LECTURE NOTES

ON

ESTIMATION AND COSTING

B.TechVIISem (IARE-R16)

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UNIT - I

GENERAL ITEMS OF BUILDING

TECHNICAL TERMS

Estimate
An estimate is the anticipated or probable cost of work and is usuallyprepared before the construction is taken up. It is indeed calculations or computations of various items of an engineering work.

Quantity survey
It is the schedule of all items of work in a building. Thesequantities are calculated from the drawing of the building. Thus quantity survey gives quantities of work done in case of each items, when priced gives the total cost. In short, quantity survey means calculations of quantities of materials required to complete the work concerned.

Specifications
Detailed specifications gives the nature, quality and class of work,materials to be used in the various parts of work , quality of the material, their proportions, method of preparation, workmanship and description of execution of work are required.

Rates
The rates of various items of works, materials to be used in the construction andthe wages of different categories of labor (skilled and unskilled) should be available for preparing an estimate. The cost of transportation charges should also be known. As far as possible sanctioned "Schedule of Rates" shall be followed or the rates may be worked out by the "Analysis of Rates" method.

Site plan
It is the plan drawn for a particular construction showing its position withrespect to approaching roads, main bazars, markets and other permanent features in a populated area. It shows the location of the area under construction with respect to the other areas and on it generally the names of the owners of areas or property holders adjoining to it are also denoted. North line is also clearly marked on it.

Line plan
Line plan can be defined as the plan of a particular construction simplyshowing main features with the help of the single lines of different portions of the constructions. Details of constructions are not generally shown on this plan. This inside and outside dimensions shown on this plan should necessarily be corresponding to actual dimensions.

Index plan
This is the plan of a particular colony showing the positions of differenthouses in single lines their number if any position of roads, schools, market, hospitals and other features etc. this plan is generally fixed on the entrance, or at exit or in the central place of the colony, for the guidance of the inhabitants and outsiders.

Detailed plan
This plan indicates a plan of a construction drawn to a definite scale,showing all detailed information required for its execution. Various sections and elevations are clearly drawn on this plan.

Centre line plan
This is actually a layout plan drawn to facilitate the laying out offoundation lines and other features. It is generally fixed on the entrance or at exit in the central place of the colony for the guidance of the inhabitants and outsiders.

Supplemantary estimate
When some additions are done in the original work, afresh detailed estimate is prepared to supplement the original work. This estimate is called supplementary estimate. It is also accompanied by all the papers as required in thru detailed estimate.

Administrative approval
For any project required by the department an approvalso sanction of the competent authority with respect to the cost and work is necessary at the first instance. Thus administrative aooroval denotes the formal acceptance by the administrative department concerned of the proposals for incurring expenditure.

Technical sanction
It means the sanction and order by the competent authority ofthe department for the detailed estimate design calculations quantities of work rates and cost of work..after the technical sanction of the estimate is received the work is then taken up for construction.

Competent authority
An officer or any other authority in the department to whomrelevant powers are delegated by the government (Financial Department).

Ordinary measurement book
It is measured book in which entries regarding the workdone or supplies made and services performed are recorded for the purpose of making payments to the contractors or the labor. Entries in the M.B are generally recorded by the sectional officers or by any other officers deputed for the purpose

Lumpsum items

Sometimes while preparing estimate for the certain small items like front architecture or decoration work of a building it is not possible to workout detailed quantities so far such lump sum items a lump sum rate is provided.

Plinth area

The built up covered area of a building measured at floor level of any storey is called plinth area.

Circulation area

The total cost of construction including all expenditures incurred plus the cost of external servicesup to the end of the completion of the work is called capital cost. It also includes the cost of preliminary works, miscellaneous items and supervisioncharges etc.

General

Estimating is the technique of calculating or computing the variousquantities and the expected Expenditure to be incurred on a particular work orproject. In case the funds available are less than the estimated cost the work isdone in part or by reducing it or specifications are altered, the following requirementare necessary for preparing an estimate.

1. Drawings like plan, elevation and sections of important points.

2. Detailed specifications about workmanship& properties of materials etc.

3. Standard schedule of rates of the current year.

Units of measurements

The units of measurements are mainly categorized for their nature, shape and size and for making payments to the contractor and also. The principle of units of measurements normally consists the following:

a) Single units work like doors, windows, trusses etc., is expressed in numbers.

b) Works consists linear measurements involve length like cornice, fencing, hand rail, bands of specified width etc., are expressed in running meters (RM)

c) Works consists areal surface measurements involve area like plastering, white washing, partitions of specified thickness etc., and are expressed in square meters (m2)

d) Works consists cubical contents which involve volume like earth work, cement concrete, Masonry etc are expressed in Cubic metres.

Rules for measurement

The rules for measurement of each item are invariably described in IS- 1200.

However some of the general rules are listed below.

1.Measurement shall be made for finished item of work and description of each item shall include materials, transport, labor, fabrication tools and plant and all types of overheads for finishing the work in required shape, size and specification.

2.In booking, the order shall be in sequence of length, breadth and height or thickness.

3.All works shall be measured subject to the following tolerances.

a).linear measurement shall be measured to the nearest 0.01m.

b).Areas shall be measured to the nearest 0.01 sq.m

c).Cubic contents shall be worked-out to the nearest 0.01 cum

Same type of work under different conditions and nature shall be measured separatelyunder separate items.

The bill of quantities shall fully describe the materials, proportions, workmanships and accurately represent the work to be executed.

In case of masonry (stone or brick) or structural concrete, the categories shall be measured separately and the heights shall be described:

a)From foundation to plinth level.

b)From plinth level to first floor level.

c)From Fist floor to second floor level and so on.

Requirements of estimation and costing

a)Estimate gives an idea of the cost of the work and hence its feasibility can be determined i.e. whether the project could be taken up with in the funds available or not.

b)Estimate gives an idea of time required for the completion of the work.

c)Estimate is required to invite the tenders and Quotations and to arrange contract.

d)Estimate is also required to control the expenditure during the execution of work.

e)Estimate decides whether the proposed plan matches the funds available or not.

Procedure of estimating or method of estimating.

Estimating involves the following operations

Preparing detailed Estimate.

Calculating the rate of each unit of work

Preparing abstract of estimate

Data required to prepare an estimate

Drawings i.e. plans, elevations, sections etc.

Specifications.

Rates.

Drawings

If the drawings are not clear and without complete dimensions the preparation of estimation become very difficult. So, it is very essential before preparing an estimate.

Specifications

General Specifications: This gives the nature, quality, class and work and materials in general terms to be used in various parts of wok. It helps no form a general idea of building.

Detailed Specifications: These gives the detailed description of the various items of work laying down the Quantities and qualities of materials, their proportions, the method of preparation workmanship and execution of work.

Rates

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

for arriving at the unit rates of each item.

The rates of various materials to be used in the construction.

The cost of transport materials.

The wages of labor, skilled or unskilled of masons, carpenters, Amador, etc.,

Complete estimate

Most of people think that the estimate of a structure includes cost of land, cost of materials and labor, but many other direct and indirect costs included and are shown below.

The following are some of L.S. Items in the estimate.

Water supply and sanitary arrangements.

Electrical installations like meter, motor, etc.,

Architectural features.

Contingencies and unforeseen items.

In general, certain percentage on the cost of estimation is allotted for the above L.S.Items Even if sub estimates prepared or at the end of execution of work, the actual cost should not exceed the L.S.amounts provided in the main estimate.

Work charged establishment

During the construction of a project considerable number of skilled supervisors, work assistance, watch men etc., are employed on temporary basis. The salaries of these persons are drawn from the L.S. amount allotted towards the work charged establishment. That is, establishment which is charged directly to work. AnL.S.amount of 1½ to 2% of the estimated cost is provided towards the work charged establishment.

Methods of taking out quantities

The quantities like earth work, foundation concrete, brickwork in plinthand super structure etc., can be workout by any of following two methods:

Long wall - short wall method

Centre line method.

Partly centre line and short wall method.

Long wall-short wall method

In this method, the wall along the length of room is considered to be longwall while the wall perpendicular to long wall is said to be short wall. To get thelength of long wall or short wall, calculate first the centre line lengths of individual walls. Then the length of long wall, (out to

out) may be calculated after adding half breadth at each end to its centre line length. Thus the length of short wall.

Measured into in and may be found by deducting half breadth from its centre linelength at each end. The length of long wall usually decreases from earth work tobrick work in super structure while the short wall increases. These lengths aremultiplied by breadth and depth to getquantities.

Centre line method

This method is suitable for walls of similar cross sections. Here the totalcentre line length is multiplied by breadth and depth of respective item to get thetotal quantity at a time.

When cross walls or partitions or verandah walls joinwith main all, the centre line length gets reduced by half of breadth for eachjunction. Such junction or joints are studied carefully while calculating total centreline length. The estimates prepared by this method are most accurate and quick.

Partly centre line and partly cross wall method

This method is adopted when external (i.e., around the building) wall isof one thickness and the internal walls having different thicknesses. In such cases,centre line method is applied to external walls and long wall-short wall method isused to internal walls. This method suits for different thicknesses walls and differentlevel of foundations. Because of this reason, all Engineering departments arepracticing this method.

Detailed estimate

The preparation of detailed estimate consists of working out quantities of various items of work and then determines the cost of each item. This is prepared in two stages.

Details of measurements and calculation of quantities

The complete work is divided into various items of work such as earth work concreting, brick work, R.C.C. Plastering etc., The details of measurements are taken from drawings and entered in respective columns of prescribed preformed. The quantities are calculated by multiplying the values that are in numbers column to Depth column as shown below:

Details of measurements form

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

Abstract of Estimated Cost

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

Types of Estimates

Abstract of estimate form

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

The detailed estimate should accompanied with

i) Report

ii) Specification

iii) Drawings (plans, elevation, sections)

iv) Design charts and calculations

v)Standard schedule of rates.

Factors to be consisdered while preparing detailedEstimate

i) **Quantity and transportation of materials:**

For bigger project, the requirement of materials is more. such bulk volume of materials will be purchased and transported definitely at cheaper rate.

ii) **Location of site:**

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

iii) **Local labor charges:**

The skill, suitability and wages of local labors are considered while preparing the detailed estimate.

Data

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

Fixing of rate per unit of an item

The rate per unit of an item includes the following:

Quantity of materials &cost

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

Cost of labour

The exact number of labourers required for unit of work and the multiplied by the wages/ day to get of labour for unit item work.

Cost of equipment (T&P)

Some works need special type of equipment, tools and plant. In such case, an amount of 1 to 2% of estimated cost is provided.

Overhead charges:

To meet expenses of office rent, depreciation of equipment salaries of staff postage, lighting an amount of 4% of estimate cost is allocated.

Methods of preparation of approximate estimate

Preliminary or approximate estimate is required for studies of various aspects of work of project and for its administrative approval. It can decide, in case of commercial projects, whether the net income earned justifies the amount invested or not. The approximate estimate is prepared from the practical knowledge and cost of similar works. The estimate is accompanied by a report duely explaining necessity and utility of the project and with a site or layout plan. A percentage 5 to 10% is allowed for contingencies. The following are the methods used for preparation of approximate estimates.

a) Plinth area method

b) Cubical contents methods

c) Unit base method.

Plinth area method

The cost of construction is determined by multiplying plinth area with plinth area rate. The area is obtained by multiplying length and breadth (outer dimensions of building). In fixing the plinth area rate, careful observation and necessary enquiries are made in respect of quality and quantity aspect of materials and labour, type of foundation, height of building, roof, wood work, fixtures, number of storey's etc., As per IS 3861-1966, the following areasinclude while calculating the plinth area of building.

Types of Estimates

Area of walls at floor level.

Internal shafts of sanitary installations not exceeding 2.0m2, lifts, air-conditioning ducts

etc.,

Area of barsati at terrace level: Barsati means any covered space open on one side constructed on one side constructed on terraced roof which is used as shelter during rainy season.

Arches of non cantilever type. Areas which are not to include

Area of lofts.

Unenclosed balconies.

Architectural bands, cornices etc.,

Domes, towers projecting above terrace level.

Box louvers and vertical sunbreakers.

Cubical Contents Method

This method is generally used for multistoreyed buildings. It is more accurate that the other two methods viz., plinth area method and unit base method. The cost of a structure is calculated approximately as the total cubical contents (Volume of buildings) multiplied by Local Cubic Rate. The volume of building is obtained by Length x breadth x depth or height. The length and breadth are measured out to out of walls excluding the plinth off set. The cost of string course, cornice, corbelling etc., is neglected. The cost of building= volume of buildings x rate/ unit volume.

Problems

Estimation of different foundations, steps and boundary walls.Example : 1 From the Drawing given below determine (a) Earth work excavationCC (1:5:10) Bed (c) R.R.Masonry in C.M. (1:6) (d) Brick Work in C.M.(1:6).

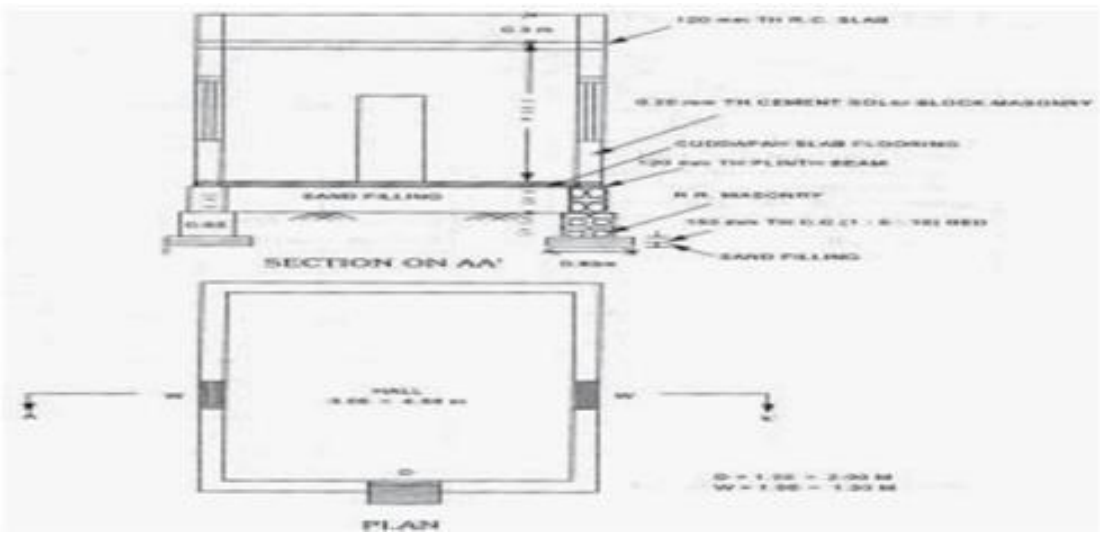
Single Roomed Building (Load Bearing type structure)
From the Drawing given below determine (a) Earth work excavation

(b) CC (1:5:10) Bed (c) R.R.Masonry in C.M. (1:6) (d) Brick Work in

C.M.(1:6). by

longwall - short wall method

Centre line Method



Technical Terms

Retaining wall

It is a structure designed and constructed to resist the lateral pressure of soil when there is a desired change in ground elevation that exceeds the angle of repose of the soil.

Aqueduct

It is a water supply or navigable channel (conduit) constructed to convey water. In modern engineering, the term is used for any system of pipes, ditches, canals, tunnels, and other structures used for this purpose.

Arch

It is a structure that spans a space while supporting weight.

Pitched roof

It is a roof structure where the roof leans to one side of the house

Flat roof

It is a type of covering of a building. In contrast to the sloped form of a roof, a flat roof is horizontal or nearly horizontal.

Culvert

It is device used to channel water. It may be used to allow water to pass underneath a road, railway, or embankment

Formwork

It is the term given to either temporary or permanent moulds into which concrete or similar materials are poured. In the context of concrete construction, the false work supports the shuttering moulds.

Load bearing

It is one in which a wall of a structure bears the weight and force resting upon it, conducting the vertical load from the upper structure to the foundation.

Handrail

It is a rail that is designed to be grasped by the hand so as to provide stability or support.

Tread

It means horizontal upper portion of a step.

Riser

This is the vertical portion of a step. It means the vertical distance between the horizontal surfaces of two consecutive steps.

Landing

This is a horizontal platform provided at the head of a series of step.

Nosing

This is the outer projecting edge of a tread.

Flight

This is consists of series of steps provided between the landings.

Flatslab

A flat slab is reinforced concrete slab supported directly over the columns without beams. Generally used when head room is limited. Such as in cellars and warehouses.

Panel

Panel is that the part of the slab bounded on each of its form sides by the centre line of columns or center lines of adjacent spans.

Drop

The drop panel is formed by increasing the thickness of slab in vicinity of supporting column.

Column head

The column head or capital located by flaring of the column at the top is primarily intended to increase the punching shear of the slab.

Brick masonry

Masonry structures are built using masonry units and mortar.

Masonry wall

Masonry walls are constructed using bricks and mortar.

Mortar

Masonry units are bonded together using mortars.

UNIT-II

EARTH WORK

All the civil engineering structures such as buildings , roads, canals, railway lines, culverts and dams earth work will there.
Cross-section of earth work of road in banking or in cutting is usually in the form of trapezium.

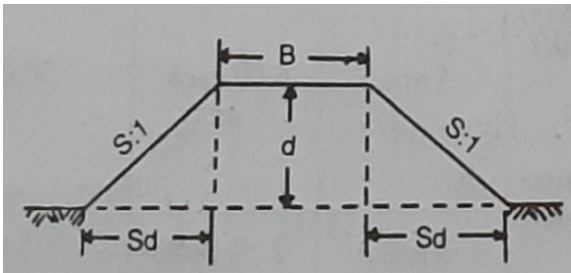


Fig. 7-1
Banking

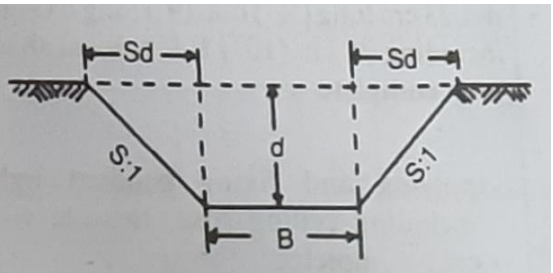


Fig. 7-2
Cutting

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

Bd+2(1/2sdxd) =Bd+sd^2

S:1 is the ratio of side slopes as horizontal :vertical.

For 1 vertical , horizontal is s, for d vertical , horizontal is sd.

Quantity =(Bd+sd^2)xL

Mean height = $\frac{d1+d2}{2}$ = dm

Sectional area is taken out from mean height = Bdm +sd^2m

Qty = (Bdm + sd^2m)x

Lead and Lift

Earth work is estimated for 30m lead for distance and 1.5m lift for height or depth and this distance of 30m and height of 1.5m are known as normal lead and lift.

For greater lead or lift the rates will be different for every unit of 30m lead & for every unit of 1.5m lift.

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

Mid-Sectional area method

Quantity = Area of mid-section area x length.

Let d1 & d2 be the height of bank at two ends portion of embankment, L the length of the section B

the formation width & S:1(horizontal :vertical).

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

Area= $Bdm + 1/2Sdm^2 + 1/2Sdm^2 = Bdm + Sdm^2$

Quantity of earth work = $(Bdm + Sdm^2)xL$.

General $Q = (Bd+Sd^2)xL$ where d stands for mean height or depth.

Area of side sloping surface

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

sloping by length

Mean sectional area method

Quantity = Mean sectional area x length.

Sectional area at one end $A1 = Bd1 + sd1^2$

Sectional area at other end $A2 = Bd2 + sd2^2$, d1 and d2 are the heights or depths at the two ends

Prismoidal formula method

Quantity or Volume = $1/6[A_1 + A_2 + 4A_m]$, where A_1 and A_2 are the cross-sectional areas at the two ends of a portion of embankment of a road of length L and A_m is the mid-sectional area.

UNIT - III

RATE ANALYSIS

Reinforced concrete and allied works

Scope

This specification covers the general requirements for concrete jobs, using on-site production facilities including requirements in regard to the quantity, handling, storage of ingredients, proportioning, batching, mixing and testing of concrete and also requirements in regard to the quality. This also covers the transportation of concrete from the mixer to the place of final deposit and the placing, consolidation, curing, protecting, repairing ad finishing of concrete. After award of the work, if so desired by the contractor, he / they may be allowed by the Engineer-in-charge till the designed mix is obtained, to carry out the reinforce concrete work In foundation and plinth as per equivalent nominal mix against the specified design mix concrete as per IS Codes. However, all other specification for design mix shall govern for nominal mix also and nothing extra shall be paid for use of extra cement on this account whether the cement is supplied by the Department or procured by the contractor.

Cement Concrete (Plain and Reinforced)

The quality of materials and method and control of manufacture and transportation of all concrete work in respect of mix, where reinforced or otherwise, shall conform to the applicable portions of these specifications. The Engineer-in-charge shall have the right to inspect the sources of materials, the layout and operation of procurement and storage of materials, the concrete batching and mixing equipments and the quality control system. Such an inspection shall be arranged by the contractor and the Engineer-in-charge's approval shall be obtained prior to starting the concrete work.

Materials for Standard Concrete

The ingredients to be used in the manufacture of standard concrete shall consist solely of a standard type Portland cement, clean sand, natural coarse aggregate, clean water, ice and admixtures if specially called for as per drawings or schedule of quantities.

Cement

Unless otherwise specified or called for by the Engineer-in-charge, cement shall be ordinary Portland cement in 50 kg bags. The use of bulk cement will be permitted only with the approval of the Engineer-in-charge. Changing of brands or type of cement within thesame structure will not be permitted. Ordinary Portland cement (OPC) 43 grade manufactured as per I.S. specifications of reputed brands like ACC / Ultratech / Zuari / Coramendel or any other brands as approved by the Engineer-in-charge from time to time shall be procured and used on the work. Joint account of cement consumed at site for every day for items of work carried shall be maintained by the Contractor for verification to ensure effective control on quality of cement used in the work.

A certified report attesting to the conformity of the cement to IS specifications by the cement manufactures chemist shall be furnished to the Engineer-in-charge, if demanded. Incase the cement is required to be arranged by the Contractor, the Contractor will have to make his own arrangement for the storage of adequate quantity of cement. Cement in bulk may be stored in bins or silos which will provide complete protection from dampness, contamination and minimize caking and false set. Cement bags shall be stored in a dry enclosed shed (storage under tarpaulins will not be permitted), well away from the outer walls and insulated from the floor to avoid contact with moisture from ground and so arranged as to provide ready access. Damaged or reclaimed or partly set cement will not be permitted to be used and shall be removed from the site. The storage bins and storage arrangements shall be such that there is no dead storage. Not more than 12 bags shall be stacked in any tier. The storage arrangement shall be got approved by the Engineer-in-charge. Consignments in cement shall be stored as received and shall be consumed in the order of their delivery. Contractor shall establish cement/concrete/soil testing laboratories at site of work with qualified person to handle the laboratory. Every consignment of cement procured shall accompany test certificate from the company indicating lot No etc.

Sample shall betaken for each lot and sent to Standard Approved Material Testing Laboratory for physical and chemical analysis. The cost of testing shall be borne by the Contractor.

Cement held in store for a period of 90 (ninety) days or longer shall be retested before use in work. Should at any time the Engineer-in-charge have reasons to consider that any cement is defective, then irrespective of its origin and / or manufacturers test certificate, such cement shallbetested immediately at a National Test Laboratory / Departmental Laboratory or such approved laboratory, and until the results of such tests are found satisfactory, it shall not be used in any work.

Aggregates

"Aggregate" in general designates both fine and coarse inert materials used in the manufacture of concrete."Fine Aggregate" is aggregate most of which passes through 4.75 mm I.S. sieve. "Coarse Aggregate" is aggregate most of which is retained on 4.75 mm I.S. sieve. All fine and coarse aggregates proposed for use in the work shall be subject to theEngineer-in-charge's approval and after specific materials have been accepted, the source of supply of such materials shall not be changed without prior approval of the Engineer-incharge. Aggregate shall, except as noted above, consists of natural sand, crushed stone and gravel from a source known to produce satisfactory aggregate for concrete and shall be chemically inert, strong, hard, curable against weathering, of limited porosity and free from deleterious materials that may cause corrosion to the reinforcement or may impair the strength and / or durability of concrete. The grading of aggregates shall be such as to produce a dense concrete of and shall be based on the "mix design" and preliminary test on concrete specified hereinafter.

Sampling and Testing

Sampling of the aggregates for mix design and determination of suitability shall be taken under the supervision of the Engineer-in-charge and delivered to the laboratory, well in advance of the schedule placing of concrete. Record of tests which have been made on proposed aggregates and on concrete made from this source of aggregates shall be furnished to the Engineer-in-charge in advance of the work or use, in determining suitability of the proposed aggregate.

Storage of aggregates

All coarse and fine aggregates shall be stacked separately in stock pile in the materialyard near the work site in bins properly constructed to avoid inter mixing of different aggregates. Contamination with foreign materials and earth during storage and while heaping the materials

shall be avoided. The aggregate must be of specified quality not only at the time of receiving at site but also at the time of loading into mixer. Rakers shall be used for lifting the coarse aggregate from bins or stock piles. Coarse aggregate shall be piled in layers not exceeding 1.00 meters in height to preventconning or segregation. Each layer shall cover the entire area of the stock pile before succeeding layers are started. Aggregates that have become segregated shall be rejected. Rejected materials after remixing may be accepted, if subsequent tests demonstrate conformity with required gradation.

Specific Gravity

Aggregates having a specific gravity below 2.6 (saturated surface dry basis) shall not be used without special permission of the Engineer-in-charge.

Fine Aggregate

Fine aggregate except as noted above, and for other than light weight concrete shall consist of natural or crushed sand conforming to IS 383. The sand shall be clean, sharp, hard, strong and durable and shall be free from dust, vegetable substances, adherent coating, clay, loam, alkali, organic matter mica, salt or other deleterious substances which can be injurious to the setting qualities / strength / durability of concrete.

Screening and Washing

Sand shall be prepared for use by such screening or washing or both as necessary, to remove all objectionable foreign matter while separating the sand grains to the required size fractions. Sand with silt content more than 3 percent will not be permitted to be used unless same is washed and silt content is brought within 3% by weight.

Gradation

Unless otherwise directed or approved, the grading of sand shall be within thelimit indicated here under:-Where the grading falls outside the limits of any particular grading zone of sieves, other than 600 micron (IS) sieve by not more than 5% it shall be regarded as falling within that grading zone. This tolerance shall not be applied to percentage passing the 600 micron (IS)sieve or to percentage passing any other sieve size on the coarser limit of grading zone I or the finer limit of grading zone IV. Fine aggregates conforming to Grading zone IV shall not be used unless mix designs and preliminary tests have shown its suitability for producing concrete of specified strength and workability.

Fineness Modulus

The sand shall have a fineness modulus of not less than 2.2 or more than 3.2 the fineness modulus is determined by adding the cumulative. Percentages retained on the following IS sieve sizes (4.75 mm, 2.36 mm, 1.18mm, 600 micron, 300 micron and 150 micron) and dividing the sum by 100.

Coarse Aggregate

Coarse aggregate for concrete except as noted above and for other than light weight concrete shall conform to IS 383. This shall consist of natural or crushed stone and gravel, and shall be clean and free from elongated, flaky or laminated pieces, adhering coatings, clay lumps, coal residue, clinkers, sag, alkali, mica, organic matter or other deleterious matter. The coarse aggregate and fine aggregate shall be tested from time to time as required by the Engineer-in-charge to ascertain its suitability for use in construction and the charges for testing aggregate shall be born by the contractor as specified herein after.

Screening and Washing

Crushed rock shall be screened and / or washed for the removal of dirt or dust coating, if so demanded by Engineer-in-charge.

Grading

Coarse aggregates shall be either in single or graded in both the cases. The grading shall be within the following limits:

Foreign Material Limitations

The percentages of deleterious substances in the coarse aggregate delivered to the mixer shall not exceed the following.

IS Sieve designation	Percentage passing for single sized aggregates						Percentage passing for graded aggregates of nominal size			
	63mm	40mm	20mm	16mm	12.5mm	10mm	40mm	20mm	16mm	12.5mm
75mm	100	-	-	-	-	-	-	-	-	-
63mm	85-100	100	-	-	-	-	100	-	-	-
37.5mm	0-30	85-100	100	-	-	-	95-100	100	-	-
19mm	0.5	0.20	85-100	100	-	-	30-70	95-100	100	100
16mm	-	-	-	85-100	100	-	-	-	90-100	-
11.2mm	-	-	-	-	85-100	100	-	-	-	90-100
9.5mm	-	0.5	0.20	0.30	0-45	85-100	10-35	25-55	30-70	40-85
4.75mm	-	0.5	0-5	0-10	0-20	0-20	0-5	0-10	0-10	0-10
2.36mm	-	-	-	-	0-5	0-5	-	-	-	-

Sl. No.	Substances	Percent by weight	
		Uncrushed	Crushed
I	Material finer than 75 micron IS Sieve	3.00	3.00
II	Coal and Lignite	1.00	1.00
III	Clay lumps	1.00	1.00
IV	Soft fragments	3.00	-
V	Total of all the above substances	5.00	5.00

Water

Water used for both mixing and curing shall be free from injurious amount of deleterious materials; potable waters are generally satisfactory for mixing and curing concrete. In case of doubt, the suitability of water for making concrete shall be ascertained by the compressive strength and initial setting time test specified in IS 456. The sample of water taken for testing shall be typical of the water proposed to be used for concreting, due account being paid to seasonal variation. The samples shall not receive any treatment before testing other than that envisaged in the regular supply of water proposed for use in concrete. The sample shall be stored in a clean container previously rinsed out with similar water. Average 28 days compressive strength of at least three 150mm concrete cubes prepared with water proposed to be used shall not be less than 90% of the average strength of three similar concrete cubes prepared with distilled water. The initial setting time of test block made with the appropriate test cement and the water proposed to be used shall not be less than 30 minutes and shall not differ by more than (+) 30 minutes form the initial setting time of control test block prepared with the appropriate test cement and distilled water. The test blocks shall be prepared and tested in accordance it the requirements of IS 4031. Where water can be shown to contain an excess of acid, alkali, sugar or salt, Engineer-in-charge may refuse to permit its use. As a guide, the following concentrations represent the maximum permissible values.

Limits of acidity

To neutralize 200ml sample of water, using phenolphthalein as an indicator, it should not require more than 2ml of 0.1 normal NaOH. The details of test shall be as given in IS 3025. **Limits of alkalinity**

To neutralize 200ml sample of water, using methyl orange as an indicator, it should not require more than 10ml of 0.1 normal HCL. The details of test shall be as given in IS 3025.

Design Mix Concrete

All reinforced concrete in the works shall be "Design Mix Concrete" as defined in I.S.456-2000. All "Design Mix Concrete" work to be carried out under these specifications shall be in grades designated as per table below:

Grades of Concrete

Grade Designation	Specified Characteristic compressive strength at 28 days(N/mm2)
M 10	10
M 15	15
M 20	20
M 25	25
M 30	30
M 35	35
M 40	40

Mix Design

This is to investigate the grading of aggregates, water cement ratio, workability and the quantity of cement required to give works cubes of the characteristic strength specified. The proportion of the mix shall be determined by weight. Adjustment of aggregate proportions due to moisture present in the aggregate shall be made. Mix proportioning shall be carried out accordingto the ACI standard designation ACI-613 or Design of concrete mixes –Road research Note No. 4, Department of Scientific and Industrial Research U.K. or I.S.10262-1982.

Selection of Water Cement Ratio

Since different cements and aggregates of different maximum size, grading, surface texture, shape and other characteristics may produce concretes of different compressive strength for the same free water cement ratio, the relationship between strength and free water cement ratio should preferably be established for the materials actually to be used. In the absence of such data, the preliminary free water cement ration (by mass) corresponding to the target strength of 28 days may be selected from the relationship shown in Fig. 1 of IS. 10262- page 7.

Alternately, the preliminary freewater ratio (by mass) corresponding to the target average strength may be selected from the relationship in Fig2-IS 10262-1982, Page 8 using the curve

corresponding to the 28 days cement strength to be used for the purpose. Other relevant items to be used with design of mix should strictly conform to the relevant clauses and appendices of IS 10262 – 1982.

Mode of Measurement for concrete work

General

Concrete as actually done shall be measured for payment, subject to the following tolerances, unless otherwise stated hereinafter. Any work done extra over the specified dimensions shall not be measured for payment.

a. Linear dimensions shall be measured in full centimeters except for the thickness of slab which shall be measured tot eh nearest half centimeter.

b. Areas shall be worked out to the nearest 0.01 sqm.

c. Cubic contents shall be worked out the nearest 0.001 cum.

d. The concrete shall be measured for its length, breadth and height/depth limiting dimensions to those specified on drawings or as directed by the Engineer-incharge.

Note: The sizes of RCC members as assumed in to estimate are based on preliminarydrawings andare likely to be changed. The contractor is not entitled to any extra claim due to such changes.

Deductions

No deduction shall be made for the following:

a. Ends of dissimilar materials e.g. joists, beams, posts, girders, rafters, purlins, trusses, corbels, steps etc. up to 500 sq.cm in cross section.

b. Opening up to 0.1 sqm. (1000 sq.cm).

c. Volume occupied by reinforcement.

d. Volume occupied by pipes, conduits, sheathing etc. not exceeding 25sq.cm. each in cross sectional area. Nothing extra shall be paid for leaving ad finishing such cavities and holes.

Column Footing

R.C.C. in foundation and footings shall be measured for its length, breadth and depths limiting dimensions to those specified in drawing or as ordered in writing by the Engineer-incharge. In case of tapering portions of column footings, the quantities shall be calculated by Prismoidal Formula.

Column

Column shall be measured from top footings to the plinth level and from plinth level to the structural slab level ad to the subsequent structural slab levels. Measurements for higher grade concrete in column at its junction with lower grade concrete beams shall be restricted total column section supporting the beam in question.

Wall

All walls shall be measured from top of the wall footing to the plinth level ad from plinth level to the top of structural first floor and to subsequent floors.

Beam and Lintel

Beam shall be measured from face to face of the columns, walls, cross beams including haunches if any. The depth of the beams shall be measured from the top of the slab tot eh bottom of the beam except in the case of inverted beam where it shall be measured from top of slab to top beams. The beams and lintels with narrow width even though acting as facia in elevation in some cases will be measured as beams and lintels only.

Slab

The length and breadth of slab laid to correct thickness as shown in the detailed drawing for as ordered by the Engineer-in-charge shall be measured between beams, walls ad columns.

Chajjas, Facias, Fins ad Mullions

a. Chajjas shall be measured net from supporting faces upto the edges of chajjas without any facia.

b. Facia shall be measured full excluding chajja thickness.

c. End fins shall be measured full.

d. Intermediate fins, mullions shall be measured between chajjs or

other supporting structural members.

e. Parapets shall be measured from top of slab / chajja.

Staircase

The concrete in all members of staircase like waist slabs, steps, cantilever steps, stringer beams etc. shall be measured for their length, breadth ad depth, limiting dimensions to those specified on drawings. No deductions shall be made for embedded plugs, pockets.

Rates

The rate for PCC / RCC shall include the cost of all materials, labour, transport, tools ad plants and all the operations mentioned hitherto, including or excluding the cost of form work and / or reinforcement as mention din the schedule for quantities. The rates also shall include the cost of testing material, mix design; cube test ad allied incidental expenses. The reinforcement steel used in the works shall be measured and paid for separately under relevant item.

Form work

General

The form work shall consist of shores, bracings, sides of beams and columns, bottom of slabs etc, including ties, anchors, hangers, inserts etc. complete which shall be properly designed and planned for the work. The false work shall be so constructed that up and down vertical adjustment can be made smoothly. Wedges may be used at the top or bottom of timber shores, but not at both ends, to facilitate vertical adjustment and dismantling of form work.

Design of Form Work

The design and engineering of form work as well as its construction shall be the responsibility of Contractor. The drawings and calculations for the design of the form work shall be submitted well in advance to the Engineer-in-charge for approval before proceeding with work, at no extra cost to the Department. Engineer-in-charge's approval shall not however, relieve Contractor of the full responsibility for the design and construction for the form work. The design shall take

into account allhe loads vertical as well as lateral that the forms will be carrying including live and vibration loadings.

Tolerances

Tolerances are specified permissible variation from lines, grade or dimensions given in drawings. No tolerances specified for horizontal or vertical buildings lines or footings. Unless otherwise specified, the following tolerances will be permitted.

Steel reinforcement

Steel reinforcement bars, if supplied or arranged by contractor, shall be either plain round mild steel bars grade as per IS 432 (part-I) or medium tensile steel bars as per IS 452 (part-I) or hot rolled mild steel ad medium tensile steel deformed bars as per IS 1139 or cold twisted steel bars and hot weld strength deformed bars as per IS 1786, as shown and specified on the drawings. Wire mesh or fabric shall be in accordance with IS 1566. Substitution of reinforcement will not be permitted except upon written approval from Engineer-in-charge.

Storage

The reinforcement steel shall not be kept in direct contact with ground but stacked on top of an arrangement of timber sleepers or the like. Reinforcement steel shall be with cement wash before stacking to prevent scale and rust. Fabricated reinforcement shall be carefully stock to prevent damage, distortion, corrosion ad deteriorations.

Quality

All steel shall be grade I quality unless specifically permitted by the Engineer-incharge. No rolled material will e accepted. If demanded by the Engineer-in-charge. Contractor shall submit the manufacturers test certificate for steel. Random tests on steel supplied by contractor may beperformed by Department as per relevant Indian Standards. All costs incidental to such tests shall be at contractors expense. Steel not conforming to specifications shall be rejected. All reinforcement shall be clean, free from grease, oil, paint, dirt loose mill, scale dust, bituminous materials or any other substances that will destroy or reduce the bond. All rods shall be thoroughly cleaned before being fabricated. Pitted and defective rods shall not be used. All bars shall be rigidly held in position before concreting. No welding of rods to obtain continuity shall be allowed unless approved by the Engineer-incharge. If welding is approved, the work shall be

carried as per 2751, according to best modern practices ad as directed by the Engineer-in-charge in all cases of important connections, tests shall be made to prove that the joints are of the full strength of bars welded. Special specifications, as specified by the Engineer-in-charge, shall be adhered to in the welding of cold worked reinforcing bars and bars other than mild steel.

Laps

Laps ad splices for reinforcement shall be shown in the drawings. Splices, in adjacent bars shall be staggered ad the locations of all splices, except those pecified on the drawing shall be approved by the Engineer-in-charge. The bars shall not be lapped unless the length required exceeds the maximum available length of bars at site.

Bending

All bars shall be accurately bent according to the sizes ad shapes shown on the detailed working drawings/ bar being schedules. They shall be bent gradually by machine or other approved means. Reinforcing bars shall not be straightened and rebent in a manner that will injure the materials. Bars containing cracks or splits shall be rejected. They shall be bent cold, except bars of over 25mm in diameter which may be bent hot if specifically approved by the Engineer-incharge. Bars bent hot shall not be heated beyond cherry red colour (not exceeding 645oC) and after bending shall be allowed to cool slowly without quenching. Bars incorrectly bent shall be used only of ht means used for straightening and rebinding be such as shall not, in the opinion of the Engineer-in-charge injure the material. NO reinforcement bar shall be bent when in position in the work without approval, whether or not it is partially embedded in ardened concrete. Bars having links or bends other than those required by design shall not be used.

Bending at Construction Joints

Where reinforcement bars are bent aide at construction joints and afterwards bent back into their original position, care should be taken to ensure that no time the radius of the bend is less than 4 bar diameters for plain mild steel or 6 bar diameters for deformed bars. Care shall also be taken when bending back bars to ensure that the concrete around the bar is not damaged.

Fixing / Placing ad Tolerance on Placing

Reinforcement shall be accurately fixed by ay approved means maintain din the correct position as shown in the drawings by the use of blocks, spacer and chairs as per IS 2502 to prevent

displacement during placing ad compaction of concrete. Bar intended to be in contact at crossing point shall be securely bound together at all such points with number16 gauge annealed soft iron wire. The vertical distances required between successive layers of bars in beams or similar members shall be maintained by the provision of mild steel spacer bars at such intervals that the main bars do not perceptibly sag between adjacent spacer bars.

Tolerance on placing of reinforcement

Unless otherwise specified by the Engineer-in-charge, reinforcement shall be placed within the following tolerances:
Tolerance in spacing

a) For effective depth, 200 mm or less + 10 mm

b) For effective depth, more than 200 mm + 15 mm

Painting

Painting should be strictly according to IS. 1477-1971 (Part-I-Pretreatment) and IS 1477-1971 (part-II painting). Painting should be carried out on dry surfaces free from dust, scale etc. The paint shall be approved by the Engineer-in-charge. Once coat of shop paint (red lead) shall be applied on steel, except where it is to be encased in concrete or where surfaces are to be field welded.

UNIT-V
VALUATION

Definitions

Expenditure

The whole amount can be spent during the financial year or not.

Capital cost

Total cost including all the expenditure incurred from beginning to the completion of a work.

Provisional sum

Estimate of bill quantities for some special work to be done by a specialist firm whose details are known at the time of preparation of estimate.

Rate of cost

The cost per unit of subhead which is arrived at by dividing the up-todate final charges on a sub-head by its up-to-date progress.

Premium

The tendered percentage rate above the notified rates.

REBATE

The tendered percentage rate below the notified rates.

PLINTH AREA

It is a covered area of a building measured at floor level. It is measured by taking external dimensions excluding plinth offset if any.

RATES

Rates followed are of sanctioned schedule of rates or nonscheduled, this fact is to be mentioned under this sub – head.

Contingencies

Incidental expenses of miscellaneous character which cannot be classified approximately under any distinct sub-head, but is added in the cost of construction necessarily.

Valuation

Valuation is the technique of estimating or determining the fair price or value of a property such as building, a factory, other engineering structure of various types, land…etc.

Salvage value

It is the value of end of utility period without being dismantled.

Sinking fund

The fund is gradually accumulated by way of periodic on annual deposit for the replacement of the building or structure at the end of its useful life.

Depreciation

Depreciation is the gradual exhaustion of a usefulness of a property. Decrease or loss in the value of a property due to its structural deterioration use, life wear and tear, decay and obsolescence.

Scrap value

Scrap value is the value of dismantled materials. For a building when the life is over the end of utility period of dismantled materials as steel, bricks, timber. Etc. will fetch certain amount which is scrap value of a building.

Objects of valuation

It is the technique of estimating and determining the fair price or value of a property such as a building, a factory or other engineering structures of various types, land etc.

Six important Purposes of Valuation

The main purposes of valuation are as follows:

Buying or Selling Property

When it is required to buy or sell a property, its valuation is required.

Taxation

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

Rent Function

In order to determine the rent of a property, valuation is required. Rent is usually fixed on the certain percentage of the amount of valuation which is 6% to 10% of valuation.

Security of loans or Mortgage

When 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 the property is required.

Valuation of a property is also required for Insurance, Betterment charges, speculations etc.

Valuation of Building

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

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

Six Methods of Valuation

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

6. Depreciation method of Valuation

Definitions

Market Value

The market value of a property is the amount which can be obtained at any particular time from the open market if the property is put for sale. The market value will differ from time to time according to demand and supply.

The market value also changes from time to time for various miscellaneous reasons such as changes in industry, changes in fashions, means of transport, cost of materials and labour etc.

Book Value

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

Capital cost

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

Capitalized Value of a Property

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

Therefore, Capitalized Value = Net income x year's purchase

Year's Purchase

Year's purchase is defined as the capital sum required to be invested in order to receive a net receive a net annual income as an annuity of rupee one at a fixed rate of interest.

The capital sum should be 1×100/rate of interest.

Thus to gain an annual income of Rs x at a fixed rate of interest, the capital sum should be x(100/rate of interest).

But (100/rate of interest) is termed as Year's Purchase.

The multiplier of the net annual income to determine the capital value is known as the Year's Purchase (YP) and it is useful to obtain the capitalized value of the property.

Sinking Fund Method

In this method, the depreciation of a property is assumed to be equal to the annual sinking fund plus the interest on the fund for that year, which is supposed to be invested on interest bearing investment.

Rental Method of Valuation

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

Direct comparison with the capital Value

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

Valuation based on profit

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

Valuation based on cost

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

Development Method of Valuation

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

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

Depreciation Method of Valuation

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

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

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

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

Depreciation is the gradual exhaustion of the usefulness of a property. This may be defined as the decrease or loss in the value of a property due to structural deterioration, life wear and tear, decay and obsolescence.

Methods for calculating depreciation

1. Straight line Method
2. Constant percentage method
3. Sinking Fund Method
4. Quantity Survey Method

Straight Line Method

In this method, it is assumed that the property losses its value by the same amount every year. A fixed amount of the original cost is deducted every year, so that at the end of the utility period, only the scrap value is left.

Annual Depreciation, D = (original cost of the asset – Scrap Value)/life in years

For example, a vehicle that depreciates over 5 years, is purchased at a cost ofUS$17,000,

and will have a salvage value ofUS$2000, will depreciate at US$3,000 per year.

($17,000? $2,000)/ 5 years = $3,000 annual straight-line depreciation expense. In otherwords, it isthe depreciable cost of the asset divided by the number of years of its useful life.

Constant Percentage Method or Declining balance Method

In this method, it is assumed that the property will lose its value by a constant percentage of its value at the beginning of every year.

Annual Depreciation, D = 1-(scrap value/original value)1/life in year

Quantity Survey Method

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

FIXATION OF RENT

Capitalized value of the property can be known by any of the methods discussed earlier and suitable value of year's purchase is adopted according to the admissible rate of interest (8% or any other fair rate).

Then, Net income = capitalized value / year's purchase

All possible outgoings are added to this net income which will give gross income from the property. Gross income or gross rent = Net rent + outgoings.

The standard rent = (Gross Income / 12) per month.

General or brief specification

This gives the nature and class of the work and materials in general terms, to be used in the various parts of work, from the foundation to the superstructure. It is a short description of different parts of work specifying materials, proportions, qualities, etc., General specifications give general idea of the whole work or structure and are useful for preparing for estimate.

Detailed specifications

Detailed specifications of excavations, filling and backfilling

Scope of Work

The scope for work covered under this specifications pertain to excavation of foundations, trenches, pits and over areas, in all sorts of soil, soft and hard rock, correct to dimensions given in the drawing including shoring, protections of existing underground utilities of any, such as water lines, electric cables etc. dewatering and shoring if necessary, stacking the useful materials as directed within the lead specified, refilling around the foundation and into the plinth with selected useful excavated earth and disposing off the surplus earth / materials within specified lead and finishing the surface to proper levels, slopes and camber etc. all complete.

Site Clearance

Before the earth work is started the area coming under cutting and filling shall be cleared of all obstruction, loose stones, shrubs, rank vegetation, grass, bushes and rubbish removed up to a distance of 150 metres outside the periphery of the area under clearance. This work is deemed to be included in the earthwork item rate and no separate payment will be admissible.

Roots and Vegetation clearance

The roots of trees if any shall be removed to a minimumdepth of 60 cm below ground level or a minimum of 30 cm below formation level whichever is lower and the hollows filled up with earth leveled and rammed. This work is deemed to be included in the earthwork items and no separate payment will be admissible for the work. Any material obtained from the site will be the property of the Government of India and the useful materials as decided by the Engineer-in-charge will be conveyed and properly stacked as directed within the lead specified.

Setting out and making profiles

Masonry or concrete pillars will be erected at suitable points in the area to serve as benchmarks for the execution of the work. These benchmarks shall be connected with G.T.S.

or any other permanent benchmark approved by the Engineer-in-charge. Necessary profiles with pegs, bamboos and strings or Burjis shall be made to show the correct formation levels before the work is started. The contractor shall supply labour and materials for setting out and making profiles and Burjis for the work at his own cost and the same shall be maintained during the excavation work. The Department will show grid co-ordinate or other reference points. It shall bethe responsibility of the contractor to set out center lines correctly with reference to the drawings and install substantial reference marks. Checking of such alignment by the Department will not absolve the contractor from his responsibility to execute the work strictly in accordance with the drawings.

Excavation

The contractor shall notify the Engineer-in-charge before starting excavation and before the ground is disturbed, to enable him to take existing level for the purpose of measurements. The ground levels shall be taken at 5 to 15 metres intervals in uniformly sloping ground and at closer distance where local mounds, pits, or undulations are met with, as directed by the Engineer-in-charge. The ground levels shall be recorded in field books and plotted on plans, which shall be signed by the Contractor and the Engineer-in-charge, before the earthwork is actually started. The labour required for taking levels, shall be supplied by the Contractor at his own cost. The Contractor shall perform excavation in all types of soils, murrum, soft and hard rock, boulders etc. in foundation, over areas and in trenches to widths, lines, levels, grades and curves as shown in the drawing or lesser widths, lines, levels, grades and levels as directed by the Engineer-in-charge and per items in the schedule of quantities.

The item in the schedule of quantities shall specify the excavation in trenches or over areas. For this purpose, the excavation for any depth in trenches for foundation not exceeding 1.5m in width or 10sqm. on plan shall be described as excavation in foundation trenches. Excavation exceeding 1.5m in width as well as 10sqm.on plan (excluding trenches for pipes, cables etc.) and exceeding 30cm in depth shall be described as excavation over areas. Excavation exceeding 1.5m in width as well as 10sqm.on plan but not exceeding 30cm. in depth shall be described as surface Excavation.

Classification of Earth work

The earthwork shall be classified under the following main categories and measured separately for each category. All types of soil, murrum, boulders, Soft rock, Hard rock.

All types of Soils, Murrum, Boulders

This includes earth, murrum, top deposits of agricultural soil, reclaimed soil, clay, sand or any combination thereof ad soft and hard murrum, shingle etc. which is loose enough to be

removed with spadies, shovel and pick axes. Boulders not more than 0.03 cum. in volume found during the course of excavation shall also fall under this classification.

Excavation in Soft Rock

This shall include all materials which are rock or hard conglomerate, all decomposed weathered rock, highly fissured rock, old masonry, boulders bigger than 0.03 cum, in volume but not bigger than 0.5 cum. and other varieties of soft rock which can be removed only with pick axes, crow bars, wedges and hammers with some difficulty. The mere fact that the contractor resorts to blasting and / or wedging and chiseling of reasons of his own, shall not mean the rock is classifiable as hard rock.

Excavation in Hard Rock

This includes all rock other than soft rock mentioned in para above 1.5.1 (b) viz. soft rock, occurring in masses, boulders having approximate volume more than 0.5 cum. plain or reinforced cement concrete, which can best be removed by chiseling and wedging where blasting cannot be permitted owing to any restriction at site.

Excavation in Hard Rock by Chiseling and Wedging:

Where blasting is not permitted and if the Engineer-in-charge so desires, the excavation shall be done by chiseling and wedging or any other agreed method.

Note: All the excavated hard rock obtained shall be stacked properly and neatly within thespecified leadby the contractor as directed by the Engineer-in-charge.

Excavation

The excavation under all classifications in areas in trenches or in pits shall be carried out systematically. Cutting shall be done from top to bottom and not under pining or under cutting will be allowed. The bottom and sides of excavation shall be dressed to proper level, slopes, steps, camber etc. by removing high spots and ramming thoroughly as directed by the Engineerin-charge. All the excavation shall be carried out strictly to the dimensions given in the drawing. The width shall generally be of the width of mudmat concrete and depth as shown in drawing or as directed by the Engineer-in-charge, according to availability of the desired bearing capacity of soil below. Any excavation if taken below the specified depths and levels, the contractor shall at his own cost fill up such over cut to the specified level with cement concrete 1:4:8 in case of excavation in all types of soils an with cement concrete 1:2:4 in case of excavation soft and hard rock. After the excavation is completed, the contractor shall notify the Engineer-in-charge to that effect and no further work shall be taken up until the Engineer-in-charge has approved the depth and dimensions an also the nature of

foundation materials, levels and measurements shall also be recorded prior to taking up any further work.

Shoring:

Unless separately provided for in the schedule of quantities, the quoted rate for excavation shall include excavation of slopes to prevent falling in soil by providing and / or fixing, maintaining and removing of shorting, bracing etc. The contractor would be responsible for the design of shoring for proper retaining of sides of trenches, pits etc. with due consideration to the traffic, superimposed loads etc. shoring shall be of sufficient strength to resist the pressure and ensure safety from slips and to prevent damage to work and property and injury to persons. It shall be removed as directed after items for which It is required are completed should the slips occur, the slipped materials shall be removed and slope dressed to a modified stable slope. Removal of the slipped earth will not be measured for payment.

Dewatering:

Unless specifically provided for as a separate item in the schedule of quantities, rate shall also include bailing or pumping out all water which may accumulate in the excavation during the progress of further works such as mud mat concrete, R.C. footings, shuttering etc. either due to seepage, springs, rain or any other cause and diverting surface flow by bunds or other means. Care shall be taken to ensure that the water discharged sufficiently away from the foundations keep it free from nuisance to other works in the neighborhood.

Disposal of Excavated Materials

Antiquities

Any finds of archeological interest such as relics of antiquity, coins, fossils or other articles of value shall be delivered to the Engineer-in-charge and shall be the property of the Government.

Useful Materials:

Any material obtained from the excavation which in the opinion of the Engineerncharge is useful, shall be stacked separately in regular stacks as directed by the Engineerincharge and shall be the property of the Government. No material excavated from foundation trenches of whatever kind they may be are to be placed even temporarily nearer than about 3m from the outer edge of excavation. Discretion of the Engineer-in-charge in such cases is final. All materials excavated will remain the property of the Department. Rate for excavation includes sorting out of the useful materials and stacking them separately as directed within the specific

lead. Material suitable and useful for backfilling or there use shall be stacked in convenient place but not in such a way as to obstruct free movement of materials, workers and vehicles or encroach on the area required for constructional purposes. It shall be used to the extent required to completely backfill the structure to original ground level or other elevation shown on the plan or as directed by the Engineer-in-charge. Materials not useful in anyway shall be disposed off, leveled and compacted as directed by the Engineer -in-charge within a specified lead. The site shall be left clan of all debris and leveled on completion.

Backfilling in sides of Foundations, Plinth, Under Floor etc

The backfilling shall be done after the concrete or masonry has fully set and shall be done in such a way as not to cause under-thrust on any part of the structure. Where suitable excavated material is to be used for backfilling, it shall be brought from the place where it was temporarily deposited and shall be used in backfilling. The scope of work for backfilling/ filling in foundation, plinth, under floors etc. shall include filling for all the buildings covered under the contract. Surplus earth available from one building, if required, shall be used for backfilling filling for other buildings also within the specified lead mentioned in the item. All timber shoring and form work left in the trenches, pits, floors etc. shall be removed after their necessity ceases and trash of any sort shall be cleared out from the excavation. All the space between foundation masonry or concrete and the sides of excavation shall be backfilled to the original surface with approved materials in layers not exceeding 150mm, in thickness, watered and well consolidated by means of rammers to at least 90% of the consolidation. Areas inaccessible to mechanical equipment such as areas adjacent to walls and columns etc. shall be tamped by hand.

rammer or by hand held power rammers to the required density. The backfill shall be uniform in character and free from large lumps, stones. shingle or boulder not larger than 75mm. in any direction, salt, clods, organic or other foreign materials which might rot. The backfilling in plinth and under floor shall be well consolidated by means of mechanical or hand operated rammers as specified to achieve the required density. Test to establish proper consolidation as required will be carried out by the Department at rates specified. Two tests per 50 sqm. will be taken to ascertain the proper consolidation. The cost of tests carried out will be recovered from the contractor's bill.

Filling in Plinth and Under Floors

After the available suitable excavated materials are exhausted as backfilling, the contractor shall notify the Engineer-in-charge of the fact and levels taken jointly with Engineerin-charge. The earth, murrum, sand, gravel etc. or such materials suitable for filling proposed to

be filled under floors and so mentioned in t he item of schedule of quantities shall then be brought to site from approved locations and sources.

Earth Filling

The earth, soft murrum etc. so brought shall be filled up in layers of 15 cm depth, each layer being well watered and consolidated by approved hand or mechanical tampers or other suitable means to achieve the required density.

Gravel or sand filling

Gravel if required to be filled under floors, shall be single washed gravel of approved quality and of size varying from 12mm t0 20mm. it shall be uniformly blind with approved type of soil and / or sand to obtain full compaction. Gravel shall be filled in specified thickness and shall be well watered and rammed entirely to the satisfaction of the Engineer-in-charge.If sand is required to be filled under floors, it shall be clean, medium grained and free from impurities. The filled in sand shall be kept flooded with water for 24hrs. to ensure maximum consolidation shall be done by the contractor at his own cost. The surface shall then be well dressed and got approved from Engineer - in-charge before any other work is taken over the fill.

Lead and Lift

Lead

The lead for disposal / deposition of excavated materials shall be as specified in therespectiveitem of work. For the purpose of measurements of lead, the area to be excavated or filled or area onwhich excavated material is to be deposited/ disposed off shall be divided in suitable blocks and for each of the block, the distance between center lines shall be taken as the leads which shall be measured by the shortest straight line route on the plan and not the actual route adopted.

Lift: Lift shall be measured from ground level. Excavation up to 1.5m depth below groundlevel anddepositing excavated material on the ground shall be included in the item of earthwork for various kinds of soil. Extra lift shall be measured in unit of 1.5m or part thereof. Obvious lift shall only be measured that is lifts inherent in the lead due to ground slope shall not be measured, except for lead up to 250m. All excavation shall be measured in successive stages of 1.5m stating the commencing level. This shall not apply to cases where no lift is involved as in hill side cutting.

Mode of Measurements:

All excavation in areas having depth more than 30cm. pits, trenches etc. shall be measured net. The dimensions for the purpose of payment shall be reckoned on the horizontal area of the excavations for the purpose of payment shall be reckoned on the horizontal area of the excavation at the base for foundations of the walls, columns, footings, rafts or other foundations, multiplied by the mean depth from the surface of ground determined by levels. Excavation for side slopes will not be paid for. Excavation in areas having depths less than 30 cms.shall be measured as surface excavation on square meter basis, mentioning the average depth of excavation.

Reasonable working space beyond concrete dimension required for waterproofing and shuttering where considered necessary in the opinion of Engineer-in-charge will be allowed in execution and considered for payment for underground water tank, sump septic tank etc.

Where direct measurements of rock excavation are not possible, volume of rock can be calculated on the basis of length, breadth, and depth of stacks made at site as mentioned in para 1.5.1 (c). The net volume shall be worked out by reducing it by 40% taking the voids into consideration as 40%. Similarly to arrive at net quantity to be paid in the case of soil, reduction at 20% of corresponding stack / truck measurements shall be made. The rate for excavation shall include carting and disposing and leveling the excavated materials within the specified lead. The rate shall also be inclusive of cost of all tools, plants, explosives, shoring, dewatering at various stages, labour, materials etc. to complete all the operations specified.

The backfilling and consolidation in sides of foundation and in plinth with excavated material will not be paid for separately. The rate quoted for excavation shall be deemed to have been included the cost of stacking of excavated materials, conveying within the specified lead, picking of selectedstacked materials, conveying it to the place of final backfill, compaction to the required proctor density etc. Payment for filling and consolidation inside the trenches, sides of foundations, plinth etc. with selected materials brought by the contractor other than the excavated material, shall be paid for separately as per the rates in schedule of quantities which includes cost of such materials/ excavation, royalty, its conveyance within the specified lead, watering, consolidating, dressing etc. Actual quantity of consolidated filling shall be measured and paid in cubic meters up to two places of decimal. The rate quoted in cum. for items of excavation is deemed to include the necessary additional quantity of excavation involved beyond the plan dimensions of the work which may be necessary to be carried out for carrying out the work in an engineering made, decided upon by the contractor. Therefore no extra payment will be made for any excavation done other than the required quantity as per the plan dimension indicated in the drawings. Measurements for excavation over areas shall be determined by levels or by "Dead men" or both at the discretion of the

Engineer-in-charge. If however the Engineer-in-charge decided on measurement by levels, levels of site shall be jointly taken and recorded by the Engineerincharge or his representatives and the contractor, before commencement of the work and after completion of the work and the quantity of work done shall be computed based on these levels. The volume of earth work shall be computed based on "Simpson's formula ' or any other approved method at the discretion of the Engineer-in-charge.

Antitermite treatment

General

Pre constructional anti-termite treatment is a process in which soil treatment is applied to a building in early stages of its construction. The purpose of anti-termite treatment is to provide the building with a chemical barrier against the sub-terrain termites. Anti- termite treatment being a specialized job, calls for thorough knowledge of the chemicals, soils, termite to be dealt with and the environmental conditions, in order to give effective treatment and lasting protection to the property undergoing treatment. It is therefore imperative that the works of anti-termite treatment should be got executed through specialized agencies only. The specialized agency should be preferably a member of the Indian pest control Association and shall have sufficient experience of carrying out similar works of magnitude envisaged in this tender.

The pre constructional soil treatment is required to be applied during the construction stages of the sub-structure up to plinth level. The contractor has to be watchful of the various stages of sub-structure works and arrange to carry out the soil treatment in time after proper coordination with Department and other contractors if any, working at site.

Scope

The scope of pre constructional anti-termite treatment covers the soil treatment with approved chemicals in water emulsion in foundation trenches for columns, plinth beams, plinth filling, at junction of walls and floor, in expansion joints etc. in stages as detailed in this specifications and drawings. Unless otherwise stipulated, the anti-termite treatment will be carried out as per IS 6313 (part II) 1981 and / or as per direction of the Engineer-incharge.

Site preparation

In order to ensure uniform distribution of the chemical emulsion and to assist penetration, the following site preparation shall be carried out:

a) Remove all trees, stumps, logs or roots from the building site.

b) Remove all concrete form work if left anywhere, leveling pegs, timber offcuts and other building debris from the area to be treated.

c) If the soil to be treated is sandy or porous, preliminary moistening will be required to fill capillary spaces in soil in order to prevent the loss of emulsion through piping or excessive percolations.

d) In the event of water logging of foundation, the water shall be pumped out before application of chemical emulsion and it should be applied only when the soil is absorbent.

e) On clays and other heavy soils where penetration is likely to be slow and on sloping sites, where run-off of the treating solution is likely to occur, the surface of the soil should be scarified to a depth of 75mm at least.

All sub-floor leveling and grading should be completed. All cutting trenches and excavations should be completed with backfilling in place, borrowed fill must be free from organic debris and shall be well compacted. If this is not done supplementary treatments should be made to complete the barrier.

Chemical to be used

The effectiveness of chemical depends upon the choice of the chemical, the dosage adopted and the thoroughness of application. The chemical solutions or emulsions are required to be dispersed uniformly in the soil and to the required strength so as to form an effective chemical barrier which is lethal and repellent to termites.

Soil treatment

One of the following chemicals in water emulsion, after approval from the Engineerincharge shall be used uniformly over the area to be treated.

Mode and Rate of Application

The chemical emulsion as stated above will be applied uniformly by sprayers at the prescribed rates as detailed below in all the sages of the treatment.

Treatment in Foundation Trenches:

In case of normal wall load bearing structures, columns pits, wall trenches and basement, the treatment shall be at 5 litres/sqm. or surface area of the bottom and sides to a height of at least 300mm. After the foundation work, the sides shall be treated at 7.5 litres/sqm. of vertical surface of substructure on each side. After the earth filling is done, treatment shall be done by rodding the earth at 150mm centers close to wall surface and spraying the chemical with the above dose i.e. 7.5 litres/sqm. In case of framed structure, the treatment shall start at adepth of

500mm below ground level. From this depth the backfill around the columns, beams and R.C.C. basement walls shall be treated at 7.5 litres / sqm. of the vertical and at 5 litres / sqm. for the horizontal surface at the bottom in the trenches / pits.

Treatment on Top Surfaces on Plinth Filling

The top surface of the filled earth within plinth walls shall be treated with chemicalemulsion at the rate of 5 litres/sqm. of the surface area before sub-base to floor is laid. If filled earth has been well rammed and the surface does not allow the emulsion to seep through, holes up to 50 to 75mm deep at 150 mm centers both ways shall be made with crow bars on the surface to facilitate saturation of the soil with the emulsion.

Treatment at Junction of Walls and floors

Special care shall be taken to establish continuity of the vertical chemical barrier on the inner wall surfaces from the finished ground level (or from level where the treatment had stopped) up to the level of the filled earth surface. To achieve this a small channel 30 X 30 mm. shall be made at all the junctions of wall / column with floor (before laying subgrade) and rod holes made in the channel up to the finished ground level at 150mm apart and the iron rod moved backward and forward to break the earth and chemical emulsion poured along the channel at 7.5 litres (or at recommended quantity per sqm. of the vertical wall / column surfaces so as to soak the soil right up to the bottom. The soil shall be tamped back into place after this operation.

Treatment for Expansion Joints

The soil beneath the expansion joins shall receive special attention when the treatment under 2.5.1 above is in progress. This treatment shall be supplemented by treating through the expansion joint after sub-grade has been laid at the rate of 2 litres per metre length of expansion joint.

Precautions during Treatment

Utmost care shall be taken to see that the chemical barrier is complete and continuous. Each part of the area shall receive the prescribed dosage of chemical emulsion.

The treatment should not be carried out when it is raining or when the soil is wet with rain or sub-soil water.

Once formed, the treated soil barrier shall not be disturbed. If by chance, treated soil barriers are disturbed, immediate steps shall be taken to restore the continuity and completeness of the barrier system.

Precautions for Health Hazards and Safety Measures

All the chemicals mentioned above are poisonous and hazardous to health. These chemicals can have an adverse effect upon health when absorbed through the skin, inhaled asvapours or spray mist or swallowed. Persons handling or using these chemicals should be warned of these dangers and advised that absorption through the skin is the most likely source of accidental poisoning. They should be cautioned to observe carefully all the safety precautions particularly when handling these chemicals in the form of concentrates. These chemicals are usually brought to the site in the form of emulsifable concentrates.

The containers should be clearly labeled and should be storedcarefully out of the reach of children and pets animal. They should be kept securely locked. Particular care should be taken to prevent skin contact with concentrates. Prolonged exposure to dilute emulsions should also be avoided. Workers should wear clean clothing and should wash thoroughly with soap and water especially before eating. In the event of severe contamination, clothing should be removed at once and the skin washed with soap and water. If chemicals splash into the eyes they shall be flushed with plenty of water and immediate medical attention should be sought.

The concentrates are oil solutions and present a fire hazard owing to the use of petroleum solvents. Flames should not be allowed during mixing. Care should be taken in the application of chemicals / soil toxicants to see that they are not allowed to contaminate wells or springs and other sources of drinking water.

Guarantee

The contractor has to furnish the guarantee for 10 (ten) years from the date of completion of work, starting that in case of reappearance of termites within the building area due to defective materials or workmanship or due to any other reasons, the contractor will arry out the necessary post constructional treatment to keep the entire area free from termite, once again, without any extra cost to the Department during the guarantee period.

Mode of measurement

The payment will be made on the basis of plinth area measurements at ground floor only for all the stages of treatment in sqm. correct to two places of decimals. Rate includes the cost of materials, labour and all tools, plants, sprayers required for complete operation.

HARD CORE / SOLING UNDER FLOORS / FOUNDATIONS

Scope of work

The work covered under this specification includes all type of soling work either by bricks or by rubble stones laid under floors / foundations, hand packed, complete as per specification mentioned below and applicable drawings.

Rubble Stone Soling

The rubble stone shall be of best variety of black trap / granite / basalt or other approved-variety of stone available locally. The stone shall be hard, durable free from defects and of required size and shall be approved by the Engineer-in-charge.

Preparation of Surface

The bed on which rubble soling is to be laid shall be cleared of all loose materials, leveled, watered ad compacted and got approved by the Engineer-in-charge before laying rubble soling. Cable or pipe trenches if shown in the drawing and as required by the Engineer-in-charge shall be got done before the soling is started.

Workmanship

Over the prepared surface, the stone shall be set as closely as possible and well packed and firmly set. The stones shall be of full height and shall be laid so as to have their bases of the largest area resting on the sub-grade. Soling shall be laid in one layer of 230mm or 150mm depth or specified thickness of soling with a tolerance of 25mm. After packing the stones properly in position, the interstices between them shall be carefully filled with quarry spoils or stone chips of larger size possible to obtain a bard, compact surface. Spreading of loose spoils or stone chips is prohibited. The entire surface shall be examined for any protrusions and the same shall be knocked off by a hammer and all interstices shall be filled with approved murrum. Excess murrum if any over the surfaces shall be removed. Unless other wise specified, the murrum shall be supplied by the contractor at his own cost from the selected area. The surfaces shall then be watered and consolidated with mechanical or sufficiently heavy wooden tampers and log-rammers as approved by the Engineer. After compaction, the Engineer-in-charge to give the required slope or level and dense sub-base and the surface shall present clean look. Adequate care shall be taken by the contractor while laying and compacting the rubble soling to see that concrete surfaces in contact with soling are not damaged.

Mode of Measurement

The quoted rate shall be per square metre of the soling of specified thickness. The linear dimension shall be measured up to two places of decimals of a metre and are worked out correct to the two places of decimals of a square metre. Plan areas of soling work actually done limiting to the dimensions as per drawings shall be measured for payment. The rate shall include all the materialslabour, transport etc. and no extra payment shall be made for work done at different levels. The rate shall also include the cost of preparation of surface, all materials and labour, watering, consolidation etc. all complete.