

ATME College of Engineering

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A T M E
College of Engineering

DEPARTMENT OF CIVIL ENGINEERING
(ACADEMIC YEAR 2026 -27)

**SUBJECT NAME: Estimation and Contract
Management**

SUB CODE: BCV702

SEMESTER: VII

INSTITUTE**Vision of the Institute**

Development of academically excellent, culturally vibrant, socially responsible and globally competent human resources.

Mission of the Institute

- To keep pace with advancements in knowledge and make the students competitive and capable at the global level.
- To create an environment for the students to acquire the right physical, intellectual, emotional and moral foundations and shine as torch bearers of tomorrow's society.
- To strive to attain ever-higher benchmarks of educational excellence

DEPARTMENT**Vision of the Department**

To develop globally competent Civil Engineers who excel in academics, research and are ethically responsible for the development of the society.

Mission of the Department

- To provide quality education through faculty and state of art infrastructure
- To identify the current problems in society pertaining to Civil Engineering disciplines and to address them effectively and efficiently
- To inculcate the habit of research and entrepreneurship in our graduates to address current infrastructure needs of society

Program outcomes (POs)**Engineering Graduates will be able to:**

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Program Specific Outcomes (PSOs)

PSO1: Provide necessary solutions to build infrastructure for all situations through Competitive plans, maps and designs with the aid of a thorough Engineering Survey and Quantity Estimation.

PSO2: Assess the impact of anthropogenic activities leading to environmental imbalance on land, in water & in air and provide necessary viable solutions revamping water resources and transportation for a sustainable development

Program Educational Objectives (PEOs)

PEO 1- Engaged in professional practices, such as construction, environmental, geotechnical, structural, transportation, water resource engineering by using technical, communication and management skills.

PEO 2- Engaged in higher studies and research activities in various civil engineering fields and life time commitment to learn ever changing technologies to satisfy increasing demand of sustainable infrastructural facilities.

PEO 3- Serve in a leadership position in any professional or community organization or local or state engineering board

PEO 4- Registered as professional engineer or developed a strong ability leading to professional licensure being an entrepreneur.

Module-1

Estimation of Building

1. Introduction

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

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

1.1 Purpose of an Estimate

- Probable cost to be made ready before taking up a project
- To obtain administrative approval in case of public construction
- To ascertain the quantities of labour required
- To fix up a construction schedule
- To justify the benefit–cost ratio
- To invite tenders and prepare bills for payment

2. Types of Estimates

Estimates may be divided into the following categories:

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

2.1 Preliminary or Approximate Estimate

Prepared to decide the financial aspect and policy, and to give the sanctioning authority an idea of the cost of the proposal. It should clearly show the necessity of the proposal and how the cost has been arrived at.

The calculation is based on data from a similar, already-completed construction nearby, executed by the department. For example, for a hospital, the per-bed cost of a recently completed hospital is multiplied by the number of beds required; for a house, the per-square-

metre plinth area rate is multiplied by the proposed covered area (with matching specifications); for a road, the expenditure per kilometre (with width) is used.

Documents to be attached:

- Detailed report
- Site plan of the proposal
- Clear mention of land acquisition, provision of electric and water supply, etc.

2.2 Plinth Area Estimate (Rough Cost)

Plinth area = Length $\times$ Breadth of the roofed portion only, excluding plinth offsets. The rate is arrived at by dividing the total cost of a similar completed building by its plinth area.

Example: If the total cost of a building is Rs. 2,00,000 and its plinth area is 50 sq.m., the plinth area rate = Rs. 2,00,000 / 50 sq.m. = Rs. 4,000 per sq.m. This rate is then multiplied by the plinth area of the proposed building to get its approximate cost.

Documents to be attached:

- Line plan with brief specifications
- Cost of various services added (electric, water supply, etc.)
- North line clearly shown on the line plan

2.3 Cubic Contents Estimate (Rough Cost)

Cubic contents = Plinth area $\times$ Height of building (measured from top of floor level to top of roof). The cubic rate is arrived at from a similar completed construction (total cost $\div$ cubic contents), and this rate is applied to the proposed building. Documents attached are the same as for the plinth area estimate.

Note: Administrative approval is granted on the rough cost estimate.

2.4 Detailed Estimate

Prepared after administrative approval of the rough cost estimate. The work is divided into sub-heads, and quantities of individual items are calculated. An abstract of cost is prepared at the end, giving quantities and rates (per the sanctioned schedule of rates) for each item. For non-schedule items, a proper rate analysis is attached.

If the site is remote, carriage/transport cost of materials should be included to avoid exceeding the administratively approved amount later. Detailed specifications and a report are also attached. Technical sanction is given on the detailed estimate.

A comprehensive detailed estimate also provides for the cost of approach road, water supply, electrical installation and land acquisition.

2.5 Annual Repair Estimate

To keep buildings and roads in good condition, annual repairs are carried out:

- Buildings — white-washing, oiling and painting of doors/windows, cement plaster repairs (inside and outside), floor repairs, etc. (this should not exceed 1.5%–2% of the capital cost of the building)

- Roads — filling patches, maintenance of berms, etc.

2.6 Special Repair Estimate

Prepared when work cannot be carried out from annual repair funds due to a genuine increase in cost. Reasons may include:

- Buildings — opening new doors, changing floors, plastering walls, etc.
- Roads — scarifying a badly corrugated/patched surface, removing old metal, adding fresh metal, and repainting the top surface

2.7 Revised Estimate

Prepared when the sanctioned estimate is exceeded by 5% or more, whether due to insufficient rates or other reasons. A comparative statement is attached on the last page, giving reasons for the cost increase in each item.

2.8 Supplementary Estimate

A fresh detailed estimate prepared in addition to the original sanctioned estimate, when additional works become necessary during execution to supplement the original work. The abstract of cost shows both the original sanctioned amount and the additional (supplementary) amount for which sanction is required.

3. Method of Estimating (Detailed Estimate)

Preparation of a detailed estimate has two stages:

3.1 Details of Measurement and Calculation of Quantities

The work is divided into different items — earthwork, concrete, brickwork, etc. — classified and grouped under sub-heads. Measurements for each item are recorded and quantities computed in the prescribed form:

Item No.	Particulars of items	No.	Length, m	Breadth, m	Height/Depth, m	Quantity, cu.m	Explanation

3.2 Abstract of Estimated Cost

The cost of each item is calculated from the quantities already computed, at a workable rate, and the total cost is worked out in the prescribed form. A contingency allowance of 3–5% is added to cover petty/unforeseen expenditure, design changes, rate changes, etc.

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

3.3 Data Required to Prepare an Estimate

9. Drawings — plans, elevations, sections, etc.
10. Specifications
11. Rates

If the drawings are unclear or lack complete dimensions, preparing the estimate becomes very difficult — clear drawings are essential.

Specifications

- General Specifications — nature, quality, class of work and materials in general terms; gives a general idea of the building
- Detailed Specifications — detailed description of each item of work, including quantities/qualities of materials, proportions, method of preparation, workmanship and execution

Rates

Unit rates for each item of work are required, based on:

12. The rates of various materials used in construction
13. The cost of transporting materials
14. The wages of skilled/unskilled labour — masons, carpenters, mazdoors, etc.

3.4 Main Items of Work

- Earthwork
- Concrete in foundation
- Soling
- Damp proof course
- Masonry
- Arch masonry work
- Lintels over openings
- R.C.C. work
- Flooring and roofing
- Plastering and pointing
- Doors and windows
- Wood work
- Iron work
- White washing / colour washing / distempering
- Painting

3.5 R.C.C. Work

R.C.C. work covers slabs, beams, columns and footings; quantities are calculated in cu.m. Dimensions of these structural elements are taken accurately from the plan and sectional elevation, with bearings added to clear lengths. Quantities are calculated in two parts:

- Cement concrete quantity, including centering and shuttering, excluding steel reinforcement

- Steel reinforcement quantity, along with the Bar Bending Schedule

3.6 Flooring and Roofing

Quantity is calculated in sq.m. by multiplying length by breadth. Length and breadth are measured as inside dimensions, from wall to wall of the superstructure.

4. Units of Measurement (Metric System)

General principle: millimetre (mm) for minute dimensions, centimetre (cm) for small dimensions, and metre (m) for large dimensions.

S. No.	Particulars of material/work	Dimensions
1	Bricks, stone blocks, etc.	All dimensions in cm
2	Tiles, slates, wall board, glass panes, A.C. sheets	Length & breadth in cm/m; thickness in mm
3	Doors and windows	Height and breadth in cm or m
4	Masonry (brick or stone, etc.)	Length and height in m
5	Painting	Length, breadth or height in m

5. Method of Building Estimate

Length, breadth and height/depth are taken from the drawing — plan, elevation and section — and must be extracted correctly.

5.1 Method 1 — Individual Wall (Long Wall / Short Wall) Method

Measure the external length of walls running longitudinally (long walls, out-to-out) and the internal length of walls running transversely (short walls, in-to-in). The same rule applies to excavation in foundation, concrete in foundation, and masonry. Note that dimensions may differ at different heights due to offsets or footings.

Long wall length (out-to-out) = centre-to-centre length + one breadth ($\frac{1}{2}$ breadth added on each side)

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

In short: add one breadth for long walls, and subtract one breadth for short walls, from the centre-to-centre length.

Example 1 — Single-Room Building (5 m × 4 m)

Estimate: earthwork in excavation, concrete in foundation, brickwork in foundation & plinth, and brickwork in superstructure.

Long wall c/c length = $5 + \frac{1}{2}(0.30) + \frac{1}{2}(0.30) = 5.30$ m. Short wall c/c length = $4 + \frac{1}{2}(0.30) + \frac{1}{2}(0.30) = 4.30$ m.

Item	Particulars	No.	L (m)	B (m)	H/D (m)	Qty (cu.m)	Explanation
1	Earthwork excavation — Long walls	2	6.20	0.90	0.90	10.04	$L = 5.30 + 0.90 = 6.20$ m
	Earthwork excavation — Short walls	2	3.40	0.90	0.90	5.51	$S = 4.30 - 0.90 = 3.40$ m
	Total					15.55	
2	Concrete in foundation — Long walls	2	6.20	0.90	0.30	3.35	$L = 6.20$ m
	Concrete in foundation — Short walls	2	3.40	0.90	0.30	1.84	$S = 3.40$ m
	Total					5.18	
3	Brickwork in fdn/plinth — L, 1st footing	2	5.90	0.60	0.30	3.65	$L = 5.30 + 0.60$
	L, 2nd footing	2	5.80	0.50	0.30	1.74	$L = 5.30 + 0.50$
	L, Plinth wall	2	5.70	0.40	0.60	2.74	$L = 5.30 + 0.40$
	S, 1st footing	2	5.50	0.80	0.20	1.76	$S = 4.30 - 0.60$
	S, 2nd footing	2	5.60	0.70	0.10	0.78	$S = 4.30 - 0.50$
	S, Plinth wall	2	5.90	0.40	0.80	3.78	$S = 4.30 - 0.40$
	Total					14.45	
4	Damp proof course — Long walls	2	11.00	0.40	-	8.80	$L = 10.60 + 0.40$
	Damp proof course — Short walls	3	5.90	0.40	-	7.08	$S = 6.30 - 0.40$
	Total					15.88	sq.m
5	Brickwork superstructure — Long walls	2	5.60	0.30	3.50	11.76	$L = 5.30 + 0.30$

Item	Particulars	No.	L (m)	B (m)	H/D (m)	Qty (cu.m)	Explanation
	Brickwork superstructure — Short walls	2	4.00	0.30	3.50	8.40	S = 4.30-0.30
	Total					20.16	cu.m

Example 2 — Two-Roomed Building

Items: earthwork in excavation, lime concrete in foundation, 1st class brickwork (CM 1:6) in foundation & plinth, 2.5 cm c.c. damp proof course, and 1st class brickwork in lime mortar in superstructure.

Long wall c/c length = $4 + 6 + 0.30 + 2 \times 0.30/2 = 10.60$ m. Short wall c/c length = $6 + 2 \times 0.30/2 = 6.30$ m.

Item	Particulars	No.	L (m)	B (m)	H/D (m)	Qty (cu.m)	Explanation
1	Excavation — Long walls	2	11.70	1.10	1.00	25.74	L = 10.60+1.10
	Excavation — Short walls	3	5.20	1.10	1.00	17.16	S = 6.30-1.10
	Total					42.90	
2	Lime concrete — Long walls	2	11.70	1.10	0.30	7.72	
	Lime concrete — Short walls	3	5.20	1.10	0.30	5.15	
	Total					12.87	
3	L, 1st footing	2	11.40	0.80	0.20	3.65	
	L, 2nd footing	2	11.30	0.70	0.10	1.58	
	L, 3rd footing	2	11.20	0.60	0.10	1.34	
	L, 4th footing	2	11.10	0.50	0.10	1.11	
	L, Plinth wall	2	11.00	0.40	0.80	7.04	
	S, 1st footing	3	5.50	0.80	0.20	2.64	
	S, 2nd footing	3	5.60	0.70	0.10	1.18	

Item	Particulars	No.	L (m)	B (m)	H/D (m)	Qty (cu.m)	Explanation
	S, 3rd footing	3	5.70	0.60	0.10	1.03	
	S, 4th footing	3	5.80	0.50	0.10	0.87	
	S, Plinth wall	3	5.90	0.40	0.80	5.66	
	Total					26.10	
4	DPC — Long walls	2	11.00	0.40	-	8.80	
	DPC — Short walls	3	5.90	0.40	-	7.08	
	Total					15.88	sq.m
5	Superstructure — Long walls	2	10.90	0.30	4.20	27.47	
	Superstructure — Short walls	3	6.00	0.30	4.20	22.68	
	Total					50.15	
	Deduct: Door opening	2	1.20	0.30	2.10	1.51	
	Deduct: Window opening	4	1.00	0.30	1.50	1.80	
	Deduct: Shelves	2	1.00	0.20	1.50	0.60	back of shelves, 10 cm wall
	Deduct: Lintel over doors	2	1.50	0.30	0.15	0.14	bearing 15 cm
	Deduct: Lintel over windows	4	1.30	0.30	0.15	0.23	bearing 15 cm
	Deduct: Lintel over shelves	2	1.30	0.30	0.15	0.12	bearing 15 cm
	Total deduction					4.40	
	Net total					45.75	cu.m

5.2 Method 2 — Centre Line Method

Find the total length of centre lines of walls (long and short, of the same type/foundation/footing), then multiply by the respective breadth and height. The wall length

stays the same for excavation, foundation concrete, all footings, and superstructure. This method is quicker but needs careful treatment at wall junctions.

At every junction of a partition/cross wall with a main wall, deduct half the breadth of the relevant item from the total centre length (e.g., one partition wall creates two junctions, so deduct one full breadth — $2 \times \frac{1}{2}$ — for excavation and foundation concrete).

Where walls are of different types (e.g., outer A-type, inner cross B-type), treat each type's total centre length separately. No deduction is needed for A-type walls, but for B-type walls, deduct half the breadth of the main (A-type) wall at each junction. No addition/subtraction is needed at corners where two walls simply meet.

Example 3 — Example 1 solved by Centre Line Method

Total centre length = AB + BC + CD + DA = 5.30 + 4.30 + 5.30 + 4.30 = 19.20 m.

Item	Particulars	No.	L (m)	B (m)	H/D (m)	Qty (cu.m)	Explanation
1	Earthwork excavation	1	19.20	0.90	0.90	15.55	Total centre length of all walls
2	Concrete in foundation	1	19.20	0.90	0.30	5.18	
3	1st footing (brickwork)	1	19.20	0.60	0.30	3.46	
	2nd footing	1	19.20	0.50	0.30	2.88	
	Plinth wall	1	19.20	0.40	0.60	4.61	
	Total					10.94	cu.m
5	Brickwork in superstructure	1	19.20	0.30	3.50	20.16	cu.m

Example 4 — Example 2 solved by Centre Line Method

Two junctions of the inner wall with the main wall. Total centre length = $2 \times \text{c/c long wall} + 3 \times \text{c/c short wall} = 2 \times 10.60 + 3 \times 6.30 = 40.10$ m. At each junction, deduct half the relevant breadth: Qty = [Total centre length – $2 \times (\frac{1}{2} \text{ breadth})$] $\times$ breadth $\times$ depth.

Item	Particulars	No.	L (m)	B (m)	H/D (m)	Qty (cu.m)	Explanation
1	Earthwork excavation	1	39.00	1.10	1.00	42.90	L = 40.10 - 1.10
2	Lime concrete in foundation	1	39.00	1.10	0.30	12.87	

Item	Particulars	No.	L (m)	B (m)	H/D (m)	Qty (cu.m)	Explanation
3	1st footing	1	39.30	0.80	0.20	6.29	
	2nd footing	1	39.40	0.70	0.10	2.76	
	3rd footing	1	39.50	0.60	0.10	2.37	
	4th footing	1	39.60	0.50	0.10	1.98	
	Plinth wall above footing	1	39.70	0.40	0.80	12.70	
	Total					26.10	
4	DPC	1	39.70	0.40	-	15.88	L = 40.10-0.40
	Deduct door sill	2	1.20	0.40	-	0.96	
	Total					14.92	sq.m
5	Superstructure brickwork	1	39.80	0.30	4.20	50.15	L = 40.10-0.30
	Deduct: Door opening	2	1.20	0.30	2.10	1.51	
	Deduct: Window opening	4	1.00	0.30	1.50	1.80	
	Deduct: Shelves	2	1.00	0.20	1.50	0.60	back of shelves
	Deduct: Lintel over doors	2	1.50	0.30	0.15	0.14	bearing 15 cm
	Deduct: Lintel over windows	4	1.30	0.30	0.15	0.23	bearing 15 cm
	Deduct: Lintel over shelves	2	1.30	0.30	0.15	0.12	bearing 15 cm
	Total deduction					4.40	
	Net total					45.75	cu.m

Note: Quantities from the long-wall/short-wall method and the centre line method are identical.

Example 5 — Two-Roomed Building with Verandah

Estimate quantities and cost of: earthwork excavation (hard soil, Rs.14/m³), lime concrete bed 1:2:4 (Rs.1,200/m³), 1st class brickwork CM 1:4 in foundation & plinth (Rs.2,000/m³), 1st class brickwork CM 1:4 in superstructure (Rs.2,200/m³), and RCC 1:2:4 roof slab.

c/c length, long walls of rooms = $4.50+0.30+4.00+2\times 0.30/2 = 9.10$ m; short walls = $3.60+2\times 0.30/2 = 3.90$ m; partition walls = 3.90 m; verandah front long wall = 9.20 m; verandah side walls = 1.85 m.

Item	Particulars	No.	L (m)	B (m)	H/D (m)	Qty (cu.m)	Explanation
1	Excavation — Long walls (rooms)	2	10.00	0.90	0.90	16.20	9.1+0.9
	Excavation — Short walls (rooms)	3	3.00	0.90	0.90	7.29	3.9-0.9
	Excavation — Partition wall front	1	3.00	0.90	0.90	2.43	
	Excavation — Verandah long wall	1	9.90	0.70	0.90	6.24	9.2+0.7
	Excavation — Verandah side walls	2	1.05	0.70	0.90	1.32	
	Excavation — Steps	1	2.60	0.80	0.15	0.31	
	Total					33.79	cu.m
2	Lime concrete — Long walls	2	10.00	0.90	0.30	5.40	
	Lime concrete — Short walls	3	3.00	0.90	0.30	2.43	
	Lime concrete — Partition wall	1	3.00	0.90	0.30	0.81	
	Lime concrete — Verandah front wall	1	9.90	0.70	0.30	2.08	
	Lime concrete — Verandah side walls	2	1.05	0.70	0.20	0.29	
	Lime concrete — Steps	1	2.60	1.00	0.15	0.39	
	Total					11.40	cu.m
5	RCC 1:2:4 roof slab	1	9.40	6.00	0.10	5.64	cu.m

Item	Particulars	No.	L (m)	B (m)	H/D (m)	Qty (cu.m)	Explanation
	Steel reinforcement (approx. 1% of RCC)					0.50	ton

Abstract of Cost — Example 5

Sl. No.	Particulars	Qty	Unit	Rate, Rs	Per	Amount, Rs
1	Earthwork excavation in foundation	31.36	cu.m	140.00	cu.m	4,390.40
2	Lime concrete bed 1:2:4	10.74	cu.m	1,200.00	cu.m	12,888.00
3	1st class brickwork (1:4) in foundation & plinth	15.90	cu.m	2,000.00	cu.m	31,800.00
4	1st class brickwork (1:6) in superstructure	27.65	cu.m	2,200.00	cu.m	60,830.00
5	RCC 1:2:4 for roof slab	5.64	cu.m	3,800.00	cu.m	21,432.00
6	Steel reinforcement	0.50	ton	3,800.00	ton	1,900.00
					Sub-total	1,33,240.40
					Add 10% (contingency)	13,324.04
					Total	1,46,564.44

Example 6 — Residential Building (Centre Line Method)

Work out quantities and cost of: earthwork excavation in soft soil (Rs.102/m³), size stone masonry CM 1:6 for foundation & basement (Rs.2,400/m³), and BBM with 1:6 CM in superstructure (Rs.3,650/m³).

Total c/c length of 30 cm walls = 75.60 m, with 4 junctions of 30 cm walls with 30 cm walls.

Item	Particulars	No.	L (m)	B (m)	H/D (m)	Qty (cu.m)	Explanation
1	Earthwork excavation	1	73.60	1.00	0.90	66.24	75.6-4(1.00/2)

Item	Particulars	No.	L (m)	B (m)	H/D (m)	Qty (cu.m)	Explanation
2	Size stone masonry — 1st footing	1	74.10	0.75	0.75	41.68	$75.6-4(0.75/2)$
	Size stone masonry — 2nd footing	1	74.70	0.45	0.45	15.13	$75.6-4(0.45/2)$
	Total					56.81	cu.m
3	Burnt brick masonry — 30 cm wall	1	75.00	0.30	3.00	67.50	$75.6-4(0.30/2)$
	Burnt brick masonry — parapet wall	1	41.00	0.15	0.75	4.61	
	Total					72.11	
	Deduct: Door D (opening)	7	1.20	0.30	0.30	0.76	
	Deduct: Door D2	1	0.90	0.30	2.10	0.57	
	Deduct: Window W	6	1.50	0.30	1.35	3.65	
	Deduct: Window W1	1	1.50	0.30	1.20	0.54	
	Deduct: V	1	0.90	0.30	0.45	0.12	
	Deduct: All-round lintel	1	41.00	0.30	0.20	2.46	
	Deduct: Lintel over internal doors D	5	1.20	0.30	0.20	0.36	
	Deduct: Lintel over internal doors D2	1	0.90	0.30	0.20	0.05	
	Total deduction					8.50	
	Net total					63.61	cu.m

Abstract of Cost — Example 6

Sl. No.	Particulars	Qty	Unit	Rate, Rs.	Per	Amount, Rs.
1	Earthwork excavation in foundation	66.24	cu.m	102.00	cu.m	6,756.48
2	Size stone masonry (1:6)	56.81	cu.m	2,400.00	cu.m	1,36,344.00
3	Burnt brick masonry (1:6)	63.61	cu.m	3,650.00	cu.m	2,32,176.50
					Sub-total	3,75,276.98
					Add 10% (contingency)	37,527.70
					Total	4,12,804.68

Example 7 — Residential Building (Centre Line Method)

Estimate: earthwork excavation, lime concrete in foundation, 1st class brickwork CM 1:6 in foundation & plinth, damp proof course, and 1st class brickwork in lime mortar in superstructure.

Total centre length of 30 cm walls (main rooms) = $(2 \times 10.60 + 3 \times 5.30) + (2 \times 9.60 + 2 \times 4.80) = 65.90$ m, with 6 junctions. Total centre length of 20 cm walls (verandahs + bathroom) = $(9.65 + 2.25) + (9.65 + 2 \times 2.75) = 27.05$ m, with 5 junctions to 30 cm walls and 1 junction to a 20 cm wall.

Item	Particulars	No.	L (m)	B (m)	H/D (m)	Qty (cu.m)	Explanation
1	Excavation — Main room walls (6 junctions)	1	63.20	0.90	1.00	56.88	$65.90 - 6(0.90/2)$
	Excavation — Verandah walls (5+1 junctions)	1	24.50	0.60	0.50	7.35	$27.05 - 5(0.90/2) - 1(0.60/2)$
	Total					64.23	cu.m
2	Lime concrete — Main room walls	1	63.20	0.90	0.30	17.06	
	Lime concrete — Verandah/bath walls	1	25.50	0.60	0.20	3.06	
	Total					20.12	cu.m

Item	Particulars	No.	L (m)	B (m)	H/D (m)	Qty (cu.m)	Explanation
3	Main rooms — 1st footing	1	64.10	0.60	0.20	7.69	
	Main rooms — 2nd footing	1	64.40	0.50	0.20	6.44	
	Main rooms — Plinth wall above footing	1	64.70	0.40	0.90	23.29	
	Verandah/bath — footing	1	25.85	0.40	0.20	2.07	
	Verandah/bath — Plinth wall above footing	1	25.90	0.30	0.70	5.44	
	Total					44.93	cu.m
4	DPC — Main room walls	1	64.70	0.40	-	25.88	
	DPC — Verandah pillars	4	0.50	0.30	-	0.60	
	DPC — Bath room (3 walls)	1	7.30	0.30	-	2.19	
	Total					28.67	sq.m
5	Superstructure — Main room walls	1	65.00	0.30	4.00	78.00	
	Superstructure — Verandah/bath walls	1	26.20	0.20	3.05	15.98	
	Total					93.98	cu.m

References: □ [VTU e-Learning Centre \(Belagavi\)](#)

- Official VTU learning portal with study materials and course resources.
- [VTU Resource Centre](#)
 - Official VTU academic resources and reference materials.
- [National Programme on Technology Enhanced Learning \(NPTEL\)](#)
 - Free courses on Estimation, Quantity Surveying, Construction Management, and RCC.
- [National Digital Library of India \(NDLI\)](#)
 - Access textbooks, lecture notes, and engineering references.
- [CPWD Works Manual](#)
 - Official manual covering estimation, specifications, measurement, and rate analysis.
- [Bureau of Indian Standards \(BIS\)](#)
 - Source for Indian Standards such as IS 1200 (Method of Measurement).

MODULE2: ROADWORK, RCC ELEMENTS & SANITARY ESTIMATION

2 Roadwork Estimation

The cross-section of a road in banking (embankment) and cutting is generally trapezoidal in shape.

Quantity of earthwork = Sectional Area $\times$ Length

Sectional area, A = $Bd + sd^2$, where $s : 1$ is the side slope (horizontal : vertical) — for 1 vertical, s is the horizontal for a depth d

Quantity of earthwork = $A \times L$

Methods of roadwork estimation:

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

2.1 Mid-Sectional Area Method

Quantity = Area of mid-section $\times$ length. If d_1 and d_2 are the heights of bank at the two ends of an embankment portion of length L , B is the formation width and $s:1$ the side slope, then:

Area of mid-section = area of rectangular portion + area of two triangular portions = $Bdm + \frac{1}{2}sdm^2 + \frac{1}{2}sdm^2 = Bdm + sdm^2$ (dm = mean height/depth).

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

Quantities are calculated in a tabular form with columns: Station/chainage, Depth/height, Mean depth/height (d), Area of central portion (Bd), Area of sides (sd^2), Total sectional area ($Bd+sd^2$), Length between stations (L), and Quantity (split into Embankment and Cutting).

2.2 Mean Sectional Area Method

Quantity = Mean sectional area $\times$ length. Sectional area at one end $A_1 = Bd_1 + sd_1^2$; sectional area at the other end $A_2 = Bd_2 + sd_2^2$ (d_1, d_2 = heights/depths at the two ends).

Mean sectional area, A = $(A_1 + A_2) / 2$

Quantity, Q = $[(A_1 + A_2)/2] \times \text{Length}$

Quantities are tabulated with columns: Station/chainage, Depth/height, Area of central portion (Bd), Area of sides (sd^2), Total sectional area, Mean sectional area, Length between stations (L), and Quantity (Embankment / Cutting).

2.3 Prismoidal Formula Method

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

where A_1 and A_2 are the cross-sectional areas at the two ends of an embankment/road portion of length L , and A_m is the mid-sectional area.

With d_1 , d_2 as the heights of banks at the two ends, d_m the mean height at mid-section, B the formation width and $s:l$ the side slope:

- $A_1 = Bd_1 + sd_1^2$
- $A_2 = Bd_2 + sd_2^2$
- $d_m = (d_1 + d_2)/2$
- $A_m = B d_m + s d_m^2 = B(d_1+d_2)/2 + s[(d_1+d_2)/2]^2$

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

2.4 Trapezoidal Method

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

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

where A_0 , A_1 , A_2 , ..., A_{n-1} , A_n are the cross-sectional areas, D is the distance between sections, and V is the volume of cutting or banking.

Example 1 — Road with 12 m Formation Width (Mid-Section Method)

Data: $B = 12$ m, side slope 1.5:1 in cutting and 2:1 in banking, falling gradient 1 in 200 from chainage 14, chain length 30 m. Rates: filling Rs.180/m³, cutting Rs.120/m³. Ground RLs are given from chainage 14 to 22; the formation level is derived from the gradient, and the point where the road passes from cutting to banking is located by proportion (found at 13.63 m past chainage 18).

Chainage	RL Ground	RL Formation	Depth	Mean Depth
14.00	108.60	108.60	0.00	
15.00	109.25	108.45	-0.80	-0.40
16.00	109.40	108.30	-1.10	-0.95
17.00	108.85	108.15	-0.70	-0.90
18.00	108.50	108.00	-0.50	-0.60
(cut→bank)	108.60	108.60	0.00	-0.25
19.00	107.25	107.85	0.60	0.30
20.00	106.80	107.70	0.90	0.75
21.00	107.15	107.55	0.40	0.65
22.00	107.20	107.40	0.20	0.30

Chainage	Depth	Mean Depth	Central Area	Side Area	Total Area	Dist., m	Bank, cu.m	Cut, cu.m
14.00	0.00	-	-	-	-	0		
15.00	-0.80	-0.40	4.80	0.24	5.04	30		151.20
16.00	-1.10	-0.95	11.40	1.35	12.75	30		382.50
17.00	-0.70	-0.90	10.80	1.21	12.01	30		360.30
18.00	-0.50	-0.60	7.20	0.54	7.74	30		232.20
(cut→bank)	0.00	-0.25	3.00	0.09	3.09	13.63		42.16
19.00	0.60	0.30	3.60	0.18	3.78	16.37	61.88	
20.00	0.90	0.75	9.00	1.13	10.13	30	303.80	
21.00	0.40	0.65	7.80	0.85	8.65	30	259.40	
22.00	0.20	0.30	3.60	0.18	3.78	30	113.40	
					Total		738.40	1168.35

Sl.	Particulars	Quantity	Unit	Rate/unit	Amount
1	Earthwork in filling	738.38	cu.m	180	1,32,908.40
2	Earthwork in cutting	1,168.35	cu.m	120	1,40,202.00
				Total	2,73,110.40
				Contingencies (3%)	8,193.31
				Work-charged establishment (2%)	5,462.20
				Grand Total, Rs	2,86,765.91

Example 2 — Road with Changing Gradient

Ground RLs are given from chainage 10 to 20. Formation level at chainage 10 = 107; gradient is 1 in 150 (downward) up to chainage 14, then changes to 1 in 100 (downward). Formation width = 10 m, side slope of banking 2:1, chain length 30 m. Rate: Rs.275/cu.m.

Chainage	RL Ground	RL Formation	Depth
10.00	105.00	107.00	2.00

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

With B = 10 m, s = 2:

Chainage	Depth	Central Area	Side Area	Total Area	Mean Area	Dist., m	Qty, cu.m
10	2.00	20.00	8.00	28.00			
11	1.20	12.00	2.88	14.88	21.44	30	643.20
12	1.16	11.60	2.69	14.29	14.59	30	437.57
13	0.50	5.00	0.50	5.50	9.90	30	296.87
14	0.78	7.80	1.22	9.02	7.26	30	217.75
15	1.60	16.00	5.12	21.12	15.07	30	452.05
16	0.60	6.00	0.72	6.72	13.92	30	417.60
17	1.20	12.00	2.88	14.88	10.80	30	324.00
18	0.38	3.80	0.29	4.09	9.48	30	284.53
19	0.70	7.00	0.98	7.98	6.03	30	181.03
20	0.10	1.00	0.02	1.02	4.50	30	135.00
						Total	3,389.60

Sl.	Particulars	Quantity	Unit	Rate/unit	Amount
1	Earthwork in filling	3,389.60	cu.m	275	9,32,140.00
				Total	9,32,140.00
				Contingencies (3%)	8,193.31
				Work-charged establishment (2%)	5,462.20
				Grand Total, Rs	9,45,795.51

Example 3 — 400 m Road Portion (Banking to Cutting Transition)

Formation width = 10 m; side slopes 2:1 in banking and 1.5:1 in cutting; downward gradient 1 in 200. The road passes from banking to cutting between stations 30 and 31; solving the symmetrical triangles gives a banking-portion length of 17 m and a cutting-portion length of 23 m (of the 40 m interval).

Station	Dist., m	Depth	Mean Depth	Central Area	Side Area	Total Area	Length, m	Bank, cu.m	Cut, cu.m
25	1000	1.00	-	-	-	-	-	-	-
26	1040	0.90	0.95	9.50	1.81	11.31	40.00	452.20	
27	1080	1.10	1.00	10.00	2.00	12.00	40.00	480.00	
28	1120	0.60	0.85	8.50	1.45	9.95	40.00	397.80	
29	1160	0.60	0.60	6.00	0.72	6.72	40.00	268.80	
30	1200	0.30	0.45	4.50	0.41	4.91	40.00	196.20	
(bank→cut)	1217	0.00	0.15	1.50	0.05	1.55	17.00	26.27	
31	1240	-0.40	0.20	2.00	0.06	2.06	23.00		47.38
32	1280	-0.80	0.60	6.00	0.54	6.54	40.00		261.60
33	1320	-0.90	0.85	8.50	1.08	9.58	40.00		383.35
34	1360	-0.80	0.85	8.50	1.08	9.58	40.00		383.35
35	1400	-0.60	0.70	7.00	0.74	7.74	40.00		309.40
							Total	1,821.95	1,384.98

(Negative depth indicates cutting.)

Item	Particulars	Quantity	Unit	Rate, Rs.	Per	Cost, Rs.
1	Earthwork in banking	1,821.95	cu.m	275.00	cu.m	5,01,036.25
2	Earthwork in cutting	1,384.98	cu.m	350.00	cu.m	4,84,743.00
					Total	9,85,779.25
					Add 10% extra	98,577.93
					Grand Total	10,84,357.18

2.5 Vertical Drop in Ground

Where the ground has a vertical drop at a point, that point has two reduced levels. Earthwork on either side of the drop is calculated in two separate operations — one using the mean of the consecutive heights/depths up to that point, and the other using the mean of the consecutive heights/depths beyond it.

Example 4 — Road with Vertical Drop (Constant Formation Level)

Constant formation level = 49.50; chain length = 50 m; formation width B = 8 m; side slope 1.5:1 in banking and 1:1 in cutting.

Station	Dist., m	Depth	Mean Depth	Central Area	Side Area	Total Area	Length, m	Bank, cu.m	Cut, cu.m
10	500	-0.50	-	-	-	-	-	-	-
11	550	-1.10	0.80	6.40	0.64	7.04	50.00		352.00
12	600	-0.80 / 1.00	0.95	7.60	0.90	8.50	50.00		425.13
13	650	1.60	1.30	10.40	2.54	12.94	50.00	646.75	
14	700	1.30	1.45	11.60	3.15	14.75	50.00	737.69	
15	750	1.50	1.40	11.20	2.94	14.14	50.00	707.00	
							Total	2,091.44	777.13

(Negative sign indicates cutting; station 12 has a vertical ground drop, so RL 50.30 and 48.50 both occur there.)

2.7. Estimation of RCC Structural Elements

RCC work is usually estimated under two items: (1) concrete work including centering & shuttering, taken in cu.m, and (2) steel reinforcement and its bending, taken in quintals. Since the quantity of steel is small, no deduction is made for it from the concrete volume.

Steel reinforcement is calculated per the actual requirement as laid in position, including overlaps, hooks and cranks, as determined from detailed drawings. Density of steel is taken as 78.5 q/cu.m.

Side cover for steel bars is usually taken the same as the clear cover; if no cover is specified, a suitable value should be assumed. Minimum clear covers: slab 15 mm, beam 20 mm, column 40 mm, footing 50 mm.

RCC estimation is done in two parts: (1) estimation of concrete, by multiplying the dimensions of the structural element, and (2) estimation of steel reinforcement, by determining the exact rebar length including hooks, bent-up/cranked length and laps, then multiplying the total length by the steel density to get the quantity in quintals.

2.7.1 Reinforcement Calculation Formulas

1. Hooked length of bar — Length of one hook = 9ϕ (ϕ = bar diameter in mm). With hooks at both ends of a straight bar: Total length = $L + 9\phi + 9\phi = L + 18\phi$

2. Cranked/bent-up bar length (45° bend) — Additional length for one bent-up = $0.42d$; for a two-sided bent-up = $2 \times 0.42d = 0.84d$, where d = distance between the lever arm of the top and bottom bars = overall depth – effective cover at top & bottom

3. Length of stirrup — $L = 2(a + b) + 24\phi$, where a = horizontal length of stirrup, b = vertical length of stirrup, and 24ϕ = overlapping length

4. Number of bars — $(\text{Total length} - 2 \times \text{side covers}) / \text{spacing} + 1$

5. Development length — 45ϕ

6. Lap length — $L = 65\phi$

2.8 Worked Problems

Problem 1 — Simply Supported Beam

Data: clear span = 4 m, bearing = 230 mm, beam size = 300×500 mm, reinforcement = 2 nos. 25 mm ϕ (tension) + 2 nos. 12 mm ϕ (compression), stirrups 10 mm ϕ @ 200 mm c/c, side/clear cover = 25 mm. Reinforcement types: straight bars with hooks at both ends, and stirrups.

Concrete: overall length $L = 4000 + 230 + 230 = 4460$ mm = 4.46 m; $B = 0.30$ m; $D = 0.50$ m. Quantity = $4.46 \times 0.30 \times 0.50 = 0.67$ cu.m.

Bottom bars: $L = 4460 - 2 \times 25 + 2 \times 9 \times 25 = 4860$ mm = 4.86 m. Top bars: $L = 4460 - 50 + 18 \times 12 = 4626$ mm = 4.63 m.

Stirrups: $a = 300 - 2 \times 25 - 2 \times 5 = 240$ mm; $b = 500 - 2 \times 25 - 2 \times 5 = 440$ mm; $L = 2(240 + 440) + 24 \times 10 = 1600$ mm = 1.60 m. Number of stirrups = $(4000 + 2 \times 230 - 2 \times 25) / 200 + 1 \approx 24$.

Sl.	Particular	Nos.	Length, m	Total Length, m	Weight, q/m	Quantity, q
1	Bottom bars, $\phi=25$ mm	2	4.86	9.72	0.0385	0.38
2	Top bars, $\phi=12$ mm	2	4.63	9.26	0.00887	0.08
3	Stirrups, $\phi=10$ mm @ 200 c/c	24	1.60	38.40	0.00616	0.24
					Total weight of steel	0.70 q

Note: Density of steel $\rho = 78.5$ q/m³; weight per unit length $= \rho \times \pi \phi^2 / 4 = 61.65 \phi^2 \approx \phi^2 / 0.0162$ (ϕ in metres).

Sl.	Particular	Quantity	Unit	Rate, Rs	Per	Amount, Rs
1	RCC work excluding steel	0.67	cu.m	675.00	cu.m	452.00
2	Steel reinforcement	0.70	q	515.00	q	360.00
					Total	812.00
					Add 5% extra	41.00
					Grand Total	853.00

Problem 2 — Doubly Reinforced Beam

Data: clear span = 5.4 m, bearing = 300 mm, size = 300×800 mm. Tension: 7 nos. 25 ϕ (4 straight, 3 bent-up @ 1400 mm from support); compression: 4 nos. 25 ϕ ; spacer bars 25 ϕ ; side face reinforcement 2 nos. 12 ϕ ; shear reinforcement 2-legged 12 ϕ @150 c/c for 1.5 m from each support, and @300 c/c for the remaining middle portion.

Concrete: $L = 5400 + 300 + 300 = 6000$ mm = 6.00 m; $B = 0.30$ m; $D = 0.80$ m. Quantity = $6.00 \times 0.30 \times 0.80 = 1.44$ cu.m.

Bottom straight bars: $L = 6000 - 50 + 18 \times 25 = 6400$ mm = 6.40 m. Top straight bars: same = 6.40 m.

Cranked bars: $d = 800 - 2 \times 25 - 2 \times 12 - \frac{1}{2} \times 25 - \frac{1}{2} \times 25 = 701$ mm. Total length = $5400 + 300 + 300 - 50 + 18 \times 25 + 0.84 \times 701 = 6988$ mm ≈ 7.00 m.

Stirrups: $a = 300 - 2 \times 25 - 2 \times 6 = 238$ mm; $b = 800 - 2 \times 25 - 2 \times 6 = 738$ mm; $L = 2(238 + 738) + 24 \times 12 = 2240$ mm = 2.24 m. Closely spaced stirrups (1.5 m each end, @150 c/c): $(3000 - 50) / 150 + 1 \approx 22$; remaining middle portion @300 c/c: $(5400 - 3000) / 300 + 1 \approx 10$. Total = 32.

Side face bars (no hooks): $L = 5400 + 300 + 300 - 50 = 5950 \text{ mm} = 5.95 \text{ m}$.

Sl.	Particular	Nos.	Length, m	Total Length, m	Weight, q/m	Quantity, q
1	Bottom straight bars, $\phi=25 \text{ mm}$	4	6.40	25.60	0.0385	0.97
2	Top straight bars, $\phi=25 \text{ mm}$	4	6.40	25.60	0.0385	0.97
3	Cranked bars, $\phi=25 \text{ mm}$	3	7.00	21.00	0.0385	0.81
4	Stirrups, $\phi=12 \text{ mm}$	32	2.24	71.68	0.0088	0.63
5	Side face bars, $\phi=12 \text{ mm}$	2	5.95	11.90	0.0088	0.11
					Total weight of steel	3.49 q

Sl.	Particular	Quantity	Unit	Rate, Rs	Per	Amount, Rs
1	RCC work excluding steel	1.44	cu.m	675.00	cu.m	975.00
2	Steel reinforcement	3.49	q	515.00	q	1,797.00
					Total	2,772.00
					Add 5% extra	139.00
					Grand Total	2,911.00

Problem 3 — RCC Slab

Room size = $3 \text{ m} \times 4 \text{ m}$; top & bottom cover = 20 mm ; side cover = 50 mm ; alternate main bars bent up. Reinforcement types: straight main bars (shorter direction), alternate bent-up main bars, and straight distribution bars (longer direction).

Concrete: L_y (longer) = $200 + 4000 + 200 = 4400 \text{ mm}$; L_x (shorter) = $200 + 3000 + 200 = 3400 \text{ mm}$; slab thickness $t = 120 \text{ mm}$. Volume = $3.40 \times 4.40 \times 0.12 = 1.80 \text{ cu.m}$.

Straight bottom main bars: $L = 3400 - 100 + 18 \times 12 = 3516 \text{ mm} = 3.52 \text{ m}$. Number = $(4000 + 400 - 100) / 200 + 1 \approx 24$ (200 mm spacing, since a bent-up bar alternates between straight bars).

Cranked bars: $d = 120 - 2 \times 20 - \frac{1}{2} \times 12 - \frac{1}{2} \times 12 = 68 \text{ mm}$. Total length = $3000 + 400 - 100 + 18 \times 12 + 0.84 \times 68 = 3573 \text{ mm} = 3.58 \text{ m}$. Number = $24 - 1 = 23$.

Distribution bars: $L = 4400 - 100 + 18 \times 6 = 4408 \text{ mm} = 4.41 \text{ m}$. Number (main field, 150 mm spacing) ≈ 24 ; number near supports (top, 150 mm spacing over a 600+200 mm strip) ≈ 12 .

Sl.	Particular	Nos.	Length, m	Total Length, m	Weight, q/m	Quantity, q
1	Straight bottom main bars, $\phi=12 \text{ mm}$	24	3.52	84.48	0.0088	0.74
2	Alternate bent-up bars, $\phi=12 \text{ mm}$	23	3.58	82.34	0.0088	0.73
3	Bottom distribution bars, $\phi=6 \text{ mm}$	24	4.41	105.84	0.0022	0.23
4	Top distribution bars, $\phi=6 \text{ mm}$	12	4.41	52.92	0.0022	0.12
					Total weight of steel	1.82 q

Problem 4 — Isolated RCC Column & Footing

Data: column size 400×600 mm; footing 2 m × 3 m, uniform thickness 450 mm; depth of foundation below GL = 1.5 m; column height above GL = 1.0 m; PCC bed (1:3:6) thickness = 75 mm. Column: 8 nos. 16 ϕ main bars with 2-legged 8 ϕ ties @150 c/c. Footing: longer direction 12 ϕ @130 c/c, shorter direction 12 ϕ @220 c/c. Side/clear cover = 50 mm.

Note: for a column & footing, earthwork excavation and PCC quantities are calculated before the RCC quantities.

- Earthwork excavation: pit size 2.20 × 3.20 m, depth 1.50 m → Quantity = $2.20 \times 3.20 \times 1.50 = 10.60 \text{ cu.m}$
- PCC bed: 2.20 × 3.20 m × 0.075 m → Quantity = 0.53 cu.m
- RCC footing (excl. steel): $2 \times 3 \times 0.45 = 2.70 \text{ cu.m}$
- RCC column (excl. steel): height = $(1.50 - 0.075 - 0.450) + 1.00 = 1.98 \text{ m}$; Quantity = $1.98 \times 0.40 \times 0.60 = 0.48 \text{ cu.m}$

Column main bars: $L = 2500 - 75 - 50 - 2 \times 12 + 45 \times 16 = 3071 \text{ mm} = 3.10 \text{ m}$.

Column stirrups: $a = 400 - 2 \times 50 - 2 \times 4 = 292 \text{ mm}$; $b = 600 - 2 \times 50 - 2 \times 4 = 492 \text{ mm}$; $L = 2(292 + 492) + 24 \times 8 = 1760 \text{ mm} = 1.76 \text{ m}$. Number = $(1975 - 50)/150 + 1 \approx 14$ (stirrups run only to the column–footing junction, so effective column length = 1975 mm; side cover applies only at the top since the column height is given as 1.0 m above GL).

Footing bars along 2.00 m: $L = 2000 - 100 + 2 \times 9 \times 12 = 2116 \text{ mm} = 2.12 \text{ m}$; number = $(3000 - 100)/120 + 1 \approx 26$. Footing bars along 3.00 m: $L = 3000 - 100 + 2 \times 9 \times 12 = 3116 \text{ mm} = 3.12 \text{ m}$; number = $(2000 - 100)/130 + 1 \approx 16$.

Sl.	Particular	Nos.	Length, m	Total Length, m	Weight, q/m	Quantity, q
1	Straight bars (column), $\varnothing=16$ mm	8	3.10	24.80	0.0158	0.39
2	Stirrups, $\varnothing=8$ mm	14	1.76	24.64	0.00395	0.10
3	Straight bars along 2.00 m, $\varnothing=12$ mm	26	2.12	55.12	0.0088	0.49
4	Straight bars along 3.00 m, $\varnothing=12$ mm	16	3.12	49.92	0.0088	0.44
					Total weight of steel	1.42 q

Sl.	Particular	Quantity	Unit	Rate, Rs	Per	Amount, Rs
1	Earthwork in excavation	10.60	cu.m	350.00	cu.m	3,710.00
2	Plain cement concrete bed	0.53	cu.m	450.00	cu.m	239.00
3	RCC in column & footing (excl. steel)	3.18	cu.m	675.00	cu.m	2,147.00
4	Steel reinforcement	1.42	q	515.00	q	731.00
					Total	6,827.00
					Add 5% extra	341.00
					Grand Total	7,168.00

2.9. Estimation of Septic Tank & Soak Pit

.1 Septic Tank

- An underground chamber made of concrete, fibreglass or plastic, into which domestic wastewater (sewage) flows for basic treatment
- Settling and anaerobic processes reduce solids and organics, but treatment efficiency is only moderate — referred to as "primary treatment"
- Septic tank systems are a type of simple onsite sewage facility (OSSF), usable in areas not connected to a sewerage system, such as rural areas

- The term "septic" refers to the anaerobic bacterial environment in the tank that decomposes/mineralizes the waste discharged into it

8.2 Soak Pit

The basic function of a soak pit is wastewater management.

- Effluent from the septic tank (greywater) must undergo partial treatment before being let into the ground soil
- Greywater passing through the soak pit is filtered, causing smaller effluent particles to settle at the bottom
- These particles are digested by micro-organisms in a sustainable degradation process; filtered water is discharged through the porous wall of the soak pit

Web site link:

IS 2470 (Part 2): 2007 – Septic Tank & Soak Pit Guidelines

IS 2470 Part 2 Overview

Bureau of Indian Standards (BIS) – IS 2470 Standard Preview

BIS Standard Preview (IS 2470 Part 2)

CONTENT SHEET**MODULE 3: SPECIFICATIONS**

Sl. No.	Topic Covered	Reference Section
1	Objectives	3.1
2	Definition and Purpose of Specification	3.2.1
3	Types of Specification (General and Detailed)	3.2.2
4	General Specifications by Class of Building (First to Fourth Class)	3.2.3
5	Detailed Specification of Common Items (earthwork, concrete, masonry, DPC, brickwork, flooring, plastering, RCC, painting, tile/marble/terrazzo)	3.2.4
6	Important Questions	3.3
7	Content Beyond Syllabus	3.4

MODULE 3: SPECIFICATIONS

3.1 Objectives

- To understand the meaning, purpose and importance of specifications in a construction contract.
- To distinguish between General Specification and Detailed Specification.
- To study the general specifications of buildings classified as First, Second, Third and Fourth class.
- To study the detailed specifications of major construction items such as earthwork, concrete, masonry, DPC, flooring, plastering, RCC work, and painting.
- To enable preparation of specification clauses for a given item of building work.

3.2 Content**3.2.1 Definition and Purpose of Specification**

A Specification is a statement of particulars — written instructions that distinguish and describe in detail the construction work to be undertaken. Specifications supplement the information shown on drawings, since drawings alone do not furnish the quantity of materials, proportion of mortar and workmanship for different items of work.

Purpose of specification in a contract document:

- Monitors the cost of unit quantity of work.
- Serves as a guide to the supervising staff and the owner in executing the work.
- Specifies the equipment, tools and plant to be engaged for the work.
- Specifies the workmanship and method of doing the work.

3.2.2 Types of Specification

- General Specification (Brief Specification): gives the nature and class of work and materials in general terms, from foundation to superstructure — usually attached with rough cost/detailed estimates.
- Detailed Specification: specifies the quality and quantity of materials, mortar proportion, workmanship, method of preparation, execution and measurement for each item of work separately.

3.2.3 General Specifications by Class of Building

Buildin g Class	Foundation/Superstruct ure	Roofing	Flooring	Doors/Windo ws	Plinth Area Rate (Rs./sq. m)
First Class	First class burnt brick in lime/cement mortar (1:6) over CC (1:6:12 or 1:8:16)	R.C.C. slab (1:2:4) with bitumen coats	Terrazzo / polished conglomerate	Teak wood, panelled/glazed	4500 – 5500
Second Class	First class burnt brick in mud mortar; cement mortar (1:6) at critical points	R.B./R. C. roof for main rooms; mud roof elsewhere	Conglomerat e; brick-on-edge in verandah	—	2500 – 3000
Third Class	Second class burnt brick in mud mortar	Second class mud roof; G.I. sheet in verandah	Brick over mud concrete, cement pointed	Kail/Chir/Mango soft wood, ledged & battened	1500 – 1800
Fourth Class	Sun-dried bricks in mud mortar; brick only at critical points	Third class mud roof	Mud floor (2.5 cm) over rammed earth	Kail/Chir soft wood battened	800 – 1000

3.2.4 Detailed Specification of Common Items

Item of Work	Key Specification Points
Earthwork in excavation	Trench dug to exact width with vertical/sloped sides as per soil; bottom levelled and rammed; excess digging filled with concrete at contractor's cost; water pumped out; earth filled back in 15 cm watered and rammed layers.
Bed concrete in foundation (CC 1:4:8)	Fresh Portland cement, clean coarse sand, 20 mm hard graded stone ballast, potable water; laid in 15 cm layers, rammed, and cured wet for a fortnight.
Size Stone Masonry (Ashlar, Coursed Rubble, Random Rubble)	Hard, sound, durable stone laid on natural bed in mortar (commonly 1:6); joints not exceeding specified thickness; cured minimum 7 days; measured in cu.m.
Damp Proof Course (25 mm, CC 1:1.5:3)	Cement concrete with 2% waterproofing compound, shuttered, compacted, cured 7 days, and finished with two coats of hot asphalt painting.
First class brick work (CM 1:6)	IS-standard first class bricks, soaked 12 hours before use, laid in English Bond with 6 mm joints, cured minimum 10 days.
2.5 cm CC flooring (1:2:4)	Surface divided into panels (max 1 m × 2 m), alternate panels laid on alternate days, compacted with wooden thapies, cured by flooding for 10 days.
Cement plastering	1:4 or 1:6 cement–sand mortar, joints raked 20 mm deep, applied in two coats (12 mm + 8 mm) with curing between coats; measured in sq.m.
Reinforced Cement Concrete (1:2:4)	IS-standard steel bars bent and tied in position with 40× diameter lap; concrete compacted with mechanical vibrator within 30 minutes of water addition; cured minimum 21 days.
Painting (new and old wood work)	Surface rubbed smooth with sandpaper, knots killed with patent knotting, old paint burnt/removed if repainting, followed by two to three coats of paint.

Item of Work	Key Specification Points
Tile / Marble / Terrazzo flooring	Laid over lime/cement concrete base with sand bedding; marble and terrazzo finished by grinding and polishing; cured 7–15 days depending on finish.

3.3 Important Questions

1. Define specification. Explain the purpose of specification in a construction contract.
2. Differentiate between General Specification and Detailed Specification.
3. Write the general specification of a First Class building for foundation, superstructure, roofing and flooring.
4. Write the detailed specification for first class brick work in CM 1:6.
5. Write the detailed specification for cement concrete (1:4:8) bed in foundation.
6. Explain the detailed specification of RCC work (1:2:4) with respect to reinforcement, laying and curing.
7. Write short notes on: Ashlar masonry, Coursed rubble masonry, Random rubble masonry.
8. Explain the specification for damp proof course and its application.
9. Write the detailed specification for terrazzo flooring.
10. Compare general specifications of First, Second, Third and Fourth class buildings.

3.4 Content Beyond Syllabus

Supplementary points for enhanced understanding, not part of the core curriculum but useful for practical exposure:

- Green building specifications: use of fly-ash bricks, AAC blocks, low-VOC paints and recycled aggregates as per IGBC/GRIHA norms.
- Performance-based specifications versus prescriptive specifications used in modern international contracts (e.g., FIDIC).
- Relevant IS codes: IS 456:2000 (RCC), IS 383 (aggregates), IS 1077 (bricks), IS 2212 (brickwork practice), IS 1200 (methods of measurement).
- Use of Building Information Modelling (BIM) for automated specification and quantity extraction.
- Ready-mix concrete (RMC) specifications and quality control as an alternative to site-batched concrete.
- National Building Code (NBC) 2016 provisions relevant to specification of materials and workmanship.

CONTENT SHEET**MODULE 4: RATE ANALYSIS**

Sl. No.	Topic Covered	Reference Section
1	Objectives	4.1
2	Definition and Formula of Rate Analysis	4.2.1
3	Components of Rate Analysis (materials, labour, tools/plant, overheads, profit)	4.2.2
4	Labour Turnout (per day per labourer)	4.2.3
5	Standard Sample Quantities and Material Rates	4.2.4
6	Worked Rate-Analysis Examples (CC, brick masonry, RCC, plastering, rubble/ashlar masonry, earthwork)	4.2.5
7	Important Questions	4.3
8	Content Beyond Syllabus	4.4

MODULE 4: RATE ANALYSIS**4.1 Objectives**

- To understand the meaning and purpose of rate analysis in construction cost estimation.
- To identify the components of cost included while analysing the rate of an item of work.
- To compute labour requirement using standard turnout per day per labour.
- To perform rate analysis for common items of work: earthwork, concrete, masonry, RCC, plastering and flooring.
- To interpret a standard schedule of rates and apply it to cost estimation.

4.2 Content**4.2.1 Definition and Formula**

Rate Analysis is the process of arriving at a correct and reasonable price or rate per unit of an item of work, based on its specification.

$$\text{Rate per unit} = \text{Total Cost} / \text{Total Quantity}$$

4.2.2 Components of Rate Analysis

- Cost of materials = Quantity of material $\times$ Rate (from Schedule of Rates / analytical basis).
- Cost of labour = Number of labourers (by category) $\times$ wage per day, based on turnout per day per labourer.
- Cost of tools, plant and machinery = lump sum (approx. Rs. 300 to Rs. 1500 depending on type of work).
- Overhead and water charges = 1% to 2% of the total cost of material and labour.
- Contractor's profit = 10% of the total cost of material and labour.

$$\text{Final / Overall Cost} = \text{Materials} + \text{Labour} + \text{Tools \& Plant} + \text{Overheads \& Water} + \text{Profit}$$

4.2.3 Labour Turnout (per day per labourer)

Item of Work	Turnout per day per labour
Earthwork	2.5 cu.m
Cement Concrete	5.0 cu.m
RCC works	3.0 cu.m
Stone Masonry	2.5 cu.m
Brick Masonry	2.0 cu.m

Item of Work	Turnout per day per labour
Cement Plastering	20 sq.m
Painting	40 sq.m

Note: Minimum number of labourers = 2; Skilled workers = 2 to 5 (depending on work);
 Total strength of labour gang typically 6 to 20. Number of masons = Total quantity of work ÷
 Turnout per day per labour.

4.2.4 Standard Sample Quantities and Material Rates

- Sample quantity for voluminous work: 10 cu.m; for surface work: 100 sq.m; for running-meter work: 100 R.m.
- Representative material rates used in analysis: Cement Rs. 325/bag; Sand Rs. 2500/cu.m; 20 mm aggregate Rs. 900/cu.m; 40 mm aggregate Rs. 600/cu.m; first class bricks Rs. 6/brick; steel Rs. 75/quintal (representative).
- Representative labour wages: Head Mason Rs. 500/day; Mason Rs. 400/day; Skilled labour Rs. 300/day; Helper Rs. 200/day; Bar bender Rs. 500/day; Carpenter Rs. 500/day.

4.2.5 Worked Rate-Analysis Examples (summary of results)

Item of Work	Sample Qty	Grand Total (Rs.)	Rate per unit (Rs.)
CC 1:5:10 bed in foundation (40 mm aggregate)	10 cu.m	33,933.00	3,395.00 / cu.m
Brick masonry CM 1:6 — foundation & plinth	10 cu.m	53,352.75	5,335.00 / cu.m
Brick masonry CM 1:6 — superstructure	10 cu.m	55,805.75	5,580.58 / cu.m
RCC M20 (1:1.5:3), 2% steel, beams & slabs	10 cu.m	70,158.59	7,020.00 / cu.m
120 mm RCC slab (1:2:4), 2% steel	100 sq.m	74,694.97	750.00 / sq.m
Random Rubble masonry CM 1:6	10 cu.m	37,783.17	3,780.00 / cu.m
Ashlar masonry CM 1:6	10 cu.m	39,236.57	3,925.00 / cu.m

Item of Work	Sample Qty	Grand Total (Rs.)	Rate per unit (Rs.)
12 mm cement plastering CM 1:6	100 sq.m	15,498.50	155.00 / sq.m
Earthwork excavation, ordinary soil	10 cu.m	10,592.50	1,059.25 / cu.m

Method used for each item: (1) compute dry/actual volume with wastage allowance, (2) split into cement, sand, aggregate/steel using the mix proportion, (3) price materials, (4) compute labour gang from turnout, (5) add tools & plant, overheads/water (1.5%) and profit (10%) to get the grand total, then divide by sample quantity for the unit rate.

4.3 Important Questions

11. Define rate analysis. What is the significance of rate analysis in estimation?
12. List and explain the various components included while preparing a rate analysis.
13. Explain the method of calculating the number of labourers required for an item of work using turnout per day per labour, with an example.
14. Carry out rate analysis for cement concrete 1:5:10 for bed concrete in foundation and determine the cost per cu.m.
15. Carry out rate analysis for brick masonry in CM 1:6 in superstructure for a sample quantity of 10 cu.m.
16. Carry out rate analysis for RCC work M20 grade with 2% steel reinforcement and determine the cost per cu.m.
17. Carry out rate analysis for 12 mm thick cement plastering in CM 1:6 and determine the cost per sq.m.
18. Explain how dry volume and wet volume of concrete are related and why an allowance of 50–60% is added.
19. Carry out rate analysis for random rubble masonry and ashlar masonry, and compare their costs.
20. What is Schedule of Rates? Explain its role in preparing a rate analysis.

4.4 Content Beyond Syllabus

- CPWD Delhi Schedule of Rates (DSR) and State PWD Schedule of Rates as official reference documents used in practice.
- Price escalation clauses and use of cost indices for long-duration contracts.
- Use of spreadsheet-based and BIM-integrated rate-analysis software for automated cost estimation.
- Standard Data Book concept — pre-computed material and labour constants published by CPWD for various items.
- Impact of GST and other statutory levies on material cost components of rate analysis.

- Life-cycle costing as an extension of rate analysis for sustainability-linked project evaluation.

CONTENT SHEET**MODULE 5: CONTRACT MANAGEMENT AND VALUATION**

Sl. No.	Topic Covered	Reference Section
1	Objectives	5.1
2	Basic Definitions: Tender, Contract, Contractor, Earnest Money, Security Money	5.2.1
3	Essential Qualifications of a Contractor	5.2.2
4	Types of Tender (Open, Closed/Selective, Negotiated)	5.2.3
5	Tender Procedure (approval, documentation, processing, opening, award)	5.2.4
6	Types of Contract	5.2.5
7	Related Concepts: Letter of Intent, PPP, E-Tendering	5.2.6
8	Valuation: Definition and Necessity	5.3.1
9	Role of Engineer and Factors Affecting Valuation	5.3.2
10	Key Definitions in Valuation	5.3.3
11	Key Formulae (Sinking Fund, Depreciation)	5.3.4
12	Methods of Valuation	5.3.5
13	Fixation of Rent	5.3.6
14	Representative Solved Problems	5.3.7
15	Important Questions	5.4
16	Content Beyond Syllabus	5.5

MODULE 5: CONTRACT MANAGEMENT AND VALUATION

5.1 Objectives

- To understand basic contract management terminology: tender, contract, contractor, earnest money and security money.
- To study the types of tenders and the tender procedure followed in Government works.
- To study the various types of construction contracts and their applicability.
- To understand the concept, necessity and methods of valuation of property.
- To compute depreciation, sinking fund, capitalized value and standard rent through numerical problems.

5.2 Content — Part A: Contract Management**5.2.1 Basic Definitions**

- Tender: a written offer to execute work or supply articles at specified rates, within a fixed time, under certain conditions of contract.
- Contract: a written or verbal undertaking by a person or firm for construction, maintenance, repair, or supply of materials, enforceable by law.
- Contractor: a person who enters into an agreement with a department/owner for execution of work or supply, under certain conditions.
- Quotation: a response to a notice inviting tenders (NIT) issued by the department.
- Earnest money: a guarantee deposit (about 2% of the estimate) submitted with the tender to show willingness to work; refunded if the tender is not accepted.
- Security money: a deposit (about 10% of the estimate, inclusive of earnest money) made once the contract is awarded; forfeitable for unsatisfactory progress or quality.

5.2.2 Essential Qualifications of a Contractor

- Financially sound.
- Sufficient knowledge to read drawings.
- Well versed with departmental procedures for bills and experience.
- Good reputation and experience.
- Ability to handle labour and material efficiently.
- Capability to arrange men and material as required.

5.2.3 Types of Tender

- Open Tender: open to all qualified bidders; published in newspapers/internet; selected on price and quality.
- Closed/Selective Tender: open only to bidders of a stated category; contractors of known reputation; lowest bidder in that category is chosen.
- Negotiated Tender: only one contractor is approached; selection is as per the client's wish.

5.2.4 Tender Procedure

21. Approval to tender — administrative approval, expenditure sanction, and technical sanction of drawings, design and estimate.
22. Tender documentation — drawings, material statement, time schedule, mode of payment, penalty clause, detailed specification, labour conditions.
23. Tender processing — screening of contractors on financial position, experience, technical expertise, equipment and litigation history; issue of Invitation to Bid.
24. Opening of tenders — sealed tenders opened on the due date before departmental officers and contractors; lowest bidder normally awarded work; earnest money of rejected tenders returned.
25. Award of contract — written notice of acceptance (Letter of Intent / Letter of Acceptance) followed by signing of the contract agreement.

5.2.5 Types of Contract

Contract Type	Key Feature
Item rate (unit price) contract	Contractor quotes rate for each item without reference to a schedule of rates.
Percentage rate contract	Contractor quotes a percentage above/below department-fixed rates.
Schedule rate contract	Work allotted at fixed item rates; payment as per quantity executed.
Labour rate contract	Contractor supplies only labour; materials supplied by department/owner.
Through rate contract	Contractor quotes a percentage above/below prevailing through rates.
Lump sum contract	Contractor executes the entire work for a fixed total sum within a fixed time.
Item rate + Lump sum (combination)	Fixed sum for the work, with schedule-rate adjustment for additions/alterations.
Piece work contract	Contractor executes items at mutually agreed rates; suited to small works.

5.2.6 Related Concepts

- Letter of Intent (LOI): an interim agreement summarizing the main points of a proposed deal; not a definitive contract but signals genuine interest, subject to due diligence.
- Public Private Partnership (PPP): a long-term arrangement between government and private entity for a service/venture, procured through a transparent process. Models include BOT-Toll, BOOT, Joint Venture, Management Contract, and BOOST.
- E-Tendering System: an electronic platform covering the complete tendering process — advertising, document exchange, bid evaluation, and contract placement — shortening the tender cycle and enabling online tracking.

5.3 Content — Part B: Valuation

5.3.1 Definition and Necessity

Valuation is the fixation of the present-day cost or expected return of a building or engineering structure. Its value depends on present utility rather than size alone.

Valuation is necessary for: rent fixation (generally 6% of the property's valuation), buying and selling, acquisition of property by Government, mortgaging to raise a loan, fixation of taxes by the Municipal Committee, and insurance.

5.3.2 Role of Engineer and Factors Affecting Valuation

- An engineer's role in valuation is invoked when a structure is to be acquired, divided, or allotted to a claim holder.
- Locality: access to markets, schools, roads and correct orientation increase value.
- Structure: quality of workmanship and materials, and maintenance condition, influence value; buildings are classified First to Fourth class as per specification.

5.3.3 Key Definitions in Valuation

Term	Meaning
Cost	Original cost of construction; used to assess loss of value due to various factors.
Gross Income	Total income received from a property during the year, without deducting outgoings.
Net Income	Income remaining after deducting outgoings from gross income.
Outgoings	Expenses incurred to keep a property revenue-generating: taxes, management, repairs (about 1.5% of construction cost, or 10% of gross income), sinking fund, miscellaneous, loss of rent, and insurance.

Term	Meaning
Obsolescence	Loss of value due to outdated style/design — poor planning, thick walls, poor ventilation — arising from changing construction techniques and comfort standards.
Freehold Property	Property in complete possession of the owner, subject to town-planning/municipal constraints.
Leasehold Property	Property given on yearly payment by the freeholder to a lease-holder, typically for a 9- to 99-year term.
Easement	A facility (water/sewer lines, air and light, drainage, access) enjoyed over another's property; the grantor is the Servant owner and the beneficiary the Dominant owner.
Scrap Value	Amount realized from sale of old materials after a structure is dismantled; typically 8–10% of construction cost, higher for wood/steel structures than RCC.
Salvage Value	Amount realized by selling a discarded property/element without breaking it up (e.g., reused railway sleepers).
Building Cost Index	An index expressing the percentage rise or fall in construction cost relative to a base year, influenced by material, labour and transport costs.
Capitalized Value	The amount of money whose annual interest at the prevailing highest rate equals the net income from the property.
Sinking Fund	A fund accumulated gradually (through an annual installment) to reconstruct a property after its useful life; typically 90% of cost is recovered this way, 10% left as scrap value.
Annuity	Return of capital investment as fixed periodic instalments (monthly/quarterly/half-yearly/yearly) over a defined number of years.
Depreciation	Gradual loss of value due to consistent use, neglect, lack of facilities, or outdated design.

5.3.4 Key Formulae

Annual Sinking Fund: $I = S \cdot i / [(1+i)^n - 1]$

where I = annual instalment, S = amount of sinking fund required, i = rate of interest (decimal), n = number of years.

Depreciated Value: $D = P \cdot (100 - rd)^n / 100$

where D = depreciated value, P = present value, rd = fixed percentage of depreciation (per year), n = age of building in years. Representative rd values: 100-year life → 1.0; 75-year life → 1.3; 50-year life → 2.0; 25-year life → 4.0; 20-year life → 5.0.

5.3.5 Methods of Valuation

- Depreciation method: structure split into walls, roof, floors, doors/windows; cost assessed at current rates and depreciation applied.
- Valuation based on cost: actual construction cost found and depreciation applied, considering type and design.
- Valuation based on profit: used for cinemas, hotels, banks, shops — capitalized value obtained by multiplying years' purchase with net profit.
- Valuation by development method: used when additions/alterations or future development affect value; anticipated future profits are considered.
- Rental method of valuation: net rental income (after outgoings) capitalized at a suitable prevailing interest rate to determine value.

5.3.6 Fixation of Rent

- Government quarters: standard rent = lower of a fixed standard rent or 10% of pay; rental statement computed at 6% interest on total construction (and land, if purchased) cost, divided by 12 for monthly rent.
- Private property: net income = capitalized value ÷ years' purchase; gross rent = net income + outgoings (repairs, taxes, sinking fund), divided by 12 for monthly rent.

5.3.7 Representative Solved Problems (results)

Problem	Given Data	Result
Sinking fund for machine	Cost Rs. 30,000; life 20 yrs; i = 5%	Annual instalment ≈ Rs. 906.30
Sinking fund for old shop	Cost Rs. 20,000; scrap 10%; life 15 yrs; i = 3%	Annual instalment ≈ Rs. 971.20
Depreciated cost for acquisition	Cost Rs. 20,000; age 20 yrs; life 80 yrs (rd = 5)	Depreciated value ≈ Rs. 7,170

Problem	Given Data	Result
Value of built property + land	Plot 500 sq.m; built-up 300 sq.m; rate Rs. 6000/sq.m; land Rs. 5000/sq.m; age 40 yrs	Total value $\approx$ Rs. 33,02,800
Standard rent from present value	Present value Rs. 20,000; $i = 6\%$	Standard rent $\approx$ Rs. 100/month
Gross rent of new building	Construction Rs. 7,00,000; land 200 sq.m @ Rs. 150/sq.m; outgoings Rs. 24,000/yr	Gross rent $\approx$ Rs. 6,000/month

5.4 Important Questions

26. Define tender and contract. Explain earnest money and security money.
27. Explain the different types of tenders with their features.
28. Explain the tender procedure followed for Government works, from administrative approval to award of contract.
29. Explain the various types of contract with suitable examples of where each is used.
30. Write short notes on Letter of Intent, Public Private Partnership, and E-Tendering.
31. Define valuation. Explain the necessity of valuation of a property.
32. Explain the following terms with examples: Freehold property, Leasehold property, Easement, Scrap value, Salvage value.
33. Derive/state the formula for annual sinking fund and solve a numerical problem based on it.
34. Explain the depreciation method of valuation and solve a numerical problem to determine depreciated value.
35. Explain the rental method of valuation and the procedure to fix standard rent for a Government building and a private property.
36. Distinguish between capitalized value, sinking fund and annuity.
37. Explain the various methods of valuation of a property.

5.5 Content Beyond Syllabus

- Real Estate (Regulation and Development) Act, 2016 (RERA) and its impact on contract transparency and buyer protection.
- Arbitration and Conciliation Act provisions used for dispute resolution in construction contracts, as an alternative to litigation.
- FIDIC (International Federation of Consulting Engineers) contract forms used in international infrastructure projects.

- Comparative property valuation using Guidance Value (Government-notified) versus Market Value.
- Use of GIS and automated valuation models (AVMs) in modern property valuation practice.
- Escrow accounts and performance bank guarantees as risk-mitigation tools in large contracts.