## MODULE-V

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

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## MATERIAL MANAGEMENT

Materials management is a vital function for improving productivity in construction projects. The management of materials should be considered at all the phases of the construction process and throughout the construction and production periods. This is because poor materials management can often affect the overall construction time, quality and budget. The purpose of material management is to assure that the right materials are at the right place, in the right quantity and quality when needed. Material management is defined as planning, identification, procuring, storage, receiving and distribution of materials.

- The purpose of material management is to assure that the right materials are in the right place, in the right quantity and quality when needed.
- The responsibility of material management department for the flow of materials from the time the materials are ordered, received, and stored until they are used in the basis of material management.
- The management of materials should be considered from the phases of the construction process and throughout the construction period.
- Generally, construction materials are bulky, expensive and are supplied in large amounts to construction sites. Therefore, there is a need for an excellent management system for handling materials.

**How do Construction site store materials?**

- Place stored materials inside buildings that are under construction and at least 6 feet from hoist ways, or inside floor openings and at least 10 feet away from exterior walls; Separate non- compatible material; and Equip employees who work on stored grain in silos, hoppers, or tanks, with lifelines and safety belts.
- Site storage involves the provision of adequate space, protection and control for materials, components and equipment that are to be kept on a construction site during the building process.

**Purposes of Material Management**

1. Efficient material planning
2. Buying or purchasing
3. Procuring and receiving
4. Storing and inventory control
5. Stock and waste control
6. Supply and distribution of material
7. Quality assurance
8. Good supplier and customer relationship
9. Improved departmental efficiency
10. Reduce the cost of project
11. Time saving
12. Achieve economy in project

**Aim of Materials Management**

The aim of Material Management in a construction site is to get:

- The Right quality
- Right quantity of supplies
- At the Right time
- At the Right place
- For the Right cost

**Objectives of Materials**

**Management *Primary objectives***

***can be classified as:***

1. Efficient materials planning
2. Buying or Purchasing
3. Procuring and receiving
4. Storing and inventory control
5. Supply and distribution of materials
6. Quality assurance

***Secondary Objectives of Materials Management:***

1. Efficient production scheduling

2. To take make or buy decisions
3. Prepare specifications and standardization of materials
4. To assist in product design and development
5. Forecasting demand and quantity of materials requirements
6. Quality control of materials purchased
7. Material handling
8. Use of value analysis and value engineering
9. Developing skills of workers in materials management
10. Smooth flow of materials in and out of the organization

**Importance of Material Management**

- The material cost content of total cost is kept at a reasonable level. Scientific purchasing helps in acquiring materials at reasonable prices. Proper storing of materials also helps in reducing their wastages. These factors help in controlling cost content of products.
- The cost of indirect materials is kept under check. Sometimes cost of indirect materials also increases total cost of production because there is no proper control over such materials.
- The equipment is properly utilized because there are no break downs due to late supply of materials
- The loss of direct labour is avoided.
- The wastages of materials at the stage of storage as well as their movement is kept under control.
- The supply of materials is prompt and late delivery instances are only few
- The investments on materials are kept under control as under and over stocking is avoided
- Congestion in the stores and at different stages of manufacturing is avoided.

***Functions of Materials Management***

Material management covers all aspects of material costs, supply and utilization. The functional areas involved in material management usually include purchasing, production control, shipping, receiving and stores.

The following functions are assigned for material management:

1. Planning and estimating the various types of materials.

2. Internal preparations for purchasing of materials.
3. Provides proper storage and distribution system.
4. Development of ancillary units.
5. Cost control of materials
6. To form research and development with respect to the material cell.
7. Production and Material Control:
8. Purchasing: Purchasing department is authorized to make buying arrangements on the basis of requisitions issued by other departments.
9. Non-Production Stores: Non-production materials like office supplies, perishable tools and maintenance, repair and operating supplies are maintained as per the needs of the business.
10. Transportation: The transporting of materials from suppliers is an important function of materials management.
11. Materials Handling: It is concerned with the movement of materials within a manufacturing establishment and the cost of handling materials is kept under control.
12. Receiving: The receiving department is responsible for the unloading of materials, counting the units, determining their quality and sending them to stores etc.

**Components of Material Management**

Materials management can be divided into the following components:

1. Quantity planning, budgeting, and estimation.
2. Procurement scheduling and purchasing.
3. Receiving goods and inspecting for damage.
4. Stock control, storage, and warehouse placement.
5. On-site handling and transport.
6. Waste management.

**Process of Material Management**

Materials management is categorized to five processes:

1. Planning
2. Procurement
3. Logistics
4. Handling

5. Waste control processes.

*1.* ***Planning:***

- The materials planning process covers setting up and maintaining the records of each materials used in each area/ job to determine target inventory levels, and delivery frequency.
- As a result, an excellent management of the materials record will help the flow of materials at the site in order to avoid several problems such as materials out of stock and materials that have not been delivered.

*2.* ***Procurement:***

- Procurement is about organising the purchasing of materials and issuing delivery schedules to suppliers and following-up, to make sure that suppliers deliver on time.
- The objective of procurement in materials management is to provide quality materials at the right time and place, and at an agreed budget.
- A failure in the purchasing process or in overseeing and organising the buying functions could result in:
    a) Over-ordering of materials (wastage problems)
    b) Over-payments for materials (administration problem)
    c) Loss of benefits (lack of skilled negotiating procedures)
    d) Lack of knowledge (when and where the best service/source might be available at any particular time)
- Procurement of materials begins with defining the requirements of the project, followed by the selection of suppliers or subcontractors, and ends with the delivery of materials at the destination.

*3.* ***Logistics:***

- The primary focus of the logistics concept in construction projects is to improve coordination and communication between project participations during the design and construction phases, particularly in the materials flow control process.
- The factors that should be taken into consideration during the logistics process for effective materials management include:
    a) Optimum forecasting of materials movement
    b) Planning of access and routing of material within a construction site
- A properly implemented materials management program can achieve the timely flow

of materials and equipment to the jobsite, and thus facilitate improved work face planning, increased labour productivity, better schedules, and lower project costs.

*4. Handling:*

- This include handling and storing of the material in site • Safe location is to provided • Proper training to the workers on handling material is to be given

*5. Waste control processes:*

- Method for reuse or removing the waste is to be established in the planning stage itself • Storage space for waste material for the short time is also to be planned.

**Advantages of Materials Management**

- Improves the performance of the organization.
- Maximum company profit and Improvement of credibility
- Improved customer service
- Enhancement of communication
- Improved quality of staff.
- Provides coordination between various departments.

**Issues in Material Management**

- Receiving materials before they are required, causing more inventory cost and chances of deterioration in quality.
- Not receiving materials at the time of requirement, causing loss of productivity.
- Incorrect materials take-off from drawings and design documents
- Subsequent design changes.
- Damage/loss of items
- Selection of type of contract for specific materials procurement.
- Piling up of inventory and controlling of the same.

## INVENTORY & INVENTORY CONTROL IN MATERIAL MANAGEMENT

- Inventory is quantity of goods owned and stored by an Organization.
- Inventory means a complete list of items such as property, goods in stock, or the contents of a building.
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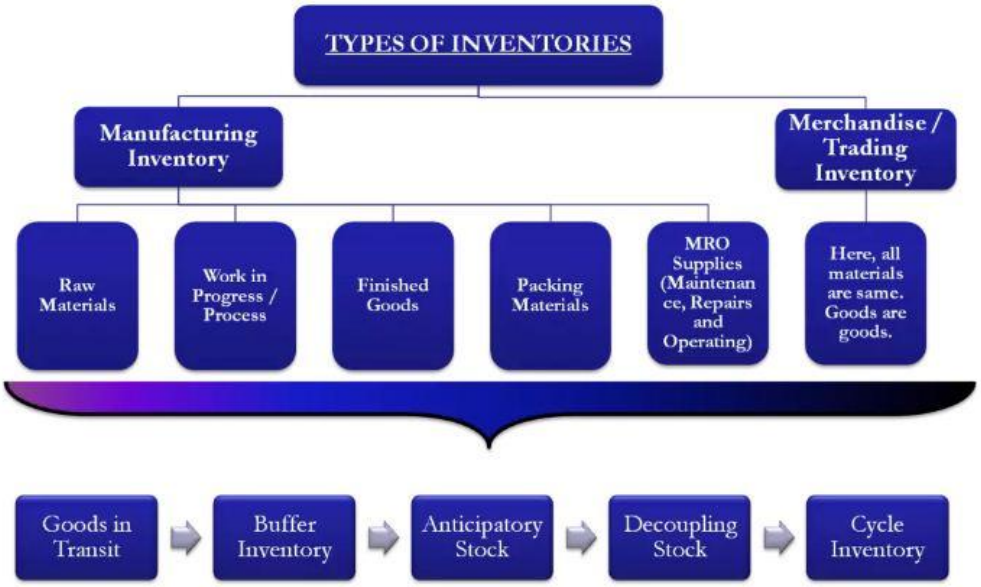
***Types of Inventory***

1. ***Merchandise / Trade Inventory***

It is the inventory of trading goods held by the trader.

2. ***Manufacturing Inventory***

It is the inventory for manufacturing and selling of goods. Based on the value addition or stage of completion, the manufacturing inventories are further classified into 3 types of inventory – Raw Material, Work-In-Progress, and Finished Goods. Another type is MRO inventories which are to support the whole manufacturing and administrating operation.




***Other Types of Inventories***

a) Goods in Transit
b) Buffer Inventory
c) Anticipatory stock
d) Decoupling Stock
e) Cycle Inventory

i) Raw materials

These are the materials or goods purchased by the manufacturer. For example, aluminum scrap is used to produce aluminum ingots. Flour is used to produce bread. Finished goods for someone can be raw material for someone. For example, the aluminum ingot can be used as raw material by utensils manufacturer.

The business importance of raw material as an inventory is mainly to protect any interruption in

production planning. Other reasons can be availing price discount on bulk purchases, guard against market shortage situation, etc.

ii) Work-in-progress (WIP)

These are the partly processed raw materials lying on the production floor. They may or may not be saleable. These are also called semi-finished goods. It is unavoidable inventory which will be created in almost any manufacturing business. This level of this inventory should be kept as low as possible.

iii) Finished goods

These are the final products after manufacturing process on raw materials. They are sold in the market. There are two kinds of manufacturing industries. One, where the product is first manufactured and then sold. Second, where the order is received first and then it is manufactured as per specifications. In the first one, it is inevitable to keep finished goods inventory whereas it can be avoided in the second one.

iv) Packing material

Packing material is the inventory used for packing of goods. It can be primary packing and secondary packing. Primary packing is the packing without which the goods are not usable. Secondary packing is the packing done for convenient transportation of goods.

v) MRO goods

MRO stands for maintenance, repair, and operating supplies. They are also called as consumables in various parts of the world. They are like a support function. Maintenance and repairs goods like bearings, lubricating oil, bolt, nuts etc are used in the machinery used for production. Operating supplies mean the stationery etc used for operating the business.

Other Types of Inventories are as follows:

i) Goods in transit

Under normal conditions, a business transports raw materials, WIP, finished goods etc from one site to other for various purpose like sales, purchase, further processing etc. Due to long distances, the inventory stays on the way for days, weeks and even months depending on distances. These are called Inventory / Goods in Transit. Goods in transit may consist of any type of basic inventories.

ii) Buffer inventory

Buffer inventory is the inventory kept or purchased for the purpose of meeting future uncertainties. Also known as safety stock, it is the amount of inventory besides the current

inventory requirement. The benefit is smooth business flow and customer satisfaction and disadvantage is the carrying cost of inventory. Raw material as buffer stock is kept for achieving nonstop production and finished goods for delivering any size, any type of order by the customer.

iii) Anticipatory stock

Based on the past experiences, a businessman is able to foresee the future trends of the market and takes certain decisions based on that. Expecting a price rise, a spurt in demand etc some businessman invests money in stocking those goods. Such kind of inventory is known as anticipatory stock. It is normally the raw materials or finished goods and this strategy is executed by traders.

iv) Decoupling inventory

In manufacturing concern, plant and machinery should always keep running. The act of stopping machinery, costs to the entrepreneur in terms of additional set up costs, repairs, idle time depreciation, damages, trial runs etc. The reason for halt is not always the demand of the product. It may be because of the availability of input. In a production line, one machine/process uses the output of other machines/process. The speed of different machines may not always integrate with each other. For that reason, the stock of input for all the machines should be sufficient to keep the factory running. Such WIP inventory is called decoupling inventory.

v) Cycle inventory

It is a type of inventory accumulated due to ordering in lots/sizes to avoid carrying the cost of inventory. In other words, it is the inventory to balance the carrying cost and holding cost for optimizing the inventory ordering cost as suggested by Economic Order Quantity (EOQ).

## INVENTORY METHODS

The method a company uses to determine it cost of inventory (inventory valuation) directly impacts the financial statements.

The three main methods for inventory costing are:

1. First-in, First-Out (FIFO)
2. Last-in, Last-Out (LIFO)
3. Weighted Average cost.

## Importance of Inventory Control

- Improves customer's relationship by timely delivery of goods & service.
- Smooth & uninterrupted production
- Efficient utilization of working capital
- Maintains economy in purchasing.
- Eliminates the possibility of duplicate ordering

## Objectives of Inventory Control

- To keep inactive, waste, surplus, scrap and obsolete items at the minimum level.
- To make sure that financial investment in inventories is minimum.
- To minimize holding, replacement and shortage costs of inventories and maximize the efficiency in production and distribution.
- To ensure adequate supply of products to customer & avoid shortage as far as possible.
- To ensure timely action for replenishment.
- To provide a scientific base for both short-term and long-term planning of materials.
- Maintain sufficient stock of raw material in period of short supply and anticipate price changes.
- Control investment in inventories and keep it at an optimum level.
- Protect inventory against deterioration, obsolescence and unauthorized use.

## Factors Affecting Inventory Control

a) Financial Factors
b) Suppliers
c) Lead Time
d) Product Type
e) Management
f) External Factors

## Advantages of Inventory Control

- Effective inventory control reduces the costs.
- Inventory control monitors the level of inventory
- Manages obsolescence

- Manages deterioration by ordering in the appropriate quantities.

## INVENTORY MANAGEMENT

- It is a systems & processes that identify inventory requirements, set targets, provide replenishment techniques and report actual and projected inventory status.
- It involves a retailer seeking to acquire & maintain a proper merchandise assortment while ordering, shipping, handling and related costs.

## INVENTORY MODELS

### ECONOMIC ORDER QUANTITY (EOQ)

- EOQ or Fixed Order Quantity system is the technique of ordering materials whenever stock reaches the reorder point.
- EOQ is the point at which inventory carrying costs are equal to order costs.
- Economic order quality deals when the cost of procurement and handling of inventory are at optimum level and total cost is minimum.
- In determining EOQ it is assumed that cost of managing inventory is made of solely of two parts:
    - Ordering Costs
    - Carrying Costs.

a) Ordering Costs: These are costs that are associated with the purchasing or ordering of materials.

b) Carrying Costs: These are costs for holding the inventories. These costs will not be incurred if inventories are not carried.

### Assumptions of EOQ

The basic model makes the following assumptions:

1) Demand is uniform, constant and continuous over time
2) The cost of placing an order is independent of size of order
3) The cost of holding a unit of stock does not depend on the quantity in stock
4) Sales occur at a constant rate
5) Safety stock level is not considered

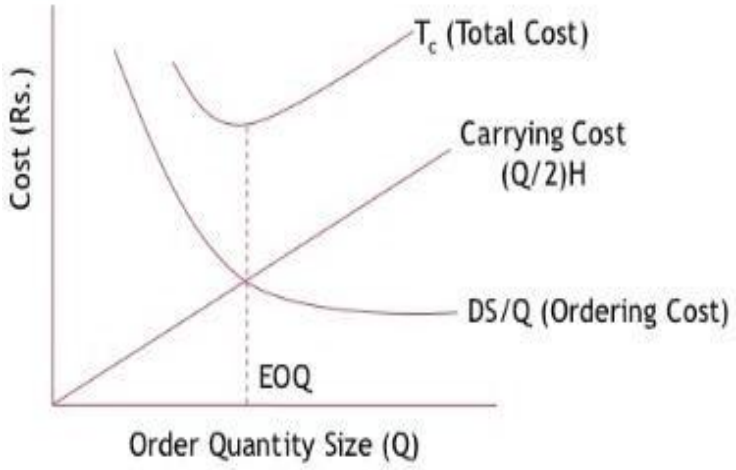
*EOQ- Costs*

EOQ accounts for 3 types of costs:

1. Unit Cost: the cost of the units themselves, assumed to be fixed, regardless of the number of units ordered

2. Inventory-Holding Cost: the cost of holding units in inventory. They include the opportunity cost of money held up in inventories, storage costs, spoilage costs, etc.

3. Fixed order Cost: represents all the costs associated with placing an order excluding the cost of the units themselves (any administrative costs of placing and/or receiving an order, transportation cost, etc.)




Total Annual Cost = Annual Purchase Cost + Annual Holding Cost + Annual Ordering Cost

$$TC = DC + \frac{Q}{2}H + \frac{D}{Q}S$$

$$EOQ = \sqrt{\frac{2DS}{H}}$$

TC = Total annual cost
D = Demand
C = Cost per unit
Q = Order quantity
S = Cost of placing order/setup cost
H = Annual holding and storage cost per unit of inventory

**Order Points & Service Levels**

1) Minimum Level – It is the minimum stock to be maintained for smooth production.
2) Maximum Level – It is the level of stock, beyond which a firm should not maintain the

stock.

3) Reorder Level – The stock level at which an order should be placed.
4) Safety Stock – Stock for usage at normal rate during the extension of lead time.
5) Reserve Stock - Excess usage requirement during normal lead time.
6) Buffer Stock – Normal lead time consumption.

## TECHNIQUES OF INVENTORY CONTROL

1) ABC Analysis
2) HML Analysis
3) VED Analysis
4) FSN Analysis
5) SDE Analysis
6) GOLF Analysis
7) SOS Analysis

### ABC ANALYSIS

- ABC analysis (or Selective Inventory Control) is an effective inventory categorization technique.
- ABC analysis provides a mechanism for identifying items that will have a significant impact on overall inventory cost
- This technique is known as Always Better Control or the alphabetical approach.
- The ABC approach states that a company should rate items from A to C.
    - "A" Category – 5% to 10% of the items represent 70% to 75% of the money value.
    - "B" Category – 15% to 20% of the items represent 15% to 20% of the money.
    - "C" Category – The remaining number of the items represent 5% to 10% of the money value.
- The relative position of these items show that items of category A should be under the maximum control, items of category B may not be given that much attention and item C may be under a loose control

## Characteristics of ABC

***A-Items:***

These items have 70% of purchase value but less in quantity about 15 to 20%. The capital should not be blocked in these items. They can be ordered frequently and consumed immediately. They are only 10 to 15% quantity wise and require special attention in stores.

***B-Items:***

They have about 20 to 25% purchase value and same quantity to purchase. Since they are medium valued items therefore large inventory of them is not necessary. They can be ordered frequently but at the same time the quantity ordered should be such that it will be economic to purchase and its shortage should not be there. They are less valued than A items and quantity-wise about 15 to 25%.

***C-Items:***

They have the least purchase cost about 10%. They are required in large quantity about 50 to 60%. They can be purchased in bulk to avail large discounts and fewer prices to pay. This will also reduce the cost of ordering and purchasing. They can be purchased once or twice in a year. They are least-valued items.

## Steps for the Classification of Items

- Find out the unit cost and the usage of each material over a given period;
- Multiply the unit cost by the estimated annual usage to obtain the net value;
- List out all the items and arrange them in the descending value (Annual Value);
- Accumulate value and add up number of items and calculate percentage on total inventory in value and in number;
- Draw a curve of percentage items and percentage value;
- Mark off from the curve the rational limits of A, B and C categories

## *Procedure for ABC* Analysis

1. Make the list of all items of inventory.
2. Determine the annual volume of usage & money value of each item.
3. Multiply each item's annual volume by its rupee value.
4. Compute each item's percentage of the total inventory in terms of annual usage in rupees.
5. Select the top 10% of all items which have the highest rupee percentages & classify

them as "A" items.

6. Select the next 20% of all items with the next highest rupee percentages & designate them "B" items.
7. The next 70% of all items with the lowest rupee percentages are "C" items.

**Advantages of ABC Analysis**

- The purchasing of various categories of items becomes easy
- Better record keeping
- Helps to exercise selective control
- Gives rewarding results quickly
- Helps to point out obsolete stocks easily.
- Provides sound basis for allocation of funds & human resources.

**Limitations of ABC Analysis**

- ABC analysis will not be effective if the material are not classified into the groups properly.
- Considers only money value of items
- It is not suitable for the organization where the costs of materials do not very significantly.
- Proper standardization & codification of inventory items needed.
- Periodic review becomes difficult

**HML ANALYSIS**

- The HML analysis is similar to ABC analysis the difference that instant "usage value, price" criteria is used.
- It is based on Pareto principle.
- The items under this analysis are classified based on their unit prices.

**VED ANALYSIS**

- VED stands for vital, essential and desirable.
- This analysis classifies inventory according to the relative importance of certain items to other items, like in spare parts.
- This is an analysis whose classification is dependent on the user's experience and

perception

**FSN ANALYSIS**

- FSN stands for fast-moving, slow-moving and non-moving items. Essentially, this segments inventory into three classifications.
- It looks at quantity, consumption rate and how often the item is issued and used.
- Fast-moving items are items in your inventory stock that are issued or used frequently.

**SDE ANALYSIS**

- The SDE analysis is commonly used to allow for better planning when procuring inventory stock.
- The SDE analysis looks at what inventory is available and classifies it according to the scarcity of supply.

**GOLF ANALYSIS**

- The letter stands for Government, Ordinary, Local and Foreign.
- These are special procedures of inventory control which may not applicable to ordinary items as they require special procedures.

**SOS ANALYSIS**

- S' stands for Seasonal items and 'OS'- Off Seasonal items.
- In general it is merit to seller to buy seasonal items at lower price and keep inventory and sell them at high price during off seasons.
- This helps to control the average inventory model value.

# SAFETY MANAGEMENT

## Construction Safety

Construction safety involves any safety procedure that is related to the construction industry or construction sites.Construction safety aims to ensure that a construction site is safe from accidents.

## Safety Precaution

- An action taken in advance to protect against possible danger, failure, or injury..
- A safeguard: followed safety precautions when using heavy machinery.
- Safety precautions includes: safety goggles, steel toed shoes, high visibility clothing, protective gloves, safety harnesses for heights, guarding on machinery to prevent access, safety procedures, man down alarms.

## Safety Symbols

Safety symbols, hazard symbols or safety labels are meaningful and recognizable graphical symbols that warn of or identify hazards associated with the location or item.

## Safety Risks in Construction

1) Working at height.
2) Moving objects.
3) Slips, trips, and falls.
4) Noise.
5) Hand arm vibration syndrome.
6) Material and manual handling.
7) Collapsing trenches.
8) Asbestos.
9) Drowning

## *NEED OF SAFETY IN CONSTRUCTION*

- Construction is highly accident prone industry

- Working in a fearless protected environment makes the team to be more productive and efficient
- Safety is one of the vital issues in the success of the project.
- Safety programme ensures the worker to be mentally and physically prepared to execute a job quickly ,fearlessly and efficiently
- Safety is a way of life
- It must be part of every individual at every time during performance of any activity.

**Factors Affecting Safety**

1) Safety awareness
2) Application of new technology in construction
3) Employee age , experience, education &safety training received .
4) Increased job-related pressure on workers
5) Excessive overtime work for employees
6) Definition of safety responsibility
7) Number of safety supervisors
8) Safety inspection by government authorities ,management &safety supervisor
9) Safety meetings
10) Implementation of safety rewards, safety fines & disciplinary actions

**Safety on a Construction Site**

- Awareness
- Training
- Communication
- Documentation
- Proper equipment
- Supervision
- Innovation
- Transparency

# SAFETY IN CONSTRUCTION

## A. Safety in the workplace

### *1) Housekeeping:*

- The contractor shall be primarily responsible for maintaining Good housekeeping and safety standards in the workplace.
- Loose materials that are not required for use shall not be placed or left behind so dangerously as to obstruct workplaces or passageways.
- All projecting nails shall be removed or bent to prevent injury.
- Equipment, tools and small objects shall not be left lying unattended or unsecured from where they could fall or cause a person to trip.
- Scrap, waste or rubbish shall not be allowed to accumulate in the site as these combustibles can create serious fire hazards and affect safe working.
- Workplaces and passageways that become slippery owing to spillage of oil or other causes shall be cleaned up or strewn with sand, ash or the like.
- Portable equipment shall be returned after use to their designated storage place.

### *2) Means of access*

- Adequate and safe means of access and egress shall be provided in all workplaces
- The means of access and egress shall be maintained in a safe condition.

### *3) Lighting and ventilation*

- All practical measures shall be taken to prevent smoke, fumes etc. from obscuring any workplace or equipment at which any worker is engaged.
- Adequate and suitable artificial lighting shall be provided where natural lighting is not sufficient.
- To prevent danger to health from air contamination by dust generated during grinding, cleaning, spraying or manipulation of materials as also to provide protection against dangerous gases, fumes, vapours, mist, etc. effective arrangements shall be made for ventilation
- Where natural lighting is not adequate to prevent danger, adequate and suitable lighting shall be provided.
- Artificial lighting shall not cause any danger due to a high brightness.
- Where necessary to prevent danger to health from air contamination by dust from the grinding, cleaning, spraying, or manipulating of materials or objects, arrangements shall be made to limit the concentration of the pollutants by thorough

ventilation, and dust generated due to movement of earthmoving machinery and other construction equipment, by spray of water in the area from time to time.

- Adequate ventilation by the circulation of fresh air shall be maintained in such places where the concentration of pollutants is likely to affect the health of the workers.
- Special care shall be taken to ventilate the workplace where gas cutting, welding or other operations involving generation of dangerous fumes, vapours, mists, gases etc. is likely.
- Where it is technically not possible to eliminate dust or noxious or harmful fumes or gases sufficiently to prevent injury to the health of the workers, the contractor shall provide suitable respiratory equipment like dust mask or gas/fume mask or breathing apparatus or other suitable respiratory equipment.

***4) Dangerous and harmful environment:***

- When an internal combustion engine exhausts into confined space or excavation or tunnel or any other workplace where neither natural ventilation nor artificial ventilation system is adequate to keep the carbon monoxide content of the atmosphere below fifty parts per million, adequate and suitable measures shall be taken at such workplace in order to avoid exposure of building workers to health hazards.
- No building worker shall be allowed to enter any confined space or tank or trench or excavation wherein there is given off any dust fumes or other impurities of such nature
- No worker shall be allowed to enter any such space unless a responsible person has certified it to be safe and fit for the entry of such building workers.

***5) Fumes/gases due to Welding and gas-cutting operations:***

- Adequate ventilation, by means of exhaust fans or forced draught, as the condition may require, shall be constantly provided; otherwise enough quantity of air shall be circulated by means of air compressors to dilute the contaminant within permissible limits
- Workers shall take necessary precautions to prevent unburned combustible gas or oxygen from escaping inside a tank or vessel or other confined space
- Gas-test shall be carried out ensure that the confined space is completely free from combustible gases and vapours.

***6) Dust, gases, fumes***

- Concentration of dust, gases or fumes shall be prevented by providing suitable means to control their concentration within the permissible limit
- For protection against such hazardous substances, besides efficient and effective means of control, personal protective equipment like dust masks, breathing apparatus, other respiratory appliances, goggles, as the case may be, shall be provided.

7) Excessive noise:

- Adequate measures shall be taken against the harmful effects of an excessive noise.
- Use of earplugs/muffs and anti-vibration gloves shall be ensured to protect the workers from the impact of exposure to such dangers.

8) Corrosive substances:

- All corrosive substances, including alkalis and acids, shall be stored and used by a person dealing with such substances at a building or other construction work in such a manner that it does not endanger the building worker and suitable protective equipment shall be provided by the employer to a building worker during handling or use of such substances at a building or other construction work and in case of spillage of such substances on the building worker, immediate remedial measures shall be taken;
- While protection of the body could be ensured by use of corrosion resistant apparel/overalls, suitable goggles, gloves, apron, gum boots etc. shall be made available to all concerned personnel.
- To deal with an accidental spillage of a corrosive substance on the body of a worker, the facility of eyewash fountain or water shower, as the case may be, shall be installed, within the easy reach of the workplace.

9) Eye protection:

- Suitable personal protective equipment for the protection of eyes shall be provided and used by the building worker engaged in operations like welding, cutting, chipping, grinding or similar operations which may cause hazard to his eyes.
- Goggles or face shield or welding screen with suitable shade of glass/filters etc. shall be provided for the protection of the eyes.

10) Overhead protection:

- It shall be ensured that at the building or other construction site, overhead protection is erected along the periphery of every building under construction that shall be of fifteen meters or more in height when completed.

- Overhead protection shall not be less than two meters wide and shall be erected at a height not more than five meters above the base of the building and the outer edge of such overhead protection shall be one hundred fifty millimetres higher than the inner edge thereof or shall be erected at an angle of not more than twenty degrees to its horizontal sloping into the building.
- It shall be also ensured that at the building and other construction work that any area exposed to risk of falling material, articles or objects is roped or cordoned off or otherwise suitably guarded from inadvertent entry of persons other than building workers at work in such area.

11) Lifting and carrying of excessive weight:

- No building worker lifts by hand or carries overhead or over his back or shoulders any materials, articles, tools or appliances exceeding in weight the maximum limits as set out in the following table unless aided by any other building worker or a mechanical device.
- No worker aided by other workers, lift by hand or carry overhead or over their back or shoulders any materials, articles, tools or other appliances exceeding in weight the sum total of the maximum limits as prescribed in the concerned Rules, unless aided by a mechanical devices:

12) Protections against fall of persons

- All scaffolds/working platforms at height of two metres or more shall be fenced;
- All guard-rails for the fencing of floor openings, gangways, elevated workplaces shall be made of sound material, good construction and possess adequate strength and be between 1 m and
    - 1.5 m above platform level, consist of two rails.
- Intermediate rails, ropes or chains shall be midway between the top and lower of edges of the top rail.
- Sufficient number of stanchions or standard poles or uprights shall be maintained to ensure the required stability and resistance.
- Guard-rails shall be free from sharp edges and be maintained in good repair.
- Floor openings through which persons could fall, shall be guarded by covering or Fencing.
- If the means of protection is removed to allow the passage of persons or goods or other purpose, the same shall be replaced as soon as possible, while making temporary arrangements for reasonable degree of safety in the meanwhile;

- Covers for floor opening shall be safe to walk on and if vehicles operate thereon it shall be safe for the same. This will require the contractor to have prior assessment of expected loads.
- Cover for floor opening shall be secured by hinges, grooves, stops or other effective means against sliding, falling down or lifting out or any other inadvertent displacement
- Covers for any openings shall not constitute any hindrance to traffic and, as far as practicable, be flush with the floor;
- If covers constitute as grids, the bars shall be spread not more than 5 cm apart
- Elevated workplaces at more than 2 m above the floor or ground shall be protected on all open sides by guardrails. It is commonly observed that fragile barricade tapes are used as a substitute of a strong and dependable fencing. This practice is prohibited. The barricade tapes can be used as markers/route guide only.
- Elevated workplaces shall be provided with safe means of access and egress such as stairs, ramps or ladders according to suitability.
- Persons employed at elevated workplaces or other situations at more than 2m from which they may fall, shall be protected by means of adequate safety nets, or platforms, or be secured by safety belts with the lanyard properly anchored above the head level of the user. All possible effort shall be made to have strong and dependable mechanical arrangement.

13) Protection against fall of objects and materials:

- Materials and objects such as scaffolding materials, waste materials or tools shall not be thrown up or down from heights, as they are liable to cause injury.
- If materials and other objects cannot be safely lowered from heights, adequate precautions such as the provision of fencing, lookout men or barriers shall be provided to protect any person from injury.

14) Protection against entry of unauthorized persons:

- Construction zones in the site and built up areas alongside main traffic routes shall be barricaded.
- Unauthorized persons shall not be allowed access to construction sites and visitors shall be provided with the required protective equipment and it be ensured that they use them effectively.

15) Head protection and other protection apparel:

- Every building worker who is required to:

- Pass through or working within the areas where there is hazard of his being struck by falling objects or materials, shall be provided with safety helmets of the type approved and tested in accordance with the national standards
- Work in water or in wet concrete or in other similar work, shall be provided with suitable waterproof
- Work in rain or in similar wet condition, shall be provided with waterproof coat with hat
- Workers using or handling of alkalis, acid or other similar corrosive substances shall be provided with appropriate protective equipment in accordance with the approved standards
- Every building worker engaged in handling sharp objects or materials at a building or other constriction work, which may cause hand injury, shall be provided with suitable hand gloves in accordance with the approved standards.

16) Stability of structures:

- No wall, chimney or other structure or part of a structure shall be left unsupported in such condition that it may fall, collapse or weaken due to wind pressure, vibration or due to any other reason.
- Entry of persons into such locations where tall structures are being built shall be regulated without a let up.

17) Safety of Structures and equipment and other safety concerns

Safety of structures like scaffoldings, platforms, gangways/walkways, towers, stairs, ladders, ramps, safety in excavation, formwork, false work, demolition work, storage, handling and use of explosives, inflammable substances and hazardous materials, gas cutting and welding, use of electricity etc.; and equipment viz. construction machinery, crushers and batching plant, boiler and other pressure vessels, transport and material handling equipment, lifting appliances, vehicles etc., shall be operated and maintained as per approved norms and :

i) They shall be made of sound material and of good construction, free from patent defects, provided with adequate safe guards, properly maintained, periodically inspected and strong enough to withstand safely the loads and stresses to which they may be subjected

ii) They shall carry enough factor of safety bearing in mind that the possibility of their abuse, which otherwise shall be prevented by constant and adequate supervision, cannot be ruled out altogether

iii) It is incumbent on the contractor to ensure that only competent and authorized persons operate the equipment or attend to electrical and mechanical systems and repair of faults or breakdowns etc.

18) Slipping, tripping, cutting, drowning and falling hazards:

- The contractor shall keep all passageways, platforms and other places free from accumulations of dust, debris or similar material and from other obstructions that may cause tripping
- Any sharp projections or protruding nails or similar projections which may cause any cutting hazard to a building workers shall be removed or otherwise made safe by taking suitable measures
- No contractor shall allow any building worker at construction work to use the passageway, or a scaffold, platform or any other elevated working surface which is in slippery and dangerous condition and shall ensure that water, grease, oil or other similar substances which may cause the surface slippery, be removed or sanded/saw-dusted or covered with suitable material to make it safe from slipping hazard
- Wherever building workers are exposed to the hazarded of falling into water, they shall be provided with rescuing arrangement from such hazard and if it is considered necessary, well equipped boat or launch manned with trained personnel shall be provided by the contractor at the site of such work
- Every open side or opening into or through which a building worker, vehicle or lifting appliance or other equipment may fall at a building or other construction work shall be covered or guarded suitably to prevent such fall except where free access is necessary by reasons of their nature of the work
- Wherever building workers are exposed to the hazards of falling from height while employed on such work they shall be provided by the employer with adequate equipment or means for saving them from such hazards, such equipment or means shall be in accordance with the standards as laid down
- Whenever there is a possibility of falling of any martial, equipment or building worker at a construction site relating to a building or other construction work, adequate and suitable safety net shall be provided in accordance with the above stipulation.

**B. <u>Equipment Safety</u>**

- Equipment safety can be achieved with necessary norms and specification for safety or operating the equipment safely. Second part of this deals with the operator who actually operates the equipment. In industries most of the accidents occur due to the operators fault. Hence, operator must be trained and motivated for safety training.

**C. <u>Operator Training</u>**

- During the training session, reviews of specific procedures that are part of everydays

work, performed by the attendees are done. The inspection and operating procedures that are taught are focussed on all aspects of proper operation. It is advised for the implementation of proper overhead material handling procedures that will increase the life of equipment and reduce maintenance cost. The training sessions include classroom training and question and answer periods.

**D. Proper Material Handling Equipment Terminology**

- Listing of codes pertaining to material handling equipment
- Daily material handling equipment operator inspection and proper inspection methods
- Proper handling practice and use of safety devices
- Basic maintenance procedures and requirements

**E. Training Aids**

- It includes on line and off line training. On line training includes training the operators to work safely on equipment and use of standard practice. Offline training includes graphs, figures, postures and video films to demonstrate graphically the correct procedures and results when they are not applied. These programs are designed to determine the safest and most productive methods to accomplish the specific tasks that are required by the company.

**F. Safety Norms and Standards**

- All material handling equipment are designed by adhering to standards and norms which are predefined by BIS ISO. For material handling equipment also there are norms and standards which relates with design of material handling equipment, operating norms of material handling equipment, safety norms of material handling equipment etc.

***G.* Crane Safety**

Improper use of cranes, hoists, and rigging devices can cause equipment to fail or loads to drop from the lifting system, resulting in personnel injury, death, significant property loss or damage to the environment. Following should be considered while working on crane and operator should have following worksite considerations, technical knowledge, manufacturer's load charts. Safe operation of overhead cranes requires operators to have the knowledge and competence to employ safe rigging practices. The rigger must rig the load to ensure its stability when lifted. The following points highlight safety tips for overhead crane operations:

1) Before use ensure the crane is suitable for the planned hoisting task. Confirm it has appropriate travel, lift and capacity.
2) Visually and physically inspect the crane before use. Check for damage, wear and proper operation of all functions.
3) Confirm the load weight. Check the capacity of all equipment including the hardware, rope and slings. Do not exceed these capacities.
4) Select the right sling for each lift. Inspect slings and other rigging hardware before use for wear, stretch, or other damage. Do not use damaged or defective slings. Use softeners around sharp corners. Do not splice broken slings.
5) When communicating with a crane operator, use clear agreed upon signals. Except for the stop signal, the crane operator should follow instructions from only one person.-a designated signaller. Where a wired or remote controller is used, the operator should become familiar with all of its functions before lifting the load.
6) Warn all people in the load lift area before starting the lift. Ensure that the path of the load is clear of persons and obstructions. Do not lift the loads over anyone. Centre the crane hoist over the load before hoisting to prevent swinging of the load.
7) Slide the sling fully onto the hoisting hook and ensure the safety catch is closed. Do not load the hook tip or hammer a sling into place.
8) Secure unused sling legs. Do not drag sling or leave loose materials on a load being hoisted.
9) Keep hands and fingers from being trapped when slack is taken out of a sling. Step away before the lift is made. Move the load and controls smoothly. Minimize load swing.
10) Walk ahead of the load during travel and warn people to keep clear. Use a tag line to prevent rotation or other uncontrolled motion. Raise the load only as high as necessary to clear objects. Do not ride on hook or load.
11) Set the loads down on blocking, never directly on a sling. Do not pull or push loads out from under the hoist.
12) Do not leave the load unattended while the load is suspended.
13) Where crane operation by other personnel must be restricted, employ lockout and tagging procedures. Store slings off the floor in a clean, dry location on hooks or racks. Do not leave slings, accessories or blocking lying on the floor.
14) Ensure that the load is free to move. If a load is stuck and the crane begins or continues to lift, it may reach its full capacity quickly. There may be little or no warning of this condition and rigging components may fail.

### *H.* Conveyor Safety

Safety tips to work with a conveyor are listed below:

1) Don't take chances around a conveyor belt.
2) Don't perform work that will expose you to a pinch point, like clearing caked material from a roller, while a belt is in operation.
3) Only work on a conveyor that is locked and tagged out.
4) If you are working near a stopped belt, and a start-up warning is given, stop what you are doing and get clear.
5) Never cross a moving belt.
6) Always cross at a bridge or designated crossing point.

### I. Fork Lift Truck Safety

1) Do not operate the machinery when loads are unstable and high above the ground.
2) Do not turn or brake suddenly while operating machinery.
3) Use designated attachments, such as crane arm, to transport loads.

### J. While loading a fork lift onto the bed of a truck using gangplanks:

1) Gangplanks should be placed securely at an appropriate incline.
2) Use the truck's installed winch or self-loader to load equipment.
3) Assign a worker to serve as a guide during loading.

### K. While transporting a coil of steel plating on the fork of a forklift:

1) Take measures to ensure that your load is not going to fall off the vehicle even during sudden stops.
2) Use a ram lift or other designated attachment to transport coils.
3) Ensure that all workers know never to step outside of the safety path.

### L. While unloading materials:

1) Check the status of a load before loading and unloading.
2) When trying to adjust a load on a forklift, lower the load to the ground first.
3) When leaving the driver's seat, set the side brake, turn off the engine, and remove the key.
4) Do not stand in front of or behind a forklift.

## SAFETY MEASURES

Safety measures are activities and precautions taken to improve safety, i.e. reduce risk related to human health.

***Some of the safety measures that a construction worker needs to remember include:***

1) Always Double Check your Work Area.
2) Be Attentive when Working With Electricity and Equipment.
3) Prevent Fires and Maintain Fencing.
4) Wear Appropriate Safety Apparel and Gear.
5) First Aid Kits Should Be Readily Available.

## SAFETY MEASURES IN DIFFERENT STAGES OF CONSTRUCTION

The activities under Health and Safety Management may be grouped under the following stages:

***1. Pre-construction stage***

a) Project development
b) Planning for construction
c) Tender Action
d) Construction stage

***2. Commissioning and handing over stage***

***Pre- construction Stage***

- Pre-construction stage activities of the project shall be required to be reviewed before the project management processes are initiated for the construction stage.
- It is desirable to assess decisions of the briefing and feasibility stage outputs such as overall planning and construction methods affecting health and safety, which may have bearing on construction stage.
- While the project documents and proposals are reviewed for the adequacy of health and safety measures, it is essential to ascertain timeframes and budgets relating to health and safety measures, including extent of management systems proposed to be employed during construction
- A concise Health and Safety Management System of construction agency shall be established from the pre-construction stage itself. The tender documents of the project shall clearly communicate the health and safety requirements of the project to the prospective contractors
- The construction agencies may be asked to submit a project specific Health and Safety

Plan proposing the methodology for managing health and safety and their capability in completing the project in a safe manner.

***Construction Stage***

Prior to the start of construction work, detailed planning shall be carried out which may include:

a) Identifying aspects of design that have bearing on health and safety during construction stage.
b) While scheduling the various activities of the construction, making adequate time allowance to carry work in accordance with health and safety requirements.
c) Reviewing the proposed method statements of various activities, identifying health and safety hazards of activities in the project and assessment of the risk level.
d) When the risk level is unacceptable, taking additional control measures including revision of the work methodology so that all identified risks are at ALARP (As Low as Reasonably Practicable) level.
e) Planning and establishing the facilities for implementation of health and safety such as workmen training facility, health centre for medical check-up and first aid, access control of employees, etc.
f) Ensuring that the temporary establishments at project site such as site offices, workmen camps, toilets, canteens and rest sheds, etc. are created meeting the requirements of the relevant statutes and standards.

- Project manager shall ensure that the construction agency has understood the challenges and has planned to meet the project specific health and safety requirement through appropriate competencies.
- Health and safety measures need proper coordination by the construction agency and such efforts of the construction agency shall be reviewed, monitored and appropriately guided by the owner/client and consultants.
- In respect of sub-contractors, Project Manager of the construction agency shall ensure that the sub-contractors meet the health and safety requirements of the project. Health and safety control and monitoring shall be established specific to the needs of the project

***Commissioning and Handing Over Stage***

- During completion and handing over of the project, effectiveness of health and safety measures and management system shall be reviewed for future planning.
- Experience and recommendations which may be necessary during operation and maintenance stage of the project, shall be documented

## SAFETY MESURES IN DIFFERENT CONSTRUCTION WORK

1) Safety measures for storage and handling of building materials
2) Safety measures in construction of elements of a building
3) Safety measure in demolition of building
4) Safety measure for hot bituminous work
5) Safety measure for scaffolding, ladders, formwork and other equipment
6) Safety measure for excavation
7) Safety measure for lifting and hoisting machinery
8) Fire safety in buildings

### 1. SAFETY MEASURES FOR EXCAVATION

- Excavation work generally means work involving the removal of soil or rock from a site to form an open face, hole or cavity using tools, machinery or explosives.
- Safety inspections should check for the type of excavation being conducted, support and warning systems in place, access areas, weather conditions, heavy equipment and PPE.
- To protect workers from injuries and fatalities, preventive measures should be implemented when workers begin excavating.
- Inspect trenches daily before work begins.

- Check weather conditions before work,
- Keep heavy equipment away from trench edges.
- Be mindful of the location of utilities underground.
- Always wear proper protective equipment.
- Protective systems like benching, sloping, shoring and shielding must be created.

***Equipment Safety during Excavation***

1) Proper selection of machinery.
2) Upkeep of the material should be done regularly.
3) Operation of machinery should be by qualified persons.
4) Mentally and physically fit persons only be allowed to work on machinery.
5) Faulty machines should not be pressed in operation.
6) Dangerous parts of the machines should be provided with proper cover.
7) While running the engine, replacement of oil, lubrication, or repair work should not be under taken.
8) While starting the machine, the operator should give a working signal
9) While working in night, proper lighting arrangements must be ensured

## 2. SAFETY MEASURES FOR DRILLING &BLASTING

***Safety Measures While Storing the Explosive***

1) Explosives should be stored in dry, well ventilated, fire resistant and bullet proof building.
2) Primers or blasting caps should be stored separately.
3) Explosives, fuse lighters etc. should not be stored in damp places or near oil or near any source of heat.
4) Warning notice should be displayed.

***Safety Measures While Drilling and Loading the Explosives***

1) Before planning the drilling operations, the nature of the strata should be examined carefully to avoid sliding after blasting.
2) Drilling should not be done where undetonated explosives are suspected.
3) Before loading the explosive in the hole, it should be ensured that the hole is bored in full length and is free from dust etc.

4) Excess explosives should not be left near the site while loading the hole.
5) Before loading a hole it should be ensured that the hole is cool and has no burning material in it.
6) While inserting the explosive into a bore hole and while inserting the blasting cap into the explosive, no force should be applied.
7) Tamping should be done with wooden tools. In no case metal tamping rod should be used.

***Safety Measures While Using Explosives***

1. Smoking or lighting fire should not be allowed near the place of explosive use.
2. After explosives are taken containers should be closed properly.
3. No unauthorised person should be allowed to go near the place of explosive use.
4. Explosives should not be handled in electrical stores.
5. Deteriorated explosives should not be used.
6. Hard set explosives should not be softened by heating over the fire or rolling it on the ground.

***Safety Measures for Short Firing with Safety Fuse***

1. To safeguard against the damage of fuse cover, it should be handled carefully.
2. The length of fuse wire should not be less than 1.2 m
3. The fuse should be ignited with a fuse lighter of proper design.
4. Before igniting the fuse, sufficient stemming should be paced over the explosive.
5. At the time of lighting the fuse, spare explosive should not be held in hand.
6. Excessive quantities of explosives should not be taken underground.

***Precautions to be taken for Blasting***

1. Proper planning
2. Avoiding fly rock
3. Cover the rock in a layer of sandbags at least in the area of the hole collar to protect the mat from damage.
4. Load and fire only the number of holes that blasting mats can adequately cover at one time, and anchor mats where possible.

## 3. SAFETY MEASURES TO BE TAKEN FOR LADDER SAFETY

1. Before use all ladders should be tested for the designed load.
2. A defective ladder should never be used.
3. The splicing of ladder should be avoided.
4. Ladder leading to lending should be extended at least one metre above the landing and secured at the upper end properly.
5. Ladders should not be supported against window panes, sashes or other unsafe or yielding objects.
6. When the ladders are used in public walk ways, suitable barricades should be provided.
7. While using ladder, one should not lean sideways more than 30 cm.
8. While ascending or descending, the user should face the ladder.
9. To prevent slipping, a ladder should be placed in such a way that it does not make an angle of lower than 75 degree with the ground.
10. Metal ladder should not be used around electric circuit or equipment.

## 4. SAFETY MEASURES TO BE TAKEN FOR SCAFFOLDING

1. The vertical standards should be embedded into the ground to withstand the loads coming on them.
2. Workers should not be allowed to lit fire near the scaffolding.
3. The boarding over which the mason sits, should be sufficient width and strength to take up the load of workers and building materials needed for immediate use.
4. Various stages of construction may be erected at convenient heights.
5. The putlog should be inserted sufficiently deep in the wall to avoid sliding.
6. The sizes of different members should be properly designed according to the load they are supposed to carry.
7. Nobody should be allowed to stand below the scaffolding.
8. As the scaffoldings are not designed to carry large quantity of building materials, only small quantity of materials should be put on the scaffolding.
9. While connecting ledgers to standards and putlogs to ledgers, lashing should be done securely.
10. When the work is over, the scaffolding should be dismantled step by step from upper side.

## 5. SAFETY MEASURES TO BE TAKEN FOR FORMWORK

- The main problem that affects c form works is shrinkage, bending and warping under loads.
- This should be avoided. Precautions to avoid these include using partially seasoned timber, standardization of members of form work, periodical inspection and maintenance etc.

## 6. SAFETY MEASURES TO BE TAKEN FOR FABRICATION IN CONSTRUCTION

1. Protective equipment
2. Flame resistant gloves
3. Safety glasses
4. Welding helmet
5. Oil resistant shoes
6. Ear plugs/ear muffs
7. Specialized garments

## 7. SAFETY MEASURES TO BE TAKEN FOR ERECTION IN CONSTRUCTION

1. Proper anchorage for stability.
2. Field bolting to help provide lateral stability and prevent rotation.
3. Secured hoisting cables to the members until they are fastened in place.
4. Clearing of access roads, pedestrian/traffic management.
5. Enough drained compacted space to move and stage equipment and supplies.
6. All walking and working surfaces must be kept clear of tripping and impalement hazards.
7. Overhead protection to prevent objects and debris from falling on workers.

## 8. SAFETY MEASURES TO BE TAKEN FOR DEMOLITION IN CONSTRUCTION

1. Be asbestos aware.
2. Personal protective equipment (PPE) must be worn.
3. Prevent accidents with training, qualification and experience.
4. Monitor noise, vibration and dust.

5. A clean site is a safe site.
6. Manage traffic movement.
7. Risk assessment and method statements are essential
8. Be aware of proximity to plant
9. Maintain a stream of communication and encourage feedback
10. Manage waste disposal

## 9. SAFETY MEASURES TO BE TAKEN FOR STORAGE

1. Timber including sleepers, runners, scantlings, ballies, plywood etc. should be stored separately in neat stacks.
2. Adequate space should be left in between the stacks to avoid fire hazard.
3. Smoking and open fires should be prohibited in timber yards and stores.
4. Petroleum products should be stored separately.
5. Adequate firefighting arrangements should be provided at site.
6. Explosives must be stored in proper places and the prescribed safety measures for handling and storage of explosives should be observed.

## 10. SAFETY REQUIREMENTS FOR MATERIAL HANDLING

1. Reassess your work practices to reduce vehicle movements within your premises.
2. Plan safe traffic routes.
3. Ensure that loads are safely secured.
4. Make sure route surfaces are constructed of suitable material and properly drained.
5. Avoid lifting materials from the floor or while seated.
6. Make use of available handling aids.
7. Refrain from using sudden or jerky movements.
8. Never lift a load over an obstacle.
9. Perform lifts in areas with adequate footing, space and lighting.
10. Modify objects and redesign jobs to make moving easier.

## 11. SAFETY MEASURES TO BE TAKEN FOR HOT BITUMINOUS MATERIALS

1. Workers engaged on jobs involving handling of hot bitumen tar or bituminous mixtures shall use protective wears such as boots and gloves.

2. While heating and handling of hot bituminous materials is to be done in the open sufficient stock of clean dry sand or loose earth.
3. Sufficient numbers of fire extinguishers or foam extinguishers should be provided at the work site.
4. Only competent persons shall operate bitumen plants.
5. When bitumen plants are working on a public road an adequate traffic control system shall be established.
6. The sprayer shall be provided with a fire resisting screen.
7. Spreaders in operation shall be protected by signals, signs or other effective means.
8. People should be warned against walking over hot mixture laid.

## IMPLEMENTATION OF WORKPLACE SAFETY PLAN

Implementation of workplace safety plan involves a host of things like educating employees and managers, and making every stakeholder of the company feel responsible for ensuring that all the safety norms and policies are being rightly followed:

1) Select a health and safety manager
2) Educate every stakeholder about the safety program
3) Periodical Training for all concerned
4) Written workplace safety program for the employees
5) Select an employee representative
6) Identify roles
7) Assign Responsibility
8) Follow through with the plan

***Key Safety Principles***

- Working safely is a condition of employment.
- Each employee is expected to give consideration to the prevention of injury to self and co- workers.
- Involvement and thinking of all people in the safety process is valued and expected.
- Continual Improvement is the goal.
- Individuals and teams must be recognized for their adherence to and advancement of safety.

***Elements of an Effective Safety Culture***

1) *Responsibility*

Companies with strong safety cultures share the value of responsibility. Each individual is morally and ethically bound to act responsibly for the good of his fellow employees, his company, and society as a whole.

2) *Accountability*

Managers must be held accountable to lead by example each and every day. Managers and supervisors need to understand that their behaviour influences everyone around them. Upper management needs to hold these individuals accountable to safety, and not look the other way as long as production goals are being met.

3) *Clear Expectations*

Safety expectations need to be set and communicated to everyone in the organization. The commitment to achieving these goals needs to be demonstrated from the top down.

4) *Ethics*

Ethically driven management systems are important in developing a strong safety culture. The goal is for employees to make decisions that not only satisfy the procedures in the safety manual but that are also ethical and moral.

5) *Next Steps*

A safety perception survey can help you evaluate your company's safety culture to determine areas for improvement.

***Development of safety and health policy***

- Safety and health policy should:
- State Organization’s commitment to safety.
- State reasons for this commitment.
- Cooperate the workers to create a healthy and safe workplace.
- Outline the safety and health responsibilities of workers at all levels in workplace.

***Safety Management System***

- An SMS is a comprehensive and integrated system that ensures that all work is conducted safely
- It should be fully documented, accessible and comprehensible.
- It recognises the potential for errors and establishes control measures which are implemented, to ensure that errors do not result in accidents.
- It is comprises of a set of work practices and procedures for monitoring and improving the safety and health of employees in all aspects of the operation.

***Elements of an Industrial Safety Policy***

1) Element 1 - Management, Leadership and Employee Involvement.
2) Element 2 – Worksite Analysis
3) Element 3 - Hazard Prevention and Control.
4) Element 4 – Safety and Health Training and Education.

***Basic Principles of Good Safety Management***

- Management Commitment
- Documented Safety Philosophy
- Safety Goals and Objectives
- Committee Organization for Safety
- Line Responsibility for Safety
- Supportive Safety Staff
- Rules and Procedures
- Safety Audits
- Safety Communications
- Safety Training
- Accident Investigations
- Motivation and awareness programmes

***Workplace Safety***

- The process of protecting employees from work related illness and injury.
- It starts by the development of a company's Environmental, Safety and Health Policy statement.
- It involves the implementation of a work place safety plan and program.

***Basic Safety Philosophy***

- Every Incident can be avoided.
- No Job is worth getting hurt for.
- Every job will be done safely.
- Incidents can be managed.
- Safety is Everyone's Responsibility.
- Safety/Best manufacturing practices
- Safety standards, procedures and practices must be developed.
- Training- Everyone must understand and meet the requirements.
- Working Safely is a Condition of Employment

***Industrial Safety Policy***

1) Purpose- To reduce work-related injury & illness
2) Content- The program should include any policy, procedure, training that protects workers from work-related injury and illness.
3) Concerns- Promote & reward safe practices at work, reducing injuries & illnesses at work and eliminating fatalities at work.

***Measuring Performance of a safety policy***

Performance can be measured by:

- Reduction in frequency of lost-time injury
- Reduction in frequency of medical treatment
- Reduction in number of sick days
- Lower workers compensation costs
- Lower medical benefits payments

***Implementation of Workplace Safety Plan***

1) Select a health and safety manager
2) Educate every stakeholder about the safety program
3) Periodical Training for all concerned
4) Written workplace safety program for the employees
5) Select an employee representative
6) Identify roles

7) Assign Responsibility
8) Follow through with the plan

## IMPLEMENTATION OF SAFETY PROGRAMME

At a minimum, the Health and safety management include the below:

1. Health and Safety Policy
2. Project Specific Health and Safety Planning
3. Resources, Roles, Responsibility and Authority
4. Competence, Training and Awareness
5. Health and Safety Communication
6. Health and Safety Reporting
7. Operation Control
8. Permit to Work Systems
9. Design and Engineering
10. Certification of Plant and Machinery, Lifting Tools and Tackles
11. Subcontractor Management
12. Fire Prevention and Control
13. Access Control
14. Safety of Visitors
15. Traffic and Logistics Management
16. Performance Monitoring and Improvement
17. Reward and Reprimand
18. Promoting a Positive Health and Safety Culture
19. Integration with other Management System

### *1. Health and Safety Policy:*

- The agencies involved in the project development such as the owner, consultant and contractor jointly or separately shall have a written statement prescribing the health and safety policy of the organization.
- The health and safety policy conveys the management commitment and intent of the organization towards health and safety, its organization and arrangements to ensure that the set objectives are met. It also provides a framework for establishing, maintaining and periodically reviewing health and safety objectives and targets.
- The policy shall be communicated to all stakeholders through display and other means.
- The policy shall be displayed in local language(s) which may be understood by majority of the workmen.

### *2. Project Specific Health and Safety Planning:*

- A project specific health and safety plan shall be developed by the main

construction agency and submitted to owner/client and the consultants for approval. On approval, the project health and safety plan shall be reference document for implementation, control and monitoring of health and safety aspects of the project by the main construction agency, owner/client, consultants and other parties concerned.

- Project health and safety plan shall describe how the project specific health and safety objectives and targets shall be achieved. It shall define the road map for achieving the standards that an organization lays down for itself so that efforts can be coordinated, synergized and monitored.
- Health and safety plan shall explain the means of establishing a positive health and safety culture at the project site. Health and safety plan shall identify and enumerate the control measures to mitigate the risks to the project completion arising out of health and safety issues so that the project is allowed to proceed without interruption and executed as per schedule.

3. ***Resources, Roles, Responsibility and Authority:***

- Project manager shall define, document and communicate the roles, responsibilities and authorities of all personnel who manage, perform and verify activities having an effect on health and safety risks. It shall also include subcontractors and visitors.
- Ultimate responsibility for health and safety shall rest with top management of the respective organization be it the owner/client, consultants or construction agency. The line management personnel who are responsible for execution of activities are directly responsible for health and safety in the work under their control.
- Health and safety department/function and health and safety officers are responsible for guiding the top management on health and safety issues and facilitating the implementation of health and safety in the project site.

4. ***Competence, Training and Awareness:***

- It shall be ensured that all employees are competent to perform the assigned work safely on the basis of appropriate education, training or experience.
- The competency requirements of different categories of employees shall be mapped and procedures shall be implemented to ensure that those deployed meet the competence requirements.
- Training needs of the different category of employees shall be identified at the beginning of the project and a training matrix and training plan shall be prepared for

implementation

- The objective of health and safety Training shall be:
  a) To equip the employee with necessary knowledge and skill to perform the work assigned to him in a safe manner;
  b) To foster continual improvement; and
  c) To imbibe safety culture

***5. Health and Safety Communication:***

- Procedures shall be established to communicate significant hazards and risks to and from employees and other interested parties. The health and safety hazards and risks may be communicated in the following ways:
  a) Sharing of accidents case studies which occurred in the project site as well in other similar projects
  b) Health and safety posters and displays
  c) Health and safety campaigns and competition involving the employees
  d) Sharing of results of the audits, inspections and other monitoring systems
  e) Establishing a system for collecting feedback on health and safety from employees and other interested parties
  f) Tool box meeting
  g) Safety signage.
- Health and safety communications addressed to workmen shall preferably be in local language(s) understandable by majority of the workmen

***6. Health and Safety Reporting:***

- Procedures shall be established for timely recording and reporting of information required for continual improvement of health and safety performance.
- Internal reporting procedures shall cover:
  a) Incident reporting
  b) Non-conformance reporting
  c) Health and safety performance reporting
  d) Hazard Identification reporting
- External reporting shall cover :
  a) Statutory reporting requirements
  b) Stakeholder reporting
- The recording of reporting of health and safety performance shall be clearly

documented in the project health and safety plan

7. ***Operation Control:***
   - The hazards identified during the planning process and the control measures identified therein shall be incorporated with the work method statement and operational control procedures shall be developed.
   - These procedures shall form single point guideline for the frontline employees in executing the job in a safe manner.
   - These procedures shall include the legal and other requirements, control measures identified to bring down the risk level as low as reasonably practicable and the measures to meet the project objectives and targets.
8. ***Permit to Work Systems:***
   - Activities requiring permit to work shall be decided before starting the construction and shall be suitably documented in the project health and safety plan. Some of the activities which may require permit to work are:
     a. Excavation
     b. Entry into confined spaces
     c. Electrical work (HV/LV)
     d. Opening manholes, covers and grills
     e. Blasting operation
     f. Hot work
     g. Industrial radiography
     h. Work on plant, machinery and other power driven equipment.
     i. Working at height
     j. Working at night
   - The project team may establish a permit to work system for any other hazardous activity which they feel need to be controlled administratively for safe execution

9. ***Design and Engineering:***
   - Design drawings, construction methodology and plans shall be reviewed to determine whether any additional risks may arise during the construction due to the features in the design or methodology.
   - Attention shall be paid to:
     a. Providing permanent hooks and loops for tying safety slings of workers,
     b. Providing holes or such arrangements to the structure to which safe working

platforms and safety nets can be connected,

c. Laying permanent slings, grab rails/bars to be used by the workers,
d. Permanent provision for attaching railings,
e. Provision for alternative access to the trapped or distressed workers,
f. Provision for communication,
g. Design facilitating barricading of the area around work site without causing hindrance to building functional activities,
h. Durability of such safety related permanent design integrated elements, and
i. Other safety practices required for the type of woks involved

***10. Certification of Plant and Machinery, Lifting Tools and Tackles:***

- Lifting appliance such as crane, hoist, derrick, winch, gin pole, sheer legs, jack, pulley block and other equipment used for lifting materials, objects or building worker; lifting gear such as ropes, chains, hooks and slings; and other accessories of a lifting appliance shall be tested and examined by a competent person for the first time.
- These shall thereafter be tested and examined by a competent person once every year as per the provision of Building and other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 and other relevant central and state rules and regulations.
- Apart from the above statutory testing and examination, project specific procedures shall be established to ensure the fitness of machinery and equipment being deployed at the project for the first time.
- Regular Inspections shall be carried out to ensure that machinery and equipment continue to be in safe condition.

***11. Subcontractor Management:***

- Past health and safety performance and capability of subcontractors to complete the job safely shall be given due consideration during selection of subcontractors.
- The project specific health and safety requirements shall be clearly communicated to the subcontractors and a commitment obtained from them on meeting the requirements.
- The health and safety performance of subcontractors shall be monitored on a regular basis and necessary directive and support shall be given to achieve the set health and safety objectives and targets

***12. Fire Prevention and Control:***

- Hazard identification and risk assessment conducted during the initial stage of the project shall identify the fire hazards from various activities and the appropriate control measures.
- As per the identified risk, fire prevention measures such as controlling the ignition source and segregation of flammable materials shall be implemented to prevent fire.
- Adequate firefighting facilities such as portable first aid fire extinguishers, fire buckets filled with water and sand, water pipelines and hoses shall be established and maintained regularly. Firefighting arrangements provided shall be suitable to fight the possible type of fire that may occur depending on the type of flammable material.
- Fire facilities shall be placed strategically such that they are accessible from any location of the site without travelling for long distances.
- Employees shall be trained on fire prevention and firefighting measures on a regular basis

***13. Access Control:***

- It is advisable to establish access control measures at the construction project to control movement of workmen and visitors. Access control may be achieved by entry pass, barcoded cards and biometric systems or other suitable means.
- Implementation of access control system helps in the following manner:
  a. It ensures that only competent and trained workmen are deployed for work.
  b. It helps in monitoring of working hours of employees so that working hours do not exceed the statutory limits.
  c. Head count in case of emergencies becomes easy as it is known how many employees are at work at any point of time

***14. Safety of Visitors:***

- Visitors for the project shall be given health and safety induction before they are allowed in to the construction project.
- It shall include the minimum PPE (Personnel Protective Equipment) to be used, hazards and risks at the work area, restricted areas of entry, emergency response arrangements, etc.
- Visitors shall always be accompanied by one of the employees of the project site.
- Visitors shall not be allowed in the hazardous areas unless they are competent and

trained to work in such areas

***15. Traffic and Logistics Management:***

- Traffic management plan shall be prepared as a part of the project health and safety plan at the initial stage of the project to manage the traffic inside the project site.
- Traffic management plan shall include:
    a. Measures for segregating pedestrian and vehicle traffic;
    b. Establish project specific traffic rules such as speed limit and one way etc.
    c. Managing the flow of traffic such that blind zones and hazardous junctions are not present;
    d. Managing the flow of traffic such that reversing can be avoided as far as possible; and
    e. Use of traffic control devices such as road humps, convex mirrors, delineator's traffic signals and barriers.
- It shall be planned to deploy flag man, security personnel and traffic marshals at critical areas to regulate traffic.

***16. Performance Monitoring and Improvement:***

- The health and safety performance monitoring and measurement procedures shall provide for:
    a) Both qualitative and quantitative measures appropriate to the project,
    b) Monitoring the extent to which project health and safety objectives are met,
    c) Proactive measures of compliance that measures compliance with health and safety plan, operational control procedures and legislation; and
    d) Reactive measures of performance to monitor accidents, ill health, near misses and non- conformances

***17. Reward and Reprimand:***

- It is important to acknowledge and encourage good health and safety performance and suitably reprimand repeated violations, non-conformances and poor health and safety performances.
- Project specific reward and reprimand system shall be prepared as a part of the project health and safety plan

***18. Promoting a Positive Health and Safety Culture:***

- The owner/client, consultant and construction agency shall jointly endeavour to promote a positive health and safety culture at the project.
- Top management of the organizations should exhibit a visible management

commitment and felt leadership towards health and safety. This shall be achieved by participating in health and safety programmes such as:

a. Project health and safety committee meeting,
b. Health and safety walk down,
c. Including health and safety in all performance review meetings, and
d. Exhibiting a safe behaviour while at site

- The top management should clearly communicate that it considers safety as core value and it shall not allow it to get compromised. Such messages when it reaches down the level in the organization enable to create a positive health and safety culture

***19. Integration with other Management System:***

- In order to enhance the efficiency and effectiveness of the organization, the health and safety management system established and implemented at the project shall be in coherence with other management systems implemented for the project such as:

a. Quality management system,
b. Environment management system, and
c. Project management approach