UNIT-1 Site Management

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.

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Unit 1

Site Management

After selecting the most suitable site for construction, the next step is to carry out the site's organisation. The site's organisation is done to ensure efficient and effective construction. It requires producing a site layout which is practical, logical, and orderly. Site layout plan is expected to show the locations of all facilities and equipment to ensure the highest efficiency in executing the construction project. A good layout plan ensures the safety, efficiency and economy of construction.
Factors to consider when organising a site include site accommodation, security, machinery, material storage, site electricity, lighting, labour, and access to sited and site roads.

Access To Site And Site Roads

Access to the Site

This should normally be specified in the contract. All entrances to the site should be identified with numbers or letters. Instructions showing the requirements for accessing and using the site should be boldly displayed at the entrance to the site. Ideally, separate exit and entry points would aid on-off movement of traffic at the site.
There should also be access for fire-fighting vehicles to the site for the duration of the project. In addition, free access must be provided to fire hydrants or static water tank. It is highly recommended that no material of construction should rest 3m from a hydrant or static water tank. Ready access to fire-fighting equipment and first aid should be continuously maintained, as well.

Site Road

All movement at the site must be efficiently planned in order to ensure effective and economic operations of machines for the project. Depending on the type of machines and their loads, different types of roads may be provided on the site. The ground conditions and cost related matters may also be factors to consider when choosing the type of road to construct. Tracked vehicles fitted with grips or heavy vehicles such as diggers will damage soft or hard grounds. Rough roads are more often used by on-site traffic, while water bound or bitumen roads are suitable for on-off site traffic. Roads must be maintained to prevent potholes and ditches from developing and damaging vehicles.
In situations where on-off site vehicles attempt to use on-site roads, adequate signs and supervision must be provided for safety reasons.

Site Organisation

The expertise of an engineer is valuable in providing adequate drainage on site. The drainage system happens to be an expensive aspect of site organisation and as such must be taken seriously. The amount of rainfall in a particular location determines the type of design to use for drainage. The run-off is part of the run which flows on the surface or subsurface when the rainstorm stops.

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Subsurface Drainage

This involves the abatement and removal of soil water. This drainage type requires:

- 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 the surface's runoff, along with underground drainage

The subsurface drainage requires fitting horizontal pipes with open joints or perforations to collect water gravitationally and transport it to outlets. The amount of water that is collected by the subsurface drainage depends on the distance of the pope from the surface of the soil, the soil permeability, the diameter of pipes, and the size and number of openings connected to the drain.

Site Accommodation

Site accommodations include the administrative office, resting rooms or temporary housing for workers. Due to the temporary nature of construction projects, there is no need to provide permanent structures of accommodating staff or for material storage.
Provision of the best and most economical facilities is encouraged to foster healthy relationship between employees and management, minimize accidents and damages as well as to reduce theft of materials. The end result of having good facility for staff is an increase in productivity of the workers.

Site for the Administrative Office

The size of the administrative office depends on the size of the work site and the number of workers. Using a rough estimate, a project requiring 300 workers has to have an office with an area of $150m^2$. If the workers number about 1000-2000, the space of about $200\text{-}300m^2$ will be adequate.
The main administrative office and storage facilities should be sited near the main entrance to the site. This includes the main contractor's and resident engineer's offices. The storekeeper's office too must be located at the entrance to receive the materials being delivered to the construction site.
The sub-contractor's office may also be located near the entrance if space is available. This foregoing arrangement makes it possible to share utility services such as heating, lighting and telephone economically. Discrete situating of administrative offices reduce the number of people walking around the construction site. Contractors and engineers' cabins should be placed in such a way as to give them a field view of the site from the windows and the main entrance.

Types of Construction

The purpose of each accommodation unit dictates the kind of construction to use in building these facilities. Generally, offices need desks, chairs, toilets, meal room and cash chest. The materials of construction to use include:

- Masonry walls and thatched roof/GI sheets;
- Timer huts;
- Mobile caravans or cabins.

Mud mortar or lime mortar can be used to construct masonry walls for easy dismantling of the walls when the project is completed. The pre-fabricated design of time huts allows for easy dismantling and

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reused at other project sites. Most caravans and mobile cabins are well-furnished with all accessories such as furniture, toilet, HVAC and lighting. Cabins are usually transported by trailers while caravans can be easily towed but the cost of these two units may is higher compared to the timber huts and masonry structure.

Temporary Housing for Labourers

Accommodation must be provided for migrant labourers when a substantial number of them have been employed. This adds extra expense to the project and could result in administrative and social issues in managing the labourers due to their large size.

Having the labour workforce and their families near the site can improve social cohesion between the staff and the surrounding communities. Permanent settlement is generally not sought for the families of migrant workers because it may lead to conflict situations with the local residents when the project is completed. Permanent residence will make sense if the construction is expected to continue for a longer duration.

When situating labour settlements, the site engineer should keep the following in mind:

- Site camps on high, well-drained grounds
- Camps should be sited close to the work site within easy walking distance. The situating should be planned in such a way that worker do not have walk for long periods. If long walking distances become necessary, then, activities must be less stressful for the workers. This should be carefully considered by the planners ahead of time.
- The floor area of $5m^2$ is normally assigned to each worker.
- Avoid locating camps close to villages to prevent conflicts with the local residents.

Essential facilities to provide at camp site include:

- First-aid boxes should be clearly marked and first aid assistants duly trained to handle emergency situations
- Provision should be made for meals room, sanitary and washing places, as well as resting and changing rooms
- **Fire Precaution/Protection/Prevention:** Temporary buildings for office, accommodation and storage should be constructed from non-combustible materials and adequately sited to reduce or prevent fires from starting too easily

Temporary Services

Provision should be made for facilities such as sanitation telephone and electricity. The relevant authorities should be contacted when there is the need for diverting services such as water, electricity, and sewage, etc., to and from existing service lines. The head engineer would normally have to supply the contractor with detail information about the services. The departments responsible for these services must also be contacted to arrange for diversion of these utilities.

Storage for Materials

Materials need to be properly stored or stacked to prevent damages, contamination and to preserve their quality to ensure work meets specifications and standards. The storage facility should provide

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protection from damage, theft and prolong the durability of the materials. Materials should be kept at a place which will require no double handling and the storage facility should be easily accessible.
Usually, materials are separated according to the type, size and length, and arranged in clean, orderly piles with no danger of falling over. High piles should be stepped back at regular intervals in height so they do not become a source of hazard to people. All passageways should be free of materials at all times. In cases where piles of materials are close to passageways, clear warning signs must be provided during the day time and red warning lights provided at night time.
The spacing of about 1 M should be allowed between piles to facilitate easy inspection and removal. Care should be taken to store all materials on dry, well-drained and firm stable surfaces. Material should not be placed in such a manner as to cause stress on the walls and other structures.
Separate flammable substances such as paints, timber, vanish and similar materials from each other in order to minimize the spread or escalation of fires. Instances, which necessitate the storage of materials near roads and public walkways, would require the provision of roadside berms for stacking the items. Permission from local authorities should be sought prior to storing materials on public roads. When construction is completed, the items must be duly removed from the site to prevent accident to the public.

Storing Various Construction Materials

Cement is usually stored in a building which must be dry and moist-proof, as well as, leak-proof. Ensure the building does not allow moisture-bearing air to cause hardening by providing adequate ventilation to prevent dampness. Cement should be stack on wooden planks having a gap of about 150-200mm from the floor. Leave a minimum spacing of about 450mm between the walls and the stacks. Pack the cement bags together to reduce circulation of air within a stack and a width limit of 4 bags and height of 15 bags per stack to prevent lumping under pressure.
The terms of usage, the site's manager should ensure older stocks are utilized first to avoid prolonged storage. Another effective way is to plan deliveries such that prolonged storage is avoided. Do not store cement for more than two months if the climate is humid. In dry areas, you may place orders for a whole season's requirement for storage if you anticipate delays or shortages.
To store cement for long periods in monsoon or humid areas, the stack has to be covered with water-proof materials. 50 tonnes of storage could be stored in $40m^2$ area with height of 2.5m. There should also be an allowance for air circulation around the stacks.

Lime

Quicklime before Slaking

The ideal scenario is to use quicklime immediately. However, if it is not possible to do so, then it should be stored in heaps on adequate platform and covered to prevent contact with rain and wind. A minimum spacing of 300mm around the heap should be maintained when stored in a shed. Care should be taken to keep water combustible materials from slaked lime.

Hydrated Lime

This should be stored in a shed and protected from dampness to reduce deterioration.

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Dry Slacked Lime

If there is the need for immediate use, then it could be stored on a platform and covered to prevent contact with rain and wind. However, if it is to be kept for a longer duration, then it should be stored in a shed.

Masonry Unit

Different types of bricks should be stack separately in a neat orderly fashion and not damped on the site. Bricks should be stacked on dry, firm surface in regular tiers immediately upon unloading to minimize breakage and defacing. The ideal configuration for stacking is 2 bricks wide, 5 bricks long and 10 bricks high. A distance of 0.8m between stacks should be enough and the stack should be covered with tarpaulin or polythene sheet.

Aggregate

Fine and coarse aggregates should be stored on hard, dry, and flat surface. Alternatively, corrugated iron sheets, planks, a floor of bricks, or a layer of lean concrete could be provided to store them to prevent contamination with vegetation, clay, particles or undesirable materials. Stack of fine and course aggregate should be separated from each other y means of a dividing wall to prevent them from mixing. For fine aggregates, a suitable store should ensure minimal loss due to the effect of blowing wind. Different sizes of course aggregate should be separated with dividing walls and clearly labelled.

Fly Ash

Bulk quantities of fly ash are stored in similar manner as fine aggregates. Storage should be such that it will allow easy access for identification of each batch. Fly ash supplied in bags should be filed to a maximum of 15 bags.

Timber

Stack timber on dry flat surfaces about 150mm from the ground to avoid effect of accumulation of water beneath the stack. Different types and length should be sorted and stored separately. Similar sized timbers are normally piled together in layers with wooden battens (crosses) in order to separate different layers from each other.

Airspace of 25mm is maintained between adjacent layers. Longer lengths are placed at the bottom and shorter ones on top; the edge of one side must be vertically aligned. The width and height should be 1.5 and 2.0m respectively with distance between adjacent stack at 450mm or more. Another method of storing timer requires using scaffold with sheet roof covering. In situations where it is no possible to stack with battens, the timber can be stored on raised concrete foundations and piled closely together using dimension and spacing specified for the batten-type storage. All types of stack should be protected from moisture (rain) and hot wind and from the sun. Place heavy weight such as metal on top of the stack to prevent distortions or warping. For longer storage periods, coat the ends of the timber with microcrystalline wax, coal tar or aluminium leaf paints.

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Structural and Reinforce Steel

Storage should be in such a manner as to prevent distortion and corrosion. Coat steel with cement wash before stacking to prevent rusting and scaling. Sort different type and sizes and store them separately on platforms which are more than 150mm above ground. To facilitate easy identification, the end of the different types should be painted with different colours.

Doors, Windows, and Ventilators

Store metal doors, windows, and ventilation on level ground on top of wooden battens ensuring dirt and ashes are prevented from coming into contact with them. On occasion, when they are delivered in crates, instructions from the manufacturer on how to stack them should be adhered to and only remove items from the crate when needed. Always stack metal frames upside down with the kick plate at the top. Do not store them for long, otherwise they might get distorted and get out of shape. Protect aluminium frames and shutters from cement-made mortar with tarpaulin coverings and make allowance for air to circulate to prevent condensation of moisture.

Wooden frames and shutters should be stored by stacking one over the other in dry and clean covered space devoid of bug infestation. Stacks should be vertical with battens arranged at regular intervals. The distance of the storage beams or pallet should be 80mm from the surface of the ground to prevent contact with water. Protective covers should be made available to protect the top of the stack and secured with the aid of heavy objects. It is best to store precast door and window frames in an upright position and protected from the damaging effect of the soil.

Roofing Materials

Roofing Cement Sheets

All roofing sheets should be stacked on top of timber and on a firm and levelled ground to a height of about 1m. Separate damaged sheet from the good ones and provide covering to protect the sheets from the elements of the weather.

Corrugated Galvanised Iron Sheet (CGI sheet)

A bundle of these should consist of 10 sheets and a total of 100 bundles per stack. For each bundle, the corrugation should run in similar direction. Also, ends should be 100-150mm from the surface of the ground to permit water to flow freely. Roof covers must be provided if they are to be stored for longer periods.

Tiles

Arrange tiles on edge and in pairs to provide protection to ribs. Tile stack could be 5-7 rows high. End tiles should be flat. Ridge and hip tile fittings should be kept separately. Also keep different types and sizes of tiles separate.

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Boards

Gypsum Boards

Gypsum boards should be stored in a clean and dry location and securely covered.

Plywood, Fibre Board, Particle Board, and Block Boards

These items must not be stored in the open and must be protected from the sun and rain. It is recommended that boards are stacked on a flat dunnage and a wooden frame constructed from 50x25mm battens placed on top, ensuring that the frame supports all 4 edges and corners. Intermediate batten should also be placed at convenient intervals to prevent warping. It should be wise to raise stacks above the ground level to protect it from water. Ensure the block of boards is vertically aligned and place weights on the top sheet to avoid warping.

Plastic and Rubber Sheets

These materials should be stored in a cool, well-ventilated room devoid of direct sunlight. Ensure fume-producing machinery such as generators, motor and other electrical equipment are kept away from these sheets to prevent damages. Other substances such as organic solvents, acids, oil and grease should also be kept away to prevent contamination. Protect the sheets from strain, stress and sharp objects. Periodic turning over of sheets is required when stored for long periods.

Glass Sheets

Generally, glass sheets should be stored into a dry environment. Make sure that it is covered. Each stack shall consist of 25 glass panes and arranged on their long edges and supported at 2 points using wood fillets, 30mm from the ends. Glass in each stack should be placed such that the bottom edge is 25mm from the bottom of the wall or any other resting support, to take a stable upright position. If the floor is quite smooth and slippery, then gunny bags should be used to cover the floor space.

Cement Pipes and Fittings

Pipes for storage should be stack using the pyramid-shaped storage configuration. Alternatively, the pipes could be stored lengthwise and crosswise in alternating pattern. It is advisable to use the pyramid shape pattern for pipes having smaller diameters in order to conserve space. A height limit of 1.5m should be maintained. Pipes of similar type and size should be stored on each stack. All cast iron detachable joints and fittings must be stored separately and then covered.

Polyethylene Pipes

Protect normal polyethylene pipes from direct sunlight by storing under cover. Polyethylene pipes may be stored in the open or under cover. Avoid storing pipes in areas having temperatures in excess of 27°C. Straight lengths of pipes should be stored horizontally in racks and provided with appropriate support to prevent pipes from setting permanently. With regards to coils, they can be stack flat one on top of the other.

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Non-plasticised PVC Pipes

Do not store this type of pipes in racks. Provide a flat surface storage without any sharp points or stones on the surface. Stack height should be limited to 1.5m and adequate support provided throughout. This would prevent distortions from occurring. Also, sockets and spigots are best stored in layers such that the sockets are arranged at alternate ends of the stacks to prevent lopsidedness. Ensure you do not store one pipe inside another. Different pipes should be sorted and stored separately. Sheds should be provided for pipes when storing in hot climates.

Pipes of Conducting Metals

The best practice for conducting metal storage is to stack them in secured, solid level sill to prevent rolling. Also provide suitable packing between each layer to minimize pressure and spreading of pile. For safety reasons, a minimum safety distance from overhead power lines should be maintained for pipe stacking and other conducting materials on the site according to the following specifications:

Voltage	Distance
Up to 11 kV	1.4m
11-33kV	3.6m
33-132kV	4.7m

Pilling and Poles

Stack pilling and poles on solid, level sills to prevent rolling. Storage area should be free from impediments such as flammable materials and vegetations.

Paints, Varnishes and Thinners

Sealed and closed containers should be used for storing these flammable substances. The containers should be stored in a well-ventilated place and kept away from sparks and fires, heat and smoke. Paints storage areas should be made up of loose sand having floor depth of 100mm. Explosion-proof switches and electrical equipment are preferable for areas housing paint. Provision should also be made for removal of deteriorated paint in the same order they were received.

Bitumen, Tar, and Asphalt

It is recommended to stack drums containing these substances vertically to a height of 3 tiers. All empty drums should be stacked pyramidal in rows. Drums which are found to be leaky must be set aside. Store bituminous roofing felt away from flammable materials.

Flammable Materials

Regulations for storing flammable substances should be strictly followed. To avoid disappointments, keep stocks of fuel and oils on site. Sometimes it is conducive to stockpile supplies for a full season in

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situations where access to these fuels will be interrupted for a long period, for instance in remote locations prone to becoming inaccessible due to blizzards or floods. It is alright to keep diesel outside in drum but it is even better to store the drums in safe buildings. Keep gasoline stored inside locked buildings to ensure safety.
Equipment, which used contaminated fuel or lubricant, may fail due to contamination. Therefore, adequate care must be given to ensure that outdoor fuel storage drums do not become contaminated by dust, moisture, or dirt. Clear all storage areas of debris, spilled fluid and other potential dangers and keep compressed gas away from buildings which serve as storage for petroleum products.

Water

Sufficient quantities of water should be supplied in tanks for use during construction work, for fire-fighting and for other duties requiring the use of water. Organic matter content should be removed from the water to improve the quality.

Sanitary Ware

Sanitary items should be stored under cover to prevent them from getting damaged. Vitreous and metal items should be stored in separate locations. Much care should be taken in handling these wares during storage and prior to installation.

Storage for Equipment and Tools

The size and capacity of workshop facilities for a construction site depends on the size of the project as well as the nearness of commercially available repair facilities. The presence of major maintenance and repair facility nearby makes it possible for the site to undertake only minimal maintenance and repair works involving greasing, oiling and changing of filters using fewer tools inside site buildings constructed from concrete floor.
However, if large scale construction is being undertaken in a remote area, then substantial equipment and tools would be required for major maintenance and repair works to be performed at the workshops. There may be activities such as welding, grinding, drilling or machining at the facilities. Adequate ground should be made available for equipment storage as well as for manoeuvrability; the recommended area of $60m^2$ should be created for each of the equipment.

Plant Requirements and Movement of the Plants

It is important to designate a suitable location with sufficient operating space for machines, so that there will not be the need for frequent repositioning. One such equipment whose positioning should be maintained for the sake of efficient and uninterrupted operation is the crane towers. However, if it becomes necessary to reposition cranes, then they should be mounted on rails, cableways or on derricks. Plants and equipment must be deployed in the most efficient manner. An excavating and a scraper should work as they move. Concreting equipment should be as close to the delivery point requiring higher amount of concrete. Adequate planning will ensure these expensive plants and equipment do not sit idle t are put to good use, including renting them or transferring them to other construction sites

where they are needed. Provision should be made for plant utilization strut for control of use, general upkeep and assessing plant performance.

Site Electricity

Regulations and guidelines for the installation of electrical sources are provided by the U.K.'s Building Regulations. These must be adhered to when dealing with electricity supply. The main issues confronting construction sites with regards to electrical installation is the unprotected nature of the outdoor installations which makes them potential hazards. Short circuiting and exposure to live wires could result in fires or shocks respectively. Electricity is required on the site to provide power for gadgets and lighting for accommodation and to power different types of machinery.

Environmental Conditions to Consider when Providing Electricity for Equipment

The effect of water, temperature, and humidity, the presence of particulate matter such as dust, wind, c corrosive substances etc., should be considered. The presence of these conditions must be taken into account when supplying power to devices and any likely negative effects mitigated immediately. Whatever circumstances exist on the site with respect to electrical installations must be conformable to the UK Standards specifications. Only persons who are qualified and holding certificates of competency from the right authority should be allowed to perform electrical installations. The next paragraphs describe the procedure for undertaking these installations.

Supply Intake Agreement

The main sources of power to a construction site are grid supply form the local authority and portable generators. It is more convenient to go for the permanent supply from the local authority since the structure being constructed would eventually require this source of power supply using permanent supply cables.

The portable generators on the other hand are more suitable for smaller construction projects which usually require temporary supply cables for electricity distribution. It is imperative to indicate the maximum amount of power required at the site for the duration of the project. The total power to a construction site depends on the amount of power required and how much spare supply is currently available from the local authority distribution set up. The site may take the required amount via a high voltage line or a high voltage supplied with a step-down transformer. There is also the option of tapping electricity with a service line below 250V or from an existing service connection. Another configuration is to take power from several sources including portable and fixed generators.

If there is insufficient supply available from the local distribution authorities, a temporary substation could be installed together with a transformer and switch gear, as close as possible to the site. For such arrangements, the installation should be undertaken following the National Electrical Code procedures. Detailed drawings showing the area for the temporary installations and the equipment that will be powered should be provided to the electricity supply authorities.

Water for Construction

Ground water consists of rain water that has seeped into the ground to become part of an underground basin or part of an underground stream. While the rain water makes its way down into the subsurface, its interaction with both organic and inorganic materials causes it to retain some components of these materials. Wells are used to tap underground source of water having the required quality.
Wells could either be shallow or deep. Shallow wells require digging the pervious rock layer until the first impervious layer is encountered. Types of shallow wells include Ole driven, bored type or dug well type which has been sunk or build. Deep wells in contrast, are obtained by boring or drilling up to the next pervious layer below the first impervious rock layer. Water from deep well tends to be of higher quality and of larger quantities than water from shallow wells.

Other Sources of Water

In case the ground water at the site is unsuitable for construction, arrangements should be made to get it from the nearest source using vehicles or pipelines, depending on the most convenient and economical choice. Storage facility for the water should be provided on site.

Site Protection

Adequate security planning needs to be done at a very early state of the project lifecycle to protect lives and properties at a reasonable cost. Security measures should be adopted to reduce costs associated with losses through sabotage, theft or terrorism. Another cost-saving security stance would be required to protect workers and assets at the site.
The extent of security measures adopted to prevent losses will depend on the nature of site location and the calibre of work being carried out. Smaller sites in town centres usually require minor security as the public can serve as a major deterrent to potential troublemakers. Big projects tend to demand more security measures to prevent losses.
Below, we list some security measures that you can adopt to prevent losses at construction sites.

Types of Fencing

Provision of a fence can offer a measure of protection for the site. The fence serves tow functions: it outlines the limit of the site as well as provides protection against losses and theft. Fences can be constructed in for the purpose of providing a physical restriction or additionally, they could also serve as visual barriers during open work construction. The type of fence employed will depend on factors such as cost, level of security, location of the site and the lifespan of the project. Typical security fence are between 1.8-2.0m in height with several lockable access points at vantage locations.

Fencing Materials

Materials used for constructing fences range from chain links, iron, concrete, timber and standard wires. Although not quite attractive, standard wires are extensively used to provide security on housing estate sites. The long straight sections of the strands should have straining posts introduced at 70m intervals

and at the ends and corners. Woven wire and chain links are also widely used. These must also be used in conjunction with straining posts, as well.
Concrete fences have the advantage of requiring no maintenance. They are, however, heavy and the post are fixed at intervals of 1.8m and linked by planks.
Timber fences offer variety of designs and blend naturally into the landscape. The come in heights of about 1-2m with centres of posts ranging between 1.8-2.4m. The sections of the post are between 75x75mm and 150x150mm.
For durable posts, use hardwood, such as, oak, chestnut, or larch. Coating the post below the surface of the ground with tar would provide adequate water proofing protection. There are three ways to fix the post. Option 1 requires setting the post in concrete but this approach could result in the timber getting rotten at the point of entry. The second option requires driving the post into position but with undesirable damage to the head and the propensity of water to attack the post. The third option involves wedging the post with a large stone in a hole and securing the fixture with smaller stones at the base and ramming the area surround the post. The recommended dimension for the post is ¼ below and ¾ above the surface of the ground. A minimum measurement of 450mm is accepted for the section below the surface.
To prolong the life of the fence, capping is placed on the posts and vertical sections to protect the end grains. A weathering face would also offer some protection by quickly directing water away.

Small Sites

To avoid stains resulting from rusting, use galvanised nails. Fences may be constructed to provide maximum security at construction sites. Basic security fences include chain link, wooden palisade or close-boarded fences. These fences can be fitted with barb-wires to provide extra security when needed. For maximum security applications, steel palisade are the preferred choice.
For small construction sites, the whole site can be surrounded with the following types of fences:

Low Chestnut Paling or Re-fence

This fence is good for highlighting the boundaries of the site to pedestrians and vehicles and also, for preventing trespassing or accidentally straying onto the site.

Chain link Fence

It is one of the most common fences used at construction sites. A height of 2.4m to the summit of the tile chain link and a total of 2.9m when barb-wore is added for maximum security. 50mm mesh sizes prevents climbing the mesh with toes. 300mm of the chain link is secured in the ground or stapled with thread hair pin through the bottom layer of the mesh and fastened into a concrete sill cast at the ground level between posts to prevent barrowing at the bottom of the chain link.
Prevent bunching together of barbed wires by fitting space bars to the barb wire and securing the chain link to the top of the barbed wire. Using burr bolts with nuts will prevent removal or dismantling. To strengthen straining posts and prevent climbing of posts, use bracing rail and diagonal reverse bracing, instead of strut.

High wire (chain link) or close-board fence with barbed wire prevents illegal access to the site. The close-boarding option is ideal for minimizing problems of noise and dust to the surrounding communities. Secured gates and doors with lock should posses the same strength as the boundary fences or boards to which they have been fixed.

Steel Palisade Fences

They are a very strong type of fence with height of 1.2-3.6m. Fences with height of 2.1m require the use of corrugated or angle palisade pales. For maximum security, have the corrugated pales reach a height of 2.4m. Posts are made of galvanized or plastic-finished I-section beams and angles are used for the rails. These fences do not require the use of struts but rather they are secured in place using bolts which are welded over the nuts to prevent removal or dismantling. Sills with dimensions of 125mm width and 225mm depth should be placed under the pales and the tip of the sills should be at ground level. Sill should not be more than 50mm below the bottom of the pales.

Large Construction Sites

The following should be taken into consideration when providing fencing to large construction sites:
Chain link fence of height 2-3m should be secured in concrete, steel or timber posts which have also been secured in the ground with concrete.
Two strands of barbed wires should be placed at the tip of the chain link.
The base of the wire should be extended 250mm into the ground to prevent tunnelling underneath.
Strong gates and padlocks should be provided. The space underneath the gate should be minimized with a bed of concrete to stop thieves from digging tunnels under.
Do not use chains to secure gate but only padlocks, otherwise the chains could be snapped with bolt scrappers.

The Gates for Fencing

Security provided by the gates should generally match that of the fence.
The material of construction should be compatible with the nearest fence.
The weight of the gate should be light without compromising the strength
The hinges and hanging point should be strong enough to withstand forces acting on these joints due to frequent opening and closing. It should be secured to prevent it from being shaken loose out of place
The circular or rectangular hollow steel sections may be used for gates designed for chain link fences. Use 50x50 nun steel mesh for welding at the intersection instead of link infill. Steel palisade fences have gates made from rectangular hollow steel section which have been welded. This mode of fabrication does not require braces but may require corner strengthening piece. The frames are covered with pales and panels of rails.
If the gate is hinged, then it will require quite a large area to open and close. There must also be flanking walls or structures on the road for the gates to rest against when opened. The trajectory of the swinging gate should be boldly marked on the road to prevent vehicles from coming close. Although hinged gates can be operated by electrical power, the large mechanical advantage available can make it easy to operate the gate manually when force is applied at the opposite end of the hinge.

For wide openings, sliding gates tend to be more preferable than hinged ones. The main advantage of a sliding gate is that it requires less space to open and close and it is better suited to electrical power operation. Tracks should be provided to carry the weight of the gated in situations where the gate is very heavy, long or thick. Lighter free-carrying gate can also be used when suitable. This can be operated on a variety of surfaces without the negative effect of ice and snow.
Seal off open access roads with planks or sand-filled drums to keep out trespassers when construction work has ceased during the night or weekends.

Additional Security Measures to Take

These include:
Materials, which could be used as access bridges, should be removed from close to the site fences and stored far away from the compound
Keep internal huts far away from the fencing except in cases where the windows face inwards. Anti-burglar alarms fitted to the internal faces and barbed wire fitted to the outside can be used if the window faces outwards
Install burglar alarm and flashing light in large open area construction sites to alert police to a particular area of break-in

Hutting

This building is used to store valuable plants and equipment. Huts should be constructed with strong materials to guarantee adequate security and prevent break-in and theft. It is best to have the hut inside the compound and grouped together, to make patrolling and guarding easy for security personnel on the site.

Administration Offices

These buildings usually contain valuable gadgets and documents for administrative and management purposes. Extra security measure should therefore be provided to prevent criminals from getting easy access to these items and information.
Some measures that could be put in place include:
There should be effective control of security keys at all time s to prevent access to files
Keep night light on in administrative area whenever necessary
Place notice signs around the administrative area to direct all visitors to the main office
Deterrent measures such as warning of prosecution of trespassers would be effect to deter potential thieves
The office sage should be hidden behind a pane or concrete build around it.

Entrance and Exit Control

Light traffic barriers could be deployed to control vehicles access to the site. Heavy barriers should only be considered when there is a high risk of vandalism or sabotage. The lifting arm type is usually used when the space is limited or it can be used to temporarily close roads. Traffic light should provide warning signal whenever the barriers are lifted. It is also good security practice to inspect vehicles

entering or leaving the premises. This is usually achieved with the help of a fully controlled barrier system. Cards and human supervision are normally used to control the workers access to the site.

Further Reading:

- ✓ ***Martin Brook, (2008), Estimating and Tendering for Construction Work***
- ✓ ***David J. Pratt, (2004), Fundamentals of Construction Estimating***
- ✓ ***Brian Greenhalgh, (2013), Introduction to Estimating for Construction***