



This document provides guidance to designers on typical language to use on the Project Notes sheet(s) and quantity calculations methods for typical bridge replacement projects requiring excavation of unsuitable materials. The recommended notes for excavation of unsuitable materials in this document are merely guidance; it is still the designer's responsibility to ensure all necessary and relevant notes are shown on the plan set and are project specific.

- a) Unsuitable Materials include, but are not limited to, the following:
  - i) Low blow counts (<math>N \leq 8</math>) within 5' depth measured from the bottom of excavation
  - ii) A-1-b or A-2-4 with less than 10% of fines below or within excavation
  - iii) High water content (~ greater than 50% water content)
  - iv) Peat
  - v) High water table - only when in conjunction with other problem factors.
- b) Section 207000 defines the bottom of structural excavation as the bottom of the foundation stabilization. Typically that will be 12" below the footings, but will be deeper if unsuitable material is identified and the contractor is directed to remove it. The entire depth called out on the Plans will be included as Structural Excavation. Only if excavation goes beyond what is defined will additional structural excavation be utilized and paid by the chart in DeIDOT Standard Specifications for item 207000.
- c) Consider the overall depth of the excavation (Structure + unsuitable material), groundwater conditions and the need for cofferdams or sheeting and shoring. In most cases, limit deeper structural excavation to an additional 5' depth. If unsuitable soils exceed this depth, consider a different foundation type.
- d) Project Notes and item Usage (To be utilized as appropriate. The Project Engineer needs to examine each site):
  - i) Plan note to be included in the Section 200 Project Notes:
    - (1) REMOVAL OF UNSUITABLE MATERIAL:  
SOIL BORINGS HAVE IDENTIFIED MATERIAL, DESCRIBED AS (insert description), THAT (IS or MAY BE) UNSUITABLE FOR BEARING OF THE STRUCTURE AT ELEVATION (x) TO (x). THIS LAYER (SHALL or MAY) BE EXCAVATED AS NECESSARY (TO A MAXIMUM DEPTH OF (x') BELOW THE BOTTOM OF FOOTING ELEVATION) UNTIL SUITABLE BEARING MATERIAL IS REACHED, AS DIRECTED BY THE ENGINEER. EXCAVATION TO ELEVATION (x) IS INCLUDED IN THE QUANTITY FOR STRUCTURAL EXCAVATION. EXCAVATION BELOW THE FOOTING ELEVATION SHALL BE BACKFILLED WITH (specify borrow type, stone and/or crushed concrete or a combination) ON GEOTEXTILE. PAYMENT UNDER (respective items).
    - (2) Where loose soil (i.e. blow count <math>< 8</math>) is present at or below the foundation elevation or moderate potential of running sand is anticipated (See Br. 2-163 example below), use the 'may be' language in this note. Include the potential ('may') depth of structural excavation in the 207000 quantity and quantities for appropriate backfill materials.
      - (a) *Case Study of BR. 2-163A on Victory Chapel Road over Penrose Branch:*
        - (i) *Road elevation 52.71, bottom of excavation 38.95, depth of excavation 13.76'*
        - (ii) *Soil layer below excavation is A-1-b with a minimum blow count of 9 (adequate for bearing pressure), but with <math>< 10\%</math> fines.*
        - (iii) *Field conditions – small amount of sand bubbling up into the bottom of the excavation at the full depth.*
        - (iv) *Solution – extra stone to create a firm sub-base.*



- (3) Where soils are even worse (such as W/H blow counts or peat is present AND the entire layer can be removed) between the footing elevation and a suitable bearing layer (typically within 5'), use the 'is/shall be' language in the above note. Include the depth unsuitable material removal as structural excavation in the 207000 quantity and quantities for appropriate backfill materials.
- (4) Where peat is present, but it is not practical to remove all unsuitable material (see discussion of Peat below) use the following note:
- (a) REMOVAL OF UNSUITABLE MATERIAL (PEAT):  
 SOIL BORINGS HAVE IDENTIFIED MATERIAL, DESCRIBED AS (insert description), THAT IS UNSUITABLE FOR BEARING OF THE STRUCTURE AT ELEVATION (x) TO (x). THIS LAYER SHALL BE EXCAVATED (x') MAXIMUM BELOW THE FOOTING ELEVATION. EXCAVATION TO ELEVATION (x) IS INCLUDED IN THE QUANTITY FOR STRUCTURAL EXCAVATION. EXCAVATION BELOW THE FOOTING ELEVATION SHALL BE BACKFILLED WITH (specify borrow type, stone and/or crushed concrete or a combination) ON GEOTEXTILE. PAYMENT UNDER (respective items).
- (i) *Peat Discussion: Peat is like a sponge, it will hold most of water until an external force is applied. As such, peat is unsuitable to serve as a subbase of spread footers or pipes. Presence of peat is not always reported on the soil boring logs. Some of the soil types that could be considered as peat are: AASHTO designations A-7-5 and A-8 and on occasion when soil materials are not given an AASHTO designation. Presence of peat may or may not be mentioned in the soil boring log notes.*  
*In cases where peat cannot be excavated in it's entirely, one may consider dumping riprap directly into the peat to add further stabilization before backfilling with selected material. Furthermore, other acceptable option would involve adding selected stone backfill wrapped in geotextiles to force a lateral squeeze within the peat layer to achieve desirable immediate settlement. Note that finding an acceptable solution to this is ongoing.*
- (b) Include the depth of unsuitable material removal as structural excavation in the 207000 quantity and quantities for appropriate backfill materials.
- e) Project Engineer needs to choose the appropriate backfill materials for excavation greater than 12" below the Footing Elevation:
- i) B borrow
  - ii) Extra coarse aggregate
  - iii) 12" coarse aggregate on x" crushed concrete (depth determined per design)
  - iv) Other stone layer such as DE #3 stone
  - v) Geotextile under any and all options.
- f) Where running sands are anticipated above the bottom of the excavation (See Br. 3-140 and 3-103 examples below), consider dictating the use of cofferdams [Item 604002] or shoring [Item 604003] to support the excavation rather than leaving it up to the contractor's choice. The Department prefers to pay for it up front rather than as an over-run.
- i) *Case Study of BR. 3-140 on Tuckers Road over Toms Dam Branch:*
- (1) *Road elevation 37.27, bottom of excavation 22.56, depth of excavation 14.71'*
  - (2) *A-1-b soil above and below bottom of excavation. Blow counts in range of 7-14. In boring 1, all layers have <10% fines; boring 2 has 10-15%, except for 2 layers lower.*
  - (3) *Field Conditions – Contractor used sheeting for the stream diversion. Coupled with construction in the wet conditions of the winter 2013-2014 (=high water table), this*



*made a locally higher water table with enough head to push water through the embankment. Excavation could not reach the bottom elevation because of water flowing out of the cut and into the work area. However, the material was stable and did not slough.*

- (4) *Solution – well point system installed to draw down water table along the line of the abutment. Also modified the stream diversion (added 2 pipes) to move more water through the work area.*
- ii) *Case Study of BR. 3-103 on Greenhurst Farm Road over Nanticoke River:*
- (1) *Road elevation 46.60, bottom of excavation 32.25, depth of excavation 14.35' + extra excavation.*
- (2) *In design, Bridge Design was concerned about the weak soil layers just below the footing elevation and the need for extra excavation (possibly extensive). Other weak soil layers with greater than 100% water content and above the footing elevation would be removed as part of 207000.*
- (3) *Field Conditions – In the field, the soil layers above the footing elevation became a huge problem. In existing conditions, these layers were confined beneath the normal water elevation in the stream and held up by excess pore pressure. When the contractor began dewatering, these layers drained freely into the work area. Without the excess pore pressure, they became unstable and sloughed off into the hole without any load.*
- (4) *Solution – the contractor could not use a sheeting box to contain the work area because of a utility line recently relocated underground (perfectly positioned under the worst of the caving material). A combination of extra excavation (of both problem soil layers) and some sheeting stabilized the excavation, but resulted in a costly overrun.*
- g) Where running sand is present that would stop the excavation from reaching the foundation elevation (See Br. 3-140 example above and 2-371A example below), include this note in Section 900 of the Project Notes:
- i) **USE OF WELL POINTS:**  
**SOIL BORINGS HAVE IDENTIFIED POTENTIAL ISSUES WITH A HIGH WATER TABLE (and/or) RUNNING SANDS, DESCRIBED AS (insert description) AT ELEVATION (x). IF NEEDED AND WITH THE APPROVAL OF THE ENGINEER, A WELL POINT SYSTEM SHALL BE USED TO LOWER GROUNDWATER ELEVATION. PAYMENT UNDER ITEM #906005 – WELL POINT SYSTEM.**
- ii) *Case Study of BR. 2-371A on K371 Barratts Chapel Rd over Double Run:*
- (1) *Road elevation 6.69, bottom of excavation -5.50, depth of excavation 12.19' + proposed extra excavation (up to 3').*
- (2) *Field Conditions - This project had both undesirable soil conditions. First, there are A-1-b soil layers above the bottom of excavation with <10% fines. Second, just below the bottom of excavation, there are soil layers with extremely high water contents (up to 218%).*
- (3) *Solution - The Contractor placed sheeting all around with some timber lagging to span across buried utilities. This method prevented any groundwater flow through the A-1-b soil layers. In addition, it was assumed that well points may be needed to control the ground water level due to information shown on soil boring log. However, it was determined that well points were not necessary in the field. The contractor that installed the previous pipes had installed a very stable sub-base; hence there was no need for extra excavations. The borings that were taken just outside of this sub-base had encountered natural material and missed the sub-base.*