KG REDDY
College of Engineering
& Technology

Course File On

Estimating, Quantity surveying & Valuation

By

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2019-2020

HOD **PRINCIPAL**

KG REDDY
College of Engineering
& Technology

COURSE FILE

Subject (Name)	:	**Estimating, Quantity surveying & Valuation**
Name (of the Faculty Member)	:	**M. RATHNA CHARY**
Designation	:	**Assistant Professor**
Regulation /Course Code	:	**R 16 / CE702PC**
Year / Semester	:	**IV / I**
Department	:	**Civil Engineering**
Academic Year	:	**2019-20**

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1. a) Vision of Civil Engineering Department

- To give the world new age civil engineers who can transform the society with their creative vibe for the sustainable development by instilling scientific temper with ethical human outlook.

1. b) Mission of civil Engineering Department

- To make the department a centre of excellence in the field of civil engineering and allied research.
- To promote innovative and original thinking in the minds of budding engineers to face the challenges of future.

1. c) Program Educational Objectives of Civil Engineering Department

PEO 1	Graduates will utilize the foundation in Engineering and Science to improve lives and livelihoods through a successful career in civil Engineering or other fields.
PEO 2	Graduates will become effective collaborators and innovators, leading or participating in efforts to address Social, Technical and Business challenges.
PEO 3	Graduates will engage in Life-Long Learning and professional development through Self-Study, continuing education or graduate and professional studies in engineering & Business.

1. d) Program Outcomes of Civil Engineering Department

PO1	**Fundamental engineering analysis skills**: An ability to apply knowledge of computing, mathematical foundations, algorithmic principles, and civil engineering theory in the modelling and design of to civil engineering problems.
PO2	**Information retrieval skills:** An ability to design and conduct experiments, as well as to analyze and interpret data.
PO3	**Creative skills:** An ability to design, implement, and evaluate a system, process, component, or program to meet desired needs, within realistic

	constraints such as economic, environmental, social, political, health and safety, manufacturability, and sustainability. Graduates have design the competence.
PO4	**Teamwork**: An ability to function effectively on multi-disciplinary teams.
PO5	**Engineering problem solving skills**: An ability to analyze a problem, and identify, formulate and use the appropriate computing and engineering requirements for obtaining its solution.
PO6	**Professional integrity**: An understanding of professional, ethical, legal, security and social issues and responsibilities. Graduates must understand the principles of ethical decision making and can interpret the ASCE Code of Ethics. Graduates will understand the proper use of the work of others (e.g., plagiarism, copyrights, and patents). Graduates will understand the special duty they owe to protect the public's health, safety and welfare by virtue of their professional status as engineers in society.
PO7	**Speaking / writing skills**: An ability to communicate effectively, both in writing and orally. Graduates are able to produce engineering reports using written, oral and graphic methods of communication.
PO8	**Engineering impact assessment skills:** The broad education necessary to analyze the local and global impact of computing and engineering solutions on individuals, organizations, and society.
PO9	**Social awareness:** Knowledge of contemporary issues. Students are aware of emerging technologies and current professional issues.
PO10	**Practical engineering analysis skills**: An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
PO11	**Software hardware interface:** An ability to apply design and development principles in the construction of software and hardware systems of varying complexity.
PO12	**Successful career and immediate employment:** An ability to recognize the importance of professional development by pursuing postgraduate studies or face competitive examinations that offer challenging and rewarding careers in Civil Engineering

2. SYLLABUS (UNIVERSITY COPY)

(CE702PC) Estimating, Quantity surveying & Valuation

IV Year B.Tech. CE-I Sem **L /T/P/D/C**

4 / -/-/- / 4

Unit - I
General items of work in Building – Standard Units Principles of working out quantities for detailed and abstract estimates – Approximate method of Estimating.

Unit - II
Detailed Estimates of Buildings. Reinforcement bar bending and bar requirement schedules.

Unit - III
Earthwork for roads and canals.

Unit - IV
Rate analysis – Working out data for various items of work over head and contingent charges.

Unit – V
Contracts –Types of contracts – Contract Documents – Conditions of contract. Valuation of buildings. Standard specifications for different items of building construction

Textbooks:
1. Estimating and Costing by B. N. Dutta, UBS publishers, (2000).
2. Estimating and Costing by G. S. Birdie.

Reference Books:
1. Standard schedule of rates and standard data book by public works department.
2. I.S. 1200 (Parts I to XXV – 1974/method of measurement of building and Civil Engineering works – B.I.S)
3. Estimation, costing and specifications by M. Chakraborthi; laxmi publications.
4. National building code

3. a) COURSE OBJECTIVES

1. Classify Basic concepts, techniques and applications of Estimation and costing.
2. Understand how to prepare a detailed estimate for a residential building and calculate the quantities for various items of work
3. Analyse the rates for various items of work and to prepare a abstract estimate
4. Designing the preparation of bar bending schedule for reinforcement works.
5. Create various Tender documents for bidding purpose

3. b) COURSE OUTCOMES

CO1: Estimate of quantities for a Residential Building & Abstract cost Estimate
CO2: Design and Prepare Bar bending schedule for reinforcement works.
CO3: Estimate the calculation of earth work quantity for roads and canals.
CO4: Analyze the rates of work quantities and labour.
CO5: Analyze different types of contracts, tender document for building & valuation

3. c) TOPIC OUTCOMES

Lecture no.	**Topic to be covered**	**Topic outcome** *(at the end of this course, the student will be able to)*
	Unit-I	
1-2	Introduction to General items of work in Building	Units of different quantities**,** procedure of estimating.
3-4	Principles of working out quantities	Principles of working out quantities for detailed and abstract estimate
5-6	Preparation of quantities for abstract estimate.	Problems related to estimation of quantities for abstract estimates by approximate method of estimating
7-8	Preparation of quantities for detailed estimate	Problems related to estimation of quantities for detailed estimates by approximate method of estimating
9-10	Estimates of building	Different types of estimates
11-12	Different methods of estimation	Description of Long wall short wall method of estimation and Centre Line method of Estimation
	Unit-II	
13-14	Long wall short wall method	Problems related to long wall and short method for a single room building

15-16	Long wall short wall method	Problems related to long wall short wall method for a Two room building & Residential building
17-18	Long wall short wall method	Problems related to long wall short wall method for a Two room building & Residential building
19-20	Centre line Method	Problems related to centre line method for a single room building
21-22	Centre line Method	Problems related to Centre line method for a Two room building & Residential building
23-24	Bar Bending Schedule	Reinforcement bar bending schedule
25-26	Bar Requirement Schedule	Problems related to reinforcement bar bending and bar bending schedule
	Unit-III	
27-28	Different Methods of Road Estimating	Mid-sectional area method, Mean Sectional area method, Prismoidal formula method
29-30	Problems on Road Estimating	Problems related to Mid- sectional area method
31-32	Problems on Road Estimating	Problems related to Mid- area method
33-34	Problems on Road Estimating	Problems related to Prismoidal formula method
MID TERM-1 EXAMINATION		
29-30	Problems on Canal works	Problems related to earthwork of canals for fully Excavation case
31-32	Problems on Canal works.	Problems related to earthwork of canals for Partly Excavation & Partly embankment case
33-34	Problems on Canal works.	Problems related to earthwork of canals for fully embankment case
	Unit-IV	
35-36	Rate analysis.	Introduction to rate analysis, material required for various items of work, rates of various quantities, material, labour

37-38	Analysis of rates for Cement Concrete for different mix proportions	Problems on analysis of rates for Cement Concrete of 1:2:4; 1:3:6 & 1:5:10 mix
39-40	Analysis of rates for Cement mortar for different mix proportions	Problems on analysis of rates for Cement Mortar of 1:2; 1:3 & 1:5 mix
41-42	Analysis of rates for plastering	Analysis of rates for Plastering for different mix proportions
43-44	Analysis of rates for brickwork	Analysis of rates for brickwork quantity.
45-46	Analysis of rates for cement concrete work	Analysis of rates for cement concrete work for different mix proportions
	Unit-V	
47-48	Contracts	Introduction to Contracting, contract document, types of contract
49-50	Different types of Contracts	Requirements of contract, types of contract
51-52	Conditions of Contract	Types of tenders, scrutinizing of tender, Accepting Tenders, Notice Inviting tender
53-54	Valuation of buildings	Introduction, Valuation of buildings, standard specification for different items of work
55-56	Valuation of buildings	Sinking Fund, Deprecation, method of valuation
57-58	Valuation of buildings	Mortgage lease, fixation of rent, problems related to it
59-60	Standard specifications	Ability to understand regarding different specifications (Internal electric wiring, underground cable works)
61-62	Specifications for different items of building work	Ability to understand regarding different specifications of overhead lines and street lights, specifications for earthing, specifications for testing and installation
MID TERM-2 EXAMINATION		

4. COURSE PRE–REQUISITES

1. Building materials, construction & planning, Reinforced concrete structures design and drawing

5. CO's, PO's Mapping

COs NO.	Cos	POs	COs NO.
CO1	Understand the preparation of an Abstract Estimate for a Residential Building	**PO1, PO4, PO11**	**CO1**
CO2	Analyze the units for various quantities of items of works	**PO2, PO3**	**CO2**
CO3	Demonstrate the calculation of earth work quantity for roads and canals.	**PO1, PO3, PO5**	**CO3**
CO4	Design and Prepare Bar bending schedule for reinforcement works	**PO2, PO3**	**CO4**
CO5	Understand how to prepare a Notice inviting tender document for bidding.	**PO1, PO4**	**CO5**

6. COURSE INFORMATION SHEET

6. a) COURSE DESCRIPTION:

PROGRAMME: B. Tech. (Civil Engineering.)	DEGREE: BTECH
COURSE: **ESTIMATING AND COSTING**	YEAR: **IV** SEM: **I** CREDITS: **4**
COURSE CODE: **A70138** REGULATION: **R13**	COURSE TYPE: **CORE**
COURSE AREA/DOMAIN: **ESTIMATING AND COSTING**	CONTACT HOURS: 4+0 (L+T) hours/Week.
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	LAB COURSE NAME: NIL

6. b) SYLLABUS:

Unit	Details	Hours
I	General items of work in Building – Standard Units Principles of working out quantities for detailed and abstract estimates – Approximate method of Estimating. Detailed Estimates of Buildings	20
II	Earthwork for roads and canals.	14
III	Rate analysis – Working out data for various items of work over head and contingent charges.	08
IV	Reinforcement bar bending and bar requirement schedules. Contracts – Types of contracts – Contract Documents – Conditions of contract.	09
V	Valuation of buildings. Standard specifications for different items of building construction	09
Total No. of classes		**60**

6. c) GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

S.NO.	DESCRIPTION	PROPOSEDACTIONS
1	NIL	NIL

6. d) TOPICS BEYOND SYLLABUS/ ADVANCED TOPICS:

1	NIL	NIL

6. e) WEB SOURCE REFERENCES:

Sl.No.	Name of book/ website
a.	https://civilread.com/download-estimation-costing-textbook-bn-
b.	nptel.ac.in/courses/105103093/14
c.	https://www.slideshare.net/thomasjbritto/estimating-andcosting-

6. f) DELIVERY/INSTRUCTIONAL METHODOLOGIES:

☑ CHALK & TALK	☑ STUD. ASSIGNMENT	☑ WEB RESOURCES
☑ LCD/SMART BOARDS	☑ STUD. SEMINARS	☐ ADD-ON COURSES

6. g) ASSESSMENT METHODOLOGIES-DIRECT

☑ ASSIGNMENTS	☑ STUD. SEMINARS	☑ TESTS/MODEL EXAMS	☑ UNIV. EXAMINATION
☐ STUD. LAB PRACTICES	☐ STUD. VIVA	☐ MINI/MAJOR PROJECTS	☐ CERTIFICATIONS
☐ ADD-ON COURSES	☐ OTHERS		

6. h) ASSESSMENT METHODOLOGIES-INDIRECT

☑ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	☑ STUDENT FEEDBACK ON FACULTY (TWICE)
☐ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

6. i) TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
Text Book 1	Estimating and Costing by B. N. Dutta, UBS publishers, (2000).
Text Book 2	Estimating and Costing by G. S. Birdie.
Reference 1 Book	. Standard schedule of rates and standard data book by public works department.
Reference 2 Book	I.S. 1200 (Parts I to XXV – 1974/method of measurement of building and Civil Engineering works – B.I.S)
Reference 2 Book	Estimation, costing and specifications by M. Chakraborthi; laxmi publications

7.TOPIC WISE COVERAGE [MICRO LESSON PLAN]			
S. No.	**Topic**	**Scheduled date**	**Actual date**
	Unit-I		
1	General items of work in Building.		
2	General items of work in Building.		
3	Standard Units Principles of working out quantities for detailed and abstract estimates		
4	Standard Units Principles of working out quantities for detailed and abstract estimates		
5	Standard Units Principles of working out quantities for detailed and abstract estimates		
6	Approximate method of Estimating.		
7	Approximate method of Estimating.		
8	Approximate method of Estimating.		
9	Approximate method of Estimating.		
10	Approximate method of Estimating.		
11	Approximate method of Estimating.		
12	Approximate method of Estimating.		
13	Approximate method of Estimating.		
	Unit-II		
14	Detailed Estimates of Buildings.		
15	Detailed Estimates of Buildings.		
16	Detailed Estimates of Buildings.		
17	Detailed Estimates of Buildings.		

18	Detailed Estimates of Buildings.		
19	Detailed Estimates of Buildings.		
20	Detailed Estimates of Buildings.		
21	Reinforcement bar bending and bar requirement schedules.		
22	Reinforcement bar bending and bar requirement schedules.		
23	Reinforcement bar bending and bar requirement schedules.		
24	Reinforcement bar bending and bar requirement schedules.		
	Unit-III		
21	**Introduction:** -Earthwork for roads and canals.		
22	Earthwork for roads		
23	Earthwork for roads		
24	Earthwork for roads		
25	Earthwork for roads		
26	Earthwork for roads		
27	Earthwork for roads		
28	Earthwork for roads		
29	Earthwork for canals		
30	Earthwork for canals		
31	Earthwork for canals		
32	Earthwork for canals		
33	Earthwork for canals		
34	Earthwork for canals		

	Unit-IV		
35	Rate analysis		
36	Working out data for various items of work over head and contingent charges.		
37	Working out data for various items of work over head and contingent charges.		
38	Working out data for various items of work over head and contingent charges.		
39	Working out data for various items of work over head and contingent charges.		
40	Working out data for various items of work over head and contingent charges.		
41	Working out data for various items of work over head and contingent charges.		
42	Working out data for various items of work over head and contingent charges.		
43	Working out data for various items of work over head and contingent charges.		
44	Working out data for various items of work over head and contingent charges.		
	Unit-V		
45	Contracts		
46	Common Types of Repairs		
47	Common Types of Repairs		
48	Contract Documents		
49	Contract Documents		
50	Conditions of contract.		
51	Conditions of contract.		

52	Valuation of buildings.		
53	Valuation of buildings.		
54	Valuation of buildings.		
55	Valuation of buildings.		
56	Standard specifications for different items of building construction		
57	Standard specifications for different items of building construction		
58	Standard specifications for different items of building construction		
59	Standard specifications for different items of building construction		
60	Standard specifications for different items of building construction		
61	Standard specifications for different items of building construction		
62	Standard specifications for different items of building construction		

8) TEACHING SCHEDULE

Subject	**PRESTRESSED CONCRETE STRUCTURES**					
Text Books (to be purchased by the Students)						
Book 1	1. Estimating and Costing by B. N. Dutta, UBS publishers, (2000).					
Book 2	2. Estimating and Costing by G. S. Birdie.					
Reference Books						
Book 3	Standard schedule of rates and standard data book by public works department.					
Book 4	I.S. 1200 (Parts I to XXV – 1974/method of measurement of building and Civil Engineering works – B.I.S)					
Unit	**Topic**	**chapter Nos**				**No of classes**
		Book 1	**Book 2**	**Book 3**	**Book 4**	
	Introduction to General items of work in Building	1				1

I	Principles of working out quantities	2				2
	Preparation of quantities for abstract estimate.	2				2
	Preparation of quantities for detailed estimate	2				2
II	Estimates of building					
	Different methods of estimation					
	Long wall short wall method	3				2
	Long wall short wall method	7				1
	Long wall short wall method	7				1
	Centre line Method	7				2
	Bar Bending Schedule					
	Bar Requirement Schedule	7				2
III	Problems on Road Estimating	11				2
	Problems on Road Estimating	11				2
	Problems on Road Estimating	11				2
	Problems on Canal works.	11				2
	Problems on Canal works	11				2
IV	Analysis of rates	5				2
	Analysis of rates for plastering	5				2
	Analysis of rates for brickwork	5				2
	Analysis of rates for cement concrete work	5				2
V	Contracts		13			1
	Different types of Contracts		13			1
	Contract document		13			1

	Conditions of Contract		13			2
	Valuation of buildings	15				4
	Specifications for different items of building work	13				5
Total No. of classes						**62**

9) Unit wise Hand-written Notes

10) OHP/LCD SHEETS /CDS/DVDS/PPT (Soft/Hard copies)

11) University previous question paper

R09

Code No: 09A70107

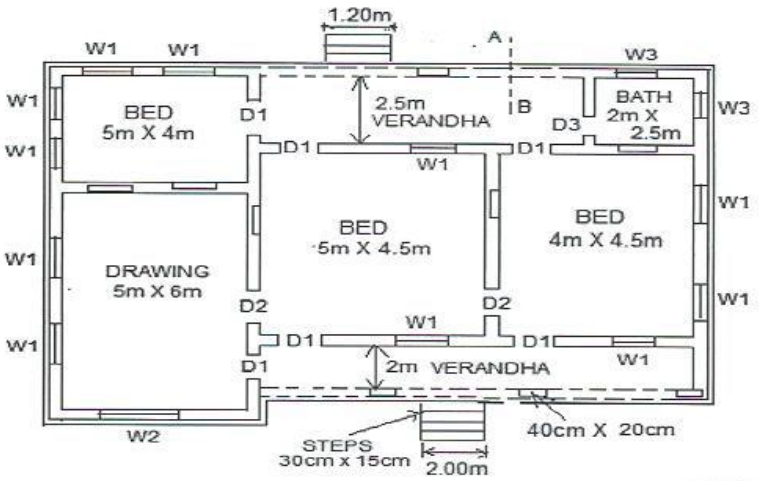
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD
B. Tech IV Year I Semester Examinations, November/December-2012
ESTIMATING AND COSTING
(CIVIL ENGINEERING)

Time: 3 hours **Max. Marks: 75**

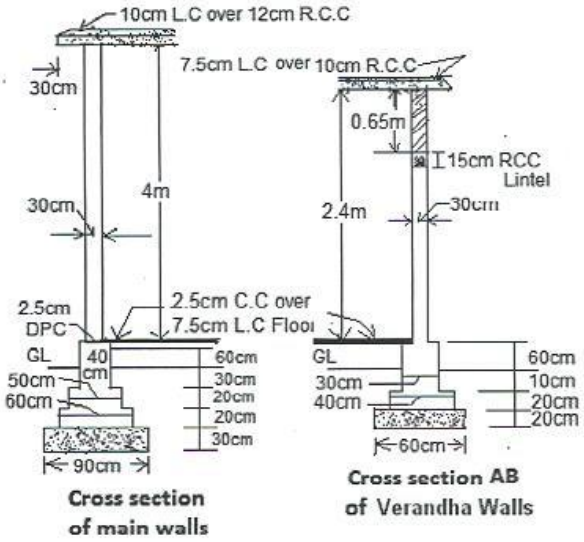
Answer any five questions
All questions carry equal marks

1.a) What are the main items of work in estimating a building?
b) What are rules followed in estimating openings in buildings?
c) What are various methods of estimating a building and explain about individual wall method? [15]

2. Estimate the quantities of the following items of a residential building from the given drawing: **Fig.1**
a) Earth work in excavation in foundation
b) Lime concrete in foundation
c) First class brick work in 1:6 cement sand mortar in foundation and plinth.
d) 2.5cm damp proof course
e) First class brick work in lime mortar in super structure.
(By any Center line Method) [15]



PLAN
(a)



Doors:
D1-120cm x 210cm(1.2m x 2.1m)
D2-100cm x 200cm(1.0m x 2.0m)
D3-75cm x 180cm(0.75m x 1.8m)
Windows:
W1-100cm x 150cm(1.0m x 1.5m)
W2-200cm x 150cm(2.0m x 1.5m)
W3-75cm x 120cm(0.75m x 1.2m)
Shelves:
S-100cm x 150cm(1.0m x 1.5m)
LINTEL OVER DOORS,WINDOWS
E.T.C 15cm R.B.

(b)

Fig.1
*Any Missing data assume suitably

3. Prepare an estimate for the portion of a road from chainage 14 to 22 from the data given below. Draw also the longitudinal and typical cross-section for cutting and banking. The rate of earth work in cutting is Rs.8.50/cum and embankment is Rs.7.50/cum. The formation width of the proposed road is 12m, sideslope 1.5: 1 in cutting and 2:1 in banking. [15]

Chainage (30m) (in m):	14	15	16	17	18	19	20	21	22
Ground R.L'S	108.6	109.25	109.4	108.85	108.5	107.25	106.8	107.15	107.20

4.a) Prepare rate analysis for the following works
i) R.C.C work in slabs 1:2:4
ii) First class brick work in super structure with 1:6 cement mortar
iii) 2.5 cm cement concrete floor 1:2:4.
b) What is analysis of rate? Explain the purpose of rate analysis. [11+4]

5. Fig. 2, shows the longitudinal section and cross section of a simple beam of clear span 5.0m. The thickness of supporting wall is 30cm.Work out the total quantity of cement concrete and steel reinforcement (mild steel). [15]

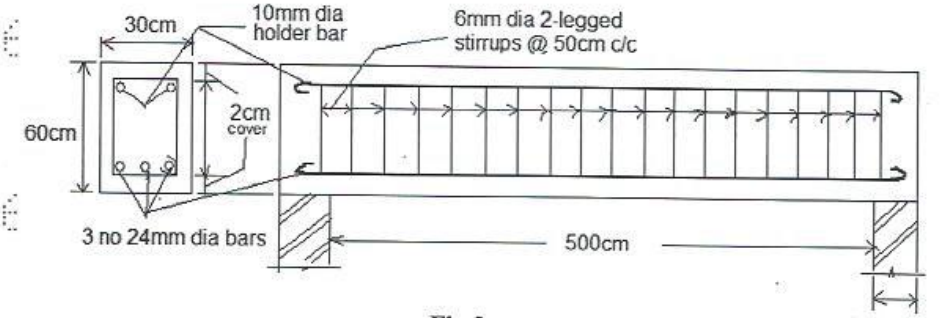


Fig.2

6. What is contract? What do you mean by contract system and also explain its types? [15]

7. A building is constructed at a cost of Rs.2,50,000 on a land purchased at Rs.50,000.The owner of the property expects a return of 9% on the cost of construction and 8% on the cost of land. The building is estimated to have future life of 60 years at the end of which it requires Rs.3,25,000 for constructing a new building in its place. Determine the standard rent of the property given.
   i) Rate of interest for sinking fund at 6%
   ii) Annual repairs at 1.5% of the cost of construction
   iii) All the other out goings is 28% of the net income of the property
   iv) Scrap value at the end of useful life of building as 10%. [15]

8. Write the general specifications for the following items of work
   a) D.P.C 2.5cm thick
   b) Painting doors and windows
   c) Cement-concrete in roof terracing
   d) Reinforced brick-work. [15]

* * * * * * *

12) MID exam Descriptive Question Papers with Key

MID 1 Question paper

1 a) what is estimating of building? And explains the methods of estimating of buildings?
b) Write the basic units of building works?

2 Estimate the quantities of the following items of a two roomed building from the given plan and section.
a) Earthwork in excavation in foundation.
b) Lime concrete in foundation.
c) 1st class brick work in cement mortar 1:6 in foundation and plinth.
d) 2.5 cm c.c damp proof course, and
e) 1st class brick work in lime mortar in super structure.

(DIAGRAM)

3 What is the road estimating? And explain their methods with neat sketches and formation tables?

4 Reduce level (R.L) of ground along the centre line of a proposed road from chainage 10 to 20 are given below.
The formation level at the 10th chainage is 107 and the road is in downward gradient of 1 in 150 up to the chainage 14 and then the gradient chainage to 1 in 100 downward. Formation width of road is 10meter and side slopes of banking are 2:1(horizontal: vertical). Length of the chain is 30metre.
Draw longitudinal section of the road and a typical cross section and prepare an estimate of earth work at the rate of Rs.275%cu m.

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

Chainage	10	11	12	13	14	15	16	17	18	19	20
R.L.of ground	105.00	105.60	105.44	105.90	105.42	104.30	105.00	104.10	104.62	104.00	103.30

(ii) R.L. of formation 107.00

(iii) I….Downward gradient…. 1in 150……..…..I……downward gradient 1 in 100……I

Answers

1. Estimating and costing in construction management is the calculation of quantities of materials, tools, equipments, labors etc. and cost associated with them.

Methods of Detailed Construction Estimation Preparation

i) Details of measurements and calculation of quantities:

The complete work is divided into various items of work such as earthwork concreting, brickwork, reinforced concrete, plastering etc. The details of measurements are taken from drawings and entered in respective columns of prescribed preformed.

The quantities are calculated by multiplying the values that are in numbers column to Depth column as shown below:

Details of measurements form

S.No.	Description of Item	No	Length (L) m	Breadth (B) m	Depth/ Height (D/H)m	Quantity	Explanatory Notes

ii) Abstract of Estimated Cost:

The cost of each item of work is worked out from the quantities that already computed in the detailed measurement form at workable rate. But the total cost is worked out in the prescribed form is known as abstract of estimated form. 4%of estimated Cost is allowed for Petty Supervision, contingencies and unforeseen items.

Abstract of Estimate Form

Item No.	Description/ Particulars	Quantity	Unit	Rate	Per (Unit)	Amount

The detailed estimate should be accompanied with:

1. Report
2. Specification
3. Drawings (plans, elevation, sections)
4. Design charts and calculations
5. Standard schedule of rates.

Factors to be considered while Preparing Detailed Estimate:

i) Quantity and transportation of materials: For bigger project, the requirement of materials is more. Such bulk volume of materials will be purchased and transported definitely at cheaper rate.

ii) Location of site: The site of work is selected, such that it should reduce damage or in transit during loading, unloading, stocking of materials.

iii) Local labour charges: The skill, suitability and wages of local labores are considered while preparing the detailed estimate.

Data for detailed estimate:

The process of working out the cost or rate per unit of each item is called as Data. In preparation of Data, the rates of materials and labour are obtained from current standard scheduled of rates and while the quantities of materials and labour required for one unit of item are taken from Standard Data Book (S.D.B).

Fixing of Rate per Unit of an Item:

The rate per unit of an item includes the following:

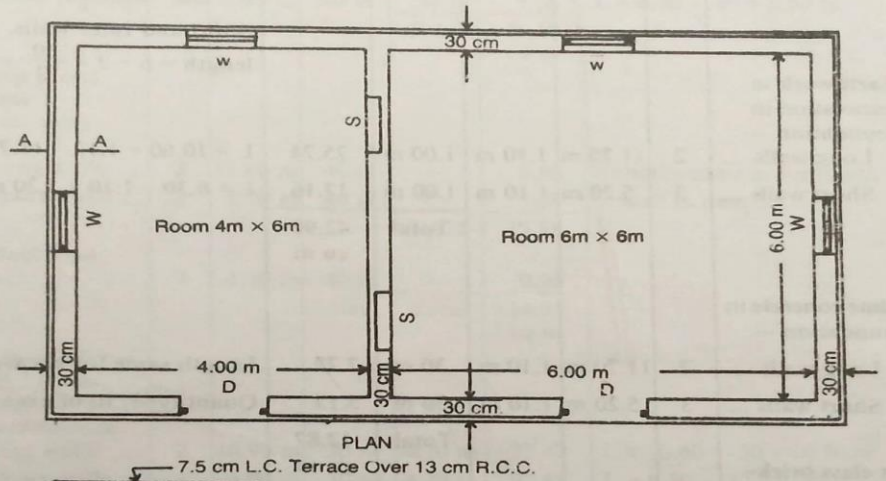
1) Quantity of materials & cost: The requirement of materials is taken strictly in accordance with standard data book (S.D.B). The cost of these includes first cost, freight, insurance and transportation charges.

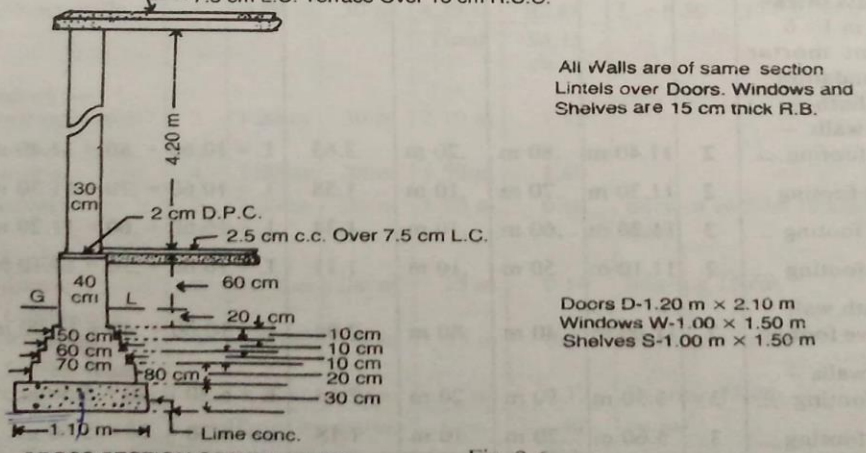
2.

Example 4(a). — Estimate the quantities of the following items of a two roomed building from the given plan and section (Fig. 2-6) :—

(1) Earthwork in excavation in foundation, (2) Lime concrete in foundation, (3) 1st class brickwork in cement mortar 1 : 6 in foundation and plinth, (4) 2.5 cm c.c. damp proof course, and (5) 1st class brickwork in lime mortar in superstructure.

TWO ROOMED BUILDING





CROSS SECTION OF WALL ON AA. Fig. 2-6

Note : — *No beam has been shown in the plan as the object of this example is to explain the method of estimating the walls only.*

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

Item No.	Particulars of Items	No.	Length	Breadth	Height or Depth	Quantity	Explanatory note
							Long wall, c/c. length = $4 \times 6 + .30 + 2 \times \frac{.30}{2}$ = 10.60 m
							Short and Inter walls, c/c. length = $6 + 2 \times \frac{.30}{2}$ = 6.30 m
1.	**Earthwork** in excavation in foundation —						
	Long walls ...	2	11.70 m	1.10 m	1.00 m	25.74	L = 10.60 + 1.10 = 11.70 m
	Short walls ...	3	5.20 m	1.10 m	1.00 m	17.16	L = 6.30 – 1.10 = 5.20 m
					Total	42.90 cu m	
2.	**Lime concrete** in foundation —						
	Long walls ...	2	11.70 m	1.10 m	.30 m	7.72	Length same for excavation
	Short walls ...	3	5.20 m	1.10 m	.30 m	5.15	Quantity=3/10 of excavation
					Total	12.87 cu m	
3.	**1st class brick-work** in 1 : 6 cement mortar in foundation and plinth —						
	Long walls —						
	1st footing ...	2	11.40 m	.80 m	.20 m	3.65	L = 10.60 + .80 = 11.40 m
	2nd footing ...	2	11.30 m	.70 m	.10 m	1.58	L = 10.60 + .70 = 11.30 m
	3rd footing ...	2	11.20 m	.60 m	.10 m	1.34	L = 10.60 + .60 = 11.20 m
	4th footing ...	2	11.10 m	.50 m	.10 m	1.11	L = 10.60 + .50 = 11.10 m
	Plinth wall above footing	2	11.00 m	.40 m	.80 m	7.04	L = 10.60 + .40 = 11.00 m
	Short walls —						
	1st footing ...	3	5.50 m	.80 m	.20 m	2.64	L = 6.30 – .80 = 5.50 m
	2nd footing ...	3	5.60 m	.70 m	.10 m	1.18	L = 6.30 – .70 = 5.60 m

Note : — *Length of subsequent footings of long walls after 1st footing may be obtain simply by deducting 10 cm from first footing.*

3.

For the calculation of earthwork in a road longitudinal section and cross-section of the ground are taken and the formation line is fixed. The formation line is fixed in consideration of flood level, gradient, height of bank, depth of cutting, etc. In plain countries road is usually in banking, but if the road is in cutting for some length and in banking for some other length, the excavated earth from the cutting portion should be utilised for the banking portion within economical limits, during the execution of the work. But for estimating of earthwork this point of utilising excavated earth from cutting in certain length in banking of the adjacent length may not be taken into account to avoid complicacy. In hilly countries road is usually both in banking and in cutting and the excavated earth from cutting is utilised for banking within economical limits.

From the L-section and formation line, the height of bank and depth of cutting are calculated the difference of R.L. of ground and R.L. of formation gives the height of bank or depth of cutting. For plain country the ground is considered as level accross, that is there is no cross-slope. The earthwork is calculated by parts of the length in between two consecutive stations of L-section and continued until the whole length is covered.

For longitudinal section R.L. of ground is usually taken by levelling instrument at every 30 metre apart along the centre line of the road. When the ground is fairly even the levels may be taken at 40 or 50 metre apart or even up to 100 metre apart. In uneven ground or hilly areas the R.L. of ground may be taken at 20 metre or more or less depending on the nature of the ground. Estimate of road is prepared kilometre wise. It is better if the distance apart of L-section is such that it is multiple to make the kilometre.

Longitudinal section is usually plotted with a horizontal scale of 1 cm = 10 m to 1 cm = 30 m and a vertical scale of 1 cm = 1 m to 1 cm = 5 m.

The quantity of earthwork may be calculated by the various methods of mensuration out of which three methods are given below :—

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

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

$= Bd_m + \frac{1}{2}sd_m^2 + \frac{1}{2}sd_m^2 = Bd_m + sd_m^2$

$\therefore$ Quantity of earthwork $= (Bd_m + sd_m^2) \times L$

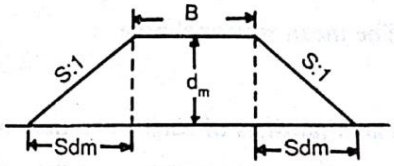


Fig. 7-4

General, $Q = (Bd + sd^2) \times L$, where d stands for mean height or depth.

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

Stations or Chain-age	Depth or Height	Mean Depth or Height "d"	Area of central portion Bd	Area of sides Sd^2	Total Sectional Area $Bd+sd^2$	Length between stations L	Quantity $(Bd + sd^2) \times L$	
							Embank-ment	Cutting

Area of side sloping surface —
The area of sides which may require turfing or pitching, may be found by multiplying the mean sloping breadth by the length.

The mean sloping breadth = $\sqrt{(sd^2+d^2)} = \sqrt{5^2+1}$, where d stands for mean d.

Area of both side slopes = 2 L, × d $\sqrt{s^2+1}$

This also may be calculated in a tabular form —

Station or Chain-age	Depth or Height	Mean depth or Height	Breadth of side slopes d $\sqrt{s^2+1}$ *Sloping breadth*	Length between stations L	Total Area of both side slopes 2 L d$\sqrt{s^2+1}$

This table may be added to the previous table or may be worked out separately, d being mean depth or height.

Method II. Mean Sectional Area Method — Quantity = Mean Sectional area × 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 and d_2 are the heights or depth at the two ends.

The mean sectional area $A = \frac{A_1+A_2}{2}$, Quantity $Q = \frac{A_1+A_2}{2} \times$ Length.

The quantities of earthwork may be calculated in a tabular form as given below :—

Stations or Chainage	Height or Depth "d"	Area of central portion Bd	Area of sides Sd^2	Total Sectional Area $Bd+Sd^2$	Mean Sectional Area	Length between station L	Quantity $(Bd+sd^2) \times L$	
							Emba-nkment	Cutting

Method III. Prismoidal Formula Method. — Quantity or volume $= \frac{L}{6}(A_1+A_2+4A_m)$

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

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

Cross-sectional area at one end —

$A_1 = Bd_1 + Sd_1^2$

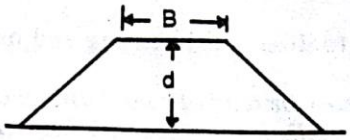


Fig. 7-5

Cross-sectional area at other end —

$A_2 = Bd_2 + Sd_2^2$

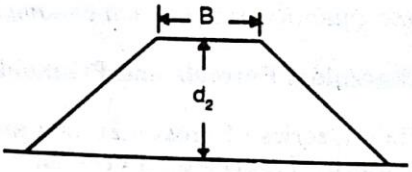


Fig. 7-6

Cross-section at middle —

$$d_m = \frac{d_1+d_2}{2}$$

$$A_m = Bd_m + Sd_m^2$$

$$= B\left(\frac{d_1+d_2}{2}\right) + S\left(\frac{d_1+d_2}{2}\right)^2$$

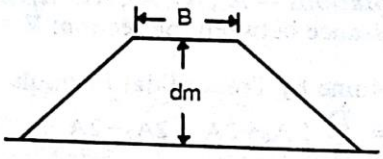


Fig. 7-7

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

$$= \frac{L}{6}\left[(Bd_1+sd_1^2) + (Bd_2+sd_2^2) + 4\left\{B\left(\frac{d_1+d_2}{2}\right) + s\left(\frac{d_1+d_2}{2}\right)^2\right\}\right]$$

$$= \frac{L}{6}\left[(Bd_1+Bd_2+4\frac{Bd_1}{2}+4\frac{Bd_2}{2}) + sd_1^2+sd_2^2+4s\frac{d_1^2+d_2^2+2d_1d_2}{4}\right]$$

$$= \frac{L}{6}\left[(3\,Bd_1+3\,Bd_2) + 2sd_1^2 + 2sd_2^2 + 2sd_1d_2\right]$$

$$= \frac{3BL}{6}(d_1+d_2) + \frac{2Ls}{6}(d_1^2 + d_2^2 + d_1d_2)$$

$$= \frac{BL}{2}(d_1+d_2) + \frac{Ls}{3}(d_1^2+d_2^2+d_1d_2)$$

$$= \left\{B\left(\frac{d_1+d_2}{2}\right) + s\left(\frac{d_1^2+d_2^2+2d_1d_2}{3}\right)\right\} \times L$$

= [Sec. Area of central portion + Sec. Area of side slope portions] × Length.

The same is also applicable for cutting.

Tabular Form for Prismoidal Formula — The above may be set in a tabular form for calculating the quantity of earthwork for a road. See Example 8, page 345 for tabular form.

Calculation of Quantities of Earthwork (Ex. 3)

B=10 m, s=2

Stations or Chain-age m	Length m	Height or Depth *Diff. of G.L. and F.L.* m	Mean height or depth d m	Central area Bd m²	Side area sd² m²	Total sec. area Bd+sd² m²	Length in betw. stations L m²	Quantity (Bd+sd²)+L Banking m³	Quantity (Bd+sd²)+L Cutting m³
10	300	2.00	—	—	—	—	—	—	—
11	330	1.20	1.60	16.00	5.12	21.12	30	633.6	—
12	360	1.16	1.18	11.80	2.78	14.58	30	437.4	—
13	390	0.50	0.83	8.30	1.38	9.68	30	290.4	
14	420	0.78	0.64	6.40	0.82	7.22	30	216.6	
15	450	1.60	1.19	11.90	2.83	14.73	30	441.9	—
16	480	0.60	1.10	11.00	2.42	13.42	30	402.6	—
17	510	1.20	0.90	9.00	1.62	10.62	30	318.6	—
18	540	0.38	0.79	7.90	1.25	9.15	30	274.5	—
19	570	0.70	0.54	5.40	0.58	5.98	30	179.4	—
20	600	1.10	0.90	9.00	1.62	10.62	30	318.6	—

Total 3513.6 cu m

ABSTRACT OF ESTIMATED COST (Ex. 3)

Item No.	Particulars of items	Quantity	Unit	Rate Rs. P.	Per	Cost Rs. P.
1	Earthwork in banking ...	3513.6	cu m	275.00	% cu m	9662.40
					Total ...	9662.40
					Add 5% (3% for Contingencies and 2% for Workcharged Establishment) ...	483.12
					Grand Total ...	Rs. 10145.52

Calculation of Areas of Side Slopes (Ex. 3-ii)

$s=2$, $\sqrt{s^2+1} = 2.236$

Station or Chainage	Height or Depth	Mean Ht. or Depth d m	Sloping breadth of side slope $d\sqrt{s^2+1}$ m	Length L m	Area of both side slopes $2Ld\sqrt{s^2+1}$ m
10	2.00	—	—	—	—
11	1.20	1.60	3.58	30	214.80
12	1.16	1.18	2.64	30	158.40
13	0.50	0.83	1.86	30	111.60
14	0.78	0.64	1.43	30	85.80
15	1.60	1.19	2.66	30	159.60
16	0.60	1.10	2.46	30	147.60
17	1.20	0.90	2.01	30	120.60
18	0.38	0.79	1.77	30	106.20
19	0.70	0.54	1.21	30	72.60
20	1.10	0.90	2.01	30	120.60
				Total	1297.80 sq m

Abstract of Cost of Turfing (Ex. 3-*ii*)

Turfing side slopes 1297.80 @ Rs. 60.00 per % sq m =	778.68
Add 5% for Contingencies, etc.	Rs. 38.93
Grand Total	Rs. 817.61

13. MID exam Descriptive Question Papers with Key

MID II Question paper

1. a) What is rate analysis?
   b) Explain the factors affecting the rate analysis?
2. a) Define valuation? Explain the need of valuation?
   b) The capitalized value of a property fetching a net annual rent of 4000/-
   Then calculate the highest rate of interest prevent being 7% ?
3. a) Explain about general specifications of 1st class and 2nd class bricks?

   b) Explain about general specifications of white washing, earthwork in foundation, plastering?

4. a) Explain the term contract documents ?

   b) List out the types of contracts in detail?

Answers

1. ANS:-

In order to determine the rate of a particular item, the factors affecting the rate of that item are studied carefully and then finally a rate is decided for that item. This process of determining the rates of an item is termed as analysis of rates or rate analysis.

The **rate of particular item of work depends** on the following:

1. Specifications of works and material about their quality, proportion and constructional operation method.

2. Quantity of materials and their costs.

3. Cost of labours and their wages.

4. Location of site of work and the distances from source and conveyance charges.

5. Overhead and establishment charges

6. Profit

Cost of materials at source and at site of construction:

The costs of materials are taken as delivered at site inclusive of the transport local taxes and other charges.

Purpose of Analysis of rates:

1. To work out the actual cost of per unit of the items.

2. To work out the economical use of materials and processes in completing the particulars item.

3. To work out the cost of extra items which are not provided in the contract bond, but are to be done 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.

Cost of labour -types of labour, standard schedule of rates:

The labour can be classified in to

1) Skilled – 1st class

2) Skilled – 2d Class

3) Unskilled

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 Ist class, remaining 70% as II class.

The rates of materials for Government works are fixed by the superintendent Engineer for his circle every year and approved by the Board of Chief Engineers. These rates are incorporated in the standard schedule of rates.

b) Factors which affect the rate analysis of civil works are:

- Specification of the civil work and materials such as quality of materials, proportion of mortar or concrete, thickness of plastering, number of coats of painting, depth of excavation, type of soil etc.
- Location of the construction site – Distance of construction site from source of materials, availability of labours, availability of water, machinery etc. influence the rate analysis of construction work.
- Quantity of materials, number of different types of labours and rates of materials and labours influence the rate analysis.
- Profit of the contractor, miscellaneous expenses and other overheads also influence the rate analysis.

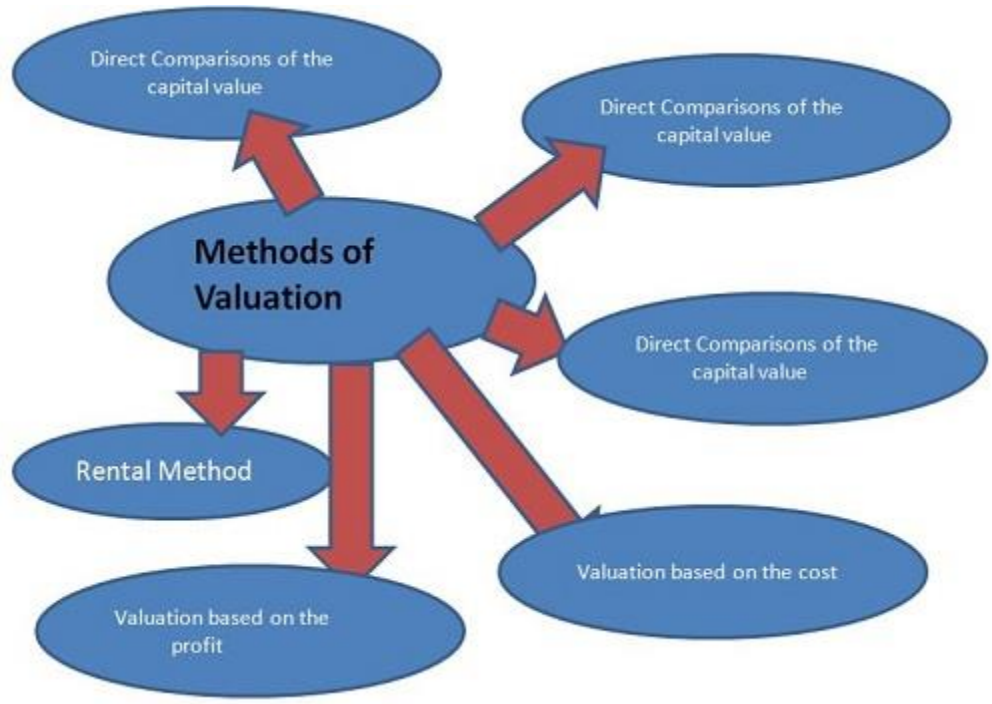
2. ANS:-

A valuation is the process of determining the fair market value of a company in a notional context, meaning that the valuation is a) time specific, b) there is no negotiation, and c) there is no exposure to the open market. Valuations are highly subjective calculations that aim to determine the fair market value of a company. There are many common situations when valuations are required, including business reorganizations, expropriations, employee share or stock option plans (ESOPs), mergers and acquisitions (M&A), and shareholder disputes.

Valuation of Building

Valuation of a building depends on the type of the building, its structure and durability, on the situation, size, shape, frontage, width of roadways, the quality of materials used in the construction and present day prices of materials. Valuation also depends on the height of the building, height of the plinth, thickness of the wall, nature of the floor, roof, doors, windows etc.

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



Six Methods of Valuation

Six Methods of Valuation

1. Rental Method of Valuation
2. Direct Comparisons of the capital value
3. Valuation based on the profit
4. Valuation based on the cost
5. Development method of Valuation
6. Depreciation method of Valuation

Rental Method of Valuation

In this method, the net income by way of rent is found out by deducting all outgoing from the gross rent. A suitable rate of interest as prevailing in the market is assumed and Year's purchase is calculated. This net income multiplied by Year's Purchase gives the capitalized value or valuation of the property. This method is applicable only when the rent is known or probable rent is determined by enquiries.

Direct comparison with the capital Value

This method may be adopted when the rental value is not available from the property concerned, but there are evidences of sale price of properties as a whole. In such cases, the capitalized value of the property is fixed by direct comparison with capitalized value of similar property in the locality.

Valuation based on profit

This method of Valuation is suitable for buildings like hotels, cinemas, theatres etc for which the capitalized value depends on the profit. In such cases, the net income is worked out after deducting gross income; all possible working expense, outgoings, interest on the capital invested etc. The net profit is multiplied by Year's Purchase to get the capitalized value. In such cases, the valuation may work out to be high in comparison with the cost of construction.

Valuation based on cost

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

Development Method of Valuation

This method of Valuation is used for the properties which are in the underdeveloped stage or partly developed and partly underdeveloped stage. If a large place of land is required to be divided into plots after providing for roads, parks etc, this method of valuation is to be adopted. In such cases, the probable selling price of the divided plots, the area required for roads, parks etc and other expenditures for development should be known.

If a building is required to be renovated by making additional changes, alterations or improvements, the development method of Valuation may be used.

Depreciation Method of Valuation

According to this method of Valuation, the building should be divided into four parts:

1. Walls
2. Roofs
3. Floors
4. Doors and Windows

And the cost of each part should first be worked out on the present day rates by detailed measurements.

The present value of land and water supply, electric and sanitary fittings etc should be added to the valuation of the building to arrive at total valuation of the property.

3. **ANS:-**

Specifications of First class brickwork

i) All of the bricks used should be of first class.

ii) See the characteristics of first class bricks

iii) Soaking of bricks should be done by submerging in a tank before use.

iv) Soaking should be continuing until the air bubbles are ceased.

v) Soaking should be for a period of 12 hour before use.

vi) Mortar specifications for first class brickwork

vii) Material of mortar should be of standard specifications.

viii) For mortar, cement should be fresh ordinary Portland cement of standard specifications.

ix) Sand should be sharp and free from organic and foreign particles.

If we want to make rich mortar, sand should be coarse or medium.

For weak mortar, local fine sand may be used.

Cement sand ratio of mortar should be 1:3 to 1:6 as specified.

To get the required proportion, materials of mortar should be measured with the measuring box.

Materials of mortar should be first mixed dry to have a uniform colour.

The platform should be clean for mortar mixing.

Mixing should be done at least three times.

Then water should be added gradually for workable consistency.

Mortar should be freshly mixed.

Old mortar should not be used.

Mortar should be mixed with water for one hour work so that mortar may be used before setting.

4. ANS:-

a) There are different types of construction contracts and their comparison is presented in this article. A construction contract is an agreement between two or more parties to execute the construction works as per certain terms and conditions.

A construction contracts contains general and special conditions of agreement, details of construction project work, their specifications, time limits, payments and penalties for delivery delays etc. and ensures every party's rights and obligations.

A construction contract document is a valid document can be enforced under certain authority or law.

Types of Construction Contract Documents

At early stages for any construction project, owner with his engineer or consultant prepares necessary documents for tender process which will be included in the contract. These documents are called contract documents.

b) Following are the types of documents in a construction contract:

1. General conditions
2. Special conditions
3. Drawings and specifications
4. B.O.Q (bill of quantity)
5. Letter of acceptance
6. Contractor bid

Conditions of Construction Contract

Conditions of contract are terms which rule the relationships between the owner and the contractor, define each party's rights and obligations, specify method of payment and determine actions required when existing any disputes between the owner and the contractor.

Following are the conditions of contract for construction projects:

- General conditions of contract
- Special conditions of contract

General conditions of contract

They are standard terms that suit the majority of projects, they include:

- Definition of the project
- Contract components
- Rights and responsibilities for the owner and the contractor
- Project schedule
- Payment method

- Warranty and delay penalty

Special conditions of contract

They are the modifications required to suit the uniqueness of the project, make the contract flexible for the nature of the project and achieve project objectives.

Selection of Type of Construction Contracts

One of the characteristics of construction projects is uniqueness. Every project has its special circumstances, so it's important to select the contract type which suits the project. The process of selecting the type of contract is developed by the owner.

14 Assignment questions unit-I

1. Explain principle units for various items of work
Ans:-.

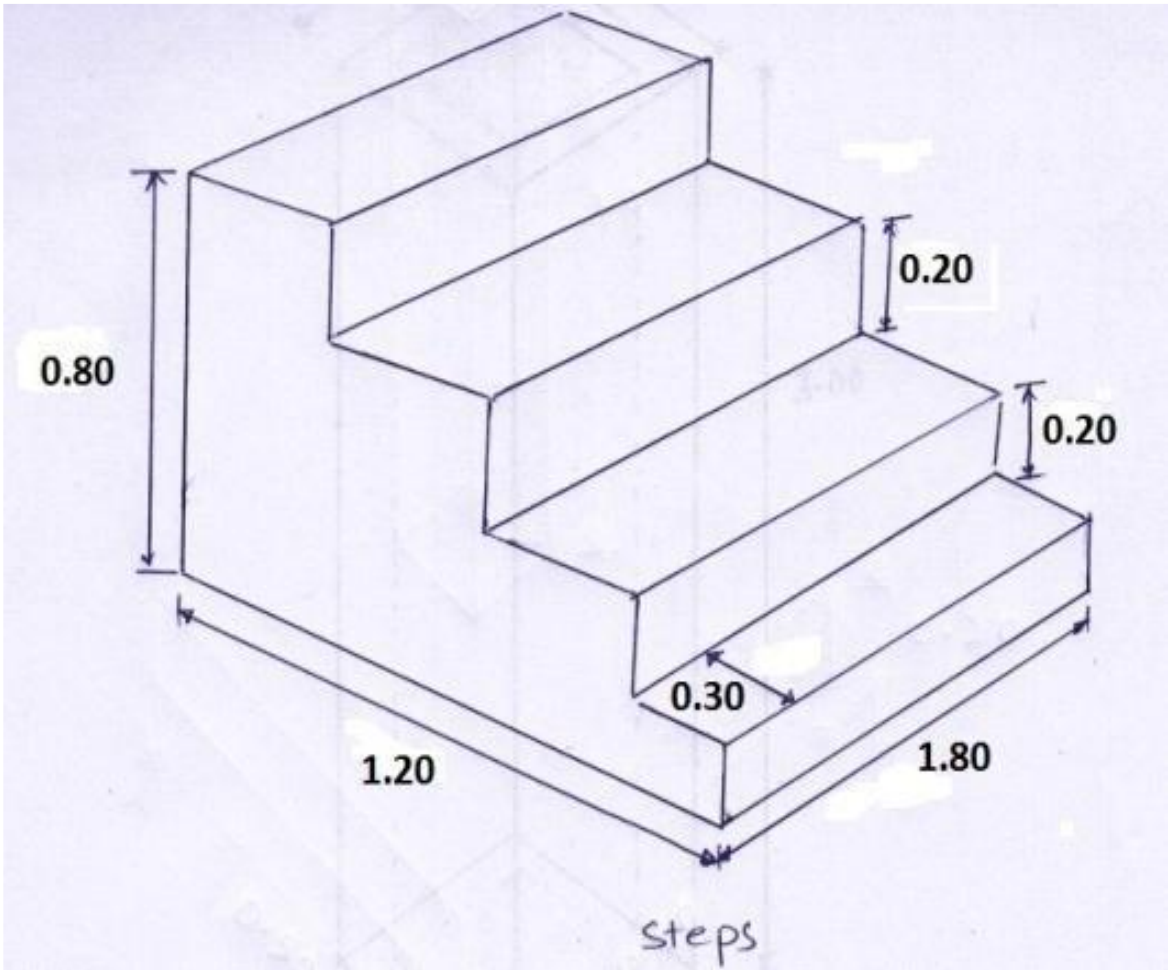
Sl no.	Particulars of item	Units of measurement	Units of payment
1.	Earthwork in excavation	cum	Per cum
2.	Earth work in filling in plinth	cum	Per cum
3.	Lime concrete in foundation	cum	Per cum
4.	Cement concrete in lintels	cum	Per cum
5.	RCC in slab	cum	Per cum
6.	Brickwork in foundation	cum	Per cum
7.	Brickwork in plinth	cum	Per cum
8.	Brickwork in super structure	cum	Per cum
9.	Stone masonry	cum	Per cum
10.	Steel reinforcement bars etc. in RCC and reinforced brick work	Quintal	Per Quintal
11.	Bending, binding of steel reinforcement	Quintal	Per Quintal

2. List out general items of work for building estimates in detail.
Ans:-

1. Earthwork in excavation
2. Earth work in filling in plinth
3. Lime concrete in foundation
4. Cement concrete in lintels
5. RCC in slab
6. Brickwork in foundation
7. Brickwork in plinth

8. Brickwork in super structure
9. Stone masonry
10. Steel reinforcement bars etc. in RCC and reinforced brick work
11. Bending, binding of steel reinforcement

3. Calculate the quantity of concrete shown in the figure



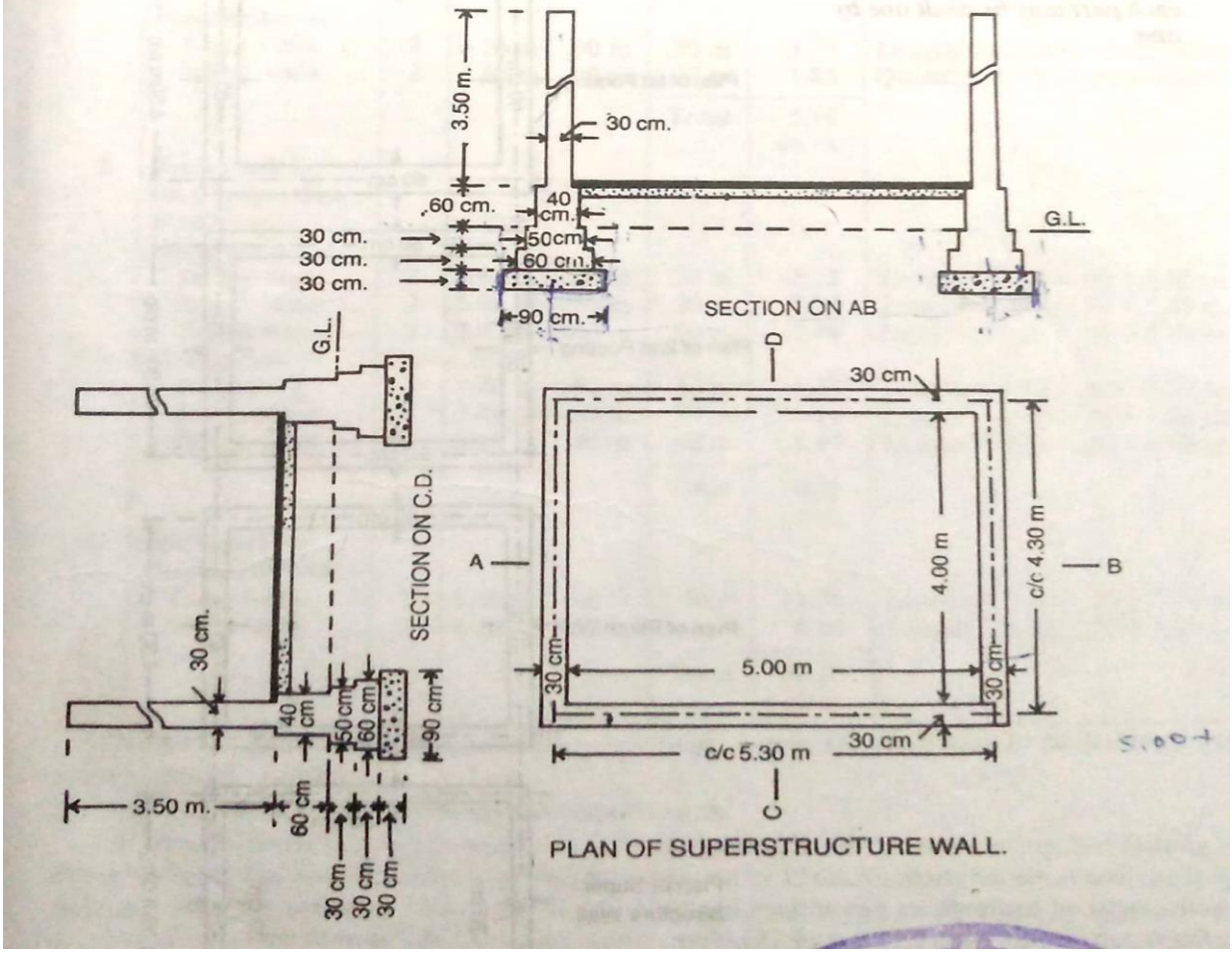
4.

The following examples (Exs. 3a, 4a, and 5a) illustrate this method :—

Example 3(a). — Fig. 2-3, the plan represents the plan of superstructure wall of a single room building of 5 m × 4 m, and Sections represent the cross-sections of the walls with foundation. Estimate the quantities of —

(1) Earthwork in excavation in foundation, (2) Concrete in foundation, (3) Brickwork in foundation and plinth and (4) Brickwork in superstructure.

The length of long wall centre to centre = 5.00 + ½ × .30 + ½ × .30 = 5.30 m. The length of short wall centre to centre = 4.00 + ½ × .30 + ½ × .30 = 4.30 m.



4 Ans:-

DETAILS OF MEASUREMENT AND CALCULATION OF QUANTITIES (Ex. 3a)

Item No.	Particulars of Items	No.	Length	Breadth	Height or Depth	Quantity	Explanatory note
1.	**Earthwork in excavation in foundation —**						
	Long walls ...	2	6.20 m	.90 m	.90 m	10.04	Length = 5.30 + .90 = 6.20 m
	Short walls ...	2	3.40 m	.90 m	.90 m	5.51	Breadth = 4.30 − .90 = 3.40 m
					Total	15.55 cu m	
2.	**Concrete in foundation —**						
	Long walls ...	2	6.20 m	.90 m	.30 m	3.35	Length same as for excavation
	Short walls ...	2	3.40 m	.90 m	.30 m	1.83	Quantity = 1/3 of excavation
					Total	5.18 cu m	
3.	**Brickwork in foundation and plinth —**						
	Long walls —						
	1st footing ...	2	5.90 m	.60 m	.30 m	2.13	Length = 5.30 + .60 = 5.90 m
	2nd footing ...	2	5.80 m	.50 m	.30 m	1.74	Length = 5.30 + .50 = 5.80 m
	Plinth walls ...	2	5.70 m	.40 m	.60 m	2.74	Length = 5.30 + .40 = 5.70 m
	Short walls —						
	1st footing ...	2	3.70 m	.60 m	.30 m	1.33	Length = 4.30 − .60 = 3.70 m
	2nd footing ...	2	3.80 m	.50 m	.30 m	1.14	Length = 4.30 − .50 = 3.80 m
	Plinth walls ...	2	3.90 m	.40 m	.60 m	1.87	Length = 4.30 − .40 = 3.90 m
					Total	10.95 cu m	
4.	**Brickwork in superstructure**						
	Long walls ...	2	5.60 m	.30 m	3.50 m	11.76	Length = 5.30 + .30 = 5.60 m
	Short walls ...	2	4.00 m	.30 m	3.50 m	8.40	Length = 4.30 − .30 = 4.00 m
					Total	20.16 cu m	

Note : *The door openings, window openings, lintels, etc. shall have to be deducted from superstructure as usual.*

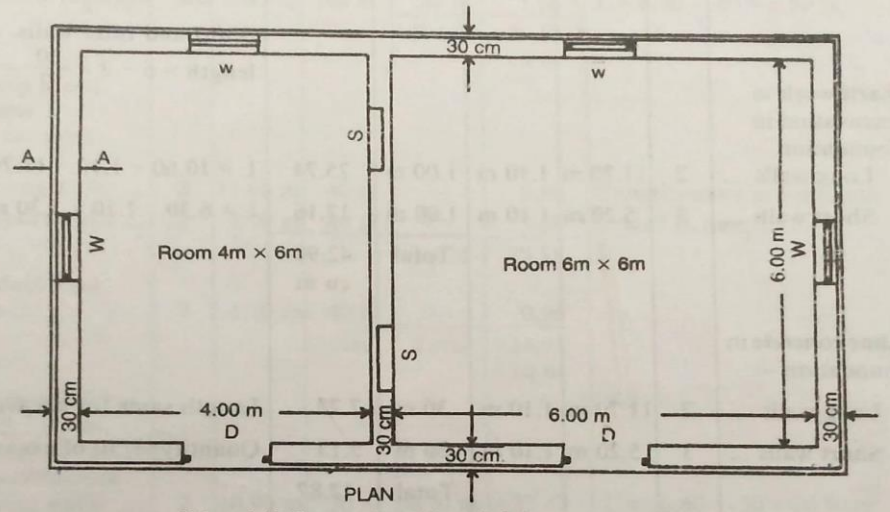
See next page (page 34) for further classification.

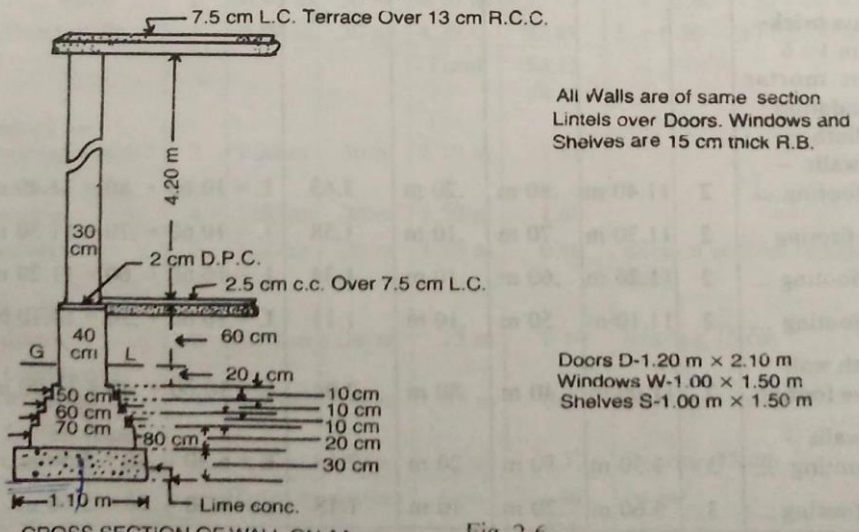
5.

Example 4(a). — Estimate the quantities of the following items of a two roomed building from the given plan and section (Fig. 2-6) :—

(1) Earthwork in excavation in foundation, (2) Lime concrete in foundation, (3) 1st class brickwork in cement mortar 1 : 6 in foundation and plinth, (4) 2.5 cm c.c. damp proof course, and (5) 1st class brickwork in lime mortar in superstructure.

TWO ROOMED BUILDING





CROSS SECTION OF WALL ON AA.

Fig. 2-6

Note : — *No beam has been shown in the plan as the object of this example is to explain the method of estimating the walls only.*

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

Item No.	Particulars of Items	No.	Length	Breadth	Height or Depth	Quantity	Explanatory note
							Long wall, c/c. length = $4 + 6 + .30 + 2 \times \frac{.30}{2} = 10.60$ m
							Short and Inter walls, c/c. length = $6 + 2 \times \frac{.30}{2} = 6.30$ m
1.	**Earthwork** in excavation in foundation —						
	Long walls ...	2	11.70 m	1.10 m	1.00 m	25.74	L = 10.60 + 1.10 = 11.70 m
	Short walls ...	3	5.20 m	1.10 m	1.00 m	17.16	L = 6.30 – 1.10 = 5.20 m
					Total	42.90 cu m	
2.	**Lime concrete** in foundation —						
	Long walls ...	2	11.70 m	1.10 m	.30 m	7.72	Length same for excavation
	Short walls ...	3	5.20 m	1.10 m	.30 m	5.15	Quantity=3/10 of excavation
					Total	12.87 cu m	
3.	**1st class brick-work** in 1 : 6 cement mortar in foundation and plinth —						
	Long walls —						
	1st footing ...	2	11.40 m	.80 m	.20 m	3.65	L = 10.60 + .80 = 11.40 m
	2nd footing ...	2	11.30 m	.70 m	.10 m	1.58	L = 10.60 + .70 = 11.30 m
	3rd footing ...	2	11.20 m	.60 m	.10 m	1.34	L = 10.60 + .60 = 11.20 m
	4th footing ...	2	11.10 m	.50 m	.10 m	1.11	L = 10.60 + .50 = 11.10 m
	Plinth wall above footing	2	11.00 m	.40 m	.80 m	7.04	L = 10.60 + .40 = 11.00 m
	Short walls —						
	1st footing ...	3	5.50 m	.80 m	.20 m	2.64	L = 6.30 – .80 = 5.50 m
	2nd footing ...	3	5.60 m	.70 m	.10 m	1.18	L = 6.30 – .70 = 5.60 m

Note : — *Length of subsequent footings of long walls after 1st footing may be obtain simply by deducting 10 cm from first footing.*

(Ex 4a Contd.)

Item No.	Particulars of Items	No.	Length	Breadth	Height or Depth	Quantity	Explanatory note
	3rd footing ...	3	5.70 m	.60 m	.10 m	1.03	L = 6.30 – .60 = 5.70 m
	4th footing ...	3	5.80 m	.50 m	.10 m	0.87	L = 6.30 – .50 = 5.80 m
	Plinth wall above footing	3	5.90 m	.40 m	.80 m	5.66	L = 6.30 – .40 = 5.90 m
					Total	26.10 cu m	
4.	**Damp proof course** 2.5 cm thick c.c. —						
	Long walls ...	2	11.00 m	.40 m	—	8.80	Lengths same as for plinth
	Short walls ...	3	5.90 m	.40 m	—	7.08	wall in item 3.
					Total	15.88	
	Deduct door sills ...	2	1.20 m	.40 m	—	0.96	
				Net	Total	14.92 sq m	
5.	**1st class brick-work** in lime mortar in superstructure						
	Long walls ...	2	10.90 m	.30 m	4.20 m	27.47	L = 10.60 + .30 = 10.90 m
	Short walls ...	3	6.00 m	.30 m	4.20 m	22.68	L = 6.30 – .30 = 6.00 m
					Total	50.15 cu m	
	Deduct —						
	Door openings	2	1.20 m	.30 m	2.10 m	1.51	
	Window openings ...	4	1.00 m	.30 m	1.50 m	1.80	
	Shelves ...	2	1.00 m	.20 m	1.50 m	0.60	Back of shelves 10 cm thick wall.
	Lintels over doors ...	2	1.50 m	.30 m	.15 m	0.14	Bearing 15 cm
	Lintels over windows ...	4	1.30 m	.30 m	.15 m	0.23	Bearing 15 cm
	Lintels over shelves ...	2	1.30 m	.30 m	.15 m	0.12	Bearing 15 cm
			Total of	deduc-	tion	4.40	cu m
				Net	Total	45.75	cu m

Note : — *Length of subsequent footing of short walls after 1st footing may be obtained simply by adding 10 cm from first footing.*

Assignment questions unit-II

1. Draw the tabular form for the calculation of earthwork with the following methods. (a) Mid – ordinate method and (b) Mean – sectional area method.

Ans:-

For the calculation of earthwork in a road longitudinal section and cross-section of the ground are taken and the formation line is fixed. The formation line is fixed in consideration of flood level, gradient, height of bank, depth of cutting, etc. In plain countries road is usually in banking, but if the road is in cutting for some length and in banking for some other length, the excavated earth from the cutting portion should be utilised for the banking portion within economical limits, during the execution of the work. But for estimating of earthwork this point of utilising excavated earth from cutting in certain length in banking of the adjacent length may not be taken into account to avoid complicacy. In hilly countries road is usually both in banking and in cutting and the excavated earth from cutting is utilised for banking within economical limits.

From the L-section and formation line, the height of bank and depth of cutting are calculated the difference of R.L. of ground and R.L. of formation gives the height of bank or depth of cutting. For plain country the ground is considered as level accross, that is there is no cross-slope. The earthwork is calculated by parts of the length in between two consecutive stations of L-section and continued until the whole length is covered.

For longitudinal section R.L. of ground is usually taken by levelling instrument at every 30 metre apart along the centre line of the road. When the ground is fairly even the levels may be taken at 40 or 50 metre apart or even up to 100 metre apart. In uneven ground or hilly areas the R.L. of ground may be taken at 20 metre or more or less depending on the nature of the ground. Estimate of road is prepared kilometre wise. It is better if the distance apart of L-section is such that it is multiple to make the kilometre.

Longitudinal section is usually plotted with a horizontal scale of 1 cm = 10 m to 1 cm = 30 m and a vertical scale of 1 cm = 1 m to 1 cm = 5 m.

The quantity of earthwork may be calculated by the various methods of mensuration out of which three methods are given below :—

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

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

$= Bd_m + \frac{1}{2}sd_m^2 + \frac{1}{2}sd_m^2 = Bd_m + sd_m^2$

$\therefore$ Quantity of earthwork $= (Bd_m + sd_m^2) \times L$

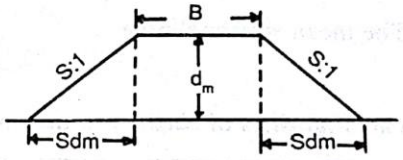


Fig. 7-4

General, $Q = (Bd + sd^2) \times L$, where d stands for mean height or depth.

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

Stations or Chain-age	Depth or Height	Mean Depth or Height "d"	Area of central portion Bd	Area of sides Sd^2	Total Sectional Area $Bd+sd^2$	Length between stations L	Quantity $(Bd + sd^2) \times L$	
							Embank-ment	Cutting

Area of side sloping surface —

The area of sides which may require turfing or pitching, may be found by multiplying the mean sloping breadth by the length.

The mean sloping breadth = $\sqrt{(sd^2+d^2)} = \sqrt{s^2+1}$, where d stands for mean d.

Area of both side slopes = 2 L, × d $\sqrt{s^2+1}$

This also may be calculated in a tabular form —

Station or Chain-age	Depth or Height	Mean depth or Height	Breadth of side slopes d $\sqrt{s^2+1}$ *Sloping breadth*	Length between stations L	Total Area of both side slopes 2 L d$\sqrt{s^2+1}$

This table may be added to the previous table or may be worked out separately, d being mean depth or height.

Method II. Mean Sectional Area Method — Quantity = Mean Sectional area × 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 and d_2 are the heights or depth at the two ends.

The mean sectional area $A = \frac{A_1+A_2}{2}$, Quantity $Q = \frac{A_1+A_2}{2} \times$ Length.

The quantities of earthwork may be calculated in a tabular form as given below :—

Stations or Chainage	Height or Depth "d"	Area of central portion Bd	Area of sides Sd^2	Total Sectional Area $Bd+Sd^2$	Mean Sectional Area	Length between station L	Quantity $(Bd+sd^2) \times L$	
							Emba-nkment	Cutting

2. Calculate the volume of earthwork for 100.00m length of road in a uniform ground. Height of the bank at one end is 0.75m and at the other end 1.20m. Formation width is 10.00m and side slopes of embankment are 2:1. Ground does not have any cross slope. Calculate the volume of earthwork by
1. mid sectional area method
2. Mean sectional area method
3. Trapezoidal method and
4. Prismoidal method

Example 3.—Reduced level (R.L.) of ground along the centre line of a proposed road from chainage 10 to chianage 20 are given below. The formation level at the 10th chainage is 107 and the road is in downward gradient of 1 in 150 up to the chainage 14 and then the gradient changes to 1 in 100 downward. Formation width of road is 10 metre and side slopes of banking are 2 : 1 (Horizontal : Vertical). Length of the chain is 30 metre.

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

Example 4.—Estimate the cost of earthwork for a portion of road for 400 metre length from the following data :—

Formation width of the road is 10 metre. Side slopes are 2 : 1 in banking 1½ : 1 in cutting.

Station	Distance in metre	R.L. of Ground	R.L. of formation
25	1000	51.00	52.00
26	1040	50.90	|
27	1080	50.50	|
28	1120	50.80	|
29	1160	50.60	Downward gradient
30	1200	50.70	of 1 in 200
31	1240	51.20	|
32	1280	51.40	|
33	1320	51.30	|
34	1360	51.00	|
35	1400	50.60	↓

Lengitudinal section of the road and type cross-section are as given in Fig. 7-9. The example can, however, be solved without the help of L-section and cross-section.

5. The formation width of a road embankment is 9.0m. The side slopes are 2.5:1. The depths along the centre line of road at 50.0m intervals are 1.2, 1.1, 1.4, 1.2, 0.9, 1.5 and 1.0.m. It is required to calculate the quantity of earthwork by
(a) Prismoidal rule. (b) Trapezoidal rule.

Assignment questions **unit-III**

1. Explain the following
   (a) Market rate.
   (b) Work-charged establishment.
   (c) Lump-sum.

Ans: -

a) Market rate: - The rates worked out based on market enquiry/ quotations and applying the percentage above/ below for similar quoted trade items plus overheads and profit. Alternately rates worked out for material/ labour based on paid bills/ vouchers produced by contractor plus profit.

(b) 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.

(c) Lump-sum:- A lump sum is a single payment of money, as opposed to a series of payments made over time (such as an annuity).

2. Calculate the quantity of materials and analyze the rate required for lime concrete in foundation with 25mm size stone ballast, lime and sand. Proportions 1:2:4 for 1 cu.m
3. Calculate the quantity of materials and analyze the rate required for lime concrete in foundation with 40mm size brick ballast with 1 lime and 2 surkhi mortar. Proportions 1:2:6 for 1 cu.m
4. Prepare the data sheet and calculate the cost of the items given below:
   Brick masonry in C.M (1:6) with country bricks – 1 cu.m
   1. 600 no's country bricks
   2. 0.38cu.m C.M (1:6)
   3. 1.40 no's mason
   4. 0.7 no's man mazdoor
   5. 2.10 no's woman mazdoor
   6. L.S. Sundries
5. Prepare the unit rates for finished items of works for cement concrete in foundation (1:5:10)

Assignment questions **unit-IV**

1. (a) What do you mean by end anchorage, explain types of end anchorages

Ans:-

A mechanical device used to transmit prestressing force to the reinforced concrete in a post tensioned member.

2. What do you mean by development length of reinforcement?

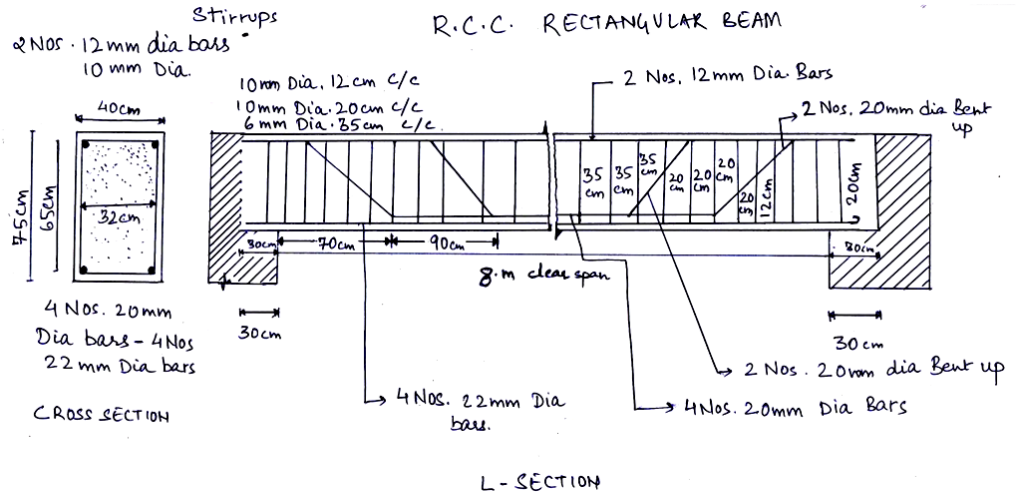
Ans:-

A development length can be defined as the amount of reinforcement(bar) length needed to be embedded or projected into the column to establish the desired bond strength between the concrete and steel (or any other two types of material).

When the reinforcement bar is no longer required to carry the tensile forces, i.e tension at that section is about zero, and then it is required to develop the bar further so that the grip/bond between the steel and concrete forms a continuous structure.

If the development length is not provided, then the restraining force in concrete section will be comparatively thin (weak) and will be unable to withhold the position of highly stressed bars resulting in splitting of bars from concrete.

3. Prepare a detailed estimate if a R.C.C beams of 8 meters clear span and 75cm x 40cm in section from the given drawing. Steel in detail and RCC work shall be calculated separately. Also prepare the schedule of bars.



5. Explain contracts and types of contracts?

Ans:-

There are different types of construction contracts and their comparison is presented in this article. A construction contract is an agreement between two or more parties to execute the construction works as per certain terms and conditions.

A construction contracts contains general and special conditions of agreement, details of construction project work, their specifications, time limits, payments and penalties for delivery delays etc. and ensures every party's rights and obligations.

6. Explain the process of acceptance of tenders and general tender conditions

Ans:-

At early stages for any construction project, owner with his engineer or consultant prepares necessary documents for tender process which will be included in the contract. These documents are called contract documents.

Following are the types of documents in a construction contract:

1. General conditions
2. Special conditions
3. Drawings and specifications
4. B.O.Q (bill of quantity)
5. Letter of acceptance
6. Contractor bid

Assignment questions unit-v

1. Find the plinth area required for the residential accommodation for an assistant engineer in the pay scale of rupees 400 to 1000 per month.

2. (a)Define valuation and explain the purpose of valuation.

0

To find out the exact cost of particular asset and know the present price of that asset. It is generally carried out once the construction of the house has come to an end or during its life. A valuation can help you to evaluate the current market value of your house.

(b)Explain capitalized value with a simple example.

Ans:-

Market capitalization/capitalization (often market cap) is a measurement of size of a business enterprise (corporation) equal to the share price times the number of shares outstanding (shares that have been authorized, issued, and purchased by investors) of a public company.

3. Give the detailed specifications of the following items of works.

(a) Colour washing

Ans:-

White wash shall be prepared from lime slaked on site and stirred with sufficient water to make a thin cream. This shall be allowed to stand for 24 hours and shall be screened though clean cloth, 4 kg of gum dissolved in hot water shall be added to each cubic meter of the cream (115 gm per cft) copper Sulphate not exceeding 3% shall be added to give required whiteness. The approximate quantity of water to be added to make cream shall be five liters per kg. Of lime. White wash shall be applied in specified coats by a dispersing agent; detergent up to a maximum of 5% will be added to the mix before application using flat brushes or spray pumps. Each coat shall be allowed to dry before

the next coat is applied .If additional coat then what have been specified are necessary to obtain uniform and smooth finish, it shall be given at no extra cost.

4. A building is situated by the side of a main road of Hyderabad city on a land of 800 sqm. The built up portion in 25m X 20m. The building is first class type and provided with water supply, sanitary and electric fittings, and the age of the building is 30 years. Workout the valuation of the property. Assume plinth area rate is Rs.200.00 and cost of land as Rs.6000 per sqm.

5. A colonizer intends to purchase a land of 100,000 sq.m area located suburb of a big city to develop it into plots of 700sq.m each after providing necessary roads and parks and other amenities. The current sale price of small plots in the neighbourhood is Rs. 30 per sq.m. The colonizer wants a net profit of 20%. Workout the maximum price of the land at which the colonizer may purchase the land.

16. Unit wise question bank

Unit-I 2marks

1. What is meant by estimating and costing and state its need?

Ans: -

Estimating and costing in construction management is the calculation of quantities of materials, tools, equipments, labors etc. and cost associated with them.

2. Write a short note on types of estimates and their purpose?

Ans: -

Before constructing any project we should need to plan for cost and time.
Then only that project could be get success.

3. What is specification and mention its necessity.

Ans:-

The estimation of building quantities like earth work, foundation concrete, brickwork in plinth and superstructure etc. can be worked out long wall short wall method and centerline method.
Following are the three different methods used for estimating building works:

a. Long wall – short wall method
c. Centerline method.

4. Write short notes on units of calculation?

Ans:-

Table below shows units of measurement of various items of civil engineering works based on IS 1200.

Sl no.	Particulars of item	Units of measurement	Units of payment
1.	Earthwork in excavation	cum	Per cum
2.	Earth work in filling in plinth	cum	Per cum
3.	Lime concrete in foundation	cum	Per cum

4.	Cement concrete in lintels	cum	Per cum
5.	RCC in slab	cum	Per cum
6.	Brickwork in foundation	cum	Per cum
7.	Brickwork in plinth	cum	Per cum
8.	Brickwork in super structure	cum	Per cum
9.	Stone masonry	cum	Per cum
10.	Steel reinforcement bars etc. in RCC and reinforced brick work	Quintal	Per Quintal
11.	Bending, binding of steel reinforcement	Quintal	Per Quintal

5. What is lump sum 'provision in estimate '?

Ans:-

A lump-sum contract is normally used in the construction industry to reduce design and contract administration costs. It is called a lump-sum because the contractor is required to submit a total and global price instead of bidding on individual items. A lump-sum contract is the most recognized agreement form on simple and small projects and projects with a well-defined scope or construction projects where the risk of different site conditions is minimal.

3 Marks

1. Distinguish between detailed and abstract estimates.

Ans:-

Detailed Estimate:

It is actually the accurate estimate which is prepared using quantities of the every items of the work, Also they are mostly prepared by work wise.

The main purpose of this estimate is the preparation of technical sanctions like the contract arranging as well as the project execution.

Abstract Estimate:

It is actually last thing or method to do in the completion of detailed estimate .All the rates as well as the quantities of the of every type of work item is made in the abstract form in this.

2. Write short notes on approximate method of estimating

Ans:-

Approximate estimates

The different types of cost estimates, those are prepared during various phases of a project are already stated in Lecture 2 of this module. As already mentioned in Lecture 2 of this module, the approximate estimates (also known as order-of-magnitude estimates) are prepared during initial stages of the project life cycle. The different methods used in the preparation of approximate estimates are described below. In addition to use in the preparation of estimates during early stages of project development, these methods may

also be sometimes used for cost estimating in the detailed design phase.

3. Explain principle units for various items of work.

Ans:-

Table below shows units of measurement of various items of civil engineering works based on IS 1200.

Sl no.	Particulars of item	Units of measurement	Units of payment
1.	Earthwork in excavation	cum	Per cum
2.	Earth work in filling in plinth	cum	Per cum
3.	Lime concrete in foundation	cum	Per cum
4.	Cement concrete in lintels	cum	Per cum
5.	RCC in slab	cum	Per cum
6.	Brickwork in foundation	cum	Per cum
7.	Brickwork in plinth	cum	Per cum
8.	Brickwork in super structure	cum	Per cum
9.	Stone masonry	cum	Per cum
10.	Steel reinforcement bars etc. in RCC and reinforced brick work	Quintal	Per Quintal
11.	Bending, binding of steel reinforcement	Quintal	Per Quintal

4. List out general items of work for building estimates in detail.

Ans:-

12. Earthwork in excavation
13. Earth work in filling in plinth
14. Lime concrete in foundation
15. Cement concrete in lintels
16. RCC in slab
17. Brickwork in foundation
18. Brickwork in plinth
19. Brickwork in super structure
20. Stone masonry
21. Steel reinforcement bars etc. in RCC and reinforced brick work
22. Bending, binding of steel reinforcement

5. Explain the following general items of work involved in the estimation for a building along with the process of calculations.

Ans:-

(a) Earthwork in excavation: - Earth work is filling the soil and excavating the soil.

(b) Earthwork in filling: - The unit of earth work is cum.
(c) Brick at soling.
(d) Cement concrete in foundation: - The concrete is used as bed in foundation.
(e) Masonry work in superstructure.
(f) 10 cm thick brickwork.

5 Marks

1. Prepare an approximate estimate of the building with a plinth area of 1600sq.m with the following data.

a. Plinth area rate Rs. 8000 per sq.m
b. Add for architectural work 2.5% of the cost.
c. Add for water supply and sanitary installation at 5% of the cost.
d. Contingencies at 3% of the cost.
e. Supervision charges at 2 % of the cost.

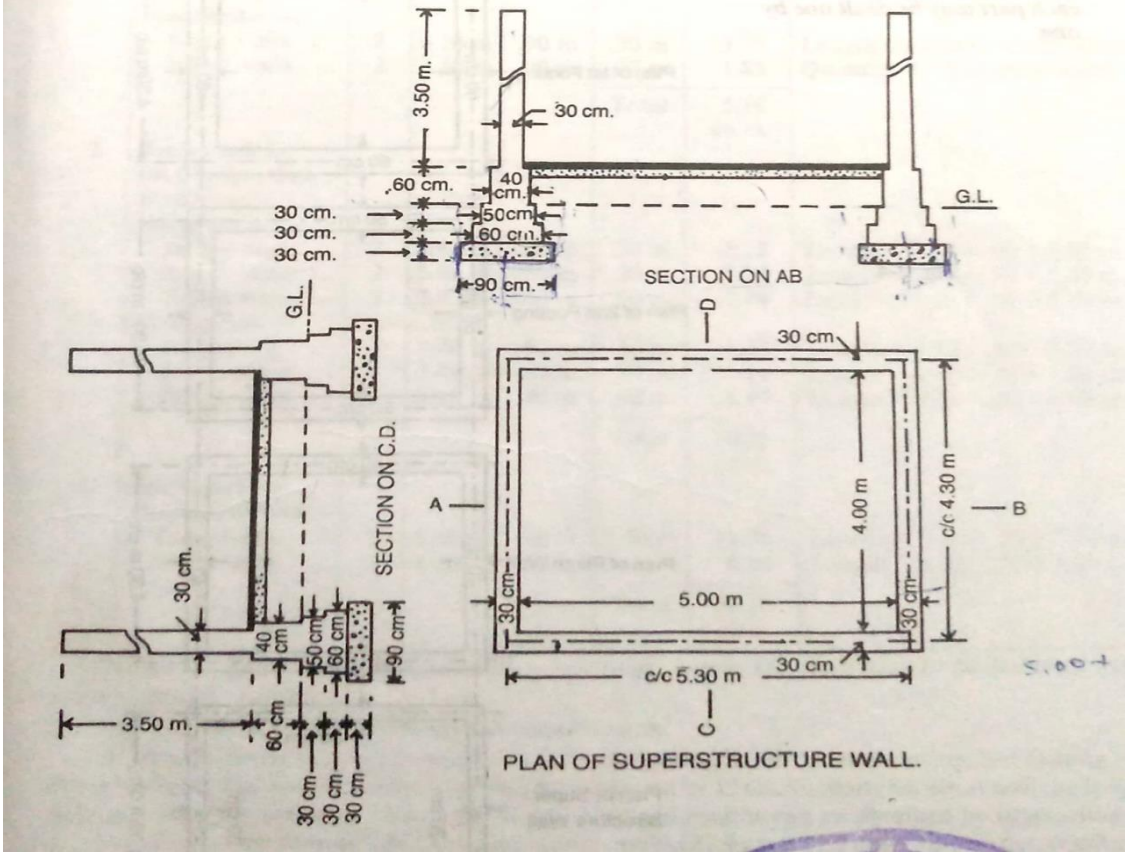
2.

The following examples (Exs. 3a, 4a, and 5a) illustrate this method :—

Example 3(a). — Fig. 2-3, the plan represents the plan of superstructure wall of a single room building of 5 m × 4 m, and Sections represent the cross-sections of the walls with foundation. Estimate the quantities of —

(1) Earthwork in excavation in foundation, (2) Concrete in foundation, (3) Brickwork in foundation and plinth and (4) Brickwork in superstructure.

The length of long wall centre to centre = 5.00 + ½ × .30 + ½ × .30 = 5.30 m. The length of short wall centre to centre = 4.00 + ½ × .30 + ½ × .30 = 4.30 m.



Ans:-

DETAILS OF MEASUREMENT AND CALCULATION OF QUANTITIES (Ex. 3a)

Item No.	Particulars of Items	No.	Length	Breadth	Height or Depth	Quantity	Explanatory note
1.	**Earthwork in excavation in foundation —**						
	Long walls ...	2	6.20 m	.90 m	.90 m	10.04	Length = 5.30 + .90 = 6.20 m
	Short walls ...	2	3.40 m	.90 m	.90 m	5.51	Breadth = 4.30 – .90 = 3.40 m
					Total	15.55 cu m	
2.	**Concrete in foundation —**						
	Long walls ...	2	6.20 m	.90 m	.30 m	3.35	Length same as for excavation
	Short walls ...	2	3.40 m	.90 m	.30 m	1.83	Quantity = 1/3 of excavation
					Total	5.18 cu m	
3.	**Brickwork in foundation and plinth —**						
	Long walls —						
	1st footing ...	2	5.90 m	.60 m	.30 m	2.13	Length = 5.30 + .60 = 5.90 m
	2nd footing ...	2	5.80 m	.50 m	.30 m	1.74	Length = 5.30 + .50 = 5.80 m
	Plinth walls ...	2	5.70 m	.40 m	.60 m	2.74	Length = 5.30 + .40 = 5.70 m
	Short walls —						
	1st footing ...	2	3.70 m	.60 m	.30 m	1.33	Length = 4.30 – .60 = 3.70 m
	2nd footing ...	2	3.80 m	.50 m	.30 m	1.14	Length = 4.30 – .50 = 3.80 m
	Plinth walls ...	2	3.90 m	.40 m	.60 m	1.87	Length = 4.30 – .40 = 3.90 m
					Total	10.95 cu m	
4.	**Brickwork in superstructure**						
	Long walls ...	2	5.60 m	.30 m	3.50 m	11.76	Length = 5.30 + .30 = 5.60 m
	Short walls ...	2	4.00 m	.30 m	3.50 m	8.40	Length = 4.30 – .30 = 4.00 m
					Total	20.16 cu m	

Note : *The door openings, window openings, lintels, etc. shall have to be deducted from superstructure as usual.*

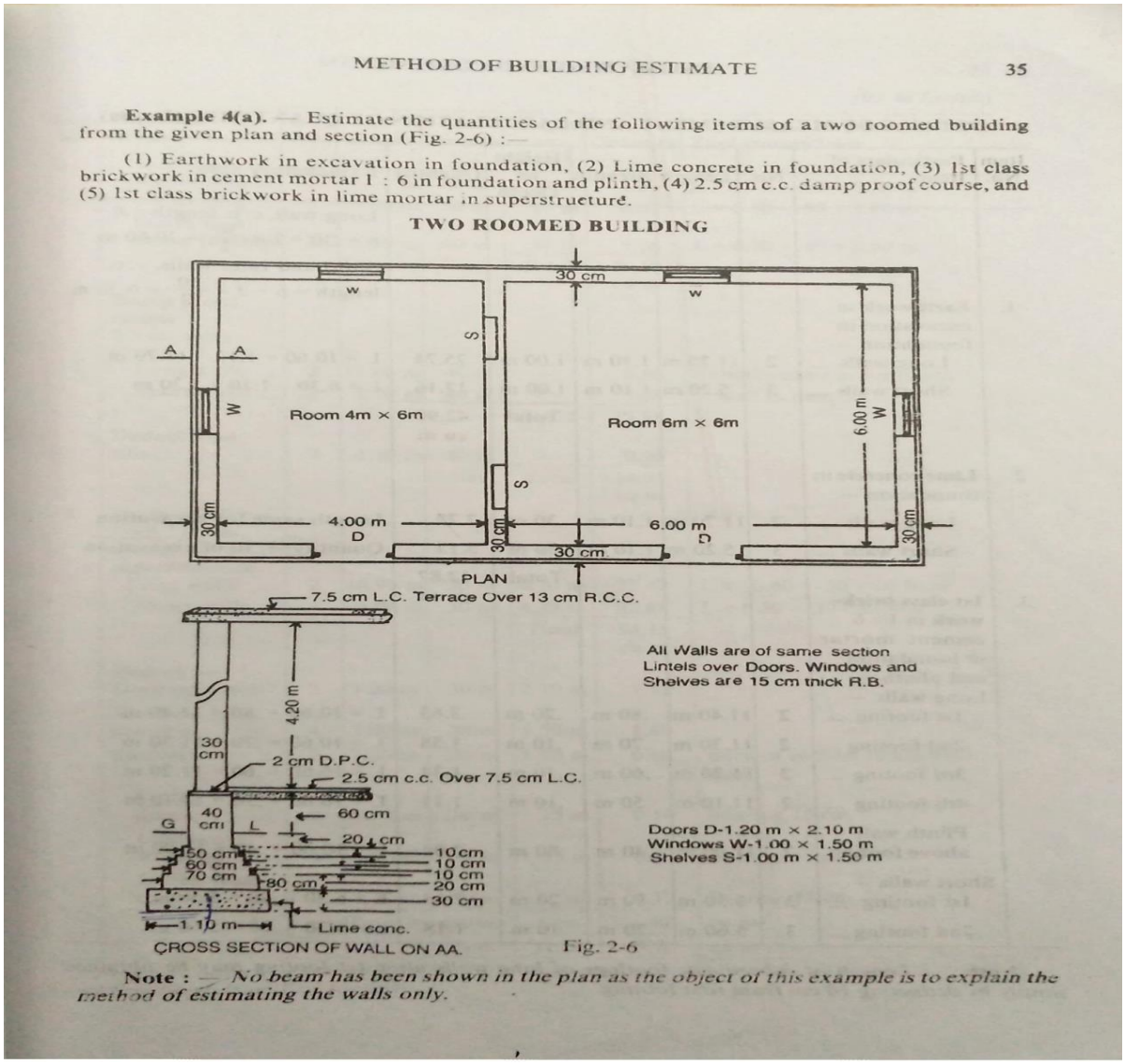
See next page (page 34) for further classification.

3. Prepare a preliminary estimate of four storeyed office building having total carpet area

of 2000sq.m for obtaining the administrative approval of the government, given the following data. It may be assumed that 40% f the built up area will be taken up by corridors, verandah, lavatories, staircase etc.

Plinth area rate in Rs. 4500/- per sq.m.
Extra due to deeper foundation at site 1 % of building cost.
Extra for special architectural treatment 0.5% of building cost.
Extra for water supply and sanitary installations at 8% of building cost.
Extra for internal electrical installation at 12.5% of building cost.
Extra for other services 5% of building cost.
Contingencies – 2.5%
Supervision charges – 10 %.

4.



METHOD OF BUILDING ESTIMATE 35

Example 4(a). — Estimate the quantities of the following items of a two roomed building from the given plan and section (Fig. 2-6) :—

(1) Earthwork in excavation in foundation, (2) Lime concrete in foundation, (3) 1st class brickwork in cement mortar 1 : 6 in foundation and plinth, (4) 2.5 cm c.c. damp proof course, and (5) 1st class brickwork in lime mortar in superstructure.

TWO ROOMED BUILDING

CROSS SECTION OF WALL ON AA.

Fig. 2-6

Note : — *No beam has been shown in the plan as the object of this example is to explain the method of estimating the walls only.*

Ans:-

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

Item No.	Particulars of Items	No.	Length	Breadth	Height or Depth	Quantity	Explanatory note
							Long wall, c/c. length = $4 + 6 + .30 + 2 \times \frac{.30}{2} = 10.60$ m
							Short and Inter walls, c/c. length = $6 + 2 \times \frac{.30}{2} = 6.30$ m
1.	**Earthwork** in excavation in foundation —						
	Long walls ...	2	11.70 m	1.10 m	1.00 m	25.74	L = 10.60 + 1.10 = 11.70 m
	Short walls ...	3	5.20 m	1.10 m	1.00 m	17.16	L = 6.30 – 1.10 = 5.20 m
					Total	42.90 cu m	
2.	**Lime concrete** in foundation —						
	Long walls ...	2	11.70 m	1.10 m	.30 m	7.72	Length same for excavation
	Short walls ...	3	5.20 m	1.10 m	.30 m	5.15	Quantity=3/10 of excavation
					Total	12.87 cu m	
3.	**1st class brick-work** in 1 : 6 cement mortar in foundation and plinth —						
	Long walls —						
	1st footing ...	2	11.40 m	.80 m	.20 m	3.65	L = 10.60 + .80 = 11.40 m
	2nd footing ...	2	11.30 m	.70 m	.10 m	1.58	L = 10.60 + .70 = 11.30 m
	3rd footing ...	2	11.20 m	.60 m	.10 m	1.34	L = 10.60 + .60 = 11.20 m
	4th footing ...	2	11.10 m	.50 m	.10 m	1.11	L = 10.60 + .50 = 11.10 m
	Plinth wall above footing	2	11.00 m	.40 m	.80 m	7.04	L = 10.60 + .40 = 11.00 m
	Short walls —						
	1st footing ...	3	5.50 m	.80 m	.20 m	2.64	L = 6.30 – .80 = 5.50 m
	2nd footing ...	3	5.60 m	.70 m	.10 m	1.18	L = 6.30 – .70 = 5.60 m

Note : — *Length of subsequent footings of long walls after 1st footing may be obtain simply by deducting 10 cm from first footing.*

(Ex 4a Contd.)

Item No.	Particulars of Items	No.	Length	Breadth	Height or Depth	Quantity	Explanatory note
	3rd footing ...	3	5.70 m	.60 m	.10 m	1.03	L = 6.30 – .60 = 5.70 m
	4th footing ...	3	5.80 m	.50 m	.10 m	0.87	L = 6.30 – .50 = 5.80 m
	Plinth wall above footing	3	5.90 m	.40 m	.80 m	5.66	L = 6.30 – .40 = 5.90 m
					Total	26.10 cu m	
4.	**Damp proof course** 2.5 cm thick c.c. —						
	Long walls ...	2	11.00 m	.40 m	—	8.80	Lengths same as for plinth
	Short walls ...	3	5.90 m	.40 m	—	7.08	wall in item 3.
					Total	15.88	
	Deduct door sills ...	2	1.20 m	.40 m	—	0.96	
				Net	Total	14.92 sq m	
5.	**1st class brick-work** in lime mortar in superstructure						
	Long walls ...	2	10.90 m	.30 m	4.20 m	27.47	L = 10.60 + .30 = 10.90 m
	Short walls ...	3	6.00 m	.30 m	4.20 m	22.68	L = 6.30 – .30 = 6.00 m
					Total	50.15 cu m	
	Deduct — Door openings	2	1.20 m	.30 m	2.10 m	1.51	
	Window openings ...	4	1.00 m	.30 m	1.50 m	1.80	
	Shelves ...	2	1.00 m	.20 m	1.50 m	0.60	Back of shelves 10 cm thick wall.
	Lintels over doors ...	2	1.50 m	.30 m	.15 m	0.14	Bearing 15 cm
	Lintels over windows ...	4	1.30 m	.30 m	.15 m	0.23	Bearing 15 cm
	Lintels over shelves ...	2	1.30 m	.30 m	.15 m	0.12	Bearing 15 cm
			Total of	deduc-	tion	4.40	cu m
				Net	Total	45.75	cu m

Note : — *Length of subsequent footing of short walls after 1st footing may be obtained simply by adding 10 cm from first footing.*

5.

Fig. 3-1

MASONRY WATER TANK

Example 2. — Estimate the cost of a masonry water tank from the given drawings (Fig. 3-2), specifications and rates.

General Specifications. — Foundation — Lime concrete. Masonry — 1st class brickwork in cement mortar 1 : 6. Wall finishing — Inside 12 mm cement plastered 1 : 2 with coarse sand. Top and outside 12 mm cement plastered 1 : 4 with local sand. Flooring — 5 cm cement concrete 1 : 1½ : 3 over 30 cm Lime concrete with neat cement finishing.

Rates. — 1. Earthwork in excavation ... ... Rs. 350.00 per cu m
2. Lime concrete in foundation and floor ... ... Rs. 220.00 per cu m

3. 1st class brickwork in 1 : 6 cement mortar ... ... Rs. 320.00 per cu m
4. 12 mm Cement plaster 1 : 2 with coarse sand ... ... Rs. 8.50 per sq m
5. 12 mm Cement plaster 1 : 4 with local sand ... ... Rs. 8.30 per sq m
6. 5 cm Cement concrete 1 : 1½ : 3 floor ... ... Rs. 55.00 per sq m

MASONRY TANK

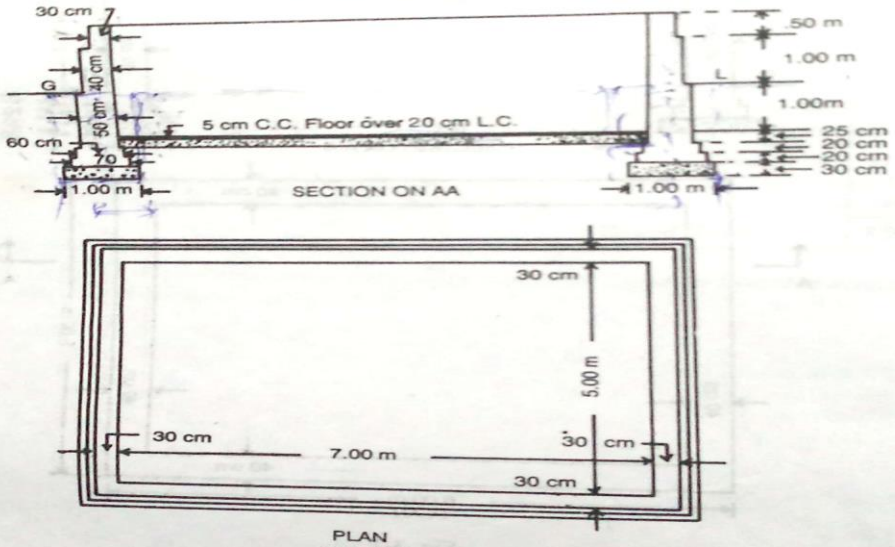


Fig. 3-2

Centre to Centre Lengths —

It may be noticed that the foundation footings are symmetrical below ground level, but above G.L. the footings are on one side only and unsymmetrical. The centre to centre distances for the portion below G.L. will be same, and for every step above G.L. the centre to centre distances will be different.

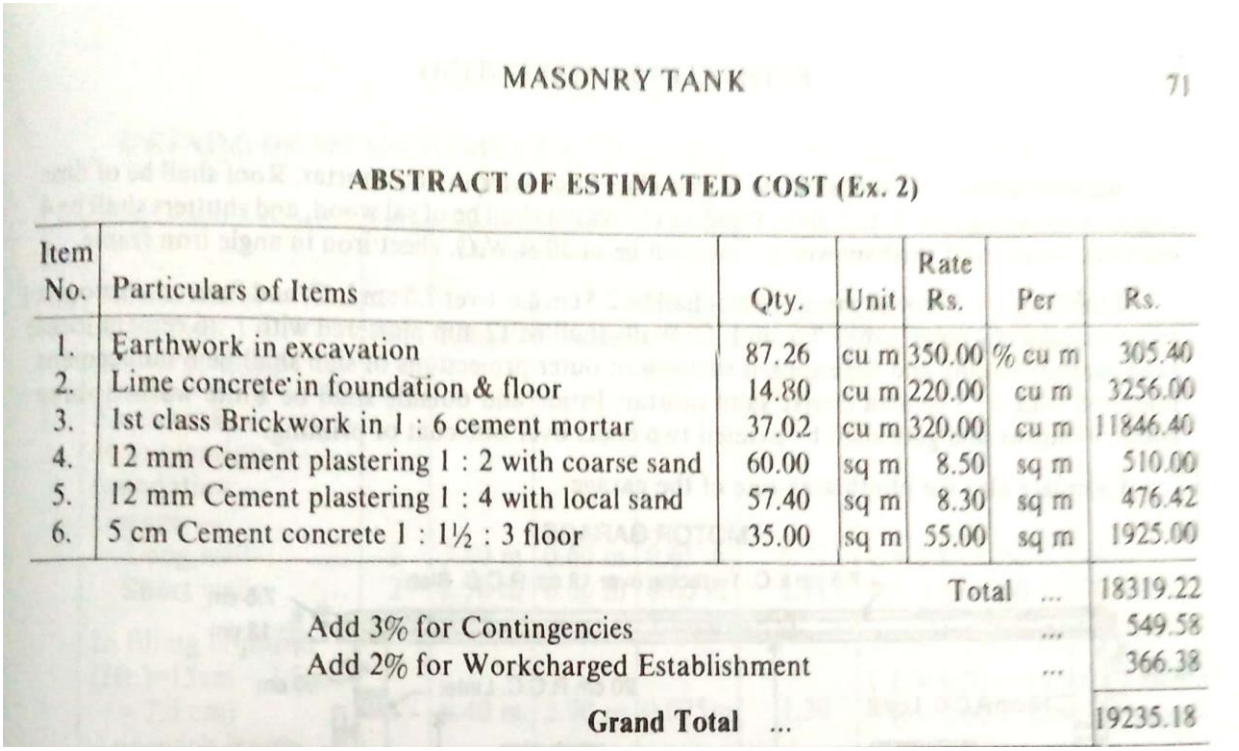
Portions below G.L. —
For all footings, c. to c. length of long wall = 7.50 m, and c. to c. length of short wall = 5.50 m.
Portions above G.L. —
For 40 cm wall, c. to c. length of long wall = 7.50 m, and c. to c. length of short wall = 5.40 m
For 30 cm wall, c. to c. length of long wall = 7.30 m, and c. to c. length of short wall = 5.30 m.

Ans:-

DETAILS OF MEASUREMENT AND CALCULATION OF QUANTITIES (Ex. 2)

Item No.	Particulars of item of work	No.	Dimensions in metre L.	B.	Ht. or D.	Quantity or Contents	Total Quantity	Explanatory notes
1.	Earthwork in excavation							
	Foundation							
	Long wall ...	2	8.50 m	1.00 m	1.95 m	33.15		L = 7.50 + 1.00 = 8.50 m
	Short wall ...	2	4.50 m	1.00 m	1.95 m	17.55		L = 5.50 – 1.00 = 4.50 m
	Central portion (inside) ...	1	6.50 m	4.50 m	1.25 m	36.56		L = 7.50 – 1.00 = 6.50 m B = 5.50 – 1.00 = 4.50 m
						Total	87.26 cu m	
2.	Lime concrete in foundation floor —							
	Foundation							
	Long walls ...	2	8.50 m	1.00 m	.30 m	5.10		
	Short walls ...	2	4.50 m	1.00 m	.30 m	2.70		
	Under c.c. floor ...	1	7.00 m	5.00 m	.20 m	7.00		
						Total	14.80 cu m	Floor lime concrete is not taken with c.c. floor as sufficiently thick.
3.	1st class brickwork in 1 : 6 cement mortar Below G.L.							
	Long wall							
	1st footing ...	2	8.20 m	.70 m	.20 m	2.29		L = 7.50 + .70 = 8.20 m
	2nd footing ...	2	8.10 m	.60 m	.20 m	1.94		L = 8.20 – .10 = 8.10 m
	50 cm wall ...	2	8.00 m	.50 m	1.25 m	10.00		L = 8.10 – .10 = 8.00 m
	Short wall							
	1st footing ...	2	4.80 m	.70 m	.20 m	1.34		L = 5.50 – .70 = 4.80 m
	2nd footing ...	2	4.90 m	.60 m	.20 m	1.18		L = 4.80 + .10 = 4.90 m
	50 cm wall ...	2	5.00 m	.50 m	1.25 m	6.25		L = 4.90 + .10 = 5.00 m
	Above G.L. —							
	40 cm long wall ...	2	7.80 m	.40 m	1.00 m	6.24		L = 7.40 + .40 = 7.80 m
	40 cm short wall	2	5.00 m	.40 m	1.00 m	4.00		L = 5.40 – .40 = 5.00 m
	30 cm long wall ...	2	7.60 m	.30 m	.50 m	2.28		L = 7.30 + .30 = 7.60 m
	30 cm short wall	2	5.00 m	.30 m	.50 m	1.50		L = 5.30 – .30 = 5.00 m
						Total	37.02 cu m	

Item No.	Particulars of item of work	No.	Dimensions in metre L.	B.	Ht. or D.	Quantity or Contents	Total Quantity	Explanatory notes
4.	12 mm Cement plaster 1 : 2 with coarse-sand inside							Length may be taken as inner perimeter in one operation — Q = 24.00 × 2.50 = 60.00 sq m
	Long walls ...	2	7.00 m	—	2.50 m	35.00		
	Short walls ...	2	5.00 m	—	2.50 m	25.00		
						Total	60.00 sq m	
5.	12 mm Cement plaster 1 : 4 with local sand outside–							
	40 cm walls —							
	Long walls ...	2	7.80 m	—	1.25 m	19.50		Height including 10 cm offset and 15 cm below G.L.
	Short walls ...	2	5.80 m	—	1.25 m	14.50		
	30 cm wall —							
	Long walls ...	2	7.60 m	—	.60 m	9.12		Height including 10 cm offset.
	Short walls ...	2	5.60 m	—	.60 m	6.72		
	On top of wall–							
	Long walls ...	2	7.60 m	.30 m	—	4.56		
	Short walls ...	2	5.00 m	.30 m	—	3.00		
						Total	57.40 sq m	
6.	5 cm cement concrete floor 1 : 1½ : 3 ...	1	7.00 m	5.00 m	—	35.00	35.00 sq m	



MASONRY TANK 71

ABSTRACT OF ESTIMATED COST (Ex. 2)

Item No.	Particulars of Items	Qty.	Unit	Rate Rs.	Per	Rs.
1.	Earthwork in excavation	87.26	cu m	350.00	% cu m	305.40
2.	Lime concrete in foundation & floor	14.80	cu m	220.00	cu m	3256.00
3.	Ist class Brickwork in 1 : 6 cement mortar	37.02	cu m	320.00	cu m	11846.40
4.	12 mm Cement plastering 1 : 2 with coarse sand	60.00	sq m	8.50	sq m	510.00
5.	12 mm Cement plastering 1 : 4 with local sand	57.40	sq m	8.30	sq m	476.42
6.	5 cm Cement concrete 1 : 1½ : 3 floor	35.00	sq m	55.00	sq m	1925.00
					Total ...	18319.22
	Add 3% for Contingencies				...	549.58
	Add 2% for Workcharged Establishment				...	366.38
	Grand Total ...					19235.18

Objective question with answers

1. The main factor to be considered while preparing a detailed estimate, is

   (A) Quantity of the materials

   (B) Availability of materials

   (C) Transportation of materials

   (D) All the above

   Answer: D

2. Pick up the correct statement from the following:

   (A) The estimated value of the work excluding the amount for contingencies, work charged establishment, tool and plants, is called work value

   (B) The actual expenditure involved to complete a work including incidental, establishment and travelling charges, is called actual cost

   (C) The formal acceptance by the administrative department for incurring an expenditure on the work, is called administrative approval

   (D) All the above

Answer: D

3. Brick walls are measured in sq. m if the thickness of the wall is

   (A) 10 cm

   (B) 15 cm

   (C) 20 cm

   (D) None of these

   Answer: A

4. The plinth area of a building not includes

   (A) Area of the walls at the floor level

   (B) Internal shaft for sanitary installations up to 2 sq m. in area

   (C) Lift and wall including landing

   (D) Area of cantilevered porch

   Answer: D

5. While estimating a reinforced cement structure, the omitted cover of concrete is assumed

   (A) At the end of reinforcing bar, not less than 25 mm or twice the diameter of the bar

   (B) In thin slabs, 12 mm minimum or diameter of the bar whichever is more

   (C) For reinforcing longitudinal bar in a beam 25 mm minimum or diameter of the largest barwhich is more

   (D) All the above

   Answer: D

6. A cement concrete road is 1000 m long, 8 m wide and 15 cm thick over the sub-base of 10 cm thick gravel. The box cutting in road crust is

   (A) 500 m3

   (B) 1000 m 3

   (C) 1500 m3

   (D) 2000 m3

   Answer: C

7. While estimating the qualities for the construction of a building, the correct metric unit is

   (A) Metre for length

   (B) Cubic metre for area

   (C) Square metres for volume

   (D) Litre for capacity

   Answer: D

8. Pick up the correct statement from the following:

   (A) In order to check up the average depth of excavation, 'Dead man s' are left at the mid-widths of borrow pits

   (B) The earthwork calculation in excavation is made from the difference in levels obtained with a level

   (C) The earth work in excavation to form the road embankment includes the formation of correct profile and depositing the soil in layers

   (D) All the above

   Answer: D

9. The brick work is not measured in cu m in case of

   (A) One or more than one brick wall

   (B) Brick work in arches

   (C) Reinforced brick work

   (D) Half brick wall

   Answer: D

10. Pick up the incorrect statement from the following:

(A) Lead is the average horizontal straight distance between the borrow pit and the place of spreading soil

(B) The lead is calculated for each block of the excavated area

(C) The unit of lead is 50 m for a distance up to 500 m

(D) The unit of lead is 1 km where the lead exceeds 2 km

Answer: D

Unit-II 2 Marks

1. Define and explain regarding Earth work embankment?
   Ans:-
   The stability of the formation depends, apart from other factors, upon the sub grade material and the methods of construction. Experience has shown that many of the problems in the maintenance of the track are due to incorrect methods of execution of earthwork. In order to have certain uniformity in practices, guidelines have been laid down by Indian Railways for the execution of earthwork in embankments and cuttings in new constructions, doubling, and conversion projects. These guidelines, given briefly in the following sections, are required to be modified to suit local conditions and prevailing circumstances.
2. Distinguish earthwork in embankment and in cutting?
   Ans:-
   Embankment means filling the soil, and cutting means excavating the soils.
3. Define the term turfing?
   Ans:-
   Turfing is the side slope of the embankment with grass.

4. Draw the tabular form for the calculation of earthwork with the following methods?
   (a) Mid – ordinate method and
   (b) Mean – sectional area method.

   Ans:-

For the calculation of earthwork in a road longitudinal section and cross-section of the ground are taken and the formation line is fixed. The formation line is fixed in consideration of flood level, gradient, height of bank, depth of cutting, etc. In plain countries road is usually in banking, but if the road is in cutting for some length and in banking for some other length, the excavated earth from the cutting portion should be utilised for the banking portion within economical limits, during the execution of the work. But for estimating of earthwork this point of utilising excavated earth from cutting in certain length in banking of the adjacent length may not be taken into account to avoid complicacy. In hilly countries road is usually both in banking and in cutting and the excavated earth from cutting is utilised for banking within economical limits.

From the L-section and formation line, the height of bank and depth of cutting are calculated the difference of R.L. of ground and R.L. of formation gives the height of bank or depth of cutting. For plain country the ground is considered as level accross, that is there is no cross-slope. The earthwork is calculated by parts of the length in between two consecutive stations of L-section and continued until the whole length is covered.

For longitudinal section R.L. of ground is usually taken by levelling instrument at every 30 metre apart along the centre line of the road. When the ground is fairly even the levels may be taken at 40 or 50 metre apart or even up to 100 metre apart. In uneven ground or hilly areas the R.L. of ground may be taken at 20 metre or more or less depending on the nature of the ground. Estimate of road is prepared kilometre wise. It is better if the distance apart of L-section is such that it is multiple to make the kilometre.

Longitudinal section is usually plotted with a horizontal scale of 1 cm = 10 m to 1 cm = 30 m and a vertical scale of 1 cm = 1 m to 1 cm = 5 m.

The quantity of earthwork may be calculated by the various methods of mensuration out of which three methods are given below :—

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

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

$= Bd_m + \frac{1}{2}sd_m^2 + \frac{1}{2}sd_m^2 = Bd_m + sd_m^2$

$\therefore$ Quantity of earthwork $= (Bd_m + sd_m^2) \times L$

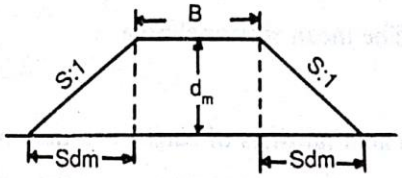


Fig. 7-4

General, $Q = (Bd + sd^2) \times L$, where d stands for mean height or depth.

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

Stations or Chain-age	Depth or Height	Mean Depth or Height "d"	Area of central portion Bd	Area of sides Sd^2	Total Sectional Area $Bd+sd^2$	Length between stations L	Quantity $(Bd + sd^2) \times L$	
							Embank-ment	Cutting

Area of side sloping surface —
The area of sides which may require turfing or pitching, may be found by multiplying the mean sloping breadth by the length.

The mean sloping breadth = $\sqrt{(sd^2+d^2)} = \sqrt{s^2+1}$, where d stands for mean d.

Area of both side slopes = 2 L, × d $\sqrt{s^2+1}$

This also may be calculated in a tabular form —

Station or Chain-age	Depth or Height	Mean depth or Height	Breadth of side slopes d $\sqrt{s^2+1}$ *Sloping breadth*	Length between stations L	Total Area of both side slopes 2 L d$\sqrt{s^2+1}$

This table may be added to the previous table or may be worked out separately, d being mean depth or height.

Method II. Mean Sectional Area Method — Quantity = Mean Sectional area × 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 and d_2 are the heights or depth at the two ends.

The mean sectional area $A = \frac{A_1+A_2}{2}$, Quantity $Q = \frac{A_1+A_2}{2} \times$ Length.

The quantities of earthwork may be calculated in a tabular form as given below :—

Stations or Chainage	Height or Depth "d"	Area of central portion Bd	Area of sides Sd^2	Total Sectional Area $Bd+Sd^2$	Mean Sectional Area	Length between station L	Quantity $(Bd+sd^2) \times L$	
							Emba-nkment	Cutting

5. Distinguish trapezoidal rule and prismoidal rule?

Ans:-

Method III. Prismoidal Formula Method. — Quantity or volume $= \frac{L}{6}(A_1+A_2+4A_m)$

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

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

Cross-sectional area at one end —

$$A_1 = Bd_1 + Sd_1^2$$

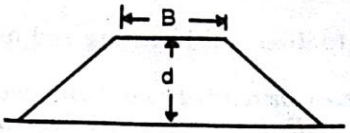


Fig. 7-5

Cross-sectional area at other end —

$$A_2 = Bd_2 + Sd_2^2$$

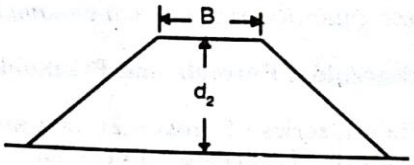


Fig. 7-6

Cross-section at middle —

$$d_m = \frac{d_1+d_2}{2}$$

$$A_m = Bd_m + Sd_m^2$$

$$= B\left(\frac{d_1+d_2}{2}\right) + S\left(\frac{d_1+d_2}{2}\right)^2$$

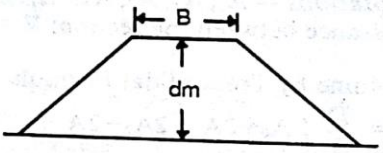


Fig. 7-7

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

$$= \frac{L}{6}\left[(Bd_1+sd_1^2) + (Bd_2+sd_2^2) + 4\left\{B\left(\frac{d_1+d_2}{2}\right) + s\left(\frac{d_1+d_2}{2}\right)^2\right\}\right]$$

$$= \frac{L}{6}\left[(Bd_1+Bd_2+4\frac{Bd_1}{2}+4\frac{Bd_2}{2}) + sd_1^2+sd_2^2+4s\frac{d_1^2+d_2^2+2d_1d_2}{4}\right]$$

$$= \frac{L}{6}\left[(3\,Bd_1+3\,Bd_2) + 2sd_1^2 + 2sd_2^2 + 2sd_1d_2\right]$$

$$= \frac{3BL}{6}(d_1+d_2) + \frac{2Ls}{6}(d_1^2 + d_2^2 + d_1d_2)$$

$$= \frac{BL}{2}(d_1+d_2) + \frac{Ls}{3}(d_1^2+d_2^2+d_1d_2)$$

$$= \left\{B\left(\frac{d_1+d_2}{2}\right) + s\left(\frac{d_1^2+d_2^2+2d_1d_2}{3}\right)\right\} \times L$$

= [Sec. Area of central portion + Sec. Area of side slope portions] × Length.

The same is also applicable for cutting.

Tabular Form for Prismoidal Formula — The above may be set in a tabular form for calculating the quantity of earthwork for a road. See Example 8, page 345 for tabular form.

3 Marks

1. (a) Explain the terms lead and lift.

   Ans:- Earth work may be either earth excavation or earth filling or Sometimes both. Basically the volume of earthwork is computed from length, breadth, and depth of excavation or filling. However the payment for the earthwork is made according to this volume as well as the lead and lift with regard to area of disposal.

   Lead is the average horizontal distance b/w site of earthwork and the area of disposal. The lead is generally measured in terms of 50m distances.

   Lift is the average vertical distance b/w level of excavation and the 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.

   -Up to 2.0-1lif
   -1.0- 1 lift
   -1.0-1 lift
   - 0.5 – 1 lift

2. How do you calculate:
   (a) Earth work with vertical fall of the ground surface for fully in banking, fully in cutting and partly in banking cutting?
   (b) Earth work on curvature of a road without transverse slope.
3. Consider a cross section and calculate its area using trapezoidal formula
4. Draw a neat sketch for earthwork banking and describe its various terms

   Ans:-

CHAPTER 7
ROAD ESTIMATING
EARTHWORK

Cross-section of earthwork of road in banking or in cutting is usually in the form of trapezium, and the quantity of earthwork may be calculated by the following methods :—

Quantity or volume = Sectional area × Length.

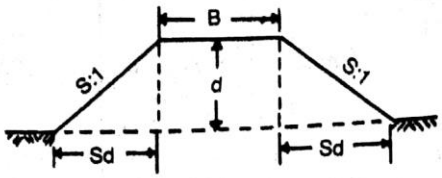


Fig. 7-1
Banking

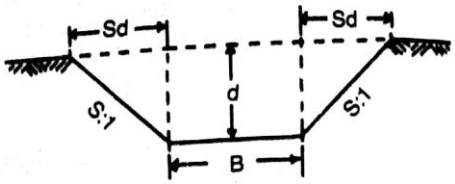


Fig. 7-2
Cutting

Sectional area = Area of central rectangular portion + Area of two-side triangular portions.

$$= Bd+2(\tfrac{1}{2}\, sd\times d) = Bd+sd^2$$

S : 1 is the ratio of side slopes as horizontal : vertical. For 1 vertical, horizontal is s, for d vertical, horizontal is sd.

Quantity= $(Bd+sd^2)\times L$.

When the ground is in a longitudinal slope, the height of bank or the depth of cutting will be different at the two ends of the section, and mean height or depth may be taken for "d" and sectional area at mid-section is taken out for mean height. Alternatively, sectional area at the two ends may be calculated and the mean of two sectional area is taken out. Sectional area at the mid-section or the mean sectional area, multiplied by the length gives the quantity.

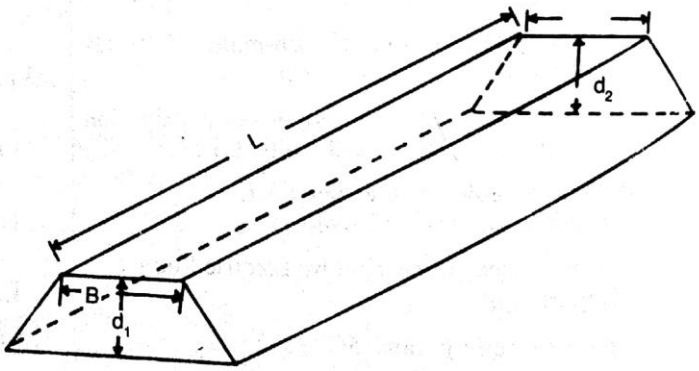


Fig. 7-3

Mean height $= \dfrac{d_1+d_2}{2}$

Different kinds of soil as sandy, clayey, rocky, etc., estimated separately as the rates vary.

Lead and Lift—Normally earthwork is estimated for 30 m lead for distance and 1.5 m lift for height or depth, and this distance of 30 m and the height of 1.5 m are known as *normal lead and lift.* Normal rate for earthwork is for 30 m lead and 1.5 m lift. For greater lead or lift the rates will be different (higher) for every unit of 30 m lead and for every unit of 1.5 m lift. The earthwork is, therefore, estimated separately for every 30 m lead and for every 1.5 m lift.

5 Marks

1. The following width of road embankment 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) Trapezoidal rule c) Prismoidal rule a) Mid Sectional rule : b=10m, n=2.

Chainage	Depths	Mean depth (dm)	Area of (bdm+sdm 2)	Length b/w Chainages	Quantity (m3) Am×L
0	1.25				
50	1.10	1.175	14.51	50	725.56
100	1.15	1.125	13.78	50	689.06
150	1.20	1.175	14.51	50	725.56
200	1.00	1.10	13.4	50	671.00
250	1.10	1.02	12.70	50	635.25
300	1.15	1.125	13.78	50	689.06

Total

4135.49m3

2. Reduce level (R.L) of ground along the centre line of a proposed road from chainage 10 to 20 are given below .The formation level at the 10th chainage is 107 and the road is in downward gradient of 1 in 150 up to the chainage 14 and then the gradient chainage to 1 in 100 downward. Formation width of road is 10meter and side slopes of banking are 2:1(horizontal: vertical). Length of the chain is 30metre.

Draw longitudinal section of the road and a typical cross section and prepare an estimate of earth work at the rate of Rs.275%cu m.

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

Chainage	10	11	12	13	14	15	16	17	18	19	20
R.L.of ground	105.00	105.60	105.44	105.90	105.42	104.30	105.00	104.10	104.62	104.00	103.30

R.L. of formation 107.00

I….Downward gradient…. 1 in 150…....I……downward gradient 1 in 100…… ……..I

Ans:-

Calculation of Quantities of Earthwork (Ex. 3)

B=10 m, s=2

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

Total 3513.6 cu m

ABSTRACT OF ESTIMATED COST (Ex. 3)

Item No.	Particulars of items	Quantity	Unit	Rate Rs. P.	Per	Cost Rs. P.
1	Earthwork in banking ...	3513.6	cu m	275.00	% cu m	9662.40
					Total ...	9662.40
					Add 5% (3% for Contingencies and 2% for Workcharged Establishment) ...	483.12
					Grand Total ...	Rs. 10145.52

3. What is the road estimating? And explain their methods with neat sketches and formation tables?

Ans:-

For the calculation of earthwork in a road longitudinal section and cross-section of the ground are taken and the formation line is fixed. The formation line is fixed in consideration of flood level, gradient, height of bank, depth of cutting, etc. In plain countries road is usually in banking, but if the road is in cutting for some length and in banking for some other length, the excavated earth from the cutting portion should be utilised for the banking portion within economical limits, during the execution of the work. But for estimating of earthwork this point of utilising excavated earth from cutting in certain length in banking of the adjacent length may not be taken into account to avoid complicacy. In hilly countries road is usually both in banking and in cutting and the excavated earth from cutting is utilised for banking within economical limits.

From the L-section and formation line, the height of bank and depth of cutting are calculated the difference of R.L. of ground and R.L. of formation gives the height of bank or depth of cutting. For plain country the ground is considered as level accross, that is there is no cross-slope. The earthwork is calculated by parts of the length in between two consecutive stations of L-section and continued until the whole length is covered.

For longitudinal section R.L. of ground is usually taken by levelling instrument at every 30 metre apart along the centre line of the road. When the ground is fairly even the levels may be taken at 40 or 50 metre apart or even up to 100 metre apart. In uneven ground or hilly areas the R.L. of ground may be taken at 20 metre or more or less depending on the nature of the ground. Estimate of road is prepared kilometre wise. It is better if the distance apart of L-section is such that it is multiple to make the kilometre.

Longitudinal section is usually plotted with a horizontal scale of 1 cm = 10 m to 1 cm = 30 m and a vertical scale of 1 cm = 1 m to 1 cm = 5 m.

The quantity of earthwork may be calculated by the various methods of mensuration out of which three methods are given below :—

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

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

$= Bd_m + \frac{1}{2}sd_m^2 + \frac{1}{2}sd_m^2 = Bd_m + sd_m^2$

$\therefore$ Quantity of earthwork $= (Bd_m + sd_m^2) \times L$

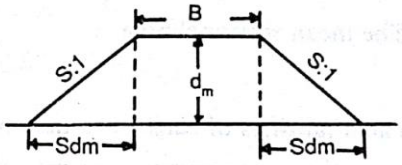


Fig. 7-4

General, $Q = (Bd + sd^2) \times L$, where d stands for mean height or depth.

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

Stations or Chain-age	Depth or Height	Mean Depth or Height "d"	Area of central portion Bd	Area of sides Sd^2	Total Sectional Area $Bd+sd^2$	Length between stations L	Quantity $(Bd + sd^2) \times L$	
							Embank-ment	Cutting

Area of side sloping surface —

The area of sides which may require turfing or pitching, may be found by multiplying the mean sloping breadth by the length.

The mean sloping breadth = $\sqrt{(sd^2+d^2)} = \sqrt{s^2+1}$, where d stands for mean d.

Area of both side slopes = 2 L, × d $\sqrt{s^2+1}$

This also may be calculated in a tabular form —

Station or Chain-age	Depth or Height	Mean depth or Height	Breadth of side slopes $d\sqrt{s^2+1}$ *Sloping breadth*	Length between stations L	Total Area of both side slopes $2 L d\sqrt{s^2+1}$

This table may be added to the previous table or may be worked out separately, d being mean depth or height.

Method II. Mean Sectional Area Method — Quantity = Mean Sectional area × 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 and d_2 are the heights or depth at the two ends.

The mean sectional area $A = \frac{A_1+A_2}{2}$, Quantity $Q = \frac{A_1+A_2}{2} \times$ Length.

The quantities of earthwork may be calculated in a tabular form as given below :—

Stations or Chainage	Height or Depth "d"	Area of central portion Bd	Area of sides Sd^2	Total Sectional Area $Bd+Sd^2$	Mean Sectional Area	Length between station L	Quantity $(Bd+sd^2) \times L$	
							Emba-nkment	Cutting

Method III. Prismoidal Formula Method. — Quantity or volume $= \frac{L}{6}(A_1+A_2+4A_m)$

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

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

Cross-sectional area at one end —

$$A_1 = Bd_1 + Sd_1^2$$

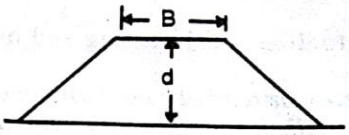


Fig. 7-5

Cross-sectional area at other end —

$$A_2 = Bd_2 + Sd_2^2$$

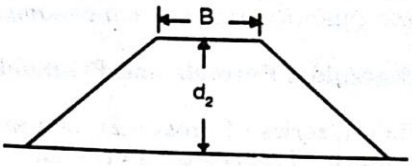


Fig. 7-6

Cross-section at middle —

$$d_m = \frac{d_1+d_2}{2}$$

$$A_m = Bd_m + Sd_m^2$$

$$= B\left(\frac{d_1+d_2}{2}\right) + S\left(\frac{d_1+d_2}{2}\right)^2$$

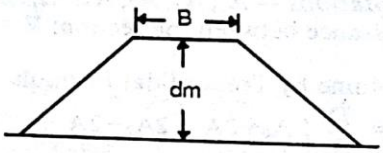


Fig. 7-7

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

$$= \frac{L}{6}\left[(Bd_1+sd_1^2) + (Bd_2+sd_2^2) + 4\left\{B\left(\frac{d_1+d_2}{2}\right) + s\left(\frac{d_1+d_2}{2}\right)^2\right\}\right]$$

$$= \frac{L}{6}\left[(Bd_1+Bd_2+4\frac{Bd_1}{2}+4\frac{Bd_2}{2}) + sd_1^2+sd_2^2+4s\frac{d_1^2+d_2^2+2d_1d_2}{4}\right]$$

$$= \frac{L}{6}\left[(3\,Bd_1+3\,Bd_2) + 2sd_1^2 + 2sd_2^2 + 2sd_1d_2\right]$$

$$= \frac{3BL}{6}(d_1+d_2) + \frac{2Ls}{6}(d_1^2 + d_2^2 + d_1d_2)$$

$$= \frac{BL}{2}(d_1+d_2) + \frac{Ls}{3}(d_1^2+d_2^2+d_1d_2)$$

$$= \left\{B\left(\frac{d_1+d_2}{2}\right) + s\left(\frac{d_1^2+d_2^2+2d_1d_2}{3}\right)\right\} \times L$$

= [Sec. Area of central portion + Sec. Area of side slope portions] × Length.

The same is also applicable for cutting.

Tabular Form for Prismoidal Formula — The above may be set in a tabular form for calculating the quantity of earthwork for a road. See Example 8, page 345 for tabular form.

Objective question with answers

1. The plinth area of a building not includes

(A) Area of the walls at the floor level

(B) Internal shaft for sanitary installations up to 2 sq m. in area

(C) Lift and wall including landing

(D) Area of cantilevered porch

Answer: D

2. If the formation level of a highway has a uniform gradient for a particular length, and the ground is also having a longitudinal slope, the earthwork may be calculated by

(A) Mid-section formula

(B) Trapezoidal formula

(C) Prismoidal formula

(D) All the above

Answer: D

3. A cement concrete road is 1000 m long, 8 m wide and 15 cm thick over the sub-base of 10 cm thick gravel. The box cutting in road crust is

(A) 500 m3

(B) 1000 m 3

(C) 1500 m3

(D) 2000 m3

Answer: C

4. The assumption on which the trapezoidal formula for volumes is based, is

(A) The end sections are parallel planes

(B) The mid-area of a pyramid is half the average area of the ends

(C) The volume of the Prismoidal is over-estimated and hence a Prismoidal correction is applied

(D) All the above

Answer: D

5. In the mid-section formula

(A) The mean depth is the average of depths of two consecutive sections

(B) The area of mid-sections is calculated by using mean depth

(C) The volume of the earth work is calculated by multiplying the mid-section area by the distance between the two original sections

(D) All of the above

Answer: D

6. Pick up the correct statement from the following:

(A) The earth work of cutting in trenches or borrow pits in fairly uniform ground is measured with the help of average depths of the dead men

(B) The earth work in trenches or borrow pits in irregular ground is measured by taking the difference in levels before and after completion of work

(C) The earth work in trenches or borrow pits, where neither a nor b is feasible, are measured from the fillings after deduction of voids

(D) All the above

Answer: D

7. The cross -sections for a highway is taken at

(A) Right angle to the centre line

(B) 30 meters apart

(C) Intermediate points having abrupt change in gradient

(D) All the above

Answer: D

8. Referring of given figure, pick up the correct statement from the following:

(A) The total length of centre line of four walls is 20 m

(B) Length of long wall out-to -out is 6.80 m

(C) Length of short walls in-to-in is 3.20 m

(D) All the above

Answer: D

9. Pick up the correct statement from the following:

(A) In order to check up the average depth of excavation, 'Dead man s' are left at the mid-widths of borrow pits

(B) The earthwork calculation in excavation is made from the difference in levels obtained with a level

(C) The earth work in excavation to form the road embankment includes the formation of correct profile and depositing the soil in layers

(D) All the above

Answer: D

10. The excavation exceeding 1.5 m in width and 10 sq.m in plan area with a depth not exceeding 30 cm, is termed as

    (A) Excavation

    (B) Surface dressing

    (C) Cutting

    (D) Surface excavation

    Answer: D

Unit –III 2 marks

1. Write short note on Scaffolding
ANs:-
Scaffolding, also called scaffold or staging is a temporary structure used to support a work crew and materials to aid in the construction, maintenance and repair of buildings, bridges and all other manmade structures. Scaffolds are widely used on site to get access to heights and areas that would be otherwise hard to get to Unsafe scaffolding has the potential to result in death or serious injury. Scaffolding is also used in adapted forms for formwork and shoring, grandstand seating, concert stages, access/viewing towers, exhibition stands, ski ramps, half pipes and art projects.

2. write a short note on standard schedule of rates
Ans:-

In order to determine the rate of a particular item, the factors affecting the rate of that item are studied carefully and then finally a rate is decided for that item. This process of determining the rates of an item is termed as analysis of rates or rate analysis.

The rate of particular item of work depends on the following:

1. Specifications of works and material about their quality, proportion and constructional operation method.
2. Quantity of materials and their costs.
3. Cost of labours and their wages.
4. Location of site of work and the distances from source and conveyance charges.
5. Overhead and establishment charges
6. Profit

3. Explain the following

Ans:-

(a) Market rate: - The rates worked out based on market enquiry/ quotations and applying the percentage above/ below for similar quoted trade items plus overheads and profit. Alternately rates worked out for material/ labour based on paid bills/ vouchers produced by contractor plus profit.

(b) 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.

(c) Lump-sum:- A lump sum is a single payment of money, as opposed to a series of payments made over time (such as an annuity).

4. What is Analysis of Rates? What is the Purpose of Rate Analysis?

Ans: -

In order to determine the rate of a particular item, the factors affecting the rate of that item are studied carefully and then finally a rate is decided for that item. This process of determining the rates of an item is termed as analysis of rates or rate analysis.

The **rate of particular item of work depends** on the following:

1. Specifications of works and material about their quality, proportion and constructional operation method.
2. Quantity of materials and their costs.
3. Cost of labours and their wages.
4. Location of site of work and the distances from source and conveyance charges.
5. Overhead and establishment charges
6. Profit

Purpose of Analysis of rates:

1. To work out the actual cost of per unit of the items.
2. To work out the economical use of materials and processes in completing the particulars item.

3. To work out the cost of extra items which are not provided in the contract bond, but are to be done as per the directions of the department
4. To revise the schedule of rates due to increase in the cost of material and labour or due to change in technique.

5. a) List out the purposes and requirements of rate analysis.

Ans:-

Purpose of Analysis of rates:

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

\

3 Marks

1. Ans:-

2. Lime concrete in Foundation or Floor with 40 mm gauge Stone Ballast, White Lime and Sand (Proportion 1 : 2 : 4) unit 1 cum. *Take — 10 cu m.*

Materials—			
Stone ballast 40 mm gauge (local)...	8.8 cu m	1800.00 cu m	15840.00
Sand or bajri (local) ...	4.4 cu m	900.00 cu m	3960.00
White lime slaked ...	2.2 cu m	800.00 cu m	1760.00
		Total ...	21560.00
Labour—			
Same as for above (item 1-a)			6015.00
	Total of materials and labour ...		27575.00
Add 1½% Water charges		...	414.00
Add 10% Contractor's profit		...	2757.50
		Grand Total ...	30746.50
Rate per cu m — Rs.30746.50 / 10 = Rs.3074.50			for 10 cu m

Approximate method of calculation of materials for 100 cum. L.C. 1 : 2 : 4 = Lime = $\frac{152}{1+2+4}$

= 22 cu m; Sand = 22 x 2 = 44 cum; Stone aggregate = 22 x 4 = 88 cu m; That is for 100, 88 : 44 : 22 as stone aggregate : Sand: Lime.

4. Ans: - and 5. Ans:-

3. Lime Concrete in Terraced Roof with 25 mm gauge Brick ballast unit — 1 cu m. *Take — 10 cu m.*

(a) With white lime and surkhi — 1 : 2 (Proportion 18 : 36 : 100, i.e., 1 : 2 : 5½ approximately).

Materials—			
Brick ballast I class 25 mm guage ...	10 cu m	700.00 cu m	7000.00
White lime slaked ...	1.8 cu m	800.00 cu m	1440.00
Surkhi ...	3.6 cu m	500.00 cu m	1800.00
Molasses (Gur) ...	12 kg	30.00 kg	360.00
Bail fruit (7 kg) in solution ...	Lump sum	70.00 L.S.	70.00
		Total ...	10670.00
Labour—			
Mistri (Head mason) ...	½ no.	350.00 per day	175.00
Mason ...	2 no.	300.00 per day	600.00
Mazdoor (Beldar) ...	10 nos.	220.00 per day	2200.00
Boy or woman coolie ...	25 nos.	200.00 per day	5000.00
Bhishti (water-man) ...	3 nos.	200.00 per day	600.00
Sundries T. and P. etc. ...	Lump sum	100.00 L.S.	100.00
		Total	8675.00
	Total of materials and labour		19345.00
Add 1½% Water charges ...	...	...	290.00
Add 10% Contractor's profit ...	...	...	1934.50
		Grand Total ...	21569.50
Rate per cu m — Rs.21569.50 / 10 = Rs.2157.00			for 10 cu m

(i) Rate per sq m for 10 cm thick L.C. terracing—

1 cu m for 10 cm thickness covers $\frac{1}{0.1}$ = 10 sqm ∴ Rate per sq m, $\frac{2157.00}{10}$ = Rs.215.70

(ii) Rate per sqm for 7.5 cm thick L.C. terracing—

1 cum for 7.5 cm thickness covers $\frac{1}{.075}$ = $13^{1}/_{3}$ sqm ∴ Rate per sqm, $\frac{2157.00}{13.3}$ = Rs.162.00

Calculation of materials (approximate) —

Lime = $\frac{154}{1+2+5\frac{1}{2}} = \frac{154}{8\frac{1}{2}}$ = 18.2 cu m; Surkhi = 18.2 x 2 = 36.4 cu m; Brick ballast = 18.2 x 5½ = 100 cu m. Approximately 18 : 36 : 100.

3. (b) With kankar lime (45% mortar) — unit 1 cu m. *Take — 10 cu m.*

Materials—			
Brick ballast I-class 25 gauge...	10 cu m	700.00 cu m	7000.00
Kankar lime ...	4.5 cu m	800.00 cu m	3600.00
Molasses (Gur) ...	12 kg	30.00 kg	360.00
Bail fruit (7 kg) in solution ...	Lump sum	90.00 L.S.	90.00
		Total ...	11050.00
Labour—			
Same as for above (item 3-a) ...			8675.00
	Total of materials and labour		19725.00
Add 1½% Water charges	...	...	295.00
Add 10% Contractor's profit	...	...	1972.50
		Grand Total ...	21992.50
Rate per cu m — Rs.21992.50 / 10 = Rs.2199.00			for 10 cu m

5 Marks

1. Ans:-

Rates worked out are ... increased by 1% for every subsequent storey. Height ... 10 m to 4 m

ANALYSIS OF RATES

1. Lime Concrete in Foundation with 40mm gauge Brick Ballast unit 1 cu m.

Take — 10 cu m.

(a) With white lime and surkhi 1 : 2 (Proportion — 16 : 32 : 100, i.e., 1 : 2 : 6 approx.)

Particulars	Qntty or Nos.	Rate Rs.	Rate P.	Cost Rs.	Cost P
Materials—					
Brick ballast I class 40 mm guage..	10 cu m	650.00 cu m		6500.00	
White lime slaked ...	1.6 cu m	800.00 cu m		1280.00	
Surkhi ...	3.2 cu m	500.00 cu m		1600.00	
		Total ...		9380.00	
Labour—					
Mistri (Head mason) ...	½ no.	350.00 per day		175.00	
Mason ...	1 no.	300.00 per day		300.00	
Mazdoor (Beldar) ...	12 nos.	220.00 per day		2640.00	
Boy or woman coolie ...	12 nos.	200.00 per day		2400.00	
Bhishti (water-man) ...	2 nos.	200.00 per day		400.00	
Sundries T. and P. etc.(Misc., Petty things) ...	Lump sum	100.00 L.S.		100.00	
		Total		6015.00	
		Total of materials and labour		15395.00	
		Add 1½% Water charges		231.00	
		Add 10% Contractor's profit		1539.50	
		Grand Total ...		17165.50 for 10 cu m	

Rate per cu m = $\frac{17165.50}{10}$ = Rs. 1716.50

Approximate calculation of materials for 100 cu m L.C. 1:2:6, Lime = $\frac{150}{1+2+6}$ 16.6. cu m; Surkhi = 16.6 x 2 = 32.2 cu m; Brick ballast = 16.6 x 6 = 99.6 cum. In practice these are taken as 16 cu m.

2. Ans:-

2. Lime concrete in Foundation or Floor with 40 mm gauge Stone Ballast, White Lime and Sand (Proportion 1 : 2 : 4) unit 1 cum. *Take — 10 cu m.*

Materials—			
Stone ballast 40 mm gauge (local)...	8.8 cu m	1800.00 cu m	15840.00
Sand or bajri (local) ...	4.4 cu m	900.00 cu m	3960.00
White lime slaked ...	2.2 cu m	800.00 cu m	1760.00
		Total ...	21560.00
Labour—			
Same as for above (item 1-a)			6015.00
	Total of materials and labour ...		27575.00
Add 1½% Water charges		...	414.00
Add 10% Contractor's profit		...	2757.50
		Grand Total ...	30746.50
Rate per cu m — Rs.30746.50 / 10 = Rs.3074.50			for 10 cu m

Approximate method of calculation of materials for 100 cum. L.C. 1 : 2 : 4 = Lime = $\frac{152}{1+2+4}$

= 22 cu m; Sand = 22 x 2 = 44 cum; Stone aggregate = 22 x 4 = 88 cu m; That is for 100, 88 : 44 : 22 as Stone aggregate : Sand: Lime.

3. Ans:-

ANALYSIS OF RATES 487

1. R.C.C. work in Beams, Slabs, etc. 1 : 2 : 4 — unit 1 cu m. *Take 10 cu m.*

Particulars	Qntty or Nos.	Rate Rs. P.	Cost Rs. P.
Materials—			
Stone ballast 20 mm gauge ...	8.80 cu m	1800.00 per cu m	15840.00
Sand (coarse) ...	4.40 cu m	1500.00 per cu m	6600.00
Cement (66 bags) ...	2.20 cu m	7650.00 per cu m	16830.00
Steel, mild steel bars @ 1% = 1 cu m @ 78.5 q/ cu m = 7.85 q ...	7.85 q	4400.00 per q	34540.00
Binding wire ...	1.50 kg	65.00 per kg	97.50
		Total	73907.50
Labour—			
Mistri (Head mason) ...	½ no.	350.00 per day	175.00
Mason ...	3 nos.	300.00 per day	900.00
Mazdoor (Beldar) ...	12 nos.	220.00 per day	2640.00
Boy or woman coolie ...	20 nos.	200.00 per day	4000.00
Bhishti (including curing) ...	6 nos.	200.00 per day	1200.00
Sundries T. and P. etc. ...	Lump sum	140.00 L.S.	140.00
		Total	9055.00
Bending, Cranking and binding steel bars in position—			
Blacksmith (II class) ...	8 nos.	280.00 per day	2240.00
Mazdoor (Beldar) ...	8 nos.	220.00 per day	1760.00
T. and P. ...	Lump sum	90.00 L.S.	90.00
		Total	4090.00
Centering and shuttering (both erection and dismantling) —			
Timber planks and ballies ...	Lump sum	1500.00 L.S.	1500.00
Carpenter (II class) ...	10 nos.	280.00 per day	2800.00
Mazdoor (Beldar) ...	10 nos.	220.00 per day	2200.00
Nails ...	Lump sum	200.00 L.S.	200.00
T. and P. ...	Lump sum	70.00 L.S.	70.00
		Total	6770.00
Total of materials and labour		...	85673.00
Add 1½% Water charges		...	1285.00
Add 10% Contractor's profit		...	8567.30
		Grand Total ...	95525.30
Rate per cu m — Rs. 95525.30 / 10 = Rs. 9552.50			for 10 cu m

4. Ans: - and 5.Ans:-

14. I-class Brickwork in Foundation and Plinth with 20 x 10 x 10 cm (nominal size) Bricks with Cement Sand Mortar 1 : 6 — unit 1 cu m. *Take — 10 cu m.*

Particulars	Qntty or Nos.	Rate Rs. P.	Cost Rs. P.
Materials —			
Brick I-class (500 bricks per cu m)...	5000 nos.	4500.00 per ‰ nos.	22500.00
Cement (13.5 bags) ...	0.45 cu m	7650.00 per cu m	3442.50
Sand (local) ...	2.7 cu m	700.00 per cu m	1890.00
		Total	27832.50
Labour —			
Mistri (Head mason) ...	½ no.	350.00 per day	175.00
Mason ...	7 nos.	300.00 per day	2100.00
Mazdoor (Beldar) ...	7 nos.	220.00 per day	1540.00
Boy or woman coolie ...	7 nos.	200.00 per day	1400.00
Bhishti (water man) ...	2 nos.	200.00 per day	400.00
Sundries, T. and P., etc. (Misc. Petty things)	Lump sum	90.00 L.S.	90.00
		Total	5705.00
	Total of materials and labour ...		33537.50
Add 1½% Water charges ...	...	...	503.00
Add 10% Contractor's profit ...	...	...	3353.75
		Grand Total	37394.25
	Rate per cu m — Rs.37394.25 / 10 = Rs.3739.00		for 10 cu m

15. I-class Brickwork in Superstructure with 20 x 10 x 10 cm Brick with 1 : 6 Cement Sand Mortar — unit 1 cu m. *Take — 10 cu m.*

Particulars	Qntty or Nos.	Rate Rs. P.	Cost Rs. P.
Materials —			
Brick I-class (500 bricks per cu m)...	5000 nos.	4500.00 per ‰ nos.	22500.00
Cement (13.5 bags) ...	0.45 cu m	7650.00 per cu m	3442.50
Sand (local) ...	2.7 cu m	700.00 per cu m	1890.00
		Total	27832.50
Labour —			
Mistri (Head mason) ...	½ no.	350.00 per day	175.00
Mason ...	10 nos.	300.00 per day	3000.00
Mazdoor (Beldar) ...	7 nos.	220.00 per day	1540.00
Boy or woman coolie ...	10 nos.	200.00 per day	2000.00
Bhishti ...	2 nos.	200.00 per day	400.00
Scaffolding	Lump sum	280.00 L.S.	280.00
Sundries, T. and P., etc. ...	Lump sum	90.00 L.S.	90.00
		Total	7485.00
	Total of materials and labour ...		35317.50
Add 1½% Water charges ...	...	...	530.00
Add 10% Contractor's profit ...	...	...	3531.75
		Grand Total	39379.25
	Rate per cu m — Rs.39379.25 / 10 = Rs.3938.00		for 10 cu m

Objective question with answers

1. The rate of payment is made for 100 cu m (per % cu m) in case of

(A) Earth work in excavation

(B) Rock cutting

(C) Excavation in trenches for foundation

(D) All the above

Answer: D

2. The rate of an item of work depends on

(A) Specifications of works

(B) Specifications of materials

(C) Proportion of mortar

(D) All the above

Answer: D

3. For the construction of buildings, the subheads of the estimate are

(A) Earthwork, Concrete work, Brick work

(B) Brickwork, Stone work, Roofing

(C) Brickwork Flooring, Wood work, Steel work

(D) All the above

Answer: D

4. Pick up the correct statement from the following:

(A) Pointing is measured in sq.m

(B) Plastering is measured in sq.m

(C) Glazing is measured in sq.m

(D) All the above

Answer: D

5. The cross -section of a road partly in banking and partly in cutting is shown in the given figure. The area of the shaded portion is

(A) $b - rd)^2/(r - s)$

(B) $b - rd)^2/(r + s)$

(C) $\frac{1}{2} \times (b + rd)^2/(r - s)$

(D) $b - rd)^2/(s - r)$

Answer: A

6. Pick up the correct statement from the following:

(A) If the bed level is above N.S.L. the canal is called fully in baking and the berms are designed as 3 d where d is full supply depth of water (F.S.D.)

(B) Area of canal in cutting = BD + Sd2 where B = bed width, d = depth of cutting and S is the side slope

(C) If F.S.L. is above N.S.L the canal is called partly in cutting and partly in filling and berms are designed as 2d where d is full supply depth

(D) All the above

Answer: D

7. Pick up the incorrect statement from the following:

(A) No deduction is made for the volume occupied by reinforcement (B) No deduction is made for the openings upto 0.1 sq.m

(C) No deduction is made for volumes occupied by pipes, not exceeding 100 sq.cm in cross-section

(D) None of these

Answer: D

8. The expected out turn of cement concrete 1 : 2 : 4 per mason per day is

(A) 1.5 m 3

(B) 2.5 m3

(C) 3.5 m3

(D) 5.0 m3

Answer: D

9. The value of 'C' of Indian type W.C. shown in the given figure is:

(A) 400 mm

(B) 450 mm

(C) 500 mm

(D) 550 mm

Answer: C

10. As per Indian Standard Specifications, the peak discharge for domestic purposes per capita per minute, is taken

(A) 1.80 liters for 5 to 10 users

(B) 1.20 liters for 15 users

(C) 1.35 for 20 users

(D) All the above

Answer: D

Unit –IV 2 Marks

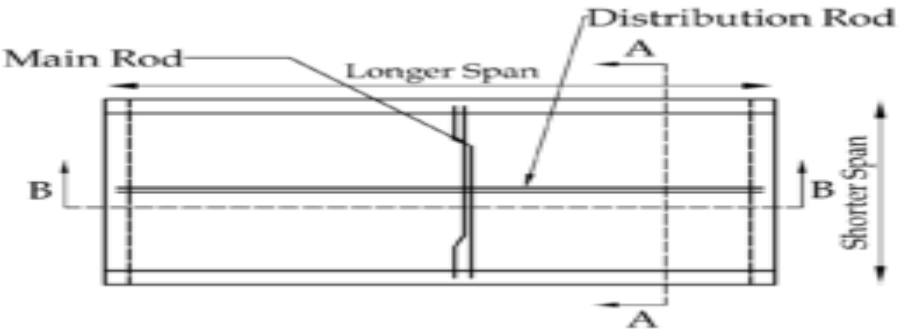
1. Distinguish Straight bar and cranked bar

   Ans:-

   When we look at any reinforcement detailing, we able to see there may be two sizes of bars used in the slab.

   We know that is main reinforcement bar and distribution reinforcement bar. But wait there is more than just the name

   In order to transfer that bending moment developed at the bottom of the slab, **Main reinforcement bar** is to provide at the shorter span direction. The purpose of the main bar is to transfer the bending load developed at the bottom of the slab to the beams.



2. State the important types of contracts

Ans:-

There are different types of construction contracts and their comparison is presented in this article. A construction contract is an agreement between two or more parties to execute the construction works as per certain terms and conditions.

A construction contracts contains general and special conditions of agreement, details of construction project work, their specifications, time limits, payments and penalties for delivery delays etc. and ensures every party's rights and obligations.

3. What is contract document? State its importance?

Ans:-

At early stages for any construction project, owner with his engineer or consultant prepares necessary documents for tender process which will be included in the contract. These documents are called contract documents.

Following are the types of documents in a construction contract:

7. General conditions
8. Special conditions
9. Drawings and specifications
10. B.O.Q (bill of quantity)
11. Letter of acceptance
12. Contractor bid

4. Write short note on lump-sum contract

Ans:-

In lump sum construction contract contractor bids a single fixed price for all activities in the project scope. This method is particularly used for large construction projects and is conventional but most popular types of construction contract.

The contractor bears the risks associated with this contract and is responsible for estimating project costs from drawings including overhead and his profit to determine the price of the project.

Lump sum construction contract is considered as the most effective means of reducing construction price and is useful when projects and its activities are well defined.

5. what are the conditions for termination of contract

Ans:-

Termination of contract is considered to be lawful when a legitimate reason exists to end the contract before performance has been completed. Some of the more common reasons for termination of contract may include:

Impossibility of Performance: Fulfilling contract terms is called "performance". Some situations may make performance of contract terms impossible. For example, in a contract for a musical concert, the contract may sometimes be terminated if the performer becomes incapacitated.

Instances of Mistake, Fraud, or Misrepresentation: If the contract was formed under conditions involving mistake, misrepresentation, or fraud, the contract may be terminated, since it was not formed according to sound contract principles.
Breach of Contract: In a contract, both parties usually have duties to fulfill. If one party fails to perform their duties, the contract may be terminated, and the non-breaching party may be able to recover losses caused by the breach.

3 Marks

3. What do you mean by end anchorage, explain types of end anchorages

Ans:-

A mechanical device used to transmit prestressing force to the reinforced concrete in a post tensioned member.

4. What do you mean by development length of reinforcement?

Ans:-

A development length can be defined as the amount of reinforcement(bar) length needed to be embedded or projected into the column to establish the desired bond strength between the concrete and steel (or any other two types of material).
When the reinforcement bar is no longer required to carry the tensile forces, i.e tension at that section is about zero, and then it is required to develop the bar further so that the grip/bond between the steel and concrete forms a continuous structure.
If the development length is not provided, then the restraining force in concrete section will be comparatively thin (weak) and will be unable to withhold the position of highly stressed bars resulting in splitting of bars from concrete.
Thus development length is provided to have a fixed support to the bars. In some cases, where there is no space or very little space is available for extra length, hooks are provided for restraints.

5. Discuss different categories of contract in detail and differentiate them with respect to their important characteristics.

Ans:-

There are different types of construction contracts and their comparison is presented in this article. A construction contract is an agreement between two or more parties to execute the construction works as per certain terms and conditions.
A construction contracts contains general and special conditions of agreement, details of construction project work, their specifications, time limits, payments and penalties for delivery delays etc. and ensures every party's rights and obligations.

6. Explain tender notice and tender documents

Ans:-

At early stages for any construction project, owner with his engineer or consultant prepares necessary documents for tender process which will be included in the contract. These documents are called contract documents.

Following are the types of documents in a construction contract:

1. General conditions

2. Special conditions
3. Drawings and specifications
4. B.O.Q (bill of quantity)
5. Letter of acceptance
6. Contractor bid

7. Define the terms : Conditions of contract and Arbitration

Ans:-

Pre-Development Fee- Many times this item can be overlooked, but remember that you spent time and effort putting a preliminary estimate, proposal, and planning before being awarded, and those hours and costs should be recovered.

Utilities - You site office needs power, washrooms, and all utilities in order to do an efficient job. All utilities should be considered including the internet, water, heating, power, and phone lines. Please be sure to include all hook-up fees for these services and do not forget to include security and alarm systems as well if needed. Portable toilets must be included in this category.

Office Trailers- If you need to set up an office trailer rent a property or similar, these costs should also be considered. Think about parking space, access entry, and rent of office equipment, computer, and hardware, software, cleaning supplies, office supplies, temporary fences, printers and even cleaning supplies for the office.

Vehicles- If your crew needs to move around the site using 4 x 4 pickups, bikes (as in some instances), Try to get your best estimate as of gas, maintenance and permits required for the vehicles. Ask for a proposal of maintenance required for each vehicle.

5 Marks

1. Explain the process of acceptance of tenders and general tender conditions

Ans:-

At early stages for any construction project, owner with his engineer or consultant prepares necessary documents for tender process which will be included in the contract. These documents are called contract documents.

Following are the types of documents in a construction contract:

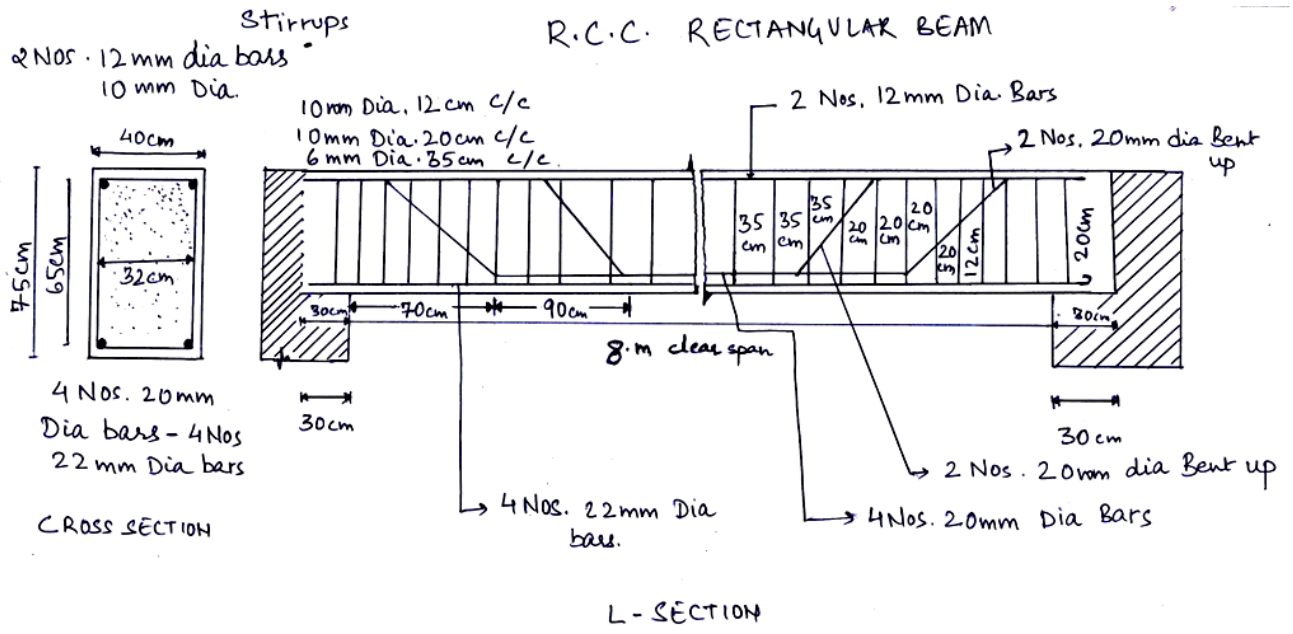
1. General conditions
2. Special conditions
3. Drawings and specifications
4. B.O.Q (bill of quantity)
5. Letter of acceptance
6. Contractor bid

2. State and explain various types of contracts for execution of works in government department

Ans:-

3. Prepare a detailed estimate if a R.C.C beams of 8 meters clear span and 75cm x 40cm in section from the given drawing.

Steel in detail and RCC work shall be calculated separately. Also prepare the schedule of bars.



Objective question with answers

1.Pick up the correct statement from the following:

A. The bent up bars at a support resist the negative bending moment

B. The bent up bars at a support resist the sharing force

C. The bending of bars near supports is generally at 45°

D. All the above.

Answer: Option D

2.The total length of a cranked bar through a distance (d) at 45° in case of a beam of effective length L, is

(A) L + 0.42 d

(B) L + (2 × 0.42 d)

(C) L – (0.42 d)

(D) L – (2 × 0.4 d)

Answer: B

3.The unit of measurement is per quintal for the following:

(A) Collapsible gates with rails

(B) Rolling shutters

(C) Expanded metal wire netting

(D) M.S. reinforcement of R.C.C. works

Answer: D

4.The weight of an item is measured correct to nearest

(A) 0.25 kg

(B) 0.50 kg

(C) 0.75 kg

(D) 1.00 kg

Answer: D

5.Beams are provided in canals if these are

(A) Fully in excavation

(B) Partly in excavation and partly in embankment

(C) Fully in embankment

(D) All the above

Answer: B

6. The item of steel work which is measured in sq.m, is

(A) Collapsible gates

(B) Rolling shutters

(C) Ventilators and glazing

(D) All the above

Answer: D

7.The height of the sink of wash basin above floor level is kept

(A) 60 cm

(B) 70 cm

(C) 75 cm to 80 cm

(D) 80 cm

Answer: C

8.For 12 mm thick cement plastering 1 : 6 on 100 sq.m new brick work, the quantity of cement required, is

(A) 0.200 m3

(B) 0.247 m3

(C) 0.274 m3

(D) 0.295 m3

Answer: C

9.The minimum width of a septic tank is taken

(A) 70 cm

(B) 75 cm

(C) 80 cm

(D) 90 cm

Answer: B

10. Pick up the item whose weight is added to the weight of respective item, is

(A) Cleats

(B) Brackets

(C) Bolts

(D) All the above

Answer: D

Unit-v 2 Marks

1. Define valuation of building and its purpose

   Ans: -

   To find out the exact cost of particular asset and know the present price of that asset.

2. Write short note on Municipal taxes

   Ans:-

   In India municipal corporations or urban local bodies (ULB's) levy two types of taxes viz. Property tax and Professional tax. Property tax is an annual amount paid by a land owner to the municipal corporation of his/her area. The municipal corporation assesses and imposes the property tax annually or semi annually. The amount is generally based on construction, area, property size etc. It also compromises lighting tax, water tax and drainage tax. Property tax is the most important tax levied by ULB's in India; most cities are greatly dependent on property tax revenue for their budget.

3. Give the detailed specifications of plastering cement mortar / lime mortar

   Ans:-

   Traditionally sand-cement mixes have always been specified in terms of mix proportions by volume and not by performance. This is still almost universal practice in South Africa. The exception is SABS 0164, The Structural Use of Masonry. This standard specifies mortar mix by compressive strength in Table 1 and then goes on to suggest suitable mix proportions which should satisfy those strength requirements in Appendix C-2.

   The recommended method of specifying by volume is to specify 1 bag of cement to, for example, 200 liters of sand measured damp and loose. The reasons are that specifying a mix as 1:6 by volume is open to serious misinterpretation (e.g. 1 bag of cement to 6 wheelbarrows of sand) and the fact that that sand's bulk changes when damp - often by as much as 30% by volume.

4. Give the detailed specifications for painting

   Ans:-

   • Where required, surfaces should be made good, i.e. filling, sanding, decorators caulk where necessary. Surface should be smooth and even unless exposed block or concrete formed walls/columns (project dependent). All existing nails, screws, wall plugs etc should be removed and made good. • All signage, notice boards, whiteboards and fixings should be removed and protected and re-fixed on completion unless otherwise stated. • All switches, sockets etc must be released from the surface and not cut in. • Where possible radiators should be removed to allow wall to be painted. Where this is not possible, wall should be painted as far as possible

3 Marks

1. Explain the following method of valuation of a building along with an example.

   (a) Valuation based on cost

   Ans:-

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

(b) Direct method of valuation

Ans:-

This method may be adopted when the rental value is not available from the property concerned, but there are evidences of sale price of properties as a whole. In such cases, the capitalized value of the property is fixed by direct comparison with capitalized value of similar property in the locality.

2. Give the detailed specifications of the following items of work.

(a) Colour washing

Ans:-

White wash shall be prepared from lime slaked on site and stirred with sufficient water to make a thin cream. This shall be allowed to stand for 24 hours and shall be screened though clean cloth, 4 kg of gum dissolved in hot water shall be added to each cubic meter of the cream (115 gm per cft) copper Sulphate not exceeding 3% shall be added to give required whiteness. The approximate quantity of water to be added to make cream shall be five litres per kg. Of lime. White wash shall be applied in specified coats by a dispersing agent, detergent up to a maximum of 5% will be added to the mix before application using flat brushes or spray pumps. Each coat shall be allowed to dry before the next coat is applied .If additional coat then what have been specified are necessary to obtain uniform and smooth finish, it shall be given at no extra cost.

.

3. Explain the Sinking fund?

Ans:-

A **sinking fund** is a fund established by an economic entity by setting aside revenue over a period of time to fund a future capital expense, or repayment of a long-term debt.

In North America and elsewhere where it is common for public and private corporations to raise funds through the issue of bonds, the term is normally used in this context. However, in the United Kingdom and elsewhere where the issue of bonds (other than government bonds) is unusual, and where long-term leasehold tenancies are common, the term is only normally used in the context of replacement or renewal of capital assets, particularly the common parts of buildings.

4. Explain the Capitalised value?

Ans:-

Market capitalization/capitalization (often market cap) is a measurement of size of a business enterprise (corporation) equal to the share price times the number of shares outstanding (shares that have been authorized, issued, and purchased by investors) of a public company.

5. Types of valuations?

Ans:-

1. Rental Method of Valuation
2. Direct Comparisons of the capital value
3. Valuation based on the profit
4. Valuation based on the cost

5. Development method of Valuation
6. Depreciation method of Valuation

5 Marks

1. List and explain general specifications of a second class building

Ans:-

General Building specification of a Second Class Building is as below:-

Foundation and plinth- Foundation and plinth shall be of 1st class brick work with lime mortar over lime concrete.

Damp proof course- D.P.C. shall be of 2cm (¾") thick cement concrete 1:2 mixed with 1 kg of Emperor per bag of cement or other standard water proofing materials.

Superstructure- Superstructure shall be of 2nd class brickwork in lime mortar. Lintels over doors and windows shall be of R.B.

Roofing- Roofing shall be of R.B. slab with7. Cm lime concrete terracing above (or flat terraced roof supported over wooden battens and beams, or Jack arch roof). Verandah roof may be of A.C. sheet.

Flooring- Floors shall be 2.5cm (1") cement concrete over 7.5cm (3") L.C. verandah floor shall be of brick tile or flag stone over lime concrete, finished cement painted.

Finishing- Inside and outside wall shall be of 12mm cement mortar plastered 1:6. Ceiling shall be cement plastered 1:3. Inside shell be white washed 3 coats, colored wash two coats 0ver one coat of white wash.

Doors and windows- Chaukhat shall be of R.C.C. or well seasonal sal wood, shutter of shisham wood or deodar wood 4cm (1 ½") thick, paneled, glazed or partly paneled and partly glazed as required, fitted with iron fitting fittings. Doors and windows shall be painted two coats over one coat of priming.

Miscellaneous- Rain water pipe shall be of cast iron finished painted. Electrification, sanitary and water fitting may be provided if required.

2. Write detailed specifications of cement concrete (1:2: 4) for M20.

Ans:-

Cement concrete is composed of cement, fine aggregates, coarse aggregates and water. While writing detailed specifications, explain the specifications of every single ingredient in detail.

CEMENT

Cement is the basic and most important ingredient of cement concrete. Cement used for construction work should be fresh and it should meet the standard specifications.

FINE AGGREGATE

Sand is used as fine aggregate in cement concrete. Sand particles should have coarse, sharp and angular edges. Size of sand particles should be such that it passes through 4.75mm sieve. Sand should be clean, free from dust and organic matters. Sea sand is prohibited for construction work, because of high salt contents.

Stone dust can also be used as fine aggregate in cement concrete, but before use make sure that it is as per specifications.

COURSE AGGREGATE

Generally, pieces of igneous rocks are used as coarse aggregates. These stones should be hard, tough, durable and clean. Aggregates shape should be cubic or closed to cubic shape. Shape of

coarse aggregates should not be laminated and elongated. It should be clean and free from any irrelevant organic matters.

Size of coarse aggregates should meet the approved construction work requirements. It should not pass through the sieve size of 5mm and coarse aggregates should be graded. Voids should not exceed 42%.

PROPORTIONING

Cement, sand and coarse aggregates should be measure according to their fixed proportions. Make a standard measuring box according to the volume of one cement bag. Volume of one cement bag is 1.25 cubic foot.

Bulking of sand should be under consideration while measuring sand proportion. Consider dry sand while calculation of proportioning. Measure the moisture content in sand and add extra volume of sand. Continuously measure moisture content during construction work and add extra volume of sand according to the amount of moisture. Don't compact coarse aggregates while proportioning.

CONCRETE MIXING

Mixing machine is used for large scale construction works. While, hand mixing is preferred as it is economical for smaller concrete works.

3. Life of various items of works in building.

Ans:-

Life of various items of works in building —

Details of items and works		Life of the works
Masonry —		
1. Brickwork in lime or cement, Boulder masonry in lime or cement, Cut stone work in lime or cement	...	100 years and above
2. Brickwork in clay, Coursed rubble in mud	...	100 years.
3. Brick arches in lime or cement mortar, Rubble stone arches in lime or cement mortar	...	100 years.
4. Sundried brickwork in clay	...	75 years.
Flooring —		
5. Brick-on-edge or flat flooring over 7.5 cm L.C.	...	40 years.
6. Cement concrete floor, Granolithic floor, stone flooring	...	50 years.
7. Terraced floor or lime concrete	...	20 years.
Roofing —		
8. R.C.C., R.B., Terraced roofing over stone flags, Jack arck Roofing with L.C. terracing	...	75 years.
9. Iron work in roofing	...	80 years.
10. Sal wood work in roof	...	60 years.
11. Country wood in work	...	15 years.
12. Allahabad lock tiling	...	25 years.
13. G.I. Sheet roofing of 22 B.W.G. sheet	...	50 years.
14. Sal ballies in roof	...	20 years.
15. Pine wood ceiling	...	30 years.
Doors and windows —		
16. Teak wood doors and windows, Sal wood doors and windows	...	40 years.
17. Country wood doors and windows	...	30 years.
Iron work —		
18. Rolled steel joist	...	75 years.
19. Wrought iron work	...	80 years.

4. Ans:-

Example 4. — A three-storied building is standing on a plot of land measuring 800 sq m. The plinth area of each storey is 400 sq m. The building is of R.C.C. framed structure and the future life may be taken as 70 years. The building fetches a gross rent of Rs. 1500.00 per month. Work out the capitalized value of the property on the basis of 6% net yield. For sinking fund 3% compound interest may be assumed. Cost of land may be taken Rs. 40.00 per sq m. Other datas required may be assumed suitably.

Gross income per year = 1500 × 12 = Rs. 18,000.00.

Outgoings per annum assuming suitable data :—

(*i*) Repairs at 1/12 of gross income	...		= Rs. 1500.00
(*ii*) Municipal tax 20% of gross rent	...	$= 18000 \times \frac{20}{100}$	= Rs. 3600.00
(*iii*) Property tax 5% of gross rent	...	$= 18000 \times \frac{5}{100}$	= Rs. 900.00
(*iv*) Insurance premium @ ½% of gross rent	...	$= 18000 \times \frac{.5}{100}$	= Rs. 90.00
(*v*) Management charges @ 6% of gross rent	...	$= 18000 \times \frac{6}{100}$	= Rs. 1080.00
(*vi*) Other miscellaneous charges @ 2% of of the gross rent	...	$= 18000 \times \frac{2}{100}$	= Rs. 360.00
(*vii*) Sinking fund required to accumulate the cost of the building (which is at the rate of Rs. 150.00 per sq m of plinth area = 400 × 3 × 150 = Rs. 180000.00) in 72 years @ 3% interest	...	= 180000 × 0.0043	= Rs. 774.00

Total of outgoings per annum = Rs. 8304.00

Net annual return = 18000 — 8304.00 = Rs. 9696.00

Capitalized value of the building = Net income × Y.P. = $9696 \times \frac{100}{6}$ = Rs. 1,61600.00

Cost of land @ Rs. 40.00 per sq m = 800 × 40 = Rs. 32000.00

Total ... = Rs. 1,93,600.00

The total value of the whole property is equal to Rs. 1,93,600.00.

5. Ans:-

Example 5. — A coloniser intends to purchase a land of 100,000 sq m area located in the suburb of a big city to develop it into plots of 700 sq m each after providing necessary roads and parks and other amenities. The current sale price of small plots in the neighbourhood is Rs. 30.00 per sq m. The coloniser wants a net profit of 20%. Work out the maximum price of the land at which the coloniser may purchase the land.

Total area of land ... = 100,000 sq m
Deduct 30% for roads, parks, etc. ... = 30,000 sq m

Net area for plots ... = 70,000 sq m

Number of plots at 700 sq m per plot = $\frac{70000}{700}$ = 100.

Selling price per plot @ Rs. 30.00 per sq m = 700 × 30 = Rs. 21,000.00.
Total price from sale of all plots = 21000 × 100 = Rs. 21,00,000.00.

Objective question with answers

1. The expected out turn of half brick partition wall per mason per day is
   (A) 1.5 m 3
   (B) 2.0 m3
   (C) 4.0 m2
   (D) 5.0 m2
   Answer: B
2. The floor area includes the area of the balcony up to
   (A) 100 %
   (B) 75 %
   (C) 50 %
   (D) 25 %
   Answer: C
3. Size, capacity and materials need be specified for
   (A) Bib-cocks
   (B) Stop-cocks
   (C) Ball valves
   (D) All the above
   Answer: D

4. For 100 sq. m cement concrete (1 : 2: 4) 4 cm thick floor, the quantity of cement required, is

(A) 0.90 m3

(B) 0.94 m3

(C) 0.98 m3

(D) 1.00 m3

Answer: B

5. The expected out turn for earth work in excavation in ordinary soil per workman per day is

(A) 1.00 cum

(B) 2.00 cum

(C) 3.00 cum

(D) 4.00 cum

Answer: C

6. The minimum width of a septic tank is taken

(A) 70 cm

(B) 75 cm

(C) 80 cm

(D) 90 cm

Answer: B

7. Pick up the item whose weight is added to the weight of respective item, is

(A) Cleats

(B) Brackets

(C) Bolts

(D) All the above

8. A cement concrete road is 1000 m long, 8 m wide and 15 cm thick over the sub-base of 10 cm thick gravel. The box cutting in road crust is

(A) 500 m3

(B) 1000 m 3

(C) 1500 m3

(D) 2000 m3

Answer: C

9. The plinth area of a building not includes

(A) Area of the walls at the floor level

(B) Internal shaft for sanitary installations up to 2 sq m. in area

(C) Lift and wall including landing

(D) Area of cantilevered porch

Answer: D

10. According to Indian Standards Institute, the actual size of modular bricks is

(A) 23 cm × 11.5 cm × 7.5 cm

(B) 25 cm × 13 cm × 7.5 cm

(C) 19 cm × 9 cm × 9 cm

(D) 20 cm × 10 cm × 10 cm

Answer: C