UNIT-4 Site Organisation

Learning Outcomes

By the end of this unit the learner will be able to:

- ✓ Explain the importance of having a proper site layout plan for construction project.
- ✓ Describe procedures involved in site organisation.

Unit 4

Site Organisation

Introduction

If the construction is to be carried out in an efficient manner, careful consideration is to be given to site organisation immediately after site selection process.

The aim of a site organisation exercise is to produce a layout that is logical, orderly and above all practical. Site layout plan should show the proposed locations of all facilities, accommodation and plant to secure optimum economy, efficiency, and safety during construction. A tidy site is the outward symbol of an efficient organisation. The main items that must be considered in the site organisation are access to site including site, roads, site accommodation for office, personnel and labour, storage of materials, plants and movement of plant, site electricity, lighting, and protection.

Access to Site and Site Roads

Access to Site

Access to site would normally be described in the contract. If the site has more than one point of access, each entrance should be identified by either a letter or number and instructions carefully displayed as to where visitors and material deliveries should be reported on arrival. To facilitate on-off movement of the site traffic, a system of exit and entrance only gates can be of advantage.

Access to firefighting equipment vehicles shall be provided to the construction site at the start of the construction and maintained until all construction work is completed. Free access from the street to fire hydrant/static water tanks, where available shall be provided and maintained at all times. No materials for construction shall be placed ,with in 3 m of hydrant/static water tanks. Free access to permanent, temporary or portable first-aid and fire-fighting equipment shall be maintained at all times.

Site Roads

The movement of plant on a site must be planned for the efficient and economic operation of the machines. This is particularly so when siting haulage roads to spoil tips. The decision on what type of roads are to be used, (for example, rough access, water bound or bitumen sprayed), will depend upon the type of plant that is to be used, the ground conditions of the site and the cost-effectiveness.

For example, if the first two points are considered, tracked vehicles, fitted with grips cannot pass continuously over water-bound or bitumen sprayed roads, as the grips on the tracks will destroy the surface. Heavy plant on flat tracks, such as diggers, cannot pass over soft or hard ground without seriously damaging the surface.

Generally, rough access roads are used by on-site traffic and water bound or bitumen sprayed roads for on-off site traffic. These roads should be maintained to prevent the breaking up of the haunches and ditches and potholes occurring, that could damage wheeled vehicles. The layout of site roads should

provide for a smooth movement of all site traffic with an economy of distance. Where Off-site vehicles, cross over or use on site vehicle roads, warning signs must be posted or be supervised for reasons of safety.

Site Organisation

Drainage systems can be one of the higher cost items in site organisation and special assistance from an engineer may be required.

The design of a drainage system is based on the amount of rainfall to be carried away at a given time. Runoff is that portion of precipitation which finds its way into natural or artificial channels either as surface flow during the storm period or as subsurface flow after the storm has subsided.

Subsurface Drainage

Subsurface drainage involves the control and removal of soil moisture. Subsurface drainage is concerned with

- carrying water away from impervious soils, clay, and rock,
- preventing seepage of water through foundation walls and lowering water tables for low flat land,
- removing surface runoff in combination with underground drainage.

Subsurface drainage may be accomplished by providing a horizontal passage in the subsoil which collects gravitational water and carries it to the outlets. Subsurface drain lines either have open joints or employ perforated pipe. Flow into subsurface drains is affected by soil permeability, depth of drain below soil surface, size and number of openings into the drain, drain spacing, and diameter.

Site Accommodation

Tile site accommodation requirements can be classified into administrative offices for contractor and engineer-in-charge, retiring rooms for workers, and at remote sites temporary housing accommodation for workers. The activities and the temporary nature of the site do not generally justify the provision of permanent buildings for staff accommodation or for the storage of materials. It is however, within the builders interest to provide the best facilities which are economically possible for any particular contract; this should promote good relationship between management and staff, it should also reduce the loss of materials due to theft, accidental damage and vandalism. Provision of better facilities and amenities on a site for staff, will ultimately lead to higher productivity.

Siting of Administrative Office

Site office accommodation varies depending on the size of the site and nature of work. As a rough guide, the site office of a construction unit employing 300 labourers needs a gross floor area of about. 150 sq m, while an operation employing 1000 to 1500 labourers needs 200 to 300 sq m.

The contractor's main office and the general storage buildings for site equipment should be located near the main entrance to the site. As all file materials being delivered to the site must be checked on arrival, file store keepers office must be at the main entrance. Care must be taken to avoid obstructing file entrance to the other vehicles while checking is carried out. For good communications it is wise to establish me resident engineer's office close to the contractor's office. If room allows, the sub-contractors office could also be ill this location. This will lead to economy in providing such services as telephones, heating, lighting, cleaning etc.

By following these points an administration area will be logically situated around the main entrance to the site thereby decreasing the number of persons walking or driving around the construction areas. Where feasible, the contractor's and resident engineer 's stress should be positioned to allow the overall view of the site from their windows including the main entrance point.

Types of Construction

The anticipated use of each unit of accommodation will govern the construction and facilities required. Offices should contain artificial lighting, desks, work tops and chairs cash chests, toilet, meals room etc. The following materials of construction are usually adopted :

a) masonry walls and thatched roof/GI/Asbestos sheets
b) timer huts and
c) mobile caravans or cabins.

Masonry walls are normally constructed with mud mortar or lean lime mortar to facilitate easy dismantling of wall. Timber huts are prefabricated to allow for ease of dismantling and assembly to facilitate the reuse on other sites. Caravans and mobile cabins are made of ply clad timber frame suitably insulated and decorated and are fully equipped with all necessary furniture, light, HVAC units if necessary. Toilets are with all necessary sanitary fittings and plumbing which call be connected to 'site services or be self-contained. While caravans can be towed, the cabins require special transporter trailers. The initial cost is higher when compared to masonry and timber huts, but can be installed faster

Temporary Housing for Labourers

If migrant labourers have to be employed, because a sufficient labour supply cannot be recruited within walking distance of the project, the site engineer must make provisions for the transportation and/or housing of the migrants. This may significantly increases the cost and may also generate administrative and social problems.

A policy of encouraging migrant labourers to bring their families generally improves social relations between the camp and the neighbouring area during the construction work. Such a policy, however, may make the migrant labourers more likely to settle in the project area after the construction work is completed. Unless the project location contributes continuous construction activities, permanent settlement of the migrant workers could create conflicts with the local population.

The site engineer should keep the following points in mind when siting labour camps :

a) Camps should be on high, well drained ground
b) Camps should be within walking distance of the work site but well separated from it (200 m min). Where the location of the work is likely to move more than 2 or 3 km during the season (For example, road/pipe/canal works), the siting of camps must be planned to avoid unnecessarily long walks and to ensure that the periods when walking distance are greatest do not coincide with the times when the work is most arduous, such as during the heat of file summer.
c) As a rule, the floor area of 5 sq m per person should be allowed.
d) Camps should be located away from villages in order to avoid clashes between workers and the local people. On irrigation project expected to increase agriculture, there may be some value in siting camps so as to form the nuclei of new villages.

Essential Facilities

a) First Aid : First aid boxes to be clearly marked and persons should be trained in first aid procedures.
b) All persons should be provided with meals room sanitary and washing facilities. Rest room and clothing room shall also be provided in large construction sites.
c) FirePrecaution/Protection/Prevention:Temporarybuildingsforoffice, accommodation and storage shall be so located as to cause the minimum fire hazard and shall be constructed from non-combustible materials as far as possible.

Temporary Services

It is the contractor's duty to arrange the supply of temporary services such as telephones, electricity and sanitation. Consideration must also be given to file diversion, due to the contract, of any existing service lines. It is usual for the engineer-in-charge to supply the contractor with the detailed information to locate the services in question, and contact the concerned departments, viz. telecommunication, water supply, sewage disposal, and electricity authorities etc. It will also be necessary to arrange who will be responsible for the diverting of any services, i.e. the contractor or the authority concerned.

Storage for Materials

The objective of proper storage and stacking of materials is to prevent deterioration or intrusion of foreign matter and ensure preservation of their quality and fitness for the work. The type of storage facilities required of any particular material will depend upon durability requirements and vulnerability to damage or theft. It is essential that the material are not allowed' to deteriorate after being delivered to the site. As a general rule, position the storage of materials so as to avoid double handling and awkward access for delivery trucks.

The materials shall be segregated as to type, size and length and placed in neat, orderly piles that are safe against falling. If piles are high, they shall be stepped back at suitable intervals in height as not to constitute a hazard to passerby. Efforts must be periodically taken, to keep the stairways, passageways and gang-

ways free from obstructions by storage of construction materials, tools or rubbish. When the piles/stacks are closer to the passageway, warning signs must be kept in daytime and red lights on and around them at nights. To facilitate inspection and removal of the materials, the piles of materials are to be arranged so as to allow a passageway of not less than 1 m width in between the piles or stacks. The passageway must be kept clear of dry vegetation. The materials shall be stored on well drained, firm and unyielding surface. Ensure that file stacked material shall not cause any undue stressed on walls or other structures. Since timber, coal, paints and similar materials present fire hazard, to provide protection against fire, these materials are to be segregated from each other so that the fire spread can be minimised.

When stacking of materials is to be done on road side berms in the street and other public places, permission to be sought from the local authority and the remnants of the same should be removed after the construction is over, so as to avoid any hazard to the public. The special care that needs to be taken in organising storage of various construction materials are discussed in subsequent paragraphs.

Cement

Cement is usually delivered to the site in 50 kg bags. Storage for cement is to be provided in a building or a shed which is dry, leak proof and as moist proof as possible. The building should be free from draughts which can bring in moist air and may cause an air set of material (hardening) and hence they must be kept in a well-ventilated building to protect them from dampness.

Cement should not be stored directly on the ground, as it would soon become damp. Cement bags shall be stacked off the floor on wooden planks in such a way as to keep them 150 to 200 mm clear from the floor and leave a minimum space of 450 mm around between exterior walls and the stacks. To minimise the circulation of air within a stack, the cement bags shall be placed close together.

As cement should not be stored for long periods on site, the manager of storage should facilitate rotational use so that the material being used comes from the older stock (i.e. cement received and removed and used more or less in the order in which they are received). Alternatively, the deliveries can be planned such that the cement is not subjected to prolonged storage. Width of a stack is to be restricted to 4 bags length or 3 m, and to prevent the possibility of lumping up under pressure, restrict the height of stack to 15 bags.

In humid climate cement should not be stored for more than two months before use. In dry areas it is wise to provide enough storage for a complete season's cement requirements, if delays are anticipated in deliveries. Storage during monsoon or in humid areas or when the cement is expected to be stored for a longer period, the stack shall be enclosed completely with water proofing membrane. To give an idea of area requirements, a room of 40 sq m area and of 2.5 m height accommodates 50 tonne of cement, allowing for air circulation around waifs.

Lime

Quicklime before Slaking .' Quicklime should be slaked as soon as possible, If unavoidable, it may be stored in compact heaps on a suitable platform having only minimum exposed area, and covered to avoid direct contact with rain or being blown away by wind. When quicklime is stored in a shed, a minimum space of 300 mm

around the heaps should be provided to avoid bulging of walls, Unslaked lime shall be stored in a place inaccessible to water and shall be segregated from combustible materials to prevent fire hazards.

Hydrated Lime : As hydrated lime is normally supplied in jute bags lined with Polyethylene or high density polyethylene woven bags lined with polyethylene or craft Paper, it should be stored in a shed/building and protect them from dampness and to minimise the warehouse deterioration.

Dry *Slaked Lime* :'If the lime is proposed to be used within a few days it may be stored on a platform suitably covered for protection from rain and wind. In case of anticipated longer storage, it may be kept in a dry and closed shed/building.

Masonry Units

The bricks shall not be dumped at site. Bricks of different types have to be stacked separately such mat double handling is reduced to a minimum. To minimize breakage and defacement of bricks, they shall be stacked on dry firm ground in regular tiers directly as they are unloaded. To facilitate proper inspection of quality and ease of counting, the bricks shall be stacked on edge with the stack is 5b bricks long, 10 bricks high, and 2 bricks wide. A clear distance of 0.80 m between stacks shall be maintained. To prevent discolouration of facing bricks tarpaulin or Polythene sheet cover shall be provided.

Aggregates

Fine and coarse aggregates shall be stored on a hard dry and level patch of ground If such a surface is not available, a platform of planks or old corrugated iron sheets or a floor of bricks or a minimum layer of lean concrete shall be made to falls so as to ensure that the aggregates do not become contaminated with lay, dust, vegetation, and other foreign matter. Stacks of fine and coarse aggregates shall be kept in separate stocking sufficiently removed from each other or shall be kept in separate stockpiles sufficiently removed from each other or separated by dividing walls to prevent getting intermixed. Fine aggregate shall be stacked in a place where the loss due to the effect of wind is minimised.

If the project requires coarse aggregate to be delivered in a larger number of different sizes, viz. 40, 20 and 10 mm depending on the use required on site, the aggregates shall be kept separately on the site by providing division walls each size being clearly labeled. It must be ensured, by careful supervision, that the stock piles are not used as a rubbish tip.

Fly ash

Flyash shall be storied in such a manner as to permit easy access for proper inspection and identification of each consignment. Storage provision for bulk qualities of flyash is similar to that of fine aggregate. When flyash is supplied in bags, file maximum height of stack shall be restricted to 15 bags high.

Timber

Timber is a hygroscopic material and therefore to prevent induce moisture movement it should be stored in such a manner that its moisture content remains fairly constant. Timber shall be stored in stacks upon well treated and even surface beams, sleepers or brick pillars so as to be above the ground level by at least

150 mm to ensure that the timber will not be affected by accumulation of water under it. Various members shall preferably be stored separately in different lengths, and materials of equal lengths shall be piled together in layers with wooden battens (crossers - made of sound wood, straight and uniform in thickness) which separates one layer from another. The crossers shall be placed in each layer in vertical alignment. Where crossers are not available, smaller sections of available structural timber itself may be employed. In any layer, an air space of about 25 mm shall be provided between adjacent members. The longer pieces shall be placed in the bottom layers and the shorter pieces in the top layers but one end of the stack shall be in true vertical alignment. The commonly recommended width and height of stack is about 1 .5 m and 2.0 m respectively. Distance between adjacent stacks is recommended to be at least 450 mm. Alternatively, a rack of scaffold tubular with a sheet roof covering makes an ideal timber store. In case of stacking with battens are not possible, the timber shall be stored on raised foundations, close piled in heaps satisfying the above height, width and spacing requirements.

The stacks shall be protected from hot dry winds or direct sun and rain. Heavy weights such as metal rails or large sections of wood shall be placed on top of the stack to prevent distortion or warping of me timber in stacks, In case timber is to be stored for a year or more, to prevent end cracking in the material, the ends of all members shall be coated with coaltar or aluminum leaf paints or microcrystalline wax.

Structural and Reinforcing Steel

Steel shall be stored in a way as to prevent distortion and corrosion, To prevent scaling and rusting, it is a desirable practice to coat the steel with cement wash before staking. To facilitate issue in sizes and lengths as to minimise wastage in cut from standard lengths, bars of different classification, sizes and lengths shall be stored separately. Structural steel shall be stored above ground level by at least 150 mm upon platforms, by earmarking separate areas for each classification of steel, Ends of bars and sections of each class shall be painted with separate nominated colours for easy identification.

Doors, Windows and Ventilators

Metal doors, windows and ventilators shall be stacked in upright (on their sills) on level ground preferably on wooden battens without coming in contact with dirt or ashes When received in crates, they shall be stacked as per manufacturer's instructions and removed from crates only as and when required. Metal frames shall be stacked upside down with the kick plates at me top. These shall not be allowed to be stored for long periods to avoid getting out of shape and hinges being strained and shutters drooping. Aluminum frames and shutters shall be protected from loose cement mid mortar by suitable tarpaulin coverings supported on temporary framing to permit circulation of air to prevent moisture condensation.

Wooden frames and shutters shall be stored in a dry and clean covered space away from infestation Frames shall be stacked one over the other in vertical stacks with cross battens at regular distance to keep the stack straight. Shutters shall be stacked one over the other, at least 80 mm from the ground on pallets or beams to ensure that (hey will not be affected by accumulation of water under them. The top of the stack shall be covered by a protective cover and weighed down by means of a suitably placed weights. Precast door and

window frames shall be stored in upright position adopting suitable measures against risk of subsidence of soil/support.

Roofing Materials

Asbestos Cem*ent Sheets:* Roofing sheets shall be stacked to a height of not more than 1 m on firm level ground, with timber or other packing beneath them. When stacked in exposed position, they shall be protected from damage by the winds. Damaged sheets shall not be stored with sound materials. All damaged sheets shall be salvaged as early as possible.

Corrugated Galvanised Iron sheets: CGI sheets shall be stacked in not more than 100 bundles per stack, built solidly with each bundle consisting of 10 sheets. Bundles shall be so laid that the corrugations run in the same direction in every course. One end of the stack shall be raised by 100 to 150 mm to allow water to flow freely. If the sheets are to be stored for a longer period, they shall be stacked under roof cover.

Tiles: Roof tiles have a greater resistance to load when it is imposed on file edge; hence the tiles shall be stacked on edge and in pairs, head to tail, to give protection to the nibs. An ideal tile stack would be five to seven rows high, with end tiles laid flat to provide an abutment. Tile fittings such as ridge and hip tiles shall be kept separately. Tiles of different quality, size and thickness shall be stored separately.

Boards

Gypsum Boards .. These shall be stored flat in a covered clean and dry place. Plywood, *Fibre Board, Particle Board, Block Board etc. :* These shall not be stored in open and exposed to direct sun and rain. The boards shall be stacked on a flat dunnage, on the top of which a wooden frame shall be constructed with battens of 50 x 25 mm in such a way that it supports all four edges and corners of the boards with intermediate battens placed at suitable intervals to avoid warping. If required, the stack shall be adequately raised above ground level to ensure that water does not get accumulated. Tile boards shall be stacked in a solid block in a clear vertical alignment with the top sheet suitably weighed down to prevent warping.

Plastic and Rubber Sheets

These shall be stored as per manufacturer's instructions, in the coolest room available having good ventilation without allowing direct light to fall on them. They shall be kept away from electric generators, motors and other electrical equipment that provide harmful gases which may damage the sheets. Contamination of the sheets with oils, greases, organic solvents, acids and fumes shall be prevented. Undue stretch and strain, kinks, sharp bends or folds or file sheets shall be avoided. In case of long storage, make space provisions to turn them over periodically.

Glass Sheets

Glass sheets shall be kept dry by providing suitable covered storage space. Tile glass sheets shall be stored on their long edges into stacks of 25 panes each supported at two points by fillets of wood at about 300 mm from each end. The Gust laid in each stack shall be so placed that, me bottom edge is 25 mm away from the base of

the wall or other support against which the stack rests. The whole stack shall he as close and as upright as possible. To prevent slipping on smooth floor, the floor shall he covered with gunny bags.

Asbestos Cement Pipes and Fittings

If the trenches are ready, the pipes shall be unloaded directly where they are required. When required to be stored, they are either stacked in pyramid shape or the Pipes placed lengthwise and crosswise in alternate layers. The pyramid shape storage is advisable in smaller diameter pipes for' conserving space in storing them, The height of the stack shall be limited to 1.5 m, Only pipes of file same class and size shall be stored in a stack. The cast iron detachable joints and fittings shall be stored under cover by separating them from asbestos cement pipes and fittings

Polyethylene Pipes

Black polyethylene pipes may be stored either under cover or in the open. Natural polyethylene pipes shall be provided with storage under to cover and also to be protected from direct sunlight. Storage of pipes in heated areas exceeding 27 C should be avoided. Straight lengths of pipes shall be stored horizontally in racks by giving continuous support to prevent the pipe taking a permanent set. Coils may be stored either on edge or by stacking flat one on top of the other.

Unplasticised PVC Pipes

Pipes should be stored on a reasonably flat surface free from stones and sharp projections so that the pipe is supported throughout the length. Storage in racks shall be avoided. Adequate support should be provided all file time. As stacking to large piles cause distortion of bottom pipes (lead to jointing problems), the stack height shall be restricted to 1.5 m. Sockets and spigots should be stacked in layers with sockets placed at alternate ends of the stack to avoid lopsided stacking. It is recommended not to store a pipe inside another pipe. Pipes of different diameters and classes shall be stored separately. In tropical climates, the pipes shall be stored under shade.

Pipes of Conducting Materials

Pipes shall be stacked in solid level sills and contain them in a manner to prevent spreading or rolling of the pipe. Suitable packing shall he placed between successive layers to reduce the pressure and resulting spreading of file pile. Following minimum safety distances from the overhead power lines shall be maintained while stacking of pipes and other conductive materials at site :

11 KV and below -- 1.4 m

above 11 KV and below 33 KV - 3.6 m

above 33 KV and below 132 KV - 4.7 m

Piling and Poles

Piling and poles shall be stacked on solid, level sill so as to prevent rolling or spreading of the stack. Tile storage area shall be maintained free of vegetation and flammable materials.

Paints, Varnishes and Thinners

As these are flammable materials, they shall be stored in sealed or closed containers and be kept in a well ventilated storage space, free from excessive heat, smoke, Sparks and flame. Loose Sand shall he laid for a depth of 100 mm on file floor of file paint storage area. Temporary electrical wiring should not be installed in paint store. When switches, electrical equipment are necessary, they shall be of explosion proof design. When the paint is likely to deteriorate with age, file manner of storage shall facilitate removal and use of lots in the same order in which they are received.

Bitumen, Tar and Asphalt

Drums or containers shall be stacked vertically on their bottoms in up to 3 tiers. Leaky drums shall be segregated. Empty drums shall be stored in pyramidal stacks neatly in rows. Bituminous roofing felts shall be stored away from other flammable materials.

Flammable Materials

Flammable materials shall be stored in conformity with relevant regulations. If stocks can be well secured, it is wise to keep several months fuel and oil requirements in anticipation of shortages. In remote areas where road communication is interrupted by periodic flood or snow, it may be necessary to stockpile supplies for one full season. Diesel fuel can be kept outdoors in drums in a locked compound,` but it is more safe in specially built store. Gasoline, either in tanks or in Jerry cans, must be kept inside a locked building.

Care shall be exercised on outdoor storage drums to avoid contamination, as moisture and dirt in hydraulic brake and transmission fluid, gasoline or lubricants may cause malfunction or failure of equipment, with possible danger to personnel. Storage area shall be kept .free of accumulation of spilled products, debris, and other hazards. Compressed gases and petroleum products shall not be stored in the same building close to each other.

Water

Water tanks of appropriate size shall be provided to store water for use in construction, curing and fire fighting purposes. Precautions have to be taken to eliminate organic impurities. The requirements and sources of water is discussed in detail in a subsequent section.

Sanitary Appliances

All sanitary appliances shall be stored under cover to prevent damage. Consideration shall be given, while accepting and storing appliances, to the sequence of removal from the store to the assembly positions. Vitreous fittings and metal ones shall be stored separately.

Storage for Equipment and Tools

The size and capacity of workshop facilities needed at the site depend not only upon the size of the project but also upon the distance from the nearest location where adequate commercial repair facilities are available. Where major maintenance and repair facilities are close at hand, site maintenance involves little more than greasing, changing of oil and filters and repair of tyres . Such works require a suitable set of tools

and a building with a concrete or brick floor. On a large project in a remote area, major maintenance and some repairs have to be carried out on site. Such work requires a frame for supporting lifting tackle to remove engines, an inspection pit; and machining, welding, and beat treatment facilities.

The equipment storage ground requires reasonably flat arid well drained ground. About 60 sq m per item of equipment should be allowed, more if the shape of the site makes manoeuvering difficult. A convenient plot is 25 m wide, allowing equipment to be stored in two rows, with manoeuvering space between. Space should also he provided for reversing of towed vehicles.

Plant Requirements and Movement of the Plants

In general terms, the location and working procedure of the plant movement should aim to minimise the repositioning of file machine, and maximize the coverage of area that the plant is required to operate over: This is particularly for cranes. Tower cranes, unless mounted on rails, derricks and cableways, should not have to be repositioned during a construction as file process is costly and, of course, during repositioning work, the crane will be out of action. Excavating plant, particularly on extended sites such as roads and air fields, should "work as they go" - for example, a scraper should start its run directed towards the spoil tip. Concreting plant should be positioned to give minimum delivery distance to the areas of the site that require the bulk of file concrete output. Construction plant and equipment is expensive to buy and hire, therefore careful planning is essential to ensure minimum idle time by deployment or transfer to another site. Plant utilization struts are required to be prepared to apply close control on use and maintenance, as well as its correct application, regular servicing and assessment of effectiveness.

Site Electricity

A supply of electricity is usually required on construction sites which are mainly outdoor electrical installations open to sky or partially covered, to provide fighting to the various units of accommodation and also to provide the power to drive small and large equipment and plants. These installations arc generally unprotected from environmental hazards as compared to installations in buildings. Also these require special consideration as they are characterised by frequent modifications. The major risk in the use of such installations arises from short circuit resulting in fire accidents and exposure to live wire resulting in shock. All installations shall be carried out in conformity with the requirements of Indian Electricity Rules (1956) as amended from time to time, which are detailed in the National Electrical Code of India, and also the relevant regulations of the electric supply authority concerned.

The following environmental conditions shall be given due consideration:

Ambient temperature, atmospheric humidify, altitude (solar radiation of harmful intensity and/or duration), presence of water (possibility of splashes or jet of water in any direction, partial or total covering of water - may affect external light fittings and site equipment), presence of foreign solid bodies (small objects and dust in large quantities), presence of flora and or would growth and fauna, presence of corrosive or polluting substances, impact (construction demolition opera(Ion), seismic effects, lightning (hazard form exposure of equipment) and wind.

All materials, fittings, equipment arid their accessories, appliances used in an electrical installation shall conform to Bureau of Indian Standards specifications wherever they exist. The work of electrical installations shall be carried out under the supervision of a person holding a certificate of competency issued by a recognised authority. The workmen shall also hold the appropriate certificate of competency. The requirements to be satisfied and the necessary precautions to be observed for such installations are discussed in subsequent paragraphs.

Supply Intake Arrangements

Two sources of electrical supply to the site are possible, viz. portable self-powered generators, and metered supply from the local area electricity board. As the supply of electricity is required finally for the building proposed to be constructed, the second source is usually adopted because it is generally possible to tap off the permanent supply cable to the proposed development for construction operations, thus saving the cost of laying a temporary supply cable to the site.

The portable self-powered generators are useful for smaller construction sites till obtaining temporary electric supply and serve as a standby in case of power failure. Such an application should indicate the maximum anticipated load demand in kW for the construction period.

Depending on the type and magnitude of construction site installation mid on the availability of spare capacity of me local area electricity distribution system, the supply intake arrangements could be through a High Voltage feeder/ a HV feeder and step down transformer/a service line at voltage below 250 V/ a tapping from one of me existing service connections. One construction site may be served by several sources of supply, including fixed or mobile power generators,

In case me loads at construction site is large and me power supply authority has no network in the vicinity of me temporary installation that could be utilised then it would be necessary to establish a temporary substation where the switch gear and transformer can be installed. The substation site shall be so selected that it is as close to the load centre as possible. The power supply authority's line should be brought up to the substation in a separate enclosure. If overhead line is to be laid up to the temporary substation, then the supporting poles, conductors, materials of the line, insulation arid the method of stringing me conductors and the mechanical strength of the line as a whole shall conform to the National Electrical Code.

The entire area where the temporary supply will be used, shall be indicated beforehand and in case me electric supply is required at me construction site for pipelines, then a drawing shall also be given to the electric supply authority. On this drawing various Points ,from where different appliances/equipment are intended to be used shall also be indicated.

Water for Construction

Sources of Water

Public Water Supply

The availability of public water supply in terms of required amount needs to be ascertained first, followed by tests on its quality to check its suitability for construction.

In case public water supply is not available or can not be used for construction, an alternate source of supply of water must be identified at the earliest. The next option is to check whether the ground water at the site itself can be made use of.

Ground Water

Rain water penetrating into the ground and escaping beyond the reach of vegetation and either collecting in underground basins or flowing underground subsurface streams constitutes a ground water source. As this water seeps down, comes in contact with organic and inorganic substances during its passage through the ground and acquires chemical characteristics representative of the strata passed through. When the quality of water is found suitable, tapping of ground water is done through different types of wells.

The wells are masonry shafts or tubewells inserted into the ground to tap the subsurface. The wells may be shallow or deep. Shallow wells may be of the dug well type sunk or built, the bored type or Ole driven type. Shallow wells are of utility in abstracting limited rates of yield from shallow pervious layer, overlying the first impermeable layer. Deep wells are taken into pervious layers below the first impermeable stratum, which can be sunk well type, Ole bored or the drilled type. Deep wells are of utility in abstracting comparatively larger supplies from different pervious layers below me first impervious layer. They yield a safer supply than shallow wells but generally contain more minerals.

Other Sources

If the ground water at the site is not found suitable for use in construction, then potential source of water supply shall be identified from a nearby location. The more of transport also shall be decided (lorries or pipelines). Provision shall be made at the site for storage of water.

Site Protection

Site selection and layout of facilities on a site can have a significant influence on the cost which an organization may have to pay for security or lack of it. Two financial benefits can usually be realized if effective security planning is done at an early stage. The first is the reduction in cost of losses that threaten every construction site regardless of size or type. Some examples of such losses are theft, terrorism, and sabotage. The second benefit that can be realized is a reduction in costs required to provide adequate security for the protection of assets and personnel.

The method of prevention of loss depends generally on where the site is situated and the types of Siteworks to undertaken. Large housing estate works to secure, while compact sites in the centre of towns require the minimum effort and cost to keep out intending trespassers, as the general public act responsibly when

intruders are seen at work. The following are some of file site protection measures adopted to prevent losses occurring on construction sites.

Types of Fencing

A construction site can be given a degree of protection by surrounding with a fence. The fence fulfills two functions, viz., defines the limit of the site or compound, and acts as a deterrent to the would be trespasser or thief . A fence can be constructed to provide physical barrier of solid construction or a visual barrier of open work construction. If the site is to be fenced as part of the contract it may be advantageous to carry out this work at the beginning of the site operations. Tile type of fencing chooses will depend upon the degree of security required, cost implications, type of reighbourhood and duration of contract. A security fence around the site or compound should be atleast 1.8 to 2 m high above the ground and include the minimum number of access points which should have a lockable barrier or gate.

Fencing Materials

The most widely used materials are timber, concrete, wrought iron, standard wire and chainlink. Standard wire used either with timber or concrete posts is a very inexpensive form of fencing and is therefore widely used on housing estates, but unfortunately has little aesthetic value. In this type of fence where the strands are in tension, straining posts must be introduced at ends and corners and ally long straight sections of fencing should have straining posts at least every 70 m. Other forms of wire fencing which give varying amounts of enclosure are woven wire and the popular chain link. These also require straining posts.

The concrete fence is generally heavy in appearance and lacks file weathering qualities of its natural timber counterpart. It is, however, durable and requires no maintenance. Concrete posts fixed at around 1.8 m spacing are linked by precast planks.

Timber offers the greatest variety of forms and effects to the designer, and being a natural material fits well with any landscaped layout. Timber fences range generally in height 1 to 2 m, centres of posts between 1.8 to 2.4 m depending on the type, and sections of posts between 75 x75 turn and 150 x 150 mm.

Posts can be fixed in several ways. Setting in concrete provides a very firm fixing, but tends to rot the timber at point of entry Alternatively the post call be driven into position. This method tends to damage the head and encourage the entry of water. Tile third method is to wedge the posts with large stones in a hole, placing more small stones around file base before back-filling and well ramming the surrounding area. This ensures good drainage around the base of file post. To increase the life of the post it is preferable to use hardwoods, wherever possible.
Whichever method of fixing is used, a fence or gate post should be ill proportion to its length of 1/4 below ground and 3/4 above ground, with a minimum of 450 mm below ground level. The most durable species of timber for use in fencing are Oak, Larch and Chestnut. Many other timbers call be quite adequate if treated at regular intervals. It is desirable to coat the post below ground with a tar material , thereby forming a water proof coating.

Capping of fencing posts and vertical members of fencing is desirable to protect the end grain and thus to

prolong the life of the fence. Where this is not possible, a weathering face should be formed to take water quickly away. Galvanized nails must always be used to avoid black stains.

Small Sites

Fences may he constructed in many different ways; the most common that gives at least basic security are chain link, close-boarded and wooden palisade that are capable of carrying barbed wire on top to give additional protection, if required. Steel palisade fences used to provide strong to maximum security are also in common use. Where a site is small the entire area may be encircled by means of the following fences :

Low Chestnut Paling or re Fence : It can be used to define the site boundary, and which highlights to all concerned the limits of pedestrian and vehicular rights of way, and prevents everything and everyone from straying on to the site by accident. It also has the added advantage of ensuring work people to remain on site. It keeps unwanted inquisitive individuals away from the work area, which is good from a safety point of view.

Chain Link Fence ; This is the most common type of fence used for security protection. For maximum security a fence needs to be around 2.4 m high to the top of tile chain link and 2.9 m to the top of the barbed wire above the chain link. Limit mesh size to 50 mm to prevent climbing with toes in mesh. Bury 300 mm of chain link in the ground, or thread hairpin staples through the bottom row of mesh and cast them into a concrete sill cast at ground level between posts to prevent borrowing and listing of bottom of chain link. To prevent bunching the lines of barbed wire together and getting over between the barbed wire and the top of the chain link, fit spacing bars to barbed wire and use chain link with barbed top. Use burr bolt ends over nuts to prevent dismantling. Use a bracing rail and diagonal reverse bracing instead of a strut to strengthen straining posts and to prevent climbing straining posts.

High wire (Chain link) or close boarded fence with barbed wire fixed at the top which not only defines the boundary of the site, but prevents anyone from gaining access without some vigorous effort. Close boarding has the advantage of minimising the nuisances of dust and noise to the surrounding building occupiers. Doors/gates and locks should be commensurate in strength with the boundary fences or hoards in which they are used.

Steel Palisade Fences: These are strong fence obtainable from 1.2 m to 3.6 m high. Corrugated or angle pales are used for fences up to 2.1 m in height, corrugated pales only for maximum security which should be atleast 2.4 m high. I-section beams are used for posts, angles for rails. Galvanized and plastic-coated finishes are available. The fencing is designed for use without struts. Fixing bolts are burned over nuts to prevent dismantling. A sill 125 mm wide, 225 mm deep is to be provided under the line of pales, the top of the sill to be approximately at ground level and not more than 50 mm below the bottom of the pales.

Large Sites

The type of fencing used depends on that which is available to the contractor, and may be erected with careful consideration to the following points:

a) Chain link fences 2-3 m high should be fixed to concrete, timber or steel posts which are concreted into the ground.
b) The top of the chain link fence should be finished off with two strands of barbed wire.
c) The base of the wire should be sunk into the ground about 250 mm to prevent anyone from gaining easy access by tunelling or undermining.
d) Care should be exercised to provide a gate or gates and padlocks of similar strength and security as the compound fencing. The gates should be flung carefully to limit the space at the bottom with perhaps a bed of concrete across the threshold to prevent thieves from gaining access by undermining.
e) Chains should not be used to secure gates and the padlock should be of extra security type which makes it extremely difficult to cut with bolt-scroppers.

Gates for Fences

Gates in a fence should be designed so that as far as possible they provide security comparable with that of the fence. Gates are manufactured in a great variety of sizes nd form. The main factors to be considered when choosing or designing a gate are:
Make sure that the material is not incongruous with the material of the adjacent

a) Make sure that the material is not incongruous with the material of the adjacent fence or wall,
b) Keep the weight of the gate as small as possible without impairing the strength, and
c) The hanging post must be strong enough to withstand the cantilevering action of the gate and also securely fixed to prevent it from being shaken loose.

In a chain link fence, gates are made of circular or rectangular hollow steel sections. For greater rigidity, 50 x 50 nun steel mesh welded at intersections is used instead of chain link infill. Gates for steel palisade fences are made with rectangular hollow steel sections welded together. The construction is not braced but corner strengthening pieces are used if necessary. Panels of rails and pales are then secured to the framing.

The gates may be of hinged or sliding type. If hinged they will require a large area for opening and closing and the road must have flanking walls or other boundaries for the gates to open against. Tile swing of the gates must be marked on the road surface to indicate that the vehicles must keep clear. Hinged gates can be operated by electrical power, but the greater mechanical advantage of manual operation enable that even heavy gates can easily moved by hand, i.e. by applying force farther away from the hinge.

Sliding gates are generally better than hinged gates for wide openings. They need less space and they are suited for powered operation. If /he gate is very long, or very high or perhaps very heavy because of armour plate infill it will need to run in a track that carries its weight. Otherwise a free-carrying gate can be used, which has the advantage of being able to operate over surfaces at different levels and of being unaffected

by the snow and ice.

Open site access roads should have a gate erected across them, or at least be sealed off with planks or drums filled with sand at night or at weekends and to make it obvious to anyone that beyond these points they would be trespassing.

Additional Security Measures

Additional security measures which need to be observed are as follows:

a) Materials should be stored away from file compound fencing inside and particularly outside to prevent anyone from using file stacks or piles as access bridges to file inside compound area.
b) Internal huts are best kept away from the compound fencing unless the windows are facing inwards. Where the windows face outwards, anti-burglar bars should be fitted on the internal faces and perhaps security wire could be fixed on the outside as an anti-vandalism measure.
c) Ladders, picks, shovels and bolt-croppers should he locked away (inside the compound area) to prevent thieves and criminals using them as access implements.
d) Burglar alarm could be installed which also could operate a flashing light set at the top of a tower, to alert or direct file police to the exact spot of the break-in. The flashing light arrangement is particularly important on large open sites where there may be two or more compound or storage areas, the direction from which alarms are sounding being sometimes difficult to access.

Hutting

Valuable items of small plant, equipment and materials are stored in huts. Tile huts should be well constructed and should have strong doors, windows and locks. Where possible they should be situated inside the compound as an added security measure, or should be grouped together for ease of patrolling by the security officer or police when the site is closed.

Administration Offices

There are many valuable items of stationery, and equipment which are retained for the proper processing of information with offices; conducting of administrative or management duties; and which, if obtained by the organised criminals would be very rewarding for the minimum of effort on their part. Therefore, the extra measures to be taken to protect the administrative area from intruders both during working hours and after are as follows :

a) Operate a sound control of security keys to prevent the wrong persons from obtaining file original or from copying them.
b) A night light could be left on in the main office if the size of the administrative area warrants it.
c) Notices should be strategically placed around administrative areas and access roads warning every visitor to report to the main or other offices before proceeding further.
d) Other warning notices such as *"Trespassers will be prosecuted"* may deter the less determined opportunist thief.

e) The office safe should be secreted behind a panel or cabinet and built into a brick or concrete surround. An added precaution would be to strap and bolt the safe into a concrete base

Entrance and Exit Control

Traffic barriers used at perimeter entrance are of light construction, intended only for control of vehicles: however where there is a danger of vandalism, barriers of robust construction should be used. The lifting arm type may be adopted where space for installation is limited. Raising road barriers are also used to close roadways temporarily. Traffic lights are necessary to warn driver when file barriers are raised. Where maximum security requirements necessitate the inspection of vehicles entering or leaving the premises, barriers used in pairs enables file passage of vehicles to be fully controlled, there call be no rushing of a lowered barrier by a following vehicle Methods of access control for labour staff may be a card operated or supervised one.

Further Reading:

- ✓ *George D. Hack, (1999), Site Selection for Growing Companies*
- ✓ *P S Gahlot, (1992), Construction Planning And Management*
- ✓ *Chris March, (2009), Business Organisation for Construction*