

ESTIMATION & COSTING

Dec 2011

Paper Code: CE-405-E

Figures in the bracket indicate full marks.

Note: Attempt any five questions. All questions carry equal marks.

Q.1.(a) What is the principle of estimation? Classify the various kinds of estimates with examples. (10)

Ans. An estimate is the anticipated or probable cost of a work and is usually prepared before the construction is taken up. Before undertaking any work or project it is necessary to know its probable cost which is obtained or derived by estimating. The estimate is prepared by computing or calculating the quantities required and then calculating the cost at suitable rates, to get the expenditure likely to be incurred in the construction of the work or structure.

If the estimate is prepared carefully and correctly there will not be much difference in between the estimated cost and the actual cost. For accurate estimating the estimator should be experienced and fully acquainted with the methods of construction.

Different types of estimates are as follows :

(i) *A detailed estimate* : This includes the detailed particulars for the quantities, rates and costs of all the items involved for satisfactory completion of a project.

(ii) *A preliminary or approximate or rough estimate* : This is an approximate estimate to find out an approximate cost in a short time and thus enables the authority concerned to consider the financial aspect of the scheme, for acceding sanction to the same. Such an estimate is framed after knowing the rate of similar works and from practical knowledge in various ways for various types of works such as : Plinth area or square-metre method, cubic rate or cubic metre method, service unit or unit rate method, bay method, approximate quantities with bill method, cost comparison method and cost from materials and labour.

Example : In irrigation projects.

(iii) *A quantity estimate or quantity survey* : This is a complete estimate or list of quantities for all items of work required to complete the concerned project. The quantity of each individual item of work is worked out from respective dimensions on the drawing of the structure. To find the cost of an item its quantity is multiplied by the rate per unit for that item. The purpose of the bill of quantities is to provide a complete list of quantities necessary for the completion of any engineering project and when priced gives the estimated cost of the project.

(iv) *Revised estimate* : A revised estimate is a detailed estimate for the revised quantities and rates of items of works originally provided in the estimate without material deviations of a structural nature from the design originally approved for a project. It is accompanied with a comparative statement abstract from showing the probable variations for quantity, rate and amount

for each item of work of the project as compared with the original estimate side by side stating the reasons of variations. A revised estimate is prepared and submitted for fresh technical sanction.

(v) *A supplementary estimate* : While a work is in progress some changes or additional works due to material deviation of a structural nature from the design originally approved may be thought necessary for the development of a project. An estimate is then prepared to include all such works. This is known as a supplementary estimate.

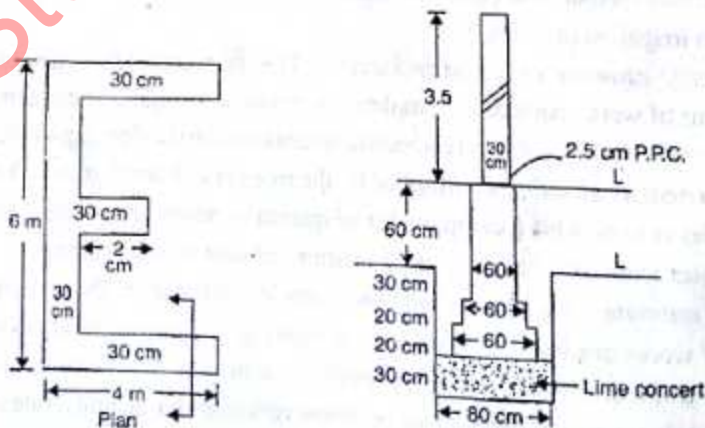
(vi) *Combination of revised and supplementary estimate* : During execution of a project it may be necessary to revise the original estimate due to increased volume of original proposed work and at the same time sanction of supplementary works. For such a case a revised estimate is prepared for the increased volume of original work and a detailed estimate for the supplementary works not included in the original schedule. The amount of supplementary estimate is added to the revised estimate, showing the amount separately. Thus the total amount of the revised estimate includes the amount for supplementary works also.

(vii) *Annual repair or maintenance estimate (A.R. or A.M. Estimate)* : Annual Repair or Annual Maintenance Estimate is a detailed estimate and is prepared to maintain the structure or work in proper order and safe condition. For building, this includes white washing, colour washing, painting, minor repairs etc. For road works the A.R. estimate provides for patch repairing, renewals, repairs of bridges and culverts, etc.

Q.1.(b) Prepare a detailed estimate of the building from the given plan and section and general specifications given as :

- (i) Foundation concrete shall be of lime concrete.
- (ii) Foundation and plinth shall be of 1st class brickwork in lime mortar.
- (iii) Damp proof course - 2.5 mm c/c 1 : 1.5 : 3.
- (iv) Superstructure - 1st class B.W in lime mortar.
- (v) Wall finishing - In side wall 12 mm cement plastered 1 : 6 and white washed 3 coats.

(10)



Ans. Detailed estimate of the building is as follows :

S. N.	Particulars of items	No	Length	Breadth	Height	Quantity	Explanatory note
1.	Earthwork in excavation in foundation –						
	Long walls ...	2	6.20 m	0.90 m	0.90 m	10.04	Length = $5.30 + 0.90 = 6.2$ m
	Short walls ...	2	3.40 m	0.90 m	0.90 m	5.51	Breadth = $4.30 - 0.90 = 3.40$ m
					Total	15.55	
						cu m	
2.	Concrete in foundation –						
	Long walls ...	2	6.20 m	0.90 m	0.30 m	3.35	Length same as for excavation
	Short walls ...	2	3.40 m	0.90 m	0.30 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	0.60 m	0.30 m	2.13	Length = $5.30 + 0.60 = 5.90$ m
	2nd footing ...	2	5.80 m	0.50 m	0.30 m	1.74	Length = $5.30 + 0.50 = 5.80$ m
	Plinth walls ...	2	5.70 m	0.40 m	0.60 m	2.74	Length = $5.30 + 0.40 = 5.70$ m
	Short walls :						
	1st footing ...	2	3.70 m	0.60 m	0.30 m	1.33	Length = $4.30 - 0.60 = 3.70$ m
	2nd footing ...	2	3.80 m	0.50 m	0.30 m	1.14	Length = $4.30 - 0.50 = 3.80$ m
	Plinth walls ...	2	3.90 m	0.40 m	0.60 m	1.87	Length = $4.30 - 0.40 = 3.90$ m
					Total	10.95	
						cu m	
4.	Brickwork in superstructure						
	Long walls ...	2	5.60 m	0.30 m	3.50 m	11.76	Length = $5.30 + 0.30 = 5.60$ m
	Short walls ...	2	4.00 m	0.30 m	3.50 m	8.40	Length = $4.30 - 0.30 = 4.00$ m
					Total	20.16	
						cu m	

Q.2. (a) What are the various methods of estimation? Compare them with respect to their utility. (10)

Ans. Various methods of estimation with their utility are as follows :

(i) *Plinth area or square-metre method* : To prepare an estimate by this method the plinth area of a buildings shall be determined first. But plinth area may also have to be worked out from floor area or carpet area or covered area or rentable area of a building. Similarly the circulation area should be known in order to calculate the plinth area of a building.

(ii) *Cubic rate or cubic metre method* : The method of estimating building cost by cubic metre volume is more accurate in general, than the method of estimating cost by plinth area, because the cost of a building depends not only on its plinth area but also on the volume of the building. By this method the volume or cubic content of the proposed building is worked out and multiplied by the rate per cubic volume of similar buildings in that locality constructed recently.

(iii) *Approximate quantities with bill method* : Multiply the total length of the walls of a building in running metre by the cost of construction per metre length of such a wall. The total length of the walls of a building is worked out from the plan. Different sections of walls in a building are considered separately. A section of a wall includes all items of works from foundation concrete to roofing. Thus the cost of excavation, foundation concrete, brickwork, D.P.C. proportionate cost of flooring and woodwork, R.C. roof, lime concrete on roof, parapet, plastering and finishing on walls, etc., per metre length are accounted. The cost of a wall below and above the plinth level should be kept separate. This facilitates the spreading of the proportionate cost of works on the superstructure walls.

In order to spread the proportionate cost for items of works as stated above on running metre length of the wall their approximate quantities and cost are calculated.

Thus, it is better to find out the estimated cost separately: (a) cost of wall including foundation and surface finishing, (b) cost for woodwork, (c) cost for flooring and (d) cost of roofing.

(iv) *Service unit or unit rate method* : In this method all costs of a unit quantity such as per km for a highway per metre of span for a bridge, per classroom for school building, per bed for hospital, per litre for water tank, etc. are considered first and the estimate is prepared by multiplying the cost per corresponding unit by the number of units in the structure.

(v) *Bay-method* : In this method, the approximate estimated cost = number of bays in the proposed structure \times Cost of one such bay. Bays are compartments or similar portions of a structure. When the area of a structure consists of similar cabins or parts such as a go-down, a railway platform, factory shades, etc., which have been built up with intermediate columns or with roof trusses on walls placed at equal distances with the same roofing on top of those supporting members, then the area may be divided from centre to centre of the supports. Each such division may be treated as a Bay.

This is the most reliable approximate estimate that can be made. But the following points should be considered.

- End bay should be considered separately due to its end wall (Gable Wall).
- Current rate per bay should be worked out from the previous recorded rate.
- The location, specifications and drawings should be the same.

(vi) Cost comparison method : By this method approximate estimates are prepared for prototype structures or units consisting several works after comparing with the past records of expenses for such works. For example when prototype staff quarters or railway stations etc., are required to be estimated approximately then the estimate for such prototype works are prepared by comparing the previous cost with the present market rates, normally by increasing the past cost on a percentage basis.

Such an estimate can be prepared quickly even during meetings. But expert knowledge is necessary to estimate the present cost of construction as compared to the previous recorded cost.

(vii) Cost from materials and labour : In this method approximate quantities of materials and labour required per sq m of the plinth area for a proposed building are worked out arbitrarily or with the help of the Empirical equations developed by Central Building Research Institute (C.B.R.I), Roorkee and multiplied by the total plinth area of the building.

Q.2.(b) What do you understand by items of works. Explain the units required to measure them. (any five). (10)

Ans. Main items of work are as follows :

(i) Earthwork : Earthwork in excavation and earthwork in filling are usually taken out separately under different items, and quantities are calculated in cu m. Foundation trenches are usually dug to the exact width of foundation with vertical sides. Earthwork in excavation in foundation is calculated by taking the dimensions of each trench length \times breadth \times depth. Filling in trenches after the construction of foundation masonry is ordinarily neglected. If the trench filling is accounted, this may be calculated by deducting the masonry from the excavation.

Earthwork in plinth filling is calculated by taking the internal dimensions in between plinth wall (length \times Breadth) which are usually less than the internal dimensions of the room by

two off sets of plinth wall i.e., $10 \text{ cm} \left(4 \frac{1}{2}'' \right)$ and height is taken after deducting the thickness of concrete in floor, usually $7.5 \text{ cm} (3'')$. If sand filling is done in plinth, this should be taken separately. The length and breadth for each filling may be same as the internal dimensions of the room if there is no off-set in plinth wall.

(ii) Concrete in foundation : The concrete is taken out in cu m by length \times breadth \times thickness. The length and breadth of foundation concrete are usually the same as for excavation, only the depth or thickness differs. The thickness of concrete varies from 20 cm to 45 cm, usually

30 cm (9" to 18", usually 12"). Foundation concrete consists of lime concrete or weak cement concrete. The proportion of cement concrete in foundation may be 1 : 4 : 8 or 1 : 5 : 10.

(iii) *Soling* : When the soil is soft or bad, one layer of dry brick or stone soling is applied below the foundation concrete. The soling layer is computed in sq m (Length \times Breadth) specifying the thickness.

(iv) *Damp proof course* : D.P.C. usually of 2.5 cm (1") thick rich cement concrete 1 : $1\frac{1}{2}$: 3 or 2 cm, $\frac{3}{4}$ " thick rich cement mortar 1 : 2 mixed with standard waterproofing material, is provided at the plinth level to full width of plinth wall, and the quantities are computed in sq m. (Length \times Breadth). Usually D.P.C. is not provided at the sills of doors and verandah openings, for which deductions are made.

(v) *Masonry* : Masonry is computed in cu m (Length \times Breadth \times Height). Foundation and plinth masonry is taken under one item, and masonry in superstructure is taken under a separate item. In storeyed building the masonry in each storey as ground floor above plinth level, first floor, etc. is computed separately. In taking out quantities the walls are measured as solid and then deductions are made for openings as doors, windows, etc. and such other portions as necessary. Masonry of different types or classes, masonry with different mortar, etc. are taken out under separate items. Arch masonry work is taken out separately. Splayed or rounded sides of wall are considered as rectangular and extreme dimensions are taken to find out the quantities. Thin partition wall is measured in sq m. Honey comb brick wall is taken under a separate item in sq m, no deduction is made for holes. Stone masonry is calculated in the same manner as for brick masonry.

Q.3.(a) What is the necessity of specification? What is the difference between general specifications and detailed specifications ? (10)

Ans. The necessities of specifications are the following :

(i) The cost of an unit quantity of work is governed by its specification.
 (ii) Specification of a work are required to describe the quality and quantity of different materials required for a construction work and is one of the essential contract documents. Thus a contractor can make a programme to procure the materials required for a project and the owner can check the quality of materials conforming to the specification avoiding dispute with contractor.

(iii) This also specifies the workmanship and the method of doing the work. Thus specification of a work serves as a guide to the supervising staff of the contractor as well as to the owner to execute the work to their satisfaction.

(iv) A work is carried out according to its specification and the contractor is paid for the same. Any change in specification changes the tendered rate.

(v) As the rate of a work is based on specification a contractor can calculate the rates of various items of works in a tender with his procurement rates of materials and labour. Thus tender paper without specifications of works is baseless, incomplete and invalid.

(vi) Specification is necessary to specify the equipments, tools and plants to be engaged for a work and thus enables to procure them beforehand.

(vii) The necessity of specification is to verify and check the strength of materials for a work involved in a project.

(viii) Specification is an essential contract document and is required for arbitration or court cases.

Difference between **general specifications** and **detailed specifications** are as follows :

General specifications : In general specifications, nature and class of works names of material and proportion that should be used in the various items of works are described. Only a brief description of each and every item is given. It is useful for estimating the project. Without going through the lengthy detailed specifications, general information for the quantities of materials, nature and class of work can be known from the general specifications, but they do not form part of contract document.

Detailed specifications : The detailed specifications form a part of the contract document. Detailed specification for a particular item specify the qualities, quantities and proportions of materials, and the method of preparation and execution for that particular item of work in a project. The detailed specifications of the different items of works are prepared separately and they describe what the works should be and how they shall be executed and constructed. Physical, chemical and electrical tests if any requires for the finished work to ensure the desired strength or quality are specified in the detailed specification. The type of machinery, equipments and special tools and plant their methods of operation when involved during execution are described in the detailed specification. The method and duration of protection of finished works as required are specified in the detailed specification. Also specify the involvements and responsibility for auxillary works, incidental damages etc. during execution of the original work. While writing the detailed specifications the same order of sequence, as the work is to be carried out, is maintained.

Q.3.(b) Give the specifications for :

(i) R.C.C.

(ii) Earth work

(iii) Painting

(iv) Flooring.

(10)

Ans. (i) R.C.C. : Steel bars shall be of M.S. or deformed steel of standard specifications and shall be free from corrosion, loose rust scales, oil, grease, paint etc. cement concrete shall be of 1 : 2 : 4 proportion by volume for slabs, beams and lintels and $1 : 1\frac{1}{2} : 3$ proportion for columns.

(ii) Earth work : Foundation trenches shall be dug out to the exact width of foundation concrete and the sides shall be vertical. Excavated earth shall not be placed within 1m (3') of the edge of the trench.

The bottom of foundation trenches shall be perfectly levelled both longitudinally and transversely.

(iii) **Painting** : The brand of the paint shall be specified and ready made paint of the required colour should be used. If thinning is required, pure turpentine may be added to the required extent. The surface shall be made perfectly smooth by rubbing with sand paper of different grades, first with coarse one and successively with fine sand papers.

(iv) **Flooring** : The cement concrete shall be of proportion 1 : 2 : 4 or $1:1\frac{1}{2}:3\frac{1}{2}$ as specified. Cement shall be fresh portland cement of standard specifications. The floor shall be levelled and divided into panels of size not exceeding 1 m in its smaller dimensions and 2 m in large dimensions.

Q.4. What are the specifications of buildings? Give the specifications for 1st class, 2nd class and 3rd class building. (20)

Ans. Specification specifies or describes the nature and the class of the work, materials to be used in the work, workmanship, etc., and is very important for the execution of the work. The cost of a work depends much on the specifications. Specifications should be clear, and there should not be any ambiguity anywhere. From the study of the specifications one can easily understand the nature of the work and what the work shall be. The drawings of a building or structure show the arrangement of the rooms and various parts, and the dimensions : length, breadth and height, with very brief descriptions of different parts. Drawings do not furnish the details of different items of work, the quantity of materials, proportion of mortar and workmanship which are described in specifications. Thus the combinations of drawings and specifications define completely the structure. Drawings and specifications form important parts of contract documents.

Specification of a first class building are as follows :

(i) **Foundation and plinth** : Brickwork in foundation and plinth shall be of first class brick in cement or lime mortar over cement or lime concrete.

(ii) **Filling** : Foundation trenches and plinth shall be filled up with local sand.

(iii) **Damp-proof course** : D.P.C. shall be 2.5 cm thick cement concrete or 2 cm thick cement mortar with 5% pudlo by weight of cement or other standard water-proofing material.

(iv) **Superstructure** : Superstructure shall be of first class brickwork in cement mortar.

(v) **Roofing** : The roof shall be 10 cm thick R.C.C. slab with 10 cm average thick lime terracing over it.

(vi) **Flooring** : Mosaic flooring shall be provided in all floors including staircase.

(vii) **Finishing** : Inside and outside shall be 12 mm thick cement plastered. The inside of drawing, dining and bed room shall be distempered and remaining portions white-washed three coats. The outside shall be two coats decorative waterproof cement coating. Wall surface of lavatory shall be covered with glazed tiles up to the top level of door.

(viii) *Doors and windows* : Doors and windows frames shall be of seasoned teak wood and shutters of 3 cm thick teak wood panelling. Brass fittings shall be provided. Doors and windows shall be varnished with French polish.

(ix) *Miscellaneous* : Rain water pipes shall be of Asbestos cement or cast-iron, finished with paint. All sanitary, water-supply and electrical fittings shall be of first class materials.

Specifications of a second class building are as follows :

(i) *Foundation and plinth* : Brickwork in foundation and plinth shall be of first class brick in cement or lime mortar over cement or lime concrete.

(ii) *Filling* : Foundation trenches and plinth shall be filled up with earth.

(iii) *Damp-proof course* : D.P.C. shall be 2 cm thick cement mortar with 5% pudlo by weight of cement or other standard water proofing materials.

(iv) *Superstructure* : Superstructure shall be 2nd class brickwork in a mud mortar.

(v) *Roofing* : The roof shall be flat terraced roof or R.B. roof.

(vi) *Flooring* : The flooring shall be 2.5 cm cement concrete over 7.5 cm lime concrete.

(vii) *Finishing* : The inside walls shall be plastered with lime or cement mortar, outside walls shall be pointed or plastered with lime or cement mortar. Inside shall be white washed three coats, and outside colour-washed two coats over one coat white-wash.

(viii) *Doors and windows* : Doors and windows frames shall be of seasoned teak wood and shutters of 4.5 cm shisham or deodar wood, panelled. They shall be fitted with iron fittings. Doors and windows shall be painted with two coats.

(ix) *Miscellaneous* : Rain water pipes shall be cast-iron. Electrification, sanitary and water supply fittings shall be of class B-type.

Specifications of a third class building are as follows :

(i) *Foundation and plinth* : Foundation and plinth shall be of 2nd class brick work in lime mortar over lime concrete. Damp proof course shall be 2 cm thick cement mortar 1 : 2 mixed with standard water proofing compound.

(ii) *Superstructure* : Superstructure shall be of second class brick work in mud mortar. Door and window opening shall be provided with arches of 2nd class brickwork in lime mortar or with wooden planks.

(iii) *Roofing* : Roof shall be of mud over tiles or bricks or planks over wooden beams or of tile or G.I. sheet or A.C. sheet sloping roof.

(iv) *Flooring* : Floor shall be of brick-on-edge floor over well rammed earth.

(v) *Finishing* : Inside and outside walls shall be plastered with lime mortar and white washed three coats.

(vi) *Doors and windows* : Chaukhat shall be of salwood, and shutters of chir mango or other country wood. Doors and windows shall be painted two coats with ordinary paint over one coat of priming.

Q.5.(a) Give the purpose and importance of rate analysis. What is the contribution of estimation in rate analysis? (10)

Ans. Main purposes of rate analysis are the following :

- (i) To determine the current rate per unit of an item at the locality,
- (ii) To examine the viability of rates offered by contractors,
- (iii) To calculate the quantity of materials and labour strength required for project planning and
- (iv) To fix up labour contract rates.

Importance of rate analysis is the basis of arriving at a correct and reasonable rate per unit work of supply, for a particular item following its specification and detailed survey of materials, labour, equipments etc. as required for the unit work and their prevailing rates.

Contribution of estimation in rate analysis is as follows : The following five sub-heads are estimated and a summation of these is the rate per unit of an item.

(i) **Quantity of materials and cost** : The estimator takes off the quantities of various materials required per unit quantity of an item following the detailed specification and calculates costs from local market rates.

Quantities of materials are those required per unit rate of work delivered at work site and its cost include first cost, freight, transportation, sales tax and insurance charges as arises in question. In case when materials like cement, steel, stone chips and bitumen are supplied departmentally then profit on the cost materials is not allowed, but cost of carriage from godown to work site shall be added.

(ii) **Labour cost** : To obtain labour costs, the number and wages of the different categories of labourers, skilled, and unskilled, namely mason or carpenter, mazdoor, boy etc. required for each unit of work should be known and this number is to be multiplied by the respective wage per day (or per hour).

(iii) **Cost of equipments, tools and plant (T & P)** : Wherever possible the cost of equipments and ordinary T. & P. those are required for general use should be allocated to specific item of rate. For example, the cost of operating a concrete mixer should be spread over those items of rates for which it is used. For certain tools and plants it is difficult to allocate their use to an individual item of rates and it is, therefore, suggested to add costs in such cases of expenditure to over-head i.e. establishment charges.

Special tools and plants : For big work or project it becomes necessary to use special type of tools and plants, viz, special type of concrete mixing machines named as batching plants, special type of mixed concrete transport vehicles named as "tripping wagon or dumper". Cranes etc. are in use. In order to purchase such type of special equipments an amount of 1% to 1½ % of the estimated cost is provided in the estimate.

(iv) **Overhead or establishment charges** : This includes such items as office rent and depreciation of its equipments, salaries of office staff, postage, lighting, travelling, telephone

account, plan and specification etc. Small tools, planks, ladders, ropes and such hand-tools as the contractor provides for his workman should also be included in the overhead charge as suggested in (iii). This is usually $2\frac{1}{2}\%$ of the net cost of a unit of rate and may rise up to 5%.

Q.5. (b) Calculate the rate for a 20 m length, 5m height and 30 m nominal thickness (1.5 brick thick) wall. (10)

Ans. Normally mortar joint will be less than 1 cm, taking 1 cm mortar joint, the actual thickness of wall be 29 cm.

$$\therefore \text{Actual volume} = 20 \times 0.29 \times 5 = 29 \text{ m}^3$$

No. of standard bricks of 20 cm \times 10 cm \times nominal size

$$= \frac{29}{0.20 \times 0.10 \times 0.10} = 14500 \text{ Nos.}$$

$$\therefore \text{No. of bricks per cu-m (nominal)} = \frac{14500}{30} = 484 \text{ Nos.}$$

– Considering 5% breakages, wastages etc. = 500 Nos. per cu.m.

– For 10 cu.m of between 5000 bricks are required.

Q.6. Write the procedure of rate analysis for :

- Earthwork
- Concrete works
- Finishing (white washing, distempering)
- Reinforced brick work.

(20)

Ans. (a) Earthwork : Procedure of rate analysis for earthwork is as follows :

(i) Excavation in foundations, trenches, etc. in ordinary soil including disposal up to 30 m (100') and lift of 1.5 m (5 ft) – 5 Beldars and 4 Mazdoors can do 28.30 cu m (1000 cu ft) per day.

(ii) Refilling excavated earth in foundations, plinth, etc., including consolidation in 15 cm (6") layers – 3 Beldars, 2 Mazdoors and $\frac{1}{2}$ Bhishti can do 28.30 cu m (1000 cu ft) per day.

(iii) Disposal of surplus earth within a lead of 30 m (100') – 1 Mazdoor can do 2.83 cu m (100 cu ft) per day.

(iv) Calculate materials required like labour etc.

(v) Labour i/c mistri, mazdoor, boy or woman coolie, sundries (T & P) etc.

(vi) Add 10% contractor's profit.

(vii) Then calculate the rate per cubic metre.

Ans. (b) Concrete works : Procedure of rate analysis for concrete works is as follows :

(i) Calculate materials required [i/c stone ballast, sand (coarse), cement, etc.]

(ii) Calculate labour required [head mason, mason, beldar, boy or woman collie, bhisti (i/c curing), forms, sundries (T & P) etc.].

- (iii) Add $1\frac{1}{2}\%$ water charges.
- (iv) Add 10% contractor's profit.
- (v) Then calculate the rate per cubic metre.

Ans. (c) Finishing (white washing, distempering) : Procedure of rate analysis for finishing is as follows :

- (i) Plastering with any mortar 12 mm ($\frac{1}{2}$ " thick) – 3 Masons, 3 Mazdoors and 1 Bhisti can plaster 40 sq m (400 sq ft) per day.
- (ii) White washing or colour washing (3 coats) – 1 White washer and 1 Mazdoor can do 60 sq m (600 sq ft) per day.
- (iii) Painting two coats such as chocolate; red, grey, etc., on wood or steel – 3 Painters and 2 Mazdoors can paint 10 sq m (100 sq ft) per day.
- (iv) Calculate the materials required [white lime slaked, glue powder, blue (pigment colour), colouring matter (pigment)].
- (v) Calculate the labour required (white washer, boy coolie, sundries (T & P)).
- (vi) Then calculate the rate per sq. m.

Ans. (d) Reinforced brick work : Procedure of rate analysis for reinforced brick work is as follows :

- (i) Calculate materials required [Brick I-class, cement, sand (coarse), mild steel rods].
- (ii) Calculate labour required [Head mason, mason, mazdoor/beldar, boy or woman coolie, bhisti (i/c curing), sundries (T & P)].
- (iii) Calculate bending and cranking steel bars :
 - Blacksmith (IInd class), Mazdoor (Beldar) (T & P)
- (iv) Centering and shuttering (both erection and dismantling) :
 - Timber planks and ballies
 - Carpenter (IInd class)
 - Mazdoor (Beldar)
 - Nails
 - T & P
- (v) Then add $1\frac{1}{2}\%$ water charges and 10 % contractor's profit.
- (vi) Then calculate rate per m³.

Q.7.(a) What do you understand by tender? What are the various features essential for a tender?

(10)

Ans. Tender : Tender is an offer in writing to execute some specified work or to supply some specified articles at certain rates, within a fixed time under certain conditions of contract and agreement, between the contractor and the department or owner or party. The

construction of work is usually done by contract. Sealed tenders are invited and the work is usually entrusted to the lowest tender. While inviting tenders the bill of quantities, detailed specifications, conditions of contract and plans and drawings are supplied on payment of the requisite cost to the contractors who tender or quote their rates.

Various features essential for a tender are as follows :

(i) *Earnest money* : Earnest money noted above should be deposited by a tenderer in any of the following forms, cheques or tokens or any forms of earnest money than those specified below, will not be accepted as valid.

(ii) *Tender without earnest money* : Tenders unaccompanied by full earnest money in requisite form will under no circumstances, be entertained and will summarily be rejected without further reference to the tenderers. No reference to previous deposit of earnest money and security for adjustment against the present tender will be accepted nor any request for recovery from any outstanding bills for earnest money against the present tender will be entertained.

(iii) *Deposit of additional earnest money for successful tenderer* : In respect of the successful tenderers who have deposited earnest money as noted in para 1 above the earnest money, on acceptance of the tender will be converted as a part of the security money and additional amount as security shall be deducted from the progressive bills as will amount (i) in the case of works costing up to Rs. 1,00,000 at 10% of the estimated cost of the work put to tender, (ii) in the case of works costing more than Rs. 1,00,000/- and upto Rs. 2,00,000/-, at 10% on the first Rs. 1,00,000/- and at 7 1/2% on the balance, (iii) in the case of works more than Rs. 2,00,000/- 10% on the first Rs. 1,00,000/- 7 1/2% on the next Rs. 1,00,000/- and at 5% on the balance, subject to a maximum of Rs. 1,00,000/- only.

(iv) *Refund of earnest money to unsuccessful tenderers* : The earnest money of all the tenderers other than the three lowest tenderers shall be returned on application and after the comparative statement is prepared and checked. Earnest money of 2nd 3rd lowest tenderers could be returned after receipt of final decision of the accepting authority concerned towards acceptance or otherwise.

(v) *Notice in the newspaper* : The notice appearing in the newspaper will also be treated as part and parcel of the tender in prescribed form.

(vi) *Submission of contract documents* : The contractor whose tender is accepted shall within seven days of issue of letter of acceptance by the accepting authority obtain contract documents in duplicate on payment of usual charges from the executive engineer..... and enter into an agreement producing the registered documents of the company or the firm. On failure to do so within the specified time, acceptance of the tender will be considered as automatically cancelled and deposited earnest money forfeited.

(vii) *Period of validity of rates quoted by the tenderer* : A tenderer shall be eligible to withdraw his tender only if he fails to receive acceptance and work order within 90 days from

from the date of opening of tender. If a tenderer withdraws his tender within this period of 90 days without giving justifiable reasons for such withdrawals to the satisfaction of the authority accepting the tender, his security money as in clause 7 shall be forfeited.

(viii) **Canvassing** : Canvassing in connection with tender is strictly prohibited and the tender submitted by the contractor who resorts to canvassing will be liable to summary rejection.

Q.7.(b) What is the purpose of maintaining muster roll ? How is pay bill prepared using muster roll? (10)

Ans. Purpose of maintaining muster roll : The muster roll being the initial record of employment and payment, is dealt with and preserved carefully at all levels. On receipt of a requisition from the sub-divisional officer, the divisional officer after considering the necessity and urgency of the work strength of labour required issues a blank form duly registered and numbered in his office indicating the period, the maximum number of labourers to be employed and their corresponding daily wages on it. The receipt book of M.R. is watched through the register of Muster Roll.

The categories of skilled and unskilled workers employed on works are daily rated Muster Roll labour whose daily attendance and outturn are recorded for the purpose of payment. The work is executed under direct supervision of the Sectional Officer or sub-Divisional Officer concerned and may be inspected by higher Officers viz, Executive Engineer and Superintending Engineer, depending on its importance.

Rules for preparation of pay bill using muster roll :

(i) One or more muster rolls may be kept for each work, but M.R. should not be prepared in duplicate. It is permissible to keep one M.R. for labourers employed on several small work in near about places.

(ii) Labourers may be paid more than once in a month, but separate M.R. must be prepared for each period of payment.

(iii) The daily attendance and absence of labourers and fines, if any, imposed on them should be recorded in ink daily in the M.R. so that the calculations may be done correctly and it may not be possible to temper with the attendance and entries and classification of cost on works and sub-heads of works may be kept separately.

(iv) After a M.R. has been passed, payment should be made as quickly as possible, and each payment is initialled and dated by the paying officer. If any item remains unpaid the details of such items should be recorded in the register of unpaid wages.

(v) The amount of unpaid wages is deposited in the cash and the amount is kept as deposit. The amount may be paid later on Hand Receipt – Form 28 duly signed and a note of payment is entered in the Register of unpaid wages against the original entry.

Pay bill using Muster Roll :

Cash book Voucher No. Dated

Name of work Part I - Nominal Roll

Category of Labour	Sl. No.	Name & Address	Father's Name	Dates										Rate	Amount	Payee's Acknowledgement	Date initial of officer making Payment
				1	2	3	4	5	6	7	8	9	10	Total	Rs.P	Rs.P	
			Daily Total														
			Initial of														
			Officer marking daily attendance														
			Initial of														
			inspecting officer														
														Total			

Passed for Rs. (Rupees) Signature Rank

Grand total of this muster roll

Deduct-Payments not made as per details transferred to register of arrears

Total amount paid in words Rupees

Date Signature Rank

Q.8. Write short notes on:

- Earnest money
- First and final bill
- Administrative sanction
- Cash Book
- Security Money.

(20)

Ans. (i) Earnest money : Earnest money is an assurance or guarantee in the form of cash on the part of the contractor to keep open the offer for consideration and to confirm his

intentions to take up the work accepted in his favour for execution as per terms and conditions in the tender. In case a tenderer fails to commence the work awarded to him, the earnest money is forfeited to government. No interest is payable upon earnest money to the contractors.

If the amount of the earnest money is not large (*i.e.* not exceeding Rs. 250/-) it may be deposited in cash in divisional or sub-divisional office. In other cases the contractor has to deposit the same in the treasury/bank and to produce the receipted challan with the tender. The contractor may also deposit the same in the form of 'Deposit at call Receipt' of a scheduled Bank duly guaranteed by the Reserve Bank of India, if so desired. The amount of the earnest money which a contractor should deposit with the tender is regulated by the department and generally for works up to Rs. 5 lakhs @ 2-1/2% of the estimated cost subject to a maximum of Rs. 10,000/-; for works above 5 lakhs @ 2% of the estimated cost subject to a maximum of Rs. 20,000/-. Enlisted contractors of a department mostly deposit a fixed permanent security according to their classification and departmental rules, in order to enable them to secure exemption from payment of earnest money.

Ans. (ii) First bill : The term indicates a single payment, made for a job or contract on its completion. In this case the payment finished by one payment after the completion of the work. This is usually applicable for small work.

Final bill : This means the payment made on running account, made to a contractor on the completion or determination of his contract and in full settlement of the account. The bill on which final payment is made is known as 'Final Bill'.

Ans. (iii) Administrative sanction : For any work or project required by a department, an approval or sanction of the competent authority of the department, with respect to the cost and work is necessary at the first instance. The approval authorises the engineering department to take up the work. Administrative approval denotes the formal acceptance by the department concerned of the proposal, and after the administrative approval is given the engineering department (P.W.D) take up the work and prepares detailed designs, plans and estimates and then executes the work. The engineering department prepares approximate estimate and preliminary plans and submits to the department concerned for administrative approval.

Ans. (iv) Cash book : The cash book is one of the most important account records of the division. It is maintained for all cash transaction taking place day to day strictly in order of occurrence. The detailed instructions are available in the fly leaf of the cash book. The pages of cash book are machine numbered. Each page is divided *Receipt side* (at left hand) and *Payment side* (at right hand).

Form - P.W.A 1 Cash Book

Receipts side					Payment side						
Date of receipt	No. of Vr. of receipt	From whom received	Amount (Cash)	Classification	Date of Payment	No. of Vr.	To whom paid etc.	Payment			Classification of charge
								Cash	Bank of Try		
									No of Ch/ch. Book	Amount	
1	2	3	4	5	6	7	8	9	10	11	12

All receipts in cash are entered in receipt side of the book. Deductions from bills for security deposit etc. and self-cheque drawn are also entered in the receipt side by contra entries from payment side.

Ans. (v) Security money : Security deposit is an amount of money which shall be deposited by the contractor whose tender has been accepted in order to render himself liable to the department to pay compensation amounting to the part or whole of his security deposit if the work is not carried out according to the specification, time limit and conditions of contract.

After acceptance of the tender of a contractor, the earnest money which he has deposited at the time of tender is treated as part of the security money and additional amount of security money is deducted from the progressive bills so that the total amount constitute is 10% on the first lakh and 7-1/2% on the balance. In case of works costing more than Rs. 2 lakhs, 10% on the first one lakh, 7-1/2% on the next one lakh and 5% on the balance, subject to a maximum of Rs. 1 lakh only (The rates as mentioned here are followed by C.P.W.D.) is deducted from the progressive bills.

The security deposit is refundable to a contractor after the prescribed maintenance period is over. In order to afford relief to the contractor a percentage (normally 50%) of the security money is refunded for the portion of the work which has been completed and whose maintenance period is over.

