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*Part I*  
*General*

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# 1

# Safety, Health & Environment in Construction —An Introduction

## 1.1. INTRODUCTION

Since last few decades, construction activities in India have increased by leaps and bounds such as multistorey buildings, houses, roads, railway lines, power plants, dams, canals, industrial buildings, steel plants, dockyards, etc. These construction projects have normally been mechanized so as to complete the work in lesser time. Construction works employ large number of skilled and unskilled labourers.

Construction industry plays a major role in the economic growth of a nation and occupies a pivotal position in the nation's development plans. India's construction industry employ a work force of more than 3 crores. It is the second largest contributor in the GDP after the agricultural sector. It also generates substantial employment and provides growth impetus to other manufacturing sectors like cement, bitumen, iron and steel, bricks, paints, tiles, etc. house, apartments, factories, offices, schools, roads, bridges, etc., are only some of the products of the construction industry. The industry's activities include work on new structures as well as additions, alterations, and repairs to existing ones.

The construction works are characterized by their inherent risk of life and limb of the workers. These are also characterized by their casual nature, temporary relationship between employer and employee, uncertain working hours, lack of basic amenities and inadequacy of welfare facilities, although the provisions of various labour laws are applicable to the construction workers. The Building and other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 and Central Rules, 1998 thereon now regulate the employment and conditions of service of building and other construction workers to provide their safety, health and welfare measures and other matters connected therewith of incidental thereto, this is a comprehensive Central Legislation for regulating the safety, welfare and other conditions of service of these workers.

Safety is very important aspect in any construction work as an accident free work environment boosts the morale of the team members working in any hazardous situation. Recognizing these facts construction projects involving various hazards and risks during

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construction prepares their own safety policy, safety manual and have a separate department/section for safety so as to create proper awareness and provide the know-how about the importance of safety during project construction, operation and maintenance. Adherence to the useful information, rules and mandatory requirements governing safety and guidelines will help prevent occupational injuries and accidents which constitute an unavoidable and needless waste of human and material resources. Compliance of safety measures during construction stage invariably leads to efficient execution of works.

***Safety means continuing and healthful living without injury. Safety is freedom from harm or the danger of harm.*** The word safety also refers to the precautions people take to prevent accidents, harm, danger, damage, loss and air/water/environmental pollution. Safety also deals with improvements in working conditions for better health.

Safety is important to everyone and at every stage of activities and at all times 'safety-first'. **Safety is necessary everywhere and at all times**, in homes, on roads, in offices, public places and while working. Construction works have more hazardous situations and activities than at home or in office. Many persons work as a team in a construction project and is of interest to every individual, group of individuals and the total project organization. Project management is responsible to provide safe working condition and individual's safety.

Now a days, occupational health and safety is finding lot of importance in most of the construction projects. It is concerned with well-being of all employees and persons in a construction project and accordingly deals with conditions and factors that have bearing on health and safety. In order that all organizations adopt uniform practices, Bureau of Indian Standards have brought out a standard called OH&S management systems IS18001: 2007 dealing with this important subject of occupational health and safety. By implementing these standards an organization can control OH&S risks and also its performance. The project organization should prepare and declare its OH&S policy and necessary mechanism should be installed to implement the policy. The systems should be monitored, compliance of policy objective ensured and continually improved.

All undesired events in a workplace which can give rise to death, ill health, injury, damage or other loss need to be thoroughly investigated, people be trained to safeguard against them, and need to be eliminated. Similarly, all hazards *i.e.*, source/situation capable of injury or ill health, damage to property or workplace environment, etc., should be identified and action plan drawn for safeguard against them.

During various stages of project construction, different hazards gain significance. For example, during civil works, pit-falls, falling of objects, collapse of structures are not unlikely. During erection work, falling of persons from heights, failure of crane/slings, falling of equipment, fires caused during welding, etc., are possible. During testing and commissioning electrically caused shocks/fires/explosions are quite possible.

Health and safety is one of the most important aspect of a construction project's smooth and effective functioning. Good health and safety performance ensures an accident free environment. The occupational health and safety (OH&S) management system need be integrated with the management of other aspects of project performance in order to:

- (a) minimize risk to employees and others,
- (b) improve performance, and
- (c) assist organization to establish the responsible image.

The objective of OH&S management system, therefore, is to continuously improve the working conditions leading to prevention of accidents and to comply with all applicable laws and regulations relating to safety. For this purpose it is necessary to create an awareness and concern for safety amongst employees (including contractors/sub-contractors' employees) through their active involvement, participation, continuous training, etc., Hazard identification, risk assessment and risk control shall be taken into account while formulating the safety plans.

## 1.2. INTEGRATION OF SAFETY, HEALTH AND ENVIRONMENT (SH&E OR SHE)

Presently construction projects are becoming more and more complex as they have to meet the requirement of increased production rate, high efficiency and optimization. These projects require huge investments. Any negligence at any stage from concept stage to design, construction, erection to operation can result into disaster, loss of human lives, huge production losses, delay in completion of project, etc., therefore, safety aspects deserve serious attention. Even if a single employee neglects safety aspects, it can lead to serious problem for everybody. Therefore, it is essential that foolproof safety systems be designed and incorporated, people trained adequately, checks and counter checks made to ensure implementation of safety aspects. It is therefore important that top management shows full commitment towards implementation of safety.

It is not only sufficient to take care of safety but other two inter-related aspects, *viz.*, health (well being of employees) and environment are also given equal importance and considerations. All these three elements are inter-related and affect each other. For instance, if health of employee is not given due regards, it may lead to accidents. If project pollute the environment around workplace, it will affect health of employees which may ultimately effect production. It is only if health and environment are in control than safety in project can be ensured. Each project, therefore has certain obligations towards keeping good environment and also towards health of people.

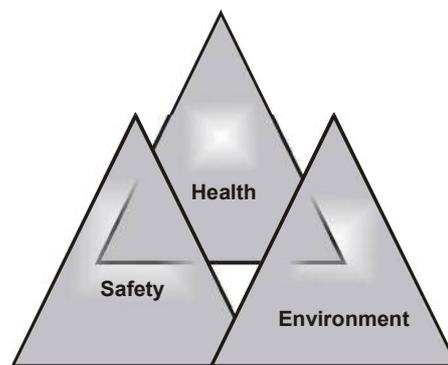


Fig. 1.1. Inter-relationship between safety, health and environment.

Any condition which can spoil health of employees should be corrected/eliminated. All employees should be subjected to medical tests periodically to check their health. Creating awareness of health amongst employees ultimately benefit project because employees will remain alert and contribute their best to the project and boost productivity.

Polluted environment not only affect the performance of project components but also life of everybody will become miserable due to poor health which in turn will affect safety. Many construction projects being prone to safety hazards and environmental degradation, utmost precautions are needed to have full control over SH&E.

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### 1.3. SH&E (SHE) CONCEPT

Safety, Health and Environment (SH&E) is also called as SHE in short. As discussed earlier safety, health and environment are inter-related and SHE management is considered as an integral part of overall management system. Commitment of top management towards safety, health and environment is essential and this management should flow to all organizational levels. The management should involve all employees, contractors, security personnel related to implementation of safety culture. This is necessary because a group decision is always considered to be a better decision than that of an individual's decision and it is also better implementable.

Construction works are full of hazards. It is necessary to identify hazards and to take precautions with a view to ensure safety of the structure, machinery and the human beings. If hazards are identified, chances of occurrence of accident can be minimized. Hazard is a condition at workplace which exists or can be caused in combination with other variables, which has the potential for accidents, serious injuries, disease, and/or property damage. Hazards are identified by conducting a careful study of all the components of a work system in order to detect problems and understand them so as to eliminate the problem and its potential consequences.

Occupational health hazards mean : (a) conditions that cause legally compensable illness, (b) any conditions in the workplace that impair the health of employees enough to make them lose time from work or to work at less than full efficiency. **Various health hazards** that may cause sickness, impaired health or significant discomfort or inefficiency in workplace are:

- (i) physical hazards like noise, vibration, thermal stress, radiations, ill lighting,
- (ii) chemical hazards like dust, fumes, fibres, gases, vapours, mists and smoke,
- (iii) biological hazards,
- (iv) ergonomic hazards,
- (v) mechanical hazards, and
- (vi) psychological hazards.

For works which by their very nature expose workers to hazards, appropriate preventing measures should be taken to avoid any danger to the safety and health of workers, the preventive measures should place emphasis on the need to eliminate or reduce the hazard at the source.

A multiplicity of health hazards are present in construction work and every effort should be made to promote awareness of this fact and need to safeguard health.

Monitoring and control of the working environment and planning of safety and health precautions should be performed as prescribed by national laws and regulations.

Whenever new products, equipment and working methods are introduced, special attention should be paid to informing and training workers with respect to the implications for safety and health.

### 1.4. SAFETY IN CONSTRUCTION

Construction sector is one of the major industry and its activities range from construction of rural houses to multistoreyed framed structures, from village roads to express highways, docks and harbours to airports, thermal power houses to major hydro-electric projects. Safety represents most important concern for the construction projects which results in increased costs and delays besides personal injuries or even fatalities.

**Construction is a high hazard occupation** and workers involved are exposed to safety and health hazards. Severity of each hazard depends on the concentration and duration of exposure of a particular job.

**Construction is an accident and injury prone sector** due to various reasons such as nature of work, difficulty in implementation of safety measures due to scattered work and seasonal employment. The **accidents occur because of:**

- (i) lack of training,
- (ii) breach of rules, regulations including non-implementation and slackness,
- (iii) overwork/overtime by workers,
- (iv) negligence/non-alertness.

Implementation of many projects are sometimes adversely affected due to unsafe operations and working conditions causing accidents, environmental pollution, health hazard, damage to buildings and other structures, property and machinery. Such safety hazards occur due to various reasons, some of which are given below:

#### **Reasons for Safety Hazards**

- (i) Negligence on the part of workers or supervisory staff,
- (ii) Faulty operation,
- (iii) Exposure of harmful substances,
- (iv) Accidental fall from a height,
- (v) Flash flood in bridge construction in hilly areas,
- (vi) Sudden subsidence of overhead structures,
- (vii) Inflow of flood water in underground operations,
- (viii) Accident with construction equipment,
- (ix) Earthquake, severe storm, tornado or cyclone,
- (x) Failure of forms, scaffolds, ramps, ladders etc.

It has been observed that most accidents can be avoided through the application of an effective safety programme. To combat the health hazards and accidents, a qualitative change in the area of safety and health management is needed during implementation of a construction project. A three-fold strategy of action should be undertaken, which consist of:

- (i) An efficient accident prevention programme,
- (ii) Immediate attention in case of accident,
- (iii) Comprehensive plan for rehabilitation of victims.

Construction project's responsibility is to build safe and economic structures. **The major objectives of the safety department in a construction project are:**

- (i) to prevent major accidents and/or catastrophic failures,
- (ii) to create safe working conditions,
- (iii) to protect the property and life of the people concerned,
- (iv) to safeguard the health of the affected people,
- (v) to take care of the environmental concerns,

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- (vi) to support the cause of economic and efficient construction and operation of the project,
- (vii) to promote green buildings and green power.

The **preventive measures** should be taken to avoid any danger to the safety and health of workers. These preventive measures should place emphasis on the need to eliminate or reduce the hazard at the source and in particular should require:

- (i) The replacement of hazardous substances, equipment or processes with substances, equipment and processes which are less harmful or hazardous to workers' safety and health;
- (ii) The reduction of noise and vibration caused by equipment, machinery, and tools,
- (iii) Control of the release of harmful agents or chemicals into the working environment;
- (iv) Training in manual lifting;
- (v) Proper working postures when workers are required to work in fixed working positions or when they are carrying out repetitive work;
- (vi) Appropriate protection against climatic conditions likely to jeopardize health;
- (vii) Where the foregoing measures are inappropriate:
  - (a) instituting work practices which will eliminate or minimize danger to safety and health; and
  - (b) supplying and requiring the use of personal protective equipment and clothing.

The construction projects' management should make arrangements for the identification and assessment of health hazards presented by the use of different operations, plant, machinery, equipment and substances at the construction site and take appropriate preventive or control measures against the identified health risks in conformity with the national laws and regulations.

Accident statistics show that construction is one of the most dangerous industry in the world. The ILO (International Labour Organization ) findings portrays an alarming picture on this score:

- (i) The accident rate in construction is four to five times higher than that of the manufacturing sector on the global scale. There is an increase in the number of work related diseases associated with construction all over the world.
- (ii) After the initial employment in the construction works, there is a dramatic increase in accident frequency over the following six to eight months. This shows that, more workers meet with accidents during the first year of their employment.

### 1.5. LOSSES DUE TO ACCIDENTS

Now a days serious attention is being paid in this matter, because now it has been clearly understood that these accidents cause heavy losses. In these losses some are direct losses and others are indirect losses.

**Direct losses:** These are the losses to the employer, which he pays to the workers for compensation. Employer also pays for medical expenses incurred on the worker. These types of losses can be measured in terms of money.

**Indirect losses:** These indirect losses arise due to the:

1. Loss of time of his injured person.
2. Loss of time of his fellow workers, who stop work at the time of accident to help him or to show sympathy or for curiosity
3. Loss of time of supervisors:
  - (a) in assisting injured worker,
  - (b) in investigation and preparing a report of accident,
  - (c) in making alternative arrangement, and
  - (d) in selecting and training the new worker to fill the vacancy if accident causes death or permanent disablement.
4. Loss due to damage caused to the material or equipment.
5. Loss due to reduction in the efficiency of the workers when he returns after recovery.
6. Loss due to reduction in the efficiency of fellow workers due to fall in their morale.
7. Loss to the injured worker. Injured worker may suffers the following losses:
  - (a) loss to his income,
  - (b) loss due to medical expenditure,
  - (c) pain felt by the worker, which cannot be compensated.
8. Effect of accident on morale of the employees. When an accident occurs, a maximum sufferer is the victim who has to bear pain and the mental agony. His family members also suffer due to the accident; organization suffers due to production loss, medical aid, compensation, reduction in efficiency, etc., cost of pain, worries, suffering to the victim and to his family cannot be computed.

## 1.6. SHE POLICY

As per rule 39 of the Building and Other Construction Workers' Central Rules, 1998, every establishment employing fifty or more construction workers shall prepare a written statement of policy in respect of safety and health of construction workers. This **policy should contain the following:**

1. The intention and commitments of the establishment regarding health, safety and environmental protection of workers;
2. Organizational arrangements made to carry out the policy referred to above specifying the responsibility at different levels of hierarchy;
3. The responsibilities of the principal employer, contractor, sub-contractor, transporter or other agencies involved in the building or other construction work.
4. Techniques and methods for assessment of risk to safety, health and environmental and remedial measures therefor;
5. Arrangements for training of workers, supervisors or other persons engaged in the construction work;

The intention and commitment referred to at (1) above shall be taken into account in making decisions relating to plant, machinery, equipment, materials and placement of construction workers.

A copy of the policy should be displayed at the conspicuous places in Hindi and a local language understood by the majority of workers at a construction site.

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Thus, it is the statutory responsibility of the project authorities in respect of safety, health and welfare of the employees arising from relevant legislations such as the Factories Act, the Indian Electricity Act, the Explosive Act, the Boiler Act, etc., besides the Building and Other Construction Workers Act.

The policy should spell out long range objectives of the company and it should be a part of company's management policy.

### **The safety policy should include the following:**

- (i) management's intent and desire to achieve safety of personnel, machinery and property,
- (ii) the scope of safety activities to be covered,
- (iii) responsibilities and accountability,
- (iv) safety authority,
- (v) safety documentation
- (vi) safety audit team and intervals of safety audits.

### **Safety Policy Objectives**

- (i) zero fatal accidents,
- (ii) zero dangerous occurrences.
- (iii) should aim at an accident frequency rate (AFR) of less than 0.5 per 100,000 hours worked.

### **Company's Responsibilities**

The company should recognize and accept its responsibility of establishing and maintaining a safe working environment for all the employees. For achieving these objectives company should have responsibility of the following:

- (i) To provide the best practicable conditions of work from the point of view of safety and health.
- (ii) To consult with its staff and their representatives to implement the policies and procedures.
- (iii) To allocate sufficient resources to provide and maintain safe and healthy conditions of work.
- (iv) To take steps to ensure that all known safety factors are taken into account in design, construction, operation and maintenance of structures, machinery and equipment.
- (v) To ensure that adequate safety instructions are given to all employees.
- (vi) To provide whenever necessary protective equipment, safety appliances and clothing and to ensure their proper use.
- (vii) To inform employees about materials, equipment or process used in their work, which are known to be potentially hazardous to safety or health.
- (viii) To keep all operations and methods of work under regular review for making necessary changes from the point of view of safety in the light of experience and up-to-date knowledge.
- (ix) To provide appropriate facilities for the first-aid and prompt treatment of injuries and illness at work.

- (x) To provide appropriate instructions, training, retraining and supervision in health and safety and first-aid, ensure that adequate publicity is given to these matters.
- (xi) To ensure proper implementation of fire prevention and the appropriate fire fighting service, together with training facilities for personnel involved in this service.
- (xii) To ensure that the professional advice is made available wherever potentially hazardous situations exist or might arise.
- (xiii) To organize collection, analysis and presentation of data on accident, sickness and incidents involving personal injury to health with a view to taking corrective, remedial and preventive action.
- (xiv) To prepare safety rules for each type of occupation/ process involved in a project.
- (xv) To ensure regular safety inspection by a competent person at suitable intervals.
- (xvi) To coordinate the activities of the company and of its contractors/ sub-contractors working in the project for the implementation and maintenance of safe system of work to comply with their legal obligations with regard to safety, health and welfare of the employees.
- (xvii) To develop contract provisions that require contractors to prepare, implement and monitor safety plans and ensure that sub contractors are also obliged to comply with the same.

## 1.7. SHE PLANNING

Based on SHE policy of the construction project, planning for hazard identification, risk assessment and risk control is needed to be done. Suitable systems need to be established and maintained for this purpose. Risk identification for activities of all personnel having access to workplace, and for facilities at the workplace need to be carried out.

The planning document results in guidelines for implementation and operation of the entire system in the organization. The policy should be audited and reviewed periodically on the basis of feedback. The organization's methodology for hazard identification and risk assessment should be defined with respect to its scope, nature and timing to ensure that:

- (i) it is proactive rather than reactive;
- (ii) provide for the classification of risks and identification of those that are to be eliminated or controlled;
- (iii) provide input into the determination of facility requirements, identification of training needs and/or development of operational controls;
- (iv) provide for the monitoring of required actions to ensure both the effectiveness and timeliness of their implementation, and
- (v) should be consistent with operating experience and the capabilities of risk control measures employed.

## 1.8. HAZARDS

Hazard is a source or a situation with potential to cause harm in terms of human injury or ill health, damage to property or environment or both. Hazards are identified in the performance of various activities, storage and handling of materials, and operation and maintenance of plant and equipment.

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The term “accident hazard” is applied to those situations, circumstances or things which potentially are dangerous and liable to do harm to persons. Hazard can also be defined as any existing or potential condition in the workplace which by itself, or by interaction with other factors result unwanted affects of injuries, property damage or other losses.

The prevention of accidental injury from a recognized hazard may be secured through protection and instructions and by removal/reduction of the hazard.

The elimination of hazards require inspection for location and elimination of hazardous conditions, cooperation with construction engineers to provide operating arrangements containing minimum of hazards.

### 1.8.1. Hazard Identification Analysis

Hazard identification analysis is very careful study of all the components of a work system in order to detect problems, to understand the relationship between the system and the problem in order to eliminate the problem and its potential consequences. Hazard identification is a process of collecting information from various sources regarding hazards. Specific jobs are subjected to analysis regarding their potentiality for hazards.

### 1.8.2. Hazard Control

Hazard control is that function which is oriented towards recognizing, evaluating and working towards eliminating hazards and destructive effects found at the workplace. Like all safety activities, it is a line responsibility and is integral part of each persons job.

Hazard control is a collaborative effort between different departments of the construction project with each department sharing its responsibility. Design department prepares specifications, which are free from hazards, and comply statutory requirements. Concern executing departments implement the designed specifications keeping in mind operating conditions and job requirements, safety department alongwith planning department ensures hazard control by hazard analysis and continuous monitoring. Maintenance sticks to its preventive maintenance schedules and ensure that its work maintains the designed standards, and implement solutions to specific problems identified in hazard analysis.

Material purchase occupies a crucial position by providing specifications for bought out items, that conform to safety and health criteria, and ensuring that no hazard arise during the transportation of such items, especially chemicals and explosives.

The specific team for hazard identification, evaluation and establishing controls will normally consist of persons drawn from safety, production, design, maintenance and planning.

A number of techniques are used to discover hazards. Some of the **commonly used techniques are:**

1. Hazard analysis
2. Job safety analysis
3. Safety inspection of structure, plant, equipment and other machineries
4. Hazard measurement and testing
5. Safety surveys/audits
6. Actions investigation and analysis

### 1.8.3.Types of Hazards

Common hazards may be classified as under:

1. Mechanical hazards
2. Electrical hazards
3. Chemical hazards

### 1. *Mechanical Hazards.*

Mechanical hazards are the most spotted hazards and are responsible for the majority of the accidents in work situations, therefore every workplace and every equipment shall be properly examined for identifying mechanical hazards and for taking mitigating measures.

#### **Common sources of mechanical hazards are:**

- (i) Unguarded or inadequately guarded shafting, shaft ends, belt drives, gears, pulleys, projections on rotating parts, chain and sprocket drives, any exposed component parts of machines, power-driven equipment which rotate rapidly, or any machine component which moves rapidly, which may strike, crush, or otherwise injure a worker etc.
- (ii) Other important mechanical hazards relate to machines of all kinds including transmission machinery, hand tools, handling materials, lifting and other appliances.  
Some of the common hazard conditions of mechanical operations may be: defective mechanical appliances, hazardous arrangement or procedure, improper lighting, improper ventilation or unsafe dress or apparel.
- (iii) Lifting equipment may be a cause of accidents due to mechanical failure or unsafe operating practice. Frequent periodic inspection and maintenance of such parts as chain, wire ropes, gears, clutches, brakes, bearings, etc., may constitute a vital part of efficient performance.
- (iv) Improper use of tools. One must always use right type of tools for various types of jobs. They must be placed properly and should be well maintained.

### 2. *Electrical Hazards.*

Since almost every machinery and plant is power driven, severe injury may cause by the passage to the body through electric current. These may be due to contact with wire, cable or rail or from stroke of lightning. The immediate effect of this is shock which may be relatively mild or severe so as to cause death (electrocution) depending upon the strength of the current and/or the path it takes passing the earth through the body. Another result is burning and the burns may be severe and deep, especially with higher voltage. **Causes of the electric hazards** may be of following types:

- (i) Electric shocks may be caused by an exposed live conductor or a faulty piece of equipment. The effect or the severity of electric shock depends upon the rate of current flow (amperes) and the duration of the flow of current. The amount of current through the body depends on the voltages to which the person is exposed and also the resistance of the person.
- (ii) Wires should be protected by metallic sheaths. Overhead power lines, electric crane rails, open-faced substation switch boards are all assumed to be safe because they are out of the reach of the workmen. This is not completely true, because of the following examples:
  - (a) A mobile crane with a long boom can accidentally contact a power line or other overhead live conductor.
  - (b) A man carrying or climbing an aluminium ladder can come in contact with overhead conductors.
  - (c) Metal bars stored vertically in racks may accidentally touch overhead crane wires and electrocute a man.
- (iii) Other causes may be:
  - (a) Faulty equipment, either badly installed or improperly repaired/badly maintained.

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- (b) Unskilled electricians.
- (c) Improper instructions.
- (d) Defective wiring which may cause short circuit.
- (e) Poor installations, misuse or overloading.
- (f) Aging and attack by foreign substances cause insulation failures which causes electrical fires or cases of electrocution.

*In such cases:*

- (i) Switch off the current,
- (ii) And/or remove casualty from the contact with the current. For this it is necessary that insulating material must be used which should be dried. The rescuer should stand on some insulating material and avoid receiving shock himself.
- (iii) Artificial respiration should be given, if breathing has stopped.

### **3. Chemical Hazards.**

The usage of chemicals with the resultant hazardous gases, vapours and fumes, is one of the most dangerous industries. The list of toxic gases, vapours and fumes is exhaustive. A simple classification of hazardous chemicals may be as follows:

- (i) Metallic dusts and fumes,
- (ii) Mineral dusts
- (iii) Volatile liquids and solids
- (iv) Gases
- (v) Others

**The effect of noxious gases are:**

- (i) Simple asphyxiants, *e.g.*, nitrogen gas, methane gas, carbon dioxide.
- (ii) Chemical asphyxiants, *e.g.*, carbon monoxide, hydrogen-sulphide, hydro cyanic acid.
- (iii) Irritant gases, *e.g.*, nitrogen dioxide or peroxide, flourine, hydrogen flouride, sulphur dioxide, ammonia.
- (iv) Organic metallic gases, *e.g.*, arsenic hydride
- (v) Inorganic metallic gases.

Several toxic chemicals and fluids are found in industries using sulphuric acid, nitric acid, soda, chloride of lime, chloride of phosphorous, sulphur chloride, phosphene chloride of zinc, nitrous chloride, iodine, artificial fertilizers, rubber, petroleum, tar, etc.

### **1.9. SAFETY PROGRAMME**

Lack of training has been identified as one of the major causes of accidents. Safety awareness is the basic requirement for reducing accidents. Most of the accidents take place due to adoption of shortcuts and/or ignoring the safety guidelines. There is a need to prepare 'project safety manual' (PSM) which should include a set of minimum safety standards and guidelines which are expected to be followed on any construction project. The manual should include the mandatory use of personal protection equipment, safety awareness training programmes, fire protection, first-aid, safety signages, accident reporting procedure.

Following are the **main objects of safety programmes** (also known as accident prevention programme) :

- (i) To reduce the human life sacrificed.
- (ii) To lessen the temporary and permanent injuries to workers.
- (iii) To reduce the time lost due to accident.
- (iv) To safeguard against loss of or damage to equipment and properties.
- (v) To control the expenses on workmen's compensation.

Safety programme should be made an integrated part of the operations of each construction company. An effective programme should be developed to suit the particular operations such as excavation, pile driving, drilling and blasting, tunneling etc. Each operation has its own hazards and a safety programme should be developed to suit the particular hazards.

Safety programme in construction industry, must receive the full support of an entire organization, beginning with top management and continuing down through the ranks to include the project managers, supervisors and workers.

#### **Essentials for Safety Programme**

In any safety programme, following are essential:

- (i) Secure full support of top management.
- (ii) Designate one person in the organization to direct safety programmes.
- (iii) Give publicity to the safety programmes.
- (iv) Develop a safety programme for each job.
- (v) Install safety programme, creating the competition with appropriate rewards for outstanding performance.
- (vi) Train new employees with the safety programmes.
- (vii) Safety practice be made effective.
- (viii) Promote good house-keeping.
- (ix) Maintain adequate first-aid facilities.
- (x) Seek assistance from insurance companies.

Now a days, safety committees are formed including executives, supervisors and workers. This also helps in creating safety consciousness.

Safety programme analyses causes of accidents and takes remedial measures. Safety programme is a continuous process. Special training are imparted to employees on safety aspects.

Safety programme is carried out in following three phases:

- (i) **Safety awareness** — This includes educational, on the job instructional training, behaviours, ergonomics, job safety analysis techniques.
- (ii) **Safety implementation** — Implementation should be carried out by all concerned.
- (iii) **Safety programme maintenance** — This phase is necessary to maintain enthusiasm and energy levels which do not deteriorate with time.

### **1.10. SAFETY EDUCATION AND TRAINING**

There should be proper facilities to impart training in safety measures to the workers. This can be accomplished by safety posters, safety films, contests and suggestions. These are useful to increase the interest of employees in accident prevention. The purpose of this training is to induce care in the use of dangerous tools or in carrying out risky operations.

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All the site staff including site manager, erection and commissioning groups, control room engineers, operating staff and maintenance staff, testing engineers, quality control engineers, stores supervisors, safety engineers are trained to ensure that they are competent to carry out their work and they have understanding and knowledge of their functions and safety.

It is a good practice to associate young personnel in various erection, commissioning, operation and maintenance activities during the execution of the project.

Training managers identify the training needs of every person in the organization with long range and short range planning. Training record is made for every employee and training requirements are reviewed regularly.

Safety training is an important factor in managing safety on construction sites. All projects shall provide as a minimum the following types of training:

**1. Induction Training** shall be given to all persons prior to permitting them, to go to the worksite. The workers ID Card should not be issued until this training has been given. This training should include at least the following:

- (a) General safety awareness
- (b) First-aid
- (c) Emergency procedures
- (d) Use of personal protective equipment
- (e) Specific site hazards

**2. Refresher Training** shall be conducted at regular intervals to ensure that all workers on site are kept up to date with safety requirements on site.

**3. Specific Training** shall be provided to the persons with safety related tasks such as crane operators, slingers and plant operators, HEM operators etc.

**4. Toolbox Talks** shall be conducted so that every worker on site receives at least two toolbox talks every week. These talks should be designed to highlight relevant safety and industrial health issues to the workforce on a regular basis in order to raise their level of awareness. These should be prepared so that they can be presented by the site supervisors.

**5. Documentation:** All training that is carried out shall be formally recorded with copies of the records being kept on the sites for inspection by the employer's representative. Details of the respective training course/programmes shall include the following information:

- (a) Course title
- (b) Course duration
- (c) Course content
- (d) Target audience
- (e) Actual audience with record of attendance.

### **Safety Promotion**

The project managers at each of their sites in the interest of promoting safety awareness amongst the workforce shall devise and implement practical safety promotion schemes. The objective of these schemes should be to recognize and reward individuals who continually endeavour to work in a safe manner.

### **1.11. SAFETY OFFICERS**

As per the Building and other Construction Workers Central Rules, 1998, Section 209, in every establishment wherein five hundred or more building and other construction workers are ordinarily employed, the employer shall appoint safety officers as per the scale laid down in

Schedule VIII annexed to these rules. Such safety officers may be assisted by suitable adequate staff. Duties, qualifications and the conditions of service of safety officers so appointed are provided in schedule VIII.

One full time construction Medical Officer for building or other construction work, employing workers up to one thousand, and one additional construction medical officer for every additional one thousand workers or part thereof. The staff including one nurse, one dresser-cum - compounder, one sweeper-cum-ward boy with each construction medical officer for full work hours.

While planning the project and before starting the project work, safety organization set-up is planned by the top management of the company. When there is no full time safety specialist, the safety functions should be carried out by a person who is either a part of organization such as site manager/site engineer or a staff member such as the personnel manager.

### REVIEW QUESTIONS

1. Write short notes on:
  - (a) Safety
  - (b) Occupational health
2. Define the terms: Hazard, accident and harm.
3. What is the difference between safety considerations and health considerations.
4. What is a SHE concept? Explain it in detail.
5. Explain the economics of safety management. Explain different types of losses due to accident.
6. Write an essay on 'safety' with an emphasis on integration of safety, health and environment.
7. Write an essay on 'safety in construction'.
8. What do you understand by 'SHE Policy'? Explain it in detail. Explain its objectives.
9. What are the responsibilities of management towards establishing and maintaining a safe working environment.
10. Write short notes on:
  - (a) Hazard identification
  - (b) Hazard control.
  - (c) SHE planning
11. Explain different types of hazards.
12. What is a safety programme? Explain. Mention different phases of safety programme.
13. How safety education and training is carried out in a construction project?
14. Explain the rule position as regards to appointment of:
  - (a) safety officers, and
  - (b) construction medical officers and their staff.
15. What do you mean by safety in construction? What are its objectives?
16. List out various health hazards in construction industry.
17. Discuss different reasons for accidents.
18. Discuss various losses due to accidents in the field of construction.