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# 3 Excavation

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# CHAPTER THREE:

## *EXCAVATION*

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During the construction of a highway or bridge, existing materials may be required to be removed. These materials occupy the space in which a new highway or bridge is planned. Therefore, they are removed or "excavated." The types of excavation are:

- 1) Common
- 2) Rock
- 3) Unclassified

Some materials excavated may be suitable for use in construction of embankment. Some are not and are disposed of completely.

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### COMMON EXCAVATION

Common excavation is the most frequently encountered type of excavation. The Specifications state that, "Common excavation shall consist of all excavation not included as rock excavation or excavation which is otherwise classified and paid for, including asphalt type pavement and all rippable materials".

Common excavation is the excavation of soil materials from within the contract limits; however, this excavation is not limited to soil materials and may include existing HMA pavement. This HMA pavement includes HMA mixtures, crushed stone, bricks, cinders, etc. If the material is indicated on the plans and is not a concrete pavement or another defined excavation, then the material is considered common excavation.

Section **203** further defines embankment construction as the excavation, hauling, and disposal or compaction of all material. Because compaction of the material is included in common excavation, soil samples are required to be obtained. These samples are submitted to the appropriate testing laboratory for determining maximum densities and moistures.

#### *SUBMITTING SAMPLES*

The manner of sampling and the number and the size of samples required depends upon two conditions:

- 1) The number of different soil types used on the contract. The submitter investigates each cut and borrow pit to determine the soil types. Only samples of the different types encountered are submitted.
- 2) The method the Contractor expects to use in the removal and placing of the soil. If each type is worked separately, the soil is required to be sampled separately. However, if the Contractor expects to blend soil types, the soils are sampled accordingly. Blending may occur during excavating or placing. Therefore, communication with the Contractor is essential.

If relatively few samples are to be secured, a 5 in. auger is a satisfactory tool for securing samples. Three foot extension sections of pipe may be required to reach the desired depth. The grading Contractor is required to supply a backhoe with an operator for securing a large number of samples or samples at depths greater than 5 ft.

The grade Technician may be required to determine where the samples are to be taken, obtain the samples, and submit the samples. Each soil sample is required to be a minimum of 25 lb and each granular material a minimum of 65 lb. A small portion of each sample is required to be retained for later reference.

### ***PREPARING THE IT 530***

When the samples are submitted to the District laboratory, they are accompanied by an IT 530 for each sample. The following special information for each sample is reported on the IT 530:

- 1) Centerline station and offset
- 2) Centerline station and offset for adjacent borrow pits
- 3) Elevation
- 4) Field office telephone number
- 5) Copies of applicable special provision sheets
- 6) Referenced specifications
- 7) Intended use
- 8) Description of soil as to texture, color, visual classification, moisture content, etc.

The appropriate laboratory determines the maximum density and optimum moisture content. These results are sent to the PE/PS for use in determining in-place soil densities.

## **ROCK EXCAVATION**

Rock excavation consists of the excavation of igneous, metamorphic, and sedimentary rock and boulders or detached stones having a volume of 1/2 yd<sup>3</sup> or greater. The material for this type of excavation is removed by blasting, by power shovel with a bucket that has a minimum capacity of 1 yd<sup>3</sup>, or by other equivalent powered equipment. Unless otherwise specified or directed, the following criteria is used in excavating the material.

### ***EXPLORATORY DRILLING***

Exploratory drilling may be required to determine the existence of cavities and possible sink holes in cut sections. These holes are 1 1/2 in. in diameter, and drilled on centerline at 100 ft intervals to a point which is 7 ft below the proposed grade. If a cavity or sink hole is found then additional holes are drilled along the edges of the pavement at 25 ft intervals. These holes are also drilled to 7 ft below the proposed grade. If the cavity has less than 5 ft of cover, then the cover is removed and the cavity treated as set out in the plans or as directed.

### ***ROCK PRE-SPLITTING***

The rock is pre-split by the use of drilling and explosives. The work is done in such a manner that minimum breakage occurs outside the neat lines of the typical cross section. The holes for this operation are from 2 in. - 4 in. in diameter, spaced 3 ft apart, and drilled 2 ft below the established grade of the cut or the predetermined bench elevation. The maximum depth of a pre-split lift is 30 ft. If a cut section requires more than one lift, the holes are drilled in such a manner that the specified offset for each succeeding lift is obtained. A horizontal distance of 2 ft off the back side of the paved side ditch line is required.

The pre-split face shall deviate no more than 6 in. from the front line and 1 ft from the back line of holes. The pre-splitting operation is kept well in advance of the regular blasting operations. The line holes are to be fired before the main excavation is blasted. There is no direct payment for pre-splitting because the cost is included in the cost of excavation.

### ***EXPLOSIVES***

The explosives to be used and the method of loading depends on the type of material to be blasted. A single strand of detonating chord or a solid column of dynamite may be used. The type used is required to be capable of pre-splitting the material with a minimum breakage outside the excavation area.

### ***PRIMARY BLASTING***

The holes for the primary blasting are drilled at least 6 ft away from the pre-split face. If additional charges are required, the holes are placed at half the distance of the full depth holes. These holes are drilled to a depth 2 ft above the pre-split face.

### ***RESTRICTIONS***

The Contractor is required to restrict the amount of explosives used near structures, rock formations, or other property that may be damaged. Adequate seismograph readings are obtained if commercial buildings are within the effective vicinity, at no additional cost. These readings are used to show that the blasting operations have not altered the existing commercial building foundations.

### ***FINISHED GRADE***

The final breakage of rock is required to conform to or closely approximate the slope lines indicated on the plans. The final slopes are required to be left reasonably smooth and uniform with all loose and overhanging rock removed. Unless otherwise permitted, no rock is allowed to project more than 1 ft beyond the established slopes. If a natural seam intersects an established slope, permission may be granted to follow the seam face for an approved distance. If the Contractor provides a finished slope which is equal or superior to that which is obtained by pre-splitting, machine methods to establish final slopes may be used. The rock is excavated to the required elevation for the full width of the roadway as indicated on the plans or as directed. The final surface of the rock excavation is required to have proper drainage. If the rock is excavated below the required elevation, the rock excavation is backfilled to the subgrade elevation with crushed stone, spalls, subbase material, or other granular material.

## **UNCLASSIFIED EXCAVATION**

Unclassified excavation consists of the excavation of and proper disposal of any type of material that is encountered during the progress of the work.

### ***WATERWAY EXCAVATION***

Waterway excavation consists of excavation and the proper disposal of material encountered in the clearing of the waterways, making channel changes, or a combination of the two. The excavation does not include Class Y excavation or the excavation made for a structure as set out in Section **206**. Waterways are cleared between the right-of-way lines unless otherwise specified. Surface objects, trees, stumps, and roots are cleared and grubbed.

### ***CLASS Y EXCAVATION***

While conducting normal waterway excavation, material may be encountered such as rock or material which consists of hard ledge rock, hard shale, conglomerate, concrete, masonry, or any similar material which is not part of the existing structure as indicated on the plans. If the material cannot be reasonably removed by any other method, the material is removed by blasting. This excavated material is defined as Class Y excavation. Section **203.02** defines material that may not be considered Class Y excavation.

### ***CLASS X EXCAVATION***

One or more of the following materials encountered within the limits of foundation excavation are defined as Class X excavation.

- 1) Solid rock, hard ledge rock, slate, hard shale, or conglomerate. Because the material cannot be reasonably removed by any other method, blasting or pneumatic or equivalent tools are required for removal.
- 2) Loose stones or boulders which are greater than 1/2 yd<sup>3</sup> in volume.
- 3) Concrete, masonry, or similar materials which are parts of an old buried structure that was not shown on the plans.
- 4) Timber grillages, old foundation piling, buried logs, stumps, or similar material that extend beyond the limits of excavation and are required to be cut off to be removed. These materials are removed back to the cofferdam limits and paid as Class X excavation.

Hard pan is not considered as Class X excavation. The limits of Class X excavation are the neat lines of the footer unless the excavation lies above another type of excavation whose limits are different. In this case, Class X excavation is paid to the limits of the underlying material.

***WET EXCAVATION***

Wet excavation is that portion of the foundation excavation, except Class X, which is below a horizontal plane designated on the plans as the upper limit of wet excavation and above the bottom of the footing. If the elevation of the upper limit of wet excavation is not indicated on the plans, an elevation of 1 ft above the elevation of low water level is used.

***DRY EXCAVATION***

Dry excavation is that portion of foundation excavation, except Class X, which is above the upper limit of the wet excavation.

***FOUNDATION EXCAVATION, UNCLASSIFIED***

Foundation excavation, unclassified includes all the work for wet excavation or dry excavation if no pay item is included for these items, regardless of whether or not water is encountered. Class X is not included in foundation excavation, unclassified.

If no upper limit of foundation excavation, unclassified is shown on the plans, the upper limit is the original ground, except where waterway excavation, common excavation, or other classified excavation overlaps the area of foundation excavation.

**DISPOSAL OF EXCAVATED MATERIAL**

Excavated material may be classified as follows:

***SUITABLE MATERIAL***

If the material removed is suitable, then the material may be used for construction of embankments, shoulders, special fills, or other places as specified or directed depending on the nature of the fill.

***UNSUITABLE MATERIAL***

If the material is unsuitable for use in the embankment, the material is removed from the right-of-way. To place unsuitable material on private property, the Contractor is required to have written permission from the property owner.



### ***EXCESS MATERIAL***

Any excess excavated material that cannot be constructively used within the contract limits may be disposed of off the right-of-way, or used as directed to widen embankments or flatten fill slopes.

Excavation obtained from within the right-of-way and planned to be used in the embankment may be wasted and replaced with borrow if permission is obtained. However, the borrow is not paid for.

### **BORROW**

Borrow is a material obtained by the Contractor from locations outside of the right-of-way to complete the planned grading section. Frequently this material is obtained from properties adjacent to the right-of-way. Many of the areas that are "borrowed" from become ponds or small lakes. Hence the term "borrow pit".

Material such as river or lake deposit, cinders, or a soil mixture with a high organic content are not allowed. Borrow material is required to be free of substances that:

- 1) Form putrefying (rotting) deposits
- 2) Form deleterious (harmful) deposits
- 3) Produce toxic concentrations or combinations that may be harmful to human, animal, plant, or aquatic life

The following borrow materials that are not suitable for the growth of vegetation may be used:

- 1) Recycled materials such as coal combustion products, recycled foundry sand, granulated slag, etc.
- 2) Dune sand
- 3) B-Borrow
- 4) Other granular material

When these materials are used they may not be placed within 1 ft of the required finished grade of the shoulders and slopes. The final 1 ft is required to be material suitable for the growth of vegetation. This material is required to be free from clods, debris, and stones.

## CONTRACTOR RESPONSIBILITIES

When borrow is necessary, the Contractor is required to submit an operation plan for approval which includes the following:

- 1) A detailed sketch showing limits relative to property and right-of-way lines
- 2) The grade of all slopes
- 3) The encasement, finishing grade, and seeding procedures
- 4) An erosion control plan for the borrow pit in accordance with 327-IAC 15-5
- 5) An archeological clearance. The archeological report is required to be conducted by a qualified archeologist. A record check and an intensive field survey is conducted. Prior to the excavating of any material, a written report of the results is furnished to the PE/PS. If any archeological sites are identified, the archeologist establishes the limits along with a reasonable border, and the Contractor is required to remain clear of the site unless the archeological site is cleared by established procedures and written authority has been issued by the PE/PS. Under no circumstances does an employee of the Contractor or INDOT share in the ownership or profit from the sale of any archeological artifacts that may be salvaged.

## PREPARING A BORROW PIT

Section **203** places limits on the location, planned excavation, and control of the drainage of the borrow pit. If the location, planned excavation, and material comply with Specifications, the Contractor may proceed with clearing the borrow pit site. Soil samples of the pit are taken and forwarded to the District Testing Department. Before any borrow material is removed from the pit, a base line is required to be established and the original cross-sections taken. The base line is established through or near the proposed borrow pit with the extremities of the line referenced outside of the excavated area.

Precautions are to be taken to ensure that the references are not disturbed. In establishing a base line, consideration is given to the topography, the line of the cross sections, and the possibility of extending sections, if necessary. If the borrow pit includes a large area, an auxiliary line is run parallel to the base line to properly align the cross sections. Unless written permission is granted, there is no excavation below the elevation of the

adjacent properties in a borrow pit within 150 ft of the nearest right-of-way line of an existing highway. A sketch is required to be made of the borrow pit layout in the permanent field notes immediately preceding the original cross section notes. A description of the location of the borrow pit is placed on the sketch, such as, the number of feet right or left of a roadway station. The name of the property owner is also placed on the sketch.

## **PEAT EXCAVATION**

Peat is partly decayed plant matter that has collected in swamps and marshes over long periods of time and is generally the first stage in the formation of coal. Dried peat varies from a light yellow-brown substance to deeper layers of dark brown, compact material which looks like brown coal. Peat is not suitable for foundations of roadways because the material is unstable and subject to settlement when additional embankment is placed upon the deposit. Therefore, peat is required to be removed from under the roadway.

Peat excavation is the removal and satisfactory disposal of peat, marl, or any other unsuitable material and any overlying material. Extremely soft organic silt is found in lake bottoms and in static areas along river bottoms (flood plains). Marl is a water-deposited sand, silt, or clay containing calcium carbonate. Marl is sometimes found immediately below peat.

In rolling country where the ground rises sharply from the peat deposit, soils have often been washed over the edge of the original peat deposit. Some peat may therefore be trapped under what appears to be the soil perimeter of the peat deposit. This also is considered to be peat excavation.

Removal of peat deposits may be done in several ways. Methods of treatment may be shown on the plans, as directed, or by other methods outlined in the Specifications. Because treatments detailed on the plans, or as directed, are not all uniform in application, only the methods outlined in the Specifications are discussed.

The Specifications detail three methods for treatment:

- 1) Treatment of existing fills
- 2) Treatment by removal
- 3) Treatment by displacement

### ***TREATMENT OF EXISTING FILLS***

Treatment of existing fills is a method used to change a fill over an existing peat deposit. The change may be in height and/or width. Treatment of existing fills may be done by several means and is usually predetermined and outlined in the contract plans.

### ***TREATMENT BY REMOVAL***

The method of treatment by removal consists of completely removing the objectionable material by machine operations. This method is usually used when the following conditions exist:

- 1) The peat deposit is small in size
- 2) The peat deposit is shallow in depth
- 3) The peat deposit limits are completely within the construction limits or right-of-way

The following takes place during the method of treatment by removal:

- 1) New original cross-sections are taken. The entire area may have settled since the original survey.
- 2) The width of excavation is to be the full toe of slope to toe of slope width of the proposed embankment.
- 3) Final cross-sections are taken after the excavation is completed.
- 4) Backfilling of the peat excavation follows as soon as possible to minimize the occurrence of slides.
- 5) If water is not present, the excavation may be backfilled with borrow or common excavation.
- 6) If water is present, the backfill is required to be B Borrow placed by end-dumping to an established grade of approximately 2 ft above free water level.

### *TREATMENT BY DISPLACEMENT*

Treatment by displacement is the most commonly used procedure for excavation of peat. This procedure is frequently used under the following conditions:

- 1) The peat deposit is large in size
- 2) The peat deposit is deeper than 10 ft
- 3) Water is present at all times
- 4) The free water level is high

The following steps are usually followed during this method of treatment, if conditions permit:

- 1) Each end of the deposit is removed until the depth of the peat excavation is greater than 10 ft. This may be subject to change as directed. If conditions permit, the upper portion of peat is excavated across the remainder of the deposit. Excavation of this upper level begins at one end and continues ahead of the displacement-backfill operation. The free water level usually controls the depth of this operation. Displacement-backfill operation is also known as "surcharge".
- 2) After the completion of the excavation, cased test holes are placed. These test holes determine the extent of peat displacement and are also used to determine final measurement of the excavation.

The surcharge operation is the most difficult portion of the treatment to control. The weight of the surcharge literally pushes or squeezes the peat from the deposited area. A crane(s) with a drag line assists the surcharge procedure by removing the peat from in front of the surcharge. Since a properly constructed surcharge is very important, several guidelines are followed during the construction of the surcharge:

- 1) The surcharge is constructed of B Borrow.
- 2) The top of the surcharge is constructed and maintained to a width equal to the full shoulder width of the embankment.

- 3) The height of the surcharge is the same as the depth of peat being excavated. The original ground is the reference elevation for measuring the peat depths and the surcharge heights.
- 4) The top of the surcharge is approximately level.
- 5) The length on the top of the surcharge is at least 2 times the depth of the peat being treated.
- 6) The surcharge is maintained and pushed forward as directed.
- 7) The crane operation is coordinated with the rate of placing the surcharge.

#### ***PEAT DISPOSAL***

Once the peat deposit is excavated, by either removal or displacement, the excavated peat may be disposed of by one of the following methods:

- 1) Uniformly spread between the toes of fill slopes and the swamp ditch lines and beyond
- 2) According to Section **203.08** (Disposal Sites)