QUANTITY SURVEYING
AND
CONTRACTS
MANAGEMENT

QUANTITY SURVEYING & CONTRACTS MANAGEMENT

Subject Code	**: 18CV71**	IA Marks: 20
No. of Lecture Hours/Week: 04		Exam Hours: 03
Total No. of Lecture Hours: 50		Exam Marks: 80

Module 1

Quantity Estimation for Building; study of various drawing attached with estimates, important terms, units of measurements, abstract, Types of estimates - Approximate, detailed, supplementary and revised. Estimation of building: Long wall – Short wall method & Center line method.

Estimate of R.C.C structures including Slab, beam, column , footings, with bar bending schedule.

10 Hours

Module 2

Estimate of Steel truss, manhole and septic tanks.

Quantity Estimation for Roads: Road estimation, earthwork fully in banking, cutting, partly cutting and partly Filling, Detailed estimate and cost analysis for roads.

10 Hours

Module 3

Specification for Civil Engineering Works: Objective of writing specifications essentials in specifications, general and detail specifications of different items of works in buildings.

Analysis of Rates : Factors Affecting Cost of Civil Works , Concept of Direct Cost , Indirect Cost and Project Cost

Rate analysis and preparation of bills, Data analysis of rates for various items of Works, Sub-structure components, Rate analysis for R.C.C. slabs, columns and beams.

10 Hours

Module 4

Contract Management-Tender and its Process: Invitation to tender, Prequalification, administrative approval & Technical sanction. Bid submission and Evaluation process. Contract Formulation: covering Award of contract, letter of intent, letter of acceptance and notice to proceed. Features / elements of standard Tender document (source: PWD / CPWD / International Competitive Bidding – NHAI / NHEPC / NPC).

Law of Contract as per Indian Contract act 1872 , Types of Contract, Entire contract, Lump sum contract, Item rate, % rate, Cost plus with Target, Labour, EPC and BOT, Sub Contracting.

Contract Forms : FIDIC contract Forms , CPWD , NHAI , NTPC , NHEPC

10 Hours

Module 5

Contract Management-Post award : Basic understanding on definitions, Performance security, Mobilization and equipment advances, Secured Advance, Suspension of work, Time limit for completion, Liquidated damages and bonus, measurement and payment, additions and alterations or variations and deviations, breach of contract, Escalation, settlement of account or final payment, claims, Delay's and Compensation, Disputes & its resolution mechanism, Contract management and administration.

Valuation: Definitions of terms used in valuation process, Cost, Estimate, Value and its relationship, Capitalized value. Concept of supply and demand in respect to properties (land , building , facilities'), freehold and lease hold , Sinking fund, depreciation–methods of estimating depreciation, Outgoings, Processand methods of valuation : Rent fixation, valuation for mortgage, valuation of land.

10 Hours

REFERENCE BOOKS:

1. **Estimating & Costing**, B. N. Dutta, Chand Publisher
2. **Quantity Surveying-** P.L. Basin S. Chand : New Delhi.
3. **Estimating & Specification -** S.C. Rangwala :: Charotar publishing house, Anand.
4. **Text book of Estimating & Costing-** G.S. Birde, Dhanpath Rai and sons: New Delhi.
5. **A text book on Estimating, Costing and Accounts-** D.D. Kohli and R.C. Kohli S. Chand: New Delhi.
6. **Contracts and Estimates,** B. S. Patil, University Press, 2006.

INTRODUCTION

Estimate: An estimate is a **computation or calculation of the quantities** required and expenditure likely to be incurred in the construction of the work. The primary objective of an estimate is to enable one to know beforehand, the cost of the work. The estimate is a probable cost of a work and is determined theoretically by mathematical calculations based on plans and drawing and current rates.

Actual cost: The actual cost of the work is known after the completion of the work.

Purpose of estimate

1. Probable cost to be made ready for taking a project.
2. To obtain administrative approval in case of public construction
3. To ascertain the qualities of the labour.
4. To fix up a construction schedule
5. To justify the benefit cost ratio
6. To invite tenders and prepare bills for payments

TYPES OF ESTIMATES

The estimates may be divided in to the following categories:-

1. Preliminary or Approximate estimate.
2. Rough cost estimate based on plinth area.
3. Rough cost estimate based on cubic contents.
4. Detailed estimate.
5. Annual repair estimate.
6. Special repair estimate.
7. Revised estimate
8. Supplementary estimate.

1. Preliminary or Approximate estimate

This estimate is prepared to decide financial aspect, policy and to give idea of the cost of the proposal to the competent sanctioning authority. It should clearly show the necessity of the proposal and how the cost has been arrived at

The calculations for approximate estimate can be done with the following data. The data can be had from a similar construction already complete in the nearby area, excuted by the department.

For example: To calculate approximate estimate for a Hospital, per bed cost is calculated from the recent completed hospital and is multiplied with the number of beds required. Similarly for a house, per square metre plinth area is calculated and is multiplied with the proposed covered area. The specifications should also be same. For a road, expenditure of per kilometre length is taken, width also plays the role.

The following documents should be attached with it.

a) Detailed report
b) Site plan of the proposal
c) It should also clearly mention about the acquisition of land, Provision of electric and water supply etc.

2. Plinth area Estimate (Based on Rough Cost)

Plinth area of a building means Length x Breadth (roofed portion only) excluding plinth offsets. The estimates are prepared on the basis of plinth areas of the various buildings proposed to be constructed. The rates are being arrived at the dividing the total cost of construction with its plinth area. For example if total cost of a building is Rs. 2 lac and its plinth area is 50 sq. m. then plinth area rate =2,00,000 = Rs.4000/- per 50 sq.m. Using this rate as basis of the next construction, approximate or rough cost of the proposal can be arrived at by multiplying the plinth area of the proposed building with this plinth area rate.

The following documents are attached with the estimate.

a) Line plan with brief specifications.
b) Cost of various services added i.e. electric and water supply etc.
c) North line should be shown clearly on line plan.

3. Cubic Contents Estimate (Based on Rough Cost)

The cubic contents of a building means plinth area x height of the building. The height is taken from top of floor level to top of roof.

The cubic contents of the proposed building are multiplied with cubic rates arrived at for the similar construction i.e. total cost of construction divided by cubic contents = cost per cubic metre.

Documents attached are as in No. 2

(Administrative approval is granted on rough cost estimate)

4. Detailed Estimate

After getting Administrative approval on rough cost estimate, detailed estimates are prepared.

In this, the estimate is divided in to sub-heads and quantities of various items are calculated individually.

In the end of the detailed quantities, an abstract of cost giving quantities of each item and rate of every item according to the sanctioned schedule of rates shall be attached. In case of non-schedule rates i.e. rates which are not given in the sanctioned schedule of rates, proper analysis of rates shall be attached. If however the work proposed to be constructed is located in a remote place, the provision for the carriage of the material shall be added in the estimate to avoid any excess over the administratively approved estimate later on. Detailed specifications & report should also be attached with the estimate. Technical sanction is given on detailed estimate.

The detailed estimate shall also provide for the cost of approach road, water supply, electric installations and acquisition of land etc, so as to call it a comprehensive estimate.

5. Annual repair estimate

In order to keep building and roads in perfect condition, annual repairs should be carried out as follow:-

(i) In case of a building-white washing, oiling and painting of doors and windows, cement plaster repairs (inside & outside), repairs of floors etc. In no case this annual repair amount should increase more than 11/2% to 2% of the capital cost of the building.

(ii) In case of a road-filling patches, maintenance of berms etc.

6. Special repair estimate

If the work cannot be carried out of the annual repair funds due to certain reasons resulting in the genuine increase in cost, then special repairs estimate is to be prepard.

The reason of increase may be:-

(i) In case of a building-opening of new doors, change of floors, plastering walls etc.

(ii) (ii) In case of roads-if the whole surface is full of corrugation & patches, then the total surface is to be scarified. The old metal is taken out, consolidation by adding more metal is done and top surface is repainted.

7. Revised estimate

When the sanctioned estimate exceeds by 5% either due to the rate being found insufficient or due to some other reasons, a fresh estimate is prepared which is called a Revised Estimate. A comparative statement on the last page of the estimate is attached giving there in the reasons of the increase of cost in case of each item.

8. Supplementary Estimate

This is fresh detailed estimate in addition to the original sanctioned estimate prepared when additional works are deemed necessary during the progress of a work to supplement the original works. The abstract of cost should show the amount of the original sanctioned estimate as well as the supplementary amount of the original sanctioned estimate as well as the supplementary amount for which sanction is required.

METHOD OF ESTIMATING

Detailed estimate: Preparation of detailed estimate consists of working out the quantities of different items of work and then working out the cost i.e. the estimate is prepared in two stages

1. **Details of measurement and calculation of quantities:** the whole work is divided into different items of work as earthwork, concrete, brickwork etc. and items are classified and grouped under different sub-heads, and details of measurement of each item of work are taken out and quantities under each item are computed in prescribed form.

   Details of Measurement form -

Item No.	Particulars of items	No.	Length, m	Breadth, m	Height or depth, m	Quantity, cu.m	Explanation

2. **Abstract of estimated cost:** The cost under item of work is calculated from the quantities already computed at workable rate, and the total cost is worked out in prescribed form. A percentage of 3 to 5 percent is added for contingencies, to allow for petty contingent expenditures, unforeseen expenditures, changes in design, changes in rates, etc. which may occur during execution of the work.

   Abstract of Estimate form -

SI No.	Particulars	Quantity	Unit	Rate, Rs	Per	Amount, Rs

Data required to prepare an estimate

1. Drawings i.e. Plans, elevations, sections etc.

2. Specifications.
3. Rates.

Drawings: If the drawings are not clear and without complete dimensions the preparation of estimation become very difficult. So, It is very essential before preparing an estimate

Specifications

a) General Specifications: This gives the nature, quality, class and work and materials in general terms to be used in various parts of wok. It helps no form a general idea of building.

b) Detailed Specifications: These gives the detailed description of the various items of work laying down the Quantities and qualities of materials, their proportions, the method of preparation workmanship and execution of work.

Rates: For preparing the estimate the unit rates of each item of work are required.

1. For arriving at the unit rates of each item.
2. The rates of various materials to be used in the construction.
3. The cost of transport materials.
4. The wages of labour, skilled or unskilled of masons, carpenters, Mazdoor, etc.,

Main items of work

1. Earthwork
2. Concrete in foundation
3. Soling
4. Damp proof course
5. Masonry
6. Arch Masonry work
7. Lintels over openings
8. R.C.C work
9. Flooring and roofing
10. Plastering and pointing
11. Doors and windows
12. Wood work
13. Iron work

14. White washing or colour washing or distempering
15. Painting

RCC Work: RCC work is for slabs, beams, columns & footings. **The quantities are calculated in cu.m.** The dimensions of the above mentioned structural elements are obtained accurately from the plan & sectional elevation. **Bearings are added to the clear lengths** to get the dimensions. Quantities are calculated in two parts, namely:

A. Cement concrete quantity **including centering & shuttering excluding steel reinforcement.**

B. Steel reinforcement quantity calculation along with **Bar Bending Schedule.**

Flooring & Roofing: Quantity is calculated in sq. m multiplying the length with the breadth. The length & breadth are measured as **inside dimensions from wall to wall of superstructure.**

<u>Units of measurements in metric system</u>

The principle for dimensions and measurements is to use millimetre (mm) for minute dimensions, centimetre (cm) for small dimensions and metre (m) for big dimensions.

	Particulars of materials and work	**Dimensions**
1	Bricks, stone blocks etc.	All dimensions in cm
2	Files, slates, wall board, glass panes A.C. sheets	Length and breadth are in cm or m and thickness in mm
3	Doors and windows	Height and breath are in cm or m
4	Masonry (brick or stone etc.)	Length and height are in m
5	Painting	Length and breadth or height are in m

METHOD OF BUILDING ESTIMATE

The dimensions, length, breadth and height of depth are to be taken out from the drawing-plan, elevation and section. From the drawings, the dimensions are to be taken out correctly.

Method 1: INDIVIDUAL WALL METHOD

In this method, measure or find out the external length of walls running in the longitudinal direction generally the long walls out-to-out, and the internal lengths of walls running in transverse direction in-to-in. the same rule is applicable to the excavation in foundation, to concrete in foundation and to masonry. Care should be taken to note the difference in dimensions at different height due to offset or footings.

Long wall length out-to-out = centre to centre + half breadth on one side + half breadth on other side = centre to centre length + one breadth

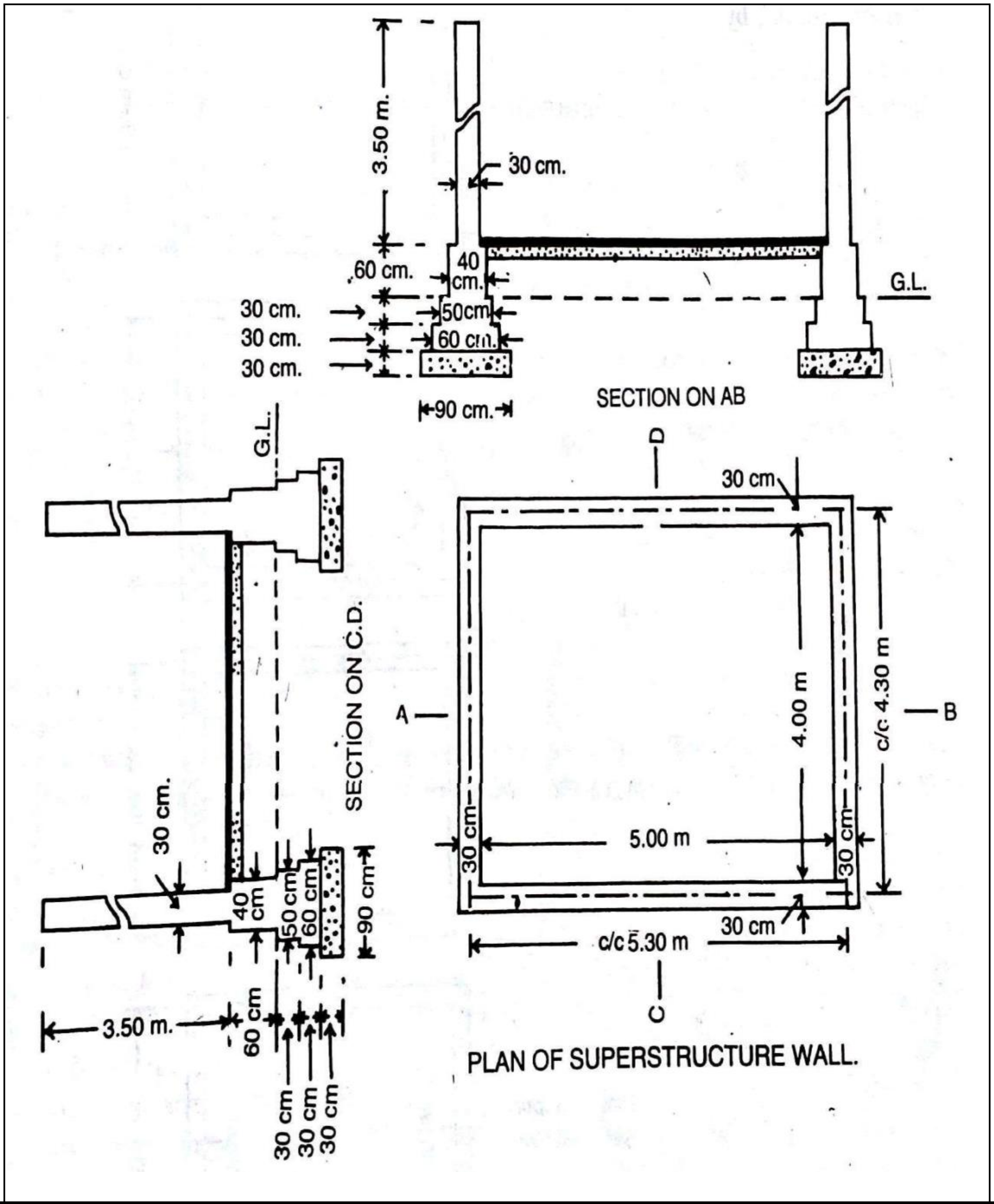
Short wall length in-to-in = centre to centre length – one breadth

That is, in case of long wall add one breadth and in case of short wall subtract one breadth from the centre length to get the corresponding lengths.

Example 1: The diagram represents the plan of the superstructure wall of a single room building of 5m x 4m, and sections represent the cross-sections of the walls with foundation. Estimate the quantities of – earthwork in excavation in foundation, concrete in foundation, brickwork in foundation and plinth, brick work in superstructure.

Length of long wall centre to centre = 5 + ½ * 0.30 + ½ * 0.30 = 5.30 m

Length of short wall centre to centre = 4 + ½ * 0.30 + ½ * 0.30 = 4.30 m



Item No.	Particulars of items	No.	Length, m	Breadth, m	Height or depth, m	Quantity, cu.m	Explanation
1	**Earthwork in excavation in foundation**						
	Long walls	2	6.20	0.90	0.90	10.04	L = 5.30 + 0.90 = 6.20 m

	Short walls	2	3.40	0.90	0.90	5.51	S = 4.30- 0.90 = 3.40 m
					Total	**15.55** cu.m	
2	**Concrete in foundation**						
	Long walls	2	6.20	0.90	0.30	3.35	L = 5.30 + 0.90 = 6.20 m
	Short walls	2	3.40	0.90	0.30	1.84	S = 4.30- 0.90 = 3.40 m
					Total	**5.18** cu.m	
3	**1st class brickwork in foundation and plinth**						
	Long walls						
	1st footing	2	5.90	0.60	0.30	3.65	L = 5.30 + 0.60 = 5.90 m
	2nd footing	2	5.80	0.50	0.30	1.74	L = 5.30 + 0.50 = 5.80 m
	Plinth walls	2	5.70	0.40	0.60	2.74	L = 5.30 + 0.40 = 5.70 m
	Short walls						
	1st footing	2	5.50	0.80	0.20	1.76	S = 4.30-0.60 = 3.70 m
	2nd footing	2	5.60	0.70	0.10	0.78	S = 4.30-0.50 = 3.80 m
	Plinth walls	2	5.90	0.40	0.80	3.78	S = 4.30-0.40 = 3.90 m
					Total	**14.45** cu.m	
4	**Damp proof course** 2.5 cm thick c.c						
	Long walls	2	11.00	0.40	-	8.80	L = 10.60 + 0.40 = 11.00 m
	Short walls	3	5.90	0.40	-	7.08	S = 6.30-0.40 = 5.90 m
					Total	**15.88** sq.m	
5	**1st class brickwork in lime mortar in superstructure**						
	Long walls	2	5.60	0.30	3.50	11.76	L = 5.30 + 0.30 = 5.60 m
	Short walls	2	4.00	0.30	3.50	8.40	S = 4.30-0.30 = 4.00 m
					Total	20.16 cu.m	

Example 2: Estimate the quantities of the following items of a two roomed building from the given plan and section- Earthwork in excavation in foundation, Lime concrete in foundation, 1st class brickwork in cement mortar 1:6 in foundation and plinth, 2.5 cm c.c. damp proof course and 1St class brickwork in lime mortar in superstructure.

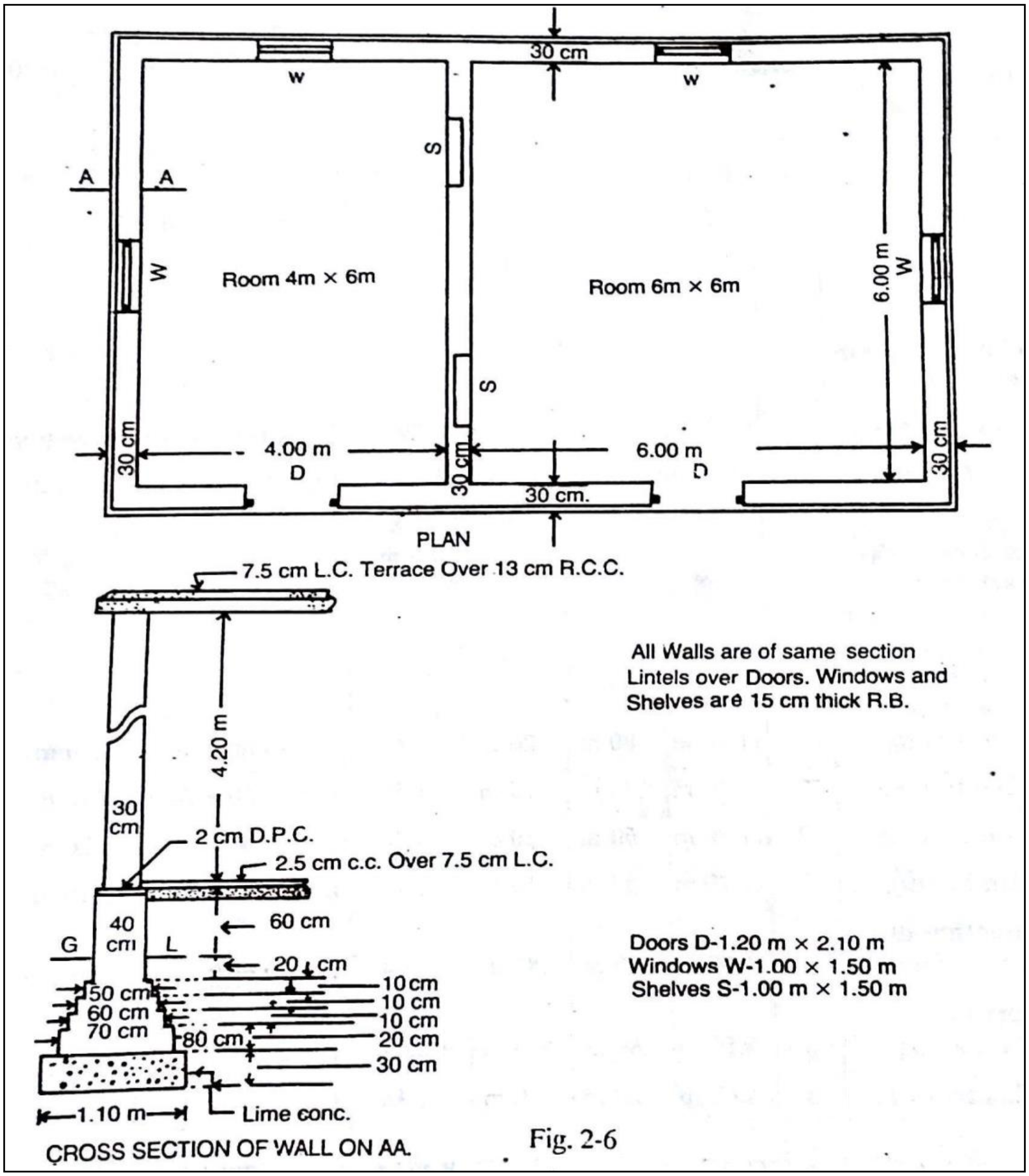


Fig. 2-6

Long wall c/c length = 4 + 6 + 0.30 + 2 * 0.30/2 = 10.60 m

Short wall c/c length = 6 + 2 * 0.30/2 = 6.30 m

Item No.	Particulars of items	No.	Length, m	Breadth, m	Height or depth, m	Quantity, cu.m	Explanation
1	**Earthwork in excavation in foundation**						
	Long walls	2	11.70	1.10	1.00	25.74	L = 10.60 + 1.10 = 11.70 m
	Short walls	3	5.20	1.10	1.00	17.16	S = 6.30 - 1.10 = 5.20 m
					Total	**42.90** cu.m	
2	**Lime Concrete in foundation**						
	Long walls	2	11.70	1.10	0.30	7.72	L = 10.60 + 1.10 = 11.70 m
	Short walls	3	5.20	1.10	0.30	5.15	S = 6.30 - 1.10 = 5.20 m
					Total	**12.87** cu.m	
3	**1st class brickwork in foundation and plinth**						
	Long walls						
	1st footing	2	11.40	0.80	0.20	3.65	L = 10.60 + 0.80 = 11.40 m
	2nd footing	2	11.30	0.70	0.10	1.58	L = 10.60 + 0.70 = 11.30 m
	3rd footing	2	11.20	0.60	0.10	1.34	L = 10.60 + 0.60 = 11.20 m
	4th footing	2	11.10	0.50	0.10	1.11	L = 10.60 + 0.50 = 11.10 m
	Plinth walls	2	11.00	0.40	0.80	7.04	L = 10.60 + 0.40 = 11.00 m
	Short walls						
	1st footing	3	5.50	0.80	0.20	2.64	S = 6.30-0.80 = 5.50 m
	2nd footing	3	5.60	0.70	0.10	1.18	S = 6.30-0.70 = 5.60 m
	3rd footing	3	5.70	0.60	0.10	1.03	S = 6.30-0.60 = 5.70 m
	4th footing	3	5.80	0.50	0.10	0.87	S = 6.30-0.50 = 5.80 m
	Plinth walls	3	5.90	0.40	0.80	5.66	S = 6.30-0.40 = 5.90 m
					Total	**26.10** cu.m	
4	**Damp proof course**						
	2.5 cm thick c.c						
	Long walls	2	11.00	0.40	-	8.80	L = 10.60 + 0.40 = 11.00 m
	Short walls	3	5.90	0.40	-	7.08	S = 6.30-0.40 = 5.90m
					Total	**15.88** sq.m	
5	**1st class brickwork in lime mortar in superstructure**						
	Long walls	2	10.90	0.30	4.20	27.47	L = 10.60 + 0.30 = 10.90 m

	Short walls	3	6.00	0.30	4.20	22.68	S = 6.30-0.30 = 6.00 m
					Total	50.15 cu.m	
	Deduct						
	Door Opening	2	1.20	0.30	2.10	1.51	
	Window Opening	4	1.00	0.30	1.50	1.80	
	Shelves	2	1.00	0.20	1.50	0.60	Back of shelves 10 cm thick wall
	Lintel over doors	2	1.50	0.30	0.15	0.14	Bearing 15 cm
	Lintel over windows	4	1.30	0.30	0.15	0.23	Bearing 15 cm
	Lintel over shelves	2	1.30	0.30	0.15	0.12	Bearing 15 cm
			Total deduction			4.40	
			Net Total			**45.75** cu.m	

Method 2: CENTRE LINE METHOD

In this method the sum total length of centre lines of walls, long and short has to be found out. Find the total length of centre lines of walls, of same type, long and short having same type of foundation and footings and then find the quantities by multiplying the total centre length by the respective breadth and the height.

In this method, the length of wall remains same for excavation in foundation, for concrete in foundation, for all footings and for superstructure. This method is quick but requires special attention and consideration at the junctions, meeting points of partition or cross walls, etc.

For buildings having cross or partition walls, for every junction of partition or cross wall with the main walls, special considerations have to be made to find out the quantities accurately. For each junction half breadth of the respective item should be deducted from the total centre line length. Thus in the case of building having one partition wall, there are two junctions, for earthwork in foundation trench and foundation concrete deduct one breadth of trench or concrete from the total centre length (2 x ½ = one for two junctions).

For buildings having different types of walls, each et of walls shall have to be dealt separately. Find the total centre length of all walls of one type and proceed in the same manner as described above. Similarly find the total centre length of walls of second type and deal this separately, and so on.

In the case of buildings having different types of walls, suppose the outer walls are of A type and inner cross walls are of B type, then all the A type walls shall be taken jointly first and then B type walls shall be taken together separately. In such cases no deduction of any kind need to be made for A type walls, but where B type walls are taken, for each junction deduction of half breadth of A type wall (main wall) shall have to be made from the total centre length of walls.

It may be noted that at the corners of the building where two walls are meeting no subtraction or addition is required.

Example 3: Solve **Example 1** problem by Centre Line method

Total centre length of walls = AB + BC + CD + DA = 5.30 + 4.30 + 5.30 + 4.30 = 19.20 M

If the total centre length is multiplied by the breadth and the depth we get the quantity of earthwork in excavation.

Item No.	**Particulars of items**	**No.**	**Length, m**	**Breadth, m**	**Height or depth, m**	**Quantity, cu.m**	**Explanation**
1	**Earthwork in excavation in foundation**	1	19.2	0.9	0.9	**15.55** cu.m	Total centre length of all walls = 19.20 m
2	**Concrete in foundation**	1	19.20	0.90	0.30	**5.18** cu.m	
3	**1st class brickwork in foundation and plinth**						
	1st footing	1	19.20	0.60	0.30	3.46	
	2nd footing	1	19.20	0.50	0.30	2.88	
	Plinth wall	1	19.20	0.40	0.60	4.61	
					Total	**10.94** cu.m	
5	**1st class brickwork in lime mortar in superstructure**	1	19.2	0.3	3.5	**20.16** cu.m	

Example 4: Solve **Example 2** problem by Centre Line method

In this problem there are two junctions of the inner wall with the main wall

Total centre length of wall = 2 x c/c of long wall + 3 x c/c of short wall

= 2 x 10.60 + 3 x 6.30 = 40.10 m

Diagram

If the total centre length is multiplied by the breadth and depth, at the junction the portions A and B shown by hatch lines come twice and we get the quantity in excess by these portions, and these excesses shall have to be deducted. The deduction may be effected reducing the centre length by half breadth for each junction

Thus the quantity of earthquake in excavation

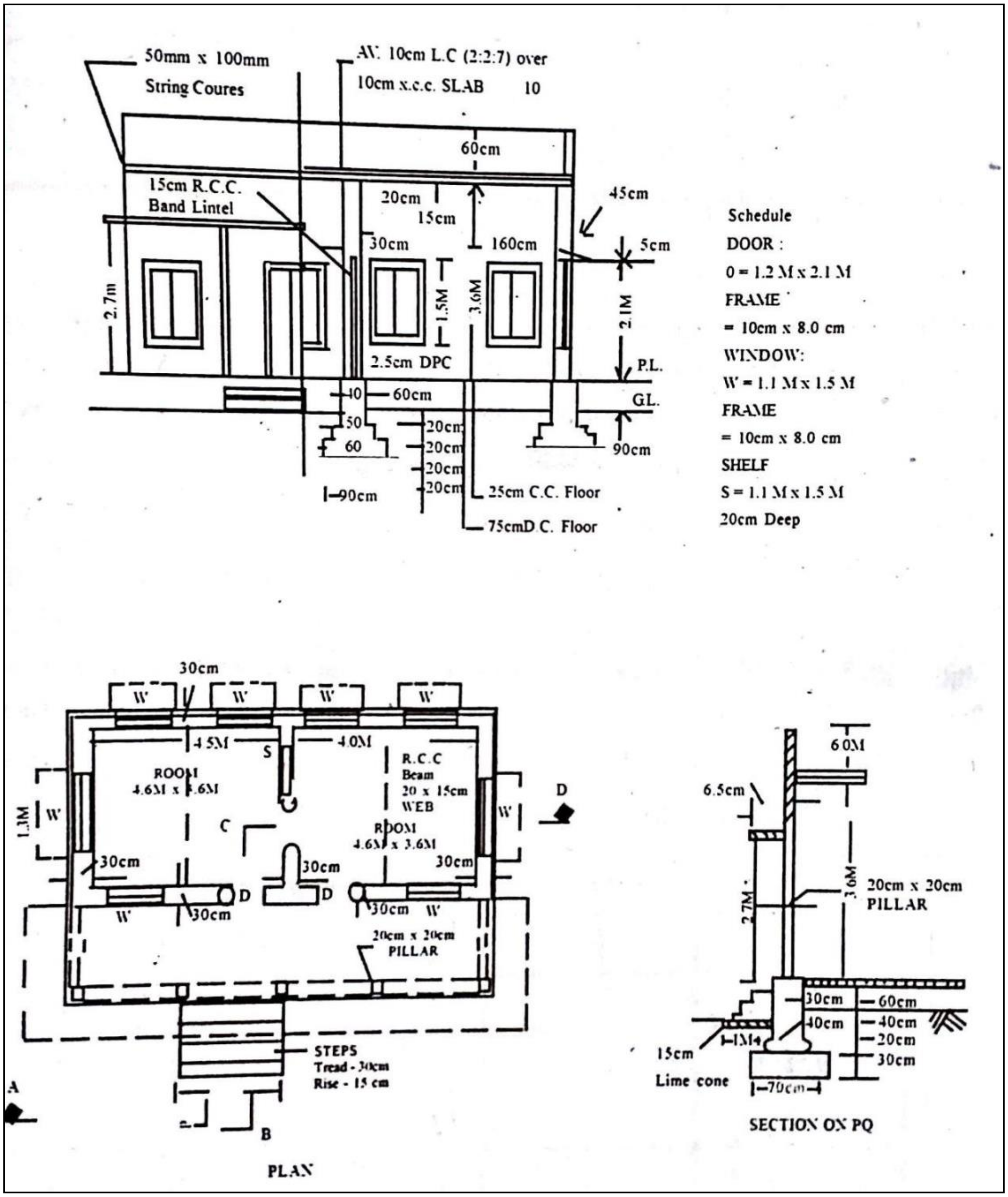
= [Total centre length – (2x1/2 breadth)] x breadth x depth

Item No.	**Particulars of items**	**No.**	**Length, m**	**Breadth, m**	**Height or depth, m**	**Quantity, cu.m**	**Explanation**
							total centre length = 40.10m
1	**Earthwork in excavation in foundation**	1	39.00	1.10	1.00	**42.90** cu.m	L = 40.10 - 2 x 1.10/2 = 39.00 m
2	**Lime Concrete in foundation**	1	39.00	1.10	0.30	**12.87** cu.m	
3	**1st class brickwork in foundation and plinth**						
	1st footing	1	39.30	0.80	0.20	6.29	
	2nd footing	1	39.40	0.70	0.10	2.76	
	3rd footing	1	39.50	0.60	0.10	2.37	
	4th footing	1	39.60	0.50	0.10	1.98	
	Plinth wall above footing	1	39.70	0.40	0.80	12.70	
					Total	**26.10**	
4	**Damp proof course**	1	39.70	0.40		15.88	L = 40.10 - 2x0.40/2 = 39.70
	Deduct door sill	2	1.20	0.40		0.96	
					Total	**14.92** sq.m	

5	**1st class brickwork in lime mortar in superstructure**	1	39.80	0.30	4.20	50.15 cu.m	L = 40.10- 2 x 0.30/2 = 39.80 m
	Deduct						
	Door Opening	2	1.20	0.30	2.10	1.51	
	Window Opening	4	1.00	0.30	1.50	1.80	
	Shelves	2	1.00	0.20	1.50	0.60	Back of shelves 10 cm thick wall
	Lintel over doors	2	1.50	0.30	0.15	0.14	Bearing 15 cm
	Lintel over windows	4	1.30	0.30	0.15	0.23	Bearing 15 cm
	Lintel over shelves	2	1.30	0.30	0.15	0.12	Bearing 15 cm
			Total deduction			4.40	
			Net Total			**45.75**	
						cu.m	

Estimation of quantities from both the methods will be exactly same.

Example 5: The accompanying figure below shows the details of a two roomed building. Estimate the quantities and cost of the following items of works: Earthwork in excavation for the foundation in hard soil at Rs 14/m^3, Lime concrete bed 1:2:4 for all walls at Rs. 1200/m^3, First class brick work (CM 1:4) in foundation and plinth at Rs. 2000/m^3, First class brick work (CM 1:4) in superstructure at Rs. 2200/m^3, RCC 1:2:4 for roof slab



Sol: Long wall and short wall method

c/c length of long walls of rooms = 4.50 + 0.30 + 4.00 + 2 x 0.30/2 = 9.10 m

c/c length of short walls of rooms = 3.60 + 2x 0.30/2 = 3.90 m

c/c length of partition walls of rooms = 3.60 + 2 x 0.30/2 = 3.90 m

c/c length of front long wall of verandah = (4.5 + 0.3 = 4.0 + 2x0.30) – 2x0.20/2 = 9.20 m

c/c length of verandah side walls = 1.60 + 0.30/2 + 0.20/2 = 1.85 m

Item No.	Particulars of items	No.	Length, m	Breadth, m	Height or depth, m	Quantity, cu.m	Explanation
1	**Earthwork in excavation in foundation**						
	Long Walls	2	10.00	0.90	0.90	16.20	9.1 + 2 x 0.9/2 = 10.00 m
	Short walls	3	3.00	0.90	0.90	7.29	3.9 - 2x0.90/2 = 3.00 m
	Partition wall verandah front	1	3.00	0.90	0.90	2.43	
	Long Wall	1	9.90	0.70	0.90	6.24	9.20 + 2x0.7/2 = 9.90m
	Verandah sides						
	Short wall	2	1.05	0.70	0.90	1.32	1.85 - 0.90/2 -0.70/2 =1.05
	Steps	1	2.60	0.80	0.15	0.31	(1 + 0.3/2) - 0.7/2 = 0.80 m
					Total	**33.79** cu.m	
2	**Lime concrete bed 1:2:4**						
	Rooms						
	Long walls	2	10.00	0.90	0.30	5.40	
	Short walls	3	3.00	0.90	0.30	2.43	
	Partition wall	1	3.00	0.90	0.30	0.81	
	Verandah						
	Front long wall	1	9.90	0.70	0.30	2.08	
	Side short walls	2	1.05	0.70	0.20	0.29	
	Steps	1	2.60	1.00	0.15	0.39	
					Total	**11.40** cu.m	

3	**First class brick work (CM 1:4) in foundation and plinth rooms**						
	Long walls						
	1st footing	2	9.70	0.60	0.20	2.33	9.1+2X0.60/2 = 9.70 m
	2nd footing	2	9.60	0.50	0.20	1.92	9.1 + 2x0.5/2 = 9.60 m
	up to plinth	2	9.50	0.40	0.80	6.08	9.1 + 2x0.4/2 = 9.50 m
	Short walls						
	1st footing	3	3.30	0.60	0.20	1.19	3.9 - 2x 0.6/2 = 3.30 m
	2nd footing	3	3.40	0.50	0.20	1.02	3.9 - 2x0.5/2 = 3.40 m
	up to plinth	3	3.50	0.40	0.80	3.36	3.9 - 2x0.4/2 = 3.50 m
					Total	**15.90** cu.m	
4	**First class brick work (1:6) in super structure**						
	Long walls	2	9.40	0.30	3.60	20.30	9.10 + 2x0.3/2 = 9.40 m
	Short walls	3	3.60	0.30	3.60	11.66	3.90 - 2x0.3/2 = 3.60 m
	Vearandah over lintel						
	long Wall	1	9.40	0.20	0.90	1.69	9.02 + 2x0.2/2 = 9.40 m
	Side short wall	2	1.60	0.20	0.90	0.58	
	Pillars	5	0.20	0.20	2.70	0.54	1.85 - 0.3/2 - 0.2/2 = 1.60 m
					Total	34.78 cu.m	
	Deductions						
	Doors	2	1.20	0.30	2.10	1.51	
	Windows	8	1.10	0.30	1.50	3.96	
	Shelf	1	1.10	0.20	1.50	0.33	
	Lintels						
	Main walls	1	20.20	0.30	0.15	0.91	4.5+0.3+4.0+2x0.30+ 3x3.6 = 20.20
	Verandah	1	12.60	0.20	0.15	0.38	4.5+0.3+4.0+2x0.30+ 2x1.6 = 12.60 m
	Shelf Opening	1	1.30	0.20	0.15	0.04	1.1 + 2x0l.1 = 1.30
			Total deduction			7.13	
			Net Total			**27.65** cu.m	

5	**RCC 1:2:4 for roof slab**	1	9.40	6.00	0.10	5.64 cu.m	0.30 + 3.6 +0.3 +1.6 +0.2 = 6.00 n
	Steel Reinforcement						
	(1% of RCC= 5.64 x 0.001 x 7850)					**0.5 ton**	

Abstract of Cost

SI No.	Particulars	Quantity	Unit	Rate, Rs	Per	Amount, Rs
1	Earthwork excavation in foundation	31.36	cu.m	140.00	cu.m	4390.40
2	Lime concrete bed 1:2:4	10.74	cu.m	1200.00	cu.m	12888.00
3	First Class brick work (1:4) in foundation and plinth	15.90	cu.m	2000.00	cu.m	31800.00
4	First class brick work(1:6) in superstructure	27.65	cu.m	2200.00	cu.m	60830.00
5	RCC 1:2:4 for roof slab	5.64	cu.m	3800.00	cu.m	21432.00
6	Steel reinforcement	0.50	ton	3800.00	ton	1900.00
						133240.40
				Taking 10% extra		13324.04
				Total		**146564.44**

Example 6: The details of a residential building are shown in the below plan. Workout the quantities and cost of the following items of work by centre line method

1. Earthwork excavation for foundation in soft soil at Rs.102/m^3

2. Size stone masonry in CM 1:6 for foundation and basement at Rs.2400/m^3

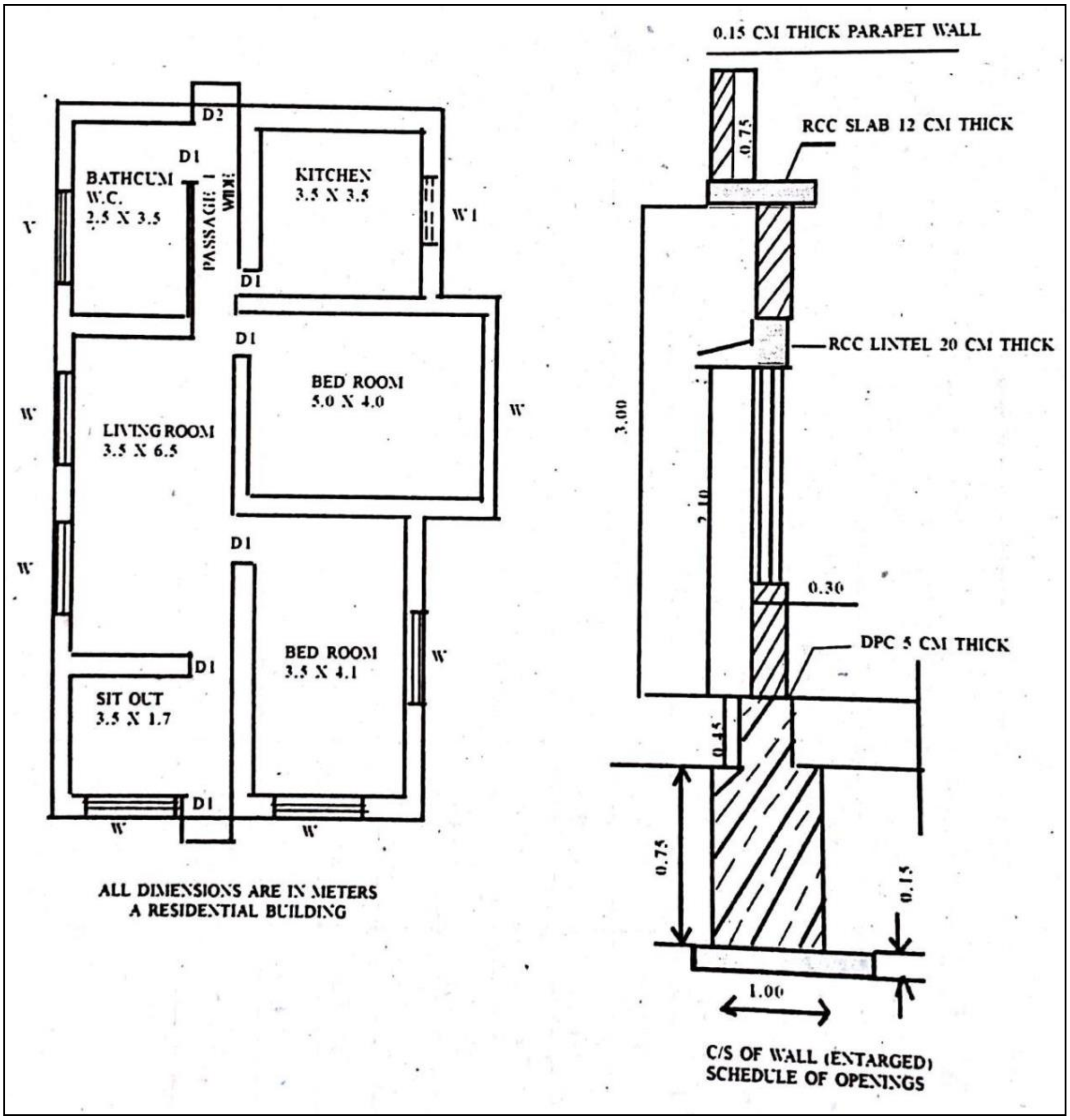
3. BBM with 1:6 CM in super structure at a rate of Rs.3650/m^3

Sol: c/c line length of 30 cm wall =

[0.30/2 + 2.5 + 0.30 + 1.0 +0.3 +3.5 + 0.30/2] x 2 + [0.30/2 + 3.5 + 0.3 + 5.0 + 0.30/2] x 2

+ [0.30/2 + 3.5 + 0.30 + 6.5 + 0.30 + 1.7 + 0.30/2] x 3 + [0.30/2 + 3.5 + 0.30/2] = **75.60 m**

No. of junctions of 30 cm wall with 30cm is **4**



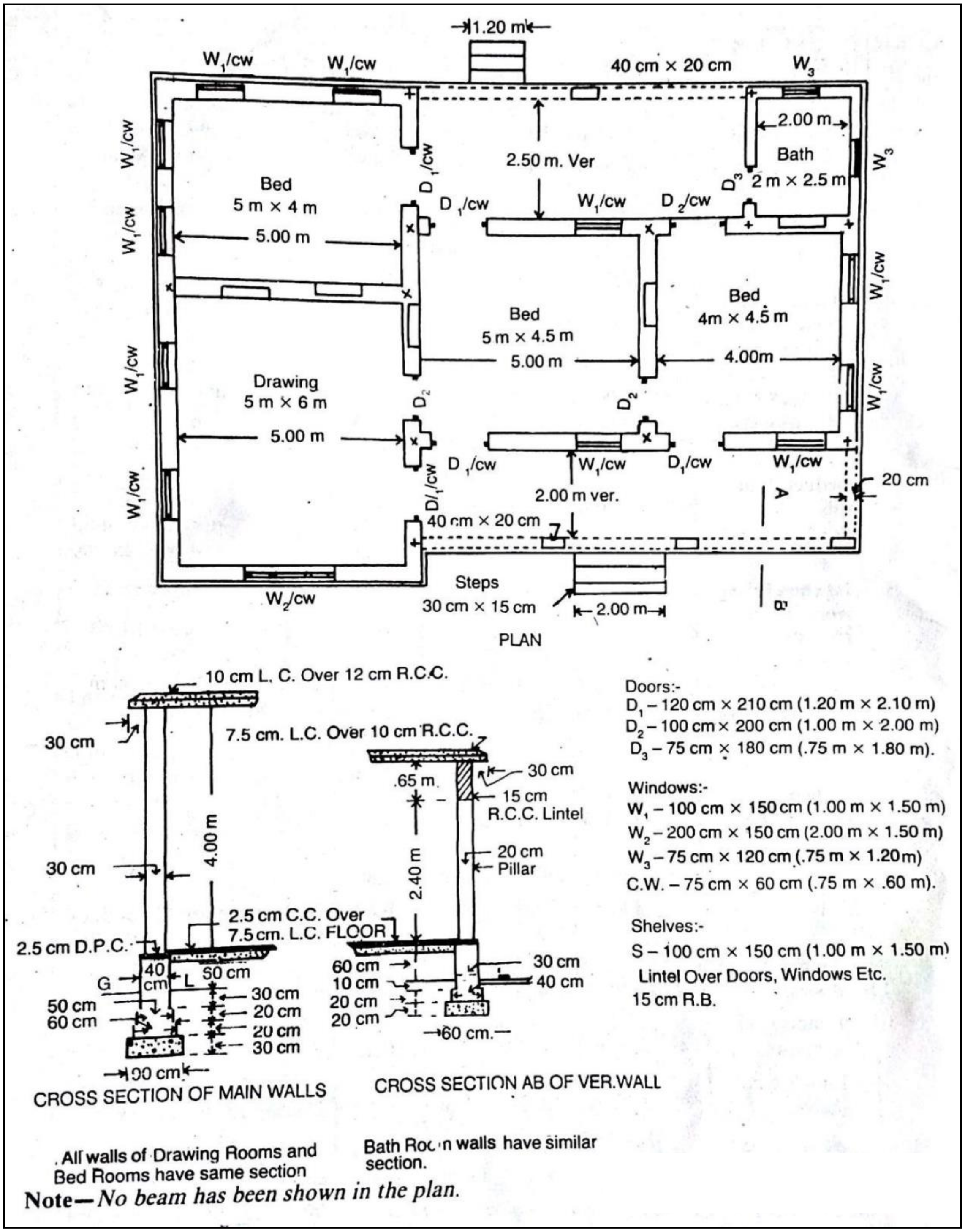
Item No.	Particulars of items	No.	Length, m	Breadth, m	Height or depth, m	Quantity, cu.m	Explanation
1	**Earthwork in excavation in foundation**	1	73.60	1.00	0.90	**66.24** cu.m	75.6 - 4(1.00/2)
2	**Size Stone Masonry (1:6)**						
	1st footing	1	74.10	0.75	0.75	41.68	75.6 - 4(0.75/2) = 74.10m
	2nd footing	1	74.70	0.45	0.45	15.13	75.6 - 4(0.45/2) = 74.70m

					Total	**56.81** cu.m	
3	**Burnt Brick Masonry**						
	for 30 cm wall	1	75.00	0.30	3.00	**67.50**	75.6 - 4 (0.30/2) = 75m
	for parapet wall	1	41.00	0.15	0.75	**4.61**	
					Total	**72.11** cu.m	
	Deduct						
	Opening for 30 cm wall						
	Door, D	7	1.20	0.30	0.30	0.76	
	D2	1	0.90	0.30	2.10	0.57	
	Window W	6	1.50	0.30	1.35	3.65	
	W1	1	1.50	0.30	1.20	0.54	
	V	1	0.90	0.30	0.45	0.12	
	Deductions for lintel						
	All round lintel	1	41.00	0.30	0.20	2.46	
	Lintel over internal walls						
	D	5	1.20	0.30	0.20	0.36	
	D2	1	0.90	0.30	0.20	0.05	
			Total deduction			8.50	
			Net Total			**63.61** cu.m	

Abstract of Cost

SI No.	Particulars	Quantity	Unit	Rate, Rs.	Per	Amount, Rs.
1	Earthwork excavation in foundation	66.24	cu.m	102.00	cu.m	6756.48
2	Lime concrete bed 1:2:4	56.81	cu.m	2400.00	cu.m	136344.00
3	First Class brick work (1:4) in foundation and plinth	63.61	cu.m	3650.00	cu.m	232176.50
						375276.98
				Taking 10% extra		37527.70
				Total		**412804.68**

Example 7: Estimate by centre line method the quantities of the following items of a residential building: 1) Earthwork in excavation in foundation, 2) Lime concrete in foundation, 3) First class brickwork in 1:6 cement sand mortar in foundation and plinth, 4) Damp proof course and 5) First class brickwork in lime mortar in superstructure.



Sol: Total centre length of all 30 cm walls of main rooms = Total centre length of walls of drawing and left side bed room + Total centre length of walls of bed rooms right side.

= (2 x c/c length of long wall + 3 x c/c length of short wall) + (2 x c/c length of long wall + 2 x c/c length of short wall) = (2 x 10.60 + 3 x 5.30) + (2 x 9.60 + 2 x 4.80) = 65.90 m.

Number of junctions = 6 with main walls of 30 cm.

Total centre length of all 20 cm walls of front verandah, back verandah and bath room

= (c/c length of front wall + c/c length of side wall) + (c/c length of back verandah long wall including bath + 2 x c/c length of cross walls of bath room) = (9.65 + 2.25) + (9.65 + 2 x 2.75) = 27.05 m.

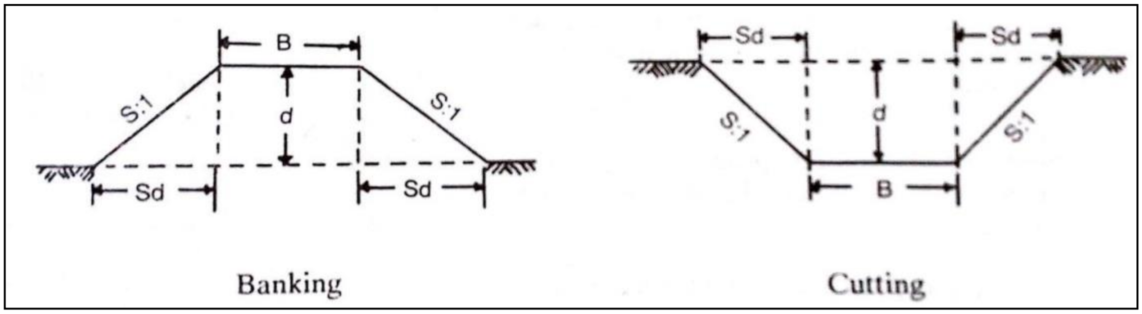
Number of junctions = 5 with walls of 30 cm and 1 with walls of 20 cm.

Item No.	Particulars of items	No.	Length, m	Breadth, m	Height or depth, m	Quantity, cu.m	Explanation
1	**Earthwork in excavation in foundation**						
	Walls of main room (6 junctions)	1	63.20	0.90	1.00	**56.88**	L = 65.90 - 6x0.90/2 = 63.20 m
	Walls of verandah (5 and 1 junctions)	1	24.50	0.60	0.50	**7.35**	L = 27.05 - 5x0.90/2 -1x0.60/2 = 24.50 m
					Total	**64.23** cu.m	
2	**Lime Concrete in foundation**						
	Walls of main rooms	1	63.20	0.90	0.30	**17.06**	L = 65.90 - 6x0.90/2 = 63.20 m
	Walls of verandah and bath	1	25.50	0.60	0.20	**3.06**	L = 27.05 - 5x0.50/2 - 1x0.60/2 =225.50 m
					Total	**20.12** cu.m	
3	**1st class brickwork in foundation and plinth in 1:6 cement mortar**						
	Walls of main rooms						
	1st footing	1	64.10	0.60	0.20	7.69	L = 65.90 - 6x0.60/2 = 64.10 m
	2nd footing	1	64.40	0.50	0.20	6.44	L = 65.90 - 6x0.50/2 = 64.40 m
	Plinth wall above footing	1	64.70	0.40	0.90	23.29	L = 65.90 - 6x0.40/2 = 64.70 m

	Walls of verandah and bath footing	1	25.85	0.40	0.20	2.07	L = 27.05 - 5x0.40/2-1x0.40/2 = 25.85 m
	Plinth wall above footing	1	25.90	0.30	0.70	5.44	L = 27.05 -5x0.40/2 -1 x 0.30/2 = 25.90 m
					Total	**44.93** cu.m	
4	**2.5 cm Damp proof course**						
	Walls of main rooms	1	64.70	0.40		25.88	L = 40.10 - 2x0.40/2 = 39.70
	Verandah pillars	4	0.50	0.30		0.60	
	Bath room (total 3 walls)	1	7.30	0.30		2.19	L = 7.30 m
					Total	**28.67** sq.m	
5	**1st class brickwork in lime mortar in superstructure**						
	Walls of main rooms	1	65.00	0.30	4.00	78.00	L = 65.90 - 6x0.30/2 = 65 m
	Walls of verandah and bath	1	26.20	0.20	3.05	15.98	L = 27.05 - 5x0.30/2 - 1x0.20/2 = 26.20 m
					Total	**93.98** cu.m	

ROADWORK ESTIMATION

Cross section of road in banking and cutting is generally in the shape of trapezium.



Quantity of earthwork = Sectional Area * Length

Therefore, Sectional area = $Bd + 2*1/2*sd*d$

$$A = Bd + sd^2$$

Therefore, Quantity of earthwork = $A * L$

S:1 (side slope = horizontal :Vertical)

i.e. for 1 Vertical, s is the horizontal

for d vertical, sd is the horizontal

Methods of doing roadwork estimation are

1) Mid-sectional area method
2) Mean-sectional area method
3) Prismoidal method
4) Trapezoidal method

1) Mid-sectional area method

Quantity = Area of mid-section x length. Let d_1 and d_2 be the height of bank at two ends portion of embankment. L be the length of the section, B the formation width and s:1 (horizontal:vertical) the side slope then,

Area of mid section = Area of rectangular portion + area of two triangular portion

$$= Bd_m + 1/2sd_m^2 + 1/2sd_m^2 = Bd_m + sd_m^2$$

Therefore, Quantity of earthwork = $(Bd + sd^2) \times L$, where d stands of mean height or depth

The quantities of earthwork may be calculated in a tabular form as shown below

Station or chainage	Depth or height	Mean depth or height d	Area of central portion Bd	Area of sides sd^2	Total sectional area, $Bd + sd^2$	Length between stations L	Quantity	
							Embankment	Cutting

2) Mean sectional Area method:

Quantity = Mean sectional area x length. Sectional area at one end $A_1 = Bd_1 + sd_1^2$, Sectional area at one end $A_2 = Bd_2 + sd_2^2$, d_1 and d_2 are the heights or depth at the two ends.

The mean sectional area $A = (A_1 + A_2)/2$, Quantity $Q = [(A_1 + A_2)/2] \times$ Length

The quantities of earthwork may be calculated in a tabular form as shown below

Station or chainage	Depth or height	Area of central portion Bd	Area of sides sd2	Total sectional area, Bd + sd2	Mean Sectional Area	Length between stations L	Quantity	
							Embankment	Cutting

3. Prismoidal Formula Method:

Quantity or volume = $L/6\ (A_1 + A_2 + 4A_m)$

Where A_1 and A_2 are the cross sectional areas at the two ends of a portion of embankment of road of length L and A_m is the mid-sectional area

Let d_1 and d_2 be the heights of banks at the two ends, and d_m be the mean height at the mid-section, B be the formation width and s:1 be the side slope.

Cross-sectional area at one end

$A_1 = Bd_1 + sd_1^2$

Cross-sectional area at other end

$A_2 = Bd_2 + sd_2^2$

Cross-section at middle

$D_m = (d_1 + d_2)/2$

$A_m = Bd_m + sd_m^2$

$= B(d_1 + d_2)/2 + s[(d_1 + d_2)/2]^2$

Quantity = $L/6\ (A_1 + A_2 + 4A_m)$

4. Trapezoidal method

When a series of cross-sectional areas are calculated at equidistant points, the volume may be worked out by trapezoidal formula

Volume by trapezoidal formula method

$V = (D/2)\ \{A_0 + 2A_1 + 2A_2 + 2A_3 + \ldots 2\ A_{n-1} + A_n\}$

$= D\ \{(A_0 + A_n)/2 + A_1 + A_2 + A_3 + A_{n-1}\}$

Where A_0, A_1, A_2, A_3…..A_{n-1} and A_n are the areas of cross-sections,

D = Distance between the section, V = Volume of cutting or banking

Example 1 Estimate the quantity of earthwork for a road of 12m formation width with the following data using mid section formula.

Chainage	14	15	16	17	18	19	20	21	22
RL of Ground	108.6	109.25	109.4	108.9	108.5	107.25	106.8	107.2	107.2

The road is proposed at uniform falling gradient 1 in 200 passing through GL at chainage 14. Length of one chain = 30 m, side slope 1.5:1 in cutting and 2:1 in banking. The rate of earthwork in filling and cutting are Rs 180/m^3 and Rs 120/m^3 respectively.

Sol:- B = 12 m, s_1=1.5 and s_s = 2

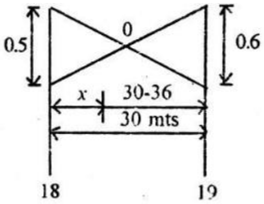
To calculate RL of formation

The road is at a falling gradient of 1 in 200 i.e. for every 200 m, there is 1 m fall for every 30 m

$$\frac{30}{1} * 200 = 0.15\, m$$

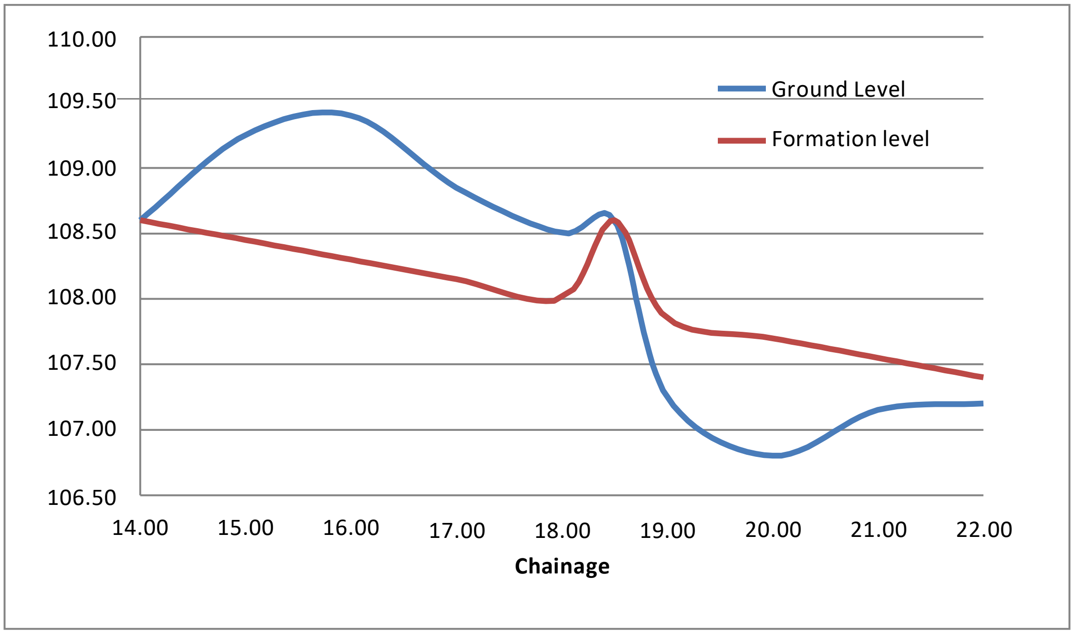
The road passes from cutting to banking on between the chainage 18 and 19. The distance where it passes through zero i.e. ground level is determined as follows:

$$\frac{x}{0.5} = \frac{30 - x}{0.60}$$



Therefore, x = 13.63 m

Chainage	**RL of Ground**	**RL of Formation**	**Depth**	**Mean Depth**
14.00	108.60	108.60	0.00	
15.00	109.25	108.45	-0.80	-0.40
16.00	109.40	108.30	-1.10	-0.95
17.00	108.85	108.15	-0.70	-0.90
18.00	108.50	108.00	-0.50	-0.60
Passes from cutting to banking				
	108.60	108.60	0.00	-0.25
19.00	107.25	107.85	0.60	0.30
20.00	106.80	107.70	0.90	0.75
21.00	107.15	107.55	0.40	0.65
22.00	107.20	107.40	0.20	0.30



Chainage	Depth	Mean Depth	Central Area, sq.m	Area of sides, sq.m	Total area, sq.m	Distance, m	Quantity, cu.m	
							Banking	cutting
14.00	0.00	-	-	-	-	0		
15.00	-0.80	-0.40	4.80	0.24	5.04	30		151.2
16.00	-1.10	-0.95	11.40	1.35	12.75	30		382.5
17.00	-0.70	-0.90	10.80	1.21	12.01	30		360.3
18.00	-0.50	-0.60	7.20	0.54	7.74	30		232.2
Passes from cutting to banking								
	0.00	-0.25	3.00	0.09	3.09	13.63		42.16
19.00	0.60	0.30	3.60	0.18	3.78	16.37	61.88	
20.00	0.90	0.75	9.00	1.13	10.13	30	303.8	
21.00	0.40	0.65	7.80	0.85	8.65	30	259.4	
22.00	0.20	0.30	3.60	0.18	3.78	30	113.4	
						total	738.4	1168
							cu.m	cu.m

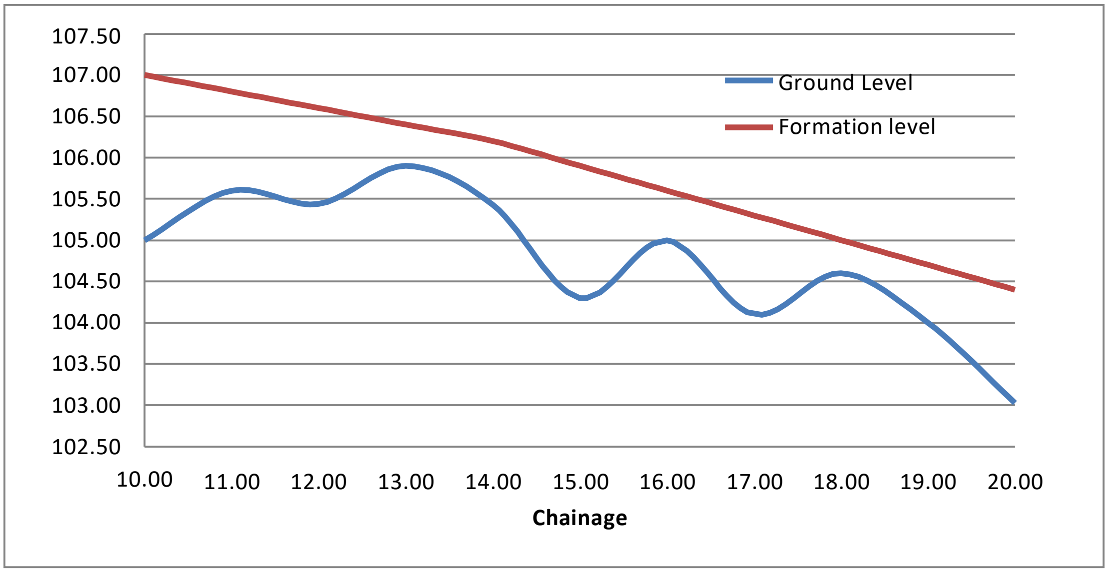
SL	Particulars	Quantity	Unit	Rate/unit	Amount
1	Earthwork in Filling	738.38	cu.m	180	132908.40
2	Earthwork in cutting	1168.35	cu.m	120	140202.00
				Total	273110.40

Contingencies	3%	8193.31
work charge establishment	2%	5462.20
Grand total, Rs		286765.91

Example 2 Reduced level of a ground along the centre line of a proposed road from the chainage 10 to chainage 20 are given below. The formation level at the 10th chainage is 107 and the road is downward gradient of 1 in 150 up to chainage 14 and then the gradient changes to 1 in 100 downward. Formation width of the road is 10 m and side slope of banking are 2:1, length of the chainage is 30m.

Draw longitudinal section of the road and the typical c/s and prepare an estimate of earthwork at a rate of Rs 275 per cu.m

Chainage	10	11	12	13	14	15	16	17	18	19	20
RL of Ground	105	105.6	105.44	105.9	105.42	104.3	105	104.1	104.6	104	103.3



Chainage	RL of Ground	RL of Formation	Depth
10.00	105.00	107.00	2.00
11.00	105.60	106.80	1.20
12.00	105.44	106.60	1.16
13.00	105.90	106.40	0.50
14.00	105.43	106.20	0.77
15.00	104.30	105.90	1.60
16.00	105.00	105.60	0.60
17.00	104.10	105.30	1.20
18.00	104.60	105.00	0.40
19.00	104.00	104.70	0.70
20.00	103.03	104.40	1.37

B = 10 m and s = 2								
Chainage	**Depth**	**Central Area, sq.m**	**Area of sides, sq.m**	**Total area, sq.m**	**Mean Area**	**Distance , m**	**Quantity, cu.m**	
							Banking	**cutting**
10	2.00	20.00	8.00	28.00				
11	1.20	12.00	2.88	14.88	21.44	30	643.20	
12	1.16	11.60	2.69	14.29	14.59	30	437.57	
13	0.50	5.00	0.50	5.50	9.90	30	296.87	
14	0.78	7.80	1.22	9.02	7.26	30	217.75	
15	1.60	16.00	5.12	21.12	15.07	30	452.05	
16	0.60	6.00	0.72	6.72	13.92	30	417.60	
17	1.20	12.00	2.88	14.88	10.80	30	324.00	
18	0.38	3.80	0.29	4.09	9.48	30	284.53	
19	0.70	7.00	0.98	7.98	6.03	30	181.03	
20	0.10	1.00	0.02	1.02	4.50	30	135.00	
						Total	3389.60	
							cu.m	

SL	Particulars	Quantity	Unit	Rate/unit	Amount
1	Earthwork in Filling	3389.6	cu.m	275	932140.00
				Total	932140.00
			Contingencies	3%	8193.31
			workcharge establishment	2%	5462.20
				Grand total, Rs	945795.51

Example 3 Estimate the cost o fearthwork for a portion of road for 400 m length from the following data:

Formation width of the road is 10 m. Side slopes are 2:1 in banking and 1.5:1 in cutting

Station	Distance in m	R.L of Ground	R.L of foramtion
25	1000	51.00	52.00
26	1040	50.90	

27	1080	50.50	Downward gradient of 1 in 200
28	1120	50.80	
29	1160	50.60	
30	1200	50.70	
31	1240	51.20	
32	1280	51.40	
33	1320	51.30	
34	1360	51.00	
35	1400	50.60	

Sol: The road passes from banking to cutting in between the stations 30 and 31. The distance where it passes through zero.i.e., ground level may be determined as followa

The two triangles on either side of zero point are symmetrical

$$\frac{x}{0.3} = \frac{40 - x}{0.40}$$

Therefore, length of banking portion is 17 m and the length of cutting portion is 40 – 17 = 23 m.

B = 10 m, s = 2 for banking and s = 1.5 for cutting									
Station or chainage	**Distance, m**	**Depth or height**	**Mean depth**	**Area of central portion Bd**	**Area of sides sd2**	**Total sectional area, Bd + sd2**	**Length between stations L**	**Quantity**	
								Embankment	**Cutting**
25	1000	1.00	-	-	-	-	-	-	-
26	1040	0.90	0.95	9.50	1.81	11.31	40.00	452.20	
27	1080	1.10	1.00	10.00	2.00	12.00	40.00	480.00	
28	1120	0.60	0.85	8.50	1.45	9.95	40.00	397.80	
29	1160	0.60	0.60	6.00	0.72	6.72	40.00	268.80	
30	1200	0.30	0.45	4.50	0.41	4.91	40.00	196.20	
Passes from banking to cutting									
-	1217	0.00	0.15	1.50	0.05	1.55	17.00	26.27	
31	1240	-0.40	0.20	2.00	0.06	2.06	23.00		47.38
32	1280	-0.80	0.60	6.00	0.54	6.54	40.00		261.60
33	1320	-0.90	0.85	8.50	1.08	9.58	40.00		383.35
34	1360	-0.80	0.85	8.50	1.08	9.58	40.00		383.35
35	1400	-0.60	0.70	7.00	0.74	7.74	40.00		309.40

Total	**1821.95** cu.m	**1384.98** cu.m

-ve sign indicates cutting

Item No.	Particulars of items	Quantity	Unit	Rate, Rs.	Per	Cost, Rs.
1	Earthwork in Banking	1821.95	cu.m	275.00	cu.m	501036.25
2	Earthwork in Cutting	1384.98	cu.m	350.00	cu.m	484743.00
			Total			**985779.25**
			Adding 10% extra			98577.93
			Grand total			**1084357.18**

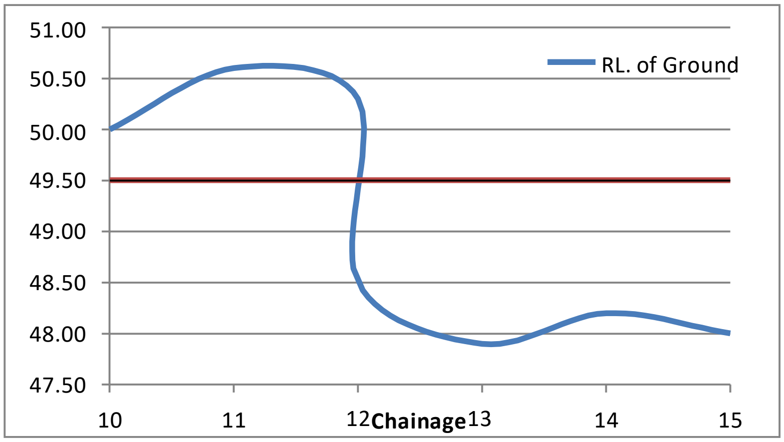
VERTICAL DROP IN GROUND

Whenever there is a vertical drop in the ground at any point, there will be two reduced levels of the ground at that point. In calculating the earthwork the portions on the either side of the vertical drop should be dealt in two operations one by taking the mean of the consecutive heights or depths up to the point and the other by taking the mean of the two consecutive heights or depths beyond the point.

Example 4 Estimate the quantity of earthwork for a portion of a road taking a constant formation level of 49.50. Length of the chain is 50 m.

The Formation width of the road is 8 m and side slope in banking is 1.5:1 and in cutting is 1:1

Station	Distance in m	R.L of Ground	R.L of foramtion
10	500	50.00	49.50
11	550	50.60	
12	600	50.30	
		48.50	
13	650	47.90	
14	700	48.20	
15	750	48.00	



B = 8m, s = 1.5 for banking and s = 1 for cutting									
Station or chainage	**Distance, m**	**Depth or height**	**Mean depth**	**Area of central portion Bd**	**Area of sides sd2**	**Total sectional area, Bd + sd2**	**Length between stations L**	**Quantity**	
								Embankmemt	**Cutting**
10	500	-0.50	-	-	-	-	-	-	-
11	550	-1.10	0.80	6.40	0.64	7.04	50.00		352.00
12	600	-0.80	0.95	7.60	0.90	8.50	50.00		425.13
		1.00							
13	650	1.60	1.30	10.40	2.54	12.94	50.00	646.75	
14	700	1.30	1.45	11.60	3.15	14.75	50.00	737.69	
15	750	1.50	1.40	11.20	2.94	14.14	50.00	707.00	
Negative sign indicates cutting							Total	**2091.44**	**777.13**
								cu.m	cu.m

Estimation of RCC Structural Elements

Reinforced cement concrete work is usually estimated under two items. **The concrete work including centring & shuttering is taken under one item in cu.m and steel reinforcement and its bending is taken under a separate item in quintal. The quantity of steel being small no deductions is made for steel from the volume of concrete.**

Steel reinforcement is calculated as per actual requirement as laid in position including over=laps hooks, cranks. Etc and is determined from the detailed drawings. The density of steel is taken as **78.5 q / cu.m.**

Usually side covers for the steel bars can be taken as same as the clear covers. If no data on clear cover or side cover is mentioned in the question, assume the suitable value.

Minimum clear cover for slab is 15 mm, beam is 20 mm, column is 40 mm, footing is 50 mm.

As said earlier, estimation for RCC components is done in two parts namely: 1) Estimation of Concrete (obtained by multiplying the dimensions of the structural element), 2) Estimation of steel reinforcement by determining the exact length of steel rebar including hook length, bent-up or cranked bar length, lap distance **The total measured length is multiplied with the steel density to get the exact quantity of steel required in quintal.**

Reinforcement calculation:

1. **Hooked length of bar**

Length of one hook = **9Ø**

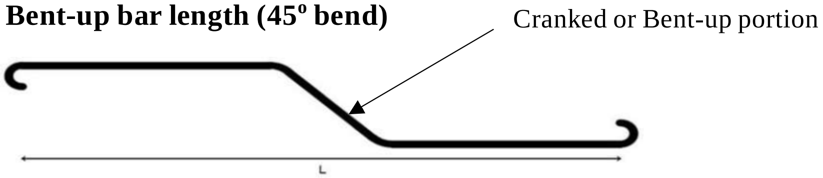
where, Φ = Bar diameter in mm

If there are two hooks at either ends of straight bar,

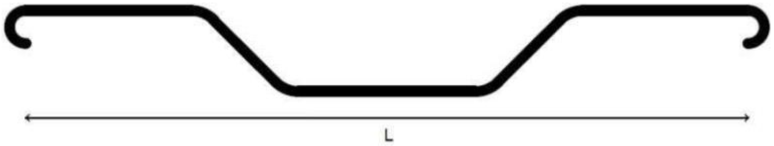
then Total length of Bar = L+9 Ø +9 Ø

= **L + 18 Ø**

2. **Cranked or Bent-up bar length (45° bend)**



The additional length for one bent-up = 0.42d

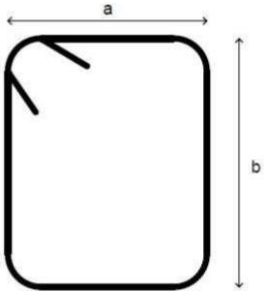


The additional length for two sided bent-up = 2 x 0.42d = 0.84d

where, d = distance b/w lever arm of top & bottom bars

d = Overall Depth – Effective cover at top & bottom

3. **Length of stirrup**



L = 2 (a+b) + 24 Ø

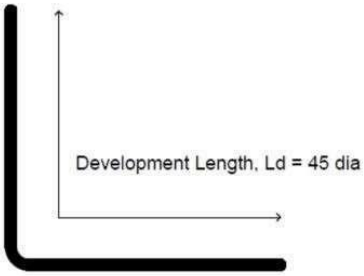
where, a = horizontal length of stirrup

b = vertical length of stirrup

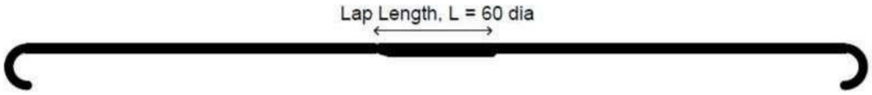
24 Ø = Overlapping length

4. **Number of Bars =** $\frac{Total\ length - 2\ x\ side\ covers}{spacing} + 1$

5. **Development Length = 45Ø**



6. **Lap Length, L = 65Ø**



Problems:

1. Workout the quantity of M20 cement concrete and reinforcement in a beam for the following details.

   Clear span = 4m

   Bearing = 230mm

   Beam size = 300 x 500 mm

   Reinforcement = 2#-25 mm Ø bars in tension region, 2#-12 mm Ø bars in compression region.

   Stirrups – 10 mm diameter bars @ 200 mm c/c

   Side cover = Clear cover = 25 mm

Sol: **Type of steel reinforcements in the above data:**

a. Straight bars with hook on **both ends**

b. Stirrups

A. <u>Concrete Estimation</u>

Quantity of M20 concrete = **L x B x D**

Where, L = Overall length of the beam = 4000 + 230 +230 = 4460 mm = 4.46 m

B = Width of the beam = 300 mm = 0.30 m

D = Depth of the beam = 500 mm = 0.50 m

Therefore, Quantity = 4.46 x 0.30 x 0.50 = **0.67 cu. m**

B. <u>Steel Reinforcement Estimation</u>

Length of Bottom bars

Providing 25 mm side cover at the ends

L = 4000 + 230 +230 -2 x side covers + 2 x Hook length

L = 4460 – 2 x 25 + 2 x 9 Ø = 4460 – 2 x 25 + 2 x 9 x 25 = 4860 mm = **4.86 m**

Length of Top bars

Providing 25 mm side cover at the ends

L = 4000 + 230 +230 – 2x 25 + 2 x 9 x Ø = 4460 – 50 + 18 x 12 = 4626 mm = 4.63 m

Length of Stirrups

L = 2 (a+b) + 24 Ø

a = 300 – 2 x Clear cover – 2 x ½ of stirrup diameter

= 300 – 2 x 25 – 2 x $\frac{10}{2} = 240\ mm$

b = 500 – 2 x Clear cover – 2 x ½ of stirrup diameter

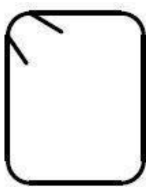
= 500 – 2 x 25 – 2 x $\frac{10}{2} = 440\ mm$

Therefore, L = 2 (240 + 440) + 24 x 10 = 1600 mm = 1.60 m

Number of Stirrups $= \frac{Total\ length - 2\ x\ side\ covers}{spacing} + 1$

$$= \frac{4000 + 2\ x 230 - 2\ x\ 25}{200} + 1 = 23.05 = 24$$

Bar Bending Schedule

SI. No.	**Particular**	**Nos. (1)**	**Length, m (2)**	**Total Length, m (3) = (1) x (2)**	**Weight, q/m (4)**	**Quantity, q (5) = (3) x(4)**
1	Bottom bars, $\emptyset = 25\ mm$ 	2	4.86	9.72	0.0385	0.38
2	Top bars, $\emptyset = 12\ mm$ 	2	4.63	9.26	0.00887	0.08
3	Stirrups, $\emptyset = 10\ mm$ @ 200 c/c 	24	1.60	38.40	0.00616	0.24
					Total weight of steel	**0.70 quintal**

Note: Density of steel, ρ = 78.5 q/m^3

Weight of steel per unit length = $\boldsymbol{\rho\ x\ Area\ of\ bar = 78.5\ x\ \frac{\pi \emptyset^2}{4} = 61.65\emptyset^2 = \frac{\emptyset^2}{0.0162}}$

Where, ∅ = diameter of bar in <u>meters</u>

Abstract Estimate

SI. No.	Particular	Quantity	Unit	Rate, Rs	Per	Amount, Rs
1	RCC work excluding steel	0.67	cu.m	675.00	cu.m	452.00
2	Steel Reinforcement	0.70	q	515.00	q	360.00
					Total	**812.00**
					Add 5% extra	**41.00**
					Grand Total	**853.00**

2. A simply supported doubly reinforced beam has the following data:

   Clear span = 5.4 m

   Bearing over the supports = 300mm

   Size =300x800mm

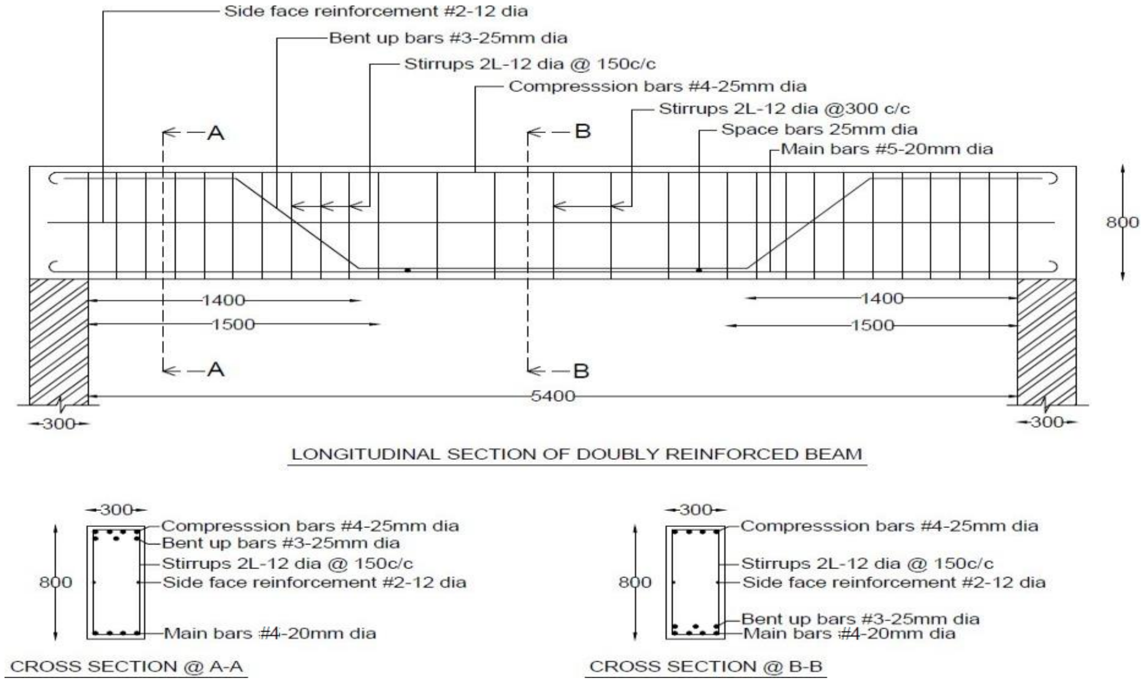
   Main reinforcement tensile: #7- 25 Ø. 4 straight and 3 bent up @ 1400mm from support.

   Compression reinforcement: #4-25 Ø Spacer bars =25 Ø

   Side face reinforcement = #2-12 Ø

   Shear reinforcement: 2L- 12 Ø @ 150 c/c for a distance of 1.5 m from the support and 2L-12 Ø @ 300 c/c for remaining middle portion.

   Workout the quantity cement concrete and reinforcement in a beam.



Sol: **Type of steel reinforcements in the above data:**

- **a.** Straight bars with hook on **both ends at Top and bottom**
- **b. Bars cranked at both ends**
- c. Side face reinforcement
- d. Stirrups

A. Concrete Estimation

Quantity of M20 concrete = **L x B x D**

Where, L = Overall length of the beam = 5400 + 300 + 300 = 6000 mm = 6.00 m

B = Width of the beam = 300 mm = 0.30 m

D = Depth of the beam = 800 mm = 0.80 m

Therefore, Quantity = 6.00 x 0.30 x 0.80 = **1.44 cu. m**

B. Steel Reinforcement Estimation

Length of Bottom Straight bars

Assuming 25 mm side cover at the ends

L = 5400 + 300 + 300 - 2 x side covers + 2 x Hook length

L = 6000 – 2 x 25 + 2 x 9 Ø = 6000 – 2 x 25 + 2 x 9 x 25 = 6400 mm = **6.40 m**

Length of Top Straight bars

Providing 25 mm side cover at the ends

L = 6000 – 2 x 25 + 2 x 9 Ø = 6000 – 2 x 25 + 2 x 9 x 25 = 6400 mm = **6.40 m**

Length of Cranked bars

Steel bar is bent-up on both sides

Therefore, additional length of bar for 2 sided bent-up bar = 0.84d

where, d = distance b/w lever arm of top & bottom bars

d = 800 – 2 x 25 – 2 x 12 – ½ x 25 – ½ x 25 = 701.00 mm

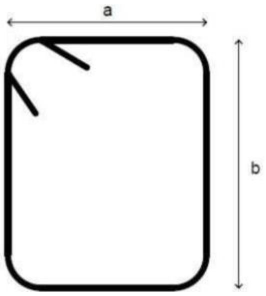
Total length = L – 2 x side cover + 2 x hook length + 0.84d

= 5400 + 300 + 300 – 2 x 25 + 2 x 9 Ø + 0.84 d

= 5400 + 300 + 300 – 2x 25 + 2 x 9 x 25 + 0.84 x 701.00

= 6988 mm = 7.00 m

Length of Stirrups



L = 2 (a+b) + 24 Ø

a = 300 – 2 x Clear cover – 2 x ½ of stirrup diameter

= 300 – 2 x 25 – 2 x $\frac{12}{2} = 238\ mm$

b = 800 – 2 x Clear cover – 2 x ½ of stirrup diameter

= 800 – 2 x 25 – 2 x $\frac{12}{2} = 738\ mm$

Therefore, L = 2 (238 + 738) + 24 x 12 = 2240 mm = 2.24 m

Stirrups are placed at **150 mm c/c up to a distance of 1.50 m** from the support on either end & in the remaining distance the spacing is at **300 mm c/c**

Number of Closely spaced stirrups $= \frac{Total\ length - 2\ x\ side\ covers}{spacing} + 1$

$= \frac{3000 - 2\ x\ 25}{150} + 1 = 20.66 = 22$

Number of stirrups in the remaining portion $= \frac{Total\ length - 2\ x\ side\ covers}{spacing} + 1$

$= \frac{(5400 - 3000)}{300} + 1$ = 9 = 10

Total number of Stirrups = 22 + 10 =32

Length of side face bars

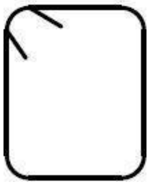
Side face bars are not provided with hooks, they are simple straight

Total length of Side face bar = L – 2 x side covers

= 5400 + 300 + 300 – 2 x 25

= 5950 mm = 5.95 m

Bar Bending Schedule

SI. No.	Particular	Nos. (1)	Length, m (2)	Total Length, m (3) = (1) x (2)	Weight, q/m (4)	Quantity, q (5) = (3) x(4)
1	Bottom Straight bars, $\emptyset = 25mm$ 	4	6.40	25.60	0.0385	0.97
2	Top Straight bars, $\emptyset = 25\ mm$ 	4	6.40	25.60	0.0385	0.97
3	Cranked bars, $\emptyset = 25\ mm$ 	3	7.00	21.00	0.0385	0.81
4	Stirrups, $\emptyset = 12\ mm$ 	32	2.24	71.68	0.0088	0.63
5	Side face bars, $\emptyset = 12\ mm$ 	2	5.95	11.90	0.0088	0.11
					Total weight of steel	**3.49 quintal**

Note: Density of steel, ρ = 78.5 q/m^3

Weight of steel per unit length = $\boldsymbol{\rho\ x\ Area\ of\ bar = 78.5\ x\ \frac{\pi\emptyset^2}{4} = 61.65\emptyset^2 = \frac{\emptyset^2}{0.0162}}$

Where, Ø = diameter of bar in <u>meters</u>

Abstract Estimate

SI. No.	Particular	Quantity	Unit	Rate, Rs	Per	Amount, Rs
1	RCC work excluding steel	1.44	cu.m	675.00	cu.m	975.00
2	Steel Reinforcement	3.49	q	515.00	q	1797.00
					Total	**2772.00**
					Add 5% extra	**139.00**
					Grand Total	**2911.00**

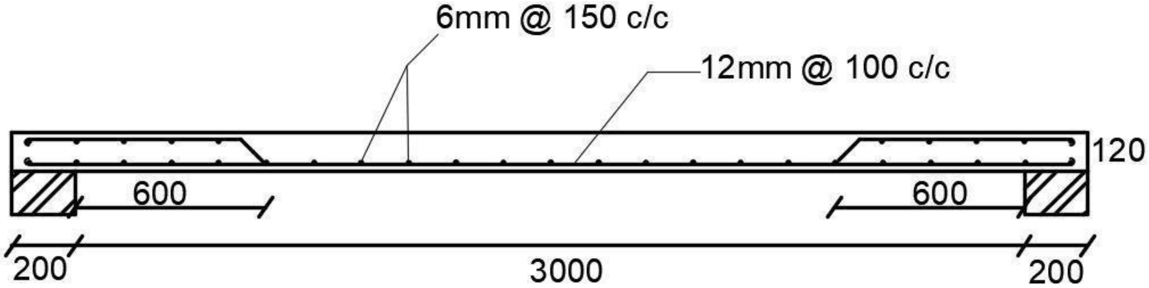
3. Prepare a detailed estimate with abstract for the RCC Slab as shown in figure.

   Room size = 3 m x 4 m

   Top & Bottom cover = 20 mm

   Side cover = 50 mm

   Alternate bars of main steel are bent-up



Sol: **Type of steel reinforcements in the above data:**

a. Straight bars as main reinforcement along shorter direction
b. Alternate bent-up bars as main reinforcement along shorted direction
c. Straight bars as distribution reinforcement along longer direction

A. Concrete Estimation

Quantity of Concrete

Overall length of slab along longer direction, $L_y = 200 + 4000 + 200 = 4400$ mm

Overall length of slab along Shorter direction, $L_x = 200 + 3000 + 200 = 3400$ mm

Slab thickness, t = 120 mm

Volume of Concrete = $L_x \times L_y \times t = 3.40 \times 4.40 \times 0.12 = 1.80$ cu.m

B. Steel Reinforcement Estimation

Length of Straight bottom main bars

Providing 50 mm side cover at the ends

L = 3000 + 200 + 200 **-** 2 x side covers + 2 x Hook length

L = 3400 – 2 x 50 + 2 x 9 $\emptyset$ = 3400 – 2 x 50 + 2 x 9 x 12 = 3516 mm = **3.52 m**

Number of Straight bottom main bars $= \frac{Total\ length - 2\ x\ side\ covers}{spacing} + 1$

$$= \frac{4000 + 2\,x\,200 - 2\,x\,50}{200} + 1 = 22.5 = 24$$

Note: Spacing between two straight bars is 200 mm, because there is bent-up bar in between the straight bar

Length of Cranked bars

Steel bar is bent-up on both sides

Therefore, additional length of bar for 2 sided bent-up bar = 0.84d

where, d = distance b/w lever arm of top & bottom bars

d = 120 – 2 x 20 – ½ x12 – ½ x 12 = 68 mm

Total length = L – 2 x side cover + 2 x hook length + 0.84d

= 3000 + 200 + 200 – 2 x 50 + 2 x 9 $\emptyset$ + 0.84 d

= 3000 + 200 + 200 – 2 x 50 + 2 x 9 x 12 + 0.84 x 68

= 3573 mm = 3.58 m

Number of Cranked Bars = Number of Straight bottom main bars – 1

= 24 - 1 = 23

Length of Distribution bars

Providing 50 mm side cover at the ends

L = 4000 + 200 +200 – 2 x 50 + 2 x 9 x $\emptyset$ = 4400 – 100 + 18 x 6 = 4408 mm = 4.41 m

Number of Distribution bars $= \frac{Total\ length - 2\ x\ side\ covers}{spacing} + 1$

$= \frac{3000 + 2\ x\ 200 - 2\ x\ 50}{150} + 1$ = 23 = 24 (Round off to near even number)

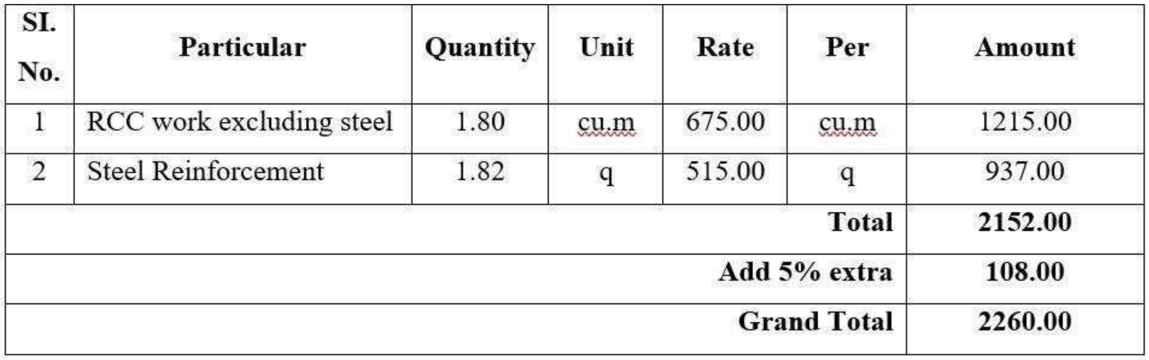
Number of Distribution bars at top near supports $= \frac{2\ (600+200)\ -\ 2\ x\ 50}{150} + 1 = 11 = 12$

(Round off to near even number)

Bar Bending Schedule

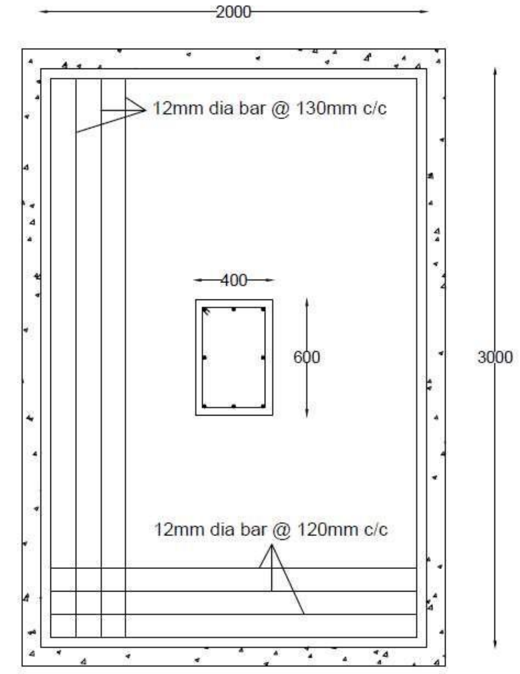
SI. No.	Particular	Nos. (1)	Length, m (2)	Total Length, m (3) = (1) x (2)	Weight, q/m (4)	Quantity, q (5) = (3) x(4)
1	Straight Bottom main bars, $\emptyset = 12\ mm$ 	24	3.52	84.48	0.0088	0.74
2	Alternate Bent-up bars, $\emptyset = 12\ mm$ 	23	3.58	82.34	0.0088	0.73
3	Bottom Distribution bars, $\emptyset = 6\ mm$ 	24	4.41	105.84	0.0022	0.23
2	Top Distribution bars, $\emptyset = 6\ mm$ 	12	4.41	52.92	0.0022	0.12
					Total weight of steel	**1.82 quintal**

Abstract Estimate

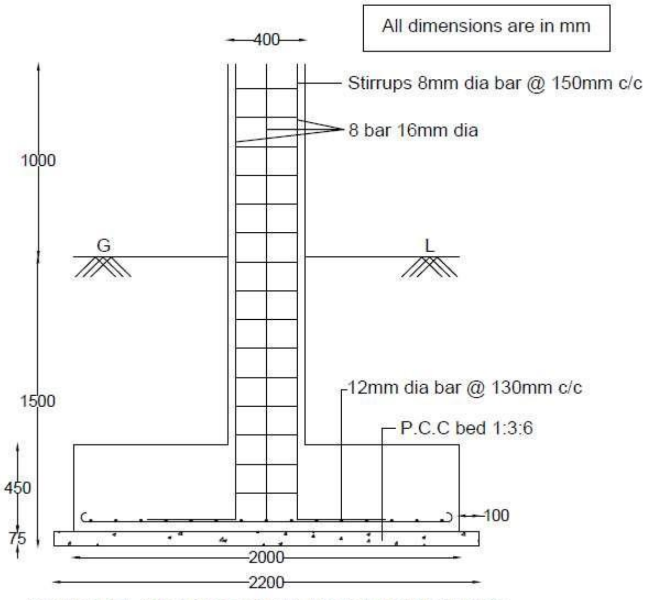


SI. No.	Particular	Quantity	Unit	Rate	Per	Amount
1	RCC work excluding steel	1.80	cu.m	675.00	cu.m	1215.00
2	Steel Reinforcement	1.82	q	515.00	q	937.00
					Total	**2152.00**
					Add 5% extra	**108.00**
					Grand Total	**2260.00**

4. Prepare a detailed estimate with abstract for an isolated rectangular RCC column and footing has the following details:
   Column size (400x600) mm
   Size of footing 2mx3m of uniform thickness 450mm
   Depth of foundation below GL = 1.5m
   Height of column to be shown above GL = 1.0m
   Thickness of PCC bed in 1: 3:6 = 75mm
   Details of reinforcement: Column: #8- 16Ø as main bars with 2L- 8Ø @ 150 c/c lateral ties
   Footing: longer direction steel – 12 Ø @ 130 c/c, Shorter direction steel – 12 Ø 220 c/c
   Take side cover & clear cover = 50 mm



PLAN OF ISOLATED RECTANGULAR COLUMN FOOTING



C/S OF ISOLATED RECTANGULAR COLUMN FOOTING

Sol: **Type of steel reinforcements in the above data:**

a. Straight bars in column with development length
b. Stirrups in column
c. Straight bars with 2 sided hooks in both the direction of footing

Note: In the case of RCC Column & footing Estimation, quantities for earthwork in excavation & PCC need to be calculated prior to RCC quantity calculations

A. <u>Earthwork excavation</u>

Depth of excavation from Ground level = 1.50 m

Size of footing for excavation from the drawing = 2.20 m x 3.20 m

Therefore, Quantity of Soil to be excavated = 2.20 x 3.20 x 1.50 = **10.60 cu.m**

B. Plain Cement Concrete Bed

Size of PCC to be laid is same as excavation pit size = 2.20 m x 3.20 m

Thickness of PCC = 0.075 m

Quantity of PCC = 2.20 x 3.20 x 0.075 = 0.53 cu.m

C. RCC in Footing excluding steel

Size of footing = 2.00 x 3.00 m

Footing Depth = 0.450m

Quantity = 2 x 3 x 0.45 = 2.70 cu.m

D. RCC in Column excluding steel

Column size = 0.40 m x 0.60 m

Column Height = (1.50 – 0.075 – 0.450) + 1.00 = 1.98 m

Quantity = 1.98 x 0.40 x 0.60 = 0.48 cu.m

E. Steel Reinforcement Estimation

1. Column

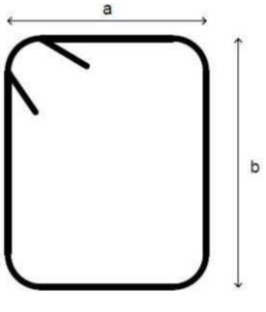
Length of Straight bars

Providing 50 mm side cover

L = 2500 – 75 – 50 – 2 x 12 + 45 Ø = 2351 + 45 x 16 = 3071 mm = 3.10 m

Length of Stirrups

L = 2 (a+b) + 24 Ø



a = 400 – 2 x Clear cover – 2 x ½ of stirrup diameter

$= 400 - 2 \times 50 - 2 \times \frac{8}{2} = 292\ mm$

b = 600 – 2 x Clear cover – 2 x ½ of stirrup diameter

$= 600 - 2 \times 50 - 2 \times \frac{8}{2} = 492\ mm$

Therefore, L = 2 (292 + 492) + 24 x 8 = 1760 mm = 1.76 m

Number of Stirrups $= \frac{Total\ length - 2\ x\ side\ covers}{spacing} + 1$

$= \frac{1975 - 50}{150} + 1 = 13.83 = 14$

Note:

a. Stirrups are provided till the junction of Column & Footing only, hence length of the column = 1975 mm.
b. Side cover is provided only at top of the column because column height is given in the detail as 1.00 m above the ground level.

2. Footing

Length of Straight bars with end hooks along 2.00 m

L = 2000 – 2 x 50 + 2 x 9 ∅ = 1900 + 2 x 9 x12 = 2116 mm = 2.12 m

Number of bars =$\frac{Total\ length-2\ x\ side\ covers}{spacing}+1$

$$= \frac{3000-2\ x\ 50}{120}+1=25.16=26$$

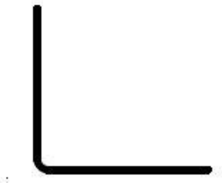
Length of Straight bars with end hooks along 3.00 m

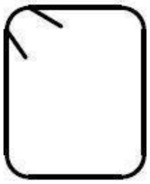
L = 3000 – 2 x 50 + 2 x 9 ∅ = 2900 + 2 x 9 x12 = 3116 mm = 3.12 m

Number of bars =$\frac{Total\ length-2\ x\ side\ covers}{spacing}+1$

$$= \frac{2000-2\ x\ 50}{130}+1=15.61=16$$

Bar Bending Schedule

SI. No.	Particular	Nos. (1)	Length, m (2)	Total Length, m (3) = (1) x (2)	Weight, q/m (4)	Quantity, q (5) = (3) x(4)
1	Straight bars, $\emptyset = 16\ mm$ 	8	3.10	24.80	0.0158	0.39

2	Stirrups, $\emptyset = 8\ mm$ 	14	1.76	24.64	0.00395	0.10
3	Straight bars along 2.00 m, $\emptyset = 12\ mm$ 	2.12	26	55.12	0.0088	0.49
4	Straight bars along 3.00 m, $\emptyset = 12\ mm$ 	3.12	16	49.92	0.0088	0.44
					Total weight of steel	**1.42 quintal**

Abstract Estimate

SI. No.	**Particular**	**Quantity**	**Unit**	**Rate, Rs**	**Per**	**Amount, Rs**
1	Earthwork in Excavation	10.60	cu.m	350.00	cu.m	3710.00
2	Plain Cement Concrete Bed	0.53	cu.m	450.00	cu.m	239.00
1	RCC work in Column & Footing excluding steel	3.18	cu.m	675.00	cu.m	2147.00
2	Steel Reinforcement	1.42	q	515.00	q	731.00
					Total	**6827.00**
					Add 5% extra	**341.00**
					Grand Total	**7168.00**

Estimation of Septic Tank & Soak Pit

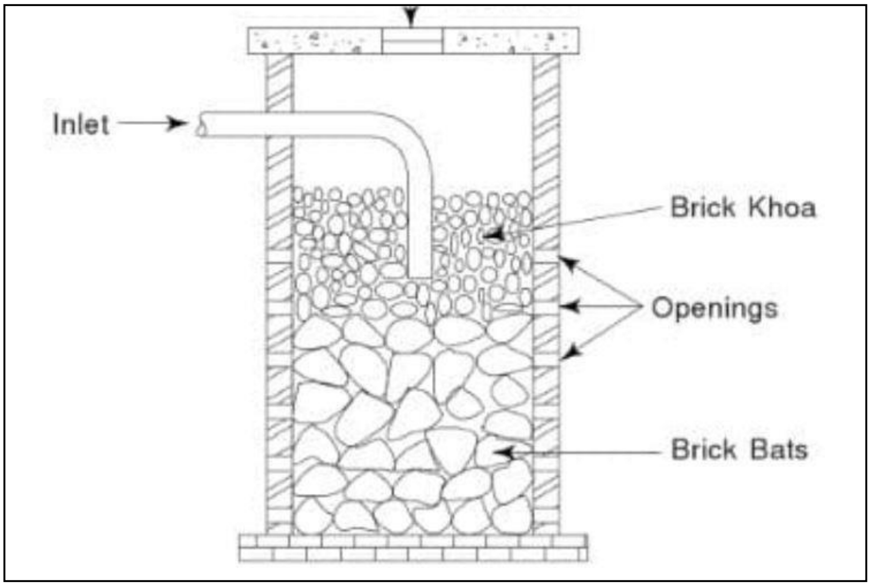
Septic Tank

- A septic tank is an underground chamber made of concrete, fiberglass or plastic into which domestic wastewater (sewage) flows for basic treatment.
- Settling and anaerobic processes reduce solids and organics, but the treatment efficiency is only moderate (referred to as **"primary treatment").**
- Septic tank systems are a type of **simple onsite sewage facility (OSSF).** They can be used in areas that are not connected to a sewerage system, such as rural areas.
- The term "septic" refers to the **anaerobic bacterial environment** that develops in the tank which decomposes or mineralizes the waste discharged into the tank.

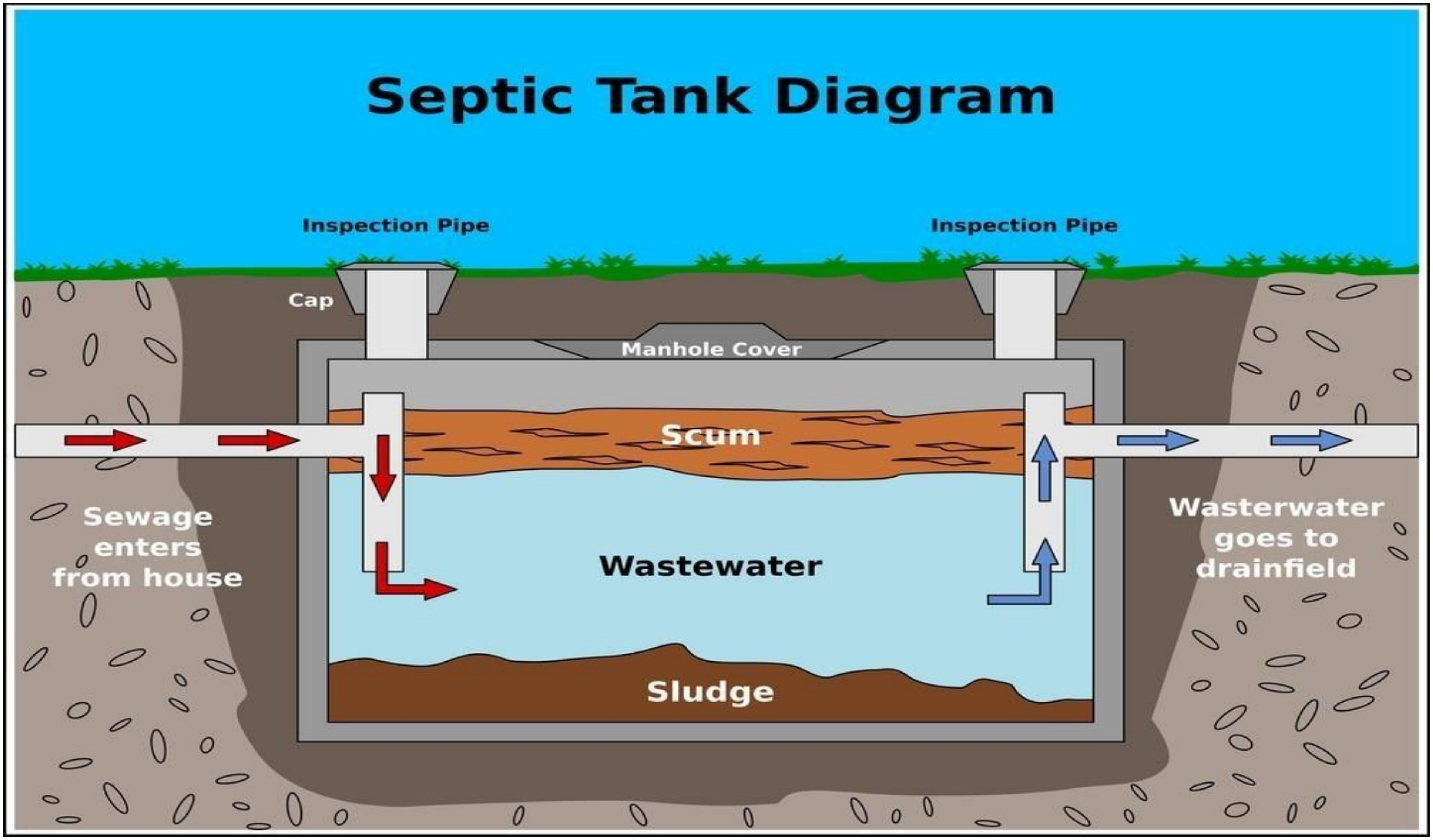
Soak Pit

The basic functions and the need for a soak pit is wastewater management.

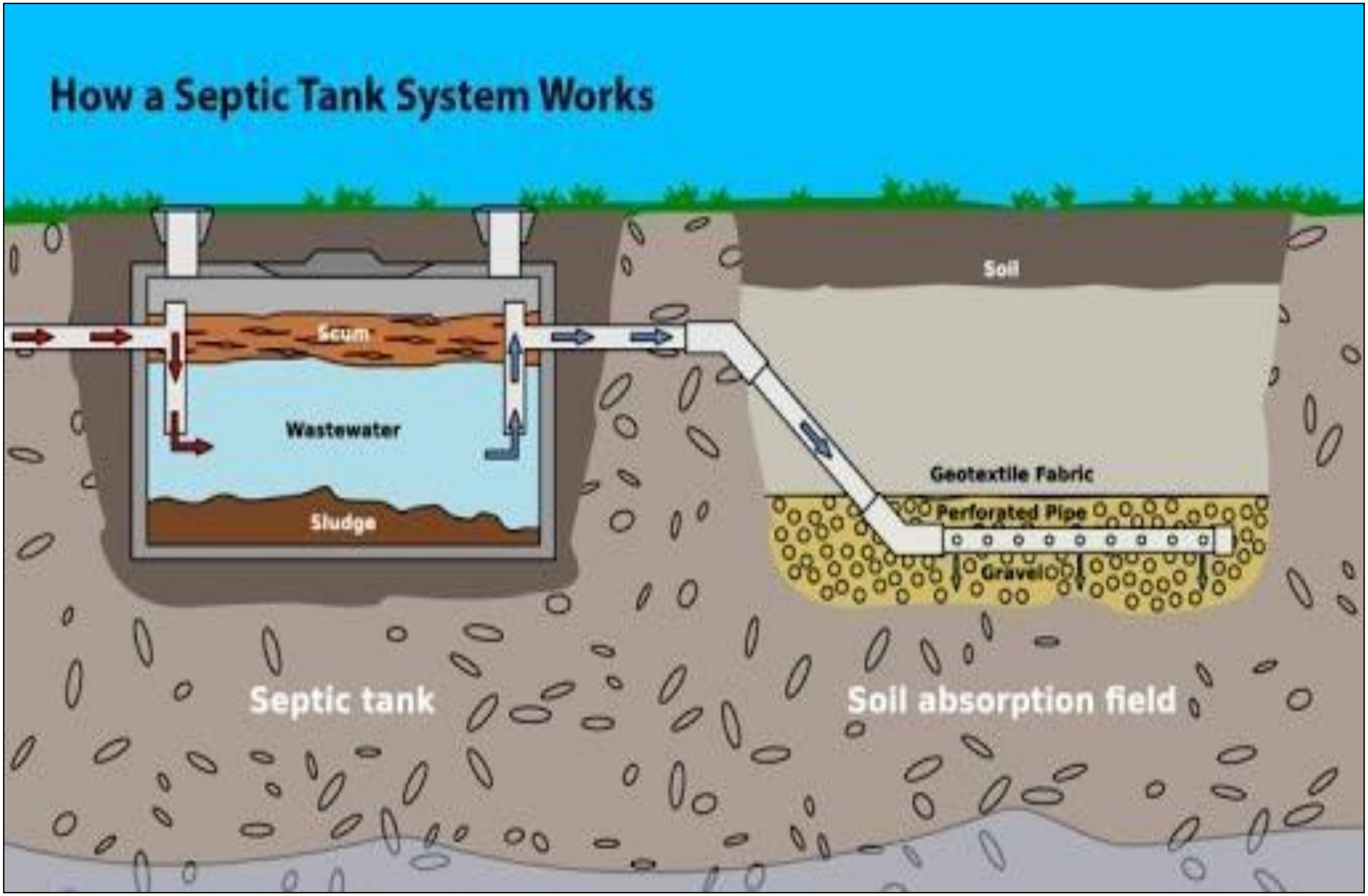
- The effluent water coming out from septic tank is called **greywater,** which must be subjected to a partial treatment before letting it into the ground soil.
- The greywater passing through the soak pit is subjected to filtration. This results in the settlement of smaller particles of effluents at the bottom of the soak pit.
- These smaller particles are digested by the microorganisms which are a sustainable process of degradation. The filtered water is then discharged out through the porous wall of the soak pit.



Soak Pit



Septic Tank Diagram
Inspection Pipe
Inspection Pipe
Cap
Manhole Cover
Scum
Sewage enters from house
Wastewater
Wasterwater goes to drainfield
Sludge


How a Septic Tank System Works
Scum
Wastewater
Sludge
Soil
Geotextile Fabric
Perforated Pipe
Gravel
Septic tank
Soil absorption field

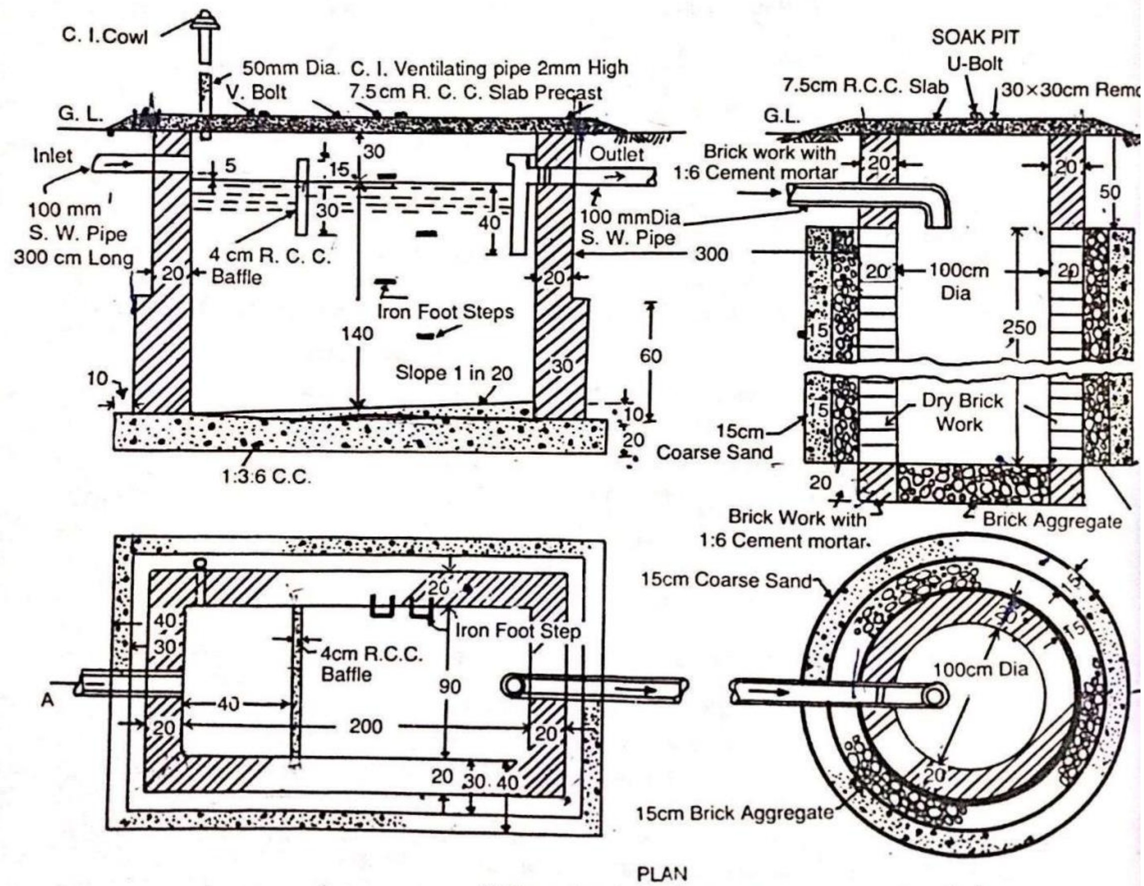
Problem

Estimate the following quantities for the septic tank & soak pit as per the given drawing

Septic tank

1. Earthwork Excavation for septic tank & soak pit @ Rs.300 per cu.m
2. PCC (1:4:8) for bed concrete for septic tank @ Rs.500 per cu.m
3. First class Brick work in CM 1:3 for septic tank @ Rs.2000 per cu.m
4. Second class Brick Work for soak pit @ Rs.1000 per cu.m
5. 12 mm thick cement mortar plastering of walls for septic tank @ Rs.700 per sq.m
6. Plastering of floor for septic tank @ Rs.600 per sq.m
7. RCC (1:2:4) for cover slab with 1% steel reinforcement for septic tank & soak pit @ Rs.1500 per cu.m

SEPTIC TANK FOR 25 USERS



PLAN

All Dimensions in Centimetre unless otherwise Specified.

Item No.	Particulars of items	No.	Length, m	Breadth, m	Height or depth, m	Quantity, cu.m	Explanation
1	**Earthwork in excavation**						
	Septic tank	1	2.80	1.70	1.95	9.28	H = 140 + 30 + 20 +5 = 1.95 m
	Soak pit up to 3 m depth	1	$\frac{\pi x 2.00^2}{4}$ = 3.14		3.00	9.42	Diameter = 2.00 m
	Soak pit lower portion	1	$\frac{\pi x 1.40^2}{4}$ = 1.54		0.20	0.31	Diameter = 1.40 m
					Total	**18.98**	
						cu.m	
2	**PCC (1:4:8) for Bed concrete for Septic Tank**						
	Floor and foundation	1	2.80	1.70	0.20	0.95	
	Sloping floor	1	2.00	0.90	0.05	0.09	D = (0+10)/2 = 5cm
					Total	**1.04**	
						cu.m	
3	**First class brickwork in 1:4 CM in septic tank**						
	Long walls						
	1st step	2	2.60	0.30	0.60	0.94	L = outer to outer
	2nd step	2	2.40	0.20	1.15	1.10	
	Short walls						
	1st step	2	0.90	0.30	0.60	0.32	L = outer to outer
	2nd step	2	0.90	0.20	1.15	0.41	
					Total	**2.78**	
						cu.m	
4	**2nd class brickwork in 1:6 cement mortar**						
	Soak pit, d_1 = 1.00 m, t = 0.20 m, $d_2 = d_1 + 2t$ = 1.40 m	1	$\frac{\pi (d_2^2 - d_1^2)}{4}$ = 0.75		0.70	**0.53**	Thickness must be considered
						cu.m	
5	**12 mm cement plaster**						
	1:3 with standard water proofing compound in septic tank						
	Long walls	2	2.00		1.70	6.80	
	Short walls	2	0.90		1.70	3.06	
					Total	**9.86**	
						sq. m	

6	**20 mm cement plaster**						
	1:3 with standard water proofing compound in floor of septic tank	1	2.00	0.90		1.80	
						sq. m	
7	**RCC (1:2:4) for cover slab with 1% steel reinforcement**						
	Septic Tank	1	2.40	1.30	0.075	0.23	
	Soak Pit	1	$\frac{\pi x 1.40^2}{4} = 1.54$		0.075	0.12	
						0.35	
						cu.m	
	Steel @ 1% of RCC quantity		$0.35\ x\ \frac{1}{100}$ $= 0.0035$		78.5 q	0.27 q	Steel density = 78.5q = 7850 kg

ABSTRACT ESTIMATE

SI No	Particulars	unit	Quantity	Rate, Rs	per	Amount, Rs
1	**Earthwork in excavation**	cu.m	18.98	300.00	cu.m	5694.00
2	**PCC(1:4:8) for Bed Concrete for septic tank**	cu.m	1.04	500.00	cu.m	520.00
3	**First class brickwork in 1:4 CM in septic tank**	cu.m	2.78	2000.00	cu.m	5560.00
4	**2nd class brickwork in 1:6 cement mortar**	cu.m	0.00	1000.00	cu.m	0.00
5	**12 mm cement plaster WALL Septic tank**	sq.m	9.86	700.00	sq.m	6902.00
6	**20 mm cement floor plaster**	sq.m	1.80	600.00	sq.m	1080.00
7	**RCC (1:2:4) for cover slab with 1% steel reinforcement**	cu.m	0.35	1500.00	cu.m	525.00
					Total	20281.00
					Add 5% extra	1014.05
					GRAND TOTAL	21295.05

Estimation of Manhole

A manhole or an inspection chamber is a unit constructed underground to provide access to the utilities like a sewer system, drainage system, etc. Hence, with the help of a manhole, underground utilities are inspected, modified, cleaned and maintained.

Purpose

The main purpose of a manhole is:

1. To perform inspection, cleaning, and removal of any obstruction present in the sewage line.
2. The joining of sewers, the change of direction or the alignment of sewers can be performed with the help of manhole.
3. These have a perforated cover which helps the foul gases to escape. Hence it is a good means of ventilation for the underground sewage system.
4. Manholes help to lay the sewer line in the conventional lengths

Types of Manhole:

Based on the depth:

1. Shallow Manhole
2. Normal Manhole
3. Deep Manhole

Based on Purpose:

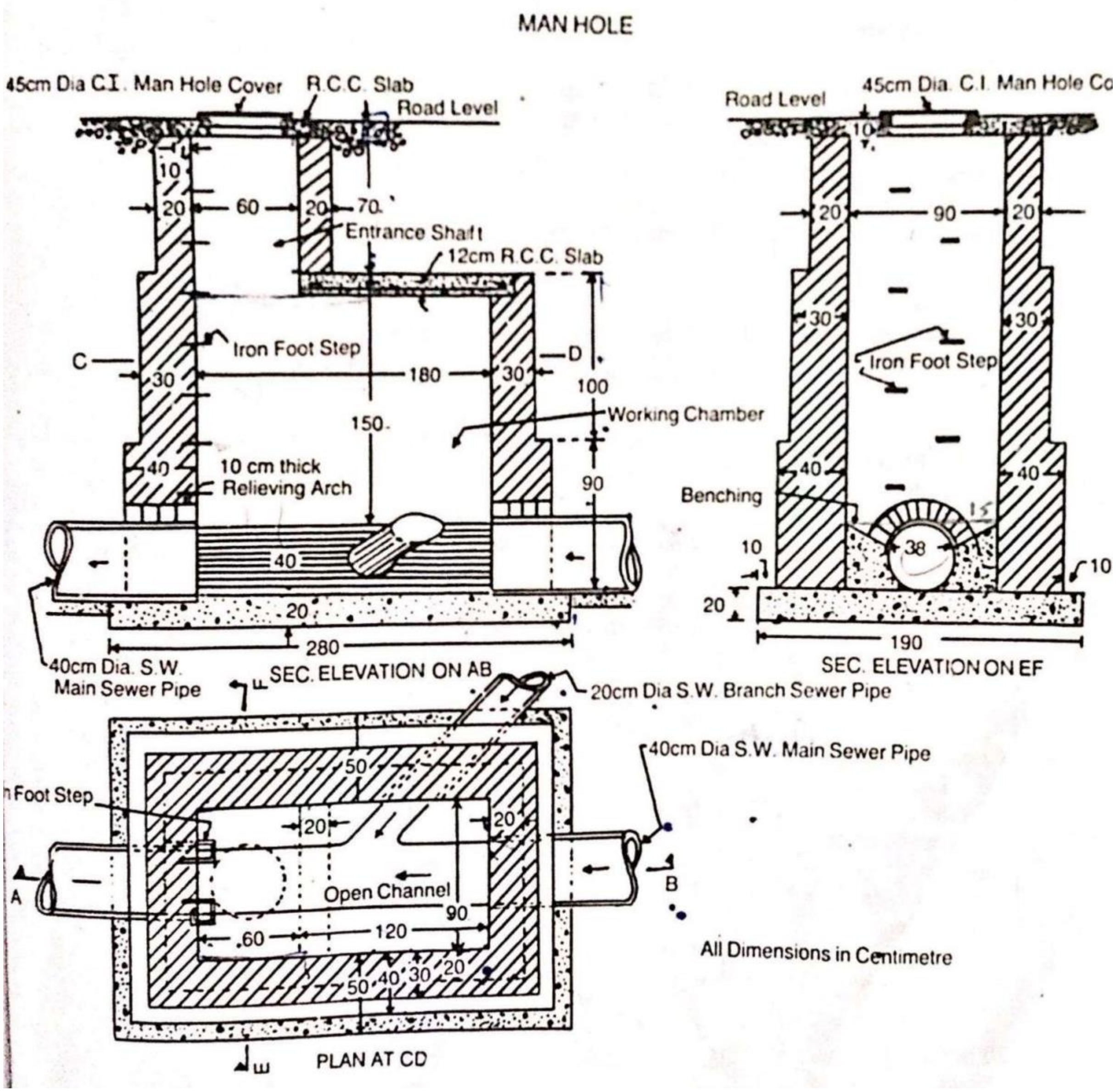
1. Where a change of sewer line is necessary
2. There is a change in sewer size and alignment.
3. A junction is formed by two or more sewer lines

Based on the material:

1. Plastic Manholes
2. Precast Concrete Manholes
3. Fiberglass Manholes

Prepare a detailed estimate of the following works in the construction of Manhole for the details given below diagram.

1. Earthwork estimation @ Rs. 300 per cu.m
2. Cement concrete (CC) Bed with 1:3:6 @ Rs. 500 per cu.m
3. First class Brick work (BBM) in Cement Mortar (CM) 1:4 @ Rs. 2000 per cu.m
4. 12mm thick CM plaster 1:4 @ Rs. 700 per sq.m
5. 20 mm thick CM plaster @ Rs. 600 per sq.m



Item No.	Particulars of items	No.	Length, m	Breadth, m	Height or depth, m	Quantity, cu.m	Explanation
1	**Earthwork in excavation**	1	2.80	1.90	2.90	15.43	
						cu.m	
2	**Cement concrete 1:3:6 with brick ballast**						
	Foundation and bed	1	2.80	1.90	0.20	1.06	
	Benching	1	1.80	0.90	0.40	0.65	
					Total	**1.71**	
						cu.m	
	Deduct						
	Upper portion of main channel	1	1.80	0.64	0.15	0.17	$B = \frac{0.90+0.38}{2} = 0.64$
	Upper portion of branch channel	1	0.30	0.20	0.15	0.01	Skew Length of pipe = 0.20+0.10 = 0.30 m
			total deduction			0.18	
			Net Total			**1.53**	
						cu.m	
3	**I class brickwork in 1:4 cement mortar**						
	Long walls 1st step	2	2.60	0.40	0.90	1.87	
	Long walls 2nd step	2	2.40	0.30	1.00	1.44	
	Long walls 3rd step	2	1.00	0.20	0.70	0.28	
	Short wall 1st step	2	0.90	0.40	0.40	0.29	No deductions for main pipe
	Short wall 2nd step	2	0.90	0.30	1.00	0.54	
	Short wall 3rd step	2	0.90	0.20	0.70	0.25	
					Total	**4.67**	
						cu.m	
4	**Cement Plastering 1:4**						
	Long walls up tp slab	2	1.80		1.50	5.40	
	Short wall up to slab	2	0.90		1.50	2.70	
	Left face Wall	1	0.90		0.82	0.74	D = 0.70 +0.12; (RCC slab of 0.12 m thick)
	Right face Wall	1	0.90		0.70	0.63	
	Remaining face	2	0.60		0.82	0.98	D = 0.70 +0.12; (RCC slab of 0.12 m thick
					Total	**10.45**	
						sq.m	
5	**20 mm thick cement plaster 1:3 in floor and channels**	1	1.80	1.20		**2.16**	B = 0.90+0.30 =1.20 m Additional 0.30 m for channel curvature
						sq.m	

ABSTRACT ESTIMATE						
SI No	**Particulars**	**unit**	**Quantity**	**Rate, Rs**	**per**	**Amount, Rs**
1	**Earthwork in excavation**	cu.m	15.43	300.00	cu.m	4629.00
2	**Cement concrete 1:3:6 with brick ballast**	cu.m	1.53	500.00	cu.m	765.00
3	**I class brickwork in 1:4 cement mortar**	cu.m	4.67	2000.00	cu.m	9340.00
4	**Cement Plastering 1:4**	cu.m	10.45	700.00	sq.m	7315.00
5	**20 mm thick cement plaster 1:3 in floor and channels**	sq.m	2.16	600.00	sq.m	1296.00
					Total	23345.00
					Add 5% extra	1167.25
					GRAND TOTAL	24512.25

SPECIFICATIONS

Definition

A Specification is a statement of particulars. Construction Specification may be defined as written instructions distinguishing and describing in detail the construction work to be undertaken.

Purpose of Specification

The Specifications are generally written to supplement the information shown on drawings. The Specification, when included in the contract documents of a project, serve the following purposes.

1. Monitors the cost of unit quantity of work.
2. Serves as a guide to the supervising staff of the contract as well as to the owner to execute the work.
3. Specifies the equipment, tools and plants to be engaged for work.
4. Specifies the workmanship and the method of doing the work.

Drawings do not furnish the details of different items of work, the quantity of materials, proportion of mortar and workmanship which are described in the specifications. Thus, drawings and specifications form important parts of contract document.

Specifications depend on the nature of the work, the purpose for which the work is required, strength of the materials, availability of materials, quality of materials etc.

Specifications are of two types:

1) General Specification or Brief Specification
2) Detailed Specification

General Specification: It gives the nature and class of the work and materials in general terms, to be used in the various parts of the work, from the foundation to the superstructure. It is a short description of different types of the work specifying materials, proportions, qualities etc.

Detailed Specification: It specifies the qualities and quantities of materials, the proportion of mortar, workmanship, the method of preparation and execution and the method of measurement. The detailed specification of different items of work are prepared separately and describe what the works should be and how shall be executed and constructed.

GENERAL SPECIFICATIONS

General specifications give the idea and class of work in general terms and are generally attached with the rough cost and detailed estimates.

1. General Specifications of First Class Buildings

Foundation and Plinth: - Shall be of first class burnt bricks in lime or cement mortar(1:6)over a bed of cement concrete. (1:6:12 or 1:8:16)

Superstructure:- Shall be of first class burnt brick work in lime or cement mortar (1:6)

Damp Proof Course:- Shall be of a cm thick cement concrete (1:2:4) with on-layer of bitumen laid hot or any other specified water proof material.

Roofing:- Shall be of R.C.C. slabs (1:2:4) covered with two coats of bitumen lalid hot and a layer of lime or cement concrete 8 cm. thick over it with a tile flooring with cement flush with cement flush pointed on the top.

Flooring:- Shall be of TERRAZO in drawing, dining, bath and W.C., 4 cm thick plain conglomerate polished floors in bed rooms and in other rooms.

Doors and Windows:- Doors and windows shall be of teak wood, panelled or panelled and glazed with gauze shutters to outer doors and fixed wire gauze to windows and ventilators Fittings shall preferably of brass or good quality metal.

Finishing:- The inside and outside walls shall have 1.25 cm. thick cement plaster. Drawing, dining and bed rooms inside of walls shall have 2 coats of distemper and other rooms shall have three coats of white washing. The outside of the wall shall have two coats of colour washing over one coat of white washing.

Painting:- Doors and windows shall be given three coats of white lead where exposed and white zinc or cream or grey silicate paint elsewhere.

Miscellaneous:- First class buildings shall be provided with first class sanitary and water supply fittings and electrical installations. A plinth protection 1.50 m. wide of bricks sloped away from the building shall be provided all round the building. Plinth Area Rate Rs. 4500.00 to Rs. 5,500 per sq. meter. (Rates variable).

2. General Specifications of Second Class Buildings

Foundation and Plinth:- All walls shall be built of first class burnt bricks laid in mud mortar over a bed of lime concrete or cement concrete. Top course of the plinth shall be laid in cement mortar(1:6)

Superstructure: - All walls shall be built of first class burnt bricks laid in mud mortar.

The Following portions to be built in cement mortar (1:6.)

a) Shills of windows, C. windows.
b) Top course of parapet.
c) Jambs of doors, windows, C. windows.
d) Drip course, cornice and weather course etc.
e) Two courses below the R.C.C. slab and roof battens.

Damp proof Course: - Damp proof course 4 cm thick shall be of Portland cement concrete (1:2:4) with one coat of bitumen laid hot.

Roofing:- All main rooms shall have R.B. roof or R.C. roof and first class or second class mud roofs over other rooms.

Floors:- the main rooms shall have conglomerate floors and verandahs shall have flat or brick on edge floors over cement concrete and sand.

Doors and Windows:- Interior and exterior surface of wall shall be cement plastered 1.25 cm thick, covered with three coats of white washing.

Painting: - Doors and windows shall be painted with three coats of chocolate paint or any other approved paint.

Miscellaneous:- Roof drainage shall be carried by means of Gargolyes and khassi parnalas. Plinth protection1.50 m. wide of bricks shall be provided all-round the building. Plinth Area Rate: Rs. 2500 to Rs.3000 per sq.m

3. General Specification of Third Class Buildings

Foundations and Plinth: - All walls shall be built of second class burnt laid in mud mortar over bed on lime concrete.

Superstructure: - All walls shall be built of second class burnt bricks laid in mud mortar. Roofing:- All rooms shall have second class mud roof and the verandahs shall have G.I. sheet roof.

Floors:- Floors everywhere shall be of brick over mid concrete and cement pointed.

Doors and Windows: - Doors and windows shall be of kail, Chir, Mango or any other soft wood, ledged, battened and braced type.

Finishing: - Interior surface of walls shall be mud plastered and covered with three coats of white washing. The outside surface shall be flush lime pointed.

Painting: - Doors and windows shall be give two coats of ordinary chocolate paint.

Plinth Area Rate: - Rs. 1500.00 to Rs. 1800.00 per sq.m.

4. General Specifications of Fourth Class Buildings

Foundation and Plinth:- All walls shall be built of se3cond class brick work laid in mud mortar.

Superstructure: - All walls shall be built of sand moulded sun dried bricks laid in mud mortar with the exception of the following which shall be built in second class brick work in mud.

1. Two courses underneath the roof battens.
2. Jambs of doors and windows.
3. Pillars under the roof beams.
4. Sills of windows, C. windows.

Roofing:- Third class mud roof. Floors: - Mud floors(2.5cm) mud plaster over the rammed earth.

Doors and Windows:- Doors and windows shall be of kail, chir or any other soft wood batten doors. Finishing:- mud and mud plaster inside and outside.

Painting: Two coats of ordinary paint.

Plinth Area Rate:- Rs. 800.00 to Rs. 1000.00 per sq.m.

Detailed Specifications of various items of works are as follows:

1. Earthwork in excavation in foundation

Excavation: Foundation trenches shall be dug out to the exact width of the foundation concrete and the side must be vertical. If the soil is not good and does not permit vertical sides, the sides should be sloped back or protected with timber shoring. **Excavated earth shall not be placed within 1m of the edge of the trench.**

Finish of Trench:

1. The bottom of the trench shall be perfectly levelled in both the directions. The sides of the trench must be perfectly levelled atleast to the thickness of the Bed Concrete.
2. Before placing the bed concrete, the surface of the trench must be lightly watered and perfectly rammed.
3. Excess digging if done by mistake, shall be filled with concrete at the expense of the contractor.
4. If rocks or boulders are found during the excavation, these should be removed and the bed of the trenches shall be levelled and made hard by consolidation.
5. Concrete shall not be laid before the inspection and approval by the Engineer-In-charge.

Finds: Any treasure and valuables or materials found during the excavation, shall be the property of the Government.

Water in foundation: Water if accumulates in trench, should be taken out by pumping without additional payment and necessary precautions shall be taken to prevent surface water to enter into the trench.

Trench filling: After the bed concrete has be laid and masonry or RCC work is done, the remaining portion must be filled by earth **in layers of 15 cm** and watered and rammed. Earth fill must be free from rubbish and refuse matters and the clods shall be broken before filling. Surplus earth not required shall be removed and disposed, and site shall be levelled and dressed.

Note: Excavation in saturated soil or different kinds of soil, soft or decomposed rock etc. shall be taken under separate items. The excavation shall be done on the same principle discussed above.

2. Bed concrete in foundation in CC (1:4:8)

Materials: Cement, fine & coarse aggregates, water

Cement shall be fresh Portland cement of standard IS specifications, and shall have required tensile and compressive stresses and fineness.

Fine aggregates shall be of coarse sand consisting of **hard, sharp and angular grains** and shall pass through screen of 5 mm square mesh. Sand shall be of standard specifications clean and free from dust and organic matters. **Sea sand shall not be used**. Fine aggregates may also be crushed stone if specified.

Coarse aggregates shall be of hard broken stone of granite or similar stone, free from dust, dirt and other foreign matters. The **stone ballast shall be 20 mm size and down** and shall be **retained in 5 mm square mesh** and well graded such that the **voids do not exceed 42 %.**

Water shall be clean and free from alkaline and acid matters and suitable for drinking purposes.

Proportion of concrete shall be **1:4:8 as mentioned in the work** above will be **cement : fine aggregates : coarse aggregates.**

Mixing: Cement is to be **placed on the mix of fine & coarse aggregates**. The whole mass mixed three or four times so that it shall be thoroughly incorporated. The required quantity of water shall be added and the entire wet mass shall be turned over until the homogeneous mixture of the required consistency is obtained.

Laying: Concrete shall be handled from the mixing platform to the place of final deposit as rapidly as possible. It shall be laid slowly and gently in **layers of 15 cm**. and thoroughly consolidated with **5.5 kg rammers**.

Curing: The concrete shall be kept wet for a fortnight. The wetting should be done by covering with gunny bags and watering frequently to keep the bags moist which helps in curing process.

3. Size Stone Masonry (SSM) in footing, plinth & wall

Ashlar Masonry

Stone shall be hard, sound, durable and tough, free from cracks, decay and weathering and defects like cavities, cracks, flaws. Sand holes, veins etc. The stones shall be laid in regular courses and all the courses shall be of the same height. This class of work is suitable for the face of piers and abutments of large bridges and also for important building.

Proportions of mortar shall be taken as 1 part of cement and 6 parts of fine aggregates by volume, the water shall be mixed only at the time of placing the masonry and should be potable.

Laying of stones: All stones shall be wetted before laying and stones shall be laid on their natural bed. All courses shall be truly horizontal. All corners shall be truly in plumb and side shall be in line and level.

Joints shall be full of mortar. Thickness must not exceed 6 mm.

Pointing All exposed joints shall be pointed with mortar as specified. The pointing when finished shall be sunk from stone face by 5mm.

Scaffolding: Double scaffolding shall be used if necessary. However, single scaffolding is provided, the holes left in the masonry work for supporting the put logs shall be filled and made good by stones to match the face work.

Curing shall be done for atleast seven days.

Measurement is taken in cubic metres.

Coursed Rubble Masonry

This masonry will be laid in courses in varying height as may not be convenient and economical according to the nature of the stone available from the quarry.

No course shall be less than 15 cm and no course shall be of greater depth than any course below. Mortar shall be specified. Joint shall **not be less thicker than 12 mm**. All side joints shall be vertical and beds horizontal.

Random Rubble Masonry

The stones are those which have been quarry dressed and unlike bricks, the stones are not if uniform size and shape. Each stone shall be laid on its quarry bed and shall be wedged or pinned strongly into position in the wall by spalls or chips. **Mortar joints shall not be thicker than 2 cm. Not more than 60 cm height** of masonry shall be constructed at a time.

4. Damp Proof Course (DPC) 25 mm thick in CC 1:1.5:3

Materials: Damp proof course consist of cement, fine and coarse aggregates **with 2% of imperno or cem-seal by weight of cement or other standard water proofing compound (1 kg per bag of cement).** The DPC shall be applied at the plinth level of 25 mm thick. Cement shall be fresh Portland cement as per IS standards. Fine aggregates shall be clean, size of 5 mm and down, coarse aggregate shall be hard and tough of 20 mm size well graded and free from dust and dirt.

Mixing: Mixing shall be done on masonry platform or tray. **Cement will be first mixed with required quantity of water proofing agent**, then the mixture is combined with fine aggregates and mixed till uniform texture is obtained and finally with coarse aggregates. Water should be potable and shall be added to get the proper consistency until uniform and homogenous concrete.

Laying:

- The level of the surface of plinth shall be checked vertically and horizontally.
- Side forms or shutters of 2.5 cm thick shall be fixed properly and firmly on both sides to confine the concrete.
- Inner surface of shuttering shall be oiled or greased.
- Concrete shall be placed within half an hour of mixing and compacted thoroughly by tamping to make dense concrete and levelled.
- Shuttering may be removed after **three days.**
- DPC work shall not be carried **across door ways** and verandah openings.

Curing: Cured by water for at least **7 days.**

Painting with Asphalt:

- Two coats of asphalt painting shall be applied on the upper surface of DPC.
- The first coat of hot Asphalt at 1.5 kg / m^2 shall be applied uniformly on the concrete surface when it is dry and the painted surface shall be disturbed immediately with coarse sand and tamped lightly.
- The second coat of hot Asphalt at 1 kg / m^2 shall be applied uniformly on the concrete surface when it is dry and the painted surface shall be disturbed immediately with coarse sand and tamped lightly.

20 mm Damp proof course: Thickness of 2 cm with CM 1:2 along with water proofing agent at a rate of 1 kg per cement bag. Mixing, laying, curing shall be done as above. The form shall be 2 cm thick.

5. First class Brick Work in CM 1:6

Materials: Bricks, cement, fine aggregates, water

Bricks:

- Shall be of **first class** of IS standards made of good earth thoroughly burnt.
- **Deep cherry red or copper colour.**
- Regular in shape with sharp edges
- Emit **ringing sound** when two bricks are struck against each other
- Free from cracks, chips, flaws & lumps.
- Shall not absorb water more than one-sixth of their weight after one hour of soaking by immersing in water.
- Crushing strength of **105 kg / m^2**

Proportions of mortar shall be taken as 1 part of cement and 6 parts of fine aggregates by volume, the water shall be mixed only at the time of placing the masonry and should be potable.

Soaking of bricks: Bricks shall be fully soaked in clean water by submerging in a tank for a duration of **12 hours** immediately before use.

Laying:

- Bricks shall be well bonded and laid in **English Bond unless otherwise specified**.
- Every course shall be truly horizontal and wall shall be truly in plumb.
- **Vertical joints of consecutive course shall not come directly over one another.**
- No damaged or broken bricks shall be used.
- Closers shall be clean cut bricks and shall be placed **near the ends of the walls** but not at the other edge.
- Mortar joints **shall not exceed 6 mm** in thickness joints shall be fully filled with mortar.
- Bricks shall be laid with **frogs upwards except in the top course where frogs shall be placed downward.**
- Brickwork shall be carried out not more than **1m height at a time**.
- All joints shall be raked and faces of wall cleaned at the end of each day’s work.

Curing: Shall be done for at least **10 days** after laying.

Scaffolding: Suitable scaffolding shall be provided to facilitate the construction of brick wall.

Measurement: Measurement is done in cu.m.

6. 2.5 cm thick CC flooring 1:2:4

Materials: Cement, fine & coarse aggregates, water

Cement shall be fresh Portland cement of standard IS specifications, and shall have required tensile and compressive stresses and fineness.

Fine aggregates shall be of coarse sand consisting of **hard, sharp and angular grains** and shall pass through screen of 5 mm square mesh. Sand shall be of standard specifications clean and free from dust and organic matters. **Sea sand shall not be used**. Fine aggregates may also be crushed stone if specified.

Coarse aggregates shall be of hard broken stone of granite or similar stone, free from dust, dirt and other foreign matters. The **stone ballast shall be 20 mm size and down** and shall be **retained in 5 mm square mesh** and well graded such that the **voids do not exceed 42 %.**

Water shall be clean and free from alkaline and acid matters and suitable for drinking purposes.

Preparation of Surface: The floor shall be levelled and divided into panels of size not exceeding 1 m in its smaller dimension and 2 m in longer dimensions. Suitable cross stope shall be provided in the floor for draining wash water.

Mixing: Cement is to be **placed on the mix of fine & coarse aggregates**. The whole mass mixed three or four times so that it shall be thoroughly incorporated. The required quantity of water shall be added and the entire wet mass shall be turned over until the homogeneous mixture of the required consistency is obtained. Concrete for one panel shall be mixed in one lot.

Laying:

- Alternate panels shall be laid in alternate days.
- The base shall be made rough and cleaned and soaked with water thoroughly and then given a cement wash just before laying.
- Concrete shall be placed gently and evenly and compacted by beating with wooden ‘thapies’ and then the surface shall be tamped with wooden tampers.
- Any unevenness shall be removed by adding 1:2 cement: sand mortar.

Curing: After laying the surface shall be left undisturbed for 2 hours and then covered with wet bags and after 24 hours cured by flooding water for at least 10 days.

Coloured floor: Surface shall be finished with coloured cement and colouring pigment of the desired colour added.

Measurement: Measurement is taken in sq.m.

7. **Cement Plastering in Cement mortar**

Materials: Cement, fine aggregates and water.

Cement shall be fresh Portland cement of standard IS specifications, and shall have required tensile and compressive stresses and fineness.

Fine aggregates shall be of coarse sand consisting of **hard, sharp and angular grains** and shall pass through screen of 5 mm square mesh. Sand shall be of standard specifications clean and free from dust and organic matters. **Sea sand shall <u>not</u> be used**. Fine aggregates may also be crushed stone if specified.

Mixing: Cement and fine aggregates are dry mixed to proportion of **1:4 or 1:6 as per the specification** till in to a uniform texture and water shall be added slowly and gradually for at least four times to give uniform paste. Mortar prepared shall be used with in 30 minutes.

Preparation of Surface: The work of cement plaster shall be carried out after masonry joints are raked out to a depth of 20 mm and well-watered. Extra projection of masonry more than 13 mm to the general level surface should be cut-off. To ensure uniform thickness of plaster as specified, narrow strips of about 10 cm wide plaster shall be applied first a distance of about 1 m centres and the gaps between such strips shall immediately be filled up with mortar.

Application of plaster: The first coat of plaster shall be uniformly applied in the best workmanship. The thickness of **the first coat shall not be less than 12 mm** and should be cured for **7 days.**

Finish: The second coat shall be started at least after 7 days and should be **8 mm thickness.**

Curing: Plastering surface shall be kept wet by sprinkling water after 12 hours for at least 7 days.

Measurement: Measurement is taken in sq.m.

8. Reinforced Cement Concrete (1:2:4)

Steel:

- Steel reinforcing bars shall be of mild steel or deformed steel of **IS standards** and shall be free from corrosion, loose rust scale, oil, grease, paint etc.
- Bars shall be hooked and bent accurately and placed in position as per design and drawing and bound together tight with steel wire at their point of intersection.
- Bars shall be bent cold by applying gradual and even motion, **bars of 40 mm diameter and above may be bent by heating to dull red** and allowed to cool slowly **without immersing in water or quenching.**
- Joints in the bar should be avoided as far as possible, when joints have to be made an overlap of **40 times diameter** of the bar shall be given with proper hooks at ends and joints should be staggered. Bigger diameter bars should be joined by welding and tested before placing in position.
- During laying and compacting of concrete the reinforcing bars should not move from their positions and bars of the laid portions should not be disturbed.

Centring and Shuttering should be done with timber or steel plates and to prevent leakage of mortar, if necessary props. Bracing and wedges are placed. A coat of soap solution, raw linseed oil or form oil of approved manufacture should be applied over the shuttering to prevent adherence of concrete.

Cement shall be fresh Portland cement of standard IS specifications, and shall have required tensile and compressive stresses and fineness.

Fine aggregates shall be of coarse sand consisting of **hard, sharp and angular grains** and shall pass through screen of 5 mm square mesh. Sand shall be of standard specifications clean and free from dust and organic matters. **Sea sand shall <u>not</u> be used**. Fine aggregates may also be crushed stone if specified.

Coarse aggregates shall be of hard broken stone of granite or similar stone, free from dust, dirt and other foreign matters. The **stone ballast shall be 20 mm size and down** and shall be **retained in 5 mm square mesh** and well graded such that the **voids do not exceed 42 %.**

Water shall be clean and free from alkaline and acid matters and suitable for drinking purposes.

Mixing: Cement is to be **placed on the mix of fine & coarse aggregates**. The whole mass mixed three or four times so that it shall be thoroughly incorporated. The required quantity of water shall be added and the entire wet mass shall be turned over until the homogeneous mixture of the required consistency is obtained.

Laying:

- Shuttering shall be clean, free from dust, dirt and other foreign matters.
- Concrete **shall be deposited (not dropped)** in its final position.
- In the case of column and wall, it is desirable to place concrete in full height if practical so as to avoid construction joints but the progress of concreting in the vertical direction shall be restricted to **1 m per hour.**
- Time duration between mixing and placing the concrete should not exceed **20 minutes.**
- During winter concreting shall not be done if the temperature falls below **4^{o} C**.
- Compaction shall be done using mechanical vibrating machine until dense concrete is obtained.
- Compaction shall be completed within 30 minutes from the point of water added to the dry mix.
- Over compaction must be avoided to prevent segregation and bleeding of concrete.
- Concrete shall be laid continuously, if laying is suspended for rest or the following day, the end shall be **sloped at an angle of 30^{o} and made rough for future joining.** When the work is resumed, the previous sloped portion **shall be roughened, cleaned and watered and coat of neat cement shall be applied** and fresh concrete shall be laid.
- Upper layer shall be laid before the lower layer has set.
- Structures exceeding **45 m in length shall be divided by one or more expansion joints.**

Curing: Concrete surface shall be kept damp by covering with wet gunny bags for **24 hours soon after the removal of shuttering** for at least **21 days.**

Measurement: Measurement shall be done in cu.m.

9. Painting New wood work

Before commencing painting work, the surface should be rubbed down with sand paper and make it smooth with $2\frac{1}{2}$ paper and then with $1\frac{1}{2}$ grade. All knots must be killed or covered with two coats of patents knotting or with a preparation of red lead glue laid on hot. When the wood surface is thoroughly dry, the priming coat shall be applied.

10. Painting on Old wood work

Before repainting, blisters must be removed making the surface level for a new coat. If it is necessary to remove the old paint, it shall be burnt off with a blow lamp or removed with paint remover. The surface shall be well scoured with hot water to remove alkaline traces when paint remover is used.

After the paint as been removed, the surface shall be thoroughly rubbed down smooth with sand paper and painted with two or three coats. Care shall be taken that wood is not charred or that an alkaline paint remover does not come in contact with the wood.

11. Tile flooring

Consists of first class burnt bricks or tiles laid flat or on edge over a bed of 10cm, thick lime concrete or cement (1:6:18) and 10cm. thick sand.

Laying: All bricks or tiles or tiles shall be laid in lime or cement mortar with bed and vertical joints full of mortar1:4 simple "lipping" at the edge shall not be permitted. The laying shall be in plain, diagonal, herring bone or other pattern as desired by the Engineer-in-charge. The work shall be protected from the effect of sun, frost and rain during construction.

Soaking: Before use, all bricks or tiles shall be soaked in clean water in tanks for at least one hour.

Joints: The joints shall not exceed 6mm in thickness. The mortar in the joints shall be struck off flush with s trowel. Care shall be taken that no mortar shall spreed over the edge of the bricks or tiles.

Curing: The floor must be kept wet for seven days after laying. If cement pointing is done, it shall be kept moist for at least 15days after the pointing has been done.

12. Marble flooring

The marble flooring shall consists of marble tiles laid on 12mm thick mortar bed over the usual base courses of 10cm base concrete 1:8:16 and 10cm said or stone filling in case of ground floor or over R.C.C slabs. In case of upper floors the mortar bed shall be of 1:3 cement sand mortar.

The marble slabs should be of approved quality and thickness 20mm to 25mm with truly plane surface. The size of marble slab shall be slightly oversize to permit cutting to actual size of tiles at the site of work.

Curing: During the progress of work and for 10days after laying, each section of floor shall be kept flooded. Three clear days shall be allowed for setting before the pavement is walked over and no weight should be rested upon the surface, until 7days after laying is completed, Polishing is done, as in case of Terrazzo flooring and no first cutting is usually needed.

13. Terrazo flooring

A rough foundation of ordinary cement concrete 1:2:4 to within 29mm below the required finish grade shall first be provide. The material of the terrazzo consisting of 1½ parts of very small marble chips machine crushed and free from marble dust and foreign matter, 6 to 13 mm, to one part cement shall then be laid and floated over the rough surface, so that flat sides of the chips lay evenly at the top if the marble chips do not show up sufficiently, the defective parts may be filled up by hand.

After the terrazzo concrete has hardened enough to prevent dislodgement of aggregate, it shall be ground down with an approved type of grinding machine shod with free rapid cutting carborundum stones to expose the coarse aggregate. The floor to be kept wet during grinding process. After this the finish shall be scrubbed with warm water and soft soap and mopped dry.

Rate Analysis

The basis of arriving the correct and reasonable price or rate per unit item of work following its specification is called as Rate analysis.

$$\textbf{Rate per unit} = \frac{Total\ Cost}{Total\ Quantity}$$

Rate analysis includes the following heads of cost:-

a. Cost of materials = Quantity of materials x Rate (from Schedule of rates / Analytical basis)
b. Cost of labours = Number of labours with category x wage per day (depends upon turnout per day per labour basis)
c. Cost of tools, plants & machinery = lumpsum (Rs. 300/- to 1500/-) depending on type of work
d. Cost of over head and water charges = 1 % to 2 % of the total cost of material and labour
e. Profit = 10 % of total cost of material and labour

Final / Overall Cost = a + b + c + d + e

Calculation of number of labours on the basis of turnout per day per labour

The following are the average turnout of each category of labour and item of work

SI. No.	Item of work	Turnout per day per labour
1	Earthwork	2.5 cu.m / day / labour
2	Cement Concrete	5.0 cu.m / day / labour
3	RCC works	3.0 cu.m / day / labour
4	Stone Masonry	2.5 cu.m / day / labour
5	Brick Masonry	2.0 cu.m / day / labour
6	Cement Plastering	20 sq.m / day / labour
7	Painting	40 sq.m / day / labour

Note:

1. Minimum number of labours – 02
2. Skilled workers – 02 to 05 (depending upon work)
3. Total strength of labours – 06 to 20

$$\textbf{Number of mason} = \frac{Total\ Quantity\ of\ work}{Turnout\ per\ day\ per\ labour}$$

Ex: Cement concrete work

Sample = 10 cu.m

Turnout = 5.0 cu.m/day/labour

Number of mason = $\frac{Total\ Quantity\ of\ work}{Turnout\ per\ day\ per\ labour} = \frac{10}{5} = 2\ Nos$

Therefore, 1 Nos head mason / day

2 Nos mason / day

2 Nos skilled labour / day Team Work

2 Nos helper / day

Total strength of labours = 07 Nos.

RCC work

Sample = 10 cu.m

Turnout = 3.0 cu.m / day / mason

Number of mason = $\frac{Total\ Quantity\ of\ work}{Turnout\ per\ day\ per\ labour} = \frac{10}{3} =$ 3.33 take nearest whole number = 3

Therefore, 1 Nos head mason / day

3 Nos mason / day

3 Nos Skilled labour / day

5 Nos helper / day

Total Strength = 12 Nos

Cost of Material

The cost of materials are taken as delivered at site inclusive of the transport, local taxes and other charges. If the materials are to be carried from a distant place, more than 8 km, then additional cost of transport is also added. The rates of materials and labour vary from place to place and therefore, the rates of different items of work also vary from place to place.

The rates of all the construction materials along with their specifications for a particular work at a particular place or state depend upon a market price or by refereeing a manual or guidelines book called ‘Schedule of Rates’.

Note: For the analysis of rates in this module, if no rates are given for the materials, assume suitable rate accordingly.

General Rates

1. Cement – Rs. 325 per bag
2. Size stone – Rs. 10 per stone

3. Table mould bricks – Rs. 6 per brick
4. Wood material – Teak wood – Rs. 75000 /cu.m; ordinary wood – Rs. 50000 / cu.m
5. Stone aggregates (jelly)
    i. 40mm size – Rs. 600 / cu.m
    ii. 20 mm size – Rs. 900 / cu.m
    iii. 10 mm and down – Rs. 700 / cu.m
6. Mangalore tile or roof tile – (25 cm x 35 cm) – Rs. 1000 / 100 tiles
7. Mosaic tile – Rs. 3000 / 100 tiles
8. White cement – Rs. 30 / kg
9. Glazed tiles – Rs. 600 / sq.m
10. Bitumen barrel - Rs. 3000 / barrel
11. AC sheet roof covering – Rs. 150 / sq.m or Rs. 250 / sq.m including all fixtures.
12. Paints
    i. Distemper paint – Rs. 75/L
    ii. Emulsion paint – Rs. 250/L
    iii. Enamel paint – Rs. 200/L
    iv. Varnish – Rs. 300/L
13. GI pipe (25 mm dia) – Rs. 150 for running meter
14. PVC pipe – Rs. 100 for running meter
15. Water proof compound – Rs. 100 / kg
16. Sand – Rs. 2500 / cu.m
17. Cost of labours
    i. Head mason – Rs. 500 / day
    ii. Mason – Rs. 400 / day
    iii. Skilled labour – Rs. 300 / day
    iv. Helper – Rs. 200 / day
    v. Carpenter – Rs. 500 / day
    vi. Helper to carpenter – Rs. 300 / day
    vii. Plumber – Rs. 500 / day
    viii. Helper to plumber = Rs. 300 / day
    ix. Bar bender – Rs. 500 / day
    x. Electrician – Rs. 400 / day
    xi. Painter – Rs. 400 / day

For rate analysis purpose, the following sample quantities are taken for the calculation

1. For all types of voluminous work – 10 cu.m
2. For all types of surface work – 100 sq.m
3. For all types of running meter work – 100 R m

IMPORTANT:

a. 1 cu.m of calculation will give higher cost for any particular item of work and a group can do a minimum work of 6 cu.m (200 cu.f) or 25 sq.m (250 sq.f). Therefore the cost of any work to be done must be as per the sample quantities shown above.

b. **Total cost of the work is for one cu.m or one sq.m.** Hence, the final cost of materials and labours at the end of the calculation will be written in per cu.m or sq.m depending on the type of work.

Rate Analysis for various items of work

1. **Cement concrete of 1:5:10 for bed in foundation with 40 mm size coarse aggregates.**

Materials: Cement, fine aggregates, coarse aggregates & water.

Take **10 cu.m** wet volume of concrete

For 10 cu.m of wet volume of concrete, **an additional 50 to 60 % of materials** must be taken for dry volume of concrete **considering the loss of materials while transporting, mixing and placing. Lets take 55 % of materials extra.**

$$\textbf{Dry Volume} = 10 + 10 \times \frac{55}{100} = 15.50 \text{ cu.m}$$

For 10 cu.m of wet concrete, the dry volume of materials will be 15.50 cu.m

Concrete proportion = 1:5:10: Therefore, sum of proportion = 1+5+10 = 16

Quantity Calculations

$$\text{Quantity Calculation} = \frac{Dry\ Volumne}{Proportion\ sum}\ x \text{ Each part}$$

1. Cement = $\frac{15.50}{16} x\ 1 = 0.968\ cu.m$

Always cement quantity must be in terms of **number of bags.**

1 cu.m volume requires 30 bags of cement (Each bag weighs 50 kg) [STANDARD]

Therefore, 0.968 cu.m requires **29 bags of cement**

2. Fine aggregate / sand = $\frac{15.50}{16} x\ 5 = 4.84\ cu.m$

3. Coarse aggregate (40 mm) = $\frac{15.50}{16} x\ 10 = 9.68\ \ cu.m$

Cost Calculation

Particulars	Quantity or Nos	unit	Rate, Rs.	per unit	Cost, Rs.
Materials					
Cement	29	bags	325.00	bag	9425.00
Fine aggregates	4.84	cu.m	2500.00	cu.m	12100.00
Coarse aggregates (40 mm)	9.68	cu.m	600.00	cu.m	5808.00
Labours (as per Turnout)					
Head Mason	1	Nos	500.00	per day	500.00
Mason	2	Nos	400.00	per day	800.00
Skilled labours	2	Nos	300.00	per day	600.00
Helper	2	Nos	200.00	per day	400.00
Cost of tools & machinery	Lumpsum				800.00
Net Total					**30433.00**
Adding 1.5 % of water charges					456.50
Adding 10 % Contractor Profit					3043.30
Grand Total for 10 cu.m of work					**33933.00**
COST PER cu.m of work = Grand Total for 10 cu.m of work / 10					**3395.00**

2. **Brick masonry in CM 1:6 in foundation and plinth with 20 x 10 x 10 cm brick**

Materials: Brick, cement, fine aggregates & water

Take volume of brick work = **10 cu.m**

As per IS standards, size of modular brick = 20 x 10 x 10 cm

Size of actual brick = 19 x 9 x 9 cm

Since, brick and cement mortar used as two separate constituents in the masonry, their quantity must be found separately as follow:

Number of bricks for 10 cu.m of work $= \frac{Volumne}{Modular\ brick\ size} = \frac{10}{0.2\ x\ 0.1\ x\ 0.1} = 5000\ Nos.$

Therefore, for 10 cu.m of work, 5000 bricks are required.

Actual volume of mortar = Total volume – net volume of bricks

= 10 – (5000 x actual brick size)

= 10 – (5000 x 0.19 x 0.09 x 0.09) = 2.30 cu.m

Increase the volume of mortar by 15 % for frog filling, for use of cut bricks, for uniform joints, wastage etc.) = 2.30 + 2.30 x 0.15 = 2.65 cu.m

Further increase the volume of mortar by 25 % for dry volume = 2.65 + 2.65 x 0.25 = 3.31 cu.m

Quantity Calculation

Sum of Proportion (1:6) = 1 + 6 = 7

1. Cement = $\frac{3.31}{7} = 0.47\ cu.m$

Always cement quantity must be in terms of **number of bags.**

1 cu.m volume requires 30 bags of cement (Each bag weighs 50 kg) [STANDARD]

Therefore, 0.47 cu.m requires **14 bags of cement**

2. Sand = $\frac{3.31}{7}\ x\ 6 = 2.84\ cu.m$

Cost Calculation

Brick masonry in CM 1:6 in foundation and plinth with 20 x 10 x 10 cm brick					
Particulars	**Quantity or Nos**	**unit**	**Rate, Rs.**	**per unit**	**Cost, Rs.**
Materials					
Bricks	5000	Nos	6.00	Nos	30000.00
Cement	14.00	bags	325.00	bag	4550.00
Sand	2.84	cu.m	2500.00	cu.m	7100.00
Labours (as per Turnout)					
Head Mason	1	Nos	500.00	per day	500.00
Mason	5	Nos	400.00	per day	2000.00
Skilled labours	5	Nos	300.00	per day	1500.00
Helper	7	Nos	200.00	per day	1400.00
Cost of tools & machinery	Lumpsum				800.00
Net Total					**47850.00**
Adding 1.5 % of water charges					717.75
Adding 10 % Contractor Profit					4785.00
Grand Total for 10 cu.m of work					**53352.75**
COST PER cu.m of work = Grand Total for 10 cu.m of work / 10					**5335.00**

3. Brick masonry in CM 1:6 in Superstructure.

When Brick size is not mentioned, take the size of modular brick i.e. 20 x 10 x 10 cm

Materials: Brick, cement, fine aggregates & water

Take volume of brick work = **10 cu.m**

As per IS standards, size of modular brick = 20 x 10 x 10 cm

Size of actual brick = 19 x 9 x 9 cm

Since, brick and cement mortar used as two separate constituents in the masonry, their quantity must be found separately as follow:

Number of bricks for 10 cu.m of work $= \frac{Volumne}{Modular\ brick\ size} = \frac{10}{0.2\ x\ 0.1\ x\ 0.1} = 5000\ Nos.$

Therefore, for 10 cu.m of work, 5000 bricks are required.

Actual volume of mortar = Total volume – net volume of bricks

= 10 – (5000 x actual brick size)

= 10 – (5000 x 0.19 x 0.09 x 0.09) = 2.30 cu.m

Increase the volume of mortar by 15 % for frog filling, for use of cut bricks, for uniform joints, wastage etc.) = 2.30 + 2.30 x 0.15 = 2.65 cu.m

Further increase the volume of mortar by 25 % for dry volume = 2.65 + 2.65 x 0.25 = 3.31 cu.m

Quantity Calculation

Sum of Proportion (1:6) = 1 + 6 = 7

1. Cement = $\frac{3.31}{7} = 0.47\ cu.m$

Always cement quantity must be in terms of **number of bags.**

1 cu.m volume requires 30 bags of cement (Each bag weighs 50 kg) [STANDARD]

Therefore, 0.47 cu.m requires **14 bags of cement**

2. Sand = $\frac{3.31}{7} x\ 6 = 2.84\ cu.m$

Cost Calculation

Particulars	**Quantity or Nos**	**unit**	**Rate, Rs.**	**per unit**	**Cost, Rs.**
Materials					
Bricks	5000	Nos	6.00	Nos	30000.00
Cement	14.00	bags	325.00	bag	4550.00
Sand	2.84	cu.m	2500.00	cu.m	7100.00
Labours (as per Turnout)					
Head Mason	1	Nos	500.00	per day	500.00
Mason	5	Nos	400.00	per day	2000.00
Skilled labours	7	Nos	300.00	per day	2100.00
Helper	10	Nos	200.00	per day	2000.00
Scaffolding	Lumpsum				1000.00
Cost of tools & machinery	Lumpsum				800.00
Net Total					**50050.00**
Adding 1.5 % of water charges					750.75
Adding 10 % Contractor Profit					5005.00
Grand Total for 10 cu.m of work					**55805.75**
COST PER cu.m of work = Grand Total for 10 cu.m of work / 10					**5580.58**

4. RCC work M20 grade with 2 % steel reinforcement in beams and slabs

Concrete proportion for M20 is 1:1.5:3

Materials: Cement, fine aggregates, coarse aggregates (20 mm), steel & water.

Take **10 cu.m** wet volume of concrete

For 10 cu.m of wet volume of concrete, **an additional 50 to 60 % of materials** must be taken for dry volume of concrete **considering the loss of materials while transporting, mixing and placing. Lets take 55 % of materials extra.**

$$\textbf{Dry Volume} = 10 + 10 \times \frac{55}{100} = 15.50 \text{ cu.m}$$

For 10 cu.m of wet concrete, the dry volume of materials will be 15.50 cu.m

Summation of proportion = 1+1.5+3 = 5.5

Quantity Calculation

1. Cement = $\frac{15.50}{5.5} x\ 1 = 2.81\ cu.m$

Always cement quantity must be in terms of **number of bags.**

1 cu.m volume requires 30 bags of cement (Each bag weighs 50 kg) [STANDARD]

Therefore, 2.81 cu.m requires **84 bags of cement**

2. Sand = $\frac{15.50}{5.5} x\ 1.5 = 4.23\ cu.m$

3. Coarse Aggregates (20 mm) = $\frac{15.50}{5.5} x\ 3 = 8.45\ cu.m$

4. Steel Reinforcement = 2 % volume of RCC work

$$= \frac{2}{100}\ x\ 10\ x\ 78.5 = 15.70\ q$$

Cost Calculation

RCC work M20 grade with 2 % steel reinforcement in beams & slabs					
Particulars	**Quantity or Nos**	**unit**	**Rate, Rs.**	**per unit**	**Cost, Rs.**
Materials					
Cement	84	bags	325.00	bag	27300.00
Fine aggregates	4.23	cu.m	2500.00	cu.m	10575.00
Coarse aggregates (20 mm)	8.45	cu.m	600.00	cu.m	5070.00
Steel Reinforcement @ 2 %	15.70	q	75.00	q	1177.50
Binding wires	2.00	kg	100.00	kg	200.00
Labours (as per Turnout)					
Head Mason	1	Nos	500.00	per day	500.00
Mason	3	Nos	400.00	per day	1200.00
Skilled labours	3	Nos	300.00	per day	900.00
Helper	6	Nos	200.00	per day	1200.00

Bar bender	2	Nos	400.00	per day	800.00
Helper for Bar bender	4	Nos	200.00	per day	800.00
Carpenter	2	Nos	400.00	per day	800.00
Helper for Carpenter	2	Nos	200.00	per day	400.00
Scaffolding (including centring and shuttering)	Lumpsum				10000.00
Cost of tools & machinery	Lumpsum				2000.00
Net Total					**62922.50**
Adding 1.5 % of water charges					943.84
Adding 10 % Contractor Profit					6292.25
Grand Total for 10 cu.m of work					**70158.59**
COST PER cu.m of work = Grand Total for 10 cu.m of work / 10					**7020.00**

5. 120 mm thick RCC slab of 1:2:4 with 2 % steel reinforcement

Note: In this item of work, the thickness of slab is specified, therefore consider an area of 100 sq.m and find the volume of concrete required for the slab

Volume of Concrete = Area x thickness of slab = 100 x 0.12 = 12 cu.m

Materials: Cement, fine aggregates, coarse aggregates (20 mm), steel & water.

Take 12 cu.m as wet volume of concrete

Taking 55 % extra for dry mix, total dry volume = 12 + 12 x 0.55 = 18.60 cu.m = 19 cu.m

Summation of Proportion = 1+2+4 = 7

Quantity Calculation

1. Cement = $\frac{19}{7} x\ 1 = 2.72\ cu.m$

Always cement quantity must be in terms of **number of bags.**

1 cu.m volume requires 30 bags of cement (Each bag weighs 50 kg) [STANDARD]

Therefore, 2.72 cu.m requires **82 bags of cement**

2. Sand = $\frac{19}{7} x\ 2 = 5.44\ cu.m$
3. Coarse Aggregates = $\frac{19}{7} x\ 4 = 10.88\ cu.m$
4. Steel Reinforcement = 2 % volume of RCC work

$$= \frac{2}{100}\ x\ 12\ x\ 78.5 = 18.84\ q$$

Cost Calculations

Particulars	Quantity or Nos	unit	Rate, Rs.	per unit	Cost, Rs.
Materials					
Cement	82	bags	325.00	bag	26650.00
Fine aggregates	5.44	cu.m	2500.00	cu.m	13600.00
Coarse aggregates (20 mm)	10.88	cu.m	600.00	cu.m	6528.00
Steel Reinforcement @ 2 %	18.84	q	75.00	q	1413.00
Binding wires	2.00	kg	100.00	kg	200.00
Labours (as per Turnout)					
Head Mason	1	Nos	500.00	per day	500.00
Mason	3	Nos	400.00	per day	1200.00
Skilled labours	3	Nos	300.00	per day	900.00
Helper	6	Nos	200.00	per day	1200.00
Bar bender	2	Nos	400.00	per day	800.00
Helper for Bar bender	4	Nos	200.00	per day	800.00
Carpenter	2	Nos	400.00	per day	800.00
Helper for Carpenter	2	Nos	200.00	per day	400.00
Scaffolding (including centering and shuttering)	Lumpsum				10000.00
Cost of tools & machinery	Lumpsum				2000.00
Net Total					**66991.00**
Adding 1.5 % of water charges					1004.87
Adding 10 % Contractor Profit					6699.10
Grand Total for 100 sq.m of work					**74694.97**
COST PER cu.m of work = Grand Total for 100 sq.m of work / 100					**750.00**

6. Random Rubble masonry with CM 1:6 in foundation

Materials – Stones of irregular shape, cement, sand & water

Consider 10 cu.m of volume of the stone masonry.

Since, the stones are procured from the quarry, they are not in definite shape. Therefore, taking 25 % extra considering the wastage the actual volume of stone is 12.5 cu.m

Assume the dry mortar volume as 4.5 cu.m (Random Rubble masonry)

Summation of proportion = 1+6 = 7

Quantity Calculation

1. Cement = $\frac{4.50}{7} x\ 1 = 0.65\ cu.m$

2. Sand = $\frac{4.50}{7} x\ 6 = 3.85\ cu.m$

Cost Calculation

Particulars	Quantity or Nos	unit	Rate, Rs.	per unit	Cost, Rs.
Materials					
Stone	12.50	cu.m	1500.00	cu.m	18750.00
Cement	0.65	bags	325.00	bags	211.25
Fine aggregates	3.85	cu.m	2500.00	cu.m	9625.00
Labours (as per Turnout)					
Head Mason	1	Nos	500.00	per day	500.00
Mason	4	Nos	400.00	per day	1600.00
Skilled labours	4	Nos	300.00	per day	1200.00
Helper	6	Nos	200.00	per day	1200.00
Cost of tools & machinery	Lumpsum				800.00
Net Total					**33886.25**
Adding 1.5 % of water charges					508.29
Adding 10 % Contractor Profit					3388.63
Grand Total for 10 cu.m of work					**37783.17**
COST PER cu.m of work = Grand Total for 10 cu.m of work / 10					**3780.00**

7. **Ashlar masonry with CM 1:6 in foundation**

Materials – Well-dressed stones, cement, sand & water

Consider 10 cu.m of volume of the stone masonry.

Since, the stones are procured from the quarry, they are not in definite shape. Therefore, taking 25 % extra considering the wastage the actual volume of stone is 12.5 cu.m

Assume the dry mortar volume as 3.00 cu.m (Ashlar masonry)

Summation of proportion = 1+6 = 7

<u>Quantity Calculation</u>

3. Cement = $\frac{3.00}{7} x\ 1 = 0.43\ cu.m$

4. Sand = $\frac{3.00}{7} x\ 6 = 2.60\ cu.m$

Note: Ashlar masonry work requires more work force in order to chisel the stones into definite shape.

Cost Calculation

Particulars	Quantity or Nos	unit	Rate, Rs.	per unit	Cost, Rs.
Materials					
Stone	12.50	cu.m	1500.00	cu.m	18750.00
Cement	0.43	bags	325.00	bags	139.75
Fine aggregates	2.60	cu.m	2500.00	cu.m	6500.00
Labours (as per Turnout)					
Head Mason	1	Nos	500.00	per day	500.00
Mason	4	Nos	400.00	per day	1600.00
Skilled labours	10	Nos	300.00	per day	3000.00
Helper	16	Nos	200.00	per day	3200.00
Cost of tools & machinery	Lumpsum				1500.00
Net Total					**35189.75**
Adding 1.5 % of water charges					527.85
Adding 10 % Contractor Profit					3518.98
Grand Total for 10 cu.m of work					**39236.57**
COST PER cu.m of work = Grand Total for 10 cu.m of work / 10					**3925.00**

8. 12 mm thick cement plastering in CM 1:6 over brick masonry

Materials: Cement, fine aggregates & water

Since plastering is a surface work, consider a sample area of 100 sq.m

Therefore, volume of mortar = Sample area x Thickness of plastering

= 100 x 0.012 = 1.2 cu.m

Increase the volume of mortar by 25 % for uneven wall surface = 1.2 + 1.2 x 0.25 = 1.50 cu.m

Further increase the volume by 30 % for dry mortar = 1.50 + 1.50 x 0.30 = 1.95 cu.m

Summation of proportion = 1+6 = 7

<u>Quantity Calculation</u>

1. Cement $= \frac{1.95}{7} x\ 1 = 0.28\ cu.m$ = 9 bags
2. Sand = $\frac{1.95}{7} x\ 6 = 1.67\ cu.m$

Cost Calculation

12 mm thick cement plastering in CM 1:6 over brick masonry					
Particulars	**Quantity or Nos**	**unit**	**Rate, Rs.**	**per unit**	**Cost, Rs.**
Materials					
Cement	9.00	bags	325.00	bag	2925.00
Sand	1.67	cu.m	2500.00	cu.m	4175.00

Labours (as per Turnout)					
Head Mason	1	Nos	500.00	per day	500.00
Mason	5	Nos	400.00	per day	2000.00
Skilled labours	5	Nos	300.00	per day	1500.00
Helper	5	Nos	200.00	per day	1000.00
Scaffolding	Lumpsum				1000.00
Cost of tools & machinery	Lumpsum				800.00
Net Total					**13900.00**
Adding 1.5 % of water charges					208.50
Adding 10 % Contractor Profit					1390.00
Grand Total for 100 sq.m of work					**15498.50**
COST PER sq.m of work = Grand Total for 100 sq.m of work / 100					**155.00**

9. Earthwork in excavation for foundation in ordinary soil

Take 10 cu.m

Particulars	**Quantity or Nos**	**unit**	**Rate, Rs.**	**per unit**	**Cost, Rs.**
No Materials					
Labours (as per Turnout)					
Head Mason	1	Nos	500.00	per day	500.00
Mason	5	Nos	400.00	per day	2000.00
Skilled labours	10	Nos	300.00	per day	3000.00
Helper	10	Nos	200.00	per day	2000.00
Scaffolding	Lumpsum				1000.00
Cost of tools & machinery	Lumpsum				1000.00
Net Total					**9500.00**
Adding 1.5 % of water charges					142.50
Adding 10 % Contractor Profit					950.00
Grand Total for 10 cu.m of work					**10592.50**
COST PER cu.m of work = Grand Total for 10 cu.m of work / 10					**1059.25**

CONTRACT MANAGEMENT

Tender:

- It is an offer in writing to execute some work or to supply some specified articles at certain rates, within a fixed time under certain conditions of contract and agreement, between the contractor and the department or owner or party.
- Agreement to complete the work at competitive rates.
- Time frame is defined to complete a work based on bill of quantities (BOQ) & specifications.
- Tender document incorporates the sum of money, time and other conditions required to carry out the contract obligations in order to complete a project or a part of it consisting of specified works.

Contract: It is defined as any kind of undertaking written or verbal by a person or a firm for construction, maintenance or repairs of a work or for the supply of materials. This agreement is enforced by law.

Contractor: A person who enters into an agreement with another person or department, for the execution of the work or supplies to be made, under certain conditions is called Contractor.

Essential Qualification of Contractor:

1 He should be financially sound
2 He should have sufficient knowledge to read the drawings
3 He should be well versed with the procedure or the department to carry out the work, submission of boils and experience
4 Good reputation and experience
5 Should have ability to handle labour and material efficiently and properly.
6 Should be capable of arranging men and material as per requirement.

Quotation: It is a response to notice inviting tenders by the department.

Earnest money: It is a guarantee in the shape of money, given by the contractor along with tender proposals confirming their willingness to work for the department. Earnest money is generally 2% of total estimate and must be deposited in the form of demand draft in favour of the department. If the tender of the contractor is not accepted, the earnest money will be refunded immediately.

Security money: It is a money which the contractor has to deposit with the department when the contract is allotted to him. It is 10% of total estimate. This money also includes earnest money already deposited by the contractor. This money can be forfeited by the department if the progress and quality of the work is not satisfactory.

Purpose of the tender

- To select a suitable contractor at a time appropriate to the situation of the project.
- To obtain an acceptable tender or offer upon which a contract can be let.
- To ensure the completion of project at scheduled time.
- To protect the interest of all stakeholders.

Invitation to tender (ITT):

- It is the initial step in competitive tendering, in which suppliers and contractors are invited to provide offers for supply or service contracts.
- Invitations to tender are also known as **'Call for bids' or 'Call for tenders'**.
- Published in Newspapers and on the Internet.

Tender Notification: It is an advertisement given in all leading newspapers and published in official gazette of government to attract more number of bidders. Notification includes:-

1. Name of the Project.
2. Name & Address of the organization offering the tender.
3. Name of work, materials or services.
4. Place of work location.
5. Approximate estimated cost of work.
6. Earnest Money.
7. Period of completion.
8. Date on which the Tender Document sale commences.
9. Date and time up to which tender documents can be obtained.
10. The cost of tender documents.
11. Due date of submission.

12. Eligibility Criteria.

Samples of tender notifications published in newspapers

ಮಿಲಿಟರಿ ಇಂಜಿನಿಯರ್ ಸರ್ವೀಸಸ್

ಇ–ಟೆಂಡರ್‌ಗಳಿಗಾಗಿ ಆಹ್ವಾನ ಪ್ರಕಟಣೆ

1) ಭಾರತದ ರಾಷ್ಟ್ರಪತಿಗಳ ಪರವಾಗಿ, ಕಮಾಂಡರ್ ವರ್ಕ್ಸ್ ಇಂಜಿನಿಯರ್ (ಎಎಫ್) ದಕ್ಷಿಣ, ಗಂಗಮ್ಮ ವೃತ್ತ, ಭದ್ರತಾ ದಕ್ಷಿಣದ ಮುಖ್ಯ ಕೊಠಡಿ ಎದುರಿಗೆ 410 ಎಎಫ್ ಸ್ಟೇಷನ್, ಜಾಲಹಳ್ಳಿ, ಬೆಂಗಳೂರು–560013 ಇವರು ಕೆಳಕಂಡ ಕಾಮಗಾರಿಗಳಿಗಾಗಿ ದ್ವಿ ಲಕೋಟೆ ವ್ಯವಸ್ಥೆಯಡಿ ಆನ್‌ಲೈನ್ ಐಟಂ ದರದ ಬಿಡ್‌ಗಳಿಗಾಗಿ ಇಲೆಕ್ಟ್ರಾನಿಕ್ ಬಿಡ್ ಗಳನ್ನು ಆಹ್ವಾನಿಸಿದ್ದಾರೆ:–

ಕಾಮಗಾರಿಯ ಹೆಸರು	ಬೆಂಗಳೂರಿನ ಜಾಲಹಳ್ಳಿಯಲ್ಲಿರುವ ಎಎಫ್ ಸ್ಟೇಷನ್‌ನ ಸಿಟಿಐ ಇಸ್ಲಿನ ಬಿಲ್ಡಿಂಗ್ ಸಂ. ಪಿ–1004 ನ ವಿಶೇಷ ದುರಸ್ತಿ ಕಾಮಗಾರಿ.
ಅಂದಾಜು ವೆಚ್ಚ	ರೂ. 18.75 ಲಕ್ಷಗಳು
ಪೂರ್ಣಗೊಳಿಸುವ ಕಾಲಾವಧಿ	153 ದಿನಗಳು (ಐದು ತಿಂಗಳು)
ಟೆಂಡರ್ ಐಡಿ	2017_MES_163216_1

1) ಹೆಚ್ಚಿನ ಮಾಹಿತಿಗಾಗಿ ವೆಬ್‌ಸೈಟ್ eprocuremes.gov.in / eprocure.gov.in ನಲ್ಲಿ ಪಡೆಯಬಹುದು.

2) ಪತ್ರಿಕೆಯಲ್ಲಿ ಪ್ರಕಟವಾಗಿರುವ ಬಿಡ್ ಆಹ್ವಾನ ಪ್ರಕಟಣೆಯು ಟೆಂಡರ್‌ನ ಪ್ರಕಟಣೆ / ಬಿಡ್ ಡಾಕ್ಯುಮೆಂಟ್‌ನ ಭಾಗ ಆಗಿರುವುದಿಲ್ಲ.

National Highways Authority of India

(Ministry of Road Transport and Highways)

NOTICE INVITING TENDER

(Competitive Bidding through e-tendering mode only)

NHAI invites bids from eligible bidders for Six Laning & Strengthening of Km. 340.000 to km. 403.400 of Hubli - Haveri section of NH-44 (old NH-4) in the State of Karnataka to be executed on Hybrid Annuity mode under NHDP Phase-V.

Last date & time of submission : 13.01.2017 (up to 11:00 Hrs.)

For details kindly visit website : www.nhai.org or https://nhai.eproc.in

BUILDING A NATION, NOT JUST ROADS

ದಾವಣಗೆರೆ ಸ್ಮಾರ್ಟ್ ಸಿಟಿ ಲಿಮಿಟೆಡ್.

ವ್ಯವಸ್ಥಾಪಕ ನಿರ್ದೇಶಕರ ಕಾರ್ಯಾಲಯ, #1776/ಎ85/ಎ86/ಸಿದ್ದವೀರಪ್ಪ ಬಡಾವಣೆ, ಶಾಮನೂರು ರಸ್ತೆ,
ದಾವಣಗೆರೆ–577 004, ದೂರವಾಣಿ ಸಂ. 08192–222383, ಸಿಐಎನ್:
U74999KA2016PLC093411 E-mail: smartcitydavanagere@gmail.com

No: DSCL/E-Tender/[redacted] [redacted]

ಟೆಂಡರ್ ಪ್ರಕಟಣೆ (ಇ–ಪ್ರಕ್ಯೂರ್‌ಮೆಂಟ್ ಪೋರ್ಟಲ್ ಮುಖಾಂತರ)

ಕರ್ನಾಟಕ ಸಾರ್ವಜನಿಕ ಸಂಗ್ರಹಣೆಗಳಲ್ಲಿ ಪಾರದರ್ಶಕತೆ ಅಧ್ಯಾದೇಶ 1999–2000 ರ (ತಿದ್ದುಪಡಿ) ಪ್ರಕಾರ ಆಕ್ಟ್ 2000 ರ ನಿಯಮದಂತೆ ಸ್ಟ್ಯಾಂಡರ್ಡ್ ಟೆಂಡರ್ ಡಾಕ್ಯುಮೆಂಟ್‌ಗಳ ಅನ್ವಯ ಅರ್ಹ ಗುತ್ತಿಗೆದಾರರಿಂದ ಇ–ಪ್ರೊಕ್ಯೂರ್‌ಮೆಂಟ್ ಪೋರ್ಟಲ್ ಮುಖಾಂತರ ಟೆಂಡರ್‌ನ್ನು ಎರಡು ಕವರ್ ಪದ್ಧತಿಯಲ್ಲಿ ಈ ಕೆಳಗೆ ಸಹಿ ಮಾಡಿರುವವರು ಆಹ್ವಾನಿಸಿರುತ್ತಾರೆ. ಅರ್ಹ ಗುತ್ತಿಗೆದಾರರು ಇ–ಪ್ರೊಕ್ಯೂರ್‌ಮೆಂಟ್ ವೆಬ್ ಸೈಟ್ www.eproc.karnataka.gov.in ನಲ್ಲಿ ಟೆಂಡರ್‌ಗಾಗಿ ಭಾಗವಹಿಸಬಹುದು ಹಾಗೂ ವಿವರಗಳನ್ನು ಪಡೆಯಬಹುದಾಗಿದೆ. ಹೆಚ್ಚಿನ ವಿವರಗಳಿಗೆ ಕಛೇರಿ ದೂರವಾಣಿ ಸಂಖ್ಯೆ: 08192–222383 ಹಾಗೂ ಇ–ಪ್ರೊಕ್ಯೂರ್‌ಮೆಂಟ್ ಸಹಾಯಕ ದೂರವಾಣಿ ಸಂಖ್ಯೆ: 080–23010900, 080–23010901, 080–38013000 ರಿಂದ ಮಾಹಿತಿ ಪಡೆಯಬಹುದು.

(ರೂ. ಲಕ್ಷಗಳಲ್ಲಿ)

ಕ್ರ. ಸ	ಇ–ಪ್ರಕ್ಯೂರ್‌ಮೆಂಟ್ ಉಲ್ಲೇಖ	ಕಾಮಗಾರಿಯ ವಿವರ	ಮುಂಗಡ ಠೇವಣಿ	ಕಾಮಗಾರಿ ಪೂರ್ಣಗೊಳಿಸ ಬೇಕಾದ ಅವಧಿ
1	UDD/ 2019-20/IND 184	ESTABLISHMENT OF SMART SCHOOLS IN DAVANAGERE CITY PHASE-II	2.55	30 ದಿನಗಳು

ಸೂಚನೆ : ಈ ಪ್ರಕಟಣೆಯಲ್ಲಿ ಯಾವುದಾದರೂ ಬದಲಾವಣೆ ಇದ್ದಲ್ಲಿ ಇ–ಪ್ರೊಕ್ಯೂರ್‌ಮೆಂಟ್ ಪೋರ್ಟಲ್‌ನಲ್ಲಿ ಪ್ರಕಟಿಸಲಾಗುವುದು ಮತ್ತು ಯಾವುದೇ ಪತ್ರಿಕಾ ಪ್ರಕಟಣೆಗಳನ್ನು ಹೊರಡಿಸಲಾಗುವುದಿಲ್ಲ. (1) ಪ್ರಿ ಬಿಡ್ ಮೀಟಿಂಗ್ ದಿನಾಂಕ & ವೇಳೆ : 11.05.2020 ಸಮಯ : 12.00. (2) ಟೆಂಡರ್ ಬಗ್ಗೆ ಮಾಹಿತಿ ಪಡೆಯಲು ಕೊನೆಯ ದಿ & ವೇಳೆ: 19.05.2020 ಸಮಯ : 15.00. (3) ಟೆಂಡರ್ ಸಲ್ಲಿಸುವ ಅಂತಿಮ ದಿನಾಂಕ ಮತ್ತು ವೇಳೆ : 26.05.2020 ಸಮಯ : 16.00. (4) ತಾಂತ್ರಿಕ ಬಿಡ್‌ನ್ನು ತೆರೆಯುವ ದಿನಾಂಕ: 27.05.2020 ಸಮಯ : 16.30. (4) ಆರ್ಥಿಕ ಬಿಡ್‌ನ್ನು ತೆರೆಯುವ ದಿನಾಂಕ: 06.06.2020 ಸಮಯ : 11.30.

ಸಹಿ/– ಉಪ ಪ್ರಧಾನ ವ್ಯವಸ್ಥಾಪಕರು–ಐ.ಟಿ.,
ದಾವಣಗೆರೆ ಸ್ಮಾರ್ಟ್ ಸಿಟಿ ಲಿಮಿಟೆಡ್.

ಸಹಿ/–ವ್ಯವಸ್ಥಾಪಕ ನಿರ್ದೇಶಕರು ಹಾಗೂ ಮುಖ್ಯ ಕಾರ್ಯನಿರ್ವಹಣಾಧಿಕಾರಿಗಳು, ದಾವಣಗೆರೆ ಸ್ಮಾರ್ಟ್ ಸಿಟಿ ಲಿಮಿಟೆಡ್, ದಾವಣಗೆರೆ.

ವಾಸಾಇ/ದಾವಣಗೆರೆ/17/ಎಂಸಿಎ/2020–21

ಕೆ.ಎಂ.ಎಫ್

ಕರ್ನಾಟಕ ಸಹಕಾರಿ ಹಾಲು ಉತ್ಪಾದಕರ ಮಹಾ ಮಂಡಳಿ ನಿಯಮಿತ

ಕಹಾಮ ಸಂಕೀರ್ಣ, ಡಾ.ಎಂ.ಹೆಚ್ ಮರೀಗೌಡ ರಸ್ತೆ, ಬೆಂಗಳೂರು 560 029, ಫೋನ್ 25536625, 25536789

ಸಂಖ್ಯೆ: ಕಹಾಮ/ಅಧಿ/ಮೊಲಾಸಸ್ ಟ್ಯಾಂಕ್–ಸಿ.[redacted]20 [redacted]0

ಇ–ಪ್ರೋಕ್ಯೂರಮೆಂಟ್ ಅಡಿಯಲ್ಲಿ ಟೆಂಡರ್ ಪ್ರಕಟಣೆ

ಕರ್ನಾಟಕ ಹಾಲು ಮಹಾ ಮಂಡಳಿಯು ಇ–ಪ್ರೋಕ್ಯೂರಮೆಂಟ್ ಅಡಿಯಲ್ಲಿ ಅರ್ಹ ಗುತ್ತಿಗೆದಾರರುಗಳಿಂದ ಈ ಕೆಳಗಿನ ಕೋಷ್ಟಕದಲ್ಲಿ ನೀಡಿರುವ ಕೆಲಸಗಳಿಗಾಗಿ ಇ–ಪ್ರೊಕ್ಯೂರ್‌ಮೆಂಟ್ ಮುಖೇನ ಟೆಂಡರ್ ಆಹ್ವಾನಿಸಲಾಗಿದೆ. ಆಸಕ್ತರು ವೆಬ್‌ಸೈಟ್ www.eproc.karantaka.gov.in ಮೂಲಕ ಟೆಂಡರನ್ನು ಸಲ್ಲಿಸಬಹುದಾಗಿದೆ. [Help desk E-mail: hphelpdesk.blr@intarvo.com] Ph No: 080-22361200

ಕ್ರಮ ಸಂಖ್ಯೆ	ಕೆಲಸದ ವಿವರ	ಸಂಖ್ಯೆ	ಇ.ಎಂ.ಡಿ. ರೂ.ಪೈ.	ಮುಕ್ತಾಯದ ಅವಧಿ
1	Design, Supply, Fabrication & Installation of Molasses Storage Tank of Capacity 850MT on Turn Key Basis to Cattle Feed Plant at Rajanukunte.	1 Job	1,40,000/-	6 Months

1. ಟೆಂಡರ್ ಷೆಡ್ಯೂಲ್‌ಗಳನ್ನು ಡೌನ್‌ಲೋಡ್ ಮಾಡಿಕೊಳ್ಳುವ ದಿನಾಂಕ: 20.04.2020 ರಿಂದ 2[redacted] ಸಾಯಂಕಾಲ 3:00 ಗಂಟೆಯವರೆಗೆ.
2. ಟೆಂಡರುಗಳನ್ನು ಸಲ್ಲಿಸಲು ಕೊನೆಯ ದಿನಾಂಕ 20.05.2020 ರ ಸಾಯಂಕಾಲ 4:00 ಗಂಟೆಯವರೆಗೆ.
3. ಟೆಂಡರುಗಳನ್ನು (Cover 1) ತೆರೆಯುವ ದಿನಾಂಕ 22.05.2020 ರಂದು ಸಂಜೆ 11.30 ಗಂಟೆಗೆ.

ಕರ್ನಾಟಕ ಹಾಲು ಮಹಾ ಮಂಡಳಿ ಪರವಾಗಿ
ಸಹಿ/–
ನಿರ್ದೇಶಕರು (ಅಭಿಯಂತರ)

Types of Tender

1. **Open tender**
    - Open to all qualified bidders
    - Published in the newspaper and internet
    - Chosen on the basis of price and quality.
    - Most effective way of obtaining many competitive rates.
2. **Close tender / Selective tender**
    - Open to bidders in the category stated in the notice only
    - Contractor of known reputations.

- Contractor who submit the lowest tender.
- Chosen for their expertise and experiences.

3. **Negotiated tender**
    - Only one contractor is approached.
    - Architect and other members of the design team.
    - As per the wish of client the contractor or firm will be selected.

Tender Procedure:

1. Approval to Tender

a. Administrative approval: Formal acceptance of the proposed work or project by the competent authority. Department of Government for a work or project for which preliminary estimate have been framed by the Public Works Department (P.W.D) to meet the needs of Department requiring work. A proposal is sent to P.W.D by any other department for its requirements. The P.W.D studies the proposal, if it is found required, a report along with preliminary estimate is sent to the department concerned for the approval. After the approval, the Engineering department prepares a detailed drawings, plans and estimates for the execution of the work.

b. Expenditure Sanction: Approval of the Government for the expenditure proposed, in the cases where all necessary. In all other cases, the re-appropriation of funds will operate as sanctions to the expenditure concerned. A revised expenditure sanction is necessary if the actual expenditure exceeds or likely to exceed the amount of original sanction up to 10%.

c. Technical Sanction: Sanction of the detailed estimate, design calculations, quantities of works, rate and cost of the work by the competent authority of the Engineering department.

The work is taken up for construction only after technical sanction is approved. This sanction guarantees that the proposals are structurally sound, and the estimate is accurately calculated based on the adequate data.

2. Tender Documentation

Before inviting a tender, the department must have the following criteria fulfilled, so as the allotment of contract to the contractor becomes a smooth process.

1. A set of detailed drawings of the proposed work.
2. Material statement mentioning material to be supplied by the department and material to be brought by the contractor.
3. Time required for project completion.
4. Mode of payment.
5. Penalty to be imposed on the contractor in case of delay on the part of the contractor.
6. Detailed specification of item.
7. Conditions on arrangement of labour shelter and rates of minimum wages.

Documentation is a compilation of:

1. Letter of invitation to tenderers
2. Articles of agreement / conditions of contract
3. Form of tender
4. Form of tenderer’s details. i.e: contractor’s registration, organization background, track record (past and present projects)
5. Letter of acceptance
6. Bank and insurance guarantee forms (performance bond)
7. Bank and insurance guarantee forms (advance payments)
8. Specifications
9. Summary of tender
10. Schedule of rates
11. Relevant drawings

3. Tender Processing

Screening of potential contractors, suppliers, or vendors to develop a list of qualified bidders who will receive the invitation-to-bid (ITB)/ tender documents.

Parameters for screening: Financial Position, Previous work experience, Technical Expertise, Management ability, Equipment workmanship and ability, Litigation history.

Opening of Tenders:

1. The tenders are opened at the place mentioned in the tender form on the due date and time mentioned.
2. Executive Engineer, Divisional Accountant and Office Superintendent represent the department on one side and contractors or their representatives are on the other side.
3. The lock of the box in which sealed tenders are dropped by the contractors is opened in presence of all. The sealed tenders are opened and are signed by both the parties.
4. Comparative statement is made item wise and work is allotted to the lowest bidder.
5. The competent authority has powers to reject the tender of the lowest bidder, but he has to give reasons and confidential remarks.
6. Earnest money of the rejected tenders is returned.
7. Signature of each contractor is taken as a token of certificate that tenders were opened in their presence and the allotment has be done to the right bidder.

4. Award of Contract

- Notice to a bidder of the acceptance of the submitted bid.
- Written confirmation of an award of a contract by client to a successful bidder.
- Stating the amount of the award, the award date, and when the contract will be signed.
- **Contract Agreement:** It is a contract deed between the Government and the Contractor. Divisional Engineer signs on behalf of Government.

Types of contracts

The different types of contracts are

1) Item rate contract

    a) Percentage rate contract
    b) Schedule rate contract
    c) Labour rate contract
    d) Through rate contract
2) Lump sum contract
3) Combination of both Item rate and Lump sum contract
4) Piece work contract

1) Item rate contract

It is also known as unit price contract. In this type of contract, the contractor quotes the rate of each item of work without reference to any schedule of rates. This method is adopted when a reasonable complete schedule of rates are not available for the place where the work is to be carried out or when the number of non-schedule items in the work is more.

a) Percentage rate contract: In this type, the rates of various items are fixed by the department and the contractor agrees to do the work at a percentage above or below the fixed rates. This method is adopted for the work at places where reasonable and complete schedule of rates is available.

b) Schedule rate contract: In this type, the work is allotted at the fixed rates for different items and the payments depends upon the quantity and kind of work done or supply made.

c) Labour rate contract: In this type, contractor undertakes only the labour portion of the work. The necessary materials are supplied to the site by the department or owner and the contractor arranges his own labours and gets the work done as per the specifications.

d) Through rate contract: In some cases, the contract quotes the rates at some percentage above or below the through rates.

2) Lump sum contract: In this contract, the contractor agrees to execute the complete work in all respects for the specified amount in specified time. The plans, drawings and specifications of all the items of the work are supplied to the contractor but the details of the quantities and schedule of items will not be given and the contractor will have to complete the work as per the plan and specification within the contract period.

3) Combination of both Item rate and Lump sum contract: In those contracts, fixed sum is agreed upon the completion of a particular work of a contractor. In case of any additions or alterations the payment is made or deducted on the basis of schedule of rates.

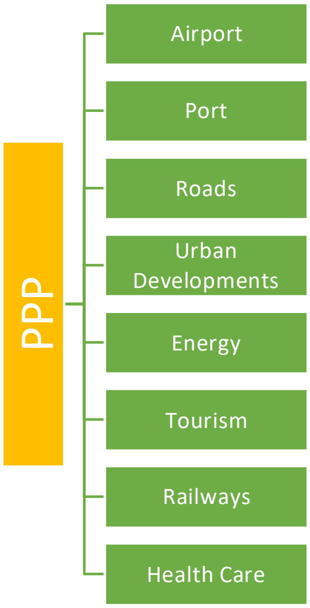
4) **Piece work contract:** The contractor agrees to execute the different items of work on mutually agreed rates. The agreement contains different items of work carried out with proper description and rates for unit quantity of work. Small works which do not require engineering skills for execution like earthwork excavation, patch work, maintenance work and white washing etc., may be carried through piecework contract.

Letter of Intent (LOI):

- Interim agreement that summarizes the main points of a proposed deal.
- Does not constitute a definitive contract but signifies a genuine interest in reaching the final agreement subject to due diligence, additional information, or fulfilment of certain conditions.
- The language used in writing a letter of intent is of vital importance.
- Memorandum of understanding' or pre-contract.

Public Private Partnership (PPP)

- It is a Government service or private business venture which is funded and operated through a partnership of government and one or more private sector companies.
- Long term partnership.
- Government of India defines PPP as “ A Partnership between a public sector entity and a private sector entity on commercial terms and in which the private partner has be procured through a transparent and open procurement system.



PPP Engagement Models in India:

1. BOT-Toll (Build Operate Transfer – Toll)
2. BOOT (Build Operate Own Transfer)
3. Joint Venture (JV)
4. Management Contract (MC)
5. BOOST (Build Operate Own Share Transfer)

E-Tendering System:

- An electronic tendering solution facilitates the complete tendering process from the advertising of the requirement through to the placing of the contract.
- This includes exchange of all relevant documents in electronic format.
- It offers an opportunity for automating most of the tendering process such as preparing a tender specification, advertising, tender aggregation, to the evaluation and placing of the contract.
- Allows contractor to download and upload tender documents online, track the status of tenders and receive mail alerts.
- Tender process cycle is significantly shortened.

VALUATION

Introduction

Valuation means fixation of cost or return expected of a building, engineering structure project (Govt. or private), at present days rates. The value of a structure may be more or less depending upon the present utility of a structure. For example, a house having a number of rooms but smaller in size will fetch less value than a house, may be smaller in area but having well planned and proper sized of rooms.

Necessity of Valuation

The following reasons necessitate the valuation of property:-

(i) Rent fixation. It is generally taken as 6% of the valuation of the property.
(ii) For buying and selling.
(iii) Acquisition of property by Govt.
(iv) To be mortgaged with bank or any other society to raise loan.
(v) For various taxes to be given and fixed, by the Municipal Committee.
(vi) Insurance: For taking out on insurance policies.

Role of an Engineer

The roll of an Engineer in valuation is felt when an Engineering structure is to be valued, if and when it is:-

(a) To e acquired
(b) To be divide
(c) To be allotted to a claim holder.

The following factors require consideration for valuation:-

(i) **Locality:-** In case a building is located in such an area, where there is easy access to market, schools and is located on road side. The Orientation of the building is according to Engineering rules. It will fetch more cost than a building which is in a neglected condition and is locate at unhealthy site.

(ii) **Structure**:- The structure of a building is also an important consideration while evaluating a building. Workmanship I attractive and the building is properly maintained, it will fetch more cost than the building in a neglected form with poor quality of material used.

According to specifications a building is divided in four classes:-

1. First Class
2. Second Class
3. Third Class
4. Fourth Class

Cost: Original cost of construction. It is used to find out the loss of value of property due to various reasons.

Net Income: Total amount of the income received from a property during the year, without deducting outgoing.

Gross Income: Total amount of the income received form a property during the year, without deducting outgoing.

Out goings: These are expenses which are incurred on a building so that it may give back revenue. The following are-various outgoings.

(i) **Taxes:-** These are annual taxes paid by the owner, such as wealth tax, property tax and municipal taxes (varies from 10% to 25% of net income).

(ii) **Management:-** Up to 10% of the gross revenue is kept aside for this expenses. This includes, chowkidar sweeper etc. this is applicable only for big buildings or apartments

(iii) **Repairs:-** For this 1 ½ % of the total construction is set aside for annual repairs of the building. These repairs are must to maintain the building. It is also calculated as 10% of the gross income.

(iv) **Sinking fund:-** This is also taken as outgoings (For details see definition)

(v) **Miscellaneous:-** This is again suitable for big buildings. Lighting of common place, expenditure of liftman etc. are to be paid by the owner.

(vi) **Loss of Rent:-** This is also an outgoing in case a building in not fully occupied by the tenants. This has to be deducted from gross income.

(vii) **Insurance:-** Premium given against fire or for theft policy.

Obsolescence:- The value of property decreases if its style and design are outdated i.e. rooms not properly set, thick walls, poor ventilation etc. the reasons of this is fast changing techniques of construction, design, ideas leading to more comfort etc.

Free hold Property:- Any property which is in complete possession f the owner is known as free hold property. The owner can use the property in an way he likes. But he will have to follow constraints fixed by town planners or Municipality before doing any construction.

Lease hold:- If a property is given to some person on yearly payment basis by the free holder, then the property is called „lease hold property‟ and the person who take s the property is called Lease-holder. In case of building, the lease is for 99 years to 9 years.

Easement:- An owner getting over the property of another person, the following faculties is known as easements.

(i) Facility of running water and sewer pipes through other’s land.
(ii) Facility of air and light.
(iii) Facility of drainage of rain water. (iv) Facility of access.

The owner who gives facilities is known as Servant owner and who enjoys facilities is called Dominant owner.

Scrap Value:- If a building is to be dismantled after the period of its utility is over, some amount can be fetched from the sale of old materials. The amount is known as Scrap Value of a building. If varies from 8% to 10% of the cost of construction according to the availability of the material.

In case where Wood & Steel are available, the scrap value is more than as R.C.C structure, as in the latter case, the material has less reuse value.

Salvage Value:- If property after being discarded at the end of the utility period is sold without being broken into pieces, the amount thus realized by sale is known as its Salvage Value.

For example, railway sleepers can be re-used as posts and even old iron rails taken out can be used as beams in a roof or sheds of a building.

Building Cost Index: A building cost index indicates the increase and decrease of the cost above the cost above the cost at a certain base year and is expressed by a percentage rise & fall. For instance taking 1960 as a base year, the present 1980 as Building Cost Index may be taken 1.25% to 150% above the cost during the year 1960.

This index depends upon cost of material, labour, transport etc.

Capitalized value:- It is defined as the amount of money whose annual interest at the highest prevailing rate will be equal to the net income received from the property. To calculate the capitalized value, it is necessary to know highest rate of interest prevailing on such properties and net income form the property.

Sinking Fund:- A fund which is gradually accumulated and aside to reconstruct the property after the expiry of the period of utility is known as sinking Fund. The sinking funds may be found out by taking a sinking fund policy with any insurance company or depositing some amount in the bank. Generally while calculating the sinking fund, life of the building is considered. 90% of cost of construction is used for calculations & 10% is left out as scrap value.

The formula used to find out the annual sinking fund,

$$I = \frac{Si}{(1+i)-1}$$

Where, I = Annual Installment Required

n = Number of years required to create sinking fund.

i = Rate of interest expressed in decimal i.e. 5% as 0.05

S = Amount of sinking fund

<u>Problems</u>

1. A printing machine is to be installed at a cost of Rs. 30000/- in a press. Assuming the life of the machine as 20 years. Calculate the amount of annual instalment of sinking fund to be deposited to accumulate the whole amount of 5% interest.

Sol: The annual sinking fund

$$I = \frac{Si}{(1+i)-1} = \frac{30000\ x\ 0.05}{(1+0.05)^{20}-1} = \text{Rs. } 906.30$$

The owner will have to deposit Rs. 906.30 per year in 5 % compound interest for 20 years to accumulate Rs. 30000/-

2. An old shop in the main market has been purchased by a person at a cost of Rs 20000/-. Work out the amount of annual sinking fund at 3% interest assuming future life of the building as 15 years and scrap value of the building as 10% of the cost of purchase.

Sol: Cost of the shop = Rs. 20000/-

Scrap value (10%) = Rs. 2000/-

Amount of sinking fund to bea accumulated after 15 years is = Rs. 20000 – Rs. 2000 = Rs. 18000/-

The annual sinking fund

$$I = \frac{Si}{(1+i)-1} = \frac{18000\ x\ 0.03}{(1+0.03)^{15}-1} = \text{Rs. } 971.20$$

The owner will have to deposit Rs. 971.20 per year in 3 % compound interest for 15 years to accumulate Rs. 18000/-

Annuity: - The return of the capital investment in the shape of annual instalments (monthy, quarterly, half yearly & yearly) for a fixed number of years in known as annuity.

Deprication

A structure, after sometimes gradually losses some of its value due to consistent use and some other similar reasons, such as,

a. The property in neglected condition
b. The property being away from essential facilities
c. Design being out of fashion

The depreciated value can be calculated using the formula,

$$D = P(\frac{100-rd}{100})^{n}$$

Where, D = Depriciated value

P = Present value

Rd = Fixed Percentage of depreciation

n = Number of years the building has been constructed in existence

Structures with 100 years life, rd =1.0, Structures with 75 years life, rd = 1.3, Structures with 50 years life, rd = 2.0, Structures with 25 years life, rd = 4.0, Structures with 20 years life, rd = 5.0.

Methods of Valuation:

1. Depriciated method of valuation
2. Valuation based on cost
3. Valuation based profit
4. Valuation by Development method
5. Rental method of valuation

1. **Depriciated method of valuation:** In this method, the structure is divided into four parts for calculating depreciation:

a. Walls

b. Roofs

c. Floors

d. Doors and Windows

The measurement is done accurately and the cost is found out using current rates.

Problems

1. The estimated cost of the building is Rs.20000/-. It is 20 years old & well maintained. The life of the structure is assumed to be 80 years. Work out the cost of building for acquisition.

Sol: Take rd = 5

P = Rs. 20000/-

n = 20

$$D = P\left(\frac{100-rd}{100}\right)^n = \boldsymbol{Rs\ 7170/-}$$

2. A plot measures 500 sq.m. The built up area is 300 sq.m. The plinth area rate of this 1st class building is Rs. 6000/- per sq. m. This rate includes cost of water supply, sanitary and electric installations. The age of the building is 40 years. The cost of the land is Rs. 5000/- per sq.m.

Sol: Cost of the land = 500 x 5000 = Rs. 2500000.00

Cost of building = 300 x 5000 = Rs. 1800000.00

Life of the building is givem 40 years. Take rd = 2, n = 40 years

$$D = P(\frac{100-rd}{100})^n = \boldsymbol{Rs. 802800.00}$$

Total value of property = 2500000 + 802800 = Rs. 3302800/-

2. Valuation based on cost: The actual cost of the construction is found out and valuation is done after considering depriciations and also caring for type of construction and desig of the construction.

3. Valuation based on profit: Valuation of cinemas, theaters, hotels, banks, big shops etc.located at suitable places is done where profit is of capitalized value. The capitalized value is calculated by multiplying year's purchase with net profit. The net profit is worked out after deducting all possible outgoings & expenditures from the gross income. In such cases the cost will be too high as compared with the cost of construction actually incurred.

4. Valuation by Development method: This method is also used for working out the value of a building. In certaion cases, some additions, alterations and improvements are carried out which increases the cost of the building. The valuator should be careful while doing evaluation about this.

In cases, when the building is still under development. In this case the future development of the building and profits from it should be anticipated while evaluating.

5.Rental method of valuation: Rent of the building is used as a base for calculating value of a building. In this method the net income by the way of rent is found out after deducting all ut goings from the gross income. A suitable rate of interest prevailing in the market is also to be assumed of such types of buildings.

Fixation of Rent

1. **Government residential bungalows or quarters:** Every Govt. official occupying Govt. accommodation has to pay remt which is called standard rent or 10% of pay, whichever is less. The practice in PWD is that when a new residential building is constructed, a rental statement is attached with the estimate, which will give the calculations of rent to be fixed. The total expenditure incurred on the constructions i.e. cost of the building, cost of water supply, sanitary and electric installations etc are

calculated at 6% interest and divided it by 12, which will give rent per month. This is also known as standard rent.

Note: If a land is purchased for the construction of the building, its cost should also be added while calculating the rental statement.

2. **Private property or Building:** In case of private properties, the Net income is worked out by dividing the capitalized value by a proper figure of year’s purchase. To get the gross rent, outgoings such as annual repairs, municipal taxes, property taxes and sinking funds etc. are added to net income. This gross rent is divided by 12, which will give rent per month. This is also called as standard rent.

   In case of private properties, the rent depends upon the situation, demand, type of construction, accommodation and facilities provided.

Problems:

1. The present value of a property is Rs. 20000/-. Calculate the standard rent. The rate of interest may be assumed as 6%.

Sol: Annual rent @ 6% $= \frac{20000\ x\ 6}{100} = Rs. 1200/-$

Therefore, Standard rent per month $= \frac{1200}{12} = Rs. 100/-$

2.A building costing Rs. 700000/- has been constructed on a freehold land measuring 200 sq. m. recently in the city. Prevailing rate of the land in the neighbourhood is Rs. Q50/- per sq. m. Determine the net rent of the property, if the expenditure on an outgoing including sinking fund is Rs. 24000/- per annum. Workout also the gross rent of the property per month.

Sol: Cost of construction = Rs. 700000/-

Cost of land @ Rs. 150/- per sq. m. = 100 x 150 = Rs. 150000/-

Net return:

On building @ 6% on the cost of construction = 700000 x 0.06 = Rs. 42000/-

On the land @ 4% on the cost of land = 150000 x 0.04 = Rs. 6000/-

Total Net income = Rs. 48000/-

Gross rent per month $= \frac{Net\ Rent + Outgoings}{12} = \frac{48000+24000}{12} = Rs. 6000/-$