UNIT-2
PROJECT MANAGEMENT

2CL-OE29

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NAAC ACCREDITED 'A+' GRADE

PROJECT PLANNING AND NETWORK TECHNIQUES

CONTENT

- Work breakdown structure
- Bar chart
- CPM and PERT
- Development of network
- Time estimates and computation
- Analysis of network

- Time-cost trade off
- Updating and resource allocation
- Use of software in management
- Management information system

PROJECT

- A **project** is a set of **interrelated activities** undertaken to meet a **defined objective**, in terms of a **product or service**, which has a **defined start date**, a **defined end date** and a **defined cost**.

- **Project** is a **temporary endeavor**.

- Each **project** is **unique in its nature**.

EXAMPLES OF PROJECTS

- Hosting a College Annual Function
- Plan a Space Shuttle to Mars
- Construct a Plant to Manufacture Ball Bearings
- Plan for Wedding
- Designing and Implement a Computer System
- Designing a Anti-lock Breaking System (ABS)
- Executing Environmental Clean-up of a Contaminated Site
- Erect a New Lab in the Dept. of Civil Engineering

PROJECT LIFE CYCLE

- The **Project Lifecycle** is the sequence of phases through which a project progresses. It includes typically four phases

  1. Initiation,

  2. Planning,

  3. Execution, and

  4. Closure.

- The number of phases and sequence of the cycle may vary based on the **company** and the **type of project undertaken**.

- As part of a project, however, they should have a **definite start and end date**.

- The lifecycle provides the **basic foundation of the actions** that has to be performed in the project.
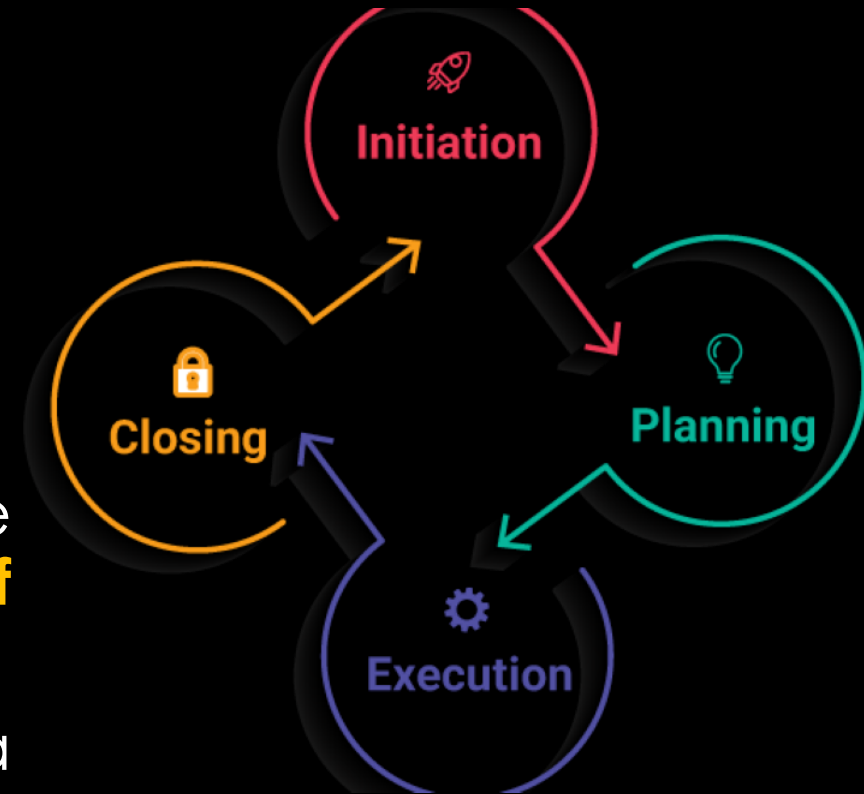
WORK BREAKDOWN STRUCTURE (WBS)

- A work breakdown structure (WBS) is **a project management tool** that divide the *project deliverable into several manageable work packages with sequence of the their execution.*

- By breaking down the project into smaller components, a WBS can integrate scope, cost and deliverables into a single tool.

- A typical WBS of a house construction is shown in the figure
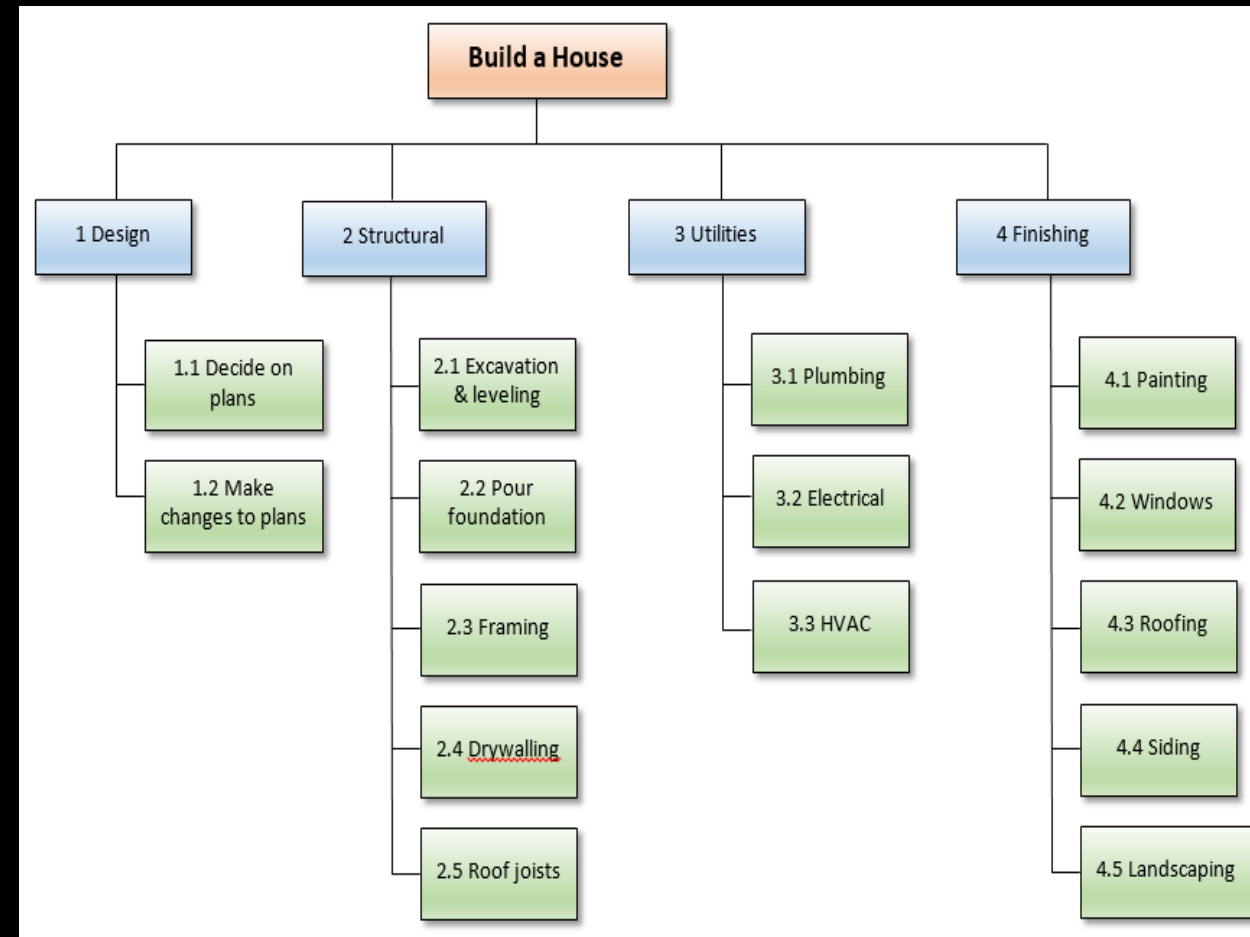
OBJECTIVE AND BENEFITS OF WBS

- **Objective:**

- To identify discrete activities or tasks that can be planned, estimated, scheduled, executed and controlled for completion

- **Benefits:**

- It helps more accurately and specifically to define and organize the scope of the total project.

- It helps with assigning responsibilities, resource allocation, monitoring the project, and controlling the project.

- Work can be done simultaneously by different team members, leading to better team productivity and easier project management.

- It allows you double check all the deliverables with the stakeholders and make sure there is nothing missing or overlapping.

BAR CHART (GANTT CHART)

- A bar chart consists of two coordinate axes, one showing the time (x-axis) and other showing jobs or activities (y-axis) to be performed.

- Also known as Gantt chart after Henry Gantt, who developed this technique around 1900.

- Each job is depicted in the form of a horizontal line and bar and length of the bar indicates the duration of the activities.

- Example of a bar chart involving the construction of a foundation with a set of activities is as shown in figure below.

BAR CHART (GANTT CHART)
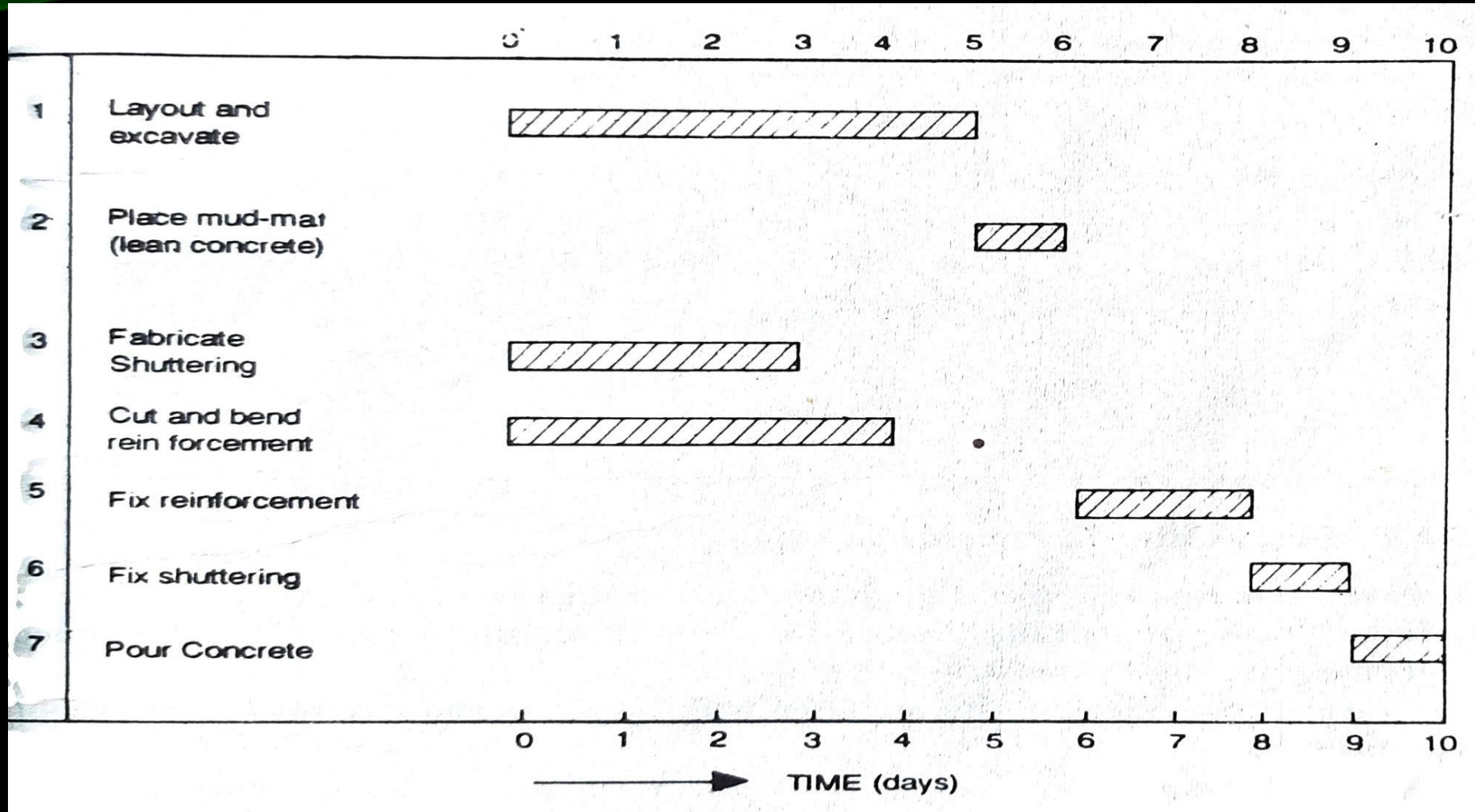
Bar chart of construction of foundation

BAR CHART (GANTT CHART)

Advantages

• Easy graphical representation to prepare and understand.

• It can also be used for scheduling resource such as material, labor equipment and money required for a project

Limitations

• Conventional Bar-chart does not indicate the progress of activities but in modified bar chart it can be shown by coloring/hatching the bar.

• Does not show clearly the interdependencies among the various activities.

• Does not indicate the critical activities requiring attention of project team

• Does not show the quantity of the work.

NETWORK ANALYSIS

- Network analysis is the general name given to certain **specific techniques** which can be used for **planning, management and control of project.**

- Main objectives network analysis are:

    1. Complete the project within stipulated period.

    2. Complete the project within the estimated cost.

    3. Optimize resources utilization

    4. Provide better coordination in interdependent activities

    5.Trade-off between Time and Cost of Project

    6.Minimize Production Delay, Interruptions and Conflicts

- The two most frequently used forms of networks are:

    1. Program Evaluation and Review Technique (PERT)

    2. Critical Path Method (CPM)

PERT

- Developed by the US Navy for the planning and control of the Polaris missile program during 1957-58.

- The emphasis was on completing the program in the shortest possible time.

- It has been used for various research and development (R & D) projects which are non-repetitive in nature, where the duration of various activities cannot be predicted with certainty. Researchers are usually not sure as to how much time a particular research activity will take.

- PERT has the ability to cope with uncertain activity completion times (e.g. for a particular activity the most likely completion time is 4 weeks but it could be anywhere between 3 weeks and 5 weeks).

- Three time estimates are used to determine the expected time of each activity which forms the basis of PERT network.

CPM

- Developed by Dupont Corporation and Remington Rand in 1956 in the United States of America (USA) to solve project scheduling problems.

- The method was successfully tried for the construction of a chemical plant in Louisville, USA.

- The emphasis was on the trade-off between the cost of the project and its overall completion time.

- CPM is extensively used in production management and construction Industry due to their repetitive nature where activity time estimates can be predicted with considerable certainty due to the existence of past experience.

PERT V/S CPM

Parameters	PERT	CPM
Basic Concept	A Probabilistic model with uncertainty in activity duration. Expected duration is calculated from to, tm, tp	A deterministic model with well known activity duration based upon past experience
Estimate	Three time estimates (optimistic time, most likely time and pessimistic time)	Single time estimates
Orientation	Network is constructed on the basis of Events (Event oriented)	Network is constructed on the basis of jobs or Activities (Activity oriented)
Nature of Job	Non- Repetitive Nature Ex: Research and development project, Defense project	Repetitive nature Ex: Civil construction, industrial setting, plant maintenance, Ship building
Focuses on	Time (meeting time target or estimating percent completion is more important. Resources are always made available as and when required)	Time-Cost trade off (Optimizing cost is more important. there is better utilization of resources)
Crashing	as there is no certainty of time activity duration cannot be reduced	Possible

APPLICATION OF NETWORK

These methods have been applied to a wide variety of problems in industries and have found acceptance even in government organizations. These include

• Construction of a dam or a canal system in a region

• Construction of a building or highway

• Maintenance or overhaul of airplanes or oil refinery

• Space flight

• Designing a prototype of a machine

• Development of supersonic planes

OBJECTIVES AND STEPS INVOLVED IN NETWORK ANALYSIS

Objectives

1. Minimization of Total Project Cost
2. Minimization of Total Project Duration
3. Trade-off between Time and Cost of Project
4. Minimization of Idle Resources
5. Minimize Production Delay, Interruptions and Conflicts

Steps involved are :

- Identify the specific activities.
- Determine proper sequence of the activities.
- Construct the network diagram.
- Estimate the time required for each activity.
- Determine the critical path , slack.
- Development of project schedule
- Calculate the variability of project duration and probability of completion in given time

ADVANTAGES 7 DISADVANTAGES OF PERT/CPM CHART

Advantages:

• A PERT/CPM chart clearly defines and makes visible dependencies between the activities.

• PERT/CPM facilitates identification of the critical path and makes this visible.

• PERT/CPM facilitates identification of early start, late start, and slack for each activity.

• PERT/CPM provides for potentially reduced project duration due to better understanding of dependencies leading to improved overlapping of activities and tasks where feasible.

Disadvantages:

• There can be potentially hundreds or thousands of activities and individual dependency relationships.

• The network charts tend to be large and unwieldy requiring several pages to print and requiring special size paper.

• The lack of a timeframe on most PERT/CPM charts makes it harder to show status although colors can help (e.g., specific color for completed nodes),

• When the PERT/CPM charts become unwieldy, they are no longer used to manage the project.

CONVENTION USED IN DRAWING NETWORK

Following two conventions are used in drawing network diagrams.
1. Activity on Arrow (A-O-A)
2. Activity on Node (A-O-N)

**Activity on Arrow (A-O-A) :**

- An activity is denoted by Arrows ➔ drawn from left to right.
- The description of the activity is written above the arrow and the time taken to complete the activity is written below it.
- An events is denoted by a number enclosed in a circle.
- A-O-A is the most commonly used convention.
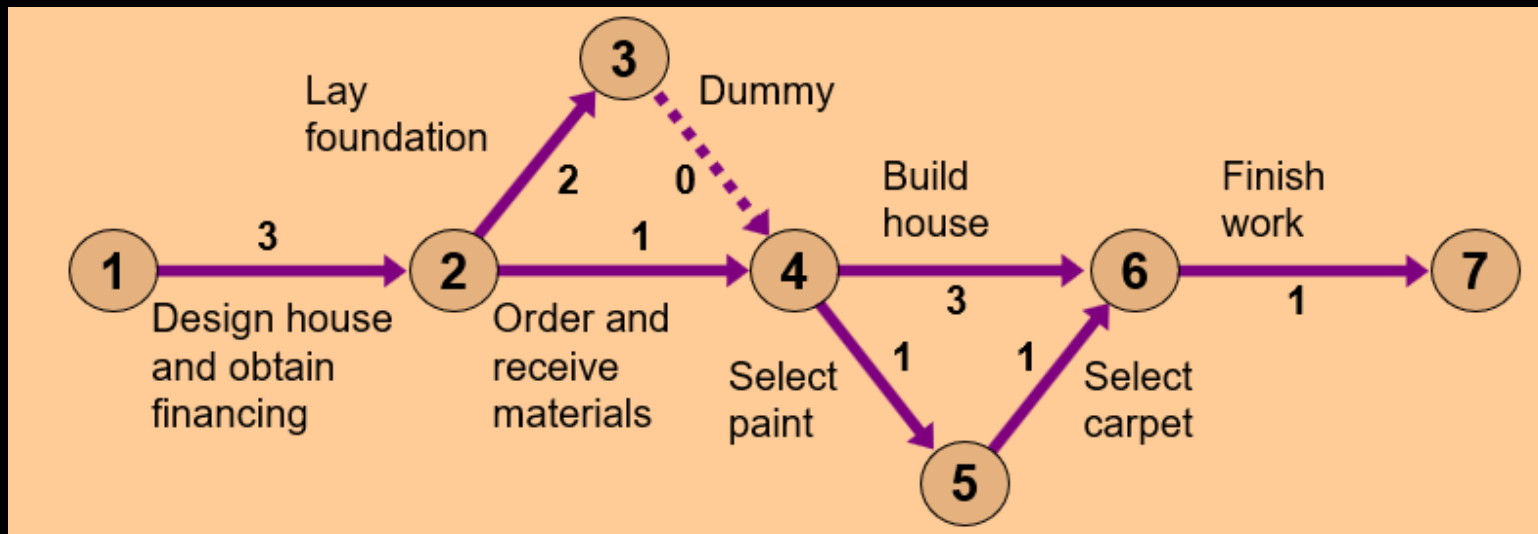
CONVENTION USED IN DRAWING NETWORK

Activity on Node(A-O-N) :

- Activities are denoted by circles(or nodes) ⬤ and arrows are used to show the precedence relation ships among activities.
- Time required to complete the activity is also indicated in the node.
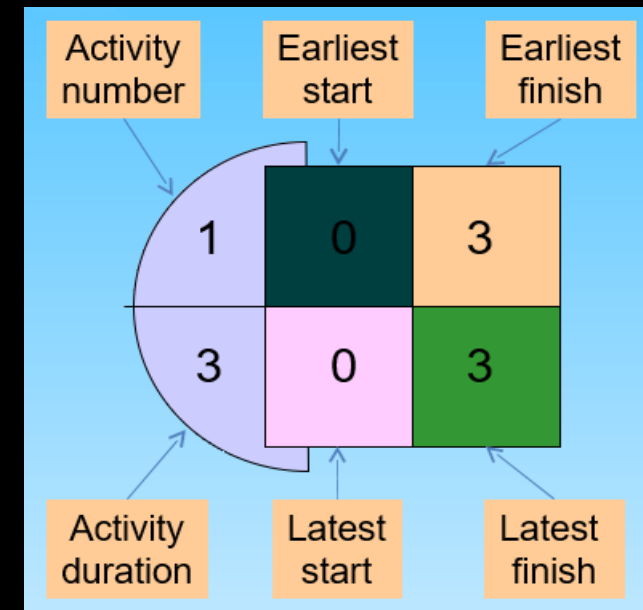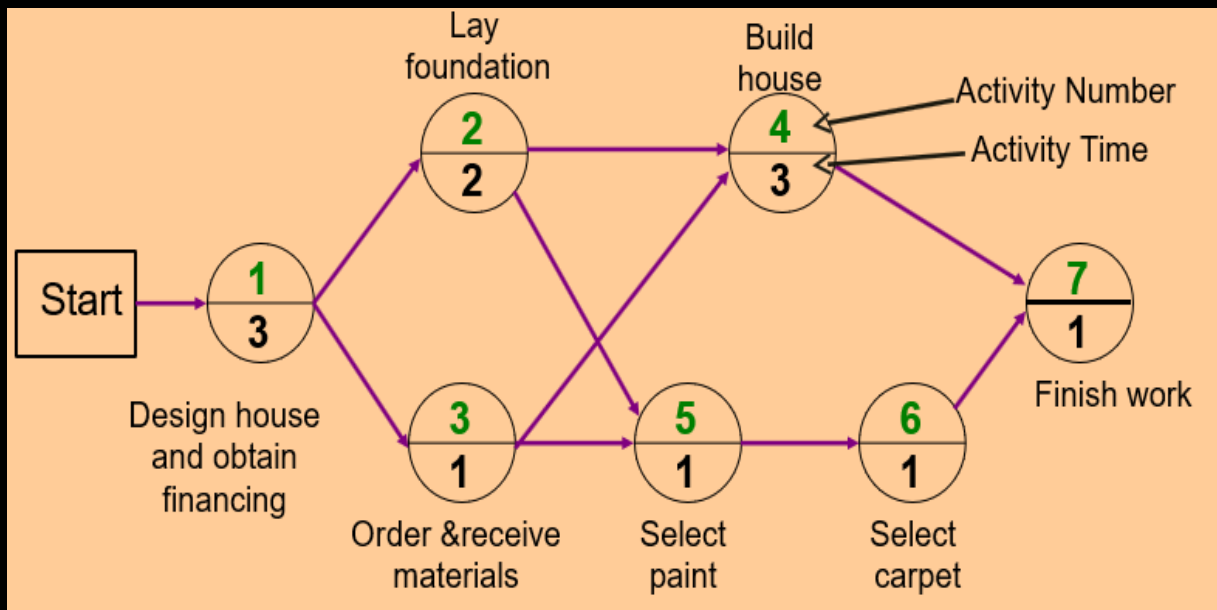
ACTIVITY

- Any individual operation which utilizes resources and has an end and a beginning is called **activity**.

- An arrow is commonly used to represent an activity with its head indicating the direction of progress in the project.

- The length of the arrow bears no relationship with the duration of the activity that it represents.

- These are classified into four categories:

A is called as an Activity
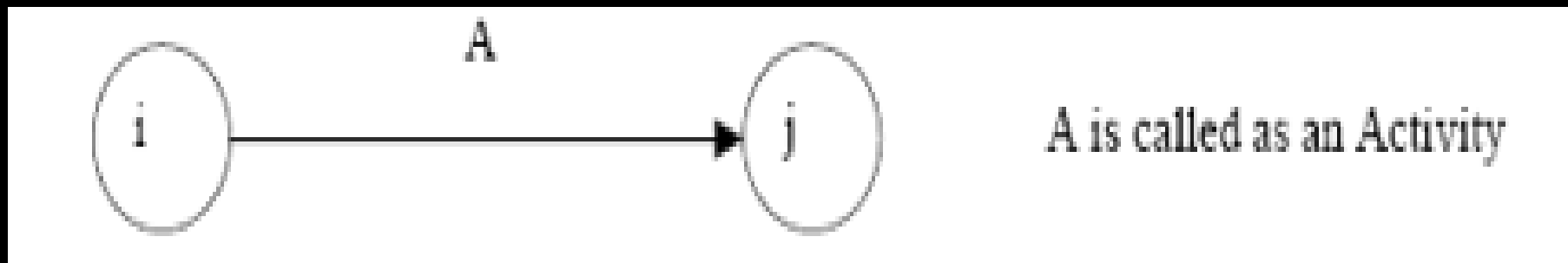
TYPES OF ACTIVITY

1. **Predecessor activity** - Activities that must be completed immediately prior to the start of another activity are called predecessor activities. **Activity A** is predecessor activity of **activities B and C**

2. **Successor activity** - Activities that cannot be started until one or more of other activities are completed but immediately succeed them are called successor activities. **Activities B and C** are successor activities of **activity A**

3. **Concurrent activity** - Activities which can be accomplished concurrently are known as concurrent activities. It may be noted that an activity can be a predecessor or a successor to an event or it may be concurrent with one or more of other activities. **Activities B and C** are concurrent activity.
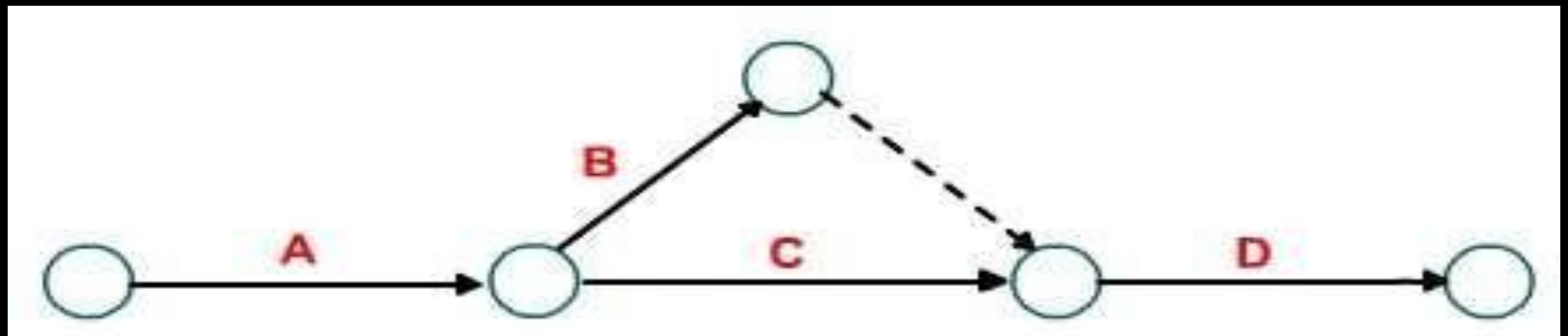
TYPES OF ACTIVITY CONT..

4. Dummy activity - An imaginary activity which does not consume any resource and time is called a dummy activity. Dummy activities are simply used to represent a connection between events in order to maintain a logic in the network. It is represented by a dotted line in a network

The dummy activity is inserted in the network to clarify the activity pattern in the following two situations:

▪ To make activities with common starting and finishing points distinguishable

▪ To identify and maintain the proper precedence relationship between activities that is not connected by events.
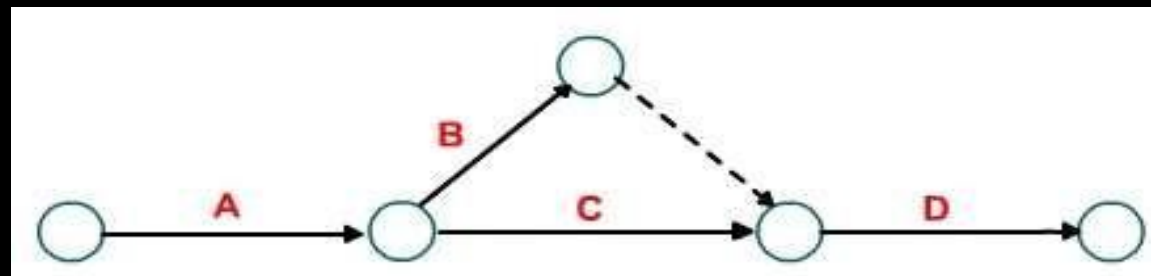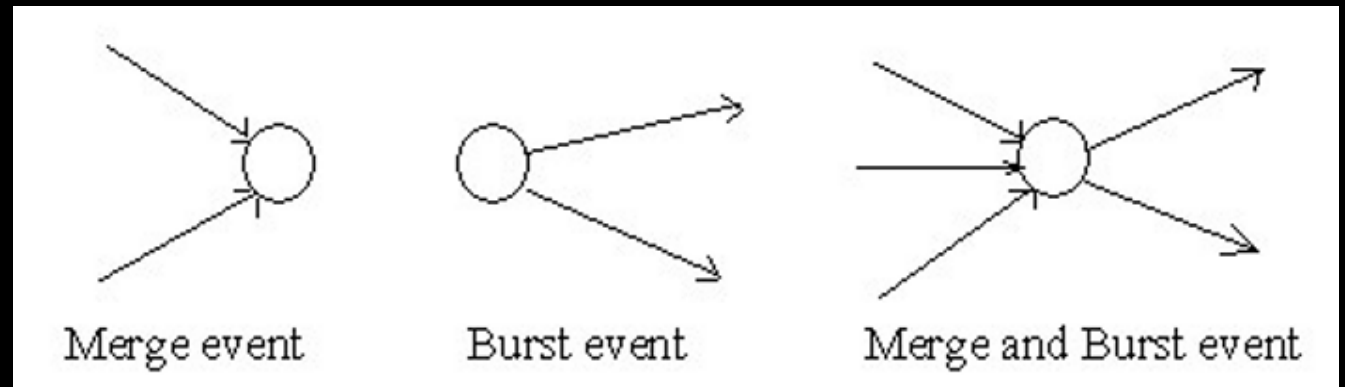
EVENT

- An **event** represents a point in time signifying the completion of some activities (**Head event**) and the beginning of new ones (**Tail event**).

- The event consumes no time or resources and usually represented by a circle in a network which is also called a node or connector.
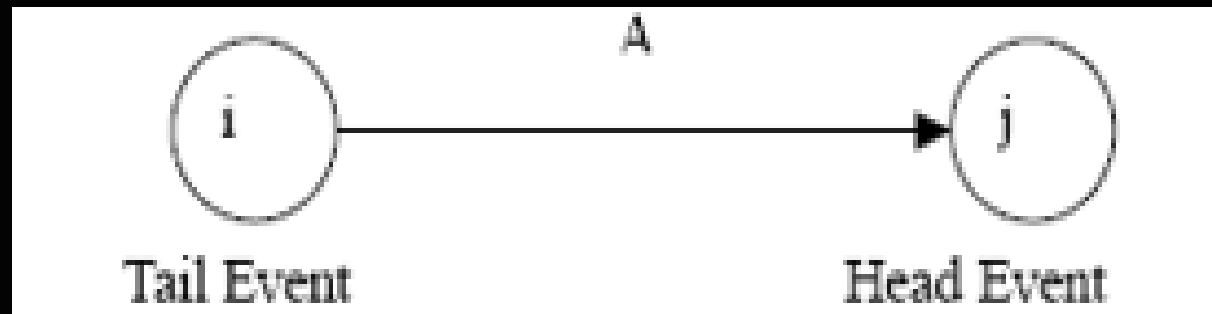
TYPES OF EVENT

The events are classified in to three categories

1. **Merge event** – When more than one activity comes and joins an event such an event is known as merge event.

2. **Burst event** - When more than one activity leaves an event such an event is known as burst event.

3. **Merge and Burst event** - An activity may be merge and burst event at the same time as with respect to some activities it can be a merge event and with respect to some other activities it may be a burst event.

Merge event   Burst event   Merge and Burst event

RULES TO DRAW THE NETWORK DIAGRAM

- Each activity is represented by one and only one arrow in the network. Length of arrow has no significance.

- No two activities can be identified by the same start and end events.

- The event numbered 1 is the start event and an event with highest number is the end event.
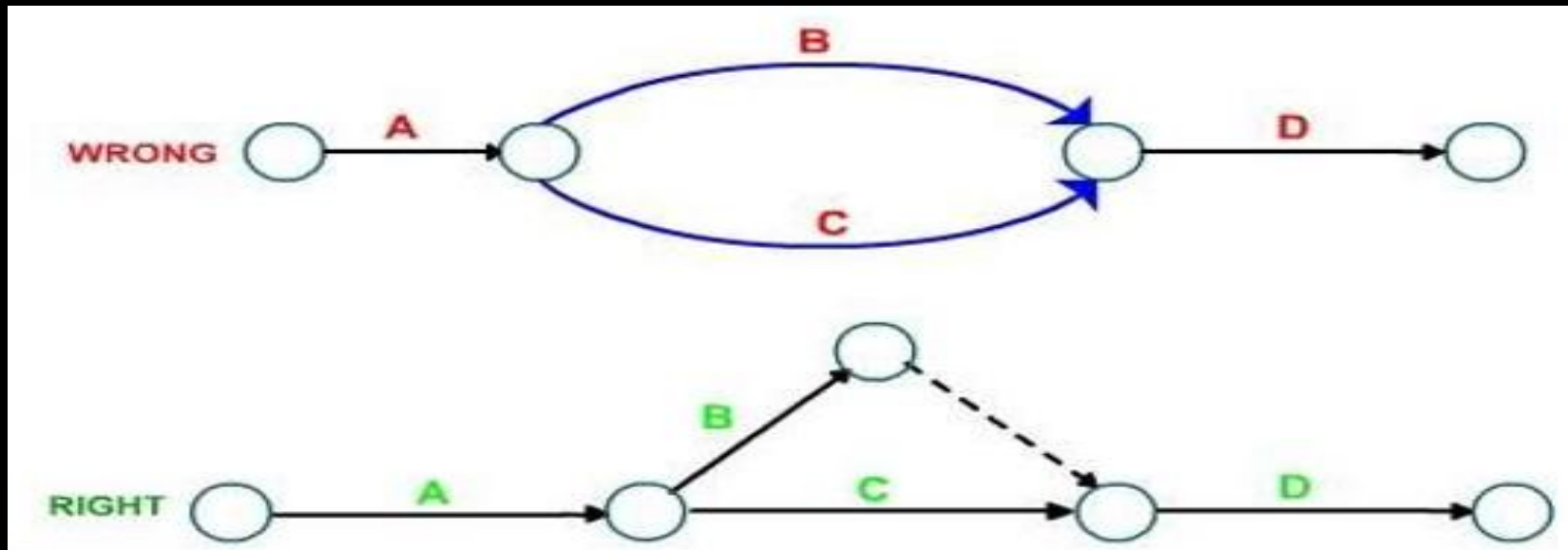
RULES TO DRAW THE NETWORK DIAGRAM

- Before an activity can begin, its preceding activity must be completed.

- Each event should have distinct number in way that head of arrow is greater than the tail. There should not be any duplication of event numbers in a network.

- Dummy activities can be used to maintain precedence relationships only when actually required. Their use should be minimized in the network diagram.
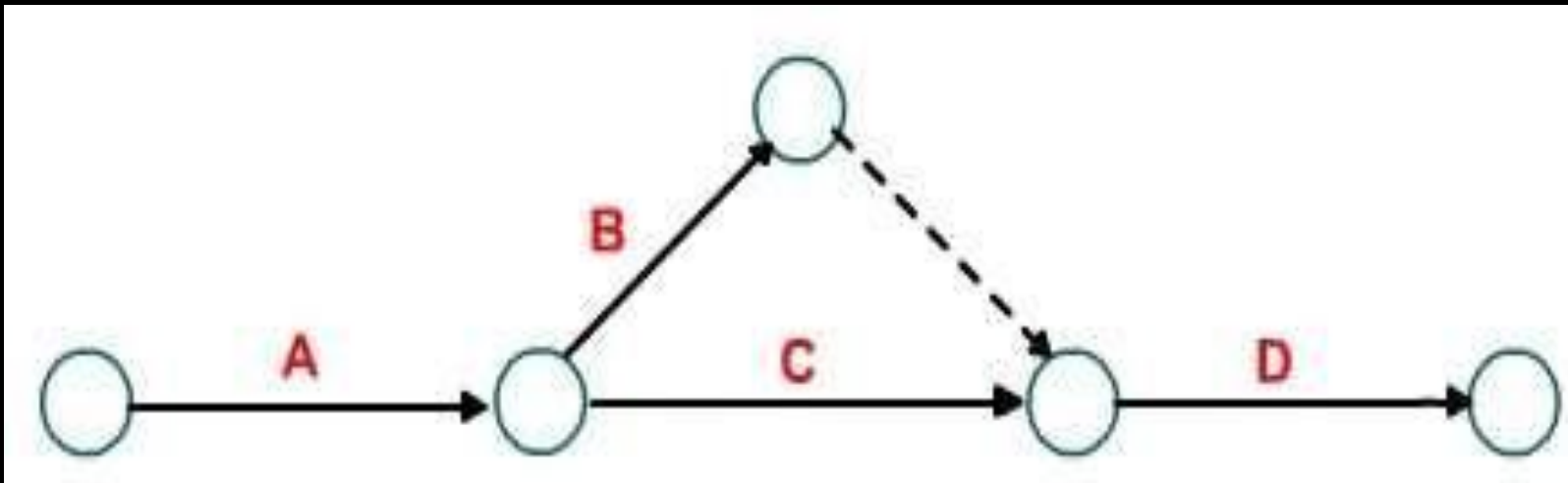
RULES TO DRAW THE NETWORK DIAGRAM

- Looping among the activities must be avoided.
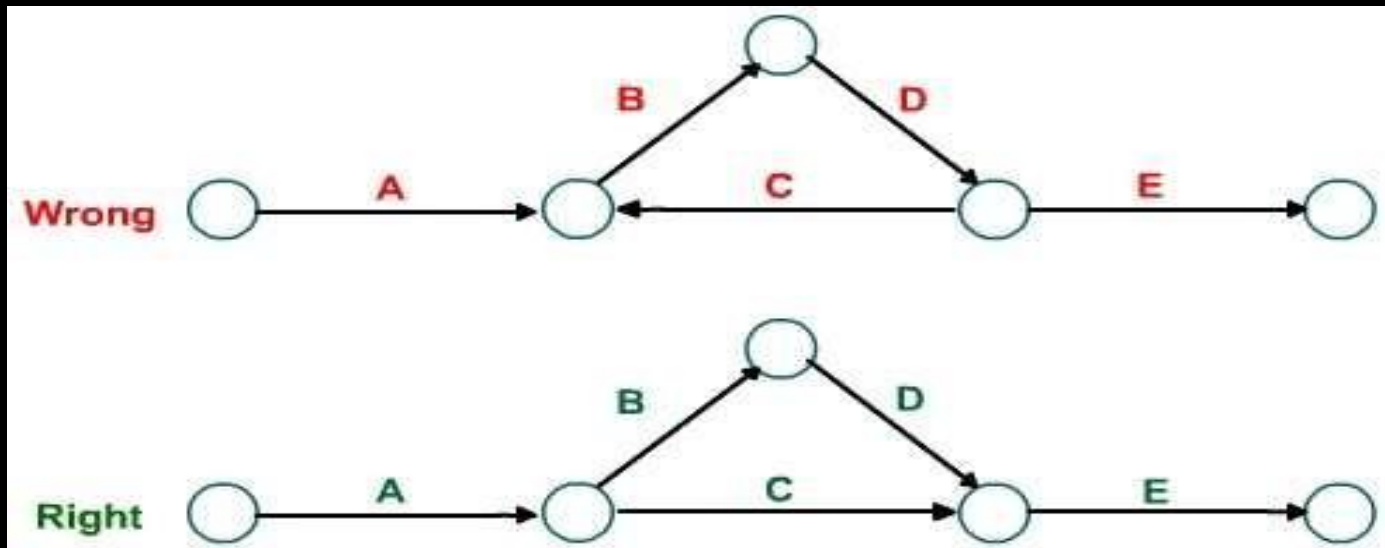
- Arrow should not intersect.
- A network should have only one start event and one end event.