

STORAGE, STACKING AND HANDLING PRACTICES

2.1 GENERAL PRACTICES

2.1.1 General Requirements and Restrictions on Storage and Handling

Materials required in construction operations shall be stored, and handled in a manner to prevent deterioration and damage to the materials, ensure safety of workmen in handling operations and non-interference with public life including safety of public, prevention of damage to public property and natural environment.

Materials shall be stored and placed so as not to endanger the public, the workers or the adjoining property. Materials shall be stacked on well-drained, flat and unyielding surface. Material stacks shall not impose any undue stresses on walls or other structures.

Materials shall be separated according to kind, size and length and placed in neat, orderly piles. High piles shall be staggered back at suitable intervals in height. Piles of materials shall be arranged so as to allow a minimum 800 mm wide passageway in between for inspection and removal. All passageways shall be kept clear of dry vegetation, greasy substance and debris.

For any site, there should be proper planning of the layout for stacking and storage of different materials, components and equipments with proper access and proper maneuverability of the vehicles carrying the material. While planning the layout, the requirements of various materials, components and equipments at different stages of construction shall be considered.

Stairways, passageways and gangways shall not become obstructed by storage of building materials, tools or accumulated rubbish.

Materials stored at site, depending upon the individual characteristics, shall be protected from atmospheric actions, such as rain, sun, winds and moisture, to avoid deterioration.

Special and specified care should be taken for inflammable and destructive chemicals and explosive during storage.

2.1.2 Manual Handling

When heavy materials have to be handled manually each workman shall be instructed by his foreman or supervisor for the proper method of handling such materials. Each workman shall be provided with suitable equipment for his personal safety as necessary. Supervisors shall also take care to assign enough men to each such job depending on the weight and the distance involved.

2.1.3 Protection against Fire

Timber, Bamboo, coal, paints and similar combustible materials shall be kept separated from each other. A minimum of two dry chemical powder (DCP) type fire extinguishers shall be provided at both open and covered locations where combustible and flammable materials are stored.

Flammable liquids like petrol, thinner etc., shall be stored in conformity with relevant regulations.

Explosives like detonators, gun powder etc. shall be stored in conformity with the fire protection provisions set forth in this Code so as to ensure safety during storage. Stacks shall not be piled so high as to make them unstable under fire fighting conditions and in general they shall not be more than 4.5 m in height.

Materials which are likely to be affected by subsidence of soil like precast beams, slabs and timber of sizes shall be stored by adopting suitable measures to ensure unyielding supports.

Materials liable to be affected by floods, tides, etc shall be suitably stored to prevent their being washed away or damaged due to floods, tides, etc.

2.1.4 Housekeeping

Stairways, walkways, scaffolds, gangways and access ways shall be kept free of building material, tools, accumulated rubbish and obstructions.

Materials or equipment stored on the street, footpath and other public places with permission from the proper Authority, and conforming to Sec 1.5.3, shall not interfere with vehicular traffic or pedestrians on the highway or street. The piles shall be arranged to leave a safe walkway unobstructed for its full length, and adequately lighted at night and at all other necessary times.

Material and equipment shall not be located within 7.5 m of a street intersection. These shall neither be so placed as to obstruct normal observation of traffic signals nor to hinder the use of public transit loading platforms.

2.2 STORAGE REQUIREMENT BY CLASSIFICATION OF MATERIALS

Stored materials shall be separately stored under following classifications, with appropriate care necessary precautions to each Classification:

- a) Climatically Sensitive Materials
- b) Durable Materials
- c) Materials Vulnerable to Rough Handling
- d) Inflammable and/or Fire Sensitive Materials
- e) Hazardous Materials

Under each classification a list of commonly used materials are listed below. Other materials used but not mentioned here shall be treated under one or more of the above listed classifications which most closely match the unlisted material.

2.2.1 Climatically Sensitive Materials

Such material shall be stored in properly constructed sheds which must be stored in cool dry and well ventilated and confines, ensuring its storage without deterioration and without contact to ground and structural members, without exposure to moisture and heat, and away from direct sun.

Materials requiring breathing, such as timber and other natural products, shall be allowed ample air flow between successive layers of stacking.

Materials subject to deformation under stress shall be supported uniformly so as not to subject it to bending load or excessive vertical load.

Materials subject to loss of quality through moisture shall be kept within impermeable wrapping, if not used within a reasonable period.

2.2.1.1 Cement

Cement shall be stored at the work site in a building or a shed which is dry, leak proof and moisture proof. The building or shed shall have minimum number of windows and close fitting doors which shall be kept closed at all times except during loading and unloading.

Cement received in bags shall be prevented from coming into contact with any dampness or moisture. Cement bags shall be stacked on wooden planks maintaining a minimum clearance of 200 mm from the floor. A minimum clear space of 450 mm shall be provided between the stacks and any exterior wall.

Maximum height of the stack shall be 15 bags and the width not more than four bags or 3m. In stacks more than 8 bags high, the bags shall be arranged alternate length and crosswise. The bags shall be stacked closely as to minimize the surface area exposed to air.

During monsoon and for storage for more than 2 months, the stack shall be kept completely enclosed by a waterproofing membrane such as polyethylene sheet which shall close on top of the sack. Care should be taken to see that waterproofing membrane is not damaged any time during the use.

Heavy containers of cement shall not be stacked more than two tiers high. Cement shall be used in the order they are received; storage shall facilitate this requirement.

Hooks shall not be used for handling cement bags unless permitted by the supervisor. Workers handling cement shall put on protective hand and face coverings and use skin protective. They shall be instructed to the need of cleanliness from time to time.

When entering a silo or bin for any purpose, the workman shall wear a lifeline attended by another workman outside. The ejection system shall be shut down and locked out during such operation.

In case cement is received in silos, the silos shall be placed near the concrete batching plant. Proper access shall be provided for the replacement of silos.

Different types of cements shall be stacked and stored separately. In similar manner cements in gunny bags, paper bags and polythene sheets shall be stored separately.

2.2.1.2 Lime

Quicklime shall be slaked as soon as possible. If unavoidable, it may be stored in compact heaps having only the minimum of exposed area. The heaps shall be stored on a suitable platform under a roof protected from rain and wind. A minimum space of 300 mm shall be provided all-round the heaps to avoid bulging of walls.

Unslaked lime shall be stored in a watertight place and shall be separated from combustible materials.

Hydrated lime shall be supplied either in containers or sacks, such as jute bags lined with polyethylene or high density polyethylene woven bags lined with polyethylene or craft paper bags.

It shall be stored in a dry room to protect the lime from dampness and to minimize warehouse deterioration. The building should be with a concrete floor and having least ventilation to eliminate draughts through the walls and roof. In general, the recommendations given in storing of cement shall be applicable for hydrated lime. When air movement is reduced to a practical minimum, hydrated lime can be stored for up to three months without appreciable change.

When dry slaked lime is to be used within a few days, it shall be stored on a covered platform and protected from rain and wind. It shall be kept in a dry and air-tight go down when immediate use is not required. However, it shall never be stored for more than two months.

Workmen handling bulk lime shall wear protective clothing, respirators, and goggles, shall be instructed in the need of cleanliness to prevent dermatitis, and shall be provided with hand cream, petroleum jelly, or similar protectors.

a) Handling of Cement and Lime

Bulk cement stored in silos or bins may fail to feed to the ejection system. When necessary to enter a silo or bin for any purpose, the ejection system employed shall be shutdown and locked out electrically as well as mechanically, when necessary for a workman to enter such storage area, he shall wear a lifeline with another workman outside the silo or hopper attending the rope.

Workmen, handling bulk cement or lime shall wear protective clothing, respirators, and goggles; shall be instructed in the need of cleanliness to prevent dermatitis, and shall be provided with hand cream, petroleum jelly, or similar preparation for protection of exposed skin.

2.2.1.3 Timber

Timber shall be stored in stacks on well treated and even surfaced beams, sleepers or brick pillars so as to be at least 200 mm above the ground level. Contact with water shall be avoided under all circumstances. Members shall be stored separately in layers according to lengths and materials of equal lengths shall be piled together in layers with crossers or wooden battens of sound wood, straight and uniform thickness.

In any layer a 25 mm air space shall be kept between adjacent members. The longer pieces shall be placed in the bottom layers and shorter pieces in the top layers. At least one end of the stack shall be in true vertical alignment. The crossers themselves in different layer shall be in vertical alignment.

The recommended width and height of a stack are 1.5 m and 2.0 m respectively. Minimum distance between two stacks shall be 800 mm. In case stacking with battens is not possible, the timber may be close piled in heaps, and the precautions specified above observed.

All timbers to be stored for a year or more, the ends of members shall be coated with coal tar, aluminum leaf paints (hardened gloss oil), microcrystalline wax or other suitable material.

The stacks of timbers shall be protected from hot dry wind, direct sun and rain. Heavy weights may be placed on top of the stacks to prevent warping of timber. Nails, metal straps, etc. attached to used timber, particularly planks and formwork for shuttering shall be removed before stacking.

Care must be taken that handler or workmen are not injured by rails, straps, etc, attached to the used timber. This applies particularly to planks and formwork for shuttering.

2.2.1.4 Bamboo

The site shall be properly inspected and termite colonies or mounds if detected shall be destroyed. All refuse and useless cellulosic materials shall be removed from the site. The ground may then be disinfected by suitable insecticides. The area should have good drainage.

Bamboo may preferably be stacked on high skids or raised platform at least 300 mm above ground, Storage under cover reduces the liability to fungal attack. Good ventilation and frequent inspection are important.

Bamboo dries by air-seasoning under cover in the storage yards from 6 to 12 weeks time.

Prophylactic treatment of bamboo during storage prevents losses due to fungi and insects even under open storage. Following chemicals are found suitable at the coverage rate of 24 liters per ton.

Sodium pentachlorophenate	: 1 percent solution
Boric acid + borax (1:1)	: 2 percent solution
Sodium pentachlorophenate + boric acid + borax (5:1:1)	: 2.5 percent solution

A mixture of these compounds yields the best results.

NOTE— for better protection of structural bamboo, (if stored outside) repetition of the treatment after four to six months is desirable.

2.2.1.5 Particle Board

See Article 2.2.3.9

2.2.2 Durable Materials

2.2.2.1 Steel Bars and Sections

Steel reinforcement bars and structural steel shall be stored in a way to prevent distortion, corrosion, scaling and rusting. Reinforcement bars and structural steel sections shall be coated with cement wash before stacking, especially in humid areas. In case of long time storage or storage in coastal areas, reinforcement bars and steel sections shall be stacked at least 200 mm above ground level.

Steel sections shall be stacked upon platforms, skids or any other suitable supports. Bars of different types, sizes and lengths and structural steel sections shall be stored separately to facilitate issues in required sizes and lengths without cutting from standard lengths. Ends of bars and sections of each type shall be painted with separate designated colors.

Tag lines shall be used to control the load in handling reinforcing bars or structural steel when a crane is used. Heavy steel sections and bundles of reinforcing bars shall be lifted and carried with the help of slings and tackles.

2.2.2.2 Bricks and Masonry Blocks

Bricks shall be stacked on dry firm ground in regular tiers. For proper inspection of quality and ease in counting, the stacks shall be 50 bricks long and 10 bricks high and not more than 4 bricks in width, being placed on edge two at a time along the width of the stack. Clear distance between adjacent stacks shall be not less than 800 mm.

Bricks of each truckload shall be put in one stack. Bricks of different types, such as, clay bricks, clay fly ash bricks, fly ash lime bricks, sand lime (calcium silicate) bricks shall be stacked separately.

Bricks of different classifications from strength consideration and size consideration (such as, conventional and modular) shall be stacked separately. Also bricks of different types, such as, solid, hollow and perforated shall be stacked separately.

Bricks made of clay containing lime shall be thoroughly soaked in water (docked) while in stack.

Bricks of different types shall be stacked separately. Concrete blocks, stone blocks and other masonry blocks shall be stored in stacks of such height as not to damage the blocks in the lower layers or topple.

Bricks shall be loaded or unloaded with care, and shall not be thrown or dumped. They shall be carried from the stack to the site of placement in small batches as and when necessary.

Brick stacks shall be placed close to the site of work so that least effort is required to unload and transport the bricks again by loading on pallets or in barrows. Unloading of building bricks or handling in any other way likely to damage the corners or edges or other parts of bricks shall not be permitted.

Blocks are available as hollow and solid concrete blocks, hollow and solid light weight concrete blocks, autoclave aerated concrete blocks, concrete stone masonry blocks and soil based blocks. Blocks shall be unloaded one at a time and stacked in regular tiers to minimize breakage and defacement. These shall not be dumped at site. The height of the stack shall not be more than 1.2 m, the length of the stack shall not be more than 3.0 m, as far as possible and the width shall be of two or three blocks. Normally blocks cured for 28 days only should be received at site. In case blocks cured for less than 28 days are received, these shall be stacked separately. All blocks should be water cured for 10 to 14 days and air cured for another 15 days; thus no blocks with less than 28 days curing shall be used in building construction. Blocks shall be placed close to the site of work so that least effort is required for their transportation. The date of manufacture of the blocks shall be suitably marked on the stacks of blocks manufactured at factory or site.

2.2.2.3 Stones

Stones of different sizes, types and classification shall be stored separately. Stones shall be stacked on dry firm ground in a regular heap not more than 1 m in height.

Veneering stones shall be stacked against vertical support on a firm dry ground in tiers up to a height of 1.2 m. A distance of about 0.8 m shall be kept between two adjacent stacks.

2.2.2.4 Aggregates

Aggregates shall be stored at site on a hard, dry and level ground. If such a surface is not available, a platform of planks or old corrugated iron sheets, or a floor of bricks, or a thin layer of lean concrete shall be used. Contact with clay, dust, vegetable and other foreign matters shall be avoided.

Fine and coarse aggregates shall either be stored separately or heaps be separated by dividing walls. Fine aggregate shall be stored in a place and manner where loss due to the effect of wind is minimum, viz. in the leeward side behind a wall, or by covering with a polyethylene sheet.

On a large job it is desirable to construct dividing walls to give each type of aggregates its own compartment. Fine aggregates shall be stacked in a place where loss due to the effect of wind is found minimum.

When withdrawals are made from heaps, no overhang in the original heap shall be permitted. Employees required to enter hoppers shall be equipped with safety belts and ~~lives~~ ^{lives}, attended by another person.

Machine driven hoppers, feeders, and loaders shall be locked in the off position prior to entry electrically as well as mechanically.

2.2.2.5 Water

Water to be used in construction shall be stored in tanks, bottom and the sides of which shall be constructed with brick or concrete. Contact with any organic impurities shall be prevented.

The total capacity of the storage tank shall be determined after taking into account the water required for fire fighting. Also See Part 4, Sec 4.2.

The tank shall be so located as to facilitate easy storage and filling in, and supply both for construction work and for fire fighting. Passage of water to the water tank shall not be blocked at any time.

2.2.3 Materials Vulnerable to Rough Handling

2.2.3.1 Aluminum Sections

Aluminum sections of different classification, sizes and lengths shall be stored separately, on a level platform under cover.

The aluminum sections shall not be pulled or pushed from the stack nor shall be slid over each other, to protect the anodizing layer.

2.2.3.2 Pulverized Fuel Ash/Fly Ash

Fly ash shall be stored in such a manner as to permit easy access for proper inspection and identification of each consignment. Fly ash in bulk quantities shall be stored in stack similar to fine aggregates, avoiding any intrusion of foreign matter. Fly ash in bags shall be stored in stacks not more than 10 bags high.

Handling: See Sec. 2.2.1.2

2.2.3.3 Cinder

Cinder shall be stored in bulk quantities in stacks similar to coarse aggregates avoiding any extrusion of foreign matter.

2.2.3.4 Pipes and Tubing

Pipes shall be stored in stacks with stoppers provided at the bottom layer to keep the pipe stack stable. The stack, particularly of smaller diameter pipes, shall be in pyramid shape. Pipes shall not be stacked more than 1.5 m high.

Each stack shall have pipes of the same type and size only. Removal of pipes shall start from the top layer and by pulling from one end. A pipe shall not be stored inside another pipe. The pipes may also be placed alternately length and crosswise.

Asbestos cement pipes shall be unloaded at location, for example near trenches. Cast iron detachable joints and fittings shall be stacked under cover and separated from the asbestos cement pipes and fittings. Rubber rings shall be kept clean and away from grease, oil, heat and light.

Pipe shall be carried one at a time on shoulders by at least two workmen. Pipe fittings and joints shall be handled individually.

Black polyethylene pipes may be stored either under cover or in the open. However, natural coloured polyethylene pipes shall be stored under cover only and protected from direct sunlight.

Coils of tubing shall be stored either on edge or stacked flat one on top of the other; in either case they shall not be allowed to come into contact with hot water or steam pipes and should be kept away from hot surface.

Straight lengths of unplasticized PVC pipes shall be stored on horizontal racks supported throughout their lengths on a reasonably flat surface free from stones and sharp projections. Pipes shall not be stacked in large piles, especially under warm conditions. Socket and spigot pipes shall be stacked in layers with sockets placed at alternate ends of the stack to avoid top sided stack.

PVC pipes shall be stored in a shaded area. The ends of pipe, particularly those specially prepared for jointing, shall be protected from abrasion. Damaged portion of a pipe shall be cut out completely.

11 KV and below	1.40 m
Above 11 KV and below 33 KV	3.60 m
Above 33 KV and below 132 KV	4.70 m
Above 132 KV and below 230 KV	5.70 m
Above 275 and below 400 kV	6.50 m

Pipes of conducting materials shall be stacked on solid level sills and contained in a manner to prevent spreading or rolling of the pipe. For storage in large quantity, suitable packing shall be placed between the layers. During transportation, the pipes shall be so secured as to prevent displacement/rolling.

In stacking and handling of pipes and other conducting materials, the following minimum vertical safety distances from overhead power lines shall be provided

Handling - Removal of pipes from a pile shall be accomplished by working from the ends of the pipe. During transportation, the pipes shall be so secured as to ensure against displacement.

2.2.3.5 Timber Piles and Poles

Piles and poles shall be stacked on solid and level sills so as to prevent rolling or spreading of the stack. The storage area shall be maintained free of vegetation and flammable materials.

Removal of piles and poles shall start from the top layer and by pulling from one end. Tag lines shall be used to control movement of piles and poles. In stacking and handling of piles and poles, precautions as laid down in Sec 2.2.3.4 shall be followed.

2.2.3.6 Sanitary Appliances

All sanitary appliances shall be stored under cover to prevent damage. In receiving and storing appliances consideration shall be given to the sequence of removal from the store to the assembly positions. Vitreous fittings shall be stacked separately from the metal ones.

Bigger sanitary appliances shall be handled one at a time. Traps, water seals and gullies shall be handled separately. Sanitary fittings shall be protected from any oil spillages; hands of the workers shall be free of any oily substance. The supporting brackets, pedestals etc. shall be checked before lowering the appliances in their position.

2.2.3.7 Doors, Windows, Ventilators and Grilles

Metal and plastic doors, windows and ventilators shall be stacked upright (on their sills) on level ground preferably on wooden battens and shall not come in contact with dirt or ashes. If received in crates they shall be stacked according to manufacturer's instructions and removed from the crates as and when required for the work. Metal and plastic frames of doors, windows and ventilators shall be stacked upside down with the kick plates at the top. These shall not be allowed to stand for long in this manner before being fixed so as to avoid the door frames getting out of shape and hinges being strained and shutters drooping. During the period of storage of aluminum doors, windows and ventilators, these shall be protected from loose cement and mortar by suitable covering, such as tarpaulin. The tarpaulin shall be hung loosely on temporary framing to permit circulation of air to prevent moisture condensation. All timber and other lignocellulosic material based frames and shutters shall be stored in a dry and clean covered space away from any infestation and dampness. The storage shall preferably be in well-ventilated dry rooms. The frames shall be stacked one over the other distances to keep the stack vertical and straight. These cross battens should be of uniform thickness and placed vertically one above the other. The door shutters shall be stacked in the form of clean vertical stacks one over

the other and at least 80 mm above ground on pallets or suitable beams or rafters. The top of the stack shall be covered by a protecting cover and weighted down by means of scantlings or other suitable weights. The shutter stack shall rest on hard and level surface. If any timber or other lignocellulosic material based frame or shutter becomes wet during transit, it shall be kept separate from the undamaged material. The wet material may be dried by stacking in shade with battens in between adjacent boards with free access of dry air. Separate stacks shall be built up for each size, each grade and each type of material. When materials of different sizes, grades and types are to be stacked in one stack due to shortage of space, the bigger size shall be stacked in the lower portion of the stacks. Suitable pallets or separating battens shall be kept in between the two types of material. Precast concrete door and window frames shall be stored in upright position adopting suitable measures against risk of subsidence of soil support.

While unloading, shifting, handling and stacking timber or other lignocellulosic material based, metal and plastic door and window frames and shutters, care shall be taken that the pieces are not dragged one over the other as it may cause damage to their surface particularly in case of the decorative shutters. The pieces should be lifted and carried preferably flat avoiding damage to corners or sides.

Metal frames of doors, windows and ventilators shall be stacked with the kick plates at the top. They shall not be kept in this manner for long, and should be taken to the fixing position as soon as possible.

2.2.3.8 Floors, Wall and Roof Tiles

Floor, wall and clay roof tiles of different types, such as, cement concrete tiles (plain, colored and terrazzo) and ceramic tiles (glazed and unglazed) shall be stacked on regular platform as far as possible under cover in proper layers and in tiers and they shall not be dumped in heaps. In the stack, the tiles shall be so placed that the mould surface of one faces that of another. Height of the stack shall not more than 1000 mm. Tiles of different quality, size and thickness shall be stacked separately to facilitate easy removal for use in work. Tiles when supplied by manufacturers packed in wooden crates shall be stored in crates. The crates shall be opened one at a time as and when required for use.

Ceramic tiles and roof tiles are generally supplied in cartons which shall be handled with care to avoid breakage. It is preferable to transport these at the site on platform trolleys.

2.2.3.9 Sheets and Boards

For storing and handling of sheets and boards, such as asbestos sheets, CGI sheets, particle boards, gypsum boards etc., the following requirements shall be fulfilled:

- a) sheets and boards shall be stacked to a height of not more than 1 m on dry, clean, firm and level ground with timber or other packing beneath them;
- b) bottom of the stack shall be raised adequately from the ground level where there is a risk of water coming on the floor;
- c) sheets and boards shall be stacked under cover and protected from damage due to wind, rain and sun;
- d) at least one edge of the stack shall be in true vertical alignment; the top sheet in each stack shall be suitably weighed down;
- e) damage to the corners and surface of sheets and boards shall be prevented and damaged sheets shall not be stacked with sound materials;
- f) sheets shall not be pushed forward against the lower sheet for more than one-fourth of the sheet length;
- g) they shall be lifted into position by two workmen, if necessary;
- h) sheets and boards shall be lowered or raised gently and not thrown; and suitable hand protection like gloves, jelly etc. shall be provided to the workmen wherever necessary.

CGI sheets shall be stacked in not more than 100 bundles per stack built solidly. Corrugations of sheets in one stack shall run in the same direction. One end of the stack shall be raised by at least 100 mm to drain accumulated water, if any. Sheets not for immediate use shall be stacked under roof.

Plywood, fiber board, particle board, block board etc. shall be stacked on a flat dunnage on top of which a wooden frame shall be constructed with battens of suitable size in such a way that it supports all four corners and edges of the boards. For boards up to a length of 2 m, minimum of one intermediate batten and for boards longer than 2 m, at least two intermediate battens shall be provided to avoid warping.

Decorative plywood and laminated and decorative boards shall be stacked in pairs facing each other. Sheets shall not be dragged one over another.

Specification laid out in BDS 1159 shall be followed for packaging of plywood, particle board, hard board and flush doors.

2.2.3.10 Cast Iron, Galvanized Iron and Asbestos Cement Pipes and Fittings

The pipes shall be unloaded where they are required, when the trenches are ready to receive them. Storage shall be provided at the bottom layer to keep the stack stable. The stack shall be in pyramid shape or the pipes placed length-wise and cross-wise in alternate layers. The pyramid stack is advisable in smaller diameter pipes for conserving space in storing them. The height of the stack shall not exceed 1.5 m. Each stack shall contain only pipes of the same class and size. Each stack shall contain only pipes of same class and size, with consignment or batch number marked on it with particulars or suppliers wherever possible. Cast iron detachable joints and fittings shall be stacked under cover and separated from the asbestos cement pipes and fittings. Rubber rings shall be kept clean, away from grease, oil, heat and light.

Pipes in the top layer shall be handled first. At a time only one pipe shall be handled by two laborers while conveying to the actual site and shall be carried on shoulders. Fittings shall be handled individually.

2.2.3.11 Glass Sheets

All glass sheets shall be kept dry and stored in a covered space. Glass sheets shall be lifted and stored upright on their long edges and put into stacks of not more than 25 sheets. They shall be supported at two points at about 300 mm from each end by fillets of wood.

The bottom of each stack shall be about 25 mm clear from the base of the wall and other support against which the stack rests. The whole stack shall be as close to upright as possible. Smooth floors shall be covered with gunny bags.

Workmen handling glass sheets, remnants and waste glass pieces, and fibre glass shall be provided with gloves, jelly and other suitable hand protections. In removing glass sheets from crates, great care shall be taken to avoid damages from breakage. Glass edges shall be covered or protected to prevent injuries to workmen.

2.2.4 Inflammable and/or Fire-Sensitive Materials

Materials under this classification shall be stored within fire-preventive confines, furnished with fire fighting provisions. Buckets containing sand shall be kept ready for use. A 5 kg dry powder fire extinguisher conforming to accepted standards shall be kept at an easily accessible position. Besides the areas shall be close to fire hydrants.

2.2.4.1 Plastic and Rubber sheets

Plastic and rubber sheets shall be stored within fire proof confines according to manufacturer's instructions. Sheets shall be stored in the coolest of the store rooms available. The room shall be well ventilated and kept dark; direct sun light shall not be allowed to fall on the stored sheets.

The sheets shall be stored away from electric generators, electric motors, switchgears and other such electrical equipment.

Contamination of the sheets with vegetable and mineral oil, grease, organic solvents, acid and their fumes, alkalis, dust and grit shall be prevented. All greasy contamination shall be removed immediately with kerosene or similar liquid, and the sheets thoroughly wiped dry and dusted with French chalk.

Undue stretch and strain, kinks, sharp bends or folds of the sheets shall be avoided in case of long time storage. The sheets shall be turned over periodically and treated with fresh chalk.

In addition, safety precautions common for all types of sheets, as laid down in Sec 2.2.3.9, shall be followed.

2.2.4.2 Paints, Varnishes, Thinners, Bitumen and Road Tar

Paints, varnishes, lacquers, thinners and other inflammable materials shall be kept in properly sealed or closed containers. The containers shall be kept in a well ventilated location, free from excessive heat, smoke, sparks or flame. The floor of the paint store shall have 100 mm thick loose sand on it.

Paint materials in quantities other than required for daily use shall be kept stocked in the regular storage place. The manner of storage shall facilitate removal and use of lots in the same order in which they are received.

Temporary electrical wiring and fittings shall not be installed in the paint store. When electric lights, switches or electrical equipment are necessary to be stored or used in the same room, the room shall be designed in a way to reduce explosion risk.

Sources of ignition, such as open flame and exposed heating elements, shall not be permitted in paint store, nor shall smoking be allowed there.

Drums or containers containing bitumen, road tar, asphalt, etc. shall be stacked vertically on their bottoms in up to 3 tiers. Leaky drums shall be either totally removed or separated. Empty drums shall be stored in pyramidal stacks neatly in rows.

Bituminous roofing felts shall be stored away from other combustible or flammable materials. They shall be handled gently to prevent cracking and damages.

Workers engaged on jobs involving handling of hot bitumen, tar, and bituminous mixtures shall use protective wears, such as boots and gloves, preferably of asbestos or otherwise of rubber, goggles and helmet. No workers shall be permitted to handle such materials without wearing the needed protective covering.

Bitumen/tar shall not be heated beyond the temperature recommended by the manufacturer of the product. While discharging heated binder from the boiler, workers shall not stand opposite to the jet so as to avoid the possibility of hot binder falling on them. The container shall be handled only after closing the control valve. While handling hot bitumen/tar, workers shall exercise scrupulous care to prevent accidental spillage thereof. The buckets and cans in which the hot material is carried from boiler shall be checked before use to ensure that they are intact and safe. Mops and other applicators contaminated with bituminous materials shall not be stored inside buildings.

Outdoor storage of drums containing flammable materials like hydraulic brake and transmission fluid, gasoline and lubricants shall be such that contamination from moisture and dirt is avoided.

The storage shall be free of spilled products, debris and other hazardous material.

Compressed gases and petroleum products shall not be stored in the same building or close to each other. Proper identification by markings, tags etc. shall be used for petroleum products delivered to the job site and stored there in drums.

Highly flammable liquids shall be stored in fire resisting containers in a special store room secluded from the main working site. For uses of up to 50 litres, liquids can be stored in the workroom in fire resistant cupboards or bins. Stores of liquids shall be clearly marked highly flammable. All empty containers shall be returned to the store.

The workmen shall dispose off any clothing or apparel spilled over by or soaked in flammable materials immediately. They shall not be allowed to continue work unless affected clothing and apparels are changed.

2.2.5 Hazardous Materials

Materials under this category are (a) those posing health hazard through breathing, such as asbestos, glass fibre, etc. or injurious and/or intoxicating fluids of various kinds, (b) materials corrosive to living bodies and (c) materials likely to explode under heat or pressure. These should be stored in a manner specific to its properties, so as to prevent hazards of all kinds.

2.2.5.1 Asbestos-based Materials

Whenever possible, materials which do not contain asbestos shall be used. Special precautions as specified by the following subsections shall be taken while handling asbestos containing materials to minimize the risk of inhaling asbestos. Handling shall be limited to as few workers as possible.

a) Handling of Asbestos-based Materials:

When cutting, sawing or machining takes place in confined place efficient local dust extraction equipment shall be installed. Alternatively, a wet method of machining by water type dust suppressed powered tools shall be used.

The best standards of good housekeeping and hygiene shall apply to cutting areas which shall be segregated and used for no other purpose. Waste materials and dust shall not be allowed to accumulate in working area or store.

A vacuum cleaning device with a high efficiency filter shall be used to keep floors, walls and fixtures free from dust accumulation. Alternatively all surfaces shall be cleaned with a wet rag and floors washed by gently spraying water. Dry sweeping or compressed air blowing shall never be used.

Asbestos insulation boards shall preferably be supplied precut and drilled from the workshop using a suitable dust control equipment. On-site preparations shall be performed in the open.

Polyethylene sheet shall be used to screen a work area in an enclosed space. Only authorized workers shall be allowed access to such areas. Appropriate signs shall mark an asbestos working area and warn against inhaling asbestos dust.

A guillotine or knife die cutter shall be used to cut sheets. The use of hammer and chisel shall be avoided.

At the end of each work shift, dust shall be either collected by a vacuum cleaner or swept up after being wetted. The dust shall then be put into a sealable container. Any rejected material shall also be placed in an impermeable bag.

b) Removal and disposal Asbestos-based Materials:

Spray method shall be used for removal of asbestos-based materials which is not covered or coated by other materials. For removing thick asbestos-based materials, soaking method with total saturation shall be used. Dry method shall only be used where the spray or soaking method cannot be used.

All moveable furniture and fittings shall be removed from the work area and other nonremovable items covered with plastic sheets. Air conditioning systems shall either be isolated from the asbestos removal area or closed down.

Before removal or stripping the asbestos, insulation coatings shall be thoroughly soaked with water or steam. In case of dry demolition of asbestos, a portable exhaust extraction plant shall be used.

Transport and storage containers shall be labeled of the contents. Waste shall be kept in strong enclosed containers or in strong sealed impervious bags. These shall not be overfilled; care shall be taken to avoid damage or spillage before disposal.

The filter bags used in a dust extracting system shall be impermeable and capable of being readily sealed and disposed off without further treatment.

c) Protective Clothing and Equipment:

Workmen engaged in works using asbestos-based material, shall wear a full body coveralls with pockets, and close fitted cuffs and necks together with a head cover. Protective clothing shall also be worn by all persons in an area into which asbestos dust is liable to escape.

The clothing shall be made of synthetic fiber. Wet weather overalls which can be hosed down may be used.

The use of suitable working clothing shall not be necessary when minor handling of asbestos containing insulation is carried out provided adequate dust control techniques are employed.

Whenever, work methods create asbestos dust, suitable protective respirator shall be used.

Respiratory protective equipment shall be properly maintained and regularly cleaned and serviced.

Every person required to use protective equipment shall be fully instructed and trained in its use.

Protective clothing and equipment shall be regarded as the means of last resort and used as a back-up of other techniques, or where effective asbestos dust control cannot be achieved by other means.

d) Personal Hygiene:

Changing room and shower facilities shall be provided for the exclusive use of persons working in an asbestos working area. Locker accommodation shall be provided for every person required to wear respirators and coveralls.

Lockers for work clothes shall be separated from others. Contaminated clothing shall be placed in a dustproof container immediately on removal. Contaminated clothing or belongings shall not be shaken or brushed. These shall be superficially cleaned by vacuum cleaning or hosing down with water.

Food and drinks shall not be handled, stored or consumed in the asbestos work area. Smoking shall be prohibited.

Workmen shall take shower before changing back into their own clothing; work clothing shall not be taken home. Parts of the body exposed to asbestos dust shall be thoroughly washed after completion of the job or before taking any meal.

Asbestos workers shall have a full size chest X-ray before commencement of work and also yearly. The reports shall be kept properly by the contractor for ready reference.

2.2.5.2 Acids and Other Corrosive Materials Working with Acid/Chemicals

When working with acids, bases, or other chemicals, one shall wear the proper clothing. The following are the five clothing items that shall be used while working with chemicals.

- a) Safety glasses/goggles: Should completely cover your eye at all times.
- b) Safety face shield: Wear over the top of any safety glasses or goggles.
- c) Full-length acid smock: Wear over the clean-room clothing.
- d) Rubber gloves: Wear with a two-inch cuff. This prevents acid from running down your arm. Also, inflate with nitrogen and submerge in water to check for pinhole leaks before using.
- e) Hard leather or other non-porous shoes

2.2.5.2.1 Transporting Acid/Chemical

The acid/chemicals used in work shall be stored in glass or plastic bottles. Transport of these chemicals shall be made by hand in a rubber or plastic bucket. If the bottle breaks or the lid leaks, the chemical will be contained in the bucket.

While transporting Acid/Chemical following rules shall be followed:

a) **DO**

Use the appropriate size container for the job.

Get help when needed.

Clean containers after use with deionized water.

Work under a fume hood

Use a funnel when pouring chemicals into a small container.

Open bottles slowly to avoid spilling and allow vapors to escape.

Know what type of reactions to expect.

Remember to triple-A (AAA): Always Add Acid to water.

b) **DON'T**

Reuse containers (adverse chemical reaction may occur).

Eat, drink, smoke, or touch any body part before washing your hands when working with chemicals.

Be afraid to ask questions.

Pour leftover chemicals back in its source container, contamination may result.

Put your face close to the bottle when pouring.

Puncture cap or lid of any bottle.

2.2.5.2.2 Storage of Acid/Chemical

Proper storage of the acid/chemicals will ensure everyone's safety. Therefore when storing acid/chemical the following care shall be taken:

- a) Store acids and bases in separate cabinets.
- b) Keep acids and solvents in different cabinets.
- c) Label shelves for quick chemical identification.
- d) Make sure that incompatibles are not stored on the same shelf.
- e) Keep same shaped bottles on the same shelf to conserve shelf space.
- f) Never store chemical containers anywhere except in designated cabinets.

When need to use the acid/chemicals:

- a) Take the oldest container whose shelf life has not expired.
- b) Make sure the container is sealed when you return it.
- c) Always return the container to its labeled shelf.

2.2.5.3 Explosives

- a) Transportation of Explosive:

Loading, unloading and handling of explosives will be supervised by competent personnel. The safety provisions of Chapter 4, Sec 4.1 and Sec 4.3 also apply for the present case.

Where the magazine is located near the construction site and blasting operations continue daily, actual requirements of explosives shall be issued from the magazine and transported to the site.

Any leftovers shall be returned to the magazine after every use.

For carrying up to 5 kg of explosives, insulated containers constructed of minimum 50 mm thick finished wood or 6 mm thick plastic or 10 mm thick pressed fiber shall be used. The containers shall have no metal parts, be waterproof and provided with a lid and nonconductive carrying device.

Vehicles transporting explosives shall have a wooden or nonsparking metal floor with high sides and ends. In open-bodied vehicles, the explosives shall be covered with a waterproof and fire-resistant tarpaulin. Electric wiring in vehicle shall be fully insulated. The nature of cargo in the vehicle shall be properly indicated on its body.

Metal, flammable, or corrosive substances shall not be transported with explosives. Explosive and detonators or blasting caps shall not be transported in the same vehicle; they shall be transported in original containers or in securely locked separate nonmetallic containers.

Smoking shall be prohibited in the vehicle carrying explosives.

- b) Storage of Explosives:

Explosives shall only be stored in remote and isolated structures of substantial construction and blast-release isolated yards. The storage area shall be clean, dry, well ventilated, and cool. The material shall not be stored near oil, gasoline, cleaning solutions, radiators, steam pipes, or other sources of heat.

Storage shall require bullet and fire-resistant magazine. Blasting caps or primers shall not be stored with explosives.

Smoking, matches, fire or flame shall not be allowed near a magazine. No leaves, grass, bush or debris shall be allowed to accumulate within 8 m of an explosive magazine. No sparking metal or tools shall be stored in a magazine. Persons shall put off shoes with metal nails before entering a magazine.

If nitroglycerine leaks down on the floor, the floor shall be immediately desensitized by washing thoroughly with an agent obtained beforehand from the supplier of the explosives.

c) Handling of Explosives:

No package containing explosives shall be dragged, dropped or handled roughly. These shall be opened only at a safe distance and properly shielded from the packages of explosives in bulk storage. The covers of the explosive cases or packages shall be replaced every time after taking out part of the contents.

Sparking metal tools shall not be used to open kegs or cases of explosives. Smoking or carrying matches, fire, flame or devices capable of producing fire or flame, shall not be permitted while handling or using explosives. Explosives shall not be carried in the pockets of any clothing or on any person.

d) Disposal of Explosives:

No explosives shall be abandoned. They shall be disposed off in accordance with the approved methods; manufacturers or the appropriate authority shall be consulted in this matter.

Explosives caps or packing shall not be left lying around. Paper or fiber materials used in packing explosives shall not be put in any subsequent use. Such materials shall be destroyed by burning.

2.3 MISCELLANEOUS

Small articles like screws, bolts, nuts, door and window fittings, polishing stones, protective clothing, spare parts of machinery, linings, packing, water supply and sanitary fittings, and electrical fittings, insulation board. etc. shall be kept in suitable and properly protected containers, boxes or store rooms.

Valuable small materials shall be kept under lock and key.

Polymeric materials such as coating, sheeting, reflective surfacing/sheeting, etc shall be stored as per the manufacturers' instructions. Special precautions shall be taken in case of storage, handling and usage of toxic materials.

2.4 SPECIAL CONSIDERATIONS

Materials constantly in use shall be relatively nearer the place of use.

Heavy units like precast concrete members shall be stacked near the hoist or the ramp.

Materials which normally deteriorate during storage shall be kept constantly moving, by replacing old materials with fresh stocks. Freshly arrived materials shall never be placed over materials which had arrived earlier.

Appropriate types of fire extinguishers shall be provided at open sites where combustible materials are stored and for each storage shed room where flammable/combustible materials are stored. For guidance regarding selection of the appropriate types of fire extinguishers reference may be made to good practice. It is desirable that a minimum of two extinguishers are provided at each such location.

Workers handling excavated earth from foundation, particularly if the site happens to be reclaimed area or marshy area or any other infected area, shall be protected against infection affecting their exposed body portions.

2.5 LOADING AND UNLOADING OF MATERIALS

a) Loading and Unloading Rail Road Wagons and Motor Vehicles

Each workman shall be instructed for the proper method of loading and unloading from rail wagons and motor vehicles, and provided with necessary equipment for safety. Supervisors shall ensure that the required number of workmen based on the weight and the distance involved in each job is available and engaged for the particular job.

Warning signals shall be displayed to indicate that the rail-wagons must not be coupled or moved while loading and unloading are carried out. The wheels of wagons and vehicles shall always be sprigged or chained while these are being unloaded; brakes alone shall not be relied upon.

Special lever bars, rather than ordinary crowbars, shall be used for moving rail wagons. Where gangplanks are used, either cleats at lower end of gangplank or pin through end of gangplanks shall be used to prevent sliding and slipping. If the gangplank is on a slope, cleats or abrasive surface shall be provided for the entire length.

When rail road wagons and motor vehicles are being loaded or unloaded near passageways or walkways, adequate warning signals shall be placed on each end of the way.

b) Manual Handling

Loading and unloading of heavy items shall be done with cranes or gantries, if available. The workmen shall stand clear of the path of the material being moved by mechanical equipment. The slings and the ropes used shall be of adequate load carrying capacity.

For loading heavy and long components manually into motor vehicles, rail wagons, trailer etc., either wooden sleepers or steel rails of sufficient length and properly secured in position shall be put against the body of the wagon/vehicle at three or four places. The slope of such makeshift ramp shall be less than 30° with horizontal.

Long items shall be dragged, one by one, gently and uniformly along the ramps by means of ropes (tag). Workmen pulling long items shall anchor their feet against a firm surface.

Loaded items may be shifted by crowbars and other suitable leverage mechanism in their right position. These shall not be pushed or moved by hand. Similar procedures as outlined above shall be followed for manual unloading of long or heavy items.

For regular and frequent handling, the maximum load a single workman is subject to carry shall be limited to 20 kg. Workmen to carry heavier loads shall be specially selected, and if necessary, trained.

While lifting a load, the body shall be kept upright; weight shall be distributed evenly and supported on the bone structure, and held close to the body. Advantage shall be taken of any device provided for assistance.