I.T.U.

FACULTY OF ARCHITECTURE

CONSTRUCTION MANAGEMENT & ECONOMICS

Basic Steps, Rules, Methods and Techniques in Planning and Programming of Construction Projects

by

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CONTENT

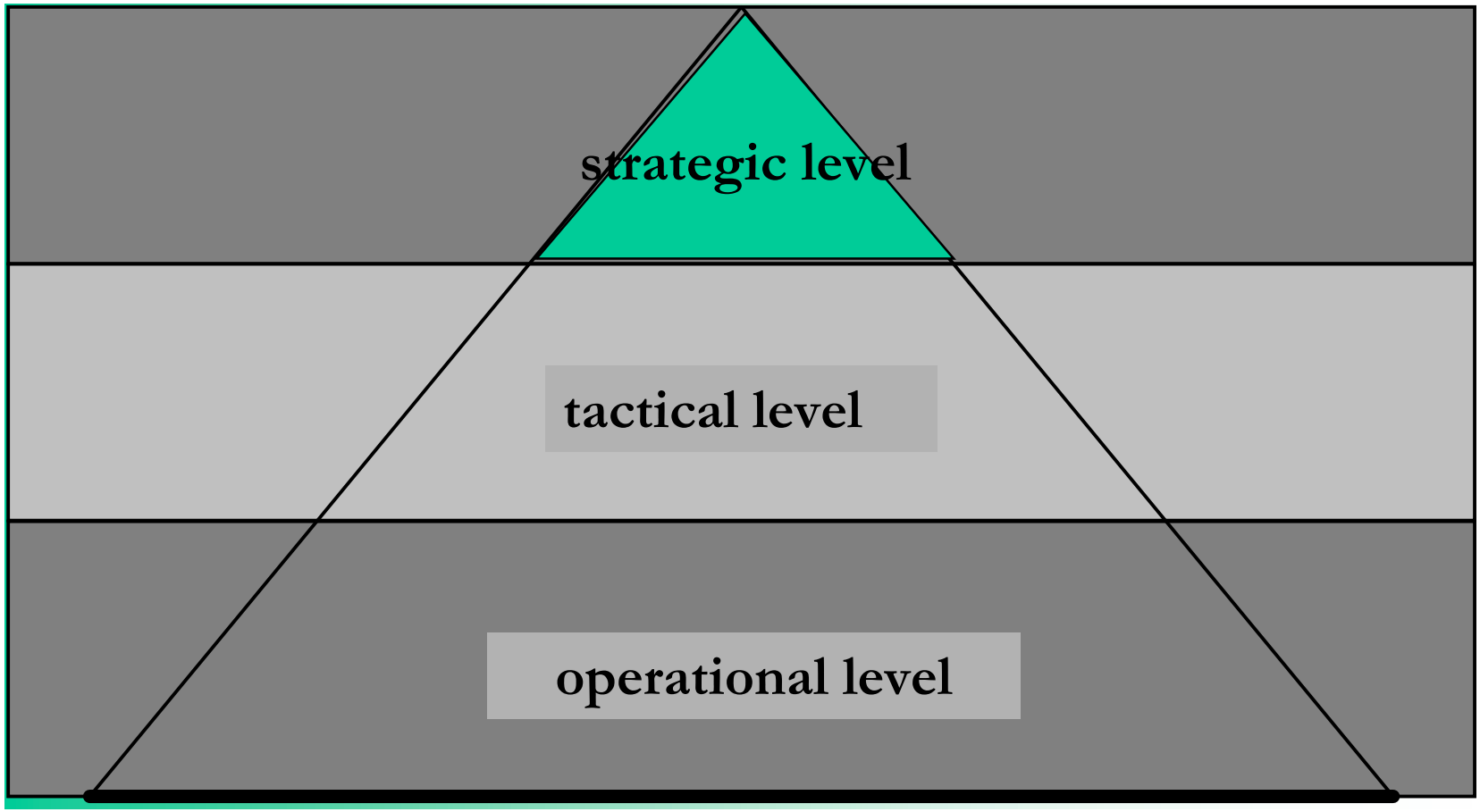
- **The meaning and importance of project planning and programming function in construction management**
- **Decision levels in project planning and programming**
- **Project Planning and Programming Process in Operational Level**
- **The Techniques being used for Project Planning and Programming**
  - Barcharts
  - Line of balance diagrams
  - Network Diagrams

Definition of Project Planning and Project Programming Concepts

- **Project Planning; means breaking down the project into the activities that must be fulfilled to realize the project; defining the type of relationships (predecessors and successor activities) between these activities; visualizing the activities and logical relations.**

- **Project Programming; means calculating early and late start-finish dates for the activities and for the project by assigning the duration of activities.**

Decision Levels in Project Planning and Programming



Aims of Project Planning and Programming

- to be able to foresee the problems that may occur at the beginning or consecutive stages of project and study on probable solutions in advance.
- to warn the management staff about the potantial problems and related activities instead of the others.
- to provide the information related to cash flow that is vital for the finance of project.
- to provide the information related to effective use of the resources by minimizing the idle time of equipment and labors.

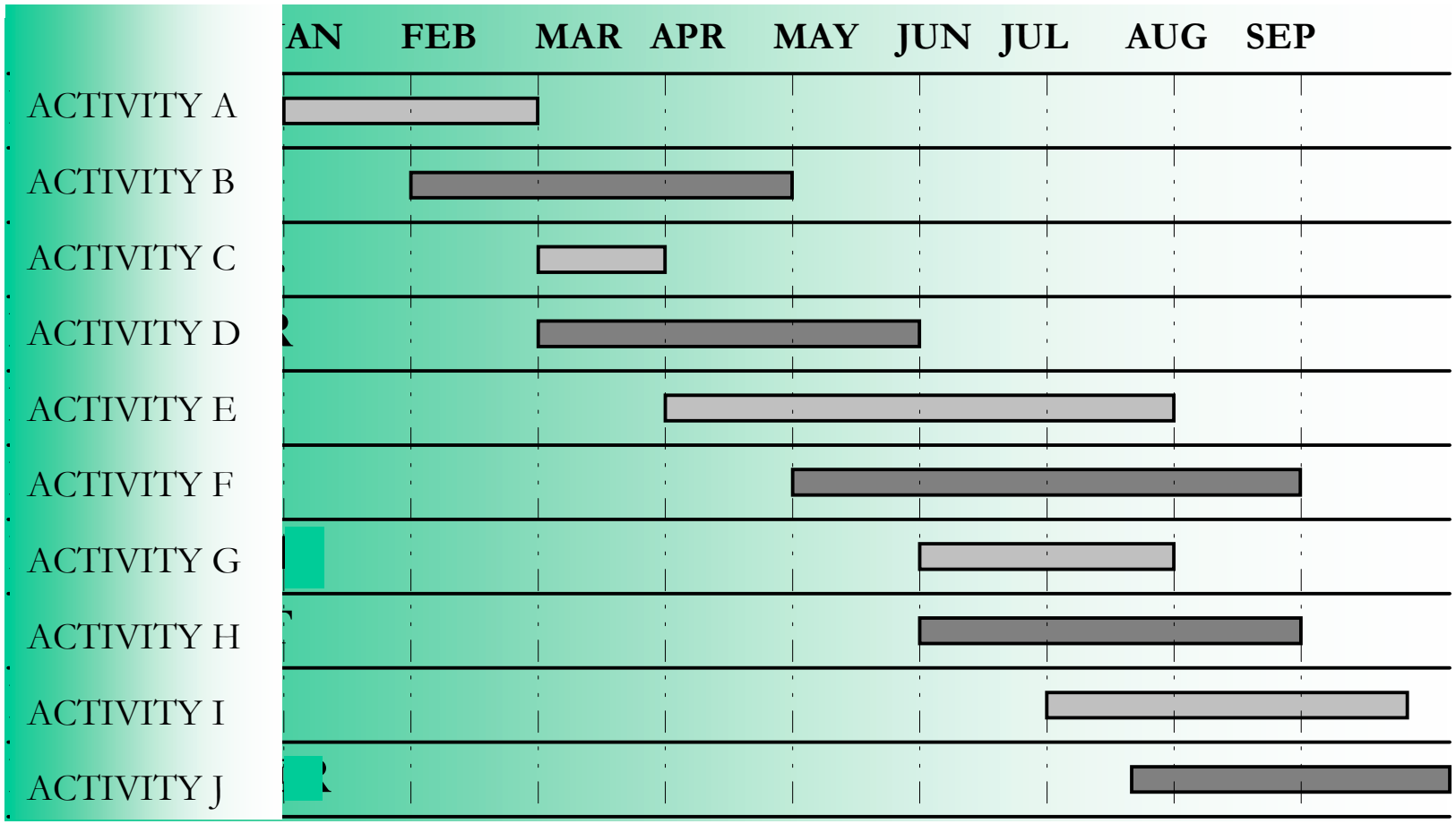
Aims of Project Planning and Programming

- to provide the information related to resources required by activities .
- to provide the information for revising the schedule by considering the progress, delay and revised targets; to help the schedule that tends to derive from target to be revised.

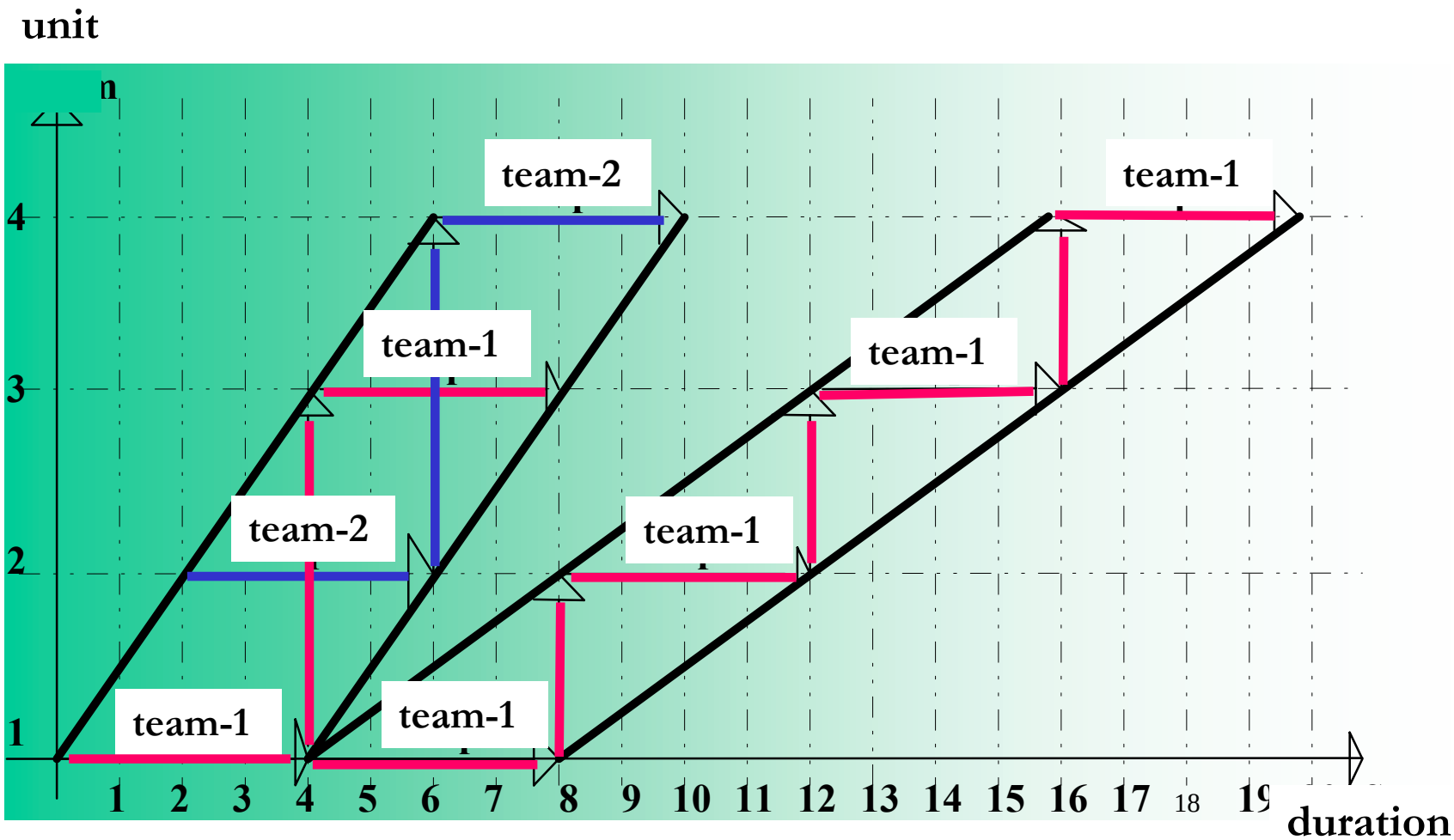
Project Planning and Programming Techniques

- Bar Charts-Gantt Charts
- Line of Balance Diagrams
- Network Diagrams
    - Arrow Diagrams
    - Precedence Diagrams

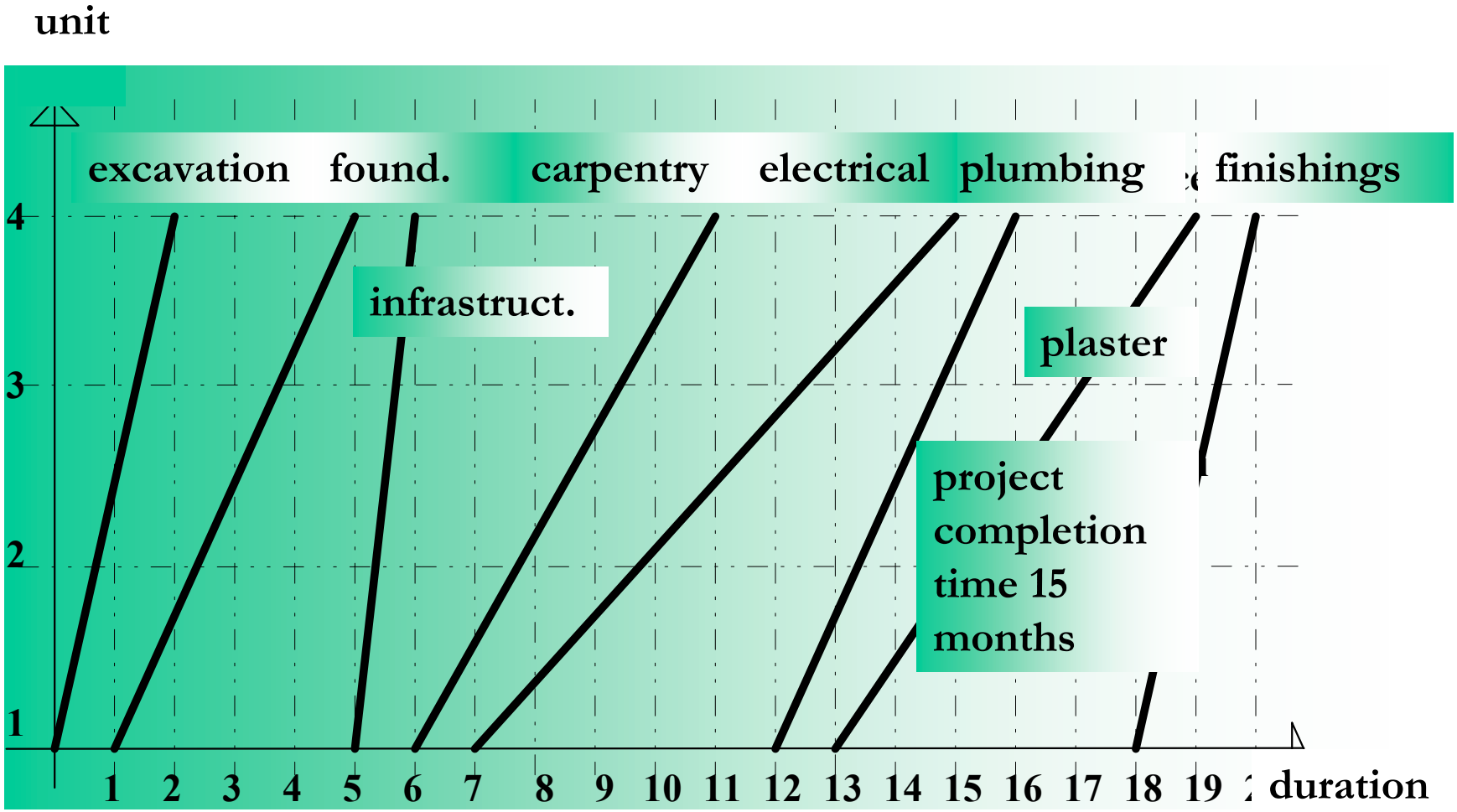
BARCHARTS


AN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
ACTIVITY A
ACTIVITY B
ACTIVITY C
ACTIVITY D
ACTIVITY E
ACTIVITY F
ACTIVITY G
ACTIVITY H
ACTIVITY I
ACTIVITY J

LINE OF BALANCE DIAGRAMS



LINE OF BALANCE DIAGRAMS



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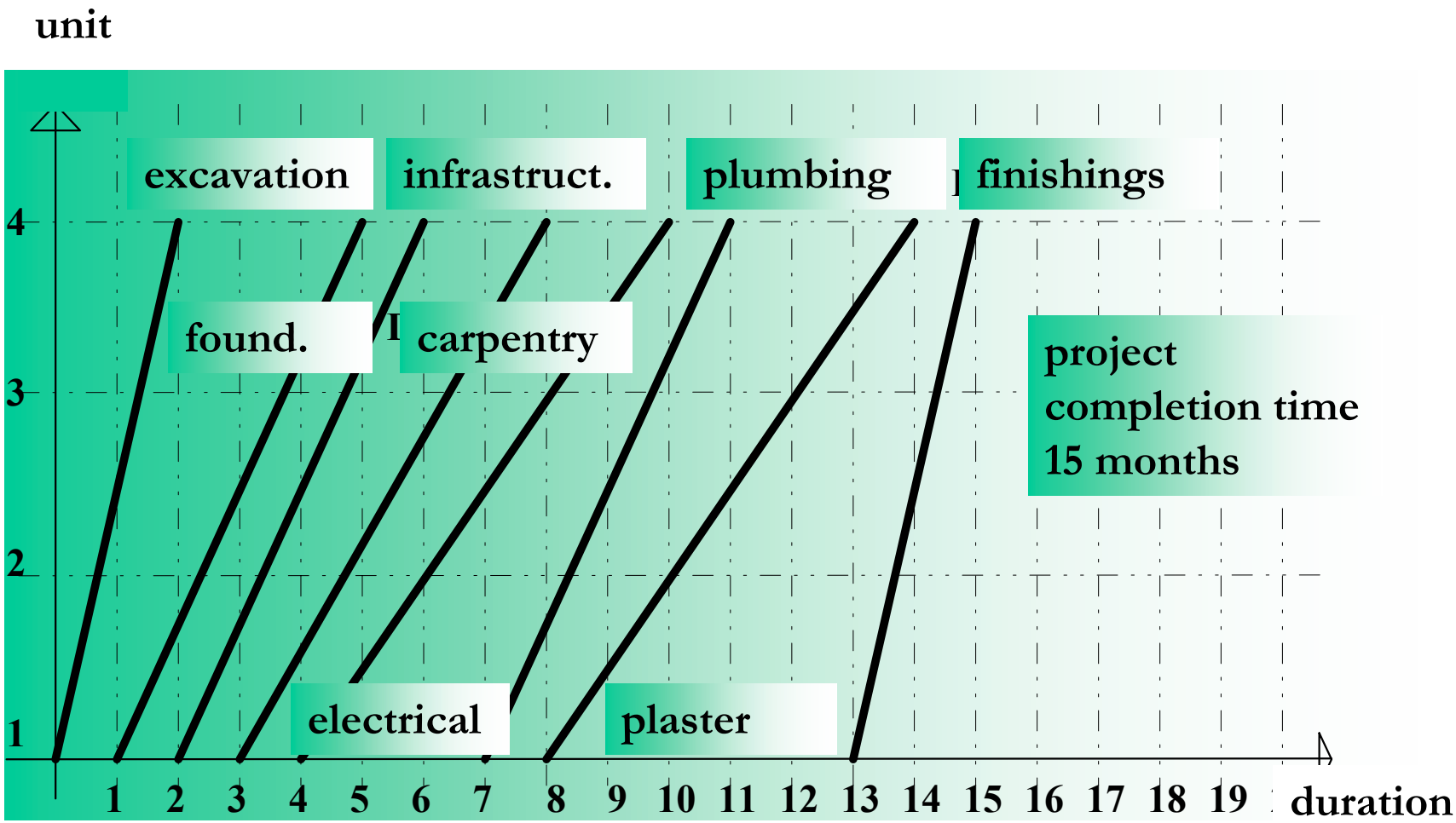
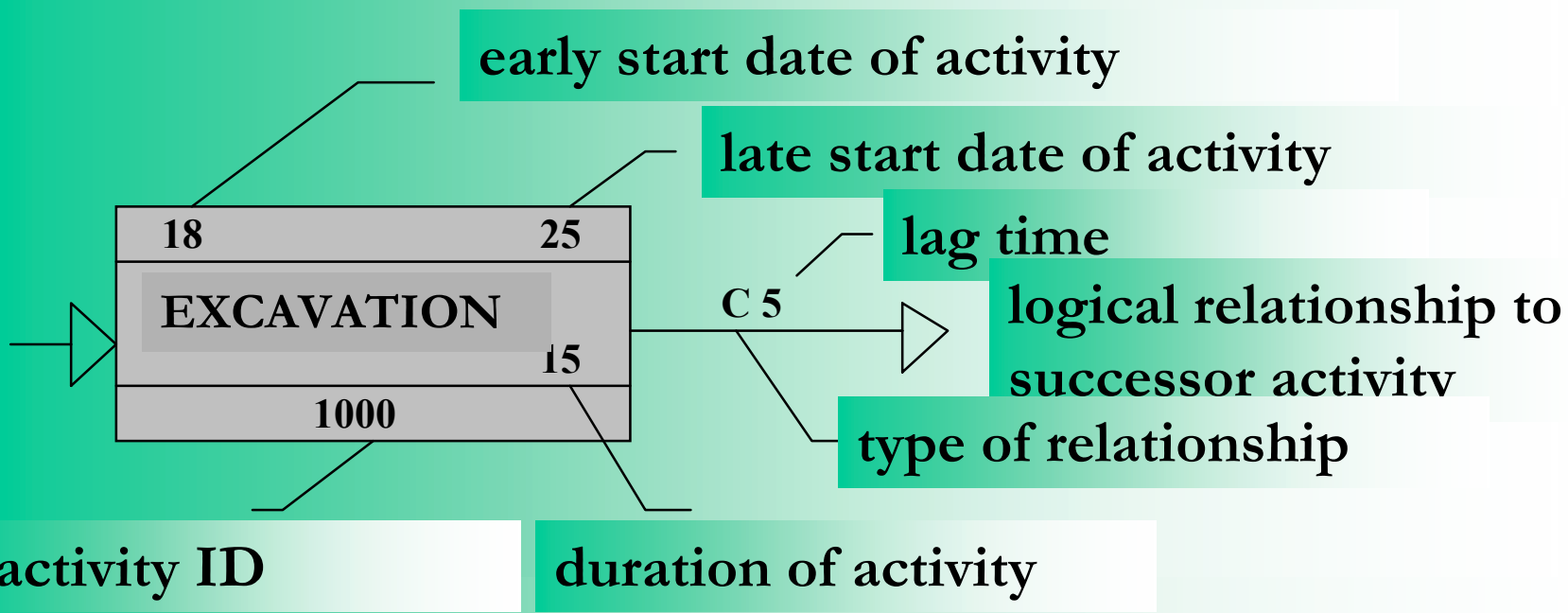


PRECEDENCE DIAGRAMS

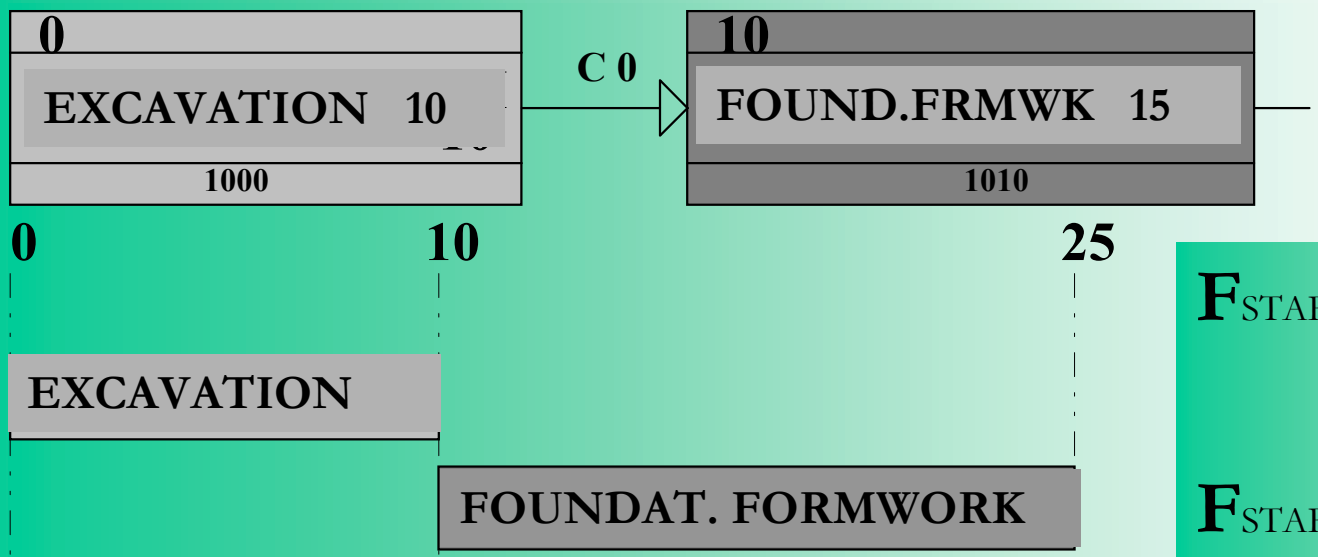
ANNOTATION



PRECEDENCE DIAGRAMS

TYPES OF ACTIVITY RELATIONSHIPS

1. C (Conventional) Type: Finish-to-Start relationship (Lag time = 0)



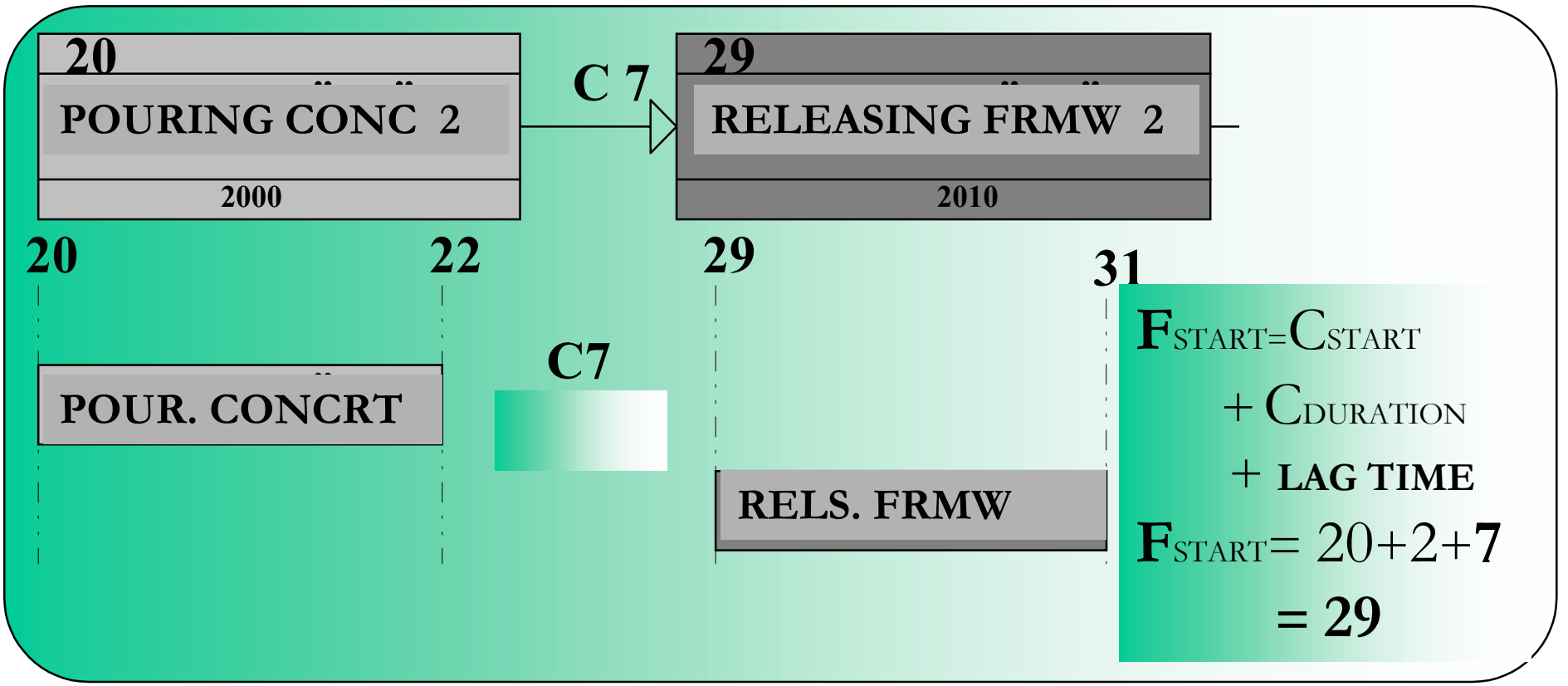
$F_{START} = E_{START} + E_{DUR}$ + **LAGTIME**

$F_{START} = 0 + 10 + 0 = 10$

PRECEDENCE DIAGRAMS

TYPES OF ACTIVITY RELATIONSHIPS

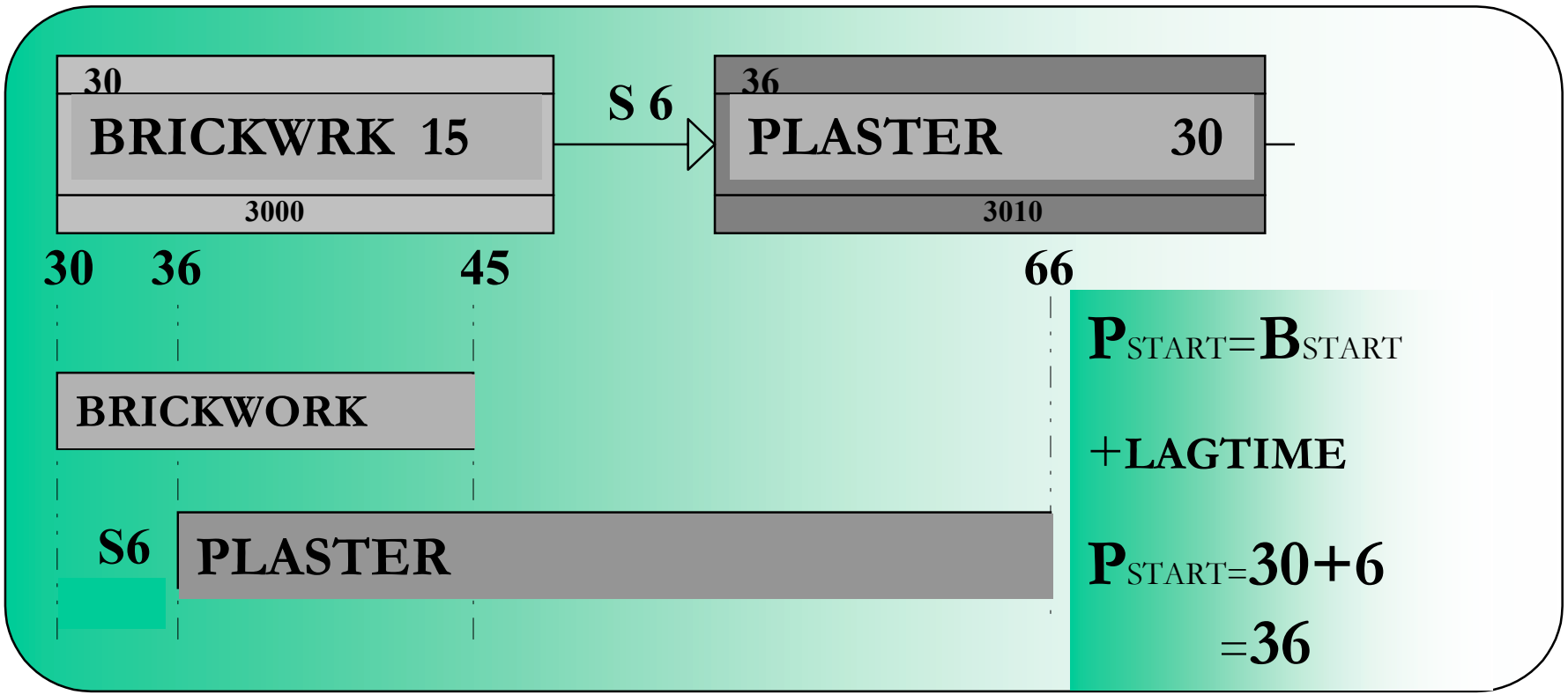
1. C (Conventional) Type: Finish-to-Start relationship (Lag time> 0)



PRECEDENCE DIAGRAMS

TYPES OF ACTIVITY RELATIONSHIPS

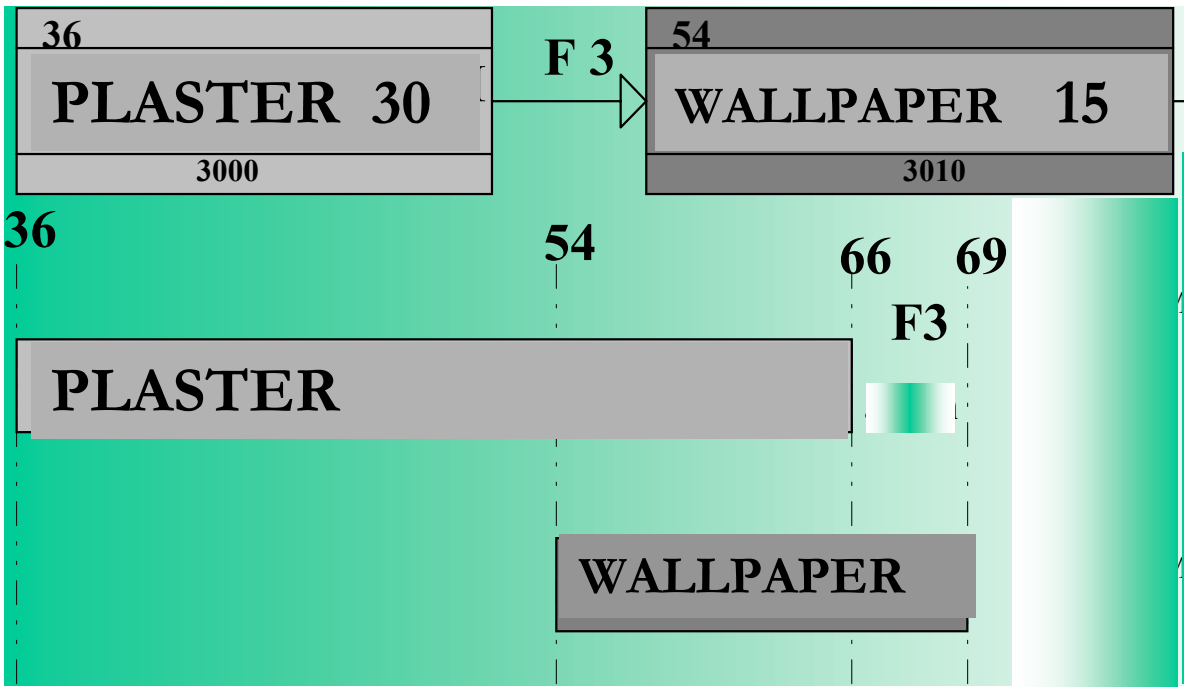
2. S Type: Start-to-Start relationship



PRECEDENCE DIAGRAMS

TYPES OF ACTIVITY RELATIONSHIPS

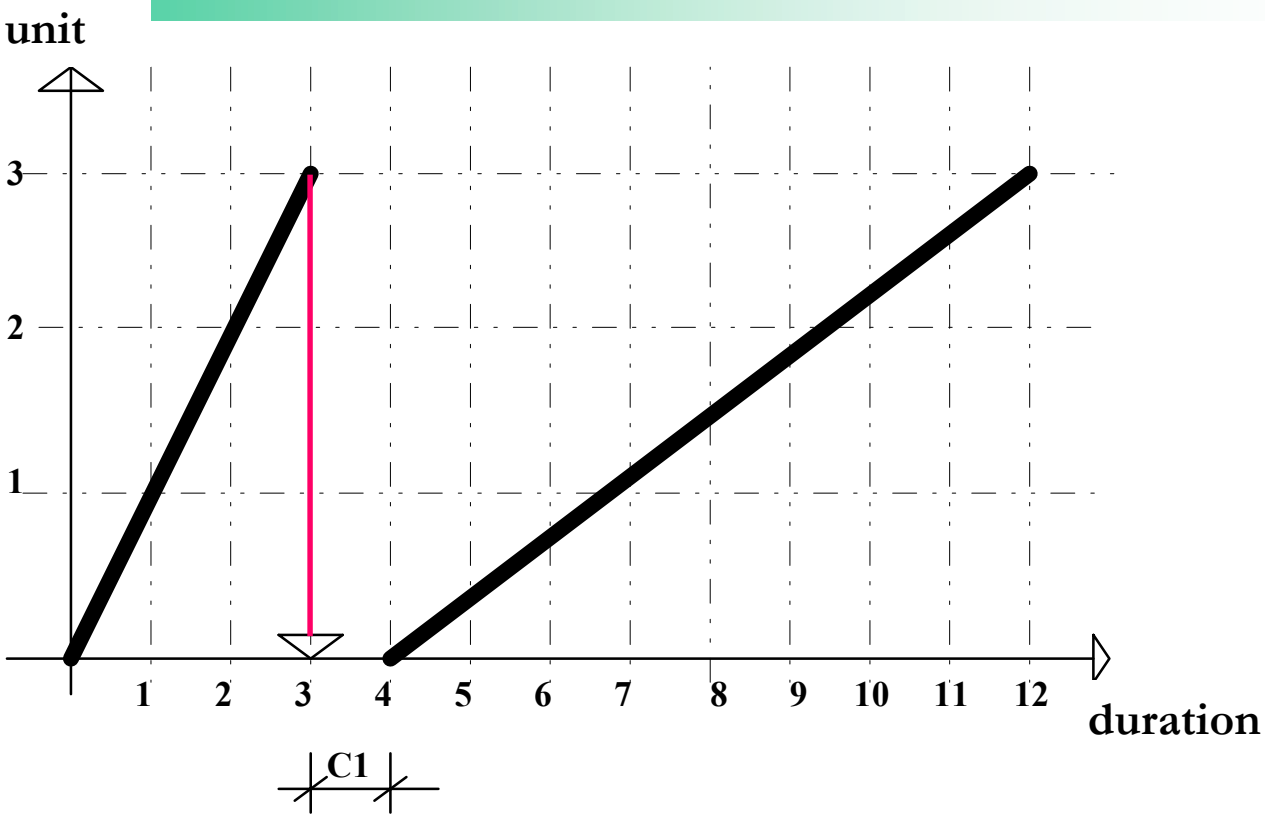
3. F Type: Finish-to-Finish relationship



$W_{START} = P_{START} + P_{DURATION} + LAGTIME - W_{DURATION}$

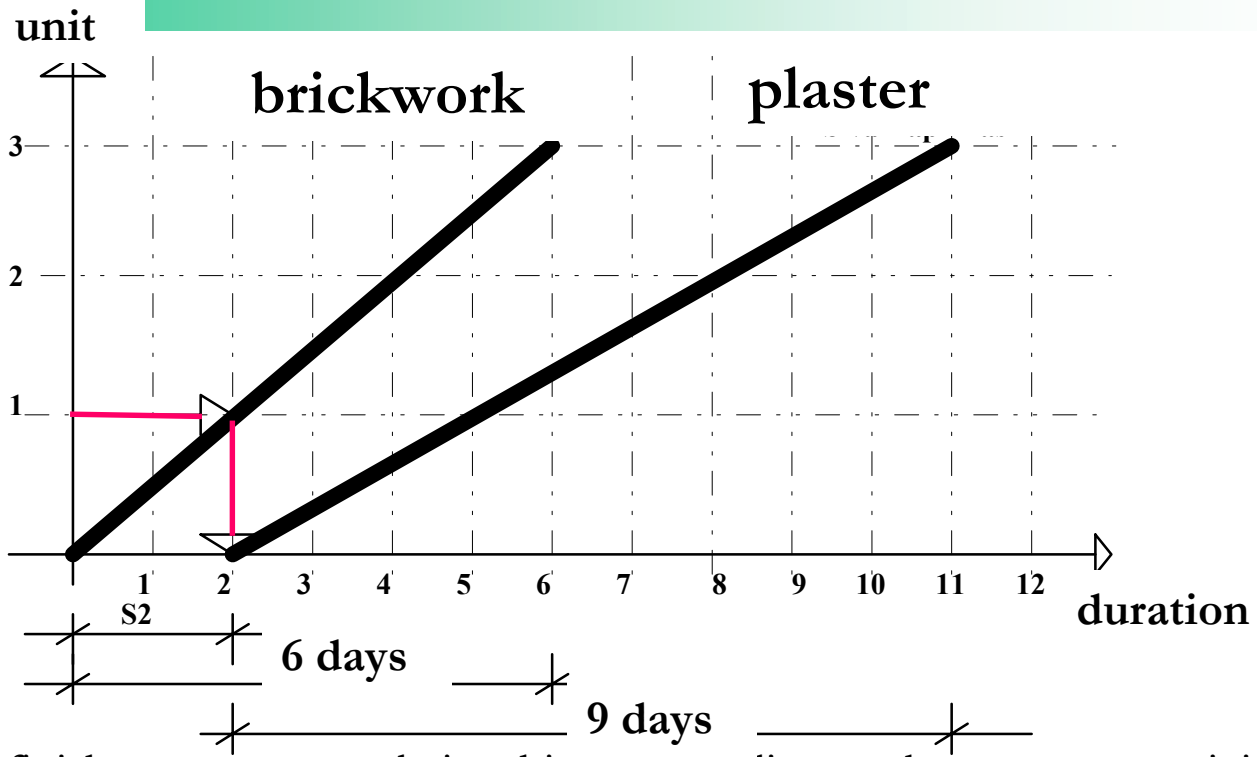
$W_{START} = 36 + 30 + 3 - 15 = 54$

TYPES OF ACTIVITY RELATIONSHIPS



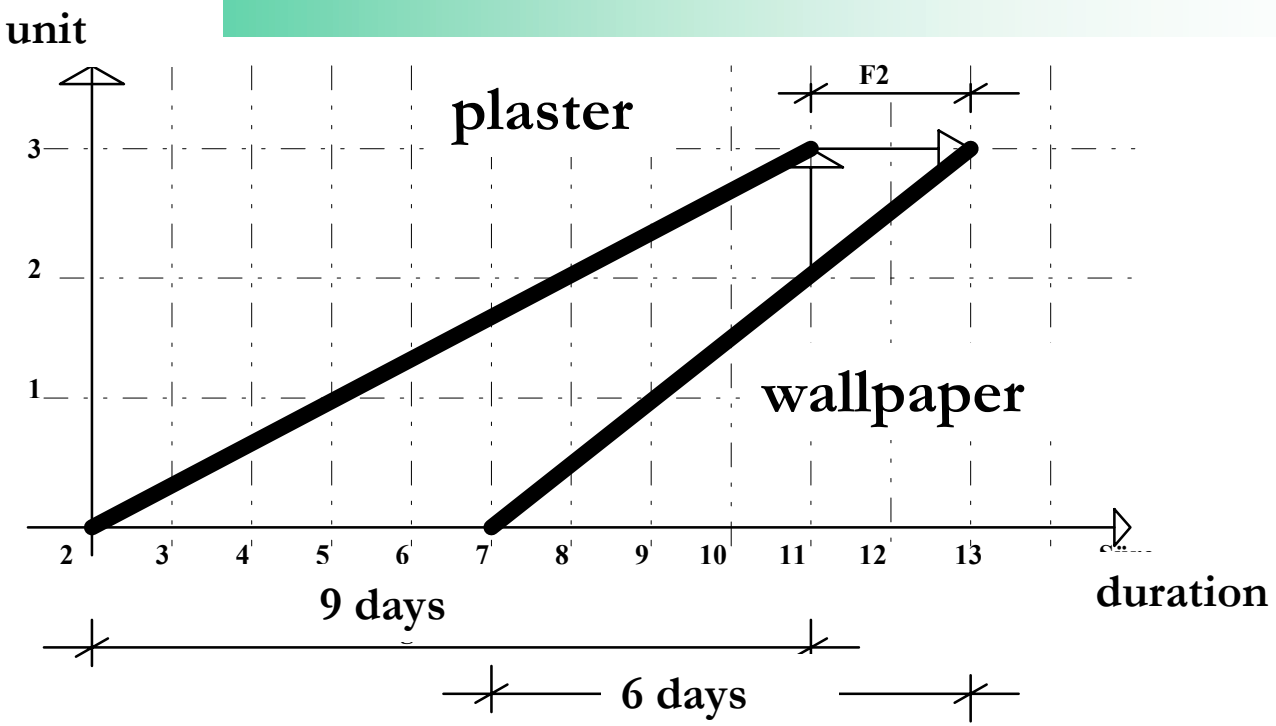
Rule 1. If finish-to-start type relationship is an obligation between two activities, i.e. these two activities can not be overlapped, a Conventional (finish-to-start) type relationship must be assigned between them. The lag time is determined due to characteristics of each activities.

TYPES OF ACTIVITY RELATIONSHIPS



Rule 2. If finish-to-start type relationship is not obligatory between two activities, i.e., they both can be overlapped, and the duration of successor activity is longer than that of predecessor activity, then start-to-start type relationship can be assigned between these two activities. Lag time is determined as the duration of realizing the production of (1,2,3...n) units of predecessor activity or determined due to the characteristics of activities.

TYPES OF ACTIVITY RELATIONSHIPS



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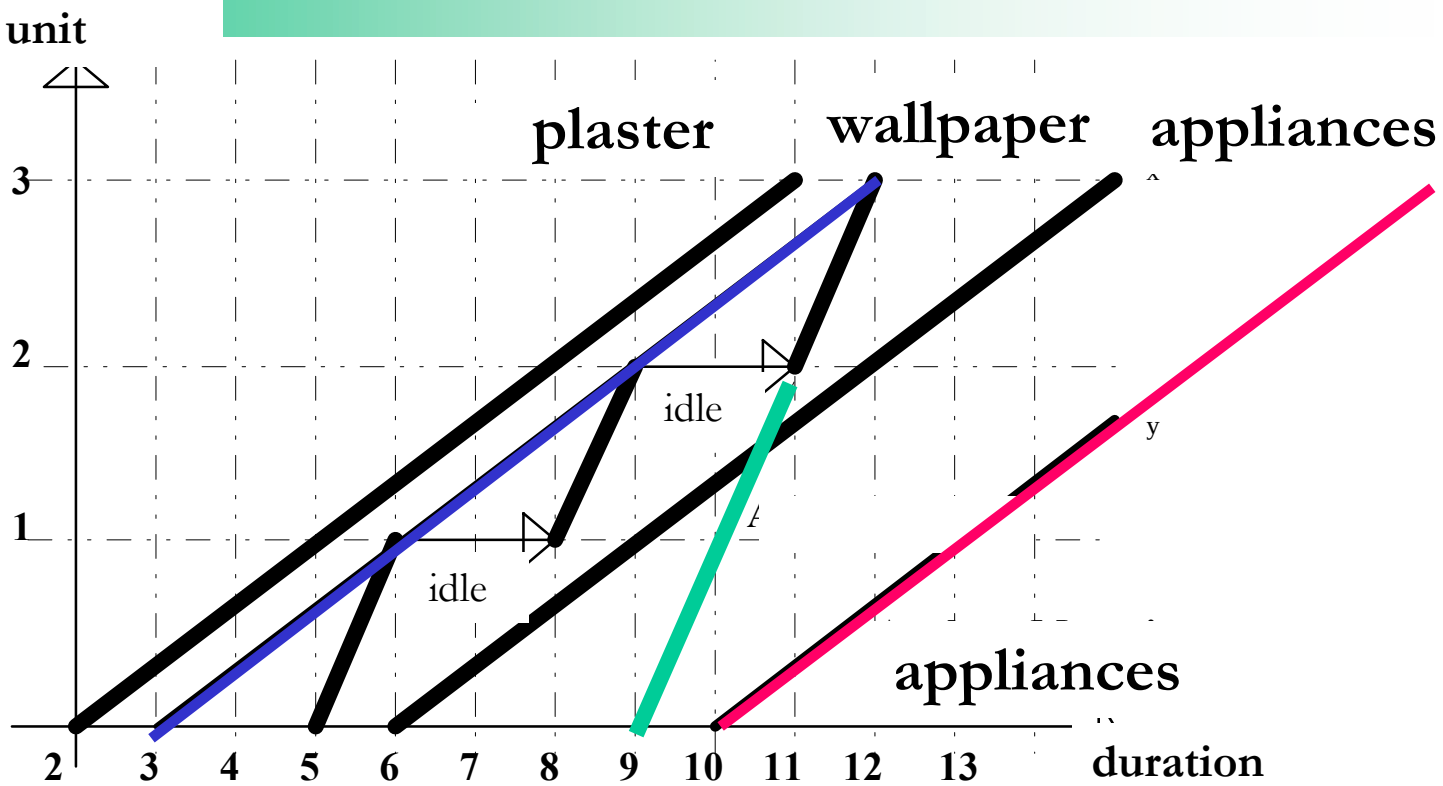
TYPES OF ACTIVITY RELATIONSHIPS

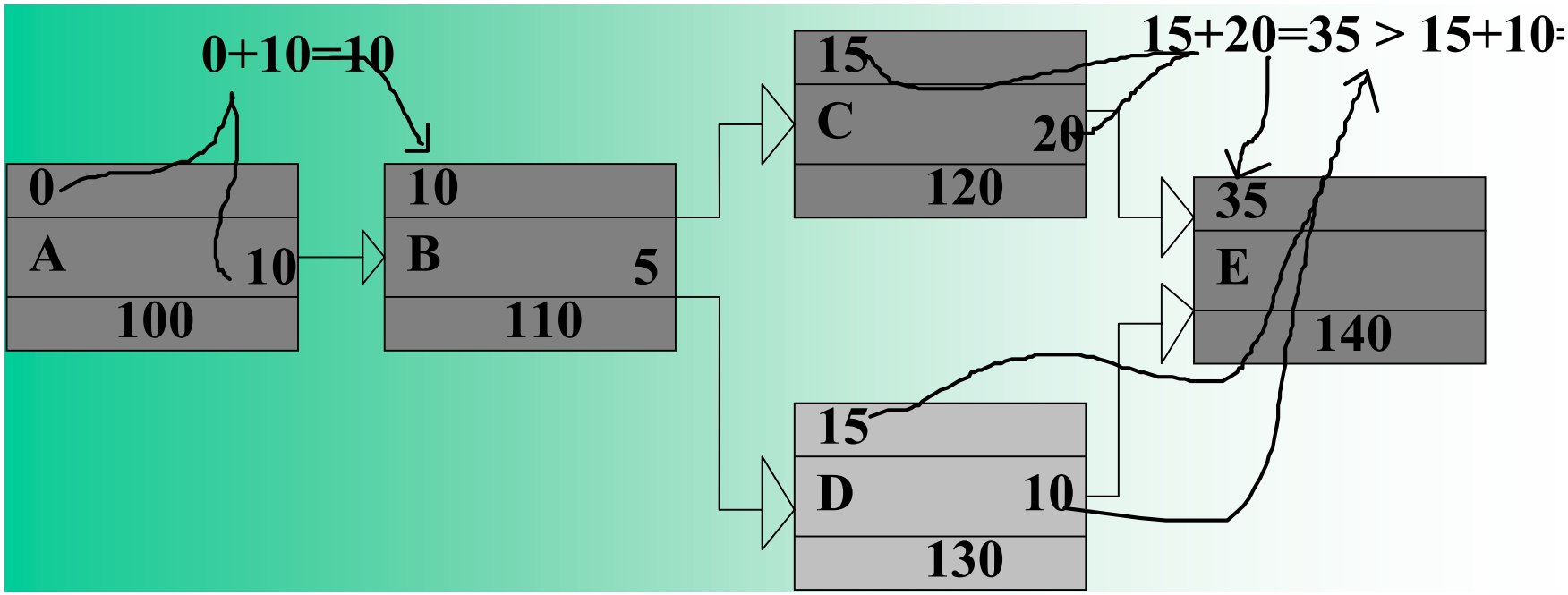


Rule 4. Finish-to-finish type relationships cause the delay of start date of next activity (see electrical appliances) that has a start-to-start type relationship with the successor. Thus, the team that fulfills the successor activity naturally will be idle for some time. The solution is balancing the speed of this activity (see wallpaper) by reducing the number of laborers in the team.

PRECEDENCE DIAGRAMS

THE ALGORITHM OF CRITICAL PATH METHOD - CPM

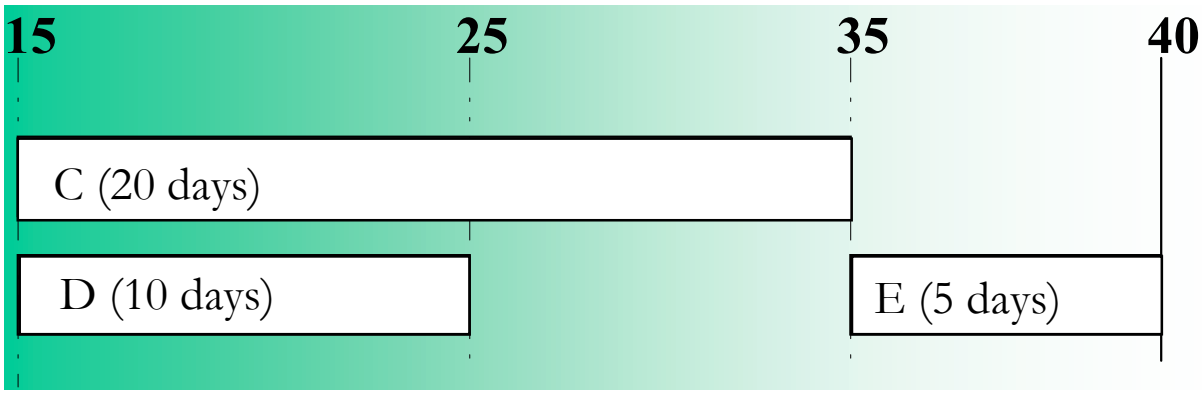
1. STEP: Forward pass: Calculation of Early Start Dates of activities.



PRECEDENCE DIAGRAMS

THE ALGORITHM OF CRITICAL PATH METHOD - CPM

1. Rule: If an activity is the successor of more than one chain of activities then, early start date of the activity equals to the duration of the longest path. That's why the greatest value that corresponds to the total duration of the longest path prior to that activity is chosen.

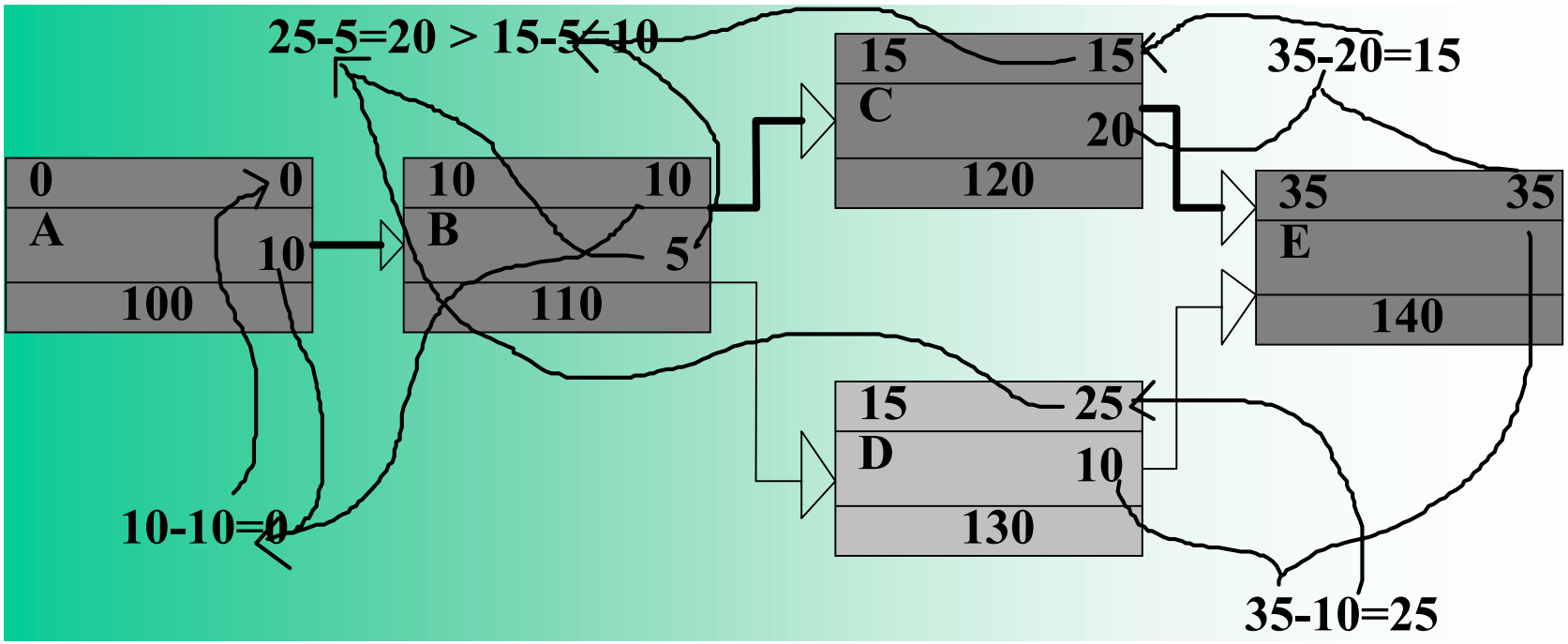


Explanation: Activity C and activity D must be completed to be able to start activity E. At the end of day 25 activity D is completed but C is not. Activity E can only start at the end of day 35.

PRECEDENCE DIAGRAMS

THE ALGORITHM OF CRITICAL PATH METHOD - CPM

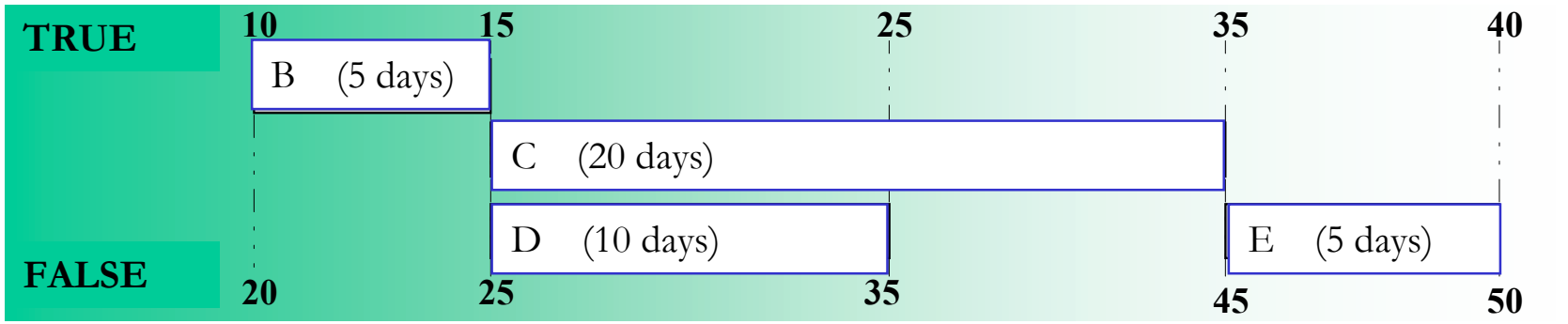
2. STEP: Backward pass: Calculation of **Late Start Dates** of activities.



PRECEDENCE DIAGRAMS

THE ALGORITHM OF CRITICAL PATH METHOD - CPM

2. Rule: The total value of the late start date of an activity and durations of chains of successor activities can not be greater than the early start date of the last activity in network. That's why minimum value is chosen in backward-pass.



Explanation: Assume that late start date of activity B is the greater value (20). Then, the earliest date that activity E can start is 45th day and the completion time of the project is 50th day. If the minimum value (10) is chosen, then the project will finish in 40 days.

PRECEDENCE DIAGRAMS

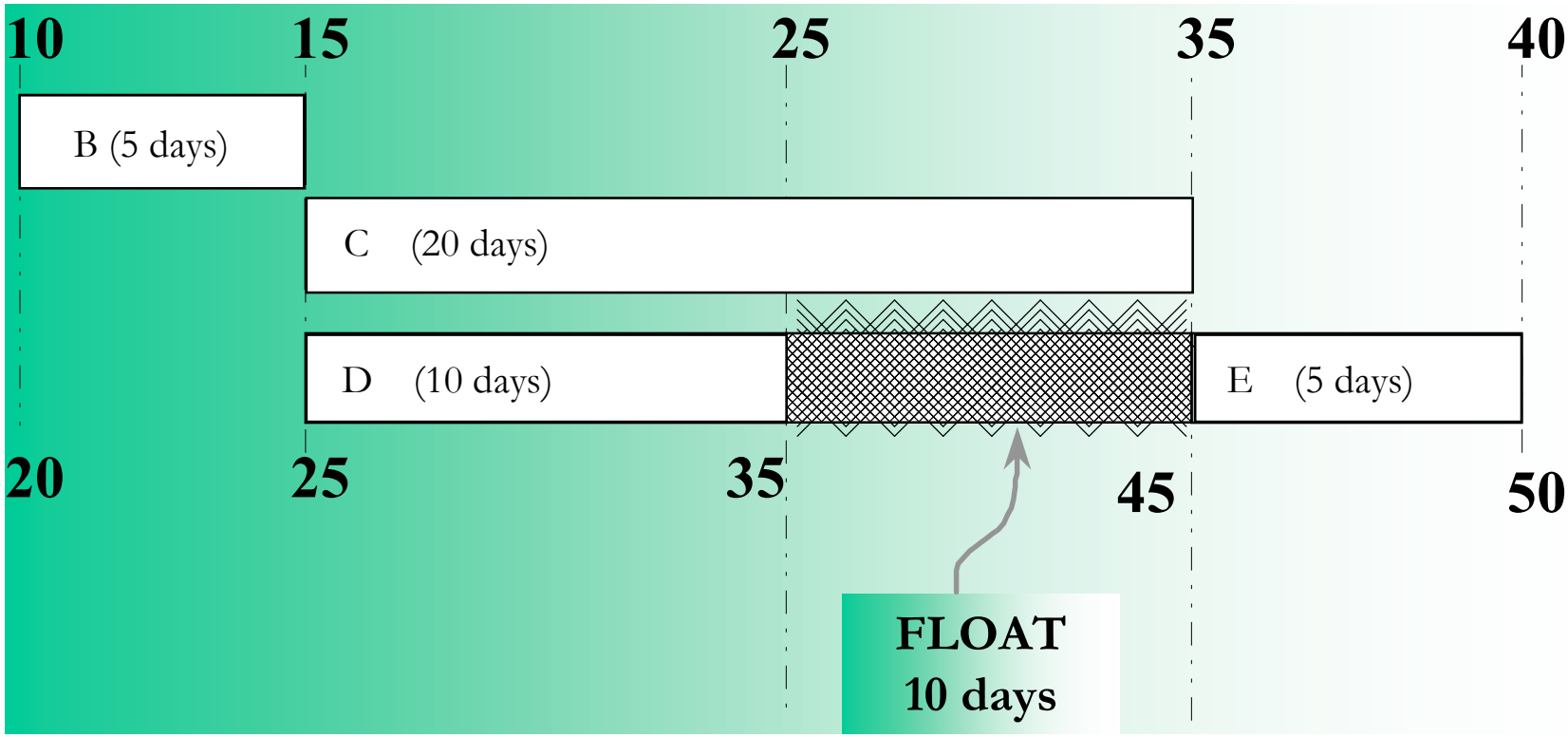
BASIC CONCEPTS OF CRITICAL PATH METHOD - CPM

CRITICAL ACTIVITY: **The activity, that cause a delay in schedule and increases the completion time of project; that has zero total float; that has an early start date which is equal to the late start date.**

CRITICAL PATH: **The longest path in network formed by the critical activities. The chain of activities that has zero total float. The chain that determines the completion time of project.**

FLOAT: **The limit of delay that is allowed for a certain activity. The maximum delay for an activity that does not affect the project completion time.**

PRECEDENCE DIAGRAMS



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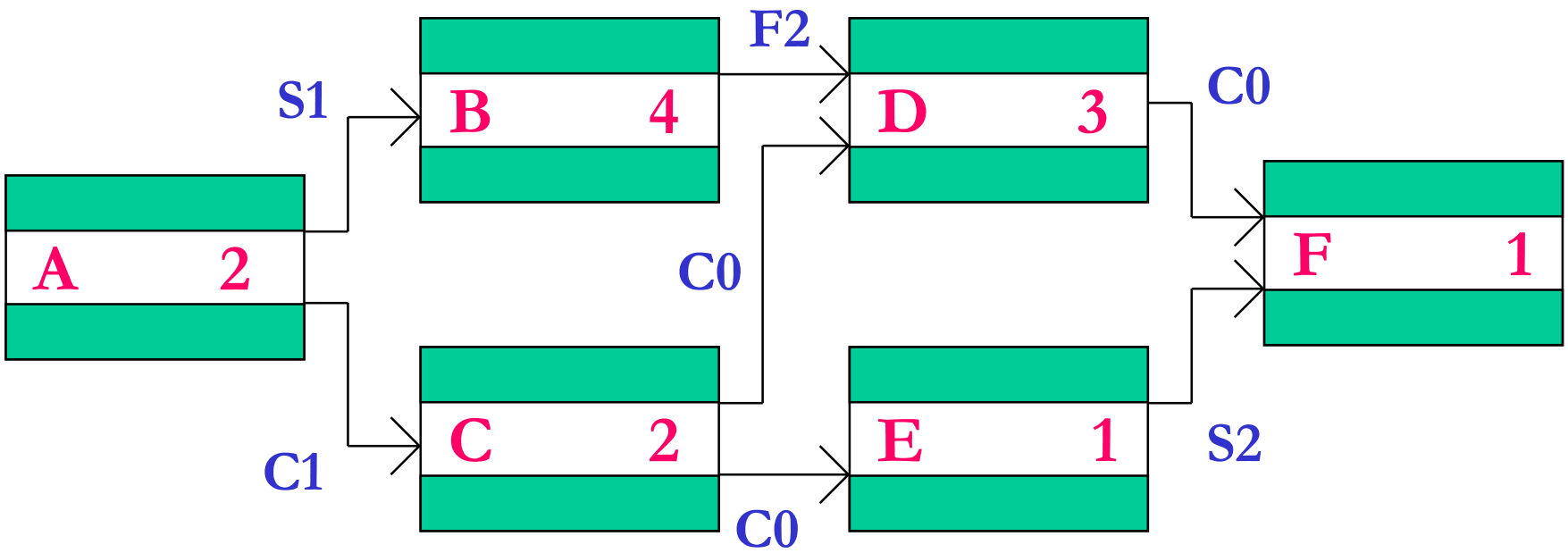
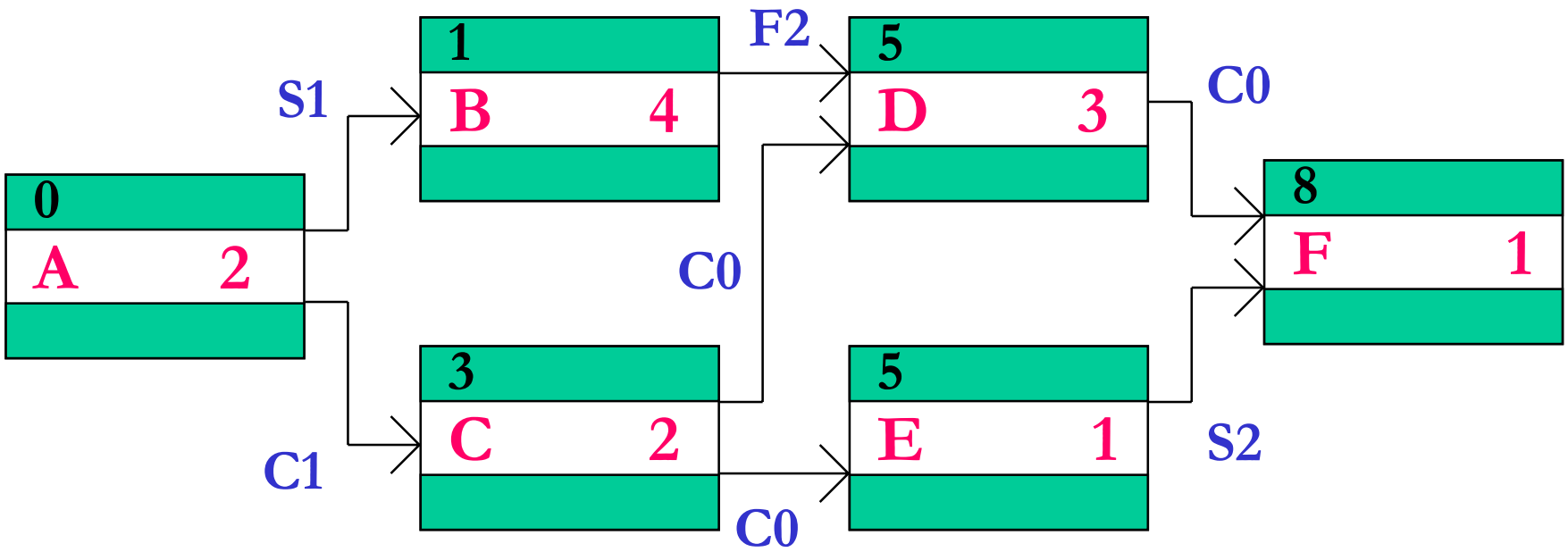


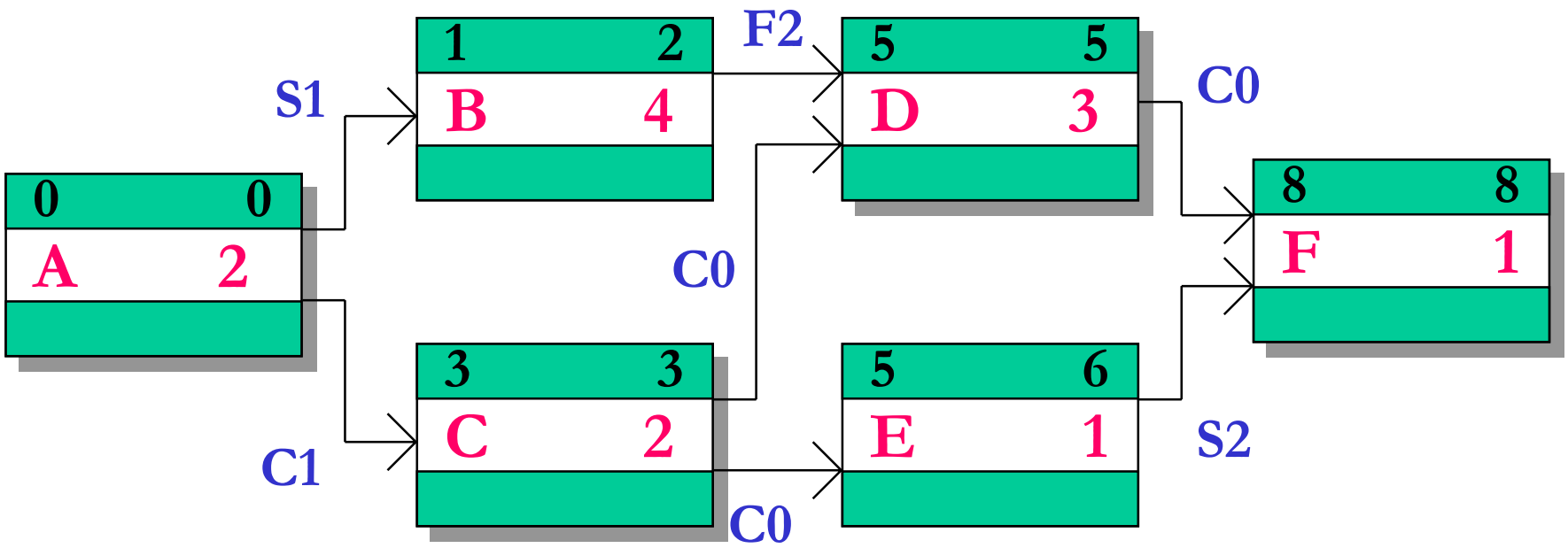
EXERCISE

PRECEDENCE DIAGRAMS



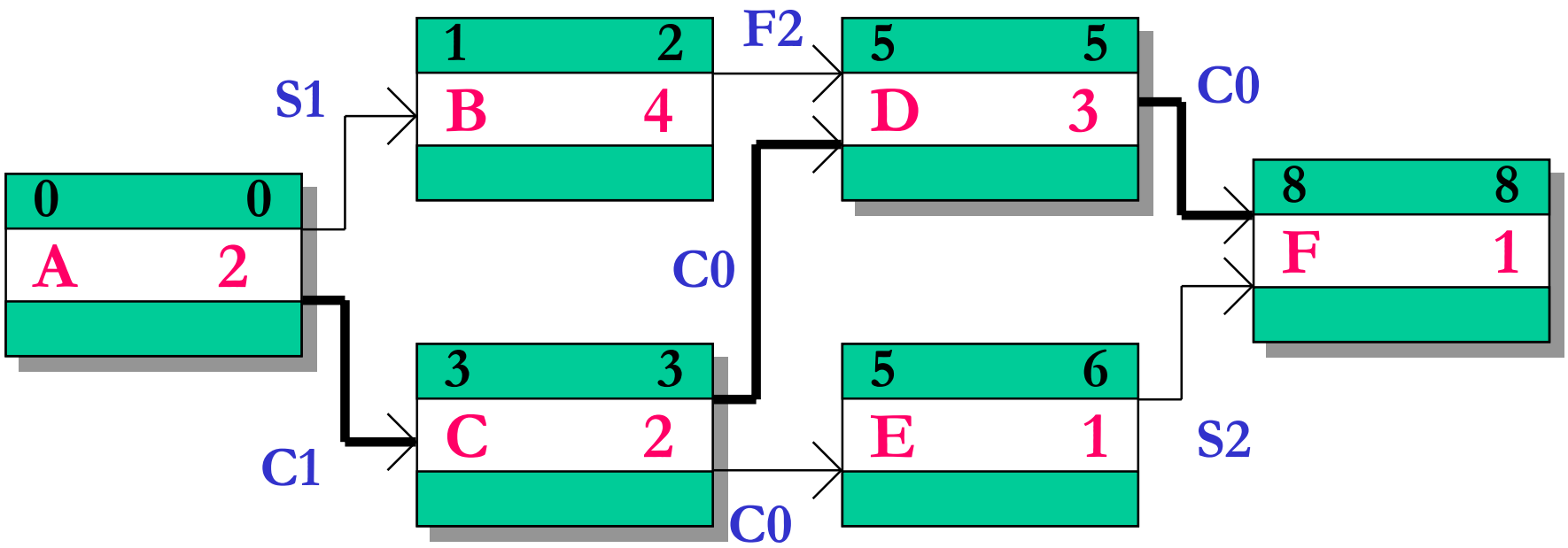
EXERCISE STEP 1: Forward Pass for Early Start Dates

PRECEDENCE DIAGRAMS



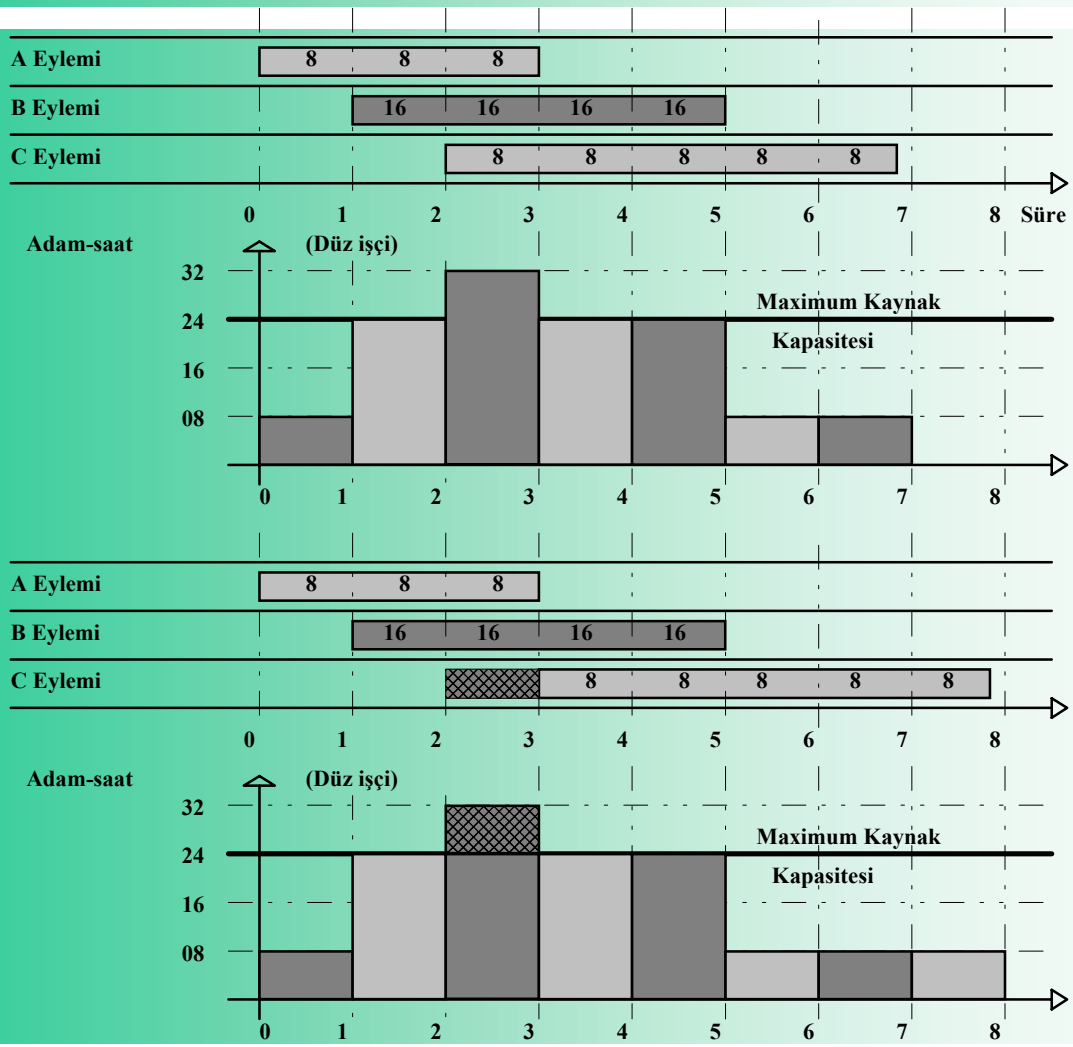
EXERCISE STEP 2: Backward Pass for Late Start Dates

PRECEDENCE DIAGRAMS



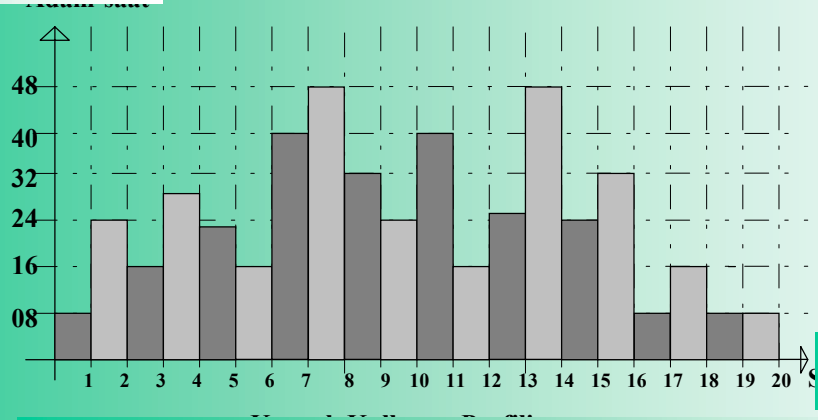
EXERCISE STEP 3: Defining the critical path and floats

RESOURCE LEVELING



RESOURCE LEVELING

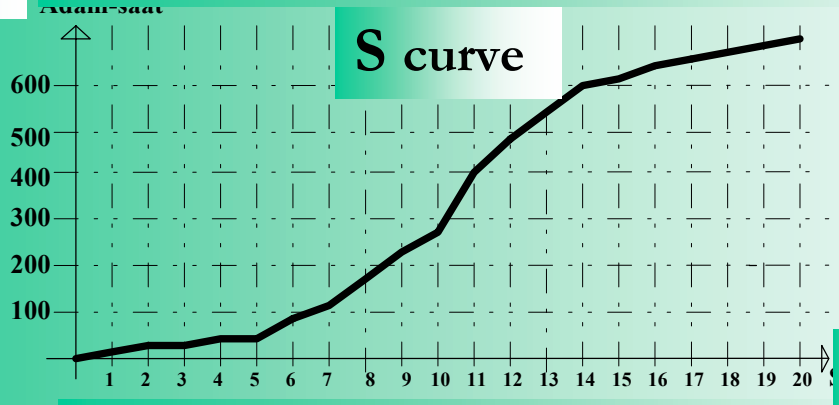
Laborer mhr



Resource requirement profile (non-cumulative)

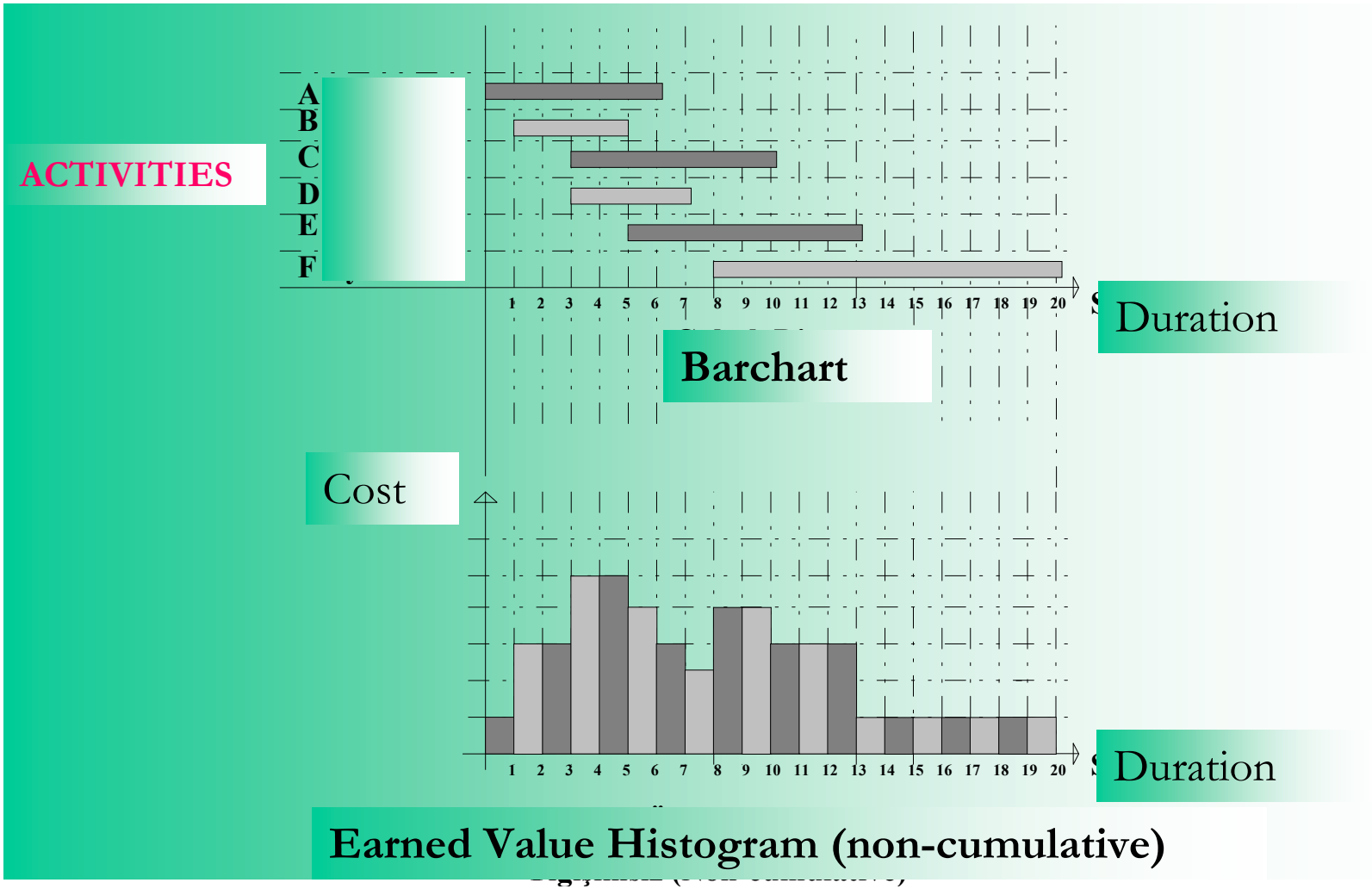
Laborer mhr

S curve



Resource requirement graph (cumulative)

COST PLANNING



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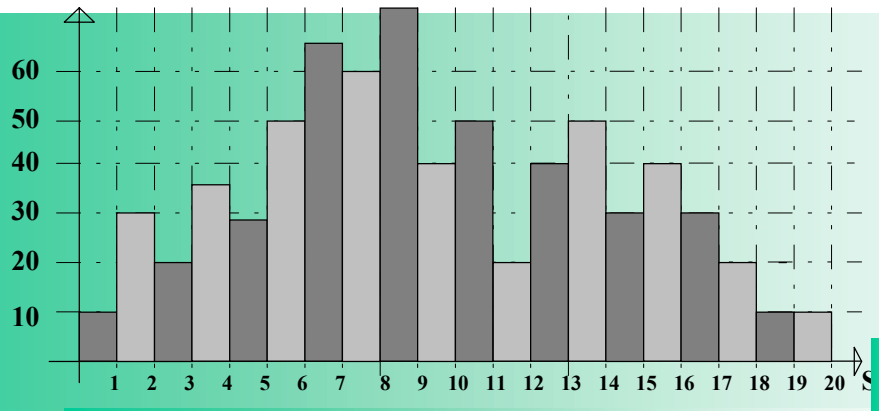
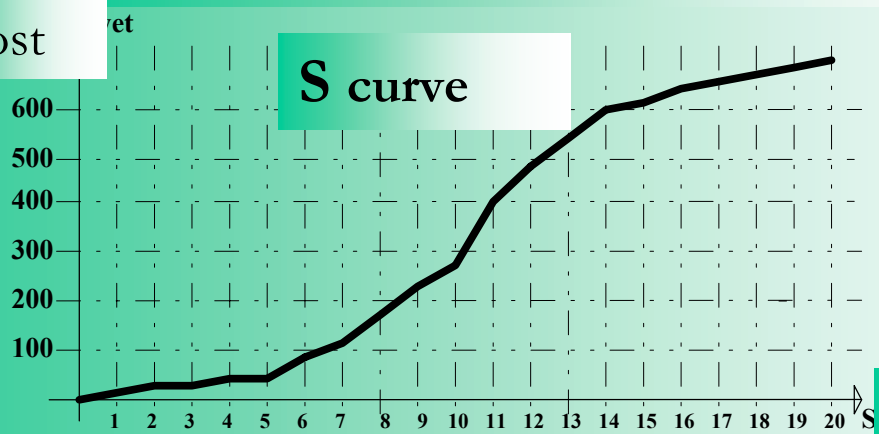


Earned Value Histogram (non-cumulative)



Earned Value Histogram (cumulative)

COST-TIME TRADEOFF