ROYAL ACADEMY: OPP: JNTU KAKATPALLU

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Estimation and Construction Management

Material Estimation and Site Work

Step 1: Quantity Take-Offs

1. Quantities of Materials Indicated in the Drawings
2. Quantities of Materials not indicated in the drawings
    1. Site Modification Works such as grading, dewatering etc
    2. Support Works such as Formwork and Shuttering

4 Categories of Calculations

- Unit Measures
  - E.g. No. of Doors/Windows
- Linear
  - E.g: Length of Pipe
- Area
  - E.g. Area for Tiling/Painting
- Volume
  - E.g. Volume of Concrete

Wastes in Estimation

- Due to Industrial Standards
  - Bricks, Wood etc come in standard dimensions. Need to be cut, resulting in some wastage
- Due to Material Handling and Installation
  - Site management and congestion
  - Quality of equipment and tools
  - Worker Skills
  - Storage and Theft

Site Work

Types of Site Work

1. Site Preparation
2. Earthwork
3. Foundation and Backfilling
4. Utility Services
5. Drainage and Containment
6. Pavements
7. Site Improvements
8. Landscaping

Site Preparation

1. Demolition
    1. Specialized Trade
2. Site Clearing
3. Tree/Monument Protection
4. Stripping Topsoil

Example

- A 6000 sq m plot is to be stripped of topsoil to a depth of 0.15m. You will use a 150KW dozer with a productivity of 83 cu.m/hr. The dozer costs Rs. 750/hr to rent, and Rs. 258.5/hr to operate. The operator must be paid Rs. 288.5 per hour. If it takes 4 hours to mobilize and demobilize the dozer, what is the cost of the job?

Solution

- Job Duration = 6000*0.15/83 = 11 hours
- Rental costs = 750*(11+4)
- Operations Cost = 258.5*11
- Labour Cost = 288.5*15
- Total Cost = Rs. 18,421 or Rs. 20.5/cu.m

Excavation Equipment

Excavator

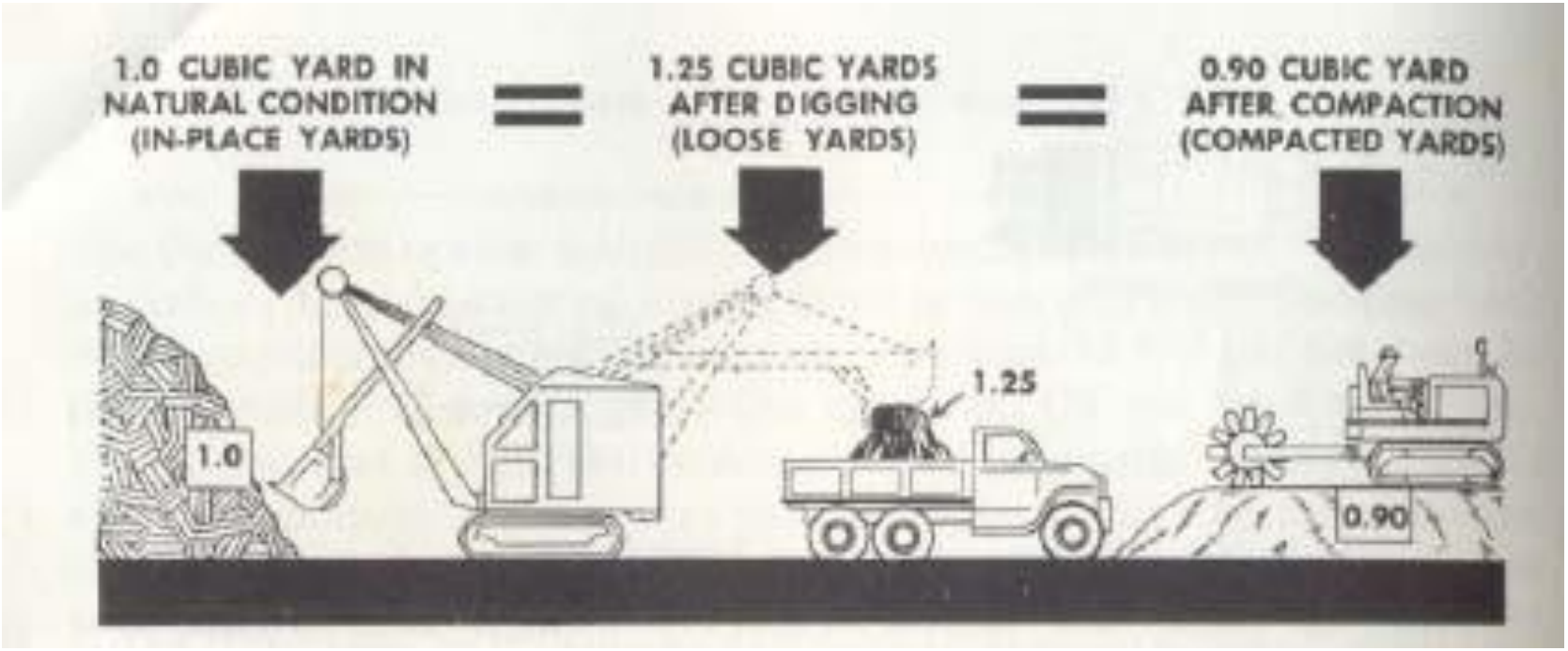
Backhoe

Excavation Equipment

Dump Truck

Compactor

Excavation Basics



Excavation Basics

- Soil in its Natural State – Bank Cubic Yards (BCY)
- Loosened Material – Loose Cubic Yards (LCY)
- Artificially Compacted Material – Compacted Cubic Yards (CCY)
- Load Factor (LF) = (wt/LCY)/(wt/BCY)
- Shrinkage factor (SF) = (wt/BCY)/(wt/CCY)
- Swell = [(wt/BCY)/(wt/LCY)-1] x 100

Example

- In a Rock excavation project, one CY of material in the cut area weighs 1500kg. However, when loose it weighs 1204.5 Kg. A volume of 1400 CY needs to be filled using a scraper of capacity 20 CY and a compactor. How many scraper loads are required, assuming a Shrinkage Factor of 0.9?

Example

- For Rock Excavation
  - Kg per LCY = 1204.5
  - Kg per BCY = 1500
  - Hence Load Factor = 1204.5/1500 = 0.8
  - Scraper Capacity is 20 CY
  - Volume per cut is 20 x 0.8 = 16 CY
  - Assume SF = 0.9, 1400 CCY required
  - Bank Requirement = 1400/0.9 = 1555 BCY
  - **Number of Scraper Loads = 1555/16 = 98**

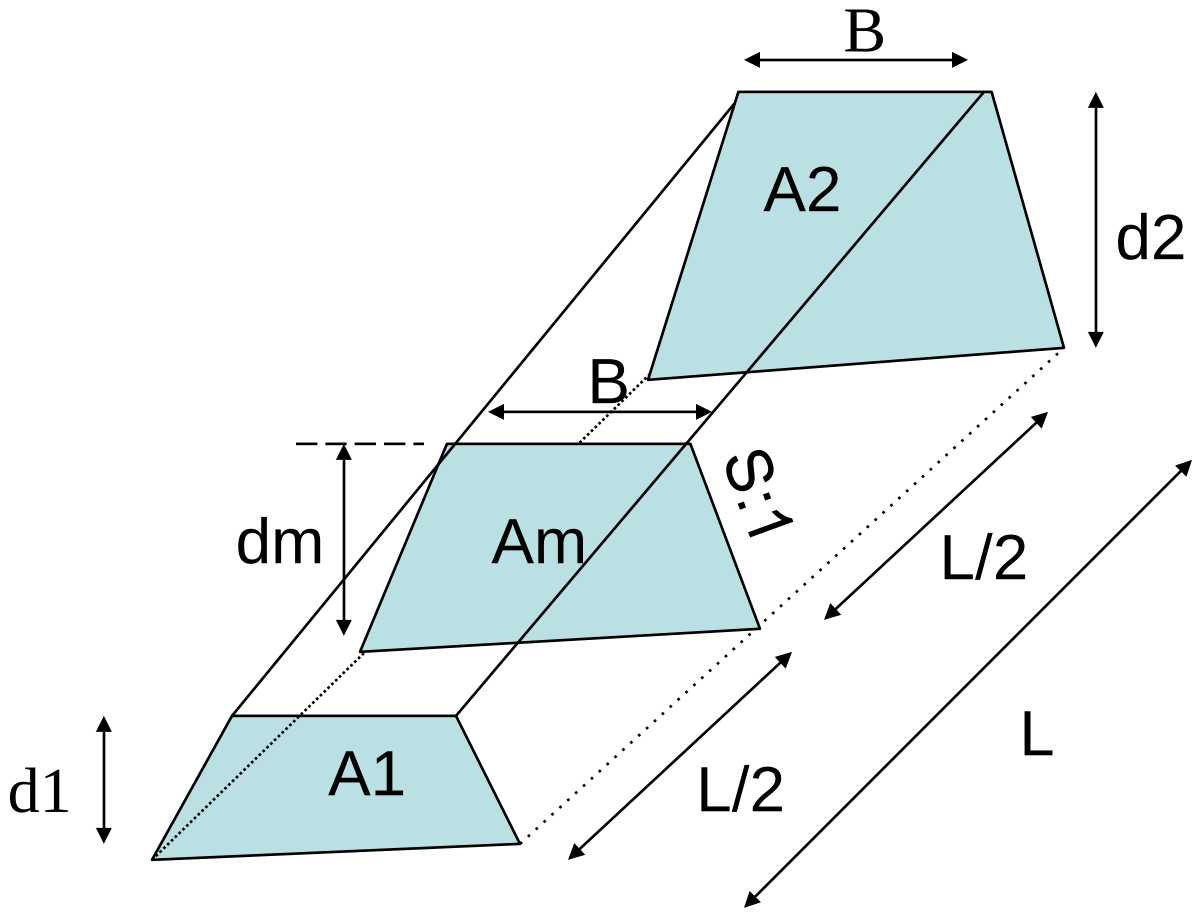
Productivity Factors to be considered

- Productivity of Shovel (volume/time)
- Waiting time for truck to be loaded (time)
- Travel time for truck (speed)
- Dumping Time
- Return time for truck
- **Use to Calculate Number of trucks required, Total Cost of Operations**

Earthmoving Production

- Estimated Productivity = Cycle/hr x Average Payload x Job Efficiency Factor
- E.g. An excavator takes .09 minutes to load, .06 minutes to swing, .04 minutes to dump and .06 minutes to swing back. It has a payload of 1.5 cu.m and will be used 45 minutes in an hour. What is its productivity?
  - Cycle Time = 25 minutes
  - Cycles Per Hour = 240
  - Productivity = 240 x 1.5 x 0.75 = 270 cu.m/hr

Estimating Earthwork Quantities



1. Mid-Section Method: Total V = (Bxdm + Sxdm^2)xL
2. Mean-Sectional Area Method: Total V = L(A1+A2)/2
3. Prismoidal Method: Total V = L/6x(A1+A2+4Am)

Problem

- Prepare and estimate for the portion of a road between chainage 14 to 22 from the data given below. The rate of earthwork in cutting is Rs. 8.50 per cu.m and embankment is Rs 7.50 per cu.m. The formation width of the proposed road is 12m, side slope is 1.5:1 in cutting and 2:1 in banking. The road formation is proposed at a uniform falling gradient 1 in 200 passing through G.L. at chainage 14. Length of one chain is 30m

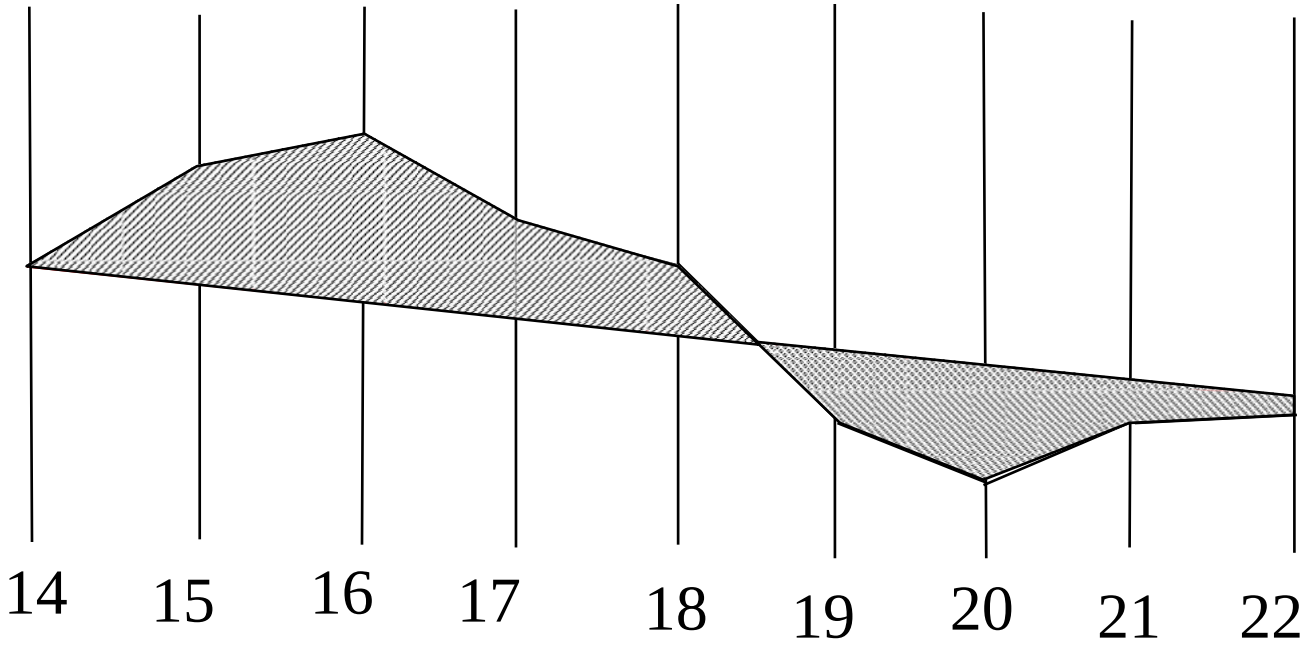
Chainage (30m)	14	15	16	17	18	19	20	21	22
R.L. of Ground	108.6	109.25	109.40	108.85	108.50	107.25	106.8	107.15	107.2

Solution

- Length of one chain = 30 m
- Hence fall per chainage = 30x1/200 = 0.15m
- The final profile calculations are:

Chainage (30m)	14	15	16	17	18	19	20	21	22
R.L. of Ground	108.6	109.25	109.40	108.85	108.50	107.25	106.8	107.15	107.2
R.L of Formation	108.6	108.45	108.3	108.15	108	107.85	107.7	107.55	107.4
Difference	0	-0.8	-1.1	-0.7	-0.5	0.6	0.9	0.4	0.2

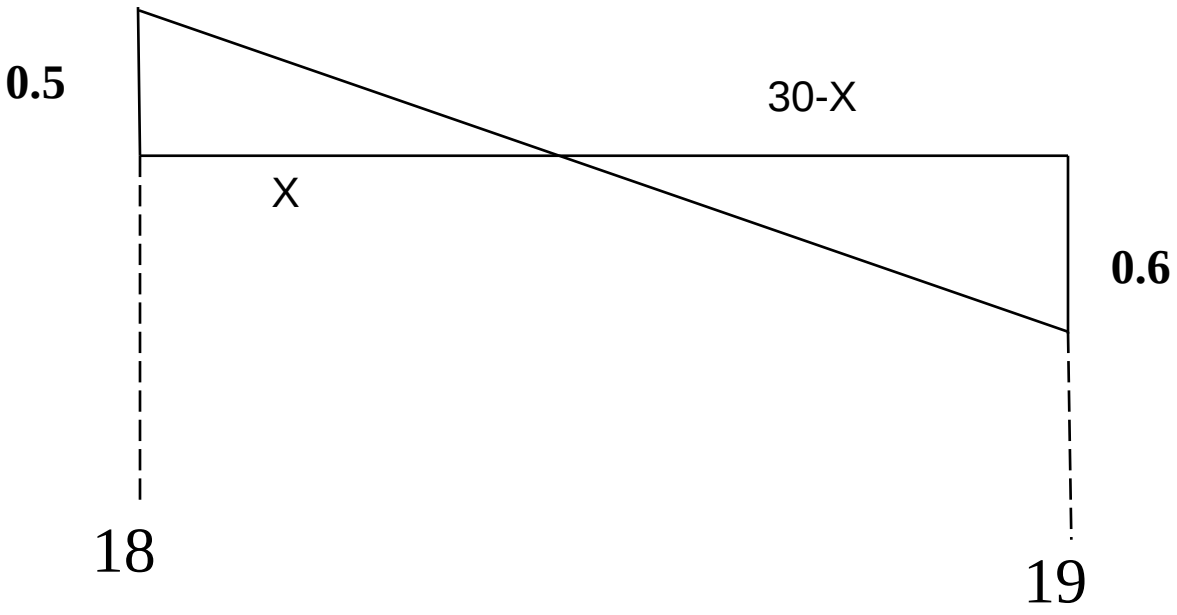
Profile



Between Chainage 18 and 19

Using Elementary Trignometry – x/0.5=30-x/0.6.

Hence x is approximately 14 m



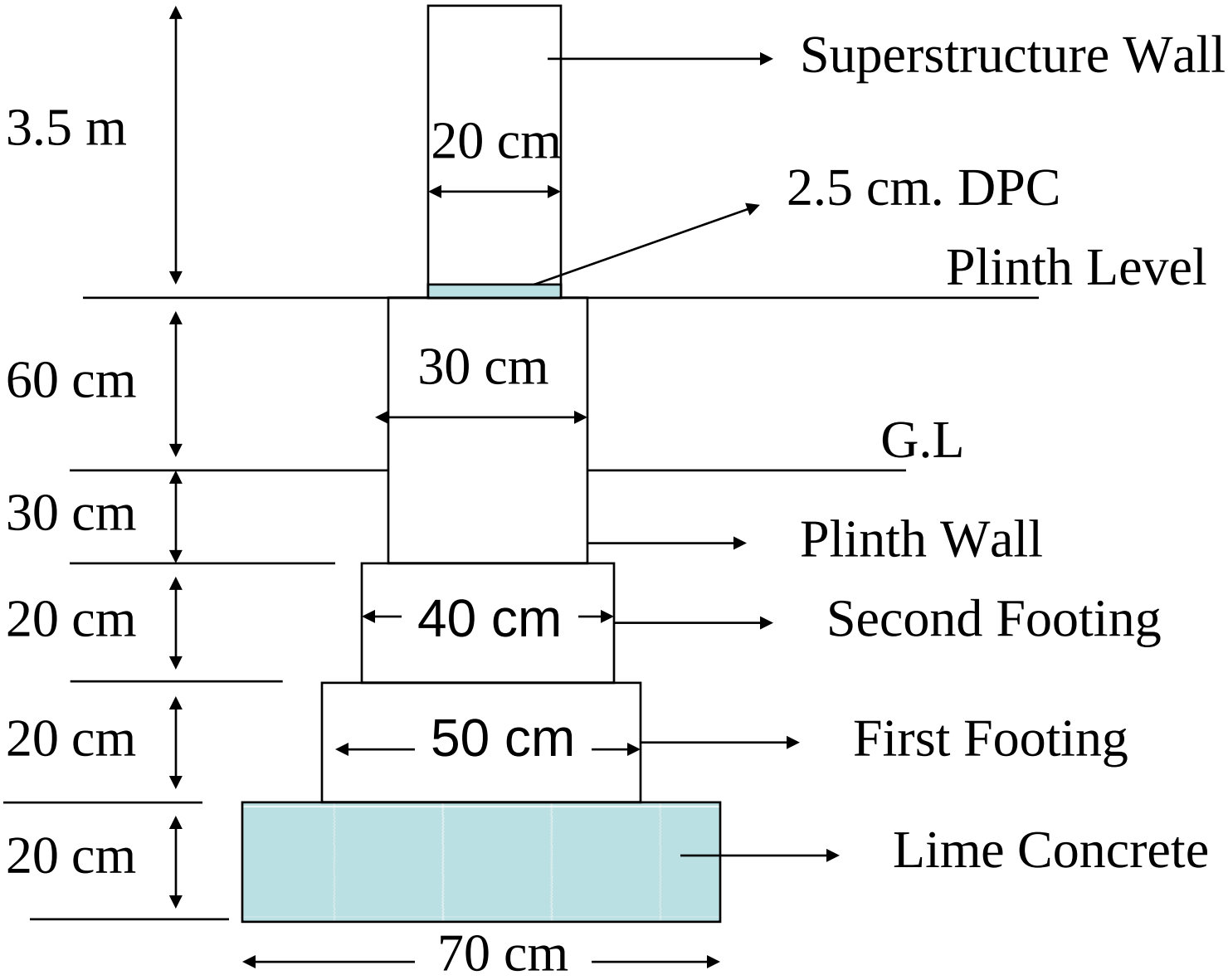
Calculations

Chainage	Depth or Height (m)	Mean Depth of Height dm (m)	Total Area using Midsection Method	Length between chainage	Cutting Quantity	Banking Quantity
14	0	0	0	0	0	0
15	-0.8	-0.4	5.04	30	151.2	
16	-1.1	-0.95	12.75	30	382.61	
17	-0.7	-0.9	12.02	30	360.45	
18	-0.5	-0.6	7.74	30	232.20	
19A	0	-0.25	3.09	14	43.31	
19	0.6	0.3	3.78	16		60.48
20	0.9	0.75	10.12	30		303.7
21	0.4	0.65	8.64	30		259.3
22	0.2	0.3	3.78	30		113.4
Total					1169.8	737.0

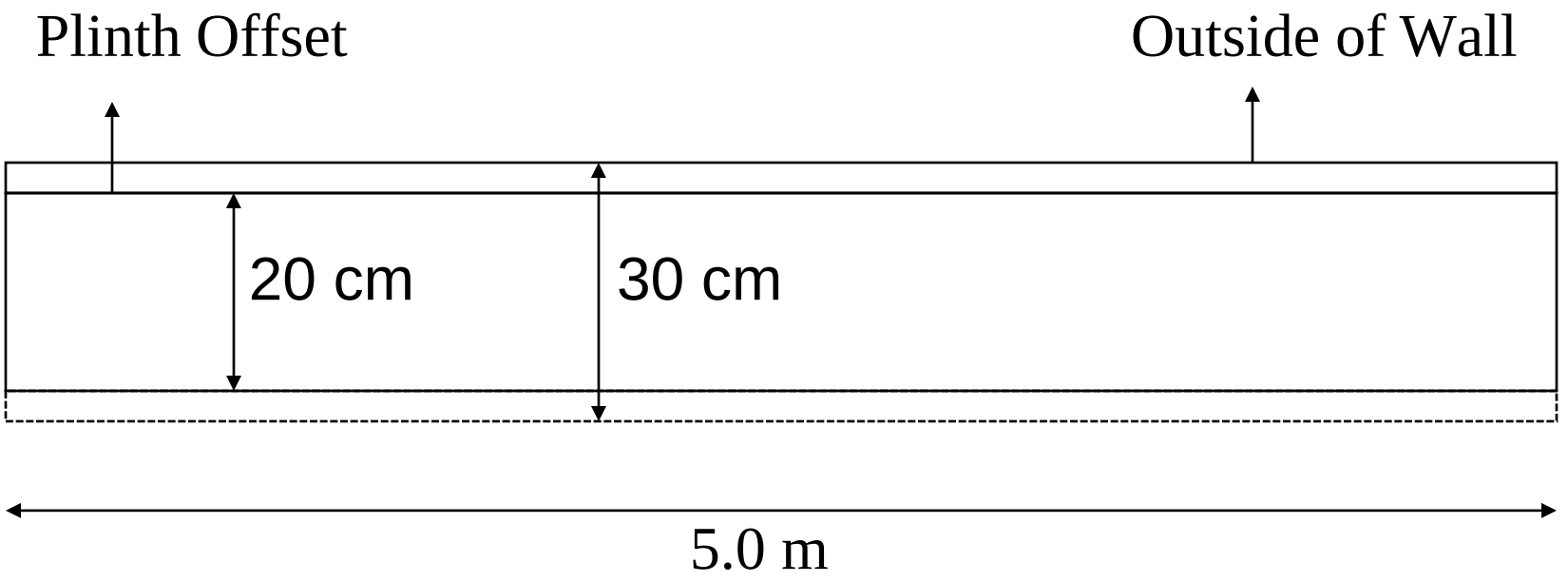
Final Estimate

No.	Item	Quantity	Unit	Unit Rate	Amount (Rs.)
1	Earthwork in Excavation	1169.8	Cu.m	8.5	9943.088
2	Earthwork in Banking	737.0	Cu.m	7.5	5527.35
Total					15470.44

Cross Section



PLAN

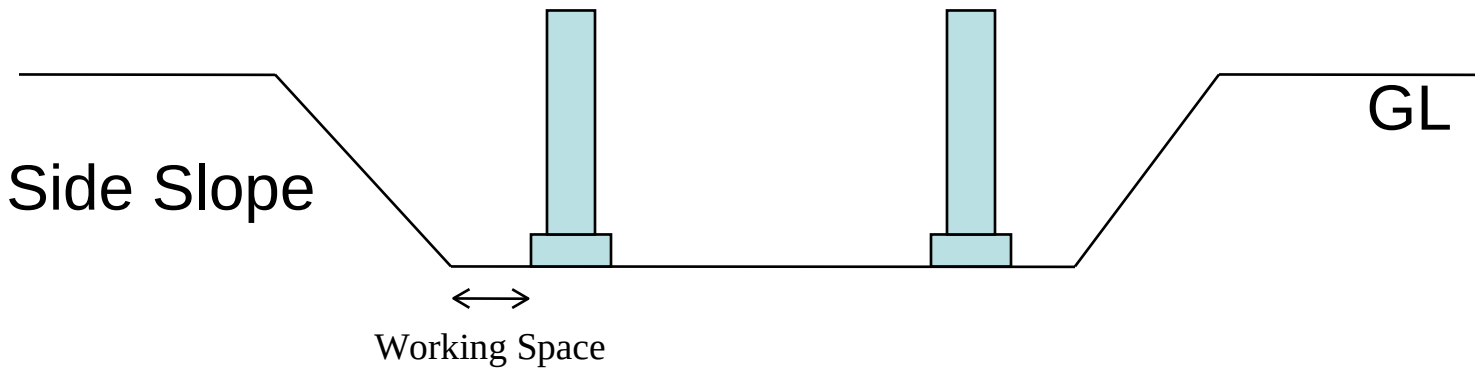


Estimate

Item No	Description	No.	Length	Breadth	Height	Qty	Unit
1	Earthwork in Excavation	1	5	0.7	0.9	3.15	cu.m
2	Lime Concrete in Foundation	1	5	0.7	0.2	0.7	cu.m
3	Brickwork in Foundation and Plinth						
	First Footing	1	5	0.5	0.2	0.5	cu.m
	Second Footing	1	5	0.4	0.2	0.4	cu.m
	Plinth Wall	1	5	0.3	0.9	1.35	cu.m
	Total					2.25	cu.m
4	Brickwork in Superstructure Wall	1	5	0.2	3.5	3.5	cu.m
5	2.5 cm thick DPC	1	5	0.2		1	sq.m

Buffers

- In Excavation you might need to consider the following
  - Working Space to the Side of the Footings
  - Side Slopes from GL to Footing Base



Backfilling

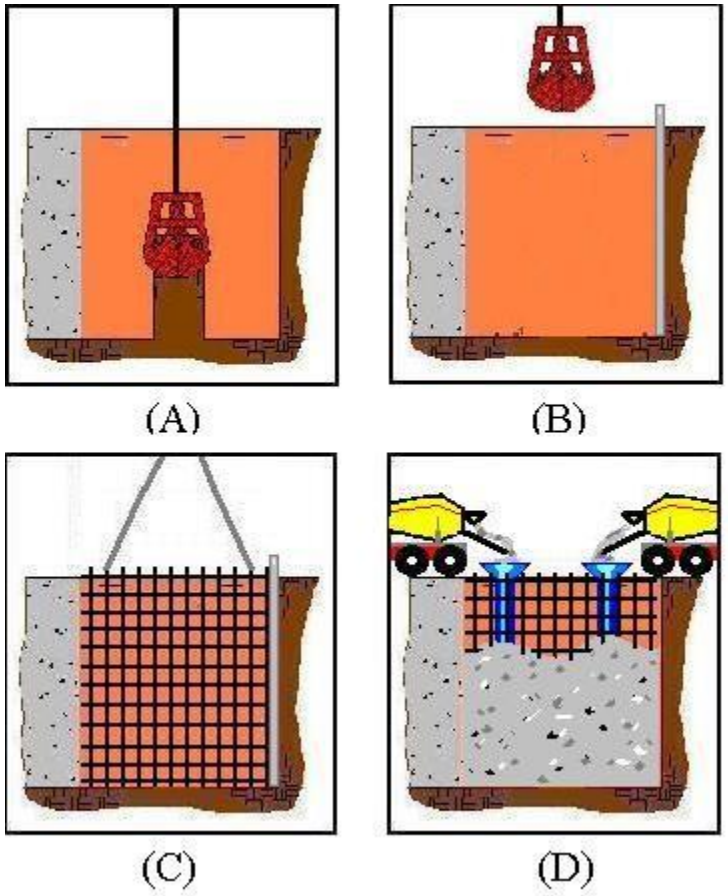
- Filling in the ‘gaps’ left after excavation
- Move material from stockpile into the excavated area
- Compact if necessary
- Location of Stockpile determines efficiency of operation

Excavation Support

- Supports need to be used when the area is congested and side slopes cannot be formed
- Example
  - Sheet Piling,
  - Soldier Piles and Horizontal Sheeting
  - Diaphragm Wall

Sheet Piles

Diaphragm Wall



Other Considerations

- Dewatering
  - If ground water level is too high. Pump the water out
- Piling
  - Number of Piles
  - Bored vs Driven etc
- Paving
  - Flexible or Rigid
- Landscaping
  - Number and Type of Trees