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ESTIMATION COSTING AND VALUATION

BY JASPAL SIR

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Estimation & Costing

→ It is technique of calculating / computing the various quantity and the expected expenditure to be incurred on a particular work / Project.

→ Estimation is carried out to fullfill the following needs.

(i) It give the idea of cost of work hence helps in decide the feasibility of project.

(ii) It give the idea of time reduried for completion of project.

(iii) It give the idea of quantity of material reduried for completion of work.

(iv) It help in inviteing the tenders for the project.

(v) It help in control the expediture on project.

(vi) It help to evaluate where there is any benifit to execute the project.

Data reduried for preparing the estimates.

- Drawing
  - ↳ Plan
  - ↳ Section
  - ↳ elevation
  - ↳ Location
  - ↳ Dimension
- Specification
  - General
    - ↳ Nature
    - ↳ Class
    - ↳ Quality of work & Material
  - Detailed
    - ↳ Quantity
    - ↳ Probation
    - ↳ Workmanship (Method of working.)
- Rate
  - ↳ Unit Rate of All Item. (3M)
    - Manpower
    - Material
    - machine

⇒ Types of Estimates

(i) Approximate / Rough Abstract / Preliminary.
- ↳ Plinth Area method
- ↳ Cubical Rate Method
- ↳ Unit Rate Method
- ↳ Typical Bay Method

(ii) Detailed.
- → Revised Est.
- → Supplementy Est.
- → Revised & Supplementy E
- → Annual Repair & Maintainence Method.

⇒ Approximate Estimate

→ For calculating approximate estimate of a work no detailed knowledge is required, & it can be done on the basic of practical knowledge.
→ It is done to obtain administrative approval of the project.
→ It help in deciding the financial aspect of the project.

Example: Cost of constru. is 1300 Rs/sq ft.
Plot area = 3000 sq ft.
No of stories = 3
Built up area 1st flor → 80%.
2nd → 85%.
3nd 90%.
255%.

⇒ $3000 \times \frac{255}{100} = 7650$ sq. ft

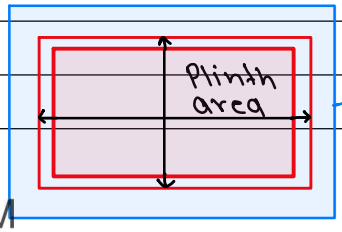
Rate ⇒ (1300 × 7650) Rs.

⇒ Approximate Estimate can be made by following met.

1. Plinth Area Method

Approximate cost = Plinth area × Rate of Plinth area

Note: Plinth Area →
The built up covered area of a building measured at the floor level of any story.



As per IS 3861 (2002)

For the purpose of plinth area following shall be 'included'.

(a) Area of wall at the floor level excluding plinth offsets if any.

(b) Shaft for sanitary, water supply installation, electrical installation, fire fighting, air conditioner & lift.

(c) Staircase.

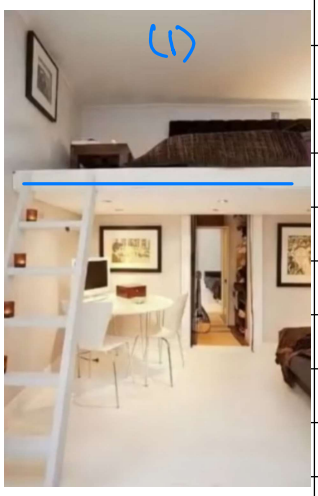
(d) In case of open verandah with parapets wall

(i) 100% area for the portion protected by projections above.

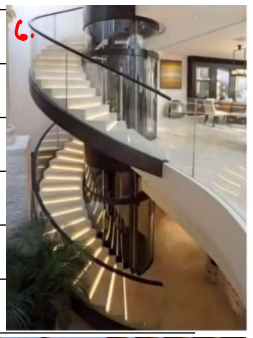
(ii) 50% area for the portion unprotected by projections above

(e) 100% area for the portion protected by projections above
50% area for the portion unprotected by projections above

(f) In case of "alcove" made by cantilever slab
↳ 25% of alcove of Ht < 1m.
↳ 50% of alcove of Ht 1-2m.
↳ 100% of alcove of Ht > 2m.

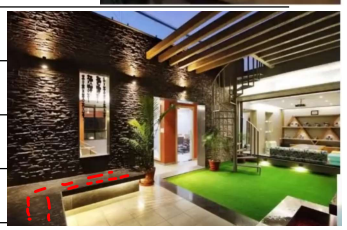


alcove → almirah in wall.

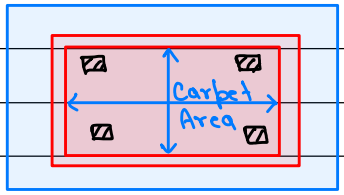


Excluded in plinth area.

1. Area of loft
2. Area of architectural band, cornice etc
3. Area of vertical sun breaker
4. Open platform
5. Terrance
6. Open spiral / service stair case
7. Area of mumty, machine room, towers domes above terrace level.



Carpet Area: The covered area of the usable spaces of rooms at any floor is termed as carpet area.
It is measured b/w the wall to walls within the building.
It is the sum of actual area which can be carpet.



Following area are not in carpet A
X = Wall area, veranda, corridors, passages, interana hall, porch staircase, stair cover, lift shaft Bathroom, kitchen, store canteen, Shaft for sanitary.

↳ Plinth area is 10-20% more than carpet area.

↳ Carpet area = Plinth area − (x + wall area)
↳ Type of building Carpet area.
Office → 60-75% of plot area
Resendial → 50-60% of plot area.

Floor Area
It is the plinth area excluding area of walls.

Floor area = Plinth area − wall area

Set Back Area.
Set back is the minimum open space red around any building.
This distance is provided to keep the construction away from roads, water bodies, other building.

Circulation Area.

Area that is help in movement of people through the building aroud the building or between the building is term as Circulation area.

Ex → Lobbies, Corridors, Stairs, lift, landing.

- Vertical CA → Stair case, lift (3% of PlinthA)
- Horizontal CA → Corridor, passage, balcony (7% Veranda, lobby etc. of PlinthA)

Note.

Floor Area Ratio (FAR) ⇒ $\frac{\text{Flor area}}{\text{Plot area}}$

Exa. FA = 1000 m^2 PA = 2000 m^2

$$FAR = \frac{FA}{PA} = \frac{1000}{2000} = .5$$

Ex. if above construction is of 4 floor storty what is FAR.

$$FAR = n \times \frac{FA}{PA} = 4 \times \frac{1000}{2000} = 2.$$

2. Cubical Content Method

↳ It is more suitable to be applied for multi storied building.

↳ Approx cost = Volume x Cubical rate.

↳ This mtd is most accurate in approximate estimation method.

3. Unit Rate Method

In this method estimate is made by considering the unit rate of different item.

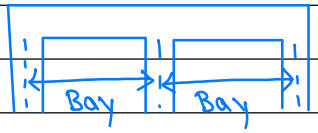
Approx cost = No of unit x Unit rate.

Type of building	Unit
School building	Classroom / bench
Hospital	Bed
Theater / stadium	Seat
Water tank	litre
Bridge.	Span

4. Typical Bay Method

→ In this, estimate is made by considering the cost of bay (span)

Approx Cost = No of bays × Bay rate (Span rate)



Lumpsum

→ While preparing an estimate, it is not possible to work out the details of "Petty items" [insignificat w.r.t civil engg]. hence their Lumpsum value is considered.

(i) Contigency (3 - 5% of Project Cost)

→ It is unforseen / incidental expenses which cannot be predicted prior to the execution of project.

Ex→ Severe accident, specialist visits on site.

(ii) Work Charge Establishment. (1.5 - 2 % of Project cost)

→ During the execution of project certain services are required, expense of which is paid from work charge establishment.

Ex. Watchman, Security camera, Supervisor.

(iii) Tools & Plants. (1 - 1.5 of Project Cost)

→ It is the cost of tools & machines purchased / hired for the execution of project.

(iv) Departmental Cost (Engineering Cost) (10-15% of Pro. cost)
→ It is the cost of engineer for certain work like: designing planning supervision etc.

(v) Sanitary & Water Supply (8% of Project cost)
(vi) Electrification (8% of project cost).

Question Prepare an approx estimate of building with total plinth area of all building as 5000 sq m, using following data.
(i) Plinth are rate Rs 5000/m^2
(ii) Cost of water supply @ 8% of cost of building
(iii) Cost of electrification @ 8%.
(iv) Cost of architectural feature @ 1% of building
(v) Cost of contigency of 3% of cost of building
(vi) Supervision charge @ 8% of total cost.

⇒ Cost of building ⇒ Plinth area × Rate
$5000 \times 5000 \Rightarrow 25 \times 10^6$ Rs

⇒ Cost of water supply ⇒ $\frac{8}{100} \times 25 \times 10^6 \Rightarrow 2 \times 10^6$ Rs

⇒ Cost of electrification ⇒ 8% ⇒ 2×10^6 Rs

⇒ Cost of architectural feature ⇒ $\frac{1}{100} \times 25 \times 10^6 = 2.5 \times 10^5$

⇒ Cost of contigency ⇒ $\frac{3}{100} \times 25 \times 10^6 = 7.5 \times 10^5$ Rs

Total cost ⇒ $(29 + .25 + .75) \Rightarrow 30 \times 10^6$ Rs

Supervision charge → $\frac{8}{100} \times 3 \times 10^7$

↳ 2.4×10^6 Rs

Total cost of building ⇒ $3 \times 10^7 + 2.4 \times 10^6$
⇒ 3.24×10^7 Rs.

⇒ Detailed Estimate

It consist of preparing the estimate in two stages.
(a) → In the first stage working of different quantity of item of project is carried out.
(b) → In second stage cost of each item is workout.

⇒ Quantity of item is reported in the form of Measurment sheet.
⇒ Cost of item is reported in the form of Abstact sheet.

Measurement sheet

Item No.	Description	No.	Length (m)	Width (m)	Height (m)	Quantity

Abstract sheet

No.	Item Description	Quantity (cost)	ate	Per

Total actual Cost = Quantity x Rate item

⇒ This method is more reliable.
→ This detailed estimate is reqired for "Technical Sanction"

A. Revised Estimate Method

→ It is done when cost of work exceed by 5% of original sanctioned cost.

Or

→ when cost of work exceeds 10% of administration sanction.

B. Supplementary Estimate

→ This is fresh detailed estimate in addition to the original sanctioned estimate prepared when additional work is also to be carried in the project.
→ The abstract cost shows the amount of original sanction estimate and supplementry amount for which the approval is requried.

C. Revised - Supplementary Estimate

It is used when there is deviation in material, design, & change in construction / item of work which required both revised & supplimentary estimate.

D. Annual Repair & Maintenance Estimate

This estimate is used for repair and maintenance of structure like painting, while washing, polishing, filling the leakage, pot holes repair etc.

⇒ Complete Estimate

→ Cost of Land,
→ Legal Expenses : Contract Between owern & Contractor
→ Maincost of Contract : Labour, Material, Supervision.
→ Contigency Cost.
→ Engg Cost.
→ Water Supply & Sanitation Cost.
→ Electrification Cost.

Note: **1. Administrative Approval**

⇒ For any project to be executed by department approval from compelent authority is required w.r.t to the cost of work on the basis of approximate estimate & is termed as "Administrative approrroval.

⇒ Thus administrative approval depends the formal acceptance by the administrative department for proposal of incurring expenditure.

2. Expenditure Sanctions

→ It is done by finacial department in which it allocates the required fund for the execution of work.

3. Technical Sanctions

After approval of administrative & expenditure sanction, the detailed estimate of project is made for Technical sanction.

4. Schedule Sanctions

List of rate of all the item like, labour, material, transportation etc are mentioned in a book which is know as 'Schedule of rate book'.

→ It is prepared by PWD, CPWD.

→ It is of following types.

CSR → Common Schedule rate

SSR → State Schedule rate

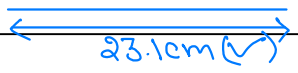
DSR → District Schedule rate

5. Degree of Accuracy (As per IS 1200)

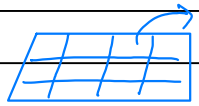
→ Dimension shall be measured upto 0.01 m (1cm).
If it is more than 2.5 m, it is measured upto 0.1m.

→ Area shall be measured upto $0.01\,m^2$

→ Volume is measured upto $0.01\,m^3$.



DPC



→ Mass shall be measured upto 1 kg.

→ Wood work shall be measured upto $0.002\,m^3$.

→ R/f shall be measured upto 0.005 m.

→ Thickness of slab projected outside the beam or column shall be measured upto 0.005 m (5mm)

Type of Work According To Cost

Work can be classified into three on the basic of cost.

	Cost (Rs).
(i) Petty Work	< 50000
(ii) Minor Work	50000 – 200000
(iii) Major Work	> 200000

Specifications

⇒ It is used to provide the discription of work reqoried to prepare the estimates.

→ These specification are of following types.

General	Detailed.
⇒ It provide general discription of various item of work.	It provide detailed discription of various item of work.
→ It specifics material, quantites proportion of materials.	It specifics quantites of material workmanship to be adopted.
Ex → Plinth area 200m^2 Flooring 50 m	Ex → Plint area 200m^2, Concrete flooring 50m.
→ It give general idea of work	It give nature of class work in detail.
→ It is red to perpare general estimate.	It is red to detailed estimate.

*** ⇒ **Units of Measurement**

'Basic idea'

→ Mass work / Volume work = (m^3)

→ Shallow & Thin section (Specify one dimension) = (m^2) → Plaster → Pipe (water work)

→ Long & thin work (Specify 2 dimension) = (m) (Running meter)

→ Piece work / Item work = Number

Sl. No.	Particulas of item	Units of Measurement	Units of payment
I	**Earth work:**		
	1. Earth work in Excavation	cum → m^3	Per%cum
	2. Earthwork in fillingin founda-tion trenches	cum	Per%cum
	3. Earth work in filling in plinth	cum	Per%cum
II	**Concrete:**		
	1. Lime concretre in foundation	cum → m^3	percum
	2. Cement concrete in Lintels	cum	percum
	3. R.C.C.in slab	cum	percum
	4. C.C. or R.C.C. Chujja, Sun-shade	cum	percum
	5. L.C. in roof terracing (thickness specified)	sqm → m^2 (500m^2 20mm → Payment.)	persqm

L.C → Lime Concrete

	6. Cement concrete bed	cum	per cum
	7. R.C. Sunshade (Specified Width & Hight	cum	1rm
III	**Damp ProofCource (D.P.C)**		
*	(Thickness should be mentioned)	sqm	persqm
IV	**Brick work:**		
*	1. Brickwork in foundation	cum	percum
	2. Brick work in plinth	cum	percum
	3. Brick work in super structure	cum	percum
	4. Thin partition walls	sqm → m^2	percum
	5. Brick work in arches	cum	percum
	6. Reinforced brick work (R.B.Work)	cum	percum
V	**Stone Work:**		
	Stone masonry	cum	percum
VI	**Wood work:** (Read)		
	1. Door sand windows frames or chowkhats, rafters beams → पल्ला	cum	percum
	2. Shutters of doors and windows (thickness specified)	sqm	persqm
	3. Doors and windows fittings (like hinges, tower bolts, sliding bolts, handles)	Number	per number
VII	**Steel work**		
	1. Steel reinforcement bars etc in R.C.C. and R.B.work. quintal → 1000 kg	Quintal	per quintal
	2. Bending, binding of steel Reinforcement	Quintal	per quintal
	3. Rivets, bolts, & nuts, Anchor bolts, Lewis bolts, Holding down bolts.	Quintal	per quintal
	4. Iron hold fasts	Quintal	per quintal
	5. Iron railing (height and types specified)	Quintal	per quintal
	6. Iron grills	sqm	per sqm

VIII	**Roofing**		
	1. R.C.C. and R.B.Slab roof (excluding steel)	cum	per cum
	2. L.C. roof over and inclusive of tiles or brick or stone slab etc (thickness specified)	sqm	per sqm
	3. Centering and shuttering form work	sqm	per sqm
	4. A.C.Sheet roofing	sqm	per sqm
IX	**Plastering, points&finishing**		
	1. Plastering-Cement or Lime Mortar (thickness and proportion specified)	sqm	per sqm
	2. Pointing	sqm	per sqm
	3. White washing, colour washing, cement wash (number of coats specified)	sqm	per sqm
	4. Distempering (number of coats specified)	sqm	per sqm
	5. Painting, varnishing (number of coats specified)	sqm	per sqm
X	**Flooring**		
	1. 25mm cement concrete over 75mm lime concrete floor (including L.C.)	sqm	per sqm
	2. 25mm or 40mm C.C. floor	sqm	per sqm
	3. Doors and window sills (C.C. or cement mortar plain)	sqm	per sqm
XI	**Rain water pipe /Plain pipe**	1RM	per RM
XII	**Steel wooden trusses**	1No	per 1No
XIII	**Glass pannels(supply)**	sqm	per sqm
XIV	**Fixing of glass panels or cleaning**	No (Number)	per no.

Wt of Steel in 1m → $\frac{\pi d^2}{4} \times 1 \times 10^{-6} \times 7850\ kg/m^3$ → density of Steel.

Major Item of work

⇒ 1. Earthwork

→ Measurement : m^3

→ Eg: Excavation, Cutting, filling, banking.

Note.1 If depth of excavation < 30cm : measurement(m^2)

Ex Surface dressing, Levelling.

Note.2 If trench width > 1.5m & depth < 30cm : measurement(m^2)

Note.3 If general lead & lift is 30m & 1.5m.

Lead :→ It is the avg distance b/w source of soil to the deposition of soil.

Lift → Avg height from source of soil to point of deposition.


Excavation


Cutting


Filling


Banking (Boundary of Canal)

⇒ 2. Steel Work

→ Density of steel = 7850 kg/m³

→ Generally it is 0.6 – 1% of total Area.

→ Weight of steel in 1m = $0.00617\,d^2$ kg/m. (d = mm)

→ Measurment ⇒ Quintal.

→ Used in: [Rolled steel section (T, L, I), Binding Wire. fastner (bolt, riuet), wire melting] ⇒ Quintal

Note.

↳ [Iron gate, Rolling shutter, Steel door, Window, Iron grill, Collapsible gate, GI sheet] ⇒ m^2

↳ [Reinforcement, Wire fencing, Threading] ⇒ Running-m.

⇒ Q What is the weight of 10mm dia bar in 20m length?

Wt of bar of 1m → $0.00617\,d^2$ → 0.00617 × 10 × 10 → .617 kg/m

⟶ 20m ⇒ 20 × .617

= 12.34 kg.

A) ROLLED STEEL SECTION

Quintal

B) ROLLING SHUTTER

m^2

C) BINDING WIRE

Q

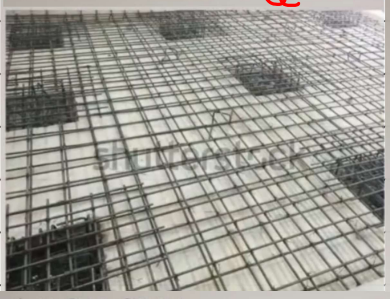
D) FABRICATION

E) FASTENER

Q

F) WIRE NETTING

Q

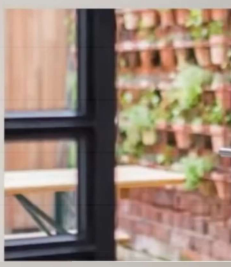


G) IRON ROOF

m^2

H) STEEL DOOR AND WINDOW

m^2



I) IRON GRILL

m^2

J) COLLAPISBLE GATE

m^2

K) GI SHEET

m^2

L) CAST IRON REINFORCEMENT

R-m

M) WIRE FENCING

R-m

N) THREADING

Running-m

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⇒ 3. Concreting.
→ Measurment : m^3

Example.
[RCC, PCC, CC, Precast Concrete, RCC chagga, lime Concrete] = m^3

Note
DPC (Damp Proof Course)
→ Provided on Plinth level
→ Rebels water from entering into super structure from sub structure
→ Depth is in range of 2-2.5 cm
→ Grade M10-M20. with water repellent chemicals. ex → Bitumen, Steric acid, Oelic acid.

LC → Lime Concrete
→ Measurment : m^2
Note:→ LC in roof terracing : m^2
Note:→ Concrete jali & Fefferic Concrete : m^2
Note:→ Concrete floor : m^2

B) P.C.C. m^3

C) C.C. m^3

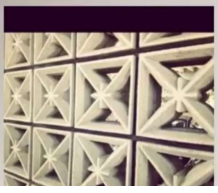
D) PRECAST m^3

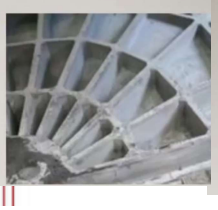
E) R.C.C CHAJJA m^3

F) DAMP PROOF COURSE (D.P.C.) m^2

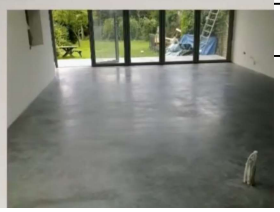
G) CONCRETE JALI m^2

H) JAFRI WORK m^2





I) CONCRETE FLOOR m^2



⇒ 4. Plastering

→ Measurment : m^2

→ In side Plaster : 12 mm { No role in strength }

→ Outside Plaster : 20 mm

→ It is done to provide surface for paint or finishes.

→ It protects the masonry work from wear & tear.

→ Lime & Cement motar used.

⇒ 5. Brick work.

Measurement : m^3

Thichness > 10cm : m^3

Thichness ≤ 10 cm m^2 (Half brick work, Partition work, Brick soling, Honey Comb work)

B) PARTITION WORK m^2

C) HONEY- COMB WORK m^2

D) BRICK SOLING m^2

⇒ 6. Wood work

Measurement : m^3

Thickness > 10cm : m^3

Thickness ≤ 10cm : m^2

{Window Frame, door frame, rafter beam, roof truss} = m^3

{Window shutter, Door shutter, Showing of timber, Timber wall} = m^2

Door & window fiting : Number

(Bolt, hinges, handle.)

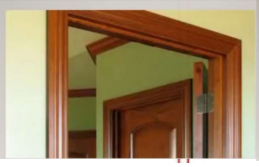
H) TIMBER WALL

m^2

G) DOOR SHUTTER

m^2

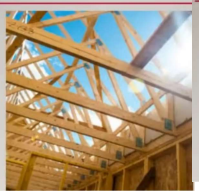
B) DOOR FRAME m^3



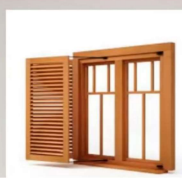
C) RAFTER m^3

D) BEAM m^3

E) ROOF TRUSS m^3



F) WINDOW SHUTTER m^2



⇒ 7. Stone Work

↳ Measurment : m^3

↳ Any type of Masonary

	Rubble Masonary	Ashlar Masonary
→	In this rough or undressed stones are used.	In this smooth ordresserd stone are used.
→	Here joint are wider & are irregular size.	Here joints are finner and of regular size (3mm).
→	It is Cheaper.	It is costly.

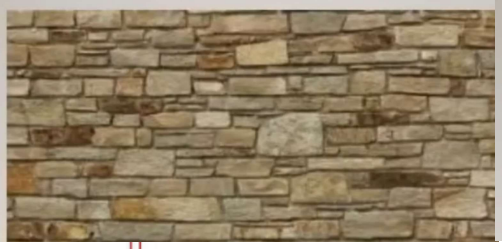
Properties	Stone Masonary	Brick Masonary
1. Strength	High	Less
(ii) Durability	High	Less
(iii) Appearance	No external treatment Red	Finishing is Re.
(iv) Mortar Joint	Thick	Thin
(v) Dampness	No	Yes
(vi) Cost	More	Less
(vii) Uses	{PIER, Dam}^{3}	Resedential or Public work.

B) STONE DRESSING m^2

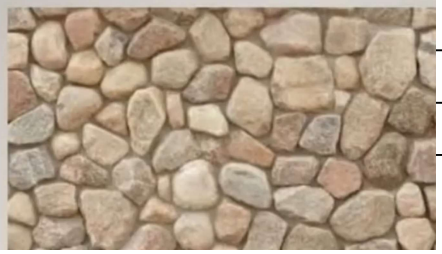
C) CHAJJA m^2

D) SUN- SHADE m^2

F) ASHLAR MASONRY



E) RUBBLE MASONRY



⇒ 8. Flooring

→ Measurment : m^2

→ Thickness of floor > 7.5cm : m^3

→ Thickness of floor < 7.5cm : m^2

Note: Generally thickness of floor 25 - 50mm.

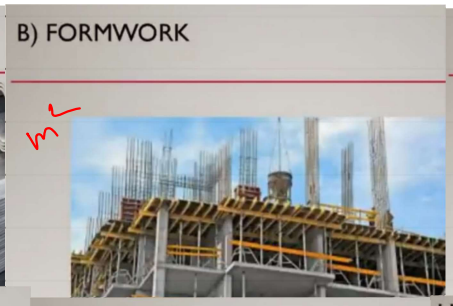
9. Miss^{n} Work

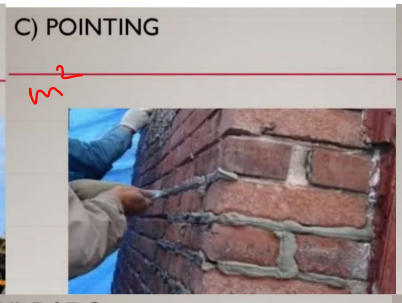
→ { AC sheet, Formwork, Pointing, Shuttering, White washing, Colouring, Painting, Dado, Centering, Distemper } = m^2

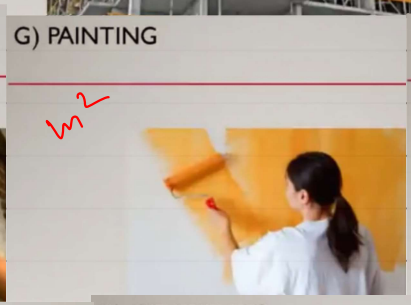
→ Electric work : Point / Number.

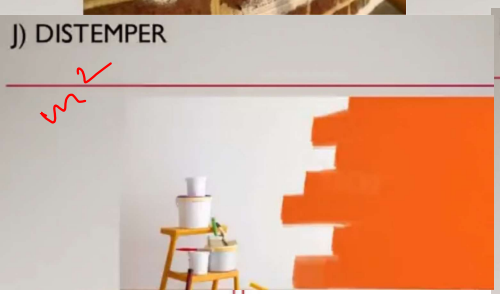
→ { Skirting, Cornice, String course, Drip course, Edging, bend } = m

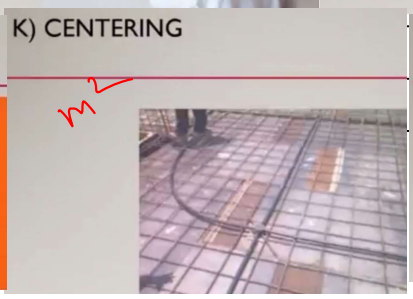
Note: According measurment rule, width should be measured very accurately than length & height.

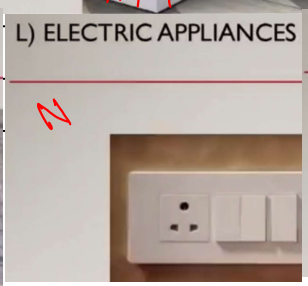


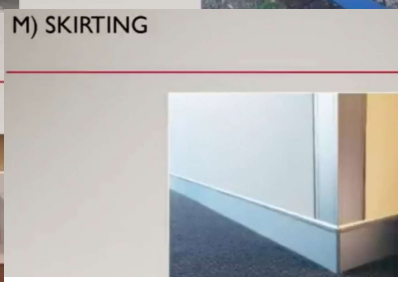












Rules of Deductions

1. Plastering

→ area of opening $< 0.5\ m^2$ (No deduction) Ex → Jamb, Soffit and sill.

→ area of opening ($0.5 - 3m^2$) : Deduction is on one side only

→ area of opening ($> 3m^2$) : Deduction is on both side.

Jamb → Vertical part of opening.

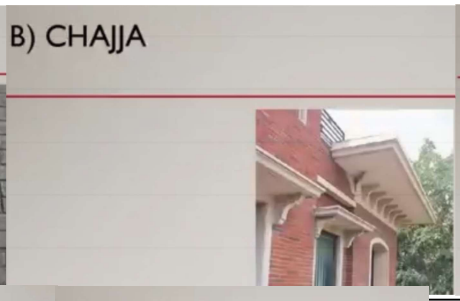
(ii) Masonary Work

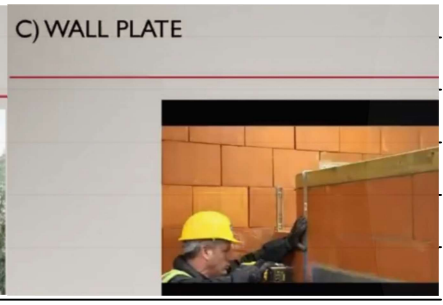
→ No deduction is made of opening of ($0.1 m^2$).

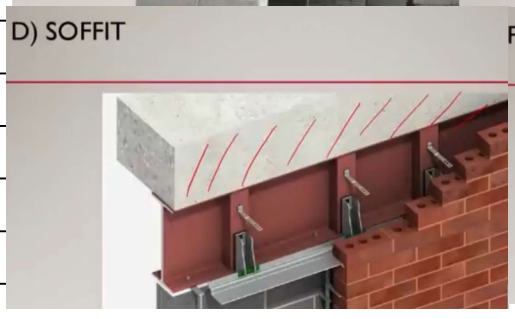
→ No deduction for lintel, chajjas, offset

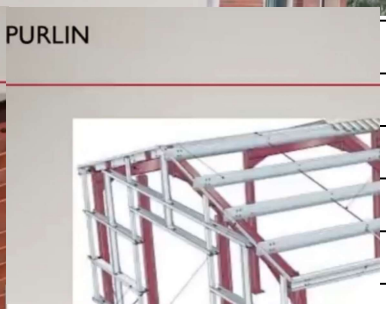
→ No deduction for end of beam, Soffit, rafter & Purlin upto $0.05\ m^2$ ($500\ cm^2$)

→ No deduction when bed plate, wall plate, bearing of chajja upto 10 cm is available.





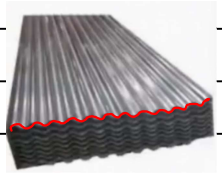




(iii) White - Washing, Colouring, Distmber

→ During White washing, colouring, distmber on AC & GI Sheet area of washing, Coloring & distmber is increased.

		Area Increase	Area coeffi For one side
→ GI sheet	Corrugated	14%.	1.14
→ AC sheet	Corrugated	20%.	1.2
→ Semi Corrugated AC sheet		10%.	1.1



Note → If these works are carried out on both the side the area of coefficient is double.

(IV) STEEL Work

Bar Bending Schedule (BBS)

↳ It is a comprehesion list that discribe the

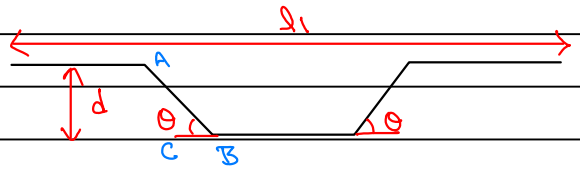
a) Location (drawing) d) Size (d=) g) bending details (?)

b) Mark (") e) Length (ℓ)

c) Type (Fe215_) f) Number (NO=)

(i) Bent UP Bar.

↳ The total length of the length of the bar to be provide is termed as Crank Length.



Length of bent AB = $\frac{d}{\sin\theta}$.

If bent is not provide, then length would be BC = $\frac{d}{\tan\theta}$

Additional length due to bent ⇒ $\frac{d}{\sin\theta} - \frac{d}{\tan\theta}$

θ	Additional length
30°	0.27d
45°	0.42d
60°	0.57d
90°	0.89d.

Ex. If in previous dia $\theta = 45°$ find Crank length

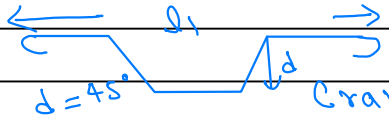
Crank length = Actual length (l_1) + Additional

$\Rightarrow l_1 + 2 \times 0.42d$

(ii) Hook Length

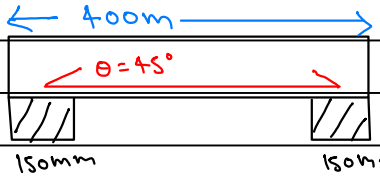
Angle of bend (θ)	Hook length
$\theta = 90°$	6ϕ
$\theta = 180°$	9ϕ
$\theta = 135°, 45°$	12ϕ

Ex.



Crank length $\Rightarrow l_1 + 0.42d \times 2 + 2 \times 9\phi$

Que.



Crank length $\Rightarrow 4000 - 150 + 12\phi \times 2$

$\Rightarrow 3850 + 12\phi \times 2$

***. VJ Brick Soling.

→ Process in which base of dry bricks is prepared is termed as soling.

Note.

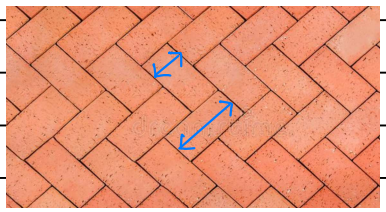
→ No of brick $1m^3$ of brick masonary = 500

$\Rightarrow \frac{1 \times 10^6}{20 \times 10 \times 10} = 500$.

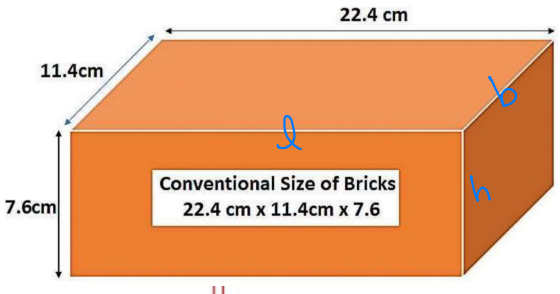
→ No of brick in edge soling of $1 m^2$ = 54

$\Rightarrow \frac{100 \times 100}{l \times b}$

→ No of brick in flat soling of $1m^2$ = 34



$\Rightarrow \frac{100 \times 100}{l \times b}$



L x b x h

Size of conventional brick = 22.4 x 11.4 x 7.6 $-cm^3$

Size of conventional brick in masonary = 25 x 12.5 x 7.5 $-cm^3$

Contrats & Tenders

Contracts

→ It is an agreement between the owner & contracter which is inforceable by court of law.

→ Contract is made so that contractor execute the work as per specification.

Requirement of Contract

→ Subject should be simple & understandable.

→ Contract should be in written.

→ It should be inforceable by court of law.

→ There must be free consent by both partics.

→ Both the partics must be competant to sign the contract.

Contract Documents

(i) Title Page : It has name of work mention over it.

(ii) Index Page : It has page reference with content.

(iii) Tender Notice : It consist of brief discription of work, cost of project & completion time and amount of earnest money.

earnest deposite → money लिया जाता है। जो कोई लगाता है क्योंकि tender भरने के बाद आगे न (1 - 2% of total cost)

security deposite → tender भरने के बाद security deposite होता है (10%) (8% = 10 - 2%) क्यो कि बिच मे आगा न जाये।

Jo Tender fill करेगा उसको earnest deposit देना होगा → और जिसको Tender मिला उसे extra 8% देना होगा for Security, and बाकी को उसका Earnest deposite मिल जायेगा

(iv) Tender Form : It consist of bill of quantities, contract rate and total cost.

(v) Schedule of Rate : Discussed earlier in details.

(vi) General Specification.

(vii) Detail Specification.

(viii) Drawing of work

(ix) Condition of contract.

(a) Contractor shall deposit 10% of estimated cost as security deposite (it includes 2% of earnest money).

Earnest Money ⇒ It is gauranteen amount which show seriousness of contractor & avoid false bids

Security deposity → It purpose is to compensate in case contractor does not fullfill the contract.)

(b) Work is open for inspection.
(c) For bad work that work can be dismantled.
(d) The work shall be done with specifications mention in contract.
(e) The work shall be completed within project period.

Type of Contract

Contract are of following types.

A. Item-Rate Contract / Unit Rate / Schedule Contract

→ In this the contracter undertakes the execution of work on the item rate basis.
→ The amount to be the contractor depends upon the quantities of various item of work actually executed.
→ This type of contracts are used for public or goverment projects.

Advantage

→ In this there is no need to detail drawing at the time of alloting the contract.
→ The payment to contractor is done on the basic of actual work.

Disadvantage.

→ The total cost of work is not known at the start of the work.
→ To increase profit, contractor may use poor quality of item.

Approx → Lot Rate

B. Percentage Rate Contract.

→ It is modified form of item rate contract.
→ Contractor here is asked to quote only percentage of fee to be taken for execution of the work.
→ This method is used in state department work.

Advantage → It is profitable to contractor.

Disadvantage → No incentive to finish the job.
Total cost is not known before the start of project

C. Cost Plus Fixed Fee Contract.

→ In this system a fixed fees is given as contractors profit irrespective of total cost work.

→ This is to control the tendency of the contraction to increase the cost of project unnecesserily.

→ Smaller the completion time more is profit and hence the contractor hurries in this case to complete the project thus compromising with quality.

→ This is generally not used.

(d) Cost Plus Variable Fee or Scale of Fees Contract.

→ In this type of contract the contractor is paid by the owner the actual cost of constraction plus an amount of fees inversly variable according to increase or decrease of the estimate cost.

Advantage In the case the contractor shall not try to to increase the cost of project unneassably.

Disadvantage :→ In this quality of material can be compromised by contractor to increase profit.

(e) Cost Plus Fixed Percentage Contract.

→ In this type of contract the contractor is paid by the actual cost by the owner with a certain percentage as fees as agreed in contract.

→ In this type of contract, proper control has to exercise by the owner in the purchase of material & in managing the man power

(f) Lum - Sum Contract

→ This is single fixed price contract.

→ In this contract contractor agrees to perfor specific job for fixed sum.

→ The owner provide the contractor exact specification of work.
→ In this contract both parties try to fix the condition of work as precisely as possible.

Advantage → Owner is aware of cost of project before the starting of project.
→ It is suitable to be use for small work / Project.
Disadvantage → It is very difficult to accomodate any change in project during its execution.
→ In case of any unforseen hazard the entire burden is over contractor.

(g) Labour Contract → In this owner (depart.) pay to the contractor only the use of labour in project.

(h) Negotiated Contract → When work is alloted to the contractor by mutual understanding b/w two parties and the cost can be negotiated, it is termed as negotiated contract.

(i) Target Contract → In this type of contract additional fee is also given to the contractor on completion of pre specified target.

(X) Turn Key Project :

— Owner is desired to deal with contractor which performs all the aspects of the project i.e; planning, drawing, execution, maintenance.

(XI) Package Contract :

— In this contract, two or more related jobs are given to a particular contractor in form of package.

(XII) Continuing Contract :

— In this type of contract, new or additional work is awarded to the contractor on same agreed terms & conditions.

(XIII) Running Contract :

— Such contracts provide goods and services at specified intervals or as and when required by the owner.

— In this case, price is not fixed and payment is done on the basis of number of units purchased.

(XIV) BOT Contract (Build- Operate- Transfer) :

— It is a contract in which contractor builds the project, operate it & transfer the work after the completion of the project period.

— eg: Highway work.

(XV) Departmental Work/Contract :

— If no contractor is willing to accept the project on given set of conditions, then the project is executed by department itself.

(XVI) Void Contract :

— This contract is done with a minor person (age below 18 years) or without free consent.

- Void → Not valid

TENDERS :

- It is defined as an offer in writing to execute the work as specified by the owner.

NOTE:

Lec-10 (1:02:00)

NIT (Notice Inviting Tenders) :

- It is prepared by administrative department after getting all the necessary approval.
- Sealed tenders are invited by giving advertisement in leading newspaper, on notice board/website & sending the letters to prominent contractors.
- In this, notice, description of work, estimated time, cost, earnest money is mentioned.

Types of Tender :

(i) Local Tender :

- In this, tender is invited for any type of work in local area or surrounding area.

(ii) Global Tender :

- For a big project, the specified work or design are required, which are available in global market. Hence, for these type of work, global tender is invited.

(iii) Open Tender :

- The client advertises this tender offer in the local newspaper & is available for all interested contractors.

(iv) Sealed Tender :

- It is invited for important and big projects.

(v) Limited Tender :

- It is only available for selected contractors.

(vi) Single Tender :

- Invitation is given only to one firm to render the service by quoting their rates.

Lec-11

Procedure of Inviting Tender :

- Tender is invited in following stages :
  (i) Preparation of tender documents
  (ii) Issue of notice inviting tender
  (iii) Submission and opening of tenders and their scruting
  (iv) Acceptance of tender & award of contract
- Tender documents consists of the following :
  (i) Tender drawings
  (ii) Specification (a) General (b) Detailed
  (iii) Bill of Quantities
  (iv) Condition of contract
  (v) Form of tender
  (vi) Form of agreement
  (vii) Form of bond
- Form of tender is given by contractor to the owner to execute the work. It consists of :
  (a) Starting date
  (b) Duration
  (c) Tender sum

- Form of agreement consists of names of all the parties (i-e; contractor & client), all the documents of contractor, signature of contractor, taxation reports of contractor, registration no. of contractor and also consists a third party which takes surity that contractor will complete the project.
- Form of bond is a bond which is signed by owner, contractor and third party. If contractor does not complete the project, then the owner recovers losses from third party.

Important Terms Used in Tendering :

Lec-11 (16:00)

(i) Earnest Money / Deposit (1-2 %) :

- It is a guarantee amount deposited by the contractor to show his seriousness for the execution of proposed work and to avoid false bid.

(ii) Security Deposit (5-10 %) :

- It is the deposit made by contractor after acceptance of his tender, purpose of which is to get work done by the contractor as per specification & stipulated time.
- This security deposit includes 2 % of earnest deposit.

- 10 % से 5 % इसकी value बहुत time पहले कर दी थी but books में 10 % ही मिलता है। presently, corona की वजह से इसको 3 % तक reduce कर दिया है। But, exam में 5-10 % ही choose करना है। 10 % is most preferable.
- Technically तो project complete होते ही ये 10 % contractor को return कर देना चाहिए पर 5 % ही return करते हैं, 5 % को hold करके रखते हैं। जब liability period खत्म हो जाता है, तब ये 5 % return करते हैं। इसको retention deposit बोलते हैं। पहले 10 % Security deposit return करें और फिर 5 % retention deposit लें, ऐसा करने की बजाय 10 % security deposit में से ही 5 % retention deposit रख लिया जाता है practically. But अगर exam में पूछे तो यही बताना है कि 10 % security deposit, project complete होने पर contractor को return कर देते हैं।

(iii) Tender Time Limit (Tender Validity Period) :

- It is the time upto which quoted bid by the contractor is valid.
- Generally, it is in the range of 30-90 days.

(iv) Extra Item :

- Items which are not specified in tender but are used in actual during the execution of project are termed as extra items.

Lec-11 (27:30)

(v) Arbitration :

- It is the process of settlement of dispute b/w the contractor & owner (department).
- Person who settles the dispute is termed as Arbitrator.
- The result of Arbitration is termed as AWARD.

(vi) Maintenance Period (Defect – Liability Period) :

- In this period, contractor is required to maintain the entire work in case any defect is observed in it.

$$\text{Maintenance Period} = \max \text{ of } \begin{cases} \text{One monsoon} \\ \text{6 months after completion} \end{cases}$$

- Project के हिसाब से इस value को बढ़ा भी सकते हैं पर above given value is standard.
- इस period के खत्म होने के बाद retention deposit, contractor को return करते हैं

(vii) Liquidity Damage (LD) :

- It is the amount of compensation paid by the contractor to the owner (dept) in case of delay of work.
  - Security deposit से compensate कर लेते हैं, पर Contractor को इसका notice भेजना पड़ता है।

(viii) Corrigendum :

- Process of extension of tender notice is termed as corrigendum.

Conditions of Corrigendum : (a) Sufficient tender form not received.
(b) Tender prepared is short for the contractor.
(c) Major change in specifications or drawing or material.

Lec-11 (47:10)

(ix) Procedure to Submit the Tender (Envelope System):

- Tender is submitted in 4 envelopes :
  - (a) Envelope - 1 : Earnest money
  - (b) Envelope - 2 : Contractor technical certificate, work experience form, registration form, tax details etc.
  - (c) Envelope - 3 : Tender form
  - (d) Envelope - 4 : Evelope 1, 2, 3 are kept in this.
- Opening of Tender : Envelope 4 → Envelope 1 → Envelope 2 → Envelope 3

Lec-12

(x) Work Order :

- After acceptance of tender, the work order is issued and time limit is given to the contractor to pay the security deposit.

(xi) Act of God :

- All the natural disasters come under the act of god.
- In such case, contractor is not liable for delay in project and owner is not liable for any damages.

(xii) Mobilization Advance :

- Some amount of money given to the contractor for mobilisation of resources to the site is termed as mobilisation advance.

(xiii) Rejection of Particular Tender :

- It is rejected in following conditions :
  - (a) Earnest money is not deposited.
  - (b) Tender is not signed by contractor.
  - (c) Contractor is not experienced.

(XIV) Rejection of all Tenders :

(a) When there is a fight b/w the contractors.

(b) When any fraud is detected in the submission of tenders.

(c) When group formation is suspected b/w the contractors.

Lec-12 (15:20)

(XV) Types of Bill :

(a) First & Final Bill :

— This bill is used for making payments to the contractors for their work as well as supplies in a single go for small projects.

(b) Running Account Bill (RA Bill):

— It is issued by the contractor upon completion of a part of work.

(c) Final Bill :

— Addition of all RA bills is termed as final bill.

Various Account Form to be Used :

(i) Measurement Book : Form No. 23

(ii) Cash Book : Form No. 7

(iii) Ist & Final Bill : Form No. 24

(iv) Running Account Bill : Form No. 25

(v) Final Bill : Form No. 26

(vi) Nominal Muster Roll : Form No. 21

↳ It is used for keeping a complete record of :

(a) Attendance

(b) Payment

(c) Unpaid wages

(d) Work done by daily labours on project

Organization Chart of PWD :

Lec-12 (36:50)

- The organizational structure has six tier hierarchy :
  (i) Engineer in-chief
  (ii) Chief Engineer
  (iii) Superintending Engineer
  (iv) Executive Engineer
  (v) Assistant Engineer
  (vi) Junior Engineer

VALUATION

Lec-12 (41:50)

- Valuation is the process of fixation of cost or return expected of a building / structure at prevalent rates.
- This value of structure depends upon the present utility of a structure.
- Factors considered for valuation are as follows :
  (a) Type of building
  (b) Location
  (c) Building structure and durability
  (d) The quality of materials used.
  (e) Size of building

Necessity of Valuation of a Property :

(a) Mortgage Loan (गिरवी रखने पर loan)
(b) Taxation : 14% in present time
(c) Rent Fixation
(d) Sell and Purchase
(e) For insurance premium
(f) For assessment of stamp duty (Registry करवाना)

Lec-13

Cost :

- It is the original cost of construction.
- It is used to find loss or profit of property value due to various reasons.

Value :

- Present day cost of a engineering structure (sellable value) is termed as value.
- It may be more or less than cost.

Lec-13 (17:25)

Price :

- Total cost including profit is termed as price.

Gross Income :

- It is total amount of income including all receipts from various source.
- The outgoings, the operational cost and collection charges are not deducted from this.

Net Income :

- It is the amount left after deducting all the outgoings, operational cost and collection charges.

Outgoings :

- The expenses that are required to be incurred in order to maintain the revenue of the structure is termed as outgoing.

(i) Taxes :

- These are annual taxes paid by the owner such as wealth tax, property tax and municipal tax etc.
- It varies b/w 10 – 25 % of net income.

(ii) Management :

- Upto 10 % of gross income is used for management purpose which includes security guard, sweeper etc.

(iii) Repairs :

- 1.5 % of the total construction cost is set aside for annual repair of building.
- These repairs are must to maintain the building.
- It is also calculated as 10 % of gross income.

(iv) Sinking Fund :

- A certain amount of the gross rent is set aside annually as sinking fund to accumulate the cost of construction at the end of design life.
  - 5 lac की गाड़ी खरीदी जिसकी life 10 years है और No scrap value. इसको 20,000 per month से rent पर दिया तो इसकी life के end पर हमारे पास फिर से 5 lac available रहें इसलिए इस 20,000 per month में से कुछ amount इस तरह से अलग रखेंगे कि 10 साल के end पर 5 lac available हों, इसको sinking fund बोलते हैं।

Lec-13 (32:50)

(v) Miscellaneous :

- Lighting of common area, expenditure of liftman etc.
- It is applicable for big buildings only.

(vi) Loss of Rent :

- This is also an outgoing in case a building is not fully occupied by the tenants.

(vii) Insurance :

- Premium given against fire or theft is also a form of outgoing.

Perpetual Income :

- Income received for indefinite period is termed as perpetual income.
  eg : pension, royalty

Differed Income :

- Income receiveable after the certain period is termed as differed income.
  eg: return from insurance policy

Lec-14

Scrap Value :

- It is defined as the value of an asset of property after being dismantled.
- It is generally taken to be 10% of cost of structure or asset.
- This value is computed by subtracting the cost of dismantling the structure from the cost of dismantled material.

$$\text{i.e., Scrap Value} = \begin{pmatrix}\text{Cost of Dismantled}\\ \text{material}\end{pmatrix} - \begin{pmatrix}\text{Cost of (labour)}\\ \text{Dismantling the structure}\end{pmatrix}$$

- This value can be +ve, −ve or zero.
- It is +ve for steel structures
  −ve for concrete
  zero for RCC structures

Salvage Value :

- It is the value of building / asset / structure at the end of its utility period without being dismantled.
- It can also be +ve, −ve or zero.

Distress Value :

- When the property is sold or purchased at a lower value than its market value, is termed as distress value.
- It is observed in following situations :
  eg: war zones, riots, earthquakes, financial problem of seller

Sentimental Value :

- When the property is sold or purchased at higher rate than its market value, it is termed as sentimental value.

Lec-14 (22:05)

Market Value :

- It is defined as the value which a property can fetch when sold out in open market.
- This value is variable, depending upon the will to buy or sell.

Speculative Value :

- When the property is purchased at lower rate but it is sold at higher value, it is known as speculative value.

Potential Value :

- When property is capable of fetching higher value than its actual cost due to its alternative use, it is termed as potential value.

Monopoly Value :

- If the owner demands higher value of the property due to some advanced feature of property like location, size, shape etc, it is termed as monopoly value.

Accomodation Value :

- When agricultural land is converted into developed land then suddenly cost of land increases, it is termed as accomodation value.

Rateable Value :

- It is the net annual letting out value of a property obtained after deducting the amount of yearly repair & maintenance cost from gross income.

$$\text{Rateable value} = \text{Gross Income} - \text{Repair \& Maintenance cost.}$$

Book Value :

- It is the value of the property/assets as being entered in account books after allowing necessary depreciation upto that time.
- It is independant of market value.

$$\text{Book Value} = \text{Original Cost} - \text{Depriciation}$$

- At the end of design life, book value is equal to scrap/salvage value, as the case may be.

Lec-15

Depreciation :

- It is defined as loss in value of an asset/building due to its continuous use over the period of time.
- This decrease in value takes place due to wear and tear, impact, corrosion, change in fashion or design etc.
- A reverse fund must be created in order to realise the total depriciation at the end of design life.

Types of Depriciation :

Physical
- It is due to wear & tear.
- eg: Construction equipments like tractor, crane etc.

Functional (Obsolence)
- It is due to change in function, fashion or design.
- eg: electronics commodity

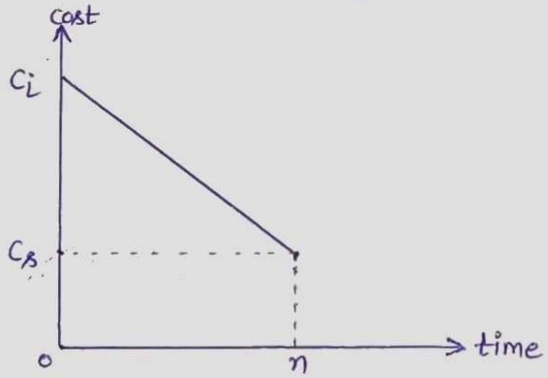
Contingent
- It is due to contingency.
- eg: accident, fire, flood, earthquake etc.

Computation of Depreciation :

- It can be computed by any of following methods :

(A) Straight Line Method :

- In this method, it is assumed that the value of an asset/building decreases by constant amount every year.



$D = C_i - C_s$ → Total Depriciation

$D_m = \frac{C_i - C_s}{n}$ → Depriciation per year

$B_m = C_i - \frac{(C_i - C_s)m}{n}$

C_i → initial cost
B_m → Book value at a particular year (time)
C_s → Scrap/salvage value
n → Design life
m → particular year (time)

- वो assets जिनमें obsolense का खतरा नहीं रहता, या जिनकी demand constant रहती है, उसमें हम ये वाला method use करते हैं, यानी civil engg. में straight line method ही use होता है।

- इस method में asset की value constant amount से decrease होती है पर rate of depreciation constant नहीं होती, rate बढ़ती जाती है। rate of depreciation = $\frac{\text{Depriciation per year}}{\text{Book value on that particular year}}$

1st year rate of depreciation, $r_1\% = \frac{\left(\frac{C_i - C_s}{n}\right)}{C_i} \times 100$

2nd year rate of depreciation, $r_2\% = \frac{\left(\frac{C_i - C_s}{n}\right)}{\left(C_i - \frac{C_i - C_s}{n}\right)} \times 100$

– This method is recommended for all the assets which have constant demand and does not face obsolescence.
[ऑब्सोलेसन्स]

Que : Original cost of building = 20 lakhs
scrap value = 2 lakhs
life = 80 years

Calculate book value after 20 years.

Sol : $D = 20 - 2 = 18$ lakhs

$Dm = \frac{18}{80} = 0.225$ lakhs/year

Depreciation after 20 years $= \frac{1.8}{8} \times 20 = 4.5$ lakhs

$\therefore$ Book value, $B_{20} = C_i - D_{20}$
$= 20 - 4.5$
$= 15.5$ lakhs.

(B) Declining Balance Method / Constant Percentage Method :

– In this method, the property is assumed to lose its value by a fixed % of its book value (FDB).
↳ Fixed Declining Balance

$B_0 = C_i$

$D_1 = FDB \cdot B_0 = FDB \cdot C_i$

$B_1 = C_i - D_1 = C_i - FDB \cdot C_i = C_i(1 - FDB)$

$D_2 = FDB \cdot B_1 = C_i(1 - FDB) \cdot FDB$

$B_2 = B_1 - D_2$ or $C_i - D_1 - D_2$
$= C_i(1 - FDB) - C_i(1 - FDB)FDB$
$= C_i(1 - FDB)^2$

Book value at the end of 'n' years, $\boxed{B_n = C_i(1 - FDB)^n = C_s}$

$$\therefore \boxed{FDB = 1-\left(\frac{C_s}{C_i}\right)^{1/n}}$$

Lec-15 (48:15)

So, depreciation after 'x' years $= C_i(1-FDB)^x \cdot FDB$

Ex: $C_i = 20L$, $C_s = 20k$, $n = 16$ years, $D_5 = ?$

$$FDB = 1-\left(\frac{2\times10^4}{2\times10^6}\right)^{1/16} = 0.25$$

$$D_5 = 2\times10^6\,(1-0.25)^5 \times 0.25 = 118652\ ₹$$

(C) Sum of the Year's Digit Method :

- This method also falls in the category of accelerated type of depreciation method like declining balance method.
- In this method, the digits corresponding to the no. of each year of list are listed in reverse order.
- The sum of these digits is then determined.
- A depreciation factor (DF) for any year is calculated as follows:

$$DF = \frac{n-m+1}{\frac{n(n+1)}{2}}$$

- The depreciation of any year by this method is given by:

$$D_m = (C_i - C_s)\,DF$$

Lec-16

Que: $C_i = 250000$ ₹
$n = 5$ years
$C_s = 25000$ ₹
Find depreciation each year by sum of year digit method.

Lec-16 (18:45)

Sol: $D = C_i - C_s = 250000 - 25000$

$= 225000$ ₹

List the years in reverse order:

Year	Remaining Life of Asset (order Number)	DF
1	5	5/15
2	4	4/15
3	3	3/15
4	2	2/15
5	1	1/15

→ written in reverse order

Sum of year's digits = 1+2+3+4+5 = 15

Depreciating Factor (DF) = $\frac{\text{Order Number}}{\text{Sum of year's digits}}$

OR, we can use expression given previously:

eg: for 4th year, $DF_4 = \frac{5-4+1}{\frac{5(5+1)}{2}} = \frac{2}{15}$

Year	ON	DF	$D_m = DF(C_i - C_s)$
1	5	5/15	$\frac{5}{15} \times 225000 = 75000$
2	4	4/15	$\frac{4}{15} \times 225000 = 60000$
3	3	3/15	$\frac{3}{15} \times 225000 = 45000$
4	2	2/15	$\frac{2}{15} \times 225000 = 30000$
5	1	1/15	$\frac{1}{15} \times 225000 = 15000$

{ Each year depreciating amount is decreasing }

Book Value

250000 − 75000 = 175000

175000 − 60000 = 115000

115000 − 45000 = 70000

70000 − 30000 = 40000

40000 − 15000 = 25000

(D) Sinking Fund Method :

Lec-16 (31:45)

— In this method, depreciation of property is assumed to be equal to sinking fund plus ~~rate~~ interest over it.

eg:

Year	Dm	Total Depretiation
1	A	A
2	A+a	2A+a
3	A+a+b	3A+2a+b
4	A+a+b+c	4A+3a+2b+c
5	⋮	⋮

5 साल design life लेकर चल रहे हैं। पहले साल की depreciation, sinking fund के बराबर लेकर चलेंगे। Sinking fund वो fund होता है, जो अगर हम एक fixed interval पर separate out कर दें तो ये design life के end पर asset की value के बराबर हो जाता है, ये fixed interval कुछ भी ले सकते हैं तो 1st year depreciation = A → sinking fund। दूसरे साल depreciation, sinking fund के बराबर तो होगी ही होगी और इस पर साथ में interest भी charge कर देंगे। तो 2nd year depreciation = A+a, a is interest on A. 3rd year में depretiation, sinking fund के equal तो होगा ही पर साथ में इस sinking fund (A) पर interest और last year के interest (a) पर भी interest charge कर देंगे। suppose total interest = b तो 3rd year में depreciation A+a+b होगा। And, so on.

— **Sinking Fund :** It is the reqd amount to be invested ~~in~~ ~~order~~ or separated at fixed interval of time (one month, one year or so →) such that at the end of design life of structure/asset, it is equal to the cost of asset/ structure.

$$\text{Annual Sinking Fund} = \text{Sinking Fund} \times \text{Sinking Fund Factor}$$

$$= S \times \left[\frac{i}{(1+i)^n - 1}\right], \quad i = \text{rate of interest per year}$$

$$S = C_i - C_s$$

– Depreciation for any year (m) using sinking fund method is given : $\boxed{D_m = \text{Annual Sinking Fund} \times (1+i)^{m-1}}$

Lec-16 (44:00)

(E) Quantity Survey Method :

– In this method, highly qualified experienced surveyor is required to compute the detail studies of property cost and depreciation cost.

eg:

Life of structure	Annual Depreciation	Total Depreciation	Cumᵛ Depreciation
0 – 5	0 %.	0 × 5 = 0 %.	0 %.
5 – 10	$\frac{1}{2}$ %. per year	$\frac{1}{2} \times 5 = 2.5$ %.	2.5 %.
10 – 20	3/4 %. per year	$\frac{3}{4} \times 10 = 7.5$ %.	10 %.
20 – 40	1 %. per year	1 × 20 = 20 %.	30 %.
40 – 80	1.5 %. per year	1.5 × 40 = 60 %.	90 %.

तो 80 years के बाद asset की value 10 % बची (90% depreciation हो गया)

Que : The initial cost of an equipment is ₹ 1100×10^3, salvage value is ₹ 100×10^3. Life of an structure is 5 years. The rate of interest for sinking fund is 8 %. Calculate the yearly depreciation and book value at the end of each year by all possible methods.

Lec-17

Sol : (i) Straight Line Method :

$$D_m = D_1 = D_2 = D_3 = D_4 = D_5 = \frac{C_i - C_s}{n}$$

$$= \frac{(1100 - 100) \times 10^3}{5}$$

$$= 200 \times 10^3 \text{ ₹}$$

(ii) Declining Balance Method :

$$FDB = 1 - \left(\frac{C_s}{C_i}\right)^{1/n} = 1 - \left(\frac{100 \times 10^3}{1100 \times 10^3}\right)^{1/5} = 0.381$$

$$D_1 = C_i \times FDB = 1100 \times 10^3 \times 0.381 = 419100 \text{ ₹}$$

$$B_1 = C_i - D_1 = 1100 \times 10^3 - 419100 = 680900 \text{ ₹}$$

Lec-17 (20:00)

$D_2 = B_1 \times FDB = 680900 \times 0.381 = 259423$ ₹

$B_2 = B_1 - D_2 = 680900 - 259423 = 421477$ ₹

$D_3 = B_2 \times FDB = 421477 \times 0.381 = 160581$ ₹

$B_3 = B_2 - D_3 = 421477 - 160581 = 260896$ ₹

$D_4 = B_3 \times FDB = 260896 \times 0.381 = 99402$ ₹

$B_4 = B_3 - D_4 = 260896 - 99402 = 161494$ ₹

★ $D_5 = B_4 \times FDB = 161494 \times 0.381 = 61529$ ₹

$B_5 = B_4 - D_5 = 161494 - 61529 = 99965$ ₹ $\neq 100 \times 10^3$ (C_8)

But book value at the end of 5th year = salvage value

i.e., $B_5 = C_8 = 100 \times 10^3$

तो ये इस method का drawback है। Last year की book value, star (★) marked & Depreciation तरीके से नहीं निकालनी है।

$B_5 = C_8 = 100 \times 10^3$ ₹

$\therefore D_5 = B_4 - B_5 = 161494 - 100 \times 10^3 = 61494$

(iii) Sum of year digit method :

$$D_m = (C_i - C_8)\left[\frac{n-m+1}{\frac{n(n+1)}{2}}\right] \Rightarrow D_1 = (1100-100)10^3\left[\frac{5-1+1}{\frac{5(5+1)}{2}}\right] = 333334 \text{ ₹}$$

$B_1 = 1100 \times 10^3 - 333334 = 766666$ ₹

$$D_2 = (1100-100)10^3\left[\frac{5-2+1}{\frac{5(5+1)}{2}}\right] = 266667 \text{ ₹}$$

$B_2 = B_1 - D_2 = 766666 - 266667 = 499999$ ₹

$$D_3 = (1100-100)10^3\left[\frac{5-3+1}{\frac{5(5+1)}{2}}\right] = 200000 \text{ ₹}$$

$$B_3 = B_2 - D_3 = 499999 - 200000 = 299999 \text{ ₹}$$

$$D_4 = (1100-100)10^3 \left[\frac{5-4+1}{\frac{5(5+1)}{2}}\right] = 133333 \text{ ₹}$$

$$B_4 = B_3 - D_4 = 299999 - 133333 = 166666 \text{ ₹}$$

$$D_5 = (1100-100)10^3 \left[\frac{5-5+1}{\frac{5(5+1)}{2}}\right] = 66666 \text{ ₹}$$

$$B_5 = B_4 - D_5 = 166666 - 66666 = 100000 \text{ ₹}$$

(iv) Sinking Fund Method :

Annual sinking fund = sinking fund x Sinking Fund Factor

$$= (C_i - C_s)\left[\frac{i}{(1+i)^n - 1}\right]$$

$$= (1100-100)\times 10^3 \left[\frac{0.08}{(1+0.08)^5 - 1}\right]$$

$$= 170456 \text{ ₹}$$

$$D_m = D(1+i)^{m-1}$$

$$D_1 = 170456\,(1+0.08)^{1-1} = 170456 \text{ ₹}$$

$$B_1 = 1100\times 10^3 - 170456 = 929544 \text{ ₹}$$

$$D_2 = 170456\,(1+0.08)^{2-1} = 184093 \text{ ₹}$$

$$B_2 = B_1 - D_2 = 929544 - 184093 = 745451 \text{ ₹}$$

$$D_3 = 170456\,(1+0.08)^{3-1} = 198820 \text{ ₹}$$

$$B_3 = B_2 - D_3 = 745451 - 198820 = 546631 \text{ ₹}$$

$$D_4 = 170456\,(1+0.08)^{4-1} = 214726 \text{ ₹}$$

$$B_4 = B_3 - D_4 = 546631 - 214726 = 331905 \text{ ₹}$$

$$D_5 = 170456\,(1+0.08)^{5-1} = 231904 \text{ ₹}$$

$$B_5 = B_4 - D_5 = 331905 - 231904 = 100\times 10^3 \text{ ₹}$$

Lec-18

Free Hold Property :

- Any property which is in complete possesoin of owner, it is known as free hold property.
- The owner can use this property in a way he likes.

Lease Hold Property :

- Any property which is given to some person on yearly payment basis by the free holder, then the property is termed as lease hold property.
- Lease in India is for 99 to 9 years in case of buildings.

Mortgage Loan :

- Loan which is being raised by the owner against its property is termed as mortgage loan.

Sinking Fund :

- It is the amount which if it is kept aside annually, at the end of design life of building / structure / asset would be equal to an amount by which construction, replacement and repair of building can be carried.
- Annual Sinking Fund = Sinking Fund × Sinking Fund factor

$$= (C_i - C_s) \times SFF$$

$$= S \times \frac{i}{(1+i)^n - 1}$$

Ex: Cost of building = 3 lakhs

i = 5 %.

Scrap value = 10 %. of cost

Design Life = 20 years

Find annual sinking fund.

Sol:

$$\text{Annual sinking fund} = (3\times10^5 - 3\times10^4) \times \frac{0.05}{(1+0.05)^{20}-1} = 8165.5 \text{ ₹}$$

Lec-18 (36:00)

Que: Cost of equipment = 8 lakhs

Scrap value = 75×10^3 ₹

Rate of Interest = 8 %.

Design Life = 8 years

Compute the annual sinking fund.

Sol: Annual Sinking Fund = S x SFF

$$= (8 \times 10^5 - 75 \times 10^3) \times \frac{0.08}{(1+0.08)^8 - 1}$$

$$= 68160 \text{ ₹}$$

यानी 68160 ₹ को 8 साल तक 8 % rate पर compound interest लगेगा तो 8 साल के end में $8 \times 10^5 - 75 \times 10^3 = 7,25,000$ ₹ collect हो जाएँगे।

Capital Cost :

– Cost of land along with cost of building is termed as capital cost.

Year Purchase :

– Capital sum required to be invested in order to receive the net income of 1 ₹ at the certain rate of interest.

$$(YR) \cdot i \cdot 1 = 1 \text{ Rs.}$$

$$\boxed{YR = \frac{1}{i}}$$

YR → Year Purchase

Capitalized Value :

– It is defined as the amount of money whose annual interest at the highest prevailing rate of interest is equal to net income from that property.

पूरे साल rate of interest change होती रहती है, तो इनमें से max. rate of interest लेनी है।

$CP \times i \times 1 = \text{net income}$

$$CP = \frac{\text{net income}}{i} = \text{net income} \times \text{year purchase}$$

Lec-18 (57:00)

Que: Annual rent = 1 lakhs

Interest rate = 5 %

What is capitalised value.

Sol: $CP \times 5\% \times 1 = 10^5$

$$CP = \frac{10^5}{0.05} = 20 \times 10^5 \text{ lakhs.}$$

Annuity :

- Annual installment of sinking fund.

Repair :

- Amount used for repair of structure is taken as follows :
- Repair amount = 1 - 1.5 % of monthly rent
  = 10 - 15 % of gross income
  = 1 - 1.5 % of total cost of project.

Lec-19

Management & Collection Charge :

- Some staff is required for maintenance of building, eg: sweeper, liftman, guards etc.
- The costing of this staff is considered in this category.
- It is taken to be 5 - 10 % of gross income.

Methods of Valuation :

- Valuation can be done by any of following methods :
  (i) Depreciation method of valuation
  (ii) Valuation based on cost
  (iii) Valuation based on profit

(iv) Valuation by development method

(v) Valuation by rental.

Lec-19 (12:35)

(i) Depreciation Method of Valuation :

- In this method, entire structure is divided into four parts:
  (a) wall
  (b) roof
  (c) floor
  (d) doors and windows
- Then, depreciation in these four components is calculated and on the basis of depreciation, we carry out the valuation of building / structure.

(ii) Valuation based on Cost :

- In this method, valuation is done based on the cost of construction of structure and the depreciation that will occur over the years.

(iii) Valuation based on Profit :

- This method is generally adopted for big commercial projects.
  eg: Valuation of cinema hall, theatres, banks, big supermarkets etc.
- This valuation is done on the basis of the profit earned.
- More is the profit earn, more will be valuation.

(iv) Valuation by Development Method :

- This method is adopted for the structures in which development is going on wrt time. eg: construction of metro
- As development progresses, valuation increases.

(v) Valuation by Rental :

- This method is generally adopted for commercial office or setups.
- Valuation is done based on rental.
- more is the rental, more is valuation

ANALYSIS OF RATES

Lec-19 (18:40)

- The process of determining the rates of any work in engg. project like earthwork, brickwork, plastering, painting etc is termed as analysis of rates.
- The rates of these work further help in determining the cost of particular work and in turn cost ~~and~~ of project.
- Analysis of rate is being done for:
  (i) To determine the actual cost of an item
  (ii) To determine the project cost
  (iii) To find the feasibility of project
  (iv) To modify existing schedule of rates
  (v) To check the rate offered by the contractor.
- Analysis of rates depends upon following:
  (i) Specifications of work and material
  (ii) Quantity of material & their cost
  (iii) Cost of labour & their wages
  (iv) Location of site
  (v) Profit charged
  (vi) Overhead and establishment
  (vii) Taxes

Task Work (Out Turn):

- It is the capacity of skilled labour to work for 8 working hours or it may be termed as output of labour per 8 working hours.

$$\text{No. of Labours} = \frac{\text{Total Work}}{\text{Task Work}}$$

S. No.	Item Description	Work done per day per mason
A	Brick Item	
(i)	Brick work in foundation and plinth with mud mortar	1.50 m^3
(ii)	Brick work in super structure with mud mortar	1.25 m^3
(iii)	Brick work in foundation and plinth (sub-structure) with lime or cement mortar	1.25 m^3
(iv)	Brick work in super structure with lime mortar and cement mortar	1 m^3
(v)	Brick work in arch	0.55 m^3
(vi)	R.B. work (Reinforced Brick work)	1 m^3
(vii)	Brick work in partition wall (Half brick wall. 4" wall)	5 m^2
B	Stone Masonary Work	
(i)	Random Rubble Stone Masonary	1 m^3
(ii)	Course rubble stone masonary	0.80 m^3
(iii)	Ashlar stone masonary	0.40 m^3
(iv)	Stone masonary in arch	0.40 m^3
C	Cement Concrete Work (CC Work)	
(i)	Lime concrete or cement concrete (PCC) in foundation and plinth	8.5 m^3
(ii)	Lime concrete in roof terracing	6 m^3
(iii)	1:2:4 CC work	5 m^3
(iv)	RCC work	3 m^3
(v)	$2\frac{1}{2}$ cm thick CC floor	7.5 m^3

D	Earth Work Items	
(i)	Earth work in excavation in rock	1 m^3
(ii)	Earth work in excavation in hard soil	2 m^3
(iii)	Earth work in excavation in ordinary soil	3 m^3
(iv)	Earth filling in plinth or foundation	4
E	Miscellaneous Item	
(i)	12 mm thick plaster work	8 m^2
(ii)	Pointing work	10 m^2
(iii)	White washing or colour washing in single coat	200 m^2
(iv)	White washing or colour washing in double coat	100 m^2
(v)	White washing or colour washing in three coat	70 m^2
(vi)	Painting or distemper for larger surface area	35 m^2
(vii)	Painting or distemper varnish in door, window frame	25 m^2
(viii)	Brick on edge in floor	7 m^2
(ix)	Brick flat floor	8 m^2
(x)	Timber frame work sal or teak wood	0.07 m^3
(xi)	Wood framing in simple wood	0.15 m^3
(xii)	Sawing of hard wood	4 m^3
(xiii)	Sawing of soft wood	6 m^3
(xiv)	Breaking of 40 mm gauge brick ballast	0.75 m^3
(xv)	Breaking of 25 mm gauge brick ballast	0.55 m^3
(xvi)	Breaking of 40 mm gauge stone ballast	0.40 m^3
(xvii)	Breaking of 25 mm gauge stone ballast	0.25 m^3
(xviii)	Ashlar stone dressing	0.70 m^3
(xix)	Mixing of mortar	3 m^3 (100 cft)
(xx)	Delivery of brick distance upto 15 m	4200 bricks
(xxi)	Delivery of brick distance upto 10 m	4200 bricks
(xxii)	Delivery of Mortar	5.5 m^3

Lead :

- Horizontal distance by which transportation is done b/w two points is termed as lead.
- The costing is done on the basis of lead for metal road & if the surface is changed, suitable modification factor is to be applied.

Lec-19 (46:25)

Type of surface	Modification Factor
Metalled	1
Cart	1·1
Sandy	1·4

NOTE :

- Costing is done on the basis of lead but transportation can also be in the vertical plane (i.e; lift). So, lift is converted into eqᵛ lead.
- To convert the lift into horⁿ lead, following modifications are applied:

Lift	Lead	eg: Lift	Lead
≤ 3.6 m	Lift × 10	2 m	2×10 = 20m
3.6 – 6 m	$(\text{Lift})^2 \times 8.3$	5 m	$(5)^2 \times 8.3 = 207.5$ m
>6 m	Lift × 20	15 m	15×20 = 300m

outturn of worker depend on lift and lead, hence the calculation is done only for 30m of the lead and 1·5m of the lift. Standard value of lift and lead which is considered to find is 1·5m and 30m, respectively. Hence, the value of lift and lead is more than this value, we have to apply modification factors.

Quantities of Various Items of Work :

Lec-20

(i) RCC or PCC :

1 m^3 of dry concrete = $\underbrace{(1.52 - 1.54)\, m^3}_{\text{depends upon w/c ratio}}$ of wet concrete

1.54 @ w/c = 0.38 and 1:2:4 → in BMC

$$\underbrace{\text{BM} + \text{FA} + \text{CA}}_{(1.52-1.54)\, m^3} + \text{water} = \underbrace{\text{Concrete}}_{1\, m^3}$$

Que : Compute the quantity of ingredients reqd to prepare 10 m^3 of design mix of 1 : 2 : 4.

Sol :

Vol. of dry concrete = $1.52 \times 10 = 15.2\ m^3$

$\therefore$ Vol. of cement = $\frac{1}{1+2+4} \times 15.2 = 2.17\ m^3$

No. of cement bags = $\frac{2.17}{0.0347} = 63$ bags

→ Vol. of 1 cement bag = 34.7 L

weight of cement = $63 \times 50 = 3150$ kg

→ weight of 1 cement bag = 50 kg.

Vol. of Sand = $\frac{2}{1+2+4} \times 15.2 = 4.34\ m^3$

Vol. of gravel = $\frac{4}{1+2+4} \times 15.2 = 8.68\ m^3$

(ii) Brick Work :

- No. of bricks in 1 m^3 of masonary = 500 (Assuming no wastage of mortar)
- Vol. of bricks in 1 m^3 of masonary = $0.7695\ m^3 = (500 \times .19 \times .09 \times .09)$
- Vol. of mortar in 1 m^3 of masonary = $0.2305\ m^3 = (1 - 0.7695)$

NOTE :

- If 20 % wastage is considered, then Vol. of mortar in $1\ m^3$ of masonary $= 0.28\ m^3$

$1\ m^3$ of dry mortar $= 1.25\ m^3$ of wet mortar (Assuming w/c = 0.38) → 25 % more than wet mortar

→ For brick work, this value is increased by 5 % bcoz undulations and frog is present in bricks, so amount of mortar will be more. → This point is only for brick work.

i.e., $1\ m^3$ of dry mortar in brick masonary $= 1.30\ m^3$ of wet mortar → 30 % more than wet mortar

- $1\ m^3$ of brick masonary, dry mortar $= (0.28 - 0.35)\ m^3 \rightarrow 1.3 \times (0.23 \text{ to } 0.28)$

Que : For 50,0000 bricks in 1 : 3 cement mortar, compute the amount of sand required.

Sol : Vol. of brick masonary using 5×10^5 bricks $= \dfrac{5 \times 10^5}{500} = 1000\ m^3$

$1\ m^3$ of brick masonary $= 0.23\ m^3$ of wet mortar

$1\ m^3$ of brick masonary $= 0.23 \times 1.3$

$= 0.3\ m^3$ of dry mortar

$1000\ m^3$ of brick masonary $= 0.3 \times 1000$

$= 300\ m^3$ of dry mortar

$\therefore$ Vol. of sand $= 300 \times \dfrac{3}{1+3} = 225\ m^3$

(iii) Plaster Work : (Std. thickness = 12 mm)

- Qty. of dry mortar = 25 % more Qty of wet mortar
- For plastering work, Qty of dry mortar = (25 % + 25 to 30 %) more Qty of wet mortar

↓ bcoz of unevenness & voids in brick

Lec-20 (47:35)

- Hence, for plaster work :

Qty of dry mortar = (55-60) % more than Qty. of wet mortar

- For 1 m^2 of plaster work : (t = 12mm)

Vol. of plaster/mortar used = 1 m^2 x 12 mm

= 0.012 m^3 → wet mortar

Vol. of dry mortar in plaster = 1.6 x 0.012 = ~~0.0186 m^3~~ = 0.0192 m^3

≃ 0.02 m^3 in 1 m^2 of plaster

(1.55 x 0.012 = 0.0186 ≃ 0.02 m^3)

Que: Calculate the qty of cement reqd in m^3 for plastering a wall of 5x4 m with 12 mm thick plaster of mix 1:6.

Sol: Area to be plastered = (5x4) x 2 = 40 m^2 ↑ both sides of wall

Vol. of dry mortar = 0.02 x 40 = 0.8 m^3

Vol. of cement = $\frac{1}{1+6}$ x 0.8 = $\frac{1}{7}$ x 0.8 = 0.114 m^3

Lec-21

(iv) Pointing :

- Dry volume of mortar for pointing = 0.6 m^3 per 100 m^2 of pointing work

(V) Damp Proof Course : (2.5 cm thick)

- Dry vol. of concrete = (1.52-1.54) Vol. of wet concrete
- If DPC is done with the mortar :

Dry vol. of mortar = (1.25) Vol. of wet mortar

Lec-21 (9:55)

Que: Find the quantity of ingredients for pointing work of $1000\ m^2$ using 1:3 cement mortar.

Sol: For $1000\ m^3$ pointing work,

$$\text{dry vol. of mortar} = \frac{0.6}{100} \times 1000 = 6\ m^3$$

$$\text{Vol. of cement} = \frac{1}{4} \times 6 = 1.5\ m^3$$

$$\text{Vol. of sand} = \frac{3}{4} \times 6 = 4.5\ m^3$$

$$\text{No. of cement bags} = \frac{1.5}{0.0347} = 44$$

Que: Find the ingredients for DPC using 1:2:4 mix of 25 mm for $100\ m^2$ plinth area.

Sol: $\text{Vol. of concrete} = 100 \times 25 \times 10^{-3} = 2.5\ m^3$

$\text{Dry vol. of concrete} = 2.5 \times 1.52 = 3.8\ m^3$

$\text{Vol. of cement} = \frac{1}{7} \times 3.8 = 0.54\ m^3$

$\text{No. of cement bags} = \frac{0.54}{0.0347} = 16$

$\text{Vol. of sand} = \frac{2}{7} \times 3.8 = 1.1\ m^3$

$\text{Vol. of gravel} = \frac{4}{7} \times 3.8 = 2.2\ m^3$

(vi) Stone Masonary Work :

- Stones reqd. for $1\ m^3$ stone masonary $= 1.25\ m^3$ (25% ↑)
- For $1\ m^3$ ↑ rubble masonary stone work, vol. of mortar reqd. $= 0.42\ m^3$
- For $1\ m^3$ of Ashlar masonary stone work, vol. of mortar reqd. $= 0.25\ m^3$
  (Rubble में mortar ज्यादा लगेगी bcoz of rough surface)

Methods of Taking Out Quantities :

Lec-21 (27:30)

— The quantities like earth work, foundation concrete, brickwork in plinth and super-structure etc. can be worked out by following methods :

(i) Long wall - short wall method

(ii) Centre Line method

(iii) Partly centre line & short wall method.

(i) **Long Wall - Short Wall Method, or**
Separate Wall Method, or
Individual Wall Method, or
Out to out & In to In Method, or
PWD Method

→ Since this method is standard, simple and accurate, it is used in PWD.

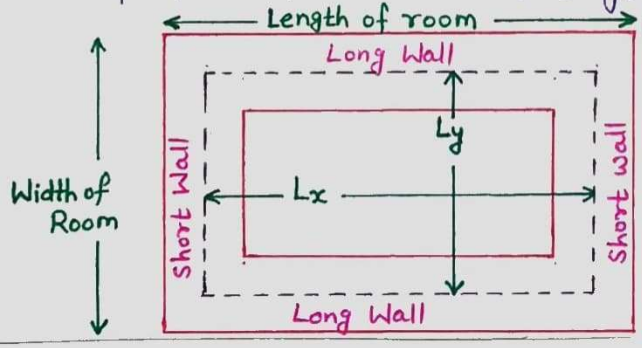
— In this method, wall along the length of room is considered to be the long wall and the wall perpendicular to this is considered short wall.

— To get the length of long and short wall, the centre line length of individual wall is computed.

— Then the length of long wall may be calculated by adding half of width at each of the centre line length. $\left(Lx + \frac{W}{2} + \frac{W}{2} = Lx + W\right)$

— Length of short wall is then computed by subtracting the half width on either side from centre line length of short wall. $\left(Ly - \frac{W}{2} - \frac{W}{2} = Ly - W\right)$

— The length of long wall usually decreases from earth work to brick work in superstructure while the length of short wall increases.



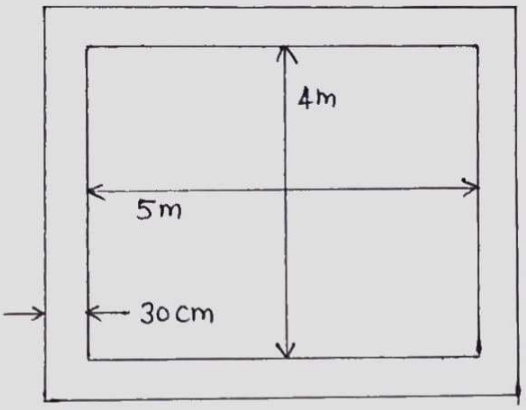
Length of Long wall $= Lx + \frac{W}{2} + \frac{W}{2} = Lx + W$

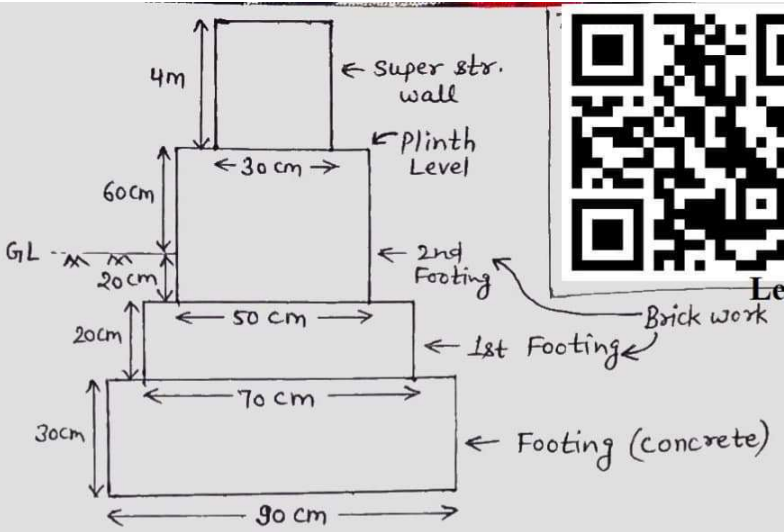
Length of Short wall $= Ly - \frac{W}{2} - \frac{W}{2} = Ly - W$

Total Length of wall = Length of (long wall + short wall)

Qty of wall = $L \times B \times H$

Que :





Sol :

Particular Item	No.	L(m)	B(m)	H(m)	Quantity(m^3)	Total qty (m^3)
(i) Earthwork in Excavation						
$L_{LW} = 5.3 + 0.45 + 0.45 = 6.2$ m	2	6.2	0.9	0.7	7.812	12.096
$L_{SW} = 4.3 - 0.45 - 0.45 = 3.4$ m	2	3.4	0.9	0.7	4.284	
(ii) Concrete work for footing						
$L_{LW} = 6.2$ m	2	6.2	0.9	0.3	3.348	5.184
$L_{SW} = 3.4$ m	2	3.4	0.9	0.3	1.836	
BRICK WORK						
(i) Sub-structure						
(a) Ist Footing						
$L_{LW} = 5.3 + 0.35 + 0.35 = 6$ m	2	6	0.7	0.2	1.68	2.688
$L_{SW} = 4.3 - 0.35 - 0.35 = 3.6$m	2	3.6	0.7	0.2	1.008	
(b) 2nd Footing						
$L_{LW} = 5.3 + 0.25 + 0.25 = 5.8$m	2	5.8	0.5	0.8	4.64	7.68
$L_{SW} = 4.3 - 0.25 - 0.25 = 3.8$m	2	3.8	0.5	0.8	3.04	
(ii) Super-structure						
$L_{LW} = 5.3 + 0.15 + 0.15 = 5.6$ m	2	5.6	0.3	4	13.44	23.04
$L_{SW} = 4.3 - 0.15 - 0.15 = 4$ m	2	4	0.3	4	9.6	

L_{LW} : Length of Long Wall

L_{SW} : Length of Short Wall

	Footing	Ist Footing	2nd Footing	Super-structure
L_{LW} :	6.2	6	5.8	5.6
L_{SW} :	3.4	3.6	3.8	4

So, As we go up from sub-structure to super-structure :
Length of long wall decreases, and
Length of short wall increases.

Lec-22 (48:10)

(ii) Center Line Method :

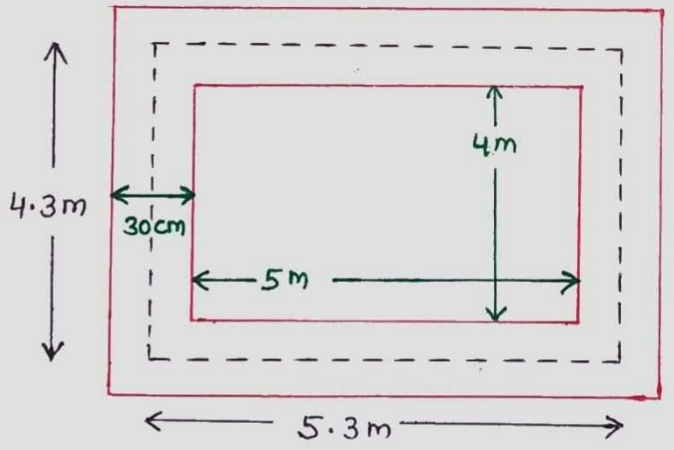
- This method is suitable for walls of similar c/s.
- Here, the total centre line length is multiplied by width & depth of the item respectively to get the total quantity of item.
- This method is most accurate and quick.
- It is also suitable for finding the quantity of wall which is curved in plan.
- Since the wall are found to overlap at the junctions, from centre to centre suitable deductions are to be made as follows :

Lec-23

Case-I : L-Junction (Corner) :

- In case of L-junction, no deduction will be applied over the centre line length.

eg:

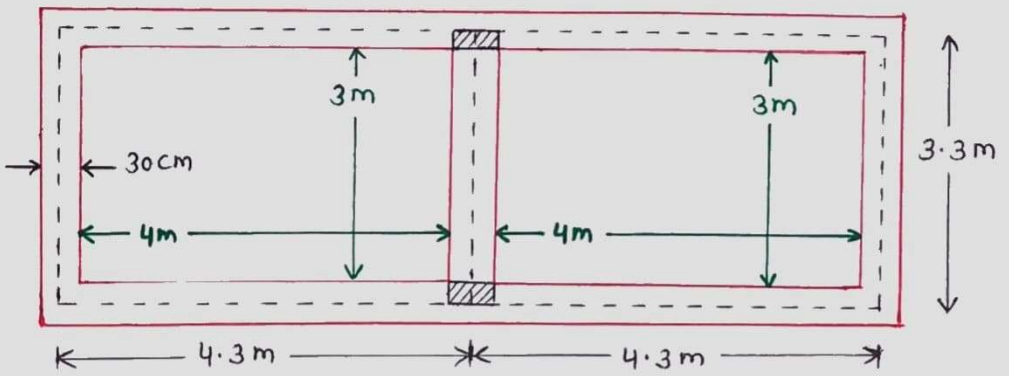


Total Center Line Length =
$2 \times (5.3 + 4.3)$
$= 19.2\,m$

Lec-23 (14:25)

Case - II : T- Junction :

- In case of T- junction, half width of wall is to be deducted from centre line length.



जब length को width और depth से multiply करेंगे, तब shaded portion 2 बार count हो जाएगा, इसलिए deduction apply करते हैं।

$$\text{Total Centre Line Length} = 8.6 \times 2 + 3.3 \times 3 = 27.1 \text{ m}$$

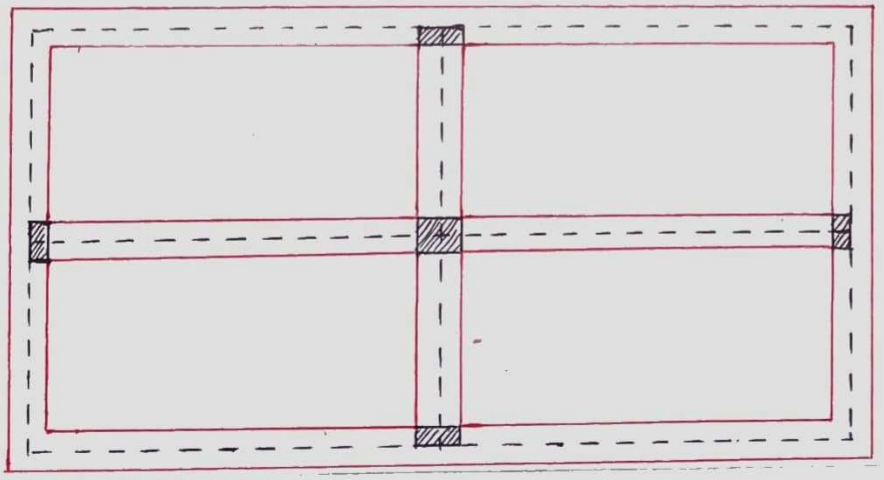
$$\text{Net Centre Line Length} = 27.1 - 2 \times \frac{0.3}{2} = 26.8 \text{ m}$$

2 T-junctions

Half width Deducted

Case - III : Cross Junction (+) :

- In case of cross junction, full width of the wall is to be subtracted from centre line length.



4 L- Junctions

4 T- Junctions

1 Cross Junction

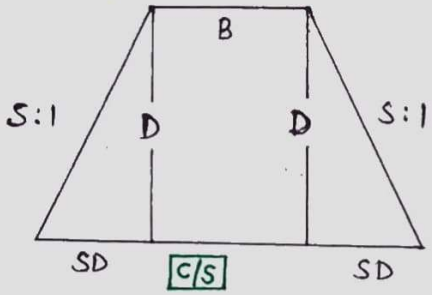
NOTE :

Lec-23 (33:00)

— Other methods for measurement of earthwork :

(i) Mid Section Method :

— In this method, the qty. of earthwork is computed with the help of size of mid-section.

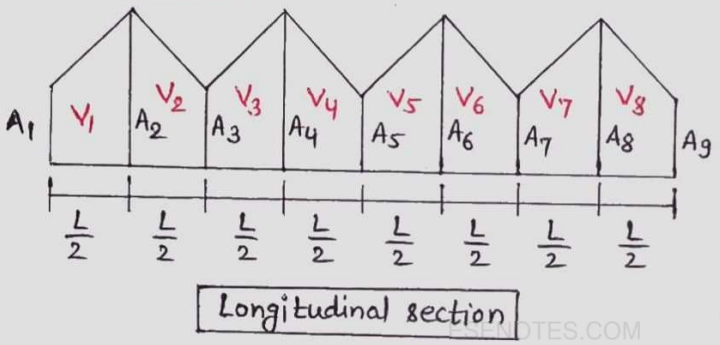


$$A = \frac{1}{2}(B + B + 2SD)D = BD + SD^2$$

$$\text{Volume} = A \cdot L$$
$$= (BD + SD^2)L$$

— Generally used for earthwork calculation of pavement and canal.

(ii) Trapezoidal Method :



Longitudinal section

$A_1, A_2, \ldots$ सारे Area अन्दर की तरफ हैं।

$$V_1 = \frac{1}{2}(A_1 + A_2)\frac{L}{2}$$

$$V_2 = \frac{1}{2}(A_2 + A_3)\frac{L}{2}$$

$$V_3 = \frac{1}{2}(A_3 + A_4)\frac{L}{2}$$

$$\vdots$$

$$V_n = \frac{1}{2}(A_{n-1} + A_n)\frac{L}{2}$$

$$V = V_1 + V_2 + \cdots + V_n$$

$$= \frac{1}{2} \times \frac{L}{2}(A_1 + A_2 + A_2 + A_3 + \cdots + A_{n-1} + A_{n-1} + A_n)$$

$$= \frac{1}{2} \times \frac{L}{2}\left[(A_1 + A_n) + 2(A_2 + A_3 + \cdots + A_{n-1})\right]$$

$$V = \frac{1}{2} \times \frac{L}{2} \left[(A_1 + A_n) + 2(A_2 + A_3 + \cdots + A_{n-1}) \right]$$

$$V = \frac{\text{Common distance}}{2} \left[\text{Area of Ist section} + \text{Area of last section} + 2(\text{Area of other sections}) \right]$$

— There is no limitation of this method and it can be applied for any number of ordinates.

(iii) **Prismoidal Method** : (Simpson's One-Third Rule)

— More accurate than previous two methods.

— Volume (V) = $\frac{\text{Common distance b/w areas}}{3} \left[\text{Area of 1st section} + \text{Area of last section} + 4(\text{Area of even section}) + 2(\text{Area of odd section}) \right]$

$$= \frac{L/2}{3} \left[A_1 + A_n + 4(A_2 + A_4 + \cdots) + 2(A_3 + A_5 + \cdots) \right]$$

— This can be applied only if number of sections are odd.

(iv) **Simpson's $\frac{3}{8}$th Rule** :

— $V = \frac{3}{8} \times \text{common distance} \times \left[A_1 + A_n + 2(\text{Area multiple of 3}) + 3(\text{remaining area}) \right]$

$$V = \frac{3}{8} \times \text{Common distance} \times \left[A_1 + A_n + 2(A_3 + A_6 + \cdots) + 3(A_2 + A_4 + A_5 + \cdots) \right]$$