

## Section 5.15

### FINAL MEASUREMENTS

#### 5.15.1 PURPOSE

To compile final measurement requirements and techniques to ensure that Final Measured, Plan Quantity, and Lump Sum Pay Items are accurately and efficiently done, without needless and costly refinements.

#### 5.15.2 GENERAL

Measurements for bituminous material, earthwork, and loose volume material in trucks have been addressed in other procedures of this *Manual*. Measured items for Area, Linear, Volume, Per Each, and Per Day under Final Measured pay items will be addressed along with Plan Quantity and Lump Sum Pay Items in this chapter. Requirements for final measurements of pay quantities are found in the [Florida Department of Transportation's \(FDOT\) Specifications](#).

#### 5.15.3 GENERAL REQUIREMENTS

##### 5.15.3.1 Final Measured Pay Items

On many items, quantities for progress and final estimates must be documented by final measurements (in the field) as the work is actually accomplished. By summarizing these items, the monthly progress estimate is generated to reflect the work completed during this period using the final measured quantities recorded. When the project is completed, *Plan Summary Boxes* in the plans, *Field Books*, and other *Department* approved forms are submitted along with the other final estimate data to substantiate the final quantities. Final measurement of pay quantities in *Field Books* will generally fall into one of the following categories:

- (A) **Area Measurement Pay Items:** When items are paid for on the basis of the area of the finished work, the dimensions for calculating these areas shall be documented in the field records. This shall be done in accordance with one of the following methods:
  - (1) The length shall be the dimension shown on the plans or the station-to-station dimension actually constructed within the project limits

designated by the Engineer. The width shall be the dimension actually constructed within the neat lines shown in the plans or designated by the Engineer/Project Administrator (PA) within the project limits.

- (2) The length and width as measured in place, usually with length measured along the centerline of the construction work, and width measured at a right angle to the tangent of the centerline.
  - (3) Stations and offsets must be recorded and used as latitudes and departures to calculate area. Curve corrections to account for a curved baseline must be applied to area calculations. When the baseline used for measuring areas is neither the project's centerline of construction nor a baseline for stationing shown in the plans, the baseline must be straight lined with beginning and ending points referenced to the centerline of construction by station and offset.
  - (4) When changes are encountered in the field, the back up documentation and calculations must be incorporated in the **Plan Summary Boxes** located within the **Summary of Quantity Sheets** in the Plans or referenced to a separate file, final measured form or **Field Book**, as documentation for final area measurements. (If computer programs are used, the calculations shall be checked and the actual site source measurements submitted with the computer output.)
- (B) **Linear Measurement Pay Items:** The dimension documented for items paid for on the basis of linear foot shall be the length shown on the plans and in the **Plan Summary Box** in the plans or the length ~~actually field~~ measured along the finished surface of the item as required.
- (C) **Volumetric Measurements Pay Items:** Field quantities for items paid for on the basis of volume in cubic units, are usually determined by one of the following methods:
- (1) Concrete quantities are generally paid for on the Plan Quantity basis unless authorized field changes have been made subject to [Section 9-3.2 of the Specifications](#), or unless final field measurements are dictated by the particular pay item such as miscellaneous concrete for contingent use (see [Section 346-9 and 346-10 of the Specifications](#)). See **Attachment 1** at end of this chapter for examples of pay adjustments for low strength concrete calculations.

- (2) Cross-~~Section~~ notes are recorded along both the original surface and for the surface of the completed work either by field parties, or as determined by aerial photography and the volumes calculated by hand or by use of the computer facilities. Cross-~~sections~~ with end area and volume computations can also be used advantageously in calculating buildup volumes of spalled concrete members. See **Figure Nos. 5.15-1 & 5.15-2.**
- (D) **Per Each Measurement Pay Items:** Items paid for as a unit, such as fence gates, etc., shall be tabulated by location in the **Plan Summary Boxes** located in the Plans with references to **Field Books**, or other final measured records.
- (E) **Each Day Pay Item for Engineer's Field Office:** As of July 2015, this pay item will no longer be used. An engineer's field office, if needed, will be provided by the consultant CEI.

### 5.15.3.2 Lump Sum Pay Items

Where the pay quantity for an item is designated to be a lump sum and the plans show an estimated plan quantity, compensation for that item will be adjusted proportionately when a plan change results in a significant increase or decrease in the quantity from the estimated plan quantity ([see Section 9-3.2.1 of the Specifications](#)). When the plans do not provide adjustments for contingencies, establishment of a new unit price through a Supplemental Agreement shall compensate for changes in the cost of completing the item.

**Note:** for Lump Sum Pay Items and Tabulation Forms, see [Section 5-14.5](#) of this Manual. For Lump Sum Projects, please see [Section 6.2](#) of this Manual.

### 5.15.3.3 Plan Quantity Pay Items

Plan Quantity Items under [Section 9-3 of the Specifications](#) are design supported. Documentation requirements are as follows:

- (1) The **Plan Summary Box** located within the **Summary of Quantity Sheets** in the Plans will show the Pay Item, Pay Item Description, Unit of Measure, Quantity, Location and Stationing.
- (2) With the new **Plan Summary Boxes** incorporated into the **Summary of Quantity Sheets** in the Plans, "sketches" are no longer required. The plan sheets are the "sketches" for the location

of the areas along with the station and offset (L or R) columns. The only difference now is that you do not have the AREA ID numbers labeled/shown in the plans nor the area boundaries. Most shapes are self-explanatory given the station and offset information. If more information is needed, it should be added to the Design Notes column. See the [FDOT CADD Manual](#).

- (3) The designer must keep all supporting information in their files until the project is completed and paid off, and in compliance with the [Records Retention and Disposal Schedule](#) requirements. ( See specifically the following Sections: Schedule #s & Item #s (RO-67(1), A-271(1), A-318(1), A-402(1), A-400(1), A-319(2), A-382(1), A-279(1), and A-319(3))
- (4) Should a dispute arise involving quantities for one or more of the plan quantity items, the Construction Office will request in writing, that the Designer provide detailed documentation or verify the concern for the plan quantity item(s) in question. The backup documentation must be produced within five (5) working days of the request from construction.
- (5) The Construction Office will not make detailed calculation entries when no changes are made. The Plan Quantity Item will not be final measured in a **Field Book** or on other final measured forms, only changes in the field or plan errors, as set forth in [Section 9-3 of the Specifications](#), are required to be documented.
- (6) When no changes are made (no Plan Errors and/or Field changes) and only Plan Quantity is to be paid, a simple red check (✓) should be shown under the "F" or "Final" column, within the **Plan Summary Box**. If a change occurs, then the differing quantity should be tabulated in the "Final" column of the **Plan Summary Box**.
- (7) Deviation from the Plan Dimensions: [Section 9-3.4 of the Specifications](#) requires 5% or \$5000 change for earthwork and \$100 for other items.
- (8) When changes in limits are authorized, the PA must show the revised quantities by showing revisions along side the original Designer's calculations. If an additional area is added, the PA could show this under a new empty row within the same pay item in the **Plan**

**Summary Box**, and under the “Remarks” column reference where the calculations for the new quantity can be located for back up. **Do not remove Designer quantity and work, please strike through.**

- (9) Some method must be employed by the PA to prove or revise the Plan Quantity. Some of the suggested methods are as follows:
- (a) Field measure
  - (b) Scale from plans
  - (c) Station to station calculations
  - (d) Joint counts (with cut-offs deducted)
- (10) Plan Quantity Items on multi-project contracts are to be evaluated per contract total, not per project total. Evaluation for multi project contracts must employ a correction to the “contract total.”

**Note:** If each project had been on a separate contract, the revised final measured quantity would have been paid. However, when two or more projects are on the same contract and the total combined change falls within the Plan Quantity Parameters, no change is made to the Plan Quantity.

See **Attachment 2** for an example of a PQ analysis of a Contract with two projects showing plan errors on both projects and where the final PQ will not change.

See **Attachment 3** for an example of a PQ analysis for one Contract with two projects showing plan errors and field changes, and where the final PQ will change.

- (11) The PA must make his/her own analysis of the accuracy of plan quantity items. It is not the intent of the Plan Quantity concept to require more laborious measurements than the old method. It is intended to save man hours through less field survey work.
- (12) Type ‘A’ and Type ‘B’ Fencing are Plan Quantity pay items. The **Payment for Extra Length Posts** will require an invoice from the Contractor. Compensation will be at invoice price plus 10%, per [Specifications, Section 550-6.2.](#)

**Example:** Contractor submits an invoice for 20 extra length posts

at an invoice price of \$250.00. An additional 10 percent = \$25.00. The compensation will be \$275.00 for the extra length posts. An adjusted fencing item will be shown with a quantity of one (1) at a unit price of \$275.00. A copy of the invoice will be submitted with the Final Estimate Package.

Gates are to be paid as each. Location and summary needs to be provided to document quantity(s).

#### 5.15.4 DEGREE OF ACCURACY

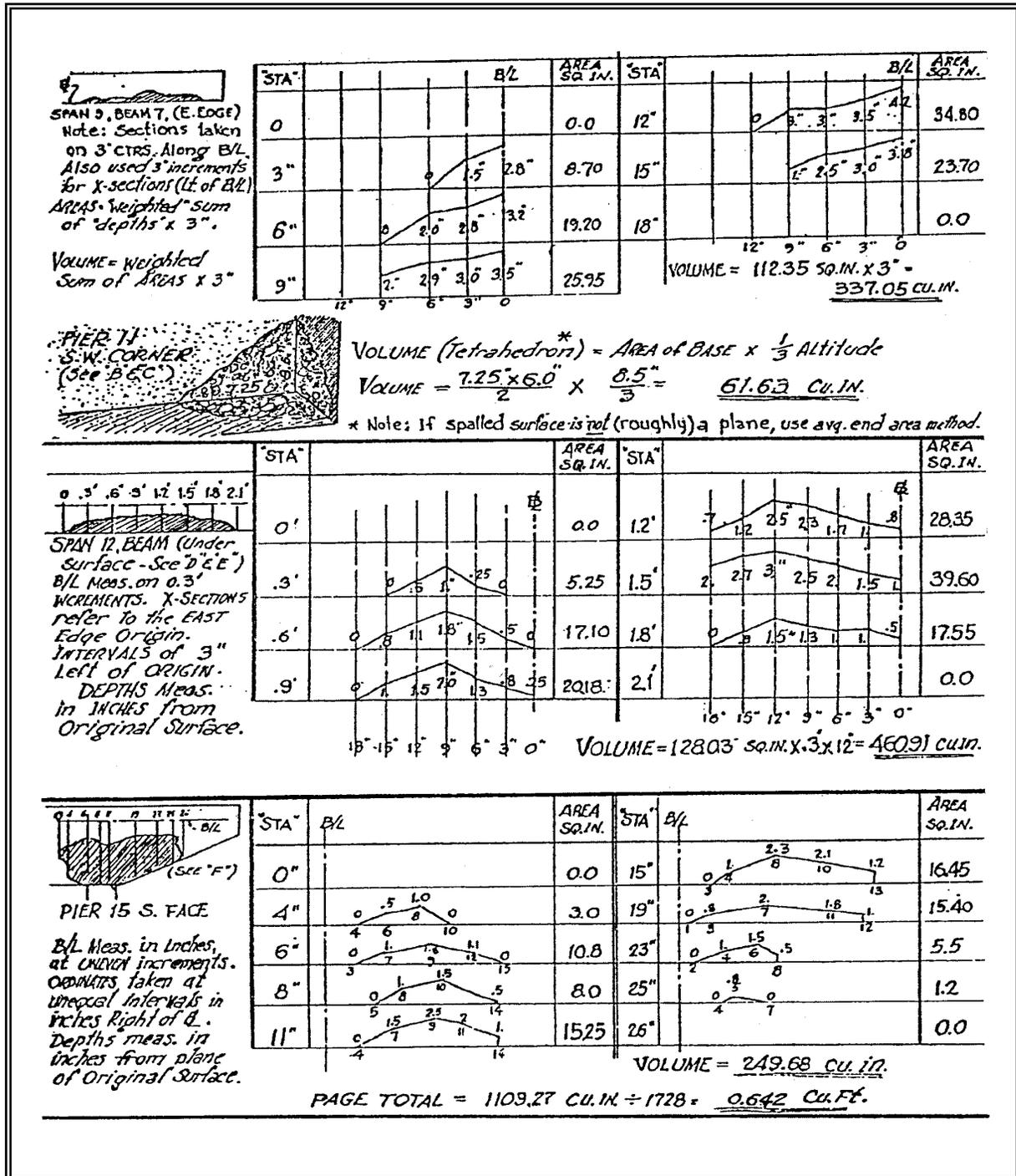
Degrees of Accuracy for pay items shall be as indicated in **Chapters 2** of the [Basis of Estimates Manual](#).

#### 5.15.5 LIST OF FIGURES AND ATTACHMENTS FOLLOWING THIS SECTION

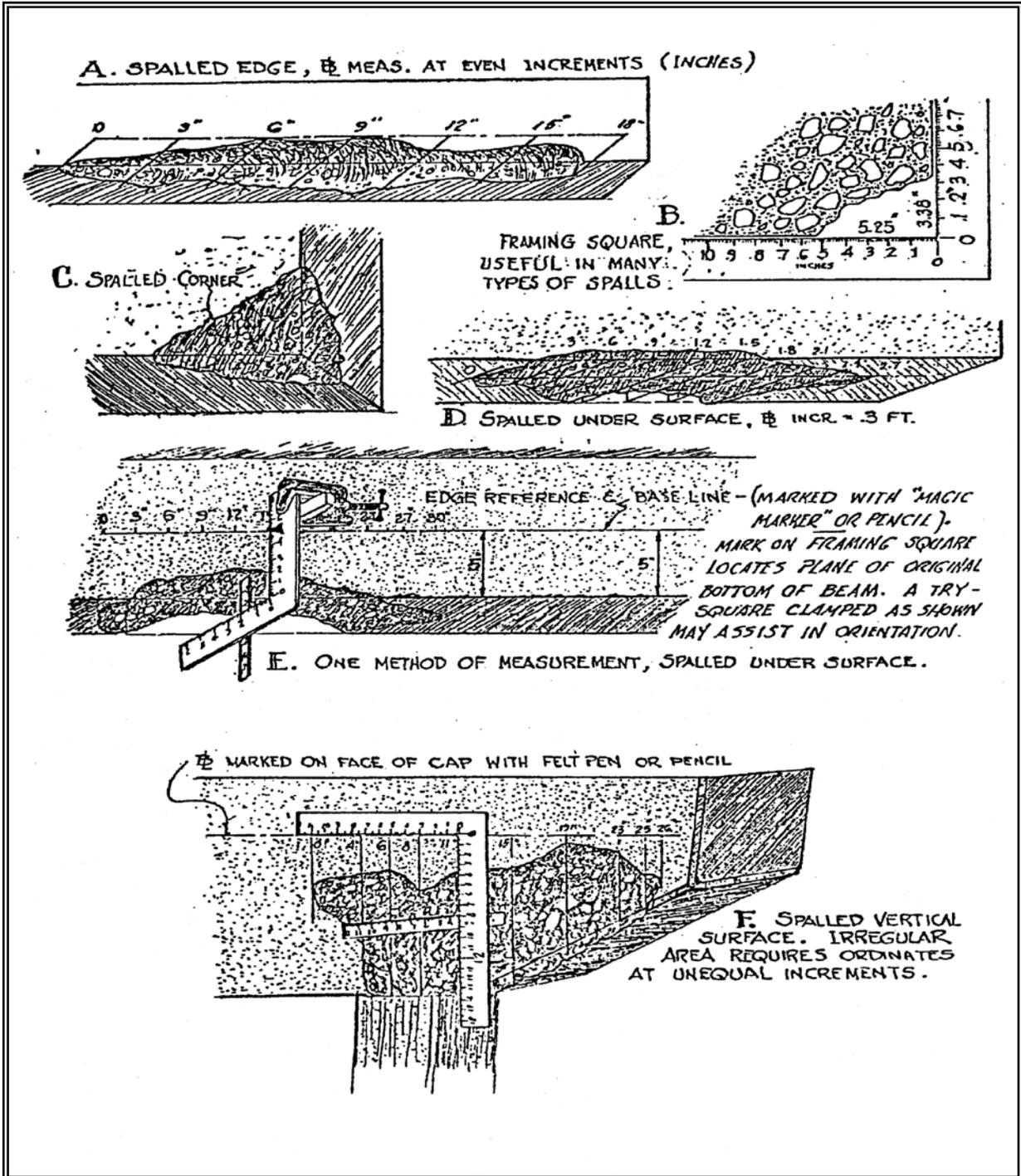
**Figure No. 5.15-1** ..... Spalled Area Sketches  
**Figure No. 5.15-2** ..... Spalled Area Sketches

**Attachment 1** ..... ~~Pay Adjustments~~ Examples of Pay Adjustments for Low Strength Concrete  
**Attachment 2** ..... Plan Quantity Analysis Example - Two Projects Under One Contract  
**Attachment 3** ..... Plan Quantity Analysis Example - One Contract

**Figure 5.15-1  
 SPALLED AREAS SKETCHES**



## Figure 5.15-2 SPALLED AREAS SKETCHES



## ATTACHMENT 1

### Examples of Pay Adjustments for Low Strength Concrete

#### 1. Linear Foot Pay Item Penalty Example:

Given Information:

- Item #521-5-5, Concrete Traffic Railing (42" Vertical Shape), is paid as Concrete Class II in units of Linear Feet.
- One pour today was 14 CY and covered 98.7 LF = 99 LF of railing
- Unit Price = \$575.00/LF
- Quantity of Concrete within the LOT = 14 CY
- 3 Cylinders were taken for the LOT. After 28 days all cylinders failed.
- Required Strength of Class II Concrete = 3,400 Pounds per Square Inch (PSI)
- Average Actual Cylinder Strength (after 28 days) = 2,850 PSI

Concrete Strength Deficiency (PSI) = 2,850 PSI – 3,400 PSI = - 550 PSI

$$\text{Percent Deficiency} = \frac{- 550 \text{ PSI}}{3,400 \text{ PSI}} = -0.16 \quad \text{OR} \quad 0.16 \times 100 = -16\%$$

This Pay Item is paid to the nearest LF. This LOT represents the entire 99 LF; therefore:

$$\$575.00/\text{LF} \times -0.16 = -\$92.00/\text{LF} \quad \text{at } \mathbf{NO \text{ PAY}}$$

In SiteManager, Create a Line Item Adjustment: Compressive Strength Failure.

$$99 \text{ LF} \times -\$92.00/\text{LF} = -\$9,108.00$$

Under Remarks: Reduction is due to 16% Compressive Strength Failure.

$$99 \text{ LF} \times -\$92.00/\text{LF} = -\$9,108.00$$

## 2. Cubic Yard Pay Item Penalty Example:

Given Information:

- Original pay item = 400-4-2 Concrete Class IV End Walls
- This LOT represents 3 failed cylinders and 25 CY.
- Original Unit Price = \$570.00/CY
- Pay Item is paid to the 10<sup>th</sup> of a CY
- Required Strength of Class IV Concrete = 5,500 PSI
- Average Actual Cylinder Strength (after 28 days ) = 5,000 PSI

Concrete Strength Deficiency (PSI) = 5,000 PSI - 5,500 PSI = - 500 PSI

$$\text{Deficiency Percentage} = \frac{- 550 \text{ PSI}}{5,500 \text{ PSI}} = -0.09 \quad \text{OR} \quad 0.09 \times 100 = -9\%$$

This Pay Item is paid to the nearest CY. This LOT represents the entire 25 CY; therefore:

$$25 \text{ CY} \times -0.09 = -2.25 \text{ CY} = - 2.3 \text{ CY at } \mathbf{NO \text{ PAY}}$$

In SiteManager, create a line item adjustment:

Compressive Strength Failure.

$$-2.3 \text{ CY} \times \$570.00/\text{CY} = -\$1,311.00$$

Under Remarks:

Reduction is due to 9% Compressive Strength Failure.

$$-2.3 \text{ CY} \times \$570.00/\text{CY} = -\$1,311.00$$

## ATTACHMENT 2

### Plan Quantity Analysis Example - Two Projects Under One Contract

**Given:**

- Type B Stabilization (*Item #160-4*)
- Plan Quantity = 70,000 SY at a unit price of \$1.00/SY

<b>Plan Quantity Analysis</b>			
Contract T1234	Original Plan Quantity	New Quantity	Plan Errors
Project 1 of 2	50,000 SY	42,000 SY	(-) 8,000 SY
Project 2 of 2	<u>20,000 SY</u>	<u>30,000 SY</u>	<u>(+) 10,000 SY</u>
	<b>70,000 SY</b>	72,000 SY	<b>(+) 2,000 SY</b>

What is the Final Pay Quantity for each job?

Step 1: Determine if the error exceeds 5%

$$\left( \frac{2,000 \text{ SY}}{7,000 \text{ SY}} \right) \times 100 = 2.9\% < 5\%$$

Step 2: Determine if the error exceeds \$5,000

$$2,000 \text{ SY} \times \$ 1.00/\text{SY} = \$2,000.00 < \$ 5,000.00$$

Both calculations in Step 1 and Step 2 do not qualify to change the original plan quantity for the contract; therefore, plan quantity for both projects will be paid due to final adjustment being less than 5% and less than \$5,000.00

**Final Stabilization Quantity for Project 1 of 2 = 50,000 SY**  
**Final Stabilization Quantity for Project 2 of 2 = 20,000 SY**

## ATTACHMENT 3 Plan Quantity Analysis Example - One Contract

Given:

- Type B Stabilization (Item #160-4)
- Plan Quantity = 70,000 SY at a unit price of \$1.00/SY;
- Two projects under one Contract
  - (1) Job 1 of 2:      Plan Quantity = 50,000 SY  
                          Plan Error = - 3,000 SY  
                          Field Changes = +300 SY, -120 SY, - 500 SY
  - (2) Job 2 of 2:      Plan Quantity = 20,000 SY  
                          Plan Error = + 8,000 SY  
                          Field Revisions = - 250 SY, -150 SY

What is the Final Pay Quantity for each job?

<b>Plan Quantity Analysis</b>			
Contract T1234	Original Plan Quantity	Plan Errors	Field Changes
Project 1 of 2	50,000 SY	- 3,000 SY	- 320 SY
Project 2 of 2	20,000 SY	+ 8,000 SY	- 400 SY
	<b>70,000 SY</b>	<b>+ 5,000 SY</b>	<b>- 720 SY</b>

Step 1: Determine if the error exceeds 5%

$$\left( \frac{5,000 \text{ SY}}{70,000 \text{ SY}} \right) \times 100 = 7.1\% > 5\%$$

Step 2: Determine if the error exceeds \$5,000

$$(5,000 \text{ SY} \times \$1.00/\text{SY}) = \$5,000 \quad (\text{Equal to } \$ 5,000)$$

Only one of the criteria above must be met for plan errors to qualify for additional payment. Although the error did not exceed \$5,000, it did exceed 5% and qualifies for additional payment.

Note: All Field Changes will be added or subtracted under each job for final pay regardless of plan errors.

Project 1 of 2:

Original Plan Quantity = 50,000 SY  
Plan Error = -3,000 SY  
Field Change = -320 SY  
**Final Quantity = 46,600 SY**

Project 2 of 2:

Original Plan Quantity = 20,000 SY  
Plan Error = +8,000 SY  
Field Change = -400 SY  
**Final Quantity = 27,600 SY**