

SAFETY DURING CONSTRUCTION

3.1 GENERAL

3.1.1 Scope

The provisions of this chapter shall apply to the safety of life and property during construction /erection/alteration of various parts of a building or any other structures. Nothing stated herein shall be construed to nullify any rules, regulations, safety standards or statutes of the local authority, Corporations, or those contained in the various Acts of the Government of Bangladesh. The specific rules, regulations and acts pertaining to the protection of the public or workmen from health and other hazards wherever specified by the local Authority/Corporation etc. or by the Act/Ordinance of the Government shall take precedence over whatever is herein specified.

3.1.2 Safety Management

The safety of personnel engaged in building construction shall be ensured through a well planned and well organized mechanism. For this, depending on the size and complexity of building construction project, safety committee shall be constituted to efficiently manage all safety related affairs. The site in-charge or his nominee of a senior rank shall head the committee and a safety officer shall act as Member Secretary. The safety committee shall be organized a training program for the personals and workers to train up them about safety issues involved in the construction process and also organize meeting of the committee regularly say fortnightly or monthly depending on the nature of the project, however, emergency meetings shall also be called as and when required. The safety committees shall deal with all the safety related issues through well structured agenda, in the meetings and all safety related measures installed at the site and implementation thereof shall be periodically reviewed.

3.2 TERMINOLOGY

For the purpose of this Part the following definitions shall apply.

Authority Having Jurisdiction: The Authority which has been created by a statute and which for the purpose of administering the Code/Part, shall authorize a committee or an official to act on its behalf; hereinafter called the 'Authority'.

Construction Equipment: All equipment, machinery, tools and temporary retaining structures and working platforms, that is, tools, derricks, staging, scaffolds, runways, ladders and all material, handling equipment including safety devices.

Floor Hole: An opening measuring less than 300 mm but more than 25mm in its least dimension, in any floor, platform, pavement, or yard, through which materials but not persons may fall; such as, a belt hole, pipe opening or slot opening.

Floor Opening: An opening measuring 300 mm or more in its least dimension, in any floor, platform, pavement or yard through which person may fall; such as hatch way, stair or ladder opening, pit or large manhole.

Guard Railing: A barrier erected along exposed edges of an open side floor opening, wall opening, ramp, platform, or catwalk or balcony, etc, to prevent fall of persons.

Materials Handling Hoists: A platform, bucket or similar enclosure exclusively meant for the lifting or lowering of construction material the hoists being operated from a point outside the conveyance.

Pile Rig: The complete pile driving equipment comprising piling frame, leader, hammer, extractor winch and power unit. Complete pile driving rig shall be mounted on rafts or pontoon or rails. Pile rig shall also be a mobile unit mounted on trailers or trucks, or a special full revolving rig for raking piles.

Platform: A working space for persons, elevated above the surrounding floor or ground, such as balcony or platform for the operation of machinery and equipment.

Scaffold: A temporary erection of timber, bamboo or metal frame work used in the construction, alteration or demolition of a building, to support or to allow the hoisting and lowering of workmen, their tools and materials.

Toe Board: A vertical barrier erected along exposed edge of a floor opening, wall opening, platform, catwalk or ramp to prevent fall of materials or persons.

Wall Hole: An opening in any wall or partition having height of less than 750 mm but more than 25 mm and width unrestricted.

Wall Opening: An opening in any wall or partition having both height of at least 750 mm and width of at least 450 mm.

3.2.1 **Safety of Workmen**

Helmets conforming to BDS 1265 and BDS 1266 shall be worn by the workmen and other personnel at all times during the work. Safety goggles of accepted standard (BDS 1360) shall be used by individuals engaged in drilling, cutting, welding and all such works which cause hazard to the eye. The welders and gas cutters shall be equipped with proper protective equipment like gloves, safety boots, aprons and hand shields having filter glass of accepted standard and suitable to the eyes of the particular worker.

3.2.2 **Site Precautions**

Construction site shall be delineated, in absence of boundary walls, by fences. During the erection of tall buildings, nylon net shall be put around the building periphery 3 to 4 meters below the working level.

Warning signs shall be displayed, where necessary, to indicate hazardous areas like high voltage zone, area of no smoking etc. Hand lamps shall be of low voltage, preferably 24V. All electrically operated hand tools shall be provided with double earthing.

3.2.3 **Site Amenities**

Toilet facilities shall be provided at all construction sites. If sewer connection is not available, temporary wells shall be used. The wells shall be provided with proper covers, bad smell protector and have to clean regularly.

Men and women workers shall be provided with separate sanitary and washing facilities.

The toilet facilities shall be located at a corner of the site so as to avoid any obstruction. Protection from bad weather and falling object, and proper privacy shall be provided to the toilet users.

Temporary toilets shall be dismantled, all wells filled up, and the whole area made level, dressed and restored back to proper grade at the end of the project. All temporary sewer connections shall be removed and the sewer capped.

Washing facilities provided at the site shall be connected to the available running water supply.

Drinking water shall be supplied to the site. In absence of any water supply facility at the site, hand tube wells shall be sunk to meet the requirements of drinking and washing.

Numbers of the sanitary and plumbing facilities required in a construction site shall be regulated by the 1965 Factories Act, and Part 8 Chapters 5 and 6.

Proper accommodation for taking meals and for taking shelter during interruption of work in night time and due to adverse weather condition with amenities of sleeping bed including provision for lights and fans have to provide.

3.3 EXCAVATION AND FOUNDATION WORK

3.3.1 General

The requirements of this section shall be satisfied in addition to those of Sec 3.12 of Part 6 for all excavation and foundation works.

The distribution of the supporting foundation shall be such as to avoid any harmful differential settlement of the structure. The type and design of the foundation adopted shall ensure safety to workmen during construction and residents of the neighboring property. Sufficient care shall be taken in areas, where withdrawal of ground water from surrounding areas could result in damages to such foundations. During the construction of the foundation, it shall be ensured that the adjoining properties are not affected by any harmful effects.

The process of excavation, filling in, pumping etc. shall avoid endangering the strength or stability of the partially completed structure. The partially completed structure shall be capable of carrying loads previously taken by temporary works which, as part of the construction procedure, have to be transferred before the completion of the work.

Excavation with intervals on any site shall be avoided. If such excavation is unavoidable, the excavated site shall be properly fenced and warning signals.

Excavation of interrupted or temporarily suspended construction shall be either backfilled or barricaded.

During construction, inspection shall be made by the engineer-in-charge to ensure that all protective works carried out to safe-guard the adjoining property are sufficient and in good order to ensure safety.

Arrangements for safe movement of workers and inspectors in the trench have to be planned and provided.

Before carrying out any excavation work/pile driving, the position, depth and size of underground structures, such as water pipes, mains, cables or other services in the vicinity to the proposed work, shall be obtained from the appropriate Authority to prevent accidents to workmen engaged in excavation work and calamities for the general public. Prior to commencement of excavation detailed data of the type of soils that are likely to be met with during excavation shall be obtained and the type of protective works by way of shoring timbering, etc, shall be decided upon for the various strata that are likely to be encountered during excavation. For detailed information regarding safety requirements during excavation reference shall be made to good practice.

3.3.2 Excavating Machinery and Tools

Heavy equipment, such as excavating machinery, shall be kept away from the trenches by a distance at least equal to the depth of trench to a maximum of 6 meters. All excavating tools shall be kept far away from the edge of trench.

3.3.3 Excavated Materials and Surcharges

Excavated materials shall be kept away from the edges of the trench to provide a clear berm of safe width. Where this is not feasible, the design of protection for the trenches shall include the additional load due to the materials.

Proximity of buildings, piles of lumber, crushed rocks, sand and other construction materials, large trees, etc. may impose surcharges on the side of the trench to cause bulging, sliding, etc.

Additional protective measures shall be taken to support the sides of the trenches under these conditions. The objects creating such threat shall be removed if possible before excavation starts.

3.3.4 Ground Water

Where deep excavation is required, the location of water-bearing strata shall be determined and the water pressure observed to take necessary precautions. Direction of natural drainage shall be determined to facilitate the design of intercepting drains to prevent the influx of ground water.

In areas where the ground water or soil contains constituents in amounts sufficient to cause damage to cement or buried metals, a chemical analysis of samples of ground water and soil shall be obtained and necessary precautions taken.

Basements or pits below ground water level, which rely on the weight the superstructure for their stability against floatation, shall be pumped day and night. Protective filters shall be used during heavy pumping in excavations. The water shall be drawn away from the excavation rather than through the ground towards the excavation.

3.3.5 Ground Condition

Adequate precautions, depending upon the type of strata met with during excavation (like quick sand, loose fills and loose boulder) shall be taken to protect the workmen during excavation. Effect of climatic variations and moisture content variations on the materials under excavation shall be constantly watched and precautions taken, where necessary, immediately to prevent accidents at work site.

Where portions of the foundation are underlain by soft materials or where the layers of such materials vary in thickness, the assessment of allowable bearing pressure shall require a settlement analysis.

Site investigations shall be sufficiently extensive to ensure that significant variations in strata thickness are detected. If required, either the resistance of the inclined or jointed strata shall be increased or the foundations shall be carried deep enough to prevent sliding.

Precautions, against pockets of poisonous/dangerous gases including protection to the workmen, shall be taken during deep excavation. Effect of climatic variations and variation in moisture content of the soil shall be constantly monitored and precautions taken immediately, when necessary.

3.3.6 Overhang, Slopes and Cavities

Overhangs in the trenches shall be supported by props. Use of heavy machinery shall be avoided under or over this area.

Where climatic or other conditions may result in deterioration of the sides of excavation, consideration shall be given to their support and protection. During excavation, adequate protections justified by established method of analysis shall be taken to prevent slope instability.

3.3.7 Blasting and Vibration

Blasting for foundation of buildings is prohibited unless special permission is obtained from the Authority. Where blasting technique is to be used, an analysis for the stability of slopes shall be carried out and steps be taken accordingly.

Attention shall be given to the geological strata of the site to ensure that it is not liable to transmission of ground vibration to areas where it may cause damage to property or the ground.

After blasting, overhangs or loose boulders shall be cleared off the site. In all excavation works, precautions shall be taken to eliminate/reduce vibration generated by adjacent machinery, vehicles, railroads, blasting, piling and other sources.

Appropriate authorities shall be notified in advance of any blasting operations when these are to take place close to public roads and railways. Also see Sec 4.3.

3.3.8 Health Hazards during Excavation

Mechanical ventilation shall be provided where gases or fumes are likely to be present in trenches.

All personnel working there shall be provided with protective respiratory equipment. All trenches/tunnel shall be provided with emergency exits (see Sec 3.11.2 and Sec 3.11.3).

The precautionary measures provided shall meet the requirements of the local health authority.

The owner shall ensure that all precautionary measures have been taken and been inspected by the appropriate Authority prior to commencement of such work.

3.3.9 Safety of Materials

Materials required for excavation, like ropes, planks for gangways and walkways, ladders, etc, shall be inspected by the Engineer-in-charge who shall ensure that no accident shall occur due to the failure of such materials (see Part 5 'Building Materials').

a) Fencing, Warning Signs and Watchman

Where excavation is going on, for the safety of public and the workmen, fencing shall be erected.

Sufficient number of notice boards and danger sign lights shall be provided in the area to avoid any member of public from inadvertently falling into the excavation. When excavations are being done on roads, diversion of the roads shall be provided with adequate notice board and lights indicating the diversion well ahead. Where necessary, recourse shall be had for additional precautionary measures by way of watchmen to prevent accident to the general public, especially during hours of darkness. If necessary, watchmen shall be employed as an additional precautionary measure to prevent any accident, especially during the night.

b) Vibrations from Nearby Sources

Vibration due to adjacent machinery, vehicles, railroads, blasting, piling and other sources require additional precautions to be taken.

c) Precautions While Using Petroleum Powered Equipment

At the site of excavation, where petroleum powered equipment is used, petroleum vapors are likely to accumulate at lower levels and may cause fire explosion under favorable circumstances.

Care shall, therefore, be taken to avoid all sources of ignition in such places.

3.3.10 Piling and Deep Foundation

All piling and deep foundation operations shall be supervised by a competent foreman. He shall also be responsible for the precautionary measures to be taken.

For work during night, lighting of at least 100 lux intensity shall be provided at the work site. In excavations deeper than 1.5 m, ladders, ramps or other means of escape, and staging shall be provided.

Every crane driver or hoisting appliance operator shall be competent to the satisfaction of the engineer-in-charge and no person under the age of 21 years shall be in-charge of any hoisting machine including any scaffolding winch, or give signals to operator.

3.3.11 Working in Compressed Air

Working in compressed air, in case of deep foundations, requires several precautions to be observed to safeguard the workmen against severe hazards to life, compressed air disease and related ailments.

Filtered compressed air shall be supplied to a working chamber sufficient to provide 0.3 m³ of fresh air per minute per person at the pressure in the chamber. Means for the escape of foul air, as well as circulation of fresh air in the chamber, shall be ensured.

Hot drinks shall be supplied to workmen employed in compressed air after leaving the chamber. No person shall carry any flammable materials inside the air-lock and nobody shall be allowed to smoke inside. Only approved type of lamps and torches shall be used. Lighting of at least 4.5 lux intensity shall be provided.

Methanometer shall be used to detect hazardous gases. Samples of air inside the well shall be taken every eight hours and tested for the presence of hazardous gases and for deficiency of oxygen. In case any hazardous gas is detected, it shall be immediately reported to the engineer and the work in the compressed air stopped.

The pressure in the chamber, in the first minute, after starting compression shall be increased to 35 kPa. It shall not be further increased until the lock attendant has checked whether or not there are complaints of discomfort. The pressure shall then be increased at a rate of 65 kPa/min. If any person complains of discomfort, the proceeding compression shall be immediately stopped and the person evacuated unless he feels comfortable again in a reduced pressure.

In case of airlocks where blasting is done, the workmen shall be permitted to start work only after an inspection by a competent professional found it to be safe. Air required for pneumatic tools shall be cooled and purified in the same way as air for working chamber.

Every man lock shall have a minimum head room of 1.8 m and at least 0.85 m³ of space per person. It shall be suitably equipped with an accurate pressure gauge, clocks, and efficient means to convey visible or nonverbal signals to the lock attendant outside. All electrical installations inside the airlock shall be of flame proof type.

All equipment shall be thoroughly inspected after every 45 days of working and every time it is shifted and reinstalled, and certified to be in a safe working condition by a competent person. A record of all such inspections shall be kept in a register.

The receiver shall be capable of maintaining the working pressure for at least four hours. Adequate access through the bulk heads and sufficient ladders shall be provided. Escape routes in tunnels shall be in the corner. Whilst any person is in a working chamber, the door between such chamber and any man-lock providing egress towards a lower pressure shall be kept open.

No person shall be in a working chamber under pressure where the wet bulb temperature exceeds 29°C measured by a thermometer using nontoxic materials.

No person shall be employed on work in compressed air unless under the supervision of a person experienced in such work. No person shall be employed where the pressure exceeds 120 kPa unless he has, within the previous four weeks been examined and certified to be fit for employment in compressed air. If a person is suffering from cold in head, sore throat, earache etc., he/she shall not be employed in compressed air. Finally work in compressed air shall be carried out only by workers whose physical aptitude for such work has been established by a medical examination and when competent person is present to supervise the conduct of the operations.

Where the pressure exceeds, a suitably constructed medical-lock shall be provided. It shall have two chambers, and doors fitted with bulls' eyes and air valve. The lock shall have couch, blanket, dry woolen garments, food etc. The medical lock shall be supplied with air, free of oil and carbon monoxide, and capable of raising the pressure from 0 to 520 kPa in 5 minutes.

3.3.12 Adjoining Properties and Service Lines

Where bored or driven piling works are to be carried out in the vicinity of old structures which are likely to be damaged, tell-tales shall be fixed on such structures to monitor their behavior while piling is in progress; timely precautions shall be taken against any adverse effect.

Steps shall be taken, if necessary, to increase the general stability of the construction site or the adjoining site(s), before new structures are erected. In all cases, the possible effect of slopes and excavation of foundation stability shall be carefully investigated.

Before excavation or pile driving, information on the location of underground utility connections shall be obtained from the relevant authorities. Probable extent of all damages due to pile driving to adjoining structures or service lines shall be ascertained in advance of operation; pile driving shall be planned accordingly, especially in the case of pre-cast pile driving.

If excavation involves cutting through existing land drains, they shall be carefully diverted into the ground drainage system. In addition, all other precautionary measures required by Sec 1.5 shall also be taken.

3.4 PILE RIG

3.4.1 Erection of Pile Rig

The frame of the rigs shall be structurally safe for all anticipated dead, live and wind loads.

Whenever the structural strength is in doubt, suitable test shall be carried out by the engineer and the results recorded. No pile driving equipment shall be used until it has been inspected and found safe.

When two or more pile drivers are used at the same location, they shall be separated by a distance at least equal to the longest leg of either rig.

Pile drivers shall be firmly supported on heavy timber sills, concrete beds or other secure foundations. If necessary, pile drivers shall be adequately guyed. Rigs not in use shall be supported by at least three guys to withstand wind, storm, gales and earthquake.

3.4.2 Operation of Pile Rig

Access to working platforms and top of pulley shall be provided by ladders. Working platforms shall be protected from wind and rain. Ladder in regular use in tall driven piling rigs, or rigs of similar nature, shall be securely fastened and extended for the full height of the rig.

Exposed gears, flywheels, etc. shall be fully enclosed. Motor gearing, transmission, electrical wiring and other parts of a hoisting machine which are sources of hazard shall have proper safeguards.

To operate energized electrical installations, insulating mats and wearing apparel, such as gloves, etc. shall be used. Sheaves on pile drivers shall be guarded against workers drawn into them accidentally.

No steam or air driven equipment shall be repaired while it is in operation or under pressure.

Steam and air lines shall be controlled by easily accessible shut-off valves. These lines shall consist of armoured hose or its equivalent.

The hose of steam and air hammers shall be securely lashed to the hammer so as to prevent it from whipping if a connection breaks. Couplings of sections of hose shall be additionally secured by ropes or chains. When not in use, the hammer shall remain in dropped position held in place by a cleat, timber or other suitable means.

Hoisting appliances shall be provided with means to reduce the risk of accidental descent of the load. Adequate precautions shall also be taken to reduce the risk of any part of suspended load becoming accidentally displaced. Care shall be taken to prevent the hammer from missing the pile.

Loads shall be adequately counter-balanced, and the tilting device secured against slipping.

Precautions in the form of securing the legs shall be taken to prevent a pile driver from overturning if a wheel breaks. Stirrups or other means shall be provided to prevent the rope from coming out of the top pulley or wheel. Hoisting ropes on pile drivers shall be made of galvanized steel.

Pile drivers shall not be erected in proximity to electric conductors. When electricity is used as power for piling rig, only armored cable conforming to BDS 901 and other relevant standards shall be used. The cable shall be thoroughly waterproofed.

3.4.3 Piles

Piles shall be prepared at a distance at least equal to twice the length of the longest pile, from the pile driver. Workers employed in the vicinity of pile drivers shall wear helmets conforming to BDS 1265. No steam or air shall be released until all workers are at a safe distance.

Piles shall be so slung that they do not swing or whip round. A hand rope shall be fastened to a pile hoisted to control its movement. Long piles and heavy sheet piling shall be secured against falling. While a pile is being guided into position in the leads, workers shall not put their hands or arms between the pile and the inside guide or on top of the pile. Inclined piles shall rest in a guide while driven.

Maximum length of ballies (wooden piles) shall be 9 m. Ballies shall not be less than 50 mm in diameter at any place and shall spread to 75-200 mm in diameter at the top depending on the class of ballies. Each ballie shall be legibly and indelibly marked with information on the species of timber, suppliers name, class of ballie etc.

Whenever required, butt ends of ballies shall be preserved with creosote-fuel oil mixture 50:50.

The driving end of a ballie post shall be provided with an iron ring or cap. When creosoted ballies are driven, adequate precautions, such as the provision of personal protective equipment and barrier creams, shall be taken to prevent injury from splashes of creosote.

3.4.4 Inspection and Tests

Pile driving equipment shall be inspected by an engineer at regular intervals not exceeding three months. A register shall be maintained at the site for recording the results of such inspection. Pile lines and pulley blocks shall be inspected by the foreman before the beginning of each shift for any excess wear or other defects.

Defective parts of pile drivers, such as sheaves, mechanism slings and hose shall be repaired by only competent technicians and duly inspected by foreman in-charge of the rig. The findings of such inspection shall be recorded in the register.

For every hoisting machine, chain, rig, hook, shackle, swivel and pulley block used in hoisting or suspending, the safe working loads shall be ascertained. Every hoisting machine and all gears shall be marked with the safe working loads and the conditions under which it is applicable.

Tests shall be performed in case of doubt and half of the tested load shall be taken as the safe working load. No part of any machine or any gear shall be loaded beyond the safe working load.

3.5 CONSTRUCTION OF WALLS

3.5.1 General

The height of wall constructed per day shall be restricted to ensure that the newly constructed wall does not collapse due to the lack of strength in the lower layers. Adequate number of expansion joints shall be provided in long walls to prevent crumpling.

3.5.2 Scaffold

Properly designed and constructed scaffolding built by competent workmen shall be provided during the construction of the walls to ensure the safety of workers. The scaffolding shall be of timber, metal or bamboo sections and the materials in scaffolding shall be inspected for soundness, strength, etc, at site by the Engineer-in-charge prior to erection of scaffolds. Steel scaffolds intended for use in normal building construction work shall conform to accepted BDS standards. Bamboo and timber scaffolds shall be properly tied to the junctions with coir ropes of sufficient strength or mechanical joints to ensure that joints do not give way due to the load of workmen and material. Joining the members of scaffolds only with nails shall be prohibited as they are likely to get loose under normal weathering conditions. The scaffold has to check after every 15 days in rainy season and 30 days in dry season. In the erection or maintenance of tall buildings, scaffoldings shall be of noncombustible material especially when the work is being done on any building in occupation. After initial construction of the scaffolding, frequent inspections of scaffolding shall be made by the Engineer-in-charge. The platforms, gangways and runways provided on the scaffoldings shall be of sufficient strength and width to ensure safe passage for the workmen working on the scaffolding. The joints provided in these gangways, platforms, etc, shall be such as to ensure a firm foot-hold to the workmen. Where necessary cross bars shall be provided to the full width of gangway or runway to facilitate safe walking.

The Engineer-in-charge shall ensure by frequent inspections that gangways of scaffolding have not become slippery due to spillage of material. Loose materials shall not be allowed to remain on the gangways. Where necessary, because of height or restricted width, hand-rails shall be provided on both sides. Workers shall not be allowed to work on the scaffolding during bad weather and high winds.

In the operations involved in the erection or maintenance of outside walls, fittings, etc, of tall buildings, it is desirable to use one or more net(s) for the safety of the workmen when the workmen are required to work on scaffoldings.

3.5.3 Ladders

Setting of Ladders: Rails of ladders shall extend at least 1m above the landing and shall be secured at the upper end. As an alternative, there shall be adequate handhold at landing or side guys with anchorage at the bottom.

To prevent slipping, a ladder shall be secured at the bottom end or held by a person at the time of use. A lean-to-ladder shall have a maximum angle of 75° with the horizontal. Ladders shall be provided with nonslip bases on slippery or sloping floors. Ladders used in strong wind shall be securely lashed in position.

A ladder shall neither be placed against window pane, sashes or such other fragile or easy yielding objects, nor in front of doors opening towards it. If set up in driveways, passageways or public walkways, it shall be protected by barricades. Ladders shall not be supported on any insecure base, e.g. scaffold, planking over trenches etc.

Use of Ladders: All ladders shall be constructed of sound material, and shall be capable of carrying the design loads. No ladder with a missing or defective rung, or supported on nails only, shall be used. A dropped ladder shall be inspected prior to reuse.

Ladders shall not be used as guys, braces or skids or in horizontal position as runways and catwalk. They shall not be generally overcrowded. Ladders shall not be spliced; when unavoidable, splicing shall be done only under the supervision of a foreman.

A user shall place his feet near the ends of the rungs rather than near the middle, and face the ladder when using it. Both the hands shall be used in climbing a ladder.

Leaning more than 300 mm from the side in order to reach another area from a single setting of the ladder shall not be allowed; the ladder shall be shifted to the required position.

All joints in the ladder shall be properly constructed. Where necessary, handrails shall be provided to the ladders. A brace shall be attached at the middle and supported from a non yielding fixed object if a ladder shows tendency to spring. Excessive deflection of ladders shall be prevented by stiffeners.

Metal ladder shall not be used close to electrical equipment or circuits. They shall be marked with 'CAUTION DO NOT USE NEAR ELECTRICAL EQUIPMENT' signs. Overhead protection shall be provided for workers working under a ladder.

Wooden ladders shall be inspected at least once in 6 weeks for damage and deterioration. Close visual inspection is recommended in preference to load testing. This condition is particularly applicable to rope and bamboo ladders where fraying of ropes and damage to bamboo is likely to occur.

3.5.4 Opening in Walls

Before making an opening in an existing wall, adequate supports against the collapse or cracking of the wall portion above the opening or roof or adjoining walls shall be provided. Staging shall be of full length of the wall opening.

Wall opening barriers and screens shall be capable of withstanding the intended load. Every chute, wall opening or any other wall opening from which there is a vertical drop of more than 1200 mm shall be guarded by barriers.

The guard shall be removable, hinged or otherwise mounted. The guards shall be kept in position regardless of the use of the opening. In addition, a grab handle shall be provided on each side of the opening. The opening shall have a minimum 25 mm high sill.

3.5.5 Projection from Walls

Formwork provided for horizontal projections out of the wall shall not be removed till walls, or other stabilizing construction, over the supporting edge of the projecting slabs providing protection against overturning are constructed.

3.5.6 Common Hazards During Walling

3.5.6.1 Lifting of Materials for Construction

Implements used for carrying materials to the top of scaffoldings shall be of adequate strength and shall not be overloaded during the work. Where workmen have to work below scaffoldings or ladder, overhead protection against the falling materials shall be provided. Care shall be taken in carrying large bars, rods, etc, during construction of the walls to prevent any damage to property or injury to workmen.

3.5.6.2 Haulage of Materials

In case of precast columns, steel beams, etc, proper precautions shall be taken to correctly handle, use and position them with temporary arrangement of guys till grouting of the base.

Manila or sisal rope shall not be used in rainy season for hoisting of heavy materials as they lose their strength with alternate wetting and drying.

3.5.6.3 Electrical Hazards

No scaffolding, ladder, working platform, gangway runs, etc, shall exist within 3 m from any uninsulated electric wire. The distance from high tension line for those features would be as per specification of PDB.

3.5.6.4 Fire Hazards

Gangways and the ground below the scaffolding shall be kept free from readily combustible materials including waste and dry vegetation at all times.

Where extensive use of blow torch or other flame is anticipated scaffoldings, gangways, etc, shall be constructed with fire resistant materials. A portable dry powder extinguisher of 3 kg capacity shall be kept handy.

3.5.6.5 Mechanical Hazards

Care shall be taken to see that no part of scaffolding or walls is struck by truck or heavy moving equipment and no material shall be dumped against them to prevent any damage. When such scaffoldings are in or near a public thoroughfare, sufficient warning lights and boards shall be provided on the scaffoldings to make them clearly visible to the public.

3.5.6.6 Fragile Materials

During glazing operations, adequate precautions shall be taken to ensure that the fragments of fragile materials do not cause any injury to workmen or general public in that area by way of providing covering to such material, side protection at work site, etc.

3.6 CONSTRUCTION OF FLOORS

3.6.1 General

Platforms, catch ropes, nets etc. shall be provided during the construction of roofs. Precautions shall be taken to employ the correct technique of hoisting materials, to use hoists of sufficient strength for the quantity of stores to be hoisted, and to prevent overloading and overturning of hoists or buckets, etc.

Where, the floor of one storey is to be used for storage of materials for the construction of roof, it shall be ensured that the total load does not exceed the capacity of the floor.

3.6.2 Use of Sheets

It shall be ensured that joints in corrugated galvanized iron or asbestos cement sheets are kept secured in position and sheets do not slip. Walking on asbestos cement sheets shall not be allowed.

Tiles shall not be left loose on the roof.

Injury to passers-by due to breakage of glass or plastic sheets shall be prevented. During wet conditions, work on sloped roof shall not be allowed unless the foreman decides that the roof is not as slippery as to pose any risk. In slopes of more than 30° to the horizontal, ladders, waist-tie etc. shall be used.

3.6.3 Platforms

Working platform required according to the type of roof shall be provided. Additional precaution shall be taken to construct the platform with sound material secured and fixed, and checked from time to time throughout the period of construction.

3.6.4 Flat Roof

Formwork provided for flat concrete roof shall be designed and constructed for the anticipated loads.

During the construction of the roof, the formwork shall be frequently inspected for defects. Enough walking platforms shall be provided in the reinforcement area to facilitate safe walking to the concreting area. Loose wires and unprotected rod ends shall be avoided.

Formwork supporting cast-in-place reinforced and pre stressed concrete floors and roofs shall be adequately tied or braced together to withstand all loads until the new construction has attained the required strengths.

3.6.5 Openings and Holes

Every temporary floor opening shall either have railing of at least 900 mm height, or shall be constantly attended. Every floor hole shall be guarded by either a railing with toe board, or a hinged cover. Alternatively, the hole shall be constantly attended or protected by a removable railing.

Every stairway floor opening shall be guarded by a railing at least 900 mm high on the exposed sides except at entrance to stairway. Every ladder way floor opening or platform shall be guarded by a guard railing with toe board except at entrance to opening.

Every open sided floor or platform 1.2 m or more above adjacent floor or ground level shall be guarded by a railing on all open sides, except where there is entrance to ramp, stairway or fixed ladder. Such entrances shall be either guarded with a swinging gate, or so offset that a person is prevented from walking directly into the opening. The railing shall be accompanied by a toe board at least 200 mm high.

The above precautions shall also be taken near the open edges of floors and roofs. Requirements of Sec 1.7.3 and 1.7.4 shall also be met.

3.6.6 Skeleton Construction

Temporary flooring of skeleton construction shall be provided with tightly planked timber over timber supports to withstand all loads. The temporary flooring can also be made of metal sheet supported on timber or tubular steel frame. No end of the timber plank or metal sheet shall remain unsupported.

A temporary safety platform or tier shall be maintained within two stories or 6 m, whichever is less, below and directly under the portion where erection of steel or precast concrete member is required. Tiers shall extend 2.5 m beyond the edge of the work area.

3.7 CONCRETE WORK

3.7.1 General

All workmen involved in concrete work shall be provided with helmet and hand gloves, especially when concrete pumps, concrete trucks or concrete precast elements are used. Precast piles shall be lifted and driven by skilled workmen under the supervision of a foreman.

Temporary fencing, either with bamboo or C.I. sheet, shall be erected around heavy equipment delineating the danger zone. All centering and shuttering materials shall be kept stacked at site before and after use.

3.7.2 Prestressed Concrete

Operating, maintenance and replacement instructions of the supplier of the prestressing equipment shall be strictly adhered to in all relevant operations. During the jacking of any tension element, the anchor shall be kept turned up close to anchor plate.

Thread on bolts and nuts shall be frequently checked for deterioration; choked units shall be cleaned. Hydraulic jacks/rams, pulling-headers and other temporary anchoring devices shall be inspected before use. The prestressing jacks shall be periodically examined for wear and tear.

No person shall stand in line with the tensioning elements and jacking equipment during the tensioning operation. Also no one shall be directly over the jacking equipment when deflection is done. Workmen shall be prevented from working behind the jacks when the tensioning operation is in progress by putting signs, barriers, or protective shields.

3.7.3 Concrete Mixers

All gears, chains and rollers of mixer plants shall be guarded. If the mixer has a charging skip, the operator shall ensure that the workmen are at safe distance before the skip is lowered. Barriers shall be provided to prevent walking under the skip while it is being lowered.

All cables, clamps, hooks, wire ropes, gears, clutches, etc. of the mixer shall be checked and serviced once a week. A trial run of the mixer shall be made and defects rectified before using a mixer.

While cleaning inside of the mixing drums, the power shall be shut and fuses removed.

3.7.4 Concrete Truck and Buckets

A reasonably smooth traffic surface shall be provided for concrete trucks. If possible, a loop road shall be provided to allow continuous operation. An easy turnout shall be provided if a loop is not possible to provide. Workmen and moving plants shall not cross the truck lines as far as practicable.

Concrete buckets conveyed by crane or overhead cableway shall be suspended from deep throated hooks, preferably equipped with swivel and safety latch. Closing and locking of the exit door of the concrete bucket shall always be checked.

3.8 FORMWORK AND SCAFFOLD

3.8.1 Scaffold and Centering Materials

Scaffolds shall be made from strong bamboo poles, wooden posts, steel pipes or any other suitable materials. They shall be adequately tied to vertical members resting on firm floor. Strong ropes shall be used to tie up bamboo poles. In addition, cross-bracing with bamboo or wooden posts shall be provided along with ties or guys of steel wire or rod not less than 6 mm in diameter.

Wooden planks or steel sheets shall be placed across horizontal poles to provide suitable footrest and carry construction materials. The whole assembly shall be securely lashed together.

Deterioration of tying ropes and rotting planks shall be checked from time to time during the construction period and changed if required.

Scaffold shall be dismantled after use piece by piece. Holes in the wall shall be filled up with the same materials as that of the wall. Filled up holes shall have uniformity in texture and color with the surrounding surface. Crash striking shall not be allowed.

Triangular wooden wedges shall be put under the posts for easy dismantling of the members.

Timber planks or steel sheets covering several posts at a time shall be placed below the vertical or inclined posts.

Horizontal and inclined bracings shall be provided for posts higher than 3 meters. Spans of beam bottoms shall be supported by posts at most 1 m apart if steel is used; instructions from the manufacturer/supplier shall be strictly followed. Spacing of props under beams shall consider the increased load, and shall be posted closer than those under the floor slab.

All scaffolding exceeding 20 m or six stories in height shall be constructed of noncombustible or fire-retardant materials. Centering layout shall be planned by the Engineer, bearing capacity of the soil and the effect of weather shall be considered in the planning.

All nails and similar projecting objects shall be removed or hammered down into the timber component of the centering and shuttering materials immediately after stripping off.

3.8.2 Formwork for Concrete

The formwork shall be strong and rigidly braced so as not to bulge or sag when concrete is placed.

It shall be constructed in such a way that it can be dismantled without causing damage to the concrete or disturbing the centering and shuttering of other elements.

Forms shall not be removed until the concrete has developed sufficient strength to support all predicted loads. Workers removing formwork shall wear helmets, gloves, heavy soled safety shoes and belts if adequate footing is not available above 2 m. In case of removal of roof shuttering, staging has to provide below the roof. While cutting any tying wires in tension, care shall be taken against backlash.

Bolts and nuts in vertical concrete walls shall be loosened and withdrawn before initial setting of concrete. The resulting hole shall be filled with rich mortar. The supports shall be dismantled in the order instructed by the Engineer.

All walls, columns, slabs etc. shall have plastic or mortar spacers (round for vertical structures and flat for slab) to be placed with the reinforcement to provide clear cover as per design. Top layers of slab reinforcement shall be held in position by steel chairs.

The formwork shall be water-tight especially for the roof slab. Bamboo matting shall be placed on planks or steel sheets to provide a rough surface after stripping of the formwork. Alternatively, ceilings shall be roughened up by chiseling immediately after stripping off the formwork.

Suitable camber shall be provided in the formwork for horizontal members. The camber for beams and slabs shall be 1 in 250, and for cantilevers, 1 in 50 of the projected length.

Half-seasoned soft-wood, laminated board or other smooth sheet shall be used for formwork for a Fair-faced finish. The upper surface of the formwork shall be covered with oiled soft building board or veneered particle board. Oiled paper or polythene sheet shall never be used.

The formwork made of materials liable to absorb water shall always be sprinkled with water before laying concrete. Water shall not be profusely used; the formwork shall be in a saturated surface dry condition.

All the forms shall be tested both individually and in combination before final use to detect any flaw or defect. Measures shall be taken immediately to remedy any faults, if detected, before the formwork is ready for use.

The frame and its joints shall be checked from time to time for the decay in ropes, bamboos, planks etc. The defective parts shall be replaced before the formwork is used.

3.8.3 Load Capacity

Scaffolds, formwork and components thereof shall be capable of supporting without failure, at least two times the maximum intended load. The following loads shall be used in designing the formwork:

- a) weight of wet concrete : 20 kN/m³;
- b) live load due to workmen and impact of ramming or vibrating : 1.5-4.0 kPa (light duty for
- c) carpenter and stone setters, medium duty for bricklayers and plasterers, heavy duty for stone masons);
- d) allowable bending stress (flexural tensile stress) in soft timbers : 8,000 kPa.

The sizes for formwork elements specified in Table 7.3.1 are applicable for spans of up to 5 m and height of up to 4 m. In case of longer span and height, formwork and support sizes shall be determined by calculating the load and approved by the engineer before use.

All formworks and scaffolds shall be strong, substantial and stable. All centering and props shall be adequately braced to ensure lateral stability against all construction and incidental loads, especially in the case of floor height more than 3.3m.

The space under the scaffold or formwork shall not be used as a working or living space. The space shall not be used as a shelter or refuge during inclement weather or at any other time.

3.8.4 Bamboos

Good, sound and uniform bamboo shall be collected in sufficient quantities for providing scaffolding, propping, temporary staging, ramp etc. The bamboos shall be free from any defects, firmly tied to each other and joints made smooth. Joining members only with nails shall be prohibited.

Bamboos for vertical support shall not be less than 75 mm in diameter, and shall be straight as far as possible. Bamboos shall be used as vertical support for up to a height of 4 meters if horizontal bracings are provided at the centre. Splicing shall be avoided.

After stripping the formwork, the bamboo posts shall be cleaned and stacked vertically in shade protected from rain and sun. Defective or damaged bamboo posts shall be removed from the site.

Table 7.3.1 Sizes of Timber and other Sections for Formwork

Types of Formwork	Members Size in mm
Flat sheetings for slab bottoms, columns and beam side	25 to 50
Beam bottoms	75x100 to 150x150
Vertical posts	75x100 to 150x150
Bamboo posts	Minimum 75 dia
Ballies	Not less than 100 dia at mid-length and 80 dia at thin end

Joist and ledgers supporting sheetings of slab	50 x 100 to 75 x 200
Studs for supporting vertical wall sheetings Columns yokes- horizontal cross, pieces supporting vertical sheetings	50 x 100 to 150 x 150 50 x 100 to 100 x 100

3.8.5 Timber Posts

Timber posts shall be used in supporting formwork up to a height of 6 m. The posts shall not be less than 80mm in diameter at any place and shall spread to at least 150mm in diameter at the top.

The timber posts shall be supported on timber planks at the bottom. Either the bottom or the top of the posts shall be wedged with a piece of triangular wood peg for easy removal. Adequate horizontal and inclined braces shall be used for all timber centering.

All timber posts shall be carefully inspected before use and members with cracks and excessive knots and crookedness shall be discarded. The joints shall normally be made with bolts and nuts.

No rusted or spoiled threaded bolts and nuts shall be used.

3.8.6 Steel Centering

Steel centering shall be used for any height. In case of patented material, the instructions of the manufacturer regarding the load carrying capacities shall be followed.

Post to post supports shall be provided with wooden planks. When tubular steel and timber centering is to be used in combination, necessary precautions shall be taken to avoid any unequal settlement.

Tubular steel centering shall be thoroughly inspected before erection. Defective members shall be discarded and coupling pins aligned to frames. Adjustment screws shall be set to their approximate final adjustment after assembling the basic unit, and the unit shall be level and plumb.

The centering frames shall be braced to make a rigid and solid unit. Struts and diagonal braces shall be in proper position and secured. As erection progresses, all connecting devices shall be in place, and fastened for full stability of joints and units.

3.9 ERECTION OPERATIONS

3.9.1 Erection and Hoisting

The erection and striking off, especially of steel structural frame, shall be done by skilled workers.

Built-up, swinging and suspended scaffolds shall also be erected by competent workers.

Care shall be taken to keep fire alarms, hydrants, cable tunnels etc. unobstructed during the construction of scaffolding and placement of ladders etc.

Anchors for guys or ties shall be checked for proper placement. The weight of concrete in which the anchors are embedded shall be checked for uplift and sliding. In a tall and heavy guy derrick, tension in guys shall be controlled by hand winches.

Enough number of bolts shall be used in connecting each piece using a minimum of two bolts in a pattern to ensure that the joint will not fail. All splice connections in columns, crane girders etc. shall be completely bolted or riveted or welded before erection as specified in the drawings.

The top flange of a truss, girder or long beam shall be temporarily reinforced with a flat bar on top of the member. On deep girders and large trusses, a safety bar running their full length shall be provided. The bar can be a single 16 mm diameter wire rope through vertical stiffeners of each member about one meter above the bottom flange and clamped at the ends with wire rope clamps. If holes cannot be provided, short eye bolts can be welded to the webs of the girder at intervals. The bolts shall be removed, and the surface chipped to leave it smooth after the erection is completed.

The first load lifted by a guy derrick shall be hanged at a low height for 10 minutes and the anchor inspected for any signs or indications of failure. No load shall be allowed to rest on wire ropes.

Ropes in operation shall not be touched. Each truss or deep girder loaded in a vehicle shall be tied back or braced together with other trusses or girders already loaded.

The ropes shall be chemically treated to resist dew and rotting. They shall not be tied on sharp edges of steel structures. They shall not be tied beyond the reach of safety belts complying to BDS 1359.

The proper size, number and spacing of wire rope clamps, depending on the diameter of the wire rope, shall be used. They shall be properly fixed and checked as soon as the rope has been stretched, particularly if new. The clamps shall be promptly tightened when expansion in rope is detected. Clamps and ropes shall be inspected frequently to be sure that they are secured at place.

3.9.2 Small Articles

Adequate supply of bolts, washers, rivets, pins etc. of required sizes shall be maintained at all times. Foot boxes on a guy derrick or climbing crane, shall be moved to the new working floor each time the rig is changed. On a mobile crane, the boxes shall be moved as soon as the crane is moved.

Bolt baskets or similar containers with handles shall be provided on floats or scaffolds where small material, such as bolts and drift pins are used. Small tools shall be gathered up and put away in tool boxes when not in use. Rivet heaters shall have safe containers or buckets for unused hot rivets.

Materials shall not be dumped overboard when a scaffold is to be moved.

3.9.3 Hoist Protection

A material hoist shall not be used to transport workers; temporary elevators shall be installed, if necessary. Proper protection by way of railing, footboard etc. shall be provided to the hoists.

Railing shall have a minimum height of 1 m while the toe board shall be at least 200 mm high.

Where erected on the outside of a building over 20 m or six stories in height, the hoist structure shall be built of noncombustible or fire retardant materials. Interlocking or any other safety device shall be installed at all stopping points of the hoists. The hoists shaft way shall be fenced in accordance with Sec 3.6.5.

No part of scaffolding or walls and openings shall be hit by crane, truck or heavy moving equipment.

3.9.4 Lifting Gear

Lifting gears shall be of good construction, sound material and adequate strength. Lifting gears must be tested and examined by a competent person. Chains, ropes and lifting tackle shall be thoroughly examined by a competent person every 6 months.

Special devices like cleats and hooks shall be used in erecting girders and other heavy structural members. These shall be shop-assembled, bolted, riveted or welded to the piece and left permanently in place after the work. A balance beam shall be used to lift laterally imbalanced pieces. Alternatively, a pair of bridle slings shall be used at safe lifting points.

Table of safe working loads shall be posted in the tackle store and in prominent positions. No chain, rope or lifting tackle shall be used for loads exceeding the safe working load. Wrought iron gear shall be effectively heat treated.

All lifting gear shall be obtained from reliable manufacturers. No home-made or improvised gear shall be used.

3.9.5 Cranes

All parts of a crane must be of good construction free from defects and properly maintained.

Before the crane is used for the first time, it must be thoroughly examined and tested by a competent person.

Crane rails shall be installed and secured on firm ground. In tower cranes, the level difference between the two rails shall remain within the limits prescribed by the manufacturer.

The safe working load shall be clearly shown on the crane; no crane shall be loaded beyond this limit. Nobody shall be allowed to work on the wheel tracks within 6 m of a crane, or under crane where he might be struck, unless effective steps are taken to warn him.

Electrical wires within the site which can possibly touch the crane or any member being lifted shall be removed or made dead. Cranes shall not be operated in proximity to a live overhead power line.

If it becomes necessary to operate the crane crossing the safe clearance from power line, the overhead power lines shall be shut off.

Cranes shall be thoroughly examined, at least once in 9 months and the results entered in a register. The crane operator shall not violate the safe reach limit of the crane as specified by the manufacturer. Cranes shall not be operated at a speed which causes the boom to swing.

No person shall be lifted or transported by the crane on its hook or boom. Toe boards and limit stops shall be provided for wheel barrows on the loading and unloading platforms. Material shall be loaded securely on the platform with no projection.

Every crane driver or hoisting machine operator shall be competent to the satisfaction of the engineer and no person under the age of 21 years shall be allowed to operate any hoisting machine and scaffolding winch, or give signals to the operator. The crane driver shall have the full knowledge of controls, signals, loading, misuse, ground and emergency regulations.

When the bucket or other members being lifted are out of sight of the crane operator, a signalman shall be posted in clear view of the loading and unloading areas, and the crane operator. Standard hand signals shall be used in controlling the movements of the crane; both the operator and the signalman shall be familiar with the signals.

The crane operator shall respond to signals only from the assigned signalman but shall obey stop signal at any time from anybody both inside and outside the site.

If a gantry crane is used, a warning bell which sounds automatically during the movement of the crane shall be given to avoid accidents to workmen crossing or standing in the path of the moving loads.

3.9.6 Slings

Chains shall not be joined by bolting or wiring links together. Shortening the chains by tying knots shall be prohibited. The chain shall be made free of twists and kinks. Proper eye splices shall be used to attach the chain hooks.

Chains with locked or stretched links and which do not move freely shall not be used. Ropes shall move freely in the sheave grooves. Sharp bends in wire ropes shall be avoided; pulley shall be used for these.

Idle and loaded slings shall not be carried together on the crane hook. In multi-legged slings, each leg shall be evenly loaded. The slings shall be of sufficient length to avoid wide angle between the legs.

3.9.7 Inspection

Materials and joints in scaffolding shall be inspected from time to time both before and after erection for the soundness, strength, damage due to weathering etc. Inspections shall be made for spillage of material or liquids, loose material lying on the gangways, and proper access to the platform.

The scaffold shall be secured to the building at enough places; no ties shall be removed. Warning sign prohibiting the use of any defective or incomplete scaffold and working in bad weather and high wind shall be posted in a prominent place. Inspections shall be made for the observance of these requirements.

3.10 ELECTRIFICATION, EQUIPMENT AND OPERATIONS

3.10.1 Wiring System

All temporary and permanent wiring systems shall be designed by an engineer. All temporary wiring shall be done by an electrician holding relevant license.

No scaffolding, ladder, working platform, gangway, runway, etc. shall be placed within 3 meter of an un-insulated live electric wire. Overhead wires/cables shall be so laid that clearances as required by Sec 2.2.3.4 are maintained.

Protection shall be provided for all electrical wiring laid on floor which shall have to be crossed over. All flexible wiring connecting the electrical appliances shall preferably be enclosed in a flexible metal sheath. Frayed and bare wires shall not be used for any temporary or permanent electrical connection.

All electrical circuits, other than those required for illuminating the site at night, shall be switched off daily at the end of the work. The main switch board shall be located in an easily accessible and prominent place. No clothing or stores shall be kept near it. One 3 kg-4.5 kg CO₂ extinguisher, or one 5-kg dry powder extinguisher, shall be provided near the switch board.

3.10.2 Guarding of Cables

All cables and signal cords shall be guarded wherever such cables and cords pass through or cross working spaces. Location of underground cables, if any, as well as overhead cables, shall be identified and the scaffolds, hoists etc. shall be installed after providing proper guards to such cables.

Respective agencies shall be consulted for the proper method of providing protection to such cables, distance to be maintained to avoid all hazards etc. Cables, especially underground, and their routes shall be marked for future reference and use.

3.10.3 Lifts

Lifts shall be installed as per instruction of the manufacturer and under proper guidance. If necessary, guards shall be stationed at the installation site. Building materials shall preferably not be carried in a lift.

Entry to the empty lift well shall be blocked; the blockade shall be capable of withstanding bumping of an individual against it. Notices/signs shall be displayed in the lift lobby when the lift is not in operation.

3.10.4 Construction Machinery

Construction machinery shall conform to standards specified in the specification of works, or determined as required on site and approved by the engineer. They shall be in running condition without any defect.

The machinery shall be operated by competent operators only. The machinery will be checked thoroughly for any defect periodically, as well as each day before use.

Every moving part of or prime mover, and every part of electric generators, motors and rotary converters shall be securely fenced. Fencing shall be of substantial construction, maintained in efficient working order, and kept in position when the machine is in motion.

If machines need to be examined, oiled or adjusted while in motion, it shall be approached by certified mechanics only. Approach to unfenced machinery is allowed only when examination, lubrication etc. cannot be done with machinery at rest, or when machinery cannot be stopped without serious interference with the ongoing process.

Exhaust of petrol or diesel powered air compressors, hoists, derricks, pumps and all such machinery shall be well away from combustible materials. Exhausts opening outside the building shall have a minimum clearance of 200 mm from combustible materials. All sources of ignition like naked flame shall be banned near petroleum- fired equipment.

3.10.5 Heating of Bitumen and Tar

Bitumen and Tar Vessels: Tanks, vats, kettles, pots, drums and other vessels for heating tar, bitumen and other bituminous materials shall be made resistant to damage due to transportation, excessive heating etc. All such vessels shall be capable of holding a full load without danger of collapse, bursting or distortion. They shall be provided with a close-fitting cover suitable for smothering a fire in the vessel preventing spillage or protecting the bituminous material from rain.

Buckets for hot bitumen, bituminous material or tar shall have the bail or handle firmly secured, and a second handle near the bottom for tipping. Bitumen or tar boilers shall be mounted on wheels for easy transportation or towing, and provided with hand pumps for spraying purposes.

Heated vessels shall not be left unattended. Only vessels using electricity for heating shall be used inside buildings. Tar boilers shall never be used on a roof constructed of combustible materials.

Bituminous material shall not be thrown into the hot vessels. Vessels shall be kept closed when not in use. Containers shall not be filled to the brim with hot bitumen or tar. Enough space shall be left in vessels for expansion of heated binder.

The vessel shall be leak-proof, and provided with controllable outlets. The buckets and cans in which the hot material is carried shall be checked for any defect before use.

Heating of Bitumen and Tar: Gas and oil-fired bitumen and tar kettles or pots shall be equipped with burners, regulators and safety devices. Heating appliances for vessels shall distribute the heat uniformly over the heating surface. If bituminous mixtures have mineral aggregate filler, some means for stirring shall be provided.

Vessels filled with bituminous materials shall be kept at a distance from combustible materials.

When vessels are used in confined spaces, the gases, fumes and smoke generated shall be removed by exhaust or forced ventilation.

No naked light shall be used near heated boilers. If a burner stops burning, the fuel supply shall be cut-off immediately and the heating tube shall be thoroughly blown out by the fan.

Cutbacks shall not be heated over an open flame unless a water jacket is used. While they are being heated, the vessel shall be kept open. Blow-lamps or similar devices shall be used for warming pipes instead of burning rags. Bitumen and tar shall not be heated beyond the temperature recommended by the manufacturer of the product.

Other Precautions: Indicator gauges shall be used to ascertain level and temperature of the material in the boiler; nobody shall be allowed to peep into the boiler to ascertain the level. In small plants, dipstick shall be used to gauge the levels in the boiling pot.

Bitumen and tar shall be kept dry. Boiler shall either have a device that prevents foam from reaching the burners, or anti-foaming agents shall be used to control foaming. The heating shall be at low temperature till the water entrapped, if any, is completely evaporated. Any water present in the boiler shall also be drained out before using it.

Bitumen or tar spilled around boilers shall be promptly cleaned up. When tanks are cleaned by steam, building-up of pressure shall be prevented. No inspection shall be made while the boiler is under use, or is pressurized.

While discharging heated binder from the boiler, workers shall not stand opposite to the jet. The container shall be handled only after closing the valve. Bitumen and tar shall be handled in a way as not to spill.

Mops and other applicators covered with bituminous materials shall not be stored inside buildings.

3.10.6 Flame Cutting and Welding

For all arc welding work, either a helmet or a hand-held face shield conforming to BDS 1360 shall be used. See also Sec 3.2.1.

All welding and flame-cutting operations shall be performed in protected areas; closed spaces shall be properly ventilated. Suitable protection against the rays of the electric arc shall be provided where arc welding operations might be viewed within normal range by persons other than the welding operators and inspectors.

When working on aluminum structures, or close to other welders, protection for the back of the head shall be arranged. When slag is being removed from weld by clipping, the eyes shall be protected by goggles conforming to BDS 1360.

Leather gauntlet gloves with canvas or leather cuffs, shall be worn by welders. Any visible foam near the arc shall be rapidly dispersed. Where argon or carbon dioxide is being used as the shielding gas, particularly in confined spaces, breathing apparatus of the airline type shall be worn.

Gas cylinders shall be kept in the upright position, and conveyed in trolleys. While being carried by cranes, the gas cylinders shall be put in cages. The cylinder shall be marked 'full' or 'empty' as the case may be.

Gas cylinders shall be stored away from open flames and other sources of fire. Oxygen cylinders shall not be stored near oil, grease, sources of gas and similar combustible materials.

When the cylinders are in use, cylinder valve key or wrench shall be placed in position. Cylinder valve shall be closed before a cylinder is moved, when the torches are being replaced or welding is stopped for some reason. The cylinder valve and connection shall not be lubricated.

A 5 Kg CO₂ or DCP type fire extinguisher must be kept where gas cutting and welding works are done. Acetylene cylinder which has been subject to heat must be kept completely submerged in water at least for 12 hours before further use.

Gas cutting and welding torches shall be lighted by special lighters, not with matches. The cables from welding equipment shall not be run over by traffic. Double earthing shall be provided to the welding machines.

If welding is to be done near combustible materials, suitable blanket shall be provided and fire extinguishers kept nearby. Welding shall not be done in areas where flammable liquids and gases are stored.

Gas lines and compressed air lines shall be marked differently by suitable color codes. Facilities shall be provided in approved closed containers for housing the necessary vision, respiratory and protective equipment required in welding operations.

3.10.7 Riveting Operation

Rivets shall be carefully handled to prevent accidental fall; wooden bottom shall be provided in rivet catchers. Chains shall not be used in riveting dollies; leather, canvas or rope sling shall be used.

Snap and plunger shall be prevented from dropping out of place by securing the pneumatic riveting hammer. Nozzle of the hammer shall be inspected from time to time. Torn or worn wire attachment shall be renewed. Water shall be kept ready for putting out fire during riveting operations.

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3.11 CONSTRUCTION HAZARDS

3.11.1 General

Implements used for carrying materials to the top of scaffolding shall be of adequate strength and shall not be overloaded during the work. Overhead protection against falling materials shall be provided under scaffoldings and ladders. Care shall be taken in carrying long and heavy bars, rods, angles and other such materials.

Precautions shall be taken to correctly handle, use and position precast RC columns, piles, steel beams, joists, angles and other heavy elements. Temporary supports with guys and props shall be provided in handling heavy elements till the member is properly and permanently secured in position. Manila or Sisal rope shall not be used in rainy season for hoisting heavy materials.

People suffering from asthma, chronic bronchitis, pulmonary fibrosis, or pneumoconiosis shall be screened out from being employed in works involving the use of paints, varnishes, plastic foam, rubber, adhesives, etc. Those having impaired lung function, hay fever, eczema, dermatitis etc. shall also be advised to avoid such work.

All construction sites shall have sufficient general and local ventilation unless otherwise required.

Adequate number of Absorptive respirators shall be provided to sites with inhalation hazard. Full breath apparatus shall be used for works of limited period in dangerous situations.

The workers shall be made aware of personal hygiene. Regular health check up shall be arranged for works requiring high physical fitness for prolonged period.

3.11.2 Fire Hazards

Gangways and the ground below the scaffolding shall be kept free from readily combustible materials including waste, debris and any vegetation at all times.

Scaffoldings, gangways, etc. shall be constructed with fire resistant materials when blow torch or other equipment producing flame is extensively used near it. A portable dry powder extinguisher of 3 kg capacity shall

be kept near all flame producing equipment. Sec 2.1.3, Sec 2.2.4 and Sec 2.2.5.3 shall also be followed in addition to the following requirements.

Fire Protection: Fire extinguishers, preferably of water type, shall be placed at strategic points.

Extinguishers shall always be placed in cranes, hoists, compressors and similar places. Where electrical equipment is used, CO₂ or dry powder extinguishers shall be provided.

In addition to fire extinguishers, other fire extinguishing equipment, e.g. sprinklers and hydrants shall also be provided and conveniently located both within the building under construction and at the building site. All extinguishers shall be maintained in a usable condition at all times in accordance to the instructions of the manufacturer.

All workmen and supervisory staff shall be clearly briefed on the use of fire extinguishers provided at the construction site. Free access shall be provided and maintained at all times to all firefighting equipment including fire hose, extinguishers, sprinkler valves and hydrants.

Where the project itself requires the installation of fixed firefighting equipment, such as hydrants, stand pipes, sprinklers and underground water mains or other suitable arrangements for the provision of water, it shall be installed and made available for permanent use as soon as possible, in no case later than the scheduled time.

A permanent hydrant system shall be made available before the building has reached the height of 20 m. This shall be extended with every increase in the number of floors, and securely capped at the top. Top hose outlets shall be at all times not more than one floor below the floor under construction. All construction sites with a fire risk shall have at least two exits.

Temporary stand pipes with required pumps shall be provided in place of permanent systems if they are designed to furnish 400 liters of water per minute at 450 kPa pressure with a standpipe size of not less than 100 mm.

A metal box of substantial size preferably to be kept open, shall be provided and maintained near each hose outlet. It shall contain adequate length of hose fitted with 12 or 20 mm nozzle to reach all parts of the floor.

Free access from the street to such stand pipe shall be maintained at all times. Materials shall not be stored within 1.5 m of any fire hydrant or in the roadway between such hydrant and the centre line of the street.

Contact shall be established and maintained with the local fire authority during construction of all buildings above 20 m in height and buildings of special occupancies like educational, assembly, institutional, industrial, storage, hazardous and mixed occupancies having areas in excess of 500 sqm on each floor.

Telephone or other means of inter-communication system within the site shall be provided during the construction of all buildings over 20 m in height or buildings with a plinth area in excess of 1000 sqm.

All waste, such as scrap timber, wood shavings, sawdust, paper, packing materials and oily substance, particularly in or near vertical shaft openings like stairways, lift shaft etc. shall be collected and disposed off safely at the end of each day's work.

An independent water storage facility shall be provided before the commencement of construction operations for fire-fighting purposes. The tank shall be kept filled up at all times. Sec 2.2.5 shall also be followed.

Flammable Materials and Explosives: Highly flammable materials, such as gasoline, oil, paints etc. shall be stored in approved containers. Storage of large quantities shall not be allowed unless stored in separate compartments or enclosures of noncombustible construction.

Where cellulose or other highly flammable paint is sprayed, flame-proof exhaust ventilation equipment shall be provided. Smoking shall be strictly controlled where highly flammable liquids are used.

Explosives like detonators, gunpowder etc. shall be stored in conformity with relevant regulations for storage and handling of explosives. Combustible materials shall not be stored on any floor under construction until all combustible form works are removed from the tier immediately above.

Temporary Heating: When temporary heating is used, all regulations as to the maximum temperature, distance from combustible materials, spark arrestors, removal of noxious gases and other similar requirements shall be fully observed. Temporary enclosure shall be provided where the source of temporary heat includes open-flame devices.

Steam Boiler: All temporary or permanent high pressure steam boilers shall be operated only by licensed operators. Where located within a building or within 3 meters of combustible materials or electric power lines, all such boilers shall be enclosed with approved noncombustible covers. Safety valves shall be adjusted to exactly 70 kPa in excess of working pressure. Two dry chemical power (DCP) type fire extinguishers of 5 kg capacity each shall be kept at easily accessible locations.

House Keeping: Rubbish, trash, nuts, bolts and small tools shall not be allowed to accumulate on the site and shall be removed as soon as conditions warrant. Combustible rubbish shall be removed daily. Rubbish shall not be burnt on the premises or in the immediate vicinity. The entire premises and area adjoining and around the construction site shall be kept in a safe and sanitary condition.

Fire Exits: All construction sites with a fire-risk shall have at least two clearly marked fire exits.

Other means of escape as required by various sections of this Code shall be provided in a construction site. Fire exits shall be easily operable; stores, packing materials or rubbish shall not obstruct the exit.

Fire walls and exit stairways required for a building shall be given priorities in construction schedule. Where fire doors, with or without automatic closing devices, are to be set in the building, they shall be hung as soon as practicable, and before fire risk is increased by way of greater use of combustible material.

3.11.3 Health Hazards

Emission: Precautionary measures shall be taken against the emission of dust, small particles, toxic gases and other harmful substances in quantities hazardous to health. Such measures shall include local ventilation, use of protective devices, medical check-up etc. Exhaust ventilation shall be employed in enclosed spaces.

Clothing: Clothes worn by the workmen shall not be of such nature and materials as to increase the chances of inflicting injuries to themselves or others. Wearing of loose garments shall be strictly avoided.

Workmen using naked flames (such as in welding) shall not wear clothing of synthetic fibre or similar materials which increases the risk of fire hazards.

Removal of Dust: Spread of dust, sand blasts and other harmful materials and chemical agents shall be controlled at or near the source to prevent overspill to adjoining premises or streets.

Proper gear and protection as required by regulations shall be provided to the workmen.

Proper methods of handling and transportation shall be followed. Places prone to generate dust shall be frequently cleaned. Machinery and plants shall be designed for easy cleaning.

First Aid and Ambulance: A copy of all pertinent regulations and notices concerning accidents, injury and first aid shall be prominently displayed at the work site.

A first aid box or cupboard shall be provided for every 150 workmen and be accessible. The provision shall also include a stretcher and cot with accessories for every 300 workmen.

In case of a site where more than 600 workmen are employed at any one time, or in which more than 300 workmen are employed at any one time and is 15 km from the nearest health service facility, provision of an ambulance shall be made.

3.11.4 Skin Hazard

Workmen engaged in works which may splash liquid or other materials liable to injure the skin shall have enough protective clothing to cover the body and limbs.

Whenever epoxy resins are mixed indoor, the place shall be adequately ventilated. Damaged protective gears shall not be used, and shall be replaced. Containers of hazardous chemicals shall be kept in a clearly marked-off area of the work space.

Spillage on and contamination of tools, equipment, or the outside of the containers shall be avoided. If spillage or contamination occurs, the affected area shall be cleaned up immediately.

Contaminated skin/part of the body shall be washed immediately with warm soapy water. Proper barrier creams shall be used. All contamination on part of the body shall be regularly and efficiently removed during breaks and after finishing time.

3.11.5 Noise Hazard

Noise shall be controlled, if possible, by soundproof shields, baffles or absorbent lined booths being fitted near or around the source. Other general methods of control shall include silencing of machine exhaust, choice of quiet machines etc.

Protective measures shall be taken if the continuous noise level at the construction site exceeds 90 dB. For levels up to 110 dB, properly fitted ear plugs of plastic, rubber or glass wool shall be provided. For levels up to 120 dB, ear muffs shall be used; for levels exceeding 120 dB, noise protection helmets shall be provided.

All noise control equipment shall be regularly inspected and maintained by adequately trained personnel. Care shall be taken to prevent noise becoming a nuisance to neighbouring property.

Other precautions as specified in Part 8 Chapter 4 shall also apply.

3.12 ADDITIONAL SAFETY REQUIREMENTS FOR ERECTION OF CONCRETE FRAMED STRUCTURES (HIGH RISE BUILDINGS)

Workmen working in any position where there is a falling hazard shall wear safety belts or other adequate protection shall be provided.

3.12.1 Handling of Plant

3.12.1.1 Mixers

All gears, chains and rollers of mixers shall be properly guarded. If the mixer has a charging skip the operator shall ensure that the workmen are out of danger before the skip is lowered. Railings shall be provided on the ground to prevent anyone walking under the skip while it is being lowered.

All cables, clamps, hooks, wire ropes, gears and clutches, etc, of the mixer, shall be checked and cleaned, oiled and greased, and serviced once a week. A trial run of the mixer shall be made and defects shall be removed before operating a mixer.

When workmen are cleaning the inside of the drums, operating power of the mixer shall be locked in the off position and all fuses shall be removed and a suitable notice hung at the place.

3.12.1.2 Cranes

See Sec 3.9.5

3.12.1.3 Trucks

When trucks are being used on the site, traffic problems shall be taken care of. A reasonably smooth traffic surface shall be provided. If practicable, a loop road shall be provided to permit continuous operation of vehicles and to eliminate their backing. If a continuous loop is not possible, a turnout shall be provided. Backing operations shall be controlled by a signalman positioned so as to have a clear view of the area behind the truck and to be clearly visible to the truck driver. Movement of workmen and plant shall be routed to avoid crossing, as much as possible, the truck lanes.

3.12.2 Formwork

The Formwork shall conform to the shape, lines and dimensions as shown on the plans, and be so constructed as to remain sufficiently rigid during the placing and compacting of the concrete, and shall be sufficiently tight to prevent loss of liquid from the concrete.

Formwork shall be designed after taking into consideration spans, setting temperature of concrete, dead load and working load to be supported and safety factor for the materials used for formwork.

All timber formwork shall be carefully inspected before use and members having cracks and excessive knots shall be discarded.

As timber centering usually takes an initial set when vertical load is applied, the design of this centering shall make allowance for this factor.

The vertical supports shall be adequately braced or otherwise secured in position that these do not fall when the load gets released or the supports are accidentally hit.

Tubular steel centering shall be used in accordance with the manufacturer's instructions. When tubular steel and timber centering is to be used in combination necessary precautions shall be taken to avoid any unequal settlement under load.

A thorough inspection of tubular steel centering is necessary before its erection and members showing evidence of excessive resting, kinks, dents or damaged welds shall be discarded. Buckled or broken members shall be replaced. Care shall also be taken that locking devices are in good working order and that coupling pins are effectively aligned to frames.

After assembling the basic unit, adjustment screws shall be set to their approximate final adjustment and the unit shall be level and plumb so that when additional frames are installed the tower shall be in level and plumb. The centering frames shall be tied together with sufficient braces to make a rigid and solid unit. It shall be ensured that struts and diagonals braces are in proper position and are secured so that frames develop full load carrying capacity. As erection progresses, all connecting devices shall be in place and shall be fastened for full stability of joints and units.

In case of timber posts, vertical joints shall be properly designed. The connections shall normally be with bolts and nuts. Use of rusted or spoiled threaded bolts and nuts shall be avoided.

Unless the timber centering is supported by a manufacturer's certificate about the loads it can stand, centering shall be designed by a competent engineer.

Centering layout shall be made by a qualified engineer and shall be strictly followed. The bearing capacity of the soil shall be kept in view for every centering job. The effect of weather conditions shall be considered as dry clay may become very plastic after a rainfall and show marked decrease in its bearing capacity.

Sills under the supports shall be set on firm soil or other suitable material in a pattern which assures adequate stability for all props. Care shall be taken not to disturb the soil under the supports.

Adequate drainage shall be provided to drain away water coming due to rains, washing of forms or during the curing of the concrete to avoid softening of the supporting soil strata.

All centering shall be finally, inspected to ensure that:

- a) footings or sills under every post of the centering are sound.
- b) all lower adjustment screws or wedges are snug against the legs of the panels.
- c) all upper adjustment screws or heads of jacks are in full contact with the formwork.
- d) panels are plumb in both directions.
- e) all cross braces are in place and locking devices are in closed and secure position.
- f) In case of balconies, the props shall be adequate to transfer the load to the supporting point.

During pouring of the concrete, the centering shall be constantly inspected and strengthened, if required, wedges below the vertical supports tightened and adjustment screws properly adjusted as necessary. Adequate protection of centering shall be secured from moving vehicles or swinging loads.

Forms shall not be removed earlier than as laid down in the specifications and until it is certain that the concrete has developed sufficient strength to support itself and all loads that will be imposed on it. Only workmen actually engaged in removing the formwork shall be allowed in the area during these operations. Those engaged in removing the formwork shall wear helmets, gloves and heavy soled shoes and approved safety belts if adequate footing is not provided above 2 m level. While cutting any tying wires in tension, care shall be taken to prevent backlash which might hit a workman.

The particular order in which the supports are to be dismantled shall be followed according to the instructions of the site engineer.

3.12.3 Ramps and Gangways

Ramps and gangways shall be of adequate strength and evenly supported. They shall either have a sufficiently flat slope or shall have cleats fixed to the surface to prevent slipping of workmen.

Ramps and gangways shall be kept free from grease, mud, snow or other slipping hazards or, other obstructions leading to tripping and accidental fall of a workman.

Ramps and gangways meant for transporting materials shall have even surface and be of sufficient width and provided with skirt boards on open sides.

3.12.4 **Materials Hoists**

The hoist shall be erected on a firm base, adequately supported and secured. All materials supporting the hoist shall be appropriately designed and strong enough for the work intended and free from defects.

The size of the drum shall match the size of the rope. Not less than two full turns of rope shall remain on the drum at all times. Ropes shall be securely attached to the drum.

All ropes, chains and other lifting gear shall be properly made of sound materials, free from defects and strong enough for the work intended. They shall be examined by a competent person who shall clearly certify the safe working load on each item and the system.

Hoist ways shall be protected by a substantial enclosure at ground level, at all access points and wherever persons may be struck by any moving part.

Gates at access points shall be at least 2 m high wherever possible. Gates shall be kept closed at all times except when required open for immediate movement of materials at that landing place.

All gates shall be fitted with electronic or mechanical interlocks to prevent movement of the hoist in the event of a gate being opened.

Winches used for hoists shall be so constructed that a brake is applied when the control lever or switch is not held in the operating position (dead-man's handle).

The hoist tower shall be tied to a building or structure at every floor level or at least every 3 m. The height of the tower shall not exceed 6 m after the last tie or a lesser height as recommended by the manufacturer. All ties on a hoist tower shall be secured using right angled couples.

The hoist shall be capable of being operated only from one position at a time. It shall not be operated from the cage. The operator shall have a clear view of all levels or, if he has not, a clear and distinct system of signaling shall be employed.

All hoist platforms shall be fitted with guards and gates to a height of at least 1 m, to prevent materials rolling/falling from the platform.

Where materials extend over the height of the platform guards, a frame shall be fitted and the materials secured to it during hoisting/lowering. (Care shall be taken to ensure that neither the frame nor materials interfere or touch any part of the hoisting mechanism.)

The platform of a goods hoist shall carry a notice stating:

- a) the safe working load; and
- b) that passengers shall not ride on the hoist.

All hoist operators shall be adequately trained and competent, and shall be responsible for ensuring that the hoist is not overloaded or otherwise misused.

All hoists shall be tested and thoroughly examined by a competent person before use on a site, after substantial alteration, modification or repair of hoists, and at least every 6 months.

Every hoist shall be inspected at least once each week by a competent person and a record of these inspections kept.

3.12.5 **Prestressed Concrete**

In pre-stressing operations, operating, maintenance and replacement instructions of the supplier of the equipment shall be strictly adhered to.

Extreme caution shall be exercised in all operations involving the use of stressing equipment as wires/strands under high tensile stresses become a lethal weapon.

During the jacking operation of any tensioning element(s) the anchor shall be kept turned up close to anchor plate, wherever possible, to avoid serious damage if a hydraulic line fails.

Pulling-headers, bolts and hydraulic jacks/rams shall be inspected for signs of deformation and failure. Threads on bolts and nuts shall be frequently inspected for diminishing cross section.

Choked units shall be carefully cleaned.

Care shall be taken that no one stands in line with the tensioning elements and jacking equipment during the tensioning operations and that no one is directly over the jacking equipment when deflection is being done. Signs and barriers shall be provided to prevent workmen from working behind the jacks when the stressing operation is in progress.

Necessary shields shall be put up immediately behind the prestressing jacks during stressing operations.

Wedges and other temporary anchoring devices shall be inspected before use.

The pre-stressing jacks shall be periodically examined for wear and tear.

3.12.6 Erection of Prefabricated Members

A spreader beam shall be used wherever possible so that the cable can be as perpendicular to the members being lifted as practical. The angle between the cable and the members to be lifted shall not be less than 60°.

The lifting wires shall be tested for double the load to be handled at least once in six months. The guy line shall be of adequate strength to perform its function of controlling the movement of members being lifted,

Temporary scaffolding of adequate strength shall be used to support precast members at predetermined supporting points while lifting and placing them in position and connecting them to other members.

After erection of the member, it shall be guyed and braced to prevent it from being tipped or dislodged by accidental impact when setting the next member.

Precast concrete units shall be handled at specific picking points and with specific devices. Girders and beams shall be braced during transportation and handled in such a way as to keep the members upright.

Methods of assembly and erection specified by the designer shall be strictly adhered to at site.

Immediately on erecting any unit in position, temporary connections or supports as specified shall be provided before releasing the lifting equipment. The permanent structural connections shall be established at the earliest opportunity.

3.12.7 Heated Concrete

When heaters are being used to heat aggregates and other materials and to maintain proper curing temperatures, the heaters shall be frequently checked for functioning and precautions shall be taken to avoid hazards in using coal, liquid, gas or any other fuel.

3.12.8 Structural Connections

When reliance is placed on bond between precast and in-situ concrete the contact surface of the precast units shall be suitably prepared in accordance with the specifications.

The packing of joints shall be carried out in accordance with the assembly instructions.

Leveling devices, such as wedges and nuts which have no load bearing function in the completed structure shall be released or removed as necessary prior to integrating the joints.

If it becomes necessary to use electric power for in-situ work, the same shall be stepped down to a safe level as far as possible.

3.13 MISCELLANEOUS

3.13.1 Stair , Ramp and Gangway

Buildings higher than two stories shall have at least one stair in usable condition at all times. This shall be extended upward with each completed floor. Till the permanent handrails are provided, temporary provisions like ropes, bamboo poles etc. shall be provided on stair.

Suitable precautions by way of support, formworks, etc. shall be taken to prevent any collapse of the stair during its construction. No person shall be allowed to use such stair until they are tested by the engineer and found fit for usage.

Where a building has been constructed to a height greater than 14 m or four stories, or where an existing building higher than 14 m is altered, at least one temporary lighted stairway shall be provided unless one or more of the permanent stairways are erected as the construction progresses.

Ramps and gangways shall be of adequate strength and evenly supported. They shall either have a sufficiently flat slope (maximum 15o to horizontal), or shall have cleats fixed to the surface. They shall be kept free from slipping hazards and obstructions.

Ramps for transporting materials shall have even surfaces, be of sufficient width and provided with 200 mm high toe boards on open sides.

Requirements as set in Sec 3.11.2 shall also be observed.

3.13.2 Fragile Fixture

It shall be ensured that sufficient number of workmen and equipment are provided to carry the fragile fixtures in the site like sanitary fittings, glass sheets, etc. Fragile fixtures shall be stored in a safe place away from the normal circulation path of people, equipment and vehicle.

See Sec 2.2 for additional requirements for safe handling of fragile fixtures and materials.

3.13.3 Hand Tools

Correct tools in good condition shall be used for each type of job. All tools, particularly at heights, shall be stowed. Wooden handles shall be made of good quality straight-grained materials. Hand tools shall be issued through a tool room where they are stored safely and inspected periodically by competent people.

Hammer head shall be securely attached to the shaft. The head shall be in good condition and the face free from chipped edges and not rounded from wear. The hammer shall not be used if the shaft is split, broken or loose.

Set spanners with splayed jaws, or box spanners showing signs of splitting shall not be used. A fixed spanner of correct size shall be preferred over an adjustable spanner. A tube shall not be used to obtain extra leverage; end of a spanner shall never be hammered. A spanner shall not be used as a hammer, nor as a wedge.

A chisel with a mushroom head shall never be used. A chisel shall be used to cut in a direction away from the body. Screwdriver handle shall be properly secured. A screwdriver shall never be used as a chisel.

Use of files with an exposed tang shall be avoided. Files shall not be used as levers or toggle-bar.

When a knife is used to cut greasy materials, the handle shall be such that it offers a firm grip and a shield shall be fitted between the handle and the blade. The cut shall always be made away from the body.

3.13.4 Steel Structure

Riding on trusses while hauling them to their final position, shall not be allowed. The hauling ropes shall be load tested before use.

Once in position, the trusses shall be kept secured with adequate temporary measures till the final fixing is carried out. Standard safety belts conforming to BDS 1359 shall be used while fixing purlins on the trusses.

In steel construction, the entire tier of iron or steel beams shall be planked over, with the exception of necessary hoist ways and permanent openings. Steelwork shall not advance more than six floors ahead of the permanent floor construction.

The proposed erection scheme of a steel work shall be analyzed and checked for safety measures undertaken; the scheme shall cover safety aspects at all stages.

3.13.5 Finish Works

Painting: The quantity of paint and thinner required only for the day's work shall be issued from the store. All unused containers of paint and thinner shall be closed with tight-fitting lids, and kept at a safe place away from the work site.

Metal receptacles with pedal operated metal lids shall be kept at the work site for depositing used cotton rags and waste. The contents of such receptacles shall be disposed off daily at a safe place, preferably by burning under proper supervision.

All containers of paint shall be deposited in the paint store after use. Used paint brushes shall be cleaned and deposited in the store. A 5 kg dry powder fire extinguisher shall be kept near the paint store (see Sec 2.2.16).

Adequate ventilation to prevent the accumulation of flammable vapour to hazardous level of concentration shall be provided in all areas where painting is done. When painting is done in confined spaces where flammable or explosive vapour may develop, required heat and power shall only be provided through covered ducts remote from the likely source of flame.

Sources of ignition, such as open flame and exposed heating elements, shall not be permitted in areas or rooms where spray painting is done, nor shall smoking be allowed there.

Polishing: Extra care shall be taken while handling polish consisting of acid and other chemical ingredients. Only the quantity of polish required for the day's work shall be kept at the work spot.

All containers of polish shall be kept closed with tight fitting lids in a safe place.

Protective clothing, gloves, respiratory equipment, etc. shall be provided to the workmen applying polishes. Sec 2.2.4 shall be observed as additional requirement.

Pavements: Pavement risers shall not be higher than 225 mm. All undulating surfaces shall be smoothed. At least a 1 m x 0.5 m area of the pavement adjacent to a vehicular road crossing shall have a checkered surface preferably of a texture and colour different from those of the surrounding surface.

Terracing: Protective clothing, gloves and shoes shall be used in terracing work, especially while handling lime and other ingredients. Lime and mortar stuck on the body shall be thoroughly cleaned. Other requirements for handling lime shall be as specified in Sec 2.2.1.2.