

## **CHAPTER 12: DRAINAGE**

### **CHINOOK WINDS AND WINTER SNOWS**

A combination which frequently results in hazardous winter conditions on shaded portions of roadways under bridges. Icing conditions are a danger in themselves, and they present further hazards during corrective maintenance operations. Paradoxically, they melt away maintenance funds. Potentially hazardous conditions and rising maintenance costs often can be prevented by thoughtful design. Hydraulics Engineers, request that designers place catch basins in such a manner so that runoff in gutters can be intercepted before it can flow under bridges to freeze in those shaded areas. This is a relatively simple design concept which, if employed wherever feasible, will not only reduce recurring maintenance cost, but may also prevent bodily harm and property damage. All surface design features should be carefully evaluated to minimize or prevent, where possible, the flow of water across pavement surfaces. This is especially important in the case of water from winter thaws. For example, snow and ice accumulations on raised islands thawing, and then freezing on the road surface, might be prevented by use of a drained, depressed island.

### **CLASSES FOR REINFORCED CONCRETE ARCH PIPE**

Class IIA is the only class available for pipe arches with a nominal span less than 73 inches. Class IIA is designed for 0' to 8' of cover. For pipe arch sizes 73 in. or greater, Class IIA, IIIA and IVA are available. Refer to Standard Plate No. 3014 for further information.

### **CULVERT APRONS IN THE CLEAR ZONE**

Several designers have shown confusion with when to use safety aprons and or grates. They should refer to Chapter 8 of the Road Design Manual for this information.

It is recommended that ALL entrance culverts have safety aprons and/or grates within the clear zone.

### **CULVERT WORK**

Whenever you revise a portion of a culvert, such as a lining or a salvage/install apron. You need to make sure that the aprons are up to current standards. If a safety apron and/or grate is needed and the existing apron does not meet this then the designer must replace the apron to bring it up to current standards.

### **DRAINAGE FLOW ARROWS**

Plans should contain drainage flow arrows on the plan sheets indicating the direction of flow for culverts, bridges, ditches, ditch breaks, etc..

## **DRAINAGE STRUCTURES ON ALTERNATE BID PLANS**

When doing alternate bid plans the designer needs to pay attention to the drainage structures. How they are handled may be different in a bituminous plan versus a concrete plan. There have been some issues with the inlet pads not being accounted for on the alternate projects.

## **FINE FILTER AGGREGATE FOR SUBSURFACE DRAINS**

Under the Spec 2502 in the 2016 and 2018 Spec Book it is not clear how fine filter aggregate is being paid for. Therefore, whenever using 2502 pipe drain items you will need to note somewhere in the plan that the fine filter aggregate is incidental.

## **GRATES**

The type of grate used with a catch basin does affect the amount of runoff intercepted along a curb and gutter. The location of the catch basin, whether on a slope or at a low point, also should be considered when choosing the type of grate to be used. The advantages and disadvantages of some of MnDOT grates are as follows:

Grate	Advantages	Disadvantages
Standard Plate 4154 (vane type) (Grate Casting 816)	<ol style="list-style-type: none"><li>1. Tends not to plug with debris.</li><li>2. Intercept large flow Depths on steep slopes with no flow across grate.</li><li>3. Bicycle safe when <del>installed</del> placed in correct position.</li></ol>	Has less capacity at low Points than parallel grate Std. Plate 4153.
Standard Plate 4152 (vane type) (Grate Casting 814)	<ol style="list-style-type: none"><li>1. Bicycle safe</li><li>2. Accommodates foot traffic Debris.</li></ol>	<ol style="list-style-type: none"><li>1. Tends to plug with debris</li><li>2. Water will tend to skip across grate with large with large flow depths on Steep slopes.</li></ol>

The above information indicates that the vane type grate (Standard Plate 4154-Grate Casting 816) should be used on grades. The parallel type grate (Standard Plate 4153 - Grate Casting 815) is recommended at low point except where bicycle traffic is expected. If the low point structures may have bicycle traffic, the vane grate (816) is recommended.

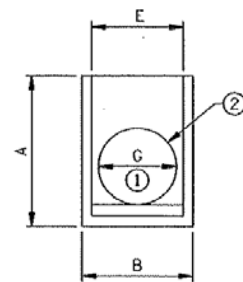
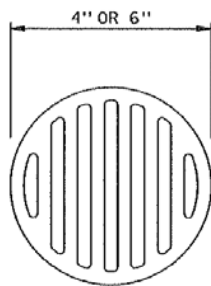
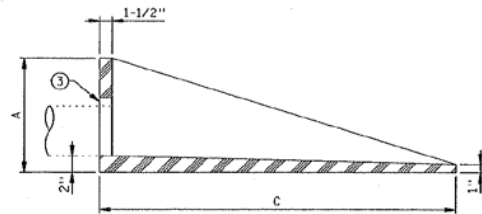
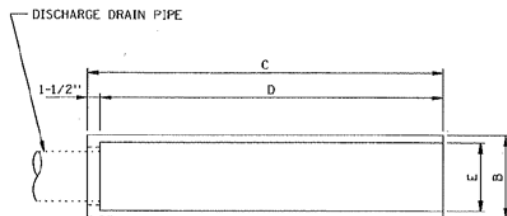
See Design Scene Chapter 3 – “ADA SAFETY GRATES, CURB BOXES, and HELPER STRUCTURES” for more information.

### **HEADWALLS (POLYETHYLENE OPTION)**

The headwall detail shown below shall be considered an unapproved standard detail to be used for headwalls for subsurface drains. The intent is to use Polyethylene (P.E.) as an option to the concrete headwall we currently use. Sub note CONCRETE HEADWALL pay item to read: THE CONTRACTOR HAS THE OPTION OF USING A POLYETHYLENE HEADWALL AS SHOWN ON SHEET \_\_\_\_.

This detail can be found on the internal website at “MnDOT A to Z”...”D”...”Design Details”...”HEADWALL”

Designers outside of MnDOT will need to contact their MnDOT project Manager to get a copy.



DIMENSIONS	4" DIA. PIPE	6" DIA. PIPE
A	11-3/4"	13-3/4"
B	7"	10"
C	36"	42-1/2"
D	34-1/2"	41"
E	5-1/2"	8-1/4"
F $\Delta$	1 - 2"	1 - 2"
① G	5"	7"
APPROX. WT.	38 LBS.	45 LBS.

$\Delta$  WALL THICKNESS - SIDES,  
BOTTOM, AND END.

#### NOTES:

SEE PLANS FOR MORE INFORMATION.

HEADWALL TO BE RECYCLED HIGH DENSITY POLYETHYLENE,  
TENSILE: 3.2 K P.S.I. MINIMUM, FLEXURAL 100 K P.S.I. MINIMUM.

- ① HOLE SIZE TO ACCEPT ALL COMMONLY USED P.V.C. PIPE.
- ② P.V.C. GRATE FOR POLY APRON IS COMMERCIALY AVAILABLE AS A FLOOR STRAINER. SHIELD IS FASTENED TO THE OUT FALL PIPE WITH 2 (TWO) NO. 10 X 1 INCH GALVANIZED SHEET METAL SCREWS.  
OPTION:  
SCREENS OF 2 OR 3 MESH, 16 GAUGE OR HEAVIER HOT DIPPED GALVANIZED CARBON STEEL WIRE. FITS SNUGLY TO SIDES AND BOTTOM AND IS BENT TO FIT SECURELY TO THE BACK OF THE ENDWALL. ALLOWS FOR APPROXIMATELY 1-1/2" - 2" EXTENSION OF OUT FLOW PIPE.
- ③ SEAL P.V.C. PIPE WITH SILICONE CAULK OR OTHER APPROVED MATERIAL

### **INPLACE DRAINAGE STRUCTURES**

On projects where inplace manholes or catch basins are likely to be either adjusted or reconstructed, the following additional information is necessary from survey crews.

- Design or type of structure
- Cone Type A, B or C.
- Height of adjusting rings – if no rings, indicate this
- Height of casting

This information is also necessary when the design requires connecting new drainage structures to inplace structures. Please inform you District Surveys Engineer of these requirements.

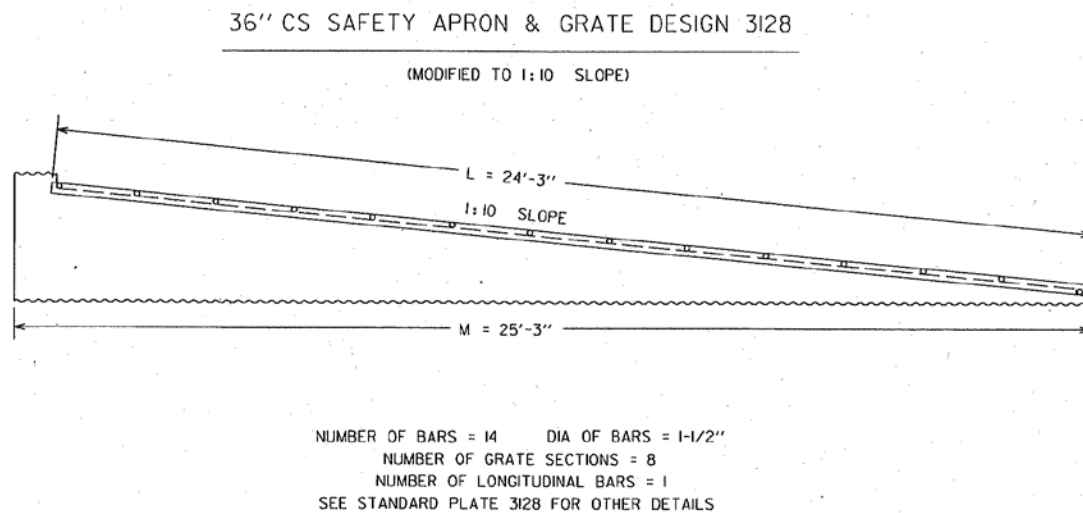
Also, during review of supplemental agreements, we noticed several agreements had to be processed due to the incorrect size of existing storm sewer pipes in the plan. A more careful check, especially those pipes that require extensions, is in order.

## **PARALLEL PIPES AND APRONS IN THE MEDIAN**

Parallel pipes located in the median require safety aprons, must be grated, and the slope modified to a 1:10. The only apron design that must be used is Apron and Grate Design 3128. Standard Plate 3148 CANNOT be used for this application. If concrete pipe is used standard plate 3128 covers the connection to the concrete pipe. The plan must also include a design detail for the 1:10 apron.

These details can be found on the internal website at “MnDOT A to Z”...”D”...”Design Details”...”SAFEAPRN1\_10B” or “SAFEAPRN1\_10SM”

Designers outside of MnDOT will need to contact their MnDOT project Manager to get a copy.



## **PIPE BEDDING**

The 2016 and 2018 Spec book does not reference the various bedding classes (e.g. B, C) but just refers to it as bedding. Therefore, we can no longer call out the pipe bedding class in the plans, it should just be referred to as “bedding”. The pipe bedding details could reference Spec 2451 for bedding requirements.

## **PIPE GAUGES**

Standard Plate 3041. This plate allows a lighter gauge metal pipe above 36 in. diameter than Standard Plate 3040. Therefore, it is better not to show any gauge within a plan unless a heavier than standard gauge is required (lighter than standard are never used). When a heavier gauge is called for, it should be sub noted as below:

2501.503 42" CAS PIPE CULVERT 10 GAUGE (1)

(1) A 10 gauge is required per Standard Plate 3040 or a 12 gauge per Standard Plate 3041.

NOTE: (1) above is assuming that the gauge requirements are based on fill conditions only. If a heavier gauge is desired for velocity - durability reasons, note (1) above should state that regardless of which plate is used, a 10 gauge pipe is required.

## **PIPE LINING**

There has been some confusion regarding pipe lining, hopefully this will clear it up...

Lining pipes must state the size of the pipe being lined....

- 2503.603 LINING SEWER PIPE\_\_” by the LIN FT...grout is incidental unless otherwise noted.
- 2507.503 LINING CULVERT PIPE (\_\_”) by the LIN FT, when using this pay item they also need to include either...
  - ❖ 2519.507 CLSM LOW DENSITY by the CU YD or
  - ❖ 2519.507 CLSM HIGH DENSITY by the CU YD or
  - ❖ If using cured in place pipe (CIPP) then pay for it as 2507.603 LINING CULVERT PIPE (\_\_”) SPECIAL by the LIN FT. Add a note stating it is Cured in Place Pipe (CIPP) because sometimes it is special but not because it is CIPP. A special provision is required for this and is being updated on a regular basis. Please contact the State Hydraulics Engineer for this write-up.

## **PLASTIC PIPE OPTION FOR STORM SEWER AND CULVERTS**

There has been some confusion with this article given the latest Technical Memorandum 17-5-B-02 issued 4-25-2017.

How plastic pipe options has not changed as a result of this Technical Memorandum. Pay for them as the existing/previous article states. The major change for this is that when listing options the designer CAN now also include PP (polypropylene pipe).

When giving plastic pipe as an option the plan should include the detail from

- Attachment D if using flexible pipe for storm sewer,
- Attachment E (First detail) if giving flexible pipe as an option for centerline culvert.
- Attachment E Treatment types if giving flexible pipe where treatments are needed.

The designer should use these details not ones they created.

Mn/DOT has agreed to include acceptable pipe materials within its construction plans. It has been determined that plastic pipe should be used more uniformly statewide for storm sewer and culverts if the plastic pipe design criteria are met. This is being provided in response to industry concern that plastic pipe, although an approved material was not being included as a bid alternate. Designers may continue to specify a particular product to be used when professional engineering judgment determines that circumstances warrant. When this is the case the designer should keep written documentation in the project file on why the option was not used.

Plastic pipe should be used in accordance with Technical memorandum No. 17-05-B-02.

### ***Storm Sewer***

Storm Sewer (2503 items) **MUST** give the plastic pipe option for pipes less than or equal to 48". If not they must have a good reason document in the project file as why the option was not given. Not wanting an option is not a valid reason for not having it.

In order to make it clear which pipes shall have options, it is recommended that for each reach of pipe that the options should be noted in the drainage tabulation. On the Statement of Estimated Quantities the listed pay item will be reinforced concrete pipe. A note shall be provided on each appropriate pay item noting that: **Plastic pipe may be used as an option.**

For storm sewer systems where some of the sewer pipe qualifies for the plastic pipe option and the rest of the sewer is concrete, the pay item should have a note on the estimate sheet showing how much pipe may be plastic.

#### **Example:**

2503.503 24" RC PIPE SEWER CLASS III (1) LIN FT 500

(1) Plastic pipe may be used as an option for 200 lin. ft.. See tabulations for locations.

Make sure the locations are shown in the drainage table.

### ***Centerline Culvert***

Plastic pipes may be used for centerline culverts as long as they meet the following requirements...

The maximum allowable diameter is 48" for use under unpaved roads or when ADT is less than 5000.

Centerline culverts shall have silt-tight joints unless designated as requiring watertight joints. A note should be in the plan when a watertight joint is required.

In order to make it clear which pipes shall have options, it is recommended that for each reach of pipe that the options should be noted in the drainage tabulation. On the Statement of Estimated Quantities the listed pay item will be reinforced concrete pipe. A note shall be provided on each appropriate pay item noting that: Plastic pipe may be used as an option.

### ***Side Culvert***

As with the storm sewer it is recommended that the tabulation for side culverts note those that will have options.

When giving the plastic pipe option they must use the generic pay items...

- 2501.602 X" SAFETY APRON by the EACH with the note...Apron material shall be the same as pipe material except that the apron for CP and PP pipe shall be CS.
- 2501.602 X" PIPE APRON by the EACH with the note... Apron material shall be the same as pipe material except that the apron for CP, PP, and CS pipe shall be GS.
- 2501.603 X" PIPE CULVERT by the LIN FT with the note...CS, CP, PP, RC may be used as acceptable pipe options. CS was used to determine the pipe lengths.

### ***Other***

Plastic pipe is dependent on soil interaction for support. Adequate compaction must be attainable for the pipe to perform satisfactorily. Areas of high groundwater or unusual soil conditions may not be suitable if compaction is not certain. Follow the design criteria in the Technical Memorandum which provide guidance on acceptable pipe sizes, cover requirements, allowable ADT for centerline culvert, and other considerations. Designers need to apply engineering judgment in such situations and limit the types of pipe materials allowed if site conditions may result in an unsuccessful installation.

### **STANDARD PLATE 3022**

This standard plate is used for safety aprons up to and including 36 inches. Standard Plate 3022 shows two design options (No. 1 & No. 2). When using this plate the designer should indicate on the drainage tabulation which option was used to determine the length of pipes.

### **STANDARD PLATE 4134**

Standard plate 4134, Curb Box Casting for Catch Basin (for Design B Curbs), was created specifically for use with 4" B curb. Some problems have occurred with this curb box. Input from the districts and the Bridge Hydraulics Section indicate that breakage has been caused by installation problems. Curb boxes are considered effective only at low-points and should normally not be used at structure locations on-grade. Proper field installation of curb boxes is important, but designers should avoid their use except at low-points. This is especially important when designing for 4" curb and gutter.

This box does not fit on our standard structures; therefore, when using this you need to place it on a structure with a 30" opening such as a Drainage Structure Design N or Drainage Structure Design 4020 or SD with a modified cover with larger hole.