

# Measuring Sitework & Excavation

# Sitework: General

- Usually only few details are available on the existing conditions of the site
- Contractors are advised by the Contract Documents to make site visits to satisfy themselves of the existing conditions.
- On a site visit an estimator would look for conditions that has impact on cost (See Figures 2.5 & 2.6 for checklist of what to look for.)

**SITE VISIT CHECKLIST**  
**Local Projects**

Estimator: \_\_\_\_\_ Date: \_\_\_\_\_  
Job Number: \_\_\_\_\_ Location: \_\_\_\_\_  
Project Name: \_\_\_\_\_

- Distance from Office: \_\_\_\_\_
- Weather Conditions: \_\_\_\_\_
- Access and Roads: \_\_\_\_\_
- Sidewalk Crossing: \_\_\_\_\_
- Site Conditions: \_\_\_\_\_
  
- Adjacent Structures: \_\_\_\_\_
  
- Obstructions: \_\_\_\_\_
- Shoring or Underpinning: \_\_\_\_\_
- Depth of Topsoil: \_\_\_\_\_
- Soil Data: \_\_\_\_\_
- Ground Water: \_\_\_\_\_
- Soil Disposal Location: \_\_\_\_\_
- Distance to Borrow Pit: \_\_\_\_\_
- Local Sand & Gravel: \_\_\_\_\_
- Electrical Service: \_\_\_\_\_
- Telephone: \_\_\_\_\_
- Sewer & Water Services: \_\_\_\_\_
- Parking and Storage: \_\_\_\_\_
- Security Needs: \_\_\_\_\_
- Temporary Fences Required: \_\_\_\_\_
- Garbage Disposal: \_\_\_\_\_
- Toilets: \_\_\_\_\_
- Site History: \_\_\_\_\_
- Possible Contamination: \_\_\_\_\_
- Other Comments: \_\_\_\_\_
  
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

**Figure 2.5** Local Site Visits

# Soil Reports

- On large projects there may be a site “Soil Report”
- The main purpose of a Soil Report is to provide information to design the foundation system
- But soil reports have useful information for excavation including (See Appendix A):
  - Types of soil found on site.
  - Soil moisture content

## Typical useful information in Soil Reports

- Useful information found in the soil report shown in Appendix A:
  - Topsoil is 8" deep to be stripped from the building area and the parking area.
  - Most excavation on this project will be in the top silt-sand layer (Soil type → impact on excavation productivity)
  - Soil moisture content was low and there was little ground water at time of investigation. But the report indicates the ground water levels are subject to fluctuation, so there may be a need for a contingency for dewatering.
  - It is recommended that the sides of the excavation have a slope of 1.5 H: 1.0 V. Shoring may be necessary if space is limited.
  - Soil compaction factors required are high, therefore strict compaction procedures will be needed.
  - Foundation concrete does not require sulfate-resistant cement.

# Bank Measure, Swell & Compaction Factors

- Swell factor indicates the increase in volume when soil is excavated. Compaction factor indicates the decrease in volume after soil is compacted.
- According to the measurement principle 'net in place', quantity takeoff is based on the dimensions of the excavated or filled area (bank measure.)
- Adjustment for swell and compaction factors is done when the takeoff items are priced.

# Excavation Safety Considerations

- Deep excavations constitute a major hazard due to possibility of embankment cave-ins. OSHA regulations require excavation deeper than 5 ft to be protected.
- To prevent cave-ins embankments are sloped or otherwise supported if sloping is not feasible.
- Sloping or shoring embankments results in extra cost which the estimator must account for.

# Measuring Notes

- See Measuring Notes for Excavation & Backfill on P. 59
- These are part of the ***Standard Method of Measurement*** with regards to Excavation and Backfill.
- Example items (see Measuring Notes, p. 59):
  - Excavations, backfill and fill material shall be measured in cubic yards or cubic meters “bank measure”
  - If different type of materials will be encountered, each type shall be described and measured separately.
  - Excavations shall be classified and measured separately in the following categories: Site clearing, Bulk excavation, Basement excavations, Trench excavations, and Pit excavation

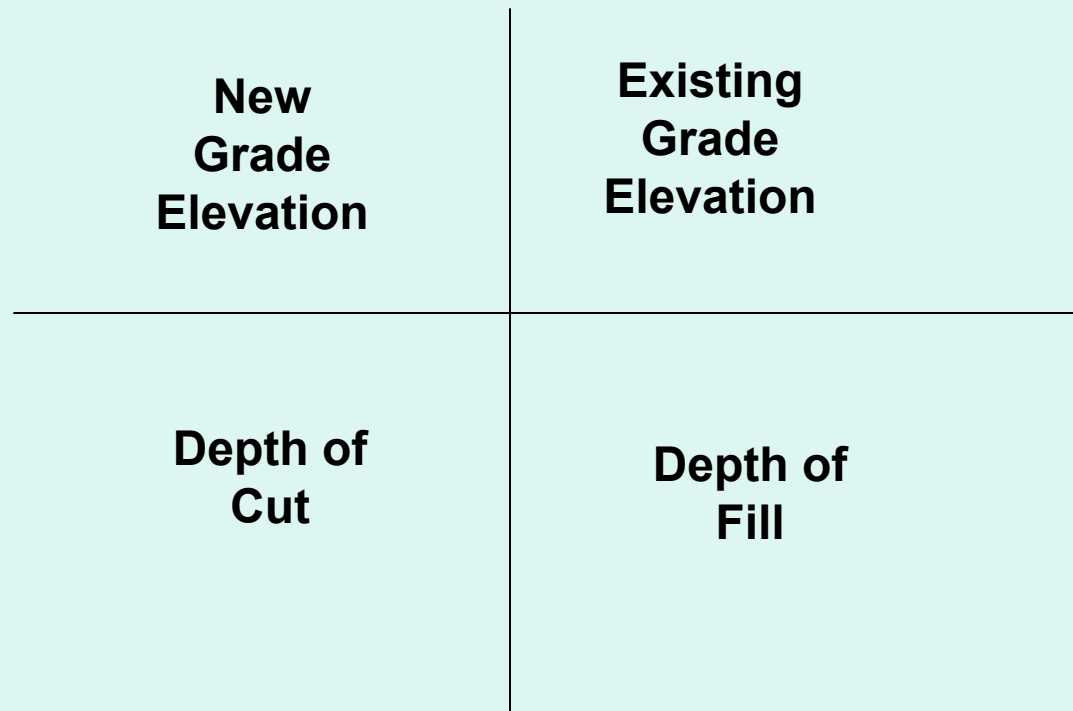


## “Grid Method” Calculations of Cut & Fill

- Requires:
  - Existing Grade elevation (through site survey)
  - Elevation of the new Grade
- The site is divided by a Grid of appropriate dimensions
- The elevation at the grid intersection points must be determined.
- The elevation of a square in the Grid is determined as the average of the elevation at its four corners.

Indicate elevations & depths at each intersection point on the Grid as follow

**Grid Intersection**



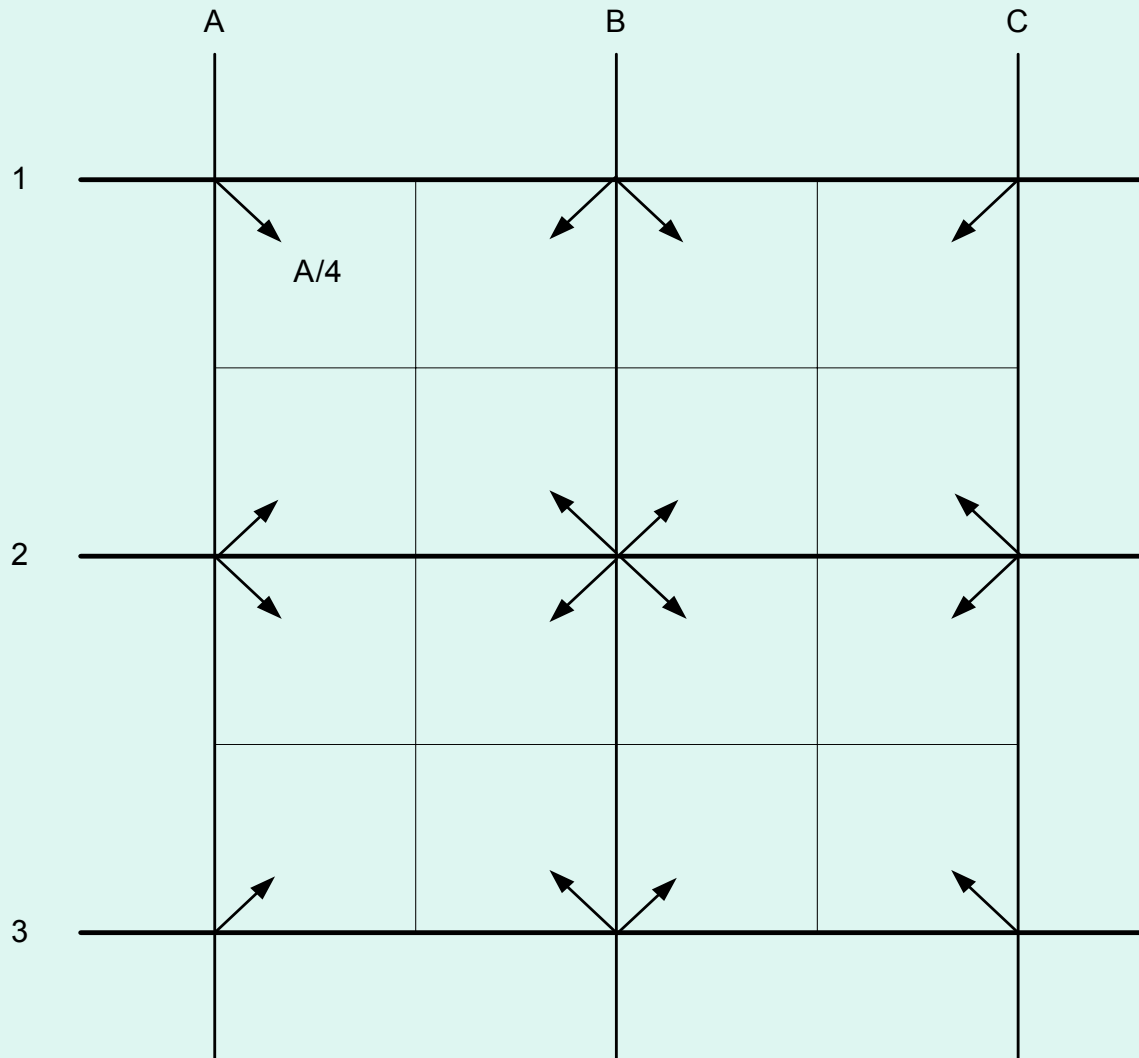
## Grid Elevations

	A		B		C		D		E	
1	4.2	6.5	4.4	5.0	4.6	3.0	4.8	1.9	5.0	2.2
	2.3		0.6		1.6			2.9		2.8
2	4.4	5.1	4.6	3.2	4.8	2.8	5.0	4.5	5.2	5.2
	0.7			1.4		2.0		0.5	0.0	0.0
3	4.6	3.6	4.8	2.0	5.0	5.3	5.2	7.1	5.4	7.9
		1.0		2.8		0.3		1.9		2.5
4	4.8	1.9	5.0	4.0	5.2	8.2	5.4	10.0	5.6	10.3
		2.9		1.0		3.0		4.6		4.7
5	5.0	3.0	5.2	3.8	5.4	6.4	5.6	7.0	5.8	7.5
		2.0		1.4		1.0		1.4		1.7

## “Grid Method” Calculations of Cut & Fill

- The elevation of a square in the Grid is determined as the average of the elevation at its four corners.

# Excavation Grid



# Excavation by Grid Method

Station	New Elev	Existing Elev	Depth Cut	Depth Fill	Freq	Area Const	Volume Cut	Volume Fill
1A	4.2	6.5	2.3	0.0	1	80	184	0
1B	4.4	5.0	0.6	0.0	2	80	96	0
1C	4.6	3.0	0.0	1.6	2	80	0	256
1D	4.8	1.9	0.0	2.9	2	80	0	464
1E	5.0	2.2	0.0	2.8	1	80	0	224
2A	4.4	5.1	0.7	0.0	2	80	112	0
2B	4.6	3.2	0.0	1.4	4	80	0	448
2C	4.8	2.8	0.0	2.0	4	80	0	640
2D	5.0	4.5	0.0	0.5	4	80	0	160
2E	5.2	5.2	0.0	0.0	2	80	0	0
3A	4.6	3.6	0.0	1.0	2	80	0	160
3B	4.8	2.0	0.0	2.8	4	80	0	896
3C	5.0	5.3	0.3	0.0	4	80	96	0
3D	5.2	7.1	1.9	0.0	4	80	608	0
3E	5.4	7.9	2.5	0.0	2	80	400	0
4A	4.8	1.9	0.0	2.9	2	80	0	464
4B	5.0	4.0	0.0	1.0	4	80	0	320
4C	5.2	8.2	3.0	0.0	4	80	960	0
4D	5.4	10.0	4.6	0.0	4	80	1472	0
4E	5.6	10.3	4.7	0.0	2	80	752	0
5A	5.0	3.0	0.0	2.0	1	80	0	160
5B	5.2	3.8	0.0	1.4	2	80	0	224
5C	5.4	6.4	1.0	0.0	2	80	160	0
5D	5.6	7.0	1.4	0.0	2	80	224	0
5E	5.8	7.5	1.7	0.0	1	80	136	0
						cu. Ft	5200	4416
						CY	193	164
<b>Summary</b>								
	<b>Bulk Cut</b>		<b>193</b>	<b>CY</b>				
	<b>Bulk Fill</b>		<b>164</b>	<b>CY</b>				
	<b>Dispose Surplu</b>		<b>29</b>	<b>CY</b>				

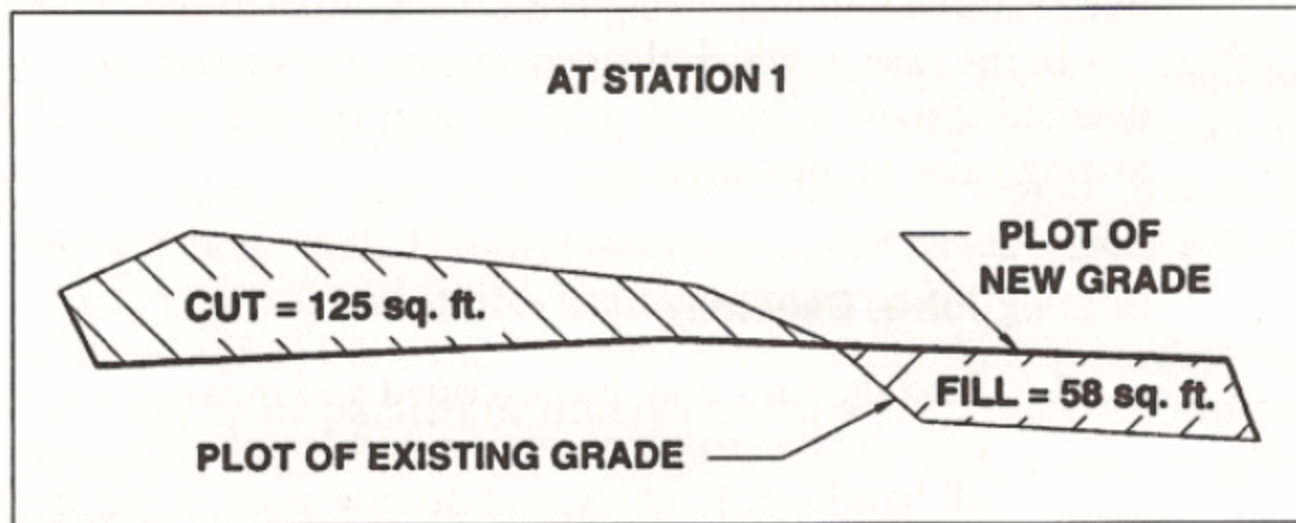
## Section Method Calculation of Cut & Fill

- Method is used when site is long and relatively narrow.
- Most appropriate for Roads

## Section Method Procedure

- Stations are established at regular intervals along the project centerline.
- Determine the existing elevations on each side of the centerline for each station.
- On graph paper, plot the cross section for each station showing the existing and the required new grade.
- Compute the areas of fill and cut from the plot of the cross sections.





Cross-sections at stations 2 through 5 are also plotted, and the areas of cut and fill are calculated at each station. The areas of cut and fill calculated from all cross-sections are as follows:

Station	Area of Cut (sq. ft.)	Area of Fill (sq. ft.)
1	125	58
2	92	73
3	51	185
4	27	243
5	75	129

## Section Method Procedure (Continued)

- Use the spacing between stations and the areas of cut and fill to determine the amounts of cut and fill.

# Section Method Example

<b>Station</b>	<b>Section Spacing</b>	<b>Actual Cut</b>	<b>Average Cut</b>	<b>Actual Fill</b>	<b>Average Fill</b>	<b>V<sub>c</sub></b>	<b>V<sub>f</sub></b>	
<b>1</b>		<b>125.0</b>		<b>58.0</b>				
	<b>20.0</b>		<b>108.5</b>		<b>65.5</b>	<b>2170.0</b>	<b>1310.0</b>	
<b>2</b>		<b>92.0</b>		<b>73.0</b>				
	<b>20.0</b>		<b>71.5</b>		<b>129.0</b>	<b>1430.0</b>	<b>2580.0</b>	
<b>3</b>		<b>51.0</b>		<b>185.0</b>				
	<b>20.0</b>		<b>39.0</b>		<b>214.0</b>	<b>780.0</b>	<b>4280.0</b>	
<b>4</b>		<b>27.0</b>		<b>243.0</b>				
	<b>20.0</b>		<b>51.0</b>		<b>186.0</b>	<b>1020.0</b>	<b>3720.0</b>	
<b>5</b>		<b>75.0</b>		<b>129.0</b>				
						<b>Volume (cu. Ft)</b>	<b>5400.0</b>	<b>11890.0</b>
						<b>Volume (cu. Yards)</b>	<b>200.0</b>	<b>440.4</b>

## Section Method Procedure (Continued)

- You can also use the following formula to determine the amounts of cut and fill.
- Volume of Cut or Fill:

$$\text{Volume} = \text{Station spacing} \times [(\text{Area}_1 + \text{Area}_N)/2 + \text{Sum of other areas}]$$

N = Number of stations; Area N = Area of last station

- [Note the error of the formula in textbook]