



CIVIL ENGINEERING PROJECT MANAGEMENT

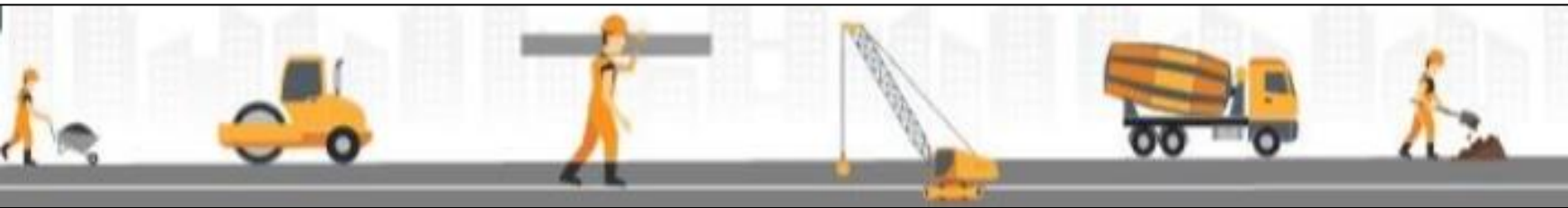
I

Unique features of construction projects ; Identification of components –Principles of preparing DPR- Construction planning and scheduling - I – Bar charts, Network Techniques, Use of CPM and PERT for planning – Drawing network diagrams – time estimates – slack – critical path-Examples

CIVIL ENGINEERING PROJECT MANAGEMENT

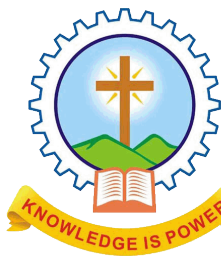
Course code: **CE 404**

3 credit course



REFERENCE BOOKS

1. Kumar Neeraj Jha, Construction Project Management
2. K K Chitkara, Construction Project Management
3. L.S. Srinath, PERT and CPM –Principles and Applications
4. B.C.Punmia & K K Khandelwal, Project Planning with CPM and PERT



PROJECT

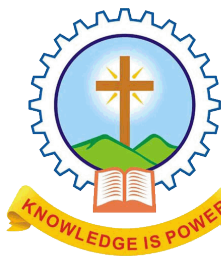
Project is a group of distinct related activities that are conducted in a coordinated effort to accomplish one or more unique product / service



PROJECT MANAGEMENT

Managing a project from an idea through to completion of project

By applying knowledge, skills, techniques to meet requirements of the project



PROJECT MANAGEMENT

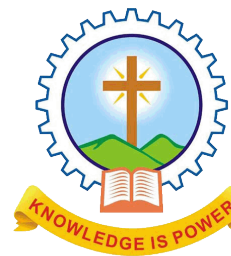
Project
Idea

Time

Finance

Human
Resource

Technical
Resource



CONSTRUCTION PROJECT

Is the organised process of constructing, renovating etc. of building or infrastructure



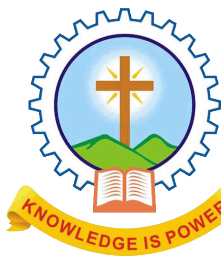
Project Include huge amount of resource:

1. Funds
2. Manpower
3. Equipment
4. Materials
5. Time



UNIQUE FEATURES OF CONSTRUCTION PROJECTS

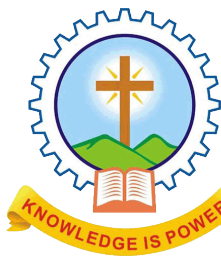
1. One time activity- it must be performed correctly the first time every time.
2. Complexity –multidisciplinary tasks to be done
3. High cost and time for execution.
4. High risk of failure
5. Difficulty in defining quality standards.
6. Uniqueness of people relationship.
7. Lack of experience of client
8. Untrained workforce



CONSTRUCTION PROJECT MANAGEMENT

Knowledge of

1. Project and business management
2. Proper understanding of the construction process



CONSTRUCTION PROJECT MANAGEMENT

General goal:

Building a project **on time, within budget, with quality standards and in safe environment**

Within the constraints



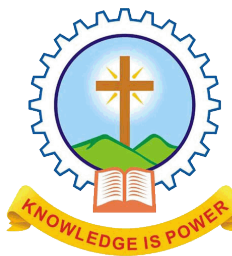
CONSTRUCTION PROJECTS - CONSTRAINTS

1. Time
2. Budget
3. Legal
4. Professional ethics
5. Environmental conditions
6. Unexpected factors
7. Labour force

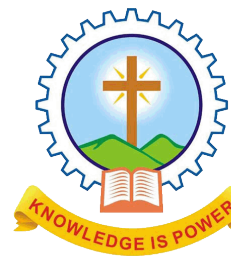


CONSTRUCTION PROJECT MANAGEMENT

1. The **planning, scheduling, evaluation and controlling** of construction tasks or activities
2. To accomplish objectives by **effectively allocating and utilising appropriate labour, time and resources**
3. In a manner that **minimises costs and maximises customer satisfaction**

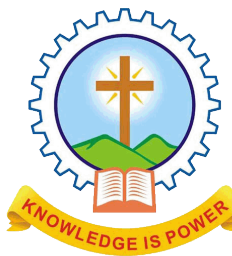


PHASES OF A CONSTRUCTION PROJECT



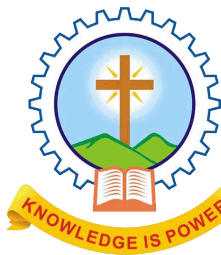
CONSTRUCTION PROJECT

1. Conceptual and Feasibility Studies
2. Planning
3. Design
4. Tendering / Contracting
5. Execution
6. Operation / Commissioning
7. Maintenance



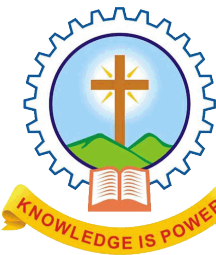
1. CONCEPTUAL AND FEASIBILITY STUDIES

- ❖ Stage at which a project is proposed to be undertaken to achieve certain aims
- ❖ Can be for individual / public interest



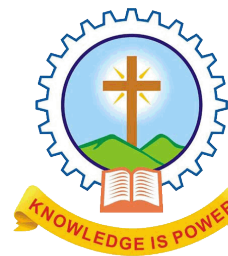
1. CONCEPTUAL AND FEASIBILITY STUDIES

1. **Technical and economic** feasibility studies
2. **Environmental impact** assessment
3. **Social Impact** assessment
4. **Land and geological survey**-location of the project
5. Assessing **possibility of major problems** during implementation of project



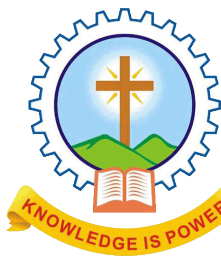
2. PLANNING - Effective allocation of resources

**Predetermined course of
action to achieve project
objective**

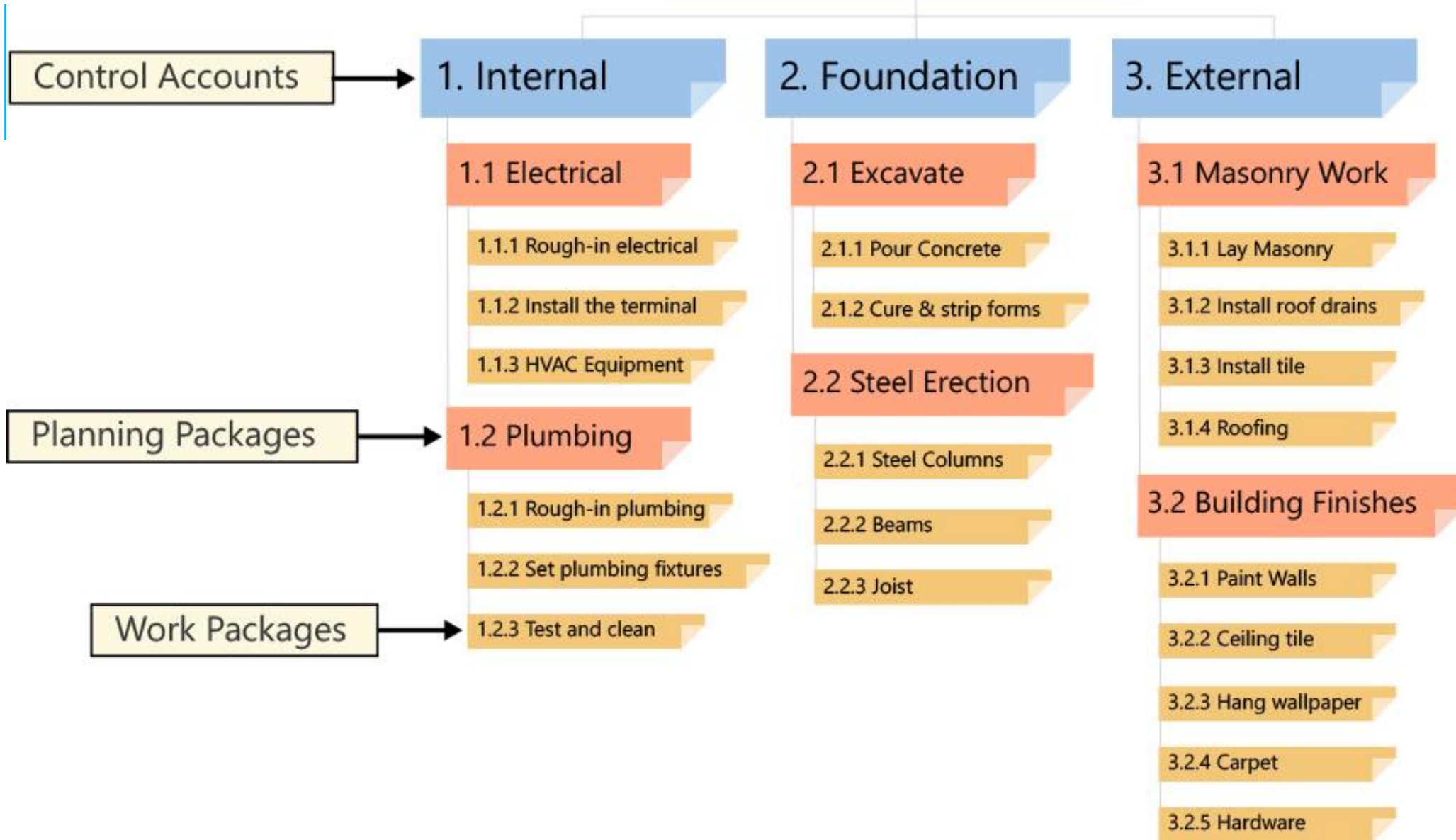


2. PLANNING - Effective allocation of resources

- Involves formulation of alternatives and choosing the most suitable
- Define scope of work
- Work breakdown structure (WBS) for activities
- Work schedule and project network
- Estimate resource and expenditure requirements



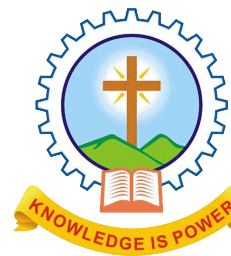
Construction of a House



3. DESIGN

More specific details and information gathered

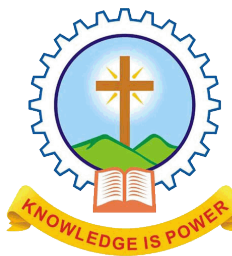
1. Preliminary design
2. Detailed design



3. DESIGN...

Preliminary design – continuation of feasibility study

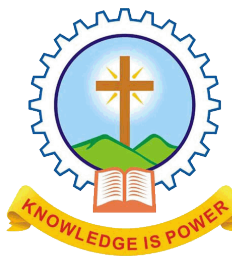
- Studies of various design alternative, their economic comparative studies and architectural aspect
- Detailed field investigation
 - Soil testing
 - Geological & hydrological data collection
 - Market survey



3. DESIGN...

Detailed design

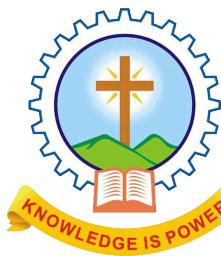
- Various components are analysed and designed
- Prepares explicit drawings and specifications for constructions



4. TENDERING AND CONTRACTING

At this phase:

1. For execution through contracting – tender notices will be issued
2. Tender preparation include:
 - Preparation of specifications and agreement conditions
 - Preparation of bills and cost estimates



4. TENDERING AND CONTRACTING

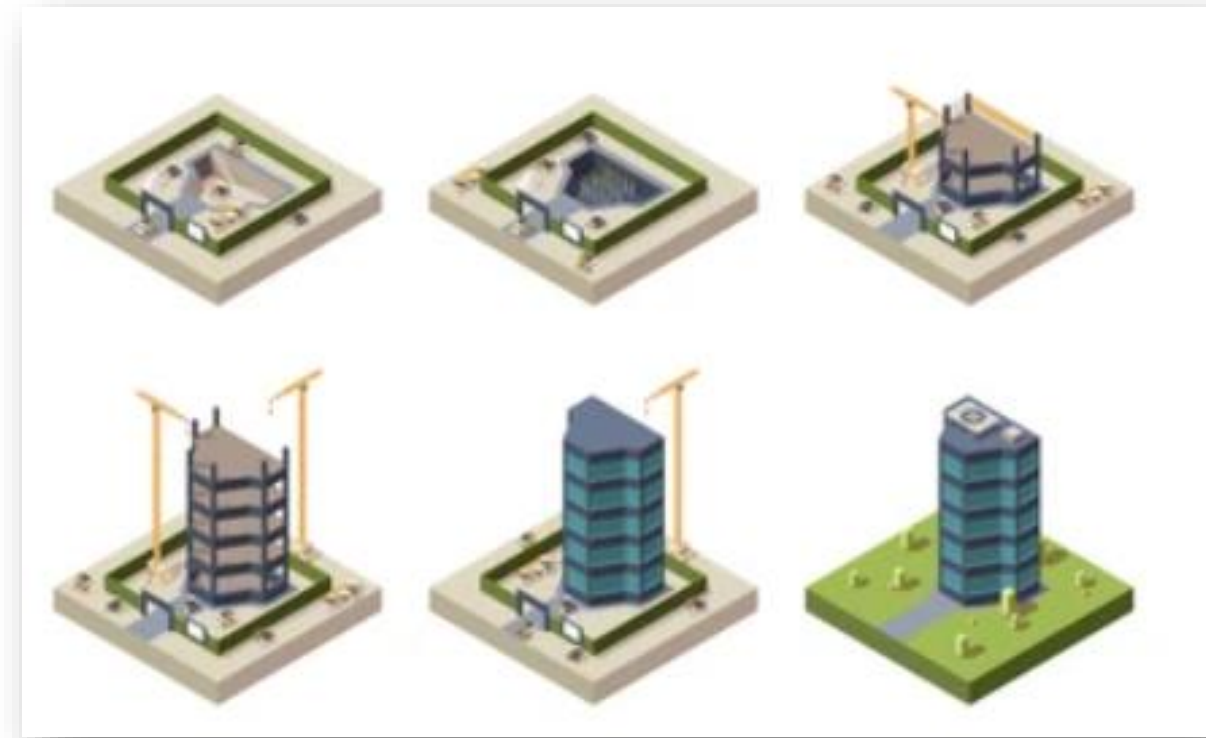
3. Evaluate bids and Qualification of contractor/suppliers is studied
4. Contract is awarded to execute the work

Outcome of this stage: Contract document, which is a legal document describing the terms and conditions to execute the project



5. CONSTRUCTION

- Project made into reality
- Most of funds are invested



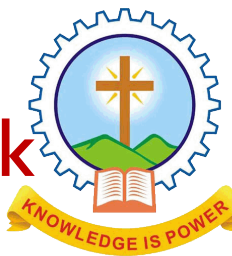
5. CONSTRUCTION

- Contractor or another agency executes the project
- Maximum coordination required between all activities
- Must be according to the detailed drawings and specifications
- Proper safety measures must be adopted
- During construction progress will be monitored
- Regular meetings with contractor to assess cost and schedule



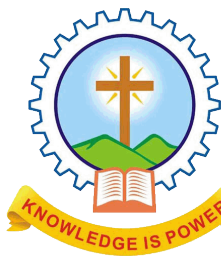
6. OPERATION / COMMISSIONING

- Check if each component / entire system is functioning according to design and specification
- To rectify the defect if any during construction work
- Changes in the design during the construction is properly documented for the purpose of technical performance and financial auditing
- Operational and maintenance instruction manuals are prepared
- Completion certificate will be issued after approval of work



7. UTILIZATION AND MAINTENANCE

- The performance, nature and extent of maintenance and repair are good indicators of quality of construction and provide a valuable feedback for the use in the construction of similar new projects
- Regular repair of the parts getting damaged has to be carried out



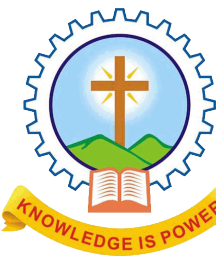
DPR – DETAILED PROJECT REPORT

DPR – DETAILED PROJECT REPORT

DPR is a detailed plan for a **project** indicating overall programme, different roles and responsibilities, activities and resources

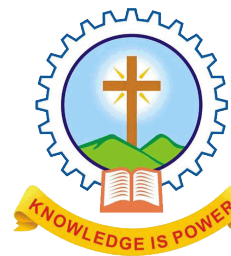
DPR – DETAILED PROJECT REPORT

- DPR is the base document for planning and implementing the project
- Indicates the technical and financial strategies to be adopted for execution of project



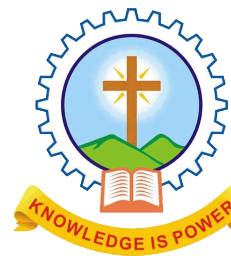
DPR: GENERAL CONTENTS

1. Project background
2. Project specifications
3. Project cost and Project finance structuring
4. Project institution framework
5. Requirements for Approvals and clearances for the project
6. Project phasing
7. Project financial viability/ feasibility aspects
8. Project benefits assessments



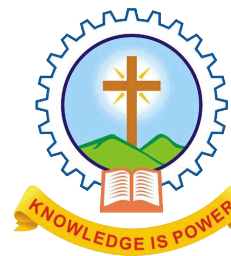
PROJECT BACKGROUND

- ❖ Necessity and aim of the project
- ❖ Utility and feasibility of project
- ❖ Brief history of project – (existing/continuation)
- ❖ Existing status of the physical infrastructure
- ❖ Basic information of users



PROJECT LOCATION DETAILS

- ❖ Details on selection of site and alignment
- ❖ Details of survey works
- ❖ Topography, orientation of site and soil data



COST DETAILS

The DPR should clearly indicate project cost for following factors:-

1. Land acquisition / site development
2. Survey & investigations
3. Engineering Project Management
4. Raw materials
5. Labour cost

COST DETAILS

6. Basic Equipment Cost
7. Cost of shifting utilities
 - Duties , Taxes & Freight
 - Freight and Transit Insurance
8. Finance / Interest During Construction
9. Consultant charges
10. Contingency

PROJECT FINANCE STRUCTURING

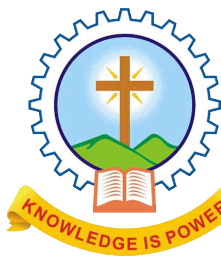
DPR must indicate the composition of fund:

- ❖ Central Government
- ❖ State Government
- ❖ ULBs Loan component
- ❖ Private Investment etc.

DETAILED SPECIFICATIONS

All information to prepare tender documents

- ❖ Arrangements for water supply, electrical installations, sanitary works
- ❖ Locations of roads and drains
- ❖ Availability and Supplying modes of raw materials, machinery etc.
- ❖ Specifications of materials and equipment



APPROVALS

The project concept must be approved for several factors like :-

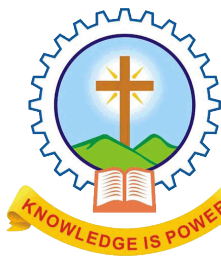
- ❖ Land - Legal matters
- ❖ Environment impact
- ❖ Disaster related risk assessment and countermeasures



APPROVALS

Details regarding obtaining various authority approvals whatever applicable must be included

- ❖ Approvals from government authorities
- ❖ Land availability and acquisition
- ❖ Forest clearance
- ❖ Highway clearance
- ❖ Electricity clearance
- ❖ Fund related clearance
- ❖ Pollution control board clearance



PROJECT BENEFITS ASSESSMENT

DPR should include:

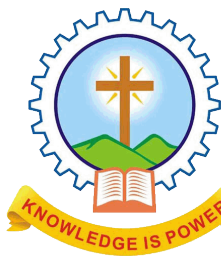
- ❖ List of project benefits from a social/economic perspective
- ❖ List of possible adverse impacts
 - ❖ Pollution
 - ❖ Environment distortions
 - ❖ Displacement of inhabitants etc..
- ❖ Economic rate of return



PROJECT INSTITUTION FRAMEWORK

The DPR needs to provide :

- ❖ Role of institutions involved in the Project
- ❖ A Roles / Responsibility matrix
- ❖ Manner of undertaking construction works
- ❖ Involvement of the construction agency in the O & M (Operations and Maintenance) activities

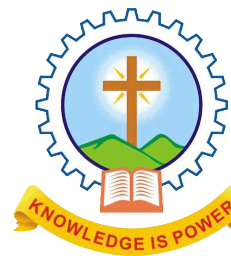


PROJECT PHASING

Project Activity Schedule to be indicated

- ❖ Schedule for tendering
- ❖ Schedule for authority clearances
- ❖ Schedule for design and implementation

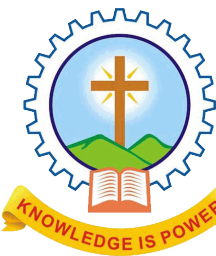
Mode of execution



PROJECT FINANCIAL VIABILITY

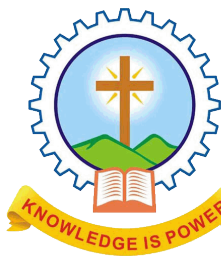
The project viability assessment section should include:

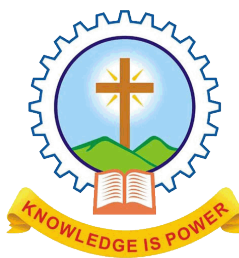
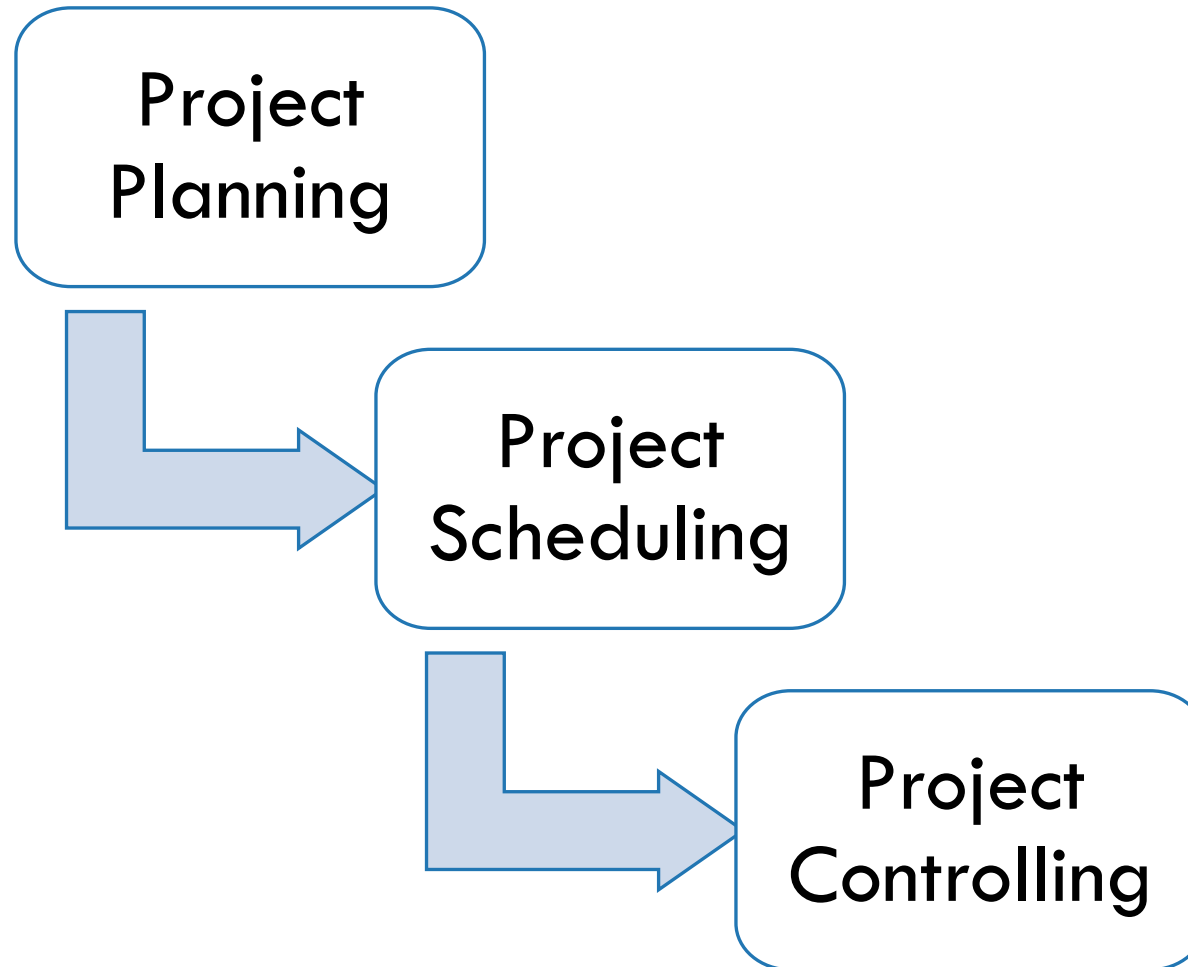
- ❖ The assumptions on cost and revenues
- ❖ Projected income and cash flow statements –
- ❖ Return or revenue income if any



CONSTRUCTION PLANNING AND SCHEDULING

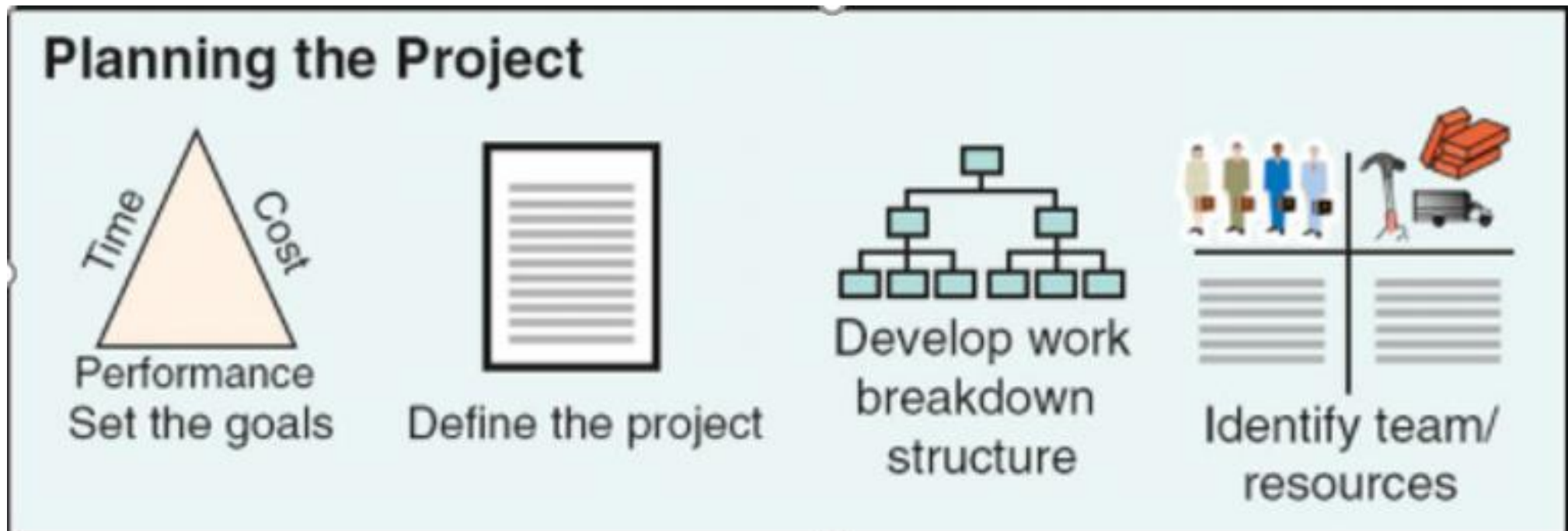
- ❖ Scope recognition
- ❖ Task definition & responsibility identification
- ❖ Effective utilization of resources (labour, material & equipment)
- ❖ Tracking and controlling project time and cost





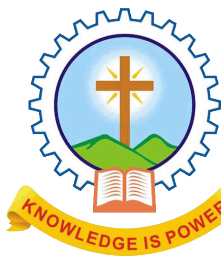
CONSTRUCTION PLANNING

Planning: Process of formulating in advance, plan of action for coordinating various activities and resources



CONSTRUCTION PLANNING - OBJECTIVES

- ❖ To predetermine how project objectives will be achieved
- ❖ To determine inter dependencies of activities
- ❖ Procurement of resources in advance
- ❖ Proper choice of equipment / technology
- ❖ Proper design of various elements of the project
- ❖ To ensure constant flow of funds till completion of projects
- ❖ To employ trained and experienced staff



CONSTRUCTION PLANNING

1. Time plan

- Design and drawing preparation
- Work quantities

2. Resources plan

- Labour
- Materials
- Equipment

3. Finance plan

- Budget
- Cash flow estimates

4. Project control plan

- Progress of planned work – updating and revising plans



CONSTRUCTION PLANNING STEPS

1. Define project objective

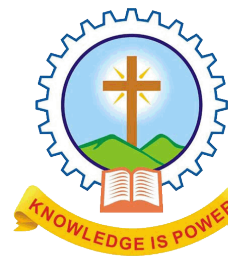
2. Generate WBS & activity list

3. Determine sequential relationships among activities

4. Evaluate resources and finalise the optimal

5. Define methodology for each work

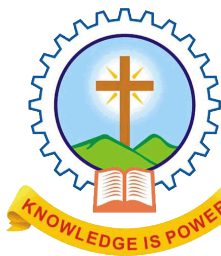
6. Estimate activity cost



CONSTRUCTION SCHEDULING

Scheduling: Process of putting the construction plan to a time scale, in a logical order and allocating resources

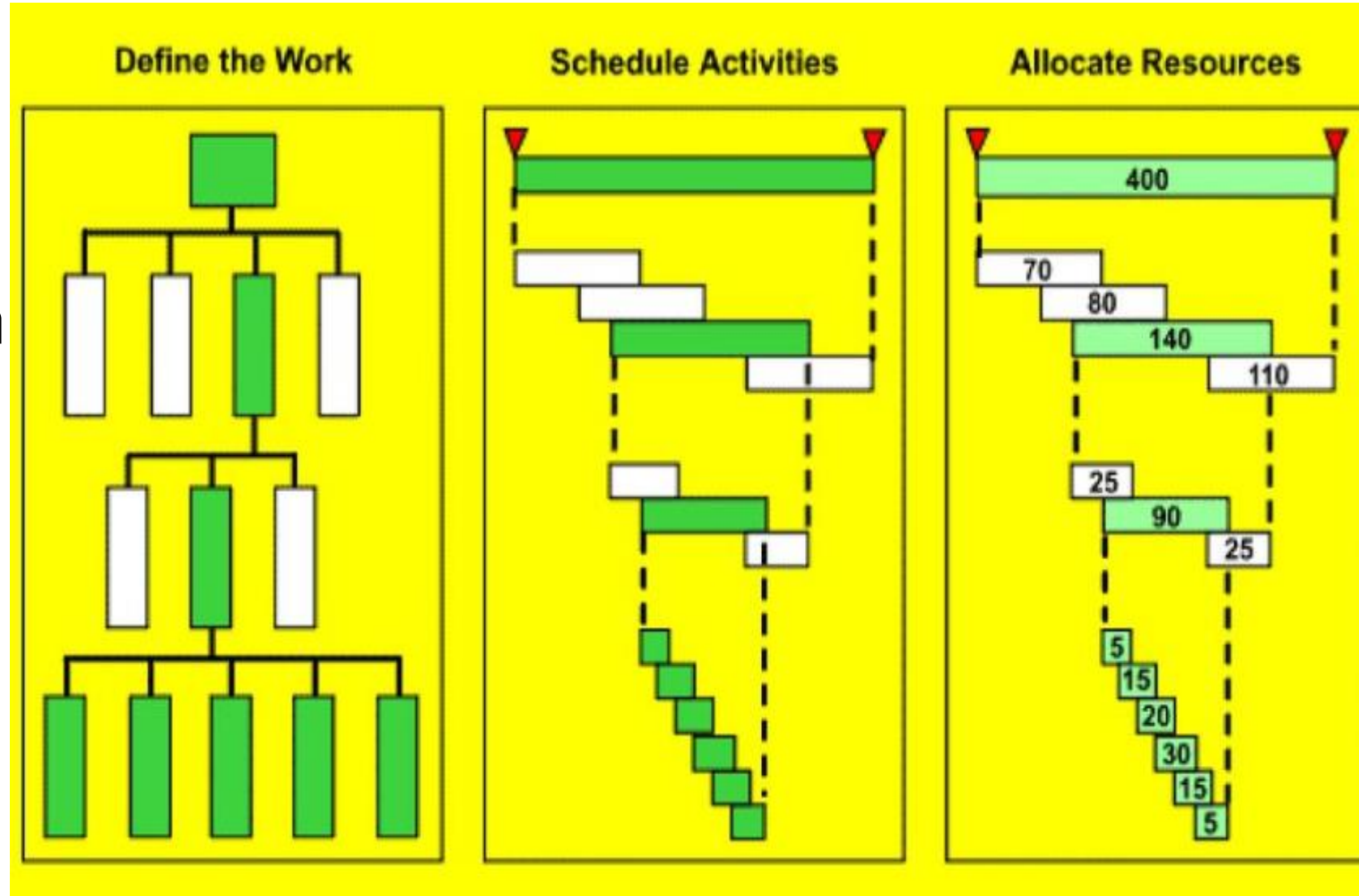
Shows duration and order of various construction activities



CONSTRUCTION SCHEDULING

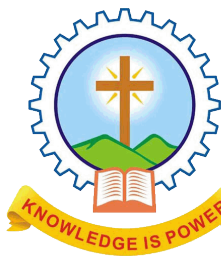
Scheduling steps:

- ❖ Defining project activities and sequence in a time scale
- ❖ Estimating their duration
- ❖ Allocating resources



SCHEDULING BENEFITS

- ❖ Analyse and forecast the progress of project
- ❖ Enables estimating funds / type and quantity of materials required at different stages
- ❖ Identify the critical activity path to determine the length of project
- ❖ Coordinate various activities with respect to resources and time
- ❖ Optimisation of resources – labour, materials, equipment
- ❖ Brings out time and resource constraints

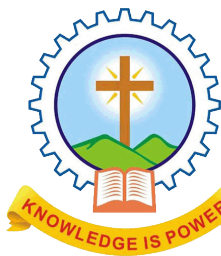


PROJECT CONTROLLING

Reviewing difference between schedule and actual performance of project

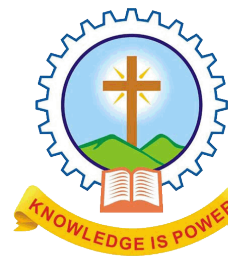
Aim:

To determine deviations from actual plan and to re-plan and reschedule to compensate for deviations

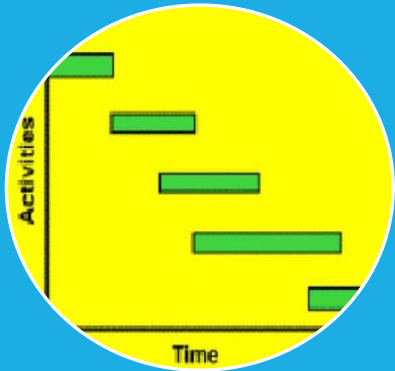


STEPS IN PROJECT CONTROL

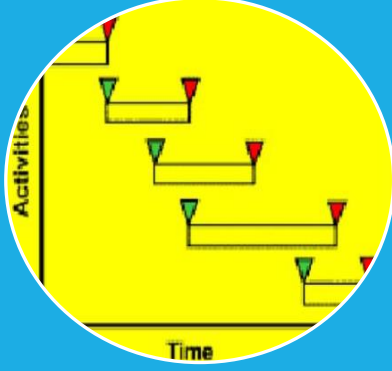
- Set targets for project preferably in terms of time
- Check project progress against the targets
- Measure deviations from actual plan and schedule
- Suggest and carryout corrective measures



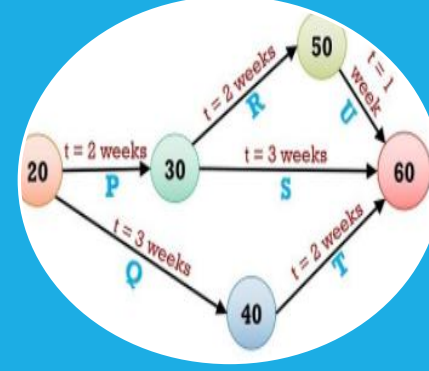
PROJECT SCHEDULING METHODS



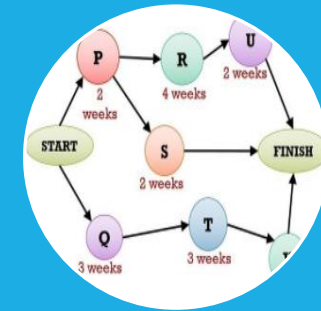
Bar charts



Mile stone charts



PERT



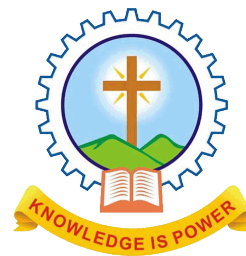
CPM

PROJECT SCHEDULING



BAR CHARTS

Is a graphical representation of activity schedule



BAR CHARTS

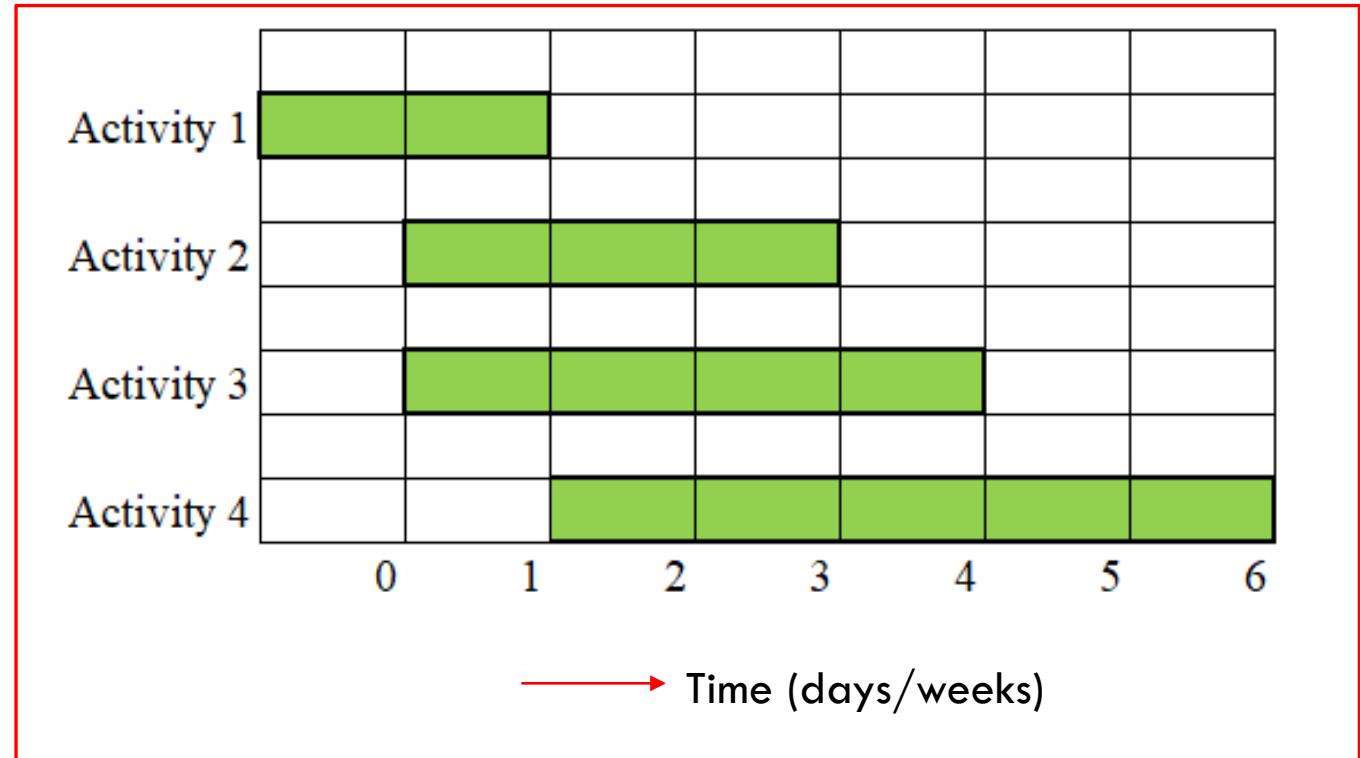
Bar Chart consists of 2 coordinate axes

1. Activities in a project
2. Time/duration of activities

Beginning of each bar: Starting time of the activity

End of each bar: Finishing time of the activity

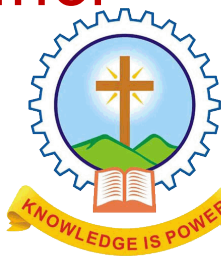
Length of bar: Time required for completion of activity



BAR CHART – EXAMPLE (REF. S. SEETHARAMAN)

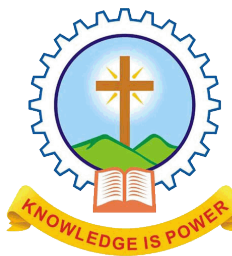
Activity No.	Duration in weeks
1	2
2	3
3	5
4	4
5	2
6	3
7	5

- Activity 2 and 3 can start and continue simultaneously after completion of activity 1
- Activity 4 can start only after completion of activity 2
- Activity 5 cannot begin until activities 2 and 3 are completed
- Activity 6 can start only after completion of activities 4 and 5
- Activity 7 is the last and can start only after completion of activity 5



BAR CHART – EXAMPLE (REF. S. SEETHARAMAN)

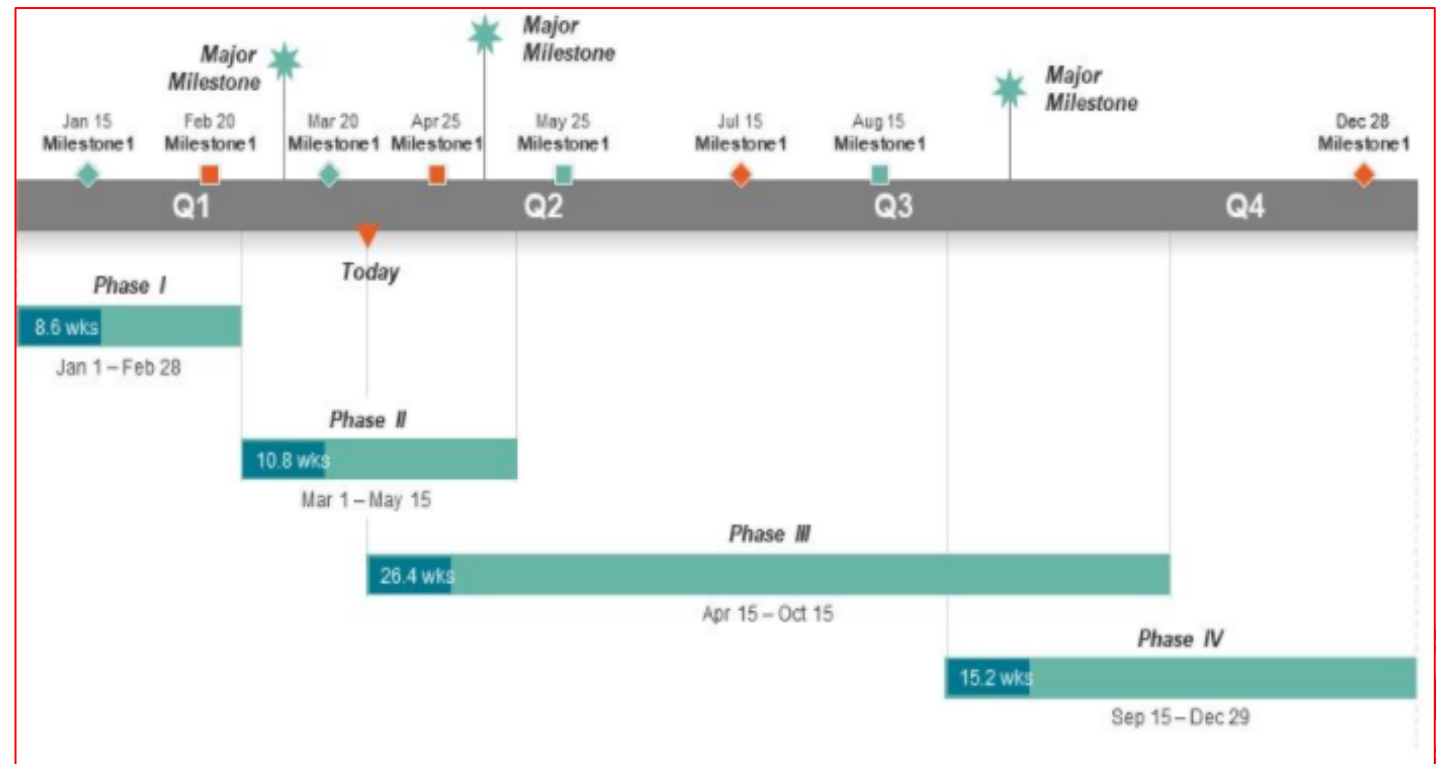
1. Prepare a bar chart
2. Compute total time for project completion



MILESTONE CHARTS

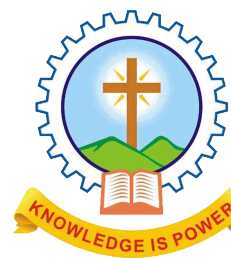
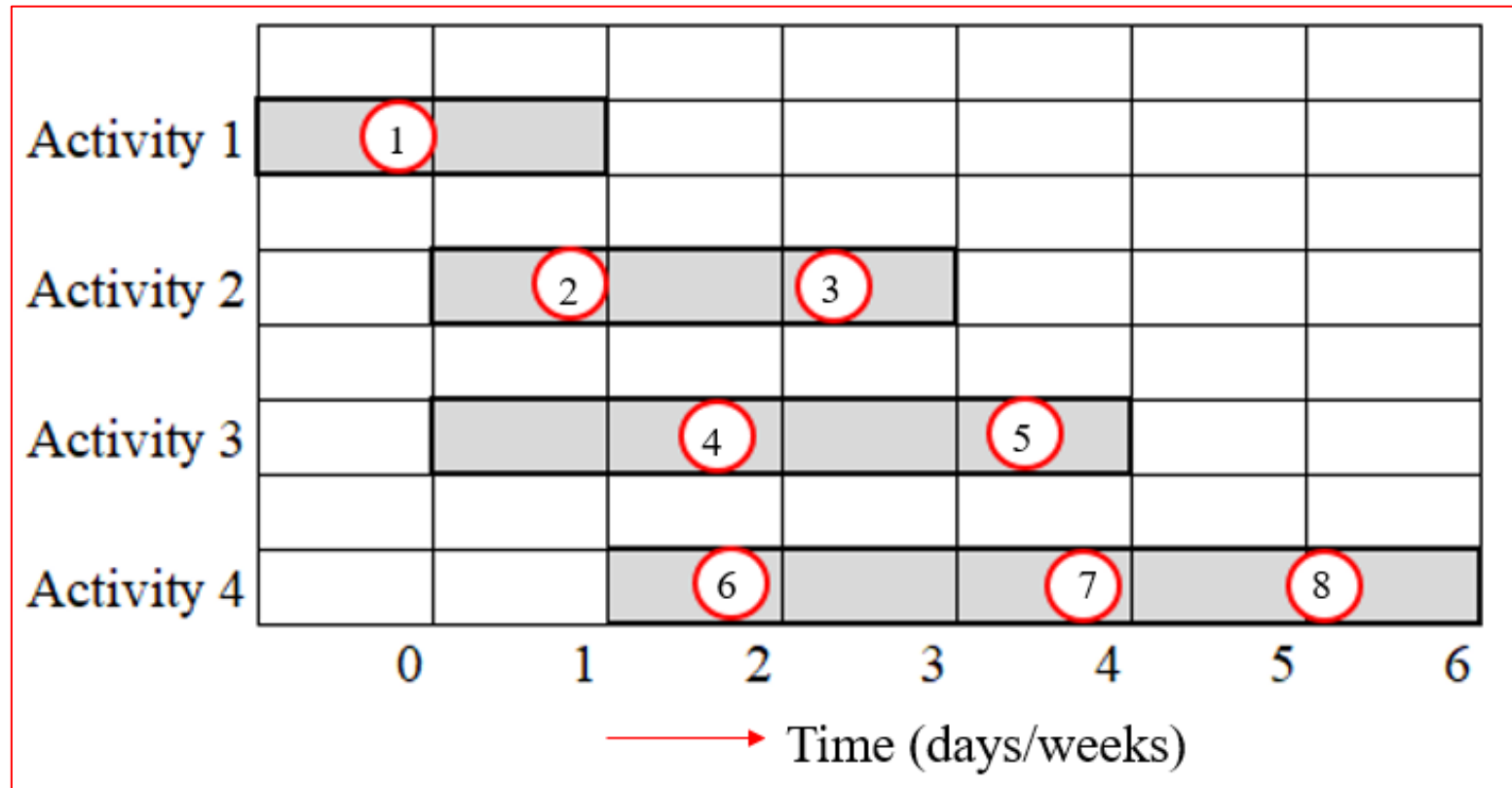
Modification of Bar charts by representing the key events in an activity

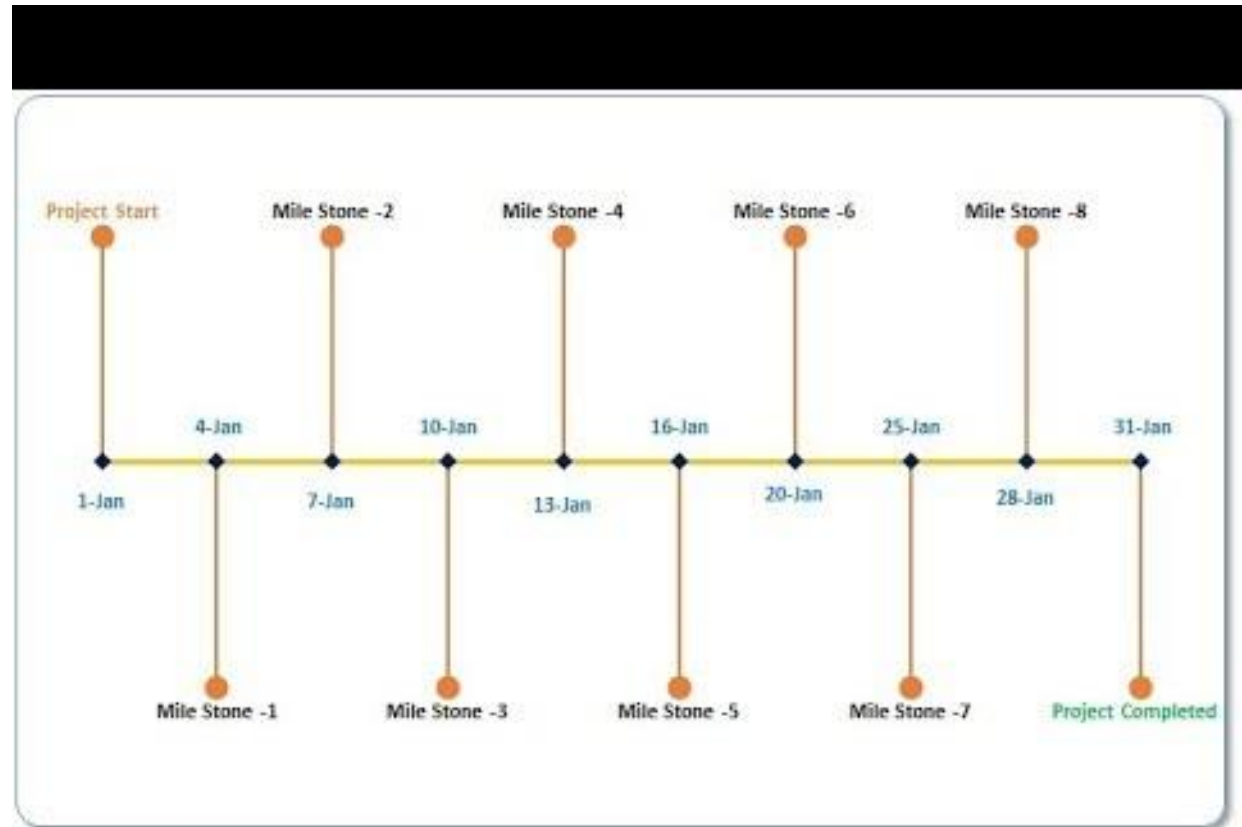
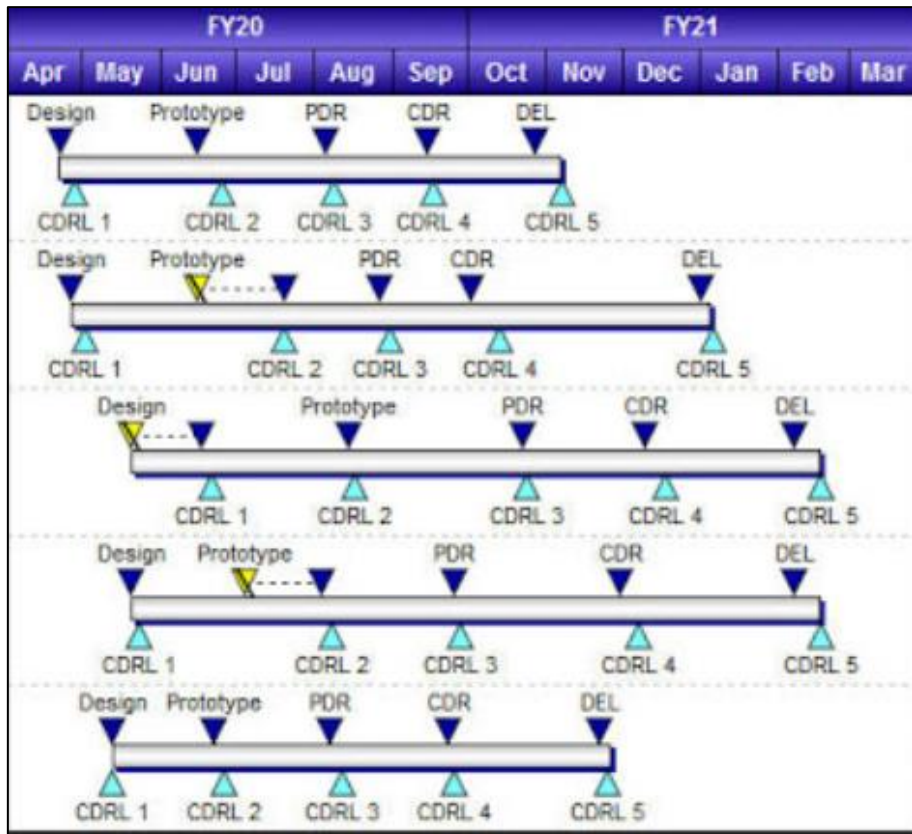
These key events are called milestones and represent a specific significant event along the main activity



MILE STONE CHARTS

- **Activities with longer duration** can be represented in milestone charts by breaking down into sub-activities and representing as mile stones





MILE STONE CHARTS

Benefits

- ✓ Better project control is possible
- ✓ Interdependencies between different key events in an activity can be represented

Limitations

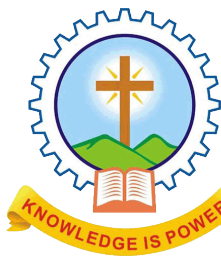
- Relationships between all activities cannot be effectively represented



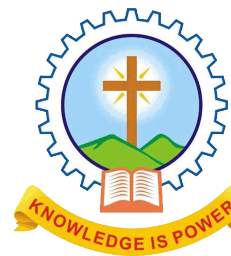
MODULE 2

Crashing and time –cost trade off, Resource smoothing and resources levelling - Construction, equipment, material and labour schedules. Preparation of job layout.

Codification of the planning system : Codification approach- Work package and activities identification code – Resource codes – Cost and Finance accounting codes – Technical document codes.



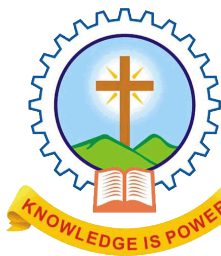
NETWORK CRASHING



NETWORK CRASHING

Process of reducing project duration by providing more resources

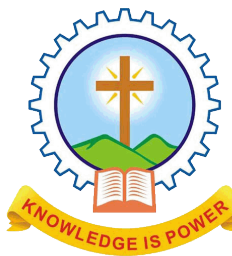
- ❖ Activities must be so scheduled to be completed with minimum cost and time
- ❖ Project duration can be reduced to certain extent **by assigning more resources** to activities
- ❖ However, doing this **increases project cost**
- ❖ This process which reduce project time by reducing duration of one or more activities is termed crashing
- ❖ Decision is based on analysis of **trade - off between time and cost**



NETWORK CRASHING

AIM

To achieve the maximum decrease in completion time for minimum additional cost



PROJECT COST

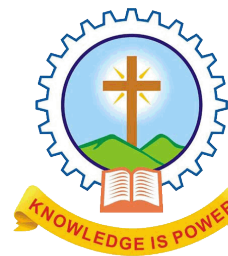
$$\text{Total project cost} = \text{Direct Cost} + \text{Indirect Cost}$$

Direct cost

- Expenditures which are directly associated with project activities
- Including **labour cost, material cost, salaries etc.**

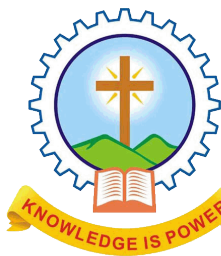
Indirect cost

- Are not directly associated with specific project activities but are assessed for whole project
- Including **administrative cost, rent, office space, loss of profit, overheads, insurance cost etc.**

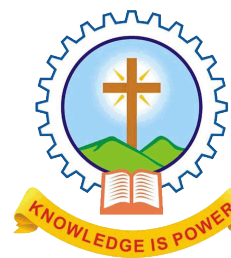
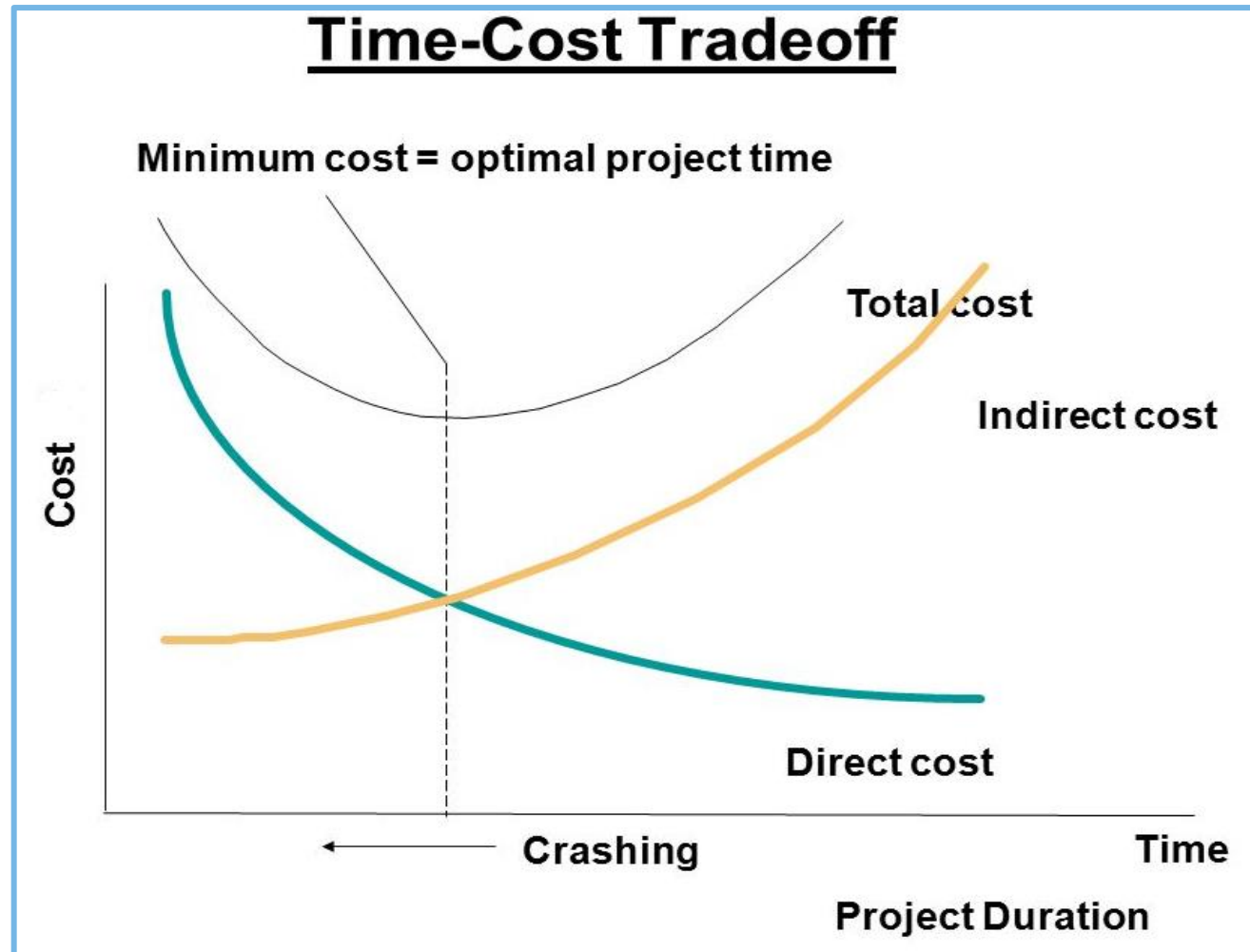


COST – TIME TRADE OFF

The analysis of inter-relationship between time and cost of a project, in order to minimise its cost and duration is termed cost-time trade off



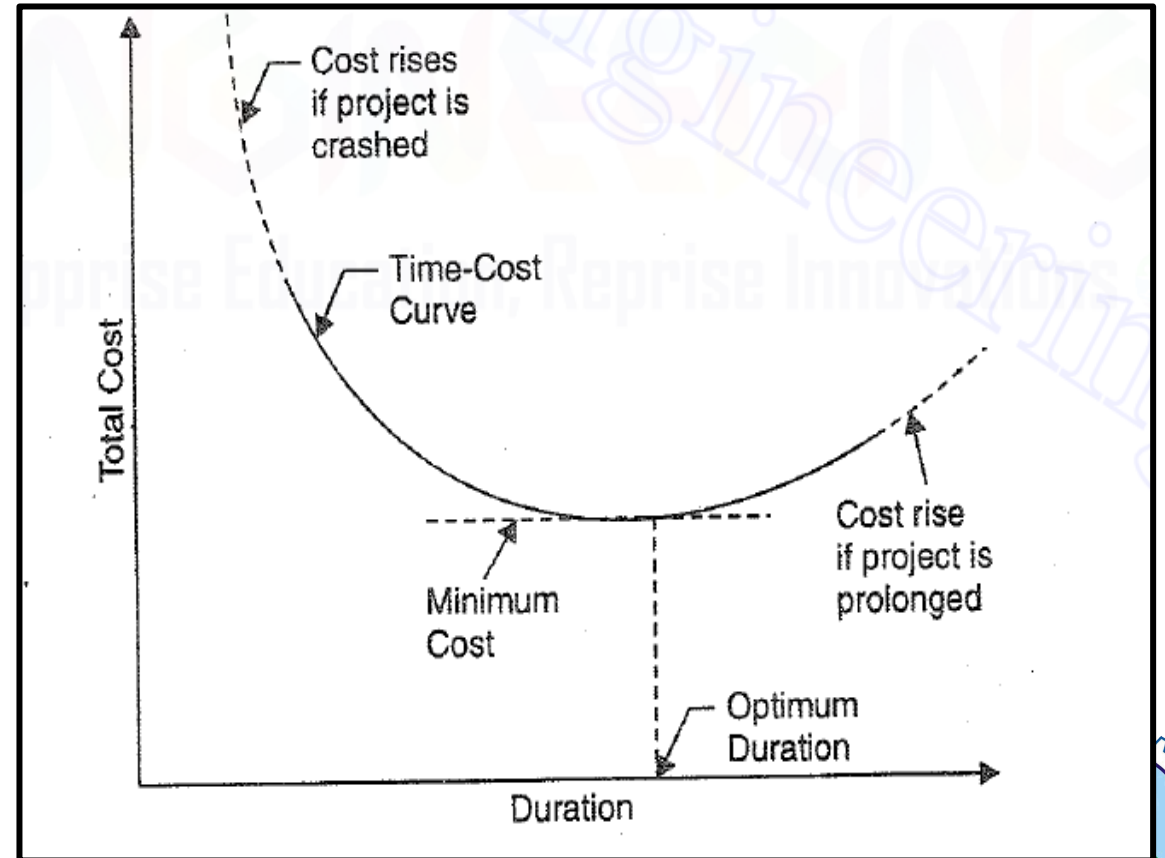
COST – TIME TRADE OFF



PROJECT COST

Total project cost:

- Increase if project crashed beyond certain extend
- Increase if project prolonged indefinitely
- Is at minimum for optimum project duration



Normal time (t_n):

Standard time which is usually allowed for an activity

Crash time (t_c): :

Minimum possible time in which an activity can be completed by providing extra resources

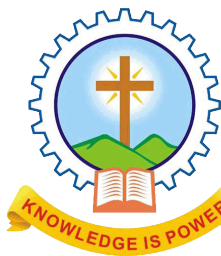
Time beyond which an activity cannot be shortened by any amount of increase in resources

Normal cost (C_n):

Direct cost required to complete the activity in normal time duration

Crash cost (C_c):

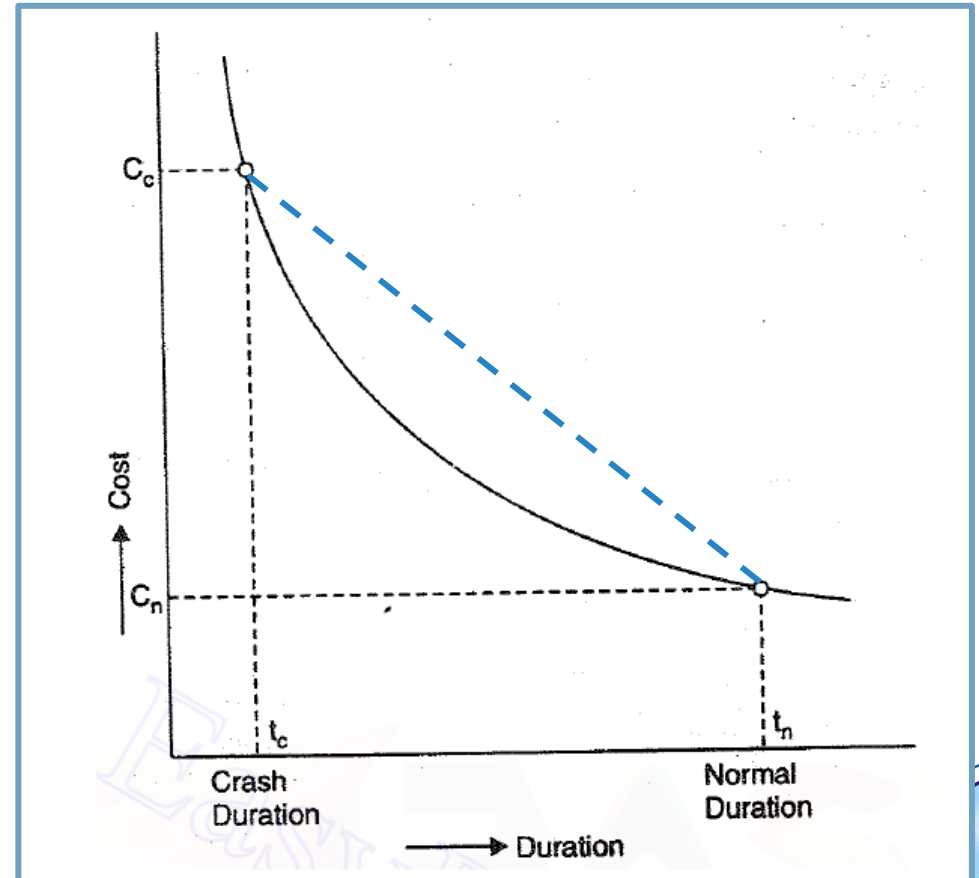
Direct cost required to complete activity within crash time



COST SLOPE:

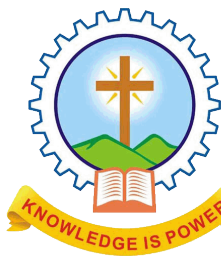
The extra cost incurred for expediting an activity to reduce the project duration by unit time

$$\text{Cost slope} = \frac{C_c - C_n}{t_n - t_c} = \frac{\Delta C}{\Delta t}$$



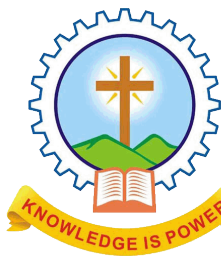
STEPS IN PROJECT CRASHING

1. Prepare network diagram and using CPM calculations find the critical path
2. Compute cost-slope for each activity
3. Reduce duration of critical activity with least cost-slope (which is not shortened to its crash duration)
4. Increase in cost can be determined by cost slope multiplied by time units
5. Reduce duration of critical activity with least cost-slope until crash duration is reached or critical path changes

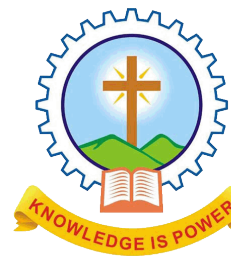


STEPS IN PROJECT CRASHING

6. When multiple critical paths arise, activities to be shortened can be determined by comparing cost slope of activities on critical path and combining them
7. Continue the process until no further shortening is possible as the crash point is reached



RESOURCE ALLOCATION



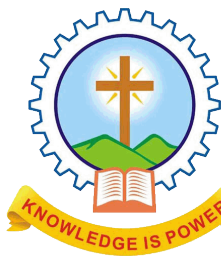
RESOURCE ALLOCATION

Estimating activity times using network diagrams are on the assumption that resources are liberally available

In practice construction projects face constraints such as:

- Resource shortage
- Delay in procurement
- Reduced availability of funds
- ...

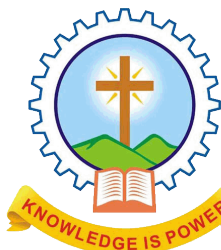
This constraints affects the performance and completion of activities and may delay the project



RESOURCE ALLOCATION

Process of assigning and scheduling available resources in the most effective and economical way

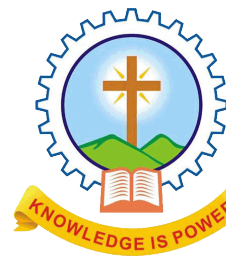
- By shifting the activities in **non-critical paths** utilising the floats
- Reallocating resources to critical activities
- Rescheduling resources in a uniform manner among activities



RESOURCE ALLOCATION

Two categories

1. **Resource smoothing** – Time constrained
2. **Resource levelling** – Resource constrained



RESOURCE SMOOTHING

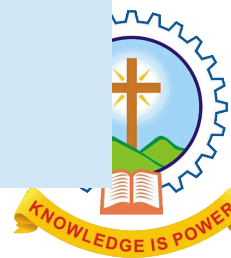
Resource Smoothing is a resource optimization technique which adjusts the different activities in a network so that the **resource requirements does not exceed predefined limits**

Time constrained resource optimising method

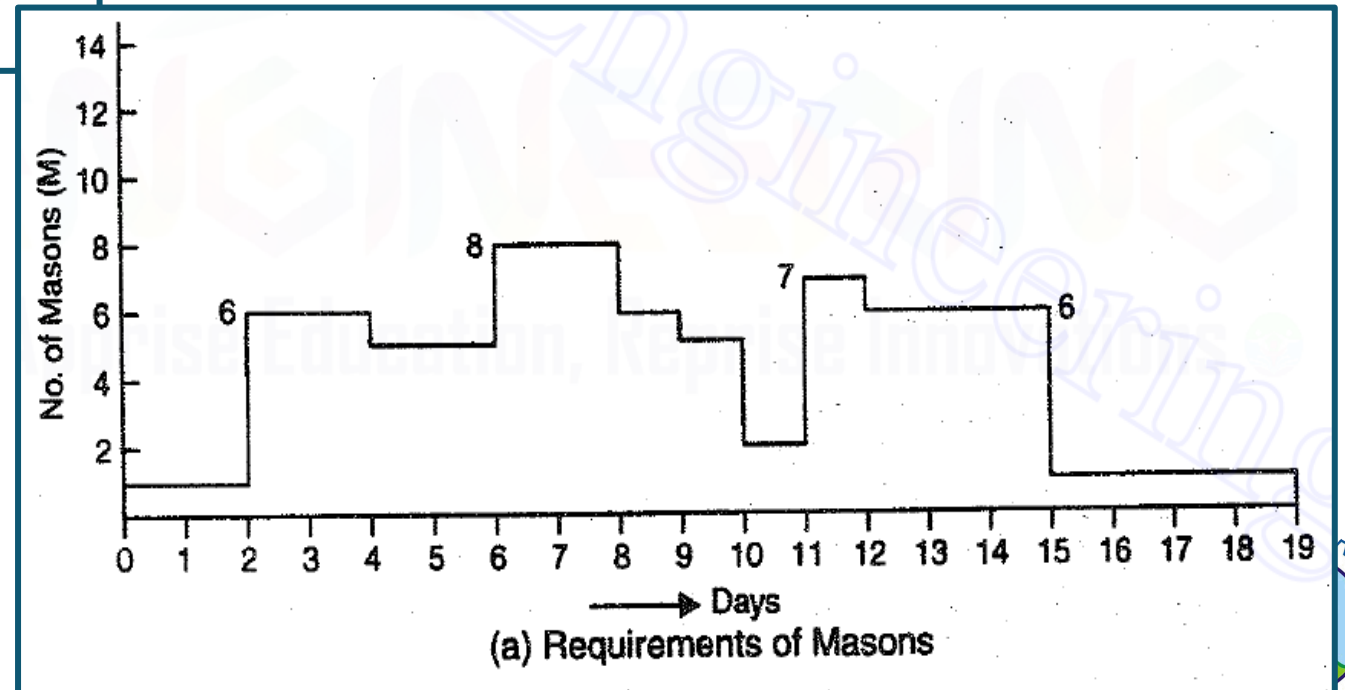
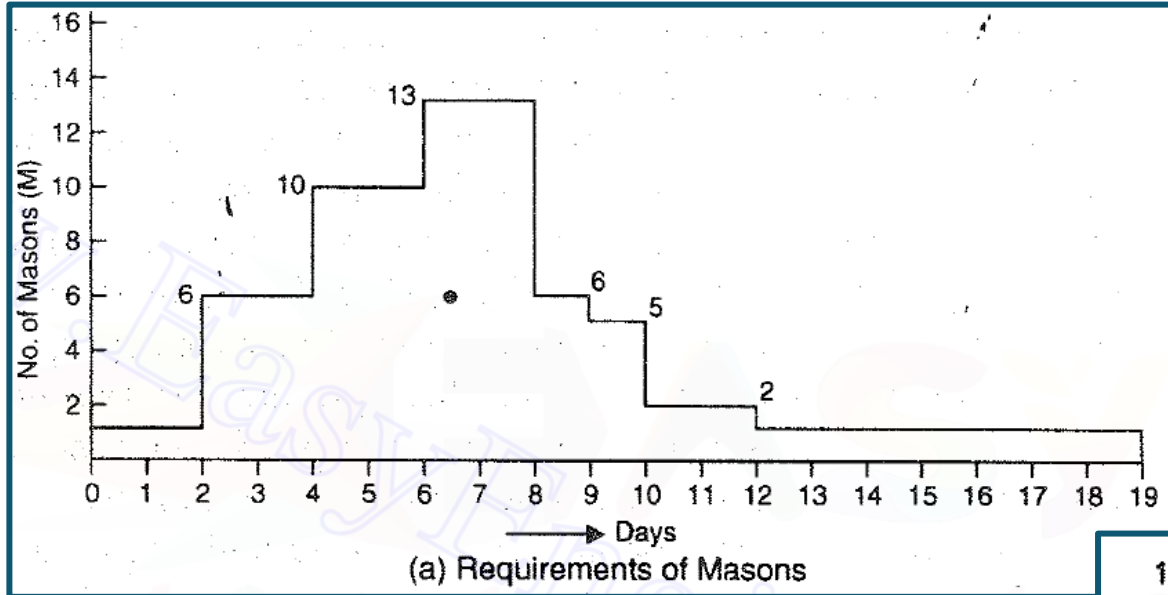
- The original project duration must be maintained
- Critical paths cannot be changed

Individual activities can be delayed dependent on floats available

- Starting time of activities can be shifted to obtain uniform resource requirement



RESOURCE SMOOTHING



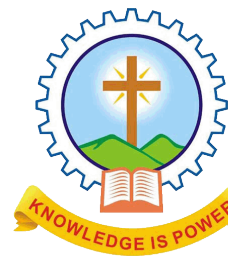
RESOURCE SMOOTHING

Can be used when there is limited time

Resources are available without constraints

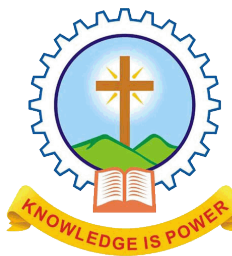
When there are larger demands for resources, it can be drawn from non-critical activities utilising the slack times

Critical activities cannot be disturbed

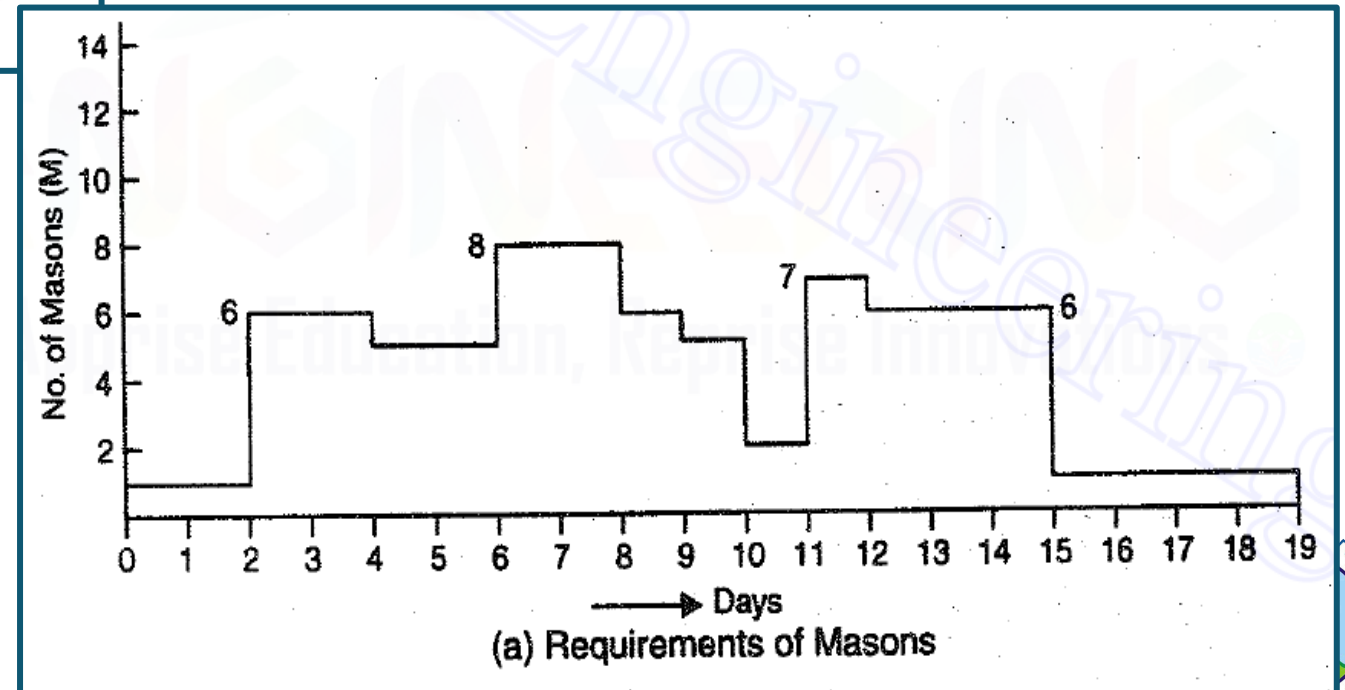
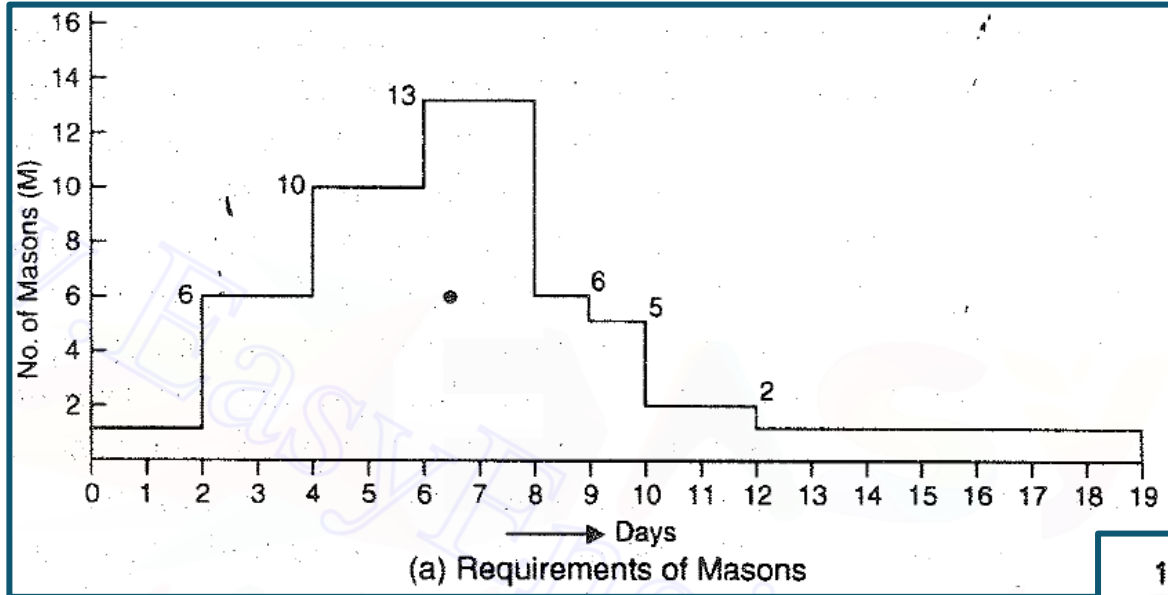


STEPS IN RESOURCE SMOOTHING

1. List out the resources required for the project and identify the important ones
2. Prepare a histogram showing cumulative resource requirements
3. Identify the peak and lower demands of resource from histogram
4. Adjust start / finish times of non-critical activities to smoothen the resource demand (to fill the troughs and lower the peaks)



RESOURCE SMOOTHING



RESOURCE LEVELLING

Resource Levelling is a resource optimization technique in which the **start dates and finish dates** of different activities **are adjusted** in order to balance the **demand for resources vs available supply**

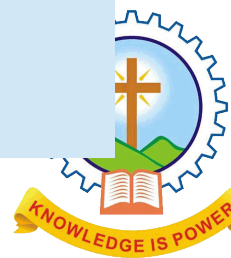
Availability of resources is the major constraint

Resources are so rescheduled that - Peak demand for any particular resource does not cross the actual availability limit

Total project duration may be extended

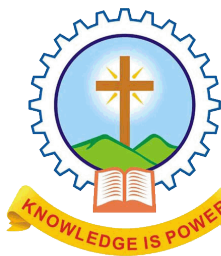
Activities with available floats can be utilised first for levelling

If further required can extend project duration time

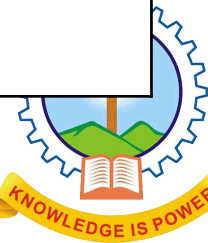


STEPS IN RESOURCE LEVELLING

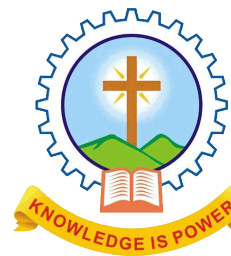
1. Lower the peak requirement of resources by staggering the resources in non-critical activities
2. Either increase the duration of critical activities OR schedule concurrent activities in a serial manner to reduce resource demand. This also will increase project duration.
3. Lower the high peaks of resource cumulative demand histogram utilising the free floats.
4. Then non-critical activities can be rescheduled to the possible extend of floats
5. Reschedule critical activities at last if required



Resource Smoothing	Resource Levelling
Time constraint scheduling (TCS)	Resource constraint scheduling (RCS)
Time is the main constraint	Resource availability is the main constraint
Project duration must be fixed	Project duration can be extended if required
Individual activities only can be delayed within available floats	Overall project / individual activities can be delayed
Changes are not allowed on critical path	Changes are allowed on critical path
Used when resources are unevenly allocated	Used when resources are over-allocated
Often performed after resource levelling	Resource levelling is usually scheduled first
May not be able to optimise all resources if sufficient float / slack is not available	Possible to optimise all resources

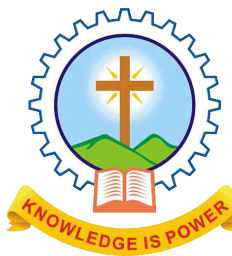


JOB LAYOUT



JOB LAYOUT

Can be defined as site space allocation for material storage, working areas, units of accommodation, plant positions, and also access and outlet for deliveries and emergency services



JOB LAYOUT

Job Layout is a scaled drawing of proposed construction site showing locations / sizes of relevant features such as:

Entry and exit points to the site

Temporary roads

Storage areas for materials

Areas for parking, loading & unloading of materials

Offices of contractors / engineers

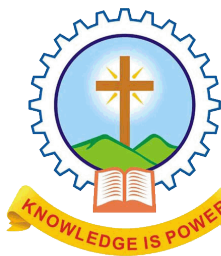
Area keeping for equipment

Bar bending area

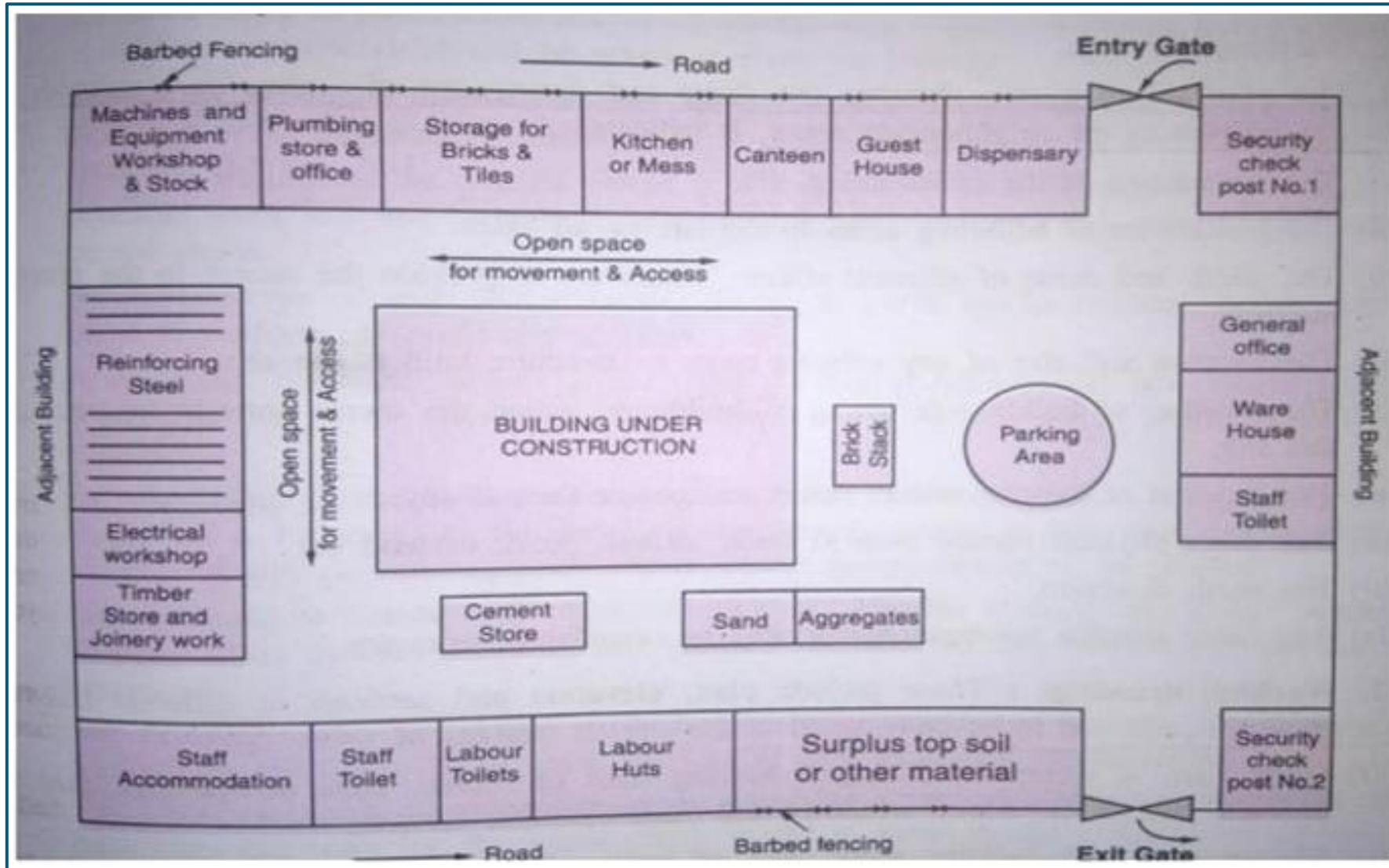
Temporary facilities (electric power, water distribution, drainage, security systems etc.)

Labour housing

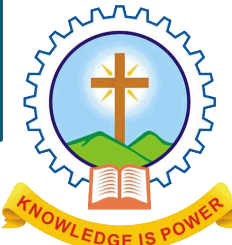
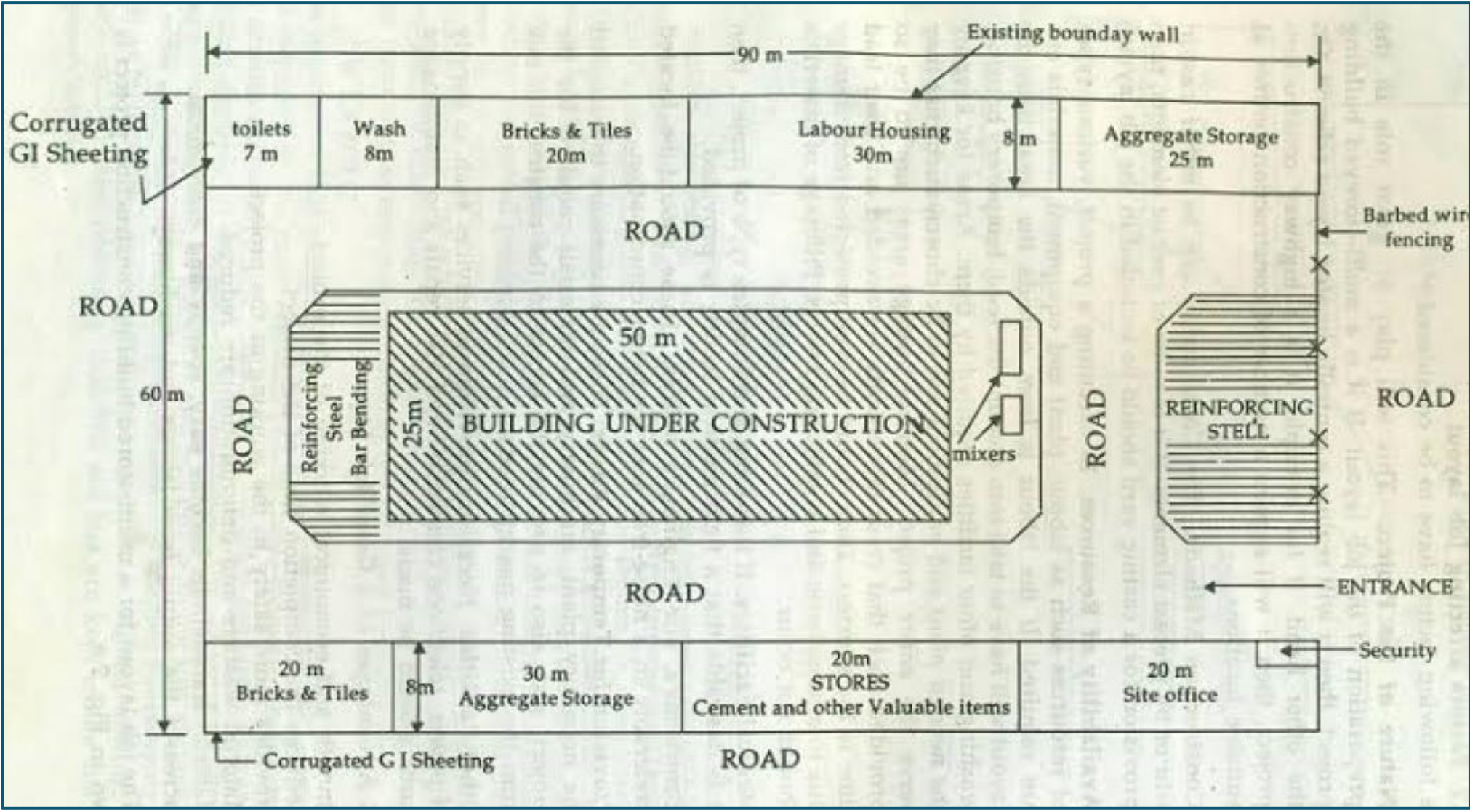
Wash area, toilets etc.



JOB LAYOUT



JOB LAYOUT

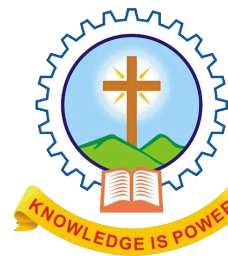


JOB LAYOUT

Construction projects must be organised and executed in most economical & safe manner

Job layout is prepared to ensure that

- The work proceeds smoothly & efficiently without interruption
- Construction resources are so arranged to achieve optimum space utilisation
- Resources can be delivered to site with no delay
- Adequate storage and accommodation facilities available if necessary



FACTORS AFFECTING JOB LAYOUT

Nature & type of work

Location of construction site

Construction methods

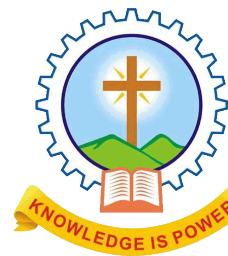
Availability of resources

Medical facilities

Offices

Provisions for roads

Required facilities



ADVANTAGES OF A GOOD JOB LAYOUT

Smooth and economic working of project

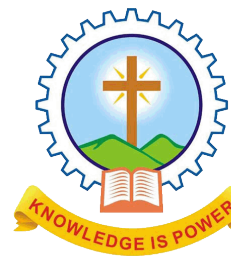
Reduces project completion time

Provides more safety while working

Wastage and deterioration of materials can be reduced

Material transactions will become fast and economical

Increased productivity of labour and machinery

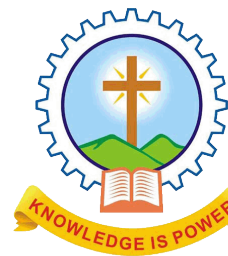


CONSTRUCTION SCHEDULE

Schedule showing the progress of construction with the starting / ending time of procedures & sequential and logical relationship of activities

Including:

- Various activities involved
- Correlations between activities
- Identify key activities
- Duration of activities
- Progress of work
- Types of resources
- Quantities of resources
-



CONSTRUCTION SCHEDULE

Include:

Time schedule

Material schedule

Labour schedule

Equipment schedule

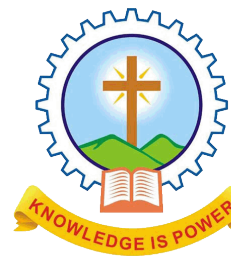
Procurement schedule

Construction activity schedule

Cash inflow schedule

Working capital schedule

Contractors schedule



MATERIAL SCHEDULE

A **material schedule** is a detailed list of construction **materials** required for a specific job

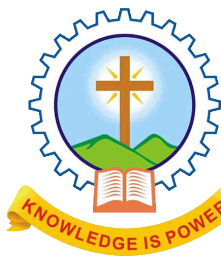
The Material Scheduling gives an overview of the material requirements

Material schedule helps the project manager to assess the timings at which each material is required

Thereby ensures steady flow of materials during project execution

Material schedule should be prepared well in advance of the start of the work

- The material should be delivered at site at proper time earlier than its use
- Materials at site should not remain unused for long



MATERIAL SCHEDULE

A **material schedule** is a detailed list of construction **materials** required for a specific job

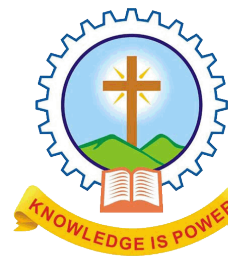
Include:

Type of material resource required for the project

Quantity of resources required

Specifications of material

Material requirement along time line of project

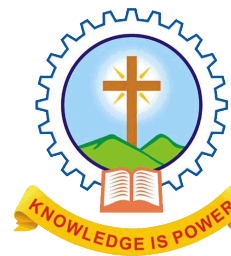


LABOUR SCHEDULE

Labour schedule helps to estimate skilled / un-skilled labours for each activity

Required labour can be arranged in advance

Reduce labour cost



EQUIPMENT SCHEDULE

Equipment schedule is a listing of the equipment required with quantities

- Type & Duration

Equipment use schedule has to be prepared before the start of the project

- To decide the type, number and dates on which a particular equipment will be needed

Include:

Type of equipment-

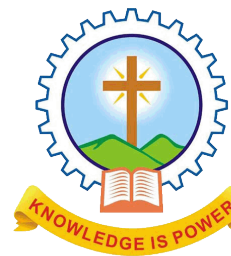
Requirement time and duration of equipment for activities

Release date of surplus equipment

Time required for maintenance work



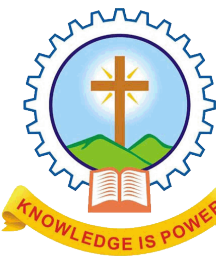
CONSTRUCTION BUDGET



BUDGET

Budget is a financial plan including estimation of revenue and expenses over a specified future period of time

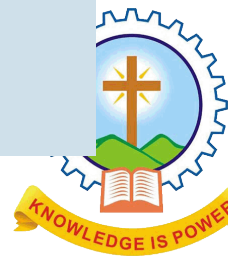
A project budget reflects financial plan for its operations



BUDGET

Include:

- Planned volume of work & its revenue
- Quantity of resources
- Expenses
- Assets & liabilities
- Cash flow
- Budget surplus
- Budget deficit



BUDGET

Primary purpose & significance of a budget:

To improve financial planning & decision making

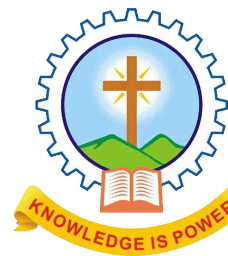
Provide definite targets for income & expenditure

To assign financial targets and resources

- To coordinate activities of various departments
- For controlling performance

As an effective tool for cost control

To identify controllable & uncontrollable cost area



TYPES OF BUDGET

Time

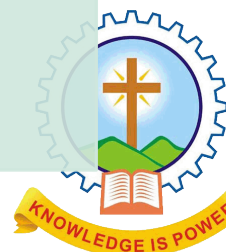
- Long term
- Short term
- Current

Flexibility

- Fixed
- Flexible

Function

- Sales Budget
- Production budget
- Financial budget
- Overheads budget
- Purchase budget
- Labour cost budget
- Cash budget
-



Short term budget

Drawn for a **shorter period** (1 yr, quarterly)

Prepared in detail

Should be enough to cover production for one seasonal cycle

Gets better cost control over day-to-day expenses

Long term budget

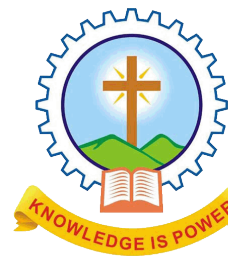
Covers budgets prepared for normally more than one year

Market trends, national income etc. influence long term budget

Current budget

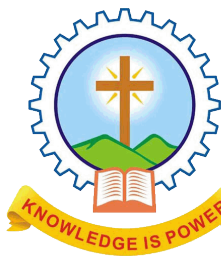
Very short term budget

Prepared **to account currently prevailing circumstances**



Fixed budget

- Budget which is **designed to remain unchanged** irrespective of the level of activity attained
- Drawn on the **assumption that there will be no change** in the budgeted time period
- Helpful only when the actual activity will be equal to budgeted activity
- Is **most suited for fixed expenses**, which have no relation to the volume of output
- Fixed -budget is **not an effective tool for cost control**

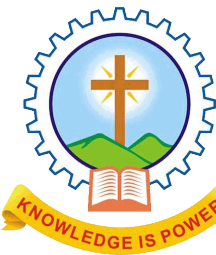


Flexible budget

Budget which is **designed to change** in accordance with the various level of activity attained

This budget serves as a **useful tool for controlling costs**

It is more **realistic, practical and useful than fixed budget**

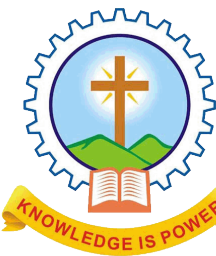


Sales Budget

It is the **starting budget** on which other budgets are based

It is a **forecasting of expected sales** for the period **both in quantity and value**

It shows what product will be sold, in what quantities, and at what prices



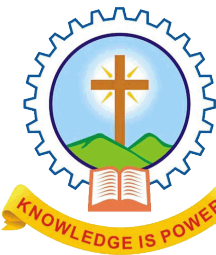
Production budget

Production budget is **prepared on the basis of the sales budget**

The production budget **lists the number of units that must be produced to satisfy sales needs**

And **estimates for the provision of inventory/raw materials**

It is helpful in anticipating the cost of production



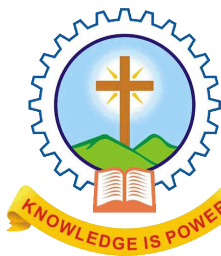
Materials/purchase budget

Purchase budget contains the amount of inventory that a company must purchase during budget period

Fixes the quantity, quality and cost of raw materials needed

Set purchase/storing requirements

The amount stated in the budget must **ensure that there is sufficient inventory on hand** to meet requirements at any point of activity execution



Labour Cost Budget

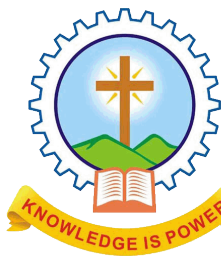
Shows the **number of each grade workmen** needed to complete the activity

Should include number of **working hours and pay scales**

This number must be approved by budget committee

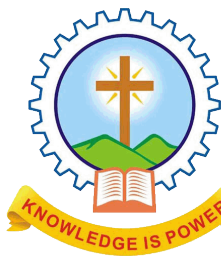
Indicate the **anticipated labour cost** for the budget period

Indicate the **anticipated cost for training** of additionally recruited labour



Plant and equipment Budget:

Which specifies the **needs of machines, equipment and tools** including their **repairs and maintenance**



Cash budget

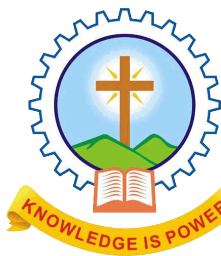
Budget showing detailed estimate of **cash inflow and outflow**

Is a detailed plan showing how cash resources will be acquired and used

Helps to detect possible shortage or excess of cash

Shows tabulated estimates of future cash receipts and payment

Possible to forecast cash balance at defined intervals



TYPES OF BUDGET – MASTER BUDGET

The **master budget** is a comprehensive financial planning document

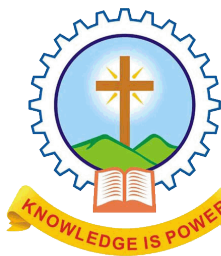
It is usually **a summary of all the divisional budgets**

Also includes budgeted financial statements, a cash forecast, and a financing plan

The master budget is typically presented in either a monthly or quarterly format, and usually covers a company's entire financial year

The master budget is composed of three parts:

1. Operating budget
2. Capital expenditure budget
3. Cash/financial budget



MASTER BUDGET

Master budget: summarises different functional budgets

Include:

Defined objective of project

Materials budget

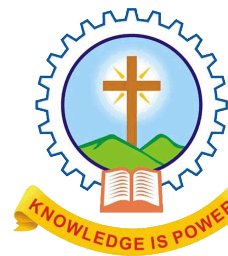
Direct labour budget

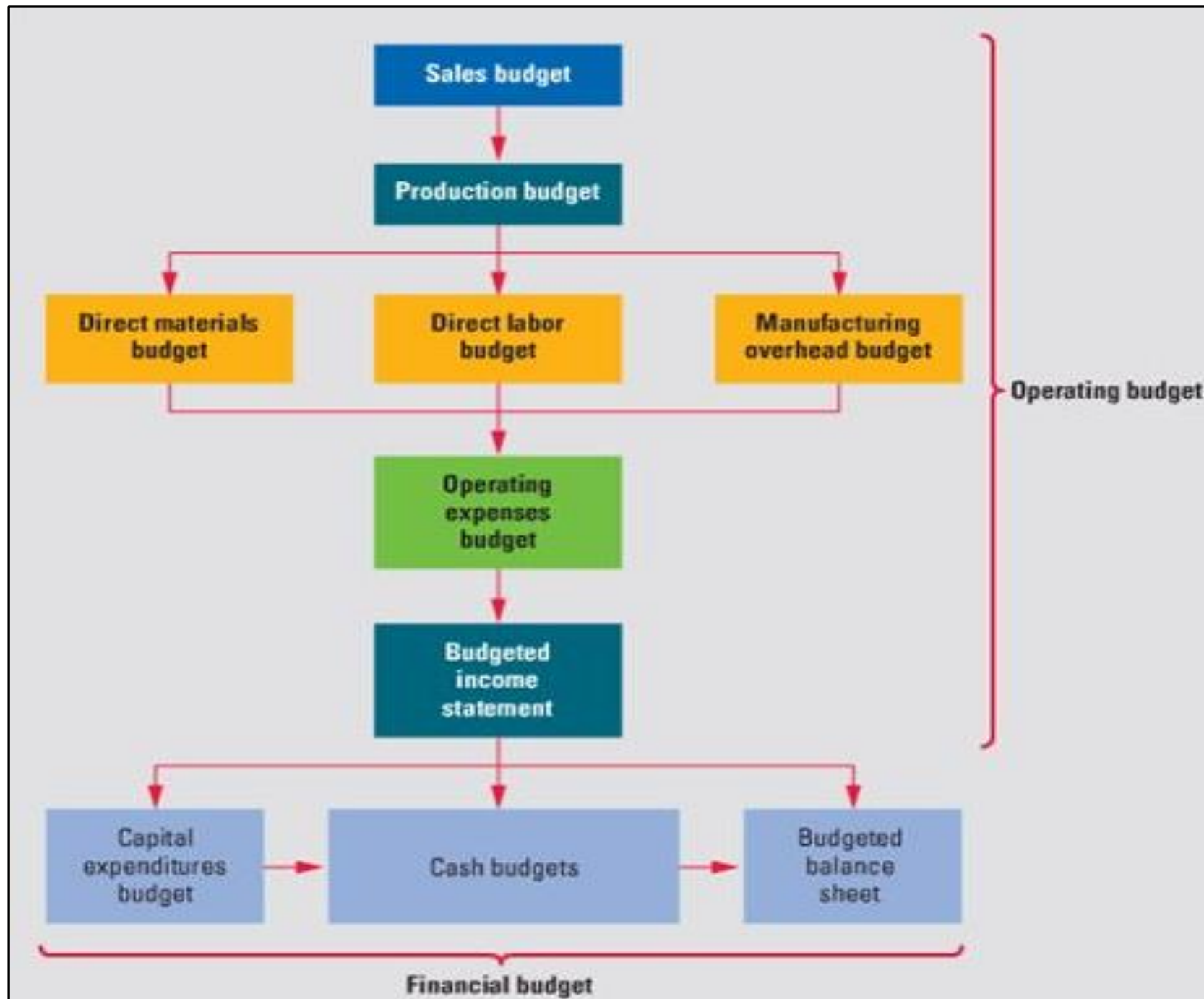
Overhead budget

Administrative budget

Financial budget

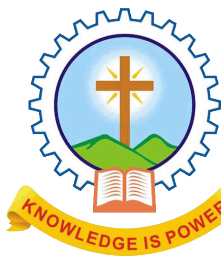
....





Mater Budget - Applications

- Combines all of the smaller budgets
- Can get a comprehensive overview of finances
- Important planning tool
 - While planning, management discusses the overall profitability and the asset and liability
- Measures performance
- Helps in improving the efficiency & interdivision coordination

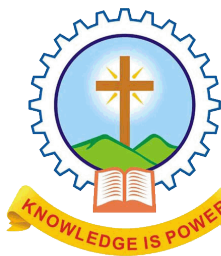


Advantages

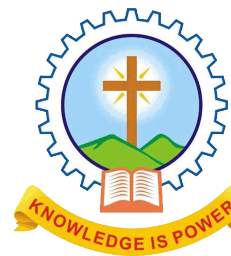
- Summary of the Divisional Budget
- Planning in Advance
- Motivation to Staff
- Gives an overall estimated profit of the organization
- Continuous improvement

Disadvantages

- Rigidity
- Difficult to update
- Includes uncertainty
- Not be accepted in all levels of management



CONSTRUCTION COST



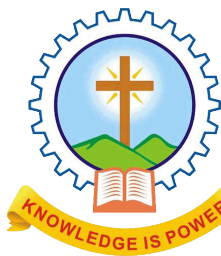
CONSTRUCTION COST

Construction cost comprise of the expenditures incurred by the various construction activities

Construction includes more than one element

Cost management must be considered from

- **Client's part:** Expense continue during design, execution & commissioning stages
- **Contractor's part:** Expense of input resources



CONSTRUCTION COST

Cost of any construction activity include:

Land procurement cost

Legal / approval expenses

Contractor's cost

Construction cost

Administration cost

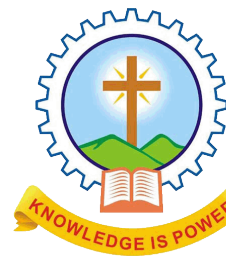
Labour cost

Materials cost

Equipment cost

Consumables cost

Overhead cost



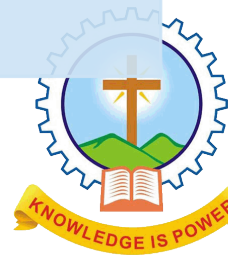
CONSTRUCTION COST

Direct cost

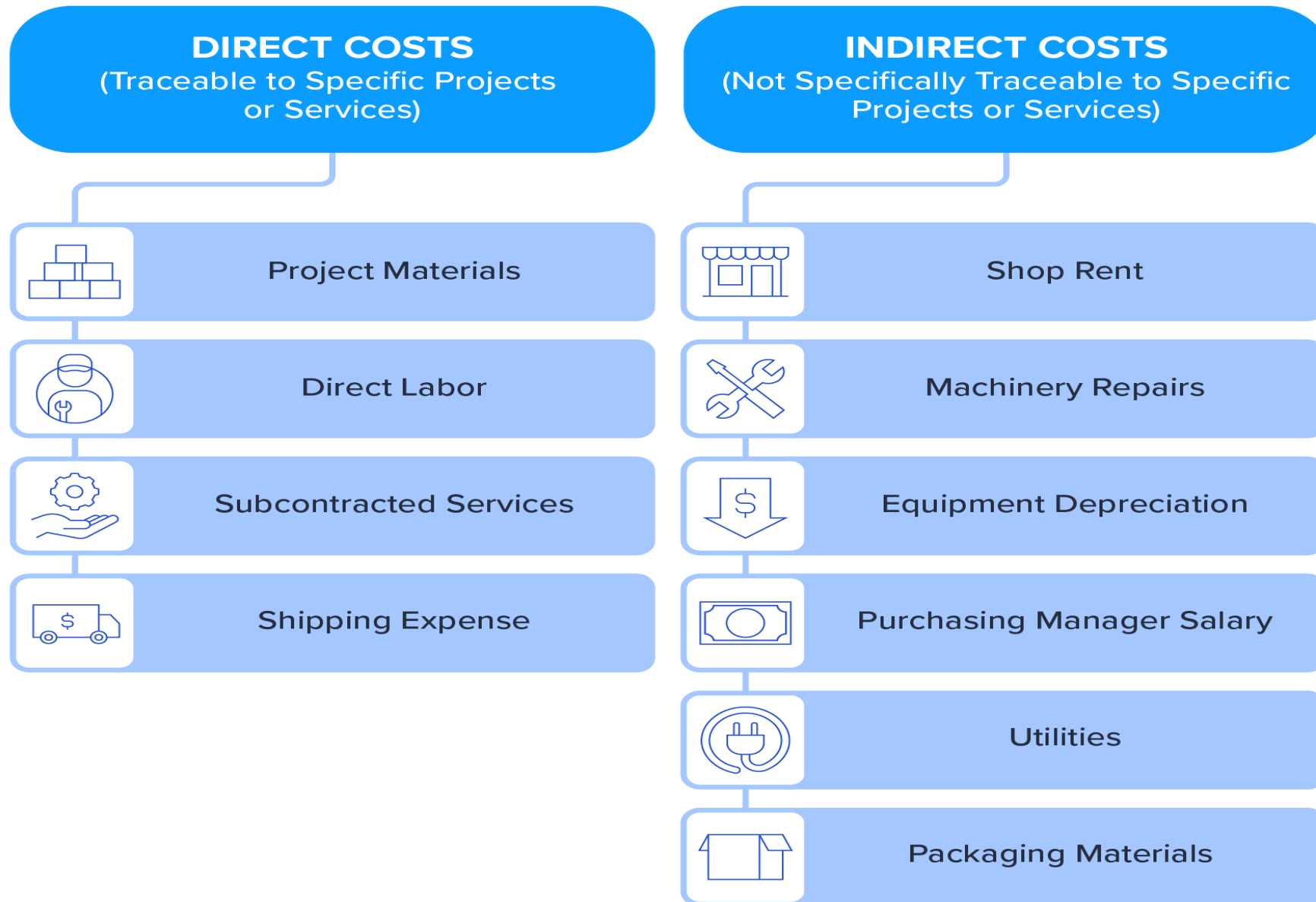
- Material cost
- Labour cost
- Other direct expenses
- Eg: Salary

Indirect cost

- Material cost
- Labour cost
- Other indirect expenses
- Eg: Rent



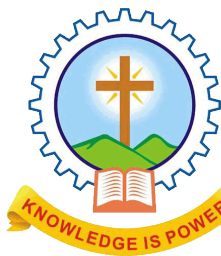
Direct Costs vs Indirect Costs



DIRECT COST

Expenses associated with the execution of any activity is termed direct cost

- Material cost
- Labour cost
- Other direct expenses



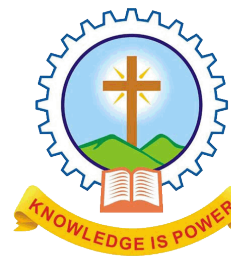
DIRECT MATERIAL COST

Costs connected with materials for project

These can be measured and costing done item-wise

Include:

- Purchase costs
- Transportation costs
 - Freight charges, customs clearance, insurance, handling charges
- Site manufacturing / fabrication charges
 - Door/window fabrication
 - Steel reinforcement fabrication
 - Tiles, bricks fabrication

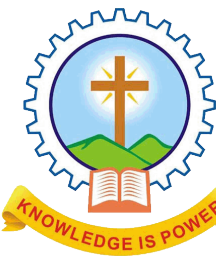


DIRECT LABOUR COST

Net expenses for procurement and wages for employees

Include:

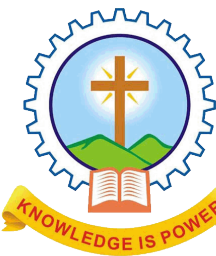
- Basic wages
- Over-time allowances
- Expenses for recruitment & conveyance to site
- Expenses such as earned leave, PF, insurance etc.



OTHER DIRECT EXPENSES

Include expenses for:

- Subcontracted activities
- Special purpose plant and machinery
- Hired resource cost
- Temporary activities for a specific work
- Special technical consultant services like architectural designing



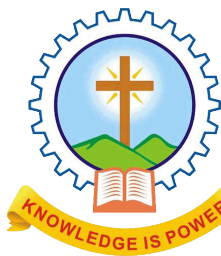
INDIRECT COST

Costs which are attributable to an entire project but cannot be identified with the performance of a single specific activity

All costs other than direct costs are indirect costs

Depends on nature of work

Constitutes a significant amount of construction cost varying from 7.5 % to 35 % of total cost

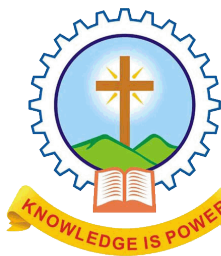


INDIRECT COST

1. Production overheads

Include all indirect manpower, materials and other expenses incurred by production responsibility centre

- Indirect manpower costs
 - Salary and wages of supervisors including construction management and related staff, clerks, security, site cleaning etc.
- Indirect material costs
 - Consumables, minor equipment
- Other indirect expenses
 - Plant hiring costs



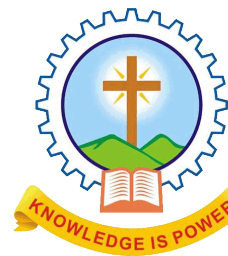
INDIRECT COST

2. External support service cost

Include all indirect manpower, materials and other expenses of the functional setup **which provide technical and logistic support**

Includes:

- Technical design & quality control services
- On site manufacturing services
- Personnel and security services



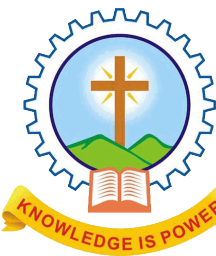
INDIRECT COST

3. Administration overheads

Include all indirect manpower, materials and other expenses incurred by project management the direction, control and administration

Includes:

- Office management costs
- Planning & co-ordination cost
- Marketing & contract management costs, etc.

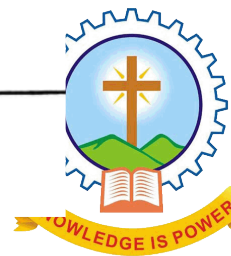
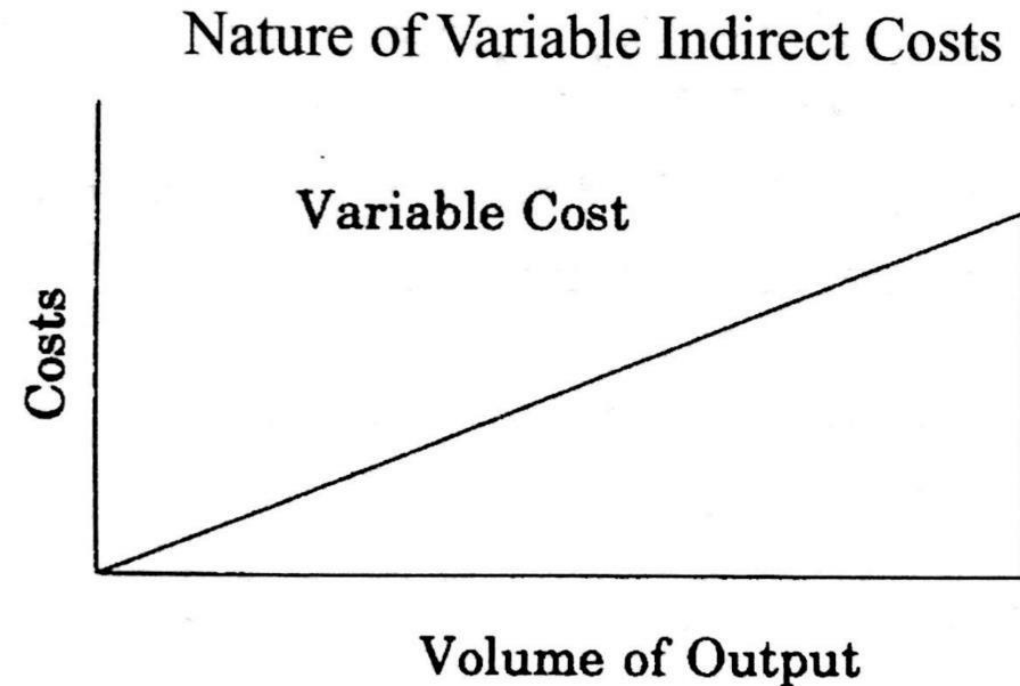


INDIRECT COST BEHAVIOUR

1. Variable cost

Vary directly with volume of work done

Variable costs are assumed to have a constant rate of change with volume of work



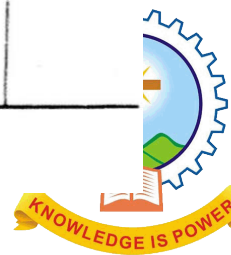
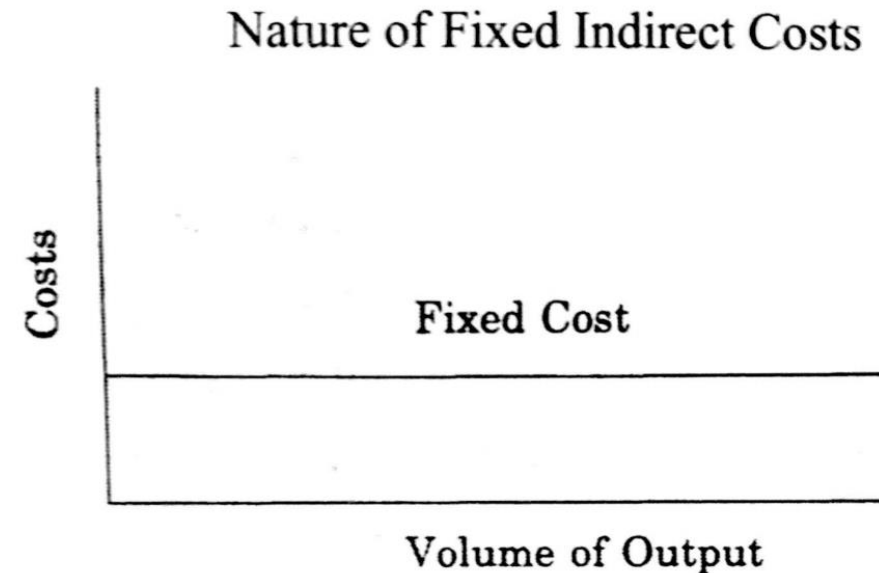
INDIRECT COST BEHAVIOUR

2. Fixed costs

Fixed costs do not show any considerable variations throughout the life-cycle of a project

Either one time costs or recurring costs

Eg: supervisor's salary, monthly rent etc.



INDIRECT COST BEHAVIOUR

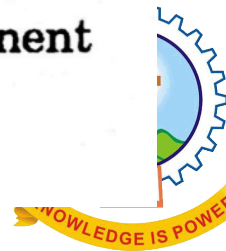
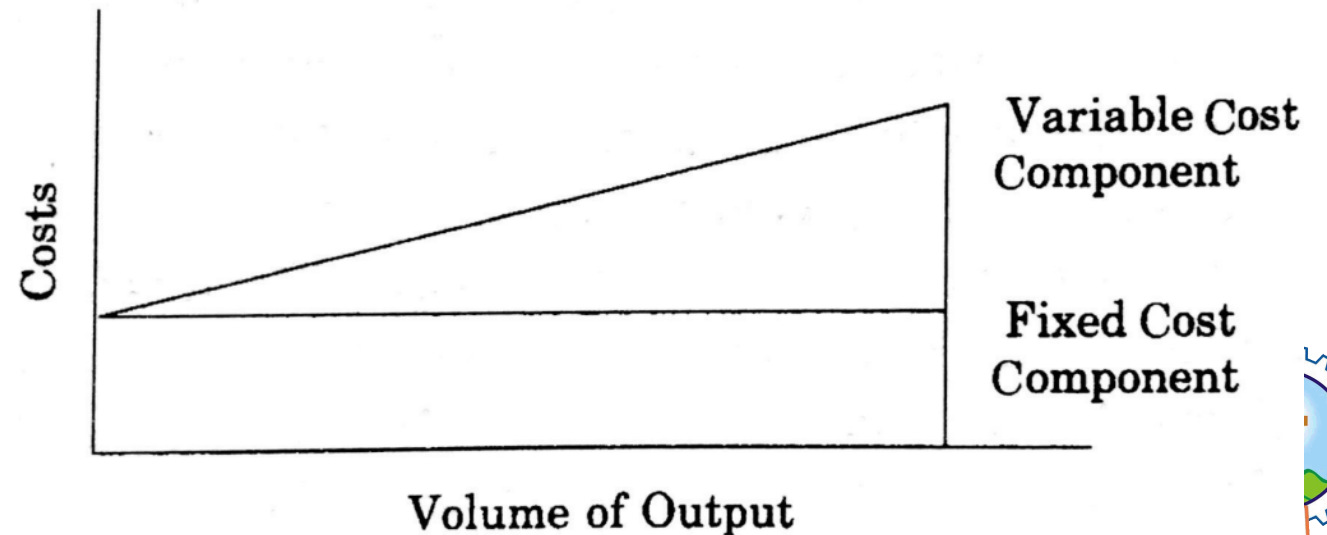
3. Semi-variable costs

These are partly fixed and partly variable costs

May vary with volume of activities

Eg: Telephone expense (fixed installation charge & variable operation charge)

Nature of Semi-variable Indirect Costs



UNIT RATE COSTING OF RESOURCES

Costing:

Method of estimating project cost

Unit Rate Costing:

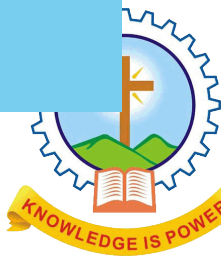
The standard cost
for one unit of
product

=

Standard rate
for one unit

x

Standard
quantity for
one unit of
product



UNIT RATE COSTING OF RESOURCES

For estimating costs of works, the expenses for resources (eg: manpower, equipment and material) are computed in terms of unit cost / hourly cost as:

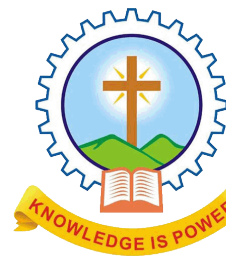
- 1. Activity Labour cost** = Labour Effort in Hours X Standard Labour Hourly Rate
- 2. Activity Equipment** = Equipment Utilization Hour X Standard Equipment Hourly Rate
- 3. Activity Materials Cost** = Material Consumption Quantity X Standard Materials Unit Price

LABOUR STANDARD HOURLY RATE

Direct labour – employed in monthly/daily wages – paid on hourly rate basis

Hourly standard rate include expenses on:

- Procurement
- Wages
- Benefits
- Statutory costs – expense demanded by law



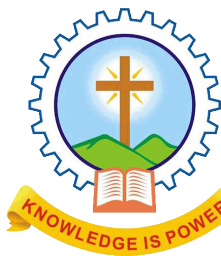
LABOUR STANDARD HOURLY RATE

For costing purpose direct labour is categorised into:

Foreman/supervisors, highly skilled, skilled, semi skilled and unskilled

This mode of estimation include annual labour estimated cost & number of productive hours in an year

Labour hourly standard cost =
$$\frac{\text{Annual estimated labour cost}}{\text{Annual productive hours}}$$



EQUIPMENT HOURLY STANDARD RATE

Equipment rate per hour = Owning cost per hour + Operating cost per hour

Owning cost

- Depreciation
- Interest on investments
- Taxes

Operating cost

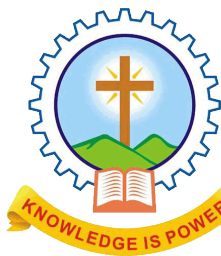
- Fuel cost
- Maintenance / repair cost
- Operator's cost
- Replacement cost



MATERIALS STANDARD PRICE

Defined as the estimated all-in price of the unit quantity of an item, delivered at the project site

- All-in price include: Source Price, Wastage Costs, Transportation Costs and Taxes



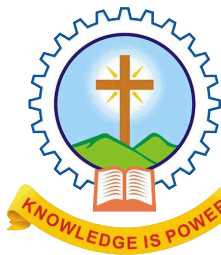
MATERIALS STANDARD PRICE

Purchase price can be estimated from

- Response to quotation invitations
- Standard price catalogues
- Past experience

Purchase price depends on

- Quantity required
- Delivery lot size
- Delivery dates
- Shelf life
- Payment terms



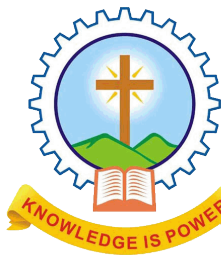
CONSTRUCTION DISPUTES

Dispute

Dispute implies assertion of right or claim by one party and rejection by another

During any project execution several issues may arise among project participants

Results in disputes between employer, engineer and contractor on various factors such as defect in construction, payments, time lag etc.



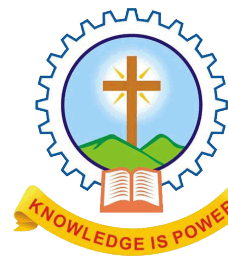
CAUSES OF DISPUTES

Dispute arises when the contracting parties disagree with a particular claim as per the contract document

There may be insufficiency in contract preparation such as:

- All the required information are thoroughly incorporated in tenders
- Inaccuracies in contract data
- Discrepancies in site data, drawings & quantities

Incompleteness, inaccuracy & inconsistency are only part of the causes for construction disputes



CAUSES OF DISPUTES

Incorrect Ground Data

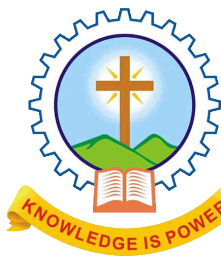
- Ground data include details such as soil properties, ground water level, temperature, etc.
- Contractor estimations are based on ground data provided with tender document
- Variations during execution time may result in disputes

Use of Faulty/Ambiguous provisions/Language in contracts

- Language of contract must be clear and not open to different interpretations
- Clear documentation must be given for procedures in case of any contingencies

Deviations

- The contract should be so designed that there must not be significant extra items & deviations



CAUSES OF DISPUTES

Unreasonable attitude

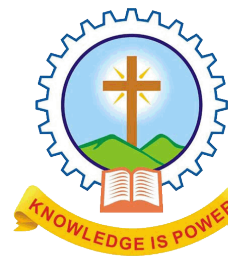
- Project participants must preserve mutual trust
- Need to keep professional approach even at stages of disagreements

Contractor being of poor means

- The contractor must have sufficient resources to carry out the project
- If not may resort to suspension or termination of projects/contracts

Unfair distribution of risks

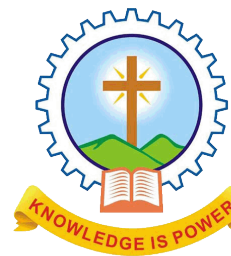
- When contractors are unfairly forced to take the risks, will cover that by hiking rates, which results in increase in project cost



DISPUTE AVOIDANCE

Means to avoid disputes:

- Fair allocation of contract risks
- Proper drafting of contract
- Use provisions for Alternate Dispute Resolution (ADR)



CATEGORIES OF DISPUTES

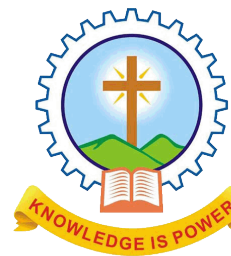
Contractor's claims against the client:

Claim for extra due to delays caused by employer

Claims for refund of money wrongly deducted

Interest on delayed payments

Compensation for breaches of contract committed by employer



CATEGORIES OF DISPUTES

Client's claim against the contractor

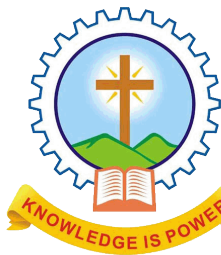
Claims for liquidated damages for delays caused by contractor in completing the work

Claims for defective work done

Claims for over payments made to the contractor

Interest on amounts claimed by the client

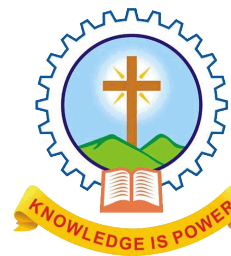
Claims by client in case of incomplete works by contractor which had to be completed by another agency



MODES OF DISPUTE RESOLUTION

Basic modes to resolve disputes during construction projects:

1. Negotiation
2. Mediation & Conciliation
3. Arbitration
4. Court Action



SETTLEMENT BY NEGOTIATION

By direct negotiations between the client and the contractor

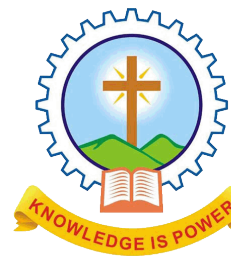
Focus on discussion on dispute among all interested parties

Resolve dispute without involvement of a third party

Process is fast & does not involve additional expense

Is an informal process, but if an agreement is reached, it may have legal significance

Best & most recommended mode of settlement of disputes



MEDIATION & CONCILIATION

Parties in dispute are assisted by neutral third parties towards settlement

An informal process

The mediators try to advise and consult impartially to bring about a mutually agreeable solution

Non-binding unless an agreement is reached

Advantages:

Less time consuming

Involve lesser costs

Outcome can be more satisfying to the parties

Minimise chances of further disputes

Provide increased confidence to parties on the ability to handle disputes



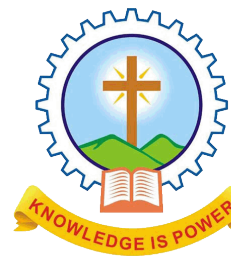
SETTLEMENT BY COURT ACTION

Dispute settlement through court action is normally taken as a last resort only

May take a number of years for court settlement

In case contractor strongly feels that injustice has been done at the direct negotiations or arbitrator level, then he should go to the court of law

Will require physical presence of contractor or contractor's top personnel



SETTLEMENT BY ARBITRATION

Arbitration is a private, contractual form of dispute resolution

Provides for the resolution of disputes by a neutral third party called arbitrator or arbitration panel

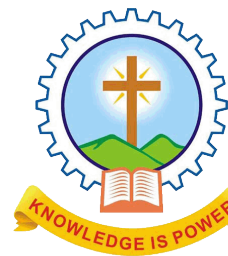
The arbitrator is chosen by the parties of disputes

Disputes are resolved on the basis of material facts, documents and relevant principles of law

- The arbitrator acts as the judge

The arbitration process is administered subject to relevant contractual rules and statutory framework applied by domestic courts

In India “**The Arbitration and Conciliation Act, 1996**” provides legal frame work for arbitration process



ARBITRATOR

Selecting arbitrator

The arbitrator is chosen by the parties of disputes

Must be impartial towards parties of disputes

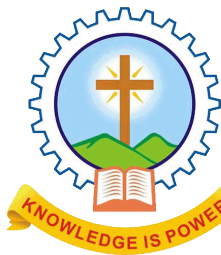
Person with sufficient technical knowledge to judge the dispute

Should understand the legal procedures

- Including collection & interpretation of evidence, examination of witness etc.

There can be a

- **Sole arbitrators** - agreed by both parties
- **Joint arbitrators** – when each party appoints their own arbitrator
- These individuals together chose a **third colleague arbitrator** to complete the bench of arbitrators



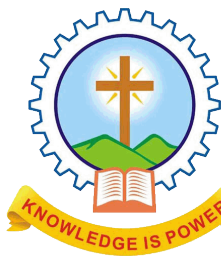
ARBITRATION AWARD

Arbitration award is the award granted by the arbitrator in their decision

It is the final and binding decision made which resolves, wholly or in part, the dispute submitted to the jurisdiction

This award can be money one party has to pay to the other party

It can also be a non-financial **award**



Arbitration Award - Types

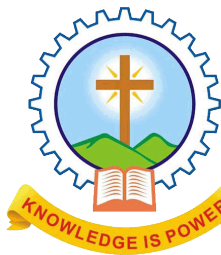
Interim Award: This is a temporary award until the tribunal has given its final decision

Partial Award: Some elements of the claim have been determined but other issues remain and need to be resolved before the final award is made. Parties can continue arbitrating the remaining issues

Performance Award: A party can be ordered to perform specific works as award other than monetary award

Final Award: This is usually in writing and signed by all the arbitrators. It must also be dated for calculating interest on payments. Once the final award is made this ends proceedings.

Additional Award: Usually once the final award is made, the tribunal has no further authority. The parties can request an additional award be made on an undecided issue still in dispute



ARBITRATION - ADVANTAGES

Faster than court litigation

- The cases can be handled quickly than the court proceedings and hence is more cost-effective

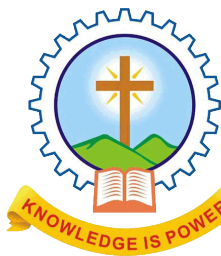
More flexible

- The scope of arbitration procedures can be decided by the parties themselves & can be deviated from the complex court proceedings

Privacy & confidentiality

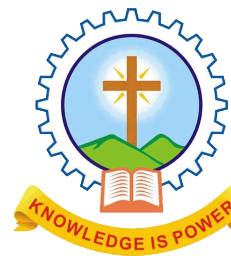
- Arbitration is a private method of dispute settling. Arbitral proceedings & arbitral awards are more confidential. General public are not allowed and the documents are also not to be made public

Need not follow official language of judicial proceedings



ARBITRATION - ADVANTAGES

- **Choice of arbitrator**
 - Ideal for technical disputes
 - Disputing parties can themselves decide the arbitrator. Since the arbitrator will be a person with domain knowledge than be a lawyer can give better resolutions
- **Economic**
 - Arbitration processes are more cost effective than court actions



ARBITRATION - DISADVANTAGES

Limited authority of arbitrators

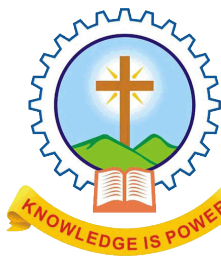
Process may subject to pressures from the stronger/wealthier side

The fees for arbitrator may increase the legal cost. This may not be cost-effective for smaller disputes/projects

Arbitration agreements may be sometimes present in ancillary agreements in contracts

- This causes parties to waive their right to access courts and to have a judge/jury to decide the case

In case of multiple arbitrators, setting hearing dates as per everyone's schedule may lead to delays

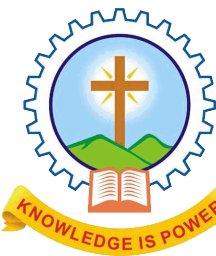


ETHICS

Ethics are moral principles that govern a person's behaviour or conducting of an activity

Ethics can be defined within a context of:

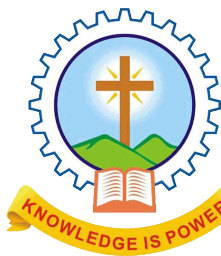
- Cultural values
- Professional values
- Social norms
- Accepted standards of behaviour



ETHICS

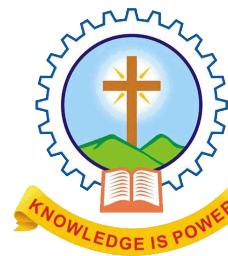
Professional Ethics defines the personal and professional standards of behaviour expected by professionals

Engineering Ethics are moral principles that apply to the practice of engineering



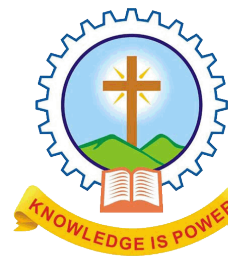
Need For Ethical Principles

- ❖ Promote **goodwill and reputation** of the organization
- ❖ Improve the **relationship with customers**
- ❖ Promotes **social responsibility** of the firm
- ❖ Improves **work environment**
- ❖ Retain **good employees**
- ❖ Avoid **legal problems**



Principles of Ethics

1. **Honesty:** Acting with Honesty, not to deceive others
2. **Accountability:** Being responsible for the work entrusted
3. **Integrity:** Having consideration for the interest of public
4. **Reliability:** The quality of being trustworthy or of performing consistently well.
5. **Objectivity:** Identify and resolve any cases of conflict of interest
6. **Fairness:** Applying the same rules, standards and criteria in similar situations
7. **Fair Reward:** Avoid acts which obstruct fair reward of others



Ethical Issues In Civil Engineering

Use of **low quality material** for construction

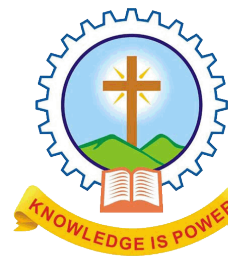
Bribery & Corruption

Fraud or deceit to obtain financial or other advantages

Extortion: When one party threatens other of adverse consequences unless other party meets certain demands

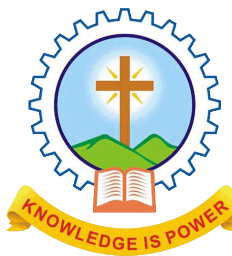
Making additional earnings by presenting **false claims**

Not adhering to the permits from government authorities regarding construction mandates



Ethical Issues In Civil Engineering

- **Overbilling by increasing unit price** for activities to raise cash flow
- **Hiding incompetency**
- **Not providing** labours with **safety equipment or insurance** as per law
- Government firms bidding against private firms while being a part of tendering process and unfairly penalize private firms
- Granting tenders to lowest quoted parties without considering experience & capacity



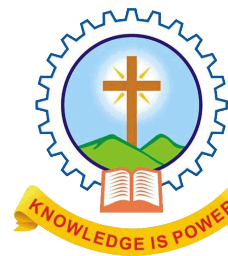
Ethical Issues In Civil Engineering

Tendering

- Client give more vital information to preferred tenderers - Bias in tendering
- Bias in tendering evaluation for major tenders
- Clients preselecting contractors and then doing tender for a statutory requirement only
- Contractors overstating their capacity and qualification & experience

Consultant Fees and Project Costs

- Developers not properly pay the consultants
- Main consultants cutting costs of another consultant's fee
- Main contractors deducting subcontractors fee without proper justification



Code of Ethics

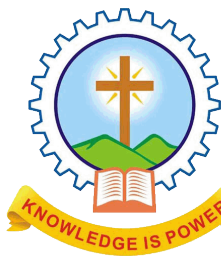
A code of ethics is a guide of principles designed to help professionals conduct works with honesty and with integrity

An ethical code may include business ethics, a code of professional practice, and an employee code of conduct

If violated will lead to ethical problems

Provides a framework for ethical judgement

Defines roles and responsibilities of professionals



Code of Ethics - ASCE

As per ASCE engineers shall adhere to certain ethical values such as:

Emphasise on **safety, health & welfare of public**

Perform services in the **area of their competence**

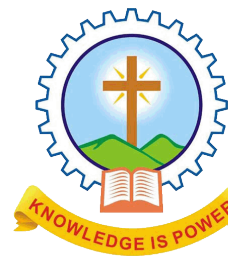
Issue **public statements** in a truthful manner

Act in a **professional manner to all participants** in the projects

Build their professional reputation on **basis of merit of services**

Not compete unfairly with others

Treat all people from different backgrounds & identities equally



Code of Ethics - ASCE

Have **no tolerance to bribery, fraud & corruption** - avoid deceptive acts

Act in a professional manner as to **uphold and enhance honour, dignity & integrity of profession**

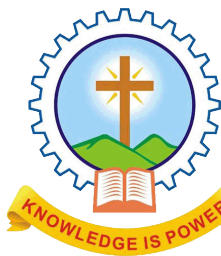
Acknowledge their errors and shall not distort or alter the facts

Engineers shall **advise their clients/employers when they believe a project will not be successful**

Avoid conflicts of interest

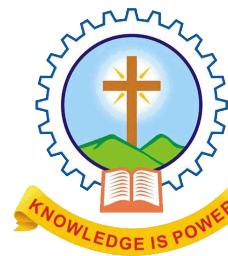
Continue their professional development throughout the careers

Should act accordingly to their **social, ecological and economic responsibilities**



Professional Code For Ethics

1. Act with honesty and without deception
2. Act fairly so as not to obtain advantage
3. Act with integrity and in the public interest
4. Conduct themselves for the greater good of clients and society at large
5. Treat & Support everyone equally irrespective of differences
6. Be respectful & chose words carefully
7. Act with objectivity by identifying and addressing potential conflicts of interest
8. Exercise professional diligence in standards of work and education
9. Seek to improve the reputation of the construction industry
10. Comply with all relevant legislation and regulations

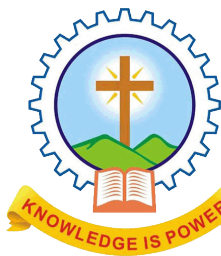


Role of professional bodies

A professional body is an organisation with individual members practicing a profession or occupation in which the organisation maintains an oversight of the knowledge, skills, conduct and practice

- Professional bodies indulge in to the advancement of the knowledge and practice of professions through developing, supporting, regulating and promoting **professional** standards for technical and ethical competence

Eg: ASCE, ICI, ICE



Role of professional bodies

Set & assess professional examinations

Provide support for continuing professional development

Publish professional journals and magazines

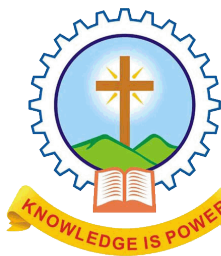
Provide networks for professionals to meet and discuss their field of expertise

Issue a code of conduct to guide professional behaviour

Deal with complaints against professionals and implement disciplinary procedures

Promote fairer access to the profession for people from all backgrounds

Provide career support and opportunities students, graduates and people already working in the profession



PROJECT MANAGEMENT INFORMATION SYSTEM

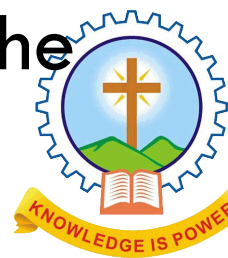
Project Management aims to achieve project objectives within certain constraints

Project implementation encounters unpredictable problems

If an effective information system is present:

- These can be handled more effectively
- Can take better and effective decisions

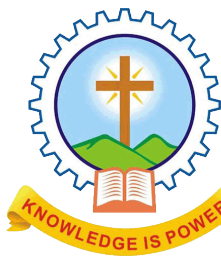
Information system: is a set of interrelated components which identify, process and store information/data which can help in the decision making process of an organisation



PROJECT MANAGEMENT INFORMATION SYSTEM

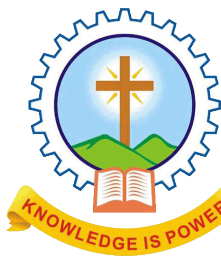
PMIS is an **integrated user-machine** system

For effective planning and control of project objectives by providing information to support the activities, managing and decision making



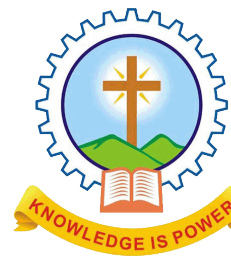
PROJECT MANAGEMENT INFORMATION SYSTEM

- **PMIS** gathers, integrates and distribute the project performance information to authorities
- PMIS **with the aim of proper** planning, executing, controlling & closing of project
 - Monitors the project activities and resources employed
 - Analyses and forecasts project performance
 - Control the project changes
 - Circulates the information to authorities/stake holders of organisation
 - Facilitates efficient communication & feed back



PROJECT MANAGEMENT INFORMATION SYSTEM

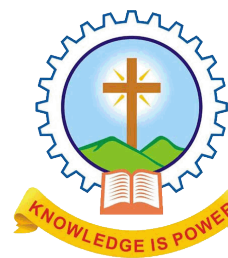
PMIS involves:



IMPORTANCE OF INFORMATION

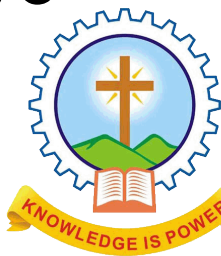
An efficient PMIS generates information which helps to:

- Improve the productivity of resources
- Enable the understanding of time & cost
- Provide early warnings for any possible issues
- Update resources planning & costing if necessary
- Bring transparency
- Organise data according to need
- Provide faster information on the progress of works



CHARACTERISTICS OF INFORMATION

- **Accuracy:** Information must be reliable, precise, clear, consistent. Should not mislead
- **Timely:** Must be available when needed
- **Economical:** Economical enough to warrant the situation
- **Adequate:** Insufficient information affects decision making process and excess information gathering involve extra costs
- **Usable:** The information provided to the manager should be relevant to his area of responsibility
- **Comprehensive:** Information must be presented in comprehensive manner with appropriate graphs & highlighting of critical factors

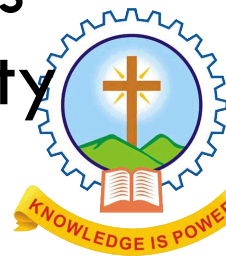


SOURCES OF INFORMATION

PMIS derives information from project's internal & external sources

Internal sources includes:

- Base plan
- Reports from project team
- Site visits
- Study of standard documents
- Performance data reports from:
 - Work management system, time management system, resources management system, costs & finance management system, quality management system, etc.

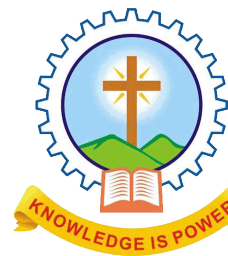


SOURCES OF INFORMATION

PMIS derives information from project's internal & external sources

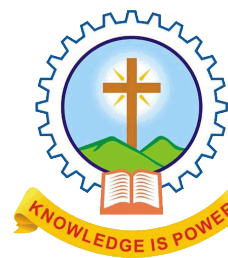
External sources includes:

- Government policies
- Research publications, industrial journals, websites
- Contractors, government & public sector agencies
- Architectural & engineering associations
- Professional bodies
- Builders & consultant associations
- National building codes
- Construction specifications etc



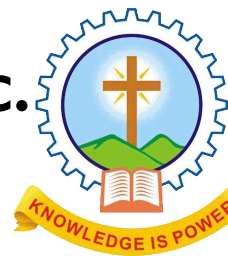
FUNCTIONS OF PMIS

1. To **develop a PMIS strategy** consulting with all project participants including project team & management
2. To **establish an initial database** with proper information
3. To **set standards** against which progress of work and cost can be compared
 - Include: Time/resource/material/labour schedule, quality & productivity standards
4. To **organise efficient means** of measuring, collecting, verifying & quantifying the data (regarding time, cost, resources, quality etc.)
5. **Identify and acquire data** from internal & external services
 - Client, suppliers, consultants, project team members etc.



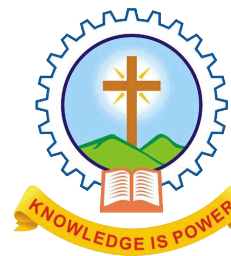
FUNCTIONS OF PMIS

6. **Manage the way of converting** the available data from the operations/activities to information
7. **To report the information** which are **correct & necessary** in a form which is interpretable in detail by managers or supervisors who will use those later. *i.e proper representation of information*
8. To provide **exception reports** highlighting the critical factors
9. **To communicate information in time** to have best corrective measures and remedial actions
10. **To create & store digital database** of documents, drawings, etc.



COMPONENTS OF PMIS

1. Hardware
2. Software
3. Database
4. Related documents
5. Operators
6. Procedures
7. Organisation breakdown structure



COMPONENTS OF PMIS

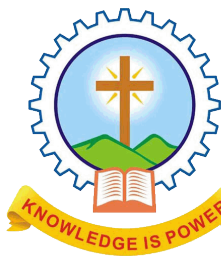
Hardware:

- Include all electronics & electro-mechanical equipment used in the computerised data processing system
- Consists of input/output devices, CPU, storage devices etc.

Software:

Hardware needs proper instructions to carry out specific operations

Software: Is a set of instructions / programs to carryout specific tasks



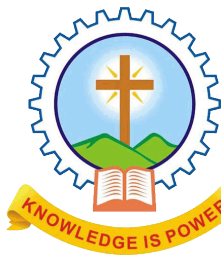
COMPONENTS OF PMIS

Database:

Involve all the data required by the software & management models

Data:

- Data is the raw input
- Data represents unanalysed facts, and events
- Data is processed to retrieve information



DATA MANAGEMENT

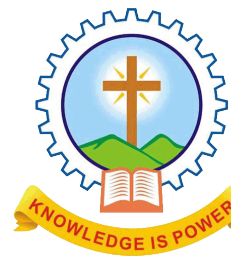
2 types of data in project management

1. Basic document data

Covers the project initial database & project baseline plans

Include: approved design & drawings, contract documents, purchase orders etc.

From these data information effective & efficient functioning of project can be analysed



DATA MANAGEMENT

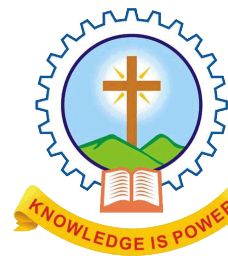
2 types of data in project management

2. Performance data

Represents actual outcome of a planned activity on a given date

Derived through performance evaluation reports, observations, appropriate measurements

Performance data is analysed by monitoring centre to check deviations from basic data & standards and make appropriate decisions



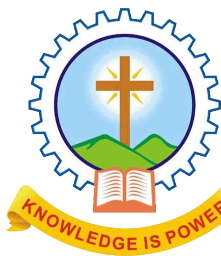
COMPONENTS OF PMIS

- **Operators:**

- Include data preparation personnel, system analysts, programmers, computer operators, etc.

- **Procedures:**

- Include basic steps to analyse data and carry out project activity
- Formal operating procedures in the form of manual or instruction booklet

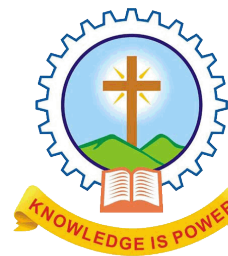


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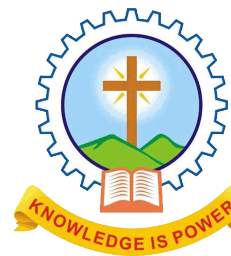
Concept of materials management – inventory – inventory control – Economic order quantity- ABC analysis. Safety in construction – Safety measures in different stages of construction – implementation of safety programme.

CONTENTS

- Safety in construction
 - Importance of safety measures
 - Causes of accidents
 - Safety measure to be adopted for different activities
 - Construction measures in different stages of construction
 - Implementation of safety programs



SAFETY IN CONSTRUCTION



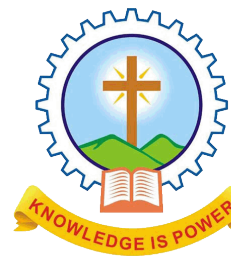
CONSTRUCTION SAFETY

Safety in construction procedures is a **vital part in the success** of a project

Construction industry is a **highly accident prone field**

Proper safety considerations are also essential for humanitarian and economic front

When **equipped with proper safety programmes**, the **safe work environment** will lead to more **effective & efficient working** from employees



TYPES OF ACCIDENTS

Accidents in construction industry are mainly due to:

Fall from high elevation 50-60%

Trapped by something collapsing or overturning 15-20 %

Being struck by an equipment or moving vehicle 10-15%%

Contact with electricity 5 %

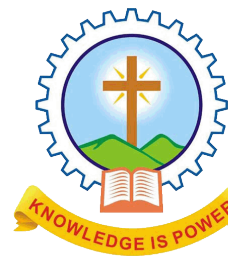
Exposure to harmful substance 1%

➤ During tunnelling & excavation

➤ Drowning

➤ Lifting of equipment

➤ During transportation



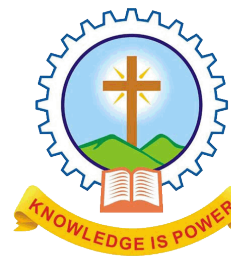
IMPORTANCE OF SAFETY MEASURES

HUMANITARIAN CONCERN

- Suffering of injured workers and families
- Proper safety accessories must be given
- Proper insurance must be organised for construction workers

LAWS AND REGULATIONS

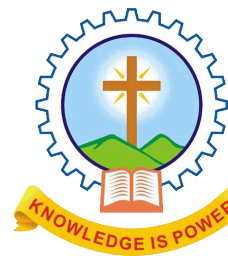
- As per laws and regulations, it is employer's responsibility to provide proper safety measures
- Violation of these laws are punishable



IMPORTANCE OF SAFETY MEASURES

MANAGEMENT CONSIDERATIONS

- A good safety record can improve morale and trust of employees
- Also improve company's public image, thereby easier to acquire negotiated jobs
- Eliminate compensation insurance
- Get greater margin of profit



IMPORTANCE OF SAFETY MEASURES

SAFETY OF MATERIALS AND EQUIPMENT

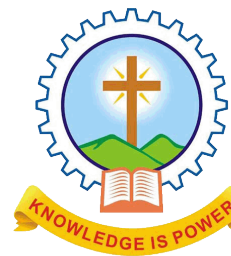
To avoid loss or spoilage of materials

To avoid damage of equipment

SAFETY OF STRUCTURE

To ensure minimum cost of construction

To ensure good quality of construction and better rate of work progress



IMPORTANCE OF SAFETY MEASURES

ECONOMIC REASONS

Many additional expenses will incur from accidents in site

Direct cost from accidents:

- Medical expenses
- Workman's compensation
- Increase in insurance premium
- Replacement of equipment/material damaged
- Court fees

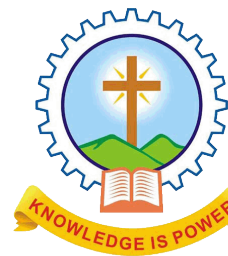
Indirect cost from accidents:

- Slow down of operations
- Decrease on productivity
- Administrative works associated
- Loss of clients' confidence
- Overtime necessitated by slow down in work

CAUSES OF ACCIDENTS

The causes of accidents in a construction site may be grouped according to their nature:

- Planning & Organisation
- Execution
- Equipment
- Management & conduct of work
- Worker's behaviour



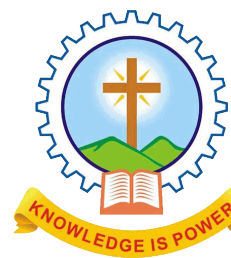
CAUSES OF ACCIDENTS

PLANNING & ORGANISATION

- Defects in technical planning
- Fixing unsuitable time limits for works
- Assigning works to incompetent contractors
- Insufficient or defective supervision of works
- Lack of cooperation with different departments

EXECUTION OF WORK

- Defects in construction
- Use of unsuitable materials
- Defective handling and processing of materials



CAUSES OF ACCIDENTS

MANAGEMENT & CONDUCT OF WORK

Inadequate preparation for work

Lack of knowledge and skill for recruited employers

Inadequate examination of equipment

Inadequate instructions from supervisors

Inadequate supervision

EQUIPMENT

Lack of equipment

Unsuitable equipment

Defects in equipment

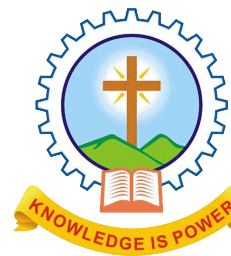
Lack of safety devices or safety measures



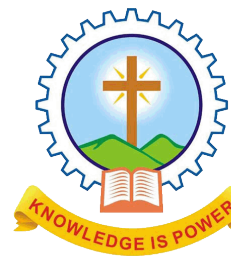
CAUSES OF ACCIDENTS

WORKER'S BEHAVIOUR

- Irresponsible acts
- Improper attitude towards work
- Emotional instability
- Improper use of safety devices
- Unauthorised acts
- carelessness



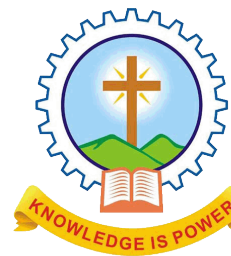
SAFETY MEASURES AT DIFFERENT STAGES OF CONSTRUCTION



SAFETY MEASURES

Proper safety measures need to be carried out at different construction stages including:

- Pre-construction stage
- Construction stage
- Commissioning and handing over stage



SAFETY MEASURES – PRE CONSTRUCTION STAGE

Plan the effective safety measure for the nature of project

Decide on the construction methods which suits the health & safety of workers

Allocate proper budget for safety considerations

Ascertain proper time frame for project

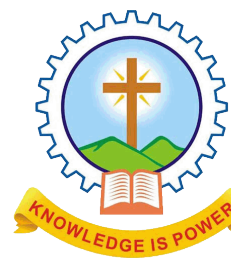
Proper safety requirements must be given in contract documents

Contracting agencies may be asked to submit a health & safety plan which effectively propose their methodology to complete the project in a safe manner



SAFETY MEASURES – CONSTRUCTION STAGE

- Design & construction methods shall be considerate towards the health and safety of people during construction
- Adequate time must be allowed to carry out activities in accordance with health & safety requirements
- Review whether the construction methods comply with safety measures and identify the possibilities of safety hazards in activities and risk levels
- If risk levels are unacceptable, take additional control measures including method revisions if required



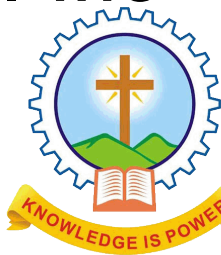
SAFETY MEASURES – CONSTRUCTION STAGE

- Establish facilities such as training facilities, medical check up, first aid, etc.

Ensure that the establishments at site such as site offices, workmen camps, toilets, canteens, etc. meet required safety standards

Construction agency shall properly coordinate the safety measures

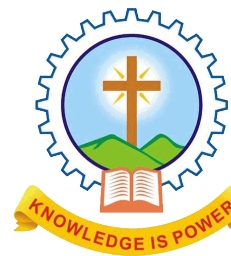
Project manager of construction agency shall ensure that all the sub-contractors meet proper safety standards



Safety measures - Commissioning stage

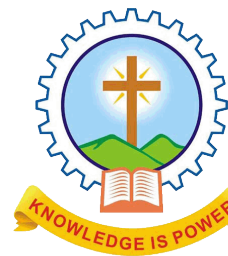
Effectiveness of health and safety measures and management system **shall be reviewed for future planning**

Experience and recommendations which may be necessary during **operation and maintenance stage** of the project, shall be documented



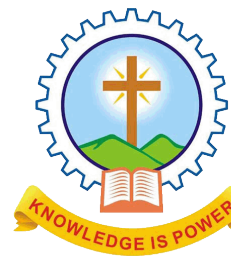
SAFETY MEASURES IN CONSTRUCTION WORK

- Safety measures for storage and handling of building materials
- Safety measures in construction of elements of a building
- Safety measures for lifting equipment
- Safety measure in demolition of building
- Safety measure for hot bituminous work
- Safety measure for scaffolding, ladders, formwork and other equipment
- Safety measure for excavation
- Fire safety in buildings



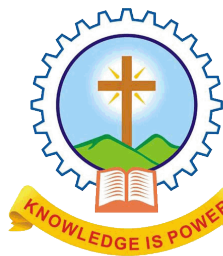
Safety Measures For Storage And Handling

- Proper storage means must be adopted to prevent deterioration of properties
- Materials prone to fire must be kept separately and adequate spacing in between
- Flammable materials must be carefully stored and only in required essential quantities
- Proper fire fighting equipment must be provided



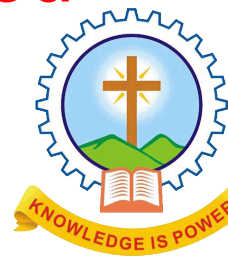
SAFETY MEASURES IN CONSTRUCTION ELEMENTS

- Design & construction of foundation should be safety to the workmen and neighbouring properties
- Properly designed and constructed scaffolding
- In case of making an opening in the existing wall, support to be given for the above wall portion
- Proper placing and removal of formwork
- Sufficient number of employees to handle heavy materials



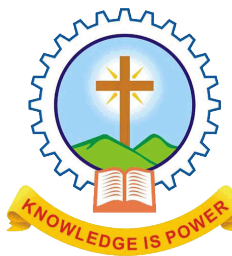
SAFETY MEASURES IN DEMOLITION OF BUILDINGS

- **Danger signs and barricades** should be provided wherever necessary
- **Suitable bracing** against accidental collapse
- During demolition workers must be provided with **proper safety equipment**
- **Fragile materials** to be removed first
- Adequate natural or artificial **lighting**
- **Easy exit** in case of emergency
- If danger is anticipated for **adjoining structures**, should be vacated
- All **service lines** including electricity, gas, water **shall be cut off**



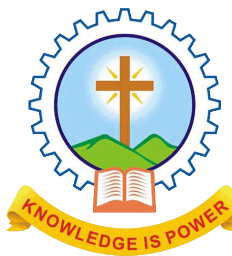
SAFETY MEASURES FOR HOT BITUMINOUS WORKS

- Experienced supervisor must take care of equipment and tools
- Ensure proper stock of fire extinguishing devices and first aid kits
- Workers to be provided with boots, gloves, goggles & helmets
- Sufficient amount of clean dry sand available and adequate supply of water
- Sufficient workers to control the traffic system



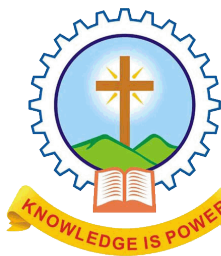
SAFETY MEASURES FOR SCAFFOLDING & FORMWORK

- Scaffoldings must be provided for all works that cannot be safely done from ground
- Strong materials must be used for scaffolding construction
- Scaffoldings must be securely fastened or braced to the building
- Protective overhead covering may be provided
- Workers should not be allowed on scaffoldings during unfavourable climate
- Safe & convenient access must be provided



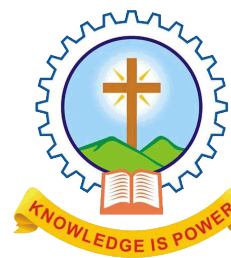
SAFETY MEASURES FOR EQUIPMENT

- All operators and supervisors for machinery must be **thoroughly trained**
- **Unauthorised people** should not handle equipment
- People handling equipment should be acquainted with the safety aspects and operation methods
- **Ropes, cables etc. must be appropriated checked** before use



SAFETY MEASURES FOR EXCAVATION

- Prior to excavation, **complete knowledge of underground structures** such as sewers, water pipe lines, gas lines etc. is essential
 - Proper precaution measure need to be taken
- **Proper lighting** must be provided
- While excavation of trench/tunnel workers must wear **safety accessories** to prevent hazards from falling materials
- **Deep excavations or trenches must be securely supported**
- Areas of excavations near to public access must be **protected by fences**
- **Warning signs** must be displayed at locations of excavation site

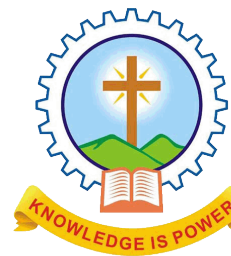


FIRE SAFETY IN BUILDING

- Emergency fire escape route which are directly connected to the ground - in addition to regular use lifts
- Early warning system to give fire alarm to be provided
 - Smoke detector for air conditioned areas
 - Heat sensitive detector for non air conditioned areas
- Good quality materials to be used to avoid chances of short circuits
- Staircase and corridor lighting shall also be connected to alternate power source
- Flammable materials shall be avoided as wall panelling, partitioning false ceilings etc.

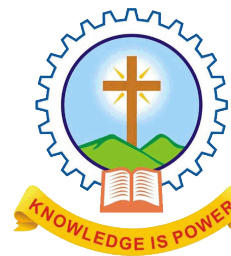


IMPLEMENTATION OF SAFETY PROGRAMME



Essential Features of a Safety Programme

- Identification of possible hazard circumstances
- Aims at reducing accidents
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IMPLEMENTATION OF SAFETY

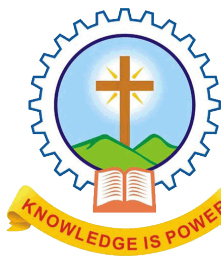
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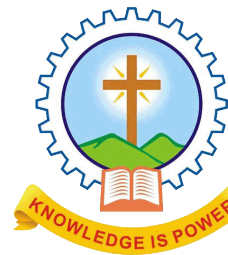
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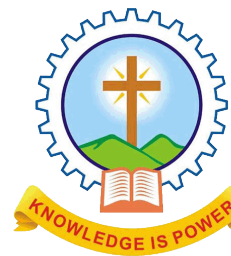
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Company safety plans shall generally include:

- First aid equipment should be available and known to employee
- Every employee should have proper personal safety equipment
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- Procedure for emergency evacuation must be clearly explained
- Safety record and accident reports of the company should be honestly kept



MEASURES TO IMPLEMENT SAFETY PROGRAMME



IMPLEMENTATION OF SAFETY

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Organisation shall have a safety policy as written statement/agreement

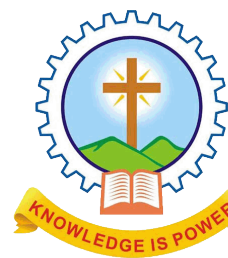
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Must be communicated to stakeholders & workers

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Common safety policies may not be applicable to all projects

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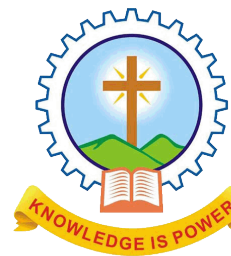
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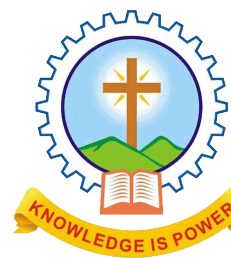
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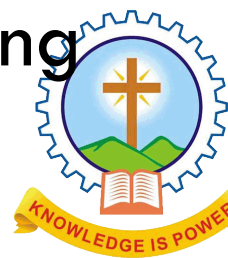
To control the activities at administrative levels

Excavations, electrical works, opening manholes etc.

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Design details shall be periodically reviewed to check for possibility of risks arising during construction activities

Provisions for alternative access/communication in confined working spaces may be provided



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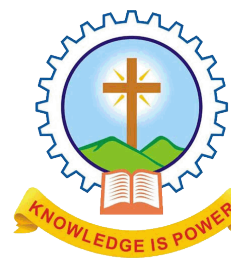
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While selecting subcontractors, their safety records and performance shall be given consideration

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12. FIRE PREVENTION AND CONTROL

Their must be policies for fire prevention

Hazard risks must be identified at planning stage itself & prevention measures need to be included in design

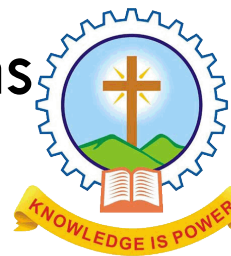
Fire fighting equipment must be provided and placed at accessible locations

13. ACCESS CONTROL

Proper access control measures may be taken as suitable

Only trained workers for the works may allowed at risky locations

Acces shall be regulated by entry passes, biometric systems etc.



IMPLEMENTATION OF SAFETY

14. SAFETY OF VISITORS

Visitors shall be given proper safety information

Safety accessories may be provided

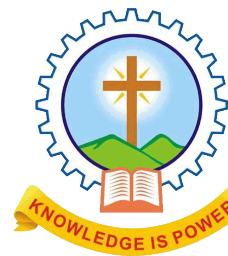
Must be accompanied by a site employee

15. TRAFFIC MANAGEMENT & LOGISTICS

Traffic management plan shall be prepared as a part of the project health and safety plan at the initial stage of the project to manage the traffic inside the project site

Segregation of pedestrian and vehicle traffic

Managing the flow of traffic such that



IMPLEMENTATION OF SAFETY

16. PERFORMANCE MONITORING AND IMPROVEMENT

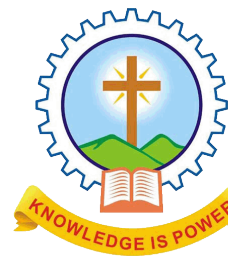
Proper monitoring and measurement need to be done at site

Periodic checks –whether the works comply with health and safety policies

17. REWARD AND REPRIMAND

Important to acknowledge and encourage good health and safety performance by rewards

Reprimand towards repeated violations, non-conformances and poor health and safety performances



IMPLEMENTATION OF SAFETY

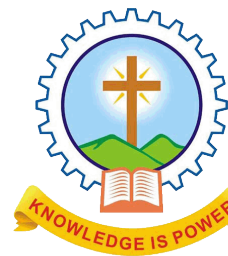
18. PROMOTING A POSITIVE HEALTH AND SAFETY CULTURE

The top management should communicate that it considers safety as an important factor and it shall not allow it to get compromised

Shall organise project safety and healthy committee meetings and performance review meetings

19. INTEGRATION WITH OTHER MANAGEMENT SYSTEM

The health & safety policies can be integrated with departments like quality management and environment management

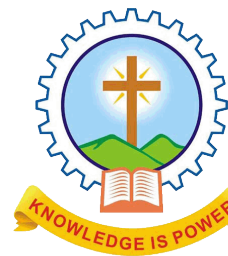


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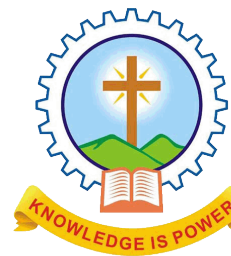
Concept of materials management – inventory – inventory control – Economic order quantity- ABC analysis. Safety in construction – Safety measures in different stages of construction – implementation of safety programme.

CONTENTS

- Safety in construction
 - Importance of safety measures
 - Causes of accidents
 - Safety measure to be adopted for different activities
 - Construction measures in different stages of construction
 - Implementation of safety programs



SAFETY IN CONSTRUCTION



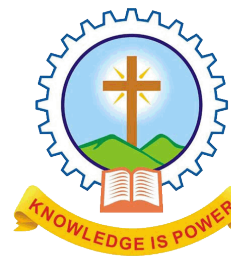
CONSTRUCTION SAFETY

Safety in construction procedures is a **vital part in the success** of a project

Construction industry is a **highly accident prone field**

Proper safety considerations are also essential for humanitarian and economic front

When **equipped with proper safety programmes**, the **safe work environment** will lead to more **effective & efficient working** from employees



TYPES OF ACCIDENTS

Accidents in construction industry are mainly due to:

Fall from high elevation 50-60%

Trapped by something collapsing or overturning 15-20 %

Being struck by an equipment or moving vehicle 10-15%%

Contact with electricity 5 %

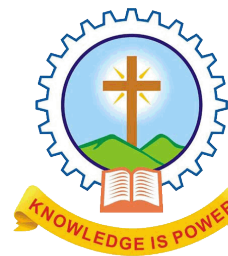
Exposure to harmful substance 1%

➤ During tunnelling & excavation

➤ Drowning

➤ Lifting of equipment

➤ During transportation



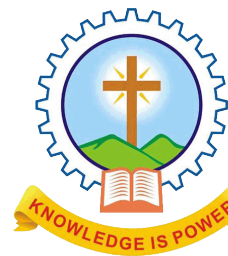
IMPORTANCE OF SAFETY MEASURES

HUMANITARIAN CONCERN

- Suffering of injured workers and families
- Proper safety accessories must be given
- Proper insurance must be organised for construction workers

LAWS AND REGULATIONS

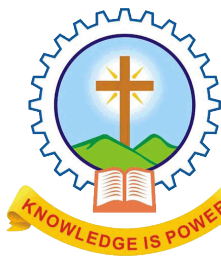
- As per laws and regulations, it is employer's responsibility to provide proper safety measures
- Violation of these laws are punishable



IMPORTANCE OF SAFETY MEASURES

MANAGEMENT CONSIDERATIONS

- A good safety record can improve morale and trust of employees
- Also improve company's public image, thereby easier to acquire negotiated jobs
- Eliminate compensation insurance
- Get greater margin of profit



IMPORTANCE OF SAFETY MEASURES

SAFETY OF MATERIALS AND EQUIPMENT

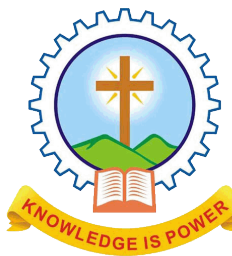
To avoid loss or spoilage of materials

To avoid damage of equipment

SAFETY OF STRUCTURE

To ensure minimum cost of construction

To ensure good quality of construction and better rate of work progress



IMPORTANCE OF SAFETY MEASURES

ECONOMIC REASONS

Many additional expenses will incur from accidents in site

Direct cost from accidents:

- Medical expenses
- Workman's compensation
- Increase in insurance premium
- Replacement of equipment/material damaged
- Court fees

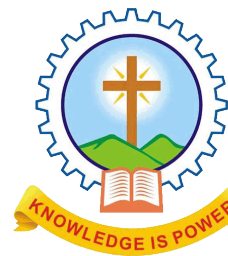
Indirect cost from accidents:

- Slow down of operations
- Decrease on productivity
- Administrative works associated
- Loss of clients' confidence
- Overtime necessitated by slow down in work

CAUSES OF ACCIDENTS

The causes of accidents in a construction site may be grouped according to their nature:

- Planning & Organisation
- Execution
- Equipment
- Management & conduct of work
- Worker's behaviour



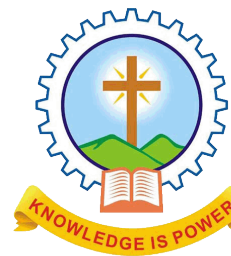
CAUSES OF ACCIDENTS

PLANNING & ORGANISATION

- Defects in technical planning
- Fixing unsuitable time limits for works
- Assigning works to incompetent contractors
- Insufficient or defective supervision of works
- Lack of cooperation with different departments

EXECUTION OF WORK

- Defects in construction
- Use of unsuitable materials
- Defective handling and processing of materials



CAUSES OF ACCIDENTS

MANAGEMENT & CONDUCT OF WORK

Inadequate preparation for work

Lack of knowledge and skill for recruited employers

Inadequate examination of equipment

Inadequate instructions from supervisors

Inadequate supervision

EQUIPMENT

Lack of equipment

Unsuitable equipment

Defects in equipment

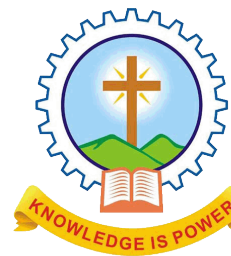
Lack of safety devices or safety measures



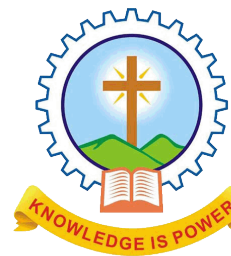
CAUSES OF ACCIDENTS

WORKER'S BEHAVIOUR

- Irresponsible acts
- Improper attitude towards work
- Emotional instability
- Improper use of safety devices
- Unauthorised acts
- carelessness



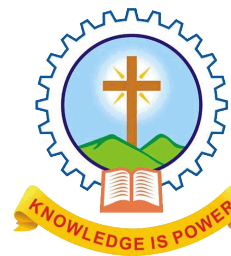
SAFETY MEASURES AT DIFFERENT STAGES OF CONSTRUCTION



SAFETY MEASURES

Proper safety measures need to be carried out at different construction stages including:

- Pre-construction stage
- Construction stage
- Commissioning and handing over stage



SAFETY MEASURES – PRE CONSTRUCTION STAGE

Plan the effective safety measure for the nature of project

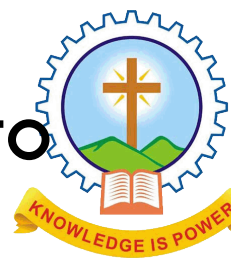
Decide on the construction methods which suits the health & safety of workers

Allocate proper budget for safety considerations

Ascertain proper time frame for project

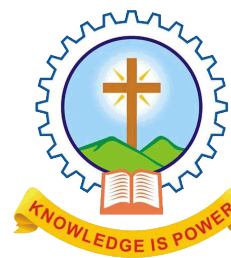
Proper safety requirements must be given in contract documents

Contracting agencies may be asked to submit a health & safety plan which effectively propose their methodology to complete the project in a safe manner



SAFETY MEASURES – CONSTRUCTION STAGE

- Design & construction methods shall be considerate towards the health and safety of people during construction
- Adequate time must be allowed to carry out activities in accordance with health & safety requirements
- Review whether the construction methods comply with safety measures and identify the possibilities of safety hazards in activities and risk levels
- If risk levels are unacceptable, take additional control measures including method revisions if required



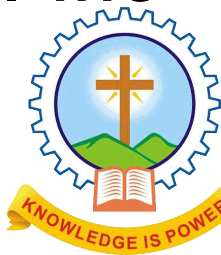
SAFETY MEASURES – CONSTRUCTION STAGE

- Establish facilities such as training facilities, medical check up, first aid, etc.

Ensure that the establishments at site such as site offices, workmen camps, toilets, canteens, etc. meet required safety standards

Construction agency shall properly coordinate the safety measures

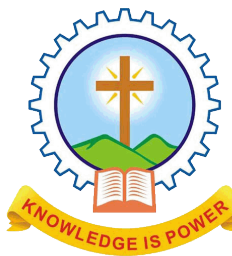
Project manager of construction agency shall ensure that all the sub-contractors meet proper safety standards



Safety measures - Commissioning stage

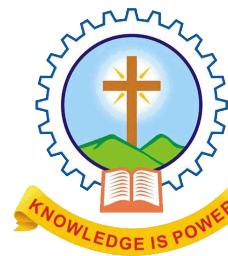
Effectiveness of health and safety measures and management system **shall be reviewed for future planning**

Experience and recommendations which may be necessary during **operation and maintenance stage** of the project, shall be documented



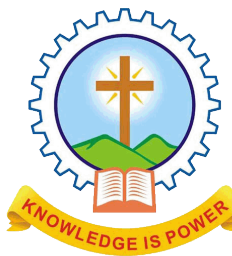
SAFETY MEASURES IN CONSTRUCTION WORK

- Safety measures for storage and handling of building materials
- Safety measures in construction of elements of a building
- Safety measures for lifting equipment
- Safety measure in demolition of building
- Safety measure for hot bituminous work
- Safety measure for scaffolding, ladders, formwork and other equipment
- Safety measure for excavation
- Fire safety in buildings



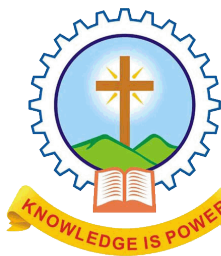
Safety Measures For Storage And Handling

- Proper storage means must be adopted to prevent deterioration of properties
- Materials prone to fire must be kept separately and adequate spacing in between
- Flammable materials must be carefully stored and only in required essential quantities
- Proper fire fighting equipment must be provided



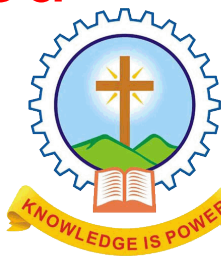
SAFETY MEASURES IN CONSTRUCTION ELEMENTS

- Design & construction of foundation should be safety to the workmen and neighbouring properties
- Properly designed and constructed scaffolding
- In case of making an opening in the existing wall, support to be given for the above wall portion
- Proper placing and removal of formwork
- Sufficient number of employees to handle heavy materials



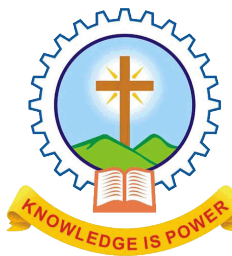
SAFETY MEASURES IN DEMOLITION OF BUILDINGS

- **Danger signs and barricades** should be provided wherever necessary
- **Suitable bracing** against accidental collapse
- During demolition workers must be provided with **proper safety equipment**
- **Fragile materials** to be removed first
- Adequate natural or artificial **lighting**
- **Easy exit** in case of emergency
- If danger is anticipated for **adjoining structures**, should be vacated
- All **service lines** including electricity, gas, water **shall be cut off**



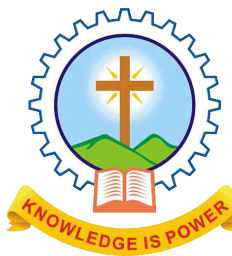
SAFETY MEASURES FOR HOT BITUMINOUS WORKS

- Experienced supervisor must take care of equipment and tools
- Ensure proper stock of fire extinguishing devices and first aid kits
- Workers to be provided with boots, gloves, goggles & helmets
- Sufficient amount of clean dry sand available and adequate supply of water
- Sufficient workers to control the traffic system



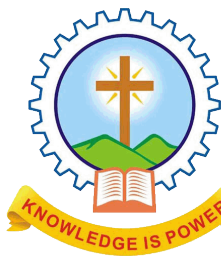
SAFETY MEASURES FOR SCAFFOLDING & FORMWORK

- Scaffoldings must be provided for all works that cannot be safely done from ground
- Strong materials must be used for scaffolding construction
- Scaffoldings must be securely fastened or braced to the building
- Protective overhead covering may be provided
- Workers should not be allowed on scaffoldings during unfavourable climate
- Safe & convenient access must be provided



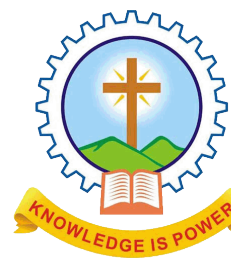
SAFETY MEASURES FOR EQUIPMENT

- All operators and supervisors for machinery must be **thoroughly trained**
- **Unauthorised people** should not handle equipment
- People handling equipment should be acquainted with the safety aspects and operation methods
- **Ropes, cables etc. must be appropriated checked** before use



SAFETY MEASURES FOR EXCAVATION

- Prior to excavation, **complete knowledge of underground structures** such as sewers, water pipe lines, gas lines etc. is essential
 - Proper precaution measure need to be taken
- **Proper lighting** must be provided
- While excavation of trench/tunnel workers must wear **safety accessories** to prevent hazards from falling materials
- **Deep excavations or trenches must be securely supported**
- Areas of excavations near to public access must be **protected by fences**
- **Warning signs** must be displayed at locations of excavation site

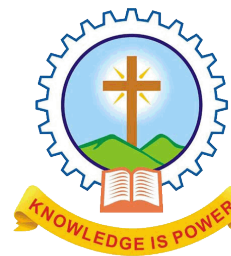


FIRE SAFETY IN BUILDING

- Emergency fire escape route which are directly connected to the ground - in addition to regular use lifts
- Early warning system to give fire alarm to be provided
 - Smoke detector for air conditioned areas
 - Heat sensitive detector for non air conditioned areas
- Good quality materials to be used to avoid chances of short circuits
- Staircase and corridor lighting shall also be connected to alternate power source
- Flammable materials shall be avoided as wall panelling, partitioning false ceilings etc.

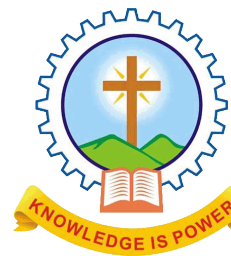


IMPLEMENTATION OF SAFETY PROGRAMME



Essential Features of a Safety Programme

- Identification of possible hazard circumstances
- Aims at reducing accidents
- Aims to arrest the reasons that cause the accidents
- Provides safety equipment and training to employees
- To enforce proper adherence to safety policies
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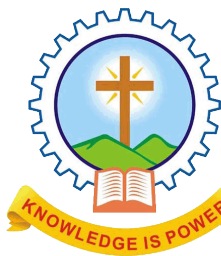
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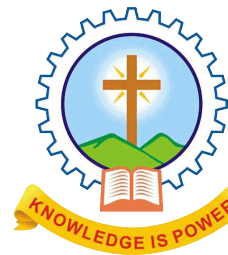
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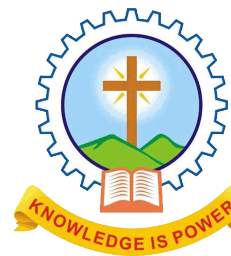
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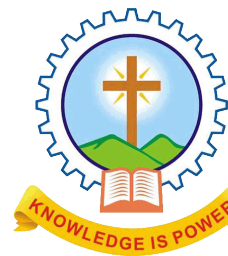
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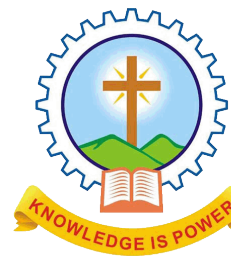
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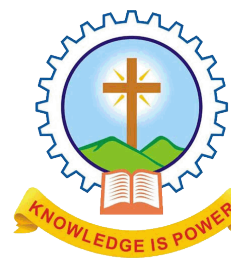
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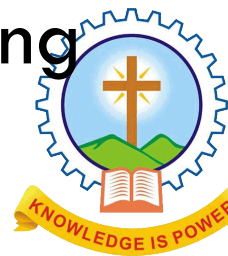
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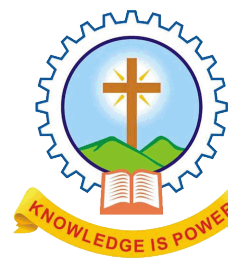
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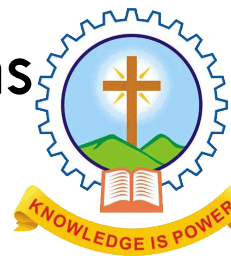
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IMPLEMENTATION OF SAFETY

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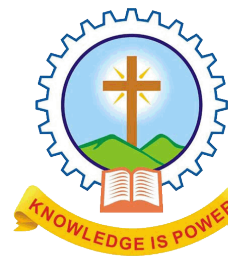
Must be accompanied by a site employee

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Traffic management plan shall be prepared as a part of the project health and safety plan at the initial stage of the project to manage the traffic inside the project site

Segregation of pedestrian and vehicle traffic

Managing the flow of traffic such that



IMPLEMENTATION OF SAFETY

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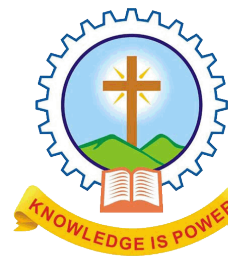
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Important to acknowledge and encourage good health and safety performance by rewards

Reprimand towards repeated violations, non-conformances and poor health and safety performances



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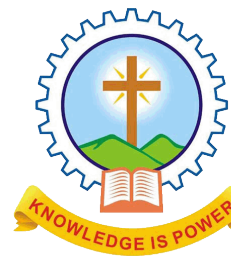
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The top management should communicate that it considers safety as an important factor and it shall not allow it to get compromised

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The health & safety policies can be integrated with departments like quality management and environment management

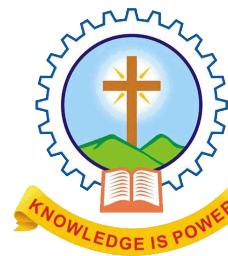


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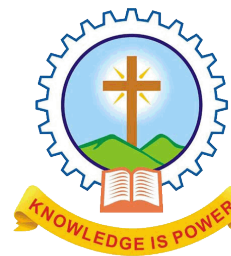
Concept of materials management – inventory – inventory control – Economic order quantity- ABC analysis. Safety in construction – Safety measures in different stages of construction – implementation of safety programme.

CONTENTS

- Safety in construction
 - Importance of safety measures
 - Causes of accidents
 - Safety measure to be adopted for different activities
 - Construction measures in different stages of construction
 - Implementation of safety programs



SAFETY IN CONSTRUCTION



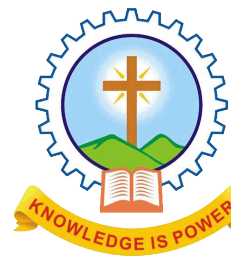
CONSTRUCTION SAFETY

Safety in construction procedures is a **vital part in the success** of a project

Construction industry is a **highly accident prone field**

Proper safety considerations are also essential for humanitarian and economic front

When **equipped with proper safety programmes**, the **safe work environment** will lead to more **effective & efficient working** from employees



TYPES OF ACCIDENTS

Accidents in construction industry are mainly due to:

Fall from high elevation 50-60%

Trapped by something collapsing or overturning 15-20 %

Being struck by an equipment or moving vehicle 10-15%%

Contact with electricity 5 %

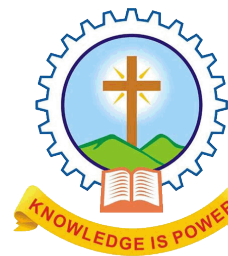
Exposure to harmful substance 1%

➤ During tunnelling & excavation

➤ Drowning

➤ Lifting of equipment

➤ During transportation



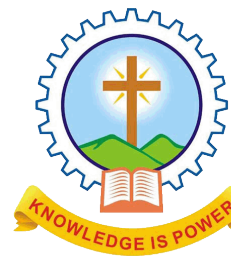
IMPORTANCE OF SAFETY MEASURES

HUMANITARIAN CONCERN

- Suffering of injured workers and families
- Proper safety accessories must be given
- Proper insurance must be organised for construction workers

LAWS AND REGULATIONS

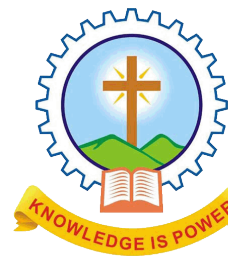
- As per laws and regulations, it is employer's responsibility to provide proper safety measures
- Violation of these laws are punishable



IMPORTANCE OF SAFETY MEASURES

MANAGEMENT CONSIDERATIONS

- A good safety record can improve morale and trust of employees
- Also improve company's public image, thereby easier to acquire negotiated jobs
- Eliminate compensation insurance
- Get greater margin of profit



IMPORTANCE OF SAFETY MEASURES

SAFETY OF MATERIALS AND EQUIPMENT

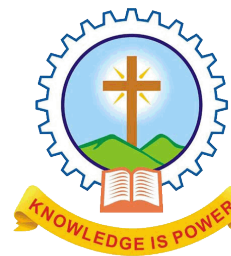
To avoid loss or spoilage of materials

To avoid damage of equipment

SAFETY OF STRUCTURE

To ensure minimum cost of construction

To ensure good quality of construction and better rate of work progress



IMPORTANCE OF SAFETY MEASURES

ECONOMIC REASONS

Many additional expenses will incur from accidents in site

Direct cost from accidents:

- Medical expenses
- Workman's compensation
- Increase in insurance premium
- Replacement of equipment/material damaged
- Court fees

Indirect cost from accidents:

- Slow down of operations
- Decrease on productivity
- Administrative works associated
- Loss of clients' confidence
- Overtime necessitated by slow down in work

CAUSES OF ACCIDENTS

The causes of accidents in a construction site may be grouped according to their nature:

- Planning & Organisation
- Execution
- Equipment
- Management & conduct of work
- Worker's behaviour



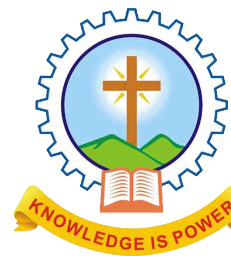
CAUSES OF ACCIDENTS

PLANNING & ORGANISATION

- Defects in technical planning
- Fixing unsuitable time limits for works
- Assigning works to incompetent contractors
- Insufficient or defective supervision of works
- Lack of cooperation with different departments

EXECUTION OF WORK

- Defects in construction
- Use of unsuitable materials
- Defective handling and processing of materials



CAUSES OF ACCIDENTS

MANAGEMENT & CONDUCT OF WORK

Inadequate preparation for work

Lack of knowledge and skill for recruited employers

Inadequate examination of equipment

Inadequate instructions from supervisors

Inadequate supervision

EQUIPMENT

Lack of equipment

Unsuitable equipment

Defects in equipment

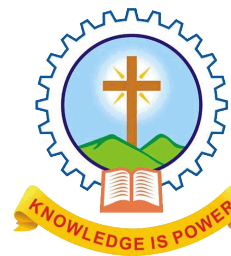
Lack of safety devices or safety measures



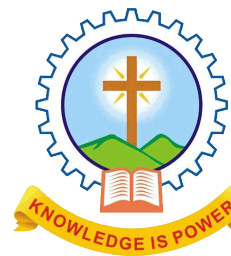
CAUSES OF ACCIDENTS

WORKER'S BEHAVIOUR

- Irresponsible acts
- Improper attitude towards work
- Emotional instability
- Improper use of safety devices
- Unauthorised acts
- carelessness



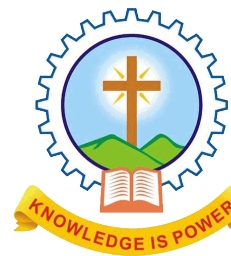
SAFETY MEASURES AT DIFFERENT STAGES OF CONSTRUCTION



SAFETY MEASURES

Proper safety measures need to be carried out at different construction stages including:

- Pre-construction stage
- Construction stage
- Commissioning and handing over stage



SAFETY MEASURES – PRE CONSTRUCTION STAGE

Plan the effective safety measure for the nature of project

Decide on the construction methods which suits the health & safety of workers

Allocate proper budget for safety considerations

Ascertain proper time frame for project

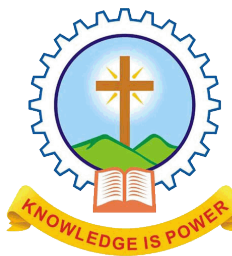
Proper safety requirements must be given in contract documents

Contracting agencies may be asked to submit a health & safety plan which effectively propose their methodology to complete the project in a safe manner



SAFETY MEASURES – CONSTRUCTION STAGE

- Design & construction methods shall be considerate towards the health and safety of people during construction
- Adequate time must be allowed to carry out activities in accordance with health & safety requirements
- Review whether the construction methods comply with safety measures and identify the possibilities of safety hazards in activities and risk levels
- If risk levels are unacceptable, take additional control measures including method revisions if required



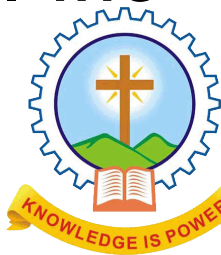
SAFETY MEASURES – CONSTRUCTION STAGE

- Establish facilities such as training facilities, medical check up, first aid, etc.

Ensure that the establishments at site such as site offices, workmen camps, toilets, canteens, etc. meet required safety standards

Construction agency shall properly coordinate the safety measures

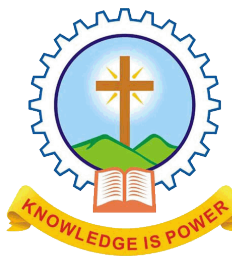
Project manager of construction agency shall ensure that all the sub-contractors meet proper safety standards



Safety measures - Commissioning stage

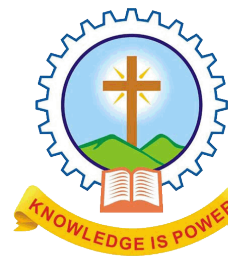
Effectiveness of health and safety measures and management system **shall be reviewed for future planning**

Experience and recommendations which may be necessary during **operation and maintenance stage** of the project, shall be documented



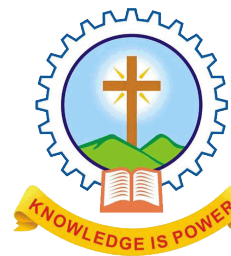
SAFETY MEASURES IN CONSTRUCTION WORK

- Safety measures for storage and handling of building materials
- Safety measures in construction of elements of a building
- Safety measures for lifting equipment
- Safety measure in demolition of building
- Safety measure for hot bituminous work
- Safety measure for scaffolding, ladders, formwork and other equipment
- Safety measure for excavation
- Fire safety in buildings



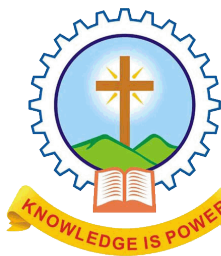
Safety Measures For Storage And Handling

- Proper storage means must be adopted to prevent deterioration of properties
- Materials prone to fire must be kept separately and adequate spacing in between
- Flammable materials must be carefully stored and only in required essential quantities
- Proper fire fighting equipment must be provided



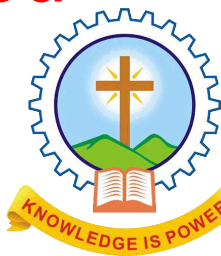
SAFETY MEASURES IN CONSTRUCTION ELEMENTS

- Design & construction of foundation should be safety to the workmen and neighbouring properties
- Properly designed and constructed scaffolding
- In case of making an opening in the existing wall, support to be given for the above wall portion
- Proper placing and removal of formwork
- Sufficient number of employees to handle heavy materials



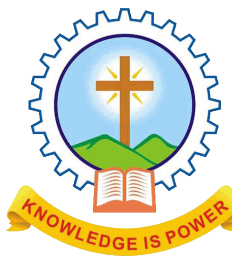
SAFETY MEASURES IN DEMOLITION OF BUILDINGS

- **Danger signs and barricades** should be provided wherever necessary
- **Suitable bracing** against accidental collapse
- During demolition workers must be provided with **proper safety equipment**
- **Fragile materials** to be removed first
- Adequate natural or artificial **lighting**
- **Easy exit** in case of emergency
- If danger is anticipated for **adjoining structures**, should be vacated
- All **service lines** including electricity, gas, water **shall be cut off**



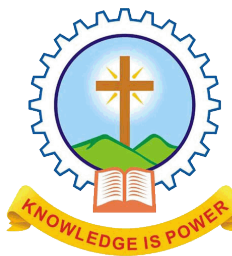
SAFETY MEASURES FOR HOT BITUMINOUS WORKS

- Experienced supervisor must take care of equipment and tools
- Ensure proper stock of fire extinguishing devices and first aid kits
- Workers to be provided with boots, gloves, goggles & helmets
- Sufficient amount of clean dry sand available and adequate supply of water
- Sufficient workers to control the traffic system



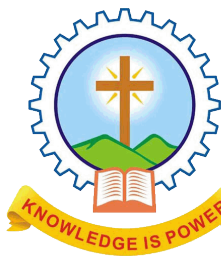
SAFETY MEASURES FOR SCAFFOLDING & FORMWORK

- Scaffoldings must be provided for all works that cannot be safely done from ground
- Strong materials must be used for scaffolding construction
- Scaffoldings must be securely fastened or braced to the building
- Protective overhead covering may be provided
- Workers should not be allowed on scaffoldings during unfavourable climate
- Safe & convenient access must be provided



SAFETY MEASURES FOR EQUIPMENT

- All operators and supervisors for machinery must be **thoroughly trained**
- **Unauthorised people** should not handle equipment
- People handling equipment should be acquainted with the safety aspects and operation methods
- **Ropes, cables etc. must be appropriated checked** before use



SAFETY MEASURES FOR EXCAVATION

- Prior to excavation, **complete knowledge of underground structures** such as sewers, water pipe lines, gas lines etc. is essential
 - Proper precaution measure need to be taken
- **Proper lighting** must be provided
- While excavation of trench/tunnel workers must wear **safety accessories** to prevent hazards from falling materials
- **Deep excavations or trenches must be securely supported**
- Areas of excavations near to public access must be **protected by fences**
- **Warning signs** must be displayed at locations of excavation site

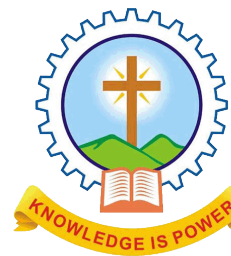


FIRE SAFETY IN BUILDING

- Emergency fire escape route which are directly connected to the ground - in addition to regular use lifts
- Early warning system to give fire alarm to be provided
 - Smoke detector for air conditioned areas
 - Heat sensitive detector for non air conditioned areas
- Good quality materials to be used to avoid chances of short circuits
- Staircase and corridor lighting shall also be connected to alternate power source
- Flammable materials shall be avoided as wall panelling, partitioning false ceilings etc.

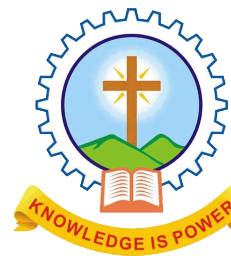


IMPLEMENTATION OF SAFETY PROGRAMME



Essential Features of a Safety Programme

- Identification of possible hazard circumstances
- Aims at reducing accidents
- Aims to arrest the reasons that cause the accidents
- Provides safety equipment and training to employees
- To enforce proper adherence to safety policies
- To practice as a continuous process



IMPLEMENTATION OF SAFETY

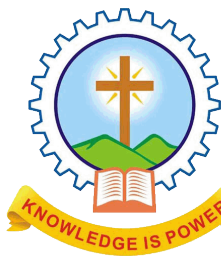
Accidents at construction sites occur due to **negligence from someone's part**

Requirement of safety must be accepted

Management shall frame proper safety policies and implement them

Requirement of safety measures is to be **made aware to the working population**

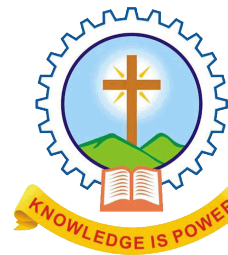
Decisions to implement safety measures must be made at project management level itself to make it effective



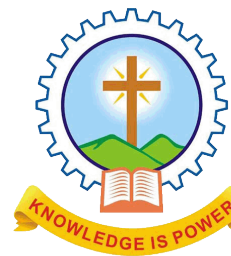
IMPLEMENTATION OF SAFETY

Company safety plans shall generally include:

- First aid equipment should be available and known to employee
- Every employee should have proper personal safety equipment
- Mandatory safety training programmes
- Procedure for emergency evacuation must be clearly explained
- Safety record and accident reports of the company should be honestly kept



MEASURES TO IMPLEMENT SAFETY PROGRAMME



IMPLEMENTATION OF SAFETY

1. HEALTH AND SAFETY POLICY

Organisation shall have a safety policy as written statement/agreement

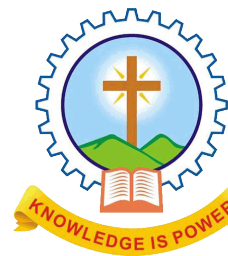
Shows management's commitment

Must be communicated to stakeholders & workers

2. Project Specific Health and Safety Planning

Common safety policies may not be applicable to all projects

Frame project specific safety plan



IMPLEMENTATION OF SAFETY

3. RESOURCES, ROLES, RESPONSIBILITY AND AUTHORITY

Safety responsibility must be taken as a team work and proper authority should be defined

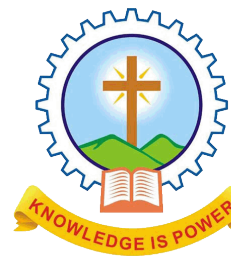
Ultimate responsibility resides with the top management

Health & safety department & officials shall guide the top management

4. COMPETENCE, TRAINING AND AWARENESS

Proper training and awareness must be provided for workers

Company shall frame a training plan for employees



IMPLEMENTATION OF SAFETY

5. HEALTH AND SAFETY COMMUNICATION

Effective communications on various safety aspects such as accident case studies, policy requirements shall be made

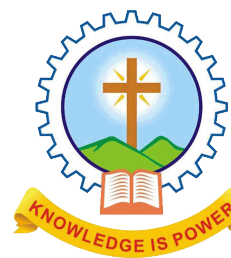
System of collecting employee feed back will also be effective

6. HEALTH AND SAFETY REPORTING

Health & safety pains must be well documented

7. OPERATION CONTROL

Activities must be controlled properly based on the hazard possibilities identified during planning



IMPLEMENTATION OF SAFETY

8. PERMIT TO WORK SYSTEMS

The project team may establish a permit to work system for any other hazardous activity

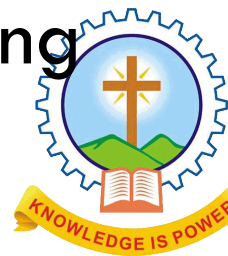
To control the activities at administrative levels

Excavations, electrical works, opening manholes etc.

9. DESIGN AND ENGINEERING

Design details shall be periodically reviewed to check for possibility of risks arising during construction activities

Provisions for alternative access/communication in confined working spaces may be provided



IMPLEMENTATION OF SAFETY

10. CERTIFICATION OF PLANT AND MACHINERY, LIFTING TOOLS AND TACKLES

Equipment and accessories must be tested and examined by a competent person for the first time

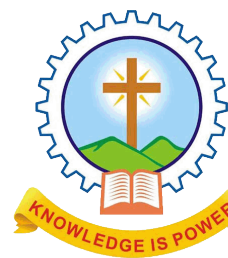
Proper follow up with periodical testing and examination shall be made mandatory

11. SUBCONTRACTOR MANAGEMENT

Company's safety policies shall be clearly communicated

While selecting subcontractors, their safety records and performance shall be given consideration

Performance shall be periodically monitored



IMPLEMENTATION OF SAFETY

12. FIRE PREVENTION AND CONTROL

Their must be policies for fire prevention

Hazard risks must be identified at planning stage itself & prevention measures need to be included in design

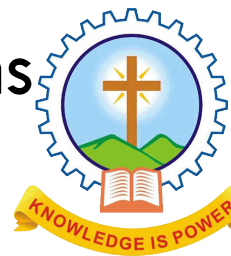
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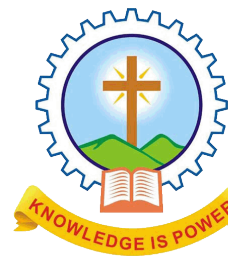
Must be accompanied by a site employee

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Segregation of pedestrian and vehicle traffic

Managing the flow of traffic such that



IMPLEMENTATION OF SAFETY

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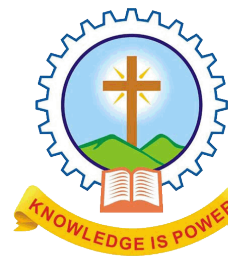
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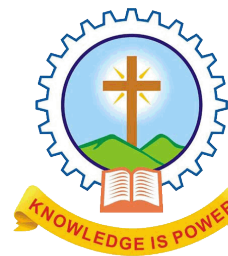
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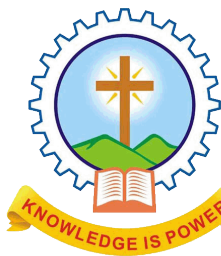
Shall organise project safety and healthy committee meetings and performance review meetings

19. INTEGRATION WITH OTHER MANAGEMENT SYSTEM

The health & safety policies can be integrated with departments like quality management and environment management



Material management deals with managing of materials along with costs

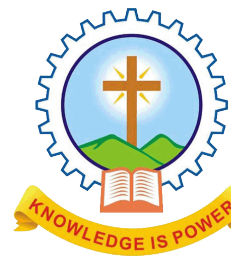


Materials Management

Material refers to any goods or services which are procured from outside the organisation which are utilised at the project site

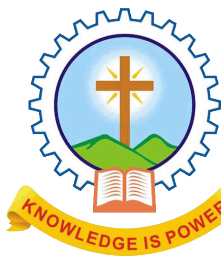
Include:

- Construction materials such as raw material, finishing materials, electrical and mechanical fittings, instruments etc.
- Supporting plants and equipment spares
- Operational and maintenance materials
-



MATERIALS MANAGEMENT

Materials management as a **definition** is the process which regulates the flow of supplies in an organization to ensure that the right materials are available at the right place at the time in the right quantity and quality and at the right cost



NEED FOR MATERIALS MANAGEMENT

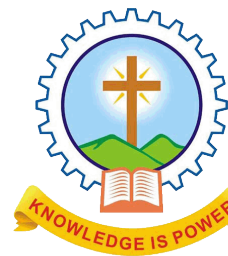
Materials account for a large fraction of construction project

For a typical building project

- Material costs – 50 - 60 %
- Labour cost – 25 %
- POL, overheads, tax components – 5 % each

As per studies it is estimated that around 10 – 20 % of materials delivered to sites end up as waste or are illegally removed due to inadequate control

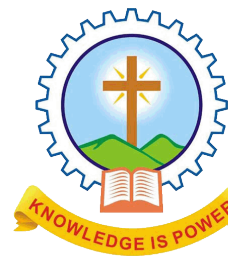
Efficient process is required in procurement, handling, storage and distribution of different types of materials



MATERIALS MANAGEMENT

Objectives

- Minimise material cost
- Procurement and supply of materials with required quantity & quality when required
- Uninterrupted operations with steady flow of materials
- Reduces costs for purchase, transport and storage of materials with scientific inventory control
- Reduce investment in inventories and use the same for more productive purposes
- Optimal paper work procedures helps to minimise delays in material procurement
- Speedy disposal of materials which are no longer required



Functions of Materials Management

1. Materials Planning

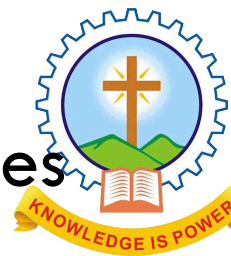
- Involves identifying materials, estimating quantities, defining specifications, forecasting requirements & locating right sources for procurement

2. Procurement

- Proper survey must be carried out about need for procurement from local market or head office (centralized purchasing)
- Local procurement should be kept to minimum as possible and limit to non-engineered items and consumables

3. Custody (receiving, warehousing, issuing)

With documents such as inward/outward/repair registers, receipt notes etc



Functions of Materials Management

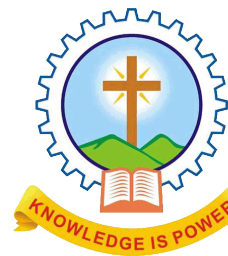
4. Materials Accounting

- To monitor inflow and consumption of raw materials
- Involves: materials stock accounting, materials issue & return accounting, monthly stock taking, materials wastage analysis

5. Transportation

- Construction materials may need to be transported through different locations
- From point of origin to storage to consumption point

6. Proper inventory monitoring & control



Functions of Materials Management

7. Material codification

Helps in mechanisation of records

Proper identification of items

Avoid duplicating of stocks under different descriptions

8. Computerisation

Helps in proper planning & scheduling and price management

9. Source development

For every major item, more than one source need to be identified

Purchase from satisfactory sources are only recommended

10. Disposal

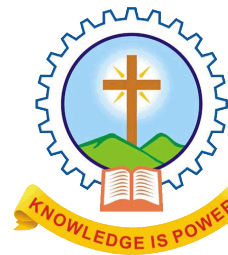
Non-reusable items must be disposed off properly after carrying out quantity and quality assessment



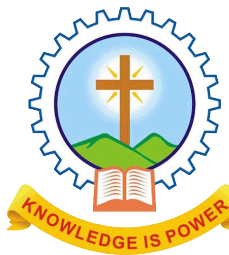
Materials Classification

Factors to be considered while classifying materials:

- Procurement time and source
- Price
- Supply reliability
- Transportation requirements
- Inventory cost
- Storage space
- Shelf life
- Construction sequence
- Project life



INVENTORY & INVENTORY CONTROL



Inventory

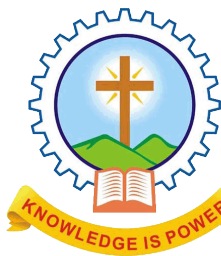
Inventories include the **physical stock of items** with an organisation for its **efficient running/operations**

Consists of raw materials, tools, spares, component parts, finished parts, materials in process etc.

- Materials in transit
- Materials in process
- Finished products which are not used

It is the 'usable but idle resource'

Inventories **cost money in terms of storage space, equipment, deterioration, and blocking of capital amount for financing these stocks etc.**



Inventory Costs

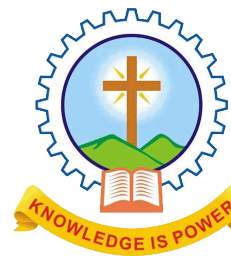
1. Cost of carrying inventories (**holding costs**)
2. Cost of incurring shortages (**stock-out cost**)
3. Cost of replenishing inventories (**ordering cost**)

Carrying costs/holding cost

This refers to the cost of blocking material in the non-productive form as inventories

Comprise of:

- Cost of blocking capital (interest rate)
- Cost of insurances
- Storage cost
- Cost due to obsolescence, deterioration



Inventory Costs

Stock-out cost

Refers to cost due to not having an item when it is demanded

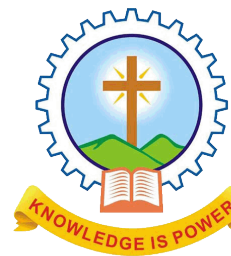
Can include the costs of emergency shipments, change of suppliers with faster deliveries, substitution to less profitable items, etc.

Ordering cost

Refers to cost or efforts expended in procurement/acquisition of stock

Costs for the process of giving an order to supplier

Increases with number of orders and independent of size of order



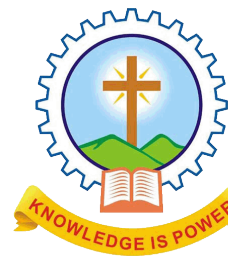
Inventory Control

Inventory control refers to “all aspects of managing a company's inventories”:

- purchasing, shipping, receiving, warehousing and storage, turnover, and reordering

It is the **process of ensuring that appropriate amount of stock is maintained** so that

- Customer demands can be met without any delay
- Keeps the inventory associated costs at the minimum



Objectives/Benefits of Inventory Control

Ensure steady supply of inventories at required time

Minimise cost of inventories

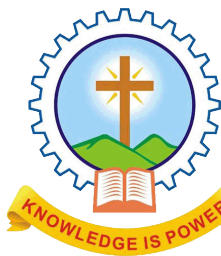
To keep investment in inventories to a minimum level

Provides check against loss of materials from theft, wastage etc.

Eliminate duplication in ordering

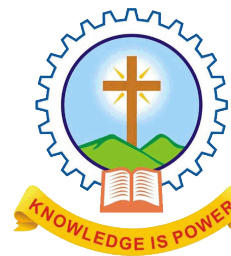
Better utilisation of available stock

Consistent and reliable basis for financial statement

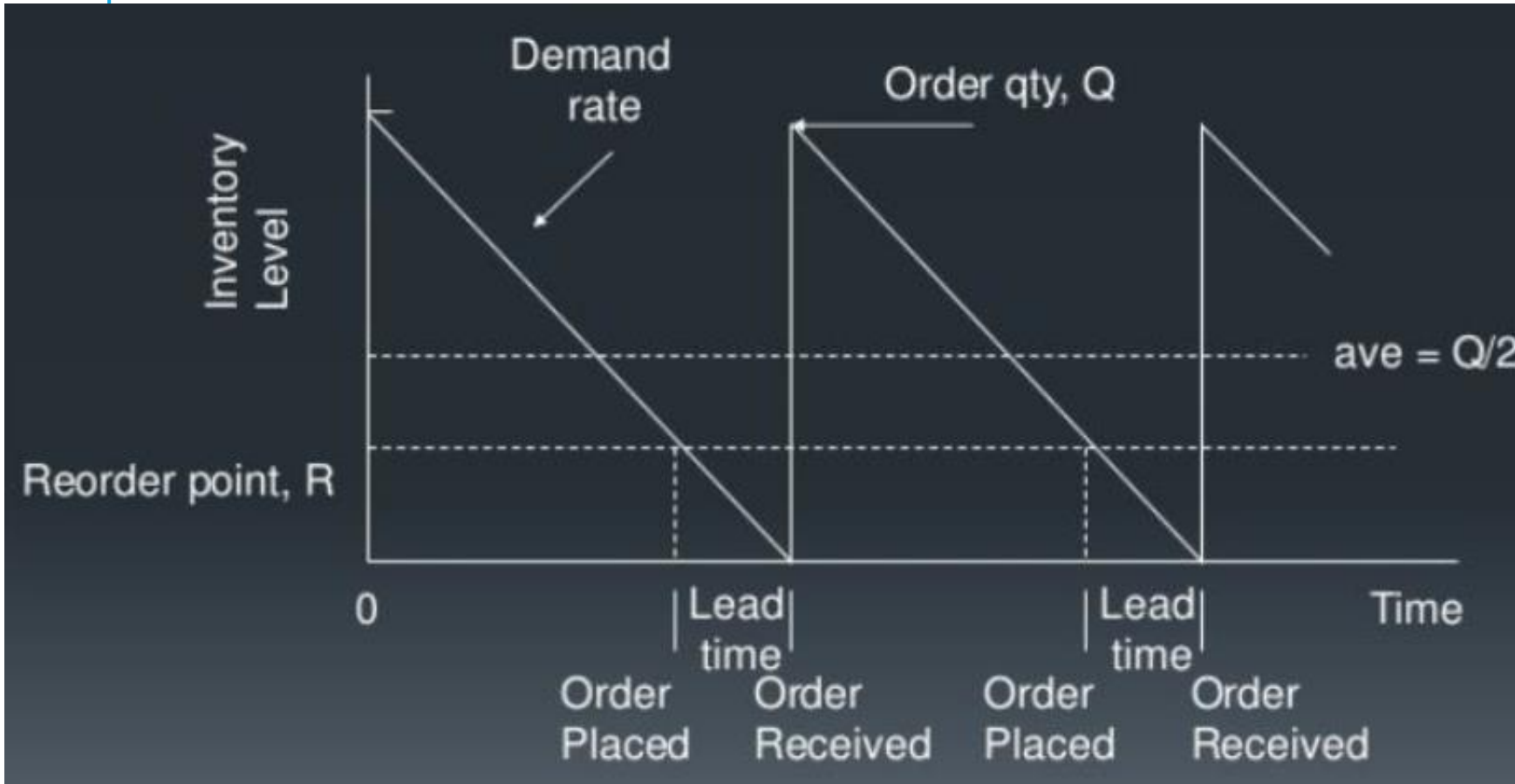


Economic Order Quantity EOQ

- **Economic Lot Size OR Economic order quantity (EOQ)** is the optimal order quantity a company should purchase for efficient operations and to minimize inventory costs
- Inventory management is tasked with calculating the number of optimal units to reduce the total costs of its inventory
- The EOQ formula is best applied in situations where demand, ordering, and holding costs remain constant over time
- The concept of EOQ is dependent on two questions regarding the aspects of inventory control
 1. **How much to buy?** Decision will be on associated costs
 2. **When to buy?** Whether to buy now or wait. Consider chances of stock out vs holding costs

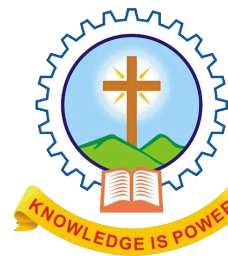


Economic Order Quantity EOQ



The time interval between placement of an order and receipt of goods against the order is called lead time

Behaviour of EOQ model

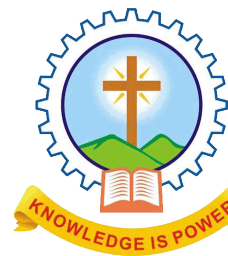


Economic Order Quantity EOQ

The time interval between placement of an order and receipt of goods against the order is called lead time

Factors influencing lead time:

- Time required by stockist
- Pre-tender work
- Tender processing time
- Transportation time
- Delivery period
- Receipt and inspection time
- Time taken in handing over

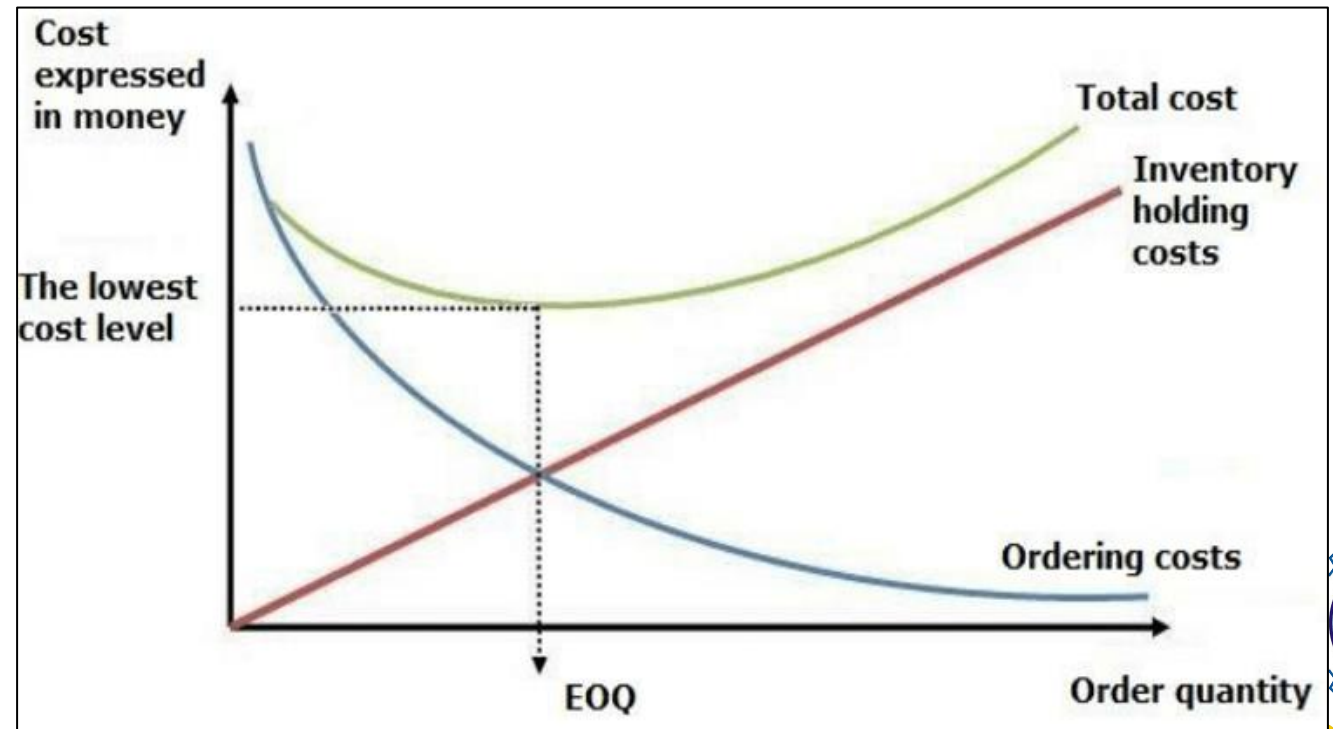


Economic Order Quantity EOQ

It is usually less expensive to procure materials in large quantities due to possible discounts and transportation efficiency

However, this will result in large quantities of inventories and are expensive to hold

EOQ model attempts to balance this opposing costs



Economic Order Quantity EOQ

Computing EOQ

Total cost = ordering cost + carrying cost

D = Demand rate; unit/year

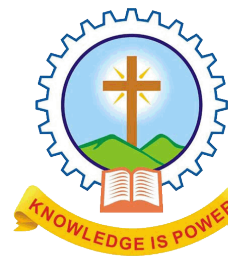
A = Ordering cost; amount/order

C = Unit cost, Cost/item

Q = Order quantity; no.of units per lot

I = Inventory carrying charges per year

- Assuming demand is at uniform rate, average inventory required = $Q/2$
- Total no. of orders placed per year = D/Q
- Order cost per year = No. of orders per year x Cost per order = $\frac{A \times D}{Q}$



Economic Order Quantity EOQ

➤ Carrying cost per year =

$$\frac{\text{Order quantity} \times \text{Unit cost of item} \times \text{Annual cost to carry}}{2} = \frac{C \times I \times Q}{2} = \frac{H \times Q}{2}$$

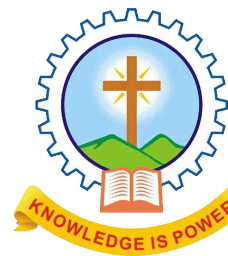
$$\text{➤ Total cost} = \frac{A \times D}{Q} + \frac{H \times Q}{2}$$

➤ For optimal Q, value of Q with minimum total cost need to be calculate

➤ Can be obtained by differentiating the total cost expression

$$\text{➤} \frac{d(\text{total cost})}{d(Q)} = 0$$

$$\text{EOQ} = \sqrt{\frac{2 \times \text{Order cost} \times \text{Demand}}{\text{Inventory carrying cost}}} = \sqrt{\frac{2 \times A \times D}{I \times C}}$$



Economic Order Quantity EOQ

The derivation of EOQ formation is based on certain assumptions:

The rate of demand is constant

Basic information on price/unit, ordering cost, carrying cost etc. is available and is fairly accurate

The process continues infinitely

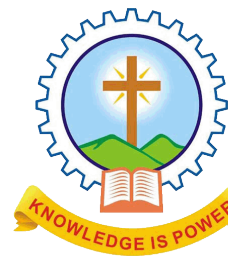
No constraints are imposed on quantities ordered, storage capacity, budget etc.

There is no shortage of items

Unit price rate is constant irrespective of the quantity purchased

Replenishment is instantaneous

Whole order quantity arrives at one time and there are no partial shipments



ABC: “Always Better Control”

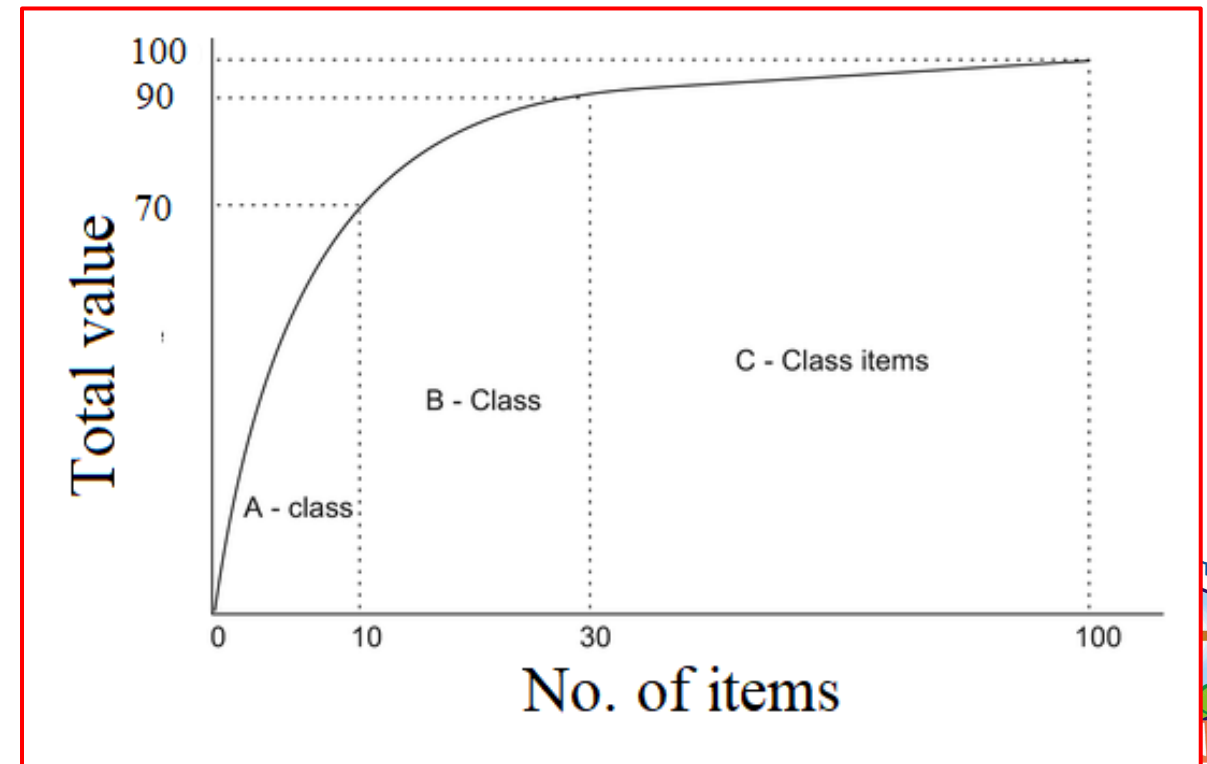
- ABC Analysis is an inventory-control methodology
- Theory of ‘significant few’ & ‘insignificant many’
- Based on the concept that
 - A small portion of the items typically represent bulk of money value of total inventories
 - A relatively large number of items form a small part of money value
- For example only 20 % of the items may account for the 80 % of the total material cost
- This technique divides inventory into 3 categories based on their annual consumption value



ABC Analysis

As per empirical approach

- A class items – account for about **70% of usage value**, but **10% of total items**
- B class items - account for about **20% of usage value** and **20% of total items**
- C class items - account for about **10% of usage value** and **70% of total items**



Type A	Type B	Type C
Accurate forecast of quantities needed	Approximate forecast of quantities needed	No need for forecasting quantities, rough estimate is enough
Involvement of senior level for purchasing	Involvement of middle level for purchasing	Junior level staff is authorised for purchasing
Ordering is on requirement basis	Ordering is on EOQ basis	Bulk ordering is preferred
Enquiry for procurement need to be sent to a large number of suppliers	Enquiry for procurement need to be sent to three to five reliable suppliers	Quotations from two to three reliable suppliers is enough
Strict degree of control is required, preferably on a weekly basis	Moderate degree of control is required, preferably on monthly basis	Relatively relaxed degree of control is sufficient, probably on quarterly basis
Low safety stock is needed	Moderate safety stock is needed	Adequate safety stock can be maintained

ABC Analysis - Procedure

Identify all items of inventory and their estimated quantities

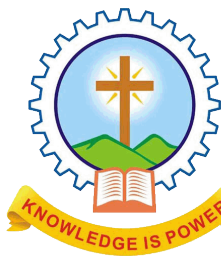
- The quantity estimates may be based on either annual consumption or project's total requirement

Determine unit rate of materials

Determine the usage values by multiplying the estimated quantities with unit rate

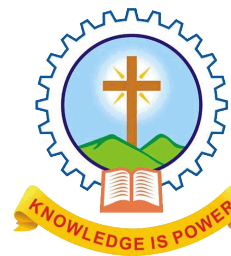
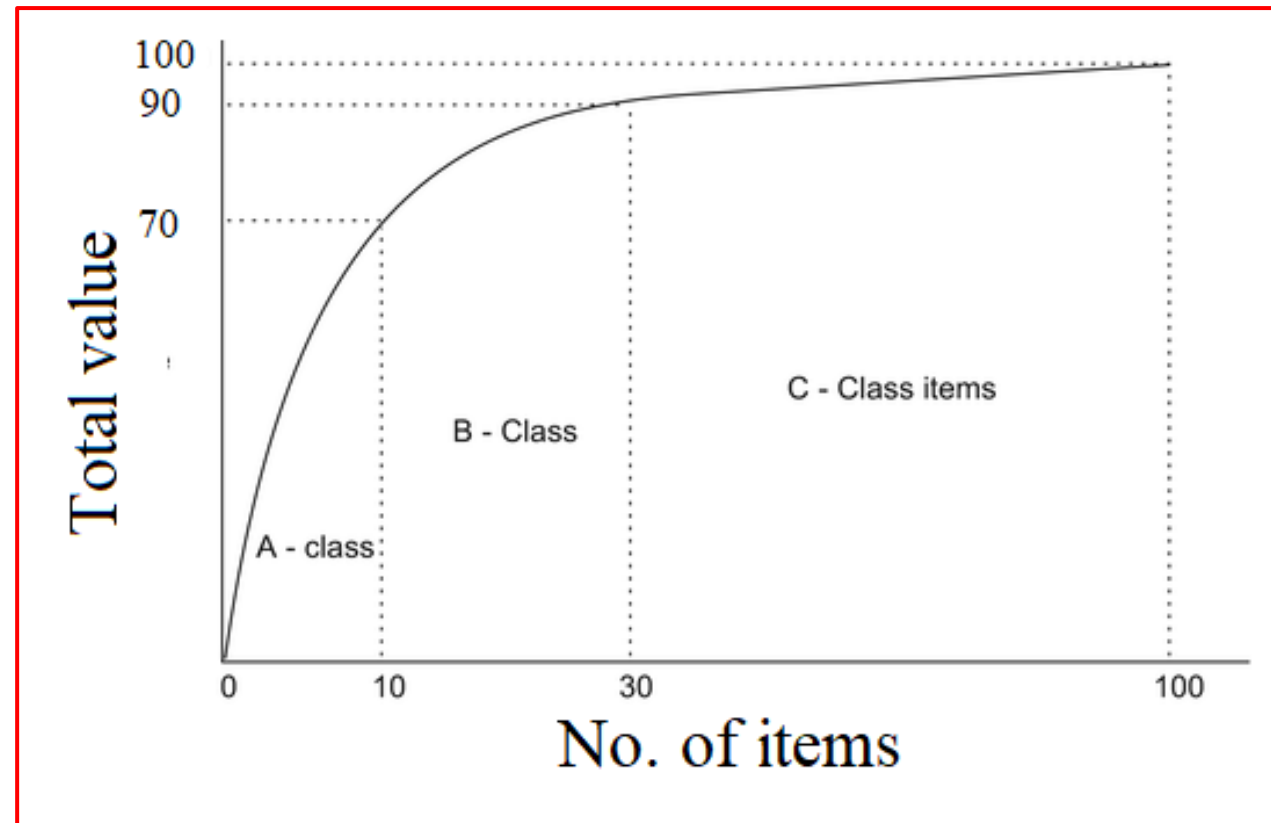
Convert these values to percentage of total annual usage cost or total project cost

Arrange these percentage costs in the highest to lowest usage value order. Also calculate the cumulative percentage



ABC Analysis

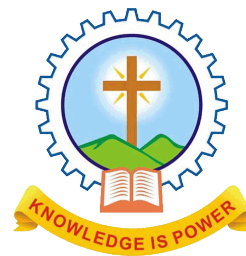
Plot Percentage of average of inventory values Vs Percentage of number of inventory items



ABC Analysis-Example

Classify the items as per ABC analysis

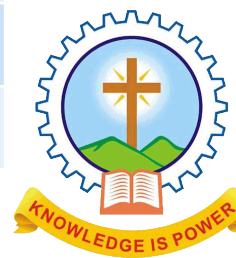
Item	Average annual consumption (number)	Average cost per unit (Rs.)
A	5000	45.00
B	1000	90.00
C	2000	225.00
D	4000	11.25
E	50	300.00
F	6000	62.50
G	2000	67.50
H	4000	18.75
I	50	375.00
J	250	105.00
K	200	187.50
L	50	150.00



1. Computation of usage value:

Usage value = unit rate x quantity

Item	Average annual consumption (number)	Average cost per unit (Rs.)	Usage value
A	5000	45.00	225000
B	1000	90.00	90000
C	2000	225.00	450000
D	4000	11.25	45000
E	50	300.00	15000
F	6000	62.50	375000
G	2000	67.50	135000
H	4000	18.75	75000
I	50	375.00	18750
J	250	105.00	26250
K	200	187.50	37500
L	50	150.00	7500

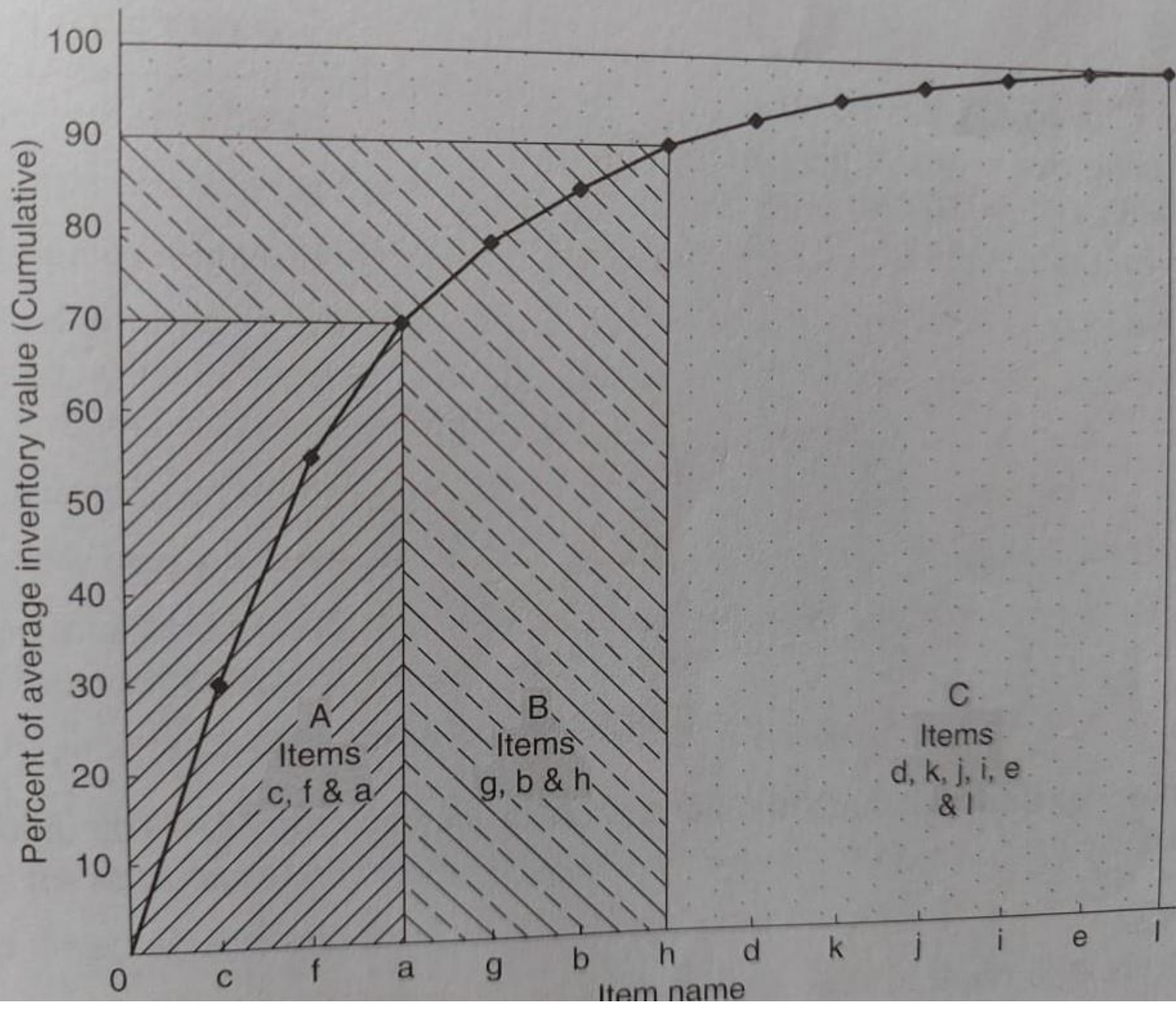


2. Computation of usage value:

Ranking the items in the descending order of usage value and finding cumulative % usage value

Item	Rank	Usage value	Cumulative usage value	Cumulative % usage value	Category
C	1	450000	450000	30	A
F	2	375000	825000	55	A
A	3	225000	1050000	70	A
G	4	135000	1185000	79	B
B	5	90000	1275000	85	B
H	6	75000	1350000	90	B
D	7	45000	1395000	93	C
K	8	37500	1432500	95.5	C
J	9	26250	1458750	97.25	C
I	10	18750	1477500	98.5	C
E	11	15000	1492500	99.5	C
L	12	7500	1500000	100	C





A
Items
c, f & a

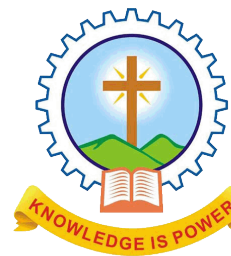
B
Items
g, b & h

C
Items
d, k, j, i, e
& l

ABC Analysis

Advantages:

- Better Control of High-Priority Inventory
- Improved Inventory Forecasting:
- Sensible Stock Turnover Rate:
- Reduces inventory carrying cost
- Conflict with Other Cost Systems
- Reduction in investment associated with inventories



ABC Analysis

Disadvantages:

- Require proper standardisation and codification of inventories
- Considers only money value of items. Importance in terms of production process or functioning is not accounted for
- Abc analysis will not be effective if the material are not classified into the groups properly
- It is not suitable for the organization where the costs of materials do not vary significantly

