# SAFETY PRACTICES DURING CONSTRUCTION

## 1.0 INTRODUCTION

Safety in Construction Management deserves utmost attention especially in the hydrocarbon industry, such as Exploration, Refineries, Pipelines and Marketing installations, Gas Processing units etc. Construction is widely recognised as one of the accident prone activities. Most of the accidents are caused by inadequate planning, failure during the construction process and/or because of design deficiencies. Besides property loss, accidents also result in injuries and fatalities to the personnel; same needs to be prevented.

The reasons for accidents during construction activities are related to unique nature of the industry, human behaviour, difficult work-site conditions, extended odd duty hours, lack of training & awareness and inadequate safety management. Unsafe working methods, equipment failure and improper housekeeping also tend to increase the accident rate in construction.

Ensuring good quality of materials, equipment and competent supervision along with compliance of standard engineering practices shall go a long way to in built safety into the system.

The objective of this standard is to provide practical guidance on technical and educational framework for safety and health in construction with a view to:

a. prevent accidents and harmful effects on the health of workers arising from employment in construction;
b. ensure appropriate safety during implementation of construction;
c. provide safety practice guidelines for appropriate measures of planning, control and enforcement.

## 2.0 SCOPE

This document specifies broad guidelines on safe practices to be adhered to during construction activities in oil industry. However, before commencing any job, specific hazards and its effects should be assessed and necessary corrective/preventive actions should be taken by all concerned. The document is intended only to supplement and not to replace or supersede the prevailing statutory requirements, which shall also be followed as applicable. The scope of this document does not include the design aspects and quality checks during construction.

## 3.0 DEFINITION

Definitions of various terminology are given below:

- *Adequate, appropriate or suitable* are used to describe qualitatively or quantitatively the means or method used to protect the worker.
- *Brace:* A structural member that holds one point in a fixed position with respect to another point; bracing is a system of structural members designed to prevent distortion of a structure.
- *By hand:* The work is done without the help of a mechanised tool.
- *Competent Authority:* A stautory agency having the power to issue regulations, orders or other instructions having the force of law.

- *Competent person:* A person possessing adequate qualifications, such as suitable training and sufficient knowledge, experience and skill for the safe performance of the specific work. The competent authorities may define appropriate criteria for the designation of such persons and may determine the duties to be assigned to them.
- *Execution agency:*
- Any physical or legal person, having contractual obligation with the owner, and who employs one or more workers on a construction site
- *Owner:*
- Any physical or legal person for whom construction job is carried out.
- It shall also include owner's designated representative/ consultant/ nominee/agent, authorised from time to time to act for and on its behalf, for supervising/ coordinating the activities of the execution agency.
- *Hazard:* Danger or potential danger.
- *Guard-rail:* An adequately secured rail erected along an exposed edge to prevent persons from falling.
- *Hoist:* A machine, which lifts materials or persons by means of a platform, which runs on guides.
- *Lifting gear:* Any gear or tackle by means of which a load can be attached to a lifting appliance but which does not form an integral part of the appliance or load.
- *Lifting appliance:* Any stationary or mobile appliance used for raising or lowering persons or loads.
- *Means of access or egress:* Passageways, corridors, stairs, platforms, ladders and any other means for entering or leaving the workplace or for escaping in case of danger.
- *Scaffold:* Any fixed, suspended or mobile temporary structure supporting workers and material or to gain access to any such structure and which is not a lifting appliance as defined above.
- *Toe-board:* A barrier placed along the edge of a scaffold platform, runway, etc., and secured there to guard against the slipping of persons or the falling of material.
- *Worker:* Any person engaged in construction activity.
- *Workplace:* All places where workers need to be or to go by reason of their work.

## 4.0 GENERAL DUTIES

### 4.1 GENERAL DUTIES OF EXECUTION AGENCIES

4.1.1 Execution agency should:

- Provide means and organisation to comply with the safety and health measures required at the workplace.
- Provide and maintain workplaces, plant, equipment, tools and machinery and organise construction work so that, there is no risk of accident or injury to health of workers. In particular, construction work should be planned, prepared and undertaken so that:
  (a) dangers, liable to arise at the workplace, are prevented;
  (b) excessively or unnecessarily strenuous work positions and movements are avoided;
  (c) organisation of work takes into account the safety and health of workers;
  (d) materials and products used are suitable from a safety and health point of view;
  (e) working methods are adopted to safeguard workers against the harmful effects of chemical, physical and biological agents.

- Establish committees with representatives of workers and management or make other arrangement for the participation of workers in ensuring safe working conditions.
- Arrange for periodic safety inspections by competent persons of all buildings, plant, equipment, tools, machinery, workplaces and review of systems of work, regulations, standards or codes of practice. The competent person should examine and ascertain the safety of construction machinery and equipment.
- Provide such supervision to ensure that workers perform their work with due regard to safety and health of theirs as well as that of others.
- Employ only those workers who are qualified, trained and suited by their age, physique, state of health and skill.
- Satisfy themselves that all workers are informed and instructed in the hazards connected with their work and environment and trained in the precautions necessary to avoid accidents and injury to health.
- Ensure that buildings, plant, equipment, tools, machinery or workplaces in which a dangerous defect has been found should not be used until the defect has been rectified.
- Organise for and remain always prepared to take immediate steps to stop the operation and evacuate workers as appropriate, where there is an imminent danger to the safety of workers.
- establish a checking system by which it can be ascertained that all the members of a shift, including operators of mobile equipment, have returned to the camp or base at the close of work on dispersed sites and where small groups of workers operate in isolation.
- Provide appropriate first aid, training and welfare facilities to workers and, whenever collective measures are not feasible or are insufficient, provide and maintain personal protective equipment and clothing in line with the requirement. They should also provide access to workers to occupational health services.
- Educate workers about their right and the duty at any workplace to participate in ensuring safe working conditions to the extent of their control over the equipment and methods of work and to express views on working procedures adopted as may affect safety and health.
- Ensure that except in an emergency, workers, unless duly authorised, should not interfere with, remove, alter or displace any safety device or other appliance furnished for their protection or the protection of others, or interfere with any method or process adopted with a view to avoiding accidents and injury to health.
- Ensure that workers do not operate or interfere with plant and equipment that they have not been duly authorised to operate, maintain or use.
- Ensure that workers do not sleep, rest or cook etc in dangerous places such as scaffolds, railway tracks, garages, confined spaces or in the vicinity of fires, dangerous or toxic substances, running machines or vehicles and heavy equipment etc.
- Obtain the necessary clearance/permits as required and specified by owner.

4.2 GENERAL DUTIES OF OWNERS

4.2.1 Owners should:

- co-ordinate or nominate a competent person to co-ordinate all activities relating to safety and health on their construction projects;
- inform all contractors on the project of special risks to health and safety;
- Ensure that executing agency is aware of the owner's requirements and the executing agency's responsibilities with respect to safetry practices before starting the job.

5.0 SAFETY PRACTICES AT WORK PLACES

5.1 GENERAL PROVISIONS

- All openings and other areas likely to pose danger to workers should be clearly indicated.
- Workers & Supervisors should use the safety helmet and other requisite Personal Protective Equipment according to job & site requirement. They should be trained to use personal protective equipment.
- Never use solvents, alkalis and other oils to clean the skin.
- Lift the load with back straight and knees bent as far as possible. Seek the help in case of heavy load.
- Ensure the usage of correct and tested tools and tackles. Don't allow the make shift tools and tackles.
- **No loose clothing should be allowed while working near rotating equipment or working at heights.**

5.2 MEANS OF ACCESS AND EGRESS

Adequate and safe means of access (atleast two, differently located) to and egress from all workplaces should be provided. Same should be displayed and maintained.

5.3 HOUSEKEEPING

5.3.1 Ensure:
- Proper storage of materials and equipment;
- Removal of scrap, inflammable material, waste and debris at appropriate intervals.

5.3.2 Removal of loose materials, which are not required for use, to be ensured. Accumulation of these at the site can obstruct means of access to and egress from workplaces and passageways.

5.3.3 Workplaces and passageways, that are slippery owing to oil, grease or other causes, should be cleaned up or strewn with sand, sawdust, ash etc.

5.4 PRECAUTIONS AGAINST THE FALL OF MATERIALS & PERSONS AND COLLAPSE OF STRUCTURES

5.4.1 Precautions should be taken such as the provision of fencing, look-out men or barriers to protect any person against injury by the fall of materials, or tools or equipment being raised or lowered.

5.4.2 Where necessary to prevent danger, guys, stays or supports should be used or other effective precautions should be taken to prevent the collapse of structures or parts of structures that are being erected, maintained, repaired, dismantled or demolished.

5.4.3 All openings through which workers are liable to fall should be kept effectively covered or fenced and displayed prominently.

5.4.4 As far as practicable, guardrails and toe-boards should be provided to protect workers from falling from elevated workplaces.

5.5 PREVENTION OF UNAUTHORISED ENTRY

5.5.1 Construction sites located in built-up areas and alongside vehicular and pedestrian traffic routes should be fenced to prevent the entry of unauthorised persons.

**5.5.2 Visitors should not be allowed access to construction sites unless accompanied by or authorised by a competent person and provided with the appropriate protective equipment.**

5.6 FIRE PREVENTION AND FIRE FIGHTING

**5.6.1 All necessary measures should be taken by the executing agency and owner to:**

- **Avoid the risk of fire;**
- **Control quickly and efficiently any outbreak of fire;**
- **Bring out a quick and safe evacuation of persons.**
- **Inform unit/fire station control room, where construction work is carried out within existing operating area.**

5.6.2 Combustible materials such us packing materials, sawdust, greasy/oily waste and scrap wood or plastics should not be allowed to accumulate in workplaces but should be kept in closed metal containers in a safe place.

5.6.3 Places where workers are employed should, if necessary to prevent the danger of fire, be provided with:

- Suitable and sufficient fire-extinguishing equipment, which should be easily visible and accessible;
- An adequate water supply at sufficient pressure meeting the requirements.

5.6.4 To guard against danger at places having combustible material, workers should be trained in the action to be taken in the event of fire, including the use of means of escape.

5.6.5 At sites having combustible material, suitable visual signs should be provided to indicate clearly the direction of escape in case of fire.

5.6.6 Means of escape should be kept clear at all times. Escape routes should be frequently inspected particularly in high structures and where access is restricted.

5.7 LIGHTING

5.7.1 Where natural lighting is not adequate, working light fittings or portable hand-lamps should be provided at workplace on the construction site where a worker will do a job.

5.7.2 Emergency lighting should be provided for personnel safety during night time to facilitate standby lighting source, if normal system fails.

5.7.3 Artificial lighting should not produce glare or disturbing shadows.

5.7.4 Lamps should be protected by guards against accidental breakage.

5.7.5 The cables of portable electrical lighting equipment should be of adequate size & characteristics for the power requirements and of adequate mechanical strength to withstand severe conditions in construction operations.

## 5.8 PLANT, MACHINERY, EQUIPMENT AND HAND TOOLS

### 5.8.1 General Provisions

- Plant, machinery and equipment including hand tools, both manual and power driven, should:
  - ✓ Be of proper design and construction, taking into account health, Safety and ergonomic principles.
  - ✓ Be maintained in good working order;
  - ✓ Be used only for work for which they have been designed.
  - ✓ Be operated only by workers who have been authorised and given appropriate training.
  - ✓ Be provided with protective guards, shields or other devices as required.
- Adequate instructions for safe use should be provided.
- Safe operating procedures should be established and used for all plant, machinery and equipment.
- Operators of plant, machinery and equipment should not be distracted while work is in progress.
- Plant, machinery and equipment should be switched off when not in use and isolated before any adjustment, clearing or maintenance is done.
- Where trailing cables or hose pipes are used they should be kept as short as practicable and not allowed to create a hazard.
- All moving parts of machinery and equipment should be enclosed or adequately guarded.
- Every power-driven machine and equipment should be provided with adequate means, immediately accessible and readily identifiable to the operator, of stopping it quickly and preventing it from being started again inadvertently.
- Operators of plant, machinery, equipment and tools should be provided with PPEs, including where necessary, suitable ear protection.

### 5.8.2 Hand tools

- Hand tools should be repaired by competent persons.
- Heads of hammers and other shock tools should be dressed or ground to a suitable radius on the edge as soon as they begin to mushroom or crack.
- When not in use and while being carried or transported sharp tools should be kept in sheaths, shields, chests or other suitable containers.
- Only insulated or non conducting tools should be used on or near live electrical installations.
- Only non-sparking tools should be used near or in the presence of flammable or explosive dusts or vapours.

### 5.8.3 Pneumatic Tools

- Operating triggers on portable pneumatic tools should be:
  - ✓ So placed as to minimise the risk of accidental starting of the machine.
  - ✓ So arranged as to close the air inlet valve automatically when the pressure of the operator's hand is removed.
- Hose and hose connections for compressed air supply to portable pneumatic tools should be:

- ✓ Designed and tested for the pressure and service for which they are intended;
- ✓ Fastened securely on the pipe outlet and equipped with the safety chain, as appropriate.

- Pneumatic shock tools should be equipped with safety clips or retainers to prevent dies and tools from being accidentally expelled from the barrel.
- Pneumatic tools should be disconnected from power and the pressure in hose lines released before any adjustment or repair is made.

### 5.8.4 Electrical Tools

- Low voltage portable electrical tools should generally be used.
- All electrical tools should be earthed, unless they are "all insulated" or "double insulated" tools which do not require earthing.
- All electrical tools should get inspected and maintained on a regular basis by a competent electrician and complete records kept.

### 5.8.5 Engines

- Engines should:
  - ✓ Be installed so that they can be started safely and the maximum safe speed cannot be exceeded.
  - ✓ Have controls for limiting speed.
  - ✓ Have devices to stop them from a safe place in an emergency.
- IC engines should not be run in confined spaces unless adequate exhaust ventilation is provided.
- When IC engines are being fuelled:
  - ✓ The engine should be shut off.
  - ✓ care should be taken to avoid spilling fuel;
  - ✓ No person should smoke or have naked light in the vicinity.
  - ✓ A fire extinguisher should be kept readily available.
- Secondary fuel reservoir should be placed outside the engine room.

## 6.0 CONSTRUCTION ACTIVITIES

The various common activities in construction are as under:

- Excavation
- Scaffolding, Platforms & Ladders
- Structural Work, Laying of Reinforcement & Concreting
- Road Work (Laying of roads)
- Cutting /Welding
- Working in Confined Space
- Proof/Pressure Testing
- Working at Heights
- Handling & Lifting Equipments
- Vehicle Movement
- Electrical
- Demolition
- Sand/shot blasting/ spray painting

The safe practices to be followed during the implementation of above construction activities are given below:

## 6.1 EXCAVATION

6.1.1 All excavation work should be planned and the method of excavation and the type of support work required should be decided considering the following:

- The stability of the ground;
- The excavation will not affect adjoining buildings, structures or roadways;
- To prevent hazard, the gas, water, electrical and other public utilities should be shut off or disconnected, if necessary;
- Presence of underground pipes, cable conductors, etc.,
- The position of culvert/bridges, temporary roads and spoil heaps should be determined;

6.1.2 Before digging begins on site, all excavation work should be planned and the method of excavation and the type of support work required decided.

6.1.3 All excavation work should be supervised.

6.1.4 Sites of excavations should be thoroughly inspected:

- Daily, prior to each shift and after interruption in work of more than one day;
- After every blasting operation;
- After an unexpected fall of ground;
- After substantial damage to supports;
- After a heavy rain, frost or snow;
- When boulder formations are encountered.

6.1.5 Safe angle of repose while excavating trenches exceeding 1.5m depth upto 3.0m should be maintained. Based on site conditions, provide proper slope, usually $45^0$,and suitable bench of 0.5m width at every 1.5m depth of excavation in all soils except hard rock or provide proper shoring and strutting to prevent cave-in or slides.

6.1.6 As far as possible, excavated earth should not be placed within one meter of the edge of the trench or depth of trench whichever is greater.

6.1.7 Don't allow vehicles to operate too close to excavated area. Maintain atleast 2m distance from edge of excavation. No load, plant or equipment should be placed or moved near the edge of any excavation where it is likely to cause its collapse and thereby endanger any person unless precautions such as the provision of shoring or piling are taken to prevent the sides from collapsing.

6.1.8 Adequately anchored stop blocks and barriers should be provided to prevent vehicles being driven into the excavation. Heavy vehicles should not be allowed near the excavation unless the support work has been specially designed to permit it.

6.1.9 If an excavation is likely to affect the security of a structure on which persons are working, precautions should be taken to protect the structure from collapse.

6.1.10 Barricade at 1m height (with red & white band/self glowing caution board) should be provided for excavations beyond 1.5m depth. Provide two entries/exits for such excavation.

6.1.11 Necessary precautions should be taken for underground utility lines like cables; sewers etc. and necessary approvals/clearances from the concerned authorities shall be obtained before commencement of the excavation job.

6.1.12 Water shall be pumped/ bailed out, if any accumulates in the trench. Necessary precautions should be taken to prevent entry of surface water in trenches.

6.1.13 During rains, the soil becomes loose. Take additional precaution against collapse of side wall.

6.1.14 In hazardous areas, air should be tested to ascertain its quality. No one should be allowed entry till it is suitable for breathing.

6.1.15 In case of mechanised excavation, precaution shall be taken to not to allow anybody to come within one meter of extreme reach of the mechanical shovel. The mechanised excavator shall be operated by a well-trained experienced operator. When not in operation, the machine shall be kept on firm leveled ground with mechanical shovel resting on ground. Wheel or belt shall be suitably jammed to prevent any accidental movement of the machine. Suitable precautions as per manufacturer guidelines should be taken for dozers, graders and other heavy machines.

6.1.16 In case of blasting, follow strictly rules for storage, handling and carrying of explosive materials and execution of blasting operation.

## 6.2 SCAFFOLDING, PLATFORMS & LADDERS

### 6.2.1 Metal as material of construction

- A scaffold should be provided and maintained or other equally safe and suitable provision should be made where work cannot safely be done on or from the ground or from part of a building or other permanent structure.
- Scaffolds should be provided with safe means of access, such as stairs, ladders or ramps. Ladders should be secured against inadvertent movement.
- Every scaffold should be constructed, erected and maintained so as to prevent collapse or accidental displacement when in use.
- Every scaffold and part thereof should be constructed :
  - ✓ In such a way so as not to cause hazards for workers during erection and dismantling;
  - ✓ In such a way so as guard rails and other protective devices, platforms, ladders, stairs or ramps can be easily put together;
  - ✓ With sound material and of requisite size and strength for the purpose for which it is to be used and maintained in a proper condition.
- Boards and planks used for scaffolds should be protected against splitting.
- Materials used in the construction of scaffolds should be stored under good conditions and apart from any material unsuitable for scaffolds.
- Couplers should not cause deformation in tubes. Couplers should be made of drop forged steel or equivalent material.
- Tubes should be free from cracks, splits and excessive corrosion and be straight to the eye, and tube ends cut cleanly square with the tube axis.
- Scaffolds should be designed for their maximum load as per relevant code.
- Scaffolds should be adequately braced.
- Scaffolds which are not designed to be independent should be rigidly connected to the building at designated vertical and horizontal places.
- A scaffold should never extend above the highest anchorage to an extent which might endanger its stability and strength.
- Loose bricks, drainpipes, chimney-pots or other unsuitable material should not be used for the construction or support of any part of a scaffold.
- Scaffolds should be inspected and certified:

- ✓ Before being taken into use;
- ✓ At periodic intervals thereafter as prescribed for different types of scaffolds;
- ✓ After any alteration, interruption in use, exposure to weather or seismic conditions or any other occurrence likely to have affected their strength or stability.

- Inspection should more particularly ascertain that:
  - ✓ The scaffold is of suitable type and adequate for the job;
  - ✓ **Materials used in its construction are sound and of sufficient strength;**
  - ✓ It is of sound construction and stable;
  - ✓ That the required safeguards are in position.
- A scaffold should not be erected, substantially altered or dismantled except by or under the supervision.
- Every scaffold should be maintained in good and proper condition, and every part should be kept fixed or secured so that no part can be displaced in consequence of normal use.
- If out-rigger scaffolding is to be used, it should be specifically designed and inspected before putting in use.

6.2.2 Lifting appliances on scaffolds

- When a lifting appliance is to be used on a scaffold:
  - ✓ the parts of the scaffold should be carefully inspected to determine the additional strengthening and other safety measures required;
  - ✓ any movement of the scaffold members should be prevented;
  - ✓ if practicable, the uprights should be rigidly connected to a solid part of the building at the place where the lifting appliance is erected.

6.2.3 Prefabricated scaffolds

- In the case of prefabricated scaffold systems, the instructions provided by the manufacturers or suppliers should be strictly adhered to. Prefabricated scaffolds should have adequate arrangements for fixing bracing.
- Frames of different types should not be intermingled in a single scaffold.
- Scaffolding shall be erected on firm and level ground.
- All members of metal scaffolding shall be checked periodically to screen out defective / rusted members. All joints should be properly lubricated for easy tightening.
- Entry to scaffolding should be restricted.
- Erection, alteration and removal shall be done under supervision of experienced personnel.
- Use of barrels, boxes, loose bricks etc., for supporting platform shall not be permitted.
- Each supporting member of platform shall be securely fastened and braced
- Where planks are butt-joined, two parallel putlogs shall be used, not more than 100mm apart, to give support to each plank.
- Platform plank shall not project beyond its end support to a distance exceeding 4 times the thickness of plank, unless it is effectively secured to prevent tipping. Cantilever planks should be avoided.
- The platform edges shall be provided with 150mm high toe board to eliminate hazards of tools or other objects falling from platform.
- Erect ladders in the “four up-one out position”
- Lash ladder securely with the structure.

- Using non-slip devices, such as, rubber shoes or pointed steel ferules at the ladder foot, rubber wheels at ladder top, fixing wooden battens, cleats etc.
- When ladder is used for climbing over a platform, the ladder must be of sufficient length, to extend at least one meter above the platform, when erected against the platform in "four up-one out position."
- Portable ladders shall be used for heights not more than 4mt. Above 4mt flights, fixed ladders shall be provided with at least 600 mm landings at every 6mt or less.
- The width of ladder shall not be less than 300mm and rungs shall be spaced not more than 300mm.
- Every platform and means of access shall be kept free from obstruction.
- If grease, mud, gravel, mortar etc., fall on platform or scaffolds, these shall be removed immediately to avoid slippage.
- Workers shall not be allowed to work on scaffolds during storms or high wind. After heavy rain or storms, scaffolds shall be inspected before reuse.
- Don't overload the scaffolding. Remove excess material and scrap immediately.
- Dismantling of scaffolds shall be done in a pre-planned sequential manner.

6.2.4 Suspended scaffolds/boatswain's chair

- In addition to the requirements for scaffolds in general as regards soundness, stability and protection against the risk of falls, suspended scaffolds should meet the following specific requirements.
  - ✓ Platforms should be designed and built with dimensions that are compatible with the stability of the structure as a whole, especially the length;
  - ✓ The number or anchorage should be compatible with the dimensions of the platform;
  - ✓ The safety of workers should be safeguarded by an extra rope having a point of attachment independent of the anchorage arrangements of the scaffold;
  - ✓ The anchorage and other elements of support of the scaffold should be designed and built in such a way as to ensure sufficient strength;
  - ✓ The ropes, winches, pulleys or pulley blocks should be designed, assembled, used and maintained according to the requirements established for lifting gear adapted to the lifting of persons according to national laws and regulations;
  - ✓ Before use, the whole structure should be checked by a competent person.

### 6.2.5 Bamboo Scaffolding

- In general, it should be avoided as far as possible. It should not be used in the unit/off-site areas and where hot work is to be done.

## 6.3 STRUCTURAL WORK, LAYING OF REINFORCEMENT & CONCRETING

### 6.3.1 General provisions

- The erection or dismantling of buildings, structures, civil engineering works, formwork, falsework and shoring should be carried out by trained workers only under the supervision of a competent person.
- Precautions should be taken to guard against danger to workers arising from any temporary state of weakness or instability of a structure.
- Formwork, falsework and shoring should be so designed, constructed and maintained that it will safely support all loads that may be imposed on it.

- Formwork should be so designed and erected that working platforms, means of access, bracing and means of handling and stabilising are easily fixed to the formwork structure.

### 6.3.2. Erection and dismantling of steel and prefabricated structures

- The safety of workers employed on the erection and dismantling of steel and prefabricated structures should be ensured by appropriate means, such as provision and use of:
  - ✓ Ladders, gangways or fixed platforms;
  - ✓ Platforms, buckets, boatswain's chairs or other appropriate means suspended from lifting appliances;
  - ✓ Safety harnesses and lifelines, catch nets or catch platforms;
  - ✓ Power-operated mobile working platforms.
- Steel and prefabricated structures should be so designed and made that they can be safely transported and erected.
- In addition to the need for the stability of the part when erected, the design should explicitly take following into account:
  - ✓ The conditions and methods of attachment in the operations of transport, storing and temporary support during erection or dismantling as applicable;
  - ✓ Methods for the provision of safeguards such as railings and working platforms, and, when necessary, for mounting them easily on the structural steel or prefabricated parts.
- The hooks and other devices built in or provided on the structural steel or prefabricated parts that are required for lifting and transporting them should be so shaped, dimensioned and positioned as:
  - ✓ To withstand with a sufficient margin the stresses to which they are subjected;
  - ✓ Not to set up stresses in the part that could cause failures, or stresses in the structure itself not provided for in the plans, and be designed to permit easy release from the lifting appliance. Lifting points for floor and staircase units should be located (recessed if necessary) so that they do not protrude above the surface;
  - ✓ To avoid imbalance or distortion of the lifted load.
- Storeplaces should be so constructed that:
  - ✓ There is no risk of structural steel or prefabricated parts falling or overturning;
  - ✓ Storage conditions generally ensure stability and avoid damage having regard to the method of storage and atmospheric conditions;
  - ✓ Racks are set on firm ground and designed so that units cannot move accidentally.
- While they are being stored, transported, raised or set down, structural steel or prefabricated parts should not be subjected to stresses prejudicial to their stability.
- Every lifting appliance should:
  - ✓ Be suitable for the operations and not be capable of accidental disconnection;
  - ✓ Be approved or tested as per statutory requirement.
- Lifting hooks should be of the self-closing type or of a safety type and should have the maximum permissible load marked on them.
- Tongs, clamps and other appliances for lifting structural steel and prefabricated parts should:
  - ✓ Be of such shape and dimensions as to ensure a secure grip without damaging the part;
  - ✓ Be marked with the maximum permissible load in the most unfavourable lifting conditions.
- Structural steel or prefabricated parts should be lifted by methods or appliances that prevent them from spinning accidentally.

- When necessary to prevent danger, before they are raised from the ground, structural steel or prefabricated parts should be provided with safety devices such as railings and working platforms to prevent falls of persons.
- While structural steel or prefabricated parts are being erected, the workers should be provided with appliances for guiding them as they are being lifted and set down, so as to avoid crushing of hands and to facilitate the operations. Use of such appliances should be ensured.
- A raised structural steel or prefabricated part should be so secured and wall units so propped that their stability cannot be imperiled, even by external agencies such as wind and passing loads before its release from the lifting appliance.
- At work places, instruction should be given to the workers on the methods, arrangements and means required for the storage, transport, lifting and erection of structural steel or prefabricated parts, and, before erection starts, a meeting of all those responsible should be held to discuss and confirm the requirements for safe erection.
- During transportation within the construction area, attachments such as slings and stirrups mounted on structural steel or prefabricated parts should be securely fastened to the parts.
- Structural steel or prefabricated parts should be so transported that the conditions do not affect the stability of the parts or the means of transport result in jolting, vibration or stresses due to blows, or loads of material or persons.
- When the method of erection does not permit the provision of other means of protection against fall of persons, the workplaces should be protected by guardrails, and if appropriate by toe-boards.
- When adverse weather conditions such as snow, ice and wind or reduced visibility entail risks of accidents, the work should be carried on with particular care, or, if necessary, interrupted.
- Structures should not be worked on during violent storms or high winds, or when they are covered with ice or snow, or are slippery from other causes.
- If necessary, to prevent danger, structural steel parts should be equipped with attachments for suspended scaffolds, lifelines or safety harnesses and other means of protection.
- The risks of falling, to which workers moving on high or sloping girders are exposed, should be limited by all means of adequate collective protection or, where this is impossible, by the use of a safety harness that is well secured to a strong support.
- Structural steel parts that are to be erected at a great height should as far as practicable be assembled on the ground.
- When structural steel or prefabricated parts are being erected, a sufficiently extended area underneath the workplace should be barricaded or guarded
- Steel trusses that are being erected should be adequately shored, braced or guyed until they are permanently secured in position.
- Load-bearing structural member should not be dangerously weakened by cutting, holing or other means.
- Structural members should not be forced into place by the hoisting machine while any worker is in such a position that he could be injured by the operation.
- Open-web steel joists that are hoisted singly should be directly placed in position and secured against dislodgment.

### 6.3.3 Reinforcement

- Ensure that workers use Personnel Protective equipment like safety helmet, safety shoes, gloves etc.
- Don't place the hand below the rods for checking clear distance. Use measuring devices.

- Don't wear loose clothes while checking the rods.
- Don't stand unnecessarily on cantilever rods.
- For supplying of rods at heights, proper staging and/or bundling to be provided.
- Ensure barricading and staging for supplying and fixing of rods at height.
- For short distance carrying of materials on shoulders, suitable pads to be provided.
- While transporting material by trucks/trailers, the rods shall not protrude in front of or by the sides of driver's cabin. In case such protrusion cannot be avoided behind the deck, then it should not extend 1/3$^{rd}$ of deck length or 1.5M which ever is less and tied with red flags/lights.

### 6.3.4 Concreting

- Ensure stability of shuttering work before allowing concreting.
- Barricade the concreting area while pouring at height/depths.
- Keep vibrator hoses, pumping concrete accessories in healthy conditions and mechanically locked.
- Pipelines in concrete pumping system shall not be attached to temporary structures such as scaffolds and formwork support as the forces and movements may effect their integrity.
- Check safety cages & guards around moving motors/parts etc. provided in concreting mixers.
- Use Personal Protective Equipment like gloves, safety shoes etc. while dealing with concrete and wear respirators for dealing with cement.
- Earthing of electrical mixers, vibrators, etc. should be done and verified.
- Cleaning of rotating drums of concrete mixers shall be done from outside. Lockout devices shall be provided where workers need to enter.
- Where concrete mixers are driven by internal combustion engine, exhaust points shall be located away from the worker's workstation so as to eliminate their exposure to obnoxious fumes.
- Don't allow unauthorised person to stand under the concreting area.
- Ensure adequate lighting arrangements for carrying out concrete work during night.
- Don't allow the same workers to pour concrete round the clock. Insist on shift pattern.
- During pouring, shuttering and its supports should be continuously watched for defects.

## 6.4 ROAD WORK

6.4.1 Site shall be barricaded and provided with warning signs, including night warning lamps at appropriate locations for traffic diversion.

6.4.2 Filled and empty bitumen drums shall be stacked separately at designated places.

6.4.3 Mixing aggregate with bitumen shall preferably be done with the help of bitumen batch mixing plant, unless operationally non-feasible.

6.4.4 Road rollers, Bitumen sprayers, Pavement finishers shall be driven by experienced drivers with valid driving license.

6.4.5 Workers handling hot bitumen sprayers or spreading bitumen aggregate mix or mixing bitumen with aggregate shall be provided with PVC hand gloves and rubber shoes with legging up to knee joints.

6.4.6 At the end of day's work, surplus hot bitumen in tar boiler shall be properly covered by

a metal sheet, to prevent anything falling in it.

6.4.7 If bitumen accidentally falls on ground, it shall be immediately covered by sprinkling sand, to prevent anybody stepping on it. Then it shall be removed with the help of spade.

## 6.5 CUTTING/WELDING

6.5.1 Common hazards involved in welding/cutting are sparks, molten metal, flying particles, harmful light rays, electric shocks etc. Following precautions should be taken: -

- A dry chemical type fire extinguisher shall be made available in the work area.
- Adequate ventilation shall be ensured by opening manholes and fixing a shield or forced circulation of air etc, while doing a job in confined space.
- Ensure that only approved and well-maintained apparatus, such as torches, manifolds, regulators or pressure reducing valves, and acetylene generators, be used.
- All covers and panels shall be kept in place, when operating an electric Arc welding machine.
- The work piece should be connected directly to Power supply, and not indirectly through pipelines/structures/equipments etc.
- The welding receptacles shall be rated for 63 A suitable for 415V, 3-Phase system with a scraping earth. Receptacles shall have necessary mechanical interlocks and earthing facilities.
- All cables, including welding and ground cables, shall be checked for any worn out or cracked insulation before starting the job. Ground cable should be separate without any loose joints.
- Cable coiling shall be maintained at minimum level, if not avoidable.
- An energised electrode shall not be left unattended.
- The power source shall be turned off at the end of job.
- All gas cylinders shall be properly secured in upright position.
- Acetylene cylinder shall be turned and kept in such a way that the valve outlet points away from oxygen cylinder.
- Acetylene cylinder key for opening valve shall be kept on valve stem, while cylinder is in use, so that the acetylene cylinder could be quickly turned off in case of emergency. Use flash back arrestors to prevent back-fire in acetylene/oxygen cylinder.
- When not in use, valves of all cylinders shall be kept closed.
- All types of cylinders, whether full or empty, shall be stored at cool, dry place under shed.
- Forced opening of any cylinder valve should not be attempted.
- Lighted gas torch shall never be left unattended.
- Store acetylene and oxygen cylinders separately.
- Store full and empty cylinders separately.
- Avoid cylinders coming into contact with heat.
- Cylinders that are heavy or difficult to carry by hand may be rolled on their bottom edge but never dragged.
- If cylinders have to be moved, be sure that the cylinder valves are shut off.
- Before changing torches, shut off the gas at the pressure reducing regulators and not by crimping the hose.
- Do not use matches to light torches, use a friction lighter.
- Move out any leaking cylinder immediately.
- Use trolleys for oxygen & acetylene cylinder and chain them.
- Always use Red hose for acetylene and other fuel gases and Black for oxygen, and ensure that both are in equal length.

- Ensure that hoses are free from burns, cuts and cracks and properly clamped.
- Avoid dragging hoses over sharp edges and objects
- Do not wrap hoses around cylinders when in use or stored.
- Protect hoses from flying sparks, hot slag, and other hot objects.
- Lubricants shall not be used on Ox-fuel gas equipment.
- During cutting/welding, use proper type goggles/ face shields.

## 6.6 WORKING IN CONFINED SPACES

6.6.1 Following safety practices for working in confined space like towers, columns, tanks and other vessels should be followed in addition to the safety guidelines for specific jobs like scaffolding, cutting/welding etc.

- Shut down, isolate, depressurise and purge the vessel as per laid down procedures.
- Ensure proper and accessible means of exit before entry inside a confined space.
- The number of persons allowed inside the vessel should be limited to avoid overcrowding.
- When the work is going on in the confined space, there should always be one man standby at the nearby manway.
- Before entering inside the vessels underground or located at lower elevation, probability of dense vapours accumulating nearby should also be considered in addition to inside the vessel.
- Ensure requisite $O_2$ level before entry in the confined space and monitor level periodically or other wise use respiratory devices.
- Check for no Hydrocarbon or toxic substances before entry and monitor level periodically or use requisite Personal Protective Equipment.
- Ensure adequate ventilation or use respiratory devices.
- Depending upon need, necessary respirator system, gas masks and suit shall be worn by everyone entering confined space. In case of sewer, OWS or in the confined area where there is a possibility of toxic or inert gas, gas masks shall be used by everyone while entering.
- Barricade the confined spaces during hoisting, radiography, blasting, pressure testing etc.
- Use 24V flameproof lamp fittings only for illumination.
- Use tools with air motors or electric tools with maximum voltage of 24V.
- House keeping shall be well maintained.
- Safety helmet, safety shoes and safety belt shall be worn by everyone entering the confined space.
- Don't wear loose clothing while working in a confined space.
- In case of the vessels which are likely to contain pyropheric substances (like Iron Sulphide), special care need to be taken before opening the vessel. Attempt should be made to remove the pyropheric substances. Otherwise, these should be always kept wet by suitable means.
- The cutting torches should also be kept outside the vessel immediately after the cutting.
- The gas cylinders used for cutting/welding shall be kept outside.
- All cables, hoses, welding equipment etc., shall be removed from confined space at end of each work day, even if the work is to be resumed in the same space the next day.
- To the extent possible sludge shall be cleared and removed from outside before entering.
- No naked light or flame or hot work such as welding, cutting and soldering should be permitted inside a confined space or area unless it has been made completely free of the flammable atmosphere, tested and found safe by a competent person.

Only non-sparking tools and flameproof hand lamps protected with guard and safety torches should be used inside such confined space or area for initial inspection, cleaning or other work required to be done for making the area safe.

- Communication should be always maintained between the worker and the attendant.

## 6.7 PROOF/PRESSURE TESTING

6.7.1 Review test procedure before allowing testing with water or air or any other fluid.

6.7.2 Provide relief valves of adequate size while testing with air or other gases.

6.7.3 Ensure compliance of necessary precautions, step wise loading, tightening of fasteners, grouting etc. before and during testing.

6.7.4 Inform all concerned in advance of the testing.

6.7.5 Keep the vents open before opening any valve for filling/draining of liquid used for hydrotesting. The filling/draining should not exceed the designed rate for pressure testing.

6.7.6 Provide separate gauges of suitable range for pressurising pump and the equipment to be tested.

6.7.7 Provide gauges at designated locations for monitoring of pressures.

6.7.8 Check the calibration of all pressurising equipment and accessories and maintain records.

6.7.9 Take readings at pre-defined intervals.

## 6.8 WORKING AT HEIGHTS

### 6.8.1 General Provision

- While working at a height of more than 3 meters, approved safety belt shall be used.
- While working at a height of more than 3 meters, permit should be issued by competent person before commencement of the job.
- Worker should be well trained on usage of safety belt including its proper usage at the time of ascending/descending.
- All tools should be carried in tool kits to avoid their falling.
- If the job is on fragile/sloping roof, roof walk ladders shall be used.
- Provide lifeline wherever required.
- Additional safety measures like providing Fall Arrestor type Safety belt, safety net should be provided depending upon site conditions, job requirements.
- Keep working area neat and clean. Remove scrap material immediately.
- Don't throw or drop material/equipment from height.
- Avoid jumping from one member to another. Use proper passageway.
- Keep both hands free while climbing. Don't try to bypass the steps of the ladder.
- Try to maintain calm at height. Avoid over exertion.
- Avoid movements on beam.
- Elevated workplaces including roofs should be provided with safe means of access and egress such as stairs, ramps or ladders.

### 6.8.2 Roof Work

- All roof-work operations should be pre-planned and properly supervised.
- Roof work should only be undertaken by workers who are physically and psychologically fit and have the necessary knowledge and experience for such work.
- Work on roofs shouldn't be carried on in weather conditions that threaten the safety of workers.
- Crawling boards, walkways and roof ladders should be securely fastened to a firm structure.
- Roofing brackets should fit the slope of the roof and be securely supported.
- Where it is necessary for a person to kneel or crouch near the edge of the roof, necessary precautions should be taken.
- On a large roof where work have to be carried out at or near the edge, a simple barrier consisting of crossed scaffold tubes supporting a tubing guardrail may be provided.
- All covers for openings in roofs should be of substantial construction and be secured in position.
- Roofs with a pitch of more than 10 should be treated as sloping.
- When work is being carried out on sloping roofs, sufficient and suitable crawling boards or roof ladders should be provided and firmly secured in position.
- During extensive work on the roof, strong barriers or guardrails and toe-boards should be provided to stop a person from falling off the roof.
- Where workers are required to work on or near roofs or other places covered with fragile material, through which they are liable to fall, they should be provided with suitable roof ladders or crawling boards strong enough and when spanning across the supports for the roof covering to support those workers.
- A minimum of two boards should be provided so that it is not necessary for a person to stand on a fragile roof to move a board or a ladder, or for any other reason.

## 6.9 HANDLING AND LIFTING EQUIPMENT:

### 6.9.1 General Provisions

Following are the general guidelines to be followed with regard to all types of handling and lifting equipment in addition to the guidelines for specific type of equipments dealt later on.

- There should be a well-planned safety programme to ensure that all the lifting appliances and lifting gear are selected, installed, examined, tested, maintained, operated and dismantled with a view to preventing the occurrence of any accident;
- All lifting appliances shall be examined by competent persons at frequencies as per statute.
- Check thoroughly quality, size and condition of all lifting tools like chain pulley blocks, slings, U-clamps, D-shackles etc. before putting them in use.
- Safe lifting capacity of all lifting & handling equipment, tools and shackles should be got verified and certificates obtained from competent authorities before its use. The safe working load shall be marked on them.
- Check periodically the oil, brakes, gears, horns and tyre pressure of all moving equipments like cranes, forklifts, trailers etc as per manufacturer's recommendations.
- Check the weights to be lifted and accordingly decide about the crane capacity, boom length and angle of erection.
- Allow lifting slings as short as possible and check packing at the friction points.

- While lifting/placing of the load, no unauthorised person shall remain within the radius of the boom and underneath the load.
- While loading, unloading and stacking of pipes, proper wedges shall be placed to prevent rolling down of the pipes.
- Control longer jobs being lifted up from both ends.
- Only trained operators and riggers should carry out the job. While the crane is moving or lifting the load, the trained rigger should be there for keeping a vigil against hitting any other object.
- During high wind conditions and nights, lifting of heavy equipments should be avoided. If unavoidable to do erection in night, operator and rigger should be fully trained for night signaling. Also proper illumination should be there.
- Allow crane to move on hard, firm and leveled ground.
- When crane is in idle condition for long periods or unattended, crane boom should either be lowered or locked as per manufacturer's guidelines.
- Hook and load being lifted shall remain in full visibility of crane operators, while lifting, to the extent possible.
- Don't allow booms or other parts of crane to come within 3 meters reach of overhead electrical cables.
- No structural alterations or repairs should be made to any part of a lifting appliance, which may affect the safety of the appliance without the permission and supervision of the competent person.

6.9.2 Hoists

- **Hoist shafts should be enclosed with rigid panels or other adequate fencing at:**
  - ✓ Ground level on all sides;
  - ✓ All other levels at all points at which access is provided;
  - ✓ All points at which persons are liable to be struck by any moving part.
- The enclosure of hoist shafts, except at approaches should extend where practicable at least 2mt above the floor, platform or other place to which access is provided except where a lesser height is sufficient to prevent any person falling down the hoistway and there is no risk of any person coming into contact with any moving part of the hoist, but in no case should the enclosure be less than 1mt in height.
- The guides of hoist platforms should offer sufficient resistance to bending and, in the case of jamming by a safety catch, to buckling.
- Where necessary to prevent danger, adequate covering should be provided above the top of hoist shafts to prevent material falling down them.
- Outdoor hoist towers should be erected on firm foundations, and securely braced, guyed and anchored.
- A ladderway should extend from the bottom to the top of outdoor hoist towers, if no other ladderway exists within easy reach.
- Hoisting engines should be of ample capacity to control the heaviest load that they will have to move.
- Hoists should be provided with devices that stop the hoisting engine as soon as the platform reaches its highest stopping place.
- Winches should be so constructed that the brake is applied when the control handle is not held in the operating position.
- It should not be possible to set in motion from the platform a hoist, which is not designed for the conveyance of persons.
- Winches should not be fitted with pawl and ratchet gears on which the pawl must be disengaged before the platform is lowered.

- Hoist platforms should be capable of supporting the maximum load that they will have to carry with a safety factor.
- Hoist platforms should be equipped with safety gear that will hold the platform with the maximum load if the hoisting rope breaks.
- If workers have to enter the cage or go on the platform at landings there should be a locking arrangement preventing the cage or platform from moving while any worker is in or on it.
- On sides not used for loading and unloading, hoist platforms should be provided with toe-boards and enclosures of wire mesh or other suitable material to prevent the fall of parts of loads.
- Where necessary to prevent danger from falling objects, hoist platforms should be provided with adequate covering.
- Counterweights consisting of an assemblage of several parts should be made of specially constructed parts rigidly connected together.
- Counterweights should run in guides.
- Platforms should be provided at all landings used by workers.
- Following notices should be posted up conspicuously and in very legible characters:
- On all hoists:
  - ✓ On the platform: the carrying capacity in kilograms or other appropriate standard unit of weight;
  - ✓ On the hoisting engine: the lifting capacity in kilograms or other appropriate standard unit of weight;
- On hoists authorized or certified for the conveyance of persons:
- On the platform or cage: the maximum number of persons to be carried at one time;
- On every approach to the hoist and on the platform: prohibition of use by persons.
- Hoists intended for the carriage of persons should be provided with a cage so constructed as to prevent any person from falling out or being trapped between the cage and any fixed part of the structure when the cage gate is shut, or from being struck by the counterbalance weight or by articles or materials tailing down the hoistway.
- On each side in which access is provided, the cage should have a gate fitted with devices which ensure that the gate cannot be opened except when the cage is at a landing and that the gate must be closed before the cage can move away from the landing.
- Every gate in the enclosure of the hoist shaft which gives access from a landing place to the cage should be fitted with devices to ensure that the gate cannot be opened except when the cage is at that landing place, and that the cage cannot be moved away from that landing place until the gate is closed.

6.9.3 Lifting ropes

- Only ropes with a known safe working capacity should be used as lifting ropes.
- Lifting ropes should be installed, maintained and inspected in accordance with manufacturers' instructions.
- Repaired steel ropes should not be used on hoists.
- Where multiple independent ropes are used, for the purpose of stability, to lift a work platform, each rope should be capable of carrying the load independently.

## 6.10 VEHICLE MOVEMENT

6.10.1 Park vehicles only at designated places. Don't block roads to create hindrance for other vehicles.

6.10.2 Don't overload the vehicle.

6.10.3 Obey speed limits and traffic rules.

6.10.4 Always expect the unexpected and be a defensive driver.

6.10.5 Drive carefully during adverse weather and road conditions.

6.10.6 Read the road ahead and ride to the left.

6.10.7 Be extra cautious at nights. Keep wind screens clean and lights in working condition.

6.10.8 All vehicles used for carrying workers and construction materials must undergo predictive/preventive maintenance and daily checks.

6.10.9 Driver with proper valid driving license shall only be allowed to drive the vehicle.

6.10.10 Routes shall be leveled, marked and planned in such a way so as to avoid potential hazards such as overhead power lines and sloping ground etc.

6.10.11 While reversing the vehicles, help of another worker should be ensured at all times.

6.10.12 An unattended vehicle should have the engine switched off.

6.10.13 Wherever possible one-way system shall be followed.

6.10.14 Barriers/fixed stops should be provided for excavation/openings to prevent fall of vehicle.

6.10.15 Load should be properly secured.

6.10.16 The body of the tipper lorry should always be lowered before driving the vehicle off.

6.10.17 Signs/signals/caution boards etc. should be provided on routes.

## 6.11 ELECTRICAL

### 6.11.1 General Provisions

- Only persons having valid licenses should be allowed to work on electrical facilities.
- No person should be allowed to work on live circuit. The same, if unavoidable, special care and authorisation need to be taken.
- Treat all circuits as "LIVE" unless ensured otherwise.
- Electrical "Tag Out" procedure "MUST" be followed for carrying out maintenance jobs.
- Display voltage ratings prominently with "Danger" signs.
- Put caution/notice signs before starting the repair works.
- All electrical equipment operating above 250V shall have separate and distinct connections to earth grid.
- Proper grounding to be ensured for all switch boards and equipment including Portable ones prior to taking into service.
- Make sure that electrical switch boards, portable tools, equipments (like grinding machine etc.) don't get wet during their usage. If it happens, stop the main supply, make the tools dry and then only use them. Check proper earthing.

- All temporary switch boards/ KIOSKS put up at work site should be suitably protected from rain and the level of same should be high enough to avoid contact with water due to water logging.
- Don't work wet on electrical system.
- Don't overload the electrical system.
- Use only proper rated HRC fuses.
- Industrial type extension boards and Plug sockets are only to be used.
- ELCB for all temporary connections must be provided. Use insulated 3-pin plug tops.
- All power supply cables should be laid properly and neatly so that they don't cause hindrance to persons working and no physical damage also takes place to the cables during various construction activities.
- All Power cables to be properly terminated using glands and lugs of proper size and adequately crimped.
- Use spark-proof/flame proof type electrical fittings in Fire Hazard zones.
- Check installations of steel plates/pipes to protect underground cables at crossings.
- Don't lay unarmored cable directly on ground, wall, roof or trees. All temporary cables should be laid at least 750 mm below ground and cable markers should be provided. Proper sleeves should be provided at road crossings. In case temporary cables are to be laid on wooden poles/steel poles, the minimum cable heights should be 4.5 M.
- Maintain safe overhead distance of HT cables.
- Don't connect any earthing wire to the pipelines/structures.
- Don't make any unsafe temporary connections, naked joints/wiring etc.
- Ensure that temporary cables are free from cuts, damaged insulation, kinks or improper insulated joints.
- Check at periodic intervals that pins of sockets and joints are not loose.
- Protect electrical wires/equipments from water and naked flames.
- Illuminate suitably all the work areas.
- All switchboards should be of MS structure only and incoming source should be marked.
- Hand lamps should not be of more than 24V rating.
- Fire extinguishers (DCP/$CO_2$/Sand buckets) should be kept near temporary switch boards being used for construction purposes. Don't use water for fighting electrical fires.
- Insulating mats shall be provided in the front and back end of switch boards.
- All parts of electrical installations should be so constructed, installed and maintained as to prevent danger of electric shock, fire and external explosion.
- Periodic checking/certification of electrical safety appliances such as gloves, insulating mats, hoods etc. to be done/witnessed along with maintaining a register at site signed by competent authority.
- A notice displaying following, should be kept exhibited at suitable places:
  - ✓ Prohibiting unauthorised persons from entering electrical equipment rooms or from handling or interfering with electrical apparatus;
  - ✓ Containing directions as to procedures in case of fire, rescue of persons in contact with live conductors and the restoration of persons suffering from electric shock;
  - ✓ Specifying the person to be notified in case of electrical accident or dangerous occurrence, and indicating how to communicate with him.
- No other cables/pipes to be laid in trench used for electrical cables.
- Utmost care should be taken while excavating Earth from cable trench to avoid damage or any accident.
- Sub-station floor cut-outs meant for switch board installations to be covered wherever installation is incomplete.

**NOTE:** A Residual Current Operated Circuit Breaker (RCCB) or Earth Leakage Circuit Breaker (ELCB), when installed, protects a human being to the widest extent. RCCB or ELCB should be provided as per Indian Electricity Rules.

### 6.11.2 Inspection and maintenance

- All electrical equipment should be inspected before taking into use to ensure suitability for its proposed use.
- At the beginning of every shift, the person using the electrical equipment should make a careful external examination of the equipment and conductors, especially the flexible cables.
- Apart from some exceptional cases, work on or near live parts of electrical equipment should be forbidden.
- Before any work is begun on conductors or equipment that do not have to remain live:
  - ✓ The current should be switched off by a responsible authorised person;
  - ✓ Precautions should be taken to prevent the current from being switched on again;
  - ✓ The conductors or the equipment should be tested to ascertain that they are dead;
  - ✓ The conductors and equipment should be earthed and short-circuited;
  - ✓ Neighboring live parts should be adequately protected against accidental contact.
- After work has been done on conductors and equipment, the current should only be switched on again on the orders of a competent person after the earthing and short-circuiting have been removed and the workplace reported safe.
- Electricians should be provided with approved and tested tools, and personal protective equipment such as rubber gloves, mats etc.
- All conductors and equipment should be considered to be live unless there is a proof of the contrary.
- When work has to be done in dangerous proximity to live parts the current should be cut off. If for operational reasons this is not possible, the live parts should be fenced off or enclosed by qualified staff from the sub-station concerned.

### 6.11.3 Testing

- Electrical installations should be inspected and tested and the results recorded.
- Periodic testing of the efficiency of the earth leakage protective devices should be carried out.
- Particular attention should be paid to the earthing of apparatus, the continuity of protective conductors, polarity and insulation resistance, protection against mechanical damage and condition of connections at points of entry.

## 6.12 DEMOLITION

### 6.12.1 General provisions

- When the demolition of any building or structure might present danger to workers or to the public:
  - ✓ Necessary precautions, methods and procedures should be adopted, including those for the disposal of waste or residues;
  - ✓ The work should be planned and undertaken only under the supervision of a competent person.
- Before demolition operations begin:
  - ✓ Structural details and builders' drawings should be obtained wherever possible;

- ✓ Details of the previous use should be obtained to identify any possible contamination and hazards from chemicals, flammables, etc.;
- ✓ An initial survey should be carried out to identify any structural problems and risks associated with flammable substances and substances hazardous to health. The survey should note the type of ground on which the structure is erected, the condition of the roof trusses, the type of framing used in framed structures and the load-bearing walls;
- ✓ A method of demolition should be formulated after the survey and recorded in a method statement having taken all the various considerations into account and identifying the problems and their solutions;

- All electric, gas, water and steam service lines should be shut off and, as necessary, capped or otherwise controlled at or outside the construction site before work commences.
- If it is necessary to maintain any electric power, water or other services during demolition operations, they should be adequately protected against damage.
- As far as practicable, the danger zone round the building should be adequately fenced off and sign posted. To protect the public a fence 2m high should be erected enclosing the demolition operations and the access gates should be secured outside working hours.
- The fabric of buildings contaminated with substances hazardous to health should be decontaminated. Protective clothing and respiratory devices should be provided and worn.
- Where plant has contained flammable materials, special precautions should be taken to avoid fire and explosion.
- The plant to be demolished should be isolated from all other plant that may contain flammable materials. Any residual flammable material in the plant should be rendered safe by cleaning, purging or the application of an inert atmosphere as appropriate.
- Care should be taken not to demolish any parts, which would destroy the stability of other parts.
- Demolition activities should not be continued under adverse climatic conditions such as high winds, which could cause the collapse of already weakened structures.
- To prevent hazards parts of structures should be adequately shored, braced or otherwise supported.
- Structures should not be left in a condition in which they could be brought down by wind pressure or vibration.
- Where a deliberate controlled collapse technique is to be used, expert engineering advice should be obtained, and:
  - ✓ It should only be used where the whole structure is to come down because it relies on the removal of key structural members to effect a total collapse;
  - ✓ It should only be used on sites that are fairly level and where there is enough surrounding space for all operatives and equipment to be withdrawn to a safe distance.
- When equipment such as power shovels and bulldozers are used for demolition, due consideration should be given to the nature of the building or structure, its dimensions, as well as to the power of the equipment being used.
- If a swinging weight is used for demolition, a safety zone having a width of at least one-and-a-half times the height of the building or structure should be maintained around the points of impact.

### 6.12.2 Demolition of structural steelwork

i) All precautions should be taken to prevent danger from any sudden twist, spring or collapse of steelwork, ironwork or reinforced concrete when it is cut or released.

ii) Steel construction should be demolished tier by tier.
iii) Structural steel parts should be lowered and not dropped from a height.

## 6.13 SAND/SHOT BLASTING/ SPRAY PAINTING

6.13.1 Sand blasting should be used only after approval from competent person.

6.13.2 Air Compressor used for sand/shot blasting/painting should have guard and positioned away from the work place.

6.13.3 Exhaust of the prime mover, if IC engine is used, should be directed away from the work place.

6.13.4 In case of motor driven compressor, the body of the motor as well as the compressor to be properly earthed.

6.13.5 The hoses used for compressed air should be of proper quality, and health of the same to be ensured through regular check/ test.

6.13.6 The operator of sand/shot blasting/painting should wear suitable PPE's including mask.

6.13.7 Adequate measures to be taken to suppress dust/spray particle.

6.13.8 Sand used for sand blasting should be suitably covered & protected from to rain/moisture.

6.13.9 When these activities are done in confined places, adequate measure to be taken for proper ventilation.

## 7.0 ADDITIONAL SAFETY PRECAUTION FOR UNITS WITH HYDROCARBONS

In addition to general safety precautions as outlined above for the activities in Clause 6.0, following additional safety precautions need to be taken for the sites within the operating area or nearby, where presence of Hydrocarbons cannot be ruled out.

- **No job shall be carried out without a valid permit.**
- **Smoking should be prohibited in all places containing readily combustible or flammable materials and "No Smoking" notices be prominently displayed.**
- In confined spaces and other places where flammable gases, vapours or dusts can cause danger, following measures should be taken:
  - ✓ Only approved type electrical installations and equipment, including portable lamps, should be used;
  - ✓ There should be no naked flames or source of ignition;
  - ✓ **Oily rags, waste and clothes or other substances liable to spontaneous ignition should be removed without delay to a safe place;**
  - ✓ **Ventilation should be provided.**
- Regular inspections should be made of places where there are fire risks. These include the vicinity of heating appliances, electrical installations and conductors, stores of flammable and combustible materials, welding and cutting operations.
- Welding, flame cutting and other hot work should only be done after issuance of work permit in line with the requirement after appropriate precautions, as required, are taken to reduce the risk of fire.
- Fire-extinguishing equipment should be well maintained and inspected at suitable intervals by a competent person. Access to fire-extinguishing equipment such as

hydrants, portable extinguishers and connections for hoses should be kept clear at all times.

- All supervisors and a sufficient number of workers should be trained in the use of fire-extinguishing equipment, so that adequate trained personnel are readily available during all working periods.
- Audio means to give warning in case of fire should be provided where this is necessary to prevent danger. Such warning should be clearly audible in all parts of the site where persons are liable to work. There should be an effective evacuation plan so that all persons are evacuated speedily without panic and accounted for and all plant and processes shut down.
- Notices should be posted at conspicuous places indicating:
- The nearest fire alarm;
- The telephone number and address of the nearest emergency services.
- The work site shall be cleared of all combustible materials, as Sparks and molten metal coming from the welding job can easily ignite combustible materials near or below the welding site. If the combustible materials cannot be removed from the area, the same shall be properly shielded.
- A dry chemical type fire extinguisher shall be made available in the work area. Also fire protection facilities like running hoses etc. as per permit should be complied with.
- Wherever required, welding screens shall be put up to protect other equipment in adjoining areas against flying sparks. Material used should be metal/asbestos/water curtain.
- Welding or cutting of vessels/ equipments used in Hydrocarbon/ hazardous chemicals shall be done after proper gas freeing and verifying the same with the explosive-meter.
- The confined space/equipment shall be gas freed and cleaned.
- Absence of any toxic gas and any flammable gas above explosion limit shall be ensured with the help of gas detection instrument and explosive meter respectively.
- Used and hot electrode stubs shall be discarded in a metal bucket.
- Use approved and certified flame arrestors for vehicles.
- Work permit to be obtained, if construction work is carried out within existing operating area.

## 8.0 FIRST AID

First aid facilities should be provided in line with various statutory regulations like factory act etc. However following care should be taken:

- First aid, including the provision of trained personnel should be ensured at work sites. Arrangement should be made for ensuring the medical attention of the injured workers. First aid box should be as per the Factory rules.
- Suitable rescue equipment, like stretchers should be kept readily available at the construction site.
- First-aid kits or boxes, as appropriate and as per statutory requirements, should be provided at workplaces and be protected against contamination by dust, moisture etc.
- First-aid kit or boxes should not keep anything besides material for first aid in emergencies.
- First-aid kits and boxes should contain simple and clear instructions to be followed, be kept under the charge of a responsible person qualified to render the first aid and be regularly inspected and stocked.

- Where the work involves risk of drowning, asphyxiation or electric shock, first-aid personnel should be proficient in the use of resuscitation and other life saving techniques and in rescue procedures.
- Emergency telephone numbers of nearby Hospitals, Police, Fire Station and Administration should be prominently displayed.

## 9.0 DOCUMENTATION

The intention of keeping documentation of all types of accident(s) is to prevent recurrence of similar accident(s).
All accidents (major, minor or near miss) should be investigated, analysed and recommendations should be documented along with implementation status.
All related data should be well-documented and further analysis highlighting the major cause(s) of accidents be done. This will help in identifying thrust areas and training needs for prevention of accidents.