QUANTITY SURVEYING AND CONTRACT MANAGEMENT (17CV81)

Course Overview

Estimation estimates the probable cost of the structure before undertaking the project. Being a civil engineer it is compulsory to know the anticipated cost of the building and building components. In this subject students are going to study about the different methods to be adopted for the estimation and calculation of quantities of different items of the work involved in building. Along with the building components students also determine the quantities involved in earthen roads with different methods. Besides estimating, costing, and analysis of rates students also study about specifications of different items of works involved in civil engineering works. In this subject students will come to know the knowledge about how to prepare tender documentation and valuation of old and new building with proper solvency and depreciation

COURSE SYLLABUS

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 - Short wall and long wall method - centre line method. Estimate of R.C.C structures including Slab, beam, column, footings, with bar bending schedule.

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.

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.

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

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, Process and methods of valuation : Rent fixation, valuation for mortgage, valuation of land.

4. RECOMMENDED BOOKS

Text Book:

- B. N. Dutta, Estimating and Costing in Civil Engineering, 27th Revised Edition, New Delhi: UBS Publishers & Distributors Ltd.
- M. Chakraborti, Estimating, Costing, Specification & Valuation in Civil Engineering, Kolkatta.

Reference Books:

- D. D. Kohli, and R. C. Kohli, A Text Book of Estimating and Costing (Civil), S Chand Publishers.
- S.C. Rangwala, Estimating, Costing and Valuation, 15th Edition, Charotar Publishing House Pvt. Ltd.
- G. S. Biridi, Textbook of Estimating & Costing, Dhanpat Rai & Sons.
- U.K. Shrivastva, Construction Planning and Management, Galgotia Publications.
- P.S. Gahlot and B.M. Dhir, Construction Planning and Management, New Age Publishers.

Referred Indian Standards

- IS : 1200 (Part 1 to 28), Methods of Measurement of Building and Civil Engineering Works, Bureau of Indian Standards

MODULE 1

QUANTITY ESTIMATION FOR BUILDING

1.1 Estimation

Estimation is a process of calculating quantities and costs of various items required in connection with a work. It is prepared by calculating the quantities from the dimensions on the drawing for various items required to complete the project and multiplied by unit cost of the item concerned.

1.1.1 Purpose of estimation

- To assess the volume of work involved in the project.
- To arrange and organize material, manpower, equipment and tools-and-plant necessary for the project.
- To fix the project completion period.
- To ascertain the fund required for completing the purpose to work.
- To justify the investment from cost benefit ratio.
- To invite tenders and preparation of bill of quantities.
- To obtain necessary administrative approval, necessary technical sanction and arrangement and allocation of funds required for the project.
- For valuation of an existing property.

1.2 Quantity Surveyor

Quantity surveyor is a person who is responsible on estimating the quantities from the design drawings, and measurement of the quantities in the site during the project implementation, and preparing the current and final payments

1.2.1 Duties of quantity surveyor:

- Preparing bill of quantities (Taking off, squaring, Abstracting and billing)
- Preparing bills for part payments at intervals during the execution of work.
- Preparing bill of adjustment in the case of variations ordered during the execution of work
- Giving legal advice in case of court proceedings

1.2.2 Essential qualities of a good surveyor

- The quality surveyor must be well versed with the drawings of work.
- He should be able to read the drawing correctly and bill the quantities accurately

- He should have a thorough knowledge of the construction procedure to be adopted, the various items of works involved in the execution: and the different materials to be used in the work.
- He should be able to prepare schedule to be priced by tenderor.

1.3 Types of Estimation

There are five types of estimate:

a. Approximate Estimate
b. Detailed Estimate
c. Quantity Estimate
d. Revised Estimate
e. Supplementary Estimate

a. Approximate Estimate: This is also known as preliminary/rough estimate. This estimate is prepared to work-out an approximate cost of the project in a short period without going into details. This estimate is done for preliminary financial evaluation of different alternatives and for administrative sanctions.

b. Detailed Estimate: This estimate is prepared by working out the quantities of different items of work and then working out the cost by multiplying the quantities by their respective rates. In detailed estimate provisions for any other expenses like contingencies, T&P, work-charged establishment etc. are added to the above cost to calculate the total amount required for project completion.

c. Quantity Estimate: Quantity Estimate/Quantity Survey is a part of detailed estimate which list the quantities of all the items required to complete the project. These quantities are worked out from the drawings. The purpose of Quantity Estimation is to prepare bill of quantities.

d. Revised Estimate: It is a detailed estimate for the revised quantities or revised rates of items of work originally provided in the estimate without any deviation in original design and specifications approved for the project. It is required when the material cost or the material quantities deviates significantly (> 5%) from sanctioned value.

e. Supplementary Estimate: This estimate is worked out during progress of work due to any changes or addition of works to originally approved. A supplementary estimate is different from the revised estimate in the aspect that, the former is worked out for the works which are not present in the original design whereas the latter is worked out when there is a deviation of materials from original proposal.

f. Abstract Estimate: This is the third and final stage in a detailed estimate. The quantities and rates of each item of work, arrived in the first two stages, are now

entered in an abstract form. The total cost of each item of work is now calculated by multiplying the quantities and respective rates.

1.4 Data Required for Estimation:

To make an estimate following data are necessary: *i.e*. drawings, specifications and rates.

Drawings: For calculating quantities of various items for the work, various drawings like plan, profile, section and elevation are required.

Specifications: Specifications contains detailed descriptions of all workmanship, materials, and methods of preparation and execution for different items of the work.

Rates: The rates per unit of various items of work, the rates of various materials to be used in the construction, the wages for various categories of labors are required for cost estimate. Moreover the distance between location of work and source of materials and cost of transportation of materials are required for calculating cost of materials at work site.

1.5 Terminology

1.5.1. Taking off in quantity surveying:

This is the process of finding out the quantities for various items of works involved in a project by taking off various dimensions from the plan, sections of the drawings and tabulating in a measurement seat. The measurement sheet contains following columns like description, number, length, breadth, thickness/height and quantity.

1.5.2. Contingencies:

There are certain expenses which are incidental in nature and it is not possible to predict them with reasonable accuracy. To cater all such expenses an additional amount of 3% to 5% of estimated cost is provided in the total estimate.

1.5.3. Lump sum items:

These are small items, such as, front architectural or decoration work of a building, fire-place, site-cleaning and dressing, etc., for which detailed quantities cannot be taken out easily or it takes sufficient time to find the details. For such items a lump-sum rate is provided in the estimate.

1.5.4. Work charged establishment:

During the construction of a project considerable number of skilled supervisors, work assistance, watch men etc., are employed on temporary basis. The salaries of these persons are drawn from the L.S. amount allotted towards the work charged establishment.

That is, establishment which is charged directly to work. An L.S. amount of 1½ to 2% of the estimated cost is provided towards the work charged establishment.

1.5.5. Tools and plants (T&P):

Use of special type of tools and plants, like concrete mixture, batching plants or WMM plant, etc., may be required for efficient execution of large projects. To cater such expenses about 1% to 1.5% of the estimated cost is allotted under the head tools and plants (T&P).

1.5.6. Day work:

During execution of a project there may be certain type of works, for which the actual quantities of labor required is difficult to measure. For example fine architectural works, and drawings in the wall. The payments towards such items are made on the basis of actual number of days or actual quantity of materials required. Such works are known as day works.

1.5.7. Sub work:

A large project may consist of several independent small works. Such small works are known as sub work. For example setting of a university may contain the construction of administrative building, classrooms, faculty chambers, hostels and faculty residences. Estimations for each of the sub works are done separately and accounts of expenditure are kept sub work wise.

1.5.8. Deposit work:

The construction or repair works whose cost is not met through government funds but through some non-government sources is called deposited work. The cost is deposited in cash or placed at disposal of the divisional officer. The works executed for municipalities or other bodies fall under this category.

1.5.9. Provisional quantities:

During preparation of an estimate if it is apprehended that additional quantities against some items may be required due to variation of site conditions, then those quantities are estimated separately from the dimensions of the drawing and kept separately in the estimate under a heading Provisional Quantities.

1.5.10. Provisional sum:

While preparing the estimate some amount is provided in it for items whose details regarding cost or specifications are unknown during the preparation. For example the cost and specifications for a lift may be unknown during estimation for the building. Such amounts are known as provisional sum. However the payments for these provisional items are done as per actual rate.

1.5.11. Prime Cost:

Prime cost is the purchase cost of articles at a shop. Prime cost is generally referred to the supply of a particular article and not for carrying out a work. The prime cost includes the

cost for carriage but excludes the cost of fixing or fitting. For example: the door and window fittings are purchased from the shop at a cost of Rs 1000.00. The transportation cost is Rs.50.00 and the cost for fixing and fitting is Rs.100.00. Then the prime costs of the fittings are Rs. 1050.00.

1.5.12. Actual Cost:

The actual cost is the actual expenditure incurred in completing a work excluding profit but including other incidental, establishment and travelling charges. The actual cost is the cost incurred by the contractor to complete the project.

1.5.13. Capital Cost:

Capital cost is the actual amount incurred in completing a work. This includes expenditure incurred in surveying, designing, planning, drawing, cost of material, equipment, laborers, supervision, legal expenses, travel expenses, taxes, electricity and water charges, contingencies and any other expenses related to the work but excluding profit.

1.5.14. Work value:

This is the total amount provided for all scheduled items of work in the estimate. Thus work value is the estimated value for the work excluding the amount for contingencies, work charged establishment, tools and plants etc. as per actual rate.

1.5.15. Abstracting in quantity surveying:

In abstracting the works of a similar description are assembled, grouped and transferred from the measurement seat to a special rolled abstract paper where they are totaled and reduced to their specified unit of measurement.

1.5.16. Summary of estimated cost:

This is the summation of abstract of estimated costs for different sub-works involved in the project and is drawn up separately. Such a summary page is prepared when a project contains different sub-works.

1.5.17. General abstract of cost:

This is the summarization of abstract of costs of several individual items of sub-works or works as a whole, like: cost of land, earthwork, bridges, pavement, retaining wall, etc. required to complete a road project. The amount required for contingency, work charged establishment, T&P, maintenance are added on percentage basis to the general abstract of a cost.

1.5.18. Bill of quantities (BOQ):

This is defined as a list of brief descriptions and estimated quantities. This lists in a tabular form all the items of work involved in connection with estimate for a project with the description, corresponding quantity, unit rate and amounts column. The columns indicating unit rate and amounts are kept blank. BOQ is provided in a tender form for item rate tenders. Contractors' put up their own competitive rates and calculate the totals

to offer their estimate amount to complete the whole work. The BOQ is also required to calculate the quantities of different materials required for the project.

1.6 Principles of Measurements

1.6.1. Units of measurement

The units of measurements are mainly categorized for their nature, shape and size and for making payments to the contractor. The principle of units of measurements normally consists the following:

Measurement Type	Unit	Characteristics of Item	Example
Length	M.R	Works have specific length and width	As pipes
Area	M^2	Works with specific thickness,	as plastering, painting,
Volume	M^3	Variable dimensions	Footings, columns, stairs,
Lump-sum (L.S)	Lump-sum (L.S)	Works have details difficult to be calculated	Earth work, earthling system (electrical).
No.	No.	Works have 3 dim. fixed	Windows, doors,
Weight	Ton / kg	Have specific width	As steel
Time	Day / hrs	Labor / equipment	Workers' wages, equipment,

1.6.2. Rules for measurement

The rules for measurement of each item are invariably described in IS- 1200. However some of the general rules are listed below.

- Measurement shall be made for finished item of work and description of each item shall include materials, transport, labor, fabrication tools and plant and all types of overheads for finishing the work in required shape, size and specification.

- In booking, the order shall be in sequence of length, breadth and height or thickness.

- Same type of work under different conditions and nature shall be measured separately under separate items.

- All works shall be measured subject to the following tolerances.
  - Linear measurement shall be measured to the nearest 0.01m.
  - Areas shall be measured to the nearest 0.01 sq.m
  - Cubic contents shall be worked-out to the nearest 0.01 cum

- In concreting works any opening more than 0.1 m^2 (for items measured by area) or 0.1 m^3 (for items measured by volume) are deducted in the quantity calculation.

- The bill of quantities shall fully describe the materials, proportions, workmanships and accurately represent the work to be executed.

- In case of masonry (stone or brick) or structural concrete, the categories shall be measured separately and the heights shall be describe.

1.6.3. Measurement for common items of work

Item	Unit	Method of measurement
Measurements for earthwork		
Site leveling	Lump sum	It takes into consideration all site leveling including the excavation, fill, till reach 0+B.M according to design drawing.
Excavation (cut)	m^3	Measured by 2 methods : 1. Footing areas according to blinding area × depth of excavation according to drawings. 2. External dimensions of the building × depth of footings
Fill (backfill)	m^3	= Excavation – concrete work for footings and columns under ground level. = Ground plan × depth of ground beams – (concrete for ground beams and ground floors)
Concrete Work		
Blinding concrete, ground concrete, benching, and slabs concrete with fixed thickness	m^2	= Length × width (the thickness should be specified in the drawings and specifications) Ribs blocks don't subtract from the slabs concrete.

Item	Unit	Method of measurement
Footings, columns, ground beams, stairs, and canopies,	m^3	= length × width × thickness o Ground beams are measured from its connection with columns o Concrete stars include the stairs, steps, stair slabs, walls supporting the stairs.
Concrete decoration works as curves.	No.	The dimensions must be specified in the drawings.
Plastering and Painting work		
Plastering and Painting	m^2	= length × width o Engineering measurement after subtracting the openings, more than 0.1 m^2 o The area is measured above the skirting (terrazzo chips)
		Internal plastering = walls + slabs
Miscellanies Work		
Block works	m^2	= length × width (the thickness should be specified in the drawings and specifications) - Subtract all openings more than 0.1 cm^2 .
Terrazzo, marble, ceramic	m^2	= length × width (engineering measurement)
Doors/ Windows	No.	The exact dimensions should be specified in the design drawings. *Sometimes carpentry works measured in m^2 or m length according to the item described in BOQ.*
Electrical and sanitary pieces / accessories	No.	The dimensions should be specified clearly in the design drawings as the sockets, lamps, fluorescent lighting, etc. W.C., washing basins, sinks, manholes, pumps… etc.
piping	M.R	The dimension and details should be specified in the drawings, as (cables, pipes, etc.)
Works with special detail	Lumps sum	All details should be specified in the drawings, as earthing, gas network, etc.

1.7 Approximate Estimate

Approximate Estimate is made to find out an approximate cost in a short time and thus enable the administrative authorities to evaluate the financial aspects of various schemes and subsequently allows them to sanction them.

1.7.1. Importance

Approximate estimate is prepared with preliminary investigation and survey. It does not require detailed surveying design, drawing etc. It is basically done to evaluate feasibility of a project. If it is observed from approximate estimate that the cost of the project is very high then the project may be abandoned without preparing a detailed estimate. Thus the cost required for detailed surveying design or drawing required for preparation of detailed estimate is saved.

1.7.2. Purpose of approximate estimate

- Approximate estimate provides an idea about the cost of the project, which enables the authority to check the feasibility of the projects considering the funds available for the project.
- Approximate estimate does not require any detail investigation, design or drawing and hence saves both time and money.
- If several alternatives are available for the original works, a comparison is done from approximate estimate and the decision is made to select the project according to this comparison.
- Approximate estimate is required for getting the administrative approval for conducting detailed investigation, design and estimation.
- Approximate estimate for a property or project is required for insurances and tax scheduling.

1.8 Methods of Approximate Estimate

There are seven methods used for approximate estimate of the building.

- Plinth area or square meter method
- Cubic rate or cubic-meter method
- Approximate quantities with bill
- Service unit or Unit rate method
- Bay Method
- Cost comparison method
- Cost from materials and labor

1.8.1. Plinth area or square meter method:

This is prepared on the basis of plinth area of the building. The rate for unit plinth area is deducted from the cost of a building having similar specifications and dimensions in the locality. The plinth area is calculated for the covered area by taking external dimensions of the building at the floor level. Plinth area does not include the courtyard or any other open spaces.

1.8.2. Cubic rate or cubic-meter method:

In this method the cost is estimated by multiplying the cubical contents of the building (length × breadth × height) with the rate calculated in cubic meter which is deducted from a building having similar specifications and dimensions in the locality.

1.8.3. Approximate quantities with bill:

In this method the total length of walls is calculated from the plant. Length of different sections of the wall like foundation including plinth and super structure and area of wood work, flooring and roofing is calculated separately. These items are then multiplied by their cost per running meter length or area in sq. to obtain the total cost.

1.8.4. Service unit or Unit rate method:

In this method all costs of a unit quantity such as per km. (highway), per meter (bridge), per classroom (may be school or colleges), per bed (hospitals), per cubic meter (water tank) is calculated and multiplied with the cost per unit deducted from similar structures in the locality.

1.8.5. Bay Method:

The rate for one additional bay is calculated. Then the approximate estimated cost for the building is worked out by multiplying the number of bays in the proposed building with the cost of one such bay.

1.8.6. Cost comparison method:

When a number of dwellings of similar specification and dimensions are constructed as a part of a larger project for example staff quarters, the approximate estimates for all such dwellings can be estimated by multiplying the quantities of various items for a prototype structure with present market rates.

1.8.7. Cost from materials and labor:

Here approximate quantities of materials and labor per sq. of plinth area are calculated with some empirical equations or from past experience. This is then multiplied by total plinth area of the building to calculate the total quantity of materials and labor required

for the building. The total cost is calculated by multiplying these quantities with prevailing unit rate.

Practice question:

Q.1: Prepare approximate estimate of a building having Plinth Area of 1700 sqm using following data: Plinth Area Rate @ Rs. 7500/- per sqm; Contingencies @ 5%; Work Charged Estb @ 2%; Water Supply & Sanitary Arrangement @ 15% on cost of building; Electrification @ 8% on building cost; Architectural Fee @ 1.5% on cost of building.

1.9 Detailed Estimate:

Detailed estimate is prepared by working out the quantities of different items of work and then working out the cost by multiplying the quantities by their respective rates. The unit-quantity method is followed to prepare a detailed estimate where, the rates per unit work of one item including profit are estimated first and the total cost for the item is found, by multiplying the cost per unit of rate by the quantity of items. In detailed estimate provisions for any other expenses like contingencies, T&P, work-charged establishment etc. are added to the above cost to calculate the total amount required for project completion. The procedure for the preparation of a detailed estimate is divided into 2 parts:

a) Details of measurement and calculation of quantities
b) Abstract of estimated cost

1.9.1. Details of measurement and calculation of quantities

Representative measurements for dimensions of all individual items involved in the whole work are taken off from the drawing of the work and entered in respective columns of a standard measurement form as shown below. Then multiplying, item wise respective dimensions of the quantities of all items are worked out in the measurement form.

Details of measurement form:

Item No.	Description	Nos.	Length	Breadth	Height/ Depth	Quantity	Remark

1.9.2. Abstract of estimated cost

The cost of each item is calculated by multiplying the quintiles computed in the measurement form with a specific rate in a tabular form known as abstract form as shown below:

Abstract of estimate form

Item No.	Descriptions	Unit	Quantity	Rate	Amount

A percentage of 3% to 5% is added for contingencies, to allow for petty expenditures, unforeseen expenditures due to changes in design, changes in rate, etc. which may occur during execution of the work. Further, a percentage of 2.0% to 2.5% is also added to meet expenditure of the work charged establishment. For big projects an amount of 1% to 1.5% of the estimated cost is also provided to purchase special tools & plants for specific purpose.

The main functions of an abstract of estimate are as follows:

- The total estimated cost and the different items of works required to complete project can be known.
- Basis on which percentage rate tenders are called after excluding the amount for contingency and work-charged establishment.
- A part of tender document and a contractor can arrive at his own rates from the schedule of work described in the description column.
- This is the basis on which bills are prepared for payment.
- Comparative costs of different items of works can be known.

1.10 Data Required for Detailed Estimate

Following data are required for calculation of detailed estimate:

- **Drawing:** The quantities of various items are taken off from the drawings mainly: plans, sections, and other relevant details for the works.
- **Specifications:** The specification of the work describes the nature, class, workmanship, method of preparation etc. which are required to calculate the cost of various items.
- **Rates:** The rates for different items of work are derived from schedule of rates or from rate analysis. The estimated cost is calculated by multiplying the rates with the quantities of various items.
- **Standing circulars:** The taxes and insurance etc. prevailing at the locality of the work is required to fix up rates of various items.

1.11 Steps in Detailed Estimate

A detailed estimate can be analyzed in five distinct steps:

- Divide the whole project or work in various items.

- Divide the various items and group them under different sub heads.
- Enter the detailed of measurement of each item of work in measurements form and calculate the total quantity of each of them.
- After the quantities are taken off, the numbers, length, area or volumes are estimated and entered in last two columns of measurements sheet. All these values must be checked by different persons by tick-mark in other color ink. If any correction is done it must be cross checked.
- Finally, the cost under item of work is calculated from the quantities computed at workable rates. These costs along with rates are entered in '*Abstract Form'*. Therein, expenditures towards contingencies, work charge establishment and tools and plants are added to the estimated cost and then totaled. This grand total gives the estimated cost of work.

1.12 Factors Affecting the Cost of a Project

- **Quantity of materials:** For a large project, the quantity of materials required is large and thus it can be procured at a lower price.
- **Availability of materials:** The cost of materials, which are easily available, is comparatively lower.
- **Transportation of materials:** The cost of transportation is added to the cost of the material at site. Thus more is the transportation cost; the more is the cost of material.
- **Location of Site:** If the site is located at an odd place for which loading, unloading, staking and restacking of materials are necessary for several times. Thus, apart from cost incurred by such operations the possibility of damage or loss in transit is more which affects the cost.
- **Labor charges:** The skill and daily wage of the local labor affects the rate of a item.

1.13 Documents Accompanying Detailed Estimate

The detailed estimate is generally accompanied by following supporting documents:

a. Report on the design
b. Specifications
c. Working drawing (Plans, section, elevation and other details)
d. Design charts and calculations
e. Particulars of scheduled rates or rate analysis

ESTIMATION OF BUILDING

1.1. Building Estimate:

The quantities like earth work, foundation concrete, brickwork in plinth and super structure etc., can be workout by any of following three methods:

a. Long wall - short wall method
b. Centre line method.
c. Partly center line and partly cross wall method

1.3.1. Long wall-short wall method

In this method, the wall along the length of room is considered to be long wall while the wall perpendicular to long wall is said to be short wall. To get the measurement of materials and works length of long wall or short wall, calculate first the center line lengths of individual walls. Then the length of long wall, (out to out) may be calculated after adding half breadth at each end to its center line length. Thus the length of short wall measured into in and may be found by deducting half breadth from its center line length at each end. The length of long wall usually decreases from earth work to brick work.in super structure while the short wall increases. These lengths are multiplied by breadth and depth to get quantities.

1.3.2. Center line method

This method is suitable for walls of similar cross sections. Here the total center line length is multiplied by breadth and depth of respective item to get the total quantity at a time. When cross walls or partitions or verandah walls join with main all, the center line length gets reduced by half of breadth for each junction. Such junction or joints are studied carefully while calculating total center line length. The estimates prepared by this method are most accurate and quick.

1.3.3. Partly center line and partly cross wall method

This method is adopted when external (*i.e.,* around the building) wall is of one thickness and the internal walls having different thicknesses. In such cases, center line method is applied to external walls and long wall-short wall method is used to internal walls. This method suits for different thicknesses walls and different level of foundations. Because of this reason, all Engineering departments are practicing this method.

1.2. Main items in building work:

Main items of work are given below:

Sl. No.	Particulars	Unit	Remarks
1	Earthwork	Cum	Earthwork in excavation and in filling should be taken out separately under different types. Foundation trenches are usually dug to the exact width of foundation with vertical sides.
2	Bed concrete in foundation	Cum	It is calculated by taking length, breadth and thickness of concrete bed.
3	Soiling	sqm	When the soil is soft, one layer of brick or stone is laid below the bed concrete.
4	Damp proof course	Cum	It is a course provided at the plinth level under the wall for the full width of plinth wall. It is not provided at the sill of door and verandah openings for which deduction is made which calculating length of D.P.C.
5	Masonry		Masonry for foundation and plinth is taken under one item and masonry for superstructure is taken under separate item. In case of wall footing, masonry for steps is calculated separately and added together. In buildings having more one floor, the masonry for superstructure for each floor is computed separately. Deductions for openings like lintels, doors, windows, cupboards, etc. is done. Thin partition walls of thickness less than 10 cm, honeycomb brickwork is taken under separate item in square meter and no deduction for holes is done.
6	R. C. C. works	Cum	R.C.C. Work is calculated for beams, lintels, columns, footing, slabs etc. No deduction for steel is done while calculating the quantity of concrete, which includes centering, shuttering and fixing of reinforcement in position. Reinforcement (quantity of steel) is taken under separate item.
7	Reinforcement	Ton	The reinforcement quantity is taken off from detail drawing and bar bending schedule. If detail drawings are not available 0.8 to 3% of concrete may be taken by volumes as a quantity of steel which is further multiplied by density.

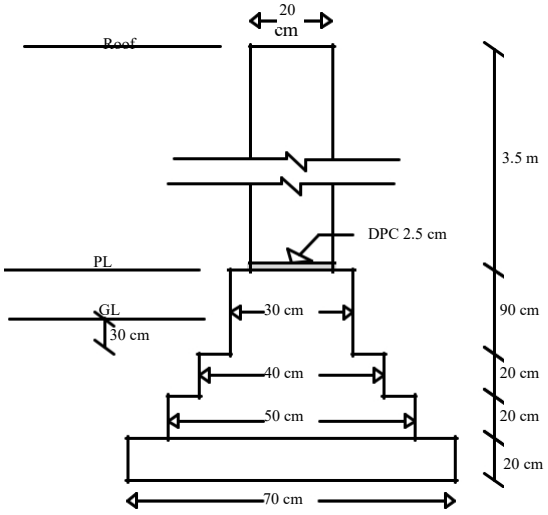
8	Flooring	Sqm/ Cum	For grounds floor, cement concrete and floor finishing of stone, marble or mosaic tiles taken under one item and quantity is calculated in square meter. For upper floors, bed of R.C.C. is taken cubic meter and other member is calculated in cubic meter.
9	Roof	Cum/ Sqm	In case of roof, flat roofs are calculated in cubic meter like slab and for pitched roof. Quantity of trusses and other members is calculated in cubic meter. In case of roofing material tiles, G.I. sheets or A.C. sheets are measured in square meter. Tiles on hip and valley are measured running meter.
10	Plastering and pointing	Sqm	Plastering is expressed with specified thickness. For masonry the measurements are taken for whole face of wall for both sides as solid and deduction for openings are made. External and internal plastering for building are taken out separately, under different items.
11	Doors and Windows	Cum/ Squm	It consists of frame and shutter. Doors and windows framers are calculated in cubic meter. Quantity is obtained by calculating length including jamb, head and sill and multiplied by cross-section of frame. Doors and window shutters are calculated in square meter. Shutter of different types should be taken separately because the rates differ. Hold-fast are taken as a separate item.
12	Painting, Varnishing, white washing and distempering	Sqm	-
13	Electrification	LS	Generally 8% of estimated cost of building works is taken for this item.
14	Sanitary and water supply works	LS	Generally 8% of estimated cost of building works is taken for this item.

1.3. Example 1: (Quantity estimation of a symmetrical wall)

The plan and cross section of a wall is given in Fig. 2.1. Estimate the quantities of following items per meter length of the wall.

a. *Earthwork in excavation in foundation trench*
b. *Lime concrete in foundation*
c. *First class brick work in 1:4 mortar mix in foundation and plinth*
d. *1st class brick work in superstructure wall*

e. 2.5 cm thick DPC (1:2:4) with water proofing compound



(Fig. 2.1)

Answer

(i) Earthwork in excavation (Length × Breadth × Height) = 1 × 0.7 × 0.9 = 0.63 cum

(ii) Lime concrete in foundation (L × B × H) = 1 × 0.7 × 0.2 = 0.14 cum

(iii) 1st class brickwork in foundation and plinth:

i. 1st footing (L × B × H) = 1 × 0.5 × 0.2 = 0.10 cum

ii. 2nd footing (L × B × H) = 1 × 0.4 × 0.2 = 0.08 cum

iii. Plinth wall (L × B × H) = 1 × 0.3 × 0.9 = 0.27 cum

Total = 0.45 cum

(iv) 1st class brickwork in superstructure (L × B × H) = 1 × 0.2 × 3.5 = 0.70 cum

(v) 2.5 cm thick DPC (L × B) = 1 × 0.2 = 0.20 sqm

Quantities can be estimated as above. But to denote the respective length, breadth and height against the dimensions estimates are prepared after ruling out measurement sheets as below.

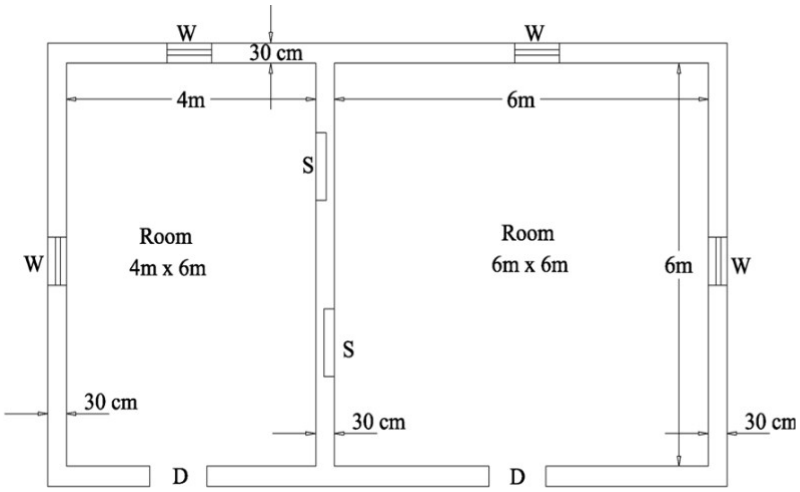
Detail Measurement and Calculation of Quantities

Item No	Description	Unit	No.	L	B	H	Quantity
1	Earthwork in excavation	cum	1	1	0.7	0.9	0.63
2	Lime concrete in foundation	cum	1	1	0.7	0.2	0.14
3	1st class brickwork (1:4) in foundation and plinth	cum					
	1st footing		1	1	0.5	0.2	0.10
	2nd footing		1	1	0.4	0.2	0.08
	Plinth wall		1	1	0.3	0.9	0.27
		Total =					0.45
4	1st class brickwork in superstructure	cum	1	1	0.2	3.5	0.70
5	2.5 cm thick DPC	sqm	1	1	0.2	-	0.20

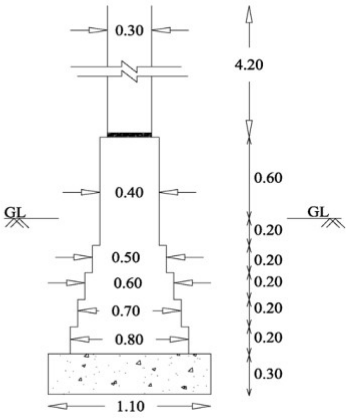
1.4. Example on long wall - short wall method

Estimate the quantities of following items of a two roomed building given in Fig 2.2.

a. *Earthwork in excavation in foundation trench*
b. *Lime concrete in foundation*
c. *First class brick work in 1:6 cement mortar in foundation and plinth*
d. *2.5 cm thick DPC (1:2:4) with water proofing compound*
e. *1st class brick work in cement mortar superstructure*



(a) Plan



(b) Details of footing

(Fig. 2.2)

The dimensions of doors, windows and selves are

Door D = 1.20 m × 2.10 m.
Windows W = 1.00 m × 1.50 m
Shelves S = 1.00 m × 1.50 m

Answer: Given in next page

Detail Measurement and Calculation of Quantities

Item No.	Description	Unit	No.	L	B	H	Quantity	Explanation
1	Earthwork in excavation in foundation	cum						Long wall, c/c. length
	Long wall		2	11.70	1.10	1.00	25.74	L = 10.60+1.10=11.70
	Short wall		3	5.20	1.10	1.00	17.16	L=6.30-1.10=5.20m
						Total =	42.90	
2	Lime concrete in foundation	cum						Length same for excavation
	Long wall		2	11.70	1.10	0.30	7.72	
	Short wall		3	5.20	1.10	0.30	5.15	
						Total =	12.87	
3	First class Brickwork in 1:6 cement mortar in foundation and plinth	cum						
	Long wall							
	1st footing		2	11.40	0.80	0.20	3.65	L=10.60+.80=11.40m
	2nd footing		2	11.30	0.70	0.10	1.58	L=10.60+.70=11.30m
	3rd footing		2	11.20	0.60	0.10	1.34	L=10.60+.60=11.20m
	4th footing		2	11.10	0.50	0.10	1.11	L=10.60+.50=11.10m
	Plinth wall above footing		2	11.00	0.40	0.80	7.04	L=10.60+.40=11.00m
	Short wall							
	1st footing		3	5.50	0.80	0.20	2.64	L=6.30-.80=5.50m
	2nd footing		3	5.60	0.70	0.10	1.18	L=6.30-.70=5.60m
	3rd footing		3	5.70	0.60	0.10	1.03	L=6.30-.60=5.70m
	4th footing		3	5.80	0.50	0.10	0.87	L=6.30-.50=5.80m
	Plinth wall above footing		3	5.90	0.40	0.80	5.66	L=6.30-.40=5.90m
						Total =	26.10	

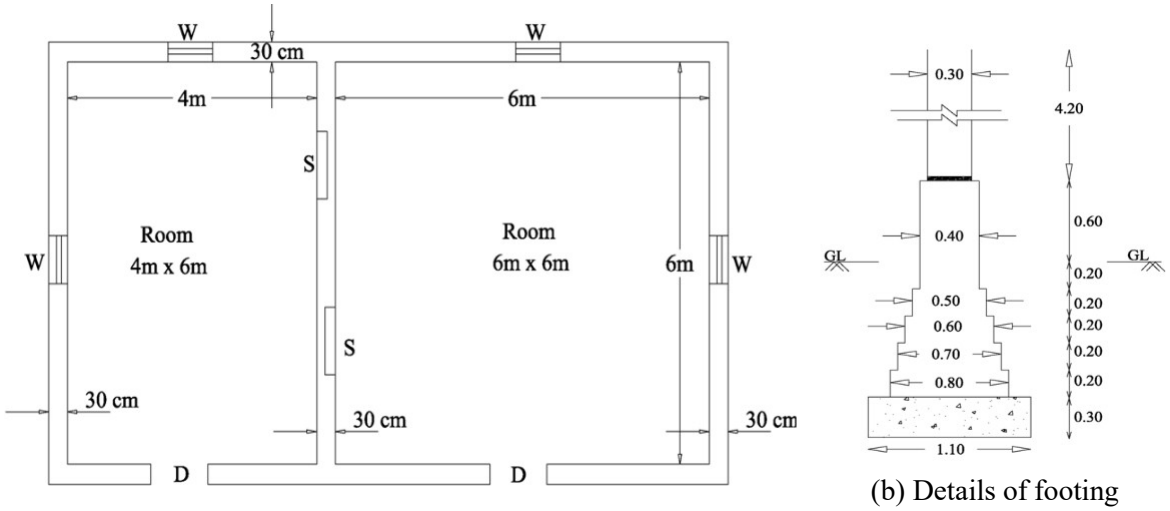
Detail Measurement and Calculation of Quantities

Item No.	Description	Unit	No.	L	B	H	Quantity	Explanation
4	2.5 mm thick DPC	sqm						
	Long Walls		2	11.00	0.40	--	8.80	L=10.60+.40=11.00m
	Short wall		3	5.90	0.40	--	7.08	L=6.30-.40=5.90m
	Deduct door sills		(-) 2	1.20	0.40	--	(-) 0.96	
						Total =	14.92	
5	1st class brick work in lime mortar in superstructure	cum						
	Long Walls		2	10.90	0.30	4.20	22.47	L=10.60+.30=10.90m
	Short wall		3	6.00	0.30	4.20	22.68	L=6.30-.30=6.00m
	Deduct for door opening		(-) 2	1.20	0.30	2.10	(-) 1.51	
	Deduct for windows opening		(-) 4	1.00	0.30	1.50	(-) 1.80	
	Deduct for shelves		(-) 2	1.00	0.20	1.50	(-) 0.60	Back of shelves 10 cm thick wall
	Deductions for lintel over doors		(-) 2	1.50	0.30	0.15	(-) 0.14	Bearing 15 cm
	Deductions for lintel over windows		(-) 4	1.30	0.30	0.15	(-) 0.23	Bearing 15 cm
	Deductions for lintel over shelves		(-) 2	1.30	0.30	0.15	(-) 0.12	Bearing 15 cm
						Total =	45.75	

1.5. Example on center line method

Estimate the quantities of following items of a two roomed building given in Fig 2.3.

a. *Earthwork in excavation in foundation trench*
b. *Lime concrete in foundation*
c. *First class brick work in 1:6 cement mortar in foundation and plinth*
d. *2.5 cm thick DPC (1:2:4) with water proofing compound*
e. *1st class brick work in cement mortar superstructure*



(a) Plan

(b) Details of footing

(Fig. 2.3)

The dimensions of doors, windows and selves are

Door D = 1.20 m × 2.10 m.
Windows W = 1.00 m × 1.50 m
Shelves S = 1.00 m × 1.50 m

Ans:

Total center length of the wall = 2 × c/c of long wall + 3 × c/c of short wall
= 2 × 10.60 m + 3 × 6.30 m = 40.10 m

It may be noted that, the above length includes some over lapped portions at the joints and these excess quantities shall have to be deducted. This is accomplished by reducing the center length by half breadth for each junction. The same principle applies to foundation concrete, to footings, plinth wall and superstructure wall. At every stage deduction of half breadth of the main wall at that particular level shall have to be made per junction from the total Centre length, and this net Centre length after deduction shall be multiplied by the respective breadth and height or depth to get quantities.

Detail Measurement and Calculation of Quantities

Item No.	Description	Unit	No.	L	B	H	Quantity	Explanation
1	Earthwork in excavation in foundation	cum	1	39.00	1.10	1.00	42.90	() ——
2	Lime concrete in foundation	cum	1	39.00	1.10	0.30	12.87	Length same for excavation
3	First class Brickwork in 1:6 cement mortar in foundation and plinth	cum						
	1st footing		1	39.30	0.80	0.20	6.29	—
	2nd footing		1	39.40	0.80	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	

Detail Measurement and Calculation of Quantities

Item No.	Description	Unit	No.	L	B	H	Quantity	Explanation
4	2.5 mm thick DPC	sqm	1	39.70	0.40	--	15.88	—
	Deduct door sills		(-) 2	1.20	0.40	--	(-) 0.96	
						Total =	14.92	
5	1st class brick work in lime mortar in superstructure	cum	1	39.80	0.30	4.20	50.15	—
	Deduct for door opening		(-) 2	1.20	0.30	2.10	(-) 1.51	
	Deduct for windows opening		(-) 4	1.00	0.30	1.50	(-) 1.80	
	Deduct for shelves		(-) 2	1.00	0.20	1.50	(-) 0.60	Back of shelves 10 cm thick wall
	Deductions for lintel over doors		(-) 2	1.50	0.30	0.15	(-) 0.14	Bearing 15 cm
	Deductions for lintel over windows		(-) 4	1.30	0.30	0.15	(-) 0.23	Bearing 15 cm
	Deductions for lintel over shelves		(-) 2	1.30	0.30	0.15	(-) 0.12	Bearing 15 cm
						Total =	45.75	

REINFORCEMENT QUANTITY ESTIMATION

1.1 Reinforcement

In RCC works, steel reinforcement may be used in the form of (a) plain round steel bars, (b)deformed bars, (c) cold twisted bars and (d) hot drawn steel tendons (in pre-stressed concrete structures) and the estimation of quantities for each type should be done separately.Accurate quantities of steel works can be calculated from the detail reinforcement drawings. However, if working drawings and schedules for the reinforcement are not available it is necessary to provide an estimate of the anticipated quantities which generally is estimated in accordance with the requirements of the standard method of measurement of building works.

The reinforcement quantities can be estimated by two methods:

(i) Approximate method, and

(ii) Estimation from bar bending schedule

1.2 Approximate method

There are two approximate methods for estimation of steel quantities. The crudest method is based on the cubical content of the structure and type. Typical values are:

- For warehouses and similarly loaded structures: 1 ton per 10.5 m3 of structure
- For offices, shops, hotels: 1 ton per 13.5 m3 of structure
- For residential, schools, temples: 1 ton per 15.05 m3 of structure

The second approximate method is by estimating the cubical content of various members of the structure. Following table (Table 3.1) gives the estimated quantities of reinforcement and its size generally used for various building works. The volume of various reinforced concrete members such as footings, beams, columns, slabs, lintels etc. are estimated first. Then the approximate quantities of reinforcement can be calculated by multiplying this volume with the approximate reinforcement required by the member.

Table 1.1 (Approximate reinforcement quantity required for various concrete members)

Sl. No	RCC Member	Quantity in kg/m^3	Size of reinforcement required
01	Column footings	**75**	10mm or 12mm 12mm, 16mm – 85%
02	Grade beams	**100**	Stirrups – 6mm or 8mm– 15% 8mm diameter – 85%,
03	Plinth beams	**125**	Stirrups 6mm – 15% 16mm, 20mm and 25mm – 90%
04	Columns	**225**	Ties – 6mm or 8mm – 10% 12mm, 16mm dia – 85%
05	Lintel beam	**125**	Stirrups – 6 mm or 8mm – 15% 8mm dia – 75%
06	Sunshades	**60**	Distributer – 6mm – 25%
07	Canopy slab up to 2.0 m span	**125**	10mm dia – 80% 125 Distributor bars – 6mm or 8mm – 20%
08	Staircase waist slab	**150**	12 or 16mm dia – 80% Distributor 8mm dia – 15%
09	Roof slab a) One way slab b) Two way slab c) Square slab (4m to 6m size)	 **80** **100** **150**	 8mm dia – 70% Distributor – 6mm – 30% 8mm dia – 100% 10 – 12mm dia – 100%
10	Main beams above 6m	**250**	20mm, 16mm, 12mm – 80 – 85% Stirrups – 8mm – 15 – 20%

1.3 Reinforcement quantity estimation from bar bending schedule

Bar bending schedule (or schedule of bars) is a list of reinforcement bars, vis-à-vis, a given RCC work item, and is presented in a tabular form for easy visual reference. This table summarizes all the needed particulars of bars – diameter, shape of bending, length of each bent and straight portions, angles of bending, total length of each bar, and number of each type of bar. This information is a great help in preparing an estimate of quantities as the weight of each reinforcement type can be estimated by directly multiplying the length and number of each bar type with its the per meter weight. This method has the advantages that:

• The sketches are representative of the actual structure

• The sketches include the intended form of detailing and distribution of main and secondary reinforcement

• An allowance of additional steel for variations and holes may be made by inspection.

Table 1.2 (Additional length of bent up bars)

Sl. No.	θ°	$\frac{D}{\sin\theta}$	$\frac{D}{\tan\theta}$	Additional Length of Bent-up Bar, l_a
1	30°	$\frac{D}{0.5}$	$\frac{D}{0.5733}$	**0.27 *D***
2	45°	$\frac{D}{0.707}$	$\frac{D}{1.0}$	0.414 *D* ≈ **0.42 *D*** (0.42 *D* is generally the value that is adopted)
3	60°	$\frac{D}{0.866}$	$\frac{D}{1.732}$	0.577 *D* ≈ **0.58 *D*** (0.58 *D* is usually adopted)

Table 1.3 (Typical Bar Bending Schedule)

Sl. No.	Details of Bar Shape	Length of Hooks	Total Length of Bar
1.	Diameter, 4d, [Straight bar], 4d, l	2[9d] = 18 d (both hooks together)	[l + 18 d]
2.	[Bent-up at one end only]], $x = \frac{l}{4}$ to $\frac{l}{6}$, D, 45°, x, l, D = Vertical distance (C/C) between bars	2[9d] = 18d (both hooks together)	[l + 18 d + 0.42 D]
3.	(Double bent-up bar) $x = \left(\frac{1}{4} \text{ to } \frac{1}{6}\right) l$, l, D, 45°, 45°, x, x	2[9d] = 18d (as for above cases)	[l + 18 d + 2 × 0.42 D]
4.	(Overlap of bars), 40 d to 45 d, (Joint)	2[9d] = 18d	Overlap length at joint = [(40 d to 45 d) + 18 d]
5.	l_1, l_2	[Here, one hooks height = 14d] 2 × (14d) = 28 d	[$l_1 + 2l_2$ + 28 d]
6.	l_1, l_2	2(12d) = 24 d	[$2(l_1 + l_2)$ + 24 d]

1.4 Calculation for weight of reinforcement

The density of steel bars may be taken as 7850 kg/m^3. Thus the weight for mm of diameter steel bar of unit length is kg/m.

Table 1.4 provides the weight per running meter for common tor steel bars.

Diameter (mm)	Sectional area (mm^2)	Weight (kg/meter length)
5	20.00	0.16
6	28.30	0.22
8	50.30	0.39
10	78.60	0.62
12	113	0.89
16	201	1.58
20	314	2.47
22	380	2.98
25	491	3.85
28	616	4.83
32	804	6.31
36	1118	7.99
40	1257	9.86
45	1590	12.49

1.5 Example on reinforcement quantity estimation

Prepare a bar bending schedule for a RCC beam of 4 m. clear span, 300 mm width and 450mm depth. It consists of hanger bars, main longitudinal bars and bent up bars at the bottom as shown in Fig. 3.2. Stirrups at a spacing of 180 mm c/c are provided though out the length of the beam. The clear cover to the reinforcement is 40 mm.

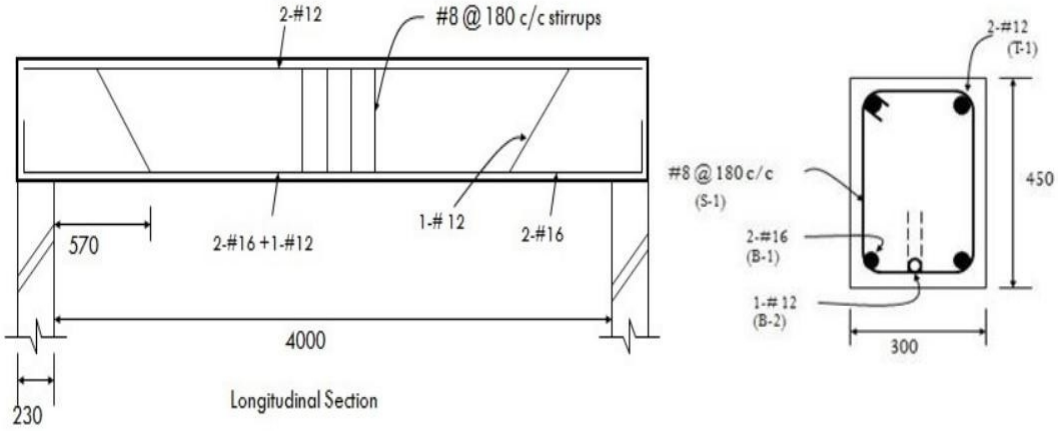


Fig: 1.1 (Reinforcement Details for the RCC beam)

Answer:

The first step in bar bending schedule is to calculate the length of various reinforcement types.

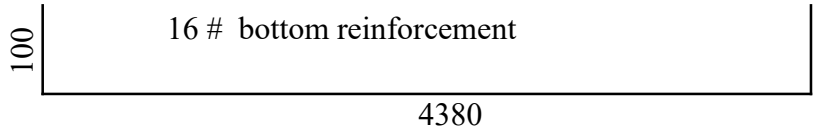
(i) Calculation for 16 # bottom reinforcement (T1)

The length for this T1 type reinforcement will be:

Length of T1 = clear span of the beam + 2 × support width – 2 × clear cover to reinforcement + 2 × bond length.

As per IS: 1786-1961, minimum bond length required . Where, is the diameter of the reinforcement. Thus, for present example, the bond length is 6×16 = 96 mm or 100 mm (say).

The length of T1 = 4000 + 2×230 - 2×40+2×100 = 4580 mm



Details of T1 type reinforcement

(ii) Calculation for 12 # bent up bars (T2)

Length of T2

L = clear span of the beam + 2 × support width – 2 × clear cover to reinforcement

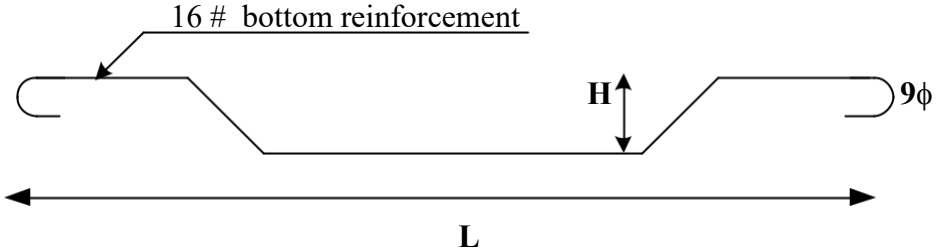
= 4000 + 2× 230 – 2 × 40 = 4380 mm

Or, H = 450 – 2 × 40 - 2 × 8 - 2 × (12/2) = 342 mm.
= 141.6 mm = 142 mm.

Length of hooks = 9 × 12 = 108 mm

Thus, the Length of T2 ,

= 4380 + 2 × 142 + 2 × 108 = 4880 mm



Details of T2 type reinforcement

(iii) Calculation for 12 # hanger bars (T3)

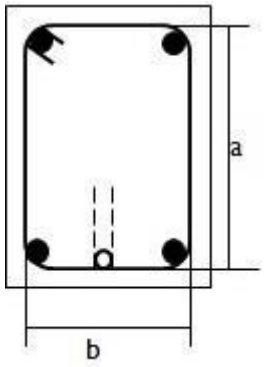
Length of T3 = clear span of the beam + 2 × support width – 2 × clear cover to reinforcement + 2 × .

Length of T3 = 4000 + 2 × 230 – 2 × 40 + 2 × = 4596 mm

4380

Details of T3 type reinforcement

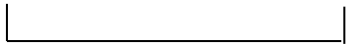
(iv) Calculation for 8 # stirrups (T4)



Details of stirrups (T4)

The spacing between two stirrups is 180 mm center to center. Thus the number of stirrups will be required is:

Bar Bending Schedule for RCC Beam

Bar Type	Shape	Numbers	Length	Diameter	Unit Weight (kg)	Total Weight (kg)
T1		2	4580	16	1.58	**14.47**
T2		1	4880	12	0.89	**4.34**
T3		2	4596	12	0.89	**8.18**
T4		24	1340	8	0.39	**12.54**
					Total =	**39.53**

MODULE 2

ESTIMATION OF STRUCTURES

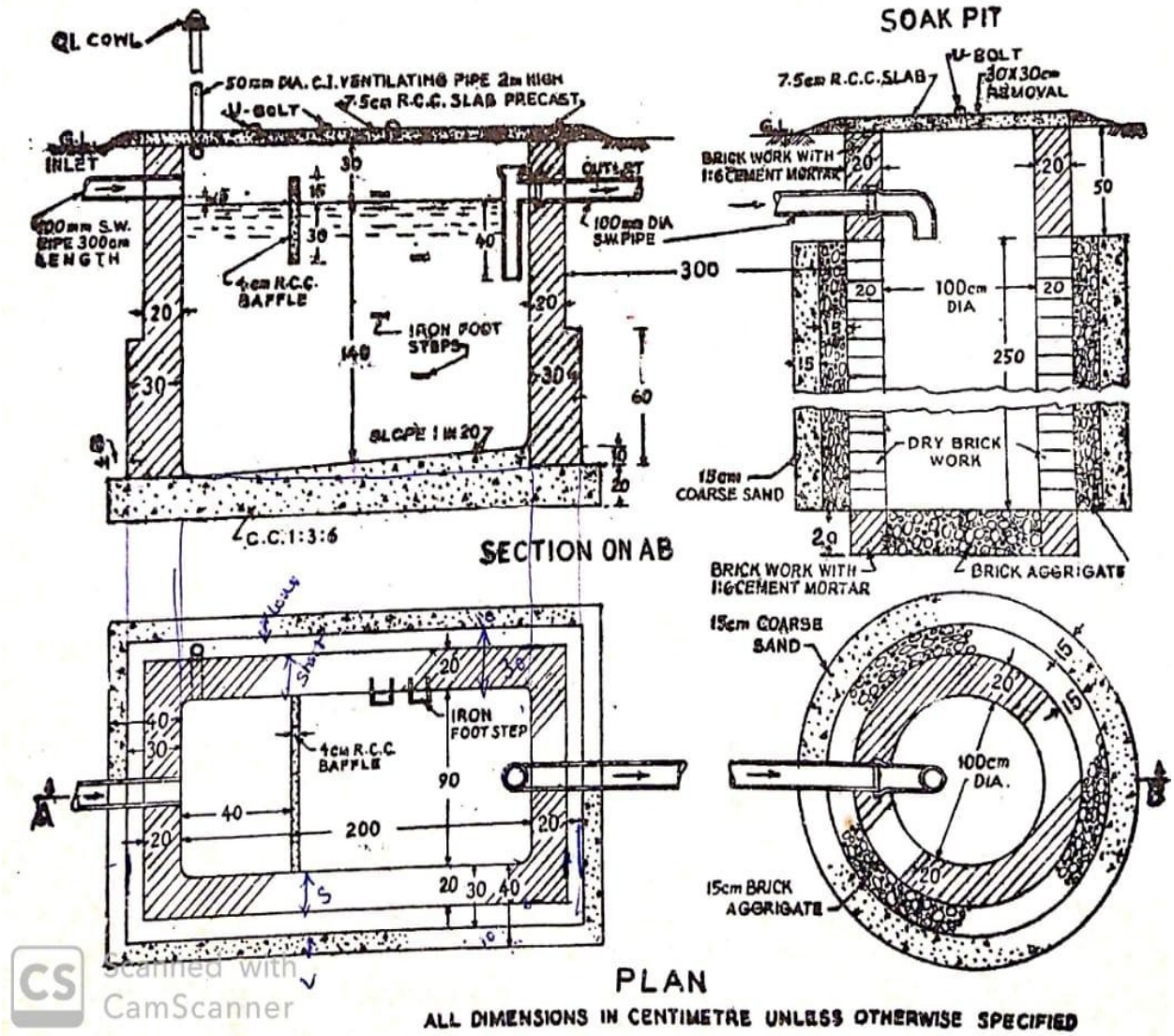
2.1 ESTIMATION OF SEPTIC TANK

ESTIMATE OF SEPTIC TANK FOR 25 USERS

Example 1.—Prepare a detailed estimate of a Septic tank with Soak-pit for users from the given drawings, Fig. 10-1.

Septic tank shall be of first class brickwork in 1 : 4 cement mortar the foundation and floor shall be of 1 : 3 : 6 cement concrete. Inside of septic tank shall be finished with 12 mm cement plaster and floor shall be finished with 20 mm cement plaster with 1 : 3 mortar mixed with standard water proofing compound. Upper and lower portion of soak-pit shall be of second class brickwork in 1 : 6 cement mortar and middle portion shall be of dry brickwork. Roof covering slabs and baffle wall shall be of precast R. C. C. The length of the connecting pipe from latrine seat may be taken as 3 metre. Assume suitable rates.

SEPTIC TANK FOR 25 USERS



2.2 SOLUTION FOR ESTIMATION OF SEPTIC TANK WITH SOAK PIT

Item no	Description	NO	Length 'm'	Breadth 'm'	Depth 'm'	Quantity	Remarks
1	Earthwork in Excavation					9.28	D = 1.40+0.30+0.20+0.05 = 1.95m
	Septic tank	1	2.8	1.7	1.95	9.28	
	Soak-pit up to 3.00m depth	1	$\frac{\pi d^2}{4} = \frac{\pi \times 2^2}{4}$	×	3	9.42	
	Soak pit lower portion	1	$\frac{\pi \times 1.4^2}{4}$	×	0.2	0.30	Below dry brickwork
						19.00m³	
2	Cement concrete - 1:3:6 Floor & Foundation	1	2.80	1.70	0.20	0.95	
	Sloping floor	1	2.00	0.90	0.05	0.09	Avg thickness = $\frac{10+0}{2}$ = 5cm
						1.04m³	
3	First class brickwork in 1:4 CM in Septic tank						
	long walls - 1st step	2	2.60	0.30	0.60	0.94	
	2nd step	2	2.40	0.2	1.15	1.10	D = 1.40-0.60+0.30+0.05 = 1.15m
	Short walls						
	1st step	2	0.90	0.30	0.60	0.32	
	2nd step	2	0.90	0.20	1.15	0.42	
						2.78 m³	
4	2nd Class brickwork in 1:6 CM in Soak pit		πd				
	Upper portion	1	$\pi \times 1.2$	× 0.20	0.50	0.38	mean circumference
	lower portion	1	$\pi \times 1.2$	× 0.20	0.20	0.15	
						0.53 m³	
5	2nd class dry brickwork in soak pit	1	$\pi \times 1.2$	0.20	2.50	1.88 m³	

2.3 ESTIMATION OF MANHOLE

ESTIMATE OF A MANHOLE

Example 4.—Prepare a detailed estimate of a Manhole from the given drawings (Fig. 6-4) and general specifications.

General Specifications—Foundation and floor concrete shall be of 1 : 3 : 6 cement concrete with brick ballast. Brickwork shall be of first class in 1 : 4 cement mortar and inner faces of wall shall be pointed with 1 : 2 cement mortar. Inside channels and benching floor shall be finished with 20 mm thick plastering with 1 : 3 cement mortar.

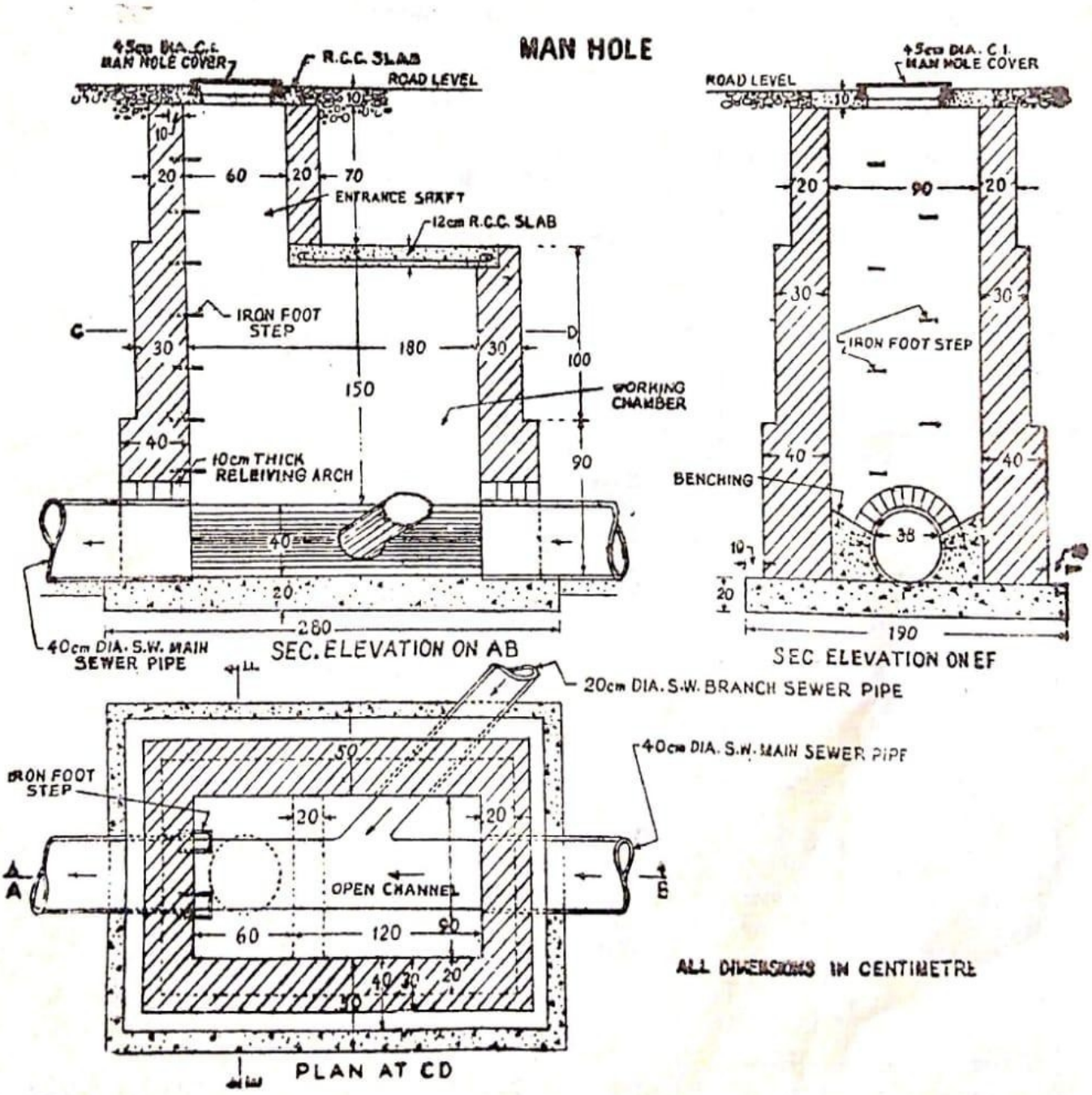


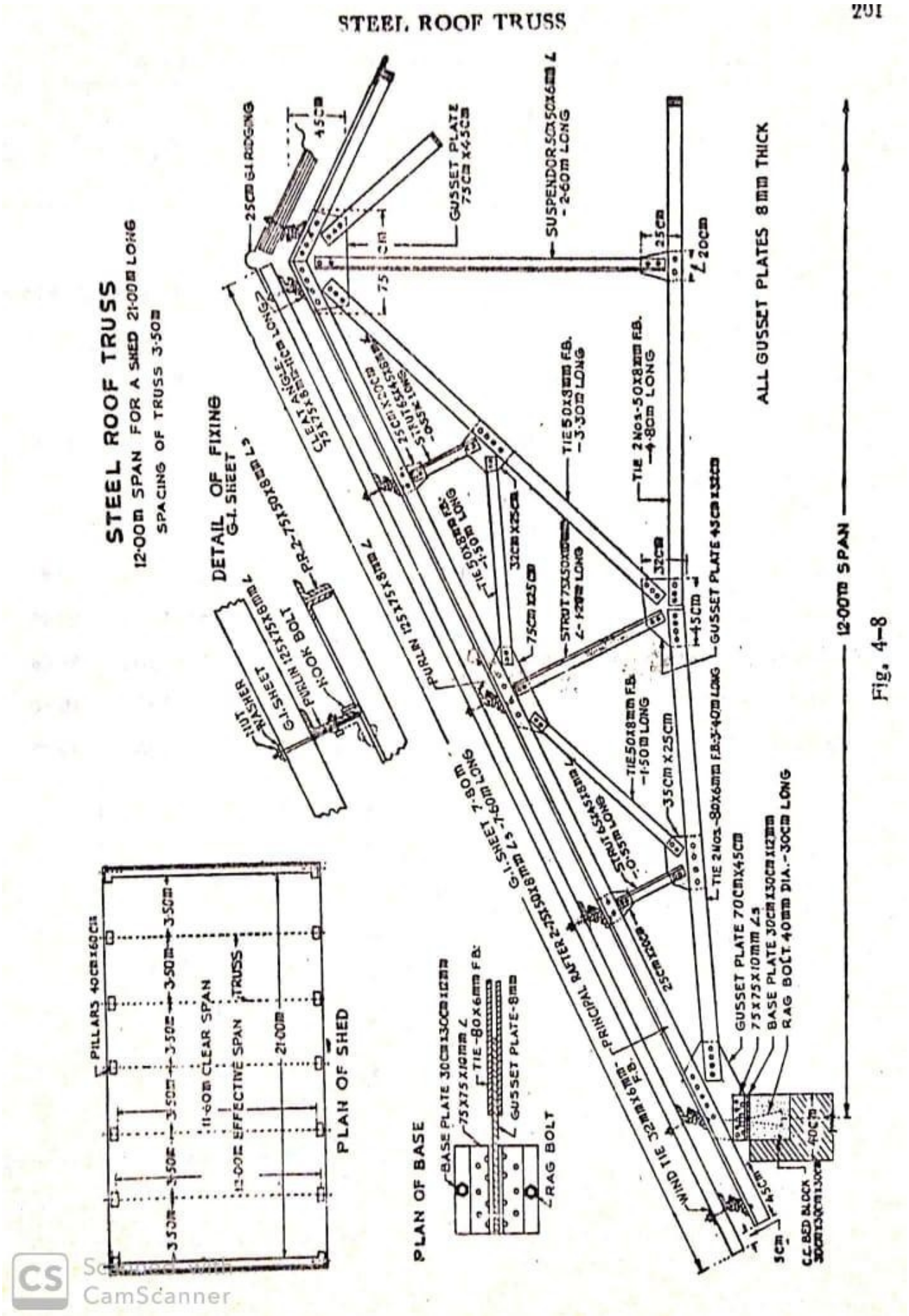
Fig. 6-4

2.4 SOLUTION FOR ESTIMATION OF MANHOLE

DETAILS OF MEASUREMENT AND CALCULATION OF QUANTITIES (Ex. 4)

Item No.	Particulars of items	No.	Length m	Breadth m	Ht. or Depth m	Quantity	Explanatory notes
1	Earthwork in excavation ...		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	
	Deduct—						
	Upper portion of main channel ...	1	1·80	·90+·33	0·15	0·17	
	Upper portion of branch channel ...	1	0·30	0·20	0·15	0·01	
			Total	of 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	1·88	No deduction for pipes
	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	L=60+20+20 =100 cm
	Short walls 1st step ...	2	0·90	0·40	0·90	0·65	
	Short walls 2nd step ...	2	0·90	0·30	1·00	0·54	
	Short walls 3rd step ...	2	0·90	0·20	0·70	0 25	
					Total	5·04 cu m	
4	Cement pointing 1 : 2—						
	Long walls up to slab ...	2	1·80	—	1·50	5·40	
	Short walls up to slab ...	2	0·90	—	1·50	5·70	
	Short—left face ...	1	0·90	—	0·82	0·74	
	Short—right face above slab ...	1	0·90	—	0·70	0·63	
	Remaining face ...	2	0·60	—	0·82	0·98	
					Total	13·45 sq m	
5	20 mm thick cement plaster 1 : 3 in floor and channels	1	1·80	1·20	—	2·16 sq m	B=90+30=120 cm *Additional 30 cm for channel curvature.*

2.5 ESTIMATION OF QUANTITY OF STTEL REQUIRED FOR STEEL ROOF TRUSS



2.6 SOLUTION FOR ESTIMATION OF QUANTITY OF STTEL REQUIRED FOR STEEL ROOF TRUSS

DETAILS OF MEASUREMENT AND CALCULATION OF QUANTITES (Ex. 6)

Item No.	Particulars of items	No.	Length m	Breadth m	Quantity or Content	Wt. per unit (from steel table)	Total Qntty. or Weight
1	**Steel work—**						
	In one truss—						
	Principal rafters 2·75⊠50×8 mm angle ..	2×2	7·70	—	30·40 m	7·4 kg/m	224·96 kg
	Struts 75×50×10 mm angle ..	2	1·20	—	2·40 m	9·0 kg/m	21 60
	Struts 65×45×8 mm angle ..	4	0·55	—	2·20 m	6·4 kg/m	14·08
	Central suspender 50×50⊠6 mm angle ..	1	2·60	—	2·60 m	4·5 kg/m	11·70
	Cleats for purlins 75⊠75×6 mm angle* ..	12	0·11	—	1·32 m	8·9 kg/m	11·75
	Cleats at base 75×75×10 mm angle (L=length of base) ..	2×2	0·30	—	1·20 m	11·0 kg/m	13·20
	Ties main central 2—50×8mm F.B	2	4·80	—	9·60 m	3·1 kg/m	29·76
	Ties main side 2—80×6 mm F.B.	2×2	3·40	—	13·60 m	3·8 kg/m	51·68
	Ties inclined 50⊠8 mm F. B. ..	4	1·50	—	6·00 m	3·1 kg/m	18·60
	Ties inclined 50×8 mm F. B. ..	2	3·30	—	6·00 m	3·1 kg/m	20·46
	Gusset plates 8 mm thick—						
	At apex ..	1	·75	·45	0·338	sq m	
	At dase ..	2	·70	·45	0·630		
	At head of strut ..	2	·75	·25	0·375		
	,, ,, ..	4	·25	·20	0·200		
	At bottom of strut ..	2	·35	·25	0·175		
	,, ,, ..	2	·45	·32	0·288		
	At inclined tie ..	2	·32	·25	0·160		
	At boottom suspender ..	1	·25	·20	0·050		
				Total	2·206 sq m	62·8 kg/sq m	139·16 kg
						C. O.	556·95 kg

*Length of cleat=width of upper flange of Principal rafter plus space in between=50+50+8=108 mm=·108 m=11 m.

Item No.	Particulars of items	No.	Length	Breadths	Quantity or Content	Wt. per unit (from steel table	Total Qntty. or Weight
						B. F.	556·95 kg
	Base plate 12 mm thick ..	2	·30	·30	0·18 sq m	94·2 kg/sq m	16·96 kg
						Total	573 91 kg
	Rivets truss and purlin cleats ..			5% of	the above		28·69 kg
	Reg bolts 40 mm Dia 30 mm long	4	—	—	4 nos.	5 kg/no.	20·00 kg
					Total	for one truss	622·60 kg
	Steel for 5 trusses—		5 times	for one	truss=5 M	622·60=	3113·00kg
	Refters at the eaves of end gable walls at 4 corners partly embedded 75×50×8 mm angle —1·50 m long ..	4	1·50	—	6·00	7·4 kg/m	44·40 kg
	Purlins 125 M 75×8 mm angle (15 cm bearing at end walls) ..	12	21·30	—	255·60 m	12·1 kg/m	3092·76kg
	Wind ties 32 M 6 mm F. B. ..	2	21·30	—	40·60	1·5 kg/m	63·90 kg
						Total	6314·06kg
2	**Painting** two coats over one coat of priming in steel work—						63·1406sq
	In one truss— (*Section and dimension are same as for steel work in item 1. Qntty.= Length×perimeter of Section*).						
	Principal rafters 75 M 50×8 mm angle [B=Perimeter=(75+50) ×2=250 mm=25 cm=·25 m]..	2×2	7·60	·25	7·60 sq m		
	Struts 75 M 50 M 10 mm angle ..	2	1·20	·25	0·60		
	Struts 65×45×8 mm angle ..	4	0·55	·22	0·48		
	Central suspender 50 M 50 M 6 mm angle ..	1	2·60	·20	0·52		
	Cleats for purlins 75×75 M 8 mm angle ..	12	·11	·30	0·40		
	Cleats at base 75 M 75 M 8 mm angle ..	2 M 2	·30	·30	0·36		

Item No.	Particulars of items	No.	Length m	Breadth m	Quantity or Content	Wt. per unit (from steel table)	Total Qntty. or Weight
	Ties main central 10×8 mm F. B. [B=perimetre=(50+8)×2 =116 mm=·116 m] ..	2	4·80	·116	1·11		
	Ties sides 80×6 mm F. B. ..	2×2	3·40	·172	2·34		
	Ties inclined 50×8 mm F. B. ..	4	1·50	·116	0·70		
	Ties inclined 50×8 mm F. B. ..	2	3·30	·116	0·77		
	Gasset plates—						
	At apex ..	1×2	·75	·45	0·68		
	At base ..	2×2	·70	·45	1·26		
	At head of strut ..	2×2	·75	·25	0·75		
	At head of strut ..	4×2	·25	·20	0·40		
	At bottom of strut ..	2×2	·35	·25	0·35		
	At bottom of strut ..	2×2	·45	·32	0·58		
	At inclined tie ..	2×2	·32	·25	0·32		
	At bottom of suspender ..	4×2	·25	·20	0·10		
	Base plate ..	2×2	·30	·30	0·36		
				Total	of one	truss=19·68	sq m
	Painting for 5 trusses ..		5 times	of one	truss =5×19·68	—	98·40sqm
	Purlins 125×75×8 mm angle ..	12	21·30	·40	—	—	102·24sqm
	Wind ties 32×6 mm F. B. ..	2	21·30	·076	—	—	3·24 sq m
						Total	203·88sqm
3	**Galvanised corrugated iron (G.I.) roofing** (All httings, hook bolts, G. I. bolts, washers, etc. are included) ..	2	21·30	7·80	—	—	332·28sqm
4	**G. I. Ridging** ..	1	21·30	—	21·30 m	—	21·30 m

Note.—*Gusset plates have been taken as rectangle from which they can be cut.*

MODULE 2

QUANTITY ESTIMATION FOR ROADS

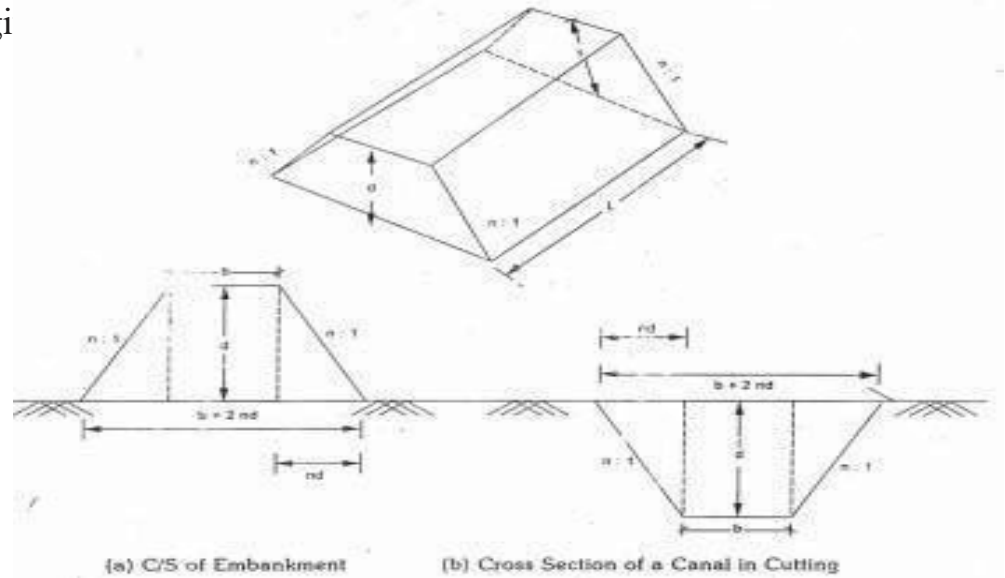
2.1 Introduction:-

Generally all the Civil Engineering projects like roads, railways, earth dams, canal bunds, buildings etc. involves the earth work.This earth work may be either earth excavation or earth filling or Some times both will get according to the desired shape and level. Basically the volume of earthwork is computed from length, breadth, and depth of excavation or filling.
In this chapter the various methods of calculating the earth work quantities shall be discussed.

Lead and Lift:
Lead:
It is the average horizontal distance between the centres of excavation to the centre of deposition. The unit of lead is 50m.
Lift :
It is the average height through which the earth has to be lifted from source to the place of spreading or heaping. The unit of lift is 2.00m for first lift and one extra lift for every 1.0m. for example when earth is to be lifted for 4.5m, Four lifts are to be paid to the contractor

i.e. Upto2.0 - 1 lift
1.0 - 1 Lift
1.0 - 1 lift } Total 04 lifts
0.5 - 1 lift }

Calculation of earth work for Roads:
7.3.1 case 1) volume of earth work in banking or in cutting having "no longi



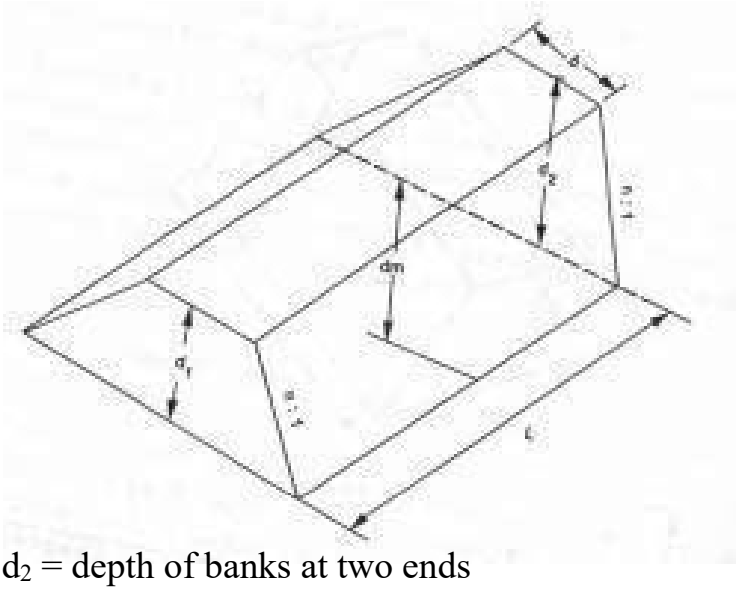
(a) C/S of Embankment (b) Cross Section of a Canal in Cutting

V = (bd+2x1/2x ndx d)L
V = (bd+nd2)L

Case 2:

When the ground is in longitudinal slope or the formation has uniform gradient for a length the earth work may be calculated by the following methods.

1. By Mid Section or Mid ordinate method.



Where d_1, d_2 = depth of banks at two ends
Mid ordinate (or) Average depth (dm) = $d_1 + d_2 / 2$

Area of mid section (A_m) = $bd_m + nd_2$
volume of earth work (v) = A x L = $\frac{(bd + nd2) \times L}{m \quad m \quad m}$

ii) Trepezoidal formula: (for two sections)
In this method also called mean sectional area method
Let A1 &A2 be two areas at two ends. A= (bd + nd2) ,
A = (bd + nd2)
($A_1 + A_2$)

Am = (A_1 + A_2) / 2

Volume of earth work (v) = $A_m \times L$

iii) Trepezoidal formula for a series of c/s areas at equal intervals.

Let A_1 ,A_2 ,A_3 and A_n are the cross sectional areas along L.S of Road 'L" is the distance between two cross sections.
The volume of earth work

$$V = \frac{L}{2}[\{A_1 + A_n\} + A_2 + A_3 + A_4 + ,,,,, + A_{n-1}]$$

iv) Prismoidal formula for a series of cross sectional areas at equal intervals. Note : This method is adopted when there is odd number of cross sections. Volume of earth work

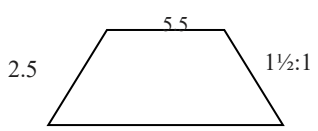
$$V = \frac{L}{3}\left[(A_1 + A_n) + 4(A_2 + A_4 + A_6 + ... + A_{n-1}) + 2(A_3 + A_5 + ... + A_{n-2})\right]$$

$$= \frac{\text{length}}{3}(\text{Sum of first and last areas}) + 4(\text{even areas}) + 2(\text{odd Areas})]$$

Earth work Calculations

Example 7.1 : Find the volume of earth work in embankment of length 12m. Top width is 5.5m and depth is 2.5m the side slopes ara 1½:1
Sol : Top width b=5.5m

Depth d= 2.5m
side slopes =1½:1 i.e. n=1.5
length L=12m



Volume of earth work $V = (bd+nd^2)L$

$= (5.5 \times 2.5 + 1.5 \times 2.52)12$
$= 77.5m^3$

Example 7.2 : The depths at two ends of an embankment of road of length 70m are 2m and 2.5m. The formation width and side slopes are 8m and 2:1 respectively. Estimate the Quantity of earth work by
a) Mid Sectional Area (ii)Mean sectional Area method.
Sol: a) b=8m, d1=2m, d2=2.5m, l=70m, n=2

$$\text{Mean depth } d_m = \frac{d_1+d_2}{2} = \frac{2+2.5}{2} = 2.25m$$

Mid sectional Area = Am = bdm+ndm2 = (8x2.25+2x2.252)2=28.125m2
Volume of earth work (V)= AmxL = 28.125x70=1968.75m^3.

b) Area of c/s at one end A_1 = bd1 +nd1/ 2= 8x2+2x2 =24m
Area of C/s at other end A_2=bd_2+nd $_2$ =8×2.5+2×2.52 =32.5m2

Average Area = A_m = (24 +32.5) / 2

Mean Sectional Area (Am) = 28.25 m^2

Volume of earth work (V)= A_m x L=28.25 x 70 = 1977.5 m^3.

Example 7.3

The following width of road embank ment is 10m. The side slopes are 2:1 The depth along the centre line road at 50m intervals are 1.25, 1.10, 1.50, 1.20, 1.0,1.10, 1.15m calculate the Quantity of earth work by

a) Mid sectional rule
b) Trepezoidal rule
c) Prismoidal rule

a) Mid Sectional rule : b=10m, n=2.

Chainage	Depths	Mean depth (d_m)	Area of (bd_m+nd_m^2)	Length b/w Chainages	Quantity (m^3) A_m×L
0	1.25				
50	1.10 }	1.175	14.51	50	725.56
		1.125	13.78	50	689.06
100	1.15				
		1.175	14.51	50	725.56
150	1.20				
		1.10	13.4	50	671.00
200	1.00				
		1.02	12.70	50	635.25
250	1.10				
		1.125	13.78	50	689.06
300	1.15				

Total 4135.49m3

a) Trepezoidal rule

$A = bd + nd^2$

$A_1 = bd1 + nd_1^2 = 10x\ 1.25 + 2x\ 1.25^2 = 15.625\ m^2$

$A_2 = bd2 + nd_2^2 = 10x\ 1.10 + 2x\ 1.10^2 = 13.42m$

$A_3 = 10x\ 1.15 + 2.1.15^2 = 14.145m^2$

$A_4 = 10x\ 1.2 + 2x1.2^2 = 14.88m^2$

$A_5 = 10x\ 1.0 + 2x1^2 = 12.0m^2$,

$A_6 = 10\ x\ 1.1 + 2x1.1^2 = 13.42m^2$

$A_7 = 10x1.15 + 2x1.15^2 = 14.145\ m^2$

Volume of earth work by Trepezoidal rule

$$\frac{15.6}{2}\left[A + A_n + (A_2 + A + .. A_{n-1})\right]$$

$$V = \frac{A_1 + A_n}{2} + \{A_2 + A_3 + \ldots\ldots + A_n\}$$

$= \mathbf{4137.50\ m^3}$

a) By Prismoidal rule

$$v = \frac{L}{3}\left[(A_1 + A_n) + 4(\text{even Areas}) + 2(\text{Odd Areas})\right]$$

$$= \frac{L}{3}\left[(A_1 + A_7) + 4(A_2 + A_4 + A_6) + 2(A_3 + A_5)\right]$$

$$= \frac{50}{3}\left[(15.625 + 14.145) + 4(13.42 + 14.88 + 13.42) + 2(14.145 + 12)\right]$$

$= 4149\ m^3$

Example 7.4:- Estimate the Quantity of earth work for a portion of road from the following data

Chainage	0	1	2	3	4	5	6	7	8	9
RL	7.50	7.70	7.50	7.25	6.85	6.95	6.70	6.45	6.30	5.95

The formation level at Chainage 0 is 8.0 and having falling gradient of 1 in 100. The top width is 12m and side slopes 1½ horizontal to 1 vertical assuming the transverse direction is in level calculate the quantity of earth work Take 1 chain = 20m by using trepezoidol & Prismoidol formula.

Sol : -

b=12m n=5

Chainage	Distance	Reduced level	Formation Level	Depth(d) of		Area of	
				Embank-ment	Cutting	Embank-ment $bd+nd^2$	Cutting
0	0	7.50	8.0	0.50		6.375	
1	20	7.70	7.8	0.10		1.275	
2	40	7.50	7.6	0.10		1.215	
3	60	7.25	7.4	0.15		1.839	
4	80	6.85	7.2	0.35		4.38	
5	100	6.95	7.0	0.05		0.63	
6	120	6.70	6.8	0.10		1.215	
7	140	6.45	6.6	015		1.837	
8	160	6.30	6.4	0.10		1.215	
9	180	5.95	6.2	0.25		3.09	

Trepezoidal formula :

$$V = L\frac{A_1 + A_n}{2} + (A_2 + A_3 + \ldots + A_{n-1})$$

$V = 365.53\ m^3$

Prismoidal formula :

$$V = \frac{L}{3}[(A_1 + A_n) + 4(\text{even areas}) + 2(\text{Odd areas})]$$

$$= \frac{L}{3}[(A_1 + A_{10}) + 4(A_2 + A_4 + A_6 + A_8) + 2(A_3 + A_5 + A_7 + A_9)]$$

$V = 317.27\ m^3$

Example 7.5:- The road has the following data

Chainage	0	20	40	60	80	100	120
RL of Ground	20.6	21.0	21.5	22.1	22.7	22.9	23.0

The formation level at chainage zero is 22.0 and having a rising gradient of 1 in 100 the top width is 12.0m and side slopes are1½ :1 Assuming the trans-

verse direction is in level. calculate the quantity of earth work by
a) Trepezoidal formula b) Prismoldal formula

Chainage Distance	Reduced level	Formation Level	Depth (d)of		Area of	
			Embark-ment	Cut-ting	Embark-ment	Cutting
0	20.6	22.0	1.40		19.74	
20	21.0	22.2	1.20		16.56	
40	21.5	22.4	0.90		12.01	
60	22.1	22.6	0.50		6.375	
80	22.7	22.8	0.10		1.215	
100	22.9	23.0	0.10		1.215	
120	23.0	23.2	0.20		2.460	

a) Trepezoidal formula:

Vol of earth work in embankment

$$V = L\left[\frac{A_1 + A_n}{2} + (A_2 + A_3 + \ldots\ldots + A_{n-1})\right]$$

$$= 20\left[\frac{19.74 + 2.46}{2} + (16.56 + 12.01 + 6.375 + 1.215 + 1.215)\right]$$

$$= 969.5 \text{ m}^3$$

b) Prismoidal formula

$$V = \frac{L}{3}[(A_1 + A_n) + 4(\text{even Areas}) + 2(\text{Odd Areas})]$$

$$\frac{20}{3}[(19.74+2.46) + 4(16.56+6.325+1.2+5) + 2(12.01+1.215)]$$

$$= 968.33 \text{m}^3$$

Example 7.6:-From the above problem if the formation level at 0th chainage in 20m. Calculate the volume of earth work by using the formulas?

Chainage	Reduced level	Formation Level	Depth (d)of		Area of	
			Embank-ment	Cutting	Embank-ment	Cutting $bd+nd^2$
0	20.60	20.00	--	0.60	--	7.740
20	21.00	20.20	--	0.80	--	10.56
40	21.50	20.40	---	1.10	---	15.015
60	22.10	20.60	--	1.50	--	21.375
80	22.70	20.80	--	1.90	--	28.215
100	22.90	21.00	--	1.90	--	28.215
120	23.00	21.20	--	1.80	--	26.460

a) Trepezoidal formula:

Vol.of earth work in cutting

$$V = L\left[\frac{A_1 + A_n}{2} + (A_2 + A_3 + \ldots\ldots + A_{n-1})\right]$$

$$= 20\left[\frac{7.74+26.46}{2} + (10.56+15.015+21.375+28.215+28.215)\right]$$

$$= 2409.6 \text{ m}^3$$

Example 7.7:-From the same above problem 7.6 if the gradient is in 100 falling calculate the quantity of earth work by using the formulas

Chainage	Reduced level	Formation Level	Depth (d)of		Area of	
			Embank-ment	Cut-ting	Embank-ment	Cutting
0	20.60	20.00	--	0.60	--	7.74
20	21.00	19.8	--	1.20	--	16.56
40	21.50	19.6	---	1.90	---	28.215
60	22.10	19.4	--	2.70	--	43.335
80	22.70	19.20	--	3.50	--	60.375
100	22.90	19.0	--	3.90	--	69.615
120	23.00	18.80	--	4.20	--	76.86

a) Trepezoidol formulae:

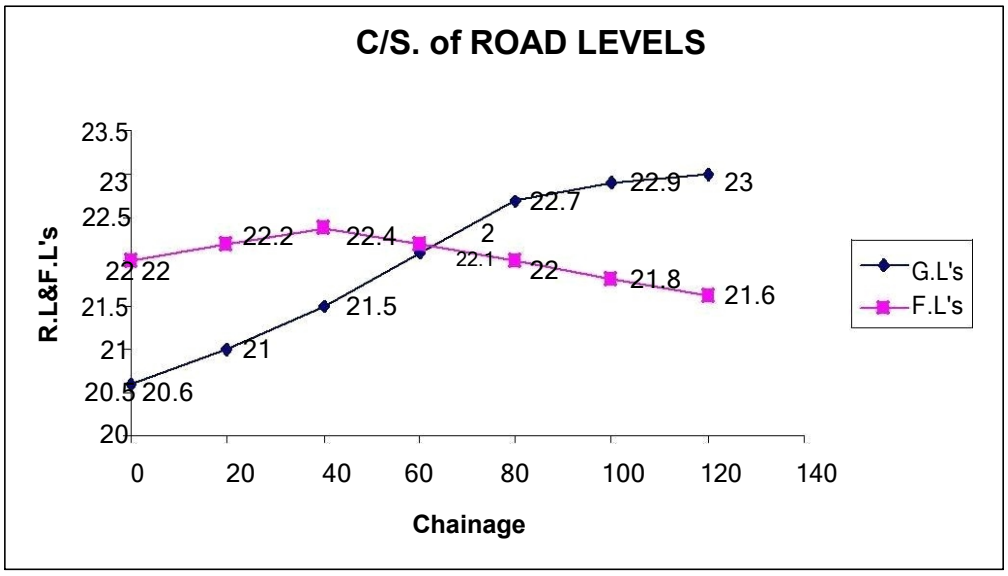
Vol.of earth work in cutting

$$V = L\left[\frac{A_1 + A_n}{2} + (A_2 + A_3 + \ldots\ldots + A_{n-1})\right]$$

$$= 20\left[\frac{7.74+76.86}{2} + (16.56+28.215+43.335+60.375+69.615)\right]$$

Example 7.8:- From the problem 7.5 if the gradient is 1 in 100 raising upto 40th chainage and 1 in 100 falling ragient from 40th Chainage to 120th chainage. Calculate the vol of earth work by using the formulas.

Chainage (m)	R.L.	F.L.	Depth (d)of .		Area of .	
			Embank-ment	Cutting	Embankment $bd+nd^2$	Cutting $bd+nd^2$
0	20.6	22.0	1.40		19.74	
20	21.0	22.20	1.20		16.56	
40	21.5	22.40	0.90		12.01	
60	22.1	22.20	0.10		1.215	
62.5			0.00	0.00	0.000	0.000
80	22.7	22.00		0.70		9.135
100	22.9	21.80		1.10		15.015
120	23.0	21.60		1.40		19.74



From similer triangel properties

$$\frac{x}{0.1} = \frac{20 - x}{0.7}$$

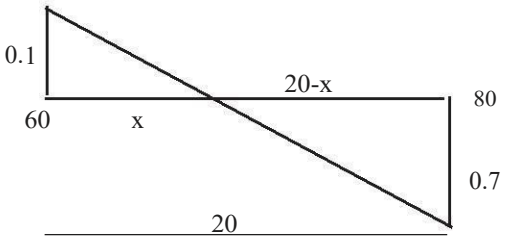
$0.7x = (20-x)0.1$

$0.7x = 2-0.1x$

$0.7x+0.1x = 2$

$0.8x = 2$

$$x = \frac{2}{0.8} = \frac{20}{8} = 2.5$$



vol of earth work in embankment

Chainage	0	20	40	60	62.5
Area	19.74	16.56	12.01	1.215	0.00

here the intervals are not equal so we have to take the seperate volumes from oth chainage to 60th chainage and 60th chainage to 62.5 chainage

V = Vol (0 - 60) + vol(60 - 62.5)

$$= \frac{19.74 + 1.215}{2} 20 + (16.56 + 12.01) + \frac{1.215 + 0.00}{2} 2.5$$

$= 782.46 m^3$

By Prismoidal

$$V = \frac{20}{3}\left[(19.74 + 1.215) + 4 \times 16.56 + 2 \times 12.01\right] + \frac{2.5}{3}\left[(1.215 + 0.00)\right]$$

$= 742.44\ m^3$

Vol of earth work in cutting

Chainage	62.5	80	100	120
Area	0.00	9.135	15.015	19.74

Volume (v) = vol (62.5-80)+Vol (80-120)

By Tripezoidal formula

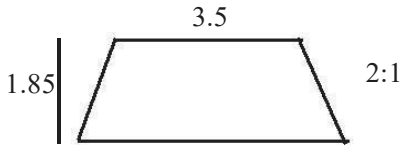
$$V = \frac{17.5}{2}\left[0 + 9.135\right] + 20\left[\frac{9.135 + 19.74}{2}\right] + 15.015$$

$= 668.98 m^3$

EXERCISE

Short Answer Questions

1. State the following formulae with usual notation
   a) Prismoidal formula
   b) Trepezoidal formula
2. For an embankment 90m long of uniform gradient when the height of bank is 2.4m at one end and 1.8m at the other end the width of embankment at top is 8m and its side slopes 2 vertical to 1 Horizontal calculate the quantity of earth work by a) Mid Sectional area method b) Mean sectional area method.
3. Find the earthwork in embankment between 5/2km to 5/5km of thepro-posed road whose c/s is given below.



Essay type questions

1. The road has the following data

Chainage in m	0	30	60	90	120
G.L. in m	25.8	26.5	27.2	28.1	28.5

The Formation level at chinage zero is 28 and having the rising gradient of 1 in 100 the top width is 10m and the side slopes are 1½ horizontal to 1 verticalAssumingtransverseslopeislevelcalculatethevolumeofearth work.

2. Thereducedlevelofgroundalongthecentrelineofaproposedroadfrom chaiage 0 to 6 are given below. The formation level at '0' chainage is 10.00 andtheroad is indown wardgradientof 1in 100 formation widthofroad is 10m and side slopes are 2:1 for both banking and cutting. Length of chain is20m calculatethequantity ofearth workrequired by a) Trepezoidal ruleb) Prismoidalrule.

Chainage	0	1	2	3	4	5	6
R L of ground	8.0	7.8	7.6	7.3	6.9	6.2	6.5

MODULE – 3

SPECIFICATION

3.1. Definition

Specification is a statement of particulars for execution of any item of work. It describes the nature and the class of the work, materials to be used in the work, the workmanship and the tools and plants which are required to complete an engineering project in accordance with its drawing and details. Specifications are written by experts of a particular field.

3.2. Necessity of Specification

A specification is a statement of particulars. An engineering specification contains the details about nature and class of the work, quality of the material to be used, workmanship and tools and plants required for the project. The drawings show the proportions and relative positions of the various components of the structure. It is not possible to furnish the information on the drawings regarding the quality of materials to be used and the quality of workmanship to be achieved during construction, due to shortage of space. Thus details regarding materials and workmanship are conveyed in a separate contract document which is known as the specifications of the work. In general, the drawings showed what is to be done, whereas the specifications state how it is to be accomplished.

3.3. Importance of Specification

- The specification describes the quality and quantity of a materials, workmanship and equipment required for execution of the project and hence it directly affects the cost of the project. Moreover, it allows the contractor to make programs for their procurement beforehand.
- Specification provides specific guidelines for the workmanship and the method of doing work. Thus, it serves as a guideline for supervising staff to execute the work.
- Specifications enable the employer to check the quality of the materials and workmanship.
- The contractor bids the tender as per the specification and is paid as per the tendered price. Any change in specification changes the tender rate.

3.4. Legal Aspects of Specifications:

- Specifications form a part of contract document, without which the contract document becomes invalid. On each page of the specifications both the parties *i.e.,* owner and contractor should sign so that these specifications, where clear instructions, regarding the quality and procedure of works etc., are given will be binding on both the parties.
- If any dispute arises between the parties, the specifications will help the arbitrator or the court to settle the dispute. If the contractor‟s work deviates from the specifications, he will be liable for penalty.

- The specification also mentions the mode of measurements, quality and procedure of item, which is binding on both the parties to adhere to it. The contractor cannot ask for extra measurements or owner cannot give less measurements.
- The general character and the scope of the work in illustrated and defined by the specifications and signed by both parties. So it becomes a legal binding on both the parties to adhere strictly to the agree specifications.
- In the absence of complete specification, the contractor‟s obligation is limited to performance of only what is called for in such incomplete specifications. As such great care has to be taken in preparing specifications.

3.5. Types of Specifications:

The specifications can be broadly classified as:

1) **General specification**
2) **Detail specification**

3.5.1 General Specification

In general specifications nature and class of the work, names of materials, and the proportions that should be used in the various items of the work are described. Only a brief description of each and every item is given. It is useful for estimating the project without going through lengthy detailed specifications general information for the quantities of the materials nature and class of the work can be known from the general specifications, but they don‟t form a part of the contract document.

3.5.2 Detail Specification

The detailed specifications describe the item of work in details, accurately and complete in all respects in relation to the drawings of the works. Detailed specification for a particular item specify the qualities, quantities and proportion of the materials and the method of preparation and execution and mode of measurements for that particular item of work in a project. The method and duration of protection of finished works as required are specified in the detailed specifications. The detailed specifications are arranged in the same sequence of order as the work carried out. The detailed specifications form an important part of contract document.

3.6. How to Write Specification

While writing specifications following principles shall be adopted:

1. **Description of materials:** The quality and size of materials required to do an item of work shall be fully described for checking up at site according to the clauses provided in the specifications. The proportion of mixing or treatment of materials if required before use shall be really described.

2. **Workmanship:** The complete description of workmanship. The method of mixing and proportion, the method of laying, preparation of base or surface, compaction, finishing and curing etc. specially applicable to the item of work shall be stated in different clauses.

3. **Tools and Plant (T&P):** The tools and plant to be engaged to carry out a work shall be described. The method of operation and by whom to be supplied shall be stated.

4. **Protection of New Work:** The method of protection of new works against damage or the method of curing if required, the test of completed work if necessary shall be described in separate clauses.

5. **Expression:** While writing a specification endeavor shall be made to express the requirements of the specification clearly and in concise form avoiding repetition and unusual words. The style of the tense shall remain same throughout. As the specifications are legal documents, terms such as suitable, proper and words having more than one meaning shall be avoided. The sentience shall be short simple and concise because fewer words will involve less risk or legal difficulty.

6. **Clauses of the specification:** As far as possible, the clauses shall be arranged in the order in which work shall be carried out. This does not mean to follow the works according to the order of arrangement, but it facilitates references. While framing the clauses for quality of materials, workmanship, tools and plants etc. practical possibilities should be realized. Correct and complete but not repeated information shall be given so that the owner and the contractor carryout the work following the specifications. Abbreviations which are familiar can be used.

3.8. General Specification of Building

Buildings are classified in four categories depending superiority of their construction specifications: Class A (First class buildings) are having highest specification while class D (fourth class) are having lowest specifications.

3.8.1 General specifications for first class building

1. **Foundation and plinth:** Foundation and plinth shall be of first class brick work in 1:6 cement mortar over 1:4:8 cement concrete.
2. **Damp proof course:** DPC shall be of 25 mm thick cement concrete (1:1.5:3), mixed with one kg of Impermo (or any water proofing material) per bag of cement.
3. **Superstructure:** Superstructure shall be of 1st class brickwork with 1:6 cement mortar. Lintels over doors and windows shall be of R.C.C.
4. **Roofing:** Roof shall be of 100 mm thick R.C.C. (1:2:4) slab with 100 mm lime terracing above over RCC lab as required. Height of the room shall not be less than 3.5 m.
5. **Flooring:** Mosaic/Marble flooring shall be provided in all floors including staircase.
6. **Finishing:** Inside and outside wall shall be finised with 12 mm cement mortar plaster (1:8). Inside shall be distempered over 2 coats of white wash. Outside shall be snowcem washed two coats over one coat of white wash.
7. **Doors and windows:** Chaukhats shall be seasoned teak wood and shutters shall be 40 mm paneled glazed. All fittings shall be provided with iron grills. All wooden and grills shall be painted with enamel paint over one coat of priming.

8. **Miscellaneous:** Rain water pipe shall be of cast iron. Building shall be provided with 1st class sanitary, water fittings and electrical installations.

3.9. Writing the Detailed Specifications for Construction Work

The detailed specifications of any work consist of two sets of provisions: General provisions and Technical provisions.

3.9.1 General provision

These are also known as conditions of contract and they apply to the work as a whole. In this document, the conditions governing the contract are written. The following groups of conditions of contract are generally accommodated under the general provisions.

a) **Conditions a relating to documents:** These pertain to Bill of quantities and schedule of prices, Drawings, Standard specifications

b) **Conditions relating to the general obligations of the contractor:** These pertain to, Acts, bye-laws and regulations, fencing, watching and lighting of the work spot, Insurance.

c) **Conditions a relating to labour and personnel:** These pertain to Accidents to workmen, Contractors representative, Rates of wages paid to the employees, Removal of the employees of the contractor.

d) **Conditions a relating to the execution of the work:** These provisions are related to Alterations, additions and omissions during the progress of work, Amount of extra items, Damages, Defective work, Work at night and on holidays, Workmanship etc.

e) **Conditions a relating to measurements and payments:** These pertain to Method of measurement of completed works, Method of payments etc.

f) **Conditions a relating to default and non-completion:** These pertain to Failure to complete the work in time, Right to suspend the work Time of completion etc.

g) **Conditions a relating to settlement of dispute:** These pertain to arbitration, Jurisdiction of court etc.

3.9.2. Technical provisions

These specifications describe the technical requirements of each type of constructions. The technical provisions contain detailed instructions regarding the desired quality of the final product. The technical provisions are of three types.

a) Specifications for materials and workmanship

For materials the following properties should be included in the specifications:

- **Physical properties** such as size, shape, grade, strength, hardness etc., Chemical composition of the material, Electrical, thermal and acoustical properties, Appearance of the material

- A clear statement regarding the **inspection and procedure of test** of the material.

- For **workmanship**, the following important features should be included in the specifications; the results desired, the tools and plants to be engaged, detailed description of the construction method for each item, Instructions regarding the protection of the finished work as well as of the adjacent property.

b) Specifications for performance

These specifications are written for the overall performance of the finished product and hence they are written if the contract is for the supply of equipment and machinery such as pumps, motors etc. In these specifications, general description, design and installation and guarantee etc., of the equipment are specified.

c) Specifications for proprietary commodities

Commercial products which are standardized or patented are called proprietary commodities. The specifications written for such materials should include the name of a particular brand or firm. (eg. Sun brand, Everest brand etc.) However, it is not desirable in case of public works to specify certain trade names or brands. To avoid monopoly and favoritism, it is general practice to specify the selected brand and then it is followed by the phrase "or equal".

3.10. Detailed Specifications of Civil Engineering Materials

3.10.1. Detailed specification for first class brick

The earth used for molding the bricks shall be free from organic matters salts and chemicals. The size, weight and colour of the burnt bricks should be uniform. The adjacent faces of the bricks are to be right angles to each other. The bricks shall be free from cracks, flaws and lumps. They should not break where dropped, from 1 meter height, on the ground. They should not absorb water by more 15 % of their self-weight when immersed in water for one hour. The average compressive strength of the bricks shall be not less than 7.5 N/mm^2. The dry weight of one brick shall not be less than 3 kg.

3.10.2. Detailed Specification for cement

Ordinary Portland cement or rapid hardening Portland cement confirming to IS: 269 – 1989 and IS:8041 – 1990 shall be used. The fineness of the cement shall not be less than 30 minutes and the final setting time shall not be greater than 10 hours. The average compressive strength, after 7 days curing, of 1:3 cement mortar cubes shall be not less than 33 N/mm2 (33 grade).

3.10.3. Detailed Specification for sand for mortar

The sand used for mortar shall be clean, sharp, heavy and gritty. It should be free from clay, salt, mica and organic impurities. It shall not contain harmful chemicals in any form. Medium and fine sand are to be used in mortars. Coarse sand shall be sieved through 600 micron sieve and used in mortars for plastering works.

3.10.4. Detailed Specification for coarse aggregate

The aggregate to be used in reinforced cement concrete shall be of blue granite stone, machine crushed and well graded with a nominal size of 20 mm. It shall be hard, dense, durable strong and free from flakes. The aggregate shall not contain harmful materials such as coal, mica clay, shells, organic impurities etc. The compressive strength, crushing value etc. of the aggregate shall be in accordance with the requirements of IS: 383 – 1970.

3.10.5. Detailed Specification for water for concrete

Water used for mixing and curing concrete shall be clean and free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete or steel. Potable water may be used for mixing concrete. The suspended organic solid matter in the water shall not exceed 200 mg/l and inorganic solid matter shall not exceed 3000 kg/l, the pH value of water shall be not less than 6. Water sued for curing should not produce any objectionable stain or unsightly deposit on the concrete surface. The presence of tannic acid or iron compounds in the water is objectionable.

3.10.6. Detailed Specification for reinforcement

The reinforcement shall be of high strength deformed steel bars confirming to IS: 1786 – 1985. It should be bendable, wieldable and have the modulus of elasticity not less than 200 kN/mm^2. The yield strength of the steel used shall not be less than 415 N/mm^2. All reinforcement bars shall be free from loose mill scales, loose rust and coats of paints, oil, mud or other coatings which may destroy or reduce bond.

3.10.7. Detailed Specification for wood for doors and windows

The wood shall be teak, well-seasoned and dry. It should be free from cracks, knots, defects and disease. It should be sawn in the direction of grains so that the edges are perfectly straight and square. The dimensions of the frames/scantlings/planks shall be as prescribed in the drawings. Patching or plugging of any kind is not permitted.

3.11. Detailed Specifications of Common Construction Works

3.11.1. Detailed specification of for earth work excavation for foundation

[**Sequence**: Leveling the surface; Dimensions; Shoring; Fencing; Dumping the soil; Water in foundation; Treatment of the bottom; Trench filling; Measurement]

a) Leveling the surface

The whole area of construction is to be cleared of tees, grass, roots of trees etc., complete and leveled horizontally to enable easy marking of centre line of the building.

b) Dimensions

The excavation shall be done in accordance with dimensions of trenches shown in the working drawings.

c) Shoring

The sides of the trenches should be vertical and the bottom of the trenches should be flat. In the case of loose soils the sides of the trenches should be shored with steel sheets.

d) Fencing

Suitable temporary fencing is to be provided around the site of excavation to avoid any accidental fall into the trenches.

e) Dumping the soil

The excavated soil is to be dumped and heaped at a minimum distance of 1.5 metre away from the trenches so that it does not slide again into the trenches.

f) Water in Foundation

Water, if any accumulated in the trench, should be pumped out without any extra payment and necessary precaution shall be taken to prevent surface water to enter into the trench.

g) Treatment of the bottom

The bottom of the trench shall be watered and compacted by ramming before the foundation concrete is laid. Excessive excavations should not be adjusted by filling with loose excavated soils. Sand or plain concrete may be used for the adjustment of levels, that too with proper compaction.

h) Trench filling

After the concrete has been laid and masonry has been constructed the remaining portion of the trench shall be filled up with earth free from rubbish and refuse materials, in layers of 15 cm and watered and well rammed.

i) Measurement

The measurement of the excavation shall be taken in cu. m. as for rectangular trench bottom width of the concrete multiplied by the vertical depth of the foundation from the ground level and multiplied by the length of trench even though the contractor might have excavated with slopping side for his convenience. The rate shall be for complete work for 30 m lead and 1.5 m lift, including all tools and plants required for completion of the works.

3.11.2. Detailed specification of for lime concrete in foundation

[**Sequence**: Lime; broken bricks; fine aggregate; proportioning; mixing; laying and compacting; curing; measurement]

a) Lime

The lime used for the concrete shall be freshly burnt and slaked. It should be free from clayey particles and ashes. Unslaked stone particles should be removed by shifting.

b) Broken bricks

The over burnt bricks and the pieces of well burnt bricks are to be broken to sizes ranging from 20 mm to 40 mm and stacked for easy measurement. The brick bats shall be free from dirt, dust, rubbish, leaf etc.

c) Fine aggregates

Surki made from well burnt brick bats is to be used as fine aggregate. It should pass through I.S. sieve no.48 and free from dust and dirt.

d) Proportioning

Lime, surki and broken bricks are to be mixed in the proportion of 1:2:5 by volume. The materials are to be measured loose without shaking or ramming.

e) Mixing

The mixing shall be done only by mechanical mixer. The broken bats are to be soaked in clean water for at least 2 hours before mixing. The materials are first mixed to get uniform distribution and then water is gradually added. The mixing process is to be continued till all the brick bats are coated with mortar uniformly and a workable concrete is obtained.

f) Laying and compacting

The concrete shall be laid to the required thickness, not more than 200 mm and a time, and compacted by ramming with rammers weighing 4.5 to 55 kg.

g) Curing

The lime concrete, so laid, is to be kept wet for at least 7 days.

h) Measurement

The measurement shall be taken in cu. m. for the finished concrete. The length and breadth shall be measured correct to 1 cm and depth correct to 05 cm.

[**Similar Item:** Detail specifications for lime concrete in roof terracing]

3.11.3. Detailed specification of random rubble masonry in foundation and basement [**Sequence**:

Materials; preparation of mortar; method of laying; curing; measurement]

a) Materials

The stone shall be obtained from the approved queries. It shall be sound, free from cracks and decay and shall have a specific gravity of not less than 2.5. [Include detail specification for cement and sand]

b) Preparation of mortar

The materials (cement and sand), with ratio 1:6, shall be first mixed dry thoroughly till uniform colour is obtained and then shall be mixed wet adding water slowly and gradually for at least turning three times to give uniform consistency.

c) Method of laying

The stones are to be laid on broadest face which gives better opportunity to fill the spaces between stones by the mortar. The stones are laid layer by layer with sufficient mortar in

between them for better binding. The outer face of the basement should be vertical and the joints are to be staggered. There shall be no gap, between the stones, unfilled by mortar.

d) Curing

The masonry should be kept in we condition by sprinkling water thrice daily for at least 7 days after construction.

e) Measurement

The measurement shall be taken in cu. m. for the finished concrete. The length and breadth shall be measured correct to 1 cm and depth correct to 05 cm.

[**Similar Items:** Detail specifications for random rubble masonry in super structure]

3.11.4. Detailed specification for 1st class brickwork in super structure

[**Sequence**: Materials; preparation of mortar; soaking of bricks; method of laying; curing; scaffolding; measurement]

a) Materials

[Include detail specification for first class brick, cement, and sand]

b) Preparation of mortar

[Similar to 5.11.3, but the ratio of cement to sand is 1:3 or as specified.]

c) Soaking of bricks

Bricks shall be well soaked in water for at least 12 hours before their use, preferably in a tank provided at site of work.

d) Method of laying

Bricks shall be well bonded and laid in English bond unless specified. Every course shall be truly horizontal and shall be truly in plumb. Broken bricks shall not be used except as closers. All corners shall be truly in plumb. Mortar joints shall break for bonding and shall not exceed 10 mm in thickness. Only skilled masons shall be employed on the work. Brick shall be laid with frogs upward except in the top course. Brickwork shall be carried out not more than 1 m height at a time. When one part of the wall has to be delayed, stepping shall be left at an angle of 45^0. All joints shall be racked and faces of the wall cleaned at the end of each days' work.

e) Curing

The work shall be kept well watered for at least 15 days.

f) Scaffolding

Necessary and suitable scaffolding shall be provided to facilitate the construction of brickwork. It shall be sound and strong enough to sustain all loads likely to come upon them.

g)Measurement

The measurement shall be taken in cu. m. The rate shall be for the complete work inclusive of scaffolding and all tools and plants.

3.11.5. Detailed specification for Reinforced Cement Concrete

[**Sequence**: Materials; form work; proportioning; mixing of concrete; laying of concrete; curing; formwork; measurement]

a) Materials

[Include detail specification for cement, sand, course aggregate, water and reinforcement]

Reinforcement shall be hooked and bent (cold) and placed in position as per design and drawing and bound together tight with 20 S.W.G binding steel wire.

b) Centering and shuttering

Centering and shuttering shall be made of timber and tight with necessary wedges and sufficiently strong and sable not to yield under laying of concrete. A coat of oil washing or a thin layer of paper shall be spread to have a smooth finished surface preventing adherence of concrete.

c) Proportioning

Proportions of cement, sand and course aggregate shall be 1:2:4 for slab, beam and lintels and 1:1.5:3 for columns unless otherwise specified. The sand and course aggregate shall be measured by volume with boxed and cement by number of bags.

d) Mixing of concrete

Concrete shall be mixed by concrete mixture. Cement, sand and course aggregate shall be put into the as per the required proportions for one batch. The total quantity shall not exceed the manufactures rated capacity. The machine shall be revolved to mix materials dry and then water shall be added up to the required quantity. After 2 minutes rotation for through mixing, the mixed concrete shall be discharged on a masonry platform or iron sheet.

e) Laying of concrete

Concrete shall be laid gently in layers not exceeding 150 mm and compacted by wooden thapi or some mechanical vibrator until a dense concrete is obtained. While concreting, steel bars shall be given side band bottom covers of concrete by pacing the precast concrete blocks of 1:2 cement mortar 25x25 mm in section and thickness of specified cover. Concreting shall be laid continuously. If laying is suspended for rest or the following day, the end shall be slopped at an angle of 30^0 and made rough for future jointing. When the work is resumed, the previous slopped surface shall be roughened, cleaned and a coat of neat cement paste shall be applied and then the fresh concrete shall be laid.

f) Curing of concrete

Freshly laid concrete shall be protected from rain by suitable covering. After 24 hrs of laying of concrete the surface shall be cured by flowing with water of above 25 mm depth or with covering by wet gunny bags. The curing shall be for a minimum period of 14 days or otherwise specified.

g) Removal of form work

The centering and shuttering shall be removed after 14 days of casting. It shall be removed slowly and carefully so that no part is disturbed.

h) Measurement

The measurement shall be taken in cu. m. The rate shall be for the complete work inclusive of form work and all tools and plants but excluding steel.

[**Similar Item:** detailed specification for plain cement concrete]

3.11.6. Detailed specification for damp proof course (D.P.C.)

[**Sequence**: Materials; preparation of mortar; Application of DPC; measurement]

a) Materials

Damp Poof Course shall be of plain cement concrete of 1:2:4 mix and 30 mm thickness. 12 mm size hard and dense stone chips shall be used as coarse aggregate and river sand of 5 mm nominal size shall be used as fine aggregate. The aggregate shall be clean and free from dust, dirt, mud, organic matter etc. The coarse aggregate is to be washed well before mixing. Fresh port land cement of I.S.I. approved brand of 43 grades is to be used as the binding material. Potable water, free from harmful salts, shall be only used for mixing the concrete.

b) Preparation of mortar

The coarse aggregate and sand are to be measured separately by volume and mixed dry in a clean and stable platform to get a mixture of uniform colour. This mixture is stacked to a uniform height and the cement of required quantity is spread over the stack, turned over in dry state first, and with water twice to get a workable and uniform concrete.

c) Application of DPC

The brickwork in basement is stopped at plinth level, cured will for 7 days, top surface cleaned well for dust by wire brushes. Form work is provided along the two sides of wall by wooden planks, to the required height. Gauge plates are to be provided at one metre interval, connecting the two side planks by nails, keeping at a clear distance equal to the width of wall at plinth level. The concrete, mixed as mentioned above, shall be placed and compacted well by tamping rods to have a net thickness of 30 mm. Damp proof course shall not have any joints, the whole concreting be completed without any break, and it need not be provided over door openings. The top surface of concrete, when starts to dry, shall be roughened to provide bondage with the super structure. The side planks shall be removed on the next day and the concrete shall be cured for 7 days by keeping the surface constantly wet.

d) Measurement

The measurement shall be taken in sq. m. The rate shall be for the complete work inclusive of all tools and plants.

3.11.7. Detailed specification of for plastering with cement mortar

[**Sequence**: Materials; preparation of mortar; preparation of surface; application of mortar; curing; measurement]

a) Materials

[Include detail specification for cement and sand]

b) Preparation of mortar

[Similar to 5.11.3, but the ratio of cement to sand is 1:4 for inner wall and 1: 6 for outer wall or as specified.]

Mortar for plastering shall be prepared at a time of such amount which can be used within the initial setting of cement.

c) Preparation of surface

The joints of brick work shall be racked out a depth of 18 mm and the surface shall be brushed, cleaned, watered and kept wet for two days before plastering. In case of cement concrete surface, the face shall lightly roughen, cleaned, washed and wetted.

d) Application of mortar

Plastering shall be started from the top and proceed towards the bottom. The plastered surface shall be made level and flush with wooden straight edges and rubbed thoroughly with wooden floats to ensure smooth and even surface.

e) Curing

The work shall be kept well watered for at least 15 days.

f) Measurement

The measurement shall be taken in sq. m. The rate shall be for the complete work inclusive of all tools and plants.

3.11.8. Detailed specification for form work and centering to R.C.C. Roofing

[**Sequence**: Strutting; formwork; centering]

a) Strutting

Props used for strutting shall be of casuarinas posts of 100 to 130 mm diameter. The props are to be vertical and rest on firm ground or on wooden sole plates of thickness not less than 40 mm. All props shall be provided with double wedges to facilitate tightening and loosening

of shuttering. The horizontal spacing of props in both directions shall not exceed 750 mm. When the height of strutting exceeds 3.5 m, suitable horizontal bracings should be provided. Splicing of props shall be as per the approved drawings. The props shall be constantly watched, by a carpenter, during the process of concreting and immediate remedial measures are to be taken in any of them get loosened.

b) Form Work

The formwork shall be of stiff and strong wood, easily workable with nails and light in weight. The form work shall be true to shape and size specified in the structural drawings and strong enough to with stand the forces caused by vibration of concrete and the incidental loads imposed on it during concreting. The unsupported length of the planks, particularly of the side plates shall not exceed 1.0 m to avoid buckling. The levels of the form work are to be checked before placing the reinforcement bars in position.

c) Centering

Well-seasoned wooden planks or steel sheets are to be used for the shuttering work. The joints shall be water tight to avoid leakage of cement slurry during compaction. The surfaces of planks and sheets which would come into contact with concrete shall be cleaned well and coated with oil of approved quality to the prevent adhesion of concrete. The complete centering work shall be assembled so that it can be removed, on completion of the specified period, easily without causing any demand to the concrete surfaces and edges.

3.11.9. Detailed specification for cement concrete flooring

a) Bottom Layer

The base shall be of cement concrete of 1:2:4 mix, 25 mm thick. The coarse aggregate, 12 mm size stone chipping, shall be hard, durable strong and free from dust and organic matters. The fine aggregate, 5 mm size river sand, shall be also free fromdirt, clay, mud etc. Fresh Portland cement having initial setting time not less than 30 minutes and of grade 33 shall be used. Portable water, free from harmful substances shall be used for mixing and curing. The concrete mixed as mentioned above shall be spread over the well prepared base, to a uniform thickness of 25 mm, compacted and leveled using wooden floats. The top surface shall be roughened with 2 mm deep lines at 100 mm intervals, with scratching sticks, to provide bond to the top layer. The bottom layer shall be cured for at least 3 days before the tope laying being laid over it.

b) Top Layer

The top layer is of 1:3 cement mortars, 12 mm thick finished with a floating coat of neat cement. Find sand, sifted through 5 mm size mesh and free from clay and dust shall be used. To have a red coloured finish, 3 kg of red oxide of approved quality may be mixed with 50 kg of cement and is used in preparing the mortar. The cement with red oxide is mixed with sand in the ratio 1:3 by volume in dry state to obtain a uniform colour. Water is then added slowly; a paste of uniform consistency is prepared and laid over the base layer to a uniform thickness of 12 mm. It is leveled and smoothened by wooden floats. In the process of finishing cement slurry mixed with enough red oxide is sprayed on top of cement mortar layer. The surface should be covered with a thin layer of water constantly from next day for at least seven days for better curing.

c) Measurement:

The measurement shall be taken in sq. m. The rate shall be for the complete work inclusive of all tools and plants.

3.11.10. Detailed specification for mosaic tile flooring

a) Base Course

The basic course shall be of 25 mm thick cement concrete of a 1:2:4 mix using 12 mm size granite stone chips as coarse aggregate and sand as fine aggregate. The top of flooring concrete or R.C.C. slab shall be cleaned well and applied with cement slurry of 2 kg/m^2 before placing the chips concrete. The base course is to be compacted, leveled and smoothed by wooden floats.

b) Mosaic Tiles

Precast tiles of 200 mm x 200 mm x 20 mm size are to be used. They shall be manufactured under hydraulic pressure of not less than 14 N/mm^2 and given the first grinding with machine before laying. The proportion of cement to sand in the backing of the tiles shall not be leaner than 1:3 by weight. Similarly the proportion of cement to marble power to marble chips in the wearing layer of the tiles shall be not leaner than 3:1:7. The marble chips shall be hard, dense sound and homogeneous in texture.

c) Laying of Tiles

The bedding for the tiles shall be with cement mortar 1:3. The average thickness of the bedding mortar shall be 20 mm and the thickness at any place shall be not less than 10 mm. Cement bedding shall be spread, tamped and corrected to proper levels and allowed to harden before the tiles are set. Neat cement slurry of honey like consistency shall be spread over the bedding at the rate of 4.4 kg/m2. Tiles shall be washed clean and shall be fixed in this grout one after another, each tile being gently tapped with a wooden mallet till is properly bedded and in level with the adjoining tiles. The joints shall be kept as thin as possible not exceeding 1.5 mm and in straight lines.

d) Curing, Polishing and Finishing

The day after the tiles are laid, all joints shall be cleared of the grey cement grout with a wire brush to a depth of 5 mm and all dust and loose mortar removed and cleaned. Joints shall then be grounded with whit e cement mixed with pigment to match the shade of tiles. The same cement slurry shall be applied to the entire surface of the tiles in a thin coat. The floor shall then be kept wet for a minimum period of 7days. The surface shall thereafter be grounded evenly with the polishing machine fitted with coarse grade grit blocks, adding required water during the process. After grinding, the surface shall be washed clean and covered with thin coat of cement slurry with pigment. The surface shall be again cured and polished with machine fitted with medium grade grit blocks. Similarly a third grinding shall be done by fine grade grit blocks. After the final polish, the surface shall be cleaned using diluted oxalic acid and wiped with a soft cloth. The measurement shall be taken in sq. m. The rate shall be for the complete work inclusive of all tools and plants.

3.11.11. Detailed specification for distempering

The distemper shall be of the approved colour and quality. Water shall be added as prescribed by the manufacture, stirred well often during use, to maintain uniform colour and consistency.

The plastered surface of the wall is scraped and cleaned with wire brushes and rubbed smooth with sand papers. Distemper shall not be applied in wet weather. It shall be applied with good brushes, first horizontally and then immediately crossed off vertically which together shall constitute one coat. The second coat will be also applied in the same manner after the first coat has dried. The finished surface shall be even and uniform and shall show no brush marks. The measurement shall be taken in sq. m. The rate shall be for the complete work inclusive of all tools and plants.

[**Similar Items**: Detail specifications for white wash and colour wash]

3.11.12. Detailed specification for Pointing

The joints of the brickwork shall be raked out to a depth of 20mm (3/4") and the surface of the wall washed and cleaned and kept wet for two days before pointing.

The materials of mortar cement and sand, or lime and surkhi or sand, or kankar lime as specified, shall be of standard specification. The materials of mortar shall be first dry mixed by measuring with boxes to have the required proportion as specified (1:2 or 1:3 for cement sand mortar, 1:1 for lime surkhi mortar or kankar lime mortar), and then mixed by adding water slowly and gradually and thoroughly mixed.

Mortar shall then be applied in the joints slightly in excess and pressed by a proper tool of the required shape. Extra mortar if any is removed and surface finished. Mortar shall not spread over the face of bricks, and the edges of the bricks shall be clearly defined to give a neat appearance. After pointing the surface shall be kept wet for seven days.

Flush pointing

The mortar shall be pressed into the ranked, cleaned and wet joints and shall be finished off flush and level with edges of brick to give a smooth appearance. The edges shall be neatly trimmed with a trowel and straight edge.

Ruled pointing

The mortar shall be passed into the ranked, cleaned and wet joints and a groove of shape and size of 5 to 6mm deep shall be formed running a forming tool of steel along the center line of the joints. The vertical joints also shall be finished in a similar way at right angles to the horizontal line. The finished work shall give a neat and clean appearance with straight edges.

Weather or truck pointing

The mortar shall be applied on the cleaned and wet joints and horizontal joints shall be pressed and finished with a pointing tool so that the joints is sloping from top to bottom. The vertical joint shall be finished as ruled pointing.

Raised or trucked pointing

The mortar shall be applied in raked, cleaned and wet joints in excess to from raised bands. The mortar shall be pressed and run with proper tool to from bands of 6mm(1/4") raised and 10mm (3/8") width or as directed.

3.11.13. Detailed specification for wood work for door and window frames

a) Materials

Timber shall be of teak, sal, deodar etc., as mentioned, well-seasoned, dry, free from sap, knots, crack or any other defects or diseases. It shall be sawn in the direction of the grains. Sawing shall be truly straight and square. The scantling shall be planned smooth and accurate to the full dimensions, rebates, rounding and mouldings as shown in the drawing made, before assembling. Patching or plugging of any kind shall not be permitted except as provided.

b) Joints

These shall be mortise and tenon type, simple, neat and strong. Mortise and tenon joints shall fit in fully and accurately without wedging or filling. The joints shall be glued framed, put together and pinned with hardwood or bamboo pins not less than 10 mm dia. after frames are put together pressed in position by means of a press.

c)Surface Treatment

Wood work shall not be tainted, oiled or otherwise treated before it has been approved by the Engineer-in-Charge. All portions of timber abutting against masonry or concrete or embedded in ground shall be painted with approved wood primer or with boiling coal tar.

d) Gluing of Joints

The contract surface of tenon and mortise joints shall be treated before putting together with bulk type synthetic resin adhesive of a make approved by the Engineer-in-Charge.

e)Fixing in position

The frame shall be placed in position truly vertical before the masonry reaches half the highest of the opening with iron clamps or as directed by the Engineer-in-Charge. In case of door frames without sills, the vertical members shall be embedded in the flooring to a depth of 40 mm or as directed by the Engineer-in-Charge. The door frames without sills while being placed in position shall be suitably strutted and wedged in order to prevent warping during construction. The frames shall also be protected from damage, during construction.

3.11.13. Detailed specification for wood work for door and window shutters

a) Materials

Specified timber shall be used, and it shall be well seasoned, dry, free from sap, knots crack or any other defects or disease. Patching or plugging of any kind shall not be permitted except as provided.

b) Joinery work:

All pieces shall be accurately cut and planned smooth to the full dimension. All members of the shutters shall be straight without any warp or bow and shall have smooth, well planned faces at right angles to each other. In case of panelled shutters the corners and edges of panels shall be finished as shown in drawings, and these shall be feather tongued into styles and rails. The panels shall be framed into groovers to the full depth of the groove leaving an air space of 1.5 mm and the faces shall be closely fitted to the sides of the groove. In case of glazed shutter, sash bars shall have mitred joints with styles. Styles and rails shall be properly and accurately mortised and tenoned. Rails which are more than 180 mm in width shall have two tenons. Styles and end rails of shutters shall be made out of one piece only. The tenons shall pass through styles for at least 1 th of the width of the style. When assembling a leaf, styles shall be left projecting as a horn. The styles and; rails shall have 12 mm groove in panelled portion for the panel to fit in.

c) For battened shutters:

Planks for batten shall be 20 mm thick unless otherwise specified and of uniform width of 125 to 175 mm. These shall be planned and made smooth, and provided with minimum 12 mm rebated joints. The joint lines shall be chamfered. Unless otherwise specified the battens for ledges and Braces shall be 30 mm thick and fixed with the battens on the inside face of shutter with minimum two number 50 mm long wood screws per batten. The ledges shall be 225 mm wide and braces 175 mm wide, unless otherwise specified. The braces shall incline downwards towards the side on which the door is being hung.

d) Gluing of joints for paneled or Glazed shutters :

The contact surfaces of tenon and mortise joints shall be treated before putting together with bulk type synthetic resin adhesive of a make approved by the Engineer-in-Charge.

Shutters shall not be painted, oiled or otherwise treated, before these are fixed in position and passed by the Engineer-in-Charge.

For glazed shutters, mounting and glazing bars shall be tub-tenoned to the maximum depth which the size of the member would permit or to a depth of 25 mm, whichever is less.

e) Fittings:

Details of fittings to be provided shall be as per the schedule of fittings supplied by the Engineer-in-Charge in each case. The cost of providing and fixing shutters shall include the cost of hinges and necessary screws for fixing the same. All other fittings shall be enumerated and paid for separately. The fittings shall conform to their respective IS specifications. Where fittings are stipulated to be supplied by the department free of cost, screws for fixing the fittings shall be provided by the contractor and nothing extra will be paid for the same.

3.11.14. Detailed specification for painting new wood work

a) Paint

Ready mixed paint of approved quality and colour shall be used

b) Preparation of surface

The surface to be painted shall be rubbed down smooth with medium and fine sand papers and cleaned off any dust. Knots, cracks holes etc., shall be filled with putty made of 2 parts of whiting. 1 part of white lead mixed together in linseed oil and leveled to the surface. A primer coat is applied to the surface with ready mixed wood primer of best quality.

c) Application

Painting shall be carried out at the driest season of the year. Paint shall be applied with brushes, smoothly spread without any visible brush mark. The second coat shall be applied when the first coat is perfectly dried. The paint shall be stirred often with stick so that it does not settle down.

CHAPTER 3

RATE ANALYSIS

3.1. Rate Analysis

The process of determining rate per unit of any work in Civil Engineering project like earthwork, concrete work, brickwork, plastering, painting etc. is known as Analysis of Rates or simply Rate Analysis. The rates of materials and labour vary from place to place and hence the rates of different items of works also vary from place to place. The rates of these works further help in determining cost of particular work and in turn cost of the project.

3.2. Necessity of Rate Analysis

- To determine the actual cost per unit of the items.
- To work out the economical use of materials and processes in completing the particulars item.
- To calculate the cost of extra items which are not provided in the contract bond, but are to be executed as per the directions of the department.
- To revise the schedule of rates due to increase in the cost of material and labour or due to change in technique.

3.3. Factors Deciding Rate of Items

The various factors that are involved in determining rate of any item, process or work are mentioned below:

- Specifications of works and material about their quality, proportion and constructional operation method.
- Quantity of materials and their costs.
- Cost of labour and their wages.
- Location of site of work and the distances from source and conveyance charges.
- Overhead and establishment charges
- Profit and miscellaneous expenses of the contractor

3.4. Procedure of Rate Analysis

The analysis of rates is worked out for the unit payment of the particular item of work under two heads: Materials and Labour.

- The cost of items of work = Material cost + Labour cost
- Other costs included to the above cost of items of work are:

- Tools and Plants (T & P) = 2.5 to 3 % of the labour cost
- Transportation cost (if conveyance more than 8 km is considered.)
- Water charges = 1.5 to 2 % 0f total cost
- Contractor's profit = 10 %

3.4.1 Material cost

The rate of various materials as per specifications for the items under consideration can be chalked out from market survey. The costs of materials are taken as delivered at site of work. This is inclusive of:

- The first cost (cost at origin),
- Cost of transport, railway freight (if any), etc.
- Local taxes and other charges.

a) Lead statement

The distance between the source of availability of material and construction site is known as "Lead" and is expressed in Km. The cost of conveyance of material depends on lead. This statement is required when a material is transported from a distant place, more than 8kms (5 miles). The lead statement will give the total cost of materials per unit item including first cost, conveyance loading-unloading, stacking charges etc.

A typical lead statement is provided as follows:

Sl. No.	Materials	Unit	Cost at Source (per unit)	Lead (in Km)	Conveyance charges (Per Km/ Per Unit)	Total Conveyance charges (/Per Unit)	Total Cost (In Rs. /Per unit)
1	Rough Stone	Cum	1000.00	200	100.00	120.00	1420.00
2	Sand	Cum	800.00	200	150.00	100.00	1250.00
3	Cement	Bag	400.00	Local	-	-	-

3.4.2. Labour cost

To obtain labour cost the number and wages of different categories of labourers, skilled (Skilled 1st Class), semi-skilled (Skilled 2nd Class) and unskilled, required for each unit of work should be known and this number is multiplied by the respective wage per day. The labour charges can be obtained from the standard schedule of rates. 30% of the skilled labour provided in the data may be taken as 1st class, remaining 70% as 2nd class.

The length of time required to do a certain piece of the work may vary according to the skill and mental development of the workmen and working conditions to the particular job.

OUT-TURN OR TASK

Particulars of items	Quantity of work per day (8 hrs a day)
1. Earthwork in excavation in foundation in ordinary soil, lead up to 50m and lift up to 1.5 m	3.00 cum per mazdoor/Beldar
2. Earthwork in excavation in hard soil for 100m lead and 1.5 m lift.	2.00 cum per mazdoor/Beldar
3. Excavation in rock	1.00 cum per mazdoor
4. Sand filling in plinth	4.00 cum per mazdoor
5. Breaking of brick ballast 40mm gauge	0.75 cum per labour/breaker
6. Breaking of stone ballast 40mm gauge	0.40 cum per labour
7. Breaking of stone ballast 20mm gauge	0.25 cum per labour
8. Brickwork in cement mortar in foundation and plinth	1.25 cum per mason
9. Brickwork in cement mortar in superstructure	1.00 cum per mason.
10. Half brick wall in partition	5.00 square meter per mason
11. Brick work in cement mortar in arches	0.55 cum per mason
12. Lime concrete in foundation/ flour	8.50 cum per mason
13. Lime concreting in roof terracing	6.00 cum per mason
14. Cement concrete (1:2:4)	5.00 cum per mason
15. R.C.C. work	3.00 cum per mason

16.	12 mm plastering with cement morter	8.00 square meter per mason
17.	Pointing with cement/line mortar	10.00 sq.m. per mason
18.	25 mm I.P.S. (cement concrete) floor	7.50 sqm per mason
19.	Terrazo floor 6 mm thick mosaic work over 20 mm cement concrete (1:2:4)	5.00 sq.m. per mason
20.	Brick flat floor in cement or lime mortar	8.00 sq. m per mason
21.	Timber framing sal or Teak wood	0.07 cum per carpenter
22.	Timber framing in country wood	0.15 cum per carpenter
23.	Door and window shutters panelled or glazed	0.15 sq.m. per carpenter
24.	White washing or colour washing one coat	200 sq.m. per white washer
25.	White washing or colour washing 3 coats	70 sq.m. per white washer
26.	Painting or varnishing doors or windows one coat	25 sq.m. per painter
27.	Distempering one coat	35 sq.m. per painter
28.	Amount of work done by a mazdoor (helper) per day.	
	i) Mix	3 cum per mazdoor
	ii) Delivery bricks	4000 to a distance of 15 m per mazdoor
	iii) Delivery mortar	5.5 cum of brick work

a) Task or out-turn work

This is the quantity of work which can be done by an artisan or skilled labour (with the help of semiskilled and unskilled labours) of the trade working for 8 hours a day. The out-turn of work per artisan varies according to the nature, size, height, situation, location etc. Out-turn is more in larger cities, as the more specialized and experienced labours are available, than the small cities and country sides.

The recommendation of All India Standard Schedule of Rates and various other govt. reports are used to work out approximate quantity of labour required to prepare the analysis of rates. IS: 7272 (part 1)-1974, provides recommendations for labour output constants for building work which can be used to fix up the labour cost.

A typical labour output constant issued by National Building Organization is provided bellow:

LABOUR REQUIREMENTS

	Description of work	Quantity	Labour
1.	Earthwork in excavation in foundation, trenches etc. in ordinary soil including disposal up to 30 m and lift of 1.5 m	28.30 m^3 (1000 cft)	Beldar - 5 nos. Mazdoor-4 nos.
2.	Refilling of excavated earth in foundation, plinth etc. including consolidation in 150 mm layer.	28.30 m^3 (1000 cft)	Beldar-3 nos. Mazdoor-2 nos. Bhisti-0.5 nos.
3.	Laying cement concrete	2.83 m^3 (100 cft)	Beldar-2 nos. Mazdoor-3 nos. Bhisti-3/4 nos. Mason-1/4 nos.
4.	Laying of R.C.C. work	2.83 m^3 (100 cft)	Beldar-3 nos. Mazdoor-3 nos. Bhisti-1.5 nos. Mason-0.5 no.
5.	Reinforcement work for R.C.C.	1 quintal	Blacksmith-1 no. Beldar-1 no.
6.	First class Brickwork in 1:4 cement morter in superstructure	2.83 m^3 (100 cft)	Mason-2.25 nos. Mazdoor-4.5 nos. Bhisti-0.5 no.
7.	Wood work in door/window fromes	0.18 m^3	Carpenter-2 nos. Beldar-1 nos.
8.	Wood work in panelled, glazed shutters etc.	0.30 m^3	Carpenter-15 nos. Beldar-4 nos.
9.	40 mm cement concrete flooring	40 m^2	Mason-5 nos. Beldar-4 nos. Mazdoor-3 nos. Bhisti-1 no.
10.	12 mm cement mortar plastering	40 m^2	Mason-3 nos. Mazdoor-3 nos. Bhisti-1 no.
11.	Three coats white washing/colour washing	60 m^2	White washer-1 no. Mazdoor-1 nos.
12.	Two coats painting on wood or steel	10 m^2	Painter-3 nos. Mazdoor-2 nos.

3.4.3. Miscellaneous cost

a) Cost of equipment, Tools and Plants (T & P)

The cost of equipment and ordinary tools and plats and miscellaneous petty items (sundries) are added to the specific item rate as lump-sum. A provision of 2.5 to 3 % of the labour cost is made for such items. In certain tools and plants if it is difficult to allocate their use for a particular item of rate; then the cost of such tools or plants may be allocated to the over-head expenditure.

For big works and projects where it becomes necessary to use special types of equipment like batching plants or WMM plant or dumpers or cranes for transportation of concrete mix, provisions of an amount 1% to 1.5% of the estimated cost is provided in the estimate under the head "special tools and plants".

b) Water charges

For drinking purpose of the workers and for the work, arrangement of water is made sinking tube well; bore well or from temporary connection from municipality. For this purpose a provision of 1.5 to 2 % of total cost (Material + Labour+ Sundries) is made in the estimate.

c) Over head charges

Overhead charges include general office expanses, rents, taxes, supervision and other cost which are indirect expanses on the job. Expanses for small tools such as planks, ladders, ropes and other hand tools are also included in the over-head charges. A provision of 2.5% to 5% is made in the rate analysis as overhead charge. Overhead charges can be divided under two categories: General Overhead and job overhead.

General overhead:
These are the expanses made throughout the year irrespective to running works in hand.

These include:

- Establishment charge including rent of office space and taxes
- Salaries to office staff
- Purchase of stationary, Printing, postage etc.
- Electricity, telephone and water bills
- Travelling expanses

Job overhead:

These are the expanses indirectly incurred for the job or the project. These include:

- o Salaries of personnel engaged for the work (Site engineers, Surveyors or site office staff)
- o Rent of temporary site office space, electricity, telephone and water bills
- o Handling of materials
- o Repairs, carriage and depreciation of T & P.
- o Labour welfare, safety measures and insurance etc.
- o Interest on investment
- o Thept and other losses.

c) Contractor's profit

Generally a provision of 10% is made in the rate analysis as contractor's profit for ordinary contracts. For small jobs 15% profit and for large jobs 8% profit may be considered as reasonable. Contractors profit is not included in rate analysis if material is supplied by the department.

3.5. Rate Analysis of Important Items

3.5.1. Earthwork in excavation in foundation including filling in trenches up to 30m lead and 1.5 m lift

Assume volume of excavation = 100 cu m

Particulars	Qnty/Nos.	Rate (Rs.)	Cost (Rs.)
Material Charges	-	-	-
Labour Charges			
1. Head Mason	0.5 Nos.	450.00 per day	225.00
2. Beldar	18 Nos.	250.00 per day	4500.00
3. Mazdoor	14 Nos.	220.0 per day	3080.00
T&P, Sundries, etc.	LS	240.00 LS	240.00
		Total Materials and Labour	**8045.00**
		Add 1.5% water charges	120.67
		Add 10% Contractors profit	804.50
		Grand Total	**8970.17**
		Rate per cu m	**Rs. 89.70**

3.5.2. First class brickwork in super structure with cement mortar (1:6)

a) Estimation of Materials

Assume volume of brickwork = 10 cu m

Nominal size of modular brick = 10 cm×10 cm× 20 cm Hence, the number of bricks required =

Actual size of modular brick = 9 cm× 9 cm× 19 cm

The remaining space is filled by mortar, hence the volume of mortar required for 10 cum = 10 – (5000 × 0.09 ×0.09 × 0.19) = 2.3 cu m.

Additional mortar required for frog filling, brick bonding and wastages @ 15%.

Thus volume of set mortar = 2.3 + 2.3 × 15\100 = 2.64 cum.

But, 1.25 cu m of dry volume of mortar materials produces 1.0 cu m set mortar.

Hence, volume of dry materials required for 2.64 cu m of set mortar = 1.25 × 2.64 cu m = 3.30 cu m.

[Note: As a thumb rule, dry volume of mortar materials is 30% of brick work] Sum of proportion of cement and sand = 1+6 = 7 Hence, volume of cement = 3.3/7 = 0.47 cu m.

However, cement is available in 50 kg bag whose volume is 0.0347 cu m.

[Mass = 50 kg; Density =1440 kg/m3; Thus, Volume = 50/1440 = 0.0347 cu m] [Thumb rule: 1 cu m of cement = 30 bags of cement.]

Therefore, number of bags required = 0.47 / 0.0347 ≈ 13.5 bags.

Volume of sand required = 0.47 × 6 = 2.82 cu m.

b) Rate Analysis

Assume, the volume of brickwork = 10 cu m.

Particulars	Qnty/Nos.	Rate (Rs.)	Cost (Rs.)
Material Charges			
1. Brick	5000 Nos.	250.00 (/100 nos.)	12500.00
2. Cement	13.5 bags	320.00 per bag	4320.00
3. Sand	2.82 cu m	350 per cu m	987.00
Labour Charges			
1. Head Mason	2 Nos.	450.00 per day	900.00
2. Mason	6 Nos.	350.00 per day	2100.00
3. Mazdoor	16 Nos.	220.00 per day	3520.00
4. Bhisti	08 Nos.	220.0 per day	1760.00
T&P, Sundries, etc.	LS	200.00 LS	200.00
		Total Materials and Labour	**26287.00**
		Add 1.5% water charges	394.30
		Add 10% Contractors profit	2628.70
		Grand Total	**29310**
		Rate per cu m	**Rs. 2931.00**

3.5.3. 12 mm thick plaster with cement mortar (1:6)

a) Estimation of Materials

Assume plastering area = 100 sq m

Hence volume of mortar for 12 mm plaster = 100 m × 0.012 m = 1.2 cum

Add 30 % more to the above volume for filling of joints, for making un uniform surface well and for wastages

Thus total set volume of mortar including wastages and joint filling etc.

= 1.2 + 1.2 × 30\100 = 1.56 cu m.

As, 1.25 cu m of dry volume of mortar materials produces 1.0 cu m set mortar;

Volume of dry materials required for 1.56 cu m of set mortar is

= 1.25 × 1.56 cu m = 1.95 cu m,

Hence, volume of cement = 1.95/7 = 0.28 cu m.

Number of bags required = 0.28 / 0.0347 ≈ 8 bags.

Volume of sand required = 0.28 × 6 = 1.68 cu m.

b) Rate Analysis

Assume, the area of plastering = 100 sq. m.

Particulars	Qnty/Nos.	Rate (Rs.)	Cost (Rs.
Material Charges			
1. Cement	8 bags	320.00 per bag	2560.0
2. Sand	1.68 cu m	350 per cu m	588.0
Labour Charges			
1. Head Mason	2 Nos.	450.00 per day	900.0
2. Mason	6 Nos.	350.00 per day	2100.0
3. Mazdoor	08 Nos.	220.00 per day	1760.0
4. Bhisti	02 Nos.	220.0 per day	440.0
T&P, Sundries, etc.	LS	200.00 LS	130.0
		Total Materials and Labour	**8478.0**
		Add 1.5% water charges	127.1
		Add 10% Contractors profit	847.8
		Grand Total	**9452.9**
		Rate per sq m	**Rs. 94.5**

6.5.4. Cement Concrete (1:2:4) for RC work excluding reinforcement and form work

a) Estimation of Materials

Assume volume of R.C.C. = 10 cu m (Set volume)

1.54 cu m dry volume of concrete making materials produces 1.0 cu m set concrete

Therefore volume of dry materials required for 10 cu m of set concrete is 15.4 cu m.

Sum of proportion of cement, sand and course aggregate = 1+2+4 = 7

Hence, volume of cement = 15.4/7 = 2.2 cu m.

Number of bags required = 2.2 / 0.0347 ≈ 64 bags.

Volume of sand required = 2.2 × 2 = 4.4 cu m.

Volume of course aggregate required = 2.2 × 4 = 8.8 cu m.

b) Rate Analysis

Assume, volume of R.C.C. = 10 cu m.

Particulars	Qnty/Nos.	Rate (Rs.)	Cost (Rs.)
Material Charges			
1. Cement	64 bags	320.00 per bag	20480.00
2. Sand	4.4 cu m	350 per cu m	1540.00
3. C. aggregate	8.8 cu m	800 per cu m	7040.00
Labour Charges			
1. Head Mason	/ Nos.	450.00 per day	225.00
2. Mason	2 Nos.	350.00 per day	700.00
3. Beldar	10Nos.	220.00 per day	2200.00
4. Mazdoor	10Nos.	220.00 per day	2200.00
5. Bhisti	05Nos.	220.0 per day	1100.00
T&P, Sundries, etc.	LS	200.00 LS	200.00
Scaffolding	LS	400.00 LS	400.00
		Total Materials and Labour	**36085.00**
		Add 1.5% water charges	541.28
		Add 10% Contractors profit	3608.50
		Grand Total	**40234.78**
		Rate per sq m	**Rs. 4023.50**

Note: If concrete mixture is employed for mixing of concrete, hiring and running charges may add @ Rs. 100.00 per cu m of concrete; but the labour may be reduced by 2 beldars per 10 cu m of concrete.

3.5.5 Lime Concrete in foundation with 25 mm down brick chips (or jhama chips) with lime surki mortar (1:2:5½)

a) Estimation of Materials

Assume volume of lime concrete = 10 cu m (Set volume)

1.54 cu m dry volume produces 1.0 cu m set concrete

Therefore volume of dry materials required for 10 cu m of set lime concrete is 15.4 cu m.

Sum of proportion of cement, sand and course aggregate = 1+2+5½ = 8½

Hence, volume of slaked lime = 15.4/8½ = 1.8 cu m.

Volume of surki required = 1.8 × 2 = 3.6 cu m.

Volume of jhama brick chips required = 1.8 × 5½ = 10 cu m.

b) Rate Analysis

Assume, volume of R.C.C. = 10 cu m.

Particulars	Qnty/Nos.	Rate (Rs.)	Cost (Rs.
Material Charges			
1. Slaked lime	1.8 cum	600.00 per cum	1080.0
2. Surki	3.6 cu m	250.00 per cu m	900.0
3. Brick chips	10.0 cu m	350.00 per cu m	3500.0
Labour Charges			
1. Head Mason	/ Nos.	450.00 per day	225.0
2. Mason	1 Nos.	350.00 per day	350.0
3. Mazdoor	18 Nos.	220.00 per day	3960.0
4. Bhisti	02 Nos.	220.0 per day	440.0
T&P, Sundries, etc.	LS	300.00 LS	150.0
		Total Materials and Labour	**10605.0**
		Add 1.5% water charges	159.0
		Add 10% Contractors profit	1060.5
		Grand Total	**11824.5**
		Rate per sq m	**Rs. 1182.5**

Note: In case of cement concrete in foundation, the labours and T&P will be same as this item. The materials like cement, sand and course aggregate can be calculated by the example 21.5.6 and accordingly rate analysis can be made.

3.5.6 Providing cold twisted steel reinforcement in R.C.C. slab including bending, binding and placing in position complete.

a) Estimation of Materials

If bar bending schedule is available, then reinforcement quantity may be estimated from the schedule. Alternatively, reinforcement steel for beams and slabs may be taken as @ 1% of volume of concrete and for columns @ 2% of volume of concrete. The weight of 1 cum of steel is 78.5 quintals.

Consider, first 10 m × 10 m of continuous slab of thickness 100 mm.

The volume of reinforced concrete = 10 m × 10 m × 0.1 m = 10 cu m

Reinforcement required by volume = 10×1/100 = 0.1 cu m

Weight of reinforcement required = 0.1 × 78.5 qu. = 7.85 qu.

Increase this amount by 5% for wastages.

Thus the volume of reinforcement required = 7.85 × 5/100 = 8.25 qu.

Black iron wire @ 1kg per quintal = 8.25 kg.

b) Rate Analysis

Assume, volume of R.C.C. slab = 10 cu m.

Particulars	Qnty/Nos.	Rate (Rs.)	Cost (Rs.)
Material Charges			
1. Reinforcement	8.25 qu.	3800.00 per qu	31350.00
2. Black Iron wire	8.25 kg	45.00 per kg	371.25
Labour Charges			
1. Blacksmith	8.25 Nos.	450.00 per day	3712.50
2. Mazdoor	8.25 Nos.	220.00 per day	1815.00
T&P, Sundries, etc.	LS	300.00 LS	130.00
		Total Materials and Labour	**37378.75**
		Add 1.5% water charges	560.70
		Add 10% Contractors profit	3737.8
		Grand Total	**41677.3**
		Rate per cu m	**Rs. 4167.7**

Note: R.C.C. works are paid separately for cement concrete work; for steel reinforcement and for centering and shuttering as per the PWD practices.

3.5.7 25 mm thick cement concrete (1:2:4) damp proof course.

a) Estimation of Materials

Assume area of DPC is = 100 sq m

The volume of concrete will be = 0.025*100= 2.5 cum.

Following example 21.5.4, the quantity of cement, sand and course aggregates required for 2.5 cu m concrete are estimated as:

Number of cement bags required = 16½ bags.

Volume of sand required = 1.10 cu m.

Volume of course aggregate required = 2.20 cu m.

Quantity of water proofing compound required = 3% by weight of cement =

= 3% of 16½×50 kg = 25 kg.

b) Rate Analysis

Assume, area of DPC = 100 sq m.

Particulars	Qnty/Nos.	Rate (Rs.)	Cost (Rs.)
Material Charges			
1. Cement	16½ bags	320.00 per bag	5280.00
2. Sand	1.1 cu m	350.00 per cu m	385.00
3. C. aggregate	2.2 cu m	800.00 per cu m	1760.00
4. Water proof compound	25 kg	25.00 per kg	625.00
Labour Charges			
1. Head Mason	/ Nos.	450.00 per day	225.00
2. Mason	08 Nos.	350.00 per day	2800.00
3. Mazdoor	08 Nos.	220.00 per day	1760.00
4. Bhisti	01 Nos.	220.0 per day	220.00
T&P, Sundries, etc.	LS	500.00 LS	100.00
		Total Materials and Labour	**13155.00**
		Add 1.5% water charges	197.33
		Add 10% Contractors profit	1315.50
		Grand Total	**14667.83**
		Rate per sq m	**Rs. 146.70**

3.5.8. Random Rubble Masonry in cement mortar (1:6) in foundation and plinth.

a) Estimation of Materials

11.7 cu m of undressed stone and 0.80 cu m of through stone (header) is required for 10 cu m of RR masonry. Further, 4.2 cum of dry mortar materials (cement and sand) are required for same volume of RR masonry work.

b) Rate Analysis

Assume, volume of RR masonry = 10 cu m.

Particulars	Qnty/Nos.	Rate (Rs.)	Cost (Rs.)
Material Charges			
1. Cement	17 bags	320.00 per bag	5440.00
2. Sand	3.6 cu m	350.00 per cu m	1260.00
3. Undressed Stone	11.7 cu m	200.00 per cu m	2340.00
4. Through Stone	0.8 cu m	250.00 per cu m	200.00
Labour Charges			
1. Head Mason	/ Nos.	450.00 per day	225.00
2. Mason	10 Nos.	350.00 per day	3500.00
3. Mazdoor	17 Nos.	220.00 per day	3740.00
4. Bhisti	2 Nos.	220.0 per day	440.00
T&P, Sundries, etc.	LS	200.00 LS	200.00
		Total Materials and Labour	**17345.00**
		Add 1.5% water charges	260.17
		Add 10% Contractors profit	1734.5
		Grand Total	**19339.6**
		Rate per cu m	**Rs. 1934.0**

3.5.9 Rule pointing in cement mortar (1:3) on brickwork on wall.

a) Estimation of Materials

An empirical quantity of 0.63 cu m (dry) mortar is required for 100 sq. m of Rule and Tuck pointing. In case of Flush pointing 75% of above quantity is required.

b) Rate Analysis

Assume, area of Rule pointing = 100 sq m.

Particulars	Qnty/Nos.	Rate (Rs.)	Cost (Rs.
Material Charges			
1. Cement	4.8 bags	320.00 per bag	1536.0
2. Sand	0.48 cu m	350.00 per cu m	168.0
Labour Charges			
5. Head Mason	/ Nos.	450.00 per day	225.0
6. Mason	10 Nos.	350.00 per day	3500.0
7. Mazdoor	09 Nos.	220.00 per day	1980.0
8. Bhisti	1 Nos.	220.0 per day	220.0
T&P, Sundries, etc.	LS	120.00 LS	120.0
Scaffolding	LS	360.00 LS	360.0
		Total Materials and Labour	**8109.0**
		Add 1.5% water charges	121.6
		Add 10% Contractors profit	810.9
		Grand Total	**9041.5**
		Rate per sq m	**Rs. 90.4**

Module 4

Contract Management – Tender and its Process

INVITATION TO TENDER (ITT):-

An invitation to tender (ITT) is the initial step in competitive tendering, in which suppliers and contractors are invited to provide offers for supply or service contracts, the ITT is one process in IT procurement.

An ITT document specifies all requirements of the organization, including goods, services and timelines, as well as the evaluation process that will be followed. Invitations to tender are often used by public sector organizations, which are legally obligated to offer contracts for goods or service requirements by that process in many countries.

PREQUALIFICATION OF TENDER:-

The main objectives are for implementation of good risk management, promotion of environmentally sustainable practices and provide industry development opportunities. Prequalification is the first stage of the tender process. The Territory intention is to only deal with prequalified suppliers where practical, and hence prequalification provides potential access to tender opportunities which are not available to suppliers who are not prequalified.

Administrative approval:-

For every work (excluding repairs) initiated by, or connected with, the requirements of another department, it is first necessary to obtain the concurrence of the department concerned to the proposals. The formal acceptance by the department concern is termed “administrative approval” of the work, and is, in effect, an order to execute certain specified works at a stated sum to meet the administrative needs of the department requiring the work. Such approval should not, however, be accorded until the professional authorities have intimated that the proposals are structurally sound and that the preliminary estimate is sufficiently correct for the purpose. In the case of works required to meet the administrative needs of the Public Works Department, the administrative approval should be accorded in that Department.

Technical sanction:-

For every work proposed to be carried out, except petty repairs the cost of which is not likely to exceed Rs. 2,500, and annual repairs for which a lump sum provision has been sanctioned by the Superintending Engineer, a properly detailed estimate must be prepared for the sanction of competent authority; this sanction is known as the technical sanction to the estimate. Such sanction can only be accorded in respect of works to be executed through the Public Works Department by Government in the Public Works Department, or, where power has been delegated to them, by officers of that department.

BID SUBMISSION & BID EVALUATION: - A tender, or 'bid' is a submission made by a prospective supplier in response to an invitation to tender. It makes an offer for the supply of goods and/or services.

Bid evaluation is the process that takes place after the tender submission deadline. It involves the opening and examining of the bids to identify the preferred supplier(s) for the project. Negotiations may then be entered into with one or more suppliers, and the successful supplier awarded the contract. Generally, bid evaluation will be carried out in accordance with evaluation criteria or a selection methodology specified in the invitation to tender. Criteria or other factors that were not included in the invitation to tender should not be used to evaluate bids, and ideally, the same evaluators should evaluate all bids.

Bidding parties should submit clear and well-organized bids, but nonetheless, a great deal of thoroughness is required in the bid evaluation process, to ensure that proposals are properly understood, bids are compliant with invitation to tender, no information is overlooked and that correct conclusions are reached

There are a number of criteria upon which a preferred bidder can be identified:

- Lowest price
- Most economically advantageous tender (MEAT)
- Mean value
- Exclusion of the extremes

Evaluation of the Bid has following parts,

- Technical Evaluation
- Commercial Evaluation
- Capacity Evaluation

BID EVALUATION or **TENDER EVALUATION**

The following steps are to be followed:

Step 1: RECEPTION OF THE BIDS

Following advertisement of the tender, ensure that every tenderer who pays the required, non-refundable, fee receives the documents, design drawings, quantities (but no guideline costs), any Community Agreement, the date of the site visit and details on where the tender documents are to be delivered, the deadline for delivery and the location and time of tender opening.

Step 2: OPENING OF THE BIDS

The responsible officer opening the bids should first advise all those present of the procedure he/she will follow. Brief details on the evaluation process (already provided in the documents and based on the guidelines above should be given to assure potential bidders that the evaluation is to be fair and equitable.

Step 3: REVIEW OF THE DOCUMENTATION

As each bid is opened, the responsible staff member may name the bidder but then must check that the bid is complete and conforms to the advertised conditions. If for any reason it is not complete (for example the site visit certificate is missing), the bid should be rejected and the bid price not disclosed. The whole document has to be returned to the bidder with a covering letter stating why it had been rejected. There is no appeal on this matter.

Step 4: TECHNICAL EVALUATION

Once the bids are declared valid, the actual points evaluation procedure can begin. Tenders should initially be assessed, in accordance with the evaluation methodology being utilized, against non-price criteria, that is, on their technical merits. The evaluation team should not have access to the tender price at this stage. The assessment of the non-price criteria is to be documented before moving onto the next stage of the evaluation.

Step 5: FINANCIAL ASSESSMENT

Once tenders have been assessed against the technical criteria, a financial evaluation of the prices tendered (or quoted) can then be undertaken. The results of the financial assessment are to be documented before moving onto the next stage of the evaluation.

Step 6: ASSESSMENT OF 'BEST COMBINED OFFER'

Having separately assessed tenders against technical and financial criteria, a comparison of 'technical worth' and 'price', is undertaken in accordance with the criteria established in the tender document, to determine which tender represents the best combined offer. This stage will establish the final ranking of the tenders.

Contract Formulation:-

Contract life cycle management "is the process of systematically and efficiently managing contract creation, execution and analysis for maximizing operational and financial performance and minimizing risk".

Importance of contract management Organizations in both the public and private sectors are facing increasing pressure to reduce costs and improve financial and operational performance. New regulatory requirements, globalization, increases in contract volumes and complexity have resulted in an increasing recognition of the importance and benefits of effective contract management.

Awarding the contract:-

Following tender evaluation and, where appropriate, negotiation, the project team will satisfy itself that an offer has been made which meets its requirements in all respects, including budgetary, and consider that it is in a position to accept an offer and award the contract to the tenderer who has made the most economically advantageous offer to the organization. It may then move directly to the award stage or make a recommendation to higher authority levels within the organization for acceptance.

This stage should also include activities such as:

• Ensuring that all relevant parties are aware of their roles and responsibilities in the immediate implementation and transition process.
• Checking that the agreed processes for contract management are in place by all the parties.
• The knowledge transfer from the procurement or project team (which may not have included members of the contracts management team) to the contracts management team takes place to ensure successful management of the contract.
• The continuity plans for the seamless transition of the service from one contractor to the new contractor will be carried out as agreed.

Letter of Intent:-

Ideal for expressing and outlining one intent with respect to another the letter of Intent template is perfect. It finds use in various arenas like a real estate purchase, negotiations in business, acceptance of offers and for proposing formal offers as well. The template gives you an entire format to follow and keeps you from going off topic. Mostly used for scholarship acceptance and purchases such template is capable of meeting more than one

need. With a complete layout for basics like subject matter, contacts, names of concerned people, name of concerned institution, number as well as title of funds etc. The letter of intent sample guides you through the entire process of writing a letter of intent while being concise and staying on top of it.

Letter of Acceptance:-

After determining the successful evaluated bidder, Client shall issue a Letter of Acceptance (LOA) in duplicate, who will return one copy to Client duly acknowledged, accepted and signed by the authorized signatory, within Three (3) days of receipt of the same by him.

The issuance of the Letter of Acceptance to the bidder shall constitute an integral part and it will be a binding to the contract.

The time taken between the date of issue of LOA and Notice to Proceed shall not prevent the contractor to mobilize the man power.

Elements of Standard Tender Documents (Source; PUBLIC WORKS DEPARTMENTAL (PWD))

- General
- Accounting Procedures:
- Safety and Economy in contracts:
- Chief Engineer (Communication and Buildings):
- Chief Engineer (National Highways):
- Legal Cell:
- Chief Architect:
- Specification for Buildings, Roads & Bridges:
- Standard Rate Analysis:
- Karnataka Highways Act:
- Register of Lands under control of PWD:
- Safeguarding Government Lands:
- Execution of works:
- Contracting strategy:
- New materials of construction:
- Acts and Rules:
- Right to Information Act and Rules:
- Continuing Education Program:
- Training for rural youth in construction:

- Computerization in Department:
- Powers of PWD officers:
- e-Governance in Public Works, Ports & IWT Department:
- Disaster Management:
- Constant Innovations:

Law of Contract as per Indian Contract Act – 1872:-

This Act may be called be the Indian Contract Act, 1872. Extent, commencement - It extends to the whole of except the State of Jammu and Kashmir; and it shall come into force on the first day of September, 1872. Enactment repealed - Nothing herein contained shall affect the provisions of any Statute, Act or Regulation not hereby expressly repealed, nor any usage or customs of trade, nor any incident of any contract, not inconsistent with the provisions of this Act.

Interpretation –clause

In this Act the following words and expressions are used in the following senses, unless contrary intention appears from the context:

(a) When one person signifies to another his willingness to do or to abstain from doing anything, with a view to obtaining the assent of that other to such act or abstinence, he is said to make a proposal;

(b) When a person to whom the proposal is made, signifies his assent thereto, the proposal is said to be accepted. A proposal, when a accepted, becomes a promise;

(c) The person making the proposal is called the "promisor", and the person accepting the proposal is called "promise",

(d) When, at the desire of the promisor, the promise or any other person has done or abstained from doing, or does or abstains from doing, or promises to do or to abstain from doing, something, such act or abstinence or promise is called a consideration for thepromise;

(e) Every promise and every set of promises, forming the consideration for each other, is an agreement;

(f) Promises which form the consideration or part of the consideration for each other, are called reciprocal promises;

(g) An agreement not enforceable by law is said to be void;

(h) An agreement enforceable by law is a contract;

(i) An agreement which is enforceable by law at the option of one or more of the parties thereto, but not at the option of the other or others, is a voidable contract;

(j) A contract which ceases to be enforceable by law becomes void when it ceases to be enforceable.

The Indian Contract Act – 1872 which consists of following chapters.

Chapter 1:- Of the communication, acceptance and revocation of proposals (Section 1 – 9)
Chapter 2:- Of contracts, violable contracts and void agreements Section (10 – 30)
Chapter 3:- Of contingent contracts (Section 31 – 36)
Chapter 4:- Of the performance of contracts which must be performed (Section 37 – 67)
Chapter 5:- Of certain relations resembling those created by contract (Section 68 – 72)
Chapter 6:- Of the consequences of breach of contract (Section 73 – 75)
Chapter 7:- Sale of goods (Section 76 – 123)
Chapter 8:- Of indemnity and guarantee (Section 124 – 147)
Chapter 9:- Of bailment (Section 148 – 181)
Chapter 10:- Agency, Appointment and authority of agents (Section 182 – 238)
Chapter 11:- Of partnership (Section 239 – 266)

Contract:-

A contract is an agreement between two or more persons and is enforceable by a court of law or equity. To be enforceable, a contract must contain certain basic information that courts have determined over the past several centuries to be necessary. The principles of what must be agreed for a contract to be enforceable date back nearly to the foundations of the English common law. Use of a written contract in the business aspects of artists' affairs facilitates, to some extent, the performance of the agreement, because a party that breaks a contract may be sued in court for the damages caused by the breach, or for specific performance of the obligation not yet discharged. Even absent litigation, a well-formed contract may induce the "other side" to make a decent out-of-court settlement, thus saving the expense of legal proceedings. An oral contract is also enforceable according to law. However, the difficulty of proving the significant terms of an oral contract renders its enforceability far more difficult.

Types of Contracts:-

Lump Sum Contract

A lump sum contract, sometimes called stipulated sum, is the most basic form of agreement between a contractor and a customer. A lump sum contract or a stipulated sum contract will require that the contractor agree to provide specified services for a stipulated or fixed price.

In a lump sum contract, the owner has essentially assigned all the risk to the contractor, who in turn can be expected to ask for a higher markup in order to take care of unforeseen contingencies. A contractor under a lump sum agreement will be responsible for the proper job execution and will provide its own means and methods to complete the work. This type of contract usually is developed by estimating labor costs, material costs, and adding a specific amount that will cover contractor's overhead and profit margin. If the actual costs of labor and materials are higher than the estimate, the profit will be reduced. If the actual costs are lower, the contractor gets more profit. Either way, the cost to the owner is the same. A lump sum contract is a suitable if the scope and schedule of the project are sufficiently defined to allow the contractor to fully estimate project costs.

Item Rate Contract or Unit Price Contract

In a unit price contract, the work to be performed is broken into various parts, usually by construction trade. This contract type is based on anticipated quantities of items which are counted in the project in addition to their unit prices. The final price of the project depends upon the quantities required to carry out the work. For example, painting is typically done on a square foot basis. Unit price contracts are seldom used for an entire major construction project, but they are frequently used for agreements with subcontractors which involve accurate identification of different types of items, but not their numbers, in the contract documents. They are also often used for maintenance and repair work.

Percentage rate contract

In this form of contract, the client's department draws up the schedule of items according to the description of items sanctioned in the estimate with quantities, rates, units and amounts shown therein.

Labour contract

This is a contract where the contractor quotes rates for the item work exclusive of the elements of materials which are supplied by the client's Department.

Piece-Work agreement

This is that for which only a rate is agreed upon without reference to the total quantity of work to be done or the quantity of work to be done within a given period.

Target Contract

This is the type of contract where the contractor is paid on a cost-plus percentage work performed under this contract. In addition, he receives a percentage plus or minus on savings or excess effected against either a prior agreed estimate of total cost or a target value arrived at by measuring the work on completion and valuing at prior agreed rates

Cost Plus Contract

Cost plus contract – The cost plus contract is an agreement which involves the buyer's consent to pay the complete cost for material and labor in addition to the amount for contractor overhead and profit. This contract type is favored where the scope of work is highly uncertain or indeterminate in addition to the types of labor, material, and equipment being similarly uncertain in nature. Here, the contractor's profit is set at a fixed amount. If actual costs are lower than the estimate, the owner keeps the savings. If actual costs are higher than the estimate, the owner must pay the additional amount. The advantage of a cost plus contract is that, generally speaking, the project will result in the building that was envisioned, even if costs run high. The builder is less likely to cut corners or argue for less expensive materials because his profit is not in jeopardy. Three key types of cost plus contracts are: • Cost + Fixed Percentage Contract - Compensation is based on a percentage of the cost. • Cost + Fixed Fee Contract - Compensation is based on a fixed sum independent the final project cost. The customer agrees to reimburse the contractor's actual costs, regardless of amount, and in addition pay a negotiated fee independent of the amount of the actual costs. • Cost + Fixed Fee with Guaranteed Maximum Price Contract – Compensation is based on a fixed sum of money. The total project cost will not exceed an agreed upper limit.

Time and Material Contracts

Time and Material Contracts are usually preferred if the project scope is not clear, or has not been defined. The owner and the contractor must establish an agreed hourly or daily rate, including additional expenses that could arise in the construction process. The costs must be classified as direct, indirect, mark-up, and overhead. Sometimes the owner might want to establish a cap or specific project duration to the contractor that must be met, in order to have the owner's risk minimized.

Incentive Contracts

Compensation is based on the contracting performance according an agreed target - budget, schedule and/or quality. The two basic categories of incentive contracts are

- Fixed Price Incentive Contracts
- Cost Reimbursement Incentive Contracts Fixed Price Incentive Contracts are preferred when contract costs and performance requirements are reasonably certain. Cost Reimbursement Contract provides the initially negotiated fee to be adjusted later by a formula based on the relationship of total allowable costs to total target costs. This type of contract specifies a target cost, a target fee, minimum and maximum fees, and a fee adjustment formula. After project performance, the fee payable to the contractor is determined in accordance with the formula.

Guaranteed Maximum Price Contract

A Guaranteed Maximum Price (also known as GMP, Not-To-Exceed Price, NTE, or NTX) contract is a cost type contract where the contractor is compensated for actual costs incurred plus a fixed fee subject to a ceiling price. The contractor is responsible for cost overruns, unless the GMP has been increased via formal change order (only as a result of additional scope from the client, not price overruns, errors, or omissions). Savings resulting from cost under runs are returned to the owner. This is different from a lump-sum contract where cost savings are typically retained by the contractor and essentially become additional profits. Sometime, savings are shared between the owner and the contractor as an incentive to keep costs down.

Design-Build Contract

A design-build contract is appropriate when the project delivery method is design-build. Traditional contracts are awarded using a design-bid-build system, where the project owner starts by hiring an architect. Once the architect has finished the design phase, the project is put out for bid to general contracting companies. The contractor with the lowest bid is awarded the project and is responsible for completing the job according to the plans created by the architect. With a design-build contract, the owner awards the entire project to a single company. It is typically awarded to a contractor, though architects or engineers may be awarded one in some specialized cases. Once the contract is signed, the contractor is responsible for all design and construction work required to complete the project. This system allows the owner to deal with a single source throughout the duration of the job, rather than coordinating between various parties. When this type of contract is awarded to a contractor, he must hire all architects and engineers required to complete the design work. The owner is still given the right to approve or reject design options, but is no longer responsible for coordinating or managing the design team. Once the owner approves the design, the same contractor then oversees the construction process, hiring subcontractors as

needed. Most of these contracts are awarded through negotiation rather than through a bid process.

Integrated Project Delivery Contract

Integrated Project Delivery (IPD) contracts represent the latest trend towards a more collaborative approach to delivering construction projects. IPD contracts are unique in that they require the involvement of owners, designers, contractors, and key stakeholders on a project as early as possible— sometimes even at the conceptual stage. This contract type results in more transparency among all the parties involved on a construction project. Additionally, both risk and reward are shared by the parties who enter into the IPD contract, resulting in greater integration of resources, processes, and expertise than would be possible under more traditional contract arrangements, as well as maximizing efficiency through all phases of design, fabrication, and construction.

Engineering, Procurement and Construction (EPC)

EPC stands for Engineering, Procurement, Construction and is a prominent form of contracting agreement in the construction industry. The engineering and construction contractor will carry out the detailed engineering design of the project, procure all the equipment and materials necessary, and then construct to deliver a functioning facility or asset to their clients. Companies that deliver EPC Projects are commonly referred to as EPC Contractors.

The EPC phase of the project is also known as the Execution phase which normally follows what is know as a FEED or Front End Engineering Design phase. The FEED is a basic engineering design used as the basis for the EPC phase. The FEED can be divided into seperate packages covering different portions of the project. The FEED packages are used as the basis for bidding on when the client offers the EPC work to the market.

Build–Operate–Transfer (BOT)

It is a form of project financing, wherein a private entity receives a concession from the private or public sector to finance, design, construct, own, and operate a facility stated in the concession contract. This enables the project proponent to recover its investment, operating and maintenance expenses in the project.

Due to the long-term nature of the arrangement, the fees are usually raised during the concession period. The rate of increase is often tied to a combination of internal and external variables, allowing the proponent to reach a satisfactory internal rate of return for its investment.

subcontract

Agreement, purchase order, or any such legal instrument issued under a prime contract (by the prime contractor to a third party the subcontractor), calling for the performance of a defined piece of work or production and/or delivery of specified goods or services. Subcontracts contain special terms and conditions that are unique to the prime contract, and flow-down provisions that proceed from it.

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MODULE 5

CONTRACT MANAGEMENT-POST AWARD

5.1 Terminology

Administrative Approval: This term denotes the formal acceptance by the Administrative department concerned, of the proposal for incurring expenditure in the PWD.

Technical sanction: It is an order by a competent authority sanctioning a properly detailed estimate of the cost of a work to be carried out by the PWD.

Detailed Estimate: An estimate prepared on the basis of the detailed quantities of all items worked out from the designs and drawings are known as a detailed estimate.

Major Estimate: An estimate whose sanctioned amount exceeds a certain fixed limit is known as major estimate. In PWD this limit is fixed at Rs.1 lakh.

Minor estimate: An estimate whose sanctioned amount is lower than a fixed limit is known as minor estimate. In PWD this limit is fixed at Rs.1 lakh.

Petty Work: A work, which does not cost more than Rs.7500 is known as a petty work.

Debit and Credit: In simple terms, „debit" means expenditure and „credit" means a receipt.

Cash: The term „cash" as defined in the CPWD code includes legal coins, notes, cheques, deposit-at-call receipts of scheduled banks, drafts and payments on demand.

5.2. Methods for Carrying out the Work

Public works are carried out either departmentally or through contractors. Complicated and important works, where a high degree of reliability in the quality of work is essential, are generally executed departmentally by engaging contractual labours. This method requires intensive planning and supervision, so that the output of labours and machines is commensurate with the expenditure incurred. For most works, however, the contract method is employed. Through this method the department, taking advantage of competitive bidding by rival contractors, is able to get the work executed at the lowest possible rates. Moreover, the risks involved in construction and the day-to-day problems are the headaches of the contractor and the departmental staff can devote sufficient time to ensure that the contractor's work is in accordance with the designs, specifications, time schedule and other conditions laid down in the agreement.

These are the different methods for carrying out the works:

1. Contract methods

2. Employment of daily labor on muster roll

3. Piece work agreement

4. Work order

In certain cases due to its situation or nature or due to being not susceptible to measurements the works cannot be carried out by contract. The work in such cases is got done by departmental labour and supply of materials, usually the day to day maintenance work is attended to by the work charged establishment. The work is done by them are not measured. They are monthly paid staff employed more or less on the same footing as the regular establishment except that their pay and allowance are charged directly to the work.

5.2.1. Contract methods

In this system the whole work is done by a contractor who arranges all materials required and employ the workers required for completion of projects in time. The contract system may be lump sum contract, item rate contract, cost plus percentage contract, labour contract or materials contract. Details about contract system are provided in previous lectures.

5.2.2. Employment of daily labor on muster roll

Work may be executed departmentally through employment of daily labours such as mason, coolies, bhisties, carpenters, etc. The materials required for the construction such as bricks, cement, sand, lime, surki, timber steel etc., and tools and plants required for the operations are got issued from the store by indent or purchase directly chargeable to the work. The attendance of the labours is kept in Muster Roll by the overseer or by his authorized agents.

a) Payments to daily labours through muster roll

Except for the regular and work charged establishments, all persons engaged departmentally for the execution of works are considered as casual labour. Their wages are drawn on "Muster rolls". Muster rolls are prepared in the prescribed form (Form 21).

The Nominal Muster Roll (N.M.R) form consists of two parts.

Part I of N.M.R. form consists of necessary columns for entering the names of labour, designation, father's name, their attendance particulars, rates of wages and the total amount payable for each labour. N.M.R form has the provision for entering the total amount of the muster, signature or left hand thumb impression of the labour as a receipt. At the bottom of this form, the person preparing such N.M.R form should sign before submitting to A.E / D.E.E who in turn verifies the details entered and makes the payment.

Part II of the muster roll is used for recording the name of work, amount of work done in cases in which the work is susceptible to measurements. Other details like the number of measurement book, pages in which the measurements are recorded will also be entered in this part. If the work is not susceptible to measurement, a remark to that effect is recorded.

Some important instructions regarding the preparation of Muster rolls are:

- Duplicate copies of muster rolls should not be prepared.

- Separate muster rolls are prepared for each period of payment. Labour may be paid more than once a month depending upon local conditions and practices.

- The daily record of attendance and times should be recorded in such a way as to leave no possibility of tampering or making unauthorized entries.

- After the muster roll has been passed, payment should be made as early as possible.

- A record of wages that remains unpaid must be kept in a register of unpaid wages.

- Subsequent payment of unpaid wages is recorded in the hand receipt. A note of the same is recorded in the register of unpaid wages as well as in the muster roll.

- Wages that remain unpaid for three months must be reported to the divisional office.

- Progress of work done by the labour is recorded and is to be compared with departmental rates.

- Muster rolls are checked with reference to entries in the measurement book to the extent of 50% in the sub-divisional and 50% in the division office, when the divisional engineer makes payments.

8.2.3. Piecework agreement

These are agreements for doing the work at agreed rates, without reference to the total quantity of work or time. Small works or piecework up to Rs.5000/- are got done through the contractors by piecework agreement. In piece-work, the quantity of work is not mentioned and only the rate is mentioned. This agreement is used (i) for small works (ii) when it is necessary to start work in anticipation of the formal acceptance of the contract and (iii) for running contract. This type contract can be terminated by both parties at any instance without any penalty. Piece work agreements are:

Advantages:

- Urgent small work can be carried without any tenders

- If a contractor leaves, another can take the work

Disadvantages:

- Only petty contractors are interested in this contract.

- Hence careful supervision is required

5.2.4. Work order

Work order is used for petty works; work orders may sometimes also mention the time limit within which the work is to be completed. No formal agreement is drawn up with the contractor as in the case of piece-work when the work is awarded by a work order.

5.3. Measurement Book (M.B.)

The measurement of all works and supplies are recorded in the measurement book and the payments of all works and supplies are made on the basis of the measurements recorded.

Land Acquisition Act

Land acquisition is defined as the process of getting back the land by the government with the certain compensation. Land is needed by the government for:

- Strategic purposes like armed forces and
- Industry and Infrastructure
- Planned development
- Residential purpose for poor, educational & health schemes
- Land for private companies for public purpose
- Needs that arise from natural calamity

5.4 Procedure for land acquisition

In India Land can be acquired by the Government according to Land Acquisition, Rehabilitation and Resettlement (LARR) Act, 2013 (Land Acquisition Act, 2013).

When the Government requires land for any of the stated purposes, a notification to that effect shall be published in the Official Gazette and in two daily newspapers circulating in that locality of which at least one shall be in the regional language. Thereupon it will be lawful for any officer and for his workmen to enter upon and survey and take levels, to dig or bore into the subsoil in such locality.

5.4.1 Objection

Any objection by any person to the process should be made in writing to the Collector within 30 days of publication of the notice.

Enquiry and award by the Collector

When government declares public purpose and shall control the land directly, consent of the land owner shall not be required. However, when the government acquires the land for

private companies, the consent of at least 80% of the project affected families shall be obtained through a prior informed process before government uses its power under the Act to acquire the remaining land for public good, and in case of a public-private project at least 70% of the affected families should consent to the acquisition process.

On the day so fixed, the Collector shall proceed to enquire into the objections (if any) and being satisfied that all the persons interested in the land who appeared before him have agreed in writing on the matters to be included in the award of the Collector in the form prescribed by rules made by the appropriate Government, make an award according to the terms of such agreement.

On making an award, the Collector shall tender payment of the market value compensation awarded by him to the persons interested and entitled thereto according to the award. If there be any dispute as to the title to receive the compensation or as to the apportionment of it, the Collector shall deposit the amount of the compensation in .the Court.

Dispute and delay for acquiring land

The Owner of the land who has not accepted the award may move to the court of law hence causing delay for acquiring a land for even several years.

Matters to be considered in determining compensation:

- The market value of the land on the date of the publication of the notification;

- The damage sustained by the person interested, by reason of the taking of any standing crops or trees which may be on the land at the time of taking possession thereof;

- The damage sustained at the time of taking possession of the land, by reason of separating such land from his other land;

- The damage sustained at the time of taking possession of the land, by reason of the acquisition injuriously affecting his other property, movable or immovable, in any other manner, or his earnings;

- If, the person interested is compelled to change his residence or place of business, the reasonable expenses incidental to such change; and

- The damage bonafide resulting from reduction of the profits of the land between time of the publication of the declaration and the time of taking possession of the land.

Dispute

Given the uncertainties involved in a constructuion project and the magnitude of funds involved it is only natural to have disagreement between the parties, but these needs to be resolved. While most such day-to-daydifferences are resolved in an amicable manner, without having to resort to a more formal mechanism, the parties at times agree to disagree and seek redressal through independent intervention.

Causes of Disputes

Following are the main causes of disputes between the owner and the contractor:

- Incorrect or different site conditions
- Use of faulty and ambiguous provision in contracts
- Change orders/extra or out-of-scope work
- Suspension of works
- Poor quality of work and construction defects
- Default by the contractor
- No publicity involved
- Unfair distribution of risk
- Delay in payments and over payment
- Levy of compensation for delay
- Termination of work-order

Various Dispute Resolution

MechanismsNegotiation

Parties themselves or their representatives try to resolve the dispute without involving any neutral third party.

Mediation

Mediation is a private, quick, cheap process (compare to either arbitration or litigation) where a third party makes possible dialogue between the parties in order that the parties can reach their own decision that is initiallynon-binding. The parties can however, agree to be bound by their final decision.

Conciliation

It is a process similar to mediation except that the conciliator can express an opinion on the merits of the caseand is required to recommend a solution if the parties fail to agree.

Mini-trial

In Mini-trial, the case is heard not by judges, but by the senior professional or other high level business peoplehaving full settlement authority from both sides. A third party neutral usually joins the party representatives listening to the proofs and arguments, an can make any necessary decision to regulate the process.

Adjudication

The dispute is referred to an adjudicator, an eminent person with sound legal knowledge, who is appointed toprovide speedy legal decision without going through time consuming court proceedings.

Arbitration

Arbitration is a process where a third party who is independent of parties, but may be appointed by them, makes a decision on the dispute. The decision is binding and can be enforced by the courts. Thus arbitration is a out-of-court proceeding where the arbitrator acts as judge. The outcome is one of a win/lose situation.

Litigation

Litigation (used when all other venues fails) is a dispute resolution method that is inquisitorial and adversarial,where by the disputants initiate legal action against the other party by going to the court. It is costly and results

into much delay for the disputants and may not do justice to the parties. However, the benefit the litigation is that the court has the authority to find out the "truth" from the parties and the enforcement of the order or the judgment is supported by other law enforcement agencies.

Advantages of Arbitration over Litigation

- Cost: Arbitration is less expensive than court proceeding.
- Speed: Disputes are settled much faster through arbitration as compared to law suit in the court.
- Convenience: Arbitration hearings are fixed considering the convenience of both the parties.
- Technical knowledge: Both parties have the distinct advantages of appointing arbitrators having technical knowledge and expertise which facilitates satisfactory judgment.
- Informality: Arbitration is conducted in a relatively informal atmosphere observing certain minimum prescribed legal formalities.
- Proceedings in the private premises: Arbitration proceedings are held in the private premises; consequently business activities of the parties do not suffer.
- Confidentiality of awards: The arbitral proceedings and an arbitral awards are generally non-public and can be made confidential.
- Finality of award: The award given by the arbitration is final except in exceptional cases.

MODULE 5

VALUATION

Definition

Valuation is the technique of determination of fair price of a property such as land, building, factory or other structures. Valuation determines present value of the property for sale or renting purpose.

Difference between Cost, Price and Value

- Cost means the original cost of construction minus the loss due to its age and change in taste or fashion.

- Price is the amount calculated adding the cost of the production, interest on investment and profit to the producer or the owner.

- Value is the worth or utility of a property. Value of a property depends largely on the demand and supply.

For example the cost to draw a painting may be 1,000/- rupees, but by adding profit for the painter the price may be fixed at 1,500/- rupees. Let us consider the painting is a very famous painting whose demand is more (like Monalisa by Leonardo da Vinci) then the value of the painting may be significantly high.

Purpose of the Valuation

The main purposes of valuation are as follows:

- Sale or Purchase of a property
- To fix up the municipal taxes, wealth tax and estate duty on a property
- To fix up the gift tax payable to the govt when the property is gifted to somebody else.
- To probate, i.e. to prove before a court that the written paper purporting to be the will of a person who has died is indeed his lawful act the official copy of a will is to be presented along with court stamp fees. The stamp fee depends on the value of a property and for this valuation is necessary.
- To divide the property among the shareholders in case of the partition.
- Assessment of income or stamp duty.
- To pay the capital gains tax when a capital asset is disposed of and the proceeds exceed the costs incurred in acquiring the asset.
- Rent Fixation
- To work out the insurance value of a property
- To determine the quantum of loan that can be sanctioned against a property as mortgage or security
- For compulsory acquisition of the property by govt. for public purpose.
- To determine the speculative value of a property, i.e. the purchase of a property with intention to sale at a later date and to make some profit.

• To fix up the betterment charges, i.e. construction of new road, providing market complex, community hall etc. so that the value of the property will increase.

Terminology

Incomes:

a) Gross income: Total income from all sources.

b) Outgoings: these are the expenses which are required to be incurred to maintain

the property. These includes: Taxes, periodic repairs, management and collection charges, sinking fund, and loss of rent (for the period when the property is not occupied).

c) Net income: The amount left after deducting all outgoings from the gross income.

d) Net income = gross income- outgoings.

e) Perpetual income: It is the income receivable for indefinite period of time.

f) Deferred Income: it is the income receivable after a lapse of certain period.

Scrap value

If a building is to be dismantled after the period 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. Scrap value varies from 7% to 10% of the cost of construction according to the availability of the material.

Salvage value

If a property after being discarded at the end of the utility period is sold without being into pieces, the amount thus realized by sale is known as its salvage

Scrap value

This is the dismantled sale value of the materials of an asset at the end of its useful life.

Scrap value is counted in the calculation of depreciation of a property at the end of the useful life and usually this is considered 10% of the cost of the structure or on lump sum basis.

This is the estimated value of an asset as a whole without dismantling at the end of its useful life.

Ordinarily the salvage value factor in the calculation is omitted by accounting scrap value

Scrap value of an asset is merely sale of scarp and has a limitation.

Salvage value deposition may take the form of a sale of the asset to a purchaser who will continue to use it for the function for which it was originally designed. In this case salvage value dominate scrap value in the calculation of depreciation

Year's purchase

It may be as the figure which when multiplied by the net income from a property gives capitalized value of the property. It can also be defined as "a certain amount of capital whose annuity of Rs.1/- at a certain rate of interest can be received"

Year"s purchase = 100/rate of interest = 1/i

Capitalized value

It is defined as that 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 prevailing on such properties and income from the property.

Example:

Calculate the capitalized value of a property fetching a net annual rent of 25000 and the highest rate of interest prevalent being 7%.

Ans:

Net annual rent = 25,000

Rate of interest = 8%

In order to get an annual interest equal to the net annual rent of Rs. 25,000

(8/100) * X = 25000

X = 25000 * (100/8) = 3, 12, 500.00

Capitalized value = Net annual income * Year"s purchase (Ans.)

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 reason of this is fast changing techniques of construction, design, ideas leading to more comfort etc.

Market value

The market value of a property is the amount, which can be obtained at any particular time from the open market if the property is put for sale. The market value will differ from time to time according to demand and supply.

Book value

Book value is the amount shown in the account book after allowing necessary depreciations. The book value of a property at a particularly year is the original cost minus the amount of depreciation up to the previous year.

Annuity

It is defined as the return of capital investment in the shape of annual instalments monthly, quarterly, half-yearly and yearly. It is the annual payments for the repayment of the capital amount invested by a party. These annual payments are made at the beginning or end of a year, usually, for a specific number of years.

- **Annuity Certain**: If the amount of the annuity is paid for a definite number of years. The lesser the number of year higher the annuity and vice versa

- **Annuity Due**: If the amount of annuity is paid at the beginning of each period or year and payments are continued for definite number of periods

- **Deferred Annuity:** If the payment of the amount of annuity begins at a future date after a number of years.

- **Perpetual Annuity:** If the payment of the annuity continues for an indefinite period.

Though annuity means annual payment, the amount of annuity may be paid by 12 monthly installments, quarterly or half-yearly installments.

Sinking fund

It is an amount which has to set aside at fixed intervals of time (say annually) out of the gross income so that at the end of the useful life of the building or the property, the fund accumulated should be equal to the initial cost of the property. The sinking fund may also be required for payment of the loans.

Where, S = Total amount of sinking fund to be accumulate

n = useful life of the property or nos. of years required to accumulate the sinking fund, i= rate of interest in decimals and I = is the annual instalments paid.

Example:

A pumping set with motor has been installed in a building at a cost of 2500.00. Assuming the life of the pump as 15 years, find the annual installment of sinking fund required to be deposited to accumulate the whole amount of 4% compound interest.

Ans:

Annual Sinking fund,

= 2500 * 0.05 = Rs. 125.00 (Ans.)

Factors Affecting Value of a Building

- Type of the building
- Location
- Building structure and durability
- The quality of materials used in the construction
- Size of the building

Depreciation

It is the loss in value of a building or property due to structural deterioration, wear and tear, decay and obsolescence. It depends on use, age, nature of maintenance etc. A certain percentage (per annum) of the total cost may be allowed as depreciation to determine its present value.

The percentage rate of depreciation is less at the beginning and increases with age.

Annual depreciation is the annual decrease in the value of the property.

Calculation of Depreciation

The amount of depreciation being known, the present value of the property can be calculated after deducting the total amount of depreciation from the original cost.

- Straight line method
- Constant percentage method
- Sinking fund method
- Quantity survey method

Straight line method

It is assumed that the property loses its value by the same amount every year. A fixed amount is deducted every year, so that at the end of the utility period, only the scrap value remains. Therefore, the annual depreciation “D” is estimated as:

And the book value after „n“ years = Original cost – n x D

Constant percentage method (declining balance method)

It is assumed that the property will lose its value by a constant percentage of its value at the beginning of every year.
Annual Depreciation,
Value of property of depreciated cost = C – DC

Sinking fund method
It is assumed that the depreciation is equal to the annual sinking fund plus the interest on the fund for the year, which is supposed to be invested on interest bearing investment.

If A is the annual sinking fund and b, c, d etc. represent interest on the sinking fund for subsequent years, then the depreciation at the end of various years can be calculated as:

Year	Depreciation for the Year	Total Depreciation	Book Value
1st year	A	A	C - A
2nd year	A + b	2A + b	C-(2A + b)
3rd Year	A + c	3A + b + c	C-(3A + b + c)

Quantity survey method

The property is studied in detail and loss in value worked out. Each step is based on some logical reasoning without any fixed percentage of the cost of the property.
Only an experienced valuator can work out the amount of depreciation and the present value of the property using this method.

Determination of Depreciation of a building
After deciding the cost using the previous measures, it is necessary to allow a suitable depreciation on the cost. The following table provides a reasonable depreciation of a building whose life if 80 years and well maintained.

Age of the building	Depreciation per year	Total depreciation
0-5 years	Nil	Nil
5-10 years	@ 0.50%	2.5%
10-20 years	@ 0.75%	7.5%
20-40 years	@ 1.00%	20%
40-80 years	@ 1.50%	60%
Total depreciation after 80 years		**90%**

The balance 10% is the net scrap value on dismantling at the end of the utility period.

Methods of Valuation of Building.

The valuation of a building is determined by working out its cost of construction at the present day rate and allowing a suitable depreciation.

Following data are required for valuation of a building

- Cost of incurred if the building to be constructed in present day
- Age of the building should be determined
- Visual inspection of its present condition
- Future life span should be determined

Estimation of present day cost

Present day cost may be estimated from the records, Estimates and Bill of Quantities. If the actual cost of construction is known, this may increase or decrease according to the percentage rise or fall in the rate obtained from the PWD Schedule of Rates. Following are the methods to ascertain the present day cost of a building:

a) Cost by detailed measurement

Cost of construction may be calculated by preparing the BOQs of various items of works by detailed measurement at site and taking the rate of each item of work as per the current PWD SOR. All the items of work shall be thoroughly scrutinized and their detailed specification ascertained as per original.

b) Cost by plinth area

The plinth area of the building is measured and the present day plinth area rate of similar buildings in the locality is studied, and the cost calculated. It is necessary to examine thoroughly the different parts of the building including the foundation, structure, doors & windows, finishes etc.

Estimation of present day value of the building

Following methods are available to determine value of a building:

a) Direct comparison method/ Plinth area method:

It is the simplest form of valuation. The cost of the property is derived from the cost of property sold recently at its neighbourhood. Plinth area cost prevailing in the locality is then worked out. Finally value of the property can be derived from Plinth area cost multiplied by the plinth area of the property. Similarly Cost may be estimated by Cubical content method.

b) Depreciation rate method:

After deciding the cost of the building or structure by any one method, described in 11.9.1, it is necessary to allow a suitable depreciation on the cost.

c) Rental method

In this method, the net income by way of rent is found out by deducting all outgoings from the gross rent. A suitable rate of interest as prevailing in the market is assumes and the years purchase is calculated. The net income multiplied by Y.P. gives the capitalized value or valuation of the property.

d) Land and building method

In this method, the market value of land and the depreciated value of building are determined individually. Then these two values are added to determine the final value of the property.

e) Development method

This method of valuation is used for the properties which are undeveloped or under developed. Those properties were brought, developed and then offered for the sale. The valuation in that case would depend on initial investment, development cost and expected profit.

Mortgage

Mortgage is the conditional conveyance of property as security for the repayment of a loan. Money borrowed against the security of mortgaged property. Amount of loan sanctioned against a mortgaged property is usually 50 – 70% of the of the property cost.

Mortgagor: The person who takes the loan.Mortgagee:

The person who gives the loan.

Mortgage Deed: Documents required for the mortgage transaction

Types of Property

a) Freehold property

When the owner is in absolute possession of the property and can utilize it in any which manner he likes. He can use the property for himself, grant lease or tenancies for any period of time.

b) Leasehold Property

It indicates the physical possession of the property, but the use of it may be allowed by the original owner (lessor) as per the lease documents.

Easement

Privileges and rights that one owner of the property enjoys through or over the property of another. The person who enjoys the easement is the Dominant owner and the owner over whose property the easements are enjoyed is the Servant owner.

1. Right to use light and air from an adjoining property.

2. Right of flow of rain water over the other‟s land.

3. Right of access from the adjoining owner‟s land.

4. Right to run services through the neighbor‟s land.

5. Right of support for a building from the adjoining owner‟s land.

Easement rights may be granted through documents for uninterrupted periods of 20 years.