G. PULLAIAH COLLEGE OF ENGINEERING AND TECHNOLOGY
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Department of Civil Engineering

Bridge Course
On
Estimation, Costing and Valuation

Building materials

Classification of Bricks as per common practice:

Bricks, which are used in construction works, are burnt bricks. They are classified into four categories on the basis of its manufacturing and preparation, as given below.

1. First class bricks

2. Second class bricks

3. Third class bricks

4. Fourth class bricks

First Class Bricks:

These bricks are table moulded and of standard shape and they are burnt in kilns. The surface and edges of the bricks are sharp, square, smooth and straight. They comply with all the qualities of good bricks. These bricks are used for superior work of permanent nature.

Second Class Bricks:

These bricks are ground moulded and they are burnt in kilns. The surface of these bricks is somewhat rough and shape is also slightly irregular. These bricks may have hair cracks and their edges may not be sharp and uniform. These bricks are commonly used at places where brick work is to be provided with a coat of plaster.

Third Class Bricks:

These bricks are ground moulded and they are burnt in clamps. These bricks are not hard and they have rough surfaces with irregular and distorted edges. These bricks give dull sound when struck together. They are used for unimportant and temporary structures and at places where rainfall is not heavy.

Fourth Class Bricks:

These are over burnt bricks with irregular shape and dark colour. These bricks are used as aggregate for concrete in foundations, floors, roads etc, because of the fact that the over burnt bricks have a compact structure and hence they are sometimes found to be stronger than even the first class bricks.

Classification of Bricks as per constituent materials

There are various types of bricks used in masonry.

• Common Burnt Clay Bricks

• Sand Lime Bricks (Calcium Silicate Bricks)

• Engineering Bricks

• Concrete Bricks

• Fly ash Clay Bricks

Common Burnt Clay Bricks

Common burnt clay bricks are formed by pressing in moulds. Then these bricks are dried and fired in a kiln. Common burnt clay bricks are used in general work with no special attractive appearances. When these bricks are used in walls, they require plastering or rendering.

Sand Lime Bricks

Sand lime bricks are made by mixing sand, fly ash and lime followed by a chemical process during wet mixing. The mix is then moulded under pressure forming the brick. These bricks can offer advantages over clay bricks such as: their colour appearance is grey instead of the regular reddish colour. Their shape is uniform and presents a smoother finish that doesn't require plastering. These bricks offer excellent strength as a load-bearing member.

Engineering Bricks

Engineering bricks are bricks manufactured at extremely high temperatures, forming a dense and strong brick, allowing the brick to limit strength and water absorption. Engineering bricks offer excellent load bearing capacity damp-proof characteristics and chemical resisting properties.

Concrete Bricks

Concrete bricks are made from solid concrete. Concrete bricks are usually placed in facades, fences, and provide an excellent aesthetic presence. These bricks can be manufactured to provide different colours as pigmented during its production.

Fly Ash Clay Bricks

Fly ash clay bricks are manufactured with clay and fly ash, at about 1,000 degrees C. Some studies have shown that these bricks tend to fail poor produce pop-outs, when bricks come into contact with moisture and water, causing the bricks to expand.

Cement

Cement is a binder, a substance that sets and hardens and can bind other materials together. Cements used in construction can be characterized as being either hydraulic or non-hydraulic, depending upon the ability of the cement to be used in the presence of water. on-hydraulic cement will not set in wet conditions or underwater, rather it sets as it dries and reacts with carbon dioxide in the air. It can be attacked by some aggressive chemicals after setting. Hydraulic cement is made by replacing some of the cement in a mix with activated aluminum silicates, pozzolanas, such as fly ash. The chemical reaction

results in hydrates that are not very water-soluble and so are quite durable in water and safe from chemical attack. This allows setting in wet condition or underwater and further protects the hardened material from chemical attack (e.g., Portland cement).

Use

• Cement mortar for Masonry work, plaster and pointing etc.

• Concrete for laying floors, roofs and constructing lintels, beams, weather-shed, stairs, pillars etc.

• Construction for important engineering structures such as bridge, culverts, dams, tunnels, light house, clocks, etc.

• Construction of water, wells, tennis courts, septic tanks, lamp posts, telephone cabins etc.

• Making joint for joints, pipes, etc.

• Manufacturing of precast pipes, garden seats, artistically designed wens, flower posts, etc.

• Preparation of foundation, water tight floors, footpaths, etc.

Concrete

Concrete is a composite material composed mainly of water, aggregate, and cement. Often, additives and reinforcements are included in the mixture to achieve the desired physical properties of the finished material. When these ingredients are mixed together, they form a fluid mass that is easily molded into shape. Over time, the cement forms a hard matrix which binds the rest of the ingredients together into a durable stone-like material with many uses.

The aim is to mix these materials in measured amounts to make concrete that is easy to: Transport, place, compact, finish and which will set, and harden, to give a strong and durable product. The amount of each material (cement, water and aggregates) affects the properties of hardened concrete.

Production of concrete

A good quality concrete is essentially a homogeneous mixture of cement, coarse and fine aggregates and water which consolidates into a hard mass due to chemical action between the cement and water. Each of the four constituents has a specific function. The coarser aggregate acts as a filler. The fine aggregate fills up the voids between the paste and the coarse aggregate. The cement in conjunction with water acts as a binder. The mobility of the mixture is aided by the cement paste, fines and nowadays, increasingly by the use of admixtures. The stages of concrete production are: Batching or measurement of materials, Mixing, Transporting, Placing, Compacting, Curing and Finishing

Stones

The process of taking out stones from natural rock beds is known as the quarrying. The term quarry is used to indicate the exposed surface of natural rocks. The stones, thus obtained, are used for various

engineering purposes. The difference a mine and quarry should be noted. In case of a mine, the operations are carried out under the ground at great depth. In case of quarry, the operations are carried out at ground level in an exposed condition.

Commonly used Stones in India.

Marble ;Sandstone ;Slate ;Basalt ;Limestone ;Granite ;Schist ;Gneiss ;Shale ;Conglomerate

Timber

A tree basically consists of three parts namely, trunk, crown and roots. The function of the trunk is to support the crown and to supply water and nutrients from the roots to the leaves through branches and from the leaves back to the roots. The roots are meant to implant the trees in the soil ,to absorb moisture and the mineral substances it contains and to supply them to the trunk.

Building Construction

The selection of the foundation type for a particular site depends on the following considerations:

1. Nature of subsoil.

2. Nature and extent of difficulties

3. Availability of expertise and equipment

Depending upon their nature and depth, foundations have been categorized as follows:

(i) Open foundations or shallow foundations

(ii) Deep foundations

Open Foundations

This is the most common type of foundation and can be laid using open excavation by allowing natural slopes on both sides. This type of foundation is practicable for a depth up to 5m and is normally convenient above the water table. The base of the structure is enlarged or spread to provide individual support. Since spread foundations are constructed in open excavations, therefore they are termed as open foundations. The various types of spread footings are:

1. Wall footings,

2. Isolated footings,

3. Combined footings,

4. Inverted arch footings,

5. Continuous footings

6. Cantilever footing

7. Grillage footing

1. Wall Footings: These footings can either be simple or stepped. The base course of these footings can be concrete or of entirely one material. They have only one projection beyond the width of the wall on either side. The width of the concrete base should be at least equal to twice the width of the wall. The depth of the concrete bed is at least equal to the projection. Generally the projection provided in the footing is 15cm, on either side.

2. Isolated or Column Footings: They are used to support individual columns. In case of heavy loaded columns, steel reinforcements are provided. Generally, 15cm offset is provided on all sides of concrete bed. The footing of concrete columns may be slab, stepped or sloped type.

3. Combined Footings: A combined footing supports two or more columns in a row. The combined footing can be rectangular in shape if both the columns carry equal loads or can be trapezoidal if both the loads are unequal. Generally they are constructed of reinforced concrete. The location of the center of the gravity of the column loads and centroid of the footing should coincide.

4. Inverted arch footing: This type of footing is used on soft soils to reduce the depth of the foundation. Loads above an opening are transmitted from supporting walls through inverted arches to the soil. In this type of footings the end columns must be stable enough to resist the outward pressure caused by the arch action.

5. Continuous footings: In this type of footing a single continuous R.C. slab is provided as foundation of two or three or more columns in a row. This type of footing is suitable at locations liable to earthquake activities. This also prevents differential settlements in structures.

6. Strap or cantilever footings: Strap footing consists of two or more individual footings connected by a beam called strap. This type of footing is used where the distance between the columns is so great that the trapezoidal footing becomes quite narrow with bending moments.

7. Grillage footings: this type of footings is used to transmit heavy loads from steel columns to the soils having low bearing power. This type of arrangements prevents deep excavations and provides necessary area at base to reduce the intensity of the pressure.

Raft Foundations

A raft or mat is a combined footing that covers the entire area beneath a structure and supports all the columns. They are used where the soil mass contains compressible lenses so that the differential settlement would be difficult to control. Raft foundation is also used to reduce the settlement above highly compressible soils by making the weight of the structure and raft approximately equal to the weight of the soil excavated. The raft is composed of reinforced concrete beam with a relatively thin slab underneath.

Deep Foundations

These foundations carry loads from a structure through weak incompressible soils or fills on to the stronger and less compressible soils or rocks at depth. These foundations are in general used as basements, buoyancy rafts, caissons, cylinders, shaft and piles

1. Basements. They are constructed in place in an open excavation. They are hollow substructures designed to provide working space below ground level.

2. Buoyancy Rafts. They are hollow substructures designed to provide a buoyant substructure beneath which reduce net loadings on the soil to the desired low density.

3. Caissons. They are hollow s8ubstructures designed to be constructed on or near the surface and then sunk as single units to their required level.

4. Cylinders. They are single small cell caissons.

5. Shaft Foundations. They are constructed within deep excavation supported by lining constructed in place and subsequently filled with concrete.

6. Pile Foundations. The pile foundation is a construction supported on piles. A pile is an element of construction composed of timber, concrete or steel or a combination of them. The piles may be placed separately or they may be placed in form of a cluster throughout the structure.

Classification of piles:

1. Classification based on function: Bearing Pile, Friction Pile, Screw Pile, compaction Pile, Uplift Pile, Batter Pile and Sheet Pile

2. Classification based on materials and composition: Cement concrete piles, Timber piles, Steel piles, Sand Piles, and Composite piles.

Arches

Arches are structural members used in a building to bridge across the opening of doors, windows, or cupboards etc. to support the weight of the superimposed masonry by arch action.

Types of arches

(I)Classification according to no. of centers -: Outline of intrados / soffit may be formed by a single arc / combination of arcs of various radii and centers and so named as one centre, two centered, 3 centered arcs

* One centered arch- They have only one centre .The types are semi-circle, segmental arch(less than a semi-circle), horse shoe arch (more than a semi-circle),

Stilted arch (semi-circular with 2 verticals portions at sprinkling’s), bulls eye arch (complete circular arch)

* Two centered arch- They are

(a)Blunt arch- Both centers are within the arch itself.

(b)Gothic/Equilateral/pointed arch-Radii of arches are equal to span and centers are on springing points.

(c)Acute/laneet arch-both the centers lie on the springing line but outside the springing points.

* Three centered arch-

(a)Elliptical arch-It is the form of semi ellipse, two centers are used for making up the ends and the third is used to draw the central position.

(b) 3 centered drop arch-procedure here is reversed. Ends of the arch formed by arc, central portion are drawn by the other 2 centers.

*Four centered arch-Two arch are on the springing line and two are

Below the springing line.

*five centered arch-It looks like semi-elliptical arch. Its procedure is as following

(i) first draw the springing line and divide into 5 parts.

(ii)With centers as A and B draw arches of radius equal to span intersecting at point C5. Join C5 with 2 and 3.and produce indefinitely.

(iii)With centers as C1 and C2 and radius 3 divisions (i/e 1-4) draw arches intersecting at 4.

(iv) Join OC1 and OC2 intersecting lines C5-2 and C5-3 and C3 and C4.

Classification According To Shape Formed By Soffit/Intrados-:

(I)FLAT ARCH (straight/ square / camber arch)-:

(II)French / Dutch arch-: Similar in design with flat arch but differs in method of construction. This is not so sound in construction and so used for small inside opening or narrow spans only.

(III)Semi-circular arch-: The shape of the arch soffit is a semi-circle. The centre of the arch lies on the springing line.

(IV)Segmental arch-:The centre lies below the springing line. The bed joint of voussoirs radiate from the centre of arch. Depth may be 20cm, 30cm or multiple of half brick. Commonly used for arch.

(VI)Relieving arch-: Generally constructed over a wooden lintel or over a flat arch. It relieves the load of lintel or flat arch. The ends should be kept inside the solid wall. These lintels restrict the use of relieving arch.

(VII)Pointed arch / Gatchis –It is formed intersection of curves at crown.Ther are 5 forms of these types of arches: drop, equilateral, tutor, larcet and venetin.

(VIII)Venetin arch-: This one form of pointed arch which has a deeper depth at crown other than arch springing line. It has 4 centers on springing line.

(IX) Florentine arch-: Similar to Venetian arch except that the intrados consist of a semi circular curve. It has three centers of springing line.

(X)Semi-circular arch-: It is formed by more than one centre usually 3 or 5 centers.

(XI)Horse shoe arch-: It has a horse shoe like.

(XII)Stilted arch-: (a) 2 cusped arch -: This arch with 2 cups has centers at different level. This arch can be made in various forms and used for decorative purposes. This is not structurally efficient.

(c) Corbel arch-: It shape justifies its name it does not have arch action. Here each course is cantilevered out over the course below until the two sides meet. This is the oldest form of arch and not used in modern buildings.

Classification According To Materials And Workmanship Involved In Construction

Stone Arch; Rubble Arch ;Ashler Arch ;Brick Arch ;Rough Brick Arch ;Rough Cut Brick Arch ;Gauged Brick Arches ;Concrete Archery ;Precast Concrete Block Archery ;Monolithic Concrete Arches ;Linear Arch / Theoretical Arch / Line Of Thrust

Cavity Wall

A cavity wall or hollow wall is the one which consists of two separate walls called leader or skins with a cavity or gap in between them.

The two leaves of a cavity wall may be of equal thickness if it is a non load bearing.

The internal leaf may be thicker than the external leaf to meet the structural requirements.

Cavity walls are often constructed forgiving better thermal insulation to the building.

It also prevents the dampness to enter and act as sound insulation.

The inner and outer skins should not be less than 10cm each(half brick).

STAIRS

The means of communication between various floors is offered by various structures such as stairs, lifts, ramps, ladders, escalators.

Stair: A stair is a series of steps arranged in a manner as to connect different floors of a building. Stairs are designed to provide an easy and quick access to different floors.

• A staircase is an enclosure which contains the complete stairway.

• In a residential house stairs may be provided near the entrance.

• In a public building, stairs must be from main entrance and located centrally.

Staircase: Room of a building where stair is located.

Stairway: Space occupied by the stair.

Classification Of Stairs Based On Materials Of Construction

General materials used in construction of stairs are

- Wooden
- Stone
- Brick
- Metals/steel
- Plane concrete
- RCC

Plastering

Applying mortar coats on the surfaces of walls, columns, ceiling etc. to get smooth finish is termed as plastering. Mortar used for plastering may be lime mortar, cement mortar or lime-cement mortar. Lime mortar used shall have fat lime to sand ratio of 1: 3 or 1: 4. If hydraulic lime is used mix proportion (lime: sand) is 1 : 2. Cement mortar of 1: 4 or 1: 6 mix is very commonly used for plastering, richer mix being used for outer walls. To combine the cost effectiveness of lime mortar and good quality of cement mortar many use lime-cement mortar of proportion (cement: lime:sand) of 1 : 1 : 6 or 1 : 1 : 8 or 1 : 2 : 8

Damp Prevention

Damp prevention is a chief requirement to ensure safety of building against dampness.

One of the basic requirements in all the buildings is that structure should be dry as far as possible.

If this is not satisfied it is likely that building may become inhabitable and unsafe from structural point of view.

In order to prevent entry of damp into a building the courses known as damp proofing courses are provided at various levels of entry of damp into a building.

Presently all buildings are given dpc treatment

So dpc prevent entry of moisture from walls floors and basements of a buildings

The treatment given to roofs of buildings for some cause is called water proofing.

Doors and Windows

Types of Windows

Depending upon the manner of fixing, materials used for construction, nature of the operational movements of shutters, etc., the common varieties of windows used in the building can be grouped as follows:

1. Casement windows
2. Sliding windows
3. Metal windows
4. Corner windows
5. Gable windows bay windows
6. Lantern or lantern lights
7. Skylights

Types of Doors

A door is a moving structure used to block off, and allow access to, an entrance to or within an enclosed space, such as a building or vehicle. Similar exterior structures are called gate. Typically doors have an interior side that faces the inside of a space and an exterior side that faces the outside of that space. While in some cases the interior side of a door may match its exterior side, in other cases there are sharp contrasts between the two sides, such as in the case of the vehicle door. Doors normally consist of a panel that swings on hinges or that slides or spins inside of a space.

Panel doors:

Panel doors, also called stile and rail doors, are built with frame and panel construction. EN 12519 is describing the terms which are officially used in European Member States. The main parts are listed below:

• Stiles - Vertical boards that run the full height of a door and compose its right and left edges. The hinges are mounted to the fixed side (known as the "hanging stile"), and the handle, lock, bolt, and/or latch are mounted on the swinging side (known as the "latch stile").

• Rails- Horizontal boards at the top, bottom, and optionally in the middle of a door then join the two stiles and split the door into two or more rows of panels. The "top rail" and "bottom rail" are named for their positions. The bottom rail is also known as "kick rail". A middle rail at the height of the bolt is known as the "lock rail", other middle rails are commonly known as "cross rails".

• Mullions - Smaller optional vertical boards that run between two rails, and split the door into two or more columns of panels, the term is used sometimes for verticals in doors, but more often (UK and Australia) it refers to verticals in windows.

• Muntin - Optional vertical members that divide the door into smaller panels.

• Panels - Large, wider boards used to fill the space between the stiles, rails, and mullions. The panels typically fit into grooves in the other pieces, and help to keep the door rigid. Panels may be flat, or in raised panel designs. Can be glued in or stay as a floating panel.

• Light or Lite - a piece of glass used in place of a panel, essentially giving the door a window.

Painting

Paint is a liquid surface coating. On drying it forms a thin film on the painted surface. Paints are classified as oil paints, water paints, cement paints, bituminous paints and special paints such as fire proof paints, luminous paints, chlorinated rubber paints (for protecting objects against acid fumes), etc. The paintings are the coating of fluid materials.

Glazing Types of Glass:

(1) Soda-lime glass
(2) Potash-lime glass
(3) Potash-lead glass
(4) Common glass