BUILDING AND CIVIL ENGINEERING DEPARTMENT

SITE AND WORKSHOP MANAGEMENT

CERTIFICATE AND ARTISAN IN PLUMBING/ BUILDING CONSTRUCTION TECHNOLOGY

MODULE I

TEACHING MANUAL

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INTRODUCTION

This module is designed to equip the trainee with skills, knowledge and attitudes to enable him/her to appreciate and apply safe working conditions on site and masonry works.

General objectives

By the end of the module unit, the trainee should be able to;

a) Prepare workshop layouts.
b) Observe safety, health and welfare in a construction site.
c) Source, purchase and store materials for construction.
d) Apply appropriate site and office procedures.

COURSE OUTLINE

S/N	TOPIC	SUB-TOPIC
1.	Site preparation	• Preliminary items for the works • Purpose of preliminary items • Regulations relating to preliminary items
2.	Site organization and planning	• Meaning of the site organization • Safety, health and welfare • Site layout • Workman indemnity
3.	Contract	• Parties to a contract • Forms of contract • Types of contract • Contact documents • Tendering methods • Law of contract

4	Procurement procedures	• Meaning of purchasing terms • Process of purchasing
5	Storekeeping	• Meaning of stores • Reasons for holding stores • Stock control methods • Storekeeping documents • Types of stores
6	Introduction of estimation of materials	• Terms used in material estimation • Role of estimator • Cost components
7	site office procedures	• Work measurement • Role of sub- contractors and nominated suppliers • Material schedules • Documentation
8	Workshop organization	• Meaning of workshop organization • Safety, health and welfare • Workshop layout • Dress code
9	Tools, equipment and machines	• Sources of finance • Methods of maintenance • Inventories • safety

SITE PREPARATION

Specific objectives

By the end of the topic, the trainee should be able to;

a) Identify preliminary items for the works.
b) Explain the purpose for preliminary items identified.
c) State the regulations relating to preliminary items.

Preliminary items for the works

1. **Site services**

a. Water

An adequate supply of wholesome drinking water and construction water should be provided and maintained at suitable points conveniently accessible to all persons employed.

b. Electricity

It is essential for running plant that is electric as well as aiding in communication channels.

c. Telephone

Construction works involves teamwork hence communication should be clear, concise, complete and correct.

d. Access roads and parking areas

Restrictions such as rights of way, tree preservation and ancient buildings should be considered.

e. Hoarding and fencing

A building site and the compound can be given a degree of protection by surrounding with a fence.

The fence fulfils two functions:

- It defines the limit of the site or compound;

- It acts as a deterrent to the would-be trespasser or thief.

A fence can be constructed to provide a physical barrier of solid construction or a virtual barrier of open-work construction.

f. Hoardings

These are close-boarded fences or barriers erected adjacent to a highway or public footpath to prevent unauthorized persons obtaining access to the site, and to provide a degree of protection for the public from the dust and noise associated building operations.

g. Security

It is best provided for by fencing and having good storage facilities.

h. Sign boards

They are mandatory since they provide relevant details regarding to the construction. They must be strategically placed especially near the site entrance.

2. Insurance

There are many risks in any construction project. The majority of these risks are usually assumed (and priced) by the contractor during the construction phase, who typically covers this exposure by taking out various insurance policies.

The most common forms of insurance under a construction contract include:

- All risks insurance – this insure against physical damage to the works (and usually materials on site).
- Professional indemnity insurance – this insures contractors with design responsibilities (i.e. under design and build contracts) against liability arising out of professional negligence.
- Public liability insurance- this provides cover for liability arising out of death or personal injury to third parties (but not the contractor's employees).
- Workers' compensation insurance- this insures the contractor against liability for the death or personal injury to its employees (usually on site) when performing the works.

PURPOSE OF PRELMINARY ITEMS

i. Safety

The Construction (Health, Safety and Welfare) Regulations:

- Establish objectives measured against assessment of risk, for the well-being of personnel of building on a building site throughout the duration of the work.
- The main areas for assessment include:
    - Temporary timbering and other non-permanent support facilities
    - Safety barriers to excavations
    - Air quality in workplace
    - Safe use doors
    - Gates and other possible means of entrance
    - Defined traffic and pedestrian routes
    - Safe means of access to and egress from all work places including special considerations for scaffolds
    - Emergency lighting and power
- Also provision must be made for welfare facilities to include:
    - Sanitation
    - Hot and cold water supply
    - First aid equipment/personnel
    - Protective clothing
    - Facilities to dry clothes
    - Appropriate accommodation for meals
- Implicit is good site management with regard for organization and planning.

ii. Security

<u>Purpose of site security</u>

- To avoid losses of materials and plant through theft, vandalism and careless behavior To
- prevent fire on site
- To prevent health injury To avoid
- accident
- To protect equipment and machinery (property)
- To protect public

iii. Health

Control of Substances Hazardous to Health Regulations:

- Manufacturing companies are obliged to monitor and declare health risks of their products, building contractors to provide operatives with protective clothing and/or a well ventilated environment if required to use them.
- Timber preservatives, welding fumes, dust from cement and insulating fibers are, as yet, a few of the unavoidable harmful constituents in building materials.

- Where these are applied, employers are obliged to monitor exposure levels, retain records, identify personnel who could be at risk and document the facilities provided for their protection.

iv. Communication

- Construction works involve team work hence communication should be clear, concise, complete and correct.
- It can be verbal or non-verbal.
- Effective communication saves time and provides feedback.

Regulations relating to preliminary items

i. Local authority by-laws

- Local authorities establish a local plan for their region. This is produced within the framework of the structure plan with regard for an economic; social and practical balance of facilities for the various communities under their administration.
- To maintain a fair and equitable interest, local plans are subjected to public consultation.
- Local authorities are also responsible for processing applications for development in their area.
- All require the deposit of area and site plan, building elevations, forms declaring ownership or nature of interest in the proposal and a fee for administration.
- If the application is refused, the applicant has a right of appeal.

ii. Building code

- The Building Regulations contains minimum performance standards expected of contemporary buildings.
- They are supported by a series of approved documents that are not mandatory, but which give practical guidance on compliance with the requirements of the regulations.
- This guidance often incorporates British Standards, Building Research Establishment, British Board of Agreement and other authoritative references.
- However, in 2016 the Kenyan government approved discarding of the British Standards in favor of European norm now in use globally.
- According to KEBS, come 2021, no product that does not conform to Eurocode will be allowed in the market.

iii. IEEE regulations

- British Standards BS 7671 concerns the requirements for electrical installation.
- They are the standard regulations for electrical installations and the safety of electrical wiring.

iv. Water act

- Under the water act, every water resource is vested in the state.
- It provides that no conveyance or lease shall convey transfer or vest in any person any property, or right or interest or privilege in respect of any water resource.
- Under section 27 any person who lacks a permit but constructs or employs works to use the water commits an offence. This is because domestic use of water is given precedence above other uses.

v. NEMA

- The National Environment Management Authority (NEMA) is established under the Environmental Management and Coordination Act (EMCA) No.8 of 1999, as the principal instrument of government in the view to ensuring implementation of al policies relating to the environment.
- It, main function in construction is to promote the integration of environmental considerations into development policies, plans, programs and projects, with a view to ensuring the proper management and rational utilization of environmental resources, on sustainable yield basis, for the improvement of the quality of human life in Kenya.

TOPIC TWO:

SITE ORGANIZATION AND PLANNING

Specific objective

By the end of the topic, the trainee should be able to;

a) Describe site organization.
b) State safety rules and regulations to be observed on site.
c) Illustrate site layout.
d) Explain the site requirements for workmen indemnity.

Management

It is a social process that consists of planning, controlling, coordination and motivation.

Principles of management

I. Division of work: Reduces the span attention or effort for any one person or group. Develops practice and familiarity.
II. Authority: The right to give orders should not be considered without reference to responsibility.
III. Discipline: Outward marks of respect in accordance with formal or informal agreement between firm and its employees.
IV. Unity of direction: One head and one plan for a group of activities with the same objectives.
V. Subordination of individual interest to the general interest: The interest of an individual or any group should not prevail over the general good.
VI. Remuneration: Pay should be fair to the employees of the firm.
VII. Centralization: It's always present to a greater or lesser extent depending on the size of the company and quality of its management.
VIII. Scalar chains: The line of authority from the top to the bottom of an organization.
IX. Order: A place for everything and everything in its place.
X. Equity: A combination of kindness and justice towards the employees.
XI. Unity of command: One man is superior.
XII. Initiative: Within the limit of authority and discipline.

XIII. Spirit de corps: Harmony is a great strength to an organization. Team work should be encouraged.

XIV. Stability of tenure of personnel: Employees need to be given time to settle into their jobs even though this may be lengthy.

Functions of management

a. Planning: It's an activity which involves decisions about the ways and means as well as achieving desired results.
b. Organizing: Is a process of devising and allocating roles arising from the grouping and structuring of activities.
c. Staffing: It involves the distribution of manpower according to the qualifications of specific duties.
d. Controlling: Involves taking corrective action where required.
e. Coordinating: Involves proper/good relationships between employers and employees and within employers themselves.
f. Motivation: Ways/factors which lead to job satisfaction and high employee morale.
   Motivators include:
   - Achievement
   - Responsibility
   - Recognition
   - Advancement

Span of management

This is the number of subordinates that a manager can control effectively. If a manager is given more people to manage, there is a danger of the law of diminishing demand to set in.

The number of subordinates that a manager can supervise depends on the following factors:

i. The nature of work being supervised
ii. Geographical dispersion of subordinates
iii. Capability of the subordinates
iv. Capabilities of the superior
v. Management style
vi. Incentives

Organization

It is an open social system receiving inputs from the environment, converting them and discharging certain output back into the environment.

Principles of organization

- Division of work
- Discipline
- Unity of direction
- Authority
- Remuneration
- Subordination of individual interests
- Centralization
- Scalar chain
- Stability of tenure of personnel
- Order
- Equity
- Spirit de corps
- Initiative

Organizing

One of the management functions is "organizing''

- Organizing therefore is selecting and combining appropriate resources (personnel and capital) and integrating them into a string of relationships that enables them to carry out plans in a coordinated and controlled way.
- Organization is the end product of the organizing process when two or more elements interact for a common purpose. If we substitute people for elements, the statement becomes a definition of a simplified organization thus every organization can be viewed as a system.
- In the complex organization the following components are always present.
    i. Activities and task: ideas and themes are being created, distributed and converted for a specific purpose.
    ii. People: those who do the creating and producing and those who manage them.
    iii. Capital: the money and machinery that make it possible to carry out the various activities by performing designed tasks.
    iv. Structure: the arrangement and relationships of activities, tasks and capital that permits them to interact in a meaningful way.

Functions of organizing

The functions of organizing will include the following:

i. Consult the original plan to be able to answer; what is to be done, how, what resources are required i.e. understanding the overall plan.
ii. Define enterprise activities that will be essential and tasks required to implement them.
iii. Obtain the appropriate people and equipment to do the job (including the staffing).
iv. Assign and condition these tasks in some sort of structural order to make coordination and control possible (this gives rise to formal organization).

Advantages of organizing

i. Comprehensive plans are able to be implemented
ii. Control is achieved

Disadvantages of organizing

i. Some formal organization restricts individuals to particular regions in the structure.
ii. Limits individual opportunity and usefulness.

Organizing process

Organizing activities is an ongoing process n dynamic, therefore it consists of the following four major ways;

a. Designing enterprise functions and their relationships.
b. Designing jobs and their responsibilities.
c. Procuring of personnel and capital to do the job.
d. Assigning and conditioning personnel and capital to their respective roles.

Organizational structure and design

Organizations are set up in specific ways to accomplish different goals, and the structure of an organization can help to hinder its progress toward accomplishing these goals.

Organizations large and small can achieve higher sales and other profit by properly matching their needs with the structure they use to operate.

Organizational structure

1. **Functional structure**

Functional structure is a set up so that each portion of the organization is grouped according to its purpose. In this type of organization, for example, there may be marketing department, a sales department and a production department.

The functional structure works very well for small businesses in which each department can rely on the talent and knowledge of its workers and support itself.

Disadvantage

The coordination and communication between departments can be restricted by the organizational boundaries of having the various departments working separately.

2. Divisional structure

Divisional structure typically is used in larger companies that operate in a wide geographic area or that have separate smaller organizations within the umbrella group to cover different types of products or market areas.

Advantage

- Its need can be met rapidly and more specifically.

Disadvantages

- Communication is inhibited because employees in different divisions are not working together.
- Divisional structure is costly because of its size and shape.

3. Matrix structure

It is a hybrid of divisional and functional structure. Typically used in large multinational companies, the matrix structure allows for the benefits of functional and divisional structures to exist in one organization.

Disadvantage

- It can power struggles because most areas of the company will have a dual management.

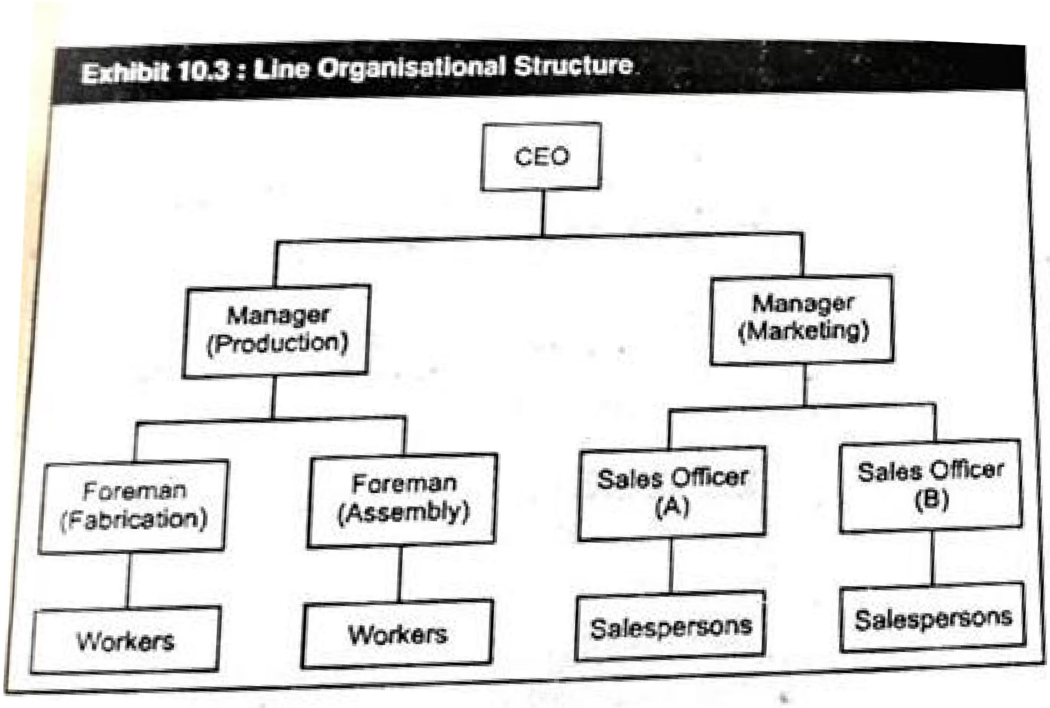
4. Geographical organizational structure

It is centered on appropriate geographical features e.g. regions, nations, sub continents etc.

5. Line organizational structure

A line organizational has only direct, vertical relationships between different levels in the firm. There are only line departments-departments directly involved in accomplishing the primary goal of the organization. For example, in a typical firm, line departments include production and marketing. In a line organization, authority follows the chain of command.

The figure below illustrates a single line organizational structure.



NB It has only direct vertical relationships between different levels in the firm.

Advantages

i. Tends to simplify and clarify authority, responsibility and accountability relationship.
ii. Promotes first decision making.
iii. Simple to understand.
iv. Because line organizations are usually small, managements and employees have greater closeness.

Disadvantages

i. Neglects specialists in planning.
ii. Overloads key persons.
iii. As the firm grows larger, the organization becomes more ineffective.
iv. Improved speed and flexibility may not offset the lack of specialized knowledge.

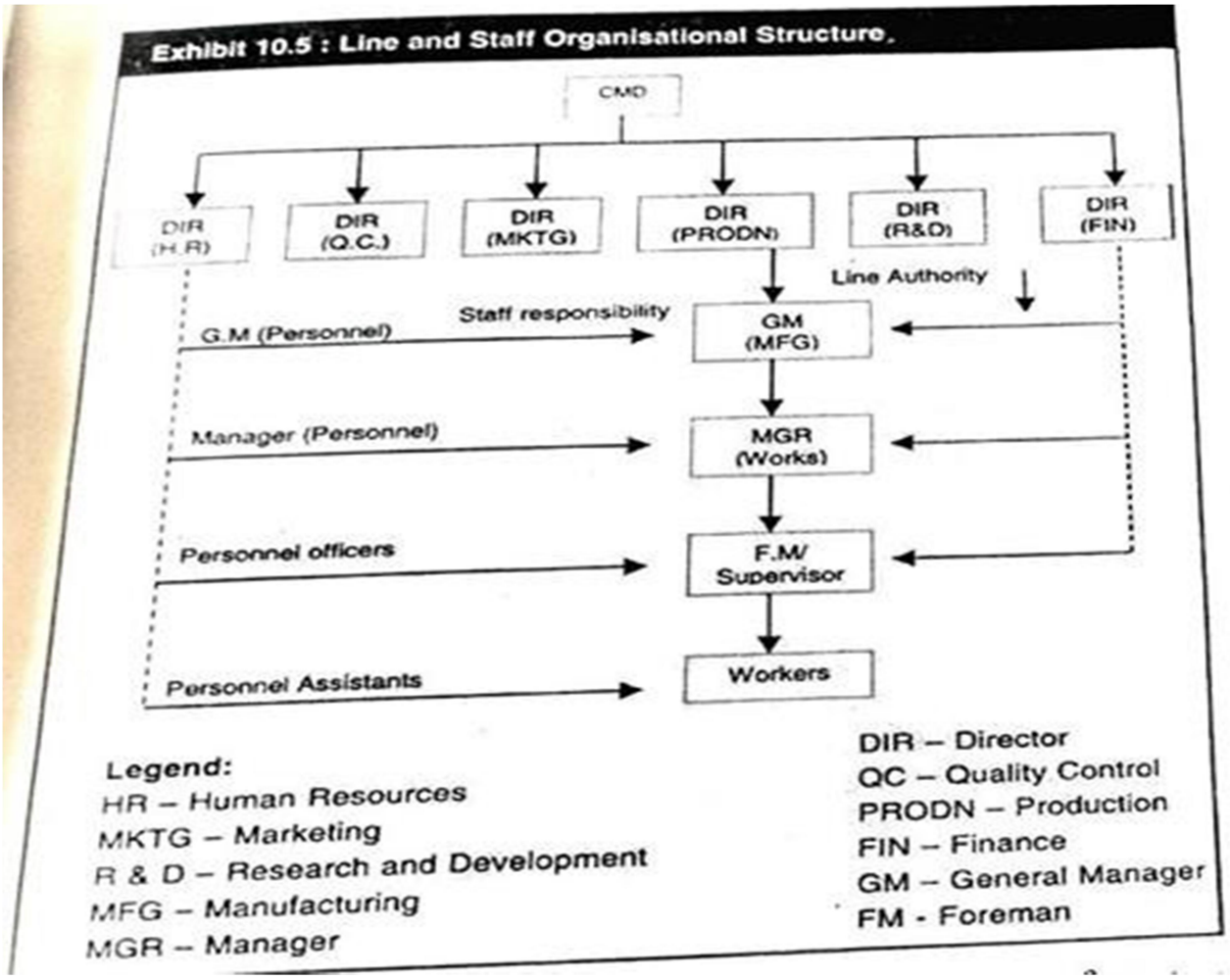
6. Line and staff organizational structure

Most large organizations belong to this type of organizational structure. These organizations have direct, vertical relationships between different levels and also specialists responsible for advising and assisting line managers.

Such organizations have both line and staff departments. Staff departments provide line people with advice and assistance in specialized areas (for example, quality control advising production department).

The figure below illustrates the line and staff organizational chart. The line functions are production and marketing whereas the staff functions include personnel, quality control, research and development, finance, accounting etc.

The staff authority is replaced of functional authority organizational structure is replaced by staff responsibility so that the principle of unity of command is not violated.



Advantages

i. Use of expertise of staff specialists.
ii. Span of control can be increased.
iii. Relieves line authorities of routine and specialized decisions.
iv. No need for all round executives.

Disadvantages

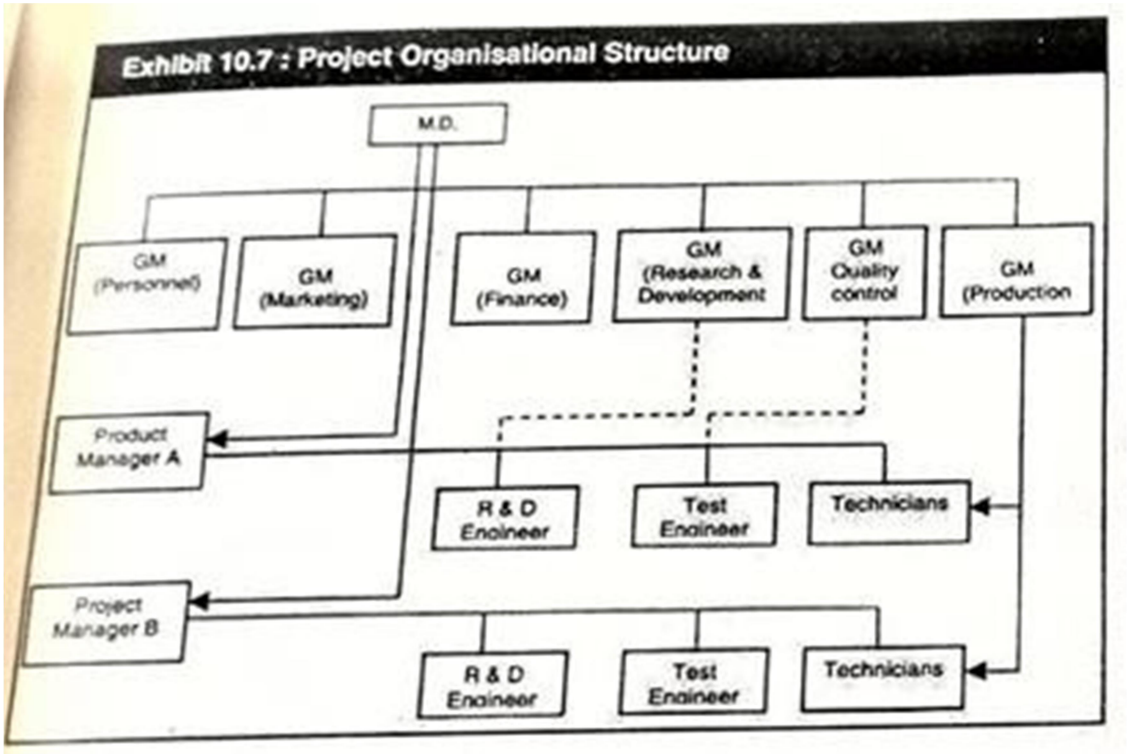
i. Conflict between line and staff may still arise.
ii. Staff officers may resent their lack of authority.
iii. Co- ordination between line and staff may become difficult.

7. Project organizational structure

The line, line and staff and functional authority organizational structures facilitate establishment and distribution of authority for vertical coordination and control rather than horizontal relationships.

In some projects (complex activities consisting of a number of interdependent and independent activities) work process may flow horizontally, diagonally, upwards or downwards.

The figure below illustrate a project organizational structure

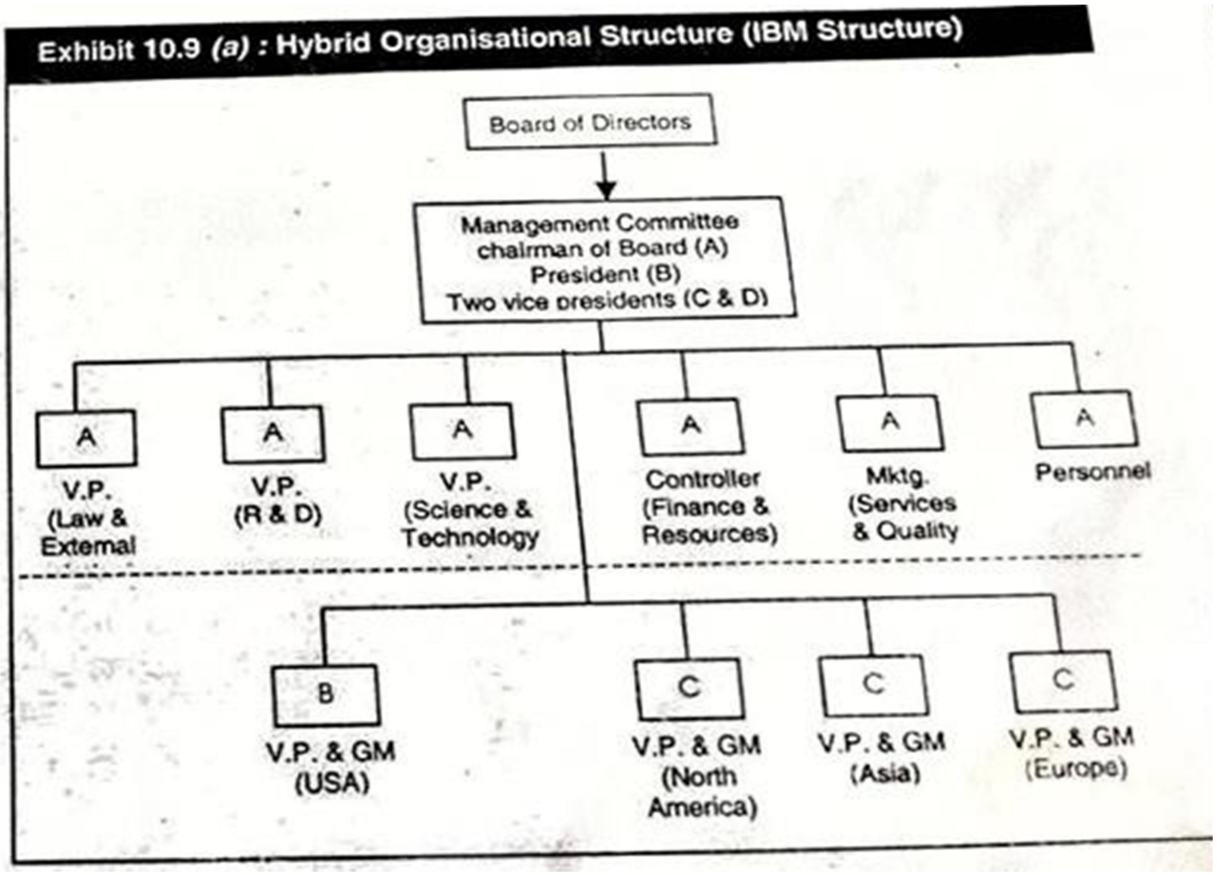


Importance of project organizational structure

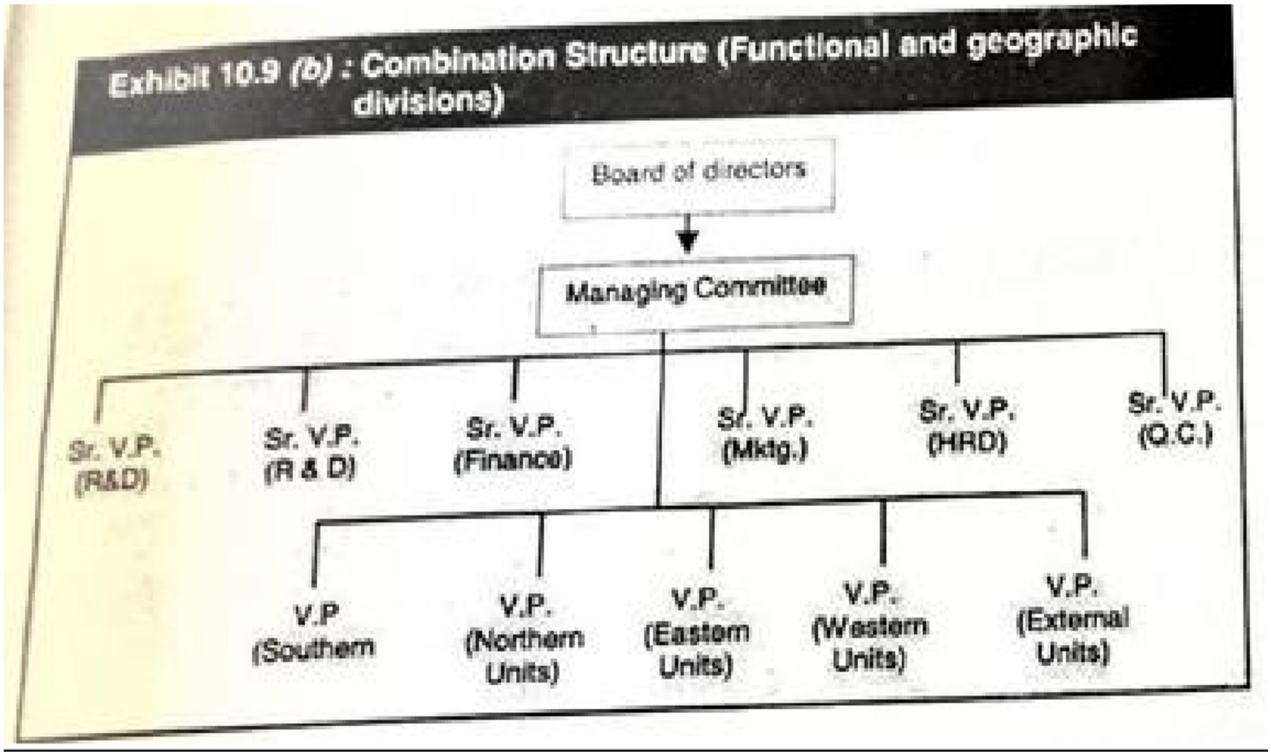
i. Work is defined by a specific goal and target date for completion.
ii. Work is unique and unfamiliar to the organization.
iii. Work is complex having independent activities and specialized skills are necessary for accomplishment.
iv. Work is critical in terms of possible gains or losses.
v. Work is not repetitive in nature.

8. Hybrid organizational structure

The figure below illustrates the hybrid organizational structure:



9. **Combination structure**
   - Used in organizations that face considerable environmental uncertainty that can be met through a divisional structure and that also require functional expertise of efficiency.
   - This type of structure is used by multinational companies operating in the global environment, for example, International Business Machines USA.



Advantages

i. Alignment of corporate and divisional goals.
ii. Functional expertise and efficiency.
iii. Adaptability and flexibility.

Disadvantages

i. Conflicts between corporate departments and units.
ii. Excessive administration overhead.
iii. Slow response to exceptional situations.

Organizational design

- Many people equate organizational design with organizational structure: The word 'lean' and 'flat' are used to describe organization design as well as its structure.
- Organizational design encompasses much more than simply the structure.
- Organization design is the process of aligning an organization's structure with its mission.
- This means looking at the complex relationship between tasks, workflow, responsibility and authority, and making sure those all support the objective of the business.
- Used to manage the total organization, the overall pattern of structural components and arrangement.
- Good organizational design helps communications, productivity and innovation,
- It creates an environment where people can work effectively.

REGULATIONS GOVERNING SITE DESIGN

i. Safety

- Site safety includes the erection of hoarding and fences which safe guard the site operatives.
- The hoarding also gives safety to the onlookers and passers-by and also safe guard the life of straying children.
- Lighting facilities, watchmen and dogs are also part of the safety on the site especially where the materials and plants are concerned.
- Provision is also made to give the operatives on site safety precautions as a measure of safety warning. i.e. where live electric wires are exposed or where a faulty machine or plant is stationed on site.
- The operatives should be provided with safety clothing.
- First aid programs should be taught to the workers orally or written.
- Provision for fire lighting equipment should be also available to the operatives and means of escape in case of fire as stated in the factory's act.
- Security of plants, equipment and materials should be an integrated interest in terms of site security.
- Use of trained manpower on site to avoid undesirable accidents and injuries on site.

ii. Welfare

- Welfare in broad terms refers to suitable conditions which can necessitate smooth and productive working of the operatives.
- The welfare facilities for the operatives on site include the following;
    - Hutments
    - Canteen facilities (sitting and eating facilities)
    - Drying rooms
    - Tools storage rooms
    - Washing and drinking water facilities

- First aid rooms, where first aid can be conducted. These are best placed near the site entrance.

iii. Health (factory's act)

- A site shall not, while work is carried out be crowded as to cause risk of injury to the health of persons or operatives working.
- Effective and suitable provision shall be made to secure and maintain circulation of fresh air in each of the work rooms on site.
- Sufficient and suitable lighting whether natural or artificial in all work rooms on site shall be provided.
- Sick and injured operatives on site should be taken to hospital, their treatment bills settled down and given sick leave whenever necessary.
- Minor and major accidents and injuries on site should be attended to promptly by giving the injured person **first aid**.

SITE LAYOUT (PLANNING)

Construction site layout planning (site planning): is a plan for the construction, which is prepared by the contractor as part of their mobilization activities before work on the site commences.

What are the requirements?

Optimization

- ❖ Time
- ❖ Materials logistic
- ❖ Cost
- ❖ Transport Minimize

- ❖ Accidents
- ❖ Resource consumption
- ❖ Material loss
- ❖ Damage and injury
- ❖ Transport times
- ❖ Waste Maximize

- ❖ Work safety
- ❖ Work efficiency

Influencing factors

Characteristic of construction site:

- Size
- Soil type
- Inclination
- Infrastructure
- Legal environment

- Neighboring buildings and plots traffic options
- Vegetation Characteristics of the

building:

- Size
- Function
- Complexity
- Structure
- Materials

Characteristics of the contractor:

- Capital
- Business strategy
- Risk strategy
- Machinery and equipment in stock.

General construction site plan

Minimum required content (with dimensions and levels):

- ❖ Floor plan and the requisite section
- ❖ Main conflicts identification
- ❖ Buildings (on the own site and neighboring plots, building heights, entrances)
- ❖ Protected items on the site (building, trees etc.)
- ❖ Roads near by the site (direction of traffic, widths, grade of slopes, materials)
- ❖ Position of the main machinery and equipment (tower crane, auto crane, concrete pump, temporary truck parking lots etc.)
- ❖ Main depots and working space of the main technologies (pre-erecting on the site)
- ❖ Temporary and steady roads on the site.
- ❖ Main facilities and temporary buildings (management, social container first aid etc)
- ❖ Infrastructure (temporary and permanent)
- ❖ Guarding system.

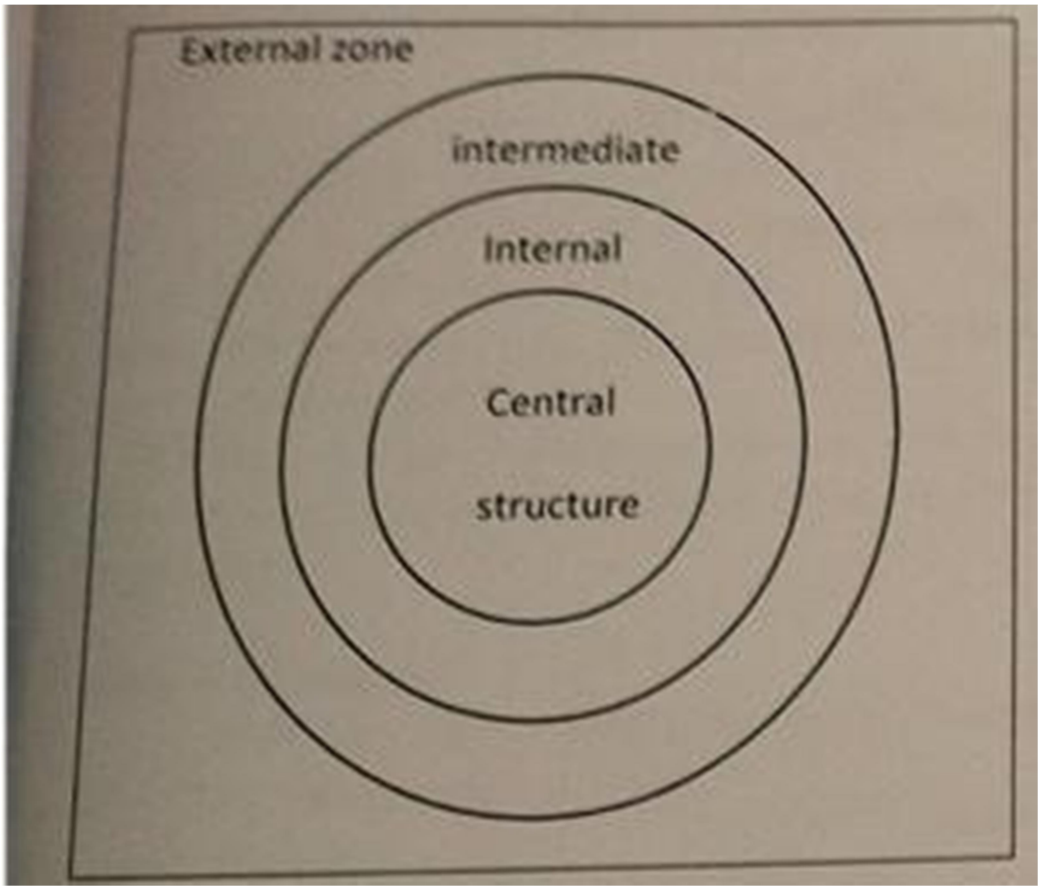
Construction site zones

Central zone: The structure and the closest place around. (Usually place for tower crane, lifting equipment, and scaffolding)

Internal zone: Uploading places, active depots (e.g. formwork, prefabricated elements etc.)

Intermediate zone: The tower crane still reaches this zone. Facilities of prefabrication, inactive depots.

External zone: The tower crane does not reach this zone. Ideal for temporary facilities, staging buildings, parking places, small machines and power tool container etc.)



Steps in site planning

Step 1- SITE GEOMETRY AND TOPOGRAPHY

- Topographic lines
- Existing building on the site
- Vegetation (trees, bushes)
- Neighboring building

Step 2- INFRASTRUCTURE AND TRAFFIC

- Streets/roads around the site
- Direction of the traffic
- Planned building
- Gas, water, wastewater, electricity, etc. Step 3-

EQUIPMENT AND INSTALLATION

- Protection equipment (guard post, fence, gate)
- Transportation routes (for machinery, for workers)
- Temporary structures
- Welfare office and storing (closed)
- First aid point
- Machinery (for material movement and technology)
- Storing areas and equipment

Broadly the initial works on site preparation include the following operations;

a. Removing accumulated rubbish and debris from the site area.
b. Clearance of all vegetable soil.
c. Election of precautionary devices, protective and security devices.
d. Development of excess roads.
e. Preparation of machine tracks and bases.
f. Election of hutments, store sheds and temporary shelters etc.
g. Installation of site services- gas, electricity, telephone, water, drainage etc.

<u>WORKMAN INDEMNITY</u>

Workmen's Compensation Insurance

This insures the contractor against liability for the death or personal injury to its employees (usually on site) when performing the works.

The main benefits are as follows;

1. **Occupational death**

24 onths of the worker's last remuneration before the death subject to a minimum.

2. Permanent disability

Percentage of death benefit as per the specified scale

3. **Loss of wages** (cash allowance) Up to first

   six months 100% of full salary. Balance six

   months 50% of the full salary.

h. Medical expenses

Incurred at local Government or public medical centers are reimbursable.

In addition to basic Workmen's Compensation cover the employer can protect himself against the claim made by the employee under Common/Sharia Law up to a selected limit of indemnity.

As an added benefit to employees the Workmen's Compensation cover can be extended to include accidents occurring within the territorial limits but outside duty hours too in line with the benefits payable under the Labour Law.

TOPIC THREE

CONTRACTS

Specific objectives

By the end of the topic, the trainee should be able to;

a) Define the term contract and tendering.
b) Explain the role of each party involved in building contracts.
c) Outline various types of contract.
d) Identify different types of contract documents.
e) Describe various methods of tendering.
f) Explain the Law of Contract.

Introduction

A contract is an arrangement entered by two or more parties, whereby the parties agree to undertake something.

The work to be undertaken could be a construction project, a service to be altered or any entity to be protected.

PARTIES TO A CONTRACT

Client

- Checks competence of all appointees.
- Ensures there are suitable management arrangements for the project.
- Allow sufficient time and resources for all stages.
- Provide information.
- Appoint the principle contractor.
- Retain and provide access to health and safety file.

Architect

- Analyze the client's brief requirements and present the initial design proposals.
- Develop the initial proposal into a more developed design.
- Prepare forms of tender for main and specialist contractors.
- Architect act on the client's behalf as an independent advisor.
- Inspecting the building work at intervals to ensure that it is being carried out generally in accordance with the contract documents.
- Administer the contract and advise the client on stage payments during the projects.
- Administers the building contract as the client's agent and is legally required to act fairly between the client and the contractor.

- Issuing of certificates upon completion.

Quantity surveyor

- Measurement of building works.
- Managing the finances for any kind of construction project, whether it's a house, a high- rise, a bridge, or a tunnel.
- Working to keep the project within the budget.
- Making sure that construction costs and production are managed as efficiently as possible.
- Resolving disputes between contracting parties.
- Preparing insurance replacement estimates for all kinds of buildings, including houses.

Engineer

- Liaising and working jointly with the design team (consulting engineers) to implement refinements.
- Negotiating modifications with architects and consulting engineers.
- Dealing skillfully with a diverse range of people including clients, architects, other engineering professionals, sub-contractors and member of the public.
- Taking responsibility for health and safety on site.
- Making judgement and solving problems.
- Supervising construction.
- Dealing with the logistics of supplies.
- Scheduling work.
- Providing appropriate plans for construction.
- Monitoring the provision of materials.
- Liaising with directing the work of sub- contractors employed on the project.
- Ensuring quality of workmanship.

Inspector

- Witnessing tests.
- Monitoring progress against the program.
- Assessing whether the works comply with legal requirements such as health and safety legislation.
- Assessing whether the works are being carried out in accordance with the contract documents (which may include taking measurement and samples).
- Monitoring site conditions to ensure work is undertaken in accordance with manufacturer's recommendations.
- Providing regular report (often weekly).
- Attending construction progress meetings.
- Keeping records of:

- ✓ Progress
- ✓ Delays
- ✓ Weather conditions
- ✓ Drawing and instructions received
- ✓ Deliveries
- ✓ Health or safety issues
- ✓ Other significant events

Clerk of works

- Inspect the work on behalf of the employer.
- Interpretation of the documents.
- Dealing on urgent matters of safety of work or workmen.
- Ordering removal or re-doing of bad work.

Sub-contractors

- Check that all workers they employ or appoint have the skills, knowledge, training and experience to carry out the work, or are in the process of obtaining them.
- Make sure that all the workers under their control have a suitable, site-specific induction, unless this has already been provided by the principal contractor.

Suppliers

- Ensuring products meet safety standards and unsafe goods do not go on the market.

<u>Validity of a contract</u>

The legal obligation to perform a contractual obligation between two parties must adhere to the following conditions;

i. There must be an offer made by one person (party) and accepted by another party. The offer must be definite and made with intention to enter into a binding contract.
ii. The contract must have norms. This consists of "deed" which is written document, signed, sealed and delivered.
iii. Every party to a contact must be legally considered and be of contractual age and of sound mind.
iv. The subject matter of the contract must be legal.
v. The concept of the party to the contract must be genuine.

TYPES OF CONTRACT

a. Bill of quantity contract

This is a contract priced by the contractor become the common form of contract. In contractual agreement, the bill of quantities becomes the major document to give the detail of the contract.

b. Lump sum contract

The contractor undertaken to carry out specific work for a fixed sum of money. The nature and extent of work is indicated in the drawings and nature of materials and workmanship described in specification.

c. Cost-plus percentage contract

The contractor is paid the actual work plus the agreed percentage for overhead and profit.

d. Cost plus fixed fee contract

The contractor is paid the actual cost incurred in the execution of work plus a fixed lump sum previously agreed upon prior to commencement.

e. Target contract

This was introduced in recent years where the contractor is engaged to execute work as cheaply as possible and a fee is quoted as percentage agreed over the target estimates.

f. All in contract

In this contract the engineers give the broad requirement to the contractor who is asked to submit full detail of design, the construction and cost of work.

They are used for specialized jobs like gas and chemical industries, oil refineries, bridge and nuclear power station.

g. Cost plus fluctuating fee contract

In this contract, the contractor is paid the actual cost of work plus a fee which is subjected to market fluctuations.

h. Schedule contract

This type of contract may be taken in one or two forms namely;

i. The client may supply a schedule of unit rates for each item and then ask the contractor when undertaking the work to state the percentage above.

ii. The contractor may be required to insert the prices against each item pf work and the comparison of price is entered which gives the sum of the contract to be made.

IMPORTANT OF CONTRACT DOCUMENTS

(a) The written carefully and clearly define the party's agreement, their expectations and their respective risks and obligations.
(b) They are useful in case where dispute arises.
(c) They provide a clear road map at the onset of the project of how the parties will proceed to carry out the work which helps to ensure that the project run smoothly and diminishing the risk of potentially fatal problems.
(d) Helps to guide or even force the parties to comply with reasonable business procedures since those procedures will be specifically spelled out in a well-written contract and become requirement of each party.

(e) In case of dispute it leads to more efficient or at least less costly resolution of dispute since there will be fewer issues to legitimately fight over.

CONTRACT DOCUMENTS

a) Working Drawings b) Specifications c) Bill of Quantities d) Form of tender e) Schedule of rates f) Conditions of contract g) Articles of agreement

a. Working Drawings

They include plans, elevations, sections and large scale details of the proposed construction project of which should be able to interpret the project at hand. Drawings of a building or a structure show the arrangement of rooms and various dimensions i.e. breadth, length and height with very few descriptions of parts.

b. Specifications

These are documents prepared by architect to supplement the drawings. A specification specifies or describes the nature and class of work and materials to be used in the various parts of work from foundations to superstructure in details as well as methods of work (workmanship). It is a short description of different parts of work, specified materials, proportions, qualities etc. For example, foundation shall be in brickwork with lime mortar or cement mortar 1:6.

c. Bill of Quantities

This is prepared for the client by professional quantity surveyor whose fee is paid by the client. Copies of bill of quantities are sent to the contractors to enable them to estimate when tendering. BQ specifies the type of materials, method of work and the quantities of work to be done. When the contract is signed, the priced BQ become part of the contract agreement and will be used for preparation of the final account and settlement of any variations.

d. Form of tender

The form of tender is a pre-printed formal offer, usually in letter form, which ensures that all tenders are received on the same basis and should be simple to compare. The tenderer fills in his name and address and a sum of money (contract sum) as an offer to carry out and complete the works as described in the conditions, drawings and bills of quantities.

e. Schedule of rates;

In appearance they are similar to a page of a bill of quantities without any quantities given. The contractor simply inserts his rates upon which his tender is based against each description of work included on the schedule. In practice only the major work items of significant cost and value are included. Those rates can then be used to value any variations. Schedules of rates are also used to obtain tenders for maintenance works.

a. Form of agreement

This is a legal document signed by both parties agreeing to abide to the conditions of contract. It states that the contractor accepts to put up the building in accordance with drawing and specifications and the client agrees for his part to pay the contract sum.

b. Conditions of contract

They are clauses in the agreement of which is stated and observed by the construction team. It defines the responsibilities of the employer, contractor, architect, engineer and other non- technical staff.

TENDERING METHODS

Open tendering

The employer advertises his proposed project and permits as many contractors as are interested to apply for tender documents. However, this method can be said to be wasteful of contractors' resources since many may spend time preparing tenders to no effect.

Also, knowing their chances of gaining the contract are small, contractors may not study the contract in detail to work out their minimum price, but simply quote a price that will be certain to bring them a profit if they win the contract.

Selective tendering

Under selective tendering, the employer advertises his project and invites contractors to apply to be placed on a selective list of contractors who will be invited to bid for the project. Contractors applying are given a list of information they should supply about themselves in order to 'pre- qualify'.

The advantage of the employer is that he can select only those contractors, who have adequate experience, are financially sound, and have the resources and skills to do the work.

Negotiated tendering

Negotiated tenders are obtained by the employer inviting a contractor of his choice to submit prices for a project. Usually this is for specialized work or when particular equipment is needed as an extension of existing work, or for the further work following a previous contract

Package deal

This type is often associated with commercial and industrial structures where simple repetitive design and speed of construction are main criteria and with clients who wish to retain the services of a contractor who has given good service and value in the past and with whom a positive relationship exists.

Design and build

In this case the contractor is responsible for the design, specification and the construction. The contract may be on a fixed price or cost reimbursement basis, which may be either negotiated, or subject to tender. These are normally used for repetitive types of building of a standard type i.e. industrial unit which the contractor has constructed previously. Past experience and familiarity of the design and construction should result in cost savings for the client.

Serial tendering

In this type of tender, the contractor is required to submit costs for carrying out work usually not against a particular project but against sample Bills of Quantity. Works schedule, or price for a sample structure in the knowledge that others of a similar nature will be undertaken. The rates given in such documents will form the basis of costing for future work undertaken, which will be measured and valued by both parties to the contract. The contract is usually also for a fixed period of time (often 5 years) after which the tendering procedure will be repeated.

LAW OF CONTRACT

Formation

1. Client goes to a consultant (architect) and gives a brief (a client's dream, desire or wish).
2. Architect prepares preliminary sketches (design). This is done to allow time for brainstorming before the final design is agreed upon.
3. Architect and the quantity surveyor prepare preliminary estimates (a cost plan or budget).
4. Architect prepares design (working drawings) and sends them to the following consultants:
    - Quantity surveyor to prepare bills of quantities.
    - Structural engineer to design structural members.
    - Electrical engineer electrical services.
    - Mechanical engineer for mechanical services e.g. hot water circulation, air conditioning.
    - Environmental services e.g. landscaping, flower gardens etc.

The process of professionals preparing specification works in their area is referred to as

Documentation of the contract.

Architect invites tender on behalf of the client. The tender are offers, quotations or bids.

On receiving the tenders, the analysis of the same is done and one of the tenders is recommended for acceptance.

If the client accepts any of the tenders, then the client and the tenderer enter into a kind of contract.

Discharge of a contract

This is termination of the contract and the contract and there basically four ways of discharging a contract:

i. **Performance**

This is when the parties have carried out their responsibilities to satisfaction of each other. The parties play the roles as stipulated in the arrangement or agreement.

ii. **Breach of the contract**

This is one party fails to perform or complete what it is supposed to do as stipulated in the contract. The party that breaches the contract has the penalty to pay as it shall be assessed and approved by a court of law.

iii. **Frustrations**

This is when the parties cannot achieve the subject matter although none of the party has failed in performing its duties. This is kind of an unfortunate way of discharging a contract.

iv. **Agreement**

An agreement can be reached between the two parties to terminate the contract without external influence. This is seen as mutual understanding between the two parties.

Remedies for breach of contract

The party affected can make the application in a court of law and the court in turn can order the following remedies:

1. It will order specific performance.
2. If there will be damages, one will be given monetary compensation.
3. Injunction. Continue in that particular state, the party causing the breach is forced to perform as agreed.

4. Quantum merit. It involves the cancellation of the contract where even the party causing the breach also gets some benefit up to what it has performed.

TOPIC FOUR

PROCUREMENT PROCEDURES

Specific objectives

By the end of the topic, the trainee should be able to:

a) Define purchasing terms.
b) Describe the purchasing process.

Procedure for ordering goods Letter of inquiry

When a trader wants to buy some goods, an enquiry is made. The main purpose of this enquiry is to find out the prices and quality of goods which can be supplied by different suppliers. Through advertisements the buyer call tenders.

A letter of enquiry which is written by the prospective buyer to a supplier seeks the following information;

- Various types of good or services for sale
- Prices for the goods or service
- The terms of trade-they may include time of delivery, mode of payment etc.

Inquiry are best made by written letters, through telephones or by fax or mail for urgent cases. Issue of a letter of inquiry is the first step in a commercial transaction.

Reply to an enquiry

The next step is a reply to the inquiry. The seller replies with a price list, a catalogue or quotation.

- ✓ Price list
  It contains prices of goods listed at the time it was made. It also doesn't promise to sell the goods at the stated prices.
- ✓ Catalogue

  It contains the details of the goods offered. The may be sometimes be illustrated using a number code.
- ✓ Quotation
  It is an offer to supply goods according to the terms and conditions stated. They are given by manufacturers or producers.

Procedure for purchasing goods

1. Identify users need for materials- a user in the organization must identify need for material

and pass the details to procurement to prepare bill of materials.

2. Describing the materials- procurement department has to get a clear idea of the material needed including technical details and price.
3. Deciding whether to acquire the materials.
4. Reviewing the market condition – this considers the general shape of the market to see how competitive it is, supply conditions, availability, new products etc.
5. Forming a long list of suppliers.
6. Forming a short list of suppliers.
7. Evaluating the short list.
8. Choosing the supplier- all aspects of the short-listed suppliers' performance are compared before doing a final negotiation and then choose the best.

Placing order

After studying the catalogue and the price list send to the buyer, the buyer will write an order form.

Quotation

It is also known as quote. It is a document that a supplier submits to a potential client with a proposed price for the supply's goods or services based on certain conditions.

Quotation usually include quite a bit of details. The supplier will include a breakdown of the factors that have led to the specific prices, such as taxes/VAT, materials, cost labour etc.

They also include the time period for when its valid.

Delivery of goods

After receiving the order from the buyer, the seller makes arrangements to deliver the goods. Documents involved in delivery include:

- Delivery note
- Packaging note
- Consignment note

- **Delivery note**

It shows the list of goods without showing their prices. It is usually written by seller to the buyer, its main function is to show the goods that have been delivered.

- **Packaging note**

It is prepared in addition to the delivery note to show the packaged items.

- **Consignment note**

It is a document provided by the carrier in which the seller fills the details of goods delivered. It also shows the names and addresses of both the seller and buyer. When the goods are delivered, the buyer has to sign in the consignment.

Invoice

After the delivery of goods, the seller writes an invoice to the buyer. An invoice is a document which shows the quality, quantity, price total value of goods, transportation charge and any discount allowed.

They are in duplicate, one for the buyer and other for the seller. When goods are delivered, the buyer checks them against the invoice to ensure that the products are in order.

Statement of account

They are documents written occasionally showing transactions that have taken place since the last statement of accounts. It enables the buyer and seller to compare the entries in their book in respect to the transactions that have taken place.

Payment

After receiving the statements, the amount owed to the seller is paid.

Receipt

Also known as packing list, packing slip, delivery docket, shipping list, delivery list, bill of parcel or customer receipt is a document written by the seller to the buyer acknowledging that the seller has received the payment following the sale of goods or provision of service.

Other documents used in purchase of goods

Pre- formal invoice

This is a document that shows the buyer how the invoice will be written if he decides to buy the goods.

Advice notes

An advice note is written by the seller to the buyer to show that the goods have been delivered.

Damage/return note

Is a note which shows the details of damaged goods and is written by the buyer to the seller and the items are returned to the seller.

Credit note

It shows the degree of money owed by the seller. It notifies the buyer of the reductions n the amount owed to him by the seller.

STORAGE OF MATERIALS

Material storage means protection of materials from all kinds of damage so as to maintain the original value of the material which has been carried to the store.

Reasons for storage of materials

I. To keep materials safe from damage and spoilage.
II. To protect the materials and maintain their value of quality.
III. To avail stored materials when needed in good condition.

TOPIC FIVE

STOREKEEPING

Specific objectives

By the end of the topic, the trainee should be able to;

a) Explain the meaning of holding stores.
b) Give reasons for holding stores.
c) Discuss various methods of stock control.
d) Outline various documents used in stock keeping.
e) Name different types of stores.

Introduction

After the completion of purchase procedure, the next important aspect Of materials management is storekeeping.

A storehouse is a building provided for preserving materials, stores and finished goods. The in- charge of store is called storekeeper or stores manager. The organization of the stores department depends upon the size and layout of the factory, nature of the materials stored and frequency of purchases and issue of materials.

According to Alford and Beatty "storekeeping is that aspect of material control concerned with the physical storage of goods." In other words, storekeeping relates to art of preserving raw materials, work-in-progress and finished goods in the stores.

Types:

Stores may be centralized or decentralized. Centralized storage means a single store for the whole organization, whereas decentralized storage means independent small stores attached to various departments. Centralized storekeeping ensures better layout and control of stores, economical use of storage space, lesser staff, saving in storage costs and appointment of experts for handling storage problems. It further ensures continuous stock checking.

It suffers from certain drawbacks also. It leads to higher cost of materials handling, delay in issue of materials to respective departments, exposure of materials to risks of fire and accident losses are practical difficulties in managing big stores.

On the other hand, decentralized stores involve lesser costs and time in moving bulky materials to distant departments and are helpful in avoiding overcrowding in central store. However, it too suffers from certain drawbacks viz., uniformity in storage policy of goods cannot be achieved under decentralized storekeeping, more staff is needed and experts may not be appointed.

Objectives of storekeeping:

Following are the main objectives of an efficient system of storekeeping:

1. To ensure uninterrupted supply of materials and stores without delay to various production and service departments of the organization.
2. To prevent overstocking and understocking of materials,
3. To protect materials from pilferage, theft fire and other risks.
4. To minimize the storage costs.
5. To ensure proper and continuous control over materials.
6. To ensure most effective utilization of available storage space and workers engaged in the process of storekeeping.

Functions of Storekeeping:

In the light of above objects, the functions performed by the stores department are outlined below:

1. Issuing purchase requisitions to Purchase Department as and when necessity for materials in stores arises.

2. Receiving purchased materials from the purchase department and to confirm their quality and quantity with the purchase order.

3. Storing and preserving materials at proper and convenient places so that items could be easily located.

4. Storing the materials in such a manner so as to minimize the occurrence of risks and to prevent losses due to defective storage handling.

5. Issuing materials to various departments against material requisition slips duly authorized by the respective departmental heads.

6. Undertaking a proper system of inventory control, taking up physical inventory of all stores at periodical intervals and also to maintain proper records of inventory.

7. Providing full information about the availability of materials and goods etc., whenever so necessary by maintaining proper stores records with the help of bin cards and stores ledger etc.

Working of the stores:

There are four sections in the process of storekeeping;

(a) Receiving section,

(b) Storage section,

(c) Accounting section, and

(d) Issue section.

These are explained as under:

(a) Receiving Section:

There are four kinds of inventories received by stores viz., (i) raw materials, (ii) stores and supplies, (iii) tools and equipments, (iv) work-in- progress or semi-finished goods.

Following procedure is followed in receiving these inventories:

(i) Receiving these incoming materials in stores.

(ii) Checking and inspection of these incoming materials and stores etc.

(iii) Recording the incoming materials in goods received book.

(iv) Preparing and forwarding goods inwards note to purchasing section.

(v) Informing the purchase department about damaged and defective goods and surplus or deficit supplies etc. along with rejection forms and notes.

(vi) Returning damaged or defective goods to the suppliers in accordance with the instructions of the purchase department.

(vii) Forwarding the materials to respective stores and locations where these are to be stored or preserved.

(b) Storage Section:

The store room should be located at a convenient and appropriate place. It should have ample facilities to store the materials properly viz. bins, racks and shelves etc. There can be a single store room in case of a small organization, but a large scale concern can have different or multiple stock rooms in addition to general or main store.

The separate stockrooms may be used for different classes of inventories. The material should be stored in such a manner as to protect it against the risks of damage, destruction and any kind of loss. Each article should have identifying marks viz., stamping, embossing, colour, coding and painting etc. These risks are

very useful in locating or identifying an article in the stores.

(c) Accounting Section:

This section is concerned with keeping proper records with regard to receipt and issue of materials. The primary task of this section is to undertake the process of inventory control.

(d) Issue Section:

The materials should be issued to respective departments on receiving duly authorized requisition slips. An entry should be made immediately on the bin card attached with the bin from where the material has been issued.

Bin cards contain valuable information with regard to receipt and issue of materials, which is greatly helpful in exercising a system of inventory control. These cards are further helpful in determining various levels of materials viz., maximum, minimum, and re-ordering level.

HOLDING STORES

All Manufacturing and Marketing Companies hold Finished Goods inventories in various locations and all through FG Supply Chain. While finished Goods move through the supply chain from the point of manufacturing until it reaches the end customer, depending upon the sales and delivery model, the inventories may be owned and held by the company or by intermediaries associated with the sales channels such as traders, trading partners, stockiest, distributors and dealers, C & F Agents etc.

REASONS FOR HOLDING STORES

1. **Markets and Supply Chain Design**

Organizations carry out detailed analysis of the markets both at national as well as international / global levels and work out the Supply Chain strategy with the help of SCM strategists as to the ideal location for setting up production facilities, the network of and number of warehouses required to reach products to the markets within and outside the country as well as the mode or transportation, inventory holding plan, transit times and order management lead times etc, keeping in mind the most important parameter being, to achieve Customer Satisfaction and Demand Fulfillment.

2. **Production Strategy necessitates Inventory holding**

The blue print of the entire Production strategy is dependant upon the marketing strategy. Accordingly organizations produce based on marketing orders. The production is planned based on Build to stock or Build to Order strategies.

While Build to Order strategy is manufactured against specific orders and does not warrant holding of stocks other than in transit stocking, Build to Stock production gets inventoried at various central and forward locations to be able to cater to the market demands.

3. **Market penetration**

Marketing departments of companies frequently run branding and sales promotion campaigns to increase brand awareness and demand generation. Aggressive market penetration strategy depends upon ready availability of inventory of all products at nearest warehousing location so that product can be made available at short notice - in terms of number of hours lead time, at all sales locations throughout the state and city.

Any non-availability of stock at the point of sale counter will lead to dip in market demand and sales. Hence holding inventories becomes a necessity.

4. **Market Size, location and supply design**

Supply chain design takes into account the location of market, market size, demand pattern and the transit lead time required to reach stocks to the market and determine optimum inventory holding locations and network to be able to hold inventories at national, regional and local levels and achieve two major objectives. The first objective would be to ensure correct product stock is available to service the market. Secondly stocks are held in places where it is required and avoid unwanted stock build up.

5. **Transportation and Physical Barriers**

Market location and the physical terrain of the market coupled with the local trucking and transportation network often demand inventory holding at nearest locations. Hilly regions for example may require longer lead-time to service. All kinds of vehicles may not be available and one may have to hire dedicated containerized vehicles of huge capacities. In such cases the will have to have an inventory holding plan for such markets.

Far away market locations means longer lead times and transportation delays. Inventory holding policy will take into account these factors to work out the plan.

6. **Local tax and other Govt. Rules**

In many countries where GST is not implemented, regional state tax rules apply and vary from state to state. Accordingly while one state may offer a tax rebate for a particular set of product category, another state may charge higher local taxes and lower inter-state taxes. In such cases the demand for product from the neighboring state may increase than from the local state.
Accordingly inventory holding would have to be planned to cater to the market fluctuation.

While in case of exports from the country of origin into another market situated in another country, one needs to take into account the rules regarding import and customs duties to decide optimum inventories to be held en route or at destination.

7. Production lead times

FG inventory holding becomes necessary in cases where the lead-time for production is long. Sudden market demand or opportunities in such cases require FG inventories to be built up and supplies to be effected.

8. Speculative gain

Companies always keep a watch on the economy, annual state budget, financial environment and international environment and are able to foresee and estimate situations, which can have an impact on their business and sales.

In cases where they are able to estimate a increase in industry prices, taxes or other levies which will result in an overall price increase, they tend to buy and hold huge stocks of raw materials at current prices. They also hold up finished stock in warehouses in anticipation of a impending sale price increase. All such moves cause companies to hold inventories at various stages.

9. Avoid Certain Costs

Finally organizations hold FG inventories to satisfy customer demand, to reduce sales management and ordering costs, stock out costs and reduce transportation costs and lead times.

LOCATION AND LAYOUT:

- The normal practice is to locate the stores near the consuming departments.
- In stores layout, the governing criteria are easy movement of materials, good housekeeping, and sufficient space for men and material handling equipment, optimum utilization of storage space, judicious use of storage equipment, such as shelves, racks, pallets and proper preservation from rain, light and other such elements.
- These problems are more important in the case of items that have a limited shelf life.

Other important factors governing the location are

- the number of end users and their location,
- the volume and the variety of goods to be handled,
- the location of the central receiving section and
- Accessibility of modes of transportation.

The important factors in the design of stores building can be summarized as follows:

1. Lighting :

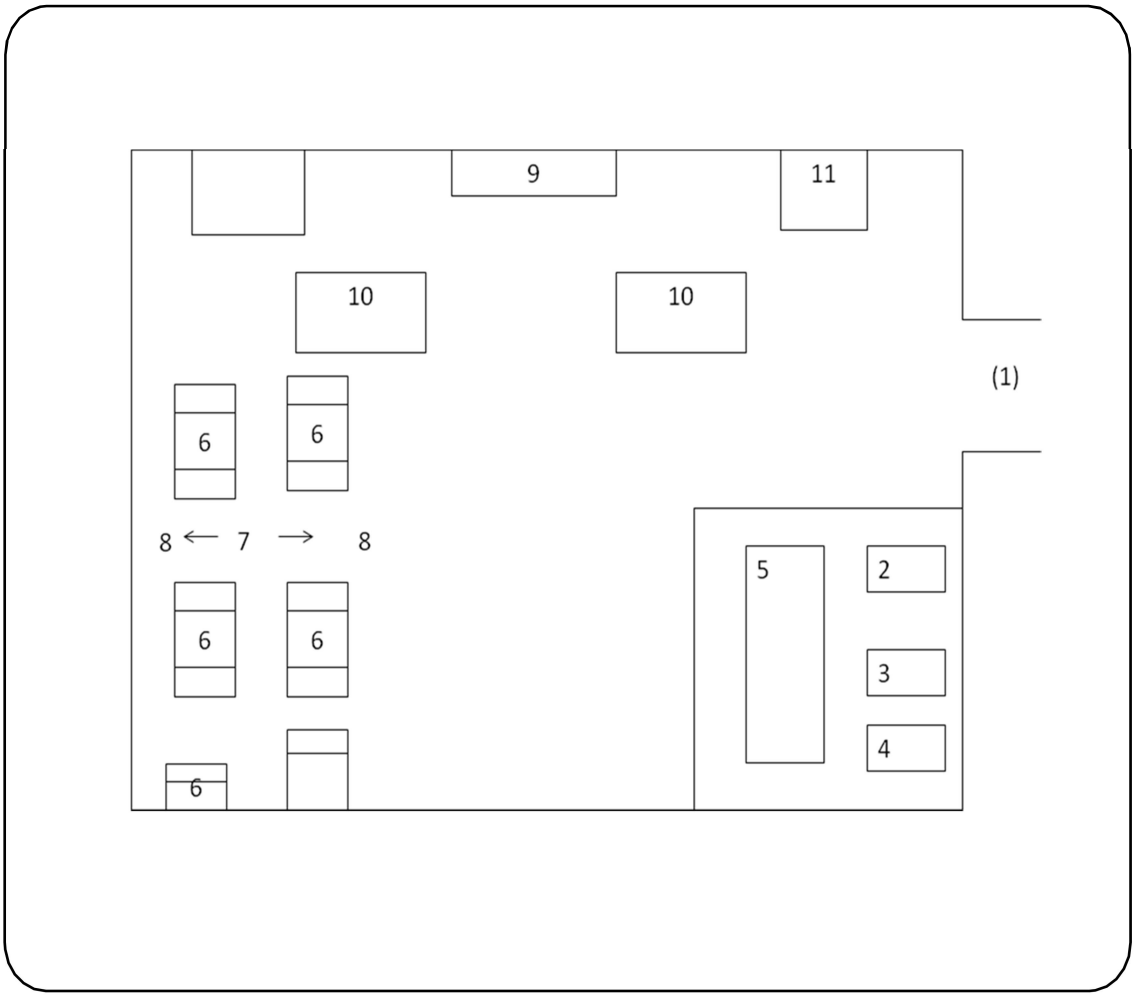
- Clear and adequate lighting is a must for a proper work environment.
- The daylight factor of the building is determined by a modified photo-electric meter, known as day light meter.
- Artificial illumination is by filament lamps or fluorescent lamp. Fluorescent lamp is more economical, and light emitted by it is cool and efficient.
- **Safety :**
- This factor is perhaps the most important aspect. In stores a large volume of goods are handled every day.
- Accidents considerably reduce the moral and effectiveness of the system.
- It has been aptly said that "if accident is a disease, then safety education is its vaccine „stores personnel's should be trained in giving first aids.

The following measures are necessary if accidents are to be checked:

a. Safety consciousness should be instilled in the minds of stores personnel through training programmes, visual aids and literature.
b. Safety appliances, such as goggles, hand gloves, full face integral helmets, use of leather clothing & boots etc., must be provided and their use must be encouraged.
c. Good housekeeping is essential. Stocking must be in appropriate locations so that handling is minimum.
d. All stores equipment must be kept in good order.
e. Healthy competition can be stimulated by installing „safety awards" and cash prizes. This also motivates others to practice safety.
f. Provision of firefighting facilities is necessary especially where inflammable materials are stored handled.
g. Other factors which merit attention include provision of toilets, routine maintenance equipment, safe electrical wrings, etc.

Factors to be Considered While Locating the Store – Room

1. The location of stores should be carefully considered in terms of ensuring maximum efficiency.
2. The store-location should minimize the cost involved in carrying of inventories and other stores operation.
3. Stores location depends upon the nature and value of materials and frequency of consumption of material.
4. Stores should be easily accessible to all use departments and there by material handling should be reduced to minimum.
5. Medicines & materials inventories should be located near the main operation theater.
6. In big organizations having number of service units and each one is located far from the central office; decentralized storage system should be followed.



1. Incoming materials receiving gate.
2. Place for dumping materials.
3. Place for sorting and checking materials &medicines.
4. Place for materials & medicines inspection.
5. Place for temporary storing of materials before placing racks, bins, etc.
6. Proper place for stringing each type of material.
7. Main aisle
8. Side aisle
9. Service window
10. Boxed containing material to be brought from container issues.
11. Counters for keeping materials to be issued.

The following are the factors to be considered while planning the layout of storage area:

1. A section adjacent to store-room should be kept reserved for the receipt of material and or their inspection before storage.
2. Stores layout should be planned, such that if provides easy receipt, storage and issue of material, preferably nearest to the point of use.
3. Store-room lay-out should minimize handling and transportation of materials.
4. An ideal store-room layout makes optimum utilization of the floor space and height.
5. The shelves, racks, bins etc, should be situated in clearly defined lanes, so that the items are quickly stored and located for physical counting or issuing.
6. The main lanes (or) aisles should usually be between 1.5 and 3 meters wide, depending upon the type of material and the amount of traffic involved.
7. Storage spaces should be clearly marked to ensure easy and quick identification.
8. Obstructions such as partitions, poles, staircases should be as far as possible eliminated or reduced.
9. The storage space must be adequately protected against waste, damage, deterioration and pilferage.
10. A place for storing the material should be decided depending on the material characteristics.
11. Store layout is such that for its efficient operations, it makes used of modern material handling equipment such forklifts, trucks conveyors etc.
12. Store lay out should be such that the store keeper is not compelled to put the newly arrived material on the top of the old. As a roll, all the old stock should be concerned first before using the new one.
13. Due space (20 to 25%) must be left in each section of store-room to allow for expansion.
14. The stores racking should not prevent the normal movement of air and temperature. The height of the rooms should be such as to give an air space of at least 500 c.ft per capita, preferably 1000 c.ft.
15. In vertical stacking (Loading one over other) the load should not touch the ceiling heights, otherwise it will prove hindrance in case of fire fighting.
16. Walls of the medical stores should be 9 -- inch bricks wall, with smooth plaster, should be white colored.
17. The height of the roof should not be less than 10 feet, in the absence of air conditioner for comfort.
18. Floor area should be at least 120 sq.ft for the occupancy by more than one person and 100 sq.ft for the occupancy by a single person.

RECORDS : STORES

The store-keeper has to maintain two stores records namely Bin card & stores ledger.

- Bin card is a stores record in which the items received and issued are clearly specified by the store-keeper.
- Whenever the materials are received, the store-keeper has to prepare a stores received note indicating the type of materials and quantity and based on that he has to fill-up the receives column in the bin card after placing the materials in their respective Bins.
- When any issue of materials is made he has to check for the authorization of the requisition before issuing the materials.
- On making the issues he has to enter into the issues column that quantity of materials issued.
- The column reserved indicates the number of items and their type kept as reserve for important jobs.

Bin card

No._____ Name of article _____ Symbol_____ Unit_____ Bin No. _____ Stores Ledger folio _____	Max. Qty _____ Min. Qty _____ PreviousYear_____ Consumption _____

ORDERED				Date	Ref	Received	Issued	Balance	Remarks
No.	Date	Qty	Date Received						
RESERVED									
Job No.		Qty	Date issued						

Store Ledger:

- It is same as Bin card, the difference is only with regard to the addition of amount column in this stores ledger used in day to day management of hospital stores.
- Whenever the materials are received from the supplier, after checking the consignment, the number of items received must be shown in the received column, under quantity.
- After the invoice sent by the supplier is verified, the rate and amount column are also filled-up.

Stores ledger

Name of material _____	Minimum Quantity _____
Symbol_____Unit_____	Maximum Quantity _____
Bin No. _____	Previous yr. Consumption _____
Bin card No. _____	Period of delivery _____

Ordered	Date	Quantity			Amount			Rate	Remarks
		Received	Issued	Balance	Received	Issued	Balance		

- When any issue is made, the store-keeper on checking the authorization of materials requisition has to make entries in the Bin card and stores ledger.
- The main advantage of stores ledger is that is adds as a counter-check for the entries shown in the Bin Card.
- Both Bin card and stores ledger must be properly up-dated in order to facilitate the physical checking of inventories.
- All discrepancies found out have to be corrected then and there, and there by the stores records are helpful for perpetual inventory control.

- **Materials Issue Procedure: (to be followed in the hospital stores):**

A standard procedure of material issue from hospital stores should be developed keeping in view of the following points.

1) Materials should be issued only against proper authorization (e.g., Materials Requisition).
2) Issuing of material should take the least possible time so that there should not be inconvenience or interruption in service process.
3) Materials should be kept at accessible and definite place to enable quick issue.
4) Proper system of classification of materials should be adopted for avoiding the issue of wrong materials.
5) Persons who come to take materials should be adopted for avoiding the issue of wrong materials.
6) Every issue should be recorded immediately in proper records like Bin cards, stock register.
7) Material issued should be priced and entered into the stores Ledger by costing department, (finance department) and not by stores-personnel.
8) Unauthorized persons should not be allowed to meddle with the stocks.

CHAPTER SIX

INTRODUCTION TO ESTIMATION OF MATERIALS

Specific objectives

By the end of the topic, the trainee should be able to;

a) Define terms relating to estimation of materials.
b) Identify techniques of analyzing materials for estimation.
c) Explain the role of an estimator.
d) Explain the components of cost for a given product.

Introduction

Estimating revolves around the need for all interested parties involved in the building process, but particularly the contractor to be able to predict as accurately as possible the cost of construction.

The purpose of estimating is to forecast costs required to complete a project in accordance to a contract's plan and specification for any given project.

The person responsible for the preparation of prices and estimates for building work is called the estimator and it is who must use his skill, experience and judgment in attempting to assess the extent of likely future costs.

ROLE OF ESTIMATOR.

1. **Build up rates;**
   An estimator will build up in detail a price for each item contained in the B/Q, allowing for the cost of the necessary labour, materials and plant, together with other site operating costs i.e. contingencies and generally a percentage to cover overheads and profit.

2. **Re-measurement;**
   This is commonly used with refurbishment work where the full extent of work cannot be accurately determined. The quantities set out in the B/Q are the estimated quantities and are not to be taken as the actual quantities; the actual quantities are measured during the construction phase i.e. Rock excavation.

3. **Prepare claims**;
   Compile claims submitted by the contractor for loss and expense incurred while carrying out the works. Items that form the basis of a claim;

- Variations
- Postponement of the works
- Adjustment of provisional sums for undefined work etc.

SOURCES OF COST INFORMATION.

a) **Priced Bills of Quantities;**
Priced B/Q from previous projects is a useful source of information, partly as the cost information tends to be current. As with other forms of cost data, there is need to adjust for the differences in location etc.

b) **Trade journals/Magazines;**
Many journals concerned with the construction industry contain frequent supplements on building costs.

c) **Priced books/Lists;**
They are usually published by Ministry of Public Works on annual basis. They contain the following information; i. Calculation of basic wage rates
ii. Day work rates
iii. Professional fees for architects; quantity surveyors and consultant engineers
iv. Market prices for building materials.
v. Labour constants etc. Price books should be carefully studied to determine the basis used to calculate market prices, labour rates and what percentage has been added to cover overheads and profit for the rates given.

d) Schedule of rates;
Prepared by contractors and used as a basis for estimates during tendering.

e) Quotations;
These are obtained from specialists' suppliers and sub-contractors.

f) Buildup of rates;
Refer to the role of estimator as highlighted previously.

N/B – Whatever the source of published information used it should be understood that the prices given are an average for guidance only. The size of a building company, its efficiency, workload, labour force, standard of workmanship and level of profit required will affect the estimator's calculation.

TERMS USED IN ESTIMATING.

Allocation of costs is the transfer of costs from one cost item to one or more other cost items. **Allowance** - a value in an estimate to cover the cost of known but not yet fully defined work. **As-sold estimate** - the estimate which matches the agreed items and price for the project scope.

Basis of estimate (BOE) - a document which describes the scope basis, pricing basis, methods, qualifications, assumptions, inclusions, and exclusions.

Bill of materials (BOM) - a list of materials required for the construction of a project or part of a project, which may include quantities.

Bill of quantities (BOQ) - a document used in tendering in the construction industry in which materials, parts, and labor (and their costs) are itemized. It also (ideally) details the terms and conditions of the construction or repair contract and itemizes all work to enable a contractor to price the work for which he or she is bidding.

Bond - usually refers to a performance bond, which is a surety bond issued by an insurance company or a bank to guarantee satisfactory completion of a project by a contractor. Other types of guarantees, such as a bid bond or a materials bond, are sometimes also required by a project owner.

Chart of accounts (Code of accounts) (COA) - a created list of the accounts used by a business entity to define each class of items for which money or the equivalent is spent or received. It is used to organize the finances of the entity and to segregate expenditures, revenue, assets and liabilities in order to give interested parties a better understanding of the financial health of the entity.

Construction is a process that consists of the creation, modification, or demolition of facilities, buildings, civil and monumental works, and infrastructure.

Construction cost - the total cost to construct a project. This value usually does not include the preplanning, site or right of way acquisition, or design costs, and may not include start-up and commissioning costs. This total or subtotal is usually identified as such in an estimate report.
Also known as Total Estimated Contract Cost (TECC).

Consumables are goods that, according to the 1913 edition of Webster's Dictionary, are capable of being consumed; that may be destroyed, dissipated, wasted, or spent (also known as consumable goods, nondurable goods, or soft goods). In construction, these may include such materials as weld rod, fasteners, tape, glue, etc.

Contingency - When estimating the cost for a project, product or other item or investment, there is always uncertainty as to the precise content of all items in the estimate, how work will be performed, what work conditions will be like when the project is executed and so on. These uncertainties are risks to the project. Some refer to these risks as "known-unknowns" because the estimator is aware of them, and based on past experience, can even estimate their probable costs. The estimated costs of the known-unknowns is referred

to by cost estimators as cost contingency.

Cost - the value of currency required to obtain a product or service, to expend labor and use equipment and tools, or to operate a business.

Cost index (or factor) - a value used to adjust the cost of from one time to another.[6] There are various published cost indexes, listed by year, quarter, or month. RSMeans publishes a historical cost index.

Costing - the process of applying appropriate costs to the line items after the take off. RSMeans refers to this as, "Price the quantities."[8] May also be called pricing.

Crew – a group of people (workers) who execute a construction activity. The crew may also include construction equipment required to execute the work.
Crew hour (ch) – one crew's effort for one hour of time.
Deliverable is a term used in project management to describe a tangible or intangible object produced as a result of the project that is intended to be delivered to a customer (either internal or external).
Direct costs are directly attributable to the cost object. In construction, the costs of materials, labor, equipment, etc., and all directly involved efforts or expenses for the cost object are direct costs.
Distributables – a classification of project costs which are not associated with any specific direct account.
Duration – the amount of clock or calendar time which is required to execute a work activity or task.
Effort - the work done in accomplishing a task or project. May be a measurement of the hours required.
Equipment - (1) a category of cost for organizing and summarizing costs, (2) construction equipment used to execute the project work, (3) engineered equipment such as pumps or tanks.
Escalation is defined as changes in the cost or price of specific goods or services in a given economy over a period. In estimates, escalation is an allowance to provide for the anticipated escalation of costs during construction.
Estimation in project management is the processes of making cost estimates using the appropriate techniques.
Facility - an installation, contrivance, or other thing which facilitates something; a place for doing something. A building, plant, road, reservoir, etc.
Field Supervision (or field non-manual) - supervisory personnel and all other non-manual staff at the construction site.
Foreman - the worker or tradesman who is in charge of a construction crew. The foreman may be a hands-on worker who contributes to the work completion or a non-working foreman. A general foreman may be in charge of all or some crews.
Fringe Benefits - labor cost elements which are provided to pay for benefits received by workers, such as health insurance, pension, training, etc.
General & Administrative Costs (G&A) - the costs of operating a construction business. These costs include such things as office space, office staff, operating facilities, etc. They are not associated with any specific project, but may be allocated across projects in a cost estimate. See also Overhead, Indirect cost.

General contractor is responsible for the day-to-day oversight of a construction site, management of vendors and trades, and communication of information to involved parties throughout the course of a building project.
General requirements - costs for general requirements (Division 1) of the project execution which are actually part of the deliverable. Examples: project management & coordination 47, temporary facilities & controls, cleaning & waste management, commissioning.
Indirect costs are costs that are not directly accountable to a cost object (such as a particular project, facility, function or product). See also, Overhead, General & Administrative Cost, Distributable.
Labor – a category of cost which is incurred to employ people (workers, crafts, trades, etc.) in the execution of construction work activity.
Labor benefits are additional costs (such as holiday pay or health insurance) which the employer pays directly to the employee or into a fund on behalf of the employee.
Labor burden is the cost of payroll taxes and insurances (such as workers' compensation) which the employer must pay to employ workers.
Labor rate (sometimes price) – the amount of currency per unit of time which is required to employ people (workers, crafts, trades, etc.) in the execution of construction work activity. The rate may represent the wage rate only, or may include various benefits and labor burdens.
Line item - one element of cost in an estimate which is listed in the estimate spreadsheet.

Location cost index (or factor) - the ratio of the cost in one location to that in another location. These may include or exclude currency exchange rates. Example: 223 in Boston / 187 in Austin = 1.19. The location cost factor is used to adjust the cost from one location to another.

Lump sum – "the complete in-place cost of a system, a subsystem, a particular item, or an entire project.
Man-hour (mh) – one person's (worker, craftsman, tradesman, etc.) effort for one hour of time. Note: some attempt to make this gender neutral by renaming this as work hour or job hour or person hour, or something similar.
Man-hour norms - a set of standard man-hour rates for work tasks, given normal working conditions.
Man-hour rate – the amount of man-hours which are consumed executing one unit of work activity.
Man-hour rate = man-hours required for work / completed work quantity. Example: Excavation 0.125 mh/cy. The man-hour rate is related to the inverse of the production rate times the number of workers in the crew performing the work. Example: Excavation at 8 cy/day (8

hour day) with 2-man crew = 2 x 8 / 8 = 2 man-hours/cy. See also Production rate. Note: some sources call this Productivity, an unnecessary confusion.
Mark-up is the difference between the cost of a good or service and its selling price. A markup is added on to the total cost incurred by the producer of a good or service in order to create a profit.
Manual labor is physical work done by people involved in construction the project. All of the various trade workers are included in manual labor, including foremen.
Means & methods - the means and methods used in executing the work.

Non-manual labor - work done by people who are not classified as manual labor.

Non-productive time - work time which is paid but does not contribute to the production of work. Examples: safety meeting, travel time, clean up time, wash up time, etc.
Open shop is a place of employment at which one is not required to join or financially support a union (closed shop) as a condition of hiring or continued employment. Open shop is also known as a merit shop.
Overhead - In business, overhead or overhead expense refers to an ongoing expense of operating a business; it is also known as an "operating expense.
Overtime is the amount of time someone works beyond normal working hours.

Per diem - a daily allowance for expenses, a specific amount of money that an organization gives an individual per day to cover living and traveling expenses (allowance) in connection with work done away from home or on tour.
Plug number - a value inserted in an estimate as a place holder and an approximation of the cost for a scope element which has not been detailed yet. See also Allowance.
Premium pay - the extra portion of wages paid when a worker works overtime. Example: Wage rate is 10.00/hour, overtime is paid at time and a half, or 15.00/hour, the premium pay is 5.00/hour.
Price is the quantity of payment or compensation given by one party to another in return for goods or services.
Pricing is the function of determining the amount of money asked in consideration for undertaking the project. Depending on the market and profit considerations, etc., the price may be more or less than the cost.
Production rate – the quantity of work which is completed in one unit of time.Production rate = completed work quantity / duration. Example: Excavation 8 cy/day = 1 cy/hour (in an 8 hour

day). RSMeans lists this as Daily Output. See also Man-hour rate. Note: some sources use the term productivity for the production rate or man-hour rate, an unnecessary confusion.
Productivity is the term which relates one rate to another rate, given two differing sets of conditions for the same work. A production rate greater than the reference production rate indicates a higher productivity. A production rate less than the reference production rate indicates a lower productivity. A man-hour rate greater than the reference man-hour rate indicates a lower productivity. A man-hour rate less than the reference man-hour rate indicates a higher productivity. (The economic concept of productivity is an average measure of the efficiency of production. Productivity is a ratio of production output to what is required to produce it (inputs).)
Productivity factor – the ratio of a selected production rate to a reference production rate. Example: selected rate = 102, reference rate = 80, productivity factor = 102/80 = 1.28.
Alternatively – the ratio of a reference man-hour rate to a selected man-hour rate. Example: selected rate = 0.104, reference rate = 0.125, productivity factor = 0.125/0.104 = 1.20. A productivity factor is often used to adjust a set of standard or normal (norm) production or man- hour rates to a set of rates for a specific project, location, or set of working conditions (see Labor Productivity Factor). Example: Specific type of excavation – standard = 150 cy/day. For specific project, location, or conditions the productivity factor is 0.80. The resulting production rate for that is 150 x 0.8 = 120 cy/day. The actual productivity factor for a project or subset of production rates (or man-hour rates) is the ratio of the actual production rate to the estimated production rate.
Profit - in accounting, is the difference between revenue and cost. In estimates, it is an allowance to provide for anticipated profit upon completion of the project.
Profit margin refers to a measure of profitability. It is calculated by finding the net profit as a percentage of the revenue.
Project - A temporary endeavor undertaken to create a unique product, service, or result.

Quality can mean a high degree of excellence ("a quality product") or a degree of excellence or the lack of it ("work of average quality").
Quantity is a property that can exist as a magnitude or multitude. For example 1200 mm or 10 each.
Quantity surveyor (QS) is a professional working within the construction industry concerned with building costs, and some other areas. A QS employs standard methods of measurement to develop a bill of quantities.

Resources are what is required to carry out a project's tasks. They can be people, equipment, facilities, materials, tools, supplies, or anything else capable of definition required for the completion of a project activity.
Schedule of values is a detailed statement furnished by a construction contractor, builder or others outlining the portions of the contract sum. It allocates values for the various parts of the work and is also used as the basis for submitting and reviewing progress payments.
Scope of a project in project management is the sum total of all of its products and their requirements or features.
Specification - an explicit set of requirements to be satisfied by a material, product, or service.

Subcontractor is an individual or in many cases a business that signs a contract to perform part **or all of the obligations of another's contract.**

Supplier - A distributor or other company which supplies materials, parts, equipment, etc.

Take off -The process of reviewing and understanding the design package and using the project scope drawings and documents to itemize the scope into line items with measured quantities.
RSMeans refers to this as, "Scope out the project," and, "Quantify."

Task - a distinct piece of work performed.

Tool - any physical item that can be used to achieve a goal, especially if the item is not consumed in the process.
Unit cost - the cost for one measured unit of completed work activity.

Unit of measure - the term used for how a bid item is quantified.

Virtual Design and Construction (VDC) is the use of integrated multi-disciplinary performance models of design-construction projects, including the Product (i.e., facilities), Work Processes and Organization of the design - construction - operation team in order to support explicit and public business objectives.
Work (1) is the amount of effort applied to produce a deliverable or to accomplish a task, (2) is everything required or supplied to complete a construction project.
Work breakdown structure (WBS) - a deliverable oriented decomposition of a project into smaller components. It defines and groups a project's discrete work elements in a way that helps organize and define the total work scope of the project.
Worker - a person engaged in the accomplishment of work. In cost estimating, the hands-on workers contribute to the production and are counted in calculations of the production rate. Other workers supervise or support the hands-on work in some way.

Wage rate - The agreed monetary compensation per hour for a person to accomplish work. This is the pay provided to the worker, excluding any fringe benefits or other labor burdens. Labor unions typically have negotiated agreements which define the wage rates for workers, as well as the rates for fringe benefits.

Techniques of analyzing materials for estimation

There are five traditional techniques used in preparation of the bills of quantity. For every new project there is the first step and the last step. For establishing the desirable result each and every step between must be accomplished by organization and cooperation.
These two things are very essential in Civil Engineering and as Civil Engineer or Quantity Surveyor you have to think and act organized.
In order to help all the members that contributes for the construction of a project to be organized and have a forehand view so as to be prepared for every difficulty, Bill Of Quantities is prepared at an early stage. Bill Of Quantities is a document usually prepared by a quantity surveyor which (ideally) details the terms and conditions under which a contract is to be let, and itemizes all works to enable a contractor to price the work for which he is bidding. These are five traditional techniques used in preparation of the bills of quantity.

- Taking off
- Working up
- Squaring
- Abstracting
- Billing

Taking off

This involves the measurement of dimensions, scaled or read from drawings, and entered in a recognized form of specially ruled paper, called dimension paper.

Working up

The term working up is applying to all the subsequent operations collectively and consists of the following process.

Squaring

Squaring the dimensions and entering the resultant lengths, areas, and volumes in the third or squaring column on the dimension paper.

Abstracting

Transferring the squared dimensions to the abstract where they are written in a recognized order, ready for billing, under the appropriate work section headings, and are subsequently totaled and r**educed to the recognized units of billing, preparatory to transfer to the bill.**

Billing

In the bills of quantities, the various items of work which together make up the complete bill are listed under the appropriate work section headings, with descriptions printed in full and quantities given in the recognized units of measurement, as laid down in the SMM(SL). The bill also contains rate and price columns for pricing by contractors when tendering for the project.
The draft bill is written directly from the abstract.

THE COMPONENTS OF COST FOR A GIVEN PRODUCT

1. Material:
The substance from which the product is made is known as material. It may be in a raw or a manufactured state. It can be direct as well as indirect.

i. Direct Material:
All material which becomes an integral part of the finished product and which can be conveniently assigned to specific physical units is termed as "Direct Material".
Following are some of the examples of direct material:
(a) All material or components specifically purchased, produced or requisitioned from stores.
(b) Primary packing material (e.g., cartoon, wrapping, cardboard, boxes etc.).
(c) Purchased or partly produced components.

Direct material is also described as raw-material, process material, prime material, production material, stores material, constructional material etc.

ii. Indirect Material:
All material which is used for purposes ancillary to the business and which cannot be conveniently assigned to specific physical units is termed as "Indirect Material". Consumable stores, oil and waste, printing and stationery etc. are a few examples of indirect material.
Indirect material may be used in the factory, the office or the selling and distribution division.

2. Labour:
For conversion of materials into finished goods, human effort is needed, such human effort is called labour. Labour can be direct as well as indirect.
i. Direct Labour:
Labour which takes an active and direct part in the production of a particular commodity is called direct labour. Direct labour costs are, therefore, specially and conveniently traceable to specific products.
Direct labour is also described as process labour, productive labour, operating labour, manufacturing labour, direct wages etc.
ii. Indirect Labour:
Labour employed for the purpose of carrying out tasks incidental to goods or services provided, is indirect labour. Such labour does not alter the construction, composition or condition of the product. It cannot be practically traced to specific units of output. Wages of store-keepers, foremen, time-keepers, directors' fees, salaries of salesmen, etc. are all examples of indirect labour costs.
Indirect labour may relate to the factory, the office or the selling and distribution divisions.

3. Expenses:
Expenses may be direct or indirect.
Direct Expenses – These are expenses which can be directly, conveniently and wholly allocated to specific cost centres or cost units. Examples of such expenses are – hire of some special machinery required for a particular contract, cost of defective work incurred in connection with a particular job or contract etc. Direct expenses are sometimes also described as "chargeable expenses."
Indirect Expenses – These are expenses which cannot be directly, conveniently and wholly allocated to cost centres or cost units.

4. Overheads:
It is to be noted that the term overheads has a wider meaning than the term indirect expenses. Overheads include the cost of indirect material and indirect labour besides indirect expenses. Indirect expenses may be classified under the following three categories:

(a) **Manufacturing (works, factory or production) Expenses –** Such indirect expenses which are incurred in the factory and concerned with the running of the factory or plant are known as manufacturing expenses. Expenses relating to production, management and administration are included therein.

Following are a few items of such expenses:

Rent, rates and insurance of factory premises, power used in factory building, plant and machinery, etc.

(b) **Office and Administrative Expenses** – These expenses are not related to factory but they pertain to the management and administration of business. Such expenses are incurred on the direction and control of an undertaking.

Examples are:

Office rent, lighting and heating, postage and telegrams, telephones and other charges; depreciation of office building, furniture and equipment, bank charges, legal charges, audit fee etc.

(c) **Selling and Distribution Expenses –** Expenses incurred for marketing of a commodity, for securing orders for the articles, despatching goods sold, and for making efforts to find and retain customers, are called selling and distribution expenses.

Examples are:

Advertisement expenses, cost of preparing tenders, travelling expenses, bad debts, collection charges etc.

NB Profit is also part of cost component.

TOPIC SEVEN

SITE OFFICE PROCEDURES

Specific objectives

By the end of the topic, the trainee should be able to:

a. Outline methods of work measurement.
b. Outline the roles of sub-contractors and nominated suppliers.
c. Prepare materials schedules.
d. Explain different office practices.

Methods of work measurement

Work measurement (WM)

Work measurement is the application of techniques designed to establish the time for a qualified worker to carry out specified jobs at a defined level of performance.

Work measurement (WM) is concerned with investigating, reducing and eliminating ineffective time, whatever may be the cause.

WM is the means of measuring the time taken in the performance of an operation or series of operations in such a way that the ineffective time is shown up and can be separated out.
Work measurement is also called by the name 'time study'. Work measurement is absolutely essential for both the planning and control of operations. Without measurement data, we cannot determine the capacity of facilities or it is not possible to quote delivery dates or costs. We are not in a position to determine the rate of production and also labor utilization and efficiency.
It may not be possible to introduce incentive schemes and standard costs for budget control.

Objectives of Work Measurement

The use of work measurement as a basis for incentives is only a small part of its total application. The

objectives of work measurement are to provide a sound basis for:

- Comparing alternative methods
- Assessing the correct initial manning (manpower requirement planning).
- Planning and control.
- Realistic costing
- Financial incentive schemes
- Delivery date of goods
- Cost reduction and cost control.
- Identifying substandard workers
- Training new employees
- Techniques of Work Measurement

For the purpose of work measurement, work can be regarded as:

1. **Repetitive work:** The type of work in which the main operation or group of operations repeat continuously during the time spent at the job. These apply to work cycles of extremely short duration.
2. **Non-repetitive work**: It includes some type of maintenance and construction work, where the work cycle itself is hardly ever repeated identically.
Techniques of Work Measurement

Various techniques of work measurement are:

- Time study (stop watch technique),
- Synthesis,
- Work sampling,
- Predetermined motion and time study,
- Analytical estimating.

1. Time study: A work measurement technique for recording the times and rates of working for the elements of a specified job carried out under specified conditions and for analysing the data so as to determine the time necessary for carrying out the job at the defined level of performance. In other words measuring the time through stop watch is called time study.
2. Synthetic data: A work measurement technique for building up the time for a job or pans of the job at a defined level of performance by totalling element times obtained previously from time studies on other jobs containing the elements concerned or from synthetic data.
3. Work sampling: A technique in which a large number of observations are made over a period of time of one or group of machines, processes or workers. Each observation records what is happening at that instant and the percentage of observations recorded for a particular activity, or delay, is a measure of the percentage of time during which that activities delay occurs.

4. Predetermined motion time study (PMTS): A work measurement technique whereby times established for basic human motions (classified according to the nature of the motion and conditions under which it is made) are used to build up the time for a job at the defined level of performance. The most commonly used PMTS is known as Methods Time Measurement (MTM).

5. Analytical estimating: A work measurement technique, being a development of estimating, whereby the time required to carry out elements of a job at a defined level of performance is estimated partly from knowledge and practical experience of the elements concerned and partly from synthetic data.

Steps Involved in Work Measurement

- Divide jobs into elements
- Observe and record each element, any of the work measurement techniques.
- Set up unit time values, by extending observed time into normal time for each unit. This can be done by applying rating factor.
- Evaluate relaxation allowance and add the same to the normal time, for each element to get the work content.
- Ascertain the frequency of occurrence of each element in the job, then multiply the work content to it. After that total the times to reach the work content of the job.
- Add contingency allowance, wherever required, to get the standard time for performing the job.

- Work measurement is helpful in evaluating the labour cost. Further, gives information with respect to the estimation of tenders, assessment of delivery schedule and fixation of the selling price.

The roles of sub-contractors and nominated suppliers

Sub-contractor

A sub-contractor is a party which agrees to perform part or all of the obligations of the main contractor under a separate contract with the ultimate employer. There are two types of subcontractors;-

(a) Domestic and

(b) Nominated sub-contractors

Domestic sub-contractors are employed directly by the main contractor i.e. to supply to supply materials, labour for the sections given to them.

Nominated sub-contractors are appointed by the client through the architect and are under the main contractor. They are specialized in nature e.g. gas installation, electrical installation, plumbing etc.

The architect may nominate or appoint a sub-contractor or supplier to carry out duties on a project as long as the contractor makes no reasonable objection to their use.

Nominated suppliers

- They are responsible for supplying goods and materials on behalf of the contractor.
- Supply plant (workplace, site) in a safe condition.
- Supply chemical and biological substances that are safe when instructions are followed correctly.
- Provide written instruction about how to use equipment safely.
- Maintaining equipment in safe condition
- Know and follow Employment Act and regulations.

Contracts should be formed between nominated parties and the contractor basically to ensure that the materials supplied or work executed is of a satisfactory standard.

The following are the **main reasons** for sub-contracting;-

- Lessen the cost of contractor i.e. work can be done at a lower cost by subcontracting. The main contractors' liability to retain, on a full time basis, all the specialists necessary for day to day operations is reduced.
- Specialized nature of work that the main contractor cannot undertake using his labour office can be sub-contracted. Requires additional specialist advice or expertise.
- Overstretched resources; for instance when undertaking a particular big job, such as a multi-site construction project.

MATERIAL SCHEDULE

Material schedule is a detailed list of construction materials needed for a specific job.

Step 1: Decide what is needed

Firstly, you need to thoroughly read through the site files (including the drawings and specifications) to work out the required materials. Are any special materials (eg imported floor coverings) or fixtures required? If so, you will need to allow additional time to order these in.

Step 2: Prefab or construct on-site?

Decide how to purchase the materials. There are two options:

- Purchase materials for construction on-site, eg timber for on-site framing.
- Purchase prefabricated components, eg wall frames, roof trusses.

Today most builders purchase pre-made wall frames and roof trusses because it speeds up work time on-site

Step 3: Work out quantities

Work out the amount of material needed. You can do this by looking at the measurements on the plans and using these to calculate the various lengths required.

This information can also be found from lists like a 'timber list' provided by the estimator as part of the tender for the project. This is the most efficient way for a building company to operate as it uses information already available.

If the builder is using a computer program for projects, this will also include the estimating requirements. It is then very simple to make the estimates into a request to quote and from there into an order. A building software system such as 'Databuild' has these work requests built into its program. Many building materials suppliers have Databuild as part of their office package and can receive a request to quote from a builder, prepare a quote and email this back to the builder.

OFFICE PRACTICES

INTRODUCTION

Definition of an office

Office is a room where relevant records for the purpose of control, planning and efficient management of the organization are prepared, handled and preserved.

Office provides facilities for internal and external communication and coordinates activities of different departments of the organization.

An office is a place where the control mechanisms for an organisation are located; where records are initiated for communication, control and efficient operations of the organisation.

FUNCTIONS OF AN OFFICE

The primary functions of an office are mainly concerned with the recording of the business transaction, i.e., making, using and preserving records for future reference.

The primary functions of an office are:

1. **Receiving and collecting information**

Receiving information relating to the activities from various sources is the major function of an office. An office receives information either from internal source or from external source.

Information received from internal source is from the departmental heads and from other levels of management. The forms/types of such information are reports, letters and telephone messages, memos, etc. Information from external source taken the form of letters, orders, invoices, enquiries, telegrams fax, etc

2. **Recording information**

Having received information from various sources and in different forms, the second primary function of an office is to record them in appropriate books/registers. The first step in recording the information is to sort them out.

Then, it involves entering the information in registers concerned as, for example, all incoming mails received are recorded in the Incoming Correspondence Register, all communication relating to enquiries in an Enquiry Book and so on.

This helps not only in easy identification, but also enables quick reference. Recording of information is also obligatory for meeting legal requirements.

3. Processing and arranging information

It is the most significant function of an office. The information collected and recorded cannot be readily used for the decision making and other purposes in the organization. Therefore it must be processed and arranged. Processing information involves preparing notes, sorting, filing, etc. All pieces of information are to be arranged in a systematic way.

4. Retrieval of information

The office provides such information to the management as and when needed from its records. The information to be provided may be of routine nature or special nature and it may be verbal or in writing. This information helps in decision making process.

5. Safeguarding/protecting assets

This involves safeguarding the assets of the office. All assets, movable and immovable, documents and office records must be guarded and protected.

6. Auxiliary/Secondary/Administrative functions

The secondary/administrative functions arise in course of business and are incidental to primary function. These functions may be classified as following:

7. Planning and Scheduling

The planning function of office is concerned with determining what is to done, who is to do it and where it is to be done. Scheduling is concerned with the time at which the events planned are to take place, i.e., both planning and scheduling functions are based upon records

8. Supervision and Control

Office is also concerned with supervising the work performed in various departments and maintain pace of work in those departments which lack efficiency. This is ensured through control techniques

9. Coordination of employees

Other function of office is to coordinate the working of other departments by issuing necessary directions from time to time. This increases the overall efficiency of the office.

10. Personnel Management

The efficiency work depends very much on the employees. Their appointment, training, promotion, appraisal and welfare are the functions of the office.

11. Purchasing of office equipment

Efficient and economical performance of the office work requires proper furniture, equipments and

machines. The office has to arrange for selection and purchasing of these items from reliable suppliers. It has also to ensure timely availability of office furniture, equipments and machines.

12. Maintain public relations

Maintaining public relation is also the function of the office. This enables the office to have a good reputation and goodwill for its existence and progress. For example; the reception office/counters to greet and receive visitors/customers

NOTE:

The above are some of the important administrative functions of an office. The nature of these functions differs from organization to organization as per the needs of particular organization.

Importance of an office

The office exists to provide clerical and administrative services needed by all the departments of a business unit. In fact, without an efficient and well organized office, official business activities cannot be carried on systematically and efficiently. The importance of office will become evident from the following:

1. **It Helps in Identification of Business**

In undertakings such as bank, insurance companies, etc., office is identified with business. Office enables the investors, customers, public, government, tax authorities, to deal with business undertakings. For enquiries, complaints, etc., people visit only the office but not other departments of the business.

2. **Facilitates Preparation of Records and Report**

The formulation of organisation policies to a large extent depends upon the reports and records which reflect the success or failure of the business. Management requires information in the form of reports frequently. Some such reports are prepared weekly and some monthly. It is in the office; such records and reports are prepared and furnished to the management. So, office serves as a store room of all records which serves as the basis for the preparation of reports.

3. **Aids Management in Carrying Out its Functions**

It is through office, managerial functions such as planning, organization, coordination and control are performed. In the words of Leafing Well and Robison “a well organized office makes it possible for management to plan its operation intelligently, to put its plan into effect surely, to follow their progress currently, to determine their effectiveness promptly, to appraise the results without delay, and to coordinate all the activities of the business”.

4. **It Provides Employment Opportunities**

With the increase in the size of business, the office work also increases. To cope up with the increased office work, more number of office staff is required. Thus, existence of office department provides gainful employment opportunities to many people.

TOPIC EIGHT

WORKSHOP LAYOUT AND ORGANIZATION

Specific objectives

By the end of the topic, the trainee should be able to;

a. Describe workshop organization.
b. State safety rules and regulations to be observed in workshop.
c. Illustrate workshop layout.
d. Describe the appropriate workshop dress code.

Introduction

After a tender has been accepted, the period before the actual construction work, it is necessary to arrange the site in the most effective and efficient manner. Sites huts, storage sheds, compound, loose material bags, mixing yard etc, should be considered first in the layout.
Thereby giving a general good organization appeal to both employees and the general public.

a. ADJOINING PROPERTIES

Most construction sites are surrounded by other structures, building etc. good relationship is paramount from the beginning of the new project.

Owners of these properties must be given preliminary information on the expected scope of work including for such aspects as dust, noise, obstruction, shortage etc.

It's also necessary to safeguard against accidents and damages of the existing property by taking photographs and getting the owners to satisfy as true and recording existing features.

b. SITE ACCESS

All sites differ from one another and require particular treatment. However the contractor should provide;

- Adequate drainage to keep the site seasonally free from standing water so that access to parts under construction is good.
- If access to a site may interfere with existing parts etc. permission of the local authority must be obtained.

c. CONTRACTOR BOARD

It is an advertising aid. The contractor board should be; visibly placed, clearly constructed and displayed so that visitors locate the site easily. The site should contain such information as; the client, the contractor, the architect, sub-contractor, the suppliers etc.

d. SITE HUTMENTS

A site consists of hutments in three groups

i. Administrative offices
ii. Operative huts
iii. Storage and general huts

WORK PROGRAM

It is a timetable for performing specific tasks in a project.

Factors affecting work program

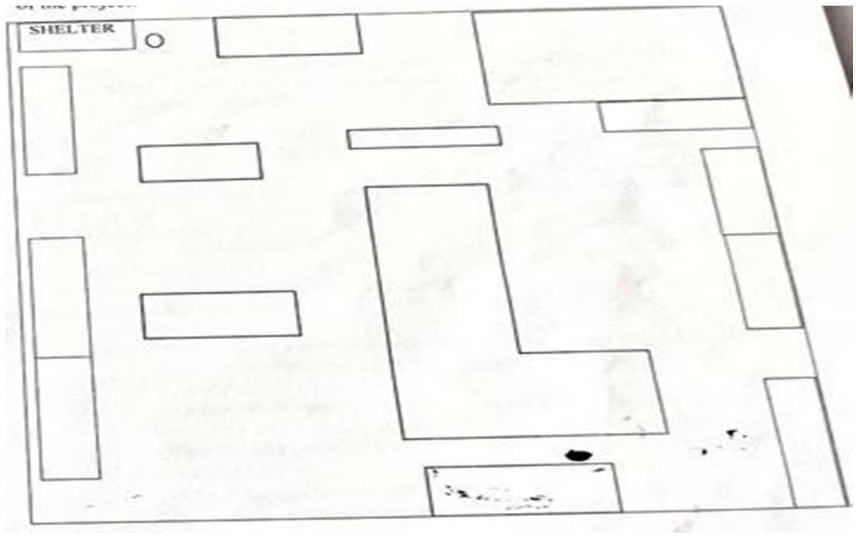
- ❖ May be affected by circumstances that may arise e.g. time used for activities that were not planned for.
- ❖ May be affected by conditions beyond control like emergencies e.g. lack of materials, lack of equipment.

Reasons for using work program

- ✓ Avoid disorganized work.
- ✓ Control and prevent loss of funds
- ✓ Adequate supply of labour and work
- ✓ Coordinate some contractors and suppliers
- ✓ Illustrate inter- dependent of activities
- ✓ Provide standards for measuring the work.

SITE LAYOUT PLAN

A satisfactory site layout plan depends on two simple principles for best results. The principle requires the use of a plan of the site showing the outline of the project.



Model site layout plan

Levels of workshop;

i. Unit workshop
ii. General unit shop
iii. General shop

Unit workshop – this shop deals with only one form of unit course e.g. masonry.

General unit shop- this is a shop where only one course e.g. automotive engineering is dealt with. It has several units which are accommodated in various sections.

General shop- it accommodates more than one course e.g. building, mechanical and electrical. It is divided into areas dealing with each course.

Workshop safety regulations

- Dress properly
- Clean floors and walls

- It should be free from dirt and slippery material
- Clear the pathway or any obstruction lying on the floor
- Ensure enough lighting and ventilation
- Organize tools and equipment properly
- Ensure a first aid kit is available

General behavior in the workshop

- Never run, always walk looking where you are going.
- Be mindful of others, yourself and the machine
- Never play in the workshop
- Be careful when handling sharp equipment
- Never eat or chew in the workshop.

Personal safety

- Remove sweaters, jackets and pullovers.
- Wear an apron, dust coat or protective clothing.
- All clothing should be tight fitting.
- Roll up long sleeves up to the elbow.
- Tuck in shirt, remove ties, rings, bangles, watches while in the workshop.
- Always wear safety boots or closed shoes.

Safety with tools

- Inform your instructor about any damaged or broken tools.
- Tools with broken or loose handles should never be used.
- Always carry tools with sharp edges facing downwards.
- All cutting tools should be sharp.
- Use the right tool for the right job.

- Never carry or keep tools in the pocket.
- Learn how to handle and use tools before using them.
- Never use damaged tools.

Working with hot metals

- Keep away all the materials that catch fire easily.
- Not more than two people should work on a project at the same time.
- Always test hot metals by dipping some drops of water on the metal.
- After using hot tools, they should be cooled in water and then oiled before storage.

Simple first aid

First aid is help given to an accident victim before been taken to the hospital. Instances that

require first aid:

1. **Serious injuries**
    a. **Bleeding** – after an accident, the next and most important thing to do is stop the bleeding. This can be done by tying a tight bandage.
    b. **Burns**- depending on the burn apply a sterilized dressing on it and not burst any blister. If burns are caused by chemicals they should remove all contaminated clothing which is stuck in the burn.
    In case of hot burns, flash plenty of cold water to the casualty then seek medical attendance.
    c. **Eye injury**- if dust or chemicals get into the eye, clean with water, tell the victim to blink their eye rapidly.
    If the eye can't be cleared or if it is injured it should be covered to prevent it from blinking and then seek medical assistance.
2. **Wounds and scratches**
    All wounds and scratches should be attended to immediately. Cover the wound with sterilized clothing and seek medical attention.
3. **Artificial respiration**
    When an accident victim has stopped breathing, start artificial respiration immediately. This should continue until the patient starts breathing again. If you suspect a victim has internal injury, never give them anything to drink or eat.
    In all cases, seek medical attention immediately.

Fire

Fire is a chemical reaction that takes place in presence of fuel, oxygen and heat. Causes of fire

- Poor workshop organization
- Electricity fault
- Careless storage of combustible material
- Careless disposal of cigarettes
- Poor ventilation
- Friction from machines

- Lightning Fire
- fighting

It is done by removing all of the three components that causes fire.

Factors to consider for site/workshop location

1. **Availability of raw materials**

Regular supply of raw materials is necessary for carrying out workshop activities. Nearness to the supply of raw materials is economical for a workshop.

1. **Accessibility**

Adequate transport services/ facilities should be available for carrying materials from the source of supply to workshop or from workshop to consumers. Transport services include water, air, railway, road etc.

2. **Availability of labour**

Labour cost is one of the main constituents of total cost of production. It influences the cost of production. Labour implies both skilled and unskilled for different types of workshop activities.

Availability of skilled and efficient labour is responsible for development of a workshop.

3. **Source of power**

Availability of cheap power and fuel supply is also important in the selection of a workshop location. Source of power include; electricity, gas, wind mill etc.

4. **Communication**

A workshop needs regular information with regard to changes in price and other valuable information. Information may be acquired through local newspapers, the internet etc.

5. **Nearness to the market**

Market greatly affect the establishment of a workshop unit and is major factor for locating a workshop site. The production of goods is undertaken with the aim of selling as quickly as possible.

6. **Nearness to adequate banking and credit facilities**

Nearness to banks and credit facilities has become important because banking has become an indispensable part of modern business.

7. **Facility of repair and maintenance**

In order to maintain uninterrupted production, repair facilities should be kept on mind before setting a workshop. A large workshop can install its own repair and maintenance facilities whereas smaller workshop can rely on established workshop repair technicians.

8. **Fire fighting**

In order to protect a workshop against risk of fire, adequate firefighting facilities must be provided.

9. **Landscape and topography**

Low-lands may experience floods and landslides while high-lands may experience volcanoes.

10. **Government policies**

Prior setting up a workshop, permission and licensing are necessary. Regulations and formalities must be complied with before setting up a workshop.

11. **Personal factors**

Personal likes and dislikes influence the location of a particular workshop.

12. **Taste and preference**
13. **Political and economic factors**
14. **Possibilities of future expansion**
15. **Competition**
16. **Security**
17. **Availability of research materials**

CHAPTER NINE

TOOLS, EQUIPMENT AND MACHINES

Specific objectives

By the end of the topic, the trainee should be able to;

a) Identify sources of capital finance for tools, equipment and machines.
b) Explain various types of maintaining tools, equipment and machines.
c) Explain how inventories are prepared and kept.
d) Describe safety precautions related to tools, equipment, machines and personnel.

Definition of Office Machines

Office machines refer to tools or devices that may be used to simplify various tasks performed in an office. Thus, office machines include anything from a date stamp to a computer used in an office.

How does machine differs from equipment?

Machines are devices that need a person's attention when operating while equipment are devices that do not need this attention.

Machine is a system or device for doing work, together with its power source and auxiliary equipment. Equipment - are machines or tools necessary to complete a given task.

Types of common office machines and equipments and their uses.

i) Computer

It is a device used for typing letters, figures and storing information.

ii) Printer

It is a device used to print out digital records/documents in the office

iii) Facsimile Machine

is a device of transmitting and reproducing letter, figures by means of signals sent over telephone lines

iv) Calculating machine (calculators).

It is used to multiply, divide, add and subtract figures as part of the clerical work.

v) Photocopier machine (photocopier)

It is used to produce exact extract copy of the original document.

vi) Typewriter

It is used to print letters and figures on the keyboard.

vii) Scanner

It is a device used to convert a paper based records to digital records.

viii) Stapling machine

It is used to pin papers together.

ix) Guillotine/trimmer (Paper cutter)

It used to cut a hip of papers or to make even edges of papers.

x) Stapler remover

This is a machine for removing staples (pins) from fast papers.

xi) Punching machine

It is an office device used for making a hole on the paper for filing purposes.

xii) Shredding machine

This is a machine used for destroying useless papers/records in the office.
This is a machine used for stamping various official letters.

xiii. Thumb tag or drawing pins.

This is an item used for holding papers in position on a notice board.

xiv. Treasury tag

It is used for securing papers in a file.

xv. Stamp pad

This is a container used for supplying ink to rubber stamps when making the impression.

xvi. Franking machine

It is a device used to print on the envelope the design of postage and date mark. In order to purchase one has to obtain license from the Post Office where payment is made in advance.

xiii. Rubber stamps

It is used for stamping various official letters.

4.4 Advantages of office machine

i. It saves labour. This means actual saving on the pay roll or an increased volume of work handled by the existing staff.
ii. It promotes accuracy and improves quality of work. E.g. accounting machine enables the management to be sure of obtaining accurate figures from its books of accounts.
iii. It saves time. Machines reduce time spent in accomplishing a task than if it were to be done manually.
iv. Machine relieves monotony. Machine operation can be monotonous but many machine applications actually relieve manual boring works.
v. It provides management with more information quickly than previously. e.g. an electronic computer.
vi. A machine enhances cooperation between people in the organization.

4.5 Disadvantages of office machines

i. Some machines quickly become out of date (obsolete). It may not be possible for machines purchased for specialized jobs to be adapted when it is necessary to introduce new systems.
ii. Some machines cause noise in the office. E.g. typewriter.
iii. Difficulty of obtaining trained and experienced personnel. The absence of an operator can cause an accumulation of works so two operators may have to be employed.
iv. Capital outlay and maintenance may be high.
v. If great care is not taken, the machine will become more important than the work it produces.
vi. Machines cause unemployment.
vii. Machines are mechanical therefore cannot do work requiring great intelligence.
viii. Machines may breakdown particularly when electrically controlled which can cause accumulation of works an office

Factors to consider when choosing or buying an office machine/equipment:

The following factors should be considered when selecting or buying any office machine or equipment:

i. Sufficient funds to meet the cost of buying that machine, maintenance and materials it will use.
ii. Durability of the machine.
iii. Availability of spare parts in the nearby markets.
iv. The volume of work in an office.
v. Trained staff for operating machine or training will be necessary after buying that machine.
vi. Output improvement in terms of quality and quantity.
vii. The availability of space for keeping it.

Sources of capital finance for tools, equipment and machines

i. Personal savings
ii. Loan
    - Short term
    - Long term
iii. Joint funding
    - Partnerships
    - Companies
    - Co-operatives
iv. Borrowing from friends and families/crowdfunding
v. Investment from venture capitalists
vi. Ploughing back profit.

Principles of operating of office machines

i. Cover the machine after use.
ii. Clean the machine.
iii. Service the machine regularly.
iv. Quickly repair it when gets faulty.
v. Oil the machine.
vi. Never leave the machine near a hot object/environment/place
vii. Inexperienced operator should not operate complex machines
viii. Switch off power whenever it is not in use.

INVENTORIES

Inventory is defined as the products within a company's supply and control that are available for sale. While inventory is generally thought of as a company's stock of product or goods, it can take many different forms.

There are several different kinds of inventory classifications. Raw materials, for example, are the materials used to manufacture or create a product. Inventory that is a work in progress comprises materials that are in the middle of the manufacturing process, whereas finished goods are the materials that have completed the manufacturing process and are ready for sale. Service inventory consists of inventory or tools that are used by service-providing companies. And finally, in-transit inventory refers to inventory that is currently in the middle of the transit process, whether by plane, train, truck, or boat.

Why Companies Keep Inventories

Keeping your inventory well-stocked is a crucial aspect of keeping business operations running smoothly. There are a few main reasons why companies choose to keep inventories stocked in their facilities.

i. Time – The time lags present in the supply chain, from supplier to user at every stage, requires that you maintain certain amounts of inventory to use in this lead time. However, in practice, inventory is to be maintained for consumption during 'variations in lead time'. Lead time itself can be addressed by ordering that many days in advance.
ii. Seasonal Demand: demands varies periodically, but producers capacity is fixed. This can lead to stock accumulation, consider for example how goods consumed only in holidays can lead to accumulation of large stocks on the anticipation of future consumption.
iii. Uncertainty – Inventories are maintained as buffers to meet uncertainties in demand, supply and movements of goods.
iv. Economies of scale – Ideal condition of "one unit at a time at a place where a user needs it, when he needs it" principle tends to incur lots of costs in terms of logistics. So bulk buying, movement and storing brings in economies of scale, thus inventory.
v. Appreciation in Value – In some situations, some stock gains the required value when it is kept for some time to allow it reach the desired standard for consumption, or for production. For example; beer in the brewing industry

In addition to these key reasons, there are financial motivations for companies to keep their inventories well-stocked. Not only does inventory figure into a company's cost of goods, it also contributes to a business profit margin. For accounting purposes, inventory counts toward a company's total assets, and it even determines a company's liability when it comes to taxes.

Because inventory is so integrally tied to companies' financial operations, understanding how it affects business is critical for ensuring future success.

How Companies Maintain Inventories

There are a few different methods companies can employ to keep track of their inventory and determine optimal levels. Some of the most common tactics include:

i. **First in, first out** — This method assumes that the item sold first is the item that was purchased or acquired first.
ii. **Last in, first out** •— This method assumes that the last item acquired is the first to be sold.

Lower of cost or market (LCM or LOCOM) — This method involves recording the item at either the historical cost or the current market value, depending on how the value of the item has changed. Each of these methods can be customized to better fit your unique inventory and business needs.

No matter which method you choose, a computerized system to help you keep track of inventory (or even a virtual inventory system) is one of the best tools available in today's technological age. There are various kinds of inventory software programs available that can easily sync with other systems currently in use,

providing an accurate, real-time assessment of inventory levels at any given time — even if inventories are geographically spread out in different facilities.

Common Inventory Risks

As with anything, there are certain risks associated with keeping and maintaining inventory. Some of the most common issues include:

- Developing an excess of inventory that can't be sold
- Having too much demand and not enough supply
- Losing inventory because it's gone bad or has expired
- Not having enough raw materials available to meet production levels
- Experiencing declines in product values
- Making errors in the inventory control process
- Working with distribution partners who can return inventory whenever they choose, creating a surplus

Despite the risks involved, maintaining and controlling inventory remains a critical part of business operations.
Well-Managed Inventory, Smooth Operations

Properly maintaining and controlling inventory allows for a range of practical and financial benefits. It allows you to consistently meet increases in demand without having to wait for a full production cycle to finish before receiving more product. It allows you to fill orders quickly and efficiently. And by providing a reliable backup supply, it prevents you from losing sales in the event that your facility experiences a system breakdown.
Regardless of your particular business goals, maintaining and accurately calculating inventory will help your company prepare for almost anything that comes your way.

SAFETY ASPECTS WITHIN THE WORKSHOP

- Provide steel cabinets to store flammable liquids and paints.
- At least two types of fire extinguishers should be strategically located in the workshop.
- First aid kit should be placed on the wall near washing facilities e.g. sink.
- All machines should be equipped with individual switches which can be easily handled by the hand.
- Stop switches should be strategically located throughout the workshop.
- A fire blanket should be hung near open flame equipment.
- All workshop doors should open outwards.
- Sufficient space should be provided for working around machines.

General placement of machines in the workshop

- The most hazardous and workstation should be placed away from the main routes. Placements of
- machines and equipment should not interfere with the opening of doors and windows.
- Machines used in sequential order should be placed in order of their use with minimum travel between them.
- Machines placed near windows should make use of natural lighting.
- They should be placed such that the operator does not face direct sunlight rays. Machines and
- equipment should be placed strategically for ease of cleaning them. Hot metal machines
- should be placed away from routes.

Space allocation in the workshop

Before approximating space needed for a workshop, one is required to determine the following;

i. The activities to be carried out in the workshop.
ii. The maximum number of craftsman to be present at each session.
iii. Specific tools, equipment and machines to be installed and consumable materials to be stored.

There is no exact amount of area demanded for any space in a workshop. The information/specifications given below are recommendations from experienced personnel:

1. For effective supervision of other workers and placing equipment the floor should be rectangular in shape with length ratio of between 1:1.5 and 1:2. Minimum width should be 11M.
2. Wherever possible avoid pillars and columns that obstruct views. Also, eliminate compartments where waste materials may accumulate.
3. Heavy equipment such as plumbing, wood , machine workshop, require the following areas per craftsman:
   i. Minimum areas should be $9M^2$
   ii. Adequate area should be $11M^2$
   iii. Desirable area should be $14M^2$
4. Light equipment workshops such as those for electricity, electronics, computer, etc. require:
   i. Minimum area should be $6M^2$
   ii. Adequate area should be $7M^2$
   iii. Desirable area should be $9M^2$
5. In addition to the above information, auxiliary room areas for storage of materials, display area an assembly area should take 10% of the total area.
6. All workshop doors should open outwards. There should be one door to enter the workshop and another to leave the workshop.
   Alternatively, there should be one double door.
7. The floor should be constructed in such way that it has a pleasing appearance, requires minimum repair and easy to clean.
   For this reason:
   i. Concrete floor should be used where there is an excess use of oil and grease.
   ii. Wood block coverings are best where relatively clean work is being done.

iii. Absorbing coverings should be used where heavy loads are expected per square meter e.g. bars.
iv. Reinforced concrete surface should be used where heavy loads are expected per square meter e.g. bars
v. Tiles should be placed where movement of equipment is not expected.

8. The ceiling height should be at least 4M or 5M ceiling heights for auxiliary rooms should be at least 2.5M.
9. Metal working shaper should be provided with adequate labelling and should be away from pathways to eliminate hazards of hot chips harming those passing by.
10. For finishing areas, e.g. wood workshop etc. the following factors should be considered:
    i. Should be dust free and well ventilated.

Glass partition for easy supervision for appropriate sizes.