

Section 5.16 EARTHWORK NOTES AND DOCUMENTATION

5.16.1 Purpose

This section includes the accepted methods for recording ~~cross-section~~earthwork notes for final pay quantities and provides procedures for documenting various excavation items, such as channel, borrow, and subsoil excavation. Guidelines for verifying earthwork items and FDOT ~~radial~~ survey requirements for construction surveys are also defined in this section. It is not the intent of these procedures to supersede the requirements in the *Surveying and Mapping Handbook*, but to enhance the process for documentation of quantities for the submittal of the *Final Estimates Documentation*.

5.16.2 Authority

[Section 20.23\(3\)\(a\)](#), and [Section 334.048\(3\)](#), Florida Statutes (F.S)

5.16.3 Reference

~~Chapter 472, Florida Statutes (F.S.)~~

~~Rule 5J-17.051, Florida Administrative Code (F.A.C.)~~
~~Rule 5J-17, Florida Administrative Code (F.A.C.)~~

~~Rule 5J-17.052, F.A.C.~~

~~Rule 5J-17.053, F.A.C.~~

[Surveying and Mapping](#) (Procedure Topic 550-030-101)

5.16.4 General

The Project Administrator (PA) shall verify a project's existing and finished graded original plan terrain and final surfaces for conformity with the lines and grades shown in the design plans template through field survey and surface to surface comparison, or by an alternate method approved by the District Final Estimates Manager (DFEM) or the District Construction Engineer (DCE).

5.16.5 Bench Loop

~~However, a complete set of levels/bench loop run is required needed on all construction projects despite the type.~~

- (A) Check Levels: run a complete set of levels/bench loop from the first to the last Bench-Mark (BM) on the job, turning through all existing BMs, without adjusting the height of instruments (HI) or "correcting up" for any differences at individual benches. If the Check Levels are within Third Order Accuracy, no additional check levels will need to be run. Third Order Accuracy requires the closure to be within:

$$0.05 \text{ ft.} \times \sqrt{\text{(distance in miles)}}$$

~~Project BMs shall only be used after a complete set of levels/bench loop has been run. The HI is established from shots made to the BM's. For hand recorded notes, record the HI to the nearest hundredth (0.01) of a foot (or better) above the first cross section to which it applies and at the top of the following pages until a different HI is established. Underscore each HI with double lines. Show BM location by description or station and offset in field notes and cross reference to the field record and page where BM elevations have been reestablished or verified. These cross section level notes must carry the same closure tolerance as running check levels.~~

~~Temporary Bench Marks (TBM) should be set only after the project check levels have been completed, and shall be accomplished by running a complete set of levels/bench loop from one of the project BMs to the TBM and back or to another established project BM.~~

~~When multiple HIs are required within only one cross section, clearly indicate by brackets or other means to which HI the different shots are referenced.~~

~~The use of Direct Red Readings are not acceptable.~~

~~The same baseline and stationing of cross sections must be used for both the original and final cross sections. Care must be exercised where match lines are required to ensure that proper stationing on each baseline is reconciled, and that proper ties are made. Stations at which cut or fill begin (daylight lines) must be identified in the notes.~~

~~The maximum distance between cross sections shall be 100 feet for flat terrain, and 50 feet for rolling terrain or closer where conditions warrant. In all cases, the breaks in terrain that will substantially affect the final quantities must be reflected in the notes.~~

~~To determine the volume at any station or run of stations, each station must have an original terrain cross section (Existing Ground), final constructed cross section, and the design plan template.~~

~~(A) Full cross sections must be taken at all stations. Half sections are not acceptable for earthwork purposes.~~

5.16.6 Existing Surface Ground Surface Verification

~~The PA will verify the method(s) used to derive the original plan terrain cross sections existing surface (i.e., location survey, aerial photos, old as-built, etc.) with the Engineer of Record. Also confirm the project's location and type (i.e., urban, rural, limited access, resurfacing, etc.).~~

~~Site inspection by tThe PA may be required to will verify the existing surfaces and check for changed conditions, such as commercial development, city or county projects, excessive erosion, or work performed by FDOT Maintenance. Other verification or qQuick checks, such as spot elevation checks, and slope stake verification, etc., may be required by the DFEM/DCE needed prior to requesting waivering of any survey requirements. Form 700-050-61, Final Measurement Miscellaneous (preferred) or Field Books shall be used to record the data collected during field and/or quick checks.~~

~~The PA will may submit Form 700-050-35, Earthwork Survey/Cross-Sections Waiver to the DFEM/DCE for approval if checks indicate the existing surface is unchanged. The DFEM/DCE will consider such things as type of work, monetary exposure, possible claims, and additional considerations before a waiver of survey is issued.~~

~~**NOTE:** A Survey Waiver Request is not required on Design Build contracts.~~

~~The PA will submit written notification to the Contractor of the Department's findings regarding acceptance or rejection of the Original Ground line (i.e. Original Plan Terrain) existing surface as shown in the plans, and obtain the Contractor's concurrence for actions taken. (See Letter 5-16-1.) Should the Contractor refuse to respond or reject the actions taken, a second notification will may be submitted advising the Contractor of the requirements as the Claimant per Specifications Section 9-3. (See Letter 5-16-2.)~~

5.16.7 Existing Surface Pre-Construction Terrain Verification Survey

When required by the DFEM/DCE, a pre-construction survey cross-sections will be performed to verify the pre-construction terrain line existing surface ground. This survey must be taken before the clearing and grubbing operation to adequately address existing surface terrain conditions at full station locations shown in the plans.

New construction projects will require complete original cross-sections pre-construction survey to be taken at intervals as directed by the DFEM/DCE. Major widening projects may also require cross-sections pre-construction survey. The original ground line pre-construction survey elevations are to be taken at break points shown in the plans and at other break points found to exist in the field within the Right-of-Way limits. See the ***Surveying & Mapping Handbook*** for further guidance.

The Contractor shall be notified in writing if there could be is a substantial change in end-areas where the Department is taking cross-sections surveying. The survey notes along with any revisions to the original plan terrain lines existing surface resulting from the Department's survey will be provided to the Contractor. Should the Contractor wish to dispute the Department's survey, they must acquire their own survey of the disputed area, certified by a Professional Land Surveyor, and at no expense to the Department. This field survey must be completed before any clearing and grubbing operations. (See ***Specifications Section 9-3.2.***)

If supplemental field cross-sections survey show a significant difference, as defined in ***Specifications Section 9-3.2.1***, quantity adjustments will be made considered.

If a deviation exists between the existing surface original plan terrain line and the preconstruction survey terrain line, the latter will replace the original plan terrain line at the cross-section stations existing surface shown in the plans.

The ***Final As-Built Plans*** will be annotated with corrections to plan quantity (Areas/Volumes) regarding erroneous cross-sections surfaces discovered by the preconstruction survey. All corrections and markups shall be done in red. The closest cross-section on either end of the area surveyed will be struck through on the ***Final As-Built Plans***. A new quantity shall be calculated by the approved method for the area surveyed using the design plan template existing surface and the terrain lines pre-construction survey with the replacements mentioned earlier. This information shall be submitted to the Contractor and the DFEM as soon as possible. A terrain surface comparison can increase or decrease the quantities. Before allowing an adjustment, the difference in the increases and decreases (net result) must be checked against the limit

set in the **Specifications Section 9-3.2**. Verify the Contract's Special Provisions for changes on the amount of this limit.

5.16.8 As-Built Surfaces for Compliance

The PA is required to document the project's as-built surfaces for compliance with plan dimensions. The PA will notify the Contractor of the Department's findings.

- (A) As soon as ~~final dressing~~ the finished graded surface in a section of the project is ~~done~~ complete, quick checks such as spot surveys, slope, or slope stake verification shall be performed at intervals or in areas deemed necessary by the DFEM/DCE.
- (B) If the quick checks of the as-built ~~cross-sections~~ surfaces reveal any substantial differences from the ~~plan template~~ finished graded surface shown in the plans, then it will be necessary to either re-grade such areas to bring them into conformance (this is done at the Contractor's expense) or reduce the pay quantities for the appropriate earthwork items within the areas not constructed to plan dimensions. Selection of which method to use is at the Department's discretion. The decision shall be based on the circumstances which exist on the particular project.
- (C) ~~Deductions for areas not constructed to plan dimensions will require a Full cross-section survey to~~ must be taken at plan intervals for in areas ~~not constructed to plan dimensions~~ designated by the DFEM/DCE.

5.16.9 Final Pay Quantities

The Department encourages the use of **Trimble Business Center (Trimble)** to be used for earthwork volume calculations and adjustments for plan quantity items. However, another approved software can be used or the PA and/or PE may manually calculate these adjustments. If provided by the Engineer of Record, .GEN files can be used to generate earthwork quantities.

- (1) Approved software must have the capability to compare surfaces, calculate volumes, and produce reports that detail earthwork quantities within the proper limits.
- (2) Where any software has been used to calculate the earthwork volumes, the required compatible electronic files (e.g. Land XML) must be

submitted with the **Final Estimates Documentation** so calculated quantities can be verified.

- (3) To determine the volume at any station or run of stations, each station location must have an original terrain cross-section (Existing Ground surface), final constructed cross-section finished graded surface, and the design plan template as-built finished graded surface.
- (4) Any adjustment for final cross-section as-built finished graded surface revisions in earthwork items are is further limited to significant differences as defined in the **Specifications Section 9-3.2** unless, in the opinion of the Engineer, a deliberate attempt has been made to optimize the tolerances to increase borrow excavation in fill sections, or to decrease the required volume of roadway or lateral ditch excavation, or embankment. In such cases, appropriate measurements shall be taken and reductions in pay quantities shall be applied.
- (5) The grading construction tolerance, as defined in **Specifications Section 9-3.2** or **120-12**, will not be used or considered as a pay tolerance, nor shall the tolerance be construed as defining a revised authorized template finished graded surface.
- (6) No adjustment will be made unless the dollar value of the quantity adjustment exceeds the limit set in the **Specifications** for the Contractor's failure to construct to plan dimensions, unless approved by the Engineer.

NOTE: The above guidelines are not applicable to trench widening projects where the plan quantity for roadway excavation is based on the net volume of the base trench. In this case, verification of the original plan terrain existing surface elevation is not required, but final cross-section as-built finished graded surface cross sections will be required if the shoulder elevations change horizontally or vertically, provided the project has a borrow pay item. If revision to plan quantity for roadway excavation is required, the computations will be based on the theoretical change in volume only for changes that exceed the limits set forth in the **Specifications Section 9-3.2**.

5.16.10 Minimum Requirements for Final Measured Earthwork Pay Item Field Notes

Cross-section Field notes are an important part of the Final Estimates field records documentation for earthwork quantities. The following requirements are specifically written for final pay earthwork notes pay items and are intended as minimum standards for any required note keeping. The Project Administrator (PA) shall ensure that minimum standard requirements are met and additional details are added as needed to clearly document the field conditions.

- (A) The **Form 700-050-61, Final Measurement Miscellaneous** or **Field Books** shall be used. (See **CPAM 5.14** for requirements.) The use of the **Final Measurement Miscellaneous Form** is preferred, since it results in savings to the Department.
- (B) Contractor's records/survey notes are not acceptable to meet these minimum requirements. As an exception, Contractor's survey notes may be used if obtained by a joint survey under the responsible charge by the Department or its representative.
- (C) The date, weather conditions, and the names of the individuals within the field crews shall be recorded on the page where each day's notes begin or a record is stored within the data.
- (D) Identify Centerline or Baseline (CL/BL) shots, as well as their location in reference with the CL/BL (i.e., left or right).
- (E) Sketches shall be plain and legible, and spaced, so that figures are not written over one another. See the **Surveying and Mapping Handbook** for guidance.
- (F) When recording data, use a 2H or 3H pencil; never use a pencil soft enough to blur.
- (G) Rod readings for earthwork notes (ground shots) are to be recorded to the nearest tenth (0.1) of a foot. The rod readings on paved surfaces will be recorded to the nearest hundredth (0.01) of a foot.
- (H) Project BMs shall only be used after a complete set of levels/bench loop has been run. The HI is established from shots made to the BM's. For hand-recorded notes, record the HI to the nearest hundredth (0.01) of a foot (or

- better) above the ~~first cross-section~~ [field notes](#) to which it applies and at the top of the following pages until a different HI is established. Underscore each HI with double lines.
- (I) Show BM location by description or station and offset in field notes and cross reference to the field record and page where BM elevations have been reestablished or verified. These ~~cross-section-level~~ notes must carry the same closure tolerance as running check levels.
- (J) Temporary Benchm-Marks (TBM) should be set only after the project check levels have been completed, and shall be accomplished by running a complete set of levels/bench loop from one of the project BMs to the TBM and back or to another established project BM.
- (K) When multiple HIs are required within only one cross-section, clearly indicate by brackets or other means to which HI the different shots are referenced.
- (L) The use of Direct Rod Readings are not acceptable.
- (M) The same baseline and stationing of ~~cross-sections~~ must be used for both the ~~original~~ [existing](#) and ~~final cross-sections~~ [finished graded surfaces](#). Care must be exercised where match lines are required to ensure that proper stationing on each baseline is reconciled, and that proper ties are made. Stations at which cut or fill begin (daylight lines) must be identified in the notes.
- (N) The maximum distance between ~~cross-sections~~ shall be 100 feet for flat terrain, and 50 feet for rolling terrain or closer where conditions warrant. In all cases, the breaks in terrain that will substantially affect the final quantities must be reflected in the notes.
- Full survey must be taken at all stations. Partial survey is not acceptable for earthwork purposes.
- (O) The PA shall verify a project's ~~existing and finished graded surfaces~~ for conformity with the lines and grades shown in the plans through field survey, or by an alternate method approved by the District Final Estimat~~shift~~

nager (DFEM) or the District Construction Engineer (DCE).

5.16.1.15.16.10.1 Minimum Field Records for Plan Quantity Pay Items

Payment for Regular Excavation, Lateral Ditch Excavation, and Embankment made under the plan quantity concept are subject to the minimum standards as stated herein.

A ~~field cross-sections~~ survey shall be required if the Department or the Contractor contends that there is a quantity error. If either party questions the plan quantity in accordance with **Specifications Section 9-3**, perform the data collection according to the methods outlined herein.

~~Field survey is required to document engineer approved changes in earthwork limits. Pay quantity for the approved changes will be calculated as indicated for final measure pay items. The PA shall verify a project's original plan terrain and final surfaces for conformity with the design plan template through field survey, or by an alternate method approved by the District Final Estimates Manager (DFEM) or the District Construction Engineer (DCE). The following information shall be used in the determination of survey method, or to request a waiver of Department survey requirements.~~

5.16.4 Original Plan Terrain

~~Verify the method(s) used to derive the original plan terrain cross sections (i.e., location survey, aerial photos, old as built, etc.) with the Engineer of Record. Also confirm the project's location and type (i.e., urban, rural, limited access, resurfacing, etc.).~~

~~Site inspection by the PA may be required to check for changed conditions, such as commercial development, city or county projects, excessive erosion, or work performed by FDOT Maintenance. Other verification or quick checks, such as spot elevation checks, slope stake verification, etc., may be required by the DFEM/DCE prior to waiving any survey requirements. **Form 700-050-61, Final Measurement Miscellaneous** (preferred) or **Field Books** shall be used to record the data collected during field and/or quick checks.~~

~~The PA will submit **Form 700-050-35, Earthwork Survey/Cross Sections Waiver** to the DFEM/DCE for approval. The DFEM/DCE will consider such things as type of work, monetary exposure, possible claims, and additional considerations before a waiver of survey is issued.~~

~~**NOTE:** A Survey Waiver Request is not required on Design-Build contracts. However, a complete set of levels/bench loop run is needed on all projects despite the type.~~

~~**5.16.10.1** The PA will submit written notification to the Contractor of the Department's findings regarding acceptance or rejection of the Original Ground line (i.e. Original Plan Terrain) as shown in the plans, and obtain the Contractor's concurrence for actions taken. (See Letter 5-16-1.) Should the Contractor refuse to respond or reject the actions taken, a second notification may be submitted advising the Contractor of the requirements as the Claimant per *Specifications Section 9-3*. (See Letter 5-16-2.)~~

~~**5.16.5** Cross-Sections to Verify Pre-Construction Terrain~~

~~**5.16.10.1** When required, cross sections to verify the pre-construction terrain line must be taken before the clearing and grubbing operation to adequately address existing terrain conditions at full station locations shown in the plans.~~

~~**5.16.10.1** New construction projects will require complete original cross sections to be taken at intervals as directed by the DFEM/DCE. Major widening projects may also require cross sections. The original ground line elevations are to be taken at break points shown in the plans and at other break points found to exist in the field within the Right of Way limits. See the *Surveying & Mapping Handbook* for further guidance.~~

~~**5.16.10.1** The Contractor shall be notified in writing if there could be substantial change in end areas where the Department is taking cross sections. The survey notes along with any revisions to the original plan terrain lines resulting from the Department's survey will be provided to the Contractor. Should the Contractor wish to dispute the Department's survey, they must acquire their own survey of the disputed area, certified by a Professional Land Surveyor, and at no expense to the Department. This field survey must be completed before any clearing and grubbing operations. (See Specifications Section 9-3.2.)~~

~~**5.16.10.1** If supplemental field cross-sections show a significant difference, as defined in Specifications Section 9-3.2.1, quantity adjustments will be considered.~~

~~**5.16.10.1** If a deviation exists between the original plan terrain line and the preconstruction survey terrain line, the latter will replace the original plan terrain line at the cross-section stations.~~

~~**5.16.10.1** The *Final As Built Plans* will be annotated with corrections to plan quantity (Areas/Volumes) regarding erroneous cross sections discovered by the preconstruction survey. All corrections and markups shall be done in red. The closest cross section on either end of the area surveyed will be struck through on the *Final As Built Plans*. A new quantity shall be calculated by the approved method for the area surveyed using the design plan template and the terrain lines with the replacements mentioned earlier. This information shall be submitted to the Contractor and the DFEM as soon as possible. A terrain comparison can increase or decrease the quantities. Before allowing an adjustment, the difference in the increases and decreases (net result) must be checked against the limit set in the *Specifications Section 9-3.2*. Verify the Contract's Special Provisions for changes on the amount of this limit.~~

5.16.10.2 Minimum Requirements Field Records for Final Measured Pay Items

Field records for final measured earthwork pay items are required. ~~for contracts let prior to July 2022.~~

(A) ~~Field Notes for Borrow Excavation~~ Field Notes

A survey of the as-built finished graded surfaces ~~Cross sections~~ are required on all projects with Borrow Excavation if the shoulder elevations move out horizontally and/or vertically. A waiver of survey or alternate method may be approved by the DFEM ~~or the~~ DCE. Listed below are some examples where surveys may be eliminated:

- (A) Milling and resurfacing projects where shoulder elevation does not change
- (B) Projects that involve only earthwork around box culvert extensions
- (C) Projects that involve restoring eroded sections

~~Fluff and shrinkage shall be considered when vehicle load count is involved in reconciling quantities. A suggested formula for calculating the Equivalent Truck Measured Volume is:~~

$$\text{Compacted Fill Volume} \times (1 + \text{shrinkage factor}) \times (1 + \text{fluff factor})$$

~~**NOTE:** Shrinkage and fluff factors must be entered as a decimal.~~

EXAMPLE:

Compacted Fill Vol.: _____ 1 CY
Shrink Factor: _____ 20%
Fluff Factor: _____ 20%

$$1.00 \text{ CY} \times 1.20 \times 1.20 = 1.44 \text{ CY}$$

Project flushed slopes that are constructed of borrow material and proposed for final payment are to be surveyed, cross-sectioned. Any volume that is determined to be above the project template finished graded surface shown in the plans must be deducted.

Additional borrow material required to fill unauthorized excavation (beyond the lines and grades shown in the plans or authorized by the engineer) will not be paid. Determine the volume of borrow placed in areas beyond the project's subsoil lateral limits (unauthorized excavation) and deduct this volume from the proposed borrow pay. Account for shrink and fluff.

NOTE: For truck measured borrow requirements, see **CPAM 5.14**.

(1) Fluff and Shrinkage

Fluff and shrinkage shall be considered when vehicle load count is involved in reconciling quantities. A suggested formula for calculating the Equivalent Truck Measured Volume is:

$$\text{Compacted Fill Volume} \times (1 + \text{shrinkage factor}) \times (1 + \text{fluff factor})$$

NOTE: Shrinkage and fluff factors must be entered as a decimal.

EXAMPLE:

<u>Compacted Fill Vol.:</u>	<u>1 CY</u>
<u>Shrink Factor:</u>	<u>20%</u>
<u>Fluff Factor:</u>	<u>20%</u>

$$\underline{1.00 \text{ CY} \times 1.20 \times 1.20 = 1.44 \text{ CY}}$$

(B) ~~Field Notes for Subsoil Excavation~~ Field Notes

The notes for subsoil excavation shall be detailed. Notes to explain the disposition of this material shall be freely used. Below are the minimum standards for these field notes: (See **Figures 5.16-1** through **5.16-4**).

- (A) The authorized limits of muck excavation, as staked in the field, shall be recorded in the earthwork notes for each pocket of muck excavation and should conform to control slopes set up by the **Standard Plans Index 120-001**, or as shown in the plans.
- (B) The listing of the limits is generally generated from the plan depth and checked as they are staked in the field. If, during the excavation, the muck is found to be deeper than the plan depth, the **Final As-Built Plans** shall be corrected by striking through the original limit and recording the new authorized limit. As such, field records ~~(i.e. field book)~~ should be included, dated and initialed.
- (C) If subsoil excavation is required in an area where ditch excavation or the ~~roadway template~~ finished graded surface in the plans falls below the existing surface original terrain, the ~~roadway template~~ finished graded surface must be redeveloped to determine the authorized subsoil excavation. This condition shall be noted in the field notes.
- (D) If extra depth muck excavation (depths greater than 5 feet) is encountered, a list of the controlling elevations shall be recorded. (See **Figures 5.16-5** through **5.16-7**).
- (E) The maximum interval for subsoil cross-sections shall be 50 feet. The beginning and ending of excavation shall always have a full cross-section and should be identified with a note (Begin Cut or End Cut), or designated as a zero area.

- (F) Partial sections must be extended to the match line to produce a complete cross-section for each station.
- (G) The earthwork notes for subsoil excavation shall always include a note for each pocket of excavation explaining the disposition of the unauthorized excavated material.
- (H) Where subsoil excavation extends outside the plans lines or authorized by the PA (including allowable tolerances) and the space is backfilled with roadway or borrow excavation, ~~the net fill, plus shrinkage allowance shall be deducted from additional authorized regular excavation or borrow excavation quantity, as applicable. (See **Specifications Section 120-13**)~~ ensure additional material is not included in payment.
- (I) ~~When embankment or regular excavation is paid for under the Plan Quantity concept, Original cross-sections for subsoil excavation are used as the basis for both plan and final pay quantities of embankment and regular excavation. Any roadway areas within the subsoil limit in which the plan originals are found to be out of tolerance, as specified in the **Specifications Section 9-3.2.1**, shall be re-cross-sectioned for all earthwork items affected. When changes to the area of subsoil excavation are made in the field, **XX of final quantities (adjustments to embankment or regular excavation will be made to accommodate the subsoil change, will be made per Spec 9-3.2.2XXXX).** Original cross-sections shall be produced and imported using the original design files from the engineer of record.~~
- ~~(J) Station's pluses needed to obtain the maximum 50 feet interval or to obtain begin and end sections may be interpolated from the existing surface ~~original plan terrain~~ sections.~~
- ~~(J) The baseline (or centerline) used for location original cross-sections is the baseline of survey. When the centerline of construction, as used for final cross-sections and control slope limits, is different from the baseline of survey, some method must be employed to make the two surveys compatible with each other.~~
- ~~(K) The baseline (or centerline) used for location original cross-sections is the center ~~baseline of survey. When the centerline of construction, as used for final cross-sections and control slope limits, is different from the location center~~ baseline of survey, some method must be employed to make the two~~

~~surveys centerlines compatible with each other. The horizontal alignment shift may be done through the use of Trimble.~~

~~(G)(K) Field Notes for Channel Excavation~~ Field Notes

(C) Channel Excavation

Channel Excavation ~~is not a plan quantity item~~ must be monitored closely since constant scouring and shoaling is normal in locations where this item is used.

- (A) Preconstruction ~~sections survey~~ shall always be taken prior to beginning of excavation.
- (B) ~~As-Built f~~ Finished graded surface ~~sections~~ are ~~always~~ required and must be ~~plotted in conjunction~~ compared with the ~~template finished graded surface shown in the plans~~ to determine the limits of final pay quantity.
- (C) If shoaling occurs after ~~the as-built finished grading surface~~ final cross-sectioning survey and prior to final acceptance of the job and the Engineer authorizes the shoaled material to remain in place, ~~re-cross-sectioning surveying~~ must be done. The volume of any such material remaining within the limits of channel excavation shown in the plans shall be deducted from the ~~measured~~ quantity of Channel Excavation.

~~5.16.65.16.1~~ As-Built Surfaces for Compliance

~~The PA is required to document the project's as-built surfaces for compliance with plan dimensions.~~

The following ~~field checks~~ shall be used to ~~either require a survey or to request a waiver of survey.~~

- ~~(A) As soon as final dressing~~ the finished graded surface ~~in a section of the project is done~~ complete, quick checks such as spot surveys, slope, or slope stake verification shall be performed at intervals or in areas deemed necessary by ~~the DFEM/DCE.~~
- ~~(B)(A) The date, weather conditions, and the names of the individuals within the field crews shall be recorded on the page where each day's notes begin or a record is stored within the data.~~

~~(C) The DFEM/DCE will consider such things as monetary exposure, possible claims, as well as supplemental information if a waiver of survey is issued.~~

~~(D)(A) The PA will notify the Contractor of the Department's findings.~~

~~(E)(A) If the quick checks of the as built cross sections reveal any substantial differences from the plan template finished graded surface shown in the plans, then it will be necessary to either re-grade such areas to bring them into conformance (this is done at the Contractor's expense) or reduce the pay quantities for the appropriate earthwork items within the areas not constructed to plan dimensions. Selection of which method to use is at the Department's discretion. The decision shall be based on the circumstances which exist on the particular project.~~

~~(F)(A) Deductions for areas not constructed to plan dimensions will require a full cross section survey to be taken at plan intervals or in areas designated by the DFEM/DCE.~~

~~(G) The plan quantity (Areas/Volumes) between the as built and plan cross sections as well as the closest cross sections extended on either end of the area surveyed will be struck through in red on the **Final As-Built Plans**. A new quantity must be calculated by the approved method for the area surveyed using the plan template finished graded surface shown in the plans and the as-built finished graded lines surface with the replacements mentioned earlier. This information will be submitted to the Contractor and the DFEM. Before allowing an adjustment, the difference (net result) must be checked to see if it exceeds the limit set in the **Specifications Section 9-3.2** or the Contract's Special Provisions, as applicable.~~

~~(H)(D) An adjustment in quantity for the surveyed areas corresponding to the appropriate earthwork items shall be calculated by an approved method. The Department encourages the use of **Trimble Business Center (Trimble)** to be used for earthwork volume calculations and adjustments for plan quantity items. However, another approved software can be used or the PA and/or PE may manually calculate these adjustments. If provided by the Engineer of Record, .GEN files can be used to generate earthwork quantities.~~

~~**5.16.7** Approved software must have the capability to compare surfaces, calculate volumes, and produce reports that detail earthwork quantities within the proper limits.~~

~~5.16.8~~ When adjustments for plan quantity items are developed, then cross-sections for terrain surface comparison and as-built template comparison shall be plotted along with the original design plan template finished graded surface and original plan terrain existing surface shown in the plans on cross-section sheets, in the same size and scale as the record set of plans for the project. This can be done manually or it is acceptable to create a plot of any changes using an approved surface-to-surface comparison software and insert into the *Final As-built Plans*.

~~5.16.9~~ No adjustment will be made unless the dollar value of the quantity adjustment exceeds the limit set in the *Specifications* for the Contractor's failure to construct to plan dimensions. Any adjustment for final cross-sections as built finished graded surface revisions in earthwork items is further limited to significant differences as defined in the *Specifications Section 9-3.2* unless, in the opinion of the Engineer, a deliberate attempt has been made to optimize the tolerances to increase borrow excavation in fill sections, or to decrease the required volume of roadway or lateral ditch excavation, or embankment. In such cases, appropriate measurements shall be taken and reductions in pay quantities shall be applied. The grading tolerance, as defined in *Specifications Section 9-3.2* or *120-12*, will not be used or considered as a pay tolerance, nor shall the tolerance be construed as defining a revised authorized template finished graded surface.

~~5.16.10~~ **NOTE:** The above guidelines are not applicable to trench widening projects where the plan quantity for roadway excavation is based on the net volume of the base trench. In this case, verification of the original plan terrain existing surface elevation is not required, but final cross-sections as built finished graded surface cross-sections will be required if the shoulder elevations change horizontally or vertically, provided the project has a borrow pay item. If revision to plan quantity for roadway excavation is required, the computations will be based on the theoretical change in volume only for changes that exceed the limits set forth in the *Specifications Section 9-3.2*.

5.16.11 Electronic Data Collection on Construction Projects

(A) Requirements:

The methods described herein apply to surveys being performed on all Department contracts with automatic or semi-automatic total station equipment (radial survey).

NOTE: All survey data generated for construction must adhere to the Department's surveying standards.

In making the decision to use radial survey methods with total station equipment, the Consultant must assure the Department that the following field survey and data processing requirements can be met:

- (1) Sufficient project control data (horizontal and vertical) exists or can be established to provide for all radial survey coverage.
- (2) Perform radial survey that meets the Triangulated Irregular Network (TIN) criteria for generating a Digital Terrain Model (DTM).
- (3) Software to compute an acceptable DTM from the radial survey data points and break line data point strings.
- (4) Field check the DTM surface, using cross-sections or profiles extracted from the DTM as compared to actual supplemental field survey.
- (5) Compute cross-sections from the DTM surfaces, perpendicular to defined alignments.
- (6) Compute earthwork volumes using Department approved surface to surface comparison software and methods.
- (7) Furnish all deliverables in a file format that is compatible with Department software, as defined in these procedures or in the contract scope of services.

(B) Project Control System:

Radial surveys must be referenced to the same project control system (baseline/centerline coordinates and benchmark datum) that was used for the Location and Design work. This basic requirement is to ensure that all survey information for the project can be related to the same reference system. This requirement can be met by occupying the existing control points that were established during the original ground survey. Or, if additional control is needed, the existing control system may be extended by:

- (1) Running a set of levels/bench loop through the required point or points.
- (2) Setting an unknown point, occupying it with the total station instrument and taking sufficient observations to define its position relative to the existing control system, as further described later.

- (3) Using technology, such as Global Positioning System (GPS), and a set of levels/bench loop to supplement existing survey control.

(C) Calibration of Conventional Total Station equipment:

The surveyor must take every precaution to ensure that the total station equipment is properly calibrated and is obtaining accurate field data. To identify systematic errors inherent in any angle-measuring device, an axis test of the instrument will be performed on a regular interval, at least once weekly.

An acceptable axis test consists of pointing at a fixed target three or more times in the Face 1 (direct) telescope orientation and recording the horizontal direction (H) and vertical direction (V) readings for each pointing. Then, transiting or “flipping” the telescope and pointing at the same target an equal number of times in the Face 2 (reverse) telescope orientation and recording those values. The values of the horizontal and vertical angle for each pointing at the target are used to perform the computations to determine if the instrument is in need of adjustment.

Each year and whenever the difference between the mean of the direct and the mean of the reverse readings depart from 180 degrees by more than 30 seconds, the instrument must be taken out of service and be adjusted for collimation error.

Readjustment of the instrument’s crosshairs and the level bubbles shall be done whenever their misadjustments affect the instrument reading by the amount of the least count, as specified for the Third Order Class II surveys. The total station instrument and retro-reflector prisms should be serviced on a regular basis and checked frequently on a calibration baseline of known distance.

(D) Establishing Position and Orientation of the Surveying Instrument:

When collecting field data by radial survey, there are two acceptable methods of establishing position and orientation of the instrument:

- (1) Setup Over Known Control Point: The instrument is setup over an existing control point, or one that can be related to the CL/BL of the project by the geometry and elevations furnished. The (XYZ) coordinate of the point setup over must be known. The height of the instrument above the control point must be measured and recorded. When the above is done, the position of the instrument has been established.

- (a) To establish orientation of the instrument, a back sight will be made by pointing to a target of a known height on a second control point with a known (XYZ) coordinate. The instrument's horizontal circle will be "zeroed" while pointing to the back sight control point. A back sight measurement of the horizontal direction, vertical direction, and distance (HVD) will be measured and recorded, including the target height. Position and orientation is now completed. Radial measurements (HVD) may be made and recorded for new survey points. All horizontal angles will be expressed as angles measured in the direct (Face 1) position.
 - (b) At the end of the field survey operations, the user shall again sight the original back sight control point and record the measurements, to ensure that the instrument was not disturbed during survey operations.
- (2) Setup over an Unknown Point: When the instrument must be set-up in a location that does not have a prior known (XYZ) coordinate or is not tied to the control geometry and project bench-mark datum, a semi-permanent monument should be set to perpetuate the location of the setup position. A bridge spike, hub and tack, iron rod, or equivalent marker, which will last throughout the data gathering operations, will serve this purpose. When the instrument is set-up, the height of the instrument above the set monument will be measured and recorded.
- (a) To establish the position of, and orient the instrument setup over the unknown point, the setup must be tied by field measurements to two points of known position. A back sight will be made to the first control point with a known (XYZ) coordinate. The horizontal measuring circle will be "zeroed" and HVD measurements will be made and recorded. A second control point with known coordinates will be selected and HVD measurements made and recorded. If available, a third control point with known coordinates may be selected and measured as a check on the position of the instrument. Target heights will also be recorded for all measurements.
 - (b) With the setup position properly established, radial measurements (HVD) to additional new survey points may then

be made and recorded. All horizontal angular values will be expressed as angles measured in the direct (Face 1) position.

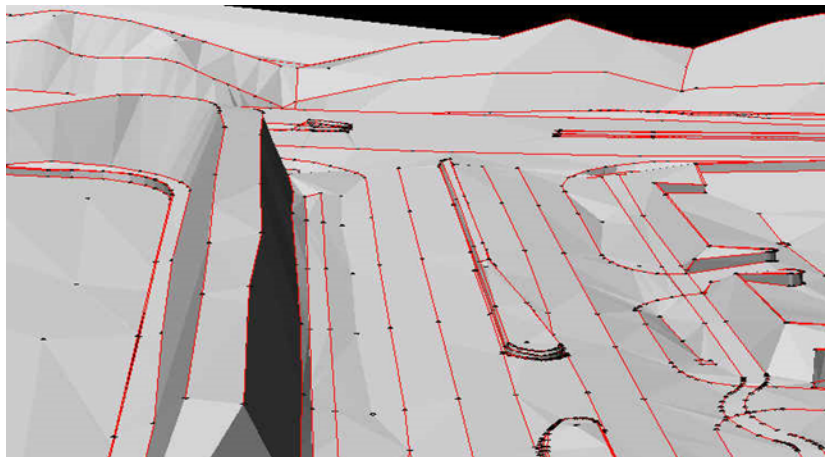
- (c) At the end of the field measurements, the observer shall always sight the original back sight and take check measurements and record them. Again, this is to ensure that the instrument has not been disturbed during survey operations.

(E) Field Observations (HVD) for DTM Surveys:

Radial survey procedures may be used to determine preconstruction surface elevations; and as the work of excavation or fill is accomplished, radial survey procedures may be used to determine final surface elevations. From DTM surfaces derived from radial survey methods, cross-sections can be generated as needed. This makes the DTM a valuable method for quantity surveys, since cross-sections can be generated at any interval along an alignment on any of the DTM surfaces.

- (1) Collect data points that represent surface elevations on the ground at reasonable proximity to accurately represent the surface. It is also important to define breaklines along boundaries in the terrain where sharp or abrupt changes in surfaces occur. Break lines along the terrain “discontinuities” will be defined by the surveyor, by indicating the connection of points representing the break line profiles.

Below is an example of a terrain surface defined by points and breaklines:



The Department requires that the field measurements (raw field data) be recorded and submitted in an acceptable format, as backup records for all DTM's.

- (2) Most electronic data collectors (~~i.e., FDOT's Electronic Field Book~~) are capable of recording HVD data. If the Consultant elects to use a data collection system that only produces (XYZ) coordinates, the raw field data (HVD) must be recorded in the field records. Reduced data, (XYZ) coordinates, alone will not be acceptable.
- (3) To assist in verifying the field notes and as an aid in checking the reduced data, the survey party shall prepare a sketch or layout of each setup and the area covered by observations. The sketch shall show the setup point, the back sight point(s), and the identification data for the location of all field data taken from the setup position.
- (4) **Figures 5.16-8** through **5.16-11** provide examples of manual field records used in lieu of electronically data collected records.

(F) Generating the DTM Surfaces:

Surface-modeling techniques, such as using triangles to represent small continuous surface areas are known as the Triangulated Irregular Network (TIN). TIN has become the standard for terrain modeling for meeting engineering requirements. Each vertex of a triangle in the TIN is formed by a field measured data point, and is located by its (XYZ) coordinate. The TIN model is constructed by connecting these survey data points to their nearest neighboring points (in XY), forming a network (surface) of irregular triangles.

- (1) It is important that the survey crew understand the TIN methodology and the assumptions made by the software when they are taking the survey data points for a DTM using the TIN method.
- (2) Before the working cross-sections are generated for earthwork computations, the DTM surfaces shall be field checked using randomly generated cross-sections or profiles extracted from the model. These cross-sections and profiles are then compared to actual ground shots taken to determine if the model matches the real-world terrain surface. This quality control check shall be performed before TIN data is used in quantities calculations.

(G) Cross-Sections from DTM Surfaces:

Once the DTM surface has been computed and field checked, cross-sections may be computed at the specified interval along the CL/BL. If final quantities are to be compared to original plan quantities, the location of TIN extracted cross-sections must be the same as the cross-sections contained in the design plans.

- (1) Field measured quantities, such as subsoil excavation, may be referenced to a construction-established baseline, as long as the original and final measurements are from the same reference.
- (2) Design cross-sections, preconstruction cross-sections, and final cross-sections must all be compared in order to determine final pay quantities. It is absolutely essential that all field data be referenced to the same alignment and station values.

(H) Survey Deliverable Data:

Requirements necessitate the retention of surveying records and backup data to support the quantity computations. This requires that the Resident Office (RO) personnel deliver certain data in a format that can be retained, verified, and, if necessary, be used to replicate the processed data at some future point in time. For products that need to be signed and sealed by a surveyor, reference **Standards of Practice as set forth in Rule Chapter 5J-17 F.A.C. “Standards of Practice—Professional Matters in Surveying and Mapping.”**

- (1) When radial survey is used, project personnel shall use the approved survey data formats authorized for use on FDOT surveys. **Trimble** or any other FDOT approved software should be used to calculate final pay earthwork volumes. If a consultant or CEI prefers to use any other software for radial surveying than that authorized for use by FDOT, they must show the Department’s District Location Surveyor (DLS) that an alternate system is able to produce the electronic files required for delivery to the Department as outlined ~~later~~ in this section. Prior to the work commencing, the consultant must receive an approval letter signed by the DLS stating that a proposed alternate system is able to produce the electronic files required by the Department.
- (2) The RO personnel shall submit:

- (a) The pre-construction survey data files produced by the data collection system used to gather the data, regardless of format.
- (b) The original field survey measurements in the approved file format for raw survey measurements at FDOT (.XML for kmat).
- (c) Any changes not observed in the field must be annotated in redline markup on the **Final As-Built Plans** and include an explanation of each change.
- (d) The reduced and processed field survey data in the standard comma delimited text file format with labeled column header information.XYZ or .TXT file format.
- (e) The survey control used to reduce and process the original field survey data in the standard comma delimited text .CTL file format with labeled column header information.
- (f) All output reports generated by the programs used to reduce and process the field survey data.

NOTE: It is the responsibility of the DLS or the delegate to verify survey data processing results before being acceptable to the Department.

- (3) At the completion of work, submit to the DLS or the delegate all files described herein, any additional reports and forms required by the DLS, such as a **DTM Certification Form** (if applicable), and a **Project Certification Letter**.
- (4) All reports related to the project.
- (5) All output files for interfacing to **Trimble**, including alignment and other geometric data (profiles) in .XML file format.
- (6) All graphics files of plan metric detail in both 2D and 3D MicroStation or AutoCAD file format.
- (7) All DTM TIN models represented as 3D MicroStation or AutoCAD files.
- (8) A project Journal file that describes:

- (a) For each DTM, a description of the surfaces, DTM settings used, survey data used to define the surface(s). The Journal shall include the alignment names and scan/pattern lines used to cut cross-sections, cross-section file names with their usage/application, and contour settings.
 - (b) For each output report generated, describe the purpose of the report and the information needed to re-generate the report.
 - (c) For each output file, describe the purpose of the file and the information needed to re-generate the file.
- (9) All data submitted must be identified with the Financial Project Identification Number(s), State Roadway Number(s), Consultant Identification (names, addresses, etc.), and Contract number.
- (10) No project will be considered acceptable or complete until all deliverables are submitted and approved by the appropriate FDOT authority.

5.16.12 Boilerplate Letters

Final Estimate Boilerplate Letters can be found on the [State Final Estimate SharePoint site](#) (Internal Use Only) in editable format.

NOTE: The letters are used to convey necessary information to concerned parties throughout the close out process. The letters and memos are templates containing common boilerplate language. The DFEO representative will choose the appropriate paragraphs for a specific contract and delete the paragraphs and instructions which do not apply. No boilerplate letter can cover all situations that might arise. Occasionally, it may be necessary to insert additional paragraphs drafted to fit the circumstances arising on a specific contract (such as addressing bonds or value-added items).

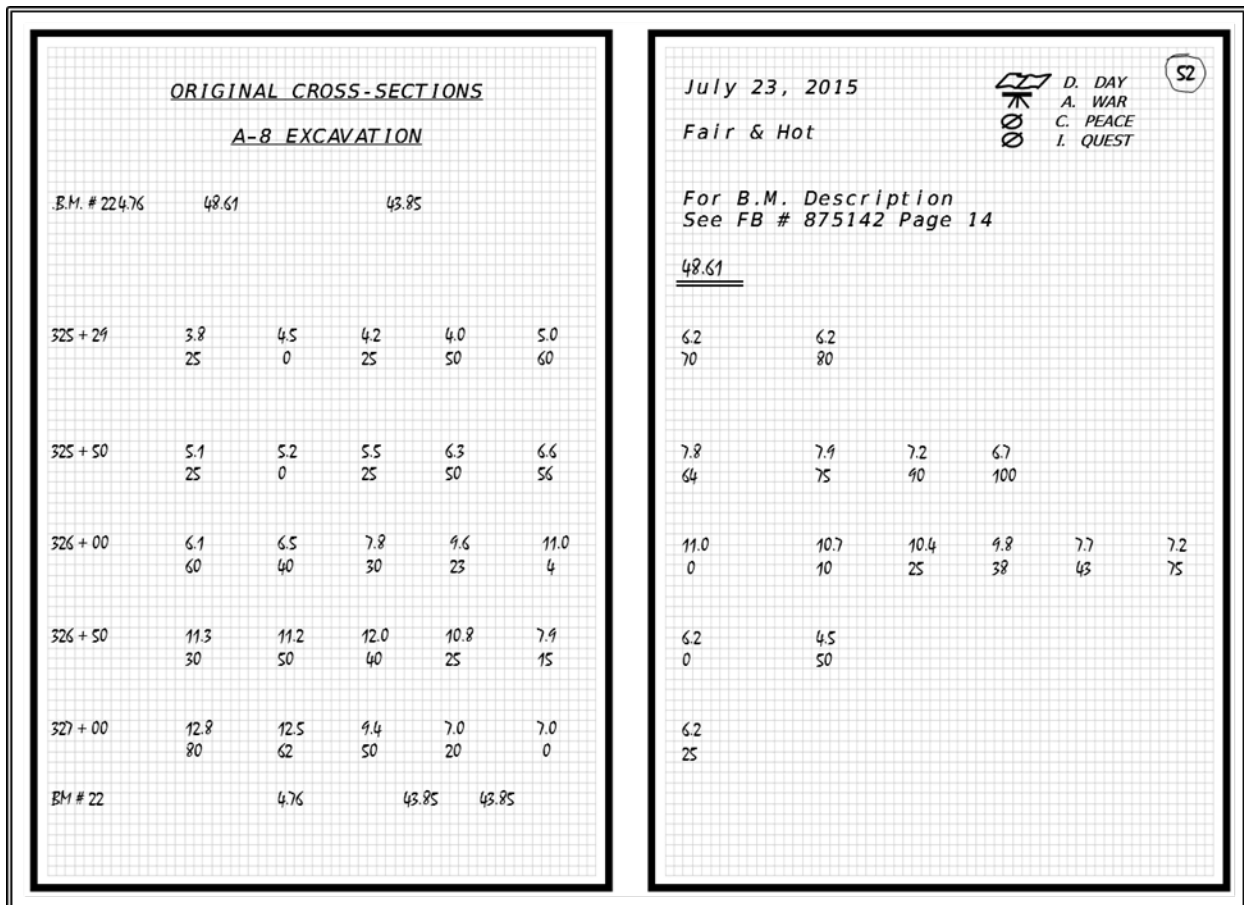
Letter 5-16-1..... Preconstruction Survey Waiver Letter
Letter 5-16-2..... Follow-up Preconstruction Survey Waiver Letter

5.16.13 List of Figures Following This Chapter

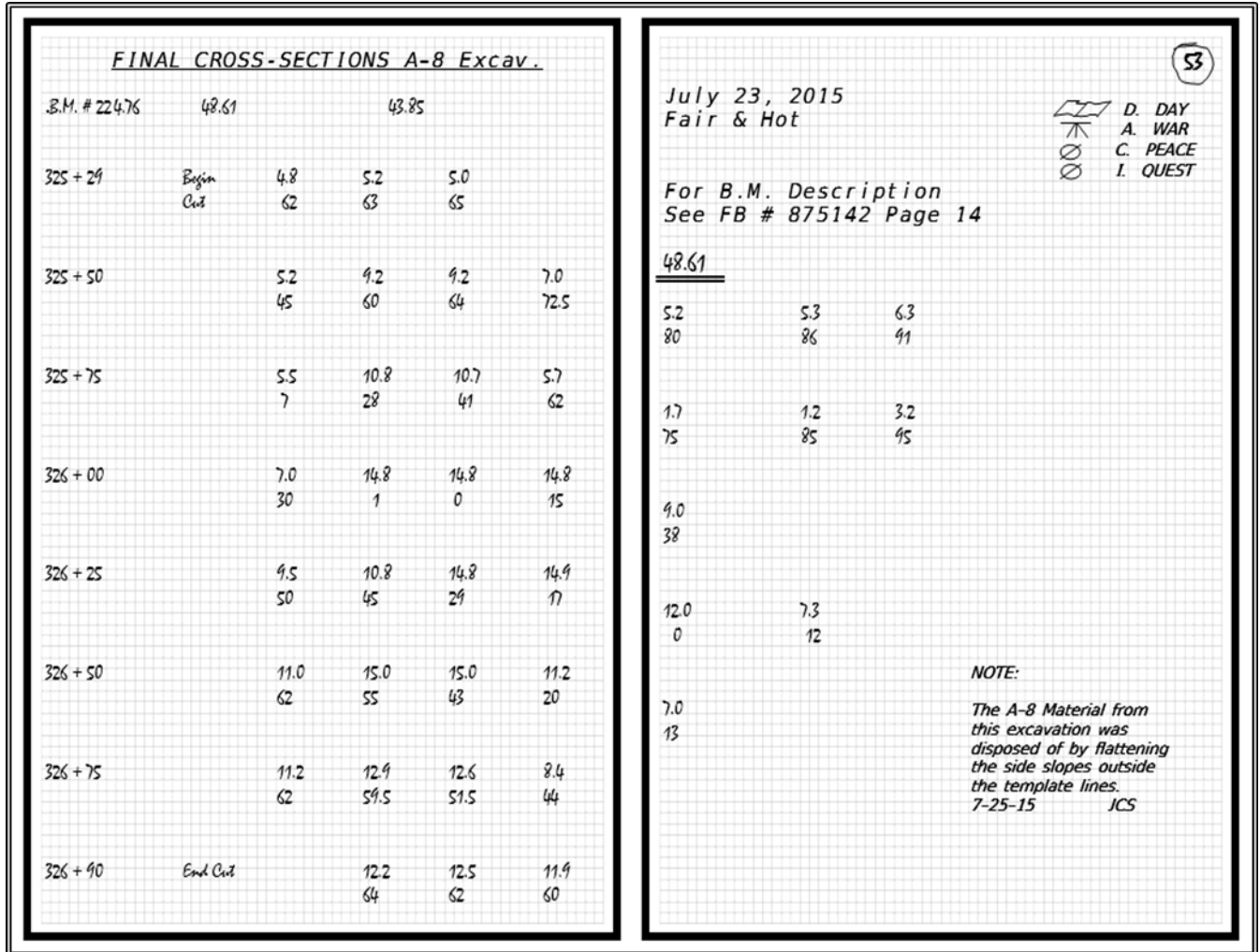
[Figure No. 5.16-1](#) Original Subsoil-Cross-section Notes
[Figure No. 5.16-2](#) Final Subsoil-Cross-section Notes

[Figure No. 5.16-3](#) Subsoil-Cross-section Limits Notes
[Figure No. 5.16-4](#) Final Subsoil-Cross-section Notes
[Figure No. 5.16-5](#) Control Elevations for Extra-Depth Muck
[Figure No. 5.16-6](#) Extra-Depth Muck Case I
[Figure No. 5.16-7](#) Extra-Depth Muck Case II
[Figure No. 5.16-8](#) Manuscript Field Book Notes
[Figure No. 5.16-9](#) Example Field Survey .TXT File
[Figure No. 5.16-10](#) Manuscript Field Book Notes
[Figure No. 5.16-11](#) Notes on Grid Paper

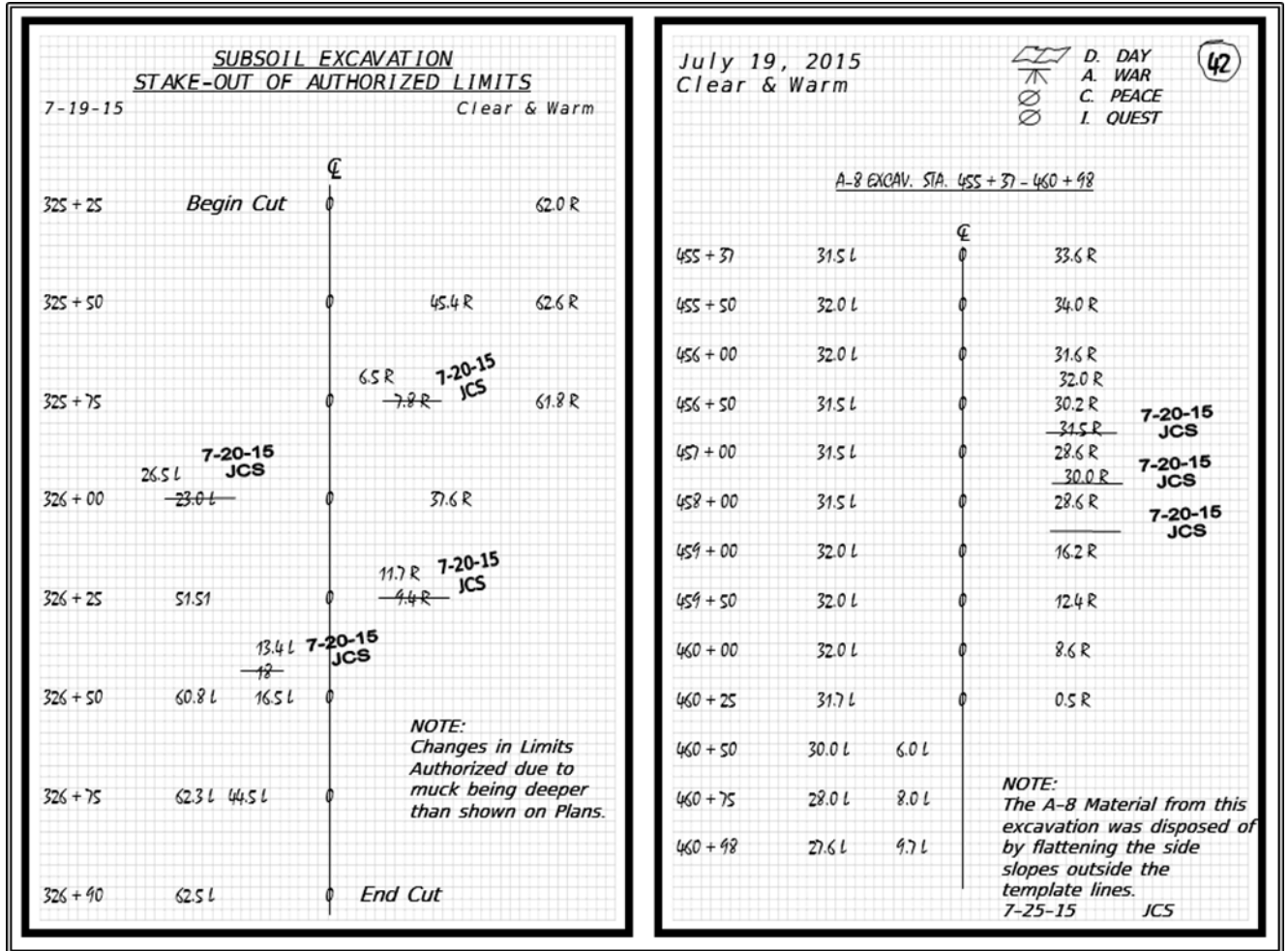
5.16.1.2 Figure 5.16-1
ORIGINAL SUBSOIL – CROSS-SECTION NOTES



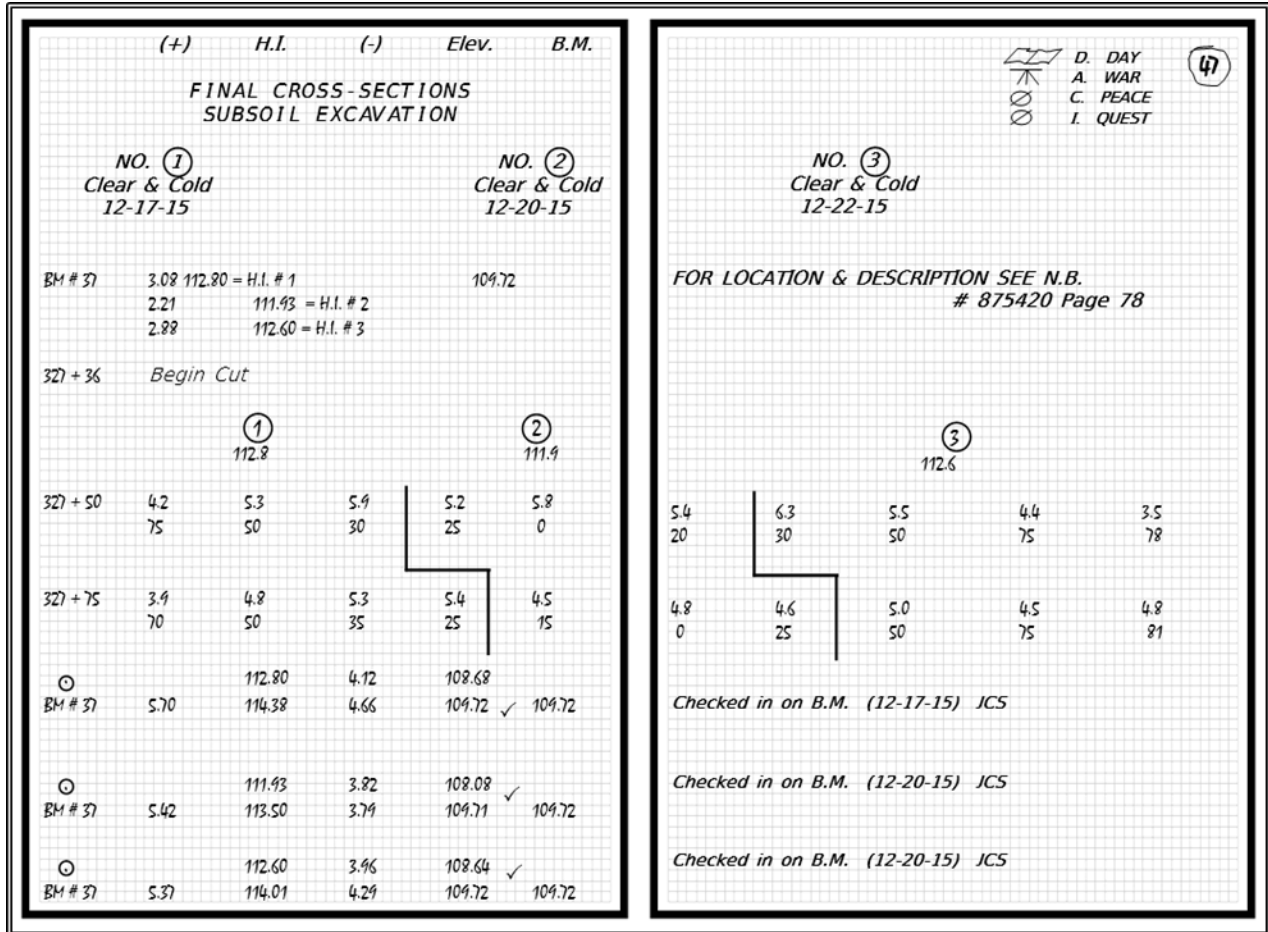
5.16.1.3 Figure 5.16-2
FINAL SUBSOIL – CROSS-SECTION NOTES



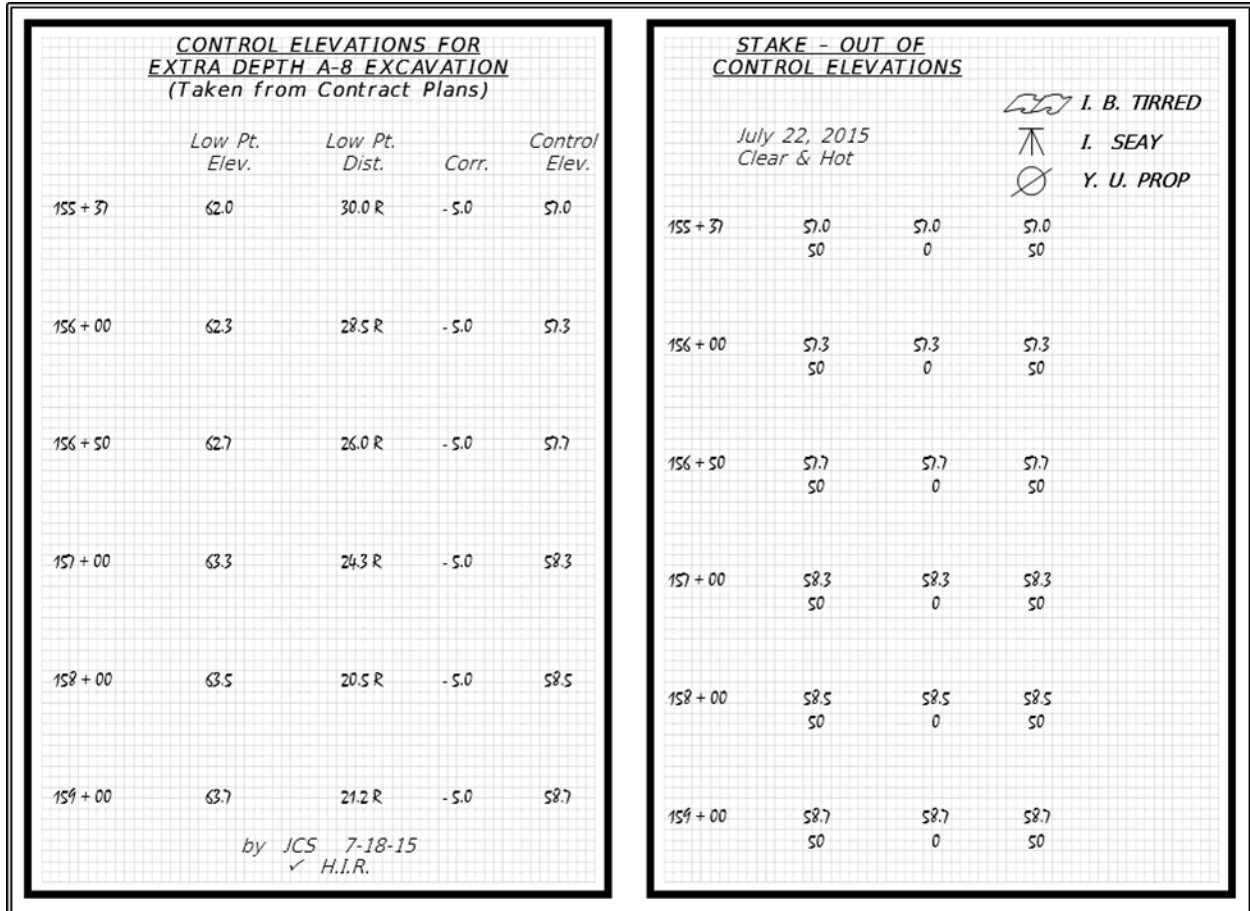
5.16.1.4 Figure 5.16-3 SUBSOIL – CROSS-SECTION LIMITS NOTES



5.16.1.5 Figure 5.16-4
FINAL SUBSOIL – CROSS-SECTION NOTES



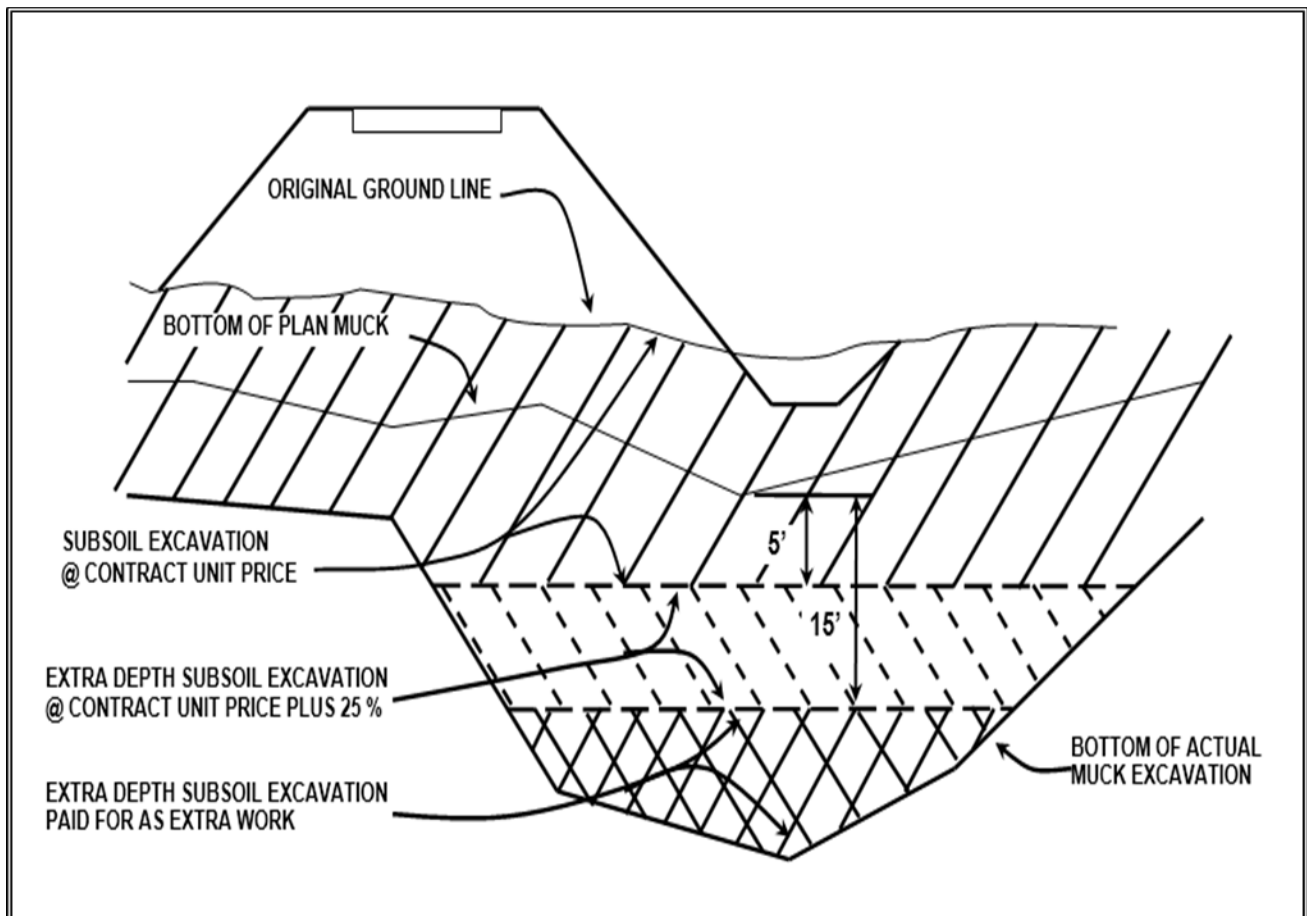
5.16.1.6 Figure 5.16-5
CONTROL ELEVATIONS FOR EXTRA-DEPTH MUCK



5.16.1.7 Figure 5.16-6 EXTRA-DEPTH MUCK CASE I

CASE I:

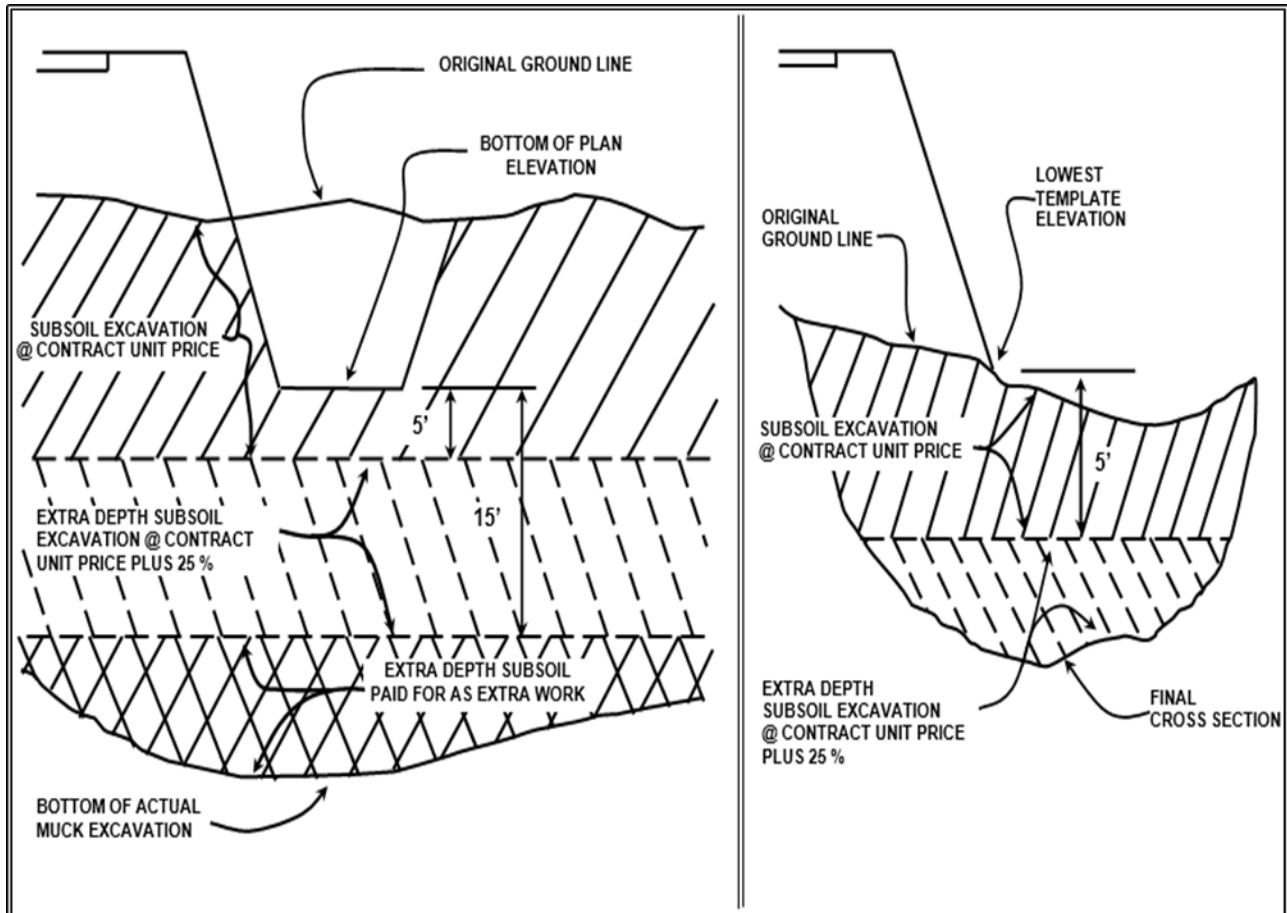
IN EVERY CASE, THE POINT OF REFERENCE FOR DETERMINING EXTRA DEPTH SUBSOIL EXCAVATION SHOULD BE THE LOWEST ELEVATION THAT MUCK IS SHOWN ON THE PLAN CROSS-SECTION AND THIS ELEVATION PROJECTED HORIZONTALLY ACROSS THEIR ENTIRE CROSS-SECTION IN MAKING THIS DETERMINATION. EACH CROSS-SECTION SHALL BE CONSIDERED SEPARATELY.



**5.16.1.8 Figure 5.16-7
EXTRA-DEPTH MUCK CASE II**

CASE II:

WHEN SUBSOIL EXCAVATION IS ENCOUNTERED WHERE NONE WAS SHOWN ON THE PLANS, EITHER IN SEPARATE AREAS OR AS AN EXTENSION TO AREAS THAT WERE SHOWN, THE POINT OF REFERENCE SHALL BE THE LOWEST ELEVATION ON THE GRADING TEMPLATE.



5.16.1.9 Figure 5.16-8 MANUSCRIPT FIELD BOOK NOTES

MANUSCRIPT FIELD BOOK NOTES-FDOT RADIAL & DTM FIELD SURVEYS			
READER INFORMATION:			
DATE: <u>05-26-15</u>	FIN PROJ. NO: <u>1974341-52-02</u>		
FIELD PARTY: <u>Arnold Rodman</u> <input checked="" type="checkbox"/> <u>Jerry Gypsum</u> <input type="checkbox"/> <u>Jace Ketchum</u> <input checked="" type="checkbox"/>	DSECS: <u>Broward Blvd Connector</u>		
	S.P. ZONE: <u>E</u> (N/E/W) MAD: <u>23</u> (27/83)		
	UNITS: <input checked="" type="checkbox"/> ENGLISH: <input type="checkbox"/> METRIC		
INSTRUMENT NAME: <u>Top Con GTS-38</u>			
WEATHER DATA: <u>Warm, partly cloudy</u>			
AXIS TEST:	FACE 1 (direct)		FACE 2 (reversed)
1)	H: <u>0 0 1</u> V: <u>105 0 10</u>	H: <u>180 0 1</u> V: <u>254 59 46</u>	
2)	H: <u>0 0 1</u> V: <u>105 0 12</u>	H: <u>179 59 57</u> V: <u>254 59 48</u>	
3)	H: <u>359 59 58</u> V: <u>105 0 10</u>	H: <u>179 59 54</u> V: <u>254 59 45</u>	
4)	H: <u>0 0 1</u> V: <u>105 0 12</u>	H: <u>180 0 2</u> V: <u>254 59 45</u>	
COMMENTS:	<u>See attached for instrument errors</u>		
INSTRUMENT SETUP INFORMATION:			
NAME OF POINT OCCUPIED:	<u>A-1</u>		
STAMPING:	<u>RLS # 4502</u>	(may be a known point or unknown point)	
FEATURE INFO:	<u>5/8" Rod & Cap</u>	SURFACE: <u>Ground</u>	<input checked="" type="checkbox"/> ON <input type="checkbox"/> OFF
MEASURED INSTRUMENT HEIGHT:	<u>4.97'</u>		
X:	Y:	Z:	
COMMENTS:	<u>Pt. in front of 7-11 store Sta 12+29.126' Lk.</u>		
BACKSIGHT NO. 1			
NAME OF CONTROL POINT SIGHTED:	<u>C-1</u>		
STAMPING:	<u>Jones 1936</u>	(XY AND Z MUST BE KNOWN)	
FEATURE INFO:	<u>Brass Disk</u>	SURFACE: <u>N/A</u>	<input type="checkbox"/> ON <input type="checkbox"/> OFF
HORIZ ANGLE (DDMMSS)	<u>129 41 10</u>	VERT ANGLE (DDMMSS)	<u>89 59 58</u>
DISTANCE:	<u>263.91'</u>	SLOPE	<input checked="" type="checkbox"/> HORIZONTAL
TARGET HEIGHT:	<u>5.0'</u>		
X:	Y:	Z:	
COMMENTS:			
BACKSIGHT NO. 2			
NAME OF CONTROL POINT SIGHTED:	<u>C-2</u>		
STAMPING:	<u>Jones 1936 AZMK</u>	(XY AND Z MUST BE KNOWN)	
FEATURE INFO:	<u>Brass Disk</u>	SURFACE: <u>N/A</u>	<input type="checkbox"/> ON <input type="checkbox"/> OFF
HORIZ ANGLE (DDMMSS)	<u>65 28 44</u>	VERT ANGLE (DDMMSS)	<u>90 0 1</u>
DISTANCE:	<u>428.15'</u>	SLOPE	<input checked="" type="checkbox"/> HORIZONTAL
TARGET HEIGHT:	<u>5.0'</u>		
X:	Y:	Z:	
COMMENTS:			
BACKSIGHT NO. 3			
NAME OF CONTROL POINT SIGHTED:	<u>SA 12+25</u>		
STAMPING:	(XY AND Z MUST BE KNOWN)		
FEATURE INFO:	<u>Nail in cap</u>	SURFACE: <u>N/A</u>	<input type="checkbox"/> ON <input type="checkbox"/> OFF
HORIZ ANGLE (DDMMSS)	<u>69 51 58</u>	VERT ANGLE (DDMMSS)	<u>90 0 2</u>
DISTANCE:	<u>121.63'</u>	SLOPE	<input checked="" type="checkbox"/> HORIZONTAL
TARGET HEIGHT:	<u>5.0'</u>		
X:	Y:	Z:	
COMMENTS:	<u>PC of S 26 30 curve on Broward Blvd Connector</u>		
<small>(Note: Horiz. Angle mandatory. Vert. Angle & distance optional)</small>			

**5.16.1.10 Figure 5.16-9
EXAMPLE FIELD SURVEY .TXT FILE**

Subsoil ascii file AA.txt - Notepad

File Edit Format View Help

20001,441428.847434,1598240.583179,8.249073,1175+50
20002,441428.735092,1598238.125447,8.759081,1175+50
20003,441430.016701,1598238.125447,8.759081,1175+50
20004,441430.980975,1598238.125447,8.759081,1175+50
20007,441478.392998,1598238.125447,8.759081,1175+50
20008,441478.788013,1598238.125447,8.759081,1175+50
20009,441480.004532,1598234.409802,9.273326,1176+00
20010,441481.835240,1598224.138807,9.328231,1176+00
20011,441506.139922,1598254.445393,11.292853,1176+30
20012,441508.202508,1598248.278096,10.785003,1176+30
20013,441509.151515,1598248.278096,10.785003,1176+30
20014,441509.151515,1598248.278096,10.785003,1176+30

This is a comma separated file.

Point ID	Northing	Easting	Elevation	Description/Station
20051	441483.136559	1598216.145655	8.057369	1176+00
20052	441486.099941	1598199.454225	9.161593	1176+00
20053	441514.847077	1598211.743498	8.410498	1176+30
20054	441515.618231	1598209.130954	8.914729	1176+30
20055	441516.331134	1598205.386415	8.601282	1176+30
20056	441516.657049	1598204.563286	8.557148	1176+30
20057	441512.295753	1598226.418298	8.304605	1176+30
20058	441528.022172	1598254.575625	15.186740	1176+50
20059	441531.899772	1598232.963018	11.202229	1176+50
20060	441532.731438	1598226.274925	10.578486	1176+50
20061	441535.691727	1598207.626787	10.574499	1176+50
20062	441558.099890	1598211.361691	12.822520	1176+73
20063	441557.525541	1598220.416386	13.238780	1176+73
20301	441382.168281	1598214.959919	9.101032	1175+00
20302	441380.098529	1598224.907655	9.933760	1175+00
20303	441384.914575	1598197.140528	7.849892	1175+00

5.16.1.14 Figure 5.16-10
MANUSCRIPT FIELD BOOK NOTES

MANUSCRIPT FIELD BOOK NOTES – FDOT RADIAL & DTM FIELD SURVEYS	
<p><u>OBSERVATION:</u></p> <p>POINT NAME <u>EP-1</u></p> <p>FEATURE: _____</p> <p>SURFACE: <u>Ground</u> <input checked="" type="checkbox"/> ON <input type="checkbox"/> OFF</p> <p>GEOMETRY: <input checked="" type="checkbox"/> POINT <input type="checkbox"/> CURVE</p> <p>HORIZ. ANGLE (DDMMSS) <u>133 37 35</u></p> <p>VERT. ANGLE (DDMMSS) <u>89 59 59</u></p> <p>DISTANCE <u>110.45'</u> SLOPE <input type="checkbox"/> HORIZ <input checked="" type="checkbox"/></p> <p>TARGET HEIGHT: <u>5'</u></p> <p>ECCEN. DIST. <input type="checkbox"/> LT <input type="checkbox"/> RT <input type="checkbox"/> FR <input type="checkbox"/> BK</p> <p>COMMENTS: _____</p>	<p><u>OBSERVATION:</u></p> <p>POINT NAME <u>EP-2</u></p> <p>FEATURE: _____</p> <p>SURFACE: <u>Ground</u> <input checked="" type="checkbox"/> ON <input type="checkbox"/> OFF</p> <p>GEOMETRY: <input checked="" type="checkbox"/> POINT <input type="checkbox"/> CURVE</p> <p>HORIZ. ANGLE (DDMMSS) <u>86 53 39</u></p> <p>VERT. ANGLE (DDMMSS) <u>89 59 20</u></p> <p>DISTANCE <u>83.08'</u> SLOPE <input type="checkbox"/> HORIZ <input checked="" type="checkbox"/></p> <p>TARGET HEIGHT: <u>5'</u></p> <p>ECCEN. DIST. <input type="checkbox"/> LT <input type="checkbox"/> RT <input type="checkbox"/> FR <input type="checkbox"/> BK</p> <p>COMMENTS: _____</p>
<p><u>OBSERVATION:</u></p> <p>POINT NAME <u>EP-3</u></p> <p>FEATURE: _____ OFF</p> <p>SURFACE: <u>Ground</u> <input checked="" type="checkbox"/> ON <input type="checkbox"/> OFF</p> <p>GEOMETRY: <input checked="" type="checkbox"/> POINT <input type="checkbox"/> CURVE</p> <p>HORIZ. ANGLE (DDMMSS) <u>46 50 54</u></p> <p>VERT. ANGLE (DDMMSS) <u>89 59 59</u></p> <p>DISTANCE <u>123.96'</u> SLOPE <input type="checkbox"/> HORIZ <input checked="" type="checkbox"/></p> <p>TARGET HEIGHT: <u>5'</u></p> <p>ECCEN. DIST. <input type="checkbox"/> LT <input type="checkbox"/> RT <input type="checkbox"/> FR <input type="checkbox"/> BK</p> <p>COMMENTS: <u>point at PC STA on edge of pavement</u></p>	<p><u>OBSERVATION:</u></p> <p>POINT NAME <u>EP-4</u></p> <p>FEATURE: _____</p> <p>SURFACE: _____ <input type="checkbox"/> ON <input type="checkbox"/> OFF</p> <p>GEOMETRY: _____ POINT <input checked="" type="checkbox"/> CURVE</p> <p>HORIZ. ANGLE (DDMMSS) <u>32 30 6</u></p> <p>VERT. ANGLE (DDMMSS) <u>90 2 27</u></p> <p>DISTANCE <u>194.78'</u> SLOPE <input type="checkbox"/> HORIZ <input checked="" type="checkbox"/></p> <p>TARGET HEIGHT: <u>5'</u></p> <p>ECCEN. DIST. <input type="checkbox"/> LT <input type="checkbox"/> RT <input type="checkbox"/> FR <input type="checkbox"/> BK</p> <p>COMMENTS: _____</p>
<p><u>OBSERVATION:</u></p> <p>POINT NAME <u>EP-5</u></p> <p>FEATURE: _____</p> <p>SURFACE: <u>Ground</u> <input checked="" type="checkbox"/> ON <input type="checkbox"/> OFF</p> <p>GEOMETRY: _____ POINT <input checked="" type="checkbox"/> CURVE</p> <p>HORIZ. ANGLE (DDMMSS) <u>26 33 1</u></p> <p>VERT. ANGLE (DDMMSS) <u>90 0 10</u></p> <p>DISTANCE <u>271.92'</u> SLOPE <input type="checkbox"/> HORIZ <input checked="" type="checkbox"/></p> <p>TARGET HEIGHT: <u>5'</u></p> <p>ECCEN. DIST. <input type="checkbox"/> LT <input type="checkbox"/> RT <input type="checkbox"/> FR <input type="checkbox"/> BK</p> <p>COMMENTS: _____</p>	<p><u>OBSERVATION:</u></p> <p>POINT NAME _____</p> <p>FEATURE: _____</p> <p>SURFACE: _____ <input type="checkbox"/> ON <input type="checkbox"/> OFF</p> <p>GEOMETRY: _____ POINT _____ CURVE</p> <p>HORIZ. ANGLE (DDMMSS) _____</p> <p>VERT. ANGLE (DDMMSS) _____</p> <p>DISTANCE _____ SLOPE _____ HORIZ _____</p> <p>TARGET HEIGHT: _____</p> <p>ECCEN. DIST. <input type="checkbox"/> LT <input type="checkbox"/> RT <input type="checkbox"/> FR <input type="checkbox"/> BK</p> <p>COMMENTS: _____</p>
<u>CHAIN FIELD NOTES</u>	
<p>USER ASSIGNED CHAIN NAME: <u>EP</u></p> <p>FEATURE: <u>edge of pavement (AP)</u> SURFACE: _____ <input type="checkbox"/> ON <input type="checkbox"/> OFF</p> <p>STATIONING: _____</p> <p>LIST OF POINTS IN CHAIN: <u>EP-1 → 5</u></p> <p>COMMENTS: <u>EOP @ inlets & midway between inlets & shot at PC</u></p>	
<p>NOTE: A DETAILED SKETCH OF THE VICINITY MUST BE ATTACHED TO THESE NOTE FORMS.</p>	

5.16.1.12 Figure 5.16-11
NOTES ON GRID PAPER

