

STAIRS L5

Introduction

While constructing a building, we may have a single level, or possibly we may have more than one floor. In this case, one building will be made by different levels. All these levels are located at different heights.

As we are having one building, we need to connect these different levels so that they act as one unit. This means that there has to be some means for this vertical transportation.

In a building, the vertical transportation can be achieved by adopting one of the following techniques:

- i. Stairs
- ii. Lifts
- iii. Ramps

A stair is a set of steps leading from one floor to the other.

It is one of the means of vertical transportation in a building. It is provided to afford means of ascent and descent between various floors of the building.

A stair has to be located in a building.

- In domestic buildings, the stair should be located at the centre of the building to give easy access to all the rooms.
- In public buildings, stairs have to be located at the entrance so as to be easy to access for new users.
- In big buildings, there can be more stairs

Materials for the construction of stairs

Being in public building, or residential building; stairs can be constructed in the following materials:

- i. Timber,
- ii. Bricks (Brick masonry)
- iii. Stones (Stone masonry)
- iv. Steel,
- v. Cement based blocks (block masonry)
- vi. Reinforced cement concrete (**R.C.C**)

In all these materials, they will be well protected against fire.

Parts of stair and their respective functions

1. **Step:** a portion of stair which permits the ascent and descent. A step is comprised of **tread and riser**. A stair is composed of a set of steps.

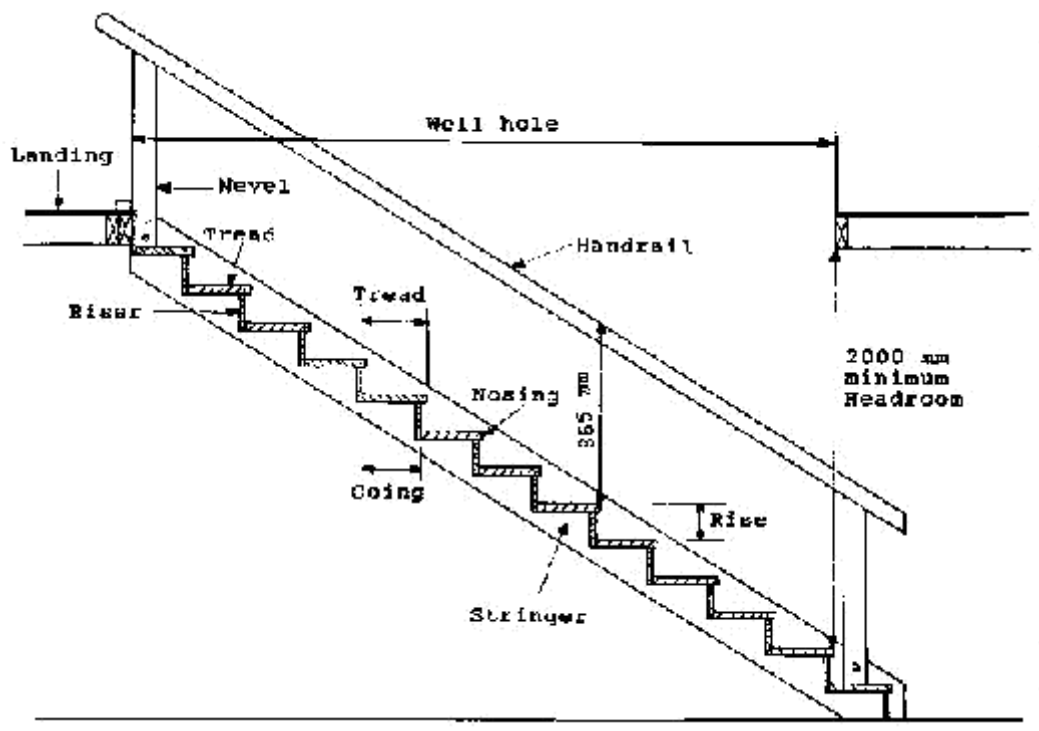
2. **Tread:** the upper horizontal portion of a step, upon which the foot is placed while ascending or descending.

3. **Riser:** the vertical portion of a step which provides a support to the tread.

4. **Staircase:** the room or enclosure in which the stair is constructed.

5. **Stair way:** the space in the stairway which is occupied (covered) by the stair.

6. **Flight:** an unbroken series of steps between consecutive landings



7. **Rise:** a vertical distance on riser between two successive riser faces.

8. **Landing:** a leveled platform at the top or bottom of a flight between the floors. **The main purpose of Landing is:**

- To facilitate to change the direction and
- To provide an opportunity for taking rest during the use of the stair.

9. **Going:** horizontal distance on the tread between two successive riser faces.

10. **Nosing:** the projecting part of the tread beyond the face of the riser. It is usually rounded off to give more architectural view

11. **Scotia:** a molding provided under the nosing to improve the elevation of a step, and to provide strength to nosing.

12. **Soffit:** underside of a step.

13. **Pitch or slope:** the angle which the line of nosing of the stair makes with the horizontal plane. It is the angle which the string makes with the horizontal plane.

Pitch is the angle of inclination that the string makes with the horizontal plane.

14. Line of nosing: the imaginary line parallel to the string and tangential to the nosing. It is parallel to the hand rail.

15. String or stringers: sloping members which support the steps of the stair. It is an inclined member on which steps are formed. The string makes the slope with the horizontal plane

16. Newel post: a vertical member placed at the ends of flights to connect the ends of the strings and hand rail.

17. Baluster: a vertical member of wood or metal supporting the hand rail.

18. Hand rail: an inclined member of timber or steel fixed at the top of balusters, for facilitating the user to put his hand while he is using the stair.

The purpose of hand rail is to provide the protection to the user against falling down from the stair.

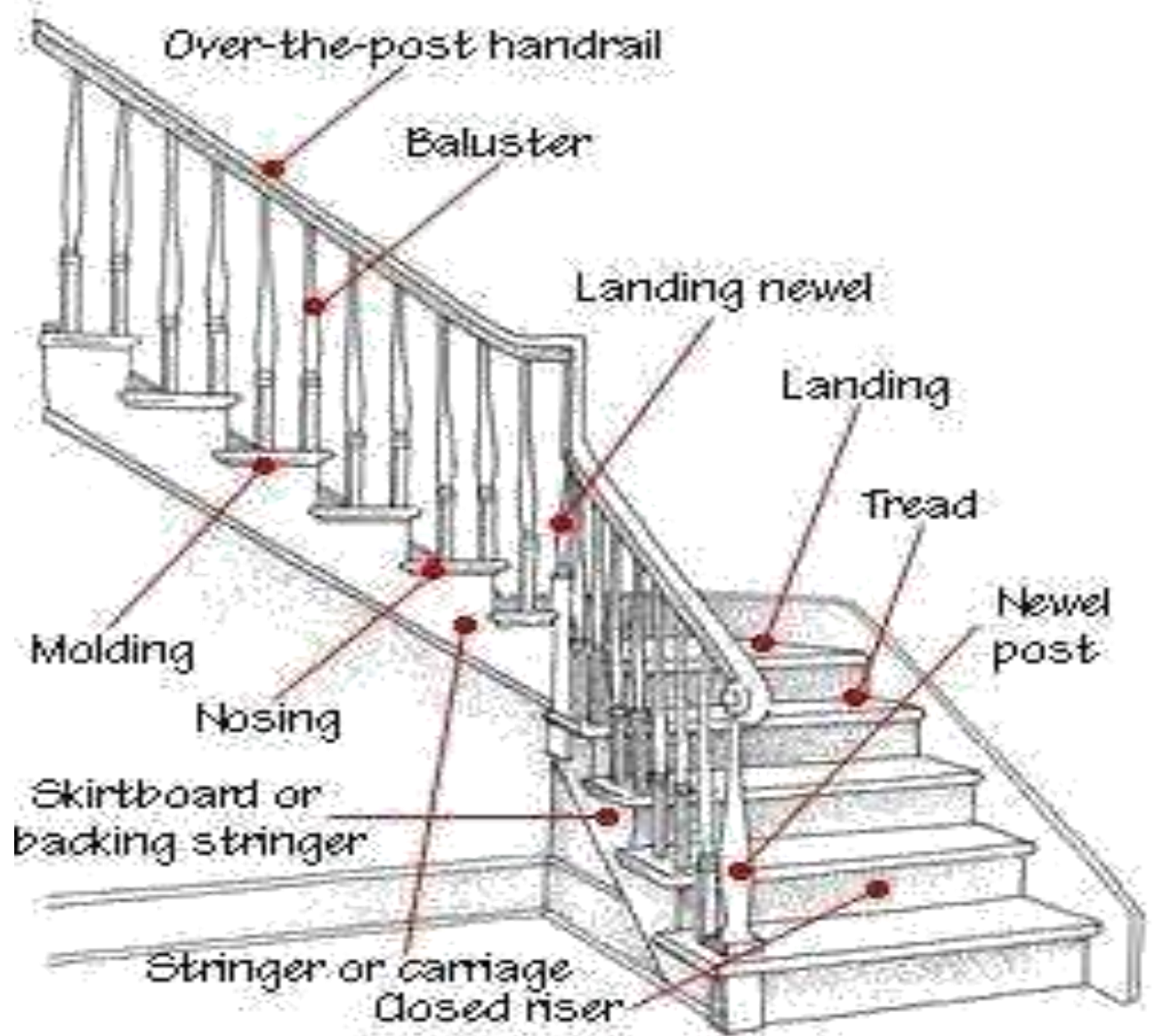
19. Balustrade: a row of balusters which supports the hand rail.

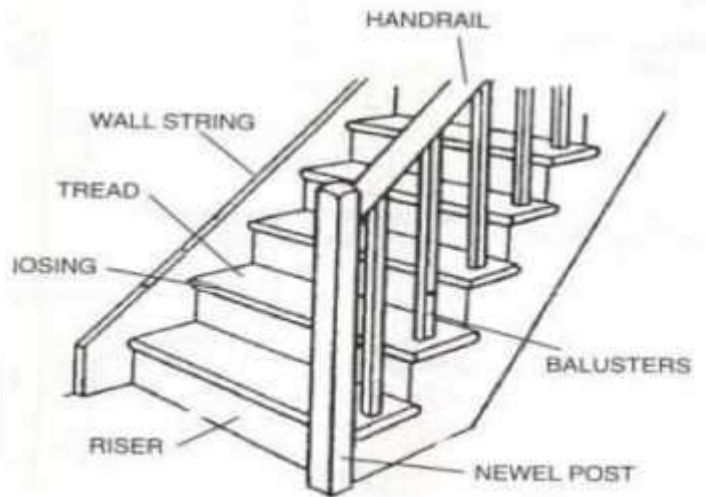
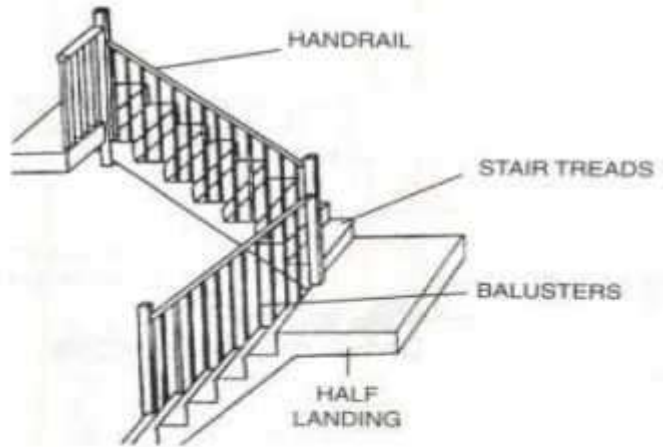
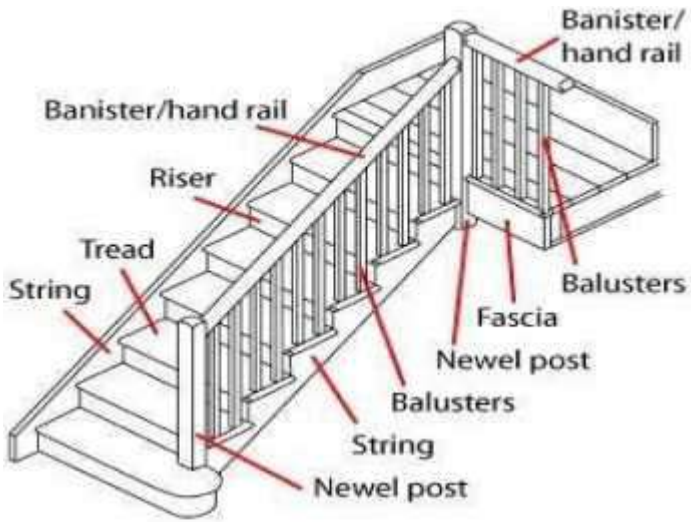
20. Head room: minimum clear vertical distance between two treads and the overhead structure.

It is the vertical distance between the step and another structure immediately above the concerned step.

21. Run: the total length of a stair in the horizontal plane, including all landings.

22. Header: horizontal structural member supporting the stair stringer or landing.





Performance requirements for the good stair

Stairs are one of the means of vertical transportation between various floors of the building. It has to be designed so as to improve **easy, quick and safe mode of communication between floors.**

A stair should fulfill the following requirements about the following points:

a) **Location**

- It has to be located so as to provide easy access to the occupants of the building.
- It should be located at the place where it is lighted and ventilated directly from the exterior (outside)

b) **Width of the stair**

The stair has to be wide enough to carry the users without being disturbed. The width of the stair will always depend upon:

- The location of the building
- The type of the building
- The use of the building
 - In domestic buildings, 90cm of width is enough
 - In public buildings, we use 1.5m to 1.8m or more.

c) **Length of flight**

In one flight; the number of steps should neither be more than 12, nor less than 3. This is to mean that we need to provide some landings to allow taking rest for long stairs.

d) **Pitch of stair**

The slope of the stair should be limited to 30° to 45° . Using a high slope of stair will produce difficult use of stair.

e) **Head room**

The minimum head room has to be between **2.1m to 2.3m** to allow free movement of a tall person using the stair with a luggage at the head. **The head room** is a clear vertical distance between the tread and the soffit of the flight immediately above it.

f) Balustrade

For open well stairs, they should always be provided with balustrade for affording safety to the user of the stair. Wider stair should have hand rails to both the sides.

g) Step dimensions

The step must have dimensions (size) allowed by standards. The rise and going should be such that they provide comfort to the users.




- The going will not be less than 25cm.
- The rise should be between 10cm (for hospitals) to 15cm (for normal use).

For comfortable ascent or descent, we should use the following rules given by standards:

- $2 \text{ Rise} + \text{Going} = 60\text{cm} - 65\text{cm}$
- $\text{Rise} + \text{Going} = 40\text{cm} - 45\text{cm}$
- $\text{Rise} \times \text{going} = 400\text{cm}^2 \text{ to } 450\text{cm}^2$
- As standards set, we will adopt $10 \times 30\text{cm}$ as the size of steps in hospital. In residential buildings as well as common buildings, we will be using $16 \times 26\text{cm}$ as the size of the stair.

h) Materials for the construction of stairs

While constructing the stair, the materials to be used will have to fulfill the following major requirements:

-  To be sufficiently strong
-  To have a good fire resistance.
-  To be serviceable for a long time (they must have a long life span)

LANDINGS

A flight of stairs is limited to 18 risers, before it must have a break. This break may be in the form of another floor level or a landing. A landing may take the following forms:

- a) **Half-space landing:** This is a landing formed between flights at 180° to one another, often referred to as a 'Dogleg' stair.

The length of the landing is equal to the width of the flight and the width of the landing is equal to twice the width of the flight, plus a stairwell if required.

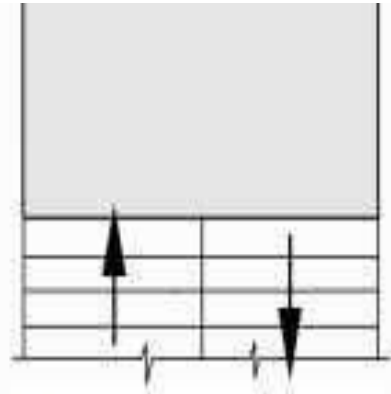
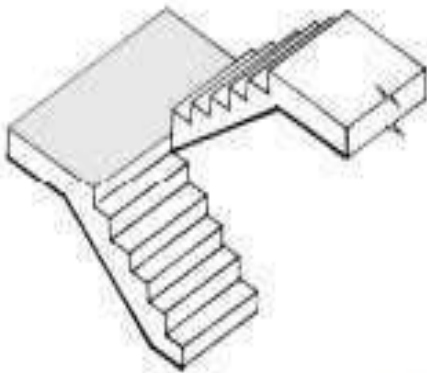


Fig. 15 Half-space landing

- b) **Quarter-space landing:** This is a landing formed between flights at 90° to one another, often referred to as a 'Quarter-turn' stair. The length of the landing is equal to the width of the flight and the width of the landing is also equal to the width of the flight.

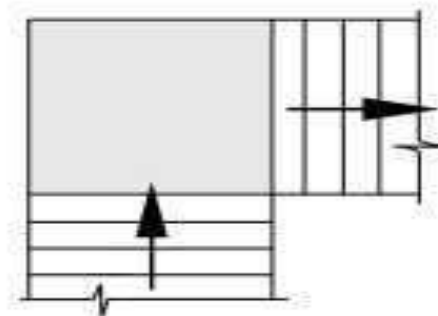
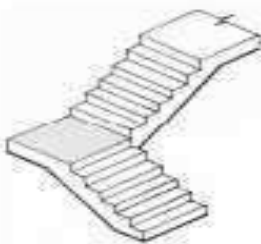


Fig. 16 Quarter-space landing

c) **Intermediate landing:** This is a landing formed between flights running in the same direction. The length of the landing is equal to at least the width of the flight and the width is equal to the width of the flights.

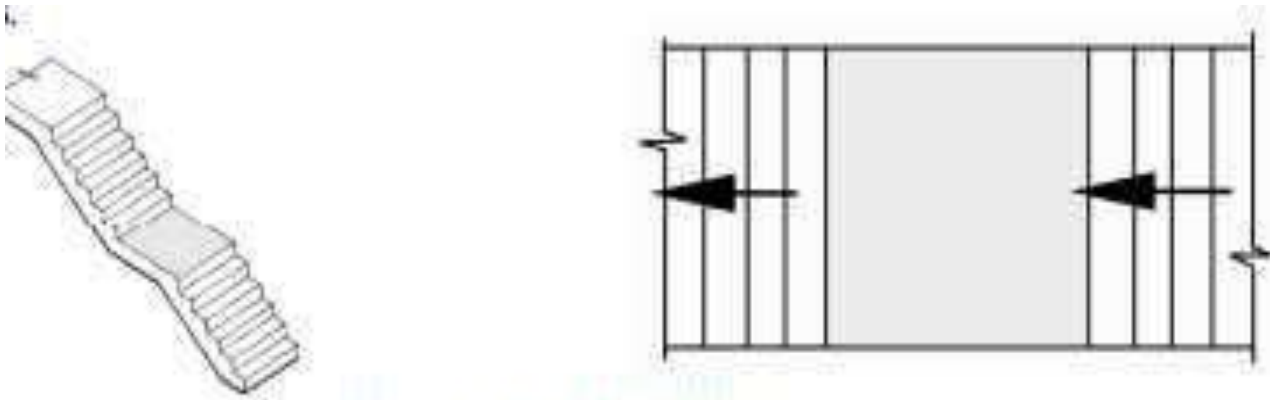


Fig. 17 Intermediate landing

Types of steps

- Bull nose step
- Round ended step
- Commode step
- Flier
- Dancing step
- Winder
- Splayed step

a) Bull nose step

This type of stair case has an initial or entrance or first step different from all other steps. The first step is made to appear as quadrant of a circle at one side and then normal flier type stairs are provided through out. The appearance of the first step is as the nose shaped of any cattle especially of a bull or ox. Hence it's named so.

b) Round ended step

In this type of stair case, the first step is made round or semi circular at one end. All other steps are normal flier type. Old buildings and forts etc. do possess this type of finish and is considered as one of the ornamental designs.

c) Splayed step

This type of stair case has a splayed or chamfered step at the beginning. This makes the only difference of this type from other first two type stairs.

d) Commode step

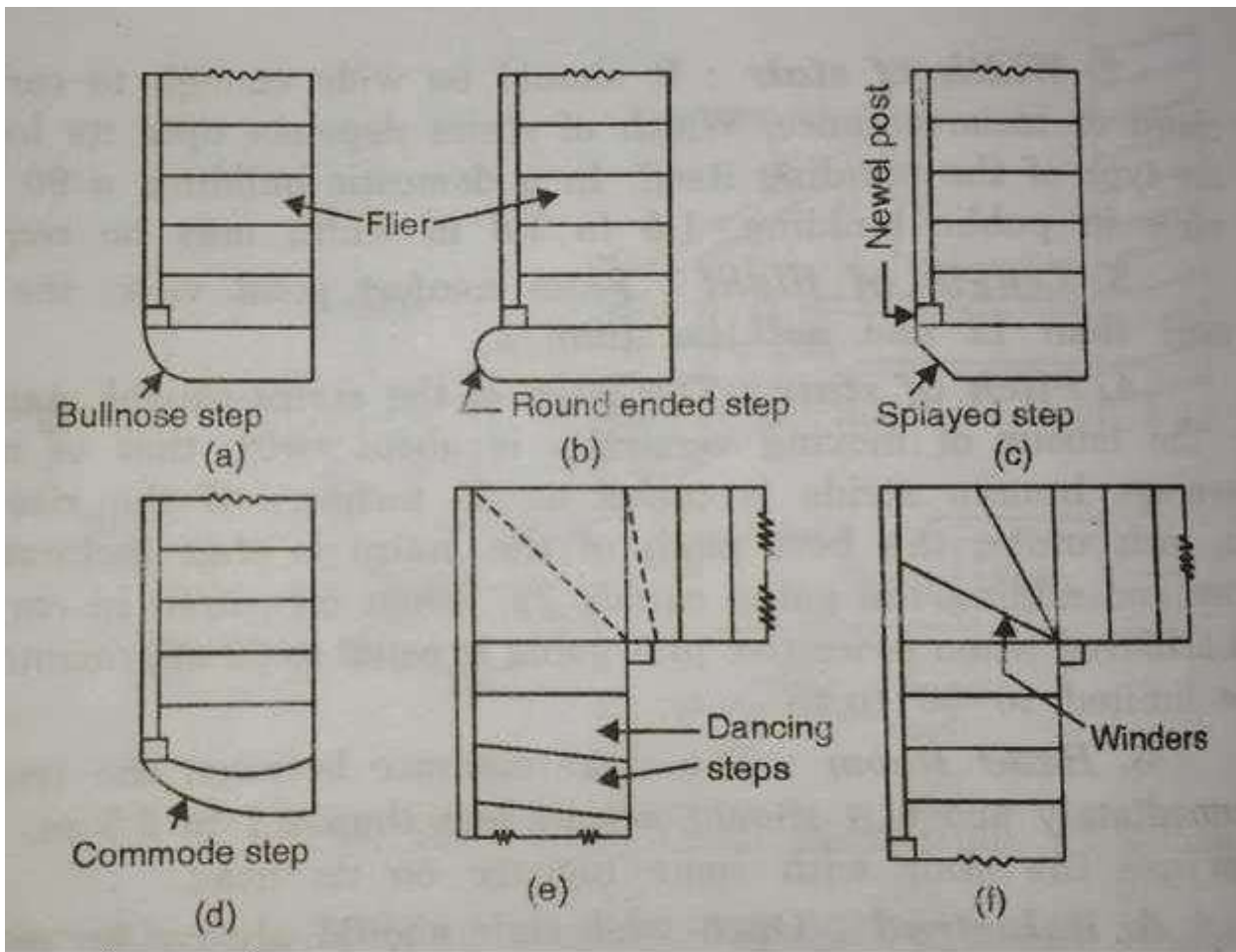
This type step has a curved tread and riser. The curved tread and riser finish may be done to one single step i.e. first step or to all the steps of a flight. This is ornamental and especially located at the stair case made to climb a stage. Also in royal buildings, it's found out.

e) Flier step

Flier type stair case is normally located and most common type stair case. It's rectangular in shape and is found in all most all the buildings.

f) Dancing step

Dancing steps are also called as balancing steps. They balance the movement of any user while climbing up of coming down through the stair case. They look similar to winders where the difference lies in its construction. They differ from winder type stair case that the steps do not radiate from a common center and hence they do possess some width at the radiation point instead of having pointed finish in case of winders. Otherwise it may be called as winder too.



OTHER TYPES OF STAIR CASES (BASED ON STEP TYPE)

Classification of stairs/Three main stair types:

Basically, stairs are classified under two broad categories:

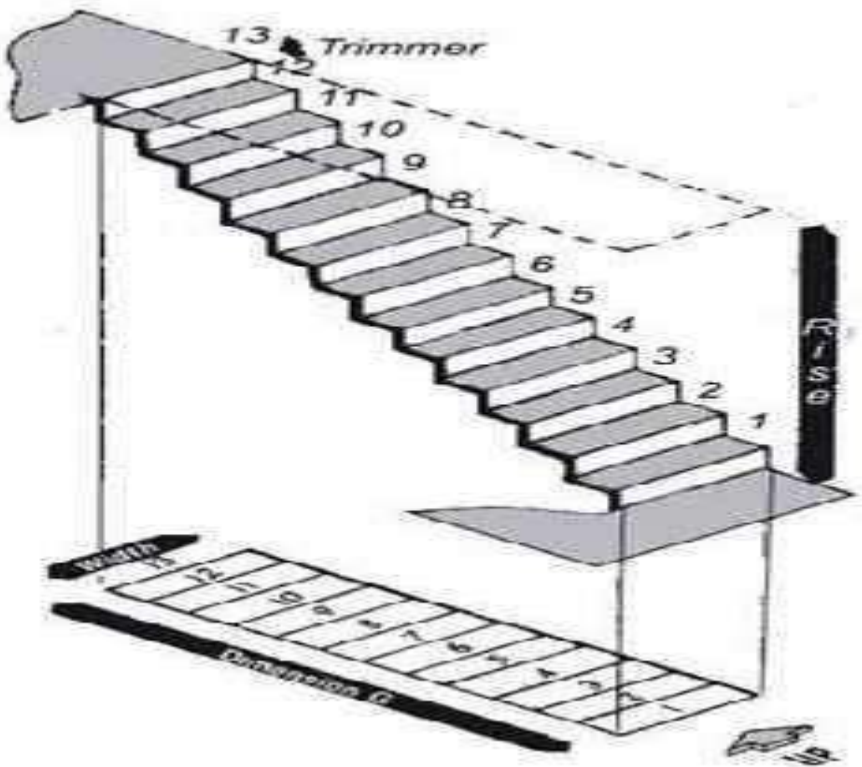
1. Straight stair
2. Turning stair
3. Curved stair

Straight stairs

A straight stair is the one which follows a straight direction without changing its direction either to the left or to the right hand side between two floors. It is mostly used for small buildings. It may consist of either:

- ¥ One single flight; or
- ¥ More than one flight (with landings)

Straight Staircase

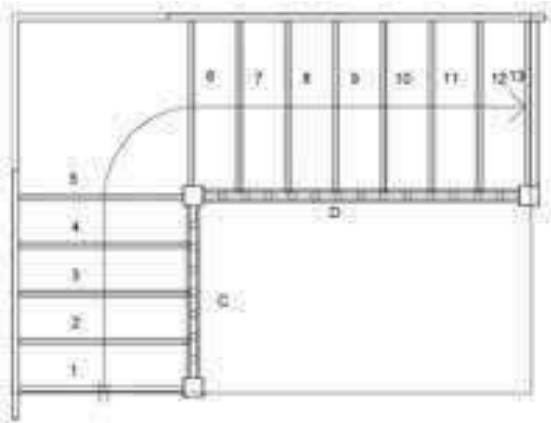


Turning stairs

They are stairs which do not follow a straight line and whose direction changes either to the left or to the right hand side. Its flight(s) changes the direction as well.

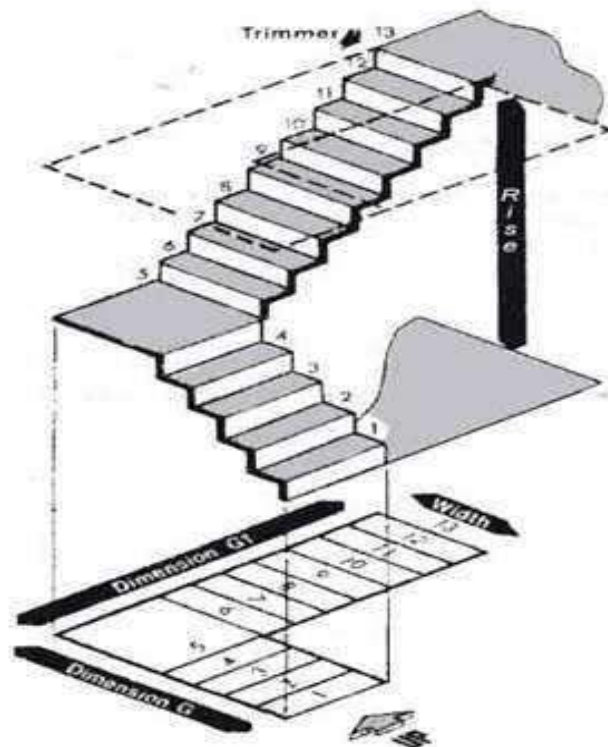
Turning stairs are divided into four different more types:

- A. **Quarter turn stair**
- B. **Half turn stair**
- C. **Three quarter turn stair**
- D. **Bifurcated stair**
- E. **Continuous stair**



- A. **Quarter turn stair**

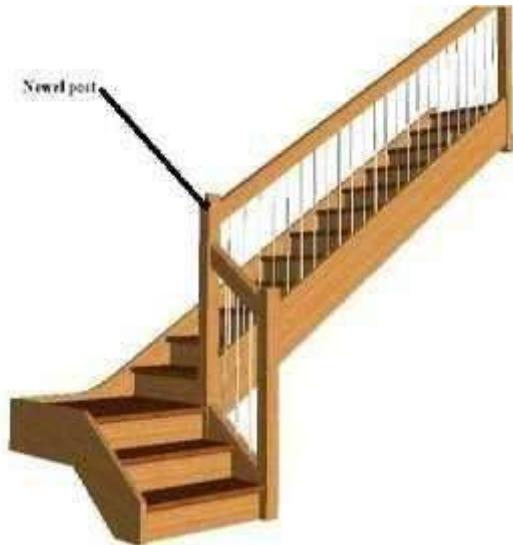
Quarter Landing Staircase



The turn is affected by introduction of a quarter space landing. The quarter turn stairs are of the following types:

1. Newel quarter turn stair
2. Geometrical quarter turn stair

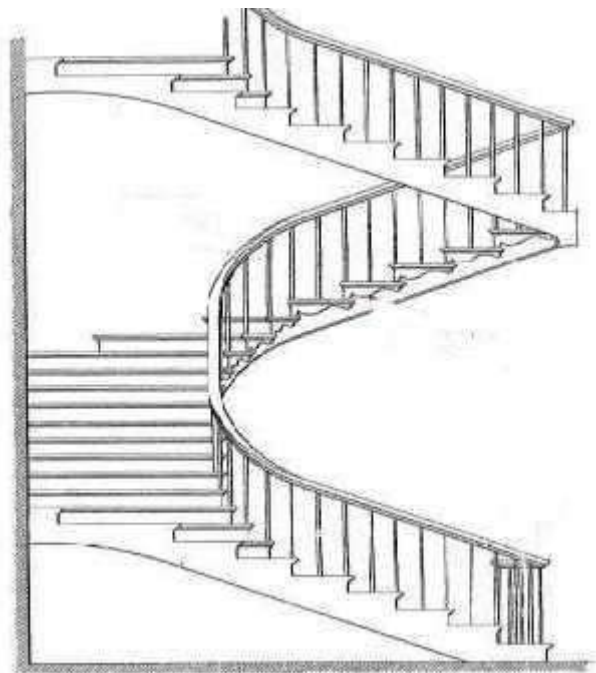
1. Newel Quarter Turn Stair



It is the quarter turn stair which has a newel post at the beginning and at the landing.

2. Geometrical Quarter Turn Stair

This is the quarter turn stair which does not have the newel post at the beginning, or at the landing. The stringer is continuous.



B. Half turn stairs

A half turn stair is the stair which has its direction reversed (changed) by 180° . They are the mostly used. Half turn stairs are classified into three types:

- i. Newel half turn stair
- ii. Open newel turn stair
- iii. Geometrical half turn stairs.

i. Newel half turn stairs

It is a half stair where newel posts are provided at the beginning and at the end of each flight.

ii. Open newel half turn stairs

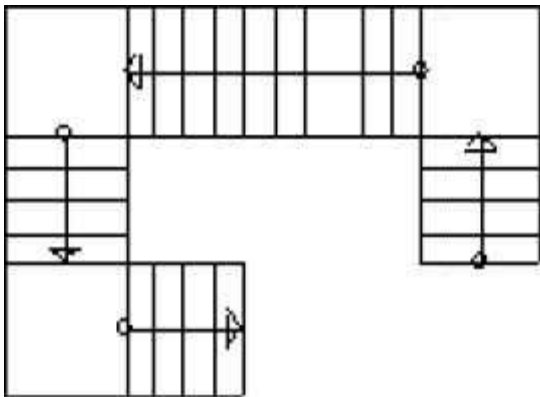
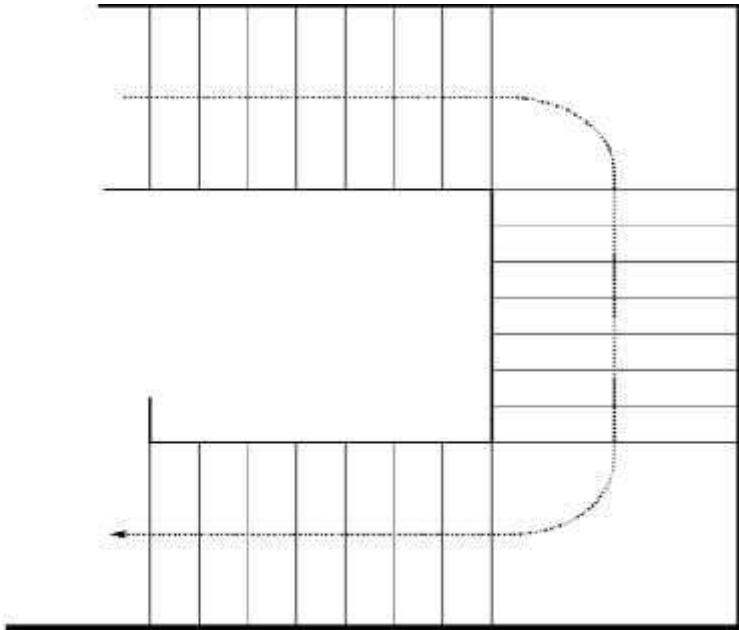
It is a half turn stair where we have a newel between the outer strings.

iii. Geometrical half turn stair

It is a half turn stair where the stringers and hand rails are continuous without any newel post. They are constructed with either a **half space landing** or **without landing**.

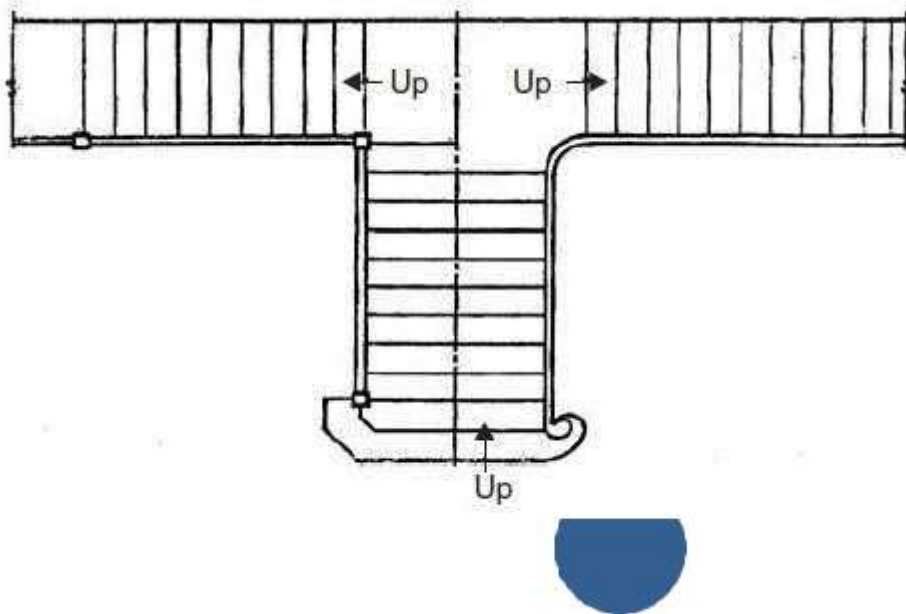
C. Three quarter turn stairs

A three quarter turn stair is the one which has its direction changed three times without its upper flight crossing the bottom one. It is used when the length of the staircase is limited and the vertical distance between the two floors



D. Bifurcated stairs

This is the stair having a wide flight at the bottom divided into two small flights on the landing: **one turning to the left hand side and another one turning to the right hand side.** This type of stair is used in public buildings and at the entrance hall.



3. Curved stair

They are stairs do not have **newel posts and landing**. They are divided into three types:

a. Circular stair

Circular stairs have the form of a regular uniform circle.

b. Spiral stair

- **Is a set of stairs that winds around a central post or column**
- Spiral stairs have the outer part larger than the inner part in the closed circle.

b. Helical stair

This curved structure leads you from one level to the next by way of a flowing circular rotation. ... The core design of the **helical staircase** frequently begins with two rolled stringers attached by treads in between

They are used where there is a limited space. Nevertheless; they are difficult to construct especially when they have to be in reinforced concrete.

Stair construction sequences:

- Setting out
- Preparation of stair members
- Assembly of stair members
- Bottom step
- Balustrade

Learning Outcome1.3: Prepare materials

- Preparation techniques of wooden materials: Measuring
- Planing

- Cutting to the dimensions
- Boring
- Preservation
- molding
- Mixing techniques of adhesive and painting materials :**
- Mechanical

manual

Learning Outcome 1.4: Set out string

- Stair setting out methods:

Diagonal method

- 3,4,5 method

- Setting out process**

- Margin line

- Leveling of string, rise and tread

LU2: PREPARE WORK PLACE

Learning Outcome 2.1: Determine exist and ground finish levels

Site study Site study depend on: The types of stair required

The total rise of the stair The total available going

The number of steps in the flight The position of any landing

Preparation of ground and exist level of stair:

- Ground clearing

Leveling:

- Horizontal
- Vertical

Learning Outcome 2.2: Set out stair footing

Elements affecting setting out of Stair footings:

- Loads to be applied

- The types of stair required The

total rise of the stair The total

available going

- The number of steps in the flight The

position of any landing

Setting out process

- Prepare materials, tools and Workplace

- Measuring

- Margin lining

- Leveling (horizontal, Vertical and Angle)

- Verification

Cutting process of stringers:

- Measuring

Marking

cutting

Fixing methods of stringers into the newel posts and/or landing:

- Nailing
- Screwing with iron corners and connectors
- Bolting
- Jointing

LU3: FIX WOODEN STAIR COMPONENTS

Learning Outcome 3.1: Locate and fix strings

Characteristics of area where the strings will be fixed:

Strong

Stability

Plane

Procedures involve for fitting and fixing string:

Prepare area

Set out of string

Lay string members

Fit and fix string members

Level string

Standard requirements of stair landings Sizes and location

Strength and stability

Shape

Construction steps a of stair landings:

- Prepare landing area
- Measure rise of stairs
- Calculate the number of steps and the treads
- Determine height of the landing
- Build the landing
- Cut the stringers
- Complete bottom stairway
- Attach the top stairway

Learning Outcome 3.3: Fix treads and risers to strings

Fixing materials:

- Nails Dowels
- Screws
- Bolt and nuts Iron corners Corner taps

Fixing Methods of and risers to string Width:

- Nailing Screwing
- Doweling Bolting

Learning Outcome 3.4: Fit and fix handrails and balusters or bracing and lateral ties to the newel post

Laying process of handrails, braces and balusters:

- marking cutting
- jointing Laying
- levelling

Techniques of fixing handrails,braces and balusters:

- Nailing Bolting
- Screwing Doweled Jointing

Safety and security requirements of stair:

- Stability
- Strength
- Durability

LU4: PERFORM FINISHING

Learning Outcome 4.1: Sand wooden stair case

Sandpaper is produced in a range of grit sizes and is **used to** remove material from surfaces, either to make them smoother (for example, in painting and wood finishing), to remove a layer of material (such as old paint), or sometimes to make the surface rougher

- :
- P60*
- P80*
- P120*
- P150 Sizes of sander papers*
- P180*
- P320*
- Sanding methods of wooden stair case:**
- Manual method :
 - Sand paper
 - Sand stone
- Mechanical method

Learning Outcome 4.2: Polish wooden stair case

Types of finishes:

Paints

Varnishes

Stains

Surface finishes:

Moisture-Cure Urethanes

Water-Based finishes

Varnish, Shellac and Lacquer finishes

Polymer finishes

Paint removers

Oil-based finishes

Methods of applying finishes:

Brushing method

Spraying method

Learning Outcome 4.3: Clean, check, maintain and store tools and equipment

- Methods of cleaning of workplace, serviceability of tools and equipment: Blooming method
- Brushing method
- Oiling method
- Use of machine
- Re-sharpening
- Techniques of Waste disposal:
 - Burning
 - Decomposition
- Guidelines in storing tools and equipment securely.
 - Dry place
 - Shelves
 - Toolboxes

