross section in the plans detailing the total Topping Thickness at each centerline of bearings and at midspan. Also show screed elevation tables similar to 0.

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

[702.9-3] NOTE TO FABRICATOR: The dimensions measured along the length of the beam, marked with a _*_, do not contain an allowance for the effect of the longitudinal grade. Include the proper allowance for these dimensions in the shop drawings.

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

702.10 ASPHALT CONCRETE WEARING COURSE

Place note **[702.10-1]** on the plans for prestressed concrete box beam bridges having an asphalt concrete wearing course. If the nominal thickness of 448 varies from the 1½" [38 mm] shown, revise the note accordingly.

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

[702.10-1] ASPHALT CONCRETE WEARING COURSE shall consist of a variable thickness of 448 asphalt concrete intermediate course, Type 2, PG64-28 and a 1½" thickness of 448 asphalt concrete surface course, Type 1H. Place the 448 intermediate course in two operations. The first portion of the course shall be of 1½" uniform thickness. Feather the second portion of the course to place the surface parallel to and 1 ½" below final pavement surface elevation.

702.11 PAINTING OF A588/A709 GRADE 50 STEEL

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

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

S*3.11.8* *DOWNDRAG*

Refer to BDM Section 202.2.3.2.c for more information.

S*3.12.2* *UNIFORM TEMPERATURE*

To determine the thermal effects for all bridges, use the following ranges of temperatures:

A. Steel or Aluminum .... -30° to 120°F

B. Concrete .... 15° to 95°F

C. Wood .... 0° to 75°F

The base construction temperature assumed for design shall be 60°F.

1004 LRFD SECTION 4 – STRUCTURAL ANALYSIS AND EVALUATION

S4.4 ACCEPTABLE METHODS OF STRUCTURAL ANALYSIS

This Manual identifies various design conditions that require specific methods of analysis. Where analysis methods are dictated by this Manual, the Designer shall provide justification during the staged review process for designs that utilize alternative analysis methods. This justification shall include impacts to project cost and schedule; safety; constructability; etc. The Department reviewer may consult with the Office of Structural Engineering to determine the appropriateness of the justification. The Department is not responsible for engineering costs incurred as a result of unjustified alternative analysis methods. Where analysis methods are not dictated by this Manual, the selection of an appropriate analysis method utilized for the design of new structures is the responsibility of the Designer.

Regardless of the analysis method utilized for design, superstructures are required to be load rated in accordance with BDM Section 900. At the inventory level, the minimum rating factor for the HL-93 loading shall be 1.0.

Listing design software used for structural analysis in the structure general notes is not required.

S4.5.1 GENERAL

Do not include the stiffness contribution of structurally continuous composite railings, curbs elevated medians and barriers in the structural analysis.

S4.6.2.2.1 APPLICATION

Use the following live load distribution factor application guidelines for *Table 4.6.2.2.1-1* and typical ODOT bridge types:

Typical ODOT Bridge Type	Applicable *Table 4.6.2.2.1-1* Cross-section
Steel beam/girder	(a)
Concrete I-beam	(k)
Composite Box beam	(f)
Non-composite box beam	(g)*

* - Use distribution factors that assume beams are connected only enough to prevent relative displacement at the interface. The tie rods specified in Standard Bridge Drawing PSBD-1-93 do not supply sufficient force to ensure units act together.

The 3.0 ft. limit specified for the roadway part of the overhang, d_e, does not apply to the determination of the interior distribution factor for cross-sections (a) and (k).

S*5.13.2.2* *DIAPHRAGMS*

Refer to BDM Section 302.5.2.6 for additional information.

S*5.13.4.5.2* *REINFORCING STEEL*

For 12.0 in., 14.0 in. and 16.0 in. diameter cast-in-place piles, the minimum wall thickness requirements of C&MS 507.06 provide sufficient longitudinal reinforcement to meet *Article 5.13.4.5.2*. Except as noted in BDM Sections 202.2.3.2.b and 303.3.2.5 for capped pile piers, no additional reinforcement is required. The additional steel required for capped pile piers shall extend from the pier cap to a minimum of 15 ft. below the finished ground line or flow line, but is not required to extend 10.0 ft. below the plane where the soil provides adequate lateral restraint.

The cast-in-place concrete piling clear distance requirements specified in *Article 5.13.4.5.2* do not apply to drilled shafts or piles for Capped Pile Piers. Refer to BDM Section 303.4.3 for reinforcing steel requirements in drilled shafts

1006 LRFD SECTION 6 – STEEL STRUCTURES

S6.4.1 STRUCTURAL STEELS

Refer to BDM Section 302.4.1.1 for steel selection criteria.

S6.4.3.1 BOLTS

The use of ASTM A 490 bolts is prohibited.

S6.6.1.2.3 DETAIL CATEGORIES

All components or details shall be designed for infinite life using the Fatigue I load combination.

S6.6.1.2.5 FATIGUE RESISTANCE

As noted in BDM Section 1006, *S6.6.1.2.3* above, all components and details shall be designed for infinite life using the Fatigue I load combination. Use of the Fatigue II load combination for finite life shall be avoided.

S6.6.2 FRACTURE

The CVN requirements specified in C&MS 711.01 meet Temperature Zone 2.

The CVN requirements for HPS 70W steels are not provided in C&MS 711.01, but are included in BDM Appendix note AN-10.