CIVIL ENGINEERING TH-3

UNIT-I

SHORT ANSWER TYPE (2 MARKS)

1. What do you mean by Estimation?

Ans-

I. The process of calculating the quantities of the items and the probable cost involved is known as estimation

II. If the estimate of the probable cost is less than the actual cost of construction, the funds remain idle which is not good for large-scale industries. If the calculated probable cost is more than the actual cost of construction, the owner may face the financial crisis that may lead to the alteration of design or suspension of the work.

2. What do you mean by Administrative Approval?

Ans-

I. Administrative approval may be defined as the 'formal acceptance of the proposal' by the competitive authority.

II. At the initial stage, rough estimates and preliminary plans are required for administrative approval.

III. The detailed estimates and drawings are prepared as the administrative approval is obtained.

3. **Define Expenditure Sanction?**

Ans-

I. The expenditure sanction may be defined as an agreement by the administration/ competitive authority on the proposed cost.

II. Any expenditure before this sanction is not allowed for the proposed construction.

III. The ministries and government departments possess the power for expenditure sanction.

4. Define Technical Sanction?

Ans-

I. The formal acceptance of the detailed proposal including designs, detailed estimates, detailed plans,etc by technical departments is known as 'technical sanction'.

II. These detailed proposals are evaluated technically by experts in civil engineering departments like the Public Work Department (PWD) for their technical feasibility and accuracy.

5. What do you mean by Approximate Estimate?

Ans-

I. Approximate estimates are the estimates that give the rough or approximate cost of the construction.

II. The preliminary survey data and soil reports with a line diagram of the project can be used for the preparation of approximate estimates.

III. The approximate estimates are required for the administrative approval of the project.

IV. The probable cost calculated in the approximate estimate should not differ from the actual cost as it helps in making the primary decision on the project.

V. It helps in tax calculation and the primary valuation of the property. It can also be used to decide the rent or cost of booking flats in the proposed buildings.

6.What you mean by detailed estimate?

Ans-

I. The detailed estimate provides an accurate estimate of the probable cost of construction in a detailed manner.

II. The cost is calculated based on the quantity of items to be used in the construction.

III. The different items of work like plastering, paints, bricks, etc. are predicted, and their cost per unit item including the profit is also estimated. The cost is calculated by multiplying the quantity of items of work by their cost.

7.Write down different types of detailed estimates.

Ans-

Different types of detailed estimates are used for different purposes. The different types of estimates based on their purpose are enlisted as follows

I. Revised Estimate

II. Supplementary Estimate`

III. Revised and Supplementary Estimate

IV. Repair and Maintenance Estimate

V. Renovation Estimate

8. What are the different roles and responsibilities of an estimator (Engineer).

Ans- Role and responsibility at the preconstruction stage, designing stage, bidding stage, construction stage and post-construction stage.

9. What is the standard format of estimate.

Ans-

I. The estimate is prepared in the form of some standard formats which helps he estimator present calculations in a detailed and brief manner.

The estimate is presented in the following types of formats: (1) Measurement sheet
(2) Abstract sheet
(3) Face sheet

10**. Define Central Public Works Department. (CPWD).**

Ans-The **Central Public Works Department** (**CPWD:**केंद्रीय लोक निर्माण विभाग) is a department under the Ministry of Housing and Urban Affairs of India and is in charge of public sector works. It serves as the builder, developer and manager of Central government properties. With time, its area of operations has also expanded to Roadways and Bridge engineering.

SHORT ANSWER TYPE (5 MARKS)

1. What is the purpose of preparing Estimate?

Ans-

I. The approximate cost of construction can be calculated from the drawing and plans however, the final or actual cost of construction can be calculated only after the construction.

II. The approximate cost gives an idea about the feasibility of the proposed project.

III. In the case of government agencies, probable cost helps in obtaining administrative approval for the execution of the project.

IV. An estimate is required to select the construction materials and equipment.

V. The estimate helps in deciding the requirement of labour for construction.

VI. The detailed cost of construction is used to decide the timeline of the project. It also helps in controlling the cost at different stages of construction.

VII. The detailed estimates are required for inviting and finalization of the tenders. The calculation of different items of work and their cost helps in choosing the best contractor for the work.

VIII. The decision-making for any commercial project depends on the cost-benefit ratio. The estimates are used in the calculation of the cost-benefit ratio.

IX. The estimate also helps for insurance purposes. It is used for the valuation of the property too. An idea of the probable cost of construction also helps in deciding the rent.

2. Write short notes on different types of Estimate?

Ans- Different types of detailed estimates are used for different purposes. The different types of estimates based on their purpose are enlisted as follows:

I. Revised Estimate

a) A revised estimate is provided when there is a deviation in the quantity and rate of the item as compared to the estimate provided by the estimator.
b) A comparative statement in the abstract format showing the variation of the quantity and rates is provided with the revised estimate.
c) The revised estimate is provided when the sanctioned amount is changed due to the change of the rate of material or quantity of the material.
d) The plans and drawings remain unchanged.

II. **Supplementary Estimate**

a) When the work is in progress, the design may be changed at some stage for the development of the project.
b) In such cases, some independent work that is different from the sanctioned work is required. In this situation, a supplementary estimate is provided.
c) The procedure of preparing the supplementary estimate is the same as that of the detailed estimate and the comparative statement is not required in this case.

III. Revised and Supplementary Estimate

a) The revised estimate is prepared when the rate of items or quantity is changed and the supplementary estimates are provided when deviation in the structural design arises.
b) Sometimes, both of these situations arise together. In this case, a revised estimate combined with the supplementary estimate is prepared.

IV. **Repair and Maintenance Estimate**

a) When the work is completed, it is needed to be maintained and repaired periodically. So, an annual repair and maintenance estimate is prepared.
b) The cost for some of the items of the works that require periodic maintenance like whitewashing, painting of doors, etc. can be predicted in the estimate. However, works like patchwork, change of glass panes, or repair of the plastering work and wall, the estimation is not possible in advance.
c) A lump sum amount for such repair and maintenance work is added.

V. **Renovation Estimate**

a) The process of improving the damaged or broken structure is known as renovation.
b) There may be partial renovation of the structures or complete renovation in which the whole structure is reconstructed. So, renovation estimates are required for the improvement of the damaged structures.
c) The renovation estimate is a kind of detailed budget and is prepared for the structures after using them for some years

3. **Write down short notes on standard format of Estimate.**

Ans- The estimate is prepared in the form of a standard formats which helps the estimator to present calculations
in a detailed and brief manner.

I. Measurement Sheet :

a) The measurements of the items and their quantity are presented in the measurement sheet.
b) The construction work is divided into different items of the work like earthwork, concreting, brick masonry work, etc.
c) The total quantity of the item of the work is calculated using the dimensions of the item.
d) The total quantity calculated in the measurement sheet is used for the calculation of the cost in the abstract sheet.

II. Abstract Sheet :

a) The cost of the construction is calculated in the abstract sheet.
b) The abstract sheet consists of the quantity, cost per unit item, and total cost. The total cost of the project is calculated by adding the cost of the total items.
c) The cost of contingencies can be taken 3% to 5% of the total cost.
d) The contingencies include the expenditure on uncertain items, petty works, or the cost incurred on any unpredictable condition during the project.
e) There may be some employees like guards or accountants for the project.
f) The cost incurred on such employees comes in the category of work charge establishment.
g) The work charge establishment cost is taken 1.5 % to 2% of the total cost.
h) The contingencies and work charge establishment cost are added to the total cost to calculate the final cost of the project.

III. Face Sheet:

a) The face sheet briefly gives the total cost of the project.
b) It acts as the front cover of the detailed and abstract estimate.
c) It consists of the estimated cost, contingency charges, work-charge establishment and any other charges that are not considered in the detailed estimate but can be taken as a percentage of the total cost.

4. What is the hierarchy of Engineering Department.

Ans-The Public Works Department (PWD) hierarchy follows a structured engineering and administrative format, typically headed by an Engineer-in-Chief or Principal Chief Engineer at the top.

Below them are Chief Engineers, Superintending Engineers (Circle level), Executive Engineers (Division level), Assistant Engineers (Sub-division level), and Junior Engineers (Section level).

Typical PWD Organizational Hierarchy (Top to Bottom):

Engineer-in-Chief (E-in-C) / Principal Chief Engineer: Overall administrative and technical head of the department.

Chief Engineer (CE): Manages specific zones or branches (e.g., Buildings & Roads, Electrical).

Superintending Engineer (SE): Heads a Circle, overseeing multiple divisions.

Executive Engineer (EE): In charge of a Division, responsible for execution and maintenance of works.

Assistant Engineer (AE) / Assistant Executive Engineer (AEE): Heads a Sub-Division.

Junior Engineer (JE): Manages technical work at the section level.

5. What is the Administrative structure of engineering Department.

Ans- Administrative Structure:

Minister/Secretary: The department operates under a Minister-in-Charge and Secretaries (Works/Roads).
Field Units: Organized into Zones, Circles, Divisions, and Sub-Divisions.
Branches: Generally divided into Buildings & Roads, Irrigation, and Public Health Engineering.

The Ministry of Works generally refers to government bodies responsible for the planning, construction, and maintenance of public infrastructure, such as buildings, roads, and bridges. Key examples include India's Central Public Works Department **(CPWD)** under the Ministry of Housing and Urban Affairs and state-level departments like the Works Department in Odisha**(OPWD).** These departments focus on civil engineering projects, including highways, electrical works, and public amenities.

Key Aspects of Public Works Departments:

Functions: Core responsibilities include constructing and maintaining government buildings, roads bridges, and infrastructure.

Structure: Often organized into specialized units (Civil, Electrical, Mechanical) with central, regional, and district offices.

Examples:

India: Central Public Works Department (CPWD) and state-specific Public Works Departments (PWD).

LONG ANSWER TYPE (10 MARKS)

1. **Write short notes on modes of measurement.**

Ans- Indian Standard Code IS 1200 provides information about the different items of work, the unit of measurement
and the mode of measurement.

I. Earthwork:-

a) Earthwork includes cutting and filling works during the construction.
b) It is the process of movement of the earthwork by excavation and filling.
c) The earthwork is measured in cu m and the unit of payment is % cu m.
d) It means that the payment for the earthwork is done per 100 cu m of earthwork volume.

i. **Excavation:** The measurement of the excavated earth is done according to the drawings.

If the depth of the excavation is not more than 30 cm, the excavation is measured in sq. m.
In this case, average depth is considered. The rate of the excavation varies with the soil and rocky strata.

ii. **Filling:** The filling is done with sand or loose earth. The deductions are made for considering the consolidation of the filling material. A deduction of 10% is considered in the measured volume for filling for the consolidated fill.

iii. **Charges for shoring:** Shoring is the process of supporting the excavated portion with the help of formwork. The charges of labor and measurement of the earth-supporting items like plank, struts, timber work, etc. are considered in the estimate.

II. **Brickwork:-** The size of a modular brick is 19cm×9cm×9cm, and the nominal size of the modular brick is 20cm×10cm×10cm. The brickwork is done in cement mortar.

III. Concrete Work:-

a) **Concrete in foundation:** The cement concrete in the foundation work is measured on the finished work. The unit of measurement and the unit of payment is cu m.
b) **Reinforced cement concrete (RCC):** The measurement for the slabs, partitions, etc. are taken to the nearest 0.5 cm while the other components are measured near 1 cm. In reinforced cement concrete, the deductions are not made for the reinforcement. The deductions are not made for pipes with volumes up to 25 sq. cm and openings up to 0.1 sq. m.
The unit of measurement and payment are cu m for RCC.

The DPC is measured in sq. m and the unit of the payment is also sq. m.

c) **Expansion joints:** The expansion joints in the roof, walls, etc. are measured in running meters. The depth and width of the joint is also stated.

d) **Concrete blocks:** If the concrete blocks exceed 10 cm on the bed, the measurement is taken in cu m otherwise the measurements are taken in the sq. m. The deductions are not made for the hollow portion of the hollow blocks.

IV. **Roof Work**:

a) The measurement of the roofing work is based on the type of roof and the material used for the roofing.

b) Terraced roof: The unit of measurement and the unit of payment is sq. m. The size and quality of the bricks, tiles
or stone slabs are mentioned.

c) Reinforced slab roofing: The unit of measurement and unit of payment are cu m. The steel reinforcement and shuttering are measured separately.

d) Asbestos corrugated roofing: The unit of measurement and unit of payment is sq. m.

e) The sheeting is measured flat and the method of fixing is mentioned. The type of the sheet and thickness of the sheet are mentioned.

V. **Floor Work**:- The measurement of the floorwork is performed in the sq. m and the unit of payment is also sq. m

VI. **Plastering** :-The measurement and payment of the plastering work is done in sq. m.

The thickness of the plastering layer is taken 12 mm, normally.

The wall plastering measurement is done for the interior and exterior faces.

For the ceiling, the measurement of the ceiling area is taken for the measurement of the plastering area. However, if the ceiling with the projected beam is provided, the ceiling is measured over the beam, and the sides of the beams are measured and added to the ceiling area.

(VII) Doors and Windows:-

The doors and windows are divided into two parts, the frame and the leaves or shutters.

The measurements of the frames and the leaves are taken separately.

a) **Frame:** The unit of measurement and unit of payment is cu. m.

b) **Leaves or shutters:** The unit of measurement and unit of payment is sq. m and the thickness of the leaves is mentioned.
For the measurement of the breadth and the height of the leaves, the rebates of the frame are taken into consideration.

(VIII) Wood Works:-

a) The type of material, finishes, and fittings required are mentioned in the specification for the woodwork.

b) The trusses, wooden beams, posts, etc. are measured and paid in cu m, however, shutters of doors, windows, wooden trellis work, etc. are measured in sq. m. Handrails, wooden piles, etc. are measured in running meters.

(IX) Steel Works:-

a) The steel works and the ironwork are measured and paid by weight generally. Plain rolled sections

b) steel bars, etc. are measured in Kg or quintals**.**

c) The nuts, bolts, rivets, etc. are calculated in numbers, and their weight can be calculated using a steel table. In some cases, the nuts, bolts, and rivets are measured as the percentage of the whole steelwork.

d) The weight is calculated by considering the mild steel density of 7850 Kg/cu m.

e) For RCC works, the weight of the reinforcement is considered and the weight of the binding wires is not considered. However, the measurement of the binding wire is included in the item.

(X)Whitewashing and Distempering :-

a) The measurement and payment for items of whitewashing and distempering are done in sq m.
b) The area of the whitewashing and distempering is kept the same as that of plastering and no extra calculation is done.
c) The measurement and payment of the painting work is done in sq m.

2. **Write short notes on Hierarchy of PWD**

Technical Sanction

Expenditure Sanction

Ans- The Public Works Department (PWD) hierarchy follows a structured engineering and administrative format, typically headed by an Engineer-in-Chief or Principal Chief Engineer at the top.

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TECHNICAL SANCTION:-

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EXPENDITURE SANCTION

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Any expenditure before this sanction is not allowed for the proposed construction.

The ministries and government departments possess the power for expenditure sanction.

UNIT-II

SHORT ANSWER TYPE (2 MARKS)

1. **Define Plinth Area.**

   Ans- Plinth area: The plinth area may be defined as the total covered area of a floor including the thickness of the walls. The plinth area is the area enclosed by the outer walls. It is calculated by the external dimensions of the building.

2. **Define carpet area.**

   Ans- Carpet area: The carpet area may be defined as the total usable area of the building. The total carpet area is calculated by subtracting the area of the external walls from the plinth area. However, the area of balconies corridors, porches, staircases, etc. is not included.

3. **Define Floor Area.**

   Ans- Floor area: The floor area may be defined as the plinth area excluding the walls. The floor area includes the area of all the rooms, kitchen, verandah, porch, water closets, etc. The area of the walls includes the openings in the wall too.

4. **Define Circulation Area.**

   Ans- Circulation area: The circulation area is the area that is required for the movement of the residents to the rooms and other places. The circulation area is a free space that is given in the houses in the form of verandahs, corridors, balconies, lift shafts, etc.

5. **Write down the different methods used to prepare Approximate Estimate.**

   Ans- The approximate estimate may be defined as a primary calculation of the cost of a construction project using some preliminary information.
   Service unit method
   Plinth area rate method
   Cubical content method
   Typical bay method
   Approximate quantity method
   Empirical Equation

6. **Define Plinth Area Method of Approximate Estimate.**

   Ans- The plinth area method is an important method for approximate estimation.
   the plinth area of the building is calculated and the cost per sq m of the plinth area is considered for calculating the total cost. The total cost is calculated by multiplying the cost per sq m of plinth area for a similar building in the same locality by the plinth area of the building.

7. **Define Service Unit Method of Approximate Estimate.**

   Ans- The service unit method is also known as the unit rate method of approximate estimate.
   The total cost of the project is calculated by multiplying the cost per unit by the number of units in a structure. The cost per unit for the highways is considered as cost per km while for the bridges the cost per m span is Considered.
   For some buildings like hospitals, cost per bed or for theatres cost per seat is calculated.

8. **Define Cubical Content Method of Approximate Estimate.**

   Ans- In the cubical content method, the volume of the building is calculated.
   The rate per unit volume of the building is multiplied by the volume of the building to get the cost of the building.
   VOLUME OF THE BUILDING= PLINTH ARAEX HEIGHT OF THE BUILDING.

9. Define Typical Bay Method of Approximate Estimate.

Ans- A bay may be defined as the distance between two supports like columns or beams. The cost of the construction of a bay is determined based on experience and multiplied by the number of bays to be constructed to get the approximate cost of the project.

APPROXIMATE COST= COST PER BAY x NUMBER OF BAYS.

10. Define Approximate Quantity Method of Approximate Estimate.

Ans- The cost of the construction is calculated by multiplying the cost per unit running m of the wall by the total length of the walls.

The plan of the building can be used for the calculation of the length of the walls. The different sections of the walls are considered separately and the calculations from the foundation to the roof are done.

SHORT ANSWER TYPE (5 MARKS)

1. **Write short notes on Approximate Estimate**.

Ans-

I. The approximate estimate may be defined as a primary calculation of the cost of a construction project using some preliminary information.
II. The purposes of the approximate estimate are as follows:
III. The approximate estimate helps in understanding the feasibility of the proposed construction project. It answers the question of whether the project is viable under given circumstances.
IV. The approximate estimate provides a rough idea about budget planning. The availability of funds and the need to secure the funds are decided based on the approximate estimate.
V. The rough estimate guides the decision-makers and managers in deciding on the acceptance or rejection of the proposed project.
VI. A rough estimate is required to get the administrative approval of the projects. The rough estimate is attached with the application for administrative approval.
VII. The approximate estimate gives an idea of the risks involved in the construction projects. If the risks of the construction project are understood at the early stage, the action plan can be prepared soon.

2. Plinth area= 150 sq m
Height of the building from the ground floor= 4 m
Height of parapet wall= 0.9 m
Rate of per cu m volume of construction = 2500 ₹/ cu m
Calculate the approximate cost of the building

Ans- Plith area (P) = 150 sq m (Given)
Height of building from ground level (Hb)= 4 m
Height of parapet wall (h)= 0.9 m (Given)
Height for volume calculation (H)= Hb +h/2 = 4 + 0.9/2 = 4.45 m
Volume of the similar type of building = Plith area (P)× Height for volume calculation (H) = 150× 4.45 = 667.5 m
Rate of per cu m volume of construction = 2500 ₹/ cu m
Cost of the building = Rate of per cu m volume × Volume of the similar type of building = 2500 × 667.5 = Rs.1668750

3. **The construction cost per unit m for a bridge is Rs.9,00,000**
   Calculate the approximate cost of construction of a two-lane bridge having a length of 200 m using the Unit area method.

   Ans- The cost of construction is calculated by multiplying the cost per unit span to the total span of the proposed bridge.

   Cost per unit m= 900000

   Span of the bridge= 200 m

   Total cost= Cost per unit span× Span of the bridge = 900000×200 = Rs.18,00,00,000

4. **The cost of construction of a school is 8000 ₹ per student.**
   What will be the cost of the construction of a school with a capacity of 200 students.

Ans- Cost of Construction per student= 8000 per student.

Capacity of students in school=200

Total estimated cost= 800x200=16,00,000

5. **If the carpet area is 1000 sq m. If the area of walls is 10 % of the carpet area and the circulation area is 30% of the carpet area, calculate the plinth area.**

   Ans- Carpet Area=1000 sq mtr.

   Wall Area= 10% of carpet area.

   =0.1x1000=100 sq m.

   Circulation Area= 30% of Carpet Area.

   =0.3x1000=300 sq m.

   Plinth Area= Carpet Area+ Wall Area+ Circulation Area

   1000+ 100+ 300= 1400 sq m.

6. **The carpet area for the proposed construction is 1200 sq m and the area of walls is 20% of the plinth area. The circulation area is taken 25% of the plinth area. Calculate the approximate plinth area for the proposed construction.**

ANS- Carpet Area= 1200 sq. m

Wall Area=20% of Plinth Area

=0.2P

Circulation Area=25% of Plinth Area.

=0.25P

Plinth Area= Carpet Area+ Wall Area+ Circulation Area

P=1200+0.2P+0.25P

P-0.45p=1200

0.55P=1200

P=1200/0.55=2182 sq. m

LONG ANSWER TYPE (10 MARKS)

1. **Plinth area : 120 sq m**
   Plinth area rate : 60000 ₹/ sq m
   Cost of water supply : 8 % of the cost of the building
   Sanitary and electricity charges : 8.5 % of the cost of the building
   Cost of decoration : 2 % of the cost of the building
   The contingencies are taken 6% and supervision charges may be taken 8.5%.
   Calculate the overall cost of the building project.
   Ans-
   Plinth area= 120 sq m
   Rate of plinth area= 60000 ₹/ sq m
   Cost of the building= 120 × 60000 = 72,00,000
   Cost of water supply= 8 % of the cost of the building =0.08x7200000
   =5,76,000
   Cost of sanitary and electricity= 8.5 % of the cost of the building = 0.085x72,00,000=612000
   Cost of decoration= 2 % of the cost of the building = 0.02x7200000=1,44,000
   Total cost of the building= 7200000+ 576000+ 612000+144000= 85,32,000
   Cost of contegencies= 6 % of the total cost of the building = 0.06x85,32,000= 5,11,920
   Supervision charges= 8.5% of the total cost of the building=0.085x85,32,000= 7,25,220
   Overall cost of the building project = Total cost of the building+ Contegencies cost+ Supervision charges
   = 85,32,000+ 5,11,920+ 7,25,320 = Rs.97,69,140.00
2. **Prepare an approximate estimate of a hospital with 120 beds.**
   The following details are available for a similar project:
   Carpet area required per bed : 6 sq m
   Area of walls : 20% of the plinth area
   Area of corridor, verandah, etc. : 25% of the plinth area
   Plinth area rate : 120000 ₹/ sq m
   Cost of water supply : 10 % of the cost of the building
   Sanitary and electricity charges : 12 % of the cost of the building
   Cost of decoration : 2.5 % of the cost of the building
   Contingencies : 6% of the total cost
   Work charge establishment cost : 5% of the total cost
   Ans-
   Carpet area per bed = 6 sq m
   Capet area for 120 beds = Carpet area per bed× total beds = 6×120 sq m = 720 sq m
   P =the plinth area
   C=the carpet area
   Plinth area (P) = Carpet area (C) + Area of walls+ Area of verandah, corridor, etc.
   Area of walls = 20% of the plinth area = 0.20×P Area of corridor, verandah, etc. = 25% of the plinth area = 0.25×P
   Plinth area (P) = C + 0.20×P + 0.25× P
   P = C+ 0.45 P P- 0.45 P = C 0.55 P = C P = C/0.55
   Plinth area (P)= carpet area/0.55
   =720/0.5
   =1310 sq m.
   Plinth area rate = 120000 / sq m

Cost of the building = Plinth area rate × Plinth area rate = 120000× 1310 = 157200000
Cost of water supply = 10 % of the cost of the building = 157200000 × 10/100 = 15720000
Cost of sanitary and electricity = 12 % of the cost of the building = 157200000 × 12/100 = 18864000
Cost of decoration = 2.5 % of the cost of the building = 157200000 × 2.5/100 = 3930000
Total cost of building= 157200000+ 15720000+ 18864000+ 3930000 = 195714000
Cost of contegencies= 6 % of the total cost of the building= 195714000 × 6/100 =11742840
Work establishment charges = 5% of the total cost of the building = 195714000 × 5/100 = 9785700
Overall cost = Total building cost+ Contegencies cost+ Work charge establishment charges = 195714000 + 11742840+ 9785700 = Rs.21,72,42,540

3. **Explain the detailed procedure of the preparation of the approximate estimate for an irrigation project**

Ans-

The approximate estimate for the irrigation projects depends on the technique to be used for the irrigation.

The approximate estimate for the irrigation projects requires a more detailed approach as it involves different hydrological, geological, and agricultural studies.

Aim/objectives of the irrigation project: The objective of the construction of the irrigation project should be understood clearly while preparing the approximate estimate. The irrigation projects may be single-purpose or multi-purpose.

Field data: The different types of field data are required for preparing the approximate cost of an irrigation project.

The geological test data and the characteristics of the layers of embedded soil are required for the calculation of the cost of excavation and construction.

The hydrological data including the level of water and their variation is also required.

Demand forecasting:

The irrigation projects are designed to meet the requirements for a design period So the forecasting of irrigation water demand for the upcoming 40-50 years is done and the final water demand is calculated for designing the irrigation system.

Project formulation and evaluation:

The project is formulated based on the data obtained in the previous sections. The different alternatives of the irrigation projects for achieving the objectives are obtained. The cost of each alternative is calculated. The cost of the irrigation project can be calculated by multiplying the cost per km to the total km. However, the cost can also be calculated by multiplying the average cost per hectare commanded area by the total commanded area. The overhead percentage and contingency cost are taken at 10% each. The cost of land acquisition is also added to the cost of construction. In the absence of the exact cost of land acquisition, it can be taken 12% of the construction cost.

4. **Explain the detailed procedure of the preparation of the approximate estimate for a water supply project.**

Ans- If the cost of construction of a similar type of water supply system is known, the cost per capita of the water supply is calculated.

The cost per capita of the water supply is multiplied by the number of people for which the water supply system is to be provided to find the cost of the water supply project.

If the data given in point 1 is not available, the water supply system is divided into different units and the cost of each unit is calculated. The cost of land acquisition is calculated at the current rates.

The cost of headwork is calculated by multiplying the cost per m3 capacity by the total capacity.

The cost of pumping machinery is calculated by multiplying the cost per horsepower (HP) by the total power required for the pumping machinery.

The cost of the rising main pipe is calculated by multiplying the cost per running m by the total height of the

rising main pipe.

The cost for the treatment units and reservoir is calculated according to the capacity in m3 and the cost of the distribution system is calculated in running m.

The overall cost is calculated by adding the different costs calculated in the previous steps. The total cost of a water supply system may be given using the following equation

APPROXIMATE COST OF WATER SUPPLY PROJECT=

COST OF LAND ACQUISITION+ COST OF INTAKE STRUCTURE+ COST OF PUMPING MACHINARY+ COST OF RISING MAIN+ COST OF TREATMENT UNIT + COST OF DISTRIBUTION RESERVOIR + COST OF DISTRIBUTION SYSTEM.

UNIT-III

1. **Define Detailed Estimate.**

   Ans-The detailed estimates are prepared for determining the cost from the actual plans and drawings.

   A detailed estimate uses detailed designs and plans to determine the quantities of the different materials and their cost in the construction.

   The current rate of the materials is taken from the schedule provided by the public work departments.

2. **Define specifications.**

   Ans- The specifications are the standards that are used for maintain the quality of the work. The specifications are required to understand the quality and ratio of the different materials used for the construction.

3. **Define schedule of rates.**

   Ans- The rates of the items and different materials are required. The schedule of rates can be obtained from the

   Public Works Department (PWD) or any authorized agency at the state or central level.

4. **Define standing circulars.**

   Ans- The standing circulars are the orders that give the rate of such items that are not available in the schedule of rates.

5. **Define GST.**

   Ans-It is a tax that is levied on services and goods.

   The GST in the construction services in India is 18% in most of cases. The GST on materials like tiles, refractory bricks ceramic goods, glass material, etc. is also 18%.

6. **Define Contingencies in the Estimated Cost.**

   Ans- The contingencies may be defined as the funds that are kept to cover the cost of uncertain events or circumstances that can occur during project implementation. The cost of contingencies is taken as a percentage of the cost of construction.

   The cost of contingencies in construction is usually taken from 3% to 5% of the cost of construction.

7. **What do you mean by supervision charges.**

   Ans- The supervision of the construction work is an important task that ensures the construction is done according to the proposed design and specifications. The supervision services in construction include the cost of construction management, contract management, cost control, quality assurance, environment management, etc. The supervision charges are 4% to 10% of the project's cost.

8. **Define long wall & short wall method.**

   Ans- The long wall and short wall method is also known as out to out and in to in method.

   In the long wall and short wall method, walls of one direction are termed as long walls and the walls perpendicular to the long walls are known as short walls.

   Length of Long wall= c/c distance+ breadth of short wall.

   Length of short wall= c/c distance- breadth of long wall.

9. **Define Centre line method of detailed estimate.**

   Ans- In centre line method, the centre-to-centre distance for each wall is calculated and the quantity of material is calculated by multiplying the centre-to-centre distance by the breadth and height of the wall.

10. **Define Work-Charged Establishment.**

    Ans- There are costs of execution of the project that include the salaries of the temporary employees, supervisors, staff, etc.

The cost of work-charged establishment is taken from 1.5% to 2% according to the Public Works Department (PWD).

11. Centre to centre length of a wall is 10 m and the breadth of the wall is 40 cm. What will be the length of the long wall and short wall.

Ans- Length of wall= 10m (C/C)

Breadth of wall=40cm=0.4m

Length of Long wall= c/c distance+ breadth of short wall.

=10+0.4=10.4m

Length of short wall= c/c distance- breadth of long wall.

10-0.4=9.60m

12. What will the weight per metre (in Kg/m) for a bar of 12 mm?

Ans- Diameter of Bar=12mm

Weight of bar (kg/m)= Bar $Dia^2/162= 12^2/162= 0.9$ kg/m

13. If the clear span of a beam is 5500 mm and the spacing for the stirrups is taken 150 mm. what will be the number of stirrups required.

Ans- clear span of the beam=5500mm

Spacing=150mm

No. of stirrups Required= 5500/150 +1= 37+1= 38

14. Calculate the total length of bar of length 1m of diameter 20mm when hooks are provided on the both the sides of the bar.

Ans- Length of Bar=1m

Diameter of Bar=20mm

Length of Hook= 9xBar Diameter= 9x20=180mm=0.18m

Total length of Bar=1+0.18=1.18m

15. Define agency charges.

Ans- The agency charges are the internal cost of the construction company incurred due to the administrative and managerial operations.

SHORT ANSWER TYPE (2 MARKS)

1. Calculate the quantities of the earthwork for a 350 m-long road. The height at the first section is 1.5 m and height at the other section is 1m. The formation width is 9 m. The side slope is given 2.5:1. Calculate the volume using the mid-sectional method, mean section method, and prismoidal method.

Height at section 1 (H1)=1.5 m

Height at section 2 (H2)= 1 m

Formation width (B)= 9 m

Length of the road (L)= 350 m

Side slope (x:1)= 2.5:1

Calculations For Mid-Sectional Area Method:-

Mean height= 1.5+1/2= 1.25m

Area of Mean Height= $9x1.25+2.5x1.25^2$= 15.16 sq.m

Volume of Earth work=15.16x350=5306 cum.

Calculations for mean sectional area method:-

Cross-sectional area at sec-1 = $9x1.5+2.5x1.5^2$=19.125 sq m.

Cross-sectional area at sec-2=$9x1.2+1.25x1.2^2$=14.40 sq m.

Mean sectional area= (19.125+14.40)/2 = 16.763 sqm.

Volume of Earthwork= 16.763x350=5867.05 cum.

Calculations for Prismoidal Formula:-

Mean height= 1.5+1/2= 1.25m

Area of Mean Height= $9x1.25+2.5x1.25^2$= 15.16 sq.m

Cross-sectional area at sec-1 = $9x1.5+2.5x1.5^2$=19.125 sq m.

Cross-sectional area at sec-2=$9x1.2+1.25x1.2^2$=14.40 sq m.

Volume of Earthwork= (19.125+14.40+4x15.16)x350/6 = 5492.95 cum.

2. Write a short note on the Detailed Estimate.

Ans-

Contingencies:

The contingencies may be defined as the funds that are kept to cover the cost of uncertain events or circumstances that can occur during project implementation. The cost of contingencies is taken as a percentage of the cost of construction.

The cost of contingencies in construction is usually taken from 3% to 5% of the cost of construction.

Work-charged establishment:

There are costs of execution of the project that include the salaries of the temporary employees, supervisors, staff, etc. These employees are paid based on the work estimate on which they are assigned. The work-charged staff are the temporary employees that may be hired to perform the particular tasks. The cost of work-charged establishment is taken from 1.5% to 2% according to the Public Works Department (PWD)

Percentage charges: The probable cost of the construction is calculated from a detailed estimate. The different charges that are taken as a fraction of the probable cost are known a the percentage charges. The contractor's profit is added at the rate of 10% of the estimated cost of construction.

Water supply and sanitary charges: The water supply and sanitary charges are also calculated as the percentage of the total cost of construction.

The provision of keeping 8% of the estimated cost of construction for the water supply and sanitary charges

Electrification charges: The installation of electrical facilities in the building and cost of electricity is also included separately like water supply and sanitary charges. The electrification charges are taken around 8% of the estimated cost.

3. Estimate the quantities of following items of a two roomed building from the given plan & section.

(I)Earthwork in excavation In foundation

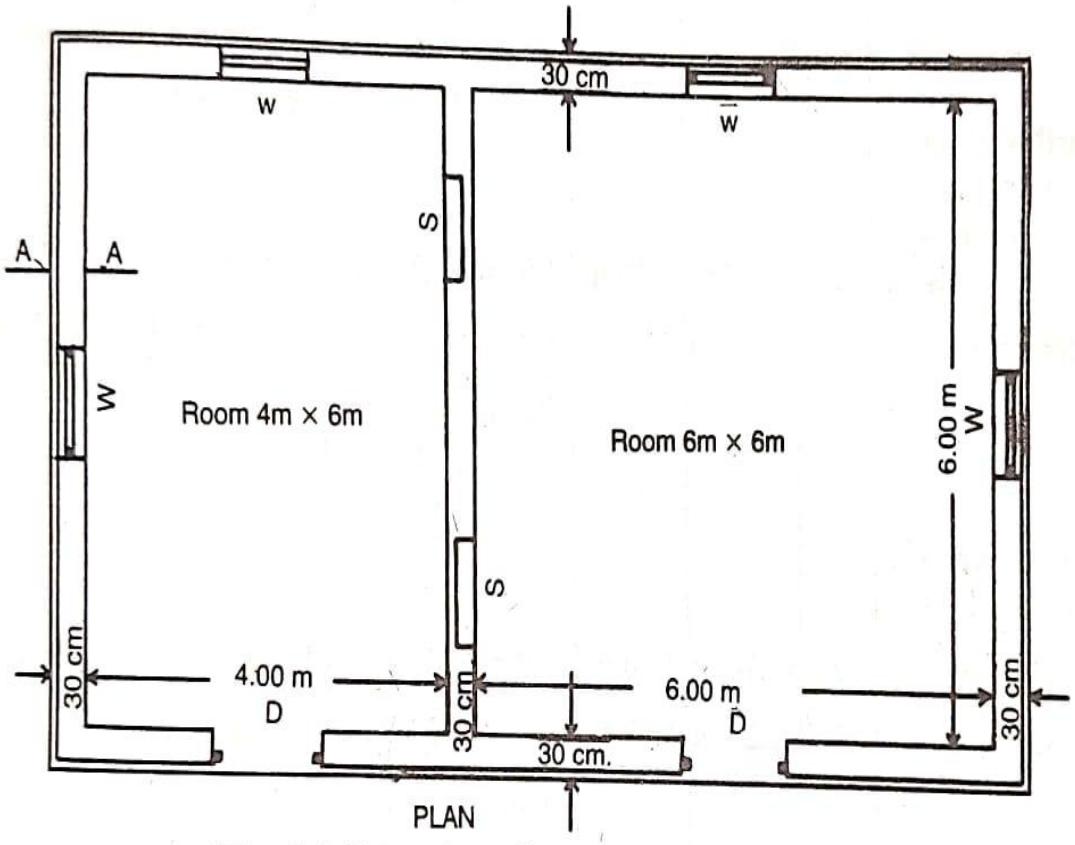
(II)Lime concrete in cement mortar

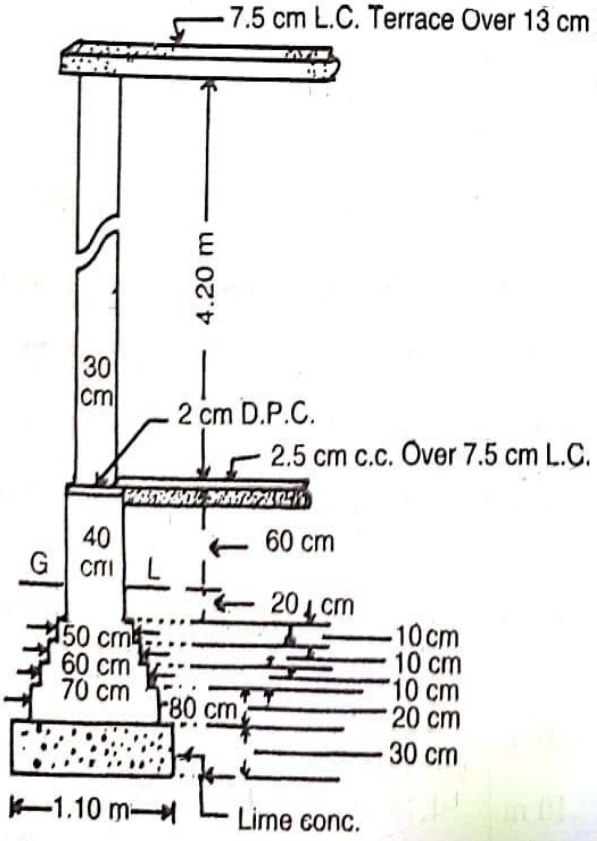
(III) 1ST class brickwork in cement mortar 1:6 in foundation and plinth

(IV) 2.5cm cc DPC.

(V) 1ST Class Brickwork in Lime mortar in superstructure.

TWO ROOMED BUILDING





CROSS SECTION OF WALL ON AA.

All Walls are of same section
Lintels over Doors. Windows and Shelves are 15 cm thick R.B.

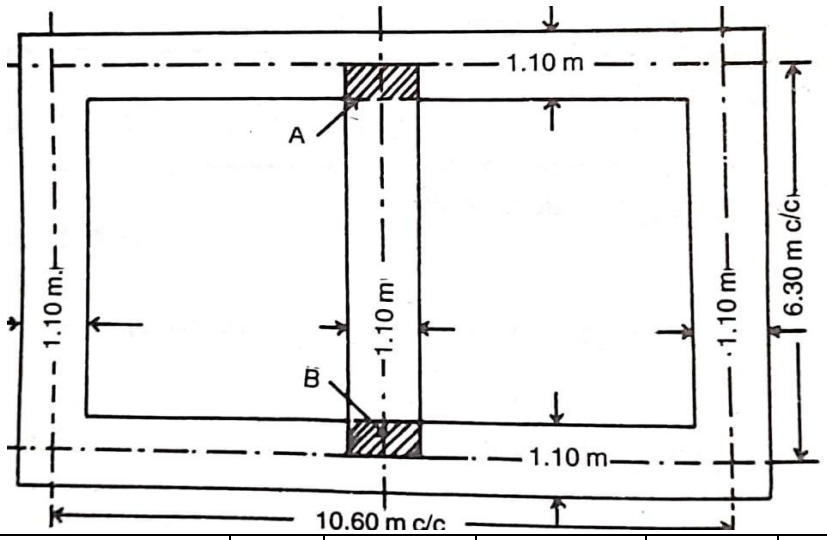
Doors D-1.20 m × 2.10 m
Windows W-1.00 × 1.50 m
Shelves S-1.00 m × 1.50 m

Fig. 2-6

ITEM NO	PARTICULAR OF ITEM OF WORK	NO	DIMENSIONAL IN METRE			QUANTITY OR CONTENTS	TOTAL QUANTITY
			L	B	H		
1	**EARTHWORK IN EXCAVTION**						
	foundation						
	long wall	2	8.5	1	1.95	33.15	
	short wall	2	4.5	1	1.95	17.55	
	central portion (inside)	1	6.5	4.5	1.25	36.56	
						TOTAL	87.26 cum
2	**LIME CONCRETE IN FOUNDATION**						
	floor foundation						
	long wall	2	8.5	1	0.3	5.1	
	short wall	2	4.5	1	0.3	2.7	
	under c.c floor	1	7	5	0.3	7	
						TOTAL	14.8 cum.
3	**1ST CLASS BRICK WORK IN**						
	1:6 cement mortar below						
	G.L						
	LONG WALL						
	1st footing	2	8.2	0.7	0.2	2.29	
	2nd footing	2	8.1	0.6	0.2	1.94	
	50 cm wall	2	8	0.5	1.25	10	
	SHORT WALL						
	1st footing	2	4.8	0.7	0.2	1.34	
	2nd footing	2	4.9	0.6	0.2	1.18	
	50 cm wall	2	5	0.5	1.25	6.25	
	3rd footing	3	5.7	0.6	0.1	1.03	
	4th footing	3	5.8	0.5	0.1	0.87	
	PLINTH WALL						
	above footing	3	5.9	0.4	0.8	5.66	
						TOTAL	26.10 cum
4	**Damp proof course**						
	2.5 cm thick c.c-						
	Long walls	2	11.00 m	40 m	-	8.80	
	Short walls	3	5.90 m	40 m	-	7.80	
					Total	15.88	
	Deduct door sills	2	1.20 m	40 m	-	0.96	
				Net	**Total**	14.92 sqm	
5	**1st class brick work in lime**						
	Mortar in superstructure						
	Long walls	2	10.90 m	30 m	4.20 m	27.47	
	Short walls	3		30 m		22.68	

					Total	50.15	
	Deduct-						
	Door openings	2	1.20 m	30 m	2.10 m	1.51	
	Window openings	4	1.00 m	30 m	1.50 m	1.80	
	Shelves	2	1.00 m	20 m	1.50 m	0.60	

3. Estimate the quantities by center line-method.



Item no	Particulars of items	no	length	breadth	Height or depth	Quantity
1	Earthwork in excavation in foundation	1	39.00 m	1.10 m	1.10 m	42.90 cum
2	Lime concrete in foundation	1	39.00 m	1.10 m	30 m	12.87 cum
3	**1st class brick work in 1:6 cement mortar in foundation and plinth**					
	1st footing	1	39.30 m	80 m	20 m	6.29
	2nd footing	1	39.40 m	70 m	10 m	2.76
	3rd footing	1	39.50 m	60 m	10 m	2.37
	4th footing	1	39.60 m	50 m	10 m	1.98
	Plinth wall above footing	1	39.70 m	40 m	80 m	12.70
					Total	26.1 cum
4	Damp proof course 2.5 cm c.c	1	39.70 m	40 m	-	15.88
	Deduct door sill	2	1.20 m	40 m	-	0.96
					Net	14.92 cum
5	1st class brick work in lime mortar in superstructure	1	39.80 m	30 m	4.20 m	50.15
	Deduct door , window , shelve openings and lintels	1				4.40
					Net	45.75 cum

3. Prepare the detailed estimate of part of a wall of a building from the given plan and section and general

Specifications.

(I) Foundation concrete shall be of lime concrete.

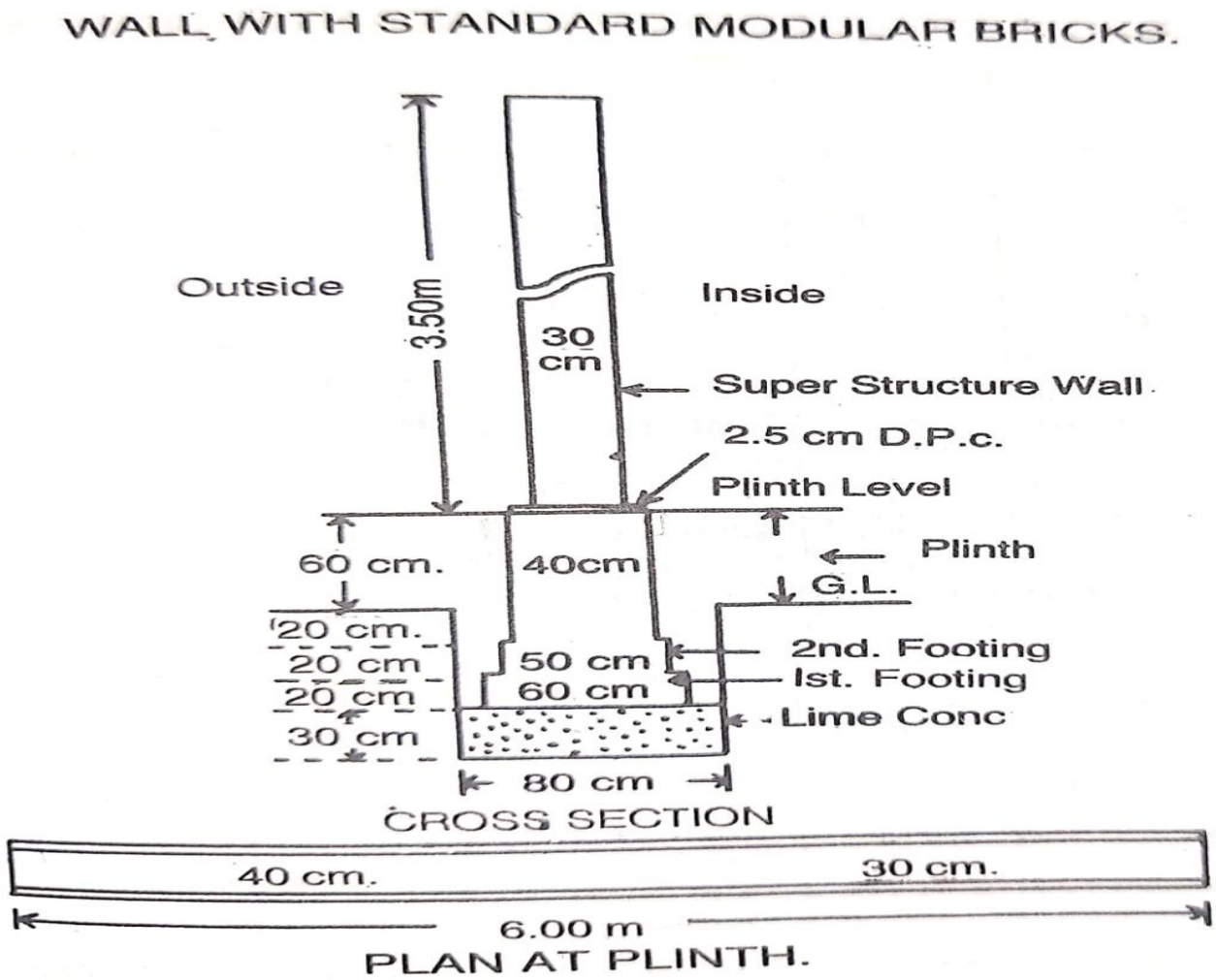
(II) Foundation and plinth shall be of 1ST Class lime mortar.

(III) Damp proof course-2.5mm cc 1:1.5:3 with water proofing compound.

(IV) Super structure 1ST Class brickwork in Lime Mortar.

(V) Wall finishing-Inside wall 12mm cement plastered 1:6 and white wash 3 coats.

Outside wall 12mm cement plastered 1:6 including 10cm below ground level and finished with two coats of Color wash over one coat of whitewashing.



ITEM NO.	DESCRIPTION OF ITEMS OF WORK	NO.	DIMENSIONS LENGTH	BREADTH	HT. OR DEPTH	QUANTITIES OR CONTENTS	TOTAL QUANTITIES
1.	Earthwork in excavation in foundation	1	6.00 m	80m	90m	4.32	4.32cum
2.	lime concrete in foundation	1	6.00m	80m	30m	1.44	1.44cum
3.	1st class brickwork in lime Mortar in foundation and plinth-						
	Ist footing	1	6.00m	60m	20m	72	
	2nd footing	1	6.00m	50m	20m	60	3.24cum
	Plinth wall up to G.L.	1	6.00m	40m	20m	48	
	Plinth wall above G.L.	1	6.00m	40m	60m	1.44	
4.	2.5 cm Damp proof corse (D.P.C.) c.c.1:1$_{1/2}$:3	1	6.00m	40m	-	2.4	2.4 sqm
5.	First class Brickwork in lime mortar for superstructure	1	6.00m	30m	3.50m	6.3	6.3 cum
6.	12mm plaster of cement sand 1:6-						
	Inside	1	6.00m	-	3.50m	21.0	46.2 sqm
	Outside including 10cm below G.L.	1	6.00m	-	4.20m	25.2	
7.	White washing 3 coats (inside)	1	6.00m	-	3.50m	21.0	21.0 sqm

ITEM No	DESCRIPTION OF ITEMS OF WORK	QUANTITY	UNIT	RATE Rs.	PER	AMOUNT Rs.
1.	Earthwork in excavation in foundation	4.32	cum	350.00	% cum	15.12
2.	Lime concrete in foundation with white Lime, surkhi and brick ballast	1.44	cum	220.00	per cum	316.80
3.	1st class brickwork with white lime and Surkhi mortar 1:2 in foundation and Plinth.	3.24	cum	300.00	per cum	972.00
4.	2.5 cm thick c.c. 1:1½:3 Damp proof Course with water proofing compound	2.4	sqm	20.00	per sqm	48.00
5.	1st class Brickwork with white lime and Surkhi 1:2 mortar in super-structure	6.3	cum	320.00	per cum	2016.00
6.	12mm cement and local sand plaster 1:6	46.2	sqm	8.50	per sqm	392.70
7.	White washing 3 coats	21.0	sqm	0.75	per sqm	15.75
8.	Colour washing 2 coats over one coat Of white washing	24.6	sqm	0.82	per sqm	20.17

	Total -	3796.54
Add for Contingencies @3%	…….	113.90
Add for Work charged Establishment @2%	…….	75.93
	GRAND TOTAL -	3986.37

LONG ANSWER TYPE (10 MARKS)

1. Reduced level (R.L) of ground along the center line of a proposed road from chainage 10 to Chainage 20 are given below. The formation level at the 10th chainage is 107 and the road in down Gradient of 1 in 150 upto chainage the chainage 14 and then the gradient changes to 1in 100 downward Formation width of road is 10 metre and side slopes of Banking are 2:1 (Horizontal:Vertical) Length of the chain is 30 metre.

Draw longitudinal section of the road and typical cross-section and prepare an estimate of earthwork at The rate of Rs.275.00% cum.

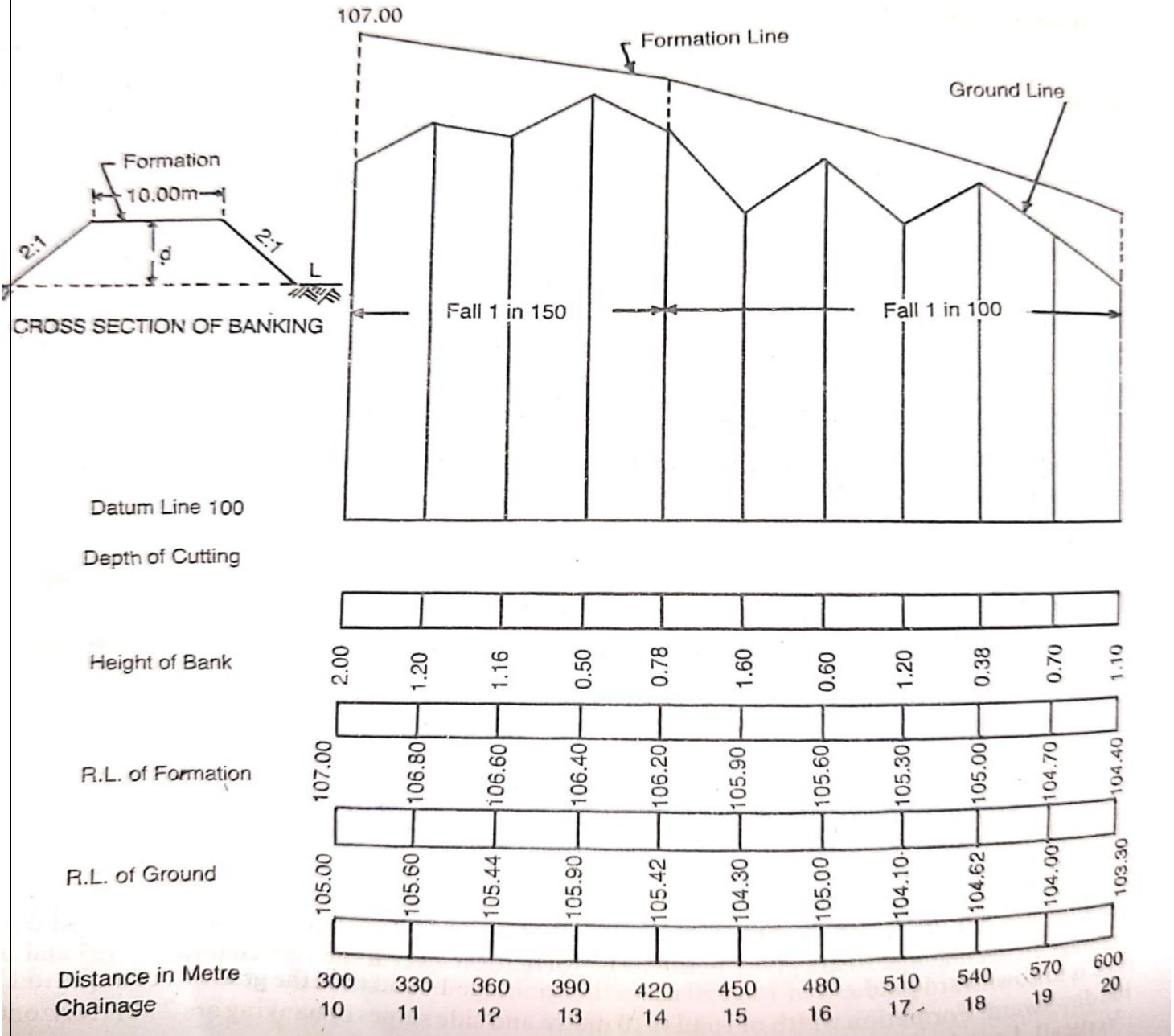
(*i*) Find also the area of the side slopes and the cost of turfing the side slopes at the rate of Rs. 60.00% sq. m.

Chainage	10	11	12	13	14	15	16	17	18	19	20
R.L. of ground	105.00	105.60	105.44	105.90	105.42	104.30	105.00	104.10	104.62	104.00	103.3

R.L. of Formation 107.00.

Gradient Down gradient 1 in 150 ——→ ←—— Down gradient 1 in 100

L=Section and Typical cross-section of the road are as given in Fig. 7-8.



B=10 m , s= 2

Stations Or Chainage m	Length m	Height or Depth diff. Of G.L. and F.L. m	Mean height or Depth (d) m	Central area Bd M^2	Side area sd^2	Total sec. Area $Bd+sd^2$ M^2	Length in Betw. Stations L M^2	Quantity $(Bd+sd^2)+L$	
								Ban King M^3	Cutting m^3
10	300	2.00	-	-	-	-	-	-	-
11	330	1.20	1.60	16.00	5.12	21.12	30	633.6	-
12	360	1.16	1.18	11.80	2.78	14.58	30	437.4	-
13	390	0.50	0.83	8.30	1.38	9.68	30	290.4	
14	420	0.78	0.64	6.40	0.82	7.22	30	216.6	
15	450	1.60	1.19	11.90	2.83	14.73	30	441.9	-
16	480	0.60	1.10	11.00	2.42	13.42	30	402.6	-
17	510	1.20	0.90	9.00	1.62	10.62	30	318.6	-
18	540	0.38	0.79	7.90	1.25	9.15	30	274.5	-
19	570	0.70	0.54	5.40	0.58	5.98	30	179.4	-
20	600	1.10	0.90	9.00	1.62	10.62	30	318.6	-

Total 3513.6 cum

ABSTRACT OF ESTIMATED COST (Ex.3)

ITEM NO	PARTICULAR OF ITEMS	QUANTITY	UNIT	RATE RS. P.	PER	COST RS. P.
1	Earthwork in banking	3513.6	cum	275.00	%cum	9662.40

TOTAL –	9662.40
Add 5% (3% for contingencies and 2% for Work charged Establishment) -	483.12
GRAND TOTAL -	Rs. 10145.52

STATION OR CHAINAGE	HEIGHT OR DEPTH (M)	MEAN HT. OR DEPTH D_m	SLOPING BREADTH OF SIDE SLOPE $Dv(S^2+1)$ (M)	LENGTH L (M)	AREA OF BOTH SIDE SLOPES $2LDv(S^2+1)$ (SQ M)
10	2.00	-	-	-	-
11	1.20	1.60	3.58	30	214.80
12	1.16	1.18	2.64	30	158.40
13	0.50	0.83	1.86	30	111.60
14	0.78	0.64	1.43	30	85.80
15	1.60	1.19	2.66	30	159.60
16	0.60	1.10	2.46	30	147.60
17	1.20	0.90	2.01	30	120.60
18	0.38	0.79	1.77	30	106.20
19	0.70	0.54	1.21	30	72.60
20	1.10	0.90	2.01	30	120.60

Abstract of Cost of Turfing (Ex. 3-ii)- Turfing side slopes 1297.80 @ Rs. 60.00 per % sq m = 778.68

- Add 5% for Contingencies, etc. = Rs. 38.93

GRAND TOTAL = Rs.817.61

3. Estimate the quantity of Earthwork in 180m length of road by using Prismoidal Formula Method.

Chainage 0 30 60 90 120 150 180 meter

R.L. of Ground -- 112.00 111.80 111.70 111.60 111.50 111.30 111.40 meter

R.L of Formation ---------- 112.60 ----------> Level

The Formation width of the road is 10 meter and the side slopes are 2:1 (2 horizontal)

B= 10m, S= 2

Chainage m	Height of bank or Depth of cutting m	$\frac{d_1+d_2}{2}$ m	Section-al area Central Portion $B\times\frac{d_1+d_2}{2}$ m	d_1^2	d_2^2	d_1d_2	$\frac{d_1^2+d_2^2+d_1d_2}{3}$	Secnl. Area of sides $S\times\frac{d_1^2+d_2^2+d_1+d_2}{3}$	Total Secnal Area Sum of Cols (4) And (9) sqm	Dis. In Betw. Stns. L m	Quantity Embankment cum	Quantity cutting cum
1	2	3	4	5	6	7	8	9	10	11	12	13
0	0.60	-	-	-	-	-	-	-	-	-	-	-
30	0.60 0.80	0.70	7.00	0.36	0.64	0.48	0.493	0.99	7.99	30	239.7	-
60	0.80 0.90	0.85	8.50	0.64	0.81	0.72	0.723	1.45	9.95	30	298.5	-
90	0.90 1.00	0.95	9.50	0.81	1.00	0.90	0.903	1.81	11.13	30	333.9	-
120	1.00 1.10	1.05	10.50	1.00	1.21	1.10	1.103	2.21	12.71	30	381.3	-
150	1.10 1.30	1.20	12.00	1.21	1.69	1.43	1.443	2.89	14.89	30	446.7	-
180	1.30 1.20	1.25	12.50	1.69	1.44	1.56	1.563	3.13	15.63	30	468.9	-
										TOTAL	**-**	**2169.00 CUM**

UNIT-IV

SHORT ANSWER TYPE (2 MARKS)

1. **What do you mean by Rate Analysis?**
   Ans- The study that defines the unit rate of the work by considering the basic requirements like the cost of labor profit of contractor, etc. is known as the rate analysis.
2. **What is the purpose of Rate Analysis?**
   Ans-The analysis of rates helps in calculating the accurate probable cost of the project by considering the most realistic rates of the material, equipment, labor, etc.
   Rate analysis is performed to determine the quantity of the extra material or equipment that is not mentioned in the contract but required for the commencement of the work.
   The rate analysis helps in revising the schedule of rates based on the changes in material, labor, or technique of construction.
3. **Write down the Importance of Rate Analysis.**
   Ans-
   a. The analysis of rates helps in the preparation of an accurate and error-free detailed estimate.
   b. Rate analysis helps the contractor to propose a realistic and economical bid.
   c. The rate analysis helps in comparing the different tenders. Hence, an accurate and realistic analysis enhances the chance of the selection of the proposed tender.
4. **What are the different items of heads are required for Rate Analysis.**
   Ans- The rate per unit item is calculated by adding the different heads.
   a. Quantity and cost of the materials
   b. Rate of earthwork
   c. Cost of labor
   d. Cost of equipment
   e. Water charges
   f. Overhead expenses
   g. Contractor's profit
5. **Write down the different category of labors available to work at site.**
   Ans-The laborers are classified based on their skills and expertise.
   The percentage of the different categories of laborers is also fixed to optimize the construction cost.
   The labor is classified into the following three categories: (1) Highly skilled labor or skilled first-class labor
   (2) Skilled labor or skilled second-class labor
   (3) Unskilled labor

6. **Define Earthwork**
   Ans- Earthowork may be defined as the removal, placement, redistribution, or compaction of the excavated materials on the construction site.
   The construction of structures like roads, bridges, tunnels, etc. requires modification of the landscape.
7. **Define Lead.**
   Ans-Lead may be defined as the horizontal distance from the centre of gravity of the excavation of the earth to the centre of gravity of deposition of the earth.
8. **Define Lift.**
   Ans- : Lift may be defined as the vertical distance from the centre of gravity of excavation of the earth to the centre of gravity of deposition of the earth.

9. **Define cutting and filling of Earthwork.**

Ans-

a. The excavation or digging of the earth is called cutting.
b. The deposition of the earth at a low-lying place is known as Filling.

10. Define Banking.

Ans-: The deposition of the earth above the ground level is known as banking.
For the construction of highways and railways alignment in low lying areas embankments is prepared.

11. Define overhead costs

Ans- Overhead costs include general office expenses, rents, taxes, supervision and other costs which are indirect expenses and not productive expenses on the job.
They are general over heads and job over heads.

12. Define Task Work or Out-Turn Work.

Ans- the capacity of doing work by an artisan or skilled labour in the form of quantity of work per day is known as task work or out-turn work.

SHORT ANSWER TYPE (5 MARKS)

1. Write short notes on procedure of Rate Analysis.

Ans-

a) The rate analysis may be defined as the systematic process of determining the rates of items of work.
b) The whole work is divided into the items of the work and their cost is calculated by adding the different types of cost. The work is defined at the beginning of the commencement of the project.
c) The data required for the rate analysis is collected and the materials are listed for the different items of the work.
d) The specifications and schedule of rate (SOR) are also collected. ‘
e) The equipment and machinery required for the project are also listed.
f) The cost of the materials is calculated using the schedule of rates and specifications.
g) The transportation charges, overhead charges, taxes, and contractor’s profit are also considered
h) The out-turn of the work and the number of laborers required at the different stages are determined.
i) The cost of labor is calculated based on the number of laborers and the types required at the different stages of the work.
j) The charges for hiring the machinery and equipment are calculated using the latest schedule of rates.
k) The contingencies and overheads are calculated and added to the cost.
l) The total cost is calculated by adding the cost of the equipment, materials, labor, overheads, etc.
m) The prepared rates are reviewed and adjusted further to finalize the rates.

2. Calculate the amount of cement concrete is used in the foundation with a mix of 1:2:4 with sand and stone ballast of 25 mm and analyze the rates for 10 cu m of the cement concrete.

- Ans- Volume of wet concrete= 10 cu m
- volume of dry concrete = 50% to 55% more than the wet concrete
- Volume of the dry mix= Volume of wet mix+ 50 to 55% of volume of wet mix = 1.54×10= 15.4 cu m
- The mix is of 1:2:4.
- Volume of cement= volume of mix/ mix ratio =15.4/1+2+4 =15.4/7 =2.2 cum. (64 bags)
- Weight of one cement bag= 50 Kg
- Weight of 64 cement bags= 64×50= 3200 Kg
- Volume of sand=2xvolume of cement= 2x2.2=4.4 cum.
- Volume of aggregate= 4xVolume of cement=4x2.2= 8.8 cum.

DESCRIPTION	QUANTITY	RATE	AMOUNT
1. Materials			
Cement (OPC 43)	2.2 cu m (3.2 tonne)	4940 per tonne	15800
Sand (Zone III)	4.4 cu m	900 ₹ per cu m	3960
Stone ballast (25 mm)	8.8 cu m	800 ₹ per cu m	7040
2. Labor			
Head mason			
Mason	1 no	458 ₹/ day	229
Mazdoor (Beldar)	0.5nos	415 ₹/ day	415
Bhisti	18 nos	358 ₹/ day	6444
Miscellaneous	2 nos	358 ₹/ day	716
Lumpsum	1500 ₹	1500	1500
TOTAL			**36104.**
WATER CHARGES (1 % OF THE TOTAL COST)			**361**
CONTRACTOR'S PROFIT (10%)			**3610.40**
GRAND TOTAL			**40075.40 ₹**
RATE PER UNIT CU M			**40075.40/10=4007.50 per cum.**

3. Prepare the Analysis RCC work with a mix of 1:2:4 in a beam. The shuttering and centering operations are also performed. Let's analyze the rates for 10 cu m of RCC work.

Ans-

Volume of wet concrete= 10 cu m

Volume of dry concrete = 50% to 55% more than the wet concrete

Volume of the dry mix= Volume of wet mix+ 50 to 55% of volume of wet mix = 1.54×10= 15.4 cu m

The mix is of 1:2:4

Volume of dry mix= 15.4 cu m

Volume of cement concrete=15.4/1+2+4 =15.4/7 =2.2 cum.

Weight of one cement bag= 50 Kg

Weight of 64 cement bags= 64×50= 3200 Kg= 3.2 tonne.

Volume of sand= 2xvolume of cement= 2x2.2=4.4cum

Volume of aggregate=4xvolume of cement=4x2.2=8.8 cum.

Steel bars @ 1% of the volume= 1% of 10 cu m= 0.1 cu m

Density of steel= 7850 Kg/m3

Weight of steel bars in 0.1 cu m= 785 Kg

Weight of binding wires = 7 Kg

Reinforced Cement Concrete (RCC) work: The requirements of the number of laborers and their types for 10 cu m of RCC work are

Head masons= 0.5 nos

Masons= 3 nos

Bhisti= 4 nos

Mazdoor= 18 nos

For 100 Kg of reinforcement for RCC work, 1 mazdoor and 1 blacksmith are required.

For 10 sq m centering and shuttering of the flat surface, 3 carpenters and 4 mazdoors are required.

DESCRIPTION	QUANTITY	RATE	AMOUNT

1. MATERIALS			
Cement (OPC 43)	2.2CUM	4940 ₹ per tonne	15800
Sand (Zone III)	4.4CUM	900 ₹ per cu m	3960
Aggregates (20 mm)	8.8CUM	800 ₹ per cu m	7040
Steel	0.1 CUM (7.85quintal)	4900 ₹ per quintal	38465
Binding wires	7kg	55 ₹ per Kg	385
			TOTAL 65650 ₹
2.LABOUR			
Head Mason			
Mason	0.5	458/day	229
Mazdoor (beldar)	3	415/day	1245
Mazdoor (coolie)	9	358/day	3222
Bhisti	9	358/day	3222
Miscellaneous	4	358/day	1432
Lumpsum		1500	1500
			TOTAL 10850
3. REINFORCEMENT			
Mazdoor	8	358/day	2864
Blacksmith	8	358/day	3008
Miscellaneous	LUMPSUM	1500	1500
			TOTAL 7372

4.CENTERING & SHUTTERING			
Hire charges (5% of materials cost)	65660x0.05	3283.50	3283.50
Mazdoor	10	385	3850
Carpenter	10	376	3760
Nails (10% of hire charges)	3283.50x0.1	383.30	3283.30
Miscellaneous	Lumpsum	1500	1500
			TOTAL 12451.80

TOTAL (MATERIAL COST+LABOR COST+ REINFORCEMENT COST+ SHUTTERING COST)	96323.8 ₹
WATER CHARGES(1 % OF THE TOTAL COST)	963.23 ₹
CONTRACTOR'S PROFIT (10%)	9632.3 ₹
GRAND TOTAL	106919.33 ₹
RATE PER UNIT CU M	10691.90 Per/cum.

4. Write short notes on Water Charges, Over Haed Charges And Contractor`S Profit.

Ans-

WATER CHARGES:

Water is an essential resource required at every stage of construction.

A huge amount of water is required for concrete mixing, curing, washing, cleaning, etc.

The municipal corporation charges for the water used in the construction project. The water charges are 1% to 1.5% of the total cost of construction.

OVERHEAD EXPENSES:

The overhead expenses in a construction project are miscellaneous expenses that should be considered in the analysis of rates.

If the overhead charges are not included in the rate analysis, it may become difficult to complete the construction at different stages.

The cost of stationary, depreciation of furniture, telephone bills, supervision charges, maintenance and repairing charges of equipment, etc. are included in the overhead expenses.

The overhead expenses from 2% to 5% of the total cost are allowed in the construction projects.

CONTRACTOR'S PROFIT:

The profit of the contractor is added by the percent of the rate per unit item.

The rate of the per unit item is calculated by adding 10% of this cost as the profit of the contractor.

If the department supplies the material, the profit on the cost of the material is not allowed.

However, 10% of the labor cost is added as the contractor's profit in this case. If it is not mentioned in the contract that the department will supply the material, The contractor's profit is added by 10% of the overall cost of material and labor

5. Water proof cement painting of approved make and quality two coats on plastered surface unit 1 sq m. Take – 100 sqm.

First coat –

Snow-cem or other make 30 kg @ Rs. 45 / k * g = 1350

Expert white washer 2 1/2 nos. @ Rs * 0.45 * 0 / d * ay = 1125

Boy coolie 2 1/2 nos. @ s * 0.33 * 0 / d * ay = 825

Sundries, T. and P., etc. L.S. = 100.00

Total = 3400.00

Add 10% Contractor's profit = 340.00

Total = 3740.00

per % sq m

Second Coat-

Snow-cem or other make 20 kg @ Rs * 0.45 * 0 / k * g = 900

Expert white washer 2 nos. @ Rs * 0.45 * 0 / d * ay = 900

Boy coolie 2 nos. @ Rs * 0.33 * 0 / d * ay = 660

Sundries, T. and P., etc. L.S. = 75.00

Total = 2535.00

Add 10% Contractor's profit = 253.50

Total = 2788.50

Total for two coats = 3740.00 + 2788.50 = 6528.50 per % sq m.

Rate per sq m. for two coats = Rs.6528.50/100 = Rs.65.30

50 kg of snowcem covers and area of 100 sqm. to 150 sq m. for two coats depending on the nature of surface.

LONG ANSWER TYPE (10 MARKS)

1. (I) Earthwork in excavation in trenches up to 1.5 m depth for laying sewers in ordinary soil including trimming, dressing, levelling in gradient, refilling of trenches in 20 cm layers watering and ramming, removing surplus earth up to 30 m distance - unit 100 cum. Take - 100 cum.

Materials -
Mistri (Head Mason) - 1/2 no. @Rs. 525.00 per day = Rs. 262.50
Mazdoor (Beldar) - 40 nos. @ Rs. 350.00 per day = Rs. 14000.00
Boy Coolie - 15 nos. @Rs. 330.00 per day = Rs. 4950.00
Sundries T. and P., etc. - Lump sum @Rs. 300.00 L.S. = Rs. 300.00
Total = Rs. 19512.50
Add 10% Contractor's profit = Rs. 1951.25
Grand Total = Rs. 21463.75
=21464.00

(II) White washing one coat unit 1 sq m. Take 100 sq m.

Particulars	Qntty or Nos.	Rate Rs. P.	Cost Rs. P.
Materials -			
White lime unslaked @ 2000.00 per q	10 kg	20.00 per kg	200.00
Glue powder	Lump sum	10.00 L.S.	10.00
Sand paper	Lump sum	10.00 L.S.	10.00
		Total =	220.00
Labour-			
White washer	2/3 no.	450.00 per day	300.00
Boy coolie	2/3 no.	330.00 per day	220.00
Sundries, T. and P., etc.	Lump sum	15.00 L.S.	15.00
		Total =	535.00
		Total of materials and labour	755.00
		Add 10% Contractor's profit...	75.50
		Grand Total =	830.50
		Rate per sq m-Rs.830.50/100=Rs.8.30	for 100 sq m

(III) White washing two coat unit 1 sq m. Take 100 sq m.

Materials-
White lime unslaked - 20 kg.
Glue powder ... L.S. Rs.15.00
Blue (pigment colour) ... L.S. Rs.15.00
10% profit....
Labour-
White washer - 1 no.
Boy coolie - 1 no.
Sundries, ladder, etc. - L.S. Rs.10.00
Rate per sq m = 1/100 of cost of 100 sq m.

(IV) White washing three coat unit 1 sq m. Take - 100 sq m.

Materials-
White lime unslaked - 30 kg.
Glue powder ... L.S. Rs.20.00
Blue (pigment colour) ... L.S. Rs. 18.00
10% profit.....

Labour-
White washer - 1 1/2 nos
Boy coolie - 1 1/2 nos.
Sundries, ladder, etc. - L.S. Rs.15.00
Rate per sq m = 1/100 of cost of 100 sq m.

Note. - (i) Requirement of lime 1 kg per 10 sq m. for each coat of white washing.
Note. - (ii) Blue pigment colour is added in the top finish coat only.

2. (I) Earthwork in Banking or in Excavation in Road or Canal Work in Layer of 20 cm including Ramming, Dressing, etc., up to 30 m lead and 1.5 m lift unit 100 cu m. Take — 100 cu m.
Materials –
Labour, etc.
Mate (Head man) - 1/2 no. - 500.00 per day – RS.250.00
Mazdoor (Beldar) - 16 nos. - 350.00 per day – Rs.5600.00
Boy or woman coolie - 16 nos.- 330.00 per day –Rs.5280.00
Dressing, Mazdoor (Beldar) - 12 no. - 350.00 per day – Rs.175.00
Sundries, T. and P, etc.
including repair and sharpening etc. - Lump sum - 250.00 L.S. - 250.00
Total of materials and labour... Rs.11555.00
Add 10% Contractor's profit...RS. 1155.50
Grand Total - Rs. 12710.00
Rate per % cum –Rs.12710.50 for 100 cu m

(II) Wood-work in Chaukhat or Frame -Wrought, Framed and Fixed -unit 1 cu m.
Sal wood work-
Take a frame or chaukhat of 200 * 120 cm door without sill of 8 * 12 cm section, of sal wood (Fig. 11-1).
Materials-
Timber 5.48 * 0.08x * 0.12 (L = 2 * 2.14 + 1 * 1.2 = 5.48) - 0.053 cu m.
Wastage 5% - 0.003 cu m
= 0.056 cu m - 40000.00 per cum - 2240.00
Labour, etc.
Mistri (Carpenter) - 1/16 no. – Rs.525.00 per day - 32.80
Carpenter - 3/4 no. - 500.00 per day – Rs.375.00
Coolie (Helper) - 1/2 no. - 330.00 per day - 165.00
Sundries, T. and P., etc. - Lump sum - 75.00 L.S. – RS.75.00
Total of labour – Rs.647.80
Total of materials and labour... Rs.2887.80
Add 10% Contractor's profit... Rs.288.78 **GRAND TOTAL** = Rs.3176.58