



## ENVIRONMENT MANAGEMENT

### AND

## HEALTH AND SAFETY PLAN

### 1. INTRODUCTION

Construction sites are most hazardous among all work places and the potential is there for anyone to be hurt if the activities are not adequately controlled. Everybody is understandably distressed when a fellow employee is killed or disabled, so the humanitarian basis for safety is apparent. Accidents don't happen but they are caused.

Most accidents can be prevented if works are planned and executed as per laid safety procedures. Various measures are available to improve safety in construction. Several of most important measures can be adopted before the construction is undertaken. Some of these are design, choice of technology and education.

This document comprise of the Environment Management and Health and Safety Plan (EHS Plan) which describes the relevant EHS standards for the execution of project namely as **“Development of Sewage Treatment Plants on PPP basis at Haridwar, Uttarakhand”**.

This EHS Plan will be implemented at project site in line with the requirements of relevant safety standards. It demonstrates the ability to consistently provide concern intended for Safety and Health of its employees and to meet all applicable legal requirements and specifications.

### 2. OBJECTIVE OF EHS PLAN

This EHS Plan aims to enhance health & safety practice at project site and satisfactory performance through effective application of the system, including the processes for the continual improvement of system and the assurance of conformity to objectives set.

This EHS Plan describes various procedures, guideline, system implementation formats, checklists and work instructions. Site Management shall follow this plan, and if necessary modification shall be made as per site specific requirement. This will be accomplished by providing a complete EHS system, methodology and reference during all the stages of the project execution, which is necessary to-

- Provide necessary safety inputs to all personnel & contractors on the development and implementation of project specific safety plan.
- Provide an attitude of personal awareness of safe working practices among all personnel working on the project.
- Identify and incorporate safety consideration as related to construction.
- Identify the risks associated with work and suggest remedial measures with the motto of loss & accident prevention.
- Achieve the prime objective of zero accident and ensure that work place is free from occupational illness.
- Inform all concerned about this plan and to identify the safe reporting line.
- To appraise the client/consultant on intending priority for safety in our project work.



### 3. SCOPE OF WORK

The scope of works covered under this document comprises of the “**Development of Sewage Treatment Plants on PPP basis at Haridwar, Uttarakhand**”.

### 4. TERMS AND DEFINITIONS:-

**Acceptable risk:** Risk that has been reduced to a level that can be tolerated by the organization having regard to its legal obligations.

**Accident:** An unintended occurrence arising out of and in the course of employment of a person resulting in injury.

**Audit:** Systematic, independent and documented process for obtaining “audit evidence” and evaluating it objectively to determine the extent to which “audit criteria” are fulfilled.

**Continual Improvement:** Recurring process of enhancing the Occupational Health and Safety Management System, in order to achieve improvements in overall Occupational Health and Safety performances, consistent with the organization’s Integrated Management System Policy.

**Corrective Action:** Action taken to eliminate the cause of a detected nonconformity or other undesirable situation in order prevents recurrence.

**Document:** Information and its supporting medium.

**First Aid Cases:** An injury which requires the attention of First Aid Providers or Registered Medical Practitioner for medical treatment only, without causing any disablement whether temporary or permanent type. The person will be brought back into the work within the shift in which the injury occurred. This will be recorded in first aid register and is subject to verification by the EHS Representative.

**Hazard:** Source, situation, or act with a potential for harm in terms of human injury or ill health or a combination of these.

**Hazard Identification:** Process of recognizing that a hazard exists and defining its characteristics.

**Ill Health:** Identifiable, adverse physical or mental condition arising from and/or made worse by a work activity and/or work-related situation.

**Incident:** Work-related event(s) in which an injury or ill health (regardless of severity) or fatality occurred or could have occurred.

**Interested Party:** Person or group, inside or outside the work place, concerned with or affected by the Occupational Health and Safety Management System performance of an organization.

**Integrated Management System policy:** Overall intentions and direction of an organization related to its OH&S performance as formally expressed by top management.

**IS:** Indian Standards.

**Man Hours Worked:** The total number of employee-hours worked by all employees working in the site premises. It includes managerial, supervisory, professional, technical, clerical and other workers including the contract labour.

**Non-Conformance:** Non-fulfillment of a requirement



**Occupational Health and Safety:** Conditions and factors that affect, or could affect the health and safety of employees or other workers (including temporary workers and contractor personnel), visitors and any other person in the workplace.

**Occupational Health and Safety Management System:** Part of an organization's management system used to develop and implement its Integrated Management System policy and manage its Occupational Health and Safety risks.

**Occupational Health and Safety Objective:** Occupational Health and Safety Goals, in terms of Occupational Health and Safety performance that an organization sets itself to achieve.

**Occupational Health and Safety Performance:** Measurable results of an organization's management of its OH&S risks.

**Organization:** Company, corporation, firm, enterprise, authority or institution, or part or combination thereof, whether incorporated or not, public or private, that has its own functions and administration.

**Preventive Action:** Action to eliminate the cause of a potential nonconformity, or other undesirable potentially situation.

**Procedure:** Specified way to carry out an activity or process.

**Protective Barricades:** Barricade that alert personnel from exposure of any hazard.

**Record:** Document stating results achieved or providing evidence of activities performed.

**Risk:** Combination of the likelihood of an occurrence of a hazardous event or exposure(s) and the severity of injury or ill health that can be caused by the event or exposure.

**Risk Assessment:** Process of evaluating the risk(s), arising from hazard(s), taking into account the adequacy of any existing controls, and deciding whether or not the risk(s) is acceptable.

**Safety:** Freedom from unacceptable risk of harm.

**Unsafe Act:** The acts or omissions by individual or by a group, which led directly to the incident or accident.

**Unsafe Conditions:** The pre-existing situation, system, equipment or any other attribute that causes the accidents or incidents.

**Work Place:** Any physical location in which work related activities are performed under the control of the organization i.e. Jagjeetpur and Sarai.

**Warning Barricades:** Barricades that alert the person from the exposure of hazard but offer no physical protection.

## 5. ROLES & RESPONSIBILITY

### 5.1 Site In-charge / Project Manager

- Responsible for the total implementation of the Safety code in the project or plant unit.
- Encourage safety and health practices among the employees under his control.
- Do hazard identification for all kind of risks involved in activities under his control.
- Carry out risk assessment as per the company procedure in consultation with H&S Dept.
- Ensure availability & Comply with company's procedures and keep record.



- Ensure compliance with local legislation and reporting to various channels for safety related information. This includes monthly reporting, incidents reporting as per company procedures and accident.
- Ensure the availability of high quality required PPEs at site.

#### 5.2 Safety Officer

- To advise the concerned departments in planning and organizing measures necessary for the effective control of personal injuries
- To recommend on safety aspects in all job studies, and to carry out detailed job safety for the selected jobs.
- To check and evaluate the effectiveness of the action taken or proposed to be taken to prevent personal injuries.
- To provide advice on ensuring high quality and availability of personal protective equipment.
- To provide advice on matters related to carrying out plant safety inspection.
- To carry out plant safety inspection in order to observe the physical condition of work and the work practices and procedures followed by workers and to render advice on measures to be adopted for removing the unsafe actions by workers.
- To investigate all incidents in-order to avoid re-occurrence of incidents and Major Mishaps.
- To render advice on matters related to reporting and investigation of industrial accidents and diseases.
- To investigate the cases on industrial disease contracted and dangerous occurrence.
- To advise on the maintenance of such records as are necessary relating to accidents, dangerous occurrences and industrial diseases.
- To promote setting up of safety committees and act as advisor and catalyst to such committees.
- To organize in association with the concerned departments, campaigns, competitions, contests and other activities which will develop and maintain the interest of workers in establishing and maintaining safe conditions of work and procedures.
- To design and conduct either independently or in collaboration with the training departments suitable training and educational programmes for the prevention of Personal injuries.
- Arranging to send the accident report (See Annexure IX) to Head Office.
- Arranging to send monthly safety statistics

#### 5.3 Construction Manager

Shall be responsible for total implementation of code at site

- Evaluating a suitable course of action in the day-to-day activities for the effective implementation of the safety program.



- Meeting regularly once in a fortnight to discuss and decide the ways and means of eliminating the factors affecting safety.
- To analyze all the activities of the coming fortnight, identifying the possible hazards and finalizing the precautions to be taken.
- To monitor the performance of the safety program and suggesting improvements whenever needed.
- Inspecting the site to locate unsafe conditions, with reference to the self-inspection checklist.
- Investigating all accidents and strengthening the safety program by additional precautions, if any, on the basis of the accident investigation.

#### 5.4 Site Engineer/ Foreman/ Supervisor

- Understanding the Safety Plan fully and follow the same in their day-to-day activities.
- Giving on the job safety instructions to their workmen daily, highlighting the possible hazards in that day's work and the precautions to be taken.
- Identifying and Eliminating all unsafe conditions in their work area.
- Keeping their work area neat and clean, especially at heights, free from loose materials.
- Taking an active part in the safety meetings.

#### 6. SITE ENTRY & SECURITY

- The site shall be fenced all-round with limited & controlled entry/exit facility.
- Suitable number of trained security personnel will be strategically deployed as per site requirements and in accordance of contract conditions.
- The security at gate should maintain separate entry/exit log book for Visitors, Employer staff & Sub-contractors staffs & labors (if any).
- The Visitors shall be given gate pass & safety broacher at the gate and then sent to Employer office for safety induction.
- Un-authorized entry shall be strictly prohibited.

#### 7. EHS INDUCTION, TRAININGS, ACCREDITATION & MOTIVATION:-

- **EHS Induction:** Induction briefings shall be mandatory, covering site EHS rules, Hazard & Risk, emergency procedures, Excavation safety, Fire safety etc are to be delivered to all personnel, prior to deputation to worksite. Inductions and briefings shall include a general element applicable to all personnel working on or visiting the plant site, as well as task-specific induction briefings applicable to the work concerned.
- **Training:** Construction/ Project Manager shall analyze training requirements and initiate a training programme with the help of HR / Admin / Safety dept to demonstrate that all persons employed, including subcontractors, are suitably qualified, competent and fit.

This will include:

- Detailed Job descriptions for all personnel, to include their specific EHS responsibilities.



- Site EHS Awareness Training for Supervisors / Workers / Visitors.
- Assessment and recording of training needs for all personnel, including subcontractor's employees in the workforce, vendor representatives and site visitors.
- A full and formal induction training programme for all Contractor's and subcontractors' employees in the workforce, vendor representatives and site visitors.
- A matrix and schedule of training requirements, covering general, task-specific and EHS-related training, showing the training frequency and interval between refresher courses.
- Timely, competent delivery of training courses.
- **Accreditation:** For commissioning and O&M phase all personnel including subcontractor workmen engaged / intend to enter a confined space or hazardous locations shall be accredited. Authorization is the recognition by the employer of the ability of an employee to safely carry out activities presenting occupational hazards for himself, for his co-workers or for the environment at a given structure for a limited duration.

The authorization is not directly linked to the hierarchical position, or the professional classification.

The authorization involves:

- Issue of an accreditation title
- Training the employee
- Monitoring the accreditation over time
- Defining a framework for action.

Authorization is mandatory for the following activities:

- Electrical substations and equipment
- Confined atmosphere
- Zones with explosion or fire hazard
- Working with Chlorine.
- Working at height

The authorization title is issued by the employer depending on:

- The technical knowledge of the person to be accredited
- The medical fitness of the person to be accredited
- The acquired theoretical and practical knowledge validated at the end of training.
- **Motivation**
  - Safety contests/competitions are being organized.-Award distribution is on National Safety Day.
  - Safety slogan competition-Award on National Safety day.
  - Safety quiz on National Safety day.



- Best Safety performance award on yearly basis (Award distribution is on National Safety Day)

## 8. HAZARD IDENTIFICATION & RISK ASSESSMENT

- All activities at site shall be started after assessing the risk as per our standard procedure. To establish an effective system of control risk assessment shall be done as per the corporate procedure No.: SI RA 001A.
- Minimum three persons shall be involved in the risk assessment process. This includes Plant Manager/Project Manager, Safety Officer & Concern Unit/Activity in-charge.
- In addition to the above professionals, designers /manufacturers/contractors/concerned supervisors can also participate if the Plant Manager thinks that their competence can add value to the assessment process.
- Revision of risk assessment / register shall be done after one year or in case of any change in process / product / machine etc.
- Corporate guidelines for threshold value for residual risk to made available each year & shall be used (<300 for 2008 & thereafter).

### 8.1 MAJOR POTENTIAL HAZARD ASSESSMENT:

The major crisis and emergencies likely to initiate in one or more combinations of the following during construction stages are as follows.

#### Hazards to (People)

- Drowning
- Fall from heights
- Asphyxiation and immediate evacuation from confined spaces
- Adverse Chemical Exposure
- Personnel Emergencies requiring immediate first aid or medical attention
- Major injuries and health effects
- Snake bite
- Any other

#### Hazards to (Process)

- Power Failure
- Process malfunction
- Instrument/ interlock failures resulting into crisis
- Cave in
- Electrocutation / short circuit/ electrical failure/ non-availability of stand by equipments.
- Possible crisis due to failure of civil structure e.g. crack, corrosion, civil structure stability assessment and prevention of crisis.



## **Hazards to (Equipment Failure)**

- Failure of equipment resulting is property damage e.g. Gas release, Chemical spills, Fire in flammable material, Electrical fire & Failure of lifting devices and material handling equipments,

## **Material related Emergencies**

- Gas releases
- Explosion

## **Environment Related Emergencies**

- Gas release
- Fire/ Explosion
- Chemical, fuel, oil spills

## **Natural Disaster**

- Flooding
- Earthquake
- Lightning
- Storm
- Sabotage

## **Others**

- Labour / Community unrest
- Political interference
- Threats of any kind

## **8.2 REVIEW OF HAZARDS IDENTIFICATION, RISK ASSESSMENT & RISK CONTROL**

Prior to start of execution or during the due course of execution, site will carry out the Risk Assessment exercise. Depending upon the risk level of each hazard, appropriate control measures will be proposed keeping in view of various legal, specifications and contractual requirements.

The site management should keep its documentation, data & records concerning the identification of hazards & the assessment & controls of risks up –to –date in respect of it are on - going activities & also extend them to cover new developments & new or modified activities, before those are introduced.

The hazards identification, risk assessment, & risk control process should be reviewed at the pre-determined time or period. The period can vary depending upon the following considerations: -

1. The nature of the hazards.
2. The magnitude of the risk



3. Changes from the normal operations.
4. Changes in raw materials, chemicals etc.

#### **Legal & Other Requirements:**

The site management should identify and follow the various legal and other statutory requirements applicable during the course of execution and keep up date in the form of "Register of Regulation" (ROR) to ensure the compliance with all applicable statutory regulatory and other requirements.

The site should also identify and follow other than specified legal and other contractual requirements applicable at site during course of execution.

#### **Objectives and program:**

In order to meet the requirements of the Integrated Management System Policy the following objectives have been set.

1. Minimize risk to our employees and other interested parties who may be exposed to OH & S risks associated with our activities.
2. Continual improvement of the OH & S Management System.
3. Reducing the frequency of all accidents and incidents and minimize the days lost.
4. Train and retrain the Site Personnel for enhancing their competence and expertise.
5. Develop use of Personal Protective Equipment (PPE) and improve safety culture.
6. Integrate OH & S with other business processes.

The site management should prepare target plan with a reasonable & achievable time scale considering its legal & other requirements, OH&S hazards & risks, operational control measures etc. Suitable indicators should also be defined for each OH & S objectives. These indicators should allow for the monitoring of the implementation of the objectives & targets.

## **9. PERSONAL PROTECTIVE EQUIPMENT (PPE)**

Every site worker & visitor shall be provided with a full set of personal protective equipment for use at all time including safety helmet, safety shoes and other specific work related eye, ear & hand protection etc. All site workers and visitors shall be required to wear PPE while working on the site, except in the offices. Adequate signage shall be displayed at site for communicating to all e.g. unauthorized entry restricted, PPE is to be worn at all times.

Safety appliances play a vital role in protecting the workmen from injury during execution of jobs. Some of the important safety appliances are listed below. They must be in good condition and conform to the EN or equivalent standards.

<b>Protection for</b>	<b>PPE to be used</b>	<b>Confirming to EN / Equivalent Standard</b>	<b>PPE Protecting from</b>
<b>Head</b>	Safety Helmet	IS: 2925 or EN 397 or equivalent applicable std.	Falling objects and hitting against structures / equipment / overhead hazards
<b>Eyes</b>	Eye protectors	EN 166 or equivalent Applicable std.	Flying objects, splashes, sprays



Protection for	PPE to be used	Confirming to EN / Equivalent Standard	PPE Protecting from
Nose	Anti dust mask	EN 149	Dusty environment
Hands	Electric insulating gloves	EN 60903/ Applicable std – suitable class	Electric shock
	Protective gloves	EN 388:1994/ or equivalent applicable std.	Mechanical risk
	Protective gloves	EN 374 or equivalent applicable std.	Protection against chemical or Microorganism
	Protective gloves	EN 511:1994 or equivalent applicable std.	Cold
Foot	Safety Shoes	EN 345 or equivalent applicable std.	Falling object, striking against object
Ears	Ear plugs Ear muffs	EN 352-2:1993 or equivalent applicable std. EN 352-1:1993 or equivalent applicable std	High noise area
	Ear muff attached to safety helmet	EN 352-3-1997/ or equivalent applicable std.	High noise area
Falls	Full body Safety Harness	EN 361:1992/ or equivalent applicable std.	Fall from height
Respiratory System	SCBA	EN: 137 or equivalent applicable std.	Toxic gas leaks, smoke, emergencies minimum two set with one stand by cylinder
	Emergency escape breathing apparatus	EN 1146 or equivalent applicable std.	Toxic gas leaks, smoke, emergencies for escape only (two numbers)
	Full face Mask	EN 140/1998 or equivalent applicable std.	
	Cartridge for full face mask	3M 6002 Acid/ Gas filter cartridge or 3M 6009 Filter cartridge/ or equivalent applicable std.	Escape from chlorine, hydrogen chloride, sulfur dioxide, or chlorine dioxide environment

## 9.1 Protection from Chlorine Gas

Protection from chlorine gas must be provided first of all for the respiratory system followed closely by protection for the eyes. This normally takes the form of a full mask with appropriate cartridge or fresh air supply system (SCBA). Protection for the rest of the body only becomes necessary if the chlorine gas concentration is high and the exposure period is extended.



A suitable gas mask will be available to every person involved in chlorine handling. Respiratory protective equipment will be carefully maintained and kept in clean, dry cabinets, properly protected by bags. Cleaning and inspection of respirators by a competent person is necessary after each occasion on which the apparatus is used.

Canister type mask should never be used in case of leakage of chlorine, oxygen deficient atmosphere and other likely adverse atmosphere.

## 9.2 Protection from H<sub>2</sub>S Gas

- Hydrogen sulphide is a colourless, flammable, extremely hazardous gas with a rotten egg smell. Some common names for the gas include Sewer gas, Stink damp, Manure gas. Hydrogen Sulphide gas is produced by bacterial breakdown of organic materials and human and animal wastes (Sewage).
- Hydrogen sulphide is heavier than air and may travel along the ground. It collects in low lying, enclosed & poorly ventilated areas such as manholes, basements, sewer lines, manure pits etc.
- The primary route of exposure is inhalation and the gas is rapidly absorbed by the lungs.
- People can smell the “rotten egg” odor of hydrogen sulphide at low concentrations in air. However with continuous low-level exposure, or at high concentrations, a person loses his/her ability to smell the gas (Olfactory Fatigue). This can happen very rapidly and at higher concentrations, the ability to smell the gas can be lost instantaneously. Therefore, DO NOT rely on your sense of smell to indicate the continuing presence of hydrogen sulphide or to warn the hazardous concentrations.
- In addition hydrogen sulphide is a highly flammable gas and gas/air mixture can be explosive. It may travel to source of ignition and flash back. On ignition it produces toxic vapours and gases such as sulphur dioxide.
- Hydrogen sulphide is an irritant and chemical asphyxiant with effect both on oxygen utilization and the central nervous system.
- Low concentrations irritate eyes, nose, throat and respiratory system (e.g. - burning/tearing of eyes, cough, shortness of breath). The effect can be delayed for several hours or sometimes several days, when working in low concentrations. Repeated and prolonged exposures may cause eye inflammations, headache, fatigue, irritability, digestive disturbances and weight loss.
- Moderate concentrations can cause more severe eye and respiratory irritation including coughing, accumulation of fluid in lungs, difficulty breathing, dizziness, nausea, vomiting etc.
- High concentration can cause shock, convulsions, inability to breathe, extremely rapid unconsciousness, coma and death. Effects can occur within a few breaths, and possibly in a single breath.
- **Protection against H<sub>2</sub>S exposure:** Before entering areas where hydrogen sulfide may be present:
  - Air must be tested for the presence and concentration of hydrogen sulfide by a qualified



person using air monitoring equipment, such as hydrogen sulfide detector tubes or a multi-gas meter that detects the gas.

- Testing should also determine if explosion precautions are necessary.
- If the gas is present, the space/area must be ventilated continually to remove the gas.
- If the gas cannot be removed, the person entering the space/area must use appropriate respiratory protection and any other necessary personal protective equipment, rescue and communication equipment.

- **Entering dangerous H<sub>2</sub>S atmospheres:**

- A level of H<sub>2</sub>S gas at or above 100 ppm is Immediately Dangerous to Life and Health (IDLH). Entry into IDLH atmospheres can only be made using:
  - 1) a full face piece pressure demand self-contained breathing apparatus (SCBA) with a minimum service life of thirty minutes, or
  - 2) a combination full face piece pressure demand supplied-air respirator with an auxiliary self-contained air supply.
- If H<sub>2</sub>S levels are below 100 ppm, an air-purifying respirator may be used, assuming the filter cartridge/canister is appropriate for hydrogen sulfide. A full face piece respirator will prevent eye irritation.
- Workers in areas containing hydrogen sulfide must be monitored for signs of over exposure.
- NEVER attempt a rescue in an area that may contain hydrogen sulfide without using appropriate respiratory protection and without being trained to perform such a rescue.

### 9.3 Respiratory and resuscitation equipment

Where required adequate number of respiratory equipment shall be provided and employee shall be trained for its use. Ensure respiratory equipment suitable for the type of operation for which is to be used. This equipment shall maintain in good condition and shall furnish the means for its continued efficient working condition. Regular inspection, cleaning and sterilization of such equipment shall be carried out in regular intervals it will be kept in an accessible closed container.

The respiratory equipment shall be either of the escape set type, Self contained Breathing Apparatus, where it is provided for possible emergency use, or working sets where work has to be carried out in conditions where toxic gases are present or where there may be deficiency of oxygen identified by the HSE officer or his appointed staff. Detail risk assessment shall be carried out for the activity

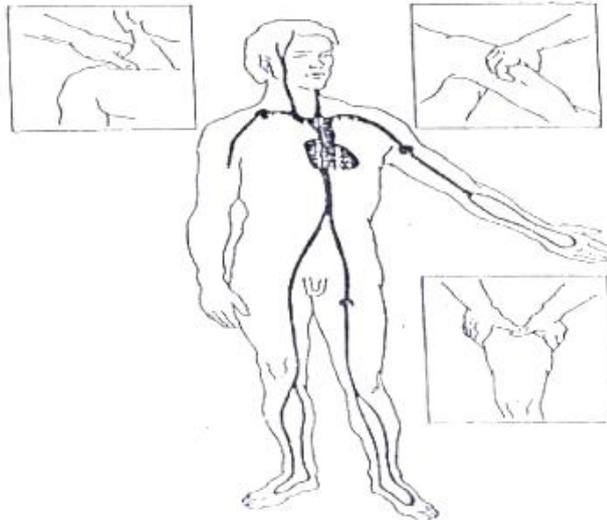
All people who may be required to use such equipment shall be adequately trained, authorized and record will be maintained.

### 10. FIRST AID

First aid is an immediate and temporary care given to the victim of an accident or sudden illness until the service of the Doctor can be obtained. It is important for the first aiders to know not only what to do but also what not to do. Improper and careless moving of the victim may increase the severity of the injury and may even cause death.



Great haste in giving first aid is usually unnecessary and sometimes harmful. However, in construction work there are two cases where great speed is necessary. They are (a) cases of severe bleeding and (b) cases where breathing is suspended requiring artificial respiration.



Main Points of Compression of major arteries

**Main Points of Compression of major arteries (Fig. 1)**

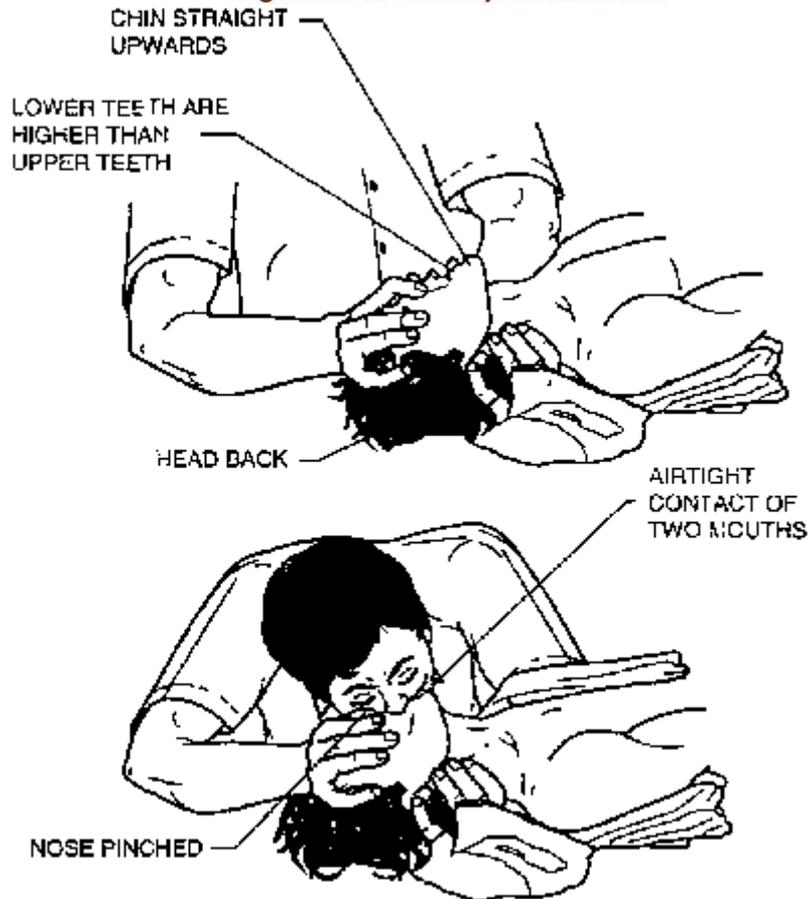
## 10.1 Bleeding

Bleeding usually is best controlled by direct pressure applied to the wound with a sterile dressing or any cloth (cleaner the better); the bleeding limb (arm or leg) slightly above keeping the victim in lying position will control the bleeding to certain extent. Bleeding can be completely controlled by applying finger pressure against the artery, which supplies blood to the bleeding area. Pressure point is given in the fig. 1.

Direct pressure on the wound should always be applied in addition to pressure on the artery.

## 10.2 Artificial Respiration

In cases of electric shock, drowning, gas poisoning, suffocation, etc. where breathing has stopped, immediate action is necessary. Artificial respiration shall be given using resuscitator however mouth to mouth respiration shall be started (as shown in fig. 2) without any time loss. Until the victim starts breathing on his own or he is brought to the doctor, artificial respiration will be continued.



**Mouth-to-mouth artificial respiration (Fig. 2)**

- 1) Lay the victim flat on his back and place a roll of clothing under his shoulders to ensure that his head is thrown well back. Tilt the victim's head back so that the chin points straight upward.
- 2) Grasp victim's jaw as shown and raise it upward until lower teeth are higher than upper teeth; or place fingers on both sides of jaw near ear lobes and pull upward. Maintain jaw position throughout the artificial respiration to prevent tongue from blocking the air passage.
- 3) Take a deep breath and place your mouth over victim's mouth as shown making airtight contact. Pinch the victim's nose shut with thumb and forefinger. If you dislike direct contact, place a porous cloth between your and victim's mouth. For an infant, place your mouth over its mouth and nose.
- 4) Blow into victim's mouth (gently in the case of an infant) until his chest rises. Remove your mouth and release the hold on the nose, to let him exhale, turning your head to hear out-rush of air. The first 8 to 10 breaths shall be as rapid as victim responds; thereafter rate will be slowed to about 12 times a minute (20 times for an infant).

**Note:**

- (a) If air cannot be blown in, check position of victim's head and jaw and re-check mouth for obstructions, then try again more forcefully. If chest still does not rise, turn victim's face down and strike his back sharply to dislodge obstructions.
- (b) Sometimes air enters Victim's stomach evidenced by swelling stomach. Expel air by gently pressing stomach during exhalation period.



## 10.3 Fractures

In case of visible fracture and even a suspected fracture, the adjacent joints will be immobilized. If the fracture is accompanied by bleeding, it will be controlled as said earlier. While carrying the victim or while transporting the victim to the Doctor, care will be taken not to disturb the fractured bone.

## 10.4 First Aid Equipment

A fully equipped first aid box will be available as near the site as possible with adequate supply of various types of sterilized dressing, Potassium permanganate solution or crystals burn Ointment, Dettol, snakebite lancet and splints etc. An artificial resuscitator will be of great help while dealing with electric shock cases where the victim stops breathing immediately. In these cases with the use of resuscitator breathing can be revived in almost all cases. Contents of the first aid box will be replenished as and when required.

Adequate numbers of personnel including sub contractor staff, Safety officer shall be trained in occupational site first aid.

Construction Manager shall ensure that emergency vehicle should readily available during the working hours.

## 11. FIRE PREVENTION & CONTROL

Basically fire is a chemical reaction. Whenever fire occurs there is combustion or burning, in other words, oxidation of substance accompanied by heat, light and smoke. Three things are necessary for fire to occur Fuel, Heat and Oxygen. The danger of fire is greater during the period of construction than it is after the completion. To eliminate the causes of fire, it is important to locate how and where fire starts. The maximum frequency of fire cause is Electrical. There are various other causes like Smoking, Hot work etc.

There shall be no fire catching materials near electrical installations, hot works etc. Diesel or other oil must be kept away from hot works & electrical installations.

- Combustible and flammable materials shall be stored in isolated locations away from buildings and operating equipments.
- Flammable liquid shall be stored and transported only in approved metal safety cans on which the contents are clearly marked.
- Oxygen and acetylene cylinders must be stored in separate compartments and always in upright position as well as secured to avoid tipping over. The storage place shall be located at least 6 meters away from any buildings any flammable liquid storage area.

**Suitable quantity of fire extinguishers shall be maintained for each class as per the fire potential.**

CLASS A FIRES - Wood, Textiles and paper.

CLASS B FIRES - Oil, petroleum, solvents, grease paint & the like.

CLASS C FIRES - Gaseous substance under pressure.

CLASS D FIRES - Reactive, chemicals, active, metals and the like.

CLASS E FIRES - Electrical equipments, delicate machines & the like.



All extinguishers provided at site shall be inspected periodically and maintained in good condition all the time.

## 12. GENERAL ELECTRICAL SAFETY

Electricity has long been recognized as a serious workplace hazard, exposing employees to electrocution, burns, fires & explosions. It contributes 10% of on the job fatalities every year. All electrical accidents are preventable! If the electrical equipments are designed, installed, operated and maintained as per approved codes of practices.

- Construction power supply shall be obtained by us only if the temporary power supply board installation conforms to I.E Regulation.
- All electric supply lines and apparatus shall be of sufficient ratings.
- The DB and all switches must be kept in temporary shed/hoods to prevent from rainwater spray.
- A danger notice in Hindi or English & local language with a sign of skull & bones (as specified in IS: 2551) shall be fixed permanently on every medium, high & extra-high voltage installations.
- Every person working on Electrical installations or on electric supply line shall be provided with electrical hand gloves & electrical shock proof shoes of appropriate capacity, safety helmet and other PPEs according to the requirement.
- No person shall work on any live electric supply line or apparatus or no person shall assist such person on work, unless he is authorized for doing so.
- Flexible cables shall not be used for electrical appliances or tools unless they are double insulated and adequately protected from mechanical damage.
- Every installation including sub-station or any other structure having more than one feed shall be distinguishable from other installations by means of an identification of permanent nature.
- All electric circuits & apparatus shall be so arranged that there is no danger of becoming accidentally charged of any part or thereof to any voltage beyond the limit for which they are intended.
- If AC & DC circuits are installed on the same support they shall be arranged/ separated and protected that they shall not come in to contact with each other when live.
- Near transformers & DG sets provision of DCP 10 kg fire-extinguisher and at main panel CO2 4.5 kg fire-extinguisher shall be installed & maintained. First-aid box & electrical hand-gloves of appropriate capacity shall be kept available in sufficient quantity.
- Procedure for CPR shall be displayed in HINDI or English and local language at prominent places.
- All DG sets, Main Panels, Distribution panels & earth pits shall be tested & inspected on monthly basis by electrical engineer/ authorized electricians and report of the same shall be maintained.



- All welding machines, electrode heaters, portable grinders shall be inspected & validated by electrical/mechanical engineer at every interval of one month.
- **ELCB** shall be provided on every distribution panels, mail panel and where-ever required.
- **Body- Earthing-** All non-current carrying metal parts of every panel, welding machines or other such equipments associated with high voltage installations shall be effectively earthed to an appropriate grounding system.
- All metal support and all reinforced and pre-stressed cement concrete supports of overhead lines and metallic fittings attached thereto shall be permanently and effectively earthed.
- **Appointment of Authorized Electrical Person** – Any electrical job shall be carried out by an authorized electrical person only.
- **Insertion of Loose Wires in Sockets:** This dangerous practice is the cause of most of the accidents in job sites. These practices must be avoided at site. Adequate three pin top must be used.
- **High Earth Pit Resistance:** The combined resistance of the earth mat will be less than 0.5 ohms. If the combined resistance of the earth grid system is higher than 0.6 ohms, the Electrical department may be contacted. The earth grid has to be inter-connected with main earth grid for construction power system.
- Continuity of Earth resistance shall also be regularly checked.
- Maintenance Work on Electrical/ Mechanical Equipment: Whenever Maintenance work is to be done on any electrical/ mechanical equipment Lock out / Tag out procedure must be followed for avoiding any incidents.

## 13. SAFETY PROCEDURES

### 13.1 EXCAVATION & OTHER RELATED WORKS

- Before starting the excavation the concern engineer shall make a detailed plan of excavation which show the machineries to be used, depth of excavation, detail of underground utilities, slop / bench / shoring to be maintained according to the soil condition, type of barricading required, entry / egress arrangement, working space at the bottom of excavation, location of excavated earth to be dumped etc.
- Sides of all excavations must be sloped to a safe angle not steeper than the angle of repose of the particular soil. If it is not possible to give a proper slope, the sides of excavation, where there is a danger of fall or dislodgment of earth or any material shall be securely supported by shoring. Where the excavation is being carried out with an excavator step down procedure will be followed.
- All effort shall be made to locate and mark all underground utilities (Water / Gas pipe lines, Electric / telephone Cables etc.). Adequate precaution & care shall be taken while working near to overhead / underground electrical lines. Once the underground utilities identified, Isolate these from source & ensure **NO FLOW** by providing Lockout /Tag Out.
- No material or load shall be placed or stacked near the edge of excavation or opening in the ground. The excavated material shall not be placed within 1.5 m of the trench or half the depth of the trench whichever is more.



- No excavation shall be started near erected scaffold or no scaffold shall be erected near excavated trench or pit. Minimum 1.5 m distance shall be maintained in these respects.
- Every accessible part of an excavation, pit or opening in the ground shall be suitably fenced with a barrier upped a height of 1 M.
- Cutting shall be done from top to bottom. NO undercutting of side of excavation shall be allowed.
- All narrow trenches 1.2 M or more deep shall at all time supplied with at least one ladder or adequate ramp for access/egress. Ladder will be extended from bottom of the trench to at least 1 M, above the surface of the ground.
- Any excavation or ditch more than 1.5 M deep must be properly shored if angle of repose is not given, before any worker is permitted to work in it. All timber / channels and planks used therein shall be inspected by a competent person. Undercutting of banks shall not be permitted.
- No machinery, crane or mobile equipment shall be positioned or operated within 1.5mtr of the edge of excavation.
- Pick and shovel people working in excavations will be kept far enough apart to prevent injury to one another.
- All workmen working inside the pit shall necessarily wear safety helmets, Safety shoes or gum-boot and reflective jackets.
- If there is any water seepage from side wall, stop the activity and rectify the condition then restart the work. Ingress of water shall be prevented at any cost. Water seepage is one of major causes of soil collapse.
- Dewatering of the pit shall be done immediately to avoid backflow resulting in soil collapse.
- Only trained and authorized persons shall operate the earth moving equipments.
- All vehicles shall be fitted with audible reverse alarm & maintained in good working condition. Reversing shall be done only when there is adequate rear view visibility or under the direction of a banks men.
- Deputation of trained banks man shall be ensured with all earthmoving equipments. All earthmovers operators/drivers/ banks men will equipped with high visibility vest.
- Inspect the site daily at the start of each shift following a rainstorm (as needed throughout the shift) or after any other hazard-increasing event.
- Maintain protective measure of soil collapse (sloping, shoring or benching) as per the requirement of soil texture.

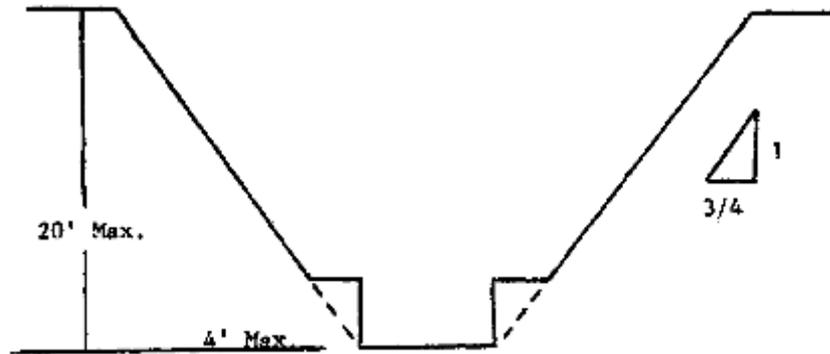
### **PROTECTIVE SYSTEM FOR EXCAVATION EMBARKMENT (Sloping, Benching & Shoring)**

For excavation following protection system will be considered as per evaluation of the soil condition & IS – 3764

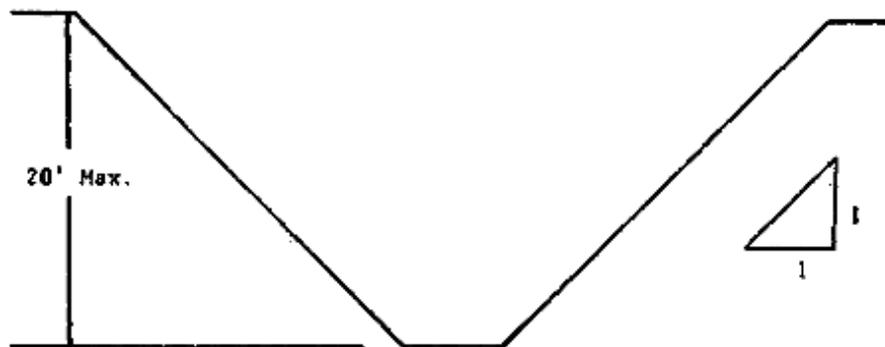


#### ▪ Sloping

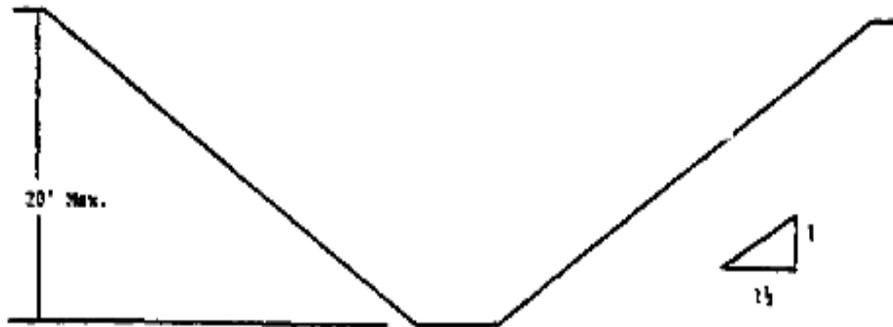
- Sloping as per nature of soil conditions or angle of repose
- **Type A** soil includes cohesive soils with unconfined compressive strength of 15 tons per square foot (126 kilograms per square meter) or greater (unless the soil is fissured due to vibration, or has been previously disturbed or subject to other factors that would require it to be classified as a less stable material). Example of Type A cohesive soils are clay, silty clay, sandy clay, clay loam, etc. When excavating in Type A soil, the maximum allowable slope is  $\frac{3}{4}$  horizontal to 1 vertical (53 degrees).



- **Type B** soil includes cohesive soils with unconfined compressive strength greater than 0.5 tons per square foot (42 kilograms per square meter) but less than 1.5 tons per square foot (126 kilograms per square meter). Example of Type B soil are angular gravel, silt, silt loam, etc. When excavating in Type B soil, the maximum allowable slope is 1 horizontal to 1 vertical (45 degrees).



- **Type C** soils includes soils with unconfined compressive strength of 0.5 tons or less per square foot (42 kilograms per square meter). Type C soil includes granular soils such as gravel, sand & loamy sand, submerged soil, etc. When excavating in Type C soil, the maximum allowable slope is 1-1/2 horizontal to 1 vertical (34 degrees).

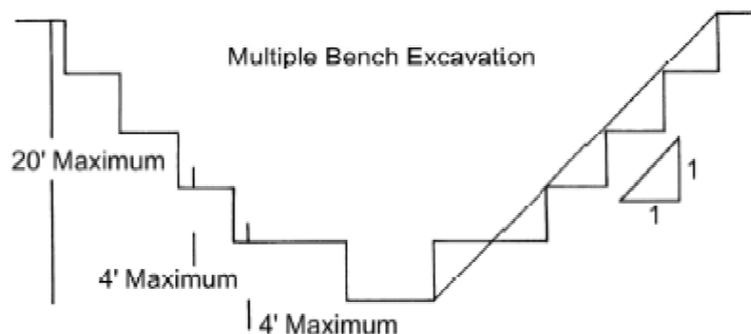


## MAXIMUM ALLOWABLE SLOPES

SOIL OR ROCK TYPE		MAXIMUM ALLOWABLE SLOPES (H:V) (1) FOR EXCAVATIONS LESS THAN 20 FEET DEEP(3)	
STABLE	ROCK	VERTICAL	(90°)
TYPE	A	3/4:1	(53°)
TYPE	B	1:1	(45°)
TYPE	C	1 1/2:1	(34°)

### ▪ Benching

The Type of soil determines the horizontal to vertical ratio of the benching side. As a general rule the vertical height of the trench must not exceed 1.2 meter for the first bench, sub sequent benches may be up to a height of maximum 1.5 meter. All sub sequent benches must be below the maximum allowable slope for that soil type. Preferably Benching will be done in 1:1 ratio (1.5 Meter Vertical to 1.5 Meter Horizontal)

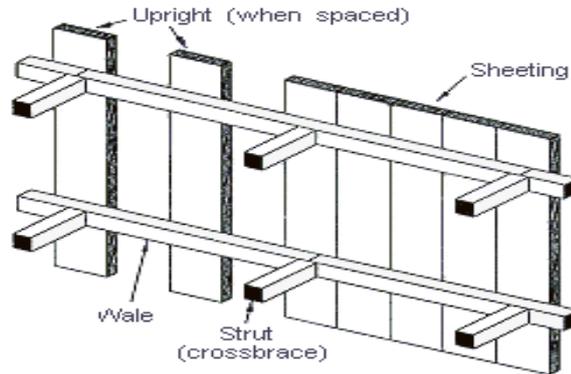


### ▪ Shoring

Shoring is the provision of support system for trench faces used to prevent the movement of soil, underground utilities, roadways & foundations. Shoring or shielding is used, when the location or depth of the cut makes sloping back to the maximum allowable slope impracticable. Shoring systems consist of posts, Wales, struts & sheeting. There are two basic types of shoring Timber & Aluminum Hydraulic shoring.



#### TIMBER SHORING.

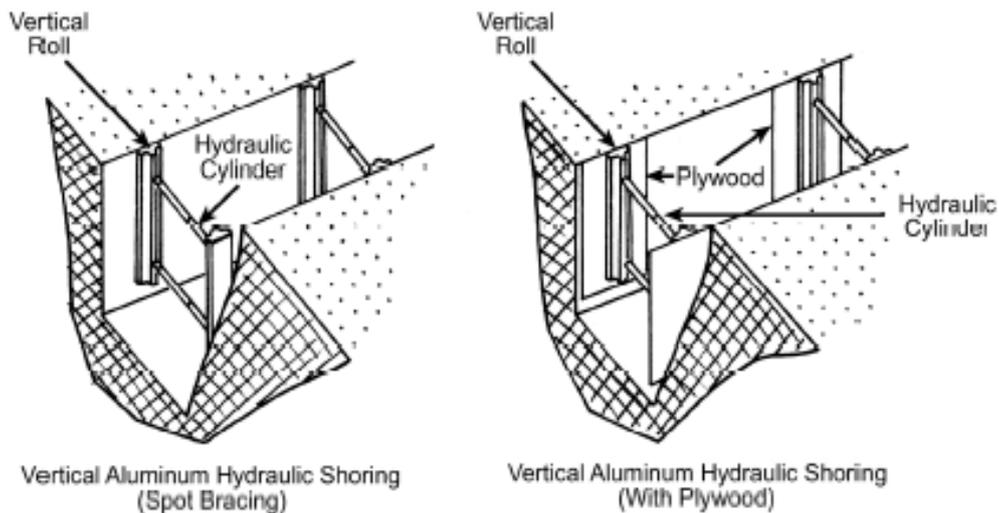


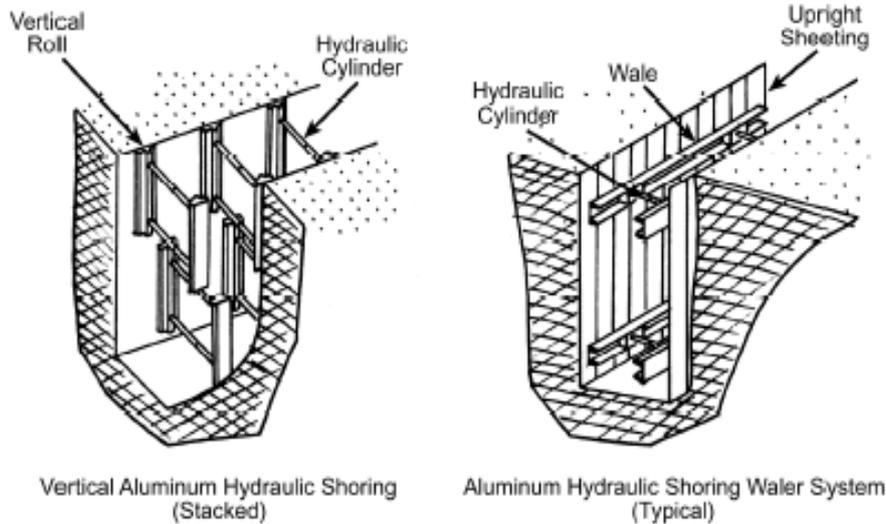
**A) Hydraulic Shoring:** The trend today is toward the use of hydraulic shoring, a prefabricated strut and/or wale system manufactured of aluminum or steel. Hydraulic shoring provides a critical safety advantage over timber shoring because workers do not have to enter the trench to install or remove hydraulic shoring. Other advantages of most hydraulic systems are that they:

- Are light enough to be installed by one worker;
- Are gauge-regulated to ensure even distribution of pressure along the trench line;
- Can have their trench faces "preloaded" to use the soil's natural cohesion to prevent movement; and
- Can be adapted easily to various trench depths and widths.

All shoring will be installed from the top down and removed from the bottom up. Hydraulic shoring will be checked at least once per shift for leaking hoses and/or cylinders, broken connections, cracked nipples, bent bases, and any other damaged or defective parts.

#### SHORING VARIATIONS: TYPICAL ALUMINUM HYDRAULIC SHORING INSTALLATIONS

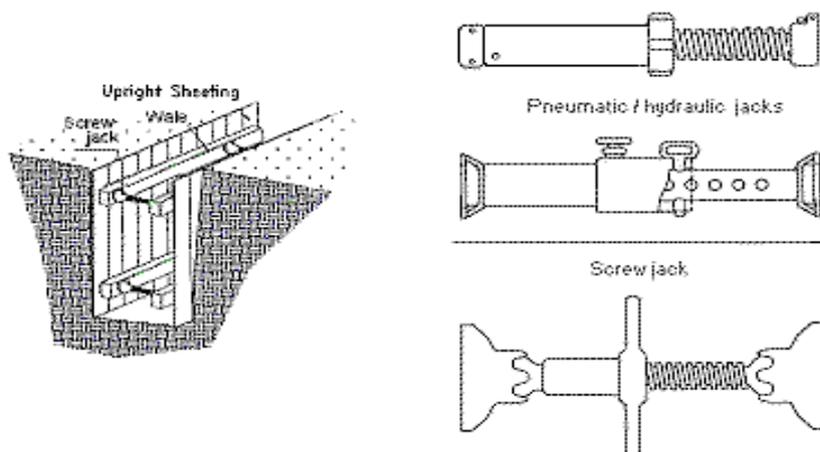




**B) Pneumatic Shoring:** It works in a manner similar to hydraulic shoring. The primary difference is that pneumatic shoring uses air pressure in place of hydraulic pressure. A disadvantage to the use of pneumatic shoring is that an air compressor must be on site.

- 1) **Screw Jacks.** Screw jack systems differ from hydraulic and pneumatic systems in that the struts of a screw jack system must be adjusted manually. This creates a hazard because the worker is required to be in the trench in order to adjust the strut. In addition, uniform "preloading" cannot be achieved with screw jacks, and their weight creates handling difficulties.
- 2) **Single-Cylinder Hydraulic Shores.** Shores of this type are generally used in a water system, as an assist to timber shoring systems, and in shallow trenches where face stability is required.

## SHORING VARIATIONS



## 13.2 SCAFFOLDING ERECTION, DISMANTLING & LADDERS

- Wooden scaffolding shall not be used at construction sites. Only standard steel scaffolds with base plates & bracings shall be used.
- Out of several available scaffolds like H-Frame, coupler (Cop-lock) etc scaffolds; Cup-lock scaffolds shall be preferred.

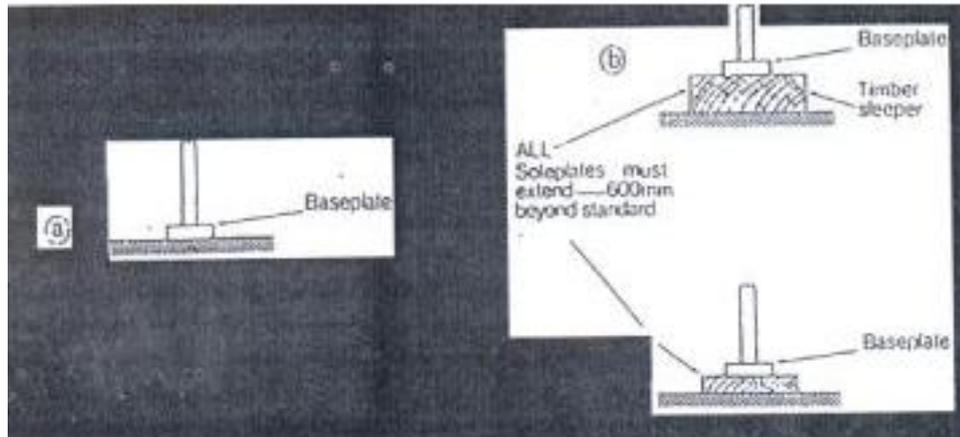


- The thickness of metal of steel pipes used as vertical &
- Horizontal members of scaffolds shall not be less than 3mm.
- Safety factor adopted in the design and erecting of scaffolds shall not be less than 4.
- Dropping or throwing materials from the top and from bottom to top should not be entertained. A rope shall be used for that purpose.
- Scaffolds shall be plumbed & leveled. It shall also be sufficiently supported, anchored or braced in order to avoid toppling.
- The maximum height of the scaffold shall not be more than 3 times of the minimum base dimension unless it is supported from sides, anchored or tied with fixed structure.
- Scaffoldings having more than 10mtr height shall be secured with fixed structure for stability at first and then at every 8mtr.
- Provide landing platform with standard hand railings at every 9mtr of height.
- The working platform of scaffolds shall be completely planked, guarded (mid-rail & hand-rail) and have proper access arrangement.
- Ladder shall not be used for access for heavy works like concrete at heights and taking equipments like vibrator etc. It shall only be used for light works. For heavy works, staging steps shall be made of maximum 250mm risers.
- If ladder is used for access, it shall be made of light & sound metal and all other ladder safety measures shall be followed.
- Scaffoldings shall be inspected after erection by activity engineer & Scaff-tag shall be displayed to show the safe / unsafe status of scaffolds.
- Scaffolds shall be re-inspected after any change in scaffold, after heavy rain or wind and on weekly basis.
- No loose materials shall be left on the platform. Place the tools in toolbox and other items in basket.
- Don't connect return cable of welding machine with the scaffold.
- Take care of overhead electric lines. Always keep 3mtr away from the overhead electric lines.
- Don't start excavation near the erected scaffolds. Any earth digging shall be 2mtr away from the base of scaffold.

#### **a. Scaffolding Erection:**

- Scaffolding erection shall be done by competent scaffolders only.
- Scaffolding shall not be erected vertically below overhead LT/HT power lines. If scaffolding is erected near HT/LT lines, it must be at least 10mtr away horizontally.
- Scaffolds shall be erected on leveled & firm ground only. If surface is not leveled & firm, it will be prepared accordingly.

- Once the surface is ready, sole plates have to be kept. It can be a timber sleeper or steel plate. Sole plates will be long enough to hold at least two vertical pipes and should extend 600 mm beyond the vertical pipes. Sole plates may be avoided in case if the scaffold is erected on a firm ground. (Ref Fig. 3).



**Fig. 3**

- However, base plates are a must, irrespective of where the scaffolding is erected. It will be 200 x 200 x 10 mm steel plate. Sole plates and base plates support the entire load of the scaffolding. They distribute the load and prevent the scaffold from sinking.
- Don't use concrete blocks, barrels, boxes, bricks etc at the base of scaffolds.
- Vertical members should not be kept more than 2M apart.

### **b. Scaffolding Dismantling**

- Scaffolding to be by the scaffolders in presence of competent/experienced supervisor.
- The area of dismantling will be cordoned off/ barricaded and no movement of personnel underneath the same.
- Scaffolding removal shall be from top to bottom only. In no any case intermediate members shall be removed.
- Loose scaffolding members shall be lowered down by rope and by throwing or using man chain.
- Loose members shall be segregated and stacked properly.
- Dismantling work shall not be carried out during night. If it is carried out during night, it shall be done by that gang who were not working during day time and proper illumination and close supervision shall be ensured.
- While erecting or dismantling of scaffold, the spanner shall be used with proper string in hand so that it will not fell down.
- During erection or dismantling, use of full body harness is must. Fasten it's lanyard with the fixed line or fixed structure or guard rail.



## c. Common Faults in Scaffolding

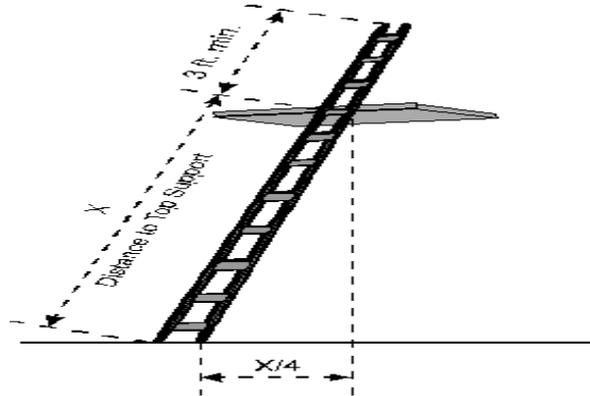
- Inadequate supporting and therefore liable to tilt.
- Absence of toe-boards and guard rails where necessary.
- Faulty alterations made without approval.
- Erected on uneven/loose ground.
- Supported by scaffold lashings instead of wire ropes.
- Couplers misused; use of putlog coupler where load bearing coupler to be used.
- Absence of ties where necessary.
- Foundations insecure.
- False supports, for example, drums, ladders, piles of brick etc.
- Outdated and damaged couplers.
- Lack of bracings.
- A defective board, large knots, splits etc.
- Inadequate access.
- Platform not wide enough - three planks is normally the minimum.

## d. Ladder

- Don't use ladder with
  - Damaged & worn stills
  - Broken, loose or missing rungs or trends
  - Mud or grease on rung (slippery)
  - Warped, sagged or distorted.
- Place a ladder so that the horizontal distance from the base to the vertical plane of the support is approximately one fourth the ladder length between supports. For example place a 4 M ladder so that the bottom is 1 M away from the object against which the top is leaning.
- Do not use ladder in a horizontal position as runways or as scaffolds. Single and extension ladder is designed for use in a nearly vertical position and not be used in horizontal position.
- Never place a ladder in front of a door that opens towards the ladder unless the door is locked, blocked or guarded.
- Place the ladder feet on a substantial, firm and level base, and not on any other objects, like barrels, wooden boxes etc.
- When using a ladder for access to high places securely lash or otherwise fasten the ladder to prevent its slipping.
- Secure both bottom and top to prevent displacement when using a ladder for access to a scaffold.
- Extend the ladder side rails at least 1 meter above the top landing.



- Do not use a metal ladder close to live electric wiring or any operational piping like acid, gas, etc. which could be damaged.
- While ascending or descending, the user shall face the ladder, use both hands and place his feet near the ends of the rungs rather than the middle. Be sure the shoes are not greasy, muddy or slippery before ascending or descending.
- Extension ladder will be sufficiently propped.



- All ladders of vertical height more than 10 meters shall be provided with an intermediate landing with guard rail, mid rail and toe board.
- No portable single ladder will be over 6 meters in length.
- Ladders should not be hung from brackets, as it tends to pull out the rungs.

Landing	-	Tie-up the ladder with this.
Aisle	-	Do not place ladders blocking this.
Doors	-	Do not keep ladders against this.
Descend	-	Do not ascend or descend with some materials in the hands.
Elec. Equip.	-	Do not use metal ladders to work in this.
Rungs	-	Do not have made shift methods, in case this breaks.

### 13.3 HEIGHT WORKS

Worldwide accident statistics shows that about 40% of accidents in construction sites happen during working at height. So it is essential to establish a procedure for safety carrying out work at height.

Following precautions to be followed to work at a height of 1m or above:

- Access to the Work-point: There must be proper access/egress arrangement to the work location for workers.
- Working Platform: The working platform shall have sufficient space, completely planked and properly guarded with toe-guard, mid-rails & hand rails.
- Points discussed in Scaffolding and ladder safety shall be in place.
- Use of full-body harness is mandatory for working at height. The harness must be fastened with fixed structure/life-line/firm hand-rails.



- Hook point are to be strong enough to stop fall and shall, where practical be vertically above the place of work.
- Engineering control for fall protection shall be given priority. In addition to engineering control, personal control shall be used.
- Permit to work system must be followed for height works.
- Workers working at height of 10mtr or more shall be medically tested and declared fit for the work.
- If concrete pouring is going on at height with the help of concrete pump, keep separate access for workers and concrete pipes.

### 13.4 FORM WORK – SHUTTERING / DISHUTTERING

#### a. General

- Tubular steel frames used as staging to support concrete formwork should have a safety factor of at least 2 and be used in accordance with the manufacturer's recommendation.
- Before erection of steel frame staging is started, a thorough inspection will be undertaken on it.
- Struts and/ or diagonal braces must be in proper position and secured for frames to develop full load carrying capacity.
- As erection progresses, all connecting devices will be in place and fastened for full stability of joints and units.
- As additional heights above two tiers are added, suitable planking will be used as a working platform, which should consist of two 50 mm x 25 mm planks minimum.
- The capacity of the soil for foundations will be determined for every staging job. The effect of weather conditions should also be taken into consideration as dry clay may become very plastic after a rainfall and show a marked decrease in load carrying capacity. Care will be taken not to disturb soil used for foundation supports.
- Timber jacks, joists, stringers and ledgers will be inspected for defects such as cracks/excessive knots.
- Final inspection of the staging equipment will be carried out to check soundness of the footing, all lower adjustment screws snug against the leg of the panel, all upper adjustment screws or heads of jacks in full contact with the formwork, panels plumb in both directions, and all cross braces in place and locking devices in closed and secure position.
- During concrete pouring operation, there will be constant inspection of the staging system with provision for correction as necessary.
- Before the reinforcement & shuttering works are started for beams, working platform/ walkways will be provided.
- Before starting the reinforcement work on concrete column, the existing scaffolding must be extended to more than the required height, so that it provides a means to anchor safety belts used by the workmen.



## b. Slip forms

- Scaffolding or work platform should provide adequate protection to workers engaged in concreting operations.
- Forms should not be moved, until concrete poured has attained sufficient strength to support it and all loads that will be imposed by next pour.
- Lifting should proceed steadily & uniformly so as to avoid overloading at one or two lift points.
- Workmen placing reinforcement rods and unloading concrete above the slip form platform should wear approved safety belts & lanyards to protect from falling.
- Temporary barricades shall be installed around the area to prevent entry of unauthorized personnel especially the place where the reinforcement rods are being lifted to the slip form floor. It is extremely risk prone.
- While lapping/ joining vertical reinforcement rods, the projections will be suitably tied to prevent its inadvertent falling off.

## 13.5 BAR-BENDING & CUTTING

- Bar-bending & Cutting requires special skill so; only trained persons will be allowed to operate the equipment.
- The bar-bending & cutting machine shall be in good working & physical condition and there shall not be oil or grease leakage from the machine.
- Equipment will be grounded / earthed.
- Equipment will be placed on sound foundations for fixing properly.
- Bars used for cutting or bending will be of designated size as per manufacturer's catalogue of the machine.
- Cutting wheel shall not be used for cutting steel rods.

## 13.6 CONCRETE POURING

- All heavy concrete pouring shall be planned for access/egress, vehicle movement, electrical connection, proper illumination etc.
- For slab casting and concrete at height shuttering, supports, scaffoldings etc shall be inspected and certified by responsible/competent engineer for their stability & intended load bearing.
- If concrete pump is being used for concrete pouring, the concrete pipes shall have separate access route. It shall not be routed commonly through man access.
- The concrete pump shall be placed at firm & leveled ground with jack. The position of pump shall not prevent general access.
- Worker, operator or helper shall not come between reversing miller and pump. It's highly hazardous.
- Only the trained persons should operate the equipment.



- If concrete pouring is being done by Boom-pacer, it shall be accordingly positioned as per manufacturer's instruction. Both out-riggers must be in fully-extended condition and placed on firm & leveled ground during use.
- The pipes, bends and the snap couplings will be checked against leakages/cracks.
- O-Ring with the proper size only will be used between the joints / connections.
- The equipment will be greased periodically.
- The concrete pipes shall be shock absorbing support.
- Slurry will be passed before pumping the concrete.
- Elephant hose will be held in position with the help of rope while discharging concrete.
- Electrical connections and earthing of the equipment will be properly done.
- Proper anchoring will be done between piping and equipment.
- Vibrating unit shall be completely enclosed and the belt transmitting power to the unit to be adequately guarded.
- Electrically operated compaction vibrators shall be totally enclosed and be protected against overloads by suitable overload relays and shall be effectively earthed.
- Be sure that the sufficient length of cable is provided to the vibrator.
- Ensure electric starters are fixed firmly on the stand.
- While needle is inserted in the vibrator, be sure that needle load is firmly locked.
- Be sure to lubricate inner core of needle.

### **13.7 MASONRY / BRICK WORK / PLASTERING**

- Masonry, Brick work & Plastering requires safety precautions described in sections: Height works, Scaffolding & Ladders, mechanical material handling and manual material handling.
- If winch is used for lifting masonry bricks and other materials, the winch, wire ropes & other lifting equipment shall be tested & certified by competent person and inspected on daily basis before taking in use.
- Safe working load with gearing arrangements will be marked on the winch.
- Winch should not be overloaded and shall not be used for carrying human in any case.
- It will be placed on a firm base and properly anchored.
- The brake, ratchet arrangement, gear and pinion including the meshing, wire rope and its clamping arrangements and direction of receiving rope drum / tie rods will be checked before using the winch.
- Ratchet arrangement will be kept in position while hoisting a load.
- Tie rod will be adjusted not to allow drum movement causing clutch arrangement to slip.
- If the winch & accessories are erected with a support of scaffold, the scaffold must be tied with fixed structure or supported properly against jerk and collapse.



## 13.8 PAINTING WORK

- Painting work shall be done in utmost care of fall prevention & fall protection.
- Painting work shall not be done with the help of hanging rope & harness. It shall be carried out by erecting proper scaffold & access arrangement. Use of full body harness shall mandatory.
- Workers engaged in painting work must have PPEs like nose mask, safety goggles, full body harness & hand gloves along with mandatory PPEs.
- Solvents used for paint is flammable; therefore necessary precautions shall be taken to prevent any ignition.
- Painter will be briefed in the work site about the nature of work and the hazards associated with the work through too box talk before commencing the work.

## 13.9 DEMOLITION

Before any demolition work is commenced and also during progress of work the following safety precautions are to be taken:

- A definite demolition procedure shall be worked out after studying the entire structure and followed strictly throughout the demolition work.
- All the roads and open areas adjacent to the work site shall be protected and caution Boards / Danger sign in local language, Hindi English shall be displayed at prominent places. Unauthorized entry to the building under demolition shall be effectively controlled.
- No electric cables or apparatus, which is liable to be a source of danger, shall remain electrically charged. Water and gas connections, if any, have to be removed, but a separate water source must be available nearby for quenching operations.
- Glass panels of doors and windows are to be removed first.
- When only a portion of a structure is to be demolished adequate props will be provided to prevent damage to the remaining portion due to shock and vibrations. Shoring of other buildings may be necessary when the demolition operation exposes or breaches and adjoining wall.
- Debris shall not allow to be thrown from heights. Remove all debris promptly, using chutes or through internal holes. Try to minimize production of dust, by watering.
- Safety appliances like safety belt, goggles, foot protection, gloves, etc. will be used, wherever necessary.
- Use only proper and tested tackles while lowering heavy materials.
- The cages, hoists, tackles should not be overloaded.
- Before demolishing buildings with over hangs, chajjas, etc. they will be properly supported and demolished first before demolishing superstructure of the buildings.
- The work will be carried out under strict supervision of a responsible supervisor. Only one man who is well experienced should give signal.



- All practical steps shall be taken to prevent danger to persons employed from risk of fire or explosion. No floor, roof or other part of the building shall be so overloaded with debris or materials as to render it unsafe.
- While breaking roof slabs, workmen should not be allowed to sit on the same floor. A separate platform with independent supports shall be used for the demolition purpose.
- Walls should not be left in an unstable condition where they may be toppled by wind or other force. Walls may need temporary support unless designed to be free standing.

#### **13.10 DUMPING, PILING & STACKING**

- Material should not be dumped against existing walls or partitions to a height that may endanger the stability of the walls.
- The maximum height of material stacking shall not be more than 1.2 mtr.
- Materials shall be stacked according to their shape & size.
- While withdrawing piled materials like loose earth, crushed stone, sand etc., from the stockpiles, no overhanging is allowed.
- No material shall be so stacked or placed as to cause danger or inconvenience to any person or public or any other agency at work.
- Dumping, piling or stacking of materials below overhead transmission lines will be avoided.
- No material will be piled, dumped or stacked at random but only in areas specified for the same.
- Roads, passageways should not be blocked by dumping, piling or stacking of materials.
- While removing materials from stacks, the sequence of removal will be only from top.

#### **13.11 MANUAL MATERIAL HANDLING**

- Strains, sprains, fractures and bruises are the common injuries arising due to unsafe manual handling. Back injury is a common problem arising out of improper manual handling.
- Methods of safe manual handling is as under:
  - Correct position of feet
  - Bent knees and straight back
  - Firm grip
  - Keep the load close to the body
  - Chin in
  - Use of feet muscle & body weight to lift the load
- Maximum load to be lifted by
  - Adult Male - 55 kg
  - Adult Female – 30 kg
- Don't allow / force to carry/lift weight above than the weight permissible by law (55 kg for adult man & 30kg for adult women).



- In case the load to be carried /lifted is lengthy, it will be carried out by two, three or more person according to the requirement.
- While carrying a heavy channel or pole by more than two persons, all persons shall stand on the same side.
- Training for ergonomically lifting/handling must be given to the workers.
- Horse-play, joking etc shall be strictly prohibited.
- The workers must be provided with all required PPEs. The workers engaged in manual bar shifting to be provided with shoulder pad.
- The walkways shall be free from slip, trip & fall hazards.

### 13.12 MECHANICAL MATERIAL HANDLING

Mechanical material handling involves use of various equipments such as chain pulley blocks, winches, different types of crane and other lifting mechanism. This is one of the most dangerous activities in terms of frequency & severity of accident. So, it needed special attention, planning and close supervision.

Following precautions shall be taken while mechanical material handling:

- Select right equipment for the job according to the weight, shape and size of the handling material.
- All cranes, chain pulley block, wire ropes, polyester belts, D-shackle and other lifting tools & tackles shall be thoroughly examined by a competent person at least once in twelve months and a record of such testing is to be maintained in prescribed format.
- Only Inspected, tested and validated (by competent authority) lifting tools & tackles shall be taken in to use. In case of any wire rope or sling found damaged or worn out, it shall be destroyed /cut in to pieces and removed from site so that chances of its getting reused shall be eliminated.
- Make sure that cranes are fitted with all safety devices like overload alarm, over-hoist limit switch, manufacturers load chart, reverse alarm etc and these equipments are in working condition.
- Inspect for any visual damage of lifting gears on daily basis before taking in to use. Wear & tear, kinks, twisting, cuts, damage of threads etc shall not be accepted and lifting gear shall be replaced with good one.
- Protect sling from sharp edges by proper packing.
- Maintain sling angle between load and sling as per rigging scheme.
- Loading/unloading shall be done in such a way that centre of gravity of load shall be in line with lifting rope. Use more than two slings to balance load of irregular shape, pipe loop etc.
- Barricade entire area of lift operation. Don't allow unauthorized person inside barricaded area.



- Working under suspended load shall be avoided to the maximum extent possible. Only authorized persons doing connection work and those required to hook or unhook loads shall be allowed to go under suspended load.

### 13.13 ERECTION & RIGGING

#### a. Erection

Tested and inspected tools and tackles and trained manpower with close supervision is key for avoiding accidents during erection and lifting activities. All major activities shall have a rigging plan and risk assessment must be done by trained and experienced personnel. In addition to this following points shall be noted.

- Load will be properly ascertained to identify center of gravity and load transfer at slinging point, before handling any equipment.
- A visual check must be done regarding fitness of all lifting & haulage tackles ropes, slings, etc. before every use.
- The common tendency of checking gear meshing lubrication, coupling matching, hole matching etc. by feeling with a finger must be strictly curbed.
- Selection of tummy bars, rollers, skids etc. will be made depending on the type of equipment to be handled.
- Eyebolts provided at correct slinging points for heavy machinery parts such as motors, generators, turbine, etc. will be utilized for handling.
- No sling will be overloaded.
- Ensure all lifting devices including crane is certified according to the local legislation.
- Proper quality of pulley block will be used. In no case, pulley block suitable for fiber rope will be used for steel wire ropes, while being used as diversion pulleys.
- No person shall walk, stand or work beneath suspended load.
- During erection, only one signalman shall give proper signals. However, a 'STOP' signal will be obeyed whoever gives it.
- For heavy lifts (5 tons or more) shall have erection plan in addition to the Risk assessment. The erection plan shall contain details of crane and lifting accessories, position of crane, space availability and step-by-step description of the whole operation.

#### b. Structural Erection

- Lift plan will be made by competent person before carrying out any lift
- The structural members will be kept in orderly manner on the ground so that they do not roll down or slide while being handled.
- The structural members will be able to be taken out as per sequence of erection without disturbing the stack. At the same time, light structures should not be stacked below heavy structural members where they are likely to be damaged.
- Clear passages will be left for easy handling and transportation of structures.



- All persons shall stand clear when a crane is sorting or shifting steel girders or other structural materials.
- While using spanners, riveting hammers, etc. at heights, they will be tied with a rope fixed to nearby structure so that it will not drop on the ground in case of any slip.
- Only those persons who are skilled in working at height will be engaged for jobs to be done at height. Persons suffering from diseases, e.g. epilepsy, blood pressure, etc. or addicted to drug/alcohol etc. should not be allowed to work at height.
- Care will be taken while lifting loads. Proper tag line must be used for guiding while lifting loads.
- While positioning a beam or fabricated structure etc. it shall be so held that the worker's hand does not get jammed against other objects.
- Loose bolt, nuts and tools must be kept in boxes and not on structures. Boxes must have proper anchorage.
- Care will be taken to fasten the erected members properly and to secure by guys etc. whenever necessary.
- Providing padding over sharp edges should protect ropes and slings.
- Slings will be carefully done so as to prevent the load from slipping.
- Proper sequence of erection will be followed.
- All electrically operated equipments like grinding machine, drilling machine, welding machine etc. must have proper earthing.
- All safety appliances like safety helmet, gloves, and safety belts must be used in erection site. Safety belts equipped with suitable lifeline must be worn by all persons working at height and standing on structural members. Lifeline must be tied to any independent strong members.

#### **c. Rigging**

Visual inspection of all lifting tackles will be carried out before every use in line with the following guidelines: Ensure all lifting tools and tackles shall be certified by competent person at least once in a year.

### **13.14 TRANSPORTATION & ROAD SAFETY**

#### **a. Transportation**

- Materials will be properly loaded considering its weight, dimension, capacity of the carrier, center of gravity of load, clearance required for safety, etc.
- Load must be properly packed and lashed before transportation.
- Trailer and other transport vehicles will be in good working conditions & the driver must have a valid license.
- All vehicles must have efficient brakes, horns & lights.



- The transport vehicles should not be overloaded. No material should project above the height of side panel or beyond the side panels. Materials may be allowed to project maximum 1.5 M at the back of deck. Red caution flag or red amp in the nights will be displayed on the projected end.
- The vehicle should not run beyond the permissible speed limit. Speed limits inside project site premises will be strictly followed.
- The driver should observe instructions for crossing the level crossing, overtaking and taking turn, etc.
- None should board or alight from a moving vehicle.
- Men should not sit on the sides of the panels or on the top of driver's cabin.
- Men should not sit near the load or over the load where there is possibility of rolling or shifting due to sudden application of brakes.
- Ensure Transportation of chlorine is subjected to the local motor vehicles rule.

#### **b. Road Safety**

- The pedestrians, cyclists, drivers must follow the standard safety rules framed for the purposes.
- Nobody should try to cross the level crossing when drop gates are closed or signal is given for blocking the road. STOP, LOOK AND PROCEED will be followed.
- None should indulge in horseplay while on the job.
- Under haste will be avoided.
- Stand clear of bushes, parked cars, or other obstacles before crossing so drivers can see you.
- Always walk on the sidewalk. If there is no sidewalk, walk facing traffic.
- Don't assume, vehicles will stop. Make eye contact with drivers, don't just look at the vehicle. If a driver is on a cell phone, he or she may not be paying enough attention to drive safely.
- Don't rely solely on pedestrian signals. Look left, right before you cross the road.
- Cross streets at marked crosswalks or intersections, if possible.
- Obey traffic signals.
- Don't wear headphones or talk on a cell phone while crossing.

#### **13.15 CONFINED SPACE WORK**

A confined space is a space that is completely or partially enclosed:

1. Which is not designed to be occupied by people, nor intended to do so, but which, when the need arises, may be occupied for the execution of work such as inspection, maintenance, repair or construction (this space could accommodate installation and start-up personnel)
2. Which has limited means for entrance and exit. This could be a ladder or very long or very narrow stairs with a very steep slope. Any object or equipment may restrict access to the space or prevent air from circulating freely



3. Which may present risks for the safety of those who enter it, because of:

- Its design, its construction or its location
- Its atmosphere or insufficient natural or mechanical ventilation
- Solids, liquids, gases and/or powdered material or substances that it contains or that can enter into it at any time
- Other related dangers.

This is usually a location whose volume/opening dimension ratio is such that natural exchanges of the air inside with the outside atmosphere are non-existent, insufficient or uncontrollable.

The restriction in the movement of air may be due to:

- Either the narrowness of the location in relation to its length or depth. The access in this case may be relatively free (open confined space)
- Or the closed nature of the place. Entrance is then from one or more openings, which may be of very small dimensions (manhole, for example), which increases the difficulties of access (enclosed confined space).

An area in direct communication with a confined space and which can be contaminated by the atmosphere of this space is treated based on the same rules.

**Examples of open confined spaces:** shafts, spy-holes, crawl spaces, cisterns, ditches, tanks, bins, vats, chemical reactors, manholes, narrow and long tunnels, large pipes, sewers, channels, chutes, underground maintenance spaces, autoclaves, some cellars, etc.

**Main risks relating to intervention in a confined space:**

Confined spaces present environments that are particularly dangerous for the life and safety of workers. These risks are greatly increased by difficulties in evacuation and the risk of panic.

The majority of accidents are caused by an atmosphere with insufficient oxygen Asphyxia due to oxygen deficiency or an excess of other gases (CO<sub>2</sub>, CO, CH<sub>4</sub>, H<sub>2</sub>S etc.). Half the deaths are of those who attempt to rescue others (chain accidents).

**H<sub>2</sub>S:** Colourless gas that smells like a rotten egg at low concentrations, odourless at high concentrations, heavier than air and irritates the eyes and the respiratory tract. Inhalation may cause pulmonary edema and a delayed loss of consciousness. Limiting exposure value: 10ppm.

**CH<sub>4</sub>:** Colorless gas, odorless and highly explosive.

**CO:** Colorless gas, odorless, flammable, lighter than air. A person over-exposed to this gas experiences humming, nausea, headache, drowsiness that may result in death, even at low concentrations. Chronic exposure may have undesirable effects on the nervous system and the cardiovascular system. Limiting exposure value: 35 ppm.

**CO<sub>2</sub>:** Colorless, odorless gas, at high doses causes headache, vertigo, tachycardia with possible loss of consciousness. Limiting exposure value: 5000 ppm.



**For entry into confined space detail procedure to be followed. No unauthorized personnel should enter into the confined space.**

#### **I CHLORINE**

Chlorine at ambient temperature and pressure is a greenish –yellow gas with a characteristic pungent and irritating odour. Gaseous chlorine is approximately 2.5 times heavier than air. Chlorine is non-flammable and non-explosive, while it is not combustible in air; it supports the combustion of some substances such as Hydrogen, turpentine ether, & hydrocarbons under certain conditions. Chlorine is a highly Toxic a hazardous in nature. Limiting exposure value 0.5 ppm

#### **II EXPLOSIVE ATMOSPHERE**

An explosive atmosphere results from the mixture of inflammable substances in the form of gases, vapors or dust, with air, in such proportion that any excessive temperature, electric arcs, sparks or other adequate energy ignition source causes its explosion. It can occur in any area where inflammable products are manufactured, stored, transformed or transported.

#### **III BIOLOGICAL HAZARD**

A) Exposure to sewage and other waste water or its products may result in a number of illnesses. These includes

- Gastroenteritis, characterized by cramping stomach pains, diarrhea and vomiting.
- Hepatitis, characterized by inflammation of the liver, and jaundice.
- Occupational asthma, resulting in attacks of breathlessness, chest tightness and wheezing, and produced by the inhalation of living or dead organisms.
- Infection of skin or eyes and
- Rarely, allergic alveolitis (inflammation of the lung) with fever, breathlessness, dry cough, and aching muscles and joints.

B) How do microorganisms enter the body

- The most common way is by hand to mouth contact during eating, drinking and smoking, or by wiping the face with contaminated hands or gloves, or by licking splashes from the skin.
- By skin contact, through cuts, scratches, or penetrating wounds
- By breathing them in, as dust, aerosol or mist.

C) Protecting workers from risks to health

- Ensure that employees and line management staff understand the risks through proper instruction, training and supervision.
- Use suitable personal protective equipment that may include water proof/abrasion-resistant gloves, footwear, eye and respiratory protection, face shield or goggles particularly effective against splashes.
- Ensure adequate welfare facilities, including clean water, soap, nail brushes, disposal paper towel, and shower where heavy contamination is foreseeable.
- Ensure adequate first aid equipment and first aider at site.



- Remind employees of all precautions they need to take to reduce the risk of infection.
- Make effective arrangements for monitoring the health of staff.

## Major Hazards in a Confined Space

### I DROWNING

Where the work involves filling tanks with water leaving an open surface, life buoy shall be provided at suitable location for promptly rescuing persons from the water and resuscitating rescued persons. All necessary action shall be taken for preventing such accidents by means of adequate guarding along with the open tanks.

### II SLIPPING/TRIPPING HAZARD

All passageways, platforms and other paces of work shall be kept free from accumulation of debris and from other obstruction that may cause tripping. Sharp projection shall be removed or covered. Oil grease, water and other substances causing slippery footing shall be removed, sanded or covered to provide safe footing.

### III HAZARDOUS & CORROSIVE SUBSTANCE

All alkalis, acids, gases and other hazardous & corrosive substances shall be stored in safe manner. Material Safety Data Sheet shall be displayed near the storage area regarding the properties of chemical and first aid measures. Suitable protective equipment for the use of such substances shall be provided to the workmen. Safety shower shall be provided near to the storage area for washing off any spillage of any corrosive substances on the employee.

### IV ACCESS TO THE WORKPLACE

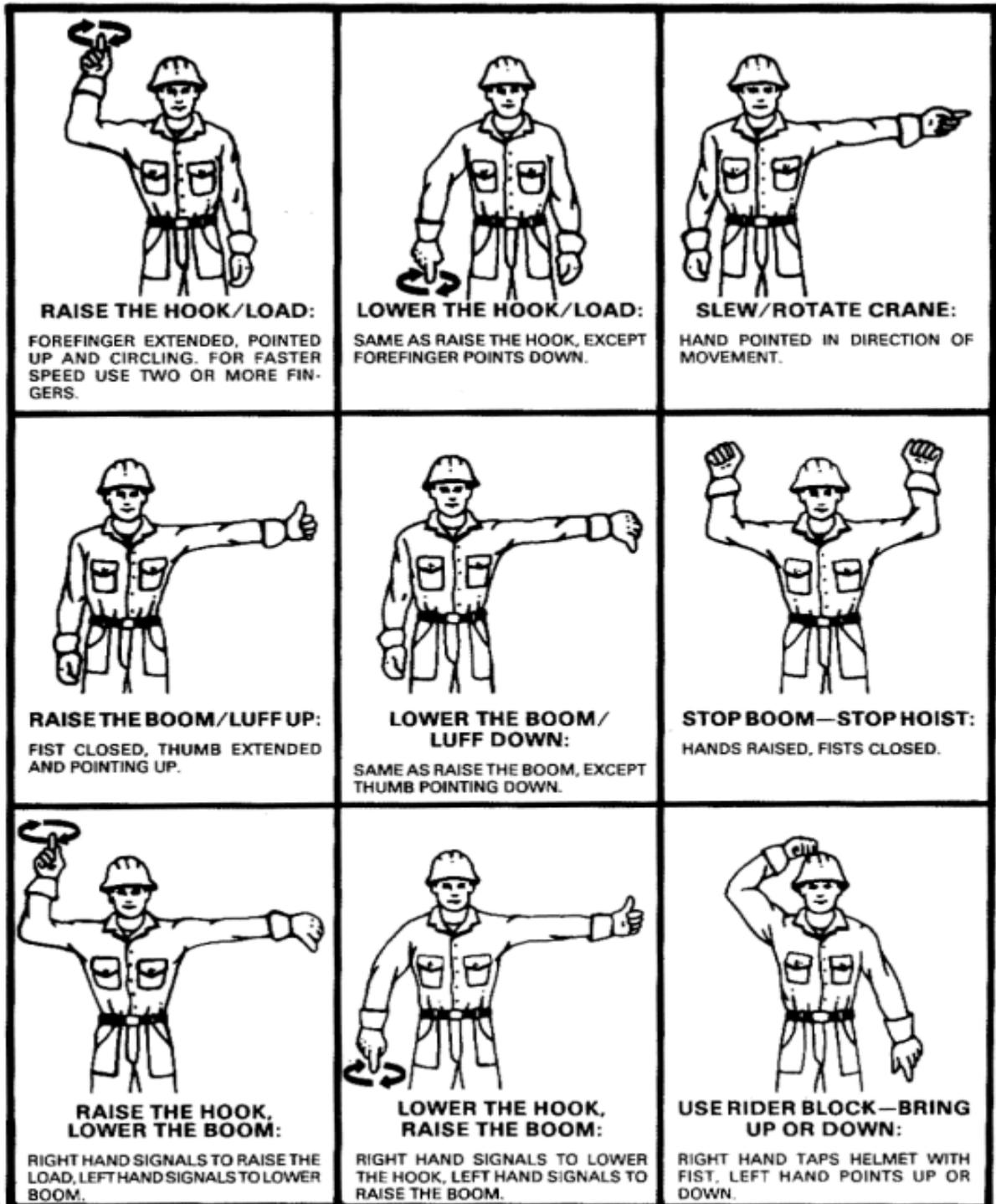
Temporary stairways, ramps or runways shall be provided as the means of access to working levels above or below ground except the nature or progress of the work prevents their installation, in which case ladders or other safe means shall be provided.

## 13.16 LIFTING TOOLS & TACKLES

### a. MOBILE CRANES

Following precautions have to be taken while using tyre mounted mobile cranes in addition to the given above.

- When traveling up a gradient, the load shall be derrick out and when travelling down a gradient, the load shall be derrick into the minimum radius, and this position shall be corrected on reaching level ground. Otherwise, constant watch on the radius will be maintained while travelling on uneven surfaces.
- The mobile crane shall be fitted with suitable horn, headlights, and side lamps, rear and stoplights and flashing direction indicator.
- A cantilever type jib of crane when travelling without load will be lowered to a horizontal position.
- The pneumatic tyres shall be maintained at the correct pressure at all times.



## b. PULLEYS

- Proper pulleys will be used according to the requirement of work.
- In no case pulley meant for Manila /Nylon rope will be used with steel rope.
- Sheaves, shaft, hook, hook pin and locking of pins will be checked before use. Necessary lubrication will be done on the required parts.
- Grooves of the sheaves will be uniform and smooth. The wire rope or fiber rope should run free without touching against the block or suspension parts.
- Ensure that sheaves should rotate freely on the shaft.



- The shaft will be free from crack and should not be worn out.
- Anchorage will be strong and firm.
- Anti-twister will be used to prevent rubbing of ropes against each other.

#### **c. CHAIN BLOCK / PULL LIFT**

- Chain blocks of proper lifting capacity supported by Test Certificate will be used for lifting known loads.
- Chain block must be checked and tested periodically. It will be lubricated before every use.
- No cannibalising will be done on chain block.
- Chain block will be tested against slip by suspending safe load.
- It should operate freely and the chain should not come out of pulleys.
- The anchorage will be strong and rigid.
- They will be checked for cracks, excessive wearing, elongation, etc. Hook opened out should not be used.
- No chain block / puller which have been tampered will be used unless it is thoroughly checked and tested by competent person.
- Chain block / pulley must be checked if stored for longer time, by subjecting to shock load to observe slipping of load, jamming of links etc.

#### **d. WINCHES**

- Safe working load with gearing arrangements will be marked on the winch and tested regularly by competent person.
- Winch should not be overloaded.
- It will be placed on a firm base and properly anchored.
- The brake, ratchet arrangement, gear and pinion including the meshing, wire rope and its clamping arrangements and direction of receiving rope drum / tie rods will be checked before using the winch.
- Ratchet arrangement will be kept in position while hoisting a load.
- Tie rod will be adjusted not to allow drum movement causing clutch arrangement to slip.

### **13.17 PLANT & EQUIPMENT**

#### **a. General**

In this section of "Plant & Equipment" the accident preventive measures to be followed for all Diesel/Petrol engines and Light/Heavy Vehicles, in general, have been covered in two separate sub-sections. These procedures and practices are applicable for all plants and equipments, which have engines or are treated as vehicles.

The specific safety measures for any particular plant or equipment has been further elaborated and detailed in the relevant equipment items subsequently.



## **b. HYDRAULIC EXCAVATORS / POWER SHOVELS**

- Trained and authorized persons should operate.
- Warning boards will be displayed where excavation is going on. Put barricade around the excavated area. "KEEP AWAY" from the "SWING AREA".
- Before starting movement of the machine check the inside, outside and down side of the machine.
- Never grab joysticks or other control levers while getting on/off the machine.
- During operation, do not read, drink or eat. Do not divert your attention away from the attachment / control board
- Never swing the load over persons.
- Never allow anyone to ride in the machine.
- Never try to operate the machine except from the seat of the operator as the machine may go out of control.
- Do not load a dumper / truck unless the driver is in a safe location.
- Working in the vicinity of electrical lines, contact the electrical department before beginning excavation.
- Treat all power lines as energized even when it is known that the power is shut off and the line is grounded.
- Always maintain more than the minimum specified clearance between the machine and the power lines, employ a qualified or experienced signalman, if required.
- Slow down the operation cycles when operating in the vicinity of power lines.
- Remember death can occur in case of an accident caused due to electric shock from the energized power line.
- Never exceed the lifting capacity of the machine.
- Keep the machine away from the edge of an excavation. Avoid cutting under the machine.
- Operating on a slope is risky.
- Heavy items to be lifted by a hydraulic excavator will be hung from the designated lifting point. Never exceed the specified lifting values as shown in the chart. Failure of the bucket/sling can occur even if the wire ropes used for the boom suspension as well as for the shovel / bucket shall be of the specified diameter.
- Always use the proper equipment for the job to be undertaken.
- While moving on a road, travel with the headlights on even in the day light. While taking a turn allow for boom overhand and other structural clearance if any. Watch for boom clearance while travelling.
- Be careful while parking the machine. Do not park the machine where there is a possibility of the ground caving-in or at low-lying areas where the rainwater might accumulate.



- The attachment is held in position by the trapped hydraulic oil in a cylinder or a motor when the machine is not working (Hydrostatic locking). If there is any leakage of hydraulic oil, the attachment might come down suddenly endangering anyone or anything who/which may be below the attachment. Make sure that attachment is firmly resting on the ground.
- Power shovels / Excavators shall be so operated as not to endanger their stability.
- Power shovels that are equipped with unit for deep digging shall either be so designed that the bucket teeth should not come nearer the under-carriage more than 40 cm or be provided with reliable stop that prevents the bucket to come nearer than the specified distance.
- The boom shall not be pulled tight against the emergency stops while supporting a load.
- The bucket or grab of the shovel shall be pulled out of the bank as soon as it is full. When not in use, the bucket shall be kept resting on stable ground and shall not be left hanging.
- The bucket or grab of a power shovel shall be fixed to restrict movement while it is being repaired.
- While operating near edge of excavations or embankment substantial space shall be provided to prevent it from approaching a dangerous position and the sides of the excavation shall be adequately shored. Heavy equipment such as excavating machinery and road traffic shall be kept back from the excavated sides at a safe distance.
- The height of benches in overburden shall not be more than the height of the boom of the machine used for digging excavation of removal.

#### **c. TIPPERS / DUMPERS**

- No unauthorized persons should operate the vehicle.
- Tipping system will be used only after positioning the vehicle for unloading (Tilt cylinder lever should not be tampered with).
- Rear view mirrors will be provided on both the sides of the cabin for reversing, loading or unloading of the vehicle.
- All tippers / dumpers should be equipped with reverse horn.

#### **d. WATER TANKERS (TRUCK MOUNTED TYPE)**

- No unauthorized person should operate the vehicle.
- Rear view mirrors will be provided on the cabin on both the sides for reversing the vehicle.
- The vehicle will be placed on a firm ground for filling or emptying the tank.

#### **e. TRACTORS**

- No unauthorized persons should operate the vehicle.
- Tilting and lifting will be done only when required.
- Vehicles will be used for towing, leveling or ploughing purposes only.
- Workers should not be allowed to travel on a tractor.



## **f. VIBRATORY COMPACTORS**

- A trained operator will be allowed to run the machine.
- If the compactor is electrically operated, the wiring/ cables will be properly laid so that movement of the machine is not restricted.
- Electrically operated compactor must be earthed properly.

## **g. VIBRATORY ROLLERS / ROAD ROLLERS**

- A trained / authorized person should operate the machine.
- Caution boards will be displayed at the site of work.
- In the vicinity of the weak structures, vibration will be minimized and to be done with precautions.
- Vibration should not be continued while the roller is not in motion.

## **h. VACUUM DEWATERING SYSTEM**

- Electrical connections will be checked against any leakage / cuts before switching on.
- A trained person only will be allowed to use the equipment.
- Proper switchboards will be used.

## **i. CONCRETE BATCHING AND MIXING PLANT**

- Skip, weigh batcher and drum will be clearly visible to the operator in the cabin.
- Trained persons only should operate the plant.
- Weighing attachment should not be tampered with / nothing should fall on it.
- Mixing drum will be cleaned after completion of each and every delivery.
- Workmen will be kept away from the area of operation of scrapper unit.
- Plant should have proper earthing.
- Periodic inspections of wire ropes will be done.
- Overloading of the scrapper/ skip unit and drum will be avoided.
- Any unwarranted mechanical noise will be carefully probed into for corrective action.
- All operators and labours for cement filling should use dust masks and helmets.

## **j. TRANSIT MIXER**

- Only trained/ valid license holding person will be allowed to operate the equipment.
- Rear view mirrors will be provided for reversing the vehicle.
- Mixing drum will be cleaned regularly.
- Inspection covers of the drum will be bolted properly.
- Water and air connections will be checked before operation.
- The vehicle shall be equipped with reverse alarm.



## **k. MIXERS**

- All gears, chains and rollers of concrete mixer will be adequately guarded to prevent damage / danger.
- Concrete mixer hopper shall be protected by side railing to prevent workers from passing under them. Operators shall make sure before lowering the skip that the operational space is absolutely clear.
- Wire rope used for hopper hoisting has to be checked thoroughly and periodically.
- Hopper hoist and anchoring brake will be checked for proper functioning.
- Be sure that motor fan guard is secured.
- Be sure that wiring is properly connected and insulated.

## **l. CONCRETE PUMP**

- Only the trained persons should operate the equipment.
- The pipes, bends and the snap couplings will be checked against leakages/cracks.
- O-Ring with the proper size only will be used between the joints / connections.
- The equipment will be greased periodically.
- Slurry will be passed before pumping the concrete.
- Elephant hose will be held in position with the help of rope while discharging concrete.
- Electrical connections and earthing of the equipment will be properly done.
- Proper anchoring will be done between piping and equipment.

## **m. CONCRETE VIBRATORS**

- Vibrating unit shall be completely enclosed and the belt transmitting power to the unit to be adequately guarded.
- Electrically operated compaction vibrators shall be totally enclosed and be protected against overloads by suitable overload relays and shall be effectively earthed.
- Be sure that the sufficient length of cable is provided to the vibrator.
- Ensure electric starters are fixed firmly on the stand.
- While needle is inserted in the vibrator, be sure that needle load is firmly locked.
- Be sure to lubricate inner core of needle.

## **n. OVERHEAD HAZARDS**

- Overhead protection shall be provided at any location where there is a hazard of falling objects. This shall particularly be observed around any scaffolding and in excavation.
- Goalposts (wooden) shall be erected under all overhead power lines with minimum safe clearance to prevent the arms or jibs of crane/plant from approaching such lines.



## **o. BAR BENDING AND CUTTING MACHINES**

- Only trained persons will be allowed to operate the equipment.
- Equipment will be grounded / earthed properly.
- Equipment will be placed on sound foundations for fixing properly.
- Bars used for cutting or bending will be of designated size as per manufacturer's catalogue of the machine.

## **p. LATHE MACHINES / POWER HACKSAW / POWER PACKS / MACHINE TOOLS**

- No un-authorized person will be allowed to operate.
- Machine will be mounted on rigid foundations.
- Machines will be grounded / earthed properly.
- Goggles / hand gloves will be used by operators during operation of the machines.

## **q. D.G. SETS**

- No unauthorized person should operate.
- Equipment will be mounted on foundation or on leveled ground with anti-vibrator pads.
- Equipment will be grounded / earthed properly as required.
- Ventilation will be proper. The exhaust piping should have less bends and no restrictions. Make and emission of DG sets shall be maintained as per the local standards.
- Safety devices will be checked / inspected before use / operation.

## **14. APPROACH ROAD / ACCESS / EGRESS**

- There must be a safe approach road for each and every structure including stores.
- The approach road shall be adequately prepared and maintained.
- The approach road from and to the work site shall never be blocked by parking vehicles or stacking materials, etc. thus blocking the movement in case of emergencies.
- It shall be ensured that ladders, stair cases, or ramps of relevant national standard are provided for safe access to and egress from the working point.
- Ladders shall not be used as access for heavy works and for carrying heavy materials. In such cases stair cases made with scaffolding materials may be used. The step for access purposes shall not be more than 250mm.
- All openings in floors where workmen are liable to work or even pass through shall be either closed or barricaded. If they are closed, a visible warning sign shall be kept to indicate the opening below the cover.
- If man-hole or other opening is used for entering a structure, the minimum size of the opening must be 900mm / 900mm.
- Electric cable of permanent or temporary nature shall not cross the road lying on ground. It must be routed at sufficient height or underground at a depth of 500 mm.



- All approach roads must be properly illuminated during night whenever workmen are liable to work or even pass through.
- Ample space must be left for reversing Millar & other construction vehicles. Reversing zones shall be marked for site.

#### 15. PHYSICAL CODITIONS FOR WORK

Physical conditions / environmental conditions at work location like Illumination level, Noise level, Presence of foul smell or toxic gases, dust, insufficient oxygen in the environment, high temperature etc contributes a lot to the health & safety of workmen.

##### a. Illumination:

- There shall be separate arrangement of illumination for walkways and working points.
- All working locations must be properly illuminated, confirming national standards.
- Access/Egress and other walkways shall also be illuminated sufficiently.
- For confined space work or working in such an environment where flammable gases are liable to present, special illumination arrangement shall be done. In such cases 24 volt DC light shall be used.
- Illumination arrangement shall be provided in such a way that it shall not cause glare to working people.
- Working area / Activities specific lighting to be taken care by subcontractor under the responsibility of site engineer.

##### b. Noise & Vibration:

- Adequate measures shall be taken to protect construction workers against the harmful effects of excessive noise or vibration.
- The noise level in no case exceeds the limits laid down in legislations i.e. 90dB.
- Where ever noise level exceeds the limit, proper arrangement shall be made to contain the noise or workers are provided with ear protection PPEs.
- Appropriate warning sign shall be displayed for the same.

##### c. Dangerous and harmful environment:

- No worker will be allowed to enter any confined space or tank or trench or excavation wherein there is given off any dust, fumes or other impurities of such nature and to such extent as is likely to be injurious or offensive to the worker or in which explosives, poisonous, noxious or gaseous material or other harmful articles have been carried or stored or in which dry ice has been used as a refrigerant, or which has been fumigated or in which there is a possibility of oxygen deficiency, unless all practical steps have been taken to remove such dust, fumes, or other impurities and dangers which may be present and to prevent any further ingress thereof, and such work place or tank or trench or excavation is certified by the responsible person to be safe and fit for the entry of such building workers.
- Measures shall be taken to remove fall smell from the work environment.



#### d. High Temperature:

- Working in conditions of extreme heat combined with additional stresses to the body from physical activity, loss of fluids, fatigue, and various other factors, can lead to dangerous health effects or can jeopardize worker safety.
- There are four environmental factors which can contribute to the amount of heat stress a worker may experience on the job -temperature, humidity, radiant heat, and air velocity.
- Sometimes heat from the sun, radiant heat from a hot surface or heat from hot processes can overwhelm the body's cooling mechanisms and result in mild to severe health disorders. These heat-related disorders include heat rash, heat cramps, heat syncope, heat exhaustion, and heat stroke.
- How much is too much? It varies, depending on the person and the situation. If improperly treated, heat stroke can be life-threatening. However, many heat-related health problems can be prevented or the risk of developing them reduced by following a few basic precautions:
  - **Acclimatization** - Give workers time to get used to the heat. With gradual increased exposure, workers become better able to tolerate the heat. Provide cool, shaded rest areas where workers can take periodic breaks as needed. Longer or more frequent breaks may be necessary when it's very hot or the work is especially strenuous. Job sharing or heavy work rotation among several workers can also lessen the heat load on workers.
  - **Rehydration** - Sweating is part of the body's natural cooling system, but it does results in water loss. The way to replace this loss and help the body continue to cool itself is to drink water or electrolyte-replacement "sport drinks" throughout the day, at least one cup every 20-30 minutes. Thirst is not enough to insure sufficient water intake. Workers should be encouraged to drink before, during, and after work. Alcohol, coffee, tea, and caffeinated soft drinks, which cause dehydration, should be avoided.
  - **Appropriate Dress/Clothing** - Thin, light-colored, loose-fitting clothing aids in evaporation and allows air movement near the skin. For some jobs, clothing with built-in air cooling features is appropriate. Reflective clothing can shield the body from radiant and convective heat. Those who work outdoors should wear a hat and sunscreen for increased protection against the sun's rays.
  - **Physical Conditioning** - Workers who are in good physical condition are better able to tolerate higher work temperatures. Encourage workers to stay in shape, avoid alcohol, and eat light, healthy meals. Heavy meals contribute to body heat and divert blood to the digestive system.
  - **Engineering Controls** - Fans, ventilators, exhaust systems, and air coolant systems help keep worksite temperatures to adaptable levels. Other controls such as installing heat shields and insulating heat-producing machinery can also help reduce radiant heat or lower the environmental temperatures. Install a temporary canopy over outdoor work areas or shade heavy equipment operators to lessen the suns intensity. Use available mechanical devices to reduce physical exertion.
  - **Work Scheduling** - To take advantage of climatic and other environmental conditions, start jobs earlier in the morning, then space hot work throughout the day. Schedule the more strenuous or the hottest work for the coolest times of the day. Schedule more



workers to reduce the work load or have them work in shifts or limit work hours within shifts to minimize exposure to high temperature and sun. Rotate work in areas where humidity may be high and air movements minimal. Postpone nonessential tasks during heat spells.

- **Monitoring** - Supervisors should check environmental conditions at least hourly and monitor worker response to the heated conditions. Heat stress is a silent hazard. Workers may not realize that there is a problem until heat stress is well advanced. In wilderness environments, recognition of the gravity of the situation is important. The victim of serious heat distress must be transported as soon as possible to the nearest medical facility. In the meantime, every effort to reduce the victim's body heat load must be made.
- **Educating** - Workers should be aware of the need to replace fluids, recognize dehydration and heat exhaustion, and know what to do when those conditions appear. Employers should train workers to recognize early warning signs of heat distress and take prompt, appropriate action. Workers should know to get immediate emergency medical attention if a worker has one or more of the following symptoms: mental confusion or loss of consciousness, flushed face, hot dry skin or no sweating. Make sure all workers know who is trained to give first aid. Emergency phone number of ambulance, hospital, and doctors should be posted and readily accessible at all job sites.

## 16. ENVIRONMENT & WASTE MANAGEMENT

All work shall be carried out in accordance with current relevant Codes and Standards and shall comply with all Acts and Statutory Regulations concerning environmental protection.

Environmental protection shall include, but not be limited to the following:

Noise emission; particulates and gaseous emission; liquid waste (collection, storage and disposal) and solid waste (collection, storage and disposal); pollution of waterways etc

Work shall be conducted in a manner to ensure:

- That no substance that can cause harm to the environment is allowed to leak, spill or escape from any container or storage area
- No oil or other effluent is allowed to escape from any source into the company's drainage system and/or local storm water system, waterways or groundwater system.
- No oil or other effluent is allowed to escape from any source onto the ground and cause soil contamination
- All dust generated during work is to be contained to prevent air pollution
- No harmful solids or liquids are to spill from containers whilst in transit on the premises
- All oil based waste material shall be kept segregated and placed in sealed drums. This material shall be disposed of through a recognized recycling company
- All water based waste shall be kept segregated. Small amounts shall be collected and stored in drums. Large amounts shall be pumped into bulk tanks for disposal.
- Noise emanating from the site shall not exceed the limit set by relevant authorities.



Following points shall be taken in to consideration for Environment & Waste management:

#### **a. Tree Cutting:**

- Provide adequate protection to safeguard trees during tree cutting work.
- Trees shall be removed from the construction sites before commencement of construction with prior permission from the concerned department/client.
- Plantation of new trees to be done based on area availability.

#### **b. Protection of top soil:**

- The top soil to be protected and compacted after completion of work, where the pipelines run, including open lands and agricultural lands, if any

#### **c. Dust Pollution**

- All earthworks will be protected in manner acceptable to the client to minimize generation of dust.
- Construction material shall be covered or stored in such a manner so as to avoid being affected by wind direction.
- Unpaved haul road up to site office / plant site to be watered periodically to reduce dust pollution.
- Trucks carrying construction material to be adequately protected to avoid the material spillage

#### **d. Noise Pollution**

- Servicing of all construction vehicles and machinery will be done regularly and during routine servicing operations, the effectiveness of exhaust silencers will be checked and if found defective will be replaced.
- Maintenance of vehicles, equipment and machinery shall be regular and up to the satisfaction to keep noise levels at the minimum.
- All potential high noise yielding machines shall meet statutory guidelines and their preventive maintenance shall be done as per the approved plan.

#### **e. Pollution from Fuel and Lubricants**

- It shall be ensured that all construction vehicle parking location, fuel/lubricants storage sites, vehicle, machinery and equipment maintenance and refueling sites will be located at least 500 m from rivers and irrigation canal/ponds.
- All location and lay-out plans of such sites shall be submitted to client as per contract.
- It shall ensured that all vehicle/machinery and equipment operation, maintenance and refueling will be carried out in such a fashion that spillage of fuels and lubricants does not contaminate the ground.
- Arrangement for collection, storing and disposal of oily wastes to the pre-identified disposal sites shall be done as approved by the client. All spills and collected petroleum products will be disposed off in accordance with state PCB guidelines.



- All arrangements shall comply with the guidelines of PCB or any other relevant laws.

#### **f. Monitoring of environment parameters**

- Seasonal monitoring of air, water, and noise and soil quality through an approved monitoring agency shall be done if required. The parameter to be monitored, frequency and duration of monitoring plan shall be prepared.

### **17. HEALTH & HYGIENE**

Occupational Health involves identifying what can cause or contribute to ill health in the workplace, determining the action required to prevent people being made ill by work, and the introduction of suitable control measures to prevent ill health.

With the support of a competent Occupational Health Professional, Managers should assess all of their work activities undertaken, identify any Occupational Health implications, and implement an Occupational Health Management Programme.

Safety Manager shall establish and maintain procedures relating to the management of occupational health. These shall include procedures for:

- Sickness Absence referral
- Medical Reviews
- Rehabilitation within the Workplace Assessment
- Health Education and Advice First Aid
- Occupational Disease Reporting and Investigation Employee Welfare Arrangements

Occupational Health performance will be collected to the Safety Manager on a regular basis.

To ensure the programme is operating effectively proactive monitoring will be undertaken.

This will include:

- Pre-employment Health Screening of all workers & staff
- Routine Health Screening
- Maintaining the Health records
- A scheduled programme for reviewing the efficacy of Occupational Health Controls

### **18. EMERGENCY PREPAREDNESS**

Emergency plan will be developed for those emergency situations that are most likely to occur and / or possess the greatest potential for loss. All types of probable emergencies shall be identified. Areas for consideration include:

- Major injuries.
- Health effects.
- Major process loss.
- Major events or property damage
- Major environmental damage / discharge / release



- Fire, flood etc.
- Bomb threats, sabotage, etc.
- Chemical spill,
- Loss of power.
- Catastrophic loss.
- Transport accidents - road,
- Emergencies involving traveling employees.

For Emergency Preparedness & Response, the site management needs to identify potential accidents & emergencies associated with their activities and accordingly proceed as follows.

- Identification of person to take charge during the emergency
- Details of actions to be taken by personnel during an emergency
- Responsibilities, authorities & duties of personnel with specific roles during the emergency
- Evacuation Procedures
- Identification & Location of hazardous materials & emergency action
- Communication with employees
- Availability of necessary information during the emergency e.g. Site Layout, Hazardous material data, procedures, work instructions & Contact telephone numbers.
- Establishment of Emergency control center with all necessary equipment and medical facilities.

#### **19. PERFORMANCE MEASUREMENT & MONITORING:**

For performance measurement and monitoring, the site should establish a performance monitoring system with some measurable indicator. The following are examples of methods that can be used to monitor OH &S performance: -

- Results of the hazards identification, risk assessment & risk control process.
- Systematic workplace inspection using checklists.
- OH & S inspection for e.g. daily safety observation
- Environmental Sampling
- Analysis of documentation & records like MSDS
- Benchmarking against good OH &S practices in other organizations

#### **20. INCIDENTS INVESTIGATION, NON-CONFORMITY, CORRECTIVE AND PREVENTIVE ACTION**

- Site management needs to ensure that all the accidents, incidents & nonconformance are investigated & corrective and preventive actions initiated.
- Site Management should reports all the accidents, incidents & nonconformance.



- Should ensure that no employees suffer any hardship as a result of reporting a non-conformance, accident & incident.
- Site management should use appropriate means to record the factual information & the result of the immediate investigation.
- **Corrective Action:** - Corrective actions are taken to eliminate the root causes of identified non-conformances, accidents or incidents in order to prevent the recurrence. Some examples of elements to be considered in establishing & maintaining corrective action are;
  - Identification & implementation of corrective & preventive measures for the short-term as well as long term.
  - Evaluation of any impact on hazards identification & risk assessment result & any need to update hazards identification, risk assessment & risk control reports.
  - Recording any required changes in procedures resulting from the action or hazards;
- **Preventive action:** - Examples of elements to be considered in establishing preventive action procedures include: -
  - Identification of any problems requiring preventive actions.
  - Initiation & implementation of preventive action & the application of controls to ensure that it is effective.
- **Follow – up:** - Corrective or Preventive action taken should be effective & permanent. Checks should be made on the effectiveness of corrective or preventive action taken. Outstanding actions should be reported to top management at the earliest.

## 21. MANAGEMENT REVIEW

Site Management shall review its OH & S performance in the Monthly Safety Committee Meetings. Typical inputs needs to include following.

- a. Site Accidents Statistics
- b. Results of the audits.
- c. Corrective actions carried out since from the previous audit.
- d. Report of the emergencies.
- e. Reports of hazards identification, risk assessment & risk control processes.