

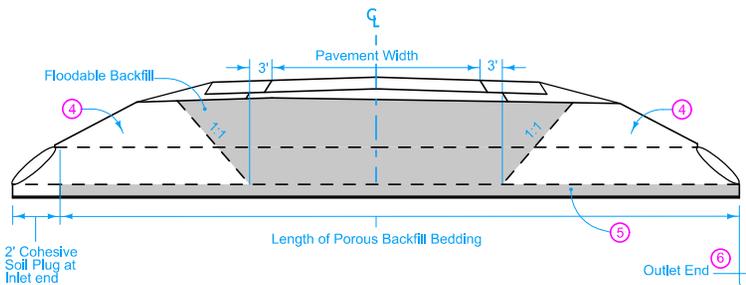
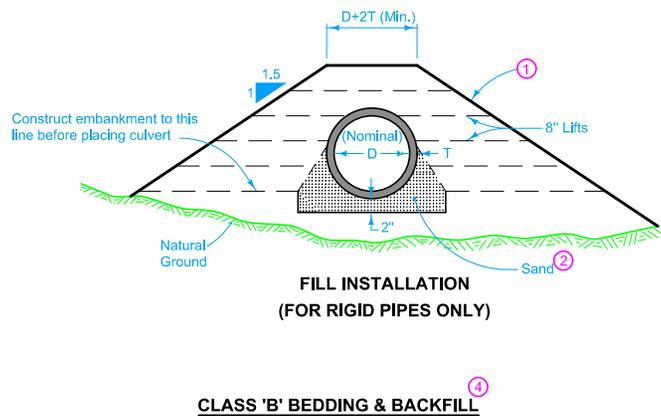
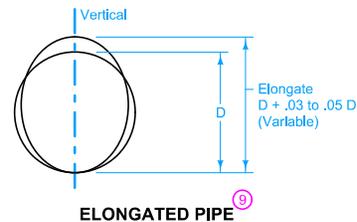
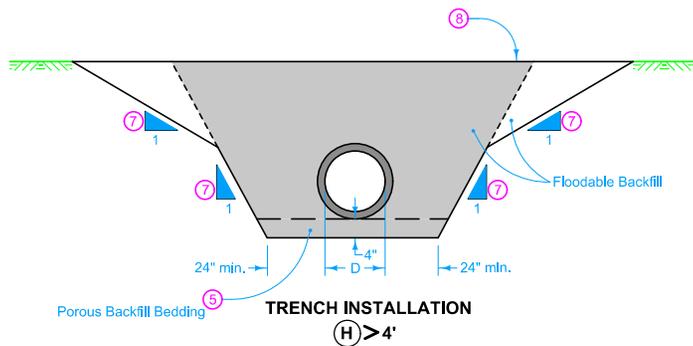
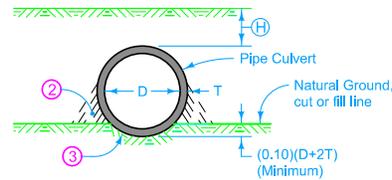
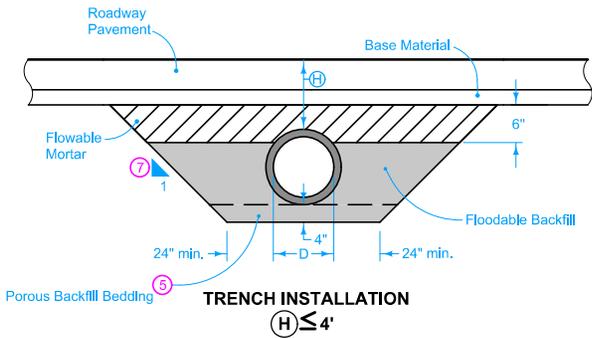
# Drainage

**Drainage**

| NO.    | DATE     | TITLE   |
|--------|----------|---|
| DR-101 | 04-18-17 | Pipe Culvert (Bedding and Backfill)                                     |
| DR-102 | 04-21-15 | Pipe Culvert (Cover and Camber)   |
| DR-103 | 04-21-15 | Pipe Culvert (Installation Details)                                     |
| DR-104 | 04-19-16 | Depth of Cover Tables for Concrete and Corrugated Pipe                  |
| DR-111 | 04-21-15 | Box Culvert (Backfill)  |
| DR-121 | 04-18-17 | Connected Pipe Joints   |
| DR-122 | 10-18-16 | Construction of Type "C" Concrete Adaptors for Pipe Culvert Connections |
| DR-141 | 04-18-17 | Pipe Bends and Half Pipe  |
| DR-142 | 04-21-15 | Culvert Pipe Tee Sections   |
| DR-201 | 04-21-15 | Concrete Aprons   |
| DR-202 | 04-21-15 | Low Clearance Concrete Pipe Aprons                                      |
| DR-203 | 04-21-15 | Metal Pipe Aprons and Beveled Ends                                      |
| DR-204 | 04-21-15 | Metal Arch Aprons (for Corrugated Metal Pipe)                           |
| DR-205 | 04-21-15 | Concrete Apron with End Wall  |
| DR-206 | 04-19-16 | Low Clearance Concrete Pipe Apron With End Wall                         |
| DR-211 | 04-21-15 | Metal Safety Slope Apron 6:1 Slope                                      |
| DR-212 | 04-21-15 | Beveled Pipe and Guard  |
| DR-213 | 04-21-15 | Pipe Apron Guard  |
| DR-301 | 04-21-15 | Subdrains for Fill or Foundation Drainage (Standard)                    |
| DR-302 | 10-20-15 | Subdrains Standard (Farm Tile Replacement)                              |
| DR-303 | 10-18-16 | Subdrains (Longitudinal)  |
| DR-304 | 10-18-16 | Outlets for Longitudinal, Transverse and Backslope Subdrains            |
| DR-305 | 04-21-15 | Subdrain Outlets (Standard Subdrain, Pressure Release and Special)      |
| DR-401 | 04-18-17 | Scour Protection for Bridge End Drain                                   |
| DR-402 | 10-18-16 | Rock Flume for Bridge End Drain   |
| DR-501 | 04-21-15 | Corrugated Metal Type "A" Diaphragm                                     |
| DR-502 | 10-18-16 | Slotted Drain for Median Crossovers                                     |
| DR-503 | 04-21-15 | Safety Grates for Box Culverts  |

# Drainage

| NO.    | DATE     | TITLE  |
|--------|----------|--|
| DR-601 | 04-18-17 | Reinforced Concrete Pipe Culvert   |
| DR-602 | 04-18-17 | Reinforced Concrete Pipe Culvert with Tees                                 |
| DR-611 | 04-18-17 | Reinforced Concrete Pipe Culvert Letdown Structure                         |
| DR-612 | 04-18-17 | Apron Tee Inlet  |
| DR-621 | 04-18-17 | Pipe Extension   |
| DR-622 | 04-18-17 | Pipe Extension Horizontal Bend One or Both Ends                            |
| DR-625 | 04-18-17 | Pipe Extension Letdown Structure with Metal Apron                          |
| DR-626 | 04-18-17 | Pipe Extension - Adding Lanes  |
| DR-627 | 04-18-17 | Pipe Extension Horizontal Bend - Adding Lanes                              |
| DR-628 | 04-18-17 | Pipe Extension Both Ends Horizontal Bend (Optional) - Adding Lanes         |
| DR-629 | 04-18-17 | Pipe Extension Letdown Structure Horizontal Bend (Optional) - Adding Lanes |
| DR-631 | 04-18-17 | Corrugated Pipe Culvert Letdown Structure with Single Elbow                |
| DR-632 | 04-18-17 | Corrugated Pipe Culvert Letdown Structure with Double Elbow                |
| DR-641 | 04-18-17 | Concrete/Corrugated Pipe Culvert Letdown Structure with Metal Apron        |
| DR-642 | 04-18-17 | Apron Pipe Tee Inlet   |
| DR-651 | 04-18-17 | Unclassified Pipe Culvert  |
| DR-652 | 04-18-17 | Unclassified Letdown Structure Single Elbow                                |
| DR-653 | 04-18-17 | Unclassified Roadway Letdown Pipe with Metal Apron                         |



Refer to **DR-104** for minimum and maximum allowable cover (H) for the particular kind of pipe culvert.

- ① The backfill adjacent to and above the pipe culvert may be placed in conjunction with normal embankment construction. Thoroughly tamp the embankment within the limits shown.
- ② Take extra care to ensure complete and satisfactory tamping of backfill material in the area immediately adjacent to the lower portion of pipe.
- ③ Carefully shape excavation below groundline either using a template conforming to actual dimension and shape of the pipe or using other means. If using other means, check with a template conforming to the actual dimension and shape of the pipe.
- ④ For culverts backfilled by flooding, place a cohesive soil plug at the inlet, outlet, and, when necessary, sides, prior to flooding.
- ⑤ 4-inch Porous Backfill bedding, 2-inch Floodable Backfill bedding may be used under unsealed rigid pipe.
- ⑥ Extend Porous Backfill through the outlet end soil plug when used for bedding.
- ⑦ Quantity calculations are based upon a 1:1 slope and minimum trench dimension. Actual slope of trench may vary based upon Contractor's operations.
- ⑧ Ground Line at time of pipe installation. When existing ground exceeds 5 feet depth over pipe, backfill and compaction by flooding is not required more than 5 feet above the pipe.
- ⑨ Where a corrugated metal pipe culvert requiring elongation is to be installed (to counteract deformation caused by backfill), complete elongation using a means approved by the Engineer. Elongation may be developed either as part of shop fabrication or field installation. Install with elongated axis vertical.

Possible Contract Items:  
Flowable Mortar  
Flooded Backfill  
Excavation, Class 20

Possible Tabulations:  
104-3  
104-4

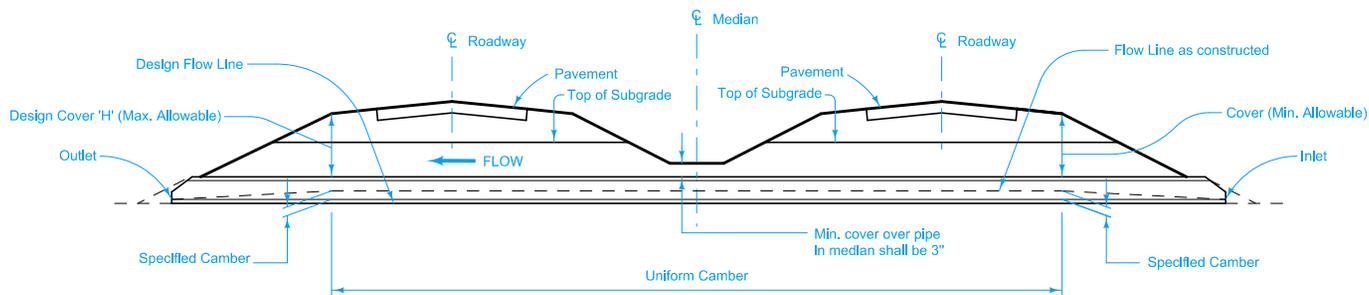
|                           |               |
|---------------------------|---------------|
| <b>IOWA DOT</b>           | REVISION      |
|                           | 2   04-18-17  |
|                           | <b>DR-101</b> |
| <b>STANDARD ROAD PLAN</b> | SHEET 1 of 1  |

REVISIONS: Changed "Porous Backfill" to "Porous Backfill Bedding" for clarity. Modified trench installation detail for H>4' to clarify pay limits.

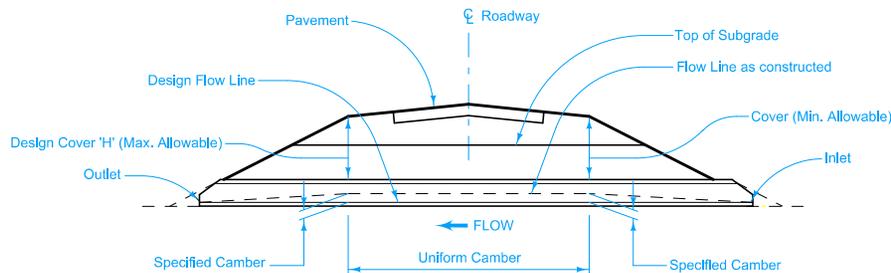
APPROVED BY DESIGN METHODS ENGINEER  
*Brian Smith*

**PIPE CULVERT**  
**(BEDDING AND BACKFILL)**

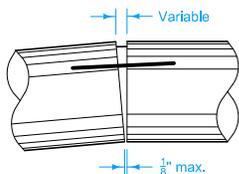
Denotes pay limits for flooded backfill



TYPICAL INSTALLATION DUAL ROADWAY



TYPICAL INSTALLATION SINGLE ROADWAY



TYPICAL JOINT IN CAMBERED PIPE ①

| Design Cover 'H' (feet) | Normal Camber (feet) |
|-------------------------|----------------------|
| 5                       | 0.08                 |
| 10                      | 0.17                 |
| 15                      | 0.25                 |
| 20                      | 0.33                 |
| 25                      | 0.42                 |
| 30                      | 0.50                 |
| 35                      | 0.58                 |

| Pipe Size 'D' | Maximum Camber (feet) |
|---------------|-----------------------|
| 24"           | 1.1                   |
| 30"           | 1.2                   |
| 36"           | 1.3                   |
| 42"           | 1.4                   |
| 48"           | 1.5                   |
| 60"           | 1.6                   |
| 84"           | 1.7                   |

ALLOWABLE CAMBER TABLES

Refer to DR-121 for pipe joint connection and wrapping.

Refer to DR-101 for culvert bedding and backfill.

COVER

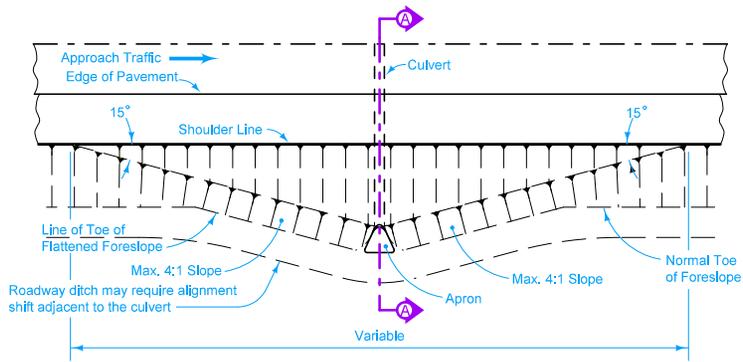
Refer to DR-104 for minimum and maximum allowable cover for the particular kind of culvert.

CAMBER

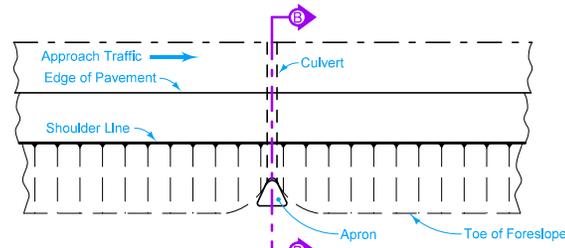
Camber is the dimension line between inlet and outlet elevation. Some settlement of the structure is usually anticipated, resulting in the design flow line between inlet and outlet. Camber is developed uniformly from inlet and outlet to a point beneath the outside shoulder lines of the roadway and is uniform between those points, as indicated. The Normal Camber indicated in the "Allowable Camber Tables" should be used unless specific camber values are indicated elsewhere in the plans.

- ① Camber for concrete pipe is created by placing pipe sections tight at the bottom of the joint with variable opening at top of joint. Camber for corrugated metal pipe to be done as directed by the Engineer.

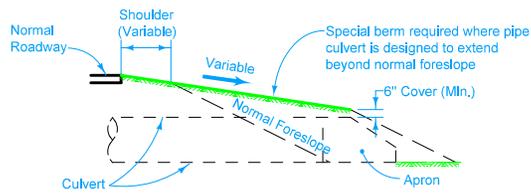
|  |              |
|--|--------------|
|  | REVISION     |
|  | New 04-21-15 |
| STANDARD ROAD PLAN                         | DR-102       |
| SHEET 1 of 1                               |              |
| REVISIONS: New. Replaces RF-30B.           |              |
| <br>APPROVED BY DESIGN METHODS ENGINEER    |              |
| <b>PIPE CULVERT<br/>(COVER AND CAMBER)</b> |              |



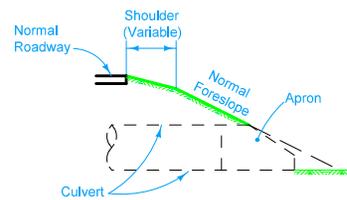
TYPICAL INSTALLATION PLAN  
WHERE SPECIAL BERM IS REQUIRED



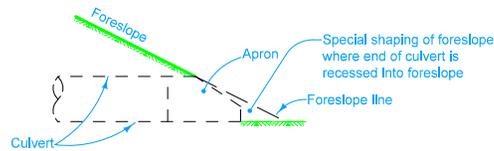
TYPICAL INSTALLATION PLAN  
WHERE CULVERT MATCHES NORMAL FORESLOPE



SECTION A-A



SECTION B-B



DETAIL OF SHAPING EARTH FORESLOPE  
AT CULVERT END

|                                  |               |
|----------------------------------|---------------|
|                                  | REVISION      |
|                                  | New 04-21-15  |
| <b>STANDARD ROAD PLAN</b>        | <b>DR-103</b> |
| REVISIONS: New. Replaces RF-30C. | SHEET 1 of 1  |

APPROVED BY DESIGN METHODS ENGINEER  
*Brian Smith*

**PIPE CULVERT  
(INSTALLATION DETAILS)**

| CONCRETE CULVERT PIPE<br>CLASS "B" BEDDING |                                       |                      |                     |                    |
|--|---------------------------------------|----------------------|---------------------|--------------------|
| DIAMETER<br>OF PIPE 'D'<br>Inches          | ( H ) MAXIMUM ALLOWABLE COVER IN FEET |                      |                     |                    |
|  | 1500D<br>(Class II)                   | 2000D<br>(Class III) | 3000D<br>(Class IV) | 3750D<br>(Class V) |
| 18   | 11                                    | 13                   | 20                  | 25                 |
| 24   | 12                                    | 14                   | 21                  | 26                 |
| 36   | 13                                    | 16                   | 23                  | 28                 |
| 48   | 14                                    | 16                   | 24                  | 29                 |
| 60   | 14                                    | 17                   | 24                  | 29                 |
| 72   | 14                                    | 17                   | 24                  | 30                 |
| 84   | 15                                    | 17                   | 25                  | 30                 |
| 96   | 15                                    | 18                   | 25                  | 31                 |
| 108  | 15                                    | 18                   | 26                  | 32                 |

| CONCRETE CULVERT PIPE<br>CLASS "C" BEDDING |                                       |                      |                     |                    |
|--|---------------------------------------|----------------------|---------------------|--------------------|
| DIAMETER<br>OF PIPE 'D'<br>Inches          | ( H ) MAXIMUM ALLOWABLE COVER IN FEET |                      |                     |                    |
|  | 1500D<br>(Class II)                   | 2000D<br>(Class III) | 3000D<br>(Class IV) | 3750D<br>(Class V) |
| 18   | 9                                     | 12                   | 18                  | 22                 |
| 24   | 10                                    | 13                   | 19                  | 23                 |
| 36   | 11                                    | 14                   | 20                  | 24                 |
| 48   | 11                                    | 15                   | 21                  | 25                 |
| 60   | 12                                    | 15                   | 21                  | 26                 |
| 72   | 12                                    | 16                   | 22                  | 26                 |
| 84   | 13                                    | 16                   | 22                  | 27                 |
| 96   | 13                                    | 16                   | 23                  | 27                 |
| 108  | 13                                    | 17                   | 23                  | 28                 |

**DESIGN CRITERIA FOR CONCRETE PIPE**

The height of cover tables have been prepared from data in the "Concrete Pipe Design Manual" published by the American Concrete Pipe Association using the values listed below.

**FOR EMBANKMENT CONDITIONS**

- Fill Material Density =  $w = 120$  lbs. per cu. ft.
- Settlement Ratio =  $rsd = +0.5$
- =  $ku = 0.13$
- \*
- Projection Ratio =  $p = 0.9$  (Class "C" bedding)
- =  $p = 0.7$  (Class "B" bedding)
- Factor of Safety =  $F.S. = 1.33$  on Ultimate Strength

\* Using a ratio of lateral to vertical earth pressure (k) of 0.37 (saturated yellow clay) and a coefficient of internal friction (u) of 0.34.

The values shown for concrete pipe were calculated for concrete pipe placed under embankment conditions. These values do not apply to design and installation of sanitary sewer except where sanitary sewer would be placed under embankment conditions.

When unclassified pipe is specified, furnish and install a class of pipe meeting the requirements on the chart.

For Steel Round Pipe, the Contractor may choose the type of corrugated pipe and installation to furnish as long as the selection conforms to the limits indicated for the type specified.

When furnishing Steel Arch Pipe, furnish pipe with corrugations as specified in plans.

Minimum allowable cover for concrete and metal pipe is 2 feet for roadway culverts and 1 foot for entrance culverts.

Maximum cover for all sizes and installations of concrete arch pipe is 12 feet.

For all sizes and installations of polyethylene pipe:  
 minimum cover = 2 feet  
 maximum cover = 24 feet for 12 to 24 inch pipes  
 20 feet for 30 to 48 inch pipes

Where a pipe size not listed in the table is required, the 'H' indicated for the next smaller size will apply.

Special installations may be designed to exceed indicated maximum allowable cover by specific modification of one or more of the following conditions:

1. Bedding Class
2. Pipe Strength (including special design pipe)
3. Type of backfill or cover material
4. Compaction requirements for backfill or cover material
5. Controlled trench width

Where site conditions favor such modifications, significant economy may result from special design installations and these should be considered. Special designs will specify particular modification of construction requirements or design criteria as applicable. Necessary modifications of normal requirements will not ordinarily be paid for separately but will be included in the price bid for culvert pipe.

CONCRETE CULVERT PIPE

|   |          |              |
|---|----------|--------------|
| <br><b>STANDARD ROAD PLAN</b>                          | REVISION |              |
|   | 1        | 04-19-16     |
| <b>DR-104</b>   |          | SHEET 1 of 3 |
| <small>REVISIONS: Added general note regarding maximum cover on concrete arch pipes.</small>  |          |              |
| <br><small>APPROVED BY DESIGN METHODS ENGINEER</small> |          |              |
| <b>DEPTH OF COVER TABLES<br/>FOR CONCRETE AND CORRUGATED PIPE</b>   |          |              |

| STEEL ROUND PIPE<br>2 $\frac{2}{3}$ " x $\frac{1}{2}$ " CORRUGATIONS |                                 |                                     |           |                  |           |                  |           |                  |           |                 |           |
|--|---------------------------------|-------------------------------------|-----------|------------------|-----------|------------------|-----------|------------------|-----------|-----------------|-----------|
| DIAMETER OF PIPE 'D' Inches  | MINIMUM COVER ABOVE PIPE Inches | (H) MAXIMUM ALLOWABLE COVER IN FEET |           |                  |           |                  |           |                  |           |                 |           |
|  |                                 | 16 GAGE (0.064")                    |           | 14 GAGE (0.079") |           | 12 GAGE (0.109") |           | 10 GAGE (0.138") |           | 8 GAGE (0.168") |           |
|  |                                 | Round                               | Elongated | Round            | Elongated | Round            | Elongated | Round            | Elongated | Round           | Elongated |
| 12   | 12                              | 70                                  | -         | 76               | -         | -                | -         | -                | -         | -               | -         |
| 15   | 12                              | 56                                  | -         | 61               | -         | -                | -         | -                | -         | -               | -         |
| 18   | 12                              | 40                                  | -         | 48               | -         | 64               | -         | -                | -         | -               | -         |
| 24   | 12                              | 23                                  | -         | 26               | -         | 33               | -         | -                | -         | -               | -         |
| 30   | 12                              | -                                   | -         | 18               | 30        | 22               | 43        | 25               | 51        | -               | -         |
| 36   | 12                              | -                                   | -         | 15               | 25        | 17               | 33        | 19               | 38        | -               | -         |
| 42   | 12                              | -                                   | -         | -                | -         | 14               | 28        | 16               | 31        | 17              | 34        |
| 48   | 12                              | -                                   | -         | -                | -         | 13               | 25        | 14               | 27        | 15              | 29        |
| 54   | 18                              | -                                   | -         | -                | -         | 12               | 24        | 13               | 25        | 13              | 26        |
| 60   | 18                              | -                                   | -         | -                | -         | -                | -         | 12               | 23        | 12              | 25        |
| 66   | 18                              | -                                   | -         | -                | -         | -                | -         | 11               | 22        | 12              | 23        |
| 72   | 18                              | -                                   | -         | -                | -         | -                | -         | 11               | 17        | 11              | 21        |
| 78   | 24                              | -                                   | -         | -                | -         | -                | -         | -                | -         | 11              | 17        |
| 84   | 24                              | -                                   | -         | -                | -         | -                | -         | -                | -         | 11              | 13        |

| STEEL ROUND PIPE<br>3" X 1" and 5" X 1" CORRUGATIONS |                                 |                                     |           |                  |           |                  |           |                  |           |                 |           |
|--|---------------------------------|-------------------------------------|-----------|------------------|-----------|------------------|-----------|------------------|-----------|-----------------|-----------|
| DIAMETER OF PIPE 'D' Inches                          | MINIMUM COVER ABOVE PIPE Inches | (H) MAXIMUM ALLOWABLE COVER IN FEET |           |                  |           |                  |           |                  |           |                 |           |
|  |                                 | 16 GAGE (0.064")                    |           | 14 GAGE (0.079") |           | 12 GAGE (0.109") |           | 10 GAGE (0.138") |           | 8 GAGE (0.168") |           |
|  |                                 | Round                               | Elongated | Round            | Elongated | Round            | Elongated | Round            | Elongated | Round           | Elongated |
| 36   | 12                              | 27                                  | 40        | 31               | 50        | 40               | 74        | -                | -         | -               | -         |
| 42   | 12                              | 21                                  | 34        | 23               | 42        | 29               | 58        | -                | -         | -               | -         |
| 48   | 12                              | 17                                  | 30        | 19               | 37        | 23               | 46        | -                | -         | -               | -         |
| 54   | 12                              | 15                                  | 27        | 16               | 32        | 19               | 38        | -                | -         | -               | -         |
| 60   | 12                              | 13                                  | 24        | 15               | 29        | 16               | 33        | -                | -         | -               | -         |
| 66   | 12                              | 13                                  | 22        | 13               | 27        | 15               | 30        | -                | -         | -               | -         |
| 72   | 12                              | 12                                  | 20        | 12               | 25        | 14               | 27        | -                | -         | -               | -         |
| 78   | 12                              | 12                                  | 18        | 12               | 23        | 13               | 26        | -                | -         | -               | -         |
| 84   | 12                              | -                                   | -         | 12               | 21        | 12               | 24        | 13               | 26        | -               | -         |
| 90   | 12                              | -                                   | -         | -                | -         | 12               | 24        | 12               | 35        | 13              | 26        |
| 96   | 12                              | -                                   | -         | -                | -         | 11               | 23        | 12               | 24        | 12              | 25        |
| 102  | 24                              | -                                   | -         | -                | -         | -                | -         | 12               | 23        | 12              | 24        |
| 108  | 24                              | -                                   | -         | -                | -         | -                | -         | -                | -         | 12              | 23        |
| 114  | 24                              | -                                   | -         | -                | -         | -                | -         | -                | -         | 11              | 23        |
| 120  | 24                              | -                                   | -         | -                | -         | -                | -         | -                | -         | 11              | 20        |

| STRUCTURAL STEEL ROUND PIPE<br>6" X 2" CORRUGATIONS |                                 |                                     |           |                  |           |                 |           |                 |           |                 |           |                 |           |                 |           |
|---|---------------------------------|-------------------------------------|-----------|------------------|-----------|-----------------|-----------|-----------------|-----------|-----------------|-----------|-----------------|-----------|-----------------|-----------|
| DIAMETER OF PIPE 'D' Inches                         | MINIMUM COVER ABOVE PIPE Inches | (H) MAXIMUM ALLOWABLE COVER IN FEET |           |                  |           |                 |           |                 |           |                 |           |                 |           |                 |           |
|   |                                 | 12 GAGE (0.109")                    |           | 10 GAGE (0.138") |           | 8 GAGE (0.168") |           | 7 GAGE (0.187") |           | 5 GAGE (0.218") |           | 3 GAGE (0.250") |           | 1 GAGE (0.281") |           |
|   |                                 | Round                               | Elongated | Round            | Elongated | Round           | Elongated | Round           | Elongated | Round           | Elongated | Round           | Elongated | Round           | Elongated |
| 60  | 12                              | 35                                  | 35        | 43               | 52        | 51              | 67        | -               | -         | -               | -         | -               | -         | -               | -         |
| 66  | 12                              | 29                                  | 32        | 35               | 45        | 41              | 61        | -               | -         | -               | -         | -               | -         | -               | -         |
| 72  | 12                              | 25                                  | 29        | 29               | 43        | 34              | 56        | -               | -         | -               | -         | -               | -         | -               | -         |
| 78  | 12                              | 22                                  | 27        | 25               | 40        | 29              | 52        | 31              | 60        | -               | -         | -               | -         | -               | -         |
| 84  | 12                              | 19                                  | 25        | 22               | 37        | 25              | 48        | 27              | 53        | -               | -         | -               | -         | -               | -         |
| 90  | 12                              | 18                                  | 23        | 20               | 34        | 22              | 44        | 23              | 47        | -               | -         | -               | -         | -               | -         |
| 96  | 12                              | 16                                  | 22        | 18               | 32        | 20              | 40        | 21              | 42        | -               | -         | -               | -         | -               | -         |
| 102   | 24                              | 15                                  | 21        | 17               | 30        | 18              | 36        | 19              | 38        | -               | -         | -               | -         | -               | -         |
| 108   | 24                              | 14                                  | 19        | 16               | 29        | 17              | 34        | 18              | 36        | -               | -         | -               | -         | -               | -         |
| 114   | 24                              | 14                                  | 18        | 15               | 27        | 16              | 32        | 17              | 33        | 18              | 36        | -               | -         | -               | -         |
| 120   | 24                              | 13                                  | 18        | 14               | 26        | 15              | 30        | 16              | 31        | 17              | 33        | -               | -         | -               | -         |
| 126   | 24                              | 13                                  | -         | 13               | 25        | 14              | 29        | 15              | 30        | 16              | 31        | -               | -         | -               | -         |
| 132   | 24                              | 12                                  | -         | 13               | 24        | 14              | 27        | 14              | 28        | 15              | 30        | -               | -         | -               | -         |
| 138   | 24                              | 12                                  | -         | 13               | 23        | 13              | 26        | 14              | 27        | 14              | 29        | -               | -         | -               | -         |
| 144   | 24                              | 12                                  | -         | 12               | 22        | 13              | 26        | 13              | 26        | 14              | 27        | -               | -         | -               | -         |
| 150   | 24                              | 12                                  | -         | 12               | 21        | 12              | 25        | 13              | 26        | 13              | 27        | 14              | 28        | -               | -         |
| 156   | 24                              | 11                                  | -         | 12               | 20        | 12              | 24        | 12              | 25        | 13              | 26        | 13              | 27        | -               | -         |
| 162   | 24                              | 11                                  | -         | 12               | 19        | 12              | 24        | 12              | 24        | 13              | 25        | 13              | 26        | 13              | 27        |
| 168   | 24                              | 11                                  | -         | 11               | 19        | 12              | 23        | 12              | 24        | 12              | 25        | 13              | 25        | 13              | 26        |
| 174   | 24                              | 11                                  | -         | 11               | 18        | 12              | 23        | 12              | 23        | 12              | 24        | 12              | 25        | 13              | 25        |
| 180   | 24                              | 11                                  | -         | 11               | 17        | 11              | 23        | 11              | 23        | 12              | 24        | 12              | 24        | 12              | 25        |

STRUCTURAL STEEL ROUND PIPE

|  |               |          |
|--|---------------|----------|
| <br><b>STANDARD ROAD PLAN</b>           | REVISION      |          |
|  | 1             | 04-19-16 |
|  | <b>DR-104</b> |          |
|  | SHEET 2 of 3  |          |
| REVISIONS: Added general note regarding maximum cover on concrete arch pipes.  |               |          |
| <br>APPROVED BY DESIGN METHODS ENGINEER |               |          |
| <b>DEPTH OF COVER TABLES<br/>FOR CONCRETE AND CORRUGATED PIPE</b>  |               |          |

| STEEL ARCH PIPE<br>2 2/3" X 1/2" CORRUGATIONS |                |                          |   |                                     |                    |                    |                    |                   |
|---|----------------|--------------------------|---|-------------------------------------|--------------------|--------------------|--------------------|-------------------|
| SPAN<br>Inches                                | RISE<br>Inches | R <sub>c</sub><br>Inches | MINIMUM<br>COVER<br>ABOVE<br>PIPE<br>Inches | (H) MAXIMUM ALLOWABLE COVER IN FEET |                    |                    |                    |                   |
|   |                |                          |   | 16 GA.<br>(0.064")                  | 14 GA.<br>(0.079") | 12 GA.<br>(0.109") | 10 GA.<br>(0.138") | 8 GA.<br>(0.168") |
| 17  | 13             | 3.5                      | 18  | 6                                   | 6                  | -                  | -                  | -                 |
| 21  | 15             | 4.125                    | 18  | 6                                   | 6                  | -                  | -                  | -                 |
| 24  | 18             | 4.875                    | 18  | 5                                   | 5                  | -                  | -                  | -                 |
| 28  | 20             | 5.5                      | 18  | 5                                   | 5                  | -                  | -                  | -                 |
| 35  | 24             | 6.875                    | 18  | 5                                   | 5                  | -                  | -                  | -                 |
| 42  | 29             | 8.25                     | 18  | 4                                   | 4                  | -                  | -                  | -                 |
| 49  | 33             | 9.625                    | 18  | -                                   | -                  | 4                  | 4                  | 4                 |
| 57  | 38             | 11.0                     | 18  | -                                   | -                  | 4                  | 4                  | 4                 |
| 64  | 43             | 12.375                   | 18  | -                                   | -                  | 4                  | 4                  | 4                 |
| 71  | 47             | 13.75                    | 18  | -                                   | -                  | -                  | 4                  | 4                 |
| 77  | 52             | 15.125                   | 18  | -                                   | -                  | -                  | -                  | 4                 |
| 83  | 57             | 16.5                     | 18  | -                                   | -                  | -                  | -                  | 4                 |

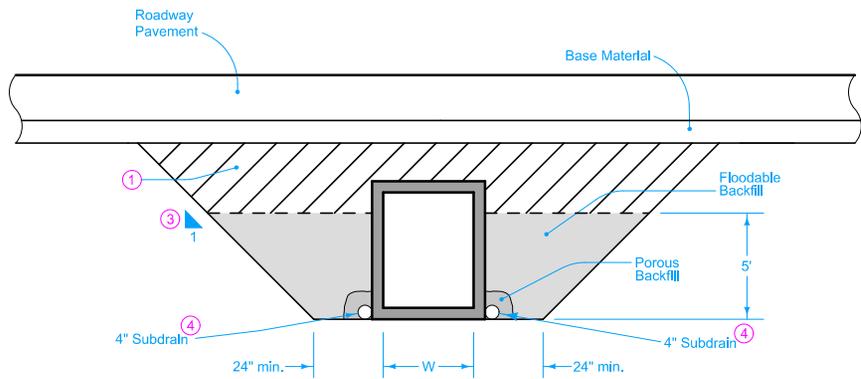
| STEEL ARCH PIPE<br>3" X 1" and 5" X 1" CORRUGATIONS |                |                          |   |                                 |                    |                    |                    |  |
|---|----------------|--------------------------|---|---------------------------------|--------------------|--------------------|--------------------|--|
| SPAN<br>Inches                                      | RISE<br>Inches | R <sub>c</sub><br>Inches | MINIMUM<br>COVER<br>ABOVE<br>PIPE<br>Inches | (H) MAX. ALLOWABLE COVER IN FT. |                    |                    |                    |  |
|   |                |                          |   | 16 GA.<br>(0.064")              | 14 GA.<br>(0.079") | 12 GA.<br>(0.109") | 10 GA.<br>(0.138") |  |
| 60  | 46             | 18.75                    | 18  | 6                               | 6                  | -                  | -                  |  |
| 66  | 51             | 20.75                    | 18  | 6                               | 6                  | -                  | -                  |  |
| 73  | 55             | 22.875                   | 18  | 8                               | 8                  | -                  | -                  |  |
| 81  | 59             | 20.875                   | 18  | -                               | 7                  | 7                  | -                  |  |
| 87  | 63             | 22.625                   | 18  | -                               | 7                  | 7                  | -                  |  |
| 95  | 67             | 24.375                   | 18  | -                               | 6                  | 6                  | -                  |  |
| 103   | 71             | 26.125                   | 24  | -                               | -                  | 6                  | -                  |  |
| 112   | 75             | 27.75                    | 24  | -                               | -                  | 5                  | -                  |  |
| 117   | 79             | 29.5                     | 24  | -                               | -                  | 5                  | -                  |  |
| 128   | 83             | 31.25                    | 24  | -                               | -                  | -                  | 5                  |  |

① Corner Radius, R<sub>c</sub>, changes from 18 inches to 31 inches for the 6 in. x 2 in. corrugation.

| STRUCTURAL STEEL ARCH PIPE<br>6" X 2" CORRUGATIONS |                |                          |   |  |                    |                   |                   |
|--|----------------|--------------------------|---|--|--------------------|-------------------|-------------------|
| SPAN<br>Inches                                     | RISE<br>Inches | R <sub>c</sub><br>Inches | MINIMUM<br>COVER<br>ABOVE<br>PIPE<br>Inches | (H) MAXIMUM ALLOWABLE<br>COVER IN FEET |                    |                   |                   |
|  |                |                          |   | 12 GA.<br>(0.109")                     | 10 GA.<br>(0.138") | 8 GA.<br>(0.168") | 7 GA.<br>(0.187") |
| 73   | 55             | 18                       | 18  | 8                                      | -                  | -                 | -                 |
| 84   | 61             | 18                       | 18  | 7                                      | -                  | -                 | -                 |
| 95   | 67             | 18                       | 18  | 6                                      | -                  | -                 | -                 |
| 106  | 73             | 18                       | 24  | 6                                      | -                  | -                 | -                 |
| 117  | 79             | 18                       | 24  | 5                                      | -                  | -                 | -                 |
| 131  | 85             | 18                       | 24  | 5                                      | -                  | -                 | -                 |
| 142  | 91             | 18                       | 24  | 4                                      | -                  | -                 | -                 |
| 154  | 100            | 18                       | 24  | 4                                      | -                  | -                 | -                 |
| 159  | 112            | 31                       | 24  | 6                                      | -                  | -                 | -                 |
| 170  | 118            | 31                       | 24  | 6                                      | -                  | -                 | -                 |
| 184  | 124            | 31                       | 24  | -                                      | 6                  | -                 | -                 |
| 195  | 130            | 31                       | 36  | -                                      | 5                  | -                 | -                 |
| 206  | 136            | 31                       | 36  | -                                      | 5                  | -                 | -                 |
| 217  | 142            | 31                       | 36  | -                                      | -                  | 5                 | -                 |
| 231  | 148            | 31                       | 36  | -                                      | -                  | 4                 | -                 |
| 239  | 154            | 31                       | 36  | -                                      | -                  | 4                 | -                 |
| 247  | 158            | 31                       | 36  | -                                      | -                  | -                 | 4                 |

STEEL ARCH PIPE

|  |               |
|--|---------------|
| <br><b>STANDARD ROAD PLAN</b>           | REVISION      |
|  | 1   04-19-16  |
|  | <b>DR-104</b> |
| SHEET 3 of 3   |               |
| REVISIONS: Added general note regarding maximum cover on concrete arch pipes.  |               |
| APPROVED BY DESIGN METHODS ENGINEER<br> |               |
| <b>DEPTH OF COVER TABLES<br/>FOR CONCRETE AND CORRUGATED PIPE</b>  |               |

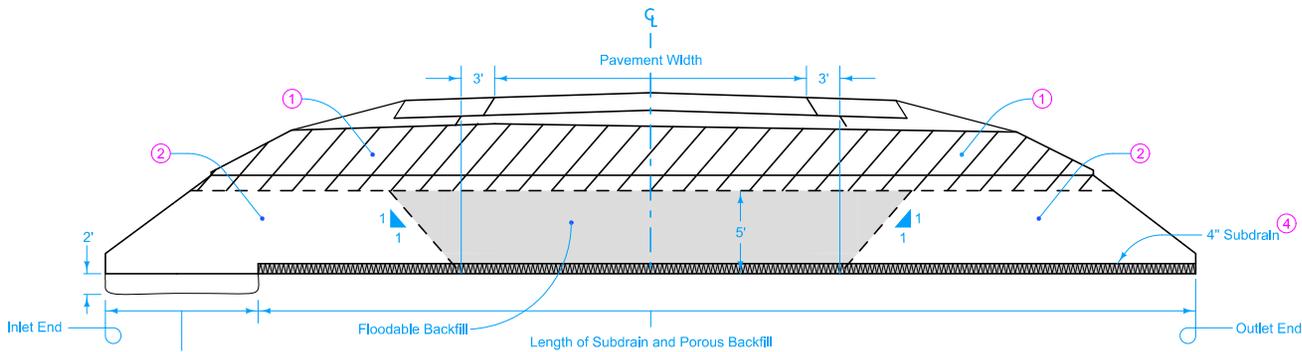


**RCB INSTALLATION**

- ① Excavated material meeting the requirements of the Standard Specifications. Compact using moisture control. The Contractor has the option to use Floodable Backfill. No additional compensation will be provided if the Contractor elects to use Floodable Backfill in lieu of suitable soil.
- ② Prior to flooding, place a cohesive soil plug to the height of the floodable backfill at the inlet, outlet and sides of the culvert.
- ③ Quantity calculations are based upon a 1:1 slope and minimum trench dimension. Actual slope of trench may vary based upon Contractor's operations.
- ④ Place at flowline elevation of culvert starting at parapet for inlet and outletting at end of outlet headwall wings. Cover with a minimum of 4 inches of Porous Backfill.

Possible Contract Items:  
 Flooded Backfill  
 Excavation, Class 20  
 Compaction with Moisture Control (Structures)

Possible Tabulations:  
 103-6  
 104-4



**TYPICAL SECTION - COHESIVE SOIL PLUG**

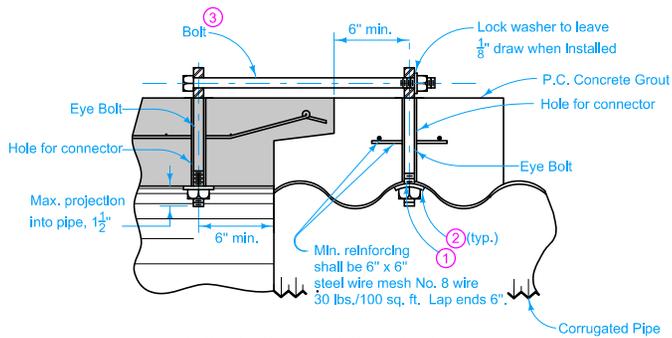
Denotes pay limits for flooded backfill

|                    |                |
|--------------------|----------------|
| <b>IOWA DOT</b>    | REVISION       |
|                    | New   04-21-15 |
| STANDARD ROAD PLAN | DR-111         |
| SHEET 1 of 1       |                |

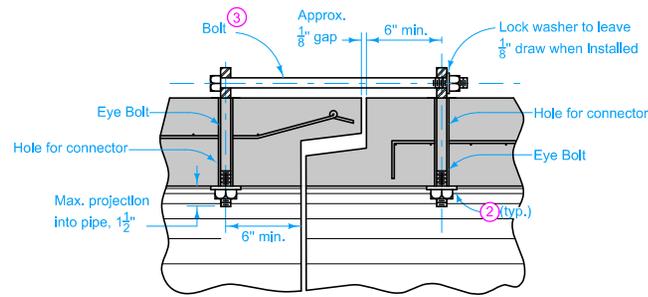
REVISIONS: New, Replaces RF-30D, Changed 12" dimension from outside of box to trench to 24" min. from inside of box to trench.

*Brian Smith*  
 APPROVED BY DESIGN METHODS ENGINEER

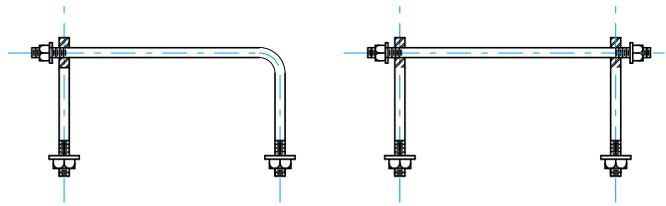
BOX CULVERT  
(BACKFILL)



**SECTION OF PIPE CONNECTOR  
(Concrete Pipe to Corrugated Pipe)**



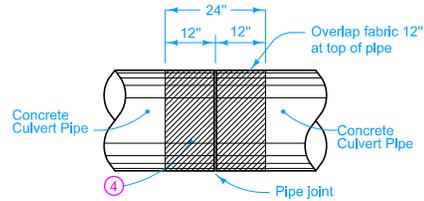
**SECTION OF PIPE CONNECTOR  
(Concrete Pipe to Concrete Pipe)**



**ONE BEND END**

**THREADED AT BOTH ENDS**

**OPTIONAL BOLTS/CONNECTORS**



**PIPE JOINT WRAPPING**

| PIPE SIZE (in.) | CONNECTOR AND BOLT SIZE (in.) | HOLE FOR CONNECTOR (in.) |
|-----------------|-------------------------------|--------------------------|
| 12 to 27        | 3/8                           | 7/8                      |
| 30 to 60        | 3/4                           | 1.0                      |
| 66 to 132       | 1.0                           | 1 1/4                    |

Wrap all joints on concrete roadway pipe culverts.

Use Type 3 Connections on all culvert pipes, unless specified otherwise. Refer to Materials I.M. 445.01 for Connector requirements.

Minimum 2 threads showing at all threaded ends.

Connections not required on pipe sections installed by trenchless methods.

For belled concrete pipe joints, connectors may be installed on the inside of the pipe.

**TYPE 1**

One connector at the top of the pipe section.

**TYPE 2 (Sealed Joint)**

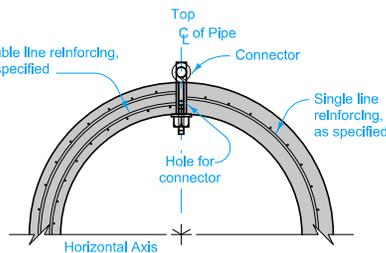
Two connectors near the top of the pipe section. For details of reinforcement, refer to AASHTO M 170 for the class of pipe required. Refer to Materials I.M. 491.09 for seal requirements.

**TYPE 3 (Non - Sealed Joint)**

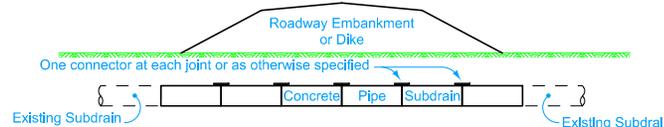
Two connectors near the top of the pipe section. For details of reinforcement, refer to AASHTO M 170 for the class of pipe required.

- ① If holes are field drilled, place a ribbon of butyl sealant around bolts before placing 3 in. x 3 in. x 1/4 in. plate on bolts through corrugated metal pipe and tightening nuts.
- ② 1 1/2 inch round x 5/64 inch thick washer or 3 in. x 3 in. x 1/4 in. square plate (shaped to pipe radius).
- ③ Connectors with One Bend End and Bell End spacers allowed per Materials I.M. 451. Refer to Optional Bolts detail.
- ④ Engineering fabric for embankment erosion control.

Possible Tabulation:  
104-3



**TYPICAL SECTION  
(Non-Sealed Joint)**



**TYPICAL INSTALLATION**

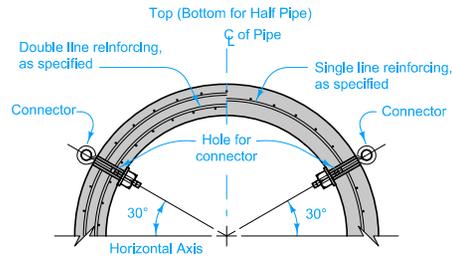
**TYPE 1 CONNECTION**

|                           |               |
|---------------------------|---------------|
|                           | REVISION      |
|                           | 2 04-18-17    |
| <b>STANDARD ROAD PLAN</b> | <b>DR-121</b> |
| SHEET 1 of 2              |               |

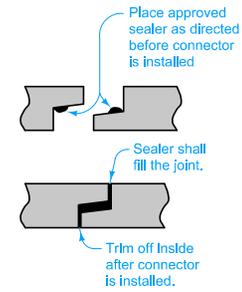
REVISIONS: Removed TYPICAL INSTALLATION TYPE 2 CONNECTION view from page 2.

*Brian Smith*  
APPROVED BY DESIGN METHODS ENGINEER

**CONNECTED PIPE JOINTS**

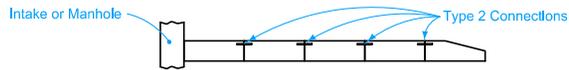


**TYPICAL SECTION  
TYPE 2 CONNECTION  
TYPE 3 CONNECTION**

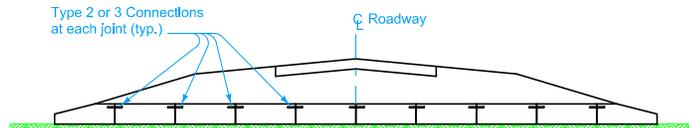


**SEALED JOINT  
TYPE 2 CONNECTION**

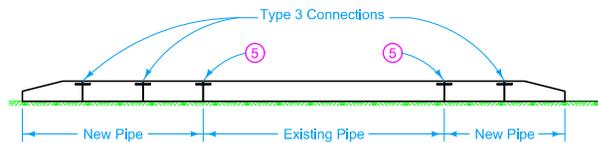
5 On culvert extensions, connect all new joints including the joint between the old and new culvert pipe. Holes may need to be drilled into existing pipes.



**TYPICAL INSTALLATION  
STORM SEWER OUTLET - TYPE 2 CONNECTION**



**TYPICAL INSTALLATION  
NEW CONSTRUCTION - TYPE 2 or 3 CONNECTION**



**TYPICAL INSTALLATION  
PIPE EXTENSION - TYPE 3 CONNECTION**

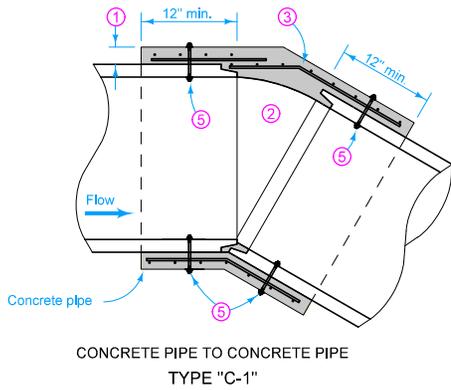
TYPE 2 AND TYPE 3 CONNECTIONS

|                           |          |               |
|---------------------------|----------|---------------|
| <b>IOWA DOT</b>           | REVISION |               |
|                           | 2        | 04-18-17      |
| <b>STANDARD ROAD PLAN</b> |          | <b>DR-121</b> |
|                           |          | SHEET 2 of 2  |

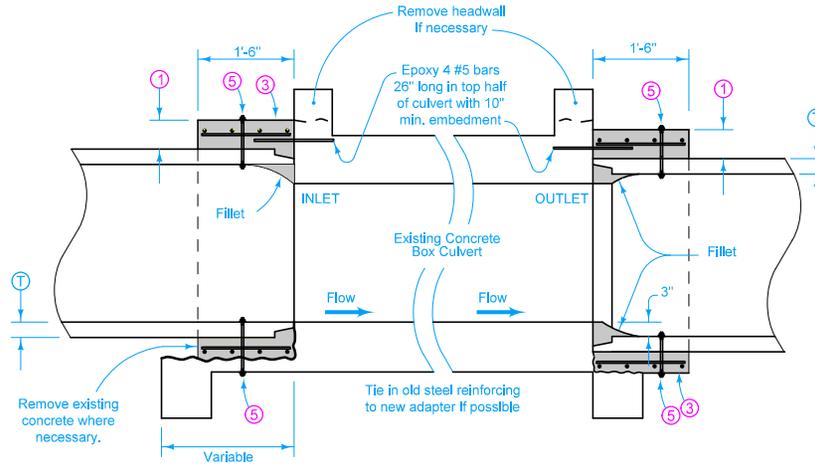
REVISIONS: Removed TYPICAL INSTALLATION TYPE 2 CONNECTION view from page 2.

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APPROVED BY DESIGN METHODS ENGINEER

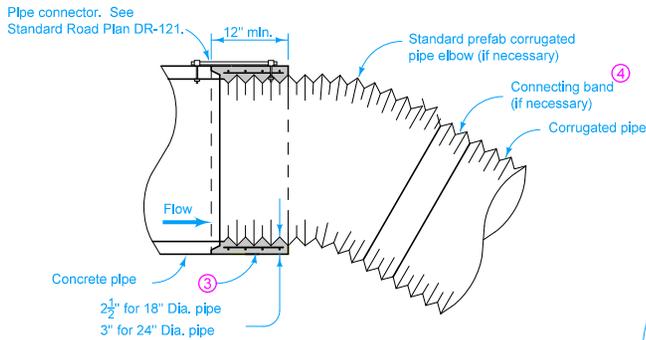
**CONNECTED PIPE JOINTS**



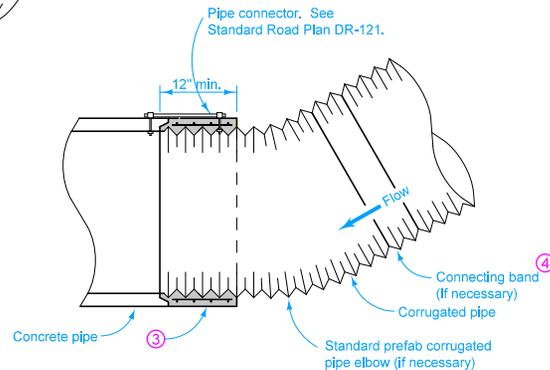
CONCRETE PIPE TO CONCRETE PIPE  
TYPE "C-1"



CONCRETE PIPE TO CONCRETE BOX CULVERT  
TYPE "C-2"



CONCRETE PIPE TO CORRUGATED PIPE  
TYPE "C-3"



CORRUGATED PIPE TO CONCRETE PIPE  
TYPE "C-4"

| ESTIMATED ENCASEMENT QUANTITIES PER LINEAR FOOT FOR "C-2" ADAPTORS |                   |                |                                      |
|--|-------------------|----------------|--------------------------------------|
| Diameter, D inches   | Concrete cu. yds. | Wire Mesh lbs. | Concrete for Fillet ("C-2") cu. yds. |
| 15   | 0.1               | 2.0            | N.A.                                 |
| 18   | 0.1               | 2.3            | N.A.                                 |
| 21   | 0.1               | 2.6            | N.A.                                 |
| 24   | 0.1               | 2.8            | N.A.                                 |
| 30   | 0.2               | 3.4            | 0.1                                  |
| 36   | 0.2               | 4.0            | 0.1                                  |
| 42   | 0.2               | 4.5            | 0.1                                  |
| 48   | 0.3               | 5.1            | 0.1                                  |
| 54   | 0.3               | 5.7            | 0.1                                  |
| 60   | 0.4               | 6.2            | 0.1                                  |
| 66   | 0.5               | 6.9            | 0.1                                  |
| 72   | 0.6               | 7.5            | 0.1                                  |
| 78   | 0.6               | 8.1            | 0.1                                  |
| 84   | 0.7               | 8.7            | 0.1                                  |

2000 D (Class III) and 3000 D (Class IV) Pipe

No payment will be made for individual adaptors.

The cost of furnishing all materials and constructing adaptor as indicated is incidental to the pipe culvert.

Removal and disposal of headwall, wingwall, or other concrete, as directed, will be paid for as "Removal of Existing Structures".

Form and construct Type "C-1" and "C-2" adaptors on the job site using methods approved by the Engineer.

Type "C-3" and "C-4" adaptors may be shop fabricated using a method approved by the Engineer for attaching a concrete collar (either tongue or groove end) to a standard section of corrugated pipe. Holes may be field drilled in corrugated pipe to match alignment with concrete pipe.

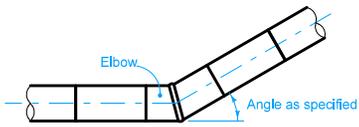
- ① Thickness same as pipe thickness (T) but not less than 4 inches.
- ② Grout opening between pipes.
- ③ Use minimum reinforcing of wire mesh 6" x 6" - W2 No. 8 wire - 30lbs/100 sq. ft. Lap ends 6 inches.
- ④ Positive type joint coupling required.
- ⑤ 5/8 inch (min.) bolts in 7/8 inch (min.) holes. Four bolts around each connection at equal intervals. Existing pipe connector holes may be used if available. Place remaining two bolts at approximate equal intervals.
- T Thickness of wall of concrete pipe. See AASHTO M 170.

|                           |          |               |
|---------------------------|----------|---------------|
| <b>IOWA DOT</b>           | REVISION |               |
|                           | 1        | 10-18-16      |
| <b>STANDARD ROAD PLAN</b> |          | <b>DR-122</b> |
|                           |          | SHEET 1 of 1  |

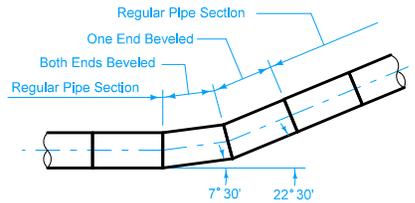
REVISIONS: Corrected two typos in general notes.

*Brian Smith*  
APPROVED BY DESIGN METHODS ENGINEER

**CONSTRUCTION OF TYPE 'C'  
CONCRETE ADAPTORS FOR  
PIPE CULVERT CONNECTIONS**



TYPICAL PLAN WITH ELBOW



TYPICAL PLAN WITH "D" SECTIONS

| REINFORCING BARS |          |                 |
|------------------|----------|-----------------|
| Size "D"         | Bar Size | Number Required |
| 12" - 21"        | #4       | 4               |
| 24" - 42"        | #6       | 8               |
| 48" - 60"        | #8       | 8               |
| 66" - 84"        | #10      | 8               |

Fabricate concrete pipe elbows and Type "D" pipe sections according to AASHTO M 170 for the size and class of pipe specified. Meet the requirements of AASHTO M 32 for wire reinforcing.

Unless specified otherwise, bevel the Type "D" section on a 7.5 degree miter. The bevel may be provided on either the tongue end or groove end of the pipe. In certain cases, both ends of the pipe section may require the beveled end.

Type "D" pipe sections will be included in the measurement for pipe culvert. No payment will be made specifically for the Type "D" section bevel. This is incidental to the price bid.

The Contractor may substitute an approved elbow for "D" section bends of 15 degrees or less. Such elbows will not be measured for payment but will be considered incidental to price bid for culvert pipe.

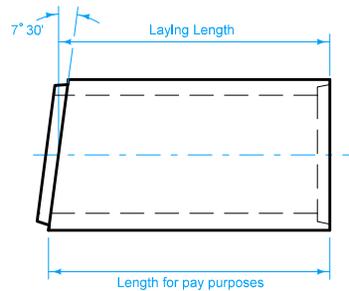
Refer to the plans for degree of elbow required for each individual installation. Minimum length of elbow is to be 5'-6" measured along centerline of pipe. Design length of pipe will be considered to be 6'-0".

Fabricate elbows using a method approved by the Engineer and which results in a finished product indicated hereon. The typical method for fabricating elbows is as follows: Steel rods, as specified, are attached to the normal wire reinforcing cage as indicated hereon. After pipe is cast, make a cut 50% of the degree of elbow desired as indicated and cut the reinforcing rods and mesh on centerline of the cut. Rotate the severed section of pipe 180 degrees and re weld the reinforcing to the opposite rods. Patch the remaining opening with cement mortar to complete a satisfactorily completed elbow as shown.

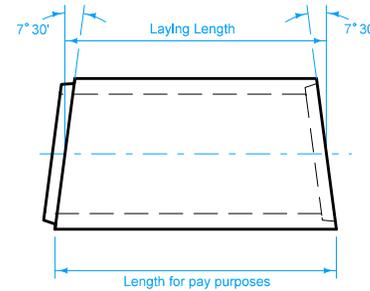
For pipe sizes up through 48" in diameter, bends may be accomplished in increments of 7.5 degrees by using standard "D" sections in appropriate combinations.

For pipe sizes from 54" to 72" in diameter, limit the "D" section to a maximum of 5 degree miter on any one end of pipe section.

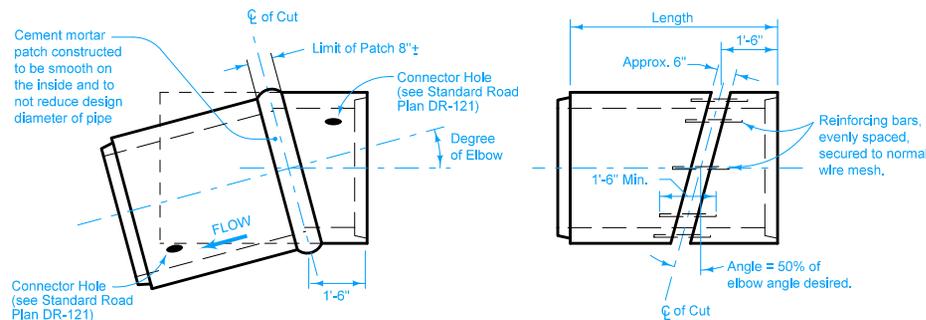
For pipe sizes through 48" in diameter, bends from 15 to 45 degrees may be accomplished using a single elbow. Bends more than 45 degrees require two elbows unless approved otherwise by the Engineer.



TYPE "D" SECTION (SINGLE BEVEL)



TYPE "D" SECTION (DOUBLE BEVEL)



TYPICAL CONCRETE PIPE ELBOW

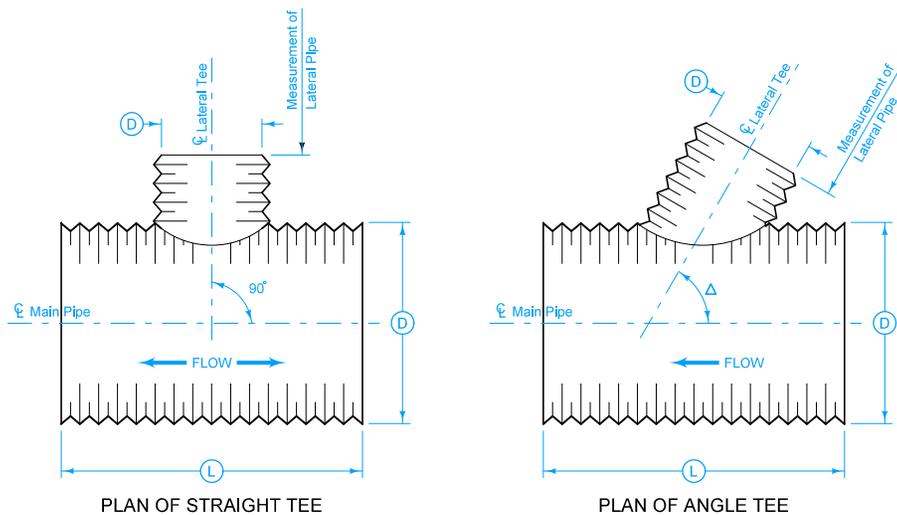
Possible Tabulation:  
104-3

|                               |               |
|-------------------------------|---------------|
| <br><b>STANDARD ROAD PLAN</b> | REVISION      |
|                               | 1   04-18-17  |
|                               | <b>DR-141</b> |
| SHEET 1 of 1                  |               |

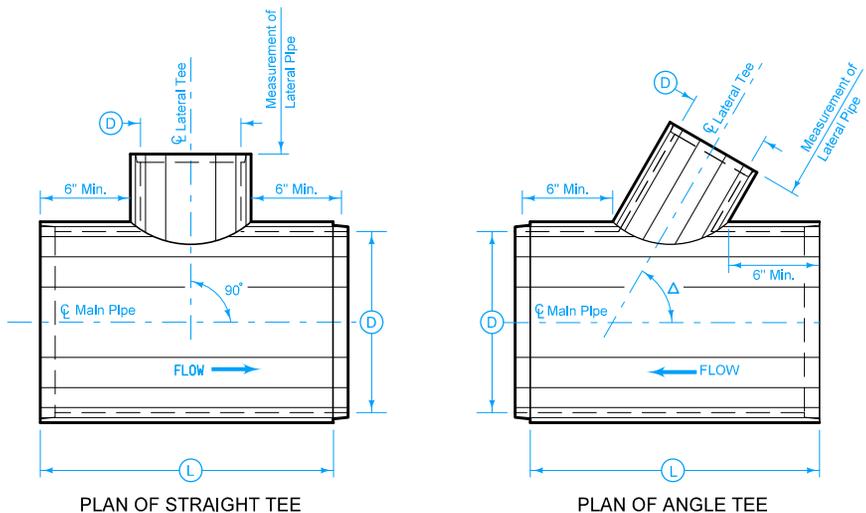
REVISIONS: Changed title from PIPE BENDS AND HALF PIPE TO PIPE BENDS. Remove DETAILS OF HALF PIPE SECTION view. Removed references to Half Pipe in Notes.

*Brian Smith*  
APPROVED BY DESIGN METHODS ENGINEER

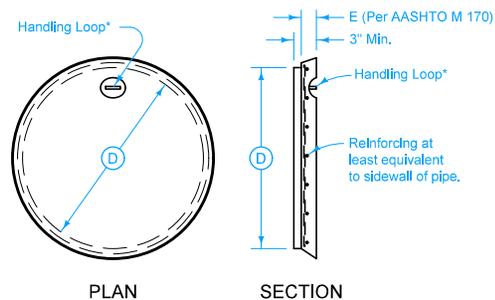
PIPE BENDS



CORRUGATED METAL PIPE



CONCRETE PIPE



\*The handling loop may be omitted when the cap is placed in a buried installation.

DETAILS OF CONCRETE PIPE CAP

Tees may be required in any size from 12 inch diameter to 48 inch diameter (in 6 inch increments) on main pipe culverts equal to or greater in diameter than that of the tee. Angle tees may be required in any delta angle (of 5 degree increment) between 45 and 90 degrees. Consider a tee section delta angle 90 degrees (straight tees) unless noted otherwise in the project plans.

Example: "18-36 inch Tee" means an 18 inch diameter 90 degree lateral tee attached to a 36 inch main pipe culvert.

Example: "24-48 inch 75 degree Tee" means a 24 inch diameter lateral tee attached to a 48 inch main pipe culvert at an angle of 75 degrees.

Fabricate the tee in such a manner as to be as free from obstruction on the inside of the pipe as is reasonable. Use a method approved by the Engineer.

**CORRUGATED METAL PIPE TEE:**  
Repair damage to protective coating resulting from installation of culvert as directed by the Engineer.

**CONCRETE PIPE TEE:**  
Length of main pipe section (L) is a minimum of 4 feet and a maximum of 6 feet. The length of main pipe section will be included in the measured length of structure.

**CONCRETE PIPE CAP:**  
The use of an approved pipe cap is required when so indicated on the detail project plans. Ensure the dimensions of the pipe cap are such that the pipe cap neatly fits the groove end of the appropriate size of culvert pipe.

The cap may be precast or it may be cast directly into the pipe end with a tight mortar joint between the cap and the pipe. Place an approved bituminous joint material between the cap and the pipe if the cap is positioned at the construction site.

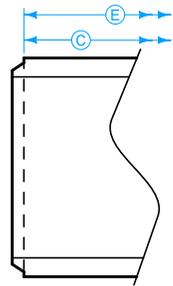
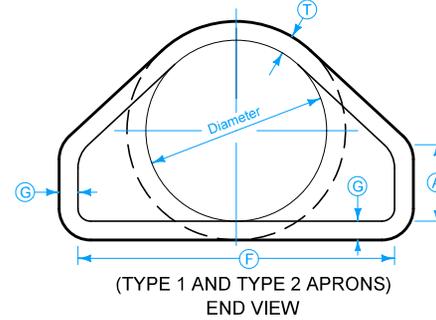
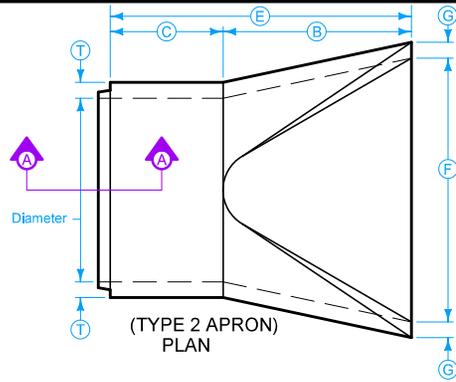
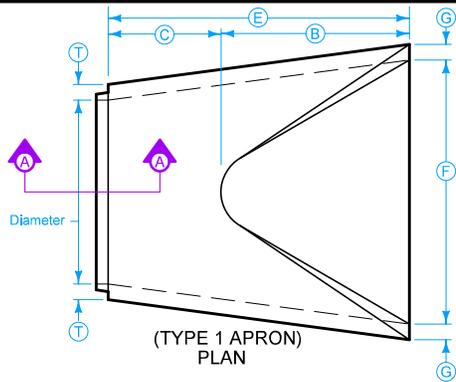
Installation of pipe cap is incidental to other pipe culvert work on the project.

|                           |          |               |
|---------------------------|----------|---------------|
| <b>IOWA DOT</b>           | REVISION |               |
|                           | New      | 04-21-15      |
| <b>STANDARD ROAD PLAN</b> |          | <b>DR-142</b> |
|                           |          | SHEET 1 of 1  |

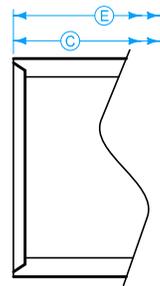
REVISIONS: New. Replaces RF-21.

*Brian Smith*  
APPROVED BY DESIGN METHODS ENGINEER

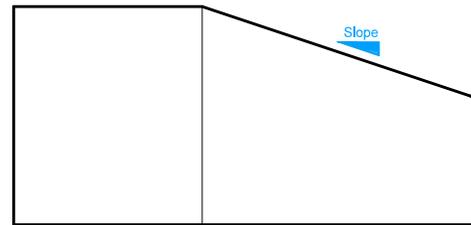
**CULVERT PIPE TEE SECTIONS**



SECTION A-A  
TONGUE END DETAIL ①



SECTION A-A  
GROOVE END DETAIL ①



Dimension 'E' shown is the minimum and is considered the design length. Adjust for any difference between the actual length of concrete apron installed and the length indicated hereon within the length of concrete culvert pipe furnished.

Install connected pipe joints as shown on DR-121.

When specified in the contract documents, install pipe apron guards as shown on DR-213. Pipe apron guards are incidental to "Concrete Aprons".

① Tongue end used on inlet end section. Groove end used on outlet end section. Comply with AASHTO M 170 for tongue and groove dimensions.

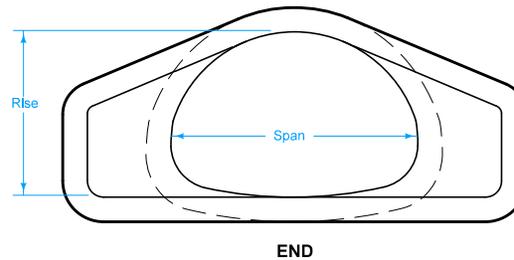
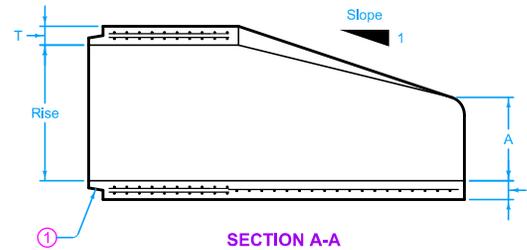
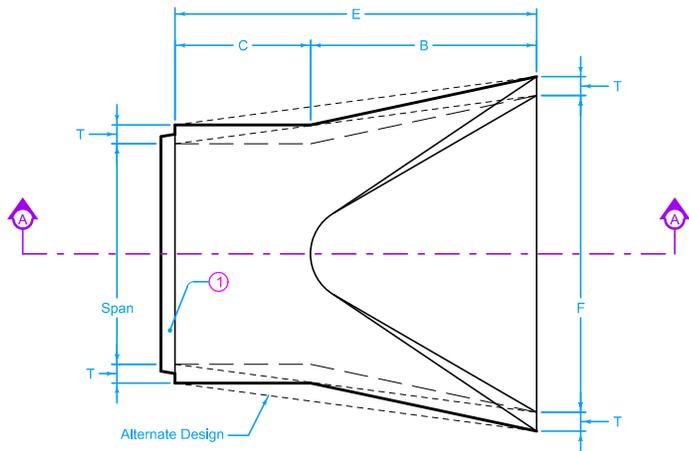
| TYPE 1 APRONS |       |                    |                      |                      |                      |        |                   |                   |
|---------------|-------|--------------------|----------------------|----------------------|----------------------|--------|-------------------|-------------------|
| DIAM.         | SLOPE | A                  | B                    | MINIMUM              |                      | F      | G                 | T                 |
|               |       |                    |                      | C                    | E                    |        |                   |                   |
| 12"           | 2.4:1 | 4"                 | 2'-0"                | 4'- $\frac{7}{8}$ "  | 6'- $\frac{7}{8}$ "  | 2'-0"  | 2"                | 2"                |
| 15"           | 2.4:1 | 6"                 | 2'-3"                | 3'-10"               | 6'-1"                | 2'-6"  | 2 $\frac{1}{4}$ " | 2 $\frac{1}{4}$ " |
| 18"           | 2.3:1 | 9"                 | 2'-3"                | 3'-10"               | 6'-1"                | 3'-0"  | 2 $\frac{1}{2}$ " | 2 $\frac{1}{2}$ " |
| 21"           | 2.4:1 | 9"                 | 3'-0"                | 3'-1 $\frac{1}{2}$ " | 6'-1 $\frac{1}{2}$ " | 3'-5"  | 3"                | 3"                |
| 24"           | 2.5:1 | 9 $\frac{1}{2}$ "  | 3'-7 $\frac{1}{2}$ " | 2'-6"                | 6'-1 $\frac{1}{2}$ " | 4'-0"  | 3"                | 3"                |
| 27"           | 2.5:1 | 10 $\frac{1}{2}$ " | 4'-1"                | 2'-0"                | 6'-1 $\frac{1}{2}$ " | 4'-4"  | 3 $\frac{1}{2}$ " | 3 $\frac{1}{2}$ " |
| 30"           | 2.5:1 | 12"                | 4'-6"                | 1'-7 $\frac{3}{4}$ " | 6'-1 $\frac{1}{2}$ " | 5'-0"  | 3 $\frac{1}{2}$ " | 3 $\frac{1}{2}$ " |
| 36"           | 2.5:1 | 15"                | 5'-3"                | 2'-9"                | 8'-0"                | 6'-0"  | 4"                | 4"                |
| 42"           | 2.5:1 | 21"                | 5'-3"                | 2'-9"                | 8'-0"                | 6'-6"  | 4 $\frac{1}{2}$ " | 4 $\frac{1}{2}$ " |
| 48"           | 2.5:1 | 24"                | 6'-0"                | 2'-0"                | 8'-0"                | 7'-0"  | 5"                | 5"                |
| 54"           | 1.8:1 | 27"                | 5'-0"                | 3'-0"                | 8'-0"                | 7'-6"  | 5 $\frac{1}{2}$ " | 5 $\frac{1}{2}$ " |
| 60"           | 1.6:1 | 29 $\frac{1}{2}$ " | 5'-0"                | 3'-0"                | 8'-0"                | 8'-0"  | 5 $\frac{1}{2}$ " | 6"                |
| 66"           | 1.7:1 | 30"                | 6'-0"                | 2'-3"                | 8'-3"                | 8'-0"  | 5 $\frac{1}{2}$ " | 6"                |
| 72"           | 1.6:1 | 30"                | 6'-6"                | 1'-9"                | 8'-3"                | 9'-0"  | 6"                | 7"                |
| 78"           | 1.8:1 | 36"                | 7'-6"                | 1'-9"                | 9'-3"                | 9'-6"  | 6 $\frac{1}{2}$ " | 7 $\frac{1}{2}$ " |
| 84"           | 1.3:1 | 29 $\frac{1}{2}$ " | 6'-9"                | 2'-6 $\frac{1}{2}$ " | 9'-3 $\frac{1}{2}$ " | 10'-0" | 6 $\frac{1}{2}$ " | 8"                |

| TYPE 2 APRONS |       |                    |                      |                      |                      |        |                   |                   |
|---------------|-------|--------------------|----------------------|----------------------|----------------------|--------|-------------------|-------------------|
| DIAM.         | SLOPE | A                  | B                    | MINIMUM              |                      | F      | G                 | T                 |
|               |       |                    |                      | C                    | E                    |        |                   |                   |
| 12"           | 2.4:1 | 4"                 | 2'-0"                | 4'- $\frac{7}{8}$ "  | 6'- $\frac{7}{8}$ "  | 2'-0"  | 2"                | 2"                |
| 15"           | 2.4:1 | 6"                 | 2'-3"                | 3'-10"               | 6'-1"                | 2'-6"  | 2 $\frac{1}{4}$ " | 2 $\frac{1}{4}$ " |
| 18"           | 2.3:1 | 9"                 | 2'-3"                | 3'-10"               | 6'-1"                | 3'-0"  | 2 $\frac{1}{2}$ " | 2 $\frac{1}{2}$ " |
| 21"           | 2.4:1 | 9"                 | 3'-0"                | 3'-1 $\frac{1}{2}$ " | 6'-1 $\frac{1}{2}$ " | 3'-5"  | 3"                | 3"                |
| 24"           | 2.5:1 | 9 $\frac{1}{2}$ "  | 3'-7 $\frac{1}{2}$ " | 2'-6"                | 6'-1 $\frac{1}{2}$ " | 4'-0"  | 3"                | 3"                |
| 27"           | 2.5:1 | 10 $\frac{1}{2}$ " | 4'-1"                | 2'-0"                | 6'-1 $\frac{1}{2}$ " | 4'-4"  | 3 $\frac{1}{2}$ " | 3 $\frac{1}{2}$ " |
| 30"           | 2.5:1 | 12"                | 4'-6"                | 1'-7 $\frac{3}{4}$ " | 6'-1 $\frac{1}{2}$ " | 5'-0"  | 3 $\frac{1}{2}$ " | 3 $\frac{1}{2}$ " |
| 36"           | 2.5:1 | 15"                | 5'-3"                | 2'-9"                | 8'-0"                | 6'-0"  | 4"                | 4"                |
| 42"           | 2.5:1 | 21"                | 5'-3"                | 2'-9"                | 8'-0"                | 6'-6"  | 4 $\frac{1}{2}$ " | 4 $\frac{1}{2}$ " |
| 48"           | 2.5:1 | 24"                | 6'-0"                | 2'-0"                | 8'-0"                | 7'-0"  | 5"                | 5"                |
| 54"           | 1.9:1 | 24 $\frac{1}{2}$ " | 5'-5"                | 2'-7"                | 8'-0"                | 7'-6"  | 5 $\frac{1}{2}$ " | 5 $\frac{1}{2}$ " |
| 60"           | 1.4:1 | 24 $\frac{1}{2}$ " | 5'-0"                | 3'-0"                | 8'-0"                | 8'-0"  | 5 $\frac{1}{2}$ " | 6"                |
| 66"           | 1.7:1 | 30"                | 6'-0"                | 2'-3"                | 8'-3"                | 8'-0"  | 5 $\frac{1}{2}$ " | 6"                |
| 72"           | 1.4:1 | 24"                | 6'-6"                | 1'-9"                | 8'-3"                | 9'-0"  | 6"                | 7"                |
| 78"           | 1.8:1 | 36"                | 7'-6"                | 1'-9"                | 9'-3"                | 9'-6"  | 6 $\frac{1}{2}$ " | 7 $\frac{1}{2}$ " |
| 84"           | 1.5:1 | 23 $\frac{1}{2}$ " | 7'-6 $\frac{1}{2}$ " | 1'-9"                | 9'-3 $\frac{1}{2}$ " | 10'-0" | 6 $\frac{1}{2}$ " | 8"                |

Contract Item:  
Apron, Concrete

Tabulations:  
104-3  
104-5C

|   |               |
|---|---------------|
|   | REVISION      |
|   | New 04-21-15  |
| <b>STANDARD ROAD PLAN</b>               | <b>DR-201</b> |
|   | SHEET 1 of 1  |
| REVISIONS: New. Replaces RF-3.          |               |
| APPROVED BY DESIGN METHODS ENGINEER<br> |               |
| <b>CONCRETE APRONS</b>                  |               |



Comply with AASHTO M 206 for Apron Reinforcement.

Dimension "E" shown is minimum and is considered the design length. Appropriately adjust for any difference between the actual length of concrete apron installed and the length indicated hereon for the length of concrete culvert pipe furnished.

Install connected pipe joints as shown on DR-121.

① Tongue end on inlet end section. Groove end on outlet end section. Inlet end section is shown.

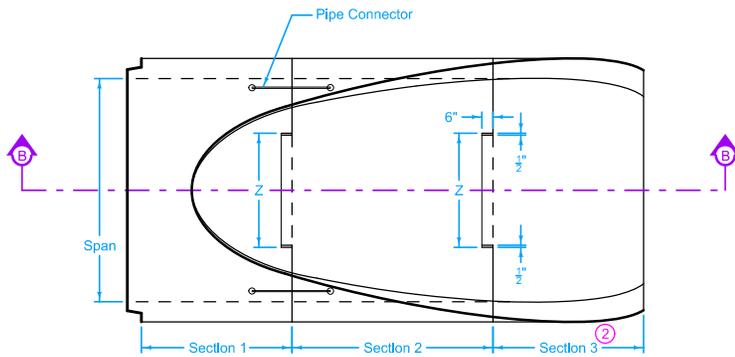
| NOMINAL DIMENSIONS<br>SPAN X RISE<br>Inches | EQUIVALENT<br>DIAMETER<br>Inches | SPAN<br>Inches | RISE<br>Inches | SLOPE | APPROXIMATE DIMENSIONS<br>Inches |          |    |    |     |     |
|---|----------------------------------|----------------|----------------|-------|----------------------------------|----------|----|----|-----|-----|
|   |                                  |                |                |       | T                                | A        | B  | C  | E   | F   |
| 22 X 14                                     | 18                               | 22             | 13 1/2         | 3:1   | 2 1/2                            | 7        | 27 | 45 | 72  | 36  |
| 29 X 18                                     | 24                               | 28 1/2         | 18             | 3:1   | 3                                | 8 1/2    | 39 | 33 | 72  | 48  |
| 37 X 23                                     | 30                               | 36 1/4         | 22 1/2         | 3:1   | 3 1/2                            | 9 1/2    | 50 | 46 | 96  | 60  |
| 44 X 27                                     | 36                               | 43 3/8         | 26 5/8         | 3:1   | 4                                | 11 1/8   | 60 | 36 | 96  | 72  |
| 52 X 32                                     | 42                               | 51 1/8         | 31 5/16        | 3:1   | 4 1/2                            | 15 13/16 | 60 | 36 | 96  | 78  |
| 59 X 36                                     | 48                               | 58 1/2         | 36             | 3:1   | 5                                | 21       | 60 | 36 | 96  | 84  |
| 65 X 40                                     | 54                               | 65             | 40             | 3:1   | 5 1/2                            | 25 1/2   | 60 | 36 | 96  | 90  |
| 73 X 45                                     | 60                               | 73             | 45             | 3:1   | 6                                | 31       | 60 | 36 | 96  | 96  |
| 88 X 54                                     | 72                               | 88             | 54             | 2:1   | 7                                | 31       | 60 | 39 | 99  | 120 |
| 102 X 62                                    | 84                               | 102            | 62             | 2:1   | 8                                | 21 1/2   | 83 | 19 | 102 | 144 |

Possible Contract Item:  
Low Clearance Concrete Pipe Aprons

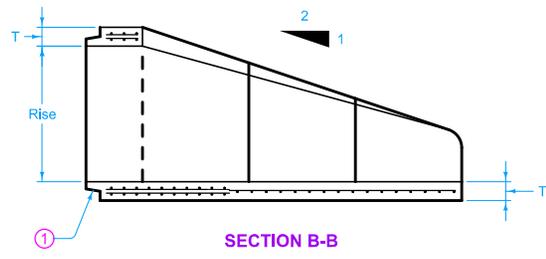
Possible Tabulations:  
104-3  
104-4

ARCH PIPE

|   |              |
|---|--------------|
|   | REVISION     |
|   | New 04-21-15 |
| STANDARD ROAD PLAN                            | DR-202       |
| REVISIONS: New. Replaces RF-42.               | SHEET 1 of 3 |
| <br>APPROVED BY DESIGN METHODS ENGINEER       |              |
| <b>LOW CLEARANCE<br/>CONCRETE PIPE APRONS</b> |              |

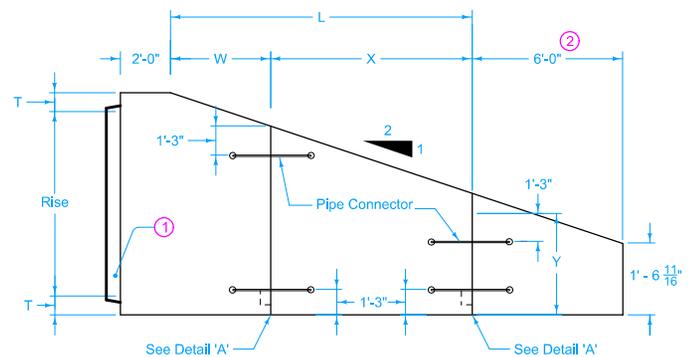


PLAN

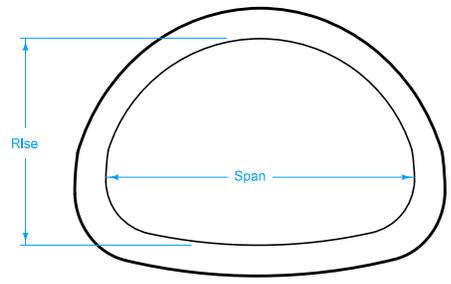


SECTION B-B

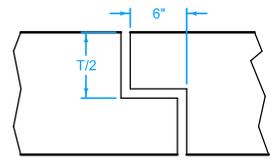
- ① Tongue end on inlet end section. Groove end on outlet end section. Inlet end section is shown.
- ② 132 inch size is a three piece end section.



ELEVATION



END

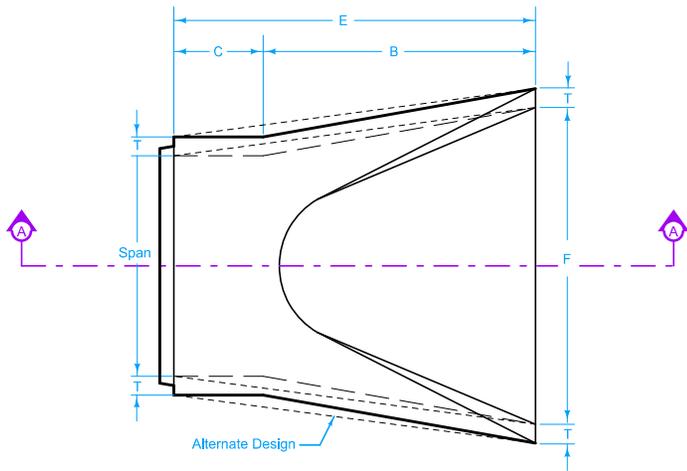


DETAIL 'A'

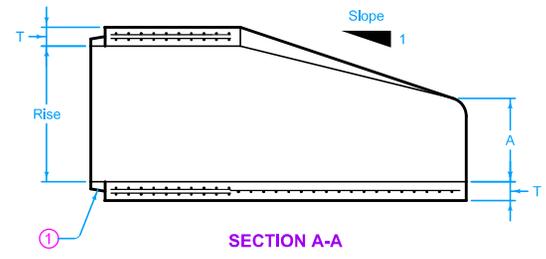
| NOMINAL DIMENSIONS<br>SPAN X RISE<br>Inches | EQUIVALENT<br>DIAMETER<br>Inches | SPAN<br>Inches | RISE<br>Inches | APPROXIMATE DIMENSIONS<br>Inches |         |    |        |        |    |
|---|----------------------------------|----------------|----------------|----------------------------------|---------|----|--------|--------|----|
|   |                                  |                |                | ①                                | ④       | ⑦  | ⑩      | ⑬      | ⑯  |
|   |                                  |                |                | ②                                | ⑤       | ⑧  | ⑪      | ⑭      | ⑰  |
| 115 X 72                                    | 90                               | 115            | 72             | 8 1/2                            | 102 1/4 | 72 | 30 1/4 | 37 7/8 | 48 |
| 122 X 78                                    | 96                               | 122            | 77 1/2         | 9                                | 112 3/2 | 72 | 40 1/2 | 39     | 54 |
| 138 X 88                                    | 108                              | 138            | 87 1/8         | 10                               | 129 1/2 | 48 | 81 1/2 | 42 3/8 | 66 |
| 154 X 97                                    | 120                              | 154            | 96 7/8         | 11                               | 144     | 48 | 96     | 46 7/8 | 78 |
| 169 X 107                                   | 132 ②                            | 168 3/4        | 106 1/2        | 10                               | 144     | 48 | 96     | 54 5/8 | 90 |

ARCH PIPE (MULTI-SECTION APRON)

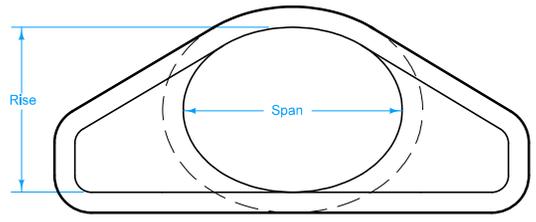
|   |               |          |
|---|---------------|----------|
| <b>IOWA DOT</b>   | REVISION      |          |
|   | New           | 04-21-15 |
| <b>STANDARD ROAD PLAN</b>                                 | <b>DR-202</b> |          |
| SHEET 2 of 3  |               |          |
| REVISIONS: New. Replaces RF-42.                           |               |          |
| <i>Brian Smith</i><br>APPROVED BY DESIGN METHODS ENGINEER |               |          |
| <b>LOW CLEARANCE<br/>CONCRETE PIPE APRONS</b>             |               |          |



PLAN



SECTION A-A



END

Comply with AASHTO M 207 for Apron Reinforcement.

Dimension "E" shown is minimum and is considered the design length. Appropriately adjust for any difference between the actual length of concrete apron installed and the length indicated hereon for the length of concrete culvert pipe furnished.

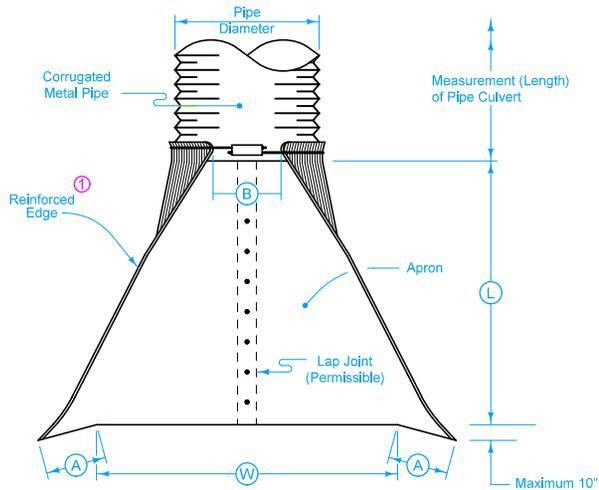
Install connected pipe joints as shown on DR-121.

① Tongue end on inlet end section. Groove end on outlet end section. Inlet end section shown.

| EQUIVALENT DIAMETER<br>Inches | SPAN<br>Inches | RISE<br>Inches | SLOPE    | APPROXIMATE DIMENSIONS<br>Inches |                                |    |    |    |     |
|-------------------------------|----------------|----------------|----------|----------------------------------|--------------------------------|----|----|----|-----|
|                               |                |                |          | T                                | A                              | B  | C  | E  | F   |
| 18                            | 23             | 14             | 3:1      | 2 <sup>3</sup> / <sub>4</sub>    | 7 <sup>1</sup> / <sub>2</sub>  | 27 | 45 | 72 | 36  |
| 24                            | 30             | 19             | 3:1      | 3 <sup>1</sup> / <sub>4</sub>    | 8 <sup>1</sup> / <sub>2</sub>  | 39 | 33 | 72 | 48  |
| 30                            | 38             | 24             | 3:1      | 3 <sup>3</sup> / <sub>4</sub>    | 9 <sup>1</sup> / <sub>2</sub>  | 54 | 18 | 72 | 60  |
| 36                            | 45             | 29             | 2.5 to 1 | 4 <sup>1</sup> / <sub>2</sub>    | 11 <sup>1</sup> / <sub>8</sub> | 60 | 24 | 84 | 72  |
| 42                            | 53             | 34             | 2.5 to 1 | 5                                | 15 <sup>3</sup> / <sub>4</sub> | 60 | 36 | 96 | 78  |
| 48                            | 60             | 38             | 2.5 to 1 | 5 <sup>1</sup> / <sub>2</sub>    | 21                             | 60 | 36 | 96 | 84  |
| 54                            | 68             | 43             | 2.5 to 1 | 6                                | 25 <sup>1</sup> / <sub>2</sub> | 60 | 36 | 96 | 90  |
| 60                            | 76             | 48             | 2.5 to 1 | 6 <sup>1</sup> / <sub>2</sub>    | 30                             | 60 | 36 | 96 | 96  |
| 72                            | 91             | 58             | 2.5 to 1 | 7 <sup>1</sup> / <sub>2</sub>    | 36                             | 63 | 33 | 96 | 108 |
| 90                            | 113            | 72             | 1.6 to 1 | 9                                | 36 <sup>1</sup> / <sub>2</sub> | 58 | 38 | 96 | 113 |

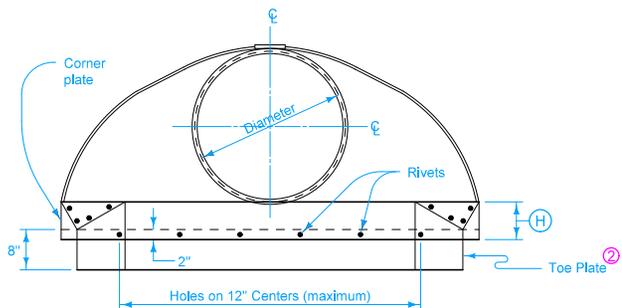
ELLIPTICAL PIPE

|   |              |
|---|--------------|
|   | REVISION     |
|   | New 04-21-15 |
| STANDARD ROAD PLAN  | DR-202       |
| REVISIONS: New. Replaces RF-42.                                     | SHEET 3 of 3 |
|   |              |
| APPROVED BY DESIGN METHODS ENGINEER                                 |              |
| <p align="center"><b>LOW CLEARANCE<br/>CONCRETE PIPE APRONS</b></p> |              |

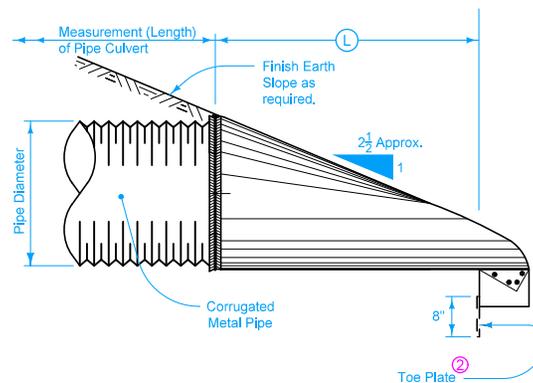


PLAN VIEW

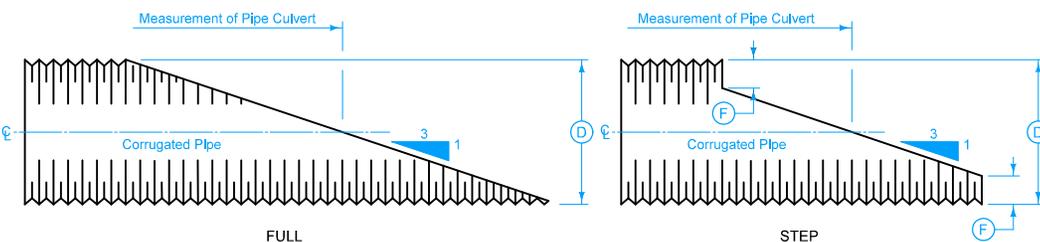
| DIMENSIONS |         |        |         |          |         |
|------------|---------|--------|---------|----------|---------|
| PIPE DIAM. | A (±1") | B MAX. | H (±1") | L (±1½") | W (±2") |
| 6"         | 4½"     | 1"     | 3"      | 8¾"      | 12"     |
| 8"         | 5½"     | 3"     | 4"      | 14½"     | 16"     |
| 10"        | 7½"     | 6"     | 6"      | 21"      | 24"     |
| 12"        | 4¾"     | 6"     | 6"      | 21"      | 24"     |
| 15"        | 6"      | 8"     | 6"      | 26"      | 30"     |
| 18"        | 7"      | 9"     | 6"      | 31"      | 36"     |
| 21"        | 8½"     | 11"    | 6"      | 36"      | 42"     |
| 24"        | 9½"     | 12"    | 6"      | 42"      | 48"     |
| 30"        | 12"     | 15"    | 7½"     | 52½"     | 60"     |
| 36"        | 14"     | 18"    | 9"      | 63"      | 72"     |
| 42"        | 16"     | 21"    | 10½"    | 73½"     | 84"     |
| 48"        | 18"     | 27"    | 12"     | 84"      | 90"     |
| 54"        | 18"     | 30"    | 12"     | 84"      | 102"    |
| 60"        | 18"     | 33"    | 12"     | 87"      | 114"    |
| 66"        | 18"     | 36"    | 12"     | 87"      | 120"    |
| 72"        | 18"     | 39"    | 12"     | 87"      | 126"    |
| 78"        | 18"     | 42"    | 12"     | 87"      | 132"    |
| 84"        | 18"     | 45"    | 12"     | 87"      | 138"    |
| 90"        | 24"     | 37"    | 11"     | 87"      | 144"    |
| 96"        | 25"     | 35"    | 12"     | 87"      | 150"    |



END VIEW



SIDE VIEW



BEVELED ENDS FOR CORRUGATED METAL PIPE

| BEVEL 3:1 |     |
|-----------|-----|
| (D)       | (F) |
| 54"       | 3"  |
| 60"       | 6"  |
| 66"       | 9"  |
| 72"       | 12" |
| 78"       | 15" |
| 84"       | 18" |
| 90"       | 21" |
| 96"       | 24" |

When specifically required as part of detail project plans, ends of pipe culvert may be provided with beveled ends as shown.

Either Full Bevel or Step Bevel may be used unless one type is specified. The slope of the bevel is 3:1 unless specified otherwise.

Beveled ends, when required, are incidental to the price bid for the culvert.

Install aprons and hardware fabricated from galvanized steel complying with Section 4141 of the Standard Specifications. Alternate design details may be submitted to the Engineer for approval.

Aprons may be attached to culvert pipe as follows:

- A. If normal culvert is of circumferential type, use an approved bolt or clamp to fasten directly to culvert.
- B. If normal culvert is of helical corrugation type:
  1. Use an approved sizing ring securely fastened to inside diameter of apron to connect the culvert pipe using special dimple band connector.
  2. "Dimple" bands are not allowed when a positive joint is specified.

Refer to Materials I.M. 441 for approved coupling devices.

Repair, to the Engineer's satisfaction, breaks or damage to the coating that occur during handling or installation.

Price bid for "Aprons, Metal" is full compensation for fabrication and installation of the metal apron.

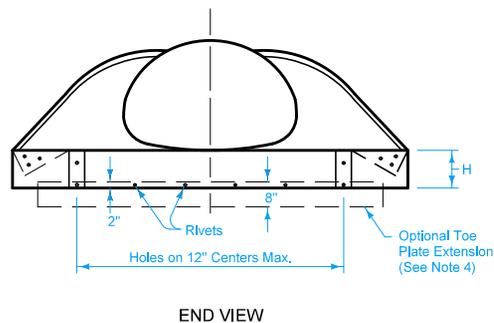
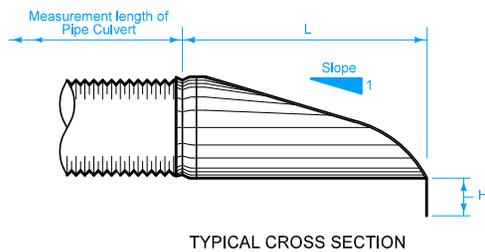
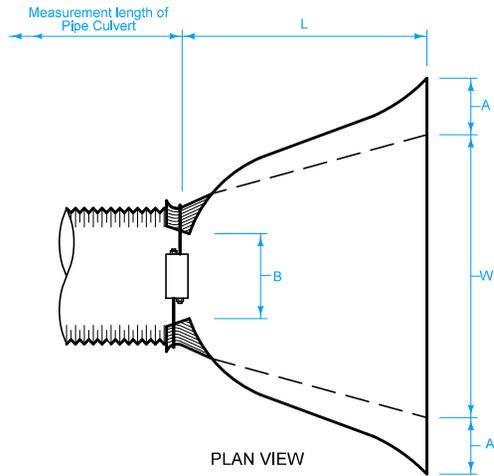
(1) On sizes 60 inches and larger, the reinforced edge should be supplemental with a galvanized stiffener angle attached with bolts.

(2) Install Galvanized Toe Plate (same gage metal as apron) on all aprons 24 inch diameter and larger

Possible Contract Item:  
Apron, Metal

Possible Tabulations:  
104-3  
104-5C

|  |              |
|--|--------------|
| <br><b>STANDARD ROAD PLAN</b>                          | REVISION     |
|  | New 04-21-15 |
| DR-203   | SHEET 1 of 1 |
| REVISIONS: New. Replaces RF-5.                         |              |
| <br><small>APPROVED BY DESIGN METHODS ENGINEER</small> |              |
| METAL PIPE APRONS<br>AND BEVELED ENDS                  |              |



| SPAN/<br>RISE | GAGE  | DIMENSIONS (In Inches) |             |            |             |            | APPROX.<br>SLOPE |
|---------------|-------|------------------------|-------------|------------|-------------|------------|------------------|
|               |       | A<br>(±1")             | B<br>(Max.) | H<br>(±1") | L<br>(±1½") | W<br>(±2") |                  |
| 17"x 13"      | 16    | 6½                     | 8½-9        | 6          | 20          | 30         | 2½               |
| 21"x 15"      | 16    | 7½                     | 11          | 6          | 24          | 36         | 2½               |
| 24"x 18"      | 16    | 8                      | 12          | 6          | 28          | 42         | 2½               |
| 28"x 20"      | 16    | 8                      | 16          | 6          | 32          | 48         | 2½               |
| 35"x 24"      | 14    | 10                     | 16          | 7          | 39          | 60         | 2½               |
| 42"x 29"      | 14    | 12                     | 18          | 7½-8       | 46          | 75         | 2½               |
| 49"x 33"      | 12    | 13½                    | 21          | 9          | 53          | 84         | 2½               |
| 57"x 38"      | 12    | 18½                    | 26          | 12         | 62          | 90         | 2½               |
| 64"x 43"      | 12    | 18                     | 30          | 12         | 69          | 102        | 2¼-2             |
| 71"x 47"      | 12/10 | 18½                    | 36          | 12         | 77          | 114        | 2¼-1½            |
| 77"x 52"      | 12/10 | 18                     | 36          | 12         | 77          | 126        | 2-1½             |
| 83"x 57"      | 12/10 | 18                     | 44          | 12         | 77          | 135±3      | 2-1½             |

Install aprons and hardware fabricated from galvanized steel complying with Section 4141 of the Standard Specifications. Alternate design details may be submitted to the Engineer for approval.

Comply with the following:

- All 3 piece bodies are to have 12-gage sides and 10-gage center panels. Multiple panel bodies are to have lap seams which are to be tightly joined by galvanized rivets or bolts.
- For the 77"x52" and 83"x57" sizes, the reinforced edge is to be supplemented by galvanized angles. The angles are to be attached by galvanized nuts and bolts.
- Angle reinforcement is to be placed under the center panel seams on the 77"x52" and 83"x57" sizes.
- Galvanized Toe plate is to be available as an accessory when specified on the order and is to be the same gage as the end section.

Aprons may be attached to culvert pipe as follows:

- If culvert is of circumferential corrugation, use an approved bolt or clamp to fasten apron directly to culvert.
- If culvert is of helical corrugation type:
  - Use an approved sizing ring securely fastened to inside diameter of apron to connect to the culvert pipe using a special dimple band connector.
  - "Dimple" bands are not allowed when a positive joint is specified.

Refer to Materials I.M. 441 for approved coupling devices.

Repair, to the Engineer's satisfaction, breaks or damage to the coating that occur during handling or installation.

Price bid for "Aprons, Metal, Arch" is full compension for fabrication and installation of metal arch aprons as indicated hereon.

Possible Contract Items:  
Aprons, Metal, Arch

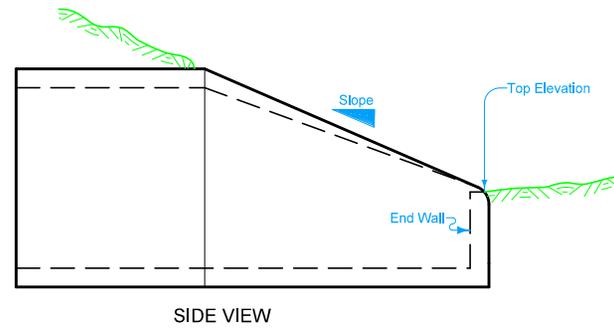
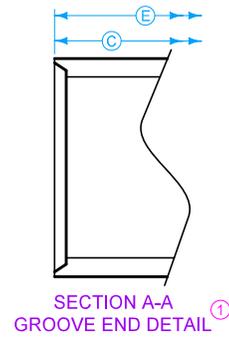
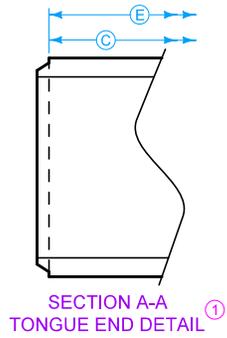
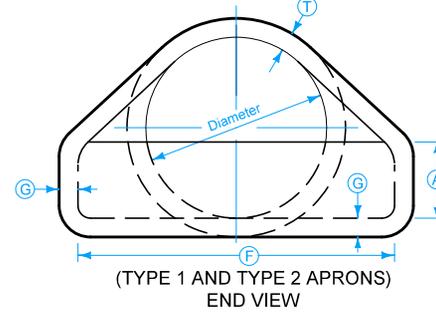
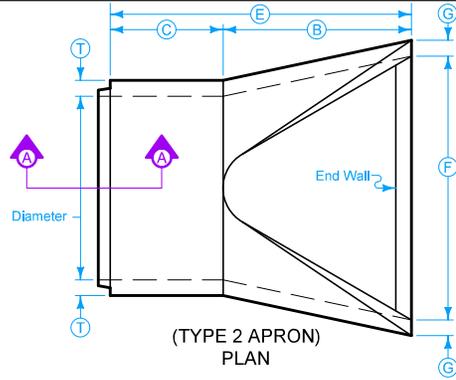
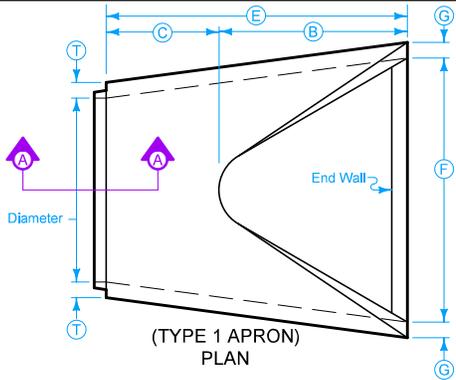
Possible Tabulations:  
104-3

|                    |              |
|--------------------|--------------|
|                    | REVISION     |
|                    | New 04-21-15 |
| STANDARD ROAD PLAN | DR-204       |
|                    | SHEET 1 of 1 |

REVISIONS: New. Replaces RF-43.

*Brian Smith*  
APPROVED BY DESIGN METHODS ENGINEER

**METAL ARCH APRONS  
(FOR CORRUGATED METAL PIPE)**



For the End Wall, match the thickness **T** and reinforcing used for the pipe apron.

Dimension **E** shown is the minimum and is considered the design length. Adjust for any difference between the actual length of concrete apron installed and the length indicated hereon within the length of concrete culvert pipe furnished.

Install connected pipe joints as shown on [DR-121](#).

When specified in the contract documents, install pipe apron guards as shown on [DR-213](#). Adjust connection locations to avoid conflict with end wall. Pipe apron guards are incidental to "Concrete Aprons".

① Tongue end used on inlet end section. Groove end used on outlet end section. Comply with AASHTO M 170 for tongue and groove dimensions.

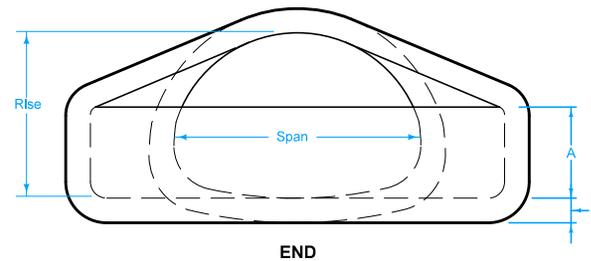
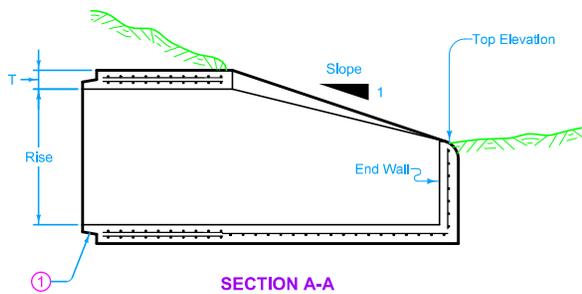
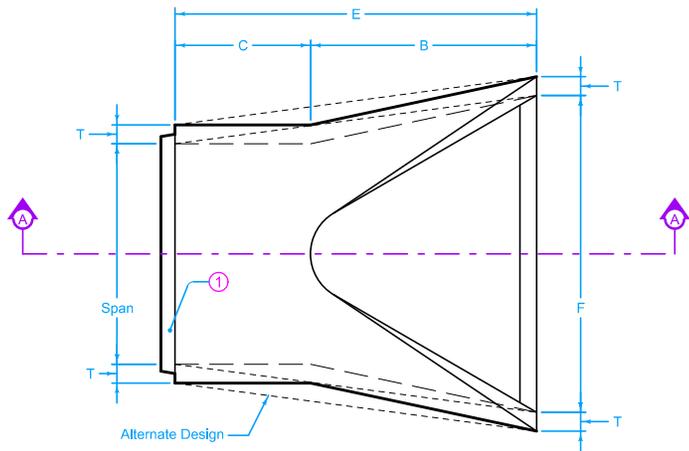
| TYPE 1 APRONS |       |                    |                      |                      |                      |        |                   |                   |
|---------------|-------|--------------------|----------------------|----------------------|----------------------|--------|-------------------|-------------------|
| DIAM.         | SLOPE | A                  | B                    | MINIMUM              |                      | F      | G                 | T                 |
|               |       |                    |                      | C                    | E                    |        |                   |                   |
| 12"           | 2.4:1 | 4"                 | 2'-0"                | 4'- $\frac{7}{8}$ "  | 6'- $\frac{7}{8}$ "  | 2'-0"  | 2"                | 2"                |
| 15"           | 2.4:1 | 6"                 | 2'-3"                | 3'-10"               | 6'-1"                | 2'-6"  | 2 $\frac{1}{4}$ " | 2 $\frac{1}{4}$ " |
| 18"           | 2.3:1 | 9"                 | 2'-3"                | 3'-10"               | 6'-1"                | 3'-0"  | 2 $\frac{1}{2}$ " | 2 $\frac{1}{2}$ " |
| 21"           | 2.4:1 | 9"                 | 3'-0"                | 3'-1 $\frac{1}{2}$ " | 6'-1 $\frac{1}{2}$ " | 3'-5"  | 3"                | 3"                |
| 24"           | 2.5:1 | 9 $\frac{1}{2}$ "  | 3'-7 $\frac{1}{2}$ " | 2'-6"                | 6'-1 $\frac{1}{2}$ " | 4'-0"  | 3"                | 3"                |
| 27"           | 2.5:1 | 10 $\frac{1}{2}$ " | 4'-1"                | 2'-0"                | 6'-1 $\frac{1}{2}$ " | 4'-4"  | 3 $\frac{1}{2}$ " | 3 $\frac{1}{2}$ " |
| 30"           | 2.5:1 | 12"                | 4'-6"                | 1'-7 $\frac{3}{4}$ " | 6'-1 $\frac{3}{4}$ " | 5'-0"  | 3 $\frac{1}{2}$ " | 3 $\frac{1}{2}$ " |
| 36"           | 2.5:1 | 15"                | 5'-3"                | 2'-9"                | 8'-0"                | 6'-0"  | 4"                | 4"                |
| 42"           | 2.5:1 | 21"                | 5'-3"                | 2'-9"                | 8'-0"                | 6'-6"  | 4 $\frac{1}{2}$ " | 4 $\frac{1}{2}$ " |
| 48"           | 2.5:1 | 24"                | 6'-0"                | 2'-0"                | 8'-0"                | 7'-0"  | 5"                | 5"                |
| 54"           | 1.8:1 | 27"                | 5'-0"                | 3'-0"                | 8'-0"                | 7'-6"  | 5 $\frac{1}{2}$ " | 5 $\frac{1}{2}$ " |
| 60"           | 1.6:1 | 29 $\frac{1}{2}$ " | 5'-0"                | 3'-0"                | 8'-0"                | 8'-0"  | 5 $\frac{1}{2}$ " | 6"                |
| 66"           | 1.7:1 | 30"                | 6'-0"                | 2'-3"                | 8'-3"                | 8'-0"  | 5 $\frac{1}{2}$ " | 6"                |
| 72"           | 1.6:1 | 30"                | 6'-6"                | 1'-9"                | 8'-3"                | 9'-0"  | 6"                | 7"                |
| 78"           | 1.8:1 | 36"                | 7'-6"                | 1'-9"                | 9'-3"                | 9'-6"  | 6 $\frac{1}{2}$ " | 7 $\frac{1}{2}$ " |
| 84"           | 1.3:1 | 29 $\frac{1}{2}$ " | 6'-9"                | 2'-6 $\frac{1}{2}$ " | 9'-3 $\frac{1}{2}$ " | 10'-0" | 6 $\frac{1}{2}$ " | 8"                |

| TYPE 2 APRONS |       |                    |                      |                      |                      |        |                   |                   |
|---------------|-------|--------------------|----------------------|----------------------|----------------------|--------|-------------------|-------------------|
| DIAM.         | SLOPE | A                  | B                    | MINIMUM              |                      | F      | G                 | T                 |
|               |       |                    |                      | C                    | E                    |        |                   |                   |
| 12"           | 2.4:1 | 4"                 | 2'-0"                | 4'- $\frac{7}{8}$ "  | 6'- $\frac{7}{8}$ "  | 2'-0"  | 2"                | 2"                |
| 15"           | 2.4:1 | 6"                 | 2'-3"                | 3'-10"               | 6'-1"                | 2'-6"  | 2 $\frac{1}{4}$ " | 2 $\frac{1}{4}$ " |
| 18"           | 2.3:1 | 9"                 | 2'-3"                | 3'-10"               | 6'-1"                | 3'-0"  | 2 $\frac{1}{2}$ " | 2 $\frac{1}{2}$ " |
| 21"           | 2.4:1 | 9"                 | 3'-0"                | 3'-1 $\frac{1}{2}$ " | 6'-1 $\frac{1}{2}$ " | 3'-5"  | 3"                | 3"                |
| 24"           | 2.5:1 | 9 $\frac{1}{2}$ "  | 3'-7 $\frac{1}{2}$ " | 2'-6"                | 6'-1 $\frac{1}{2}$ " | 4'-0"  | 3"                | 3"                |
| 27"           | 2.5:1 | 10 $\frac{1}{2}$ " | 4'-1"                | 2'-0"                | 6'-1 $\frac{1}{2}$ " | 4'-4"  | 3 $\frac{1}{2}$ " | 3 $\frac{1}{2}$ " |
| 30"           | 2.5:1 | 12"                | 4'-6"                | 1'-7 $\frac{3}{4}$ " | 6'-1 $\frac{3}{4}$ " | 5'-0"  | 3 $\frac{1}{2}$ " | 3 $\frac{1}{2}$ " |
| 36"           | 2.5:1 | 15"                | 5'-3"                | 2'-9"                | 8'-0"                | 6'-0"  | 4"                | 4"                |
| 42"           | 2.5:1 | 21"                | 5'-3"                | 2'-9"                | 8'-0"                | 6'-6"  | 4 $\frac{1}{2}$ " | 4 $\frac{1}{2}$ " |
| 48"           | 2.5:1 | 24"                | 6'-0"                | 2'-0"                | 8'-0"                | 7'-0"  | 5"                | 5"                |
| 54"           | 1.9:1 | 24 $\frac{1}{2}$ " | 5'-5"                | 2'-7"                | 8'-0"                | 7'-6"  | 5 $\frac{1}{2}$ " | 5 $\frac{1}{2}$ " |
| 60"           | 1.4:1 | 24 $\frac{1}{2}$ " | 5'-0"                | 3'-0"                | 8'-0"                | 8'-0"  | 5 $\frac{1}{2}$ " | 6"                |
| 66"           | 1.7:1 | 30"                | 6'-0"                | 2'-3"                | 8'-3"                | 8'-0"  | 5 $\frac{1}{2}$ " | 6"                |
| 72"           | 1.4:1 | 24"                | 6'-6"                | 1'-9"                | 8'-3"                | 9'-0"  | 6"                | 7"                |
| 78"           | 1.8:1 | 36"                | 7'-6"                | 1'-9"                | 9'-3"                | 9'-6"  | 6 $\frac{1}{2}$ " | 7 $\frac{1}{2}$ " |
| 84"           | 1.5:1 | 23 $\frac{1}{2}$ " | 7'-6 $\frac{1}{2}$ " | 1'-9"                | 9'-3 $\frac{1}{2}$ " | 10'-0" | 6 $\frac{1}{2}$ " | 8"                |

Contract Item:  
Apron, Concrete

Possible Tabulation:  
104-3

|  |               |
|--|---------------|
|  | REVISION      |
|  | New 04-21-15  |
| <b>STANDARD ROAD PLAN</b>                            | <b>DR-205</b> |
|  | SHEET 1 of 1  |
| <small>REVISIONS: New. Replaces Detail 1407.</small> |               |
|  |               |
| <small>APPROVED BY DESIGN METHODS ENGINEER</small>   |               |
| <b>CONCRETE APRON<br/>WITH END WALL</b>              |               |



| NOMINAL DIMENSIONS<br>SPAN X RISE<br>Inches | EQUIVALENT<br>DIAMETER<br>Inches | SPAN<br>Inches   | RISE<br>Inches    | SLOPE | APPROXIMATE DIMENSIONS<br>Inches |                    |    |    |     |     |
|---|----------------------------------|------------------|-------------------|-------|----------------------------------|--------------------|----|----|-----|-----|
|   |                                  |                  |                   |       | T                                | A                  | B  | C  | E   | F   |
| 22 X 14                                     | 18                               | 22               | 13 $\frac{1}{2}$  | 3:1   | 2 $\frac{1}{2}$                  | 7                  | 27 | 45 | 72  | 36  |
| 29 X 18                                     | 24                               | 28 $\frac{1}{2}$ | 18                | 3:1   | 3                                | 8 $\frac{1}{2}$    | 39 | 33 | 72  | 48  |
| 37 X 23                                     | 30                               | 36 $\frac{1}{4}$ | 22 $\frac{1}{2}$  | 3:1   | 3 $\frac{1}{2}$                  | 9 $\frac{1}{2}$    | 50 | 46 | 96  | 60  |
| 44 X 27                                     | 36                               | 43 $\frac{3}{8}$ | 26 $\frac{5}{8}$  | 3:1   | 4                                | 11 $\frac{1}{8}$   | 60 | 36 | 96  | 72  |
| 52 X 32                                     | 42                               | 51 $\frac{1}{8}$ | 31 $\frac{5}{16}$ | 3:1   | 4 $\frac{1}{2}$                  | 15 $\frac{13}{16}$ | 60 | 36 | 96  | 78  |
| 59 X 36                                     | 48                               | 58 $\frac{1}{2}$ | 36                | 3:1   | 5                                | 21                 | 60 | 36 | 96  | 84  |
| 65 X 40                                     | 54                               | 65               | 40                | 3:1   | 5 $\frac{1}{2}$                  | 25 $\frac{1}{2}$   | 60 | 36 | 96  | 90  |
| 73 X 45                                     | 60                               | 73               | 45                | 3:1   | 6                                | 31                 | 60 | 36 | 96  | 96  |
| 88 X 54                                     | 72                               | 88               | 54                | 2:1   | 7                                | 31                 | 60 | 39 | 99  | 120 |
| 102 X 62                                    | 84                               | 102              | 62                | 2:1   | 8                                | 21 $\frac{1}{2}$   | 83 | 19 | 102 | 144 |

ARCH PIPE

Comply with AASHTO M 206 for Apron Reinforcement.

Dimension "E" shown is minimum and is considered the design length. Appropriately adjust for any difference between the actual length of concrete apron installed and the length indicated hereon for the length of concrete culvert pipe furnished.

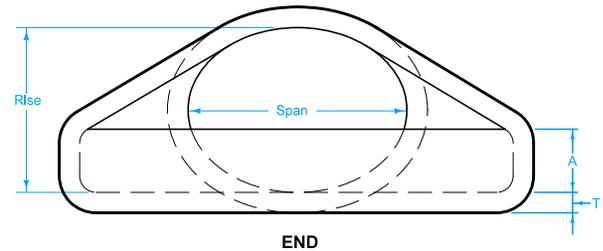
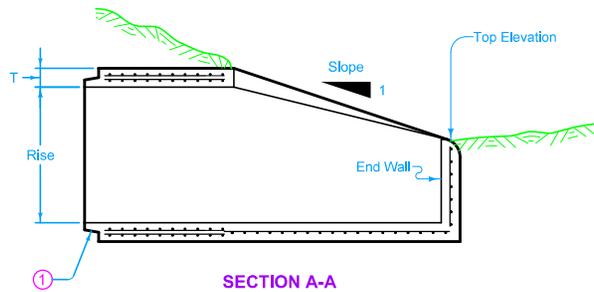
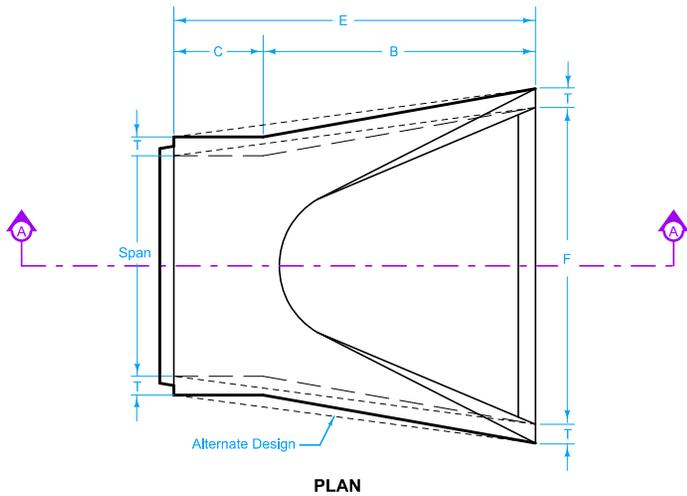
Install connected pipe joints as shown on DR-121.

① Tongue end on inlet end section. Groove end on outlet end section. Inlet end section shown.

Possible Contract Item:  
Low Clearance Concrete Pipe Aprons

Possible Tabulations:  
104-3  
104-4

|  |              |
|--|--------------|
|  | REVISION     |
|  | New 04-19-16 |
| STANDARD ROAD PLAN   | DR-206       |
| REVISIONS: New.  | SHEET 1 of 2 |
| <br>APPROVED BY DESIGN METHODS ENGINEER                    |              |
| <b>LOW CLEARANCE CONCRETE<br/>PIPE APRON WITH END WALL</b> |              |



Comply with AASHTO M 207 for Apron Reinforcement.

Dimension "E" shown is minimum and is considered the design length. Appropriately adjust for any difference between the actual length of concrete apron installed and the length indicated hereon for the length of concrete culvert pipe furnished.

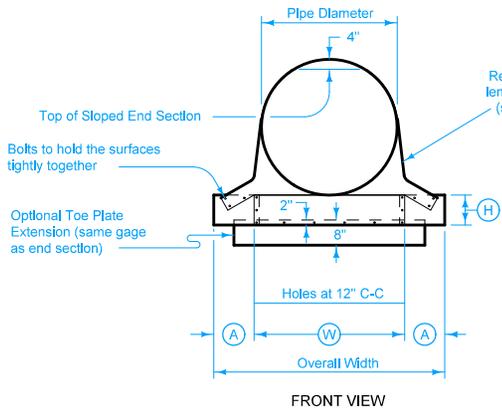
Install connected pipe joints as shown on DR-121.

① Tongue end on inlet end section. Groove end on outlet end section. Inlet end section shown.

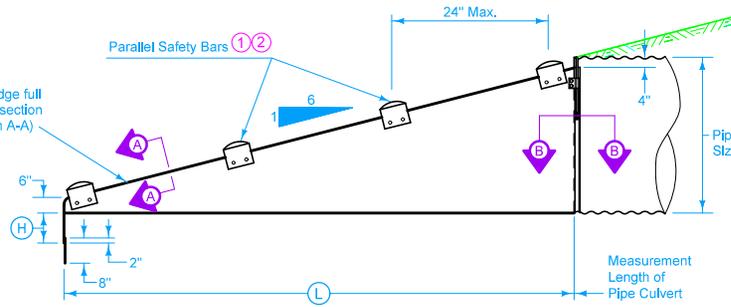
| EQUIVALENT DIAMETER<br>Inches | SPAN<br>Inches | RISE<br>Inches | SLOPE    | APPROXIMATE DIMENSIONS<br>Inches |                  |    |     |                 |                 |
|-------------------------------|----------------|----------------|----------|----------------------------------|------------------|----|-----|-----------------|-----------------|
|                               |                |                |          | T                                | A                | B  | C   | E               | F               |
|                               |                |                |          | 18                               | 23               | 14 | 3:1 | 2 $\frac{3}{4}$ | 7 $\frac{1}{2}$ |
| 24                            | 30             | 19             | 3:1      | 3 $\frac{1}{4}$                  | 8 $\frac{1}{2}$  | 39 | 33  | 72              | 48              |
| 30                            | 38             | 24             | 3:1      | 3 $\frac{3}{4}$                  | 9 $\frac{1}{2}$  | 54 | 18  | 72              | 60              |
| 36                            | 45             | 29             | 2.5 to 1 | 4 $\frac{1}{2}$                  | 11 $\frac{1}{8}$ | 60 | 24  | 84              | 72              |
| 42                            | 53             | 34             | 2.5 to 1 | 5                                | 15 $\frac{3}{4}$ | 60 | 36  | 96              | 78              |
| 48                            | 60             | 38             | 2.5 to 1 | 5 $\frac{1}{2}$                  | 21               | 60 | 36  | 96              | 84              |
| 54                            | 68             | 43             | 2.5 to 1 | 6                                | 25 $\frac{1}{2}$ | 60 | 36  | 96              | 90              |
| 60                            | 76             | 48             | 2.5 to 1 | 6 $\frac{1}{2}$                  | 30               | 60 | 36  | 96              | 96              |
| 72                            | 91             | 58             | 2.5 to 1 | 7 $\frac{1}{2}$                  | 36               | 63 | 33  | 96              | 108             |
| 90                            | 113            | 72             | 1.6 to 1 | 9                                | 36 $\frac{1}{2}$ | 58 | 38  | 96              | 113             |

ELLIPTICAL PIPE

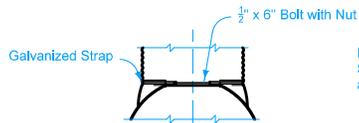
|  |              |
|--|--------------|
|  | REVISION     |
|  | New 04-19-16 |
| STANDARD ROAD PLAN   | DR-206       |
| REVISIONS: New.  | SHEET 2 of 2 |
| <br>APPROVED BY DESIGN METHODS ENGINEER                    |              |
| <b>LOW CLEARANCE CONCRETE<br/>PIPE APRON WITH END WALL</b> |              |



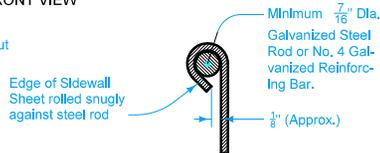
FRONT VIEW



SIDE ELEVATION

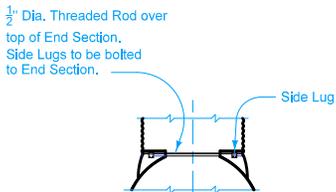


CONNECTOR  
(15"-24" Dia.)

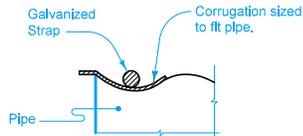


SECTION A-A

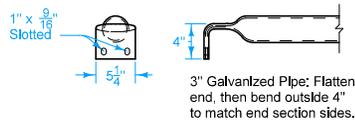
| Pipe Dia. (In.) | Min. Thick. In. | Dimensions (Inches) |    |    |    |               |     |
|-----------------|-----------------|---------------------|----|----|----|---------------|-----|
|                 |                 | Gage                | A  | H  | W  | Overall Width | L   |
| 15              | .064            | 16                  | 8  | 6  | 21 | 37            | 30  |
| 18              | .064            | 16                  | 8  | 6  | 24 | 40            | 48  |
| 21              | .064            | 16                  | 8  | 6  | 27 | 43            | 66  |
| 24              | .064            | 16                  | 8  | 6  | 30 | 46            | 84  |
| 30              | .109            | 12                  | 12 | 9  | 36 | 60            | 120 |
| 36              | .109            | 12                  | 12 | 9  | 42 | 66            | 156 |
| 42              | .109            | 12                  | 16 | 12 | 48 | 80            | 192 |
| 48              | .109            | 12                  | 16 | 12 | 54 | 86            | 228 |
| 54              | .109            | 12                  | 16 | 12 | 60 | 92            | 264 |
| 60              | .109            | 12                  | 16 | 12 | 66 | 98            | 300 |



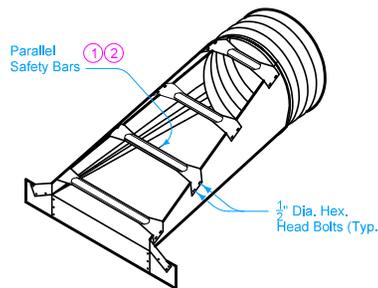
CONNECTOR  
(30"-60" Dia.)



SECTION B-B



PARALLEL SAFETY BARS



PERSPECTIVE VIEW  
OF APRON

Install aprons and hardware fabricated from galvanized steel complying with Section 4141 of the Standard Specifications. Alternate design details may be submitted to the Engineer for approval.

- Apron may be attached to culvert pipe as follows:
- A. If normal culvert is of circumferential corrugation type, use an approved bolt or clamp to fasten apron directly to apron.
  - B. If normal culvert is of helical corrugation type:
    1. Use an approved sizing ring securely fastened to inside diameter of apron to connect to the culvert pipe using special dimple band connector.
    2. "Dimple" bands will not be allowed when a positive joint is specified.

Refer to Materials I.M. 441 for approved coupling devices.

Repair, to the Engineer's satisfaction, breaks or damage to the coating that occur during handling or installation.

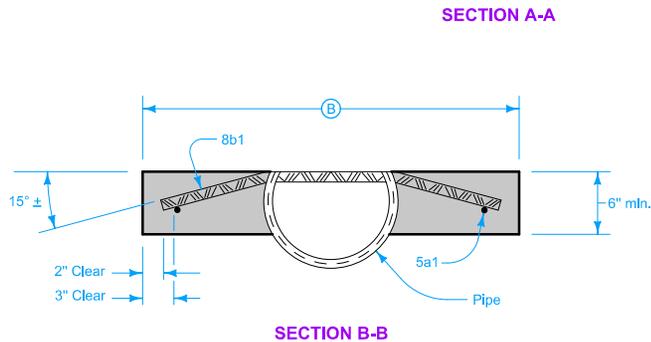
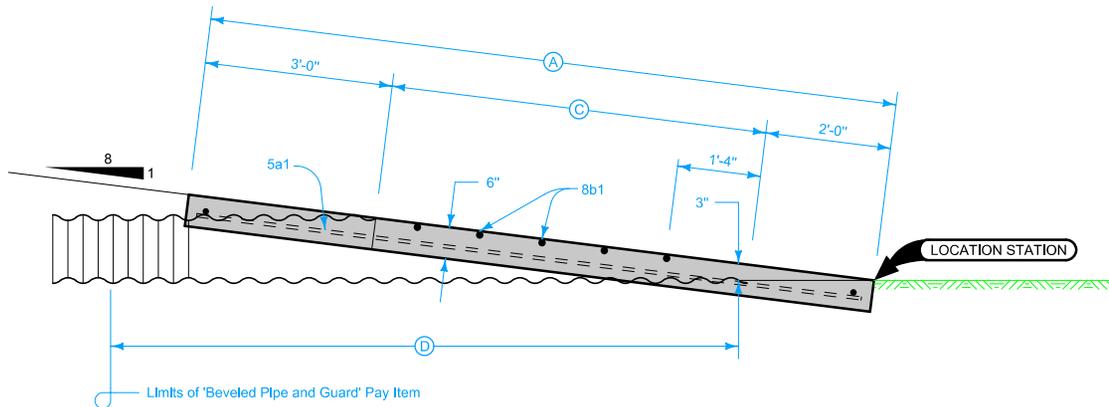
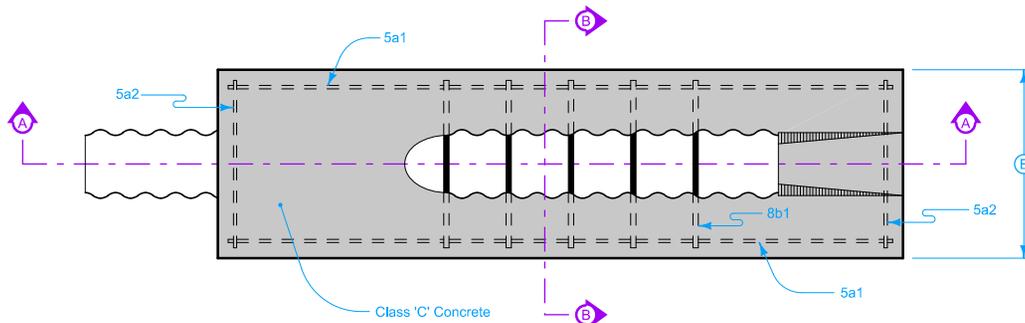
Price bid for "Aprons, Safety Slope" is full compensation for fabrication and installation of the apron.

- ① Number of bars required will vary depending on the length of the end section.
- ② Parallel safety bars are required for pipes 30" diameter and larger. For pipe 24" diameter and smaller, parallel safety bars will be required only when specified in the project plans.

Possible Contract Item:  
Aprons, Safety Slope

Possible Tabulation:  
104-3

|  |                          |
|--|--------------------------|
| <br><b>STANDARD ROAD PLAN</b>                          | REVISION<br>New 04-21-15 |
|  | DR-211                   |
|  | SHEET 1 of 1             |
| REVISIONS: New. Replaces RF-44                         |                          |
| <br><small>APPROVED BY DESIGN METHODS ENGINEER</small> |                          |
| METAL SAFETY SLOPE APRON<br>6:1 SLOPE                  |                          |



| TABLE OF DIMENSIONS |        |       |        |        |
|---------------------|--------|-------|--------|--------|
| PIPE SIZE           | A      | B     | C      | D      |
| 12"                 | 11'-0" | 3'-0" | 6'-0"  | 10'-0" |
| 15"                 | 13'-2" | 3'-3" | 8'-2"  | 12'-0" |
| 18"                 | 15'-4" | 3'-6" | 10'-4" | 14'-0" |
| 21"                 | 17'-8" | 3'-9" | 12'-6" | 16'-0" |
| 24"                 | 19'-8" | 4'-0" | 14'-8" | 18'-0" |

| REINFORCING BAR LIST |     |          |       |       |         |          |        |              |            |
|----------------------|-----|----------|-------|-------|---------|----------|--------|--------------|------------|
| PIPE SIZE            | BAR | LOCATION | SHAPE | COUNT | LENGTH  | LIN. FT. | WEIGHT | TOTAL WEIGHT | SPACING    |
| 12"                  | 5a1 | Base     | ▬▬▬▬  | 2     | 10'-8"  | 21.4     | 22.3   | 65.8         | See Detail |
|                      | 5a2 | Base     | ▬▬▬▬  | 2     | 2'-8"   | 5.4      | 5.6    |              | See Detail |
|                      | 8b1 | Base     | ▬▬▬▬  | 5     | 2'-10"  | 14.2     | 37.9   |              | 12"        |
| 15"                  | 5a1 | Base     | ▬▬▬▬  | 2     | 12'-10" | 25.7     | 26.8   | 90.7         | See Detail |
|                      | 5a2 | Base     | ▬▬▬▬  | 2     | 2'-11"  | 5.9      | 6.2    |              | See Detail |
|                      | 8b1 | Base     | ▬▬▬▬  | 7     | 3'-1"   | 21.6     | 57.7   |              | 12"        |
| 18"                  | 5a1 | Base     | ▬▬▬▬  | 2     | 15'-0"  | 30.0     | 31.3   | 118.1        | See Detail |
|                      | 5a2 | Base     | ▬▬▬▬  | 2     | 3'-2"   | 6.4      | 6.7    |              | See Detail |
|                      | 8b1 | Base     | ▬▬▬▬  | 9     | 3'-4"   | 30.0     | 80.1   |              | 12"        |
| 21"                  | 5a1 | Base     | ▬▬▬▬  | 2     | 17'-2"  | 34.4     | 35.9   | 148.6        | See Detail |
|                      | 5a2 | Base     | ▬▬▬▬  | 2     | 3'-5"   | 6.9      | 7.2    |              | See Detail |
|                      | 8b1 | Base     | ▬▬▬▬  | 11    | 3'-7"   | 39.5     | 105.5  |              | 12"        |
| 24"                  | 5a1 | Base     | ▬▬▬▬  | 2     | 19'-4"  | 38.7     | 40.4   | 181.3        | See Detail |
|                      | 5a2 | Base     | ▬▬▬▬  | 2     | 3'-8"   | 7.4      | 7.7    |              | See Detail |
|                      | 8b1 | Base     | ▬▬▬▬  | 13    | 3'-10"  | 49.9     | 133.2  |              | 12"        |

For reinforcing steel used in construction of "Beveled Pipe and Guard", use deformed bars meeting the requirements of Article 4151.03 of the Standard Specifications and hot-dip galvanized according to ASTM A123.

Use Class 'C' Concrete in the construction of Beveled Pipe and Guard.

Cut the pipe to fit the foreslope. Cut slots into the pipe for placement of the No. 8 bars. After the foreslope has been placed, fit the No. 8 bars into the slots cut in the pipe so they will be in proper position when the concrete collar is poured.

Price bid for "Beveled Pipe and Guard," each, is full compensation for furnishing all materials and constructing the Beveled Pipe and Guard.

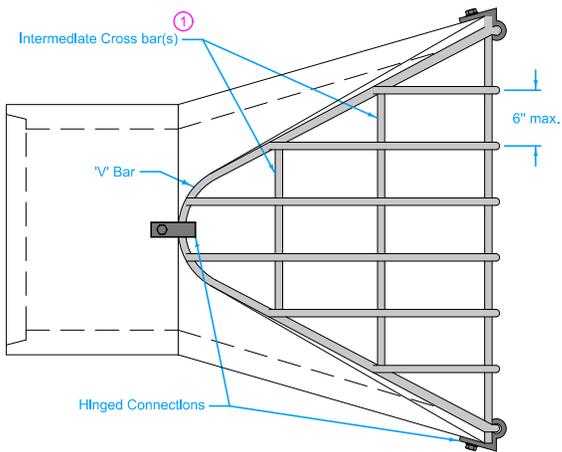
Special Note:

A silt fence ditch check is required immediately upstream from the inlet. Refer to EC-201 for construction details.

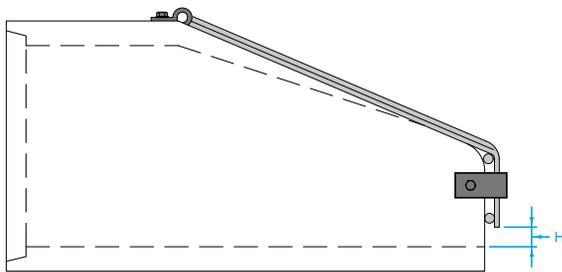
Possible Contract Item:  
Beveled Pipe and Guard

Possible Tabulations:  
104-3  
112-8

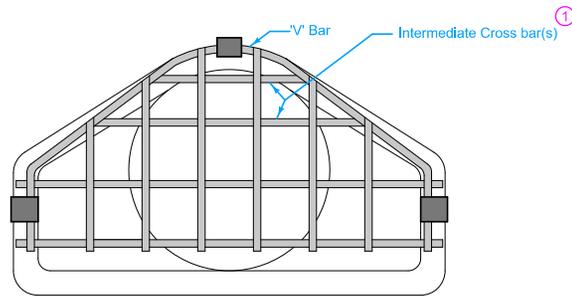
|                                     |               |
|-------------------------------------|---------------|
|                                     | REVISION      |
|                                     | New 04-21-15  |
| <b>STANDARD ROAD PLAN</b>           | <b>DR-212</b> |
|                                     | SHEET 1 of 1  |
| REVISIONS: New. Replaces RF-27.     |               |
|                                     |               |
| APPROVED BY DESIGN METHODS ENGINEER |               |
| <b>BEVELED PIPE AND GUARD</b>       |               |



PLAN



PROFILE



FRONT

| ROUND     |     | ARCH                   |    |
|-----------|-----|------------------------|----|
| PIPE SIZE | H   | PIPE SIZE              | H  |
| 12"       | 2½" | 22" x 14" to 29" x 18" | 4" |
| 15"       | 3"  | 37" x 23" to 44" x 27" | 5" |
| 18" - 24" | 4"  | 52" x 32" to 65" x 40" | 6" |
| 27" - 36" | 5"  | 73" x 45" to 88" x 54" | 7" |
| 42" - 54" | 6"  |                        |    |
| 60" - 72" | 7"  |                        |    |
| 78" - 90" | 8"  |                        |    |

| BAR SIZES |                        |                  |           |          |
|-----------|------------------------|------------------|-----------|----------|
|           | PIPE SIZE              | HOLE DIA. REQ'D. | BOLT DIA. | BAR SIZE |
| ROUND     | 12" - 24"              | ¾"               | ¾"        | ¾"       |
|           | 27" - 48"              | 7⁄8"             | ¾"        | 1"       |
|           | 54" - 90"              | 1 1⁄8"           | 1"        | 1 1⁄4"   |
| ARCH      | up to 29" x 18"        | ¾"               | ¾"        | ¾"       |
|           | 37" x 23" to 59" x 36" | 7⁄8"             | ¾"        | 1"       |
|           | 65" x 40" to 88" x 54" | 1 1⁄8"           | 1"        | 1 1⁄4"   |

BOLT LENGTH = PIPE WALL THICKNESS + 2½"

Provide guard dimensions to fit with Type of apron provided (DR-201 or DR-202). V Bar is to completely rest on apron.

Use ASTM A615, Grade 40, or merchant quality, smooth or deformed steel bars in construction of the guard. Comply with fabrication requirements of Section 2404 of the Standard Specifications.

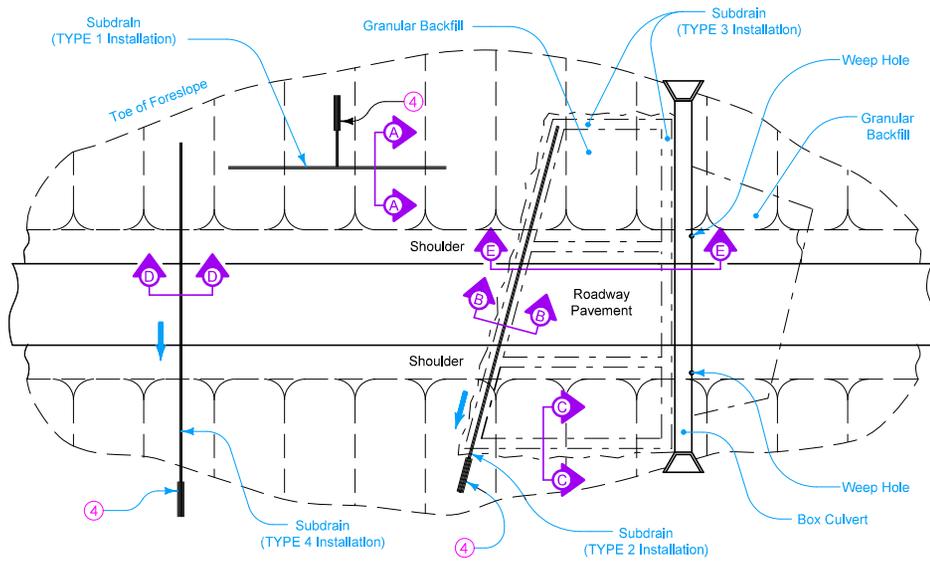
Hot-dip galvanize the completed apron guard according to ASTM A123.

Use bolts, nuts, washers, and fasteners complying with Article 4153.06 of the Standard Specifications.

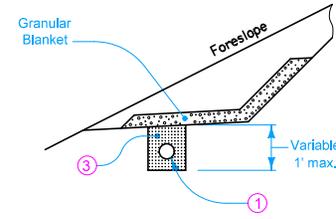
- ① All guards are to have at least one intermediate cross bar. If pipe size is 60 inches or greater, use two intermediate cross bars equally spaced.

Possible Tabulation:  
104-3

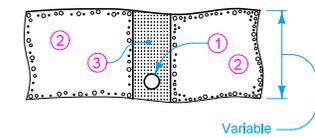
|  |              |
|--|--------------|
| <br><b>STANDARD ROAD PLAN</b>                          | REVISION     |
|  | New 04-21-15 |
| DR-213   | SHEET 1 of 1 |
| REVISIONS: New, replaces RF-26.                        |              |
| <br><small>APPROVED BY DESIGN METHODS ENGINEER</small> |              |
| PIPE APRON GUARD                                       |              |



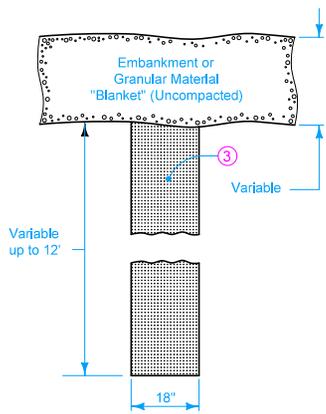
PLAN VIEW OF TYPICAL STANDARD SUBDRAIN INSTALLATIONS



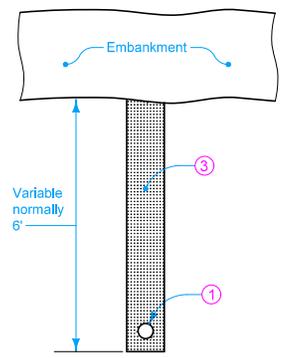
TYPE 1 INSTALLATION  
BENCH DRAIN  
SECTION A-A



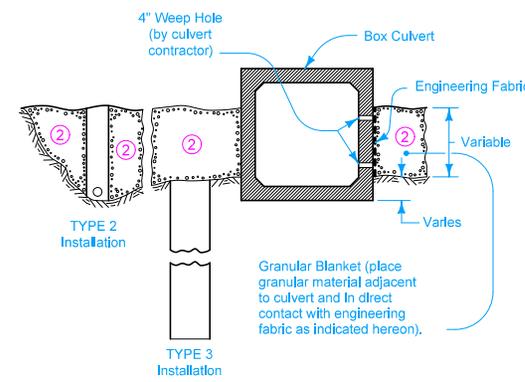
TYPE 2 INSTALLATION  
SUBDRAIN  
SECTION B-B



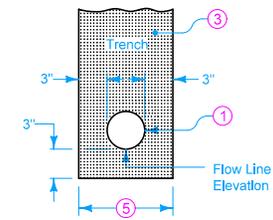
TYPE 3 INSTALLATION  
TRENCH DRAIN  
SECTION C-C



TYPE 4 INSTALLATION  
SUBDRAIN  
SECTION D-D



SECTION E-E  
SUBSOIL DRAINAGE



TUBING PLACEMENT DETAIL  
ALL TYPES

For specific information for individual locations, refer to the detail project plans, soils survey sheets, and tabulations of subdrains.

Dispose of material excavated from trenches for subdrain as directed by the Engineer. No extra compensation will be made for such disposal.

Cap blind ends of subdrains with a metal cap or by other methods approved by the Engineer. Install all perforated pipe with the perforations centered on flowline of the bottom side of the subdrain.

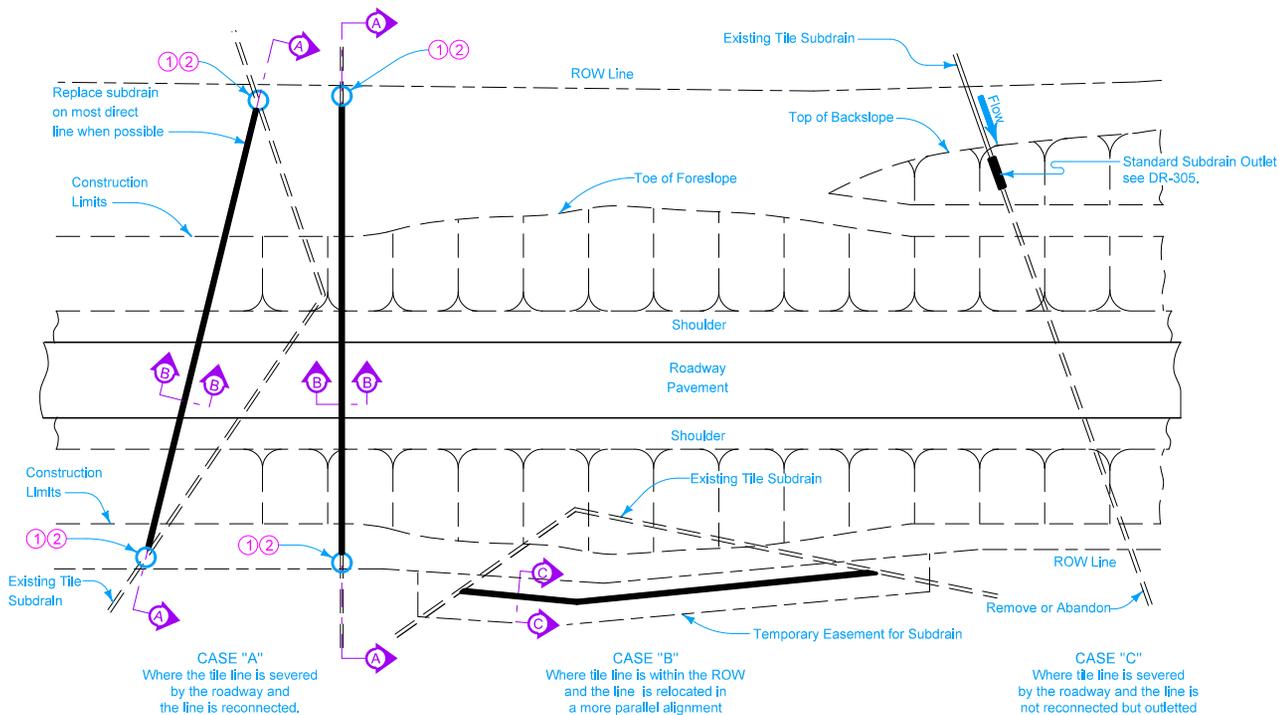
Place Granular Material for Blankets as indicated on the plans.

- ① Perforated Subdrain (Polyethylene Corrugated Tubing).
- ② Granular Material for Blanket (Uncompacted).
- ③ Porous Backfill (Uncompacted).
- ④ For Subdrain outlet construction details, see DR-304 and DR-305.
- ⑤ 10 inches for 4 inch subdrain; 12 inches for 6 inch subdrain.

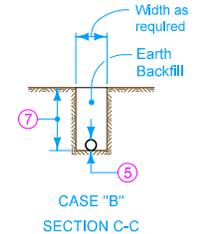
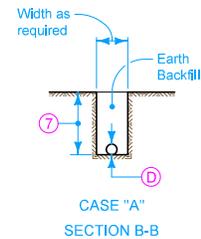
- Possible Contract Items:
- Standard Subdrain
  - Trench Drain
  - Granular Material for Blanket and Subdrain
  - Subdrain Outlet (DR-304)
  - Subdrain Outlet (DR-305)

Possible Tabulation:  
104-5C

|   |          |               |
|---|----------|---------------|
| <b>IOWA DOT</b>   | REVISION |               |
|   | New      | 04-21-15      |
| <b>STANDARD ROAD PLAN</b>   |          | <b>DR-301</b> |
| REVISIONS: New. Replaces RF-19A.                                    |          | SHEET 1 of 1  |
| <i>Brian Smith</i><br>APPROVED BY DESIGN METHODS ENGINEER           |          |               |
| <b>SUBDRAINS<br/>FOR FILL OR FOUNDATION DRAINAGE<br/>(STANDARD)</b> |          |               |



TYPICAL PLAN FOR REPLACING OR RELOCATING EXISTING FIELD TILE



When the existing tile lines are intercepted by roadway construction, replace them within the ROW limits of the project, or outlet them in a ditch or channel. Where the roadway intersects the tile line in an undesirable alignment, as shown in Case 'A', relocate the tile line to accomplish a more nearly right angle. Where the existing tile line alignment is more parallel to the roadway and within the construction limits, relocate the tile outside the ROW line, as shown in Case 'B'. In cases where new construction requires existing subdrain to outlet into the roadway ditch, as shown in Case 'C', provide the Standard Subdrain Outlet shown in DR-305.

Replace tile lines within the ROW limits according to the replacement schedule shown below. Install an inspection access at each end of replaced tile line. Replace tile lines outside the ROW limits using the same size of pipe as existing line.

| REPLACEMENT SCHEDULE CASE 'A'<br>(Pipe size in inches) |                                |                 |
|--|--------------------------------|-----------------|
| Existing Tile Size                                     | PROPOSED SUBDRAIN SIZE (D) (4) |                 |
|  | Concrete Pipe                  | Coated CMP Pipe |
| 4  | -                              | 10              |
| 6  | -                              | 12              |
| 8  | 12                             | 15              |
| 10   | 15                             | 18              |
| 12   | 15                             | 21              |
| 15   | 18                             | 24              |
| 18   | 21                             | 30              |
| 21   | 24                             | 36              |
| 24   | 30                             | 36              |
| > 24   | Existing tile size + 6"        | (6)             |

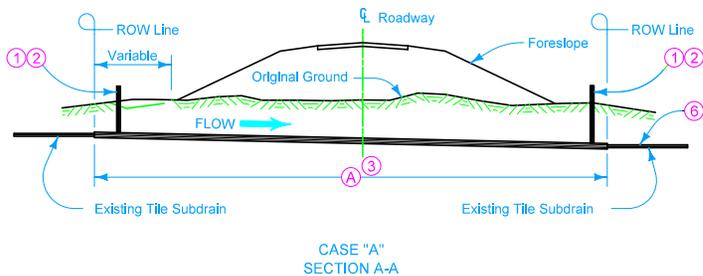
Install relocated or replacement subdrain so as to cause a minimum of disturbance to existing field tile. Connect to lines of existing tile drains in such a way as to leave the existing tile drains in a functional condition.

Cap blind ends of subdrains with a metal cap or as approved by the Engineer.

When concrete culvert pipe of 2000D (Class III) or stronger is required, furnish and install a DR-121 Type 1 connection at no additional cost to the Contracting Authority.

Possible Contract Items:  
Standard Subdrain  
Subdrain Outlet

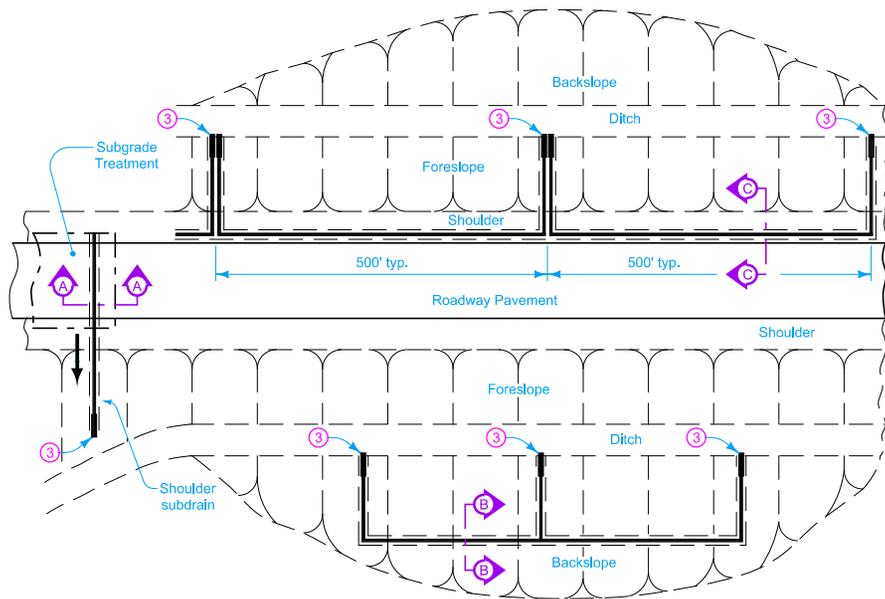
Possible Tabulation:  
104-5C



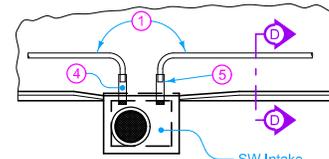
CASE "A" SECTION A-A

- 1 4 inch diameter inspection access with cap. Minimum of 3 feet above ground. Use PVC meeting the requirements of Article 4146.03 of the Standard Specifications.
- 2 Inspection access is required to allow inspection by the upstream and downstream property owners. Perforated pipe may be used to allow ditch drainage into subdrain if approved by adjacent property owners.
- 3 Dimension (A) indicates the R.O.W. limits in which replacement of tile subdrain according to the replacement schedule is required.
- 4 Replacement sizes provide equivalent capacity based on a 6 inch settlement assuming a 0.20% slope with  $n=0.013$  for concrete pipe and  $n=0.025$  for corrugated pipe (Manning's Formula)
- 5 Replace in kind (size and type) or with 'PE' slotted pipe, a minimum of one size larger than existing line.
- 6 When multiple drains are connected to one outlet, the outlet is to provide full capacity for all connected drain systems.
- 7 Depth as required.

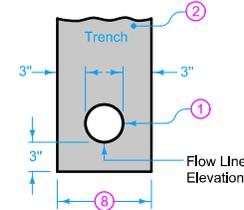
|   |                          |
|---|--------------------------|
| <br><b>STANDARD ROAD PLAN</b>                                   | REVISION<br>1   10-20-15 |
|   | <b>DR-302</b>            |
|   | SHEET 1 of 1             |
| REVISIONS: Changed reference from RF-19F to DR-305 In CASE 'C'. |                          |
| APPROVED BY DESIGN METHODS ENGINEER<br>                         |                          |
| <b>SUBDRAINS<br/>STANDARD<br/>(FARM TILE REPLACEMENT)</b>       |                          |



PLAN



INTAKE OUTLET



TUBING PLACEMENT ALL TYPES

When culverts which are less than 1 foot below the trench bottom are encountered within a tabulated subdrain, stop the trench 3 feet from the culvert and resume 3 feet beyond the culvert.

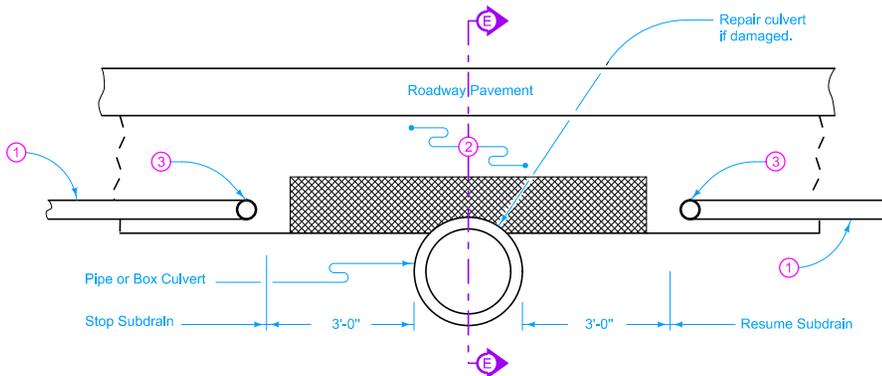
On new construction projects, place the subdrain after the special backfill, if required, and prior to granular or paved shoulder material.

Except for backslope installations, if the Contractor's operations result in a trench, place and compact granular shoulder material in the trench to be level with the adjacent surface prior to opening lanes to traffic.

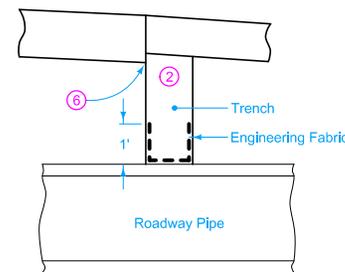
- ① Perforated Subdrain (Corrugated Polyethylene Tubing).
- ② Porous Backfill for Subdrain (compacted).
- ③ Subdrain outlets. See DR-304.
- ④ 2 foot section of corrugated metal pipe of diameter 2" larger than subdrain or 2 foot section of double-walled PE or PVC pipe of the same diameter as subdrain. Pipe will be paid for as "Subdrain Outlet (DR-303)".
- ⑤ Connect PE or PVC outlet with an appropriate coupler. Connect CMP outlet one of two ways: (1) Inside-fit reducer coupler (1 foot minimum fit inside CMP); or (2) Insert 1 foot of the 4 inch subdrain into 6 inch CMP and fully seal entire opening with grout.
- ⑥ Place porous backfill in direct contact with a minimum of 2 inches of pavement and continuous to shoulder material as per note 10 or 11.
- ⑦ If the trench is inadvertently carried over the culvert, repair the trench as detailed on this sheet. If obstruction is 1 foot or more below trench bottom, carry subdrain line over in continuous alignment. No payment will be made for trench repair.
- ⑧ 10 inches for 4 inch subdrain. 12 inches for 6 inch subdrain.

Possible Contract Items:  
 Subdrain, Longitudinal, (Backslope)  
 Subdrain, Longitudinal, (Shoulder)  
 Subdrain Outlet (DR-303)  
 Subdrain Outlet (DR-304)

Possible Tabulation:  
 104-9



TRENCH REPAIR AT PIPE CULVERT ⑦



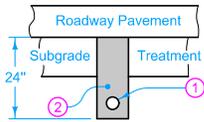
SECTION E-E

|                 |                           |              |
|-----------------|---------------------------|--------------|
| <b>IOWA DOT</b> | REVISION                  |              |
|                 | 2                         | 10-18-16     |
|                 | <b>STANDARD ROAD PLAN</b> |              |
| <b>DR-303</b>   |                           | SHEET 1 of 2 |

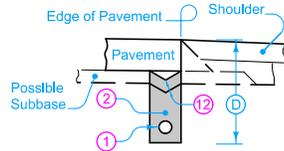
REVISIONS: Changed text from Roadway Pavement to Roadway Pavement In TRENCH REPAIR AT PIPE CULVERT detail on page 1.

*Brian Smith*  
 APPROVED BY DESIGN METHODS ENGINEER

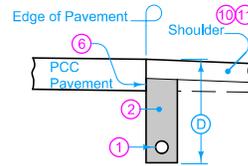
**SUBDRAINS  
 (LONGITUDINAL)**



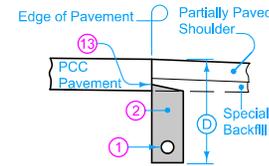
**TYPE 5 INSTALLATION**  
SECTION A-A  
Subgrade Treatment Subdrain



**TYPE 6 INSTALLATION**  
SECTION C-C  
For Drain Placement Prior to  
Subbase or Pavement Placement

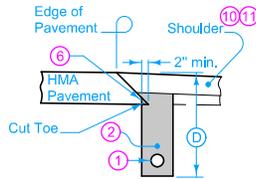


**TYPE 7A INSTALLATION**  
SECTION C-C

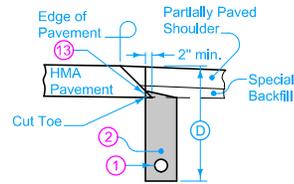


**TYPE 7B INSTALLATION**  
SECTION C-C

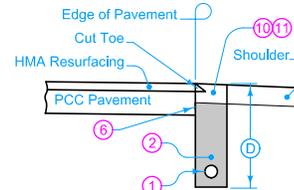
- ① Perforated Subdrain (Corrugated Polyethylene Tubing).
- ② Porous Backfill for Subdrain (compacted).
- ⑥ Place porous backfill in direct contact with a minimum of 2 inches of pavement and continuous to shoulder material as per note 11 or 12.
- ⑨ Install subdrain as cut proceeds.
- ⑩ On existing Granular or Earth Shoulders, replace with 4 inch minimum depth granular shoulder material.
- ⑪ On Paved Shoulders, refer to Section 2502 of the Standard Specifications for finishing shoulder.
- ⑫ Cut "V" notch just prior to subbase (if proposed) or pavement placement to assure uncontaminated contact.
- ⑬ Place top of subdrain trench at the bottom of pavement. Backfill trench so that a wedge of porous backfill has a minimum vertical contact of 2 inches with the pavement.



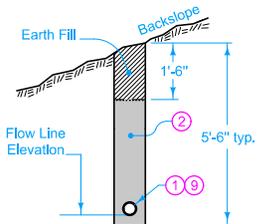
**TYPE 8A INSTALLATION**  
SECTION C-C



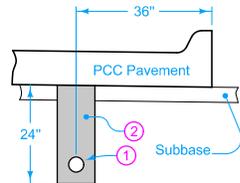
**TYPE 8B INSTALLATION**  
SECTION C-C



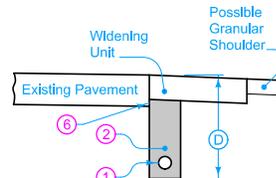
**TYPE 9 INSTALLATION**  
SECTION C-C  
Composite Pavement  
with Existing Shoulder



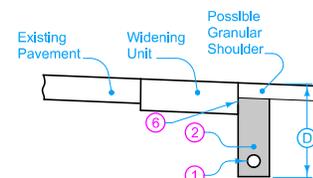
**TYPE 11 INSTALLATION**  
SECTION B-B  
Backslope



**TYPE 12 INSTALLATION**  
SECTION D-D

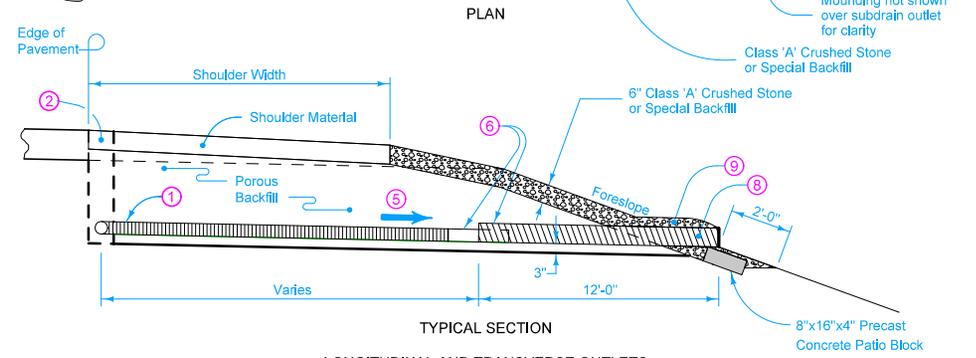
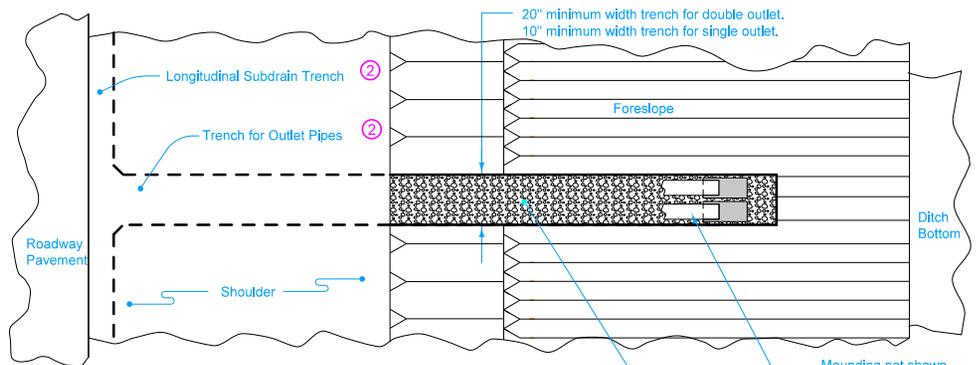


**TYPE 13 INSTALLATION**  
SECTION C-C  
For New Widening Unit if  
Thinner than Existing Pavement

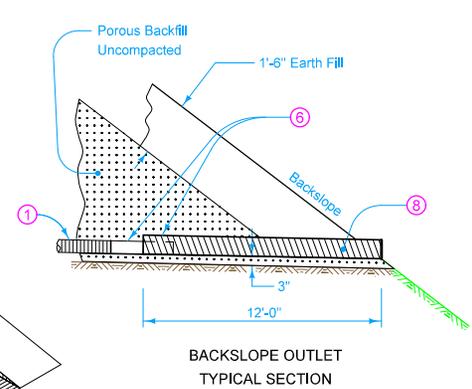
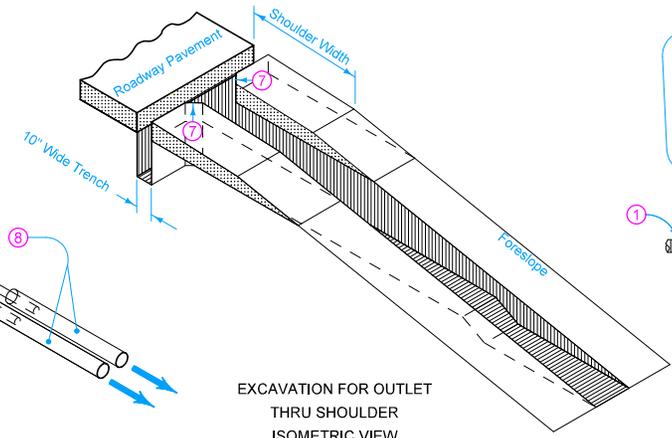
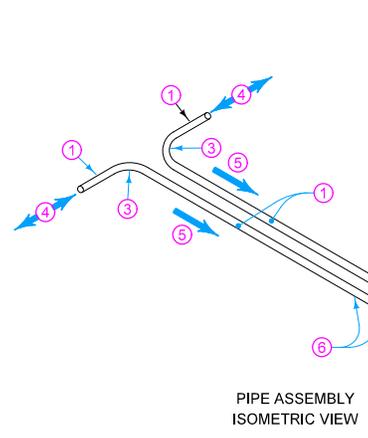


**TYPE 14 INSTALLATION**  
SECTION C-C  
For New Widening Unit if  
Thicker than Existing Pavement

|   |                               |
|---|-------------------------------|
| <br><b>STANDARD ROAD PLAN</b>   | REVISION                      |
|   | 2 10-18-16                    |
|   | <b>DR-303</b><br>SHEET 2 of 2 |
| REVISIONS: Changed text from Roadway Payment to Roadway Pavement In TRENCH REPAIR AT PIPE CULVERT detail on page 1. |                               |
| <i>Brian Smith</i><br>APPROVED BY DESIGN METHODS ENGINEER   |                               |
| <b>SUBDRAINS</b><br><b>(LONGITUDINAL)</b>   |                               |



LONGITUDINAL AND TRANSVERSE OUTLETS



- ① Perforated Subdrain (Polyethylene Corrugated Tubing).
- ② On projects where existing shoulder material is removed, replace the shoulder material according to Article 2502.03, C of the Standard Specifications.
- ③ 'Y' or 'T' connection will not be allowed. Place subdrain on 1 foot minimum radius.
- ④ Direction of flow.
- ⑤ 6 inch minimum drop in elevation between longitudinal subdrain and outlet. 12 inch minimum drop for projects using recycled PCC subbase.
- ⑥ Corrugated metal pipe outlet 2 inches larger than subdrain pipe or corrugated double-walled PE or PVC pipe of the same diameter as the subdrain pipe with an appropriate coupler. If metal pipe is used, the pipes should be coupled in one of the following ways: (1) Use an inside fit reducer coupler (insert coupler a minimum of 12 inches into CMP); or (2) Insert 1 inch of the 4 inch subdrain into the 6 inch metal outlet pipe, then fully seal the entire opening with grout.
- ⑦ Bevel the trench to provide a minimum of 3 inches of porous backfill surrounding all portions of subdrain pipe.
- ⑧ Corrugated metal pipe outlet 2 inches larger than existing subdrain pipe, or corrugated double-walled PE or PVC pipe of the same diameter as the existing subdrain pipe.
- ⑨ Place class 'A' crushed stone or Special Backfill over outlet and carefully compact to avoid damaging outlet pipe.

Possible Contract Item:  
Subdrain Outlet, DR-304

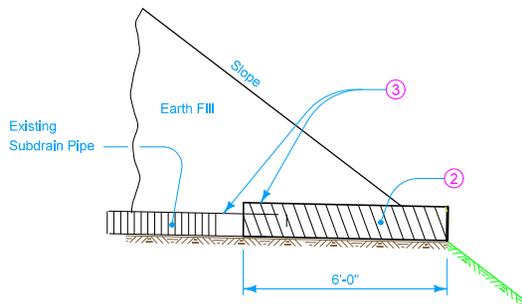
Possible Tabulation:  
104-5C

|                           |               |              |
|---------------------------|---------------|--------------|
| <b>IOWA DOT</b>           | REVISION      |              |
|                           | 1             | 10-18-16     |
|                           | <b>DR-304</b> |              |
| <b>STANDARD ROAD PLAN</b> |               | SHEET 1 of 1 |

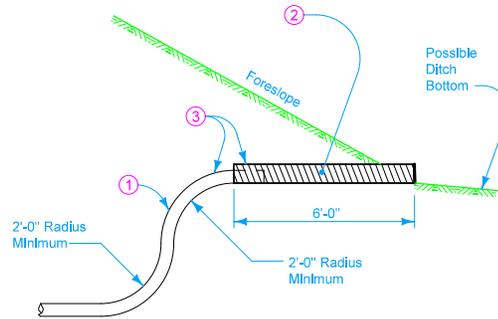
REVISIONS: Removed first paragraph in notes and added Designer Info button.

*Brian Smith*  
APPROVED BY DESIGN METHODS ENGINEER

**OUTLETS  
FOR LONGITUDINAL, TRANSVERSE  
AND BACKSLOPE SUBDRAINS**

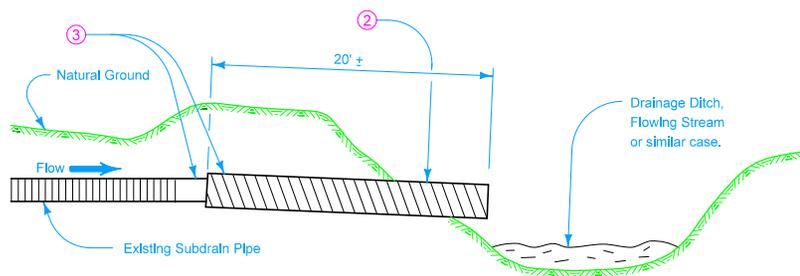


**STANDARD SUBDRAIN OUTLET  
TYPE A**  
For existing subdrain pipes 12" or less in diameter. (4)



**PRESSURE RELEASE OUTLET  
TYPE B**

- (1) Perforated Subdrain (Polyethylene Corrugated Tubing).
- (2) If corrugated metal pipe is used, an outlet 2 inches larger than existing subdrain pipe is required. If double-walled PE or PVC pipe is used, an outlet pipe of the same diameter as the existing subdrain pipe may be used.
- (3) The pipes should be coupled in one of the two following ways: (1) Use an inside fit reducer coupler (coupler must be inserted a minimum of 12 inches into C.M.P.); or (2) Insert 12 inches of the existing subdrain pipe into the corrugated metal outlet pipe, then fully seal the entire opening with grout.
- (4) For existing subdrain pipes larger than 12 inches in diameter, use Special Outlet, Type C.



**SPECIAL OUTLET  
TYPE C**

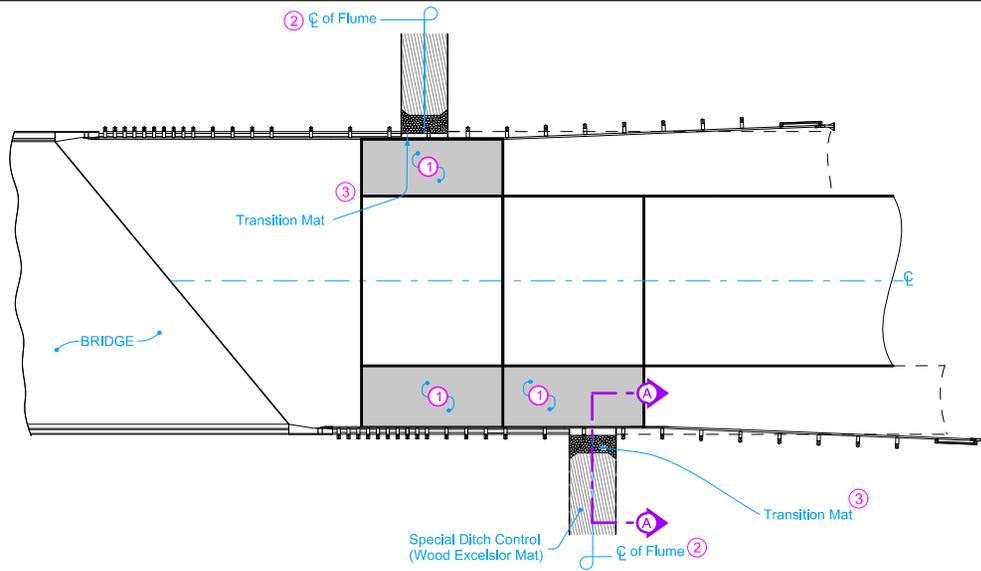
Possible Contract Item:  
Subdrain Outlet (DR-305)

Possible Tabulation:  
104-5C

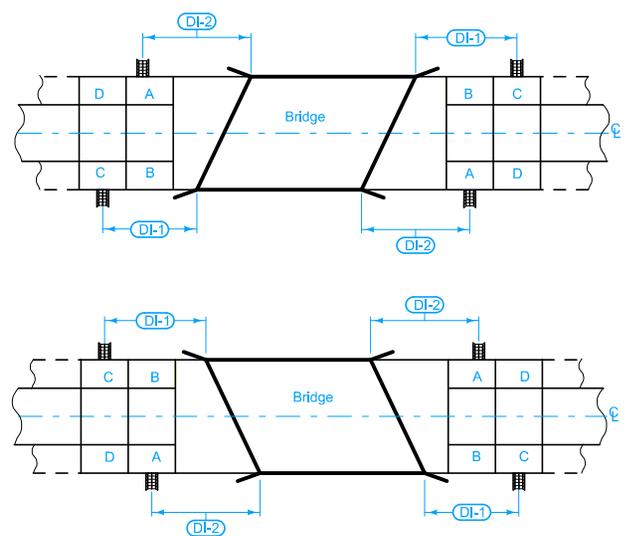
|  |          |               |
|--|----------|---------------|
| <b>IOWA DOT</b>  | REVISION |               |
|  | New      | 04-21-15      |
| <b>STANDARD ROAD PLAN</b>                              |          | <b>DR-305</b> |
|  |          | SHEET 1 of 1  |
| REVISIONS: New. Replaces RF-19F. Removed rodent guard. |          |               |

*Brian Smith*  
APPROVED BY DESIGN METHODS ENGINEER

**SUBDRAIN OUTLETS  
(STANDARD SUBDRAIN,  
PRESSURE RELEASE AND SPECIAL)**



PLAN



PCC SHOULDER PANEL LOCATIONS ②

Price bid for "Bridge End Drain, DR-401" is full compensation for furnishing, installing, and constructing the Bridge End Drain as shown.

- ① Continue 4 inch sloped curb to edge of flume per section B-B. Refer to [BR-201](#), [BR-202](#), [BR-203](#), or [BR-204](#) for details of 4 inch curb.
- ② DI-1 and DI-2 distances measured from center of Bolt Pattern.
- ③ Abut Transition Mat (see [EC-105](#)) panels to the edge of the pavement to prevent from being undercut by water. Cut panels to fit around guardrail posts to ensure pavement edge contract. No deduction will be made for area of Transition Mat removed for guardrail posts.

Possible Contract Items:  
 Bridge End Drain, DR-401  
 Paved Shoulder, Portland Cement Concrete (Paved Shoulder Panel for Bridge End Drain)

Incidental to Paved Shoulder:  
 Modified Subbase  
 Polymer Grid

Incidental to Bridge End Drain:  
 Transition Mat  
 Seeding and Fertilizing  
 Soil Fill  
 Special Ditch Control (Wood Excelsior Mat)  
 Turf Reinforced Mat, Type 2  
 Watering for Sod, Special Ditch Control, or Slope Protection  
 Mobilization for Watering

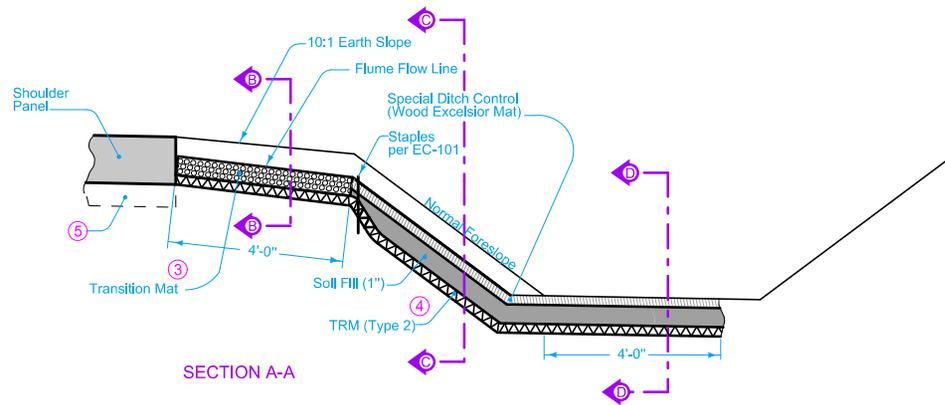
Possible Tabulation:  
 104-8A

|                           |               |         |
|---------------------------|---------------|---------|
| <b>IOWA DOT</b>           | REVISION      |         |
|                           | 2             | 4-18-17 |
| <b>STANDARD ROAD PLAN</b> | <b>DR-401</b> |         |
| SHEET 1 of 2              |               |         |

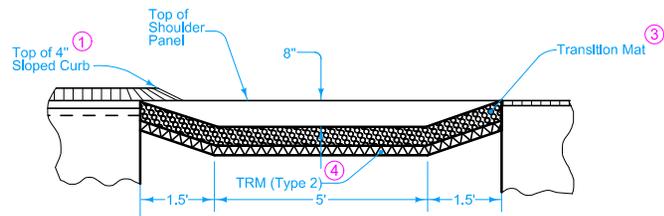
REVISIONS: Replaced text "Outlet or Channel Scour Protection" with "Transition Mat".  
 Renumbered notes. Added hyperlinks to EC-104 and EC-105.

APPROVED BY DESIGN METHODS ENGINEER  
*Brian Smith*

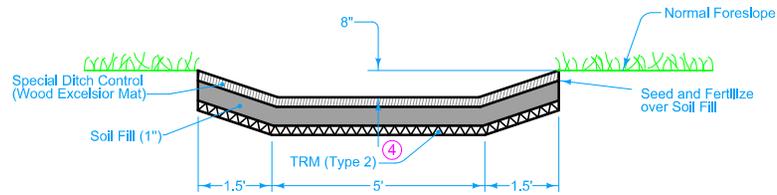
SCOUR PROTECTION  
FOR BRIDGE END DRAIN



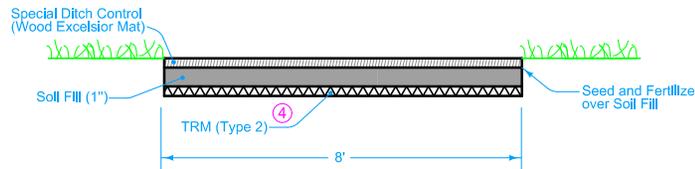
- ① Continue 4 inch sloped curb to edge of flume per section B-B. Refer to BR-201, BR-202, BR-203, or BR-204 for details of 4 inch curb.
- ③ Abut Transition Mat (see EC-105) panels to the edge of the pavement to prevent from being undercut by water. Cut panels to fit around guardrail posts to ensure pavement edge contact. No deduction will be made for area of Transition Mat panel removed for guardrail posts.
- ④ Extend TRM (see EC-104) flume 4 feet beyond toe of slope.
- ⑤ Install modified subbase and polymer grid under PCC shoulder panels as shown in Section A-A on BR-201, BR-202, BR-203, or BR-204.
- ⑥ Transition the flume flow line depth from 3 inches at the downstream edge of Transition Mat to 8 inches with an approximate transition rate of 1 inch vertical per 1 foot horizontal.
- ⑦ Transition the flume flow line depth from 8 inches at the toe of slope to 0 inches with an approximate transition rate of 2 inches vertical per 1 foot horizontal.



SECTION B-B

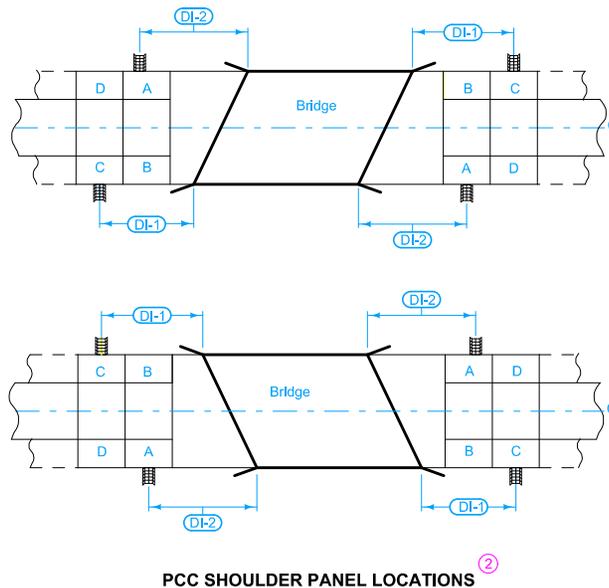
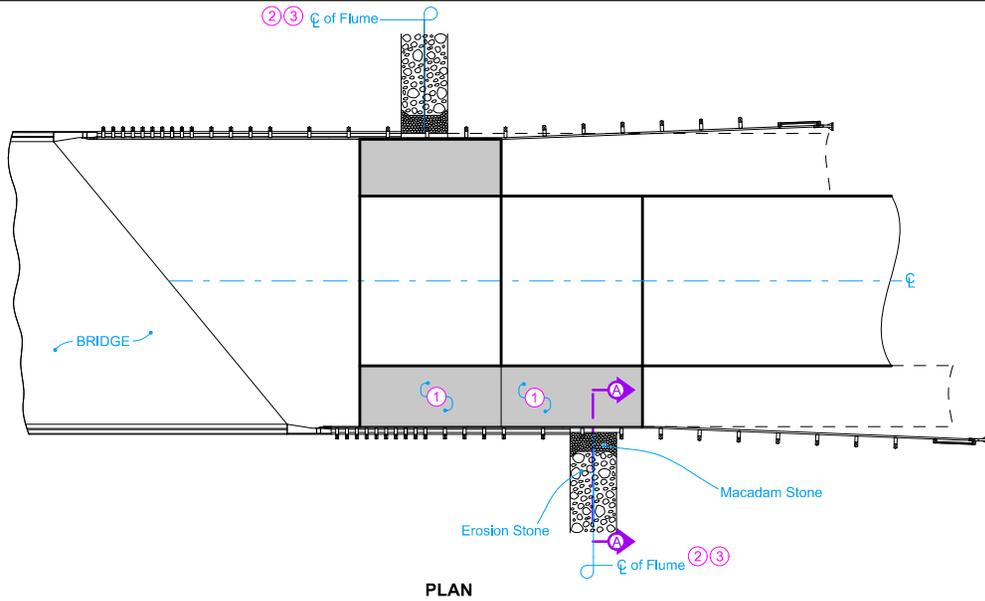


SECTION C-C



SECTION D-D

|  |          |         |
|--|----------|---------|
| <br><b>STANDARD ROAD PLAN</b>  | REVISION |         |
|  | 2        | 4-18-17 |
|  | DR-401   |         |
| SHEET 2 of 2   |          |         |
| <small>REVISIONS: Replaced text "Outlet or Channel Scour Protection" with "Transition Mat".<br/>Renumbered notes. Added hyperlinks to EC-104 and EC-105.</small> |          |         |
| <br><small>APPROVED BY DESIGN METHODS ENGINEER</small>   |          |         |
| <b>SCOUR PROTECTION<br/>FOR BRIDGE END DRAIN</b>   |          |         |



Price bid for "Bridge End Drain, DR-402" is full compensation for furnishing, installing, and constructing the Bridge End Drain as shown.

- ① Continue 4 inch sloped curb to edge of flume per section B-B. Refer to BR-201, BR-202, BR-203, or BR-204 for details of 4 inch curb.
- ② DI-1 and DI-2 distances measured from center of Bolt Pattern.
- ③ Extend rock flume to toe of backslope. If no backslope exists, extend rock flume a minimum of 4 feet beyond the toe of foreslope.

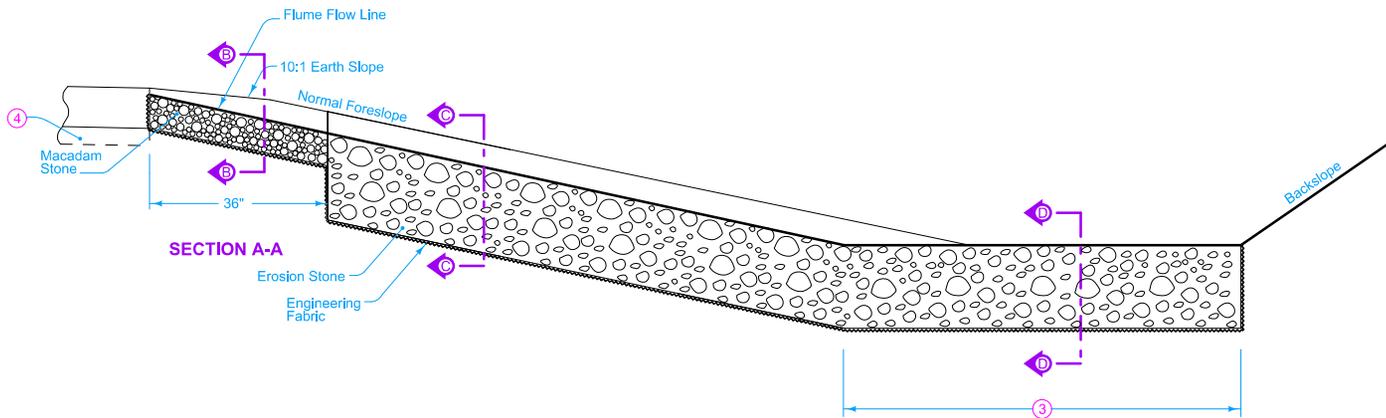
Possible Contract Items:  
 Paved Shoulder, Portland Cement Concrete (Paved Shoulder Panel for Bridge-End Drain)  
 Bridge End Drain, DR-402

Incidental to Paved Shoulder:  
 Modified Subbase  
 Polymer Grid

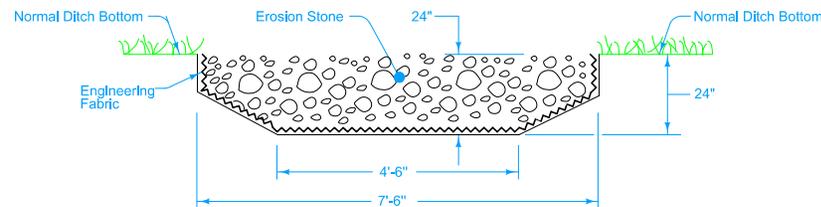
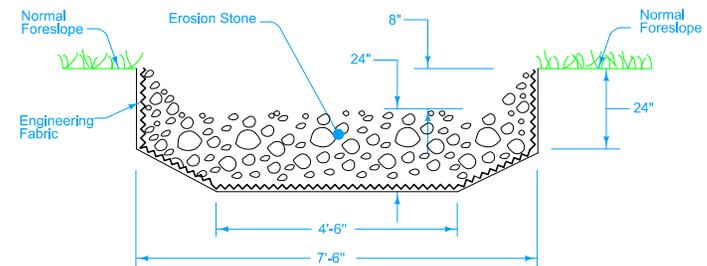
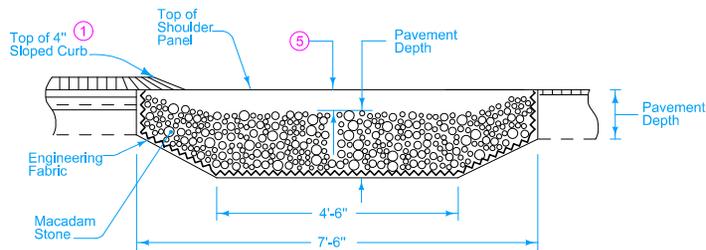
Incidental to Bridge End Drain:  
 Macadam Stone Base Material  
 Erosion Stone  
 Engineering Fabric  
 Excavation, hauling, and disposing of material

Possible Tabulation:  
 104-8A

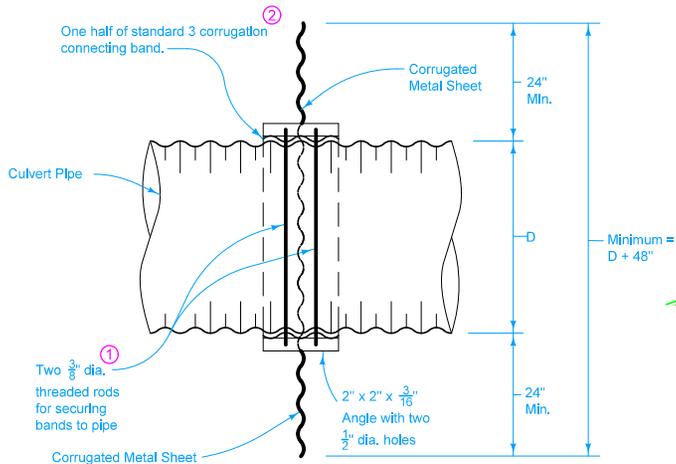
|   |          |          |
|---|----------|----------|
|   | REVISION |          |
|   | 2        | 10-18-16 |
| STANDARD ROAD PLAN  | DR-402   |          |
| SHEET 1 of 2  |          |          |
| REVISIONS: Modified Section A-A, Added Section D-D, Renumbered notes 2 through 5, Added note 6. |          |          |
|   |          |          |
| APPROVED BY DESIGN METHODS ENGINEER   |          |          |
| ROCK FLUME FOR<br>BRIDGE END DRAIN  |          |          |



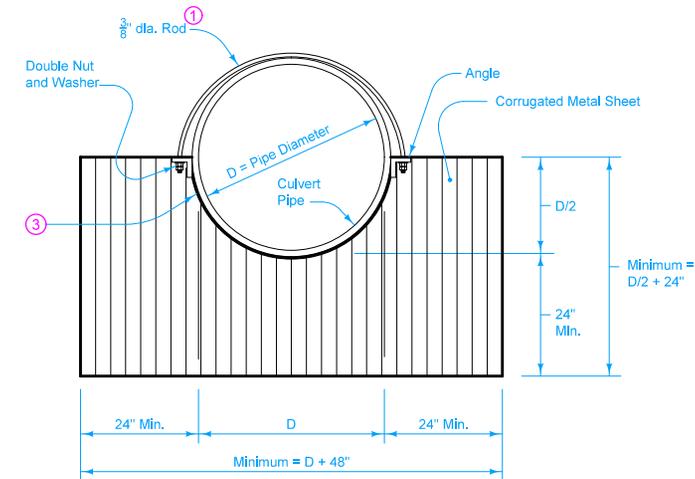
- ① Continue 4 inch sloped curb to edge of flume per section B-B. Refer to BR-201, BR-202, BR-203, or BR-204 for details of 4 inch curb.
- ③ Extend flume to toe of backslope. If no backslope exists, extend rock flume a minimum of 4 feet beyond the toe of foreslope.
- ④ Install modified subbase and polymer grid under PCC shoulder panels as shown in Section A-A on BR-201, BR-202, or BR-203, or BR-204.
- ⑤ Transitions from 2 inches at edge of pavement to 8 inches within 3 feet.
- ⑥ Transition the flume flow line depth from 8 inches at the toe of slope to 0 inches with an approximate transition rate of 2 inches per 1 foot horizontal.



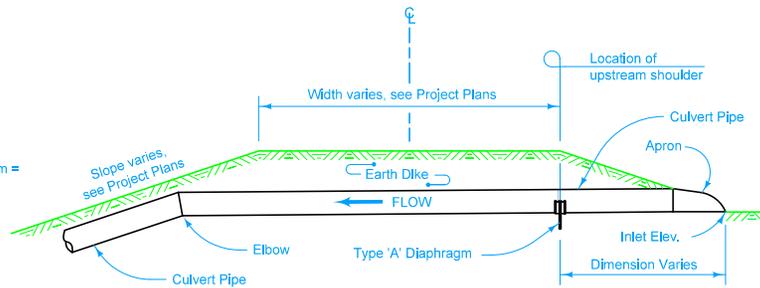
|  |               |
|--|---------------|
| <br><b>STANDARD ROAD PLAN</b>  | REVISION      |
|  | 2   10-18-16  |
|  | <b>DR-402</b> |
| SHEET 2 of 2   |               |
| <small>REVISIONS: Modified Section A-A, Added Section D-D, Renumbered notes 2 through 5, Added note 6.</small> |               |
| <i>Brian Smith</i><br><small>APPROVED BY DESIGN METHODS ENGINEER</small>                                       |               |
| <b>ROCK FLUME FOR<br/>BRIDGE END DRAIN</b>   |               |



PLAN VIEW

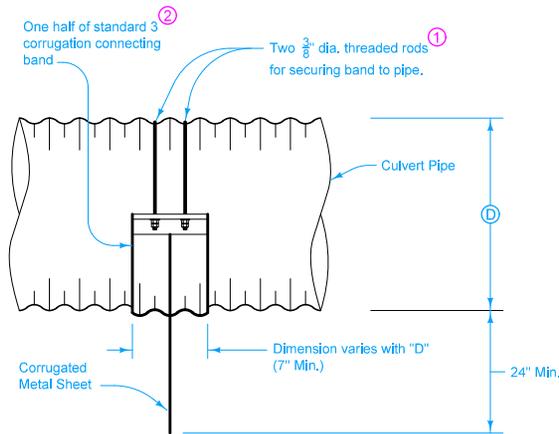


END VIEW



DIAPHRAGM INSTALLATION

Place diaphragm below upstream shoulder of dike unless otherwise specified on Project Plans.



SIDE VIEW

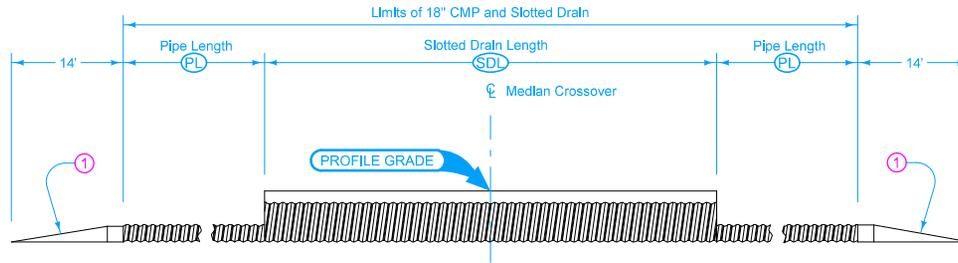
Install the Type "A" Diaphragm (anti-seep device for use on letdown structures) directly below the upstream shoulder of the dike.

Type "A" Diaphragm consists of a sheet of corrugated metal of the dimensions indicated hereon and of the same thickness as the pipe used for culvert pipe. Fabricate this sheet from one or more sheets of corrugated metal. Lap a minimum of one corrugation and weld or rivet at a minimum of 3 inch centers along the seam if two or more sheets are used. Weld the sheet on both sides to a standard half connecting band of dimensions indicated hereon. Securely attach this assembly to the pipe by means of two 3/8 inch diameter rods of appropriate length placed in two adjacent valleys of the corrugated pipe and threaded with double nut and washer.

Details are shown using corrugated metal culvert pipe. Make appropriate modifications as indicated, subject to the approval of the Engineer, as necessary where concrete culvert pipe is used. Use plastic diaphragms when connecting to plastic pipe.

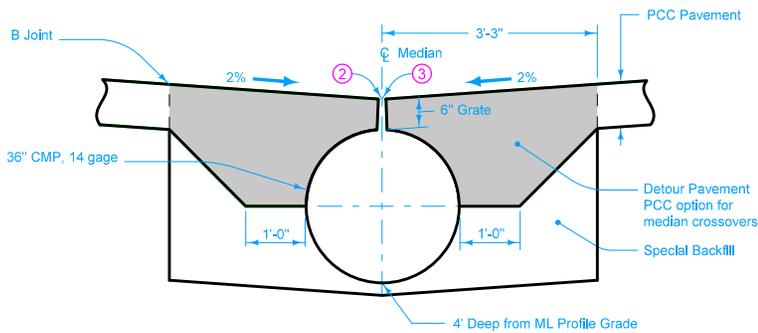
- ① Normal half of connecting band may be used in lieu of rods when approved by the Engineer.
- ② Use flat steel band of equivalent dimensions where Type "A" Diaphragm is to be installed on Concrete Culvert pipe.
- ③ Weld corrugated metal sheet to the connecting band using a continuous weld. Shape to fit outside pipe diameter.

|   |               |
|---|---------------|
| <b>IOWA DOT</b>   | REVISION      |
|   | New 04-21-15  |
| <b>STANDARD ROAD PLAN</b>                                 | <b>DR-501</b> |
| SHEET 1 of 1  |               |
| REVISIONS: New. Replaces RF-7.                            |               |
| <i>Brian Smith</i><br>APPROVED BY DESIGN METHODS ENGINEER |               |
| <b>CORRUGATED METAL<br/>TYPE "A" DIAPHRAGM</b>            |               |

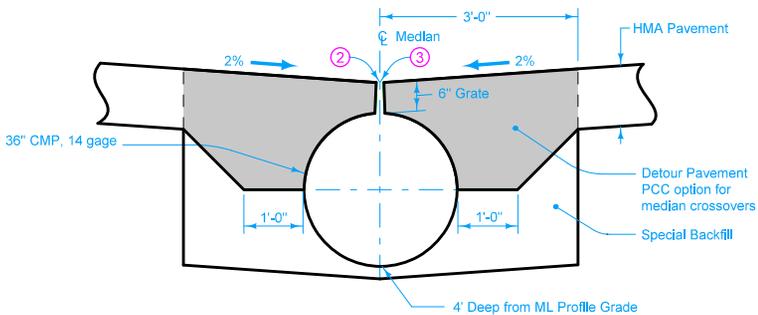


LONGITUDINAL SECTION THROUGH CMP SLOTTED DRAIN ASSEMBLY

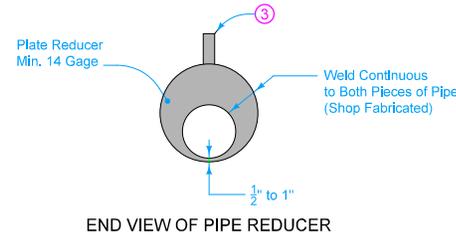
- ① Beveled pipe and guard. See DR-212.
- ② During construction of crossover pavement, cover slotted drain with duct tape or wood block.
- ③ Slotted grate 6 inches high x 1 1/2 inches opening width. Use 3/16 inch material for spacers and bearing bars (sides).



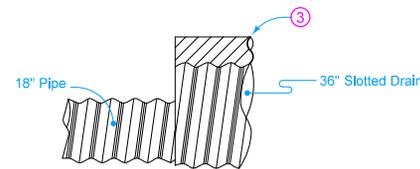
PCC PAVEMENT SITUATION



HMA PAVEMENT SITUATION



END VIEW OF PIPE REDUCER



SIDE VIEW OF PIPE REDUCER

| TABLE OF QUANTITIES                                |        |        |        |        |        |
|--|--------|--------|--------|--------|--------|
| Standard Road Plan                                 | PV-500 | PV-503 | PV-506 | PV-509 | PV-512 |
| Median Width                                       | 50'    | 64'    | 68.24' | 82'    | 100'   |
| ③ Slotted Drain Length                             | 116'   | 110'   | 110'   | 102'   | 94'    |
| ① Pipe Length                                      | 132'   | 110'   | 104'   | 90'    | 76'    |
| <b>Bid Items</b>                                   |        |        |        |        |        |
| 36" Corrugated Metal Slotted Pipe Drain w/6" Grate | 116'   | 110'   | 110'   | 102'   | 94'    |
| 18" dia. Corrugated Metal Roadway Pipe Culvert     | 264'   | 220'   | 208'   | 180'   | 152'   |

Possible Contract Items:  
 Beveled Pipe and Guard  
 Culvert, Unclassified Roadway Pipe, 18" Dia.  
 Detour Pavement  
 Drain, Corrugated Metal Pipe Slotted, 36", w/6" Grate  
 Special Backfill

Possible Tabulation:  
 112-8

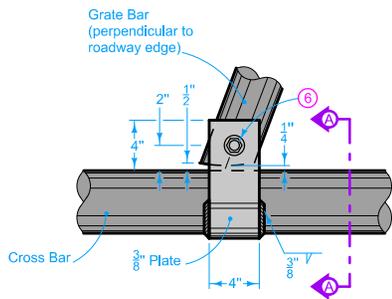
|                           |               |              |
|---------------------------|---------------|--------------|
| <b>IOWA DOT</b>           | REVISION      |              |
|                           | 1             | 10-18-16     |
|                           | <b>DR-502</b> |              |
| <b>STANDARD ROAD PLAN</b> |               | SHEET 1 of 1 |

REVISIONS: Changed Unclassified Entrance Pipe to Unclassified Roadway Pipe to coincide with Tab 112-8, Median Crossovers.

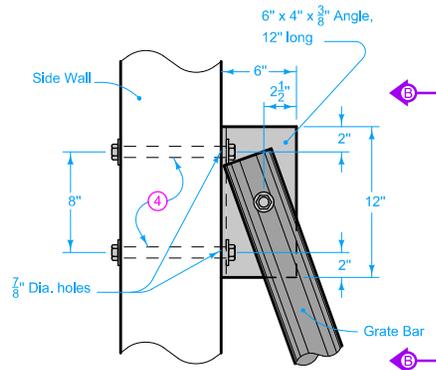
*Brian Smith*  
 APPROVED BY DESIGN METHODS ENGINEER

**SLOTTED DRAIN FOR  
 MEDIAN CROSSEVERS**



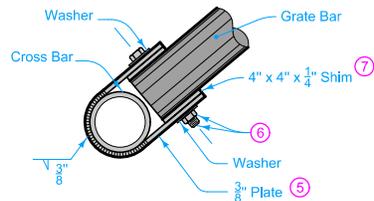


**DETAIL 'A'  
TOP VIEW**

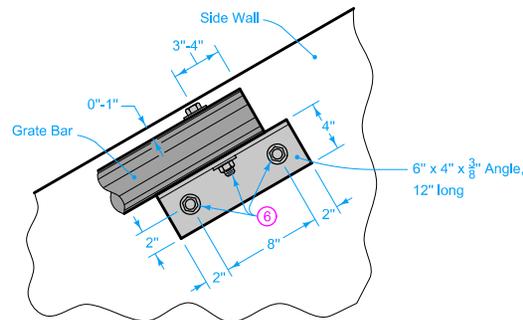


**DETAIL 'B'  
TOP VIEW**

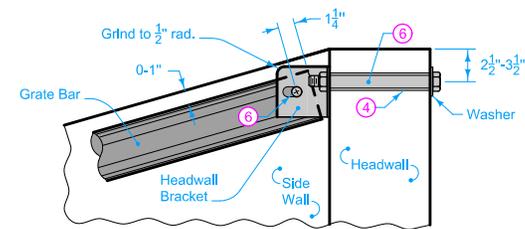
- ④ Drill  $\frac{7}{8}$  inch diameter holes using equipment designed to cut through concrete and reinforcing steel.
- ⑤ Bend plates or strips without cracking material.
- ⑥  $\frac{3}{4}$  inch bolt, lock nut and washers. All holes are to be  $\frac{7}{8}$  inch diameter.
- ⑦ Shim thickness equal to difference in diameters of Grate Bar and Cross Bar.



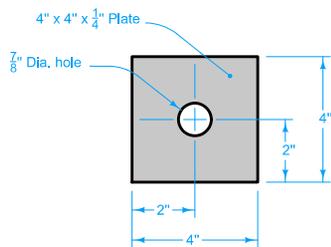
**SECTION A-A**



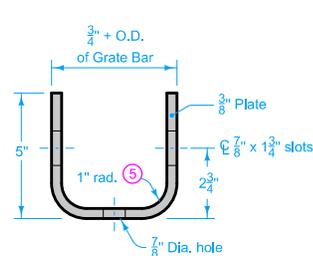
**SECTION B-B**



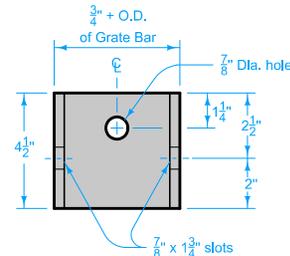
**SECTION C-C**



**SHIM DETAIL**



**HEADWALL BRACKET  
TOP VIEW**



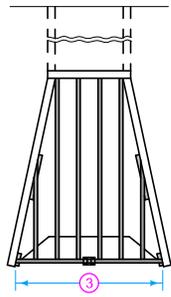
**HEADWALL BRACKET  
FRONT VIEW**

|                               |               |
|-------------------------------|---------------|
| <br><b>STANDARD ROAD PLAN</b> | REVISION      |
|                               | New 4-21-15   |
|                               | <b>DR-503</b> |
| SHEET 2 of 4                  |               |

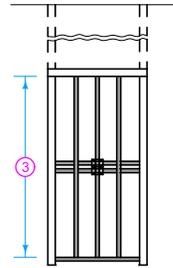
REVISIONS: New. Replaces RF-29.

*Brian Smith*  
APPROVED BY DESIGN METHODS ENGINEER

**SAFETY GRATES  
FOR BOX CULVERTS**



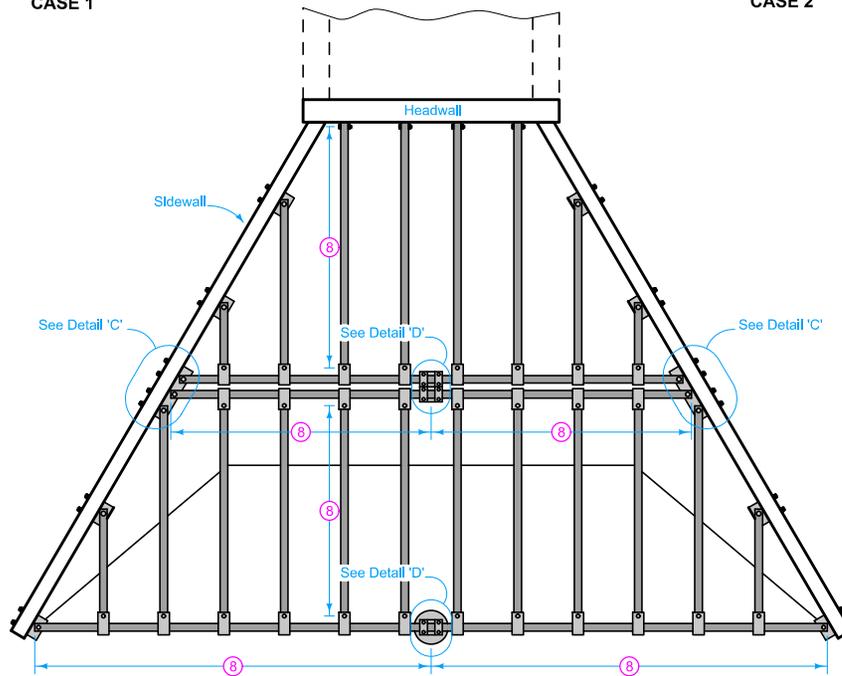
CASE 1



CASE 2

③ If more than 20 feet, midspan support is required. Refer to sheets 3 and 4.

⑧ Length of span (20 feet maximum).



INSTALLATION PLAN WITH MIDSPAN SUPPORT

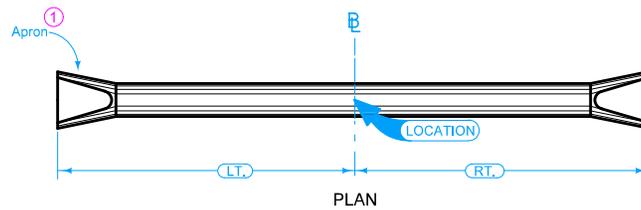
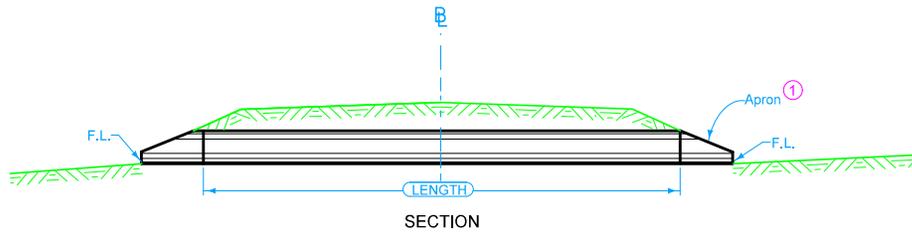
|   |               |
|---|---------------|
|   | REVISION      |
|   | New 4-21-15   |
| <b>STANDARD ROAD PLAN</b>                 | <b>DR-503</b> |
| REVISIONS: New. Replaces RF-29.           | SHEET 3 of 4  |
| <br>APPROVED BY DESIGN METHODS ENGINEER   |               |
| <b>SAFETY GRATES<br/>FOR BOX CULVERTS</b> |               |



$\bar{E}$  is  $\bar{C}$  of roadway, dike, survey, or other as detailed on plans.

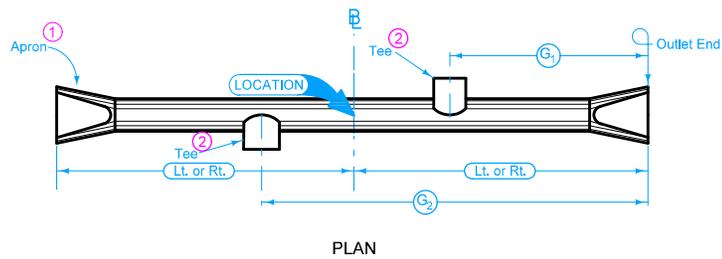
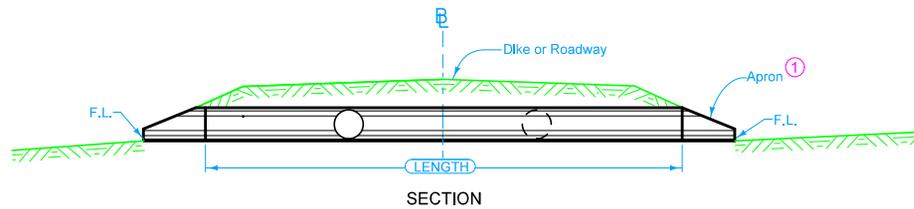
Skew angle is the angle which one end of the pipe is ahead (by stationing) of line perpendicular to the  $\bar{E}$ .  
(Example: skew Rt. ahead 30 degrees)

- ① Refer to the following:  
 DR-201 for circular concrete.  
 DR-202 for low clearance concrete.  
 DR-203 for circular metal.  
 DR-205 for circular concrete with end wall.  
 DR-206 for low clearance concrete with end wall.



Possible Tabulation:  
104-3

|  |          |              |
|--|----------|--------------|
| <br><b>STANDARD ROAD PLAN</b>           | REVISION |              |
|  | 2        | 04-18-17     |
| <b>DR-601</b>  |          | SHEET 1 of 1 |
| REVISIONS: Modified note 1 to include references to additional apron types.  |          |              |
| <br>APPROVED BY DESIGN METHODS ENGINEER |          |              |
| REINFORCED CONCRETE<br>PIPE CULVERT  |          |              |



REINFORCED CONCRETE PIPE CULVERT

$B$  is  $C$  of roadway, dike, survey, or other as detailed on the plans.

Skew angle is the angle which one end of the pipe is ahead (by stationing) of a line perpendicular to the  $B$ . (Example: skew Rt. ahead 30 degrees).

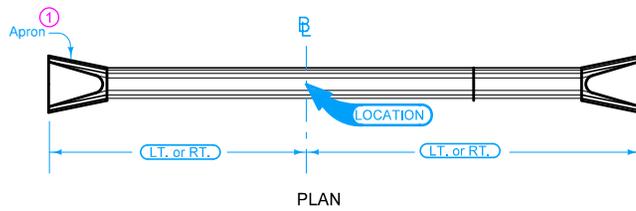
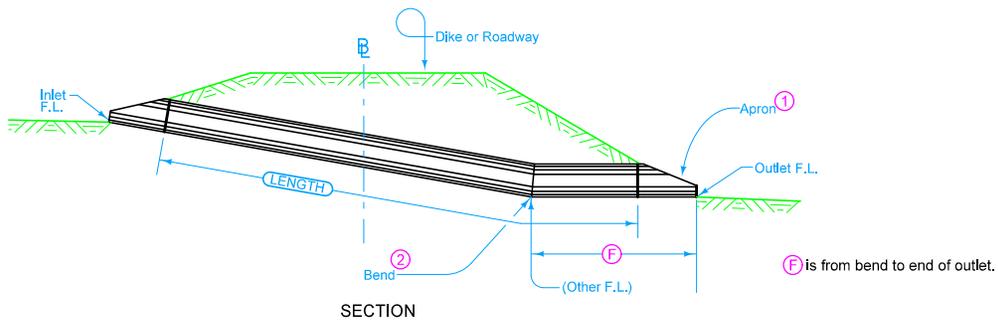
$G$  is the dimension to  $C$  of Tee from outlet end of pipe. Either one or two Tees are required as specified.

- ① Refer to the following:  
 DR-201 for circular concrete.  
 DR-202 for low clearance concrete.  
 DR-203 for circular metal.  
 DR-205 for circular concrete with end wall.  
 DR-206 for low clearance concrete with end wall.

- ② See DR-142.

Possible Tabulation:  
 104-3

|  |              |
|--|--------------|
|  | REVISION     |
|  | 1   04-18-17 |
| STANDARD ROAD PLAN   | DR-602       |
| SHEET 1 of 1   |              |
| <small>REVISIONS: Modified note 1 to include references to additional apron types.</small> |              |
|  |              |
| <small>APPROVED BY DESIGN METHODS ENGINEER</small>   |              |
| <b>REINFORCED CONCRETE PIPE CULVERT<br/>         WITH TEES</b>                             |              |



⊕ is ⊕ of roadway, dike, survey, or other; as detailed on plans.

- ① Refer to the following:  
 DR-201 for circular concrete.  
 DR-202 for low clearance concrete.  
 DR-203 for circular metal.  
 DR-205 for circular concrete with end wall.  
 DR-206 for low clearance concrete with end wall.
- ② Bend may be accomplished by use of metal elbow, Pipe Adaptor (DR-122), Type "D" Section, or Concrete Elbow (DR-141) as specified.

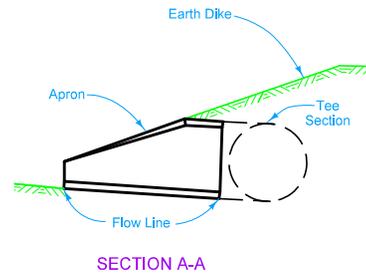
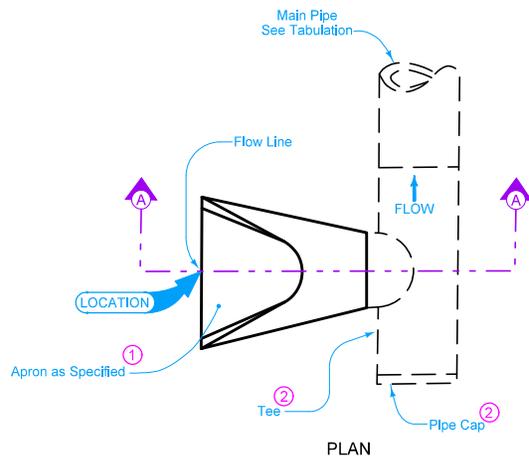
Possible Tabulation:  
104-3

|  |          |               |
|--|----------|---------------|
| <b>IOWA DOT</b>  | REVISION |               |
|  | 1        | 04-18-17      |
| <b>STANDARD ROAD PLAN</b>  |          | <b>DR-611</b> |
|  |          | SHEET 1 of 1  |
| REVISIONS: Modified note 1 to include references to additional apron types.  |          |               |
| <br>APPROVED BY DESIGN METHODS ENGINEER |          |               |
| <b>REINFORCED CONCRETE PIPE CULVERT<br/>LETDOWN STRUCTURE</b>  |          |               |

is of roadway, dike, survey, or other as detailed on the plans.

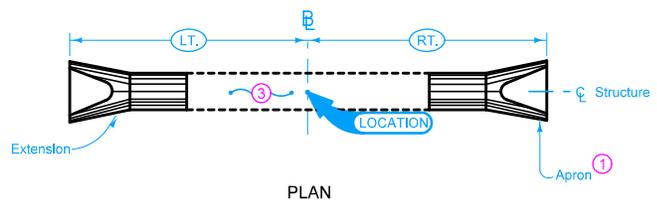
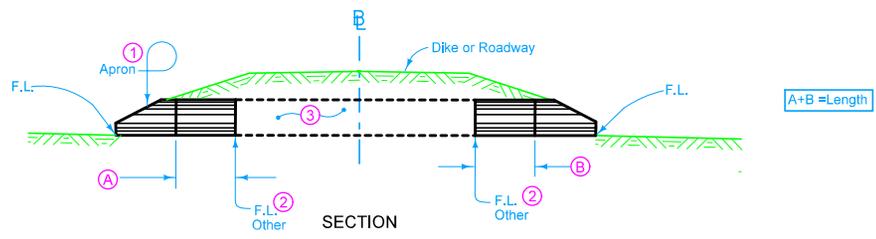
Use when specified. This type of inlet assembly may be substituted for the inlet apron shown on drawings of standard type drainage structures.

- ① Refer to the following:  
 DR-201 for circular concrete.  
 DR-202 for low clearance concrete.  
 DR-203 for circular metal.  
 DR-205 for circular concrete with end wall.  
 DR-206 for low clearance concrete with end wall.
- ② See DR-142.



Possible Tabulation:  
104-3

|   |          |               |
|---|----------|---------------|
| <b>IOWA DOT</b>   | REVISION |               |
|   | 1        | 04-18-17      |
| <b>STANDARD ROAD PLAN</b>   |          | <b>DR-612</b> |
|   |          | SHEET 1 of 1  |
| REVISIONS: Modified note 1 to include references to additional apron types. |          |               |
| <i>Brian Smith</i>  |          |               |
| APPROVED BY DESIGN METHODS ENGINEER   |          |               |
| <b>APRON TEE INLET</b>  |          |               |



$\bar{E}$  is  $\bar{C}$  of roadway, dike, survey, or other as detailed on plans.

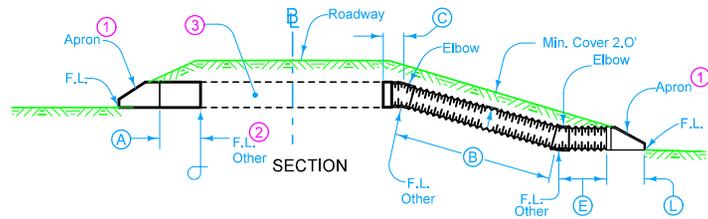
Extend on line of existing structure to Lt., Rt., or both as specified. Adaptors may be required, see [DR-122](#).

- ① Refer to the following:  
[DR-201](#) for circular concrete.  
[DR-202](#) for low clearance concrete.  
[DR-203](#) for circular metal.  
[DR-205](#) for circular concrete with end wall.  
[DR-206](#) for low clearance concrete with end wall.
- ② Optional Type "D" section only when specified in tabulation.
- ③ Existing structure.

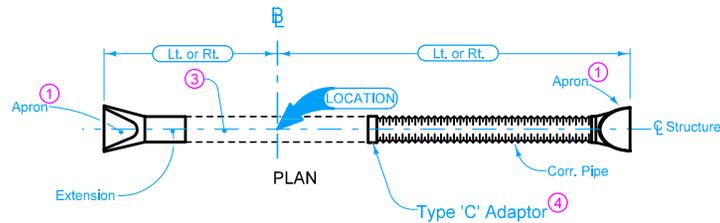
Possible Tabulation:  
104-3

|  |          |               |
|--|----------|---------------|
| <b>IOWA DOT</b>  | REVISION |               |
|  | 1        | 4-18-17       |
| <b>STANDARD ROAD PLAN</b>  |          | <b>DR-621</b> |
|  |          | SHEET 1 of 1  |
| <small>REVISIONS: Modified note 1 to include references to additional apron types.</small> |          |               |
| <i>Brian Smith</i><br>APPROVED BY DESIGN METHODS ENGINEER                                  |          |               |
| <b>PIPE EXTENSION</b>  |          |               |





A = Concrete Pipe Length  
 B+C+E = Corr. Pipe Length



$\bar{E}$  is  $\bar{C}$  of roadway, dike, survey, or other as detailed on plans.

Extend on line of existing structure to Lt., Rt., or both as specified. Adaptors may be required, see DR-122.

- ① Refer to the following:  
 DR-201 for circular concrete.  
 DR-202 for low clearance concrete.  
 DR-203 for circular metal.  
 DR-204 for arch metal.  
 DR-205 for circular concrete with end wall.  
 DR-206 for low clearance concrete with end wall.
- ② Optional Type "D" section only when specified in tabulation.
- ③ Existing structure.
- ④ See DR-122.

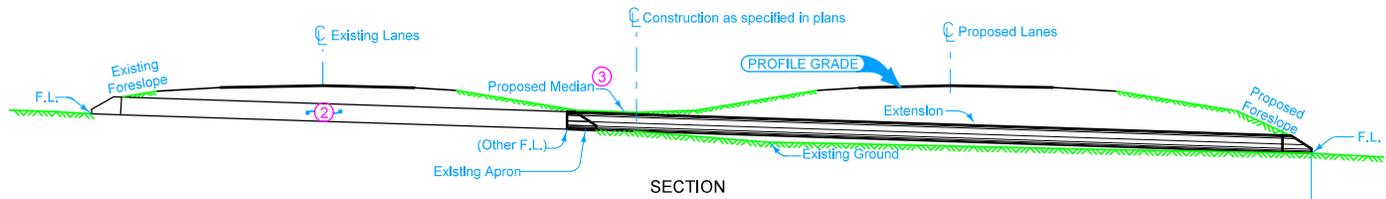
Possible Tabulation:  
 104-3

|  |          |               |
|--|----------|---------------|
| <b>IOWA DOT</b>  | REVISION |               |
|  | 1        | 4-18-17       |
| <b>STANDARD ROAD PLAN</b>  |          | <b>DR-625</b> |
|  |          | SHEET 1 of 1  |
| <small>REVISIONS: Modified note 1 to include references to additional apron types.</small> |          |               |
| <i>Brian Smith</i><br>APPROVED BY DESIGN METHODS ENGINEER                                  |          |               |
| <b>PIPE EXTENSION<br/>LETDOWN STRUCTURE<br/>WITH METAL APRON</b>                           |          |               |

Extend on line of existing structure to Lt., Rt. or both as specified. Adapters may be required, see DR-122.

Optional Type "D" section or elbow for vertical drop only when specified in tabulation.

- ① Refer to the following and specify if inlet or outlet:  
 DR-201 for circular concrete.  
 DR-202 for low clearance concrete.  
 DR-205 for circular concrete with end wall.  
 DR-206 for low clearance concrete with end wall.
- ② Existing structure.
- ③ If less than 12 inch cover over pipe in median, install median pipe and dike.



SECTION



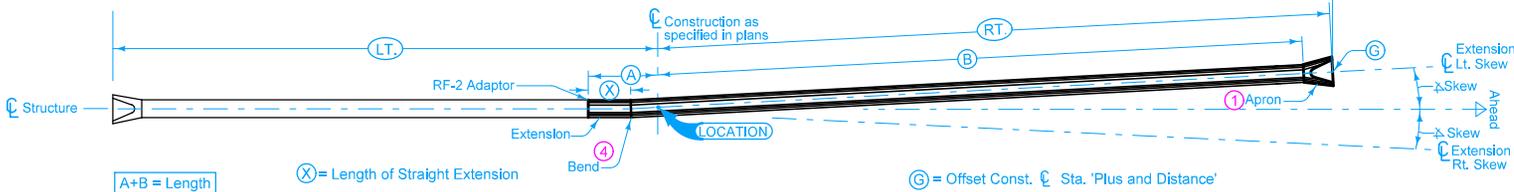
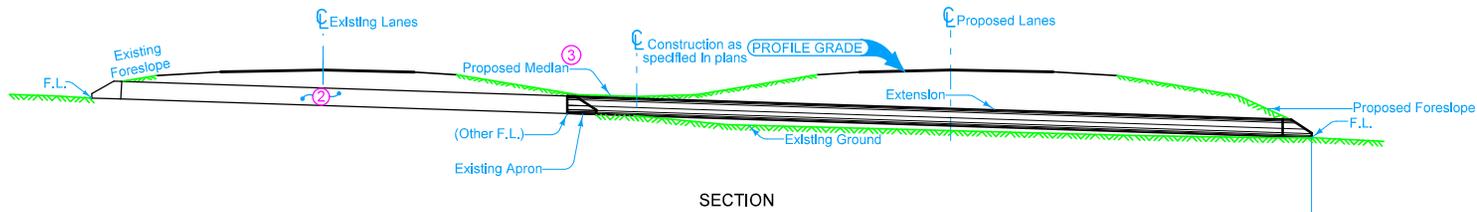
PLAN

Possible Tabulation:  
104-3

|  |          |               |
|--|----------|---------------|
| <b>IOWA DOT</b>  | REVISION |               |
|  | 1        | 04-18-17      |
| <b>STANDARD ROAD PLAN</b>  |          | <b>DR-626</b> |
|  |          | SHEET 1 of 1  |
| REVISIONS: Modified note 1 to include references to additional apron types.  |          |               |
| <br>APPROVED BY DESIGN METHODS ENGINEER |          |               |
| <b>PIPE EXTENSION - ADDING LANES</b>   |          |               |

Extend in the direction specified with skew measured from centerline of existing structure. Dimension Rt. or Lt. is measured at  $\text{CL}$  of pipe along laying length.

- ① Refer to the following and specify if inlet or outlet:  
**DR-201** for circular concrete.  
**DR-202** for low clearance concrete.  
**DR-205** for circular concrete with end wall.  
**DR-206** for low clearance concrete with end wall.
- ② Existing structure.
- ③ If less than 12 inch cover over pipe in median, install median pipe and dike.
- ④ Bend may be accomplished by use of Adaptor (**DR-122**), Type "D" Section, or Concrete Elbow (**DR-141**) as specified.



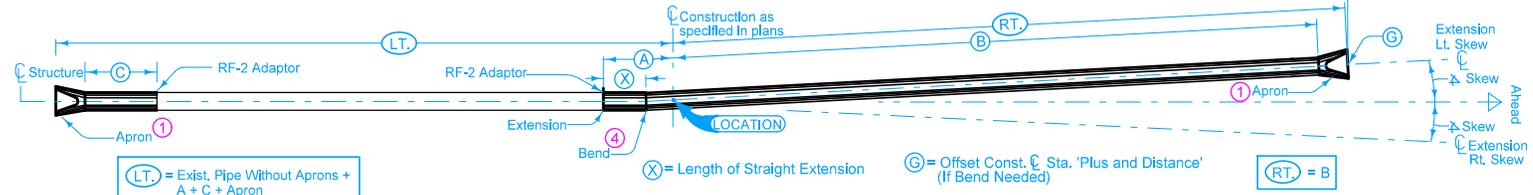
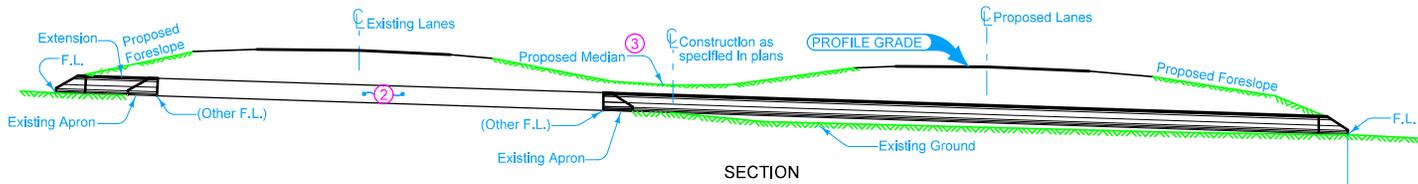
PLAN

Possible Tabulation:  
104-3

|   |          |               |
|---|----------|---------------|
| <b>IOWA DOT</b>   | REVISION |               |
|   | 1        | 04-18-17      |
| <b>STANDARD ROAD PLAN</b>   |          | <b>DR-627</b> |
|   |          | SHEET 1 of 1  |
| REVISIONS: Modified note 1 to include references to additional apron types. |          |               |
| <i>Brian Smith</i>  |          |               |
| APPROVED BY DESIGN METHODS ENGINEER   |          |               |
| <b>PIPE EXTENSION<br/>HORIZONTAL BEND -<br/>ADDING LANES</b>                |          |               |

Extend in the direction specified with skew measured from centerline of existing structure. Dimension Rt. or Lt. is measured at  $\bar{C}$  of pipe along laying length.

- ① Refer to the following and specify if inlet or outlet:  
**DR-201** for circular concrete.  
**DR-202** for low clearance concrete.  
**DR-205** for circular concrete with end wall.  
**DR-206** for low clearance concrete with end wall.
- ② Existing structure.
- ③ If less than 12 inch cover over pipe in median, install median pipe and dike.
- ④ Bend may be accomplished by use of Adaptor (**DR-122**), Type "D" Section, or Concrete Elbow (**DR-141**) as specified.



$\bar{L.T.}$  = Exist. Pipe Without Aprons + A + C + Apron

X = Length of Straight Extension

G = Offset Const.  $\bar{C}$  Sta. 'Plus and Distance' (If Bend Needed)

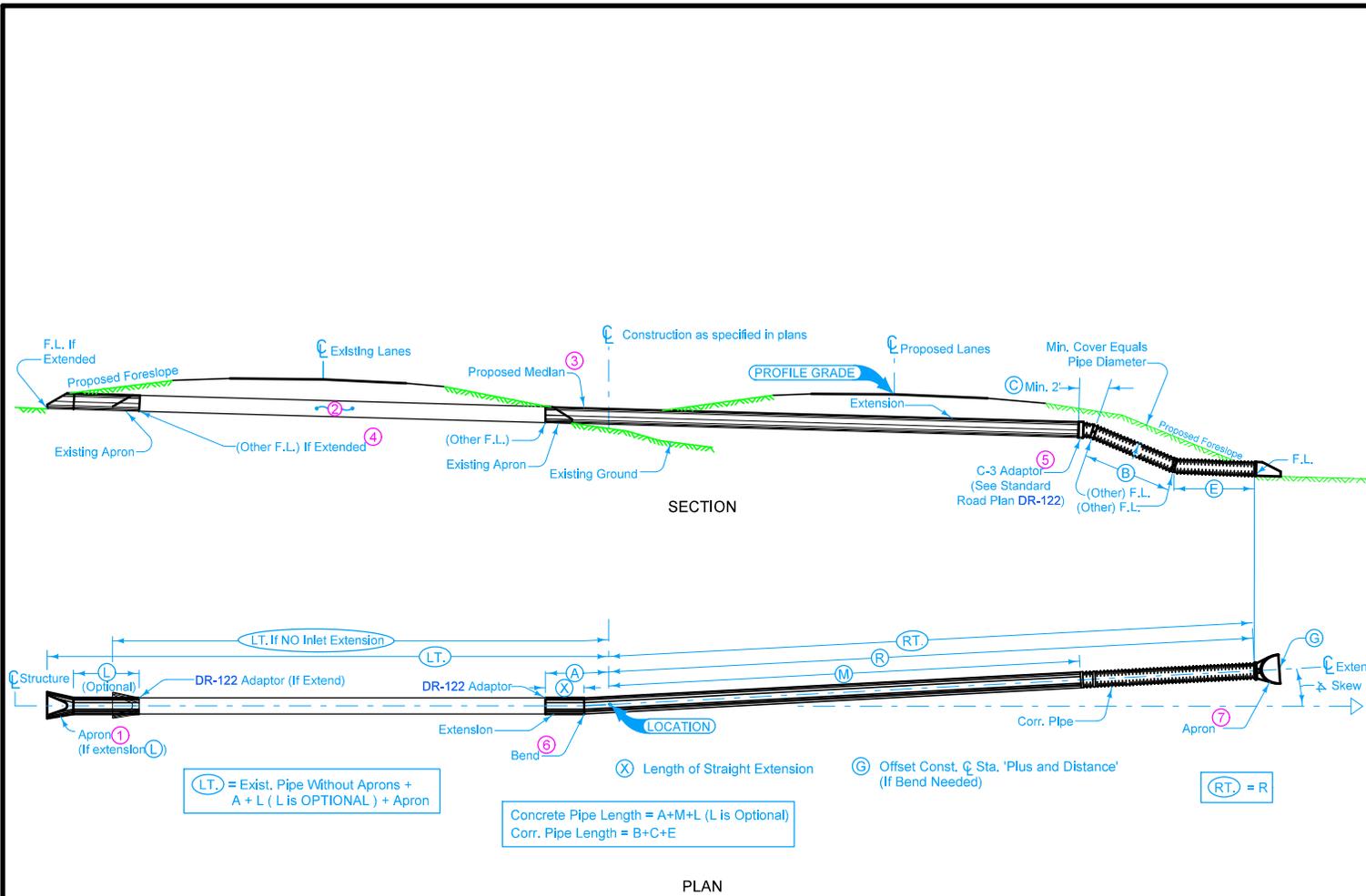
$\bar{R.T.}$  = B

A+B+C = Extension Length

PLAN

Possible Tabulation:  
104-3

|  |          |               |
|--|----------|---------------|
| <b>IOWA DOT</b>  | REVISION |               |
|  | 1        | 04-18-17      |
| <b>STANDARD ROAD PLAN</b>  |          | <b>DR-628</b> |
|  |          | SHEET 1 of 1  |
| REVISIONS: Modified note 1 to include references to additional apron types.  |          |               |
| <br>APPROVED BY DESIGN METHODS ENGINEER |          |               |
| <b>PIPE EXTENSION BOTH ENDS<br/>         HORIZONTAL BEND (OPTIONAL) -<br/>         ADDING LANES</b>                          |          |               |

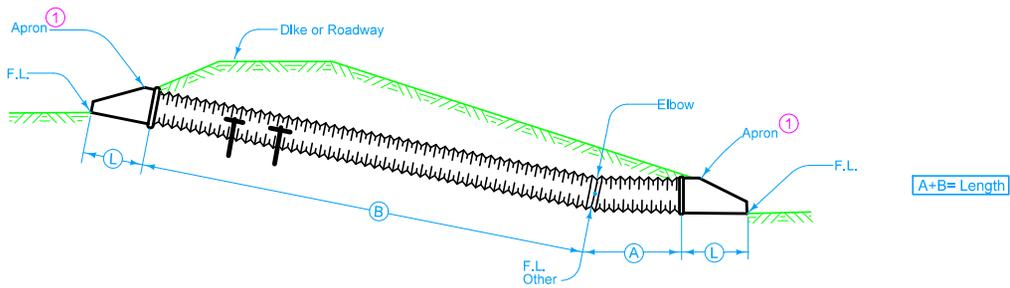


If bend is required, extend in the direction specified with skew measured from centerline of existing structure. Dimension Rt. or Lt. is measured at  $\phi$  of pipe along laying length.

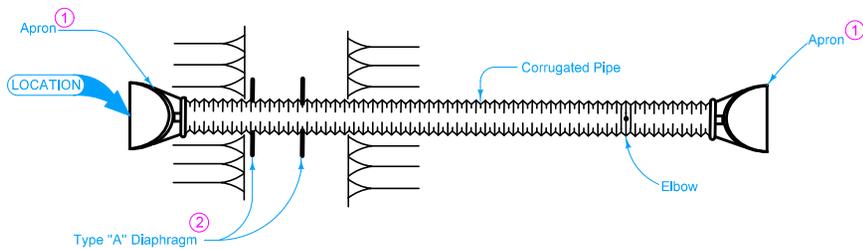
- ① Refer to the following:  
 DR-201 for circular concrete.  
 DR-202 for low clearance concrete.  
 DR-205 for circular concrete with end wall.  
 DR-206 for low clearance concrete with end wall.
- ② Existing structure.
- ③ If less than 12 inch cover over pipe in median, install median pipe and dike.
- ④ Optional Type "D" Section only when specified in the tabulation.
- ⑤ Install C-3 adaptor beyond proposed shoulder line. Flowline approximately 6 feet below shoulder elevation.
- ⑥ Bend may be accomplished by use of Type "D" Section or Concrete Elbow (DR-141) as specified.
- ⑦ Refer to the following:  
 DR-203 for the circular metal.  
 DR-204 for arch metal.

Possible Tabulation:  
104-3

|   |          |               |
|---|----------|---------------|
| <b>IOWA DOT</b>   | REVISION |               |
|   | 1        | 04-18-17      |
| <b>STANDARD ROAD PLAN</b>   |          | <b>DR-629</b> |
|   |          | SHEET 1 of 1  |
| REVISIONS: Modified notes 1 and 7 to include references to additional apron types.        |          |               |
| <i>Brian Smith</i>  |          |               |
| APPROVED BY DESIGN METHODS ENGINEER   |          |               |
| <b>PIPE EXTENSION LETDOWN STRUCTURE<br/>HORIZONTAL BEND (OPTIONAL) -<br/>ADDING LANES</b> |          |               |



SECTION



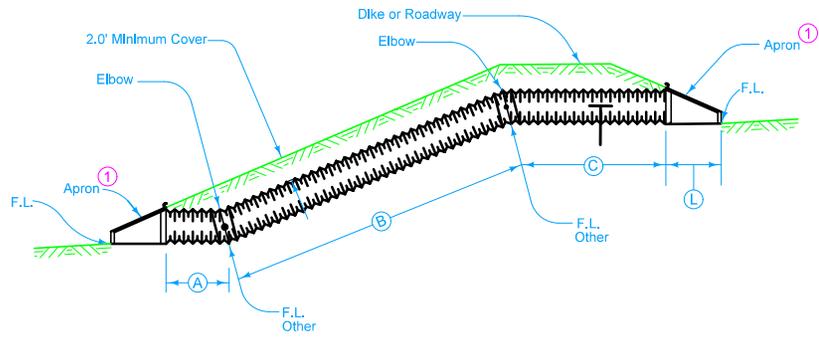
PLAN

Standard type joint couplings are required. See [Materials I.M. 441](#).

- ① Refer to the following:  
[DR-203](#) for the circular metal.  
[DR-204](#) for arch metal.
- ② See [DR-501](#). If more than one diaphragm is specified, install 15 feet apart or as specified.

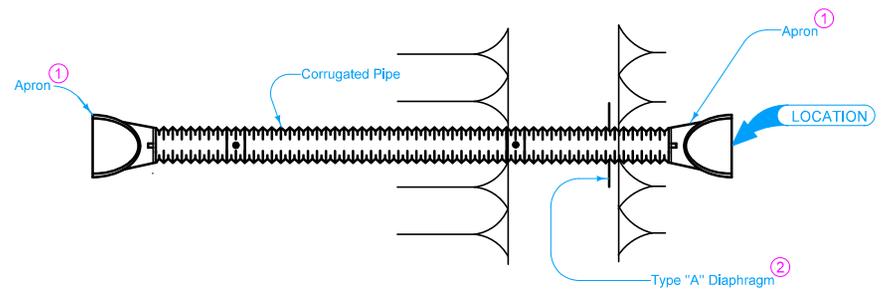
Possible Tabulation:  
104-3

|  |          |               |
|--|----------|---------------|
| <b>IOWA DOT</b>  | REVISION |               |
|  | 1        | 04-18-17      |
| <b>STANDARD ROAD PLAN</b>  |          | <b>DR-631</b> |
|  |          | SHEET 1 of 1  |
| REVISIONS: Modified note 1 to include references to additional apron types.  |          |               |
| <br>APPROVED BY DESIGN METHODS ENGINEER |          |               |
| <b>CORRUGATED PIPE CULVERT<br/>         LETDOWN STRUCTURE<br/>         WITH SINGLE ELBOW</b>                                 |          |               |



A+B+C = Pipe Length

SECTION



PLAN

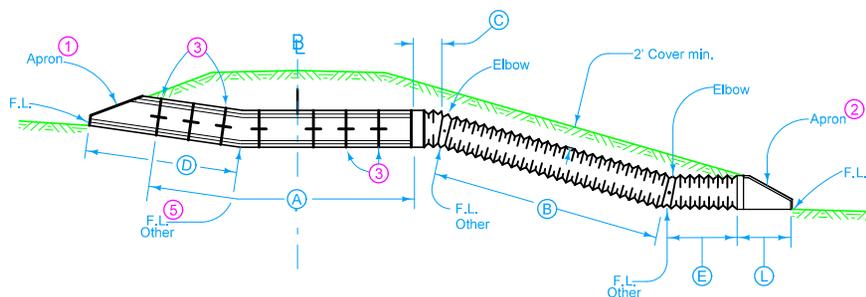
Standard type joint couplings are required. See [Materials I.M. 441](#).

Connection to outlet, if required, is incidental and will not be paid for separately.

- ① Refer to the following:  
[DR-203](#) for the circular metal.  
[DR-204](#) for arch metal.
- ② See [DR-501](#). If more than one diaphragm is specified, install 15 feet apart or as specified.

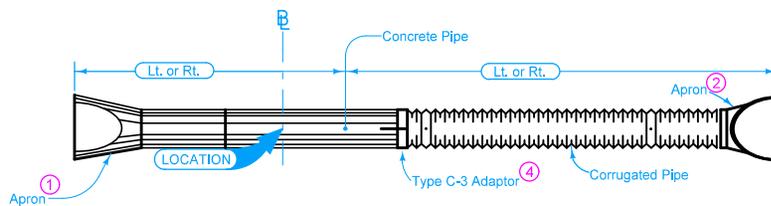
Possible Tabulations:  
104-3

|  |               |
|--|---------------|
| <b>IOWA DOT</b>  | REVISION      |
|  | 1   04-18-17  |
| <b>STANDARD ROAD PLAN</b>  | <b>DR-632</b> |
| SHEET 1 of 1   |               |
| REVISIONS: Modified note 1 to include references to additional apron types.  |               |
| <br>APPROVED BY DESIGN METHODS ENGINEER |               |
| <b>CORRUGATED PIPE CULVERT<br/>         LETDOWN STRUCTURE<br/>         WITH DOUBLE ELBOW</b>                                 |               |



A= Concrete Pipe Length  
 B+C+E= C.M.P. or P.E.P. Length

SECTION



PLAN

$\bar{C}$  is  $\bar{C}$  of roadway, dike survey or other as detailed on the plans.

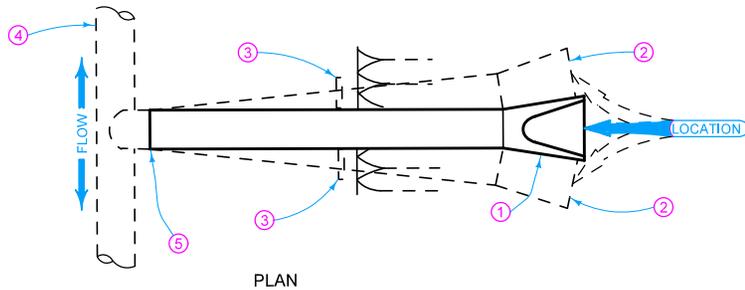
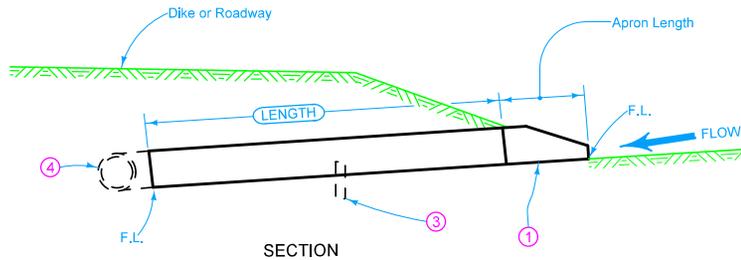
Skew angle is the angle which one end of the pipe is ahead (by stationing) of a line perpendicular to the  $\bar{C}$ . (Example: Skew Rt. ahead 30 degrees)

Standard type joint couplings are required. See [Materials I.M. 441](#).

- ① Refer to the following:  
[DR-201](#) for circular concrete.  
[DR-202](#) for low clearance concrete.  
[DR-205](#) for circular concrete with end wall.  
[DR-206](#) for low clearance concrete with end wall.
- ② Refer to the following:  
[DR-203](#) for the circular metal.  
[DR-204](#) for arch metal.
- ③ See [DR-121](#).
- ④ See [DR-122](#).
- ⑤ Optional "D" section only when specified in the tabulation. Refer to [DR-141](#).

Possible Tabulation:  
 104-3

|   |          |               |
|---|----------|---------------|
| <b>IOWA DOT</b>   | REVISION |               |
|   | 2        | 04-18-17      |
| <b>STANDARD ROAD PLAN</b>   |          | <b>DR-641</b> |
|   |          | SHEET 1 of 1  |
| REVISIONS: Modified notes 1 and 2 to include references to additional apron types.  |          |               |
| <br><small>APPROVED BY DESIGN METHODS ENGINEER</small> |          |               |
| <b>CONCRETE/CORRUGATED PIPE<br/>         CULVERT LETDOWN STRUCTURE<br/>         WITH METAL APRON</b>  |          |               |



is  $\text{C}$  of roadway, dike, survey, or other as detailed on the plans.

Connection to outlet, if required, is incidental and will not be paid for separately

- ① Refer to the following:  
 DR-201 for circular concrete.  
 DR-202 for low clearance concrete.  
 DR-203 for circular metal.  
 DR-204 for arch metal (metal pipe only).  
 DR-205 for circular concrete with end wall.  
 DR-206 for low clearance concrete with end wall.
- ② Possible alignment if Type "D" Section or angle Tee is used.
- ③ Type "A" Diaphragm when specified, see DR-501.
- ④ Outlet structure.
- ⑤ Type "D" Section or angle Tee when specified.

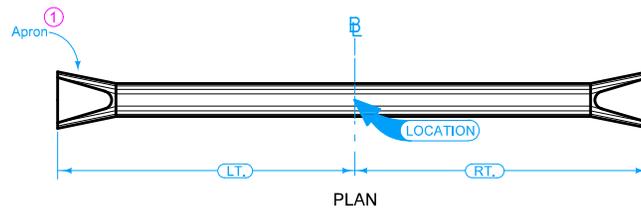
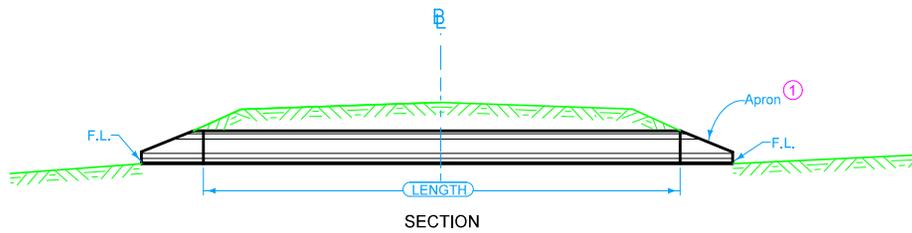
Possible Tabulation:  
104-3

|   |          |               |
|---|----------|---------------|
| <b>IOWA DOT</b>   | REVISION |               |
|   | 1        | 04-18-17      |
| <b>STANDARD ROAD PLAN</b>   |          | <b>DR-642</b> |
|   |          | SHEET 1 of 1  |
| REVISIONS: Modified note 1 to include references to additional apron types. |          |               |
| <i>Brian Smith</i>  |          |               |
| APPROVED BY DESIGN METHODS ENGINEER   |          |               |
| <b>APRON PIPE TEE INLET</b>   |          |               |

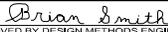
$\bar{C}$  is  $\bar{C}$  of roadway, dike, survey, or other as detailed on plans.

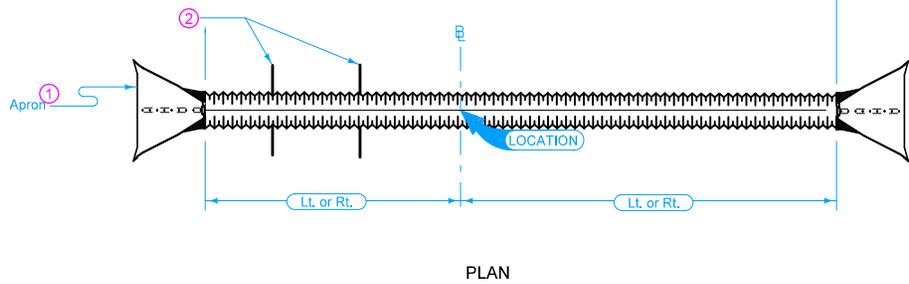
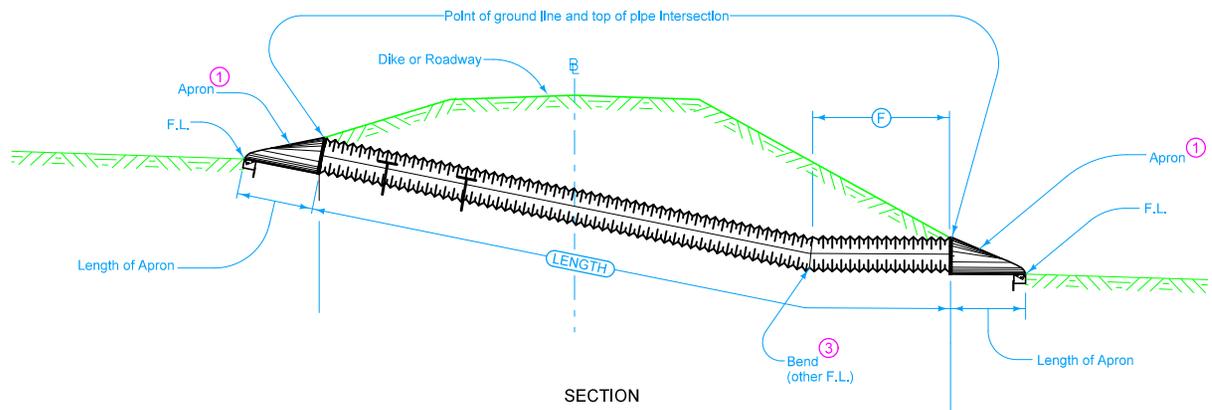
Skew angle is the angle which one end of the pipe is ahead (by stationing) of line perpendicular to the  $\bar{C}$ .  
(Example: skew Rt. ahead 30 degrees)

- ① Refer to the following:  
 DR-201 for circular concrete.  
 DR-202 for low clearance concrete.  
 DR-203 for circular metal.  
 DR-204 for arch metal (metal pipe only).  
 DR-205 for circular concrete with end wall.  
 DR-206 for low clearance concrete with end wall.



Possible Tabulation:  
104-3

|   |          |              |
|---|----------|--------------|
| <br><b>STANDARD ROAD PLAN</b>                          | REVISION |              |
|   | 2        | 04-18-17     |
| <b>DR-651</b>   |          | SHEET 1 of 1 |
| <small>REVISIONS: Modified note 1 to include references to additional apron types.</small>  |          |              |
| <br><small>APPROVED BY DESIGN METHODS ENGINEER</small> |          |              |
| <b>UNCLASSIFIED PIPE CULVERT</b>  |          |              |



UNCLASSIFIED LETDOWN  
STRUCTURE SINGLE ELBOW ④

$\theta$  is  $\angle$  of roadway, dike, survey, or other as detailed on the plans.

Skew angle is the angle which one end of the pipe is ahead (by stationing) of a line perpendicular to the  $\theta$ . (Example: skew Rt. ahead 30 degrees)

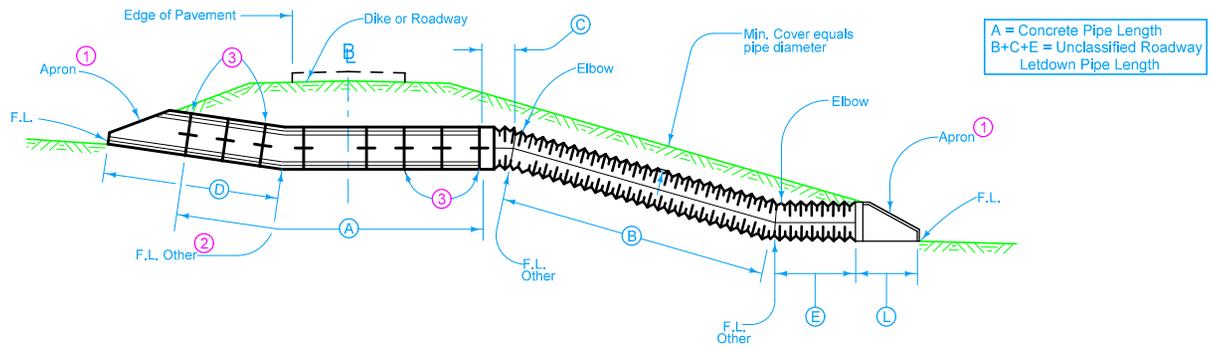
Standard type joint couplings are required. See **Materials I.M. 441**.

When the concrete option is used, use connected joints (**DR-121**) for the outer three joints.

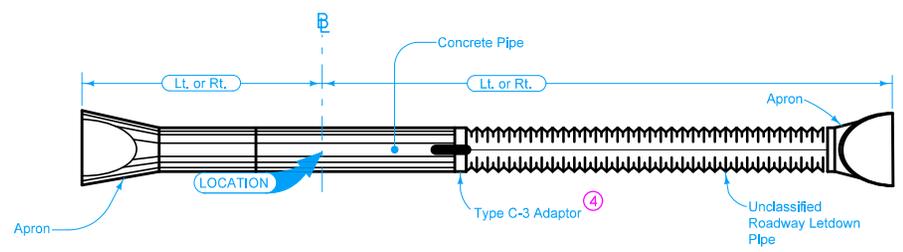
- ① Refer to the following:  
**DR-201** for circular concrete.  
**DR-202** for low clearance concrete.  
**DR-203** for circular metal.  
**DR-204** for arch metal (metal pipe only).  
**DR-205** for circular concrete with end wall.  
**DR-206** for low clearance concrete with end wall.
- ② Type "A" Diaphragm, see **DR-501**. If more than one diaphragm is specified, install them 15 feet apart or as specified.
- ③ Bend may be accomplished by use of metal elbow, Pipe Adapter (**DR-122**), Type "D" Section, or Concrete Elbow (**DR-141**) as specified. Bend is considered incidental to the Length of pipe.

Possible Tabulation:  
104-3

|   |          |               |
|---|----------|---------------|
| <b>IOWA DOT</b>   | REVISION |               |
|   | 1        | 04-18-17      |
| <b>STANDARD ROAD PLAN</b>   |          | <b>DR-652</b> |
|   |          | SHEET 1 of 1  |
| REVISIONS: Modified note 1 to include references to additional apron types. |          |               |
| <i>Brian Smith</i>  |          |               |
| APPROVED BY DESIGN METHODS ENGINEER   |          |               |
| <b>UNCLASSIFIED LETDOWN STRUCTURE<br/>SINGLE ELBOW</b>                      |          |               |



SECTION



PLAN

$\bar{E}$  is  $\bar{C}$  of roadway, dike, survey, or other as detailed on the plans.

Skew angle is the angle which one end of the pipe is ahead (by stationing) of a line perpendicular to the  $\bar{E}$ . (Example: skew Rt. ahead 30 degrees)

Standard type joint couplings are required. See **Materials I.M. 441**.

- ① Refer to the following:  
 DR-201 for circular concrete.  
 DR-202 for low clearance concrete.  
 DR-203 for circular metal.  
 DR-204 for arch metal (metal pipe only).  
 DR-205 for circular concrete with end wall.  
 DR-206 for low clearance concrete with end wall.
- ② Optional "D" Section only when specified in tabulation.
- ③ See DR-121
- ④ See DR-122.

Possible Tabulation:  
104-3

|   |          |               |
|---|----------|---------------|
| <b>IOWA DOT</b>   | REVISION |               |
|   | 1        | 04-18-17      |
| <b>STANDARD ROAD PLAN</b>   |          | <b>DR-653</b> |
|   |          | SHEET 1 of 1  |
| <small>REVISIONS: Modified note 1 to include references to additional apron types. Added note 4.</small>                                    |          |               |
| <br><small>APPROVED BY DESIGN METHODS ENGINEER</small> |          |               |
| <b>UNCLASSIFIED ROADWAY LETDOWN PIPE<br/>WITH METAL APRON</b>   |          |               |