

LECTURE NOTES

ON

CONSTRUCTION MANAGEMENT

DIPLOMA IN CIVIL ENGINEERING (6 TH SEMESTER)

BY

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Aims and objective of construction management :-

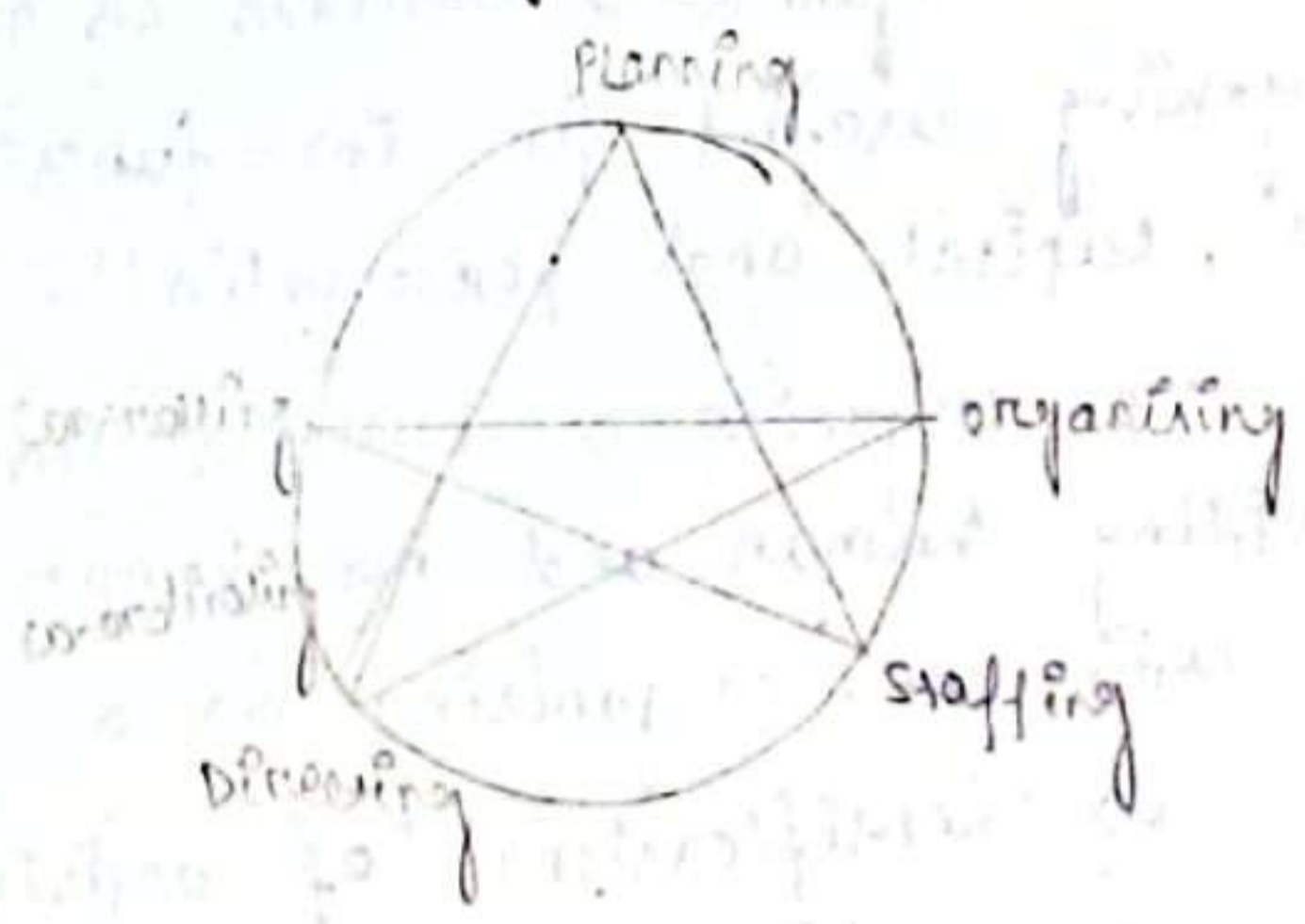
Aim- The aim of the construction management is to forecast or predict as many dangers and problems as possible; and to plan, organize and control activities so that the project is completed as successfully as possible in spite of all the risks.

Objectives :-

- To complete the project in specified time and with allocated budget.
- To plan and schedule the work and distribute between various departments. Deployment of personnel in different tasks.
- To achieve high quantity workmanship.
- create an organization that works as a team.
- using the limited available resources and producing maximum output.
- providing safe and satisfactory working conditions for all personnel and workers.

Functions of construction management :-

- 1) planning
- 2) organizing
- 3) staffing
- 4) Directing
- 5) Co-ordinating
- 6) controlling



1) Planning :-

It is the basic function of management. It deals with checking out a future course of action and deciding in advance the most appropriate course of actions for achievement of predetermined goals.

According to KOONTZ, "planning is deciding in advance what to do, when to do and how to do. It bridges the gap from where we are and where we want to be."

A plan is future course of actions. It is an exercise in problem solving and decision making. Planning is determination of course of action to achieve desired goals.

Thus, planning is a systematic thinking about ways and means for accomplishment of predetermined goals. Planning is necessary to ensure proper utilization of human and non-human resources.

2) organising :-

It is the process of bringing together physical, financial and human resources and developing productive relationship amongst for achievement of organisational goals.

According to Henry Fayol.

"To organise a business is to provide it with everything useful for its functioning i.e., raw material, tools, capital and personnel's".

To organise a business involves determining and providing human and non-human resources to the organisation of structure. organising as a process involves.

- Identification of activities
- classification of grouping of activities
- Assignment of duties.
- Delegation of authority and creation of responsibility
- Co-ordinating authority and responsibility relationships

3) Staffing :-

It is the function of manning the organisation structure and keeping it manned.

Staffing has assumed greater importance in the recent years due to advancements of technology, increase in size of business, complexity of human behaviour etc.

The main purpose of staffing is to put right man on right job. i.e., square pegs in square holes and round pegs in round holes.

According to Kootz and O'Donell, "managerial function of staffing involves manning the organisation structure, through proper and effective selections, appraisal and development of personnel to fill the roles designed on the structure". Staffing involves;

→ Man power planning

(estimating man power in terms of searching, choose the person and giving the right place).

→ Recruitment, selection and placement,

→ Remuneration.

→ Training and development.

→ Performance Appraisal.

→ Promotions and transfer.

4) Directing :-

It is that part of managerial function which actuates the organisational methods to work efficiently for achievement of organisational purposes.

It is considered life-spark of the enterprise with sets it in motion the action of people because planning, organising and staffing are the more proportions for doing the work.

Direction is that human-personnel aspect of management which deals directly with influencing, guiding, supervising, motivating sub-ordinate for the achievement of organisational goals.

Direction has following elements:-

- supervision.
- Motivation
- Leadership
- communication.

Supervision:-

It implies overseeing the work of sub-ordinates by their superiors. It is the act of watching and directing work and workers.

Motivation:-

It means inspiring, stimulating or encouraging the sub-ordinates with zeal to work, positive, negative, monetary, non-monetary incentives may be used for this purpose.

Leadership:-

It may be defined as a process by which manager guides and influences the work of sub-ordinates in designed direction.

Communication:-

It is the process of passing information, experience, opinion etc. from one person to another. It is a bridge of understanding.

5) Co-ordinating:-

The process of co-ordination involves synchronising individual efforts with the goals of the enterprise. Today's organisations have grown in size and in characters. A large number of people work there in. So, coordination has become very pertinent in achieving harmony of individual actions towards accomplishment of company objectives.

In effective coordination between different functions of a business enterprise can ruin the enterprise.

6) Controlling:-

It implies measurement of accomplishment against the standards and correction of deviation if any to ensure achievement of organisational goals.

The purpose of controlling is to ensure that everything occurs in conformance with the standards.

An efficient system of control helps to predict deviations before they actually occur.

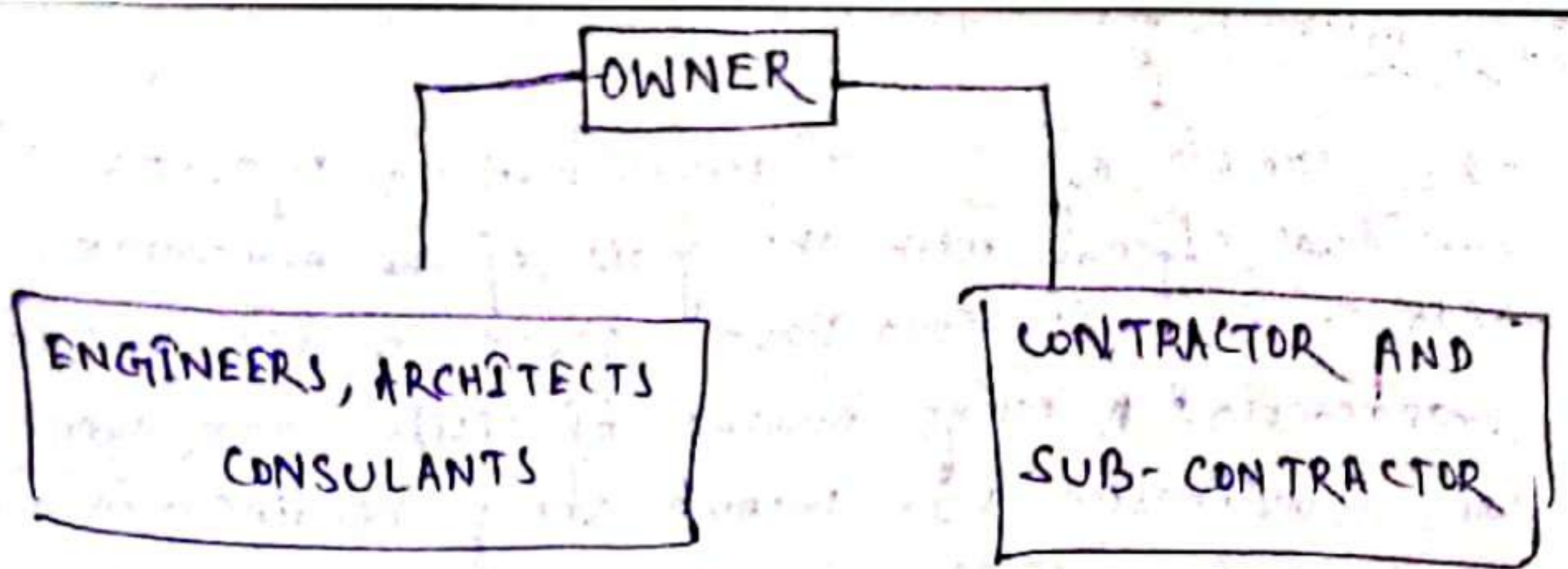
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CONSTRUCTION TEAM:-

For civil engineering project, a construction team is composed of owner, engineers / architects and contractor.

The object of the team is convert owner's conceptual project into a reality. The owner is the head of team and forms the team of engineers and contractor to serve his interest.

The function of the constituents of any team is subject to the nature and magnitude of the project.



OWNER:-

- The owner may be an individual or group of individual, private or public sector company.
- The owner is the ultimate authority over the project. All the power of decision making regarding managerial, financial and administrative aspects is invested in him. He is responsible for the funds and other resources of the project.

Duties and responsibilities of the owner:-

- He appoints an Engineer and delegates his power to work to him and in ^{consultation} ~~consultation~~ with him, he appoints other necessary staff for the purpose.
- He obtains necessary sanction for its construction from competent authority.
- He allocates the estimated cost to the Engineer.
- He enters into a contract with the contractor by signing the contract.
- He estimates the Engineer the desired completion time.

- He gives possession of work site to the contractor.
- He safeguards the program of work from outside interferences.
- He makes to payment to the contractor on production of certified bill from the Engineer.
- He takes over possession of the completed project from the contractor.
- In case of conflict with the contractor, he appoints lawyer for defending his case.

Engineer :-

- It includes the empowered construction Engineer solely responsible for the project management, store control inspection and quality assurance, construction, supervision.
- It also includes architects, structural Engineer, quality ~~control~~ ^{surveyor} ~~quality~~ surveyor, mechanical and electrical Engineer specialists such as structural consultant, safety and maintenance planners, soil investigations etc.

The duties and liabilities of each are follows.

Construction Engineer :-

- He gets prepared the necessary drawings, specifications and estimates.
- He check up soil condition.
- He prepares tender and awards the contract to the selected contractor.
- He supervises the work and ensures that the drawings and specifications are being followed faithfully.

- He submit the progress report from time to time to owner.
- He is bounded by terms and conditions of contract.
- In case of dispute, the engineer shall help to settle the disputes by technical analysis.

ARCHITECTS:-

The duty of the architect is to assess the owner's functional requirements and prepare plan and specifications for the purpose.

STRUCTURAL ENGINEER:-

The structural engineer is to prepare structural design as per requisite loads through technical design and to prepare working drawings which is handed over to the construction engineer.

MECHANICAL ENGINEER:-

He is responsible for mechanical services associated with the project during and after construction.

ELECTRICAL ENGINEER:-

He is concerned with the preparation of working drawing for electrical power and distribution system during and after construction.

QUANTITY SURVEYOR :-

His duty is to

- a) estimate the cost of work.
- b) prepare bill of quantities and tender documents.
- c) ~~prepare~~ prepare the cash flow statement during construction.
- d) ~~prepare~~ assess the extra cost due to special features.
- e) prepare the final accounts on completion of the project.

SPECIALISTS :-

They have to perform specialised work entrusted to them. Such as soil investigation collects information regarding soil for the proper design of foundation.

CONTRACTOR :-

The contractor may be an individual or a large construction company. In some project, the contractor may sublet part of the work to a sub-contractor or petty contractor.

This is done because a contractor may not have the required infrastructure for certain works. The contractor has to execute various types of works and has to make all necessary arrangements for labour, equipment, material, etc. In order to complete the project within stipulated time and cost.

The vital duties and liabilities of a contractor are covered by the conditions of contract.

Duties and liabilities of the contractor.

- The contractor undertakes execution of work or services concerned there with as per terms and conditions of the contract agreement.
- He has to visit the work site, study soil condition before tendering.
- He should ascertain accessibility, availability of water supply and electric power and other facilities for construction purposes and should see local conditions also.
- He has to collect local rates of materials and labour to determine the item rate.
- He should be required to designate a responsible representative who is authorised to act on his behalf.
- He is required to obtain all building permits in connection with the work.
- It is duty and liability of a contractor to follow the labour act.
- It is duty of contractor to safeguard his own men and materials.
- It is the responsibility of contractor to safeguard the completed portion of work until it is finally handed over to the owner.
- He should thoroughly study the clauses of conditions of contract and follow the contract agreement truly.

→ He should finally hand over the completed work to the owner and get the final payment and settling the running bill amounts.

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CONSTRUCTIONAL RESOURCES:-

Constructional i.e., creation in the form of finished product is the direct result of using various resources in the most effective ways. The various resources being used in the construction project can be enumerated as,

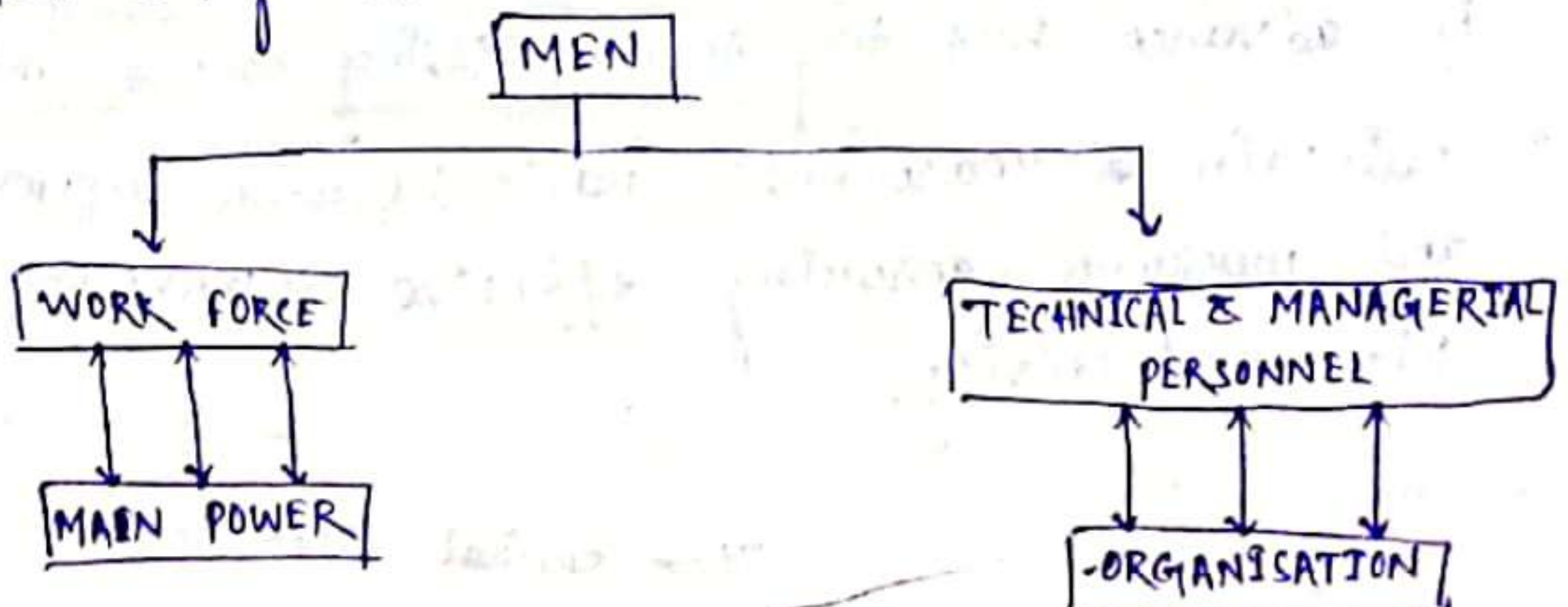
- 1) MEN
- 2) MATERIALS
- 3) MACHINERY
- 4) MONEY

In addition to main resources mentioned above, other resources in the form of infra-structure is also necessary for construction projects.

- a) power
- b) water
- c) space
- d) communication means.

↓ MEN :-

'Men' resources is one of the essential ingredients to carry out project activities and it is basically grouped in two categories.



(A) WORK FORCE (OR MAN POWER) :-

The work force i.e., the man power consists of skilled and unskilled workers. Meticulous care has to be taken in man power planning in order to ensure timely deployment of just the required number of workmen of the right trade and skill. Both over-manning and under-manning are bad. At the same time there should be no sudden fluctuations in the labour strength.

MAN POWER PLANNING :-

In a construction organisation, manpower planning is done as explained below.

- describe the work elements and man-power-skill-specifications and assess the number of ^{man days} ~~man days~~ of various trades and skills to be put every week/month.
- draw a chart of manpower needed week wise or month wise using a CPM network.
- adjust the schedule and manpower requirements avoiding sudden and steep fluctuations.
- ascertain the availability of men of the right trade and skill for recruitment.
- ~~recruit~~ recruit and train the scarce categories in advance but try to keep edging to the minimum.
- maintain a reasonable ratio between supervisor and workmen ensuring effective supervision and high productivity.

CPM → critical path method

⑧ TECHNICAL AND MANAGERIAL PERSONNEL (ORGANISATION) :-

Technical and managerial personnel effectively use the available human resources in such a way that the project is finished within stipulated time and the budget. And it is called ORGANISATION of an engineering project or industrial concern. It is a basic frame work of human resources who is responsible for executing the project.

ORGANISATION PLANNING :-

organisation needs effective planning. organisation can be defined as the pattern of ways in which a large number of people engaged in a complexity of tasks, relate themselves to each other in systematic establishment and accomplishment of mutually agreed purposes.

The functions of organisation may be enumerated as follows :-

- a) It establishes the pattern of relationship by giving duties and responsibilities to an individual or group.
- b) It provides adequate communication.
- c) It demarcates the authority, responsibilities and duties of each individual or group.
- d) It coordinates or integrates and controls the activities of individual or groups to achieve common objectives of the business enterprise or engineering project.

Therefore, it is evident that an organisation for the construction contracting has to be built taking into account the general principles of management, ~~has to~~ ~~be built taking into~~ the need of accountability and the special characteristics of the construction industry.

MATERIALS :-

Materials such as brick, stone, timber, cement, sand, stonechips, steel, lime, paint, centering and shuttering, water supply, sanitary and electrical fittings, petrol, oil, lubricants etc. are termed as material resources which are required for construction of civil engineering projects.

A material schedule showing the quantity, quality and with exact time and date of its delivery is prepared by assessment with reference to work schedule (or activity calendar) and it is the duty of construction engineer to look into the material schedule and give order for supply of various materials at the appropriate time of construction period.

MACHINERY :-

For any construction work, various plants/equipments and tools are required at different point of time during the execution period. Depending upon the type and nature of a construction job, machinery required at site may include batching plant, mixer, vibrator, trucks, tractors, excavators, cranes, pumps, generators, workshop equipments etc. It is pertinent to prepare an equipment schedule or equipment calendar so that the construction manager may have no difficulty in arranging the equipments for the purpose at the right time and the work will not be held-up because of lack of any equipment. On the basis of economic analysis, a construction engineering/contractor may arrange by transferring from ~~to~~ other site or buying or hiring. It must be remembered that non-availability of the appropriate equipments or

1001 In time can hold-up the working work leading to financial loss and delays.

MONEY:-

Money or fund is the single most important resource because all other resources are directly dependent on the availability of fund. So the financial resource should therefore be planned and arranged with special care for smooth cash in-flow and out-flow and to avoid any delay in the project activities.

POWER:-

Power is an essential resource required for lighting, running equipments and machinery and for other facilities.

WATER:-

For performance of some construction items of a civil engineering project, water plays an important role. Hence a source of water-supply must be generated at the work site to serve both domestic and constructional use.

SPACE:-

For execution of civil engineering project, it is essential that work site must be available for other facilities also viz.

- storing materials.
- providing yards for bar benders, carpenters, installation of equipments and plants, repair workshop casting yard etc.
- site office and labour camp etc.

COMMUNICATING MEANS:-

Land communication means should be available to the work site to facilitate the execution work of the project. Telephone and other facilities also be available for the transfer of information and instructions etc.

Importance of construction project / construction planning

Construction planning :-

An administrative process by which suitable line of action is selected out of the various alternatives available for the project work is called planning.

Importance :-

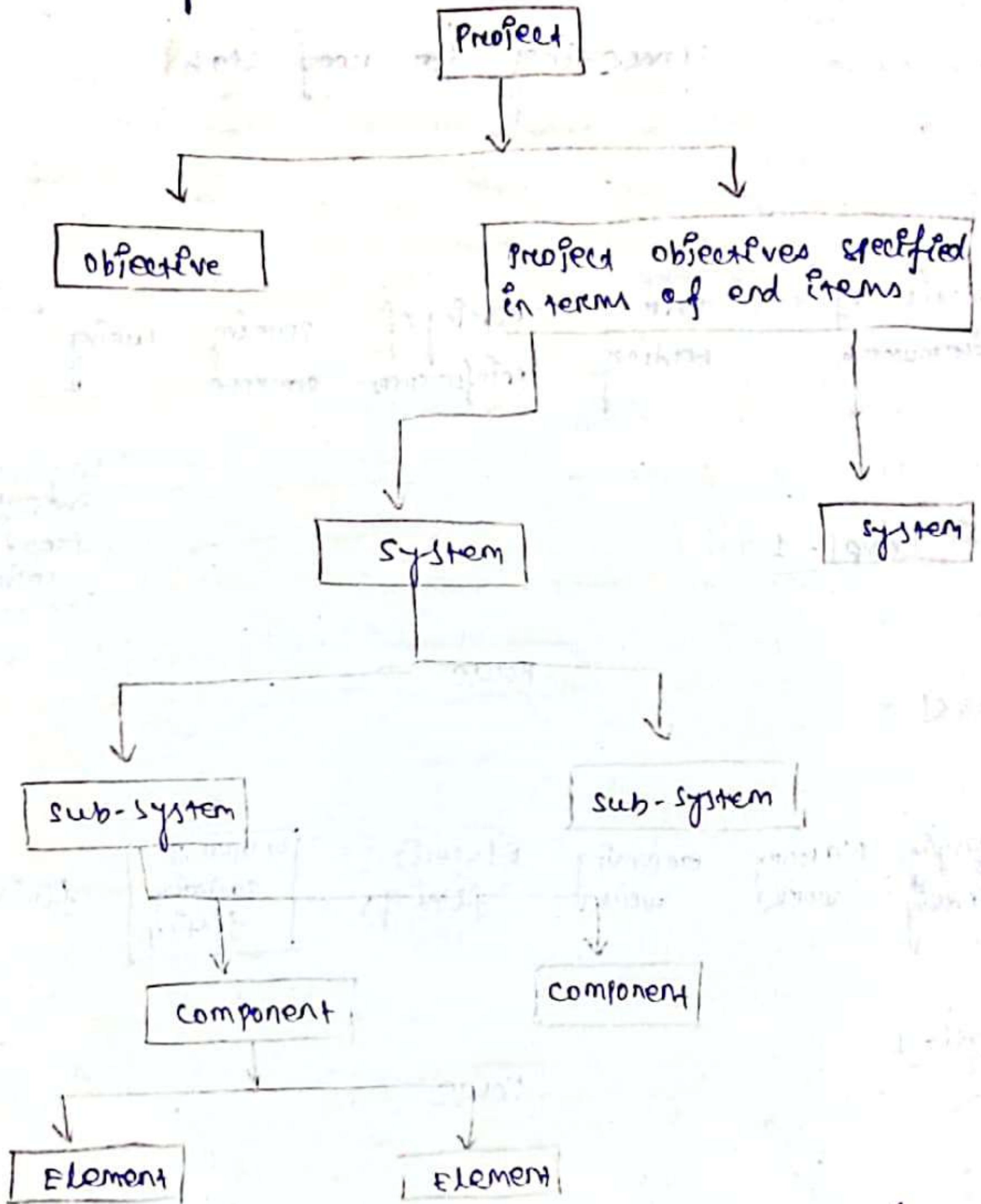
- Planning helps to minimize the cost by optimum utilization of available resources.
- Planning reduces irrational approaches, duplication of works and inter departmental conflicts.
- Planning encourages innovation and creativity among the construction managers.
- Planning imparts competitive strength to the enterprise.

Developing work breakdown structure for construction work :-

Work breakdown structure :-

- In any construction project, the various activities that make up the project have to be clearly identified.
- Process of breaking the project into easily identifiable major systems, their sub-systems and discrete activities is called the work breakdown structure.

→ Major project is first identified in terms of its end items, then split into systems, sub-systems, then their components and elements.

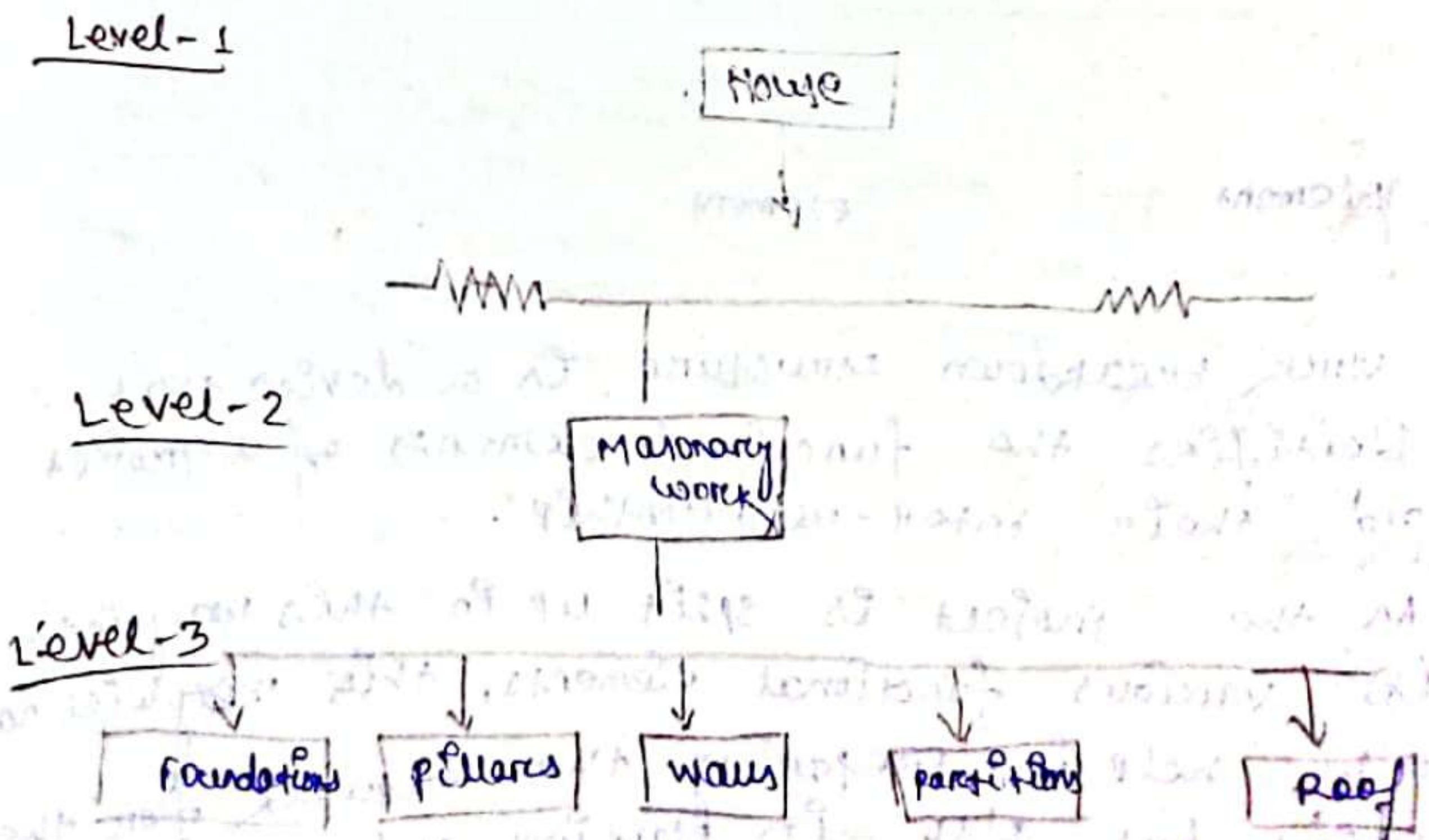
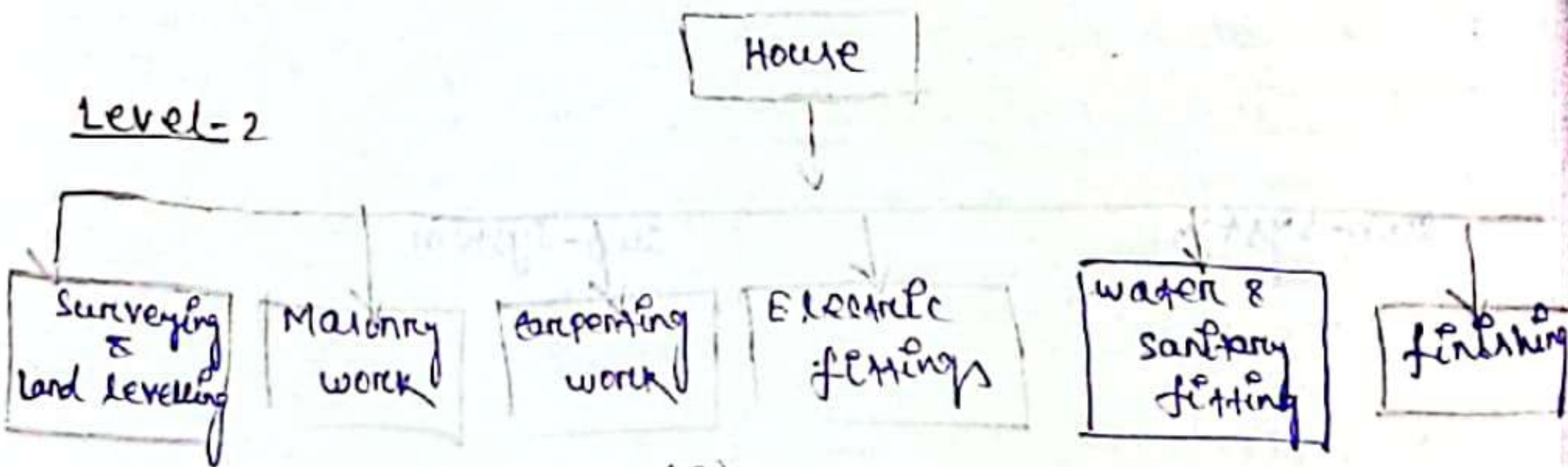
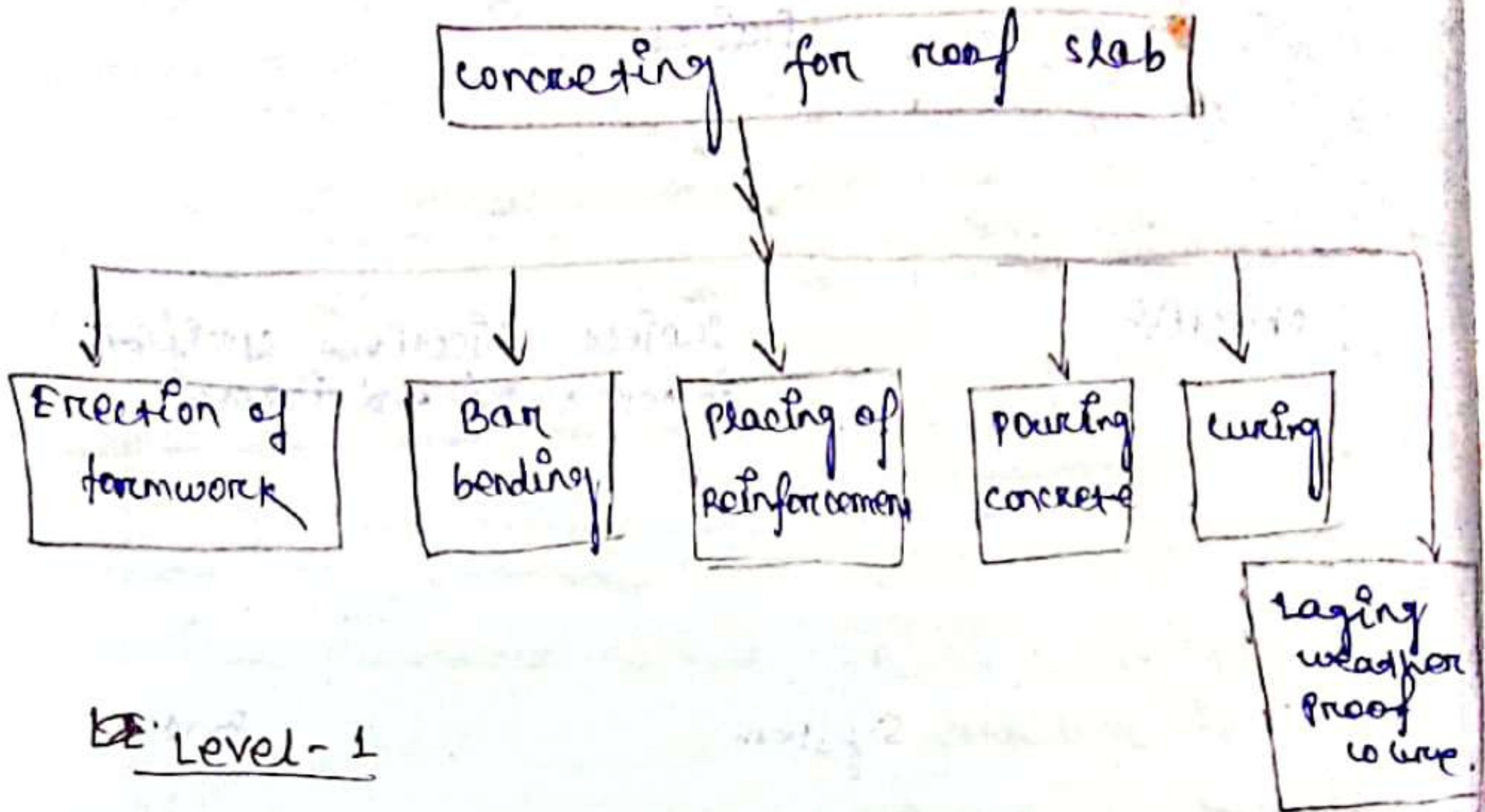


(work breakdown structure of a project)

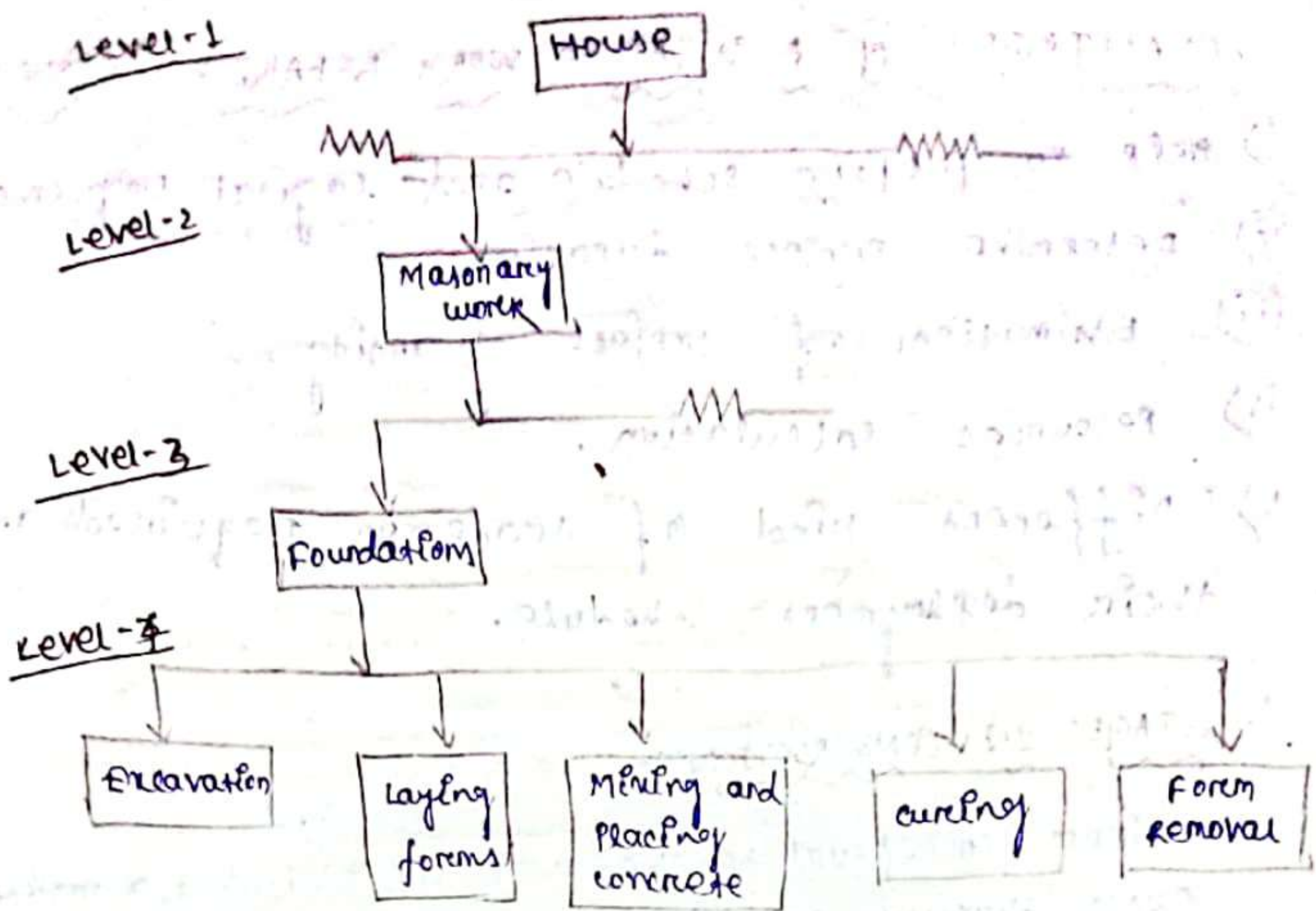
→ work breakdown structure is a device that identifies the functional elements of a project and their inter-relationship.

→ As the project is split up in this way into its various functional elements, this will not only help in preparing the network for the project but also in planning and scheduling.

The concreting work for the roof slab of a residential building can be split up into various elements as follows.



(b)



(c)

That figure is work breakdown structure for house construction project.

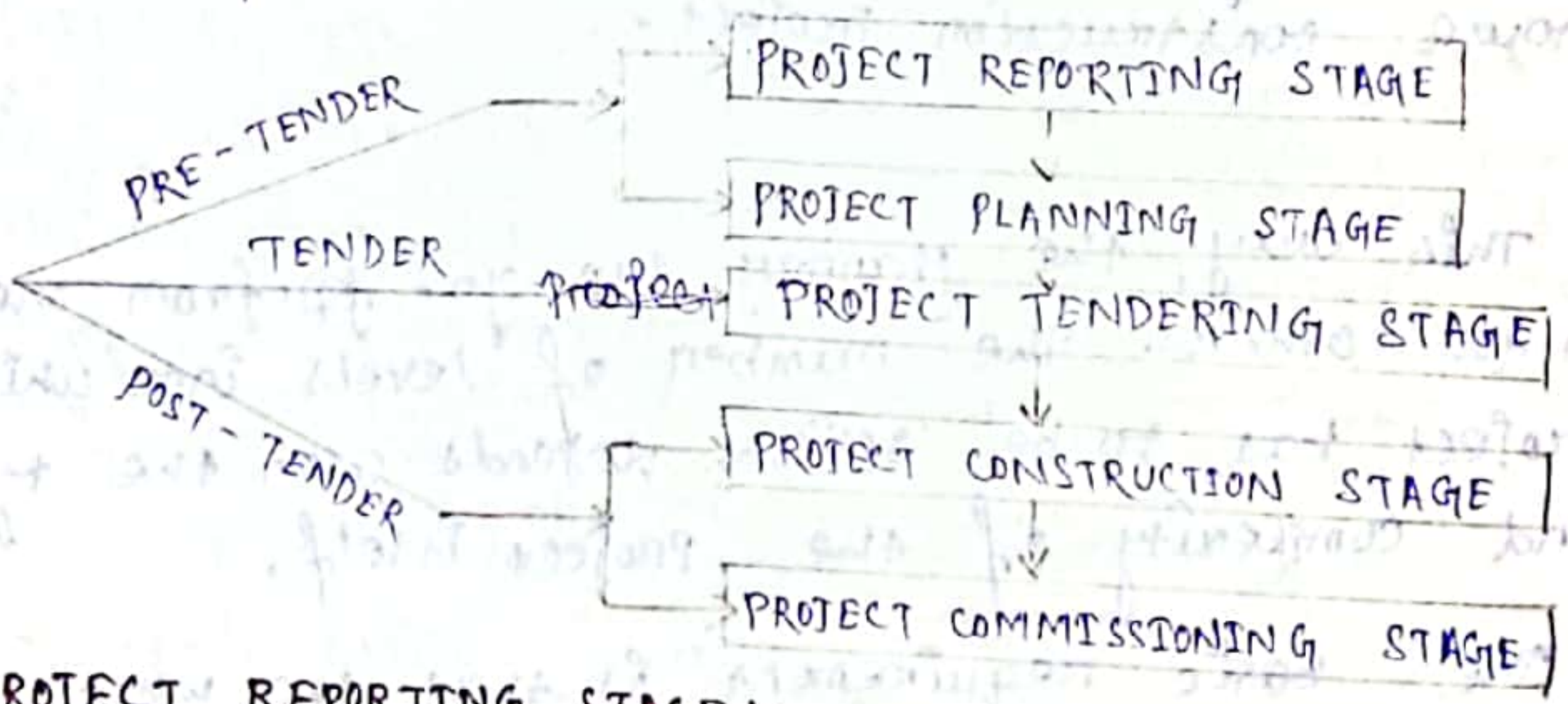
- This way, the planner can go from one level to the other. The number of levels into which the project has to be split depends upon the type and complexity of the project itself.
- The basic requirement is that the work breakdown schedule should be detailed enough to allow the eventual construction of PERT/CPM network which will precisely reflect the inter-relationship among all the events and activities which make-up the entire project.
- The work breakdown schedule so obtained presents the entire project in a systematic way so that inter-relationships among all phases of the project are easily seen.

ADVANTAGES OF A DETAILED WORK BREAKDOWN STRUCTURE

- i) help to prepare schedule and logical sequence
- ii) determine project duration.
- iii) estimation of project quantity.
- iv) resources calculation.
- v) Different kind of tradesman required and their deployment schedule.

STAGES IN CONSTRUCTION :-

from conceptual to the realistic situations, a project passes through several stages completely distinct from each other and each stage has its own purposes and functions.



PROJECT REPORTING STAGE :-

It is also called briefing stage where ideas of the project are originated by individual or group of individuals on a public sector or private sector company. Conceptual ideas of the project are thoroughly studied with regard to the cost and benefits so as to establish the economic viability or social utility of a project.

Purpose :-

The purpose of this stage is to study the conceptual ideas of a project and prepare a reporting or briefing by specifying project functions. The architects, engineers and other members of a construction team correctly interpret the owner's wishes and provide an estimated cost.

Activities :-

A civil engineering project begins with a thorough investigation of the scope and economic feasibility of a project. This is the preliminary stage (or the pre tender stage), and many factors are broadly stated

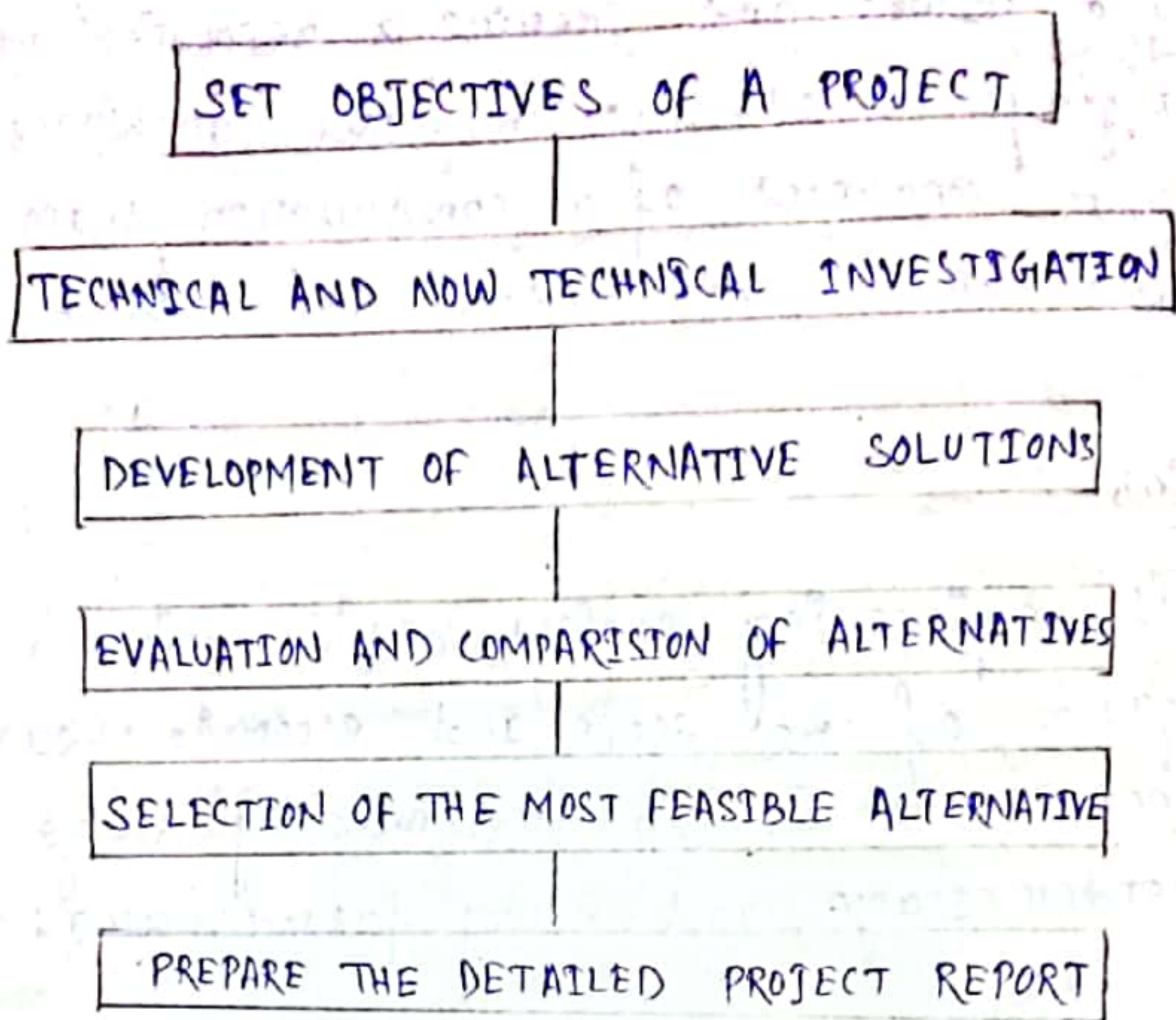
on the basis of both technical and non-technical investigations, many alternative proposals may be given due consideration.

Non-technical investigations include economic and social factors which may define the scope of the project including market survey for resource identification.

Technical investigations include geological and geographical survey with many site investigations such as soil conditions, ground water level and others.

All the feasible alternatives are studied and the most feasible one is selected for the purpose for which a report with recommendation is made.

The functions of this stage may be summarised as



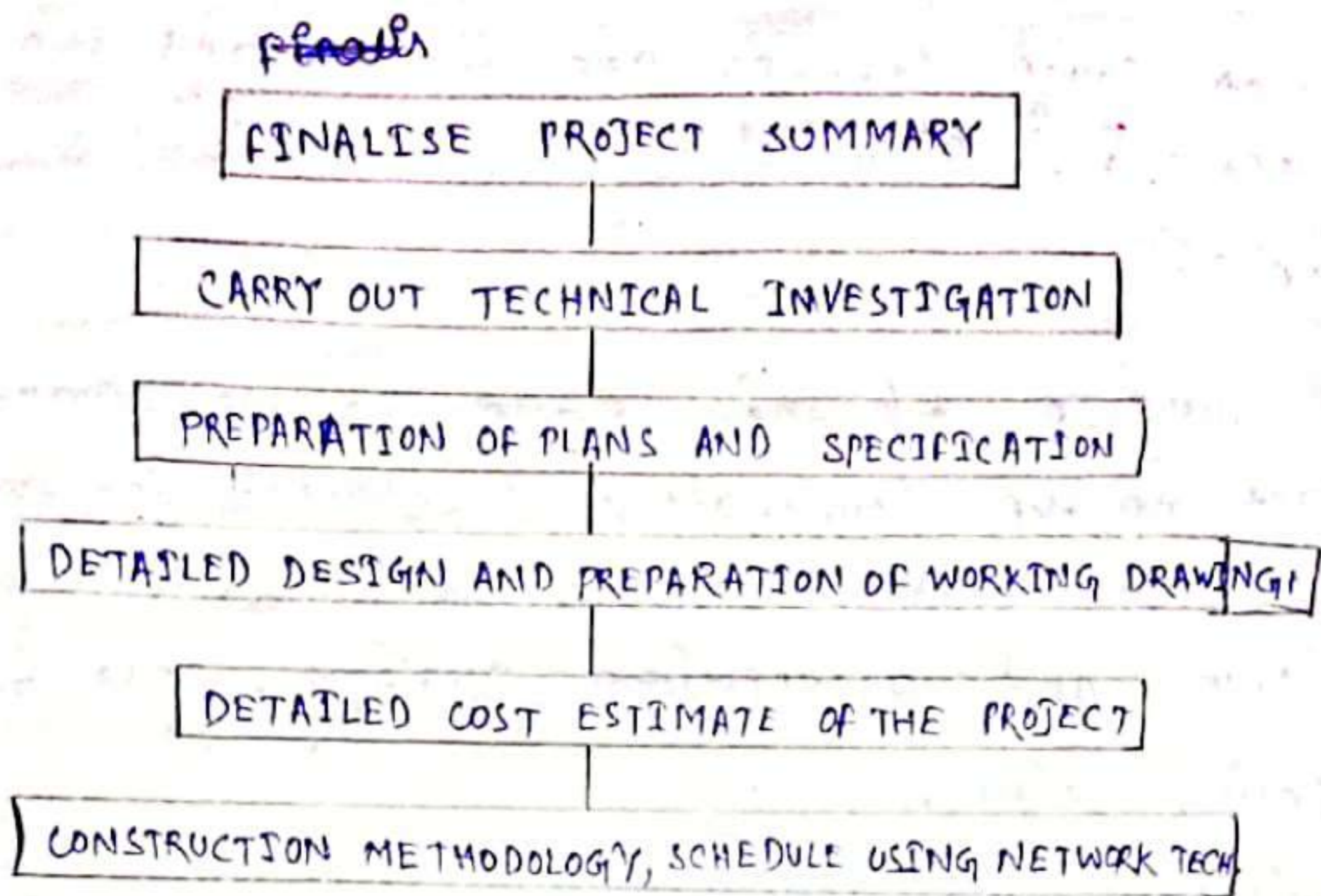
PROJECT PLANNING STAGE :-

This is very important stage when a realistic and detailed cost estimate of the chosen project is made. Any modifications later on will result in adding to the project cost.

Purpose :-

The purpose of this stage, is to prepare project summary, to prepare detailed drawings and specifications to make detailed structural design and finally to get the detailed estimated cost of the project. The type of construction and methodology for network technique is worked out.

Functions :-



PROJECT COMMISSIONING STAGE :-

It is the stage in which the performance of the structure is evaluated and nature of maintenance and repair is proposed.

Purpose :-

The purpose of this stage is to ensure that the construction work has been completed as specified in the contract documents. If any changes, have been made because of some reasons, they must be recorded for technical performance and financial implications.

Functions :-

Various functions involved in this stage are;

- i) to keep various records of the actual work.
- ii) to have quality inspection thoroughly to remove the defects if found.
- iii) to prepare operating and maintaining manuals.
- iv) to carry out the performance test of the structure.
- v) to have training and recruitment of staff for ~~commissioning~~ commissioning schedule.

PROJECT TENDERING STAGE :-

In this stage tenders are invited and the contract is awarded.

Purpose :-

The purpose of this stage is to award a contract to the contractor selected for the purpose on suitable terms and conditions ensuring requisite and appropriate quality, cost and completion time.

FUNCTIONS :-

Preparation of tender document and obtaining tenders through N.I.T.

comparative statement of tenders

Ascertaining resource capacity, work experience and reliability of the contractors.

Award of the contract to the selected contractor and contract document.

work order and possession of site to the contractor.

N.I.T → Notice Invited Tender

PROJECT CONSTRUCTION STAGE :-

During this stage, actual work is executed as per plans and specifications prepared earlier. The construction methodology is carried out in a planned manner preventing wastage of manpower, materials and money and ensuring completion of the project within stipulated time, cost and quality.

Functions :-

- i) Using CPM network, the following construction schedules or calendars are prepared where requirement of each with exact date is clearly demarcated. This facilitates the work of construction management along with controlling and monitoring.
 - a) Activity schedule / calendar
 - b) Material schedule / calendar
 - c) Worker schedule / calendar
 - d) Fund schedule / calendar
 - e) Equipment schedule / calendar
- ii) Provision of services and facilities must be provided before starting the construction work.
- iii) A typical layout of service camp should be incorporated.
- iv) Supervision of construction work within the contractual agreement and ensuring the quality of work and checking of work as per plans and specifications is made.

v) co-ordination of sub-contractors and various sections is done.

vi) Inspections, quality control and progress of work are the main function of this stage.

vii) If there is any problem ~~or~~ during the construction, it must be sorted out amicably.

viii) Final checking of the completed work is made and final payment is made to the contractor.

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Bar-chart :-

→ A bar-chart consists of two co-ordinates axes, one showing time and other showing jobs or activities to be performed. Each job is depicted in the form of a horizontal line or bar and the length of the bar indicates duration of the jobs or activity.

→ Bar chart were introduced by Henry Gantt around ~~1980~~ 1900 ad. Therefore, these are called as Gantt chart.

→ Bar-chart is a graphical representation activity v/s time.

→ usually horizontally axis represents the time duration and vertical axis represents the activities or jobs to be performed.

- Activities are shown with the help of a bar.
- The beginning and end of each bar shows the time of start and time of finish of activity respectively.
- Therefore, the length of the bar represents the time required for the completion of the activity.

Event :-

An event is a specific instant of time which makes the start or end of an activity. Event consumes neither time nor resources.

Activity :-

An activity is the actual performance of the task and requires time and resources for its completion. It is the work required to complete a specific task.

EX → draw the bar-chart for finalisation of designs and work order for a building project.

<u>Activity</u>	<u>Description</u>	<u>Time for completion</u>
A.	→ site selection and survey	→ 4 weeks
B.	→ Design	→ 6 weeks
C.	→ Preparation of drawing	→ 3 weeks
D.	→ Preparation of specifications and tender documents	→ 2 weeks
E.	→ TENDERING (N.I.T)	→ 4 weeks
F.	→ selection of contractor	→ 1 week
G.	→ Award of work order	→ 1 week

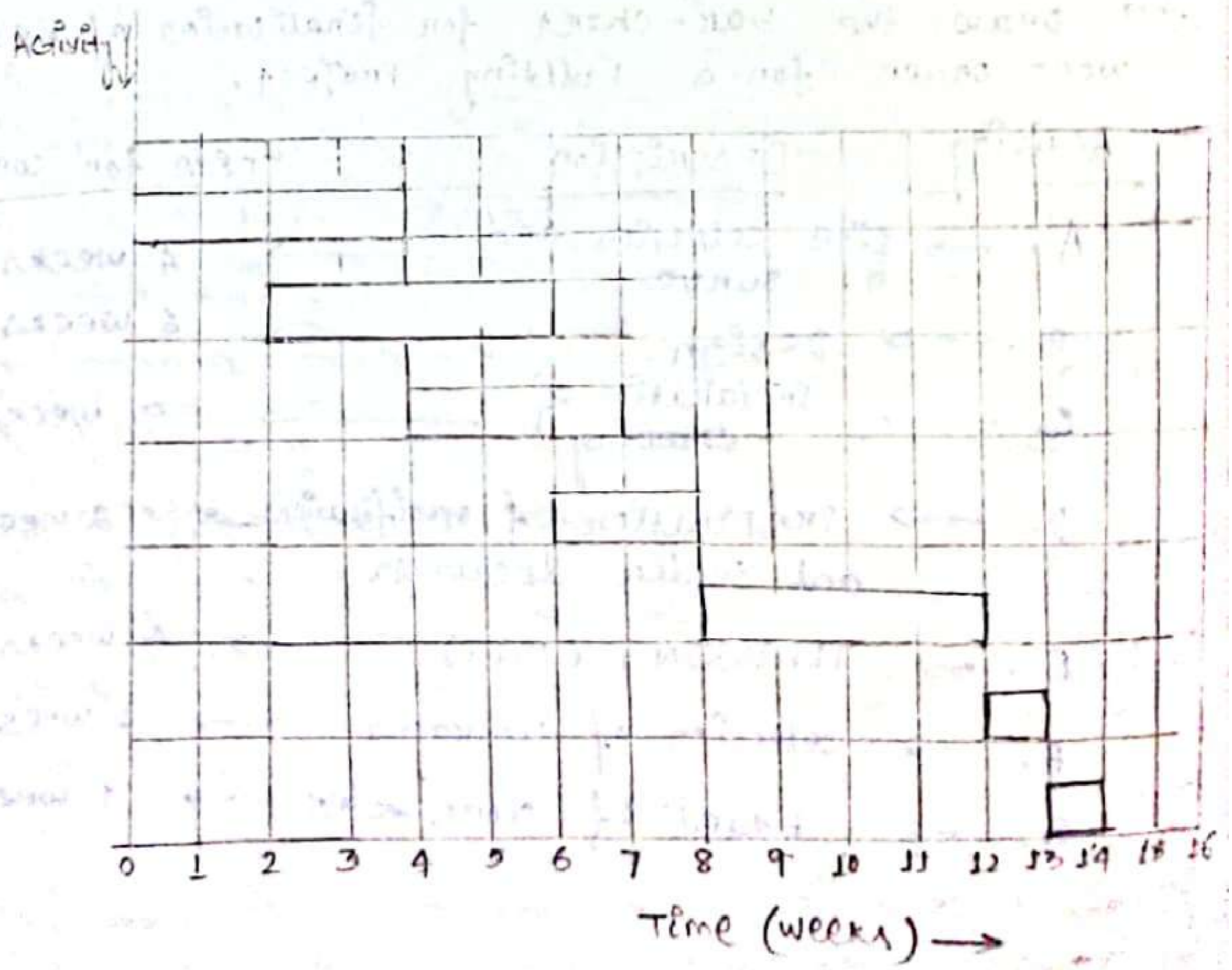
Solution 2

on the above project, Activity A and B can start concurrently, since some parts of the architectural and structural designs can be done even if complete survey data is not available,

similarly drawing work can also be started as soon as survey work is over, though all the designs are still not complete.

specifications can be finalised when once the designs are complete.

Activity E can be started on when activity D is complete. Activities E, F and G are to be completed in sequential order.



From the figure we conclude that the total time required for this phase is 14 weeks.

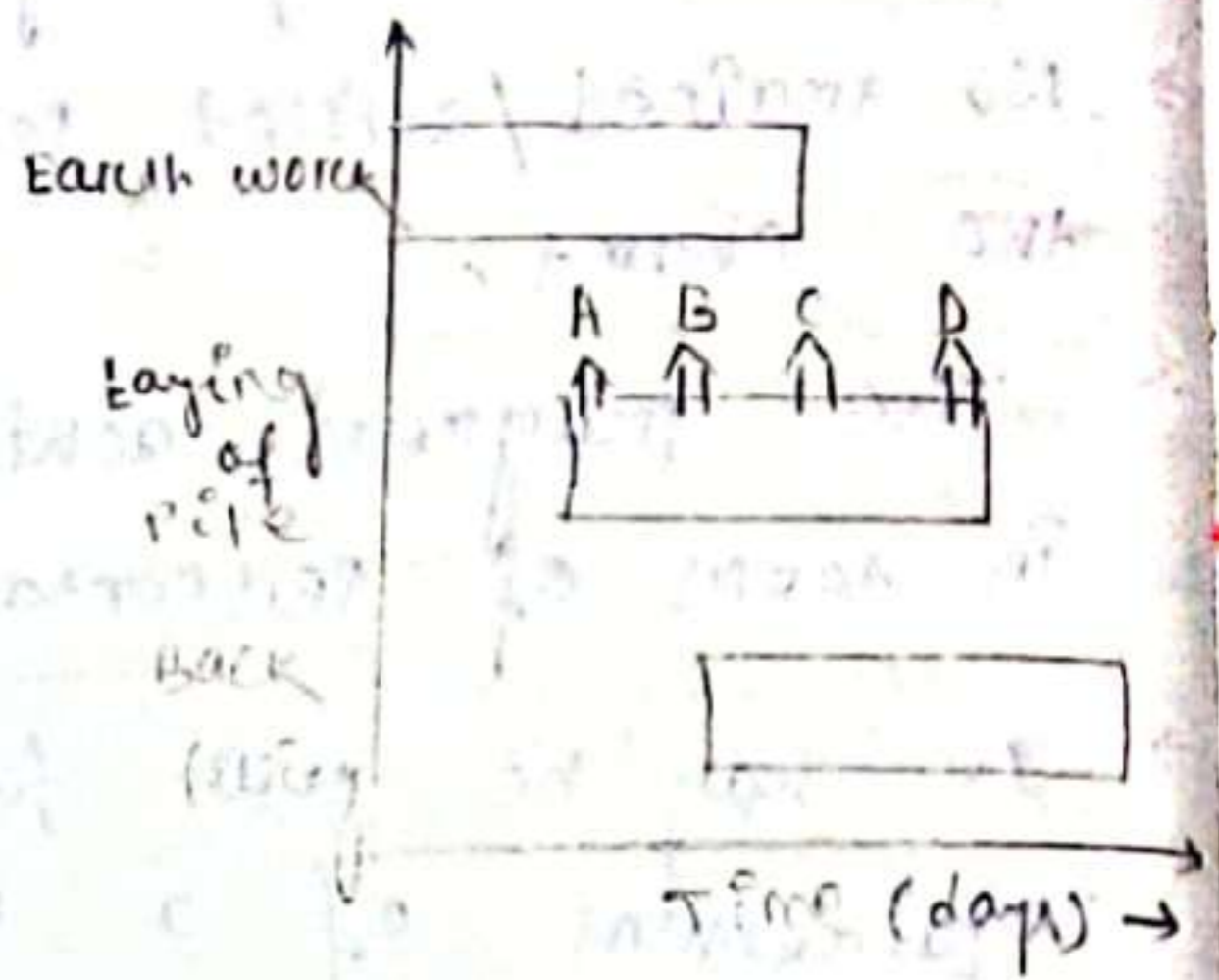
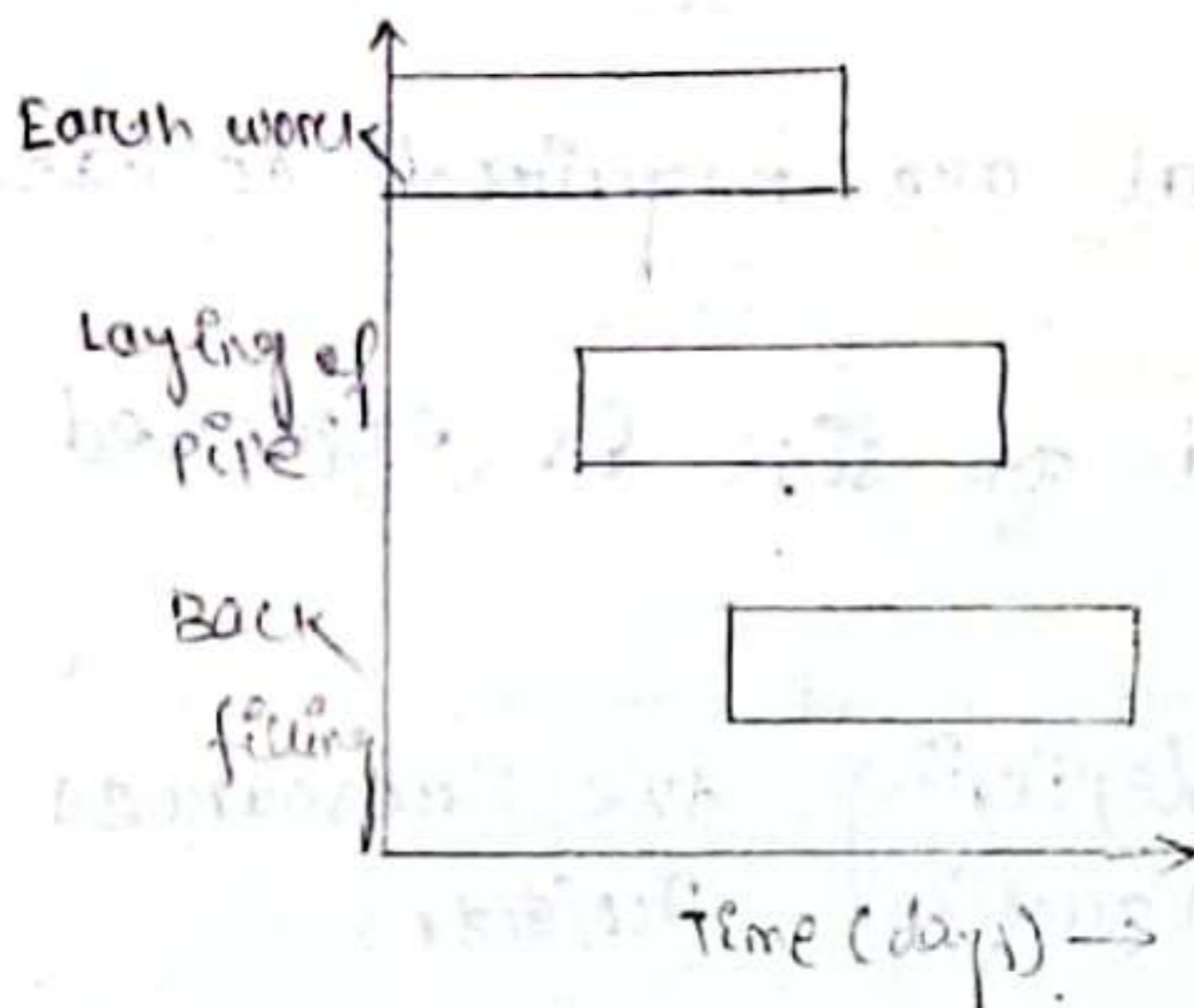
Advantages of Bar-chart

- It is simple to draw, easy to understand and can be drawn quickly.
- No trained/skilled personal are required to make the chart.
- The progress achieved at site is expressed in terms of percentage.
- It may be used for depicting the resources requirement of a construction project.
- It provides a visual representation of the entire project which shows exactly when each of the above activities is supposed to start or finish.

Limitations of Bar-chart:-

- Lack of degree of details
- ↳ Lack of degree of details:-
- In case of big projects only major activities can be shown, if all the activities of big project are shown on the bar chart then it may become too clumsy. Therefore bar charts are not preferred for big projects.
- An activity is represented as a bar, without any details of sub-activities contained in it. Due to this effective control over activities can not be done.
- For example consider activity in the below bar chart 'Laying of pipe work' is shown as a bar, but following sub-activities controls the satisfactory and timely completion of the activity.

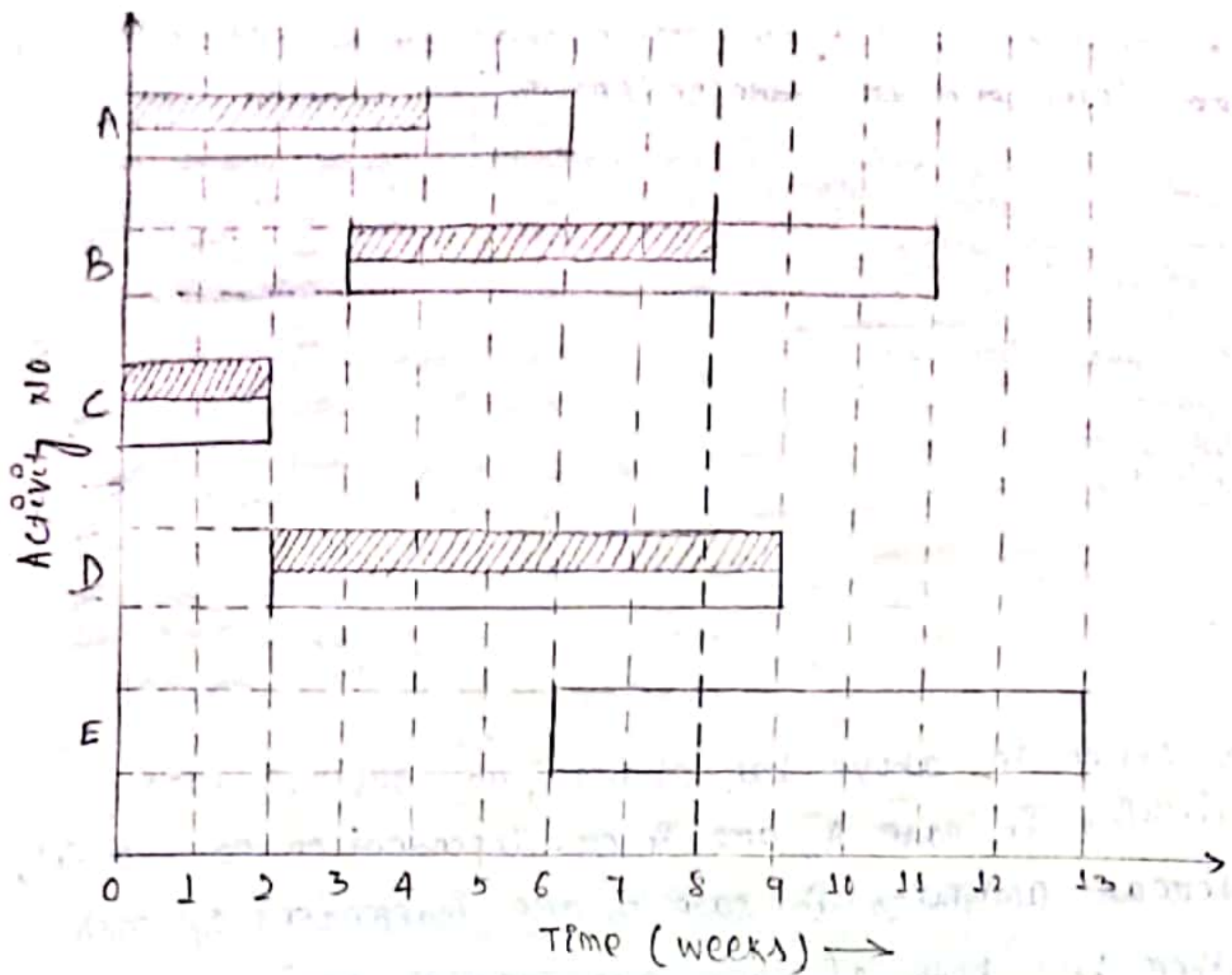
- A. Notice inviting for supply of pipe.
- B. Finalisation of bid.
- C. Supplies of pipes at size.
- D. Final laying of pipe.



→ For the satisfactory and timely completion this activity these sub-activities should be scheduled properly. The above detail can be shown effectively by marking stages (also called milestones) on that particular activity bar.

2) Review of project progress.

- A bar chart does not show the progress of work in the project and therefore it can not be used as a control device.
- As progress made at a particular instant of time is required for proper control of the project.
- The difficulty or drawback can be overcome by showing the progress of each activity by hatched lines in the half of the width of the bar.



→ Progress of each activity is marked on the above bar chart with the help of hatched lines at the end of 8 weeks.

Following observations are made :-

- 1) Activity A is behind schedule by 4 weeks
- 2) Activity B is on schedule and Activity C is completed.
- 3) Activity D is ahead of schedule by 1 week.
- 4) Activity E has not started yet and therefore need to be rescheduled.

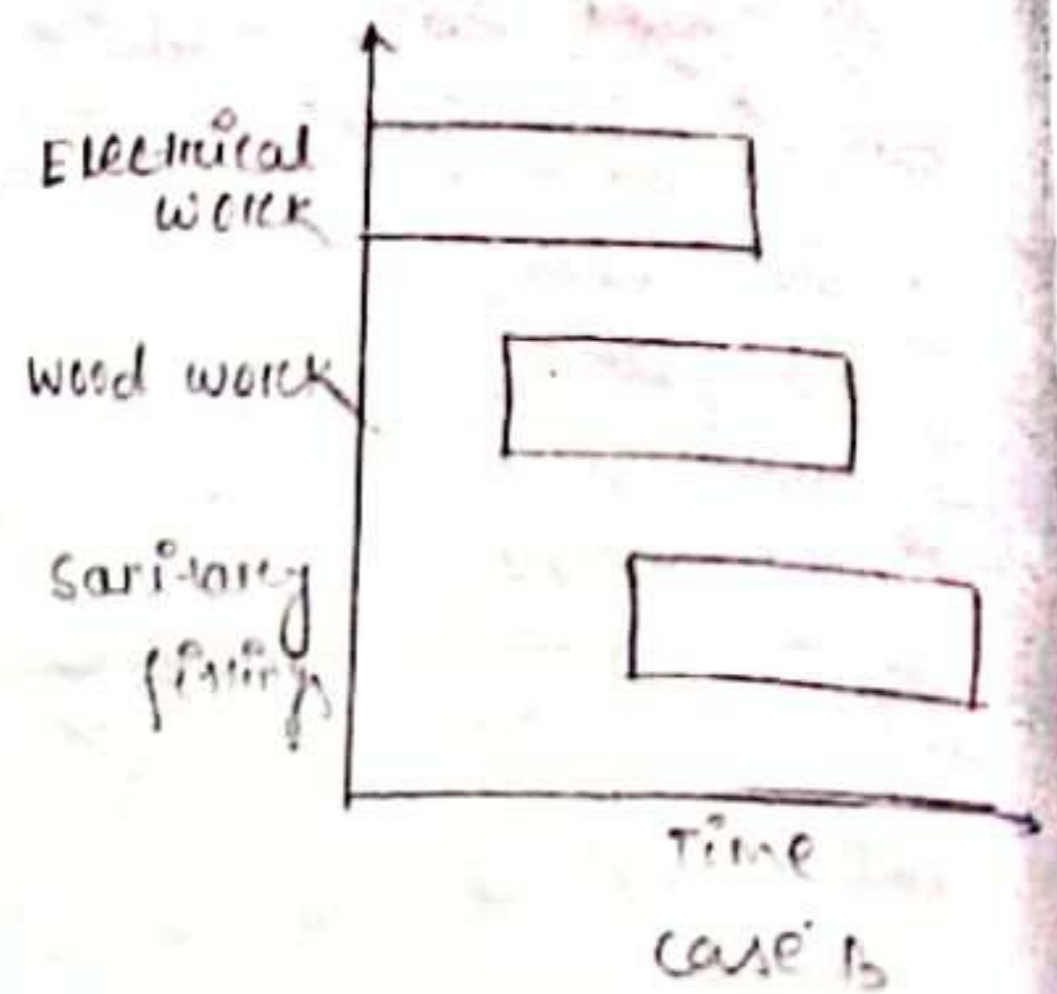
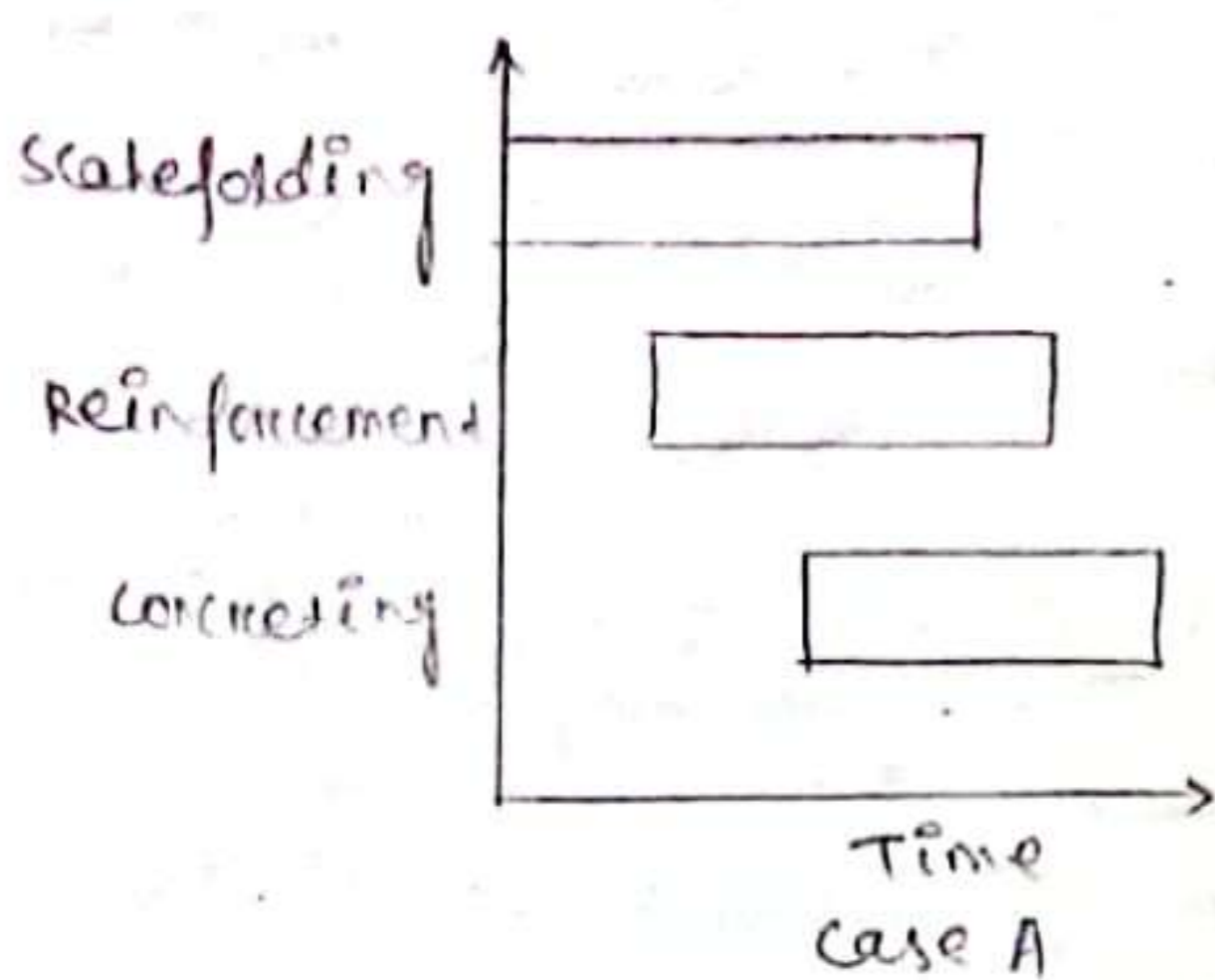
3) Activity Inter-relationship :-

→ There is a serious drawback with the bar charts that they do not show interdependencies and relationship between various activities of the project.

→ We know that there are some activities of a project which are performed concurrently, while there are some activities which are performed only after the completion of some other activity.

→ Activities which start after completion of some other activity are shown serially, whereas concurrent activities are represented by parallel bars.

→ one can not draw a conclusion that concurrent activities are dependent or independent of each other.



→ As shown in above bar charts, we observe that activities in case A are inter-dependent on each other, whereas activities in case B are independent of each other but both of them are parallel activities.

4) Time uncertainties :-

→ Bar charts are not at all useful in those projects where there are uncertainties in determination of time required for completion of particular activities.
e.g → research projects.

→ Because of the uncertainties of time determination will lead to rescheduling of few activities and the flexibility of rescheduling can not be shown in bar chart diagrams.

5) It does not indicate the critical activities of the project.

→ It does not distinguish between critical and non-critical activities, knowledge of critical activities need the maximum attention of construction team to finish the project in time.

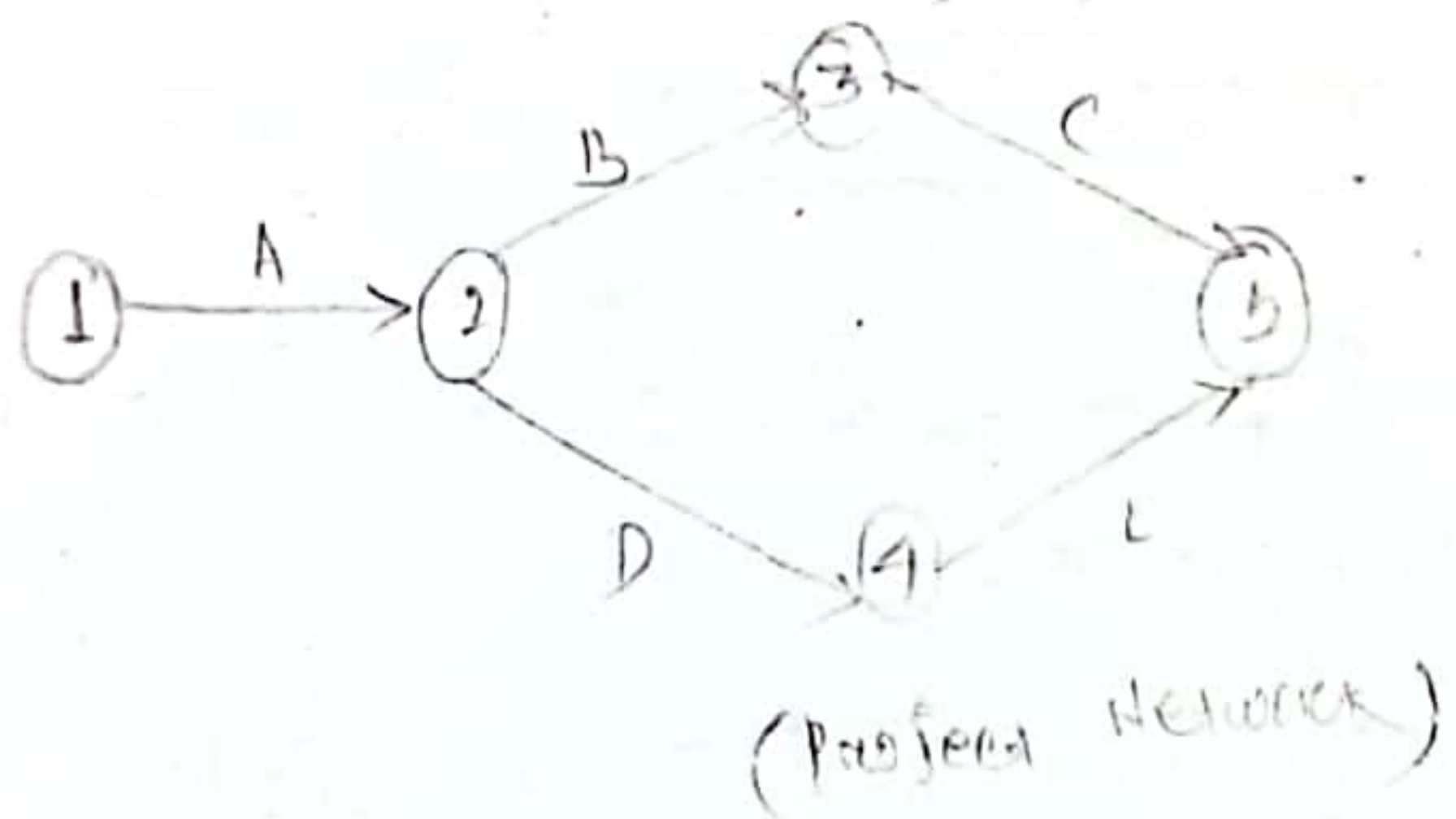
6) No cost optimization :-

→ since exact critical path is not available in bar chart so it is not possible to crash the activities and get the optimum cost and duration of the project.

CPM (Critical path Method) :-

These are used for scheduling of project. Activities

Project :- consists of N no. of activities interrelated to each other and are to be executed in their order for completion product.



NO. of Activity → A, B, C, D, E

NO. of EVENT → 1, 2, 3, 4, 5

A is predecessor of B & D.

B is predecessor of C

NO predecessor of A.

D is " of E.

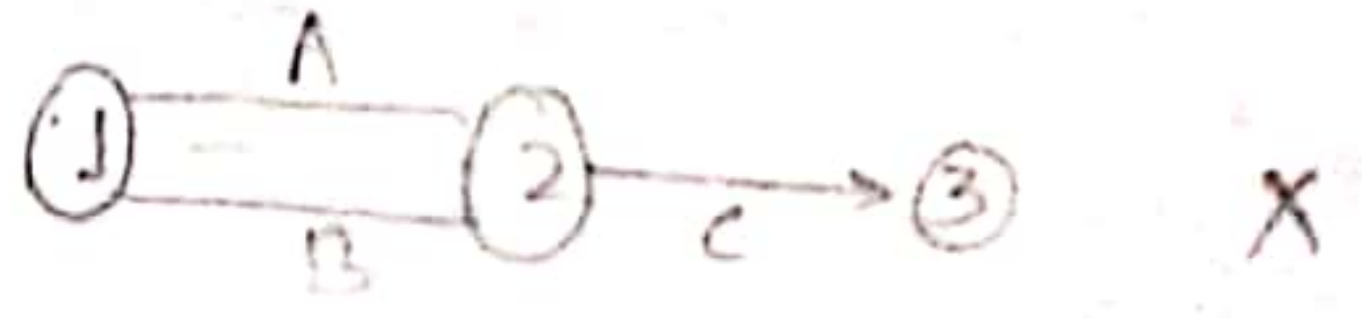
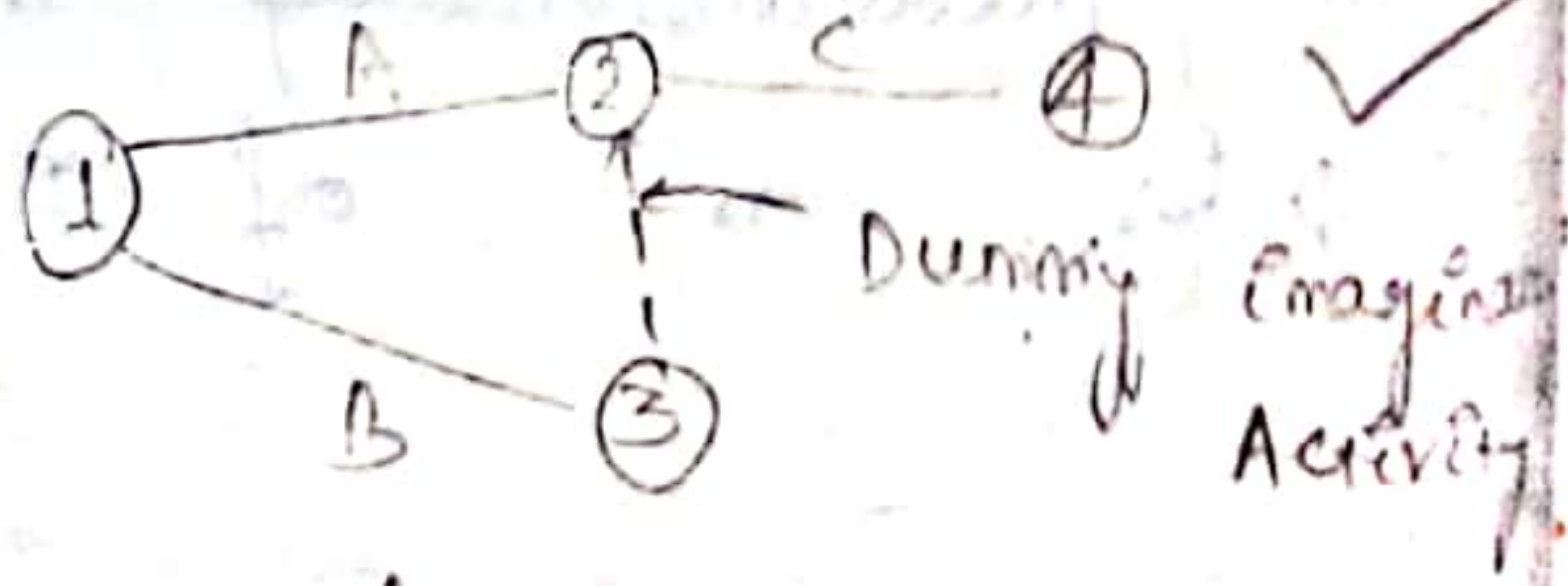
Rules to draw project network :-

- There should be single arrow for every activity
- Every activity should have start & end node
- Project should follow in one direction.
- Project should have only one start node and only one finish node.



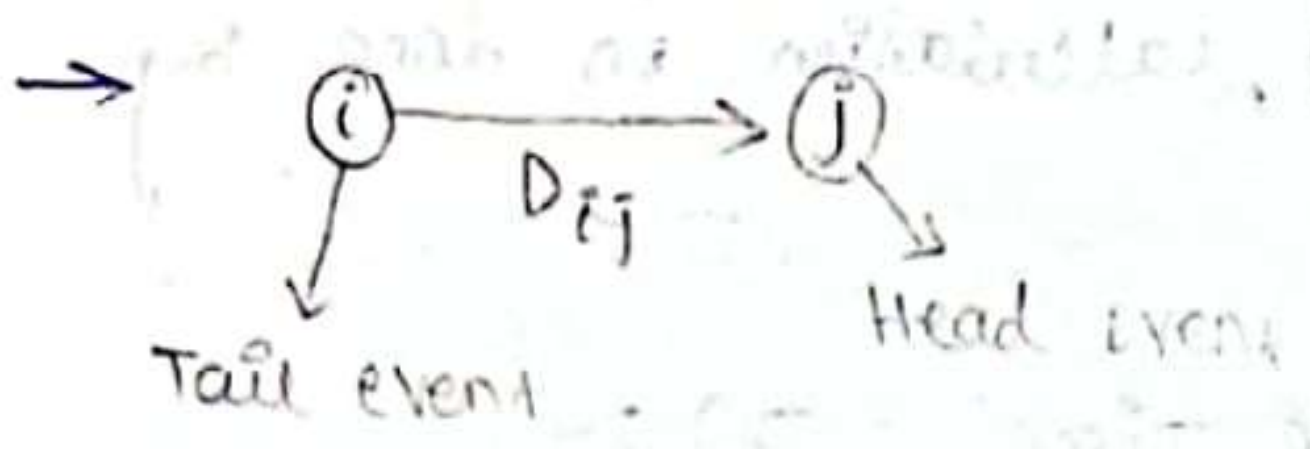
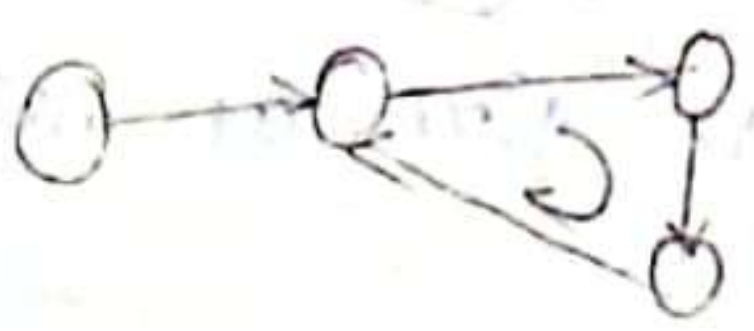
→ Two Activity should not have common start and end nodes.

Activity	Predecessor
A	—
B	—
C	A, B



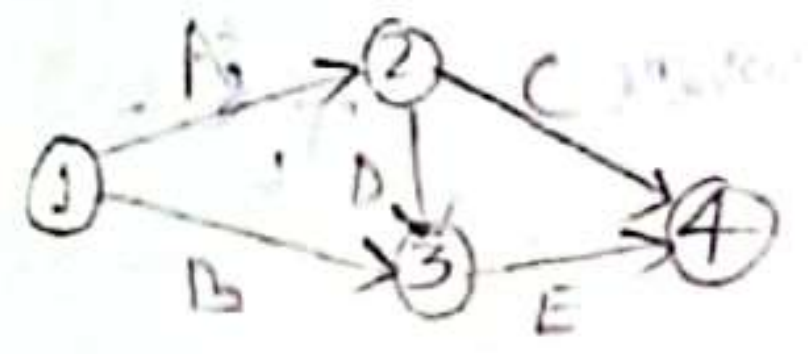
Dummy Activity:-

- It consumes no resources and time (Duration = 0)
- It used to satisfy predecessor relationship.
- we can use any kind of dummy activity but EF only needed.
- there should be no looping allowed in network.

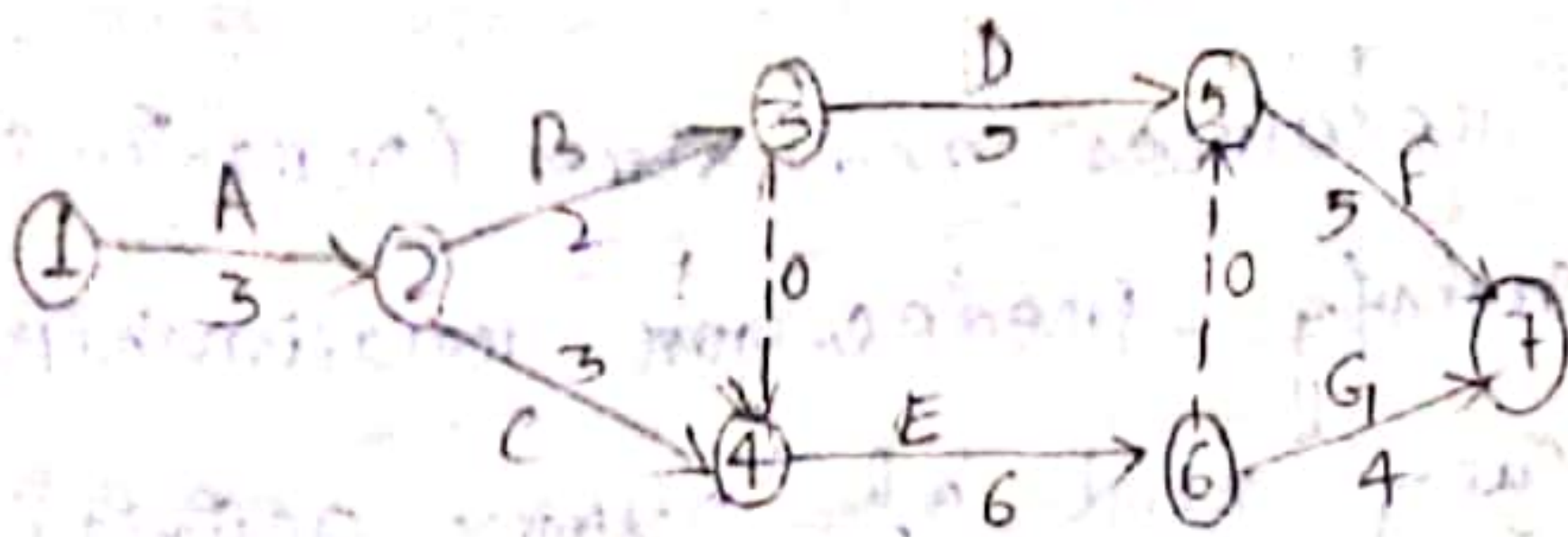


$$j > i$$

Activity	Event	Duration
A	1-2	15
B	1-3	20
C	2-4	08
D	2-3	10
E	3-4	12



Activity	Duration	Activity Immediately Preceding	Following
A	3	None	B, C
B	2	A	D, E
C	3	A	E
D	6	B	F
E	6	B, C	F, G
F	5	D, E	None
G	4	E	None



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Event time :-

Earliest occurrence time (TE) :-

It is the earliest time at which an event can occur.

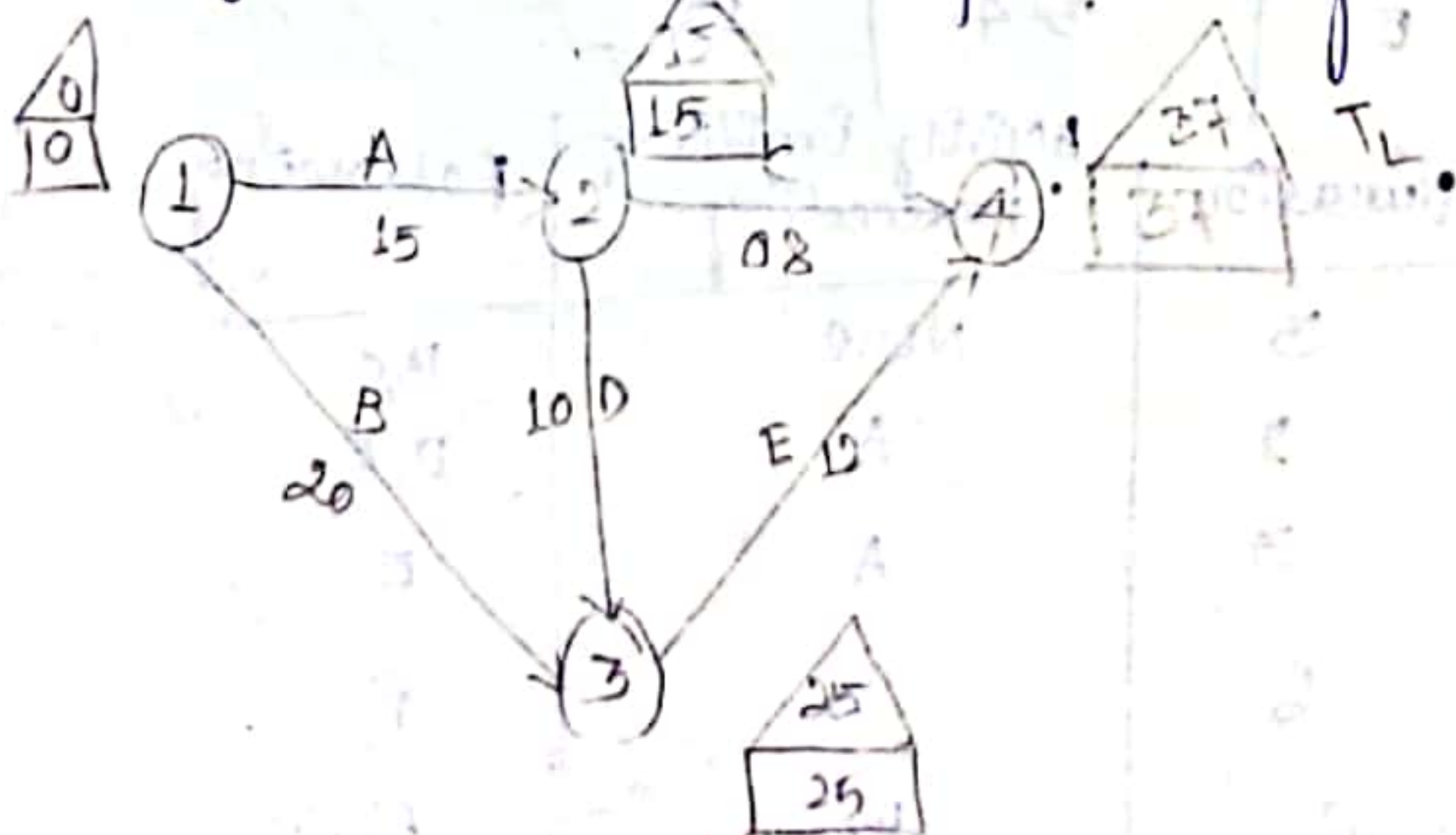
$T_E^j = \text{Maximum}(T_E^i + t^{ij})$, calculation is done by forward pass rule.

Latest allowable occurrence time (TL) :-

It is latest (delayed) time by which an event must be completed so such that the project completion time is not affected.

where, $T_L^i = \text{Minimum}(T_L^j - t^{ij})$ calculated by backward pass rule.

t^{ij} = Duration of activity i-j.



Draw the project network and calculate the duration of the project and find the critical path and Activity

Activity	EVENT	Duration
A	1-2	15
B	1-3	20
C	2-4	08
D	2-3	10
E	3-4	12

Earliest occurrence time of EVENT ① = 0

Earliest occurrence time of EVENT ②

$$= T_E^1 + t^{1-2}$$

$$= 0 + 15 = 15$$

Earliest occurrence time of EVENT ③

$$T_E^3 = \max \left(\begin{aligned} & T_E^2 + t^{2-3} \\ & = 15 + 10 = 25 \end{aligned} \right)$$

and $T_E^3 = T_E^1 + t^{1-3}$

$$= 0 + 20 = 20$$

maximum of value of $T_E^3 = 25$.

Earliest occurrence time of EVENT ④

$$T_E^4 = \max \left(\begin{aligned} & T_E^3 + t^{3-4} = 25 + 12 = 37 \\ & T_E^2 + t^{2-4} = 15 + 8 = 23 \end{aligned} \right)$$

maximum value of $T_E^4 = 37$.

Event 3

$$\begin{aligned}T_L^3 &= T_L^4 - t^{3-4} \\ &= 37 - 12 \\ &= 25\end{aligned}$$

Event 2

$$T_L^2 = T_L^4 - t^{2-4}$$

$$= 37 - 8$$

$$= 29$$

$$T_L^1 = T_L^3 - t^{1-3}$$

$$\begin{aligned}T_L^3 &= T_L^4 - t^{3-4} \\ &= 37 - 12 \\ &= 25\end{aligned}$$

$$T_L^2 = \text{minimum} \begin{pmatrix} T_L^3 - t^{2-3} = 25 - 10 = 15 \\ T_L^4 - t^{2-4} = 37 - 8 = 29 \end{pmatrix}$$

Minimum value = 15.

$$T_L^1 = \text{minimum} \begin{pmatrix} T_L^2 - t^{1-2} = 15 - 15 = 0 \\ T_L^3 - t^{1-3} = 25 - 20 = 5 \end{pmatrix}$$

$$\text{Slack} = T_L - T_E$$

START AND FINISH TIME OF ACTIVITY :-

EST \rightarrow Earliest start time of an activity.

EFT \rightarrow Earliest finish time

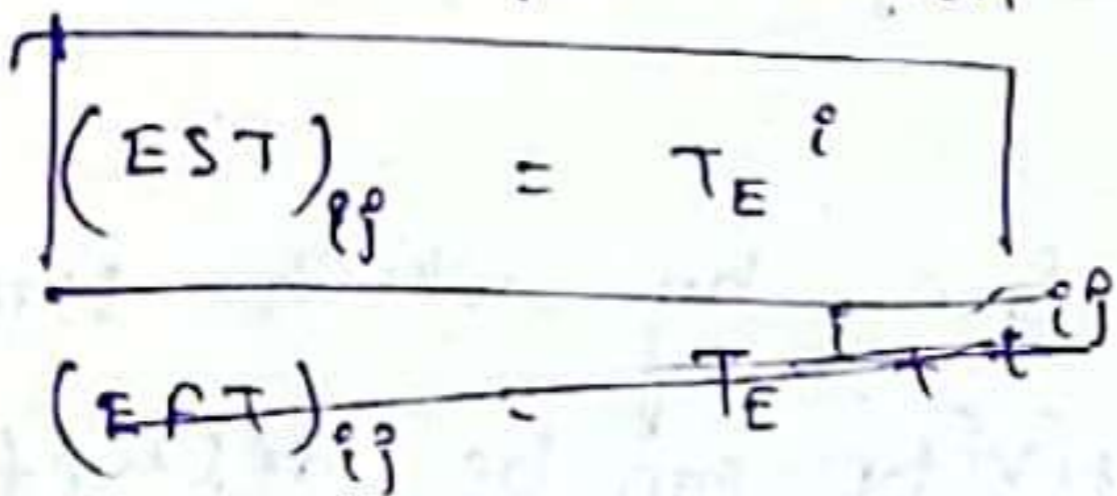
LST \rightarrow Latest start time

LFT \rightarrow Latest finish time.

1) Earliest start time :-

\rightarrow It is the earliest time by which an activity can start.

\rightarrow It is equal to the earlier event time (T_E) for the event from which the activity arrow originate



2) Earliest finish time :-

\rightarrow It is the earliest time by which the activity can be completed.

\rightarrow It is equal to the earlier start time + the activity duration.

$$EFT = T_E^i + t_{ij}$$

3) Latest start time (LST) :-

\rightarrow It is latest or delayed time by which the activity can started without delaying the completion of project.

\rightarrow LST is equal to the latest occurrence time (T_L) for the event at which the activity arrow terminates minus the duration of the activity

$$\boxed{LST^{iP} = T_L^i - t^{iP}}$$

→ Latest Finish Time (LFT) :-

→ It is the latest ^{or} delayed time which the activity can be finished without delaying the completion of project.

→ It is equal to the latest occurrence time (T_L^j) of the event at which the activity terminate.

$$\boxed{LFT^{iP} = T_L^j}$$

Float :-

It indicates the time by which starting or finishing of an activity can be delayed without affecting the project completion time.

→ Total float

→ free total float

→ Independent float.

1) Total float :-

→ Difference between maximum time available and actual time required for the completion of activity.

→ Maximum available time we can get when activity starts at earliest time and finish by latest finish time.

$$\text{Total float } (f_T) = T_L^j - T_E^i - t^{ij}$$

$$\text{OR } LST - EST$$

$$LFT - \cancel{EFT} - \cancel{EFT}$$

2) Free float :-

It is defined as the amount of time by which an activity can be delayed without affecting the EST of ~~the~~ succeeding activity,

$$f_F = T_E^j - T_E^i - t^{ij}$$

$$\text{OR } f_F = f_T - S_j$$

3) Independent float :-

It is the amount of time by which an activity can be delayed when all the preceding activities are completed as late as possible and all succeeding activities started as early as possible,

$$f_{ID} = f_F - S_j$$

Activity	Event	Duration	EST	EFT	LS	LFT	FT	FF
A	1-2	15	0	15	0	15	0	0
B	1-3	20	0	20	5	25	5	5
C	2-4	08	15	23	29	37	14	14
D	2-3	10	15	25	15	25	0	0
E	2-3	2						
E	3-4	12	25	27	25	37	0	0

\therefore As $f_T = 0$ for A, D, E.

Therefore, $\textcircled{1} \rightarrow \textcircled{2} \rightarrow \textcircled{3} \rightarrow \textcircled{4}$

OR A — D — E

is critical path.

Critical path :-

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→ It is the longest path time where in a project. These time also gives project duration.

CPM

→ In CPM critical path passes through the critical activities i.e., activities having total float is equal to zero.

Note :-

In CPM critical path passes through those events where ~~stage~~ ^{slack} is zero.

Although it is a necessary condition but not sufficient condition.

PERT :-

Project Evaluation And Review Technique .

It is used for planning, scheduling and monitoring the project.

Time estimates :-

Deterministic :-

→ Planner has enough knowledge about activity and gives a single estimate of duration which is almost accurate.

→ This approach of estimating time used in CPM method.

Probabilistic Approach :-

→ Planner does not have much idea about the activity as there is little and no past history about it. The limits within which the duration is occur is estimated.

→ ~~PERT~~ PERT follows the probabilistic approach and absorbs the uncertainties into the time estimate for activity and project duration.

→ PERT is used in R & D type project such as space industry, defence industry etc. as such projects are of non-repeating type or one through type for which correct time estimate can not be made.

→ For the PERT analysis is event oriented in this analysis interest is more focused on the events rather than activities.

→ In order to take ~~into~~ account the uncertainties involved in the activity times. Three ^{kind} ~~types~~ of each activity time estimate is made for each activity in PERT.

1) Optimistic time (t_o)

2) Pessimistic time (t_p)

3) Most likely time (t_m) ?

1) Optimistic time (t_o) :-

→ It is the minimum time required for an activity if everything goes perfectly well without any problems or adverse conditions developed during the execution of the activity.

→ In this time estimate no provisions are made for delay or setbacks and better than normal conditions are assumed to prevail during the execution of the activity.

2) Pessimistic Time Estimate (t_p) :-

→ It is the maximum time required for an activity if everything goes wrong and abnormal situations prevail.

→ This time estimate does not include the possible effects of major external catastrophes such as flood, earthquakes, fire, labour strikes etc.

3) Most likely time estimate (t_m) :-

→ It is time required to complete the activity if normal conditions prevail.

→ This time estimate lies between pessimistic and optimistic ~~or~~ time estimates.

Expected time of an activity (t_e) ..

→ After the estimation of ~~3~~ 3 type estimates we should obtain an average or mean time taken for the completion of an activity.

→ The average or mean time taken for the completion of an activity is called as expected time.

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

Standard deviation :-

$$\text{Standard deviation } (\sigma) = \frac{t_p - t_o}{6}$$

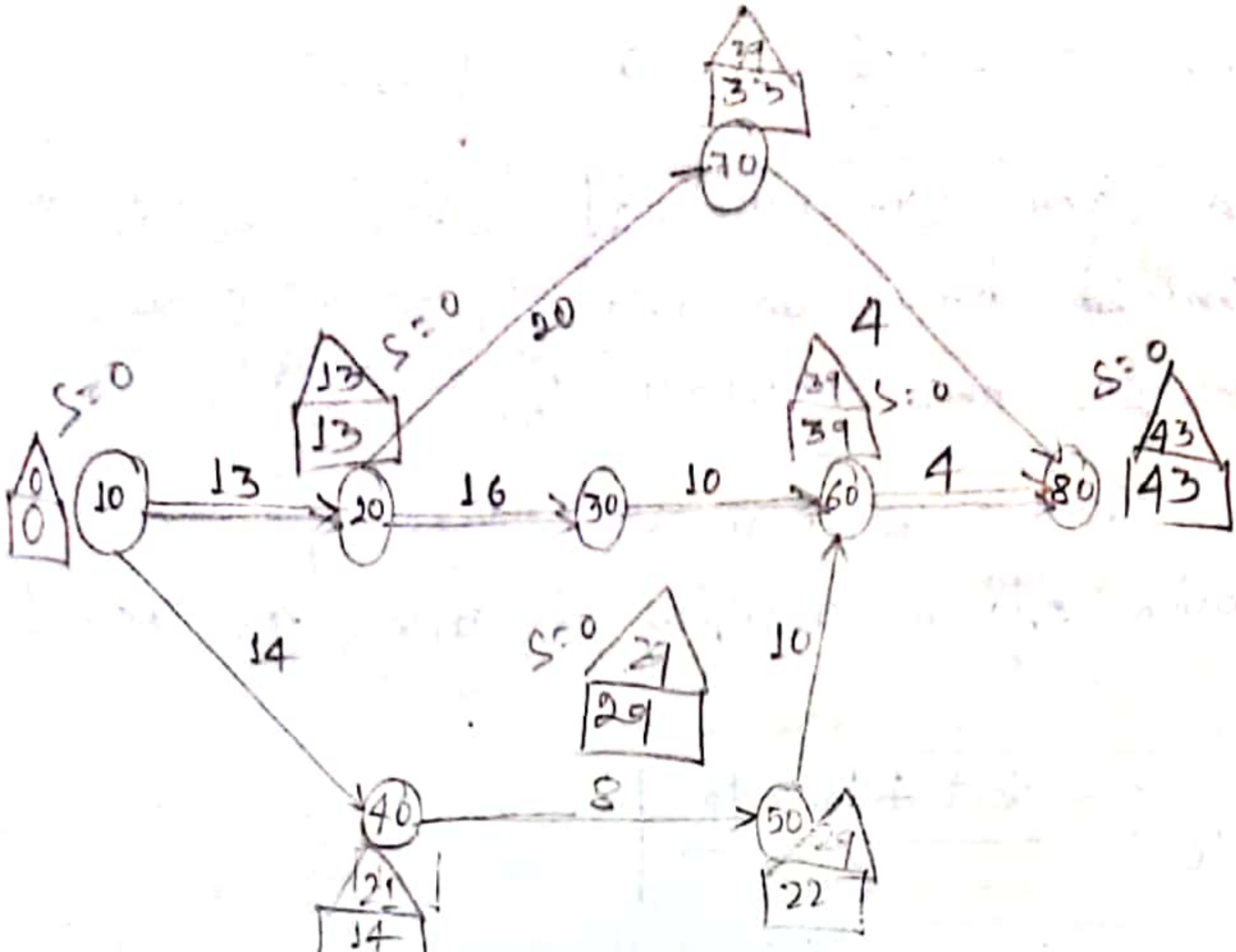
$$\text{Variance } (\sigma^2) = \left(\frac{t_p - t_o}{6} \right)^2$$

Note :-

Variance is the measure of uncertainties greater the variance greater will be uncertainties.

Q ~~What~~ with the help of given data, draw the diagram and find the project completion time based on expected time ..

Preceding event node	Succeeding event node number	Optimistic time (t_o)	Conservative time (t_m)	Most likely time (t_p)	Expected time (t_e)
10	20	10	12	20	13
10	40	5	15	19	14
20	30	10	15	26	16
20	70	15	20	25	20
30	60	5	10	15	10
40	50	4	8	12	8
50	60	5	10	15	10
60	80	2	4	6	4
70	80	2	4	6	4



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

$$= \frac{10 + 4 \times 12 + 20}{6}$$

$$= 13$$

Therefore, critical events are $10 \rightarrow 20$
 $10 \rightarrow 20 \rightarrow 30 \rightarrow 60 \rightarrow 80$

completion time in terms of expected time
 $\therefore 13 + 16 + 10 + 4 = 43$ week.

PERT

CPM

- | | |
|---|---|
| 1) Network diagram is event oriented. | 1) Network diagram is activity oriented. |
| 2) It uses probabilistic approach and is suitable for research and development and non repetitive project. | 2) It uses deterministic approach and is suitable for repetitive type of project. |
| 3) 3 time estimates are given for completion of an activity. | 3) Single time estimate is given for each activity. |
| 4) Follows β distribution. | 4) Follows Normal distribution. |
| 5) Cost of project is directly proportional time and hence to minimize the project cost the project completion time is minimized. | 5) Cost model has to be developed using which minimum cost of the project is found. |
| 6) Critical events are identified by using the concept of slack. | 6) Critical activities are identified by using concept of float. |
| 7) Critical path will be path joining the critical. | 7) Critical path will be the path joining all the critical activities. |

D-14-10-19

Define network analysis. Write down the features of network analysis.

Ans- Following are the features of network planning:

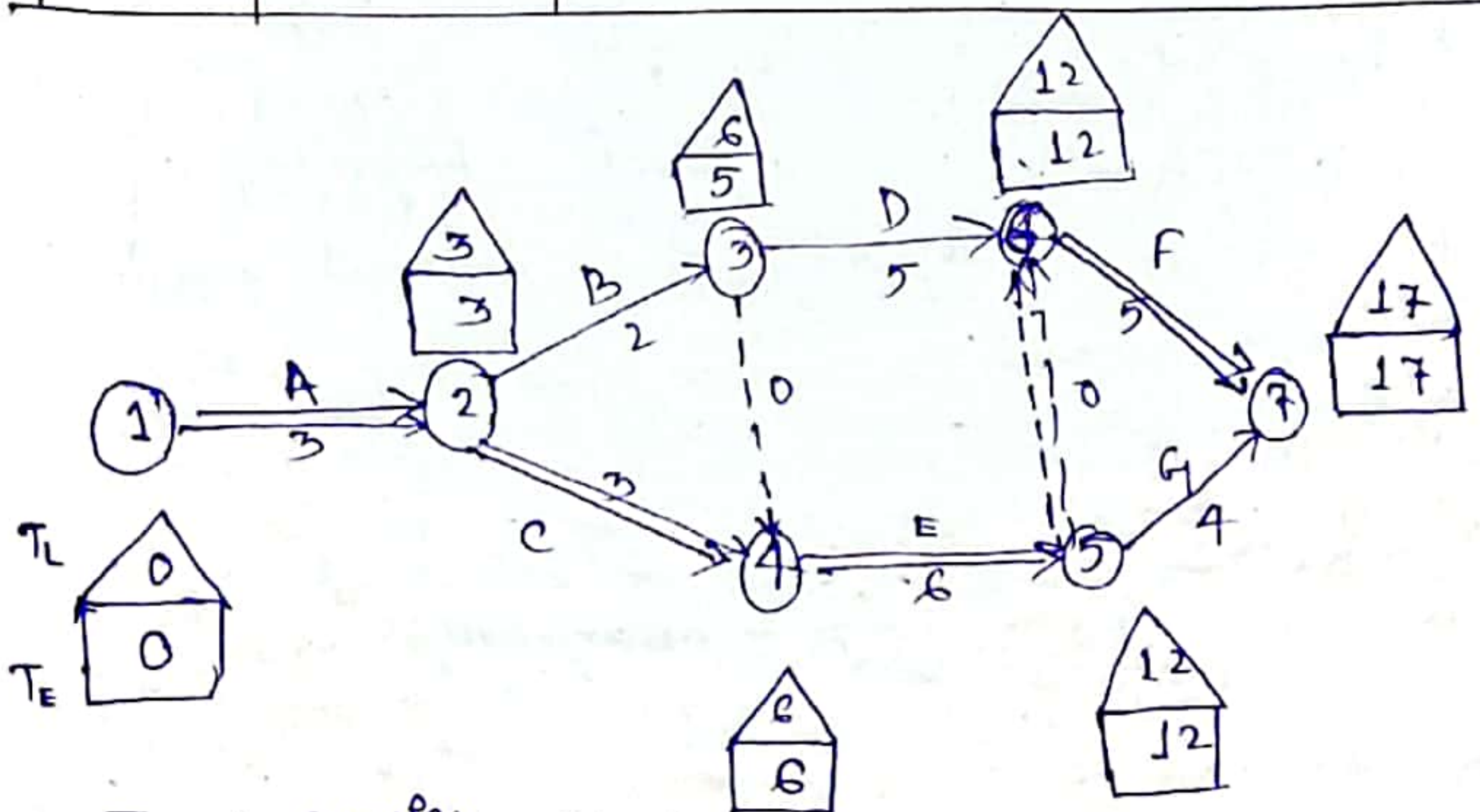
- 1) It expresses the project in a graphical form.
- 2) It forms a basic document for the preparation of work schedules of different tasks and activities connected with the project.
- 3) It gives an overall picture at a glance of the whole project and indicates the inter-relationship between various activities, jobs and events of the project.

- 4) It helps in ascertaining activities over critical path and at the same time, the tolerable slackness or delay for other activities can also be known from the study of network diagram of the project.
- 5) It is a flexible self-adjustment technique and it can be easily modified for various reasons such as mistakes in original calculation, strike of labourers, new rules and regulations, availability of resources etc.
- 6) It serves as a check ~~time~~ on time of completion with respect to the cost and hence, it grants optimum utilization of resources.
- 7) It serves as a medium of communication for various groups associated in the execution of the project.
- 8) The available resources can be diverted and utilized advantageously over the activities along the critical path for the project.

Problem:-

From data of the table prepare the network diagram, decide the completion period and complete the critical path method schedule.

Activity Item	Duration in days	Activity following	Immediately preceding
A	3	None	B, C
B	2	A	D, E
C	3	A	E
D	5	B	F
E	6	B, C	F, G
F	5	D, E	None
G	4	E	None



T_E = Earliest occurrence time
 T_L = Latest allowable finish time

Activity	Duration	EST	EFT	LST	LFT	F _T	F _L
A	3	0	3	0	3	0	0
B	2	3	5	4	6	1	0
C	3	3	6	3	6	0	0
D	5	5	10	7	12	2	2
E	6	6	12	6	12	0	0
F	5	12	17	12	17	0	0
G	4	12	16	13	17	1	0

As total float zero, in A-C-E-F activity, so this path is called critical path.

Stores :-

A wide variety of stores and equipments is utilized for construction work.

This includes building material like bricks, stone, aggregates, cement, lime, steel bars, structural steel, sanitary fittings, water supply, electrical stores and fittings as well as variety of machinery and equipment.

Objectives of Store Management :-

- Minimum utilisation of the space for storage.
- Easy handling during the process of receipt, inspection, storage and issue and to ensure undisturbed flow.
- Preservation of stores accounts against spillage, breakage, deterioration and theft.
- Proper maintenance of store accounts of store accounts to have control over receipts and issues and to fix accountability of any deficiency.

Functions of Store Management :-

Following are the functions of store department and duties of store keeper.

- i) Receiving ~~the~~ materials, ^{goods} and equipments and checking them for identification.
- ii) Proper recording to receipts of goods.
- iii) Placement of right materials at right place.
- iv) Issue of items to the user only on the receipts of authorized store requisition.

- v) Recording and updating receipts and issue materials.
- vi) Preventing unauthorized p. from entering the store.
- vii) Planning store spaces.

LIST OF VARIOUS STORAGE SPACE :-

- a) Floor space
- b) Platform
- c) RACKS
- d) Shelves
- e) Bins
- f) Trays
- g) Silos & bunkers
- h) Barrels / tankers.

Issue of materials from stores :-

Indent :-

It is basically a letter raised by employees of an institute asking for material needed which are present in the store. The indents can be raised by any employee when he requires items from the stores.

Indent format

User department code					
Sl. No.	Item code	Item name	Qty required	Qty issued	Remarks

Invoice :-

An invoice is a document that is issued by a seller to the buyer. An invoice indicates the quantities and costs of the goods or service rendered.

Bin Card :-

- Bin card is the statement of all the receipts and issue of the stock from the store department. It is also called stock card or bin tag.
- This card is attached to each bin or container of store.
- It is the responsibility of the store keeper to write every in and out of stock from the store.
- The physical stock count and stock quantity reported according to the bin card should be equal; otherwise internal audit department will have the right to investigate the matter with management.
- Bin card only contain quantity column for both receipts and issue. At the close of each transaction the stock level is calculated to make sure that at every point of time, it can be reconciled with the physical count.

BIN CARD

Product Name :- _____

In charge :- _____

Location :- _____

Date	In or Receipts	Out or Issue	Total on Hand or Balance

STORE Ledger :-

- Store ledger look like bin card but there is slightly minor difference found between these two. which is the addition of value figures of in store ledger.
- As we know that bin card only keep quantity in records, so it lacks the valuation of inventory. In order to fulfill this deficiency, costing department takes support from store ledger.

STORE LEDGER CARD

Product Name :- _____

Location :- _____

Receipts			ISSUES			on order		
Date	Quantity	Value or Price	Date	Quantity	Price	Date	Quantity	Price

Comparison between Bin card and store ledger.

BIN CARD	STORES LEDGER
1) It is used only to record receipts and issues of quantity and balance there in.	1) store ledger is used to record both quantity and the amount of receipts and issues.
2) It is maintained by the store in charge or store keeper.	2) It is maintained by the costing accounting department of entity.
3) It is updated as and when receipts and issues are made in the store department.	3) It is updated when the costing department gets the proper documents from the relevant department normally from store department.

4) It is kept inside the store department.

5) Transactions are updated individually because at every point of time, store keeper needs to be aware of the actual position of the stock.

4) It is kept outside the store department or at a place where store keeper has no access.

5) It is normally updated after a certain period and one entry is posted for similar items.

Store accounting procedure :-

The term store keeping is very wide in sense and includes all operations involved in the management and handling of building materials which flow in and out of the stores of a big construction company.

The functions of store keeper may broadly be divided into the following 3 categories,

a) ordering

b) Receiving

c) Issuing

a) ordering :-

The requirements of different materials by various departments are collected and forwarded to the purchasing department.

b) Receiving :-

As soon as the materials are received, they are checked and stored properly.

c) Issuing :-

The materials are issued to the departments as required.

Following are the general principles to be strictly observed in store keeping,

- 1) Accounting
- 2) checking
- 3) Golden rule
- 4) Issuing materials

1) Accounting :-

The account of materials should be kept in such a way that it should be possible to work out the expenditure on stores during a certain period if the materials are purchased for a particular job, the cost may directly be debited to that job.

2) checking :-

Suitable checking procedure for physical verification of the materials should be established and followed at regular intervals.

3) Golden rule :-

The golden rule that no material should enter or leave the stores without documentary evidence, it should be strictly enforced.

4) Issuing materials :-

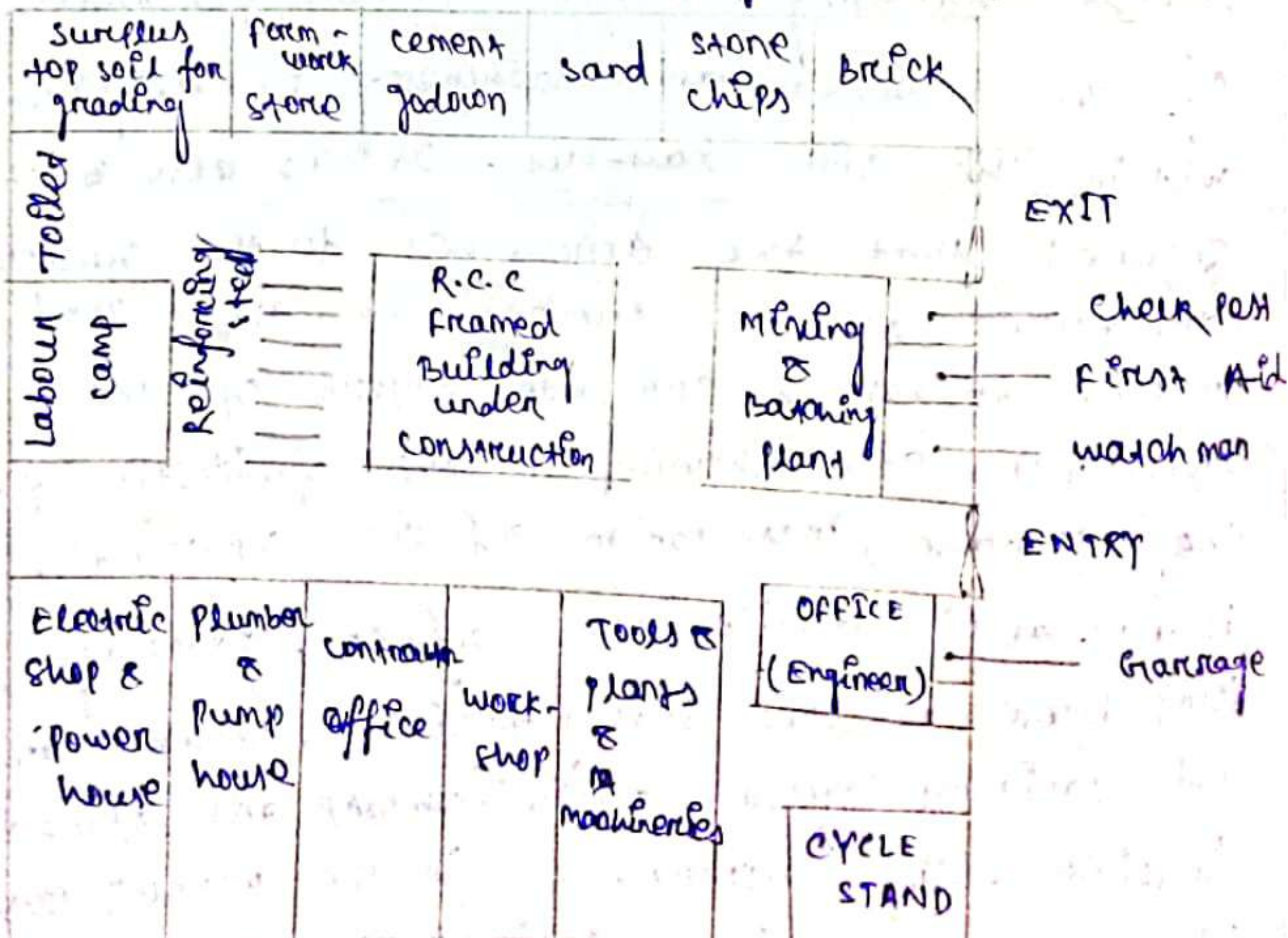
The standard requisition forms should be developed by the department and materials should only be issued against requisition forms duly signed by the authorised persons of the organisation.

Job Lay out :-

- A good job lay-out does pay good dividends in a construction programme. It is the basic responsibility of a site engineer to prepare a job lay-out for the project. He will draw to scale the area available for office, warehouses, storage of materials, equipments and earth, fabricating reinforcing steel etc.
- In preparing the job lay-out, a site engineer should endeavour to arrange all areas to reduce the time consumed in carrying materials from storage areas to the project, to facilitate the smooth working without any hindrance and to ~~over~~ obviate double handling. Proper approach for movements of the vehicles and machinery is required within the site lay-out. It has also to be ensured that the approaches to the various structures are not cumbersome. It is good practice to have a complete layout of the construction site showing all the facilities for the storage, installation of the construction plans and equipments, office, garage, pump house, electric supply-provision, water supply and sanitary system, service ~~to~~ camp and plant facilities, free approaches for the working places etc. In such a lay-out even care has to be

taken to see that there is adequate space for disposal of excavated debris, at least for the requirements of the back filling, so as to avoid double handling on back-filling materials.

Materials which are frequently used must be stored together close to the construction plant. The general office and warehouse should be located near the main entrance. It also requires fencing of the property line and security arrangement to have a close watch on the materials placed at the construction site. A typical job lay-out for a multi-storeyed framed R.C.C. building.



Explain the factors influencing the selection, design and layout of temporary facilities and services at construction site.

Ans - The following factors affect the job layout of a construction site.

- a) Access to site
- b) Topography of ground
- c) Temporary roads.
- d) Construction plants / machinery
- e) Construction method
- f) Construction material
- g) Accommodation
- h) Service

a) Access to site :-

There should be one entrance and exit to the site for proper flow of traffic and from the security point of view. Proper sign-post should be erected to direct transport vehicles delivering various construction material at site. The main gate should be managed by watch and ward staff to regulate entry to and exit from the site.

b) Temporary roads :-

Temporary roads are constructed within the site and also to provide access to the site and the nearest existing road. Temporary roads should be planned to serve all major items of plant / machinery and material storage yards.

at site

c) Topography ground :-

In order to avoid flooding of the work site during monsoons, temporary drain should be incorporated in the job layout. The storage yards should be located on higher and firm ground to avoid submergence and deterioration of materials.

d) Construction plant and machinery :-

Plant/machinery should be located in a nearer to that it serves the entire building or structure to be constructed. The location should also ensure minimum possible leads for the various construction material.

e) Construction materials :-

Provision of adequate storage yards and covered stores be made in the job layout for storage of various construction materials such as cement, bricks, aggregate, steel rounds and structurals, shuttering, scaffolding, timber, paints etc.

f) Construction method :-

The job layout should take into account the construction methods to be adopted at the worksite. For ex - If the building elements are to be pre-cast, the provision of a casting yard should be made in the job layout.

g) Accommodation :-

All site offices should be centrally located, preferable in a noise-free area. This will facilitate better co-ordination among the various sections at site.

h) Services :-

The job layout should take into account the provision of various services such as water supply, power supply, telephone lines, repair and maintenance yards etc.

Q Explain the points to be remembered while storing materials at site.

AM - Stored materials must not ~~also~~ create a hazard for employees. Employers should make workers aware of such factors as the material's height and weight, how accessible the stored materials are to the user, and the condition of the containers where the materials are being stored when stacking and piling materials. To prevent creating

hazards when storing materials, employees must do the follows:-

- keep storage areas free from accumulated materials that cause tripping, fires, or explosions, or that may contribute to the harboring of rats and other pests.
- place stored materials inside buildings that are under construction and at least 6 feet from hoist ways, or inside floor openings and at least 10 feet away from exterior walls;
- separate noncompatible material; and
- Equip employees who work on stored grain in silos, hoppers, or tanks with lifelines and safety belts.

In addition, workers should consider placing bound material on racks, and secure it by stacking, blocking, or interlocking to prevent it from sliding, falling, or collapsing.

CONSTRUCTION ORGANISATION

Ch-05

D-17-10-19

An organisation is a group of person working together to achieve goal. It is the relationship which exist between people working together.

Types of organisation:-

- 1) Line organisation.
- 2) Line and staff organisation.
- 3) Functional organisation.
- 4) Project organisation.
- 5) Matrix organisation.

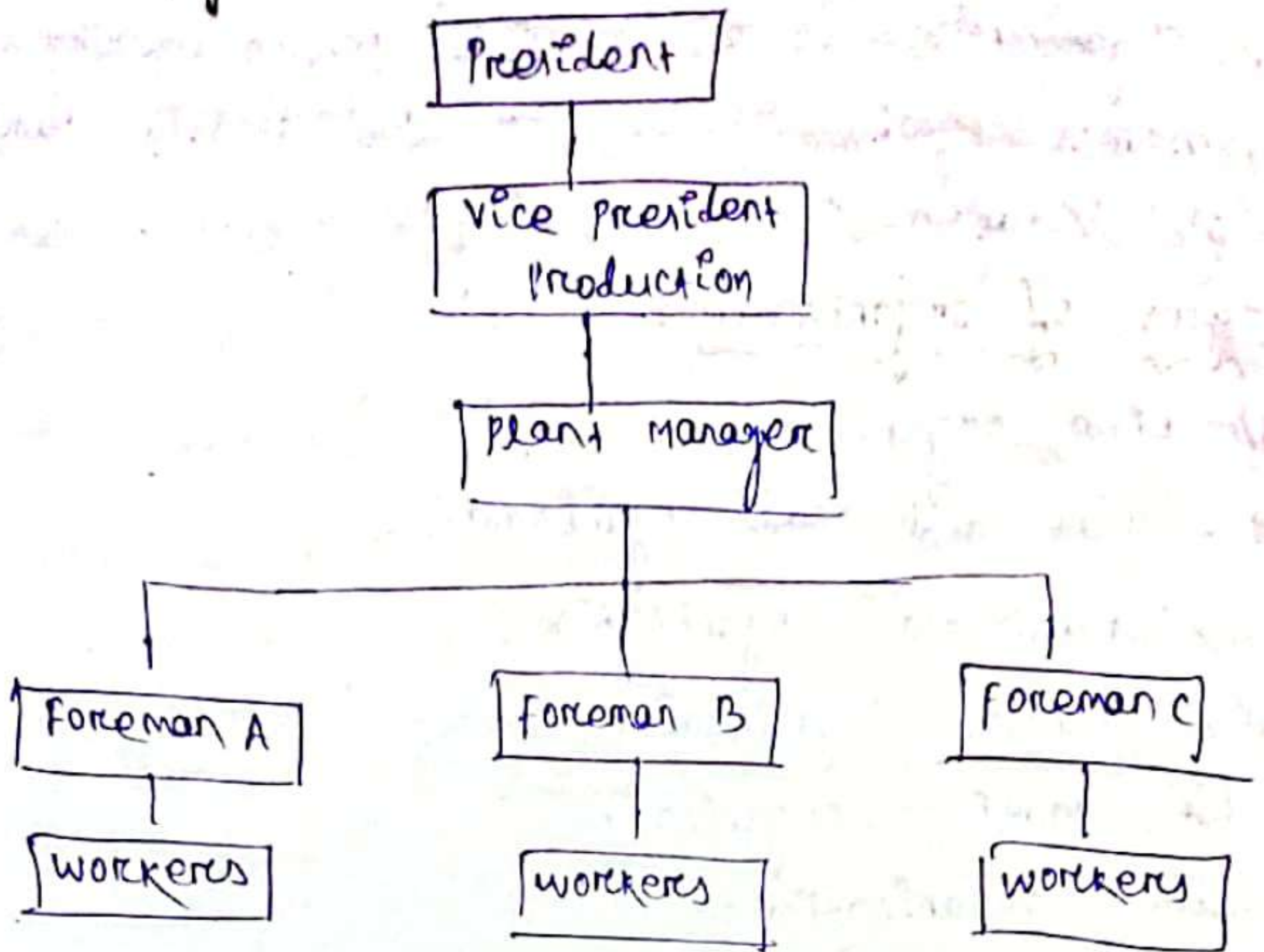
1) Line organisation:-

Line organisation is the simplest and oldest form of organisation structure, it is called as military or departmental or scalar type of organisation. Under this system, authority flows directly and vertically from the top of the managerial hierarchy down to different levels of managers and subordinates and down to the operative level of workers.

Line organisation authority, responsibility and accountability at each level. The personnel in line organisation are directly involved in achieving the objectives of the organisation.

Line organisation →

Line Organisation Structure



Advantages of Line Organisation :-

- The line organisation structure is very simple to understand and simple to operate.
- Communication is fast and easy and feedback can be acted upon faster.
- Responsibility is fixed and unified at each level and authority and accountability are clear-cut, hence each individual knows to whom he is responsible and who is ~~over~~ or ~~truth~~ responsible to him.
- Since it is especially useful when the company is small in size, it provides for greater control and discipline in the organisation.
- It makes rapid decisions and effective co-ordination possible. So it is economic and effective.

- The people in line type of organisation get to know each other better and to feel close to each other.
- The system is capable of adjusting itself to changing conditions for the simple reason that each executive has ~~so~~ sole responsibility in his own sphere.

Disadvantages of Line Organisation:-

- It is a rigid and inflexible form of organisation.
- There is a tendency for line authority to become dictatorial.
- It overloads the executive with pressing activities so that long-range planning and policy formulation are often neglected.
- There is no provision for specialists and specialisation, which is essential for growth and optimisation.
- Different departments may be much interested in their self-interests, rather than overall organisation interests and welfare.
- It is likely to encourage nepotism.
- It does not provide any means by which a good worker may be rewarded and bad one punished.

2) Line and staff organisation:-

This type of organisation structure is in large enterprises. The functional specialists are added to the line in line and staff organisation. Here, staff is basically advisory in nature and usually does not possess any command authority over line managers. Allen has defined line and staff organisation as follows.

"Line functions are those which have direct responsibility for accomplishing the objectives of the enterprises and staff refers to those elements of the organisation that help the line to work most effectively in accomplishing the primary objectives of the enterprises".

In the line and staff organisation staffs assist the line managers in their duties in order to achieve the high performance. So, in an organisation which has the production of textiles, the production manager, marketing manager and the finance manager may be treated as line executives, and the departments headed by them may be called line departments.

On the other hand, the personnel manager who deal with the recruitment, training and placement of workers, the quality control manager who ensure the quality of products and the ~~PR~~ public relations manager are the executives who perform staff functions.

Types of staff :-

The staff organisations mentioned above all have in common the fact that they are auxiliary to the main functions of the business. There are, however, different types of staff.

- 1) Personal staff
 - 2) Specialized staff
 - 3) General staff
- ~~Personal staff.~~

1) Personal staff :-

Personal staff consists of a personal assistant or adviser attached to the line executive at any level. His main function is to aid and advise the line executive as also to perform any other work assigned to him.

In business, the personal staff is typified by the private secretary, who may keep the executive's personal check book, buy his Christmas presents and arrange his appointments. General or business executives are given personal staff assistants on the same theory. Their time is too valuable to be spent in handling the details of daily living.

2) Specialised staff :-

The specialised staff have expert knowledge in the specific fields. The specialised staff are those that handle the specialised functions. For eg → accounting, personnel, engineering and research. It is now impossible for one man to familiarise himself with all the various specialities needed in the modern large business.

Hence the general or the company president, and perhaps the department head, is provided with experts in each field to counsel him on the various specialise staff could serve in any of the following capacities :-

- a) Advisory capacity
- b) service capacity
- c) control capacity

a) Advisory capacity :-

Its purpose is to render specialised advice and assistance to management when needed. Some typical areas covered by advisory staff are legal, public relations and economic development areas.

b) service capacity :-

This group provides a service, which is useful to the organisation as a whole and not to any specific division or function.

e) control capacity :-

This includes quality control staff that may have the authority to control the quality and enforce standards.

3) General staff :-

Any decision that cuts across departmental lines must be made by the chief executive. It cannot be delegated to the head of a specialised staff group or to a line department head, since other department heads will naturally resent interference in their department heads will naturally resent interference in their department by someone who is in no way their superior.

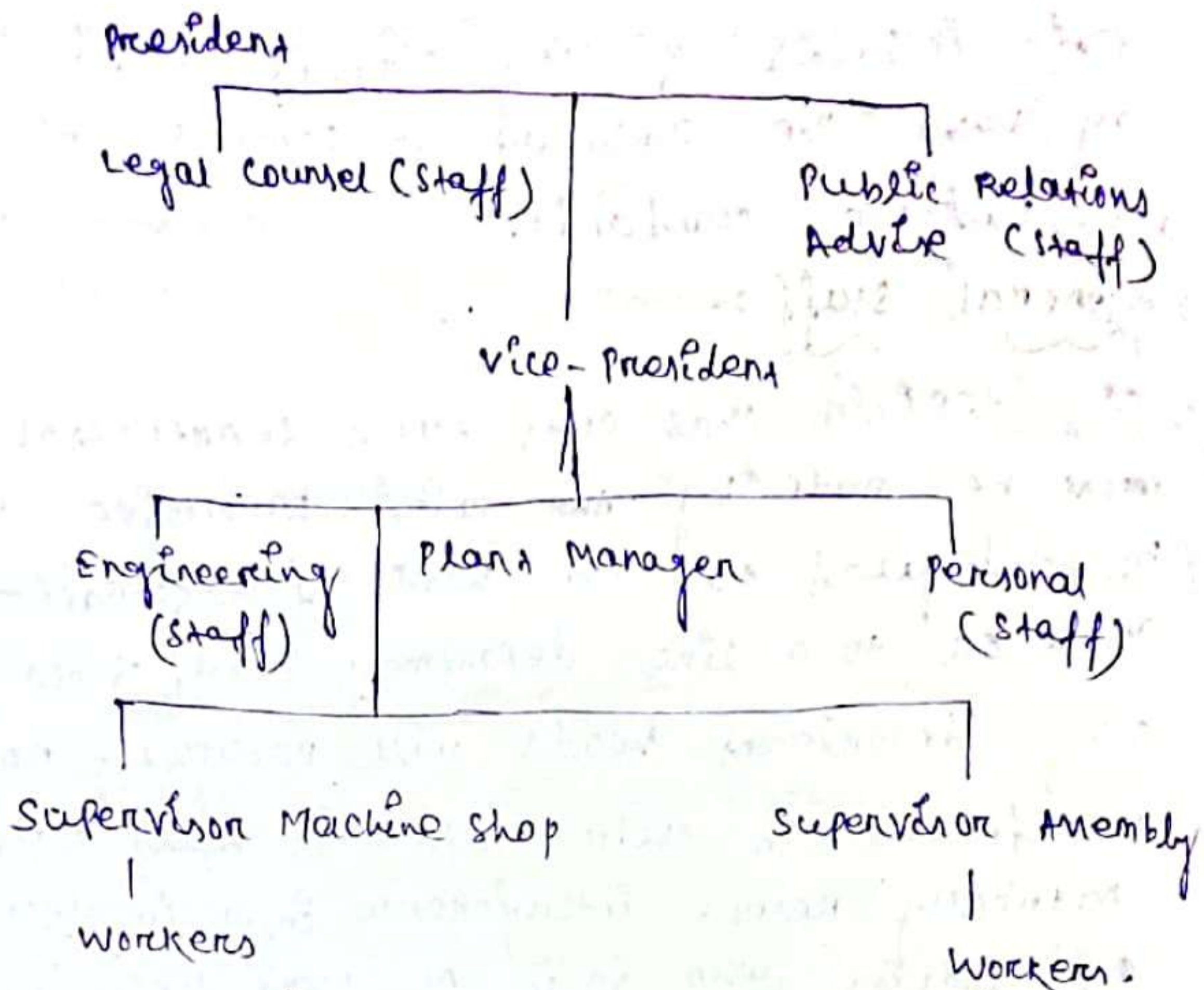
A typical case would be a change in the organisation structure of the company as a whole: the combination of two departments under a single head, for eg on the organisation of a new top-level department.

It is with these functions that cannot be delegated that the general staff personnel can provide assistance and save the time of the top man.

The title of the general staff person is most often "assistant to" the company president, or other executive.

A staff member may serve as a coach, diagnostician, policy planner, co-ordinator, trainer, strategist etc.,

Line and staff organisation chart :-



Advantages of line and staff organisation :-

- 1) Line officers can concentrate mainly on the doing function as the work of planning and investigation is performed by the staff.
- 2) Since the organisation comprises line and staff functions, decisions can be taken easily.
- 3) The staff officers supply complete factual data to the line officers covering activity within and without their own units. This will help to greater co-ordination.
- 4) It provides an adequate opportunity for the advancement of workers.
- 5) The staff services provides a training ground for the different positions.

- 6) Adequate organisation a balance among the various activities can be attained easily.
- 7) The system is flexible for new activities may be undertaken by the staff without forcing early adjustments of line arrangements.
- 8) Staff specialists are conceptually oriented towards looking ahead and have the time to do programme and strategic planning and analyse the possible effect of expected future events.

Disadvantages of line and staff:-

- 1) confusion and conflict may arise between line and staff. because the allocation of authority and responsibility is not clear and members of the lower levels may be confused by various line orders and staff advices.
- 2) Too much reliance on staff officers may not be beneficial to the business because line officials may lose much of their judgement and initiative.
- 3) staff generally advise to the lines, but line decides and acts.
- 4) normally, staff employees have specialised knowledge and expert. line makes the final decisions, even though staff give their suggestions.
- 5) staff officers are much educated so their ideas may be more theoretical and academic rather than practical.
- 6) Although expert advice is available it reaches the workers through the managers.

7) since staff specialists demand higher payments, it is expensive.

Forms of organisational structure :-

Functional organisation :-

Grouping people performing similar activities into departments.

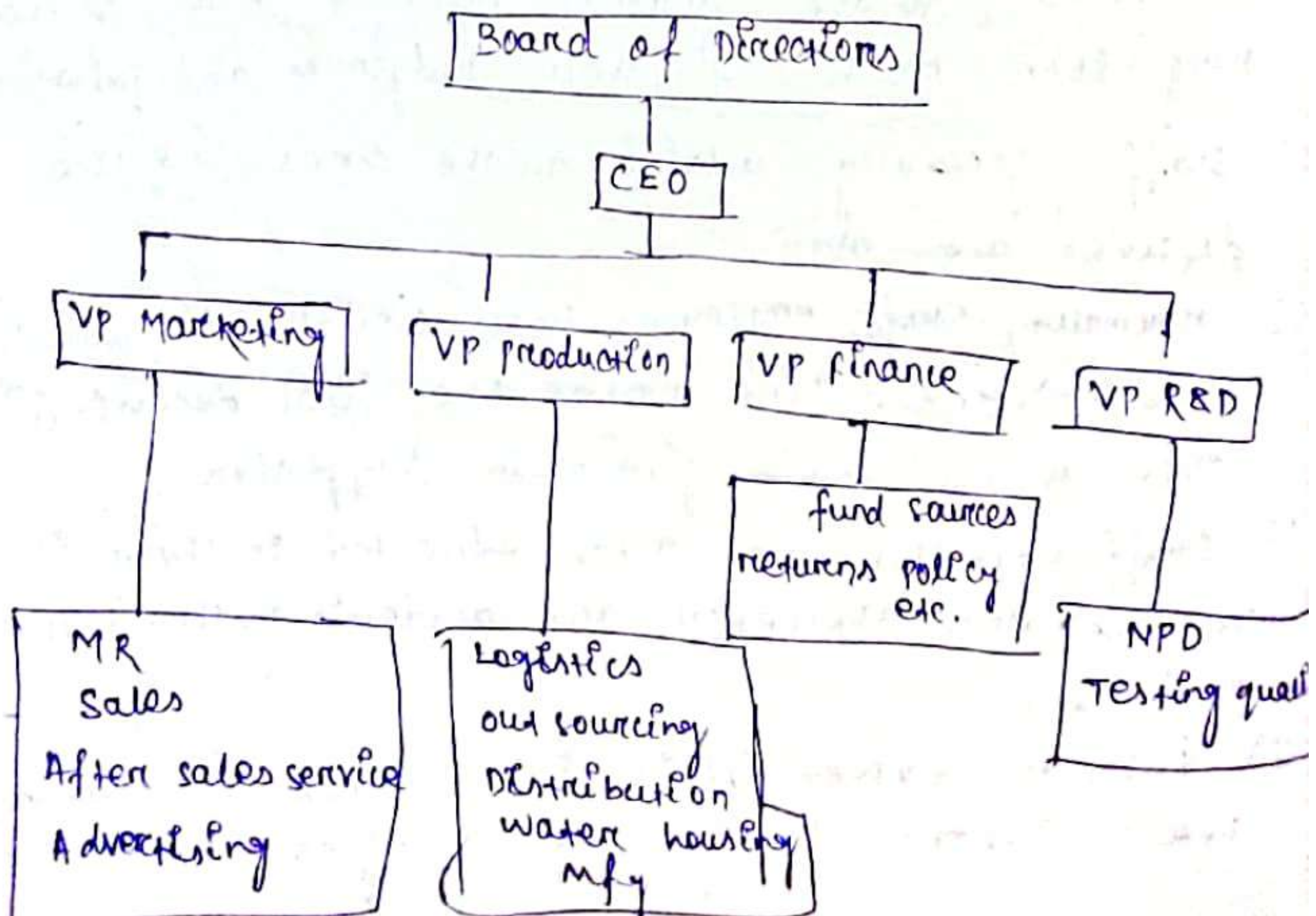
Project organisation :-

Grouping people into project teams on temporary assignments.

Matrix organisation :-

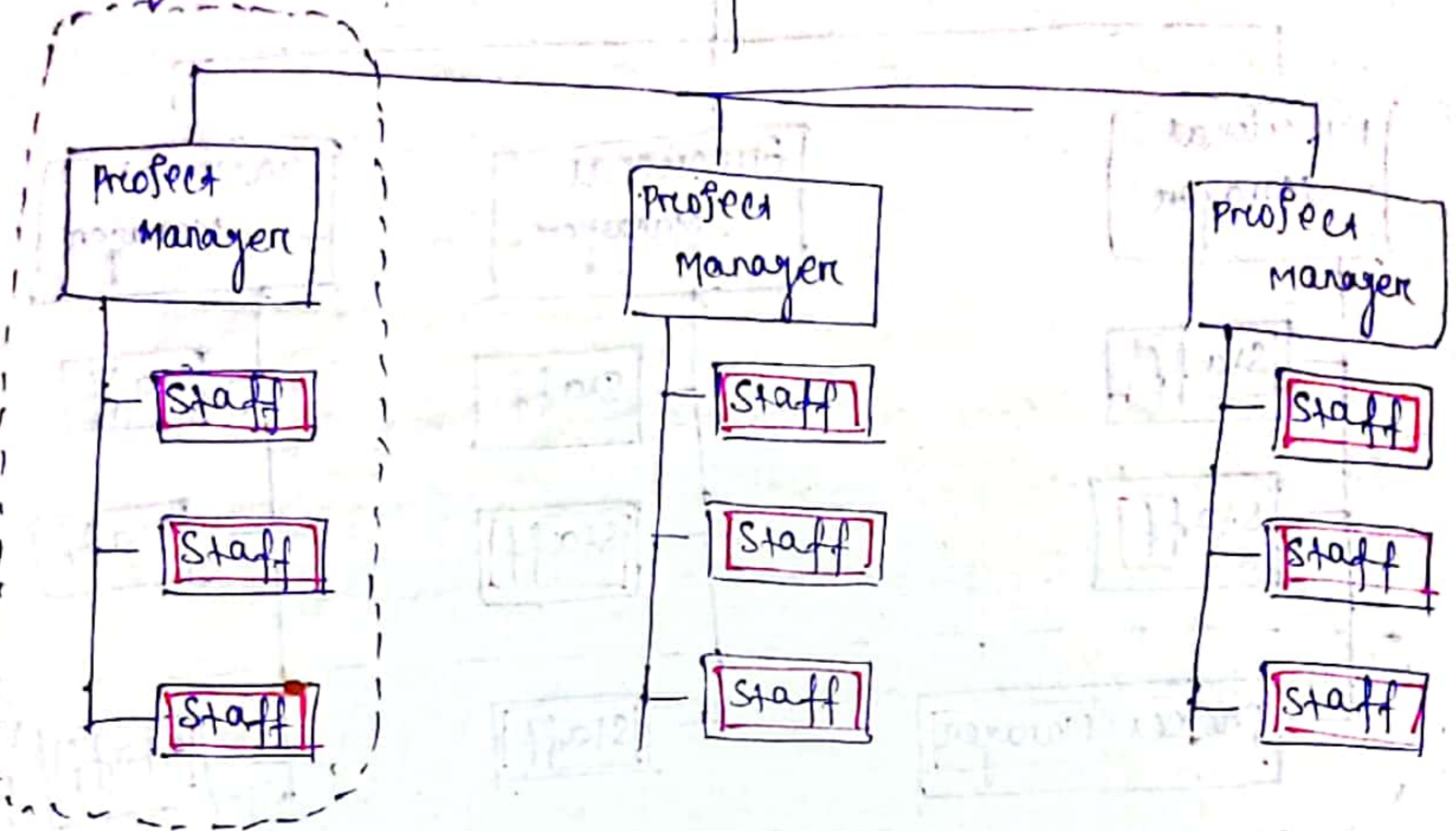
Companies are structured by creating a dual hierarchy in which functions and project have equal prominence.

Functional organisation :-



Project Organisation
Product Co-ordination

Chief Executive



(Red boxes represent staff logged in project activities)

Strengths

Weaknesses

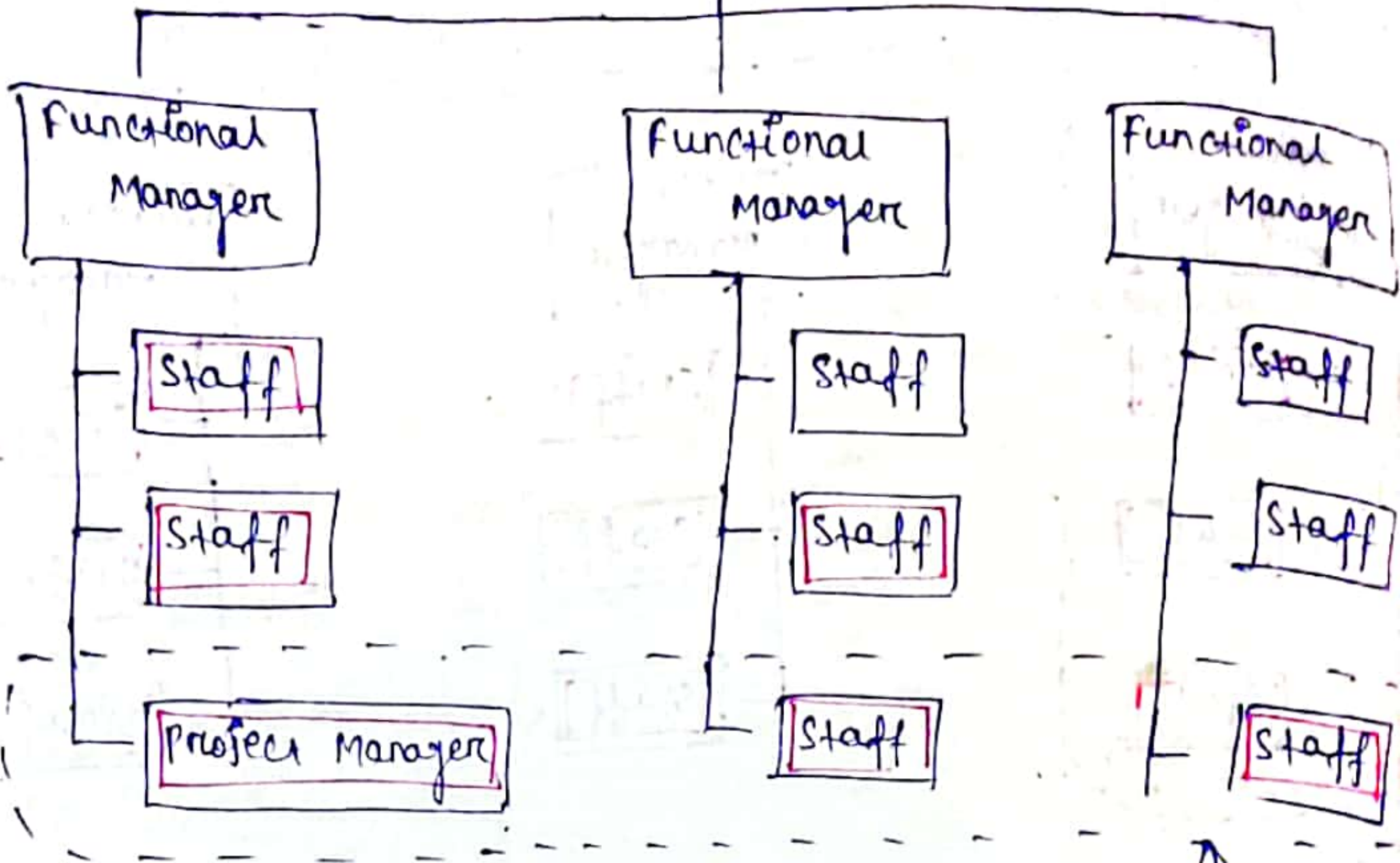
- Assign authority to solely Project manager.
- Improved communication across functions.
- Effective and speedy ^{DM} ~~PM~~ (Decision making).
- Promotes creation of career of PM experts.

- setting of maintaining teams can be expensive.
- Loyalty to project not to organization.
- Difficult to maintain pool of intellectual capital.
- concern ~~at the~~ @ future after project gets over.

Matrix

organisation

Chief Executive



(Balanced Matrix organisation)

↑
Project
co-ordination

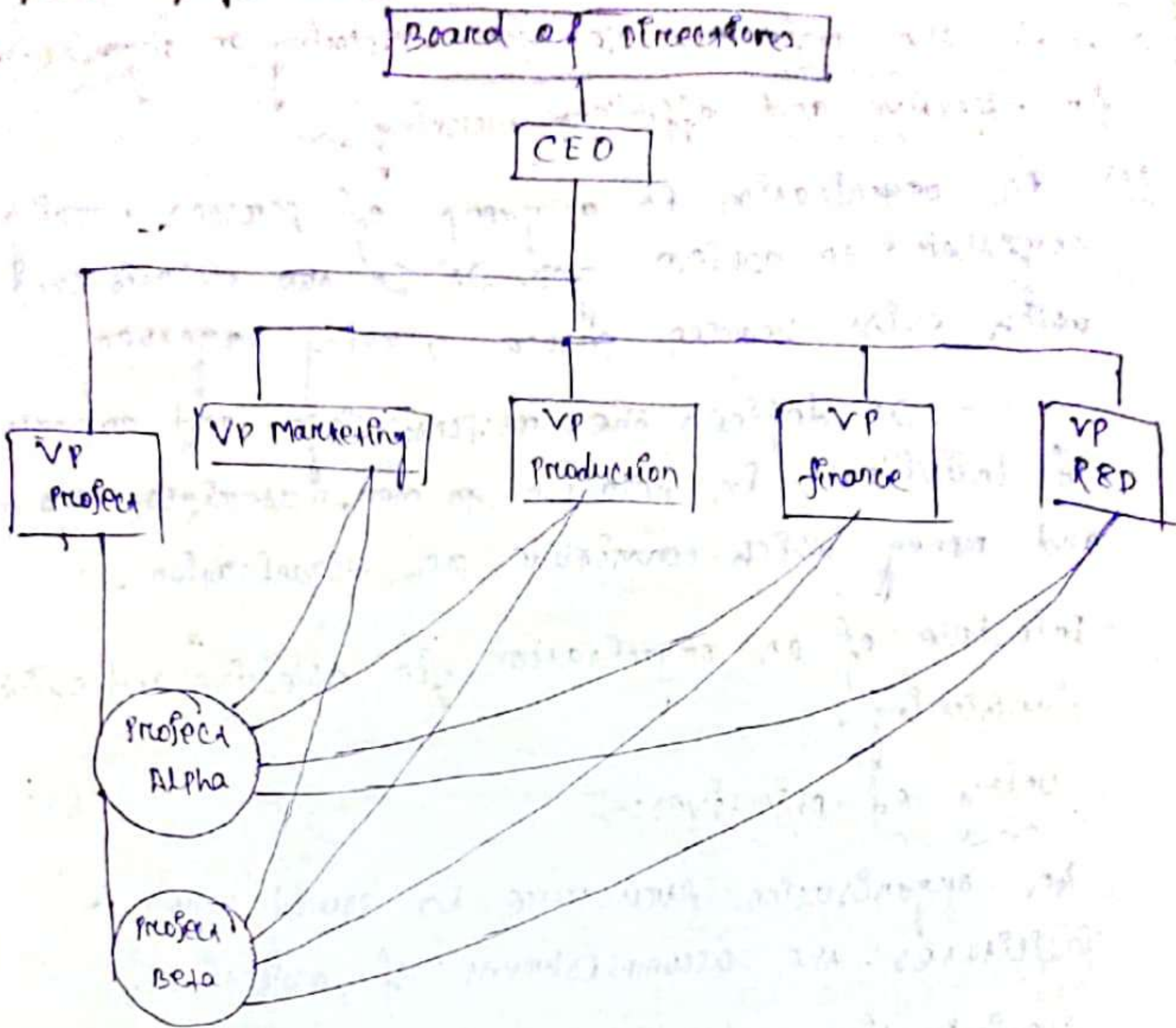
Strengths

Weakness

- suited to dynamic environments.
- Emphasizes the dual importance of project management and functional efficiency.
- Promotes co-ordination across functions.
- use of scarce resources on competing basis.

- Two bosses.
- sometimes difficult to share resources.
- Frustrating - caught between project and functional requirements.

Project Organisation :-



Functional Organisation :-

Strengths

- No changes required in firms design.
- Enable the development of in depth knowledge.
- Allows for standard career path.

Weakness

- siloing difficult to achieve cross functional co-operation.
- Lack of customer focus.
- Long time due to structure problems, lack of ownership, slower communication.
- project may be sub-optimized due to varying interest or commitment.

Explain the main principles for developing an organisation for effective and efficient working.

Ans An organisation is a group of persons working together to achieve goal. It is the relationship which exist between people working together.

It defines the responsibilities and authority of individuals in relation to men, materials, machinery and money which constitute an organisation.

Principle of an organisation for effective and efficient functioning.

Unity of objectives:-

An organisation structure is sound when it facilitates the accomplishment of objectives.

Specialization and division of work:-

The activities of every member of the organisation should be confined as far as possible to the performance of a single function.

According to 'FAYOL' "to organising a business is to provide it with everything useful to its functioning raw material, tools, capital and personal."

Staffing:-

It is the process of filling all positions in the organisation with adequate and qualified personal. Staffing consists of man covering the requirements, selection, training, compensation and

Directing :-

It is managerially function of guiding, supervising, motivating and leading peoples towards the attainment towards a plan target performance.

→ Directing is the execution function of management because it is in consult with the execution of plans and policies.

→ Direction functions includes following activities.

i) Supervising, people at work.

ii) Motivation i.e., creating the willingness to work for certain objectives.

iii) Communication i.e., that is establishing understanding with employees regarding plans and implementation.

iv) For leadership influence behaviour of employee.

Controlling :-

It is the process of ensuring that the organisation is moving in designed direction and that progress is being made towards the achievement of goals.

Q) Explain the importance of leadership and human relations in managing a construction project.

Ans - Importance of Leadership :-

It is an important function of management which helps to maximize efficiency and to achieve organizational goals. The following points justify the importance of leadership in a concern.

i) Initiates action :-

Leader is a person who starts the work by communicating the policies and plans to sub-ordinates from where the work actually starts.

ii) Motivation :-

A leader proves to be playing an incentive role in the concern's working. He motivates the employees with economic and non-economic rewards and thereby gets the work from the sub-ordinates.

iii) Providing Guidance :-

A leader has do not only supervise but also play a guiding role for the sub-ordinates.

iv) Creating confidence :-

confidence is an important factor which can be achieved through experiencing the work efforts to the sub-ordinates.

v) Building Moral :-

Moral denotes willing co-operation of the employees towards their work and getting them into confidence and winning their trust.

Human Relations in managing a construction project :-

→ For the successful completion of the project there must be an inter-relationship between the three categories.

1) Co-relationship between the owner and an engineer:-
→ At the owner finances the work and employs an engineer who agrees to perform his professional duties with reasonable efforts and skills. If the engineer makes an unfortunate mistake, in spite of due skill, he is not liable for his mistake, unless the owner proves that he failed to perform his duty carefully.

2) Co-relationship between an engineer and contractor:-
→ Similarly, there is much co-relation between an engineer and a contractor as the latter executes the work in strict supervision of the former. The contractor has to work as per the design data and drawings in consultation with the engineer so that there may not arise any dispute between the engineer in charge of the project and the contractor later on. Therefore, in the interest of economy and quality of work a close co-operation between an engineer and a contractor is necessary.

Q.3 What are the conflicts in organization? Discuss genesis of conflicts and types of conflicts.

Ans 1) Conflict within the individual:-

The conflict within the individual is usually value related, where role playing expected of the individual does not conform with the values and beliefs held by the individual. For example, a secretary may have to lie on instructions that he is not in the office to avoid an unwanted visitor or an unwanted telephone call.

This may cause a conflict within the mind of the secretary who may have developed an ethic of

telling the truth. Similarly, many Indians who are vegetarians and find it very hard to remain vegetarians may question the necessity of the vegetarian philosophy thus causing a conflict in their minds.

In addition to these value conflicts, a person may be faced with a role conflict. For example, a telephone operator may be advised and required to be polite to the customers by her supervisor, who may also complain that she is spending too much time with her customers. This would cause a role conflict in her mind.

Similarly, a police officer may be invited to his brother's wedding where he may find that some guests are using drugs which are against the law. It may cause conflict in his mind as to which role he should play - as of a brother or as of a police officer.

2) Interpersonal conflict :-

Interpersonal conflict involves conflict between two or more individuals and is probably the most common and most recognized conflict. This may involve conflict between two managers who are competing for limited capital and manpower resources.

This conflict can become further acute when the scarce resources cannot be shared and must be obtained. Similarly, if there are two equally deserving preferents and they are

both up for promotion, but only one of them can be promoted because of budget and positional constraints, then this could result in interpersonal conflict between the two professors.

Another type of interpersonal conflict can relate to disagreements over goals and objectives of the organization. For example, some members of a board of directors of a school may want to offer courses in sex education while others may want to ~~of~~ find this proposal conflict among the members of the board.

Similarly, a college or a university may have a policy of quality education so that only top quality students are admitted while some members of the organizational board may propose "open admission" policy where all high school graduates are to be considered for admission.

For example, two marketing managers may argue as to which promotional methods would result in higher sales. These conflicts become highlighted when they are based upon opinions rather than facts. Facts are generally indisputable, resulting in agreements.

These interpersonal conflicts are often the results of personality clashes. People with widely different characteristics and attitudes are bound to have views and aims that are inconsistent with the views and aims of others.

3) Conflict between the individual and the group

As has been discussed before, all formal groups and informal groups have established certain norms of behaviour and operational standards which all members are expected to adhere to.

For example, in some restaurants, all tips are shared equally by all waiters and waitresses. Some particular waitresses who may be overly polite and efficient may feel that she deserves more, thus causing conflict between her and the group.

The conflict may also be between the manager and a group of subordinates or between the leader and the followers. A manager may take a disciplinary action against a member of the group causing conflict with the group and this may result in reduced productivity.

"Mutiny on the Bounty" is a classic example of rebellion of the crew of the ship against their leader, based upon the agreement that the crew received at the hands of their leader.

4) Intergroup conflict :-

An organisation is an interlocking network of groups, departments, sections or work teams. The intergroup conflicts are not so much personal in nature as they are due to factors inherent in the organizational structure.

One of the most common conflicts is between the line and the staff members of the organization. The line managers may resent their dependence on staff for information and recommendations. The staff may resent their inability to implement directly their own decisions and recommendations.

These inter-unit conflicts can also be caused by inconsistent rewards and differing performance criteria for different units and groups. For example, sales people who depend upon their commission as a reward for their efforts may promise their customers.

Different functional groups within the organization may come into conflict with each other, because of their different specific objectives. There are some fundamental differences among different units of the organization both in the structure as well as operations and processes and thus each unit develops its own organizational sub-structure.

A classic example of inter-unit conflict is between sales and production as described earlier. The sales department is typically customer-oriented and wants to maintain high inventories for filling orders as they are received which is costly option as against the production department which is strongly concerned about cost effectiveness requiring as little inventory of finished product at hand as possible.

Similarly, intergroup conflict may arise between day shift workers and night shift workers who might blame each other for anything that wrong from mining tools to maintenance problems.

5) Inter-organizational conflict:-

Conflict also occurs between organisations who are dependent upon each other in some way. This conflict may be between buyer organisation and supplier organisations about quantity, quality and delivery times of raw materials and other policy issues.

Such conflict could also be between unions and organisations employing their members, between government agencies that regulate certain organisations and the organisations that are affected by them.

Resolving conflicts 2

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- Provide conflict resolution training.
- provide communication skills training.
- Help staff develop positive work relationship.
- implement team building activities.
- Develop strong communication channels.
- create an environment that encourages participation.
- provide conflict mediation training for leader.
- provide third-party conflict mediation services.
- Make sure employee are clear about organizational ~~post~~ goals and priorities.
- Treat everyone fairly.

Define labour schedule :-

Ans- Labour schedule gives the manpower requirement of the project in labour form for various stages.

LABOUR SCHEDULE :-

The classification of labours, their number and the period during which they will be engaged for each activity listed down. The information obtained may be consolidated and put on weekly/monthly basis in a labour schedule.

The table gives a clear picture of labour requirement in exact number during the execution period of the project and it gives ample time to manage the requirements easily. A direct measure of labour expenditure alone on the site can be obtained easily. It helps in efficient and optimum deployment of the labour force in the project.

Sl. No.	Activity	Working dates	Classification of labours	No. of men
1.	Leveling and clearance of site (A)	11/8, 12/8, 13/8	Foreman Tractor operator labours	1 1 4
2.	Earth work involved in foundation	-----	Foreman Tractor operator Grader operator Truck driver mechanic labours	1 5 2 2 1 10
	and so on			

Table 9.4

Labour schedule

Sl. No.	Classification of labours	Aug 98			SEP 98				OCT 98		
		11 II	18 III	25 IV	1 I	8 II	15 III	22 IV	-	-	-
1.	Foreman	1	1	1	2	2	2	2			
2.	Mechanic	1	1	1	1	1	1	1			
3.	Truck driver		1		1		1				
4.	Tractor operator	2	2	1	-	2	2	3			
5.	Aggregate bucket	-	-	-	-	-	-	2			
6.	Mixer operator	-	-	-	-	-	-	1			

	Labours ----	4	4	4	10	10	12	15	-	-	-

2. a) what is invoice in material management?

Ans- An invoice management is a document that is issued by a seller to the buyer. An invoice indicates the quantities and costs of the goods or service rendered.

b) Discuss essential steps for optimum labour output.

Ans- on any construction site the contractor's financial gain is dependent, amongst other things, on completion of the work in good time and at the least cost, and the productivity of labour has a direct bearing on this being achieved. The factors affecting the performance of labour generally fall into 3 categories.

(i) The human capacity for work

(ii) The competence of site management

(iii) The motivation of the workers.

competence of the site management :-

The various measures that may be taken to improve the physical work capacity or to motivate the workers will not be effective if site management is substandard. It is essential for the workers to have confidence in their supervisors. If the workers observe that ~~site~~ site management is poor, unfair or corrupt, their morale,

motivation and consequent productivity will be reduced. Examples of management shortcomings which reduce efficiency and productivity in this way include: delayed, unclear or inadequate instructions? Delays in delivery of materials, tools or equipment? Provision of poor tools and equipment? unbalanced work gangs? use of wrong methods? Bad advance planning or allocation of work tasks? 1.3.3 Motivation of workers. workers are motivated in their work by a variety of methods, all of which may be present in varying degrees. This is a negative and unsatisfactory form of incentive. Discipline:- This is exemplified by

punctuality, lack of absenteeism, good standards of ~~work~~ workmanship and the observance of site cleanliness and hygiene. when the discipline is lacking, site morale is generally low and productivity is unsatisfactory.

Site rules drawn up and explained to all workers by either supervisors. Supervisors; by personal example, setting a high standard in self-discipline workers encouraged to feel that they are working with, rather than under, the supervisor. Retribution should be a matter of inevitability rather than severity. No breach of discipline should go unchecked. Developing self-discipline through pride in achievement

3) What is morale?

Ans - Morale is a state of mind where there is confidence, courage and zeal among people united in a common effort to succeed, leading companies are constantly looking for ways to elevate employee morale and managers, supervisors office personnel and others who can accomplish this are highly valued.

4) What are the characteristics of labour and explain it?

Ans - Some of the most important characteristics of labour are as follows:-

a) Physical strength and stamina:-

Skilled construction labour must perform task at construction sites that require extensive physical labour including lifting, climbing, bending, digging and operating hand and power tools, looking for construction labour who possess physical strength and stamina.

b) Manual dexterity and co-ordination:-

Along with physical strength, construction workers must have excellent hand-eye co-ordination be able to move his/her hands, quickly and be able to group and assemble objects with 2 hands, and also needs co-ordination which is the ability to work with both arms, both leg or legs or one leg and one arm.

c) Strong reading and math skills:-

It is also important for construction labour in all trades to be very attentive to specifications made by construction contractors. They must be able to ~~read~~ read and interpret blue prints and work related documents, A good understanding of geometry helps with interpreting design.

d) Building and mechanical knowledge :-

familiarity with building materials and experience using tools involved in the construction, repair and restoration of buildings, highways bridges, and other structures are more important skills to look for in a construction worker.

e) Excellent vision and depth perception :-

construction jobs require accuracy and precision for this reason, it is also very important that construction workers have good eyesight. They must have the ability to read blue prints and see details at close range, as well as from a distance, when operating machines, skilled construction labour must be able to see the gauges and dials to make sure everything is functioning properly and be able to perceive how near or how far to move equipment.

5) Explain the methods of measurement of morale.

6) In this method the management may conduct a yearly survey to find out the morale of the employees. For this purpose the management may conduct direct interview or can use questionnaires.

7) Morale Indicators :-

This shows the attitude of the employee towards the organization. Morale indicators are the factors which include labour turnover, accident rate, training record absenteeism etc. These factors are the indicators of variation in the morale of the employee, which help the management to analyze the causes of fluctuation in the morale of the employee and take corrective action.

(iii) use of suggestion boxes :-

Here the employees are asked to put their grievances and suggestions in a box without disclosing their identity. This method is suitable where employees have no courage to place their dissatisfaction openly.

(iv) observation of employee attitude :-

Here the morale of the employee is observed by his activities and behaviour. The managers generally measure the morale of an employee by his productivity. But this method is not reliable as morale may be high but productivity may be low and vice-versa.

6) Explain about different methods of wage payments.

Ans- Systems of methods of wage payments :-

Any worker who puts some labour produces some result, the quantity of which shall vary with the efficiency of the individuals. Better the efficiency of any worker, more will be the output. The wages thus can be calculated on the basis of the work irrespective of the time taken in completing it.

So, there are two systems of wage payments in common use :-

- a) Time work or Day work or Time rate system.
- b) Piece work or piece rate system.

a) Time work system :-

This is probably the oldest and more commonly employed system of wage payment chiefly adopted in India. In this system the worker, regardless of his output, is paid a fixed remuneration per unit of time, which may be an hour, day, week or month. Here, as the workers do not find any incentive for more output.

Advantages :-

- It is easy for wage calculation and can be understood by the workers easily.
- All workers of one class whether skilled or unskilled get the same wages.
- Better quality of work can be achieved.
- It avoids the workers over-streaining themselves, mentally and physically, thus causing less fatigue.
- The system is very suitable for works of artistic nature of requiring high workmanship as the workers will not be tempted for hurried work.
- This is suitable method where the work can not be measured.
- It ensures regular employment and greater security of service for the workers.

Disadvantages :-

- It requires constant supervision.
- It is unsatisfactory in so far as it leaves no incentive for a skilled worker to produce more than the inefficient workers.
- There is a less of labour production efficiency cannot be increased easily.

- Accurate cost forecasting is impossible.
- It does not inspire the spirit of competition in the workers and thus there are little chances of output being raised.

b) piece work system :-

Under this system, payments to individual workers are done according to the amount of work done. The workers thus have incentive to do more work as greater the efforts one puts in, greater would be reward. The rates fixing should be done by sufficiently experienced technical persons, from the past records based on performances. This system is used when the quality of work is of less importance than quantity.

7) Discuss motivation and different approaches to motivation. Also classify various motives.

Ans- Motivation is defined as the process that motivates a person into action and induces him to continue the course of action for achievement of the goal. There are five motivational needs of an entrepreneur.

a) Physiological need :-

These needs are basic to all human life and include food, clothing, shelter and other necessities of the life. They exert tremendous influence on human behaviour.

Entrepreneur also being a man needs to meet his physiological needs for survival. He/she is motivated to work in the enterprises to have economic rewards to meet the basic needs.

b) safety and security need :-

After satisfying the physiological needs the next need few are called safety and security needs. These needs find expressions in such desires as economic security and protection from physical dangers. Meeting these requires more money and hence the entrepreneur is motivated to work more in his enterprises.

c) social need :-

Social need refers to belongingness. All individual wants to be recognized and accepted by others. An entrepreneur also want recognition in the society.

d) esteem need :-

This need refers to self esteem and self respect. They include such needs which indicate self confidence, achievement, competence, knowledge and independence. In case of entrepreneur the ownership and self control over enterprise satisfies their esteem needs by providing them status, respect, reputation and independence.

e) self actualization :-

This refers to self fulfillment. An entrepreneur gets the following rewards. out of a construction work =

1) Job satisfaction

2) social respect

3) money

4) ~~professional~~ professional growth.

5) ~~power~~

For an entrepreneur the following risks are involved.

- i) Losing the construction site competition.
- ii) Losing money due to price escalation.
- iii) Non-availability of skilled labour.
- iv) Dispute related to labour relation.
- v) Accident and other professional hazards.

Labour laws :-

1) Minimum wages act of 1948 :-

The minimum wages act of 1948 was passed for the welfare of the labour and providing for fixing the minimum wages of labour. The act aims at making provisions for the statutory fixation for the minimum rate of wages in no. of industries where there is an extensive chances of exploitation of labour. The main provision of minimum wages act are :-

- The setting of advisory committees to collect information on which the minimum wages are based.
- The wages of a worker in any schedule to employment shall be payable on working day by
 - a) The seventh day after the last day of the wage period if the establishment is less than 1000 employees
 - b) The tenth day after the last day of the wage period if establishment has more than 1000 employees
- The wages of an employee should be paid without any deduction except those items given below:
 - a) fines in respect of acts of omissions.
 - b) Absence from duty.
 - c) loss of goods directly attributable to the neglect of the employee.
 - d) House accommodation provided by the employer.
 - e) Amenities and services provided by the employer.
 - f) Income tax.
 - g) subscription to the provident fund.
 - h) Recovery of advances.
 - i) Payment to co-operative societies or life insurance corporation.

2) Workmen Compensation Act of 1923 :-

Workmen Compensation Act of 1923 aimed to protect the victims of accidents and their families from hardships out of and in the course of employment. The act covers the workers employed in hazardous occupation as specified in the schedule but excludes those employed in clerical or administrative work. The act provides for payments of compensation in case of accidents on work sites. The compensation however is not payable for injuries into

→ Disobedience or negligence.

→ Non-observance of safety measures.

→ consumption of liquor.

→ Diseases which are not contracted as a result of occupations. In the case of the death of a worker, compensation is paid under all circumstances.

Repairing the equipment schedule :-

A civil engineering project needs a variety of equipment and it is imperative for the engineer/contractor to know what type of equipments and what number of the equipment and for how many days (with exact dates) for each will be needed for the purpose. So that he may arrange them timely by hiring or by purchasing or by any other means and the work may not be delayed because of non-availability of equipment.

Following the procedure adopted by labour schedule. Demand for equipments for each activity listed down is furnished and then consolidated list of the equipments is shown date wise/week wise/~~month wise~~ month wise for entire period of construction project.

Sl. No.	Activity	Working Dates	Type of Equipments	Number
1.	Local sand filling in foundation and plinth.	Say 2/9, 3/9, 4/9.	Tractor water sprinkler subgrader	2 1 1
2.	casting of R.C.C. slab in roof	10/10, 11/10	Aggregate bin shovel pan concrete mixer vibrator concrete spreader concrete finisher	2 5 10 2 2 2 2
	and so on...			

Table 9.6		EQUIPMENT SCHEDULE											
Sl. No.	Equipment	Aug 98			Sept 98					Oct 98			
		11	18	25	2	9	16	23	30	7	14	21	28
1.	Traction	2	-	-	-	-	-	-	-	-	-	-	-
2.	Crane	1	1	-	-	-	-	-	-	-	-	-	-
3.	Bulldozer	2	-	-	-	-	2	1	-	-	-	-	-
4.	Power shovel	1	-	-	-	-	-	-	-	1	-	-	-
5.	Truck	2	2	1	-	-	-	-	-	1	-	1	-
6.	Subgrader	-	-	2	2	-	-	-	-	-	-	-	-
7.	Aggregate bin	-	-	-	-	-	-	-	-	-	-	2	2
8.	Cement silo	-	-	-	-	-	-	-	-	-	-	1	1
9.	Concrete mixer	-	-	-	-	-	-	-	-	-	-	2	2
10.	Vibrator	-	-	-	-	-	-	-	-	-	-	2	2
	and so on												

SELECTION OF CONSTRUCTION EQUIPMENT :-

Basically there are two aspects for the selection of construction equipments in a project. The first aspect deals with the type, size and other particulars of the equipments and the second aspect whether it is to be purchased, hired or to be procured under hire-cum-purchase arrangement, but in all the aspects, the following factors must be taken into account before having a final choice :-

1) Existing Equipments :-

Maximum utilization of the existing equipment should be done in order to reduce the cost of production to the minimum. If certain type of equipment is already being used in the project, it is desirable to have additional equipments of the same type because the existing workmen are already acquainted with the operation of such machines and the workshop is well equipped with the spare parts and repairing of spare parts.

2) Availability of the equipment :-

In far as practicable the equipment which is early available in the market should be selected for the purpose because any delay in delivery may increase the cost of construction or cost of production substantially.

3) Standard Equipment :-

In general the choice should be restricted to standard equipment because its delivery time is short, trained operators are available and spare parts can be easily procured in the market, repairing may be done easily.

4) Special Equipment :-

If the project is very big, special equipment may be selected provided the economic analysis justifies the purchase. If it is not available in the market, it has to be manufactured as per specifications laid by the project authorities to suit the job requirements.

5) Operating cost :-

The most efficient and therefore the most economical equipment is one whose operating cost is the minimum. Record of such equipment previously used should be taken as a guide for determining its suitability and economic viability. However in absence of this guide, fresh economic analysis should be made.

6) Indigenous Equipment :-

It is always advisable to purchase equipment which is manufactured in our country because this will decrease the repair cost and down time cost and at the same time it will be beneficial to be national.

7) obsolescence :-

obsolescence of the equipment should not be overlooked. Research and development going on in the design of equipment should be ascertained.

8) Economical life :-

Economical life of the equipment must be analysed and it should not be less than the useful period of the project.

9) Cost benefit analysis :-

For various alternatives, cost benefit analysis must be made and selected selection is based on economics only. The equipment must pay for itself by earning more money than its cost.

10) Suitability of equipment for future :-

The equipment should be of versatile nature so that it can be used for other purposes which will mean higher demand and will bring high resale value.

11) Study of site condition :-

Topographical condition, type of soil, existing approach roads and other working conditions must be studied before making any final decision.

12) Size of equipment :-

Size of equipment should meet the demand of work. It is better to use more than one equipment of small size than using of one of large size.

Cost of owning and operating :-

- The cost of possession of an equipment is known as cost of owning to which can be added ^{the} cost of fuel for running the equipment.
- It is generally estimated on hourly basis.
- This is the amount by which an equipment should be hired and it of course does not include the labour cost.

The following factors affect the cost of owning and operating :-

- a) initial cost of equipment which consists the price of equipment, transportation cost, loading and unloading charges and installation cost.
- b) severity of service condition under which it is to be used.
- c) ~~It is used per year~~ no. of hours it is used for year.
- d) The care ^{with} which the maintained or repaired.
- e) The demand for equipment after its useful period i.e., salvage value.
- f) useful life of equipment in years.

The following cost constitute the cost of owning and operating :-

- Depreciation cost.
- Maintenance and repair cost.
- Investment cost.
- Fuel or energy consumption cost.
- Lubricating oil cost.

Note :-

Depreciation cost, maintenance and repair cost and investment cost should be obtained separately on yearly basis by using appropriate methods and latter on converted into hourly cost. However, fuel or energy cost and lubrication cost is derived on hourly basis only.

Q Explain about importance of owning and operating cost in making decision for hiring and purchase of equipment.

AM Buying :-

Buying results in direct ownership of the equipment by buying is done either through cash purchase by using company funds or through financing purchase. The outright cash purchasing is done when sufficient funds are available. However cash purchase can have an adverse effect on company's cash flow as it reduces the liquid asset thus affecting company's working capital. When sufficient funds are not available for outright cash purchase, the equipment can be acquired by finance purchase.

wherein the purchasing is done through loan arrangements from lenders i.e., banks or other financial institutions that includes the payment of loan through installments along with an initial down payment. one of the main advantages of owning the equipment by outright cash purchase is that it may result in lowest other cost per operating hour as compared to renting or lower

Renting :-

It is a method of 'acquiring' the equipment for a shorter duration. It is an alternative to direct ownership of the equipment for a shorter period. Aquisition of equipment through renting is suitable when the contractor or the construction company requires the equipment for a project task of shorter duration. In addition through renting, the company can select the equipment that is exactly suited for the project task and it is possible to acquire the equipment based on latest technology which is more productive than older models. In these circumstances, renting of the equipment is more beneficial than direct ownership even though the rental charges are higher than the direct ownership charges. Since the equipment is not owned by the user, there is no tax benefit associated with depreciation of the equipment.

Leasing :-

It is another method of acquiring the equipment, for a longer period of time as compared to equipment renting. It is a long term alternative to direct ownership of the equipment. The leasing company is known as lessor whereas the user of the equipment is known as lessee. Lease is a contract between the lessor and the lessee wherein the lessee uses the equipment owned by lessor by paying the rentals over the lease period. Mostly the lease is more than six months and may run up to years. It is important for the lessee to know about the detail of past and ongoing leases in which lessor is involved and also to check the terms and conditions of the lease agreement before entering into lease contract with lessor. Most of the equipment leases are noncancellable. During lease period the lessor retains the ownership of the equipment and also gets the tax benefits from depreciation of the equipment. Thus there is no tax benefit to lessee from the depreciation of the equipment.

Steps for inspection and testing of construction equipment :-

Am-Inspection and testing of equipment :-

Inspection and testing, including cleaning is required in order to keep work equipment in good working order and to ensure that it remains safe. If inspection and testing is not carried out properly, two types of risk can be created :-

- The performance of the equipment, including any safety features; may deteriorate to the where the users are put at risk.
- The persons carrying out the inspection, testing and maintenance may be put at risk.

It is essential that an appropriate 'competent person', conducts the inspection and/or testing of equipment. But there remains a responsibility on all personnel to identify defective or potentially defective equipment, where whenever this may come to their attention and to take appropriate action.

Equipment failing to meet the requirements of a specific inspection and/or test shall be dealt with immediately either by rectifying the fault or reporting it in appropriate consideration shall be given as to whether the equipment may remain in service.

It is essential that all inspections and/or tests together with any maintenance activities or repairs of equipment be recorded. As a minimum, such records shall include the following:

- information on the type and model equipment;
- any identification mark or number that it has;
- its normal location;
- the date that the inspection was carried out;
- who carried out the inspection;
- any faults found as a result of the inspection;
- any action taken regarding such faults;
- to whom, and by whom, these faults have been reported;
- the date when repairs or other necessary action were carried out.

The inspection and/or test frequency / schedule identified for each particular item of equipment shall be regarded as a minimum requirement shall be increased for equipment that is used extensively or where an item of equipment may have been used beyond its recommended working limits or for a purpose for which it was not intended. When determining the frequency of inspection and/or test, consideration should also be given to the following:-

- Intensity of use - frequency and maximum working limits;
- operating environment, for example - marine, outdoors
- Legislative requirements;
- manufacture guidance;
- variety of operation - Is the equipment performing

the same task all the time or does this change.

→ Risk to health and safety from malfunction or failure.

Ch → 10

Importance of safety or accident prevention programme

Accident prevention programmes must be made an integral part of the construction industry, because it is aimed to reduce the no. of accidents and thereby the cost of construction.

The following are the primary objectives of the accident prevention programme :-

a) Safety of Personnel :-

- To reduce the human life sacrificed.
- To lessen the temporary and permanent injuries to workers.
- To prevent needless pain and suffering to the employees.

b) Safety of material and equipment :-

- To avoid loss of materials or spoilage of materials.
- To avoid loss of or damage to equipment.

c) Safety of structures :-

- To provide minimum cost of construction of structure of demolition of structure.
- And thereby ensuring the good quality of the output and better rate of construction.

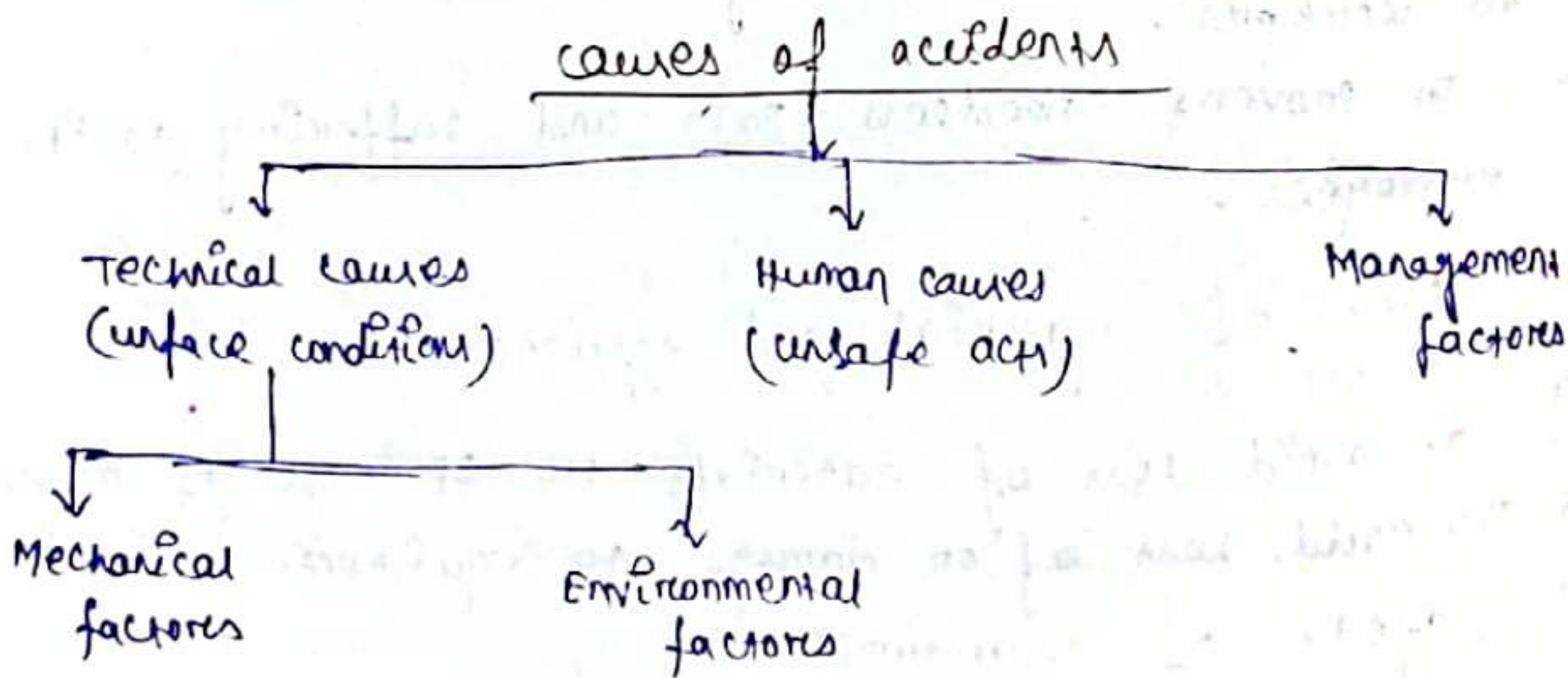
d) Management consideration :-

Management derives the greatest benefit from accident prevention programme in terms of the following :-

- To eliminate the cost of workmen's compensation insurance.
- To avoid loss of time because of accident.
- To get greater margin of profit because of minimum cost of construction/operation.
- To generate the confidence and trust of employees for its strong stability.

Causes of accident :-

An accident is an unplanned incident and for each such incident, there is usually a specific cause or causes if one could but discover them.



Mechanical factors :-

Mechanical factors, signifying the unsafe conditions, reflect deficiencies in plans, equipment, tools, materials handling system etc., these are listed down below :-

- i) unsafe mechanical design on construction.
- ii) Hazardous arrangements (piling, overloading etc.)
- iii) Improper machine guarding
- iv) Defective devices

- v) improper material handling,
- vi) Broken safety guards
- vii) protruding nails
- viii) Leaking acid valve.
- ix) untested boilers or pressure vessels.

Environmental factors :-

It is also signify unsafe conditions of work environment, indicating physical and atmospheric conditions of work which indirectly promote the occurrence of accidents. The factors include;

- i) very low temperature which causes shivering.
- ii) very high temperature which causes headache and sweating.
- iii) very high humidity which causes discomfort, fatigue and drowsiness shadow etc.
- iv) presence of dust, fumes, smoke, toxic and lack of proper ventilation.
- v) Noise, bad odour and flash emanating from the nearby machinery, equipment or processes.
- vi) poor housekeeping.

PERSONAL (HUMAN) FACTORS :-

Personal factors signifying the unsafe acts by persons concerned are due to ignorance, carelessness, forgetfulness etc. These factors are:-

- i) Age and health
- ii) Home environment.
- iii) Number of dependents and financial positions
- iv) Lack of knowledge and skill.
- v) Improper attitude towards work.
- vi) carelessness and recklessness.

- vii) Day dreaming and inattentiveness.
- viii) Emotional instability (e.g., jealousy, revengefulness)
- ix) High anxiety level.
- x) Unnecessary exposure to risks.
- xi) Fatigue.
- xii) Working at unsafe speeds.
- xiii) ~~Working at~~ non use or improper use of safety devices.
- xiv) Overconfidence or false confidence.

MANAGEMENT FACTORS :-

Callousness on the part of the management in imparting accident prevention programmes causes accidents. These are listed as below :-

- i) Non-availability of the safety accessories to the workers like helmet, plastic gloves, safety belts, gumboots, goggles etc.
- ii) Lack of safety instructions and training and communication gaps.
- iii) Discontinuity in regular employment in the construction industry.
- iv) Rapid change in character of work.
- v) Award of contract or work order to incompetent persons who do not appreciate the risks involved.
- vi) Lack of proper provisions of safety director/officials and recruitment of technically incompetent workers.

Safety measures for demolition :-

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

- 1) On every demolition work, danger signs should be provided all around the structure and doors giving access to the structure. Barricades should be erected around the structure and at least two exits must be provided for the escape of workmen during any emergency.
- 2) During night time, red lighters should be placed around the barricades and entry of unauthorised persons restricted.
- 3) At the time of demolition work, workers should use all safety appliances such as helmets, goggles, gloves etc.
- 4) In case any danger is anticipated to the adjoining structure during the process of demolition, the same should be got vacated to avoid any danger to human life.
- 5) The process of demolition may weaken the side wall of an adjoining structure and to prevent possible damage, these walls should be supported until permanent protection is provided.
- 6) The power on all electrical service lines must be shut off and all such lines disconnected before the demolition work is started.
- 7) All gas, water, steam and other service lines must be shut off before the demolition work is started.

SAFETY MEASURES FOR SCAFFOLDING, LADDERS FORMWORK AND OTHER EQUIPMENTS:

- 1) 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.
- 2) In case, scaffolds are to be kept for a long period a regular plank stair way, wide enough to allow two persons to pass, should be erected with handrails on both sides.
- 3) When work is being carried out over a scaffold platform, a protective overhead covering should be provided for the men working on the scaffold.
- 4) All wooden ladders or bamboo ladders must be strong enough.
- 5) Ladders in heavy duty work should not exceed 6m in length; for light work it should not exceed 8m in length.
- 6) Dismantling of scaffold should be in a proper sequence.
- 7) No un-insulated electric wires should exist within 3m of working platform.
- 8) The supporting kullas should be individually strong and properly braced and fastened.
- 9) All persons handling construction equipment should

be fully acquainted with the safety aspects of the machines and their operation.

SAFETY MEASURES FOR FORMWORK :-

PRECAUTIONS :-

- Workers must be provided with safe access to the work.
- Guard rails must be put in place as work progresses.
- Access ladders must be properly erected, tied and propped at least 1m above the landing platform.
- Ladders on an open scaffold must be used for access.
- ~~Access ladders must be properly erected, tied and propped at least~~
- Equipment must be in good order before use. Original manufacturer's pins must be used in adjustable props.
- Formwork, falsework and temporary supports must be checked, properly tied, footed, braced and supported before loading and before pouring walls or columns.
- Workers must be protected from wet concrete by use of protective gloves and boots and from the effects of silica dust by avoiding the need to scabble by using a retarder or by the provision of respirators.
- There is a planned striking procedure that everyone is made aware of before the work commences.

Safety measures for fabrication:-

→ supply personal protective equipment for prevention from the risk of accident, injury or health problem.

Common protective clothing for fabrication

industries are safety glasses, ~~gloves~~ flame resistance gloves, ear ~~plugs~~ plug, welding helmet, oil resistance shoes

→ conduct regular inspections and maintenance of work place.

Q What do you mean by quality control?

AM - Quality control is a procedure or set of procedures intended to ensure that a manufactured product or performed service adheres to a defined set of quality criteria or meets the requirements of the client or customer.

Q State the need for inspection and quality control in construction works.

AM - Need for inspection and quality control :-

The objective of inspection and quality control is to achieve sound construction work which results in structures of good quality at reasonable cost. Inspection and quality control are required on all construction projects to ensure that the work is done in accordance with plans, specifications and good practice and to avoid defects. An entirely safe design may be completely ruined by careless execution. This can lead to defective work with possibility of the failure of the structure. Careful inspection and quality control is, therefore, as important as the preliminary investigation and design. As important it is very difficult and expensive to rectify a structure after it is constructed, it is necessary to inspect the structure during its various construction stages. On large jobs, a separate inspection agency is generally provided to ensure effective inspection and quality control.

Comprehensive inspection forms one of the important considerations for efficient and satisfactory construction, along with innovative design, appropriate specification, reliable construction practices, and a committed construction team.

The objectives to be achieved through inspection should be determined before commencement of construction so that proper arrangements 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 carrying 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 and the purpose of inspections is to find out, by observation and on testing ~~whether~~ 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 and field testing of materials; ~~and field testing~~
- measurement and proportioning of construction materials;
- examination of layout, ~~formwork~~ ^{formwork}, foundations etc.
- testing specimens in the laboratory;
- observation of construction equipment and plants;
- preparation of records and reports.

90 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 and requirements. Quality control ensures that work proceeds in accordance with the specifications laid down and inspections is the tool through which it is practised.

Principles of Inspection :-

In case of large construction projects, a separate inspection agency is generally provided to ensure effective inspection and quality control. This inspection agency plays an important role in the execution of works and has diverse duties and responsibilities. For this purpose, an inspector is generally entrusted with the job of inspection. The inspector is a professional having knowledge of the principles and methods involved in the execution of works.

To start with, an inspector has to familiarize himself with the plans and specifications of the construction project. With this background, the inspector should be able to have a good judgement of everything that he inspects. For efficient inspection, specifications form a very important consideration and should be studied thoroughly by the inspector.

An inspector is generally authorized to stop any work which is not carried out according to plans and specifications. This is, however, considered as a last resort when it is clear that unsatisfactory work will result from continued operations. The inspector is authorized to stop use of materials and equipment which do not comply with the specifications and sound engineering practice.

Enforcement of Specifications:-

Specifications consists of instructions for the guidance of construction and inspection staff of order to construct sound and stable structures. Specification requirement may be divided into the following two groups.

- requirements which are definite.
- requirements which are laid down by the engineer in charge.

Specification requirements in the latter can become necessary where precise requirements cannot be laid down due to insufficient investigations or where difficult or new situations may arise.

On case of earthwork, specification requirements may be further grouped based on performance or procedure. Where performance is the essence of requirements, it is not logical to insist on any particular procedure or equipment to be used to produce the specified result.

At the time of execution of works, differences may arise between the contractor and the inspector regarding the interpretation of certain requirements of specifications. However, these differences can be resolved by discussion with particular reference to the work in hand. It is essential that specifications are framed in clear terms indicating precisely the specific requirements along with allowable variations to accommodate unforeseen field situations.

WORK STUDY :-

- Work study is a generic term for those ^{techniques} ~~they~~ ^{for} particularly method study and work measurement, which are used in all its content and which lead systematically to the investigation of all the factors which effect the efficiency and economy of the situation being review, in order to effect ~~the~~ ^{an} improvement.
- The main objective of work study is improved productivity of main machines and materials.
- The aim of work study is determined the best method of performing each operation and to eliminate wastage so that production increases with less fatigue.
- The work study is also used in determining the standard time that a qualified worker should take to perform an operation when working at a normal place.

Role of work study :-

- To standardised the method of doing a work.
- To minimise the unit cost of production.
- To determine the standard time for doing a task.
- To minimise the material movement and operators movement to eliminate the unnecessary human movement.
- To utilise facilities such as - man, machine and material cost effectively.

Advantages of work study :-

- Work study ensures higher productivity.
- Better working condition with less fatigue.
- ~~Rise~~ Higher wages to workers.
- Uniform production flow.
- Job satisfaction and job security to workers.
- Reduction in unit cost of production.
- Quality products to the auto consumer.
- Fast delivery schedule.
- Harmonious employer - employee relation.
- Better service to customer.

Q How to control the financial and physical progress by corrective measures.

Am - Following are the probable causes of excessive cost of construction of any project.

- 1) Low bid
- 2) Insufficient knowledge of job conditions.
- 3) Increase in cost of materials and labour.
- 4) Adverse climatic conditions.
- 5) Improper selection of construction equipment.
- 6) Inefficient management and supervision.

The first four causes are not possible to correct after the project is started. There is some opportunity to remove the first cause as the last cause is certainly controllable. The construction cost control analyse the performance of labour and materials and it aims in correcting the losses due to inefficient management.

and supervision.

Total Quality Management (TQM) is a participative systematic approach to planning and implementing a constant organizational improvement process. This approach is focused on exceeding customer's expectations, identifying problems, building commitments and promoting open decision making among workers, there are five major steps to TQM and each are essential to successful implementation.

1) Commitment and understanding from employees:-

It is key to ensure that all employees within your organization know about the total quality management policies and make them an fundamental part of their work.

2) Quality improvement culture:-

The organisational culture needs to be modernized on a continuous basis to encourage employee feedback your employees are full of valuable knowledge embrace it.

3) Continuous improvement in process:-

Total quality management is a continuous process and not a program. This requires constant improvement in all the related policies, procedures and controls established by management.

4) Focus on customer requirements:-

In today's market, customers require and expect perfect goods and services with zero defects. Focusing on customer requirements is significant to long term survival and essential in order to build relationship with customers.

5) Effective controls

It is essential to monitor and measure the performance to the business. It is to forget how many times in a year an employee does not confirm to be controlled procedure or how many times piece of equipment was own due to unplanned maintenance. If strict documentation is maintained, you will be able to objectively quantify areas for improvement and focus your efforts where they will provide the greatest return of both your time and financial resources.

Aims and objective of construction management :-

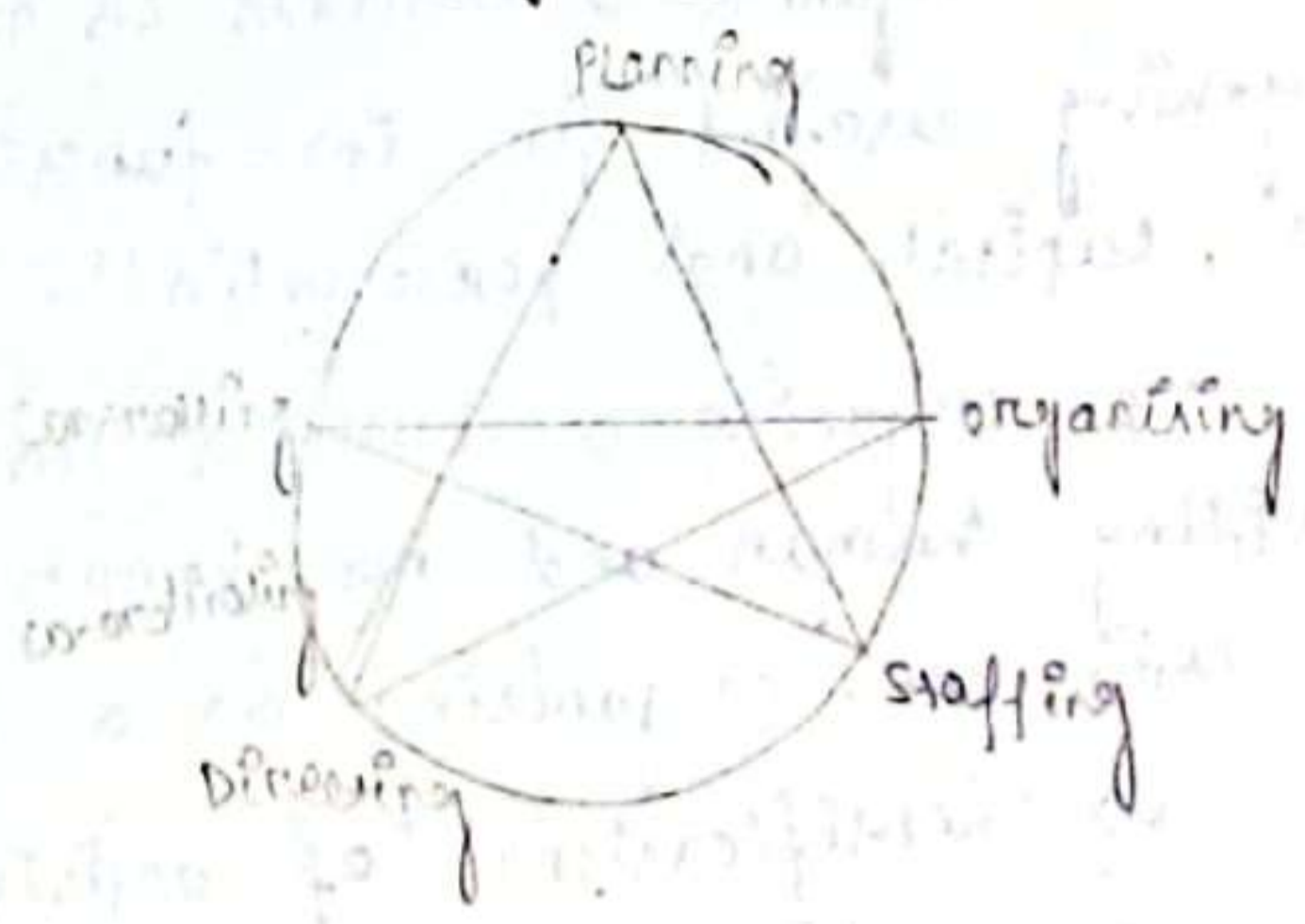
Aim- The aim of the construction management is to forecast or predict as many dangers and problems as possible; and to plan, organize and control activities so that the project is completed as successfully as possible in spite of all the risks.

Objectives :-

- To complete the project in specified time and with allocated budget.
- To plan and schedule the work and distribute between various departments. Deployment of personnel in different tasks.
- To achieve high quantity workmanship.
- create an organization that works as a team.
- using the limited available resources and producing maximum output.
- providing safe and satisfactory working conditions for all personnel and workers.

Functions of construction management :-

- 1) planning
- 2) organizing
- 3) staffing
- 4) Directing
- 5) Co-ordinating
- 6) controlling



1) Planning :-

It is the basic function of management. It deals with checking out a future course of action and deciding in advance the most appropriate course of actions for achievement of predetermined goals.

According to KOONTZ, "planning is deciding in advance what to do, when to do and how to do. It bridges the gap from where we are and where we want to be."

A plan is future course of actions. It is an exercise in problem solving and decision making. Planning is determination of course of action to achieve desired goals.

Thus, planning is a systematic thinking about ways and means for accomplishment of predetermined goals. Planning is necessary to ensure proper utilization of human and non-human resources.

2) organising :-

It is the process of bringing together physical, financial and human resources and developing productive relationship amongst for achievement of organisational goals.

According to Henry Fayol.

"To organise a business is to provide it with everything useful for its functioning i.e., raw material, tools, capital and personnel's".

To organise a business involves determining and providing human and non-human resources to the organisation of structure. organising as a process involves.

- Identification of activities
- classification of grouping of activities
- Assignment of duties.
- Delegation of authority and creation of responsibility
- co-ordinating authority and responsibility relationships

3) Staffing :-

It is the function of manning the organisation structure and keeping it manned.

Staffing has assumed greater importance in the recent years due to advancements of technology, increase in size of business, complexity of human behaviour etc.

The main purpose of staffing is to put right man on right job. i.e., square pegs in square holes and round pegs in round holes.

According to Kootz and O'Donell, "managerial function of staffing involves manning the organisation structure, through proper and effective selections, appraisal and development of personnel to fill the roles designed on the structure". Staffing involves;

→ Man power planning

(estimating man power in terms of searching, choose the person and giving the right place).

→ Recruitment, selection and placement,

→ Remuneration.

→ Training and development.

→ Performance Appraisal.

→ Promotions and transfer.

4) Directing :-

It is that part of managerial function which actuates the organisational methods to work efficiently for achievement of organisational purposes.

It is considered life-spark of the enterprise with sets it in motion the action of people because planning, organising and staffing are the more proportions for doing the work.

Direction is that human-personnel aspect of management which deals directly with influencing, guiding, supervising, motivating sub-ordinate for the achievement of organisational goals.

Direction has following elements:-

- supervision.
- Motivation
- Leadership
- communication.

Supervision:-

It implies overseeing the work of sub-ordinates by their superiors. It is the act of watching and directing work and workers.

Motivation:-

It means inspiring, stimulating or encouraging the sub-ordinates with zeal to work, positive, negative, monetary, non-monetary incentives may be used for this purpose.

Leadership:-

It may be defined as a process by which manager guides and influences the work of sub-ordinates in designed direction.

Communication:-

It is the process of passing information, experience, opinion etc. from one person to another. It is a bridge of understanding.

5) co-ordinating:-

The process of co-ordination involves synchronising individual efforts with the goals of the enterprise. Today's organisations have grown in size and in characters. A large number of people work there in. So, coordination has become very pertinent in achieving harmony of individual actions towards accomplishment of company objectives.

In effective coordination between different functions of a business enterprise can ruin the enterprise.

6) controlling:-

It implies measurement of accomplishment against the standards and correction of deviation if any to ensure achievement of organisational goals.

The purpose of controlling is to ensure that everything occurs in conformance with the standards.

An efficient system of control helps to predict deviations before they actually occur.

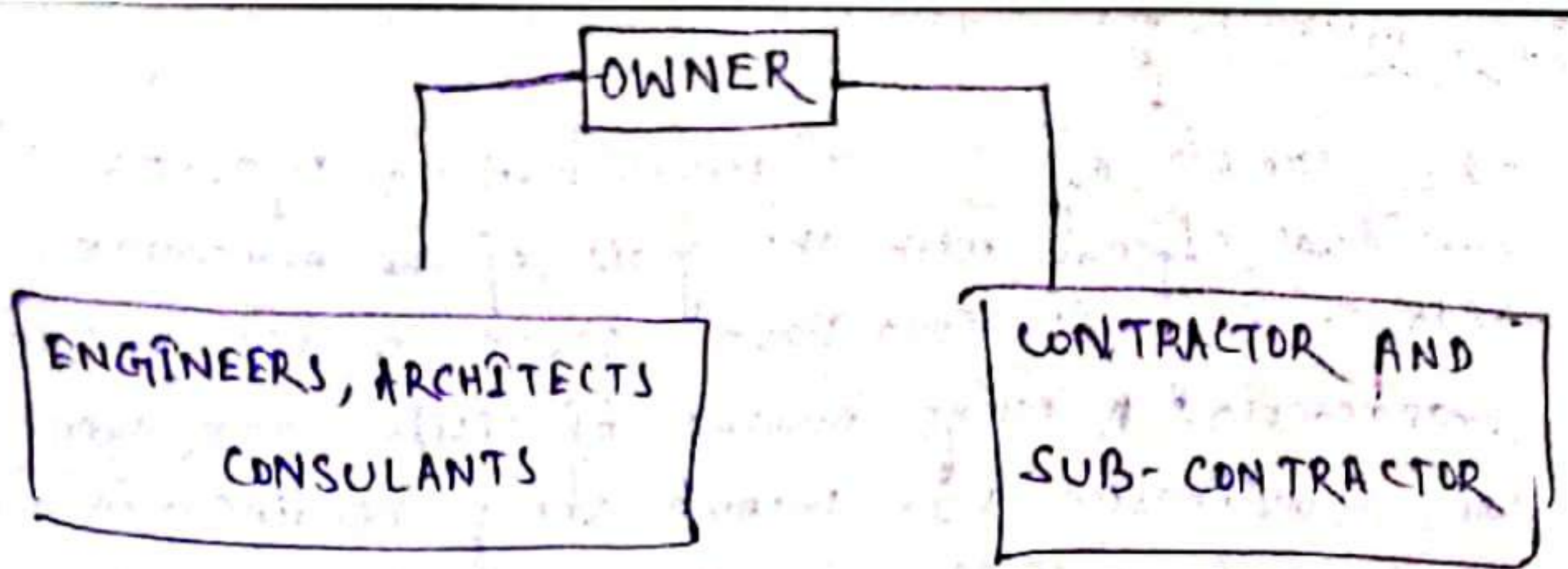
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CONSTRUCTION TEAM:-

For civil engineering project, a construction team is composed of owner, engineers / architects and contractor.

The object of the team is convert owner's conceptual project into a reality. The owner is the head of team and forms the team of engineers and contractor to serve his interest.

The function of the constituents of any team is subject to the nature and magnitude of the project.



OWNER:-

- The owner may be an individual or group of individual, private or public sector company.
- The owner is the ultimate authority over the project. All the power of decision making regarding managerial, financial and administrative aspects is invested in him. He is responsible for the funds and other resources of the project.

Duties and responsibilities of the owner:-

- He appoints an Engineer and delegates his power to work to him and in ^{consultation} ~~consultation~~ with him, he appoints other necessary staff for the purpose.
- He obtains necessary sanction for its construction from competent authority.
- He allocates the estimated cost to the Engineer.
- He enters into a contract with the contractor by signing the contract.
- He estimates the Engineer the desired completion time.

- He gives possession of work site to the contractor.
- He safeguards the program of work from outside interferences.
- He makes to payment to the contractor on production of certified bill from the Engineer.
- He takes over possession of the completed project from the contractor.
- In case of conflict with the contractor, he appoint lawyer for defending his case.

Engineer :-

- It includes the empowered construction Engineer solely responsible for the project management, store control inspection and quality assurance, construction, supervision.
- It also includes architects, structural Engineer, quality ~~control~~ ^{surveyor} ~~quality~~ surveyor, mechanical and electrical Engineer specialists such as structural consultant, safety and maintenance planners, soil investigations etc.

The duties and liabilities of each are follows.

Construction Engineer :-

- He gets prepared the necessary drawings, specifications and estimator.
- He check up soil condition.
- He prepares tender and awards the contract to the selected contractor.
- He supervises the work and ensures that the drawings and specifications are being followed faithfully.

- He submit the progress report from time to time to owner.
- He is bounded by terms and conditions of contract.
- In case of dispute, the engineer shall help to settle the disputes by technical analysis.

ARCHITECTS:-

The duty of the architect is to assess the owner's functional requirements and prepare plan and specifications for the purpose.

STRUCTURAL ENGINEER:-

The structural engineer is to prepare structural design as per requisite loads through technical design and to prepare working drawings which is handed over to the construction engineer.

MECHANICAL ENGINEER:-

He is responsible for mechanical services associated with the project during and after construction.

ELECTRICAL ENGINEER:-

He is concerned with the preparation of working drawing for electrical power and distribution system during and after construction.

QUANTITY SURVEYOR :-

His duty is to

- a) estimate the cost of work.
- b) prepare bill of quantities and tender documents.
- c) ~~prepare~~ prepare the cash flow statement during construction.
- d) ~~prepare~~ assess the extra cost due to special features.
- e) prepare the final accounts on completion of the project.

SPECIALISTS :-

They have to perform specialised work entrusted to them. Such as soil investigation collects information regarding soil for the proper design of foundation.

CONTRACTOR :-

The contractor may be an individual or a large construction company. In some project, the contractor may sublet part of the work to a sub-contractor or petty contractor.

This is done because a contractor may not have the required infrastructure for certain works. The contractor has to execute various types of works and has to make all necessary arrangements for labour, equipment, material, etc. In order to complete the project within stipulated time and cost.

The vital duties and liabilities of a contractor are covered by the conditions of contract.

Duties and liabilities of the contractor.

- The contractor undertakes execution of work or services concerned there with as per terms and conditions of the contract agreement.
- He has to visit the work site, study soil condition before tendering.
- He should ascertain accessibility, availability of water supply and electric power and other facilities for construction purposes and should see local conditions also.
- He has to collect local rates of materials and labour to determine the item rate.
- He should be required to designate a responsible representative who is authorised to act on his behalf.
- He is required to obtain all building permits in connection with the work.
- It is duty and liability of a contractor to follow the labour act.
- It is duty of contractor to safeguard his own men and materials.
- It is the responsibility of contractor to safeguard the completed portion of work until it is finally handed over to the owner.
- He should thoroughly study the clauses of conditions of contract and follow the contract agreement truly.

→ He should finally hand over the completed work to the owner and get the final payment and settling the running bill amounts.

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CONSTRUCTIONAL RESOURCES:-

Constructional i.e., creation in the form of finished product is the direct result of using various resources in the most effective ways. The various resources being used in the construction project can be enumerated as,

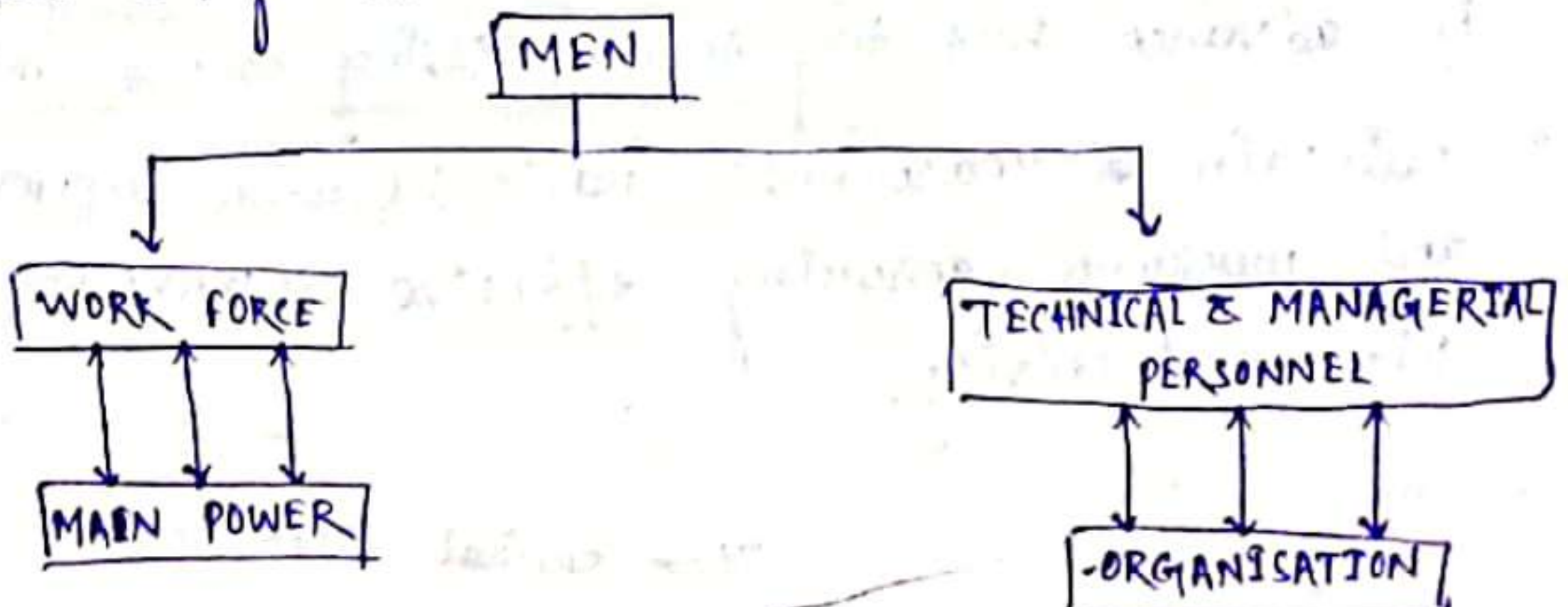
- 1) MEN
- 2) MATERIALS
- 3) MACHINERY
- 4) MONEY

In addition to main resources mentioned above, other resources in the form of infra-structure is also necessary for construction projects.

- a) power
- b) water
- c) space
- d) communication means.

↓ MEN :-

'Men' resources is one of the essential ingredients to carry out project activities and it is basically grouped in two categories.



(A) WORK FORCE (OR MAN POWER) :-

The work force i.e., the man power consists of skilled and unskilled workers. Meticulous care has to be taken in man power planning in order to ensure timely deployment of just the required number of workmen of the right trade and skill. Both over-manning and under-manning are bad. At the same time there should be no sudden fluctuations in the labour strength.

MAN POWER PLANNING :-

In a construction organisation, manpower planning is done as explained below.

- describe the work elements and man-power-skill-specifications and assess the number of ^{man days} ~~man days~~ of various trades and skills to be put every week/month.
- draw a chart of manpower needed week wise or month wise using a CPM network.
- adjust the schedule and manpower requirements avoiding sudden and steep fluctuations.
- ascertain the availability of men of the right trade and skill for recruitment.
- ~~recruit~~ recruit and train the scarce categories in advance but try to keep edging to the minimum.
- maintain a reasonable ratio between supervisor and workmen ensuring effective supervision and high productivity.

CPM → critical path method

⑧ TECHNICAL AND MANAGERIAL PERSONNEL (ORGANISATION) :-

Technical and managerial personnel effectively use the available human resources in such a way that the project is finished within stipulated time and the budget. And it is called ORGANISATION of an engineering project or industrial concern. It is a basic frame work of human resources who is responsible for executing the project.

ORGANISATION PLANNING :-

organisation needs effective planning. organisation can be defined as the pattern of ways in which a large number of people engaged in a complexity of tasks, relate themselves to each other in systematic establishment and accomplishment of mutually agreed purposes.

The functions of organisation may be enumerated as follows :-

- a) It establishes the pattern of relationship by giving duties and responsibilities to an individual or group.
- b) It provides adequate communication.
- c) It demarcates the authority, responsibilities and duties of each individual or group.
- d) It coordinates or integrates and controls the activities of individual or groups to achieve common objectives of the business enterprise or engineering project.

Therefore, it is evident that an organisation for the construction contracting has to be built taking into account the general principles of management, ~~has to~~ ~~be built taking into~~ the need of accountability and the special characteristic of the construction industry.

MATERIALS :-

Materials such as brick, stone, timber, cement, sand, stonechips, steel, lime, paint, centering and shuttering, water supply, sanitary and electrical fittings, petrol, oil, lubricants etc. are termed as material resources which are required for construction of civil engineering projects.

A material schedule showing the quantity, quality and with exact time and date of its delivery is prepared by assessment with reference to work schedule (or activity calendar) and it is the duty of construction engineer to look into the material schedule and give order for supply of various materials at the appropriate time of construction period.

MACHINERY :-

For any construction work, various plants/equipments and tools are required at different point of time during the execution period. Depending upon the type and nature of a construction job, machinery required at site may include batching plant, mixer, vibrator, trucks, tractors, excavators, cranes, pumps, generators, workshop equipments etc. It is pertinent to prepare an equipment schedule or equipment calendar so that the construction manager may have no difficulty in arranging the equipments for the purpose at the right time and the work will not be held-up because of lack of any equipment. On the basis of economic analysis, a construction engineering/contractor may arrange by transferring from ~~to~~ other site or buying or hiring. It must be remembered that non-availability of the appropriate equipments or

1001 In time can hold-up the working work leading to financial loss and delays.

MONEY:-

Money or fund is the single most important resource because all other resources are directly dependent on the availability of fund. So the financial resource should therefore be planned and arranged with special care for smooth cash in-flow and out-flow and to avoid any delay in the project activities.

POWER:-

Power is an essential resource required for lighting, running equipments and machinery and for other facilities.

WATER:-

For performance of some construction items of a civil engineering project, water plays an important role. Hence a source of water-supply must be generated at the work site to serve both domestic and constructional use.

SPACE:-

For execution of civil engineering project, it is essential that work site must be available for other facilities also viz.

- storing materials.
- providing yards for bar benders, carpenters, installation of equipments and plants, repair workshop casting yard etc.
- site office and labour camp etc.

COMMUNICATING MEANS:-

Land communication means should be available to the work site to facilitate the execution work of the project. Telephone and other facilities also be available for the transfer of information and instructions etc.

Importance of construction project / construction planning

Construction planning :-

An administrative process by which suitable line of action is selected out of the various alternatives available for the project work is called planning.

Importance :-

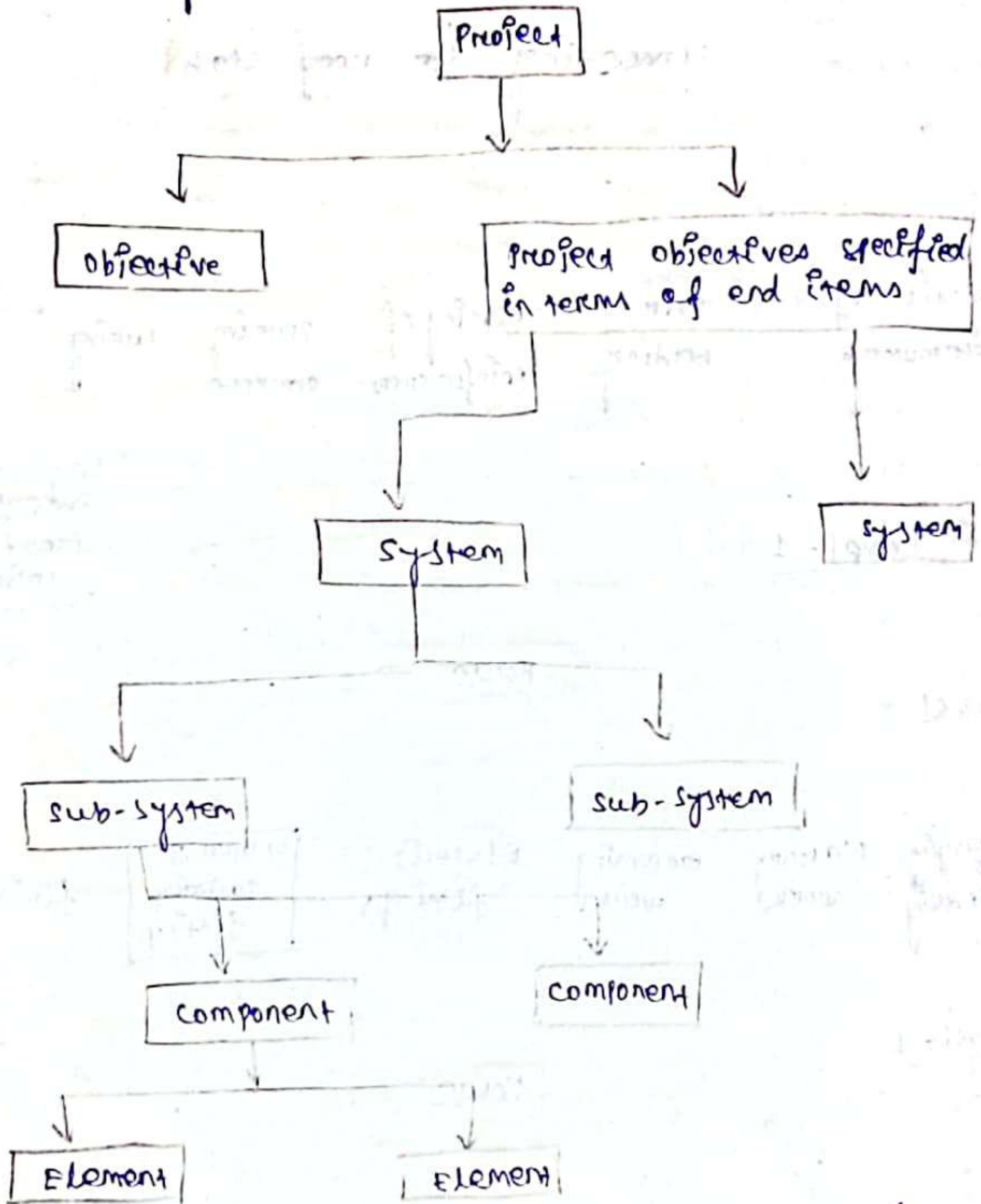
- Planning helps to minimize the cost by optimum utilization of available resources.
- Planning reduces irrational approaches, duplication of works and inter departmental conflicts.
- Planning encourages innovation and creativity among the construction managers.
- Planning imparts competitive strength to the enterprise.

Developing work breakdown structure for construction work :-

Work breakdown structure :-

- In any construction project, the various activities that make up the project have to be clearly identified.
- Process of breaking the project into easily identifiable major systems, their sub-systems and discrete activities is called the work breakdown structure.

→ Major project is first identified in terms of its end items, then split into systems, sub-systems, then their components and elements.

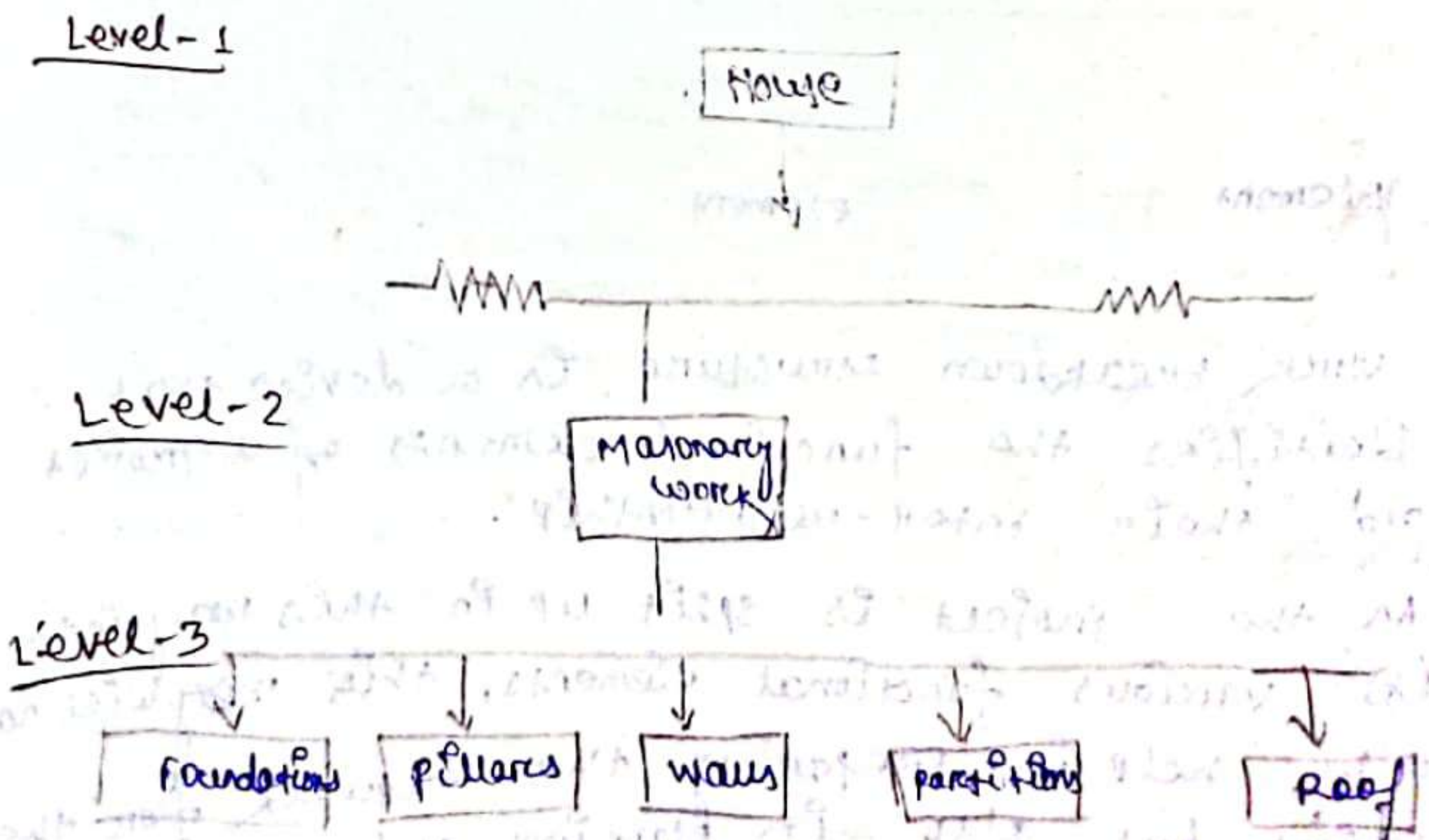
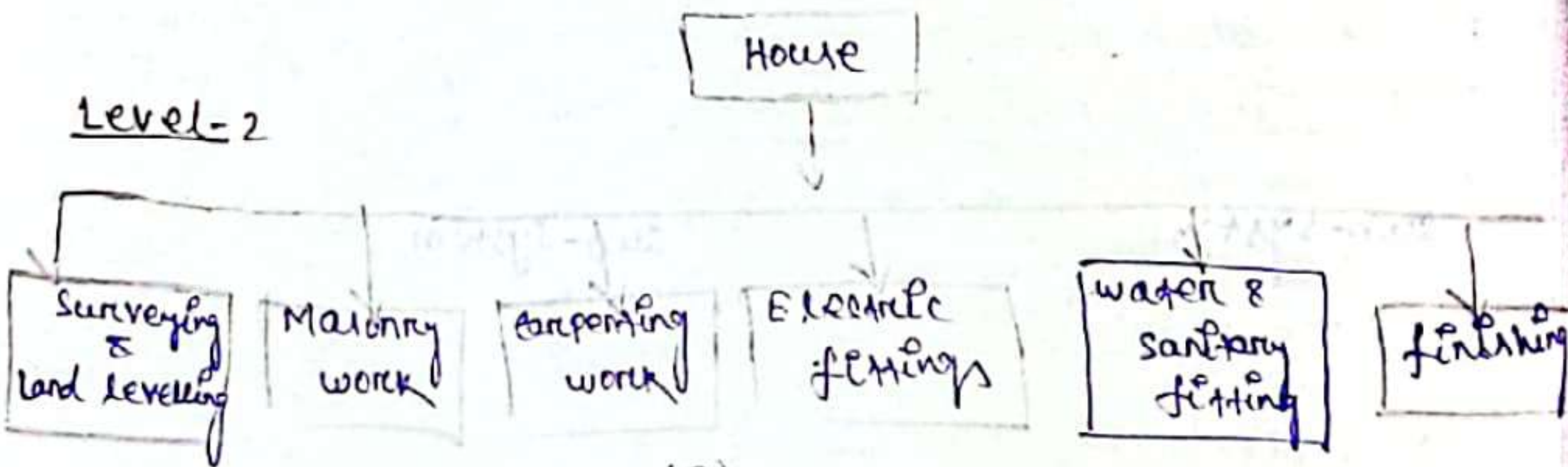
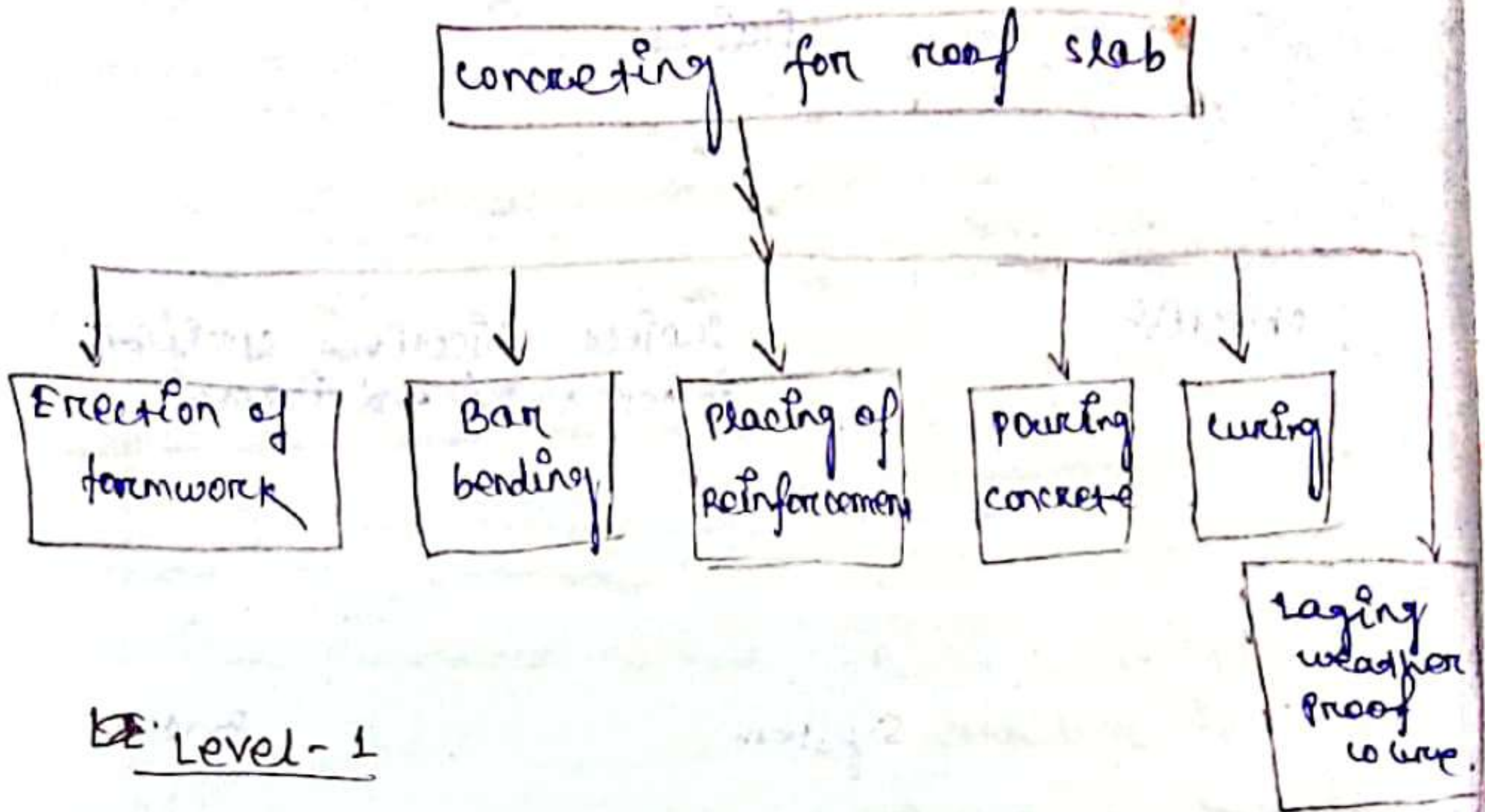


(work breakdown structure of a project)

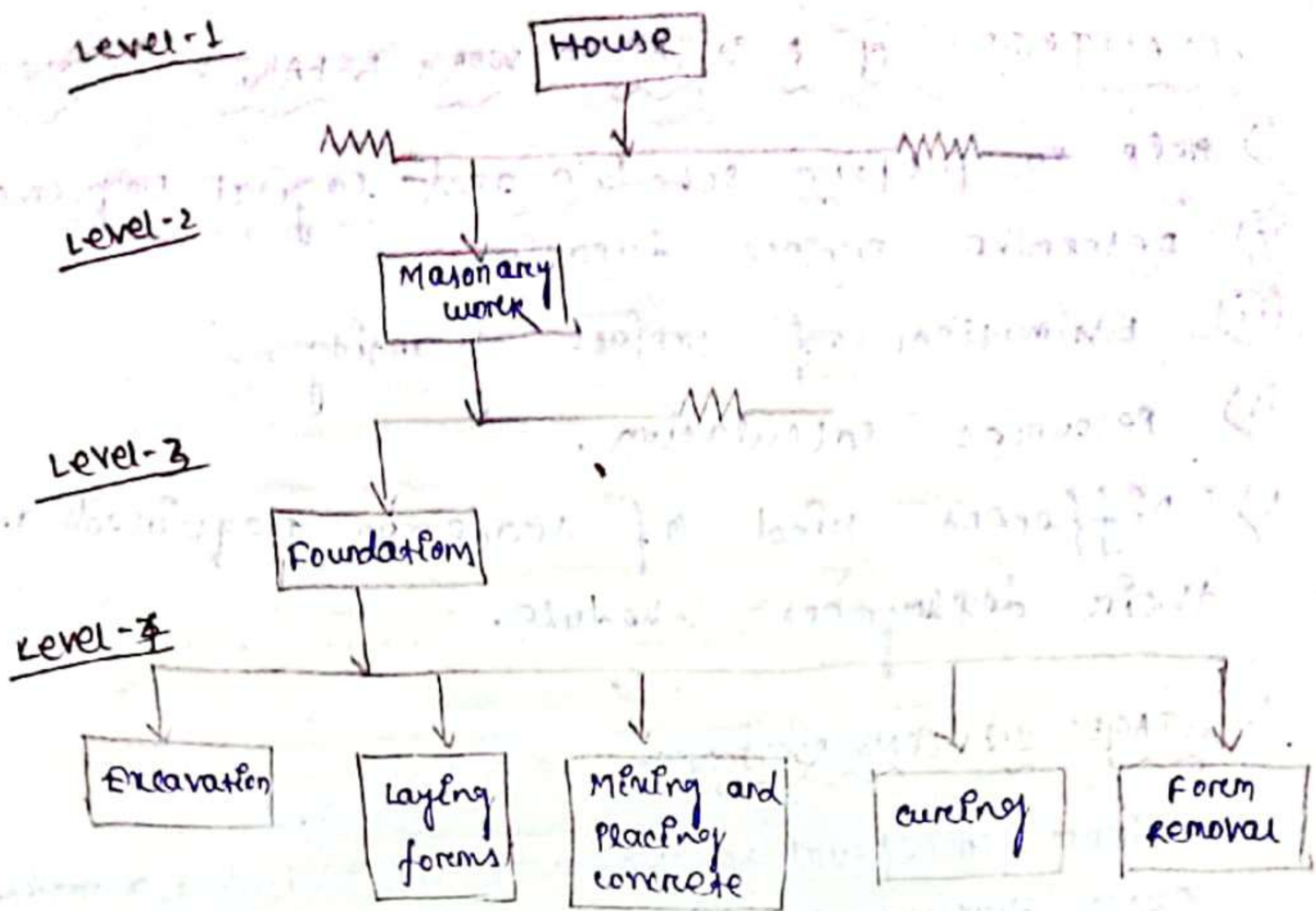
→ work breakdown structure is a device that identifies the functional elements of a project and their inter-relationship.

→ As the project is split up in this way into its various functional elements, this will not only help in preparing the network for the project but also in planning and scheduling.

The concreting work for the roof slab of a residential building can be split up into various elements as follows.



(b)



(c)

That figure is work breakdown structure for house construction project.

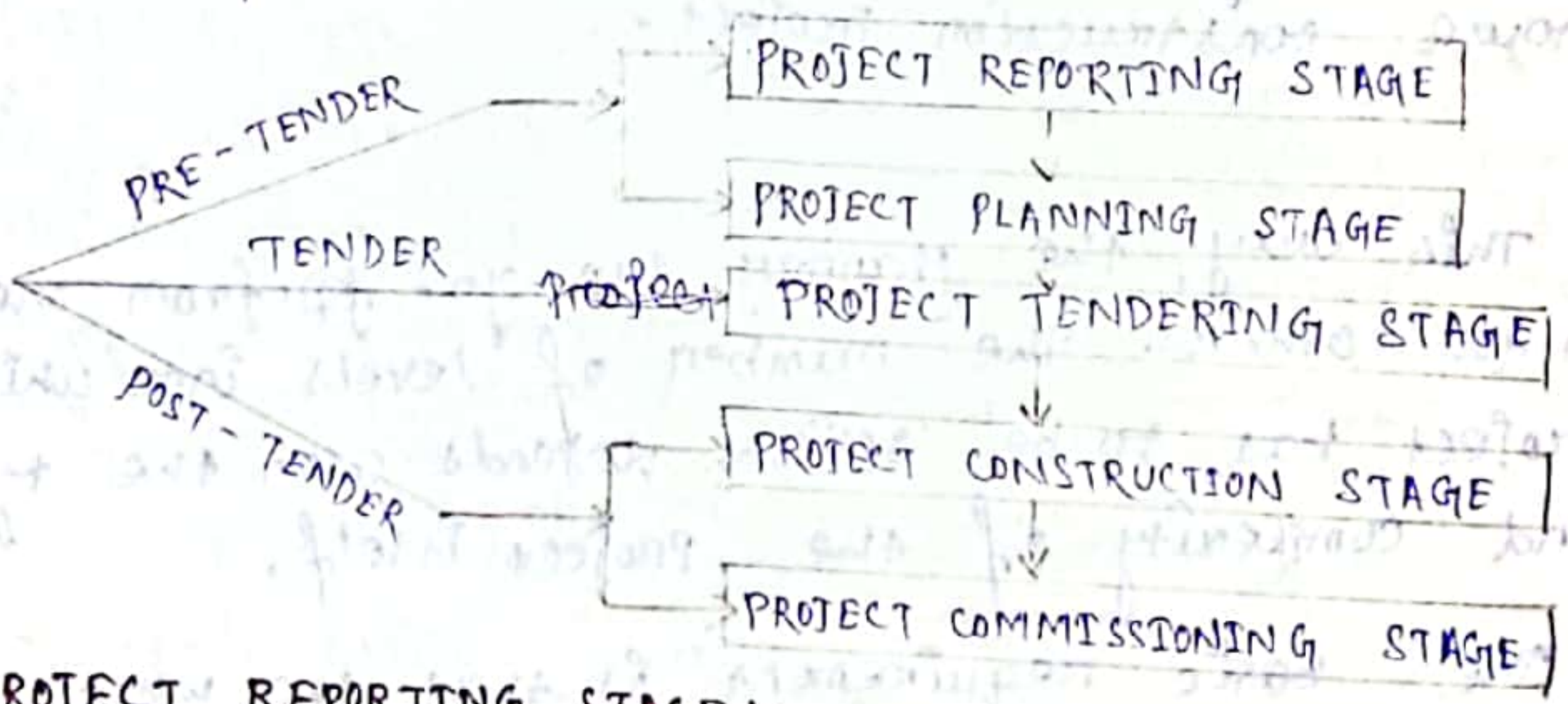
- This way, the planner can go from one level to the other. The number of levels into which the project has to be split depends upon the type and complexity of the project itself.
- The basic requirement is that the work breakdown schedule should be detailed enough to allow the eventual construction of PERT/CPM network which will precisely reflect the inter-relationship among all the events and activities which make-up the entire project.
- The work breakdown schedule so obtained presents the entire project in a systematic way so that inter-relationships among all phases of the project are easily seen.

ADVANTAGES OF A DETAILED WORK BREAKDOWN STRUCTURE

- i) help to prepare schedule and logical sequence
- ii) determine project duration.
- iii) Estimation of project quantity.
- iv) Resources calculation.
- v) Different kind of tradesman required and their deployment schedule.

STAGES IN CONSTRUCTION :-

from conceptual to the realistic situations, a project passes through several stages completely distinct from each other and each stage has its own purposes and functions.



PROJECT REPORTING STAGE :-

It is also called briefing stage where ideas of the project are originated by individual or group of individuals on a public sector or private sector company. Conceptual ideas of the project are thoroughly studied with regard to the cost and benefits so as to establish the economic viability or social utility of a project.

Purpose :-

The purpose of this stage is to study the conceptual ideas of a project and prepare a reporting or briefing by specifying project functions. The architects, engineers and other members of a construction team correctly interpret the owner's wishes and provide an estimated cost.

Activities :-

A civil engineering project begins with a thorough investigation of the scope and economic feasibility of a project. This is the preliminary stage (or the pre tender stage), and many factors are broadly stated

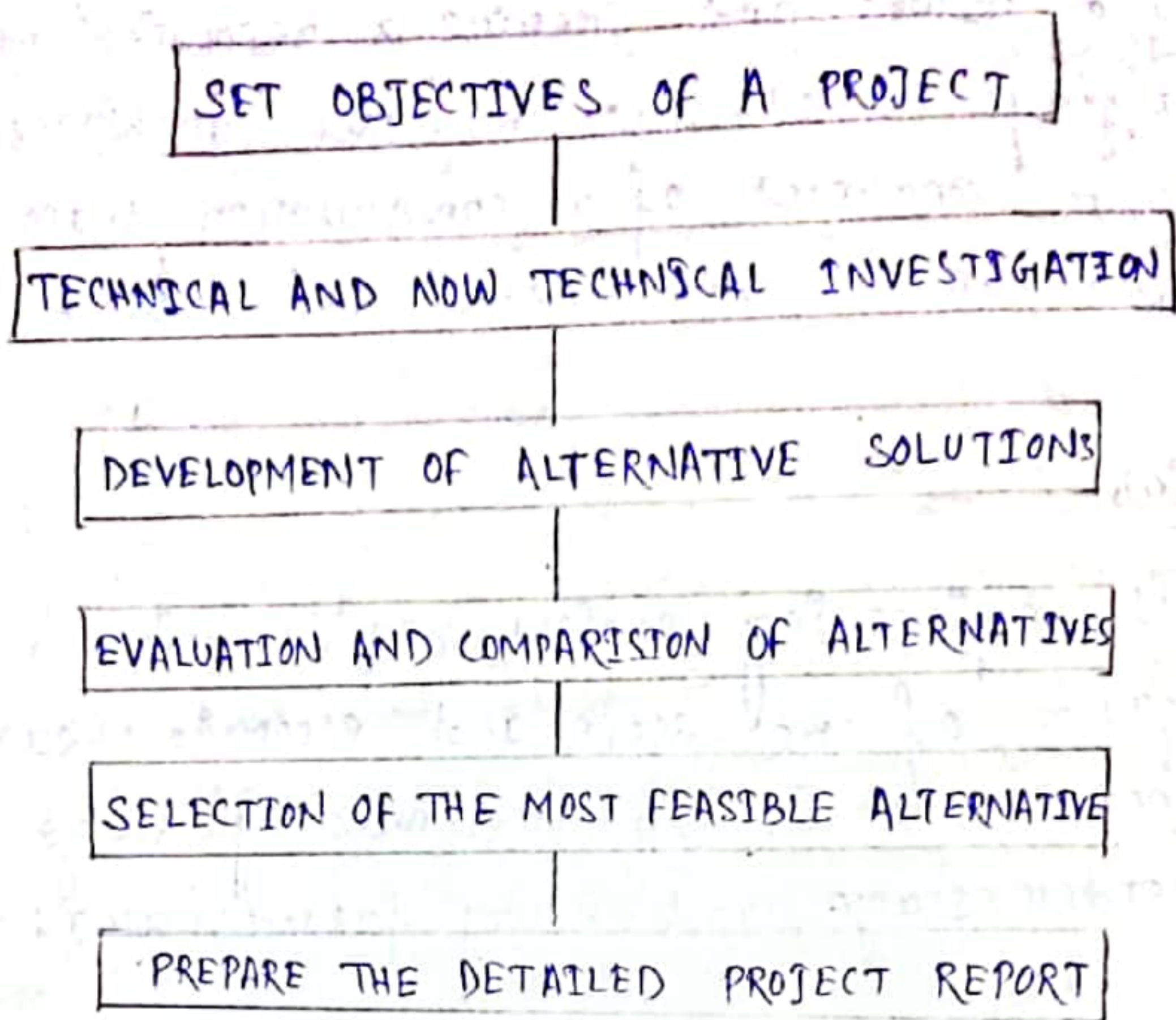
on the basis of both technical and non-technical investigations, many alternative proposals may be given due consideration.

Non-technical investigations include economic and social factors which may define the scope of the project including market survey for resource identification.

Technical investigations include geological and geographical survey with many site investigations such as soil conditions, ground water level and others.

All the feasible alternatives are studied and the most feasible one is selected for the purpose for which a report with recommendation is made.

The functions of this stage may be summarised as



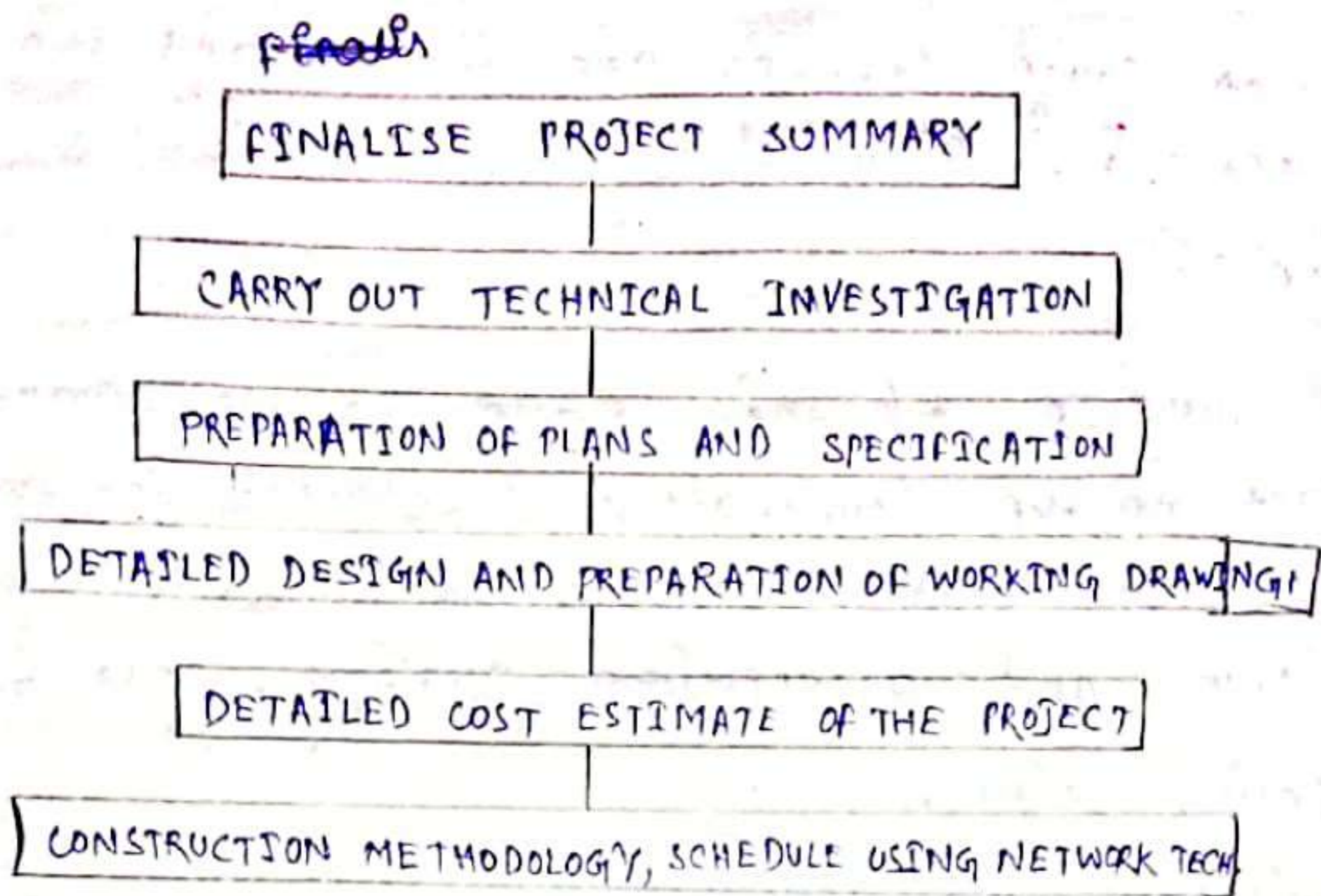
PROJECT PLANNING STAGE :-

This is very important stage when a realistic and detailed cost estimate of the chosen project is made. Any modifications later on will result in adding to the project cost.

Purpose :-

The purpose of this stage, is to prepare project summary, to prepare detailed drawings and specifications to make detailed structural design and finally to get the detailed estimated cost of the project. The type of construction and methodology for network technique is worked out.

Functions :-



PROJECT COMMISSIONING STAGE :-

It is the stage in which the performance of the structure is evaluated and nature of maintenance and repair is proposed.

Purpose :-

The purpose of this stage is to ensure that the construction work has been completed as specified in the contract documents. If any changes, have been made because of some reasons, they must be recorded for technical performance and financial implications.

Functions :-

Various functions involved in this stage are;

- i) to keep various records of the actual work.
- ii) to have quality inspection thoroughly to remove the defects if found.
- iii) to prepare operating and maintaining manuals.
- iv) to carry out the performance test of the structure.
- v) to have training and recruitment of staff for ~~commissioning~~ commissioning schedule.

PROJECT TENDERING STAGE :-

In this stage tenders are invited and the contract is awarded.

Purpose :-

The purpose of this stage is to award a contract to the contractor selected for the purpose on suitable terms and conditions ensuring requisite and appropriate quality, cost and completion time.

Functions :-

Preparation of tender document and obtaining tenders through N.I.T.

comparative statement of tenders

Ascertaining resource capacity, work experience and reliability of the contractors.

Award of the contract to the selected contractor and contract document.

work order and possession of site to the contractor.

N.I.T → Notice Invited Tender

PROJECT CONSTRUCTION STAGE :-

During this stage, actual work is executed as per plans and specifications prepared earlier. The construction methodology is carried out in a planned manner preventing wastage of manpower, materials and money and ensuring completion of the project within stipulated time, cost and quality.

Functions :-

- i) Using CPM network, the following construction schedules or calendars are prepared where requirement of each with exact date is clearly demarcated. This facilitates the work of construction management along with controlling and monitoring.
 - a) Activity schedule / calendar
 - b) Material schedule / calendar
 - c) Worker schedule / calendar
 - d) Fund schedule / calendar
 - e) Equipment schedule / calendar
- ii) Provision of services and facilities must be provided before starting the construction work.
- iii) A typical layout of service camp should be incorporated.
- iv) Supervision of construction work within the contractual agreement and ensuring the quality of work and checking of work as per plans and specifications is made.

v) co-ordination of sub-contractors and various sections is done.

vi) Inspections, quality control and progress of work are the main function of this stage.

vii) If there is any problem ~~or~~ during the construction, it must be sorted out amicably.

viii) Final checking of the completed work is made and final payment is made to the contractor.

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Bar-chart :-

→ A bar-chart consists of two co-ordinates axes, one showing time and other showing jobs or activities to be performed. Each job is depicted in the form of a horizontal line or bar and the length of the bar indicates duration of the jobs or activity.

→ Bar chart were introduced by Henry Gantt around ~~1980~~ 1900 ad. Therefore, these are called as Gantt chart.

→ Bar-chart is a graphical representation activity v/s time.

→ usually horizontally axis represents the time duration and vertical axis represents the activities or jobs to be performed.

- Activities are shown with the help of a bar.
- The beginning and end of each bar shows the time of start and time of finish of activity respectively.
- Therefore, the length of the bar represents the time required for the completion of the activity.

Event :-

An event is a specific instant of time which makes the start or end of an activity. Event consumes neither time nor resources.

Activity :-

An activity is the actual performance of the task and requires time and resources for its completion. It is the work required to complete a specific task.

EX → draw the bar-chart for finalisation of designs and work order for a building project.

<u>Activity</u>	<u>Description</u>	<u>Time for completion</u>
A.	→ site selection and survey	→ 4 weeks
B.	→ Design	→ 6 weeks
C.	→ Preparation of drawing	→ 3 weeks
D.	→ Preparation of specifications and tender documents	→ 2 weeks
E.	→ TENDERING (N.I.T)	→ 4 weeks
F.	→ selection of contractor	→ 1 week
G.	→ Award of work order	→ 1 week

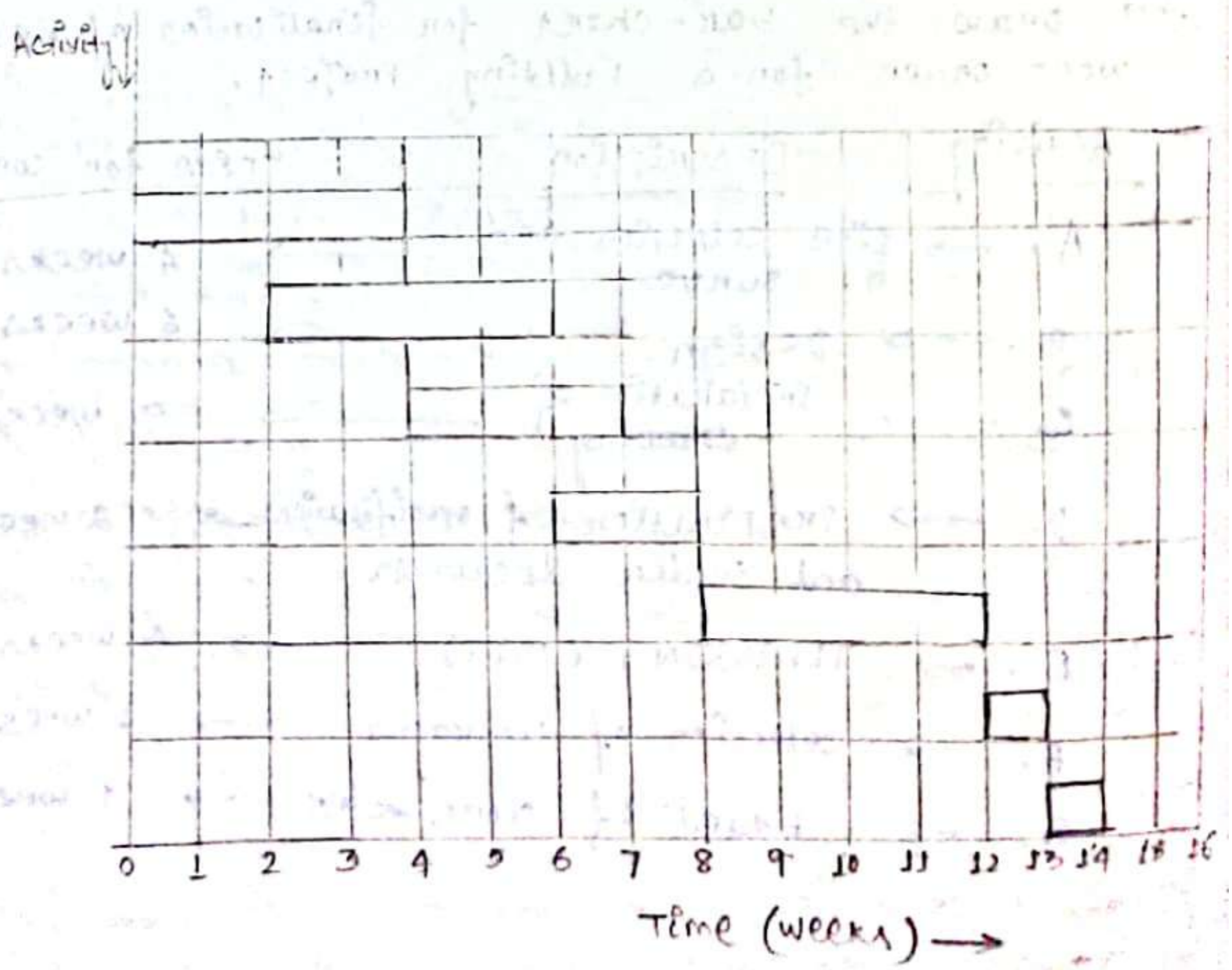
Solution 2

on the above project, Activity A and B can start concurrently, since some parts of the architectural and structural designs can be done even if complete survey data is not available,

similarly drawing work can also be started as soon as survey work is over, though all the designs are still not complete.

specifications can be finalised when once the designs are complete.

Activity E can be started on when activity D is complete. Activities E, F and G are to be completed in sequential order.



From the figure we conclude that the total time required for this phase is 14 weeks.

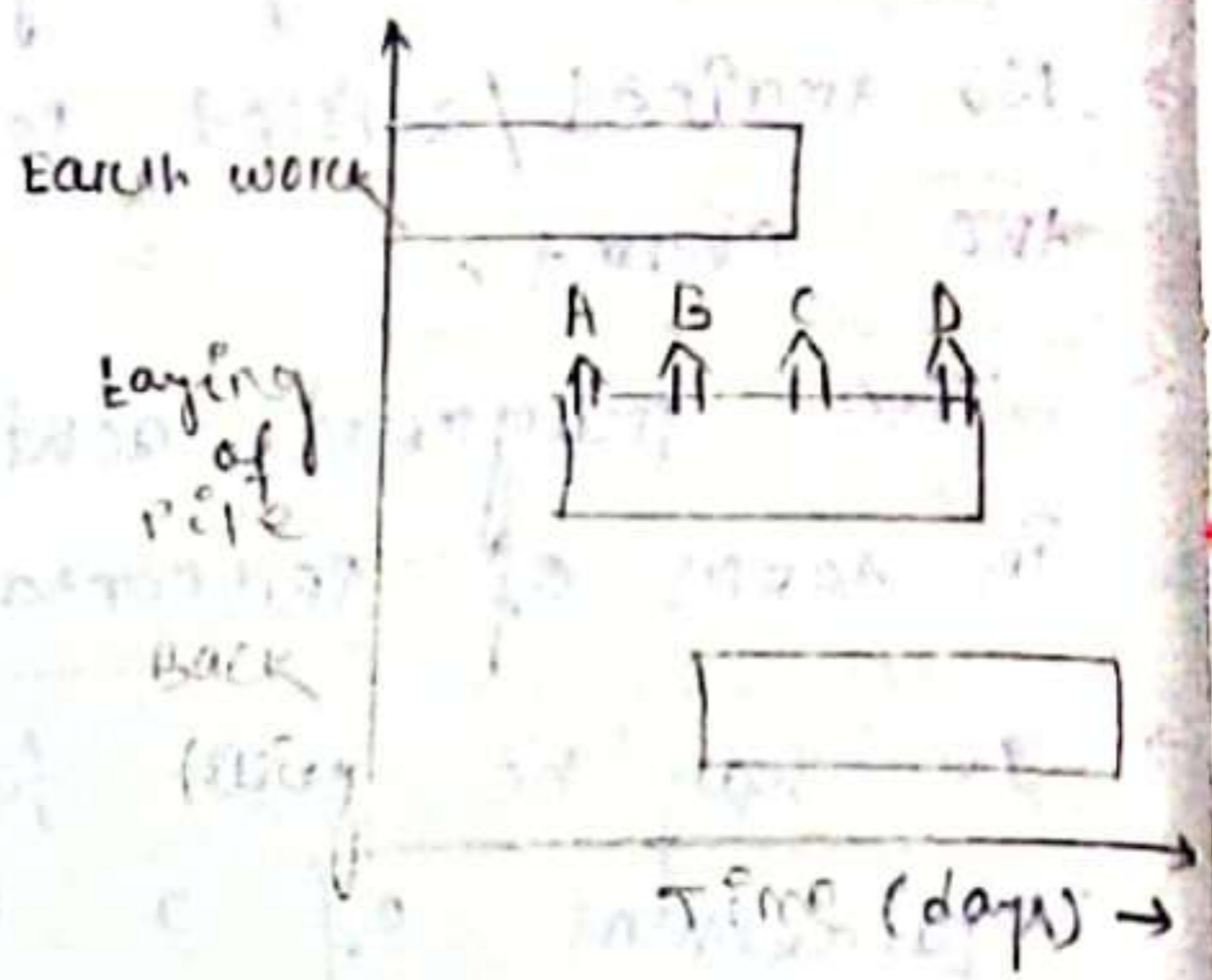
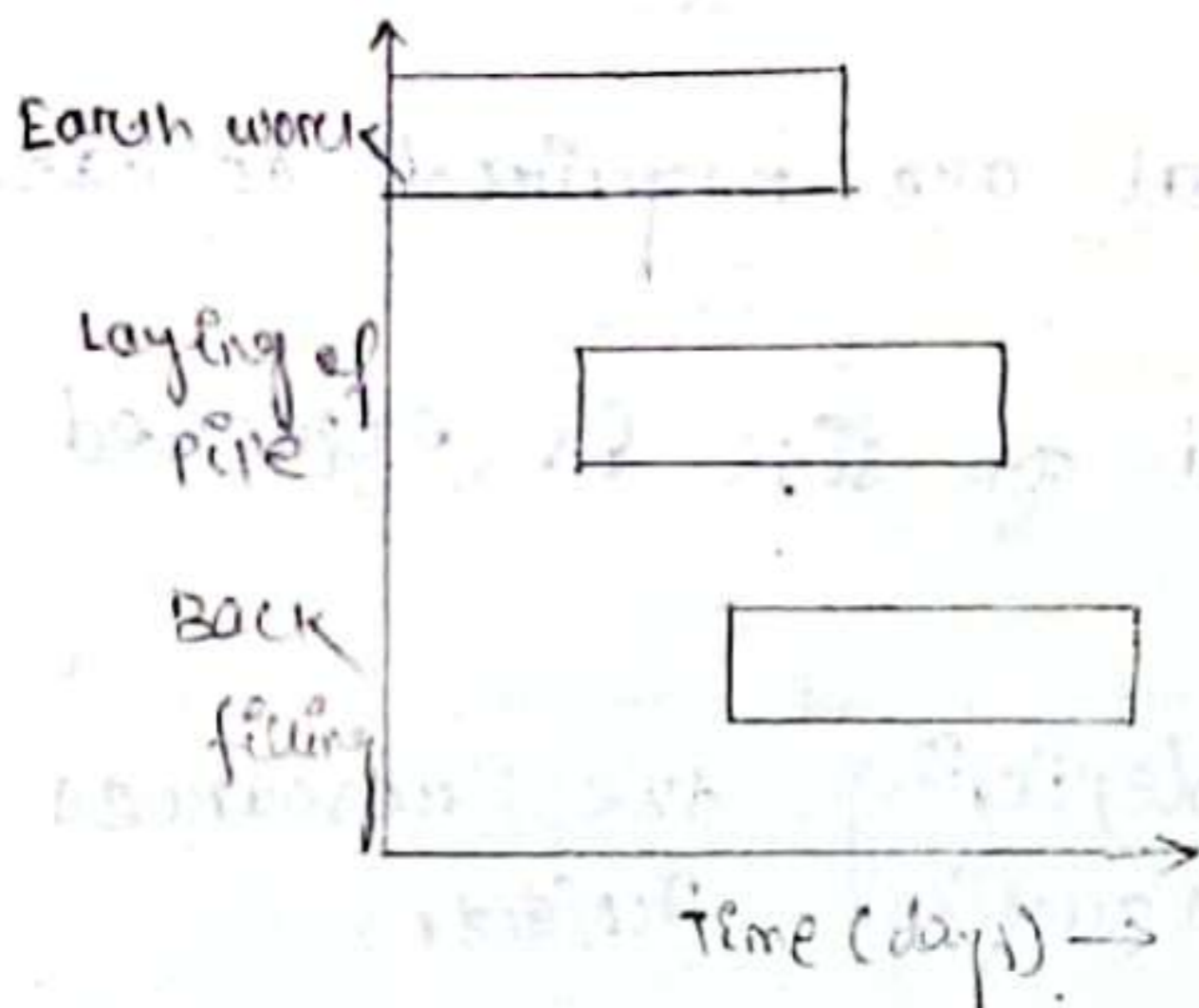
Advantages of Bar-chart

- It is simple to draw, easy to understand and can be drawn quickly.
- No trained/skilled personal are required to make the chart.
- The progress achieved at site is expressed in terms of percentage.
- It may be used for depicting the resources requirement of a construction project.
- It provides a visual representation of the entire project which shows exactly when each of the above activities is supposed to start or finish.

Limitations of Bar-chart:-

- Lack of degree of details
- ↳ Lack of degree of details:-
- In case of big projects only major activities can be shown, if all the activities of big project are shown on the bar chart then it may become too clumsy. Therefore bar charts are not preferred for big projects.
- An activity is represented as a bar, without any details of sub-activities contained in it. Due to this effective control over activities can not be done.
- For example consider activity in the below bar chart 'laying of pipe work' is shown as a bar, but following sub-activities controls the satisfactory and timely completion of the activity.

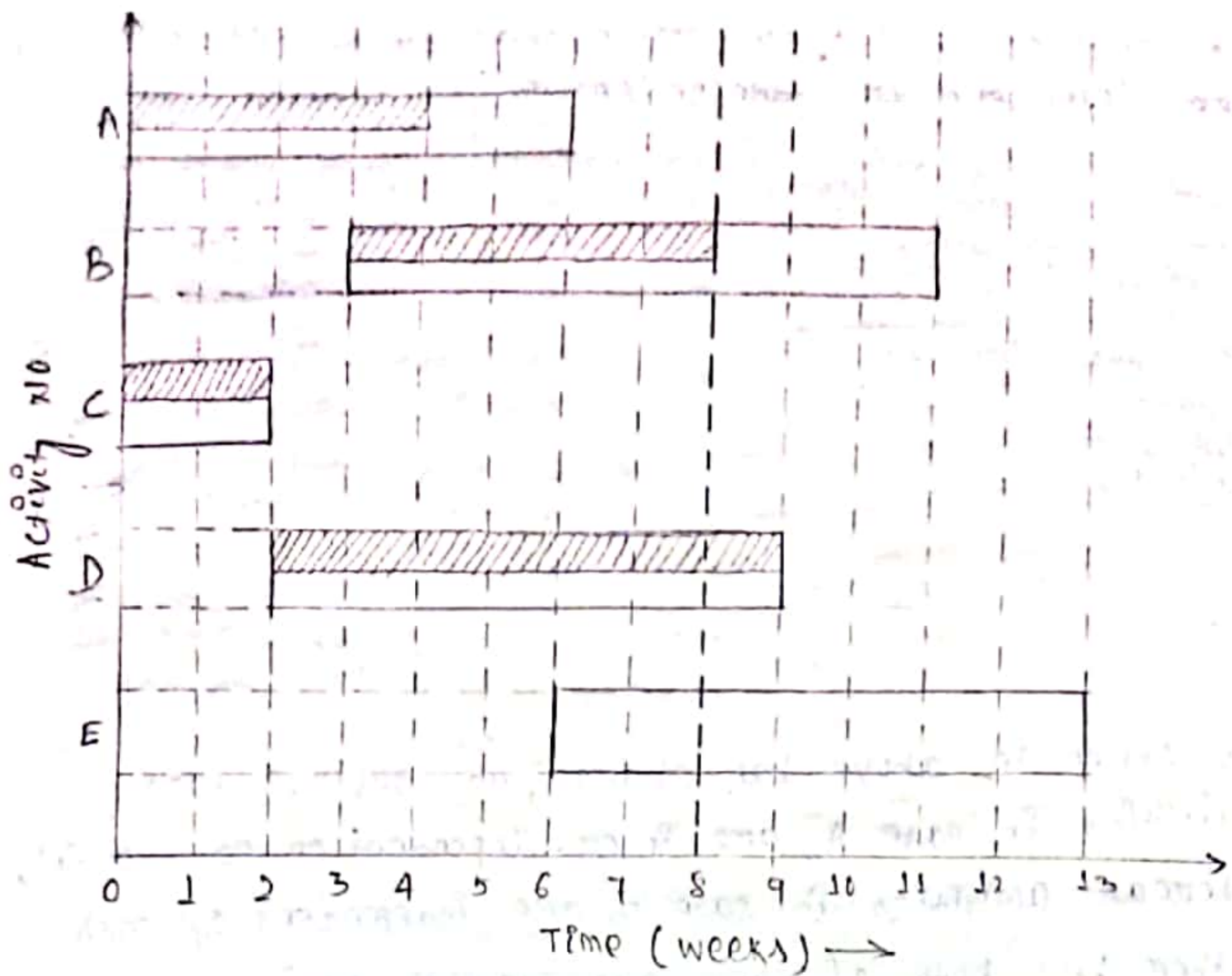
- A. Notice inviting for supply of pipe.
- B. Finalisation of bid.
- C. Supplies of pipes at site.
- D. Final laying of pipe.



→ For the satisfactory and timely completion this activity these sub-activities should be scheduled properly. The above detail can be shown effectively by marking stages (also called milestones) on that particular activity bar.

2) Review of project progress.

- A bar chart does not show the progress of work in the project and therefore it can not be used as a control device.
- As progress made at a particular instant of time is required for proper control of the project.
- The difficulty or drawback can be overcome by showing the progress of each activity by hatched lines in the half of the width of the bar.



→ Progress of each activity is marked on the above bar chart with the help of hatched lines at the end of 8 weeks.

Following observations are made :-

- 1) Activity A is behind schedule by 4 weeks
- 2) Activity B is on schedule and Activity C is completed.
- 3) Activity D is ahead of schedule by 1 week.
- 4) Activity E has not started yet and therefore need to be rescheduled.

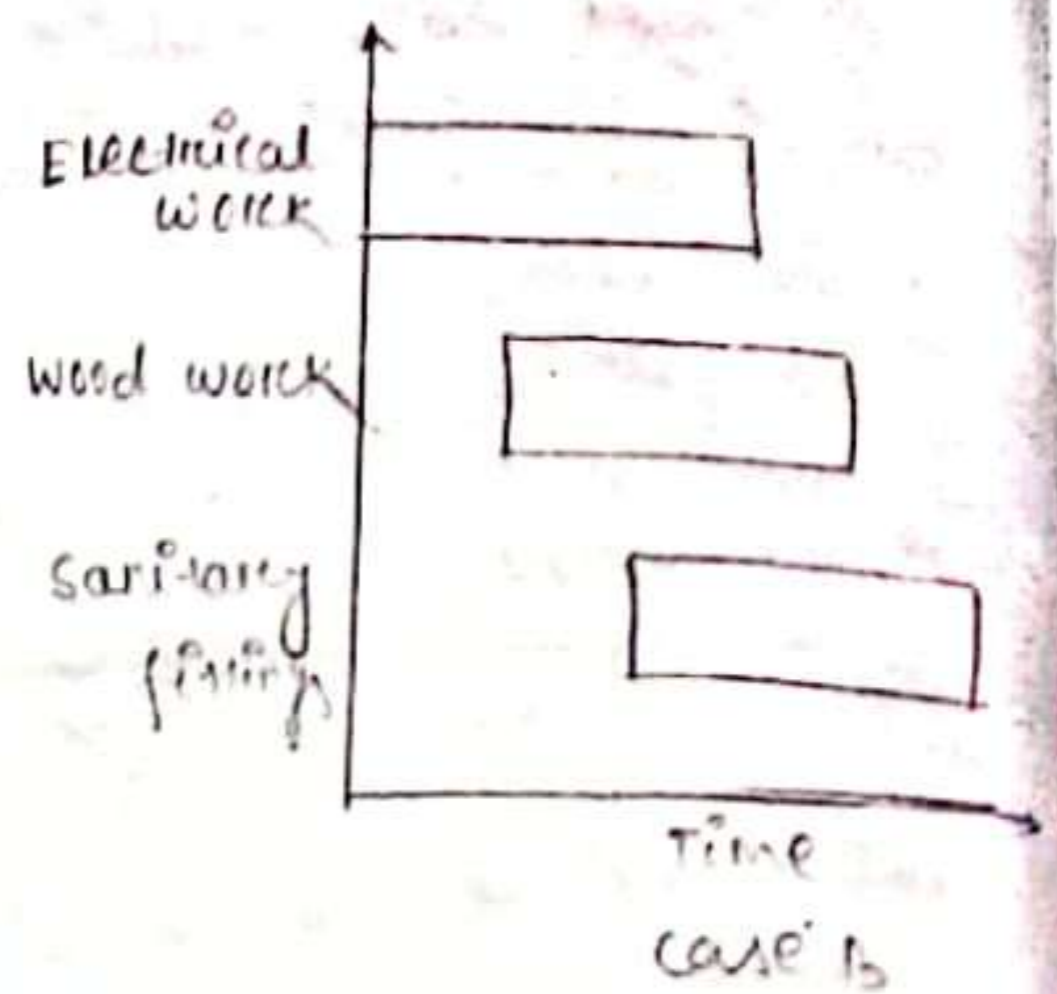
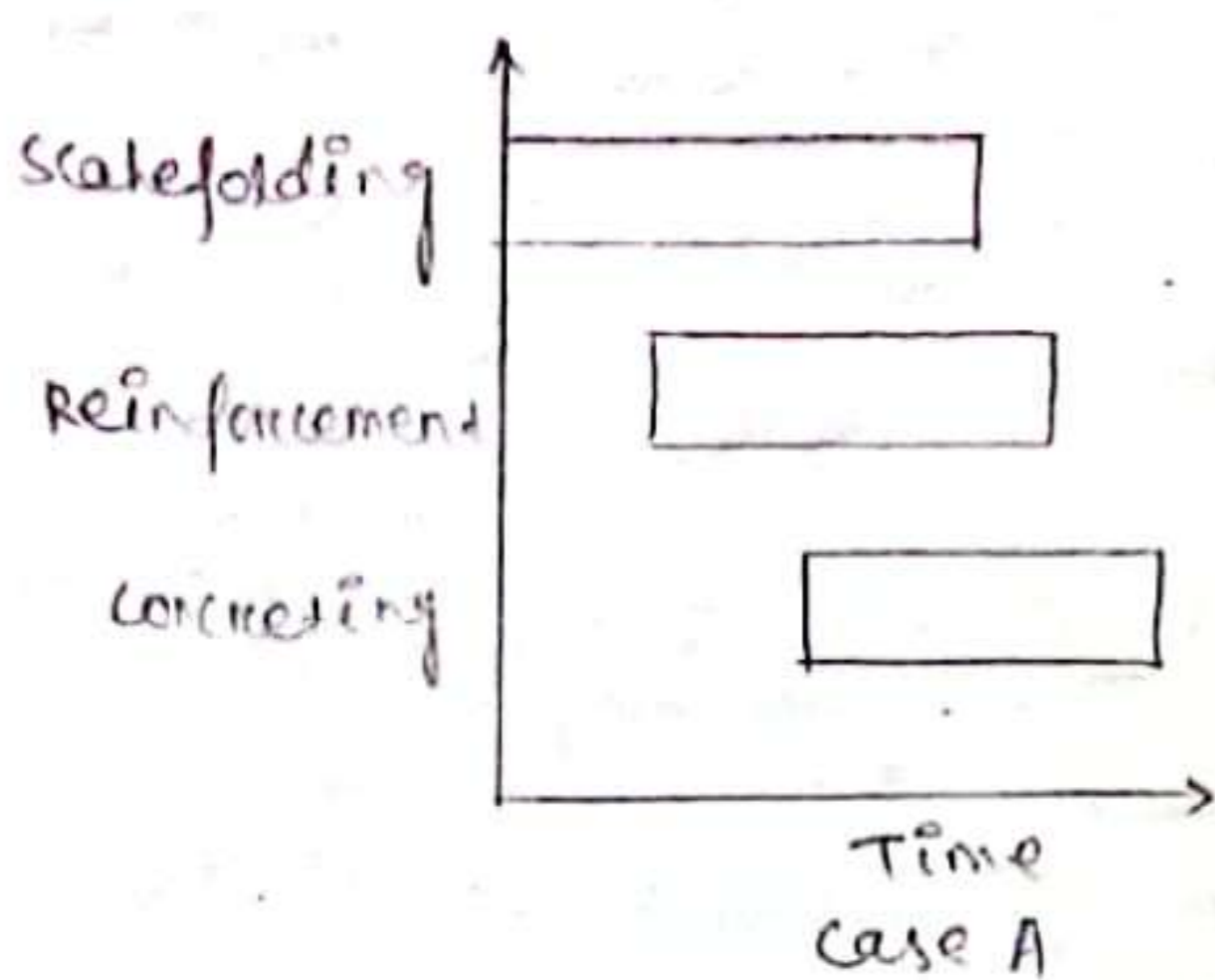
3) Activity Inter-relationship :-

→ There is a serious drawback with the bar charts that they do not show interdependencies and relationship between various activities of the project.

→ We know that there are some activities of a project which are performed concurrently, while there are some activities which are performed only after the completion of some other activity.

→ Activities which start after completion of some other activity are shown serially, whereas concurrent activities are represented by parallel bars.

→ one can not draw a conclusion that concurrent activities are dependent or independent of each other.



→ As shown in above bar charts, we observe that activities in case A are inter-dependent on each other, whereas activities in case B are independent of each other but both of them are parallel activities.

4) Time uncertainties :-

→ Bar charts are not at all useful in those projects where there are uncertainties in determination of time required for completion of particular activities. e.g → research projects.

→ Because of the uncertainties of time determination will lead to rescheduling of few activities and the flexibility of rescheduling can not be shown in bar chart diagrams.

5) It does not indicate the critical activities of the project.

→ It does not distinguish between critical and non-critical activities, knowledge of critical activities need the maximum attention of construction team to finish the project in time.

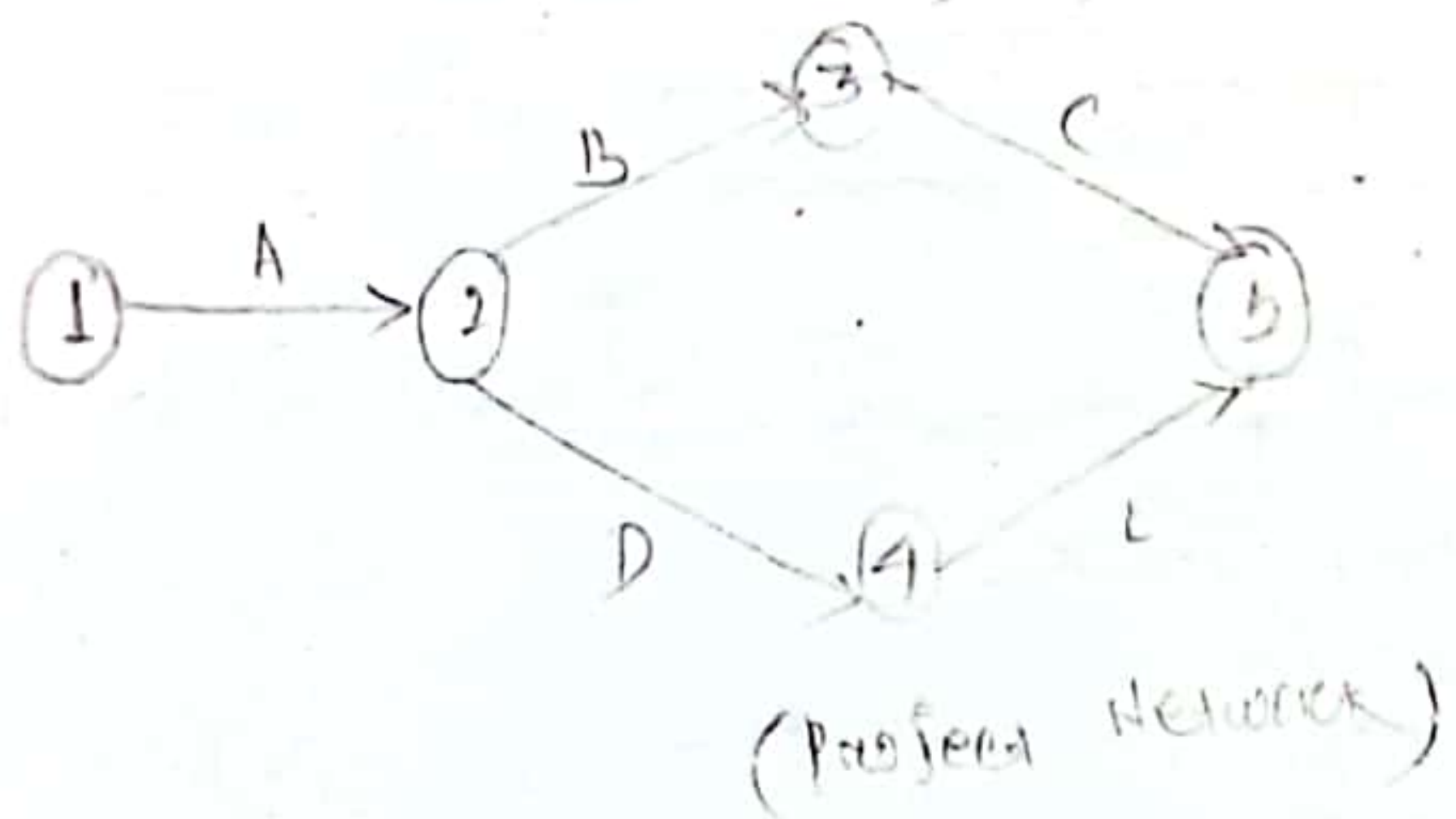
6) NO COST OPTIMIZATION :-

→ Since exact critical path is not available in bar chart so it is not possible to crash the activities and get the optimum cost and duration of the project.

CPM (Critical path Method) :-

These are used for scheduling of project. Activities

Project :- consists of N no. of activities interrelated to each other and are to be executed in their order for completion product.



NO. of Activity → A, B, C, D, E

NO. of EVENT → 1, 2, 3, 4, 5

A is predecessor of B & D.

B is predecessor of C

NO predecessor of A.

D is " of E.

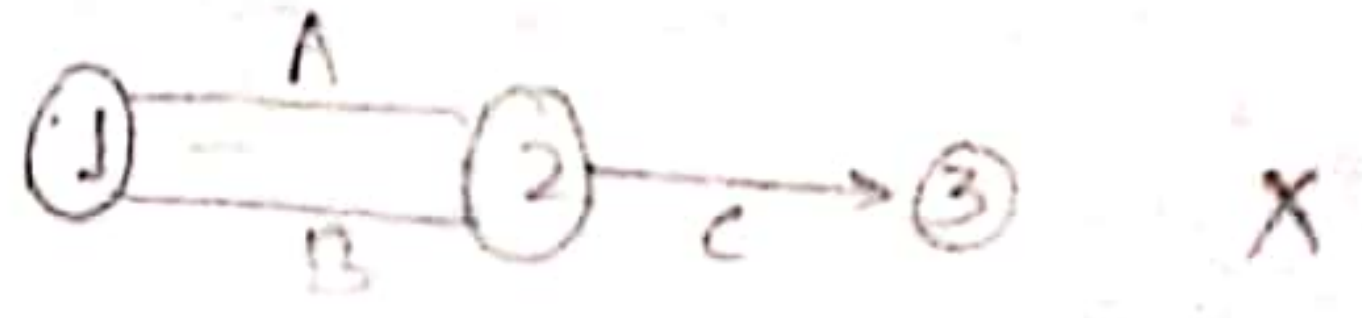
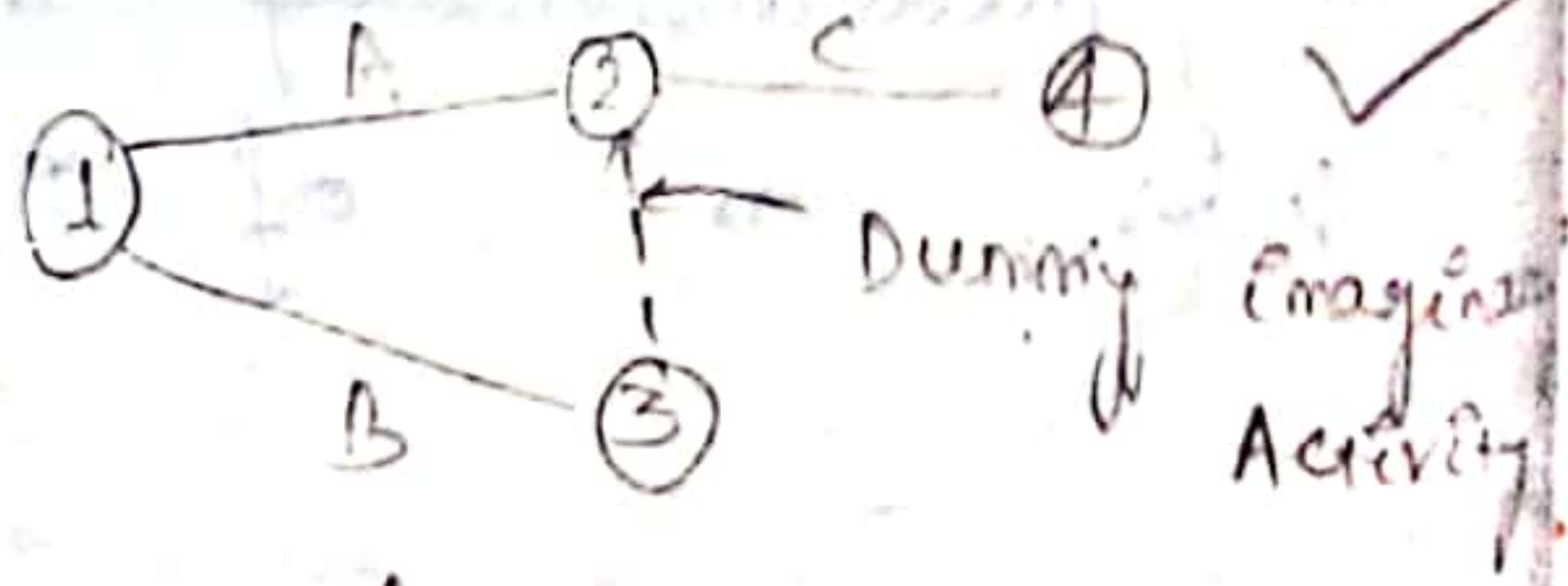
Rules to draw project network :-

- There should be single arrow for every activity
- Every activity should have start & end node
- Project should follow in one direction.
- Project should have only one start node and only one finish node.



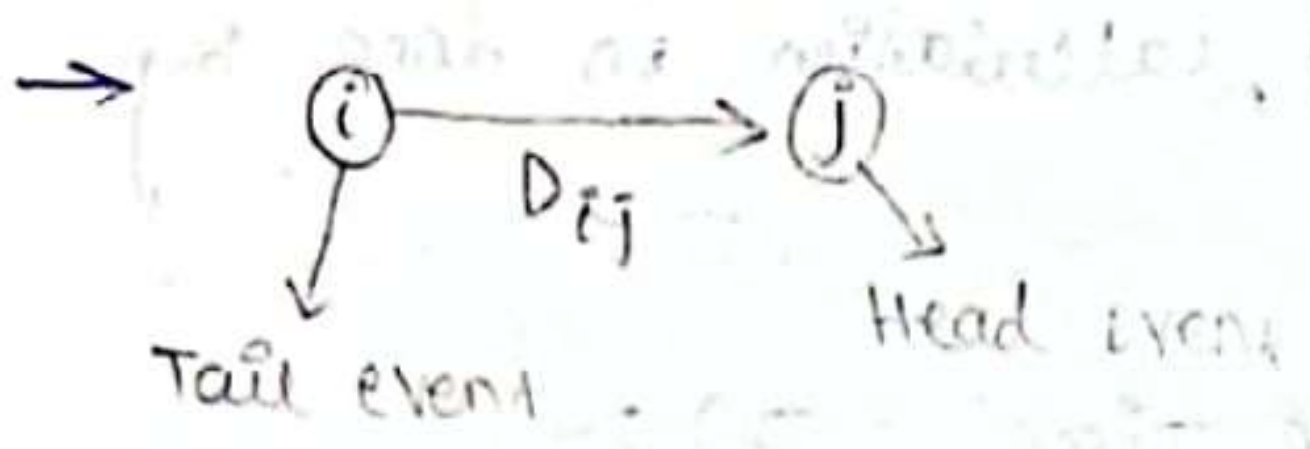
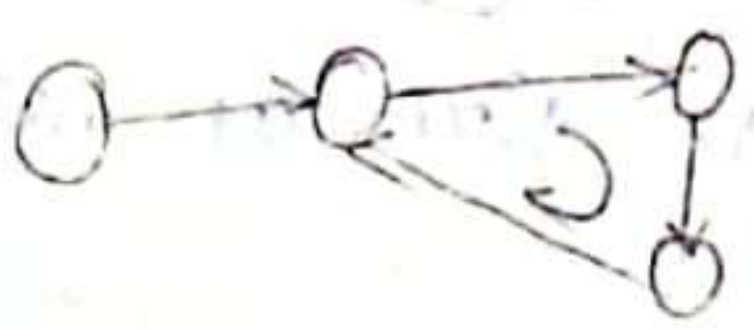
→ Two Activity should not have common start and end nodes.

Activity	Predecessor
A	—
B	—
C	A, B



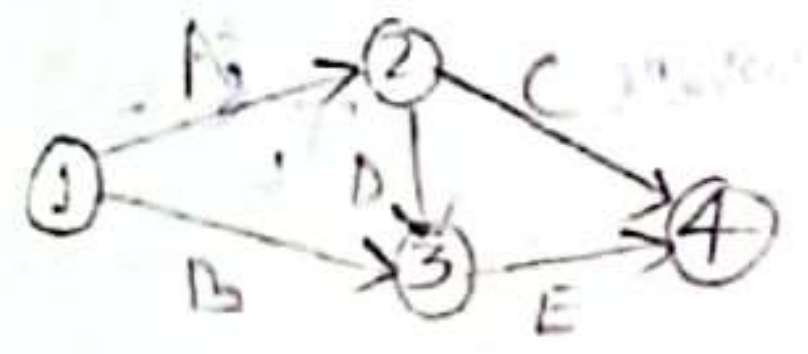
Dummy Activity:-

- It consumes no resources and time (Duration = 0)
- It used to satisfy predecessor relationship.
- we can use any kind of dummy activity but EF only needed.
- there should be no looping allowed in network.

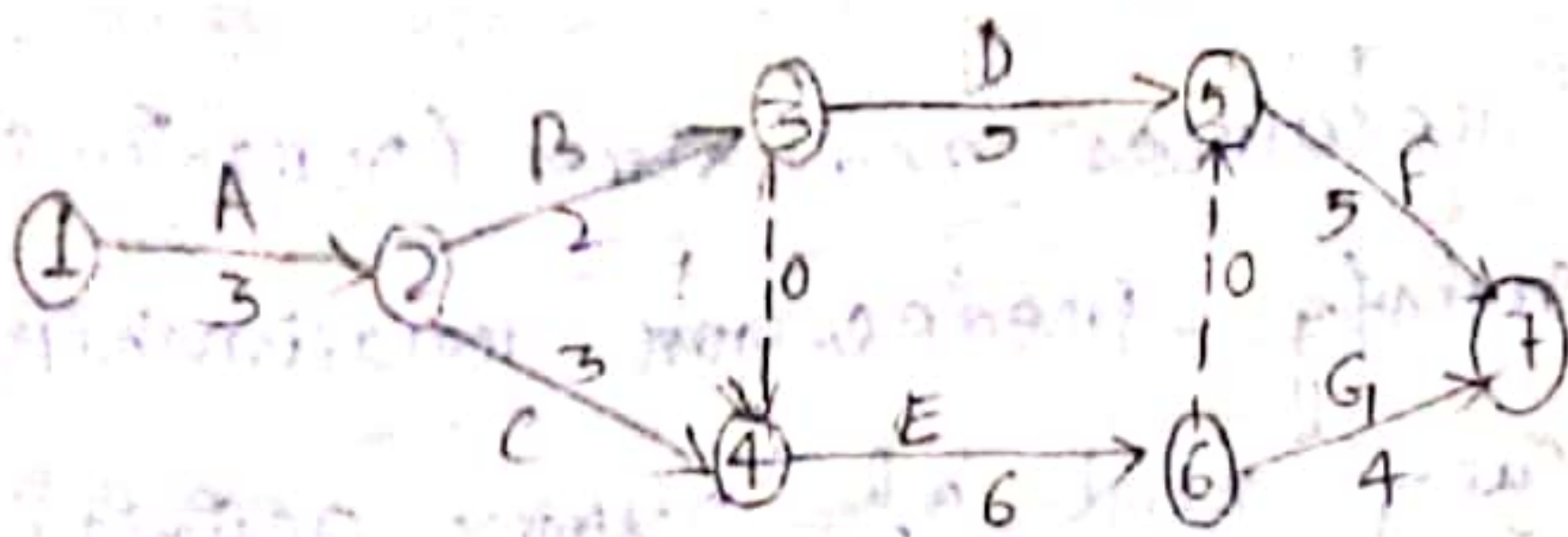


$j > i$

Activity	Event	Duration
A	1-2	15
B	1-3	20
C	2-4	08
D	2-3	10
E	3-4	12



Activity	Duration	Activity Immediately Preceding	Following
A	3	None	B, C
B	2	A	D, E
C	3	A	E
D	6	B	F
E	6	B, C	F, G
F	5	D, E	None
G	4	E	None



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Event time :-

Earliest occurrence time (TE) :-

It is the earliest time at which an event can occur.

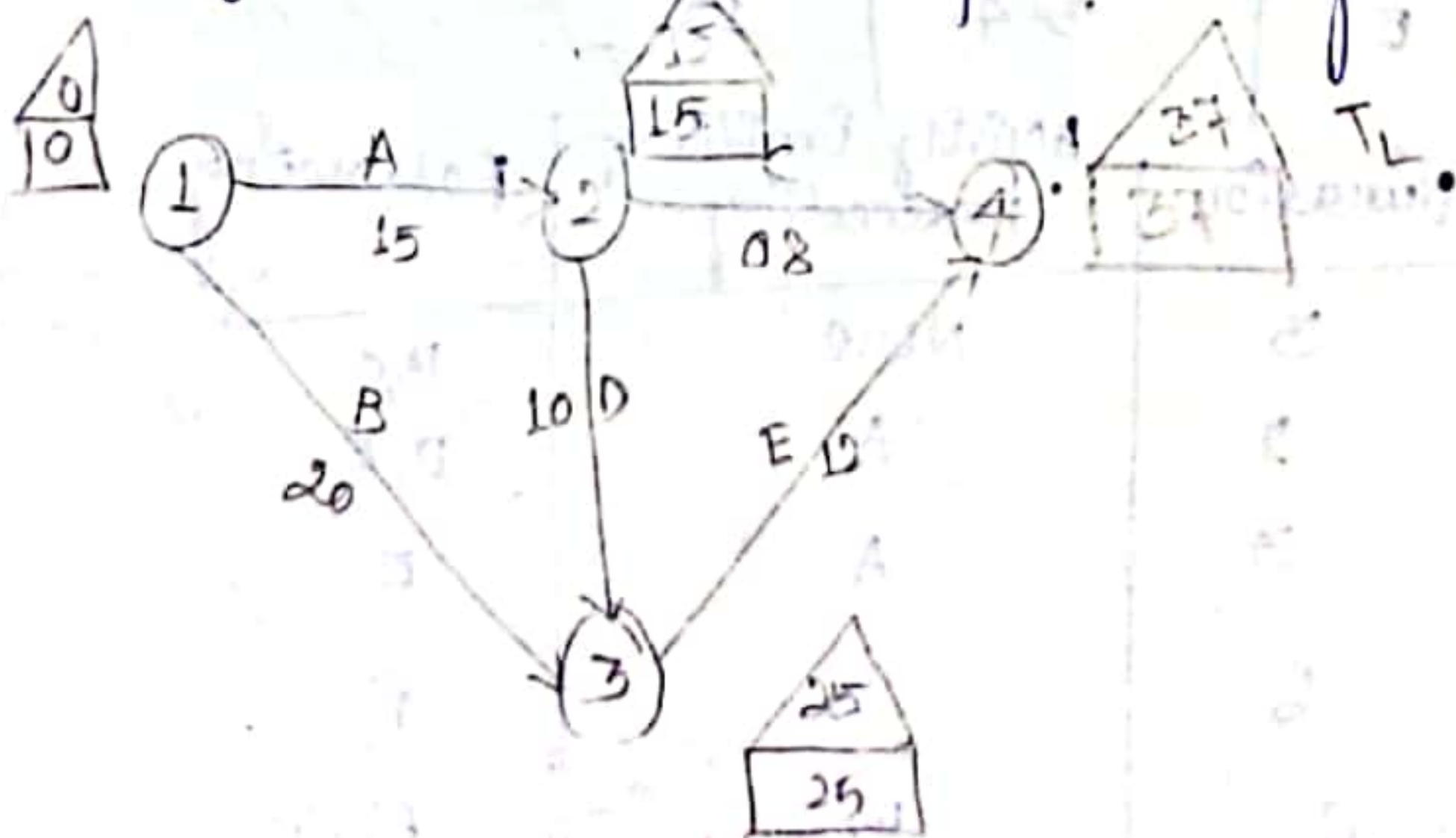
$T_E^j = \text{Maximum} (T_E^i + t^{ij})$, calculation is done by forward pass rule.

Latest allowable occurrence time (TL) :-

It is latest (delayed) time by which an event must be completed so such that the project completion time is not affected.

where, $T_L^i = \text{Minimum} (T_L^j - t^{ij})$ calculated by backward pass rule.

t^{ij} = Duration of activity i-j.



Draw the project network and calculate the duration of the project and find the critical path and Activity

Activity	EVENT	Duration
A	1-2	15
B	1-3	20
C	2-4	08
D	2-3	10
E	3-4	12

Earliest occurrence time of EVENT ① = 0

Earliest occurrence time of EVENT ②
 $= T_E^1 + t^{1-2}$
 $= 0 + 15 = 15$

Earliest occurrence time of EVENT ③
 $T_E^3 = \max \left(\begin{aligned} &T_E^2 + t^{2-3} \\ &= 15 + 10 = 25 \end{aligned} \right)$

and $T_E^3 = T_E^1 + t^{1-3}$
 $= 0 + 20 = 20$

maximum of value of $T_E^3 = 25$.

Earliest occurrence time of EVENT ④

$T_E^4 = \max \left(\begin{aligned} &T_E^3 + t^{3-4} = 25 + 12 = 37 \\ &T_E^2 + t^{2-4} = 15 + 8 = 23 \end{aligned} \right)$

maximum value of $T_E^4 = 37$.

Event 3

$$\begin{aligned}T_L^3 &= T_L^4 - t^{3-4} \\ &= 37 - 12 \\ &= 25\end{aligned}$$

Event 2

$$T_L^2 = T_L^4 - t^{2-4}$$

$$= 37 - 8$$

$$= 29$$

$$T_L^1 = T_L^3 - t^{1-3}$$

$$\begin{aligned}T_L^3 &= T_L^4 - t^{3-4} \\ &= 37 - 12 \\ &= 25\end{aligned}$$

$$T_L^2 = \text{minimum} \begin{pmatrix} T_L^3 - t^{2-3} = 25 - 10 = 15 \\ T_L^4 - t^{2-4} = 37 - 8 = 29 \end{pmatrix}$$

Minimum value = 15.

$$T_L^1 = \text{minimum} \begin{pmatrix} T_L^2 - t^{1-2} = 15 - 15 = 0 \\ T_L^3 - t^{1-3} = 25 - 20 = 5 \end{pmatrix}$$

$$\text{Slack} = T_L - T_E$$

START AND FINISH TIME OF ACTIVITY :-

EST \rightarrow Earliest start time of an activity.

EFT \rightarrow Earliest finish time

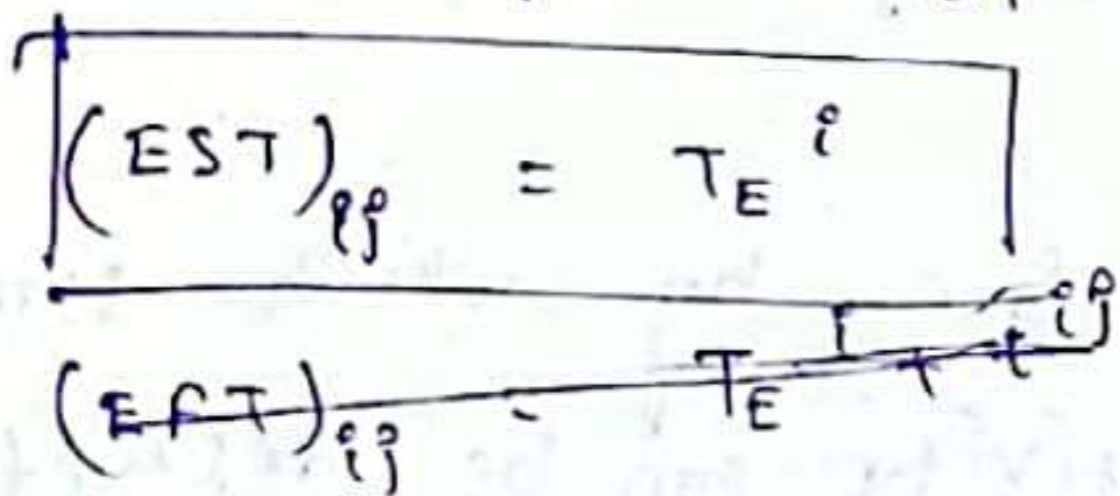
LST \rightarrow Latest start time

LFT \rightarrow Latest finish time.

1) Earliest start time :-

\rightarrow It is the earliest time by which an activity can start.

\rightarrow It is equal to the earlier event time (T_E) for the event from which the activity arrow originate



2) Earliest finish time :-

\rightarrow It is the earliest time by which the activity can be completed.

\rightarrow It is equal to the earlier start time + the activity duration.

$$EFT = T_E^i + t^{ij}$$

3) Latest start time (LST) :-

\rightarrow It is latest or delayed time by which the activity can started without delaying the completion of project.

\rightarrow LST is equal to the latest occurrence time (T_L) for the event at which the activity arrow terminates minus the duration of the activity

$$LST_{iP} = T_L^i - t_{iP}$$

↳ Latest Finish Time (LFT) :-

→ It is the latest ^{or} delayed time which the activity can be finished without delaying the completion of project.

→ It is equal to the latest occurrence time (T_L^j) of the event at which the activity terminate.

$$LFT_{iP} = T_L^j$$

Float :-

It indicates the time by which starting or finishing of an activity can be delayed without affecting the project completion time.

→ Total float

→ free total float

→ Independent float.

1) Total float :-

→ Difference between maximum time available and actual time required for the completion of activity.

→ Maximum available time we can get when activity starts at earliest time and finishes by latest finish time.

$$\text{Total float } (f_T) = T_L^j - T_E^i - t^{ij}$$

$$\text{OR } LST - EST$$

$$LFT - \cancel{EFT} - \cancel{EFT}$$

⇒ Free float :-

It is defined as the amount of time by which an activity can be delayed without affecting the EST of ~~the~~ succeeding activity,

$$f_F = T_E^j - T_E^i - t^{ij}$$

$$\text{OR } f_F = f_T - S_j$$

⇒ Independent float :-

→ It is the amount of time by which an activity can be delayed when all the preceding activities are completed as late as possible and all succeeding activities started as early as possible,

$$f_{ID} = f_F - S_j$$

Activity	Event	Duration	EST	EFT	LS	LFT	FT	FF
A	1-2	15	0	15	0	15	0	0
B	1-3	20	0	20	5	25	5	5
C	2-4	08	15	23	29	37	14	14
D	2-3	10	15	25	15	25	0	0
E	2-3	2						
E	3-4	12	25	27	25	37	0	0

\therefore As $f_T = 0$ for A, D, E.

Therefore, $\textcircled{1} \text{---} \textcircled{2} \text{---} \textcircled{3} \text{---} \textcircled{4}$

OR A—D—E

is critical path.

Critical path:-

D-01-10-19

→ It is the longest path time where in a project. These time also gives project duration.

CPM

→ In CPM critical path passes through the critical activities i.e., activities having total float is equal to zero.

Note:-

In CPM critical path passes through those events where ~~stage~~ slack is zero.

Although it is a necessary condition but not sufficient condition.

PERT :-

Project Evaluation And Review Technique .

It is used for planning, scheduling and monitoring the project .

Time estimates :-

Deterministic :-

→ Planner has enough knowledge about activity and gives a single estimate of duration which is almost accurate .

→ This approach of estimating time used in CPM method .

Probabilistic Approach :-

→ Planner does not have much idea about the activity as there is little and no past history about it . The limits within which the duration is occur is estimated .

→ ~~PERT~~ PERT follows the probabilistic approach and absorbs the uncertainties into the time estimate for activity and project duration .

→ PERT is used in R & D type project such as space industry, defence industry etc. as such projects are of non-repeating type or one through type for which correct time estimate can not be made .

→ For the PERT analysis is event oriented in this analysis interest is more focused on the events rather than activities .

→ In order to take ~~into~~ account the uncertainties involved in the activity times. Three ^{kind} ~~types~~ of each activity time estimate is made for each activity in PERT.

1) Optimistic time (t_o)

2) Pessimistic time (t_p)

3) Most likely time (t_m) ?

1) Optimistic time (t_o) :-

→ It is the minimum time required for an activity if everything goes perfectly well without any problems or adverse conditions developed during the execution of the activity.

→ In this time estimate no provisions are made for delay or setbacks and better than normal conditions are assumed to prevail during the execution of the activity.

2) Pessimistic Time Estimate (t_p) :-

→ It is the maximum time required for an activity if everything goes wrong and abnormal situations prevail.

→ This time estimate does not include the possible effects of major external catastrophes such as flood, earthquakes, fire, labour strikes etc.

3) Most likely time estimate (t_m) :-

→ It is time required to complete the activity if normal conditions prevail.

→ This time estimate lies between pessimistic and optimistic ~~or~~ time estimates.

Expected time of an activity (t_e) ..

→ After the estimation of ~~3~~ 3 type estimates we should obtain an average or mean time taken for the completion of an activity.

→ The average or mean time taken for the completion of an activity is called as expected time.

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

Standard deviation :-

$$\text{Standard deviation } (\sigma) = \frac{t_p - t_o}{6}$$

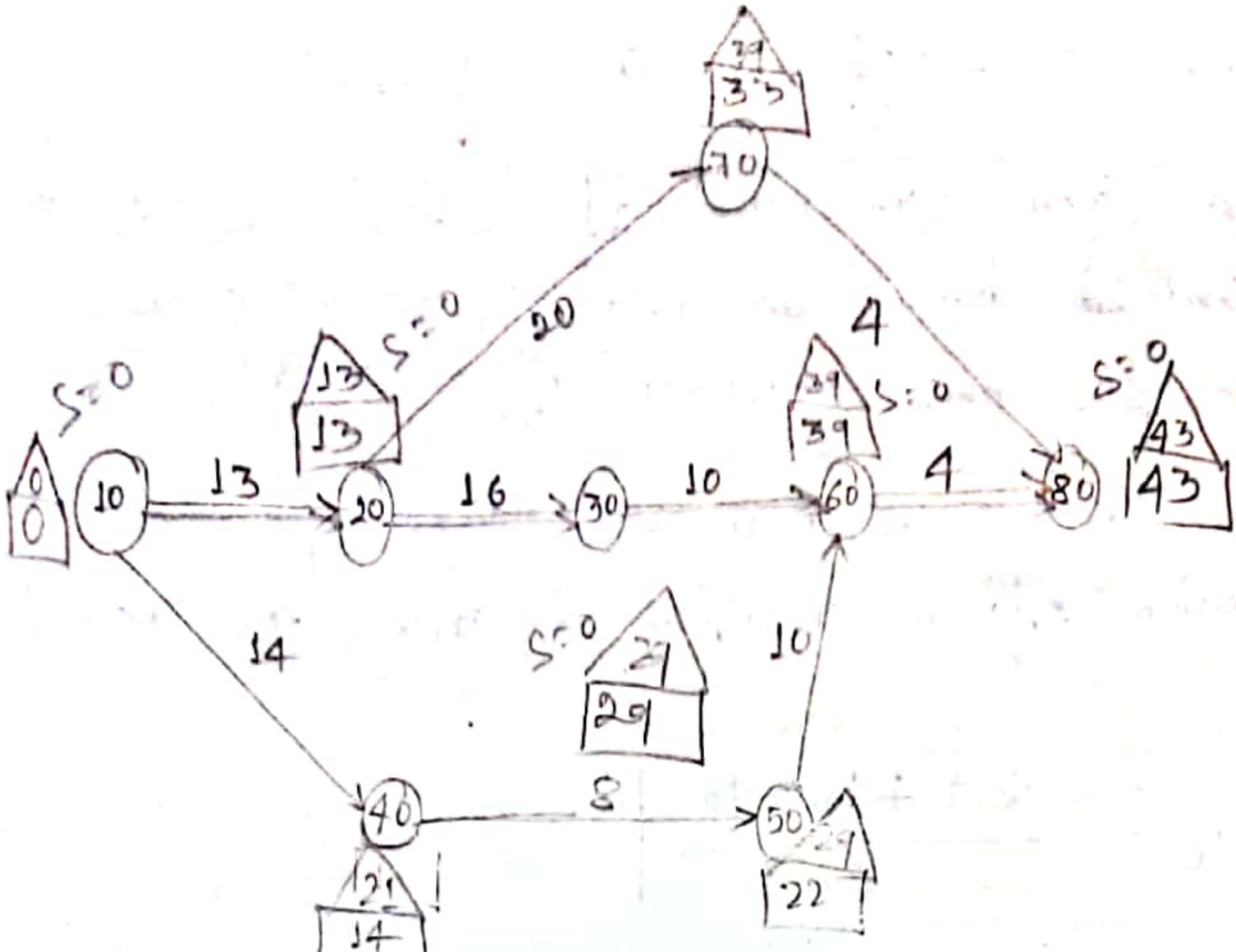
$$\text{Variance } (\sigma^2) = \left(\frac{t_p - t_o}{6} \right)^2$$

Note :-

Variance is the measure of uncertainties greater the variance greater will be uncertainties.

Q ~~What~~ with the help of given data, draw the diagram and find the project completion time based on expected time ..

Preceding event node	Succeeding event node number	Optimistic time (t_o)	Conservative time (t_m)	Most likely time (t_p)	Expected time (t_e)
10	20	10	12	20	13
10	40	5	15	19	14
20	30	10	15	26	16
20	70	15	20	25	20
30	60	5	10	15	10
40	50	4	8	12	8
50	60	5	10	15	10
60	80	2	4	6	4
70	80	2	4	6	4



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

$$= \frac{10 + 4 \times 12 + 20}{6}$$

$$= 13$$

Therefore, critical events are $10 \rightarrow 20$
 $10 \rightarrow 20 \rightarrow 30 \rightarrow 60 \rightarrow 80$

completion time in terms of expected time
 $\therefore 13 + 16 + 10 + 4 = 43$ week.

PERT

CPM

- | | |
|---|---|
| 1) Network diagram is event oriented. | 1) Network diagram is activity oriented. |
| 2) It uses probabilistic approach and is suitable for research and development and non repetitive project. | 2) It uses deterministic approach and is suitable for repetitive type of project. |
| 3) 3 time estimates are given for completion of an activity. | 3) Single time estimate is given for each activity. |
| 4) Follows β distribution. | 4) Follows Normal distribution. |
| 5) Cost of project is directly proportional time and hence to minimize the project cost the project completion time is minimized. | 5) Cost model has to be developed using which minimum cost of the project is found. |
| 6) Critical events are identified by using the concept of slack. | 6) Critical activities are identified by using concept of float. |
| 7) Critical path will be path joining the critical. | 7) Critical path will be the path joining all the critical activities. |

D-14-10-19

Define network analysis. Write down the features of network analysis.

Ans- Following are the features of network planning:

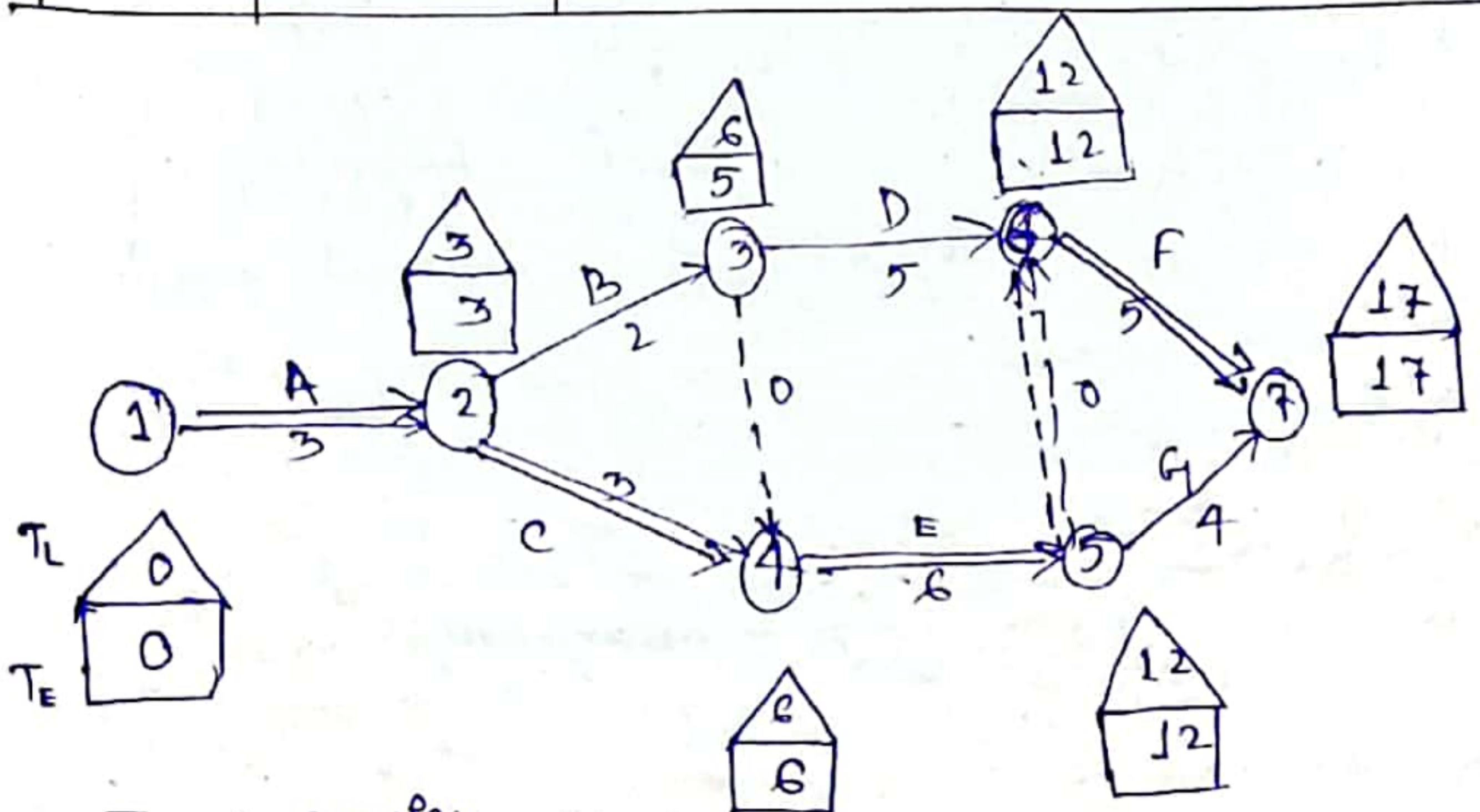
- 1) It expresses the project in a graphical form.
- 2) It forms a basic document for the preparation of work schedules of different tasks and activities connected with the project.
- 3) It gives an overall picture at a glance of the whole project and indicates the inter-relationship between various activities, jobs and events of the project.

- 4) It helps in ascertaining activities over critical path and at the same time, the tolerable slackness or delay for other activities can also be known from the study of network diagram of the project.
- 5) It is a flexible self-adjustment technique and it can be easily modified for various reasons such as mistakes in original calculation, strike of labours, new rules and regulations, availability of resources etc.
- 6) It serves as a check ~~time~~ on time of completion with respect to the cost and hence, it grants optimum utilization of resources.
- 7) It serves as a medium of communication for various groups associated in the execution of the project.
- 8) The available resources can be diverted and utilized advantageously over the activities along the critical path for the project.

Problem:-

From data of the table prepare the network diagram, decide the completion period and complete the critical path method schedule.

Activity Item	Duration in days	Activity following	Immediately preceding
A	3	None	B, C
B	2	A	D, E
C	3	A	E
D	5	B	F
E	6	B, C	F, G
F	5	D, E	None
G	4	E	None



T_E = Earliest occurrence time
 T_L = Latest allowable finish time

Activity	Duration	EST	EFT	LST	LFT	F _T	F _L
A	3	0	3	0	3	0	0
B	2	3	5	4	6	1	0
C	3	3	6	3	6	0	0
D	5	5	10	7	12	2	2
E	6	6	12	6	12	0	0
F	5	12	17	12	17	0	0
G	4	12	16	13	17	1	0

As total float zero, in A-C-E-F activity, so this path is called critical path.

Stores :-

A wide variety of stores and equipments is utilized for construction work.

This includes building material like bricks, stone, aggregates, cement, lime, steel bars, structural steel, sanitary fittings, water supply, electrical stores and fittings as well as variety of machinery and equipment.

Objectives of Store Management :-

- Minimum utilisation of the space for storage.
- Easy handling during the process of receipt, inspection, storage and issue and to ensure undisturbed flow.
- Preservation of stores accounts against spillage, breakage, deterioration and theft.
- Proper maintenance of store accounts of store accounts to have control over receipts and issues and to fix accountability of any deficiency.

Functions of Store Management :-

Following are the functions of store department and duties of store keeper.

- i) Receiving ~~the~~ materials, ^{goods} and equipments and checking them for identification.
- ii) Proper recording to receipts of goods.
- iii) Placement of right materials at right place.
- iv) Issue of items to the user only on the receipts of authorized store requisition.

- v) Recording and updating receipts and issue materials.
- vi) Preventing unauthorized p. from entering the store.
- vii) Planning store spaces.

LIST OF VARIOUS STORAGE SPACE :-

- a) Floor space
- b) Platform
- c) RACKS
- d) Shelves
- e) Bins
- f) Trays
- g) Silos & bunkers
- h) Barrels / tankers.

Issue of materials from stores :-

Indent :-

It is basically a letter raised by employees of an institute asking for material needed which are present in the store. The indents can be raised by any employee when he requires items from the stores.

Indent format

User department code					
Sl. No.	Item code	Item name	Qty required	Qty issued	Remarks

Invoice :-

An invoice is a document that is issued by a seller to the buyer. An invoice indicates the quantities and costs of the goods or service rendered.

Bin Card :-

- Bin card is the statement of all the receipts and issue of the stock from the store department. It is also called stock card or bin tag.
- This card is attached to each bin or container of store.
- It is the responsibility of the store keeper to write every in and out of stock from the store.
- The physical stock count and stock quantity reported according to the bin card should be equal; otherwise internal audit department will have the right to investigate the matter with management.
- Bin card only contain quantity column for both receipts and issue. At the close of each transaction the stock level is calculated to make sure that at every point of time, it can be reconciled with the physical count.

BIN CARD

Product Name :- _____

In charge :- _____

Location :- _____

Date	In or Receipts	Out or Issue	Total on Hand or Balance

STORE Ledger :-

- Store ledger look like bin card but there is slightly minor difference found between these two. which is the addition of value figures of in store ledger.
- As we know that bin card only keep quantity in records, so it lacks the valuation of inventory. In order to fulfill this deficiency, costing department takes support from store ledger.

STORE LEDGER CARD

Product Name :- _____

Location :- _____

Receipts			ISSUES			on order		
Date	Quantity	Value or Price	Date	Quantity	Price	Date	Quantity	Price

Comparison between Bin card and store ledger.

BIN CARD	STORES LEDGER
1) It is used only to record receipts and issues of quantity and balance there in.	1) store ledger is used to record both quantity and the amount of receipts and issues.
2) It is maintained by the store in charge or store keeper.	2) It is maintained by the costing accounting department of entity.
3) It is updated as and when receipts and issues are made in the store department.	3) It is updated when the costing department gets the proper documents from the relevant department normally from store department.

4) It is kept inside the store department.

5) Transactions are updated individually because at every point of time, store keeper needs to be aware of the actual position of the stock.

4) It is kept outside the store department or at a place where store keeper has no access.

5) It is normally updated after a certain period and one entry is posted for similar items.

Store accounting procedure :-

The term store keeping is very wide in sense and includes all operations involved in the management and handling of building materials which flow in and out of the stores of a big construction company.

The functions of store keeper may broadly be divided into the following 3 categories,

a) ordering

b) Receiving

c) Issuing

a) ordering :-

The requirements of different materials by various departments are collected and forwarded to the purchasing department.

b) Receiving :-

As soon as the materials are received, they are checked and stored properly.

c) Issuing :-

The materials are issued to the departments as required.

Following are the general principles to be strictly observed in store keeping,

- 1) Accounting
- 2) Checking
- 3) Golden rule
- 4) Issuing materials

1) Accounting :-

The account of materials should be kept in such a way that it should be possible to work out the expenditure on stores during a certain period if the materials are purchased for a particular job, the cost may directly be debited to that job.

2) Checking :-

Suitable checking procedure for physical verification of the materials should be established and followed at regular intervals.

3) Golden rule :-

The golden rule that no material should enter or leave the stores without documentary evidence, it should be strictly enforced.

4) Issuing materials :-

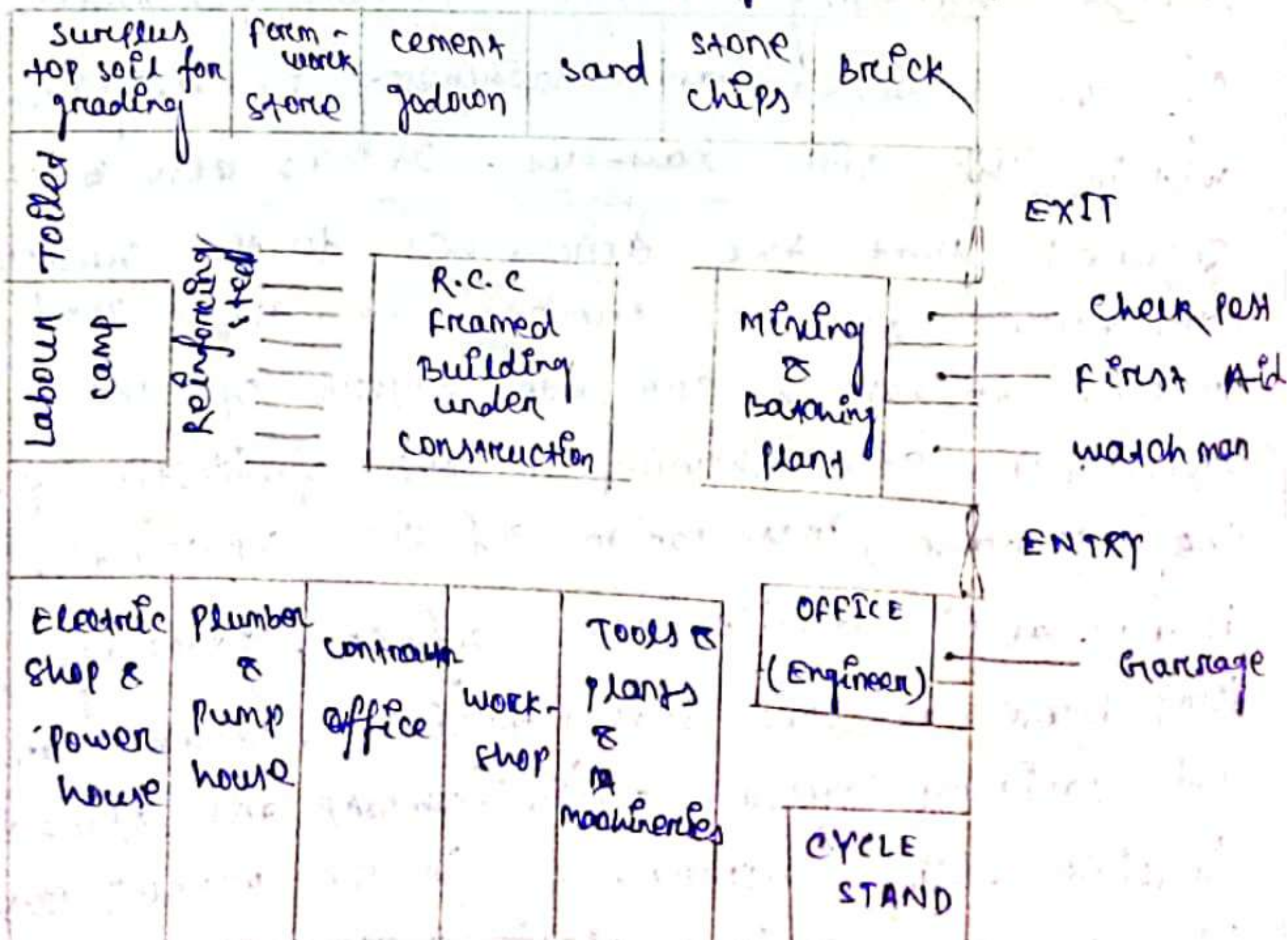
The standard requisition forms should be developed by the department and materials should only be issued against requisition forms duly signed by the authorised persons of the organisation.

Job Lay out :-

- A good job lay-out does pay good dividends in a construction programme. It is the basic responsibility of a site engineer to prepare a job lay-out for the project. He will draw to scale the area available for office, warehouses, storage of materials, equipments and earth, fabricating reinforcing steel etc.
- In preparing the job lay-out, a site engineer should endeavour to arrange all areas to reduce the time consumed in carrying materials from storage areas to the project, to facilitate the smooth working without any hindrance and to ~~over~~ obviate double handling. Proper approach for movements of the vehicles and machinery is required within the site lay-out. It has also to be ensured that the approaches to the various structures are not cumbersome. It is good practice to have a complete layout of the construction site showing all the facilities for the storage, installation of the construction plans and equipments, office, garage, pump house, electric supply-provision, water supply and sanitary system, service ~~to~~ camp and plant facilities, free approaches for the working places etc. In such a lay-out even care has to be

taken to see that there is adequate space for disposal of excavated debris, at least for the requirements of the back filling, so as to avoid double handling on back-filling materials.

Materials which are frequently used must be stored together close to the construction plant. The general office and warehouse should be located near the main entrance. It also requires fencing of the property line and security arrangement to have a close watch on the materials placed at the construction site. A typical job lay-out for a multi-storeyed framed R.C.C. building.



Explain the factors influencing the selection, design and layout of temporary facilities and services at construction site.

Ans - The following factors affect the job layout of a construction site.

- a) Access to site
- b) Topography of ground
- c) Temporary roads.
- d) Construction plants / machinery
- e) Construction method
- f) Construction material
- g) Accommodation
- h) Service

a) Access to site :-

There should be one entrance and exit to the site for proper flow of traffic and from the security point of view. Proper sign-post should be erected to direct transport vehicles delivering various construction material at site. The main gate should be managed by watch and ward staff to regulate entry to and exit from the site.

b) Temporary roads :-

Temporary roads are constructed within the site and also to provide access to the site and the nearest existing road. Temporary roads should be planned to serve all major items of plant / machinery and material storage yards.

at site

c) Topography ground :-

In order to avoid flooding of the work site during monsoons, temporary drain should be incorporated in the job layout. The storage yards should be located on higher and firm ground to avoid submergence and deterioration of materials.

d) Construction plant and machinery :-

Plant/machinery should be located in a nearer to that it serves the entire building or structure to be constructed. The location should also ensure minimum possible leads for the various construction material.

e) Construction materials :-

Provision of adequate storage yards and covered stores be made in the job layout for storage of various construction materials such as cement, bricks, aggregate, steel rounds and structurals, shuttering, scaffolding, timber, paints etc.

f) Construction method :-

The job layout should take into account the construction methods to be adopted at the worksite. For ex - If the building elements are to be pre-cast, the provision of a casting yard should be made in the job layout.

g) Accommodation :-

All site offices should be centrally located, preferable in a noise-free area. This will facilitate better co-ordination among the various sections at site.

h) Services :-

The job layout should take into account the provision of various services such as water supply, power supply, telephone lines, repair and maintenance yards etc.

Q Explain the points to be remembered while storing materials at site.

AM - Stored materials must not ~~also~~ create a hazard for employees. Employers should make workers aware of such factors as the material's height and weight, how accessible the stored materials are to the user, and the condition of the containers where the materials are being stored when stacking and piling materials. To prevent creating

hazards when storing materials, employees must do the follows:-

- keep storage areas free from accumulated materials that cause tripping, fires, or explosions, or that may contribute to the harboring of rats and other pests.
- place stored materials inside buildings that are under construction and at least 6 feet from hoist ways, or inside floor openings and at least 10 feet away from exterior walls;
- separate noncompatible material; and
- Equip employees who work on stored grain in silos, hoppers, or tanks with lifelines and safety belts.

In addition, workers should consider placing bound material on racks, and secure it by stacking, blocking, or interlocking to prevent it from sliding, falling, or collapsing.

An organisation is a group of person working together to achieve goal. It is the relationship which exist between people working together.

Types of organisation:-

- 1) Line organisation.
- 2) Line and staff organisation.
- 3) Functional organisation.
- 4) Project organisation.
- 5) Matrix organisation.

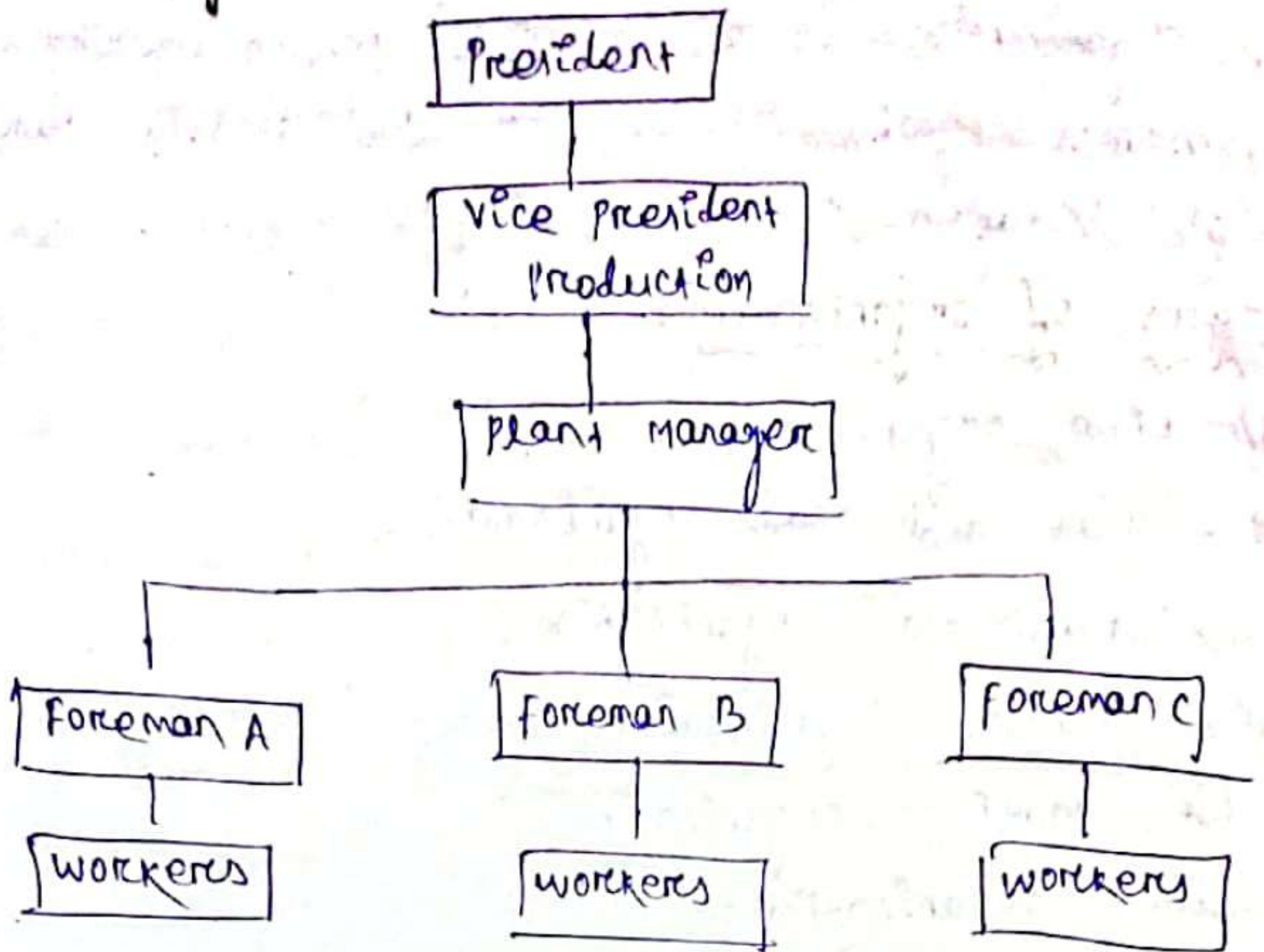
1) Line organisation:-

Line organisation is the simplest and oldest form of organisation structure, it is called as military or departmental or scalar type of organisation. Under this system, authority flows directly and vertically from the top of the managerial hierarchy down to different levels of managers and subordinates and down to the operative level of workers.

Line organisation authority, responsibility and accountability at each level. The personnel in line organisation are directly involved in achieving the objectives of the organisation.

Line organisation →

Line Organisation Structure



Advantages of Line Organisation :-

- The line organisation structure is very simple to understand and simple to operate.
- Communication is fast and easy and feedback can be acted upon faster.
- Responsibility is fixed and unified at each level and authority and accountability are clear-cut, hence each individual knows to whom he is responsible and who is ~~over~~ or ~~truth~~ responsible to him.
- Since it is especially useful when the company is small in size, it provides for greater control and discipline in the organisation.
- It makes rapid decisions and effective co-ordination possible. So it is economic and effective.

- The people in line type of organisation get to know each other better and to feel close to each other.
- The system is capable of adjusting itself to changing conditions for the simple reason that each executive has ~~so~~ sole responsibility in his own sphere.

Disadvantages of Line Organisation:-

- It is a rigid and inflexible form of organisation.
- There is a tendency for line authority to become dictatorial.
- It overloads the executive with pressing activities so that long-range planning and policy formulation are often neglected.
- There is no provision for specialists and specialisation, which is essential for growth and optimisation.
- Different departments may be much interested in their self-interests, rather than overall organisation interests and welfare.
- It is likely to encourage nepotism.
- It does not provide any means by which a good worker may be rewarded and bad one punished.

2) Line and staff organisation:-

This type of organisation structure is in large enterprises. The functional specialists are added to the line in line and staff organisation. Here, staff is basically advisory in nature and usually does not possess any command authority over line managers. Allen has defined line and staff organisation as follows.

"Line functions are those which have direct responsibility for accomplishing the objectives of the enterprises and staff refers to those elements of the organisation that help the line to work most effectively in accomplishing the primary objectives of the enterprises".

In the line and staff organisation staffs assist the line managers in their duties in order to achieve the high performance. So, in an organisation which has the production of textiles, the production manager, marketing manager and the finance manager may be treated as line executives, and the departments headed by them may be called line departments.

On the other hand, the personnel manager who deal with the recruitment, training and placement of workers, the quality control manager who ensure the quality of products and the ~~PR~~ public relations manager are the executives who perform staff functions.

Types of staff :-

The staff organisations mentioned above all have in common the fact that they are auxiliary to the main functions of the business. There are, however, different types of staff.

- 1) Personal staff
 - 2) Specialized staff
 - 3) General staff
- ~~Personal staff.~~

1) Personal staff :-

Personal staff consists of a personal assistant or adviser attached to the line executive at any level. His main function is to aid and advise the line executive as also to perform any other work assigned to him.

In business, the personal staff is typified by the private secretary, who may keep the executive's personal check book, buy his Christmas presents and arrange his appointments. General or business executives are given personal staff assistants on the same theory. Their time is too valuable to be spent in handling the details of daily living.

2) Specialised staff :-

The specialised staff have expert knowledge in the specific fields. The specialised staff are those that handle the specialised functions. For eg → accounting, personnel, engineering and research. It is now impossible for one man to familiarise himself with all the various specialities needed in the modern large business.

Hence the general or the company president, and perhaps the department head, is provided with experts in each field to counsel him on the various specialise staff could serve in any of the following capacities :-

- a) Advisory capacity
- b) service capacity
- c) control capacity

a) Advisory capacity :-

Its purpose is to render specialised advice and assistance to management when needed. Some typical areas covered by advisory staff is legal, public relations and economic development areas.

b) service capacity :-

This group provides a service, which is useful to the organisation as a whole and not to any specific division or function.

e) control capacity :-

This includes quality control staff that may have the authority to control the quality and enforce standards.

3) General staff :-

Any decision that cuts across departmental lines must be made by the chief executive. It cannot be delegated to the head of a specialised staff group or to a line department head, since other department heads will naturally resent interference in their department heads will naturally resent interference in their department by someone who is in no way their superior.

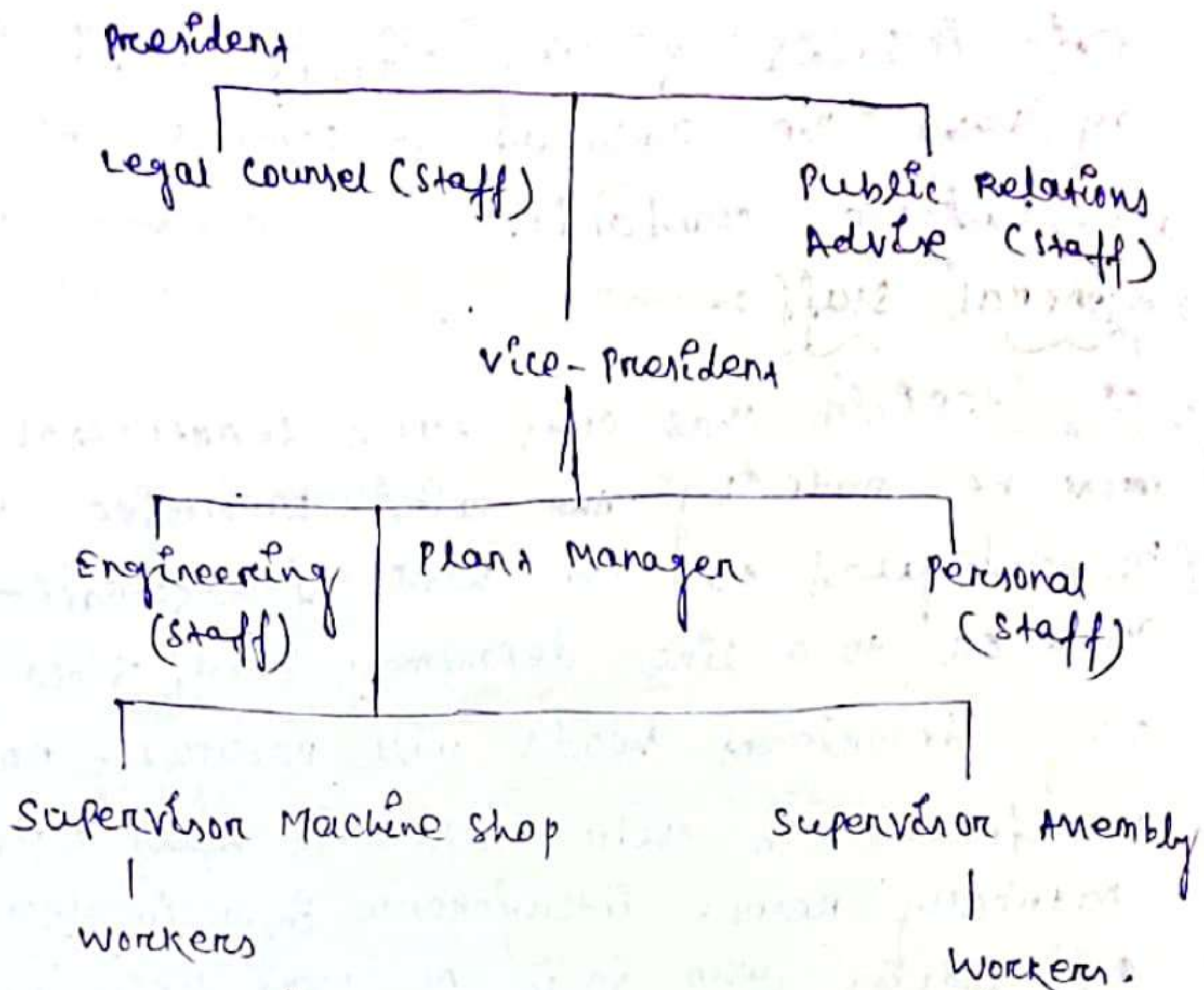
A typical case would be a change in the organisation structure of the company as a whole: the combination of two departments under a single head, for eg on the organisation of a new top-level department.

It is with these functions that cannot be delegated that the general staff personnel can provide assistance and save the time of the top man.

The title of the general staff person is most often "assistant to" the company president, or other executive.

A staff member may serve as a coach, diagnostician, policy planner, co-ordinator, trainer, strategist etc.,

Line and staff organisation chart :-



Advantages of line and staff organisation :-

- 1) Line officers can concentrate mainly on the doing function as the work of planning and investigation is performed by the staff.
- 2) Since the organisation comprises line and staff functions, decisions can be taken easily.
- 3) The staff officers supply complete factual data to the line officers covering activity within and without their own units. This will help to greater co-ordination.
- 4) It provides an adequate opportunity for the advancement of workers.
- 5) The staff services provides a training ground for the different positions.

- 6) Adequate organisation a balance among the various activities can be attained easily.
- 7) The system is flexible for new activities may be undertaken by the staff without forcing early adjustments of line arrangements.
- 8) Staff specialists are conceptually oriented towards looking ahead and have the time to do programme and strategic planning and analyse the possible effect of expected future events.

Disadvantages of line and staff:-

- 1) confusion and conflict may arise between line and staff. because the allocation of authority and responsibility is not clear and members of the lower levels may be confused by various line orders and staff advices.
- 2) Too much reliance on staff officers may not be beneficial to the business because line officials may lose much of their judgement and initiative.
- 3) staff generally advise to the lines, but line decides and acts.
- 4) normally, staff employees have specialised knowledge and expert. line makes the final decisions, even though staff give their suggestions.
- 5) staff officers are much educated so their ideas may be more theoretical and academic rather than practical.
- 6) Although expert advice is available it reaches the workers through the managers.

7) since staff specialists demand higher payments, it is expensive.

Forms of organisational structure :-

Functional organisation :-

Grouping people performing similar activities into departments.

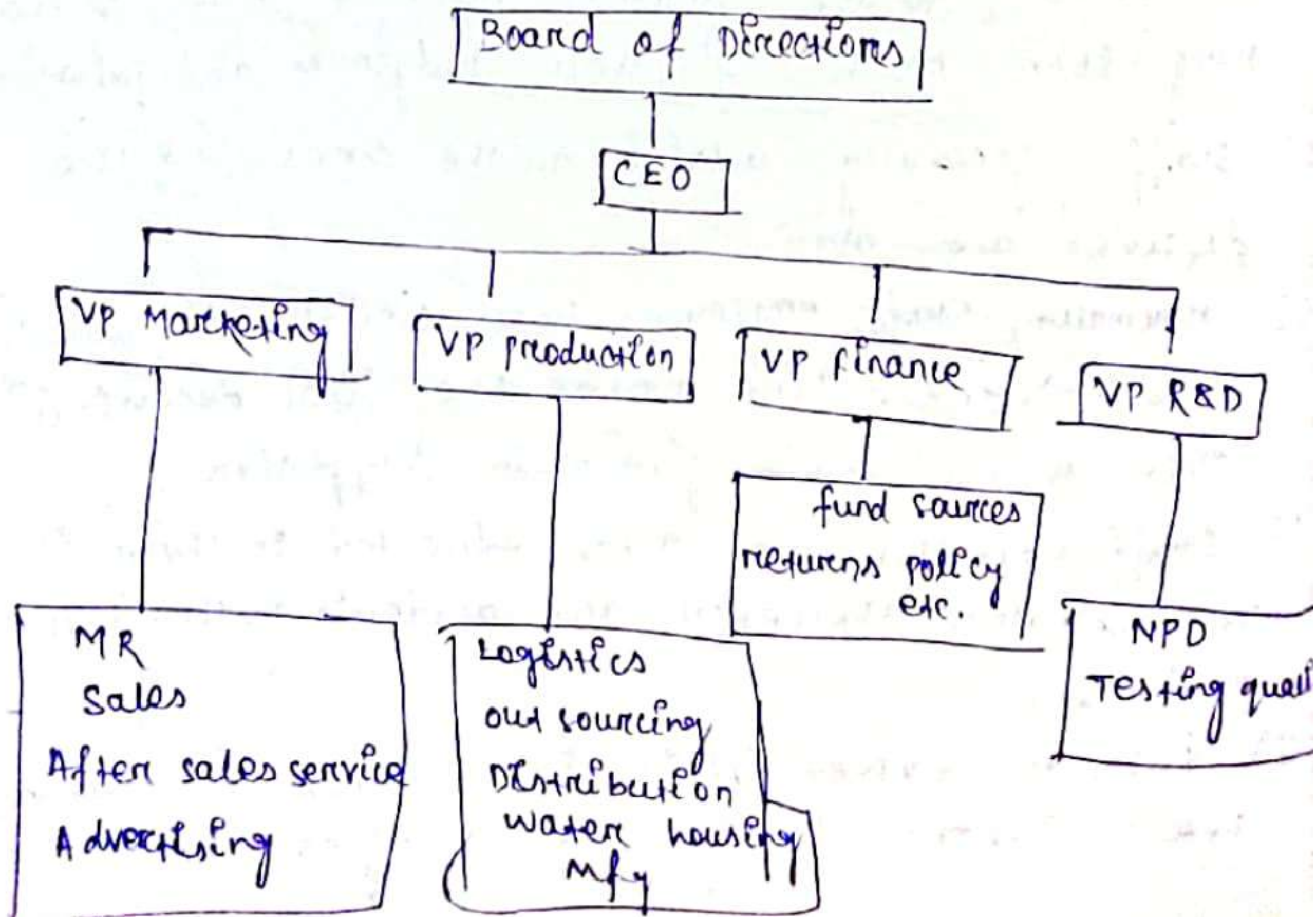
Project organisation :-

Grouping people into project teams on temporary assignments.

Matrix organisation :-

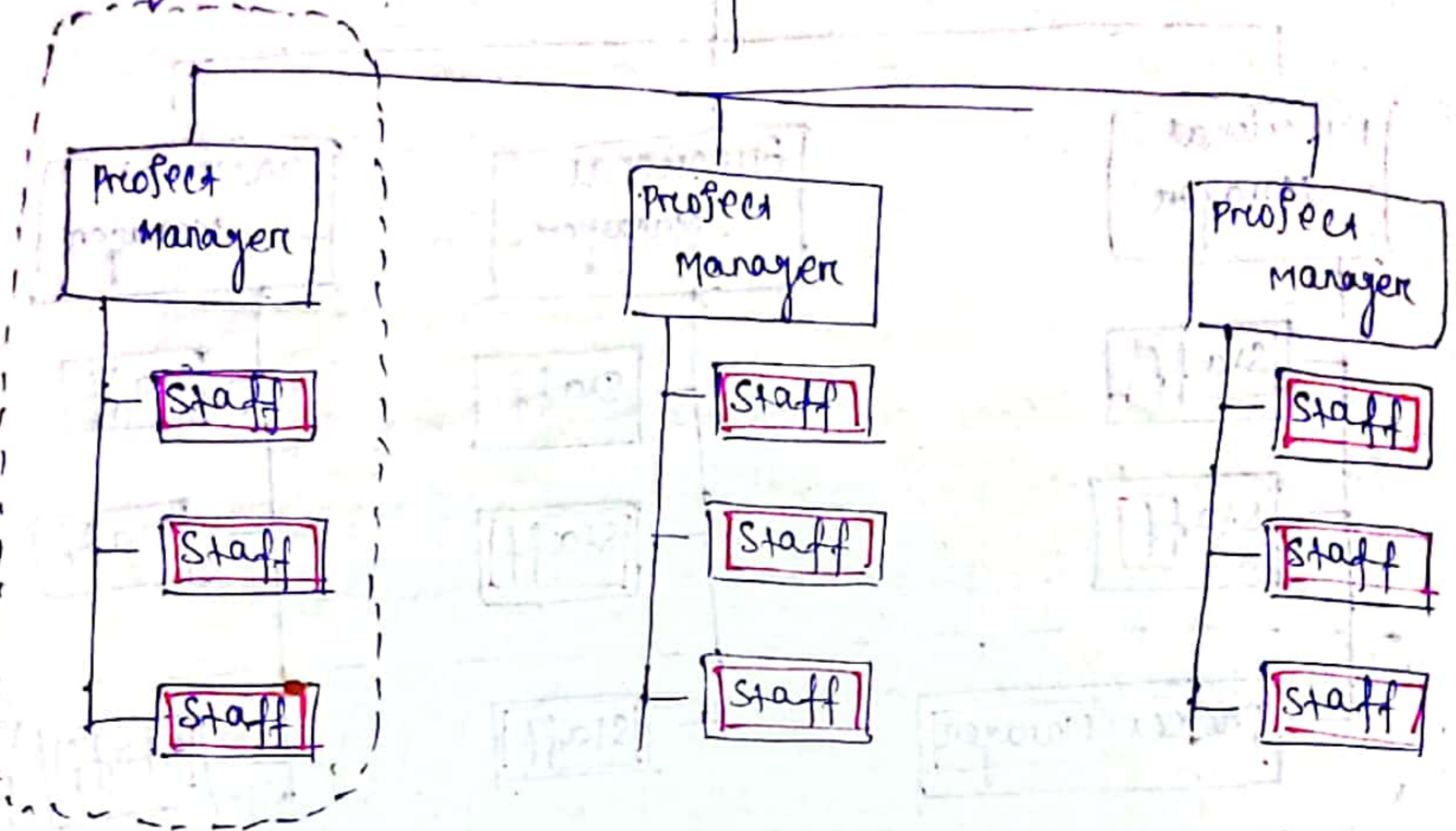
Companies are structured by creating a dual hierarchy in which functions and project have equal prominence.

Functional organisation :-



Project Organisation
Product Co-ordination

Chief Executive



(Red boxes represent staff logged in project activities)

Strengths

Weaknesses

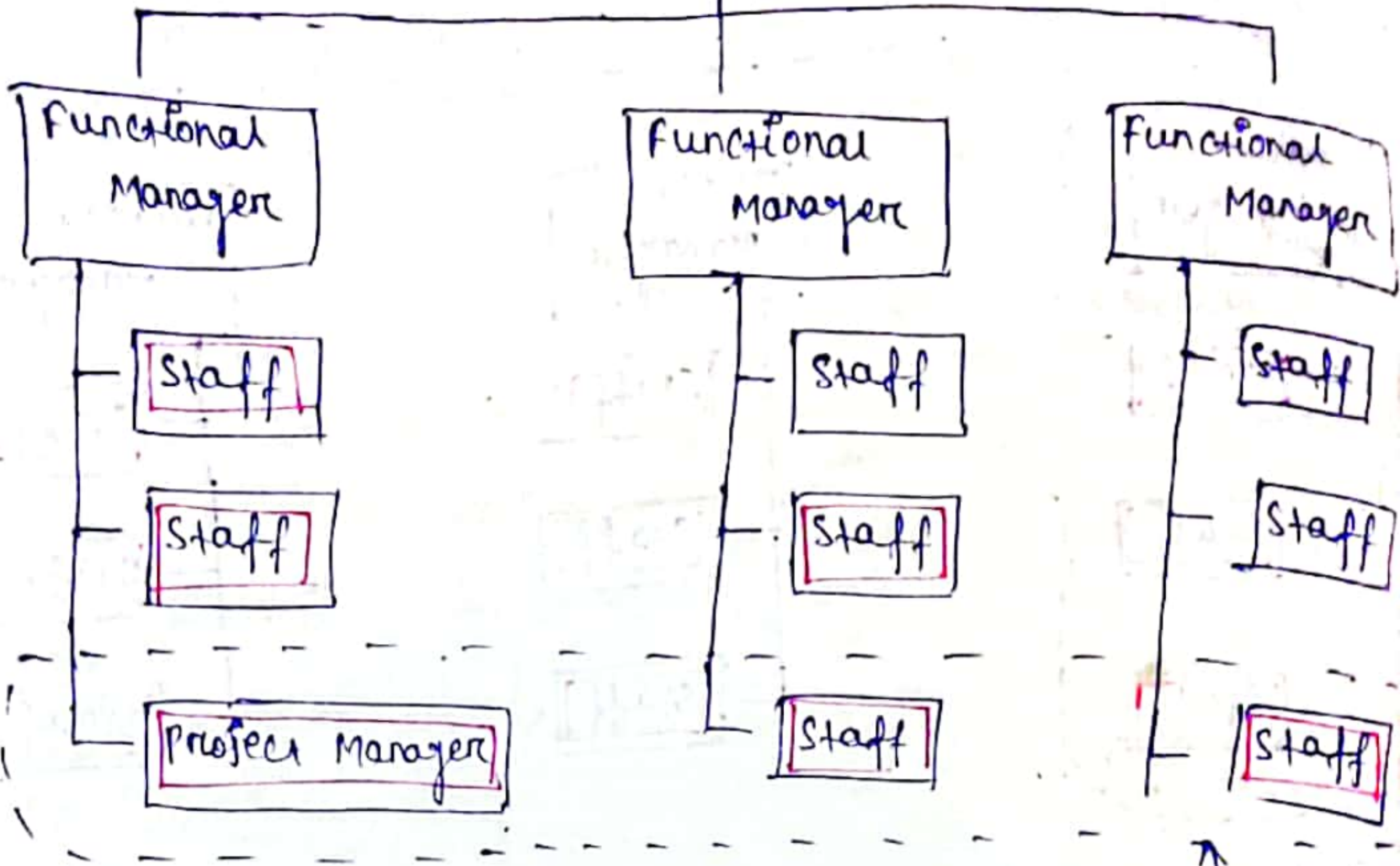
- Assign authority to solely Project manager.
- Improved communication across functions.
- Effective and speedy ^{DM} ~~PM~~ (Decision making).
- Promotes creation of career of PM experts.

- setting of maintaining teams can be expensive.
- Loyalty to project not to organization.
- Difficult to maintain pool of intellectual capital.
- concern ~~at the~~ @ future after project gets over.

Matrix

organisation

Chief Executive



(Balanced Matrix Organisation)

↑
Project
co-ordination

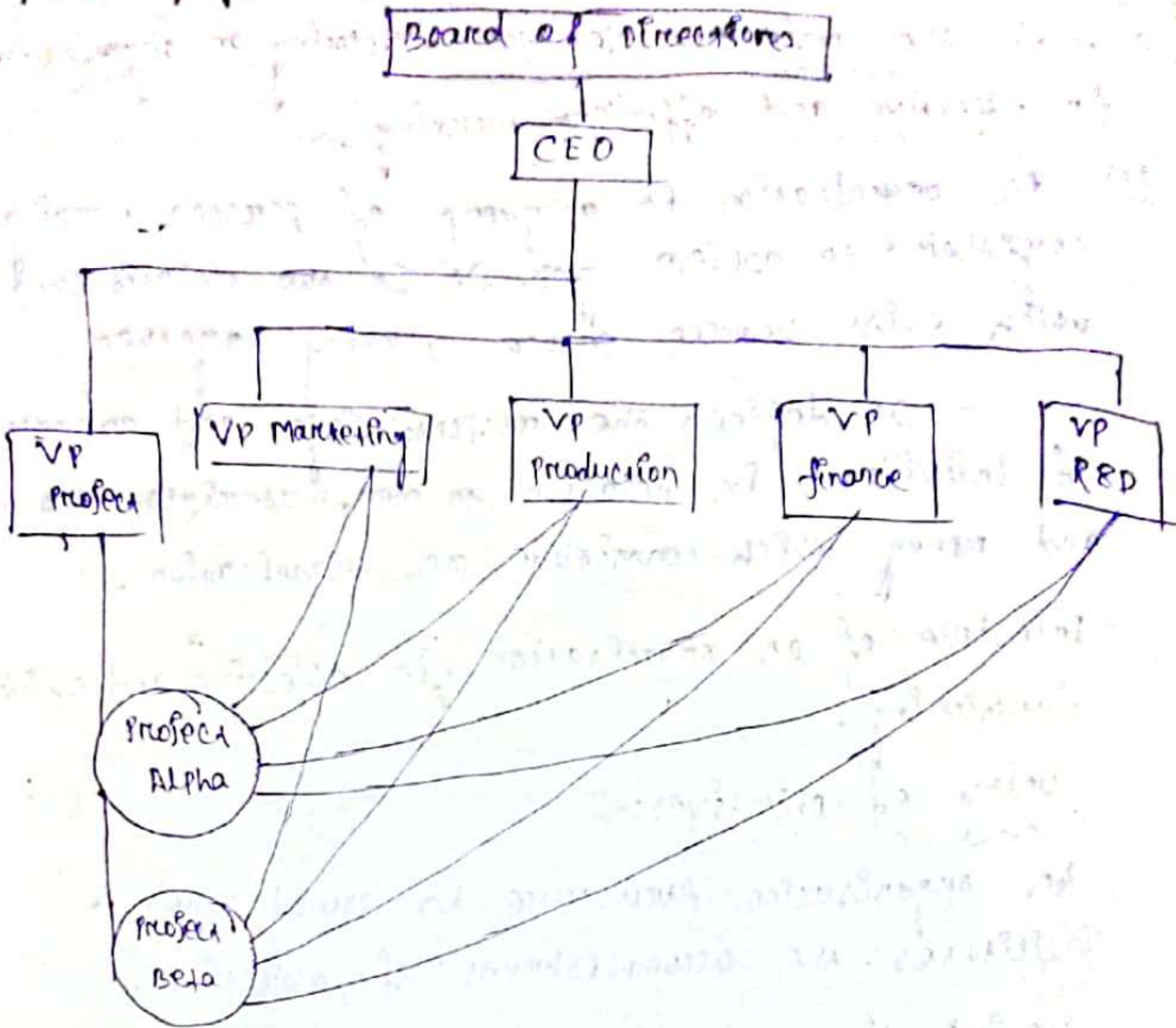
Strengths

Weakness

- suited to dynamic environments.
- Emphasizes the dual importance of project management and functional efficiency.
- Promotes co-ordination across functions.
- use of scarce resources on competing basis.

- Two bosses.
- sometimes difficult to share resources.
- Frustrating - caught between project and functional requirements.

Project Organisation :-



Functional Organisation :-

Strengths

- No changes required in firms design.
- Enable the development of in depth knowledge.
- Allows for standard career path.

Weakness

- siloing difficult to achieve cross functional co-operation.
- Lack of customer focus.
- Long time due to structure problems, lack of ownership, slower communication.
- Project may be sub-optimized due to varying interest or commitment.

Explain the main principles for developing an organisation for effective and efficient working.

Ans An organisation is a group of persons working together to achieve goal. It is the relationship which exist between people working together.

It defines the responsibilities and authority of individuals in relation to men, materials, machinery and money which constitute an organisation.

Principle of an organisation for effective and efficient functioning.

Unity of objectives:-

An organisation structure is sound when it facilitates the accomplishment of objectives.

Specialization and division of work:-

The activities of every member of the organisation should be confined as far as possible to the performance of a single function.

According to 'FAYOL' "to organising a business is to provide it with everything useful to its functioning raw material, tools, capital and personal."

Staffing:-

It is the process of filling all positions in the organisation with adequate and qualified personal. Staffing consists of man covering the requirements, selection, training, compensation and

Directing :-

It is managerially function of guiding, supervising, motivating and leading peoples towards the attainment towards a plan target performance.

→ Directing is the execution function of management because it is in consult with the execution of plans and policies.

→ Direction functions includes following activities.

i) Supervising, people at work.

ii) Motivation i.e., creating the willingness to work for certain objectives.

iii) Communication i.e., that is establishing understanding with employees regarding plans and implementation.

iv) For leadership influence behaviour of employee.

Controlling :-

It is the process of ensuring that the organisation is moving in designed direction and that progress is being made towards the achievement of goals.

Q) Explain the importance of leadership and human relations in managing a construction project.

Ans- Importance of Leadership :-

It is an important function of management which helps to maximize efficiency and to achieve organizational goals. The following points justify the importance of leadership in a concern.

i) Initiates action :-

Leader is a person who starts the work by communicating the policies and plans to sub-ordinates from where the work actually starts.

ii) Motivation :-

A leader proves to be playing an incentive role in the concern's working. He motivates the employees with economic and non-economic rewards and thereby gets the work from the sub-ordinates.

iii) Providing Guidance :-

A leader has do not only supervise but also play a guiding role for the sub-ordinates.

iv) Creating confidence :-

confidence is an important factor which can be achieved through experiencing the work efforts to the sub-ordinates.

v) Building Moral :-

Moral denotes willing co-operation of the employees towards their work and getting them into confidence and winning their trust.

Human Relations in managing a construction project :-

→ For the successful completion of the project there must be an inter-relationship between the three categories.

1) Co-relationship between the owner and an engineer:-
→ At the owner finances the work and employs an engineer who agrees to perform his professional duties with reasonable efforts and skills. If the engineer makes an unfortunate mistake, in spite of due skill, he is not liable for his mistake, unless the owner proves that he failed to perform his duty carefully.

2) Co-relationship between an engineer and contractor:-
→ Similarly, there is much co-relation between an engineer and a contractor as the latter executes the work in strict supervision of the former. The contractor has to work as per the design data and drawings in consultation with the engineer so that there may not arise any dispute between the engineer in charge of the project and the contractor later on. Therefore, in the interest of economy and quality of work a close co-operation between an engineer and a contractor is necessary.

Q.3 What are the conflicts in organization? Discuss genesis of conflicts and types of conflicts.

AM 1) Conflict within the individual:-

The conflict within the individual is usually value related, where role playing expected of the individual does not conform with the values and beliefs held by the individual. For example, a secretary may have to lie on instructions that he is not in the office to avoid an unwanted visitor or an unwanted telephone call.

This may cause a conflict within the mind of the secretary who may have developed an ethic of

telling the truth. Similarly, many Indians who are vegetarians and find it very hard to remain vegetarians may question the necessity of the vegetarian philosophy thus causing a conflict in their minds.

In addition to these value conflicts, a person may be faced with a role conflict. For example, a telephone operator may be advised and required to be polite to the customers by her supervisor, who may also complain that she is spending too much time with her customers. This would cause a role conflict in her mind.

Similarly, a police officer may be invited to his brother's wedding where he may find that some guests are using drugs which are against the law. It may cause conflict in his mind as to which role he should play - as of a brother or as of a police officer.

2) Interpersonal conflict :-

Interpersonal conflict involves conflict between two or more individuals and is probably the most common and most recognized conflict. This may involve conflict between two managers who are competing for limited capital and manpower resources.

This conflict can become further acute when the scarce resources cannot be shared and must be obtained. Similarly, if there are two equally deserving preferents and they are

both up for promotion, but only one of them can be promoted because of budget and positional constraints, then this could result in interpersonal conflict between the two professors.

Another type of interpersonal conflict can relate to disagreements over goals and objectives of the organization. For example, some members of a board of directors of a school may want to offer courses in sex education while others may want to ~~of~~ find this proposal conflict among the members of the board.

Similarly, a college or a university may have a policy of quality education so that only top quality students are admitted while some members of the organizational board may propose "open admission" policy where all high school graduates are to be considered for admission.

For example, two marketing managers may argue as to which promotional methods would result in higher sales. These conflicts become highlighted when they are based upon opinions rather than facts. Facts are generally indisputable, resulting in agreements.

These interpersonal conflicts are often the results of personality clashes. People with widely different characteristics and attitudes are bound to have views and aims that are inconsistent with the views and aims of others.

3) Conflict between the individual and the group

As has been discussed before, all formal groups and informal groups have established certain norms of behaviour and operational standards which all members are expected to adhere to.

For example, in some restaurants, all tips are shared equally by all waiters and waitresses. Some particular waitresses who may be overly polite and efficient may feel that she deserves more, thus causing conflict between her and the group.

The conflict may also be between the manager and a group of subordinates or between the leader and the followers. A manager may take a disciplinary action against a member of the group causing conflict with the group and this may result in reduced productivity.

"Mutiny on the Bounty" is a classic example of rebellion of the crew of the ship against their leader, based upon the agreement that the crew received at the hands of their leader.

4) Intergroup conflict :-

An organisation is an interlocking network of groups, departments, sections or work teams. The intergroup conflicts are not so much personal in nature as they are due to factors inherent in the organizational structure.

One of the most common conflicts is between the line and the staff members of the organization. The line managers may resent their dependence on staff for information and recommendations. The staff may resent their inability to implement directly their own decisions and recommendations.

These inter-unit conflicts can also be caused by inconsistent rewards and differing performance criteria for different units and groups. For example, sales people who depend upon their commission as a reward for their efforts may promise their customers.

Different functional groups within the organization may come into conflict with each other, because of their different specific objectives. There are some fundamental differences among different units of the organization both in the structure as well as operations and processes and thus each unit develops its own organizational sub-structure.

A classic example of inter-unit conflict is between sales and production as described earlier. The sales department is typically customer-oriented and wants to maintain high inventories for filling orders as they are received which is costly option as against the production department which is strongly concerned about cost effectiveness requiring as little inventory of finished product at hand as possible.

Similarly, intergroup conflict may arise between day shift workers and night shift workers who might blame each other for anything that wrong from mining tools to maintenance problems.

5) Inter-organizational conflict:-

Conflict also occurs between organisations who are dependent upon each other in some way. This conflict may be between buyer organisation and supplier organisations about quantity, quality and delivery times of raw materials and other policy issues.

Such conflict could also be between unions and organisations employing their members, between government agencies that regulate certain organisations and the organisations that are affected by them.

Resolving conflicts 2

D-23-10-19

- Provide conflict resolution training.
- provide communication skills training.
- Help staff develop positive work relationship.
- implement team building activities.
- Develop strong communication channels.
- create an environment that encourages participation.
- provide conflict mediation training for leader.
- provide third-party conflict mediation services.
- Make sure employee are clear about organizational ~~post~~ goals and priorities.
- Treat everyone fairly.

Define labour schedule :-

Ans- Labour schedule gives the manpower requirement of the project in labour form for various stages.

LABOUR SCHEDULE :-

The classification of labours, their number and the period during which they will be engaged for each activity listed down. The information obtained may be consolidated and put on weekly/monthly basis in a labour schedule.

The table gives a clear picture of labour requirement in exact number during the execution period of the project and it gives ample time to manage the requirements easily. A direct measure of labour expenditure alone on the site can be obtained easily. It helps in efficient and optimum deployment of the labour force in the project.

Sl. No.	Activity	Working dates	Classification of labours	No. of men
1.	Leveling and clearance of site (A)	11/8, 12/8, 13/8	Foreman Tractor operator labours	1 1 4
2.	Earth work involved in foundation	-----	Foreman Tractor operator Grader operator Truck driver mechanic labours	1 5 2 2 1 10
	and so on			

Table 9.4

Labour schedule

Sl. No.	Classification of labours	Aug 98			SEP 98				OCT 98		
		11 II	18 III	25 IV	1 I	8 II	15 III	22 IV	-	-	-
1.	Foreman	1	1	1	2	2	2	2			
2.	Mechanic	1	1	1	1	1	1	1			
3.	Truck driver		1		1		1				
4.	Tractor operator	2	2	1	-	2	2	3			
5.	Aggregate bucket	-	-	-	-	-	-	2			
6.	Mixer operator	-	-	-	-	-	-	1			

	Labours ----	4	4	4	10	10	12	15	-	-	-

2. a) what is invoice in material management?

Ans- An invoice management is a document that is issued by a seller to the buyer. An invoice indicates the quantities and costs of the goods or service rendered.

b) Discuss essential steps for optimum labour output.

Ans- on any construction site the contractor's financial gain is dependent, amongst other things, on completion of the work in good time and at the least cost, and the productivity of labour has a direct bearing on this being achieved. The factors affecting the performance of labour generally fall into 3 categories.

(i) The human capacity for work

(ii) The competence of site management

(iii) The motivation of the workers.

competence of the site management :-

The various measures that may be taken to improve the physical work capacity or to motivate the workers will not be effective if site management is substandard. It is essential for the workers to have confidence in their supervisors. If the workers observe that site management is poor, unfair or corrupt, their morale,

motivation and consequent productivity will be reduced. Examples of management shortcomings which reduce efficiency and productivity in this way include: delayed, unclear or inadequate instructions? Delays in delivery of materials, tools or equipment? Provision of poor tools and equipment? unbalanced work gangs? use of wrong methods? Bad advance planning or allocation of work tasks? 1.3.3 Motivation of workers. workers are motivated in their work by a variety of methods, all of which may be present in varying degrees. This is a negative and unsatisfactory form of incentive. Discipline:- This is exemplified by

punctuality, lack of absenteeism, good standards of ~~work~~ workmanship and the observance of site cleanliness and hygiene. when the discipline is lacking, site morale is generally low and productivity is unsatisfactory.

Site rules drawn up and explained to all workers by either supervisors. Supervisors; by personal example, setting a high standard in self-discipline workers encouraged to feel that they are working with, rather than under, the supervisor. Retribution should be a matter of inevitability rather than severity. No breach of discipline should go unchecked. Developing self-discipline through pride in achievement

3) What is morale?

Ans - Morale is a state of mind where there is confidence, courage and zeal among people united in a common effort to succeed, leading companies are constantly looking for ways to elevate employee morale and managers, supervisors office personnel and others who can accomplish this are highly valued.

4) What are the characteristics of labour and explain it?

Ans - Some of the most important characteristics of labour are as follows:-

a) Physical strength and stamina:-

Skilled construction labour must perform task at construction sites that require extensive physical labour including lifting, climbing, bending, digging and operating hand and power tools, looking for construction labour who possess physical strength and stamina.

b) Manual dexterity and co-ordination:-

Along with physical strength, construction workers must have excellent hand-eye co-ordination be able to move his/her hands, quickly and be able to group and assemble objects with 2 hands, and also needs co-ordination which is the ability to work with both arms, both leg or legs or one leg and one arm.

c) Strong reading and math skills:-

It is also important for construction labour in all trades to be very attentive to specifications made by construction contractors. They must be able to ~~read~~ read and interpret blue prints and work related documents, A good understanding of geometry helps with interpreting design.

d) Building and mechanical knowledge :-

familiarity with building materials and experience using tools involved in the construction, repair and restoration of buildings, highways bridges, and other structures are more important skills to look for in a construction worker.

e) Excellent vision and depth perception :-

construction jobs require accuracy and precision for this reason, it is also very important that construction workers have good eyesight. They must have the ability to read blue prints and see details at close range, as well as from a distance, when operating machines, skilled construction labour must be able to see the gauges and dials to make sure everything is functioning properly and be able to perceive how near or how far to move equipment.

5) Explain the methods of measurement of morale.

6) In this method the management may conduct a yearly survey to find out the morale of the employees. For this purpose the management may conduct direct interview or can use questionnaires.

7) Morale Indicators :-

This shows the attitude of the employee towards the organization. Morale indicators are the factors which include labour turnover, accident rate, training record absenteeism etc. These factors are the indicators of variation in the morale of the employee, which help the management to analyze the causes of fluctuation in the morale of the employee and take corrective action.

(iii) use of suggestion boxes :-

Here the employees are asked to put their grievances and suggestions in a box without disclosing their identity. This method is suitable where employees have no courage to place their dissatisfaction openly.

(iv) observation of employee attitude :-

Here the morale of the employee is observed by his activities and behaviour. The managers generally measure the morale of an employee by his productivity. But this method is not reliable as morale may be high but productivity may be low and vice-versa.

6) Explain about different methods of wage payments.

Ans - Systems of methods of wage payments :-

Any worker who puts some labour produces some result, the quantity of which shall vary with the efficiency of the individuals. Better the efficiency of any worker, more will be the output. The wages thus can be calculated on the basis of the work irrespective of the time taken in completing it.

So, there are two systems of wage payments in common use :-

- a) Time work or Day work or Time rate system.
- b) Piece work or piece rate system.

a) Time work system :-

This is probably the oldest and more commonly employed system of wage payment chiefly adopted in India. In this system the worker, regardless of his output, is paid a fixed remuneration per unit of time, which may be an hour, day, week or month. Here, as the workers do not find any incentive for more output.

Advantages :-

- It is easy for wage calculation and can be understood by the workers easily.
- All workers of one class whether skilled or unskilled get the same wages.
- Better quality of work can be achieved.
- It avoids the workers over-streaining themselves, mentally and physically, thus causing less fatigue.
- The system is very suitable for works of artistic nature of requiring high workmanship as the workers will not be tempted for hurried work.
- This is suitable method where the work can not be measured.
- It ensures regular employment and greater security of service for the workers.

Disadvantages :-

- It requires constant supervision.
- It is unsatisfactory in so far as it leaves no incentive for a skilled worker to produce more than the inefficient workers.
- There is a less of labour production efficiency cannot be increased easily.

- Accurate cost forecasting is impossible.
- It does not inspire the spirit of competition in the workers and thus there are little chances of output being raised.

b) piece work system :-

Under this system, payments to individual workers are done according to the amount of work done. The workers thus have incentive to do more work as greater the efforts one puts in, greater would be reward. The rates fixing should be done by sufficiently experienced technical persons, from the past records based on performances. This system is used when the quality of work is of less importance than quantity.

7) Discuss motivation and different approaches to motivation. Also classify various motives.

Ans- Motivation is defined as the process that motivates a person into action and induces him to continue the course of action for achievement of the goal. There are five motivational needs of an entrepreneur.

a) Physiological need :-

These needs are basic to all human life and include food, clothing, shelter and other necessities of the life. They exert tremendous influence on human behaviour.

Entrepreneur also being a man needs to meet his physiological needs for survival. He/she is motivated to work in the enterprises to have economic rewards to meet the basic needs.

b) safety and security need :-

After satisfying the physiological needs the next need few are called safety and security needs. These needs find expressions in such desires as economic security and protection from physical dangers. Meeting these requires more money and hence the entrepreneur is motivated to work more in his enterprises.

c) social need :-

Social need refers to belongingness. All individual wants to be recognized and accepted by others. An Entrepreneur also want recognition in the society.

d) Esteem need :-

This need refers to self esteem and self respect. They include such needs which indicate self confidence, achievement, competence, knowledge and independence. In case of entrepreneur the ownership and self control over enterprise satisfies their esteem needs by providing them status, respect, reputation and independence.

e) self actualization :-

This refer to self fulfillment. An entrepreneurs gets the following rewards. out of a construction work =

1) Job satisfaction

2) social respect

3) money

4) ~~professional~~ professional growth.

5) ~~power~~

For an entrepreneur the following risks are involved.

- i) loosing the construction site competition.
- ii) loosing money due to price escalation.
- iii) non-availability of skilled labour.
- iv) dispute related to labour relation.
- v) Accident and other professional hazards.

Labour laws :-

1) Minimum wages act of 1948 :-

The minimum wages act of 1948 was passed for the welfare of the labour and providing for fixing the minimum wages of labour. The act aims at making provisions for the statutory fixation for the minimum rate of wages in no. of industries where there is an extensive chances of exploitation of labour. The main provision of minimum wages act are :-

- The setting of advisory committees to collect information on which the minimum wages are based.
- The wages of a worker in any schedule to employment shall be payable on working day by
 - a) The seventh day after the last day of the wage period if the establishment is less than 1000 employees
 - b) The tenth day after the last day of the wage period if establishment has more than 1000 employees
- The wages of an employee should be paid without any deduction except those items given below:
 - a) fines in respect of acts of omissions.
 - b) Absence from duty.
 - c) loss of goods directly attributable to the neglect of the employee.
 - d) House accommodation provided by the employer.
 - e) Amenities and services provided by the employer.
 - f) Income tax.
 - g) subscription to the provident fund.
 - h) Recovery of advances.
 - i) Payment to co-operative societies or life insurance corporation.

2) Workmen Compensation Act of 1923 :-

Workmen Compensation Act of 1923 aimed to protect the victims of accidents and their families from hardships out of and in the course of employment. The act covers the workers employed in hazardous occupation as specified in the schedule but excludes those employed in clerical or administrative work. The act provides for payments of compensation in case of accidents on work sites. The compensation however is not payable for injuries into

→ Disobedience or negligence.

→ Non-observance of safety measures.

→ consumption of liquor.

→ Diseases which are not contracted as a result of occupations. In the case of the death of a worker, compensation is paid under all circumstances.

Repairing the equipment schedule :-

A civil engineering project needs a variety of equipment and it is imperative for the engineer/contractor to know what type of equipments and what number of the equipment and for how many days (with exact dates) for each will be needed for the purpose. So that he may arrange them timely by hiring or by purchasing or by any other means and the work may not be delayed because of non-availability of equipment.

Following the procedure adopted by labour schedule. Demand for equipments for each activity listed down is furnished and then consolidated list of the equipments is shown date wise/week wise/~~month wise~~ month wise for entire period of construction project.

Sl. No.	Activity	Working Dates	Type of Equipments	Number
1.	Local sand filling in foundation and plinth.	Say 2/9, 3/9, 4/9.	Tractor water sprinkler subgrader	2 1 1
2.	casting of R.C.C. slab in roof	10/10, 11/10	Aggregate bin shovel pan concrete mixer vibrator concrete spreader concrete finisher	2 5 10 2 2 2 2
	and so on...			

Table 9.6		EQUIPMENT SCHEDULE											
Sl. No.	Equipment	Aug 98			Sept 98					Oct 98			
		11	18	25	2	9	16	23	30	7	14	21	28
1.	Traction	2	-	-	-	-	-	-	-	-	-	-	-
2.	Crane	1	1	-	-	-	-	-	-	-	-	-	-
3.	Bulldozer	2	-	-	-	-	2	1	-	-	-	-	-
4.	Power shovel	1	-	-	-	-	-	-	-	1	-	-	-
5.	Truck	2	2	1	-	-	-	-	-	1	-	1	-
6.	Subgrader	-	-	2	2	-	-	-	-	-	-	-	-
7.	Aggregate bin	-	-	-	-	-	-	-	-	-	-	2	2
8.	Cement silo	-	-	-	-	-	-	-	-	-	-	1	1
9.	Concrete mixer	-	-	-	-	-	-	-	-	-	-	2	2
10.	Vibrator	-	-	-	-	-	-	-	-	-	-	2	2
	and so on												

SELECTION OF CONSTRUCTION EQUIPMENT :-

Basically there are two aspects for the selection of construction equipments in a project. The first aspect deals with the type, size and other particulars of the equipments and the second aspect whether it is to be purchased, hired or to be procured under hire-cum-purchase arrangement, but in all the aspects, the following factors must be taken into account before having a final choice :-

1) Existing Equipments :-

Maximum utilization of the existing equipment should be done in order to reduce the cost of production to the minimum. If certain type of equipment is already being used in the project, it is desirable to have additional equipments of the same type because the existing workmen are already acquainted with the operation of such machines and the workshop is well equipped with the spare parts and repairing of spare parts.

2) Availability of the equipment :-

In far as practicable the equipment which is early available in the market should be selected for the purpose because any delay in delivery may increase the cost of construction or cost of production substantially.

3) Standard Equipment :-

In general the choice should be restricted to standard equipment because its delivery time is short, trained operators are available and spare parts can be easily procured in the market, repairing may be done easily.

4) Special Equipment :-

If the project is very big, special equipment may be selected provided the economic analysis justifies the purchase. If it is not available in the market, it has to be manufactured as per specifications laid by the project authorities to suit the job requirements.

5) Operating cost :-

The most efficient and therefore the most economical equipment is one whose operating cost is the minimum. Record of such equipment previously used should be taken as a guide for determining its suitability and economic viability. However in absence of this guide, fresh economic analysis should be made.

6) Indigenous Equipment :-

It is always advisable to purchase equipment which is manufactured in our country because this will decrease the repair cost and down time cost and at the same time it will be beneficial to be national.

7) obsolescence :-

obsolescence of the equipment should not be overlooked. Research and development going on in the design of equipment should be ascertained.

8) Economical life :-

Economical life of the equipment must be analysed and it should not be less than the useful period of the project.

9) Cost benefit analysis :-

For various alternatives, cost benefit analysis must be made and selected selection is based on economics only. The equipment must pay for itself by earning more money than its cost.

10) Suitability of equipment for future :-

The equipment should be of versatile nature so that it can be used for other purposes which will mean higher demand and will bring high resale value.

11) Study of site condition :-

Topographical condition, type of soil, existing approach roads and other working conditions must be studied before making any final decision.

12) Size of equipment :-

Size of equipment should meet the demand of work. It is better to use more than one equipment of small size than using of one of large size.

Cost of owning and operating :-

- The cost of possession of an equipment is known as cost of owning to which can be added ^{the} cost of fuel for running the equipment.
- It is generally estimated on hourly basis.
- This is the amount by which an equipment should be hired and it of course does not include the labour cost.

The following factors affect the cost of owning and operating :-

- a) initial cost of equipment which consists the price of equipment, transportation cost, loading and unloading charges and installation cost.
- b) severity of service condition under which it is to be used.
- c) ~~It is used per year~~ no. of hours it is used for year.
- d) The care ^{with} which the maintained or repaired.
- e) The demand for equipment after its useful period i.e., salvage value.
- f) useful life of equipment in years.

The following cost constitute the cost of owning and operating :-

- Depreciation cost.
- Maintenance and repair cost.
- Investment cost.
- Fuel or energy consumption cost.
- Lubricating oil cost.

Note :-

Depreciation cost, maintenance and repair cost and investment cost should be obtained separately on yearly basis by using appropriate methods and latter on converted into hourly cost. However, fuel or energy cost and lubrication cost is derived on hourly basis only.

Q Explain about importance of owning and operating cost in making decision for hiring and purchase of equipment.

AM Buying :-

Buying results in direct ownership of the equipment by buying is done either through cash purchase by using company funds or through financing purchase. The outright cash purchasing is done when sufficient funds are available. However cash purchase can have an adverse effect on company's cash flow as it reduces the liquid asset thus affecting company's working capital. When sufficient funds are not available for outright cash purchase, the equipment can be acquired by finance purchase.

wherein the purchasing is done through loan arrangements from lenders i.e., banks or other financial institutions that includes the payment of loan through installments along with an initial down payment. one of the main advantages of owning the equipment by outright cash purchase is that it may result in lowest other cost per operating hour as compared to renting or lower

Renting :-

It is a method of 'acquiring' the equipment for a shorter duration. It is an alternative to direct ownership of the equipment for a shorter period. Aquisition of equipment through renting is suitable when the contractor or the construction company requires the equipment for a project task of shorter duration. In addition through renting, the company can select the equipment that is exactly suited for the project task and it is possible to acquire the equipment based on latest technology which is more productive than older models. In these circumstances, renting of the equipment is more beneficial than direct ownership even though the rental charges are higher than the direct ownership charges. Since the equipment is not owned by the user, there is no tax benefit associated with depreciation of the equipment.

Leasing :-

It is another method of acquiring the equipment, for a longer period of time as compared to equipment renting. It is a long term alternative to direct ownership of the equipment. The leasing company is known as lessor whereas the user of the equipment is known as lessee. Lease is a contract between the lessor and the lessee wherein the lessee uses the equipment owned by lessor by paying the rentals over the lease period. Mostly the lease is more than six months and may run up to years. It is important for the lessee to know about the details of past and ongoing leases in which lessor is involved and also to check the terms and conditions of the lease agreement before entering into lease contract with lessor. Most of the equipment leases are noncancellable. During lease period the lessor retains the ownership of the equipment and also gets the tax benefits from depreciation of the equipment. Thus there is no tax benefit to lessee from the depreciation of the equipment.

Steps for inspection and testing of construction equipment :-

Am-Inspection and testing of equipment :-

Inspection and testing, including cleaning is required in order to keep work equipment in good working order and to ensure that it remains safe. If inspection and testing is not carried out properly, two types of risk can be created :-

- The performance of the equipment, including any safety features; may deteriorate to the where the users are put at risk.
- The persons carrying out the inspection, testing and maintenance may be put at risk.

It is essential that an appropriate 'competent person', conducts the inspection and/or testing of equipment. But there remains a responsibility on all personnel to identify defective or potentially defective equipment, where whenever this may come to their attention and to take appropriate action.

Equipment failing to meet the requirements of a specific inspection and/or test shall be dealt with immediately either by rectifying the fault or reporting it in appropriate consideration shall be given as to whether the equipment may remain in service.

It is essential that all inspections and/or tests together with any maintenance activities or repairs of equipment be recorded. As a minimum, such records shall include the following:

- information on the type and model equipment;
- any identification mark or number that it has;
- its normal location;
- the date that the inspection was carried out;
- who carried out the inspection;
- any faults found as a result of the inspection;
- any action taken regarding such faults;
- to whom, and by whom, these faults have been reported;
- the date when repairs or other necessary action were carried out.

The inspection and/or test frequency / schedule identified for each particular item of equipment shall be regarded as a minimum requirement shall be increased for equipment that is used extensively or where an item of equipment may have been used beyond its recommended working limits or for a purpose for which it was not intended. When determining the frequency of inspection and/or test, consideration should also be given to the following:-

- Intensity of use - frequency and maximum working limits;
- operating environment, for example - marine, outdoors
- Legislative requirements;
- manufacture guidance;
- variety of operation - Is the equipment performing

the same task all the time or does this change.

→ Risk to health and safety from malfunction or failure.

Ch → 10

Importance of safety or accident prevention programme

Accident prevention programmes must be made an integral part of the construction industry, because it is aimed to reduce the no. of accidents and thereby the cost of construction.

The following are the primary objectives of the accident prevention programme :-

a) Safety of Personnel :-

- To reduce the human life sacrificed.
- To lessen the temporary and permanent injuries to workers.
- To prevent needless pain and suffering to the employees.

b) Safety of material and equipment :-

- To avoid loss of materials or spoilage of materials.
- To avoid loss of or damage to equipment.

c) Safety of structures :-

- To provide minimum cost of construction of structure of demolition of structure.
- And thereby ensuring the good quality of the output and better rate of construction.

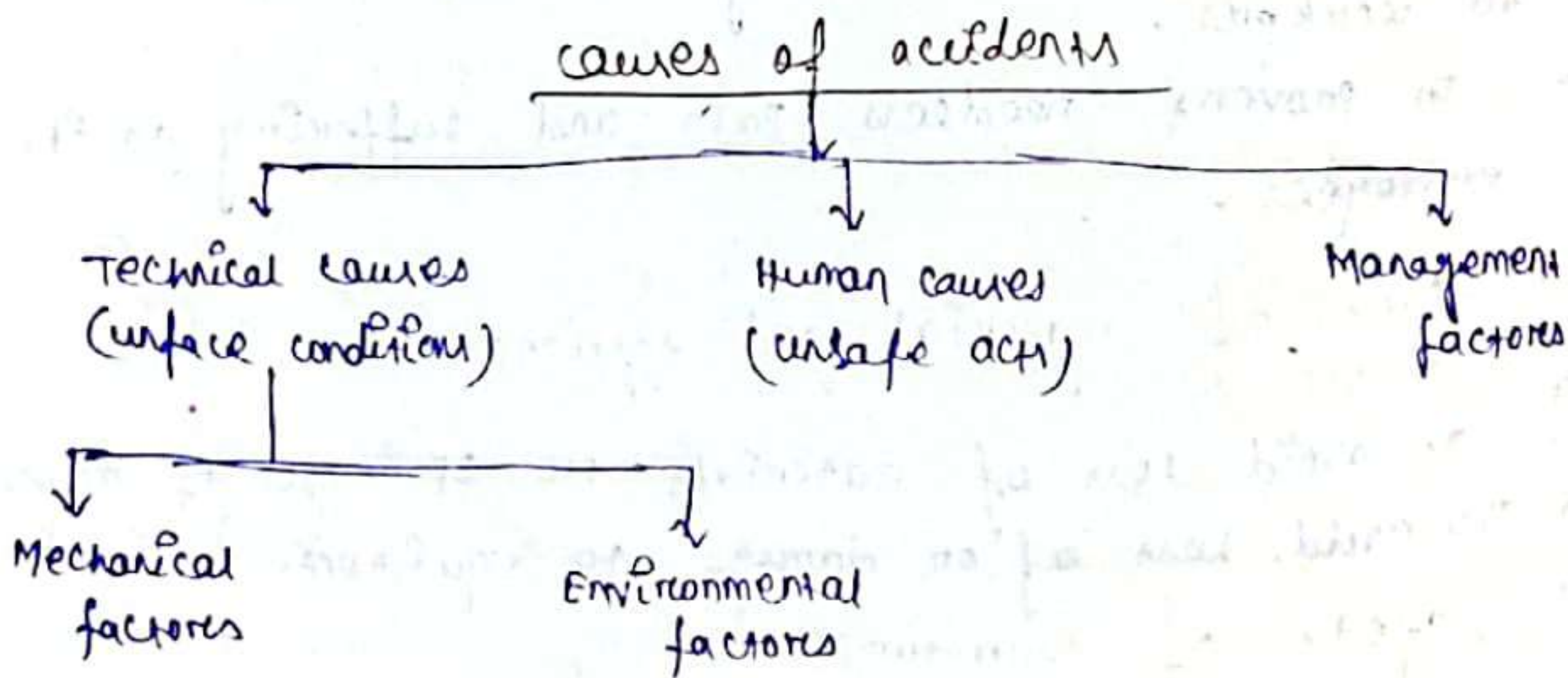
d) Management consideration :-

Management derives the greatest benefit from accident prevention programme in terms of the following :-

- To eliminate the cost of workmen's compensation insurance.
- To avoid loss of time because of accident.
- To get greater margin of profit because of minimum cost of construction/operation.
- To generate the confidence and trust of employees for its strong stability.

Causes of accident :-

An accident is an unplanned incident and for each such incident, there is usually a specific cause or causes if one could but discover them.



Mechanical factors :-

Mechanical factors, signifying the unsafe conditions, reflect deficiencies in plans, equipment, tools, materials handling system etc., these are listed down below :-

- i) unsafe mechanical design on construction.
- ii) Hazardous arrangements (piling, overloading etc.)
- iii) Improper machine guarding
- iv) Defective devices

- v) improper material handling,
- vi) Broken safety guards
- vii) protruding nails
- viii) Leaking acid valve.
- ix) untested boilers or pressure vessels.

Environmental factors :-

It is also signify unsafe conditions of work environment, indicating physical and atmospheric conditions of work which indirectly promote the occurrence of accidents. The factors include;

- i) very low temperature which causes shivering.
- ii) very high temperature which causes headache and sweating.
- iii) very high humidity which causes discomfort, fatigue and drowsiness shadow etc.
- iv) presence of dust, fumes, smoke, toxic and lack of proper ventilation.
- v) Noise, bad odour and flash emanating from the nearby machinery, equipment or processes.
- vi) poor housekeeping.

PERSONAL (HUMAN) FACTORS :-

Personal factors signifying the unsafe acts by persons concerned are due to ignorance, carelessness, forgetfulness etc. These factors are:-

- i) Age and health
- ii) Home environment.
- iii) Number of dependents and financial positions
- iv) Lack of knowledge and skill.
- v) Improper attitude towards work.
- vi) carelessness and recklessness.

- vii) Day dreaming and inattention.
- viii) Emotional instability (e.g., jealousy, revengefulness).
- ix) High anxiety level.
- x) Unnecessary exposure to risks.
- xi) Fatigue.
- xii) Working at unsafe speeds.
- xiii) ~~Working at~~ non use or improper use of safety devices.
- xiv) Overconfidence or false confidence.

MANAGEMENT FACTORS :-

Callousness on the part of the management in imparting accident prevention programmes causes accidents. These are listed as below :-

- i) Non-availability of the safety accessories to the workers like helmet, plastic gloves, safety belts, gumboots, goggles etc.
- ii) Lack of safety instructions and training and communication gaps.
- iii) Discontinuity in regular employment in the construction industry.
- iv) Rapid change in character of work.
- v) Award of contract or work order to incompetent persons who do not appreciate the risks involved.
- vi) Lack of proper provisions of safety director/officials and recruitment of technically incompetent workers.

Safety measures for demolition :-

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

- 1) On every demolition work, danger signs should be provided all around the structure and doors giving access to the structure. Barricades should be erected around the structure and at least two exits must be provided for the escape of workmen during any emergency.
- 2) During night time, red lighters should be placed around the barricades and entry of unauthorised persons restricted.
- 3) At the time of demolition work, workers should use all safety appliances such as helmets, goggles, gloves etc.
- 4) In case any danger is anticipated to the adjoining structure during the process of demolition, the same should be got vacated to avoid any danger to human life.
- 5) The process of demolition may weaken the side wall of an adjoining structure and to prevent possible damage, these walls should be supported until permanent protection is provided.
- 6) The power on all electrical service lines must be shut off and all such lines disconnected before the demolition work is started.
- 7) All gas, water, steam and other service lines must be shut off before the demolition work is started.

SAFETY MEASURES FOR SCAFFOLDING, LADDERS FORMWORK AND OTHER EQUIPMENTS:

- 1) 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.
- 2) In case, scaffolds are to be kept for a long period a regular plank stair way, wide enough to allow two persons to pass, should be erected with handrails on both sides.
- 3) When work is being carried out over a scaffold platform, a protective overhead covering should be provided for the men working on the scaffold.
- 4) All wooden ladders or bamboo ladders must be strong enough.
- 5) Ladders in heavy duty work should not exceed 6m in length; for light work it should not exceed 8m in length.
- 6) Dismantling of scaffold should be in a proper sequence.
- 7) No un-insulated electric wires should exist within 3m of working platform.
- 8) The supporting kullas should be individually strong and properly braced and fastened.
- 9) All persons handling construction equipment should

be fully acquainted with the safety aspects of the machines and their operation.

SAFETY MEASURES FOR FORMWORK :-

PRECAUTIONS :-

- Workers must be provided with safe access to the work.
- Guard rails must be put in place as work progresses.
- Access ladders must be properly erected, tied and propped at least 1m above the landing platform.
- Ladders on an open scaffold must be used for access.
- ~~Access ladders must be properly erected, tied and propped at least~~
- Equipment must be in good order before use. Original manufacturer's pins must be used in adjustable props.
- Formwork, falsework and temporary supports must be checked, properly tied, footed, braced and supported before loading and before pouring walls or columns.
- Workers must be protected from wet concrete by use of protective gloves and boots and from the effects of silica dust by avoiding the need to scabble by using a retarder or by the provision of respirators.
- There is a planned striking procedure that everyone is made aware of before the work commences.

Safety measures for fabrication:-

→ Supply personal protective equipment for prevention from the risk of accident, injury or health problem.

Common protective clothing for fabrication

Industries are safety glasses, ~~gloves~~ flame resistance gloves, ear ~~plugs~~ plug, welding helmet, oil resistance shoes

→ conduct regular inspections and maintenance of work place.

Q What do you mean by quality control?

AM - Quality control is a procedure or set of procedures intended to ensure that a manufactured product or performed service adheres to a defined set of quality criteria or meets the requirements of the client or customer.

Q State the need for inspection and quality control in construction works.

AM - Need for inspection and quality control :-

The objective of inspection and quality control is to achieve sound construction work which results in structures of good quality at reasonable cost. Inspection and quality control are required on all construction projects to ensure that the work is done in accordance with plans, specifications and good practice and to avoid defects. An entirely safe design may be completely ruined by careless execution. This can lead to defective work with possibility of the failure of the structure. Careful inspection and quality control is, therefore, as important as the preliminary investigation and design. As important it is very difficult and expensive to rectify a structure after it is constructed, it is necessary to inspect the structure during its various construction stages. On large jobs, a separate inspection agency is generally provided to ensure effective inspection and quality control.

Comprehensive inspection forms one of the important considerations for efficient and satisfactory construction, along with innovative design, appropriate specification, reliable construction practices, and a committed construction team.

The objectives to be achieved through inspection should be determined before commencement of construction so that proper arrangements 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 carrying 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 and the purpose of inspections is to find out, by observation and on testing ~~whether~~ 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 and field testing of materials; ~~and field testing~~
- measurement and proportioning of construction materials;
- examination of layout, ~~formwork~~ ^{formwork}, foundations etc.
- testing specimens in the laboratory;
- observation of construction equipment and plants;
- preparation of records and reports.

90 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 and requirements. Quality control ensures that work proceeds in accordance with the specifications laid down and inspections is the tool through which it is practiced.

Principles of Inspection :-

In case of large construction projects, a separate inspection agency is generally provided to ensure effective inspection and quality control. This inspection agency plays an important role in the execution of works and has diverse duties and responsibilities. For this purpose, an inspector is generally entrusted with the job of inspection. The inspector is a professional having knowledge of the principles and methods involved in the execution of works.

To start with, an inspector has to familiarize himself with the plans and specifications of the construction project. With this background, the inspector should be able to have a good judgement of everything that he inspects. For efficient inspection, specifications form a very important consideration and should be studied thoroughly by the inspector.

An inspector is generally authorized to stop any work which is not carried out according to plans and specifications. This is, however, considered as a last resort when it is clear that unsatisfactory work will result from continued operations. The inspector is authorized to stop use of materials and equipment which do not comply with the specifications and sound engineering practice.

Enforcement of Specifications:-

Specifications consists of instructions for the guidance of construction and inspection staff in order to construct sound and stable structures. Specification requirement may be divided into the following two groups.

- requirements which are definite.
- requirements which are laid down by the engineer in charge.

Specification requirements in the latter can become necessary where precise requirements cannot be laid down due to insufficient investigations or where difficult or new situations may arise.

On case of earthwork, specification requirements may be further grouped based on performance or procedure. Where performance is the essence of requirements, it is not logical to insist on any particular procedure or equipment to be used to produce the specified result.

At the time of execution of works, differences may arise between the contractor and the inspector regarding the interpretation of certain requirements of specifications. However, these differences can be resolved by discussion with particular reference to the work in hand. It is essential that specifications are framed in clear terms indicating precisely the specific requirements along with allowable variations to accommodate unforeseen field situations.

WORK STUDY :-

- Work study is a generic term for those ^{techniques} ~~they~~ ^{for} particularly method study and work measurement, which are used in all its content and which lead systematically to the investigation of all the factors which effect the efficiency and economy of the situation being review, in order to effect ~~the~~ ^{an} improvement.
- The main objective of work study is improved productivity of main machines and materials.
- The aim of work study is determined the best method of performing each operation and to eliminate wastage so that production increases with less fatigue.
- The work study is also used in determining the standard time that a qualified worker should take to perform an operation when working at a normal place.

Role of work study :-

- To standardised the method of doing a work.
- To minimise the unit cost of production.
- To determine the standard time for doing a task.
- To minimise the material movement and operators movement to eliminate the unnecessary human movement.
- To utilise facilities such as - man, machine and material cost effectively.

Advantages of work study :-

- Work study ensures higher productivity.
- Better working condition with less fatigue.
- ~~Rise~~ Higher wages to workers.
- Uniform production flow.
- Job satisfaction and job security to workers.
- Reduction in unit cost of production.
- Quality products to the end consumer.
- Fast delivery schedule.
- Harmonious employer - employee relation.
- Better service to customer.

Q How to control the financial and physical progress by corrective measures.

Am - Following are the probable causes of excessive cost of construction of any project.

- 1) Low bid
- 2) Insufficient knowledge of job conditions.
- 3) Increase in cost of materials and labour.
- 4) Adverse climatic conditions.
- 5) Improper selection of construction equipment.
- 6) Inefficient management and supervision.

The first four causes are not possible to correct after the project is started. There is some opportunity to remove the first cause as the last cause is certainly controllable. The construction cost control analyse the performance of labour and materials and it aims in correcting the losses due to inefficient management.

and supervision.

Total Quality Management (TQM) is a participative systematic approach to planning and implementing a constant organizational improvement process. This approach is focused on exceeding customer's expectations, identifying problems, building commitments and promoting open decision making among workers, there are five major steps to TQM and each are essential to successful implementation.

1) Commitment and understanding from employees:-

It is key to ensure that all employees within your organization know about the total quality management policies and make them an fundamental part of their work.

2) Quality improvement culture:-

The organisational culture needs to be modernized on a continuous basis to encourage employee feedback your employees are full of valuable knowledge embrace it.

3) Continuous improvement in process:-

Total quality management is a continuous process and not a program. This requires constant improvement in all the related policies, procedures and controls established by management.

4) Focus on customer requirements:-

In today's market, customers require and expect perfect goods and services with zero defects. Focusing on customer requirements is significant to long term survival and essential in order to build relationship with customers.

5) Effective controls

It is essential to monitor and measure the performance to the business. It is to forget how many times in a year an employee does not confirm to be controlled procedure or how many times piece of equipment was own due to unplanned maintenance. If strict documentation is maintained, you will be able to objectively quantify areas for improvement and focus your efforts where they will provide the greatest return of both your time and financial resources.