Office of Design

Culvert Excavation and Backfill

This section discusses excavation and backfill for pipe culverts, box culverts, and livestock passes installed under pavement. Pipe culverts installed under pavement are placed according to DR-101. Contractors may elect to install rigid pipes using the fill installation method; however, trench installation is more common. Flexible pipe requires trench installation. Regardless of pipe type, quantities will be based on a bedding thickness of 4 inches below the pipe.

Excavation

Reinforced Concrete Pipe

In fill areas, assume the contractor will use the fill installation shown on DR-101. If the pipe is located in an area that will require a partial cut, see Figure 1, calculate the quantity of Class 20 as described in Article 2402.04, B, 3 of the Standard Specifications. Remember to account for the thickness of the pipe and the 4 inch bedding.

In cut areas, the trench installation shown on DR-101 is used. Trench installation may also be used in partial fill areas. Refer to DR-101 for a cross section of the trench.
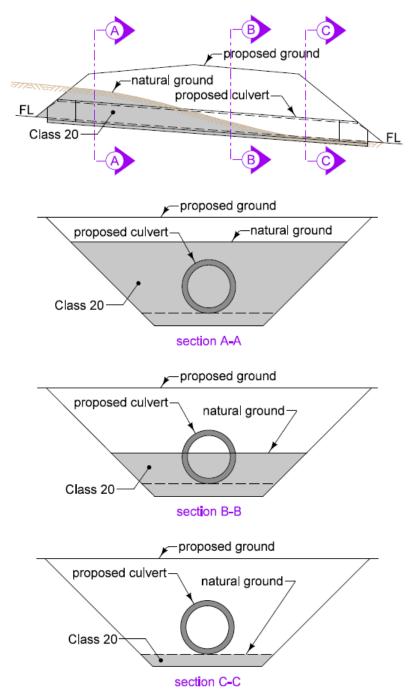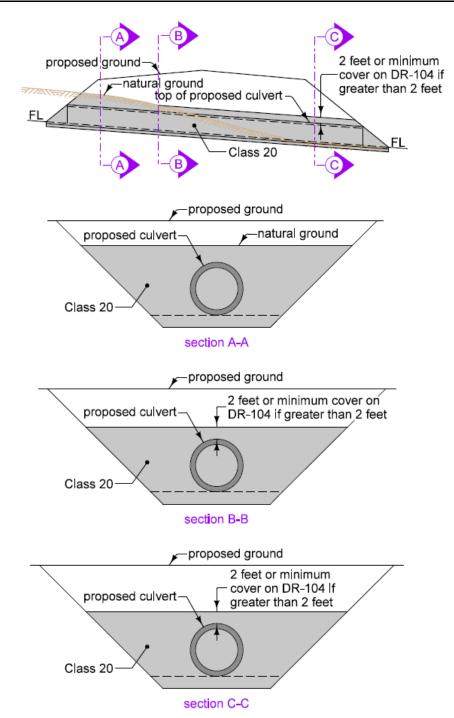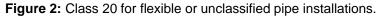
Figure 1: Rigid pipe installation with partial cut.

Flexible or Unclassified Pipe

Flexible (metal or plastic) pipe is always installed using the trench installation shown on DR-101. Refer to DR-101 for a cross section of the trench. Calculate Class 20 up to existing ground or to 2 feet above top of pipe (or the minimum pipe cover shown on DR-104 if greater than 2 feet) for the length of trench, see Figure 2. Remember to account for the thickness of the pipe and the 4 inch bedding.

Figure 2: Class 20 for flexible or unclassified pipe installations.

Unclassified pipe may be either flexible or rigid depending on the contractor's choice. Designers should assume flexible pipe and calculate Class 20 the same as for flexible pipe. Since the pipe thickness isn't known, use concrete pipe thickness to be conservative.

Reinforced Concrete Box Culvert and Livestock Pass

Calculate Class 20 as described in Article 2402.04, B, 4 of the Standard Specifications. Refer to DR-111 for a cross section of the trench.

Backfill

Pipe Culverts Installed Under Pavement

The quantity of flooded backfill is equal to floodable backfill plus porous backfill, see Tabulation 104-3.

H in DR-101 is defined as the cover over the pipe. Because of the slopes of the pipe and pavement, this depth can vary along the pipe. For these calculations, focus on the depth under the pavement area. If any depth of cover under the pavement is less than or equal to 4 feet, include the flowable mortar quantity. Two quantities will need to be determined: flooded backfill and flowable mortar.

Quantities for Flooded Backfill are calculated using the proposed ground. Where the proposed ground is greater than 5 feet above the top of pipe, use top of pipe plus 5 feet as the maximum trench depth (see Note 8 of DR-101). This maximum is based on Article 2416.03, C of the Standard Specifications. To ensure competitive bidding for fill versus trenched installation, this item will be paid as plan quantity. Care should be taken to estimate Flooded Backfill as accurately as possible.

For letdown structures, use Class C bedding under the letdown portion and Class B bedding on the portion of the pipe under the roadway. Flooded backfill quantity should be calculated as if the pipe continued to the foreslope at the same slope as the cross road portion.

A gap will exist between the top of the flowable mortar and the normal top of subgrade, see Figure 3. If this gap exceeds 6 inches (e.g. superelevated curves), fill the area with Special Backfill or Modified Subbase. If it is 6 inches or less, fill the area with Granular Subbase or Modified Subbase.
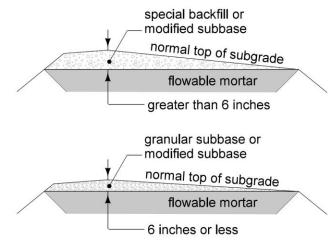

Figure 3: Gap between flowable mortar and normal top of subgrade.

Pipe Culverts Installed outside of Pavement

For roadway pipe culverts not installed under pavements, bedding and backfill (if excavated material) is incidental to pipe culvert and pipe excavation, respectively.

For entrance pipe culverts, excavation is included in other quantities.

Box Culverts and Livestock Passes Installed under Pavement

Normally, culverts are let a year in advance of the paving and are backfilled according to the Embankments Adjacent to Culverts and Structures specifications (see Section 2107 of the Standard Specifications), and the Placing Backfill Materials and Embankments Adjacent to Bridges, Culverts, or Structures specifications (see Section 2402 of the Standard Specifications). Occasionally, the pavement above the culvert will be constructed in the same year as the culvert. In these cases, a combination of flooded backfill and suitable backfill is used to prevent pavement issues caused by settlement of this material. Floodable backfill is placed to a height of 5 feet. The remaining backfill is suitable soil. Refer to DR-111 for a cross section. The quantity of flooded backfill is equal to floodable backfill plus porous backfill, see Tabulation 104-4.

Designers should keep in mind that although a project may be graded one year and paved the next, the timing of the grading and paving projects may result in less than a full calendar year between the grading and paving. In cases such as these, designers may still want to consider using flooded backfill.

> Use of flooded backfill should be discussed at a PMT meeting to ensure the District is in agreement.

Box Culverts and Livestock Passes Installed outside of Pavement

For roadway box culverts not installed under pavements, backfill is placed according to Article 2402.03, H of the Standard Specifications.

Chronology of Changes to Design Manual Section:

005B-002 Culvert Excavation and Backfill

5/9/2017   Revised
                  Added in material from Section 1E-7 that is better suited in this section.

8/5/2016   NEW
                  New. Information formerly contained in Section 5A-5.