

LECTURE NOTES
ON
CONSTRUCTION MANAGEMENT
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CONSTRUCTION MANAGEMENT

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UNIT : 1

Construction industry and management :

1. Organization in Construction Management

- Organization is the process of arranging and coordinating people, resources, and activities to achieve project goals efficiently. In construction, organization helps manage men, materials, machinery, money, and methods.

2. Objectives of Organization (in Construction Industry)

- The main objectives are: Achieving Project Goals: Complete construction projects within time, cost, and quality limits.
- Division of Work: Break down work into manageable tasks (planning, design, execution, supervision).
- Efficient Use of Resources: Proper use of labor, equipment, materials, and finances.
- Clear Authority and Responsibility: Define who is responsible for what (engineer, contractor, supervisor, workers).
- Coordination: Ensure smooth coordination between departments like planning, procurement, and site execution.
- Effective Communication: Establish clear communication channels between management and workers.
- Avoiding Duplication and Conflicts: Prevent overlapping duties and confusion at the construction site.

3. Principles of Organization

These are basic guidelines for forming an effective organization.

1. Principle of Objective: Every organizational structure should be designed to achieve clearly defined goals.
2. Principle of Division of Work: Work should be divided according to skills, specialization, and experience.
3. Principle of Authority and Responsibility: Authority given to a person must match their responsibility. No responsibility without authority.
4. Principle of Unity of Command: Each worker should receive orders from only one superior to avoid confusion.
5. Principle of Span of Control: A manager should supervise a limited number of subordinates for effective control.
6. Principle of Coordination: All departments and individuals must work together harmoniously.
7. Principle of Hierarchy (Scalar Chain): There should be a clear chain of command from top management to workers.

8. Principle of Flexibility: Organization should be adaptable to changes in project size, technology, or conditions.

9. Principle of Efficiency: Organization should aim at minimum cost and maximum output.

4. Importance in Construction Industry

- Reduces delays and cost overruns, Improves quality and safety, Enhances teamwork and productivity, Helps in successful project completion.

TYPES OF ORGANIZATION IN CONSTRUCTION INDUSTRY

- The construction industry is broadly divided into Government (Public) sector and Private sector organizations based on ownership and control.

1. Government / Public Construction Organizations

- Definition: Government or public construction organizations are owned, controlled, and financed by the government to execute public works for social and economic development.
- Examples: Public Works Department (PWD), Central Public Works Department (CPWD), State Highways Department, Irrigation Department, Municipal Corporations, Public Sector Undertakings (PSUs) like NHAI, NBCC.
- **Features:** Funded by government budget, Works for public welfare, not profit, Follows strict rules, procedures, and regulations, Projects awarded through tender system, High emphasis on safety and quality standards
- **Advantages:** Ensures development of public infrastructure, Stable employment opportunities, Transparency through tendering process, Large-scale projects handled
- **Disadvantages:** Slow decision-making, Rigid procedures, Less flexibility and innovation

2. Private Construction Organizations

- Definition: Private construction organizations are owned and managed by individuals or private firms and operate mainly for profit.
- Examples: Private contractors, Real estate developers, Construction companies (L&T, Tata Projects, Shapoorji Pallonji), Consulting firms (Architects, Engineers)
- **Features:** Funded by private investors or loans, Profit-oriented, Flexible management structure, Quick decision-making, Competitive working environment
- **Advantages:** Faster execution of projects, Efficient management, Innovation and use of modern technology, Better cost control
- **Disadvantages:** Profit motive may affect quality if not regulated, Job security may be less, Risk of financial instability

3. Comparison between Government and Private Construction Organizations

Aspect	Government / Public	Private
Ownership	Government	Private individuals/firms
Objective	Public welfare	Profit
Funding	Government funds	Private capital
Decision-making	Slow	Fast
Flexibility	Less	More

Procedures Rigid Flexible

ROLE OF VARIOUS PERSONNEL IN CONSTRUCTION ORGANIZATION

A construction organization involves different professionals working together to plan, execute, control, and complete a project successfully. Each person has specific duties and responsibilities.

1. Owner / Client

Role: Initiates the project, Provides finance for the project, Defines project requirements and scope, Appoints consultants and contractors, Approves drawings, estimates, and payments

Examples: Government department, private developer, individual owner

2. Project Manager

Role: Overall in charge of the construction project, Plans, schedules, and monitors project activities, Coordinates between owner, consultants, and contractor, Controls time, cost, quality, and safety, Manages risks and resolves conflict

3. Engineer (Site / Resident Engineer)

Role: Supervises construction work on site, Ensures work is done as per drawings and specifications, Checks quality of materials and workmanship, Maintains site records and progress reports, Coordinates with contractors and supervisors

4. Architect

Role: Prepares architectural drawings and designs, Plans building layout, aesthetics, and functionality, Coordinates with structural and services engineers, Approves materials, finishes, and design changes, Inspects work for design compliance

5. Structural Engineer

Role: Designs structural components (foundation, beams, columns), Ensures safety and stability of the structure, Provides structural drawings and calculations, Guides site staff on structural execution

6. Contractor

Role: Executes construction work as per contract, Arranges labor, materials, equipment, and machinery, Ensures timely completion of the project, Maintains site safety and quality, Responsible for site management and supervision

7. Sub-Contractor

Role: Executes specialized works such as, Electrical, Plumbing, HVAC, Finishing works, Works under the main contractor, Ensures quality and timely completion of assigned work

8. Site Supervisor / Foreman

Role: Directly supervises workers at the site, Allocates daily work to laborers, Ensures safety practices are followed, Reports daily progress to site engineer

9. Planning Engineer

Role: Prepares project schedules (bar charts, CPM, PERT), Monitors progress and identifies delays, Assists in resource planning, Updates project timelines

10. Quantity Surveyor / Billing Engineer

Role: Prepares estimates and bills of quantities, Measures executed work, Prepares interim and final bills, Controls project cost and variations

11. Safety Officer

Role: Ensures safety rules and regulations are followed, Conducts safety training and inspections, Prevents accidents on site, Maintains safety records

12. Store Keeper / Materials Engineer

Role: Manages procurement and storage of materials, Maintains stock registers, Issues materials as per requirement, Prevents wastage and theft

13. Accountant / Finance Officer

Role: Manages project finances, Handles payments to suppliers and labor, Maintains financial records, Prepares financial reports

14. Labor / Skilled Workers

Role: Perform actual construction work, Follow instructions from supervisors, Ensure quality workmanship, Maintain safety at the site.

AGENCIES ASSOCIATED WITH CONSTRUCTION WORK

Construction work involves several agencies that coordinate from planning to completion of a project. Each agency has defined roles and responsibilities.

1. Owner (Client)

Definition: The owner is the person or organization that initiates the construction project and has legal ownership of it.

Roles and Responsibilities: Identifies the need for the project, Provides finance for construction, Final authority in decision-making, Appoints promoter, designer, architect, and builder, Approves plans, drawings, estimates, and payments

Examples: Government departments, private individuals, companies, institutions

2. Promoter

Definition: A promoter is an individual or organization that conceptualizes and develops a project, especially in real estate and housing projects.

Roles and Responsibilities: Conducts feasibility studies, Arranges land acquisition, Obtains statutory approvals and permissions, Arranges finance and investments, Markets and sells the project

Examples: Real estate developers, housing boards

3. Builder

Definition: A builder is responsible for the actual construction and execution of the project.

Roles and Responsibilities: Executes construction as per drawings and specifications, Employs labor, supervisors, and subcontractors, Procures materials, tools, and equipment, Ensures safety, quality, and timely completion, Maintains site management and coordination

4. Designer

Definition: A designer prepares the technical and functional design of the project.

Roles and Responsibilities: Develops conceptual and detailed designs, Prepares layout plans and technical drawings, Coordinates with architect and engineers, Ensures designs meet client requirements and standards, Incorporates safety, sustainability, and economy in design

Examples: Structural designers, service designers (electrical, plumbing)

5. Architect

Definition: An architect is a licensed professional responsible for the planning, aesthetics, and functional design of buildings.

Roles and Responsibilities: Prepares architectural drawings and plans, Designs building appearance and space utilization, Coordinates with structural and services engineers, Assists in obtaining building approvals, Inspects work for compliance with design intent

6. Relationship Between Agencies

Owner appoints promoter/architect/designer/builder, Promoter coordinates finance, approvals, and marketing, Architect and designer prepare drawings and specifications, Builder executes the project as per plans, All agencies work together to achieve project goals

ROLE OF CONSULTANT IN PREPARATION OF DETAILED PROJECT REPORT (DPR)

1. Introduction: A consultant is a professional or firm appointed by the owner to provide technical, financial, and managerial expertise for planning and execution of a construction project. One of the most important responsibilities of a consultant is the preparation of the Detailed Project Report (DPR).

2. Detailed Project Report (DPR)

Definition: A Detailed Project Report (DPR) is a comprehensive document that provides technical, financial, economic, and managerial details of a project, required for approval, funding, and execution.

3. Role of Consultant in DPR Preparation

3.1 Project Identification and Objectives: Understand client requirements and project objectives, Define scope, capacity, and purpose of the project, Identify project constraints and assumptions

3.2 Feasibility Studies: Conduct technical feasibility (site suitability, technology), Carry out financial feasibility (cost-benefit analysis), Assess economic and social feasibility, Evaluate environmental feasibility

3.3 Site Investigation and Data Collection: Study site location, access, and topography, Conduct soil investigation and surveys, Collect data on utilities, climate, and local conditions

3.4 Preparation of Design and Drawings: Prepare conceptual and preliminary designs, Develop detailed drawings and layouts, Coordinate with architects, structural, and services engineers, Ensure compliance with relevant codes and standards

3.5 Cost Estimation: Prepare detailed cost estimates, Calculate quantities and rates, Include provisions for contingencies and escalation, Assess life-cycle cost of the project

3.6 Construction Planning and Scheduling: Prepare construction methodology, Develop project schedules (bar chart / CPM), Estimate manpower, materials, and equipment requirements

3.7 Environmental and Statutory Clearances:Conduct environmental impact assessment (EIA) if required,Ensure compliance with local laws and regulations,Assist in obtaining statutory approvals and permits

3.8 Risk Analysis and Management:Identify technical, financial, and execution risks,Suggest mitigation measures,Provide contingency planning

3.9 Financial Planning:Estimate project funding requirements,Suggest sources of finance,Prepare cash flow statements

3.10 DPR Documentation and Submission:Compile all technical, financial, and managerial details,Prepare DPR in prescribed format,Submit DPR to client / funding agencies for approval

ROLE OF CONSULTANT IN CONSTRUCTION PROJECTS

(Monitoring of Progress & Quality, Settlement of Disputes)

1. Role of Consultant in Monitoring of Progress

- Meaning:Monitoring of progress involves continuous checking and evaluation of construction work to ensure that the project is progressing as per approved schedule.
- Responsibilities of Consultant:Review construction schedules (Bar chart, CPM, PERT),Monitor actual progress versus planned progress,Conduct regular site inspections and meetings,Identify delays and their causes,Suggest corrective measures to recover delays,Verify contractor's progress reports,Recommend extensions of time (EOT) when justified,Report progress status to the owner/client

2. Role of Consultant in Quality Monitoring

- Meaning:Quality monitoring ensures that construction work is carried out as per specifications, drawings, and standards.
- Responsibilities of Consultant:Check materials for quality and specifications,Inspect workmanship at various stages of construction,Ensure compliance with approved drawings and codes,Approve materials, samples, and workmanship,Witness and verify tests on materials and structures,Issue instructions for rectification of defective work,Maintain quality control records and reports

3. Role of Consultant in Settlement of Disputes

- Meaning:Disputes are disagreements between the owner and contractor regarding payments, quality, delays, variations, or contractual obligations.
- Responsibilities of Consultant:Interpret contract conditions impartially,Examine claims related to extra items, delays, and variations,Verify measurements, rates, and bills,Provide fair and technical recommendations,Act as a mediator between owner and contractor,Suggest amicable settlement to avoid litigation,Assist in arbitration proceedings, if required,Ensure decisions are as per contract and engineering practice.

UNIT –II

Site Layout

PRINCIPLES GOVERNING SITE LAYOUT

1. Introduction:Site layout is the planning and arrangement of temporary and permanent facilities on a construction site to ensure safe, smooth, and economical execution of work.

A good site layout helps in:Reducing material handling,Improving productivity,Ensuring safety,Saving time and cost

2. Principles Governing Site Layout

1. Minimum Movement:Arrange materials, equipment, and work areas to minimize movement of men and materials.Reduces time, labor, and cost.

2. Proper Flow of Work:Site layout should follow the sequence of construction activities.Avoid crossing and backtracking of materials.

3. Safety and Security:Provide safe access routes and emergency exits.Separate pedestrian and vehicle movement.Ensure fencing, lighting, and security arrangements.

4. Optimum Use of Space:Utilize available site area effectively.Avoid overcrowding and wastage of space.Plan storage areas as per material requirements.

5. Accessibility:Provide easy access to:,Materials,Equipment,Work zones,Ensure proper entry and exit points for vehicles.

6. Flexibility:Layout should be flexible to accommodate,Changes in construction stages,Increase in manpower or equipment,Temporary facilities should be relocatable.

7. Proper Storage of Materials:Store materials near the point of use.Protect materials from damage, weather, and theft.Provide covered storage for cement, steel, etc.

8. Efficient Equipment Utilization:Place plants and machinery for maximum efficiency.Ensure minimum idle time of equipment.Avoid interference between machines.

9. Environmental Considerations:Control dust, noise, and waste disposal.Provide drainage to prevent water stagnation.Follow environmental regulations.

10. Welfare Facilities:Provide adequate facilities for workers:Drinking water,Toilets,Rest areas,First aid

11. Provision for Utilities:Plan temporary arrangements for:Electricity,Water supply,Drainage,Ensure uninterrupted services.

12. Economy:Layout should be cost-effective.Reduce unnecessary handling, delays, and rework.

FACTORS AFFECTING SITE LAYOUT

Site layout depends on several technical, environmental, and managerial factors.

1. Size and Shape of Site:Large sites allow flexible arrangement of facilities.Irregular or narrow sites restrict movement and storage.

2. Nature and Type of Project:Building, road, bridge, dam projects require different layouts.High-rise buildings need vertical material movement planning.

3. Construction Method and Sequence:Layout depends on construction stages and work flow.Equipment location changes with project progress
4. Availability of Space Around Site:Limited space requires compact planning.Urban sites need careful material storage and access control.
5. Type of Materials and Equipment:Bulk materials require large storage areas.Heavy machinery needs firm ground and clear access.
6. Site Access and Transportation:Entry and exit points for vehicles:Proximity to roads, railways, and supply sources
7. Safety and Environmental Conditions:Provision for safety zones and emergency access:Dust, noise, drainage, and waste management
8. Local Regulations and Codes:Municipal rules, environmental laws, and safety standards
9. Duration of Project:Long-duration projects require permanent temporary facilities,Short projects need minimal facilities

PREPARATION OF SITE LAYOUT

Step 1: Site Study and Survey::Study topography, soil conditions, and surroundings,Identify access roads and utilities

Step 2: Identify Project Requirements::Type and quantity of materials,Labor strength and machinery,Temporary facilities required

Step 3: Planning of Zones::Work zone,Storage area,Equipment yard,Office and welfare facilities

Step 4: Arrangement of Facilities::Place materials near point of use,Ensure safe vehicle and pedestrian movement

Step 5: Utility Planning::Temporary water, power, drainage, and lighting

Step 6: Safety and Security Planning::Fencing, signage, fire protection,Emergency routes and first aid

Step 7: Preparation of Layout Drawing::Draw layout to scale,Mark all temporary and permanent structures

Step 8: Review and Approval::Review layout for efficiency and safety,Get approval from project manager / client

LAND ACQUISITION PROCEDURES AND PROVIDING COMPENSATION

- Land Acquisition
- Meaning:Land acquisition is the legal process by which government acquires private land for public purposes like roads, dams, railways, and housing projects.
- Land Acquisition Procedure (General Steps):Identification of Land,Land required for the project is identified.Preliminary Notification.Government issues notification declaring intent to acquire land.Survey and ObjectionsLand survey conducted.Landowners may raise objections.Declaration of Acquisition.Final declaration confirming land acquisition.Land ValuationAssessment of market value of land and assets.Award of Compensation.Compensation amount is decided and announced.Taking Possession.Government takes possession of land after payment.

Providing Compensation

- Principles of Compensation:Fair market value of land,Value of buildings, trees, and crops,Solatium (additional compensation),Interest for delay in payment

- Modes of Compensation:Cash payment,Land-for-land (in some cases).Rehabilitation and resettlement benefits.

UNIT –III

Planning and scheduling

IDENTIFYING BROAD ACTIVITIES IN CONSTRUCTION WORK

& ALLOTING TIME TO THEM

Introduction:

Construction work involves a number of activities carried out in a logical sequence.

Identifying broad activities and allotting time helps in Proper planning and scheduling, Timely completion of project, Efficient use of resources, Control of delays and cost overruns

Identifying Broad Activities in Construction Work: Broad activities are the major stages of construction, each consisting of several sub-activities.

1. Pre-Construction Activities: Project feasibility study, Site selection and survey, Land acquisition, Preparation of DPR, Approval of drawings and estimates, Tendering and contract award
2. Site Preparation Activities: Site clearance and fencing, Temporary facilities (site office, stores, Access roads, Water and power arrangements)
3. Earthwork and Foundation Activities: Excavation, Dewatering (if required), Foundation concrete, Backfilling and compaction
4. Superstructure Activities: Columns, beams, and slabs Brickwork / blockwork, Staircases
5. Roofing Activities: Roof slab casting, Waterproofing, Drainage arrangements
6. Finishing Activities: Plastering, Flooring, Painting, Doors and windows
7. Services Installation Activities, Electrical works, Plumbing and sanitation, Fire-fighting and HVAC
8. External Development Works: Roads and pavements, Drainage, Landscaping, Compound wall
9. Testing, Commissioning & Completion: Testing of services, Rectification of defects, Final inspection, Handing over project

Allotting Time to Construction Activities

Meaning Time allotment is the process of estimating the duration required for each construction activity based on various factors.

Factors Affecting Time Allotment: Size and type of project, Construction method, Availability of labor and materials, Equipment and technology used, Weather conditions, Site constraints, Skill level of workers

Methods of Allotting Time

1. Experience-Based Estimation, Based on past similar projects, Simple and quick method
2. Quantity-Based Estimation, Time calculated using quantity of work and productivity rates
3. Bar Chart (Gantt Chart): Activities plotted against time, Easy to understand and monitor

4. Network Techniques (CPM / PERT):Activities arranged in logical sequence,Identifies critical activities and total project duration

6. Example of Time Allotment (Typical Building Project)

Activity	Time Duration
Pre-construction	1–2 months
Site preparation	2–3 weeks
Foundation	1 month
Superstructure	3–4 months
Roofing	2 weeks
Finishing	2–3 months
Services	1–2 months
External works	1 month

METHODS OF SCHEDULING

Development of Bar Charts, Merits & Limitations

1. Introduction to Scheduling:Scheduling is the process of deciding when each construction activity will start and finish so that the project is completed within the planned time.

2. Methods of Scheduling in Construction Management

1. Bar Chart (Gantt Chart):Activities represented by horizontal bars against time:Simple and widely used method

2. Milestone Chart:Shows key events or milestones instead of all activities,Useful for management review

3. Network Methods:CPM (Critical Path Method),PERT (Program Evaluation and Review Technique),Shows logical relationships between activities

4. Line of Balance (LOB):Used for repetitive works (roads, housing projects),Shows progress of activities over time and location

Bar Chart (Gantt Chart)

Definition:A bar chart is a graphical representation of construction activities plotted against time, showing start time, duration, and finish time of each activity.

Development of Bar Chart

Step 1: Identify Activities:List all construction activities in proper sequence

Step 2: Estimate Duration:Calculate time required for each activity

Step 3: Decide Time Scale:Choose time units (days, weeks, months)

Step 4: Draw Axes:Horizontal axis → Time

Vertical axis → Activities

Step 5: Draw Bars: Draw horizontal bars corresponding to duration of each activity

step 6: Review and Update: Modify chart based on progress and changes

5. Example of Bar Chart (Simple)

Activity	Duration (Weeks)
Site clearance	1
Excavation	2
Foundation	3
Superstructure	8
Finishing	6

Merits of Bar Chart

- Simple and easy to understand
- Quick to prepare
- Shows start and finish times clearly
- Useful for small and medium projects
- Helps in progress monitoring
- Easy to modify and update

Limitations of Bar Chart

- Does not show interdependence of activities
- Critical activities cannot be identified
- Not suitable for large and complex projects
- Does not show effect of delays clearly
- Resource planning is difficult
- No clear indication of float or slack time

Applications of Bar Chart

- Planning and scheduling construction activities
- Monitoring project progress
- Reporting to management and client

NETWORK TECHNIQUES IN CONSTRUCTION MANAGEMENT

Network is a diagram showing logical sequence of activities in a construction project.

It is the basis for CPM (Critical Path Method) and PERT (Program Evaluation and Review Technique).

1. Elements of a Network

1.1 Event / Node

Definition: A point in the network where an activity starts or ends.

Characteristics: Does not consume time, Marks start or completion of activity, Represented by a circle or rectangle

Example: Start of excavation, completion of foundation

1.2 Activity

Definition: A task or work that consumes time and resources and moves the project from one event to another.

Characteristics:Has start and finish events,Has duration,Represented by arrow in Activity-on-Arrow (AOA) method

Example: Excavation, concreting, plastering

1.3 Dummy Activity

Definition: An imaginary activity used in network diagrams to show dependency between activities without consuming time or resources.

Purpose:Maintains correct logical relationship,Avoids ambiguity when two activities share start or end events,Representation: Dashed arrow in AOA network

1.4 Predecessor and Successor

Predecessor Activity: Activity that must be completed before another activity starts

Successor Activity: Activity that follows another activity

Example: Excavation is predecessor of foundation; foundation is successor of excavation

2. Precautions in Drawing Network:Clearly identify all activities and their dependencies,Use unique events (no duplication),Avoid loops or circular references,Maintain correct logical sequence of activities,Include dummy activities only when necessary,Ensure each activity has one start and one finish event,Check time and resource consistency after drawing

3. Numbering the Events

Purpose:Numbering events gives unique identification to each node for reference in calculations (like earliest start, latest start, floats).

Rules for Numbering:Start from the first event (usually 1 or 0),Number events from left to right (progressive direction of project),Ensure numbers increase along the network,Avoid skipping or repeating numbers,Use the smallest number possible for events that can start earliest

Example:

Event Activity Connected

- 1 Start of site clearance
- 2 Completion of site clearance → Start excavation
- 3 Completion of excavation → Start foundation

MATERIAL MANAGEMENT

- Material Management is the process of planning, organizing, and controlling the flow of materials from purchase to use in construction.
- Objectives:Ensure right material, at right time, in right quantity, at right cost,Avoid shortage or excess inventory,Reduce material handling and storage costs,Improve project efficiency

1. Ordering Cost

- Definition: Ordering cost is the cost incurred each time an order is placed for procurement of materials.
- Components of Ordering Cost: Cost of preparing purchase orders, Administrative expenses (clerical, phone, emails), Transport / freight cost (if paid per order), Inspection and receiving costs
- Characteristics: Increases with number of orders, Independent of quantity per order

2. Inventory Carrying Cost (Holding Cost)

- Definition: Inventory carrying cost is the cost of holding or storing materials in stock for a period of time.
- Components of Inventory Carrying Cost: Capital cost (interest on investment), Storage / warehousing cost, Insurance cost, Depreciation, obsolescence, or spoilage cost, Handling and security cost
- Characteristics: Increases with inventory level, Reduces if ordering more frequently in smaller quantities
- **3. Economic Order Quantity (EOQ)**
- Definition: EOQ is the optimum order quantity that minimizes total material cost (sum of ordering cost and carrying cost).
- Purpose: Reduce total cost of material management, Avoid overstocking or stockouts
- Assumptions of EOQ Model: Demand is constant and known, Lead time is constant, Ordering cost and carrying cost are constant, No quantity discounts, Material is used at a uniform rate

4. EOQ Formula:

$$EOQ = \sqrt{\frac{2 \times D \times C_o}{C_h}}$$

Where: EOQ = Economic Order Quantity (units)

co= Ordering cost per order

CH= Carrying HOLDING cost per unit per year

D = Annual demand

TC=Ordering Cost+Carrying Cost

Total Cost (TC) in EOQ

TC=Ordering Cost+Carrying Cost

$$TC = (D \times P) + (D \times S) / Q + (Q \times H) / 2,$$

where D=Demand, P=Unit Price, S=Order Cost, H=Holding Cost per Unit, and Q=Order Quantity (EOQ).

STORE MANAGEMENT

1. Introduction: Store management deals with the receipt, storage, issue, and control of materials required for construction projects.

Effective store management ensures continuous availability of materials at minimum cost.

2. Objectives of Store Management, Ensure right material in right quantity and quality, Prevent loss, theft, damage, and deterioration, Reduce inventory carrying cost, Maintain accurate material records, Support smooth progress of construction work

3. Functions of Store Management: Receipt and inspection of materials, Proper storage and preservation, Issue of materials as per requirement, Stock control and inventory management, Maintenance of store records, Disposal of surplus and scrap materials

VARIOUS RECORDS RELATED TO STORE MANAGEMENT

1. Purchase Requisition: Raised by site engineer for material requirement: Specifies quantity, type, and time of requirement

2. Purchase Order (PO): Issued to supplier: Contains material details, quantity, rate, delivery schedule

3. Goods Received Note (GRN): Prepared when materials are received, Records quantity received and condition of materials

4. Bin Card: Kept in store near material location

Shows: Quantity received, Quantity issued, Balance in stock

5. Store Ledger: Maintained in accounts department, Shows quantity and value of materials, Used for cost control

6. Material Issue Slip: Authorizes issue of materials from store, Issued to site supervisor or engineer

7. Stock Register: Consolidated record of all materials in store

8. Scrap Register: Records scrap, damaged, or surplus materials

INVENTORY CONTROL BY ABC TECHNIQUE

1. **Introduction:** ABC analysis is an inventory control technique based on the principle of selective control (Pareto's law).

Small % of items account for large % of cost

2. Classification in ABC Analysis

Category	% of Items	% of Inventory Value	Control Level
A items	5-10%	70-80%	Very strict
B items	15-25%	15-25%	Moderate
C items	60-70%	5-10%	Simple

3. Examples

A items: Cement, steel, heavy machinery parts

B items: Pipes, fittings

C items: Nails, bolts, small tools

4. Advantages of ABC Analysis

- Better control of costly items
- Reduces inventory investment
- Improves efficiency of store management
- Focuses attention on critical materials

INTRODUCTION TO MATERIAL PROCUREMENT THROUGH PORTALS

1. Meaning

Material procurement through portals refers to online purchasing of construction materials using digital platforms or e-procurement systems.

2. Types of Procurement Portals

Government portals: GeM (Government e-Marketplace)

Private portals: Supplier websites, E-commerce platforms for construction materials

3. Process of Online Procurement: Registration on portal, Search and compare materials, Place online order, Online payment / approval, Delivery and inspection

4. Advantages of Procurement through Portals: Transparency in purchasing, Competitive pricing, Faster procurement process, Easy tracking of orders, Reduced paperwork

5. Limitations: Dependence on internet and technology, Limited inspection before delivery, Logistics and delivery delays

UNIT -IV

Construction Contracts and Specifications

TYPES OF CONSTRUCTION CONTRACTS

1. Introduction:A construction contract is a legal agreement between the owner and the contractor that defines:

- Scope of work
- Contract price
- Time for completion
- Terms and conditions
- Different types of contracts are adopted depending on nature of work, risk involved, and project requirements.

2. Main Types of Construction Contracts

2.1 Lump Sum Contract (Fixed Price Contract)

- Definition:A contract in which the contractor agrees to complete the work for a fixed total amount.
- Features:Total cost decided before starting work,Contractor bears most of the risk ,Suitable when drawings and specifications are complete
- Advantages:Easy administration,Owner knows total project cost,Simple billing
- Disadvantages:Not suitable for uncertain work,Changes increase disputes

2.2 Item Rate Contract (Unit Price Contract)

- Definition:Payment is made based on actual quantities executed at agreed unit rates.
- Features:Rates fixed, quantities variable,Widely used in government projects
- Advantages:Flexible for quantity variations,Fair payment based on actual work
- Disadvantages:Final cost not known in advance,Requires detailed measurement

2.3 Percentage Rate Contract

- Definition:Contractor quotes a percentage above or below the estimated cost.
- Features:Based on department schedule of rates,Used mainly in public works
- Advantages:Easy comparison of bids,Simple tendering process
- Disadvantages:Less incentive to reduce cost,Final cost uncertain

2.4 Cost Plus Contract

- Definition:Contractor is paid actual cost of work plus a fixed fee or percentage as profit.
- Types:Cost plus percentage,Cost plus fixed fee
- Advantages:Suitable for emergency or complex projects,Contractor risk is minimum
- Disadvantages:No incentive to control cost,Difficult to monitor expenses

2.5 Labour Contract

- Definition:Contractor supplies labour only, materials are provided by owner.
- Advantages:Better quality control by owner,Suitable for small works
- Disadvantages:Requires close supervision,Owner bears material risk

2.6 Piece Work Contract

- Definition: Work is carried out at agreed rates without commitment to full work.
- Advantages: Useful for small or urgent works, No long-term commitment
- Disadvantages: Difficult to control quality, Not suitable for large projects

2.7 Turnkey Contract

- Definition: Contractor is responsible for design, construction, and commissioning of the project.
- Features: Single point responsibility, Project handed over in ready-to-use condition
- Advantages: Saves time, Reduced owner involvement
- Disadvantages: High cost, Limited control by owner

2.8 Design and Build Contract

- Definition: Contractor is responsible for both design and execution.
- Advantages: Faster project completion, Better coordination
- Disadvantages: Design control reduced for owner

3. Comparison of Major Contracts

Contract Type	Cost	Certainty	Risk on Contractor	Suitability
Lump sum	High	High	Well-defined projects	
Item rate	Medium		Medium	Govt. works
Cost plus	Low	Low	Emergency works	
Turnkey	High	High	Industrial projects	

1. Contract Documents

- Definition: Contract documents are the set of written and drawn documents that define the rights, duties, and obligations of the owner and contractor.
- Contents of Contract Documents
- Notice Inviting Tender (NIT): Announces the project and invites bids
- Tender Form: Contractor's offer to execute the work
- Letter of Acceptance (LOA): Owner's acceptance of contractor's bid
- Agreement Form: Legal agreement signed by both parties
- Conditions of Contract: General and Special conditions
- Specifications: Description of materials and workmanship
- Drawings: Architectural, structural, and service drawings
- Bill of Quantities (BOQ): List of items with quantities and rates
- Addenda and Clarifications: Changes or instructions issued during tender.

2. Specifications

- Definition: Specifications are written descriptions stating the quality, type of materials, workmanship, and method of execution for construction work.
- 2.1 Types of Specifications
- General Specifications: Describe the nature and class of work, Applicable to entire project, Give overall quality requirements

- Detailed Specifications: Give item-wise description
- Include: Materials, Proportion and mix, Method of execution, Measurement and payment, Importance of Specifications, Ensure required quality, Basis for inspection and testing, Help in cost estimation, Reduce disputes

3. Conditions of Contract

Conditions of contract define rules and responsibilities of the owner and contractor.

3.1 General Conditions of Contract (GCC)

- Meaning: General conditions are standard conditions applicable to all contracts.
- Typical General Conditions: Definitions and interpretation, Duties and responsibilities of contractor, Time for completion, Extension of times, Payments and bills, Security deposit and retention money, Penalty and liquidated damages, Termination of contract. Dispute resolution and arbitration
- Characteristics: Common to all projects, Usually printed and standardized, Rarely changed

3.2 Special Conditions of Contract (SCC)

- Meaning: Special conditions are project-specific conditions introduced to meet special requirements.
- Examples of Special Conditions: Work in restricted or hazardous areas, Night working conditions, Special safety requirements, Use of specific materials or technology, Special payment terms, Local site conditions
- Characteristics: Vary from project to project, Override general conditions if conflict arises, Tailored to specific project needs

4. Difference Between General & Special Conditions

Aspect	General Conditions	Special Conditions
Applicability	All projects	Specific project
Nature	Standard	Customized
Flexibility	Less	More
Priority	Lower	Higher (if conflict)

CONTRACT MANAGEMENT

& ARBITRATION AND SETTLEMENT (INTRODUCTION)

1. Contract Management

Definition: Contract management is the process of planning, executing, monitoring, and closing a construction contract to ensure that all parties fulfill their contractual obligations.

2. Objectives of Contract Management: Ensure completion of work within time and cost, Maintain quality as per specifications, Prevent disputes and misunderstandings, Ensure fair payment to contractor, Protect interests of owner and contractor

3. Functions of Contract Management: Contract Administration, Interpretation of contract documents, Issue of instructions and clarifications

- Time Management: Monitoring project schedule, Granting extension of time (EOT)

- Cost Management: Measurement and certification of bills, Handling variations and extra items
- Quality Control: Ensuring compliance with specifications, Inspection and testing
- Risk and Dispute Management: Identifying potential disputes, Early resolution through negotiation
- Contract Closure: Final bill settlement, Completion certificate, Release of security deposit

4. Disputes in Construction Contracts

- Meaning: A dispute is a disagreement between the owner and contractor related to:
- Payment and bills
- Delays and extensions
- Quality of work
- Variations and extra items
- Interpretation of contract conditions

5. Settlement of Disputes (Introduction)

- Methods of Dispute Settlement:
- Negotiation
- Arbitration
- Litigation (Court)
- Arbitration is preferred in construction due to speed, confidentiality, and technical expertise.

6. Arbitration (Introduction)

Definition: Arbitration is a method of resolving disputes outside the court by appointing a neutral third party called an arbitrator.

7. Procedures Involved in Arbitration (Introduction Only)

- Reference of Dispute: Dispute is formally referred to arbitration as per contract clause
- Appointment of Arbitrator: Arbitrator appointed by mutual consent or as per contract terms
- Submission of Claim: Contractor submits claims, Owner submits counter-claims
- Hearings: Parties present evidence and arguments
- Arbitration Award: Arbitrator gives a final decision (award)
- Implementation of Award: Parties comply with the arbitrator's decision

8. Advantages of Arbitration

- Faster than court proceedings
- Less expensive
- Technical expertise of arbitrator
- Confidential process
- Binding decision

UNIT -V

Safety in Construction

- Safety in Construction Industry—Causes of Accidents,
- Remedial and Preventive Measures.

SAFETY IN CONSTRUCTION INDUSTRY

Causes of Accidents, Remedial & Preventive Measures

1. Introduction

The construction industry is one of the most hazardous industries due to the involvement of heavy machinery, working at heights, electrical works, and continuous movement of materials and workers.

- Construction safety aims to protect:
- Workers
- Equipment
- Property
- Environment

2. Causes of Accidents in Construction Industry

2.1 Human Causes

Lack of safety awareness and training, Carelessness and negligence, Fatigue and overwork, Alcohol or drug abuse, Not using personal protective equipment (PPE)

2.2 Equipment-Related Causes

Defective or poorly maintained machinery, Improper use of tools and equipment, Absence of safety guards, Overloading of cranes and lifting equipment

2.3 Site Conditions

Poor housekeeping, Slippery surfaces, Unsafe scaffolding and ladders, Poor lighting and ventilation, Congested work areas

2.4 Management-Related Causes

Lack of safety planning, Inadequate supervision, Non-compliance with safety rules, Pressure to complete work quickly

2.5 Environmental Causes

Extreme weather conditions (rain, heat, wind), Noise and dust, Poor visibility

3. Common Construction Accidents

- Falls from height
- Slips and trips
- Electrocution
- Struck by falling objects
- Collapse of scaffolding or excavation

4. Remedial Measures (After Accident)

- Definition: Remedial measures are actions taken after an accident to minimize damage and prevent recurrence.
- Measures: Immediate medical aid and emergency response, Investigation of accident causes, Repair or replacement of faulty equipment, Revision of safety procedures, Training and counseling of workers, Disciplinary action for safety violations

5. Preventive Measures (Before Accident)

5.1 Safety Planning: Preparation of safety plan for each project, Risk assessment and hazard identification

5.2 Training and Awareness: Regular safety training programs, Toolbox talks and safety meetings, Safety signage and instructions

5.3 Use of Personal Protective Equipment (PPE)

- Helmets
- Safety shoes
- Gloves
- Safety belts and harnesses
- Eye and ear protection

5.4 Safe Equipment and Machinery: Regular inspection and maintenance, Use of certified equipment, Proper guarding of machines

5.5 Safe Site Practices: Proper scaffolding and formwork, Safe access and walkways, Good housekeeping, Proper storage of materials

5.6 Management Commitment

- Appointment of safety officer
- Strict enforcement of safety rules
- Incentives for safe work practices

LABOUR LAWS AND ACTS PERTAINING TO

CIVIL CONSTRUCTION ACTIVITIES

1. Introduction

The construction industry employs a large workforce, often working in hazardous conditions. To protect the rights, safety, health, and welfare of construction workers, the government has enacted several labour laws and acts.

These laws regulate:

- Working conditions
- Wages and welfare
- Safety and health
- Social security benefits

2. Objectives of Labour Laws in Construction

- Protect workers from exploitation
- Ensure safe and healthy working conditions
- Regulate working hours and wages
- Provide welfare and social security benefits
- Maintain industrial harmony

3. Important Labour Laws and Acts Related to Civil Construction

3.1 Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 (BOCW Act)

Regulates employment and working conditions, Provides safety, health, and welfare measures, Applicable to construction establishments

3.2 Building and Other Construction Workers Welfare Cess Act, 1996

Provides for collection of cess, Funds used for welfare of construction workers

3.3 Minimum Wages Act, 1948

Ensures payment of minimum wages to workers, Prevents exploitation of labour

3.4 Contract Labour (Regulation and Abolition) Act, 1970

Regulates employment of contract labour, Ensures welfare and safety of contract workers

3.5 Workmen's Compensation Act, 1923 (Now called Employees' Compensation Act, 1923)

Provides compensation for injury, disability, or death due to accidents at work

3.6 Factories Act, 1948

Applicable where construction includes manufacturing activities, Ensures safety, health, and welfare in factories

3.7 Employees' Provident Fund (EPF) Act, 1952

Provides retirement and social security benefits

3.8 Employees' State Insurance (ESI) Act, 1948

Provides medical and cash benefits in case of sickness or injury