

SPECIFICATION

Definition

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

Importance of Specification

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

Types of Specifications

1)General Specification

In general specifications nature and class of the work, names of materials, and the proportions that should be used in the various items of the work are described. Only a brief description of each and every item is given. It is useful for estimating the project without going through lengthy detailed specifications general information for the quantities of the materials nature and class of the work can be known from the general specifications, but they don't form a part of the contract document.

2) Detail Specification

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

While writing specifications following principles shall be adopted:

1. Description of materials: The quality and size of materials required to do an item of work shall be fully described for checking up at site according to the clauses provided in

the specifications. The proportion of mixing or treatment of materials if required before use shall be really described.

2. Workmanship:

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

3. Tools and Plant (T&P):

The tools and plant to be engaged to carry out a work shall be described. The method of operation and by whom to be supplied shall be stated.

1. I. General Specifications of a First Class Building

Foundation and plinth—Foundation and plinth shall be of I-class brickwork in lime mortar or 1 : 6 cement mortar over lime concrete or 1 : 4 : 8 cement concrete.

Damp proof course—D.P.C. shall be 2.5 cm (1") thick cement concrete 1:1½:3, mixed with one kg of Impermo per bag of cement or other standard water proofing materials as specified and painted with two coats of bitumen.

Superstructure—Superstructure shall be of I-class brickwork with lime mortar or 1 : 6 cement mortar. Lintels over doors and windows shall be of R.C.C.

Roofing—Roof shall be of R.C.C. slab with an insulation layer and lime concrete terracing above, supported over R.S. Joists or R.C.C. beams as required. Height of rooms shall not be less than 3.7 m (12 feet).

Flooring—Drawing room and dining room floors shall be of mosaic (terrazo). Bathroom and W.C. floors and dado shall be of mosaic (terrazo). Floors of bedrooms shall be coloured and polished of 2.5 cm (1") cement concrete over 7.5 cm (3") lime concrete. Floors of others shall be of

2.5 cm (1") cement concrete over 7.5 cm (3") lime concrete polished.

Finishing—Inside and outside walls shall be of 12 mm (½") cement lime plastered 1 : 1 : 6. Drawing, dining and bedrooms—inside shall be distempered, and others—inside white washed 3 coats. Outside shall be coloured snowcem washed two coats over one coat of white wash.

Doors and windows—Chaukhats shall be seasoned teak wood. Shutters shall be teak wood 4.3 cm (1¾") thick panelled glazed or partly panelled and partly glazed as required, with additional wire gauge shutters. All fittings shall be of brass. Doors and windows shall be varnished or painted two coats with high class enamel paint over one coat of priming. Windows shall be provided with iron gratings or grills.

Miscellaneous—Rain water pipes of cast iron or of asbestos cement shall be provided and finished painted. Building shall be provided with 1st class Sanitary and Water fittings and Electrical installations. 1 metre wide 7.5 cm thick C.C. 1 : 3 : 6 apron shall be provided all round the building.

II. General Specifications of a Second Class Building

Foundation and plinth—Foundation and plinth shall be of 1st class brickwork with lime mortar over lime concrete.

Damp proof course—D.P.C. shall be of 2 cm ($\frac{3}{4}$ ") thick cement concrete 1 : 2 mixed with 1 kg of Impermo 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—Roof shall be R.B. slab with 7.5 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 or Allahabad tiles.

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

Finishing—Inside and outside walls shall be of 12 mm cement mortar plastered 1 : 6. Ceiling shall be cement plastered 1 : 3. Inside shall be white washed 3 coats, colour washed two coats over one coat of white wash.

Doors and windows—Chaukhat shall be of R.C.C. or well seasoned sal wood, shutters of shisham wood or deodar wood 4 cm ($1\frac{1}{2}$ ") thick, panelled, glazed or partly panelled and partly glazed as required, fitted with iron fittings. Doors and windows shall be painted two coats over one coat of priming.

Miscellaneous—Rain water pipes shall be of cast iron finished painted. Electrification, and sanitary and water fittings may be provided if required.

III. General Specifications of a Third Class Building

Foundation and plinth—Foundation and plinth shall be of 2nd class brickwork in lime mortar over lime concrete. Damp proof course shall be 2 cm thick cement mortar 1 : 2 mixed with standard water proofing compound.

Superstructure—Superstructure shall be of second class brickwork in mud mortar. Door and window opening shall be provided with arches of 2nd class brickwork in lime mortar or with wooden planks.

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.

Flooring—Floor shall be of brick-on-edge floor over well rammed earth.

Finishing—Inside and outside walls shall be plastered with lime mortar and white washed three coats.

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.

IV. GENERAL SPECIFICATIONS OF A FOURTH CLASS BUILDING

Foundation and superstructure—Foundation and superstructure shall be of sun-dried or kutchra bricks in mud mortar. Door and window openings shall be provided with arches of 2nd class brickwork in lime mortar or with wooden planks. Inside and outside shall be water proof mud plastered.

Roofing—Roof shall be of tile roof over bamboo and wooden supports.

Flooring—Floor shall be kutchra or earthen floor finished with "gobri" washing (cowdung lepping).

Doors and windows—Doors and windows shall be of chir or mango wood, or country wood.

The detailed specifications of various items of works are as follows :—

1. Earthwork in excavation in foundation—

Excavation—Foundation trenches shall be dug out to the exact width of foundation concrete and the sides shall be vertical. If the soil is not good and does not permit vertical sides, the sides should be sloped back or protected with timber shoring. Excavated earth shall not be placed within 1 m (3') of the edge of the trench.

Finish of trench—The bottom of foundation trenches shall be perfectly levelled both longitudinally and transversely and the sides of the trench shall be dressed perfectly vertical from

bottom up to the least thickness of loose concrete so that concrete may be laid to the exact width as per design. The bed of the trench shall be lightly watered and well rammed. Excess digging if done through mistake shall be filled with concrete at the expense of the contractor. Soft or defective spots shall be dug out and removed filled with concrete or with stabilized soil. If rocks or boulders are found during excavation, these should be removed and the bed of the trenches shall be levelled and made hard by consolidating the earth. Foundation concrete shall not be laid before the inspection and approval of the trench by the engineer-in-charge.

Finds—Any treasure and valuables or materials found during the excavation, shall be property of the Government.

Water in foundation—Water, if any accumulates in the trench, should be bailed or pumped out without any extra payment and necessary precautions shall be taken to prevent surface water to enter into the trench.

Trench filling—After the concrete has been laid masonry has been constructed the remaining portion of the trenches shall be filled up with earth in layers of 15 cm (6") and watered and well rammed. The earth filling shall be free from rubbish and refuse matters and all clods shall be broken before filling. Surplus earth not required, shall be removed and disposed, and site shall be levelled and dressed.

Measurement—The measurement of the excavation shall be taken in cu m (cu ft) as for rectangular trench bottom width of concrete multiplied by the vertical depth of foundation from ground level and multiplied by the length of trenches even though the contractor might have excavated with sloping side for his convenience. Rate shall be for complete work for 30 m (100 ft) lead and 1.50 m (5') lift, including all tools and plants required for the completion of the works. For every extra lead of 30 m and every extra lift of 1.5 m separate extra rate is provided.

Excavation in saturated soil—Excavation in saturated soil or below sub-soil water level shall be taken under a separate item and shall be carried out in the same manner as above. Pumping or bailing out of water and removal of slush shall be included in the item. Timbering of the sides of trenches if required shall be taken under a separate item and paid separately.

Note—Excavation in different kinds of soil mixed with mooram or karnkar or shingle, soft rock or decomposed rock or shale hard rock, etc., shall be taken under separate items. The excavation shall be done on the same principle as above item 1.

2. Lime concrete in foundation—

Materials—All materials shall be as per standard specifications. Coarse aggregate shall be of hard, well-burnt or overburnt brick ballast of 40 mm gauge. It shall be deep cherry red or copper colour, and shall be clean, free from dust, dirt, and other foreign matters. It shall be homogeneous in texture and roughly cubical in shape. Ballast which appears porous or shows signs of saltpetre shall not be used. Brick ballast shall pass through square mesh of 52.5 mm and not more than 20 per cent shall pass through a mesh of 25 mm. Any rejected material shall be removed from site of work within 24 hours.

Fine aggregate shall be of surkhi or sand or cinder as specified, and clean and free from dust, dirt, and foreign matters. Surkhi shall be made of well burnt bricks or brick bats (not overburnt) and shall pass through a sieve of 2.5 meshes per sq cm. (144 meshes per sq in). Surkhi is preferable for better concrete.

Lime shall be white fat lime (unless otherwise specified) and shall be freshly burnt and free from ashes and other foreign matters. Lime shall be slacked at site of work and screened through a sieve of 3 meshes to a cm (8 meshes to an inch).

Proportion—The concrete shall consist of 1 cu m of brick ballast, 0.32 cu m of surkhi (sand or cinder) and 0.16 cu m of white lime in the proportion of 100 : 32 : 16 by volume.

Mixing—Mixing shall be done on a clean watertight, masonry platform of sufficient size. Brick ballast shall be stacked in a rectangular layer of uniform thickness usually 30 cm (12") high and well soaked with clean water for a period of at least three hours.

Lime and surkhi (or sand or cinder) shall be measured with wooden box in the proportion 1 : 2 and mixed thoroughly dry to have uniform colour. The dry mix of lime and surkhi (or sand or cinder) shall be spread over the stacked ballast to the required thickness to give the specified proportion. The materials shall then be mixed dry turning at least three times. Clean water shall then be added slowly and gradually by water-can to the required quantity while mixing and the materials mixed thoroughly by turning at least three times so that whole surface of each ballast gets coated with mortar and the mix becomes plastic of uniform colour of workable consistency and should be such that the ballast do not separate from the mortar. Concrete shall be mixed only for day's work, old and stale concrete shall not be used. For big work the mixing shall be done by machine. In this case aggregate and wet mortar shall be poured in the drum, while it is revolving. The water shall be added slowly to the required quantity and the mixing shall be continued for at least one minute, till a mix of uniform colour and workable consistency is obtained and should be such that the ballast do not separate from the mortar.

Laying and compacting—Bed of foundation trench shall be lightly sprinkled with water before concrete is laid. Concrete shall be laid slowly and gently (not thrown) in layers of not more than 20 cm (8") and thoroughly consolidated to 15 cm (6") with 6 kg (12 lbs) iron rammers. During consolidation concrete should be kept free from earth, dirt, leaves and other foreign matters. The consolidation shall be checked by water test, by digging a hole of about 7.5 cm dia. and 7.5 cm deep in the concrete and filling water. The water level should not sink more than 1.25 cm in 15 minutes if concrete has been well-consolidated.

Joint and consecutive layers—When joint in a layer of concrete are unavoidable, the end shall be sloped at an angle of 30° and junctions of different layers shall break joint. In laying upper layer of concrete, the lower surface shall be made rough and cleaned and watered before upper layer is laid.

Curing—Concrete after completion shall be kept wet for a period of at least 7 days and no masonry shall be constructed upon it during this period. The curing shall be done by spreading gunny bags or sand or keeping them wet by water-can at regular interval.

Measurement—Measurement shall be taken in cu m (cu ft) for the finished concrete. The length and breadth shall be measured correct to 1 cm and depth correct to 0.5 cm. The rate shall be for the complete work including the cost of form work if required, and all tools and plants.

Note—If kankar lime is used 0.35 cu m of kankar lime shall be used with 1 cu m ballast (35 cu m kankar lime with 100 cu m ballast) and no surkhi or sand or cinder shall be added.

When brick ballast is not available, in hill areas, stone ballast 40 mm (1½") gauge, sand and white lime may be used in the same proportion as above.

3. Lime concrete in roof terracing—

Materials—All materials shall be of standard specifications. Coarse aggregate shall be of well burnt or overburnt brick ballast of 25 mm gauge. It shall be deep cherry red or copper colour and shall be clean, free from dust, dirt and other foreign matters. It shall be homogeneous in texture and roughly cubical in shape. Ballast which appears porous or shows signs of saltpetre shall not be used. Brick ballast shall be such as to pass through a square mesh of 37.5 cm and not more than 20 per cent shall pass through a mesh of 20 cm. Any rejected material shall be removed from site of work within 24 hours

Fine aggregate shall be of surkhi, clean free from dust, dirt and foreign matters. Surkhi shall be made from well burnt bricks or brick bats (not overburnt) and shall pass through a screen of 25 meshes per sq cm (144 meshes per sq in).

Lime shall be white fat lime and shall be freshly burnt and free from ashes and other foreign matters. Lime shall be slaked at site of work and screened through a sieve of 3 meshes to a cm (8 meshes to an inch).

Proportion—Concrete shall consist of 1 cu m brick ballast, 0.36 cu m of surkhi and 0.18 cu m white lime (proportion 100 : 36 : 18 by volume).

Mixing—Mixing shall be similar to lime concrete in foundation (item 2).

Laying and consolidation—Surface shall be lightly sprinkled with water and then concrete shall be laid slowly and gently (not thrown) in layers so as to have the required slope and specified thickness after compaction. The concrete shall then be lightly rammed with 6 kg (12 lbs) rammers and during preliminary ramming the surface shall then be perfectly levelled by means of trowel, straight edge and spirit level. The concrete shall then be kept further consolidated by two rows of labourers sitting close and beating the concrete with wooden 'thapis' and moving forward and backward covering the whole surface. The beating shall continue for at least seven days until the concrete is thoroughly compacted and until the 'thapis' rebound from the surface when struck on the concrete. Special care shall be taken to consolidate the concrete properly at the junction with the parapet wall and the junctions shall be rounded.

When beating is in progress, the surface of the concrete shall be frequently sprinkled with a mixture of lime molasses and boiled solution of 'bael' fruit for water proofing. Bael fruit solution shall be prepared by boiling 2 kg of bael fruit in 100 to 130 litres of water and to this solution after cooling 3.5 kg of molasses (gur) and the required quantity of lime shall be mixed.

Finishing—As soon as beating has been completed the mortar that has come to top shall be softened by the addition of lime, 'molasses' and 'bael fruit' solution and smoothed by rubbing and pressing with a trowel or float to a fine polish. No plaster shall be used on any account for finishing the surface. The finished surface shall have a minimum slope of 1 in 50 and maximum slope of 1 in 36 towards the rainwater outlet. For every 40 sq m of roof area, 100 mm diameter rainwater pipe shall be provided.

Curing—The concrete shall be kept wet for a fortnight. The wetting should be done by covering with straw or sand and watering frequently by water-can or dividing into squares by mud kiaris which shall be kept flooded with water.

Measurement—The measurement shall be taken for the finished work of superficial area in sq m (sq ft) stating the average thickness. The average thickness shall be measured correct to 6 mm and length and breadth shall be measured correct to 1 cm. No deduction in measurement shall be made for opening up to 0.4 sq m and extra payment shall not be made for extra material or labour involved in forming such opening. For opening exceeding 0.4 sq m deductions will be made in the measurement but extra payment shall not be made for material and labour involved in forming such opening. Rate shall be for the finished work including all tools and plant.

Instead of Bael fruit the solution of Terminalia Chebula (kadukai) may be used, as used in South India. Dry nuts of kadukai shall be broken to small pieces, and allowed to soak in water. The solution be prepared to have a proportion of 600 g of kadukai, 200 g of molasses and 40 litres of water for 100 sq m area of roof concrete. The solution is brewed for 12 to 24 hours, and the resulting liquor is decanted and used for the work.

Note—(i) If kankar lime is used, 0.45 cu m of kankar lime shall be mixed with 1 cu m brick ballast (proportion 45 : 100).

(ii) If stone ballast is used the proportion shall be 1 cu m of stone ballast of 25 mm gauge, 0.5 cu m of sand and 0.25 cu m of white lime (proportion 1 : 2 : 4).

(iii) *The finished thickness of lime concrete in roof terracing may be 7.5 cm to 12 cm (3" to 4½").*

(iv) *The surface finishing may be taken in sq m under a separate item.*

4. Cement concrete 1 : 2 : 4—

Materials—Aggregate shall be of inert materials and should be clean, dense, hard, sound, durable, non-absorbent and capable of developing good bond with mortar.

Coarse aggregate shall be of hard broken stone of granite or similar stone, free from dust, dirt and other foreign matters. The stone ballast shall be of 20 mm (¾") size and down and all should be retained in a 5 mm square mesh (¼" square) and well graded such that the voids do not exceed 42 per cent. (The gauge of the stone ballast shall be as specified depending on the thickness of concrete and nature of work. For building work 20 mm gauge and for road work and mass work 40 to 60 mm gauge may be used.

Fine aggregate shall be of coarse sand consisting of hard, sharp and angular grains and shall pass through screen of 5 mm (3/16") square mesh. Sand shall be of standard specifications clean and free from dust, dirt, and organic matters. Sea sand shall not be used. (Fine aggregate may also be of crushed stone if specified).

Cement shall be fresh portland cement of standard I.S.I. specifications, and shall have the required tensile and compressive stresses and fineness.

Water shall be clean and free from alkaline and acid matters and suitable for drinking purposes.

Proportion—The proportion of concrete shall be 1 : 2 : 4 as cement : sand : stone : ballast by volume unless otherwise specified. Minimum compressive strength of concrete of 1 : 2 : 4 proportion shall be 140 kg per sq cm (2000 lbs/sq in) on 7 days.

Stone aggregate and sand shall be measured by volume with boxes. Cement need not be measured by box, one bag of cement (50 kg) should be considered as 1/30 cu m (1.2 cu ft). Size of measured box may be 30 cm × 30 cm × 38 cm or 35 cm × 35 cm × 28 cm equivalent to content of one bag of cement. All materials shall be dry. If damp sand is used compensation shall be made by adding additional sand to the extent required for the bulking of damp sand. Mixing shall be of machine mixing. For small work hand mixing by batches may be allowed.

Hand mixing—Mixing shall be done in masonry platform or sheet iron tray. For concrete of 1 : 2 : 4 proportion, first two boxes of sand and one bag of cement shall be mixed dry thoroughly and then this dry mix of cement and sand shall be placed over a stack of 4 boxes of stone aggregate and the whole mixed dry turning at least three times to have uniform mix. Water shall then be added slowly and gradually with a water-can while being mixed to the required quantity 25 to 30 litres (5 to 6 gallons) per bag of cement, to give a plastic mix of the required workability and water cement ratio. The whole shall be mixed thoroughly turning at least three times to give a uniform concrete.

Machine mixing—Stone ballast sand and cement shall be put into the cement concrete mixer to have the required proportion. For concrete of 1 : 2 : 4 proportion first four boxes of stone ballast, then two boxes of sand and then one bag of cement shall be put into the C.C. Mixer, the machine shall then be revolved to mix materials dry and then water shall be added gradually to the required quantity, 25 to 30 litres (5 to 6 gallons) per bag of cement to have the required water cement ratio. The mixing should be thorough to have a plastic mix of uniform colour. It requires 1½ to 2 minutes' rotation for thorough mixing. Mixed concrete shall be unloaded on a masonry platform or on a sheet iron. *Output of concrete mixer is 15 to 20 mix per hour.*

Slump—Regular slump test should be carried out to control the addition of water and to maintain the required consistency. A slump of 7.5 cm to 10 cm (3" to 4") may be allowed for building work, and 4 cm to 3 cm (1½" to 2") may be allowed for road work.

Formwork—Formwork centering and shuttering shall be provided as required, as per standard specifications before laying concrete to confine to support or to keep the concrete in position. The inner surface of shuttering shall be oiled to prevent concrete sticking to it. The base and formwork over which concrete to be laid shall be watered by sprinkling water before concrete is laid. Forms should not be removed before 14 days in general, side forms may however be removed after 3 days of concreting. Formworks shall be removed slowly and carefully without disturbing and damaging concrete.

Laying—Concrete shall be laid gently (not thrown) in layers not exceeding 15 cm (6") and compacted by pinning with rods and tamping with wooden tampers or with mechanical vibrating machine until a dense concrete is obtained. (For important work mechanical vibrating should be used, for thick or mass concrete immersion type vibrators and for thin concrete surface vibrators should be used for compacting concrete). Over-vibration which will separate coarse aggregate from concrete should be avoided. After removal of the form-work in due time the concrete surface shall be free from honey combing, air holes or any other defect.

Concrete shall be laid continuously, if laying is suspended for rest or for the following day the end shall be sloped at an angle of 30° and made rough for further jointing. When the work is resumed, the previous sloped portion shall be roughened, cleaned and watered and a grout of neat cement shall be applied and the fresh concrete shall be laid. For successive layer the upper layer shall be laid before the lower has set.

Curing—After about two hours' laying when concrete has begun to harden, it shall be kept damp by covering with wet gunny bags or wet sand for 24 hours, and then cured by flooding with water making mud walls 7.5 cm (3") high or by covering with wet sand or earth and kept damp continuously for 15 days. If specified, curing may be done by covering concrete with special type of waterproof paper as to prevent water escaping or evaporating.

Note—(i) *For weak concrete 1 : 3 : 6, 1 : 4 : 8, 1 : 5 : 10, etc., stack measurement and hand mixing in a pucca platform may be allowed as in lime concrete (item 2). For foundation concrete or weak concrete brick ballast or cheap type stone ballast of 40 mm (1½") size may be used.*

(ii) *Approximate quantity of water required for cement may be taken 30% by weight of cement plus 5% by weight of total aggregate. For concrete compacted by mechanical vibrators the quantity of water shall be reduced by 20%.*

5. Reinforced cement concrete (R.C.C.)—

Steel—Steel reinforcing bars shall be of mild steel or deformed steel of standard specifications and shall be free from corrosion, loose rust scales, oil, grease, paint, etc. The steel bar shall be round and capable of being bent (doubled over) without fracture. Bars shall be hooked and bent accurately and placed in position as per design and drawing and bound together tight with 20 S.W.G. annealed steel wire at their point of intersection. Bars shall be bent cold by applying gradual and even motion, bars of 40 mm (1½") diameter and above may be bent by heating to dull red and allowed to cool slowly without immersing in water or quenching. Joints in the bar should be avoided as far as possible, when joints have to be made an overlap of 40 times diameter of the bar shall be given with proper hooks at ends and joints should be staggered. Bigger diameter bars should be joined by welding and tested before placing in position. While concreting steel bars shall

be given side and bottom covers of concrete by placing precast cover blocks underneath of 1 : 2 cement mortar 2.5 cm × 2.5 cm (1" × 1") in section and thickness of specified cover, 4 cm to 5 cm (1½" to 2") for beam and 1 cm to 2 cm (½" to ¾") for slab. During laying and compacting of concrete the reinforcing bars should not move from their positions and bars of the laid portions should not be disturbed.

Centering and shuttering—Centering and shuttering shall be made with timber or steel plate close and tight to prevent leakage of mortar, with necessary props, bracings and wedges, sufficiently strong and stable and should not yield on laying concrete and made in such a way that they can be slackened and removed gradually without disturbing the concrete. No plastering should be made on the concrete surface. A coat of oil washing should be applied over the shuttering or paper should be spread to have a smooth and finished surface and to prevent adherence of concrete. For slab and beam small camber should be given in centering, 1 cm per 2.5 m (½" per 10 ft) with a maximum of 4 cm (1½"). Centering and shuttering should not be removed before 14 days in general (4 days for R.C.C. columns, 10 days for roof slab, and 14 days for beams). The centering and shuttering shall be removed slowly and carefully so that no part is disturbed or damaged. (For details of centering and shuttering see item 29).

Proportion of cement concrete—Cement concrete shall be of 1 : 2 : 4 proportion by volume for slabs, beams and lintels, and 1 : 1½ : 3 proportion for columns unless otherwise specified.

Materials for concrete—Cement, sand and coarse aggregate shall be same as for cement concrete in item 4. The stone aggregate shall usually be 20 mm to 6 mm (¾" to ¼") gauge unless otherwise specified. For heavily reinforced concrete members as in the case of ribs of main beams the maximum size of aggregate should usually be restricted to 5 mm less than the minimum clear distance between the main bars or 5 mm less than the minimum cover to the reinforcement whichever is smaller. Where the reinforcement is widely spaced, limitations of the size of the aggregate may not be so important.

Mixing—Same as for cement concrete in item 4.

Laying—Before laying the concrete, the shuttering shall be clean, free from dust, dirt and other foreign matters. The concrete shall be deposited (not dropped) in its final position. In case of columns and walls it is desirable to place concrete in full height if practical so as to avoid construction joints but the progress of concreting in the vertical direction shall be restricted to one metre per hour. Care should be taken that the time between mixing and placing of concrete shall not exceed 20 minutes so that the initial setting process is not interfered with. During winters concreting shall not be done if the temperature falls below 4°C. Concrete shall be protected by frost and concrete affected by frost shall be removed and work redone.

Concrete shall be compacted by mechanical vibrating machine until a dense concrete is obtained. The vibration shall continue during the entire period of placing concrete. Compaction shall be completed before the initial setting starts, *i.e.*, within 30 minutes of addition of water to the dry mixture. Over-vibration which will separate coarse aggregate from concrete shall be avoided. After removal of the form work in due time, the concrete surface shall be free from honey combing, air holes or any other defect.

Concrete shall be laid continuously, if laying is suspended for rest or the following day, the end shall be sloped at an angle of 30° and made rough for future jointing. When the work is resumed, the previous sloped position shall be roughened, cleaned and watered and a coat of neat cement shall be applied and the fresh concrete shall be laid. For successive layer the upper layer shall be laid before the lower layer has set.

Structures exceeding 45 metres in length shall be divided by one or more expansion joints. Structures in which plan dimension changes abruptly shall be provided with expansion joints at the

section where such changes occur. Reinforcement shall not extend across an expansion joint at the break between the sections shall be complete.

Curing—Same as for cement concrete in item 4.

Finishing—If specified the exposed surface shall be plastered with 1 : 3 cement sand mortar not exceeding 6 mm ($\frac{1}{4}$ ") thickness and the plastering shall be applied immediately after removal of the centering while the concrete is green. Immediately before applying the plaster the surface of concrete shall be wetted and neat cement wash shall be given.

Measurement—Measurement shall be taken in cu m (cu ft) for the finished work and no deduction shall be made for the volume of steel. Steel reinforcement shall be measured under a separate item in quintal (cwt). Plastering, if any, shall not be included in the measurement. The rate for R.C.C. work shall be for the complete work excluding steel but including centering and shuttering and all tools and plants.

Note—Student should repeat the specifications of materials, mixing, laying and curing in short as described under cement concrete in item 4.

6. Damp proof course 2.5 cm (1") c.c. 1 : 1½ : 3—

Materials—Damp proof course shall consist of cement, coarse sand and stone aggregate of 1 : 1½ : 3 proportion with 2% of *impermo* or *cem-seal*, or *Acco proof* by weight of cement or other standard water proofing compound (1 kg per bag of cement). The damp proof course shall be applied at the plinth level in a horizontal layer of 2.5 cm thickness. The cement shall be fresh portland cement of standard specifications. The sand shall be clean, coarse of 5 mm size and down, and the stone aggregate shall be hard and tough of 20 mm size well graded and free from dust and dirt. (Composal, pudlo, cico and other standard water proofing compound may be used, and the quantity shall be used as per instruction of the manufacturers.)

Mixing—Mixing shall be done in a masonry platform or in a sheet iron tray in the proportion of 1 : 1½ : 3 by measuring with measuring boxes. The cement is first mixed thoroughly with the water proofing compound to the required quantity, and then mixed dry with the sand in the proportion of 1 : 1½. The mix of cement and sand shall then be mixed dry with stone aggregate to have the proportion 1 : 1½ : 3. Clean water shall then be added slowly and gradually while being mixed, to the required quantity to give a plastic mix of the required workable consistency. The mixing shall be done by turning at least three times to give a uniform and homogeneous concrete.

Laying—The level of the surface of the plinth shall be checked longitudinally and transversely. The top of walls at damp proof course should be laid with frogs of the brick downward. Side forms or shuttering of strong wooden batten of 2.5 cm thickness shall be fixed properly and firmly on both sides to confine the concrete so that the shuttering does not get disturbed during compaction and mortar does not leak through. The inner edges of the shuttering shall be oiled to prevent concrete adhering to it. The surface of the wall shall be cleaned and the masonry shall be wetted by watering before concrete is laid. The concrete shall be laid within half an hour of mixing and compacted thoroughly by tamping to make dense concrete and levelled both longitudinally and transversely. After two hours of laying the surface of concrete shall be made rough and chequered so as to form a key with the wall above. The damp proof course shall be laid in continuation in one day without any joints. Joints or breaks if unavoidable shall be given at the sills of doors or openings. If joints cannot be avoided the joint shall be sloped and the sloped surface shall be applied with neat cement wash just before starting concreting on the following day. Shuttering may be removed after three days. On removal of the shuttering the edges should become smooth without any honey combing.

Curing—The damp proof course shall be cured by watering and kept wet for 7 days, and the construction of wall above may be started. The surface shall be cleaned and wetted before masonry is started.

Painting with Asphalt—Two coats of asphalt painting may be applied on the upper surface of damp proof course, if specified. The first coat of hot asphalt at 1.5 kg per sq m (15% kg % sq ft) shall be applied uniformly on the surface when the concrete is dry and the painted surface is blinded immediately with coarse sand and the surface is tamped lightly. The second coat of hot asphalt at 1 kg per sq m (10 kg % sq ft) should then be applied uniformly and the surface is immediately blinded with coarse sand and tamped lightly.

2 cm Damp proof course.—The damp proof course may be of 2 cm ($\frac{3}{4}$ ") thick layer of 1 : 2 cement and coarse sand mortar with standard water proofing compound at the rate of 1 kg per bag of cement. The mixing, laying, curing, etc., shall be done in the same manner as above. The form or shuttering shall be 2 cm thick.

7. Brickwork I class—

Bricks—All bricks shall be of first class of standard specifications made of good brick earth thoroughly burnt, and shall be of deep cherry red or copper colour. Bricks shall be regular in shape and their edges should be sharp and shall emit clear ringing sound on being struck and shall be free from cracks, chips, flaws and lumps of any kind. Bricks shall not absorb water more than one-sixth of their weight after one hour of soaking by immersing in water. Bricks shall have a minimum crushing strength of 105 kg per sq cm (1500 lbs per sq in).

Mortar—Mortar shall be specified and materials of mortar shall be of standard specifications.

For cement mortar cement shall be fresh portland cement of standard specifications. Sand shall be sharp, clean and free from organic and foreign matters. For rich mortar coarse or medium sand should be used and for weak mortar local fine sand may be used. Proportion of cement sand mortar may be of (1 : 3 to 1 : 6 as specified). Materials of mortar shall be measured to have the required proportion with measuring box and first mixed dry to have a uniform colour in a clean masonry platform and then mixed by adding clean water slowly and gradually to have workable consistency and mixed thoroughly by turning at least three times. Fresh mixed mortar shall be used, old and stale mortar shall not be used and mortar for one hour's work only shall be mixed with water so that the mortar may be used before setting starts.

Lime surkhi (or sand or cinder) mortar if specified shall be mixed in the specified proportion by grinding in mortar mill for at least three hours on the same day of use. Lime shall be fresh and slaked and screened at site of work. Fresh mixed mortar within 24 hours shall be used, old and stale mortar should not be used. For small work hand mixing may be allowed in the same manner as for cement mortar described above. [Proportion of lime surkhi (or sand or cinder) mortar may be 1 : 2 to 1 : 3 as specified.]

Soaking of brick—Bricks shall be fully soaked in clean water by submerging in a tank for a period of 12 hours immediately before use. Soaking shall be continued till air bubbling is ceased.

Laying—Bricks shall be well bonded and laid in English bond unless otherwise specified. Every course shall be truly horizontal and wall shall be truly in plumb. Vertical joints of consecutive course shall not come directly over one another, vertical joints in alternate course shall come directly over one another. No damaged or broken bricks shall be used. Closers shall be of clean cut bricks and shall be placed near the ends of walls but not at the other edge. Selected best shaped bricks shall be used for face work. Mortar joints shall not exceed 6 mm ($\frac{1}{4}$ ") in thickness and joints shall be fully filled with mortar. Bricks shall be laid with frogs upward except in the top course

where frogs shall be placed downward. Brickwork shall be carried out not more than 1 m (3 ft) height at a time. When one part of the wall has to be delayed, stepping shall be left at an angle of 45°. Corbelling or projections where made should not be more than ¼ brick projections in one course. All joints should be raked and faces of wall cleaned at the end of each day's work.

Curing—The brickwork shall be kept wet for a period of at least 10 days after laying. At the end of day's work the tops of walls shall be flooded with water by making small weak mortar edging to contain at least 2.5 cm (1") deep water.

Protection—The brickwork shall be protected from the effect of sun, rain, frost, etc., during the constructions and until such time it is green and likely to be damaged.

Scaffolding—Necessary and suitable scaffolding shall be provided to facilitate the construction of brick wall. Scaffolding shall be sound and strong and supports and members sufficiently strong so as to withstand all loads likely to come upon them.

Measurement—Brickwork shall be measured in cu m (cu ft). Different kinds of brickwork with different mortar shall be taken under separate items. The thickness of wall shall be taken as multiple of half brick as half brick 10 cm, 1 brick 20 cm, 1½ brick 30 cm and so on. The rate shall be for the complete work including scaffolding and all tools and plants.

Brickwork in arch—In addition to the above type of arch—rough arch or axed or gauged arch as the case may be, and the centering of the arch should be specified.

8. Brickwork II class and III class—

For II-class brickwork bricks shall be of second class and mortar shall be as specified, may be kankar lime or white lime and surkhi (or sand or cinder) of 1 : 2 to 1 : 3 proportion. Mortar joints shall not exceed 10 mm (¾") in thickness. Bricks shall be soaked in water for at least three hours immediately before use. Other details are same as for item 7 above.

For III-class brickwork bricks shall be III class if otherwise not specified. Mortar shall be as specified and mortar joints shall not exceed 12 mm (¾") in thickness. Bricks shall be dipped into a tub of water before use.

9. Brickwork in mud mortar—

Bricks shall be specified, may be of II class or III class. The mud should be made of selected earth of tenacious nature so that it sticks and binds bricks. The earth should be soaked in water at least one day before and then worked up with water by labourer treading it, until it is perfectly free from lumps and forms a thick plastic mix. Joints should not exceed (½") 12 mm thickness. Soaking of bricks is not required. The bond of brickwork shall be of English bond. Not more than 60 cm (2') height of brickwork shall be carried out at a time, and the walls must be truly in plumb and every course shall be truly horizontal. Other details of laying, protection, scaffolding and measurement will be similar to item 7 above.

10. Reinforced brickwork (R.B. work)—

Material—Bricks shall be strictly of first class quality and selected first class bricks shall be used. Mortar shall consist of cement and coarse sand of 1 : 3 proportion. Cement shall be fresh portland cement. Sand shall be coarse of 5 mm (3/16") size and down and sharp, clean and free from foreign matters. Steel reinforcement shall be of standard specification as described in item 5, page 570.

Centering and shuttering—The centering and shuttering shall be made with planking or sheeting of bamboos packed together at the required level supported on runners of beams and covered with a thin layer of about 2.5 cm thick of earth finished off with a light sprinkle of sand. The centering shall be simple in construction so that it could be easily removed without disturbing the structure. The planking shall be kept clear of the bearings for slab and will rest on cross beams only. Planks shall not be laid too close as to tender them liable to jam. Cross beams shall be carried on the walls supported at intervals by ballies or temporary dry brick pillars. The top surface of centering shall be given a camber of 2 mm for every 30 cm of span up to a maximum of 3 mm for slabs and 1.5 mm for every 30 cm of span to maximum of 4 cm for lintels.

Mixing of mortar—Mortar of cement and sand shall be mixed thoroughly in the proportion of 1 : 3, first by mixing dry and then adding water slowly and gradually and mixing by turning at least three times to get uniform plastic mix of workable consistency, so that the mortar may be packed round the reinforcement. Quantity of water shall not exceed 25 litres (6.5 gls) per bag of cement. Mortar shall be mixed just before it is actually required and shall be used within 30 minutes. Stale mortar shall never be used.

Laying—All bricks shall be thoroughly soaked with water for not less than six hours immediately before use. Bricks shall be laid with frogs downward over the centering in straight line parallel to the direction of the reinforcement bars leaving the required gap for mortar joint. No vertical joint should come along the inner edge of the wall. The gap for mortar joint in which reinforcement has to be placed shall not be less than four times the diameter of bar, so as to provide a cover of 12 mm ($\frac{1}{2}$ ") on all sides of the steel bars. Usually mortar joint shall be 32 mm to 40 mm ($1\frac{1}{4}$ " to $1\frac{1}{2}$ "). Other joints where there will not be any bar, may be 6 mm to 10 mm ($\frac{1}{4}$ " to $\frac{3}{8}$ ") thick. Reinforced brick slab shall have a bearing equal to their thickness with a minimum of 12 cm.

After the bricks have been laid and arranged over the whole area fresh mixed mortar shall be placed into the gaps in between the bricks to a thickness of 2.5 mm (1"). Reinforcing rods previously cut to the correct length and bent and hooked as per design shall be placed exactly at the centre of the joint and pressed down into the mortar to leave 12 mm ($\frac{1}{2}$ ") clear mortar below the bar. The joints shall then be filled in completely with fresh mortar. Newly laid portion shall not be disturbed or walked over. Each slab shall be laid in one operation. Care shall be taken that the reinforcement at all points is completely surrounded on all sides by mortar.

Centering and shuttering shall be removed slowly and carefully without any shock not earlier than 10 days. After removal of the centering if the work is found defective and rods are exposed and visible to sufficient extent the work shall be dismantled and reconstructed. In such a case no extra payment shall be made for reconstruction. If rods are exposed at few places only, they should be covered with rich cement mortar of 1 : 2 proportion by pressing the mortar into the gap immediately after removal of the centering while the laid work is green.

For double layers the upper layer shall be laid with joints of 10 mm ($\frac{3}{8}$ ") thickness with 1 : 3 cement and coarse sand mortar immediately after laying the bottom layer. If there are top bars provided in the upper layer, the joints shall be thicker as for bottom layer.

2.5 cm to 4 cm (1" to $1\frac{1}{2}$ ") thick cement concrete of 1 : 2 : 4 proportion may be provided over the one layer of R.B. work if specified to have greater compressive strength.

Curing—Same as for item No. 4, page 570.

Measurement—Same as for item No. 5, page 572.

16. Brick-on-edge or brick flooring over 7.5 cm (3") lime concrete—

The bricks shall be first class selected to have smooth face, good red colour and hardness. The mortar shall be specified (1 : 6 cement sand mortar, or 1 : 2 lime surkhi mortar or kankar lime mortar). All bricks shall be soaked in water in a tank for at least 12 hours before use. Lime concrete of base shall be of the same specification as for item 2. The surface of base lime concrete shall be cambered or sloped for draining wash water as per drawing or instructions. The bricks shall be laid with mortar as specified with break joints at half the length of brick, with the required bond. The surface should be checked frequently with spirit level and wooden straight edge to have a true surface. No damaged or broken bricks shall be used anywhere except at the edges, where properly straight cut bricks shall be used. Mortar joints shall not exceed 12 mm ($\frac{1}{2}$ ") and all joints should be full of mortar. The brick work should not be disturbed but shall be kept wet for at least 10 days. The surface should be finished with pointing with cement mortar as specified.

17. White washing—

Fresh white lime slacked at site of work should be mixed with sufficient water to make a thin cream. The approximate quantity of water required in making the cream is 5 litres of water to 1 kg of lime. It shall then be screened through a coarse cloth and gum (glue) in the proportion of 100 grams of gum to 16 litres (three chattacks of gum to 6 gallons) of wash shall be added. The surface should be dry and thoroughly cleaned from dust and dirt. The wash shall be applied with 'moonj' or jute brush, vertically and horizontally alternately and the wash kept stirred in the container while using. Two or three coats shall be applied as specified and each coat shall be perfectly dry before the succeeding coat is applied over it. After finishing the surface shall be of uniform colour. The white wash should not splash on the floor and other surfaces. In old surface the surface should be cleaned and repaired with cement mortar where necessary and allowed to dry before white wash is applied. For final coat blue pigment powder should be mixed to the required quantity with the lime water to give a bright white surface.

18. Colour washing—

Colour wash shall be prepared with fresh slacked white lime mixed with water to make thin cream adding the coloured pigment to the required quantity to give the required tint. Gum (glue) in the proportion of 100 gm of gum to 16 litres (three chattacks of gum to six gallons) of wash shall be added. The colour wash may be applied one or two coats as specified. The method of application should be same as for white washing (item 17). For new work the priming coat shall be of white wash.

19. Distempering—

The distemper shall be of best quality and the colour should be as specified. The distemper should be mixed and prepared and water added, as laid down in the instructions of the manufacturer. First a paste is made by adding little hot water to the distemper powder and stirred thoroughly, and the paste is allowed to stand for a few minutes. The paste is then thinned with water to have a thin cream to the consistency of oil paint and stirred thoroughly all the time while applying. If the surface is rough, it should be smoothed with sand paper.

The surface must be perfectly dry before distempering is commenced. In new cement plaster the surface shall be washed over with a solution of zinc sulphate, one kg zinc sulphate in 10 litres of water and then allowed to dry. In old surface, the surface shall be repaired with plaster

CONTRACTS

Contract : An agreement enforceable by law is a **Contract**.

Agreement : Every promise and every set of promises, forming the consideration for each other, is an Agreement. The agreement must create legal obligations between the parties is an **Enforceable**.”

Contract : It is an undertaking by a firm or a person to do any work under certain terms and conditions.

Contractor: A person or a firm who undertakes any type of contract.

Arranging Contractor: Contract for a work is arranged by inviting sealed tenders, by issuing tender notices.

Initial Decisions

- ✓ Site investigations should have revealed ground conditions.
- ✓ Decisions will have been taken on the way design is to be carried out.
- ✓ A Planning Supervisor will have been appointed.
- ✓ Decisions will have been taken on the breakdown of construction into different contract packages to suit capabilities of potential tenders for civil works, plant suppliers, etc.
- ✓ Environmental studies will have been undertaken and requirements assessed.
- ✓ Initial project programmes will have been produced to indicate the sequences of construction.
- ✓ Financial planning will have been completed to ensure funds will be available.
- ✓ Approvals

TWO BROAD CATEGORIES

- ✓ Price Given in Advance Contracts (Priced-based Contracts)
- ✓ Cost Reimbursement Contracts (Cost-based Contracts)

TYPES OF CONTRACTS

- 1) Lump sum contract
 - a) Lump sum and schedule contract
- 2) Schedule contracts or Item Rate contract or Unit Price Contract
- 3) Labour contract
- 4) Percentage rate Contract
- 5) Materials supply contract
- 6) Piece-Work agreement
- 7) Cost plus percentage rate contract
- 8) Cost plus fixed fee contract
- 9) Cost plus sliding or fluctuating fee scale contract
- 10) Target Contract
- 11) Measured Contract
- 12) Negotiated Contract

1) Lumpsum Contract:

- ✓ Sometimes called ***Drawings and Specifications Contract***.
- ✓ The contractor agrees to perform a stipulated job of work in exchange for a fixed sum of money.
- ✓ To complete it in all respects within a specified time for a fixed amount.
- ✓ Payment may be staged at intervals on the completion of milestones.
- ✓ Deposit of 10% security money is taken by the department.
- ✓ The contractor is responsible for preparing his B.O.Q. (Bill of Quantities).
- ✓ On completion of the work no detailed measurements of different items of work is required.

- ✓ Lower financial risk to Employer.
- ✓ Higher financial risk to Contractor.

Advantages

- ✓ The final price is known, by the owner, before the work commences.
- ✓ The contractor has more incentive to reduce his cost to increase the profit.
- ✓ The contractor hopes to complete the job as quickly as possible, to minimize overhead, to maximize profit and to move to the next Job.
- ✓ When level of risks is low and quantifiable, and
- ✓ When the client does not wish to be involved in the management of his project.
- ✓ That can be accurately and completely described at the time of bidding such as residential and building construction.
- ✓ When limited variation is needed.

Disadvantages

- ✓ Changes in drawings and specifications can be very expensive and source of trouble. In other words the contract has very limited flexibility for design changes.
- ✓ The contractor carries much of the risks.
- ✓ The tendered price may include high risk contingency.
- ✓ Competent contractors may decide not to bid to avoid a high-risk lump sum contract.

a) Lumpsum and Schedule Contract

- ✓ In this type of contract, the schedule of rates is also provided in the contract agreement.
- ✓ Measurement of extra items only shall have to be taken. The original work is however be checked and compared.
- ✓ The contract however includes a fixed sum within a fixed time along with the detailed specifications and conditions, and the scheduled rates.

2) Schedule Contract or Item Rate Contract

- ✓ The contractor undertakes the execution or construction of a work on the item rate basis only.
- ✓ The payment to the contractor is made by detailed measurement of different items of works actually done by the contractor.
- ✓ The amount the contractor receives depends on the number of items of work done.
- ✓ The contract agreement includes quantities, rates and amounts of various items of work.
- ✓ It also includes the 10% security money, penalties, etc.
- ✓ Item rate contract may also be a percentage above or below the printed schedule of rates of the department.
- ✓ Used for repair and maintenance works or under conditions of urgency.
- ✓ Estimated quantities are surveyed by Architect/Engineer.
- ✓ Contractors enter unit prices against the estimated quantities of work.
- ✓ Useful on projects where the nature of the work is well defined, but the quantities of work cannot be accurately determined in advance of construction. Suitable for highways, dams, airports...
- ✓ It is also called as **UNIT PRICE CONTRACT**.

Advantages and Disadvantages

- ✓ Fair basis for competition.
- ✓ In comparing with lump-sum contract,
 - A) Changes in contract documents can be made easily by the owner.
 - B) Lower risk for contractor.
- ✓ The exact final price of the project is not known to the owner until the completion of the project.

4) Labour Contract

- ✓ All materials for the construction are arranged and supplied at the site of work by the department or owner.
- ✓ The labour contractor engages the labour and gets the work done according to specifications.

- ✓ The contract is on item rate basis for labour portion only.
- ✓ The contractor is paid for the quantities of work done on measurement of the different items of work at the stipulated rate as in agreement.
- ✓ Contractor uses his own tools for working.
- ✓ Plants and machineries are arranged by department or owner.
- ✓ This system of contract is not generally adopted in government works but preferable for private sectors.

Advantages of Labour Contract :—

- (i) The materials stored by the Government are thus utilised.
- (ii) The increase in the cost of the work is checked inspite of any rise in the prices of such materials in the market.
- (iii) Difficulty in obtaining certain materials in the open market can be avoided and thus better progress with standard quality of materials can be mentioned.

Disadvantages of Labour Contract :— (i) There may be delay in obtaining the materials by the department subsequently the contractor is required to keep himself in touch with the day to day position regarding the supply of materials from the department.

(ii) A large storage area is required to store the different kinds of materials and constant guarding, etc. are essential. Beside these constant accounting of materials by employing additional staff is necessary. For all such expenditure the ultimate cost of materials may be higher than the cost of materials procured directly by a contractor from open market.

(iii) Theft from store, shortage of materials, difficulty during handing over storage charge accounting all materials are constant troubles for a department.

(iv) Refund of surplus departmental materials by a contractor in a good condition, wastage, damage etc. are also involved in this type of contract.

4) Percentage Rate Contract

In this form of the contract department draw up the schedule of items according to the description of items mentioned in the estimate with quantities, rates, units and amount shown there in. Thus the department fix up the item rates of the tender (so called as Item Rate Tender).The Contractors are required to offer to carryout the work at per with the rate shown in specific price schedule or percentage above or below the rates indicated in the schedule of items of work attached to the tender. The percentage

above or below or at per tendered by the contractor apply on the overall amount of quantities.

5. Materials supply contract or contracts for the supply of materials :—In this form the contractors have to offer their rates for supply of the required quantity of materials of inclusive of all local taxes, carriage and delivery to the specified stores within the time fixed in the tender. This form of contract is generally used when purchase of materials, viz., Bricks, stone chips, furniture, pipes and specials etc. are involved. All materials received should be examined and counted or measured, as the case may be when delivery is taken.

Advantages of materials supply contract :—(i) Payment of this type of contract can be made promptly, and so the contractors try to take the supply order even at less profit, resulting low cost of the materials.

(ii) As the supply of materials is taken through a contractor, the department receiving the supply of materials does not worry due to loss of materials, breakage, damage charges during transit.

Disadvantages of materials supply contract :—(i) Constant control for quality of materials to be received at several batches at different times is required.

(ii) During submission of tender intending contractors may form a ring to get the supply order at a higher rate at different turns.

6. Price Work Agreement :—As the name signifies, the Piece Work Agreement is that for which only a rate is agreed upon without reference to the total quantity of work to be done or the quantity of work to be done within a given period. In case of petty work valued up to Rs. 10,000/—each inclusive of cost of materials may be carried out through contractors by Piece Work Agreement. In this type of agreement detailed specifications and the total cost of the whole work to be done are mentioned. It is terminable from either side at any time and can not be called a contract in true sense. Work may be executed in simple "work order" agreement form, there is no security money and penalty clause.

Advantages of Piece Work Agreement :—(i) Urgent small work may be taken up for execution without inviting tender and a reasonable time is saved.

(ii) If a contractor delays to execute the work or uses inferior quality of materials or leaves the work partially complete separate contractor may be engaged at any time.

Disadvantages of Piece Work Agreement :—For this type of Small Work approved contractors find a little interest and as such work becomes in hand of petty contractors having little management system and adequate knowledge to carry out the work following departmental procedures.

7. Cost Plus percentage rate contract :—In tendering for work on a "Cost plus" basis the contractor is paid the actual cost of the work, plus an agreed percentage addition to allow for profit. This type of contract is generally adopted when conditions are such that labour and materials rates are liable to fluctuate. In adopting this system of tendering no "Bill of Quantities" or "Schedule of Rates" has to be priced but the owner or the Department should carefully define the actual cost and record exactly what is permissible in the cost of the work.

Advantages of cost plus percentage rate contract :—(i) It has the merit that contracts can quickly be drawn up and agreed and also work of an urgent nature put in hand without delay. It is for this reason, useful to a large extent during war period when urgency prevails and work is required to be started at short notice.

(ii) This type of contract is suitable when work can not be executed by other type of contracts at a competitive rate due to uncertainty and fluctuation in the market rates of labour and materials.

Disadvantages of cost plus percentage rate contract :—

(i) Close supervision and checking of delivery notes and invoices which it involves, makes it unsuitable for works where the necessary staff is not available.

(ii) It is to the contractor's advantage to make the cost as high as possible by wasting material and employing inefficient workmen, as the contractor takes little risk and his profit is assured. This form of tender is not popular with contractors, despite the fact that they can not lose on it, for it tends to spoil the pushing qualities of those carrying out the work.

8. Cost Plus fixed fee contract :—In this type of contract the contractor is paid by the owner an agreed fixed lump sum amount over and above the actual cost of the work. This fixed fee shall cover overheads and profit to the contractor. The fee does not vary with the actual cost of the work as in the case of cost plus percentage rate contract.

Advantages of cost plus fixed fee contract :—

(i) Since the fixed fee cover the contractor's overhead charges and profit the contractor shall naturally try to complete the work speedily in order to earn his fee as soon as possible.

Disadvantages of cost plus fixed fee contract :—

(i) This form of tender is not popular with contractors, despite the fact that they can not lose on it. The contractor shall try to complete the work as early as possible even by purchasing materials at higher rate and engaging labour at high charges and thus the owner may lose a reasonable amount to carry out the work by this type of contract.

9. Cost plus sliding or fluctuating Fee scale contract :—In this type of contract the contractor is paid by the owner the actual cost of construction plus an amount of fee inversely variable according to the increase or decrease the estimated cost agreed first by both the parties. Thus higher the actual cost lower will be the value of fee and vice versa.

*Advantage 1—*In this case a contractor shall not try to increase the actual cost as in the case of “cost plus percentage rate” or shall not be indifferent as in the case of “cost plus fixed fee contract” Because interest of a contractor is totally involved with the variation of the actual cost. Thus if the actual cost lower both the owner and the contractor will be benefited. This is the best of the cost plus type contract.

*Disadvantage 1—*The estimated cost must be very accurately determined. In case if the estimate is very higher than the actual cost due to inefficiency of the estimator a contractor will get more amount on the basis of savings and vice versa.

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

*Advantages of Target Contract !—*The contractor is encouraged to use his skill and experience in keeping the cost as low as possible. This type of contract is profitable to both the contractor as well as to the owner.

*Disadvantages of Target Contract :—*The contractor may show higher cost of construction and thus he gains more amount even covering the penalty due to excess expenditure.

11. Measured Contract or Schedule Contracts :—Except lump-sum contract all other types of contracts are measured contract In this case the total cost of a work is worked out by detailed measurement of different items of work after its completion A bill is then prepared by multiplying the measured quantities by their respective rates. Examples of measured contract are item rate contract, percentage contract, cost-plus type contract, material supply contract etc. but not Lump-Sum contract.

12 Negotiated Contract :—When work is awarded on contract by mutual negotiation between the parties without call of tenders, it is said to be a negotiated contract. It may be in any of the forms mentioned in 1, 2, 3, and 5 of 17-3. In the Public Works Department the contracts are negotiated only in special circumstances with a view—

- (i) to obtain reasonable rates, or
- (ii) to meet the situation arising out of emergency, viz, construction of shelters for displaced persons, or strengthening Runway for national defence etc. at short notice.

Advantages of this system are that it brings some economy in expenditure. The parties selected being always reliable and financially sound, ensure uninterrupted work with less chances of dispute.

Factors influencing the Choice of the Type of Contracts

- ✓ The appropriateness for providing an adequate incentive for efficient performance by the contractor
- ✓ The ability to introduce changes
- ✓ The allocation of risks
- ✓ The start and completion date of the project

CONTRACT DOCUMENT

Before the work is given out on contract an agreement or bond is prepared. The following documents shall be attached to the contract agreement or bond which should be duly endorsed and sealed. Each page shall bear the signature of the contractor and the accepting authority and a:: corrections shall be similarly initialled :-

1.Title page -- having the name of work, contract bond number, etc.

2.Index page -- having the contents of the agreement with page references.

3.Tender notice — giving brief descriptions of the work, estimated cost of work, date and time of the tender, amount of earnest money and security money, time of completion, etc., Earnest money, usually 2% of the estimated cost, is deposited along with tender.

4.Tender form -- giving the bill of quantities, contractor's rates, and total cost of works, and time for completion, progress of works, security money, penalty clause etc.

5.Bill of quantities or schedule of quantities --- giving quantities and rates of each item of work and cost of each item of work and the total cost of the whole work.

6.Schedule of issue of materials — giving list of materials to be issued to the contractor with rates and place of issue.

7.General specifications — specifying the class and type of works in general.

8.Detailed specifications -- of each item of work, and of each material to be used in the work.

9.Drawings — complete set of drawings including plans, elevations, sections, detailed drawing, etc. and site plan. all fully dimensioned.

10.Condition of contract — containing the terms and conditions of contract in detail. The conditions specify the following:—

- (i) Rates inclusive of materials, transport, labour, T. and P. all other agreements necessary for completion of work,
- (ii) Amount of the security money,
- (iii) Time for completion of the work,
- (iv) Progress to be maintained.
- (v) Penalty for unsatisfactory and bad work, for failure in maintaining progress, for delay in completion,
- (vi) Mode of payment, running account payment, final payment, security money refund,
- (vii) Extension of time limit of contract,
- (viii) Rules for employment of debitable agency, termination of contract,
- (ix) Minimum wages to labour, compensation to labour.
- (x) Authority deciding extra items and contractors claims, etc.

II. Special condition -- depending on the nature of works, regarding taxes, royalties, which are included in rates, labour camp, labour amenities, compensation to labour in case of accident. etc.

Compensation for delay in completion. — Contractor is liable to pay as compensation or penalty an amount equal to 1% of the estimated cost of the work (contracted amount) or such smaller amounts as the Executive Engineer or the competent authority may decide for every day that the work remains uncommenced or unfinished after the due date. The maximum limit of penalty is 10% of the total contract amount.

Liquidated Damages. — It is a fixed stipulated sum of penalty by the contractor or having no relationship with real damage. It is usually exorbitant and fixed per day varying from Rs.50.00 to Rs.100.00 per day for the excess period taken for the completion of the work than that specified in the contract.

Unliquidated Damages. — This is known as ordinary damages having relation with the actual damage done. It will increase or decrease according to increase or decrease in the damage, for the non-completion of the work within due date of completion, or for not maintaining progress as per condition of contract.

Extension of Time. — The Executive Engineer or competent authority may grant the necessary extension of time for valid reasons if the contractor applies for extension of time within the time. Reason may be the materials, labour, etc., not being available, bad weather condition, land not available in due time, etc. The contractor should apply for extension of time before the due date of completion as provided in the contract agreement.

Termination of Contract. — The contract can be terminated by the Executive Engineer or by competent authority in default or bankruptcy of the contractor and penalty may be imposed as per terms of the contract agreement. If the contractor does not fulfil the terms and conditions of contract as -- if he leaves the work, if he does not maintain progress, if he does not observe the rules, instruction, etc., the contract agreement may be rescinded and all of his security money be confiscated or penalty up to the extent of 10% of the estimated cost may be imposed on the contractor. For termination of contract due notice shall have to be served on the contractor.

Debitable Agency. — This is an agency which is employed to execute a work or part of a work at the cost of a contractor who fails to complete or to show unsatisfactory progress of the work. The debitable agency may be in the form of daily labour or another contractor and may be employed by giving proper notice

to original contractor and the whole cost which is usually higher, is debited or charged to the original contractor.

Termination of Contracts

A contract may be terminated by the employer in any one of the following five ways.

1. Termination by agreement.
2. Termination by breach.
3. Termination by performance.
4. Termination by the impossibility of performance.
5. Termination by operation of provisions of the law.

1. Termination by agreement. The contract can be terminated by mutual agreement at any stage of work. The contractor is paid for the work done by him up to the time of such termination. This is sometimes done to accommodate the changes in the old contract and new contract is drawn with the same party or with some other party.

2. Termination by breach. When one party breaks the provisions of the contract it is known as breach of contract. In this circumstance the other party has a right to terminate the contract. Further, the injured party has right to claim the damages or losses suffered due to such breach of terms and conditions of the contract. The only thing required would be that the injured party must be in a position to justify the amount claimed for such damages in case the matter goes to court.

3. **Termination by performance.** If the work is being carried out as per its terms and conditions it is obvious that it will be treated as terminated as soon as the work is completed in all respects. Such a performance of the contract is known as specific performance. It is an ideal condition for the terminating of a contract. However in construction works, it is rare to obtain such a conditions of termination of a contract.

When a contract is executed with minor changes or up to a certain degree due to certain situations beyond the control of either party, it is known as substantial performance. These changes are also recognised as a sufficient cause for termination of a contract, provided no damage has been suffered by the owner due to such substantial performance.

4. **Termination by operation of provisions of the law.** A contract may also be terminated by the operation of various prevailing laws. The laws may be pertaining to inheritance, bankruptcy or limitations of time. The contract for professional services is treated as terminated by the death of the person who was to give such service. However generally the contracts are not terminated due to death of one of the parties. This is so because the obligations of such party are automatically transferred to the legal successors.

5. **Termination by the impossibility of performance.** If unexpected conditions arise due to which it is very difficult to follow the provisions of the contract, the contract may be terminated. In case of contract for the construction of building, if it is discovered that the land on which the building is to be constructed belongs to some body else, the contract would be treated as terminated. Unusual weather conditions, high floods etc. also sometimes make performance of contract impossible and hence contract in such conditions is terminated.

In order to terminate a contract a registered notice is served on the contractor framing charges against him for violation of the clause or clauses of the terms and conditions of the contract allowing a fixed time usually 14 days. In case the contractor fails to defend himself or the notice remains unreplyed the contract can be terminated by the owner.

Progress of work being slow, non-completion of work in time, work not being according to drawings and specifications, non-compliance of engineers instructions are the usual causes on ground of which the owner can terminate the contract.

20.5. Conditions of Contract

Conditions of contract are also known as general provisions. They are written in different clauses and they mainly relate to the work as a whole. Their object is to avoid dispute between the parties concerned and to keep them away from the courts of law. The conditions of contract are prepared in the legal phrasology. Since conditions of contract regulate and relate the work being done, there is every possibility that disputes may arise. In that case conditions of contract are put to test as it is these conditions which protect the legal interests of both the parties. In case of very important and complicated contracts, the job of framing conditions is entrusted to a competent lawyer.

The conditions of contract to be included in any particular work depend on the nature of the work. The following conditions of contract are generally accommodated in case of most of the civil engineering contracts.

1. Conditions relating to the general obligations of contractor.
2. Conditions relating to labour and personnel.
3. Conditions relating to the execution of the work.
4. Conditions relating to documents.
5. Conditions relating to measurements and payments.
6. Conditions relating to default and non-completion of work.
7. Conditions relating to assignments and sub-letting.
8. Conditions relating to settlement of disputes.
9. Special conditions.

UNIT III SPECIFICATION AND TENDERS

Data – Schedule of rates – Analysis of rates – Specifications – sources – Detailed and general specifications – Tenders – Contracts – Types of contracts – Arbitration and legal requirements.

Data for Estimate: -

To make out an estimate for a work the following data are necessary – (1) Drawing (plans, section, etc.), (2) Specifications, and (3) Rates.

(1) Drawings. – Plan, sectional elevations, and detailed to scale, fully dimensioned are required. The plan, elevation and sectional elevations are usually drawn to a scale of 1 cm = 1 m (1"=8'), and detailed drawings are prepared to scales of 1 cm = 29 cm (1"=1' to 1"=2')

(2) Specifications: –

(i) General Specifications or Brief Specifications.- These gives the nature, quality and class of work and materials, in general terms, to be used in the various parts of the work. General specifications help to from a general idea of the whole building or structure and are useful in preparing the detailed estimate.

(ii) Detailed Specifications:- These give the detailed description of the various items of work laying down the quantities and qualities of materials, their proportions, the method of preparation, workmanship and execution of work. Detailed specification describe every item of work separately, in detail and are helpful for the execution of the different items of work.

SPECIFICATIONS

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 the 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 from important part of contract document.

During writing specification attempts should be made to express all the requirements of the work clearly and in a concise form avoiding repetition. As far as possible, the clauses of the specification should be arranged in the same order in which the work will be carried out. The specifications are written in a language so that they indicate what the work is should be, and words “shall be” or “should be” are used.

Specifications depend on the nature of the work, the purpose for which the work is required, strength of the materials, availability of materials, quality of materials, etc.

Specifications are of two types:-

- (1) General Specification and Brief specifications and
- (2) Detailed specification.

General or brief specification – General specification gives the nature and class of the work and materials in general terms, to be used in the various parts of the work, from the foundation to the superstructure. It is a short description of different parts of the work specifying materials, proportions, qualities, etc. General

specifications give general idea of the whole work or structure and are useful for preparing the estimate.

For general idea, the general specifications of different class of buildings are given below. These will of course vary according to the necessity and type of works.

General Specification of a First Class Building

Foundation and plinth – Foundation and plinth shall be of I-class brickwork in lime mortar or 1:6 cement mortar over lime concrete or 1: 4 : 8 cement concrete.

Damp proof course – D.P.C shall be 2.5 cm(1”) thick cement concrete 1:1½ : 3, mixed with one kg of Impermo per bag of cement or other standard water proofing materials as specified and painted with two coats of bitumen.

Superstructure – Superstructure shall be of I-class brickwork with lime mortar or 1:6 cement mortar. Lintels over doors and windows shall be of R.C.C.

Roofing – Roof shall be of R.C.C. slab with an insulation layer and lime concrete terracing above, supported over R.S. Joists or R.C.C. beams as required. Height of rooms shall not be less than 3.7 m (12feet).

Flooring – Drawing room and dining room floors shall be of mosaic (terrazzo). Bathroom and W.C floors and dado shall be of mosaic (terrazzo). Floor of bedrooms shall be colored and polished of 2.5 cm(1”) cement concrete over 7.5cm(3”) lime concrete. Floors of others shall be of 2.5cm(1”) cement concrete over 7.5 cm(3”) lime concrete polished.

Finishing – Inside and outside walls shall be of 12 mm (1/2”) cement lime plastered 1:1:6. Drawing, Dining and bedrooms – inside shall be distempered, and others – Inside white washed 3 coats. Outside shall be colored snowcem washed two coats over one coat of white wash.

Doors and windows – Chaukhats shall be seasoned teak wood. Shutters shall be teak wood 4.3 cm (1¾”) thick paneled glazed or as required, with additional

wire gauge shutters. All fittings shall be of brass. Doors and windows shall be varnished or painted two coats with high class enamel paint over one coat of priming. Windows shall be provided with iron gratings or grills.

Miscellaneous – Rain water pipes of cast iron or of asbestos cement shall be provided and finished painted. Building shall be provided with 1st class Sanitary and water fittings and Electrical installations. 1 meter wide 7.5 cm thick C.C. 1:3:6 apron shall be provided all round the building.

DETAILED SPECIFICATION

The detailed specification is a detailed description and expresses the requirement in detail.

The detailed specification of an item of work specifies the qualities and quantities of materials, the proportion of mortar, workmanship, the method of preparation and execution and the methods of measurement. The detailed specifications of different items of work are prepared separately, and describe what the works should be and how they shall be executed and constructed. Detailed specifications are written to express the requirements clearly in a concise form avoiding repetition and ambiguity. The detailed specifications are arranged as far as possible in the same sequence of order as the work is carried out. The detailed specifications if prepared properly are very helpful for the execution of work. The detailed specifications form an important part of contract document.

Every engineering department prepares the detailed specifications of the various items of works, and get them printed in book form under the name 'Detailed Specifications' When the work, or a structure or project is taken up, instead of writing detailed specification every time, the printed Detailed Specifications are referred.

The detailed specifications of various items of works are as follows:–

1. Earthwork in excavation of foundation –

Excavation – Foundation trenches shall be dug out to the exact width of foundation concrete and the sides shall be vertical. If the soil is not good and does not permit vertical sides, the sides should be sloped back or protected with timber shorting. Excavated earth shall not be placed within 1 m (3') of the edge of the trench.

Finish of trench – The bottom of foundation trenches shall be perfectly leveled both longitudinally and transversely and the sides of the trench shall be dressed perfectly vertical.

Schedule of Rates:

It is a list of rates of various items of works. To facilitate the preparation of estimates, and also to serve as a guide in setting rates in connection with contract agreements, a schedule of rates for all items of work is maintained in the Engineering Department in the form of a printed book known as “ Schedule of Rate Books”.

Rate per unit of various items of work and materials, rates of wages of labour and rates of transport are given in the ‘Schedule of Rates’. P.W.D. maintains a printed schedule of rate book for various items of the work and estimates are prepared with these rates.

The rates are workable rates for the completion of the items including materials, transport, labour, profit, etc., The Schedule of rate is prepared on the basis of analysis of rates.

RATES:

For preparing the estimate the unit rates of each item of work are required.

1. For arriving at the unit rates of each item.
2. The rates of various materials to be used in the construction.
3. The cost of transport materials.

4. The wages of labour, skilled or unskilled of masons, carpenters, Mazdoor, etc.,

Analysis of Rates

Definition : 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 rates 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.
4. 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 2nd Class
- 3) Un skilled

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.

Lead statement:

The distance between the source of availability of material and construction site is known as "Lead " and is expected in Km. The cost of conveyance of material depends on lead.

This statement will give the total cost of materials per unit item. It includes first cost, conveyance loading, unloading stacking, charges etc.

The rate shown in the lead statement are for metalled road and include loading and staking charges .

The environment lead on the metalled roads are arrived by multiplying by a factor

- a) for metal tracks - lead x 1.0
- b) For cartze tracks - Lead x 1.1
- c) For Sandy tracks - lead x 1.4

Note: For 1m^3 wet concrete = 1.52m^3 dry concrete approximately

Specific Weight of concrete= 1440 kg/m^3 (or) 1.44 t/m^3

1 bag of cement = 50 Kg.

Example 1:- Calculate the Quantity of material for the following items.

- a) R.C.C. (1:2:4) for 20m^3 of work
- b) R.C.C. (1:3:6) for 15m^3 of work

$$\text{a) Quantity of cement required} = \frac{1}{(1+2+4)} \times 1.52 \times 20 = 4.14\text{m}^3 \times 1440 / 50$$

$$= 119.26 \text{ bags.}$$

$$\text{Quantity of Sand required} = \frac{2}{(1+2+4)} \times 1.52 \times 20 = 8.28 \text{ m}^3$$

$$\text{Quantity of Sand required} = \frac{4}{7} \times 1.52 \times 20 = 16.56 \text{ m}^3$$

$$\text{b) Quantity of cement required} = \frac{1}{10} \times 1.52 \times 1.5 = 2.28 \text{ m}^3 \times 1440 / 50$$

$$= 65.66 \text{ bags.}$$

$$\text{Quantity of Sand required} = \frac{3}{10} \times 1.52 \times 15 = 6.84 \text{ m}^3$$

$$\text{Quantity of Sand required} = \frac{6}{10} \times 1.52 \times 15 = 13.68 \text{ m}^3$$

Contract. – Contract is an undertaking by a person or firm to do any work under certain terms and conditions. The work may be for the construction or maintenance and repairs, for the supply of materials, for the supply of labour, for the transport of materials, etc.

Contractor.– The term contractor means a person or firm who undertakes any type of contract. Usually, this term is confined to the contractors engaged for the construction or execution of work of repairs.

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.

Earnest money.– While submitting a tender the contractor is to deposit a certain amount, about 2% of the estimated cost, with the department, as earnest

money as guarantee of the tender. This amount is for a check so that the contractor may not refuse to accept the work or run away when his tender is accepted. In case the contractor refuses to take up the work his earnest money is forfeited. Earnest money of the tenderer whose tender has not accepted is refundable. The amount of earnest money depends on the estimated cost of works and is as follows:–

Rs. 50.00 for works up to Rs. 2,000.00. Rs. 100.00 for works above Rs. 2,000.00 to Rs. 5,000.00, Rs. 200.00 for works above Rs. 5,000.00 to Rs. 10,000.00 and Rs. 100.00 for every Rs. 5,000.00 or part there of above Rs. 10,000.00.

Earnest money should be in cash or encashable at any time. Earnest money may be in the form of deposit in Treasury or state bank or other approved bank or Government security, or Savings Certificate or Post Office, Savings Pass-Book or cash certificate, pledged to the Executive Engineer.

Security money. – On acceptance of the contractor has to deposit 10% of the tendered amount as security money with the department which is inclusive of the earnest money already deposited. This amount is kept as a check so that the contractor fulfils all the terms and conditions of the contract and carries out the work satisfactorily according to the specifications and maintain progress and completes the work in time. If the contractor fails to fulfill the terms of contract his whole or part of the security money is forfeited by the department. The security money is refunded to the contractor after the satisfactory completion of the whole work after a specified time, usually after one rainy season or six months of the completion of the work.

Instead of collecting the whole of security money in one instalment before starting the work this can be collected gradually by deducting from the running account bill of the contractor.

Usually the earnest money is taken as part of the security money and the balance amount of security money is collected by deduction from the running account bill of the contractor at 10% of every running bill, up to the extent of 10 per cent of the total cost of whole work.

Arranging contractor.— Contract for a work is arranged by inviting sealed tenders, by issuing tender notice, specifying earnest money, security money, estimated cost, date and time for the submission of tenders etc. One month's time should be given, for the submission of tenders for work whose estimated cost exceed Rs.20,000.00. For urgent work shorter notice may be given but reason for short notice should be kept in record. Tender are opened at the specified date and time by the officer inviting tenders or by his authorized agent, in presence of the contractors or their agents, and the tenders are serially numbered, and signed by the officer opening the tenders; and the rates are the road out and a comparative statement is prepared. The tenders together with comparative statement with the recommendation of the Assistant Engineer or Sub-Divisional Engineer or Executive Engineer are sent to the competent authority for accepting the tender. Usually the lowest tender is accepted but the lowest tender may not be accepted if the capacity of the contractor is doubted or his record of previous work is not satisfactory, or due to other valid reason. After the tender is accepted and the contractor deposits the requisite security money, an order to start work is given to the contractor, and all the tender papers are page numbered and indexed and a contract bond or agreement is prepared and sealed and kept in safe custody.

Power of Accepting tender.— The tenders can be accepted by different authorities according to their power prescribed in financial rule. The following are the powers of different authorities for sanctioned work:—

Chief Engineer	...	...	...	Full Power
Superintending Engineer	...	...	...	Full Power

Executive Engineer	...	...	...	Up to Rs. 5,00,000.00
District Engineer or S.D.O	...	...	...	Up to Rs. 50,000.00
Assistant Engineer	...	...	...	Up to Rs. 20,000.00

Tender notice.— Tender for work or supply are invited by issuing tender notice in prescribed form. In the tender following particulars are given:—

(i) Name of the authorities inviting tender; (ii) Name of work, and its location; (iii) Estimated cost; (iv) Time of completion; (v) Cost of complete set of tender forms and conditions; (vi) Date, time and place of tender; (vii) Amount of earnest money and security money; (viii) Validity of tender, etc.

Tender notice is posted in the notice board of the department and for major work the tender notice in brief is also given in the newspaper.

DIFFERENT METHOD OF CARRYING OUT WORK

The following are the different methods of carrying out work:—

(i) Employment of daily labour on Muster Roll; (ii) Piece Work Agreement; (iii) Work order; (iv) Lump sum contract; (v) Lump sum and Schedule contract (vi) Scheduled contract or item rate contract; (vii) Labour contract; (viii) Cost plus percentage contract.

Daily Labour – Muster Roll System.— Work may be executed departmentally by employing daily labour, as masons, coolies, bhisties, carpenters, etc. The materials required for the construction as bricks, cement, sand, lime, surkhi, timber, steel, etc., and tool and plants required for the operations, are got issued from the store by indent or purchased directly chargeable to the work. The attendance of the labourers is kept in Muster Roll (Form 21) by the overseer or by his authorized agent as work-supervisor, mistry, mate, etc. The attendance of labour is checked, and initialed by Assistant Engineer or Sub-Divisional or Divisional Engineer frequently during their inspections. The labourers are paid

weekly, fortnightly, monthly or at the completion of work according to the requirement. A Temporary Advance or Temporary Imprest by cheque or cash for the total amount is then issued to the overseer or the Assistant Engineer who then disburses the wages to the labourer and signs against each payment. The account of the payment is maintained in Cash Imprest Account (Form 2) by the disburer in duplicate, and one part together with Muster Roll is submitted to the Divisional or Sub-Divisional Officers where it is incorporated in the monthly account. Other part of the Imprest account is kept with the disburer as his office copy.

Piece Work Agreement (P.W.A)- P.W. Agreement is that where only rates are agreed upon without reference to the total quantity of work or time, and that involves payment of work done at the stipulated rate. Small works or piece-work up to Rs. 2,000.00 may be carried out through contractors by Piece-work Agreements. The P.W. Agreement contains only the descriptions of different items of works to be done and the rate to be paid for but does not provide the quantities of different items to be executed nor the time within which the work is to be completed.

Procedure for Termination Piecework Agreement.- If the agreement is terminated before the work is completed, a notice specifying the date of its termination, is served on the piece worker and a receipt obtained. If materials at site are to be taken over, they are on no account used until the valuation statement has been accepted in writing by the pieceworker.

Work Order.- Small work up to Rs. 2,000.00 may be carried out by work Order. This is a contract and specifies the approximate quantities of different items of work, detailed specifications of each item of work, time for completion of the whole work, penalty that will be imposed for not fulfilling terms and conditions, etc. Payment is made on the measurement of the work done and 10 percent of the bill amount is deducted from the running account bill of the contractor as security money which amount is refunded in the final payment on the satisfactory

completion of the work. Debitable agency can be engaged for bad work or for unsatisfactory progress. Contractors are usually selected by taking quotations. (P.W. Agreement is used in P.W.D. and work Order is used in Irrigation Department.)

CONTRACT SYSTEM

In contract system the work is got done through contractors who arrange all material required and employ the workers required for the completion of the work in time. A contract agreement is a bond, the contractor and the Department are bound by the terms and conditions of the contract. The contract agreement stipulates the quantities of works and rates, the detailed specification of various items of work to be done, the time limit within which the whole work shall have to be completed and various other conditions. Contracts are usually arranged by inviting sealed tenders and entrusting the work to the lowest tender usually.

Lump Sum Contract.- In Lump – Sum Contract the contractor undertakes the execution or construction of a specific work with all its contingencies, to complete it in all respects within a specified time for a fixed amount. The detailed specification of all items of works pertaining to the whole work, plans and detailed drawings, and deposit of 10% security money, penalty, progress and other conditions of contract are included in the contract agreement. The general specification and descriptions of different part of the building with dimensions where required are included. The quantities or schedule of different items of work are not provided, the contractor shall have to complete the work as per plan and specification, within the contract fixed sum, within a fixed time irrespective of quantities of different items. On completion of the work no detailed measurement of different items of work is required but the whole work is compared and checked with plans and drawings.

Lump Sum and Schedule Contract.- This is similar to lump sum contract but the schedule of rates is also provided in the contract agreement. In this system

the contractor undertakes the execution or construction of a particular work at a fixed sum within a specified time as per plans and detailed specifications and conditions, and the schedule of rates for various items of work are also provided which regulates the extra amount to be paid or deducted for any additions and alteration. In this case also no measurement of various items of work involved in the original work is required, but measurement of extra items only shall have to be taken. The original work shall however be checked and compared, other conditions of contract are included in the contract agreement.

Schedule Contract or Item Rate Contract.- In schedule contract, the contractor undertakes the execution or construction of a work on the item rate basis. The amount the contractor is to receive depends upon the quantities of various items of work actually done. The contract agreement: includes quantities, rates and amounts for various items of work and the total amount of contract (Bill of quantities with rate, amount and total amount), plans and detailed drawings, detailed specifications and deposit of 10% security money, penalty, progress, date of completion and other conditions of contract. The payment to the contractor is made by detailed measurement of different items of works actually don by the contractor. The system is used for all works,

Conditions of contract. - General conditions of contract are as follows:-

Rates are for complete work including materials, transport, labour, T. and P. and all other agreements necessary.

Contractor shall deposit 10% of the estimated cost as security money, or this amount may be collected gradually from the running account bill of the contractor. Contractor shall have to complete the work by a specified date and have to maintain a monthly progress. If he fails in maintaining the progress or completing the work in time he is liable for compensation or penalty and part or whole of the security money may be forfeited. Time may be extended by the competent

authority on written application of the contractor on valid reason. Running account payment shall have to be made to the contractor from time to time as the work progress. The contractor shall have to arrange for all tools and plants, the work shall be open for inspection, work should not be sublet, contractor shall have to pay wages to the workers as per the rates of the wages of locality. Compensation to the workman shall be paid by the contractor for any accident or damage. For any claim or dispute the decision of the Superintending Engineer shall be final.

All taxes, royalties, etc., shall have to be paid by the contractor which are included in the rates. Labour camp shall have to be maintained and other amenities to labour shall have to be provided.

Contract agreement binds both the contractor and the department legally. Contractor's responsibility is to observe the rules, regulations to the department and to complete the work according to the specifications plans, designs and instructions and in time and not to abandon the work in the middle. Department's requirement is to see that the work is done as per plans, specifications, designs, etc. and progress of the work is maintained and the whole work is completed in time.

CONTRACT DOCUMENT

Before the work is given out on contract an agreement or bond is prepared. The following documents shall be attached to the contract agreement or bond which should be duly endorsed and sealed. Each page shall bear the signature of the contractor and the accepting authority and a:: corrections shall be similarly initialled :-

1. Title page -- having the name of work, contract bond number, etc.
2. Index page -- having the contents of the agreement with page references.
3. Tender notice — giving brief descriptions of the work, estimated cost of work, date and time of the tender, amount of earnest money and security money,

time of completion, etc., Earnest money, usually 2% of the estimated cost, is deposited along with tender.

4. Tender form -- giving the bill of quantities, contractor's rates, and total cost of works, and time for completion, progress of works, security money, penalty clause etc.

5. Bill of quantities or schedule of quantities --- giving quantities and rates of each item of work and cost of each item of work and the total cost of the whole work.

6. Schedule of issue of materials — giving list of materials to be issued to the contractor with rates and place of issue.

7. General specifications — specifying the class and type of works in general.

8. Detailed specifications -- of each item of work, and of each material to be used in the work.

9. Drawings — complete set of drawings including plans, elevations, sections, detailed drawing, etc. and site plan. all fully dimensioned.

10. Condition of contract — containing the terms and conditions of contract in detail. The conditions specify the following :—

(i) Rates inclusive of materials, transport, labour, T. and P. all other agreements necessary for completion of work,

(ii) Amount of the security money,

(iii) Time for completion of the work,

(iv) Progress to be maintained.

(v) Penalty for unsatisfactory and bad work, for failure in maintaining progress, for delay in completion,

(vi) Mode of payment, running account payment, final payment, security money refund,

(vii) Extension of time limit of contract,

(viii) Rules for employment of debitable agency, termination of contract,

(ix) Minimum wages to labour, compensation to labour.

(x) Authority deciding extra items and contractors claims, etc.

II. Special condition -- depending on the nature of works, regarding taxes, royalties, which are included in rates, labour camp, labour amenities, compensation to labour in case of accident. etc.

Labour Contract. — In labour contract the contractor undertakes contract for the labour portion. All materials for the construction are arranged and supplied at the site of work by the department or owner, the labour contractor engages labour and gets the work done according to specifications. The contract is on item rate basis for labour portion only and contractor is paid for the quantities of work done on measurement of the different items of work at the stipulated rate in the contract agreement. Materials for scaffolding, centering and 'stuttering and other similar materials are supplied by the department 'or owner: contractor may also use his own materials for scaffolding, centering and shuttering, etc., if provided in the agreement. Contractor uses his own tools for working, but plants and machineries are arranged by the department or owner. An agreement with all conditions of contract, rates, bill of quantities, etc., is prepared before the work is given out to the contractor. This system of contract is not generally adopted in the Government department. Private buildings are however constructed by labour contract system. Which is less troublesome.

Cost plus percentage contract. — In this system contractor is given certain percentage over the actual cost of the construction as his profit. Contractor arranges materials and labour at his cost and keeps proper account and he is paid by the department or owner the whole cost together with certain percentage, say 10% as his profit as agreed upon beforehand. An agreement is prepared with all conditions of contract in advance. In this case proper control in the purchase of the materials and in labour shall have to be exercised by the department or owner.

Labour engaged through contractors. -- Normally, labourer should not be engaged and paid through contractor. In the case of emergency when labourers are not available directly and the work is required very urgently, labourers may be employed through contractor. In such cast if possible, the quantities of work done should be determined by measurement at the completion of the work and the contractor paid at suitable rates on the measured quantities. But if this method is not practicable, it is permissible to pay the contractor on the basis of number of labourers employed day-to-day at current rates a profit or commission being included in the rate or paid separately on lump sum or percentage basis. When payment on measured work is not possible a record of the number of labourers employed day-to-day should be kept by the overseer incharge and a report submitted to the Assistant Engineer or Executive Engineer to enable him to keep a check on the work and expenditure and to deal with the contractor's claim.

Penalty. — Penalty is a sort of fine for non-fulfilment of terms of contract. Every contract usually contains certain provisions for penalty for breach of terms and conditions of contract as for not maintaining the progress, for delay in completion, for bad work, etc. The penalty may be a fixed-sum per day, or a certain percentage of the estimated cost up to 10%, etc.

Compensation for delay in completion. — Contractor is liable to pay as compensation or penalty an amount equal to 1% of the estimated cost of the work (contracted amount) or such smaller amounts as the Executive Engineer or the competent authority may decide for every day that the work remains uncommenced or unfinished after the due date. The maximum limit of penalty is 10% of the total contract amount.

Liquidated Damages. — It is a fixed stipulated sum of penalty by the contractor or having no relationship with real damage. It is usually exorbitant and fixed per

day varying from Rs.50.00 to Rs.100.00 per day for the excess period taken for the completion of the work than that specified in the contract.

Unliquidated Damages. — This is known as ordinary damages having relation with the actual damage done. It will increase or decrease according to increase or decrease in the damage, for the non-completion of the work within due date of completion, or for not maintaining progress as per condition of contract.

Extension of Time. — The Executive Engineer or competent authority may grant the necessary extension of time for valid reasons if the contractor applies for extension of time within the time. Reason may be the materials, labour, etc., not being available, bad weather condition, land not available in due time, etc. The contractor should apply for extension of time before the due date of completion as provided in the contract agreement.

Termination of Contract. — The contract can be terminated by the Executive Engineer or by competent authority in default or bankruptcy of the contractor and penalty may be imposed as per terms of the contract agreement. If the contractor does not fulfil the terms and conditions of contract as -- if he leaves the work, if he does not maintain progress, if he does not observe the rules, instruction, etc., the contract agreement may be rescinded and all of his security money be confiscated or penalty up to the extent of 10% of the estimated cost may be imposed on the contractor. For termination of contract due notice shall have to be served on the contractor.

Debitable Agency. — This is an agency which is employed to execute a work or part of a work at the cost of a contractor who fails to complete or to show unsatisfactory progress of the work. The debitable agency may be in the form of daily labour or another contractor and may be employed by giving proper notice to

original contractor and the whole cost which is usually higher, is debited or charged to the original contractor.

UNIT IV

VALUATION

Necessity – Basics of value engineering – Capitalised value – Depreciation – Escalation – Value of building – Calculation of Standard rent – Mortgage – Lease

Valuation – Valuation is the technique of estimating or determining the fair price or value of a property such as a factory, other engineering of various types, land, etc. By valuation the present value of a property is determined. The present value of property may be decided by its selling price, or income or rent it may fetch. The value of property depends on its structure, life, maintenance, location, bank interest, legal control, etc. The value also depends on supply on demand and the purpose for which valuation is required.

Cost means original cost of construction of purchase, while value means the present value (saleable value) which may be higher or lower than the cost.

Purpose of valuation – The main purpose of valuation are as follows:-

- i. Buying or selling Property – When it is required to buy or to sell a property, its valuation is required.
- ii. Taxation – To assess the tax of a property its valuation its valuation is required. Taxes may be Municipal Tax, Wealth Tax, Property Tax, etc., and all the taxes are fixed on the valuation of the property.
- iii. Rent fixation - In order to determine the rent of a property, valuation is required. Rent is usually fixed on certain percentage of the amount of valuation (6% to 10% of the valuation)
- iv. Security of Loans or Mortgage – When loans are taken against the security of the property, its valuation is required.

- v. Compulsory acquisition – whenever a property is acquired by law compensation is paid to the owner. To determine the amount of compensation valuation of the property is required.
- vi. Valuation of a property is also required for insurance, Betterment Charges, Speculation.

Gross Income – Gross income is the total income and includes all receipts from various sources the outgoings and the operational and collection charges are not deducted.

Net income or Net return – This is the saving or the amounts left after deducting all outgoings, operational and collection expenses from the gross income or total receipt.

Net income = Gross income – outgoings.

Outgoings – Outgoings or the expenses which are required to be incurred to maintain the revenue of the building. The various types of outgoings are as follows:-

1. Taxes – These includes Municipal Tax, Property Tax, Wealth Tax, etc., which are to be paid by the owner of the property annually. These taxes are fixed on the basis of '*Annual Rental Value*' of the property after deduction for annual repairs, etc.
2. *Repairs* – The repairs are required to be carried out every year to maintain a property in fit condition. The amount to be spent on repairs depends on the age, construction nature of the building, etc., and usually 10 to 15 percent of the gross income or gross rent or 1 to 1½ months rent is allowed for repairs. For annual repairs 1% to 1½% of the total cost of construction may also be taken.

3. *Management and Collection charges* – These include the expenses on Rent Collector, Chaukidar, (watchman) Liftman, Pump attendant, Sweeper, etc. About 5 to 10 percent of the gross rent may be taken on these account. For small building none of these may be required and there will be no outgoings on these account.
4. *Sinking Fund* – A certain amount of the gross rent is set aside annually as sinking fund to accumulate the total cost of construction when the life of the building is over. This *Annual sinking fund* is also taken as outgoings.
5. *Loss of rent* – The property may not be kept fully occupied in such a case a suitable amount should be deducted from the gross rent under outgoings.
6. *Miscellaneous* – These include electric charges for running life, pump, for lighting common places, and similar other charges which are to be borne by the owner.

Scrap Value – Scrap value is the value of dismantled materials. For a building when the life is over at the end of its utility period the dismantled materials as steel, bricks, timber, etc., will fetch a certain amount which is the *scrap value* of the building. In the case of machine the scrap value is the value of the metal only or the value of the dismantled parts. The scrap value of a building may be about 10 percent of its total cost of construction.

Salvage value – It is the value at the end of the utility period without being dismantled. A machine after the completion of its usual span of life or when it become uneconomic, may be sold and one may purchase the same for use for some other purpose, the sale value of the machine is the *salvage value*. It does not include the cost of removal, sale, etc.

Market value – The *Market value* of a property is the amount which can be obtained at any particular time from the open market if the property is put for sale. The market value will differ from time to time according to demand and supply. The market value also changes from time to time for various miscellaneous reasons such as changes in industry, changes on fashions, means of transport, cost of materials and labour, etc.

Book value - *Book value* is the amount shown in the account book after allowing necessary depreciations. The book value of a property at a particular year is the original cost minus the amount of depreciation up to the previous year. The *book value* depends on the amount of depreciation allowed per year and will be gradually reduced year to year and at the end of the utility period of the property the book value will be only scrap value.

Ratable value – *Ratable value* is the net annual letting value of a property, which is obtained after deducting the amount of yearly repairs from the gross income. Municipal and other taxes are charged at a certain percentage of the *ratable value* of the property.

Obsolescence – The value of property or structures become less by its becoming out of date in style, in structure in design, etc., and this is termed as *Obsolescence*. An old dated building with massive walls, arrangements of rooms not suited in present days and for similar reasons, becomes obsolete even it is maintained in a very good condition, and its value becomes less due to obsolescence. The obsolescence may be due to the reasons such as progress in arts, changes in fashions, changes in palling ideas, new inventions, improvements in design technique, etc.

Annuity – *Annuity* is the annual periodic payments for repayments of the capital amount invested by a party. These annual payments are either paid at the end of the year or at the beginning of the year, usually for a specified number of years.

If the amount of annuity is paid for a definite number of periods or years, it is known as *Annuity certain*. In such cases the amount of annuity will be higher, the lesser the number of the years the higher will be the amount and vice versa up to the whole amount of capital.

If the amount of annuity is paid at the beginning of each period of year and payments continued for definite number periods, it is known as *Annuity due*.

If the payment of annuity begins at some future date after a number of years, this is known as *Deffered Annuity*.

If the payments of annuity continue for indefinite period, it is known as *Perpetual Annuity*.

Capital cost – Capital cost is the total cost of construction including land, or the original total amount required to possess a property. It is the original cost and does not change, while value of a property is the present cost which may be calculated by methods of valuation.

Capitalized value - The Capitalized value of a property is the amount of a money whose annual interest at the highest prevailing rate of interest will be equal to the net income from the property. To determine the capitalized value of property it is required to know the net income from the property and the highest prevailing rate of interest.

Year's purchase (Y.P.) – Year's purchase is defined as the capital sum required to be invested in order to receive an annuity of Re. 1.00 at certain rate of interest. For 4% interest per annum, to get Rs. 4.00 it requires Rs.100.00 to be deposited in a

bank. To get Re.1.00 per year it will be required to deposit $\frac{1}{4}$ of Rs.100.00, i.e., $\frac{100}{6} = 16.67$ and so on.

Sinking fund – The fund which is gradually accumulated by way of periodic on annual deposit for the replacement of the building or structure at the end of its useful life is termed as *sinking fund*. The object of creating sinking fund is to accumulate sufficient money to meet the cost of construction or replacement of building or structure after its utility period.

The amount of annual installment of the sinking fund may be found out by the formula. $I = \frac{Si}{(1+i)^n - 1}$, where S = total amount of sinking fund to be accumulated, n – number of years required to accumulate the sinking fund, I – rate of interest in decimal (e.g., 5% = 0.05); and I = annual installment required.

Depreciation – Depreciation is the gradual exhaustion of the usefulness of a property. This may be defined as the decrease or loss in the value of a property due to structural deterioration use, life wear and tear, decay and obsolescence. Usually, the percentage rate of depreciation is less at the beginning and gradually increase during later years.

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

Method of calculating depreciation – The various methods of calculating depreciation are as follows:- (1) Straight line method, (2) Constant percentage method, (3) Sinking fund method and (4) Quantity survey method.

In all these methods, it is necessary to decide the economic or effective life of the property.

(1) *Straight line method.* - In this method it is assumed that the property loses its value by the same amount every year. A fixed amount of the original cost is deducted every year, so that at the end of the utility period only the scrap value is left.

Annual depreciation $D = \frac{\text{Original cost} - \text{scrap value}}{\text{life in year}} = \frac{C-S}{n}$, where C- original cost, S – Scrap value, n – life of the property in years and D – annual depreciation. The book value after the number of years, say N years = original cost – N x D.

(2) *Constant percentage method or Declining balance method.* – In this method, it is assumed that the property will lost its value by a constant percentage of its value at the beginning of every year.

Annual depreciation, $D = 1 - \left(\frac{S}{C}\right)^{1/n}$, where C, S, n and D have the same meaning as above.

The value of the property of the depreciated cost at the end of the first year, = C-DC= C₁

The value of the property at the end of the second year = C₁-DC₂ and so on.

The value of the property or the depreciated cost at the end of the m years = $C \left(\frac{S}{C}\right)^{m/n}$

The formula will fail when S = 0. When the ratio $\frac{S}{C}$ is very small, the depreciation for the first year will be considerable.

(3) *Sinking fund method.* – In this method the depreciation of property is assumed to be equal to the annual sinking fund plus the interest on the fund for that year, which is supposed to be invested on interest bearing investment. If A is the annual sinking fund and b, c, d, etc., represent interest on the Sinking fund for subsequent years, and C= total original cost, then

At the end of	Depreciation for the year	Total depreciation	Book Value
1 st year	A	A	C-A
2 nd year	A+b	2A+b	C-(2A+b)
3 rd year	A+c	3A+b+c	C-(3A+b+c)
4 th year	A+d	4A+b+c+d	C-(4A+b+c+d)
			So on

(4) *Quantity survey method.* – In this method the property is studied in detail and loss in value due to life, wear and tear, decay, obsolescence, etc., worked out. Each and every step is based on some logical ground without any fixed percentage of the cost of the property. Only experienced valuer can work out the amount of depreciation and present value of a property by this method.

VALUATION OF BUILDING

Valuation of a building depends on the type of the building, its structure and durability, on the situation, size, shapes, frontage, width of roadways, the quality of materials used in the construction and present – day prices of materials. This also depends on the height of the building, height of plinth, thickness of wall, nature of floor, roof, doors, windows, etc. A building located in the market area will have higher value than a similar building in the residential are. The valuation of building mainly depends on the income it will fetch if let out. Usually 6% interest per

annum of the capital cost is taken as annual rent, it may be more or less according to the prevalent market rate.

Cost from record – Cost of construction may be determined from the estimate, from the bill of quantities, from record at present – day rate. If the actual cost of construction is known, this may increase or decrease according to the percentage rise or fall in the rates which may be obtained from the P.W.D. schedule of rates.

Cost by detailed measurement – If record is not available, the cost of construction may be calculated by preparing the bill of quantities of various items of works by detailed measurement at site and taking the rate for each item as prevalent in the locality or as current P.W.D. schedule of rates. All the items of works should be thoroughly scrutinized and their detailed specifications ascertained as actually exist.

Cost by plinth area basis - To fix the plinth area rate it's necessary to examine thoroughly the different parts of the building, the foundation, structure, floor, roof, doors and windows, finishing, etc. If judiciously worked out the cost determined by plinth area method will be fairly correct and sufficient for practical purpose. Cost may be calculated by *cubical content method*.

Determination of depreciation – After deciding the cost of the building or structure by any one of the above method it is necessary to allow a suitable depreciation on the cost the depreciation depends on the ultimate use of the building the present age of the building, nature of maintenance, etc. Generally, for the first 5 to 10 years there is little depreciation of the building or structure. The depreciation increases with the life.

For a building whose life is considered as 80 years, if well maintained the following may be reasonable depreciation:-

	Depreciation per year	Total depreciation
0 to 5 years		... = Nil
5 to 10 years	@ ½ per cent	... = 2.5 per cent
10 to 20 years	@ ¾ per cent	... = 7.5 per cent
20 to 40 years	@ 1 per cent	... = 20.0 per cent
40 to 80 years	@ 1½ per cent	... = 60.0 per cent
	Total	... 90.0 per cent

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

Method of valuation. – The following are the different 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.

1. Rental method of valuation. – In this method, the net income of rent is found out by deducting all outgoings 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 Y.P 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.

- 1. 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 evidence 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. 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 annual income is worked out after deducting from the gross income all possible working expenses, outgoings, interest on the capital invested, etc. The net profit is multiplied by Y.P to get the capitalized value. In such cases the valuation may work out to be too high in comparison with the cost of construction.
- 3. 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.
- 4. Development method of valuation** – This method of valuation is used for the properties which are in the undeveloped stage or partly developed and partly undeveloped stage. If a large piece 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 additions, alterations or improvements, the development method of valuation may be used. The valuation of the property may be worked out from the anticipated future net income which it may fetch after its renovation. The net income multiplied by the Y.P will give the anticipated capitalized value. The total

expenditure required to be incurred in renovation should be worked out, and the original cost of the property together with the new expenditure should be compared with anticipated value and decided if the investment in renovation is justified.

5. Depreciation method of valuation – According to this method of valuation the building should be divided into four parts viz. – (i) Walls (ii) Roofs (iii) Floor and (iv) Doors and windows; and the cost of each parts should first be worked out on the present-day rates by detailed measurements.

Depreciated value of each part is ascertained by the formula $D = P \left(\frac{100-rd}{100}\right)^n$, where D is the depreciated value, P is the cost at present market rate and rd the fixed percentage of depreciation (rate of depreciation, r stands for rate and d for depreciation) and n the number of years the building had been constructed. The value of rd may be taken as below:–

Structures with 100years life, rd = 1.0, Structures with 75 years life, rd = 1.3, Structure with 50 years life, rd = 2.0, Structures with 25 years life. rd = 4.0 Structure, with 20 years life, rd = 5.0.

The values arrived at will be exclusive of cost of land, water supply, electric and sanitary fitting, etc., and will apply to those buildings only which have been properly maintained.

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.

Cost of land – For the valuation of the whole property the cost of land should also be added to the depreciation value of the building. The cost of land should be taken as prevalent in the locality from the recent sale transactions or from the enquiries from the property Brokers or from the Sub-Registrar's Office.

For Mortgage purposes, the mortgage value of a property is taken as $\frac{1}{2}$ to $\frac{2}{3}$ of the valuation or capitalized value.

MORTGAGE LEASE

Mortgage – An owner can borrow money against the security of his property, and for that purpose he is required to grant an interest to the party advancing the loan. The loan is required to be returned in specified time. The person who takes the loans is known as *Mortgagor*, and the person who advances the loan is known as Mortgagee, and the relevant document for the mortgage transaction is known as *Mortgage deed*. When the loan is fully repaid together with interest the mortgagor has got the right to free his property from the mortgagee, and this is known as Equity of redemption.

The amount of loan will depend on the valuation of the property, usually 50 to 70 per cent of the valuation is advanced as loan. The interest should be paid by regular installments, and the loan also may be repaid by regular installments spread over the specified period of the mortgage.

Freehold property – A *freehold* property means that the owner is in absolute possession of the property, and the owner can utilize the same in any manner, he likes, subject to the rules and regulations of Government and local authorities. He may use the property by himself, he may grant leases, or tenancies for a short period or any period.

Leasehold property – It indicates the physical possession of the property and the use of it may be allowed by the original (lessor) as per lease document. The owner of a freehold property may give permission to any other person to use his

freehold which is known as giving property on lease. The person who takes lease is known as lessee or leaseholder and the owner who grants lease is known as lessor.

The main types of lease are:-

(1) Building lease (2) Occupation lease

1. *Building lease* – The owner of a freehold land leases out his plot of land to somebody to construct a building, on payment of a yearly ground rent by the leaseholder. The leaseholder constructs the building and maintains it at his own expenses and earns some rent from the building. The net income to the leaseholder will be net rent minus the ground rent he pays to the lessor. As the leaseholder has to invest sufficient money in constructing the building, such lease is granted for long period for 99 or 999 years. At the end of the lease period the lessor has got the right on his land together with the structure on the land.
2. *Occupation lease* – In this case the building or the structure is build by the owner (freeholder) and the built up property is given on lease for the purpose of occupation for a specified period on payment of certain amount of annual rent. The occupational lease may be for residential, office, factory, shop, etc. The lease period will depend on the purpose for which the structure or building has been constructed. If for a factory, the lease period should be 10 to 30 years, for other cases it may be less. In occupation lease the maintenance of the building or structures is usually done by the leaseholder which may be provided in the lease deed.

Easement – Easement are the rights and privileges which one owner of a property enjoys through or over the property of another. The person who enjoys the easements over a property is called Dominant owner and the

owner over whose property the easements are enjoyed is called *Servient owner*. The following are some of the main easements:-

- (1) Right to use light and air from and over the property of the adjoining owner's land.
- (2) Right of access from the adjoining owner's land.
- (3) Right to run and maintain water and drainage pipes through the neighbour's land.
- (4) Right of flow of rain water over other's land.
- (5) Right of support for a building from the adjoining owner's land.

FIXATION OF RENT

The rent of building is fixed on the basis of certain percentage of annual interest on the capital cost and all possible annual expenditures on outgoings. The capital cost includes the cost of construction of the building, the cost of sanitary and water supply work and the cost of electric installations and the cost of subsequent additions and alterations if any. The cost of construction also includes the expenditures of the following:-

- (1) Raising, leveling and dressing sites,
- (2) Construction of compound walls, fences and gates,
- (3) Storm water drains, and
- (4) Approach roads and other roads within the compound.

To this net return, all possible expenditures on outgoings are added to get gross annual rent.

Gross rent = Net rent + outgoings.

Dividing the gross rent by 12, rent per month can be calculated. The rent worked out by this procedure is known as Standard rent, while the actual rent of the property, may be higher or lower than this rent depending upon the situation of the property, type of construction, demand and supply, etc.

VALUATION AND RENT FIXATION OF GOVERNMENT BUILDING

Rent Statement – For every Government residential building the rent, the occupant has to pay, is normally calculated on a statement known as the Rent Statement. The rent statement is prepared under the following conditions.

- i) When a residential building is newly constructed,
- ii) When a residential building is acquired by purchase, lease, or transfer.
- iii) When there are additions and alternations to a residential building, costing beyond certain limit fixed by the Government,
- iv) When whole or part of a building or other non-residential building is to be used for residential purposes.

FIXATION AND CALCULATION OF RENT OF GOVERNMENT BUILDING

The basis for calculation of standard rent is to allow a certain percentage of interest on the capital cost and to add the annual expenditure on repairs, maintenance and taxes. The capital cost includes the construction, of the building, the cost of sanitary and water supply works, and the cost of electric installations, etc. The cost of land is not included in the capital cost. The Standard rent is fixed as per rules framed by the Government, which differs to some extent from State to State

Method 1. – According to this method the annual standard rent is taken as 6% per annum of the total capital cost. The capital cost includes the cost of construction of the building, the cost of sanitary and water supply works, and the cost of electric installations. The cost of construction of compound walls, fencing and gates and the cost of approach roads, and other roads within the boundaries are also considered as part of the capital cost. The cost of land is not included.

Method 2. – According to this method the standard rent is calculated at 6% interest on the capital cost and in addition the expenditure on annual and special

maintenance and repairs, and municipal and other taxes are added. For annual repairs $1\frac{1}{2}\%$ of the cost of building, 1% of water supply works. 1% of the cost of sanitary works, and $1\frac{1}{2}\%$ of the cost of electric installations are allowed per annum.

For quadrennial and special repairs 0.6% of the cost of building, $3\frac{1}{2}\%$ of the cost of water supply works, $3\frac{1}{2}\%$ of the cost of sanitary works and $3\frac{1}{2}\%$ of the cost of electric installations are allowed per annum.

Municipal and property taxes are taken as actual amount to be paid, or calculated on the percentage basis of rent as per rules of Municipal Board or Government.

Rent fixed by the above method is the maximum rent or standard rent for building, but the Government official occupying has to pay 1/10 of salary or emoluments, in addition he has to pay the water tax, normal as well as excess sewerage charges and Electricity bill. House tax maintenance cost property tax paid by Government or owner. For Government residential building, a rent statement is usually prepared during the preparation of the estimate and enclosed with the estimate.

For Government residential building constructed before July 1921 an interest of $3\frac{1}{2}\%$ is allowed instead of 6% for fixing standard rent.

If a = total plinth area of the building, b = plinth area of portion used for non-residential purpose from centres to centres of walls and c = plinth area of the verandahs directly in front of the non-residential portion and used for non-residential purpose then b + c = plinth area of non-residential portion. Proportionate rent of the residential portion = standard rent of whole building

$$\times \frac{a(b+c)}{a} .$$

UNIT V

REPORT PREPARATION

Principles for report preparation – report on estimate of residential building – Culvert – Roads – Water supply and sanitary installations – Tube wells – Open wells.

Introduction

Each estimate is accompanied with a report describing the various features of the work. The report should be written in such a manner that on the study of the report one can form an idea, about the whole work. A few typical reports and estimate for different works are given below to form a general idea. The report of each work will differ from the other and shall have to be written according to the nature of the work. The report is usually given at the beginning of the estimate followed by calculations, design, general and detailed specifications, analysis of rates, materials statement and then the detailed estimate. The plans and drawings are enclosed at the end. In the last page of the abstract of estimate there are space for signatures for the Assistance Engineer, the Executive Engineer and the Superintending Engineer and for the sanctioning authority. In the top of title page, the estimate number, name of work, name of division, head of accounts, total cost of title page, the estimate, etc., are written. In index page the contents and page numbers are also given.

Report should consist of the following main points : -

- ✓ Brief history, with reference to the proposal.
- ✓ Object, necessity, utility and feasibility of the project with reasons.
- ✓ Surveying
- ✓ Accommodation provided or brief description of the works provided in the estimate.
- ✓ Nature of soil and topography of the land, orientation, etc.,
- ✓ General specifications and basis of design calculations.

- ✓ Arrangements for water supply, sanitary works and electrical installations.
- ✓ Roads and drains.
- ✓ Miscellaneous items as labour amenities, temporary accommodation for staff, etc., for big project.
- ✓ Manner of execution.
- ✓ Total cost and how to be financed.
- ✓ Return or revenue income if any.
- ✓ Rent statement if any.
- ✓ Time of execution.

REPORT ON ESTIMATES FOR THE CONSTRUCTION OF RESIDENTIAL BUILDING

The detailed estimate for construction of a residential building for the Executive Engineer at Udaynagar has been prepared in compliance of S.E.'s letter no dated There is no building for the residence of the Executive Engineer at Udaynagar and he has to live in a rented building with meager accommodation at a very high rent. It has, therefore, been proposed to construct a residential building for the Executive Engineer. The head of the accounts will be 50 civil original works, building.

The estimate provides for the following accommodation: –

One drawing room, one dining room, three bed rooms, one guest room, and the necessary store, kitchen, baths, front and back verandahs and motor garage per plan enclosed.

A site has already been selected having a land of 60m x 30m (200 x 100) for the construction of the building having good soil and proper drainage and this much of land has to be acquired. The building shall be oriented to face north direction.

The building shall have lime concrete foundation and first class brick masonry with lime mortar up to plinth level and the superstructure shall be first class brick work in cement mortar, 1:6. Lintels shall be of R.B work and roof

shall be R.C.C. with lime concrete terrace finishing. The drawing and dining rooms shall have mosaic floor and other rooms 2.5cm (1") c.c. floor over 7.5cm (3") lime concrete. Inside and outside walls shall be 12mm (1/2") cement lime plastered 1:1:6, and ceiling shall be 6mm (1/2") cement plastered 1:3. Inside of drawing and dining rooms shall be colour washed and inside of remaining rooms shall be white washed and outside wall shall be colour washed. Doors and windows shall be of 4.5cm (1³/₄") thick teak wood with chaukhat of sal wood and enamel painted. All work shall be strictly as per detailed P.W.D. specification.

The estimate has been prepared at P.W.D. schedule of rates, and for non-schedule items on analysis of rates. The foundation has been designed for a safe load of 9 tonne per sq m (8 ton per sq ft) and the R.C.C. roof has been designed for a safe load of 150 kg per sq m (30 lbs per sq ft) with 1400 kg per sq cm (20000 lbs per sq in) as safe tensile stress of steel and 50 kg per sq cm (750 lbs per sq in) as safe compressive stress of concrete. All designs and calculations have been included in the estimate. Plans and drawings and site plans are also enclosed with the estimate.

Provision has been made for electrification and sanitary and water supply works and 20% of the estimated cost of the building works has been included for these works. As there is no sewer line in the area a septic tank shall have to be constructed for which lump sum provision of Rs700.00 has been made in the estimate.

Provision for compound with a gate in the front and barbed wire fencing on the sides and back, and approach road have also been made in the estimate.

A statement of important materials as cement, steel, coal, etc., which shall have to be arranged by the department is also enclosed with the estimate. A rent statement is also enclosed.

The work shall be carried on contract by inviting tenders. The work shall have to be completed within six months from the date of start.

The estimate work out as Rs.5,000.00 and is submitted for sanction and allotment of fund.

REPORT ON ESTIMATE FOR CONSTRUCTION OF A CULVERT

The estimate has been prepared for the construction of an arch culvert of 3 m span in 15 km–300 m on Lucknow - Daulatpur road. The road at this point is flooded almost every year during the rainy season, causing flood and damages in the area. During the last inspection the Executive Engineer has asked to prepare an estimate and this estimate has been prepared in compliance of E.E's letter no dated the cost of construction will be met from 50 civil work special repairs.

The culvert has been designed for I.R.A. Class a loading. The catchment area has been determined from the 2.5 cm (1") map of the area, which comes to 1200 acres, and the water way has been calculated by the Talbot formula $a = cA^{\frac{3}{4}}$, where a = waterway in sq ft, A = catchment area in acres, and c = constant and has been taken as 0.2. All calculation and design have been enclosed with the estimate.

The soil has been tested and has been found to be good, and ordinary spread foundation will be sufficient. The foundation shall be of cement concrete 1:4:8 and abutments, with walls and parapets shall be of brick masonry in 1:5 cement mortar, the arch work shall be brick masonry in 1:3 cement mortar. Exposed surfaces shall be cement pointed 1:2. All works shall be as per detailed P.W.D. Specification.

The estimate has been prepared at P.W.D. Schedule of Rates. A statement of materials, cement, bricks, coal, etc., required for the construction, has been enclosed with the estimate. The work shall be executed on contract by inviting tenders and the work shall be started after the rainy season and shall be completed within four month's time.

The estimate amounting to Rs. 15,000.00 is submitted for sanction and allotment of Fund.

REPORT ON THE ESTIMATE FOR A ROAD CONSTRUCTION

The estimate for the construction of Hindnagar - Kaliganj road of 25 km–500m in length has been prepared for linking Kaliganj with the District Headquarters in compliance with S.E.'s letter nodated

Kaliganj is an important market place for agricultural products and there are some cottage industries in the area, and there having no road the area is not being developed. The proposed road will also serve many villages on either side. The people of the locality have also represented and demanded separately for the construction of this road. It is therefore essential to construct this road. The proposal has been included in the Fourth Five Year Plan and the cost will be met from the Road Development Fund.

Alignment of the road follows an existing cart road with straightening when necessary and avoiding congested areas as far as possible. Flat curves have been provided with a minimum radius of 150m. In selecting the alignment the principles of shortest route, serving maximum population, minimum drainage crossing easy gradient economy of construction, etc., have been followed. The road passes mostly through uncultivated area in plane land, and mostly in banking of 60 cm to 90 cm high excepting a few places where the road passes in low land where high banking will be required.

Profile survey has been made for the whole length of the road for 60 m width on each side of the centre line and L-section has been fixed by taking levels at every 30 m and cross levels have been taken at every 90 meter. Formation line has been fixed to have easy gradient and ruling gradient of 1 in 40 has not been reached anywhere. Highest flood level has been kept in view and formation line has been kept above normal flood level.

A number of culverts will be required along the length of the road and a bridge of about 30 m span will be required across the stream in km 12. A list of bridges and culverts of different span has been enclosed and provisions have been made on the basis of running meter of span at the rate of Rs.5,000.00 per r

m of span for culverts and Rs.6,000.00 per r m of span for bridges. Bridges shall have to be designed on I.R.C. class A loading and their detailed estimate shall have to be prepared separately.

A present land of 30 m width shall be required and has been provided in the estimate. Temporary land for borrow pits shall be required for one year for taking earth for embankment and provision has been made accordingly. The formation width of the road shall be 10 m and side slope 2:1 in banking and ½ : 1 in cutting.

The road shall be metal led with soling coat of brick on edge with over burnt brick and two coats of metalling, inter coat, each of 8 cm compacted layer with stone ballast. The two wearing coats shall be of one coat of bituminous painting. Provisions for metalling and painting have been made in the estimate accordingly. Brick shall be burnt by contract by the side of road distributed along the road in three brick kilns. Coal shall have to be supplied to contractors for burning bricks and a statement of coal requirement is enclosed. Stone metal shall be hard granite type and shall be collected from the approved quarry.

The whole work of construction shall be spread in five years, earth work one year, rest for settlement one year, metalling two years and painting one year.

Second coat bituminous painting shall be done after one year of 1st cost of painting and cost of painting shall be met from maintenance grant.

All works shall be done strictly as per detailed P.W.D. Specifications. The estimate has been prepared at P.W.D. Schedule of rates and local current rates and analysis of rates have been given for non-schedule items. The work shall be done by contract by inviting tenders.

Survey Plan, L-section of the proposed road are enclosed with the estimate. An index plan showing the alignment has also been enclosed.

The estimate amounting to Rs. 25,00,000.00 has been submitted for sanction and allotment of fund.

REPORT ON ESTIMATION OF WATER SUPPLY INSTALLATIONS

This estimate provides drinking water supply to the village “Sirunagallur” in Madurananthakam Panchayat Union of Kancheepuram District.

At present there is no public drinking water supply to the village and the people get drinking water from the private irrigation wells. The population of the village is about 3,000 and they experience hardship in getting drinking water from the private wells. Very often this village is affected by drought.

They(people) have been representing to the collector for providing drinking water supply system to their village. The collector has ordered for it and hence this estimate.

In this estimate provisions have been made for the following items:

1. 150mm diameter and 60m deep well.
2. Multistage turbine pump of 7.5 Kw capacity.
3. An overhead tank of 1,20,000 litres capacity.
4. Distribution system.

The bore well is proposed to sunk near a stream at a distance of 1Km from the village. The cost of multistage turbine pump will be Rs.30,000. The R.C.C. overhead tank will be constructed near the bore well for a height of 15m from Ground level.

The distribution system consists of a 75mm dia. G.I. main from the overhead tank and 20mm dia. G.I. distributors will be provided. It is proposed to distribute the water at selected points by 20mm taps.

The estimate has been prepared adopting the schedule at rates and works out to Rs.3,50,000. The expenditure can be met from the fund allotted for self sufficiency scheme. The estimate may be sanctioned and fund allotted.

*(sd). Panchayat Union Engineer
(President Panchayat Union)*