15CV36 BUILDING MATERIALS AND CONSTRUCTION - SOLUTIONS

Module 1

1a. Write requirements of good building stones.

a) **Appearance**- face work it should have fine, compact texture; light-coloured stone is preferred as dark colours are likely to fade out in due course of time.
b) **Structure** - It should have a uniform texture, free from cavities, cracks and patches.
c) **Strength** – It should be strong enough to withstand the disintegrating action of weather.
d) **Seasoning** – stones should be well seasoned.
e) **Weathering** – Resistance of the stones against wear and tear due to atmospheric agencies should be high.
f) **Specific gravity** – It should be between 2.3 to 2.5.
g) **Toughness** - Tough stones are used where vibratory loads are expected.
h) **Hardness** - It is an important for floors, pavements and aprons of bridges.
i) **Porosity and water absorption** – porosity of the stone depends on mineral constituents, cooling time and structural formation. A porous stone disintegrates as it absorbs rain water, freezes, expands and causes cracking.
j) **Workability** – Stones should be such that cutting, dressing and bringing it to shape and size should not be uneconomical.

1b. Briefly explain causes of deterioration of stones.

i. **Rain water** - Rain water acts both physically and chemically on stones. The physical action is due to the erosive and transportation powers and the latter due to the decomposition, oxidation and hydration of the minerals present in the stones.
ii. **Wind** – It carries fine particles of dust , when it blows at high speed particles will strike against the stone surface and thus stone will decayed. The wind allows rain water to enter pores of stones with force. Such water on freezing, expands and splits the stones.
iii. **Vegetable growth** – The creepers and certain trees develop on the stone surfaces with their roots in joints between the stones. Such roots attract moisture and keep the surface damp. At the same time , they may try to expand also, resulting in stone decay
iv. **Alternate wetness and drying** – Stones are made wet by various agencies such as rain, frost, dew etc. Such wet surface is dried by sunshine , It is found that stones subjected to such alternate wetness and drying wear out quickly.
v. **Living organisms** – Some living organisms like worms and bacteria act upon stones and deteriorate them.
vi. **Nature of mortar** – The nature of mortar used as a binding material may react chemically with any one of the constituents of stones and thus lead to disintegration of stones.

1c. Explain briefly classification of bricks based on properties.

Classification of bricks Class I	Class II	Class III	Class IV
Table mounted	Ground mounted	Ground mounted	Over burnt
Burnt in Kiln	Burnt in Clamp	Burnt in Clamp	Burnt in Clamp
Regular in size and shape	Hair line cracks	Irregular& Distorted Edge	Dark colour
Water absorption not greater than 20% by weight	Water absorption not greater than 22% by weight	Water absorption not greater than 25% by weight	Water absorption not greater than 25% by

			weight
Superior work	Used where plaster coat is given	Temporary work	Used as an aggregate for foundations and floors

OR

2a. Write classification of mortar based on properties.

Types of Mortars used in Building Construction:

Following are the types of mortars based on different factors:

1. Nature of application
2. Based on binding material used
3. Bulk density
4. Special purpose mortars

Types of Mortars Based on Nature of Application

There are two types of mortars based on the nature of application. They are

- Brick or stone laying mortar
- Finishing mortar

Bricklaying or Stone Laying Mortar

Generally, in masonry walls the structural units such as stones or bricks are bonded together by using mortar. The proportions of ingredients for this purpose is decided with respect to the kind of binding material used.

Finishing Mortar

Finishing mortar is used for pointing and plastering works. For general type of plastering cement or lime mortar is used. Finishing mortar is also used for architectural effects of building to give aesthetic appearances. The mortar used for ornamental finishing's should have great strength, mobility and resistance against atmospheric action like rain, wind, etc..

Types of Mortars Based on Binding Material Used

In mortar, Binding material play key role. The quality, durability and strength of the mortar will mainly depend on the quantity and quality of binding material used. Classification based on the binding material used is as follows.

- Cement mortar
- Lime mortar
- Gypsum mortar
- Gauged mortar
- Surkhi mortar
- Aerated cement mortar

Cement Mortar

In this type, cement is used as binding material and sand is used as adulterant (fine aggregate). The proportion of cement and sand is decided based on the specified durability and working conditions. Cement mortar will give high strength and resistivity against water. The proportion of cement to sand may varies from 1:2 to 1:6.

Lime Mortar

In case of lime mortar, lime is used as binding material. There are two types of limes namely fat lime and hydraulic lime. Fat lime in lime mortar requires 2 to 3 times of sand and it is used for dry work.

Hydraulic lime and sand in 1:2 ratios will give good results in damp conditions and also suitable for water logged areas. The lime mortar has a high plasticity so; it can be placed easily.

Gypsum Mortar

Gypsum mortar consists of plaster and soft sand as binding material and fine aggregate. In the Egyptian ancient structures called as pyramids, gypsum mortar is used. Gypsum mortar will have low durability in damp conditions.

Gauged Mortar

Gauged mortar consists lime, cement and sand. We knew that lime mortar has high plasticity and cement has high strength than lime so, whenever we mixed these both in some proportions then the resultant will give two properties in economical way. So, this is also called as composite mortar or lime-cement mortar. Usually 1:6 to 1:8 ratio of cement to lime will be used to prepare gauged mortar.

Surkhi Mortar

Surkhi mortar consists lime, surkhi and water. Surkhi is used as adulterant or fine aggregate. Sometimes half amount of sand and half amount of surkhi also used. Surkhi is finely powdered burnt clay which is free from any admixtures, impurities. It will give more strength than sand and cheaply available in the market.

Aerated cement mortar

General cement mortar does not contain good plasticity and workability. To make it more plastic and workable, air entraining agents are added to cement mortar. The resulted mortar is called as aerated cement mortar.

Types of Mortars Based on Bulk density

Based on the bulk density of mortar in dry state, mortars are classified into two types.

- Heavy mortar
- Lightweight mortar

Heavy mortar

If the mortar having bulk density of 15 KN/m^3 or more then it is called as heavy mortar. Generally heavy quartzes are used as adulterants in this type of mortars.

Lightweight mortar

If the mortar having bulk density of less than 15 KN/m^3 then it is called as light mortar. Generally light porous sands, soft sands are used as adulterants in this type of mortars

Special purpose mortars

Other than the above described types there are some mortars with special purposes. They are

- Fire resistant mortar
- Lightweight mortar
- Packing mortar
- Sound absorbing mortar
- X-ray shielding mortar
- Chemical resistant mortar

Fire Resistant Mortar

If there is any fire warnings to the structures in a particular zone, then we will go for fire resistant mortar which acts as fireproof shield. By adding aluminous cement to the fine powder of fire bricks we will get fire resistant mortar.

Lightweight Mortar

Lightweight mortar is generally used in the soundproof and heat proof constructions. It will be obtained by adding saw dust, wood powder or, asbestos fibers, jute fibers coir etc. to the lime mortar or cement mortar.

Packing Mortar

The constituents of packing mortars are generally cement-sand, cement-loam or sometimes cement-sand-loam. This type of mortar is used to pack the oil wells. Packing mortar should be of high homogeneity, water resistance and high strength.

Sound Absorbing Mortar

It is used to reduce the noise level and acts as sound proof layer. It consists cement, lime, gypsum, slag etc. as binding materials and pumice, cinders as adulterants.

X-ray Shielding Mortar

To provide protection against ill effects of X-rays, the X-ray room walls and ceilings are plastered by X-ray shielding mortar. This is heavy type mortar with bulk density around 22KN/m^3. Fine aggregates from heavy rock and suitable admixtures are used to prepare this type of mortar.

Chemical Resistant Mortar

It is generally used where there is a chance of chemical attack on the structures. There are so many types of chemical resistant mortars can be prepared but the selection of mortar is dependent of expected damage by particular chemical or group of chemicals.

The additives added may not resist all the chemical attacks. For example, silicate type chemical mortar resists nitric, chromic, Sulphuric or any acidic damages but it cannot prevent the structure against damage by alkalies of any concentration.

2c. Explain the importance of size, shape and texture of coarse aggregates.

Importance of size of aggregate

The largest maximum size of aggregate practicable to handle under a given set of conditions should be used. Using largest possible maximum size will result in

- Reduction of the cement content
- Reduction in water requirement
- Reduction of drying shrinkage of concrete

The maximum size of aggregate that can be used in any given condition may be limited by

- Thickness of section
- Spacing of steel reinforcement
- Cover of reinforcement
- Mixing, Handling and placing of concrete

For heavily reinforced concrete member , the nominal maximum size of aggregate should be restricted to 5mm and for reinforced concrete work , aggregate having a maximum size of 20mm are generally considered.

Shape of aggregate

The shape of aggregate is an important characteristic since it affects the properties of concrete. The shape of aggregate depends on

- Characteristics of parent rock
- Type of crushers

Aggregates may be of: -

- **Rounded aggregates -**They are obtained from river or sea shore and produce minimum voids (about 32 per cent) in the concrete. They have minimum ratio of surface areato the volume, and the cement paste required is minimum. Poor interlocking bond makes itunsuitable for high strength concrete and pavements.
- **Irregular aggregates -** Require more cement paste ascompared to rounded aggregate. Because of irregularity in shape, they develop good bond and are suitable for making ordinary concrete.
- **Angular aggregate -** They possess well-defined edges formed at the intersection of roughly planar faces. Crushed rocks of all types are an example.
- **Flaky –** Usually angular of which the thickness is small relative to the width and or the length.Eg- Laminated Rocks.
- **Elongated -**A particle whose length is greater than two dimensions.

For economizing the cement requirement, rounded aggregates are preferred. But for better bond strength, angular aggregates are preferred since they have better interlocking properties. Flaky aggregates or flat aggregates will affect workability, cement requirement, strength and durability making a poor concrete.

Texture of aggregate

Surface texture is the measure of **smoothness** or **dullness** or **roughness** of a particle surface. Surface texture depends on

- Hardness
- Grain size
- Pore structure
- Structure of rock
- Degree to which forces acting on particle surface have smoothened or roughened the surface

Hard, dense, fine grained materials have smooth fracture surfaces. As surface smoothness, contact area decreases, less bonding area. A smooth particle will require a thinner layer of paste to lubricate its movement with respect to other aggregate particles. But rough textured particle develops higher bond strength in tension than smooth textured aggregate.

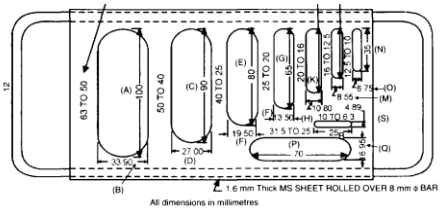
3c. Explain Flakiness and Elongation Index test on aggregates.

Flakiness and elongation index

Because of large number of flaky particles in the coarse aggregate more voids are formed in the concrete consequently more mortar is required to fill the voids, resulting in uneconomic concrete mix.

The flakiness index of aggregate is the percentage by weight of particles in it whose **least** dimension **is less than 0 .6 times of their mean dimension**.

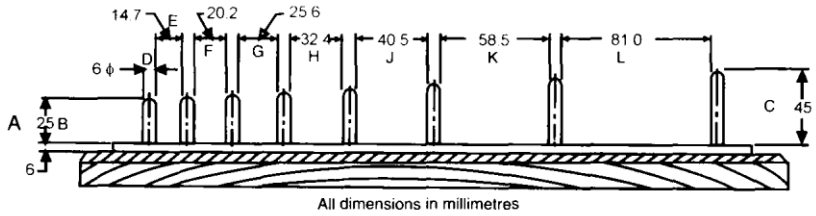
For example, the mean sieve size for an aggregate passing through 50 mm and retained on 40 mm sieve is (50 + 40)/2 = 45.0 mm. If the least lateral dimension is less than 0.6 × 45 = 27.0 mm, the aggregate is classified as flaky.For flakiness index (F.I) sufficient quantity of aggregate is taken (around 200 pieces of fraction). The sample is sieved through I.S. sieves like 63mm, 50mm, 40mm etc. For determining F.I, the aggregate retained on sieves are separated. Now, each aggregate piece is passed through the corresponding slot in the thickness gauge



Thickness Gauge

Flakiness Index is calculated as weight of aggregate passing a particular slot of aggregate divided by the total aggregate weight.

The elongation index on a aggregate is the percentage by weight of particles whose **greatest** dimension **is greater than 1.8 times their mean dimension**. For determining E.I, the aggregate are sieved through the corresponding sieves. Aggregate retained on each sieve are separated. Then each aggregate piece is passed through the corresponding slot of length gauge.



Length gauge

Elongation Index is calculated as weight of aggregate retained on a particular slot of aggregate to the total weight of aggregate.

Module 2

3a. Write functions and requirements of foundations.

Functions of a good foundation:

- Reduction of load intensity

To distribute the total load coming on the structure on a larger area so that intensity of load at its base does not exceed safe bearing capacity of subsoil.

- Even distribution of load

It distributes the non uniform load of superstructure evenly to the subsoil.

- Lateral stability

To give enough lateral stability to the structures against various disturbing forces, such as wind and rain.

- Provision of Level surface

Provide a level and hard surface over which the superstructure can be built.

- Protection against soil movements

To prevent or minimize cracks due to moisture movement because of expansion and contraction of subsoil.

- Safety against undermining

To provide structural safety against undermining or scouring due to animals, flood water etc

Essential requirements of a good foundation:

- It should be Rigid enough to bring down differential settlement.
- It should be located so that its performance may not be affected due to any unexpected future influence.
- Located at a sufficient depth so as to check failure due to swelling, sliding and overturning of soil.
- It should sustain the dead and imposed loads and transmit these subsoil in a such a way that pressure on it will not cause settlement which would impair the stability of building.

3b. Explain with sketches i) Combined footing ii) Strap footing.

i) Combined footing

A combined footing supports two or sometimes three column in a row. Combined footing is used when property lines, equipment locations, column spacing or other considerations limit the footing

clearance at the column locations. The combined footing can be rectangular in shape if both the columns carry equal loads, or can be trapezoidal if there is a space limitation and they carry unequal loads. Generally they are constructed of reinforced concrete.

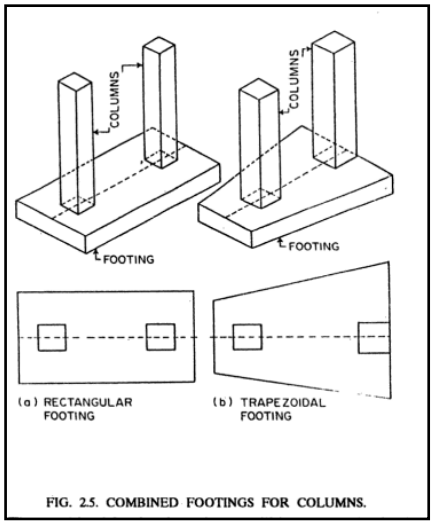
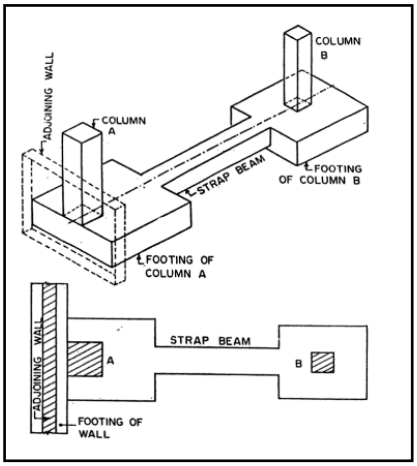


FIG. 2.5. COMBINED FOOTINGS FOR COLUMNS.

ii) Strap footing

Cantilever footing consists of two individual footings connected by a beam called a strap. It is also sometimes called as strap footing. Cantilever footing may be used where the distance between the columns is so great that a trapezoidal combined footing becomes quite narrow, with resulting high bending moments. The strap beam does not remain in contact with soil so a strap doesn't transfer any pressure to the soil.



3c. Explain with sketch any type of pile foundation.

These foundations are known as deep foundations. A pile is a slender column made of wood, concrete or steel. A pile is either driven into the soil or formed in situ by excavating a hole and then filling it with concrete. A group of piles are driven to the required depth and are capped with R.C.C. slab, over which super structure is built. The pile transfer the load to soil by friction or by direct bearing, in the latter case, piles being taken up to hard strata. This type of foundations is used when top soil is not capable of taking the load of the structure even at 3–4 m depth.

End bearing piles

Bearing piles rest on hard strata and transfer the load by bearing. Such piles are preferred. These piles are used if the hard strata are available at reasonable depth.

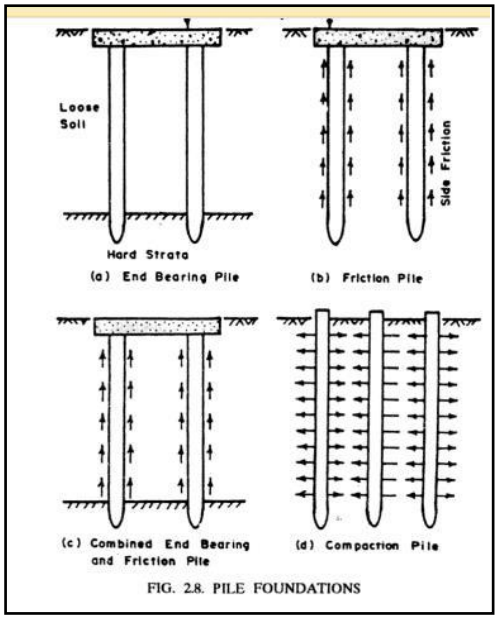
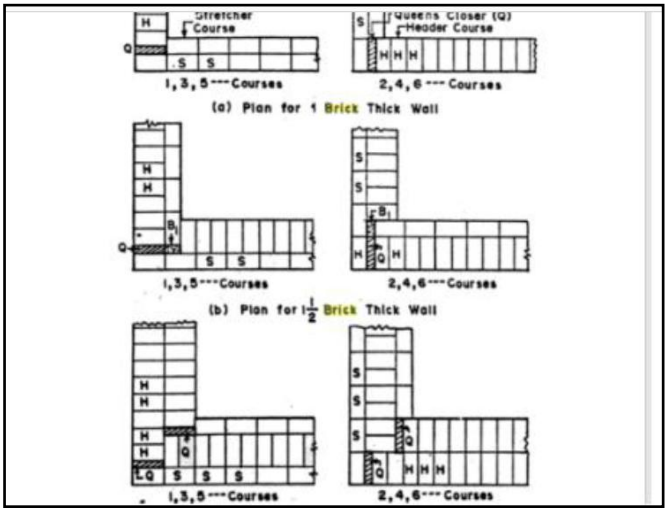


FIG. 2.8. PILE FOUNDATIONS

OR

4a With neat sketches features of English and Flemish bond.

English bond



a) It is most commonly used type of bonds.

b) It consists of alternate courses of headers and stretchers and it is strongest bond. Vertical joints of header courses come over each other.

c) Similarly Vertical joints of stretcher courses come over each other.

d) It is essential to place quoin closer after a quoin header in every alternate course.

e) Every header comes centrally over the joint between two stretchers in coursebelow.

f) In stretcher course there should be a minimum overlap of 1/4 their length over headers.

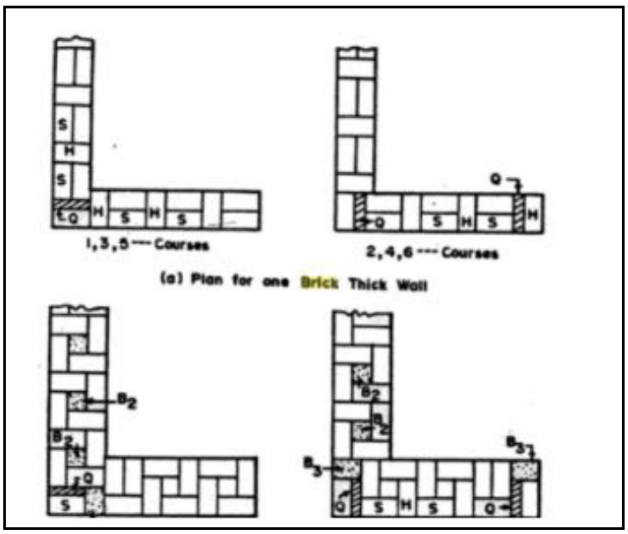
g) A header should never start with the queen closer as there are more chances of displacement.

h) Since joints in the header course are more than joints in the stretchers, jointsin the header courses are made thinner.

Flemish bond

a) Every course consists of alternate header and stretcher in the same course.
b) The facing and backing has same appearance
c) Quion closers are kept next to quoin headers
d) For walls having even multiples of half bricks no bat are used

e) For walls having odd multiples of half bricks ,half bats and three fourth bats are used



4b. Explain Classification of stone masonry.

Types of Stone Masonry:

Based on the arrangement of the stone in the construction and degree of refinement in the surface finish, the stone masonry can be classified broadly in the following two categories

1. Rubble masonry
2. Ashlar masonry

Rubble masonry

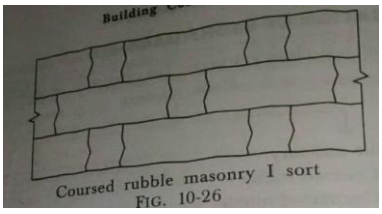
The stones used are either undressed or roughly dressed having wider joints. The stones as obtained from the quarry are taken in use in the same form or they are broken and shaped in suitable sizes by means of hammer as the work proceeds.

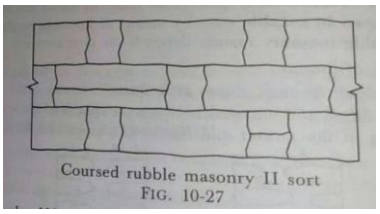
I. **Coursed Rubble masonry** - height of stones vary from 50 mm to 200mm. The stones are sorted out from the work commences. The masonry work is then carried out in courses such that the stones in a particular course are of equal heights. This type is used in construction of public buildings, residential buildings. They are sub divided as

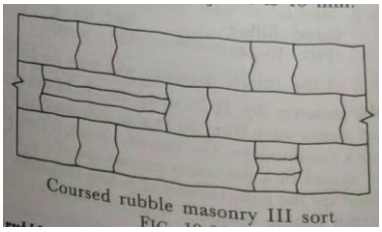
a) Coursed Rubble Masonry sort 1 – Stones of same height and courses are of same height. faces are dressed by means of a hammer and bushings do not exceed 40mm.Mortar thickness does not exceed 10mm.

b) Coursed Rubble Masonry sort 2 - Stones of different height and courses need not of same height. Two stones make one course. Mortar thickness does not exceed 12mm.

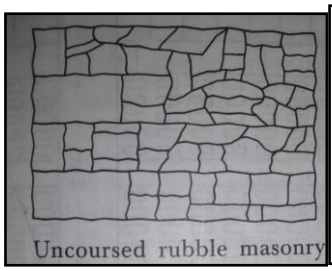
c) Coursed Rubble Masonry sort 3 - Stones of different height and courses need not of same height. Three stones make one course. Mortar thickness is 16mm. Stones are of different heights minimum being 50mm.

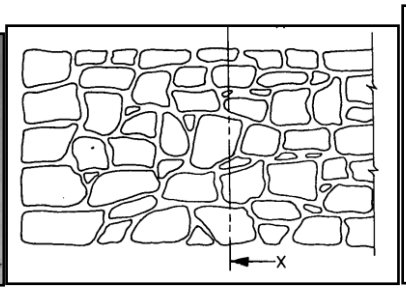

Coursed rubble masonry I sort
FIG. 10-26

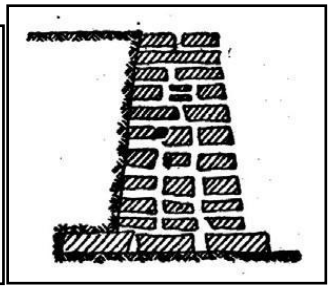
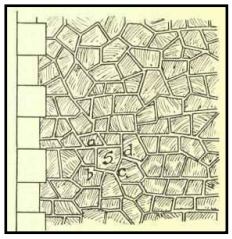

Coursed rubble masonry II sort
FIG. 10-27


Coursed rubble masonry III sort

II. **Un coursed rubble masonry** – Here the stones are not dressed. But they are used as they are available from the quarry, except knocking out some corners. Courses are not maintained regularly. Larger stones are laid first and the spaces between them are then filled by means of spalls or snecks. The wall is brought to a level every 300 to 500mm. This type of rubble masonry being cheaper is used for the construction of compound walls, go downs , garages , labour quarters etc.





III. **Random rubble masonry** – Stones of irregular sizes and shapes are used. The stones are arranged so as to give a good appearance, and it requires good skill to make this structurally stable. They are of two types

1) Random rubble masonry I sort - Face stones are chisel dressed and mortar thickness does not exceed 6mm.

2) Random rubble masonry II sort - Face stones are hammer dressed and mortar thickness does not exceed 12mm. It is used in the construction of

Random rubble masonry

IV. Dry rubble masonry - This is just similar in construction to the coursed rubblemasonry III sort except that no mortar is used in the joints. This type of construction is the cheapest, but it requires more skill in construction. It is used extensively in compound walls, pitching on bridge approaches , retaining walls. In order to prevent the displacement of stones and to make it more stable, two courses at top and about 500mm length at the ends are sometimes built in mortar.

Dry Rubble masonry

V. Polygonal rubble masonry –

In this type of masonry the stones are roughly hammer dressed to an irregular polygonal shape. The stones should be so arranged as to avoid long vertical joints in face work and to break joints as much as possible. Small stone chips should not be used to support the stones on the facing as shown in the figure below. It requires more skill in the construction of this type of masonry.

Polygonal rubble masonry

VI. Flint rubble masonry - This type of masonry is used in the areas where the flint is available in plenty. The flint stones varying in thickness from 8 to 15cm and in length from 15 to 30cm are arranged in the facing in the form of coursed or uncoursed masonry. They are irregular shaped nodules of silica which are extremely hard and brittle. Strength of the wall is increased by introducing lacing courses of either thin long stones or bricks or tiles at vertical distances of 1 to 2m.

Flint rubble masonry

Ashlar Masonry

In this type of construction, square or rectangular blocks of stones are used. This type of masonry is built from accurately dressed stones with uniform and fine joints of about 3mm thickness by arranging the stone blocks in various patterns. The size of stones blocks should be in proportion to wall thickness. The height of stones varies from 250mm to 300mm. The length of the stones should not exceed three times the height and depth into the wall should be at least equal to half the height.

Different types of Ashlar masonry are

I. Ashlar fine masonry – In this type of Ashlar masonry, beds, sides and faces are finely chisel – dressed. The stones are arranged in proper bond and thickness of the mortar joints does not exceed 3mm. This type of construction gives perfectly smooth appearance, but it is costly in construction. The thickness of the course is generally not less than 15cm. All the angles and edges that remain exposed in the final position remain as perfect squares and are free from chipplings. Headers and stretchers are laid in alternate courses. The exposed joints are finely pointed. The width of the stone is not kept less than its height.

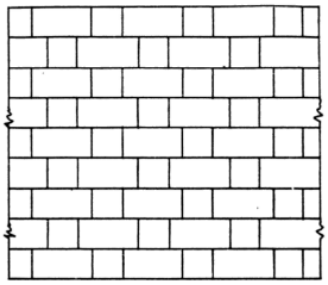


FIG. 5.21. FINE TOOLED ASHLAR MASONRY.

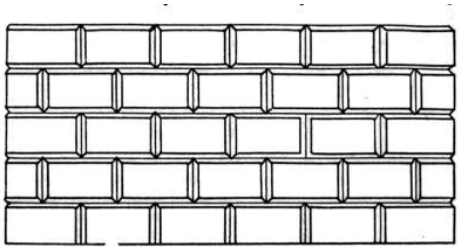


FIG. 5.22. ASHLAR CHAMFERED.

II. Ashlar rough tooled masonry – In these beds and sides are finely chisel dressed. The face is made rough by means of tools. A strip of 25mm width is provided around the perimeter of every stone exposed for view. Thickness of joints should not exceed 6mm.

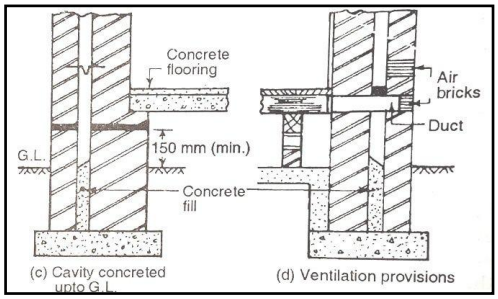
III. Ashlar quarry faced or rock faced - In this type of ashlar masonry , a strip of 25mm wide is made by chisel around the perimeter of every stone exposed for view as in case of rough tooled ashlar. But the remaining portion of the face is left in the same form as received from quarry. Only projections on the face known as the buildings, exceeding 80mm are removed by a hammer this type gives a massive appearance.

IV. Ashlar chamfered masonry- The strip is provided as above. it is then chamfered or bevelled at an angle of 45 degrees by means of chisel for a depth of about 25mm. another strip 12mm is provided on the remaining exposed face of the stone and the surface inside this strip is left in the same form as received from quarry. A neat appearance of grooved joints is obtained with the help of this type of construction.

V. Ashlar block in course - This occupies an intermediate position between rubble masonry and ashlar masonry. The faces of the stones are generally hammer dressed and the thickness of mortar joints does not exceed 6mm. The depth of the courses may from 15 to 30 cm.

4c. Define cavity walls. Give advantages of cavity walls.

Cavity walls are constructed with two separate walls for single wall purpose with some space or cavity between them. These two separate walls are called as leaves of cavity wall. The inner wall is called as internal leaf and outer wall is called as external leaf. Cavity wall is also called as Hollow wall.



Advantages

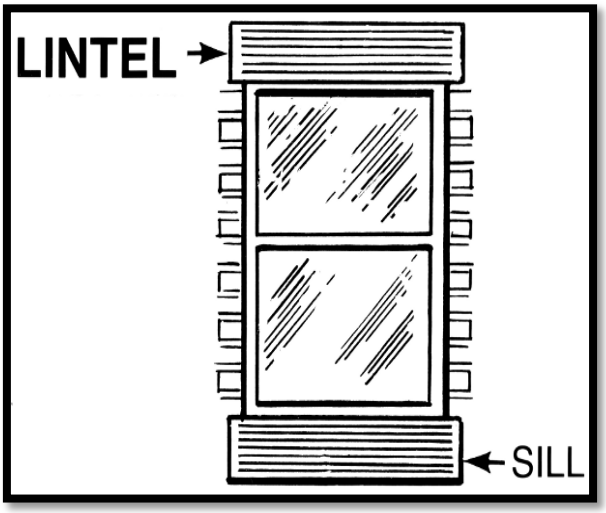
a) Cavity walls give better thermal insulation than solid walls. It is because of the space provided between two leaves of cavity walls is full of air and reduces heat transmission into the building from outside.
b) Economically they are cheaper than solid walls.
c) Moisture content in outer atmosphere is does not allowed to enter because of hollow space between leaves. So, they also prevent dampness.
d) They also act as good sound insulators.
e) They also reduce the weights on foundation because of their lesser thickness.
f) Outer Efflorescence is also prevented.

Module 3

5a. Explain briefly classification of Lintels.

Lintels

- A lintel is defined as a horizontal structural member which is placed across the opening.



The bearing of lintel should be the minimum of the following

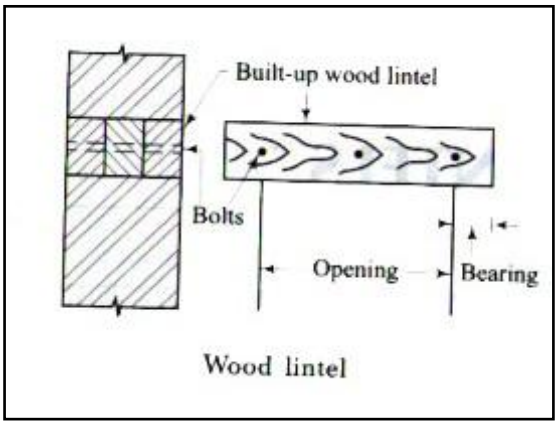
- 10cm
- Height of lintel
- $1/10^{th}$ to $1/12^{th}$ of span of lintel

Lintels are simple, easy to construct while special centring or formwork is required for the construction of an arch.

Lintels are classified into the following types, according to the materials of their construction:

- Timber lintels
- Stone lintels
- Brick lintels
- Reinforced Brick lintels
- Steel lintels
- Reinforced cement concrete lintels

Timber lintels



- Easily available in hilly area.
- Oldest type of lintel
- Relatively costly, structurally weak and vulnerable to fire.
- Easily decay, if not properly taken care.

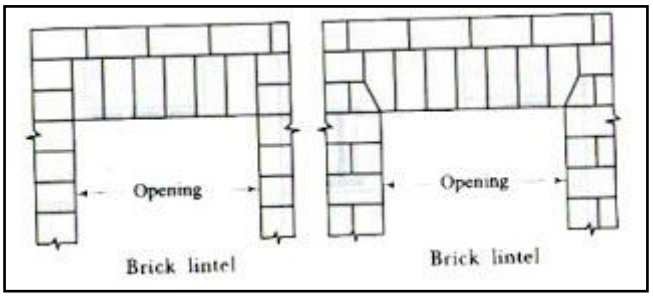
Stone lintels

- Used , where stones are easily available.
- Consists of a simple stone slab of greater thickness.

- Due to high cost and its inability to with stand the transverse stress load.
- The depth of stone lintel is kept equal to 10cm per metre of span , with minimum of 15cm.
- They are used for 2m span.
- It cracks when subjected to vibratory loads. So it should be used with caution where shock waves are quite common.

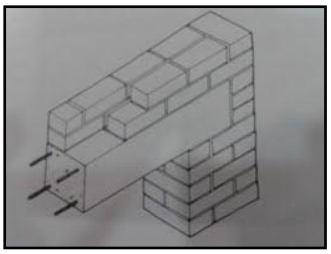
Brick lintels

- The brick are hard, well burnt , first class bricks .
- Suitable for small span.
- The bricks having frogs are more suitable, because when filled with mortar it increases the shear resistance of end joints.
- Depth of lintel is kept equal to 10 – 20cm depending upon the span



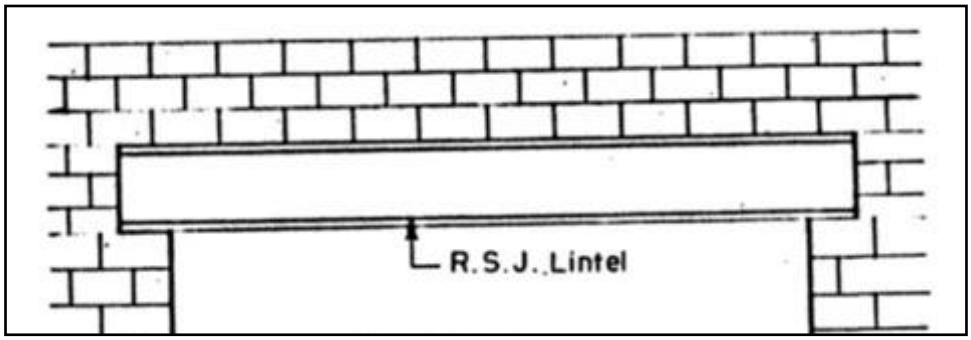
Reinforced cement concrete lintels

- Common in used.
- They may be pre-cast.
- For smaller span, the pre-cast concrete lintels are used.
- For cast in situ units , form work is required.
- Depth of lintel depends on span.
- Fire resistant
- Ease in construction
- Depth of lintel and reinforcement depends upon the span and the magnitude of loading
- Longitudinal reinforcements consists of mild steel bars are provided near the bottom of lintel to take up tensile stresses.



Steel lintels

- ❖ Provided at large opening and where the super-imposed loads are heavy.
- ❖ It consists of rolled steel joists.
- ❖ Either used singly or in combination of two or three units joint with bolts.



5b. With sketches classification of arches based on number of centres.

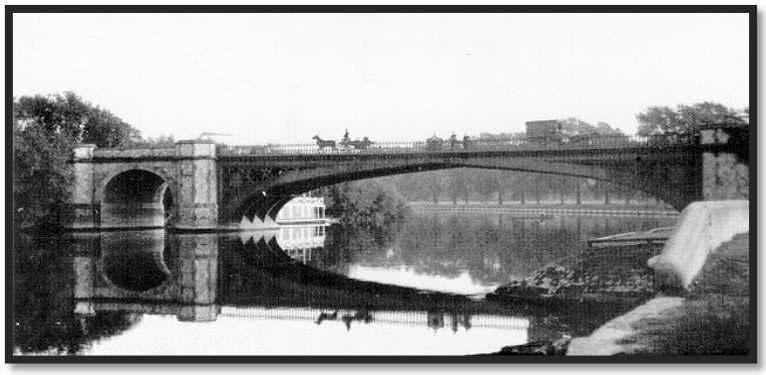
Classification based on Number of centres

- ❖ **One centred arch.**
- ❖ **Two centred arch**
- ❖ **Three centred arch**
- ❖ **Four centred arch**
- ❖ **Five centred arch**

- **One centred arch**

Segmental, semi circular, flat arches come under this category.

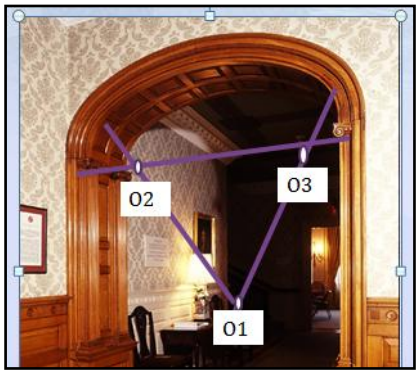
Sometime, a perfectly circular arch known as bull's eye arch, provided for circular window.



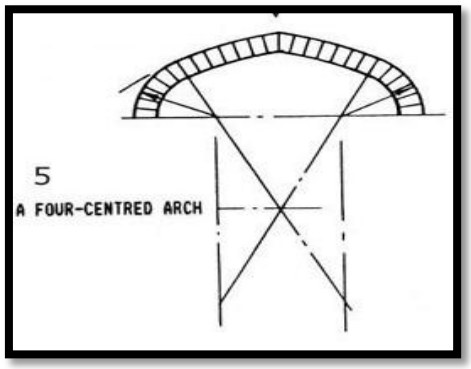
- **Two centred arch**

Pointed, semi-elliptical arches come under this category.

- **Three centred arch.**
  Elliptical arches come under this category.
  O1, O2 and O3 are the center.



- **Four centred arch**
  It has four center.
  Venetian arch is typical example of this type.



- **Five centred arch**
  This type of arch, having five centres's, gives good semi-elliptical shape.
  5c. What are the factors the selection of flooring materials?

  1 – Material

  Some of the most popular tile materials are wood, laminate, ceramic, brick, marble, granite, slate, porcelain, mosaic and vinyl. All these materials are available in many colors and price ranges.

  2 – Durability

  While ceramic, brick and vinyl are highly resistant to wear and tear, some other options such as granite and marble may be prone to cracks and staining. Before you select a tile, carefully consider the foot traffic in the intended area of installation.

  3 – Resistance to Water

  In areas such as the kitchen and bathroom, some of the better options for tiles are materials such as marble, granite, mosaic or ceramic. However, you must also remember that the smooth finish on marble and granite can increase the chances slipping. Hardwood and laminate are not good choices for the kitchen or bathroom.

  4 – Indoor or Outdoor Use

  Some of the best tiles for outdoor use include terracotta, clay and brick. Most other tile materials can be adversely affected by the elements if they are installed outdoors.

  5 – Ease of Maintenance

  The texture of the tile and the number of grooves on the material have a direct relation with the amount of dirt the tiles will accumulate. You must also consider the compatible cleaners for the tile. Stone tiles and other expensive options require special cleaners that will not erode the sealant or damage the surface.

  6 – Resistance to Chemicals

If you plan to install the tiles in a commercial environment or in an area where they may be subject to abrasive materials or chemicals, you must select a hardy tile, such as slate.

7 – Attractiveness

Tiles are available in a variety of finishes ranging from glossy and semi glossy to dull. Some of the tiles that are most sought after for their attractiveness include marble, granite and hardwood. Mosaic tiles are also attractive and provide a range of color options.

8 – Size and Shape of Tiles

Square or rectangular tiles are no longer the standard. Tiles are available in every shape imaginable. Some interesting options include hexagonal, octagonal, circular, triangular and concave shapes. Keep in mind the final look you want to achieve. Choose darker colors for high traffic areas that are prone to more dirt.

9 – Room of Installation

Higher traffic areas such as the living room, family room and kitchen require tough tiles that will last for long. Kids' playrooms require tiles that will stand up to abrasion and heavy use as well. Bedrooms can be suitable for stone or wood tiles that will require delicate care.

10 – Exposure to Sunlight

Consider the amount of sunlight that streams into the room at different times of day. Some tiles are equipped with ultraviolet proof coatings that provide more protection. Synthetic materials such as concrete and vinyl offer more sunlight resistance.

OR

6a. Explain the procedure of laying terrazzo flooring.

Mosaic flooring is made of small pieces of broken tiles of china glazed or of cement, or of marble, arranged in different pattern. These pieces are cut to desired shapes and sizes. A concrete base is prepared as in the case of concrete flooring, and over it 5 to 8 cm thick lime-surkhi mortar is spread and levelled, over an area which can be completed conveniently within working period so that the mortar may not get dried before the floor is finished. On this, a 3 mm thick cementing material, in the from of paste of two parts of slaked lime, one part of powdered marble and one part of puzzolana material, is spread and is left to dry for about 4 hours. Thereafter, small pieces of broken tiles or marble pieces of different colours are arranged in definite patterns and hammered into the cementing layer. The surface is gently rolled by a stone roller of a 30 cm dia. and 40 to 60 cm long, sprinkling water over the surface, so that cementing material comes up through the joints, and an even surface is obtained. The surface is allowed to dry for 1 day and is, thereafter, rubbed with a pumice stone fitted with a long wooden handle, to get smooth and polish surface. The floor is allowed to dry for two weeks before use.

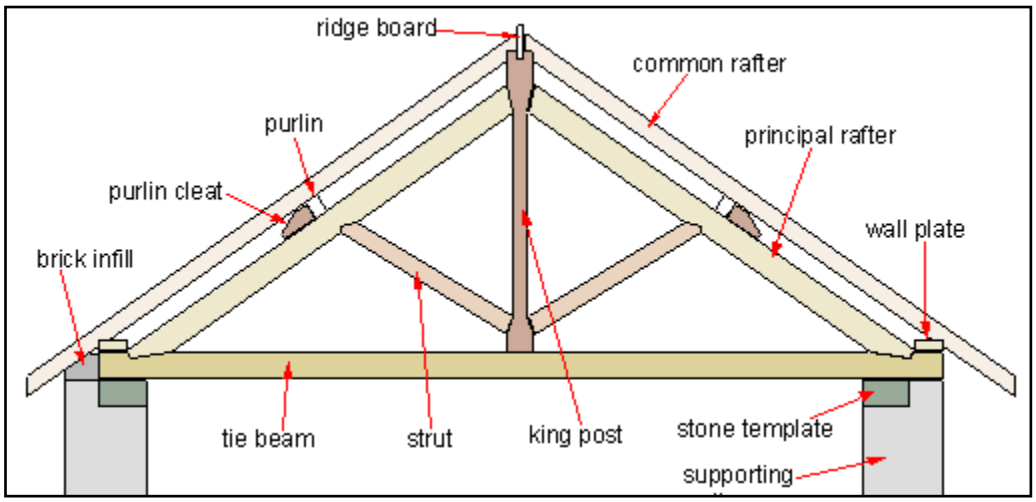
6b. Write requirements of good roof.

1. It should have adequate strength and stability to carry the superimposed dead and live loads.
2. It should effectively protect the building against rain, sun , wind etc and it should be durable against the adverse effects of these agencies.
3. It should be waterproof, and should have efficient drainage arrangements.
4. It should provide adequate thermal insulation.
5. It should be fire resistant.
6. It should provide adequate insulation against sound.

6c. With a neat sketch explain a King post roof truss.

It consist of i) Lower tie beam ii) Two inclined principal rafters iii) Two struts and a iv) king post. The principal rafters support the purlins and purlin support common rafters, which in turn roof covering. The spacing of king post truss is limited to 3m centre to centre. The truss is suitable for

sans varying from 5 to 8 meters. The lower horizontal tie beam receives the needs of the principal rafters and prevents the wall from spreading out due to thrust. The king post prevents the tie beam from sagging at its centre of span. The struts connected to the tie beams and the principal rafters in inclined direction; prevent the sagging of principal rafters. Ridge beam is provided at the apex of the roof to provide end support to the common rafters. The trusses are supported on the bed blocks of stone or concrete embedded in the supporting walls so that load is distributed to a greater area.



Module 4

7a. Explain with neat sketches i) Panelled and ii) Collapsible door.

i) Panelled door

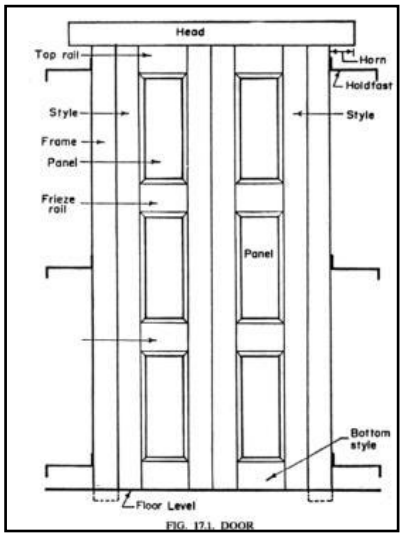


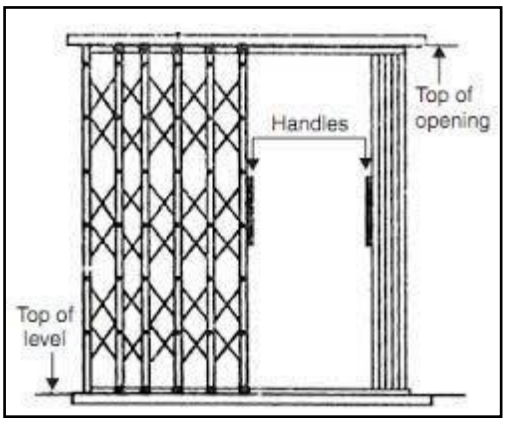
FIG. 17.1. DOOR

- These types of doors are widely used in all types of buildings since they are strong and give better appearance.
- Panel doors consist of vertical members called styles and horizontal members called rails.
- Styles and rails form the framework into which panels are inserted.
- Panels may be solid wood, plywood, particleboard or louvered or have glass inserts.
- Additional vertical members called mullions are used to divide the door into any number of panels.
- The minimum width of style is kept as 100 mm. The minimum width of bottom rail and lock rail is kept as 150mm.
- The entire frame is grooved on all the inside faces to receive the panels.

ii) Collapsible door

- Such doors are used in garages, workshops, public buildings etc. to provide increased safety and protection to property.

- The doors do not require hinges to close or open the shutter nor the frame tohang them.
- It acts like a steel curtain.
- The door is made up from vertical double channels (20x10x2 mm), jointed together with the hollows on the inside to create a vertical gap.
- These channels are spaced at 100-120 mm apart and braced with diagonal iron flats.
- These diagonals allow the shutter to open or closed.
- The shutters operate between two rails, one fixed to the floor and other to the lintel.
- Rollers are mounted at the top and bottom.



7b. Explain with neat sketches i) Panelled and Glazed window ii) Bay window

Panelled and Glazed window

- This is a type of casement window where panels are fully glazed.
- The frame has styles, top rail and a bottom rail.
- The space between top and bottom rail is divided into number of panels with small timber members called, sash bars or glazing bars.
- The glass panels are cut 1.5-3.0 mm smaller in size than the panel size to permit movement of sash bars. Glass panes are fixed to sash bars by putty or by timber beads.

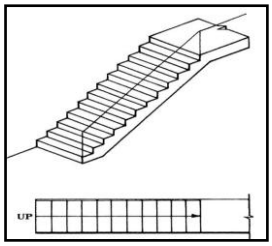
Bay window

- The window projecting outward from the external walls.
- Wide and decoratively impressive allow for 180° view.
- A multi-panel window, with at least three panels set at different angles to create an extension from the wall line.
- It is commonly used in cold country where snow often falls.
- They may be triangular, circular, rectangular or polygonal in plan.

8a. Explain with sketches types of stairs.

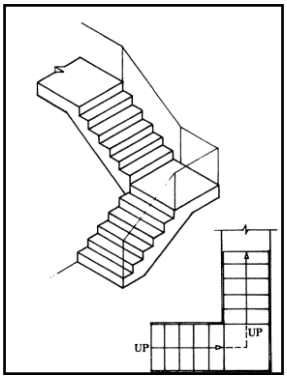
Straight stair

- All steps lead in one direction.
- Simplest form of stair arrangement.
- It may consist of one or more flights.
- They are used when space available for staircase is long but narrow in width.
- The width and the length of the landings should be equal.



Turning stair

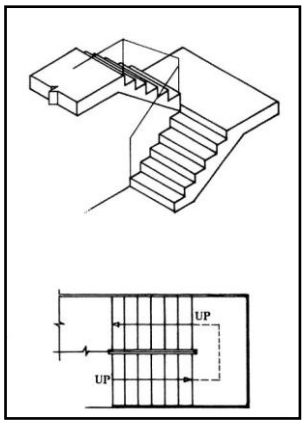
i. Quarter turn stair



- A stair turning through one right angle is known as quarter turn stair.
- The change in direction can be affected by either introducing a landing or by providing winders
- If a quarter turn stair is branched into two flights at a landing is known as a *Bifurcated stair*.
- This types of stair is commonly used in the public buildings near the entrance hall .
- The stair has a wider flight at bottom which bifurcates into two narrower flights at the landing.

ii. Half turn stair

- A stair turning through right angle is known as Half Turn Stairs.
- A half turn star may be of dog-legged type or open newel type.

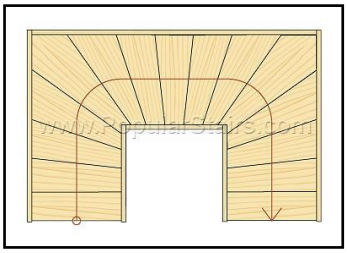


Dog legged stairs

- The flights run in opposite directions and there is no space between them in plan.
  - A level landing is placed across the two flights at the change of direction.
  - This type of stair is useful where the width of the staircase hall is just sufficient to accommodate two width of stair.

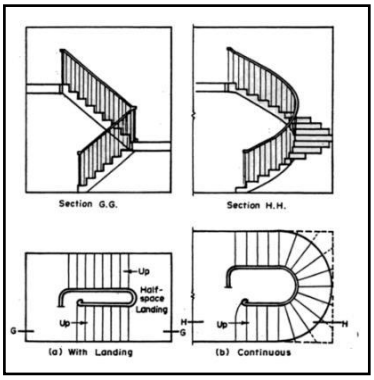
Open well stair

- Space between the upper and lower flights causes half space landing to be longer.
- In case of open newel stair, there is a well or hole or opening between flights in plan.
- This well may be rectangular or of any geometrical shape and it can be used for fixing lift.
- These staircase are useful where available space for staircase has a width greater than twice the width of steps.

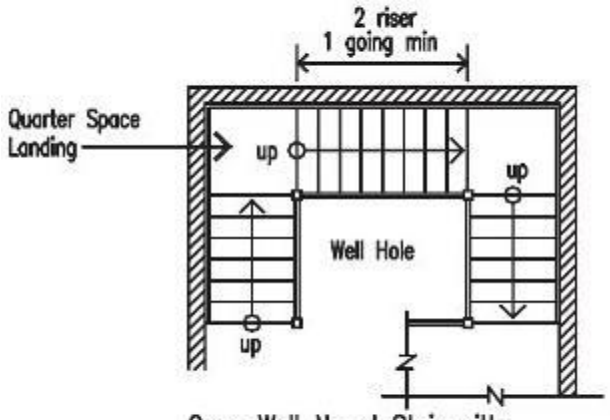


iii. Geometrical Half turn stairs

- Have any geometrical shape and requires no newel posts.
- The handrail continues without interruption and without any angular turns.
- Its construction requires considerable skill and it is weaker than corresponding open newel stair.



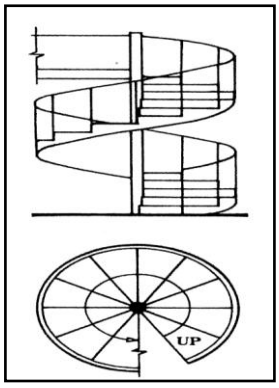
Three quarter turn stairs



Open Well Newel Stair with Quarter Space Landing

- A stair turning through three right angles is known as a three quarter stair. In this case ,an open well is formed.
- This types of stair is used when the length of the staircase is limited and when the vertical distance between the two floor is quite large.

Spiral stairs or Circular or Helical

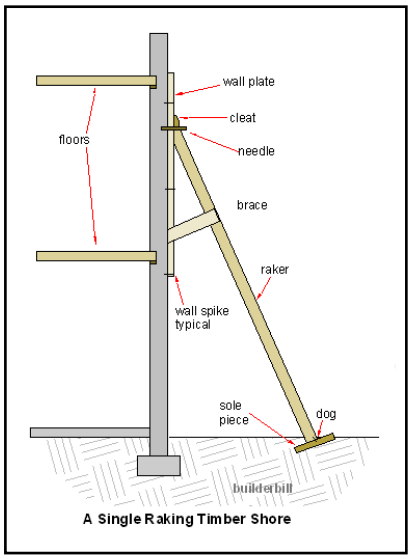


- When viewed from top it appears to follow a circle with a single centre of curvature.
- The spiral stairs are provided where space available is limited and traffic is low.
- These stairs can be constructed in R.C.C., Steel or Stone. Steps radiate from the center and they do not have either any landing or any intermediate newel post
- Some of the important facts to be noted in connection with the circular stairs are: flights consist of winders only and may be continued through any number of turns.
- It may be of cast iron or mild steel or concrete. Usually its structural design and construction of are complicated in nature.
- For concrete spiral stairs, the steel reinforcement is heavy and formwork is complicated. These make the concrete spiral stairs expensive. The core of spiral stair may be solid or hollow and the stair may be provided with cut or closed strings.

8b. Write short notes on i) Shoring ii) Underpinning

i) Shoring

It is the means of providing support to get stability of a structure temporarily under certain circumstances during construction, repair or alteration.



For shoring timber or steel tubes may be used. Sometimes both are used in combination. If timber is used its surface should be coated with a preservative so as to protect against wet rot.

- The shoring should be designed based on the load it has to sustain and duration of load.
- Shoring may be given internally or externally depending on the case and in certain cases they may be provided on either side of the wall to produce additional stability.
- Shoring should be installed only after getting the permission if necessary, of the local authorities.
- There is no time limit to which the shoring has to be kept; it may range from weeks to years depending on the case.

Types of shoring

 Raking or inclined shores

(1) In this method, inclined members called rakers are used to give lateral support to the wall. It consist of wall plate, needles , cleats, bracing and sole plate. The wall plate is placed vertically along with the wall and is secured by means of needles. Rakers should be inclined to ground by 45and it should be properly braced at suitable intervals. The sole plate should be properly embedded into ground at an inclination and should be of proper section. The size of sole plate should be such that it accommodates all the rakers and a cleat provided along the outer edge.

 Flying or horizontal shores

Here shores are used to give horizontal support to two adjacent parallel walls which have become unsafe due to removal or collapse of intermediate building . It consists of wall plates, needles, cleats, struts , horizontal shore straining pieses and folsing wedges.They have the advantage that building operations of ground are not obstructed . In the case of flying shores, the centre lines of shore, struts, those of wall should meet at floor level. If the floor levels are different , horizontal shore should be placed either midway between the evels of two floors of equal strength. The struts should be inclined at 450, and it should not exceed 600. Flying shores are inserted when the old building is being removed , and should be in position till new construction. ***Sreelakshmi***

 Dead or vertical shores

It consists of vertical members called dead shores supporting horizontal members called as needles. Holes are made in the walls at suitable height and needles, which are made of thick wooden sections, inserted into the holes, which are supported by dead shores. The dead shores stand away from the walls so that the repair work is not obstructed. The shores are supported on sole plates and folding wedges. They are provided to rebuild the defective lower part of wall, deepen existing foundation and to make large opening in the wall. Shores should be removed only when the new work has gained sufficient strength, but in no case earlier than 7 days of completion of new work.

ii) Underpinning

It is the method of supporting the structures while providing new foundations or carrying out repairs and alterations without disturbing the stability of existing structures. It is carried under following conditions:

1. When a building with deep foundation is to be constructed adjoining a building which is built on shallow footings. Here the shallow footings should be strengthened first.
2. In order to protect an existing structure from the danger of excessive or differential settlement of foundation.
3. In order to improve the bearing capacity of foundation so as to sustain heavier loads for which deepening or widening of foundation is done.
4. In order to provide a basement for an existing structure.

Methods of underpinning

1. Pit method
2. Pile method
3. Chemical method

1. Pit method

In this method, entire length of foundation to be underpinned is divided into sections of 1.2 m to 1.5m. A hole is made in the wall and a needle is inserted in the hole. Bearing plates are used to support the wall above the needle. Needles are supported on screw jacks. The foundation pit is excavated up to desired level and new foundation is laid. When the work of one section is over, work on next section is taken up and then remaining sections are taken up.

2. Pile method

In this method, piles are driven at regular interval along both sides of the wall. The piles are connected through concrete needles, penetrating through the wall. These beams incidentally act as a pile caps also. This method is very useful in water logged area and clayey soils.

3. Chemical method

- In this method the foundation soil is consolidated by employing chemicals.
- Perforated pipes are driven in an inclined direction beneath the foundation . The slopes are provided such that the entire area under the existing footing comes under the area used to be strengthened.
- After the pipes are installed, solution of sodium silicate in water is injected through the pipes. This is a two-injection method. The pipes are withdrawn and at the time of withdrawal of pipes, calcium or magnesium chloride is injected through pipes.
- Chemical reaction takes place between these two chemicals and the soil is strengthened by consolidation. This method is suitable for granular soils.

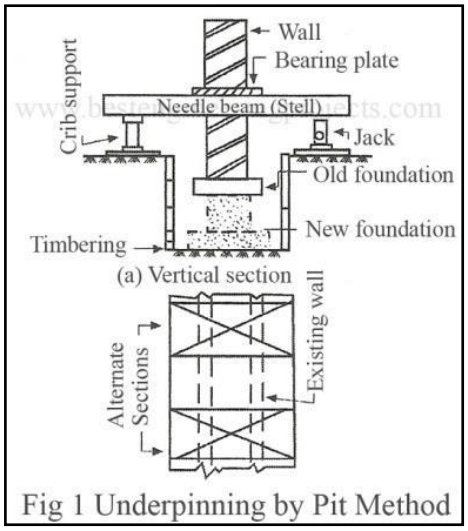


Fig 1 Underpinning by Pit Method

Module 5

9 a . Write the purposes of plastering.

- Give decorative effect
- Protect surface against vermin
- Conceal inferior materials
- Protect external surface against penetration of rain water and other atmospheric agencies.

9 b. Explain various types of plaster finishes.

- **Lime Plaster**

Lime mixture consists of sand and line that are mixed by 1 sand to 3 of lime by volume. Not only this mixture is used for under coat but also used as finish coat. Lime plaster might be shrink after drying so animal hair of about 5 Kg is used for 1 m^2 to avoid lime plaster cracking and shrinking. Lime plaster could be used for ancient structure restoration and rehabilitation.

- **Cement Plaster**

Grey powder Portland cement is mixed with water by the ratio of 1cement to 3 or 4 clean washed sand by volume as an under coat for hard background for example brick block walls and partitions. Mixture of sand and cement might be plastic and require experienced and skill labor therefore plasticizer or lime is added to the mixture usually by volume ratio of 1cement:0.25 lime: 3 sand or 1 cement to 4 sand with plasticizer.

- **Gypsum Plaster**

Gypsum plaster is widely used plaster materials that could be mined naturally or produced as a by-product. So, important gypsum plaster that is employed as under coat, finish coat, and replaced lime and cement broadly. Moreover, small expansion of gypsum is considered significant propertied that prevent shrinkages and cracks. Furthermore, depending on applications for walls or ceilings gypsum plasters can be categorized such as casting, undercoat, finish, one coat and machine applied plaster.

9 c Explain Stucco Plastering

Stucco is a name given to a decorative type of plaster which gives an excellent finish. Stucco plaster can be used for interior as well as exterior surfaces. It is usually laid in three coats making the total thickness of plaster of about 25mm. The first coat is called as scratch coat with 12mm in thickness. The second coat is called as the finer coat or brown coat with 10mm in thickness. The third coat is called the white or finishing coat with 3mm in thickness. Each coat should be permitted to dry thoroughly before the next coat is applied.

OR

10 .a Explain various constituents of Paint.

Constituents of paint

- base
- carrier or vehicle
- drier
- colouring pigment
- solvent or thinner

i. Base

Base is a solid substance in the form of fine powder generally metallic oxide. The type of base determines the character of paint and imparts durability to the surface painted. Various bases are White lead, Red lead , oxide powder , oxide of Iron . It hides the surface to be painted.

ii. carrier

Carrier is a liquid substance which holds the different ingredients of paint in liquid suspension. Eg – Linseed oils, nut oil, poppy oil. Raw linseed oil is thin, but it takes a long time to dry.

iii. Drier

They are used to accelerate the process of drying and hardening by extracting oxygen from the atmosphere and transferring to vehicle. It reduces the elasticity of paint; they should not be used in the final coat. Liquid driers are finely ground compounds of metals such as cobalt, lead, manganese dissolved in a volatile liquid whereas paste driers consist of above metals mixed with large percentage of inert fillers such as barytes , whiting etc and then ground in linseed oil.

iv. Colouring pigment

It is a white or colored pigment, mixed with a paint to get desired color of the paint.

v. Thinner

It is a liquid which thins the consistency of the paint and evaporates after the paint film has been applied.eg – Spirit of turpentine, naphtha, Benzine alcohol, Methyl amyl acetate.

10. b Explain different methods of Pointing a plastered surface.

It is applied to finishing of mortar joints in masonry. Pointing consist of raking the joints to a depth of 10 to 20 mm and filling it with better quality mortar in desired shape. Pointing is done with mortar mixes like lime mortar 1: 2 mix and cement mortar 1:3 mixes. After preparing the surface and cleaning and wetting the joints as desired above, mortar is carefully placed in desired shape in these joints. A small trowel is used for placing the mortar in the joint: the mortar is pressed to bring perfect contact between the old interior mortar of joint and new mortar. Care should be taken to see that in case of ashlar and brickwork with first class bricks, mortar does not cover face edges. The pointed surface is kept wet for at least a week to till it sets after application.

10. c . Explain different methods of damp proofing.

1. Use of damp proofing course (D.P.C)
2. Integral damp proofing
3. Surface treatment
4. Cavity wall construction
5. Guniting
6. Pressure Grouting

USE OF D.P.C:

D.P.C which is other wise called as damp proof course is a water repellant membrane or damp proofing course between the source of dampness and the part of building adjacent to it. The mechanism covers a wide range of materials which may consist of flexible materials like bitumen,

mastic asphalt, bituminous felts, plastic or polythene sheets, cement concrete etc. D.P.C course may be provided either horizontally or vertically in floors and walls etc. or in both direction as per requirement.

INTEGRAL DAMP PROOFING:

This consists of integrating certain water proofing compound or water repellant
compound to the concrete mix, so that the concrete it self becomes water resistive. These water proofing compounds may be in 3 forms:

i. Compounds of void filling material made from chalks, talc, fullers, earth etc. which fills the voids of concrete under the mechanical action principle making it highly impermeable to water due to presence of lesser voids.

ii. Compounds like alkaline silicate, aluminium sulphate, calcium chlorides etc. react with concrete to produce water proof concrete. Also compounds like soap, petroleum, oils, fatty acids like stearates of calcium, sodium, ammonia etc. work on water repulsion principle. So when these are mixed with concrete, the concrete becomes water repellant. However all these materials after addition should be able to resist the super imposed load as well as should maintain the bond between the concrete materials.

iii. Commercial publo, permo, silka etc are available as water repellant materials.

SURFACE TREATMENT:

In this method, application of water repellant layer by using some special compounds on the surface of floors through which water enters in the form of moisture is done to protect it from getting damped. Various water proofing agents are used in practice out of which calcium and aluminum olets or stearates which are called metallic soaps are much effective against rain water penetration. Pointing and plastering of exposed surfaces must be done carefully, using water proofing agents like sodium and potassium silicates and aluminum and zinc sulphate and barium hydroxide and manganese sulphate etc. This treatment gets effective against the moisture and normal water but not against water under pressure.

CAVITY WALL CONSTRUCTION:

This is effective method of not only damp prevention but also sound insulation and temperature protection. The main wall of the building is shielded by an outer skin wall and there exists a cavity left in between them. Cavity wall is highly essential in swampy areas and notably there is no reduction of load carrying capacity due to cavity.

GUNITING:

This is a special type of surface treatment in which dampness caused by water under pressure is checked effectively. In this process, deposition of the impervious layer under pressure is done which is rich in cement and the ratio of cement and sand is 1:3. The mortar is sprayed upon the wall using cement gun with a pressure of 200 to 300 kN/m^2. The nozzle of the gun is kept at a distance of 75 to 90 cm from the wall surface. After getting the impervious layer, the surface should be cured at least for 10 days. This is done particularly over pipes and cisterns and outer walls.

PRESSURE GROUTING:

In this process, forcing of cement mortar into the cracks and voids under pressure which are present in the structural components of the building is done. The defects may be in structure or inside the ground i.e. near foundation. Thus the structural components and the foundations which are liable to the water penetration and moisture penetration are thus made water resistant. This method is quite effective in checking the seepage of water of the ground through the foundations and the sub structures of the buildings. This is also an effective method in counteracting differential settlement and in shrinking and expansive soil where there occurs shrinkage in summer.