WINTER – 16 EXAMINATIONS

Subject Code: 17501 **Model Answer- Estimating and Costing**

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)

(ISO/IEC -270001 – 2005 certified)

Important Instructions to Examiners:

1) The answer should be examined by keywords and not as word-to-word as given in the model answer scheme.

2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.

3) The language error such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and communication skill).

4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figure drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.

5) Credits may be given step wise for numerical problems. In the some cases, the assumed constants values may vary and there may be some difference in the candidates answer and model answer.

6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidates understanding

Important notes to Examiners:-

i. In Q.No-1(A)/ (b) Rates may differ place to place hence examiner should give proportionate marks.
ii. In Q.3 (B)/ (b) pay work is written instead of day work, If student attempts this sub-question examiner should give full marks.
iii. In Q.3(B)/(c) student may calculate the qty of reinforcement by assuming different clear cover (15 to 25 mm) & out of four bottom bars student may consider 2 bars as straight & 2 bars as bent up hence examiner should give proportionate marks.
iv. In Q.4(b) Examiner should keep in mind that rates of materials and labours differs from place to place and time to time, proportionate marks should be given for following the correct procedure of preparing rate analysis.
v. In Q.4(c) 1) Examiner should keep in mind that rates of materials and labours differs from place to place and time to time, proportionate marks should be given for following the correct procedure of preparing rate analysis. 2) It is common practice in P.W.D. or in reference books to assume 10 cu.m of volume for the rate analysis of items having mode of measurement as 'cu.m' & calculate quantity of materials, task work of labour for 10 cu.m volume. The purpose of mentioning 300 mm thickness of brickwork in the question was to give idea to the student that the unit of brickwork is in cu.m & not in sqm as taken for partition wall (115mm thick). 3) If student has assumed area of brickwork as 100 sqm & calculated the volume of brickwork as 3cu.m by multiplying with thickness 0.30m, then the examiner should give proportionate mark if student has calculated quantity of material, task work of labour for 3cu.m accurately & followed the remaining procedure of rate analysis correctly.
vi. In Q.No-5(a) & 5(b) Examiner should give full marks if Student calculates the quantity of brickwork either by Long wall-Short wall (out to out – in to in) method or by Centerline method, the final answer should be same.
vii. In Q.5 (b) R.C.C. slab thickness is written 12 mm instead of 120 mm, if student calculate the quantity by taking 12 mm thickness full marks should be given.
viii. In Q.5 (c) student may calculate the qty of reinforcement by assuming different clear cover (25 to 50 mm) hence examiner should give proportionate marks.
ix. In Q.6 (a) thickness of mortar bed, type & proportion of mortar is not mentioned hence if student have assumed thickness of mortar bed, type of mortar as cement mortar & proportion or attempted this question full marks should be given by the examiner.

Question and Model Answers	Mark
Q.1 (A) Attempt any THREE of the following:	**12 M**
a) What is estimating & costing and state two purpose of estimating & costing.	**4 M**
Estimating - It is the process of calculating the quantities and costs of various items required for satisfactory completion of the work. **Costing -** The process of Calculating the actual cost of work before its execution is called as 'Costing'. **Purposes of estimating:-** • To know the approximate cost of proposed work. • To obtain administrative approval and technical sanction. • To know the requirement of tools, plants and equipment. • To fix up the completion period. • To draw up a construction schedule and programme. • To invite tender for execution of work. • To keep control over expenditure during construction. **Purpose of Costing:-** • To arrange the finance for proposed work. • To know the probable cost of project before the execution. • For valuation of existing property • To know the cost of various items, well in advance, to be constructed	**1M** **1M** **1M (for any two)** **1M (for any two)**
b) State the local rate of following materials:	**4 M**
1) Murum - Rs.500 to Rs.750 Per Cu.m. 2) Traditional Bricks - Rs.5 to 9 Per No 3) Cement – Rs.280 to 325 Per Bag 4) Rubble - Rs.600 to 800 Per Cu.m **(Note:- Rates may differ place to place hence examiner should give proportionate marks)**	**1M each**
c) State the units of measurement for following item of work:	**4 M**
1) Flooring - Sq.m. (m^2) 2) Concrete - Cu.m.(m^3) 3) Basin - Nos. 4) Plastering – Sq.m ((m^2)	**1M each**
d) List different types of detailed estimates.	**4 M**
1) Fresh/New Detailed Estimate. 2) Revised Estimate. 3) Supplementary Estimate 4) Revised & Supplementary Estimate. 5) Maintenance & Repair Estimate.	**1M each (for any four)**

Q.1 (B) Attempt any two of the following — **8 M**

(a) What is bar bending schedule? State any two advantages of preparing bar bending schedule. — **4 M**

Bar bending schedule - It is a list of reinforcement bars in a tabular form, prepared for all types of R.C.C. Members. — **1 M**

Sr.No	Particulars of bar	Shape	Dia. (Ø)	No.	Length (m)	Total Length (m)	Wt. (kg/m)	Total Wt. (kg)

1 M

Advantages of Bar Bending Schedule –

1) Helps to convert the diameter vise measured length of reinforcement in terms of weight.

2) The requirement of different size of bars in terms of weight can be known for procurement from market.

3) Helps the bar bender to cut & bent reinforcement accurately at site.

4) It facilitates the site engineer to check the actual reinforcement placed in structural member & for fast preparation of bills.

1M each (for any two)

(b) State rules of deduction as per IS1200 for : — **4 M**

(i) Brick work for walls — **2M**

No deduction should be made for the following:-

1) Openings up to $0.1m^2$ in area

2) Ends of beams, posts, purlins, Rafters etc. up to 0.05 m^2 in section

3) Bearings of floors and roof slabs are not deducted from masonary

4) Wall plates & bed plates, bearing of slab and chajja where thickness does not exceed 10cm

1M each (for any two)

(ii) Painting Work (internal) — **2 M**

1) No deduction shall be made for ends of joists, beams, posts, etc, and openings not exceeding 0.5 m^2 each and no addition shall be made for reveals, jambs, soffits, sills, etc, of these openings nor for finish around ends of joists, beams, posts, etc.

2) Deductions for openings exceeding 0.5 m^2 but not exceeding 3 m^2 each when both faces of wall are provided with the same finish, deduction shall be made for one face only and no addition shall be made for reveals, jambs, soffits, sills, etc, of these openings.

3) In case of openings of areas above 3 m^2 each, deductions shall be made for openings, but jambs, soffits and reveals shall be measured.

4) No deduction shall be made for attachment, such as casings, conduits, pipes, electric wiring and the like.

1M each (for any two)

(c) State situation under the following estimates prepared: — **4 M**

(i) Revised Estimate — **2 M**

1) When the original sanctioned estimate is likely to exceed by more than 5%

2) When the expenditure on a work exceeds or likely to exceeds the amount of administrative

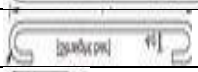
sanctioned by more than 10% 3) If there is change of rate or quantity of materials. 4) Major addition or alterations are introduced in original work.	**1M each (for any two)**
(ii) Approximate estimate	**2 M**
1) To give the client rough idea of probable expenditure in short time without calculating the actual quantities, from the cost of similar structure having similar specification, construction & locality. 2) In case of Government & public bodies, for sanctioning of the expenditure required for the project in the form of Administrative approval. 3) In case of commercial projects to study the cost-benefit ratio. If it is justified the project is carried out. 4) For BOT/PPP Systems approximate estimates plays important role for decision making & for preparation of Feasibility Report of Project	**1M each (for any two)**
Q.2 Attempt any Two of the following	**16 M**
(a) Describe the procedure for preparation of approximate estimate of an irrigation project.	**8 M**
There are different systems of irrigation. But in general the method of preparing approximate estimates involved the following steps. 1) **Statements of objects –** It should be ascertained whether the project is for single purpose i.e. to serve only one purpose or multiple purpose project i.e. serve more purposes. (Like Irrigation, Hydroelectric power, water supply etc.) 2) **Collection of data –** To arrive at reasonable decision from the preliminary estimate reliable data (like physical, Hydrologic, Geological, Agricultural etc.) to serve the objects are collected and furnished to prepare the approximate estimate. 3) **Projections of planning -** The future needs should be evaluated. The true economical demand in future period is estimated. 4) **Project Formulation –** Comprehensive list of all the possible alternative units should be prepared and defined the boundary conditions which restrict the project. In the Catalogue all the possible project units along with the alternative plans for each project unit is indicated. 5) **Project Evaluation –** • Preliminary estimate for each of the catalogued project units are prepared by comparison of cost method. • The approximate cost of the proposed units is found by modifying the known cost of similar units constructed previously in accordance with one particular cost index figure.	**1M** **1M** **1M** **1M**

• Approximate estimated cost of units of irrigational canals may be prepared per kilometer basis depending on the capacity of canal or multiplying the commanded area in hectares' of canals by approximate average cost per hectare. • From alternative units the most efficient unit whose benefit cost ratio is more than one, the unit or units may be recommended for construction. • An amount for contingency (normally 10%) is added to the cost of project. • For overheads as percentage (usually 10%) cost of the approximate estimate is included in the estimate. • At last the cost for land acquisition (normally 12%) is added to frame the total approximate estimated cost of a project.	**4M**
(b) Describe the procedure for preparing approximate estimate of road project.	**8 M**
Procedure for preparing approximate estimate of road project:- 1) Reconnaissance Survey is conducted to determine best possible route & to collect information like extent of waterway, high flood level, no's & length of bridges, total alignment length, probable amount of earthwork, geological characteristics & land value etc 2) Preliminary Survey along the selected route is conducted to determine the various distances, heights & angles From the above survey reports, maps & data, approximate estimate is prepared per 'km' basis by adding following heads:- i) Cost of earthwork in excavation, embankment, hauling etc. is worked out by using contour map ii) Cost of bridges & culverts is calculated by multiplying its span by cost per meter span of similar existing structure. iii) Cost of sub-base consisting of soling & edging according to nature of soil selected is worked out for road width per 'km' iv) Cost of base-course including premix carpet is worked out per 'km' basis v) Cost of boundary stones/pillars is taken as lump sum per 'km' vi) Total cost of heads i) to v) is calculated vii) Contingencies- 15% & W.C.- 5% added to above Total cost viii) Cost of permanent land is added finally to work out the approximate total estimated cost of the road project	**1M** **1M** **6M**

(c) Prepare approximate estimate of a bridge having 5 Spans of 40 m each using following data: (i) Cost of existing bridge 1.2 cr. (ii) Existing bridge having 3 spans of 50m each.	**8M**
Cost of existing bridge = Rs. 1.2 Cr. = 1,20,00,000/- Total length of existing bridge = 3 x 50 = 150 m Cost of existing bridge Per 'm' length = $\frac{1,20,00,000}{150}$ = **Rs. 80,000/- per 'm'** Total length of new bridge = 5 x 40 = 200 m Approximate cost for new bridge = 80,000 x 200 = Rs.1,60,00,000/- **Approximate Estimated Cost of Bridge = Rs. 1.6 Cr.**	**2M** **2 M** **2 M** **2 M**
Q3. Attempt any Four of the following:	**16 M**
(a) Prepare check list of R.C.C. framed structure for preparing a detailed estimate	**4 M**
1) Site clearance 2) Earth work in excavation 3) P.C.C. below foundation 4) R.C.C. for footing, column, beam & slab etc. 5) Plinth filling 6) P.C.C. below flooring 7) Brickwork in superstructure 8) Wood work for door & window frames 9) Plastering (Internal & External) 10) Plumbing 11) Electrification 12) Flooring 13) Skirting 14) Wood work for door & window shutter 15) Painting (Internal & External) 16) Misc. works **(Note:- if student has written minimum 8 items as per sequence of execution, full marks should be given by examiner)**	**4 M**

(b) What is prime cost & day work	**4 M**
1) Prime Cost: Prime cost is the actual cost of articles at shop and refers to supply of articles only and not to carrying out work. During preparation of an estimate, it is not always possible to specify exact types of articles required, for ex: water supply fittings, sanitary fittings, door and window fittings, etc. are to be decided during the time of actual fitting according to the choice of the owner or Engineer-In-Charge. For the execution of such items reasonable amount is kept in the estimate as Prime Cost. 2) **DayWork:** The term Day work is used to denote a procedure of costing or valuing an item of work on the basis of actual labours and material required. Certain types of work cannot be paid by measurement viz. special types of architectural works, dismantling partition wall, taking out root of trees during earthwork in excavation for foundation trenches etc. are paid on the basis of actual quantity of materials and labour hours required to complete the job are denoted by Day Work. **(Note:- pay work is written instead of day work, If student attempts this sub-question examiner should give full marks)**	**2 M** **2 M**
(c) A R.C.C. Lintel size 250 x 150 mm & clear span of 1.5m is reinforced with 4 bars of 10 mm @ bottom & 3 bars of 8 mm @ top. The stirrups of 6 mm are provided 150 mm c/c. bearing of lintel is 150 mm. calculate the total quantity of steel reinforcement.	**4 M**
Given :- B = 250mm D = 150 mm , T_L = Clear span + 2 x bearing = 1.50 + 2 x 0.15 = 1.8m Assume clear cover = 20mm Effective depth, d = D-2x clear cover = 150- 2 x 20 = 110 mm i) Length bottom of straight bar $L_{SB} = T_L – 2$ x side cover + 2 x 9ϕ = 1800 – 2 x 20 + 2 x 9 x 10 =1940 mm = 1.940 m (4 Nos) ii) Length of anchor Bar $L_{AB} = T_L – 2$ x side cover + 2 x 9ϕ = 1800 – 2 x 20 + 2 x 9 x 8 =1904 mm = 1.904 m (3 Nos) iii) Length of Stirrups A = 250 – 2 x 20 = 210 B = 150 – 2 x 20 = 110 L_{ST} = 2 (A + B) + 24 ϕ = 2 (210 + 110) + 24 x 6 = 784 mm = 0.784 m iv) Number of stirrups = $\frac{\text{TL} – 2 \text{ x Clear cover}}{\text{Spacing}} + 1$	**1 M** **1 M**

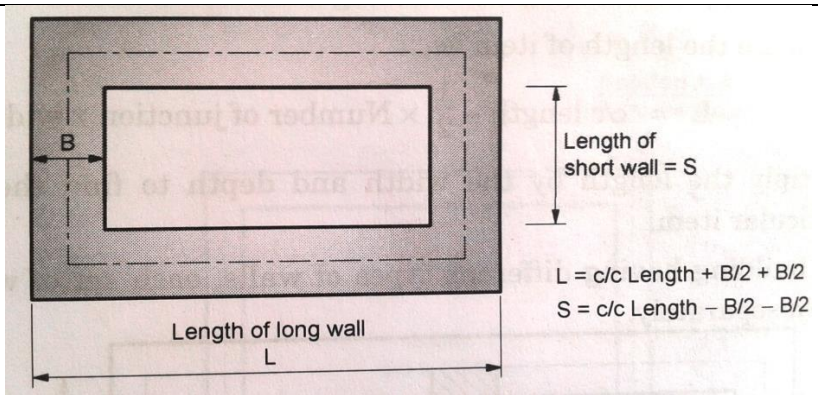
= $\frac{1800-2 \times 20}{150}$ + 1 = 13 Nos Bar Bending Schedule:-	**1 M**

Sr No	Description	Shape of bar	Dia (ϕ)	No.	L	Total Length	Wt Kg/m	Total Wt (kg)
1	Bottom straight bar		10	4	1.940	7.760	0.617	4.787
2	Top anchor bar		8	3	1.904	5.712	0.395	2.256
3	Stirrups		6	13	0.784	10.192	0.222	2.262
								9.305 kg

(Note:-Student may calculate the qty of reinforcement by assuming different clear cover (15 to 25 mm) & out of four bottom bars student may consider 2 bars as straight & 2 bars as bent up hence examiner should give proportionate marks.)

1 M

(d) Explain the long wall & short wall method of taking out quantities.	**4 M**



1M for neat labeled fig.

"Long wall and short wall" is also called as "PWD method" or "out-to-out" and "in-to-in" method. For the accurate estimate the dimensions, length, breadth and height or depth are taken out correctly from drawings. Then the following steps are followed:-

1) Draw the center line plan.
2) Consider wall spanning in horizontal direction as "long wall" and vertical direction as "short wall" in plan or vice versa.
3) Calculate the center to center lengths of long wall and short wall
4) Calculate length of long wall (out to out) Length of long wall = c/c length of long wall + width of item
5) Calculate length of short wall (in to in) Length of short wall = c/c length of short wall - width of item
6) Multiply the length by the width and depth to find the quantity.

(Note:- Student should draw a diagram showing long wall and short wall or at least write sample Calculation of long wall and short wall.)

3M for Discription

(e) What is work charged establishment & contingencies	**4 M**
1) Work Charged Establishment: During the construction of a project/work some supervisory staff such as supervisors, watchman, store clerk etc. are appointed on temporary basis. The wages to be paid to this staff is charged directly to the estimate of the work. To meet this expenditure a provision is made in the estimate of every work, which is known as work charged establishment. It is about 2 to 2.5 % of the estimated cost of the work. **2) Contingencies:** It is the incidental expenses of a miscellaneous character which cannot be reasonably predicted during preparation of estimate and to meet such unforeseen expenses an additional amount of 3% to 5% of the estimated cost of the works is provided in the total estimate.	**2 M** **2 M**
Q.4. Attempt any TWO of the following:	**16 M**
(a) State and explain four factors affecting rate of an item.	**8 M**
1) Material: - The rate of an item depends upon specification of materials. The price of various materials depends upon market conditions. The cost of material is taken as delivered at site inclusive of transport, local taxes, and other charges. **2) Labour**: - The nos & wages of various categories of labour (skilled, semiskilled & unskilled) affects the rate of an item. Nos. of labour required for particular work depends upon their efficiency, site condition etc. **3) Specification**: - Specification shows the proportion & quality of material to be used & method of execution of work. If superior quality material issued rate will be higher. **4) Location of work**:- If the site is in remote areas, transportation charges increases similarly labour charges also varies i.e. if site conditions are difficult, cost will be more **5) Profit of the contractor: -** Normally 10% of actual cost of work is considered as contractor profit. But if contractors profit is more or less the rate of an item correspondingly affected. **6) Conditions of Contract**: - If the condition of contract is very stiff the rates are high. **7) Tools & Plants**:- Use of special equipments increases the cost of construction **8) Miscellaneous: -** Time of completion, climatic condition, also affects the rate of item.	**1 M For each**
(b) Prepare rate analysis for U.C.R. masonry in C.M.(1:5) for foundation	**8 M**
Assume, volume of U.C.R. masonry = 10 cu.m **Calculation of materials:-** a) Dry volume of cement mortar = 42 % of volume of masonry = (42/100) x 10 = 4.2 cu.m b) Volume of cement = {4.2/(1+5)} x 1 = 0.7 cu.m Number of bags of cement = 0.7/0.035 = 20 bags c) Volume of sand = {4.2/(1+5)} x 5 = 3.5 cu.m d) Volume of stone = 1.25 x volume of masonry = 1.25 x 10 = 12.5 cu.m e) Number of through stone = 2 Nos / cu.m Number of stone required = 2 x 10 = 20 Nos	 **1/2 M** **1/2 M** **1/2 M** **1/2 M** **1/2 M**

Sr. No	Particular	Quantity	Rate	Per	Amount
A	**Material**				
1	Cement	20	300	Bag	6000
2	Sand	3.50	1950	Cum	6825
3	Stones	12.50	600	Cum	7500
4	Through stone	20	34	No	680
				Total (A)	**21005**
B	**Labour**				
1	Head Mason	0.5	600	Day	300
2	Mason	14	500	Day	7000
3	Male Mazdoor	10	350	Day	3500
4	Feamale Mazdoor	08	250	Day	2000
5	Bhisti	2	350	Day	700
6	Sundries T.&P.	L.S.	L.S.	L.S.	250
				Total (B) =	**13450**
	Total Cost of Material & Labour (C) = Total (A+B)				**34455**
	Add Water Charges @ 1.5% of Total Cost of Material & Labour =				516.82
	Overall Cost= Total Cost + Water Charges =				**34971.82**
	Add Contractors Profit @ 10% of Overall Cost (E) =				3497.18
	Grand Total= Overall Cost + Contractors Profit =				**38469.00**
	Rate per cu.m = Grant total / Assumed Volume of U.C.R. Masonry =				**3847.00 per cum**

(Note: - Examiner should keep in mind that rates of materials and labours differ from place to place and time to time, proportionate marks should be given for following the correct procedure of preparing rate analysis.)

2 M

2 M

1/2 M

1/2 M

1/2 M

(c) Prepare rate analysis for B.B. masonry in C.M.(1:6) 300 mm thick wall. **8 M**

Rate Analysis for Brick Work in Super Structure in C.M (1:6) in Super Structure

Assume Volume of Brick Masonry = 10 cu.m

1) Calculation of materials

a) Dry Volume = 30% of volume of masonry = $\frac{30}{100}$ x 10 = 3.00 cu.m.

1/2 M

b) Volume of Cement = $\frac{\text{Dry Volume}}{\text{Sum of Mix Proportion}}$ x Content of cement in proportion

Volume of Cement = $\frac{3.0}{1+6}$ x 1 = 0.4285 cu.m

No. of Cement Bags = $\frac{0.4285}{0.035}$ = 12.24 bags = approximately = 13 bags **1/2 M**

c) Volume of Sand = $\frac{\text{Dry Volume}}{\text{Sum of Mix Proportion}}$ x Content of Sand in proportion

Volume of Sand = $\frac{3.0}{1+6}$ x 6 = 2.571 cu.m **1/2 M**

d) Number of Bricks

Size of one Brick = 19cm x 9cm x 9 cm = 0.19m x 0.9m x 0.9m

Add thickness of Mortar throughout = 1cm

Size of Brick with mortar = 0.2m x 0.1m x 0.1m **1 M**

Number of Bricks = $\frac{10}{0.2 \times 0.1 \times 0.1}$ = 5000 Nos.

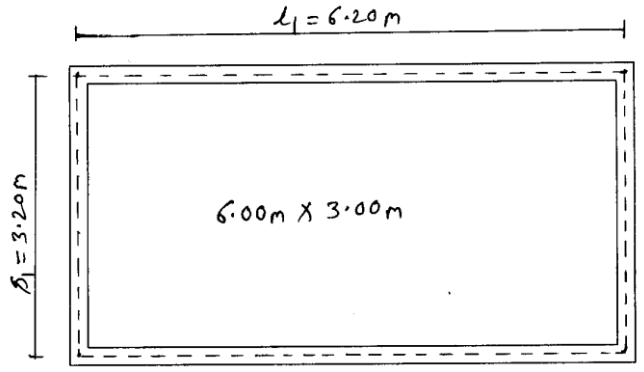
Sr. No	Particular	Quantity	Rate	Per	Amount	
A	**Material**					
1	Cement	13	300	Bag	3900	**2 M**
2	Sand	2.571	1950	Cum	5013.45	
3	Bricks	5000	7	Nos	35000	
4	Scaffolding	L.S.	L.S.	L.S.	500	
				Total (A)	**44413.45**	
B	**Labour**					
1	Head Mason	0.5	600	Day	300	
2	Mason	8	500	Day	4000	
3	Male Mazdoor	8	350	Day	2800	
4	Feamale Mazdoor	10	250	Day	2500	**2 M**
5	Bhisti	2	350	Day	700	
6	Sundries T.&P.	L.S.	L.S.	L.S.	200	
				Total (B)	**10500**	
	Total Cost of Material & Labour (C) = Total (A+B)				**54913.45**	
	Add Water Charges @ 1.5% of Total Cost of Material & Labour =				823.70	**1/2 M**
	Overall Cost= Total Cost + Water Charges =				**55737.15**	
	Add Contractors Profit @ 10% of Overall Cost (E) =				5573.71	**1/2 M**
	Grand Total= Overall Cost + Contractors Profit =				**61310.86**	
	Rate per cu.m = Grant total / Assumed Volume of U.C.R. Masonry =				**6132.0 per cum**	**1/2 M**

{Note:- 1) Examiner should keep in mind that rates of materials and labours differs from place to place and time to time, proportionate marks should be given for following the correct procedure of

preparing rate analysis. 2) It is common practice in P.W.D. or in reference books to assume 10 cu.m of volume for the rate analysis of items having mode of measurement as 'cu.m' & calculate quantity of materials, task work of labour for 10 cu.m volume. The purpose of mentioning 300 mm thickness of brickwork in the question was to give idea to the student that the unit of brickwork is in cu.m & not in sqm as taken for partition wall (115mm thick). 3) If student has assumed area of brickwork as 100 sqm & calculated the volume of brickwork as 3cu.m by multiplying with thickness 0.30m, then the examiner should give proportionate mark if student has calculated quantity of material, task work of labour for 3cu.m accurately & followed the remaining procedure of rate analysis correctly.}

Q.5 Attempt any TWO of the following: **16 M**

(a) Find quantity of brickwork, P.C.C., excavation & internal plaster for a underground water tank. **8 M**



PLAN

1) Assume horizontal wall as long wall & vertical walls as short wall

l_1= 0.20/2+6.00+0.20/2= 6.20 m **1/2 M**

s_1=0.20/2+3.00+0.20/2= 3.20 m

Sr. No.	Description of item of work	No.	Length L (m)	Breadth B (m)	Depth D (m)	Quantity	Total Quantity
1	Brickwork 0.2m thick						
	Long wall L_1= 6.20+0.20 = 6.40m	2	6.40	0.20	2.00	5.12	
	Short wall S_1= 3.20 - 0.20 = 3.00m	2	3.00	0.20	2.00	2.40	
							7.52 cu.m
	{Note: - The examiner should give full marks if Student calculates the quantity of brickwork either by Long wall-Short wall (out to out – in to in) method or by Centerline method, the final answer should be same.}						
2	P.C.C. (0.20 m thick) L=6.00+2x0.20+2x0.15 = 6.70m	1	6.70	3.70	0.20	4.96	

1 .5 M

	B=3.00 +2x0.20+2x0.15 = 7.70m							
							4.96 cu.m	**2 M**
3	Excavation	1	6.70	3.70	2.20	54.54		
							54.54 cu.m	**2 M**
4	Internal plaster for wall L=2 x (3.00+6.00)= 18m	1	18.00	-------	2.00	36.00		
							36.00 sqm	**2 M**

(b) Work out the quantity of following items for septic tank having internal size 1.5 m x 3.5 m & height 1.50 m. the top of slab of septic tank is 20 cm above ground level. **8 M**

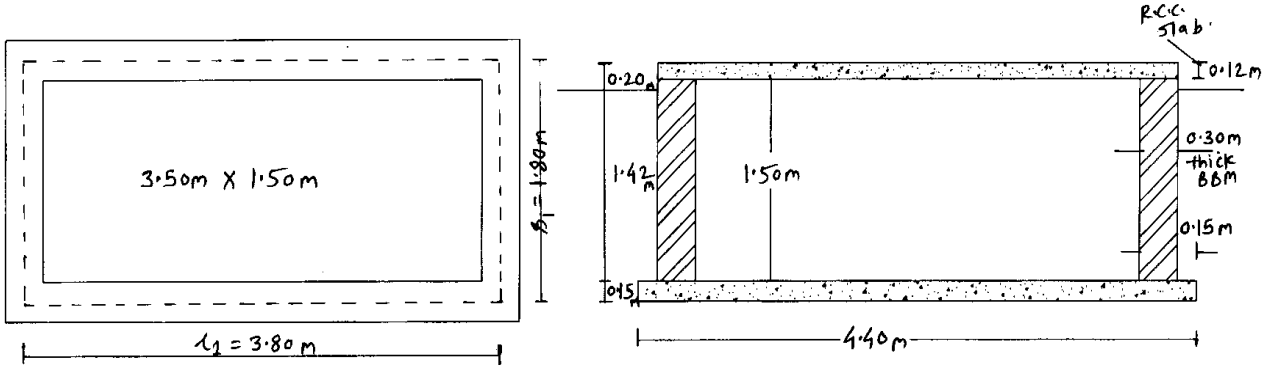
(i) Earthwork in excavation

(ii) P.C.C. (M15) 15 cm thick

(iii) B.B. masonry in C.M. (1:6) 300 mm thick

(iv) R.C.C. slab M20 on septic tank 12 mm thick

15 cm offset is provided for P.C.C. on all sides of septic tank



PLAN SECTION

1 M for correct fig.

1) Assume horizontal wall as long wall & vertical walls as short wall

l_1= 0.30/2+3.50+0.30/2= 3.80 m

s_1=0.30/2+1.50+0.30/2= 1.80 m

No.	Description of item of work	No.	Length L (m)	Breadth B (m)	Depth D (m)	Quantity	Total Quantity
1	Earthwork in excavation L= 3.50+2x0.30+2x0.15 = 4.40m	1	4.40	2.40	1.57	16.58	

	B= 1.50+2x0.30+2x0.15 = 2.40m							
							16.58 cu.m	**1.5 M**
2	P.C.C.	1	4.40	2.40	0.15	1.58		
							1.58 cu.m	**1.5 M**
3	B.B. masonry in C.M. (1:6)							
	Length of Long wall L_1= 3.80+0.30 = 4.10m	2	4.10	0.30	1.50	3.69		
	Length of Short wall S_1= 1.80 - 0.30 = 1.50m	2	1.50	0.30	1.50	1.35		
							5.04 cu.m	**2 M**
	{Note: - The examiner should give full marks if Student calculates the quantity of brickwork either by Long wall-Short wall (out to out – in to in) method or by Centerline method, the final answer should be same.}							
4	R.C.C. slab L= 3.50+2x0.30= 4.10m B= 1.50+2x0.30= 2.10m	1	4.10	2.10	0.12	1.03		
							1.03 cu.m	**2 M**

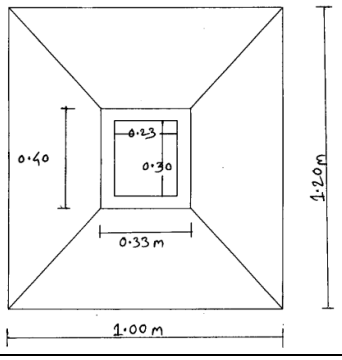
(Note:- R.C.C. slab thickness is written 12 mm instead of 120 mm, if student calculate the quantity by taking 12 mm thickness full marks should be given.)

(c) Work out the quantity of concrete and steel in footing for R.C.C. column given in (see fig.-2) using following data. **8 M**

Column	No.	Column size	Footing size	de/ds	Footing reinforcement
C2	07	230 x 300	1000 x 1200	350/150	10 @ 150 c/c both way

Assume suitable cover to the reinforcement

1) Calculation of concrete quantity



A_1 = 1.00x 1.20 = 1.20 sqm

A_2 = 0.33 x 0.40 = 0.132 sqm

d_s= 0.15 m **1 M**

Volume of rectangular portion (V_1) = A_1 x d_s
= 1.20 x 0.15 = 0.18 cu.m **1 M**

A_m = ½(A_1+ A_2) = 0.67 sqm
h = d_e - d_s
= 0.35- 0.15 = 0.20m
Volume of Trapezoidal portion (V_2) **1 M**

a) By using prismoidal formula

V_2= h /6 [A_1+ A_2 + 4 A_1+ A_2]
= 0.20/6[1.20 + 0.132+ 4 x 0.67]
= 0.134 cu.m

Volume of one footing = V_1+ V_2
=0.18 + 0.134 = 0.314 cu.m

Total volume of concrete for 7 footings: 7 x 0.314 = 2.198 cu.m

Or **1 M**

b) By using trapezoidal formula

V_2= h /3 [A_1+ A_2 + $\sqrt{A_1 x A_2}$]

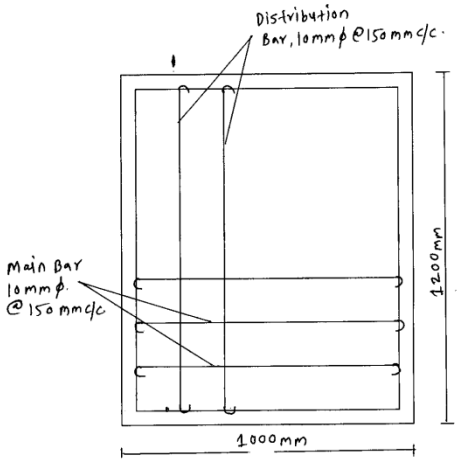
= 0.20/3[1.20 + 0.132+ $\sqrt{1.20 \times 0.132}$]

= 0.115 cu.m

Volume of one footing = V_1+ V_2
=0.18 + 0.115 = 0.295 cu.m

Total volume of concrete for 7 footings: 7 x 0.295 = 2.065 cu.m

2) Calculation of reinforcement quantity



Assume clear cover (all round) = 50 mm

1) Length of main bar

L_x = (l_x – 2 x clear cover) + 2x9ϕ
= (1000 – 2 x 50) + 2 x 9 x 10 = 1080 mm
L_x = 1.080 m

No of main bars = $\frac{\text{Ly – 2x Clear cover}}{\text{Spacing of main bar}}$ +1

= $\frac{1200-2 \times 50}{150}$ + 1 = 9 nos

1 M

1) Length of distribution bar

L_y = (l_y – 2 x clear cover) + 2x9ϕ

= (1200 – 2 x 50) + 2 x 9 x 10 = 1280 mm

L_y = 1.280 m

No of distribution bars = $\frac{\text{Lx – 2x Clear cover}}{\text{Spacing of distribution bar}}$ +1

= $\frac{1000-2 \times 50}{150}$ +1 = 7 nos

1 M

Sr No.	Description	Shape of bar	Dia. (ϕ)	No.	L	Total Length	Wt Kg/m	Total Wt (kg)
1	Main bar (L_x)		10	9	1.080	9.72	0.617	6.00
2	Distribution bar (L_y)		10	7	1.280	8.96	0.617	5.53
							Wt. of reinforcement for one footing=	11.53
							Wt. of reinforcement for 7 footing=	**80.70 kg**

2 M

Note:-Student may calculate the qty of reinforcement by assuming different clear cover (25 to 50 mm) hence examiner should give proportionate marks.

Q.6 Attempt any FOUR of the following: **16 M**

(a) Prepare rate analysis for mosaic tile flooring 20 mm thick **4 M**

Assume Area of mosaic flooring = 100 sqm

Assume size of mosaic tile = 20 x 20 cm

Assume thickness of lime mortar bed = 20 mm & proportion as lime mortar 1:2:4

No of mosaic tile = 100/(0.20x0.20)= 2500 No

Wet volume of mortar = 100 x (20/1000) = 2.00 cu.m

Dry volume of mortar = 25 % more of total wet volume

= (25/100) x 2.00 = 2.50 cu.m

Volume of Cement = {2.50/(1+2+4)} x 1 = 0.357 cu.m

Number of bags of Cement = (0.357/0.035) =10.20 say 11 bags

Taking extra cement for neat cement slurry & joints etc. during laying of tiles = 6 bags

Total cement quantity = 11=6 = 17 bags

Volume of Lime = {2.50/(1+2+4)} x 2 = 0.714 cu.m

Volume of Sand = {2.50/(1+2+4)} x 4 = 1.428 cu.m

1M

Sr. No	Particular	Quantity	Rate	Per	Amount	
A	**Material**					**1M**
1	Cement	17	300	Bag	5100	
2	Lime	0.714	4100	Cum	2927.40	
3	Sand	1.428	1950	Cum	2784	
4	Mosaic tiles	2500	30	No.	75000	
5	Polishing stone	L.S.	L.S.	L.S.	500	
6	Oxalic acid powder	L.S.	L.S.	L.S.	200	
				Total (A)	**86511.40**	
B	**Labour**					
1	Head Mason	1	600	Day	600	
2	Mason	20	500	Day	10000	**1M**
3	Male Mazdoor	12	350	Day	4200	
4	Feamale Mazdoor	8	250	Day	2000	
5	Bhisti	2	350	Day	700	
6	Polisher	20	500	Day	10000	
7	Sundries T.&P.	------	L.S.	L.S.	200	
				Total (B)	**27700**	
	Total Cost of Material & Labour (C) = Total (A+B)				**114211.40**	
	Add Water Charges @ 1.5% of Total Cost of Material & Labour =				1713.17	
	Overall Cost= Total Cost + Water Charges =				**115924.57**	
	Add Contractors Profit @ 10% of Overall Cost (E) =				11592.45	**1M**
	Grand Total= Overall Cost + Contractors Profit =				**127517.02**	
	Rate per sqm = Grant total / Assumed Volume of U.C.R. Masonry =				**1275.00 per sqm**	

(Note: -Thickness of mortar bed, type & proportion of mortar is not mentioned hence if student have assumed thickness of mortar bed, type of mortar as cement mortar & proportion or attempted this question full marks should be given by the examiner.)

(b) Explain the factors to be considered in preparation of detailed estimate **4 M**

1) Quantity & availibilty of materials: - The required quantity of material should be available in the nearby area of work. The material shall be purchased either in bulk or small quantity depending upon the volume of work.

2) Labour component: - Daily wages of local labours (skilled, semi-skilled & unskilled) should be considered before preparation of detailed estimate.
3) Specification: - The specification of items should be studied before preparation of detailed estimate.
4) Location of site: - The estimator should visit the site of work before preparation of detailed estimate. If the site is not approachable then the amount required for cutting of jungles, construction of temporary roads, arrangement of electricity should be included in the detailed estimate.
5) Transportation of materials: - If material required for the project is not available locally, then loading, transportation, unloading charges should be considered before preparation of detailed estimate.

1M each (for any four)

(c) What are the different methods used for calculation of earthwork quantities for road & canal? Explain any one **4 M**

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

1 M

Mid sectional area method:- In this method first the area of the mid section is calculated by taking into account the different heights at the two end portions & then it is multiplied by the length of the section to get volume of earthwork.

Let B = formation width

d_1& d_2 = depth at different chainages (embankment/cutting)

s:1 = side slope

Mean depth (d_m) = ½(d_1+d_2)

Area of Mid section = B x d_m + s x d_m^2

L= chainage interval

Quantity of earthwork = (B x d_m + s x d_m^2) x L

2 M

Chainage (m)	Depth (d)	Mean depth (d_m)	Area of Rectangular portion (B x d_m)	Area of Triangular portion (s x d_m^2)	Total Area (B x d_m + s x d_m^2)	Length (L)	Quantity (Q)	
							Embankment (+ve)	Cutting (-ve)

1 M

(Note:- examiner should give proportionate marks if student explains any one of the remaining method)

(d) What is task work? State any three factors affecting task work	**4 M**
Task work:-The capacity of doing work by a skilled labour in the form of work per day is known as task work **Factors Affecting Task Work:-** 1) Output of skilled labour depends on the nature, size, height, location, climatic condition, technique adopted etc. of the work. 2) Efficient site organization & management increases the labour output. 3) Higher wages, incentives, less working hours & other amenities such as labour camp, drinking water, toilets, improves the labour output.	**1 M** **1M each**
(e) Explain procedure for preparation of detailed estimate for a small R.C.C. slab culvert	**4 M**
Following procedure is adopted for preparation of detailed estimate for a small slab culvert:- 1) Study the detailed drawing carefully. decide & list the items of slab culvert such as:- a) Earth work in excavation for foundation trenches b) P.C.C. bed below the foundation c) Masonry work d) R.C.C. for slab e) Filling material upto formation lavel f) Parapet wall, railing, guard stones g) Pointing for external faces of wall h) Coping above face wall 2) Work out the dimensions of the above items & enter in the measurement sheet 3) Calculate the quantities for the item of work in measurement sheet 4) Find out the rate per item of work by either rate analysis or by referring D.S.R.& enter in abstract sheet 5) Add 3 to 5% contingencies & 2 to 2.5 % work charged establishment to calculate total estimated cost.	**2M** **1/2 M** **1/2 M** **1/2 M** **1/2 M**
(f) Describe the procedure for preparing rate analysis	**4 M**
Following procedure is to be adopted for preparation of rate analysis of any item of work:- 1) Assume quantity of given item as per its mode of measurement 2) Calculate the quantity of various materials required for the item 3) Calculate the quantity of various types of labours with reference to their task work for completing the item 4) Take lump-sum charges for tools & plants, sundries if any required	

5) Calculate Total cost of material & labour = cost of material + cost of labour + charges of tools-plants etc. if any 6) Calculate water charges as 1.5% on Total cost of materials & labours 7) Calculate Overall cost = Total cost of material & labour + water charges 8) Calculate contractors profit as 10% on Overall cost 9) Calculate Total cost of the item = overall cost + contractors profit 10) Work out Rate per unit of item = Total cost of the item / assumed quantity of item	**4 M**