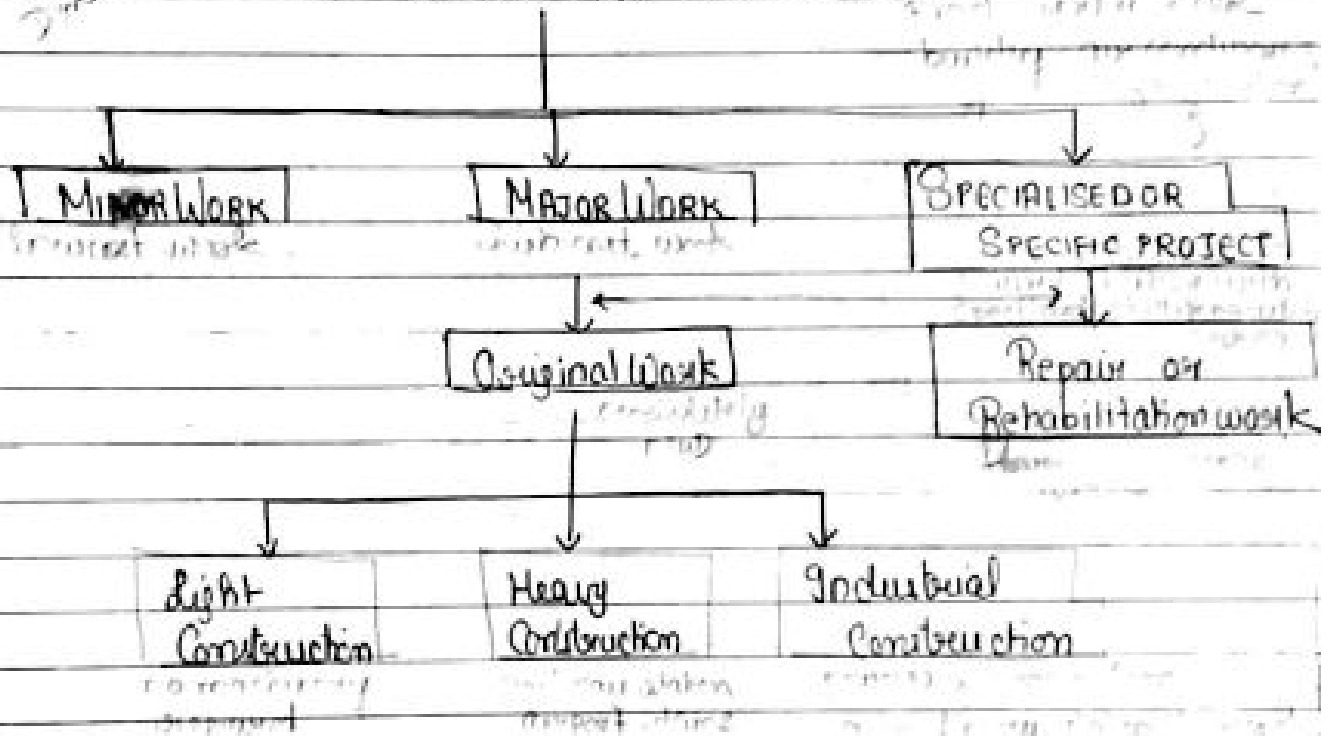


UNIT I:-

(A) Construction Classification:



(B) Types of Construction.

- Residential - Housing
 - Commercial - Shops
 - Heavy
 - Civil
 - Mech.
 - Industrial (Civil, Mech, Elec)] Factories, Petroleum
 - Environmental (Waste Management, Petroleum)
- Dam
Airport
Harbour

underpinning -
underpinning -

Specialized

Demolition -
Shifting of old
structures and etc.

explosive
implosive

23

Method Of Construction

(a) On the Basis of use of labour

- labour based
- labour intensive
- machine based
- combination of labour & machine

(b) Based On Employment Of Agency

- direct labour or departmental labour
- through contractor but direct supervision by client
- through contractor but design and supervision by consultant

(c) BOT (Build Operate & Transfer)

(d) Build On Site

- 1) prefabricated (cast & cured) assembly at site

- 2) Go to site and all construction at site
- 3) Mix of both

- M1

(e) Based On Type of Construction

- Strengthening of old structures → (underpinning)
- Demolition
- Shifting of old structure & base

(f) Based On Permanency

- Temporary (shoring)
- Permanent (form)
- Semi Permanent

(g) Based On Movability

- detachable
- semi detachable
- fixed

(g) Based On Location

- On land
- On land & by
- Deep water
- Space
- climatic zone

16 February
Monday

Ques What are the various materials used in formwork?

- 1) Timber
- 2) Plywood
- 3) Handboards
- 4) Fibre forms
- 5) Gypsum boards
- 6) Sheet piling
- 7) Plastic forms
- 8) Cast forms
- 9) wire mesh
- 10) inflated membrane
- 11) steel formwork

Timber: Timber is required for practically all jobs of formwork. It should be durable & reusable & sufficient strength characteristic. Timber is economical for small construction job & is flexible, easy to erect with good thermal insulation.

Plywood: It is extensively used for formwork for concrete especially for sheathing, decking and form lining. The interior type of plywood is bonded with resistant glue & exterior with water proof glue.

Handboard: This is material manufactured by using glass or other material on panels instead of form panels. It has a density of 20-30 pounds per cubic foot.

Thin forms: These are used as low forms for concrete walls, steps and slabs. They are thin like an slab or a suspended floor of the concrete as far as thickness measurement. To overcome some of the practical limitations capacity. These forms could be made of glass or wood. Manufacturing instructions are followed for use of these forms.

Gypsum board: These are made to avoid for archaic design or conventional pattern for a special concrete face. These are fragile and needs extra care. These are generally reinforced with organic fibre over steel.

Plastic forms: P.V.C and neoprene, polyethylene, polypropylene, glass fibres and various plastic forms. They are easy to clean & don't rust. Assembly and dismantling is easy. They don't deform. They are also available.

Self forms: These are the forms which are not removed after casting. They are part and parcel of structure. Precast concrete planks, precast slab panels, precast concrete joist, clay board tubes, ferrocement planks, clay tiles, blocks, ferrocement structures are combined with concrete as self form.

Delimited membrane: These are sometimes used as formwork in special cases when inflating the membrane to the required shape. It is coated

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with layers of plaster which is reinforced with steel mesh with flexibility. Casters may be done by shot casting. These kind of forms reduce construction time and thus result in low cost saving. These membrane can used in caissons in inaccessible places (used in tunnel boring).

Steel sheet piling used in fine fabricated formwork. In most steel form are fabricated when dimensional tolerances are critical or when the forms are planned to be re-used. Steel form becomes most efficient after a dozen uses or thirty or more.

- What are the requirements of good formwork?
- 1. The material should be as cheap as possible.
 - 2. It should be reusable several times.
 - 3. It should be work free.
 - 4. The structure & quantity of formwork material should be minimum.
 - 5. It should be strong enough to withstand all loads coming on it.
 - 6. It should be stiff enough so that deflection is minimum.
 - 7. It should be as flat as possible.
 - 8. The surface of the formwork should be smooth.
 - 9. It should be easy to strip.
 - 10. The joints of formwork should be tight so that lateral displacement under load is minimum.
 - 11. All joints should be free from form.
 - 12. The formwork should rest on non-yielding supports.

Q.11 What are the measures to be taken to achieve economy in formwork?

- 1) The use of irregular shapes or forms should be avoided as far as possible.
- 2) It should be fabricated into modular sizes as large as possible so as to allow reuse of the form as far as possible.
- 3) The structural component should be designed so as to permit use of commercially available forms.
- 4) The working drawings of formwork should be checked before fabrication.
- 5) The components of the form should be prefabricated in shop ground using power equipment to reduce delay and labour cost.
- 6) The removal and reuse of forms should be practised & if it is save to do so.
- 7) The forms should be designed to provide adequate strength and rigidity.
- 8) Assembly line method should be used to fabricate forms.
- 9) Double headed nails should be used in timber forms to prevent damage to timber.
- 10) Formwork should be cleaned and oiled after each use.
- 11) Use of construction joint should be made to improve the quality of form and also reuse of forms.
- 12) When mechanical vibrators are to be used, the shells should be used in place of nails and wire ties to ensure safety.

Q.12 What are the measures to be taken to achieve economy in formwork?

Formwork as per IS code 1047-1964

What is code is referred in respect of formwork?
Necessary various shipping time for different component of structure? (over 2000)

What is tolerance limit in formwork (and product - 1/2 mm)

Schedule of construction

Planning → Concrete → Cast → Feasibility

What is Scheduling?

Scheduling is a graphical representation which shows phasing of construction activities with starting and completion dates and sequential relationship among the various activities in a project so that the work can be carried out in an orderly and an effective manner to achieve most economic cost.

Explain how construction schedule are prepared

- 1) The project is divided into no. of operations.
- 2) Expenses of these operation are derived after knowing their relationship properly.
- 3) The quantum of work involve in each operation has to be calculated.
- 4) The time required for different activities are calculated based on quantity of work and rate of performance of each activity.
- 5) The total time required for completion of project is calculated.

With this chart - the client
 knows exactly what is going on

USES

- quantity of work involved in various stages of construction
- actual progress of work checks
- schedule of work can be known

What are the advantages of scheduling

- 1) By studying schedules of any project many alternatives and many alternative methods the best method can be chosen
- 2) It gives clear ideas regarding material, manpower, machine at diff stages of work
- 3) Since the start time and completion time of project is known all necessary arrangement to acquire adequate materials, manpower and water machine can be made well in advance.
- 4) Resource utilization is optimised.
- 5) Actual progress of work can be monitored easily by using schedule in respect of actual when in case of delays proper remedial measures can be taken so that program is back on track.
- 6) Inter relationship of various activities at different stages are known but can fix them according to their priority.
- 7) Total duration of completed project is known well in advance.

Classification of Scheduling

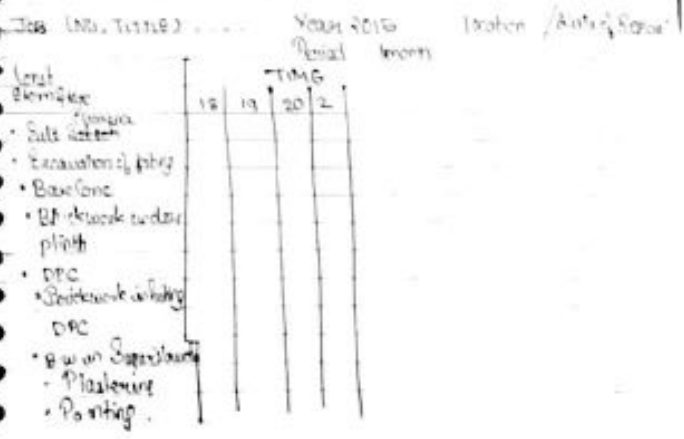


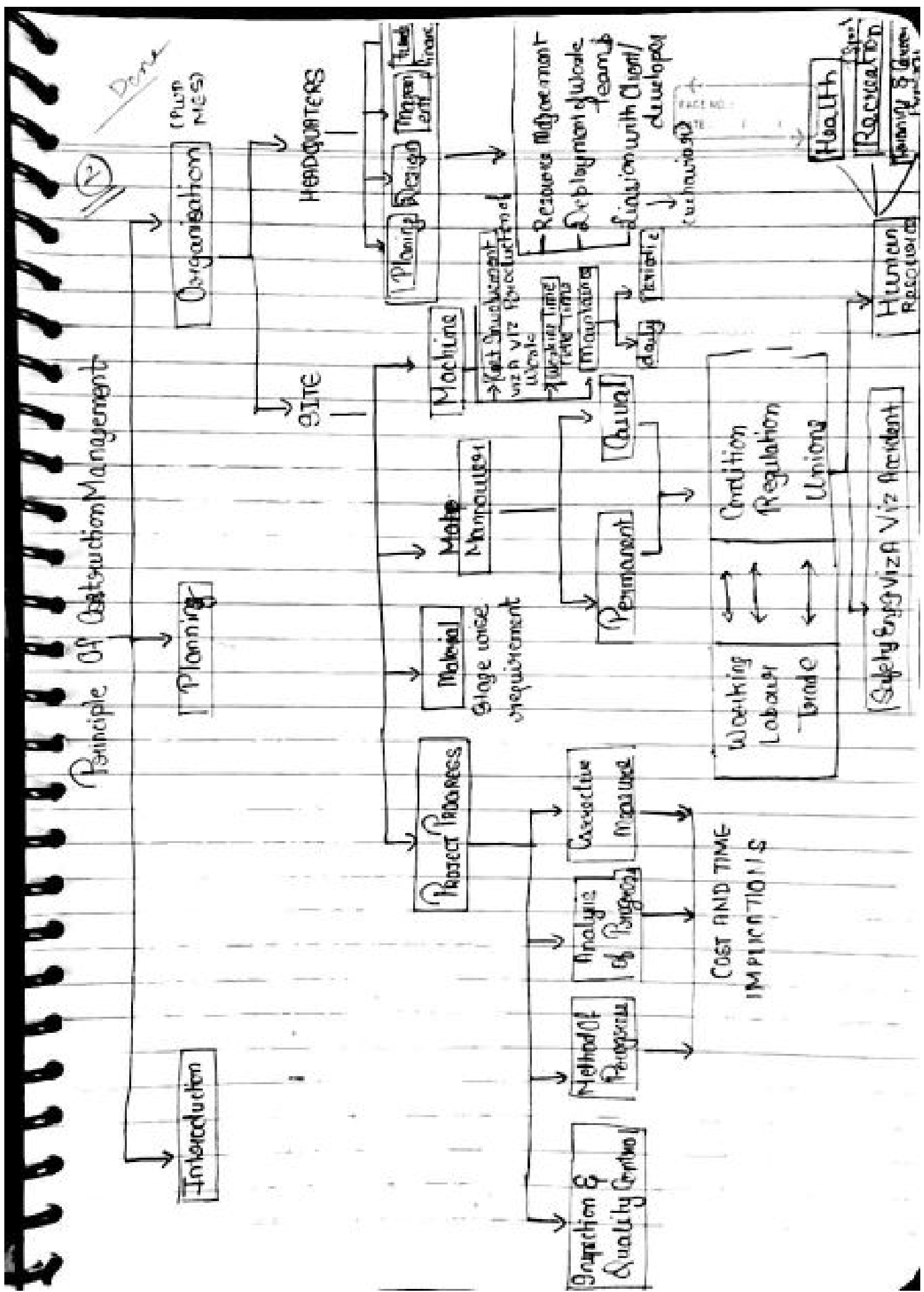
Method Of Scheduling

- 1) Bar Charts or Gantt Chart
- 2) Mile Stone Chart
- 3) Network analysis

In scheduling:
 Wednesday

Schedule of Construction





Job layout → It is a plan that shows construction work should be carried out in most economical manner to aid the smooth execution of project. Job layout is prepared by site showing all relevant features such as entry & exit points & is also necessary that flow out & in are kept in mind.

10/03/20
 Job layout
 Question: What are Job layout of Multistorry building or Draw Job layout for residential building?

23 March
 Monday

What are factors affecting job layout?

- nature of project
- construction method
- availability of resources
- Emergency & first aid facility
- contractors & supervisors offices
- accommodation & staff accommodation
- provision of access of road
- connectivity of utility

Advantage of Job layout:-
 - smoothening & working of project economy
 - reduce completion of time
 - safety on work project
 - no material wastage due to theft or deterioration
 - material transportation become easy speed & economical
 - Increased output from labour & machinery

25 February 2018
 Wednesday
 Network Analysis
 Activity: denoted by an arrow
 Event: denoted by node, generally denoted by a circle

Network logic: sequence of events
 Question: What is dummy in a network? What is its use?
 Answer: It is very similar to an activity but it does not consume any resources. It is merely a method by which interdependence of activity or event can be clearly shown. It is generally shown by dashed arrow.
 USE:-
 A dummy is an activity with zero time consume.

FUNCTIONS OF DUMMY:-
 - Dummy maintains the logic of network perfectly
 - Dummy keeps the numbering system of network unique

Network: It is a diagram showing the relation of activity and event of the project. In this diagram various items of work are shown in a sequential order. It is a convention to start first activity at the left side of the network and proceed to the right.

Constraints: There are some activity cases which the manager have no control such as weather but these activity have affect on contract of the project.

Earliest Start [ES]: This is the earliest time at which an activity can be started. It is equal to earliest finish of pre activity if there are two or more activities pre-operation then the greater value of time is to be considered.

Earliest finish time [EF]: This is the earliest time that an activity can be finish.

Float: It is the difference between time available to do the job & time required to do the job. Thus it is the time by which the activities can be delayed without delaying completion of project.

Slack: also like float but used in float.

Type of float:

Total float - This is the amount of time that an activity can be delayed without delaying the project completion.

Free float - This is the amount of time that an activity can be delayed without delaying the early start of any activity that follows it.

Critical path: It represent the series of activities for which each activity has a zero float time. It determines the maximum time required to complete the project.

Type of Network:

- AOA Network: (activity on arrow) / arrow diagrams
- AON Network: (activity on node) / precedence diagram
- EOD (Event Oriented Diagrams) Network

Rules for Drawing A Network:

1. A network must have only one initial node.
2. Initial node will have only outgoing arrows.
3. A network can have only one final node.
4. Final node will have only incoming arrows.
5. No activity can start until its tail event has occurred.
6. An event cannot occur until all the activities leading to it can be complete.
7. No event can occur twice.
8. An arrow should represent a singular instruction.
9. Individuality and separate entity of each activity must be maintained.
10. The network should be drafted such that all activities are drafted and completed by the end.
11. All constraints and interdependencies should be shown properly on the network using dummy.
12. Network logic should always be maintained.
13. Scheduling or time flow is usually shown from left to right.

What are the advantages of network techniques over conventional techniques?
The interrelationship of all activities or operations are

Clearly shown especially in a network technique
(But that doesn't hold)

- 1) When delay occurs the critical operation or activities will fall out for extra attention using techniques it is not possible on benchmark
- 2) Timing analysis identifying and identifying using network

11th March 2015
Wednesday

Comparison between CPM & PERT

CPM PERT

Activity oriented event oriented

No allowance given in activities in determination of time
3 types of time estimates are used
- optimistic time
- pessimistic time
- most likely time

critical only where time estimate could be with given resources (determine comparison)



1. Bel in the governing factor
identical to monitor the cash flow
there is the governing factor identical for both, first observation

2. Critical path gives central activities
critical activities
critical path gives the critical activities

3. activities are subjected by resources & cash on construction but emphasis on activity
same that emphasize on completed event and not on activity

4. CPM used in project of substitute nature
used in RND projects (Research & Development) also in major projects such as dam, highways, bridges

5. Specific terminology used in network
float, total float, free float, S float, free float

6. float is expected time
float or variable occurrence
float is likely time
& critical event

Advantages Of CPM:

1. If anything is wrong with planning of project CPM project can easily identify it and necessary action could be taken to identify it.
2. It assist in preparation of most economic time table for operation of project.
3. It assist in selection of best combination of equipment & labour so as to complete the project on time.
4. It determines the activities and operation which are to be control w.r.t time of completion for successful finish of the project.
5. It is an open ended process giving sufficient flexibility to the management to suit their requirement and obligation.
6. It makes the most economic use of available resources (manpower, machine, money).
7. It permit systematic overview of project at various stages & accordingly amend to make uncertainties which may be not thought.

8. It rationalises construction costing & financing.

9. It shows the activity and operations which can be reasonably delayed without having any impact on final completion of project.

10. The steady of information and data available from this method it suggests alternate scheme also.

11. The use of this method make it possible to work out the optimum project duration.

Limitation Of CPM-

1. It is expensive.
2. It needs special skills to prepare network diagram and continuously updating it.
3. If the assumption made for completion of project are not fulfill the project cannot be completed on time.

Analysis and Scheduling of Network-

What steps need to be followed in analyzing & scheduling of network?

STEP 1:- Calculate the earliest started event time and latest allowable time for each event assuming time estimates for each activity are correct.

Step 2: Determine the critical path which governs the minimum project completion time.

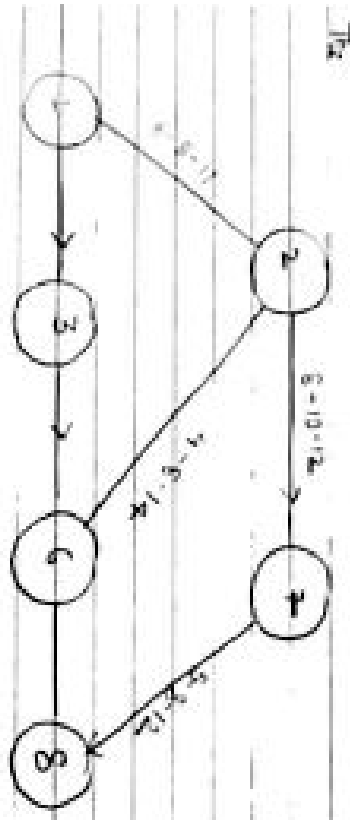
Step 3: Determine the amount of slack for each activity along the critical path.

Step 4: Prepare the activity schedule with help of above info and start date of each activity.

Step 5: Determine the possibility of diverting from non-critical activities by critical activities with regard to resource project completion time.

Step 6: This can be easily done with the help of float slack.

Step 7: Analyze the network again after considering the resources float slack and work-out saved starting and completion date of the activity.



from which on the activity is delayed in order to apply.

Step 1: Identify the activities of the project.

Step 2: Link them in sequence and/or parallel path using the activity which immediately precedes and follows each activity.

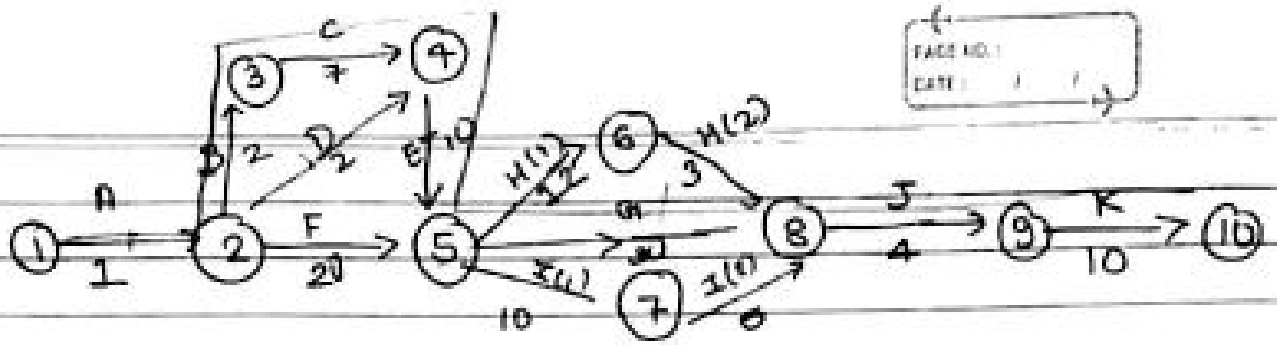
Step 3: Estimate the duration of each activity.

Step 4: Interconnect activity and events by drawing the network.

Step 5: Fix the activities in such way that no or the least of the activity.

Step 6: A chart should be prepared to list each activity with an appropriate duration, earliest start, earliest finish, latest finish and float.

Step 7: Determine critical path to determine minimum project time.

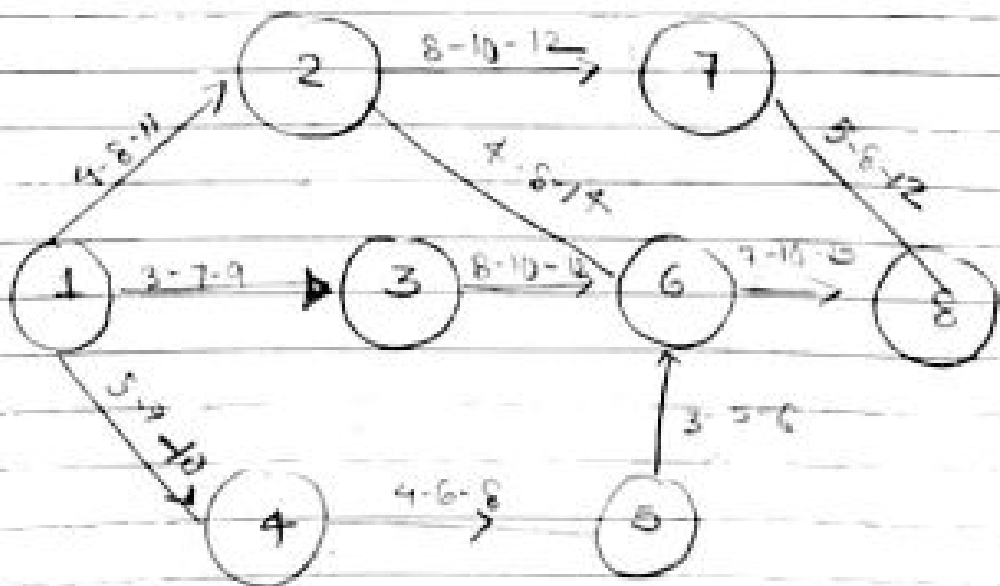


The following data is for construction of building draw a CPM network on basis of this data. calculate earliest and latest critical time and show the critical path? Pg 798, 799, 800

OR

The network shown is for construction of building with activities & their time shown in network. Activities are listed below. Calculate earliest & latest time & draw critical path?

The network for a certain job shown determine the accepted the for each of path & path which part is critical.



$$lc = \frac{t_0 + 4t_l + t_p}{6}$$

$$2^7 \times 10 \left[\frac{1}{100} \right]$$

Path A 1-3-6-8

Path B 1-2-7-8

Path C 1-2-6-8

Path D 1-4-5-6-8

Optimist Mortality Remember

1) 28 (2+2+2+2) 27 38

2) 19 28 35

3) 217 26 40

4) 19 28 33

Path / Activity to ti tp te 2te

1-2	6	8	11	8:17
2-7	8	10	12	12:04
7-8	5	8	12	12:17

1-3	3	7	9	6:44
3-6	8	10	12	2:01
6-8	7	10	12	

Path Activity to ti tp te 2te

1-2	4	8	11	5:16
2-6	4	12	14	15:04
6-8	7	10	15	10:33

D 1-4 5 7 10 7:44

4-5	4	6	8	6:43
5-6	2	9	6	4:03
6-8	7	10	15	10:33