

IAT 2 Building materials and construction Question paper and solution

1. Explain the salient features of framed and paneled door
2. What are the requirements of good stair
3. Write short notes on shoring and underpinning
4. Differentiate between fixed window and pivoted window
5. Define stair. Explain thread, rise, flight and landing
6. Explain the different types of stairs

1. Technical terms involved in doors and windows

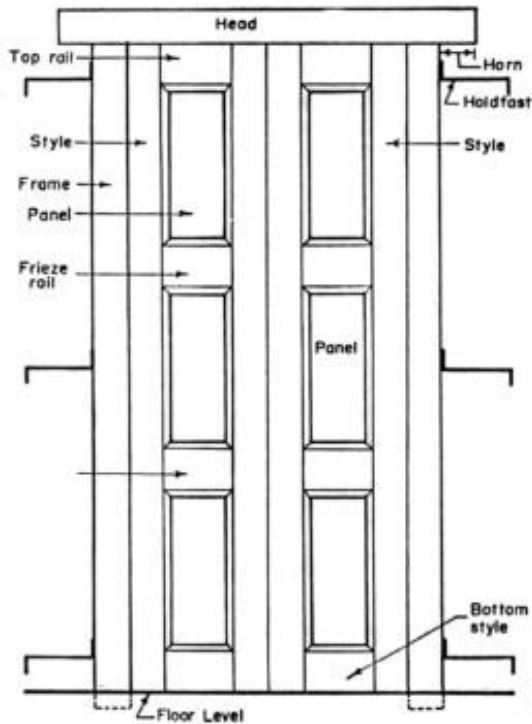


FIG. 17.1. DOOR

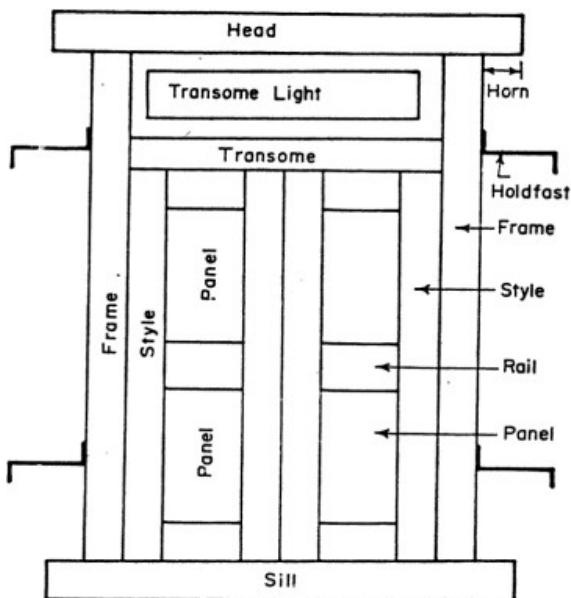


FIG. 17.2. WINDOW.

- **Top rail** – The top rail is the horizontal piece that sits across the very top of the door.
- **Freeze rail** - Similar to the top rail, except it sits horizontally across the next divide down between the panels on the door. This is often at eye height and not all doors have a cross rail. This is sometimes known as cross rail.
- **Middle rail** – Sits horizontally across the middle of the door. Not all doors have a middle rail.
- **Bottom rail** – Sits horizontally across the very bottom of the door.
- **Stiles** – This is the collective name for the vertical components that sit on the outside edge of a door.
- **Lock stile** – This is the vertical edge of the door which sits on the opposite side of the door to the hinges, and contains the lock or latch.
- **Panel** – The panels, which may be timber or glass, are what fill the frame formed by the stiles and rails of a door.
- **Top mullion** - This is the vertical element of the door that forms a division between different panels at the very top of a door. This is sometimes known as first mullion.
- **Moulding** – This is decorative detailing that can be used around the edge of the door stiles, rails and mullions. It may be simple or highly decorative, such as crown moulding.
- **Frame or lining** – The door frame (external) or lining (internal) is what the door fits within and which covers the walls.
- **Head** – The head is the part of the door frame that sits horizontally to form the top of the frame.

2. Following are the General Requirements of a Good Stair:

Location of Staircase:

Staircase should be located such that it can be easily accessible from different rooms of the building.

Its location should be such that it has spacious and convenient approaches are available without any hassle. Staircases must have the adequate provision of light and ventilation directly from the exterior of the building.

Width of Stair:

It should be wide enough, so that a user can easily use it without any inconvenience. The width of the step depends upon its location and varies with the type of building itself. Generally for domestic buildings **1 m (3.3 feet)** width is sufficient, while for public buildings **5 to 2.0 m (5 to 6.5 feet)** width is required.

Length of Flight:

For the comfortable ascent and descent of stairway, it is recommended that the number of steps in a single flight should not be **more than 12 and less than 3**. If the design is such that there are more than 12 steps, an intermediate landing must be provided.

Pitch of Stair:

The pitch of stair should not be more than **37 degree** in any type of stairs, so that climbing the stairs is less tiresome and dangerous.

Head Room:

The head room or clearance between the tread and the soffit should not be less than **2 m (7.2 feet)**, so that even a taller person can use the staircase comfortably.

Balustrade & Railings:

The open well or designer staircases should always be provided with balustrade and railings for the safety of users. The railing must be of suitable size and shape so that it can be easily gripped in hand.

The Dimensions of Stair:

The dimensions of stair should be such that it provides comfort to the user. The rise and tread of each step in a stair should be of uniform dimension throughout the staircase.

Winders:

The introduction of winders in a stair should be avoided if possible. They are dangerous and increase the cost of construction.

Materials of Construction:

The material used for construction should be such that it provides a sufficient strength and stability, fire resistance, sound insulation and last but not the least an aesthetic appearance to the stair.

3. Shoring

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

Such circumstance arises when

1. The stability of a structure is endangered due to removal of a defective portion of the structure.
2. The stability of a structure is endangered due to unequal settlement during construction itself or in long run.
3. Certain alterations are to be done in present structure itself. Eg: remodeling of walls, changing position of windows etc.
4. Alterations are carried out in adjacent building for remodeling, strengthening of foundation, etc.

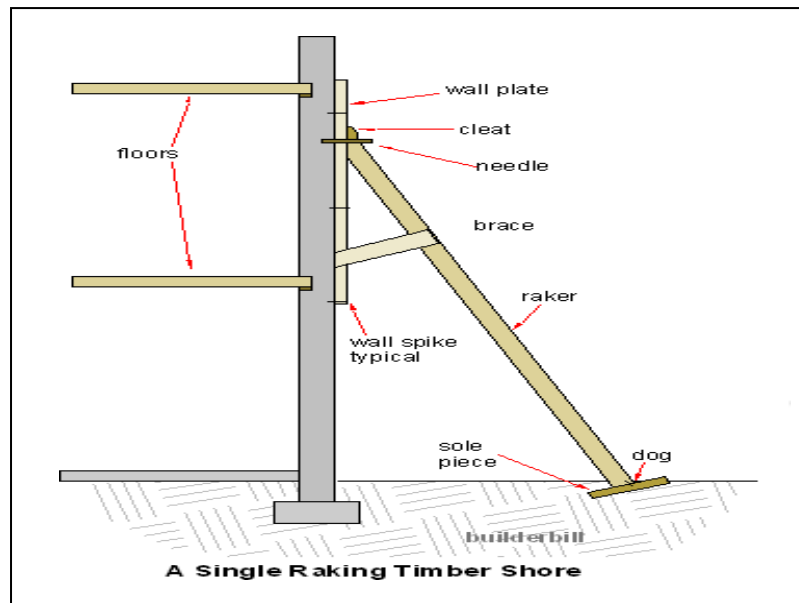
For shoring timber or steel tubes may be used. Sometimes both are used in combination. If timber is used its surface should be coated with a preservative so as to protect against wet rot.

- 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 consists 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 45° and 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

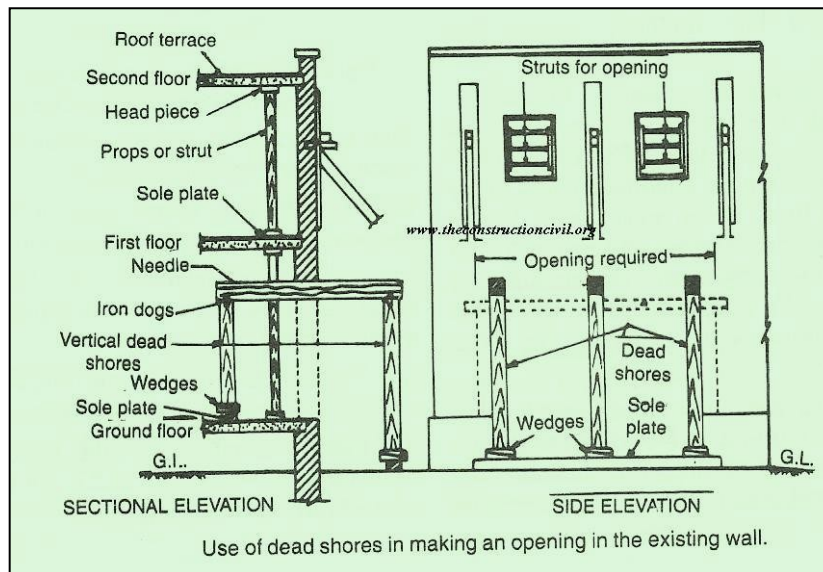


the outer edge.

- 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 pieces 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 45°, and it should not exceed 60°. Flying shores are inserted when the old building is being removed, and should be in position till new construction.

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.

Underpinning

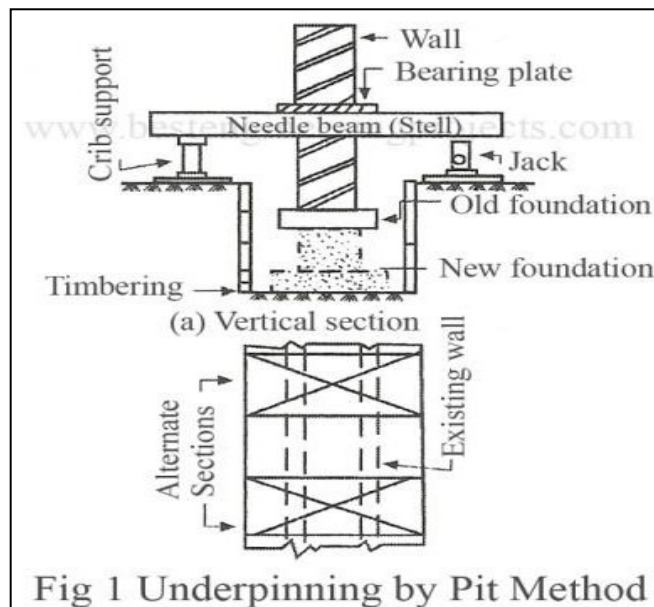
- It is the method of supporting the structures while providing new foundations or carrying out repairs and alterations without disturbing the stability of existing structures. It is carried under following conditions:
 1. When a building with deep foundation is to be constructed adjoining a building 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.

Before implementing appropriate underpinning measures the following important points should be carefully attended:

- The existing structure should be fully examined carefully and appropriate underpinning method should be adopted.
- All poor masonry work, such as joints, cracks, plastering should be rectified before.
- Necessary shoring and strutting should be done such that existing structure is safe.
- Urgent repair like grouting of cracks, insertion of rod between walls , etc. should be carried out before commencing underpinning.
- Adequate care should be taken to ensure that there should be no movement of structure for which levels should be marked.
- Underpinning process is not a science but an art should be exercised depending on the situation.

Methods of underpinning

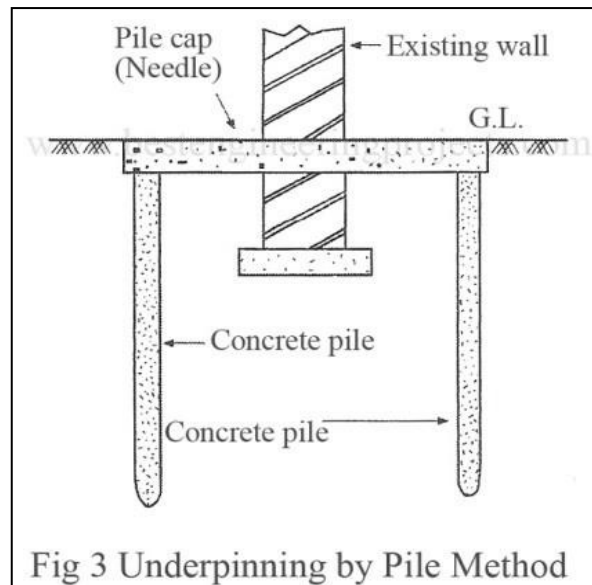
1. Pit method
 2. Pile method
 3. Chemical method
1. Pit method



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

4. Fixed Window

Fixed windows are often known as picture windows, which mean they can't be opened or closed. They're often found in homes with high or vaulted ceilings or installed as an arched window over vaulted areas, doors and even other windows. They serve one main purpose: to frame a gorgeous view. However, they do have many other benefits to homeowners. First, let's understand what the definition of a fixed window is and the types of fixed windows that are offered.

Pivoted Windows

Pivoted windows are a suitable replacement window choice for homeowners who wish to include maximum ventilation in a room. The pivot window sash is secured to the window frame by a pivot mechanism, located mid-way along opposing window sashes which attach the window sash to the frame. The window can then swing inwards either horizontally or vertically, depending on the location of the pivot mechanisms. This leaves the sash suspended in the middle of the frame, held by the opposing pivots. A replacement pivot window provides a window frame option that can open completely.

5. Stair: Series of steps or flights of steps for passing from one level to another

Tread

The part of the stairway that is stepped on. It is constructed to the same specifications (thickness) as any other flooring. The tread "depth" is measured from the outer edge of the step to the vertical "riser" between steps. The "width" is measured from one side to the other.

Riser

The vertical portion between each tread on the stair. This may be missing for an "open" stair effect

Flight:

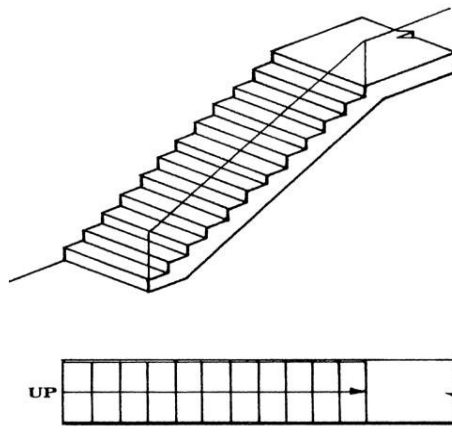
A continuous series of steps without any break or landing is known as flight.

08. Landing:

Landing is a platform provided between two flights. A landing extending to full width of staircase is known as half spaced landing and the landing extending to only half across a staircase is called as quarter space landing.

6. Classification of stairs

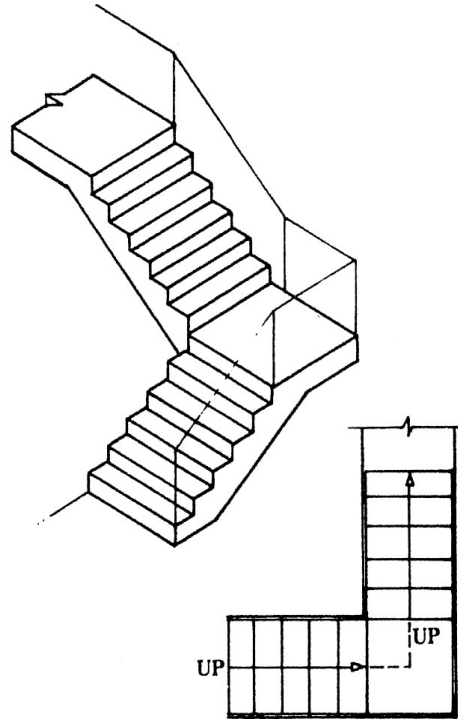
1. Straight stair



- 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.

2. 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 type 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.

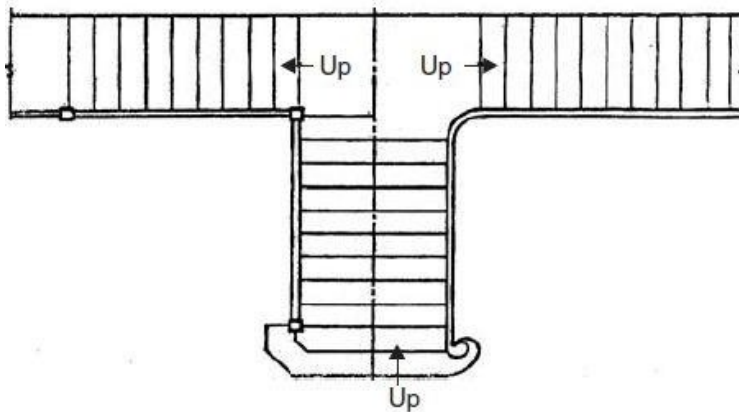
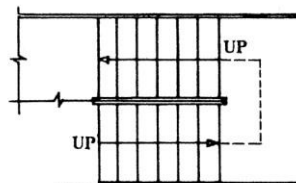
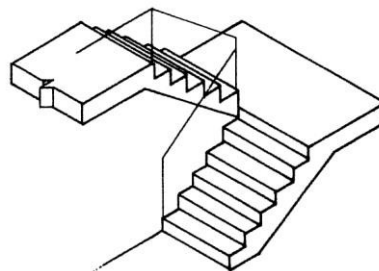


Fig. 8.40. Bifurcated stairs

ii. Half turn stair

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

i. Dog legged stair

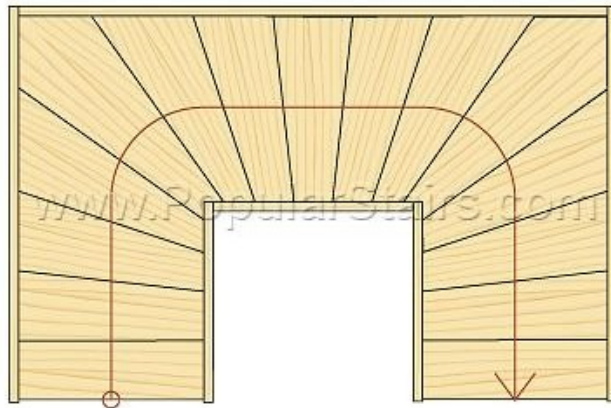


- The flights run in opposite directions and there is no space between them in plan.
- A level landing is placed across the two flights at the change of direction.
- This type of stair is useful where the width of the staircase hall is just sufficient to accommodate twice width of stair.

ii. Open well stair

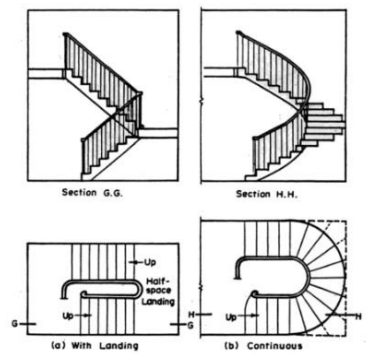
- Space between the upper and lower flights causes half space landing to be longer.
- In case of open newel stair, there is a well or hole or opening between flights. This well may be rectangular or of any geometrical shape and it can be used for fixing lift.
- These staircase are useful where available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

twice the width of steps.

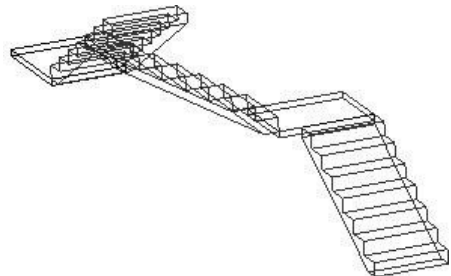
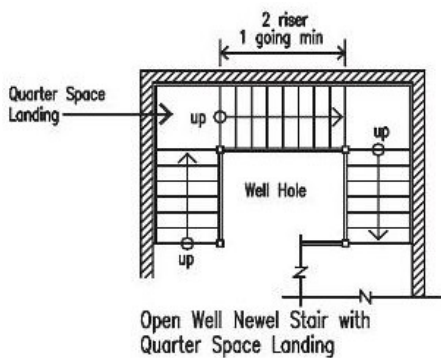


iii. Geometrical Half turn stairs

- 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.



3. Three quarter turn stairs

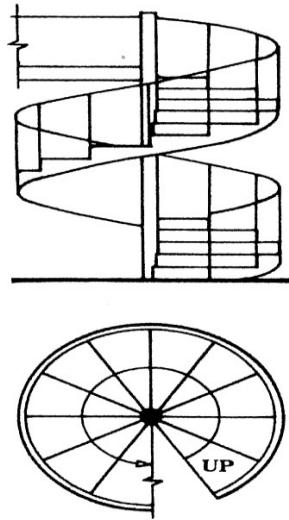


- A stair turning through three right angles is known as a three quarter stair.
- In this case ,an open well is formed. This types of stair is used when the length of the staircase is limited and when the vertical distance between the two floor is quite large.

4. Continuous stairs

Continuous stairs that turn or wind about a central well hole which has rounded corners or is circular or elliptical and that have the strings and rails arranged upon geometric principles and running continuously from top to bottom.

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.

Stairs of diff. Materials



R.C.C. Stairs



Stone Stairs



Timber Stairs



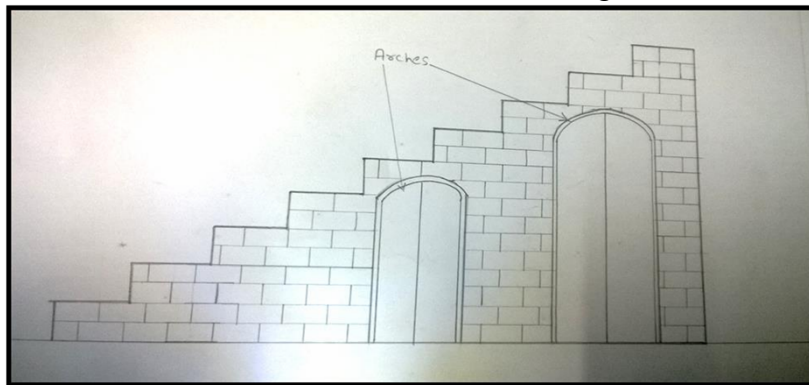
Brick Stairs



Metal Stairs

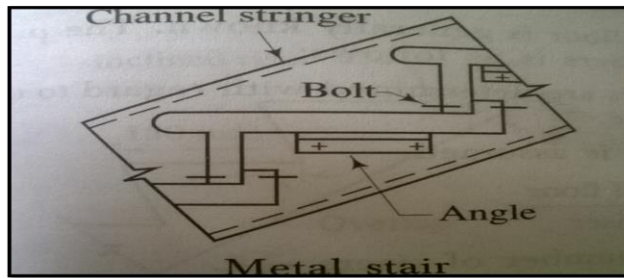
Brick stairs

- not frequently used.
- may be built of solid masonry construction or arches may be provided in a lower portion.
- When arches are provided, the total masonry work is reduced and cupboards may be provided in this hollow space.
- Treads are generally made equal to length 1.50 bricks and risers with the layers of 2 brick respectively.
- The treads and risers are finished with suitable flooring material.



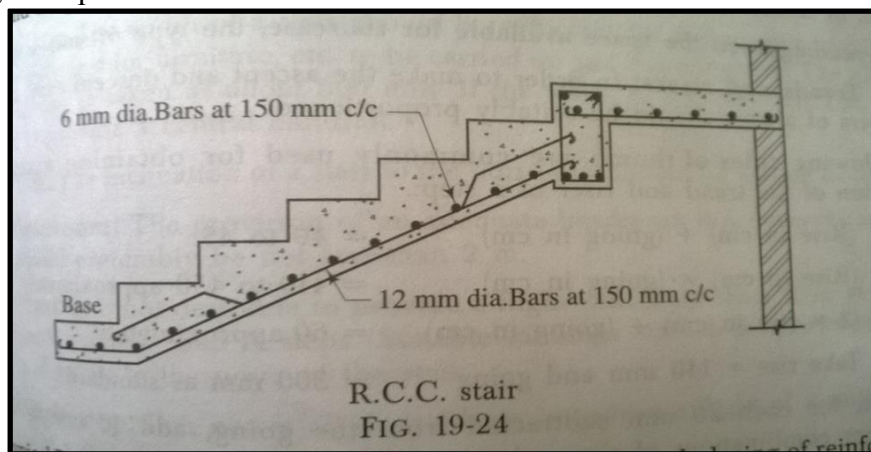
Metal stairs

- The external fire-escape stairs are generally made of metal.
- The common metals used are cast iron, bronze and mild steel.
- used only as emergency stairs, not common in residential and public building.
- mostly used in factories, godowns, workshops etc.
- stringers are usually of channel section.
- For metal stairs the metal balusters with handrail of pipe are used.
- tread and riser of a step may be of one unit as shown in figure.



RCC stairs

- commonly used in all type of constructions for residential, public, and industrial buildings ,in case of framed structures, R.C.C. stairs is perhaps only choice.
- Very good fire resistance.
- can be easily moulded to the desired shape.
- steps can be provided with suitable finishing material such as marble, tile, etc.
- can be easily maintained clean and they are strong, durable and pleasing in appearance.
- can also be easily rendered non-slippery and can be designed for greater width and longer shapes.



Wooden stairs

- Cheap, light in weight, easy to construct & maintenance - mostly used for residential buildings.
- Problem occurs during fire because occupants of upper floors cannot escape. But if stair is constructed from good quality timber like oak, teak, mahogany, etc. using min. thickness of 45mm, to serve the requirements of a fire-resisting stair to a great extent.

The imp factors to be considered in case of a wooden stair are as follows :

1. The joints connecting risers & treads are nailed or screwed.
2. Stringers may be a cut/open string or close string.
3. Scotia blocks gives an additional finish to a wooden step if provided.
4. A metal strip may be provided on the nosing of a wooden step to increase its resistance against wear & tear.
5. Small triangular wooden blocks, known as *glue blocks*, may be provided at the inner angle formed b/w a tread & riser gives an additional touch, placed at abt 80mm distance.
6. In some cases, the risers may be totally omitted. The treads are housed in the strings & the soffit is covered with wooden battens or metal sheets.
7. Timber used -----

- free from fungal decay, insect attack & other defects.
- edges should be finished smooth.
- pieces of timber having abnormal light weight should not used.

Stone stairs

- Stones should be hard & non-absorbent.
- Possess enough resistance to the action of fire.
- Mostly used for warehouses, workshops & other public buildings.
- Widely used where ashlar stones are easily available,
- Restricted in residential buildings to outside stairs. Being heavy in weight, stone stairs require stable support to avoid the danger of damage due to settlement of supporting walls.