



INDIANA DEPARTMENT OF TRANSPORTATION

Driving Indiana's Economic Growth

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Mitchell E. Daniels, Jr., Governor
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APPROVED MINUTES

February 17, 2011 Standards Committee Meeting

(Changes to the Final Draft shown as highlighted in yellow)

April 19, 2011

TO: Standards Committee

FROM: Scott Trammell, Secretary

RE: Minutes for the February 17, 2011 Standards Committee Meeting

The Standards Committee meeting was called to order by Mr. Miller at 9:01 a.m. on February 17, 2011 in the 9th Floor Conference Center. Mr. Miller began by stating the ground rules and that some items may need to be addressed out of order due to individual's schedules.

The meeting was adjourned at 3:00 p.m.

The following committee members were in attendance:

Mark Miller, Chairman
Greg Pankow, Constr. Mgmt.
Yadu P. Shah*, Rdway Services
Randy Strain, Str. Services
Ron Walker, Office of Materials Mgmt.

Dave Andrewski, Pvmt. Eng.
Bob Cales, Contract Admin.
Joseph Bruno**, Traffic Admin.
Jim Keefer, Fort Wayne Dist.
Tom Caplinger, Crawfd. Dist.

**Proxy for John Wright*

***Proxy for Dave Boruff*

Also in attendance were the following:

Tony Perkinson, FHWA
Scott Trammell, Secretary
Steve Smart, HySpan BridgeSystems
Todd Edwards, CPI Supply
Steve Cooney, ISCO-Pipe
Eric Carleton, ICPC
Jeff Von Handorf, API
Joe Fisher, CONTECH

Jim Reilman, INDOT
Steve Fisher, INDOT SiteMngr.
Paul Berebitsky, ICA
Sam Martin, CPI Supply
Tony Uremovich, INDOT
Dave Keaffaber, Contech
Dan Liotti, Midwest Mole
Darin Duncan, CPI Supply

The following agenda items were considered:

A. GENERAL BUSINESS ITEMS

OLD BUSINESS

(No items considered)

NEW BUSINESS

1. Approval of the January 20, 2011 Minutes

ACTION: Approved as Submitted

Motion: Mr. Cales
Second: Mr. Andrewski
Ayes: 9
Nays: 0

2. Standard Drawing 724-BJTS-02 should have been deleted as part of action of October 19, 2006 Standards Committee Meeting. It shows details of joint Type BS, whose specifications were deleted per that action.

ACTION: To Delete Standard Drawing

B. CONCEPTUAL PROPOSAL ITEMS

OLD BUSINESS

(No items considered)

NEW BUSINESS

(No items considered)

C. STANDARD SPECIFICATIONS, SPECIAL PROVISIONS AND STANDARD DRAWINGS PROPOSED ITEMS

OLD BUSINESS

<u>Item No. 01A</u>	<u>01/20/11 (2010 SS)</u>	<u>Mr. Strain</u>	<u>page 10</u>
731		MECHANICALLY STABILIZED EARTH	
		RETAINING WALLS	
901.10		Components of MSE Retaining Walls	
910.07*		Blank Steel Components of MSE	
		Retaining Walls	

(*Changes to the 910.07 ~~Steel Drain Pipe~~ Blank have been approved by the Standards Committee on March 18, 2010 Meeting)

ACTION: PASSED AS REVISED

<u>Item No. 01B</u>	<u>01/20/11 (2010 SS)</u>	<u>Mr. Strain</u>	<u>page 36</u>
211.03.1		Structure Backfill Types	

901.09

*Air Cooled Blast Furnace Slag
for Retaining Walls*

ACTION: PASSED AS REVISED

<u>Item No. 01C</u>	<u>01/20/11 (2010 SS)</u>	<u>Mr. Strain</u>	<u>page 41</u>
727		BLANK	
728		BLANK	
729		BLANK	
730		BLANK	
732		BLANK	
733		STEEL BIN-TYPE RETAINING WALL	
910.08		Blank Steel Bin-Type Retaining Wall Units	

ACTION: PASSED AS SUBMITTED

<u>Item No. 01D</u>	<u>01/20/11 (2010 SS)</u>	<u>Mr. Strain</u>	<u>page 48</u>
734		PERMANENT EARTH RETENTION SYSTEM FOR CUT-WALL APPLICATION	

ACTION: PASSED AS SUBMITTED

<u>Item No. 01E</u>	<u>01/20/11 (2010 SS)</u>	<u>Mr. Strain</u>	<u>page 57</u>
735		TEMPORARY WIRE-FACED MECHANICALLY STABILIZED EARTH RETAINING WALLS	

ACTION: PASSED AS REVISED

<u>Item No. 01F</u>	<u>01/20/11 (2010 SS)</u>	<u>Mr. Strain</u>	<u>page 63</u>
918.05(c)		Type III Geogrid for Modular Block Walls	

ACTION: WITHDRAWN

<u>Item No. 05</u>	<u>01/20/11 (2010 SS)</u>	<u>Mr. Pankow</u>	<u>page 66</u>
707.01		Description	
707.02		Materials	
707.03		General Requirements	
707.04		Steel and Concrete Requirements	
707.04(a)		Reinforcing Bars	
707.04(b)		Prestressing Strands	
707.04(c)		Concrete	
707.04(c)1		Cold Weather Concrete	
707.04(c)2		Hot Weather Concrete	
707.04(c)3		Acceptance Testing	
707.04(c)3a		Precast, Non-Prestressed Members	
707.04(c)3b		Precast, Prestressed Members	
707.04(d)		Other Requirements	
707.05		Forms	
707.06		Placing and Finishing Cement Concrete	
707.07		Removal of Forms and Curing	
707.07(a)		Wet Curing without Supplemental Heat	
707.07(b)		Accelerated Curing	

707.08	Handling and Shipping
707.09	Placing Structural Members
707.10	Precast Prestressed Concrete Deck Panels
707.11	Method of Measurement
707.12	Basis of Payment
910.01(b)7	Uncoated 7 Wire Strand for Prestressed Concrete

ACTION: PASSED AS REVISED

Item No. 06 01/20/11 (2010 SS) Mr. Strain page 84

Standard Drawings:

601- BACRGRBA-01	ROADSIDE BRIDGE-APPROACH GUARDRAIL
601- BACRGRBA-02	MEDIAN BRIDGE-APPROACH GUARDRAIL
601- MPPGRRP-017	GUARDRAIL AT MEDIAN-SIDE PIER PROTECTION GUARDRAIL
601- MPPGGRBS-021	MEDIAN PIER PROTECTION GUARDRAIL AT BRIDGE SUPPORT
601- MPPGRRP-036	GUARDRAIL AT MEDIAN PIERS PROTECTION GUARDRAIL
601- MPPGRRP-045	GUARDRAIL AT MEDIAN PIER PROTECTION GUARDRAIL
601- RPPGRRP-013	GUARDRAIL AT OUTSIDE-ROADSIDE PIER PROTECTION GUARDRAIL
601- RPPGRRP-024	GUARDRAIL AT OUTSIDE-ROADSIDE PIER PROTECTION GUARDRAIL
601-RPPG-03	ROADSIDE PIER PROTECTION GUARDRAIL
601-RPPGRRP-041	GUARDRAIL AT ROADSIDE PIER PROTECTION GUARDRAIL
601-RPPGRRP-052	GUARDRAIL AT ROADSIDE PIERS PROTECTION GUARDRAIL
601-RPPG-06	ROADSIDE PIER PROTECTION GUARDRAIL

Indiana Design Manual:

49-4.02(01)	(as BACKUP) Barrier Length Needed in Advance of Hazard for Adjacent Traffic
49-4.02(04)	Length of Need at Outside-Shoulder Bridge Pier Support
49-4e(1)	Minimum Guardrail Length Required In Advance Of Hazard
49-4e(10)	Guardrail Pay Length Approach To Bridge Support Inside Clear Zone
49-4e(2)	Guardrail Configuration For Outside-Shoulder Approach To Bridge
49-4e(3)	Guardrail Configuration And Length Of Need For Median-Shoulder Approach To Bridge
49-4e(4)	Guardrail Configuration For Bridge Support Inside Clear Zone, Two-Way Roadway, Single Overhead Structure
49-4e(5)	Guardrail Configuration For Bridge Support Inside Clear Zone, Two-Way Roadway, Twin Overhead Structure
49-4e(6)	Guardrail Configuration For Bridge Support Inside Clear Zone, One-Way

49-4e(7) Roadway, Single Overhead Structure, Outside Shoulder
 Guardrail Configuration For Bridge Support Inside Clear Zone, One-Way Roadway, Twin Overhead Structure, Outside Shoulder

49-4e(8) Guardrail Configuration For Bridge Support Inside Clear Zone, One-Way Roadway, Single Overhead Structure, Median Shoulder

49-4e(9) Guardrail Configuration For Bridge Support Inside Clear Zone, One-Way Roadway, Twin Overhead Structure, Median Shoulder

49-4k ~~Length Of Need Requirement For Pier Protection~~

49-8.01(04) Design Procedure

49-9.02 Bridge-Railing End Protection

49-9a ~~Bridge Railing End Protection Requirements~~

ACTION: PASSED AS REVISED

NEW BUSINESS

(PART 2)

Item No. 01	02/17/11 (2010 SS)	Mr. Walker	page 119
SECTION 725		SLIP LINING OF EXISTING PIPE	
907.25		Thermoplastic Liner Pipe Liners	
907.25(a)		Solid Wall HDPE Liner Pipe Liner	
907.25(b)		Profile Wall HDPE Liner Pipe Liner	
907.25(c)		Profile Wall PVC Liner Pipe Liner	
912.05		Foaming Agent	

ACTION: PASSED AS REVISED

Item No. 02	02/17/11 (2010 SS)	Mr. Pankow	page 136
714.03		Design Requirements	
714.09		Method of Measurement	
714.10		Basis of Payment	
715.03		General Requirements	
715.14		Basis of Payment	
723.17		Scour Protection	
723.18		Method of Measurement	
723.19		Basis of Payment	

Standard Drawings:

714-BCSP-01	BOX CONCRETE CULVERT SCOUR PROTECTION
714-BCSP-021	BOX CULVERT SUMPING AND SCOUR PROTECTION
715-PCSP-01	PIPE SUMPING PROTECTION
723-CCSP-01	THREE-SIDED CONCRETE CULVERT SCOUR PROTECTION
723-CCSP-02	THREE-SIDED CONCRETE CULVERT SCOUR PROTECTION, SECTION
723-CCSP-03	THREE-SIDED CONCRETE STRUCTURE SCOUR PROTECTION, PLAN

723-CCSP-04 THREE-SIDED CONCRETE STRUCTURE
SCOUR PROTECTION, SECTION
723-CCSP-05 THREE-SIDED CONCRETE CULVERT
SCOUR PROTECTION, PLAN
723-CCSP-06 THREE-SIDED CONCRETE CULVERT
SCOUR PROTECTION, SECTION

ACTION: PASSED AS SUBMITTED

Item No. 03	02/17/11 (2010 SS)	Mr. Pankow	page 154
SECTION 619		PAINTING BRIDGE STEEL	
711.02		Materials	
711.48		Shop Cleaning and Storage of ASTM	
		A 709 Grade 50W (ASTM A 709M	
		Grade 345W) Weathering Steel	
711.70		Field Cleaning and Storage of ASTM	
		A 709 Grade 50W (ASTM A 709M	
		Grade 345W) Weathering Steel	
910.02(b)		Weathering Steel	
910.02(bc)		High Strength Structural Steel	
910.02(ed)		High Performance Steel	
910.02(de)		Charpy V-Notch Toughness Tests	
910.02(ef)		Mill Test Reports	
910.02(fg)		High Strength Bolts, Nuts, and Washers	
910.02(gh)		Bolts Other Than High Strength Bolts	

Standard Drawings:
619-PRWS-01

PAINTING REQUIREMENTS FOR
WEATHERING STEEL

ACTION: PASSED AS REVISED

Item No. 04	02/17/11 (2010 SS)	Mr. Pankow	page 180
701.05(b)1		Scheduling	
701.05(b)3		Restrike	
701.08		Nominal Driving Resistance of Production Piles	

ACTION: PASSED AS SUBMITTED

Item No. 05	02/17/11 (2010 SS)	Mr. Strain	page 183
706.03.104		Concrete Railing With Reinforced Concrete Moment Slab	
706.0405		Steel Railings	
706.0506		Method of Measurement	
706.0607		Basis of Payment	
718.02		Materials	
718.03		Pipe Installation	
718.03(a)		Locations Outside MSE Wall Limits	
718.03(b)		Underdrains for MSE Walls	
718.09		Method of Measurement	
718.10		Basis of Payment	

Standard Drawings:
706-BRRW-01

RAILING TYPE FC AND MOMENT SLAB
ASIDE MSE WALL - PCCP

706-BRRW-02 RAILING TYPE FT AND MOMENT SLAB
ASIDE MSE WALL -PCCP
706-BRRW-03 RAILING TYPE FC AND MOMENT SLAB
ASIDE MSE WALL - HMA PAVEMENT
706-BRRW-04 RAILING TYPE FT AND MOMENT SLAB
ASIDE MSE WALL - HMA PAVEMENT
706-BRRW-05 RAILING TYPE FC AND MOMENT SLAB
ATOP MSE WALL - PCCP
706-BRRW-06 RAILING TYPE FT AND MOMENT SLAB
ATOP MSE WALL - PCCP
706-BRRW-07 RAILING TYPE FC AND MOMENT SLAB
ATOP MSE WALL - HMA PAVEMENT
706-BRRW-08 RAILING TYPE FT AND MOMENT SLAB
ATOP MSE WALL - HMA PAVEMENT
706-BRRW-10 RAILING AND MOMENT SLAB AT MSE WALL

ACTION: PASSED AS REVISED

Item No. 06 02/17/11 (2010 SS) Mr. Pankow page 201
711.65(d)1 Bolt Tension
717.03 General Requirements
906.07(b) Type M
908.09 Structural Plate Pipe, Pipe-Arches,
and Arches

ACTION: PASSED AS SUBMITTED

Item No. 07 02/17/11 (2010 SS) Mr. Andrewski page 204
Standard Drawings:
503-CCPJ-02 LONGITUDINAL JOINT
503-CCPJ-08 LONGITUDINAL CONSTRUCTION JOINT
506-CCPP-01 CONCRETE PAVEMENT PATCH DETAILS

ACTION: PASSED AS SUBMITTED

Item No. 08 02/17/11 (2010 SS) Mr. Pankow page 211
801.16(b) Maintenance of Traffic for Mobile
Operations

ACTION: PASSED AS REVISED

Item No. 09 02/17/11 (2010 SS) Mr. Strain page 214
701-B-068 BITUMEN COATING FOR PILES

ACTION: PASSED AS SUBMITTED

Item No. 10 02/17/11 (2010 SS) Mr. Strain page 218
701.02 Materials
701.09(A)2 Predrilling
701.14 Method of Measurement
701.15 Basis of Payment
913.056 Bentonite Grout

ACTION: PASSED AS REVISED

Item No. 11 02/17/11 (2010 SS) Mr. Strain page 224
 701.15 Basis of Payment

ACTION: PASSED AS SUBMITTED

Item No. 12 02/17/11 (2010 SS) Mr. Strain page 227
 Recurring Special Provision:
 703-C-138 REINFORCING BARS FOR METRIC
 DESIGNED CONTRACTS

ACTION: PASSED AS SUBMITTED

Item No. 13 02/17/11 (2010 SS) Mr. Strain page 230
 Recurring Special Provision:
 707-B-085 ALTERNATE PRESTRESSED PRECAST
 CONCRETE I-BEAM TO STANDARD AASHTO
 TYPE IV PRESTRESSED PRECAST
 CONCRETE I-BEAM

ACTION: PASSED AS SUBMITTED

Item No. 14 02/17/11 (2010 SS) Mr. Strain page 235
 Recurring Special Provision:
 709-M-019 SURFACE SEAL FOR BRIDGE TO BE
 PAINTED

Standard Drawing:
 709-SSBP-01 SURFACE SEAL IN BRIDGE-STEEL-
 PAINTING PROJECT

ACTION: PASSED AS SUBMITTED (TO DELETE RSP)

Item No. 15 02/17/11 (2010 SS) Mr. Strain page 239
~~713.04.105~~ Temporary Pipe
~~713.0506~~ Temporary Approaches
~~713.0809~~ Method of Measurement
~~713.0910~~ Basis of Payment

ACTION: PASSED AS SUBMITTED

Item No. 16 02/17/11 (2010 SS) Mr. Strain page 243
 Recurring Special Provision:
 717-R-152 ALTERNATES TO STRUCTURAL PLATE
 STRUCTURES

ACTION: PASSED AS SUBMITTED

Item No. 17 02/17/11 (2010 SS) Mr. Strain page 247
 Recurring Special Provision:
 720-M-021 EXTENSION OF CAST IRON FLOOR DRAINS

ACTION: PASSED AS SUBMITTED

Item No. 18 02/17/11 (2010 SS) Mr. Strain page 250
~~720.04.15~~ *Capping Existing Structures*
720.056 Method of Measurement
720.067 Basis of Payment

ACTION: PASSED AS REVISED

Item No. 19 02/17/11 (2010 SS) Mr. Strain page 253
720.03.1 *Retrofitting Existing Structures*
720.06 Basis of Payment

ACTION: PASSED AS REVISED (TO DELETE RSP)

Item No. 20 02/17/11 (2010 SS) Mr. Strain page 256
724.02(c) *Expansion Joint Sealing System*
724.04 Method of Measurement
724.05 Basis of Payment
906.07(c) *Expansion Joint Sealing System*

ACTION: WITHDRAWN

Item No. 21 02/17/11 (2010 SS) Mr. Strain page 264
SECTION 727 *STRUCTURAL CONCRETE REPAIR BY EPOXY*
INJECTION
909.12 *Epoxy Resin Additives for Injection*
Into Concrete

ACTION: PASSED AS REVISED

Item No. 22 02/17/11 (2010 SS) Mr. Strain page 268
SECTION 710 **PATCHING CONCRETE STRUCTURES AND**
REPOINTING MASONRY IN STRUCTURES
SECTION 729 **CONCRETE FOR PATCHING BRIDGE**
STRUCTURESBLANK

ACTION: PASSED AS REVISED

cc: Committee Members (11)
FHWA (3)
ICA (1)

SPECIFICATION REVISIONS

(OLD BUSINESS ITEM)

REVISION TO STANDARD SPECIFICATIONS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: Desire to include the longstanding retaining wall recurring special provisions for mechanically stabilized earth retaining walls in the 2012 spec book.

PROPOSED SOLUTION: Incorporate the mechanically retaining wall RSP in the 2012 spec book and delete the RSP.

APPLICABLE STANDARD SPECIFICATIONS: 731, 901.10, 910.07

APPLICABLE STANDARD DRAWINGS: None

APPLICABLE DESIGN MANUAL SECTION: Ch 68

APPLICABLE SECTION OF GIFE: None

APPLICABLE RECURRING SPECIAL PROVISIONS: 731-R-202

Submitted By: Randy Strain

Title: Bridge Policy and Standards Engineer,
Bridge Design, Inspection, Hydraulics, and Technical Support Division

Organization: INDOT

Phone Number: 2-3339

Date: January 24, 2010

APPLICABLE SUB-COMMITTEE ENDORSEMENT? INDOT Retaining Wall Committee

REVISION TO STANDARD SPECIFICATIONS (OLD BUSINESS ITEM)
SECTION 731 MECHANICALLY STABILIZED RETAINING WALLS

(Changes shown as: deletion – strikethrough and addition – underlined.)

~~731 R 202 MECHANICALLY STABILIZED EARTH RETAINING WALLS~~

~~(Revised 06-17-10)~~

The Standard Specifications are revised as follows:

SECTION 731, BEGIN LINE 1, INSERT AS FOLLOWS:

SECTION 731 -- MECHANICALLY STABILIZED EARTH RETAINING WALLS

731.01 Description

This work shall consist of the design, furnishing materials, and placement of ~~mechanically stabilized earth~~MSE retaining walls in accordance 105.03.

~~The Contractor shall perform the necessary work to verify that the foundation is at the correct elevation, that the wall is constructed to the correct alignment, and that the work is in accordance with the specified tolerances. The checking of alignments and tolerances shall include verifying that the plumbness of the face panels is in accordance with 731.10 over the entire height of the wall. Alignment shall be checked at each layer of panels after the backfill behind the panels has been compacted, and the results shall be recorded.~~

731.02 General Design Requirements

~~The mechanically stabilized earth~~An MSE retaining wall shall consist of a non-structural concrete leveling pad, concrete face panels, precast or cast-in-place concrete coping, ground reinforcement elements mechanically connected to each panel, and an external drainage system if required, and accommodations for appurtenances behind, in front of, under, mounted upon, or passing through the wall. Ground reinforcement shall have sufficient strength, frictional resistance, and quantity as required by design.

~~The mechanically stabilized earth~~MSE retaining walls system is to~~shall be selected from the Department's list of approved Retaining Wall Systems. A Retaining Wall System manufacturer may will be included~~considered for inclusion on the Department's list by following procedure J of ITM 806, Procedure J. The quantities shown in the Schedule of Pay Items will be the same for each MSE retaining wall system. The MSE retaining wall panels~~all mechanically stabilized earth wall systems. All mechanically stabilized earth walls shall be constructed in accordance with as shown on the panels' working~~approved plans and panel shop drawings, based on the requirements herein. The recommendations of the wall system suppliers shall not override the minimum performance requirements contained herein.

If the wall manufacturer needs additional information to complete the design, the Contractor shall be responsible for obtaining such information.

All appurtenances behind, in front of, under, mounted upon, or passing through the wall such as drainage structures, utilities, or other appurtenances shown on the plans, shall be accounted for in the ~~stability~~ design of the wall.

The ~~mechanically stabilized earth~~ wall design shall follow the general dimensions of the wall envelope shown on the plans. ~~The plans will locate~~ working drawings shall show the location of the concrete leveling pad to be at or below the theoretical leveling pad elevation shown on the plans. The top of ~~the~~ each face panel shall be at or above the top of the panel elevation shown on the plans.

Where a coping or barrier is utilized, the wall face panel shall extend up into the coping or barrier a minimum of 2 in. (50 mm). The top of the face panels may be level or sloped to meet the top of the face panel line ~~noted~~ shown. Cast-in-place concrete will not be an acceptable replacement for panel areas ~~noted~~ indicated by the wall envelope.

Where walls or wall sections intersect with an included angle of 130° or less, a vertical corner element separate from the standard panel face shall abut and interact with the opposing ~~standard~~ panels. The corner element shall have ground reinforcement connected specifically to that panel and shall be designed to preclude lateral spread of the intersecting panels.

Face panels shall be designed to accommodate a differential settlement of 1 linear unit in 100. Face panels ~~between~~ of an area greater than 32 sq ft (3 m²) through and 64 sq ft (3.0 and 6.0 m²) shall be designed to accommodate differential settlement of 1 linear unit in 200. Where shown on the plans, slip joints to accommodate excessive or differential settlement shall be included.

Only 1 typical face panel shape and size architectural finish shall be used ~~perfor a project that is part of a contract with multiple projects or contracts with MSE walls.~~

731.03 Design Criteria

The internal stability shall be the responsibility of the Contractor. ~~The design by the manufacturer shall~~ Engineer will consider ~~the internal and~~ the external stability of the wall mass including the applied bearing pressure, overturning, sliding, and stability of temporary construction slopes. The design for internal stability shall be in accordance with the design, construction, and commentary divisions of the AASHTO LRFD Bridge Design Standard Specifications, for Highway Bridges, unless specified otherwise herein. ~~The analysis of settlement, bearing capacity, and overall slope stability will be the responsibility of the Engineer.~~

(a) Geotechnical Considerations

The theoretical failure plane within the soil mass shall be analyzed so that the soil-stabilizing component extends sufficiently beyond the failure plane to stabilize the material. External loads which affect the internal stability such as those applied through piling, bridge footings, traffic, crashwall, or ~~and~~ slope surcharge, shall be accounted for in the design. The sizes of all structural elements shall be determined such that the design load stresses do not

~~exceed the allowable factored stresses found shown in the AASHTO LRFD Bridge Design Standard Specifications for Highway Bridges, unless otherwise shown on the plans.~~

~~The maximum allowable yield stress for reinforcement shall not exceed the manufacturer's recommendation.~~

~~The ϕ , angle for the internal design of the reinforced backfill shall be assumed to be 34°. The ϕ angle of the backfill behind the reinforced portion of the MSE volume shall be assumed 30°. The ϕ angle for the internal design of the foundation soils shall be assumed 30°. For the external design parameters, such as but not limited to, bearing capacity, sliding, overturning, eccentricity, and global stability, the actual soil strength parameters used shall be obtained from the geotechnical report. mechanically stabilized earth mass shall be assumed to be 30°.~~

(b) Height of Wall

~~The wall limits shall be defined by the wall envelope as shown on the plans. For design purposes, the height of wall, H, shall be measured from the theoretical top of the leveling pad to the top of the wall. For a wall with a level surcharge situation, the top of the wall shall be measured to the top of the coping or to the gutter line of the traffic barrier. The top of the wall shall be the theoretical top of the face panels only when where a coping or barrier is not used. For a wall with a sloping surcharge, the top of the wall shall be measured at a point that is 0.3H back from the face where the design height is H and the actual wall height is H. For an abutment face, the design height, H, shall be defined as the height measured from the top of the leveling pad to the top of the roadway surface. For a wall with a sloping surcharge the top of the wall shall be measured at a point 0.3H back from the face where the design height is H and the actual wall height is H.~~

~~For aesthetic considerations and to make differential settlement unnoticeable, the panels shall be erected such that the horizontal site line is discontinuous at every other panel. This shall be accomplished by starting erection with the lower panel level of each wall by alternating full height and half height panels. Panels above the lowest level shall be of a standard size except as required to top out the wall to be in accordance with the plan elevations.~~

(c) Ground Reinforcement

~~The connections of the ground reinforcement length shall be the controlling length resulting from the internal or external design. to the panels shall be in 2 elevations for standard panels. The connections shall not be more than 30 in. (750 mm) apart vertically. To prevent out-of-plane rotation, standard face panels shall be connected to ground reinforcement on at least 3 different points in 2 different planes. However, preapproved systems utilizing a horizontal stabilizing leg to prevent rotation shall only require ground reinforcement attachments in 1 plane. Partial panels shall have 3 different connection points, but only 1 plane shall be attached to ground reinforcement. Panels, which are located at the top of the wall, shall not be attached to the coping or the traffic barrier.~~

The ground reinforcement shall be the same length from the bottom to the top of each wall section ~~whether bar mats, grids, or strips steel are~~ regardless of the type of ground reinforcement used. Differing ground reinforcement elements shall be ~~clearly~~ marked for ease of construction. This element may be used individually or in a prefabricated grouping. ~~The minimum length of the ground reinforcement shall be 0.7H, but not shorter than 8 ft (2.44 m), in accordance with the AASHTO Standard Specifications for Highway Bridges for an abutment on a spread footing.~~

The ground reinforcement for the ~~mechanically stabilized earth~~ MSE volume shall be sized using the lesser of the ~~allowable forces~~ factored loads for each specific connection and each specific reinforcing element. The connection's ~~allowable force shall be taken as 2/3 of the connection test applied factored load and effective pullout at the allowable pullout deformation limit of 1/2 in. (13 mm) or 1/2 of the ultimate load, whichever is less.~~ The ground reinforcement length shall be determined in accordance with the AASHTO LRFD Bridge Design Specifications, as required for internal design or as shown on the plans. The length shall exceed the minimum noted as required for design consideration. One hundred percent of the ground reinforcement, which is designed and placed in the reinforced earth zone shall be connected to the face panels.

For mats, grids, or strip steel, the minimum zinc coating thickness shall be 2 oz/sq ft (610 g/m²). Such thickness shall be assumed to be 4 mils (90.86 μm) for purpose of calculation of reduced structural section.

The ~~design contact~~ factored applied bearing pressures under the stabilized mass for each reinforcement unit's length shall be clearly indicated ~~shown on the shopworking drawings. It and shall not exceed the maximum allowable~~ factored soil bearing capacity ~~resistance~~ shown on the plans. Passive pressure in front of the wall mass will ~~shall~~ be assumed to be zero for design purposes.

731.04 Submittals

The Contractor shall submit working drawings and 1 copy of the design computations for approval. If the computations are computer generated, 1 sample set of hand calculations in accordance with 105.02. Wall construction operations, for 1 wall location, shall not begin until the also be submitted. The Contractor receives written notice that the working drawings shall submit 8 sets of design drawings for approval after the design computations are approved, and before beginning wall construction operations. Design computations and design drawings shall be signed and sealed by a professional engineer.

- (a) *The ~~design~~ working drawings shall include all details, dimensions, quantities and cross-sections necessary to construct the wall. ~~They and~~ shall include, but shall not be limited to, the following:*

1. *A Plan and elevation sheet or sheets for each wall.*

~~2. An elevation view of the wall which shall include the elevation at the top of the wall at all horizontal and vertical break points at least every 50 ft (15 m) along the face of the wall, all steps in the leveling pads, the designation as to the type of panel, the length of soil reinforcing systems, the distance along the face of the wall to where changes in length of the soil reinforcing systems occur, and an indication of the original and final ground lines and maximum bearing pressures.~~

~~32. A plan view of the wall that indicates the offsets from the construction centerline to the face of the wall at all changes in horizontal alignment. A plan view and elevation view which detail the placing position and connection of all steel-ground reinforcement units reinforcing elements in areas where piling, utility, or other structures are near the wall.~~

3. An elevation view of the wall which shall include the following:

a. The elevation at the top of the wall at all horizontal and vertical break points at least every 50 ft (15 m) along the face of the wall.

b. All steps in the leveling pad.

c. The designation as to the type of wall unit.

d. The length of ground reinforcement units.

~~4. A typical cross section or cross sections showing elevation relationship between ground conditions and proposed grades, as well as the drainage system.~~

~~54. All general notes required for constructing the wall.~~

~~6. All horizontal and vertical curve data affecting the wall.~~

~~7. A listing of the summary of quantities on the elevation sheet for each wall.~~

~~(b) All pPanel details shall show all dimensions necessary to construct the element, all reinforcement in the element, and the location of soil reinforcing systemground reinforcement connection devices embedded in the panels.~~

~~(c) The dDetails for construction of the walls around drainage facilities and the outlet lettingoutletting of internal drainage from the backfill zoneMSE volume.~~

~~(d) All dDetails of the architectural treatment.~~

- (e) ~~The~~ Details for diverting strips or mesh ~~ground reinforcement~~ around obstructions such as piles, catch basins, and other utilities shall be submitted for approval.
- (f) ~~The~~ Details for each ~~the connections~~ between the concrete panel and the ~~mesh or strip~~ ground reinforcement.
- (g) ~~Determination of the~~ φ angles for reinforced materials and retained materials.

~~Design calculations and shop drawings shall be submitted to the Engineer for review and approval.~~

MATERIALS

731.05 Materials

~~The Contractor shall make arrangements to purchase the materials described herein, including concrete face panels, retaining strips or mesh, tie strips, fasteners, joint materials, and all necessary incidentals, from a mechanically stabilized earth wall system manufacturer on the Department's list of approved retaining wall systems.~~

Materials shall be in accordance with the following:

<u>Admixtures for Concrete</u>	912.03
<u>Air Cooled Blast Furnace Slag</u>	901.09
<u>Alignment Pins</u>	910.07(d)
<u>B Borrow</u>	211.02
<u>Coarse Aggregate, Class A or Higher, Size No. 8 or 91</u>	904
<u>Components of MSE Retaining Walls</u>	901.10
Concrete Admixtures	912.03
<u>Concrete, Class A or Class C</u>	702
<u>Fine Aggregate, Size No. 23</u>	904
<u>Fly Ash</u>	901.02
Geotextile <u>Geogrid</u>	918.0205
<u>Joint Spacers and Joint Covering</u>	901.10(b)
<u>Portland Cement</u>	901.01(b)
Rapid Set Patching <u>Setting Patch Materials</u>	901.07
Steel Welded Wire Reinforcement, Smooth	910.01
<u>Reinforcing Bars</u>	910.01
<u>Steel Components</u>	910.07
<u>Steel Welded Wire Reinforcement, Smooth and Deformed</u>	910.01(b)
<u>Structure Backfill</u>	211.03.1, 904.05
<u>Underdrains for MSE Walls</u>	718.03
<u>Water</u>	913.01

REVISION TO STANDARD SPECIFICATIONS (OLD BUSINESS ITEM)
 SECTION 731 MECHANICALLY STABILIZED RETAINING WALLS (CONTINUED)

~~In the reinforced area of the MSE volume, Bbackfill material used in the mechanically stabilized earth wall volume shall be structure backfill, type 3, in accordance with 211 except that nominal size aggregate No. 30 shall not be used. The sizeinternal friction or ϕ angle of the structure backfill selected for use in the reinforced areasoil mass shall be not less than 34° in accordance with AASHTO T 236 or AASHTO T 297 under consolidated drained conditions. Testing for the ϕ angle shall be performed on the portion finer than No. 8 (2.36 mm) sieve, using a sample of the material compacted to 95% in accordance with AASHTO T 99, methods C, or D. No testing for the ϕ angle is required when 80% of the MSE volume shall remain the same for that wall volume.materials are greater than No. 4 (4.75 mm) sieve. An approved geotechnical laboratory shall perform the tests.~~

Concrete for the leveling pad and coping shall be class A. Concrete used in openings to accommodate appurtenances behind, in front of, under, mounted upon, or passing through the wall shall be class C.

The Contractor shall supply the MSE retaining wall components listed above, including tie strips, fasteners, bearing pads, and all necessary incidentals, through a manufacturer listed on the Department's list of approved retaining wall systems.

Structure backfill criteria shall be as follows:

<i>Property</i>	<i>Criteria</i>	<i>Test Method</i>
<i>pH</i>	<i>$5 < \text{pH} < 10$</i>	<i>AASHTO T 289</i>
<i>Chlorides</i>	<i>$< 100 \text{ ppm}$</i>	<i>AASHTO T 291</i>
<i>Sulfates</i>	<i>$< 200 \text{ ppm}$</i>	<i>AASHTO T 290</i>
<i>Organic Content</i>	<i>1 % max.</i>	<i>AASHTO T 267</i>
<i>Resistivity</i>	<i>$3000 \Omega \text{ cm (min.)}$</i>	<i>AASHTO T 288</i>
<i>Permeability & Gradation</i>	<i>30 ft/day (9 m/day) (min.)</i>	<i>AASHTO T 215 AASHTO T11 & T27</i>

~~If the minimum resistivity exceeds $5000 \Omega \text{ cm}$, the requirement of the testing for chlorides and sulfates may be waived. The resistivity shall be tested at 100% saturation. The gradation shall be run on the material used in the permeability test. All of the above tests shall be run a minimum of once per 2 calendar years per source.~~

~~ACBF shall be in accordance with the pH, chlorides, sulfates, organic content, resistivity and permeability requirements of structural backfill as noted above and ITM 212. Total sulfides shall also be determined in accordance with EPA 376.1, using the 100 mL pH water samples obtained during ITM 212, and shall not exceed 400 ppm. The ACBF shall have a maximum corrosion rate as follows for steel and zinc when tested in accordance with ASTM G 59.~~

- ~~1. Zinc Corrosion Rate First 2 years — $15 \mu\text{m/yr/side}$~~
- ~~2. Zinc corrosion to depletion — $4 \mu\text{m/yr/side}$~~
- ~~3. Carbon steel rate — $12 \mu\text{m/yr/side}$~~

~~If ACBF or coarse aggregate No. 8 is used, and soil, B borrow, structural backfill, or coarse aggregate No. 53 is to be placed above the ACBF or No. 8 aggregate, a single layer of geotextile shall be placed on top of the ACBF aggregate in accordance with 616.11. A type C certification in accordance with 916 for the geotextile materials shall be furnished to the Engineer prior to use.~~

~~The structure backfill shall be supplied in accordance with 904 and a type A certification in accordance with 916 for the above additional testing of the structure backfill shall be furnished to the Engineer prior to use. One copy of all test results performed by the Contractor, which are necessary to demonstrate compliance with the specifications, shall also be furnished to the Department's Geotechnical Section. An approved geotechnical laboratory shall perform the tests.~~

~~(a) Concrete Face Panels~~

~~Concrete shall be in accordance with the applicable requirements of 702. Concrete shall have a compressive strength equal to or greater than 4000 psi (27.5 MPa) at 28 days.~~

~~Retarding agents, accelerating agents, or additives containing chloride shall not be used without approval. Air entraining and slump requirements shall be in accordance with 702.05.~~

~~Ground reinforcement connecting hardware and rebar lifting devices shall be set in place and secured prior to beginning casting, in accordance with the dimensions and tolerances shown on the design drawings.~~

~~1. Testing and Inspection~~

~~Acceptability of the panels will be determined on the basis of compressive strength tests and visual inspection. The panels shall be considered acceptable regardless of curing age when compressive test results indicate that the compressive strength is in accordance with 731.05(a). The wall manufacturer of the panels shall provide for all testing and inspection services during the production of the panels. Services shall be completed by a Department approved testing laboratory. An American Concrete Institute certified concrete field testing technician, grade I, shall be present during production of the face panels to direct all sampling and testing.~~

~~2. Casting~~

~~The panels shall be cast on a flat area, with the front face of the form at the bottom, and the back face at the upper part. Tie strip guides shall be set on the rear face. The concrete in each unit shall be placed without interruption and shall be consolidated as necessary to prevent the formation of segregation or cleavage planes. Clear form oil from the same manufacturer shall be used throughout the casting operation.~~

~~3. Curing~~

~~The panels shall be cured for a sufficient length of time such that the concrete develops the specified compressive strength.~~

~~4. Removal of Forms~~

~~The forms shall remain in place until they may be removed without damage to the unit.~~

5. Concrete Finish

~~The concrete surface for the front panel face shall have a surface finish produced from contact with the form. The rear face of the panel shall be roughly screeded to eliminate open pockets of aggregate and surface distortions in excess of 1/4 in. (6 mm).~~

6. Tolerances

~~All panels shall be manufactured within the tolerances as follows:~~

a. Panel Dimensions

~~Lateral position of tie strips shall be within 1 in. (25 mm). All other dimensions shall be within 3/16 in. (5 mm).~~

b. Panel Squareness

~~Squareness, as determined by the difference between the 2 diagonals, shall not exceed 1/2 in. (13 mm).~~

c. Panel Surface Finish

~~Surface defects on smooth formed surfaces measured on a length of 5 ft (1.5 m) shall not exceed 1/8 in. (3 mm). Surface defects on textured finished surfaces measured on a length of 5 ft (1.5 m) shall not exceed 5/16 in. (8 mm).~~

7. Compressive Strength

~~Acceptance of the concrete panels with respect to compressive strength will be determined on the basis of production lots. A production lot is defined as 50 panels.~~

~~Frequency of production control testing will consist of a minimum of 1 test per production lot but not less than 1 test per day. The wall manufacturer will sample the concrete in accordance with AASHTO T 141 and prepare a minimum of 2 cylinders in accordance with AASHTO T 23. Curing of the cylinders shall be in the same manner as the panels are cured.~~

~~When the average results of 2 cylinders tested in accordance with AASHTO T 22, meet or exceeds the requirements of 731.05(a), the production lot panels or those panels represented by a day's testing may be shipped.~~

~~When the cylinder test results are less than the requirements of 731.05(a) and additional cylinders for testing are not available, the manufacturer may core the panels. The wall manufacture will randomly select 2 panels from the lot for core testing in accordance with AASHTO T 24. The wall manufacturer shall obtain 1 core on the backside of each panel with a device that produces uniform test samples without coring completely through the panel. Coring shall not be located within 6 in. (150 mm) of the panel fasteners or the edges of the panels and shall avoid the panel's reinforcement. The wall manufacture shall fill the core holes with equivalent concrete materials or rapid set patching materials and trowel to produce a smooth finish. Excess material removed during troweling shall not be reused. If rapid set patching~~

~~material is used, mixing and curing shall be in accordance with the manufacturer's recommendations. If the average strength test results from the cores meet or exceed the requirements of 731.05(a), the production lot panels may be shipped.~~

~~A type A certification in accordance with 916 shall be furnished for each shipment prior to use of the panels. All cylinder or core test results, including the age of the cylinders or cores at the time of testing, shall be included on the certification for each production lot.~~

~~Verification of compressive strengths of the panels will be conducted by the Engineer. The frequency of verification testing will be 1 test for every 750 panels per manufacturer with a minimum of 1 test per contract. One panel will be randomly selected and 2 locations selected for coring. The Engineer will obtain two 4 in. (100 mm) cores on the backside of the panel without coring completely through the panel. The Contractor shall refill the core holes with rapid set patching materials and trowel to produce a smooth finish. Excess material removed during troweling shall not be reused. Mixing and curing of the patching materials shall be in accordance with the manufacturer's recommendations.~~

~~The Engineer will test the cores in accordance with AASHTO T 24. The verification test results will be averaged and compared to the manufacturer's results reported on the certification. If the initial verification test results do not meet the requirements of 731.05(a), the Engineer will randomly select 2 different panels for additional verification testing. If the additional verification tests meet the requirements of 731.05(a), no further action is required. If the test results still do not meet the requirements of 731.05(a), installation of panels shall cease and the Engineer will conduct an investigation. Panels manufactured on the same dates as the panels cored for verification tests that have already been installed will be considered and adjudicated as a failed material in accordance with normal Department practice as listed in 105.03. The Engineer will conduct verification testing until 3 consecutive dates of production meet the strength requirements of 731.05(a). The Contractor or wall manufacturer shall make arrangements so that panels from 3 consecutive dates of production are accessible for coring. Installation of panels may resume once acceptable verification testing results are achieved.~~

8. Rejection

~~Units shall be subject to rejection due to failure to be in accordance with the requirements specified above. In addition, the following defects may be sufficient cause for rejection:~~

- ~~a. Defects which indicate imperfect molding~~
- ~~b. Defects which indicate honeycombed or open texture concrete~~
- ~~e. Defects in the physical characteristics of the concrete, such as broken or chipped concrete, or color variations or dunnage marks on the front face due to excessive form oil or other reasons.~~

~~The Engineer will determine whether spalled, honeycombed, chipped, or otherwise defective concrete shall be repaired or be cause for rejection. Repair of concrete, if permitted, shall be completed in a satisfactory manner. Repair to concrete surfaces that are to be exposed to view after completion of construction shall be subject to approval~~

~~9. Marking~~

~~The place and date of manufacture, and production lot number shall be clearly scribed on the rear face of each panel.~~

~~10. Handling, Storage, and Shipping~~

~~All panels shall be handled, stored, and shipped so as to eliminate the danger of chipping, cracks, fractures, and excessive bending stresses. Panels in storage shall be supported on firm blocking located immediately adjacent to tie strips to avoid bending the tie strips.~~

~~(b) Concrete Leveling Pad~~

~~Concrete, class A, for the leveling pad shall be in accordance with the applicable requirements of 702.~~

~~(c) Concrete Coping~~

~~Concrete, class A, for the coping shall be in accordance with the applicable requirements of 702. Reinforcing steel in the coping shall be in accordance with the applicable requirements of 703. The coping may be precast or cast in place.~~

~~(d) Welded Wire Reinforcement, Clevis Connector, and Connector Bar~~

~~The welded wire reinforcement shall be shop fabricated of cold drawn steel wire in accordance with ASTM A 82 and shall be welded into the finished mesh fabric in accordance with ASTM A 185. Galvanization shall be in accordance with ASTM A 123.~~

~~Clevis connectors, if used, shall be attached to the alignment templates using the bars provided with the forms. The vertical and horizontal alignment of the connectors shall be $\pm 1/8$ in. (± 3 mm). The holes inside the loops shall be free of all concrete and debris, loose or otherwise.~~

~~The clevis connector shall be fabricated of cold drawn steel wire in accordance with ASTM A 82 and welded in accordance with ASTM A 884. Loops shall be galvanized in accordance with ASTM A 153 Class B 3 or ASTM A 123.~~

~~The connector bar, if used, shall be fabricated of cold drawn steel wire in accordance with ASTM A 884 and galvanized in accordance with ASTM A 123.~~

~~A type A certification in accordance with 916 for welded wire reinforcement, clevis connector, and connector bars shall be furnished prior to use of the materials.~~

~~(e) Ground Reinforcement~~

~~The ground reinforcement may be a deformed steel strip or a welded wire grid. The grid or strip used shall be consistent with that used in the pullout test and shall be consistent throughout the project.~~

~~The grid shall consist of not less than 2 longitudinal wires, perpendicular to the wall, welded to equally spaced cross ribs capable of developing passive pressure with the fill. The deformed strip shall be of constant width. The strip thickness shall vary only from the standard undeformed section to the standard deformed section as required to produce the pullout resistance.~~

~~All longitudinal wires of each welded wire grid shall be of the same diameter. All transverse wires of each welded wire grid shall be of the same diameter, but not necessarily the same as the longitudinal wire diameter.~~

~~The face panel edges shall be configured to conceal the joints. All horizontal and vertical joints shall be covered with a joint cover to prevent backfill leakage while passing water.~~

~~Reinforcing strips shall be hot rolled from bars to the required shape and dimensions. Physical and mechanical properties of the strips shall be in accordance with ASTM A 572 Grade 65 or A 572M Grade 450. Tie strips shall be shop fabricated with hot rolled steel in accordance with the minimum requirements of ASTM A 570 Grade 50 or A 709M Grade 345. Galvanization for reinforcing strips and tie strips shall be in accordance with ASTM A 123 and the minimum zinc coating thickness shall be 2 oz/sq ft (0.64 L/m²). All reinforcing strips and tie strips will be inspected to ensure that they are true to size and free from defects which may impair their strength and durability.~~

~~A type A certification in accordance with 916 shall be furnished for ground reinforcement prior to use of the materials.~~

~~(f) Reinforcing Bars~~

~~Mill certificates for reinforcing bars as shown on the plans shall be furnished for approval. All reinforcing bars shall be in accordance with ASTM A 615 Grade 60 (A 709M Grade 400).~~

~~A type A certification in accordance with 916 shall be furnished for reinforcing bars prior to use of the materials.~~

~~(g) Fasteners~~

~~Fasteners shall consist of 1/2 in. (13 mm) diameter, hexagonal cap screw bolts and nuts, which shall be galvanized and in accordance with ASTM A 325 (A 325M).~~

~~A type A certification in accordance with 916 shall be furnished for fasteners prior to use of the materials.~~

~~(h) Alignment Pins~~

~~The rods used to align the face panels during construction shall be 3/4 in. (19 mm) diameter, 12 in. (300 mm) long. The rods shall be mild steel, polyvinyl chloride, or fiberglass. A sample shall be submitted prior to use to the Materials and Tests Division for approval.~~

(i) Joint Materials

~~Bearing pads shall be rubber, neoprene, polyvinyl chloride, or polyethylene, and of the type and grade recommended by the supplier of the mechanically stabilized earth wall system.~~

~~The joint cover shall be either a non-woven needle-punch polyester geotextile or a woven monofilament polypropylene. The joint cover shall be attached to the rear face of the panels with a suitable adhesive.~~

~~Horizontal and vertical joints shall be provided between adjacent face panels to prevent concrete-to-concrete contact and chipping when differential settlement occurs. The horizontal and vertical joints shall contain compression blocks, pins, or other approved means as recommended by the manufacturer to provide a uniform joint. Panels without an uninterrupted vertical joint shall have a minimum joint thickness of 3/4 in. (19 mm).~~

~~A type A certification in accordance with 916 for joint materials shall be furnished prior to use of the materials.~~

CONSTRUCTION REQUIREMENTS

731.06 General Requirements

~~The wall manufacturer's representative shall provide technical instruction, guidance in preconstruction~~pre-construction~~ activities including the preconstruction conference, and on-site technical assistance to the Contractor during construction.~~

731.07 Foundation Preparation

~~The foundation for the structure shall be graded level for a width equal to or exceeding the length of the ground reinforcement~~reinforcing strips~~ or as shown on the plans. Prior to wall construction, the foundation, if not in rock, shall be compacted in accordance with 203. The base of the wall excavation shall be proofrolled with ~~an~~ approved compacting equipment. If unsuitable foundation material is encountered, it shall be removed and replaced with B borrow in accordance with 211.02 and compacted in accordance with 211.04.~~

~~At each foundation level, a~~An~~ unreinforced concrete leveling pad shall be provided at each foundation level as shown on the plans. The leveling pad shall be cured in accordance with 702.22 for a minimum of 12 h before placement of concrete face panels.~~

731.08 Retaining Wall Excavation

~~The Contractor shall notify the Engineer a minimum of 7 calendar days or other time as mutually agreed upon before beginning the excavation so that measurements can be taken of the undisturbed ground. ~~This work shall consist of the excavation of material whose removal is necessary for the construction of the mechanically stabilized earth walls in accordance with the~~~~

~~plans, the requirements herein, or as directed. Excavation shall include the construction and subsequent removal of all necessary bracing, shoring, sheeting, cribbing, and all pumping, bailing, and draining.~~

Prior to starting excavation operations at the wall site, clearing and grubbing shall be in accordance with 201.03. ~~The area~~ Contractor shall be cleared ~~and grubbed~~ and grubbed ~~the area~~ to the excavation in accordance with the limits shown on the plans. All timber, stumps, ~~and~~ debris shall be disposed of in accordance with 201.03. Excavation shall include the construction and subsequent removal of all necessary bracing, shoring, sheeting, and cribbing. Excavation shall also include all pumping, bailing, and draining.

~~The Contractor shall notify the Engineer a sufficient time before beginning the excavation so that measurements may be taken of the undisturbed ground.~~

~~Where necessary for safety, t~~ The excavation shall be shored or braced in accordance with State and local safety requirements ~~standards. Excavation and related work shall be performed such that no portion of the wall is endangered by subsequent operations.~~

~~Where excavation for the wall requires is adjacent to a traveled way, the method for shoring, sheeting, or bracing, the method~~ excavation opening shall be shown on the working drawings. Excavation operations shall not begin until approved before beginning the excavation. The Contractor receives notice that shall submit 5 copies of drawings in accordance with 206.09 showing details of the working drawings are approved ~~proposed method of excavation protection.~~

After the excavation for ~~the~~ each wall location has been performed, the Contractor shall notify the Engineer. The material beneath the leveling pad shall be compacted in accordance with 203. Concrete for the leveling pad shall not be placed until the Engineer has approved the depth of the excavation and the foundation material. The leveling pad shall be in accordance with 731.07.

~~All sheeting and bracing shall be removed as the backfilling progresses.~~

~~All material for backfill shall be subject to approval and shall be free from large or frozen lumps, wood, or other undesirable material. All backfill shall be compacted in accordance with 203.~~

731.09 Wall Erection

Concrete face panels shall be handled by means of a lifting device set into the upper edge of each panel ~~the panels~~. Panels shall be placed in successive horizontal lifts in the sequence shown on the plans as backfill placement proceeds. As backfill material is placed behind the panels, the panels shall be maintained in vertical position by means of temporary wooden wedges placed in the joint at the junction of the 2 adjacent panels on the external side of the wall. External bracing will be required for the initial lift.

Panels shall be stored on blocking to minimize contact with the ground or being covered by standing water. Panels placed in contact with the ground or covered by standing water shall have face discoloration removed by means of a chemical wash. ~~Panels shall be stored on blocking to minimize contact with the ground or being covered by standing water.~~

Plumbness, vertical tolerances, and horizontal alignment tolerances shall not exceed 3/4 in. (19 mm) ~~as when~~ measured with a 10 ft (3 m) straightedge. The maximum allowable offset in panel joints shall be 3/4 in. (19 mm). For a wall of over 10 ft (3 m) height, the overall plumbness from top to bottom of the wall shall not exceed 0.05 in./ft (41.3 mm/m) of wall height.

For aesthetic considerations and to make differential settlement unnoticeable, the panels shall be erected such that the horizontal site line is discontinuous at every other panel. This shall be accomplished by starting erection with the lower panel level of each wall by alternating full-height and half-height panels. Panels above the lowest level shall be of a uniform size, except as required to top out the wall, to be in accordance with the plan elevations.

The Contractor shall perform the necessary work to verify that the foundation is at the correct elevation, that the wall is constructed to the correct alignment, and that the work is in accordance with the specified tolerances. The checking of alignments and tolerances shall include verifying that the plumbness of the face panels is in accordance with 731.10 over the entire height of the wall. Alignment shall be checked at each layer of panels after the backfill behind the panels has been compacted, and the results shall be recorded.

The connections of the ground reinforcement to the panels shall be in 2 elevations for full height panels. The connections shall not be more than 30 in. (760 mm) vertically apart. To prevent out-of-plane rotation, full height face panels shall be connected to the ground reinforcement on at least 3 different points in 2 different planes. However, a preapproved system utilizing a horizontal stabilizing leg to prevent rotation shall require only ground reinforcement attachments in 1 plane. Partial size panels shall have 3 different connection points, but only 1 plane shall be attached to the ground reinforcement. Panels located at the top of the wall shall not be attached to the coping or traffic barrier.

Ground reinforcement shall be placed normal to the face of the wall, unless otherwise shown on the plans or as directed. Prior to placement of the ground ~~reinforcement~~ ~~reinforcing strips~~, backfill shall be compacted in accordance with 731.11~~10~~.

731.10 Joint Spacers and Joint Covering for Wall Panels

Horizontal and vertical joint spacers shall be provided between adjacent face panels to prevent concrete-to-concrete contact and chipping if differential settlement occurs. Panels without an uninterrupted vertical joint shall have a minimum joint thickness of 3/4 in. (19 mm). Joint covering shall be provided and attached to the rear face of the panels.

731.10~~11~~ Backfill Placement

Backfill placement shall ~~closely~~ follow erection of each course of panels and ground reinforcement. All sheeting and bracing shall be removed as the backfilling progresses. Backfill

shall be placed so as to avoid damage or disturbance to the wall materials or misalignment of the concrete face panels. All material for backfill shall be subject to approval and shall be free from lumps, wood, or other undesirable material. Wall materials that become damaged or disturbed during backfill placement shall be removed and replaced or corrected as directed. All misalignment or distortion of the concrete face panels due to placement of backfill outside the limits described herein shall be corrected as directed.

The work shall also include B borrow backfilling above a theoretical 1:1 slope behind the ground reinforcement ~~as in accordance with the details~~ shown on the plans.

B borrow and No. 4 size ~~S~~structure backfill shall be compacted to 95% of the maximum dry density in accordance with AASHTO T 99. ~~Compaction equipment shall be in accordance with 409.03(d).~~ Density of the B borrow and No. 4 size structure backfill compacted aggregate will be determined in accordance with 203.24(b). Compaction equipment shall be in accordance with 409.03(d). For all other structure backfill material ~~If No. 8 backfill materials are used,~~ compaction shall consist of 4 passes with a vibratory roller and 1 pass with the same roller in static mode. ~~The~~ A vibratory roller shall be equipped with a variable amplitude system, and a speed control device. It shall, and have a minimum vibration frequency of 1000 vibrations per min. A roller in accordance with 409.03(d) ~~4~~ may be used. All displacement or rutting of the aggregate shall be repaired prior to placing subsequent material.

The maximum loose lift thickness shall not exceed 8 in. (200 mm). ~~However, except that lifts within 3 ft (0.9 m) off from the wall or closer shall not exceed 5 in. (125 mm) in loose thickness. This lift thickness shall be decreased if necessary, to obtain the specified density.~~

Compaction within 3 ft (0.9 m) of the back face of the concrete face panels shall be achieved by means of a minimum of 5 passes with a lightweight mechanical tamper, roller, or an alternative vibratory system.

At the end of each day's operation, the last level of backfill shall be sloped away from the wall units. ~~Surface concrete face panels. In addition, surface runoff from adjacent areas shall not be permitted to enter the wall construction site.~~

Subsurface drainage for the pavement section shall be underdrains for MSE walls and shall be as shown on the plans.

Cutting or altering of the basic structural section of ground reinforcement at the site will be prohibited, unless the cutting is preplanned and detailed on the approved ~~working design~~ drawings. Cutting shall ~~only~~ be considered only if adequate additional ground reinforcement is provided to produce the required strength shown in the approved calculations. If the ground reinforcement grid or strip is shortened in the field, the cut ends shall be covered with a galvanized paint or ~~bitumastic~~ ~~50~~ coal tar to prevent corrosion of the metal.

731.112 Method of Measurement

REVISION TO STANDARD SPECIFICATIONS (OLD BUSINESS ITEM)
SECTION 731 MECHANICALLY STABILIZED RETAINING WALLS (CONTINUED)

~~The measurement of concrete face panels and wall erection will be based on measured by the square foot (square meter) of area contained within the neat line limits of the wall surface area envelope shown on the plans and not that of the wall system supplier.~~

~~The concrete leveling pad will be measured by the linear foot (meter). Common excavation will be measured by the cubic yard (cubic meter) in accordance with 203.27, to the neat lines shown on the plans. Structure backfill and B borrow will be measured in accordance with 211.09 to the neat lines shown on the plans. Underdrains for MSE walls will be measured in accordance with 718.09. Unsuitable foundation materials, if found, will be measured in accordance with 211.09. Geotextile materials if used in accordance with 731.05 will not be measured.~~

~~The measurement of concrete face panels, and wall erection will be based on the neat line limits of the wall envelope as shown on the plans. The wall envelope limits will be considered to be the vertical distance from the top of the leveling pad to the top of the coping, and the horizontal distance from the beginning to the end of the leveling pad.~~

~~Precast or cast-in-place concrete coping will not be measured. Drainage of the backfill including piping, aggregates, or and geotextile materials will not be measured.~~

731.12 Stockpiled Concrete Face Panels

~~Partial payment will be made for panels and ground reinforcement stockpiled on the project site or at the Contractor's approved storage location. Partial payment will be based on the delivered cost of the wall panels, as verified by invoices that include freight charges. The Contractor shall furnish the invoices and type A certification. The partial payment will not exceed 75% of the contract unit price for concrete face panels. Prior to construction, the Engineer will verify that the panels are in accordance with 731.05(a).~~

731.13 Basis of Payment

~~The accepted quantities of concrete face panels will be paid for at the contract unit price per square foot (square meter). Wall and wall erection will be paid for at the contract unit price per square foot (square meter). The concrete leveling pad, complete and in place, will be paid for at the contract unit price per linear foot (meter) for leveling pad. Common excavation will be paid for at the contract unit price per cubic yard (cubic meter) in accordance with 203.28, to the neat lines shown on the plans. Structure backfill and B borrow will be paid for at the contract unit price per cubic yard (cubic meter) in accordance with 211.10. Underdrains for MSE walls will be paid for in accordance with 718.10. Unsuitable foundation materials will be paid for in accordance with 211.10.~~

Payment will be made under:

Pay Item	Pay Unit Symbol
Face Panels, Concrete	SFT (m2)
Leveling Pad, Concrete	LFT (m)

REVISION TO STANDARD SPECIFICATIONS (OLD BUSINESS ITEM)
SECTION 731 MECHANICALLY STABILIZED RETAINING WALLS (CONTINUED)

Wall Erection SFT (m2)

The cost of designing the wall system, services including the testing laboratory, certified testing personnel, and the testing and inspection of the concrete panels shall be included in the cost of ~~concrete-face panels~~, concrete.

The cost of all ~~mechanically stabilized earth~~ wall materials including concrete face panels, ground reinforcement, tie strips, fasteners, joint materials, precast or cast-in-place concrete coping, repair or replacement of face panels damaged or removed due to backfill placement, and incidentals shall be included in the cost of ~~concrete-face panels~~, concrete.

The cost of all labor and materials required to prepare the wall foundation, place the ground reinforcement, and erect the concrete face panels shall be included in the cost of wall erection.

The cost of labor and materials required to provide for the drainage of the backfill including piping, aggregates, and geotextile materials shall be included in the cost of ~~concrete face panels~~, concrete.

The cost of refilling and refinishing of the core holes from verification coring shall be included in the cost of ~~concrete-face panels~~, concrete.

The cost of performing the laboratory tests by an approved geotechnical laboratory for ~~structure~~ backfill or ACBF slag shall be included in the cost of the pay items in this section.

The cost of all labor and materials for required geotextile materials, ~~used~~, shall be included in the cost of the pay items in this section.

The cost of cutting, altering, and recoating ~~of~~ the ground reinforcement at the site shall be included in the cost of wall erection.

The Standard Specifications are revised as follows:

SECTION 901, AFTER LINE 608, INSERT AS FOLLOWS:

901.09 Blank (*reserved for Item 01B on this Agenda*)

901.10 Components of MSE Retaining Walls

(a) PCC Components

1. Face Panels

Precast concrete face panels shall be produced from a source listed in the Department's List of Certified Precast Concrete Producers, in accordance with ITM 813. Concrete shall have a compressive strength equal to or greater than 4000 psi (27.5 MPa) at 28 days.

The target water cementitious ratio for the concrete mix design shall not exceed 0.435. The cement content and target water cementitious ratio of the concrete mix design shall be sufficient to obtain the specified minimum 28-day compressive strength. Approved air entraining admixture and chemical admixture Type A, B, C, D, or E may be used.

Ground-reinforcement connection hardware and reinforcing-bar lifting devices shall be set in place and secured prior to beginning casting, in accordance with the dimensions and tolerances shown on the working drawings.

a. Production Control Testing and Inspection

The manufacturer shall provide for all testing and inspection services during each day's production of the panels. The frequency of production control testing shall be based on a lot of 50 panels, or fraction thereof, for each day's production. Sampling and testing of the plastic concrete shall be in accordance with 505.01, or the ASTM equivalent. A minimum of 1 water cementitious ratio, and slump, air content, and relative yield tests shall be run per production lot, per day. A minimum of two 6 in. by 12 in. (150 mm by 300 mm) cylinders shall be cast per day's production lot for compressive strength determination. Cylinders shall be cured in the same manner as the panels they represent. Relative yield, air content, and slump of the concrete shall be in accordance with 702.05. Compressive strength shall be determined in accordance with AASHTO T 22 or ASTM C 39, with lot acceptance based on the average of 2 cylinders tested at an age no greater than 28 days. Panels shall not be shipped until the compressive strength meets or exceeds the 28 day requirement.

If the cylinder-test results do not satisfy the requirements described herein, and additional cylinders for testing are not available, the manufacturer may core the panels. The wall manufacturer shall randomly select 2 panels from the lot for coring in accordance with AASHTO T 24 or ASTM C 42. The wall manufacturer shall obtain 1 core on the backside of each panel with a device that produces uniform test samples without coring completely through the panel. Coring shall not be located within 6 in. (150 mm) of the panel fasteners or the edges of

the panels, and shall avoid the panel's reinforcing steel. The wall manufacturer shall fill the core holes with equivalent concrete materials or rapid setting patch materials, and trowel to produce a smooth finish. Excess material removed during troweling shall not be reused. If rapid setting patch material is used, mixing and curing shall be in accordance with the manufacturer's recommendations. Compressive strength testing shall be performed on the cores. If the average strength-test results from the cores satisfy or exceed the requirements described herein, the production lot panels may be shipped.

b. Casting

The panels shall be cast on a flat area, with the front face of the form at the bottom, and the back face at the upper part. Tie strip guides shall be set on the rear face. The concrete in each unit shall be placed without interruption and shall be consolidated as necessary to prevent the formation of segregation or cleavage planes. Clear form oil from 1 manufacturer shall be used throughout the casting operation.

c. Curing

The panels shall be cured for a sufficient length of time such that the concrete develops the specified compressive strength.

d. Removal of Forms

The forms shall remain in place until they can be removed without damage to the unit.

e. Concrete Finish

The concrete surface for the front panel face shall have a surface finish produced from contact with the form. The rear face of the panel shall be screeded to eliminate open pockets of aggregate and surface distortions in excess of 1/4 in. (6 mm).

f. Tolerances

All panels shall be manufactured within the tolerances as follows:

(1). Panel Dimensions

Lateral position of tie strips shall be within 1 in. (25 mm). All other dimensions shall be within 3/16 in. (5 mm).

(2). Panel Squareness

Squareness, as determined by the difference between the 2 diagonals, shall not exceed 1/2 in. (13 mm).

(3). Panel-Surface Finish

Surface defects on smooth formed surfaces measured on a length of 5 ft (1.5 m) shall not exceed 1/8 in. (3 mm). Surface defects on textured finished surfaces measured on a length of 5 ft (1.5 m) shall not exceed 5/16 in. (5 mm).

g. Compressive Strength Verification

Verification of the panels' compressive strengths will be conducted by the Engineer. The frequency of verification testing will be 1 test for every 750 panels per manufacturer with a minimum of 1 test per contract. One panel will be randomly selected and 2 locations will be selected for coring. The Contractor shall obtain two 4 in. (100-mm) cores on the backside of the panel without coring completely through the panel, in the presence of the Engineer. The Contractor shall refill the core holes with rapid setting patch materials and trowel to produce a smooth finish. Excess material removed during troweling shall not be reused. Mixing and curing of the patching materials shall be in accordance with the manufacturer's recommendations.

The Engineer will test the cores in accordance with AASHTO T 24. The verification-test results will be averaged and shall be in accordance with 901.10(a)1a. If the initial verification-test results do not satisfy the requirements described herein, the Engineer will randomly select 2 different panels for additional verification testing. If the additional verification tests satisfy the requirements described herein, no further action is required. If the test results still do not satisfy the requirements described herein, installation of panels shall cease and the Engineer will conduct an investigation. Panels manufactured on the same dates as the panels cored for verification tests that have already been installed will be considered and adjudicated as a failed material in accordance with 105.03. The Engineer will conduct verification testing until 3 consecutive dates of production satisfy the strength requirements described herein. The Contractor or wall manufacturer shall make arrangements so that panels from 3 consecutive dates of production are accessible for coring. Installation of panels may resume once acceptable verification testing results are achieved.

h. Rejection

Units shall be subject to rejection due to their failure to be in accordance with the requirements specified above. The following defects may result in rejection.

- (1) Defects which indicate imperfect molding.*
- (2) Defects which indicate honeycombed or open-texture concrete.*
- (3) Defects in the physical characteristics of the concrete, such as broken or chipped concrete, or color variations or dunnage marks on the front face due to excessive form oil or other reasons.*

The Engineer will determine whether spalled, honeycombed, chipped, or otherwise defective concrete shall be repaired or be cause for rejection. Repair of concrete, if permitted, shall be completed in a manner which is acceptable to the Engineer. Repair to concrete surfaces that are to be exposed to view after completion of construction shall be subject to approval.

i. Marking

The place and date of manufacture, and production-lot number shall be shown on the rear face of each panel.

j. Handling, Storage, and Shipping

All panels shall be handled, stored, and shipped so as to eliminate the danger of chipping, cracks, fractures, or excessive bending stresses. Panels in storage shall be supported on blocking located immediately adjacent to tie strips to avoid bending the tie strips.

2. Coping

The coping may be precast or cast-in-place.

(b) Joint Spacers and Joint Covering

The horizontal and vertical joint spacers shall include compression blocks, pins, or other manufacturer-recommended materials to provide a uniform joint.

The joint cover shall be either a non-woven needle-punch polyester geotextile or a woven monofilament polypropylene. The joint cover shall be attached to the rear face of the panels with a manufacturer-recommended adhesive.

A letter certifying that the joint spacers and joint cover adhesive material supplied is in accordance with the manufacturer's recommendations shall be provided prior to use of the materials.

The Standard Specifications are revised as follows:

SECTION 910, LINE 470, DELETE AND INSERT AS FOLLOWS:

910.07 ~~Blank~~ Steel Components of MSE Retaining Walls

(a) Backing Mats, Clevis Connector, Connector Bar, and Wire-Facing

1. Backing Mats

Backing mats shall be smooth steel welded wire reinforcement in accordance with 910.01(b)5. Galvanization, if required, shall be in accordance with ASTM A 123, coating grade 55, or ASTM B 695, class 55. The Engineer will test samples in accordance with ASTM A 185.

2. Clevis Connector

Clevis connectors, if used, shall be attached to the alignment templates using the bars provided with the forms. The vertical and horizontal alignment of the connectors shall be $\pm 1/8$ in. (± 3 mm). The holes inside the loops shall be free of all concrete and debris, loose or otherwise.

The clevis connector shall be fabricated of cold-drawn steel wire in accordance with ASTM A 82, and welded in accordance with ASTM A 884. Loops shall be galvanized in accordance with ASTM A 153 class B-3, ASTM A 123, coating grade 55, or ASTM B 695 class 55.

A type A certification in accordance with 916 shall be furnished for the clevis connector. The results of the tension, bend, and coating adhesion tests, and measurements of coating thickness and average weight of the coating, shall be included on the certification for the clevis connector.

3. Connector Bar

The connector bar, if used, shall be fabricated of cold-drawn steel wire in accordance with ASTM A 884, and galvanized, if so shown on the plans, in accordance with ASTM A 123, coating grade 55, or ASTM B 695 class 55.

A type A certification in accordance with 916 shall be furnished for the connector bars. The results of the coating adhesion test and the measurements of coating thickness, average weight of the coating, and coating flexibility, shall be included on the certification for the connector bar.

4. Wire-Facing

Wire-facing shall be smooth steel WWR in accordance with 910.01(b)5. Galvanization, if required, shall be in accordance with ASTM A 123, coating grade 55, or ASTM B 695, class 55. All wire-facing shall be handled, stored, and shipped so as to eliminate the danger of excessive bending stresses. The Engineer will test samples in accordance with ASTM A 185.

(b) Ground Reinforcement

The ground reinforcement shall be either a deformed steel strip or a welded-wire grid. The grid or strip used shall be consistent with that used in the pullout test and shall be consistent throughout the project.

The grid shall consist of not less than 2 longitudinal wires, perpendicular to the wall, welded to equally-spaced cross ribs capable of developing passive pressure with the fill. The deformed strip shall be of constant width. The strip thickness shall vary only from the undeformed section to the deformed section as required to produce the pullout resistance.

The face-panel edges shall be configured to conceal the joints. All horizontal and vertical joints shall be covered with a joint cover to prevent backfill leakage while passing water.

Ground-reinforcement units shall be hot rolled from bars to the required shape and dimensions. Physical and mechanical properties of the units shall be in accordance with ASTM A 572 Grade 65 (A 572M Grade 450). Tie strips shall be shop fabricated with hot-rolled steel in accordance with the minimum requirements of ASTM A 570 Grade 50 (A 709M Grade 345). Galvanization for ground-reinforcing units and tie strips shall be in accordance with ASTM A 123, coating grade 85 or ASTM B 695 class 80. All ground-reinforcement units and tie strips will be inspected to ensure that they are true to size and free from defects which can impair their strength and durability.

A type A certification in accordance with 916 shall be furnished for ground reinforcement prior to use of the materials. The results of the yield strength, coating thickness, and coating adhesion tests shall be shown on the certification.

(c) Fasteners

Fasteners shall consist of 1/2 in. (13 mm) diameter, bolts, nuts, and washers and shall otherwise be in accordance with 910.02(f)1 with the exception that the hardware shall be coated in accordance with ASTM A 153, class C or ASTM B 695, class 55.

The supplier shall provide a certificate of compliance with all requirements for high strength bolts, nuts, and washers used in the assembly of MSE retaining walls. The certification, in addition to complying with the applicable requirements of 916, shall include the lot number and heat number on the shipping package and indicate when or where all testing was performed.

(d) Alignment Pins

The rods used to align the face panels during construction shall be 3/4 in. (19 mm) diameter and 12 in. (300 mm) in length. The rods shall be mild steel, polyvinyl chloride, or fiberglass. A type C certification in accordance with 916 shall be furnished for the alignment pins.

COMMENTS AND ACTION

(OLD BUSINESS ITEM)

SECTION 731 MECHANICALLY STABILIZED RETAINING WALLS

901.10 COMPONENTS OF MSE RETAINING WALLS

910.07 ~~BLANK~~ STEEL COMPONENTS OF MSE RETAINING WALLS

DISCUSSIONS: This item was submitted and presented by Mr. Strain. Further explanation was given by Mr. Reilman concerning the addition of underdrains for the MSE walls.

There was much discussion on panel testing and testing frequency. Mr. Walker concurred with the reduced frequency of testing since it will be done by the manufacturer and the Contractor, in the presence of the Engineer.

Mr. Miller asked for comments from Industry. There were none.

Mr. Caplinger asked if the underdrains should also be mentioned in the Method of Measurement and in the Basis of Payment. Mr. Reilman agreed and said that he will add that language to those sections. These changes are shown in these minutes.

This item and motion was revised.

<p>Motion: Mr. Strain Second: Mr. Cales Ayes: 9 Nays: 0</p>	<p>Action: <input type="checkbox"/> Passed as Submitted <input checked="" type="checkbox"/> Passed as Revised <input type="checkbox"/> Withdrawn</p>
<p>Standard Specifications Sections affected: SECTION 700 - STRUCTURES; 901.10 pg 752; 910.07 pg 829.</p> <p>Recurring Special Provision affected: 731-R-202 MECHANICALLY STABILIZED EARTH RETAINING WALLS</p> <p>Standard Sheets affected: NONE</p> <p>Design Manual Sections affected: CHAPTER 68</p> <p>GIFE Sections cross-references: NONE</p>	<p><input checked="" type="checkbox"/> 2012 Standard Specifications Book <input type="checkbox"/> Revise Pay Items List</p> <p>RSP (No. <u>731-R-202</u>) Effective <input type="checkbox"/> Letting RSP Sunset Date: <u>Sep. 01, 2011</u></p> <p><input type="checkbox"/> Revise RSP (No. <u> </u>) Effective <input type="checkbox"/> Letting RSP Sunset Date: <u> </u></p> <p>Standard Drawing Effective <input type="checkbox"/> <input type="checkbox"/> Create RPD (No. <u> </u>) Effective <input type="checkbox"/> Letting <input type="checkbox"/> Technical Advisory</p> <p>GIFE Update Req'd.? Y <input type="checkbox"/> N <input type="checkbox"/> By <input type="checkbox"/> Addition or <input type="checkbox"/> Revision</p> <p>Frequency Manual Update Req'd? Y <input type="checkbox"/> N <input type="checkbox"/> By <input type="checkbox"/> Addition or <input type="checkbox"/> Revision</p> <p>Received FHWA Approval? <u>Yes</u></p>

SPECIFICATION REVISIONS
REVISION TO STANDARD SPECIFICATIONS

(OLD BUSINESS ITEM)

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: As part of incorporating the retaining wall recurring special provisions in the 2012 spec book the structure backfill section needs some additions as a result.

PROPOSED SOLUTION: Incorporate the appropriate language from the 731-R-202 RSP into the 211 and 901 sections respectively.

APPLICABLE STANDARD SPECIFICATIONS: 211.03.1, 901.09

APPLICABLE STANDARD DRAWINGS: None

APPLICABLE DESIGN MANUAL SECTION: Ch 68

APPLICABLE SECTION OF GIFE:None

APPLICABLE RECURRING SPECIAL PROVISIONS: 731-R-202

Submitted By: Randy Strain

Title: Bridge Policy and Standards Engineer,
Bridge Design, Inspection, Hydraulics, and Technical Support Division

Organization: INDOT

Phone Number: 2-3339

Date: January 24, 2011

APPLICABLE SUB-COMMITTEE ENDORSEMENT?INDOT Retaining Wall Committee

REVISION TO STANDARD SPECIFICATIONS (OLD BUSINESS ITEM)
 SECTION 211 - B BORROW AND STRUCTURE BACKFILL
 211.03.1 STRUCTURE BACKFILL TYPES

(The Standards Committee has approved changes that shown highlighted in gray on December 17, 2009 meeting.)

The Standard Specifications are revised as follows:

SECTION 211, BEGIN LINE 112, DELETE AND INSERT AS FOLLOWS:

(c) Type 3

1. ~~This shall consist of s~~Structure backfill in accordance with 904.05, except only nominal size aggregates 1 in., 1/2 in., No. 4 or No. 30, or coarse aggregate No. 5, No. 8, No. 9, No. 11, or No. 12 shall be used. No slag other than ACBF will be permitted.

A type A certification in accordance with 916 for the additional structure-backfill testing described below shall be furnished to the Engineer prior to use. An approved geotechnical laboratory shall be used to perform the tests. ~~One copy of all test results shall also be furnished to the Department's Office of Geotechnical Services.~~

Structure backfill for all retaining walls shall be in accordance with the following criteria:

<i>Property</i>	<i>Criteria</i>	<i>Test Method</i>
<i>pH</i>	<i>5 < pH < 10</i>	<i>AASHTO T 289</i>
<i>Organic Content</i>	<i>1 % max.</i>	<i>AASHTO T 267</i>
<i>Resistivity, min.</i>	<i>3000 Ω cm</i>	<i>AASHTO T 288</i>
<i>Permeability, min.</i>	<i>30 ft/day (9 m/day)</i>	<i>AASHTO T 215</i>

The gradation shall be run on the material used in the permeability test. Testing for permeability shall be performed on the sample of the material compacted to 95% in accordance with AASHTO T 99, Method C or D. All of the tests listed above shall be run a minimum of once per calendar year per source. The ~~Office of Geotechnical Services~~Engineer will evaluate the source of the material from each source and determine the appropriate tests to be performed.

In addition to the criteria above, structure backfill for use in MSE, steel bin-type, cut-wall, and temporary wire-faced retaining wall systems shall also be in accordance with the following criteria:

<i>Property</i>	<i>Criteria</i>	<i>Test Method</i>
<i>Chlorides</i>	<i>< 100 ppm</i>	<i>AASHTO T 291</i>
<i>Sulfates</i>	<i>< 200 ppm</i>	<i>AASHTO T 290</i>
<i>Resistivity, min.</i>	<i>3000 Ω cm</i>	<i>AASHTO T 288</i>
<i>Internal friction angle, φ</i>	<i>34° minimum</i>	<i>AASHTO T 236* or T 297*</i>

** under consolidated drained conditions*

REVISION TO STANDARD SPECIFICATIONS

(OLD BUSINESS ITEM)

SECTION 211 - B BORROW AND STRUCTURE BACKFILL

211.03.1 STRUCTURE BACKFILL TYPES

(CONTINUED)

*If the minimum resistivity exceeds 5000 Ω cm, the requirement for the testing of chlorides and sulfates may be waived. The resistivity shall be tested at 100% saturation. All of the tests listed above shall be run a minimum of once per calendar year per source. The **Office of Geotechnical Services Engineer** will evaluate ~~the source of~~ the material from each source and determine the appropriate tests to be performed.*

*For MSE, concrete block, or wire-faced retaining walls, testing for ϕ shall be performed on the portion that passes the No. 8 (2.36 mm) sieve, using a sample of the material compacted to 95% in accordance with AASHTO T 99, Method C or D. Testing for ~~ϕ~~ **internal friction angle** is not required if 80% of the materials do not pass the No. 4 (4.75 mm) sieve.*

(d) Type 4

- 1. ~~R~~removable flowable backfill in accordance with 213.

(e) Type 5

- 1. ~~N~~on-removable flowable backfill in accordance with 213.

REVISION TO STANDARD SPECIFICATIONS

(OLD BUSINESS ITEM)

SECTION 901 - PCC MATERIALS

901.09 AIR COOLED BLAST FURNACE SLAG FOR RETAINING WALLS

The Standard Specifications are revised as follows:

SECTION 901, AFTER LINE 608, INSERT AS FOLLOWS:

901.09 Air Cooled Blast Furnace Slag for Retaining Walls

If ACBF or coarse aggregate is used, and soil, B borrow, structural backfill, or coarse aggregate is to be placed above the ACBF or coarse aggregate, a single layer of geotextile shall be placed on top of the ACBF or coarse aggregate in accordance with 616.11. A type C certification in accordance with 916 for the geotextile materials shall be furnished to the Engineer prior to use.

ACBF shall be in accordance with the pH, chlorides, sulfates, organic content, resistivity, and permeability requirements of structure backfill as listed in 211.07. It shall also be in accordance with ITM 212. Total sulfides shall also be determined in accordance with EPA 376.1, using the 100-mL pH water samples obtained during the ITM 212 test, and shall not exceed 400 ppm. The ACBF shall have a maximum corrosion rate as follows if tested in accordance with ASTM G 59.

- (a) Zinc corrosion rate, first 2 years15 $\mu\text{m}/\text{yr}/\text{side}$*
- (b) Zinc corrosion rate, to depletion4 $\mu\text{m}/\text{yr}/\text{side}$*
- (c) Carbon-steel corrosion rate.....12 $\mu\text{m}/\text{yr}/\text{side}$*

COMMENTS AND ACTION

(OLD BUSINESS ITEM)

211.03.1 STRUCTURE BACKFILL TYPES

901.09 AIR COOLED BLAST FURNACE SLAG FOR RETAINING WALLS

DISCUSSIONS: This item was introduced and presented by Mr. Strain as stated on the proposal page of the meeting agenda.

Mr. Walker expressed concern as to whether all tests would apply to each material, and recommended leaving the test frequency at one year. Geotechnical Services will evaluate each source and determine the necessary tests, since testing is expensive and not all tests are appropriate.

Mr. Walker suggested adding a sentence after the first table (shown in these minutes). There will be an amendment to identify sizes and tests to be run.

Mr. Andrewski inquired as to the reason for the geotextiles. Mr. Reilman stated that it is carried over from the exiting language from the provision.

The motion to approve this item was revised by Mr. Strain.

<p>Motion: Mr. Strain Second: Mr. Cales Ayes: 9 Nays: 0</p>	<p>Action: <input type="checkbox"/> Passed as Submitted <input checked="" type="checkbox"/> Passed as Revised <input type="checkbox"/> Withdrawn</p>
<p>Standard Specifications Sections affected: 211.03.1 pg 195; 901 pg 752. Recurring Special Provision affected: 731-R-202 MECHANICALLY STABILIZED EARTH RETAINING WALLS Standard Sheets affected: NONE Design Manual Sections affected: CHAPTER 68 GIFE Sections cross-references: NONE</p>	<p><input checked="" type="checkbox"/> 2012 Standard Specifications Book <input type="checkbox"/> Revise Pay Items List <input type="checkbox"/> Create RSP (No. ____) Effective ____ Letting RSP Sunset Date: ____ <input type="checkbox"/> Revise RSP (No. ____) Effective ____ Letting RSP Sunset Date: ____ Standard Drawing Effective ____ <input type="checkbox"/> Create RPD (No. ____) Effective ____ Letting <input type="checkbox"/> Technical Advisory GIFE Update Req'd.? Y ___ N ___ By ____ Addition or ____ Revision Frequency Manual Update Req'd? Y ___ N ___ By ____ Addition or ____ Revision Received FHWA Approval? <u>Yes</u></p>

SPECIFICATION REVISIONS (OLD BUSINESS ITEM)

REVISION TO STANDARD SPECIFICATIONS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: Desire to include the longstanding retaining wall recurring special provisions for steel bin walls in the 2012 spec book.

PROPOSED SOLUTION: Incorporate the steel bin wall RSP in the 2012 spec book and delete the RSP.

APPLICABLE STANDARD SPECIFICATIONS: 733, 910.08

APPLICABLE STANDARD DRAWINGS: None

APPLICABLE DESIGN MANUAL SECTION: Ch 68

APPLICABLE SECTION OF GIFE: None

APPLICABLE RECURRING SPECIAL PROVISIONS: 732-R-433

Submitted By: Randy Strain

Title: Bridge Policy and Standards Engineer,
Bridge Design, Inspection, Hydraulics, and Technical Support Division

Organization: INDOT

Phone Number: 2-3339

Date: January 24, 2011

APPLICABLE SUB-COMMITTEE ENDORSEMENT? INDOT Retaining Wall Committee

(Changes shown as: deletion – strikethrough and addition – underlined.)

~~732 R 433 METAL BIN TYPE RETAINING WALLS~~

~~(Revised 02-16-06)~~

The Standard Specifications are revised as follows:

SECTION ~~732~~733, BEGIN LINE 1, INSERT AS FOLLOWS:

SECTION ~~732~~733 -- ~~METAL~~STEEL BIN-TYPE RETAINING WALL

732733.01 Description

This work shall consist of furnishing materials and placement of ~~metal~~steel bin-type retaining walls in accordance with 105.03.

MATERIALS

732733.02 Materials

~~The Contractor shall make arrangements to purchase the materials described herein, including the wall units and all necessary incidentals. Materials shall be in accordance with the following:~~

<u>Fasteners</u>	<u>910.02(g)1</u>
<u>Steel Bin-Type Retaining Wall Units</u>	<u>910.08</u>
<u>Structure Backfill</u>	<u>211.03.1, *904.05</u>

~~* Slag will not be allowed~~

~~Structure backfill shall have a minimum resistivity of 3000 Ω cm at 100% saturation when tested in accordance with AASHTO T 288. The pH of the backfill material shall be in the range of 5 to 10 as determined in accordance with AASHTO T 289. The maximum soluble salt content of the backfill material shall not exceed 100 ppm chlorides and 200 ppm sulfates as determined in accordance with AASHTO T 291 and AASHTO T 290, respectively. If the minimum resistivity exceeds 5000 Ω cm at 100% saturation, the requirement of testing for chlorides and sulfates may be waived.~~

(a) Metal Bin-Type Retaining Walls

~~Metal bin type retaining walls shall consist of adjoining closed face cells filled with structure backfill to form a gravity type retaining structure. The cells are constructed of sturdy lightweight, steel members that are bolted together. The necessary bolts and appurtenances shall be furnished for complete assembly of the units into a continuous closed face wall of connected bins.~~

~~The units in the wall shall be in accordance with the dimensions shown on the plans. The units shall present a uniform workmanlike appearance when assembled. The base metal shall be no less than 16 gage.~~

~~The base metal sheets shall be galvanized on both sides by means of the hot dip process in accordance with ASTM A 123 and the minimum zinc coating thickness shall be 2 oz/sq ft (610 g/m²). All metal sheets will be inspected to ensure that they are true to size and free from defects, which may impair their strength and durability.~~

~~A type A certification in accordance with 916 for the bin wall shall be furnished prior to use. One copy of all test results performed by the Contractor, which are necessary to demonstrate compliance with the specifications, shall be furnished to the Engineer.~~

(b) Backfill Material

~~Backfill materials used infor the bin-wall sections shall be structure backfill, type 3, in accordance with 211.~~

~~A type A certification in accordance with 916 for structure backfill shall be furnished prior to use. One copy of all test results performed by the Contractor, which are necessary to demonstrate compliance with the specifications, shall be furnished to the Engineer.~~

CONSTRUCTION REQUIREMENTS

732733.03 General

~~All units shall be ~~so~~ fabricated such that units of the same nominal size shall be fully interchangeable. ~~No~~ ~~d~~Drilling, punching, or drifting to correct defects in manufacture will not be permitted. ~~All units having improperly punched~~ Each unit with unauthorized holes shall be replaced ~~with no additional payment~~. The ends of all stringers and spacers shall be bolted to corner columns by means of connecting channels.~~

~~The proper curvature for the face of a wall constructed on a curve shall be obtained through by the use of shorter stringers in the front or rear panels of retaining walls as shown on the plans or as otherwise directed.~~

~~The wall height and depth may be varied. Two or more ~~designs of retaining wall~~ designs walls may be incorporated in the same wall by the use of standard split columns to make the connection on the step back.~~

732733.04 Foundation Preparation

~~The foundation for the structure shall be graded level ~~for the bin walls~~ or as shown on the plans. Prior to wall construction, the foundation, if not in rock, shall be compacted in accordance with 203. The base of the wall excavation shall be proofrolled with a vibratory roller weighing ~~not~~ not less than 10 t (9 Mg), or with other approved compacting equipment. If unsuitable foundation material is encountered, it shall be removed and replaced with B borrow in accordance with 211.02 and compacted in accordance with 211.04.~~

732733.05 Retaining Wall Excavation

Retaining wall excavation shall be in accordance with 731.08.

~~This work shall consist of the excavation of material whose removal is necessary for the construction of the bin type retaining walls in accordance with the plans, the requirements herein, or as directed. Excavation shall include the construction and subsequent removal of all necessary bracing, shoring, sheeting, cribbing, and all pumping, bailing, and draining.~~

~~Prior to starting excavation operations at the wall site, clearing and grubbing shall be in accordance with 201.03. The Contractor shall clear and grub the area to the excavation in accordance with the limits shown on the plans. All timber, stumps, and debris shall be disposed of in accordance with 201.03.~~

~~The Contractor shall notify the Engineer a sufficient time before beginning the excavation so that measurements may be taken of the undisturbed ground.~~

~~Where necessary for safety, the excavation shall be shored or braced in accordance with State and local safety standards. Excavation and related work shall be performed such that no portion of the wall is endangered by subsequent operations.~~

~~Where excavation for the wall is adjacent to a traveled way, the method for shoring, sheeting, or bracing the excavation opening shall be approved before beginning the excavation. The Contractor shall submit five copies of drawings in accordance with 206.09 showing details of the proposed method of excavation protection.~~

~~After the excavation for each wall location has been performed, the Contractor shall notify the Engineer.~~

~~All material for backfill shall be subject to approval and shall be free from large or frozen lumps, wood, or other undesirable material. All backfill shall be compacted in accordance with 203.~~

732733.06 Backfill Placement

~~The fill material~~filling~~ for the interior of the bin and behind the wall shall be structure backfill placed in layers not to exceed 6 in. (150 ~~mm~~) in thickness. Backfilling behind the wall shall progress with the filling of the bins and shall not be carried ahead of the interior bins. Existing slopes, which are shaped so as to cause a wedge action in the backfill, shall be benched before backfilling.~~

~~Structure backfill shall be compacted to 95% of the maximum dry density in accordance with AASHTO T 99. Compaction equipment shall be in accordance with 409.03(d). Density of the compacted backfill will be determined in accordance with 203.24(b). The moisture content of the backfill material prior to and during compaction shall be uniformly distributed throughout each layer. Backfill material shall have placement moisture content between optimum and -3~~

percentage points of the optimum moisture content. Backfill material with placement moisture content in excess of the optimum moisture content shall be removed and reworked until the moisture content is uniformly acceptable through the entire lift.

Compaction within 3 ft (0.91 m) of the back face of the ~~bins~~bin walls shall be achieved by means of a minimum of ~~three~~ passes with a lightweight mechanical tamper, roller, or an alternative vibratory system.

Backfill placement shall otherwise be in accordance with 731.11.

~~At the end of each day's operation, the last level of backfill shall be sloped away from the bin walls. In addition, surface runoff from adjacent areas shall not be permitted to enter the wall construction site.~~

732733.07 Method of Measurement

~~This work~~The measurement of steel bin walls will be ~~measured by~~based on the square foot (square meter) of ~~facial area for each design height~~contained within the neat line limits of the wall envelope shown on the plans and ~~not that~~thickness of the wall ~~system supplier~~complete in place and accepted. Common excavation will be measured by the cubic yard (cubic meter) in accordance with 203.27 ~~to the neat lines shown on the plans~~. Structure backfill will be measured in accordance with 211.09. Unsuitable foundation materials, if found, will be measured in accordance with 211.09.

732733.08 Basis of Payment

This work will be paid for at the contract unit price per square foot (square meter) for ~~binwall, steel, bin walls~~. Common excavation will be paid for ~~at the contract unit price per cubic yard (cubic meter)~~in accordance with 203.28. ~~Structure to the neat lines shown on the plans~~. ~~The structure~~ backfill will be paid for ~~at the contract unit price per cubic foot (cubic meter)~~ in accordance with 211.10. Unsuitable foundation materials will be paid for in accordance with 211.10.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit Symbol</u>
<u>Binwall, SteelBin Walls, Metal</u>	SFT (m2)

The cost of furnishing, handling, and installing the ~~steel~~metal units, including all materials, bolts, and appurtenances; necessary excavation and structure backfill testing; and all labor, equipment, all necessary incidentals, or replacement of ~~steel~~any metal units with ~~unauthorized holes, or those damaged and replaced during construction~~ shall be included in the cost of the ~~pay item~~bin walls.

REVISION TO STANDARD SPECIFICATIONS

(OLD BUSINESS ITEM)

SECTION 910 - METAL MATERIALS

910.08 STEEL BIN-TYPE RETAINING WALL UNITS

SECTION 910, AFTER LINE 556, INSERT AS FOLLOWS:

910.08 Steel Bin-Type Retaining-Wall Units

Wall units shall consist of adjoining closed-face cells filled with structure backfill to form a gravity-type retaining structure. The cells shall be constructed of members in accordance with AASHTO M 218 (M 218M) that are bolted together. The necessary bolts and appurtenances shall be furnished for complete assembly of the units into a continuous closed-face wall of connected bins.

Working drawings shall be submitted in accordance with 105.02.

The units shall present a uniform workmanlike appearance once assembled. The base metal shall be not less than 16 gage (1.6 mm).

The steel sheets shall be galvanized on both sides in accordance with ASTM A 123, coating grade 85. All sheets will be inspected to ensure that they are true to size and free from defects, which may impair their strength and durability.

A type A certification in accordance with 916 for the bin-wall sheets shall be furnished prior to use. The results of the steel yield strength and coating adhesion tests, and measurement of the coating thickness, shall be shown on the certification.

COMMENTS AND ACTION

(OLD BUSINESS ITEM)

SECTION 733 STEEL BIN-TYPE RETAINING WALL

910.08 STEEL BIN-TYPE RETAINING WALL UNITS

DISCUSSION: This item was introduced and presented by Mr. Strain, who explained that this long-standing RSP was edited and configured for incorporation into the standard specifications.

There were no comments or discussion for this item, as all in attendance were in agreement.

<p>Motion: Mr. Strain Second: Mr. Cales Ayes: 9 Nays: 0</p>	<p>Action: <input checked="" type="checkbox"/> Passed as Submitted <input type="checkbox"/> Passed as Revised <input type="checkbox"/> Withdrawn</p>
<p>Standard Specifications Sections affected: SECTION 700 pg 652; 910.08 pg 829. Recurring Special Provision affected: 732-R-433 METAL BIN-TYPE RETAINING WALLS Standard Sheets affected: NONE Design Manual Sections affected: CHAPTER 68 GIFE Sections cross-references: NONE</p>	<p><input checked="" type="checkbox"/> 2012 Standard Specifications Book <input type="checkbox"/> Revise Pay Items List RSP (No. <u>732-R-433</u>) Effective <input type="checkbox"/> Letting RSP Sunset Date: <u>Sep. 01, 2011</u> <input type="checkbox"/> Revise RSP (No. <input type="checkbox"/>) Effective <input type="checkbox"/> Letting RSP Sunset Date: <input type="checkbox"/> Standard Drawing Effective <input type="checkbox"/> <input type="checkbox"/> Create RPD (No. <input type="checkbox"/>) Effective <input type="checkbox"/> Letting <input type="checkbox"/> Technical Advisory GIFE Update Req'd.? Y <input type="checkbox"/> N <input type="checkbox"/> By <input type="checkbox"/> Addition or <input type="checkbox"/> Revision Frequency Manual Update Req'd? Y <input type="checkbox"/> N <input type="checkbox"/> By <input type="checkbox"/> Addition or <input type="checkbox"/> Revision Received FHWA Approval? <u>Yes</u></p>

SPECIFICATION REVISIONS (OLD BUSINESS ITEM)
REVISION TO STANDARD SPECIFICATIONS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: Desire to include the retaining wall recurring special provision for cut walls in the 2012 spec book.

PROPOSED SOLUTION: Incorporate the cut wall RSP in the 2012 spec book and delete the RSP.

APPLICABLE STANDARD SPECIFICATIONS: 734

APPLICABLE STANDARD DRAWINGS: None

APPLICABLE DESIGN MANUAL SECTION: Ch 68

APPLICABLE SECTION OF GIFE: None

APPLICABLE RECURRING SPECIAL PROVISIONS: 734-R-566

Submitted By: Randy Strain

Title: Bridge Policy and Standards Engineer,
Bridge Design, Inspection, Hydraulics, and Technical Support Division

Organization: INDOT

Phone Number: 2-3339

Date: January 24, 2011

APPLICABLE SUB-COMMITTEE ENDORSEMENT? INDOT Retaining Wall Committee

REVISION TO STANDARD SPECIFICATIONS (OLD BUSINESS ITEM)
SECTION 734 - PERMANENT EARTH RETENTION SYSTEM FOR CUT-WALL APPLICATION

(Changes shown as: deletion – strikethrough and addition – underlined.)

~~734 R 566 PERMANENT EARTH RETENTION SYSTEM FOR CUT WALL APPLICATION~~

~~(Adopted 08 20 09)~~

The Standard Specifications are revised as follows:

SECTION 734, BEGIN LINE 1, INSERT AS FOLLOWS:

SECTION 734 - PERMANENT EARTH RETENTION SYSTEM FOR CUT-WALL APPLICATION

734.01 Description

This work shall consist of designing and constructing a permanent earth retention system utilizing a cut-wall application in accordance with 105.03. Cut-wall applications refer to a class of earth retention systems in which construction of the system is performed from the top of the wall to the base utilizing either externally or internally stabilized elements or a combination of both. Geotechnical Engineering Circular No. 2 – Earth Retaining Systems, Report No. FHWA-SA-96-038 provides further discussion of cut-wall applications.

MATERIALS

734.02 Materials Contractor Design Requirements

Materials shall be in accordance with the following:

<i>Geotextile Under Riprap</i>	<i>918.02</i>
<i>Pneumatically Placed Mortar</i>	<i>708</i>
<i>Prestressing Strand</i>	<i>910.01(b)7</i>
<i>Reinforcing Bars</i>	<i>703</i>
<i>Steel H Piles</i>	<i>915.02</i>
<i>Steel Pipe Piles</i>	<i>915.01</i>
<i>Steel Sheet Piling</i>	<i>910.21</i>
<i>Steel Welded Wire Reinforcement, Smooth and Deformed</i>	<i>910.01</i>
<i>Structural Concrete</i>	<i>702</i>
<i>Structural Steel</i>	<i>910.02</i>

~~Structure backfill material used in the work described herein shall be in accordance with 211.~~

~~Drainage pipe shall be underdrain pipe in accordance with 715.02(d).~~

CONSTRUCTION REQUIREMENTS

~~734.03 General Requirements~~

~~Excavation and embankment shall be in accordance with 203.~~

~~Welding shall be in accordance with 711.32.~~

~~734.04 Contractor Design Requirements~~

The permanent earth retention system utilizing a cut-wall application shall be designed by a professional engineer having experience in the design of at least 3 completed permanent earth retention systems involving cut-wall applications. The permanent earth retention system shall be designed using the procedure described in the AASHTO LRFD Bridge Design Specifications, or in the FHWA report 0-IF-03-017, Soil Nail Walls. The required partial safety factors or allowable strength factors for Service Load Design, SLD, and load and resistance factors for ~~Load and Resistance Factor Design, LRFD~~, shall be in accordance with the above-referenced publications. The minimum factor of safety for SLD global stability or minimum required LRFD global stability shall be in accordance with the above-referenced publications, unless specified otherwise. Structural design of an individual wall element not addressed in the FHWA report shall be designed in accordance with the AASHTO specifications. Geometric data and design criteria including shear strength parameters and unit weights for soil and rock, corrosion protection, internal and external drainage requirements, horizontal and vertical alignment of the wall, and all known site and construction constraints, wall facing, and facing architectural requirements shall be as shown on the plans.

(a) Design Calculations

Design calculations shall include, but not be limited to, the following:

1. A written summary report which describes the overall design.
2. Applicable code requirements and design references.
3. Design cross-section geometry including soil and rock strata and location, magnitude and direction of design slope, external surcharge loads, and piezometric levels with the most critical slip surface shown along with the minimum calculated SLD factor of safety for global stability or minimum required LRFD global stability soil resistance to load ratio.
4. Design criteria including the undrained and drained shear strength parameters and unit weights for soil and rock.
5. Unit bond resistances for externally and internally stabilized elements.
6. Partial safety factors and strength factors for SLD or load and resistance factors for LRFD used in the design on the pullout resistance, surcharges, unit weights of soil and rock, and all materials proposed for the system including, but not limited to shotcrete, steel and concrete.

7. *Seismic design acceleration coefficient.*
8. *Design calculation sheets with the contract number, designation number, wall location and designation, date of preparation, initials of designer and checker, page number shown on each page, and an index page.*
9. *Design notes including an explanation of all symbols and computer programs used in the design.*
10. *Structural design calculations for all temporary and permanent facing and facing connections, including consideration of flexural and shear strength of the facing and all externally stabilized elements, tensile strength of all headed studs, upper cantilever, minimum reinforcement ratio, mechanical splices, welds, built-up sections, and cover and splice requirements.*

(b) Working Drawings

The limits of the wall and ground survey data shall be verified before preparing the drawings. Working drawings shall include all details, dimensions, quantities, ground profiles, cross sections necessary to construct the wall, and the following:

1. *A plan view of the wall identifying the following:*
 - a. *A reference centerline and elevation datum.*
 - b. *The offset from the construction centerline to the finished face of the wall at its base and at all changes in horizontal alignment.*
 - c. *Beginning and ending stations of the wall.*
 - d. *Right-of-way and permanent or temporary construction easement limits, location of all known active and abandoned existing utilities, adjacent structures, or other potential interferences.*
 - e. *The centerline of each drainage structure or drainage pipe behind, passing through, or passing under the wall.*
 - f. *Limit of externally and internally stabilized elements.*
 - g. *Subsurface exploratory locations with appropriate reference base lines to fix the locations of the explorations relative to the wall.*
2. *An elevation view of the wall identifying the following:*
 - a. *The elevations at the top of the wall, at all horizontal and vertical break points, and at least every 30 ft (9.14 m) along the wall.*

- b. Elevations at the base and top of the wall for casting the facing.*
- c. Beginning and ending stations of the wall.*
- d. The distance along the face of the wall to all steps in the base of the wall.*
- e. All externally and internally stabilized elements as well as vertical and horizontal spacing.*
- f. The location of drainage elements and permanent facing expansion and contraction joints along the wall length.*
- g. Existing and finished grade profiles, both behind and in front of the wall.*
- 3. Design parameters and applicable codes.*
- 4. General notes for constructing the wall including sequencing and all special construction requirements, such as dewatering, if required.*
- 5. Horizontal and vertical curve data affecting the wall and control points.*
- 6. Match lines or other details to relate the wall stationing to centerline stationing.*
- 7. A listing of the summary of quantities on the elevation drawing of each wall showing estimated square ~~feet~~yards (square meters) of exposed wall face areas and other pay items.*
- 8. Typical sections including staged excavation elevations, wall elements, and corrosion protection details.*
- 9. Typical details of production and test anchors or nails defining the orientation and dimensional relationships of the unbonded and bonded lengths.*
- 10. Details, dimensions, and schedules for all externally and internally stabilized elements, reinforcing bars, steel welded wire reinforcement, bearing plates, headed studs, and attachment devices for pneumatically placed mortar, cast-in-place, or prefabricated facings.*
- 11. Details and dimensions for appurtenances such as barriers, coping, drainage gutters, and fences.*
- 12. Details for constructing the wall around drainage facilities.*

REVISION TO STANDARD SPECIFICATIONS (OLD BUSINESS ITEM)
SECTION 734 - PERMANENT EARTH RETENTION SYSTEM FOR CUT-WALL APPLICATION

13. *Details for terminating the wall and adjacent slope construction.*

14. *Facing finishes, color and architectural treatment requirements for permanent facing elements.*

(c) Submittals

The Contractor shall submit working drawings and design calculations ~~and working drawings as described herein and in accordance with 105.02. The calculations and drawings shall be signed and sealed by a professional engineer.~~

At least 30 calendar days before the start of the wall construction, the Contractor shall submit a quality control plan, QCP, for approval. The QCP shall include, but not be limited to, personnel qualifications, wall construction procedures and sequencing, a verification testing program, and a performance monitoring program. ~~No work~~ shall not begin until written notice has been received from the Engineer that the QCP has been accepted.

1. Personnel Qualifications

The field superintendent or field foreman shall have supervised the construction of a minimum of 3 completed walls of the same type as that submitted by the Contractor.

2. Verification Testing Program

The program shall include a verification testing program of all production and test anchors and nails. The program shall identify the test locations, the type of test, i.e., proof, performance, or pullout, testing procedures, acceptance criteria, and load and measuring devices to be used.

MATERIALS

734.03 Materials

Materials shall be in accordance with the following:

<u>Geotextile Under Riprap.....</u>	<u>918.02</u>
<u>Pneumatically Placed Mortar.....</u>	<u>708</u>
<u>Reinforcing Bars.....</u>	<u>703</u>
<u>Steel H Piles.....</u>	<u>915.02</u>
<u>Steel Pipe Piles.....</u>	<u>915.01</u>
<u>Steel Sheet Piling.....</u>	<u>910.21</u>
<u>Steel Welded Wire Reinforcement, Smooth and</u>	
<u>Deformed.....</u>	<u>910.01</u>
<u>Structural Concrete.....</u>	<u>702</u>
<u>Structural Steel.....</u>	<u>910.02</u>
<u>Structure Backfill.....</u>	<u>904.05</u>
<u>Uncoated 7 Wire Strand.....</u>	<u>910.01(b)7</u>

Drainage pipe shall be underdrain pipe in accordance with 715.02(d).

CONSTRUCTION REQUIREMENTS

734.04 General Requirements

Excavation and embankment shall be in accordance with 203.

Welding shall be in accordance with 711.32.

734.053- Performance Monitoring Program During Construction

The program shall identify points of monitoring interest, in accordance with Geotechnical Engineering Circular No. 2 – Earth Retaining Systems, Report No. FHWA-SA-96-038, and the frequency of monitoring during and following construction of the wall. The program shall also include a baseline survey for points of monitoring interest.

~~During construction,~~ The Contractor shall immediately notify the Engineer if indications/signs of ground movement in the vicinity of the wall, increased size of old cracks, or separation of joints in structures, foundations, streets, or paved ~~or~~ unpaved surfaces are observed. The Contractor shall monitor the performance of the wall and movements of buildings, roads, or other facilities within a distance of ~~3~~ three times the excavation depth for the wall. If the Engineer determines that the movements exceed those anticipated for construction, the Contractor shall take corrective actions necessary to arrest the movement, or ~~make perform~~ repairs.

Within 30 days after completion of the work, as-built drawings shall be submitted to the Engineer. Revised design calculations signed by the professional engineer shall be provided for all design changes made during the construction of the permanent earth retention system.

734.0506 Performance Requirements Monitoring After Construction

Performance monitoring by the Contractor shall be done during construction and for a period of ~~one~~ one year ~~from the date the Contractor has been relieved of further maintenance, as set out in the final following acceptance letter from of the Department contract.~~ The Contractor shall post a warranty bond for the performance monitoring that ~~occurs~~ takes place after the Contractor has been relieved of further maintenance ~~contract is accepted.~~ The Contractor shall make evaluations of the test and monitoring data and performance of the wall at the frequency defined in the approved performance monitoring program. The Contractor, if necessary during the monitoring period or as directed, shall ~~immediately take steps to~~ correct deficiencies in the capacities of individual elements or take other corrective measures which may be required to prevent damage or excessive movement of the wall and adjacent facilities. The Contractor shall submit all test and monitoring data to the Engineer on a weekly basis or as otherwise directed.

734.0607 Method of Measurement

Cut wall will be measured by the square ~~foot~~ yard (square meter) of exposed face area of wall above finished grade as shown on the plans.

REVISION TO STANDARD SPECIFICATIONS (OLD BUSINESS ITEM)
SECTION 734 - PERMANENT EARTH RETENTION SYSTEM FOR CUT-WALL APPLICATION

734-0708 Basis of Payment

The accepted quantities of cut wall will be paid for at the contract unit price per square ~~foot~~ (square meter) for cut wall.

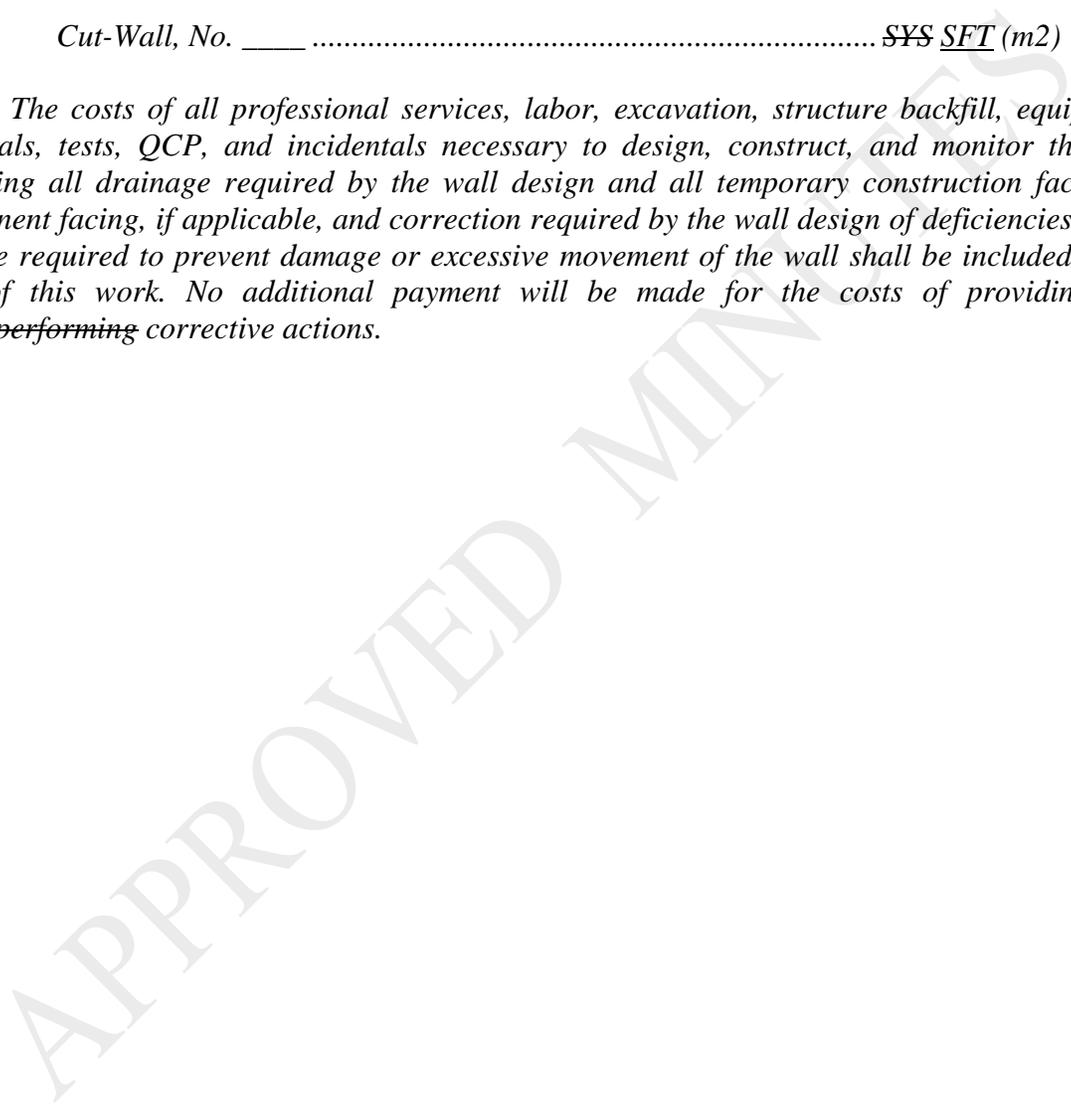
Payment will be made under

Pay Item

Pay Unit Symbol

Cut-Wall, No. ____ SYS SFT (m2)

The costs of all professional services, labor, excavation, structure backfill, equipment, materials, tests, QCP, and incidentals necessary to design, construct, and monitor the wall including all drainage required by the wall design and all temporary construction facing or permanent facing, if applicable, and correction required by the wall design of deficiencies which may be required to prevent damage or excessive movement of the wall shall be included in the cost of this work. No additional payment will be made for the costs of providing and ~~taking~~ performing corrective actions.



COMMENTS AND ACTION

(OLD BUSINESS ITEM)

SECTION 734 - PERMANENT EARTH RETENTION SYSTEM FOR CUT-WALL APPLICATION

DISCUSSION: This item was introduced and presented by Mr. Strain.

Mr. Pankow asked if we had even used this provision yet. Mr. Reilman and Mr. Strain explained that it had indeed been used and expect more use in the future.

Mr. Cales stated that the units and measurement have changed so it will get a new pay item number.

<p>Motion: Mr. Strain Second: Mr. Cales Ayes: 9 Nays: 0</p>	<p>Action: <input checked="" type="checkbox"/> Passed as Submitted <input type="checkbox"/> Passed as Revised <input type="checkbox"/> Withdrawn</p>
<p>Standard Specifications Sections affected: SECTION 700 pg 652.</p> <p>Recurring Special Provision affected: 734-R-566 PERMANENT EARTH RETENTION SYSTEM FOR CUT-WALL APPLICATION</p> <p>Standard Sheets affected: NONE</p> <p>Design Manual Sections affected: CHAPTER 68</p> <p>GIFE Sections cross-references: NONE</p>	<p><input checked="" type="checkbox"/> 2012 Standard Specifications Book <input checked="" type="checkbox"/> Revise Pay Items List</p> <p>RSP (No. <u>734-R-566</u>) Effective <input type="checkbox"/> Letting RSP Sunset Date: <u>Sep. 01, 2011</u></p> <p><input type="checkbox"/> Revise RSP (No. <u> </u>) Effective <input type="checkbox"/> Letting RSP Sunset Date: <u> </u></p> <p>Standard Drawing Effective <input type="checkbox"/> <input type="checkbox"/> Create RPD (No. <u> </u>) Effective <input type="checkbox"/> Letting <input type="checkbox"/> Technical Advisory</p> <p>GIFE Update Req'd.? Y <input type="checkbox"/> N <input type="checkbox"/> By <input type="checkbox"/> Addition or <input type="checkbox"/> Revision</p> <p>Frequency Manual Update Req'd? Y <input type="checkbox"/> N <input type="checkbox"/> By <input type="checkbox"/> Addition or <input type="checkbox"/> Revision</p> <p>Received FHWA Approval? <u>Yes</u></p>

SPECIFICATION REVISIONS

(OLD BUSINESS ITEM)

REVISION TO STANDARD SPECIFICATIONS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: Desire to include a unique provision for temporary wire faced retaining wall in the 2012 spec book.

PROPOSED SOLUTION: Incorporate the provision in the 2012 spec book.

APPLICABLE STANDARD SPECIFICATIONS: 735

APPLICABLE STANDARD DRAWINGS: None

APPLICABLE DESIGN MANUAL SECTION: Ch 68

APPLICABLE SECTION OF GIFE: None

APPLICABLE RECURRING SPECIAL PROVISIONS: None

Submitted By: Randy Strain

Title: Bridge Policy and Standards Engineer,
Bridge Design, Inspection, Hydraulics, and Technical Support Division

Organization: INDOT

Phone Number: 2-3339

Date: January 24, 2011

APPLICABLE SUB-COMMITTEE ENDORSEMENT? INDOT Retaining Wall Committee

The Standard Specifications are revised as follows:

SECTION 735, BEGIN LINE 1, INSERT AS FOLLOWS:

**SECTION 735 - TEMPORARY WIRE-FACED MECHANICALLY-STABILIZED-EARTH
RETAINING WALLS**

735.01 Description

This work shall consist of the design, furnishing materials, and placement of temporary wire-faced mechanically-stabilized-earth retaining walls in accordance with 105.03.

735.02 General Design Requirements

A temporary wire-faced MSE wall shall consist of wire facing elements, ground-reinforcement elements mechanically connected to the wire facing elements, and a drainage system if required. Concrete face panels will be required for the lower course of the wall if shown on the plans. Ground reinforcement shall have sufficient strength, frictional resistance, and quantity as required by the design.

A temporary wire-faced MSE wall shall be constructed in accordance with the approved plans and panels working drawings based on the requirements herein. The recommendations of the wall-system supplier shall meet or exceed the minimum performance requirements included herein.

If appurtenances interfere with connecting ground reinforcement to face panels, back up panels shall be provided.

The top of the wire facing elements shall be at or above the top of the wall envelope shown on the plans.

The maximum dimensions for wire-face panels shall be limited to 2 ft (0.6 m) vertical and 8 ft (2.5 m) horizontal.

735.03 Design Criteria

The design life of the wall shall be 36 months. The minimum allowable yield stress for reinforcement shall be 65 ksi (450 MPa). The maximum allowable stress in the reduced section after sacrificial steel has been removed at the end of the design life shall be $0.55F_y$ for WWR. The maximum allowable stress may be increased to $0.77F_y$ if the design life does not exceed 36 months. The reduced section of ground reinforcement shall be limited to the allowable stress shown above at the end of the 36-month design life.

The connections of the ground-reinforcing steel to the wire facing shall not be more than 24 in. (600 mm) apart vertically.

The design shall otherwise be in accordance with 731.02 and 731.03.

REVISION TO STANDARD SPECIFICATIONS (OLD BUSINESS ITEM)
SECTION 735 - TEMPORARY WIRE-FACED MECHANICALLY STABILIZED RETAINING WALLS

735.04 Submittals

The Contractor shall submit working drawings and design calculations in accordance with 105.02. Wall construction operations shall not begin until the Contractor receives written notice that the working drawings are approved.

- (a) The working drawings shall include all details, dimensions, quantities and cross sections necessary to construct the wall. They shall include, but shall not be limited to, that listed in 731.04(a) and (b).
- (b) Wire-facing details shall show all dimensions necessary to construct the element, all wire in the element, and the location of ground-reinforcing-system devices attached to the wire-facing.

MATERIALS

735.05 Materials

Materials shall be in accordance with the following:

Admixtures for Use in Concrete.....	912.03
Air-Cooled Blast-Furnace Slag.....	901.09
Alignment Pins	910.09(c) 910.07(d)
B Borrow	211.02
Coarse Aggregate, Class A or Higher, Size No. 8 or 91.....	904
Components of MSE Retaining Walls	901.10
Concrete Admixtures.....	912.03
Concrete, Class A.....	702
Fine Aggregate, Size No. 23.....	904
Fly Ash	901.02
Geotextile	913.18
Geotextile for Underdrains	913.19 918.03
Joint Spacers and Joint Covering	901.10(b)
PCC Components.....	901.10
Portland Cement	901.01(b)
Rapid Setting Patching Materials	901.07
Reinforcing Bars	910.01
Steel Components.....	910.08 910.07
Steel Welded Wire Reinforcement, Smooth.....	910.01(b)5
Water.....	913.01

Backfill material used in the temporary wire-faced MSE-wall volume shall be structure backfill, type 3 in accordance with 211 with the exception that nominal size aggregate No. 30 shall not be used.

All retention fabric or filter cloth shall be geotextile for use with underdrains.

The Contractor shall supply the MSE retaining wall components described above, including wire-facing, concrete face panels, retaining strips or mesh, tie strips, fasteners, earth-retention materials, drainage system components, and all necessary incidentals, through a manufacturer shown on the Department's list of approved retaining wall systems.

CONSTRUCTION REQUIREMENTS

735.06 General Requirements

Foundation preparation shall be in accordance with 731.07. Retaining-wall excavation shall be in accordance with 731.08.

735.07 Wall Erection

The wall-system components shall be constructed in accordance with the wall-system supplier's recommendations and construction manual.

The Contractor shall perform the necessary work to verify that the foundation is at the correct elevation, that the wall is constructed to the correct alignment, and that the work is in accordance with the specified tolerances.

Ground reinforcement shall be placed normal to the face of the wall, unless otherwise shown on the plans or as directed. Prior to placement of the ground reinforcement, backfill shall be placed and compacted in accordance with 731.11.

Where shown on the plans, backing mats shall be placed behind the wire-facing.

Where shown on the plans, galvanized screens with openings not exceeding ½ in. (13 mm) shall be placed behind the wire-facing to retain the earth.

735.08 Method of Measurement

The measurement of temporary wire-facing and temporary wall erection will be based on the square foot (square meter) of area contained within the neat line limits of the wall envelope shown on the plans and not that of the wall system supplier.

Common excavation will be measured in accordance with 203.27. Structure backfill and B borrow will be measured in accordance with 211.09. Unsuitable foundation materials, if found, will be measured in accordance with 211.09. Geotextile materials will not be measured.

Drainage of the backfill including piping, aggregates, and incidentals will not be measured.

735.09 Basis of Payment

The accepted quantities of temporary wire-facing and temporary wall erection will be paid for at the contract unit price per square foot (square meter). Common excavation will be paid for in accordance with 203.28. Structure backfill and B borrow will be paid for in

REVISION TO STANDARD SPECIFICATIONS (OLD BUSINESS ITEM)
SECTION 735 - TEMPORARY WIRE-FACED MECHANICALLY STABILIZED RETAINING WALLS

accordance with 211.10. Unsuitable foundation materials will be paid for in accordance with 211.10.

Payment will be made under:

<i>Pay Item</i>	<i>Pay-Unit Symbol</i>
<i>Temporary Wire-Facing.....</i>	<i>SFT (m2)</i>
<i>Temporary Wall Erection.....</i>	<i>SFT (m2)</i>

The cost of all MSE retaining wall components including wire-facing elements, concrete face panels, ground reinforcing, tie strips, fasteners, soil retention materials, repair or replacement of wire-facing elements damaged or removed due to backfill placement, and incidentals shall be included in the cost of temporary wire-facing.

The cost of all labor and materials required to prepare the wall foundation, to place the ground reinforcement, and to erect the concrete face panels shall be included in the cost of temporary wall erection.

The cost of labor and materials required to provide for the drainage of the backfill including piping, aggregates, or geotextile materials shall be included in the cost of temporary wire-facing.

The cost of performing the laboratory tests by an approved geotechnical laboratory for structure backfill or ACBF slag shall be included in the cost of the pay items in this section.

The cost of all labor and materials for geotextile materials used shall be included in the cost of the pay items in this section.

The cost of cutting, altering, and recoating of the ground reinforcement at the site shall be included in the cost of temporary wall erection.

COMMENTS AND ACTION

(OLD BUSINESS ITEM)

SECTION 735 - TEMPORARY WIRE-FACED MECHANICALLY STABILIZED RETAINING WALLS

DISCUSSION: This item was introduced and presented by Mr. Strain. Mr. Strain stated that this provision has been used for some time.

After brief discussion, the committee agreed to change the language regarding geotextiles and incidentals.

The motion to approve this item was therefore revised.

<p>Motion: Mr. Strain Second: Mr. Cales Ayes: 9 Nays: 0</p>	<p>Action: <input type="checkbox"/> Passed as Submitted <input checked="" type="checkbox"/> Passed as Revised <input type="checkbox"/> Withdrawn</p>
<p>Standard Specifications Sections affected: SECTION 700 pg 652.</p> <p>Recurring Special Provision affected: NONE</p> <p>Standard Sheets affected: NONE</p> <p>Design Manual Sections affected: CHAPTER 68</p> <p>GIFE Sections cross-references: NONE</p>	<p><input checked="" type="checkbox"/> 2012 Standard Specifications Book <input type="checkbox"/> Revise Pay Items List</p> <p><input type="checkbox"/> Create RSP (No. ___) Effective ___ Letting RSP Sunset Date: ___</p> <p><input type="checkbox"/> Revise RSP (No. ___) Effective ___ Letting RSP Sunset Date: ___</p> <p>Standard Drawing Effective ___ <input type="checkbox"/> Create RPD (No. ___) Effective ___ Letting <input type="checkbox"/> Technical Advisory</p> <p>GIFE Update Req'd.? Y ___ N ___ By ___ Addition or ___ Revision</p> <p>Frequency Manual Update Req'd? Y ___ N ___ By ___ Addition or ___ Revision</p> <p>Received FHWA Approval? <u>Yes</u></p>

SPECIFICATION REVISIONS (OLD BUSINESS ITEM)

REVISION TO STANDARD SPECIFICATIONS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: The Department does not have a material specification for geogrid used with modular block walls.

PROPOSED SOLUTION: Incorporate the attached geogrid material specification in the 2012 spec book.

APPLICABLE STANDARD SPECIFICATIONS: 918.05

APPLICABLE STANDARD DRAWINGS: None

APPLICABLE DESIGN MANUAL SECTION: Ch 68

APPLICABLE SECTION OF GIFE: None

APPLICABLE RECURRING SPECIAL PROVISIONS: None

Submitted By: Randy Strain

Title: Bridge Policy and Standards Engineer,
Bridge Design, Inspection, Hydraulics, and Technical Support Division

Organization: INDOT

Phone Number: 2-3339

Date: January 24, 2011

APPLICABLE SUB-COMMITTEE ENDORSEMENT? INDOT Retaining Wall Committee

REVISION TO STANDARD SPECIFICATIONS

(OLD BUSINESS ITEM)

SECTION 918 - SOIL FABRICS
 918.05 GEOGRID

The Standard Specifications are revised as follows:

SECTION 918, AFTER LINE 118, INSERT AS FOLLOWS:

(c) Type III Geogrid for Modular Block Walls

<i>PROPERTY</i>	<i>TEST METHOD</i>	<i>UNIT</i>	<i>VALUE</i>
<i>Open Area</i>	<i>COE CWD 2215</i>	<i>percent</i>	<i>50 < % < 80</i>
<i>Ultimate Strength, MD, min.</i>	<i>ASTM D 6637</i>	<i>lb/ft (N/m)</i>	<i>1500 (21,890)*</i>
<i>Long Term Design Strength, Allowable, LTDS-MD, min.</i>	<i>GRI-GG4</i>	<i>lb/ft (N/m)</i>	<i>1000 (14,600)**</i>

* Minimum Average Roll Value: property value calculated as average minus 2 standard deviations.

$$LTDS = \frac{T_{ult}}{(RF_{CR})(RF_{IR})(RF_D)}$$

Where:

T_{ult} = Ultimate strength

RF_{CR} = Reduction factor for creep

RF_{ID} = Reduction factor for installation damage

RF_D = Reduction factor for durability

** Geogrid material shall be of high-density polyethylene, HDPE; polypropylene, PP; or polyester, PET, polymers. The minimum reduction factors are as follows:

$RF_{CR} = 2.6$ for HDPE, 4.0 for PP, 1.6 for PET

$RF_{ID} = 1.10$

$RF_D = 1.10$

Independent laboratory test results for creep test in accordance with ASTM D 5262 shall be submitted. Geogrid shall have an adequate open aperture to establish proper interlock between geogrid and backfill material.

COMMENTS AND ACTION

(OLD BUSINESS ITEM)

918.05 GEOGRID

This item was Withdrawn without discussion.

<p>Motion: Second: Ayes: Nays:</p>	<p>Action: <input type="checkbox"/> Passed as Submitted <input type="checkbox"/> Passed as Revised <input checked="" type="checkbox"/> Withdrawn</p>
<p>Standard Specifications Sections affected: 918.05 pg 903.</p>	<p><input type="checkbox"/> 20 Standard Specifications Book <input type="checkbox"/> Revise Pay Items List</p>
<p>Recurring Special Provision affected: NONE</p>	<p><input type="checkbox"/> Create RSP (No. ___) Effective ___ Letting RSP Sunset Date: ___</p>
<p>Standard Sheets affected: NONE</p>	<p><input type="checkbox"/> Revise RSP (No. ___) Effective ___ Letting RSP Sunset Date: ___</p>
<p>Design Manual Sections affected: NONE</p>	<p>Standard Drawing Effective ___ <input type="checkbox"/> Create RPD (No. ___) Effective ___ Letting <input type="checkbox"/> Technical Advisory</p>
<p>GIFE Sections cross-references: NONE</p>	<p>GIFE Update Req'd? Y ___ N ___ By ___ Addition or ___ Revision Frequency Manual Update Req'd? Y ___ N ___ By ___ Addition or ___ Revision Received FHWA Approval? ___</p>

SPECIFICATIONS REVISIONS
REVISION TO STANDARD SPECIFICATIONS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: The 707 precast prestressed structural member specification needs updating to better clarify curing requirements, acceptance testing, and other minor items.

PROPOSED SOLUTION: Incorporate the proposed changes into the 707 specification section.

APPLICABLE STANDARD SPECIFICATIONS: 707

APPLICABLE STANDARD DRAWINGS: None

APPLICABLE DESIGN MANUAL SECTION: None

APPLICABLE SECTION OF GIFE: None

APPLICABLE RECURRING SPECIAL PROVISIONS: None

PAY ITEMS AFFECTED: None

Submitted By: Greg Pankow

Title: State Construction Engineer

Organization: INDOT

Phone Number: 2-5502

Date: January 24, 2011

APPLICABLE SUB-COMMITTEE ENDORSEMENT: An ad hoc committee consisting of Charles Bersch, Bob Dahman, Dave Hamilton, Tommy Nantung, Greg Pankow, Jim Reilman, Perry White, and Tony Zander were involved with the proposed changes. Industry was also provided an opportunity to comment. All comments received were considered for inclusion.

REVISION TO STANDARD SPECIFICATIONS (OLD BUSINESS ITEM)
SECTION 707 - PRECAST AND PRESTRESSED CONCRETE STRUCTURAL MEMBERS

Changes that are shown highlighted in gray have been approved by the Standard Committee on [November 20, 2008](#) and on [June 18, 2009](#)

The Standard Specifications are revised as follows:

SECTION 707, BEGIN LINE 1, DELETE AND INSERT AS FOLLOWS:

SECTION 707 – PRECAST AND *PRECAST* PRESTRESSED CONCRETE STRUCTURAL MEMBERS

707.01 Description

This work shall consist of ~~the fabrication and~~ furnishing, and installation of reinforced precast or ~~precast prestressed~~ concrete structural members or, if specified, concrete deck panels cast outside the structure, transported to, and incorporated into the structure, *or precast prestressed concrete structural members having a design 28-day concrete compressive strength, f'_c , of up to and including 8000 psi (55.2 MPaa),* all in accordance with 105.03.

10

707.02 Materials

Materials shall be in accordance with the following:

20

Admixtures for Concrete.....	912.03
<i>Backer Rod.....</i>	<i>906.02(b)</i>
Coarse Aggregates, Class A or Higher, Size No. 91*.....	904
Concrete Curing Materials.....	912
Concrete Sealers.....	909.09, 909.10
Elastomeric Bearings.....	915.04
Fine Aggregates, Size No. 23.....	904
Fly Ash.....	901.02
<i>Ground Granulated Blast Furnace Slag.....</i>	<i>901.03</i>
<i>PCC Sealer/Healer.....</i>	<i>901.06</i>
Portland Cement.....	901.01(b)
<i>Prestressing Strand.....</i>	<i>910.01(b)7</i>
Reinforcing Bars.....	910.01
<i>Silica Fume.....</i>	<i>901.04</i>
<i>Uncoated 7 Wire Strand.....</i>	<i>910.01(b)7</i>

30

**Maximum size coarse aggregate shall be equal to 2/3 of the spacing between individual reinforcing bars, bundles of bars, prestressing strands, or post tensioning ducts.*

Structural steel for steel intermediate diaphragms shall be in accordance with 910.02(a) and shall be galvanized in accordance with ASTM A 123 after cutting, bending, and welding. Bolts for steel intermediate diaphragms shall be 7/8 in. (22 mm) and in accordance with 910.02(f), except they shall be type 1. All bolts, nuts, washers, and similar threaded fasteners shall be galvanized in accordance with ASTM A 123 or may be mechanically zinc coated in accordance with ASTM B 695, class 50.

40 ~~Tensioning rods and steel plates used with adjacent prestressed-concrete box beams shall be in accordance with ASTM A 706, Grade 36 (A 706M, Grade 250). Nuts used with such tensioning rods shall be heavy hex in accordance with ASTM A 563 (A 563M). Grout used with such beams shall be non-shrink in accordance with ASTM C 1107.~~

707.03 General Requirements

50 ~~All precast non-prestressed structural members shall be manufactured by a Department Certified Precast Concrete Producer in accordance with ITM 813. All precast prestressed structural members including, but not limited to, concrete deck panels, box-beams, I-beams, U-beams, and bulb-T beams shall be manufactured in a Department approved plant in accordance with ITM 814. Dimensions and design requirements for structural members shall be as shown on the plans. Lengths and dimension tolerances shall be as shown on the plans or as otherwise specified.~~

~~A beam whose dimensions exceed the tolerances shown on the plans will be rejected. A beam which is to include a field attached curb shall have curb reinforcement located longitudinally within 3/4 in. (20 mm) of the locations shown on the plans.~~

60 ~~Structural steel diaphragms shall be fabricated and erected in accordance with 711. Steel diaphragms shall include all connection angles, plates, and associated hardware required for a complete installation. The Contractor shall replace, re-galvanize, or repair all damaged galvanized material at the discretion of the Engineer.~~

CONSTRUCTION REQUIREMENTS

707.03 General Requirements

70 ~~Dimensions and design requirements for structural members shall be as shown on the plans. Lengths and dimension tolerances shall be as shown on the plans or as otherwise specified. A beam which is to include a field attached curb shall have curb reinforcement located longitudinally within 3/4 in. (20 mm) of the locations shown on the plans. If detailed drawings are not included in the plans, shopworking drawings shall be submitted for approval in accordance with 105.02. Certified mill test reports shall be furnished for all high tensile uncoated 7 wire strands. Fabrication shall not begin until the shop drawings are approved.~~

~~Where temperature requirements are specified herein, the Contractor shall provide the Department with written verification that the temperature requirements have been met.~~

~~Where temperature requirements are specified herein, the Contractor shall provide the Department with written verification that the temperature requirements have been met.~~

80 ~~Prior to the beginning of fabrication, a prefabrication meeting shall be held at the fabrication facility or another agreed upon location. The meeting shall be conducted by the~~

~~fabricator~~ Contractor and attended by the fabricator's production supervisor and quality control inspector, and the Engineer. The ~~fabricator~~ Contractor shall take notes of the meeting and distribute copies to all attending parties within ~~five~~ 5 days of the date of the meeting. Items to be discussed at the meeting shall include a minimum of: fabrication and shipping schedule including hours of operation; line of communication between ~~fabricator~~ Contractor and Engineer; material test reports; ~~shop~~ working drawings; special fabrication methods; fabrication hold points for inspection; final inspection and acceptance of materials; method of shipment. The requirement to hold prefabrication meetings may be waived by the Department, ~~if the Department so chooses.~~

90

A type A field office in accordance with 628 shall be provided at any facility that fabricates precast prestressed structural members for the Department's exclusive use. In lieu of a field office, a work area and the following items in accordance with 628 for the exclusive use by the Department shall be provided on the property where the structural members are being fabricated.

100

- (a) office desktop
- (b) office chair
- (c) broadband internet service
- (d) telephone
- (e) fax machine
- (f) copier
- (g) filing cabinet.

~~Where temperature requirements are specified herein, the fabricator shall provide the Department with written verification that the temperature requirements have been met.~~

CONSTRUCTION REQUIREMENTS

110

707.04 Steel and Concrete Requirements

(a) Reinforcing Bars

A tight coat of concrete grout extending 1/2 in. maximum from the top of precast and ~~precast~~ prestressed concrete *structural* members will be permitted to remain on reinforcing bars extending from precast and precast prestressed *structural* members. All loose and flaky material on these reinforcing bars shall be removed. Lap splices shall be in accordance with 703.06. ~~In lieu of tying, reinforcing bars may be welded in accordance with 703.06.~~

120

(b) Prestressing Strands

Uncoated 7 wire strands shall be used as prestressing strands. The splicing of straight prestressing strands is acceptable provided that the location of the splice does not occur within a concrete *structural* member. Splicing of draped strands is not allowed. Spliced prestressing strands shall have the same twist or lap. For single strand tensioning, slippage of the splices

REVISION TO STANDARD SPECIFICATIONS (OLD BUSINESS ITEM)
SECTION 707 - PRECAST AND PRESTRESSED CONCRETE STRUCTURAL MEMBERS

should be considered in computing the elongation. For multiple strand tensioning, either all of the strands shall be spliced or not more than 10% of the strands. If all of the strands are spliced the average splice slippage shall be considered in computing the elongation. If 10% or less of the strands are spliced, no slippage allowance ~~shall~~ will be required.

130 Wire breaks will be permitted to remain on the prestressed concrete casting bed as follows:

Number of Strands in Bed	Wire Breaks
19 or F fewer	0
20 through 39	1
40 through 59	2
60 or M more	3

The ends of each permitted wire break shall be tied to the strand. If more than the permissible number of wire breaks appears in a particular strand pattern, or if more than ~~one~~ 1 broken wire appears in an individual strand, such strands shall be removed and replaced.

140 The tolerance for the center of gravity for a prestressing strand group shall be $\pm 1/4$ in. (± 6 mm). The tolerance for the longitudinal position of handling devices shall be ± 6 in. (± 150 mm).

(c) Concrete

150 Concrete shall be air entrained and in accordance with the applicable requirements of 702.05. The concrete shall have a minimum temperature of 50°F (10°C) and a maximum temperature of 90°F (32°C) at the time of placement. ~~When a chemical admixture types A, D, F, or G is used, it shall be used in combination with an air entraining admixture. A high range water reducing, HRWR, or high range water reducing retarding, HRWRR, admixture system shall~~ may be used. Chemical admixture types B, C, and E will ~~only be permitted~~ only allowed with prior written permission. ~~Admixtures, other than air entraining admixtures, shall not be used with air entrained cement. Air-entraining cement will not be permitted.~~ The cement content of the mixed concrete shall be sufficient to obtain the specified minimum 28-day compressive strength. The total of portland cement and other cementitious materials shall be a minimum of 564 lbs/cu yd (335 kg/m³) and shall not exceed 800 lbs/cu yd (475 kg/m³). Silica fume may be added in an amount not to exceed 5% of the total cementitious material. ~~Slump shall be no less than 2 in. (50 mm) nor more than 5 in. (125 mm) for concrete without chemical admixtures or concrete containing chemical admixture types A and D.~~

160 When a type A, D, or E admixture is not used, or if a type B or C chemical admixture is used, slump shall be no less than 1 in. (25 mm) or more than 3 in. (75 mm). When concrete admixtures type A, D, or E is used, slump shall be no less than 2 in. (50 mm) or more than 5 in. (125 mm). When ~~concrete containing admixture type F, G, or admixture systems is used, the concrete shall have a slump no less than 3 in. (75 mm) nor more than 78 in. (475200 mm).~~ The

amount of time from mixing to placement and consolidation shall be a maximum of 30 min. The concrete shall not be retempered with additional amounts of chemical admixture types F or G after the initial mixing has been completed.

1. Cold Weather Concrete

Cold weather concrete shall be in accordance with 702.11 ~~except that two minimum-maximum recording type thermometers shall be provided in the enclosure.~~

170

2. Hot Weather Concrete

When it is necessary to fabricate concrete structural members during times of hot weather the mix water may be chilled or an appropriate amount of ice may be added to the concrete mix in order to produce concrete of the temperature **specified** herein.

3. Acceptance Testing

180

Acceptance of precast and precast prestressed *structural* members will be based on tests for slump, air content, and compressive strength. ~~All slump, air content, and compressive strength tests shall be performed in the presence of the Engineer. Compressive strength shall be obtained from test cylinders described herein.~~ The 28-day compressive strength shall be equal to or greater than the specified concrete compressive strength. ~~Test cylinders for acceptance shall be molded and field cured in accordance with ASTM C 31 and tested in accordance with ASTM C 39. The fabricator shall make a minimum of two 6 in. dia. by 12 in. test cylinders per member cast. The fabricator may elect to make additional cylinders for acceptance testing prior to 28 days. The 28 day compressive strength of the concrete for each structural member will be determined by the average strength of two cylinders representing that member. The strength of any individual cylinder for a member shall not be lower than 95% of the specified concrete compressive strength. The fabricator may elect to make and test additional cylinders for acceptance at an earlier age in lieu of the 28 day requirement. All slump, air content, and compressive strength tests shall be performed in the presence of the Engineer. Slump and air content measurements shall be obtained each time cylinders are made. Compressive strengths of the structural members shall be determined from cylinder sets described herein. The 28-day compressive strength shall be equal to or greater than the specified concrete compressive strength. The compressive strength of the concrete for each structural member will be determined from the average strength of the cylinder set representing that member. No individual strength within a cylinder set representing a structural member shall be less than 90% of the specified concrete compressive strength.~~

190

All molds, facilities, labor, and materials necessary to prepare, ~~and cure, and test the test specimens~~ cylinder sets shall be furnished.

200

a. Cylinder Set

A cylinder set shall consist of at least 3 cylinders obtained from 3 separate batches or loads of concrete used in casting a structural member. The batches or loads to be sampled may be as directed by the Engineer. All cylinders for acceptance shall be 6 in. diameter by 12 in.,

molded and field cured in accordance with ASTM C 31. The Contractor may make additional cylinder sets for use in acceptance testing.

210 *All cylinders shall be identified by use of Department-marked cylinder identification tags which are inserted a maximum of 3/8 in. (10 mm) into the top of each freshly molded cylinder. The cylinder number, a unique structural member identification number, temperature, air content, and slump of the concrete represented by each cylinder shall be referenced to the numbers on these cylinder identification tags and provided to the Engineer by the end of each day in which cylinders are cast.*

Cylinders shall be stored as near as possible to the point of deposit of the concrete represented. All surfaces of the cylinders shall be protected from the elements in the same manner as the formed structural members. ~~The~~ Cylinders shall be cured at the same temperature and moisture environment as the structural members.

220 *Cylinders shall be in the moisture condition resulting from the selected curing treatment prior to testing. To meet these conditions, the cylinders shall be removed from the molds at the time the structural member is removed from the form work. Cylinders shall be tested in accordance with ASTM C 39. The Contractor shall have on file a certificate of calibration for the testing machine. All cylinders in a cylinder set, for a given age, shall be broken within the time tolerances shown in ASTM C 39. The Department will remove cylinder identification tags prior to the Contractor testing the cylinders.*

b. Precast, Non-Prestressed Structural Members

230 *When fabricating precast non-prestressed structural members, a minimum of 1 cylinder set shall be made per member cast. The 28-day compressive strength of the concrete for each structural member will be determined by the average strength of the cylinder set representing that member. The fabricator may elect to make additional cylinder sets for use in acceptance testing prior to 28 days.*

c. Precast, Prestressed Structural Members

240 *A minimum of 2 cylinder sets shall be made for each structural member cast. One cylinder set shall be tested and used to determine when the precast prestressed structural member has met or exceeded the required strength for detensioning the prestressing bed. If an additional cylinder set as described above has been made, the Contractor may test this set to determine if the required strength for detensioning of the prestressing bed has been met or exceeded, or if the required 28-day compressive strength has been met or exceeded prior to an age of 28 days. The Engineer will accept the results from the compression testing on the additional cylinder set, in place of either the detensioning strength test results, or the 28-day compressive strength test results, if the results equal or exceed the respective compressive strength requirements. If an additional cylinder set was not made, or if the additional cylinder set does not meet or exceed the 28-day compressive strength requirement, the remaining cylinder set shall be tested at 28 days of age to determine the acceptability of the structural members.*

250 *Coring of precast prestressed structural members shall not be performed. Precast prestressed structural members that have been cored will not be accepted. Compressive strength results for cylinders that exceed 28 days in age or results from cylinders that do not have the Department-marked cylinder identification tag intact will result in the structural members not being accepted.*

(d) Other Requirements

~~The fabricator shall control prestressing operations and shipment of structural members through the use of compressive strength test cylinders that are molded and field cured in accordance with ASTM C 31.~~

260 Precast concrete *structural* members which are not prestressed shall have a minimum compressive strength of 4500 psi (31 MPa) in 28 days. Precast prestressed *structural* members shall be in accordance with the following unless otherwise shown on the plans:

1. Maximum water/cementitious ratio in pounds (kilograms) of water per pound (kilogram) of cementitious material shall be 0.420.
2. Minimum 28-day compressive strength of concrete shall be 5000 psi (34.5 MPa).
- 270 3. Minimum compressive strength of concrete at time of prestressing shall be 4000 psi (27.628 MPa).
4. Initial tension of prestressing strands shall be as shown on the plans.

280 Inspection of the precast prestressed *structural* member during manufacture and checking and testing aggregates, cement, concrete, and steel specimens ~~will~~shall be performed. All specimens shall be furnished without cost to the Department. Inspection, checking, and testing performed by the Department will not relieve the Contractor or the fabricator from performing their own quality control inspection, testing, and checking as necessary to maintain quality control over the manufacturing, handling, and curing procedure. A permanent record of the force applied to and measured elongation obtained for each prestressing strand and the identification of the strand and ~~unit~~*structural member* to which the record applies shall be provided. This record shall be certified that it accurately represents the force applied and measured elongation by the fabricator's production supervisor and provided to the Engineer prior to shipment.

707.05 Forms

290 Structural members shall be manufactured in steel forms which are unyielding, smooth, mortar-tight, and of sufficient rigidity to prevent distortion due to pressure of the concrete. They shall be so designed that the finished concrete is in accordance with the required dimensions and contours. The design of the forms shall take into account the effect of vibration of the concrete as

it is placed. Forms shall be ~~filleted or chamfered at all sharp corners and shall be given a bevel or draft at all projections to ensure easy removal~~ in accordance with 702.13(a). Exposed edges of curbs shall be beveled or edged. Forms shall be set and maintained true to the lines designated until the concrete is sufficiently hardened or for periods hereinafter specified. Interiors of forms shall be treated with an approved formulated form coating which allows them to be released without adhering, discoloring, or otherwise damaging the concrete. Form coating materials shall not come in contact with either reinforcing bars or prestressing strands.

707.06 Placing and Finishing Cement Concrete

300 The temperature of the prestressing strands and forms shall be monitored between the time of the application of prestressing force and the placement of the concrete. During hot weather, approved means shall be undertaken to cool the ~~prestressing strands and~~ forms immediately prior to placement of the concrete.

When abutment anchorage set-ups where prestressing strands are anchored to abutments that are independent from the form, thermal adjustments shall be made if the temperature of the prestressing strands at the time of tensioning differs by more than 25°F (15°C) from the temperature of the concrete mixture during placement. This requirement will not apply to self-stressing beds.

310 *Void boxes, inserts, and attachments shall be securely fastened in order to maintain the proper position during concrete placement and consolidation. All voids shall have weep holes or otherwise be vented during beam production until after the initial concrete set, then sealed before the beams are shipped.*

320 Concrete, during and immediately after depositing, shall be consolidated with vibrators and suitable spading tools. Vibration shall be applied at the point of deposit and in the area of freshly deposited concrete. The vibrators used may be internal, external, or a combination of both. Internal vibration shall be of sufficient duration and intensity to consolidate thoroughly, but shall not be continued so as to cause segregation. Vibration shall not be continued at any ~~one~~ point so that localized areas of grout are formed.

The entire operation of depositing and consolidating the concrete shall be conducted so that the concrete will be smooth, dense, and free from any honeycomb or pockets of segregated aggregates. The concrete in each *structural* member shall be placed in ~~one~~ continuous operation. The outside vertical faces of ~~face~~ fascia girders *structural members* and the exposed face and top of the curb section, *if applicable*, shall be finished in accordance with 702.21.

330 ~~Voids in prestressed concrete box beams shall be vented during beam production until after the initial concrete set, then sealed before the beams are shipped.~~

The tops of all beams and the outside faces and bottom flanges of the fascia beams shall be sealed ~~with an approved concrete sealer~~ in accordance with 709.

707.07 Removal of Forms and Curing

Side forms may be removed when no distortion, slump, or misalignment of the concrete will result. Precast members which are not prestressed shall remain on the bottom supporting forms for the span until the concrete has reached a strength of at least 2,000 psi (13.8 MPa) as evidenced by test cylinders made and cured in the same manner as the slab.

340

~~Curing shall be in a suitable~~ enclosure designed to minimize heat and moisture loss. ~~and~~ Insulated blankets may be used. The concrete in the form shall be maintained at a minimum temperature of 50°F (10°C) during the entire curing cycle. Curing for precast or precast prestressed structural members shall be done by wet curing without supplemental heat or by accelerated curing. During the period of initial set of the structural member and during the accelerated curing by radiant heat, the concrete shall be kept wet by the method outlined below for wet curing without supplemental heat.

350

Approval shall be obtained before curing is done by any means other than those outlined below.

Side forms may be removed when no distortion, slump, or misalignment of the concrete will result. Precast structural members which are not prestressed shall remain on the bottom supporting forms for the span until the concrete has reached a strength of at least 2,000 psi (13.8 MPa) as evidenced by cylinders sets made and cured in the same manner as the slab.

(a) Wet Curing without Supplemental Heat

~~Curing may be done by wet curing or by accelerated curing.~~

360

When wet curing without supplemental heat is used, the exposed surfaces of the structural members shall be covered by ~~two~~ 2 layers of wet burlap and the burlap shall be kept wet to ensure that free water is present at all times. In lieu of using wet burlap, the Contractor may propose an alternate method which provides a moist environment with free water being present at all times. ~~The Contractor shall receive~~ Written approval from the Engineer will be required prior to ~~using~~ use of the proposed alternate method. Additional curing of precast or precast prestressed ~~units~~ structural members will not be required provided the minimum specified ultimate strength can be obtained.

370

In precast prestressed concrete structural members, wet curing without supplemental heat shall continue until such time as the compressive strength of the concrete reaches or exceeds the strength specified for transfer of prestress or detensioning. At this point wet curing is considered to have concluded. Detensioning shall be performed within 6 hours after wet curing has concluded. In precast non-prestressed structural members, wet curing without supplemental heat shall continue until such time as the compressive strength of the concrete reaches the strength specified for stripping of forms.

(b) Accelerated Curing

380 When accelerated curing of the concrete is used, it shall be done by low pressure steam or radiant heat curing. ~~Insulated blankets may be used to reduce heat and moisture loss subject to maintaining a 50°F (10°C) minimum temperature. The heat shall always be applied at a controlled rate following the initial set of the concrete, and an effective method of retaining the heat and moisture in the concrete shall be used during the curing cycle. Radiant heat may be applied by means of pipes circulating steam, hot oil or hot water, or by electric heating elements. When steam is used, the jets shall be positioned so that they do not discharge directly on the concrete, forms, or cylinders. The steam shall be at 100% relative humidity to prevent loss of moisture and to provide moisture for proper hydration of the cement.~~

390 ~~Curing shall be in a suitable enclosure to minimize heat and moisture loss. Except to maintain a minimum concrete temperature of 50°F (10°C), heat shall not be applied until the concrete has attained its initial set. The time of initial set may be determined by ASTM C 403. Once the penetration resistance, as performed in accordance with ASTM C 403, equals or exceeds 500 psi (3.5 MPa) accelerated curing may begin. When the initial set is not determined by ASTM C 403, the initial application of heat shall be from 2 to a minimum of 4 h after final concrete placement. If retarders are used and the initial set is not determined by ASTM C 403, this time shall be increased to 4 to a minimum of 6 h after final concrete placement. Heat shall always be applied at a controlled rate following the initial set of the concrete, and an effective method of retaining the heat and moisture in the concrete shall be used during the entire curing cycle.~~

400 ~~During the initial application of radiant heat or live steam, the ambient temperature within the curing shall increase at an average rate not exceeding 40°F/h (5°C/h) until the curing temperature is reached. Neither the maximum temperature within the enclosure nor the maximum temperature on the surface of the concrete shall exceed 160°F (71°C). The maximum curing temperature shall be held until the concrete has reached the minimum required strength for moving precast and precast prestressed. In discontinuing the steam application, the air temperature inside the enclosure shall decrease at a rate not to exceed 70°F/h (20°C/h) until the temperature has reached 20°F (7°C) above the temperature of the air to which the member will be. Time and temperature recording thermometers shall be provided and used to verify compliance with the stated heating and cooling rates. Detensioning should be accomplished immediately after accelerated curing has been discontinued, provided the member has met or exceeded the specified release strength. When multiple members are cast in the same bed, all members shall meet or exceed the specified release strength prior to detensioning. Additional curing of precast or precast prestressed units will not be required provided the minimum specified ultimate strength can be obtained.~~

410 ~~During the initial application of radiant heat or live steam, the temperature measured in the concrete shall increase at an average rate not exceeding 36°F/h (20°C/h). The maximum concrete temperature shall not exceed 158°F (70°C). A minimum of 3 time and temperature~~

420 *recording devices capable of recording temperatures in degrees Fahrenheit or Celsius at intervals not exceeding 15 minutes shall be provided throughout a contiguous form group and common heat source. The time and temperature recording devices shall be located at the portions of the contiguous form group likely to experience the maximum temperatures during curing.*

The curing temperature shall be sustained until the concrete has reached the minimum required strength for detensioning the structural members.

430 *As the application of heat is discontinued, the concrete temperature shall decrease at a rate not to exceed 50°F/h (28°C/h). When the concrete temperature has reached 40°F (22°C) or less above the ambient temperature outside the curing enclosure, accelerated curing is considered to have concluded. Detensioning shall be performed after accelerated curing has concluded, provided the compressive strength of the concrete in the structural member has met or exceeded the specified release strength. A thermometer shall be provided to monitor ambient air temperatures. This thermometer does not have to have recording capabilities.*

The time and temperature recording devices shall be used to verify compliance with the heating and cooling rates contained herein.

440 *When multiple structural members are cast in the same bed, all members shall meet or exceed the specified release strength prior to detensioning. Additional curing of precast or precast prestressed structural members will not be required provided the minimum specified ultimate strength can be obtained.*

450 *A grinder or other methods that induce minimal amounts of heat into the prestressing strand shall be used to cut off prestressing strands. The ends of the concrete structural member where prestressing strands have been cut to be flush with the end of the member shall be coated with bituminous mastic sealant in accordance with 907.11. All prestressing strands that are exposed and protrude from the end of the beam shall be protected from rusting by use of a spray, brush, or roller-applied rust-inhibiting paint or other material that is not considered detrimental to bonding with concrete.*

~~Radiant heat may be applied by means of pipes circulating steam, hot oil or hot water, or by electric heating elements. When steam is used, the jets shall be positioned so that they do not discharge directly on the concrete, forms, or test cylinders. The steam shall be at 100% relative humidity to prevent loss of moisture and to provide moisture for proper hydration of the cement.~~

460 ~~During the period of initial set of the member and during the accelerated curing by radiant heat, the concrete shall be kept wet by the method outlined above for wet curing.~~

~~Approval shall be obtained before curing is done by any means other than those outlined above.~~

707.08 Handling and Shipping

470 Precast and precast prestressed *structural* members shall not be subjected to excessive abuse which produces crushing or undue marring of the concrete. All *structural* members damaged during handling, storing, transporting, or erecting shall be replaced. Unless otherwise approved, precast and precast prestressed *structural* members shall be handled with a suitable hoisting device provided with a spreader sling. The spreader shall be of sufficient length to prevent horizontal forces being produced in the *structural* member due to lifting and shall be equipped with leads and hooks at each end. The ~~girders~~*structural members* shall be lifted by the devices shown on the plans. Proposed alternate lifting devices and procedures shall be approved prior to use and shown on the ~~shop~~*working* drawings. If any other method of handling is used, it shall be shown on the ~~shop~~*working* drawings and approved prior to use. ~~If any other method of handling is used, it shall be shown on the shop drawings and approved prior to use.~~ If the method produces horizontal forces in the precast or precast prestressed *structural* member, sufficient reinforcement shall be added to compensate for them.

480 The *structural* members shall remain in an upright position at all times and shall be supported as indicated herein when in storage and during transportation to the construction site.

In storage, all *structural* members shall be fully supported across their width on battens not less than 4 in. (100 mm) wide with ~~one~~ being placed at each end at the centerline of the bearing. The supports of the *structural* members while in storage shall be maintained in a level position so no twisting occurs.

490 Precast *structural* members shall not be shipped nor used until the concrete compressive strength reaches a minimum of ~~4,500~~*4500* psi (31 MPa) for members which are not prestressed and ~~5,000~~*5000* psi (34.5 MPa) for members which are prestressed.

500 During transportation, the *structural* members shall be supported with truck bolsters or battens no less than 4 in. (100 mm) wide which are padded with no less than 1/2 in. (13 mm) of rubber. The ends of I-beams, *U-beams*, and *bulb-T beams* shall extend no more than the depth of the beam and not more than ~~3.56~~ ft (1 m) beyond the supports. The ends of box-beams shall extend no more than 1 1/2 times their depth and not more than 3 ft (0.9 m) beyond the supports. The ends of slabs shall extend no more than the depth of the beam beyond the supports. Supports of cantilever beams shall be as shown on the plans. Trucks with double bolsters will be permitted, provided the beams are fully seated on the outer bolsters and the inner bolsters are no more than 8 ft (2.4 m) from the ends of the beams. Wood blocks or other suitable material shall be placed under the tie chains to prevent chipping the concrete.

707.09 Placing Structural Members

Erection of precast prestressed structural members shall commence at the centerline and proceed out to the curb, ~~one~~*one* member at a time. As each *structural* member is placed, the transverse tie bars, if shown on the plans, shall be inserted and secured. Any shifting of the

510 *structural* members shall be done while they are held free of the supports by the hoisting device. The use of a steel pinch bar will not be permitted. *Structural* ~~M~~members shall be set to proper line and grade with uniform bearing on bridge seats, mortar joints, or bearing pads as required on the plans. When required, *structural* members shall be secured to the pier or bent with dowel rods. Holes for dowels shall be filled with mortar at fixed ends and with crack or joint filler at expansion ends. Longitudinal keyway joints shall be cleaned. A coat of cement mortar shall be scrubbed on the surface. The joint shall be filled with a non-shrinking grout composed of ~~one~~ 1 part portland cement, ~~two~~ 2 parts No. 23 fine aggregate, and an approved non-shrinking additive or a non-shrink, non-metallic cementation grout in accordance with ASTM C 1107. All bolts or drains shown on the plans as necessary or desirable to be placed in the concrete shall be placed by the methods and at the locations shown on the plans. Necessary tie rods, tie bolts, and hardware for tying *structural* members together shall be furnished.

520 Dowel holes shall not be grouted nor concrete or the forming thereof, be placed in floor slabs, diaphragms, or shear keys prior to receipt of complete documentation of the acceptability of the *structural* members and bearing pads, including the satisfactory laboratory reports and certifications in accordance with 915.04(e). Neither the *structural* members, nor the bearings will be considered incorporated into the work, and neither will be paid for until this documentation is accomplished satisfactorily.

530 Railing, when required, shall be of the type shown on the plans. The component parts shall be in accordance with 706, unless otherwise indicated on the plans. Other precast or precast prestressed structural members shall be placed in the structure in accordance with the plans and the specifications or special provisions indicated for the type of structure being built.

530 Cranes or other heavy erection equipment may be operated on the precast or precast prestressed *structural* members only if approved in writing and if a proposed operating procedure is submitted showing loading, distribution of loads, resulting stresses, and that the design of the *structural* members is satisfactory to permit. However, such approval shall not relieve the Contractor of any damage from this operation.

540 *After adjacent prestressed-concrete box beams are in place, the transverse tensioning rods shall be preliminarily tightened as shown on the plans. The rods shall be final tensioned as shown on the plans. The final tensioning shall yield 20,000 psi (138 MPa) as developed by means of a torque of 19 lb/ft (271 N/m). The tensioning-rod recesses and longitudinal joints between beams shall be filled with grout.*

707.10 Precast Prestressed Concrete Deck Panels

Precast prestressed concrete deck panels shall be designed as a non-composite section to support the dead load of the panel, reinforcement, plastic concrete, and a construction load of 50 lb/ft²sq ft (2.4 kPa). ~~The panel shall be designed as a composite section with the class C concrete to support the live load. The Contractor shall revise the area of top longitudinal reinforcement~~

REVISION TO STANDARD SPECIFICATIONS (OLD BUSINESS ITEM)
SECTION 707 - PRECAST AND PRESTRESSED CONCRETE STRUCTURAL MEMBERS

~~over interior supports for negative moment to be equal to the total area of top and bottom longitudinal reinforcement.~~

550

When the Contractor elects to use precast prestressed deck panels, the panel shall be designed as a composite section with class C concrete to support the live load. The Contractor shall revise the area of top longitudinal reinforcing bars in the deck over interior supports for negative moment to be equal to the total area of top and bottom longitudinal reinforcing bars.

560

~~Shop~~Working drawings shall be submitted in accordance with 105.02. Design ~~computations~~calculations shall be submitted only for total slab thicknesses greater than 8 in. (200 mm) or clear spans in excess of 7.56 ft (2.3 m). Design shall be in accordance with ~~either the AASHTO Standard Specifications for Highway Bridges or the AASHTO Load Resistance Factor Design~~LRFD Bridge Design Specifications as shown on the plans. Details such as type, size, and location of the ~~reinforcement~~reinforcing bars, the prestressing strands, ~~welded wire reinforcement~~WWR, and concrete shall be as shown on the plans.

570

The concrete for deck panels shall be placed in accordance with 702.20. The concrete shall be vibrated to prevent honeycombs and voids, especially at the corners and edges of the panels. The tops of the deck panels shall be broom or wire brush finished in the direction of the prestressing strands. The corrugations formed shall be uniform in appearance and shall not be more than 1/4 in. (6 mm) in depth. The coarse aggregate shall not be displaced when preparing the roughened surface.

707.11 Method of Measurement

Precast or precast prestressed concrete structural members will be measured by the linear foot (meter). Railing will be measured in accordance with 706.05 if specified as a pay item. Structural steel for intermediate diaphragms will not be measured.

When the Contractor elects to use precast prestressed concrete deck panels, the panels will not be measured for payment.

707.12 Basis of Payment

580

The accepted quantities of precast or precast prestressed concrete structural members will be paid for at the contract unit price per linear foot (meter) for structural member, concrete, of the type and size specified. ~~Precast or precast prestressed concrete structural members for which the type and size is not shown in the Schedule of Pay Items will be paid for at the contract lump sum price for structural members, concrete.~~

Railing will be paid for in accordance with 706.06 when specified as a pay item.

Payment will be made under:

590

Pay Item

Pay Unit Symbol

REVISION TO STANDARD SPECIFICATIONS (OLD BUSINESS ITEM)
SECTION 707 - PRECAST AND PRESTRESSED CONCRETE STRUCTURAL MEMBERS

Structural Member, Concrete, _____, _____LFT (m)
type size SFT (m²)

600 Reinforcing bars, *prestressing strands*, elastomeric bearing pads, modifications to bearing pads, bearing beams required for box beams, bearing assemblies required for I-beams, bulb-T beams, U-beams, and box beams, bearing plates, expanded polystyrene, threaded reinforcing bars, threaded inserts in ~~face~~*fascia* beams, hex bolts, sealer on the outside face and bottom flange of ~~face~~*fascia* beams and on the tops of all beams, and necessary incidentals shall be included in the cost of the pay items of this section. *The cost of tensioning rods and steel plates shall be included in the cost of the pay items of this section.* The cost for providing all molds, *cylinder identification tags*, facilities, labor, and materials necessary to prepare and cure the test specimens required for work in this section shall be included in the cost of the pay items in this section.

No payment will be made for removing and replacing prestressing strands due to excessive wire breakage, or replacing precast or precast prestressed *structural* members damaged during handling, storing, transporting or erecting.

610 When the Contractor elects to use precast prestressed concrete deck panels, the cost of the panels shall be included in the cost of class C concrete in superstructure.

The cost of railing shall be included in the cost of the pay items of this section if such railing is not specified as a pay item.

The cost of all materials, including galvanizing, labor, and equipment for furnishing and installing steel intermediate diaphragms shall be included in the cost of structural member, concrete of the type and size specified.

620 *The cost of time and temperature recording devices and their monitoring shall be included in the cost of the structural members.*

The cost of a field office or of providing the field office items listed herein shall be included in the cost of the pay items of this section.

REVISION TO STANDARD SPECIFICATIONS

(OLD BUSINESS ITEM)

SECTION 910 - METAL MATERIALS

910.01(b)7 UNCOATED 7 WIRE STRAND FOR PRESTRESSED CONCRETE

The Standard Specifications are revised as follows:

SECTION 910, BEGIN LINE 81, DELETE AS FOLLOWS:

7. Uncoated 7 Wire Strand for Prestressed Concrete

Uncoated 7 wire strand ~~for prestressed concrete~~ shall be in accordance with ASTM A 416. The strand shall have the minimum tensile strength and initial tension shown on the plans.

Uncoated 7 wire strand shall be covered by a type A certification in accordance with 916. The certification shall include the lot number, size, cross-sectional area, yield strength, breaking strength, strand composition, modulus of elasticity, and a load-elongation curve for each size of strand supplied.

APPROVED MINUTES

COMMENTS AND ACTION

(OLD BUSINESS ITEM)

SECTION 707 - PRECAST AND PRESTRESSED CONCRETE STRUCTURAL MEMBERS
 910.01(b)7 UNCOATED 7 WIRE STRAND FOR PRESTRESSED CONCRETE

DISCUSSION: This item was presented by Mr. Pankow and explained, and clarified by Mr. Reilman.

Mr. Cales suggested removing the sentence in 707.12 concerning lump sum pay items. The committee agreed

The motion to approve this item was revised.

<p>Motion: Mr. Pankow Second: Mr. Cales Ayes: 9 Nays: 0</p>	<p>Action: <input type="checkbox"/> Passed as Submitted <input checked="" type="checkbox"/> Passed as Revised <input type="checkbox"/> Withdrawn</p>
<p>Standard Specifications Sections affected: SECTION 707 begin pg 521; 910.01(b)7 pg 820.</p>	<p><input checked="" type="checkbox"/> 2012 Standard Specifications Book <input checked="" type="checkbox"/> Revise List of Pay Items</p>
<p>Recurring Special Provision with same affected sections: 206-B-113 GENERAL BRIDGE REQUIREMENTS</p>	<p>RSP (No. 206-B-113) Effective ___ Letting RSP Sunset Date: <u>Sep. 01, 2011</u> <input type="checkbox"/> Revise RSP (No. ___) Effective ___ Letting RSP Sunset Date: ___</p>
<p>Standard Sheets affected: NONE</p>	<p>Standard Drawing Effective ___ <input type="checkbox"/> Create RPD (No. ___) Effective ___ Letting <input type="checkbox"/> Technical Advisory</p>
<p>Design Manual Sections affected: NONE</p>	<p>GIFE Update Req'd? Y ___ N ___ By ___ Addition or ___ Revision</p>
<p>GIFE Sections cross-references: NONE</p>	<p>Frequency Manual Update Req'd? Y ___ N ___ By ___ Addition or ___ Revision</p>
	<p>Received FHWA Approval? <u>Yes</u></p>

SPECIFICATION REVISIONS
REVISION TO STANDARD DRAWINGS

(OLD BUSINESS ITEM)

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: Information regarding guardrail length and placement approaching a bridge is now on Standard Drawings, and instead belongs in Design Manual. Some current information is also duplicated, and sometimes contradictory.

PROPOSED SOLUTION: Delete existing Standard Drawings listed below; replace them with new Standard Drawings listed below. The design-related information which appears on the existing drawings does not appear on the new ones. Revise appropriate Design Manual text and add and delete Manual figures as listed below. More-specific descriptions appear under Applicable Standard Drawings, and the second page of this proposal.

FHWA's Keith Hoernschemeyer has concurred in this proposal, 12-17-10.

APPLICABLE STANDARD SPECIFICATIONS: None

APPLICABLE STANDARD DRAWINGS:

New Dwg No	Exist Dwg No	Drawing Contents
<u>GuardRail at Bridge Approach series</u>		
601-GRBA-01	601-BAGR-01	Bridge approach, 2-way rdwy
601-GRBA-02	601-BAGR-02	Bridge approach, divided rdwy
<u>GuardRail at Bridge Support series</u>		
601-GRBS-01	601-MPPG-02	Guardrail-to-pier clearance; downstream guardrail treatment
Deleted	601-RPPG-03	Guardrail-to-pier clearance, same as 601-MPPG-02
Deleted	601-RPPG-06	Guardrail-to-pier clearance, same as 601-MPPG-02
<u>GuardRail at Roadside Pier series</u>		
601-GRRP-01	601-RPPG-04	Roadside pier, 2-way rdwy, single overhead str
601-GRRP-02	601-RPPG-05	Roadside piers, 2-way rdwy, twin overhead str
601-GRRP-03	601-RPPG-01	Roadside pier, divided rdwy, outside, single overhead str
601-GRRP-04	601-RPPG-02	Roadside piers, divided rdwy, outside, twin overhead str
601-GRRP-05	601-MPPG-04	Roadside pier, divided rdwy, median side, single overhead str
601-GRRP-06	601-MPPG-03	Roadside piers, divided rdwy, median side, twin overhead str
601-GRRP-07	601-MPPG-01	Roadside pier, divided rdwy, median side, single tandem overhead str

APPLICABLE DESIGN MANUAL SECTION:

Revise 49-4.02(01) Barrier Length of Need in Advance of Hazard for Adjacent Traffic,
49-4.02(04) Length of Need at Outside-Shoulder Bridge Pier
49-8.01(04) Design Procedure, and
49-9.02 Bridge-Railing End Protection.

SPECIFICATION REVISIONS (OLD BUSINESS ITEM)

REVISION TO STANDARD DRAWINGS

Add new Manual Figures 49-4E(1) through 49-4E(10).
Delete existing Manual Figures 49-4K and 49-9A.

APPLICABLE SECTION OF GIFE: None

DESIGN MANUAL REVISIONS TO SECS. 49-4.02(01) 49-4.02(04), 49-8.01(04), 49-9.02
Copy to be deleted is overstruck. Copy to be added is italic.

AFFECTS TOWARD DELETION OF DESIGN-RELATED MATERIAL ON STANDARD DRAWINGS

<u>New Figure</u>	<u>Configuration</u>	<u>Based on Existing Standard Drawing to be Deleted</u>
49-4E(1)	min gdrl lgth	601-BAGR-01, bottom half, or Table BAGR-1
	“	601-MPPG-02, Table MPPG-1
	“	601-MPPG-02, Table MPPG-2
	“	601-RPPG-03, Table RPPG-1
	“	601-RPPG-03, Table RPPG-2
49-4E(2)	2W-BR-OS	601-BAGR-01, top half
49-4E(3)	1W-BR-MS	601-BAGR-02
49-4E(4)	2W-SO-OS	601-RPPG-04
49-4E(5)	2W-TO-OS	601-RPPG-05
49-4E(6)	1W-SO-OS	601-RPPG-01
49-4E(7)	1W-TO-OS	601-RPPG-02
49-4E(8) detail (a)	1W-SO-MS	601-MPPG-04
49-4E(8) detail (b)	“	601-MPPG-01, bottom half
49-4E(9) detail (a)	1W-TO-MS	601-MPPG-03
49-4E(9) detail (b)	“	New detail, not based on an existing standard drawing
49-4E(10)	gdrl pay lgth	Not based on an existing standard drawing

1W = one-way roadway; 2W = two-way roadway

BR = bridge on roadway; SO = single overpass; TO = twin overpasses

MS = median shoulder; OS = outside shoulder

Submitted By: Randy Strain

Title: Bridge Policy and Standards Engineer, of
Bridge Design, Inspection, Hydraulics, and Technical Support Division

Organization: INDOT

Phone Number: 232-3339

Date: 1-24-11

49-4.02(01) Barrier Length Needed in Advance of Hazard for Adjacent Traffic

4. Minimum Length of Barrier. If the design speed is 50 mph or higher, the required length in advance of the hazard for adjacent or opposing traffic will be the greater of the calculated length or 100 ft where GRET type I is used. Otherwise such length will be the greater of the calculated length or 50 ft.

If the design speed is 45 mph or lower, the required length of guardrail in advance of the hazard for adjacent traffic will be the greater of the calculated length or 50 ft. *The minimum guardrail length required in advance of a hazard should be as shown in Figure 49-4E(1).*

5. Guardrail Configuration at Approach to Bridge or Support. See the following figures to determine the guardrail configuration and minimum pay length for each situation listed below.

49-4E(2)	Guardrail Configuration for Outside-Shoulder Approach to Bridge
49-4E(3)	Guardrail Configuration for Median-Shoulder Approach to Bridge
49-4E(4)	Guardrail Configuration for Bridge Support Inside Clear Zone, Two-Way Roadway, Single Overhead Structure
49-4E(5)	Guardrail Configuration for Bridge Support Inside Clear Zone, Two-Way Roadway, Twin Overhead Structures
49-4E(6)	Guardrail Configuration for Bridge Support Inside Clear Zone, One-Way Roadway, Single Overhead Structure, Outside Shoulder
49-4E(7)	Guardrail Configuration for Bridge Support Inside Clear Zone, One-Way Roadway, Twin Overhead Structure, Outside Shoulder
49-4E(8)	Guardrail Configuration for Bridge Support Inside Clear Zone, One-Way Roadway, Single Overhead Structures, Median Shoulder
49-4E(9)	Guardrail Configuration for Bridge Support Inside Clear Zone, One-Way Roadway, Twin Overhead Structures, Median Shoulder
49-4E(10)	Guardrail Pay Length for Approach to Bridge Support

The L_{ET} portion of a guardrail end treatment type OS or MS, shown on Figures 49-4E(2) through 49-4E(9), should be considered as part of the guardrail length of need as described in Section 49-8.01(04) item 2.

49-4.02(04) Length of Need at Outside-Shoulder Bridge Pier Support

1. Pier Support Located \leq 16 ft from Edge of Travel Lane. The pier support-protection barrier must be attached to the upstream traffic end of the pier support. The minimum required barrier length is shown in Figure 49-4K, ~~Length of Need Requirement for Pier Protection,~~ and described below 49-4E(1), *Minimum Guardrail Length Required in Advance of Hazard.*

REVISION TO STANDARD DRAWINGS

(OLD BUSINESS ITEM)

BACKUP: IDM 49-4.02(01), 49-4.02(04), 49-8.01(04) AND 49-9.02

- ~~a.~~ If the pier end is located outside the clear zone and the design speed ≥ 50 mph, the minimum required length is 100 ft.
- ~~b.~~ If the pier end is located outside the clear zone and the design speed ≤ 45 mph, the minimum required length is 50 ft.
- ~~e. a.~~ If the pier support end is located inside the clear zone and the design speed ≥ 50 mph, the
- ~~e. b.~~ If the pier support end is located inside the clear zone and the design speed ≤ 45 mph, the

49-8.01(04) Design Procedure

2. Relationship Between GRET and Guardrail Length of Need. *Some GRETs can function as typical guardrail as described below.*
 - a. GRET Type OS. A 37.5-ft portion of the downstream end of a GRET type OS can function as typical guardrail ~~and can~~, *so therefore should* be considered as part of the length of need in advance of the obstruction. Therefore, where GRET type OS is warranted, the pay length for the guardrail run is equal to the required length of need for the guardrail minus 37.5 ft.
 - b. GRET Type MS. A 12.5-ft portion of the downstream end of a GRET type MS can function as typical guardrail ~~and can~~, *so therefore should* be considered as part of the length of need in advance of the obstruction. Therefore, where GRET type MS is warranted, the pay length for the guardrail run is equal to the required length of need for the guardrail minus 12.5 ft.

GRET type I or II cannot function as typical guardrail, so no portion of it should be considered as part of the guardrail length of need.

These reduced pay lengths are to be reflected in the guardrail lengths shown on the plans.

49-9.02 Bridge-Railing End Protection

The AASHTO LRFD Bridge Design Specifications requires that each bridge-railing end *should* be protected from direct collision by traffic. The type and ~~the amount~~ *extent* of protection required are determined based on the location of the bridge-railing end relative to the clear zone. ~~and~~ *The*

minimum extent of protection should be in accordance with Figure 49-9A, Bridge Railing-End Protection Requirements as shown in Figure 49-4E(1), Minimum Guardrail Length Required in Advance of Hazard. Conditions in an urban area can preclude the protection as shown in Figure 49-4E(1). See LRFD Bridge Design Specifications Article 13.7.1.2 and its Commentary for other options.

The required length of bridge-approach guardrail, including the guardrail transition, for both shoulders of a 2-lane, 2-way highway, or the outside shoulders of a divided highway is based on the clear-zone requirement for the roadway and the design speed. The calculated length is rounded up to the nearest whole multiple of 6.25 ft. The length shown herein in Figure 49-4E(1) is that required to protect the end of the bridge railing only and should be considered the minimum requirement. All hazards adjacent to the bridge-railing end should be considered where bridge-approach-guardrail length is ~~computed~~ to be determined.

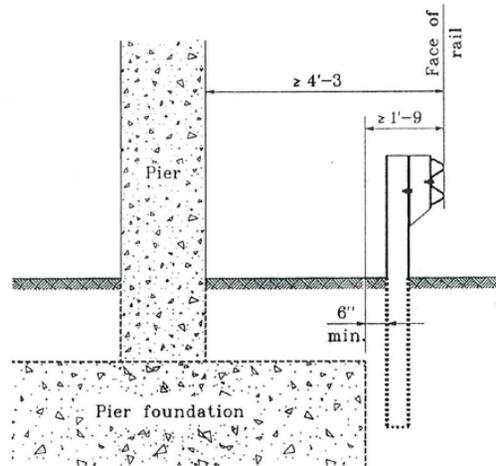
APPROVE

GENERAL NOTES

1. This drawing shall be used where W-beam guardrail is specified along the outside shoulder of a multi-lane divided roadway to shield the piers of overhead structures.
2. The details on this drawing are typical guardrail layouts for shielding the piers of single or tandem overhead structures. The required length of guardrail shall be determined in accordance with Tables RPPG-1 and RPPG-2, and shall be as shown on the plans.
3. Dimensions and details not shown on this drawing shall be as shown on the plans.

TABLE RPPG-1			
Outside (Right Side) Shoulder Pier Approach Guardrail Lengths at Piers/Frame Bents $\leq 16'$ from Pavement Edge			
Design Speed (mph)	Pier End Inside Clear Zone	Pier End Outside Clear Zone	Guardrail Pay Length (ft.)
	Required Minimum Length (ft.) in Advance of the Pier/Frame Bent End		
≥ 50	$>$ of the rounded calculated length of need or 100'	100'	Required minimum length
< 50	$>$ of the rounded calculated length of need or 50'	50'	minus 25' for GP transition

TABLE RPPG-2			
Outside (Right Side) Shoulder Pier Approach Guardrail Lengths at Piers/Frame Bents $> 16'$ from Pavement Edge			
Design Speed (mph)	Pier End Inside Clear Zone	Pier End Outside Clear Zone	Guardrail Pay Length (ft.)
	Required Minimum Length (ft.) in Advance of the Pier/Frame Bent End		
≥ 50	$>$ of the rounded calculated length of need or 100'	100'	Required minimum length
< 50	$>$ of the rounded calculated length of need or 50'	50'	plus length to shield pier face

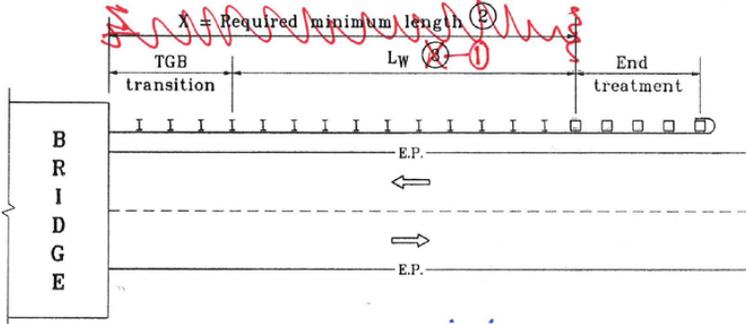


Guardrail to Pier Clearance

DELETE DWG. DUPLICATES EXISTING 601-MPPG-02.

INDIANA DEPARTMENT OF TRANSPORTATION	
ROADSIDE PIER PROTECTION GUARDRAIL	
SEPTEMBER 1997	
STANDARD DRAWING NO. E 601-RPPG-03	
DETAILS PLACED IN THIS FORMAT 11-15-99	
	/s/ Anthony L. Uremovich 8-01-99 DESIGN STANDARDS ENGINEER DATE
	/s/ [Signature] 8-01-99 CHIEF HIGHWAY ENGINEER DATE
	ORIGINALLY APPROVED 9-01-97

601-BAGR-01 ROADSIDE BRIDGE APPROACH GUARDRAIL



Two-Lane Two-Way Bridge Approach Guardrail
Typical All Four Corners

NOTES:

- 1. This sheet shall be used when W-beam guardrail is specified for bridge approach guardrail and is connected to the bridge rail with guardrail transition type TGB. *DESIGN-RELATED*
- 2. See Table BAGR-1 for required length. The actual length of guardrail required at each location shall be as shown on the plans. *shown on plans*
- 1. ~~2~~ *Lw = length of W-beam guardrail at 6-3 post spacing, ft. Required*

TABLE BAGR-1			
OUTSIDE SHOULDER BRIDGE APPROACH GUARDRAIL LENGTHS			
Design speed (mph)	Location of Bridge Rail End		
	Inside Clear Zone	Outside Clear Zone	L _w
	Required Minimum length X		
≥ 50	> of the rounded calculated length of need or 100'	100'	X - 25'
< 50	> of the rounded calculated length of need or 50'	50'	

TO NEW IDM FIG. 49-4E(1)

601-GRBA-01

INDIANA DEPARTMENT OF TRANSPORTATION

ROADSIDE BRIDGE - APPROACH GUARDRAIL

Two-way MAY 1999 *ROADWAY*

STANDARD DRAWING NO. ~~E 601-BAGR-01~~

DETAILS PLACED IN THIS FORMAT 11-15-99

/s/ Anthony L. Uremovich 11-15-99
DESIGN STANDARDS ENGINEER DATE

/s/ Firooz Zandi 11-15-99
CHIEF HIGHWAY ENGINEER DATE

DESIGN STANDARDS ENGINEER ORIGINALLY APPROVED 5-03-99

Anthony L. Uremovich
REGISTERED PROFESSIONAL ENGINEER
No. 18095
STATE OF INDIANA

GENERAL NOTES

1. This drawing shall be used where W-beam guardrail is specified along the median side shoulder of a multi-lane divided roadway to shield the piers of tandem overhead structures.
2. The details on this drawing are typical guardrail layouts for shielding the piers of tandem overhead structures. The required length of guardrail shall be determined in accordance with Tables MPPG-1 and MPPG-2, and shall be as shown on the plans.
3. Dimensions and details not shown on this drawing shall be as shown on the plans.

DESIGN-RELATED

TO NEW IDM FIG. 49-4E(1)

DETAIL TO NEW STD DWG 601-GR85-01

TABLE MPPG-1

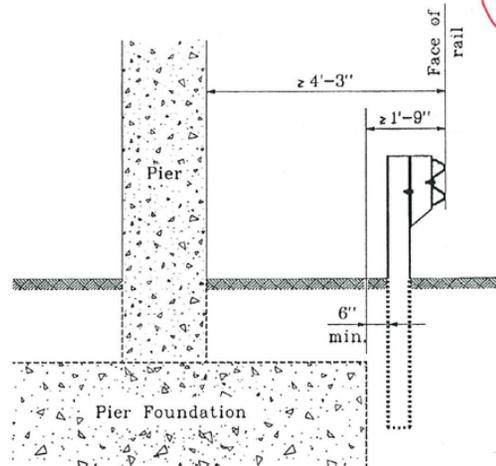
Outside (Right Side) Shoulder Pier
Approach Guardrail Lengths at Piers/Frame Bents
≤ 16' from Pavement Edge

Design speed mph	Pier End Inside Clear Zone	Pier End Outside Clear Zone	Guardrail Pay Length (ft)
	Required Minimum Length (ft) in Advance of the Pier/Frame Bent End		
≥ 50	> of the rounded calculated length of need or 100	100	Required minimum length
< 50	> of the rounded calculated length of need or 50	50	minus 25' for GP transition

TABLE MPPG-2

Outside (Right Side) Shoulder Pier
Approach Guardrail Lengths at Piers/Frame Bents
> 16' from Pavement Edge

Design speed mph	Pier End Inside Clear Zone	Pier End Outside Clear Zone	Guardrail pay length (ft)
	Required Minimum Length (ft) in Advance of the Pier/Frame Bent End		
≥ 50	> of the rounded calculated length of need or 30	100	Required minimum length
< 50	> of the rounded calculated length of need or 15	50	plus length to shield pier face



Guardrail to Pier Clearance

INDIANA DEPARTMENT OF TRANSPORTATION	
MEDIAN PIER PROTECTION GUARDRAIL	
SEPTEMBER 1997	
STANDARD DRAWING NO. E 601-MPPG-02	
DETAILS PLACED IN THIS FORMAT 11-15-99	
	/s/ Anthony L. Uremovich 11-15-99 DESIGN STANDARDS ENGINEER DATE
	/s/ Firooz Zandi 11-15-99 CHIEF HIGHWAY ENGINEER DATE
DESIGN STANDARDS ENGINEER	ORIGINALLY APPROVED 9-01-97

Design Speed (mph)	With GRET Type OS, MS, or II (ft)	With GRET Type I (ft)
≥ 50	50	100
≤ 45	50	50

**MINIMUM GUARDRAIL LENGTH REQUIRED
IN ADVANCE OF HAZARD**

Figure 49-4E(1)

Design Speed (mph)	Pier End Inside Clear Zone	Pier End Outside Clear Zone
	Required Minimum Length	
≥ 50	Calculated Length of Need or 100 ft, whichever is greater	100 ft
≤ 45	Calculated Length of Need or 50 ft, whichever is greater	50 ft

LENGTH-OF-NEED REQUIREMENT FOR PIER PROTECTION**Figure 49-4K**

TABLE DATA
DELETE, AS ~~THE~~ RESEMBLE,
SO ARE THEREFORE SUPERSEDED,
BY DATA IN ~~THE~~ NEW FIG 49-4E(1)

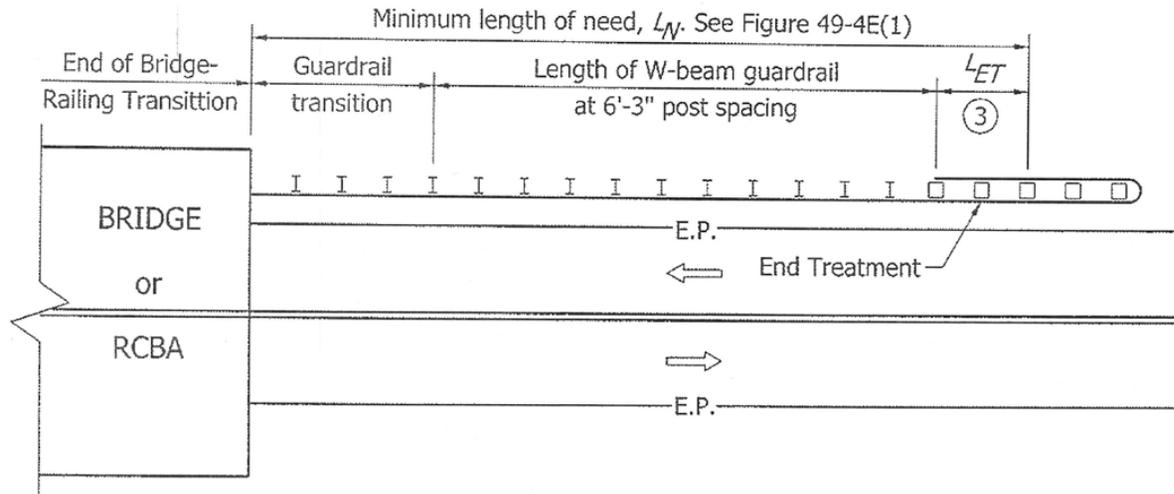
Design Speed, mph	With Guardrail End Treatment Type I	With Guardrail End Tmt. Type OS or MS
≥ 50	Length of Need or 100 ft, whichever is greater	Length of Need or 50 ft, whichever is greater
≤ 45	Length of Need or 50 ft, whichever is greater	Length of Need or 50 ft, whichever is greater

Note: This is the minimum bridge-approach guardrail length, including guardrail-transition length.

BRIDGE-RAILING-END PROTECTION REQUIREMENTS

Figure 49-9A

DELETE, AS TABLE DATA RESEMBLE,
SO ARE THEREFORE SUPERSEDED,
BY DATA IN NEW FIG 49-4E(1)



NOTES:

1. For a two-lane two-way roadway, this configuration should be used at all four corners.
2. For a one-way roadway, this configuration should be used only on the upstream-approach's outside shoulder. Guardrail is required on the downstream side only if there is a hazard to be shielded.
- ③ The L_{ET} portion of a guardrail end treatment type OS should be considered as part of L_N as described in Section 49-8.01(04) Item 2.

GUARDRAIL CONFIGURATION FOR
OUTSIDE-SHOULDER APPROACH TO BRIDGE

Figure 49-4E (2)

REVISION TO STANDARD DRAWINGS

(OLD BUSINESS ITEM)

601-BAGR-02 MEDIAN BRIDGE APPROACH GUARDRAIL

NOTES:

- This drawing shall be used when W-beam guardrail is specified for bridge approach guardrail and is connected to the bridge rail with guardrail transition type TGB.
- See Table B-1-2 for required length. The actual length of guardrail required at each location shall be as shown on the plans.
- See Standard Drawing E 601-BAGR-01 for Table B-1-1 for required minimum length X.
- Explanation for Table B-1-2:
 20 = clear zone, ft.
 132 = req'd length of double faced guardrail at 6'-3" post spacing, ft.

Handwritten Annotations:

- DESIGN-RELATED** (circled in red)
- 1-X** See alternate placement detail on Standard Drawing E 601-GRET-07 for alternate placement detail.
- 2-X** L_w = length of W-beam guardrail at 6'-3" post spacing, ft. **required** **shown on plans**
- 3-X** Transition rail as required for MS unit. **end treatment**
- Guardrail will only be required when there is a hazard to be shielded** **shown on plans**
- GRBA-02** **601-001**
- TO NEW-IDM FIG. 49-4E(10)** (circled in red)

TABLE B-1-2

MEDIAN SHOULDER BRIDGE APPROACH GUARDRAIL LENGTHS, ft

Median Slopes	DESIGN SPEED (mph)			
	50	55	60	110
Flatter than 6:1	(4) 20	22	29	30
	152	176	221	256
6:1	20	24	32	34
	152	185	231	273
5:1	24	26	36	38
	169	193	243	286

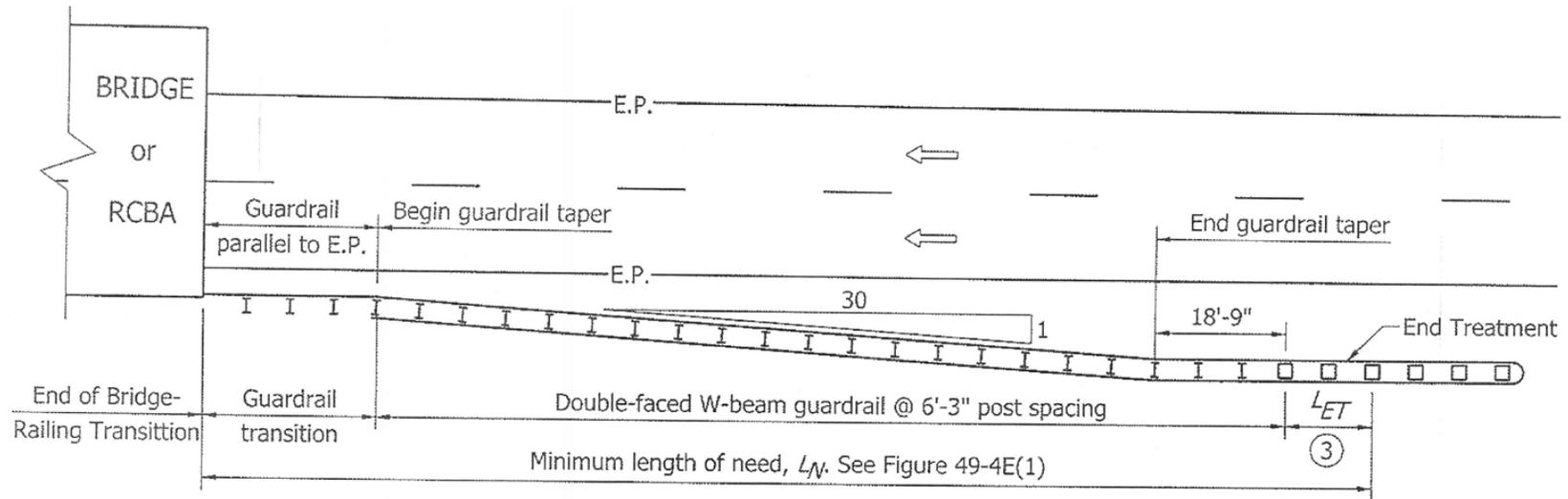
INDIANA DEPARTMENT OF TRANSPORTATION

MEDIAN BRIDGE APPROACH GUARDRAIL, DIVIDED ROADWAY
MARCH 2005

STANDARD DRAWING NO. E ~~601-BAGR-02~~

	/s/ Richard L. VanCleave	3-01-05
	DESIGN STANDARDS ENGINEER	DATE
	/s/ Richard K. Smutzer	3-01-05
	CHIEF HIGHWAY ENGINEER	DATE

DESIGN STANDARDS ENGINEER



Median Slope	DESIGN SPEED (mph)			
	≤ 50	55	60	65
Flatter than 6:1	20	22	29	30
	150	175	225	250
6:1	20	24	32	34
	150	188	238	275
5:1	24	26	36	38
	175	200	250	300

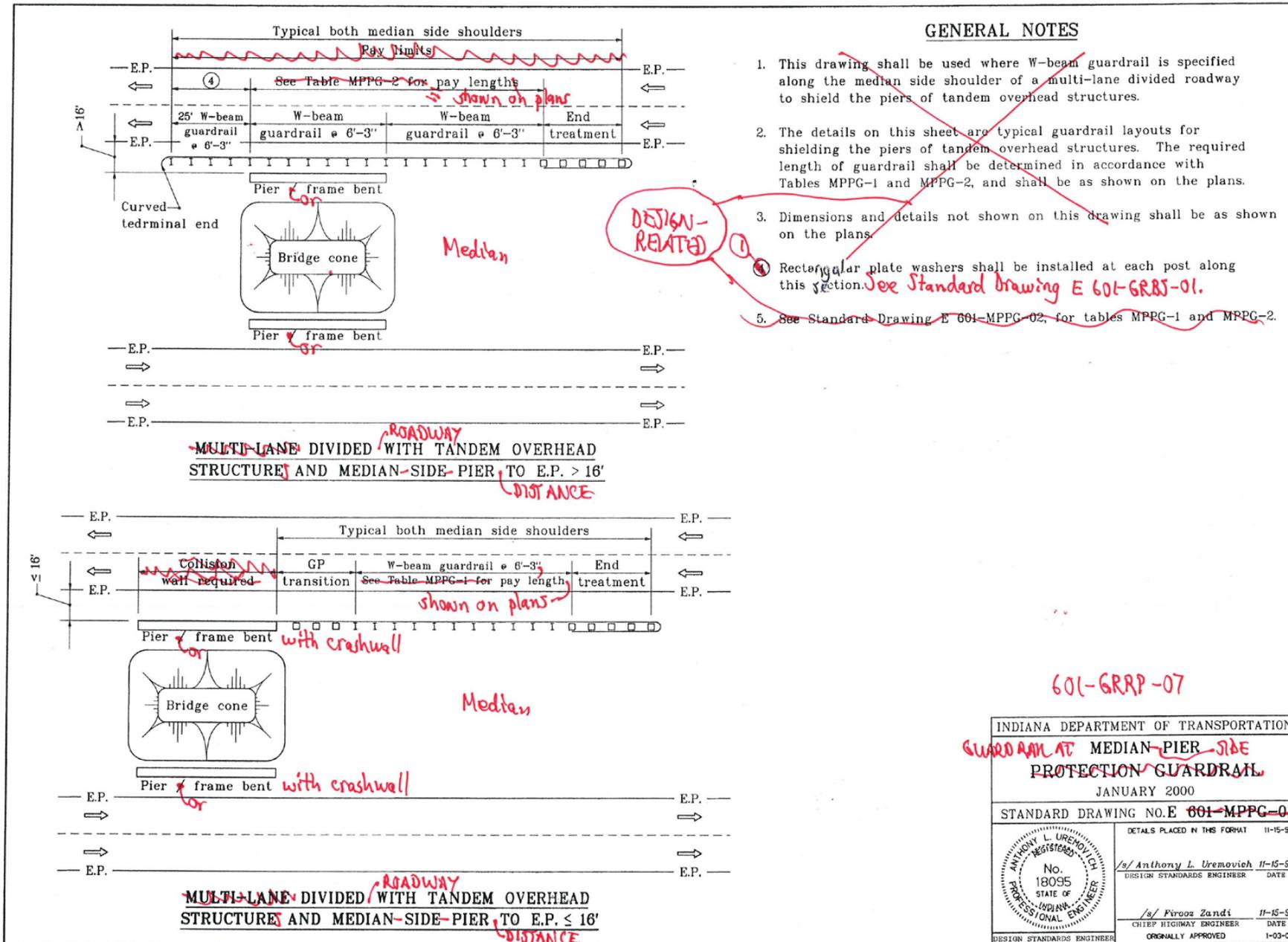
NOTES:

1. For a one-way roadway, this configuration should be used only on the upstream-approach's median shoulder. Guardrail is required on the downstream side only if there is a hazard to be shielded.
2. In the fractional values in the table, the numerator represents the clear-zone width, (ft). The denominator represents L_N (ft).
- ③ The L_{ET} portion of a guardrail end treatment type MS should be considered as part of L_N as described in Section 49-8.01(04) Item 2.

GUARDRAIL CONFIGURATION AND LENGTH OF NEED FOR MEDIAN-SHOULDER APPROACH TO BRIDGE

Figure 49-4E (3)

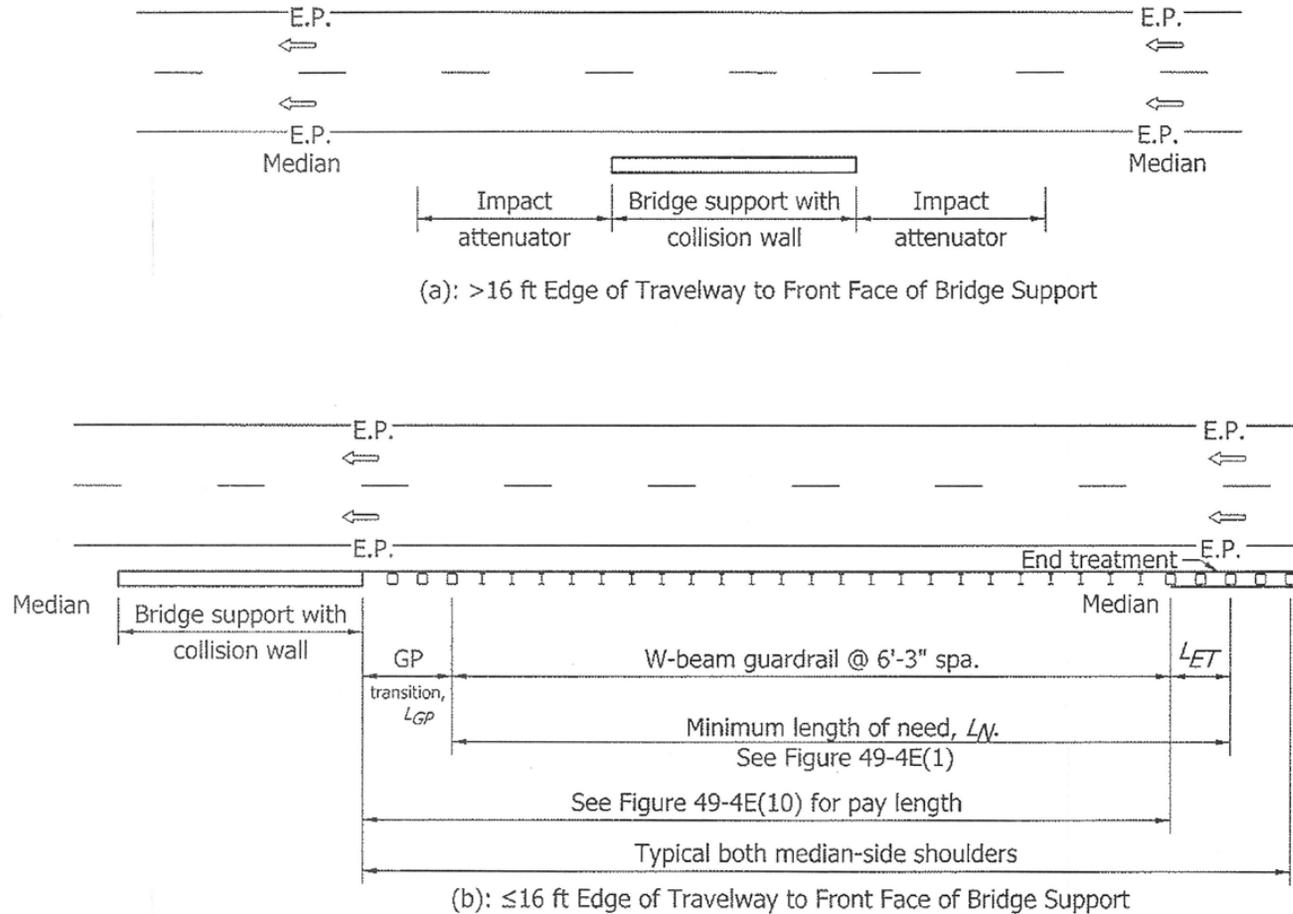
601-MPPG-01 MEDIAN PIER PROTECTION GUARDRAIL



REVISION TO STANDARD DRAWINGS

(OLD BUSINESS ITEM)

BACKUP: IDM FIGURE 49-4E(8) GUARDRAIL CONFIGURATION FOR BRIDGE SUPPORT INSIDE CLEAR ZONE, ONE-WAY ROADWAY, SINGLE OVERHEAD STRUCTURE, MEDIAN SHOULDER (DRAFT)



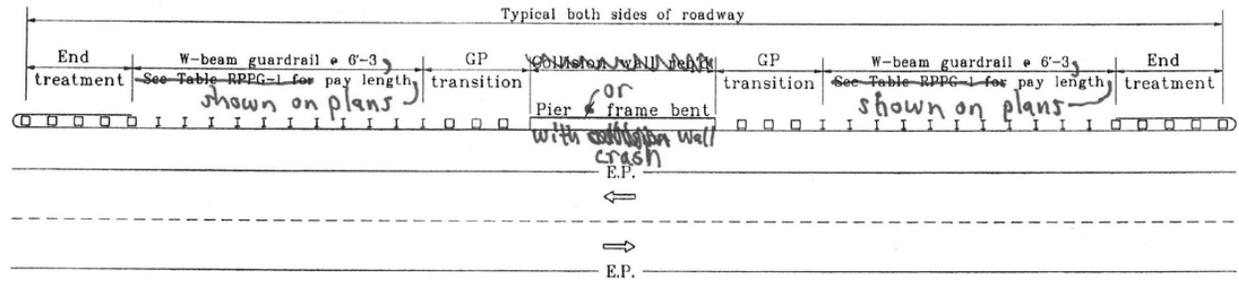
GUARDRAIL CONFIGURATION FOR BRIDGE SUPPORT INSIDE CLEAR ZONE,
ONE-WAY ROADWAY, SINGLE OVERHEAD STRUCTURE, MEDIAN SHOULDER

Figure 49-4E (8)

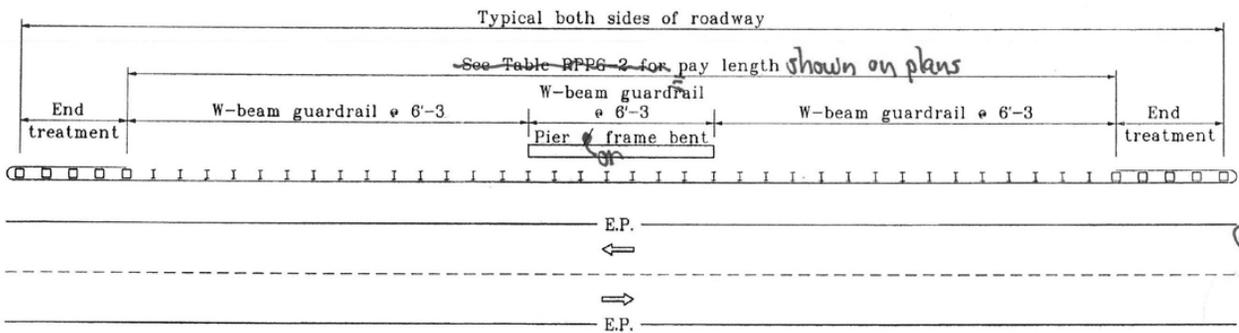
DESIGN-RELATED

GENERAL NOTES

1. This drawing shall be used where W-beam guardrail is specified along a two-lane two-way roadway to shield the piers of overhead structures.
2. The details on this drawing are typical guardrail layouts for shielding the piers of a single overhead structure. The required length of guardrail shall be determined in accordance with Tables RPPG-1 and RPPG-2, and shall be as shown on the plans.
3. Dimensions and details not shown on this drawing shall be as shown on the plans.
4. See Standard Drawing E 601-RPPG-03 for tables RPPG-1 and RPPG-2.



TWO-LANE TWO-WAY ^{ROADWAY} WITH SINGLE OVERHEAD STRUCTURE AND PIER TO E.P. $\leq 16'-0$ ^{DISTANCE}



TWO-LANE TWO-WAY ^{ROADWAY} WITH SINGLE OVERHEAD STRUCTURE AND PIER TO E.P. $> 16'-0$ ^{DISTANCE}

ADD 601-RPPG-03

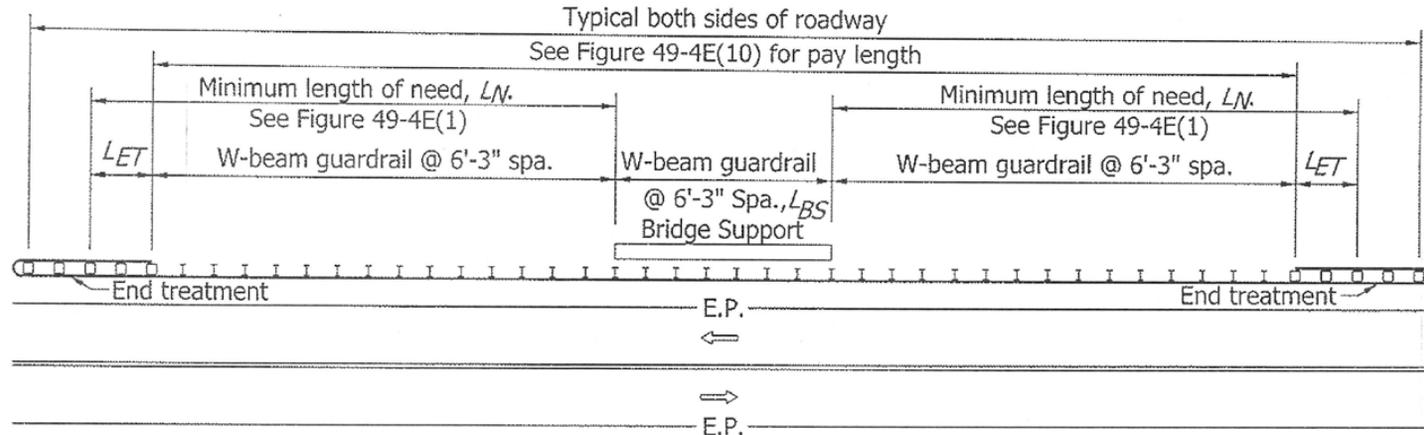
601-GRRP-01

INDIANA DEPARTMENT OF TRANSPORTATION	
GUARDRAIL AT ROADSIDE PIER PROTECTION GUARDRAIL	
APRIL 1995	
STANDARD DRAWING NO. E 601-RPPG-04	
DETAILS PLACED IN THIS FORMAT	11-15-99
	/s/ Anthony L. Uremovich 11-15-99 DESIGN STANDARDS ENGINEER DATE
	/s/ Pirooz Zandi 11-15-99 CHIEF HIGHWAY ENGINEER DATE
DESIGN STANDARDS ENGINEER	ORIGINALLY APPROVED 4-03-95

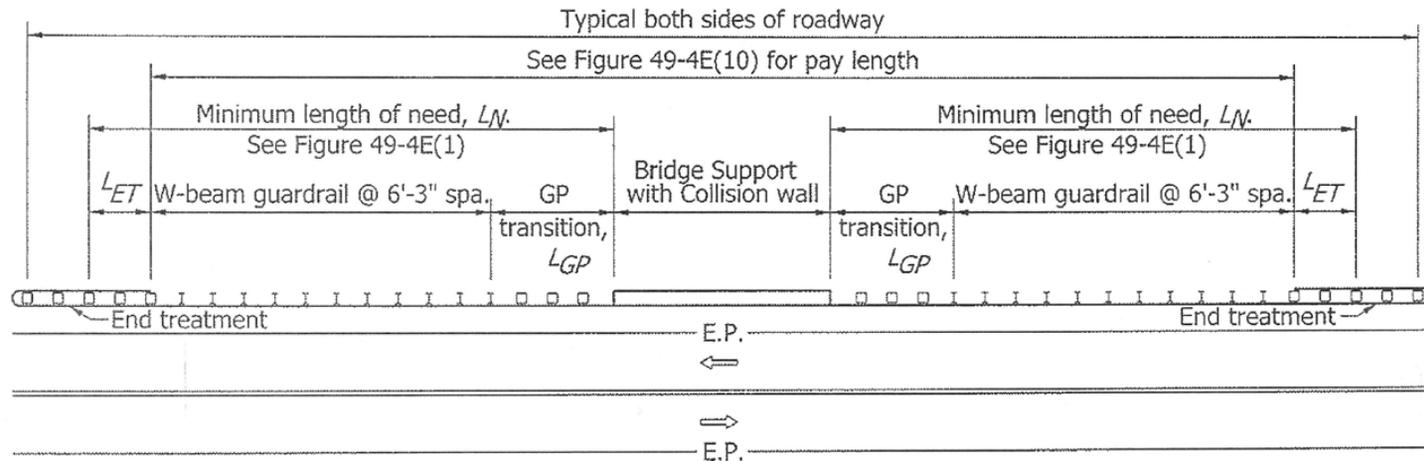
REVISION TO STANDARD DRAWINGS

(OLD BUSINESS ITEM)

BACKUP: IDM FIGURE 49-4E(4) GUARDRAIL CONFIGURATION FOR BRIDGE SUPPORT INSIDE CLEAR ZONE, TWO-WAY ROADWAY, SINGLE OVERHEAD STRUCTURE (DRAFT)



(a): >16 ft Edge of Travelway to Front Face of Bridge Support



(b): ≤16 ft Edge of Travelway to Front Face of Bridge Support

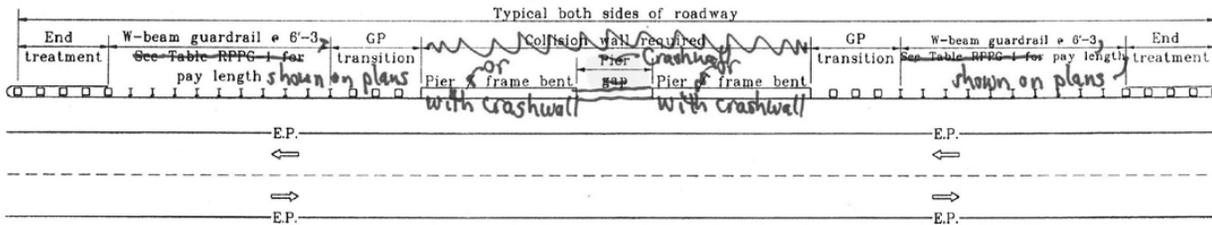
GUARDRAIL CONFIGURATION FOR BRIDGE SUPPORT INSIDE CLEAR ZONE,
TWO-WAY ROADWAY, SINGLE OVERHEAD STRUCTURE

Figure 49-4E (4)

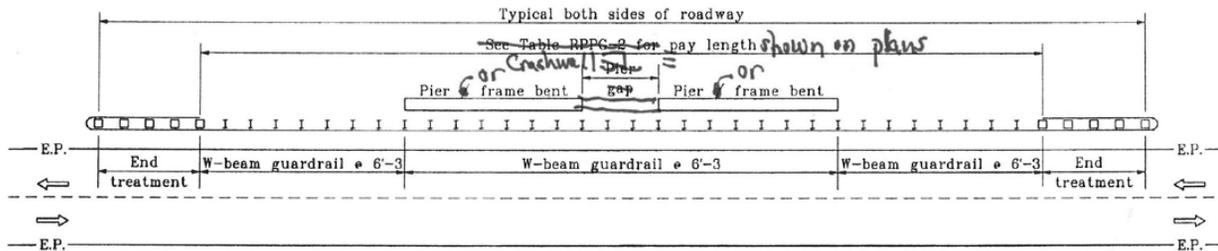
GENERAL NOTES

DESIGN-RELATED

1. This drawing shall be used where W-beam guardrail is specified along a two-lane two-way roadway to shield the piers of tandem overhead structures.
2. The details on this drawing are typical guardrail layouts for shielding the piers of tandem overhead structures. The required length of guardrail shall be determined in accordance with Tables RPPG-1 and RPPG-2, and shall be as shown on the plans.
3. Dimensions and details not shown on this sheet shall be as shown on the plans.
4. See Standard Drawing E 601-RPPG-03 for tables RPPG-1 and RPPG-2.



TWO-LANE TWO-WAY WITH TWIN OVERHEAD STRUCTURES AND PIERS TO E.P. ≤ 16'-0"



TWO-LANE TWO-WAY WITH TWIN OVERHEAD STRUCTURES AND PIERS TO E.P. > 16'-0"

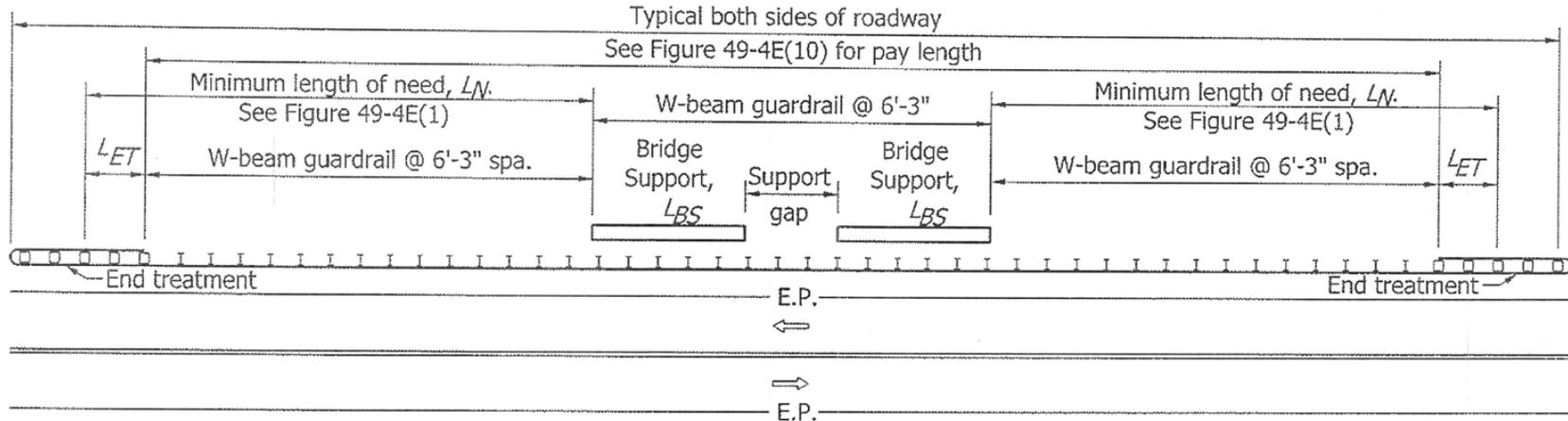
601-GRRP-02

INDIANA DEPARTMENT OF TRANSPORTATION	
GUARDRAIL AT ROADSIDE PIERS PROTECTION GUARDRAIL	
MAY 1999	
STANDARD DRAWING NO. E 601-RPPG-05	
	DETAILS PLACED IN THIS FORMAT 11-15-99
	/s/ Anthony L. Uremovich 11-15-99 DESIGN STANDARDS ENGINEER DATE
	/s/ Firooz Zandi 11-15-99 CHIEF HIGHWAY ENGINEER DATE
DESIGN STANDARDS ENGINEER	ORIGINALLY APPROVED 5-03-99

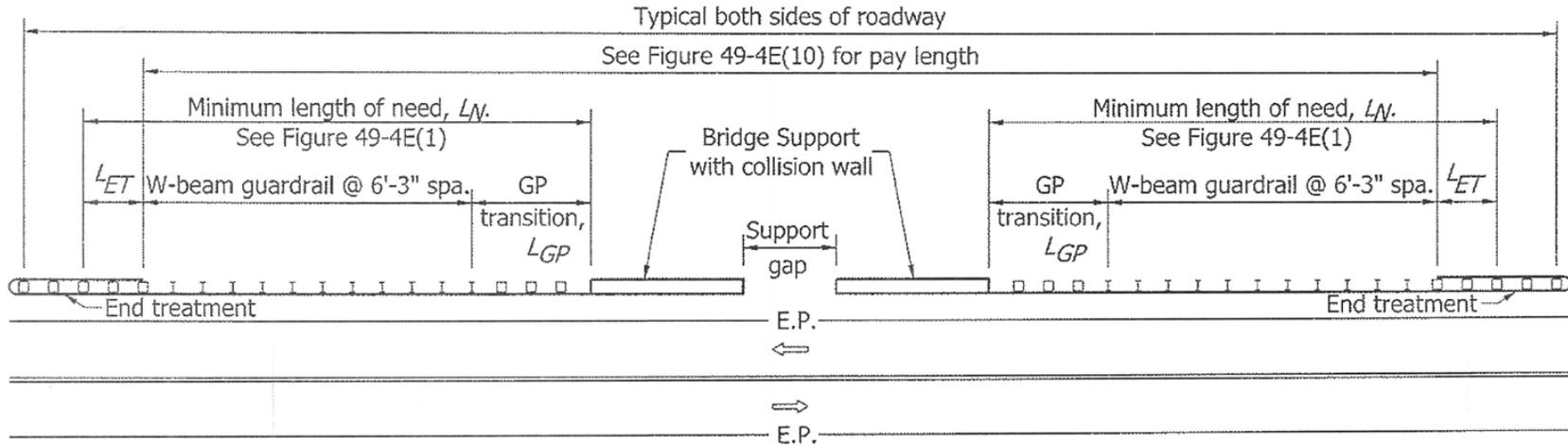
REVISION TO STANDARD DRAWINGS

(OLD BUSINESS ITEM)

BACKUP: IDM FIGURE 49-4E(5) GUARDRAIL CONFIGURATION FOR BRIDGE SUPPORT INSIDE CLEAR ZONE, TWO-WAY ROADWAY, TWIN OVERHEAD STRUCTURE (DRAFT)



(a): >16 ft Edge of Travelway to Front Face of Bridge Support



(b): ≤16 ft Edge of Travelway to Front Face of Bridge Support

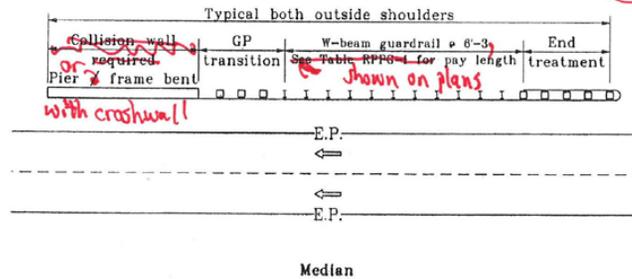
GUARDRAIL CONFIGURATION FOR BRIDGE SUPPORT INSIDE CLEAR ZONE, TWO-WAY ROADWAY, TWIN OVERHEAD STRUCTURES

Figure 49-4E (5)

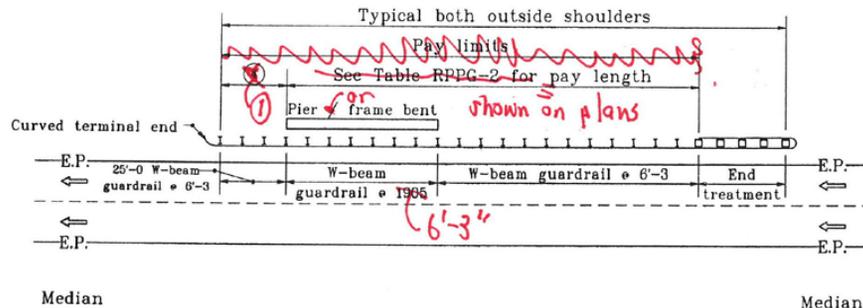
GENERAL NOTES

1. This drawing shall be used where W-beam guardrail is specified along the outside shoulder of a multi-lane divided roadway to shield the piers of an overhead structure.
2. The details on this drawing are typical guardrail layouts for shielding the piers of single or tandem overhead structures. The required length of guardrail shall be determined in accordance with Tables RPPG-1 and RPPG-2, and shall be as shown on the plans.
3. Dimensions and details not shown on this drawing shall be as shown on the plans.
- ① ~~1.~~ Rectangular plate washers shall be installed at each post along this section. See Standard Drawing E 601-GRBS-01.
3. See Standard Drawing E 601-RPPG-03, for tables RPPG-1 and RPPG-2.

DESIGN-RELATED



MULTI-LANE DIVIDED WITH SINGLE OR TANDEM OVERHEAD STRUCTURES AND SHOULDER-PIER TO E.P. \leq 16'-0" ^{ROADWAY} ^{OUTSIDE-DISTANCE}



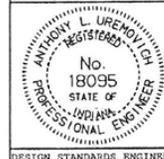
601-GRPP-03

GUARDRAIL AT OUTSIDE PIER PROTECTION GUARDRAIL

APRIL 1995

STANDARD DRAWING NO. E 601-RPPG-01

DETAILS PLACED IN THIS FORMAT 11-15-99



/s/ Anthony L. Uremovich 11-15-99
DESIGN STANDARDS ENGINEER DATE

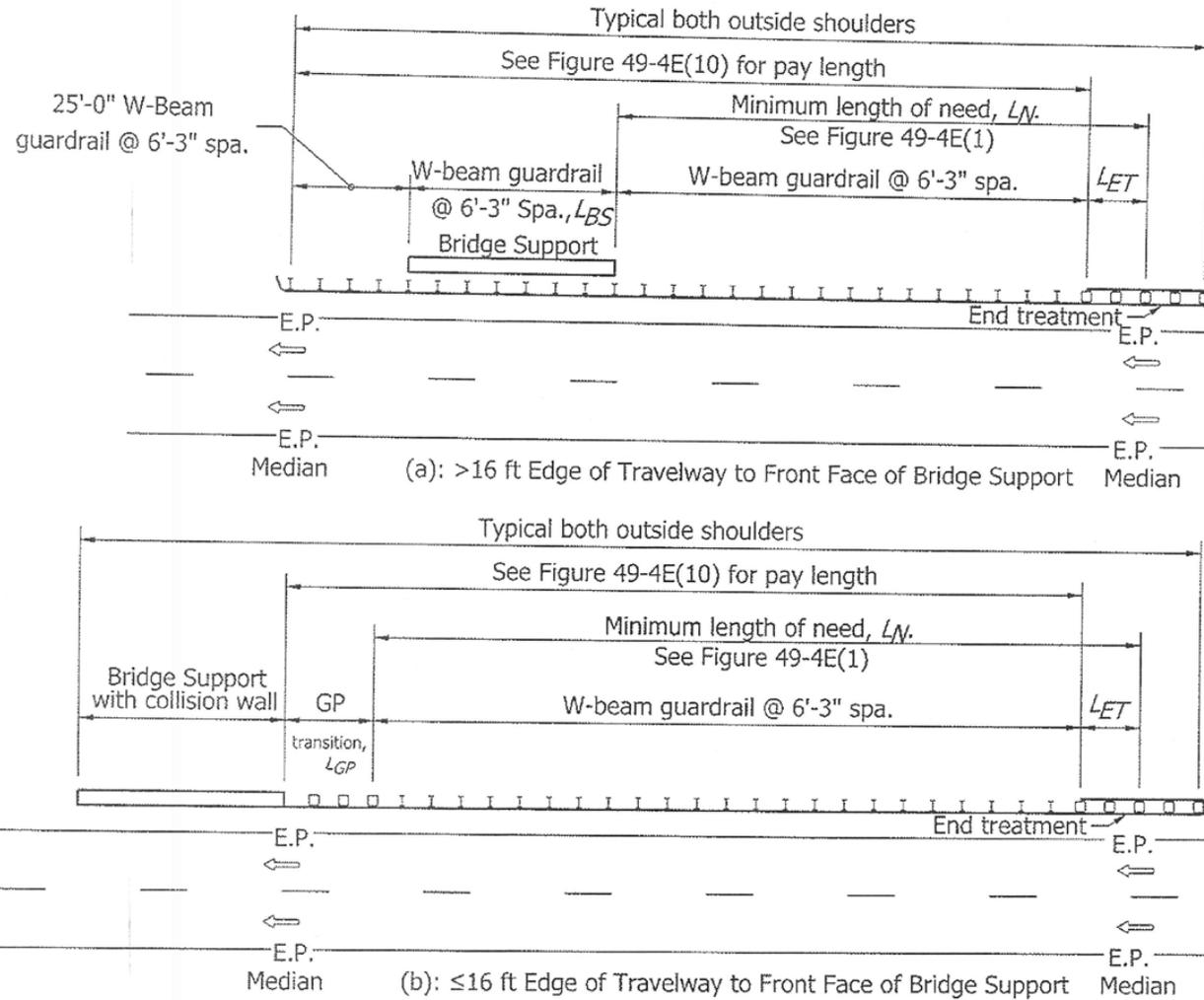
/s/ Firooz Zandi 11-15-99
CHIEF HIGHWAY ENGINEER DATE
ORIGINALLY APPROVED 4-03-95

MULTI-LANE DIVIDED WITH SINGLE OR TANDEM OVERHEAD STRUCTURES AND SHOULDER-PIER TO E.P. $>$ 16'-0" ^{ROADWAY} ^{OUTSIDE-DISTANCE}

REVISION TO STANDARD DRAWINGS

(OLD BUSINESS ITEM)

BACKUP: IDM FIGURE 49-4E(6) GUARDRAIL CONFIGURATION FOR BRIDGE SUPPORT INSIDE CLEAR ZONE, ONE-WAY ROADWAY, SINGLE OVERHEAD STRUCTURE, OUTSIDE SHOULDER (DRAFT)



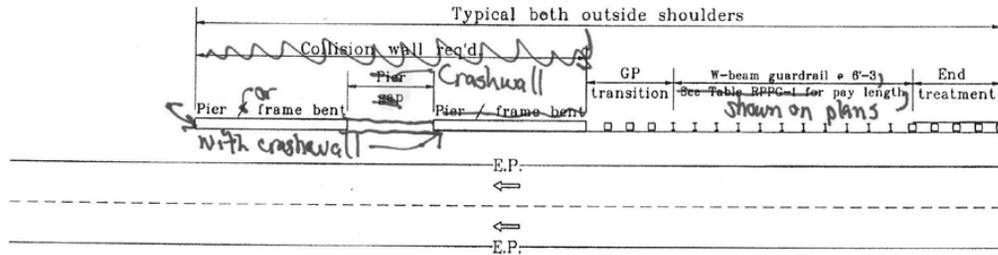
GUARDRAIL CONFIGURATION FOR BRIDGE SUPPORT INSIDE CLEAR ZONE, ONE-WAY ROADWAY, SINGLE OVERHEAD STRUCTURE, OUTSIDE SHOULDER

Figure 49-4E (6)

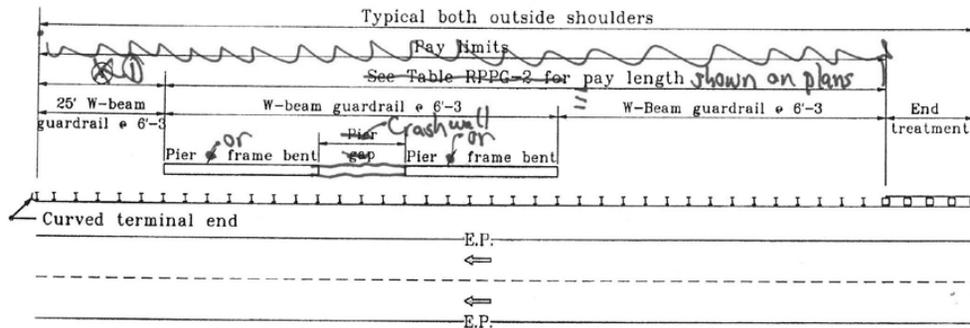
GENERAL NOTES

1. This drawing shall be used where W-beam guardrail is specified along the outside shoulder of a multi-lane divided roadway to shield the piers of an overhead structure.
2. The details on this drawing are typical guardrail layouts for shielding the piers of twin overhead structures. The required length of guardrail shall be determined in accordance with Tables RPPG-1 and RPPG-2, and shall be as shown on the plans.
3. Dimensions and details not shown on this drawing shall be as shown on the plans.
4. Rectangular plate washers shall be installed at each post along this section. *See Standard Drawing E 601-GRBS-01.*
5. *See Standard Drawing E 601-RPPG-03 for Tables RPPG-1 and RPPG-2.*

DESIGN REVISED



MULTI-LANE DIVIDED ROADWAY WITH TWIN OVERHEAD STRUCTURES AND OUTSIDE-SHOULDER PIER TO E.P. ≤ 16'-0" DISTANCE



MULTI-LANE DIVIDED ROADWAY WITH TWIN OVERHEAD STRUCTURES AND OUTSIDE-SHOULDER PIER TO E.P. > 16'-0" DISTANCE

601-GRRP-04

GUARDRAIL AT OUTROADSIDE PIER PROTECTION GUARDRAIL

SEPTEMBER 1997

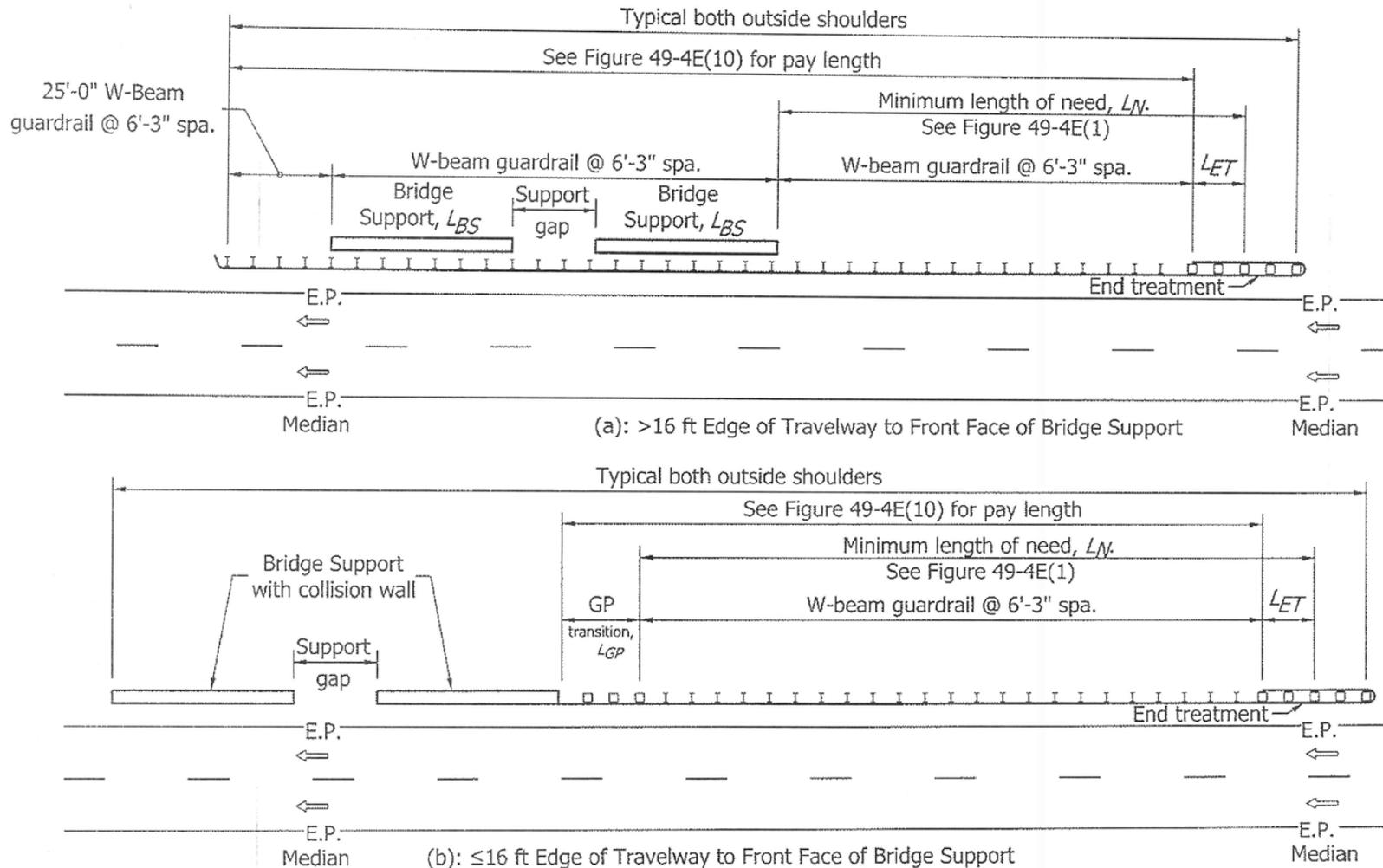
STANDARD DRAWING NO. E ~~601-RPPG-02~~

	DETAILS PLACED IN THIS FORMAT 11-15-99 /s/ Anthony L. Uremovich 11-15-99 DESIGN STANDARDS ENGINEER DATE /s/ Firooz Zandi 11-15-99 CHIEF HIGHWAY ENGINEER DATE DESIGN STANDARDS ENGINEER ORIGINALLY APPROVED 9-01-97
--	--

REVISION TO STANDARD DRAWINGS

(OLD BUSINESS ITEM)

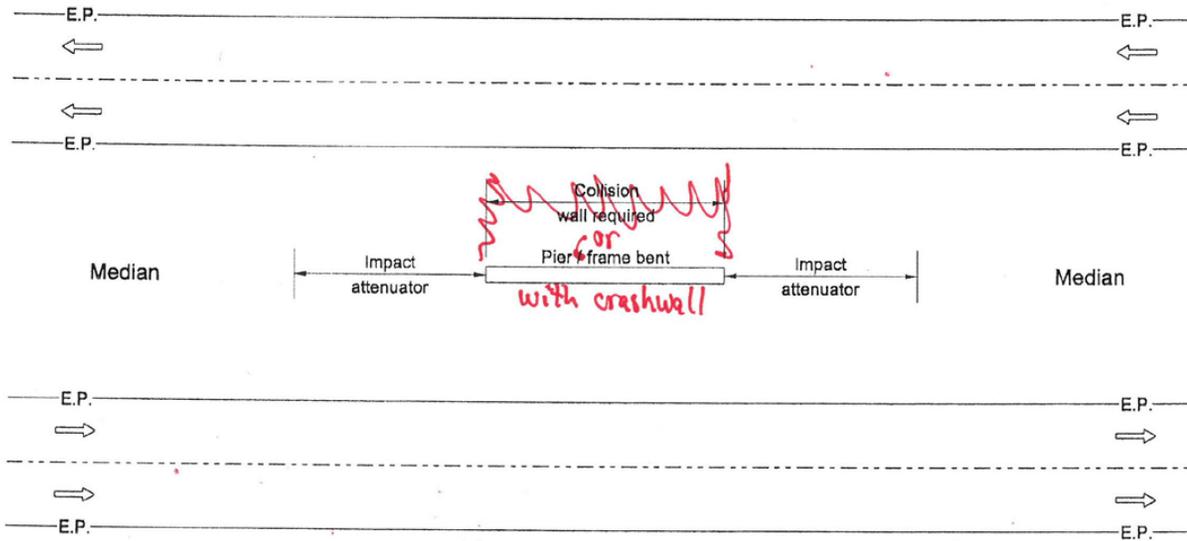
BACKUP: IDM FIGURE 49-4E(7) GUARDRAIL CONFIGURATION FOR BRIDGE SUPPORT INSIDE CLEAR ZONE, ONE-WAY ROADWAY, TWIN OVERHEAD STRUCTURE, OUTSIDE SHOULDER (DRAFT)



GUARDRAIL CONFIGURATION FOR BRIDGE SUPPORT INSIDE CLEAR ZONE, ONE-WAY ROADWAY, TWIN OVERHEAD STRUCTURES, OUTSIDE SHOULDER

Figure 49-4E (7)

601-MPPG-04 MEDIAN PIER PROTECTION GUARDRAIL



~~MULTI-LANE~~ ^{ROADWAY} DIVIDED WITH SINGLE OVERHEAD STRUCTURE AND MEDIAN PIER

GENERAL NOTES

1. This sheet shall be used when impact attenuator units are specified in conjunction with collision walls in the median of a multi-lane divided roadway to shield piers of single overhead structures.
2. The details on this sheet are typical layouts for shielding the median piers of single overhead structures with impact attenuators and collision walls. The actual layouts shall be as shown on the plans.
3. Dimensions and details not shown on this sheet shall be as shown on the plans.

DESIGN-RELATED

601-GRRP-05

INDIANA DEPARTMENT OF TRANSPORTATION

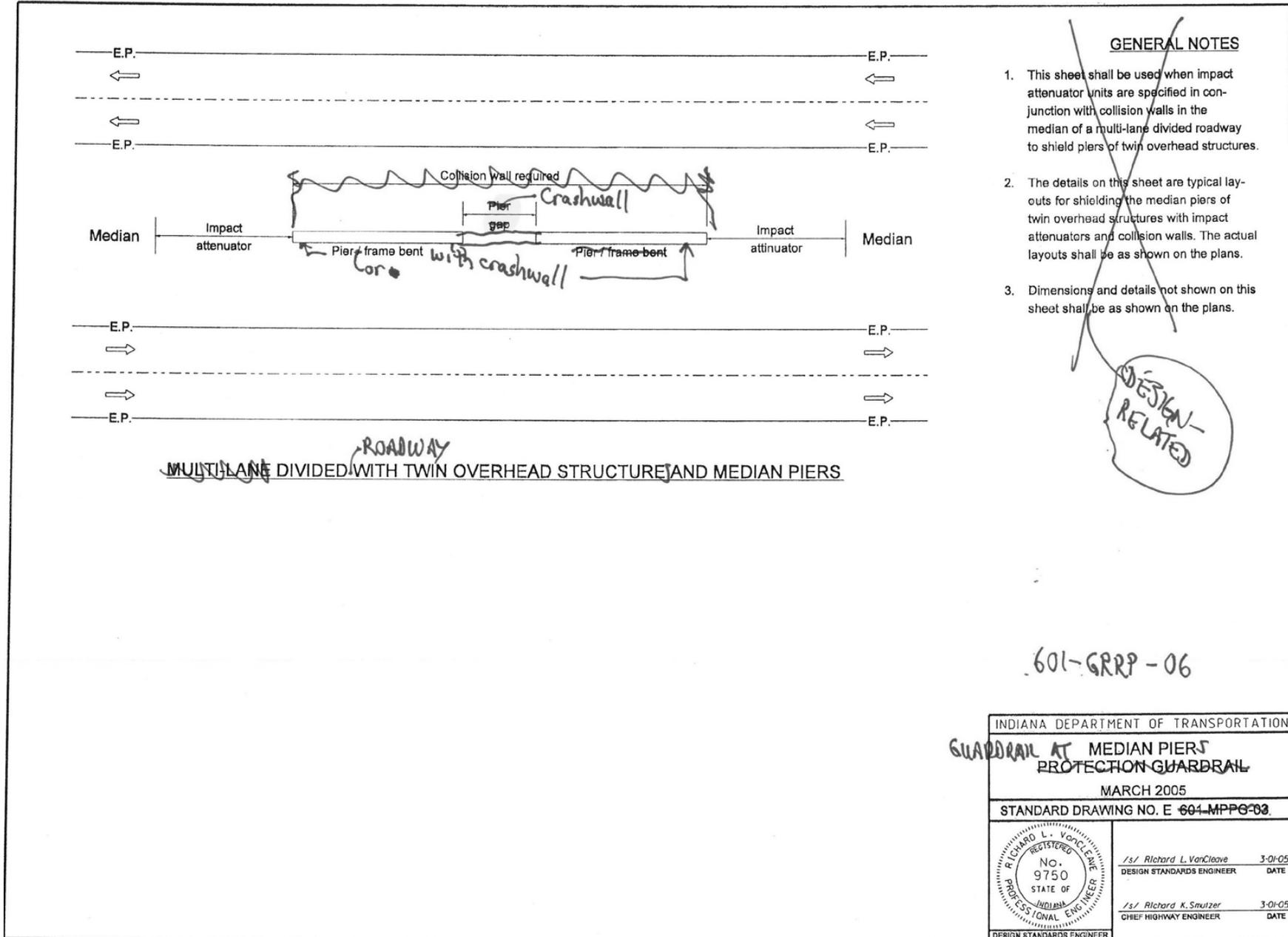
GUARDRAIL AT MEDIAN PIER PROTECTION GUARDRAIL

MARCH 2005

STANDARD DRAWING NO. E ~~601-MPPG-04~~

	/s/ Richard L. VanCleave DESIGN STANDARDS ENGINEER	3-01-05 DATE
	/s/ Richard K. Spitzer CHIEF HIGHWAY ENGINEER	3-01-05 DATE

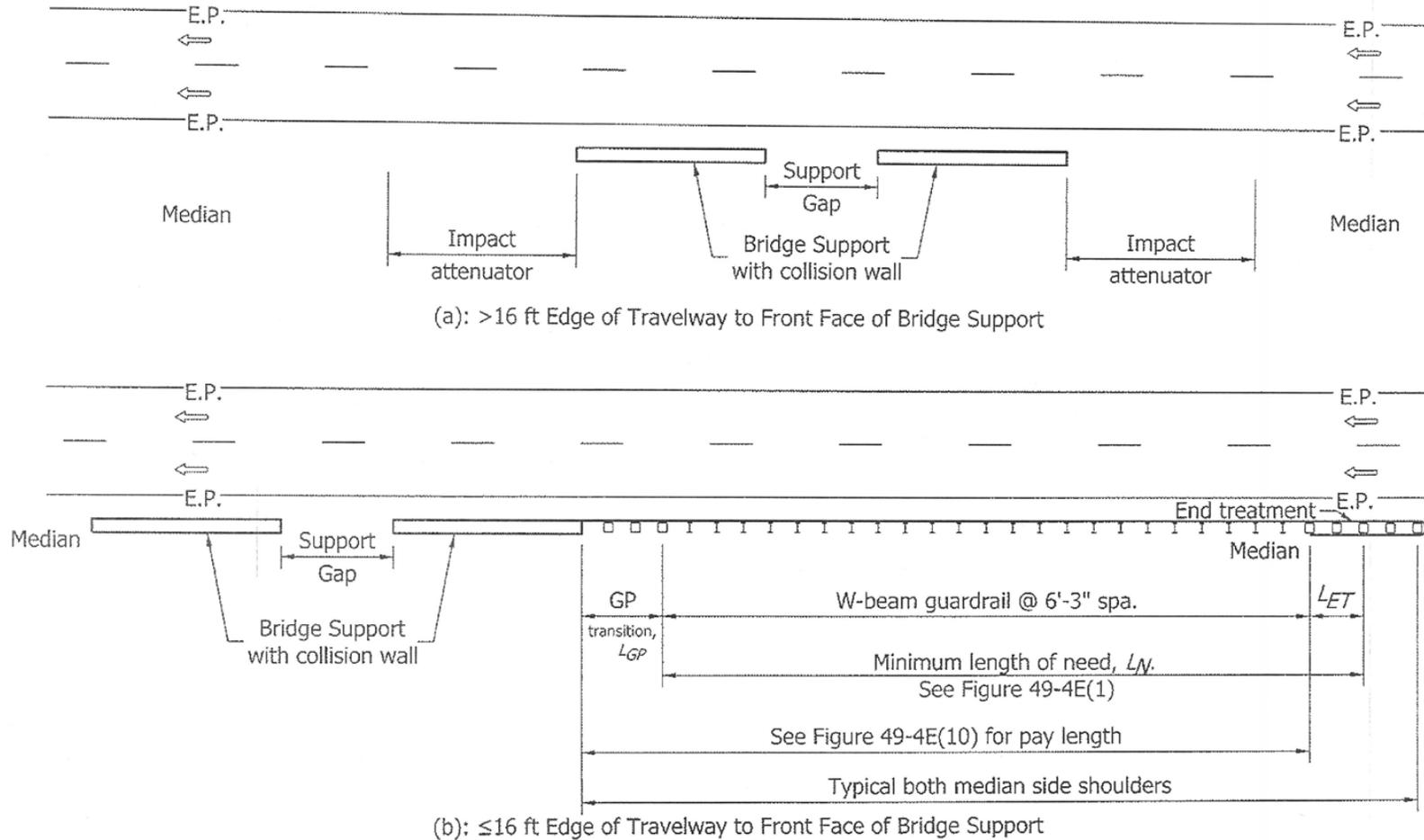
601-MPPG-03 MEDIAN PIER PROTECTION GUARDRAIL



REVISION TO STANDARD DRAWINGS

(OLD BUSINESS ITEM)

BACKUP: IDM FIGURE 49-4E(9) GUARDRAIL CONFIGURATION FOR BRIDGE SUPPORT INSIDE CLEAR ZONE, ONE-WAY ROADWAY, TWIN OVERHEAD STRUCTURE, MEDIAN SHOULDER (DRAFT)



GUARDRAIL CONFIGURATION FOR BRIDGE SUPPORT INSIDE CLEAR ZONE, ONE-WAY ROADWAY, TWIN OVERHEAD STRUCTURES, MEDIAN SHOULDER

Figure 49-4E (9)

Travel Configuration	Overpass Type and Location	Guardrail Pay Length, Support > 16 ft from Edge of Travelway (ft)	Guardrail Pay Length, Support ≤ 16 ft from Edge of Travelway (ft)
Two-Way Roadway	One Structure	$2(L_N - L_{ET}) + L_P$	$2(L_N - L_{ET} + L_{GP})$
	Twin Structures	$2(L_N - L_{ET} + L_P) + L_G$	$2(L_N - L_{ET} + L_{GP})$
One-Way Roadway	Outside Shoulder, One Structure	$L_N - L_{ET} + L_P + 25$	$L_N - L_{ET} + L_{GP}$
	Outside Shoulder, Twin Structures	$L_N - L_{ET} + 2L_P + L_G + 25$	$L_N - L_{ET} + L_{GP}$
	Median-Side Shoulder	(1)	$L_N - L_{ET} + L_{GP}$

(1) No guardrail is required. An impact attenuator is required where shown on Figure 49-4E(8) or 49-4E(9).

**GUARDRAIL PAY LENGTH FOR APPROACH
TO BRIDGE SUPPORT INSIDE CLEAR ZONE**

Figure 49-4E(10)

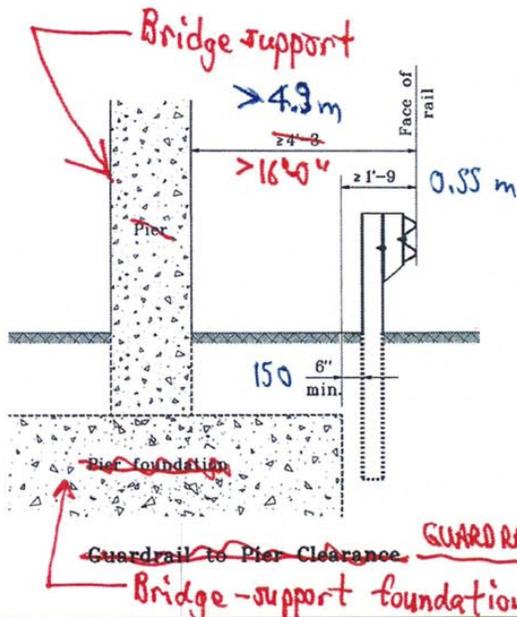
GENERAL NOTES

1. This drawing shall be used where W-beam guardrail is specified along a two-lane two-way roadway to shield the piers of overhead structures.
 2. The required length of guardrail shall be determined in accordance with Tables RPPG-1 and RPPG-2, and shall be as shown on the plans.
- Dimensions and details not shown on this drawing shall be as shown on the plans.

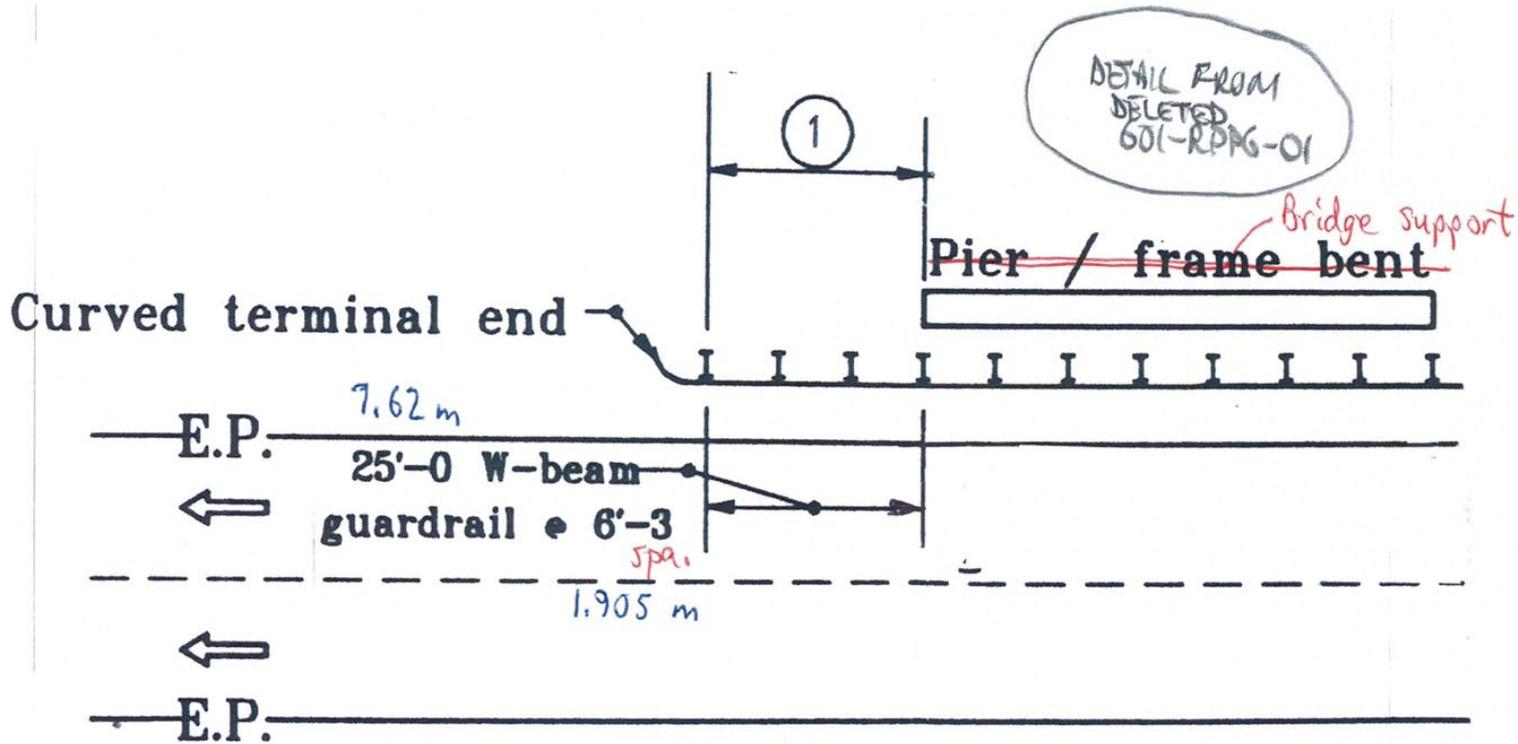
NOTES ARE DESIGN-RELATED

RETAIN AS STANDARD
DETAIL DRAWING, WITH
NEW DESIGNATION
DRAWING

GUARDRAIL REDESIGNED
AT BRIDGE SUPPORT



INDIANA DEPARTMENT OF TRANSPORTATION	
ROADSIDE PIER	
PROTECTION GUARDRAIL	
SEPTEMBER 1997 GRB-01	
STANDARD DRAWING NO. E 601-RPPG-06	
	DETAILS PLACED IN THIS FORMAT 11-15-99
	/s/ Anthony L. Uremovich 11-15-99 DESIGN STANDARDS ENGINEER DATE
	/s/ Ferooz Zandi 11-15-99 CHIEF HIGHWAY ENGINEER DATE
DESIGN STANDARDS ENGINEER	ORIGINALLY APPROVED 9-01-97



NOTES:

- ① Washers required for each post in this section shall be rectangular plate washers, as shown on Standard Drawing E601-WBGC-02.

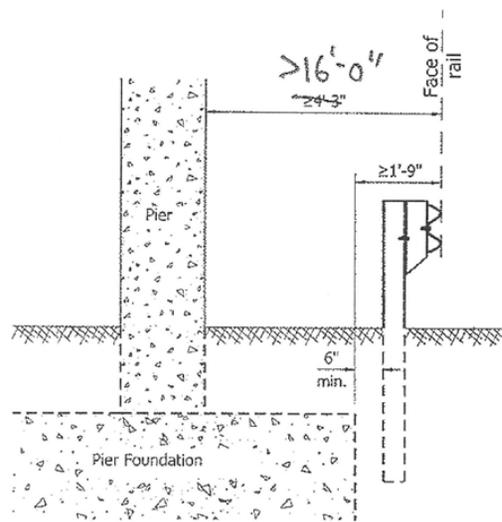
Median

~~DOWNSSTREAM GUARDRAIL TREATMENT~~

INCLUDE ON
 NEW STD DWG THAT
 ADDRESSES NOTE ④ ON
 DWG 601-RDPG-01

~~DOWNSSTREAM GUARDRAIL~~
 AT BRIDGE ~~PIER~~ SUPPORT
 STD. DWG. No. E601-GRBS-01^S

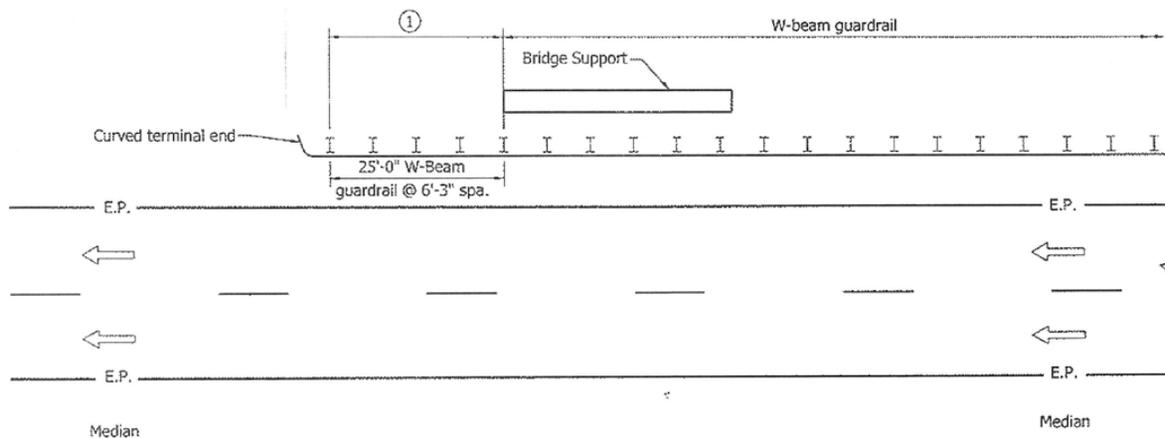
601-GRBS-01 GUARDRAIL AT BRIDGE SUPPORT (PROPOSED NEW, DRAFT)



GUARDRAIL-TO-PIER CLEARANCE

NOTE:

- ① Washers required for each post in this section shall be rectangular plate washers, as shown on Standard Drawing E 601-WBGC-02.



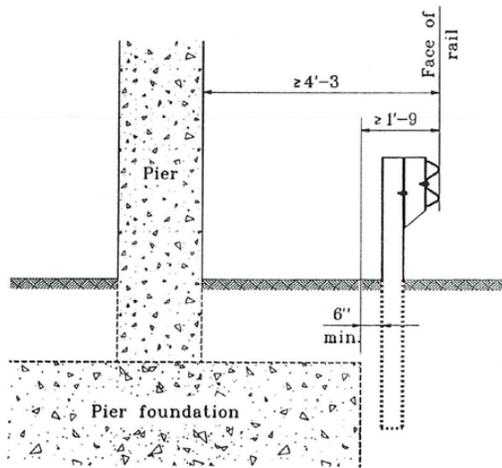
DOWNSTREAM GUARDRAIL TREATMENT

INDIANA DEPARTMENT OF TRANSPORTATION	
GUARDRAIL AT BRIDGE SUPPORT	
DECEMBER 2010	
STANDARD DRAWING NO. E 601-GRBS-01	
DESIGN STANDARDS ENGINEER	DATE
CHIEF HIGHWAY ENGINEER	DATE

GENERAL NOTES

1. This drawing shall be used where W-beam guardrail is specified along a two-lane two-way roadway to shield the piers of overhead structures.
 2. The required length of guardrail shall be determined in accordance with Tables RPPG-1 and RPPG-2, and shall be as shown on the plans.
- Dimensions and details not shown on this drawing shall be as shown on the plans.

DELETE DWG.
 DUPLICATES EXISTING
 601-MPPG-02.



Guardrail to Pier Clearance

INDIANA DEPARTMENT OF TRANSPORTATION	
ROADSIDE PIER PROTECTION GUARDRAIL	
SEPTEMBER 1997	
STANDARD DRAWING NO. E 601-RPPG-06	
	DETAILS PLACED IN THIS FORMAT 11-15-99 /s/ Anthony L. Uremovich 11-15-99 DESIGN STANDARDS ENGINEER DATE
DESIGN STANDARDS ENGINEER	/s/ Firooz Zandi 11-15-99 CHIEF HIGHWAY ENGINEER DATE ORIGINALLY APPROVED 9-01-97

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APPROVED MINUTES

Item No. 06 01/20/11 (2010 SS) (contd.)

Mr. Strain

Date: 02/17/11

COMMENTS AND ACTION

(OLD BUSINESS ITEM)

601-BAGR-01 and -02; 601-MPPG-01 through -04; 601-RPPG-01 through -06;
NEW 601-GRBS-01; 601-GRRP-01 through -07; 601-GRBA-01 and -02.

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APPROVED MINUTES