MASTER PROJECT PLAN

- Define project
- Estimate durations and costs
- Develop project network
- Schedule resources and costs

RESOURCES AND TIME

- PROJECT NETWORK TIMES ARE NOT A SCHEDULE UNTIL RESOURCES HAVE BEEN ASSIGNED

- COST ESTIMATES ARE NOT A BUDGET UNTIL THEY HAVE BEEN TIME-PHASED

TYPES OF PROJECT CONSTRAINTS

- TECHNICAL OR LOGIC CONSTRAINTS – THESE ARE RELATED TO NETWORK SEQUANCE
- PHYSICAL CONSTRAINTS – ACTIVITIES THAT CAN'T OCCUR IN PARALLEL OR ARE AFFECTED BY CONTRACTUAL OR ENVIRONMENTAL CONDITIONS
- RESOURCE CONSTRAINTS – PEOPLE, MATERIALS, EQUIPMENT

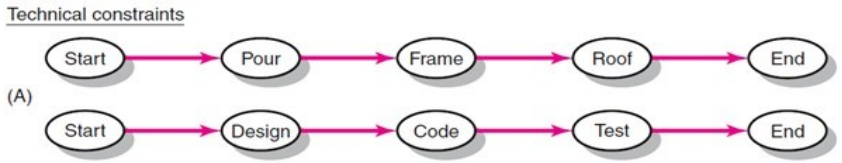
TERMINOLOGY

TIME-PHASED SCHEDULE – THIS IS A COMPARISON MADE BETWEEN ACTUAL AND PLANNED SCHEDULE AND COSTS

RESOURCE SMOOTHING (LEVELING) – BECAUSE DEMAND RESOURCES WILL VARY OVER THE LIFE OF THE PROJECT, IT MAY BE NECESSARY TO DELAY NON-CRITICAL ACTIVITIES IN ORDER TO EVEN OUT RESOURCES

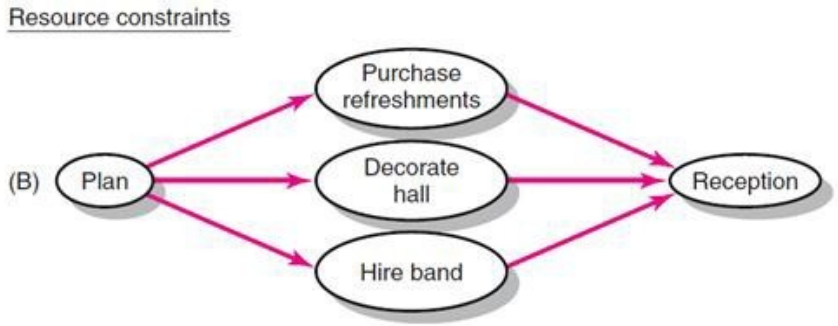
OVERVIEW OF RESOURCE SCHEDULING PROBLEM

- Scheduling



- **Assumption: people and equipment are available**
- Absence or shortage of resources can drastically change the technical constraints.

Overview of Resource Scheduling Problem



- Parallel activities have the potential for resource conflict. In this example, planning a wedding reception includes these activities This parallel network likely assumes that there is a resource available for each of the parallel tasks. But what if the same resource is responsible for all of these tasks?

Overview of Resource Scheduling Problem

- Only one person performing all these activities now requires that the activities now be performed in sequence:

- As a result, the duration has now been extended due to lack of Resources

RESOURCE CONSTRAINED SCHEDULING

- When resources are not available to meet peak demands, the late start of some activities must be delayed and duration of the project increased. This is call **resource-constrained scheduling**.

Types of Resource Constraints

- **People:** Human resources are typically classified by the skills they bring to the project: programmer, mechanical engineer, welder, inspector, etc. These many skills of human resources add to the complexity of scheduling projects.
- **Materials:** Chemicals for a scientific project, concrete for a road project, survey data for a marketing project. Material availability and shortages have been blamed for the delay of many projects.
- **Equipment:** Equipment is usually presented by type, size, and quantity and is often overlooked as a constraint. The most common mistake is assuming the resource pool is adequate for the project. Recognition of equipment constraints before the project begins can avoid high crashing or delay costs.

Classification of Scheduling Problems

- **Classification of Problem**
  - Using a priority matrix will help determine if the project is time or resource constrained.
- **Time-Constrained Project**
  - Must be completed by an imposed date.
  - Time is fixed, resources are flexible: additional resources are required to ensure project meets schedule.
- **Resource-Constrained Project**
  - Is one in which the level of resources available cannot be exceeded.
  - Resources are fixed, time is flexible: inadequate resources will delay the project.

Resource Allocation Methods

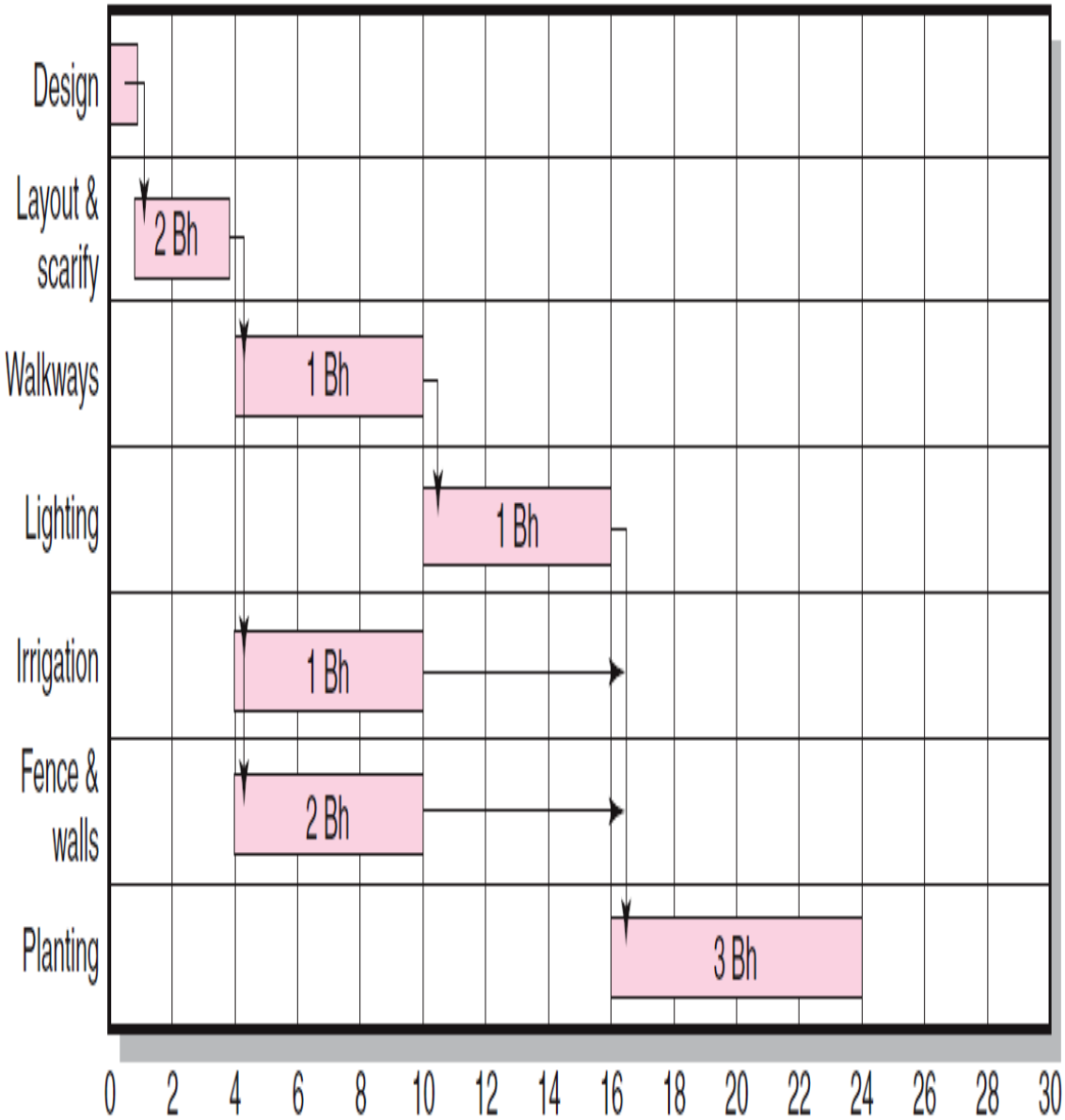
- **Limiting Assumptions**
  - Splitting activities is not allowed—once an activity is start,
- it is carried to completion.
  - Level of resources used for an activity cannot be changed.
- **Risk Assumptions**
  - Activities with the most slack pose the least risk.
  - Reduction of flexibility does not increase risk.
  - The nature of an activity (easy, complex) doesn't increase risk

RESOURCE ALLOCATION METHODS

- **Time-constrained projects: Smoothing Resource Demand.**
  - This method focuses on resource utilization. It is difficult to manage a schedule when resource availability is erratic.
  - Project managers typically resolve this by using **resource leveling** techniques that balance or smooth resource demand.
  - Leveling basically delays non-critical activities using slack (float) to reduce peak demand.
  - **Benefit:** Peak resource demands are reduced, resources over the life of the project are reduced, and fluctuation in resource demand is minimized.

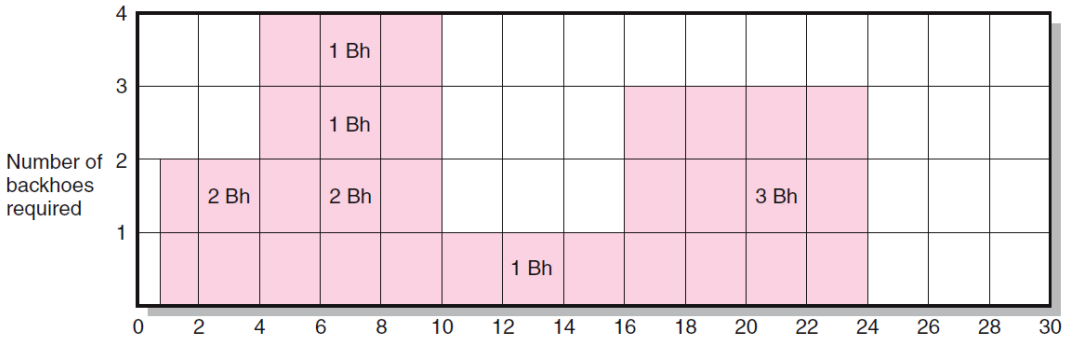
Botanical Garden example:
Project uses only <u>one resource</u> (backhoes) and all backhoes are interchangeable

This bar chart shows activities on a time scale. dependencies=vertical arrows; horizontal arrows=activity slack.

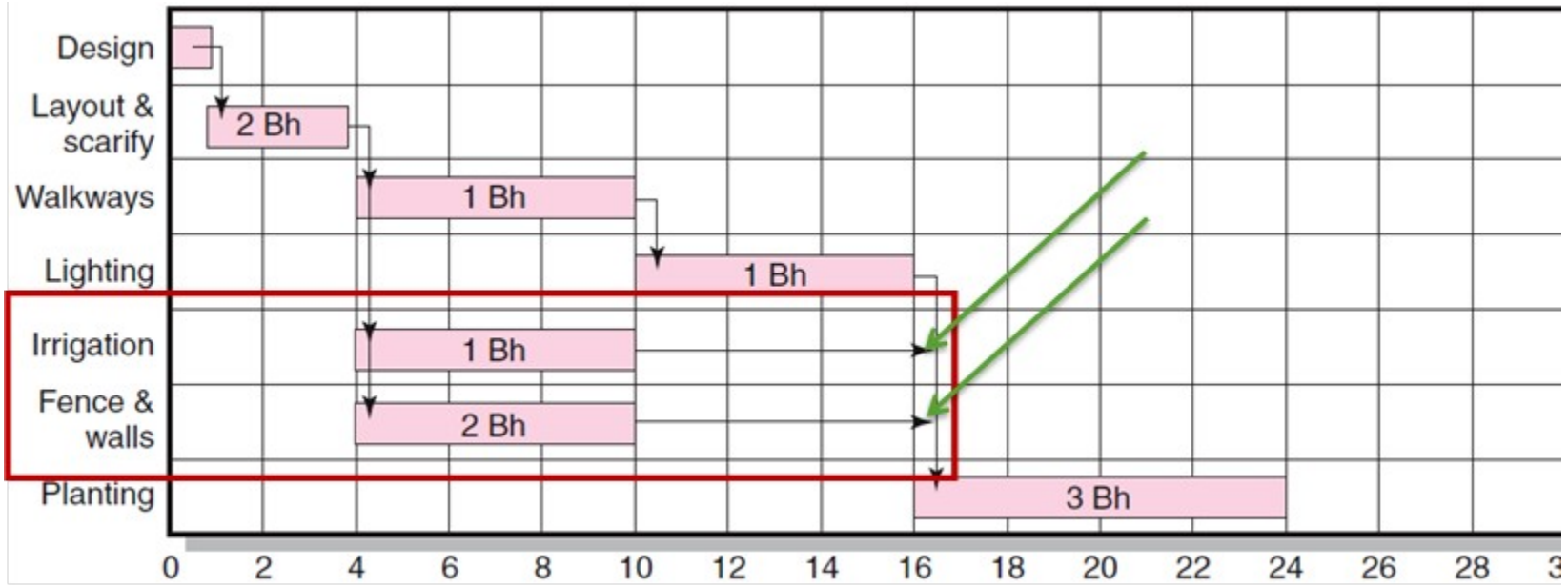


Botanical Garden example: This is a resource profile showing when a backhoe is needed and during which periods of the project

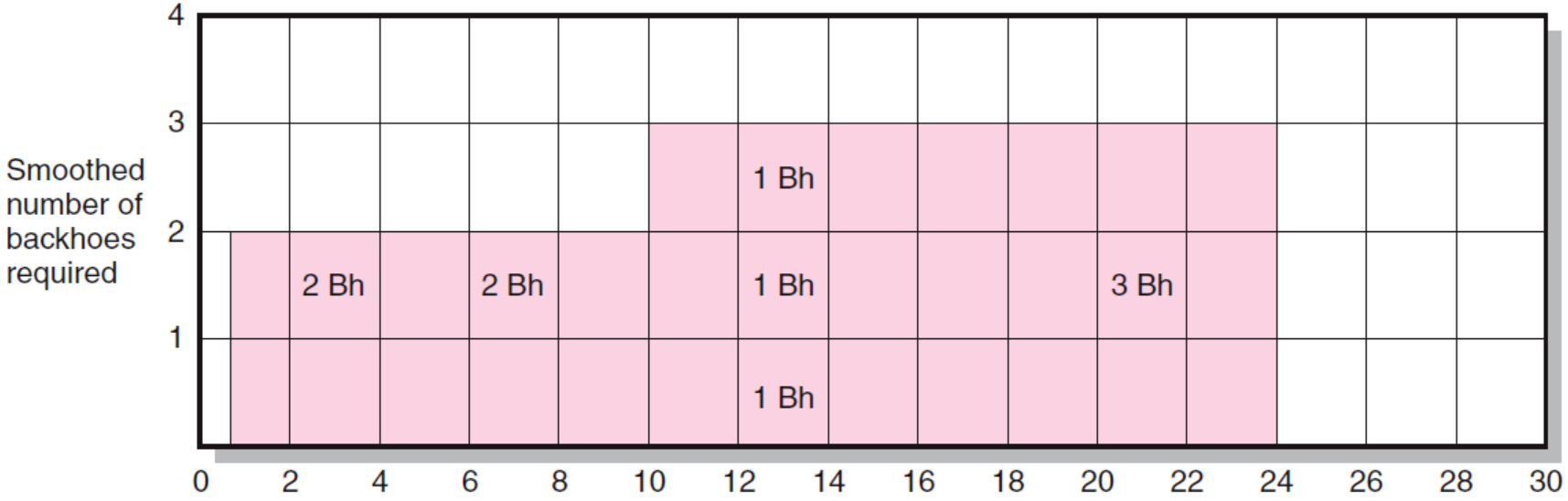
The resource profile shows the use of 4 backhoes during periods 4 thru 10.



Botanical Garden example: The goal of this project is to reduce the resource demand on the backhoes. Notice the slack on Irrigation and Fence & Walls activities. These are the only two activities that have slack. *How can the project manager reduce demand and level this resource?*



Botanical Garden example: The project manager centered on the activity having the least risk of being late: *Fence and walls*. By delaying this one activity and starting it in period 10 instead of 4, the number of backhoes needed over the life of the project had been reduced from 4 down to 3 (25%).



Resource Allocation Methods
Resource Demand Leveling for Time-Constrained Projects:

- **Advantages**

- Peak resource demands are reduced.
- Resources over the life of the project are reduced.
- Fluctuation in resource demand is minimized.

- **Disadvantages**

- Loss of flexibility that occurs from reducing slack, in this case, eliminating the slack on “fence & walls” activity.
- Increases the criticality of more activities.With “fence & walls” having no slack and this project being time sensitive, nothing could go wrong or else the project would suffer a delay.

Resource-Constrained Projects

- Resources are limited in quantity and availability
- Activities are scheduled using **heuristics (or rule-of-thumb)** that focuses on activities having:
- Minimum slack
- The smallest or least duration
- The lowest activity ID number
- **Heuristics** is applied by using the *parallel method*: an iterative process starting with the first time period and scheduling the start of activities period-by-period by using the 3 priority rules (above).