OHIO DEPARTMENT OF TRANSPORTATION

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

July 15, 2005

To: Users of the Bridge Design Manual

From: Tim Keller, Administrator, Office of Structural Engineering

By: Sean Meddles, Bridge Standards Engineer

Re: 2005 Third 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 Third Quarter, 2005 Revisions to the ODOT BDM

BDM Section	Affected Pages	Revision Description
203.1	2-17	This section contained out dated references that were updated. Also, a clarification was added to ensure that the correct flow rates are used for projects that impact an NFIP study area.
203.2	2-18 through 2-19.2	In 203.2 D, the Division of Water website at Ohio Department of Natural Resources has been provided. Also, the permitting requirements of a local flood plain are established by the Local Flood Plain Coordinator. The noted restriction for the size of the drainage area was in error and has been removed. In 203.2 H, some clarification was provided for the analysis requirements for projects involving impacts to NFIP study areas.
603	6-10	Note [16] was revised to include the construction plan submission requirements established in the 2005 CMS, Section 501.05. Note [17] was deleted as a result of the 2005 CMS, Section 501.05 requirements.
603.1	6-10 through 6-12	Note [18] was revised to include the construction plan submission requirements established in the 2005 CMS, Section 501.05. The "Protection of Traffic" portion of the note has been removed. Other portions of the notes were revised for consistency with CMS 501.05.
610.5	6-27	Note [46] was revised to reflect the inclusion of epoxy injection into the 2005 CMS, Section 512.07.
909.5	9-16	The file name in 909.5 C was incorrectly provided as "Summary.lis". The corrected name is "Report.lis"
AN-2	Appendix-15 through Appendix-16	The acceptable pH range for the select granular fill material has been corrected. Corrected a reference for retired SS864 with CMS 512.
AN-3	Appendix-24 through Appendix-25	The acceptable pH range for the select granular fill material has been corrected. Corrected a reference for retired SS864 with CMS 512.
AN-4	Appendix-33 through Appendix-34	The acceptable pH range for the select granular fill material has been corrected. Corrected a reference for retired SS864 with CMS 512.
ARN-25	Appendix-109.13 through Appendix-109.14	Retired note [17] has been added to the appendix for historical purposes.

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 by the method described in USGS Water-Resources Investigations Report 89-4126 "Techniques for Estimating Flood-Peak Discharges of Rural Unregulated Streams in Ohio".

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 Report 89-4126 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

allowable backwater elevation corresponds with the backwater elevation which currently exists.

G. When a proposed structure is subject to the approval of a Conservancy District, the waterway shall be designed to comply with their regulations if more restrictive than ODOT's.

H. The design of all highway encroachments on the 100 year flood plain shall comply with the regulations as stated in the Code of Federal Regulations (23 CFR 650 A). Engineers responsible for bridge hydraulics should read these regulations to become familiar with their contents. When a highway encroachment is located in a detailed NFIP study area, create a duplicate of the original NFIP water surface model. Actual field survey data may be used to supplement the original NFIP data.

When making an encroachment, the proposed structure size submitted for preliminary design review shall be supported by an analysis of design alternatives with consideration given to capital costs and risk. "Risk" is defined as the consequences attributable to an encroachment. Risk includes the potential for property loss and hazard to life (A Flood Hazard Evaluation).

When making an encroachment on a NFIP designated flood plain in the floodway fringe, the rise in the water surface is limited to one foot [0.3 meters] above the natural 100 year flood elevation as given by the NFIP study. No increase in the 100 year water surface is allowed when encroaching on a NFIP designated floodway (44 CFR 60.3(d)(3)). See Figure 201.

For bridges located outside NFIP jurisdiction regions, a limit of a one foot [0.3 meters] rise in the 100-year water surface elevation caused by any encroachment above the natural (no bridge, no roadway, no development, etc.) condition is mandated by the Ohio Revised Code, section 1521.13. There may be cases when this is too stringent of a criterion and may not be practical due to physical constraints or economic considerations. The Local Flood Plain Coordinator will need to be involved in any discussions/decisions when a new structure exceeds the one foot rise criteria. The responsible government agency which initiated the project will be responsible for contacting and coordinating with the Local Flood Plain Coordinator.

Longitudinal encroachments require alternative location studies to be summarized in the Conceptual Alternatives Study (L&D Section 1403.3). Evaluation of specific bridge hydraulics may not be necessary when alternative highway alignments are under consideration for the project. Refer to the Code of Federal Regulations (23 CFR 650 A) for more specific information.

I. It should not be assumed that an attempt should be made to lower existing high water elevations. However, for bridge replacement projects where the existing structure is severely hydraulically taxed, an effort should be made to improve the hydraulics for both the design and 100 year recurrence interval discharges, with consideration of the one foot [0.3 meters] rise criterion discussed in Section 203.2.h. No allowable backwater requirements are set by these criteria; rather the allowable backwater should be determined by good engineering judgment considering the area inundated and the mean velocities induced through the structure.

J. In general, the bridge should be designed to clear the design year frequency flood. This criterion

may be waived because of roadway design constraints such as existing at-grade intersections, perpetuating existing profile grades, existing backwater elevations, presence of existing road overflow or other reasons.

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K. Spill-thru type structures are generally preferred for cost effectiveness and hydraulic efficiency.

203.3 SCOUR

For bridges over waterways, armor the entire spill-through slope in front of the abutments and wingwalls, including the corner cones with Rock Channel Protection of the type determined from the following table. Rock Channel Protection requires the use of a filter. A 6 inch [150 mm] bed of crushed aggregate is allowed as an alternate in CMS 601.09 and should be specified when the rock is to be placed below water. The Item Master pay item descriptions allow for the differentiation between all options: with filter, with fabric filter or with aggregate filter.

The following table, relating bridge channel mean velocity of the design discharge versus rock type and thickness, shall apply as minimums. Special circumstances such as protection on the outside of curves or in northern regions of the state where ice flow is a concern may require greater rock thickness.

Velocity (ft/s)	Type	Thickness
0-8	C	2'-0"
8-10	B	2'-6"
above 10	A	3'-0"

Velocity (m/s)	Type	Thickness
0-2.4	C	600 mm
2.4-3.0	B	750 mm
above 3.0	A	1000 mm

The locations, length, and the top of slope elevations for the rock channel protection should be shown on the Site Plan. The rock should be shown in greater detail in the roadway section in conjunction with the channel plans. It will generally be economical to provide bank protection during the initial construction in order to provide sufficient embankment protection to minimize future maintenance.

A. Excavation for stream channel work shall be limited to that portion of the channel one foot [300 mm] above normal water elevation in order to minimize intrusion and to preserve the natural low water channel. Where the spill-thru slope infringes upon the natural low water channel, excavation should be made for placement of the rock channel slope protection at the toe of the slope.

B. Substructures for bridges over waterways shall be supported by piling or drilled shaft foundations unless the footings can be founded on bedrock. Substructures for precast reinforced concrete three-sided flat-topped and arch culverts are addressed in the Location and Design Manual, Volume 2.

C. For bridges over waterways where bedrock is determined to be at or close to the flow line,spread footings or drilled shafts shall be used. Spread footings shall be embedded into the bedrock in

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

[13] Note Retired - See appendix

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

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.

PROTECTION OF PRESTRESSED CONCRETE SUPPORT SYSTEMS: Before deck slab cutting is permitted, draw the outline of primary prestressed concrete 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 the edges of those members. 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 prestressed concrete members that are to be incorporated into the proposed structure. Replace or repair prestressed concrete 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.

REMOVAL METHODS: The Contractor may remove concrete by cutting and by means of hand operated pneumatic hammers employing pointed or blunted chisel type tools. For removals over structural members (prestressed box beam, I-beam, steel beam steel girder, etc), the Contractor may use a hammer heavier than 35 pounds [16 kilograms] but not to exceed 90 pounds [41 kilograms] unless approved by the Engineer. Removal methods over structural members shall ensure adequate depth control and prevent nicking or gouging the primary structural members.

Due to the possible presence of attachments (e.g., finishing machine, scupper and form supports, etc.) to existing structural members, perform work carefully during deck removal to avoid damaging structural members that are to remain. Replace or repair structural members damaged by the removal 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.

DECK REMOVALS - COMPOSITE DECK DESIGNS - STEEL SUPERSTRUCTURES: Due to the presence of welded studs to the existing structural steel, submit a detailed procedure of the deck removal to the Engineer at least 7 days before construction begins. Department acceptance is not required. The procedure shall include all details, equipment and methods to be used for removal of the concrete over the flanges and around the studs. Replace or repair main steel and studs damaged by the removal 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.

DECK REMOVALS - COMPOSITE DECK DESIGNS - PRESTRESSED SUPERSTRUCTURES: Due to the presence of composite reinforcing steel between the deck and the prestressed beam flanges, submit a detailed procedure of the deck removal to the Engineer at least 7 days before construction begins. Department acceptance is not required. The procedure shall include all details, equipment and methods of removal

over the prestressed beams and around the composite reinforcing steel. Replace or repair prestressed members and composite reinforcing damaged by the removal 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.

EXISTING WELDED ATTACHMENTS: Remove existing welded attachments (e.g., finishing machine and form supports; and supports for scuppers and bulb angles which are to be removed) located in the designated tension portions of the top flanges of existing steel members and grind the flange surfaces smooth. Carefully grind parallel to the flanges.

MEASUREMENT & PAYMENT: The Department will measure the quantity of removals on a lump sum basis. The Department will pay for the accepted quantities of removals at the contract price for Item 202, Portions of Structure Removed, As Per Plan.

For modifications to or extensions of existing concrete substructure members where aesthetics is a concern, include the following notes in an Item 202, as per plan note.

[19] CUT LINE CONSTRUCTION JOINT PREPARATION: Saw cut boundaries of proposed concrete removals 1 inch [25 mm] deep. Remove concrete to a rough surface. Leave the existing reinforcing steel, if required in the plans, in place. Install dowel bars if specified. Prior to concrete placement abrasively clean joint surfaces and existing exposed reinforcement to remove loose and disintegrated concrete and loose rust. Thoroughly clean the joint surface and exposed reinforcement of all dirt, dust, rust or other foreign material by the use of water, air under pressure, or other methods that produce satisfactory results. Existing reinforcing steel does not have to have a bright steel finish, but remove all pack and loose rust. Thoroughly drench existing concrete surfaces with clean water and allow to dry to a damp condition before placing concrete.

dimensions and requirements defined in the project plans.

Submit construction plans in accordance with CMS 501.05.

If, during the jacking operations, cracking of the concrete superstructure, separation of the concrete deck from the steel stringers, or other damage to the structure is visually observed, immediately cease the jacking operation and install supports to the satisfaction of the Engineer. Analyze the damage and submit a method of correction to the Engineer for approval. Epoxy inject all beams that separate from the deck for the distance of the separation in accordance with CMS 512.07. The Department will not pay for the cost of this epoxy injection or other required repairs. The bridge bearings shall be fully seated at all contact areas. If full seating is not attained, submit a repair plan to the Engineer. The Department will not pay for the repair costs to ensure full seating on bearings.

The Department will measure this work on a lump sum basis.

The Department will pay for the accepted quantities at the contract price for Item 516, Jacking and Temporary Support of Superstructure, As Per Plan.

610.6 FATIGUE MEMBER INSPECTION

When re-decking a continuous beam bridge containing top flange fillet-welded cover plates and/or field butt-welded beams, provide the following note to facilitate the Engineer's inspection of the welded connections.

[47] INSPECTION OF EXISTING STRUCTURAL STEEL: The Engineer will visually inspect all existing butt-welded splices and/or top flange cover plate fillet welds to ensure the welds, plates and beams or girders are free of defects and cracks. If necessary, remove all deck slab haunch forms immediately adjacent to such welds that may interfere with the Engineer’s inspection. The inspection will not take place until the top flanges are cleaned according to 511.10, but it will be done before the deck slab reinforcement is installed. The Department will pay for the cost associated with this inspection with Item 511, Superstructure Concrete. The Engineer will report all cracks found to the Office of Construction Administration, Bridge Construction Specialist, along with specific information on location of the cracks, length, and depth so an evaluation and repair or replacement recommendation can be made.

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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 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 truck given in Figure 901.

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

The inventory and operating ratings shall be expressed in terms of the AASHTO HS20-44 loading (English Units), rounded off to the nearest single decimal point.

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 hand calculations should be a part of the 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

equal as approved by the Reinforced Earth Company. Supply certified test data to the Engineer upon delivery of the geotextile material to the project.

2.4 ALIGNMENT PINS

The pins used to align the face panels during construction shall be round, smooth number 5 bars made of mild steel or smooth 3/4 [19 mm] diameter PVC rod.

2.5 SELECT GRANULAR EMBANKMENT

The select granular embankment material in the reinforced soil mass shall be CMS 304 Aggregate Base or CMS 703.11 Structural Backfill Type 2; except as follows:

A. The material shall not contain slag.

B. The material shall conform to AASHTO T 289-91 with a pH range between 5.0 and 10.0.

C. The material shall conform to AASHTO T 288-91 with a resistivity greater than 3,000 ohm-cm. If the resistivity is greater than 5,000 ohm-cm, AASHTO T 290-95 and T 291-94 may be waived.

D. The material shall conform to AASHTO T 291-94 with chloride levels less than 100 ppm.

E. The material shall conform to AASHTO T 290-95 with sulfate levels less than 200 ppm.

Take all acceptance samples from the stockpile. Transport and handle the material to minimize the segregation of the material prior to the placement.

Furnish the Engineer a Certificate of Compliance from an independent Testing Laboratory, certifying that the above material complies with this specification and a copy of all test results performed for contract compliance. The Engineer will accept the material based upon a visual inspection of the material and a review of the Certificate of Compliance and all test reports.

2.6 CONCRETE LEVELING PAD

The leveling pad may be unreinforced cast-in-place concrete or reinforced precast concrete. The concrete shall be at least 6 inches [150 mm] thick and have a minimum compressive strength of 2500 psi [17.2 Mpa]. Cure the cast-in-place concrete for a minimum of 12 hours prior to placing the first row of facing panels.

2.7 BACKFILL DRAINAGE

Furnish porous backfill, CMS 518, with filter fabric, CMS 712.09 Type B, and 6 inch [150 mm] perforated plastic pipe, 707.33, as shown in the plans. The pipe shall be continuous and sloped to provide a positive gravity flow.

2.8 CONCRETE COPING AND SLEEPER SLAB

The coping and sleeper slab shall be cast-in-place, Class C concrete, in accordance with CMS 511. The Department will not accept precast concrete copings. Reinforcing steel shall be epoxy coated meeting the requirements of CMS 509. Seal the concrete coping with an epoxy-urethane sealer in accordance with CMS 512.

3.0 DETAIL DRAWINGS

Prepare detail drawings and design calculations in accordance with the 17th Edition of the AASHTO *Standard Specifications for Highway Bridges* and these provisions. In the event of a conflict, this specification will govern.

The detail drawings shall include the following information:

A. A site plan for the full length of the retaining wall

B. An elevation view of the full length of the retaining wall showing the location of each individually labeled panel section

C. The soil reinforcement lengths

D. Representative cross-sections at each design change

E. Backfill drainage details

F. Actual bearing pressures

G. Allowable bearing pressures

H. Design life

I. Angle of internal friction of select granular material

An Ohio Registered Engineer shall sign, seal and date the detail drawings, design calculations and acceptance letter provided in the appendix of this provision.

Thirty (30) days prior to the commencement of wall construction, submit to the Engineer: two copies of the detail drawings on 11" x 17" sheets; two copies of the design calculations; and the signed acceptance letter. The Engineer will submit the drawings, calculations and acceptance letter to the Office of Structural Engineering (OSE) for information. Department approval is not required.

Ensure that the shop drawings meet the requirements for materials, field measurements,

G. Face panels that do not meet the tolerances specified in 2.1.6.

H. Lifting inserts not useable

I. Exposed reinforcing steel

J. Cracks at the PVC pipe or pin

K. Insufficient concrete compressive strength

L. Panel thickness in excess of 3/16 inch [5 mm] from that shown on the plans

The Engineer will decide if an attempt may be made to repair a defective panel. The Contractor or supplier shall make the repairs at his own expense. If the repairs are made to the Engineer's satisfaction, the panel will be acceptable.

2.1.8 MARKING

The Manufacturer shall clearly mark the back surface of each panel with the date of manufacture, the production lot number and the piece-mark detailed in the shop drawings.

2.1.9 HANDLING, STORING AND SHIPPING

Handle, store, and ship panels in such a manner as to avoid chipping, cracking and fracturing the panels; excessive bending stresses; and damaging the soil reinforcement attachment devices. Support panels on firm blocking while storing and shipping.

2.2 SOIL REINFORCEMENT

The soil reinforcement shall consist of a welded wire mesh conforming to the requirements of 709.10 and be galvanized according to 711.02.

2.3 JOINT MATERIALS

2.3.1 BEARING PADS

In the horizontal joints between the reinforced concrete facing panels, install at least two bearing pads per panel at a uniform spacing. The bearing pads shall be neoprene elastomeric pads having a durometer hardness of 55 ± 5, high density polyethylene pads with a minimum density of 59 lb/ft^3 [0.946 g/cm^3] or equivalent. Supply certified test data to the Engineer upon delivery of the material to the project.

2.3.2 JOINT COVER

Cover all joints between panels on the back side of the wall with a geotextile material meeting

the minimum requirements for filtration applications as specified by AASHTO M288. The minimum width and lap shall be 1'-0" [300 mm]. The adhesive used to attach the geotextile material to the panels shall be Pliobond 5001, as manufactured by Goodyear Rubber Company or equal as approved by Foster Geotechnical. Supply certified test data to the Engineer upon delivery of the geotextile material to the project.

2.4 ALIGNMENT PINS

The pins used to align the face panels during construction shall be round, smooth number 5 bars made of mild steel or smooth 3/4 [19 mm] diameter PVC rod.

2.5 SELECT GRANULAR EMBANKMENT

The select granular embankment material in the reinforced soil mass shall be CMS 304 Aggregate Base or CMS 703.11 Structural Backfill Type 2; except as follows:

A. The material shall not contain slag.

B. The material shall conform to AASHTO T 289-91 with a pH range between 5.0 and 10.0.

C. The material shall conform to AASHTO T 288-91 with a resistivity greater than 3,000 ohm-cm. If the resistivity is greater than 5,000 ohm-cm, AASHTO T 290-95 and T 291-94 may be waived.

D. The material shall conform to AASHTO T 291-94 with chloride levels less than 100 ppm.

E. The material shall conform to AASHTO T 290-95 with sulfate levels less than 200 ppm.

Take all acceptance samples from the stockpile. Transport and handle the material to minimize the segregation of the material prior to the placement.

Furnish the Engineer a Certificate of Compliance from an independent Testing Laboratory, certifying that the above material complies with this specification and a copy of all test results performed for contract compliance. The Engineer will accept the material based upon a visual inspection of the material and a review of the Certificate of Compliance and all test reports.

2.6 CONCRETE LEVELING PAD

The leveling pad may be unreinforced cast-in-place concrete or reinforced precast concrete. The concrete shall be at least 6 inches [150 mm] thick and have a minimum compressive strength of 2500 psi [17.2 Mpa]. Cure the cast-in-place concrete for a minimum of 12 hours prior to placing the first row of facing panels.

2.7 BACKFILL DRAINAGE

Furnish porous backfill, CMS 518, with filter fabric, CMS 712.09 Type B, and 6 inch [150 mm] perforated plastic pipe, 707.33, as shown in the plans. The pipe shall be continuous and sloped to provide a positive gravity flow.

2.8 CONCRETE COPING AND SLEEPER SLAB

The coping and sleeper slab shall be cast-in-place, Class C concrete, in accordance with CMS 511. The Department will not accept precast concrete copings. Reinforcing steel shall be epoxy coated meeting the requirements of CMS 509. Seal the concrete coping with an epoxy-urethane sealer in accordance with CMS 512.

3.0 DETAIL DRAWINGS

Prepare detail drawings and design calculations in accordance with the 17th Edition of the AASHTO *Standard Specifications for Highway Bridges* and these provisions. In the event of a conflict, this specification will govern.

The detail drawings shall include the following information:

A. A site plan for the full length of the retaining wall

B. An elevation view of the full length of the retaining wall showing the location of each individually labeled panel section

C. The soil reinforcement lengths

D. Representative cross-sections at each design change

E. Backfill drainage details

F. Actual bearing pressures

G. Allowable bearing pressures

H. Design life

I. Angle of internal friction of select granular material

An Ohio Registered Engineer shall sign, seal and date the detail drawings, design calculations and acceptance letter provided in the appendix of this provision.

Thirty (30) days prior to the commencement of wall construction, submit to the Engineer: two copies of the detail drawings on 11” x 17” sheets; two copies of the design calculations; and the

signed acceptance letter. The Engineer will submit the drawings, calculations and acceptance letter to the Office of Structural Engineering (OSE) for information. Department approval is not required.

Ensure that the shop drawings meet the requirements for materials, field measurements, construction requirements and contract requirements. Coordinate details of the work to be performed by other entities on the project. The Department will not make allowance for additional cost or delays to the Contractor for incorrect fabrication as a result of failure to coordinate or perform this coordination. Submit two copies of the shop drawings on 11" x 17" sheets to the Engineer with the delivery of the materials to the project. Department approval of the shop drawings is not required.

The Manufacturer shall maintain record fabrication drawings according to Supplement 1073 for each standard panel design produced.

4.0 CONSTRUCTION REQUIREMENTS

4.1 WALL EXCAVATION

Perform wall excavation to the bottom of the leveling pad and reinforced soil mass in accordance with CMS 503.

4.2 UNDERCUT AND BACKFILL

Remove unsuitable foundation soils below the reinforced soil mass to the limits shown in the project plans or as directed by the Engineer. Use the select granular embankment material, section 2.4, for backfill and compact according to CMS 203.06 and 203.07.

4.3 FOUNDATION PREPARATION

For a width equal to or exceeding the width of the reinforced soil mass, level and compact the foundation soil according to Item 203.05.

4.4 WALL ERECTION

Place concrete panels as shown on the accepted detail drawings. Lift panels from the lifting devices set into the upper edge of each panel. Place panels and backfill in successive horizontal lifts according to the sequence shown on the detail drawings. Use external bracing as necessary for the initial lift. As the backfill material is placed behind the panels, maintain the panels in vertical position by means of temporary wooded wedges placed in the panel joints on the external side of the wall. Remove the wedges as soon as the panel above the wedged panel is completely erected and backfilled.

For vertical walls, vertical tolerances (plumbness) and horizontal alignment tolerances shall not exceed 3/4 inch [20 mm] when measured along 10 feet [3000 mm] straight edge. The maximum

the minimum requirements for filtration applications as specified by AASHTO M288. The minimum width and lap shall be 1'-0" [300 mm]. The adhesive used to attach the geotextile material to the panels shall be Pliobond 5001, as manufactured by Goodyear Rubber Company or equal as approved by SSL, LLC. Supply certified test data to the Engineer upon delivery of the geotextile material to the project.

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F. Actual bearing pressures

G. Allowable bearing pressures

H. Design life

I. Angle of internal friction of select granular material

An Ohio Registered Engineer shall sign, seal and date the detail drawings, design calculations and acceptance letter provided in the appendix of this provision.

Thirty (30) days prior to the commencement of wall construction, submit to the Engineer: two copies of the detail drawings on 11” x 17” sheets; two copies of the design calculations; and the

ARN-24 STRUCTURAL SURVEY AND MONITORING OF VIBRATIONS

This proposal note was retired in April 2005.

ITEM SPECIAL - STRUCTURAL SURVEY AND MONITORING OF VIBRATIONS - 04/19/02

1.0 Description. This work consists of conducting a survey of the condition of structures and the monitoring of ground vibrations. The survey work is to be conducted before and after all construction work is performed which could cause undesirable ground vibrations. Ground vibrations and acoustics shall be monitored at the appropriate times during the duration of this project.

2.0 Personnel Qualifications. A Professional Engineer, registered in the State of Ohio, shall be engaged by the Contractor to be in charge of conducting a structural survey and in charge of monitoring vibrations and acoustics. The engineer in charge of performing the required work under this item is herein referred to as the Monitoring Foreman. The Monitoring Foreman and/or his team of experts shall have collectively worked on two similar projects or shall have collectively accrued not less than two years of successful experience in performing the type of work specified by this note. The monitoring foreman and/or his team of experts shall have expertise in (1) conducting structural surveys by video methods, (2) monitoring vibrations with a seismograph or with other appropriate instrumentation, and (3) assessing sites for potential damage that may occur as a result of the proposed construction. Documentation of this experience shall be furnished at the preconstruction meeting.

2.1 The requirement for the Monitoring Foreman to be an engineer can be waived provided that the Monitoring Foreman's experience or the collective experience of the monitoring team shows substantial expertise in performing the required work.

3.0 Structural Survey. The structural survey shall include but not be limited to the following:

3.1 Documentation of, the integrity of existing building materials and the general overall condition of the structures recorded by written text, photographs, and VHS video cassette recording.

3.2 The establishment of locations and elevations of reference points, chosen by the Monitoring Foreman, for documentation of measurements.

3.3 A detailed on-site inspection conducted in the presence of the Project Engineer, the Contractor, property owners, property tenants if appropriate, and representatives of any involved utility companies.

3.4 Documentation of all structural deficiencies with regard to location, size, type, etc.

4.0 Monitoring of Vibrations and Acoustics. The monitoring of vibrations and acoustics shall include but not be limited to the following:

4.1 Determination and documentation of existing levels of vibrations and noise.

4.2 Monitoring of all construction operations that significantly contribute to the production of vibrations and noise with a special effort made to document the vibration and sound levels associated with blasting and/or pile installation procedures.

4.3 The development of criteria for controlling construction activities so that the Monitoring Foreman's allowable predetermined vibration levels are not exceeded during construction.

5.0 Water Quality. When appropriate, water samples shall be collected from wells, streams or project runoff areas to document before and after construction site conditions regarding the quality of water available in the vicinity of the project.

6.0 Ground Vibration. Vibration monitoring guidelines can be found in FHWA's May 1985 manual entitled "Rock Blasting" and in various other reports.

The peak particle velocity (PPV) of ground vibrations is generally used to monitor the effect of vibrations on structures. When monitoring vibrations consideration must be given to (1) the type of structure being evaluated and (2) the frequency of the vibrations (low frequency 40 Hz). Generally allowable ground vibration peak particle velocities range from 13mm/second (0.5 inches per second) to 50mm/second (2.0 inches per second) depending on the type of structure under consideration. When an allowable PPV is exceeded, the vibration producing operation shall be suspended and alternative construction procedures should be evaluated. The Director shall be consulted whenever the measured magnitude of the vibration level is considered potentially capable of producing structural damage.

7.0 Method of Measurement. The final twenty percent of the payment for this work shall not be made until the Office of Structural Engineering has received and approved three copies of the Monitoring Foreman's final report. The final report shall be typed and contain all measurements, conclusions, and recommendations which resulted from performing the above required work. Included with the reports shall be one copy of all pictures and video recordings. Interim reports shall be furnished to the Project Engineer during construction thereby keeping the Project Engineer informed of the Monitoring Foreman's progress and findings. The original tapes shall remain in the exclusive possession of the Monitoring Foreman for a period of not less than 10 years.

8.0 Method of Payment. Payment for this item will be made at the contract lump sum price for Item Special - “Structural Survey and Monitoring of Vibrations".

ARN-25 RETIRED NOTE 17

Include the following note as part of an Item 202, “As Per Plan” note when protection of traffic is required.

[17] PROTECTION OF TRAFFIC: Prior to demolition of any portions of the existing superstructure, submit plans for the protection of traffic (vehicular, pedestrian, boat, etc.) adjacent to and/or under the structure to the Director at least 30 days before construction begins. These plans shall include provisions for any devices and structures that may be necessary to ensure such protection. Maintain the temporary vertical clearances specified on the plans or in the proposal at all times except as otherwise approved by the Director.

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.

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.