

216 Earthwork

216.1 General

Earthwork is a generic term for all items of work, materials and operations required to construct the excavated areas and the embankments of a project.

[FDOT Specifications Sections 110, 120, and 125](#) define the terms, method of measurement, basis of payment, and pay items associated with earthwork.

In general, earthwork on a highway project consists of:

- **Clearing and Grubbing** – Complete removal of existing flexible pavement (asphalt and base) and rigid pavement. See [Standard Specifications Section 110](#) for additional requirements.
- **Embankment** – Compacted fill material needed to construct the roadway. See [Standard Specifications Section 120](#) for additional requirements.
- **Regular Excavation** – See [Standard Specifications Section 120](#) for additional requirements.
- **Subsoil Excavation** – See [Standard Specifications Section 120](#) for additional requirements.
- **Excavation for Structures and Pipe** – See [Standard Specifications Section 125](#) for additional requirements.

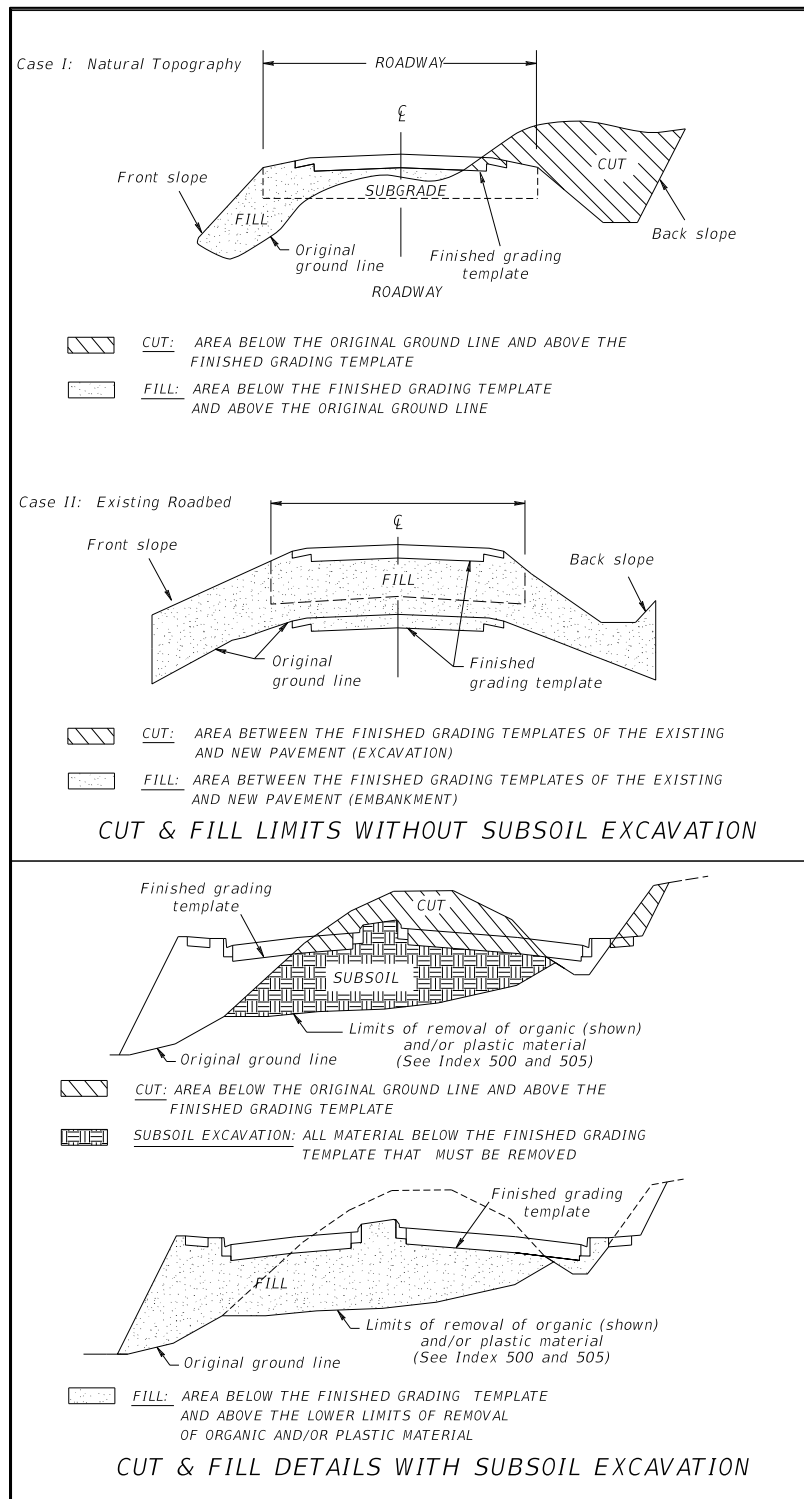
The most important roadway operation involving earthwork is constructing the roadbed. The roadbed is constructed by excavating soil from cut sections and placing soil as embankments in fill sections. In cut sections, the roadbed is built below the original ground line, soil is excavated to the elevation of the proposed roadbed. In fill sections, the roadbed is built above the original ground line, soil is placed as embankment to the elevation of the proposed roadbed. The original ground line is defined as the contour of existing natural topography.

For projects involving construction over existing roadbeds:

- Removal of existing flexible and rigid pavement is included in the Clearing and Grubbing pay item, as defined in [Standard Specifications Section 110](#). The clearing and grubbing depth within the existing pavement structure may vary since the existing shoulder and roadway bases are likely at different elevations (unless the existing shoulder was constructed at full depth).
- Excavation involves removal of material below the finished grading template of the existing pavement. The finished grading template is defined as the contour of the finished side slopes, unpaved shoulders, and the bottom of the shoulder and roadway base (clearing and grubbing limit) for flexible or rigid pavement.

Figure 216.1.1 illustrates cut and fill limits and details. Additional criteria and earthwork details are found in the [Standard Plans, Indexes 120-001, 120-002, and 160-001](#).

Figure 216.1.1 Examples of Cut and Fill Limits



216.2 Classification of Soils

The Department uses a system of soil classification that places materials into groups and subgroups based on soil fraction, liquid limit and plasticity index. This classification determines if and where the materials may be placed or left in their original position on a project. The soils survey, testing and classification of materials must be performed by a qualified geotechnical laboratory. The plans will include the information about the soil classification on the soil survey sheet and by showing the boring data soil boxes on the cross section sheets. If it is determined that an organic or plastic material must be removed below the finished grading template, the lower limits of removal of organic or plastic material will be shown to determine the area and volume of subsoil excavation.

216.3 Cross Sections

The details of cut and fill of earthwork are shown on the cross sections. The cross sections of the existing surface are usually obtained by location field survey or photogrammetry. The finished profile grades, typical section details, pavement design details, superelevation and horizontal alignments are used in combination to develop the finished template at each location where an existing cross section was obtained or generated. Sometimes it is advisable to develop and plot intermediate cross sections or half-sections to accurately determine quantities.

Cross sections cannot be finalized until late in the design process. However, preliminary cross section templates, developed early in the design process, can assist the designer in establishing many of the other design elements such as guardrail, shoulder gutter, inlets and special ditch grades. Preliminary cross sections are also used in performing the Soils Survey. Cross section templates should be plotted as soon as the alignment, profile grades and typical section details are established.

The interval selected for showing cross sections in the plans will vary according to project specific factors. For guidance see **FDM 319.3**.

216.4 Earthwork Pay Items

Table 216.4.1 provides guidelines for selecting the appropriate earthwork pay items.

Table 216.4.1 Guidelines for Selecting Earthwork Pay Items

Description	Control Lines	Recommended Pay Item		
		(A) Projects with Cross Sections	(B) Projects with Limited or No Cross Sections	
<p>Case I (Natural Topography): Earthwork operations above the original ground line</p> <p>Case II (Above Existing Pavement): Earthwork operations above the finished grading template of existing roadbed</p>	Fill	<p>Case I: From the original ground line to the finished grading template</p> <p>Case II: Between the finished grading templates of the existing and new pavement</p>	Embankment (CY)	Borrow Excavation (Truck Measure) (CY)
<p>Case I (Natural Topography): Earthwork operations below the original ground line</p> <p>Case II (Below Existing Pavement): Earthwork operations below the finished grading template of existing roadbed</p>	Cut	<p>Case I: From original ground line to the finished grading template</p> <p>Case II: Between the finished grading templates of the existing and new pavement</p>	Regular Excavation (CY)	Regular Excavation (3-R Projects) (LS)
Subsoil earthwork operations below the original ground line	Cut	From the finished grading template or original ground line (whichever is lower) to the lower limits of removal of organic or plastic material	Subsoil Excavation (CY)	Subsoil Excavation (CY)
	Fill	From the lower limits of removal of organic or plastic material removed to the finished grading template	Embankment (CY)	Borrow Excavation (Truck Measure) (CY)
With significant quantities of lateral ditch or channel excavation the designer may select to pay for separately		From original ground line to the finished grading template	Lateral Ditch Exc. Channel Exc. (CY)	N/A
<p>Notes:</p> <p>1. Pay items listed in column (A) cannot be used in conjunction with those listed in column (B).</p>				

216.4.1 Regular Excavation

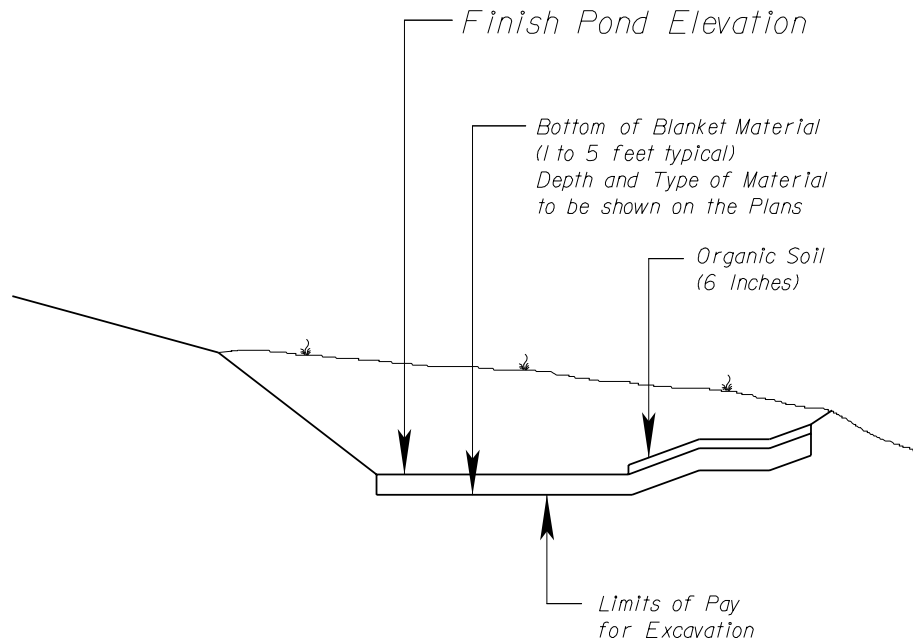
This is the most general classification of earthwork excavation. Roadway excavation consists of the excavation and the utilization or disposal of all materials necessary for the construction of the roadway, ditches, channel changes, etc., except for removal of existing pavement as defined in [Standard Specifications Section 110](#). When Lateral Ditch or Channel excavation pay items are not called for in the plans, the total quantity of all excavation must be paid for as Regular Excavation. Roadway Excavation consists of the net volume of material excavated between the original ground line (natural topography) or finished grading template of an existing roadbed, as applicable, and the finished grading template of new pavement.

216.4.1.1 Stormwater Treatment Ponds

Retention or detention areas that require considerable excavation should be summarized separately and added to the Regular Excavation. This is especially important if there is a large quantity and the area is removed from the project by some distance.

Some environmental permits now require that the plans call for excavating additional depth below the finish elevation of the bottom of a pond or ditch. They also require that the area of extra depth be replaced with “blanket material” that will either allow for percolation or not allow for percolation as required by the permit. The drawing below shows the limits of pay for excavation in this situation. The depth and type of fill material must be identified in the plans.

Figure 216.4.1 Pond Template



216.4.1.2 Regular Excavation (RRR Projects Only)

The pay item for Regular Excavation (RRR Projects Only) - Lump Sum is used on resurfacing (RRR) projects that meet the following conditions:

- (1) There are limited or no cross sections on the project.
- (2) Existing typical sections are reasonably consistent throughout the project.
- (3) If utility adjustments are a consideration on the project, the designer will need to be sure that sufficient data is available to allow the utility to be relocated or adjusted.
- (4) There are no right of way requirements on the project.
- (5) There is no change in the existing horizontal or vertical alignment.
- (6) There are no major special ditches on the project.
- (7) There are no major intersection modifications.
- (8) Show quantity of Excavation in Summary of Earthwork, but pay for as 1 Lump Sum.

Regular Excavation (RRR Projects Only) - Lump Sum may be used on intersection improvements and minor widening projects if they comply with the same listed above.

Earthwork will be paid for as Borrow Excavation (Truck Measure) and Regular Excavation (RRR Projects Only) – Lump Sum. The designer will calculate these quantities based on information obtained from the field and the proposed typical section. The designer must conduct a thorough field review to ensure existing field conditions are accurately reflected in earthwork estimates.

216.4.2 Subsoil Excavation

Subsoil Excavation consists of the excavation and disposal of any material that in its original position is excavated below the finished grading template or original ground line, whichever is lower.

The soils investigation survey documents the organic or plastic material found on the project. Likewise, the cross sections and the earthwork calculations must use the lower limits of removal of organic or plastic material in determining the quantities for Subsoil Excavation.

Where future widening of the roadway is anticipated, specify the limits of removal necessary to accommodate the future widening.

At some locations the complete removal of organic or soft soils may not be practical due to the depth. Review the subsoil excavation with the Geotechnical Engineer of Record and where constructability concerns exist, consult with the District Geotechnical Engineer to review design alternatives. If a geosynthetic reinforced design is selected, refer to **FDM 263** for plan content and design requirements. Additional information concerning geotechnical design can be found in the [Soils and Foundations Handbook](#).

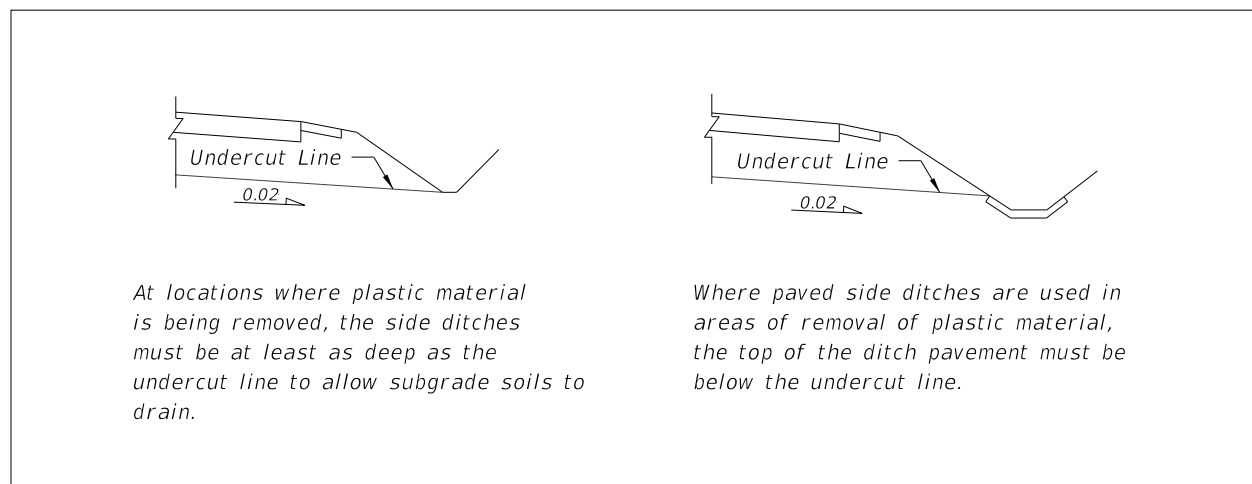
Where subsoil excavation is required due to plastic soils, ensure that adequate drainage of the pavement subgrade is provided. **Figure 216.4.2** illustrates the required excavation undercut line (i.e., grade and extent of excavation bottom) for flush shoulder roadways. To accommodate normal undercuts, the side ditches should be at least 3.5 feet below the shoulder break.

For curbed roadways, additional subsoil excavation may be needed beyond that shown in **Figure 216.4.2** or underdrains must be installed in accordance with [Standard Plans, Index 120-002](#). Coordinate the removal of plastic materials with the Drainage Engineer of Record, as it may affect various drainage design elements including the profile grade of the ditch bottoms.

The embankment quantities (areas and volumes) may be checked by calculating the areas and volumes required to fill the excavated areas created by subsoil removal. See example given in **FDM 216.1**.

Do not include the payment for subsoil excavation in the pay quantities for other items no matter how small the subsoil quantity.

Figure 216.4.2 Undercut Detail of Plastic Material with Relation to Side Ditches



Embankment (fill) or Regular Excavation (cut) should be used in conjunction with the pay item Subsoil Excavation. Both Embankment and Regular Excavation are plan quantity items. The quantities are based on line and grades shown in the plans and would allow construction personnel to field verify the quantities of material used on a project. Subsoil Excavation is a field measure item, and the final pay quantity will be determined by cross section taken when the removal of the material is completed.

216.4.3 Lateral Ditch Excavation

Excavation required to construct inlet and outlet ditches at structures, changes in channels of streams and ditches parallel to the right of way, but separated from the roadway template, may be designated by the designer as Lateral Ditch Excavation.

On projects with very little of this type of excavation, this earthwork is usually included in the Regular or Roadway Excavation. If there is a significant amount of Lateral Ditch Excavation, it should be detailed, calculated and summarized separately in the Summary of Earthwork.

Quantities for **Excavation for Structures and Pipe** must not be included in the quantities for Lateral Ditch or other excavation pay items.

216.4.4 Channel Excavation

The pay item for Channel Excavation consists of the excavation and satisfactory disposal of all material from the limits of the channel as shown in the plans. This work is generally called for by the plans and has lines, grades, typical sections and other details shown for excavating a channel change or a major modification to an existing channel or stream. This work may be significantly different from regular excavation or lateral ditch excavation, requiring draglines, barges or other special equipment. It is typically detailed, calculated and summarized separately.

216.4.5 Borrow Excavation (Truck Measure)

The pay item for Borrow Excavation (Truck Measure) is only used on projects with limited or no cross sections. It is used to indicate that the contractor is to furnish earthwork material from areas provided by him and generally outside the project limits. This could include material with a specific minimum bearing value for building up existing shoulders, when appropriate for the project.

Borrow material may be obtained from within the right of way of the project, if available. The proposed borrow areas must be reviewed and coordinated with the District Environmental Coordinator to minimize environmental disturbance and promote a future original appearance.

When the designer chooses the method of payment as Borrow Excavation (Truck Measure), a fill adjustment must be made to the net total fill material calculated from the plans to allow for handling. An additional adjustment (truck) is added to obtain a representative volume of material required. This is not a plan quantity item, but it is very important that a realistic determination of quantities be calculated by the designer.

216.4.6 Embankment

This item includes placing material above the original ground line (areas of natural topography), finished grading template (areas of existing roadbeds), or above the lower limits of removal of organic or plastic material, as applicable, to the finished grading template of new pavement. Refer to **FDM 210.4** and **211.4** for additional requirements for shoulder gutters.

216.5 Earthwork Quantities

Earthwork quantities may be checked by the method of average end areas:

$$\text{CUBIC YARDS} = \frac{\text{EA1} + \text{EA2} \times \text{LENGTH}}{2}$$

216.5.1 Variation in Quantities

When detailing and determining earthwork quantities, use the most probable base option within the optional base group. A plan note should also be shown in the plans stating which option was used for plotting the cross sections and calculating the earthwork quantities (see **FDM 307.2.1**).

216.6 Summary of Earthwork

A subtotal for each group (e.g., mainline, side street, pond) should be shown in the Summary of Earthwork for each earthwork operation (subsoil excavation, regular excavation and embankment). This summary should be shown on the Summary of Earthwork in the Estimated Quantities Report. See **FDM 902** for information on Estimated Quantities Report.

See Chapter 8 of the **BOE** for examples of Summary of Earthwork.