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Chapter 1,
Introduction & Methods of Estimating

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Outline
→ Introduction & Methods of Estimating
→ System of units
→ Units of measurement & payment for items of work & materials
→ Requirements of Estimating
→ Methods of measurement of building & civil engineering works
→ Subhead of various items of work
→ Various methods of taking out quantities: Centre line method, long & short wall, Crossing Method
→ Abstracting bill of quantities.

※ Introduction:-

→ Estimating is the process of predetermining of cost & size of any work. In other word an estimate for any construction work may be defined as the process of calculating the quantity & cost of various item required in proposed work.

→ Quantity Estimate: L×B×H or L×B or L only
Cost Estimate:- Quantity * unit rate of each item of work.

→ An accuracy in estimate is very important, if estimate is exceed it becomes very difficult to arrange for additional money. An estimate maybe varying due to inaccuracy in preparing estimate, omission of item, change in design & improper rates. so, accuracy of an estimate depends on a drawing, method of estimating, consideration of rates & probable expenses which may be required for various unforeseen works.

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※ Importance of Estimation

→ To fix budget for the proposed project
→ To calculate required quantities of materials & number of labours for proposed project
→ To draw up a work schedule for proposed project
→ To fix up a completion period for proposed project.
→ Useful to check the works done by contractor during & after execution.
→ To prepare tender document for the project
→ To prepare valuation of land & building.

* Estimated Cost & Actual Cost:-

→ The estimated cost is the probable cost of work & is determined theoretically by mathematical calculation based on drawing & current rates.
→ The actual cost is known after completion of work.
→ The estimated cost should not differ by more than 5% of actual cost.

* System of Units:

In general, the units of different item of work are based on following principle.
a) Mass, voluminous & thick work → L×b×h → m^3
b) Shallow, thin & surface work (thickness < 25mm) → L×b → m^2
c) Linear work / long & thin works → L → Running meter
d) Piece works / Job works → number

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✻ Units of measurement & payments for items of works & materials

SN	Description	Unit of (MKS) Measurement	Payment
1.	Earthwork	~~Cu.m~~	
	→ Elw in excavation	Cu.m	per cu.m
	→ Elw in filling	Cu.m	per cu.m
	→ Surface dressing	Sq.m	per sq.m
	→ Quarrying of stone or boulder	Cu.m	per cu.m
	→ Blasting of rock	Cu.m	Per cu.m
	→ Rock excavation	Cu.m	per cu.m
2.	Brickwork		
	→ Flat Brick soaling	Sq.m	per sq.m
	→ Brickwork in foundation	Cu.m	per cu.m
	→ Brickwork in cornice, coping, drip course	Rm	Per Rm
	→ Half brick thick wall	Sq.m	per sq.m
3.	Stonework		
	→ Stone masonry, Random Rubble masonry in walls, arch	Cu.m	per cu.m
	→ Stone slab in roofing, shelve etc.	Sq.m	per sq.m
	→ Stonework in wall facing or lining (thickness specified)	Sq.m	per sq.m
4.	Concrete work		
	→ PCC in foundation	Cu.m	per cu.m
	→ Lime concrete in foundation	Cu.m	per cu.m
	→ 75mm thick PCC	Sq.m	per sq.m
	→ DPC (thickness specified)	Sq.m	per sq.m
	→ RCC work	Cu.m	per cu.m
	→ Formwork	Sq.m	Per sq.m
	→ Precast PCC & RCC	Cu.m	per cu.m
5.	Woodwork		
	→ Woodwork in door & window frame	Cu.m	per cu.m
	→ Woodwork in rafters, beam, roof trusses	Cu.m	per cu.m
	→ Timbering of trenches, boarding etc.	Sq.m	per sq.m
	→ Plywood, window & door shutters	Sq.m	per sq.m
	→ Woodwork in partition	Sq.m	per sq.m
	→ Ballies (ϕ specified)	meter	per meter
6.	Flooring work		
	→ Sand filling	Cu.m	per cu.m
	→ mosaic flooring	Sq.m	per sq.m
	→ marble flooring	Sq.m	per sq.m
	→ Screed (kora)	Sq.m	per sq.m
	→ Cement sand punning	Sq.m	per sq.m
7.	Finishing work		
	→ plaster work	Sq.m	per sq.m
	→ Painting work	Sq.m	Per sq.m
	→ skirting (thickness & Ht. specified)	~~Sq~~m	per ~~Sq~~m
	→ Whitewashing, colour washing, cement washing	Sq.m	per sq.m
	→ Distempering (No. of coat specified)	Sq.m	per sq.m
	→ Enamel painting on door & window	Sq.m	per sq.m
	→ Painting letters & figures	no.	per no
8.	Roofing work		
	→ Tiled roofing	Sq.m	per sq.m
	→ Tile on ridge of roof	m	per m
	→ CGI Roof	Sq.m	per sq.m
	→ Asbestos Cement (AC) sheet roof	Sq.m	per sq.m
	→ Slate roofing, timber roofing	Sq.m	per sq.m
9.	Steel work		
	→ Steel reinforcement	quintal	per quintal

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	→ Channels, Angles, I-section, Beam etc.	quintal	per quintal
	→ Bending, binding of steel reinforcement	quintal	per quintal
	→ Iron work in truss	quintal	per quintal
	→ Iron gate	sq.m	per sq.m
	→ Iron grill, collapsible gate	sq.m	per sq.m
	→ Rolling shutter	sq.m	per sq.m
	→ Steel door & window	sq.m	per sq.m
	→ Threading in iron	cm	per cm
	→ Boring holes in iron	no.	per no.
10.	Miscellaneous Items		
	→ Cutting trees	no.	per no.
	→ Railing (Height & Type specified)	m	per m
	→ pile driving	m	per m
	→ pipe laying (dia specified)	m	per m
	→ Site clearance work	sq.m	per sq.m
	→ Furniture (type & size specified)	no.	per no.
	→ Fixing door & window	no.	per no.
	→ Bituminous Road Surfacing	sq.m	per sq.m
	→ Water closet (W.C), wash basin etc.	no.	per no.
	→ Electric Wiring	point	per point
	→ Grouting-work in Crack	m	per 'm'
	→ Grouting work in Road	sq.m	per sq.m
11.	Material		
	→ Brick	no	per no.
	→ Cement	bag of 50kg	per ~~kg~~ bag
	→ Sand	cu.m	per cu.m
	→ Aggregate	cu.m	per cu.m
	→ Brick ballast, stone ballast	cu.m	per cu.m

→ Steel	quintal	per quintal
→ Bitumen	tonne	per tonne
→ A.C. sheets	sq.m	per sq.m
→ Switches, plugs, bulbs etc.	no.	per no.
→ Pipe	m	per m
→ Explosive for ≠ blasting	kg	per kg
→ Varnish, oil	litre	per litre
→ paints	litre	per litre

* Data Requirement for Estimation:-

(a) Detail working drawings (Architectural, structural, water-supply & sanitary, Electrical, HVAC etc)

(b) Detail specification (Documents describing the quality, quantity & workmanship for every items of work)

(c) Rate (Material, labours, transportation etc)

(d) Method of measurement:-

The methods of measurement for different civil works are needed to calculate quantities of various item of work.

Eg:-

- 10% deduction for uncompacted filling of earth
- In RCC work - no deduction for volume of reinforcement
- In brickwork - no deduction for opening of area less than 0.1 sq.m

* Method of Measurement for building & other civil engineering works

→ Measurement of work occupied a very important place in estimation & execution of any work or project.

→ General Rules:-

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1) Measurement shall be itemwise for finished item of work. The description of each item should be included in remarks.
2) In booking dimension the order shall be in sequence of length, breadth & height or depth or thickness.
3) All item of work shall be measure net subject to following tolerance unless otherwise stated
   - Dimension shall be measured to nearest 0.01m / 1cm / ½"
     Except for i) Thickness of slab → nearest to 0.005m
     ii) Steel work → nearest to 0.001m
     iii) Reinforcement → nearest to 0.005m
     iv) Woodwork → nearest to 0.001m
   - Area shall be measured to nearest 0.01sqm or 0.1sq.ft
     Except for steel work area → nearest to 0.001m²
   - Cubic content shall be measured to nearest 0.01cu.m or 0.1cu.ft except for woodwork → nearest to 0.001 m³.
4) Some type of work under different condition & nature shall be measured separately under separate item of works.
5) Bill of quantities shall fully describe the material proportion & workmanship
6) System of units should be used correctly.

*Earthwork:
→ The excavation in trenches or from borrows pits in fairly uniform ground, the measurement of cutting in trenches or borrows pits shall be made.
→ In case of uncompacted fills → 10% deduction from actual measurement.

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*Brickwork:
→ Measurement:- l x b x t
→ Deduction for doors, windows & other openings including lintels
→ No deduction for areas < 0.1sqm
→ Rate shall be inclusive of all necessary scaffolding, watering & cutting of bricks, curing materials & labour.

*plastering work:
→ Measure in square meter (feet) of the surface over which plaster has been done.
→ No deduction for ends of joints, beams, posts etc. & opening not exceeding 0.5sqm.
→ For opening 0.5 - 3sq.m, deduction for one face only.
For opening > 3sqm, deduction for both face of opening.
→ Minm thickness of plaster = 12.5 mm
For inside wall :- 1:5 cement mortar
For ceiling :- 1:3 cement mortar
For outside wall :- 1:4 cement plaster

*Painting Works:-
→ Measured in sq.m of finished area.
→ Deduction similar to plastering
→ Multiplying coefficient are used to get equivalent plain area for different surfaces.
→ Providing & applying primer coat & minimum two coats of the approved quality paint including the cost of material scaffolding & labours.

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* Concrete work:-

→ Measurement in cubic meter or cubic feet
→ No deduction for opening upto 0.1 sq.m
→ No deduction shall be made for ~~openings~~ volume occupied by reinforcement.
→ Formwork, centering & shuttering work shall be taken under separate item in sq.m
→ Reinforcement, bending & binding shall be measured under separate item in kg or quintal.

* Subheads of Various Items of work:-

→ Earthwork
→ Concrete work
  • pcc work
  • Rcc work
→ Masonary work
  • Brick work
  • Stone work (stone masonry in 1:6 cement mortar)
→ Wood work
→ Flooring work
  • Screeding (20mm thick, 1:4)
  • Flagstone flooring (1" to 1.5" thick, 1:4 mortar)
  • Cement punning (1:1 cement punning)
→ Finishing work
  • Cement plaster work
  • painting work
  • Roofing work

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* Sheets used in Estimating:-

(a) Quantities Measurement Sheet

SN	Description of work	No.	L	B	H	Qty	Unit	remarks

(b) Abstract of Cost (AOC)

S. N.	Description of works	Quantity	Unit	Estimate Amount		Remarks
				Rate (RS)	Amount (RS)	

(c) Bill of Quantities (BOQ)

S N	Description of works	Unit	Quantity	Rate (RS)		Amounts (NRS)	Remarks
				In figure	In words		

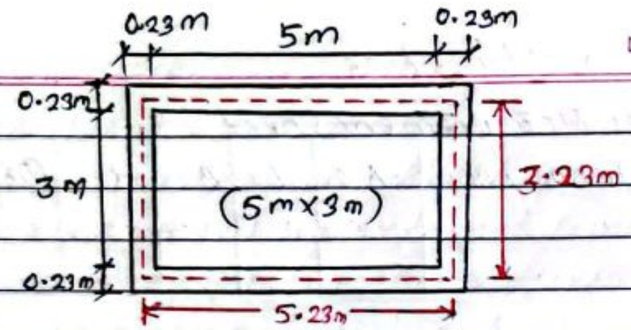
* Various Methods of ~~abstracting~~ (calculating) Quantities:-

→ The calculation of quantities of materials can be done using following methods
  i) Centreline method
  ii) Long wall & short wall method
  iii) Crossing method

(i) Centre Line Method:-

→ This method is suitable only if the offsets are symmetrical & the building is more or less rectangular in shape.
→ According to this method, total length of centreline of wall is calculated & this length is multiply by corresponding breadth & height of item of work to find its quantity.

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Centre line length = $2 \times 5.23 + 2 \times 3.23 = 16.92m$
Thickness/width of wall = 0.23m
Height of wall = 3m
Quantity of brickwork = $16.92 \times 0.23 \times 3 = 11.67m^3$

(ii) Long wall & Short wall Method:-
→ According to this method, the long wall is consider first & the wall perpn to this wall is consider as short wall.
→ The long wall is measured from out to out & the short wall is measured from in to in. After finding the length of wall, this length is multiplied by corresponding breadth & height of item of work to find quantity of that item.
→ From above figure,
length of long wall = $5 + 0.23 + 0.23 = 5.46m$
Length of short wall = 3m
Total length of wall = $2 \times 5.46 + 2 \times 3$
$= 16.92m$
Width of wall = 0.23m
Height of wall = 3m
Quantity of brick work = $16.92 \times 0.23 \times 3 = 11.67m^3$
→ Used for building having unsymmetrical layouts, walls of varying thickness, height etc.
→ Upto plinth level from footing, we can use this method to estimate the quantity.

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(iii) Crossing Method:-
→ In this method, lengths & breadths of the masonry walls at plinth level are taken (internal dimension of room + thickness of the walls) for calculating quantities
→ The centre line length is obtain by calculating the overall perimeter of building & subtracting four times thickness of wall on it.
From figure,
Total length = $2 \times 5.46 + 2 \times 3.46 - 4 \times 0.23$
$= 16.92m$

* Contingency:-
→ Incidental expenses of miscellaneous items which cannot be classified approximately under any distinct sub-head while estimating but is added on the cost of construction for uncertainty works
→ (3-5)% of estimated cost added as contingency.

* Overhead Cost:-
→ During the execution of works some miscellaneous expense such as general office expenses, rents, supervision, stationary expenses, travelling expenses etc. have to be incurred the same if not counted in the rate analysis of item of work there can be lost on completion of job. So, cost of such expenses is provided as overhead cost.
(a) General Overhead → office establishment, stationary, printing, Travelling expenses, Rent, communication etc.
(b) Job Overhead:- Supervision (salary of site engineer), handling of materials, repairing of tools, interest on investment, insurance etc.

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✻ Some Important Definitions

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* Plinth Area:
→ Builtup covered area of building at floor level of any storey
→ Calculated by taking external dimensions of building at floor level excluding plinth offsets.
→ Not include area of courtyard, open area, balconies & cantilever projection etc.

* Floor Area/ Rentable area:
→ Total area of floor in between walls, area of floor of all rooms, verandas, corridors, entrance halls, stair case, kitchen, store, toilet/bathroom etc.

* Circulation Area:
→ Floor area of verandas corridors, entrance halls, staircase, roof room, balconies, lifts is known as circulation area because such area are used for movement of person.

* Carpet Area:
→ Liveable area of building
→ Carpet Area = Total floor area − Circulation area − Other unliveable area (toilet, bathroom etc)
→ Exclude kitchen, pantry, stores & similar other areas which are not used for living purpose in residential building
→ For residential building, carpet Area = 50-65% of plinth area
For public building, carpet area = 60-75% of plinth area
For ordinary building, wall area = 10-15% of plinth area
For multi-storied building, wall area = 5-10% of plinth area

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Chapter-2, Types of Estimate

Contents

→ Approximate Estimates
→ Detailed Estimates
→ Revised Estimates
→ Supplementary Estimates
→ Annual repair & Maintenance Estimates
→ Extension & Improvement Estimates
→ Complete Estimates
→ Split up of cost of building works:

✻ Approximate Estimates:-

→ Preliminary / Abstract / Rough Estimate
→ done to find approximate cost in short time.
→ It is required for preliminary studies of various projects.
→ This estimate is prepared from practical knowledge & cost of similar works.
→ Types,
  i) Unit rate Estimate
  ii) plinth area estimate
  iii) Cubic Rate Estimate.

* Unit Rate Estimate:-
This type of estimate is prepared on the per unit basis if the appropriate cost of unit is found, total cost of project can be calculated.
→ Building work - per student for school, college
  - per bed for hospital
  - per seat for cinema hall etc.
→ Road work - per KM

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→ Bridge work - per meter length.
→ Irrigation work - per km of canal, per hector of commanded area

* Plinth Area Estimate:-
→ In this method, plinth area rate of building is calculated adopted from the cost of similar building having similar specification, height & construction in same locality.
→ plinth area = Carpet area + Circulation area + kitchen/toilet + wall area

Q. prepare a preliminary estimate of an emergency covid Hospital building having carpet area of ground floor as 1200sqm. Take circulation area 20% of builtup area. Area covered by brickwall is 10% of builtup area. Assume plinth area rate of civil work is NRS 18,000 per sq.m. Cost of water supply & sanitation is 9% of building cost & cost of electrical work is 8% of building cost. Add 15% for deeper foundation. Cost of contingencies & supervision charge are 5.5% of total cost.
→ Let, plinth area = x,
Then, x = carpet area + circulation area + wall area

$$x = 1200 + \frac{20}{100} \times x + \frac{10}{100} \times x \Rightarrow x = 1714.28 \text{sqm}$$

Building cost = plinth area * plinth area rate
= 1714.28 x 18,000
= RS 3,08,57,040

Cost of water supply & sanitary = 0.09 x 30857040 = RS 2771133.6
Cost of Electrical work = 0.08 x 30857040 = RS. 2468563.2
Cost of deeper foundation = 0.015 x 30857040 = RS. 462855.6

classmate Total cost = 30857040 + 2771133.6 + 2468563.2 + 462855.6
= RS 36561592.40

Cost of contingencies & supervision charge = $\frac{5.5}{100} \times 36561592.40$
= RS. 2011107.58

Total cost = 36561592.40 + 2011107.58
= RS. 38572699.98

* Cubic Rate Estimate
→ This estimate is worked out on the basis of cubical content of the proposed building & then multiplying with rate per cubic content.
→ Estimate = plinth area x height * Cubical content rate
→ Height is taken from top of floor level to the top of flat roof or half way of sloped roof.

* Detailed Estimate:-
→ Detailed estimate is an accurate estimate & consists of working out the quantities of each item of works & cost. The dimensions of each item are taken out correctly from drawing & quantities of each item are calculated & abstracting & billing are done.
→ The detailed estimate is prepared in two stages.
i) Details of measurement & calculation of Quantities

SN	Description	No.	Length	width	Height	Quantity	Unit	Remarks

(ii) Abstract of Estimated cost

SN	Description	Quantity	Unit	Rate	Amount	Remarks

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→ 5-10% of total estimated cost for contingencies & 2-5% for work charge establishment should be added.
→ The detailed estimate is accompanied with
i) Detailed report
ii) Detailed specification for execution of work
iii) Detailed drawings (plans, siteplan, elevⁿ, sections etc)
iv) Calculation & design of various items such as for beams, slabs, irrigation channels etc.
v) Schedule of rates followed & premium if allowed.

→ Factors to be consider for preparation of detail estimate
i) Quantity of materials.
ii) Availability of materials
iii) Transportation of materials
iv) Location of site
v) Availability of labour

✻ Revised Estimate:-

→ Revised Estimate is also a detailed estimate & is prepared when
a) The original sanctioned estimate is exceeds or likely to exceed by more than 5%
b) The expenditure on a work exceeds or likely to exceed the amount of administrative sanction by more than 10%
c) There is material rate deviation from the original proposal, even though the cost may be same.
→ The revised estimate should be accompanied by all the papers in case of detailed estimate & also should

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include the comparative statement, showing the variation in each item of works, its quantity, rate & cost of original & revised, excess or saving & giving the reason of excess & saving in case of each item.

✻ Supplementary Estimate:-

→ It is a detailed estimate & is prepared when additional work are required to supplement the original works or when further development is required during the progress of work.
→ This is a fresh detail estimate of additional works in addition to the original estimate.
→ The abstract should show the amount of original estimate & the total amount including the supplementary amount for which sanction is required.

✻ Annual Repair & Maintenance Estimate:-

→ In order to keep the structure in proper condition, annual repair & maintenance are carried out. The estimate prepared for this purpose is known as annual repair & maintenance estimate.

✻ Extension & Improvement Estimate:-

→ When some changes & extensions are required to be made in the old work, a detailed estimate of extension & improved work is carried out which is called as extension & improvement estimate.

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* Complete Estimate:-

→ In complete estimate, following cost should be included.

1) Cost of land
2) Cost of preliminary works (feasibility study, investigation & surveying)
3) Cost of preliminary design, drawing & estimate
4) Cost of detailed design, drawing, estimate, specification & contract documents.
5) Cost of electricity, watersupply & sanitory works
6) Cost of design & supervision charges
7) Cost of external services
8) Cost of repair & maintenance etc.

* Splitup of cost of building works

(a) General splitup

→ Labour cost → 30-35% of total cost
→ material cost → 65-70% of total cost

(b) stagewise breakup:-

→ Construction below plinth level → 10-15% of total cost
→ Construction above plinth level → 85-90% of total cost

(c) Activity wise breakup:-

→ Foundation work :- 17-18%
→ Brickwork / blockwork :- 20%
→ Concreting & reinforcement steel = 15%
→ Door, windows & ventilators = 12%
→ Roof waterproofing & finishing with tiles = 5%
→ plastering :- 5-6% → Flooring :- 5% → Painting :- 2-3%
→ watersupply, electrification, sanitory works :- 12-13%
→ Other works → (4-5)%

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Chapter 3, Analysis of Rates

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Contents

→ Introduction
→ Purposes of rate analysis
→ Importance of rate analysis
→ Cost of items, transportation cost, other expenses & overhead, Contigency
→ Requirements of rate analysis
→ Factors affecting the rate analysis.

* Introduction:-

→ Method of determining the rate per unit of particular item of work considering the cost & quantities of material, cost of labours, hire of tools & plants, contractor profit etc. is known as rate analysis.
→ The rate of materials & labors vary from place to place & therefore the rate of different item of work also varies from place to place.

* Purposes of Rate Analysis:-

→ To workout the actual cost per unit of item
→ To workout the economical use of material.
→ To workout the cost of extra items which are not provided in contract document (BOQ)
→ To revise the schedule of rates due to increase in the cost of materials, labor or due to change in technique of construction.
→ To examine the viability of rates offered by contractors
→ To fix up labour contract rates.

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* Importance of Rate Analysis

→ The process of doing analysis gives clear picture of the various types of labours & materials required for completing the particular work.
→ To settle disputes betn contractor & client
→ It can be used for compensation by insurance.

* Requirements of Rate Analysis

The following are the main requirements for doing the rate analysis & arriving at the correct rates of the items.
a) Correct information of market rates of materials
b) Correct information of rate of various categories of labours
c) Output of labors
d) knowledge, rate & out turn of various types of plants to be used in construction works.
e) Upto date knowledge of construction
f) Appropriate standard norms.

* Factors affecting the rate analysis

1) Quality of materials
2) Proportion of mortars
3) Construction facilities available with regards to tools & plants to the site of work
4) Location of site of work
5) Facilities available for transportation of labors & materials to work site.
6) Transportation charges, condition of road or passage to site of work.

7) Overhead charges (2-5%)
8) Miscellaneous expenditure of profit desired.
9) Experience of workers & amenities provided to them.
10) Proper management & guidance.

* Goverment procedure of preparing rate analysis

Total cost of materials = Rs 'x'
Total cost of labors = Rs 'y'
Cost of Hire of tools & plants = Rs 'z'
Subtotal (A) = Rs (x + y + z)
Contractor overhead & profit = 15% of A = 0.15A
Total (B) = A + 0.15A = 1.15A
VAT (optional) (C) = 13% of B
= 0.13 × 1.15A = 0.1495A
Grand Total = B + C = 1.15A + 0.1495A
= 1.2995A

** Notes :-

→ In concrete mix, to get dry mix (cement + sand + agg), increase 50 to 60% of wet mix
→ In mortar mix, to get dry mix (cement + sand), increase 30 to 35% of wet mix
→ In plastering work, first increase 25% filling in betn joints & irregular surface. In case of ceiling of concrete surface (plain surface only) increase 10 to 15% of wet mix to get total wet mix. Then, to get dry mix (cement + sand) increase 30% to 35% of wet mix.
→ In case of brickworks, increase 15% to 20% of total works due to wastage & dressing.

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Volume of dry mortar mix = 30% to 40% of stone masonry.

→ In RCC works,

To get reinforcement: 1% of volume of RCC

Binding wire = 1 kg per quintal.

* Calculation of Quantities of material & Rate Analysis

\# Material required for cement concrete (M15, 1:2:4) ($1m^3$)

Here,

Compacted volume of cement concrete = $1 m^3$

Dry quantities of cement concrete = $1.55 m^3$ (↑ by 55%)

Mix of proportion of concrete = 1+2+4 = 7

Required quantities of cement = $\frac{1.55}{7} = 0.221 m^3$

$= 0.221 \times 28.8 = 6.4$ bags

Required quantities of sand = $0.221 \times 2 = 0.442 m^3$

Required quantities of Agg = $0.221 \times 4 = 0.88 m^3$

Reqd quantities of water = $0.5 \times 0.221 \times 1000$

$= 110.5$ Ltr.

Labour, Skilled = 1.5 nos

Unskilled labors = 7 nos.

Rate Analysis,

a) Material

cement 6.4 bags @ 900 per bag = RS 5760.00

Sand 0.442 ~~bag~~ m^3 @ 1375 per m^3 = RS 607.75

Aggregate $0.88 m^3$ @ 1475 per m^3 = RS 1303.90

b) Labor

Skilled labor = 1.5 nos @ 1500 per person = RS 2250

Unskilled labour = 7 nos @ 1000 person = RS 7000

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W/C ratio for mortar & plaster = 0.8 to 1

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Subtotal = 5760 + 607.75 + 1303.9 + 2250 + 7000

= RS 16921.25

15% contractor's overhead & profit = 0.15×16921.25

= RS 2538.24

Total cost = 19459.49 per m^3

Note:-
Half brick wall = 110 mm
One & half brick wall = 350 mm (110+10+230)
Two brick wall = 470 mm (230+10+230)

* Material required for brick masonry laid in cement mortar (1:4)

Let, volume of brick = $1 m^3$

Size of brick = 230mm × 110mm × 55mm

Add 10mm mortar joint, 240mm × 120mm × 65mm

Required quantities of brick = $\frac{1}{0.24 \times 0.12 \times 0.065} = 535$ nos

Add 5% wastage = $1.05 \times 535 = 560$ nos

Volume of mortar = $1 - 535 \times 0.23 \times 0.11 \times 0.055 = 0.26 m^3$

Add 30% of dry volume = $1.3 \times 0.26 = 0.338 m^3$

proportion of mortar = 1+4 = 5

Reqd volume of cement = $\frac{0.338}{5} = 0.068 \times 28.8 = 1.96$ bags

Reqd volume of sand = $0.068 \times 4 = 0.272 m^3$

Reqd volume of water = $0.068 \times 1 \times 1000 = 68$ L

Skilled labours = 1.4 nos

Unskilled labours = 4.2 nos.

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* 12mm thick cement ~~mortar~~ sand plastering (1:4) in brick wall (100m² area)

Here,

volume of cement plaster = $100 \times 0.012 = 1.2m^3$

Increase 25% for filling gap in between joints & irregular surface.

$= \frac{25}{100} * 1.2 + 1.2 = 1.5m^3$

Add 30% of dry volume of cement plaster = $1.5 \times 1.3 = 1.95m^3$

proportion of mortar = 1+4 = 5

Required quantities of cement = $\frac{1.95}{5} = 0.39 \times 28.8$

$= 11.23$ bags

Required volume of sand = $0.39 \times 4 = 1.56m^3$

Required vol. of water = $0.39 \times 1 \times 1000 = 390L$

Labors,

skrilled labours = 12 nos.

unskrilled labours = 16 nos.

* Material required for stone masonry laid in cement mortar

→ The requirement of stone varies from 10% to 33% depending upon the quality of dressing required.

→ Generally, 35% to 45% of dry mortar is considered for Random Rubble Masonry & 12% to 20% for ashlar masonry.

* 1000 kg Steel Reinforcement Bar:-

unit = 1000kg

a) Steel Reinforcement bar = 1000kg

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Add 5% for wastage = $0.05 \times 1000 = 50kg$

Total Weight of rebar = 1050 kg

b) Binding wire 1% of steel rebar

$= 0.01 \times 1000 = 10kg$

Labour:-

Skilled labour = 8 nos/mt

Unskilled labour = 12 nos/mt

* Calculation of Quantities of mosaic or Terazzo Flooring

Unit - 100sqm

6mm thick mosaic layer over 20mm thick concrete (1:2:4)

(a) For 20mm thick cement concrete (1:2:4)

Volume of compacted concrete = $\frac{20}{1000} \times 100 = 2m^3$

Add 10% for unevenness,

Total volm of concrete = $\frac{10}{100} \times 2 + 2 = 2.2m^3$

Add 55% for dry volume of concrete = $1.55 \times 2.2 = 3.41m$

proportion of cement concrete = 1+2+4 = 7

Required volume of cement = $\frac{3.41}{7} = 0.487 \times 28.8$

$= 14$ bags

Required volume of sand = $0.487 \times 2 = 0.98m^3$

Required volume of aggregate = $0.487 \times 4 = 1.96m^3$

For water,

$W/C = 0.6$

water = $0.6 \times 0.487 \times 1000$

$= 292.2L$

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b) 6mm thick mosaic layer (1:2)

Volume of wet mosaic concrete = $\frac{6}{1000} \times 100 = 0.6 m^3$

Add 20% for surface cutting, unevenness etc,

Volume of wet mosaic concrete = $1.2 \times 0.6 = 0.72 m^3$

Increase 50% for dry volume,

volume of dry mosaic concrete = $1.5 \times 0.72 = 1.08 m^3$

White cement / grey cement = $\frac{1.08}{1+2} \times 1 = 0.36 \times 28.8$

$= 10.37$ bags

Cement: Marble chips (1:2)

Marble chips = $2 \times 0.36 = 0.72 m^3 = 0.72 \times 1650$

$= 1188 kg$

($1 m^3$ of marble chips = 1650 kg)

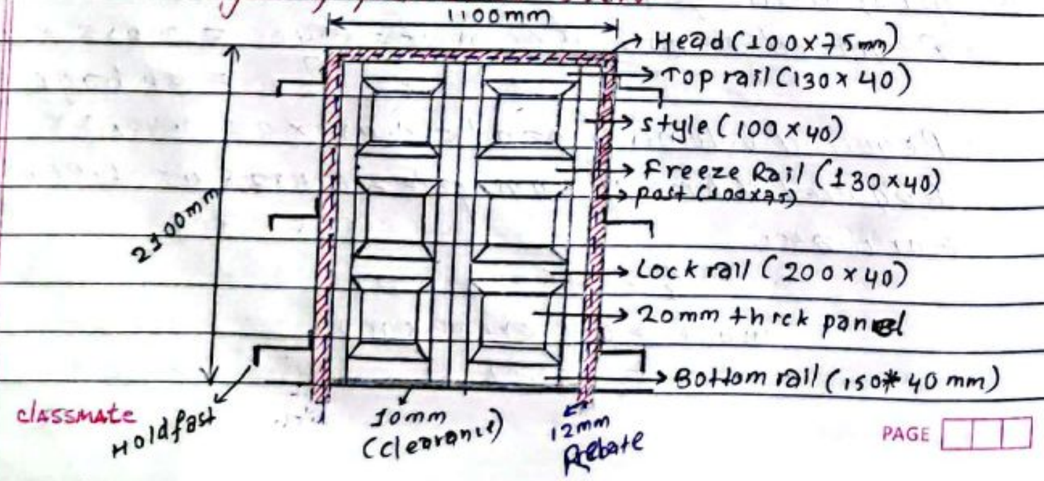
Along with white cement, marble dust is generally used to get whitish finish.

Marble dust = $\frac{1}{3}$ * wt of cement

$= \frac{1}{3} * 10.37 \times 50 = 174 kg$

For coloured pigment, add 2 to 5 kg per bag of cement.

Rate Analysis of Panelled Door:



Unit = $2.1 \times 1.1 = 2.31 m^2$

S/N	Description	No.	L(m)	B(m)	H(m)	Quantity	Remarks
1.	Frame	1	5.36	0.075	0.1	0.0402	L = 2.1+1.1+2.1+0.03x2
	Add 10% for wastage					0.0040	(30mm below GL)
					Total	$0.044 m^3$	
2.	Panelled door shutter						(12mm Rebate)
	Top rail	1	0.974	0.13	0.04	0.0051	L = 1.1 - 2x0.075 + 2x0.012
	Freeze rail	1	0.974	0.13	0.04	0.0051	
	Lock Rail	1	0.974	0.2	0.04	0.0079	
	Bottom Rail	1	0.974	0.15	0.04	0.0058	
	Style	4	2.027	0.1	0.04	0.0324	L = 2.1 - 0.075 - 0.01 + 0.012
	Panel	6	0.311	0.02	0.496	0.0185	L = (1.1 - 2x0.075 + 2x0.012 - 4x0.1 + 4x0.012)/3
					Sub Total	0.0718	
	Add 10% for wastage					0.00748	H = (2.1 - 0.075 + 0.012 - 0.01 - 0.13x2 - 0.2 - 0.15 + 6x0.012)/3
					Total	0.0823 m^3	

* Rate Analysis:

→ Frame

1) Material

Timber $0.044 m^3$ @ 195600 per m^3 = 8606.4

Hold fast 6 nos @ 150 per no. = 900

Screw 12 nos @ 1.0 per no = 12

Bitumen lumpsum =

2) Labour:

Skilled labour 1.5 nos @ 1500 per no. = 2250

Unskilled labour 0.15 nos @ 1000 per no. = 150

Subtotal = Rs 11918.4

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Add 15% contractor's overhead & profit of subtotal = 0.15 × 11918.4
= 1787.76

Total = RS 13706.16

→ Panelled door shutter

1) Material

Timber 0.0823 m³ @ 195600/m³ = 16092.88

2) Hardware fitting

Anodized Tower bolt

300 mm × 10 mm ϕ, 1 NO @ 350 per no = 350

150 mm × 10 mm ϕ, 1 NO @ 250 per no = 250

Aluminium Handle, 1 NO @ 200 per no = 200
(100 mm)

Aluminium Aldrop, 1 NO @ 600 per no. = 600
(300 mm long & 16 mm ϕ)

Hinges (150 mm long), 6 Nos @ 75 per no. = 450

Wooden cleat, 2 nos @ 150 per no. = 300

Hinges (75 mm), 2 nos @ 70 per no = 140

Screw (40 mm), 50 nos @ 1 per no = 50

Screw (20 mm), 40 nos @ 0.5 per no = 20

Labour:

Skilled labour → 10 nos @ 1500 per no = 15000

Unskilled labour → 1 nos @ 1000 per no = 1000

Subtotal = RS 16,000 + 2360 = RS 18,360

Add 1% for tools & plant, = 183.6

15% contractors overhead & profit = 2754

Total = RS 21297.6

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✻ Water Supply & Sanitary Works:

* Wash Basin complete set (560 × 400 mm)

Unit - 1 set

a) Material

1) 560 × 400 wash basin white glazed with CI bracket ⇒ 1 no @ 4500 per
= 4500

2) 40 mm ϕ CP P or S Trap with ⇒ 1 no @ 550 per no = 550
cleaning holes & plugs

3) 40 mm ϕ CP waste coupling ⇒ 1 no @ 675 per no. = 675
with CP chain & rubber plug

4) 15 mm ϕ CP fancy type mixer ⇒ 1 no @ 4500 per no = 4500

5) 15 × 450 mm PVC pipe connector ⇒ 2 nos @ 375 per no = 750

6) Screw zinc oxide ⇒ Lumpsum ⇒ 200

Total = RS 11,175.00

b) Labour:-

Skilled labour ⇒ 2 nos @ 1500 per no = 3000

Unskilled labour ⇒ 2 nos @ 1000 per no = 2000

RS 5,000

Subtotal = 11175 + 5000 = 16,175

Adding 15% contractors overhead & profit = 2426.25

Total cost = RS 18601.25

✻ Asphalt Concrete

* Prepare an analysis of rate for 40 mm thick premix asphalt concrete:-

Unit = 100 m²

1) Material:-

Bitumen CB (cutback) = 46/10 × 100 = 460 kg @ 150 per kg = RS. 69,000

Kerosene (LS) = 20 Lt @ 130 per Lit = RS 2600

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Wood (Boiler) = $^{18}/_{10} \times 100$ = 180 kg @ 50 per kg = RS 9000
Wood (mass) = 72/10 x 100 = 720 kg @ 50 per kg = RS 36,000
Wood (patch) = 108/10 x 100 = 1080 kg @ 50 per kg = RS 54,000
20 mm Aggregate = 0.23/10 x 100 = 2.3 m^3 @ 1375 per m^3 = RS 3162.5
12 mm Aggregate = 0.15/10 x 100 = 1.5 m^3 @ 1375 per m^3 = 2062.5
Coarse sand = 0.19/10 x 100 = 1.9 m^3 @ 1275 per m^3 = 2422.5
Total = RS 1,78,2475

2) Labour:-
Unskilled = 1/10 x 100 = 10 nos @ 1000 per no = 10,000
Roller = 0.11/10 x 100 = 1.1 hrs @ 5000 per hr = 55,00
Mixer = 0.11/10 x 100 = 1.1 hrs @ 5000 per hr = 55,00
RS 21,000

Add 15% contractors overhead & profit = 0.15 * (178247.5+21,000)
= 29887.12

Total cost = 1782475 + 21,000 + 29887.12
= RS 229134.625

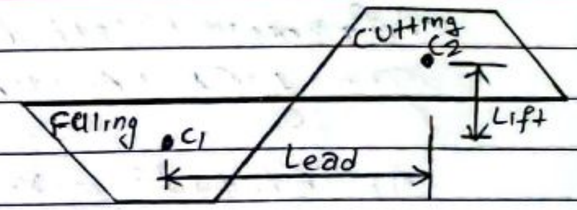
* Road Construction in plain Area:-

→ Volume of Earthwork
It is measured in cubic meters without any allowance for increase in bulk. The volume of earthwork shall be calculated by multiplying the length, breadth & depth or height measured from ground from which soil has been taken out.

→ Lead & Lift:
Lead is the horizontal distance between the centroid of cutting to the centroid of filling.
Lift is the vertical distance bet^n centroid of cutting & filling.

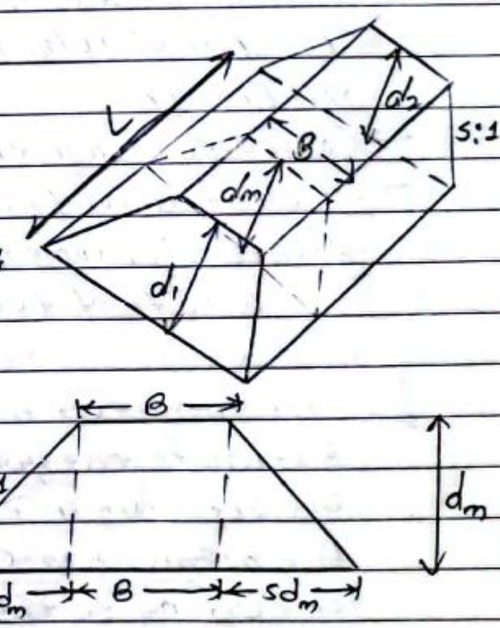
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→ Normally, Earthwork is estimated for 30m lead for distance & 1.5m lift for height or depth.



→ During the estimation of earthwork in road, the volume of earthwork may be calculated by the various methods. of

(a) Mid Sectional Area Method:
Let, S = sideslope
B = formation width
$d_m = \frac{d_1 + d_2}{2}$
Quantity = Area of midsection * length
Now,
Area of midsection
$= B \times d_m + 2 \times \frac{1}{2} \times s d_m \times d_m$
$= B d_m + s d_m^2$
$\therefore Q = (B d_m + s d_m^2) \times L$



(b) Trapezoidal Method:
$Q = \left(\frac{A_1 + A_2}{2}\right) \times L$
$A_1 = B d_1 + s d_1^2$ & $A_2 = B d_2 + s d_2^2$

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(c) Prismoidal Method:

$$D = \frac{1}{6}(A_1 + A_2 + 4A_m)$$

$A_1 = Bd_1 + sd_1^2$ = X-sectional area at one end

$A_2 = Bd_2 + sd_2^2$ = X-sectional area at other end

A_m = Mean sectional area = $Bd_m + sd_m^2$,

Where, $d_m = (d_1 + d_2)/2$

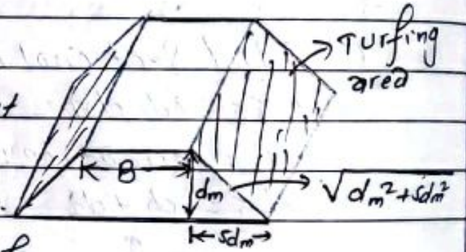
* Turfing:-

→ It is done on side slopes & on the shoulders of rular road to prevent soil Erosion.

→ Commonly used in embankment slope.

→ It also reduces the dust nuisance & gives a pleasing appearance of roadside.

width of turfing = $\sqrt{d_m^2 + sd_m^2}$



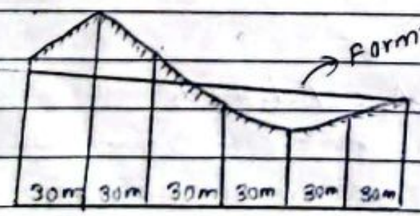
Q The longitudinal section of road has been shown in figure. Estimate the quantities of

a) Earthwork in embankment having a sideslope 2:1

b) Earthwork in Cutting having sideslope 1.5:1

c) Turfing to the sides of banking only.

Length of each chain = 30m, Formation width of road = 12m



V : H = 2 : 1

RL of formation	108	107	106	105	104	103	102
RL of ground	109.3	109.1	107.1	104.4	102.9	102.3	101.7
distance in chain	14	15	16	17	18	19	20

→ Solution,

Using mid section method,

Chainage	Depth of station (m)	Mean depth d_m (m)	Area of central portion $B \times d_m$ (m^2)	Area of side slope sd_m^2 (m^2)	Total area $Bd_m + sd_m^2$	Distance 'L'	Quantity (m³) Banking	Quantity (m³) Cutting	Turfing: Length of side slope $d_m\sqrt{1+s^2}$ (m)	Turfing: Total area $2Lxd_m\sqrt{1+s^2}$ (m^2)
14	-1.3									
15	-2.1	1.7	20.4	4.34	24.74	30		742.2		
16	-1.1	1.6	19.2	3.84	23.04	30		691.2		
0	0	0.55	6.6	0.45	7.05	20		141		
17	0.6	0.30	3.6	0.18	3.78	10	37.8		0.67	40.2
18	1.1	0.85	10.2	1.45	11.65	30	348.5		1.9	114
19	0.7	0.90	10.8	1.62	12.42	30	372.6		2.01	120.6
20	0.3	0.5	6	0.5	6.5	30	195		1.118	67.08
						Σ	954.9	1574.4		341.88 m^2

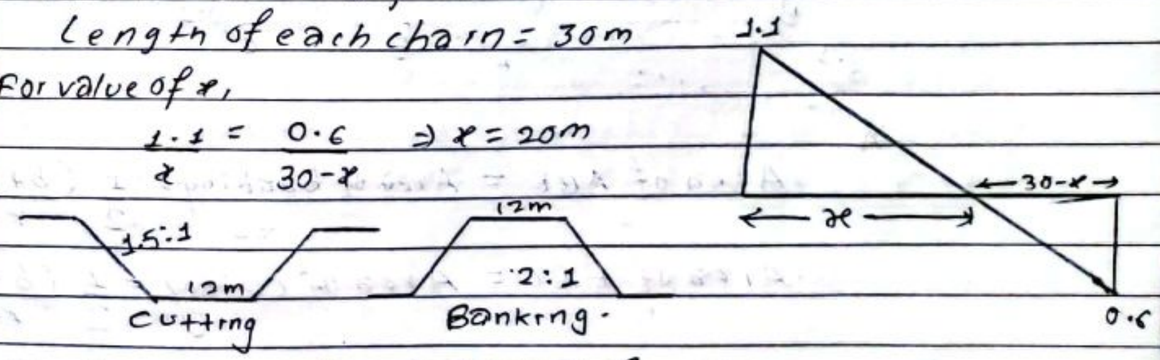
Here,

Formation width of road (B) = 12m

Length of each chain = 30m

For value of x,

$$\frac{1.1}{x} = \frac{0.6}{30-x} \Rightarrow x = 20m$$



Earthwork in cutting = 1574.4 m^3

Earthwork in Banking = 954.9 m^3

Turfing to sides of banking = 341.88 m^2

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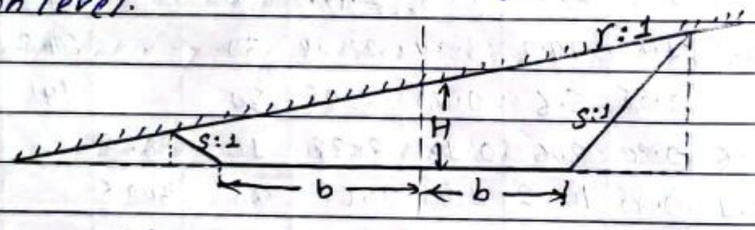
Calculation of Earthwork in Hilly Area Roads

The quantity of earthwork in hilly areas is calculated by average sectional area method. In the hilly area, three types of cross-section are found as follows-

1) Fully in Banking
2) Fully in Cutting
3) Partly filling & partly in cutting

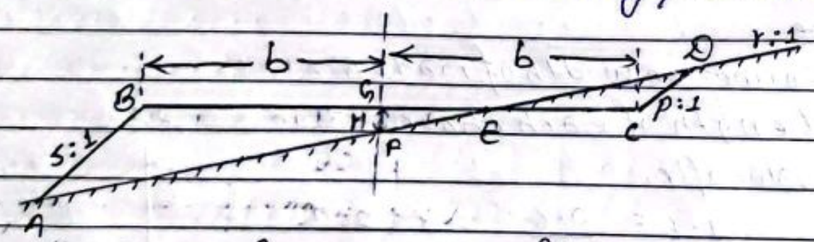
Alternative method for calculating earthwork in hill roads

1) When ground is slaping transversely & does not cut formation level.



$$\text{Area in cutting/filling} = \frac{5b^2 + r^2(2bH + 5H^2)}{r^2 - s^2}$$

2) When centre line 'EG' is in banking portion:-

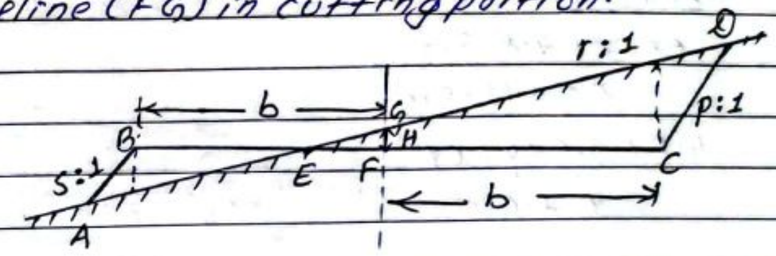


$$\text{Area of ABE} = \text{Area of banking} = \frac{1}{2}\frac{(b+rH)^2}{r-s}$$

$$\text{Area of EDC} = \text{Area of cutting} = \frac{1}{2}\frac{(b-rH)^2}{r-p}$$

Where, $s:1 \Rightarrow$ Side slope of banking
$p:1 \Rightarrow$ Side slope of cutting

3) When centreline (EG) in cutting portion.



$$\text{Area of ABE} = \text{Area of banking} = \frac{1}{2}\frac{(b-rH)^2}{r-s}$$

$$\text{Area of EDC} = \text{Area of cutting} = \frac{1}{2}\frac{(b+rH)^2}{r-p}$$

Q// Calculate the quantity of earthwork in a length 1km from the data given below.
Natural slope of ground = 1 in 6
Formation width of road = 7m
Side slope in cutting = 1:1
Side slope in filling = 2:1
Depth of cut at centre lane at 12KM = 0.5m
Depth of cut at centrelane at 13KM = 0.8m

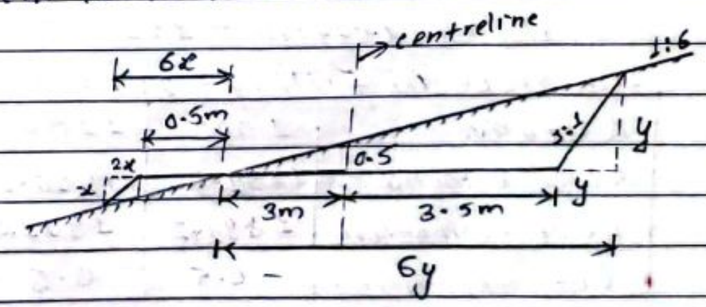
→ At 12KM

$2x + 0.5 = 6x$

$x = 0.125$

$6y = 3 + 3.5 + y$

$y = 1.3m$



$$\text{Area of filling} = \frac{1}{2} \times 0.5 \times 0.125 = 0.03125\ m^2$$

$$\text{Area of cutting} = \frac{1}{2} \times 6.5 \times 1.3 = 4.225\ m^2$$

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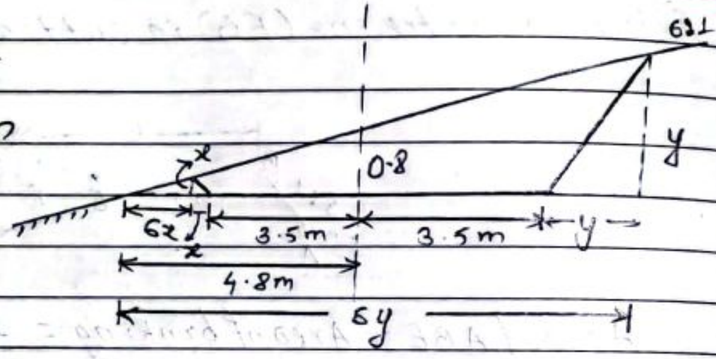
At 1 9KN,

$6x + x = 4.8 - 3.5$

$x = 0.1875\ m$

$4.8 + 3.5 + y = 6y$

$y = 1.66\ m$



Area of cutting $= \frac{1}{2} \times (4.8+3.5) \times 1.66 - \frac{1}{2} \times 7 \times 0.185^2$

$= 6.769\ m^2$

So, volume of filling $= \left(\frac{0 + 0.03125}{2}\right) \times 1000 = 15.5\ m^3$

Volume of cutting $= \left(\frac{4.225 + 6.769}{2}\right) \times 1000 = 5502.5\ m^3$

Q. Work out the quantity of earthwork in cutting & filling of a part of a hillroad as per data given below.

Transverse slope of ground = 1 in 6

Formation of road = 10m

Side slope in cutting = 1:1

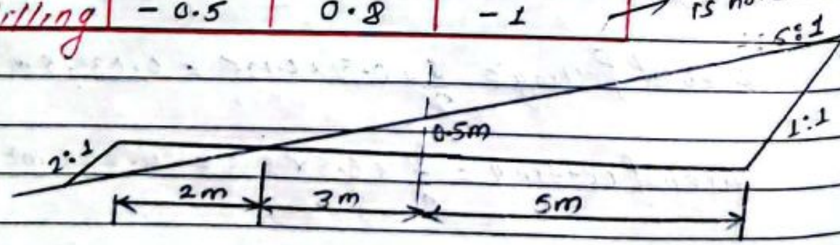
Side slope in filling = 2:1

Distance	1000	1100	1200
RL of Ground	1899.7	1920.2	1906
RL of formation	1899.2	1901.00	1905.00
Cutting/Filling	−0.5	0.8	−1

(RL of formation − RL of ground)

this last row is not given in qn.

→ At 1000m,



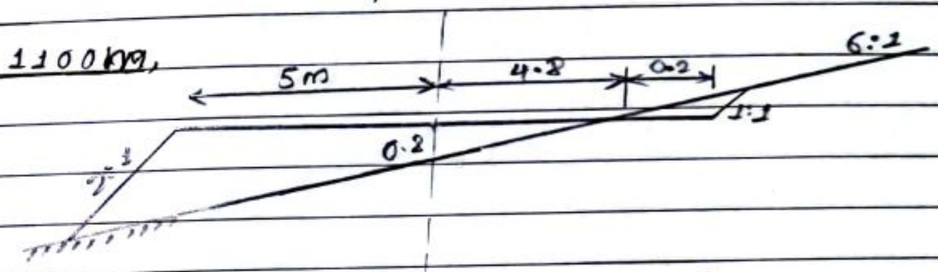
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Area of filling $= \frac{1}{2} \frac{(6 - rH)^2}{r - s} = \frac{1}{2} \frac{(5 - 6 \times 0.5)^2}{(6 - 2)} = 0.5\ m^2$

Area of cutting $= \frac{1}{2} \frac{(6 + rH)^2}{r - p} = 0.5 \times \frac{(5 + 6 \times 0.5)^2}{6 - 1} = 6.4\ m^2$

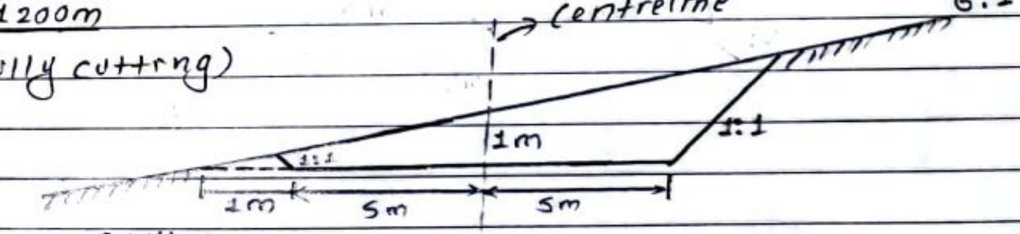
→ At 1100m,



Area of filling $= \frac{1}{2} \frac{(6 + rH)^2}{r - s} = \frac{1}{2} \frac{(5 + 6 \times 0.8)^2}{(6 - 2)} = 12.005\ m^2$

Area of cutting $= \frac{1}{2} \frac{(6 - rH)^2}{r - p} = \frac{1}{2} \frac{(5 - 6 \times 0.8)^2}{(6 - 1)} = 0.004\ m^2$

→ At 1200m (fully cutting)



Area of ~~filling~~ cutting $= \frac{56^2 + r^2(26H + 5H^2)}{r^2 - s^2} = \frac{1 \times 5^2 + 6^2(2 \times 5 \times 1 + 1 \times 1^2)}{6^2 - 1^2}$

$= 12.028\ m^2$

Volm of earthwork in filling betn 1000 to 1100m $= \left(\frac{0.5 + 12.005}{2}\right) \times 100 = 625.25\ m^3$

Volm of Earthwork in filling betn 1100-1200m. $= \left(\frac{12.005 + 0}{2}\right) \times 100 = 600.25\ m^3$

Volm of Earthwork in cutting betn 1000 to 1100m $= \left(\frac{6.4 + 0.004}{2}\right) \times 100 = 320.2\ m^3$

Volm of Earthwork in cutting betn 1100 to 1200m $= \left(\frac{0.004 + 12.028}{2}\right) \times 100$

$= 601.6\ m^3$

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Detailed Estimate of Load Bearing Structure

For Room,

Centreline of long wall = 0.35/2 + 2.5 + 0.35 + 4.5 + 0.35/2
= 7.7m

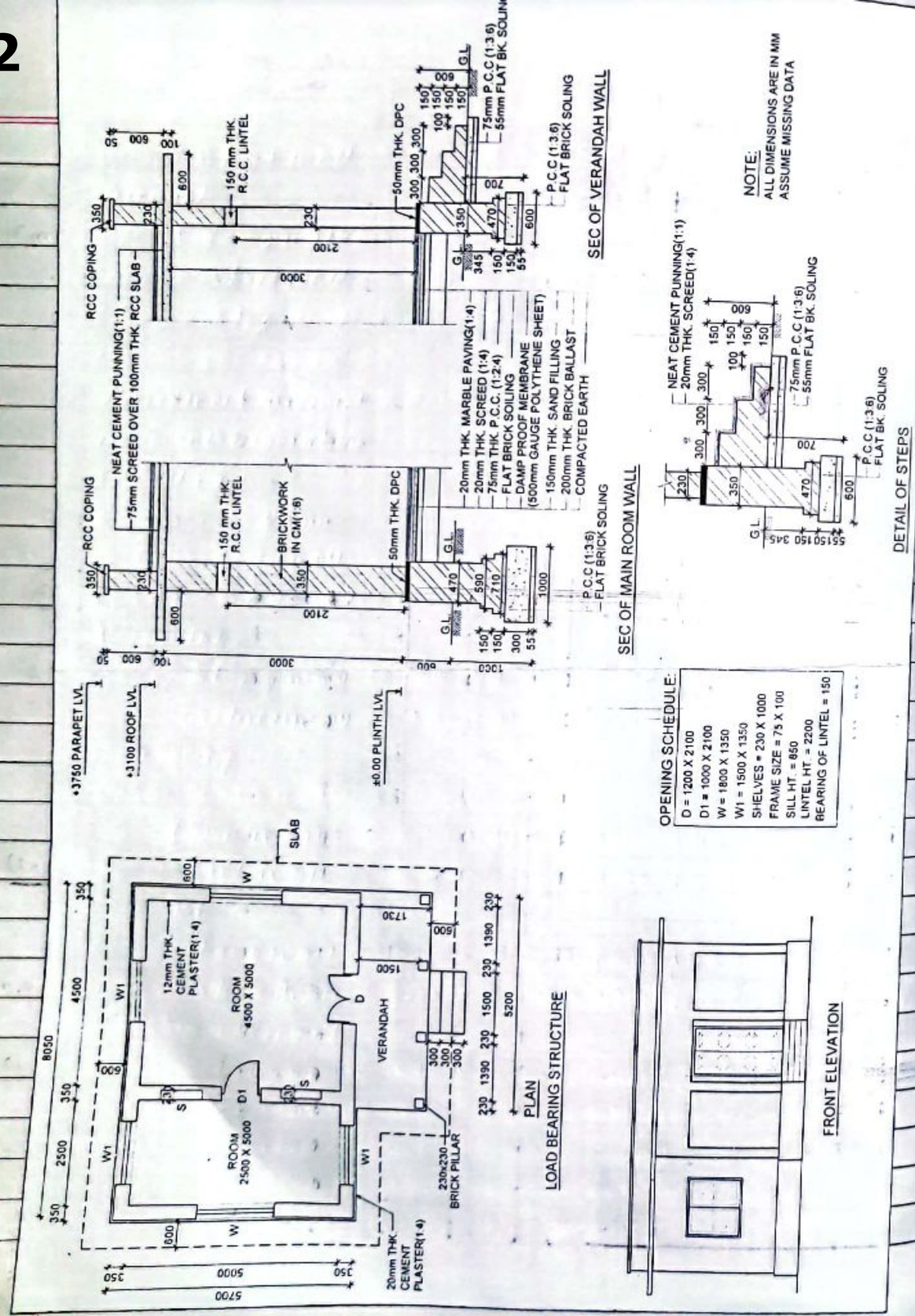
centreline of short wall = 0.35/2 + 5 + 0.35/2 = 5.35m

for Verandah,

Centreline of long wall = 0.23/2 + 1.39 + 0.23 + 1.5 + 0.23 + 1.39 + 0.23/2
= 4.97m

Centreline of short wall = 1.5 + 0.23/2 + 0.35/2 = 1.79m

SN	Description	No	L(m)	B(m)	H(m)	Ø	Remarks
1.	Earthwork						
1.1	Earthwork in Excavation						
	Room						
	Long wall	2	8.7	1	1	17.4m³	l = 7.7 + 1/2 + 1/2
	Short wall	3	4.35	1	1	13.05m³	l = 5.35 - 0.5 - 0.5
	Verandah						
	Long wall	1	5.57	0.6	0.7	2.34m³	l = 4.97 + 0.6/2 + 0.6/2
	Short wall	2	0.99	0.6	0.7	0.83m³	l = 1.79 - 0.6/2 - 1/2
	Step	1	1.7	0.875	0.13	0.19m³	l = 0.1 + 1.5 + 0.1 b = 0.9 x 9 + 0.1 - (0.6/2 - 0.35/2) h = 0.075 + 0.055
						33.81m³	
1.2	Earth filling in trench		1/5 * 33.81	=		6.76m³	
2.	Brickwork						
2.1	Flat Brick soiling						
	Room						
	Long wall	2	8.7	1	—	17.4m²	



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	Short wall	3	4.35	1	—	13.05m³	
	Verandah						
	Long wall	1	5.57	0.6	-	3.34m³	
	short wall	2	0.99	0.6	-	1.18m³	
	Step	1	1.7	1	-	1.7m³	b = 0.3 + 0.3 + 0.3 + 1
						36.67m³	
2.2	Brickwork in cement mortar (1:6) in foundation						
	1st footing,						
	Room						
	Long wall	2	8.41	0.71	0.15	1.79m³	l = 7.7 + 0.7½ + 0.7½
	Short wall	3	4.64	0.71	0.15	1.48m³	l = 5.35 − 0.7½ − 0.7½
	Verandah						
	Long wall	1	5.44	0.47	0.15	0.38m³	l = 4.97 + 0.47½ + 0.47½
	Short wall	2	1.2	0.47	0.15	0.17m³	l = 1.79 − 0.7½ − 0.47½
	2nd footing						
	Room						
	long wall	2	8.29	0.59	0.15	1.46m³	l = 7.7 + 0.59½ + 0.59½
	short wall	3	4.76	0.59	0.15	1.26m³	l = 5.35 − 0.59½ − 0.59½
	Verandah						
	long wall	1	5.32	0.35	0.895	1.66m³	l = 4.97 + 0.35½ + 0.35½
	short wall	2	1.38	0.35	0.895	0.86m³	h = 0.345 + 0.6 − 0.05 l = 1.79 − 0.35½ − 0.47½
	3rd footing upto plinth						
	Room, Long wall	2	8.17	0.47	0.895	6.87m³	l = 7.7 + 0.47½ + 0.47½ h = 0.6 + 0.345 − 0.05
	Short wall	3	4.88	0.47	0.895	6.16m³	l = 5.35 − 0.47½ − 0.47½
	Step, 1st step	1	1.5	0.9	0.15	0.20m³	b = 0.3 + 0.3 + 0.3
	2nd step	1	1.5	0.6	0.15	0.13m³	b = 0.3 + 0.3
	3rd step	1	1.5	0.3	0.15	0.06m³	
						22.48m³	

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2.3	Brickwork in cement mortar (1:6) in super-structure						
	Room, Long wall	2	8.05	0.35	3	16.90m³	l = 7.7 + 0.35/2 + 0.35/2
	Short wall	3	5	0.35	3	15.75m³	l = 5.35 − 0.35/2 − 0.35/2
	Verandah,						
	Long wall	1	5.2	0.23	0.9	1.07m³	l = 4.97 + 0.23/2 + 0.23/2
	Short wall	2	1.5	0.23	0.9	0.62m³	h = 3 − 2.1 l = 1.79 − 0.35/2 − 0.23/2
	Brick pillar	4	0.23	0.23	2.1	0.44m³	(7.7+0.35−0.23)
	Parapet wall	1	30.50	0.23	0.6	4.21m³	l = 7.82×2 + 7.43×2
						38.39m³	
	Deduction (−)						
	Door (D)	1	1.2	0.35	2.1	0.88m³	
	D1	1	1	0.35	2.1	0.73m³	
	Window (W)	2	1.8	0.35	1.35	1.7m³	
	(W1)	3	1.5	0.35	1.35	2.12m³	
	Shelves (S)	2	1	0.23	1	0.46m³	
	Lintel						
	Door (D)	1	1.5	0.35	0.15	0.07m³	l = 1.2 + 0.15 + 0.15
	D1	1	1.3	0.35	0.15	0.06m³	l = 1 + 0.15 + 0.15
	Window (W)	2	2.1	0.35	0.15	0.22m³	l = 1.8 + 0.15 + 0.15
	W1	3	1.8	0.35	0.15	0.28m³	l = 1.5 + 0.15 + 0.15
	Shelves (S)	2	1.3	0.35	0.15	0.13m³	l = 1 + 0.15 + 0.15
				Total	= 32.34m³	6.65m³	
3	RCC Coping	1	30.5	—	—	30.5Rm	
4.	Timber work						
4.1	Door & window frame						
	Door (D)	1	5.4	0.075	0.1	0.04m³	l = 2.1 + 1.2 + 2.1
	Door (D1)	1	5.2	0.075	0.1	0.039m³	l = 2.1 + 1 + 2.1
	Window (W)	2	6.3	0.075	0.1	0.094m³	l = 1.8×2 + 1.35×2

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	Window (W_1)	3	5.7	0.075	0.1	0.128 m³	l = 1.5×2 + 1.35×2	
						0.301 m³		
4.2	Door & window shutter							
	Panel Door Shutter (D)	1	1.074	–	2.027	2.17 m²	l = 1.2 − 2×0.075 + 2×0.012 h = 2.1 − 0.075 + 0.012 − 0.01	
	Flush Door shutter (D_1)	1	0.874	–	2.027	1.77 m²	l = 1 − 2×0.075 + 2×0.012	
	Openable glazed window						l = 1.8 − 2×0.075 + 2×0.012	
	shutter (W)	2	1.674	–	1.224	4.09 m²	h = 1.35 − 2×0.075 + 2×0.012	
	Openable glazed window							
	shutter (W_1)	3	1.374	–	1.224	5.04 m²	l = 1.5 − 2×0.075 + 2×0.012	
5.	Concrete Work							
5.1	PCC (1:3:6) in foundation							
	Room							
	Long wall	2	8.7	1	0.3	5.22 m³	l = 7.7 + ½ + ½	
	Short wall	3	4.35	1	0.3	3.91 m³	l = 5.35 − ½ − ½	
	Verandah							
	Long wall	1	5.57	0.6	0.15	0.5 m³	l = 4.97 + 0.6/2 + 0.6/2	
	Short wall	2	0.99	0.6	0.15	0.089 m³	l = 1.79 − ½ − 0.6/2	
						9.72 m³		
5.2	75mm thick pcc (1:3:6)							
	Step	1	1.7	1	–	1.75 sqm	l = 1.5 + 0.1 + 0.1 b = 0.3×3 + 0.1	
5.3	50mm thick DPC							
	Room, Long wall	2	8.17	0.47	–	7.67 m²	l = 7.7 + 0.47/2 + 0.47/2	
	Short wall	3	4.88	0.47	–	6.88 m²	l = 5.35 − 0.47/2 − 0.47/2	
	Verandah, Long wall	1	5.32	0.35	–	1.86 m²	l = 4.97 + 0.35/2 + 0.35/2	
	Short wall	2	1.3	0.35	–	0.91 m²	l = 4.97 − 0.35/2 − 0.47/2	
	Deduction					17.32 m²		
	Door Sill							

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	Door (D)	1	1.2	0.47	–	0.56 m²	
	Door (D_1)	1	1	0.47	–	0.47 m²	
			Total		DPC =	1.03 m² 16.29 m²	
6	RCC work						
	Lintel						
	Door (D)	1	1.5	0.35	0.15	0.078 m³	
	D_1	1	1.3	0.35	0.15	0.068 m³	
	Window (W)	2	2.1	0.35	0.15	0.22 m³	
	W_1	3	1.8	0.35	0.15	0.28 m³	
	Shelves	2	1.3	0.35	0.15	0.136 m³	
	Slab	1	9.25	6.9	0.1	6.38 m³	l = 8.05 + 0.6 + 0.6
		1	6.4	1.73	0.1	1.107 m³	b = 5.7 + 0.6 + 0.6 l = 5.2 + 0.6 + 0.6
						8.269 m³	
7.	Flooring work						
7.1	Earth filling in plinth						
	Room no 1	1	4.88	2.38	0.12	1.39 m³	l = 5 − 0.06 − 0.06
	Room no 2	1	4.88	4.38	0.12	2.56 m³	b = 2.5 − 0.06 − 0.06 h = 0.6 − 0.225 − 0.055 − 0.15 − 0.2
	Verandah	1	4.62	1.38	0.12	0.76 m³	l = 4.97 − 0.35/2 − 0.35/2
						4.71 m³	b = 1.79 − 0.47/2 − 0.35/2
7.2	Brick Ballast Filling						
	Room no 1	1	4.88	2.38	0.2	2.32 m³	
	Room no 2	1	4.88	4.38	0.2	4.27 m³	
	Verandah	1	4.62	1.38	0.2	1.27 m³	
						7.86 m³	
7.3	Sand filling						
	Room no 1	1	4.88	2.38	0.15	1.74 m³	
	Room no 2	1	4.88	4.38	0.15	3.2 m³	
	Verandah	1	4.62	1.38	0.15	0.95 m³	
						5.89 m³	

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7.4	500gauge polythene sheet						
	Room No 1	1	4.88	2.38	–	11.61 m²	
	Room No 2	1	4.88	4.38	–	21.37m²	
	Verandah	1	4.62	1.38	–	6.37m²	
						39.35m²	
7.5	Flat Brick Soiling						
	Room no-1	1	4.88	2.38	–	11.61m²	
	Room no-2	1	4.88	4.38	–	21.37m²	
	Verandah	1	4.62	1.38	–	6.37m²	
						39.35m²	
7.6	75mm thick pcc (1:2:4)						
	Room no-1	1	4.88	2.38	–	11.61m²	
	Room no-2	1	4.88	4.38	–	21.37m²	
	Verandah	1	4.62	1.38	–	6.37 m²	
						39.35m²	
7.7	20 mm thick screed						
	Room no-1	1	5	2.5	–	12.5m²	
	Room no-2	1	5	4.5	–	22.5m²	
	Verandah	1	5.2	1.73	–	8.99m²	
	Deductron						
	Brick pillar	4	0.23	0.23	–	0.21m²	
						43.78m²	
7.8	20 mm thick marble paving						
	Room no-1	1	5	2.5	–	12.5m²	
	Room no-2	1	5	45	–	22.5m²	
	verandah	1	5.2	1.73	–	8.99 m²	
	Deductron						
	Britk pillar	4	0.23	0.23	–	0.21m²	
						43.78m²	

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8	Plaster work						
8.1	12.5mm thick cement sand plaster (1:4) inside the building						
	• Ceiling						
	Room no-1	1	5	2.5	–	12.5m²	
	Room no-2	1	5	4.5	–	22.5m²	
	• Wall						
	Room no-1	1	15	–	3	45m²	l = 2.5x2+5x2
	Room no-2	1	19	–	3	57m²	l = 5x2+4.5x2
	Sides of shelves	2	4	0.23	[illegible]	1.84m²	l = 1+1+1+1
	Deduction			Subtotal		138.84m²	
	Door (D)	1x½	1.2	–	2.1	1.26m²	
	D1	1	1	–	2.1	2.1 m²	
	Window (W)	2x½	1.8	–	1.35	2.43m²	
	W1	3x½	1.5	–	1.35	3.03 m²	
				deduction		8.82m²	
				Total =		130.02m²	
8.2	20mm thick cement sand Plaster (1:4) outside the building.						
	upto plinth	1	31.49	–	0.76	23.89m²	l = (8.05+0.06+0.06)x2 + (5.7+1.73+0.06x2)x2
	Above plinth level	1	27.5	–	3	82.5m²	h = 0.6+0.06+0.1 l = 8.05x2+5.7x2
	Verandah						
	Ceiling	1	4.74	1.5	–	7.11m²	l = 5.2−0.23−0.23
	Wall						
	Inside surface	1	7.74	–	0.9	6.96m²	l = 4.74+2x1.5
	Outside surface	1	8.60	–	0.9	7.79m²	h = 3−2.1 l = 5.2+2x1.73
	soffit of wall	1	7.28	0.23	–	1.67m²	l = 1.39+1.5+1.39+1.5x2

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	Brick pillar	4	0.92	—	2.1	7.72m²	l = 0.23×4
	• parapet wall						
	Inside surface	1	29.12	—	0.6	17.47m²	l = (8.05 − 0.23 − 0.23)×2 + (5.7 + 1.73 − 0.23 − 0.23)×2
	outside surface	1	30.96	—	0.6	18.57m²	l = 8.05×2 + (5.7 + 1.73)×2
	Top	1	30.04	0.57	—	17.12m²	l = (18.05 − 0.23)×2 + (5.7 + 1.73 − 0.23)×2
							b = (0.06 + 0.05)×2 + 0.35
	• Projection slab						
	Top portion	1	33.36	0.6	—	20.01m²	l = (8.05 + 0.6×2)×2 + (5.7 + 1.73)×2
	Soffit of slab	1	33.36	0.6	—	20.01m²	l = (8.05 + 0.6 + 0.6)×2 + (5.7 + 1.73 + 0.6×2)×2
	Eaves of slab	1	35.76	—	0.1	3.57m²	
	Deduction					234.39 m²	
	Door (D)	4×½	1.2	—	2.1	1.26m²	
	Window (W)	2×½	1.8	—	1.35	2.43m²	
	W1	3×½	1.5	—	1.35	3.03m²	
						6.72m²	
					Total	227.67m²	
9	Painting work						
9.1	Distemper paint inside & outside building				130.02+	227.67m² (same as plastering) = 357.69m²	
9.2	Enamel paint on the door & window						
	panel door (D)	1×2	2.5 1.2	—	2.1	6.3m²	
	Flush door (D1)	1×2	2.25 1	—	2.1	4.72m²	
	Openable glazed window W	2×1	1.6 1.8	—	1.35	7.77m²	
	W1	3×1	1.6 1.5	—	1.35	9.72m²	
						28.51m²	
10	Roofing						
10.1	75 mm thick screed	1	7.59	5.24	—	39.77m²	l = 8.05 − 0.23 − 0.23 b = 5.7 − 0.23 − 0.23
		1	4.74	1.73	—	8.2m²	l = 5.2 − 0.23 − 0.23 b = 1.73 + 0.23 − 0.23
10.2	Neat cement punning	1	7.59	5.24	—	39.77m²	
		1	4.74	1.73	—	8.2m²	
						95.94m²	

Detailed Estimate of Framed Structure Building

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* Some points:-

(a) Diameters of Reinforcement Bars

6mm, 8mm, 10mm, 12mm, 16mm, 20mm, 25mm, 28mm, 32mm & 40mm

(b) Standard length of steel bar = 12m

(c) Weight of steel bar

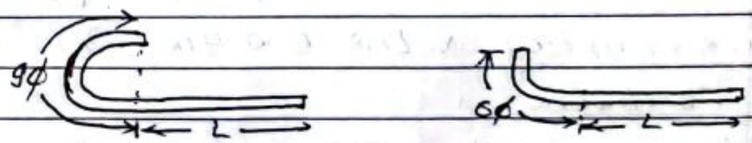
$$\text{Weight } (W) = \frac{d^2}{162} \text{ kg/m}$$

where, d = diameter of bar in mm

(d) Clear Cover:

Footing = 50 mm
Column = 40 mm
Beam = 25 mm
Slab = 15 mm

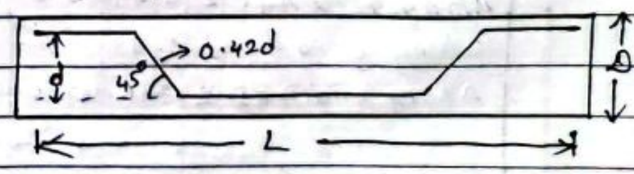
(e) Hook length:



(f) Overlapping / Lap length

Tension bar → 50ϕ & Compression member = 47.5ϕ

(g) Crank bar / bent up bars:



cutting length of cranked bar = L + 0.42d + 0.42d

d = D − 2 * clear cover.

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(i) Number of bars

$$\text{number of bars} = \frac{\text{Total length}}{\text{spacing}} + 1$$

(j) Length of stirrups

Length of stirrups = $2(a+b) + 24\phi$

$a = A - 2*\text{Clear cover} - 2*\text{dia of stirrups}$

$b = B - 2*\text{clear cover} - 2*\text{dia of stirrups}$



(k) Steps used to calculate reinforcement

→ Calculate length of bar
→ Calculate number of bar
→ Total length of bar = number of bar * length of bar
→ Check the bar diameter
→ weight per 'm' = $d^2/162$ kg/m
→ Total weight of steel = Total length x weight per m.

* Estimation of Two Room Framed Structure Building:-

S.N	Description	No	L(m)	B(m)	H(m)	Q	Remarks
1.	Earthwork						
1.1	Earthwork in Excavation						
	Footing F_1	2	1.8	1.8	1.5	$9.72m^3$	
	F_2	4	1.5	1.5	1.5	$13.5m^3$	$l = 4.73 - 1.5/2 - 1.5/2$
	Along grid A&C	2	3.23	0.6	0.6	$2.32m^3$	$= 3.23m$
	Along grid B	1	2.93	0.6	0.6	$1.05m^3$	$l = 4.73 - 1.8/2 - 1.8/2$
	Along grid ① & ②	2	3.66	0.6	0.6	$2.63m^3$	$l = 3.73 + 3.23 - 1.5/2 - 1.8 - 1.5/2$
						$29.22m^3$	
1.2	Earthwork in filling	1	1/5	* 29.22		$5.844m^3$	

2.	Flat Brick Soiling						
	Footing F_1	2	1.8	1.8	—	$6.48m^2$	
	F_2	4	1.5	1.5	—	$9m^2$	
	Along grid A & C	2	3.23	0.6	—	$3.87m^2$	
	Along grid B	1	2.93	0.6	—	$1.76m^2$	
	Along grid ① & ②	2	3.66	0.6	—	$4.39m^2$	
						$25.5m^2$	
3	Concrete Work in Footing						
3.1	75mm thick PCC (1:3:6)						
	Footing F_1	2	1.8	1.8	—	$6.48m^2$	
	F_2	4	1.5	1.5	—	$9m^2$	
	Along A & C	2	3.23	0.6	—	$3.87m^2$	
	Along B	1	2.93	0.6	—	$1.76m^2$	
	Along 1 & 2	2	3.66	0.6	—	$4.39m^2$	
						$25.5m^2$	
4.	RCC Work						
4.1	Concrete work upto tie beam						
	Footing (F_1)						
	square	2	1.8	1.8	0.2	$1.29m^3$	
	trapezoidal	2	1/2	(1.8x1.8 + 0.7x0.7)x0.3		$1.12m^3$	$h = 0.5 - 0.2$
	Footing (F_2)				—		
	Square portion	4	1.5	1.5	0.2	$1.8m^3$	
	Trapezoidal portion	4	1/2	(1.5x1.5 + 0.7x0.7) x 0.25		$1.39m^3$	$h = 0.45 - 0.2$
	Column upto tie beam						
	Column (C1)	2	0.3	0.3	1.47	$0.26m^3$	$h = 1.5 + 0.6 - 0.055 - 0.075 - 0.5$
		4	0.3	0.3	1.52	$0.55m^3$	$h = 1.5 + 0.6 - 0.075 - 0.45 - 0.055$
	Tie beam				—		
	Along A, B, C	3	4.43	0.23	0.35	$1.07m^3$	$l = 4.73 - 0.3/2 - 0.3/2$
	Along ① & ②	2	6.36	0.23	0.35	$1.02m^3$	$l = 3.73 + 3.23 - 0.3/2 - 0.3 - 0.3/2$

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4.2	Formwork upto tie beam						
	Footing (F_1)	2	7.2	–	0.2	2.88 m²	$l = 1.8 \times 4$
	F_2	4	6	–	0.2	4.8 m²	$l = 1.5 \times 4 = 6$
	Column, C_1	2	1.2	–	1.47	3.53 m²	$l = 0.3 \times 4 = 1.2$
	C_1	4	1.2	–	1.52	7.29 m²	
	Tie beam						
	Along grid A, B & C	3	4.43	0.93	–	12.36 m²	$b = 0.35 + 0.23 + 0.35$
	Along grid 1 & 2	2	6.36	0.93	–	11.83 m²	
						42.69 m²	
4.3	RCC Work in Superstructure (1:1.5:3)						
	Column C_1	6	0.3	0.3	3	1.62 m³	
	Floor beam						
	Along Grid A & C	2	4.43	0.23	0.22	0.45 m³	$l = 4.73 - 0.3/2 - 0.3/2$
	Along Grid B	1	4.43	0.23	0.22	0.22 m³	$h = 0.35 - 0.13$
	Along Grid 1 & 2	2	6.36	0.23	0.22	0.64 m³	$l = 3.73 + 3.23 - 0.3 - \frac{0.3}{2} - \frac{0.3}{2}$
	Slab	1	8.16	5.93	0.13	6.29 m³	$l = 3.73 + 3.23 + 0.6 + 0.6$
						9.22 m³	$b = 4.73 + 0.6 + 0.6 = 5.93$
4.4	Formwork in Super structure,						
	Column C_1	6	1.2	–	3	21.6 m²	$l = 0.3 \times 4$
	Floor beam	~~2~~	~~4.43~~				
	Along grid A & C	2	4.43	–	0.44	3.89 m²	$h = 0.22 + 0.22$
	Along grid B	1	~~4.43~~	–	0.44	1.94 m²	(two sides only)
	Along grid 1 & 2	2	6.36	–	0.44	5.59 m²	
	Slab	1	8.16	5.93	–	48.38 m²	$l = 3.73 + 3.23 + 0.6 + 0.6$
	Eaves of slab	1	28.12	–	0.13	3.66 m²	$l = 8.16 \times 2 + 5.93 \times 2$
						85.06 m²	

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Bar Bending Schedule (BBS)

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N = Number of bar, n = Number of items

SN	Description	N	n	L(m)	Size (mm)	Ø(m)	$d^2/162$	Total kg	Remarks
1.	Foundation & GF								$l = 1.8 - 2\times0.05 + 2\times6\times0.016$
	Footing F_1	22	2	1.892	16	83.24	1.58	131.53	$N = \left(\frac{1.8 - 2\times0.05}{0.18}\right) + 1$ in one direction
									= 11 in one direction
	Footing F_2	18	4	1.592	16	114.62	1.58	181.1	$l = (1.5 - 2\times0.05) + 2\times6\times0.016$
									$N = \left(\frac{1.5 - 2\times0.05}{0.18}\right) + 1$ in one direction
2.	Column upto tie beam								
	Column (C_1)								
	4 nos. 20mm Ø	4	6	3.138	20	75.31	2.47	186.01	$L = 1.5 + 0.6 - 0.055 - 0.075 - 0.05 - 2\times0.016 + 0.3 + 47.5\times0.02$
	4 nos. 16mm Ø	4	6	2.948	16	70.75	1.58	111.78	$L = 1.5 + 0.6 - 0.055 - 0.075 - 0.05 - 2\times0.016 + 0.3 + 47.5\times0.016$
	Tres (8Ø @ 100 c/c)								
	Square Type	20	6	1.008	8	120.96	0.4	48.38	$\text{Number} = \left(\frac{1.5+0.6-0.055-0.075}{0.1} - 0.05 - 2\times0.016\right) + 1$
									$a = 0.3 - 2\times0.04 - 2\times0.008 = 0.204$
									$b = 0.3 - 2\times0.04 - 2\times0.008 = 0.204$
									$L = 2(a+b) + 24 * 0.008 = 1.008$
	Rhombus Type	20	6	0.768	8	92.16	0.4	36.86	$h = \sqrt{p^2+b^2} = \sqrt{0.102^2+0.102^2}$
									$= 0.144$
									$a = 0.144$, $b = 0.144$
									$L = 2(0.144 + 0.144) + 24\times0.008$
3.	Tie beam								
3.1	Along grid A, B, C								
	3-16Ø, bottom bar	3	3	6.35	16	57.15	1.58	90.29	$L = 4.73 - 0.3/2 - 0.3/2 + 2\times60\times0.016$
	3-16Ø, top bar	3	3	6.35	16	57.15	1.58	90.29	
	8Ø stirrups @ 150 c/c	31	3	1.088	8	101.18	0.4	40.47	$No = \left(\frac{4.73 - 0.3}{0.15}\right) + 1 = 30.53$
									$L = (2+3)\,124\times0.008 = 1.088$
									$a = 0.23 - 2\times0.025 - 2\times0.008 = 0.164$
									$b = 0.35 - 2\times0.025 - 2\times0.008 = 0.284$

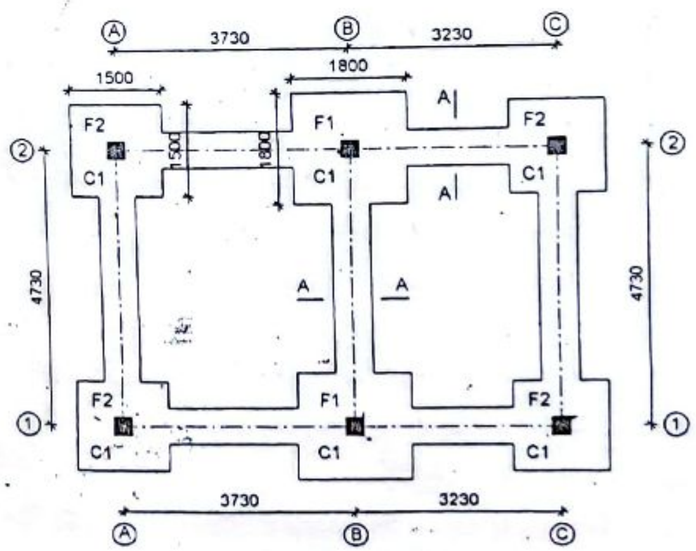
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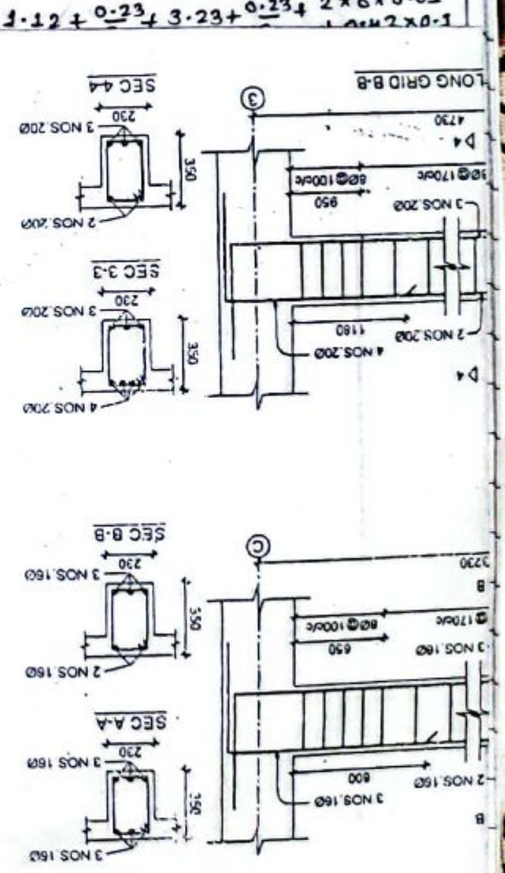
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3.2	Along grids ⑧2								
	3-16ϕ bottom bar	3	2	8.58	16	51.48	1.58	81.33	L = 3.73+3.23 − 0.3/2 − 0.3/2 + 2×60×0.016
	3-16ϕ top bar	3	2	8.58	16	51.48	1.58	81.33	
	8ϕ stirrups @ 150mm c/c	45	2	1.088	8	97.92	0.4	39.17	No. of stirrups = (3.73−0.3+1)/0.15 + (3.23−0.3)/0.15 + 1 + 1
4.	Rebar in Superstructure								
4.1	Column C_1								
	4 nos. 20mmϕ	4	6	3.85	20	92.4	2.47	228.2	L = 3 − 0.35 + 60×0.02 = 3.85
	4 nos. 16 mmϕ	4	6	3.61	16	86.64	1.58	136.88	L = 3 − 0.35 + 60×0.016
	Ties (8ϕ@100c/c)								
	square	31	6	1.008	8	187.488	0.4	74.99	N = (3 − 0.04)/0.1 + 1 = 30.6
	Rhombus	31	6	0.763	8	142.84	0.4	57.14	
4.2	Floor beam								
	Along grid Ⓐ Ⓑ & Ⓒ								
	3-20mmϕ bottom	3	3	6.83	20	61.47	2.47	151.83	L = 4.73 − 0.3/2 − 0.3/2 + 2×60×0.02
	2-20mmϕ top bar	2	3	6.83	20	40.98	2.47	101.22	
	Extra bar	2	3	2.455	20	14.73	2.47	36.38	L = 1.18 + 60×0.02 + 0.075
	8mmϕ stirrups	36	3	1.088	8	117.504	0.4	47	No. of stirrups = (0.95/0.3 + 1)×2 + (4.73 − 0.3 − 0.3/2)/0.17 = 36
									a = 0.23 − 2×0.025 − 2×0.008 = 0.164
									b = 0.35 − 2×0.025 − 2×0.008 = 0.284
									L = 2(a+b) + 24ϕs = 1.088m
	Along grid 1 & 2								
	3-16mmϕ bottom	3	2	8.58	16	51.48	1.58	81.33	L = 3.73+8.23 − 0.3/2 − 0.3/2 + 2×60×0.016
	2-16mmϕ top	2	2	8.58	16	34.32	1.58	54.22	
	Extra bar	1	2	1.965	16		1.58		L = 0.93 + 60×0.016 + 0.075
		1	2	2.18	16		1.58		L = 0.93 + 0.3 + 0.8 + 2×0.075
		1	2	1.835	16		1.58		L = 0.8 + 60×0.016 + 0.075
	Stirrups								
	In span 3.73m	29	2	1.088	8	63.1	0.4	25.24	No = (0.75/0.1 + 1)×2 + (3.73 − 0.3 − 2×0.75)/0.17
	In span 3.23m	25	2	1.088	8	54.4	0.4	21.76	No = (0.65/0.1 + 1)×2 + (3.23 − 0.3 − 2×0.65)/0.17
4.3	Slab								No. of bar, a⑧b = (4.73 − 0.23/2 − 0.23/2)/0.15 + 1 = 31
	Bar 'a'	16	1	4.607	10	73.71	0.62	45.7	L = 3.73 + 0.6 + 0.23/2 + 2×6×0.01 + 0.42×0.1/0.1
									d = 0.13 − 2×0.015 = 0.1
	Bar 'b'	15	1	~~5.092~~ 4.927	10	76.38	0.62	47.35	L = 3.73 + 0.23/2 + 0.23/2 + 0.97 + 0.42×0.1 + 2×6×0.01
	Bar 'c'	16	1	4.107	10	65.71	0.62	40.74	L = 3.23 + 0.23/2 + 0.6 + 2×6×0.01 + 0.42×0.1
	Bar 'd'	15	1	4.742	10	71.13	0.62	44.1	L = 1.12 + 0.23/2 + 3.23 + 0.23/2 + 2×6×0.01 + 0.42×0.1

Two =



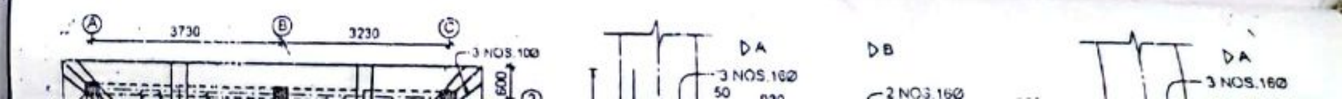


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3.2	Along grid 1 & 2									
	3-16ϕ bottom bar	3	2	8.58	16	51.48	1.58	81.33	L = 3.73+3.23−0.3/2−0.3/2 +2×60×0.016	
	3-16ϕ top bar	3	2	8.58	16	51.48	1.58	81.33		
	8ϕ stirrups @ 150mm c/c	45	2	1.088	8	97.92	0.4	39.17	NO. of stirrups = (3.73−0.3+3.23−0.3)/0.15 +1+1	
4.	Rebar in Superstructure									
4.1	Column C_1									
	4 nos. 20mmϕ	4	6	3.85	20	92.4	2.47	228.2	L = 3−0.35+60×0.02 = 3.85	
	4 nos. 16 mmϕ	4	6	3.61	16	86.84	1.58	136.88	L = 3−0.35+60×0.016	
	Ties (8ϕ@100c/c)									
	square	31	6	1.008	8	187.48	0.4	74.99	N = (3−0.04)/0.1 +1 = 30.6	
	Rhombus	31	6	0.768	8	142.84	0.4	57.14		
4.2	Floor beam									
	Along grid A,B&C									
	3-20mmϕ bottom	3	3	6.83	20	61.47	2.47	151.83	L = 4.73 − 0.3/2 − 0.3/2 + 2×60×0.02	
	2-20mmϕ Top bar	2	3	6.83	20	40.98	2.47	101.22		
	Extra bar	2	3	2.455	20	14.73	2.47	36.38	L = 1.28 + 60×0.02+0.075	
	8mmϕ stirrups	36	3	1.088	8	117.504	0.4	47	No. of stirrups = (0.95/0.1 +1)×2 + (4.73−0.3−0.85/0.17) = 36	
									a = 0.23 − 2×0.025 − 2×0.008 = 0.164 b = 0.35 − 2×0.025 − 2×0.008 = 0.284 L = 2(a+b) + 24ϕ8 = 1.088m	
	Along grid 1 & 2									
	3-16mmϕ bottom	3	2	8.58	16	51.48	1.58	81.33	L = 3.73+3.23 − 0.3/2 − 0.3/2 + 2×60×0.016	
	2-16mmϕ Top	2	2	8.58	16	34.32	1.58	54.22		
	Extra bar	1	2	1.965	16		1.58		L = 0.93 + 60×0.016 + 0.075	
		1	2	2.18	16		1.58		L = 0.93 + 0.3 + 0.8 + 2×0.075	
		1	2	1.835	16		1.58		L = 0.8 + 60×0.016 + 0.075	
	Stirrups									
	In Span 3.73m	29	2	1.088	8	63.1	0.4	25.24	No = (0.75/0.1 +1)×2 + (3.73−0.3−2×0.75/0.17)	
	In span 3.23m	25	2	1.088	8	54.4	0.4	21.76	No = (0.65/0.1 +1)×2 + (3.23−0.3−2×0.65/0.17)	
4.3	Slab								No. of bar, a&b = (4.73−0.23/2−0.23/2)/0.15 +1 = 31	
	Bar 'a'	16	1	4.607	10	73.71	0.62	45.7	L = 3.73+0.6+0.23/2 +2×6×0.01+0.42×0.1 ; d = 0.13−2×0.015 = 0.1	
	Bar 'b'	15	1	5.092 ~~5.979~~	10	76.38	0.62	47.35	L = 3.73+0.23/2+0.23/2+0.97+0.42×0.1 +2×6×0.01	
	Bar 'C'	16	1	4.107	10	65.71	0.62	40.74	L = 3.23+0.23/2+0.6+2×6×0.01+0.42×0.1	
	Bar 'd'	15	1	4.742	10	71.13	0.62	44.1	L = 1.12+0.23/2+3.23+0.23/2+2×6×0.01 +0.42×0.1	
	Bar 'e'	45	1	5.607	10	252.3	0.62	156.43	No = (3.73+3.23−0.23−0.23)/0.15 +1 = 45 ; L = 4.73+0.6+0.23/2+0.42×0.1+2×6×0.01	
	Bar 'f'	16	1	1.955	10	31.28	0.62	19.39	No. of bar = (4.73−0.23)/0.3 +1 = 16 ; L = 1.12+0.23/2+0.6+2×6×0.01	
	Bar 'g'	16	1	1.805	10	28.88	0.62	17.91	L = 0.97+0.23/2+0.6+2×6×0.01	
	Bar 'h'	23	2	2.235	10	102.81	0.62	63.74	No. of bar = (3.73+3.23−0.23−0.23)/0.3 +1 = 23 ; L = 1.4+0.23/2+0.6+2×6×0.01	



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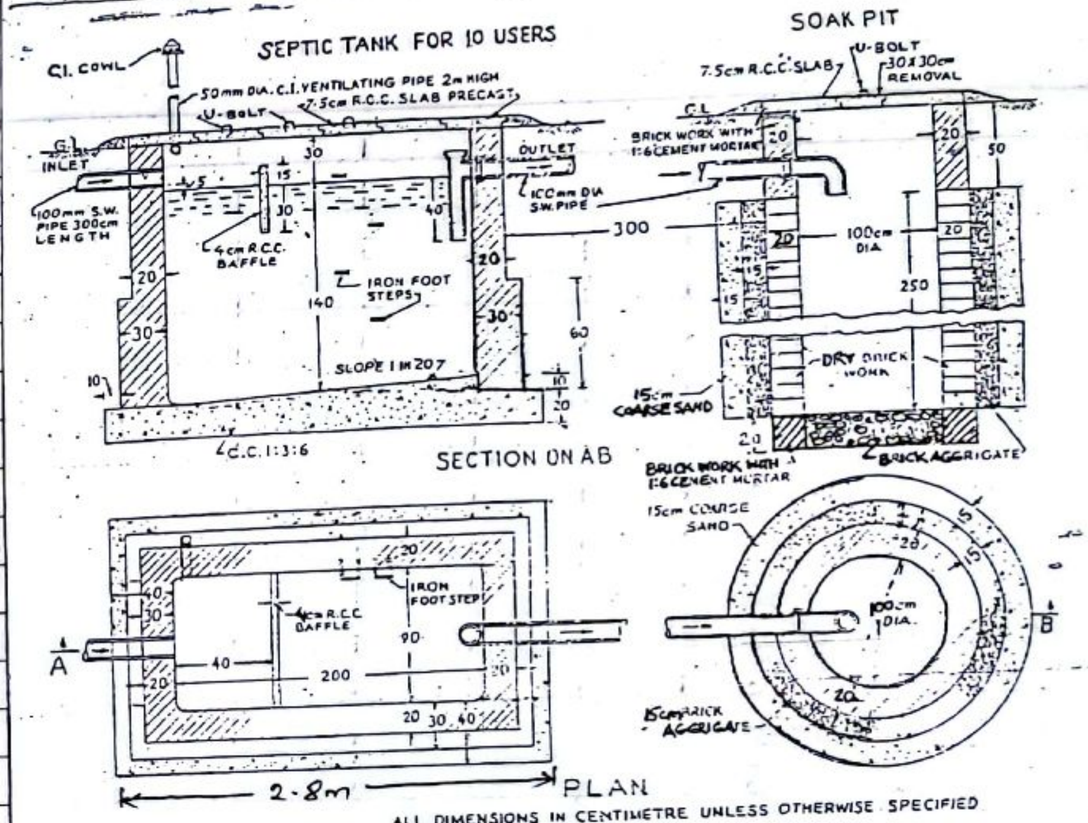
Sumit Paudel

* Estimate of a Septic Tank :-

DATE

S.N.	Description	No	L(m)	B(m)	H(m)	Q	Remarks
1.	Earthwork in Excavation						L = 2+0.4+0.4
	septic tank	1	2.8	1.7	1.95	9.28 m³	B = 0.8+0.4x2
	Soakpit						H = 1.4+0.3+0.2+0.1/2
	→ upto 3m	1	$\frac{\pi x 2^2}{4} = 3.14$	–	3	9.42 m³	
	→ below 3m	1	$\frac{\pi x 1.4^2}{4}$		0.2	0.31 m³	
					Total	19.01 m³	
2.	Cement Concrete (1:3:6)						
	Septic tank						
	a) Rectangular portion	1	2.8	1.7	0.2	0.952 m³	L = 2+0.4+0.4
	b) slope portion	1	2	0.9	0.05	0.09 m³	H = (0.1+0)/2
3)	1st class brickwork 1:4 cement mortar						
	Septic tank						
	1st step						
	Long wall	2	2.6	0.3	0.6	0.936 m³	L = 2+0.3+0.3
	short wall	2	0.9	0.3	0.6	0.324 m³	
	2nd step						
	Long wall	2	2.4	0.2	1.15	1.104 m³	L = 2+0.2+0.2
	short wall	2	0.9	0.2	1.15	0.414 m³	H = 1.4+0.3+0.05-0.6
4)	2nd class brickwork 1:4 cement mortar in soak pit						
	upper portion	1	π x 1.2	0.2	0.5	0.376 m³	
	Lower portion	1	π x 1.2	0.2	0.2	0.151 m³	
5)	Dry brickwork in soakpit	1	π x 1.2	0.2	2.5	1.884 m³	
6)	Coarse Sand filling in soakpit	1	π x 1.35	0.15	2.5	2.179 m³	D = 1+0.2x2+0.15+0.15
7)	Brick aggregate filling in soakpit						
	side	1	π x 1.55	0.15	2.5	1.826 m²	D = 1+0.2x2+0.15
	bottom surface	1	π x 3²/4	–	0.2	0.157 m³	

ESTIMATE OF A SEPTIC TANK



ALL DIMENSIONS IN CENTIMETRE UNLESS OTHERWISE SPECIFIED

Fig. 119

Septic tank shall be of a first class brick work in 1:4 cement mor The foundation and floor shall be of 1:3:6 cement concrete Inside of septic tank shall be finished with 12 mm thick cement plaster and floor shall be finished with 20mm thick cement plaster with 1:3 mortar mixed with water proofing compound

Upper and lower portions of soak pit shall be of second class brick work in 1:6 cement mortar and middle portion shall be of dry brick work.

Roof covering slabs and baffle wall shall be of precast R.C

The length of the connection pipe from latrine seat may be

Sumit Paudel

* Estimate of a Septic Tank :-

DATE

S.N.	Description	No	L(m)	B(m)	H(m)	Q	Remarks
1.	Earthwork in Excavation						L = 2+0.4+0.4
	septic tank	1	2.8	1.7	1.95	9.28 m³	B = 0.8+0.4×2
	Soakpit						H = 1.4+0.3+0.2+0.1/2
	→ upto 3m	1	$\frac{\pi \times 2^2}{4} = 3.14$	–	3	9.42 m³	
	→ below 3m	1	$\frac{\pi \times 1.4^2}{4}$		0.2	0.31 m³	
					Total	19.01 m³	
2.	Cement Concrete (1:3:6)						
	Septic tank						
	a) Rectangular portion	1	2.8	1.7	0.2	0.952 m³	L = 2+0.4+0.4
	b) slope portion	1	2	0.9	0.05	0.09 m³	H = (0.1+0)/2
3)	1st Class brickwork						
	1:4 cement mortar						
	Septic tank						
	1st step						
	Long wall	2	2.6	0.3	0.6	0.936 m³	L = 2+0.3+0.3
	short wall	2	0.9	0.3	0.6	0.324 m³	
	2nd step						
	Long wall	2	2.4	0.2	1.15	1.104 m³	L = 2+0.2+0.2
	short wall	2	0.9	0.2	1.15	0.414 m³	H = 1.4+0.3+0.05−0.6
4)	2nd class brickwork						
	1:4 cement mortar						
	in soak pit						
	upper portion	1	π×1.2	0.2	0.5	0.376 m³	
	Lower portion	1	π×1.2	0.2	0.2	0.151 m³	
5)	Dry brickwork in soakpit	1	π×1.2	0.2	2.5	1.884 m³	
6)	Coarse Sand filling in soakpit	1	π×1.85	0.15	2.5	2.179 m³	D = 1+0.2×2+0.35/2+0.15
7)	Brick aggregate filling in soakpit						
	side	1	π×1.55	0.15	2.5	1.826 m²	D = 1+0.2×2+0.15
	bottom surface	1	$\pi \times 2^2/4$	–	0.2	0.157 m³	

8)	12mm thick cement plaster inside Septic tank						
	Long wall	2	2		1.7	6.8 m²	L = 2 m, H = 1.7
	Short wall	2	0.9	–	1.7	3.06 m²	L = 0.9 m
9)	20 mm thick cement plaster (1:4) on floor	1	2	0.9	–	1.8 m²	
10)	RCC precast slab in septic tank	1	2.4	1.3	0.075	0.234 m³	B = 0.9+0.2×2 L = 2+0.2×2
	Baffle wall	1	1.1	0.05	0.45	0.037 m³	Bearing, 10 mm on each wall
	Cover slab of soakpit	1	$\frac{\pi \times 1.4^2}{4}$	–	0.075	0.115 m³	D = 1+0.2+0.2
11)	Vent pipe with circowl (50mm ϕ)	1	2				
	100mm ϕ inlet sewerage pipe	1	3				
	100 mm dia tee	1					
	Iron foot step	4					
	100 mm ϕ outlet sewer pipe	1	3				

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* Estimate of slab Culvert:-

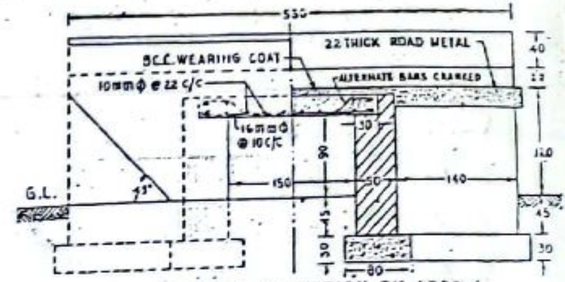
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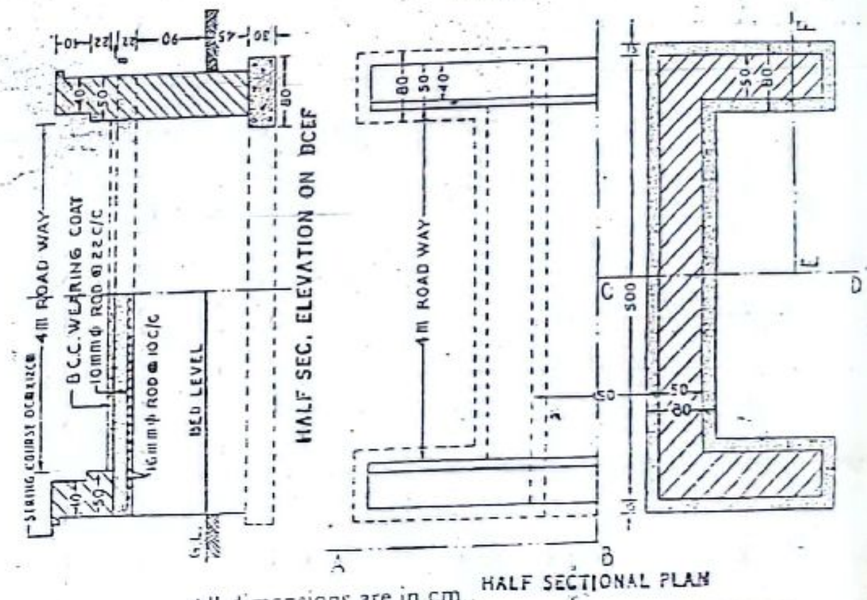
S.N.	Description	No	L(m)	B(m)	H(m)	Qty	Remarks
1.	Earthwork in Excavation						L = 5 + 0.15×2
	a) Abutment wall	2	5.3	0.8	0.75	6.36m³	h = 0.45+0.3
	b) Wing wall	4	1.4	0.8	0.75	3.36m³	
2.	Cement concrete in foundation (1:2:4)						
	a) Abutment wall	2	5.3	0.8	0.3	2.54m³	
	b) Wing wall	4	1.4	0.8	0.3	1.34m³	
3.	First class brick work in cement mortar (1:4)						
	a) Abutment wall	2	5	0.5	1.57	7.85m³	h = 0.9+0.45+0.22
	b) Wing wall	4	1.4	0.5	1.57	4.7m³	
	c) parapet wall, 50cm layer	2	5.3	0.5	0.3	1.59m³	
	d) parapet wall, 40cm layer	2	5.3	0.4	0.4	1.69m³	
*	Deduction for bearing of RCC slab in abutment	2	5	0.3	0.22	−0.66m³	
4.	String course 8×12 cm	2	5.3			10.6Rm	
5.	RCC slab excluding reinforcement cement but including shuttering & centering	2	5.3	2.1	0.22	2.31m³	
6.	Reinforcement						
	a) 16mm ϕ straight bar	26	2.338	60.788	@ 1.58kg/m	96.06kg	No. of bar = $\frac{5-2\times0.025}{0.1}$ +1 = 51
	b) 16mm ϕ bentup bar	25	2.48	62	@ 1.58kg/m	97.96kg	(25+26)
	c) 10mm ϕ bottom distb bar	11	5.238	57.618	@ 0.617 kg/m	35.55kg	No. of bar = $\frac{2.1-2\times0.025}{0.1}$ +1 = 11
	d) 10mm ϕ top distb bar	2×3	5.238	31.428	@ 0.617 kg/m	19.39kg	
7.	Cement pointing (1:3) to exposed surface of brickwork						
	a) Inner faces of abutment	2	5	—	1.05	10.5m²	h = 0.9+0.16
	b) Face wall	2	5.3	—	1.97	20.88m²	h = 1.2+0.22+0.4+0.15
	c) Innerside & top of parapet	2	5.3	—	1.12	11.87m²	h = 0.22+0.9+0.1+0.4
	d) Ends of parapet	2×2 2×2	0.5 0.4	= =	0.3 0.4	0.6 m² 0.64 m²	
*	Deduction for						
	a) Rectangular opening	2	1.5	—	1.05	−3.15m²	
	b) Triangular portion of face wall	4×½	1.4	1.4	—	−3.92m²	

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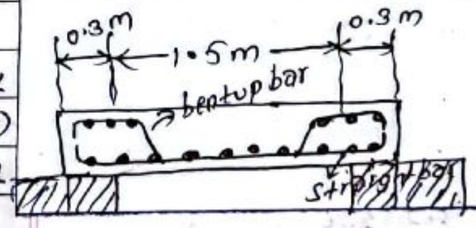
10-15 cm plaster

3. Calculate the quantities of the following item of work for a slab culvert of 1.5 clear span and 4.0 m roadway from the accompanying drawing.
   i) Earthwork in excavation
   ii) First class brickwork
   iii) RCC slab
   iv) Reinforcement





All dimensions are in cm.



Nominal mass per running meter
For 10 mm ϕ 0.617 kg
Fro 20 mm ϕ 2.467 kg
Consider cover of slab = 25 mm

Leff = 1.5 + 0.3 = 1.8m

Length of straight bar = 2.1 − 2×0.025 + 2×9×0.016 = 2.338

Length of bentup bar = 2.1 − 2×0.025 + 2×9×0.016 + 2×0.42d = 2.48m
(d = D − 2×0.025) = 0.17m

length of distb bar = 5 − 2×0.025 + 2×9×0.016 = 5.238m

No. of 10mm ϕ top distb bar = $\frac{0.9}{0.22}$ = 4.09 ≈ 6 = 2×3

$(L/4 + L/4) = L/2 = 1.8/2 = 0.9m$

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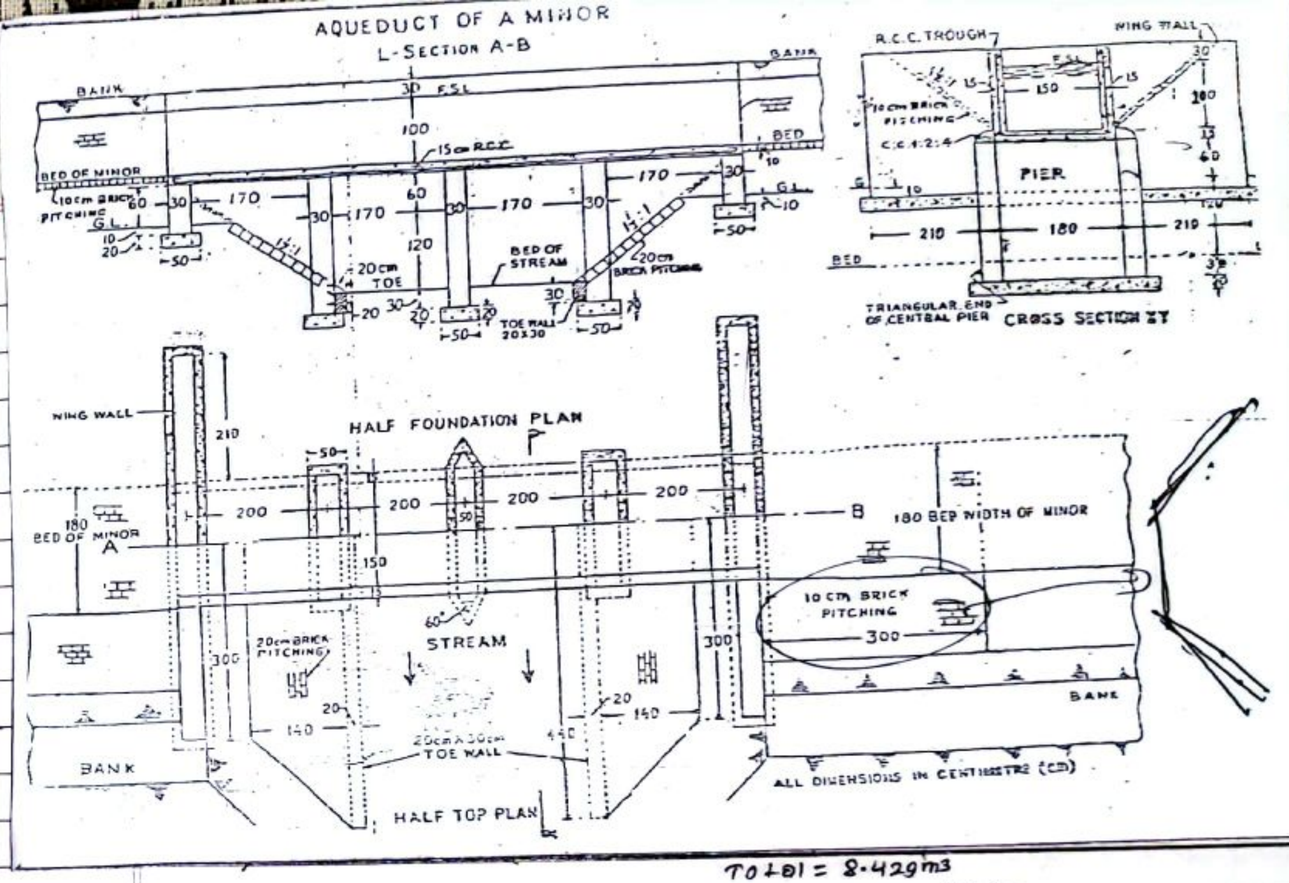
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Estimation of Aqueduct of a Minor:-

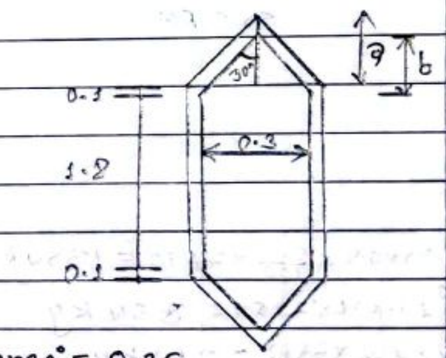
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SN	Description	NO	L(m)	B(m)	H(m)	Qty	Remarks
1.	Earthwork in excavation in foundation					(m³)	L = 1.8+0.1+0.1
a)	Central pillar straight portion	1	2.0	0.5	0.5	0.508	h = 0.3+0.2
b)	Central pillar traingular portion	2	$\frac{1}{2}$ x	0.5x0.43	0.5	0.1075	
c)	Ends pillar at bed	2	2	0.5	0.5	1	L = 1.8+0.1x2
d)	Ends pillar at bank including wing wall	2	6.2	0.5	0.3	1.86	L = 0.1+3+3+0.1
e)	Slopes of stream for pitching	2	$\left(\frac{3.2+6}{2}\right)$	1.68	0.2	4973	prefer frgure.
f)	Slopes of minor for pitching	2x2	3	1.98	0.1	2376	b = $\sqrt{1.65^2+1.1^2}$
g)	Bed of minor of pitching	2	3	1.8	0.1	1.08	
i)	Toe wall	2	8.8	0.2	0.3	1.056	L = 4.4+4.4
					Total	12.952	m³
2.	Cement Concrete (1:4:8) in foundation						
a)	Central pillar straight portion	1	2.0	0.5	0.2	0.2	
b)	Central pillar traingular portion	2	$\frac{1}{2}$x	0.5x0.43	0.2	0.043	
c)	Ends pillar at bed	2	2	0.5	0.2	0.4	
d)	Ends pillar at bank	2	6.2	0.5	0.2	1.24	
					Total	1.883	m³
3.	I-class brickwork in cement mortar (1:4)						
a)	Central pillar straight portion	1	1.8	0.3	2.1	1.134	h = 0.3+1.2+0.6
b	Central pillar traing. portion	2	$\frac{1}{2}$x	0.3x0.26	2.1	0.164	
c)	Ends pillar at bed	2	1.8	0.3	2.1	2.26	
d)	Ends pillar at bank	2	6	0.3	0.7	2.52	h = 0.6+0.1
e)	wing wall	4	2.1	0.3	2.1	5.292	L = 3−0.9, h = 0.3+1.8
					Total	11.37	m³
4.	RCC work in trough excluding steel & its bending but including centering & shuttering						
	- Bottom slab	1	8.3	1.8	0.15	2.241	b = 1.8
	- Vertical sides	2	8.3	0.25	2.1	2.614	L = 8+0.15+0.15
					Total	4.85	m³

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Total = 8.429 m³

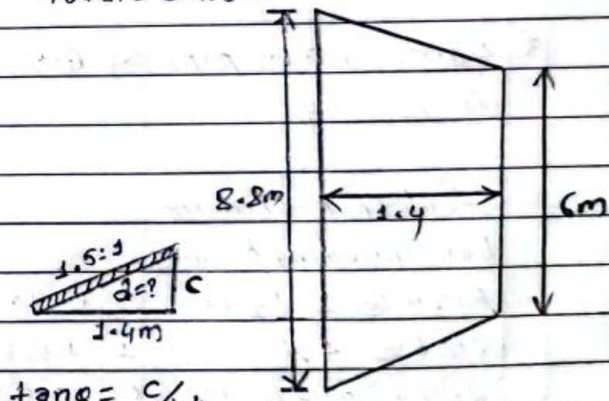


$\tan 30° = \frac{0.25}{a}$

$a = 0.43\,m$

$\tan 30° = \frac{0.15}{b}$

$b = 0.26\,m$



$\tan\theta = \frac{c}{1.4}$

$\frac{1}{1.5} = \frac{c}{1.4} \Rightarrow c = 1.4/1.5 = 0.93m$

$d = \sqrt{1.4^2+0.93^2} = 1.68m$

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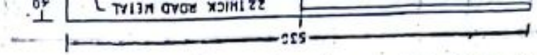
Estimation of Aqueduct of a Minor:-

DATE

SN	Description	NO	L(m)	B(m)	H(m)	Qty	Remarks
1.	Earthwork in excavation in foundation					(m^3)	L = 1.8+0.1+0.1
a)	Central pillar straight portion	1	2.0	0.5	0.5	0.500	h = 0.3+0.2
b)	Central pillar traingular portion	2	$\frac{1}{2}$ x	0.5x0.43	0.5	0.1075	
c)	Ends pillar at bed	2	2	0.5	0.5	1	L = 1.8+0.1x2
d)	Ends pillar at bank including wing wall	2	6.2	0.5	0.3	1.86	L = 0.1+3+3+0.1
e)	Slopes of stream for pitching	2	$\left(\frac{8.1+6}{2}\right)$	1.68	0.2	4.973	prefer figure.
f)	Slopes of minor for pitching	2x2	3	1.98	0.1	2.376	b = $\sqrt{1.65^2+1.1^2}$
g)	Bed of minor of pitching	2	3	1.8	0.1	1.08	
i)	Toe wall	2	8.8	0.2	0.3	1.056	L = 4.4+4.4
					Total	12.952 m^3	
2.	Cement Concrete (1:4:8) in foundation						
a)	Central pillar straight portion	1	2.0	0.5	0.2	0.2	
b)	Central pillar traingular portion	2	$\frac{1}{2}$x	0.5x0.43	0.2	0.043	
c)	Ends pillar at bed	2	2	0.5	0.2	0.4	
d)	Ends pillar at bank	2	6.2	0.5	0.2	1.24	
					Total	1.883 m^3	
3.	I-class brickwork in cement mortar (1:4)						
a)	Central pillar straight portion	1	1.8	0.3	2.1	1.134	h = 0.3+1.2+0.6
b)	Central pillar traing. portion	2	$\frac{1}{2}$x	0.3x0.26	2.1	0.164	
c)	Ends pillar at bed	2	1.8	0.3	2.1	2.26	
d)	Ends pillar at bank	2	6	0.3	0.7	2.52	h = 0.6+0.1
e)	[illegible] wing wall	4	2.1	0.3	2.1	5.292	L = 3-0.9, h = 0.3+1.8
					Total	11.37 m^3	
4.	RCC work in trough excluding steel & its bending but including centering & shuttering						
	- Bottom slab	1	8.3	1.8	0.15	2.241	b = 1.8
	- Vertical sides	2	8.3	0.15	2.1	2.614	L = 8+0.15+0.15
					Total	4.85 m^3	

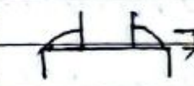
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5. Calculate the quantities of the following item of work for a slab culvert of 1.5 clear span and 4.0 m roadway from the accompanying drawing.

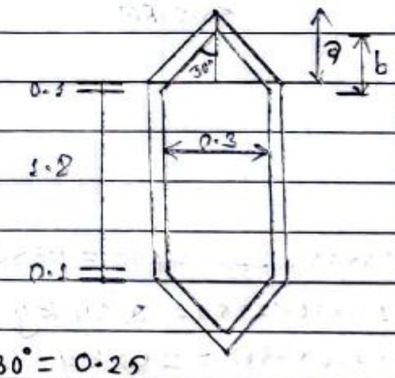


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5.	Mild steel reinforcement bars including bending in RCC works @ 1% of steel		$\frac{1}{100}$ x 485 x 78		50	380.7 kg	
6.	Cement concrete in top ends central piller	2	$\frac{1}{2}$x0.3	x0.25	$\frac{1}{3}$x0.15	0.0039 m^3	
7.	Cement pointing (1:2)					(m^2)	perimeter (P)
a)	Central piller	1	4.8	–	1.8	8.64	P = 1.8x2 + 4x$\sqrt{0.15^2+0.25^2}$
b	Ends piller at bed	2	4.2	–	1.8	~~15.12~~	L = 1.8x2+0.3x2
c)	Ends piller at bank	2	1.8	–	0.6	2.16	
d)	Wing wall	4	2.1	–	2.1	17.64	h = 1.8+0.3
					Total	43.56 m^2	
8.	Dry brick pitching with straight over burnt brick						
a)	Slopes of stream (20cm)	2	$\left(\frac{8+8+6}{2}\right)$	1.68	0.2	4.973	same as excavation
b)	Slopes of minor (10cm)	2x2	3	1.98	0.1	2.376	
c)	Bed of minor (10cm)	2	3	1.8	0.1	1.08	

Total = 8.429 m^3

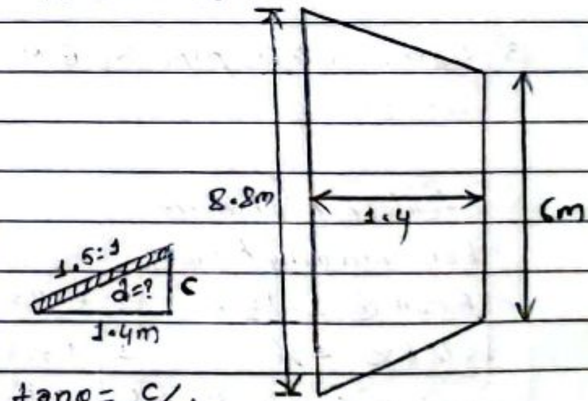


$\tan 30° = \frac{0.25}{a}$

$a = 0.43m$

$\tan 30° = \frac{0.15}{b}$

$b = 0.26m$



$\tan\alpha = c/1.4$

$\frac{1}{1.5} = \frac{c}{1.4} \Rightarrow c = 1.4/1.5 = 0.93m$

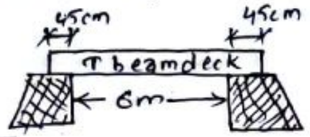
$d = \sqrt{1.4^2+0.93^2} = 1.68m$

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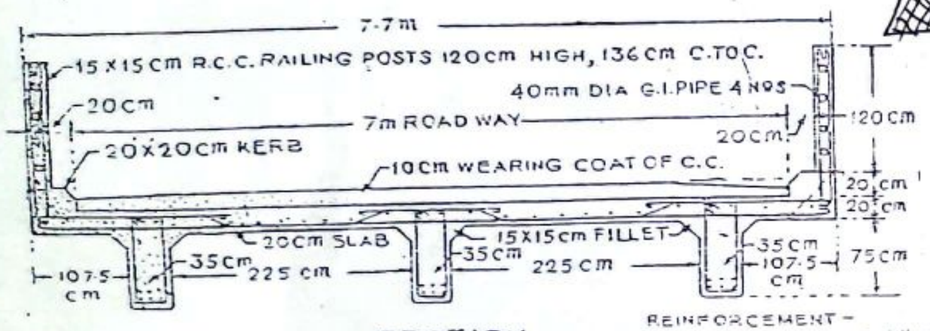
Estimation of RCC T beam Decking

Estimate the quantity of following item of work from the accompanying R.C.C T beam decking beam for a bridge of one span of 6.0m. The bearing of the beams on either side of abutment = 50cm.

a) RCC work (1:2:4) b) Wearing coat c) GI pipe in railing d) Steel rebar.



R. C. C. T-BEAM DECKING



SECTION

REINFORCEMENT –
BEAM — @ 2.5%
SLAB AND POSTS @ 1%

2)	RCC (1:2:4) in wearing coat	1	6.9	7	0.1	4.83	m^3
3)	40mm dia GI pipe in railing	2×4	6.9			55.2	RM
4)	Steel reinforcement bars including binding						
	Beam @ 2-½%	3	$6.9 \times 0.35 \times 0.95 \times \frac{2.5}{100} \times 7850$			= 1350 kg	
	Slab @ 1%	1	1% of 10.626×7850			= 834 kg	
	Railing post @ 1%	6×2	$0.324 \times 1\% \times 7850$			= 260 kg	

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Estimation of RCC T-beam decking

S.N	Description of work	No.	L(m)	B(m)	H(m)	Q	Remarks
1.	RCC work (1:2:4) excluding steel & its bending but including centering & shuttering						
a)	T-beam ribs	3	6.9	0.35	0.75	5.434 m^3	L = 6 + 0.45 + 0.45
b)	Fillets	3x2	6.9	$\frac{1}{2}$ x 0.15 x 0.15		0.466 m^3	
c)	Deck slab	1	6.9	7.7	0.2	10.626 m^3	
d)	Railing post	6x2	0.15	0.15	1.2	0.324 m^3	No. of railing post = $\frac{6.9}{1.35}+1$ = 6
e)	Kerbs	2	6.9	0.35	0.2	0.966 m^3	
2)	RCC (1:2:4) in wearing coat	1	6.9	7	0.1	4.83 m^3	
3)	40mm dia GI pipe in railing	2x4	6.9			55.2 RM	
4)	Steel reinforcement bars including binding						
	Beam @ 2-½%	3	6.9 x 0.35 x 0.95 x $\frac{2.5}{100}$ x 7850 = 1350 kg				
	Slab @ 1%	1	1% of 10.626 x 7850 = 834 kg				
	Railing post @ 1%	6x2	0.324 x 1% x 7850 = 260 kg				

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Chapter 5, Valuation

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Contents

→ Introduction
→ Purpose of valuation
→ Terms used in valuation
→ Methods of determining value of property
→ Methods of valuation Report Writing

✻ Introduction:-

→ Technique of estimating or determining the fair price or present value of property such as building, factory, other engineering structures.
→ Valuation is an art of judgement based on experience and relevant statistical data to forecast the value of property at present
→ Cost means original cost of construction while value means the present value which may be higher or lower than the cost.

✻ Purpose of valuation

→ Buying or selling of property
→ For mortgage (धितो) as security of loan
→ For determination of rent
→ For tax fixation/assessment of taxes
→ For compulsary acquisition (जग्गा अधिग्रहण)
→ For fixation of insurance premium
→ To determine speculation (परिकल्पना), more than fair price in selling
→ To determine betterment charge, more than fair price in buying
→ For probate (उत्तराधिकारको प्रमाणीकरण)
→ For partition of property (बाँडफाँड)
→ To determine the compensation for any loss due to E/B, work.

* Principle of Valuation:-

→ Cost depends upon supply & demand of property.
→ Cost depends upon its design, specification of material used & location of property
→ Cost varies with the purpose for which valuation is made.
→ Cost is affected by the age of property & its physical conditions.
→ In valuation, a vender must be willing to sell & purchaser willing to buy.
→ present & future use of any property should be given due weightage in valuation.
→ Cost Analysis must be based on statistical data as it may sometime require evidence in court.

✻ Factors affecting the valuation:-

i) Location
ii) Climatic Condition
iii) Population census
iv) Supply & demand function
v) Rate of interest
vi) Topography
vii) Rent Restriction act
viii) Security on capital
ix) Abnormal Condition
x) Purpose

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Terms Used in Valuation

1) Value & Cost:
→ Value indicates the present market value of any property which may be higher or lower than cost of construction
→ Cost means actual cost of construction.

2) Book Value:-
→ It is original investment shown in account books of a company on its assets including properties & ~~assets~~ machinates.
→ Book value is applicable on building & movable properties but not on land
→ Book value = Original cost - Total depreciation up to previous year

3) Assessed value:
→ Value of any property recorded in record of local authority which is used for the purpose of determining the various taxes to be collected from owner of the property.

4) Distressed value or forced sale value:
→ When a property is sold at a lower price than the market value of that time, it is said to have a distress value
→ It is due to
i) Financial difficultres of seller
ii) Insufficient knowledge about market value
iii) Quarrel among partners
iv) Court decree (अदालतको फैसला)
v) Panic due to war or riots or civil accomodation.

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5) Replacement Value:-
→ Value of property or its services calculated on the prevailing market rate to replace the same.

6) Ratable value:-
→ Net annual letting value property, which is obtained after deducting the amount of yearly repairs from gross income. Municipal & other taxes are charged on the ratable value of property.

7) Potential Value
→ Some property like land has an inherent value which may go on increasing due to passage of time or can fetch more return if used for some alternative purposes. This inherent valve is known as potential value.

8) Annuity:
→ Annual periodic payments for repayment of the capital amount invested in a property or in some other form of investment by a party.

9) Perpetual Annuity:-
→ If the payment of annuity continue for indefinite period, it is known as perpetual annuity.

10) Differed Annuity:-
→ If the payment of annuity begins at some future data after a number of years, this is known as differed annuity.

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11) Scrap value:-
→ Dismantled materials value of property at the end of its utility period.
→ 10% of cost of construction in case of building

12) Salvage value
→ Value of any property at the end of utility period without being dismantled.

13) Gross income:
→ Total income from all sources without deducting the outgoing necessary for operation, taxes, maintenance, replacement etc.

14) Outgoing:-
→ These are the expenses incurred to maintain the property by undertaking periodic repairs. It also include goverment tax, sinking fund, management or collection charge, other miscellaneous charges.

15) Net income:-
→ Amount left after deducting all outgoings, operational & collection expenses from gross income
Net income = Gross income − Outgoing

16) Capitalized Value:-
'Amount of money whose interest at the highest prevailing rate of interest will be equal to the net income from the property in perpetuity.

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→ Simply, to income one rupees in one year, how much money we have to invest is capitalized value (CV)
C.V = Net income * years purchase (y.p)

17) Year's Purchase (Y.P.)
→ Capitalized value required to be invested in order to receive an annuity of Rs 1.00 at the prevailing rate of interest.

$$\text{Year's purchase} = \frac{100}{\text{Rate of interest}}$$

Foreg: Suppose rate of interest is 4%, then yp = 100/4 = Rs 25, That means, To get Rs 1 per year, it will be required to deposit Rs 25.

18) Sinking fund:-
→ It is a fund which is built up for sole purpose of replacement or reconstruction of a property when it loses its utility either at the end of its life span or becoming obsolete
→ This fund is regularly deposited as installments in a bank
→ The calculation of sinking fund depends upon the life span of a property & rate of interest.
→ The sinking fund is calculated for 90% of cost of construction because remaining 10% will be recovered by scrap value when life of property is over.

→ $S = \frac{S_n \times R}{(1+R)^n - 1}$, n = Utility period / life of property
R = Rate of interest
S_n = Sinking fund to be accumulated in n years
S = Yearly installment of sinking fund.

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19) Depriciation:-

→ Depriciation may be defined as the gradual decrease or loss in value of a property because of constant structural deterioration, use, wear & tear, decay etc.

→ Types of depriciation

a) Physical depriciation
- due to wear & tear
- Action of time & natural forces

b) Functional depriciation
- Due to inadequacy (space limit)
- Obsolescence (old fashion & design)

* Method of determining rate of depriciation

(i) Straight line method:
(ii) Constant percentage method / Declining balance method
(iii) Sinking fund method
(iv) Quantity Survey method.

* Straight line method:

→ In this method, it is assumed that property loses its value by same amount every year.

$$\text{Annual Depriciation (D)} = \frac{\text{Orrginal Cost} - \text{Scrap value}}{\text{Life in years}} = \frac{C-V}{n}$$

Where, C = Orrginal cost
V = Scrap value / Salvage value
n = Utilty period or life of property (yrs)

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* Methods of Valuation

(a) Rental Method
(b) Profit based method
(c) Cost based method
(d) Development based method
(e) Depriciation method
(f) Plinth area method
(g) Capital value comparison method.

* Rental Method:-

→ In this method, the rental income is calculated after deducting all outgoings from gross rent, years of purchase is calculated after adopting current bank interest & then capitalized value of property is worked out.

→ Capitalized value (CV) = Net rent * Year's purchase (YP)

Net rent = Gross rent - outgoings

$$Y.P = \frac{1}{i_p + i_c}$$

Where, i_p = Current bank interest

i_c = coeff. of sinking fund = $\frac{R}{(1+R)^n - 1}$

Where, R = Rate of interest for sinking fund.

Q. A RCC framed structure building having cubic content of 1400 m^3 was constructed 15 yrs. Back on a free tenure measing about 1100 m^2. The building fetches a rent of about Rs 40000 per month. What amount will you recommend for advance loan to the owner against the mortgage if the rate of land in the area is Rs 500/m^2?

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Expenses:-
Insurance premium: RS 900.00 per annum
Management & collection tax: 8% of gross rent
Municipal tax: 30% of gross rent
Repair: 5% of gross rent
Assume that the future life is 60 yrs
Rate of interest is 8% & redemption of capital is 5%

→ Given,
per month rent = RS 14000.00
Gross annual rent = 12 × 14000 = 1,68,000
Outgoings,
i) Insurance premium = RS 900.00
ii) Management & collection tax = 0.08 × 168000 = RS 13440
iii) Municipal Tax = 0.3 × 168000 = RS 50,400
iv) Repair = 0.05 × 168000 = RS 8,400
Total outgoings = RS 73140.00
Net Rental Income = 168000 − 73140 = RS 94860
Also,

$$i_p = 8\%$$

$$i_c = \frac{R}{(1+R)^n - 1} = \frac{0.05}{(1+0.05)^{60} - 1} = 0.00282$$

$$Y.P = \frac{1}{i_p + i_c} = \frac{1}{0.08 + 0.00282} = 12.07$$

Capitalized value = Net rental income × YP
= 94860 × 12.07
= RS 1145375.5
Value of land = RS 1100 × 500 = RS 5,50,000
Total value of property = 1145375.5 + 550000
= RS 1695624.22

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Now, 60% (50–70%) of value of property can be recommended for advance loan against the mortgage of property.
Recommended advance loan = 60% of RS 1695624.22
= RS 1017374.53

* Profit Based Method:-
→ This method is similar to rental method & is applicable for the building like hotels, cinemas, shop etc.
→ In this method, net profit is worked out after deducting all possible outgoings & years purchase calculated after adopting current bank interest rate & multiplied by YP to get capitalized value of property.

Q. Worked out the valuation of a cinema hall with following data.
Cost of land = RS 1,20,000, Gross income = 7,50,000
Expenses undergone for annum-
i) To run cinema hall including staff salary, electricity charges, municipal taxes & printing etc 30% of gross income
ii) Repair & maintenance of machinery plant & equipment is 5% of their capital cost which is RS 950000
iii) Sinking fund for machineries whose life is estimated as 25 years, at 4% after allowing 10% scrap value
iv) Insurance premium is RS 10000 per annum
v) Annual repair of hall is 2% of gross income.
Assume year's purchase for 60 years at 8% & redemption of capital at 4%

→ Solution

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→ Gross income = Rs 7,50,000

Outgoings:-

i) To run cinema hall = 0.3 × 750000 = 225000

ii) Repair & maintenance of machinery plant & equipment
= 0.05 × 9,50,000 = 47500

iii) Sinking fund ⇒ $S = S_n \times \frac{R}{(1+R)^n - 1}$

Here, S_n = 90% of 9,50,000 = 8,55,000

R = 4%

n = 25 yrs

$S = 8,55,000 \times \frac{0.04}{(1+0.04)^{25}-1} = 20530.22$

iv) Insurance premium = Rs 10,000

v) Annual repair of hall = 0.02 × 7,50,000 = 15000

Total outgoings = Rs 318030.22

Net profit = 7,50,000 − 318030.22 = 431969.78

Now,

i_p = 8%

$i_c = \frac{R}{(1+R)^n - 1} = \frac{0.04}{1.04^{60}-1} = 0.0042$

$Y.p = \frac{1}{i_p + i_c} = \frac{1}{0.08 + 0.0042} = 11.87$

C.V = Net profit * yp = 431969.78 × 11.87 = 5130282.42

Value of land = Rs 120,000

Then,

Total value of property = C.V + L.V
= 5130282.42 + 120000
= Rs. 5247481.289

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* Cost Based Method

→ In this method, the actual cost incurred in constructing the building or in processing the property is taken as basis to determine the value of property. In such cases, necessary depreciation should be allowed & the points of obsolescence should also be considered.

* Development based method:-

→ This method of valuation is used for properties which are in the developed stage or partly developed stage.

→ If a large place of land is required to be divided into the plots after providing roads, parks etc, this method of valuation is used.

→ Further in an existing building if some improvements are to be made, this method is used.

Q) A city corporation has to acquire an area of 3,50,000 m² for the development of a new colony. After developing the area, it is proposed to be sold at Rs 45 per m². Worked out the maximum compensation which can be given to the owners whose land is to be acquired for developing the colony assuming:

i) The corporation establishment charge 15% of the sale pric

ii) 40% area to be provided for roads, parks etc.

iii) Colony improvement expenditure Rs. 7 per m²

iv) Engineer's & Architect's fee 4% of the sale price.

⇒ Solution:-

Total area to be acquired = 3,50,000 m²

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Area to be provided for roads, parks = 40% of 3,50,000
= 140000 m²

Net area available for making plots for sale
= 350000 − 140000
= 210000 m²

Total income from selling of plot = 210000 × 45
= 9450000

→ Outgoings:-

i) Establishment charges = 15% of 9450000
= 1417500

ii) Colony improvement = 350000 × 7 = 2450000

iii) Engineer's & Architects fee = 0.04 × 9450000 = 378000

Total outgoings = Rs 4245500.00

Maximum price of undeveloped land = 9450000 − 4245500
= 5204500

Maximum possible compensation which can be given to land owners = $\frac{5204500}{350000}$ = Rs 14.87/m²

* Depreciation Method of Valuation:-

→ According to this method, the depreciated value of a building is directly calculated with the help of following formula,

$$D = P\left[\frac{100 - r_d}{100}\right]^n$$

Where, D = Depreciated value of building after 'n' years
P = cost of the building at present market rate.
r_d = Rate of depreciation
n = Age of building

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→ Rate of depreciation based on life of building

Life of building (yrs)	r_d
100	1
75	1.3
50	2
25	4
20	5

Q What is the present value of property having area of land 270 m² with 25 years old, first class building with a plinth area of 100 m²? The building is provided with water supply & electric filtering. Assume life of building as 100 years. r_d = 1, cost of land Rs 1500 per m². Take present value of same building is Rs 8000 per m².

→ Here,

Value of land = 15000 × 270 = 4050000

Cost of building = 100 × 8000 = 800000

Rate of depreciation (r_d) = 1%

Life of building = 100 years

Age of building = 25 years

Depreciated value of building (D) = $P\cdot\left(1 - \frac{r_d}{100}\right)^n$

$$D = 800000\left(1 - \frac{1}{100}\right)^{25} = 622257.08$$

Total value of property = L.V + D
= 4050000 + 622257.08
= Rs 4672257.08

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* Plinth area method of valuation:-

→ If it is not possible to estimate correctly the quantity of different items of work, the plinth area method of valuation is used.

→ In this method, the resent plinth area rate of similar building in the same locality with the same specification is worked out, multiplied with the plinth area of building whose valuation is to be done & suitable depriciation is allowed.

Q. A free hold residential property having plinth area of 100m² constructed 20 years ago on a plot of land measuring 500m² is proposed to be purchased by 'A' for his use. The present rate of construction of the similar building is Rs 9000 per m² of the plinth area & cost of land is Rs 2000/m². Advice 'A' at what cost he should purchase the property.

→ Here,

Cost of land = Rs 500 × 2000 = Rs 1000000

cost of building = 100 × 9000 = Rs 900000

Assume, life of building = 80 years

scrap value = 10% of cost of building

Then,

Annual depriciation (D) = $\frac{C - V}{n}$

(using straight line method)

$D = \frac{900000 - 0.1 \times 900000}{80}$

= Rs 10125 per annum

Total depriciation for past 20 years = Rs 10125 × 20

= Rs 20,2500

Present value of building = Rs 900000 − 202500

= Rs 697500

Total value of property = value of land + present value of building

= 1000000 + 697500

= Rs 1697500

Hence, 'A' is advised to purchase the property at the cost of Rs 1697500.00.

* Capital Value Comparison method:-

→ This method is used for valuation of the property, when the rental value of property is not available but sale records of similar buildings are available.

→ In this method, capitalized value of property is worked out by direct comparisons with other capitalized value of similar property in the same locality, whose sale records are available.

Q. An owner has decided to sell his vacant property of 30 years old. Single storied building having a total plinth area of 110 m². The cost of land is 300000.00 compared with adjoining areas. There is no comparable instance of lathing value available in the locality but the present plinth area rate to constant such a new building has been determined from current sale price which is Rs. 5500.00 per m². What should be the sale price of the property having total life of 80 years & annual sinking fund interest is 5%?

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→ solution

Cost of Building = 110 × 5500 = Rs 605000/-

~~To determine depreciation, use straight line method of depreciation.~~ (Depreciation using sinking fund method)

Life of building = 80 years.

Sinking fund coefficient for 80 yrs (S_c) = $\frac{R}{(1+R)^n - 1}$

$= \frac{0.05}{1.05^{80} - 1} = 1.03 \times 10^{-3}$

$= 0.001$

Now, we know,

$S = S_n \times \frac{R}{(1+R)^n - 1}$

Where, S = Yearly installment of sinking fund

S_n = Sinking fund to be accumulated in 'n' years

If S = Rs 1 per annum, then

$S_n = \frac{1 \times (1+0.05)^{30} - 1}{0.05} = 66.44$

Rate of depreciation in 30 years = 0.001 × 66.44 = 0.06644

Total depreciation in 30 years = Rs 605000 × 0.06644

= Rs 40196.20

Then,

Depreciated value of Building = Rs 605000 − Rs 40196.20

= Rs 564803.80

Also,

Value of land = Rs 300000

Sale price of property = Depreciated value of building + value of land

= 564803.80 + 300000

= Rs 864803.8

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✻ Methods of valuation Report Writing:

→ After doing all the valuation work, the valuation report is prepared for submitting in the concerned department (Tax department, bank etc.). The valuation report is submitted in the standard format approved by the concerned department.

→ The valuation report is divided into three parts

Part1 :- Details about property

Part2 :- Valuation Calculation

Part3 :- Valuation Declaration

Appendix :-

1) Introductory details
2) Technical details
3) Area calculation
4) Land value
5) land ownership certificate
6) Citizenship certificate
7) Drawings
8) photographs

✻ Introductory Details :-

a) Details about property	c) Details of Surrounding (चार किल्ला)	e) Site Services
- location	- North/south	- Watersupply
- plot number	- East/west	- Electricity
- area of plot	d) Details of Road	- Drainage
b) Details about owner of property	- Type, width	f) Site Constraints
- owner's name	e) Site details	- Surcharge bad
- Father's name	- Shape	- High Tension line
- Grand father's name	- Topography	- Noise
- Address	- Frontage	- pollution etc.

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Q. You have been asked to prepare a valuation report of a property (land & building). Mention various datas which you will collect as valuator.

→ As a valuator we will consider the following things & valuate the given land & building. For this we will first take the introductory details as,

1) Location (street, ward no, town etc)
2) Plot no. of land
3) Area of plot (according to land registration office)
4) Owner of the property, this includes
   a) Owner's name
   b) Father's name
   c) Grandfather's name
5) Age of owner
6) Current address of owner
7) Details of surrounding properties
   a) North b) South c) East d) West
8) Details of access road
   a) Type
   b) Width
9) Distance of property from nearest commercial, busy builtup area.
10) Site Details
   a) Shape c) Width of frontage
   b) Topography d) Depth
11) Site Services
   a) Water Supply
   b) Electricity c) Sewerage
12) Site constraints
   a) Surcharge overhead c) Noise
   b) High Tension line d) Pollution

* Additional data:

1) Purpose for which valuation is made
2) Brief description of the property
3) Is the property situated in residential commercial mixed industrial area?
4) Classification of the locality high class, middle class, poor class or mixed.
5) It is freehold or leasehold land?
6) Are there any agreement of leasement?
7) Is the building owner occupied / tenanted / both?
8) Details of water supply & electricity charges are any to be borne by owner?
9) Has the tenant to bear the whole or part of the cost or repairs & maintenance?
10) What is the amount of property tax? Who is bearing it? Details with document proof.
11) Is the building insured? If so give amount for which it is insured and annuals & premium.
12) What was the method of construction?
13) Has the ~~not~~ whole or part of the land been notified for acquisition by government?
14) Rent
   • Name of Tenants / Lessee
   • Monthly or annual rent.

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15) Gross amount received for the whole property.
16) Is any dispute between landlord & tenant regarding rent pending in a court of law?
17) Has any standard rent been fixed for the premises under any law relating to the control of rent?
18) Sales:
Give instantaneous of sales of property in the locality on separate sheets indicating the name & address of the property, registration number, sales price & area of land sold.

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Chapter 6: Specification

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Contents:-

- Introduction
- Necessity of Specification
- Types of Specification :- General & Detailed Specification
- Specification Writing Technique
- Specification writing :- Civil works, water supply & sanitary works & Electrical works

✻ Introduction:-

- Specification is a specific description of particular subject.
- An engineering specification contain detail description of all workmanship & quality of materials which are req to complete an engineering project in accordance with drawing & details.
- In another word, the document describing the quality & workmanship of every item of works known as specification.

✻ Principle to be adopted while writing specification

1) Quality, size & treatment of materials shall be described.
2) The method of mixing to proportion, the method of laying, finishing & other process involve in item of works shall be described.
3) The tools & plants to be engaged to carryout works shall be described.
4) How to protect our new work shall be described.
5) The unit of measurement & payment shall be described.
6) The method of measurement of item of work shall be described.
7) To manage conflict during execution of project, several

clauses shall be described for special condition.
8) The specification are written in a language so that they indicate what the work should be and words "shall be" and "should be" are frequently used.

✻ Importance of Specification

- The cost of unit quantity of work is governed by its specification.
- To verify & check the strength of materials for a work involved in a project
- Tender / Contract document & agreement without specification is incomplete, baseless & invalid.
- To specify the equipment, tools & plants to be employed for a works & thus enables to procure or hire.
- To procure the materials required for a project & to check the quality of materials.
- It serves as a guide for site engineers.
- It serves as evidence in case of dispute.
- The change in specification changes the contract cost.

✻ Purpose of Specification :-

- To specify the nature of work
- To estimate the quantity & Cost
- To clarify the ambiguity.
- To identify the quality of materials.
- To identify the material proportion
- To identify the types of workmanship used.

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✱ Types of Specification:-

(a) General / brief description
(b) Detailed Description
(c) Standard Specification
(d) Special specification
(e) Open / Manufacturer specification
(f) Restricted specification:

* General Specification:-

→ Nature & class of works, names of materials & proportion that should be used in the various items of works are described.
→ Only a brief description of each & every item is given.
→ It is useful for estimating the project. But, they donot form part of contract document.

* Detailed Specification:-

→ This is detailed written description of every item in the schedule of quantities, which specifies the materials to be used, its quality, workmanship & the results to be achieved.
→ Usually, specification of the items is written in the same sequence as they are mentioned in the BOQ
→ It is a part of contract document regarding quality of materials, workmanship & equipments.
→ The detailed specifications of the different items or works are prepared separately & they describe what the works should be & how they shall be executed & constructed.

(For more detail, prefer the specification of building construction work by DUDBC)

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✱ Specification Writing of Civil Works:-

1) Site clearance & demolition

→ Removal of trees, stubs higher than 1.5m
→ Removal of structures, fences etc.
→ Demolition of already constructed building

2) Earthworks, Excavations & Foundation

* Earthworks

→ Formations prepare
→ Sloping elaboration
→ Drainage

* Excavation for foundation:

→ Excavations: (If trench is deep & soil is loose, timbering of trench must be done)
→ Fillings: well compacted
→ Utilization of excavated material
→ Backfilling around structures.

* Standard foundations:

→ Concrete foundation: well vibrated, specified dimensions as per drawings including formwork, specified grade of concrete.
→ Foundation is stone masonry & concrete
→ Column Foundations & pile caps

* Foundation ancillaries:

→ Waterproofing of footings — Hot fixed bitumen
→ Waterproofing of foundation with & without basement.
→ Perimeter & superficial drainage.

3) Concrete, Formworks & Reinforcement:

* In situ Concrete:-

→ General requirements for concrete.

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→ Materials:
- Cement: Manufacturing date, testing of cement, standard specification
- Water: Free from organic matter
- Aggregate:

→ storage of material: stored in dried spaces.
→ Measurement & proportioning of concrete materials. (weight batching is more accurate)
→ W/c ratio: As per IS 456:2000, kept min^m (0.5-0.6)
Max^m quantity of water for 50kg cement = 30L
→ Concrete grade & strength (M15, 20, 25, 30 --)
→ Construction joints (Min^m shear) (dry mix - 2min)
→ Mixing of concrete, Transportation, placing. (do not fall from 1m height)
→ Compaction of concrete (needle vibrator & plate vibrator)
→ Slump test (check w/c ratio from slump test)
→ Preparation of cube for compressive strength test (Min^m 9 cube, (7, 15 & 28 days), place concrete in three layers in cube, size of cube 150mm, Do not compact cube by vibrator, use tamping rod only)
→ protection & curing
protection in low/high temp^r areas. Curing is done after 24 hour of concreting.
→ Mode of measurement.

* Formworks:-
→ Scope
→ Material
- Timber & plywood
- Metal
- Aluminium
- (Do not use bamboo for centering & shuttering)

→ Shop drawings
→ Construction: check spacing of posts, placing of baseplate
→ Cleaning & treatment of forms
→ Removal of forms:
column - 30 hrs
(side) Beam - 2 days
props to beam - 15 days
slab (side) - 4 days
props to slab = 11 days.
→ Engineer may allow a shorter period when using RHC.
→ Tolerance
- plumb ± 1 in 1000 of height
- Levels - 3mm before any deflections & taken place

→ Reuse of forms
timber - 3 to 5 times use
→ Mode of measurement.

* Reinforcement bar:
→ Scope
→ Material:-
- Steel reinforcement bar (Fe500) (comply with IS 432-1966 & 1139-1966)
- binding wire (16 gauge generally)
(free from corrosion, loose rust, mill scale etc)

→ Shop drawing
prepare BBS as per drawing & approve by structural engineer.

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→ Testing
Elongation, bending, shear strength, tensile strength etc.
→ Workmanship
• cleaning
• Bending – as per bar bending schedule
• placing in position – check c/c spacing
• Splicing – IS 2751-1966
Tension bar – 60ϕ & compression bar = 47.5ϕ
→ Cover to reinforcement – use cover blocks
Footing – 50mm, Column – 40mm, beam – 25mm
Slab/staircase – 15mm
→ Exposed Reinforcement bar: Use anti corrosive paint
prevent from rusting
→ Mode of Measurement & payment
↓ kg ~~per kg~~ per kg

4) Brick Work
→ Scope
→ Material: Brick, cement, fine aggregate, water
→ Combination of materials
a) proportion: (1:3 to 1:6)
b) Mixing: (5% more for hand mixing)
w/c ratio = 0.8 to 1.
→ Preliminary works prior to laying
a) wetting bricks: wet 12 hours before use
b) Scaffolding: Height > 1.5m, use single scaffolding
c) Old Works: clean by wire brush, place cement slurry & plaze brick.

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→ Laying of brick
• Specify types of bond
• If not specified, it is english bond
⇒ Facework
⇒ Joints: 10mm
⇒ Uniform raising of brick wall

→ Clearing of Completion
• Curing: Curing for 10 days after laying
• protection: protect from effect of sun, rain, frost etc during construction
→ Mode of measurement & payment
↓ cum ↓ per cubic meter

5) Timber Work: (IS 1328-1959)
→ Scope: preparation, supply & fixing of frames for door, window, ventilator etc.
→ Material
(a) Timber:
• quality: best quality seasoned timber
• colour: Uniform
• Moisture content – Min^m as possible (< 12%)
• Stacking
• Approval: Approved by engineer
• Sawing
• Rejection
(b) species of timber (Teak wood, Hard wood)
(c) Glue (d) Nails & Screw

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→ Precautions against decaying ~~(Paint, finishing & fixing)~~
→ Workmanship (Joint, finishing & fixing)
→ Framing (Wooden frame)
→ Scaffolding
→ Iron work (Holdfasts 4 for window & 6 for doors)
→ Precaution against fire
→ Inspection
→ Defective work

6) Plastering:
→ Scope
→ Material: cement, sand, water
→ Mortar proportion: 1:3 to 1:6 (cement:sand)
dry mix of cement & sand, use mortar within two hours of mixing
→ Scaffolding: double scaffolding
→ Preliminary work
• Surface preparation: brushed the surface, well wetted. Column, beams, wall faces etc. shall be hacked with approved means & joint of masonry wall shall be raked to a minimum depth of ½" deep to form a proper key
• Application of undercoat
• Application of finishing coat.
Ceiling plastering shall be completed before starting of wall plas
→ Curing: at least 7 days
→ Testing: work shall be frequently tested with straight edge & plumb bob
→ Measurement & Rates
↓ ↓
sq.m per sqm

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7) Painting Works:
→ Scope: painting works on surfaces of timber, plaster, metal etc.
→ Materials: paint
→ Surface preparation for painting
• The surface shall be made perfectly smooth by rubbing with sand paper of different grades
• All holes & open joints should be filled with strong putty.
• In steel, all rusts & scales shall be perfectly removed by scrapping & brushing.
• Newly plaster surface should be left for two months before painting.
• painting surface should be completely dry.
→ Application of paint:
• Prime coat / first coat is applied with the brush
• After drying prime coat, next two coats shall be applied.
• Each coat should be dried properly before next is applied.
• If old paint is to be removed, it may be removed by washing with soda water or with caustic soda. After removing, paint surface should be dried & rubbed with sand paper & paint is applied.
• In old painting surface, if repainting is required, the surface should be washed with soap water & then paint shall be applied.
• In steel work, exposed to weather, the painting should be done either with red oxide paint or with aluminium paint
→ Measurement & Rates
↓ ↓
sq.m per sq.m

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8) Tubular Truss / Metal Truss:-

→ Scope:- Tubes shall be designated by their nominal bore. These shall be light, medium or heavy depending upon wall thickness

→ Materials: steel
- Tubes shall be clean finished & reasonably free from scale.
- Wall thickness > 4mm, construction exposed to weather
  > 3.2mm, construction not exposed to weather

→ Fabrication: → Welding (IS 820 & IS 816-1956)
→ Bolting (IS 800 - 1962)

→ Caps & bases for columns: True & square to axis of column

→ Sealing of tube:- When end of tube is not connected to another member, the end shall be properly & completely sealed.

→ Flattened End:- Ends of tubes may be flattened or otherwise formed to provide for welded.

→ Assembling: Carried out in safe & proper manner using derricks, lifting tackles, winches, ropes etc.

→ Painting:- Two coat anti corrosive paint (redoxide)

→ Measurements & Rates
Rm or quintal → per m / per quintal

9) Sheet Roof Covering:-

→ Scope

→ Material:- Corrugated galvanized iron sheet (IS 209:1979)
The corrugated iron sheet shall be of specified gauge.
The sheet shall be free from rust.
Generally, 24 gauge sheet is used.

→ Laying & fixing
Each sheet shall be laid on wooden or steel purlin with an end overlap of 150mm minimum as per drawing & side overlap of two & half corrugations. Sheets shall be joined together with galvanized hook bolts or L type of 8mm diameter.

→ Slope: Roof slope shall not be flatter than 1 in 5

→ Wind Ties: 40mm * 6mm & shall be fixed at eave ends.

→ Ridge & valley

→ Measurement & Rates
→ sqm → per sqm

10) Ceramic Tiles:-

→ Scope:

→ Material
Tiles:- glazed or non-glazed ceramic tile
Mortars:- Cement sand mortar (1:3) or (1:2)
The tiles shall be of approved colour, size & shape.

→ Installing the tiles:-
- Surface shall be brushed, cleaned & wetted
- Apply 12mm thick, 1:4 cement mortar, cured for at least 24 hours before application of floating coat.
- Apply 3mm thick floating coat.
- Install the tiles by firmly pressing the tile into the floating coat to true plane & position.

→ Finishing
- All the joints should be grouted full with a plastic mix of neat cement by trowel, brush or finger application.
- During grouting all excess grout shall be cleaned off the tile surface with damp cloth sponges.

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→ Sample of tiles:
The color, size, shape of sample shall be approved by architect or owners.

→ Measurement & Rates
sq.m ↓ per sq.m

11) Terrazzo or Mosaic Flooring:-

→ Scope

→ Material
(a) Cement (opc) (b) Sand (fine) (c) Aggregate
(d) Marble chips:
Marble chips shall be of 3mm gauge having maximum size 3m & min^m size 1.5mm shall be of good quality.
(e) Marble dust
(f) Colour pigment
(g) Carborandom stone - 60 nos, 80 nos, 120 nos
(h) Wax polish (i) Turpentine (j) Glass strip.

→ Combination of material
1) Mixing ⇒ Mixing shall be done on watertight platform.
2) Mosaic floor consists of two layers
i) Underlayer - 40mm thick pcc (1:2:4)
ii) Top layer - 6mm thick mosaic concrete
• White or grey cement & marble chips (1:2)
• Marble dust (1/3 by wt of cement)
• Colour pigment (2-5 kg per bag of white cement)

2) Laying
First level the base course, Glass strip should be fixed while laying base course. Over this, marble stone should be [illegible]

laid, the joints should not be more than 3mm. The joints should be painted with white cement slurry.

3) Curing:-
After about two hours of laying, the surface shall be covered with wet bags & kept wet & left undisturbed for two days.

4) Finishing:-
• Oxalic acid powder shall be rubbed well on the surface with grinding machine with water.
• This operation shall be repeated until the surface becomes perfectly smooth & glossy.
• Grinding & polishing shall be done by grinding machine in three operations.

→ Mode of measurement & payment
m^2 ↓ per sq.m

12) Stoneworks:-

→ Scope

→ Materials
a) Stone: stone shall be hard, tough, round & durable of approved quarry. Types of stone depends on type of masonry either ashlar or rubble. Water absorption < 5%
Length of stone shall not exceed three times its height.
b) Cement c) Sand d) water

→ Proportion of Mortar:- (1:4 to 1:6)

→ Laying of stone:
All the stones shall be thoroughly wetted before use. Stone shall be laid alternate headers & stretchers with break joint & proper joint bond shall be maintained not to have any vertical joints

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in two consecutive layers. Each course shall be truly horizontal & each stone shall be laid on its natural bed. The wall shall be truly in plumb. No joints shall be thicker than 3.5mm.

→ Curing:- The masonry wall shall be kept moist for a period of at least 10 days.

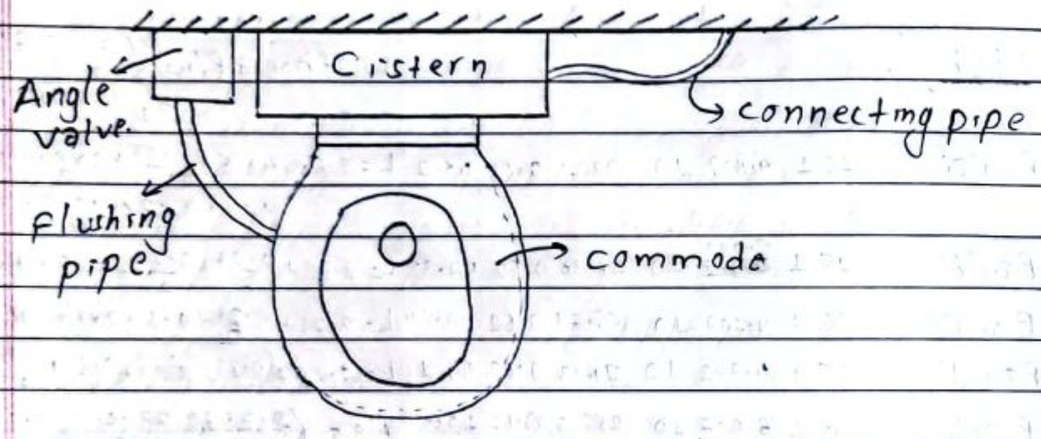
→ Mode of Measurement & payment
↓ m^3 . ↓ per cubic meter.

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* Prepare an analysis of rate for providing & fixing W.C. commode with low level cistern per number.



A. Material		(Rs)
a) White Glazed Ceramic chy W.C. Commode with pors trap	1 nos @ 7854	7854
b) White glazed ceramic clay 10L Capcity low level cistern with complete accessories	1 nos @ RS 3230	3230
c) Commode Cover with C.P. Hinge	1 nos @ 2200	2200
d) C.P. Angle valve (Bluestar or equivalent)	1 nos @ RS 1098	1098
e) PVC pipe connector with coupling	1 nos @ Rs 290	290
f) 32 mm dia. pvc with coupling	1 nos @ RS 315	315
g) Pipe tape clamp, screws etc.	Lumpsum	600
		15587
B. Labors		
a) Skilled	3 nos @ RS 650	1950
b) Unskilled	3 nos @ RS 475	1425
		3375
C. Hire of plants & tools	3% of 1425	42.75
	Total cost	19004.75
Considering 15% overhead & profit,	= 1.15 x 19004.75	= RS 21855.4

* Specification for Bituminous Macadam Road

→ Scope:- This specification deals with basic outline for the design, construction & controls needed while laying bituminous macadam course for highways.

→ Materials:-

• Bitumen:-

→ The bitumen shall be viscosity graded paving bitumen complying with Indian standard Specification (IS73)

→ Viscosity grade (VG 10 in cold area & VG 40 in hot area)

→ Temp^r (Temp^r > 30°C, use VG 20-30)

• Coarse Aggregate:-

→ Crushed rock, gravel or other hard material retained on 2.36 mm sieve.

→ Shall be clean, hard, durable, must satisfy shape, size, strength, durability & water absorption criteria.

• Fine Aggregate:-

→ Passing through 2.36 mm sieve & retained on 75 μ sieve.

→ clean, free from dust & organic matter, hard, durable

• Aggregate grading & bitumen content

→ Combined grading of coarse aggregate & fine aggregate shall confirm to limits given in IS specification.

→ Construction:-

a) Cleaning of Surface:-

By means of mechanical broom, high pressure-air jet

b) Filling up of potholes & sealing of cracks:-

Any potholes/cracks shall be repaired & sealed.

c) Profile corrective course:-

Depending on site condition, laid either as separate layer or as a composite layer.

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d) Primecoat & Tack Coat
As per IRC 16-2007, "Standard Specification & Code of practice for prime coat & Tack coat".

e) Mixing:
→ Bituminous macadam shall be prepared in a hot mix plant (HMP) of adequate capacity & capable of yielding a mix of proper & uniform quality with throughly coated aggregate.
→ The difference in temp of aggregate & bitumen shall not exceed 15°C.

f) Transportation:
→ Transported in clean insulted covered vehicles.

g) Laying:
• Weather & Seasonal limitation:
Bituminous macadam shall not be laid
a) in presence of standing water on surface.
b) during rain in imminent
c) when base/binder course is damp
d) Surface temp is less than 10°C
e) When wind speed > 40KM/hr at 2m height
• Preparation of base
• Spreading:
- Spread continuously to the paver without delay.
- Bituminous material should be free from dragging, tearing & segregation.
- In restricted area, spread & levelled by handtool.

h) Compaction:
→ Commence compaction as soon as possible after laying.
→ Rolling shall commence at edge & progress towards the centre longitudinally to balance the camber.
→ Compaction with vibratory steel wheel roller, pneumatic roller with specified amplitude, frequency & tire pressure.

(i) Joints:
• All joints shall be cut vertical to the full thickness of the previously laid mix. All loosened material shall be discarded & vertical face be coated with any viscosity grade bitumen.
• By heating the joint, apply new layer of bitumen.

(j) Arrangement for traffic
• Bituminous surface shall be covered with next pavement course within a maximum of 48 hours until which no traffic shall be applied.

→ Controls
• Surface finish:
The levels of bituminous macadam shall not vary from those calculated with reference to longitudinal & cross profile.
• Surface Evenness:
The measurement & checking of surface evenness shall be done by a 3m straight edge in accordance with the procedure in IRC SP16: 2004.
• Quality control during construction
To ensure quality of material & works, the tests must be performed. The testing results must be within acceptance criteria.
→ Unit of measurement & Mode of Payment per sq.m

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Specification of Water Supply & Sanitary Works:-

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1) General:-
The sanitary, plumbing water supply & other related works are to be laid to alignments & grades shown on the drawings but subject to such modifications as shall be ordered by the engineer from time to time to meet the requirements of the work.

2) Shop drawings:-
Details on shop drawings submitted for approval shall show clearly the relations of the various parts to the main members & lines of the structure & where correct fabrication of the work depend upon field measurements such measurements shall be made by the contractor & noted on the drawings before being submitted for approval.

3) Materials:-
Unless specified mentioned otherwise all the applicable codes & standards updated & in force published by Bureau of Indian Standard (IS) or equivalent B.S. Standard.
IS 651 1980 → Salt glazed stoneware pipe & fittings
IS 778 1984 → Gunmetal gate, check valves for water
IS 782 1983 → Caulking lead
IS 1172 1971 → Basic requirements of water supply, drainage & sanitation
IS 1239 1982 → Specification of M.S. or C.I. pipes
IS 1879 1975 → Specification for CI fittings
IS 1985 1988 → UPVC spigot & socket soil, waste & vent pipe & fittings
IS 1729 1974 → Cast iron manhole covers & frames used in drainage work
IS 1719 1979 → Cast iron spigot & socket soil, waste & vent pipes & fittings.

IS 1742 1983 → Code of practice for building drainage
IS 2064 1973 → Code of practice for selection, installation & maintenance of sanitary appliances
IS 2065 1983 → Code of practice for water supply in building
IS 771 1979 → Specification for vitreous china sanitary wares.
IS 1966 1963 → Specification for RCC Hume pipe.

4) Cutting & Making Good:
→ Contractor shall provide all necessary holes, chases in structural members as building work proceeds. Whenever holes are cut or left originally in concrete surface they shall be made good with cement concrete M15 grade & the surface restored as in original condition.

5) PVC Pipe Installation:-
→ Before we at site, all PVC pipes shall be tested by filling up with water for at least 10 minutes. After filling pipes shall be struck with a hammer & inspected for blow holes & cracks. All defective pipes shall be rejected & removed from the site.

6) Specification of Materials
- Polyvenylchloride pipes (PVC)
  - confirming to ASTM-D-1785
  - Specified wall thickness & working pressure.

- Galvanized Steel Pipes & Fittings:-
  - Confirming to IS 1239-1964, medium class.

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(e) Testing: All pipes, fittings & valves shall be tested by hydrostatic pressure of 7 kg for medium class. Pressure shall be maintained for a period of at least two hours without appreciable drop in the pressure after fixing at site.

- Cast Iron pipes & fittings:

→ All the pipes & fittings shall have ISI mark on it. Fittings shall include bends, elbows, tees, Y-tees, reducers etc as per the requirements of drawing.

→ All CI pipe & fittings including joints shall be tested by smoke test after completion.

- Valves & Ball Cocks:

→ Valves shall be heavy gunmetal full way gate valves or non-return valves confirming to IS 778-1962. (class I). Valves shall be tested at manufacturer's works to a pressure of 21 kg/cm². All valves shall be approved by engineer before we

- Brass fittings:

All brass stop cocks & bib cocks shall be heavy type bright finished with renewable leather washers confirming to IS 781-1967.

f) Sanitary Fixtures & Accessories:

→ Shall be of best quality, approved by engineer

→ All fixtures & fittings shall be provided with all such accessories that are required to complete the item in working condition. Color of sanitary ware, when specified shall be selected by engineer.

→ Fixtures shall conform to IS 2556-1967.

a) Orrissa Pan

→ W.C. pan shall be 588 mm long Orrissa type or as specified in the bill of quantities. Each W.C. Pan shall be provided with one 100 mm dia. porcelain 'P' or 'S' trap with vent & with automatic flush pipe system complete set.

b) European W.C. set:-

→ Shall be wash down set of double trap symphonic type with automatic flush pipe system complete as specified in bill of quantities.

c) Urinals & Divisionplates:

→ Urinals shall be standing type large flat back of 400x350x600 mm size. Each urinal shall be provided with one 40 mm ϕ chromium plated brass bottle trap with pipe to wall & wall flange.

d) Wash Basin:

→ Shall be of specified size.

→ Shall be fixed on walls as in the drawing & as per instruction.

→ 15 mm cp pillar cock, 32 mm ϕ cp waste with chain & plug, 32 mm cp bottle trap, 15 mm cp angular valve, 500 mm long connector flexible metal finished pipes with couplings at both ends all complete.

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e) Stainless Steel kitchen Sink:-
→ shall be of specified size
→ shall be fixed on RCC slab as per drawings & instruction.
→ kitchen Sink shall have one 15mm CP pillar cock, 15 mm CP angular stop cock, 15 mm pvc connector with both ends coupling, 40mm CP waste coupling with plug, stay & chain, 40mm CP 'S' trap.

(f) Mirrors:
→ 5.5 mm thick,
→ All edges shall be rounded off
→ Fixed on backing of 6mm thick commercial board or on plaster mounting & fixed to wall with brass screws & washers.

(g) Towel Rails:
→ shall be of CP brass with two brackets.
→ Size of rail shall be as specified.

(h) Clamps:
→ Holder bat clamps shall be of standard design & fabricated from M.S. flat 40x3mm with 12mm bolts & nuts.
→ They shall be painted with two coats of black bitumen paint before fixing. Holder bat clamps shall be fixed in cement concrete 1:2:4

i) CP Floor Traps:
→ The slope of flooring shall be so maintained that the floor trap shall easily take the total water.

j) Inspection Chamber:
→ Shall be made with brickwork in 1:4 cement mortar, concrete base of M15, 12mm plaster with 1:4 cement sand mortar & 1:1 cement sand punning with proper benching.

k) Electric Pump:-
→ Shall be of specified BHP centrifugal pump of required capacity.
→ The pump shall be installed with suction & delivery connection, motor starter, foot valve, gate valve, washout tee with gate valve
→ It shall be rested on concrete foundation with necessary electrification.

8) Commissioning & Testing:
→ Before commissioning & testing of fixtures, contractor shall ensure that all soil waste stacks & drainage system are connected to the respective manholes & the outfall sewer. S/he shall also ensure that water supply system has been commissioned & tested.
→ Fixtures shall be cleaned & all debris & dirt removed. All stickers, labels etc shall be removed with hot water.

Specification of Electrical Work

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→ In general, following standard specification shall be followed.

Fused distribution board	IS 2625-1966
Fluorescent lamp	IS 2418-1965
PVC cable	IS 1554-1964
GLS Lamps	IS 418-1963
Switch Socket outlets	IS 1293-1967
Switches for domestic purpose	IS 3854-1966
Steel boxes for housing accessories	IS 5133-1969
Earthing	IS 3043-1966
Wiring Installation	IS 732-1965
Ceiling fan	IS 374-1966

1) Samples: Prior to the commencing procurement, the contractor shall submit for approval, technical description, related catalog & a sample of all cable, conduit accessories, switches, power outlets, lamps, fluorescent tubes, fixtures etc which are to be procured & installed.

2) location of fixtures: Location of conduit, fixtures, witches, outlets distribution boards & other electrical equipment & appliances shall generally be in accordance with the updated construction drawings & in accordance with specifications & mounting heights & location details mentioned therein.

3) Conduit: Rigid, non metallic conduit of an approved manufactures confirming to IS 2509 shall be used only with corresponding approved accessories.

4) Cables: Electrical cable used in installation shall generally be of following types.

a) Flexible Cable:-
→ Connection to fixtures, equipment from terminal points in outlet boxes, junction boxes.
→ Shall not beless than twin core, 48/0.2mm size with copper conductar & thermoplastic insulation.

b) Final Subcircuit Cable:-
→ Wiring from distribution board to terminal box, junction box.
→ High conductivity, standard copper canductors with PVC insulation rated at 500 VAC.
→ Color coding shall be maintained

c) Mains & Sub mains Cable:-
→ Submains cable used for electrical distribution from main switch board to several power distribution board within buildings.
→ Mains cable used to interconnect the main switchboard in the building to the tapoff point in the power utility service.
→ Shall be multicore cables with standard aluminium conductors, PVC insulated & rated for 660/1100 VAC.

5) Power Outlets: Conforming to IS 1293-1977 shall be three-pin switch sockets rated at 5/15A, single phase. The outlets shall have an earth connection.

6) Ceiling & Wall Fans: Ceiling & wall fans of an approved manufacture shall be of the type & sweep drameters as shown in drawings or the bill of quantity.

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7) Exhust Fans: Heavy duty fans of an approved manufacture. Shall have integral metal units. The fan shall be capable of delivery rate of not less than 700 m³/h at 1200 rpm. A steel louvered shutter shall be provided to close off the fan opening.

8) Light Fixtures: Incandescent & fluorescent light fixtures shall be supplied & installed as per drawings. Fluorescent fixtures shall generally be surface mounted. Light fixtures for outdoor application either as post-top lanterns, street lights .... Shall be integrally waterproof with rubber gaskets.

9) Fire Alram System: Shall compuse of equipment of an approved manufacture genera & shall feature a distinctly audible siren/horn specifically designed for such purpose.

10) Call bells / Chimes: Call bells for application in selected rooms shall feature a well modulated audible tone / Chime generated by electronic circuitry & shall generally be of the musical type with multiple intensity selection.

11) Fuses:- High Rupturing Capacity (HRC) fuse links & fittings used in the installation to provide backup protection for miniature circuit breakers shall conform to IS 2208.

12) Miniature Circuit Breakers (MCBs) ⇒ Shall be used to protect final subcircuits from the distribution board. Circuit breakers shall be in accordance with IS 9928 or equivalent shall be of an approved manufactures shall incorporate the

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following safety features
a) Thermal overload protection
b) Magnetic short circuit protection.
c) at least 3kA breaking capacity at 415 VAC, 50 Hz

13) Distribution Boards: Shall be manufactured from at least 16 SWG sheet steel, shall be suitable for flush mounting & shall be painted with two coats of enamel over two coats of primer.

14) Main Switch Board: Shall be a modular, free standing, dead front extendible unit fabricated from sheet steel not less than 16 SWG & painted with two coats of primer. Switch board shall be complete with
→ Copper bus bars of suitable rating
→ lifting lugs & cable entry knockouts
→ Earth terminals & neutral links
→ clearly labeled incoming & outgoing switch fuses or MCCBs
→ Voltmeter & ammeter.

15) Wiring:
→ Wiring in the final subcircuits shall be lapped with cable termination in the distribution box & the related outlet box of the fixture. Use of intermediate junction boxes shall be discouraged. Joints in cable within the conduit shall be prohibited.

16) Earthing:- Station earth points shall be constructed

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to provide ground points for all earth continuity conductors used in this installation. The station earth shall be as specified in the appropriate Indian Standards. Bonding of the station earth to the main earth terminal inside the building shall be with an earth conductor or strip not less than 100sq.mm in cross sectional areas.

17) Lighting Electrode:- It shall be installed on the building roof to provide protection to the premises in case of lighting strikes. The electrode shall be effectively grounded by means of a copper strip not less than 100sq.mm in cross-section to an earthing station.

18) Cabling:- Laying of cables between two points shall follow the following methods.
a) laying of cables directly in the ground, in outdoor application
b) laying or supporting of cables in cable trays, trenches & ducts or clipped on to the walls or structural members of the building.

19) Tests:-
a) polarity test: To verify that all terminals are correctly connected with regard to line, neutral & earth
b) Insulation test bet" line & neutral conductors
c) Insulation test bet" all non earthed conductors & the earth on a live system.
d) Earth resistance test including the earth loop test &
e) Other tests to verify safety & integrity of the installation.

20) As-installed drawings:- After all tests on the completed installation have been approved, the contractor shall submit copies along with the original set of as installed electrical drawings in hard bound covers for subsequent maintenance & operation. They shall clearly indicate
a) Conduit runs & sizes with the number & sizes of cables enclosed in the conduit
b) distribution patterns & circuits in main & sub distribution & the controlling switchgear.
c) location of each stations & conductors
d) location of all electrical appliances, equipment & components.
e) Underground & overground cable routes sizes, cable trays & ducts provided.

21) Lighting Arrestor:
A three phase assembly of pole mounted, lightning arrestor of an approved manufacturer shall be supplied & installed to protect system from lightning & voltage surges.

22) Drop out fuse: A fuse disconnecting switch assembly with drop out type fuses shall be composed of three single phase units of an approved manufacturer suitable for vertical pole-mounting outdoors. The fuses shall be suitable for application on 11kV system voltage & a rated maximum voltage of 15kV with a current rating of 100A & an interrupting capacity of 12.5kVA.