1.1 Need / Importance of Workplace Safety

Workplace safety is essential regardless of the size of a company. All companies, big or small, need to incorporate safety in their workplaces.

Well-implemented safety measures keep employees safe and also protect industrial equipment. It is the responsibility and duty of employers to protect their employees and keep them safe.

A safe work environment is essential for both employees and employers alike. It is the right of all employees to have safety in the workplace.

It is not possible to measure the effects of human casualties. They can have grave consequences for employees and their families and friends as well.

This is why workplace safety and health measures are necessary. They are essential for the well-being of employers and employees alike. The feeling of assurance that one has, knowing that he will return safely from work, is more significant than anything else.

Every business has safety risks that could impact employees if not managed efficiently. These types of safety risks fall under the term occupational safety.

Occupational safety deals with all aspects of physical, mental and social health and safety in a workplace. It is the umbrella for company's efforts to prevent injuries and hazards in all work environments.

Every industry presents various kinds of safety hazards to its employees. The spectrum of possible occupational safety risks ranges from severe and immediate physical dangers to milder hazards. The more immediate cases can be fires, explosions, chemical hazards or other such dangers that present an immediate threat to an employee's life. Milder hazards include challenges in ergonomics, workloads, mental capacity and general well-being of employees. The latter kinds of risks often take place in an office environment. However, whatever business you are in, there is always the possibility of an accident happening to someone.

Benefits of a Safe and Healthy Work Environment **--\---** Work-related injuries, illnesses and deaths are costly to everyone. A safe and healthy work environment pays, in more ways than one.

For Workers -- Work injuries and illnesses can affect every aspect of life for workers and their families.

For workers, injuries or illnesses can cause: .. Loss of life,

- Pain and suffering, \\ Loss of income and financial well-being, \\ Stress on relationships,
- Loss of job or career, \\ Health-care costs beyond what is covered by insurance.

Workers may also suffer from low self-esteem, loss of independence, mental health problems, other medical problems, and damaged relationships.

For Employers A safe and healthy workplace not only protects workers from injury and illness, it can also lower injury/illness costs, reduce absenteeism and turnover, increase productivity and quality, and raise employee morale. In other words, safety is good for business. Plus, protecting workers is the right thing to do.

Workplaces with successful safety and health management systems reduce injury and illness costs 20-40%, according to OSHA.. **For a small business, one injury can mean financial disaster. Costs to a business include: 1.** Production losses **2.** Wages for work not performed 3. Increased workers' compensation insurance costs **4.** Damage to equipment or machinery 5. Hiring and/or training new employees **6.** Decline in product quality and worker morale 7. Decline in worker morale **8.**High turnover and lost work time

The cost of workplace injuries, illnesses and deaths is much greater than the cost of workers' compensation insurance alone. Insurance is just the tip of the iceberg when it comes to these costs.

Safety Pays for Everyone

The cost of injury prevention is far less than the cost of an injury. A safe and healthy workplace attracts and retains quality employees. It's an asset to a community, operates more efficiently and enjoys a healthy bottom line. The business and the workers thrive in a safe, healthy, respectful and caring environment.

Safe and healthy workplaces:

- Have more satisfied, productive workers who
  - Produce higher quality products and services
  - Return to work more quickly after an injury or illness
  - Feel loyal to the organization
- Are better places to work \\ Retain employees
- Establish positive community relations

1.3 **Ways to Create a Safe Working Environment. . 1**;.**Being Aware and Identifying workplace Hazards** --- This is the first step to create a safe working environment. Employers need to identify workplace hazards and safety issues first. Then they must take measures to address them accordingly. Workplace safety hazards can include mechanical issues, dangerous chemicals, hazardous electrical equipment, etc. **** Mechanical problems can occur at any time while operating machinery in the workplace. Also, working with heavy equipment is very risky and can cause accidents. \\\ If employees need to work with chemicals, they have to be very cautious. Dangerous chemicals can burn or poison employees. Inhaling or ingesting them can even cause death.

Also, working with electronic equipment can have risks as well. Faulty electrical equipment can electrocute employees, causing severe problems.

Employees should be aware of the types of equipment and know the hazards in their workplace. This enables them to stay clear of such dangers and unfortunate situations. Also, employers should train employees in the proper operation of machinery and equipment.

2.Implementing Workplace Safety Programs--\--The first step in building a safety program is to get all employees to commit to workplace safety. One way to do this is to include workplace safety in the company's mission statement. It should be the duty of every employee to carry out the safety policies.

Employers should investigate all accidents in the workplace. They should encourage employees to follow all safety procedures. \\ Moreover, employers should clearly state the hazards of not following them in writing. This reduces the chances of mistakes.

3.Providing Proper Safety Training to Employees. --- Training is an important part of every company's safety program to protect employees from accidents. Research shows that new employees have a higher risk of workplace accidents. It is the lack of knowledge of workplace hazards and proper work techniques that cause this greater risk.

Employers should provide employees with the necessary training to reduce workplace accidents. Employees should operate all equipment and machinery safely and adequately.

For instance, employers should adequately teach the operation of heavy machinery to employees. Only trained or certified employees should operate such types of equipment. This is why it is essential to provide safety training to employees by experts.

4.Using Protective Safety Equipment --\--The usage of equipment worn to minimize exposure to hazards that cause workplace injuries is significant. Not doing so can cause injury or even death.

Employees may have to work with chemicals, machines, electronics, and other potential work hazards. Employers must provide such employees with personal protective equipment (P.P.E.).

P.P.E. should be safely designed, constructed, and fit comfortably. Examples of P.P.E. are gloves, protective eyewear, clothing, earplugs, hard hats, etc.

5.Reporting Unsafe Working Conditions ---\-- Employees must inform any safety hazards or work risks to the management. Employers are legally obligated to ensure safe working environments for their employees. They must end workplace safety hazards and promote safety in the workplace.

6.Practicing Correct Posture ---\--- Bad posture is one of the main reasons for back pain. It is imperative to practice good and correct posture to reduce the risk of getting hurt.

For example, if you have to sit for long hours, use specially designed chairs. Also, always sit upright.

7. Reducing Workplace Stress --\-- **Workplace stress** can cause many health problems like anxiety, depression, etc. \ Job insecurity, **workplace bullying**, high workload, etc., cause workplace stress. Learn how to combat workplace stress and avoid its adverse effects. Workplace stress can have drastic effects on workplace productivity and employee health.

8. Promoting Regular Breaks ---\-- Employers should encourage employees to take regular breaks. Taking frequent breaks will prevent tiredness and fatigue. This will further prevent injuries or illnesses. Breaks help employees stay fresh and focused.

9. Staying Sober and Alert --\-- One of the major reasons for workplace fatalities is substance abuse. **Substance abuse causes around 40% of all industrial workplace fatalities.**

Individuals under the influence of alcohol or drugs are less alert. Their decision-making ability, coordination, concentration, and motor control get compromised. This creates risks for workplace injury and fatalities.

10. Easy Access to Exits in Case of Emergencies --\-- If there is an emergency, it is important to have easy access to emergency exits. Easy access to emergency exits will reduce injuries and casualties. Also, it is important to have quick ways to shut down equipment in case of emergencies.

11.Using Mechanical Aids --\-- An industrial job may need employees to work with heavy equipment. There are many injury risks involved in trying to lift and move heavy objects. Employees can use a conveyor belt, forklift, or wheelbarrow instead of lifting manually.

OSHA Norms

***As per 'the** occupational safety, health and working conditions code, 2020' Govt. of India:*

(A) **DUTIES OF EMPLOYER:**

(i) Every employer shall,— (a) ensure that workplace is free from hazards which cause or are likely to cause injury or occupational disease to the employees;

(b) comply with the occupational safety and health standards declared under section 18 or the rules, regulations, bye-laws or orders made under this Code;

(c) provide such annual health examination or test free of costs to such employees of such age or such class of employees of establishments or such class of establishments, as may be prescribed by the appropriate Government;

(d) provide and maintain, as far as is reasonably practicable, a working environment that is safe and without risk to the health of the employees;

(e) ensure the disposal of hazardous and toxic waste including disposal of e-waste;

(f) issue a letter of appointment to every employee on his appointment in the establishment, with such information and in such form as may be prescribed by the appropriate Government and where an employee has not been issued such appointment letter on or before the commencement of this Code, he shall, within three months of such commencement, be issued such appointment letter;

(g) ensure that no charge is levied on any employee, in respect of anything done or provided for maintenance of safety and health at workplace including conduct of medical examination and investigation for the purpose of detecting occupational diseases;

(h) relating to factory, mine, dock work, building or other construction work or plantation, ensure and be responsible for the safety and health of employees, workers and other persons who are on the work premises of the employer, with or without his knowledge, as the case may be.

(2) Without prejudice to the generality of the provisions of sub-section (1), the duties of an employer shall particularly in respect of factory, mines, dock, building or other construction work or plantation include—

(a) the provision and maintenance of plant and systems of work in the workplace that are safe and without risk to health;

(b) the arrangements in the workplace for ensuring safety and absence of risk to health in connection with the use, handling, storage and transport of articles and substances;

(c) the provision of such information, instruction, training and supervision as are necessary to ensure the health and safety of all employees at work;

(d) the maintenance of all places of work in the workplace in a condition that is safe and without risk to health and the provision and maintenance of such means of access to, and egress from, such places as are safe and without such risk;

(e) the provision, maintenance or monitoring of such working environment in the workplace for the employees that is safe, without risk to health as regards facilities and arrangements for their welfare at work.

(B) Duties of Employee

Every employee at workplace shall,— (a) take reasonable care for the health and safety of himself and of other persons who may be affected by his acts or omissions at the workplace; with the safety and

(b) comply health requirements specified in the standards;

(c) co-operate with the employer in meeting the statutory obligations of the employer under this Code;

(d) if any situation which is unsafe or unhealthy comes to his attention, as soon as practicable, report such situation to his employer or to the health and safety representative and in case of mine, agent or manager referred to in section 67, safety officers or an official for his workplace or section thereof, as the case may be, who shall report it to the employer in the manner as may be prescribed by the appropriate Government;

(e) not wilfully interfere with or misuse or neglect any appliance, convenience or other thing provided at workplace for the purpose of securing the health, safety and welfare of workers;

(f) not do, wilfully and without reasonable cause, anything, likely to endanger himself or others; and

(g) perform such other duties as may be prescribed by the appropriate Government.

(C) **Rights of Employee**

(1) Every employee in an establishment shall have the right to obtain from the employer information relating to employee's health and safety at work and represent to the employer directly or through a member of the Safety Committee as constituted under section 22, if constituted by the employer for such purpose, regarding inadequate provision for protection of his safety or health in connection with the work activity in the workplace, and if not satisfied, to the Inspector-cum-Facilitator.

(2) Where the employee referred to in sub-section (1) in any workplace has reasonable apprehension that there is a likelihood of imminent serious personal injury or death or imminent danger to health, he may bring the same to the notice of his employer directly or through a member of the Safety Committee referred to in sub-section (1) and simultaneously bring the same to the notice of the Inspector-cum-Facilitator.

(3) The employer or any employee referred to in sub-section (1) shall take immediate remedial action if he is satisfied about the existence of such imminent danger and send a report forthwith of the action taken to the Inspector-cum-Facilitator in such manner as may be prescribed by the appropriate Government.

(4) If the employer referred to in sub-section (3) is not satisfied about the existence of any imminent danger as apprehended by his employees, he shall, nevertheless, refer the matter forthwith to the Inspector-cum-Facilitator whose decision on the question of the existence of such imminent danger shall be final.

HEALTH, SAFETY AND WORKING CONDITIONS

(1) The employer shall be responsible to maintain in his establishment such health, safety and working conditions for the employees as may be prescribed by the Central Government.

(2) Without prejudice to the generality of the power conferred under sub-section (1), the Central Government may prescribe for providing all or any of the following matters in the establishment or class of establishments, namely:— (i) cleanliness and hygiene;

(ii) ventilation, temperature and humidity;

(iii) environment free from dust, noxious gas, fumes and other impurities;

(iv) adequate standard of humidification, artificially increasing the humidity of the air, ventilation and cooling of the air in work rooms;

(v) potable drinking water;

(vi) adequate standards to prevent overcrowding and to provide sufficient space to employees or other persons, as the case may be, employed therein;

(vii) adequate lighting;

(viii) sufficient arrangement for latrine and urinal accommodation to male, female and transgender employee separately and maintaining hygiene therein;

(ix) effective arrangements for treatment of wastes and effluents; and

(x) any other arrangement which the Central Government considers appropriate.

Module 2 Safety Management function

System Safety -- A system can be defined as a group of interconnected elements united to form a single entity . Systems may include something as simple as a toaster or as complex as a chemical refinery . Perhaps the most important thing about systems is that they can sometimes be and often are further defined into subsystems , assemblies , subassemblies , and components . Some basic terms related to safety : ==**Safety** can be defined as making something free from the likelihood of harm , Roland and Moriarty state that safety in a system is " a quality of a system that allows the system to function under predetermined conditions with an acceptable minimum of accidental loss . "

A hazard is anything that can possibly cause danger or harm to equipment , personnel . property . or the environment . It is a circumstance that has the potential , under the right conditions , to become a loss . Risk involves the probability that an incident will occur or the chance of occurrence . The higher the risk (including probability and cost of loss) , the more important it becomes to find and mitigate the hazard .

An " accident " is a dynamic occurrence caused by the activation of a hazard and consists of a number of interrelated events resulting in a loss . It can cause the injury or death of individuals as well as property damage to equipment and hardware . A related term that is sometimes used to refer to accidents but is actually a different kind of event is an incident . An " incident " is also an unplanned event but may or may not

have an adverse effect . An incident may simply be an occurrence with no losses . These are sometimes referred to as " near misses .

System safety can be defined as an optimum degree of safety , established within the constraints of operational effectiveness , time , and cost achievable throughout all phases of the system life cycle " . The system - safety concept deals with the before - the - fact identification of hazards as opposed to the after - the fact approach used for years .

System Life Cycle --\--The system life cycle consists of six phases : concept , definition , development , production . deployment , and disposition . At the end of each phase , a safety review is conducted . A decision is then made whether to continue the project or place it on hold , pending further examination . **During the concept phase** , historical data and technical forecasts are developed as a base for a system hazard analysis . A Preliminary Hazard Analysis (PHA) is conducted during this phase . At the gross level , a Risk Analysis (RA) is performed to ascertain the need for hazard control and to develop system - safety criteria . Safety management will be doing the initial work on the System Safety Program Plan (SSPP) . Three basic questions must be answered by the time the concept phase is completed :

Have the hazards associated with the design concept been discovered and evaluated to establish hazard controls ? . ---\-- Have risk analyses been initiated to establish the means for hazard control ? ---\--- Are initial safety design requirements established for the concept so that the next phase of system definition can be initiated ? " --\-- ranie : Safety System Cycle

Phase	Safety Control Point	Result
Concept	Concept design review	Establish design for general evolution
Definition	Preliminary design review	Establish general design for specific development
Development	Critical design review	Approve specific design for production
Production	Final acceptance review	Approve product for release in deployment
Deployment	Audit of operation and maintenance	Control of safety operation and maintenance

The **definition phase** is used to verify the preliminary design and product engineering . Reports presented at design review meetings typically discuss the technological risks , costs , human engineering , operational and maintenance suitability , and safety aspects . In addition subsystems . assemblies , and subassemblies of the system are defined at this time . The PHA is updated and a Subsystem Hazard Analysis (SSHA) is initiated so it can later be integrated into the System Hazard Analysis (SHA) . Safety analysis techniques are used during this phase to identify safety equipment , specification of safety design requirements , initial development of safety test plans and requirements , and prototype testing to verify the type of design selected .

Environmental impact , integrated logistics support , producible engineering , and operational use studies are done during the development phase . The SSHA and safety design criteria are also completed during this phase . Interfaces with other engineering disciplines within the organization are fostered . Using the data collected , a go / no - go decision can be made before production begins **.--\-- The production phase** of the system life cycle involves close monitoring by the safety department . In addition , the quality - control

department becomes important because of its focus on inspection and testing of the new product . Training begins during this phase . Updating of the analyses started during the definition and development phases continues . Finally , all the information collected during this phase is compiled into the System Safety Engineering Report (SSER) . The SSER identifies and documents the hazards of the final product or system . --\--**When the system** becomes operational , it is in the deployment phase . Data continues to be collected and training is conducted . If any problems occur , individuals responsible for system safety must be available to follow up and decide on possible solutions . The system safety group in the organization also reviews any design changes made on the system or product.

A sixth phase of the system life cycle , the disposition or termination phase , is the time that a product or system is removed from service . In certain cases , the removal of a product may in itself create a hazardous situation . A good example is asbestos removal from a building or light transformer replacement due to PCBs Safety professionals monitor these situations so both the worker and the public are protected .

System Safety Management

Malasky defines " system safety management " as " that element of program management which ensures the accomplishment of the system safety tasks , including identification of system safety requirements ; planning , organizing , and controlling those efforts which are directed toward achieving the safety goals ; coordinating with other (system) program elements , and analyzing , reviewing , and evaluating the program to ensure effective and timely realization of the system safety objectives

Elements of a System - Safety Program Plan (SSPP) --\- 1.System safety program Plan (SSPP) must specify the four elements of an effective system safety program : **2.** A planned approach for task accomplishment . **3.**Qualified people to accomplish the tasks .**4.** Authority to implement the tasks through all levels of management **5.** Appropriate resources for manning and funding to ensure that tasks are completed . **To accomplish these objectives , the SSPP should describe :** 1.The safety organization **2 .** System safety program milestones .**3.** General system safety requirements and criteria ..**4.**Hazard analysis techniques and formats . **5.**System safety data .**6.** Safety verification.**7.** Audit programs.**8.** Training requirements.**9.** Mishap and hazardous malfunction analysis and reporting .**10.** System safety interfaces .

Tools and Techniques --\- In item four of the SSPP , a company must identify the types of techniques used in analyzing and evaluating system hazards . The following section will discuss some of the tools commonly used by the safety practitioner .

Preliminary Hazard Analysis A PHA is the initial effort in identifying hazards which singly or in combination could cause an accident or undesired event . PHA is a system - safety analysis tool used to identify hazard sources , conditions , and potential accidents (Roland and Moriarty . 1990) . At the same time , PHA establishes the initial design and procedural safety requirements to eliminate or control these identified harardous conditions . A PILA is performed in the early stages of the conceptual cycle of system development . It can be performed by engineers , contractors , production line supervisors , or safety professionals . Management must always first look at any risk involved in the operation of the system.

After identifying hazards and their resultant adverse effects , the analyst will rate cach according to the Hazard Classification class , which could be one of four categories : • Class 1 Catastrophic : A condition (s) that will cause equipment loss and / or death or multiple injuries to personnel --\- Class II Critical : A condition (s) that will cause severe injury to personnel and major damage to equipment , or will result in a hazard requiring immediate corrective action --\-- Class III Marginal : A condition (s) that may cause minor injury to personnel and minor damage to equipment --\-- Class IV Negligible : A condition (s) that will not result in injury to personnel , and will not result in any equipment damage . --\-- Roland and Moriarty (1990) show how to develop a Hazard Assessment Matrix to determine a Hazard Risk Index using frequency of occurrence and hazard category.

Frequency of Occurrence	Hazard Categories			
	I Catastrophic	II Critical	III Marginal	IV Negligible
(A) Frequent	1A	2A	3A	4A
(B) Probable	1B	2B	3B	4B
(C) Occasional	1C	2C	3C	4C
(D) Remote	1D	2D	3D	4D
(E) Improbable	1E	2E	3E	4E

The Hazard Risk Index (HRI) is then determined by reading the chart and assigning risk into one of the four levels of acceptability:

I Unacceptable

II Undesirable with management waiver required

III Acceptable with management review

IV Acceptable without review

Hazard Analysis Techniques --The role of the safety professional is to anticipate , identify , and evaluate hazards ; give advice on the avoidance , elimination , or control of hazards ; and attain a state for which the risks are judged to be acceptable **. To achieve this , they adopt a system - safety concept that includes** : 01. an understanding of the hazard --2. An understand of the risk.--\ 3 An understand of unwanted releases of energy and unwanted releases of hazards materials being the causal factors for hazard related incidents , and --04. • a knowledge of the principles and techniques used to control hazards and reduce their associated risks to an acceptable level (Manuele , 1993) .

A hazard analysis is used to identify any dangers that might be present in a proposed operation , the types and degrees of accidents that might result from the hazards , and the measures that can be taken to avoid or minimize accidents or their consequences (Hammer , 1989) . The SHA is primarily performed during the definition and development phases of the system life cycle (Roland and Moriarty , 1990) . However , it should be continuously implemented throughout the life cycle of a system , project , program , and activity to identify and control hazards . The purpose of performing an analysis during the early stages of the life cycle is to reduce costs . If the analysis is done after the system is in operation , the system may need to be redesigned and consequently withdrawn from service . In addition , if the system is close to the end of its life cycle , it might not be cost - effective to change it (Brauer , 1990) . --\-

A hazard analysis should contain the following information : Descriptive information ---System mode ---\--Subsystem mode of subsystem of hazard origin -\---Hazard description --\-- Hazard effects --\--Likelihood or relative likelihood of each hazard ……-\-**Causation events of each hazard** --\-- Identification of events precisely as to subsystem mode , system mode , and environmental constraints.--\- **• Subsystem interface problems of special significance** --/-- Identification of subsystem involved -Identification of system and subsystem modes -System risk evaluation -Severity listing of each hazard -Likelihood of each hazard -.--\-- **• Risk summary** -Listing risks of each hazard and for the system as a function of system modes --\---A logical evaluation of acceptability of system risk.s--\\-- Recommendations as to system risk control .

Technic of Operations Review (TOR) In 1987 , D. A. Weaver developed the Technic of Operations Review (TOR) (Ferry , 1988) . It was designed to uncover management oversights and omissions instead of hardware or operator problems . The four steps of a TOR analysis are state , trace , eliminate , and seek . . During the state portion of the analysis , detailed information about the hazard is gathered . If the hazard is discovered as the result of an accident , a summary of the mishap report is reviewed . The trace portion uses a sheet displaying possible operational errors under eight categories : • **Training** includes all errors

related to inadequate preparation of the employee . • **Responsibility** considers errors in the organizational requirements which may have contributed to the hazard **. Decision and direction** looks at the lack of or inadequacy in the decision - making process which causes errors in the performance of the product or employee . **Supervision** refers to errors due to problems with the direction of employee work . **Work groups** problems can be traced to the interpersonal relationships within the group **. Control deals** with errors related to inadequate safety precautions Personal traits can be traced to the individual's personality and how it affects the individual's job performance **. Management** can be traced to poor managerial control . These factors are then discussed by the group . Those found to have contributed to the accident can be further broken down until all the causative factors have been identified . \\ When the trace portion of the analysis is finished , the " eliminate " step begins . Sometimes the trace step can identify a large number of contributing factors , a number often overwhelming to the group evaluating the hazard . Therefore , the eliminate step is used to discuss each contributing factor and evaluate its merit to the process . \\ The final step , " seek , " looks for possible actions that need to be taken to correct the problem These solutions should then be implemented .

SAFETY MANAGEMENT FUNCTION Safety , like many other management activities , consists of planning , organizing , controlling . directing , and possibly staffing . **(1) Planning** " A job well planned is a job well done . " " A job well planned is a job half finished . " These axioms have been repeated for decades , and they hold some truth . A well - planned operation involves a series of deliberate steps . First , the safety practitioner must forecast the needs of the safety department for the coming year . This involves reviewing the records of successes and failures as well as all the resources used in the past . It also means anticipating the obstacles that may be encountered during the coming planning period . This forecasting of coming needs or predicting when they will occur is a result of looking at the past and studying the future . . .\\ Once forecasts are made , the practitioner must anticipate resources needed to meet those needs and make requests accordingly . This is part of a proactive as opposed to a reactive approach to safety . The practitioner does not wait for incidents to occur , but rather anticipates and plans to deal with problems beforehand . **(2) Organizing** Unlike most management activities , safety usually operates from a purely staff position . The implications of this pervade safety and affect the way it operates in the organization . To understand the management of safety , an understanding of line and staff positions is essential . \\ Line positions are charged with carrying out the major function or functions of the organization . First - line supervisors , plant managers , and even company presidents are considered line officers within an organization . Staff positions , on the other hand , are charged with supporting or helping the line positions . Typically , staff positions have no real authority over line activities : staff members only assist and advise the line officers . \\ Safety managers , safety engineers , safety professionals , and safety technicians are nearly always considered staff personnel and nearly always operate from a staff position . A safety manager's job is to monitor safety , compare what they find against existing standards , and advise line management as to any corrective actions that need to be taken from a safety standpoint . \\ All members of the organization must buy into safety to establish a safety culture . This only happens with support and continual input from top management . The safety professional acts as a resource or guide in helping the team establish itself . Management of safety becomes a responsibility of the leader of the work group and the individual members . (**3) Controlling** Controlling occurs through a number of sub - functions . It involves looking at what is happening in the organization by monitoring or comparing the results of the observations to established standards , and taking appropriate corrective actions . This occurs through inspections . audits , records reviews , interviews with employees and supervisors , and a careful watch on what is happening in the organization . The results of monitoring are compared to results from previous years , existing safety regulations , and published or internally developed standards . Any deficiencies are noted and plans are made for correction . Before drastic changes occur . management approval and support are sought . \\ **The** safety practitioner soon learns requests for change typically cost money , time , or other resources . In addition , these requests are competing with those from production , marketing , and other branches of the organization whose managers believe they can best utilize the company's resources . The management team will consider the safety request , weigh it against those from the rest of the organization , and respond

accordingly . Management support for safety is a result of its perception of how well safety supports the organization . \\ Allegedly , the major tool used by professionals to monitor the state of safety in the organization has been the audit . Audit is a term loosely used by professional and semi - professional safety practitioners . It can mean anything from a cursory inspection of hand tools by shop personnel to a complete review of the safety program by the safety staff and numerous collaborating personnel . In reality , the audit is a tool that permits the assignment of a quantitative or numerical value to some aspect of the safety program . It is used to determine where that program is relative to where it ought to be . **(4) Directing** The safety practitioner does not actively direct or lead in the organization , unless he has a staff or allocated resources . This job belongs primarily to line management . Ideally , the safety practitioner is given adequate resources , including a safety budget , to help line management accomplish its objectives . A typical safety budget would be 2 to 3 percent of sales volume . Safety personnel operating from a staff position will only be successful with support , including financial support , from line management. **(5) Staffing** Staffing is an issue organizations should embrace . The opportunity to hire productive , creative people is also conducive to the growth and advancement of the whole organization . In addition , the safety practitioner should be aware the process contains pitfalls . If a job requires strength and endurance , the safety practitioner should ensure the company has a clear , written job description . Applicants are only hired contingent on their ability to meet all predetermined physical requirements . A careful review of all affirmative action regulations is necessary to ensure company screening procedures are in compliance with the acts **. (6) Communications** The ability to communicate effectively is critical to the success of safety practitioners . They must be able to speak in terms that management understands . This requires knowledge of accounting , economics , and modern production and quality theory . Strong human relations skills and related language ability are important to any successful safety effort . The safety practitioner will be working with top management and frontline workers . An effective safety professional needs to have the personality and ability to relate to both groups . \\ The typical safety practitioner spends significant time in front of groups , often in training activities . Public speaking skills can be useful in these situations . Thoughts need to be well organized and the presentation should always be polished . This requires preparation and practice . Safety professionals who are not properly prepared in public speaking may join professional groups or may take courses to help them prepare . **(7) Evaluation of the System** Since the safety practitioner is operating from a staff position , any success is a result of his ability to enlist the support of line personnel . This comes about as a result of being well integrated into the organizational structure and culture , and is also a result of being able to enlist the support and cooperation of the line managers . Obviously , to accomplish this , two things are needed . First , top management must have already endorsed safety as being important to the organization , and it must have already given safety an appropriate level of support . This occurs because management perceives that safety is a worthwhile and contributing entity within the organization and that its activities are cost - effective . . \\ Support comes not only in terms of resources , but also in terms of commitment to holding all members of the management team responsible and accountable for safety within their own operations . Each and every manager is responsible , not just for production , but for safe production . \\ Second , the safety manager must be perceived as an integral part of the management team . Line managers can call on the safety manager for advice and help in making their own operations safer . The safety manager's guidance will help them to create and maintain a safe workplace for their employees . Line managers can make proposals and compete for the safety staff's time and budget to help them ; but , ultimately , the responsibility and accountability for safety rest on their shoulders.

OSHA Guidelines for function of safety management -- On January 29 , 1989 , OSHA published voluntary safety and health guidelines for general industry . OSHA concluded that effective management of worker safety and health protection is a decisive factor in reducing the extent and the severity of work - related injuries and illnesses . Effective management addresses all work - related hazards , including those potential hazards that could result from a change in worksite condition or practices . It addresses hazards whether or not they are regulated by government standards . In general , OSHA advises employers to maintain a program providing a systematic approach o recognize and protect employees from workplace hazards . This requires the following : **1. Management commitment and employee**

involvement are complementary . -- Management should value worker safety and health and commit to its visible pursuit as it would to other organizational goals . A means should be established to encourage workers develop and / or express their own commitment . This requires clearly stating and communicating safety and health policies and holding managers , supervisors , and employees accountable for meeting their safety responsibilities **. 2 Worksite analysis involves examining the workplace for existing and potential hazards** ---. Comprehensive baseline and periodic safety and health surveys should be conducted . Job hazard analysis , accident , and near - miss investigations should also be held . Workers should be able to report unsafe conditions without fear of reprisal . Trends of illness and injury should be studied i over time to identify patterns and prevent problems from recurring **. 3. Once hazards or potential hazards are recognized , they should be controlled , prevented , and / or eliminated** ---. This requires engineering controls where appropriate , administrative controls , or personal protective equipment where necessary . Emergency plans , complete with drills and training . should be evaluated . Medical programs should be established . **4. Training should address the safety and health responsibilities of all personnel** . -- Managers . supervisors , and workers should understand their responsibilities and the reasons behind them . This training should be reinforced through performance feedback and enforcement of safe work practices .

MODULE 3 Hazard Identification and Control

Hazard A hazard is defined as "any workplace condition or practice that could cause an injury or illness to an employee." **There are two forms of exposure to hazards** .1. Physical exposure. When an employee is within arm's length of a hazard. Examples include noise, hazardous atmospheres, and temperature extremes.

2. Environmental exposure. The employee can be anywhere in relation to the hazard. Environmental hazards could affect one employee or everyone within a facility.

Hazard Identification and Control

Some basic steps in the hazard identification and control process are: Step 1**: Identifying Hazards**

The first step in the process is to identify hazardous conditions, unsafe behaviors, and system weaknesses that might result in accidents. The safety inspection process and observation are two effective hazard identification tools.

Step 2: **Analyzing Hazards --** Once hazards are identified, we need to analyze them. To make sure the analysis process is successful, it's important to assume all hazards can be prevented, eliminated, reduced, or controlled. The Job Hazard Analysis (JHA) is an excellent tool for analyzing the hazards inherent in specific jobs.

Step 3**: Controlling Hazards --** Once hazards are identified, it's important analyze and control them using a systematic strategy. It's important to assume that all hazards can be prevented, eliminated, reduced, or controlled. A systematic strategy, called the "Hierarchy of Controls," is an effective approach for keeping the workplace safe and protecting workers.

Identifying Hazards -- To help identify hazards, we can group them into three categories:

1. **Physical hazards**: This first category includes: materials, tools, equipment, machinery, and the physical environment. Each of these represent hazardous physical conditions. It may seem counterintuitive, but physical hazards actually account for the fewest number of workplace accidents.

Physical Hazards:

- Materials: Hazardous materials include hazardous:
  - Liquid and solid chemicals such as acids, bases, solvents, explosives, etc.
  - Solids like metal, wood, plastics.
  - Gases like hydrogen sulfide, methane, etc.

Tools,Equipment and Machinery:This area includes machinery and tools used to produce or process goods.

Examples include:
- Equipment may not be properly guarded or maintained.
- Tools may be defective or not used for the intended purpose.

➢ Environment: This area includes facility design, hazardous atmospheres, temperature, noise, factors that cause stress and contribute to an unsafe environment.

Examples include:
- Areas in workplace may be too hot, cold, dusty, dirty, messy, wet, etc.
- The facility may be too noisy, or contain dangerous gases, vapors, liquids, or fumes.
- Facility and workstation design may not suitable.
- The workplace psychosocial climate may be causing stress, hurry, or illness.

2. **Behavioral hazards**: This second category describes unsafe employee behaviors and practices in the workplace. Unsafe behaviors and practices account for most workplace accidents.

Behavioral Hazards:

➢ Personal actions and performance: This area includes unsafe employee behaviors at all levels in the organization. Examples include:
- Employees may be taking short cuts, not using personal protective equipment, and otherwise ignoring safety rules. --\\-- Employees may not be using tools, equipment, machinery, or vehicles properly.
- Supervisors may be telling their employees to take shortcuts to ensure the work schedule is met.
- Managers may act in a coercive manner towards their supervisors.

3. **Systemic hazards**: The last category includes weaknesses in the safety management system structure, design, and performance. System weaknesses contribute to the unique hazardous physical conditions and unsafe personal behaviors and are ultimately responsible for most injuries and illnesses in the workplace.

Systemic Hazards:

➢ System structure, design, and performance: Every company has, to some degree, a safety and health management system (SHMS). System weaknesses represent the root causes of accidents.
- A safety manager, officer, or coordinator has not been hired.
- A functioning safety committee does not exist.
- Written preventive/corrective maintenance programs are not developed.
- Employees have not been trained on their safety responsibilities.
- Two common methods are used to identify hazards in the workplace: safety inspections and observations. Both of these methods should be accomplished regularly. The frequency of inspections and observations should be based on the nature of the hazards in the workplace.

- 1**. Safety Inspection**

To identify hazards in the workplace, the most common strategy is the walk-around inspection. Here are some important points about safety inspections:

➢ Most companies conduct safety inspections in compliance with OSHA rule requirements. Safety inspections may be effective, but only if the people conducting the inspection are properly educated and trained in hazard identification and control concepts and principles specific to the company. In high hazard industries which see change on a daily basis, it takes more than an occasional inspection to keep the workplace safe from hazards.

➢ In world-class safety cultures, supervisors as well as all employees, inspect their areas of responsibility as often as the hazards of the materials, equipment, tools, environment, and tasks demand.

➢ Employees should inspect the materials, equipment, and tools they use, and their immediate workstation for hazardous conditions at the start of each workday. They should inspect equipment such as forklifts, trucks, and other vehicles before using them at the start of each shift. Again, it's better to inspect closely and often.

➢ **2. Observation --** To overcome the weakness inherent in the safety inspection process, a safety observation program is used because it focuses primarily on employee behaviors, not physical hazards. The Safety Observation Program can help prevent injuries and illnesses by observing employees on the job.

There are two types of observation programs: formal and informal:
(a) Formal observation programs include written plans that detail the observation process, participant responsibilities, tracking, reporting, and results.

(b) Informal observation programs do not include written plans. Usually safety committees and supervisors conduct random walk-around observations, and use the information to correct unsafe behaviors, as well as physical hazards.

- A trained team of observers will make observations of employees at work more effective and consistent. The observations should note the date and time, location, employee being observed, and results of the observation.
- Observers have the following responsibilities:

- attend observation program training;
- participate in targeted observations as assigned;
- partner with other observers to share experience and findings;
- coach new observers when they conduct initial observations;
- complete the required number of observations;
- observes employees performing various jobs;
- coach and correct unsafe behaviors on the spot;
- provide specific positive feedback on behaviors to employees working safely; and
- review observation results to recommend program improvements and to plan future observations.

- **Behaviors to observe include:**

- PPE – Is the worker properly using PPE?
- Respiratory Protection – Is the worker properly using respirators as required?
- Ladder Safety – Is the worker using ladders safely using three-point control procedure?
- Forklift Operation – Is the worker correctly using forklift and other powered industrial trucks (PITs)?
- Scaffolding – Is the scaffold properly installed and is the worker working safely on the scaffold?
- Housekeeping – Is the worker keeping the workstation clean and not creating trip hazards?
- Proper Tool for the Job – Is the worker using a tool that is proper for the job and using the tool safely?
- Ergonomics – Is the worker using proper postures, lifting techniques, and positioning, and is the workstation properly designed for the job?
- Improper LO/TO – Is the worker working on a hazardous energy source following proper LO/TO procedures?
- Other/Comments – Is the worker generally behaving in a safe manner (not hurried, or engaged in horseplay)?

Step 2: <u>Analyzing Hazards and Exposure</u>

- The process of analysis can be defined as "A systematic examination and evaluation of data or information, by breaking it into its component parts to uncover their interrelationships." In the workplace, the process of analysis breaks down job procedures, incidents, and accidents to determine component parts and causes.
- Two common methods are used to analyze hazards and exposure: The Job Hazard Analysis (JHA) and incident/accident investigation.

I. **Job Hazard Analysis (JHA**)

The Job Hazard Analysis (JHA) can answer weaknesses of the walk-around inspection process. It uncovers unsafe work practices as well as hazardous conditions because sufficient time is given to close analysis of one unique task at a time. A typical JHA is accomplished by a team composed of at least one employee and one analyst and includes the following steps:

1. The employee accomplishes several cycles of the task.
2. The analyst observes and takes notes about what's being done.
3. After the observation is completed, the analyst divides the task into a sequence of unique steps.
4. The team analyzes each step to identify hazardous materials, equipment, tools, and unsafe exposures.
5. The team next determines the safety precautions needed to eliminate or mitigate the hazards in each step.
6. The team takes the information gathered to write a safe work procedure (SJP) for the entire task.
7. The team asks another employee to give the SJP a fresh look by performing the task to ensure the steps are designed to prevent injuries and illnesses.The SJP may then be used as a valuable training resource. Each JHA should be reviewed at least annually or whenever there is a change in the task that might introduce a new hazard.

II**. Incident/Accident Investigation**

Investigating a worksite provides employers and workers the opportunity to identify hazards in their operations and shortcomings in their safety and health programs. Most importantly, it enables employers and workers to identify and implement the corrective actions necessary to prevent future incidents and accidents. Investigations that focus on identifying and correcting root cause system weaknesses, not on finding fault or blame, also improve workplace morale and increase productivity, by demonstrating an employer's commitment to a safe and healthful workplace.

Step 3: Controlling Hazards and Exposure

- Traditionally, a prioritized hazard control (Hierarchy of Controls: HOC) strategy has been used to implement feasible and effective controls.
- **Hazard Controls**

These three control methods focus on controlling the hazard.

1. Elimination: The best solution is to totally eliminate the hazard. For instance, a simple way to eliminate the need to work at elevation is to eliminate the need to use a ladder to change ceiling light bulbs by using a extension pole.
2. Substitution: Substitution is the next-best solution. For instance, the employer might replace large heavy containers with smaller containers.
3. Engineering Controls: Design or redesign equipment. In this case, printing equipment might be designed to prevent the possibility of a worker getting caught by a rotating shaft.

- **Exposure Controls**

These three control methods focus on controlling behaviors to reduce exposure to the hazard. These controls are farther down the hierarchy because they work only so long as employees comply with the controls' requirements.

1. Warnings: Warnings may be visual, audible, or both. They may also be tactile. Visual warnings include signs, labels, tags, and lights. Audible warnings include alarms, bells, beepers, sirens, horns and announcement systems. Tactile warnings may include vibration devices or air fans. For example, a sign would be posted outside a confined space that forbids entry.
2. **Administrative Controls**: These controls focus on mandating safe behaviors and work practices using written safety policies, procedures, rules, supervision, and training. These controls effectively is a challenge because supervisors must regularly monitor their employees as they perform tasks. Bottom line, these controls work only so long as employees follow them.
3. **Personal Protective Equipment (PPE):** The use of PPE is probably the most common control method used for controlling hazards. PPE forms a barrier between workers and hazards. For instance, knee pads might be used to protect the knees when laying carpet.

Pressure Hazards

- Pressure hazards exist within pressure systems due to the stored energy of the compressed gas and the chemical nature of that gas.
- **Measurement of pressure hazards**

Several methods of detecting pressure hazards:

- Sounds can be used to signal a pressurized gas leak. Gas discharge may be indicated by a whistling noise.
- Workers should not use fingers to probe for gas leaks. Cloth streamers may be tied to the gas vessel to indicate leaks.
- Soap solutions may be smeared over the vessel surface so that bubbles are formed when gas escapes. A stream of bubbles indicates gas release.
- Scents may be added to gases that do not naturally have an odor—such as natural gas.
- Leak detectors that measure pressure, current flow, or radioactivity may be useful for some types of gases.
- Corrosion may be the long-term effect of escaping gases.

- **Common causes of gas leaks**:

- Contamination by dirt can prevent the proper closing of gas valves, threads, gaskets, and other closures.
- Over-pressurization can overstress the gas vessel.

- The container closure may distort and separate from gaskets, leading to cracking.
- Excessive temperatures applied to dissimilar metals that are joined may cause unequal thermal expansion, loosening the metal-to-metal joint.
- Materials may crack because of excessive cold.
- Operator errors may lead to hazardous gas release.

- **Reduction of Pressure Hazards**

- Pressurized vessels should be stored in locations away from cold or heat sources, including the sun.
- Cryogenic compounds may boil and burst the container when not kept at the proper temperatures.
- Hoses should be firmly clamped at the ends when pressurized whipping action of pressurized flexible hoses can be dangerous.
- Gas compression can occur in sealed containers exposed to heat.
- Aerosol cans may explode violently when exposed to heat.
- Pressure should be released before working on equipment check gauges before any work begins.
- Water hammer is a shock effect caused by liquid flow suddenly stopping & produces loud noises. The momentum of the liquid is conducted back upstream in a shock wave and may damage pipe fittings & valves in a shock wave, and may damage pipe fittings & valves. Reduction of this hazard involves using air chambers in the system and avoiding the use of quick-closing valves.

Fire Hazards

- Fire hazards are workplace hazards that involve the presence of flame or the risk of an uncontrolled fire and thereby endanger life.
- **Fire hazards include:**

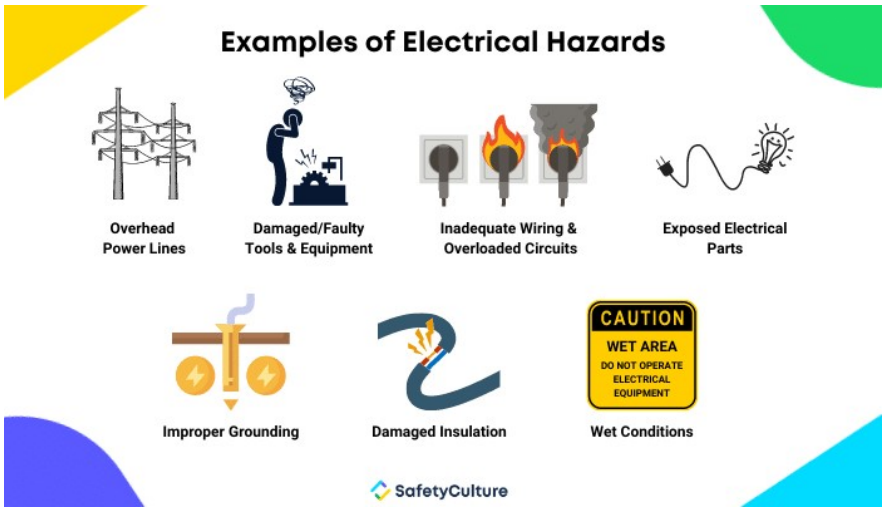
- Live flames \\ Sparks \\ Hot objects \ Flammable chemicals
- Chemicals that can aggravate a fire.

- Another category of fire hazard are situations and events that impede fire protection and prevention methods. This can include impediments to firefighting, compromised built-in fire safety systems, and situations that restrict the escape of people from an affected building or area in the event of a fire.
- OSHA requires workers to train all employees to recognize fire hazards, use fire extinguishing equipment and systems in a safe and effective manner, and how to evacuate safely in the event that a fire cannot be controlled.
- Every workplace that has potential fire hazards must be equipped with a sufficient number of conveniently located and easily accessible fire exits.
- **The following fire hazards are found in various workplaces**:

- Open flames used in various applications (such as welding)
- Electric wires, higher loads, loose connections, and old electrical equipment
- All cooking and heat generating appliances
- Smoking and the use of personal lighters or matches
- Improper or unauthorized storage of flammable and hazardous materials and chemicals
- Insufficient capacity and numbers of emergency exits and stairs
- Hindrance to sight or reach firefighting equipment, markings, and alarm systems
- Insufficient numbers and types of fire extinguishers
- Absence of fire detection and alarm system
- Violation of building and fire codes

Electrical Hazards

- An Electrical Hazard can be defined as a serious workplace hazard that exposes workers to burns electrocution, shock, arc flash / arc blast, fire, or explosions.
- Common electrical hazards in the workplace and electrical safety tips to mitigate these risks are:



1. **Overhead Power Lines**

Overhead powered and energized electrical lines have high voltages which can cause major burns and electrocution to workers. A minimum distance of 10 feet from overhead power lines and nearby equipment should be maintained. Site surveys should be conducted to ensure that nothing is stored under overhead power lines. Also, safety barriers and signs must be installed to warn nearby non-electrical workers of the hazards present in the area.

2. **Damaged Tools and Equipment**

Exposure to damaged electrical tools and equipment can be very dangerous. Anything should not be fixed unless anyone is qualified to do so. Cracks, cuts, or abrasions on cables, wires, and cords should be thoroughly checked. In case of any defects, that should be repaired or replaced. Lock Out Tag Out (LOTO) procedures should be performed at all times before commencing electrical maintenance and repairs. LOTO procedures are there to protect all workers on a worksite.

3. **Inadequate Wiring and Overloaded Circuits**

Using wires of inappropriate size for the current can cause overheating and fires to occur. The correct wire suitable for the operation and the electrical load to work on should be used. The correct extension cord designed for heavy-duty use should be used. Also, an outlet should not be overloaded and proper circuit breakers should be used. Regular fire risk assessments should be perform to identify areas at risk of bad wiring and circuits.

4. **Wet Conditions**

Electrical equipment should never be operated in wet locations. Water greatly increases the risk of electrocution especially if the equipment has damaged insulation.

5. **Exposed Electrical Parts**

Examples of exposed electrical parts include temporary lighting, open power distribution units, and detached insulation parts on electrical cords. These hazards can cause potential shocks and burns. These items should be secured with proper guarding mechanisms and exposed parts should be checked to be repaired immediately.

6. **Improper Grounding**

The most common OSHA electrical violation is the improper grounding of equipment. Proper grounding can eliminate unwanted voltage and reduce the risk of electrocution. The metallic ground pin should never be removed as it is responsible for returning unwanted voltage to the ground.

7. **Damaged Insulation**

Defective or inadequate insulation is a hazard. One should be aware of damaged insulation and report it immediately. All power sources should be turned off before replacing damaged insulation and attempt should never be made to cover them with electrical tape.

- **Causes of Electrical Hazards:**

- Faulty or damage wiring or equipment.
- Loose connections.
- Use of poor quality fittings.
- Lack of earthing/bonding and grounding.
- Use of overrated fuse or jumper.
- Working on live equipment.
- Overloading of power sockets and equipment.
- Poor housekeeping.
- Handling of electrical equipment with an incompetent person and lack of training awareness.
- Lack of safe working procedure and communication.
- Failure to use appropriate PPE and use.
- Lack of warning signs.

- **Electrical Safety Control Measures:**

- A competent and experienced person shall be allowed to do electrical jobs.
- Don't work on live equipment, isolation and multi lock system shall be followed.
- Don't hang cloth or any material on electrical equipment.
- Handling of electrical equipment or switchgear shall not be done with wet hand or body.
- Electrical switches or access to them shall not block by any material.
- Use appropriate PPE while working on electrical equipment.

MODULE 4 Hazards in Construction Industry

- A construction site is an area of land where roads, buildings, or some form of infrastructure are being built or renovated.
- Here's a list of construction hazards and guidelines to prevent accidents or deaths in the industry:

1. Working at heights **2. Moving** objects. **3** Slips, trips, and falls. **4** Noise. **5 and** arm vibration syndrome **6.** Material and manual handling. **7.** Collapsing trenches. **8.** Asbestos **9.** Electricity. 10. Airborne fibres and materials

- **Working at Heights**

- Working from heights is the most common cause of fatal injuries to workers.
- Suitable training is required for all employees who work at height. Employees should be trained in working on different pieces of equipment and surfaces, such as how to work safely on scaffolding, ladders, and roofs.
- Working at height must be properly planned and supervised, and certain approaches and precautions should be adopted.
- These are:

(i) Avoid working at height where possible. For example, if something can be assembled on ground level, do it there.

(ii) Use equipment with an extra level of safety to reduce the risk of a fatal fall. For example, a scaffold with a double guard-rail.

(iii) Minimise the consequences of a fall, for example by providing a safety net.

(iv) Wear the necessary P.P.E. such as a safety harness.

- **Moving Objects**

- A construction site is an ever-changing environment, and construction hazards continue to increase as construction is underway. There are many moving objects commonly encountered on construction sites. These include overhead lifting equipment, supply vehicles, and diggers, all of which move around a usually uneven terrain.
- To reduce risks, workers should:

(i) Avoid working close to the moving object.

(ii) Be vigilant of their surroundings, especially if the object does not have lights or beepers.

(iii) Wear Personal Protective Equipment (PPE), such as a high visibility jacket, to ensure they are seen.

(iv) Never stand behind large operating plant machinery and never stand under suspended loads.

- **Slips, Trips and Falls**

- Slips, trips, and falls can happen in almost any environment.

- As construction sites often have uneven terrain, buildings at various stages of completion, and unused materials on site, there are slightly fewer incidents of these kinds of injuries than in other industries.
- Most of these could be avoided by effectively managing working areas and access routes, such as excavations and footpaths.
- Risks should always be reported and sorted to reduce the chances of injury.
- To reduce harm due to Slips, Trips and Falls, you should:

(i) Uneven surfaces – The risk of these can be reduced by providing walkways that are clearly designated as walkways, having good conditions underfoot, and being well lit.

(ii) Obstacles – Instances of slipping and tripping over obstacles can be dramatically reduced by everyone keeping their work and storage areas tidy and designating specific areas for waste collection.

(iii) Trailing cables – Cordless tools should be used where possible. If this is not possible, cables should be run at high levels.

(iv) Wet or slippery surfaces – If a surface is slippery with mud it should be treated with stone, and if it is slippery with ice it should be treated with grit. Any areas that are slippery should be signposted, and footwear with a good grip should be worn.

- **Noise**

- Construction is noisy and, as a result, noise is a common construction hazard.
- Loud, repetitive, and excessive noise causes long term hearing problems, such as deafness.
- Noise can also be a dangerous distraction and may distract the worker from the task at hand, which can cause accidents.
- It is the employer's responsibility to carry out a comprehensive noise risk assessment, and provide appropriate PPE where necessary.

- **Hand Arm Vibration Syndrome**

- Hand Arm Vibration Syndrome (HAVS) is a painful and debilitating disease of the blood vessels, nerves, and joints. It is usually caused by the prolonged use of hand-held power tools, including vibratory power tools and ground working equipment.
- HAVS is preventable, however once the damage is done, it is permanent.
- Damage from the disease can include the inability to do fine work, and cold temperatures can trigger painful attacks in the fingers.
- Construction workers should be given appropriate protection when using vibrating tools, and equipment should be well maintained.

- **Material Handling – Manual And By Equipment**

- Materials and equipment are constantly being lifted and moved around construction sites, whether this be manually or by equipment. Either way, handling carries a degree of risk.
- For manual handling, training must be provided to ensure employees can lift and carry materials safely.
- For lifting equipment handling, there are lots of risks, especially when operating lifting equipment on uneven ground. If an employee is required to use lifting equipment, they must be trained to operate the equipment safely, and a regular test should be taken to check their ability to use the equipment.
- Always check that plant is fit for use and that it's certificated and inspected before use.

- **Collapsing Trenches**

- A common occurrence on construction sites is the collapsing of trenches with workers inside. Further, a building that is being demolished or under construction can suddenly and unexpectedly collapse, which can seriously injure, or even kill, those inside.
- Incidents commonly occur within excavations on construction sites, such as an unsupported excavation collapsing with workers inside.
- Here are some safety measures that need to be put in place to prevent excavations from collapse and to reduce the risk of operatives falling into excavations.

(i) Never work in an unsupported excavation.

(ii) Ensure an excavation is supported and fully secure.

(iii) Regularly inspect the excavation both before and during the work shift.

(iv) Always check that the edge protection of an excavation is 100% intact before you enter it.

(v) Always maintain a safe distance from the edge of all deep excavations.

- **Asbestos**

- Asbestos refers to a set of six naturally occurring fibrous minerals.

- When materials that contain asbestos are disturbed or damaged, these fibres are released into the air. Inhaling these fibres can cause fatal and serious diseases such as lung cancer, asbestosis, and pleural thickening.
- Workers on construction sites must be trained to understand what to do should they come across any suspicious materials that may contain asbestos.
- If there is asbestos on the construction site, workers must be informed where it is and how to handle it safely. When handling asbestos, we need to wear fully regulated PPE equipment at all times to prevent fibres from being inhaled or absorbed through the skin.

- **Electricity**

- It is harmful to be exposed to electrical live parts. Harm can occur either by touching live parts directly, or indirectly by a conducting object or material.
- Most of these accidents arise from contact with overhead or underground power cables and electrical equipment/machinery.
- Electric shocks are a common cause for falls from ladders, scaffolds, and other work platforms. There is also a growing number of electrocutions involving workers who are not qualified electricians, but who are carrying out electrical work on construction sites.
- Consequently, incidents can easily be avoided by using technology such as CAT and Genny scanning equipment to scan an area and foresee potential services and prevent service strikes.

- **Airborne Fibres and Materials**

- A lot of dust is produced on construction sites. The dust on construction sites is often an invisible, fine, and toxic mixture of hazardous materials and fibres. This can damage the lungs and lead to diseases such as chronic obstructive pulmonary disease, asthma, and silicosis.
- All employers have to ensure protective equipment is used.

- Site Security

- Having inadequate security around a construction site may danger the public and lead to an unnecessary incident.
- Always make sure that boundary safety fencing is 100% secure and there are no openings for the public to access.

Hazard due Acceleration and Fall

- Fall hazard is a hazard that could cause workers' less of balance or physical support.
- A fall can be fatal, especially if head injuries are incurred.
- Falls are a major cause of accidental death in the home and the workplace.
- The consequences of a fall depend on three major factors:

1. Velocity of the initial impact
2. Magnitude of deceleration upon impact
3. Orientation of the body upon impact

- **Causes of Falls**

- A foreign object on the walking surface: Any object that is in a position to trip someone or cause a slip.
- Design flaw in the walking surface: Uneven surfaces, poorly designed floor coverings, etc.
- Slippery surfaces: Poor choice of material, accidental spills, poor housekeeping etc. Particularly prevalent in industrial plants where numerous lubricants and cleaning solvents are used.
- An individual's impaired physical condition: Visual impairment/distraction, lack of awareness etc.

- **Kinds of Surface Falls**

- Trip and fall: Such accidents occur when workers encounter an unseen foreign object in their path. When they strike the object, they trip and fall.
- Stump and fall: Such accidents occur when a worker's foot suddenly meets a sticky surface or a defect (i.e. cracked sidewalk) in the walking surface. Expecting to continue at the established pace, the worker fall when his/her foot is unable to respond properly.
- Step and fall: Such accidents occur when a person's foot encounters an unexpected step down (e.g. a hole in the floor or a floor board that gives way). This can happen when employee thinks that he/she reached the bottom of the stairs when is really one more step.
- Slip and fall: Such accidents occur when the worker's center of gravity is suddenly thrown out of balance (e.g. an oily spot causes a foot to shoot out from under the worker).

- **Prevention**

➢ Choose a good material on set: For walking surfaces, select surface material that has highest coefficient of friction.
➢ Retrofit an existing surface: Retrofit existing surfaces with friction enhancement devices such as runners, skid strips, carpet, grooves, abrasive coatings, grills, and textured coverings.
➢ Practice a good housekeeping: Regardless of the type of the surface, keep it clean and dry. Spilled water, grease, oil, solvents should be removed immediately.
➢ Require non-skid footwear: Employees who work in areas where slipping is likely to be a problem should be required to wear shoes with special nonskid soles.
➢ Inspect surfaces frequently: Safety and health professionals should conduct frequent inspections and act immediately when a hazard is identified.

- **Prevention Programs**

➢ Policy statement/commitment: Statement to convey management's commitment to safety to include – intent, scope of activity, responsibility, accountability, the safety professional's role, authority, and standards.
➢ Review and acceptance of existing walkways: Contain the criteria that will be used for reviewing all walkway surfaces and determining if they are acceptable.
➢ Reconditioning and retrofitting: Include recommendations and timetables for reconditioning or retrofitting existing walkways that do not meet review and acceptance criteria.
➢ Maintenance standards: How often surfaces should be cleaned, resurfaced, replaces and procedures for meeting maintenance standards.
➢ Inspections, audits, records, tests; list of inspections, audits, and tests: List of how frequently and where.
➢ Footwear programs: Specify type of footwear for employees who work on different type of surfaces.
➢ Legal defense methods: Outline of company's legal defense to show that the company was not negligent (slip and fall prevention programs).
➢ Measure results: Explain how the program will be evaluated and how often.

- **Effective Fall Protection**

➢ Have a plan: An organization should develop a written fall protection plan that contains a statement of commitment from both management and employees, rules and regulations relating to fall protection, and explanation of the training programs and training requirements.
➢ Establish proper fall protection requirements: Require the use of fall protection equipment anytime an employee works more than 4 feet above the floor in general industry, 6 feet or more in construction and 10 or more when on a scaffolding.
➢ Provide proper fall protection equipment and procedures and require their use: Might include personal fall arrest system, coveralls, safety nets, positioning devices, warning lines, controlled access zones, and safety monitoring.
➢ Ensure proper use and type of equipment: Proper type for this situation, employees inspect it before putting it on, fits properly, and is properly attached to anchor points.
➢ Provide training: Fall protection training for supervisors and employees including how to recognize fall hazards and how to properly use all equipment.

- **Impact & Acceleration Hazard**

➢ Impact hazard is the impact of a natural or human made hazard that negatively affect society or environment.
➢ Acceleration is a very important factor in the identification and analysis of appropriate fall protection plans and equipment.
➢ The amount of acceleration determines the amount of impact or force that will be placed on the employee.
➢ The assessment towards this hazard is by identifying the use and effectiveness of personal protective equipment such as hard hats, safety boots and overheard protection of workers at lower levels also should play a role in acceleration analysis.
➢ Prevention

▪ Head protection - Impact attenuation and penetration resistance, electrical insulation
▪ Eye and face protection - goggles or face shields
▪ High mass low velocity, low mass high velocity

Mechanical Hazard Mechanical hazards are those associated with power-driven machines, whether automated or manually operated.

- In an industry, people interact with machines that are designed to drill, cut, shear, punch, etc. If appropriate safeguards are not in place or if workers fail to follow safety precautions, these machines can apply the same procedures to humans which can cause major human injuries. Also machines can cause damage to the property and machines can also harm the environment.
- **Common Mechanical Injuries**

➢ Fracture: Machines used to deform engineering materials in a variety of ways can also cause broken bones. Fracture is the medical term for a broken bone. It can be classified as simple, compound or complete fracture.

➢ Puncturing/Stabbing: Puncturing results when an object penetrates straight into the body and pulls straight out, creating a wound in the shape of the penetrating object.

➢ Straining and spraining: A strain results when muscles are overstretched or torn. Strains and sprains can cause swelling and intense pain.

➢ Friction and abrasion: A section of the skin being rub away by the machine.

➢ Entrapment: Being caught in a moving part of a machine or equipment or plant.

➢ Crushing: Injury occurs when body part is caught between two hard surfaces. that progressively move together, thereby crushing anything between them. It is mostly painful, and difficult to heal.

➢ Shearing: Injury occurs mechanical force that acts on an area of skin in a direction parallel to the body's surface. It depends on the pressure exerted.

➢ High pressure injection: This is an injury caused by high-pressure injection of oil, grease, diesel fuel, gasoline, solvents, water, or even air, into the body.

➢ Cutting and Tearing: A cut occurs when a body part comes in contact with a sharp edge. The seriousness of cutting or tearing depends on how much damage is done to the skin, veins, arteries, muscles, and even bones.

- **Mechanical Hazards occur** majorly in three area: **1.** The point of operation: Point where work is performed on the material, such as cutting, shaping, boring, etc. **2.** Power transmission apparatus: Components of the mechanical system that transmit energy to the part of the machine performing the work. Example, flywheels, pulleys, belts, connecting rods, couplings, cams, spindles, chains, cranks, gears, etc.

3.Machine moving parts: Parts of the machine that move while the machine is working. These may include reciprocating, rotating, and transverse moving parts, as well as feed mechanisms and auxiliary parts of the machine.

- **Mechanical hazards can be caused by:**

➢ controlled moving unprotected parts which are freely accessible, for example, squeezing points, shearing points, cutting and puncturing points, intake and catching points as well as butt joints.

➢ dangerous surfaces such as corners, edges, points, cutting, surfaces with high surface roughness.

➢ mobile work equipment; for example in connection with remote controls, guidance systems, reverse driving, driving with restricted visibility, on unpaved ground or with a load changing the centre of gravity.

➢ uncontrolled moving parts such as overturning, rolling, sliding or falling parts or detached, bursting or flying parts and media splashing out under pressure or ejected media or working material.

➢ slippery surfaces and tripping hazards.

➢ crash to a lower surface or object.

- **Managing Mechanical Hazards** All hazards associated with the use of machinery can be managed by adopting safe work procedures and the application of appropriate safeguards. \\- Safeguarding helps to minimize the risk of accidents from machine by forming a barrier which protect the operator or other persons from the equipment hazards point/danger area. Most guards are used at the point of operation.
- **Safeguarding from mechanical hazards**: All the hazards can be reduced by the application of appropriate safeguards. The National Safety Council (NSC) defines safeguarding as follows:

➢ Machine safeguarding is to minimize the risk of accidents of machine- operator contact. The contact can be either.

➢ A direct contact with moving part.

➢ Contact with chips, chemical and hot metal splashes, and circular saw kickbacks.

➢ Caused by the direct result of a machine malfunction.

- **Safeguard Requirements**

➢ Be secure and durable: Safeguards should be attached so that they are secure.

- Protect against falling objects: Objects falling onto moving machine mechanisms increase the risk of accidents, property damage, and injury. It should be prevented.
- Create no interference: Safeguards can interfere with the progress of work if they are not properly designed. So worker may be disable it due to work deadline.
- Allow safe maintenance: Safeguards should be designed to allow the more frequently performed maintenance tasks.

- **General Precautions**

- All operators should be trained in the safe operation and maintenance of their machines.
- All machine operators should be trained in the emergency procedures to take when accidents occur.
- All employees should know how to activate emergency shutdown controls.
- Inspection, maintenance, adjustment, repair, and calibration of safeguards should be carried out regularly.
- Supervisors should ensure that safeguards are properly in place when machines are in use.
- Operator teams of the same system should be trained in coordination techniques.
- Operators should be trained and supervised to ensure that they dress properly for the job.
- Shortcuts that violate safety principles and practices should be avoided.
- Other employees who work around machines but do not operate them should be made aware of the emergency procedures.

- **OSHA'S standard for Machine Guarding:**

- Types of guarding: One or more methods of machine guarding must be provided to protect people.
- Guarding the point of operation: Any point of operation that might expose a person to injury must be guarded.
- Machines requiring point of operation guards: Some special machines requires guards which are guillotine cutters, shears, alligator shears, power presses, milling machines, power saws etc.
- Exposure of blades. Blades must be guarded or blades must always be inside a frame.
- Anchoring fixed machinery: Machines must be anchored while fixing it in one location to stop its moment.

- **Types of Machine Guards** Safeguard are generally used for safety purpose. There are different types of machine guards.

1. **Fixed guards:** Fixed guard is a permanent part of the machine. It is not dependent upon moving parts to function. It may be constructed of sheet metal, screen, wire cloth, bars, plastic, or any other material that is substantial enough to withstand whatever impact it may receive and to endure prolonged use.

2. **Interlocked guards:** Shut down the machine when the guard is not securely in place or is disengaged. The main advantage of this type of guard is that it allows safe access to the machine.

3. **Adjustable guards:** Provide a barrier against a variety of different hazards associated with different production operations. They have the advantage of flexibility. However, they are not dependable barrier as other guards, and they require frequent maintenance and careful adjustment.

4. **Self adjusting guard:** The openings of these barriers are determined by the movement of the stock. As the operator moves the stock into the danger area, the guard is pushed away, providing an opening which is only large enough to admit the stock. After the stock is removed, the guard returns to the rest position. This guard protects the operator by placing a barrier between the danger area and the operator.

- Safeguarding helps manage hazards associated with the use of machinery and equipment, but the need for safe work procedure must not be left out. The safe work procedures covers:

- 1.Adopting safe system of work 2. Equipment inspection and maintenance
- 3.Adequate training and 4. Supervision.

Hazard due to Heat and Temperature

- Heat is the measure of the ability of a substance, or more generally of any physical system, to transfer heat energy to another physical system.
- Temperature is the average movement of the molecule at specify volume.
- Normal Temperature: Average Human temperature is 98.6°F -/+ 0.9°F or 37°C -/+ 0.5 °C.
- Extreme heat is defined as temperatures which hover 10 degrees or more above the average high temperature for a region Extreme heat.
- Very hot and very cold environments can be dangerous to our health.
- Heat-related illness prevention starts by determining if a heat hazard is present in the workplace. Two heat sources contribute to the risk of heat-related illness.

1. Environmental heat is produced by warm or hot surroundings.
2. Metabolic heat, generated by the body, is related to workload (physical activity).

To determine workers' total heat stress, employers must assess both of the above heat sources.

- Factors that have a role in creating an occupational heat stress risk to workers include:

➢ Environmental conditions (such as air temperature, humidity, sunlight, and air speed), especially on sequential days.
➢ Presence of heat sources (e.g., hot tar ovens or furnaces) in the work area.
➢ Level of physical activity, i.e., the workload leading to body heat production.
➢ Use of clothing or protective gear that can reduce the body's ability to lose excess heat.
➢ Individual/personal risk factors.

- Exposure to extreme heat can result in occupational illnesses caused by heat stress, including heat stroke, heat exhaustion, heat syncope, heat cramps, heat rashes, or death.

➢ **Heat Stroke:** Heat Stroke is the most serious heat related disorder. Body becomes unable to control its temperature. Body temperature rapidly rises. Sweating mechanism fails. Body is unable to cool down. Body temperature can rise to 106°F or higher in 10 to 15 minutes. Heat stroke can cause death or permanent disability if emergency treatment is not given.
➢ **Heat Exhaustion**: Workers most prone to heat exhaustion are the elderly, employees with high blood pressure and those working in hot environments. Dehydration causes blood volume to decrease. The body's s response to excessive loss of water and salt. Usually through excessive sweating.
➢ **Heat Cramps**: Heat cramps usually affect workers who sweat a lot during strenuous activity. This sweating depletes the body's salt and moisture levels. Low salt levels in muscles causes painful cramps. Heat cramps may also be a symptom of heat exhaustion.

- Heat can also increase workers' risk of injuries: it may result in sweaty palms, fogged-up safety glasses, and dizziness, and it may reduce brain function responsible for reasoning ability, creating additional safety hazards. Other heat injuries, such as burns, may occur as a result of contact with hot surfaces, steam, or fire.
- To reduce the risks of heat hazard:

➢ Remove or reduce the sources of heat where possible.

➢ **Control the temperature**: Control the temperature using engineering solutions e.g;

- change the processes \\ use fans or air conditioning \\ use physical barriers that reduce exposure to radiant heat

➢ Provide mechanical aids: Provide mechanical aids where possible to reduce the work rate.

➢ Regulate the length of exposure to hot environments by:

- allowing employees to enter only when the temperature is below a set level or at cooler times of the day.
- issuing permits to work that specify how long employees should work in situations where there is a risk.
- providing periodic rest breaks and rest facilities in cooler conditions.

➢ Prevent dehydration: Working in a hot environment causes sweating which helps keep people cool but means losing vital water that must be replaced. Provide cool water in the workplace and encourage workers to drink it frequently in small amounts before, during (this is not possible in some situations eg respiratory protective equipment use or asbestos removal) and after working.

- Provide personal protective equipment: Specialised personal protective clothing is available which incorporates, for example, personal cooling systems or breathable fabrics. This may help protect workers in certain hot environments. Protective clothing or respiratory protective equipment is often provided to protect from a hazard at work, e.g; asbestos. This type of equipment, while protecting the employee from this hazard may expose the employee to heat stress.

- Training: Provide training for workers, especially new and young employees telling them about the risks of heat stress associated with their work, what symptoms to look out for, safe working practices and emergency procedures.

- Acclimatisation: Allow workers to acclimatise to their environment and identify which workers are acclimatised/assessed as fit to work in hot conditions.

- Identify who is at risk: Identify employees who are more susceptible to heat stress either because of an illness/condition or medication that may encourage the early onset of heat stress, e.g; those with heart conditions. Advice may be needed from an occupational health professional or medical practitioner.

- Monitor health: Monitor the health of workers at risk and then seek advice from occupational health professionals with a good working knowledge of the risks associated with working in heat stress situations.

MODULE 5 Safe Practices Rules

- A safe and healthy workplace is one of the keys to the success of any industry. By establishing good health and safety practices in the workplace, an industry is likely to have more motivated and productive employees.
- **The following goals have to be established by any industry**

(1) Provide workers with a safe work environment.
(2) Conduct routine/regular workplace inspections.
(3) Provide Personal Protective Equipment.
(4) Develop and implement safe work procedures and rules.
(5) Provide on-going safety training.
(6) Enforce safety rules and appropriate discipline.
(7) Provide on-going property conservation practices.

- **Employee orientation program**: All new employees must attend the Safety Orientation Session prior to starting work within their assigned area. This session will be conducted under the direction of the Safety Director and in coordination with Human Resources. Upon completion of the Safety Orientation Session, each new employee will be required to acknowledge that they have received, understand, and will abide by the industry's Safety Program. All participants must sign a statement verifying that they have completed the session. This report will be filed in the employee's personnel file. The following topics are covered in the Safety Orientation Session:

1. Company History .2. Safety Program/Policy & Work rules 3. Responsibilities
4. Safety Education/Training 5. Safety Audit/Inspections 6. Accident Reporting/Investigation Requirements
7. First Aid & Blood borne Pathogens 8. Personal Protective Equipment 9. Tool & Equipment Use
10. Material Handling 11. Machine Guarding 12. Hazard Communication 13. Emergency Action

- **Safety Rules:** All safety rules must be obeyed. Failure to do so will result in strict disciplinary action.

1. All injuries must be reported as soon as possible.
2. No horseplay, alcohol, or drugs allowed on premises. No alcohol usage allowed during lunch break.
3. PPE must be worn as prescribed by management.
4. All tools/equipment must be maintained in good condition.
5. Only appropriate tools shall be used for specific jobs.
6. All guards must be kept in place.
7. No spliced electrical cords/wiring allowed.

- **Safety committee**: General functions of the Safety Committee can include:

(1) Identifying workplace hazards. (2) Enforcement of Safety Rules. (3) Measuring safety performance
(4) Reducing frequency/severity of injuries . (5) Creating safety policies
(6) Developing and monitoring safety programs

- **Specific tasks of the Safety Committee can include:**

(1) Conducting self-inspections of the workplace (2) Review employee reports of hazards

(3) Assist in safety training (4) Creating safety incentive programs (5) Publish/distribute safety newsletter
(6) Inspect PPE (7) Post safety posters/slogans on bulletin board (8) Identify Light Duty Jobs

- **Emergency action plan**: The Emergency Action Plan (EAP) is in place to ensure employee safety from fire and other emergency. At the time of an emergency, all employees should know what type of evacuation is necessary and what their role is in carrying out the plan? In some emergencies total and immediate evacuation will be necessary. In other emergencies only partial evacuation may be necessary. Floor plans (maps) and exits have to be posted in each department.
- **Safety Education**: It deals primarily in the development of mind, broadening one's knowledge in the field of safety by understanding the concept or principle of any hazardous material on the job activity. The cause for the hazard or the hazardous property of the material one handles can be ascertained easily through education and then it could be explained even to the uneducated employees through any kind of communication technique. This develops the consciousness, awareness and a state of mental alertness among the workers to identify and prevent the hazardous situations.
- **Safety Training**: Safety training is an extension of safety education which lies effectively in the use of safety work practices and techniques. The general benefits from the safety training are:

1. Training activities indirectly demonstrate company's interest in employees which leads to good human relations at work.
2. Understanding the importance of safety and hence following safe work procedures in the operation of machines, equipment's and handling materials
3. Training saves the time spent by the supervisor to instruct and correct
4. Knowing the techniques of firefighting, first aid, lifting, stacking etc. helps a lot in the accident prevention and in emergencies.

- **Training programmes** on specific areas like fire extinguishing, first aid, noise, industrial hygiene, major hazards control during emergencies, uses of personal protective equipment's must be covered.
- **Training can be given by:**

1. On-Job training 2. Lecture Method 3. Group Discussions 4. Case Studies
5. Learning by doing 6. Demonstration and visit.

Personal Protective Equipment (PPE)

- Personal protective equipment commonly referred to as "PPE "includes all clothing and work accessories designed to protect employees from injury or infection. It refers to the protective clothing, helmets, hard hats, hearing protectors, respirators, goggles or other garments or equipment's meant to protect the wearers' body from injury by heat, chemicals, infection, electrical hazards, airborne particulate matter etc.
- The purpose of personal protective equipment is to reduce employee exposure to hazards when engineering and administrative controls are not effective to reduce these risks.
- PPE does not eliminate the hazard but reduce the employees' risk of exposure to accident causing situations.
- **Personal protective equipment can be broadly classified into**

1. Non - respiratory protective equipment
2. Respiratory protective equipment

- Non- respiratory protective devices include head protectors, eye protectors, hand and arm protectors, foot and leg protectors, body protectors and skin protectors.
- Respiratory protective equipment's include different kinds of breathing apparatus like filter respirators, airline respirators, self- contained breathing apparatus etc.
- When selecting a PPE to reduce a risk to health and safety, the employer should ensure that the PPE is

➢ suitable for the nature of work and any hazard associated.
➢ of suitable size and fit and reasonably comfortable for the person to wear.
➢ maintained, repaired or replaced.
➢ used or worn by the worker, so far as is reasonably practicable.

- **Duties of employees on using PPE**

➢ PPE must be worn and used in accordance with the instructions provided to them.
➢ PPE must be examined before use.
➢ Any defect must be immediately reported to the supervisor.
➢ Employees must take care of the PPE provided to them.

- **Head Protection**: An Injury to the head can pose serious threat to the brain. Therefore, head protection is considered important. Head injuries are usually caused by the falling objects, bumping against a fixed object, contacting exposed electrical conductors etc.

➢ **Safety Helmets**: A safety helmet must be worn where a person may be struck on the head by a falling body, flying objects, overhead spills of hot and corrosive chemicals, electric shock etc. A wide range of accessories can be fitted with the helmets for variable working conditions. The hard shell of the safety helmet is designed to protect the head against impact. Helmets are made out of materials such as fiber-glass reinforced plastic, HDPE, aluminum alloy etc. To provide best protection, a safety helmet must fit properly. Care and Maintenance of helmets are essential. Helmets must be checked regularly for cracks or other damages. Helmets must be cleaned at least once in a month in warm water or recommended cleanser and air dried. The helmet must be protected from direct exposure to extreme conditions of heat and cold, chemicals etc.

➢ **Hard Hats**: Safety hats protect the head from impact, penetration and electrical shock. A hard hat is a type of helmet predominantly used in workplace environments such as construction sites, to protect the head from injury. Hard hats are classified into three categories: Class A - General Service, limited voltage protection Class B - Utility Service, high voltage protection Class C - Special Service, no voltage protection

- Ear Protection: High noise levels are predominant in most industrial settings, carry a very serious impact on the employees. Hearing loss has an impact on the person's quality of life. Hearing loss can also affect the safety of the working environment when a worker can't hear a warning or alarm signal. People working in highly noisy areas must wear ear protection aids.

➢ **Ear Plugs**: An ear plug is a device that is meant to be inserted in the ear canal to protect the wearer from loud noise, intrusion of water, foreign bodies, dust or excessive wind. Most earplugs are made of foam that is inserted into the ear canal. Ear plugs are rated with Noise Reduction Ratings which provide a guide to the noise protection provided by the device. Ear plugs may be better in hot, humid or confined work areas and better for employees who wear other personal protective equipment's. The ear plugs may be disposable or reusable in nature. Disposable ear plugs are meant for onetime usage and made of formable material. Reusable ear plugs are premolded and made of silicone, plastic or rubber.

➢ **Ear Muffs**: Ear muffs are the objects designed to cover a person's ear for protection or for warmth. Ear muffs have cups and cushions that fit securely around the ears, covering them completely, and are held in place by a head band. Thermal ear muffs work in cold environment to keep a person's ear warm. Acoustic ear muffs protect the wearer from extreme noises.

- **Eye and Face Protection**: Eyes are vulnerable to mechanical, chemical and thermal hazards. The employer shall ensure that each affected employee uses appropriate eye or face protection when exposed to eye or face hazards from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, or potentially injurious light radiation. OSHA suggests that eye protection be routinely considered for use by carpenters, electricians, machinists, mechanics, millwrights, plumbers and pipefitters, sheet metal workers and tinsmiths, assemblers, sanders, grinding machine operators, sawyers, welders, laborers, chemical process operators and handlers, and timber cutting and logging workers. Employers of workers in other job categories should decide whether there is a need for eye and face PPE through a hazard assessment. Examples of potential eye or face injuries include:

1. Dust, dirt, metal or wood chips entering the eye from activities such as chipping, grinding, sawing, hammering, the use of power tools or even strong wind forces.
2. Chemical splashes from corrosive substances, hot liquids, solvents or other hazardous solutions.
3. Objects swinging into the eye or face, such as tree limbs, chains, tools or ropes.
4. Radiant energy from welding, harmful rays from the use of lasers or other radiant light (as well as heat, glare, sparks, splash and flying particles).

Eye and face protection choices include the following:

➢ **Safety Glasses**: Safety glasses are the most commonly used form of eye protection. They are basically designed to provide protection from flying particles that may strike the eyes from the front. Ordinary prescription glasses do not provide adequate protection. It must confirm to the standards. All safety glasses should have side shields.

➢ **Goggles:** Goggles are intended for use when protection is needed against chemicals or particles. Impact protection goggles which contain perforations on the sides of goggle are not to be used for chemical splash protection, therefore are not recommended. Splash goggles which contain shielded vents at the top of

the goggle are appropriate for chemical splash protection, and also provide limited eye impact protection. Goggles only protect the eyes, offering no protection for the face and neck.

- **Face Shields**: Full face shields provide the face and throat and partial protection from flying particles and liquid splash. For maximum protection against chemical splash, a full-face shield should be used in combination with chemical splash goggles. Face shields are appropriate as secondary protection when implosion (e.g. vacuum applications) or explosion hazards are present. Face shields which are contoured to protect the sides of the neck as well as frontal protection are preferred.

- Arm and Hand Protection: Arms and hands are vulnerable to cuts, burns, bruises, electrical shock, chemical spills, and amputation.

- **Gloves**: Gloves provide protection for the hands and arms from chemicals, temperature extremes, and abrasion. Their proper selection is vital to their ability to protect. This is especially true when dealing with potential exposure to chemicals. It is imperative to remember that both the thickness and the type of material the glove is manufactured from affect the ability to serve as a barrier against a chemical. Another factor in the selection of gloves is the wearer's need for dexterity. It is often advisable to reduce the size and thickness of the glove to increase the dexterity. Caution is also required when using gloves around moving equipment. Gloves should not be used by anyone whose hands are exposed to moving parts in which their hands could get caught. The following is a general list of the types of gloves:

- Disposable latex gloves \\ Chemical resistant gloves \\ Leather gloves
- Non asbestos heat-resistant gloves \\ Metal-mesh gloves for operations cutters \\\ Cotton gloves.

- **Foot Protection**: The toes, ankles and feet are exposed to a wide range of on the job injuries. Safety shoes and boots provide impact and compression protection for workers who handle heavy materials or work in areas where materials could roll or fall onto their feet. Foot protection is usually in the form of steel-toed work boots, with a steel shank to protect the bottom of the foot from puncture wounds. In wet environments, steel-toed boots that are waterproof and slip-resistant may be necessary. The hazards that workers are exposed to will determine what type of foot protection is most appropriate for the job.

- Respiratory Protection: Respiratory hazards include airborne contaminants such as dusts, mists, fumes and gases or oxygen deficient atmospheres. A respirator is a protective face piece, hood or helmet that is designed to protect the wearer against various harmful airborne agents. Respirators should not be the first choice for respiratory protection in workplaces. They should only be used

- when following the "hierarchy of control" is not possible (elimination, substitution, engineering or administrative controls)
- while engineering controls are being installed or repaired
- when emergencies or other temporary situations arise (e.g., maintenance operations).

The two main types are: 1. air-purifying respirators (APRs) and 2.supplied-air respirators (SARs).

1. **Air-purifying respirators** can remove contaminants in the air that we breathe by filtering out particulates (e.g., dusts, metal fumes, mists, etc.). Other APRs purify air by adsorbing gases or vapors on a sorbent (adsorbing material) in a cartridge or cannister. They are tight-fitting and are available in several forms:

- mouth bit respirator (fits in the mouth and comes with a nose clip to hold nostrils closed - o for escape purposes only)
- quarter-mask (covering the nose and mouth),
- half-face mask (covering the face from the nose to below the chin), or
- full facepiece (covering the face from above the eyes to below the chin). Respirators with a full-face piece also protect the eyes from exposure to irritating chemicals. Examples of **air-purifying respirators (APRs)** include:
- particulate respirators (previously called dust, fume, and mist respirators or masks),
- chemical cartridge respirators that can have a combination of chemical cartridges, along with a dust prefilter: this combination provides protection against different kinds of contaminants in the air
- gas masks (contain more adsorbent than cartridge-type respirators and can provide a higher level of protection than chemical cartridge respirators)
- powered air-purifying respirators (PAPRs).

2. **Supplied-air respirators (SARs)** supply clean air from a compressed air tank or through an airline. This air is not from the work room area. The air supplied in tanks or from compressors must meet certain standards

for purity and moisture content. Supplied-air respirators may have either tight-fitting or loose-fitting respiratory inlets. Respirators with tight-fitting respiratory inlets have half or full facepieces. Types with loose fitting respiratory inlets can be hoods or helmets that cover the head and neck, or loose-fitting facepieces with rubber or fabric side shields. These are supplied with air through airlines. Examples of supplied-air respirators (SARs) include:

- self-contained breathing apparatus (SCBA),
- airline supplied-air respirators,
- protective suits that totally encapsulate the wearer's body and incorporate a life- support system.

3. There are some combinations of airline respirators and SCBAs that allow workers to work for extended periods in oxygen-deficient areas or where there are airborne toxic contaminants. The auxiliary or backup SCBA source allows the worker to escape with an emergency source of air if the airline source fails.
4. There are also combination air-purifying and atmosphere supplying respirators. These will offer worker protection if the supplied-air system fails, if the appropriate air-purifier units are selected. These cannot be used in oxygen-deficient areas or where the air concentration of a contaminant exceeds the IDLH level (i.e., immediately dangerous to life or health). Since filters capture particles, caution must be exercised to always check that these filters are not clogged as it makes it harder for air to pass through and increase the likelihood of contaminated air entering the mask. Cartridges can also become "full" or saturated. It will stop working and "breakthrough" will occur - this term means that the gases or vapors will leak through the cartridge. Both cartridges and filters must be replaced on a regular basis by using the manufacturer's recommendations (usually determined by using warning properties or end-of- service indicators).

Module 06 ERGONOMICS

Ergonomics .. Ergonomics is the science of designing work tasks to fit the worker, keeping in mind the capabilities and limitations of the human body.

- Jobs and tasks that are frustrating, uncomfortable, or inefficient are typically not ergonomically correct.
- An effective ergonomic improvement process seeks to identify and eliminate any deterrent to maximum work capacity, and limit worker fatigue and discomfort while improving process efficiency and productivity.
- Ergonomic problems result in productivity, efficiency, quality, and safety problems. Ergonomic improvements result in productivity, quality, and safety improvements.
- Ergonomics safety ensures that the products, methods, and environment that a worker uses are appropriate to fit the worker's job requirements and personal capabilities.
- The GOAL of ergonomics is to prevent worker fatigue and discomfort that can lead to potential MSDs, and to make the company more competitive and successful in reaching its goals.
- Good Ergonomics = Good Economics
- Proper ergonomics contribute to well-being, efficiency, and long-term health.
- **The principles of ergonomics apply to four primary scenarios in the workplace:**

1. Objects workers use: Make sure the tools or equipment workers use are easy to handle and allow natural movement. Tools and equipment should feel like an extension of the body. They should be easy to grip, of manageable size and weight and in good working order.
2. Work Processes: This addresses any work situation where an employee must perform a series of tasks, often repeatedly. Assembly line work is a classic example. Everything that the worker needs should be close and easy to reach. The movements required to complete the task should be natural and efficient. The necessary equipment should move freely without causing undue strain.
3. Work Spaces or Environments: Here we are concerned with how a person sits, stands, or moves at work. Some examples to consider in an office environment include: The desks should be arranged to encourage good posture. Workers who have to talk on the phone and type at the same time have headsets so they don't have to cradle a phone between their ear and shoulder. Desk should be at the right height .
4. How workers move objects: Teach workers the proper way to lift, pull, and push objects. This is a very simple fix, and yet injuries from poor lifting, pushing, and pulling technique continue to top the charts when it comes to the causes of workplace injuries.

Importance of Ergonomics

a) Increases productivity

- Best ergonomic solution enhances the productivity
- Ergonomic reduces the unwanted tension, awkward position of the body.
- Ergonomic is focused in making the work your easier and comfortable, this thereby reduces any kind of stress, risk and enhances the satisfaction and productivity.

b) Reduces the cost

- Ergonomics can be considered as the one-time investment
- As ergonomics is focused about marinating the better health of the worker it can further reduce the cost of compensation that would be made by the injured or unhealthy staffs.
- It also reduces the indirect and the opportunity cost that could have incurred due to injury.

c) Improves the quality of the work

- Improved ergonomics favors the favorable environment where the workers can work efficiently.
- As the ergonomics improves, level of satisfaction in the quality of the work increases.

d) Others

- Helps to reduce the absenteeism due to more comfort, safety and healthy working environment
- Assurance to the worker as their workplace is safer (acts as the motivation)
- More focus on the working environment and worker's health makes them feel valued and boost of moral.

➢ Ergonomic Injuries/Musculoskeletal Disorder (MSDs)

- Ergonomic injuries or MSDs can affect the muscles, nerves, tendons, ligaments, joints, cartilage and spinal discs.
- Musculoskeletal disorder (MSDs) is also known as the repetitive motion injury.
- MSDs are the condition that can affect muscles, joints and bones.
- MSD are caused due to individual risk factor or ergonomic risk factor.
- MSDs are the single largest category of workplace injuries and are responsible for almost 30% of all worker's compensation costs.

➢ Ergonomic Risk Factors

The major workplace ergonomic risk factors to consider are:

1. High Task Repetition

- ➢ Many work tasks and cycles are repetitive in nature, and are frequently controlled by hourly or daily production targets and work processes.
- ➢ High task repetition, when combined with other risks factors such high force and/or awkward postures, can contribute to the formation of MSD.
- ➢ A job is considered highly repetitive if the cycle time is 30 seconds or less.
- ➢ Control methods to consider:
  - **Engineering Controls** – Eliminating excessive force and awkward posture requirements will reduce worker fatigue and allow high repetition tasks to be performed without a significant increase in MSD risk for most workers.
  - **Work Practice Controls** – Providing safe & effective procedures for completing work tasks can reduce MSD risk. In addition, workers should be trained on proper work technique and encouraged to accept their responsibilities for MSD prevention.
  - **Job Rotation** – Job task enlargement is a way to reduce duration, frequency and severity of MSD risk factors. Workers can rotate between workstations and tasks to avoid prolonged periods of performing a single task, thereby reducing fatigue that can lead to MSD.
  - Counteractive Stretch Breaks – Implement rest or stretch breaks to provide an opportunity for increased circulation needed for recovery.

2. Forceful Exertions

- ➢ Many work tasks require high force loads on the human body. Muscle effort increases in response to high force requirements, increasing associated fatigue which can lead to MSD.
- ➢ Control methods to consider:

- Engineering Controls – Eliminating excessive force requirements will reduce worker fatigue and the risk of MSD formation in most workers. Using mechanical assists, counter balance systems, adjustable height lift tables and workstations, powered equipment and ergonomic tools will reduce work effort and muscle exertions.
- Work Practice Controls – Work process improvements such as using carts and dollies to reduce lifting and carrying demands, sliding objects instead of carrying or lifting, and eliminating any reaching obstruction to reduce the lever arm required to lift the object.
- Proper Body Mechanics – Workers should be trained to use proper lifting and work techniques to reduce force requirements.

3. Repetitive/Sustained Awkward Postures

- Awkward postures place excessive force on joints and overload the muscles and tendons around the effected joint.
- Joints of the body are most efficient when they operate closest to the mid-range motion of the joint. Risk of MSD is increased when joints are worked outside of this mid-range repetitively or for sustained periods of time without adequate recovery time.
- Control methods to consider:

- Engineering Controls – Eliminate or reduce awkward postures with ergonomic modifications that seek to maintain joint range of motion to accomplish work tasks within the mid-range of motion positions for vulnerable joints. Proper ergonomic tools should be utilized that allow workers to maintain optimal joint positions.
- Work Practice Controls – Work procedures that consider and reduce awkward postures should be implemented. In addition, workers should be trained on proper work technique and encouraged to accept their responsibility to use their body properly and to avoid awkward postures whenever possible.
- Job Rotation – Job rotation and job task enlargement is a way to reduce repeated and sustained awkward postures that can lead to MSD.
- Counteractive Stretch Breaks – Implement rest or stretch breaks to provide an opportunity to counteract any repeated or sustained awkward postures and allow for adequate recovery time.

Benefits of Ergonomics

- Here are some of the most notable benefits of ergonomic safety in the workplace:

- Lower injury rates and MSD incidences.
- Reduction in human costs associated with MSDs.
- Reduction in company direct and indirect costs associated with MSDs.
- Improved worker safety.
- Increased worker comfort.
- Reduced worker fatigue.
- Increased productivity from making jobs easier and more comfortable for workers.
- Improved product quality. Studies have shown a corresponding relationship between good ergonomics and improved product quality. On the other hand, poor ergonomics leads to frustrated and fatigued workers that don't do their best work.
- Reduced absences because workers will be less likely to take time off to recover from muscle soreness, fatigue, and MSD-related problems.
- Reduced turnover as workers are more likely to find an ergonomically designed job more satisfying and within their physical capacity.
- Prevention is a shared responsibility. When workers see that the company is serious about eliminating ergonomic risk factors in the workplace, improved worker morale will result and workers will be more likely to address the MSD risk factors under their control.
- Ergonomics plays an important role in building a culture of safety, health, and wellness.

Ergonomic Safety Tips

- Here are some general ergonomic safety tips to help prevent the most prevalent ergonomic hazards:

1. **Workstation improvements**.

- Redesign workstations to eliminate awkward postures.
- Provide adjustable equipment that can be used by workers to allow neutral postures.

- Maintain good body posture.

2. **When transporting and handling**

- Be knowledgeable about body limitations.
- Provide carts for transporting materials to eliminate lifting.
- Require all loads to be labeled with their weight.
- When lifting, keep your back straight and lift with your legs.
- Assign two or more staff to lift heavy objects depending on weight.
- Lift slowly and carefully.
- Don't twist or turn your spine while carrying the load.
- Use shoulder pads to cushion loads carried on the shoulder.
- Use knee pads for kneeling tasks.
- Store materials at waist height to minimize reaching.
- Design containers with handles for easy gripping.

3. **Staff scheduling and training**

- Rotate workers among different tasks to avoid repetitive motions.
- Improve the work schedule to minimize excessive overtime that causes fatigue.
- Increase staff to reduce individual workloads.
- Provide sufficient employee breaks.
- Adequate recovery time can reduce fatigue.
- Provide workers with training on ergonomics policies and procedures.

4. **General housekeeping**

- Follow good housekeeping practices.
- Keep floors free of obstruction.
- Use tools in good condition that fits the hand.
- Properly maintain power tools to reduce exposure to vibration.
- Use gloves to protect against vibration and rough surfaces.
- Always practice proper machine handling.

Ergonomics Principles

There are 10 fundamental principles of ergonomics which are:

1. Work in neutral postures

- Proper posture maintenance is necessary.
- Working too long with "C" curve can cause strain.
- Keeping the proper alignment of neck, hands, wrist are also necessary.

2. Reduce excessive force

- Excessive pressure or force at the joints can cause injury.
- Better to minimize the work that requires more physical labor.

3. Keep everything in reach

- Keeping everything in reach would help in avoiding unneeded stretching and strain.
- More or less this principle is related with maintaining good posture.

4. **Work at proper height**

- Working at right makes things way easier.
- Sometimes height can be maintained by adding extensions or avoiding extensions on the chair or tables.

5. **Reduce excessive motions**

- Repetitive motion needs to be avoided.
- This can cause disorder and numbness in long run.

- Motion scan be reduced by the use of power tools.

6. **Minimize fatigue and static load**

- Fatigue is common in strenuous work.
- Having to hold things for longer period is example of static load.
- Fatigue can be reduced by the intervals and the breaks between the works.

7**. Minimize pressure points**

- One needs to be aware of pressure points.
- Almost everyone of has to sit on chairs that had cushioning, one of the pressure point is behind knees, which happens if air is too high or when you dangle your legs. Pressure point is also created in between your thigh and the bottom of a table when you sit.
- Anti-fatigue mats or insole can be used.

8. **Provide clearance**

- Work area should have enough clearance.
- Let the worker not worry about the bumps that they have to encounter on daily basis.

9. Move, exercise and stretch

- Move and stretch when you can.
- It better to take intervals between the works and stretch and move along.
- Stretching technique may differ and depend on the work one does.

10. Maintain a comfortable environment

- This principle is focused on the other component of the working environment.
- It is concerned about the lightening, space, cool air and many more.

Ergonomic Process

Implementing an ergonomic process is effective in reducing the risk of developing MSDs in high-risk industries as diverse as construction, food processing, firefighting, office jobs, healthcare, transportation and warehousing. The following are important elements of an ergonomic process:

- **Provide Management Support** - A strong commitment by management is critical to the overall success of an ergonomic process. Management should define clear goals and objectives for the ergonomic process, discuss them with their workers, assign responsibilities to designated staff members, and communicate clearly with the workforce.
- **Involve Workers** - A participatory ergonomic approach, where workers are directly involved in worksite assessments, solution development and implementation is the essence of a successful ergonomic process. Workers can:
  - Identify and provide important information about hazards in their workplaces.
  - Assist in the ergonomic process by voicing their concerns and suggestions for reducing exposure to risk factors and by evaluating the changes made as a result of an ergonomic assessment.
- **Provide Training -** Training is an important element in the ergonomic process. It ensures that workers are aware of ergonomics and its benefits, become informed about ergonomics related concerns in the workplace, and understand the importance of reporting early symptoms of MSDs.
- **Identify Problems** - An important step in the ergonomic process is to identify and assess ergonomic problems in the workplace before they result in MSDs.
- **Encourage early reporting of MSD Symptoms** - Early reporting can accelerate the job assessment and improvement process, helping to prevent or reduce the progression of symptoms, the development of serious injuries, and subsequent lost-time claims.
- **Implement Solutions to Control Hazards** - There are many possible solutions that can be implemented to reduce, control or eliminate workplace MSDs.
- **Evaluate Progress** - Established evaluation and corrective action procedures are required to periodically assess the effectiveness of the ergonomic process and to ensure its continuous improvement and long-term success. As an ergonomic process is first developing, assessments should include determining whether goals set for the ergonomic process have been met and determining the success of the implemented ergonomic solutions.