

## LECTURE NOTES

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# CONSTRUCTION MANAGEMENT

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**6<sup>TH</sup> SEMESTER**

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# ∴ Construction Management :- (Chapter-1)

## Construction management -

It is the branch of management that deals with manage of construction work i.e. supervision of construction work, tendering, contracting and execution of construction work.

## Historical feature of construction management

→ In the ancient time man chose wandering lifestyle subsequently they decided to settle down by constructing a permanent shed. so construction is an old age profession. The art of construction has been slowly developed into since over the country.

→ There are several complex old monuments and other construction work in India signify the great skill of past architecture.

→ Construction today is an own linked or critical term creation of ideas till its successful implementation and execution.

## Aim of construction management -

- The main aim of construction management is to successfully apply business and management skills in position within the construction industry.
- To manage a quality construction project from start to the completion while maintaining budget, schedule and safety requirements.

## Objective of construction management -

- The main objectives of construction management are as follows.
- To create a clear idea for construction work.
  - Completion of the work within estimated budget and specified time.
  - Analysing and evaluating for high quality workmanship.
  - Providing safe and satisfactory work for all personnel and workers.

- Taking sound decision at the lowest Practical management level through the deliveration of Authority.
- Motivation People to give their best Performance within their capacity.
- Creating and organizing a work as a team.

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### Function of construction management -

- (1) Planning
- (2) Scheduling
- (3) Organising
- (4) Staffing
- (5) Directing
- (6) Controlling

#### (1) Planning -

It includes forecasting and formulating the objective, Policies, Programms, Schedules etc.

#### (2) Scheduling -

Scheduling is the another factor of construction management, it refers to fitting of final work Plan to a time scale. It shows the duration and order.

of various construction activities.

### 3) Organising

It includes identification and grouping of work. It should define authority, responsibility and relationship bet<sup>n</sup>

It should be decide the work to be taken from degree and diploma

### 4) Staffing

→ It deals with the various aspects of staffs and includes selection, participation, counselling, training, compensation of staff.

→ The person aquanted should be competent and they should be trained.

### 5) Directing

It includes communication and motivation. The communication indicates guidans and result given to the staff. The motivation indicates accelerating attitude through inspeeting, training, making facilities, financial benifite.

## (6) Controlling

The organisation should lay down performance standards for particular job and should try to achieve a measure.

### Construction Team

owner

Architect

Engg. Engineer

Contractor

owner

- owner makes a team for his project or management first.
- He directs the team members how to work out the project.
- Manage the whole team with encourage with effort.
- He helps to use is individuals ability and efficiency.
- Develop a dynamic and devoted team which works as a single entity.

## Architect

An architect is a person who plans, design and reviews the construction of any civil project they are licence and professionally trained in the earth and science building design.

- He gives a presentation of drawing to convey basic design concept from the design team to the client.
- He produces detailed drawing and specification of the project to be used for construction.
- Roles and responsibility are vary depends on the agreement with the client.
- He issues construction drawing and inspect the construction work.

## Engineer-

- The engineer designs the Project and gives its effort for a construction of a Proj.
- He adopts some cost method with Practical knowledge.
- He defines the result expected with Practical limit.
- He designs a Project in such a way that it grants maximum advantages at a optimum cost.
- He furnishes the necessary foundation details whenever possible.
- He prepares plans estimates specifications of the Project.
- He provides suitable check on cost of labour, materials, equipment and supervision charges.
- He always reconnects the local materials and labours.
- He supervises the Project during construction.



## Contractor -

- Contractor is a person who builds the project which is prepared by the engineer.
- He adopts most reliable technique for the safety of labour.
- He carries out the work as per specification and instruction by the engineer.
- He employs trained and experienced staff.
- He maintains an atmosphere of cooperation with the labour force.
- He maintains the construction equipment in proper work order. He satisfies himself with a reasonable percentage of profit.

## Resource of construction -

(i) Man Power

(ii) Machineries

(iii) Materials

(iv) Capital fund

### (i) Man Power -

→ Skill and semi-skill, technical and non-technical Personal include in man Power.

→ Man resource is one of the essential ingredient to carry out project activities.

→ As certain the availability of man of right trend and skill for requirement.

→ Maintain a reasonable ratio between senior and work man ensuring effective supervision and high productivity.

### (ii) Machineries -

→ The minimum requirement of machineries must be available in the construction company for execution of construction work.

→ Depending upon the types and nature of construction work machineries required at the site may include batching plant, miniature vibration truck, tractor, excavator.

crane, drums, workshop equipments.

→ It is required to prepared an equipment schedule so the construction manager may have no difficulty in arranging equipment for the purpose of the right time and the work will not be held off due to lack of any tools.

(ii) Materials-  
→ Materials such as bricks, stone, timber, cement, sand, steel, paint, water supply, sanitary and fitting, electrical supply and fitting, petrol oil etc. are termed as material resources which are required for construction of civil engineering product.

→ A material schedule showing the quantity, quality and with exact time and date of its delivery is prepared by assignment with the reference to work schedule.

→ It has been estimated that for any product cost of material is 50% of total product so the material should be available in local area or within 1-1.5 km area of site of project for economic completion project work.

## Capital Fund -

- Adequate ~~but~~ fund must be available for smooth implementation of the project and Proper financial Planning is essential.
- Financial resource should be planned and arrange with special care before starting of project work for smooth conduction of project otherwise there will be  
in work.

# Construction Planning (chapter-2)

## Construction Planning-

Construction Planning is the fundamental part of construction work or management in which organising, scheduling, starting and co-ordinating are included.

## Importance of construction Planning-

- A traffic schedule known as a programme should be prepared before real construction work which is very much effective for an engineer.
- The programme should be included details estimated regarding construction work like finance requirement that of starting of construction work that of completion of construction work.

## Need of construction Planning-

- The term construction is no longer limited only to the physical activities including man material and machineries but covers the entire activities from conception to realization of construction period.
- Construction Planning is the most important constituent of construction management also planning is the mental process deciding about the future line of the action.

→ The Planning is the course of action to achieve the desired result taking into consideration the present needs and future requirements.

→ The need for better construction practice or systemise planning and programming of work and effective management in the industry is therefore demanded of the day.

→ The construction planning of a project must consider investigation market survey bidding the work post tender negotiation agreement planning for the work monitoring controlling the work process. It work during execution of to completion of work.

### Construction Planning

#### Work break down structure: (W.B.S)

It is a hierarchical system that represent the construction project in increasing level of details to define, organise and display the project work in measurable or manageable components.

#### Steps of work break down structure -

- 1 - Function
- 2 - Initial break down
- 3 - Further break down
- 4 - Implementation.

## 1- Function

Essentially a work breakdown structure is a hierarchical map of your project down our plan, which helps you visualise our overall it out in the form of block charts. <sup>you can sketch</sup>

## 2- Initial break down

Define your top level objective next divide our top level objective into its constituent task.

## 3- Further breakdown -

→ Divide your next level task into their constituent task. continue dividing the task until you reach a level of simplification that allows a dedicated team of workers to handle each task.

## 4- Implementation

Decide how long each task should take add up times to get a rough idea of how long the project will take.

Work breakdown structure - (WBS)

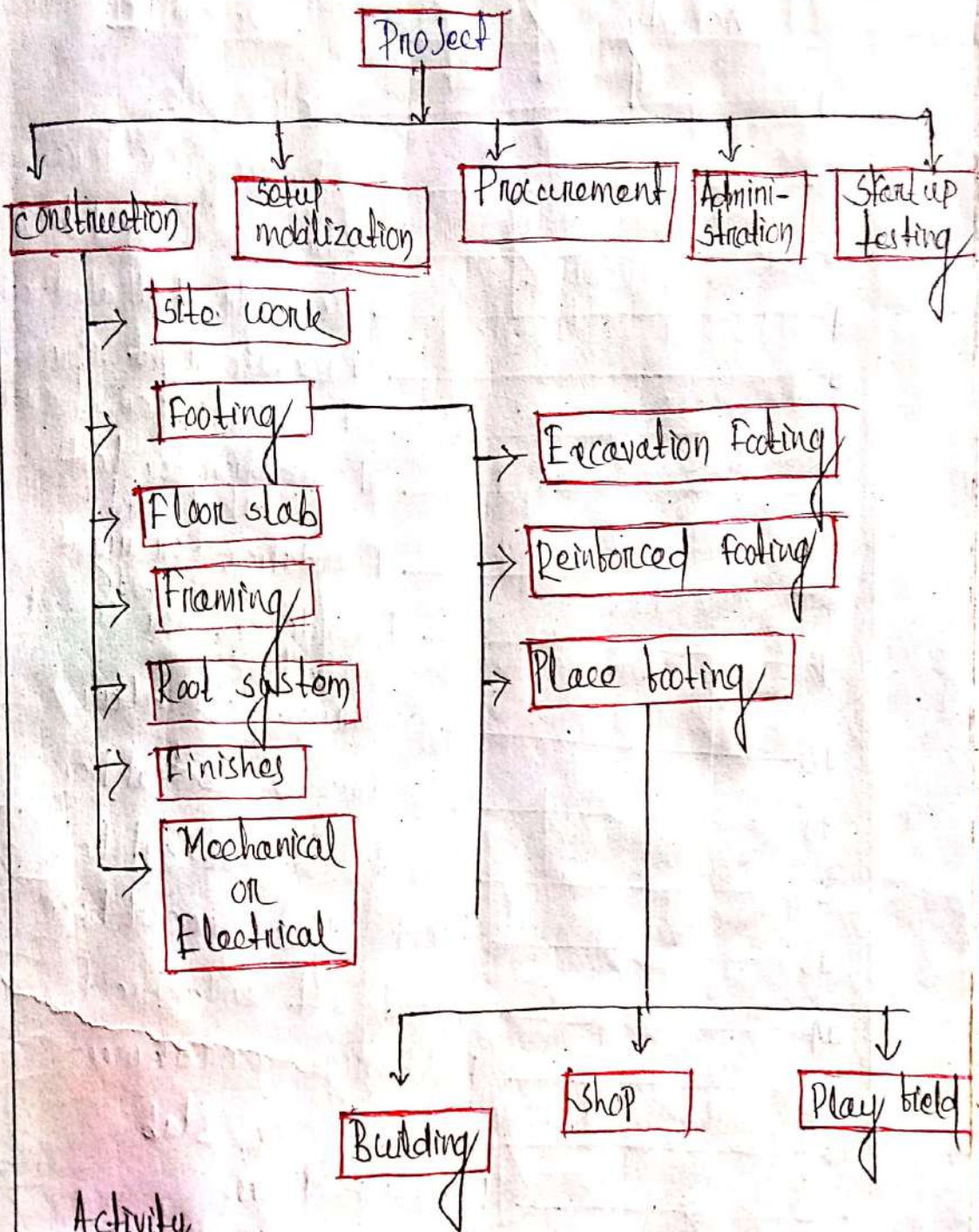
Level-1 → Project

Level-2 → Sub Project

Level-3 → sub network

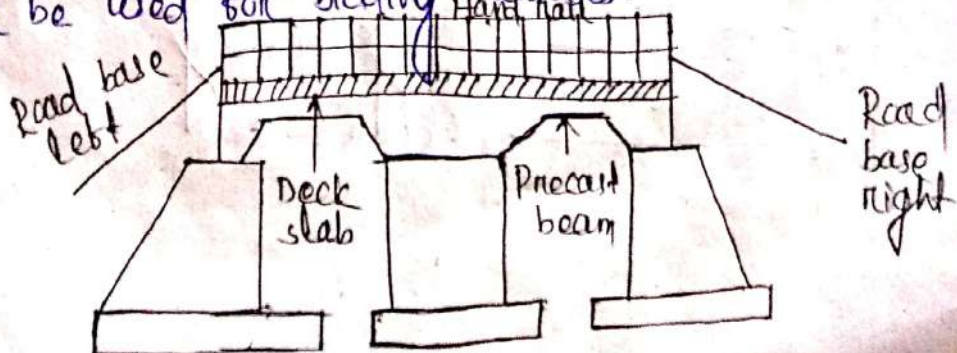
Level-4 → Activity

Level-5 → sub activity



Activity

Ex:- a double span bridge and break the construction work into activities. The plan will be used for bidding purposes.





<u>Activity</u>	<u>Description</u>
1	setup site
2	Procure Reinforcement
3	Procure Precast beam
4	Excavate left abutment
5	Excavate right abutment
6	Excavate central abutment
7	Foundation for left abutment
8	Foundation for right abutment
9	Foundation for central abutment
10	construct left abutment
11	construction central Pier
12	Erect left Precast beam
13	Erect right Precast beam
14	Field left embankment
15	Field right embankment
16	construct deck slab
17	Left road base
18	Right road base
19	Road base
20	Road surface
21	Bridge railing
22	clean site.

## Stage of construction Planning

- ① Pre-tendering stage
- ② Project-tendering stage
- ③ Post-tendering stage

### ① Pre-tendering stage

Pre-tendering stage are two types

- (a) Project reporting stage
- (b) Project Planning stage.

#### (a) Project reporting stage -

##### Activity

The Purpose of this stage is to study the conceptual idea of a project and prepare a report for investigation and estimation and satisfying owner wish.

##### Function

- Set objective of a project.
- Technical and non-technical investigation.
- Development of alternative solution.
- Evaluation and comparison of alternative.
- Selection of most feasible alternatives.
- Preparation of the details project report.

## (b) Project Planning stage -

### Activity

The Purpose of this stage is to Prepare Project Summary to Prepare detail drawing and Specification and finally to get detailed estimated cost of the Project.

### Functions

### Function

- Finalise Project Summary.
- Carry out technical investigation.
- Preparation of Plans and Specification.
- Detailed design and preparation of working drawing.
- Detailed cost estimates of the Project.
- construction methodology and preparation of schedule.

## (2) Project Tendering stage -

### Activity

In this stage tenders are invited and the contracts is avoided. The Purpose of this stage is to award a contract to a contractor selected for the purpose on suitable terms and conditions.

## Function

- Preparation of tender; document and obtaining tenders comparative statement of tenders.
- As shortening resource capacity work experience and reliability of the contractor.
- Award of the contract to the selected contractor and contract document.
- Work order and Procurement of contractor

## ③ Post tendering stage -

### (a) Project construction stage

#### Activity

- During this stage actual work is executed as per Plan and specification prepared earlier.

- The construction method is carried out in a Plan manner, preventing wastage of men power, material and money for completion of Project.

#### Function

- using CPM (critical path method) network following following schedule prepared. one is activity schedule and other is material schedule Provision facilities and service

most be provided before starting the construction work.

- A typical layout of the Plant and service camp should be in contracted.
- Co-ordination of sub-contractor and various section is done.
- Final checking of the completed work is made and final payment is made to the contractor.

### Project commissioning stage-

The Purpose of the stage is to ensure that the work has been completed as specified in the contractor document if any change have been made they must be recorded for and financial implementation.

### Function

- To keep various record to the actual work.
- To have quality inspection thoroughly to remove the defects if found.
- To Prepare operating and maintaining manual.
- To have training and recruitment of staff for commission schedule.

## Construction Scheduling

A construction scheduling is a graphical representation which shows the phasing rate of construction with starting and completion of each and every activity as per sequence.

## Scheduling by using bar chart

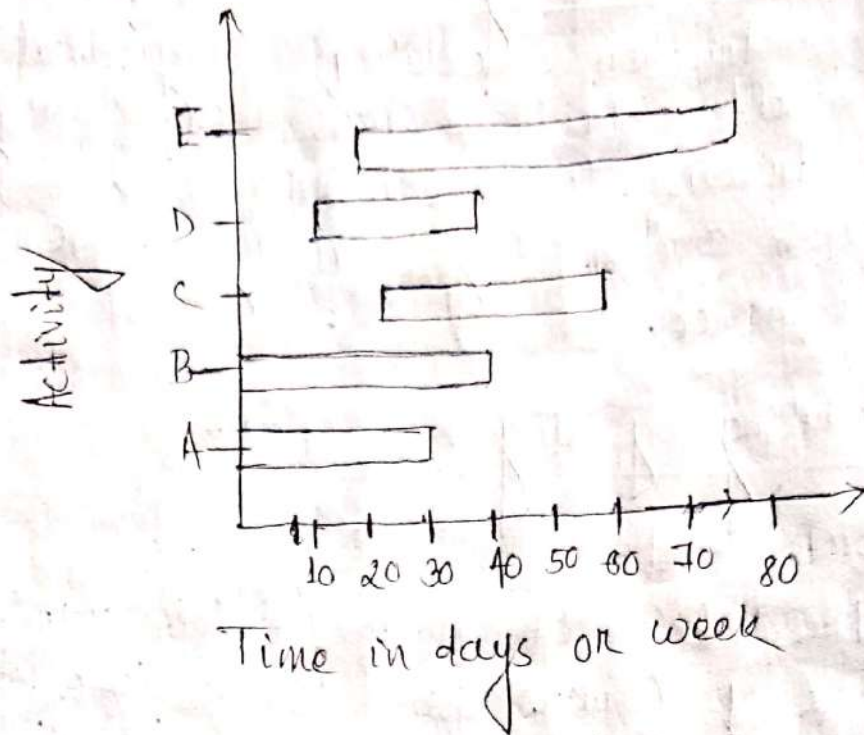
### Bar chart -

→ In dealing with complex project representation showing various jobs to be done at the time and money this type of chart is known as bar chart.

It consists of 2 co-ordinate axis one representing the time and other activity and job content.

→ The length of the bar indicates the duration of job. Taken bar completion.

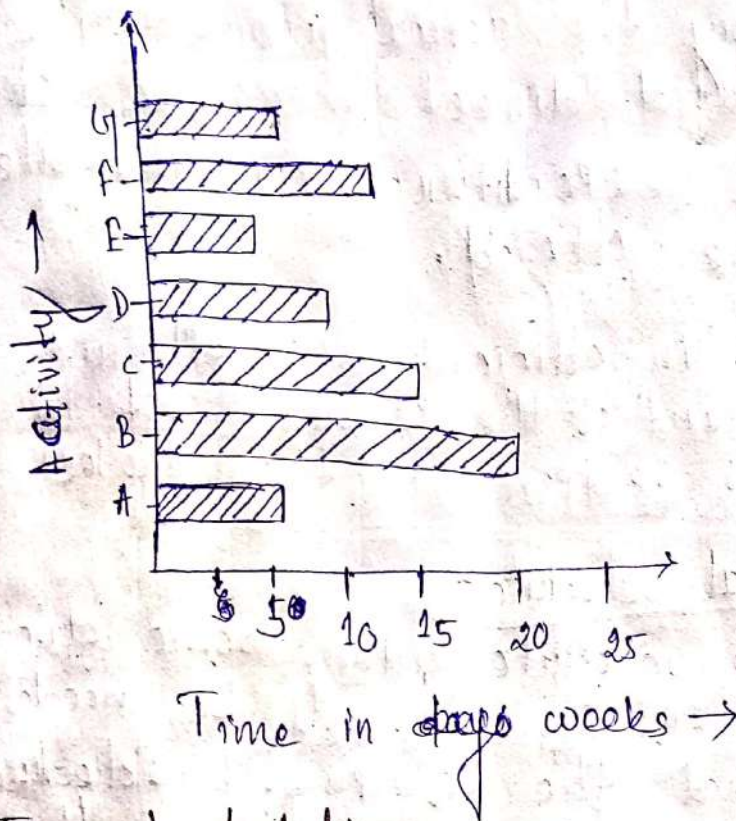
→ A, B, C can be started at same time and proceed concurrently or in parallel through take different time of completion.



Repair a construction schedule with the help of bar chart for a compound wall des in its preparation

List of activity-

- A. Clearing of site - 5 weeks
- B. Excavation of foundation - 20 weeks
- C. Erection of formwork - 45 weeks
- D. Reinforcement preparation - 10 weeks
- E. Reinforcement erection in position - 5 weeks
- F. Pouring of concrete and finishing - 12 weeks
- G. Removing equipment and cleaning the site - 6 weeks



### Types of scheduling

There are 4 types of scheduling

- ① Labour scheduling
- ② Equipment / Material
- ③ Financial scheduling
- ④ Machinery scheduling

→ The aim of the schedule is to decide that no. of skilled labour, unskilled labour, technical or non-technical labour required for execution for different activity or different time.

→ It provides the side in charge.



- By noting the actual work with a chart and direct measure of labour expenditure on the site can be obtained.
- It helps in efficient and optimum deployment of the labour cost in various sections of the project.

### ② Material schedule

In this schedule within some dates some equipments will be needed for that, the equipment schedule has to be prepared before the starting of the project i.e. arranged will be in advanced form from the schedule. delay in work that may occur either due to non availability or break down of equipment.

### ③ Financial schedule

The schedule is essential both pre-tendering and post-tendering stage. This schedule shows the amount of cash required at the different construction project.

## A) Machinery schedule -

- Machinery schedule may be prepared from the construction schedule to avoid the delay in execution of work on construction.
- Machinery should reach the site of work well in advanced before about one week of the starting of work.
- Machinery schedule may be prepared either month wise or week wise depending upon the extending project or storage space.

## Limitation of Bar chart -

- Bar chart does not established the control over the various activities of the project.
- A bar chart doesn't given the overall progress of the project.
- It is not possible to review or revise the program.
- A bar chart doesn't in corporate degree of tolerance for delay in estimated duration of activities.
- It doesn't indicate the inter relationship between various activities.

→ It is unable to supply information to the effect that what will happen to the succeeding activities when the preceding activities closed or stop.

Construction technique with the help of network technique -

The all types of networks related to construction work having some activities, event and there interrelationship. The network technique is used to so the inter relationship between activity and event with the help of some method CPM and PERT.

CPM → Critical Path Method

PERT → Programme Evaluation and Review Technique

12.11.18 Difference bet<sup>n</sup> CPM and PERT.

## CPM

→ It is basically having deterministic approach in the design of network.

→ Only one time estimate is required for each activity.

→ It is built up of activity oriented diagram.

→ Time and cost both are controlling factor there is an optimum duration of the project at which the project cost is minimum. This can be oriented by crashing the network.

→ Critical event must have a zero slack.

→ It is recommended for respective nature of work where past experience are adequately available

## PERT

→ It is basically having probabilistic approach in the design of network.

→ 3 time estimates (optimistic time, pessimistic time, most likely time) for each activity.

→ It is built up of event oriented diagram.

→ Time only the controlling factor and the cost is assumed proportional to the project duration.

→ Critical event may be ~~clear~~ zone depending upon the project schedule completion time.

→ It is recommended for research and development project where past experience are available

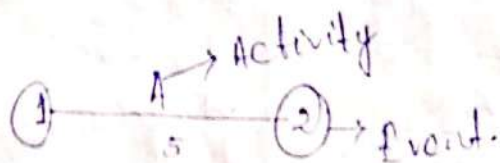
on whose mode  
of uncertainty  
lies on in the  
time of estimation.

## Network Analysis -

Network analysis is related to network diagram which is graphical or pictorial representation of some logical order of activities on the such that we established the interrelationship and inter dependence of one activity on all activities of the project.

Activity = A, B, C, D etc

Event = 1, 2, 3, 4 etc.



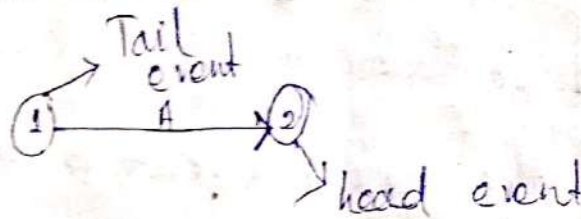
### Activity

It is the performance of task or operation which consume time and resources has a definite beginning or ending. It is denoted by A, B, C, D.

## Event

It is an instantaneous point in time marking the beginning or end of one or more activities. It is denoted by 1, 2, 3, 4 etc.

e.g. Excavation - Excavation completed



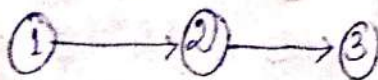
Tail of the arrow signifies the commencement of activity and the head signifies the completion of activities.

### \* Preceding activity -

It is the activity which is completed before an event takes place.

### \* Succeeding activity -

It is that activity which begins after an event takes place.



2 is Preceding by 1

2 is Succeeding by 3.

# CPM

EST - Earliest starting time

LFT = Latest finishing time.

Est -

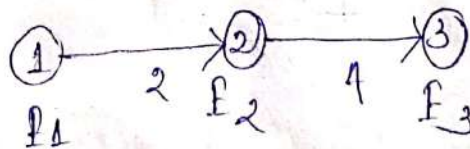
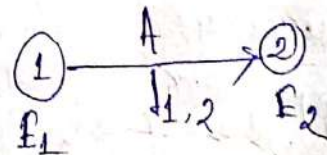
→ It signifies the earliest that an activity can start with reberencement commencement Project.

→ Est of the first event is always zero.

→ For calculation of EST we start from left and progressively move from left to right.

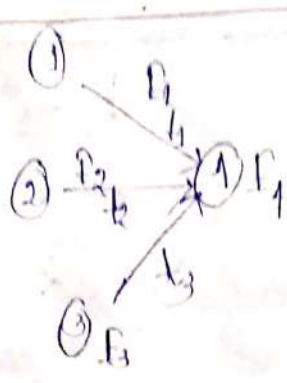
Est of head event = Est of tail event + duration both these two event

$$\Rightarrow E_2 = E_1 + T_{1,2}$$



$$E_2 = E_1 + 2$$

$$E_3 = E_2 + 4$$



$$E_1 = E_2 + t_{1,2}$$

$$E_1 = E_3 + t_{1,3}$$

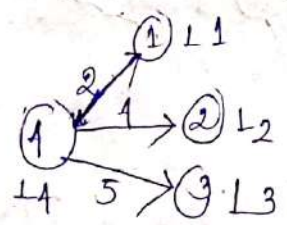
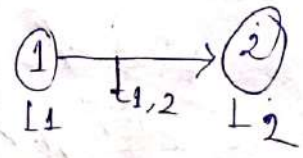
Always take the <sup>m</sup>max value in merging case.

LFT-

It is the latest time by which an activity should be finished or otherwise the project completion time delay.

LFT of tail event = LFT of <sup>head</sup>event - duration bet<sup>n</sup> these two ~~events~~

$$L_1 = L_2 - t_{1,2}$$



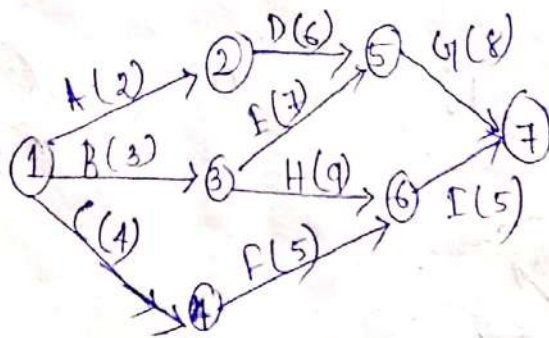
→ In LFT case ~~max~~ taken the ~~small~~ <sup>m</sup>min value.

→ But Est and LFT for starting event are always zero.



Name of Activity	Pre-requisite Activity	Estimated time
A	None	2
B	None	3
C	None	4
D	A	6
E	B	7
F	C	5
G	D, E	8
H	B	9
I	H, F	5

Find out the critical path.



$$① \rightarrow ② \rightarrow ⑤ \rightarrow ⑦ = 2 + 6 + 8 = 16$$

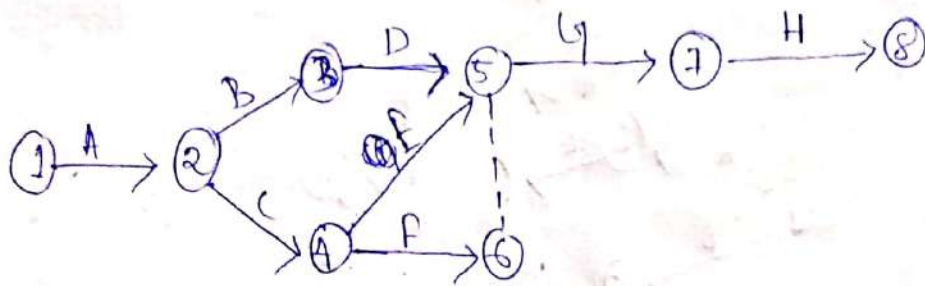
$$① \rightarrow ③ \rightarrow ⑤ \rightarrow ⑦ = 3 + 7 + 8 = 18$$

$$① \rightarrow ③ \rightarrow ⑥ \rightarrow ⑦ = 3 + 9 + 5 = 17$$

$$① \rightarrow ④ \rightarrow ⑥ \rightarrow ⑦ = 4 + 5 + 5 = 14$$

∴ The critical path is B - E - G.

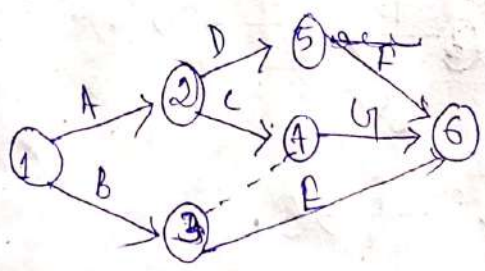
<u>Activity</u>		<u>Predecessor</u>
A	—	None
B	—	A
C	—	A
D	—	B
E	—	C
F	—	C
G	—	D, E, F
H	—	G



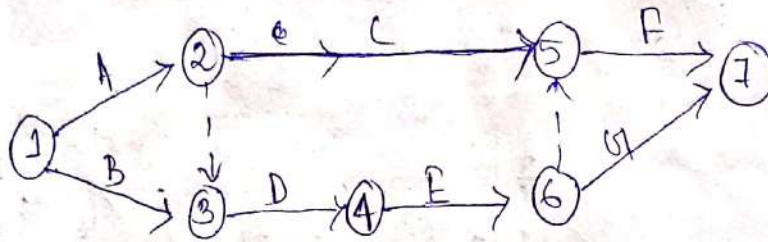
### ✓ Dummy Activity

certain activity which neither represent a connection or consume time nor resources but are simply to represent a connection or link between the events is called dummy activity.

<u>Activity</u>	<u>Predecessor</u>
A	None
B	None
C	A
D	A
E	B
F	D
G	B and C



<u>Activity</u>	<u>Predecessor</u>
A	None
B	None
C	A
D	A and B
E	D
F	C and E
G	E



CPM

EST  $\begin{cases} E_s \\ E_f \end{cases}$

LFT  $\begin{cases} L_s \\ L_f \end{cases}$

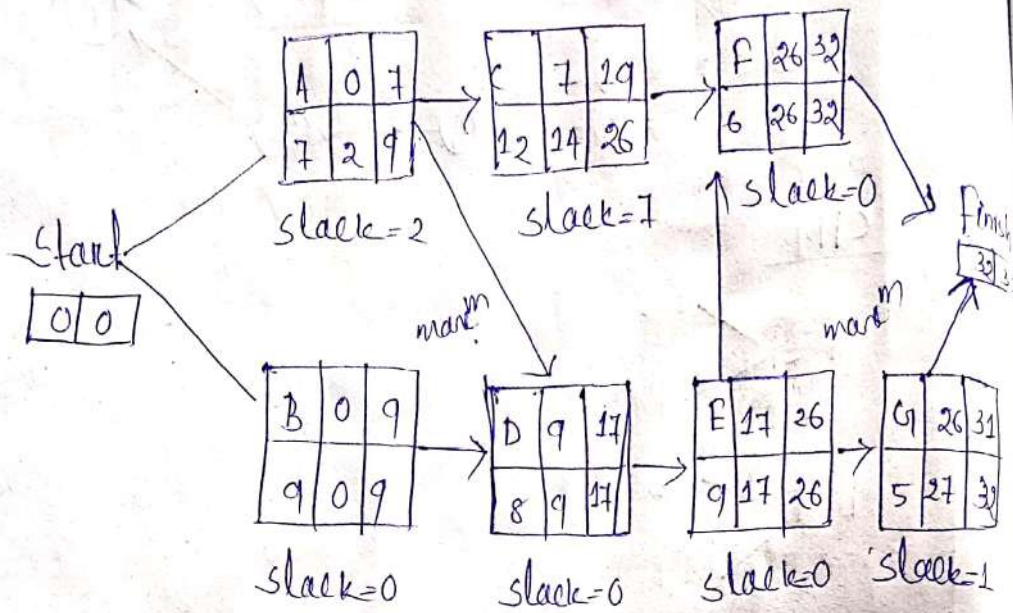
$E_s$  = Earliest start

$E_f$  = Earliest finish

$L_s$  = Latest start

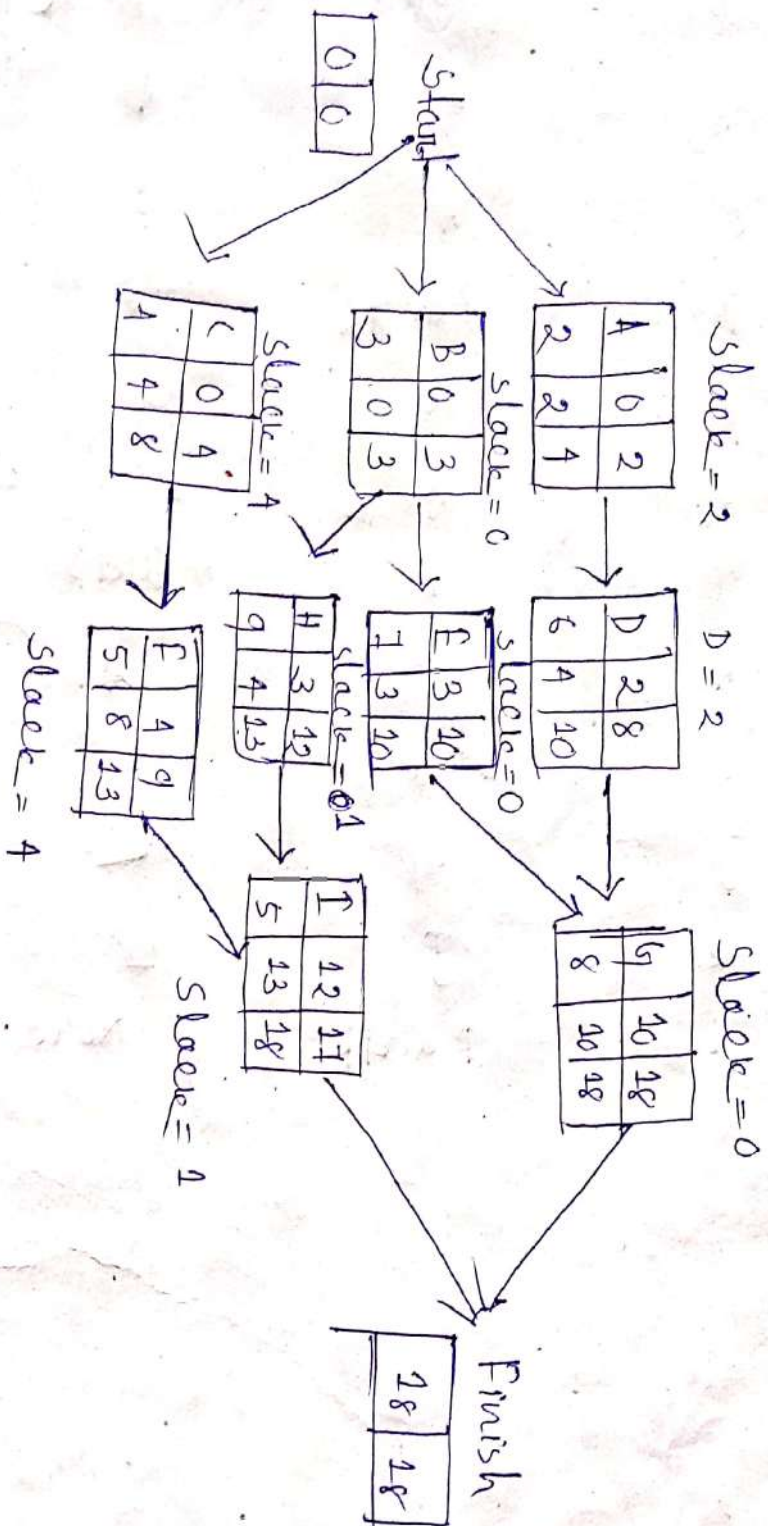
$L_f$  = Latest finish

<u>Activity</u>	<u>Predecessors</u>	<u>Duration</u>
A	None	7
B	None	9
C	A	12
D	A and B	8
E	D	9
F	C and E	6
G	E	5



B-D-E-F = Critical Path

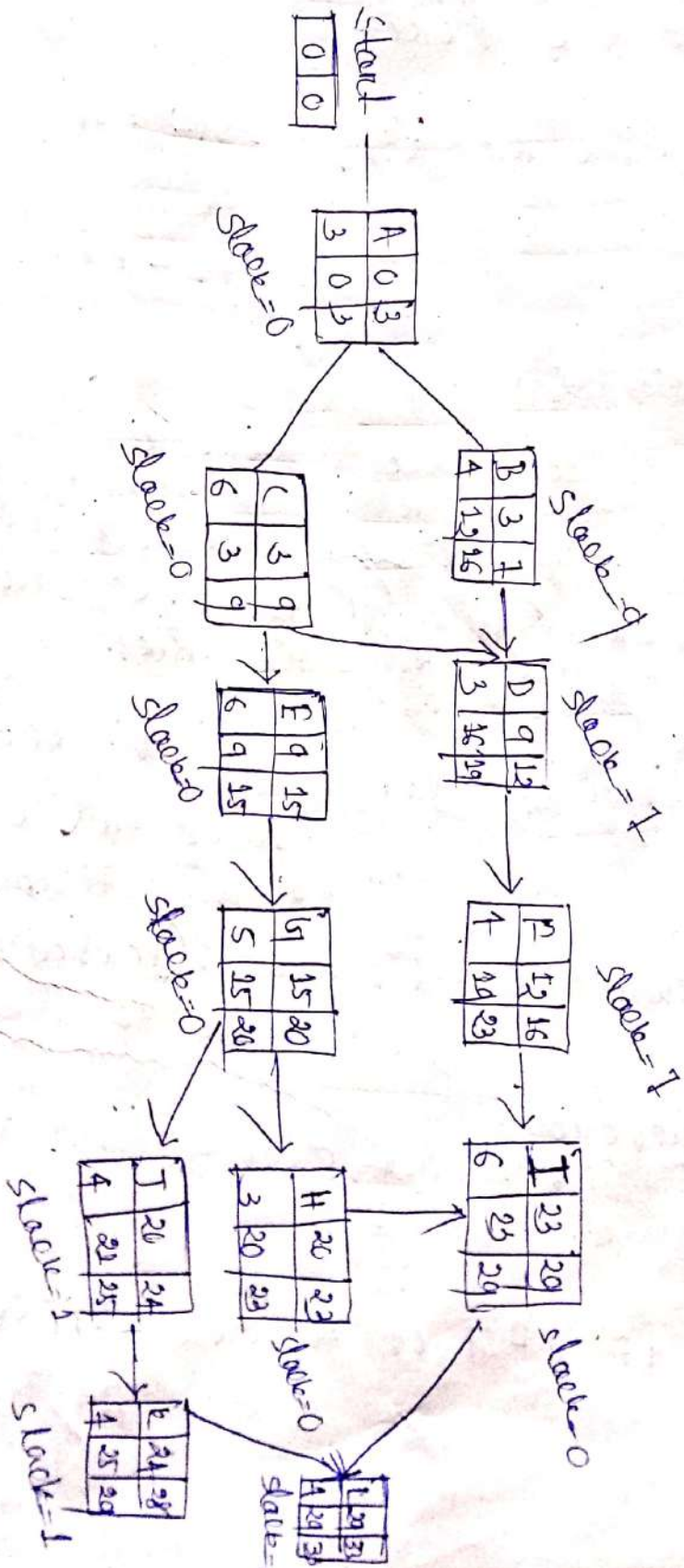
$\text{slack} = LF - EF$ <p style="text-align: center;">or</p> $LS - ES$
--



critical path B-E-G = Critical Path

<u>Activity</u>	<u>Preceding</u>	<u>Following</u>	<u>Duration</u>
A	None	B and C	3
B	A	D	4
C	A	E	6
D	B and C	F	3
E	C	G	6
F	D	I	4
G	E	H and J	5
H	G	K and I	3
I	F and H	L	6
J	G	K	4
K	J	L	4
L	I and K	None	4

Critical Path  $\rightarrow$  A - C - E - G - H - I - L





- ① Float -  
 It is used to mean the full amount of time by which a particular activity can be delayed without causing any effect on the completion of the project.

$$\text{Total float (TF)} = \text{LST} - \text{EST}$$

or

$$= \text{LFT} - \text{EFT}$$

- ② Free Float.

It is used to mean the amount of time by which the start of an activity may be delayed without interfering with the start of any succeeding activities.

$$\text{Free float (FF)} = \text{EST of head event} - \text{EST of tail event} - \text{Activity time.}$$

- ③ Independent float or Interbearing use to mean the

different LFT of head event and activity time.

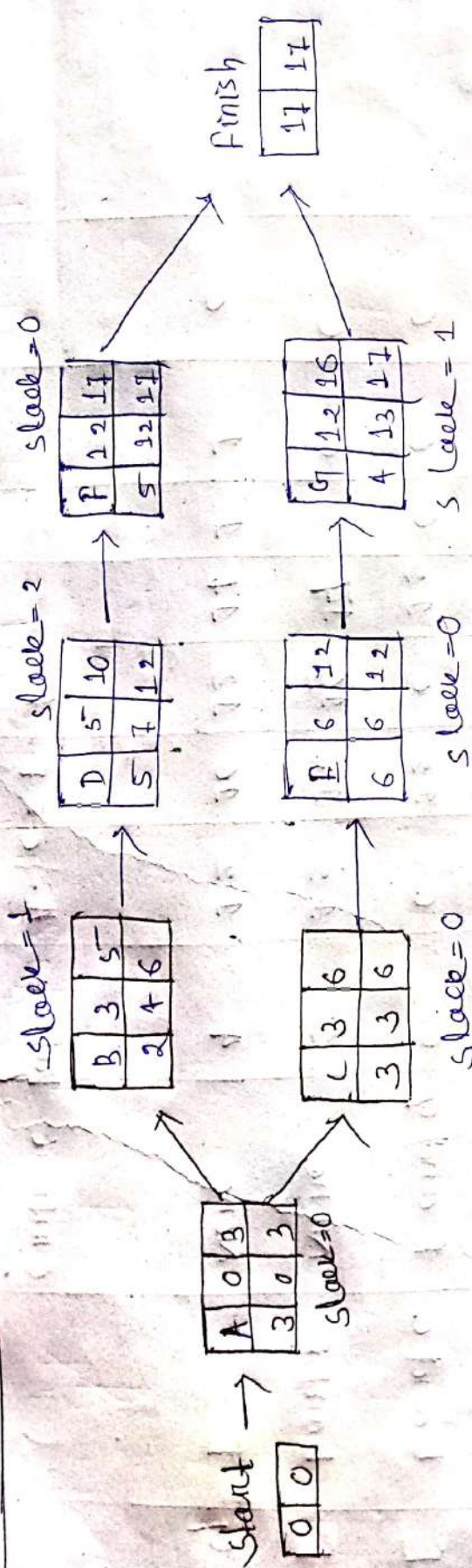
$$\text{IF} = \text{EST of tail event} - \text{LFT of head event} - \text{Activity time.}$$

$$\text{IF} = \text{TF} - \text{FF}$$

Activity	Preceding Activity	Succeeding Activity	Activity Time	ES	EF	LS	LF	FF	FF	IF	IF
A	None	Bandc	3	0	3	0	3	0	0	0	critical
B	A	D	4	3	7	12	16	9	2	7	critical
C	A	E	6	3	9	3	9	7	0	0	critical
D	Bandc	F	3	9	12	16	19	7	0	0	—
E	C	G	6	9	15	9	15	0	7	0	critical
F	D	I	4	12	16	19	23	7	0	0	critical
G	E	H and J	5	15	20	15	20	0	0	0	critical
H	G	I	3	20	23	20	23	0	0	0	critical
I	F and H	L	6	23	29	23	29	0	0	0	—
J	G	K	4	20	24	21	25	1	0	1	—
K	G	L	4	24	28	25	29	1	1	0	—
L	I and K	None	4	29	33	29	33	0	0	0	critical

Problem-

<u>Activity</u>	<u>Duration</u>	<u>Preceding</u>	<u>Following</u>
A	3	None	B and C D and E
B	2	A	E
C	3	A	F
D	5	B	F and G
E	6	B and C	None
F	5	D and E	None
G	4	F	None



Critical Path = A - C - E - F

Activity	Preceding Activity	Succeeding Activity	Activity Time	ES	EF	LS	LF	TF	FF	TF	Remark
A	None	B and D	3	0	3	0	3	0	0	0	
B	A	D and E	2	3	5	4	6	1	0	1	
C	A	E	3	3	6	3	6	0	0	0	
D	B	F	5	5	10	7	12	2	2	0	
E	B and C	F and G	6	6	12	6	12	0	0	0	
F	D and E	None	5	12	17	10	17	0	0	0	
G	E	None	4	12	16	13	17	1	1	0	
		Critical Path =		A - C - E - F							

## PERT - (Program Evaluation And Review Technique)

It is method of analysis which involves task in completing a given project, especially the time needed to complete each task and identifying the max<sup>m</sup> time needed to complete the total project.

- ① Optimistic Time ( $T_o$ )
- ② Pessimistic Time ( $T_p$ )
- ③ Most likely Time ( $T_m$ )
- ④ Expected Time ( $T_e$ )

### ① Optimistic Time -

It is the max<sup>m</sup> possible time required to accomplish a activity assuming everything proceeds better for the completion of the particular activity.

### ③ Most likely Time -

It is the best estimated time for an activity, which is based on experience judgment of similar activity being executed.

② Pessimistic Time -

It is the max<sup>m</sup> estimated time required to accomplish an activity, assuming all relevant circumstances for the completion of that particular activity exceptionally and favorably.

④ Expected Time

It is the average time the activity would require if an activity is repeated on number of occasions over an extended period of time.

$$T_e = \frac{T_o + 4T_m + T_p}{6}$$

Activity	$T_o$	$T_m$	$T_p$	$T_e$
A	2	4	6	4
B	6	8	10	8
C	1	5	7	5
D	1	5	9	5
E	6	8	10	8
F	5	7	8	7

$$T_{eA} = \frac{T_o + 4T_m + T_p}{6}$$

$$= \frac{2 + 4 \times 4 + 6}{6}$$

$$= \frac{2 + 16 + 6}{6}$$

$$= \frac{24}{6}$$

$$= 4$$

$$T_{eB} = \frac{6 + 4 \times 8 + 10}{6} = 8$$

$$T_{eC} = \frac{1 + 4 \times 5 + 7}{6} = 5$$

$$T_{eD} = \frac{1 + 4 \times 5 + 9}{6} = 5$$

$$T_{eE} = \frac{6 + 4 \times 8 + 10}{6} = 8$$

$$T_{eF} = \frac{5 + 4 \times 7 + 8}{6} = 7$$



Standard  
variation

Variance

$$\frac{T_p - T_o}{6}$$

$$\left(\frac{T_p - T_o}{6}\right)^2$$

$$(i) \frac{6-2}{6}$$

$$\left(\frac{6-2}{6}\right)^2 = 0.44$$

$$(ii) \frac{10-6}{6}$$

$$\left(\frac{10-6}{6}\right)^2 = 0.44$$

$$(iii) \frac{7-1}{6}$$

$$\left(\frac{7-1}{6}\right)^2 = 1$$

$$(iv) \frac{9-1}{6}$$

$$\left(\frac{9-1}{6}\right)^2 = 1.7$$

$$(v) \frac{10-6}{6}$$

$$\left(\frac{10-6}{6}\right)^2 = 0.44$$

$$(vi) \frac{8-5}{6}$$

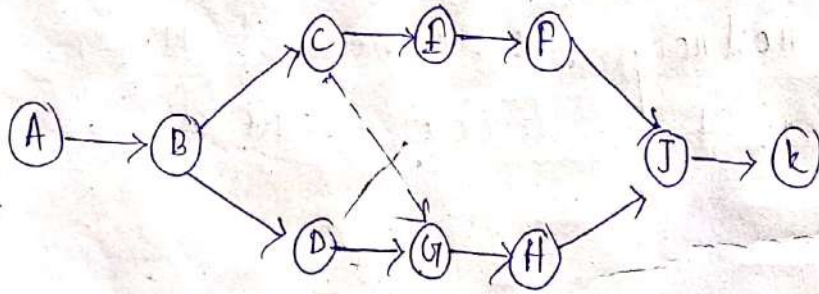
$$\left(\frac{8-5}{6}\right)^2 = 0.25$$

Draw a PERT network -

- A is the 1<sup>st</sup> event and k is the end event.
- J is succeeding event of ~~event~~ F.
- B is succeeding event of A.
- C and D are ~~succer~~ succer event of B.
- D is a Preceding event of G.
- E and F occur after event C.
- E Preceeds F.
- C reached train the occurrence of G.
- G Preceeds the event H.
- H Preceeds the event J.
- F nextrength occurrence of H
- k is the succer event of J.

A → B

<u>Activity</u>	<u>Predecessor</u>	<u>Successor</u>
A		B
B		C and D
C	B	G (Dummy)
D	B	G
E		J
F	E	J
G		F (Dummy)
H	G	J
J	H	
K	J	
I		



Percentage of Probability -

$$Z \text{ factor} = \frac{\text{Schedule time} - \text{expected mean time}}{\text{Standard variation}}$$

Find the z-factor for completing the project in 38 weeks, hence the expected mean time is 37 weeks.

$$= \frac{38-37}{4.81} = 0.20$$

calculate the completion time duration for which company should bid considering 93% probability, here z-factor of 93% = 1.50

$$z\text{-factor} = \frac{\text{Scheduling Time} - \text{Expected time}}{\text{Standard variation}}$$

$$1.50 = \frac{38 - 37}{4.81}$$

$$\Rightarrow 1.50 \times 4.81 = x - 37$$

$$\Rightarrow 1.50 \times 4.81 + 37 = x$$

$$\Rightarrow x = 44.21$$

# Material and Management

The material management is the approach for planning, organising, controlling all the activities with the help of material info in concern organisation.

## Objectives of material management-

- To minimize the material cost.
- To reduce investment tied in in inventories for use in other productive purpose and to develop high inventory turn over ratio.
- To procure and provide materials of desired quality when required at lowest possible overall cost of the concern.
- To purchase receive transport and store material efficiently and to reduce the related cost.
- To trace new source of supply and to develop partial relation with them in order to ensure continuous material supply at reasonable rate.

- To conduct studies in areas such as quality consumption and cost of material so as to minimize cost of production.
- To trace Personnel in the field of material management in order to increase operational efficiency.

### Store management -

Store management is the important part of the material management. Various materials are received at the construction ~~site~~ <sup>site</sup> and these are to be stored properly till they are consumed on work.

### Objectives of store management -

- Minimize utilization of the space for storage.
- Easy handling during the process of receipt, inspection, storage and to ensure an uninterrupted flow.
- Prevention of store against spillage, breakage, deterioration and theft.

→ Proper maintenance of store account to have central over <sup>received</sup> issue to fix accountability of any deficiency.

### Function of store management-

- Receiving materials goods, requirement and checking them for identification.
- Proper recording to receipt of goods.
- Placement right material at right place.
- Maintenance of stock, safety in good condition by taking all precautions to ensure that they don't suffer from damage and deterioration.
- Issue of item to the users only on the receipt of otherist store requisition.
- Recording and updating receipt of material and issue of material.
- Making sheer that stores are kept clean in good ~~order~~ order.
- Preventing unauthorized person from entering the store.

→ Planning of storage space ensuring economic and efficiency.

Imp.

### Issues for Records-

- (1) Invoice
- (2) Indent
- (3) Bin card

#### (1) Invoice-

Invoice is a receipt which is issued from the seller to the buyer in which all the specification, amount, quantity of materials are present. This is required in the time of material receipt from a company to organisation.

#### (2) Indent-

Indent is a book which is required during the material shifted from the store to any work place or laboratory. In this book all materials are same as per the invoice.



### b) Bin card -

Bin card is receipt of goods which kept in stores and it contains date wise record of receipt, issues and balance of each item of stock. All the items are maintain in a tabular form.

### Accounting Procedure-

- Recognition of need receipt and analysis of Purchase requisition.
- selection of possible potential sources of supply.
- Making request for quotation.
- Receipt and analysis of quotation.
- selection of right source of supply.
- Issuing the Purchase order.
- flow of Pending order.
- Analysing receiving reports, Processing discrepancies and rejection.

## Inspecting of stone / material -

The inspecting procedure includes two things.

- the site store whether the sight keep the materials and other goods properly or not.
- The material must keep in store in a proper way because its affected by rain or other atm. agent.
- Whether store keeper maintain the store register / record properly or not.

## T and P Account Register -

In site store there is a store record for tools or plants. The store keeper register and issue the tools and plants used in the site issued by the sight manager and contractor which are worker order construction organisation.

# Construction Site Management (chapter -)

## Layout -

A job layout can be defined as space allocation for material storage, working area, units of accommodation, plant position, general circulation area and also access and egress for daily delivery and emergency services.

## Objective of layout -

- Prepare or choose a proper plan for a project.
- Make economic in proper handling the material and cost related to workers.
- Effective use of available area by planning the layout properly.
- Minimization of production area by planning the layout properly.
- Minimization of production delayed because the plant layout is significant factor in the timely completion of order.
- Improve the quality control.
- Minimize equipment investment as per budget.
- Better production control.
- Better supervision (properly handling, arranging the supervision of workers and get full view of entire plant).

→ Take care of the safety of workers.

### Specification

It describes the material and workmanship required for a development or construction.

→ It includes the quantity, schedule and drawing.

→ It varies considerably depending on the stage.

### Review of site management-

→ It is an one type of plan in which all the plans (Prepared before work started) are checked.

→ Check whether the plan has completed as per planned or not.

→ Check how the working process is going on.

→ ~~where~~ It is checked in between the different stages of work.

→ After every stage completion there is a review meeting.

→ This meeting includes discussion of plans, finalizing the new rules, if necessary and checking the old set.

→ The review plan is mandatory for better performance of all employ related to that project.

### Factors Influencing for selection of site-

→ Approach to road.

→ site should be nearer to the towns or locality.

→ No complaints or violence arise near or inside the construction site.

### Design and layout of temporary facilities and service -

→ In construction site there must be site office, site store room for official work or other important meeting conducted bet<sup>n</sup> site incharge or higher authority and sub-ordinate.

→ For water supply and electric supply, there is permanent point to be installed is to be avoided. For discontinuous supply on the

construction site.

→ Therefore design, planning and layout temporarily must be needed till the final direction on the project reach.

Principle of site management.

→ The basic principle of storing material at site is effective management and supervision.

→ Materials are storing in site store or any temporary shed, it should keep in such way that no external agency affected by material.

→ The site keeper must be emphasized about the date in purchasing and use of material and maintaining the record for that.

## Location of Equipment-

→ The location of equipment is always inside the construction site and a plant nearer to site. so that the supply of equipment into the site takes few minutes.

→ Some equipments are store where labour stayed inside campus and they are brought their equipment while coming to work place.

→ Many equipments are store in a store room and many are in temporary shed.

→ Heavy machineries are kept inside the work place as per required time.

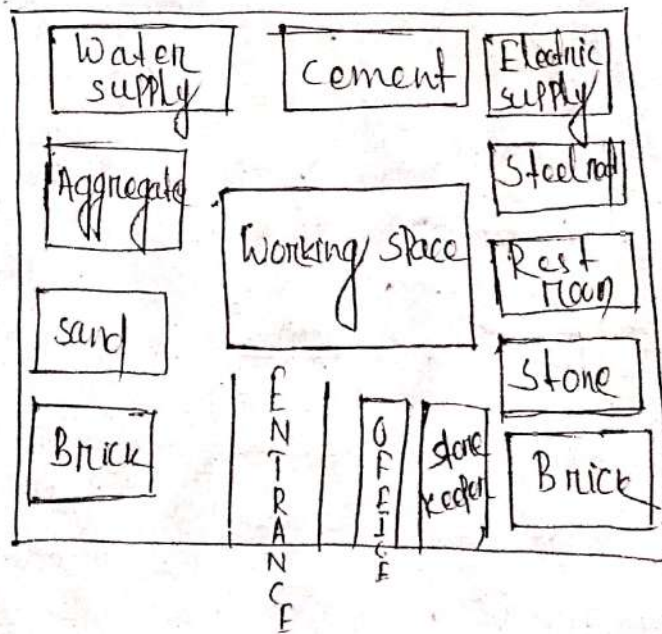
## Organising of Labour-

→ Labour are the real hand of construction ~~work~~ <sup>site</sup> so that we should taken care of them.

→ Take them to the site from there home to the working place in a rent ~~the~~ vehicle.

- Make temporary house inside the site for there accomodation.
- For them safety management is there and some time training arrangement is there.
- After all these arrangement a site manager can be easily organised the labour at the ~~site~~ site.

### Layout of a construction site-





## -: Construction Organisation :- (Chapter-5)

- The construction organisation may be defined as the process of
- Identifying and grouping of the work to be performed.
- Defining and delegating responsibilities and authorities.
- Establishing relationship for the enabling people to work most effectively together in accomplishing objective.

### Characteristics of construction organisation-

- construction comprise organisational structure refers to the both the arrangement of job rule and the reporting and the operation relationship bet<sup>n</sup> and within these rules.
- A variety of rules and responsibilities within these rules.
- A variety of rules and responsibilities including marketing, purchasing, human resources, finance, pre-construction task, and construction operation.
- Most corporate structure organised according to the department function or areas of responsibility.
- It is the pattern of wage is when a large no. of people engaged in a company of task relate themselves in each other in systematic establishment.

## Importance of construction Organisation-

→ Some construction organisation can contribute greatly to the continuity and success of the enterprise.

(i) Facilitated Administration.

(ii) Facilitated growth and diversification.

(iii) Stimulates Creativity.

(iv) optimum use of resources.

### (i) Facilitated Administration-

→ A properly design and balanced organisation facilitates both management and operation of the construction company. In adequate organisation may not only discouraged also actually produce effective administration.

### (ii) Facilitated growth and diversification -

→ The said organisation permits and allabrooks the new theme always.

→ The organisation structure can be profoundly affect the people of the construction company in proper organisation. facilitates the effect use of manpower.

(ii) Stimulates creativity

Sound organisation stimulates independent creative ~~sound organisations~~ thinking and incentive providing, well defined area of work with broad latitude with the development of new and improve way of doing work

(iv) Optimum use of resources

→ The sound organisation structure permits optimum use of technical and human resources.

→ The organisation can introduce latest technological improvement i.e. computers, computerised equipments it also make optimum use of human efforts through specification by placing right portion to right place/position.

Types of organization-

There are three types of organisation types are.

- (i) Line organisation
- (ii) Line and staff organisation
- (iii) Functional organisation.

The types of organisation depends upon its size, nature of its business activity and complexity of problem faced by it.

## (i) Line Organisation -

- It is ~~the~~ one of the simplest form of organisation and is commonly adopted in civil engineering projects its significant feature is a clear line of responsibilities and authorities right through the management structure.
- A direct relationship of authority and responsibility is established between the superior and the subordinates.

### Merits

- It is simple and easy to understand.
- It permits quick decision.
- In the type of organisation his individual responsible to a single person there is no scope of shifting on responsibility.
- It promotes discipline among the employe.

### Demerits

- The department heads are overburdened as all decisions have to be taken by them.
- Due to this personnel are unable to innovate. The concentration of authority may lead to certain undesirable practices such as partrachies or terrorism.

## (ii) Line and staff organisation -

- Line organisation are unsuitable for large and complex project the individuals to constitute the staff in a organisation are experts who have no line authority and whose function is largely advisory.
- This type of organisation comes to into existence because line authority cannot assume direct responsibilities for all functions such as research, design, planning, scheduling etc.
- All these activities are performed by staff while the line authority maintain discipline and satisfy in an organisation.

### Merits -

- Functional expertise and experiences are available from staff personnel.
- It is based on Plans specification.
- It provides more job opportunity.
- Quality of Product better.

### Demerits -

- The staff may be ineffective due to lack of authority to enforce their decision.
- The line members may sometimes resent the view point of the staff member and vice versa. This may lead to friction and mis understanding Line and staff personal

### (iii) Functional Organisation -

→ The basic of the functional organisation is the Specialization. In such organisation work is carried out on a functional basis and each function is carried out by specialist.

→ All similar and related works are grouped together under one person.

#### Merits

→ Division of labour is done on the basis of functional specialization.

→ Manual work is separated from mental work.

→ Quality of work is enhanced due to specialisation.

#### Demerits

→ Each person has to report a number of superiors which creates indiscipline.

→ This type of organisation is at variance with the principle of unit of command.

→ Co-ordination is difficult.

## Principle of organisation -

- (i) Relationship between basic concept and organisation.
- (ii) Responsibility and authority.
- (iii) Team control.
- (iv) Job and task.

→ A Principle of general rule or truth that may be expected to apply under similar condition only where.

→ Organizing being universal problem for all business concern may principle have been designed as guide lines in considering the organisation needs of a concern and for successful organisation relationship.

→ This Principle of organisation accessed in arriving at the final structure of an industrial organisation to carryout basic objective of the basic organisation.

### (i) Relationship between basic concept and organisation

After the objective is determined the work to be pre-bound the types of work decide the selection of personnel and physical facilities.

## (ii) Responsibility and authority-

Responsibility means account ability. It may be considered as the obligation of a sub-ordinates to his boss to do a work given to him.

- Since the top man in the organisation cannot do each and every thing himself along a definite chain of responsibility and authority is provided from top executive to each employe.
- Authority empowers the superior to make a sub-ordinate to do the work, every body in the organisation from top level to down words. Posses some authority to secure co-operation from sub-ordinate.
- Authority and responsibility must go together if the goals of the organisation are to be achieved efficiently and effectively.

## (iii) Team control-

- It refers to the no. of sub-ordinate that report to an educative can supervise directly.
- The educative has limited time available for his activity.
- Depending upon the condition of the construction company the team control may be any no. of varying 2 to 20



→ If the construction team is small and educative man tends to over supervisees and may do over spoon feeding to his sub-ordinate on the other hand.

#### (iv) Job and Task -

Whenever an employee is made responsible to accomplish a particular task he must be given due to the authority to control and direct effort towards completing the task.

→ When an employee is authorised to take up a job is held responsible for its performance also.

#### Leadership

Leadership is the quality of behavior of the managers by which the leaders to inspired their sub-ordinates creating trust and confidence in them for which get maximum co-operation and support.

#### Necessity, styles and role of leadership -

→ The sub-ordinates gets maximum co-operation and trust from them and abstract quality of manager to induce his workers to do whatever they are directed to do with zeal and confidence.

→ The concept of leadership lies on the creation of followers it is the followers who make the manager a leader.

→ A manager may get sub-ordinate because he has authority and he may not get followor unless he makes the people willing to follow him, only willing followers can and will make him a leader.

→ The importance of leadership function in a modern management can be very well understood by reviewing the various functions which are generally performed by manager as a leader.

### Duties of Leadership

- He formulates objectives for his group.
- He gives orders and instructions to do work.
- He maintains disciplines in the organisation.
- He maintains communication in the organisation.
- He listen to the sub-ordinate and responds to their needs.
- He maintain unity and ~~character~~ cohesiveness in the organisation.
- He inspired and motivates the various member in his group.

## Human Relation -

It refers to the researchers of organisational development who study the behaviour of the people in groups in particular work place group and other related concept in fields such as constructional, industrial and organisational (Psychological) (Subordinate, Peers, Superior)

### Relation with sub-ordinates -

Be a good sub-ordinates only other you can enhanced the credit of your bosses. A good sub-ordinates is one in whom the boss of family can maintain.

### Relation with superior

Be a good superior, only then, you will be respected for what you do, by appreciated as a team leader. A good superior takes a team to a new height and then by take the organisation at the family into achieved targets which are very difficult.

### Relation with Peer

Be a good Peers only they you will be in a position to build up long term relationship for coming days. A Peer is one who values opinion of another Peer helps him out when other one needs and be a good pal who is interested in other person growth.

## Characteristics of good behaviour -

- Learn continuously: on daily based they alot time in order to become familiarised with new aspects.
- Listen intently: They know what questions to ask and understand how to apply those lessons to their excessy day life.
- Have the ability: To see things from others people prospective.
- see the big picture and can effectively delegate work that can be done by others.
- Leaders learn from every experiences.
- Effectively deal with the disapproval.
- Focus on continuously improving their sub-ordinates.

## Mob Psychology (or) crowd Psychology -

→ It is the broad study of how individual behaviours is impacted when large group together.

→ It is the branch of social psychology -

( Grievance → complaint  
Bias - directed )

and these Psychologist have developed several the ones and interact with that of the individuals with in it.

## \* Handling of Grievance-

### → Grievance:

A grievance or complaint can be a real or imagined feeling of dissatisfaction that an employ experiences the course of their job.

### → How to handle / Manages:

→ Quick action: As soon as the grievance arises it should be identified and resolved.

→ Acknowledging Grievance: The manager should eager and to look into the complaint impartially and without any bias.

### → Gathering facts:

The manager should gather appropriate sufficient facts on planning the grievance nature.

→ Examining the causes of grievance: means the actual cause should be identified.

→ Deciding: After identifying the causes alternative course of action should be taken by the manager.

### Absenteeism-

→ It is defined as, patterns of missing work in which an employ is habitually frequently absent from work.

→ Possible causes of absenteeism includes job dissatisfaction, on-going personal issues and ~~some~~ chronic medical problems.

→ Regardless of course worker with a pattern of being absent may put his reputation and his employed status at risk.

### Labour welfare

→ To look after welfare of labour in any organisation the labour welfare officers are appointed by government and they perform the following activities.

- ① Financial general grievances of workers.
- ② observing service conditions.
- ③ Hearing general grievances for workers.
- ④ Protection of seniority.
- ⑤ Provision of provident fund and insurance.
- ⑥ Regular payment of salary on specified date.
- ⑦ Supervising labour relations with employees.

Following facilities are provided to the labour which are associated with the welfare of labour.

- Accommodation requirement.
- canteen facility.
- Drinking water arrangement.
- Welfare - cooperative store facility.
- Direction facility.
- Existence of proper lighting and ventilations.
- Medical facility.
- Parking facility for vehicles of workers.
- safety of workers.
- sanitary arrangement.
- Training of workers.
- Transportation arrangement.

### Conflicts in organisation

The problems which arise with the construction projects and giving the impression problems includes increase in project cost, project delay, reduce productivity, loss of profit or damage in business relationship.

- \* Conflicts in organisation are 3-types.
- Intra personal conflicts.
  - Inter personal conflicts.
  - Inter group conflicts.

### Intra Personal conflicts -

In the conflicts there is one person is responsible for the creation of problems which may be the behavioural conflict such as in adequate thinking, bad way of communication co-operative less etc. which are related to a leader of a group or organisation.

### Inter personal conflicts

In this conflicts there are conflicts between 2 or more than 2 people here the conflicts creation related to technical problem and also ideas, creation etc.

### Inter group conflicts

In this conflicts there 2 or more groups are related to each other. Here one group is created dispute with another group and also other groups.

### Genesis of conflicts -

- Delay of payment for completed work.
- changing requirements.
- Losses of communication between various parties.
- Problems with neighbour.
- In adequate contractor management supervision and coordination.
- In adequate CPM scheduling and update requirement.



- Destructive conflicts developed as a result of limited resources like not enough time, money, labour, material or equipments.
- causes of conflicts may be behavioural problems, ~~contractual~~ contractual problems and technical problems.

### Resolving Conflicts

- (i) Agree on a mutually acceptable time and place to discuss the conflict.
- (ii) State the problem as you see it and least your concept.
- (iii) Let the other problem have his or her say.
- (iv) Listen and ask questions.
- (v) Stick to one conflict at a time.
- (vi) Request behaviour changes only.
- (vii) Agree to the best way to resolve the conflicts and to a timetable for implementing it.
- (viii) If the discussion breaks down, reschedule, another time to ~~meet~~ meet, considered bringing in a third party.

# Construction Labour & Labour Management:-

Labour:- Labour is a human effort or service which are directed towards Production or Construction.

## Preparing Labour Schedule:-

The aim of the scheduled is to decide the numbers of skilled and unskilled labour required for the execution of different operation on different dates it is the manpower requirement of the project in a tabular form for various stages.

## The Labour Scheduled serves the following Purposes:-

- > It provides the site encharge with example warning of his future labour requirement.
- > By noting the actual work face regularly on the chart, a direct margin of labour expenditure on site can be obtained.
- > If a manpower shortage is likely in a particular section of the project, then immediate fill the position or replace a new manpower.
- > It helps in efficient and optimum disemployment of the labour force in various section of the project.

## Essential Steps for optimum labour out put:-

### Labour Productivity:-

- > Implement a vacancy control committee that receives and approves all the positions, re placement or new.
- > Build a flexible work force attracting higher quality parttime workers through competitive offering
- > Providing sufficient facilities for him or her and also family
- > Payment system should update as per time & money.

## Characteristics:-

- > Labour is original and indispensable factor of construction.
- > He is an active factor of construction.
- > Labour cannot be separated from the labourer.
- > Labour supply is inelastic.
- > Labour has weak bargaining power.
- > Efficiency of labourers differs due to their ability.

## \* Wage & their Payments:-

- > Wages may be defined a payment for the uses of labour.
- > Wages include both money and non money payments.
- > Non-money payments may also be called fringe benefit.
- > The payment of wages on the basis of a year, a month, a week, a day, an hour is probably the most common method.
- > In all society taking from the most primitive people have been selling their services for wages.
- > Wage labour existed from ancient, through the mid age and till the time the construction company developed and gave birth to the modern wage system.

## Labour Incentives:-

- > Incentive is an inducement (attract) and reward which is given to a worker for his efficiency and hard work.
- > Incentive motivates and encourages a workers to produce more & better.
- > Incentives are in-addition to the job hourly rate and are in proportion to the workers contributions towards production.
- > Incentives may be classified as direct, indirect, financial, non-financial, semi-financial etc.
- > Direct incentives are paid to an individual worker for his own contribution where as indirect incentives are paid to a group of workers.
- > Financial incentives involves direct monetary payment or benefit where as non-financial incentives includes good working condition amenities and social benefits in the organisation.
- > Example for financial incentives -> Bonus, Profit share.
- > Example for non-financial -> Job satisfaction, better and healthy working condition and surrounding chances of promotion.

-> Example for Semi-financial Incentives -> It includes Provision on subsidies recreation and medical facilities to the workers and subeclies educational facility for their children.

-> Pension and other benefits

Wage: (mode & method of wages & Payments): -

- a. Nominal wages
- b. Real wages.

A. Nominal wages: -

The remuneration paid to the workers in form of money is known as nominal wages.

-> It doesnot include the value of any benefit that may be provided.

B. Real wages: -

Real wages includes the value of other benefits such as leaves medical care, house rent, allowance, bonus etc. In addition to nominal wages.

Payments: -

method of Payments: -

- a. Time rate system
- b. Piece rate system.

A. Time Rate System: -

In this system a suitable rate of payment is fixed at per unit of time directed by labourers. The unit of time can be hours, days, weeks months usually the rate of payment for casual labour is fixed per day and for regular employed per month.

Advantages: -

It is simple and easy to understand by labour. as the payment to all workers of the same category is fixed at the same rate  
-> This method specially is useful in situations where the measurement of output is not feasible

Disadvantages: -

As well workers of the same category are paid at some rate there is no incentive for higher output at honest workers  
-> As the workers are assured of their wages irrespective of output there output is low.

## B. Price Rate System:-

In this system the payment to the workers is made on the basis of his out put.

- > The work done by each labour is measured and payment made at the agreed rate.
- > The rate of each item of work is fixed on the basis of past record of out put.

### Advantage:-

- > workers with higher out put get higher wages.
- > Due to greater efforts of workers overall production is increased.
- > Less supervision is required.
- > Effective cost control can be ensured.

### Disadvantage:-

- > There are no guaranteed wages for labour.
- > Workers are over strained in an effort to get more money for increased out put.
- > This system is suitable for works which can be measured.

### Motivation:-

It is a reason for acting or behaving in a particular way or a set of facts and argument used in support of a proposal.

### Types of motives:-

- A. Intrinsic motivation
- B. Extrinsic motivation

#### A. Intrinsic Motivation:-

It means that the individual has the desire to perform a specific task.

- Examples:-
- > Our deep rooted desires have the highest motivation power. ~~examples~~ acceptance, curiosity, honour, independence, order, power, social contact, social status.

#### B. Extrinsic motivation:-

It means our desire to perform a task are controlled by an outside source.

- > It is external in nature.

#### Examples:-

- > Employ of the month award.
- > Benefit Packages.
- > Bonus.
- > Organised activities.

## Different Approaches to motivation:-

### i. Traditional approach:-

Related to Incentives Pay System

### ii. Human relation approach:-

- Related to strong social needs.
- Needs are more important than money.

### iii. Human resources approach:-

Related to contribution of people

### iv. Behavioural approach:-

- Awards are consequence of behaviour.
- Incentive encourages and discourages.

## Labour Law:-

- (1) There are always some conflicts bet<sup>n</sup> employ and employers
- (2) During last 50 years with the increase in cost of learning the employ, employer, conflicts also increased, there by a result is struck out ultimately the govt. which initially was a silent observer of some rules and regulation on some laws to minimise the conflicts and the disputes between employ and employer.

### Types of Labour Law:-

1. Related to factory Act 1948
2. Related to wages Payments.
3. Related to Union / worker's Association
4. Related to insurance.

### 1. Related to factory act 1948:-

The factory regulate condition of work (health, safety etc), the interest of worker and it is for the welfare of factory works. This act receive from the governer general of India on September 23<sup>rd</sup> 1948. This act is applicable in many factory in which 10 or more then 10 workers are working.

### 2. Related to wages Payments:-

- It includes all remuneration (Salary + allowances) Pay able to an employ with respect to his employment.
- wages also includes over time remuneration such as bonus, Pension, Provident fund, contribution by the employer

### 3. Related to Unions/worker's Associations:-

- > A continuous associations organized for the purpose of maintaining and improving the condition of their working life.
- > There are more than 17 thousand registered trade union in which the membership union of the order of around 575 to 600

### 4. Related to Insurance:-

- > The employ state the insurance act was start because the workman compensation act of 1924 would not support as much as we need.
- > It would benefit the industrial workers.

### Morale:-

- > It is the degree of enthusiasm and willingness with which he works for the organisation is known as morale.
- > Though every worker is basically human being the morale of workers vary it may be high or it may be low.

### Determination of morale:-

- > Confidence of individual member in the purpose of the group
- > Confidence of the individual member in their colleagues.
- > Organisational efficiency
- > confidence of different members of the group in the leadership & the ability of leader
- > Condition in the ground and working conditions.

### Measurement of morale:-

- > Behaviour of individual and work groups
- > changes in turn over rate.
- > effects on productivity of employees.
- > Remarks by workers.
- > Regularity in attendance
- > The special measure for morale of an organisation are interview and opinion survey.

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## Equipment Management:-

The equipment management at the const<sup>n</sup> site on which there are various types of equipments & heavy machinery used for different works.

These machinery may have construction company or hiring from others.

The machinery have not be idea, the site engineer must supervise the machinery whether it's work or not.

The site engineer must engaged on the machinery in site to perform some work it may be small or large it called equipment management.

### Preparing for equipment management schedule:-

→ When machinery entry in to the site engineer register the machine or equipment number or utility of machine or equipment in types of work.

→ The site engineer list the machinery equipment used in site and gives emphasis on it whether the machine working or not.

→ The site engineer analysis the chart if the shortage of machinery then the engineer higher the mechanic & if machinery are many but work become less than it report to the higher authority.

### Identification of different equipment:-

→ In construct<sup>n</sup> site there are some alternative of main machinaries (crane, excavator, lifting machinaries crane etc) because if the machinaries breakdown.

→ The work will be stop for the machine alternative equipments must be present in the construction.

### Importance of Owning & Operating cost in making decision for hiring & Purchase of equipment:-

→ The higher authority request for quotation including all terms



and conditions to the owner & analysis the quotation after given by owners.

- > If the quotation to be economical for constructions organisation then the work is given to that owner.
- > After the works order, owner to be asked to entry machine & equipments in the construction sites.
- > The dealers to be asked for service provided for newly purchasing machinery & equipments.

### Inspection & testing for equipments:-

- > Before entry into construction site the machine and equipments are checked for details such as types of engine specification machine working properly or not etc.
- > To check the licence of vehicle licence of operator & licence of official operator.
- > If the machine should be hire for day night works, for the operator must be minimum in two in nos.
- > Safety materials should be provided to the operator before entry into the const<sup>n</sup> site.

### Maintenance of equipments & minor repairs:-

- > The maintenance of the machine part are find out & then a schedule is prepare for the maintenance & corrective action.
- > The maintenance should be done in each and every machine.
- > According to schedule maintenance are done on every day, every week, every month, on every six month & after one year.
- > Problems of the machiness are find out by operator with in it required maintenance or prepare of that machine the operator should inform to the site engineer (mechanical/electrical)
- > A form will be filled of by the project manager sign with operator for outgoing of machine for maintenance & repairs.

## Initial Cost:-

It is the capital investment required to own the equipment. It includes purchase cost, sales tax, transportation cost etc.

## Interest Cost:-

It is the annual cost of interest charged on the borrowed money or capital investment.

## Taxes:-

It represents the property taxes to be paid to the state or local govt.

## Insurances:-

It is the cost of keeping the equipment in the const<sup>n</sup> site when it is not operating on the work site.

- > Levels of quality in finished product
- > Levels of performance of specific quality.
- > Cost of inspection and testing.

## 2. Object for Conformance:-

- > To reduce the loss due to defect
- > To improve the quality of product going to consumer.
- > Improving quality maintenance.
- > Reducing the cost of inspection.

## Quality Standard:-

- (a) During construction
- (b) After construction

## A. During construction:-

- The plan should be repaired as per their budget.
- > According to the fund the contractor try to give the best quality of the material.
  - > The contractor also bargain or fix the price or rate of workmanship and also materials.

-> If any small changes required during const<sup>n</sup> he can modified the structure with the consult of engineer.

-> Contractors have an arrangement Paper in which all available & with help of this arrangement he can fulfill the requirements.

After Construction:-

The inspection committees have been Prepared.

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# Quality Control :-

- The term quality conveys there is something good and desirable on Product or Service.
- quality conveys the impression what consumers expect from Product or Service.
- It is the fitness for purpose of the lowest cost and quality of the Product is regarded as the degree to which it fulfill the requirement of consumer.

## Control of Quality :-

It is a series of related activities carried out in various department in an organisation to establish the fitness for use.

## Concept of quality Control (management) :-

The quality control is an effective system for integrating the quality department, quality maintenance and quality improvement efforts to various groups in an organisation so as to enable Product and service at the most economical level intending customer satisfaction.

## Objectives of quality Control :-

1. objective for holding status
2. objective for conformance

## 1. Objective for holding status :-

- Defect level identification.
- Yield and defect level of various Process.
- Levels of quality in finished Product.
- Levels of Performance of specific quality.
- cost of inspection and testing.

## 2. Object for Confirmation:-

- > To reduce the losses due to defect
- > To improve the quality of product going to consumer.
- > Improving quality maintenance.
- > Reducing the cost of inspection.

## Quality Standard:-

a. During construction.

b. After construction.

### A. During Construction:-

- > The plan should be repaired as per their budget.
- > According to the fund the contractor try to give the best quality of the materials.
- > The contractor also bargain on fix the price or rate of workmanship and also materials.
- > If any small changes required during construction, he can modified the structure with the consult of engineer
- > Contractors have an arrangement paper in which all specifications quality, rate are available and with help of this agreement he can fulfil the requirement.

### B. After Construction:-

The inspection committee have been prepared and the test should be done check the quality standard.

- > They check all materials used in construction structure are fitted as per agreement or not.
- > If any changeable material found which is beyond the arrangement then it can be replaced.
- > If any modification required then also done.

## Method of quality Control:-

1. Destructive
2. Non-Destructive

## 1. Destructive :-

These methods or test, are done to verify properties of a material determine the viability of well helps due to reduce the failure, accident cost and ensure compliance with regulation

→ Example of destructive method are mechanical test, tensile, bend impact, hardness testing, macro and micro testing, metal analysis, metallographic examination

→ With the help of universal, testing machine we can test the tensile bend, hardness and beam test of a sample

## 2. Non-destructive method :-

Non destructive test show if cracks, corrosion or other fault exists.

→ The example are visual testing, radiographic testing, ultrasonic pulse velocity method, physical test of buildings and building construction physical testing of soil, Penetank test.

### i. Radiographic testing :-

Radiographic enables the inspection of internal structure of a test object through the use of penetrating radiations, which may be electric magnetic (X-ray,  $\gamma$ -ray etc) (gamma)

→ The quantity of radiation passing through, the object is major and used to deduced the structure of the test object.

→ The field inspection, gamma( $\gamma$ ) ray is most commonly used

### ii. Ultrasonic Pulse Velocity Method :-

The basic assumption in ultrasonic testing of concrete to the structure is that concrete is in elastic material transmit longitudinal compression and shear waves.

→ The velocity with which these waves travel through the body of concrete is dependent on its elastic modulus which is controlled by the properties of concrete.

→ These Properties of concrete are in turn related to strength of concrete

→ The apparatus use of in this method generate a pulse the computer body by the application of a mechanical impulse

→ There are 3 basic way by which this pulse can be transmitted and recorded through transducers.

→ The first is the direct transmission, which is the most satisfactory method. here the transmitter and receiver are placed on the opposite side.

→ The second method is semi-direct transmission which is not show satisfactory as compare to the previous one

→ The third method is indirect transmission which is least satisfactory of all. It is suitable for water retaining structure.

# Monitoring Progress

## Def<sup>n</sup>:-

It is a pattern recognition technique It involves comparing the actual progress data, comparing them against the reliable planned progress data of evaluated the overall project progress at specified of cost off dates.

## \* Progress & Programme:-

### Progress:-

Progress describes the sequence in which task must be carried out so that a project can be completed on time.

### Programme:-

It is one type of schedule in which the every day work with progress is mentioned.

### Programmes will after identified:-

- > Dates and durations allocated to tasks.
- > Task which can only be carried other task have been completed
- > The need for specific resources such as plant, services or materials and their lead time.
- > A design programme scheduling task from appointment of the consultant to the reappointment of contractor.

## Construction Progress of work:-

The summary of the progress made in each area of the project.

- > The analysis of progress against the programme
- > Progress photo



→ An assessment of any quality issue.

→ Weather record.

→ An assessment of any design issue or any other issue

→ Any instruction required from the claimed.

### Work Study: - (2 mark)

Work Study is a generic term for their techniques method study and work measurement which are used in the examination of human work in all its extent and which lead systematically to the investigation of all the factors which affect the efficiency and economy of the situation being receive of in order to effect improvement

### Method Study: - (2 mark)

Method study enables the industrial engineer to subject his operations to systematic analysis

→ The main purpose of method study is to eliminate the unnecessary operation and to achieve the best method of performing the operation.

### Motion Study: -

Motion study is the part of method study when an analysis of the motion of the operator or work will be studied by following method:

- i) Use of the human resources.
- ii) Arrangement of work place
- iii) Design of tools and equipments (materials)

### Work Measurement: - (Or) Time Study:-

The work measurement human as time study it is absolutely essential both the measurement data

→ we cannot determine the capacity of the facility of work progress. It is not possible to achieve delivery dates and costs and also labour utilisation and efficiency.

→ Time study has been defined by British Standard Institution as the application of technique design to establish the time for the qualified worker to carrying out a specified job at defined level of performance.

# Safety Management In construction site (chapter 1)

The construction is the one of the most dangerous sector. so, the management is made. Some rules which can go along way to help. Prevent accidents and occupation hazardous is known as safety management.

## Importance of safety

- Everybody in the construction industry must remember that precaution is always greater cure.
- Accident don't happen their caused and most of accident can be prevented.
- In order to avoid accident, the safety is very important in construction site.
- Every body in construction site work should be in proper safety.
- Accident can be reduce to certain extent by choice of technology, education and training.

## Cause and Effect of Accident

It is defined as any occurrence that interferes with the orderly progress of activity.

### Causes -

- Accident due to heavy masonry.
- Unsafe Physical condition
- Personal factor
- Unsafe act.
- Human causes
- Electrical

### Accident due to heavy masonry

These accidents occur from crane, tower, excavator, drilling, rig etc.

### Unsafe Physical condition -

It includes ~~in~~ improper guarding, improper ventilation, unsafe clothing.

### Personal factor-

Sometimes accident occur due to some Personal factor due to lack of knowledge. Physical weakness, tamperature, awareness of work.

### Unsafe act -

- It is violence commonly accepted some Procedure.
- These include working at unsafe speed.
- Loading machine beyond capacity
- Not using safety device or safety clothes.
- Adopting unsafe Procedure.

### Human causes -

These include age experience, health, training and attitude.

### Electrical causes

Not providing people Protection devices  
not obeying proper instruction and  
also not providing safety precaution.

- Failure to use insulated Piers, screw devices and rubber gloves etc.

## Safety measure In works -

→ There are various work side like excavation, scaffolding, formwork, fabrication, erection, demolition etc. in which safety measures are highly necessary.

### For Excavation

→ When we do the excavation work we have to fix a sign board from some distance from sight.

→ The soil which comes out from the digging place we put them at some feet or meter to cover the work ~~site~~ site.

### Preventive measure -

- Helment.
- Hand gloves.
- steel or rubber shoes.
- safety jacket.

### For Scaffolding

Before doing the scaffolding work the worker should fix the supporting structure which is increasing manner or in zigzag manner to hold him. A ~~rope~~ or belt should take with him to the work site holding.

## Framework

In form work ~~work~~ site nobody allow to go nearer to the structure in which the work is going on and some brass covers are provided to cover the place.

## Fabrication

The fabrication or manufacturing work take more safety measures. In cement manufacturing plant.

The worker should cover their eye and nose. In the manufacturing the blasting time chose the night time.

## Erection

In erection work some safety measures are required like safety glasses for cover the eyes, and to take preventive measure not to face breathing problem and a helmet which having touch and steel shoes.

## Development of safety consciousness -

→ We all know that the safety consciousness is the most potent factor in the prevention of accident. It may be defined as awareness of hazard and alertness of danger.

→ We need to develop safety consciousness and make safety a value. Most employees can be treated to someone's take of safety consciousness.

→ If an employ takes chances works in onset practice and improper use of improper tools or levels on a open hall or unguarded, the employ is not in safety consciousness.

By observing following step we can develop the safety consciousness -

→ To know the job and we thoroughly family are in the work plane.

→ Make revise and utilise the job safety analysis for task to be done.

→ Perform our own task in such a way that will not create of leave on hazards. which may cause accident. informing other employings.



- Take an active part in safety meeting.
- Report all hazards, unsafe practices and accident, current all hazards we absorb.
- Accept responsibility for using safety, protective equipment on the job.
- Teach coworkers and others about accident prevention.

### Imp. Safety Legislation -

There are 2 types of act includes the safety legislation.

- ① Workmen's compensation act
- ② Contract labour act.

It is an act which takes place a duty on all employers to ensure that the health safety and well being at work for their employees.

#### ① Workmen's compensation act -

In 1923, in this act provision for payment of compensation to workmen and their dependance in case of injury

→ This act includes some mandatory points, notice of accident, medical examination statement of fatal accident, amount of compensation.

→ Amount of compensation payable to a workmen's depends on the nature of injury cause by accident.

### ② Contract Labour Act

→ In case of death resulting from injury the amount of compensation shall be equal to 50% of the monthly wages deceased this is workmen multiplied by the relevant factor or an amount of rupees 50000 which ever is more.

### ② Contract Labour Act-

→ In the act 1970 it was started to regulate the employment of the contract labour in certain establishment and to introduce better condition of work.

→ contract labour differs from direct labour in terms of employment relationship with the establishment method of wages or payment.

→ The contract workmen are hired, supervise and remunerated by contractor.

→ In this act applied to principal employer of the establishment and the contractor where in 20 or more workmen are employed even for one day during preceding one month as contract labour.

### Duty for Principal Employer -

→ Registration for the establishment.

→ Display of following notices such as rate of wages, <sup>hours</sup> ~~aware~~ of work, wedge period, date and payment, wages, date of unpaid wages and name and address of the inspector having jurisdiction.

→ As per maintenance and preservation of register of contractor.

- Filing of return of commencement and completion of the contract.
- Filing of annual return.
- Ensure provision that facilities of washing, drinking water, unimal latrins are provided by the contractor.

### Duty of contractor

- Licencing.
- Renewal of licencing.
- Maintenance and Preservation of register of wedges, register of deduction of damage or loss, register advance register of over time.
- Display of notices which are same as Principal employer.
- Provide the facility as Per Provision ensure by the Principal employer: Employment guard. Service certificate.