Network tehnics :-

Network technics provide a rational approach to the planning & controlling of construction work. The two commonly used network technic are CPM & PERT.

CPM stands for critical path method
PERT stands for program evaluation & review technics.

CPM :-

→ It is an algorithm for scheduling a set of project activities.

→ It is determined by identifying the longest stretch of dependent activities & measuring the time required to complete them from start to finish.

PERT :-

→ It is a statistical tool used in project management, which was designed to analyze & represent the tasks involved in completing a given project. It is the time duration of various activities. Three time estimates are used to determine the espected or average time of each activity. The expected time forms the basis of the PERT network.

Computation of expected time:-

The three time estimates are used in PERT are described below

Optimistic time estimate(to) :-

It is the shortest possible time for completing an activity if everything proceeds as planned without

any problem. the activity is performed under ideal condition.

Most likely time estimate (t_L) :-

It is the time for completing an activity under normal condition in this case conditions are not ideal & minor mishape may occur

pessimistic time estimate (t_p) :-

It is the maximum time required to complete an activity under abnormal or extremely adverse conditions in which everything goes run. The estimate however does not includes calastrophes such as fires, earthquake, floods etc

The expected time estimate for each activity is computed on the basis of statics as under

$$t_e = \frac{t_o + 4t_L + t_p}{6}$$

where t_e = expected time for the activity
t_o = optimistic time estimate
t_L = most likely time estimate
t_p = pessimistic time estimate

SL No	Activity	Time estimate in days		
		t_o	t_L	t_p
1.	Driving precast piles for a bridge abutment	22	30	50
2.	Erecting roof russes for a factory shed	11	14	17
3.	concreting foundation of turbo-generator	3	$5\frac{1}{4}$	6
4.	fabricating sheet metal AC ducts for an auditorium	12	16	17.

Activity :- 1

Driving Precast Piles for a bridge abutment

$t_o = 22$, $t_L = 30$, $t_p = 50$

$$t_e = \frac{t_o + 4t_L + t_p}{6}$$

$$= \frac{22 + 4 \times 30 + 50}{6}$$

$$= 32 \text{ days}$$

Activity - 2

Erecting roof trusses for a factory shed

$t_o = 11$, $t_L = 14$, $t_p = 17$

$$t_e = \frac{t_o + 4t_L + t_p}{6}$$

$$= \frac{11 + 4 \times 14 + 17}{6}$$

$$= 14 \text{ days}$$

Activity - 3

concreting foundation of turbogenerator

$t_o = 3$, $t_L = 5\frac{1}{4}$, $t_p = 6$

$$t_e = \frac{t_o + 4t_L + t_p}{6}$$

$$= \frac{3 + 4 \times 5\frac{1}{4} + 6}{6} = 5 \text{ days}$$

Activity - 4

Fabricating sheet metal AC ducts for an auditorium

$t_o = 12$, $t_L = 16$, $t_p = 17$

$$t_e = \frac{t_o + 4t_L + t_p}{6}$$

$$= \frac{12 + 4 \times 16 + 17}{6} = 15.\frac{1}{2} \text{ days}$$

Comparision betn CPM & PERT :-

CPM

(i) CPM is activity oriented

(ii) single time estimates are used for the various activities & the time estimates are deterministic

(iii) CPM is used for respective types of project where the time estimates for various activities are either known or can be determined fairly accurately

(iv) CPM places emphasis upon optimising allocation of resources & minimising overall project cost

PERT

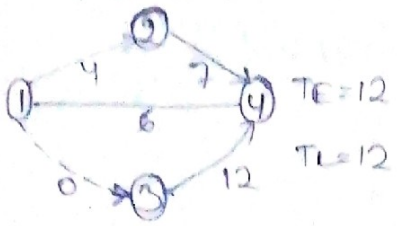
(i) PERT is event oriented

(ii) The estimates for activities are probablystic the following 3 activities are used in PERT
  (i) optimistic time (t_o)
  (ii) pessimistic time (t_p)
  (iii) likely time (t_e)

(iii) PERT is used for pioneering type of projects which are the first of their own kind & where prior data about activity times not available

(iv) PERT lays emphasis on reducing project completion time without cost constraint

The earliest given time of event no. 4 = 12 days as explained below



(Earlieys & latest event time)

The Earliest Possible accurance of an event no 4 is depended upon completion of activities 2-4, 1-4, 3-4 all of which lead to this event assuming that Project the project starts at 0 days the completion time of these activities is

Activity 2-4 = 0 + 4 + 7 = 11 days
Activity 1-4 = 0 + 6 = 6 days
Activity 3-4 = 0 + 0 + 12 = 12 days

Thus the earliest possible accurance of event no 4 upon complet of activities 2-4, 1-4, 3-4 is 12 days so te = 12 days

(2) Latest event time :-

It is defined as the latest possible accurance of an event ~~(illegible)~~ with delaying the project completion time it is the latest time when all activities leading to an event may be completed without delaying the project completion time.

TL in generally relation below the event

For example :-

In the network shown in pervious fig. the latest event time TL event no 4 = 12 days represent compiation is project is 12 days.

(3) Forward Pass :-

For calculating the earliest event time TE computation are made in a Forward direction Left to right. This process is called as forward pas

Consider the network shown in fig. The process of forward pass unde taken to calculate the earliest event time TE of event no 2, 3, 4 & it is assume that event no 1 occure at 0 unit of time.

TE of event no 2 = 0 + 3 = 3 units of time
TE of event no 3 = 0 + 1 = 1 units of time
TE of event no 4 depnds of both activities 2-4 & 3-4
Activity 2-4 is completed in 3 + 4 = 7 unit
Activity 3-4 is 1 + 5 = 6 units

TE of event no 4 is 7 when both activities are completed
TE of event no 4 = 7 units
TE of event no 5 = 7 + 2 = 9 units

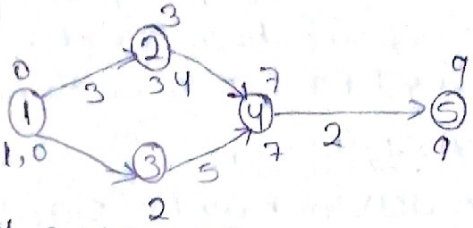
The computation of T_E of the event is shown in fig.

Forward Pass calculating T_E

Backward Pass :-

For calculating the latest event time T_L computation are made in a backward direction (Right to left) the Progress is called the backward pass

Consider the network shown in fig the process of backward pass is undertaken to calculate the latest event time T_L on event numbers 5, 4, 3, 2 & 1



T_L of event number of 5

Event number 5 is the last event representing project completion are such

T_L of event no 5 without the laying the project completion

$= T_E$ of event no 5 = 9 units

$\therefore$ T_L event no 5 = 9 units of time

T_L of event no 4 = 9 - 2 = 7 units

T_L of event no 3 = 7 - 5 = 2 units

T_L of event no 2 = 7 - 4 = 3 units

on path T_2 the latest time of event number 1

on path 2-1 the latest time for event number 1 = 3 - 3 = 0

Hence T_L for event no 1 is 0 as other wise the overall computation of project will be deleted.

So T_L of event no 1 = 0 unit.

Earliest start time (EST) Earliest Finish time (EFT) :-

For analysis of CPM network which are activity oriented the following activity times are used

(i) Earliest start time
(ii) Earliest Finish time
(iii) Latest start time
(iv) Latest Finish time

(i) Earliest start time of an activity (EST) :-

It is the earliest time when an activity can commence since the starting point of an activity is the 'tail event', the earliest start time of an activity is the T_E of the 'tail event' Earliest start time of an activity EST) = T_E of the tail event = T_E i

(ii) Earliest finish time of an activity (EFT):
It is the earliest time when an activity can be finished. Earliest Finish time of an activity (EFT) = Earliest start time of the activity + Duration of activity
For ex. in the network shown in fig. backward pass of calculating Earliest start time (EST) of activity 2-4 = TE of tail event no = 3 units.
Earliest Finish time (EFT) of activity 2-4 = T_E of tail event n + duration of activity 2-4 = 3+4 = 7 units.

(iii) Latest finish time of an activity (LFT):-
It is the latest time when an activity may be finished without delaying the completion time of the project. since the finishi point of the activity is the 'head event' the latest finish time the activity is the same as T_L of the head event.
Latest finish time of an activity (LFT) = T_L of the head eve

(iv) Latest start Time of an Activity (LST):-
It is the latest time when an activity may be started with delaying the completion time of the project.
Latest start time of an activity = Latest Finish time of Fini activity (LST) = LFT − t_{ij}
activity − duration of activity =
$= LFT - t_{ij}$
$= T_L^j - t_{ij}$

Advantages of CPM :-
The adoption of CPM technic in the construction industry is rapid increasing because of its following advantages
(i) If something goes wrong with the planning of project it can be easil identify & then concentration may be made to correct the same
(ii) It assists in preparation of the most economical time table all the operation of the project.
(iii) It assists the selection for the best combination of the equipment & labour so as to finish of the project in time
(iv) It determines the activities & operations which are to be controlled with respect to their time of completion for th successful finish of the project as a whole
(v) It helps in working out the effect of variation such as extra work change of order of work etc. upto the time of completion & upon the cost of the project.

Ch-3 Construction organisation

What is organisation?

Ans:- (i) An organisation is a group of person working together to achieve an establish goal.

(ii) It is the relationship which exists bet'n people taking part in a group of activity.

(iii) It defines the responsibility & authority of individual in relation to man, material, money & machine which constitute the resources of an organisation.

Types of organisation :-

The basic of structure of an organisation depends upon its size the nature of its business activities & the complexity of the problems faced by it. The organisation structure can be ~~distributed~~ classified into 3 types

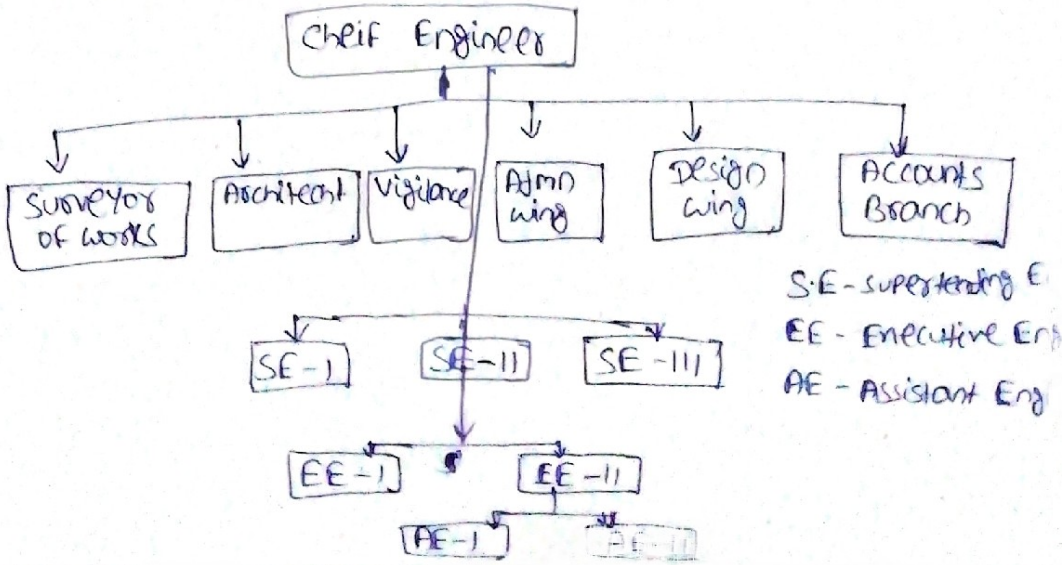
(i) Line organisation
(ii) Line & staff organisation
(iii) Functional organisation

Line & staff organisation :-

(i) Line organisation are unsuitable for large & complex project where the key main need to be assisted by specialist in different

(ii) The individual who constitute the staff in an organisation are those who have to line authority but whose function is largely advisory

(iii) This type of organisation comes into existance because line authority can not assume direct responsibility for all the such as research, design, planning, scheduling & recording performance etc.



Merits of Line & staff organisation :-

(i) Functional expertise & experience is available from staff personal
(ii) It is based upon planned specialisation.
(iii) Specialised of work is done by staff personal & line personal can devote their time to achieve sectional target.
(iv) It provides more job opportunity
(v) Due to staff specialisation there is more efficient utilisation of human & physical resources
(vi) Quality of product is better

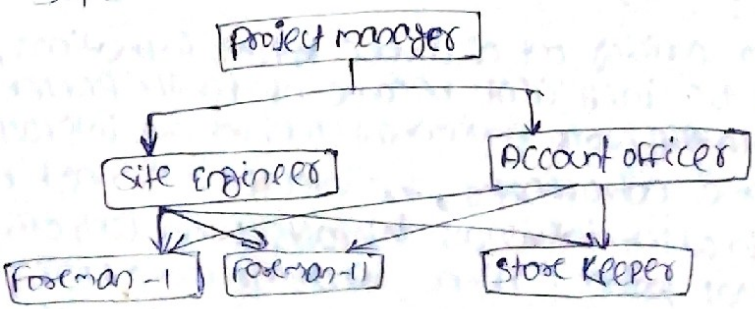
Demerits of Line & staff organisation :-

(i) The staff may be in effective due to lack of authority to enforced their decision. has duties & responsibility are not clearly defined.
(ii) There is bound to be some confusion in the relationship of the line & staff personal
(iii) Line members may sometimes accept the view point of staff members & vice versa. This mainly to friction & misunderstanding bet'n line & staff personal.

Functional organisation :-

The basis of functional organisation is specialisation. In such an organisation work is carried out on a functional basis & each function is carried out by a specialist. This removes the staff personal from for his assisting capacity & gives him authority & responsibility for the supervision & administration.

The idea behind this type of organisation is to divide the work in such a manner that each person has to perform a minimum number of function & full responsible for those aspects of work All similar & related work is grouped together under a person in order to perform his function effectively a person has to report to several superiors for different phase or aspects of the work



Functional organisation (Construction company)

Merits of Functional organisation :-

(i) Division of level is done on the basis of function specialisation.
(ii) manual work is separated from mental work.
(iii) quality of work is enhanced due to specialisation

Demerits of functional organisation :-

(i) Each person has to report a number of superior which weakens discipline.
(ii) co-ordination is more difficult.
(iii) over head cost are increased due to a number of speci

Leadership :-

Leadership is needed for every project or organisation at different level for various reasons -

(i) To help in defining the mission of the group
(ii) To create an environment in which group members become committed to the objective of the group.
(iii) To serve as an interpreter of messages & behaviour of the group & indivisuals who may have some influence on the group
(iv) To co-ordinate the activities of the group members is to ensure comfortivable & consistent efforts towards the organisatio goal achievement.
(v) To provide needed resources for the group.

Thus head of different groups working on the project seem appropriate leadership to achieve the established objective

Human relations :-

The term human relation applies to all interation, good & bad among The behaviours of people at work & how various elements of th work place affect the people are important to the study of human relations in an organisation or project someone may be irregular at work due to health problem arrising out of adverse type formations, while another might be inefficient because of family problems. Human behaviour in the work enviornment includes the interaction betn superiors & some subordinates, the interaction amongst peers & the way in which indivisuals interacts with each other in formal & non formal groups. Human behaviour in the work enviornment covers more than just the activities involved with the actual work itself.

LABOUR MANAGEMENT

The construction industry is one of the largest industry in india & employees about 50 million skilled & unskilled workers.

Workers in the construction industry are hired as & when required & are retrenched due to the temporary nature of their job workers remain ideal till they find work at new construction site. construction labour however he is hired on a temporary basis & leads a migratory life. work on different sites.

Wedges of Construction workers :-

construction workers are paid very low wedges. The net worth of wedges is considerably reduced due to periods of unemployment. There are 2 methods of making wedge payment to labour.

(a) Time rate system
(b) Piece rate system

Time rate-system :-

In this system a suitable rate of payment is fixed per unit of time that labour is engaged on the work. The unit of time may be hour day, week, fortnight or month. In india the rate of payment for casual labour is determined per day & that of regular employees per month.

piece rate system :-

In this system payment is based on out put or production of workers payment is made at the agreed them for the actual quantum of work done by each labour. In this system a good worker can make more money by increasing his out put.

Quality control

e. Explain the
Need for inspection & quality control in construction works. state
State the important principles of inspection & enforcement of specification

Ans:-

Need for inspection & quality control

The objective of inspection & quality control is to achieve sound construction work which results in structure of good quality at reasonable cost. inspection & quality control are required on all construction project. To ensure that the work is done in accordance with plans, specification & good practice & to avoid defects. An entirely safe design may be completely

ruined by careless execution. This can be need to defe
work with possibility of failure of the structure. Careful insp
& quality control is, therefore as important as the preliminary
investigation & design. As these it is very difficult &
expensive to rectify a structure after it is constructed.
It is necessary to inspect the structure during its various
construction stage. On large job a separate inspection age
is generally provided to ensure effective inspection & quality
control.

Comprehensive inspection forms on of the important cons
for efficient & satisfactory construction along with innovative
, Appropriate specification, reliable construction practice, & c
committed construction team.

The objectives to be achieved through inspection should be
determined before commencement of construction so that proper arrange
can be made at site. Inspections need to be carried out at various
stages of the work in order to achieve the desired quality. While carryin
out the inspection of works, materials, products etc, these are to be
compared with predetermined standards. These standards specify
generally the limits of permissible variability & the purpose
of inspections is to find out, by observation & or testing, whether
the quality of work, materials or products lies within the
acceptable limits of variability or not. Generally, inspection of
construction work at various stages covers.

* Sampling, identification, examination & field testing of materials.
* Measurement & Proportioning of construction materials.
* Examination of layout, formwork, foundations etc,
* Testing specimens in the laboratory.
* observation of construction equipment & plant.
* Preparation of records & reports.

In a construction project, quality control is one of the important
functions of management. It is primarily required to satisfy the
owner's stated needs & requirements. Quality control ensures
that work proceeds in accordance with the specifications laid do
& inspections is the tool through which it is practised.

Principles of inspection :-

In case of large construction projects, a separate inspection agen
is generally provided to ensure effective inspection & quality co

SAFETY IN CONSTRUCTION

Importance of safety :-
safety construction is a

Question :-
* Explain the cause of accidents on a construction site. Describe the safety measures required in excavation, storage and demolition work.

Ans :- Cause of Accidents on a construction site :-

Importance of safety :-

Safety in construction is a prime requisite but in often get neglected on work sites. With the advancement in construction technology, the need for proper attention of safety aspects has become essential for human, economic & other consideration The wide range of construction & building activities involving complex techniques have led to many new problems of safety proper steps should be taken to improve safety on construction sites so that loss of limb & life, suffering & damage resulti From avoidable accidents is prevented. Promotion of safety measures at site will result in a better work environment, higher productivity & greater contentment among workers.

Most of the accidents in the construction industry happen due to lack of proper education & training in regard of safety measures & also because of negligence & ignorance on the pa of either the worker or management or both. Below Table gi the percentage of fatal accidents & their causes, in the

construction industry in India employs more labour than any other industry. The construction industry is also one of the least organised & as a result there is scope for the exploitation of labour. In a country like India, safety is all the more important because of lack of social security to the family left behind. Thus, it becomes necessary to consider certain safety measures to prevent accidents.

Table-1

Percentage of Fatal Accidents & their causes in the construction industry.

SL.NO. Causes	Approximate percentage of Fatal Accidents
1. Falling persons	45
2. Falling materials	14
3. Transport	14
4. Lifting Equipement	7
5. Excavation	7
6. Electricity	6
7. Other causes	7

Safety measures :-

Prevention of accidents is a major aim of construction management, both for human & financial considerations. Whatever the nature of construction projects, accidents are likely to occur causing physical injury, casualities & loss of money. In order to prevent accidents at construction sites, certain safety measures need to be taken in the following major activities prone to risks of accidents.

Safety measures for excavation :-

The following safety measures should be adopted at the time of excavation.

(i) In all works, an experienced & competent Foreman & supervisor should look after the excavation work. He should have authority to enforce safety rules & prevent the use of defective/unsafe appliances.

(ii) Before doing the excavation work, a complete knowledge of underground structures (such as sewers, water pipe lines, gas mains etc.) is essential & proper precautions should be taken to prevent accident to the workmen engaged in excavation work.

(iii) Safety helmets should be worn by all persons entering a trench where hazards from falling stones, timber or other materials exist.

(iv) whenever workmen have to excavate in trenches, in soil, s
or Fissured rock, or hard soil exceeding 2m in depth, the trenc
should be securely shored & timbered.

(v) sheathing should be placed against the side of the trench so
the length of each piece of sheathing is vertical. where the
trench is excavated in loose or soft soil, each piece of
sheathing should be driven into the bottom of the trench so
as to be firmly held in place.

(vi) Excavated material should be kept away from the edge of
the trench in order to provide a clear berm width of not le
than one third the final depth of excavation. However, in
special cases where disposal area is limited, the minimum
berm width should not be less than 1m.

(vii) Heavy equipment, such as excavating machinery, trucks,
dumpers etc. should be kept away from the excavated sites a
distance not less than the depth of the trench or at least 6m
for trenches deeper than 6m.

(viii) At places where public is likely to trespass, fences or
barricades should be erected to avoid accidents. At night,
excavated areas should be adequately lighted.

Safety in storage :-

(i) Timber including sleepers, runners, scantlings, battles,
plywood etc, should be stored separately in neat stacks.
Adequate space should be left in between the stacks to avoid
fire hazard. smoking & open fires should be prohibited in timber
yards & stores.

(ii) petroleum products should be separately stored. smoking & open
fires should be strictly prohibited where these products are stor
only essentially required quantities of such products should be a

(iii) Adequate fire fighting arrangements should be provided at site
particularly in areas where petroleum products & timber are stor

(iv) Explosives must be stored in proper magazines & the prescr
safety measures for handling & storage of explosives should be a

Safety measures for Demolition :-

various safety measures to be adopted at the time of
demolition of buildings are :-

(i) on every demolition work, danger signs should be provided
all round the structures & doors giving access to the structu
Barricades should be erected around the structure & at leas

two exists must be provided for the escape of workmen during any emergency.

(ii) During night time, red lightes should be placed around the barricades & entry of unauthorised persons restricted.

(iii) At the time of demolition work, workers should use all safety appliances such as helmets, goggles, gloves etc.

(iv) In case any danger in anticipated to the adjoining structure during the process of demolition, the same should be got vacated to avoid any danger to human life.

(v) The process of demolition may weaken the side walls of an adjoining structure & to prevent possible damage, these walls should be supported until permanent protection is provided.

(vi) The power on all electrical service lines must be shut OFF & all such lines disconnected before the demolition work is started.

(vii) All gas, water, steam & other service lines must be shutoff before the demolition work is started.

(viii) If a structure to be demolished has been partially wrecked by fire, explosion or other catastrophe, the walls & damaged roofs should be braced suitably.

(ix) No demolition work should be carried out at night especially when the structure to be demolished is in an inhabited area.

Safety measures for Scaffolding, formwork & other equipment:-

(i) Every scaffold should be securely supported or suspended and properly strutted or braced to ensure stability.

(ii) All scaffolds and working platforms should be securely fastened to the building or structure. If independent of a building, they should be braced or guyed properly.

(iii) If scaffolds are to be used to a great extent for long periods of time, a regular plank stairway, wide enough to allow two people to pass, should be erected with handrails on both sides.

(iv) When work is being performed above a scaffold platform, a protective overhead covering should be provided for the men working on the scaffolds. The protection shouldn't be more than 3m above the scaffold platform & should be made of planks.

(v) During dismantling of scaffolds, necessary precautions should be taken to prevent injury to persons due to fall of loose materials, bracings & other parts of scaffolds.

(vi) Care should be taken to see that no un-insulated elec wires exist within 3 metres of the working platform, gangway etc of a scaffold.

(vii) The supporting ballies for formwork should be checked for each individual member. The ballies should be properly braced. Many accidents occur due to negligence on this account.

(viii) All operators and supervisors of machines should thoroughly trained in operating the machines and equipment. All persons handling construction equipment should be completely acquainted with the safety aspects of machines and then operations.

(ix) Safety in terms of both main and auxiliary equipment should be considered at all construction sites. Unauthorised persons should not be allowed to handle or operate any equipment. Ropes, guys and connections should thoroughly checked before use.

Safety in Fabrication and Erection :-

(i) All equipment such as gas cutting and welding sets, drills, power hacksaws, grinders etc. should be checked periodically to ensure their safe working.

(ii) Moving parts of all equipment should be provided with safety guards.

(iii) Rubber pipe-lines for oxygen and acetylene gas should be regularly checked for leakage or damage. Leakage of gas from regulators, pipe-lines or connections with the ~~regt~~ gas torch should be rectified immediately.

(iv) workers engaged in gas cutting & welding operations should wear suitable gloves and aprons and use proper welding screens.

(v) Power cables for all equipment should be properly insulated & protected from damage & cuts.