PENNDOT - Inlet Standards

Presentation By:

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January 28, 2009

Gannett Fleming

pennsylvania
DEPARTMENT OF TRANSPORTATION

New Inlet Standards

- RC-45M (16 Shts) – Inlet Tops, Grates & Frames
- RC-46M (44 Shts) – Inlet Boxes
- Released August 29, 2008 under Change #4
- New Standards may be used immediately without affecting Letting Schedules
- New Standards must be used on all PS&E Submissions after March 1, 2009

Existing Inlet Standards

- Current RC-34M Inlet Standards (10 Shts) dated March 30, 2006 will be Eliminated at a future date
- Standard will still be used for current jobs under design
- The Department still needs to clarify how the new standards will be used for rehabilitation projects when just replacing the top units

Why new Standards?

- To update the design requirement from Working Stress Design (WSD) to Load and Resistance Factor Design (LRFD)
- To provide box designs for larger pipe diameters (up to 96" for RCP)
- To provide box designs to accommodate deeper installations (30' deep versus 9' deep)
- To allow flexibility for the precaster to use rebar, welded wire fabric, or a combination of both to meet the steel areas in the tables

Why new Standards?

- To provide standard details and designs that can be used by fabricators and contractors in order to provide a level playing field
- To provide new details and guidelines for the fabrication and construction of inlet boxes
- To permit angled pipe openings and corner penetrations in the inlet boxes

Why new Standards?

- To resolve construction and performance problems
- To provide separate designs for Cast-in-Place boxes and Precast boxes
- To eliminate the need for Shop Drawings and pre-approvals
  - Previously a special design and shop drawings were required for any inlet that had a depth > 9'. This resulted in additional review time and costs to the Department.

Design Criteria

- PENNDOT Design Manual, Part 4,Structures
- AASHTO LRFD Design Specifications, 1998

Meetings

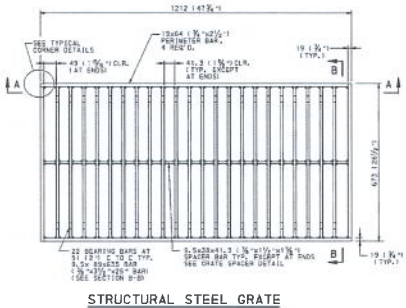
- PENNDOT
- Six Meetings held with Fabricators from March 2006 thru June 2008
- Clearance Transmittal sent out in June 2008

RC-45M Inlet Tops, Grates, and Frames

RC-45M - Grates

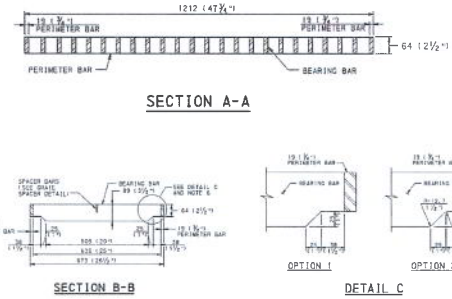
- Grates - Overall Length and Width of Grates Remains the Same (26½" x 47¾")
- Structural Steel Grates (Grade 50)
  - Revised Bearing Bars from ½" x 2½" to 3/8" x 3½" (2½" Perimeter Depth)
- Cast Iron Grates
  - Minor Changes
  - Added Details for Two Piece Grate

RC-45M - Grates



STRUCTURAL STEEL GRATE

RC-45M - Grates



RC-45M – Concrete Top Units

- Types: Type C, C Alternate, M and S
- Overall Length and Width of Top Units Remains the Same as Current Standard
- Increased Depth (12" Minimum) to provide better performance and durability under traffic loads

RC-45M – Concrete Top Units

- Precasters may want to retrofit their existing forms to account for the additional depth
- Revised "Top" Slopes on Units (1" Drop across unit)
  - Precasters will be permitted to retrofit their existing forms to maintain the slope as shown on RC-34M while meeting a 12" minimum depth

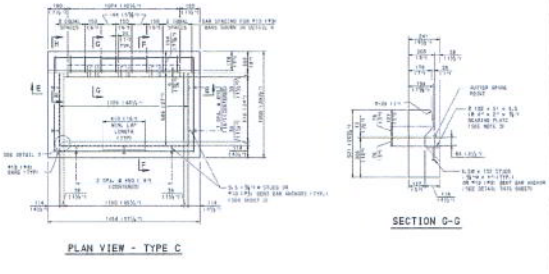
RC-45M – Concrete Top Units

- Revised Reinforcement Details
- Increase Angle Size from 1¼" x 1¼" x 1/8" to 1¾" x 1¾" x ¼"
- Added Studs and Bent Bar Details for connection of angle to concrete

RC-45M – Concrete Top Units

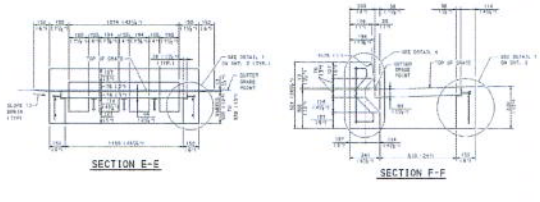
- New Tops
  - Type D-H
  - Type D-H Level
- Top Units for Rehabilitation Projects
  - The Department still needs to determine how to replace the "top units" on rehabilitation projects since the depth of the top units have been increased

RC-45M – Concrete Top Units Type C

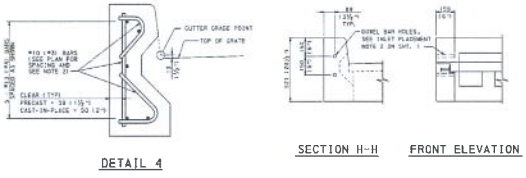


- Increased Supports from 1 to 3

RC-45M – Concrete Top Units Type C



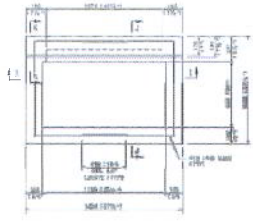
RC-45M – Concrete Top Units Type C



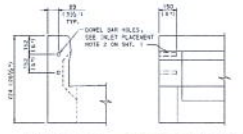
DETAIL 4

SECTION H-H FRONT ELEVATION

RC-45M – Concrete Top Units Type C - Alternate

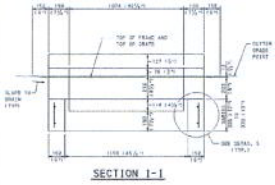


PLAN VIEW - TYPE C ALTERNATE

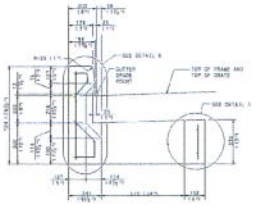


SECTION K-K FRONT ELEVATION

RC-45M – Concrete Top Units Type C - Alternate

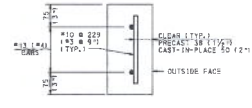


SECTION I-I



SECTION J-J

RC-45M – Concrete Top Units Type C - Alternate



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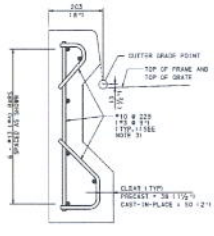
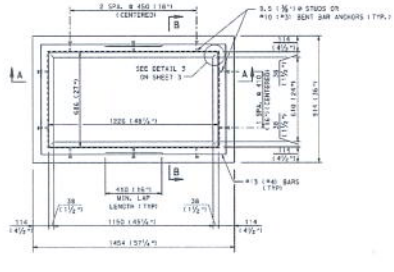


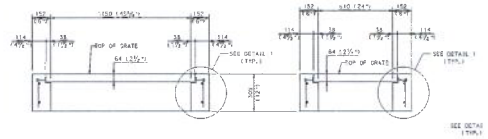
DETAIL 6

RC-45M – Concrete Top Units Type M

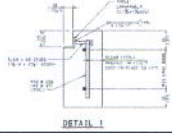


PLAN VIEW - TYPE M

RC-45M – Concrete Top Units Type M

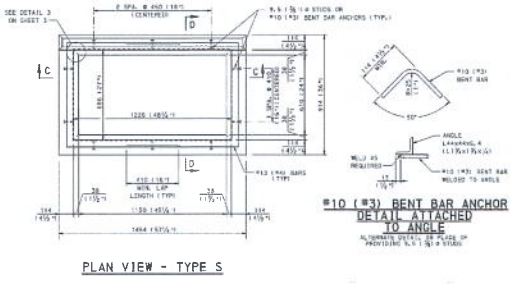


SECTION A-A SECTION B-B

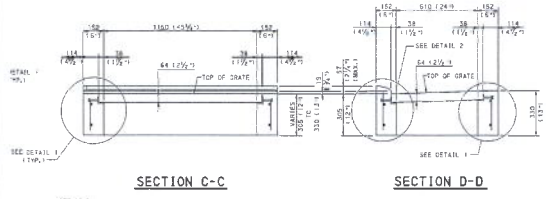


DETAIL 1

RC-45M – Concrete Top Units Type S



RC-45M – Concrete Top Units Type S



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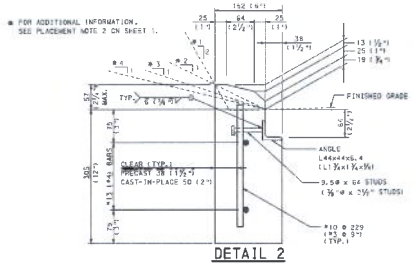
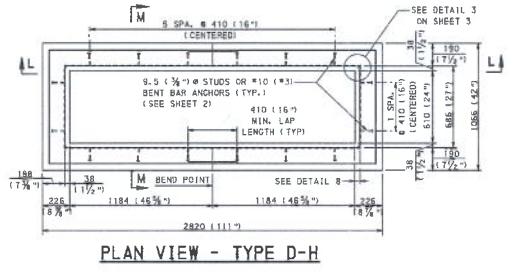
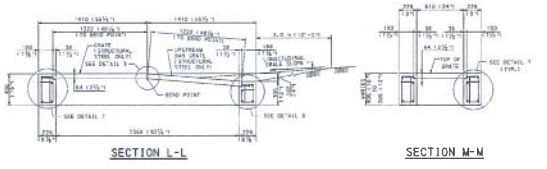


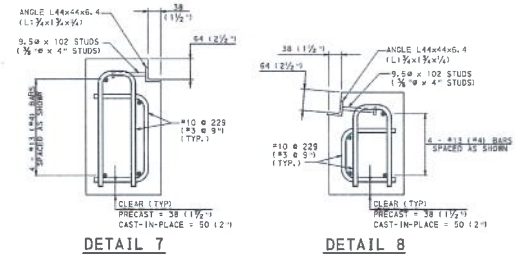
RC-45M – Concrete Top Units Type D-H



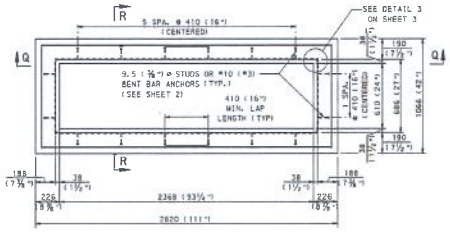
RC-45M – Concrete Top Units Type D-H



RC-45M – Concrete Top Units Type D-H



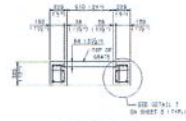
RC-45M – Concrete Top Units Type D-H Level



PLAN VIEW - TYPE D-H LEVEL

RC-45M – Concrete Top Units Type D-H Level

SECTION Q-Q



SECTION R-R

RC-45M – Frames

- Type C and M Frame
  - Minor Changes
- Type C Frames – Grade 50 Steel

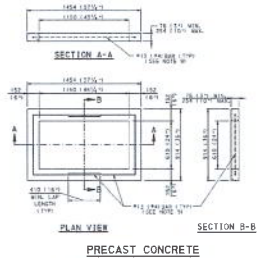
RC-45M – Grade Adjustment

- Two Types Detailed in the Standard
  - Precast Concrete
  - Structural Steel
- Brick or Brick and Mortar are not permitted for Grade Adjustments due to poor performance problems
- Alternate Types:
  - HDPE or Rubber Grade Adjustment Rings are permitted for grade adjustment if requested by the Contractor and Accepted by PENNDOT prior to installation

RC-45M – Precast Concrete Grade Adjustment Rings

- Precast Concrete:
  - Permitted Depths from 3" to 10" (Tapers Permitted) (Previous depths – 2" to 6")
  - Added Details for Type D-H Top
  - Permitted to be Fabricated in any shape to form the Rectangular dimensions of the top unit.
  - Only one ring is permitted for new construction.

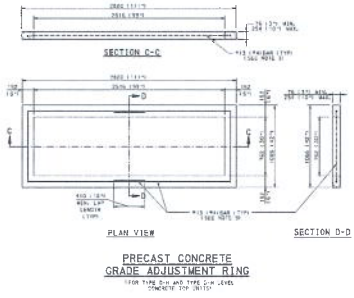
RC-45M – Precast Concrete Grade Adjustment Rings



PLAN VIEW SECTION B-B

PRECAST CONCRETE
GRADE ADJUSTMENT RING

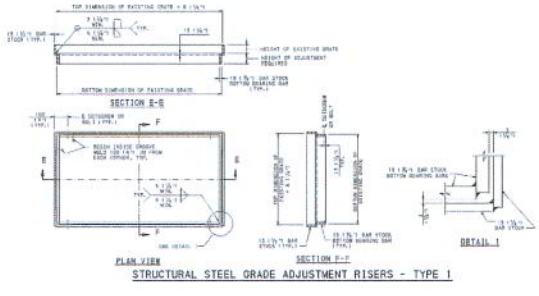
RC-45M – Precast Concrete Grade Adjustment Rings



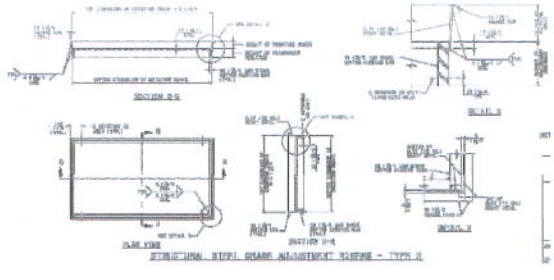
RC-45M – Structural Steel Grade Adjustment Risers

- Structural Steel:
  - Two types (per SOL 432-07-04)
    - Type 1 – Existing Grate Thickness + ½" to 6" maximum
    - Type 2 – 1" minimum to Existing Grate Thickness + ½" maximum
  - Risers to be Custom Fabricated

RC-45M – Structural Steel Grade Adjustment Risers



RC-45M – Structural Steel Grade Adjustment Risers



RC-46M Inlet Boxes

RC-46M – Inlet Boxes

- Box Types (Inside Dimensions):
  - Standard (2'-0" x 3'-9¼")
  - Type 4 (4'-0" x 4'-0")
  - Type 5 (5'-0" x 5'-0")
  - Type 6 (6'-0" x 6'-0")
  - Type 7 (7'-0" x 7'-0")
  - Type 8 (8'-0" x 8'-0")
  - Type 9 (9'-0" x 9'-0")
  - Type 10 (10'-0" x 10'-0")
  - Type D-H (2'-6" x 8'-3")

RC-46M – Inlet Boxes

➢ Reinforced Pipe Sizes (Inside Dimensions):

INLET TYPE	INSIDE WIDTH (in)	INSIDE LENGTH (in)	MAXIMUM PERMITTED PIPE DIAMETER ALONG WIDTH (in)	MAXIMUM PERMITTED PIPE DIAMETER ALONG LENGTH (in)
STANDARD	24"	45 1/4"	18"	36"
4	48"	48"	36"	36"
5	60"	60"	42"	42"
6	72"	72"	54"	54"
7	84"	84"	66"	66"
8	96"	96"	72"	72"
9	108"	108"	84"	84"
10	120"	120"	96"	96"
D-H	30"	99"	18"	72"

RC-46M – Inlet Boxes

- Two Separate Designs

  ➢ Cast-in-Place – Class A Cement Concrete (3,000 psi)

  ➢ Precast Concrete – Class AA Cement Concrete, Modified (4,000 psi)

RC-46M – Inlet Boxes

➢ Design Tables:
  ➢ Cast-in-Place Concrete with Reinforcement Bars (WWF not permitted with CIP Boxes)

  ➢ Precast Concrete with Reinforcement Bars

  ➢ Precast Concrete with Welded Wire Fabric

RC-46M – Inlet Boxes

➢ Design Depths (Finished Grade Elevation to Bottom Slab Elevation):

  ➢ 5'-0" minimum
  ➢ 30'-0" maximum

➢ Box segments to be marked with maximum installation depth

RC-46M – Inlet Boxes

➢ Design Tables:
  ➢ Determine Box Type

  ➢ Determine Depth

  ➢ Go to appropriate Table to determine member thicknesses and reinforcement requirements

RC-46M – Inlet Boxes

➢ Customized Rectangular Boxes:
  ➢ Rectangular Boxes may be used provided the Design Requirements are based on the larger inside dimension

  ➢ Fabricator to determine the minimum inside box size dimensions required based on the pipe opening and than determine the appropriate Design Table to be used

  ➢ This requirement was added to allow the fabricators to utilize their existing forms

RC-46M – Inlet Boxes

- Customized Rectangular Boxes:
  - Min. Required Inside Dimensions:
    - L = 6'-5"
    - W = 2'-0"
  - Fabricated Dimensions
    - L = 6'-6"
    - W = 2'-0"
  - Design Table:
    - Type 7 → 6'-6" < 7'-0"

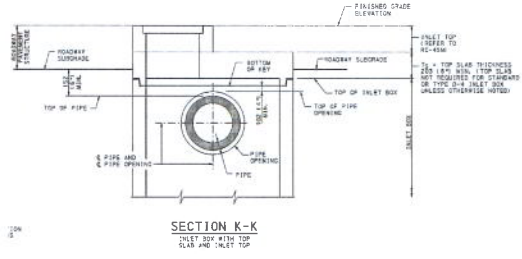
RC-46M – Inlet Boxes

- Combining Reinforcement Bars and WWF in Precast Boxes:
  - Member Thicknesses and Reinforcement Requirements must meet the Requirements of the Reinforcement Bar Tables and the following requirements:
    - Bar Size and Spacing
    - Wire Size and Spacing
    - Cover and Clearance Between Layers

RC-46M – Inlet Boxes

- Top Slabs:
  - Designed to support the Top Units when the inlet box is larger than the Standard Box

RC-46M – Top Slabs

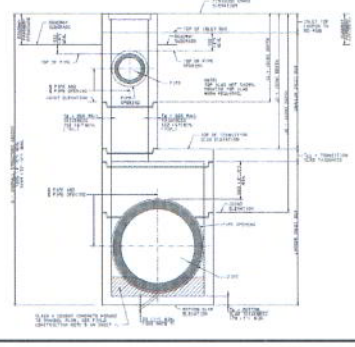


SECTION K-K
INLET BOX WITH TOP SLAB AND INLET TOP

RC-46M – Inlet Boxes

- Transition Slabs:
  - Used to transition a larger box to a smaller box
  - Contractor / Fabricator to determine when a Transition Slab will be used
  - Only 1 Transition Slab is permitted within an Inlet Assembly

RC-46M – Transition Slabs



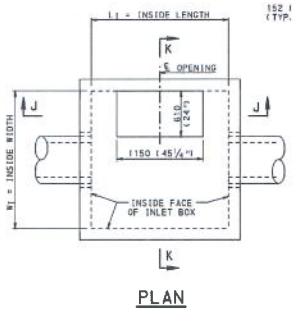
RC-46M – Inlet Boxes

- Shop Drawings:
  - Shop Drawings are not required when the top slabs, transition slabs, and inlet boxes are Constructed / Fabricated in accordance with the Standard
  - Production Drawings are suggested for fabrication or construction of the inlet boxes

RC-46M – Inlet Boxes

- Changes:
  - Bottom Slab Thickness was increased from 6" due to clearance requirements.
    - CIP - 9" Minimum
    - Precast – 7" Minimum
  - Wall Steel (Minimum):
    - Reinforcement Bars – 0.15 in^2 / ft. Each Way (#3 @ 9")
    - WWF – 0.12 in^2 / ft. Each Way

RC-46M – Inlet Boxes



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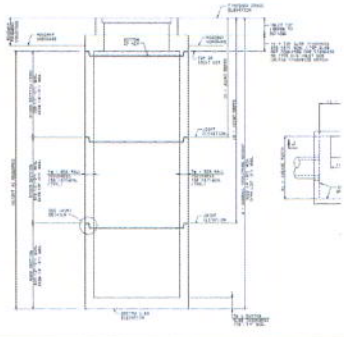

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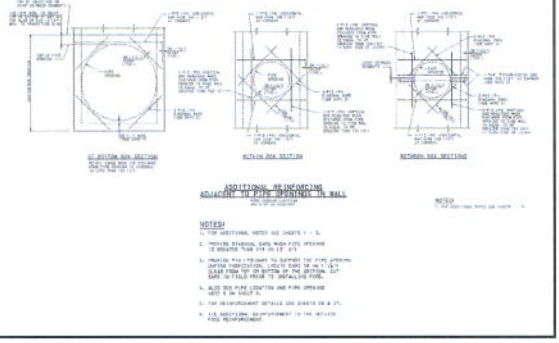

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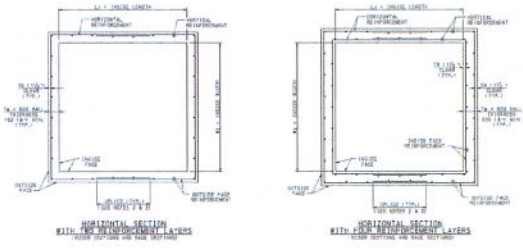
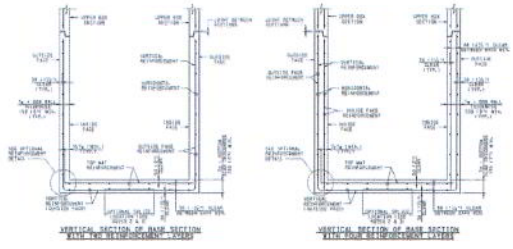
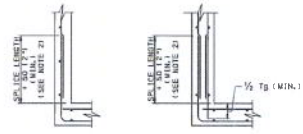


RC-46M – Inlet Boxes



TYPICAL SECTIONS
PRECAST INLET BOXES
WITH REINFORCEMENT BARS

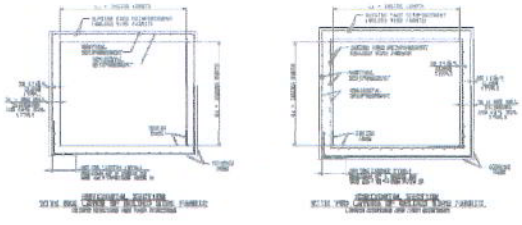
RC-46M – Inlet Boxes



TWO REINFORCEMENT LAYERS | FOUR REINFORCEMENT LAYERS

OPTIONAL REINFORCEMENT DETAILS

RC-46M – Inlet Boxes



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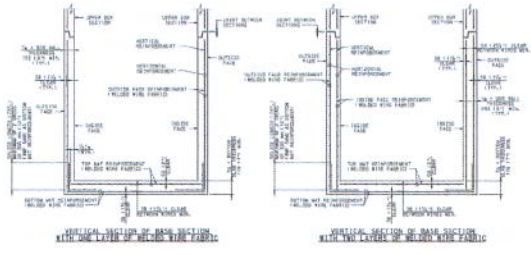
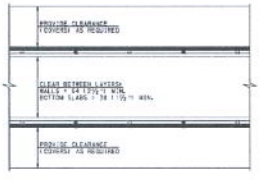


TYPICAL SECTIONS
PRECAST INLET BOXES
WITH WELDED WIRE FABRIC

RC-46M – Inlet Boxes



NESTED WWF DETAIL

NESTED WWF NOTES:

1. FABRICATOR IS PERMITTED TO FABRICATE THE PRECAST CONCRETE INLET BOXES USING NESTED WWF IN ACCORDANCE WITH THE FOLLOWING REQUIREMENTS:
   - THE MEMBER THICKNESS AND THE REQUIRED AREA OF STEEL MUST MEET THE REQUIREMENTS OF THE WELDED WIRE FABRIC DESIGN TABLES SHOWN ON SHEETS 34 - 45.
   - THE CLEAR DISTANCE BETWEEN PARALLEL WIRES IS NOT PERMITTED TO BE LESS THAN 38 mm [1½"].
   - ALL OTHER COVER AND CLEARANCE REQUIREMENTS ARE MET.
2. A MAXIMUM OF TWO LAYERS OF WWF IS PERMITTED TO BE NESTED PER MAT.

RC-46M – Inlet Boxes

PRECAST CONCRETE INLET BOX SUMMARY TABLE
BOX TYPE - STANDARD
U.S. CUSTOMARY UNITS

RISER SECTIONS

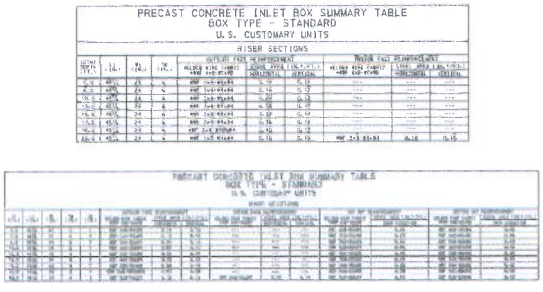
JOINT DEPTH (FT.)	H (FT.)	W (IN.)	T1 (IN.)	T2 (IN.)	OUTSIDE FACE REINFORCEMENT HORIZONTAL BAR SIZE	OUTSIDE FACE REINFORCEMENT HORIZONTAL SPACING (IN.)	OUTSIDE FACE REINFORCEMENT VERTICAL BAR SIZE	OUTSIDE FACE REINFORCEMENT VERTICAL SPACING (IN.)	INSIDE FACE REINFORCEMENT HORIZONTAL BAR SIZE	INSIDE FACE REINFORCEMENT HORIZONTAL SPACING (IN.)	INSIDE FACE REINFORCEMENT VERTICAL BAR SIZE	INSIDE FACE REINFORCEMENT VERTICAL SPACING (IN.)
7.0	45 5/8	24	6	7	#3	9	#3	6	---	---	---	---
11.0	45 5/8	24	6	7	#4	6	#3	6	---	---	---	---
14.0	45 5/8	24	6	7	#4	7	#3	6	---	---	---	---
16.0	45 5/8	24	6	7	#3	4	#3	6	---	---	---	---
18.0	45 5/8	24	6	7	#4	5	#3	6	---	---	---	---
20.0	45 5/8	24	6	7	#4	6	#3	6	---	---	---	---
28.0	45 5/8	24	6	7	#4	3	#3	5	#4	12	#3	5

PRECAST CONCRETE INLET BOX SUMMARY TABLE
BOX TYPE - STANDARD
U.S. CUSTOMARY UNITS

BASE SECTIONS

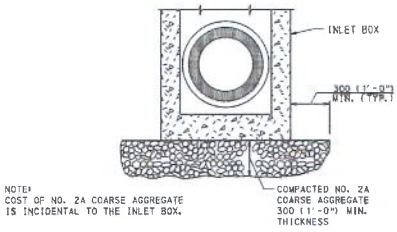
H (FT.)	L1 (IN.)	W1 (IN.)	T1 (IN.)	T2 (IN.)	OUTSIDE FACE REINFORCEMENT HORIZONTAL BAR SIZE	OUTSIDE FACE REINFORCEMENT HORIZONTAL SPACING (IN.)	OUTSIDE FACE REINFORCEMENT VERTICAL BAR SIZE	OUTSIDE FACE REINFORCEMENT VERTICAL SPACING (IN.)	INSIDE FACE REINFORCEMENT HORIZONTAL BAR SIZE	INSIDE FACE REINFORCEMENT HORIZONTAL SPACING (IN.)	INSIDE FACE REINFORCEMENT VERTICAL BAR SIZE	INSIDE FACE REINFORCEMENT VERTICAL SPACING (IN.)	TOP MAT REINFORCEMENT BAR SIZE	TOP MAT REINFORCEMENT SPACING (IN.)
7.0	45 5/8	24	6	7	#3	9	#3	6	---	---	---	---	#3	6
11.0	45 5/8	24	6	7	#3	6	#3	6	---	---	---	---	#3	6
13.0	45 5/8	24	6	7	#4	9	#3	6	---	---	---	---	#3	6
16.0	45 5/8	24	6	7	#3	4	#3	6	---	---	---	---	#3	6
19.0	45 5/8	24	6	7	#4	6	#3	6	---	---	---	---	#3	6
30.5	45 5/8	24	8	7	#4	12	#3	6	#4	12	#4	12	#3	6

RC-46M – Inlet Boxes


PRECAST CONCRETE INLET BOX SUMMARY TABLE
BOX TYPE - STANDARD
U.S. CUSTOMARY UNITS

RISER SECTIONS

RC-46M – Inlet Box Subbase



INLET BOX SUBBASE PREPARATION DETAIL

(SEE FIELD CONSTRUCTION NOTES ON SHEET 1)

Other Revisions

Other Revisions

- Publication 408 (Specifications):
  - Section 605 – Endwalls, Inlets, Manholes and Spring Boxes
  - Section 606 – Grade Adjustment of Existing Misc. Structures
  - Section 705 – Joint Material
  - Section 714 – Precast Concrete Products
  - Section 1105 – Fabricated Structural Steel

Other Revisions

- Design Manual, Part 2 – Highway Design
- Design Manual, Part 3 – Plans Presentation

Other Revisions – Pay Items

- Existing Pay Items will be eliminated
- New Pay Items for Grates
  - Inlet Grate
  - Bicycle Safe Grate
  - ADA Compliant Grate
  - Vane Inlet Grate
  - Inlet Grates for Type D-H Concrete Top Unit
  - Inlet Grates for Type D-H Level Concrete Top Unit

Other Revisions – Pay Items

- Top Units will be paid for separately from the Inlet Boxes
  - Type "X" Concrete Top Unit and Grate
  - Type "X" Concrete Top Unit and Bicycle Safe Grate
  - Type "X" Concrete Top Unit and ADA Compliant Grate
  - Type "X" Concrete Top Unit and Vane Grate
  - Type "X" Concrete Top Unit using Existing Grate

Other Revisions – Pay Items

- Frames will be paid for separately from the Inlet Boxes
  - Type "X" Frame and Grate
  - Type "X" Frame and Bicycle Safe Grate
  - Type "X" Frame and ADA Compliant Grate
  - Type "X" Frame and Vane Grate
  - Type "X" Frame using Existing Grate

Other Revisions – Pay Items

- Inlets boxes will be paid for based on the Type of box Depth of Installation
  - Type "X" Inlet Box, Height ≤ 10'
  - Type "X" Inlet Box, Height > 10' and ≤ 20'
  - Type "X" Inlet Box, Height > 20' and ≤ 30'
  - Type "X" Inlet Box, Height > 30'

- The cost of excavation, compacted No. 2A coarse aggregate, inlet box, transition slab, top slab, backfill and any other miscellaneous items required will be incidental to the cost of the inlet box.

Updating the New Standards

- Currently a few fabricators are using the new Standards to fabricate items which they do not have Acceptance from PENNDOT.

- PENNDOT is monitoring the use of the New Standards.

- This process will help use correct any constructability issues that arise and make the new standards even better

- Update will be completed in the later part of 2009

Designer Information

- The Designer will be responsible to determine the following:
  - Type of Grate
  - Type of Top Unit
  - Type of Inlet Box based on the required RCP pipe size.
  - Installation Depth of Inlet Box

- The Designer must ensure that the requirements of the Standards and the Design Manuals are met and that the information is shown correctly on the Contract Documents.

Contractor Information

- The Contractor / Fabricator will be responsible to select the components of the inlet assembly based on the information shown on the Contract Documents and Standard Drawings.

- The Contractor / Fabricator will be responsible for the construction and installation of the inlet assembly based on the information shown on the Contract Documents and Standard Drawings.

Acknowledgments

- Mark Burkhead, PENNDOT HQAD
- Bob Horwhat, PENNDOT, Materials
- Rhett Heiple, Gannett Fleming
- Hank Bonstedt, PPA
- Fabricators

Questions