AE 301 (CONSTRUCTION TECHNOLOGY)

1.0: SITE PREPARATION

Before the commencement of actual building construction, there is the need to conduct certain preliminary site activities. This is to enable the building team have foreknowledge of a site. Some activities which preceded the actual building construction are:

i. Site investigation and organization (layout)
ii. Site welfare facilities
iii. Storage and protection of materials
iv. Site fencing and hoarding
v. Site clearance and excavation
vi. Leveling and setting out
vii. Ground water control.

1.1: Site Investigation and Organization – A preliminary examination or survey of the job is made during the designing and post-designing stages of a project. The survey enables the builder/architect/engineer to precisely have an idea about the site and assess if there are peculiar problems to the proposed contract. It is this initial understanding of these problems that the building team will use to design the building to suite the site. Similarly, the contractor could plan and organize his activities, sufficiently to achieve success and minimize time. This is done by producing a site layout plan and placing equipment and materials in specific positions for easy reach, handling and utilization.

Provision of services during site organization to a building site maybe temporary where the work is transient (short period), e.g. construction of highways. Elsewhere the services will be a permanent necessity and should be installed accordingly to avoid repeating the work, e.g. building construction. It is often advantageous to the contractor to provide these services particularly electricity and water, from where permanent installation could be mace. Other temporary services may include: access to site, watchman services, dust control (by watering ground area), site clean (debris clearance), etc.

Some considerations to be given by the contractor during reconnaissance and layout prior to constructional works are:

i. Availability and means of access to the site whether by road, rail or waterway.
ii. Availability of suitable materials/equipment and spare available for erecting plant and or storing materials around the site.
iii. Availability of space to erect temporary site offices and welfare facilities.
iv. The effect of vibration on adjacent structure when the construction involves using heavy/massive equipment (e.g. in piling) should be considered.
v. The availability of water and power supply should be ascertained and the rate of payment investigated.
vi. Knowledge of the nature and type of soil, and the level of water table is important as the way necessitate subsoil drainage and cause flooding.
vii. The local planning authorities should be approached to ascertain whether there is any special or significant restriction which could adversely affect the development of site (e.g. underground cables).
viii. Valuable information can be obtained by talking with the local inhabitants of the area.
ix. Any special condition that may limit work in anyway should be noted and taken care of e.g. weather or climatic condition.

1.2 Subsoil Exploration (Trial boreholes) –Trial boreholes to determine the nature of a subsoil is an important part of an early site investigation. The building design and structural loading can be related to the detailed and thorough examination of the subsoil bearing potential (ability to withstand load). Preliminary examination may be with trial pits excavated by spade or a hand anger. When more detailed information is required, a powered anger is more effective.

The depth of boreholes can be several meters deep for high rise buildings, and boring can be at random or regular intervals. Samples of subsoil can be extracted loose or distorted, or undisturbed in steel tubes. They are recorded on a borehole log, and samples are then taken for laboratory analysis to establish the moisture content, bearing capacity and chemical composition.

1.3. Site Welfare Facilities –The provision of shelter and accommodation for taking meals and deposition of clothes is a basic requirement on all sites. The builder should provide a hut for workmen so that meals and short rest can be taken, and also for storage of clothing not required for work during the day and protective clothing at night. The mass room or canteen should be convenient for washing facilities. Adequate wash basins, troughs and showers with soaps and towels are required. (an isolated sanitary facility with water closets is also required). Provision for first aid is also very important, and every contractor must provide first-aid accommodation to include a couch, stretchers, bandages, blankets, equipment, etc a trained person in first-aid treatment is to be available on site during working hours.

1.4: Storage and Protection of Materials – Materials such as cement, timbers, bricks and blocks should be protected from weather by storing in a shed or well stacked in a suitable position on the site, where they will not be liable to damage and are adequately protected. Electrical and plumbing (sanitary) fittings should be kept in a locked shed to avoid theft or breakage. Proper storage is necessary because saturated cement with time sets and becomes hardened resulting to wastage. Saturation also affects the mortar or concrete strength. Water is readily absorbed by timber causing deformation and rot, this should be avoided. A saturated brisk or block will be very difficult to handle. They should be well protected.

1.5 Site Fencing and Hoardings –A permanent fence or a temporary hoarding will be required around the site. This is a barrier made of block wall, wooden or mental stalk or rail or wire in some cases used old zinc to provide security and protect equipment and materials, and to keep out intruders. It also protections the ugly sight of construction and preserves the beauty till completion. The hoardings are removed after the completion of the project. The hoardings should be well erected and in sage order so as not to cause injury to workers or passé.

1.6. Site Clearance excavation to soil –The site should be cleared of the bushes, shrubs, trees, etc. which are on the building position and around the storage and temporary facilities area. The roads should be grubbed up and completely removed. Before any building is erected, it is essential that the area to be occupied by the building has the vegetable top soil removed from site completely or placed on one side, and spread level over areas after completion of the project to provide gardens. The organic content of the vegetable soil may be injurious to concrete, and so it should never be used for backfilling, or making up levels under the building. The path of excavation of topsoil is normally 150mm. Leveling, land clearance and stripping of the topsoil are all easily achieved with a bulldozer.

1.7. Ground Water Control: - Excavation and sample boreholes frequently reveal and locate a level of saturation within a few meters below the surface. This is known as the water table and it varies with season. Excavation below the water table will be difficult and the strength of any concrete placed in water will be seriously affected. A pre-knowledge of this fact helps the contractor to be equipped and prepare with his diesel powered water pump for the temporary removal of water during excavation and concreting.

1.8 Setting Out and Leveling – After the stripping of the topsoil and general site leveling, it is important that the structure is built in the correct position as shown on the arc a building is marked out with string lines and pegs to indicate foundation trenches and walls. The frontage line (building line) is an imaginary line shown on the site plan, or determined by the local authority, set back from the centre line of the road way.

2.0: SUBSTRUCTURE WORK

2.1: FOUNDATIONS

A foundation is defined as, that part of a structure which is in direct contact with the ground to which super imposed loads and dead loads are transmitted or received. It is also an integral part of a building which transfers the structural load from a building safely to the ground. Many at times, during the construction of a building, the load on the foundation gradually increases and eventually, this will result in settlement if the settlement is slight and uniform throughout the area of the building, no damage will occur to the building. But if the settlement is extensive and unequal, serious damage may result in the form of cracked walls, distorted doors and windows and in some cases failure may be completed by the collapse of the building.

Selection of foundation types and design depends on the total building load and the nature and quality of the subsoil. It is essential to achieve a satisfactory balance between the building load and subsoil characteristics, otherwise overstressing of the subsoil will lead to excessive building settlement and serious structural defeats.

The purpose (importance) of foundation is to distribute the weight of the structure to be carried over a sufficient area of bearing surface, so as to prevent the subsoil from spreading and to avoid settlement of the structure. A foundation should safety sustain (Carry) and transmit to the ground the combined dead load, imposed load and wind load, without impairing the stability of any part of the building. Foundations are designed to support a number of different kinds of loads:

i. The DEAD LOAD of the building, which is the sum of the weight of the frame, the floors, roofs, and walls, electrical and mechanical equipment and the foundation itself.
ii. The LIVE (IMPOSED) LOAD, which is the sum of the weights of people in the building, the furnishings, sanitary fixtures and the equipment they use, snow, ice and rain load on the roof.
iii. The WIND LOAD, which can apply literal, downward, and uplift load to a foundation.

All foundation settle to some extent as the soil around and beneath them adjust itself to the loads. Foundation settlement in most buildings is measured in millimeters. If the total settlement occurs roughly at the same rate from one side of the foundation to the other, no harm is likely to be done to the building. This is because all parts of the building rest on the same kind of soil. But if differential settlement occurs (when the building occupies a piece of land that is underlain by two or more areas of different types of soil with very different load bearing capacities) in which the various columns and load bearing walls of the building settle by substantial different amounts, the frames of the building become distorted, floors may stapes, walls and glass may crack, doors and windows may be difficult to open, etc. the primary objective of foundation design is to minimize differential settlement by loading the soil in such a way that equal settlement occur under the various parts of the building.

2.1: TYPES OF FOUNDATIONS

There are four principal types of foundation

i. Strip,
ii. Pad,
iii. Raft and;
iv. Pile foundations.

2.1.1: STRIP FOUNDATION: This type of foundation is a continuous level support for load bearing walls. It is usually made of a continuous strip of concrete of 1:3:6 mix, and may be reinforced (1:2:4) mix for poor subsoil or high loading. The continuous strip serves as a level base on which the wall in built and should be of such width as to spread the load on the foundation to an area of subsoil capable of supporting the load without stress. The width of a concrete strip foundation depends on the bearing capacity of the subsoil, the less the width of the foundation for the same load. The minimum width of a strip foundation is 450mm and least thickness is 150mm. they are suitable for low-rise construction.

2.1.2: PAD FOUNDATION: These are isolated pairs or column of brick, masonry or reinforced concrete often in the form of a square or rectangle pad of concrete for supporting ground beams, and in turn supporting walls. It is very economical to use pad foundation where the subsoil has poor bearing capacity for some depth below the surface, rather than excavating deep trenches and raising wall in strip foundations. It is also used where isolated columns are specified, especially in framed buildings. The spread of area of this type of foundation depends on the load on the soil and the bearing capacity of the subsoil.

2.1.3: RAFT FOUNDATION: In soft compressible subsoil, such as soft clay or peat subsoil. It is necessary to form a raft foundation to spread over the whole base of the building. Raft foundation consists of a raft of reinforce concrete under the whole of the building design to transmit the load of the building to the subsoil below the raft. Relative settlement between the foundations of columns is avoided by the use of a raft foundation.

2.1.4: PILE FOUNDATION: Pile foundations are used where the subsoil has poor and uncertain bearing capacity and in poor drained area where the water table is high and there is appreciable ground movement. Piles are usually employed because in these types of subsoil, it might be necessary to excavate beyond 2m to meet a stable stratum. And it is uneconomical to consider normal excavation beyond about 2m below the ground level. The pile column of concrete either cast insitu or precast driven into the ground to transfer the loads through the poor bearing soil to a more stable stratum. Boring is undertaken by a powered auger. The pile foundations are normally employed in the construction of bridges and oil platforms on seas.

2.2: RETAINING WALLS & BASEMENTS

2.2.1: RETAINING WALLS: Retaining walls are structures designed and constructed to resist the lateral pressure of soil when there is a desired change in ground elevation that exceeds the angle of repose of the soil. That is, they are designed to restrain soil to unnatural slopes. They are used to bound soils between two different elevations often in areas of terrain possessing undesirable slopes or in areas where the landscape needs to be shaped severely and engineered for more specific purposes like hillside farming or roadway overpasses.

In addition, retaining walls are useful in the built environment especially at bridge sites as abutment walls (for support of bridges), riverbank area including shoreline protection and within the house in a sloppy terrain. A retaining structure must support its back-fill without detrimental lateral movement, and the surface of the back-fill must not settle unduly. These deformations depend to a large extent on the properties of the back -fill and the subsoil. If the subsoil contains compressible layers, these are likely to consolidate under the weight of the back-fill and lead to differential settlements. Since the pattern of settlement tends to be bowl-shaped, it is not uncommon for settlement to result in retaining wall tilting toward the back-fill. More commonly the wall rotates forward or away from the back-fill as a result of the lateral forces involved. Settlement within the back-fill may be minimized by careful control during construction.

2.2.1.1: TYPES OF RETAINING WALLS: Generally, retaining walls can be grouped into the following categories:

i. Free standing or tied back retaining walls;
ii. Retaining walls for basement construction and
iii. Retaining walls for bridge abutment.

i. Free Standing or Tied-back retaining walls include the:
   - Gravity retaining wall, used in dams and for earth embankment;
   - Cantilever retaining wall, used for bridge abutment and general earthworks retainment;
   - Counterfort retaining wall for earthworks retainment of a considerable height;
   - Buttress retaining wall, also used for earthworks retainment as in counterfort but with the counterfort at the back of the wall, that is, the other side of the retained earth;
   - Tie-back retaining walls, used mainly in shoreline protection for jetties and wharfs and;
   - Reventment retaining walls for embankment slope protection in road works.

ii. The retaining walls for basement construction more or less fall under the category of cantilever retaining wall but with lesser heel width since the wall is subjected neither to overturning moment nor to sliding force. And;

iii. Retaining wall for bridge abutments are purely cantilever retaining walls. Good examples are the underpass walls of Maryland interchange, Maryland, Lagos and approaches to bridges.

2.2.1.2: GRAVITY/MASS RETAINING WALLS: which depend on their dead weight for stability are mostly used for walls up to 2m high but may be economically higher if locally available materials could be used. The mass of the structure is used to resist both the overturning and sliding forces. These walls need not be homogeneous since it is not uncommon to have a hollow concrete wall filled with earth to act as the gravity retaining walls. These walls usually contain nominal amount of reinforcements near the exposed surfaces to control temperature cracking. In view of these and also due to simple formwork, these walls may be economical up to 3m high. Another version of the gravity retaining wall is the semi-gravity retaining wall. It is somewhat slenderer and more conservative of materials. However, it requires vertical reinforcement along the inner face and into the footing to resist the rather small tensile forces that develop in these locations. A nominal amount of temperature steel must be provided to control surface cracking. It may be economical for heights up to 6m or thereabout.

2.2.1.3: CANTILEVER WALLS: rely on the bending strength of the cantilevered slab (wall) above the base to resist the forces. These are more economical in the use of materials (usually reinforced concrete or steel) and can be up to 7.5m in height. Associated with cantilever walls are counterfort walls which are restrained from overturning by the force exerted by the mass of earth behind the walls; and buttressed walls which transmit their thrust to the soil through buttresses projecting from the front wall. In fact, a high cantilevered wall may be unduly thick and it may be more economical for the slab forming the wall to span mainly horizontally between counterforts which acts as vertical cantilevers. Another form of cantilever walls are the tied back walls which are restrained from overturning by anchors at one or more levels. These are popular as water front structures especially as shoreline protection works in jetties and harbours.

2.2.2: DESIGN CONSIDERATION FOR RETAINING WALLS

The most important consideration in proper design and construction of retaining walls is to recognize and counteract the tendency of the retained material to move down slope due to gravity. This creates lateral earth pressure behind the wall which depends on the angle of internal friction (ϕ) and the cohesive strength or cohesion (c) of the retained material, as well as the direction and magnitude of movement the retaining structure undergoes.

Retaining walls shall be designed to withstand lateral earth and water pressures, the effects of surcharge loads, the self-weight of the wall and in special cases, earthquake loads in accordance with the general principles specified in this section. Retaining walls shall be designed for a service life based on consideration of the potential long - term effects of material deterioration on each of the material components comprising the wall. Permanent retaining walls should be designed for a minimum service life of 50 years.

In the choice and design of retaining walls, the following must be considered:

i. Materials for construction: The materials, labour, and technology available for construction must be considered. Where technology may inhibit cantilevered walls, other forms may be adopted. In the case of basement walls, the materials and technology for water proofing is of utmost importance. On the other hand, good concrete of very high strength of at least 30N/mm2 (minimum of Grade 30) with good fair faced finish will require less maintenance both in terms of cost and frequency.
ii. Design Technique: This involves the manipulation of design principles to achieve a more economical design, for example, extending the foundation to a deeper depth to reduce sliding and overturning and improving on the base width.
iii. Construction Techniques: Where very soft soil underneath the retaining wall is encountered, piling may be used to support the walls at intervals to advantage. The walls will be built off the coping beam serving as the pile cap. In addition, erosion on the face of the wall should be prevented through proper protection. Joints, where applicable, should be properly designed and constructed so that they do not become the source of weakness to the structure.
iv. Drainage: Weep holes must be provided in the walls to prevent a buildup of hydraulic pressures which can otherwise increase loads unduly. Drains should be provided in front of the walls to collect water dripping from the weep holes.
v. Service: In cases where the walls are used as walls in basement to houses etc., provision must be made for services to penetrate the walls without loss of strength or functionality especially in water proofing.

2.3: BASEMENT:

A basement is a building under the ground resulting from the removal of all the soil within the periphery of the building up to the required level which may be in excess of one storey height (that is, over of 3.0m). The surrounding soil must of necessity be contained and when there is ground water, the problem of containment becomes more pronounced. This is often prevented by constructing a retaining wall. The retaining wall may serve as the external wall. Alternatively, the retaining wall may serve as the fencing wall given adequate space for other uses along the external wall perimeter (may be expansive) or just a distance, say 1.5m after the external wall as working area. Generally, basement walls have to withstand earth pressures and also possibly water pressure.

Where basements are in waterlogged soils the effect of water pressure must be taken into account. The upward water pressure is uniform below the whole area of the basement floor, which must be capable of resisting the pressure less the weight of the slab. The walls must be designed to resist the horizontal pressure of the waterlogged ground. It is necessary to prevent the basement from floating. There are two critical stages. When the structure is completed the total weight of the basement and all superimposed dead loading must exceed the maximum upward pressure of the water by a substantial margin. When the basement only is completed, there must also be an excess of downward load. If these conditions are not present, one of the following steps should be taken:

i. The level of the ground water near the basement should be controlled by pumping or through other measures.
ii. Temporary vents should be formed in the floor or at the base of the walls to enable water flow to the basement freely; thereby equalizing the external and internal pressures. The vents should be sealed when sufficient dead load from the super structure is obtained.
iii. The basement should be temporarily flooded to a depth such that the weight of water in the basement, together with the dead load, exceeds the total upward force on the structure.

2.4: EARTHWORK SUPPORT: When excavations (trench) are dug in water saturated soils, it is important to provide supports to the side of the excavation. This is done to prevent the walls from caving-in (collapse) causing severe injury or death to those required to work inside the trench. Apart from causing injury and death, it will be additional cost to the builder to re-excavate and renew the damaged work in the trench. Should the sides support collapse, timber and steel are normally used for trench. The process of supporting trenches is generally termed "timbering/planking. The amount and of support, strutting "side and system of arrangement of the various timers depends on:

i. The type and nature of subsoil to be supported
ii. The depth of excavation.
iii. The length of time the trench is to remain open
iv. The time of year or climatic conditions prevailing when the trench is excavated.

Timber is often the most convenient material for shallow trenches. Steel interlocking poling's are often used for deep water-logged subsoil. Adjustable steel struts are also more convenient and have considerable re-use value for all depths of excavation.

The timbering members used in trench support are as follows:

i. Poling board –There are of 1.0 to 1.5m in length to suit the trench depth, and they vary in cross-section from 175 by 35mm to 225 by 50mm. They are placed vertically and against the soil of all the sides of excavation.
ii. Walling's –These are longitudinal members running the length of the trench and supporting the poling boards. They vary in sizes from 175 by 50mm to 225 by 75mm.
iii. Struts –These are usually squared timbers, either 100 by 100mm or 150 by 150mm in sizes. They are used to support the wallings, which in turn holds the poling boards in position. Adjustable steel struts are also in great use.
iv. Sheeting –These consist of horizontal boards abutting one another to provide continuous barrier when excavating in loose soils and common size for the sheeting is 175 x 75mm and there is overlap of about 150mm at the point of connection between two stages. Alternatively, steel interlocking poling with adjustable steep struts are used.

2.5: SETTLEMENT OF FOUNDATION

As the soil settles, so does the foundation. The settlement of a foundation of a building or a structure may be defined as the vertical movement (change in elevation) of the base of the footing under the influence of their over-weight or due to other causes. In other words, settlement is the sinking of a structure due to a compressive deformation of the underlying soil. The effect of settlement depends upon many factors such as its magnitude, uniformity and the type of structure. Settlement is not always a bad characteristic of structure provided it is uniform throughout and does not reach excessive limit. The magnitude of the settlement that should occur, when foundation loads are applied to the ground, depends on the rigidity of sub-structure and compressibility of the underlying strata. For the safety of foundations, the engineer-in-charge should be well familiar with all causes of settlement

2.5.1: Uniform Settlement: Uniform settlement is settlement, which is brought about when the entire structure, under uniform pressure distribution on a uniform, homogeneous soil material, settles evenly without causing additional stresses in the structure.

2.5.2: Non-uniform or Differential Settlement: The foundations of different elements of a structure may have un-equal settlements and the difference between such settlements will cause non-uniform or differential settlement, which may be disastrous, leading to cracking of the structural members, impairment of the structural rigidity of the building, and eventually to the collapse of the structure.

This is particularly true with statically indeterminate structures such as continuous beams on more than two supports, frames, arches, vaults, and others. In these structures, settlement of a support induces supplement moments, and if these additional bending moments are not taken into account in proportioning the structural members, the structure may turn out to be too weak to resist the additional moments, and may start to crack.

3.0: SUPERSTRUCTURE:

3.1: WALLS: Walls are any continuous vertical members whose length and height are both much larger than the thickness. Wall subjected to no loads other than their own weight such as panel or enclosure walls are called non-load bearing walls. Walls with a primary function of resisting horizontal loads are called shear walls. They may also serve as bearing walls.

3.1.1: Functions of Walls

i. It provides necessary resistance to rain penetration
ii. It is capable of resisting both positive and negative wind pressure
iii. It gives required degree of thermal insulation
iv. It provides the required degree of sound insulation to suit the building type
v. It provides sufficient openings for the admittance of natural daylight and ventilation

3.1.2: Walls Classification: Walls can be classified into the following

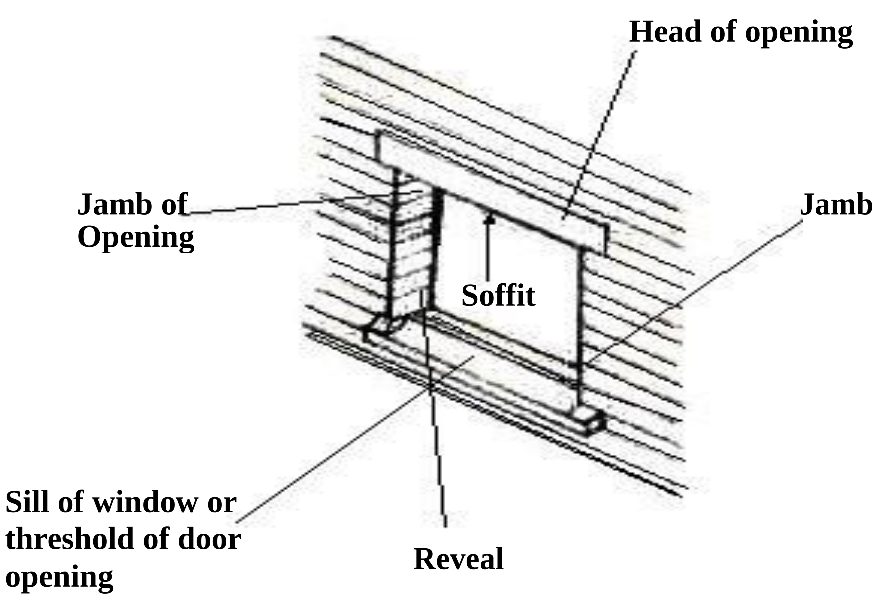
i. Load-bearing walls
ii. Non-load-bearing walls

3.1.3: Methods of Constructing Walls

i. **Load-bearing external walls:** These walls are normally used for domestic buildings or other small structures that are one or two storeys high. The weight of the roof and any upper floors is supported by load-bearing masonry of brick, block or stone construction. Load-bearing walls are constructed to rest on foundations which are usually strip foundations.
ii. **Non-load-bearing external walls:** These walls are often built from corrugated sheets cladding that is attached to a framework of steel rails and columns. The cladding sheets, does not support the structure of the building. Support is provided by the framework. The cladding sheets must be wind-resistant.

3.2 OPENING IN WALLS

Openings in internal and external walls are for mainly the provision of windows and doors; these are usually required for access, privacy, ventilation, outside view etc



Jambs: - Is the term used for the full height of opening either side of the window of the brickwork.

Reveal: - Describes the thickness of the wall revealed by cutting the opening and the reveal is the surface of brick work as long as the height of the opening.

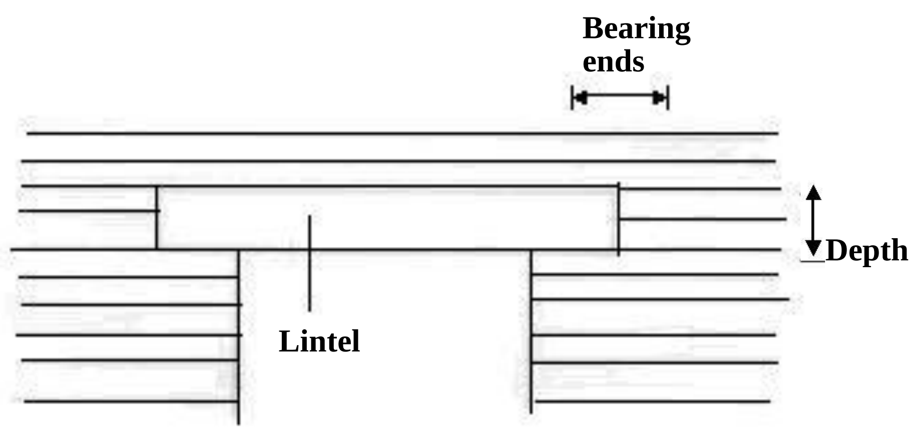
Sill: - Is the lower part of the opening for windows.

Threshold: - Lower part of opening for doors.

Soffit: - In the bottom part of head or top of opening.

Head of Openings: - The brickwork or block work over the head of openings (soffit) has to be supported either by a flat lintel or an arch.

Lintel: - Is any single solid length of concrete, steel, timber or stone built in over an opening to support the wall above it.



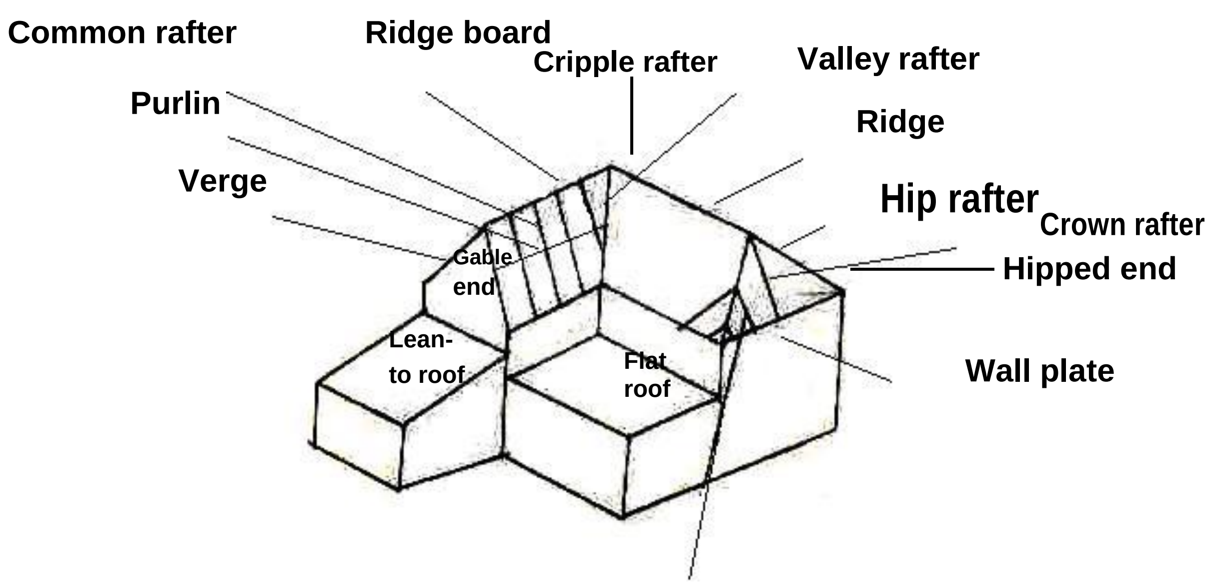
Window or door opening

The ends of the lintel are built into the brick or block work over the jambs so as to transmit the weight carried by the lintel to the jambs. The area on which the end of lintel bears is termed its bearing ends. The wider the opening the more load the lintel has to support and the greater its bearing at ends must be so as to transmit the load it carries to an area capable of supporting it. Lintels in most cases are rectangular in section, could be ‘precast’ (cast inside a mould the wall) or cast in-situ (cast in position inside a timber mould fixed over the opening in walls).

3.3: ROOF

The roof structure serves principally to prevent weather penetration and as a barrier against heat loss. The roof structure is broadly classified into two groups, flat roofs and pitch roofs. Roof structures are classed according to the interrelationship of components which make up their framework as follows: Single roofs, double roofs, triple roofs, trussed rafters. Materials employed or used for the construction of roofs are basically timer, concrete, and steel. Most pitch roofs are normally constructed of timer or steel, possibility of flat roofs in timber and steel still exist. Consequently, most roof structure in concrete are constructed as flat roofs.

The figure below shows a combination of roof formations. This unlikely arrangement indicates constructional forms, components and allied terminology which must be noted.



Jack rafter

3.3.1: TYPES OF ROOF

i. **Pitch roof:** A pitch roof has one or more roof slopes at a pitch or slop of more than 10° to horizontal. The most common roof shape is the symmetrical pitch roof, pitched to central ridge with equal slope. A mono pitched roof has only one slope free standing vision lean to roof. A pitched roof is stable in most weather and its slope disposes of rainwater quickly. The main supporting structure is timber, which is easy to work and transport. Pitched roof can be built in different ways depending on the loads and sizes. Below are the lists of pitched roof that use different methods of construction:

- ✓ Lean-to roof
- ✓ Couple roof
- ✓ Closed couple roof
- ✓ Collar roof
- ✓ Trussed rafters roof

ii. **Flat Roof:** A flat roof is basically a low-pitched roof and is defined as a pitch of 10° or less to the horizontal. The angle of pitch is governed by the type of finish which is to be applied to the roof. Flat roofs can be timber or reinforced concrete and are popular forms of roofing for houses. Points to consider when constructing a flat roof:

  - ✓ It requires a deck or slab
  - ✓ It must have some insulation
  - ✓ A method of disposing rainwater etc

3.3.2: PROPERTIES AND FIXING DETAILS OF ROOF COVERINGS

- **Tile covering:** Roof tiles are usually made from clay or concrete that is moulded into suitable shapes. The tiles are overlapped so that the rainwater flows down the slope of the roof and the roof structure underneath remains dry. Fixing details of tile covering includes:

- ✓ Fix the battens to the correct gauge position
- ✓ Begin laying tiles at the eaves
- ✓ Make sure that each tile interlocks with the tile next to it
- ✓ Finish laying the tiles at the ridge.

- **Roof sheets covering:** This is covering the roof with sheeting materials like corrugated fibre cement and corrugated galvanized steel. Fixing detail includes:
  - ✓ Position the first sheet in the bottom corner of the roof framework
  - ✓ Drill through a sheet on top of the corrugations.
  - ✓ Fix it to the purlins with galvanized iron drive screws and supped washers
  - ✓ Lay the next sheet so that it overlaps the first sheet by one corrugation
  - ✓ Fix a special ridge member that is in two parts.

3.4: CONCRETE PRODUCTION:

Concrete is an artificial material, obtained by mixing cement, coarse aggregate, fine aggregate and water, in suitable proportions. These ingredients, when freshly mixed, produce a plastic mass which can be poured into suitable forms or moulds, to give the desired shape to the resulting solid mass. The plastic mass gets converted into a solid stone-like hard mass with the passage of time, as a result of the chemical reaction taking place between cement and water. The aggregates do not undergo any chemical change. They simply act to give mass volume to the concrete and reduce shrinkage effects. Hardened concrete resemble stone in weight, strength, and hardness.

Concrete is an important and versatile material, and extensively used building material that can be easily manufactured on site. Concrete while in plastic state can be moulded into almost any shape; and when set (dry) it possesses great strength and durability. Concrete as produced, achieves a great strength depending on the quality and quantity of cement in it. The richer the concrete is in cement, the greater the strength of the concrete. So also a dense and stronger concrete is obtained depending on how dense and tough the coarse aggregate is. Concrete is divided into two types. These are plain and reinforced concrete. When concrete is embedded with reinforcement to increase its tensile strength, it is called reinforced concrete. Without the reinforcement it is called plain concrete. Production of good concrete is based on the following use of the materials that make it up:

- ✓ The particles of aggregates should be clean and free from coatings of dust and clay if the full bond is to be developed.
- ✓ All aggregates should be inert in water and should not contain constituents that are likely to decompose or change in volume through exposure to the atmosphere.
- ✓ They should be free from organic impurities which may affect the setting and hardening of

cement.

- ✓ They should have a low absorption value, if used for concrete exposed to the weather or in contact with liquid.

3.4.1: PRODUCTION PROCESS OF CONCRETE:

i. BATCHING: Batching is the process of measuring the desired quantity of the various constituents of concrete to obtain the desired mix for the concrete. Batching can be by weight or by volume.

- **Batching by Volume:** In this method an open top box called a gauge box is used to measure the quantity of the various materials. Cement is most times supplied for use in a unit 50 kg bag and has a volume of about 0.035 m3. For a 1:2:4 mix ratio, the gauge box is filled once with cement, two times with fine aggregate and four times with coarse aggregate. At all times the top of the gauge box is struck off level each time. If the fine aggregate is damp or wet its volume will increase by up to 25% and therefore the amount of fine aggregate should be increased by this amount. This increase in volume is called bulking. Batching by volume is not a very accurate method. This is because the weight of cement per unit volume varies depending on the degree of compaction during loading into the gauge box. This method is therefore not suitable for high quality work. It is however adequate for most small size jobs.
- **Batching by Weight:** This method entails measuring out the exact quantities of the various materials using any suitable weighing method depending on the quantity of the materials to be batched. This is the better method since it has a greater accuracy and the weighing balance can be attached to the mixing machine. It water is usually measured by volume and specified as to the number of litres per bag of cement to be mixed.

ii. MIXING: Mixing of concrete is done by two means. These are hand mixing and machine mixing.

- **Hand Mixing:** Hand mixing should be carried out on a clean hard surface. The materials should be thoroughly mixed in the dry state twice before the water is added. The water should be added slowly and mixed at least three times.
- **Machine mixing:** Machine mixing is done in stationery or transit mixers. The mix should

be turned over in the mixer for at least two minutes after adding the water in the stationery mixer. The first batch from the mixer tends to be harsh since some of the mix will adhere to the sides of the drum. This batch should be used for some less important work such as filling in weak pockets in the bottom of the excavation. In the transit mixer, the batched materials are charged into the mixer and the mixing takes place as the concrete is taken to the point where it is to be used.

- **Ready mixed:** This is used for large batches with lorry transporters up to 6m3 capacity. It has the advantage of eliminating site storage of materials mixing plant, with the guarantee of concrete manufactured to quality – controlled standards. Placement is usually direct from the lorry; therefore, site- handling facilities must be coordinated with deliveries.

iii. HANDLING: If concrete is to be transported for some distance over rough ground, the runs should be kept as short as possible since vibration of this nature can cause segregation of the materials in the mix. For the same reason concrete should not be dropped from a height of more than 1m. If this is unavoidable a chute should be used.

3.4.2: SPECIFYING CONCRETE: Concrete can be specified by any of the following methods:

- **Designed Mix:** The mix is specified by a grade corresponding to required characteristic compressive strength at 28days.There are 12 grades from C7.5 to C60, the C indicates the compressive strength in N/mm2 or MPa. Flexural (F) strength grades may also be specified as F3, F4 or F5 i.e. 3, 4 or 5 N/mm2. Also the requirement must specify the cement and aggregate content and maximum free water/ cement ratio.
- **Prescribed Mix**: This is a recipe of constituents with their properties and quantities used to manufacture the concrete. The specification must be made for:
  - ✓ The type of cement
  - ✓ Type of aggregates and their maximum size
  - ✓ Mix proportions by weight Degree of workability

  Prescribed mixes are based on established data indicating conformity to strength, durability and other characteristics. Examples of prescribed mix include the following:

  1:3:6/40mm aggregate. 1:2:4/20mm aggregate. Suitable mixes for different jobs are: -

  - 1: 3:6 - Mass concrete

- 1:2:4 - Reinforced concrete

- **Nominal mixes:** This is the older method of proportioning concrete mixes and was widely used in the past. For small jobs, the use of nominal mixes is still fairly adequate enough. The method is very simple and fast. In this mix proportioning method, the proportion of cement and aggregates are fixed, only the water-cement ratio is varied. Table 1(c) shows some nominal mixes and where they could be used.

  For these kinds of mixes to meet the necessary requirements of fresh and hardened concrete, trial mixes should be made first. If after the trial a mix does not prove to be satisfactory, one should change the ratios of the coarse to fine aggregates until a satisfactory mix is arrived at. For instance, the ratios of coarse to fine aggregates could be varied between the limits of 1½:1 and 3:1, but the sum of the proportions of the fine and coarse aggregates of the selected prescribed mix should not be varied.

  The best ratio of fine to coarse aggregate depends on:
  - Grading of the fine aggregate
  - Particle shape
  - Surface particle texture of the coarse aggregate

3.4.3: Control for Concrete Mix

Workability: The quality of plastic concrete mix (fresh concrete) is assessed by workability test. Workability is the fluidity of concrete. Generally, workability is defined as the ease with which a given set of materials can be mixed into concrete and subsequently handled, transported and placed with minimum loss of homogeneity. Thus, the term workability means compactibility, placeabilty, pumpability, mobility, and stability. The degree of workability is selected based on the following considerations:

- ✓ Method of mixing
- ✓ Method of transportation
- ✓ Method of placing
- ✓ Nature of the reinforcement (whether congested or not)
- ✓ Method of compaction.

Factors Affecting Workability: The workability of a concrete mix can be improved without necessarily increasing the mix water content, raising the water content for workability could cause segregation, bleeding, low strength and durability of the hardened concrete, etc. The workability can be improved by changing the followings:

- ✓ Aggregates ‘grading
- ✓ Maximum aggregate size
- ✓ Water/cement ratio (cement and water content)
- ✓ Aggregate/cement ratio
- ✓ Aggregate shape
- ✓ Aggregate texture

Assessment of Workability: Workability cannot be measured. It can only be assessed indirectly by measuring the slump or the compacting factor.

Slump Test: This test together with careful observation of the concrete is the best means of assessing workability of a mix. The slump test assists in assessing the consistency of a mix. The plasticity and harshness is best noted by observing the appearance of the slump specimen after the mould has been removed. A plastic mix (workable mix) will tend to stick together and subsides unbroken when the mould is removed, while a harsh mix breaks. Using the slump test a mix could have:

- ✓ True slump: representing mix with low to medium workability
- ✓ Shear slump: representing harsh mix, low cement grading, improper shapes and textures etc.
- ✓ Collapse slump: representing mix with high workability

Compacting Factor test: Slump test is satisfactory for medium and high workability. Where concrete of very low workability is to be tested, the compacting factor test is more appropriate. This test is done with a compacting factor apparatus. Compacting factor test measures the degree of compaction achieved by a standard amount of work done. The compacting factor is expressed to two decimal places. The value of C.F. ranges from 0.75 to 1.0. Concretes with C.F. 0.75 cannot be compacted with hand. Table 21.0 compares degrees of workability of concrete as assessed by compacting factor and slump tests. Table 22 shows recommended workabilities for different types of constructions.

Table 21.0 Comparison between workability assessment methods slump and compacting factor test

Slump (mm)	Compacting Factor	Degree of Workability
0 --25	0.78	Very low

25-50	0.85	Low
50-100	0.92	Medium
100-175	0.95	High

3.5 USE OF FORM WORK IN FLOOR CONSTRUCTION

Concrete when first mixed is a fluid and therefore to form any concrete member the wet concrete must be placed in a suitable mould to retain its shape, size and position as it sets. These moulds are called formwork. Formwork provides a level platform to support the wet concrete until it hardens enough to be self-supporting. The formwork is made from timber boards propped up from the floor below by timber supports. The structure must take account of any beams, lintels and openings. It should be strong and stable so that it can support the weight of people and plant as well as the concrete.

Concrete for floor is basically a four sided box with provisions for beams that may be constructed monolithically with the floor and propped in the correct position and to the desired level. It is essential that all joints in the formwork are constructed to prevent the escape of grout which could result in honeycombing and/or feather edging in the slab cast.

3.6: SCAFFORDING

3.6.1: Principles of Scaffolding: Scaffolds are temporary working structures made from poles of wood or metal erected around the perimeter of a building or a structure to provide a safe working place at a height that cannot be reached from the ground. They are usually required when the working height or level is 1.500m or more above the ground level. All scaffolds must comply with the minimum requirements and objectives of the constructions (Health Safety and Welfare) Regulations 1996.

3.6.2: Parts of a Scaffold: The basic parts of a scaffold consist of the following and are:

Base boards are timber boards that support the base plate on soft or uneven ground.

Base plates are square metal plates that fit into the bottom of scaffold tubes to spread the load.

Braces are poles fixed diagonally to stiffen the scaffold by forming a triangle.

Standards are the vertical poles that carry the weight of the scaffold to the ground.

Toe boards are the boards along the edges of platforms which prevent materials from falling.

Transoms are cross pieces that rest on the ledgers and support the platform.

Ledgers are longitudinal horizontal components that are fixed to the standards.

Putlogs are transverse horizontal members fixed to the ledger.

3.6.3: TYPES OF SCAFFORD

i. **Putlog Scaffolds:** These are scaffolds which have an outer row of standards joined together by ledger which in turn support the transverse putlogs which are built into the bed joints or perpends as the work proceeds. They are therefore only suitable for new work in bricks

ii. **Independent scaffolds:** These are scaffolds which have two rows of standards each row joined together with ledgers which in turn support the transverse transoms. The scaffold is erected clear of the existing or proposed building but is tied to the building or structure at suitable intervals.

iii. **Mobile scaffolds:** Mobile scaffolds sometimes called mobile tower scaffolds are constructed to the basic principles as for independent tubular scaffolds and are used to provide access to restricted or small area and or where mobility is required.

iv. **Cantilever scaffolds:** These are a form of independent tied scaffold erected on cantilever beams and used where it is impracticable undesirable or uneconomic to use a traditional scaffold requires special skills and should therefore always be carried out by trained and experienced personal

v. **Suspended scaffold:** Suspended scaffold, these consist of a working platform in the form of a cradle which is suspended from cantilever beams or out riggers from the roof of a tall building to give access to the facade for carrying out light maintenance work and cleaning activities. The cradle can have manual or power control and be in single units or grouped together to form a continuous working platform. If grouped together they are connected to one another at their allotment ends with hinges to form a gap of not more than 25mm wide. Many high rise building gave a permanent cradle system installed at roof and this is recommended for all building over 30 m high.

Ten commandments of scaffolding

i. Ensure loadings will not be exceeded.
ii. Bases are complete, firm, on level ground
iii. Diagonal bracing to be adequate
iv. Check ties, and mesh cloth, as part of regular inspection.
v. Lock wheels on mobile scaffold before using it.

vi. Ladders MUST be secured at the top and bottom.
vii. Handrails and/or toe boards MUST be in place before anyone starts working.
viii. Planks should be secured.
ix. Scaffold is NOT a workbench. You don't grind, weld or straighten rebars with it.
x. IF IN DOUBT - ASK.

3.7 STAIRCASE

The most common form of vertical circulation in upstairs and access to the upper floors is the stairway. One can define stair as a number of steps leading from one level to another, and its function is to provide means of movement between floor to floor in storey building, and as well serves, as means of escape from upper floors in case of fire accident. Functional requirements of stair case

- ✓ Stability
- ✓ Fire resistance
- ✓ Sound insulation
- ✓ Strength

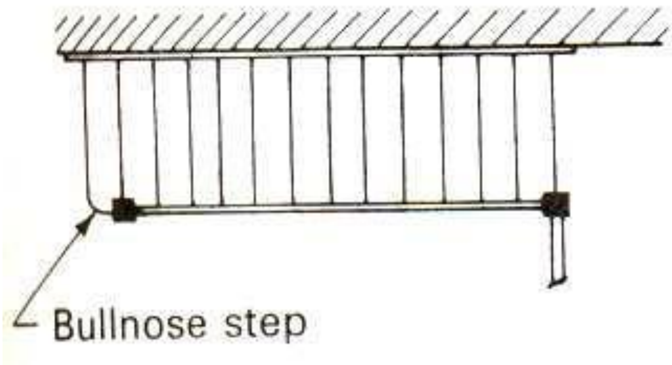
Safety requirements of staircase

- ✓ Durability
- ✓ Headroom
- ✓ Balustrades
- ✓ Ventilation and light window
- ✓ Handrail
- ✓ Uniform steps

3.7.1: TYPES OF STAIRS:

- **Straight flight** (not more than 15 steps)

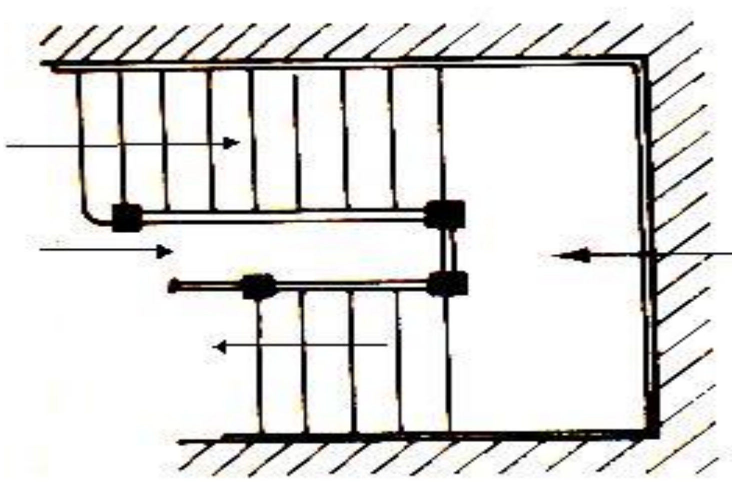
  This is kind of stair that has only one or more flight in straights order and it has not more than fifteen steps before landing. This is most suitable where space is limited and cannot accommodate other types of stairs.



Straight flights

- **Open well stair** (with 2/4 space landing)

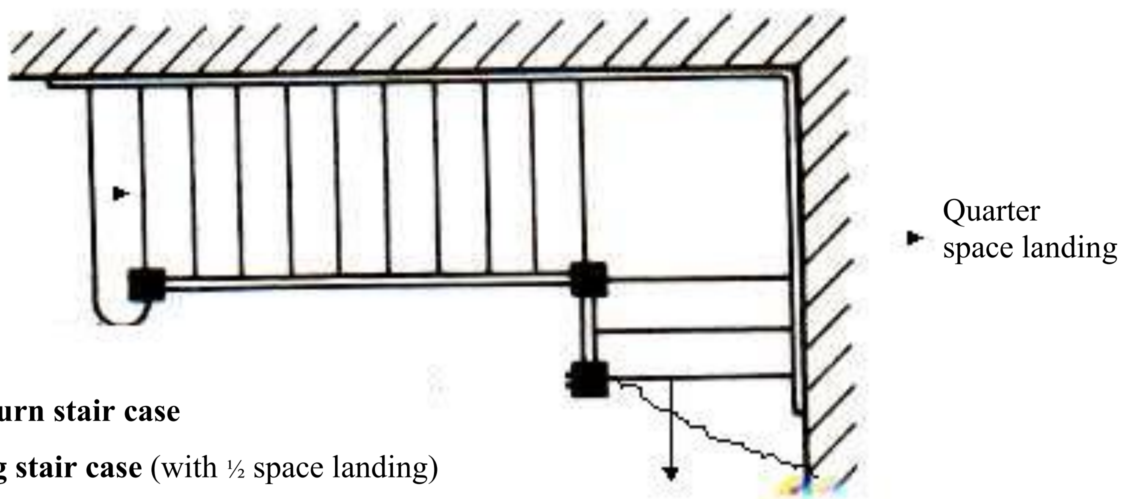
  This is a kind of stair which has two quarter space of landing and space in between the two flight.



Open well stair

- **Quarter turn stair case**

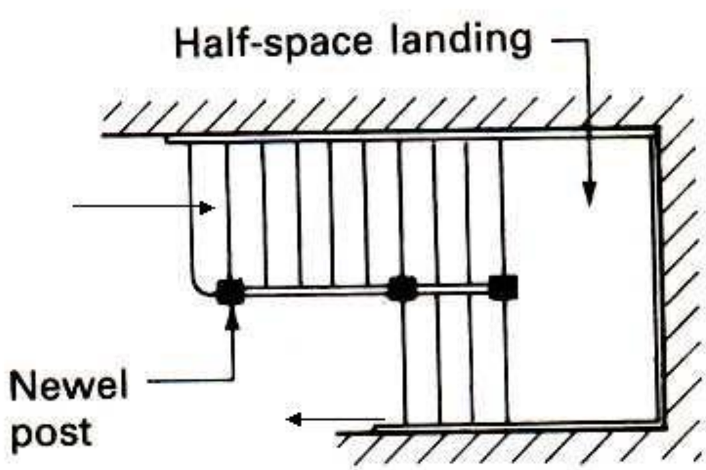
  This is a kind of stair that one needs to turn through a quarter of circle from the first flight to the second flight.



Quarter turn stair case

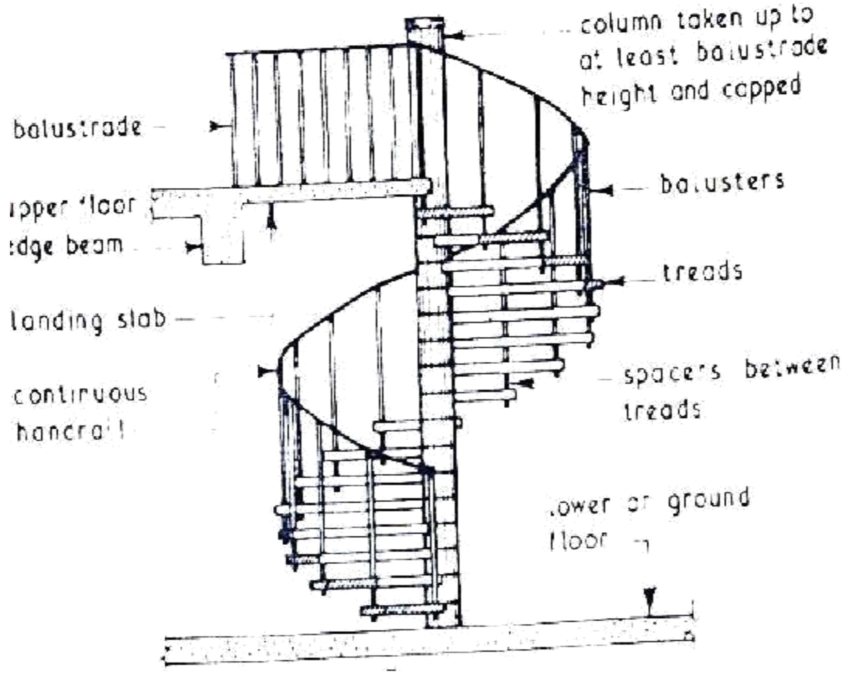
- **Dogleg stair case** (with ½ space landing)

  This is a kind of stair that has have space landing with no space in between the first and the second flight, this means one ascending will have to turn half of a circle to be on the second flight.



Dogleg stair case

- **Spiral staircase:** This is a kind of stair that one ascending will have to turn to complete circle before he could reach the floor above.



Spiral staircase

3.8: PARTITION WALLS

It is an internal wall which is constructed to divide the spaces in an enclosed building into rooms or areas. It can be constructed using bricks, sandcrete blocks, timber, metal, glass or plastics.

3.8.1: Functions of Partition Walls: Partition walls perform the following functions

- ✓ Divide the inside of a building into rooms and spaces
- ✓ Divide a building into separate occupancies
- ✓ Separate adjoining properties
- ✓ Sometimes help to support loads if it is so designed.

3.8.2: Types of Partition Walls

- ✓ **Party walls:** is a wall separating adjoining building belonging to different owners or occupied by different persons.
- ✓ **Separating walls**: is a wall separating different occupancies within the same building.
- ✓ **Curtain wall:** Is the self-supporting wall carrying no other vertical wall load, but subjected to lateral forces.

3.9: FENESTRATION IN BUILDING

Fenestration refers to openings in a building which allow access for air (ventilation), light, walkways and comfort. These openings are also part of building components. They are namely doors, windows, chimneys, courtyard, screened walls etc

3.9.1 Functional requirement of opening in walls

Openings are made in walls to accommodate doors and windows, and also on some are made to admit light and air into the building. But these openings forms weakness in walls, and if there happens to be any settlement or shrinkage of materials in the structure, then cracking is most likely to be seen where these openings are. Therefore, it is essential to ensure that care is taken when making opening, in bricks work to achieve the greatest amount of strength and stability of the walling surrounding them.

3.9.2 Treatment to Openings

An opening consists of a head, jambs and sill. The different methods and treatments which can be used in their formation are many but are based on the same concepts.

All openings should be treated with anti-termite treatments, and anti-rust treatment; BSC most materials used for doors and windows are either timber or steel.

Doors and windows are the main openings in brick walls. Their locations are shown on the working drawings together with the head and sill height. These heights should relate to the datum or over site slab level. If this is not the case, then the heights must be recalculated and decision taken as to which courses will take the openings. The brick work is finished neatly on each side of the opening with a stop-end. The method is similar to finishing off at a quoin. Insert a closer before the last header in alternate courses in English and Flemish board.

The sill does not need special treatment but at the head there are alternative methods to carry the brickwork across the opening. These are lintels and Arches

3.10 Lintels and Arches

Lintel

A lintel (figure 3.1) is a beam that spans across a horizontal opening and supports the load just above the opening. Lintels can be timber or concrete. Timber is fine for short spans but is not durable. For this reason, most lintels are built from reinforced concrete.

The lintel can be covered with skin decorative brickwork which needs support. This is done by:

- Bolting a galvanized steel angle to the concrete lintel.
- building the decorative brickwork on the edge of the angle;
- Tying the brick joints to the lintel with metal ties.

Constructing concrete lintels

Structural engineers design lintels for larger buildings but the following basic guidelines could be used to construct a lintel for domestic scale construction. Table 3.1 gives some basic requirements for smaller lintels.

After designing the lintel, it should be cast (or made). Lintels can be in situ or precast. The span will determine the height of the lintel, which should correspond to the height of full brick courses.

Table 3.1 Standard dimensions for lintels

Span (mm)	Depth (mm)	Reinforcement sizes (mm)
900	150	10
1200	150	12
1500	215	12
1800	215	16

The design of the lintel should use these additional requirements:

- one reinforcement bar for each 112mm width of lintel;
- the width must be at least 1/20th of the span;
- the bearing of the lintel must be more than 150mm;

- at least 25mm of concrete must cover the bottom of the reinforcement bar;
- at least 50mm of concrete must cover the ends of the bar.

3.11: FINISHES

Finishes are the treatments that are put on internal floors, internal and external walls ceilings and soffits of suspended floors. They serve decorative and practical functions. They improve the appearance of the structures underneath, and also prolong building life spans. The treatments called finishes include:

- plastering
- rendering
- painting

Plastering: Plastering is the application of a smooth coat of material to walls and ceilings. The purpose of plastering is to provide a jointless, hygienic, easily decorated smooth finish to walls. Plaster covers up the unevenness of bricks, blocks or concrete. Plaster is mixed with water to make a plastic mixture, which can be spread directly on a surface in thin layers of about 10 mm thickness. The surface absorbs the water in the mix by a process called suction. The suction process stiffens the plaster rapidly so that it can be leveled while it sets and hardens. When the plaster dries it leaves a hard, smooth finish for decoration. Plaster consists of powdered cement, sand and lime or gypsum. All these materials except sand are supplied in bags.

Rendering: Rendering refers to the process of applying a cement and sand plaster coat to the outside walls of a building. Rendering is applied to:

- ✓ Improve the appearance of concrete block walls
- ✓ Provide a waterproof finish to porous blocks such as landcrete and sandcrete blocks
- ✓ Provide a base for colour finish.

Rendering is a mixture of cement and sand. Lime is sometimes added to improve its pliability.

Several kinds of finishes and textures are common to external rendering. They improve the appearance of the cement and sand mix and help to control shrinking and cracking, which affects the waterproof quality of render.

Painting: Painting is the application of a pigmented liquid that stretches thinly across a surface when the liquid dries out. Walls, ceilings, woodwork and metalwork are painted to

- ✓ Provide a decorative appearance
- ✓ Protect the surface from moisture penetration
- ✓ Protect the surface from rusting.

A standard paint consists of

- ✓ Thinners
- ✓ Pigments
- ✓ Binders.

3.11.1 **Floor Finishes:** Floor finishes are usually applied to a structural base but may form part of the floor structure as in the case of floor boards. Most finishes are chosen to fulfill a particular function such as:

Resistance to wear: Some parts of a building receive more use than others or are in closer contact with the dust or mud outside. The floor finish should match the type of wear that is normal in a specific part of a building so that it lasts many years without replacement.

Resistance to grease and oil: The floor should not be damaged by grease and oil spills and they should be easily wiped from the surface. Spills are a particular problem in kitchens

Resistance to water spills: The flooring in bathroom and kitchen needs to withstand water spills from washing or plumbing leaks.

Ease of cleaning: Surfaces that allow dirt to easily penetrate are harder to keep clean. If ease of cleaning is a priority, then a hard smooth finish is better than a soft open texture.

Warmth or coolness: Hard smooth surfaces are cool to walk on because they conduct heat away. Soft textured finishes like carpet give a room a warmer feel which may be suitable for cooler climates.

Noise: Hard surfaces do not absorb sound so they are noisier than soft surfaces

Cost: The costs vary enormously for the higher range of finishes. The cheapest finish is a cement screed. The most expensive are carpet, wood block or special floor tiles.

3.11.2: Different types of floor finishes

The following are the most common types of floor finishes.

- Terrazzo tiles
- PVC
- Granolithic screeds
- Cement and sand screed
- Ceramic tiles finish
- Wood floor finish

Terrazzo tiles

The floor is floated once it has been soaked in ebonite (hardened PVC materials that is flexible to a limit) is laid in modules floor is then cast with thickness of 20 mm and a grinding machine is then used to grind the surface to finish after about 2-3 days of casting. The floor after grinding may be 19mm thick. Detergent or washing solvent is used to wash the surface after grinding. The surface is then polished to finish. Terrazzo floors are laid by applying a 25 mm cement and sand screed which is followed by the cement and marble mixture (i.e. terrazzo) while the screed is still fresh. An important feature of a terrazzo finish is the strip of metal, ebonite or plastic strips which go through the screed to the subfloor to divide it into bays. The purpose of the strips is to limit the bays to $1m^2$. This prevents shrinkage cracks and makes the floor finish particularly decorative if different colours of terrazzo are used.

Pre-cast terrazzo tiles

This is the one that is prepared in the workshop or factories and brought to site and laid in position. In the case of ebonite PVC, the gaps are filled with glamn. But we butter the bottom of the tile with thick cement only.

PVC tiles

The PVC tiles have precise measurements (300 x 300 x 3mm). They must be laid on a perfectly smooth screed because they are so thin and fixed with adhesive. However, they can be fitted so closely that they do not have a gap in the joints. PVC tiles are usually resistant to grease and oil, water proof and durable. Although they come in wide range of colours and textiles, PVC tiles are one of the cheapest floor finishes that one can buy and lay. They are maintained by applying a surface coating of wax and then washing with soapy water.

Granolithic screeds

This uses granite chippings in a cement and sand screed in 1:1:3 mixes to improve the wearing qualities. The granite chips are graded from 5mm to dust. This screed can be laid on fresh concrete so that it forms a 25mm monolithic bond in bays which are less than $10m^2$. If the screed is laid after the concrete is dry, then the thickness of the screed must be 40-50mm. The top of the granolithic screed must be leveled and compacted. It becomes firm when it sets. In this case you must smooth it with a steel trowel at least three times in a 6 hour period to produce a hard, dense surface without an accumulation of fine particles. The screed must be cured for seven days.

Cement and sand screed

This type of floor finish is laid if the concrete subfloor is not smooth or level enough for a floor finish. The screed consists of a layer of mortar, which provides a good surface when leveled with a steel trowel. The thickness of the mortar, which does not give any structural support, varies from 25 to 60 mm in a 1:3 cement and sand mix depending on the circumstances. As little water as possible is used to minimize shrinkage.

Ceramic floor tiles

This type of tiles is made from ceramics. This are product from refine natural clays which are pressed after grinding and tempering into the desired shape before being fire at high temperature. They are valuable in sizes ranging from 50 x 50 mm to 300 x 300 mm in thickness of 9.5mm to 13mm.They are laid on mortar beds. Some tiles have wide joints which have to be filled separately, while others are fitted so tightly that no joint filling is needed.

Wood floor finish

The most common wood floor finishes are

- Wood mosaic
- Wood strip

Wood Mosaic

Wood mosaic is a low-cost type of hardwood floor which uses off-cuts of hardwood. The wood is shaped into pieces 150 x 300 x10 mm and assembled into 300 x 300 x 10 mm panels. The panels are laid in groups of five in a basket weave pattern on a paper backing which holds them together while they are transported. Each panel is laid separately on a completely dry cement and sand screed which is first of all cleaned of all loose materials. They panels are stuck on the screed with adhesive so that each panel fits tightly against the next. The installation is completed by removing the paper backing.

Wood strip

Wood strip flooring is made from timber strips in softwood or hardwood fixed to battens on concrete subfloor. The battens are secured by

- Casting galvanized metal clips into the concrete or screed.
- Casting dovetail battens into the screed so they are anchored as the screed dries.

The process is completed by sanding or polishing to a fine finish.

3.11.3: WALL FINISHINGS

In wall finishes, the following can be applied

- Plastering
- Rendering
- Tiling

Applying a plaster finish

One, two or three coats of plaster may be applied to achieve a smooth finish. Generally, two coats need to be applied unless plasterboards are being used, in which case only one coat is needed. Three coats are only used if the surface is extremely uneven. The first coat in a three-coat finish, called a screed coat, is applied to level the surface and to ensure that the plaster is the correct thickness. The background is first all prepared. Any depressions in the surface should be filled with mortar or neat plaster. A cement and sand mixture (1:3 combined with minimal water) is applied with a trowel. The sand should be well graded to reduce cracking from shrinkage after the plaster dries. Before the first coat fully sets, it should be scratched to provide a key for the second coat and leave to dry. A finishing coat of neat plaster is then applied with a steel float to produce a thick, smooth finish.

External rendering: Several finishes and textures are common to external rendering such as; Smooth render, roughcast render, scraped render, pebbledash render, Tyrolean render to improve the appearance of cement and sand mix and help to control shrinking and cracking, which affects the waterproof quality of render.

Wall tiling: Tiles are made from clays with special additives. Common sizes for wall tiles are

- 150 x 150 x 5-6 mm
- 100 x100 x4-5 mm

Their shapes and sizes may vary, but the method of fixing and pointing are the same for all tiles. On an even surface, tiles are fixed using the thin bed method using a special adhesive 1-2 mm thick to fix thin tiles to a smooth surface such as plaster. It can only be used on smooth surfaces since the adhesive is the only anchor for the tiles. On an uneven surface, the thick bed method is used to fix the wall tiles. A 1:4 cement sand mortar is prepared and spread over a wall as a wet bed to push the tiles into. Battens of the same thickness as the tiles and mortar bed can be nailed to the wall to act as a guide to the finished levels.

3.11.4: **Ceiling finishes**

The soffit of reinforced concrete slab that forms the ceiling should be level if the formwork was well built. If the surface is very uneven, then you will need to apply three coats of plaster. The first coat is the render coat, which creates a level surface with screeds. It should be about 10 mm thick. The second coat called the float coat should be 6 mm thick, and the ceiling should be finished off with a final 2 mm coat of neat plaster.

Plasterboards can make good ceilings timber suspended floors or pitched timber roof. The boards are fixed so that their lengths are at right angles to the floor joist or ceiling joists at 400 mm centres. The boards are usually large and heavy; about 2400 x 1200 mm and weigh 25 kg. Boards nailed at 150 mm centres along the lines of the joists. The joints at the ends of the boards should be under a joist, which may require cutting to fit. The process is finished by binding and filling the joints before applying a skim coat of plaster.

Painting of ceiling

Ceilings are painted to make it attractive, protect the surface from moisture penetration and rust. The following steps are taken in the plastering of ceilings:

- Remove all plaster splashes with a scraper
- Fill in and rub down any holes, scratches or grooves
- Remove dust with a soft brush
- Dilute the emulsion with 10 per cent additional water and paint it on as a priming coat.
- Leave it about an hour
- Apply the full-strength emulsion
- Leave it for 2 or 3 hours
- Paint on the final coat of emulsion