[2078 - Bhadra] (Regular)

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Subject: Estimating and Costing (CE705)

(Assignment)

[2078-Bhadra] (Regular)

[078BCE178]

(Q.1) ~~Estimate that esti~~

(Q1) Explain that estimated cost is never the actual cost. What are the data required for estimating?

→ Estimated cost is the predicted cost of a project before construction which is based on material, manpower, machineries and overhead cost.
Actual cost is the real cost found after completion of the project.

- Estimated cost is never the actual cost because of following reasons:-
  (i) Market fluctuations
      ↳ Price of material, manpower and machineries keep changing.
  (ii) Site conditions
      ↳ Soil, water table, accessibility and weather can cause variations.
  (iii) Design changes
      ↳ Modifications during construction after quantities and cost.
  (iv) Human factor
      ↳ Delay, inefficiency, strikes, accidents or workmanship affect costs.
  (v) Unforeseen circumstances
      ↳ Natural disasters, inflation, transport delays, etc.

(vi) Fluctuation in exchange rate of foreign currency (for donor projects and international contractor)
(vii) Change in government policies

- Data required for estimating:-
(i) Detail Drawing:
↳ Plan, Elevation, section and other data.
(ii) Specifications
↳ Method of work, type of material, type of machinery, manpower, etc
(iii) Rates:
↳ District rates of material and machinery.
(iv) Field data
↳ Location, Road condition, material availability
(v) Contingencies and overhead charges.
(vi) Duration of project for escalation consideration

(Q2) What are the various methods of taking out quantities of civil engineering? Explain briefly. State the different factors considered during detailed Estimation.

→ The quantities of various items such as earthwork in excavation, foundation concrete, brick work in foundation, plinth and superstructure etc can be estimated by following methods:
⟶

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(1) Long wall short wall method
(Or 'out to out' and 'In to in' method)

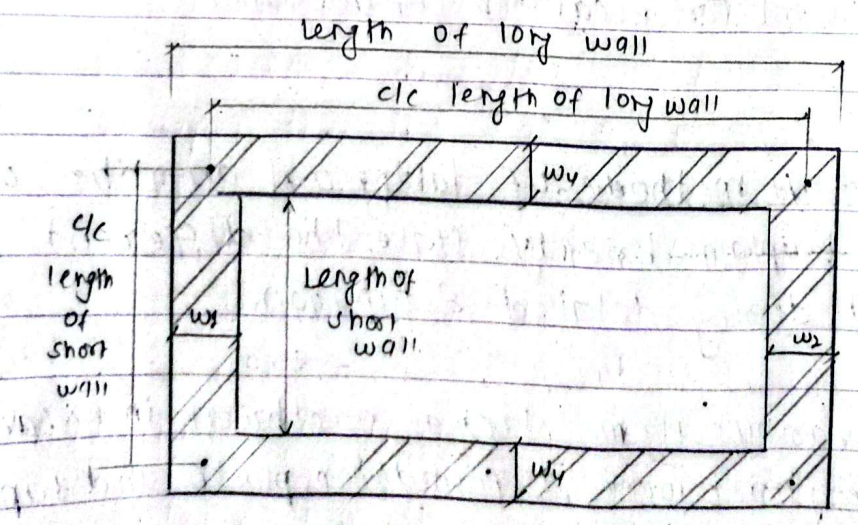
→ In this method, the longer walls in a building (generally in one direction) are considered as long walls and measured from out-to-out and shorter or partition walls, in a perpendicular direction of the long walls, are considered as short walls and are measured from in-to-in for a particular layer of work.

→ Lengths of long wall and short walls are separately multiplied by breadth and height of the corresponding layer and are added to get the quantity.

→ Lengths vary in every layer of footing.

→ Length of long wall = c/c length of long wall + $\frac{w_1}{2} + \frac{w_2}{2}$

→ Length of short wall = c/c length of short wall - $\frac{w_3}{2} - \frac{w_4}{2}$



⑤ centreline Method

→ In this method, calculate the total centre line length of walls in a building and multiply the same by the breadth and depth of the respective item to get the total quantity at a time.

→ For different sections of walls in a building, the centreline length for each type shall be worked out separately.

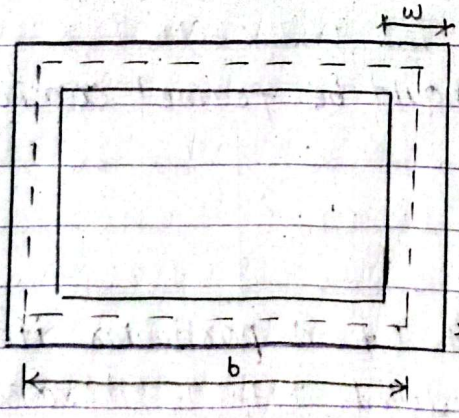
→ In case of partition or verandah walls joining with main wall the centre line length shall be reduced by half the breadth of the layer of main wall that joins with the partition or verandah wall at the same level.

→ Number of such joints are studied first to calculate the centre line length.

→ In case of unsymmetrical wall (generally rare), no advantage may be claimed by this method over others as the centre line length varies at every layer.

→ In all other cases, more quicker and as accurate as other method.

→ Specially adopted for estimating circular, hexagonal, octagonal, etc. shaped building.



$P = 2(a+b)$

Total quantity of work = $P * w * H$

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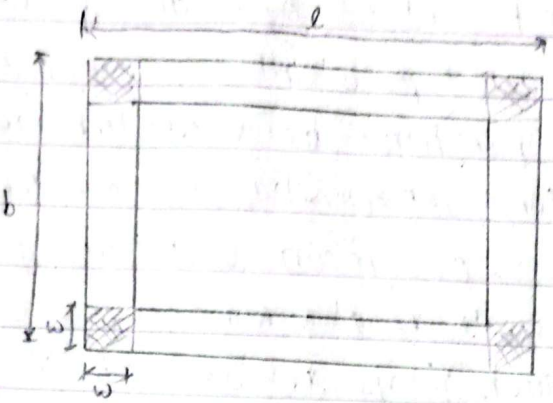
(3) Crossing method

↳ In this method, calculate the overall perimeter of the building and subtract from this four times the thickness of wall to obtain the centre line length.

↳ Rarely used now.

$P = 2(l+b) - 4*w$



⋕ ← must be deducted.

2nd part

- Different factors considered during detailed estimate:

(a) Quantity of materials

↳ For large construction a large quantity of materials is required and thus can be purchased at a rate cheaper than the rate of materials required for minor works.

↳ Rate of works should be framed considering the volume of works.

(b) Availability of materials:

↳ As estimated cost of a particular item becomes higher than the scheduled rate if there is no assurance that the materials will be available as and when required.

(c) Transportation of materials
↳ Proportionate cost of transportation becomes higher for small quantity of materials compared to large quantity of materials.

(d) Location of site:
↳ If site involves lots of loading, unloading, stacking and restacking of materials, the point of damage or loss in transit should be considered carefully.

(e) Local labour charges
↳ Skills and daily wages of local labour matters.

(Q.3) Prepare a preliminary estimate of the four storied office building having carpet area of 250 m² per story. The height of each story is 3.5m and on the roof floor there is parapet wall of 0.90m height. The cube rate of building in that locality is Rs. 250 c/m. Take 10% built up area is covered by walls and 35% by circulation ~~process~~ purposes. Assume other necessary suitable provisions.

→ Solution:-

Here,

~~Total volume~~

Plinth area (P) = Carpet area + Area of walls + Circulation area

or, $P = 250 + 10\%\text{ of } P + 35\%\text{ of } P$

or, $P - 0.1P - 0.35P = 250$

or, $\left[P = \frac{250}{0.55} = 454.545\ m^2\right]$

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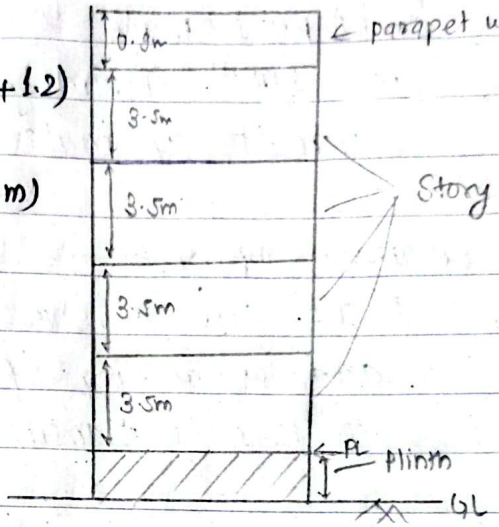
Total volume (V):

$= P * H$

$= 454.545 \left(3.5m * 4 + \frac{0.9}{2} + 1.2\right)$

(considering plinth height as 1.2m)

$= 7113.63\ m^3$



Thus,

Building cost (C) = V * Rs 250/cum

(Civic cost) = 7113.63 * 250

= Rs. 1778407.5

≈ Rs. 17,78,000

Assume,

water supply and sanitation = 9% of C (5 to 10%)

Electrical Installation = 9% of C (5 to 10%)

Overall cost (OC) = Rs. 17,78,000 * (1 + 0.09 + 0.09)

= Rs. 20,98,040

Contingencies = 5% of OC

Supervision = 6% of OC

Grand total cost (G) = OC (1 + 0.05 + 0.06)

= Rs. 23,28,824

Nearly, = Rs. 23,28,900

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(Q.NO.4) What are the requirements for rate analysis? Explain the factors affecting the rate analysis.

→

Require

Fixing up the reasonable rate per unit of an item of work or supply is called rate analysis.

⇒ • Requirements of rate analysis:

(i) Detailed specification of item (material, proportion, workmanship)
(ii) Material cost (local availability, transport, wastage)
(iii) Labor cost and their output (skilled, semi-skilled, unskilled)
(iv) Plant and equipments hire charges.
(v) Overheads and contractors profit.
(vi) Market survey and standard data books (NBC)
(vii) lead and lift charges.

⇒ • Factors affecting rate Analysis:

(i) Specification of work (ordinary, specialized, hazardous)
(ii) The present material rate
(iii) Daily wages of skilled and unskilled manpower
(iv) The range of lead and lift charges (distance and elevation)
(v) Percentage of overhead cost.
(vi) The range of profit and availability of water connection at construction site.
(vii) Availability of materials (nearby quarry, transport)

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(viii) Location of work site
(urban/rural & accessibility available)

(ix) Season of construction
↳ construction in rainy season increases cost

(x) Profit margin expected by contractor.

(xi) Government regulations
↳ taxes, duties and minimum wage act.

(xii) Time factor and escalation in long projects.

(Q. NO 5) Prepare an analysis of rate for sal wood door and window frame per m^3.

→ Solution:-

Saal wood required = 1.1 m^3 (10% wastage)
Number of Holdfast = 92 NO
Number of screws = 184 No. } from Norms (DUDBC)

Materials	Quantity	Unit	Rate (Rs.)	Total (Rs.)	Remarks
1. Saalwood	1.1	m^3	2,80,000	3,08,000	
2. Holdfast	92	NO.	18	1656	Materials
3. Screws	184	No.	3	552	
	Sub total (A)			3,10,208	
1. Skilled	34	man/day	1200	40,800	
2. Unskilled	3.4	man/day	900	3060	Labours
	Sub total (B)			43,860	

Total (A+B) = Rs. 3,54,068

C. Hire of tools and plants
@ 3% of unskilled labour = 3% of 3060
= Rs 91.8

D. Total (A+B+C) = Rs 354159.8

D. Contractor's overhead and profit = 15% of 354159.8
@ 15% of (A+B+C)
= Rs. 53,123.97

Grand total (A+B+C+D) = Rs 407,283.77

Thus,
Rate per 1 m^3 of door/window frame using sal wood
= Rs. 407,283.77

[078BCE178]

(Q.NO.6) Prepare the analysis of rates of one metric ton of reinforcement. Labor norms per MT skilled 12 no/m³/day, unskilled 12 no/m³/day. Assume suitable rates.

→ Solution:

Here, [MT = Metric ton]

TMT Rod required = 1.05 MT (5% wastage)

Binding wire = 10 kg (10% of reinforcement)

A. Materials	Quantity	Unit	Rate (Rs)	Total (Rs)	Remarks
1. TMT Rod	1.05	MT	94000	98700	@ Rs. 94/kg
2. Binding wire	10	kg	120	1200	
Subtotal (A)				99900	
B. Labours					
1. skilled	12	no.	1245	14940	(082/083 Kathmandu District rate)
2. unskilled	12	no.	935	11220	
Subtotal (B)				26160	

C. Hire tools and plants @ 3% of unskilled labour = 3% of 11220 = Rs. 336.8

Total (A+B+C) = Rs. 1,26,396.8

D contractor's overhead and profit @ 15% of (A+B+C) = 15% of Rs. 126396.8 = Rs. 18,959.52

Grand total (A+B+C+D) = Rs. 1,45,356·32

Thus,

Rate per MT of rod = Rs. 1,45,356·32.

Rate per kg of rod = Rs. 145·356

(1MT = 1000kg)

(Q NO. 7) What are the tasks you need to consider in preparing estimate of a building project work? Explain in brief. Discuss estimation of irrigation project.

→ Tasks that are to be considered in preparing estimate of a building project work:

1. Civil works
   - → Site clearance & site preparation
   - → Earth works
   - → PCC works
   - → RCC works
   - → Brick works or stone masonry works, etc
   - → Flooring works
   - → Wood works
   - → Metal works
   - → Finishing works like plaster, painting, etc.

2. Sanitary works
   - → water supply, sanitary and drainage work within the building and their connections with outside supply.

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→ Detail of HVAC (Heat, ventilation, Air conditioning)
→ Toilet & bathroom fittings and their connection with water supply and drainage system.

3. Electrical and Communication works.
→ Internal layout of electrical power supply and connections.
→ outside connections for boundary
→ communication works - wiring for telephone, internet, securities camera, etc.

4. Miscellaneous works.
→ Boundary walls, fences, gateway, pathways parking, garden, etc.
→ soil investigation, dismantling of old structures, etc.
→ Special tools and plants required.
→ Acquisition of land if necessary
→ Others.

• Estimation of irrigation project:
1. Civil works
→ Site clearance
→ Head works
→ Earthworks for cutting and filling in canal alignment
→ Canal lining works.
→ Intake works
→ Flow regulation works

→ Cross drainage works
→ Distribution works
→ Others.

2. Miscellaneous works
→ Safety works
→ Tools and plants
→ Land acquisition works
→ Other work.

Note: The item vary according to amount of discharge and intake and distribution system of irrigation

(Q. NO. 8) Prepare detailed estimate of the item of work from the building drawing (figure 1) attached herewith:

(a) Earthwork in excavation in foundation
(b) PCC (1:3:6) in foundation
(c) Brickwork in 1:6 cement sand mortar upto plinth
(d) Plastering work 1:4 for the ceiling.

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SN	Description of works	no	L	B	H	Q	unit	Remarks
(a)	Earth work in excavation of foundation							
	(i) Outer wall	1	25	0.85	1.08	22.95		0.08+0.1+0.3+0.3+0.3 = 1.08m
	(ii) Partition wall	1	2.85	0.60	0.78	1.33		0.08+0.1+0.3+0.3 = 0.78m
								$3.7 - \frac{0.85}{2} - \frac{0.85}{2} = 2.85m$
	Total					24.28	m^3	
(b)	PCC (1:3:6) in foundation							
	(i) Outer wall	1	25	0.85	0.10	2.125		
	(ii) Partition wall	1	2.85	0.60	0.10	0.171		$3.7 - \frac{0.85}{2} - \frac{0.85}{2} = 2.85m$
	Total					2.30	m^3	
(c)	Brickwork in 1:6 mortar upto plinth							
	(i) Outer wall 750mm	1	25	0.75	0.3	5.625		
	(ii) Outer wall 650mm	1	25	0.65	0.3	4.875		
	(iii) Outer wall 550mm	1	25	0.55	0.3	4.125		
	(iv) Outer wall 400mm	1	25	0.40	0.3	3		450-150 = 300mm = 0.3m
	(v) Partition wall 500mm	1	3.05	0.50	0.3	0.458		$3.7 - \frac{0.65}{2} - \frac{0.65}{2} = 3.05m$
	(vi) Partition wall 400mm	1	3.15	0.40	0.3	0.378		$3.7 - \frac{0.55}{2} - \frac{0.55}{2} = 3.15m$
	(vii) Partition wall 250mm	1	3.30	0.25	0.3	0.248		$3.7 - \frac{0.4}{2} - \frac{0.4}{2} = 3.3m$
	Total					18.71	m^3	

Centerline length of outer wall

$$= 2 * \left[\left(7900 - \frac{400}{2} + \frac{400}{2}\right) + \left(5400 - \frac{400}{2} - \frac{400}{2}\right)\right]$$

$$= 2 * (7500 + 5000)$$

$$= 25m$$

c/c length of partition wall $= 5400 - 1300 - \frac{400}{2} - \frac{400}{2}$

$$= 3.7m.$$

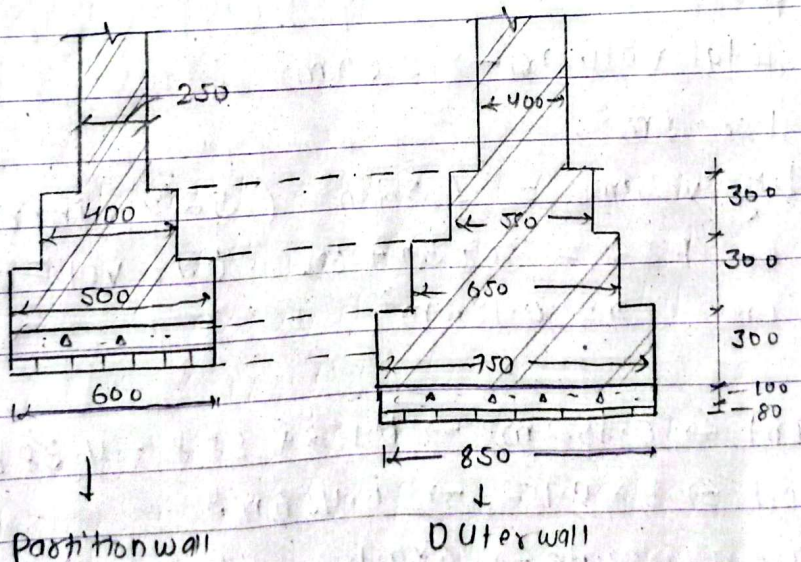


Fig: (Intersection)

(d)	Plastering work 1:4 for ceiling							
	(i) Ceiling Room (3450×3300)	1	3.45	3	-	10.35		(measured in m^2)
	(ii) Ceiling Room (3400×4600)	1	3.4	4.6	-	15.64		
	Total					25.99	sq.m	

ⓐ Earthwork → $24.28 m^3$

ⓑ PCC (1:3:6)

Total volume → $2.30 m^3$

say, For $1 m^3$,

Dry volume = $1.52 m^3$ (52% increase)

on $1.52 = x + 3x + 6x$ (x = vol^m of cement)

or $x = 0.152 m^3$

Cement → $0.152 m^3$ → $0.152 * 28.8 = 4.38$ bags

Sand → $3 * 0.152$ → $0.456 m^3$

Coarse aggregate → $6 * 0.152$ → $0.912 m^3$

Wt. of water = $0.5 *$ wt. of cement (considering w/c ratio = 0.5)

= $0.5 * 4.38 * 50$

= 109.5 kg

= 109.5 litres

For $2.30 m^3$

Cement = $2.3 * 4.38$ = 10.07 bags.

Sand = $2.3 * 0.456$ = $1.049 m^3$

Coarse = $2.3 * 0.912$ = $2.098 m^3$

Water = $2.3 * 109.5$ = 251.85 litres

(c) Brick work in 1:6 mortar

∴ Total volume = $18.71 m^3$

Say, mortar thki = 10mm

Size of brick = 230 * 115 * 57 mm

with mortar = 240 * 125 * 67 = $0.00201 m^3$

No. of bricks required = $\frac{18.71}{0.00201}$ = 9308.46

wastage 5% = ~~24.87~~ 465.42

Total brick = 9773.88

Volume of mortar = $4.676 m^3$

x = cement = $\frac{4.676}{1+6}$ = $0.668 m^3$

sand = 6 * 0.668 = $4.008 m^3$

Bricks ≃ 9774 nos.

Cement = 0.668 * 28.8 = 19.24 bags

sand = $4.008 m^3$

water = 0.668 * 0.7 * 28.8 * 50 = 673.4 litres (w/c = 0.7)

(d) Plastering work (1:4) ceiling.

Say, plaster thickness = 12.5mm

Total volume = 25.99 * 0.0125 = $0.325 m^3$

Dry volume = 1.32 * 0.325 = $0.429 m^3$ (32% extra)

cement = $\frac{0.429}{1+4}$ = $0.0858 m^3$ = 2.47 bags

sand = 4 * 0.0858 = $0.343 m^3$

water = 0.7 * 2.47 * 50 = 86.45 litres

[078BCE178]

(Q.NO.9) Calculate the quantity of earthwork and area of permanent land required for the land acquisition purpose for a portion of a channel from following data.

Bed width = 4m

Free Board = 45cm

Side slope in cutting = 1:1

Side slope in Banking = 1.5:1

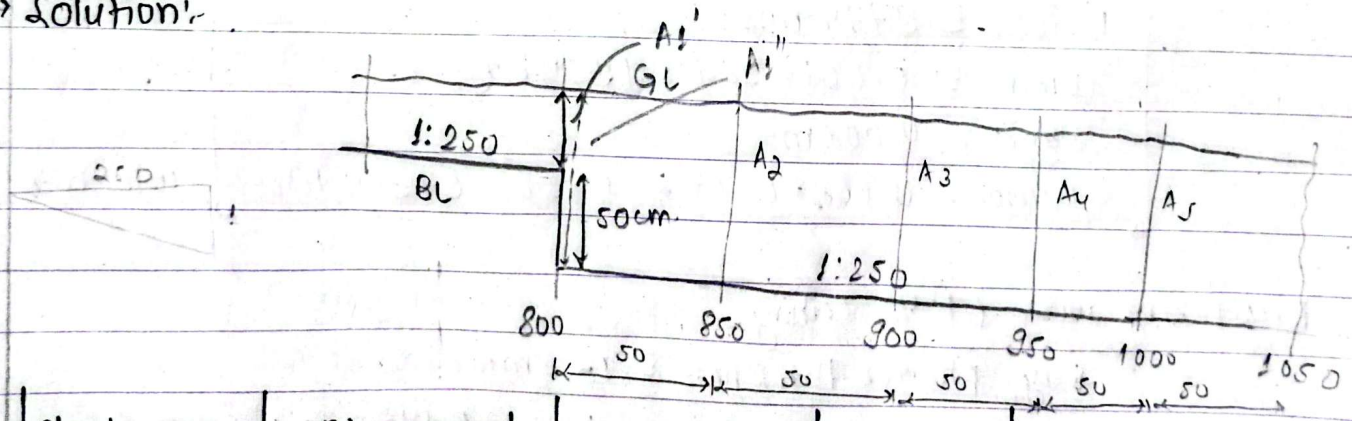
Full supply depth = 1m

Top width of bank = 3m left and 1.5m right

There is 50cm fall at chainage 800m.

Chainage	800	850	900	950	1000	1050
RL ground	109.8	109.7	109.55	109.30	109.25	109.15
RL Bed	109.52		Bed slope (1:250)			

→ Solution:-



Chainage	RL ground	RL Bed	h
800	109.8	109.52	0.28
800	109.8	109.52-0.5=109.02	0.78
850	109.7	108.82	0.88
900	109.55	108.62	0.93
950	109.30	108.42	0.88
1000	109.25	108.22	1.03
1050	109.15	108.02	1.13

h → depth of digging (cutting)

Volume of cut:

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Chainage	Depth of cutting (d) (GL-BL)	Area of cutting ($Bd+Sd^2$)	Mean Area	Distance (D)	volume of cutting (V_c)	Unit
800	0.28	1.198				
800	0.78	3.728				
880	0.88	4.294	4.01	50	200.57	
900	0.93	4.585	4.44	50	221.98	
950	0.88	4.294	4.44	50	221.98	
1000	1.03	5.181	4.74	50	236.88	
1050	1.13	5.797	5.49	50	274.44	
				Total	1155.86	cu.m.

B = 4m (Bed width)
S1 = 1.5 (Banking slope)
S = 1 (cutting slope)
b_1 = 3m (left width of bank)
b_2 = 1.5m (right width of bank)
f = 0.45m (free board)
H = 1m (Full supply depth)

Volume of Embankement

Chainage	Height above bed level (H') = H+f	Height above GL (h = H'-d)	Filling area $(b_1+b_2)*h + 2S*h^2$	Average area	Distance (D)	volume fill (V_f)	Balancing volume ($V_f - V_c$)
800	1.45	1.17	9.372				
800	1.45	0.67	4.362				
850	1.45	0.57	3.540	3.95	50	197.53	-3.03
900	1.45	0.52	3.151	3.34	50	167.27	-54.71
950	1.45	0.57	3.540	3.34	50	167.27	-54.71
1000	1.45	0.42	2.419	2.98	50	148.97	-87.91
1050	1.45	0.32	1.747	2.08	50	104.16	-170.28
							cum.

Total = -370.64 cum

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Thus, 370.64 m^3 of earthwork should be taken elsewhere.

For the permanent land acquired;

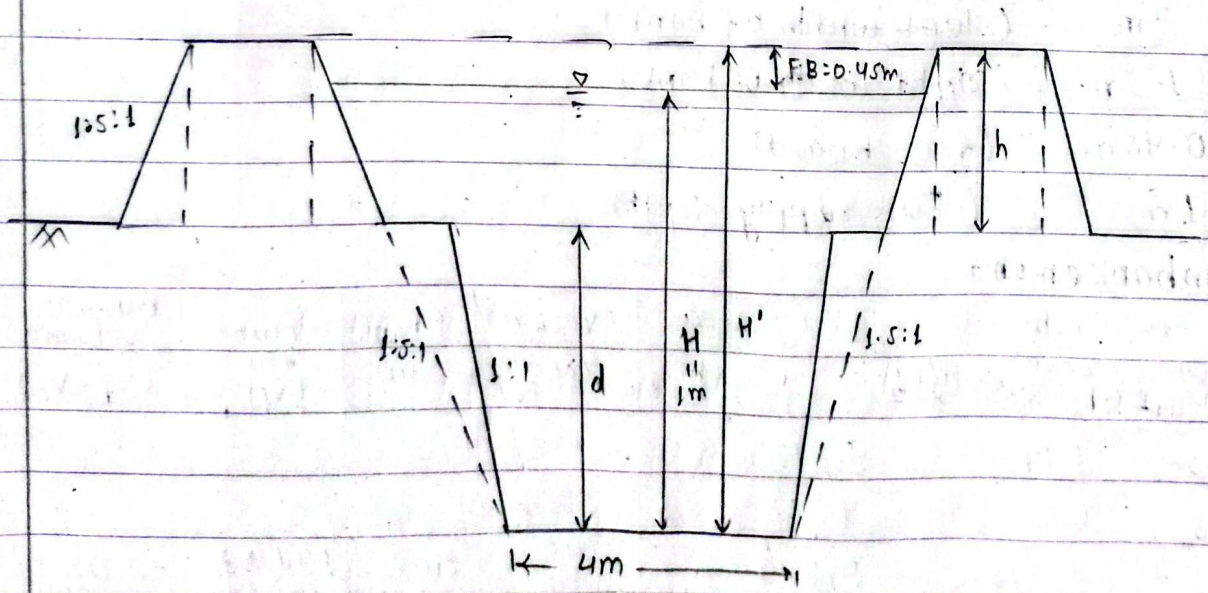
Maximum width = $B + b_1 + b_2 + 2s_1 \times h + 2s_1 \times H'$ + Extra width beyond outer toe of bank to property line (say 1.2m)

Taking $h = 1.17$ m & $H' = 1.45$m

Maximum width = $4 + 3 + 1.5 + 2 \times 1.5 \times (1.17 + 1.45) + 2$

= 17.56m

Area of land required for land acquisition purpose is



Fig

(078BCE178)

Chainage	h	H'	$b_1+b_2+B+2\times S_1\times h+2S_1\times H'$	length	Area
800	1.17	-	-	-	-
800	0.67	1.45	16.06	50	803
850	0.57	1.45	15.76	50	788
900	0.52	1.45	15.61	50	780.5
950	0.57	1.45	15.76	50	788
1000	0.42	1.45	15.31	50	765.5
1050	0.32	1.45	15.01	50	750.5
				Total	4675.5 sqm.

Thus,

Area of land required for land acquisition purpose is 4675.5 m^2 or 0.46755 hectares.

[078BCE178]

(Q.10) From the attached drawing (figure 2) attached of RCC column, estimate the following items:

(i) RCC 1:2:4 in column

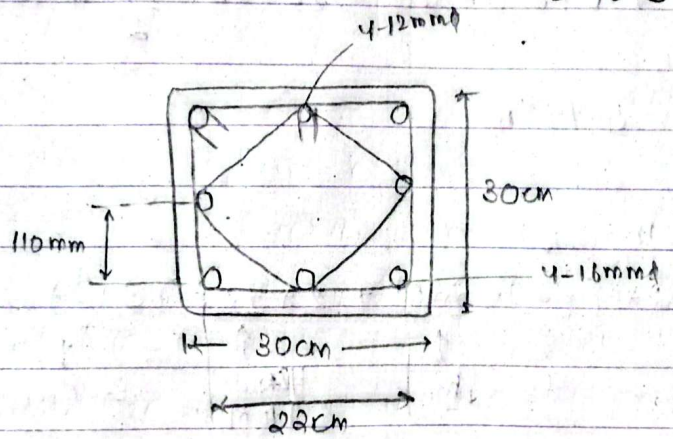
(ii) Steel Reinforcement work excluding formwork.

→ Sol^n:

(i)

RCC in column (above GL) = $1 * 0.3 * 0.3 * 3.5$ (size of column (30×30); 3.5 ↑ Height above Ground level.)

$= 0.315 m^3$



(ii)

No. of 12mm main bars = $\frac{1500 - 2*50}{100} + 1 = 15$ (clear cover)

No. of 10mm main bars = $\frac{1500 - 2*50}{100} + 1 = 15$ (spacing)

length of rebar, $l = 1500 - 2*50 + 100*2 = 1600mm$ (Development length)

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Column rebar length (For 12mm bar)

$= 3500 + 700 + 200 - \underset{\text{clear cover}}{50} - 12 - 10 - \frac{12}{2} + 45 \times 12 + \underset{\text{Development length}}{100}$

$= 4.962\,m$

Column rebar length (For 16mm bar)

$= 3500 + 700 + 200 - 50 - 12 - 10 - \frac{16}{2} + 45 \times 16 + 100$

$= 5.140\,m$

For stirrups (rectangular)

cutting length: $2 * (\underset{a}{220} + \underset{b}{220}) + 2 * \underset{\text{Hook}}{75} - (3 * (2 * 6)) - \underset{\text{2-135° bend}}{2 * (3 * 6)}$

(40mm clear cover) 3-90° bend

$= 958\,mm$

$= 0.958\,m$

For Diamond tie:-

cutting length $= 4 * \sqrt{110^2 + 110^2} + 2 * 75 - 3 * (2 * 6) + 2 * (3 * 6)$

$= 700\,mm$

$= 0.7\,m$

Length for providing stirrups $= 3500 + 700 + 200 - 50 - 50 - 12 - 10 - 16$

$= 4.312\,m$

No. of stirrups $= \frac{4.312}{0.150} + 1 \approx 30$

[BTBDCE178]

S.N.	Description of works	NO.	dia (mm)	length (m)	wt/m ($d^2/162$)	wt	units	Remarks
1.	Footing main bars	15	12	1.6	$12^2/162$	21.33		
2.	Footing distribution bars	15	10	1.6	$10^2/162$	14.81		
3.	Column (12 mmϕ)	4	12	4.962 5.140	$12^2/162$	17.64		
4.	Column bar (16 mmϕ	4	16		$16^2/162$	32.49		
5.	Stirrups (Rectangular)	30	6	0.958	$6^2/162$	6.39		
6.	Stirrups (Cross/diamond)	30	6	0.70	$6^2/162$	4.67		
	Sub- Total					97.33	kg.	
7.	Binding wire					0.973	kg	(1%).
	Total Reinforcement					98.303	kg	

Thus, steel reinforcement required is 98.303 kg.