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SCHOOL OF BUILDING AND ENVIRONMENT

DEPARTMENT OF ARCHITECTURE

UNIT – I – SPECIFICATION & ESTIMATION - SAR1402

INTRODUCTION TO SPECIFICATION

SPECIFICATION

Specifications describe 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

Drawings + specification =

Purpose of giving Specifications

- The cost of a unit quantity of work is governed by its specifications.
- Specification of a work is required to describe the quality and quantity of different materials required for a construction work and is one of the essential contract documents.
- This also specifies the workmanship and the method of doing the work. Thus specification of a work serves as a guide to a supervising staff of a contractor as well as to the owner to execute the work to their satisfaction.

- A work is carried out according to its specification and the contractor is paid for the same. Any change in specification changes the tendered rate.
- As the rate of work is based on the specification, a contractor can calculate the rates of various items of works in tender with his procurement rates of materials and labour. Thus tender rate without specification of works is baseless, incomplete and invalid.
- Specification is necessary to specify the equipment tools and plants to be engaged for a work and thus enables to procure them beforehand.
- The necessity of specification is to verify and check the strength of materials for a work involved in a project.

Types of Specifications

- **General Specifications**

  In general specifications, nature and class of works and names of materials that should be used are described. Only a brief description of each and every item is given. It is useful for estimating the project. The general specifications do not form a part of contract document.

- **Detailed Specifications**

  The detailed specifications form a part of a contract document. They specify the qualities, quantities and proportions of materials and the method of preparation and execution for a particular item of works in a project. The detailed specifications of the different items of the work are prepared separately and they describe what the work should be and how they shall be executed. While writing the detailed specifications, the same order sequence as the work is to be carried out is to be maintained.

  Detailed specifications consists of:

- General provisions
  - Conditions of contract
  - Depend on nature of work
  - Relating to documents
  - General obligations of the contractor
  - Conditions relating to labour
  - Subletting, execution of work
  - Measurement and payment
  - Default and non-completion settlement of disputes and specific conditions etc..

- Technical provisions
  - Shows desired quality of final product
  - Details of inspection and test
  - Deals with specifications of materials, workmanship, performance and proprietary commodities
- Standard specifications
  - Strandadized format.
  - Lengthy process of wording will be avoided.
  - Saves time, labour and cost.
  - Eg: earth work, brick work, etc.
- Can be used in Cpwd, Mes, Railway dep.

Essential requirements of specifications

Subject matter:

- The subject matter of the specification should relate to the information required for the contractor after the contract is given to him.
- The requirements which are to be enforced only should be included in the specification.

Grammar:All sentences should follow the rules of grammar. Abbreviations:

- Well known abbreviations in the building industry should be used. Development of style:
- The main aim is to resent a clear picture of facts. The style of arranging of ideas should be clear and brief.

Selection of words:

- Suitable words in the desired meaning should be used. Words having more than one meaning or unfamiliar words shall not be used.

Accuracy:

- The information given in the specification should be complete and correct. Information should not be repeated.

Clearness

- As far as possible the information should be clear. It should state whether the contractor shall or shall not do. In fact the parties, owner and contractor should follow the same sense.

Brevity:

- Sentences should be short simple and concise. Straight forward specification would be clearly understood by the persons filling the tenders. The brevity is the essence of specifications.

Practical limits & commercial sizes:

- The specification should be framed within the practical limitation of the materials and workman ship. It should not specify practical impossibilities. It should specify the use of commercial sizes and pattern of materials available in the market.

Fairness:

- The specification should be fair and should not be framed in such a way so as to throw all the risks on the shoulders of the contractors. Likely hazards, difficulties should be specified so as to give a clear picture of the work to the contractor.

Steps involved in specification writing:

- Earthwork excavation

  Starting of work- Workmanship- excavated material- protection to existing services- measurement.

- Cement concrete for foundation

  Mix proportion- cement mortar- aggregates- mixing- placing- ramming- curing- measurement.

- Random rubble masonry in CM (1:5)

  Properties of stones - dressing - soaking in water - minimum and maximum of each course (layer)
  - mix proportion - mortar thickness - workmanship bond stones - scaffolding - measurements.

- Coursed rubble masonry I sort in CM 1:5

  Properties of stones - dressing - soaking in water - height of each course - mix proportion - mortar thickness - workmanship - bond stones - scaffolding measurements.

- Brickwork in CM 1:5

  Properties of bricks - size of bricks - soaking in water - mix proportion -- mortar thickness - workmanship - bond- placing - scaffolding - measurements

- RCC slab 12cm thick proportion (1:1.5:3)

  Mix proportion - cement - fine aggregate - coarse aggregate - water - water cement ratio or slump
  - type of reinforcement - centering - laying reinforcement- mixing - laying and compaction - curing

- finishing of exposed surfaces - measurement.

- RCC sunshade

  Proportion - cement - fine aggregate - coarse aggregate - water cement ratio of slump - type of reinforcement - centering - fixing and tying grills mixing— laying and compaction curing - finishing of exposed surfaces - measurements. Coursed rubble masonry in CM 1:5

- Plastering with cement mortar 1:5- 12mm thick

  Preparation of surfaces to be plastered - removal of existing mortar on the surface - watering - mix proportion - plastering thickness - finishing - curing – measurement.

- Pointing with cement mortar 1:3

  Preparation of surface to be pointed - removal of existing mortar watering - mix proportion - pointing type - workmanship - mortar thickness -- finishing curing - measurement.

- Flooring with mosaic tiles

  Properties - cement mortar (1:3) preparation of bedding with 12 cm thick - laying tiles workmanship polishing - measurement.

- Laying of stoneware pipes

  Excavation- pipe diameter- preparing the surface with slope- joining the pipes- inspection- covering the surface- measurement.

- Surface dressing over existing one

  Preparation of the road surface - spreading the metal – rolling applying binding material - Applying stone chips - rolling - gradient - camber - seal coat – application- measurement.

- Gravel packing for revetment

- Preparation of surface - watering --mixing the gravel - ramming –slope- finishing- measurement.

- Rough stone dry packing for aprons

  Properties of stones - height - filling the gaps – slope- modelling – finishing- measurement.

- Strutting to centering for RCC works

  Type of surface - height - type of wood - shuttering - centering - Re-use of shutters- connections
  – measurements.

SPECIFICATION FOR DIFFERENT ITEMS

Specifications for the following items –Bricks; sand; cement; coarse aggregate; water; reinforcement; storing and handling of materials; Earth work in foundation; PCC; RCC; First class brick work in cement mortar; half brick thick partition in cement mortar; reinforced brick work; DPC; glazed tiles in skirting and dado; cement plaster; joinery in wood, steel & aluminium; painting to walls –emulsion, enamel paint ; painting to joinery ; varnishing ; French polishing ; based on surveys and Current trends.

Specifications for various materials Cement

Cement shall be fresh Portland cement of standard ISI specifications. It should have the required tensile and compressive stresses and fineness. The colour of the cement should be uniform grey colour. Initial setting time should be about 30 minutes for ordinary cement. Final setting time should be 10 hours.

- **Sand**

Sand should be clean, free from dust, dirt and organic matters. Sand shall be of hard, sharp and angular grains. Should pass through a screen of 5mm but completely retained on 0.07mm mesh. The fineness modulus of sand should be 2.5 and 3.0.

- **Coarse aggregate**

A good aggregate should have Clear, strong, tough, angular with sharp edges and cubical

in shape. Size varies from 15mm to 40mm. As far as possible graded aggregate to be used.

Mass concrete- 40 mm

Reinforced concrete – 20mm

- **Reinforced steel** Steel

types:

- Mild steel – Ultimate tensile strength 4200kg/m3
- Medium tensile steel- Ultimate tensile strength

5000kg/m3 - Deformed bars and Cold twisted bars

- High tensile deformed steel

- Should be free from corrosion, rust, scales, oil, paint etc.
- Capability to bent without fracturing.

- Joints to have an overlap of 40 times the diameter of bar and has to be staggered.
- Bigger dia bars to be joined by welding

Earthwork in excavation in foundation:

- **Excavation**

Foundation trenches shall be dug out to the exact width of foundation concrete and the side 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 1m (3') of the edge of the trench.

- **Finish of trench**

The bottom of foundation trench shall be perfectly levelled both longitudinally and transversely and the sides of the trench shall be dressed perfectly vertical from bottom. 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 spot shall be dug out and removed filled with concrete or with stabilized soil. If rock or boulder 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 bailed or pumped out without any extra payment and necessary precaution shall be taken to prevent surface water to enter into the trench.

- **Trench filling**

After the concrete has been laid masonry shall be constructed the remaining portion of the trench shall be filled up with earthinlayer of 15cm (6") and wateredand well rammed. Theearth 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 general level and multiplied by the length of trenches even through the contractor might have excavated with sloping side for his convenience. Rate shall be for complete work for lift, including all tools and plants required for the completion of the works. For extra lead of 30m and extra lift of 1.5m separate extra rate is provide

Excavation in saturated soil:

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

Lime concrete in foundation:

- **Materials**

All materials shall be per standard specification. Coarse aggregate shall be hard, well-burnt or over burnt brick ballast of 40mm gauge. It shall be deep cherry red or copper colour and shall be clean, free from dust, dirt and ther 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 of 20 per cent pass through a mesh of 25mm. any rejected material shall be removed from site of work within 24 hours.

- **Fine aggregate**

It 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 brick or brick bats (not over burnt) and shall pass through a sieve of 2.5 meshes per sq cm (144 meshes per sq in). Surkhi as preferable 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 three 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 water light, masonry platform of sufficient size. Brick ballast shall be staked in a rectangular layer of uniform thickness usually 30cm (12”) high and well soaked with clean watera period of at least three hours.Lime and surkhi shall be measured with wooden box in the proportion of 1:2 and mixed thoroughly dry to have uniform colour. The dry mix of lime and surkhi shall be spread over the staked ballast required thickness to give the specified proportion. Then material is mixed at least three times. Clean water is then added slowly for mixing purpose. Concrete shall be mixed only for day’s work, old and slate concrete shall not be used. For big work the mixing shall be done by machine. 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 does not separate

- **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 layer of not more than 20cm (8”) and thoroughly consolidated to 15cm (6”) with 6kg (12lbs) iron rammer. During consolidation concrete should be kept free from earth,dirt, leaves and other foreign material. The consolidation shall be checked by water test, by digging hole about 7.5cm dia. and 7.5cm deep in the concrete and filling water. The water level should not sink more than 1.25cm in 15min if concrete has been well – consolidated.

- **Joint and consecutive layers:**

  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 compaction shall be wet for a period of at least 7 days and no masonary shall be constructed upon it during this period. The curing shall be done by spreding gunny bags or sand or kipping 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 for the complete work including the cost of form work if required, and all tools and plants.

Specifications for Plain Cement Concrete (PCC)1:2:4 Materials

Specifications

- **Aggregate** shall be of invert 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 20mm size and smaller. All the coarse material should be retained in a 5mm square mesh and should be well graded such that the voids do not exceed 42%.
- **Fine aggregate** shall be of coarse sand consisting of hard, sharp and angular grains and shall pass through a screen of 5mm square mesh. Sand shall be of standard specifications, clean and free from dust, dirt and organic matter. Sea sand shall not be used.
- **Cement shall be fresh Portland cement of standard ISI 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 Specifications

- 1:2:4 (cement : sand : stone ballast) by volume when specified. Minimum compressive strength of concrete of 1:2:4 proportion shall be 140 kg/cm2 in 7 days.

Laying Technique

- Concrete shall be laid gently (not thrown) in layers not exceeding 15cm and compacted by pinning with rods and tamping with wooden tampers or with mechanical vibrating machine until a dense concrete is obtained.

Curing Method

- After about two hours of laying of concrete, when the concrete has begun to harden, it shall be kept damp by covering with wet gunny bags or wet sand for 24 hours.

Hand mixing

- Mixing shall be done on masonry platform or sheet iron tray.

Machine mixing

- Stone ballast, sand and cement shall be put into cement concrete mixer to have the required proportions.

Slump

- Regular slump test should be carried out to control the addition of water and to maintain the required consistency. A slump of 7.5cm to 10cm may be allowed for building work.

Formwork

- Formwork centering and shuttering shall be provided as required as per the standard specification 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.

Laying Technique

- Concrete shall be laid gently (not thrown) in layers not exceeding 15cm and compacted by pinning with rods and tamping with wooden tampers or with mechanical vibrating machine until a dense concrete is obtained.

Curing Method

- After about two hours of laying of concrete, when the concrete has begun to harden, it shall be kept damp by covering with wet gunny bags or wet sand for 24 hours.

RCC (1:1.5:3) for slabs, beams, lintels and staircase:

- **Centering-** The centering for the concrete work shall be sufficiently strong and rigid and in good condition so as to turn out a good smooth surface. The spacing of timber bullies shall not be more than 120cm centre to centre. The bullies shall be supported at the base on 40mm thick wooden plate having area not less than 0.10sq m.
- The surface of formwork shall be oiled before placing of concrete.
- **Proportion-** The proportion of cement concrete shall be of one part of cement, two parts of sand four parts of aggregates by volume.
- **Cement-** The cement shall be used in this work shall comply with the standard requirements.
- **Fine Aggregate-**The sand to be used shall be clean and coarse and shall be free from any organic or vegetable matter. The sand shall be washed, if there is any trace of earth in it.
- **Coarse Aggregate-** The coarse aggregate shall be from 20mm to 40mm and 33% of black trap metal carrying in size from 20mm to 6mm. The coarse aggregate for the concrete work shall be clean and free from impurities such as earth, coal dust and other organic materials. The unclean aggregates shall have to be screened and washed before use.
- **Water-** The water to be used in concrete work shall be clean and fresh.
- **Mixing-** The mixing of concrete shall be done in a mechanical mixer or by hand operations depending on the quantity of the concrete which shall be decided by the engineer. In the former case, the mixing drum shall be turned at least for 1.5 minutes after all the ingredients are added and the drum shall be completely emptied every time. The concrete from the drum shall be placed on a water tight platform.
- **Laying and Curing-** Before start laying of concrete in position; the centering shall be well watered. The concrete shall be laid in forms and tapped in such a way that no honeycomb surface appears on removal of the forms. The cement concrete shall be kept well watered for at least 20 days.
- **Finishing of Exposed surface-** All exposed surfaces of the concrete work shall be finished with 12mm thick cement plaster finish and three coats of white or colour wash shall be applied on these exposed surfaces of concrete.
- **Measurement-** Measurement shall be taken in cu m(cu ft) for the finished work and deduction shall be made for the volume of steel. Steel reinforcements shall be measured under separate item in qintal(cwt). Plastering shall not be included.

Damp Proof Course 2.5 cm c.c. 1:1 ½:3 Materials:

- Damp proof course shall consist of cement, coarse sand and stone aggregate of 1:1 ½:3 proportion with 2% of impermo or cem-seal 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.

Mixing:

- Mixing shall be done in a masonry platform or in a sheet iron tray in the proportion of 1:1 ½:3 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 sand in the proportion of 1:1 ½.
- The mix of cement and sand shall than be mixed dry with stone aggregate to have the proportion 1:1
  ½:3.
- 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 the concrete shall be made rough an checkered so as toform 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 the doors or the 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 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. 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. 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 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.

Specifications of First-class brickwork

- All of the bricks used should be of first class.
- See the characteristics of first class bricks.
- Soaking of bricks should be done by submerging in a tank before use.
- Soaking should be continued until the air bubbles are ceased.
- Soaking should be for a period of 12 hour before use.

Mortar specifications for first class brickwork

- Material of mortar should be of standard specifications.
- For mortar, cement should be fresh ordinary Portland cement of standard specifications.
- Sand should be sharp and free from organic and foreign particles.
- If we want to make rich mortar, sand should be coarse or medium. For weak mortar, local fine sand may be used.
- Cement sand ratio of mortar should be 1:3 to 1:6 as specified.
- To get the required proportion, materials of mortar should be measured with the measuring box. Materials of mortar should be first mixed dry to have a uniform color.
- The platform should be clean for mortar mixing.
- Mixing should be done at least three times.
- Then water should be added gradually for workable consistency. Mortar should be freshly mixed.
- Old mortar should not be used.
- Mortar should be mixed with water for one hour work so that mortar may be used before setting.

Lime Surkhi mortar

- If specified lime surkhi mortar, should be mixed in 1:2 to 1:3 ratio as specified, by grinding in mortar mill for at least three hours to use on the same day.
- Lime should be fresh and should be

screened. Fresh mixed mortar should be used.

- For small work, hand mixing may be allowed just as in the case of cement sand mortar.

Soaking of brick

- Soaked in clean water by submerging in a tank for 12 hours before use. Soaking to be done the air bubbling is ceased.

Laying of first class brickwork

- Bricks should be laid in English bond unless otherwise specified.

Every course of brick should be horizontal.

- Vertical joints of consecutive brick layer should not come on each other.
- Vertical joints of alternate brick layer should come directly over one another.
- Closers should be of clean cut bricks.
- Closers should be placed at the end of the walls but not at the otheredge.

Best shaped brick should be used for face work.

  - Mortar joints should not exceed 6 mm or 0.5 inch in thickness.

- Joints should be fully filled with mortar.
- Bricks should be laid with frogs upwards except in the top brick layer.
- In the top course of brickwork, frog should be laid downward.
- Brickwork should be done for 1 meter or 3 feet height at a time.
- When one part of the wall has to be delayed then stepping should be done at an angle of 45 degree.
- Projections which are made should not be more than 1/4th of the brick in one course.
- All joints should be raked and faces of wall should be cleaned at the end of every day's work.

Curing of First class brickwork

- Brickwork should be kept wet for the period of at least 10 days.
- Top of the walls should be flooded with water at the end of the days work by making small weak mortar edging to contain at least 2.5 cm or 1 inch deep water.

Other considerations for first class brickwork

- Brickwork should be protected from the effect of sun, rain, frost etc., during the construction.
- Suitable Scaffolding should be provided to facilitate the construction of brickwork.
- Scaffolding should be strong enough to withstand all the expected loads to come upon them.

Measurement of First-class brickwork

- Brickwork should be measured in cubic meter or cubic feet.
- Different kinds of brickwork with different mortar should be taken under separate item.
- Thickness of wall should be taken as multiple of half brick.
- For example half brick wall thickness is taken as 10 cm or 4.5 inch.
- Full brick wall thickness is taken as 9 inches or 20 cm and so on.
- Rate should be for the complete work including scaffolding and all tools and plants used.

Plastering

- Joints of brickwork to be raked out to a depth of 18mm
- Surface is washed and kept wet for 2 days
- The mortar, cement and sand are of standard specifications- dry mixed and water will be
- added Thickness – 12mm. Application dashing with trowel and pressed float for smooth surface.
- Ceiling plaster done before wall plaster
- Surface kept wet for 10 days. Protect from rain, sun frost
- Plastering will be applied in 3 coats- 1st coat 10mm, 2nd 10mm to 6mm, finishing coat 5 to 6mm.
- Second coat will be applied once the first is set and racked
- Work shall be tested with straight edge and plumb bob
- Curing of plaster- 10days
- Defective part will be cut and replaced
- Final finishes- textures, scraped textures, canvas, wavy combed, cork float etc.

Painting

- The brand of the paint shall be specified and ready-made paint of the required colour should be used.
  If thinning is required, pure turpentine may be added to the required extent.
- Surface- perfectly smooth by rubbing with sand paper of different grades, first with coarse one and with fine sand papers.
- All holes and open joints should be filled with strong putty or with a mixture of glue and plaster of paris and smoothed by rubbing with sand paper.
- In steel work, all rusts and scales shall be perfectly removed by scrapping and brushing.
- The number of coats shall be as specified in new work one priming coat and then two coats of paints shall be applied.
- The paint shall be applied with brushes evenly and smoothly by crossing and laying of in the direction of grains of wood-work and no brush marks should be visible.
- Each coat shall be perfectly dry before the next is applied.
- Before the next coat is applied, the surface shall be rubbed with No 0 sand paper, to give a smooth and glazed surface.
- The paint should be stirred in the container immediately before use. Brushes should be cleaned and washed with turpentine at the end of the days work and kept dry.
- For stiff paints- mix with double boiled linseed oil and turpentine for a think cream
- Removal of paint- wash with soda water / blow lamp by scrapping / patent stain remover
- Surface dried and rubbed with sand paper and smoothened before applying paint
- Repainting- washing walls with soap water and painted on top

- Steel work- painted with red oxide paint or aluminium paint.

Painting steel and Iron work

- All rust scales, dirt, suppliers delivery marks, oil, grease, etc., shall be removed by rubbing with sand paper before painting.
- All structural steel, work shall be painted with red lead before erection except the surfaces which will be in contact with concrete.
- Where corrosive effect is likelihood from sea atmosphere, a coat of raw linseed oil shall be applied on the surface immediately after cleaning and before the 1st coat of red lead is applied.
- Two to three coats of approved ready-manufactured paint or ready-mixed paint shall be applied after erection of the structural member.
- Each coat shall be allowed to dry up.

Varnishing

- Knots, holes, cracks, etc., shall be filled and covered with putty made of whiting and linseed Oil.
- Surface is made smooth with sand paper.
- Two coats of boiled linseed oil or two thin coat of glue as -specified shall be applied
- Each coat will be smooth down with a fine sand paper.
- The varnish shall be applied with brushes using strong firm strokes, of brushes and spread evenly.
- The brushes shall be of good quality and perfectly cleaned.
- In no case sand paper shall be rubbed across grain, which may cause the finest marks on the finished, surface.
- Specified quality of copal varnish shall then be laid on the prepared surface in thin coats unless any other brand is specially mentioned.
- For new wood work a second coat shall be applied after the first coat of varnish has thoroughly been dried up.
- Varnishing shall be done during dry weather and should not be allowed to be taken in rainy days.

French spirit polishing

- Pure shellac varying from pale orange to lemon yellow colour, free from resin, dirt etc., shall be dissolved in methylated spirit at the rate of 0.15 kg of shellac to I litre of spirit. Suitable Pigment shall he added to get required shade.

- Preparation of surface. —The surface of the timber shall be cleaned and rubbed down smooth with sand paper. Knots if visible shall be covered with lead and glue laid on hot. Holes and indentations on the surface shall be filled with putty and smoothened.

- The surface shall then be given a coat of wood filler made by mixing whiting (powdered chalk) in methyl spirit at the rate of 1.5 kg of whiting per litre of spirit.

- Application. —A pad of woollen cloth covered by a fine cloth shall be used to apply polish. The pad shall be moistened with the polish and rubbed hard on the wood, in series of overlap circles applying the polish sparingly but uniformly over the entire surface to give a uniform surface and high gloss. Second coat applied after drying in the same way as for the first coat.

Reinforced brickwork (R.B. work)

Material

- Bricks shall be strictly of first class quality. Mortar shall consist of cement and coarse sand of 1 : 3 proportion. Cement shall be of portland cement. Sand shall be coarse of 5 mm and clean. Steel reinforcement shall be of standard specification.

Centering and shuttering

- The centering and shuttering shall be made with planking wood packed together at the required level supported on runners of beams and 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.

Mixing of mortar

- Mortar of cement and sand shall be mixed thoroughly in the proportion of by mixing dry and then adding water slowly and gradually and mixing by turning atleast. Quantity of water shall not exceed 25 litres (6.5 g1s) 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 hour, 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. , so as to provide gap of 12 mm (1/2") on all sides of the steel bars. Usually mortar joint shall be 32 mm to 40 mm. Other joints where there will not be any bar, may be 6 mm to 10 mm (1/4" to 3/8"). Reinforced brick slab shall have a bearing equal to their thickness with a minimum of 12cm.
- After the bricks have been laid and arranged over the whole area fresh mixed mortar shall be into the gaps in between the bricks to a thickness of 2.5 cm (I"). Reinforcing rods of 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 (1/2") clear mortar below the bar. Then it shall then be filled in completely with fresh mortar. Care shall be taken that the reinforcement at all points is completely surrounded on all sides by mortar.

Curing (Same as first class brickwork) Measurement (Same as first class brickwork)

Finishing

- Plastering of the underside and sides shall be done immediately after opening of the centering with fresh cement and coarse sand mortar of 1 : 3 proportion to a minimum thickness of 12 mm (1/2").

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 1kg of lime**.
- It shall then be screened through a coarse cloth and gum (glue) in the proportion of **100grams of gum to 16 litres**
- The surface should be dry and thoroughly cleaned from dust and dirt.
- The wash shall be applied with 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.

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 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 smoothened 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 he repaired with plaster of paris wherever required and then whole surface sand papered and washed and allowed to dry.
- The number of coats shall be two or as specified. The distemper shall be kept well stirred in containers and shall be applied with broad brushes first horizontally and immediately crossed vertically.
- Brushing should not be continued too long to avoid brush marks. The second coat shall be applied after the first coat is dried up. After each day's work the brushes shall **be washed and kept dry**. Distempering should be done during dry weather but **not during too hot weather nor wet weather**.

Oil distempering

- Ordinary dry distemper in powder form
- Oil is mixed to the dry compound while manufacturing.
- While application, required amount of water is added to it and applied to the surface.

Skirting and dados:

- Skirting is usually around 6inches high around floors and normally made of same design and material as that of the floors. Primarily to protect walls daily from floor mopping and minor spillages on floors.
- Dados are 4 feet or more in height, in baths, WCs and in Staircases, on walls, made of glazy materials like glazed porcelain/vitrified tiles. In staircases, even synthetic enamel paints are also used. In staircases, dados protect the walls from frequent human touches and in Bath and W.C, it protects the plastered walls from water splashes during washing and bathing.

Tile flooring, Dado & Skirting

- The type, quality and thickness of tiles for flooring, skirting and dados shall be of the best quality as described and approved by the Project Manager
- shall be hard, dense, uniform, homogenous in texture, have even crystallising grains and be free from cracks and other defects.
- All angles and edges of the tiles shall be true and square and free from chipping. Bull nosing, grooves & chamfering of edges for staircases & skirting, etc., shall be as indicated in the detailed drawings.
- Before laying sub-surfaces shall be thoroughly cleaned and washed of all loose materials, dirt, etc and then well wetted without forming water pools on the surface.

Bedding

- The screed bed for laying floor tiles shall be of cement and sand mortar 1:4. Bedding over which the tile shall be laid shall not be less than 10mm at any place. Tiles shall be soaked in water before laying.

Laying

- Base concrete or RCC slab shall be cleaned and wetted. The bedding shall then be laid evenly over the surface, tamped and corrected to desired levels and allowed to harden enough to offer a rigid cushion to tiles.
- Before laying the tiles, cement slurry of honey like consistency at 3 kg/ sq m shall be applied over the bedding. At a time, area to accommodate about twenty tiles shall be applied with cement slurry.
- Tiles shall then be washed clean and fixed in the grout one after the other, each tile being gently tapped in its position till it is properly bedded and in level and line with adjoining tiles.
- The joints shall be as thin as possible but not exceeding 1.5mm wide. The ceramic tiles shall be set, jointed with cement slurry and pointed in neat coloured cement to match the colour of tiles. The surface shall be cured for seven days and then washed clean.
- In the cases of skirting and dado, vertical surfaces shall be thoroughly cleaned and wetted and evenly and uniformly covered with approximately a 12mm thick coat of cement mortar (1:4).
- The wall surface shall be covered with about 10mm thick plaster of cement and sand mortar as indicated and allowed to harden.
- The plaster shall be roughened with wire brushes or by scratching diagonal lines. The back of tiles shall be buttered with cement paste and set on bedding mortar.
- The tiles shall be gently tapped in position one after the other.
- Top of skirting or dado shall be truly horizontal and the joints vertical or as per required pattern. Joints shall be flush pointed with white cement with pigment to match the colour of tiles.
- The payment shall be made for the actual work done on site on superficial area basis and no extra amount shall be paid for wastage of materials, anchors, dowels, etc,

- The rate of the marble work shall include any drilling, cutting, fitting or making any special provisions required in the marble work.
- Flaming on polished granite to achieve the required undulated flame finish shall be done using the thermal torch.
- The ignited torch shall be held at 45 degrees to the granite slab plane with required temperature using combination of Oxygen and LPG gasses in presence of continuous water jet for immediate cooling. The pressure of the gasses required, depends on the level, intensity and pattern of flaming as approved by the Project consultant. Granite Slabs for Lift flooring shall have suitable Epoxy underlays & adhesives as per the detailed drawings and manufacturers specifications.

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SCHOOL OF BUILDING AND ENVIRONMENT

DEPARTMENT OF ARCHITECTURE

UNIT – II – SPECIFICATION & ESTIMATION - SAR1402

INTRODUCTION TO ESTIMATION

Estimation – definition; purpose; types of estimate; various methods of approximate estimate of buildings with Introduction of computer applications in estimation.

DETAILED ESTIMATE
Detailed estimate – data required, factors to be considered, methodology of preparation, abstract of estimate, contingencies, work-charged establishment, bill of quantities, different methods for estimating building works, methods of measurement of works. – With case studies.

ESTIMATE:

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

DATA FOR ESTIMATE

Drawings

Plan, sectional elevations, and detailed drawings to scale and fully dimensioned are required. The plan, elevation and sectional elevations are usually drawn to a scale of 1cm=1m and detailed drawings are prepared to scales of 1 cm=10 cm to 1 cm=29 cm

Specifications

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 pans 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.

Detailed Specifications.

These give the detailed description of the various items of work laying down the quantities and qualities of materials, their proponions, 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.

Rates

The rates per unit of various items of work, the rates of various materials to be used in the construction, and the wages of different categories of labour, skilled or unskilled as mason. carpenter. mazdoor, bhishti, etc., available for preparing estimate. The location of the work and its distance from the source of materials and the cost of transport should be known. These rates may be obtained from P.W.D. Schedule of Rate book or the rates may be worked out by the "Analysis of rate" method.

Different types of estimate

(I) Preliminary Estimate or Approximate or Abstract Estimate or Rough Cost Estimate.

(2) Plinth Area Estimate.

(3) Cube Rate Estimate or Cubical Content Estimate.

(4) Approximate Quantity Method Estimate.

(5) Detailed Estimate or Item Rate Estimate

(6) Revised Estimate.

(7) Supplementary Estimate.

(8) Supplementary and Revised Estimate.

(9) Annual Repair or Maintenance Estimate

Preliminary or Approximate or Abstract Estimate

- It is required for preliminary studies of various aspects of a work or project, to decide the financial position and policy for administrative sanction by she competent administrative authorities. In case of commercial projects as Irrigation projects, Residential building project and similar projects which earn revenue income, the probable income may be worked out, and from the preliminary estimate the approximate cost may be known and then it may be seen whether the investment on the project is justified or not.
- For non-commercial projects or for projects giving no direct return, their necessity, utility, availability or money, etc may be considered before final decision is taken.
- The approximate estimate is Prepared from the practical knowledge and cost of the similar works.
- This estimate is prepared showing separately the approximate cost of all important items of work as cost of land, cost of each building, cost of roads, water supply sanitary works, electrification, etc.

- The estimate is accompanied by brief report explaining the necessity and utility of the project and showing how the cost of separate items have been arrived at. This is also accompanied with a site plan or layout plan. A percentage of about 5% to 10% is added as contingencies.

Plinth area Estimate:

- This is prepared on the basis of plinth area of building, the rate being deducted from the cost of similar building having similar specification, heights and construction, in the locality. Plinth area estimate is calculated by finding the plinth area of the building and multiplying by the Plinth area Rate. The plinth area should be calculated for the covered area by taking external dimension of the building at the floor level. Courtyard and other open area should not be included in the plinth area. Plinth area estimate is only approximate, and is a preliminary estimate, to know the approximate cost before hand. If the plan of the building is not ready or available, at the beginning just prepare a proposal, floor area of rooms, etc. may be determined from the requirement and 30 to 40 per cent of the total area thus found may be added for walls, circulation and waste to get the approximate total plinth area which multiplied by the plinth area rate gives the approximate cost of the building. The approximate cost of a building having plinth area of 100 sq m @ Rs. 900,' - per sq m works out as 90000. For storeyed building, the Plinth Area Estimate is prepared for each storey separately.

Cube rate of Estimate:

Cube rate of Estimate is a preliminary estimate or an approximate estimate, and is prepared on the basis of the cubical contents of the building the cube rate being detected form the cost of the similar building having similar specifications and construction, in the locality.

- This is calculated by finding the cubical content of the building, (length x breadthxheight) and multiplied it by the cube rate. The length and breadth should he taken as the external dimension of the buildings at the floor level and the height should be taken from the floor level to top of roof (or half way of the sloped roof). For storeyed building the height should be taken between the floor level of one storey to top of next-higher floor. The foundation and plinth, and the parapet above roof are not taken into account in finding the cubical content.
- Cube rate estimate is most accurate as compared to the Plinth Area Estimate as the height of the building is also compared. The approximate cost of a building of cubic content (volume) of 400 cu in @ Rs. 180,- per cu m comes to Rs. 72,000.

Approximate Quantity Method Estimate

In this method approximate total length of walls is found in running metre and this total length multiplied by the rate per running metre of wall gives a fairly accurate cost. For this method the structure may be divided into two parts viz. (i) foundation including plinth and (ii) superstructure. The running metre cost for foundation and superstructure should be calculated first and these running metre rate should be multiplied by the total length of walls.

- To find the running metre rate for foundation, the approximate quantities of items such as excavation, foundation, brickwork upto plinth, and damp proof, course are calculated per running metre and by multiplying by the rates of these items - the price or rate per running metre is determined. Similarly for superstructure the price or rate per running metre is determined from the approximate quantities of brickwork, wood works, roof, floor finishing, etc. For this method the plan or line plan of the structure should be available.

Detailed Estimate or Item Rate Estimate

Detailed estimate is an accurate estimate and consists of working out the quantities of each item of works, and working the cost. The dimensions, length, breadth and height of each item are taken out correctly from drawing and quantities of each item are calculated, and abstracting and billing are done. Thedetailed estimate is prepared in two stages :—

- (i) Details of Measurement and Calculation of Quantities—The details of measurements of each item of work are taken out correctly from plan and drawings and quantities under each item are computed or calculated in a tabular form named as Details of Measurement.
- (ii) Abstract of estimated cost,— the cast of each item of work is calculated in a tabular form from the quantities already computed and total cost is worked out in Abstract of Estimate Form .The rates of different items of work are taken as per schedule of rates or current workable rates or analysed rates for finished items of work. A percentage usually 3% of the estimated cost is added to allow for contingencies for miscelaneous petty items which do not come under any classified head of items of work and a percentage of about 2% is provided for workcharged establishment. The Grand total thus obtained gives the estimated cost of work.
- The detailed estimate is usually prepared work-wise, under each sub-work as main building. servant quarters, garage, boundary walls etc.
- The detailed estimate is accompanied with :—
- (I) Report.
- (2) General specifications.
- (3) Detailed specifications.

- (4) Drawings:—Plan, elevation, Sectional elevations, Detailed drawings, Site plan or Layout plan or Index plan etc.
- (5) Calculation and designs. —Designs of foundation, beam, slab, lintel, design of channel in case of irrigation channel, design of thickness of metal crust in case of road etc.
- (6) Analysis of rates, if rates are not as per schedule of rates or for the non-scheduled items.
- Detailed Estimate is prepared for technical sanction of the competent authority, for arranging contract and for the execution of work. If in the 'Abstracts of Estimate' form the columns of rates and amounts are left blank (to be filled by contractor it is then known as bill of Quantity.

Revised Estimate:

- Revised Estimate is a detailed estimate and is required to be prepared under any one of the following circumstances: (i) When the original sanctioned estimate is exceeded or likely to exceed by more than 5%. (ii) When the expenditure on a work exceeds or likely to exceed the amount of administrative sanction by more than 10%. (iii) When there is material deviation from the original proposal, even though the cost may be met from the sanctioned amount.
- The revised estimate should be accompanied by a comparative statement showing the variations of each item of works, its quantity, rate and cost under original and revised, side by side. The excess or saving and reason for variation.
- Supplementary Estimate is a detailed estimate and is prepared when additional works are required to supplement the original works, or when further development is required during the progress of work. This is a fresh detailed estimate of the additional works in addition to the original estimate.
- The Abstract should show the amount of the original estimate and the total amount including the Supplement, amount for which sanction is required.

Supplementary and Revised Estimate

When a work is partially abandoned and the estimated cost of the remaining work less than 95 per cent of the original work, that is less than 95 per cent of the original sanctioned estimate. or when there are material deviations and changes in the design which may cause substantial saving in the estimate, then the amount of the original estimate is revised by the competent authority. A supplementary and Revised Estimate is then prepared and fresh Technical sanction of the competent authority is obtained. If at any time either before or during the execution of original work, it is found that the original estimate is excessive, then Divisional officer may sanction a revised estimate of reduced amount. While giving such sanction the Accountant General and other higher authorities are informed.

Annual repair or Maintenance Estimate (A.R. or A.M. Estimate)

Annual Repair or annual Maintenance Estimate is a detailed estimate and is prepared to maintain the structure or work in proper order and safe condition. For building; this includes white washing, color washing, painting, minor repairs etc. For road works the A. R estimate provides for patch repairing, renewals, repairs of bridge, and culverts, etc. Further, there may be special repair estimate, Monsoon damage repair estimate, etc.

Contingencies

The terms 'Contingencies indicates incidental expenses of miscellaneous character which cannot be classified under any distinct item sub-head, yet pertain to the work as a whole. In an estimate a certain amount in the form of contingencies of 3 per cent to 5 per cent of estimated cost, is provided to allow for the expenses for miscellaneous petty items which do not fall under any sub-head of items of work. Miscellaneous incidental expenses which cannot be classified under any sub-head or item, are met from the amount provided under contingencies. If there is any saving against the amount provided under contingencies, this amount may the utilized with the sanction of the competent authority, to meet the expenses of extra items of work. if any unforeseen, expenditure, expenses to minor changes in design, etc.

Work charged Establishment

Work-charged Establishment is the establishment which is charged to works directly. During the construction of a building or a project, a certain number of work-supervisors, chaukidars, etc., are required to be employed, and their salaries are paid from the amount of work-charged establishment provided in the estimate. For work-charged establishment a percentage 0f 11/2% to 2% of the estimated cost is included in the estimate_ The work-charged employees are temporary staff and their appointment shall have to be sanctioned by the competent authority for a specific period. Their services are terminated at the expiry of the sanctioned period, if their services are required fresh sanction shall have to be taken. Their services can however be terminated at any time but usually one months' notice is given For big work or project a percentage of 1% to 11/2% of the estimated cost is provided in the estimate for the purchase of Tools and Plants which will be required for the execution of the work. Normally the contractor has to arrange and use his own tools and plants.

Report—Estimate is usually accompanied with a report which gives all information in brief, of the whole work or project. Report should be such as to give a clear picture or idea of the whole project or work. Report should consist of the following main points :—

- (i) Brief history, with reference to the proposal.
- (ii) Object, necessity, utility and feasibility of the project with reasons.
- (iii) Selection of site or selection of alignment.
- (iv) Surveying.
- (v) Accommodation provided or brief description of the works provided in the estimate.
- (vi) Nature of soil, and topography of the land, orientation, etc.
- (vii) General specifications and basis of design calculations.
- (viii) Arrangements for water supply, sanitary works and electrical installations.

- (ix) Roads and drains
- (x)Miscellaneous items as labour amenities, temporary accommodation for staff. etc. for big project.
- (xi) Manner of execution.

- (xii) Total cost and how to be financed.
- (xii)Return or revenue income if any.

(xiv)Rent statement if any

(xv) Time of execution.

Schedule of rates—Schedule of rates 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 books 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. maintain printed schedule of rate book for various items of the work and estimate is 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. Usually, transport of materials upto distance of 8 km (5 miles) is included in the rates. As the rates vary slightly from year to year, the rates are increased or decreased by a percentage on the 'Schedule of Rates'. If the workable rates differ much from the Schedule of Rates', then the rates are revised and a new 'Schedule of Rates' is prepared.

Bill of Quantities - It is a statement of the various items of work giving the description, quantities and unit of rates. It is prepared in a tabular form similar to the 'Abstract of Estimated cost' of the detailed estimate, but the rate and amount columns are left blank (unfilled). When priced, that is, the rates and the amounts

are filled up and totaled, this gives the estimated coat. It is primarily meant for inviting tender, and supplied to the contractor to fill up the rates and amounts columns. On receipt-Of the tenders the rates and amounts are compared and decision about entrusting the work is finalized.

Bill of Quantities (Typical Sheet)

Item No	Particulars of item	Quantity	Rate Rs. P	Unit per	Amount Rs. P
1.	Earth work in excavation	32.51 cu.m		Per % cu.m	
2.	Earth work in filling	27.48 cu.m		Per % cu.m	
3.	Lime concrete in foundation	11.33 cu.m		Per cu. m	
4.	Ist Class brickwork in lime mortar in foundation and Plinth	23.14 cu.m		Per cu. m	
5.	Damp proof course 2.5cm C.C. $1:1^{1/2}:3$	11.02 cu.m		Per sq. m	

6.	First Class brickwork in 1:6 cement mortar	31.76 cu.m		Per sq. m	
7.	And so on	-		-	

Note – For different type of works, tenders, contract, security money, measurement, payment, preparation of project, stock account etc. (see chapter 17 P.W.D Account and procedure for works).

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SCHOOL OF BUILDING AND ENVIRONMENT

DEPARTMENT OF ARCHITECTURE

UNIT – III – SPECIFICATION & ESTIMATION - SAR1402

RATE ANALYSIS

Introduction

The determination of rate per unit of a particular item of work, from the cost of quantities of materials, the cost of labourers and other miscellaneous petty expenses required for its completion is known as the Analysis of Rates.
The rates of materials and labour vary from place to place and hence the rates of different items of works also vary from place to place.

Purpose of Rate Analysis

Following are the main purpose of doing rate analysis

1. To work out the actual cost per unit of the items
2. To work out the economical use of materials and process in completing the particular items
3. To work out the cost of extra items which are not provided in the contract bond but are to be done as per direction 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.

Importance of Rate Analysis

The process of doing rate analysis gives a clear picture of the various types of labour and material required for completing particular work.

Requirement of Rate Analysis

1. Correct information of the market rate and materials
2. Correct information of the rate of various categories of labourers
3. Output of laborues i.e. task or out turn per day for various types of labourers.
4. Knowledge, rate and out turn of various types of plants to be used in the construction work.
5. Update knowledge of construction work

Factors affecting of Rate Analysis

1. Quality of materials
2. Proportion of mortars
3. Construction facilities available with regards to tools and plants
4. Location of the site work
5. Facilities available for transportation of labour and material to the work site.
6. Transportation charges, condition of road or passage to the site of work
7. Overhead charges
8. Miscellaneous expenditure and profit desired
9. Experience of workers and amenities provided to them
10. Proper management and guidance.

Procedure for Rate Analysis

The analysis of rate is done for the unit of payment of the particular item. Details of materials and labour are worked out and are added together to get the total cost of material and labour. To this 1.5% of its added for water charges (only in those item which require water in any way). 10% contractor's profit is also added. The total of all above is the cost of item.

Let the cost of material for unit item = x

Let the cost of labours T + P, sundries etc. For unit item = y

Total cost of material and labourers = x+y

Add 1.5 water charges $= \frac{1.5}{100}(x+y)$

Add 10% Contractor's profit $= \frac{10}{100}(x+y)$

Grand total $= (x+y)+(1+\frac{1.5}{100}+\frac{10}{100})$

Rate per unit of the Item =1.115(x+y).

Need of Rate Analysis

1. To determine the actual cost per unit of the items.
2. To work out the economical use of materials and processes in completing the particulars item.
3. To calculate the cost of extra items which are not provided in the contract bond, but are to be executed 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

RATES OF ITEMS DEPEND ON:

1. Specifications of works and material, their quality, proportion and method of constructional operation.
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 and miscellaneous expenses of the contractor.

COST OF MATERIALS

1. The costs of materials are taken as delivered at site of work.
2. This is inclusive of The first cost (cost at origin),

Cost of transport , railway freight (if any), etc.

Local taxes and other charges.

Labour

May be classified into three types.
- Skilled Ist class
- Skilled IInd class
- Unskilled

Labour charges can be obtained from Schedule of Rates. 30% of the skilled labour in data should be taken as Ist class and remaining 70% as IInd class.

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 convenayce of material depends on lead.
This statement is required when a material is transported from a distant place, more than 8kms (5 miles).

Typical example of Lead Statement

S.No.	Materials	Cost at Source	Per	Lead in Km	Conveyance charges per Km
1	Rough Stone	260.00	cum	18	5.00/cum
2	Sand	12.00	cum	25	4.00/cum
3	Cement	2100.00	tonn	Local	-

Analysis of Rates from Lead Statement

S.No.	Mtls.	Cost at Source	Per	Lead in Km	Conveyance charges Rs.	Total Conveyance charges Rs.	Total Cost Rs.
1	Rough Stone	260.00	cum	18	5.00/cum	5×18= 90.00	260+90= **350.00**
2	Sand	12.00	cum	25	4.00/cum	4×25= 100.00	100+12= **112.00**
3	Cement	2100.00	tonn	Local	-	-	2100/ tonn

Lead

During the earthwork, the average horizontal distance between center of excavation to the center of deposition is known as Lead.
Lead is normally calculated in multiple of 50m

Lift

Similarly during the earthwork, the average height through which soil has to be lifted from source to the place of spreading(also known as heaping) is known as Lift.
The first Lift is taken upto 2m.
The extra lift is counted for upto 1m after the first lift and so on.

Let us say we need to calculate number of lifts
when soil is to be lifted 3.5m from the source.
Upto 2m : 1 Lift
1m : 1 Lift
0.5m : 1 Lift
Total number of Lifts are 3 in this case.

CONTRACTOR'S PROFIT

This is the 6-10% net profit that is allowed to the contractor.
10% profit is not allowed on cement and steel.

MISCELLANEOUS

Lump sum provisions are made for miscellaneous items.

OVERHEAD COSTS

The overhead costs comes to about 6-8% of the project cost and include the indirect expenses incurred during the execution of a project.

General Overheads

a) Establishment (office staff)
b) Stationary, printing, postage
c) Travel expense
d) Telephone
e) Rent & taxes

Job Overheads

a) Supervision (salaries of engineer, supervisor etc)
b) Handling of materials
c) Repairs, carriage, depreciation of T&P
d) Labour amenities
e) Workers compensation, insurance etc
f) Interest on investment

g) Losses on advances

TASK / OUT TURN WORK

- The capacity of doing work by an artisan or skilled labour in the form of quantity of work per day in known as Task Work or Out-turn of the labour.
- The out turn of work per artisan varies with situations and locations.
- In bigger cities where specialized and experienced labour is available, the out-turn is greater than in small towns and country side.
- In well organized work, less labour is required.

Analysis & Rates

The capacity of doing work by an art is an or s killed labour in the form of quantity of work per day is known as the task work or out turn of the labour.

T he out- turn of work per art is an varies to some extent according to the nature, size, height, situation,

location, etc ., I n bigger c i ties where s specialized and experienced labour is available the out - turn is greater than s mall towns and ccountry sides. In well organized work les s labour is required.

The following may be taken as the approximate quantity of work or out turn or task for an average art is an per day.

SNo.	**Particulars of items**	Quantity	Per day
1.	Brick work in lime or cement mortar in foundation and plinth	1. 25cum	(45cuft) per mason
2.	Brick work in lime or cement mortar in superstructure	1. 00cum	(35cuft) per mason
3.	Brick work in mud mortar in foundation and plinth	1. 50cum	(55cuft) per mason
4.	Brick work in mud mortar in superstructure	1. 25cum	(45cuft) per mason
5.	Brick in cement or lime mortar in arches	0. 55 cum	(20cuft) per mason
6.	Brick in cement or lime mortar in jack arches	0. 55 cum	(20cuft) per mason
7.	Half brick wall in partition	5. 00sqm	(50sqft) per mason
8.	Coursed rubble stone masonry in lime cement mortar including dressing	0. 80cum	(30 cuft)per mason
9.	Random rubble stone masonry in lime or cement mortar	1. 00cum	(35cuft) per mason
10.	Ashlars masonry in lime or cement mortar	0. 40cum	(15cuft) per mason
11.	Stone arch work	0. 40cum	(15cuft) per mason
12.	Lime concrete in foundation or floor	8. 50cum	(300cuft)per mason
13.	Lime concrete in roof terracing	6. 00cum	(200cuft)per mason
14.	Lime concrete 1: 2; 4	5. 00cum	(175cuft)per mason
15.	RB work	1. 00cum	(35cuft) per mason
16.	RCC work	3. 00cum	(125cuft)per mason

17.	12mm (1/ 2) plastering with cement or lime mortar	8. 00sqm	(80sqft) per mason
18.	Pointing with cement or lime mortar	10. 00sqm	(100sqft)per mason
19.	White washing or colour washing coats	70. 00sqm	(700sqft)per white washer
20.	W hite washing or colour washing coats	200. 00sqm	(2000sqft)per white washer
21.	Painting or varnishing doors or windows one coat	25sqm	(250sqft)per painter
22.	Coal tarring or soligum painting one coat	35. 00sqm	(350sqft)per painter
23.	Painting large surface one coat	35. 00sqm	(350sqft)per painter
24.	Distempering one coat	35. 00sqm	(350sqft)per painter
25.	2. 5cm(1') CC floor	7. 50sqm	(75sqft) per painter
26.	Flag store floor laying with lime or cement mortar excluding LC	10. 00sqm	(100sqft)per painter
27.	Brick on edge in floor lime or cement mortar excluding LC	7. 00sqm	(70sqft) per painter
28.	Brick bat floor as in above	8. 00sqm	(80sqft) per painter
29.	Timber framing sal or teak wood	0. 07cum	(2. 5cuft) per carpenter
30.	Timber framing sal or country wood	0. 15cum	(5cuft)per carpenter
31.	Door and window shutters paneled or glazed	0.15sqm	(7sqft) per carpenter
32.	Door and window shutters paneled or battened	0. 80sqm per	(0. 80sqft)per carpenter
33.	Sawing hard wood of sawers	4. 00sqm per	(40sqft) per pair
34.	Sawing soft wood of sawers	6. 00sqm per	(40sqft) per pair
35.	Single Allahabad tiling or Mangalore tiling	6. 00sqm	(60sqft) per tile layer
36.	Double Allahabad tiling	4. 00sqm	(40sqft) per tile layer
37.	Breaking of brick ballest 40mm (11/ 2") gauge or breaker	0. 75cum	(35cuft)per labourer
38.	Breaking of brick ballest 25mm (1") gauge or breaker	0. 55cum	(20cuft)per labourer
39.	Breaking of stone ballest 40mm (11/ 2") gauge or breaker	0. 40cum	(10cuft)per labourer
40.	Breaking of stone ballest 40mm (11/ 2") gauge or breaker	0. 40cum	(10cuft)per labourer
41.	Breaking of stone ballest 25mm (1") gauge or breaker	0. 25cum	(10cuft)per labourer
42.	Ashlar stone dressing	0. 70cum	(25cuft) per stone cutter
43.	Flag stone dressing	1. 50sqm	(25sqft) per stone cutter

44. Earthwork in excavation in ordinary soil	3.00cum	(100cuft)per belder Mazdoor	
45. Earthwork in excavation in hard soil	2.00cum	(75cuft)per belder mazdoor	
46. Excavation in soil	1.00cum	(35cuft)per belder Mazdoor	
47. laid by a manson in brick work upto a height of 3m (10") Amount of work done by a mazdoor helper per day	Number of bricks 600 bricks per mason.		
Mix	3.00 cum (100 cuft) mortar per mazdoor		
48. Deliver Brick 4000 No's to a distance of 15m (5'0") per mazdoor			
49.	Deliver mortar 5.5cum	(200 cuft)	per mazdoor
50. (Rest 1.5% of 50 per cuft) of brick work. Building	Scaffolding for single storey residential		

Items 46,47 and 48 are based on the committee report on rates and cost government of India.

LABOUR (MAZDOOR) REQUIRED FOR DIFFERENT WORKS

Extract from the report on productivity projects in building industries issued by National Building Organization are given below.

a) Earthwork per 28. 30 cum (12000 cu f t)

1) Excavation in foundations, trenches etc., in ordinary soil including disposal up to 30m (100') and lift of 1. 5m(5ft) –5 beldars and 4 mazdoors can do 28. 30 cum (1000cu ft) per day.
2) Refilling excavated earth in foundations, pointh etc, including consolidation in 15cm(6") layers -3 beldars, 2 mazdoors and ½ bhisti can do 28. 30 cum (1000cu ft) per day.
3) Disposal of surplus earth within a lead of 30m (100') -1 mazdoor can do 2. 83cum (100 cuft) per day.

b) Cement concrete work per 2. 83 cum (100cuf t)

laying cement concrete – 2 beldars, 3 mazdoors, ¾ bhisti and ¼ mason, can do 2. 83 cum (100 cuft) per day.

c) RCC work:-

1) Laying reinforced concrete – 3 beldars, 3 mazdoors, 1½ Bhisti and ½ mason can do 2. 83 cum (100cuft) per day.

2) Centering and shuttering for flat surfaces – 4 beldars and 4 carpenters (II class) can do 9. 6sqm(96s q ft) per day.
3) Reinforcement work for R C C –1 blacksmith or fit ter and 1 beldar can bend and place in position 1 quintal (2 cwt) of steel per day.

d) Stone work per 2. 83 cum (100cuf t) -

Random rubble masonry with blue stone in foundations -3 masons, 3 beldars, 2 mazdoors and 1/ 4bhisti can do 2. 83 cum (100cuft 0 per day

e) Brick work pe r 2. 83 cum (100cuf t) -

First class brick work in 1: 4 cement mortar in superstructure partition walls, junctions of roof, parapet walls and string course – 2½ masons, 4½ mazdoors and 1/ 2 bhisti can do 2. 83 cum (100cuft) per day.

F) Wood work :-

1) For the frames of doors and windows –2 carpenters and 1 beldar can work 0. 18 cum (6. 40cuft) of wood equivalent to door frames 7. 5cm x 10m of 1. 2m x 2. 1m (3'x 4'of 3'x 11'x 7')siz e per day.
2) For paneled, glazed, etc, shutters -15 carpenters and 4 beldars can make and fix 4 shutters 40 mm thick of size 2. 00m x 1. 15m (1 ½ thick of size of 6'-9x 3'-9') per day. Quantity of wood per shutter – 0. 075 cum, ie2. 66 cuft.

g) Iron work :-

1) Fixing 40mm x 3mm= 38cm(1 ½ " x ½ 'x 15"0 flat iron holdfasts -1 blacksmith (II class), I mason and I beldar can fix 36 holdfasts per day.
2) Fixing 16mm dia. 5/ 3" dia) M S rods –1 blacksmith (II class), 2 carpenters (II class) and 3 mazdoors can fix 16. 5 m (54rft) per day.

h) Flooring: -

4cm thick (1 1/ 2 ")thick cement concrete flooring of 40sqm (400sqft) require 5 masons, 4 beldars, 3 mazdoors and 1 bhisti per day for mixing laying and finishing.

I) Finishing :-

1) Plastering with any mortar 12mm (5") thick – 3 masons, 3 mazdoors and 1 bhisti can plaster 40sqm (400a ft) per day.
2) White washing or colour washing (3 coats) – 1 white washer and 1 mazdoor can do 60sqm (600sqft) per day.

3) Painting two coats such as chocolate, red, grey, etc on wood are steel –3 Painters and 2 mazdoors can paint 10sqm (100sqft) per day.

LOAD FOR A TWO – BULLOCKS CART

Sl.No	Particulars of materials	Quantity or Number	
		On Kachcha Road	On Pucca Road
1.	Brick 19 cm x 9cm x 9cm	275nos	400nos
2.	Brick ballast	0. 85 cum (30cuft)	1. 10 cum (40cuft)
3.	Stone ballast	0. 70 cum (25 cuft)	1. 00 cum (35cuft)
4.	Kankar	0. 85 cum (30cuft)	1. 10 cum (40cuft)
5.	Sand surkhi	0. 85 cum (30cuft)	1. 10 cum (40cuft)
6.	Lime	1. 10 cum (40cuft)	1. 40 cum (50cuft)
7.	Tiles Allahabad or Mangalore	275nos	400nos
8.	Cement	15bags	20 bags
9.	Steel	0. 75 tonne	1 tonne

Note; A bullock can carry about one tonne load. The average speed for a bullock cart may be taken as 3. 20km (2 units) per hour and ¾ hour may be allowed for loading and unloading. Taking 8 hours working per day, the number of t rips per day, can be calculated.

LOAD FOR TRUCKS

ON PUCCA METALLED ROAD –

Trucks 3 tonners 5 tonners 8 tonners diesel truck Brick or Allahabad tiles or Mangalore t iles -1000nos 1500nos 2000 nos

Cement, steel and other Heavy materials 3 tonne 5 tonne8 tonne

Other materials –
Ballast, Kankar, grit Sand coal, etc., 2. 8cum 4. 20cum 5. 6c um (100cuft)
(150cuft)(2 0 0cu ft)

On kachcha earthen road the load will be less by 33 per cent.

MATERIALS FOR DIFFERENT ITEMS OF WORKS

The requirement of materials for different items of works is as given below: -

S.No	Description	Qunty	
1.	Bricks (9" x 4 ½ " x 3" or 20 cm x 10cm x 10cm nominal size) for brick work	1350 nos for 100cuft	50000 nos per % cum (500nos. per cum)
2.	Dry mortar for brick work 30%	30cuft for 100 cuft	30cum for 100 cum
3.	Stone for rubble stone masonry 125%	125cuft for 100 cuft	125cum for 100 cum
4.	Dry mortar for rubble stone masonry 42%	42cuft for 100 cuft	42cum for 100 cum
5.	Bricks for brick ballast for lime concrete	1050cuft for 100 cuft	37000cum for 100 cum
6.	Brick bats or brick ballast for lime concrete	150cuft for 100 cuft	150cum for 100 cum
7.	Brick ballast for lime concrete	100cuft for 100 cuft	100cum for 100 cum
8.	Dry mortar for lime concrete I foundation and floor 35%	35cuft for 100	35cum for 100 cum
9.	Dry mortar for lime concrete in roof terracing 45%	45cuft for 100	45 cum for 100 cum
10.	Materials for cement concrete 1: 2: 4		
	Ballast or grit 88%	88cuft for 100cuft	88 cum for 100 cum
	Sand 44%	44cuft for 100cuft	44 cum for 100 cum
	Cement 22%	22cuft for 100cuft	22cum (60 bags) for 100 cum
11.	Materials for 2. 5cm (1")cc 1:2: 4 floor		
	Stone grit	8cuft for 100sqft	2 for 100 (40 cum)
	Sand	4cuft for 100s	1 for 100 (20 cum)
	Cement	2¼ cuft (2 bags) for 100cuft	0.08cum (24 bags) for 100 cum
12.	Bricks for R B work	1200nos for 100cuft	42000 nos (420 mps (erici)
13.	Dry mortar for R B work 45%	45cuft for 100cuft	45cum for 100 cum

14.	Dry mortar for 12mm (1/ 2) plastering	6cuft for 100sqft	2.00 cum for 100 sq.m
15.	Dry mortar for pointing in brickwork	2cuft for 100sqft	0.60cum for 100 sq.m
16.	Lime for white washing one coat	1kg for 100sqft	10kg for 100 sq.m
17.	Dry distemper for ist coat	0. 65 kg for 100sqft	$6^{1/2}$ kgfor 100sq.m
18.	Dry distemper for 2 nd coat	0. 50 kg for 100sqft	5kg for 100 sqm
19.	Snow-Ce m for Ist coat	3kg for 100sqft	30kg for 100 sqm
20.	Snow-Ce m for 2nd coat	2kg for 100sqft	20kg for 100 sqm
21.	Paint ready mixed for painting one coat	1/ 3gl. for 100sqft	10ltr for 100 sqm
22.	Paint (stiff) for painting one coat	1kg for 100 sq.ft	10kg for 100 sqm
23.	Bricks (20 x 10 x 10cm) for brick floor or half brick wall	500 No's for 100 sq.ft	5000 no for 100cum..sqm
24.	Dry mortar for brick floor or half brick wall	12cuft for 100 sq.ft	3.20 cum for 100 sqm
25.	Bricks (9" x 4 ½ " x 3") for brick flat work	350 no's for 100 sq.ft	3500 nos for 100 sqm
26.	Dry mortar for brick flat floor	8cuft for 100 sqft	2.25cum for 100cum
27.	Bricks (9" x 4 ½ " x 3") required for honey comb wall	325 nos for 100 sq.ft	3250 no's for 100sqm
28.	Dry mortar for honey comb wall	8 cuft for 100 sq.ft	2.5cum for 100cum
29.	Materials for 2cm (3/ 4")thick damp proof course of 1: 2 cement mortar		
	Cement	325 nos for 100 sq.ft	0.90cum (27bags) for 100cum
	Sand	6 cuft for 100 sq.ft	1.80cum for 100cum
	Compound or impermo @ 1kg per bag of cement	2.5kg for 100 sqft	27kg for 100sq.m
30.	Materials for 2. 5cm (1")cc 1: 1 ½ : 3 damp proof course		
	Stone grit	8cuft for 100 sqft	2.25cum for 100cum
	Sand coarse	4cuft for 100 sqft	1.13cum for 100cum

	Cement	$2^{1/2}$ cuft ($2^{1/2}$Bags)for 100 sqft	0.75cum for (221/2bags) for 100cum
	Compound or impermo @ 1kg per bag of cement	$2^{1/2}$ Kg for 100 sq.ft	$22^{1/2}$ Kg for 100 sq.m
31.	Bitumen or asphalt for painting on D P C or on roof – 1st coat	15kg for 100 sqft	150kg for 100 sqm
	2nd coat	10kg for 100 sq.ft	100kg for 100 sqm
32.	G G I sheet for roof	128sqft for 100 sqft	128sqm for 100 sqm
33.	A G corrugate d sheet for roof	115 sqft for 100 sqft	115sqm for 100sqm
34.	Timber for paneled door shutter 4cm (1 ½") thick	15cuft for 100 sqft	4.5cum for 100cum
35.	Timber for battend door shutter 4cm (1 ½") thick	13 cuft for 100 sqft	4.0cum for 100cum
36.	Timber for paneled & glazed shutter 4cm (1 ½") thick	11cuft for 100 sqft	3.0cum for 100cum
37.	Timber for fully glazed shutter 4cm (1 ½") thick	8cuft for 100 sqft	2.0cum for 100cum

RATE ANALYSIS FOR DIFFERENT ITEMS OF WORK

Nature of work	Quantity	Labour
(a) 1.Earthwork Excavation in foundation trenches etc. in ordinary soil including disposal upto 30m and lift of 1.5m	28.30m^3(1000 cuft) -----do-----	Beldar – 5 No's Mazdoors – 4 No's Beldar – 3 No's Mazdoors – 2 No's Bhisti – 0.5 No's Mazdoors – 1 No's.
2.Refilling of excavated earth in foundations, plinth etc. including consolidation in 15 cm layers.	28.30m^3(100 cuft)	Beldar – 5 No's Mazdoors – 4 No's Beldar – 3 No's Mazdoors – 2 No's Bhisti – 0.5 No's Mazdoors – 1 No's.
Disposal of surplus earth within a lead of 30m		
Cement concrete work		
Laying of cement concrete	2.83 m^3 (100 cuft)	Beldar – 2 No's Mazdoors – 3 No's Bhisti – 0.75 No's Mason – 0.25 No's
RCC Work	2.83m^3(100 cuft)	Beldar – 3 No's

Description	Quantity of materials	Per
Laying of RCC Work		Mazdoors – 3 No's Bhisti – 1.5 No's Mason – 0.5 No's
6.Centering and shuttering for flat surfaces	9.6m^2(100 sq.ft)	Beldar – 4 No's Carpenters – 4 No's (II class)
7.Reinforcement work for RCC	1 quintal (2 ewt)	Blacksmith – 1 No's Or fitter
Stone Work		Beldar – 1 No
8.Random rubbie masonry with blue stone in (e) Brick work	2.88 m^3(100cuft)	Mason– 3 No's Beldar – 3 No's Mazdoor – 2 No's Bhisti – 0.25 No's
9.First class brick work in 1:4 cement mortar in superstructure ,partition walls junctions of roof, parapet wall and string course.	2.83 m^3(100cuft)	Mason– 2.25 No's Mazdoor – 4.5 No's Bhisti – 0.5 No's
Wood work 10.Frames of doors and windows 11.paralleled,ga;zed shutters etc Iron work	0.18 m^3(6.4cuft) 0.30 m^3(10.64cuft)	Carpenter – 2 No's Beldar – 1 No's Carpenter – 15 No's Beldars – 4 No's
12.Fixing of 40x38x3mm flat boldfasts	36 No's	Blacksmith – 1 No's (II class) Mason – 1 No's Beldars – 4 No's
13. Fixing of 16mm 5/8dia. M.S. rods (h) Flooring	16.5 r.m (54 r.ft)	Blacksmith – 1 No's (II class) Carpenters – 2 No's Beldars – 3 No's
14. 4cm (1.5") thick cement concrete flooring (f) Flooring	40 m^2 (400sq.ft)	Masoons – 5 No's Beldars – 4 No's Mazdoors – 3 No's Bhisti – 1 No's
15.12mm (1/2") thick plastering	(400 sq.ft)	Mazdoors – 3 No's Bhisti – 1 No's
16. 3"coats white or colour washing	60m^2(600 sq.ft)	Whitewasher – 1 No's Mazdoors – 1 No's
17. Two coats painting on wood or steel in chocolate red,grey etc, colour	10m (100 sq.ft)	Painters – 3 No's Mazdoors – No's

Kindly note : - The rate and calculation here they mentioned is basic kindly refere online for the revised rate for items of work to be carried out.

1.Brick for obtaining brick ballast for lime concrete	3700 Nos	10 m^3 of L.C
2.Brick-bats for brick-ballast for lime concrete	10.5m^3	10 m^3 of L.C
3.Dry mortar for brick work	3m^3	10 m^3 of B.W
4.Stone for rubbie stone masonry	12.5m^3	10 m^3 of S.M
5.Dry mortar for rubbie stone masnory	4.2m^3	10 m^3 of S.M
6.Bricks for Brick work	5000 Nos	10 m^3 of B.W
7.Bricks for reinforced brick work	4200 Nos	10 m^3 of R.B.W
8.Dry mortar for R.B. work	4.5m^3	10 m^3 of R.B.W
9. Dry mortar for pointing in B.W	0.6 m^3	100 m^3 or surface
10.Brick Ballast for Lime concrete	10 m^3	10 m^3 of L.C
11.Dry mortar for Lime concrete in foundation and floor	3.5 m^3	10 m^3 of L.C
12.Dry mortar for I.C is roof terracing	4.5 m^3	10 m^3 of L.C
13.Lime for one coat white washing	10 kg	100 m^2 of Surface
14.dry distemper for 1st coat	6.5kg	100 m^2 of Surface
15.dry distemper for 2nd coat	5 kg	100 m^2 of Surface
16.Snow-cem for 1st coat	30Kg	100 m^2 of surface
17.Snow-cem for 2nd coat	20Kg	100 m^2 of surface
18.Stiff paint for one coat painting	10Kg	100 m^2 of surface
19. Ready mixed paint for	10 Litres	100 m^2 of surface

one coat painting		
20. 2cm thick D.P.C of 1:2 cement mortar Cement Sand Composed or Impermo @/Kg of cement	0.90 m^2 1.80 m^2 27Kg	100 m^2 of surface
21. 2.5cm thick D.P.C of 1:5:3 C.C. Cement Coarses sand Stoen grit Composed or Impermo @/Kg of cement	0.75 m^2 1.80 m^2 1.80 m^2 22.5 Kg	100 m^2 of D.P.C
22.Drymortar for half brick wall or brick flooring	3.2 m^2	100 m^2 of surface
23.Bricks for brick flooring or half rick wall (19 x9 x9 cm size)	5000 No's	100 m^2 of surface
24.Brick for flat bricks flooring (23x12x7 cm)	3500 No's	100 m^2 of surface
25. Bricks for honey comb wall (23x12x7 cm)	3200 No's	100 m^2 of surface
26.Dry mortar for honey comb wall	2.5 m^2	100 m^2 of surface
27.A.C. Corrogated sheets for roof	115 m^2	100 m^2 of surface
28. G.I Sheets (corrugated) for roof	115 m^2	100 m^2 of surface
29.Asphalt or Bitumen for painting on D.P.C or on roof 1st coat 2nd coat	150 Kg 100 Kg	100 m^2 of surface
30.materials for 25.cm thick 1:2:4 C.C flooring Cement	0.08 m^2	100 m^2 of surface

Sand Grit	1.20 m^2 2.40 m^2	

Materials Rates:- The material rates vary from place to place. Materials rates given below have been used for the rate analysis of various items in this chapter.

Material	Rate at Site
1.Bricks 1st Class (150)	1575/- per % No's.
2.Brick 2nd class (100)	1250/- per % No's.
3.Burnt bricks (Straight all) (Khanjar)	1500/- per % No's.
4.Brick Tiles	1575/- per % No's.
5.Overburnt brick ballast 4 cm gauge	260/- per m^3
6.1st Class brick ballast 2.5 cm gauge	290/- per m^3
7.hard stone ballast 6mm to 10mm gauge	630/- per m^3
8.Stone ballast 20mm gauge	875/- per m^3
9.Stone ballast 40mm to 65mm gauge	315/- per m^3
10.Stone ballast 12mm gauge	775/- per m^3
11.Ordinary Portland Cement	140/- per bag
12. Portland White Cement	475/- per bag
13. White lime for lime wash	300/- per quintal
14. White lime for concrete and masonry (unslaked)	180/- per quintal
15.Marble chips (white or black)	160/- per quintal
16.Marble chips (coloured)	140/- per quintal
17.Marble Dust	125/- per quintal
18.Coarse sand	400/- per m^3
19.Local sand	150/- per m^3
20.Surkhi	290/- per m^3
21.Kankar Lime	360/- per m^3
22.Steel	1650/- per quintal
23.Teak wood	36000/- per m^3
24.Shisham wood	25000/- per m^3
25.Sal wood	20000/- per m^3
26.Country wood	11000/- per m^3

The Labour rates vary from place to place . Labour rates given below has been used for the preparation of rate analysis of various items of work in this chapter.

Type of Labour	Unit	Rate
	Per day	Rs
1.Mistri	- do -	130.00
2.mason	- do -	115.00
3.Carpenter	- do -	130.00
4.Blacksmith	- do -	110.00
5.Hammer -man	- do -	75.00
6.Fitter	- do -	80.00
7.Thatcher	- do -	80.00
8.Painter	- do -	110.00
9.Plumber	- do -	120.00
10.Stone cutter	- do -	90.00
11.Mate	- do -	100.00
12. Beldar	- do -	75.00
13.Mazdoor (coolie)	- do -	65.00
14.Bhisti	- do -	75.00
15.Well Sinker	- do -	80.00
16.Bullock cart with two bullocks and one driver	- do -	180.00
17.Mote or charsa including two bullocks,one driver one puller	- do -	170.00
18.Sawyer per pair	- do -	90.00
19.White washer	- do -	80.00
20.Beldar for bitumen or Tar work	- do -	77.00
21.Glazier	- do -	80.00
22.Rivetter or welder	- do -	80.00
23.Cane -man	- do -	75.00
24.Brick moulder	- do -	80.00

The quantities of materials and number fo labours given in the various items of rate-analysis as per standards laid down by the government departments. For obtaining the rate of a particular the reader should multiply the rate of materials and labourers with their respective quanatities

complete the rate analysis as given in this chapter.

Problems for Understanding.

Item No. 1 – Analysis of rate of excavation in foundation in ordinary soil including lift upto 1.5m and lead upto 30m and including filling ,watering and ramming of excavated earth and removal and disposal of surplus earth as directed by the engineering – in-charge upto a distance of 30m.
(for –per % cu.m)

S.No	Particulars	Qnty or No's	Rate	Amount
1	Mistri	0.5 No's	130.00 p.day	65.00
2	Beldar	21 No's	75.00 p.day	1575.00
3	Coolie	25 No's	65.00 p.day	1625.00
4	Blacksmith for tools sharpening etc	0.5 No's	90.00 p. day	45.00
			Total	3310.00
5	Tools plants and baskets etc.	-	Lump Sum Total	16.00
				3326.00
Add 10% for contractor's Profit				332.60
Grand Total				3658.60
Rate per.cu.m =3658.60/100 = Rs. 36.58				Per % cu.m

Item No. 2 – Analysis of rate of excavation in foundation in soil mixed with moorum /Shingle/ kankar,requiring the use of special T and P such as pickaxes,sabbals etc.

(for –per % cu.m)

S.No	Particulars	Qnty or No's	Rate	Amount
1	Mistri	0.5 No's	130.00 p.day	65.00
2	Beldar	28 No's	75.00 p.day	2100.00
3	Coolie	23 No's	65.00 p.day	1625.00
4	Blacksmith for sharpening T & P etc	0.5 No's	90.00 p. day	45.00
			Total	3835.00
5	T & P and Basket	-	Lump Sum	
			Total	16.00
				3851.00
Add 10% for contractor's Profit				385.10
Grand Total				4236.10
Rate per.cu.m =4236.10/100 = Rs. 42.36				Per % cu.m

Item No. 3 – Analysis of rate of Cast Cement Concrete as in item No.14, but also including supply of reinforcement and its bending complete work (for –per % cu.m)

S.No	Particulars	Qnty or No's	Rate	Amount Rs.
	Materials: As in item No.13	-	-	18737.50
	Labour : As in item No.13	-	-	3330.00
	Centering & shuttering both erection and dismantling As in item No. 14 Extra	-	-	2375.00
1	Mild steel bars @ 1% =0.1 cu.m.m	7.85 quintal	1650/-p.q	12952.50
2	Blacksmith	8 No's	110.00/- p.day	880.00
3	Beldar	8 No's	75.00/- p.day	600.00
4	T & P etc	-	L.S	15.00
	Total			14,447.00
	Total of all materials and labour			38890.00
	Add $1^{1/2}$ for water charges			583.35
	Add 10% for Contractor's profit			3889.00
	Grand total			43362.35
	Rate per.cu.m =43362.35/10 = Rs. 4336.23			Pu.10.cu.m

Item No. 4 – Analysis of rate of R.C.C work in column in proportion of 1:1.5:3 with cement coarse sand and 2 cm stone ballast including supply of all materials. T & P etc. required for complete work. (for –per % cu.m)

S.No	Particulars	Qnty or No's	Rate	Amount Rs.
1.	Materials: Stone ballast of 2cm gauge	8.4 cu.m	875/- p.cu.m	7350.00
2	Coarses sand	4.2 cu.m	400/- p.cu.m	1680.00
2	Cement (2.8 cu.m)	84 Bags	140/- p.bag	11760.00
3	M.steel bars @ 1.5%= 0.15cu.m @ 78.5 q/cu.m	11.78 quintal	1650/- p.quintal	19437.00
			Total	40227.00

4	Labour: As in item No.15 Centering & shuttering both erection and dismantling As in item No.14 Bending and binding of steel bars	- -	- -	3330.00 2375.00
1	Blacksmith	12 No.s	90/- p.day	1080.00
2	Beldar	12 No.s	75/- p.day	900.00
3	T & P etc	-	L.S	15.00
Total of all materials and labour				47927.00
Add $1^{1/2}$ for water charges				718.90
Add 10% for Contractor's profit				4792.70
Grand total				53438.60
Rate per.cu.m =53438.60/10 = Rs. 5343.86				Pu.10.cu.m

Item No. 5 – Analysis of rate of first class brick work in kankar lime in foundation and plinth including supply of all materials, labour and T & P etc. complete work. (for –per % cu.m)

S.No	Particulars	Qnty or No's	Rate	Amount Rs.
1.	Materials: Bricks (500 bricks per cu.m)	5000 No's	1575/- p.% No's	7875.00
2	Kankar Lime	3.0 cu.m	360/- p.cu.m	1080.00
	Labour			
2	Mistri	0.6 No	130/- p.day	78.00
3	Mason	7 No's	115/- p.day	805.00
4	Beldar	7 No's	75/- p.day	525.00
5	coolie	7 No's	65/- p.day	455.00
6	Bhisti	2 No.s	75/- p.day	150.00
7	T & P etc	-	L.S	20.00
Total Total of materials and labour				2033.00 10988.00

Add $1^{1/2}$ for water charges	164.82
Add 10% for Contractor's profit	1098.80
Grand total	12,251.62
Rate per.cu.m =12251.62/10 = Rs. 1225.16	Pu.10.cu.m

Item No. 6 – Analysis of rate of first class brick work in 1:6 Cement sand mortar including supply of all materials, labour, T & P etc., complete item of work (for –per % cu.m)

S.No	Particulars	Qnty or No's	Rate	Amount Rs.
1.	Materials: Bricks	5000 No's	1575/- p.% No's	7875.00
2	Cement (0.45 cu.m)	13.5 Bags	140/- p.bag	1890.00
3	Local sand	2.7 cu.m	150/- p.cu.m	405.00
	Labour: Same as per item No.18		Total	10170.00 2033.00
Total of materials and labour Add $1^{1/2}$ for water charges Add 10% for Contractor's profit Grand total Rate per.cu.m =13606.34/10 = Rs. 1360.63				12203.00 183.05 1220.30 13,606.34 Pu.10.cu.m

Item No. 7 – Analysis of rate of first class brick work in 1:4 Cement sand mortar including supply of all materials, labour, T & P etc., complete item of work (for –per % cu.m)

S.No	Particulars	Qnty or No's	Rate	Amount Rs.
1.	Materials: Bricks	5000 No's	1575/- p.% No's	7875.00
2	Cement (0.45 cu.m)	18 Bags	140/- p.bag	2520.00
3	Local sand	2.4 cu.m	150/- p.cu.m	360.00
	Labour: Same as per item No.18		Total	10755.00 2033.00
Total of materials and labour Add $1^{1/2}$ for water charges Add 10% for Contractor's profit Grand total Rate per.cu.m =14258.62/10 = Rs. 1425.86				12788.00 191.82 1278.80 14258.62 Pu.10.cu.m

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SCHOOL OF BUILDING AND ENVIRONMENT

DEPARTMENT OF ARCHITECTURE

UNIT IV - ECONOMICS AND ARCHITECTURE

INTRODUCTION

Economics as a determinant to Architectural land & Built form

Business Environment

Introduction of business environment

Types of environment

- External environment factors
- Internal environment factors

Business environment is the sum total of all external and internal factors that influence a business. You should keep in mind that external factors and internal factors can influence each other and work together to affect a business.

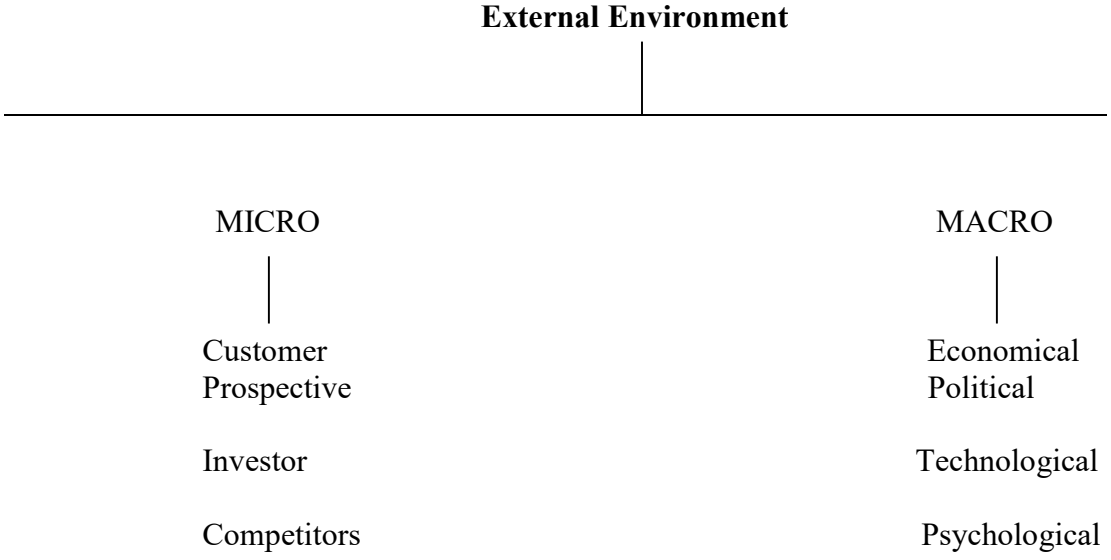
Type of Environment

External Environment : conditions, entities, events and factors surrounding an organisation that influence its activities and choice, and determine its opportunities and risk. Also called external environment.

Internal Environment : In multicellular organisms

The aqueous environment that is outside the sells but inside the body.

External Environment factor



Suppliers Legal

Management Demographic
Employees

Micro Environment
"the immediate small-scale environment of an organism or a part of an organism, especially as a distinct part of a large environment."

Macro Environment
" the environment external to a business, including technological, economic , natural , and regulatory forces that marketing efforts can not control."

MACRO ENVIRONMENT

- Economic
- Non Economic

ECONOMIC ENVIRONMENT

- Economic Problems
- Functioning of Economy
- Economic stages that exists at a given time in a country
- Economic planning , such as five year plan , budget, etc.
- Economic policies e.g., monetary policy

NON ECONOMIC ENVIRONMENT

Regulatory Environment

- Socio-Cultural Environment
- Demographic Environment
- Technological Environment
- Political Environment

<u>Regulatory Environment</u>

. Constitutional Framework
. Policies relating to pricing and foreign investment
. Policies related to the public sector

Socio- Cultural Environment

. Social Customs & Rituals and practices
  Lifestyle patterns
. Family Structure
. Role & Position of men , women , children and aged in family & society.

¨ **Demographic Environment**

. Growth of population
. Age Composition
. Life Expectancy
. Sex Raito
. Inter-state Migration

Technological Environment

. Sources of technology
. Technological development
. Impact of technology

¨ **Political Environment**

. Political parties in power
. Political Philosophy

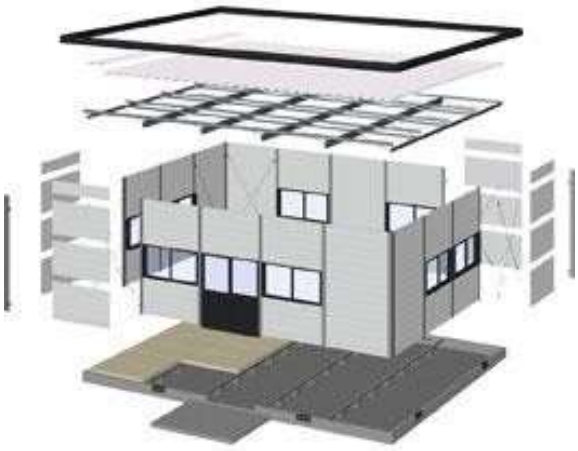
INNOVATIVE CONSTRUCTION TECHNIQUES

1. PREFABRICATION.
2. 3D MODELLING.
3. FILLER SLAB.
4. FERROCEMENT

These Construction Techniques are the latest trends in industry

PREFABRICATION TECHNIQUES

Prefabrication is the practice of assembling components of a structure in a factory or other manufacturing site, and transporting complete assemblies or sub-assemblies to the construction site where the structure is to be located.
Prefabrication has come a long way and is gaining in popularity up on project budgets and timelines. The technique has a few big advantages



AIMS OF PREFABRICATION CONSTRUCTION

- Components manufactured under controlled conditions.
- Speed of construction is increased since no curing period is necessary.
- Light weight.
- Easy workability.
- Thermal insulation.
- Less time consuming.
  cost effective

MATERIALS USED

- Concrete.
- Steel.
- Treated wood.
- Aluminium.
- Cellular concrete.
  ceramic products




COMPONENTS

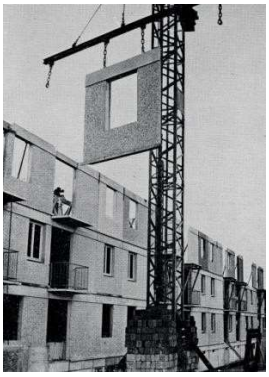
- Flooring.
- Roofing.
- Beams.
- Slabs.
- Columns.
- Walls.
- Staircase.
- Lintels & sunshade

VARIOUS PREFAB SYSTEMS.

- Open prefab system this system is used on the base of the basic structural elements to form whole or part of a building.
  Further categorised into
  * partial prefab open system.
  * full prebab open system**.**

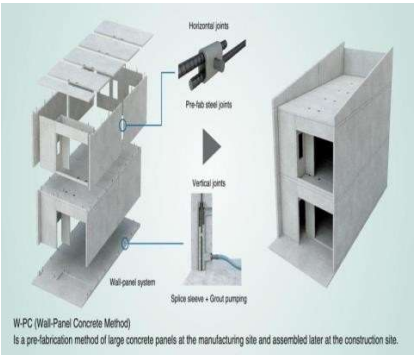
ADVANTAGES

- High quality product.
- Requires less labour.
- Time savings.
- Mass production is easy and quick.
- Protected and controlled production.
- Cost saving.
- Ensures high degree of safety.
- Less space consuming**.**



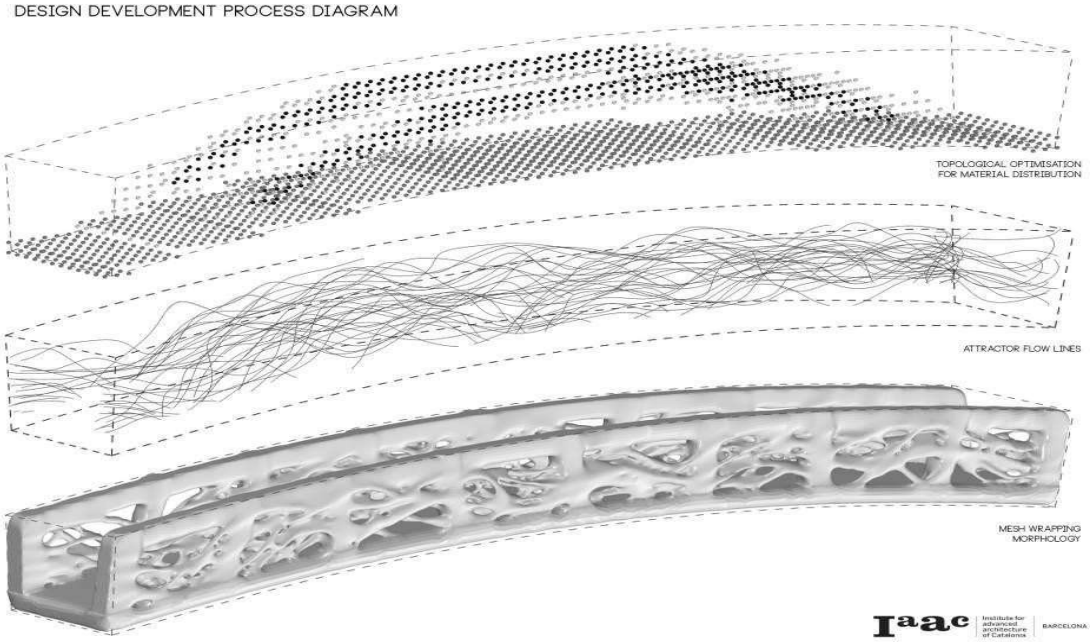
DISADVANTAGES

- Careful handling of components.
- Attention has to be paid to the strength and corrosion resistance of joining of pre-fabricated sections to avoid failure of joints.
- Transportation cost may be hight for voluminous sections.
- Require heavy duty cranes and precision measurements for joints.
-



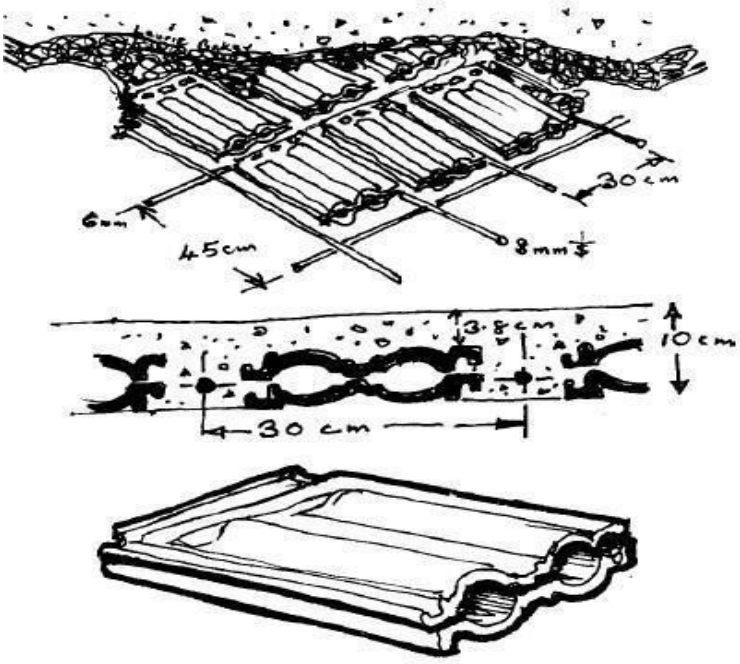
3D MODELLING

- The first pedestrian bridge printed in 3D in the world was inaugurated last December 14 in the urban park of Alcobendas, Madrid. which has a total length of 12 meters and a width of 1.75 meters and is printed in micro-reinforced concrete.



FILLER SLAB

The filler slab is a mechanism to replace the concrete in the tension zone. The filler material, thus, is not a structural part of the slab. By reducing the quantity and weight of material, the roof become less expensive, yet retains the strength of the conventional slab. The most popular filler material is the roofing tile. Mangalore tiles are placed between steel ribs and concrete is poured into the gap to make a filler slab. The structure requires less steel and cement and it is also a good heat insulator.



MATERIALS USED IN FILLER SLAB

- Manglore tiles.
- Burnt clay bricks.
- Hollow concrete blocks.
- Stabilized mud blocks.
- Clay pots.
- Coconut shells.

ADVANTAGES

- Thermal insulation.
- Better aesthetics.
- Considerable cost ceiling.
- Co2 reduction.
- Promoting reuse of materials.

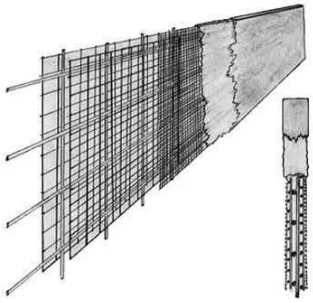
- Promoting sustainability and green concept.
- Reduction of concrete quality.

FERROCEMENT

- Ferrocement or ferro-cement is a system of reinforced mortar or plaster applied over layer of metal mesh, woven expanded-metal or metal-fibers and closely spaced thin steel rods such as rebar.

TECHNIQUES OF MANUFACTURE

- Hand Plastering
- Semi mechanised Process
- Centifuging and Guniting.

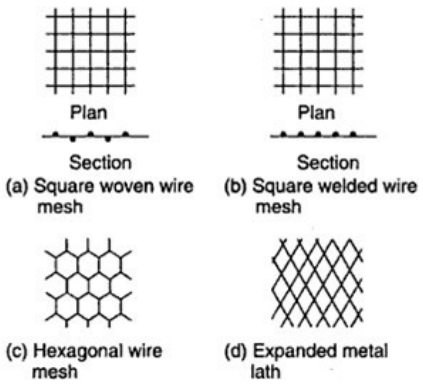


MATERIALS USED IN FERRO CEMENT

- Cement mortar mixture
- Skeleton steel
- Stell mesh reinforcement
- Fibre reinforcement polymeric mesh

- 

- **CEMENT MORTAR MIX**
- Ordinanry potland cement and fine aggregate matrix is used
- The matrix constitutes of 95% of cement mortar and 5% mesh of the composite
- Fa (sand) occupies 60-75% of mortar
- Pasticizers and other admixtures are used

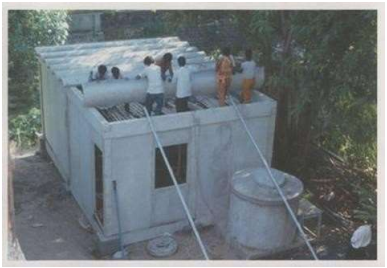


PROPERTIES OF FERROCEMENT

- Durable
- Cheap
- Versatile material
- Less shrinkage
- Low weight
- High tensile strength
- Stiffness

- Better impact
- Punching shear resistance
- Undergo large deformation before cracking





APPLICATION OF FERROCEMENT

- Marine applications
- Water supply and sanitation
- Agricultural
- Residential building
- Rural energy
- Miscellaneous uses

ADVANTAGES OF FERROCEMENT

- Highly versatile
- 20% saving of material and cost
- Sustainable for pre casting
- Flexible in cutting , drilling and jointing
- Good fire resistant
- Good impermiablity
- Low maintenance cost
- Labour intensive
- Highly water proof
- Higher strength to weight ratio than RCC.

Selection of a Suitable Site:
10 Factors to Consider

Availability of Raw-materials
Nearness to the Market
Nearness to Sources of Operating Power
Labour Supplies
Transportation
Finance
Climate
Industrial Inertia
Personal Preferences
Government Policy

Availability of Raw-Materials:
The place selected should be such where the raw materials are available easily. There should be an easy approach to the place of raw-material.

From example:
Iron and steel industry in Bihar, Textile factories in Gujarat and Maharashtra Jute works in Bengal owe their success on account of easy availability of raw-
materials. It reduces the cost of transportation.

Nearness to the Market:
Manufacturing a thing successfully is not sufficient. It is also necessary that the output should find ready market and that the product is sold at a price to yield reasonable profit. This is possible only when the market is not far away. Nearness of the market ensures transportation costless and minimum wastage.

Nearness to Sources of Operating Power:
Every industry requires fuel for working the machinery and unless the region has rich fuel resources of power now available are coal, hydro-electricity and oil etc. Coal is the cheapest source of power, but it is very bulky and involves high transportation costs.

Labour Supplies:
For the successful and un-interrupted working of a factory, availability of adequate supply of labour of the right type at reasonable wages is also very essential. There are some industries in which the inherited skill of the workers in an important factor in the process of manufacturing.
For example—The development of the dying and printing industry in Farukhabad and the glass industry in Ferozabad d have been mainly located there due to the availability of skilled labour in these towns.

Transportation:
Every manufacturing industry requires cheap and efficient means of transportation for the movement of both raw-materials from the source of supply to the factory and finished product from the factory to the markets or the centres of consumption. The location of the plant, should therefore be at a place where adequate transport facilities are available at cheaper rate.

Finance:
No productive activity is possible without the availability of adequate capital. Banks, stock exchanges and other similar institutions help in capital formation and expansion of industry by providing financial help to it from time to time.

Climate:
Certain industries for their successful working require a special type of climate. For example—Cotton textile industry requires humid climate while the photographic goods industry flourishes best in regions of dry climate. Climate also affects the efficiency of labour.

Momentum of Early Start or Industrial Inertia
There is a tendency for an established industry to remain localized in a particular areas in which it arose even after some of the original advantages possessed by that area for such work have lost their previous importance. If however, the entrepreneur acts rationally and his necessary knowledge he will choose the location which offers the lowest cost per unit of output.

Personal Preferences
Location of any industry may sometimes be decided according to the personal preferences and prejudices of the industrial enterprises.
Government Policy
These days the government plays an important role in determining the location of new industries.
In addition to the factors discussed above cost of land and building for setting up the factory topography of the area; the possibilities of future expansion etc., are some other factors which influence the decision-making regarding location of industry.

INNOVATIVE CONSTRUCTION MATERIALS

Hydroceramics have the ability to reduce indoor temperature by up to 6 degrees celsius.

Developed by: Institute of Advanced Architecture of Catalonia

3

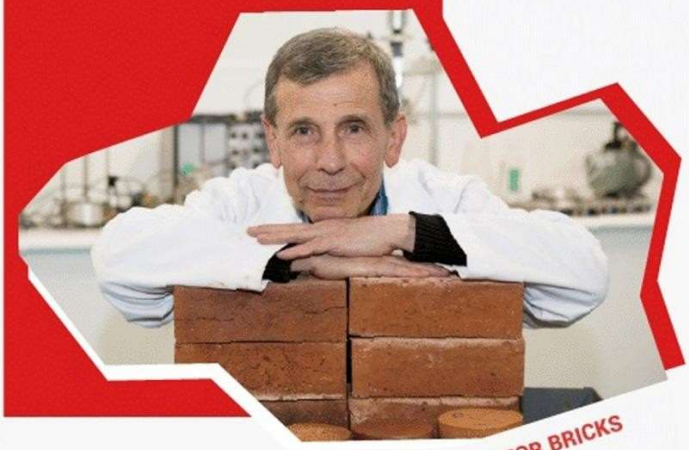
CIGARETTE BUTTS TO MAKE BRICKS

The impact on the environment is tremendous. Elements such as arsenic, chromium, nickel and cadmium enter the soil and harm nature.

In order to reduce the impact of cigarette butts on the environment, researchers at RMIT developed lighter and more energy efficient bricks made of cigarette butts. In short, innovatively utilizing waste in a much more eco-friendly manner.

On a yearly basis, 6 million cigarettes are manufactured and they produce 1.2 million tonnes of cigarette butt waste.

Developed by: RMIT



CIGARETTE BUTTS FOR BRICKS

4

MARTIAN CONCRETE

MARTIAN CONCRETE

It's finally done! We have concrete that can be used to build structures in Mars now. The researching team at the Northwestern University, has created concrete that can be made with the materials available on Mars.

In order to make the martian concrete, sulphur is heated at 240° celsius which melts it into a liquid.

Developed by: Northwestern University

In order to make the martian concrete, sulphur is heated at 240° celsius which melts it into a liquid.

Developed by: Northwestern University

LIGHT GENERATING CEMENT

5

Dr. José Carlos Rubio Ávalos from UMSNH of Morelia, has created cement that has the ability to absorb and irradiate light. With this new light generating cement the potential uses and application of it can be huge.

Energy usage is low because the cement can be created at room temperature.

Developed by: UMSNH of Morelia

6

THE CABKOMA STRAND ROD

The Komatsu Seiten Fabric Laboratory, based in Japan has created a new material called the CABKO-MA Strand Rod. It is a thermoplastic carbon fiber composite.

The strand is the lightest seismic reinforcement and is very aesthetically pleasing.

A single strand of CABKOMA Strand Rod of 160 meter length weighs only 12 kg which is 5 times lighter compared to a metal rod.

Developed by: Komatsu Seiten Fabric Laboratory

THE CABKOMA STRAND ROD

composite.

The strand is the lightest seismic reinforcement and is very aesthetically pleasing.

A single strand of CABKOMA Strand Rod of 160 meter length weighs only 12 kg which is 5 times lighter compared to a metal rod.

Developed by: Komatsu Seiten Fabric Laboratory

BIOLOGICALLY PRODUCED FURNITURE

Another very beautiful innovation in the construction industry is the invention of bioplastic furniture. So far there are two pieces of furniture created through this material – a chaise lounge and a small chair for kids.

This process is low energy, pollution free and requires low technology for the manufacture.

Developed by: Terreform One and Genspace

7

BIOLOGICALL FURNITURE

FURNITURE

8

FLOATING PIERS

FLOATING PIERS

Over the water of Italy's lake Iseo, you can see another great innovation in the construction industry – Floating piers by artists, Christo and Jean-Claude. It is a three kilometer long walkway with 100,000 square meters of yellow cloth wrapped around it. The cubes undulate along the waves of the lake.

The floating dock system is composed of 220,000 polyethylene cubes of high density.

Developed by: Christo and Jean-Claude

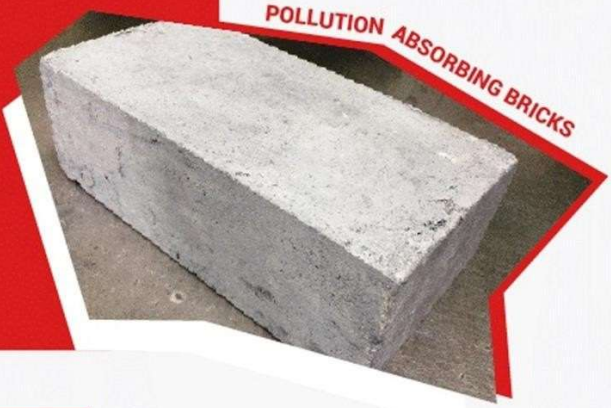
POLLUTION ABSORBING BRICKS

9

The Breathe Brick sucks in pollutants in the air and releases filtered air. The innovative material is designed to be part of a building's standard ventilation system. It has a two layer facade system, with the specialist bricks on the outside and standard insulation on the inside.

By performing wind tunnel tests, it was proven that the system can filter 30% fine particle pollutants and 100% coarse particles such as dusts.

Developed by: Cal Poly



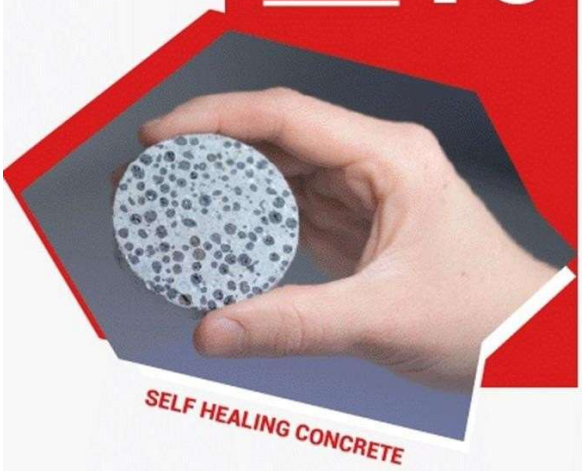
10

SELF HEALING CONCRETE

Dutch civil engineer, Dr. Schlangen at Delft University has created a self healing concrete. This is demonstrated by breaking the material in two, putting the pieces together, and heating the concrete in a microwave oven. Once the melted material cools down, it joins together.

It is estimated that this innovative technology could save $90 million annually.

Developed by: Delft University



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VALUATION

DEFINITION

It is the method of determining the present value of property such as building, a factory, other engineering structures of various types, land etc. By valuation the present value of a property is defined. The present value of property may be decided by its selling price, and income or rent it may fetch.
The value of property depends on its structure, life, maintenance, location, bank interest, etc.

Cost: means original cost of construction of purchase.

OBJECTIVES OF VALUATION

- When the owner of the property wants to sell it
- When a man wants to purchase a property , its valuation is required to assess its market value
- The valuation of property is done for fixation of taxes like (municipal tax, wealth tax ,estate duty (i.e. death duty) etc.
- For determine the rent of property. Valuation is requires. usually rent percentage is fixed based on valuation . Its ranges from 6% to 10%
- If need of loan, to be taken against the security of the property, its valuation is required.
- If property is acquired by the government by law, for paying its compensation ,valuation is required.
- For getting the insurance of the property, its valuation required.
- When a case is to be filed with respect to property, determine court fee, its valuation is required.

PURPOSE OF VALUATION

Buying or selling property:
when it is required to buy or to sell a property, its valuation is required.

Taxation:
To assess the tax of property its valuation is required. Taxes may be municipal tax, wealth tax, property tax, etc., and all taxes are fixed on the valuation of the property.

Rent fixation:
In order to determine the rent of a property, valuation is required. Rent is usually fixed on certain percentage of valuation (6% to 10% of the valuation). Security of loans or mortgage: when the loans are taken against the security of the property, its valuation is required.

Compulsory acquisition:
whenever a property is acquired by law compensation is paid to the owner. To determine the amount of compensation valuation of property is required. Valuation of a property is also required for insurance etc.

Gross income:
gross income is the total income and includes all receipts from various sources the outgoing and the operational and collection charges are not deducted.

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

Sinking fund:
A certain amount of 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.

Scrape value:
scrape value is the value of the dismantled material. That means after dismantle we will get the steel, brick, timber etc. in case of machines the scrape value is metal or dismantle parts.
In general the scrape value is about 10% of total cost of construction.
Scrape value = sale of useable material – cost of dismantling and removal of the rubbish material.

Salvage Value:
It is the value of the utility period without being dismantled. We can sale it as a second handle.

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. This value is changes from time to time for various reasons such as change in industry, change on fashion, means of transport, cost of material and labour etc.

FACTOR AFFECTING THE MARKET VALUE

- Change in area quality
- Change in taste and Fashion
- Design of property
- Communication facilities
- Rapid developments
- Loan facilities
- Change in policy
- Effect of population
- Financial effect

Book value:
Book value is the amount shows in the account book after allowing necessary depreciation. The book value of property at a particular year is the original cost minus the amount of depreciation year. The end of the utility period of the property the book value will be only scrape value.

Distress value:
Where a property cannot fetch full market value , due to fear of war, riots, earthquakes etc.

Monopoly value :
Sometime certain properties possess special advantages with respect to adjoining properties due to location, size, shape, frontages etc. The owner of such properties posses higher value than the market rate .such price is called as monopoly value.

Accommodation value:
During the expansion or development of city or town, the surrounding agricultural land is converted into accommodation .

Guide line value :
For collecting the revenue on sale/purchase of land & buildings the circles rate of land are fixed by D.M of the district . The stamp duty is charged on the value of property at these rates , such values may be said as guide line value.

Depreciation:
Depreciation is the loss in the value of the property due to is use, life, wear, tear, decay and obsolescence. The general annual decrease in the value of a property is known as annual depreciation. Usually, the percentage rate of depreciation is less at the beginning and generally increase during later years.

METHODS OF CALCULATING DEPRECIATION:
1) Straight line method
2) Constant percentage method
3) Sinking fund method.

Straight line method
Annual depreciation = $\frac{\text{Orginal cost} - \text{Scrap value}}{\text{Life in year}}$

Constant percentage method
Annual depreciation = $1 - \{ \text{Scrap value} \}^{1/n}$
$\{ \text{Original cost} \}$

Sinking Fund Method
The depreciation of property is assumed to be equal to the annual sinking fund plus the interest on the fund for that year. This method is helpful for calculating the book value of property.

At the end of	Depreciation for the concerned year	Total depreciation	Book value of proeprty
1st yr	S	S	(C-S)
2nd yr	S+i	(2S+i)	C-(2S+i)
3rd yr	S+j	(3S+i+j)	C-(3S+i+j)
4th yr	S+k	(4S+i+j+k)	C-(4S+i+j+k)
5th yr	S+l	(5S+i+j+k+l)	C-(5S+i+j+k+l)

Here S - Annual sinking fund
C - Original cost of property
i,j,k,l etc represent the interest on the sinking fund for subsequent years.

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.

Depreciation	**Obsolescence**
1) This is the physical loss in the value of the property due to wear & tear, decay ect. 2) Depreciation depends on its original condition, quality of maintenance and mode of use. 3) this is variable according to the age of the property. More the age, more will be the amount for the depreciation. 4) there are different methods by witch the amount of depreciation can be calculated.	1) The loss in the value of the property is due to change of design, fashion, in structure of the other, change of utility, demand. 2) obsolescence depends on normal progress in the arts, inadequacy to present or growing needs etc. 3) this is not dependent on age of the building. A new building may suffer in its usual rent due to obsolescence. 4) At present there is no method of calculation of obsolescence.

ANNUITY:
Annuity For making the weaker section of people as house owner now days government is running schemes. Under this schemes the house is given to such people and the cost is realized in monthly, six-monthly or annual instalment payments. If the interest on the fixed deposit is given annually, then the interest is also an annuity.

TYPES OF ANNUITY

Annuity Certain
When the amount of annuity is paid for definite periods or number of years

Annuity Due
If the annuity is paid at the beginning of each period of years and payments

are continued for certain fixed no. of periods

Deferred Annuity

When the payment of annuity starts at some future date after the no of years

Perpetual Annuity

In case the annuity is to be continued for indefinite period.

VALUATION OF REAL PROPERTY:

• Valuation of building is depends on the type of building. Its structure and durability, on the situation, size, shape, width of road way, quality of material used in the construction and present day prise of material.

• Also depend on the locality if it is in market area having high value then the residential area.

• And depending on the specialities in the building like sewer, water supply, and electricity etc.

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

METHODS OF DETERMINING THE VALUE OF PROPERTY

- ❑ Rent method
- ❑ Profit base method
- ❑ Cost based method
- ❑ Development based method
- ❑ Depreciation method and value
- ❑ Plinth area method
- ❑ Capital value comparison method

The age of the building is generally obtained from record if available or by enquires or from visual inspection.

• Present day cost may be determined by the following methods:

• Cost from record:

cost of construction may be determined from the estimate, from the bill of quantities, from record at present rate. If the actual cost of the construction is known, this may increase or decrease according to the percentage rise or fall in the rates which may be obtained from the public work department (PWD) schedule of rates.

• **Cost by detailed measurements**:
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 measurements at the site and taken the rate for each item as prevalent in the locality or as current PWD schedule of rates.

Cost by plinth area basis:
The above methods are lengthy, a simple method is to calculate the cost on plinth area basis. The plinth area of the building as measured and the present day plinth area rate of similar building in the locality is obtained by enquiries and then the cost is calculated

METHOD OF VALUATION:
the following are the different methods of valuations in our context are
1) Rental method

2) Profit based method

3)Depreciation method

Rental method of valuation:
In this method, the net income by way of rent is found out by deducting all outing goings 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 when the rent is known or probable rent is determined by enquiries.

Valuation based on profit:
This method of valuation is suitable for buildings like hotels, cinema 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 expressions, outgoings, interest on the capital
invested etc. the net profit is multiplied by Y.P to get the capitalized
value. In such case the valuation may work out to be too high in comparison with the cost of construction.

Depreciation Method of Valuation:
• According to this method the depreciated value of the property on the
present day rates is calculated by the formula:
$D = P[(100 - rd)/100]n$
Where,
D –depreciated value
P –cost at present market rate
rd –fixed percentage of depreciation
(r stands for rate and d for depreciation)
n –The number of years the building had been constructed.
To find the total valuation of the property, the present value of land, water supply,
electric and sanitary fitting etc; should be added to the above value.

The value of rd can be taken as given in table below

S.N	Life of Building	rd value
1	75 – 100	1
2	50 – 75	1.3
3	25 – 50	2
4	20 – 25	4
5	<= 20	5