Carpentary joints - I

Objectives: At the end of this lesson you shall be able to
- **define the term carpentry and joinery**
- **state the different technical terms in carpentry**
- **state the principle of joints**
- **enumerate classification of joints**
- **explain the types of lenthening joint.**

Introduction

Now a days wood is a valuable building material, which is not easily available everywhere, so one has to learn with more care about carpentry joints and fasteners and fixtures. By the study of these a trainee can select a right joint for a right position and to make that joint in the right way.

Definition

The timber which is to be used for the structural purpose (such as doors, windows, frames, trusses etc) is to be dressed plained framed and placed in position. Thus a carpenter constructs permanent timber work such as roofs, floors etc. as well as temporary timber work such as scaffolding, shoring , centering etc.

The term joinery is used to indicate the art of preparing internal fittings and finishing of timber. Thus a joint construct timber works such as door, windows, stairs floorboard, furniture, cup-boards etc. Thus the joinery is used for delicate construction required precise workmanship for enhancing the architectural beauty of timber. In India the workman who is employed for the work of carpentary and joinery is known as carpenter.

Technical Terms in Carpentary

The following technical terms are commonly used in carpentry.

Sawing

It is the art of cutting wood by means of a saw.

Shooting

It is the art of dressing of edges of timber pieces as to make them straight and square with the face.

Chamferring

It consists, of taking off the edge or corner of a wooden member. The Chamfered member has a slopping edge which is usually has a slope of 45^0. If the angle of chamfer is other than 45^0 then it is known as a bevel.

Planing

It is the process of taking off the shaving from wood, with the help of a tool known as planer. By planing, timber surfaces are made smooth.

Mitring and scribing

Mitring is the process of joining two wooden members at a angle, if one end of moulding is cut to suite the profile of another moulding it is known as scribing.

Moulding

It is the process of shaping various units of construction either by hand or by machine.

Rebating

It is the process of cutting a rectangular groove on the edge of a timber piece so as to enable the edge or tongue of another timer piece to fit into the former.

Housing

It is the process of sinking of edge of one piece of timber into another by cutting grooves across it grain.

Groove and grooving

Grooving is a term used to indicate a recess formed in a timber member. If the groove is made parallel to the grain, it is known as plough grooving. If the groove is made across the grains, it is known as cross grooving.

Nosing

Nosing is the edge of portion overhanging a vertical surface.

Studding

It is the term applied to the fixing of small timber battens to timber walls to which laths and boards are to be nailed.

Battens

It is a narrow strip of wood which is nailed over joints of boards.

Veneering

It is the process of covering of entire or part of exposed surface of timber by means of veneers for decorative purpose.

Bead

It is the rounded or semicircular moulding provided on the edge or surface of wood.

Principles covering the construction of joint

The joints play the most important role in timber construction because they improve aesthetic appearance, provide structural stability and facilitate the construction. However they form the weakest part of a timber structure. Hence the following general principle baed on the recommendations of Proff: Rankine, should be observed in the construction of timber joints.

The Joint should be cut and placed in such a way that it weakens the connection member to the minimum.

Each abutting surface of a joint should be as far as possible, normal to the line of pressure coming upon the joints.

Each abutting surface of a joint should be designed for the maximum compressive stress likely to come upon it.

The surface of a joint should be formed and fitted accurately so that there is even distribution of pressure.

The fastenings, used to connect members may be so proportional that they possess equal strength in relation to the member which they connect.

The fastening should be placed and designed so as to avoid failure of a joint by shear or crushing.

The joint should be simple as far as possible.

Classification of Joints

Joints are classified into the following six categories.

i Lengthening joints.

ii Widening joints

iii Angle joints

iv Oblique – shouldered joint

v Bearing joint

vi Framed joint.

Lengthening Joint

These joints are also known as longitudinal joints or spliced joints. These joints are used to increase the length of wooden member. The method of lengthening depends upon the situation of a member in a framed structure. Lengthening joints are of various types.

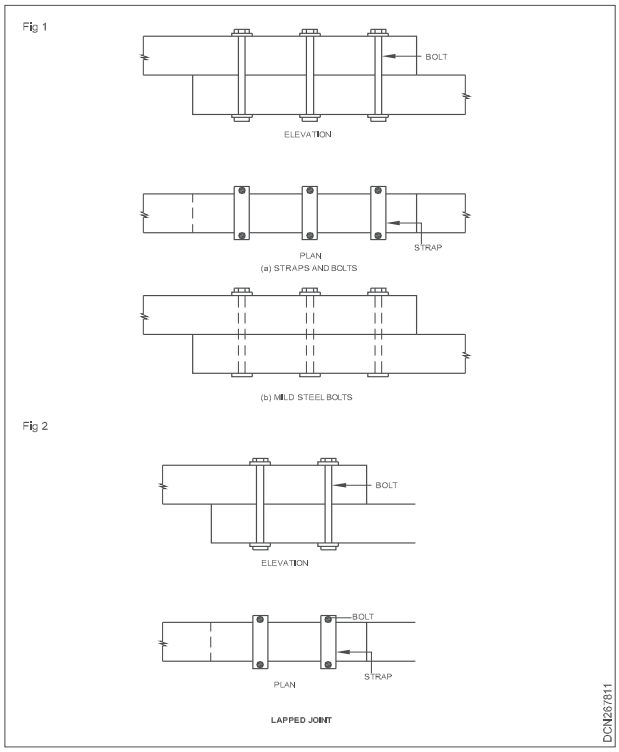
1 Lapped joint

2 Fished joint

3 Scarfied joint

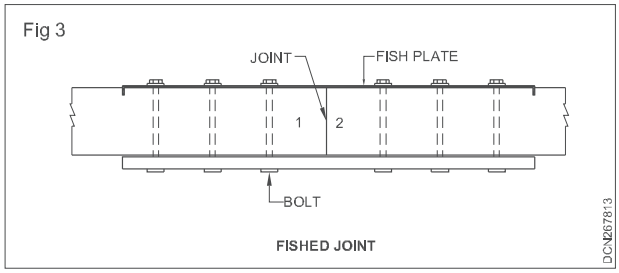
4 Tabled joints

Lapped joint (Fig 1 & 2)



This is the simplest form of joint and is formed by putting two timber pieces one over the other for a short distance and then binding them together by means of iron straps or stirrups, iron straps are provided with bolts on sides for additional strength if the member has to resist a tensile stress, the bolts passing through both the pieces may be provided.

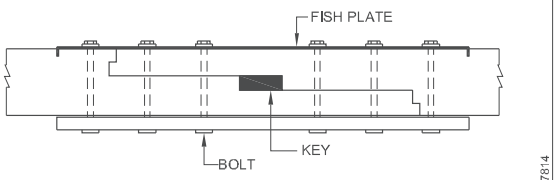
Fished Joint (Fig 3)



In this joint the end of the two members are cut square and placed touching each other. They are then jointed together placing wooden or iron fish plate on opposite faces and securing these by passing boths through them. The bolts are arranged in zig-zag fashion in plan. So that there is only one bolt hole at any cross-section. The ends of fish plate should be slightly bent and pressed into the timber pieces, to increase the strength of joints. Keys and intended fish plates are also provided to the strengthening the joints. It is used for rough and temporary structure such as scaffolding, centering, shoring and form work etc.

Scarfied joint or spliced joint (Fig 4)

Fig 4

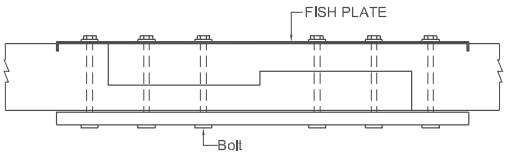


SCARFED JOINT OR SPLICED JOINT

In this type of joint, the projections are made at the end of one piece and corresponding depressions are formed on the other piece. Two pieces are then secured together by means of bolts, straps, fish plates and keys. Such joints give good appearance, since the uniform depth of the member is obtained.

Tabled joint (Fig 5)

Fig 5



TABLED JOINT

These joints are formed when the member is subjected to both tension as well as compression. It is similar to spliced joint but is formed by cutting special shape in both pieces and securing then with fish plate, bolts, keys etc.

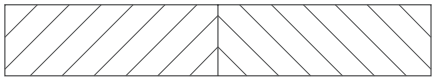
ii Widening Joint

These joints are also called side joints or boarding joints and are used for extending the width of boards or planks. The members are placed edge to edge. These are used for wooden doors, floors, tables etc.

a Butt joints (Fig 6)

These are also known as square plain or ordinary joints are it is used for ordinary purposes.

Fig 6

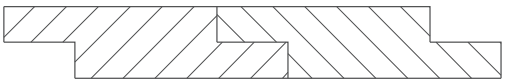


BUTT JOINT

b Rebated joints (Fig 7)

It is formed by overlapping cut portions. The joint remains dust proof after the shrinkage of timber.

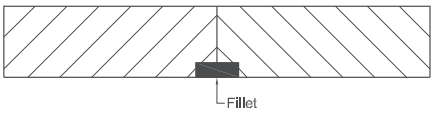
Fig 7



REBATED JOINT

Rebated and filleted joints (Fig 8)

Fig 8



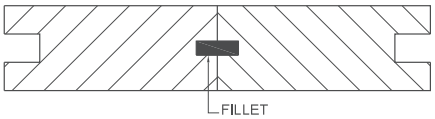
REBATED AND FILLETED JOINT

It is formed by introducing wooden fillet in the rebated portions, having small depression. It is used for floors of factories etc.

Ploughed and Tongued joint (Fig 9)

It is formed by introducing wooden fillet in the grooves cut in the two pieces.

Fig 9

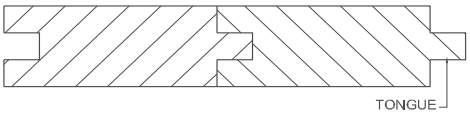


PLOUGHED AND TONGUED JOINT

Tongued and grooved joint (Fig 10)

It is formed by making fillet in one piece and groove in the other.

Fig 10

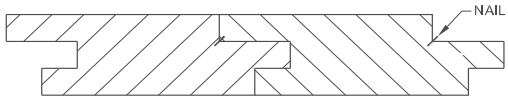


TONGUED AND GROOVED JOINT

DCN26781A

Rebated, tongued and grooved joint (Fig 11)

Fig 11



REBATED, TONGUED AND GROOVED JOINT

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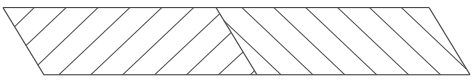
It is formed by forming a rebate in addition to tongue and groove. Nail is placed in such a way that it cannot be seen.

Splayed Joint (Fig 12)

Fig 12



SPLAYED JOINT

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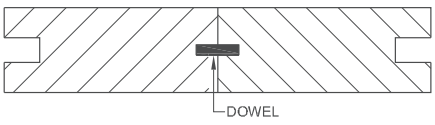
It is formed by splaying the ends of the timber pieces. This joint is used for ordinary purpose but it is superior to butt joint.

Dowelled Joint (Fig 13)

Fig 13



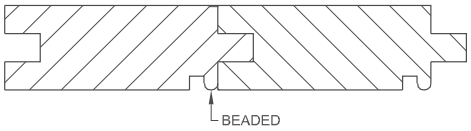
DOWELLED JOINT

DCN26781D

It is formed by making grooves in the centre portion at the end of each piece and inserting dowels of gun metal brass, bronze or copper. This joints is very strong.

Matched and beaded joint (Fig 14)

Fig 14



MATCHED AND BEADED JOINT

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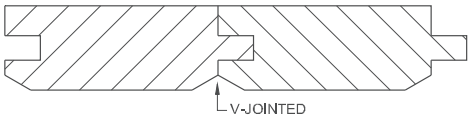
This joint is formed by tongued and grooved arrangement and has special moulding on one silde to give good appearance.

Matched and V- Jointed Joint (Fig 15)

Fig 15



Matched and v-Jointed Joint

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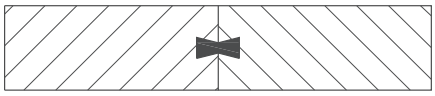
This is a similar to the beaded joint expect that it is chamfered in shape of V.

Dovetailed joint (Fig 16)

Fig 16



DOVETAILED JOINT

DCN26781G

It is formed by providing dovetail shaped keys to fit in the corresponding grooves in the connecting members.

Carpentry joints - II

Objectives: At the end of this lesson you shall be able to
- **explain the bearing joints**
- **explain the angled joint (cornoer joints)**
- **explain different types of fastenings and their uses.**

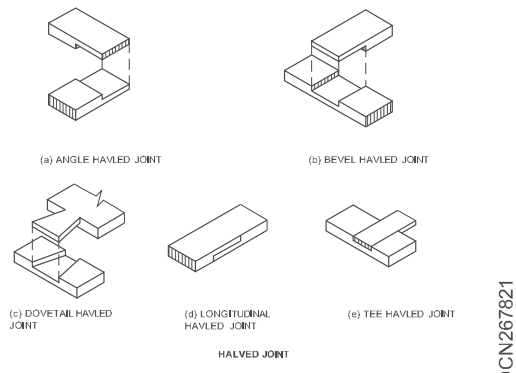
Bearing joint

Bearing joints are provided when two members meet at right angles to each other.

Bearing joints are of the following types

1 Halved Joint (Fig 1)

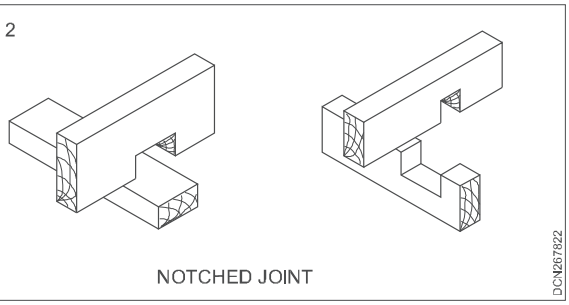
Fig 1



These joints are formed by cutting through half the depth of each member meeting at right angle, so that top surfaces of both the members flush. Various forms of halved joints are angle halved joint, longitudinal halved joint, tee-halved joint, bevelled halved joint and dovetail halved joint.

2 Notched Joint (Fig 2)

Fig 2

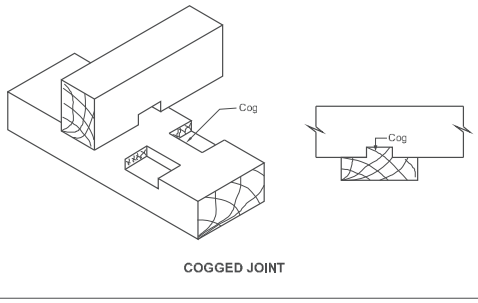


This joint is formed by cutting notch in one or both pieces. The former is known as single notched joint while the latter is known as double notched joint.

3 Cogged joint (Fig 3)

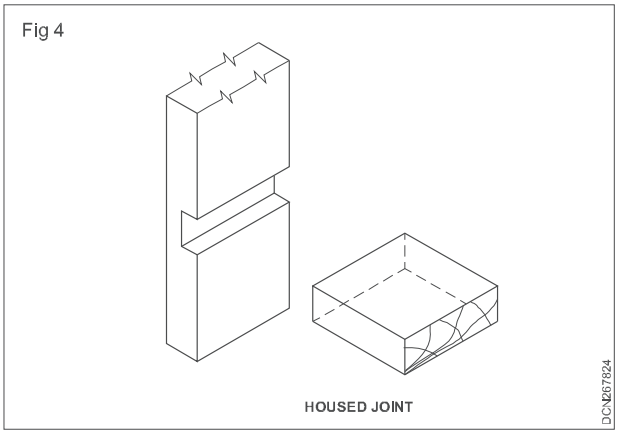
This joint is formed by cutting small notch in the upper timber member and providing notches on the lower member with a projection in the centre. The projection is known as cog. The upper piece in which small notch has been formed, accommodates this cog.

Fig 3



4 Housed Joint (Fig 4)

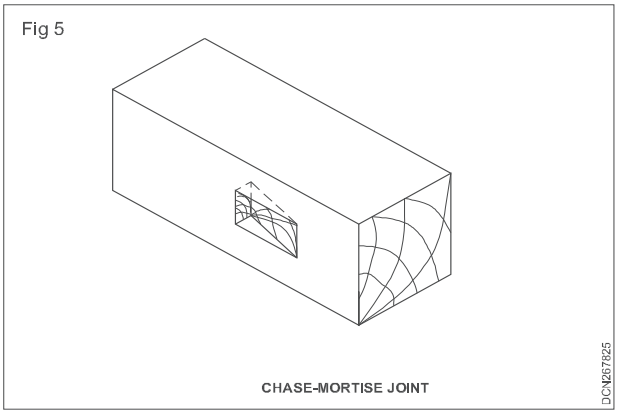
Fig 4



It is formed by fitting the entire thickness of the end of one member for a short distance into another piece. It is used in stairs in which the ends of risers and treads are housed in the strings.

5 Chase – Mortise joint (Fig 5)

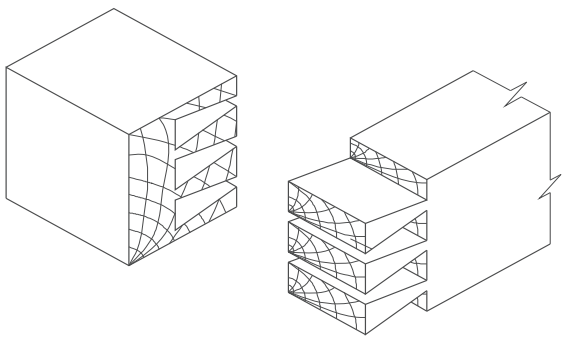
Fig 5



This is used for joining a subsidiary member to a primary member already fixed earlier. A wedge shaped recess is formed in the main member while a tenon of corresponding shape is formed in the secondary member.

6 Dove –tailed joint (Fig 6)

Fig 6



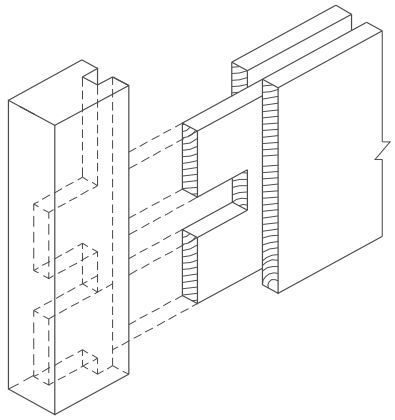
DOVE-TAILED JOINT

DCN267826

This joint is formed by cutting wedge shaped pieces from each member and by hooking the projection of one member into other. This joint is used for curves of sky-lights and corners of boxes, cabinets, drawers etc.

7 Mortise and tenon joint (Fig 7)

Fig 7



MORTICE AND TENON JOINT

DCN267827

This joint is formed by cutting projection known as tongue or tenon in one member which fits into a slot called mortise, cut into the other member.

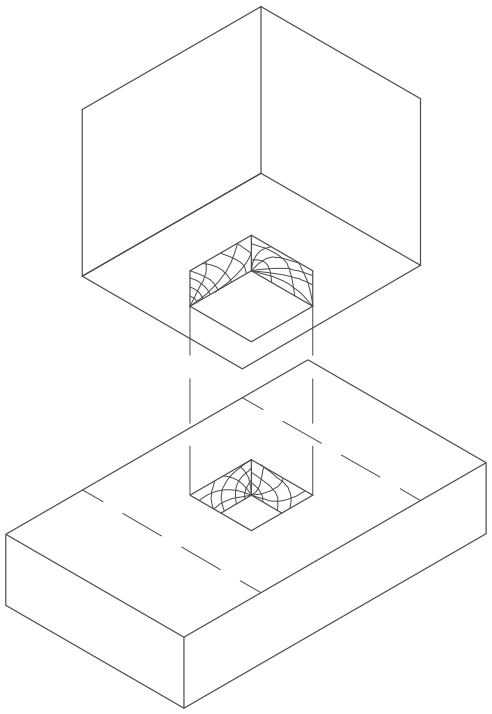
8 Joggle or Stump or Stub tenon Joint (Fig 8)

This is used for framing studs into the sill of wooden partition all. It is similar to mortice tenon joint except that the tenon is short in length and does not extend for full depth of mortised member.

9 Bridle Joint (Fig 9)

This joint is commonly used in wooden trusses at the junction of struts and ties. It is formed by cutting a type of mortise at the end of one piece to fit in the bridle or projection left upon another piece.

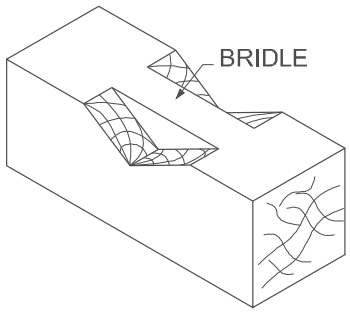
Fig 8



JOGGLE OR STUMP OR STUB TENON JOINT

DCN267828

Fig 9



BRIDLE JOINT

DCN267829

10 Fox-tail Wedging joint (Fig 10)

This joint is formed by cutting a slightly dovetail shaped mortice to have a lesser depth than the member. The tenon is cut and two sockets are made in the tenon in which wedges are inserted. The entire assembly is then inserted in the mortice.

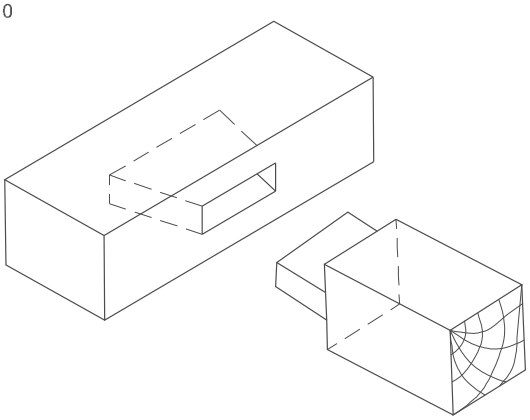
11 Tusk-tenon joint (Fig 11)

This joint is very strong and is commonly used to join timber pieces for construction. The joint is formed of tenon, tusk and horn. It is employed for joining members of equal depth, meeting each other at right angle.

Angle Joint (Corner Joint)

Corner Joints are used when two members are to be jointed so as to form a corner or angular edge. These joints are very often secured by nails and glue.

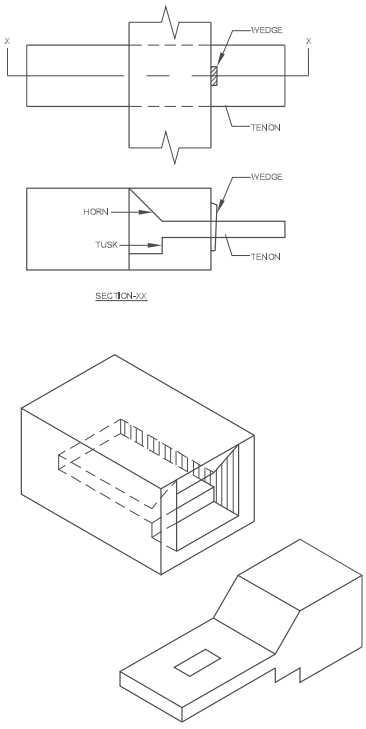
Fig 10



FOX-TAIL WEDJING JOINT

DCN26782A

Fig 11



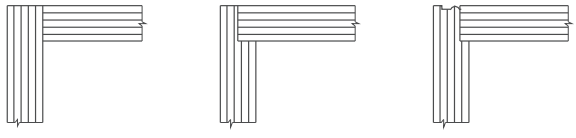
TUSK-TENON JOINT

DCN26782b

Following are the commonly used angle joints

1 Butt joint (Fig 12)

Fig 12



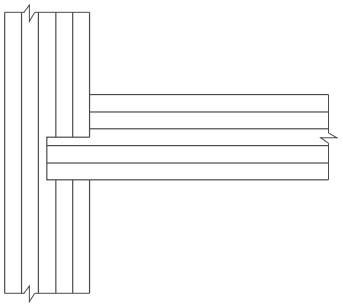
BUTT JOINT

DCN26782c

The members are connected by joining them edge to edge. The joints may be rebated and beaded to give better appearance. The joints may also be tongued.

2 Grooved and tongued joint (Fig 13)

Fig 13



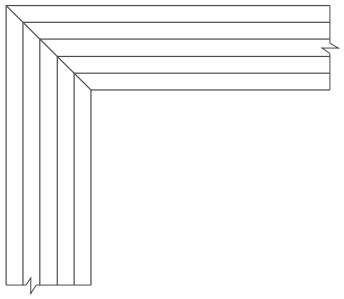
GROOVED AND TONGUED JOINT

DCN26782D

The joint is formed by fitting the projection of one member into the groove of the other.

3 Plain Mitred Joint (Fig 14)

Fig 14



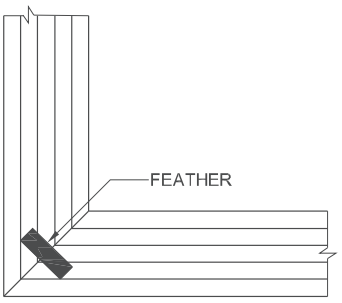
PLAIN MITRED JOINT

DCN26782E

The joint is formed by cutting the edge of both the members by an angle.

4 Mitred and feathered joint (Fig 15)

Fig 15



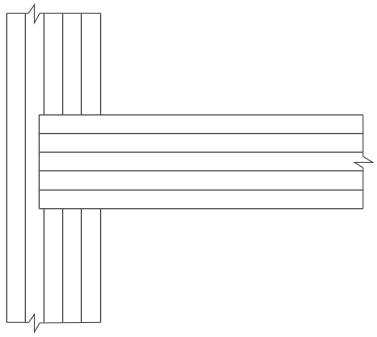
MITRED AND FEATHERED JOINT

DCN26782F

In this an additional wooden member called feather is inserted in the middle of the mitred joint.

5 Housed Joint (Fig 16)

Fig 16



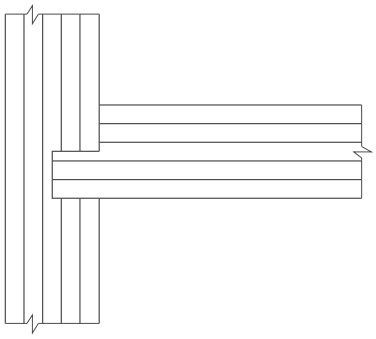
HOUSED JOINT

DCN26782G

The joint is formed by fitting one member completely into the depression of the other.

6 Shouldered and house joint (Fig 17)

Fig 17



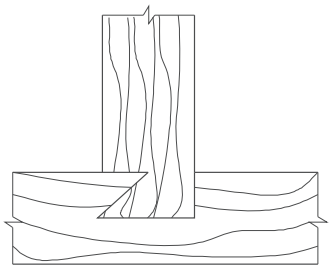
SHOULDERED AND HOUSED JOINT

DCN26782H

In this joint only a part of one member is fit into the corresponding depression of the other.

7 Dove tailed housed joint (Fig 18)

Fig 18



DOVETAILED HOUSED JOINT

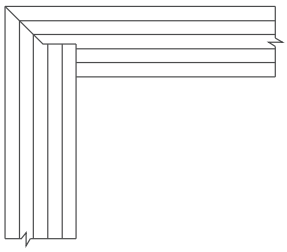
DCN26782I

This is a special type of housed joint in which one member is housed into the other by dovetail shapped projection and cut.

8 Mitred and rebated joint (Fig 19)

The joint is formed by using rebate in addition to the mitre.

Fig 19

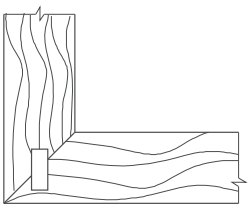


MITRED AND REBATED JOINT

DCN26782J

9 Mitred, rebated and feathered joint (Fig 20)

Fig 20



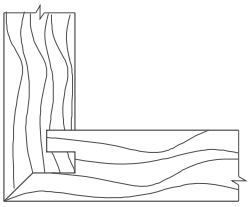
MITRED, REBATED AND FEATHERED JOINT

DCN26782K

The joint is formed by inserting a feather in the mitred and rebated joint.

10 Tongued Grooved and Mitred Joint (Fig 21)

Fig 21



TONGUED GROOVED AND MITRED JOINT

DCN26782L

This joint is formed by making tongue and groove in the lower edge of the mitred, to give improved appearance.

Oblique-shouldered Joint

These joints are used when two members meet at an angle other than right angle, such as in timber truss construction.

Following are the different types of oblique joints

1 Briddle Joint

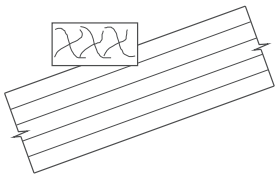
2 Mitred Joint

3 Dove-tailed halved joint

These joints are similar to those discussed earlier except that members will meet at an angle other than right angle

4 Birds Mouth Joint (Fig 22)

Fig 22



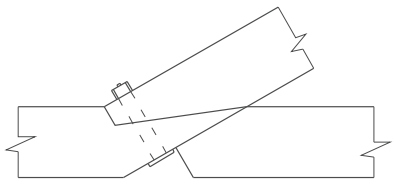
BIRDS MOUTH JOINT

DC2102EM

This joint is formed by cutting angular notch called birds mouth, in the main member to which the other member is partially inserted and fitted.

5 Oblique – tenon Joint (Fig 23)

Fig 23



OBLIQUE-TENON JOINT

DCN26782N

This is used for connecting horizontal member to an inclined member, both the members being bigger in size. The tenon of an inclined member is oblique, which is fixed into the corresponding mortise of the horizontal member. The joint is further strengthened by bolt, key, strap etc.

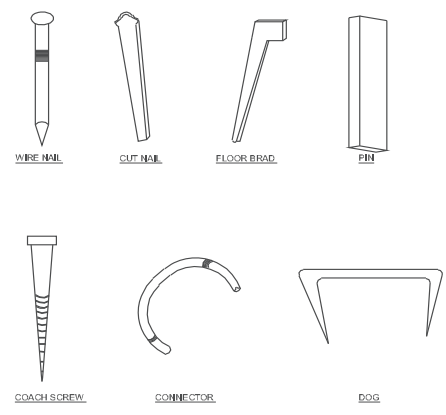
Framing Joint

Framing joints are used to construct the frames of doors, windows, ventilators etc. These joints are similar to bearing joints except that they are not supposed to carry stress as compared to bearing joints. To get the desired architectural effects, these joints are suitably modified.

Fastenings and Tools

The timber joints are secured in position with the help of following fastenings. (Fig 24)

Fig 24



FASTENINGS

DCN26782O

1 **Wire-nails:** These are circular or oval in shape made of wrought iron or steel.

2 **Cut-nails:** These are trapezoidal in section, and are smaller in length.

3 **Floor boards:** These are tapering nails of rectangular section with head at one end and are used for securing floor boards.

4 **Pins:** These are small wooden pieces used for securing joints of door and window shutters.

5 **Screws:** They make the joint stronger because of the greater holding power. These may be round headed or counter sunk.

6 **Coach Screw:** It has a square head which is turned by a spanner.

7 **Bolts:** These are used for large size members; Washers are used with nuts to prevent damage to timber.

8 **Spikes:** These are large nails of 10-15cm length used to secure heavy members.

9 **Connectors:** These are metal rings or corrugated sheet pieces which are driven into the member after abutting them.

10 **Dog:** A dog is a v-shaped wrought iron fastening with pointed ends, which is driven to connect the members. It is used for temporary structures.

11 **Dowels:** These are small wooden pieces which are driven in the members to keep their faces in one plane.

12 **Socket:** These are made of wrought iron or cast iron and are used to protect the end of the members. Sockets are called shoes when they are fixed to the bottom end of the member.

13 **Straps:** These are bands of steel or wrought iron which can be used to join two pieces of timber. The breath of strp is about 40mm-50mm and thickness depends upon the stress coming upon it.

14 **Fish plate:** These are wooden or iron plates which are placed on the opposite faces of timber joint. The fish plates are secured in position by bolt passing through the timber pieces.

15 **Wedger:** These are tapering pieces of wood, used in securing mortice and tenon joint.

Types of doors - I

Objectives: At the end of this lesson you shall be able to
- **define doors & windows**
- **explain the features & location of doors & windows**
- **enlist the technical terms**
- **determine size of doors**
- **explain door frame**
- **enumerate types and classifications of doors**
- **explain types of doors according to arrangement of components Introduction.**

A door or window is an unavoidable part of building, which may be a frame work of wood, steel, glass to give access to men, materials, light and ventilation.

Definition

Door may be defined as an openable barrier secured in a wall opening. A door is provided to give an access to the inside of a room of a building.

Basically a door consists of two parts:

1 Door frame and

2 Door shutter.

The door shutter is held in position by the door frame which in turn is fixed in the opening of the wall by means of hold fasts.

A window is also a vented barrier secured in a wall opening. The function of the window is to admit light and air to the inside of building and to give a view to the outside.

A window also consists of two parts:

1 Window Frame.

2 Window shutter.

The frame is secured to the wall opening with the help of hold fasts. And window shutters are held in position by the window frame.

Location of doors and windows

The following points should be kept in mind while locating doors and windows.

1 The number of doors in a room should be kept minimum since large number of doors causes obstruction and consume more area in circulation.

2 The location of door should meet functional requirements of a room. It should not be located in the centre of the length of a wall. A door should preferably be located near the corner of a room, nearly 20cm away from the corner.

3 If there are two doors in a room, then they should preferably be located in opposite walls facing each other, so as to provide good ventilation and free air circulation in the room.

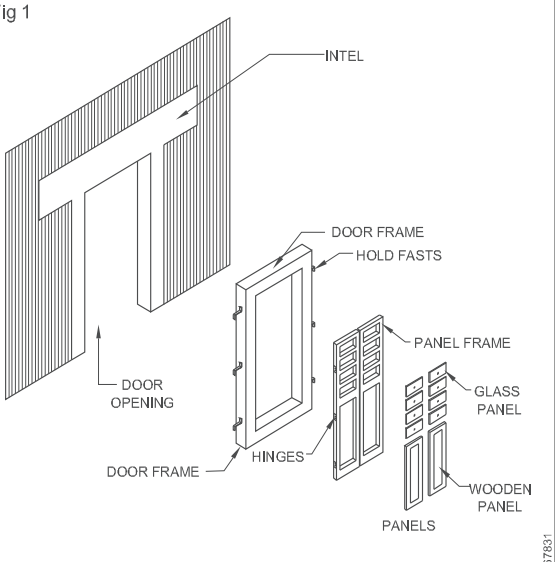
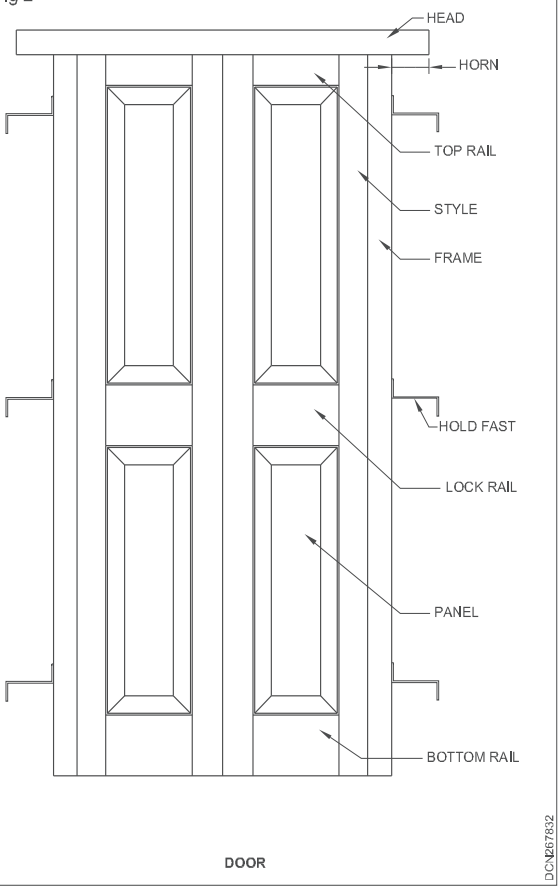
4 The size and number of windows should be decided on the basis of important factors, such a distribution of light control of ventilation and privacy of occupants.

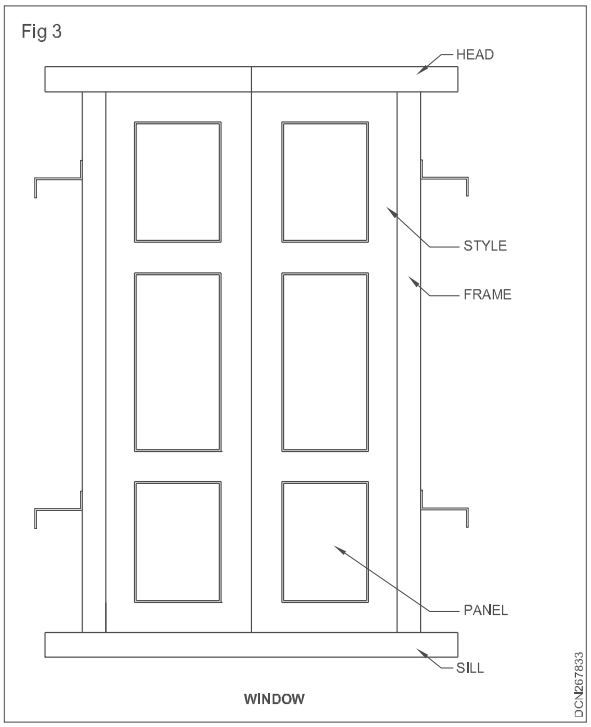
5 The location of a window should also meet the functional requirements of the room such as interior decoration, arrangement of furniture etc.

6 A window should be located in opposite walls, facing door or another window, so that cross ventilation is achieved.

7 From the point of a view of fresh air, a window should be located on the northern side of a room or located in the prevalent direction of wind.

8 The Sill of a window should be located about 70cm-80cm above floor level of the room.

Sl No.	Terms	Figure
1	**Frame:** It is an assembly of horizontal and vertical members forming an enclosure to which the shutters are fixed.	Fig 1  DOORS DCN267831
2	**Shutters:** Openable part of a door or window.	
3	**Head:** Topmost horizontal part of a frame.	
4	**Sill:** Lowermost horizontal part of a frame.	
5	**Horn:** Horizontal projection of head or sill.	
6	**Style:** Vertical outside member of the shutter frame.	
7	**Top rail:** Top most horizontal member of a shutter.	
8	**Lock rail:** Middle horizontal member of door a shutter.	
9	**Bottom rail:** Lower most horizontal member of a shutter.	Fig 2  DOOR DCN267832
10	**Cross rail:** Additional horizontal rails, fixed between the top and bottom rails of a shutter.	
11	**Panel:** Area of shutter enclosed between the adjacent rail and styles.	
12	**Mullion:** Vertical member of a frame, which is employed to sub-divide a window or a door.	
13	**Transom:** Horizontal member of a frame which is employed to sub-divide a window opening horizontally.	
14	**Hold fast:** Mild steel flats, generally bent into Z-shape, to fix or hold the frame to the opening.	

Sl No.	Terms	Figure
15	**Rebate:** Depression or recess made inside the door frame, to receive the door shutter.	Fig 3 
16	**Sash:** Special type of frame, made of light sections and designed to carry glass.	
17	**Louvers:** A piece of timber which is fixed is in inclined position within a frame.	
18	**Architrave:** A strip of wood, usually moulded or splayed which is fixed around the sides and head of opening	

Size of Doors

The size of door should be such that it would allow the movement of largest object and tallest person likely to use. As a rule, the height of door should not be less than 1.80M. The width of door should be such that two persons can pass through it walking shoulder to shoulder. The common widths – height relation used in india is as follows.

1 Width = 0.40 to .0.60 height

2 Height= (width +1.2) metre.

The following are the generally adopted sizes of doors for various types of buildings.

I Doors of residential building.

a External door = 1.00 x 2.00m to 1.10 x 2.00m

b Internal door = 0.90 x 2.00m to 1.00 x 2.00 m

c Doors of bathrooms and closets

= 0.70 x 2.00 to 0.8 x 2.00m

d Carriage of cars

= 2.25m (height) x 2.25m width to 2.25m (height) x 2.40 width

II Public building such as schools, hospitals, libraries, etc.

a 1.2m x 2.00m

b 1.2m x 2.10m

c 1.20m x 2.25m

Indian standard Instituion recommends that the size of door frame should be derived after allowing a margin of 5mm all round an opening for convenience of fixing. The width and height of an opening is in directed by no.of modules where each modules is of 100mm.

For example a designation of 8 DS 20 denotes a door opening having width equal to 8 modules (is 8x 100=800 mm) and height=20 modules (is 20 x 100 = 2000 mm) with single shutter.

The letter 'D' denotes a door opening and letter's' stands for single shutter. Illrly the designation 10DT 21 of door opening denotes.

Width of opening = 10 x 100 = 1000 mm

Height of opening = 21 x 100 = 2100 mm

D - Stands for door, T-stands for double shutter. The thickness of shutter shall be 20,25 or 30 mm depending upon size.

Door frame

A door frame is an assembly of horizontal and vertical members forming an enclosure to which door shutters are fixed. The vertical members are known as jambs, posts, while the horizontal top member connecting the posts is called the head which has horns on both sides. The size of the frame is determined by allowing a clearance of 5 mm to both the sides and top of an opening

Door frame are made of following matrials.

1 Timber

2 Steel Section.

3 Aluminum section.

4 Concrete.

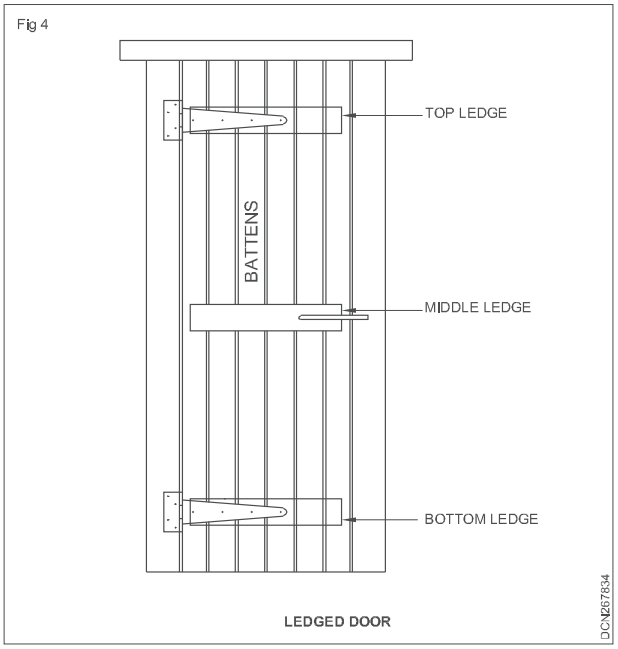
5 Stone.

Out of these, timber frames are more commonly used. However in factories, workshops etc steel frames are used. Aluminium frames are costlier and are used only for residential buildings where more funds are available. With the increasing cost of timber, concrete frames are more popular in urban areas.

Classifications

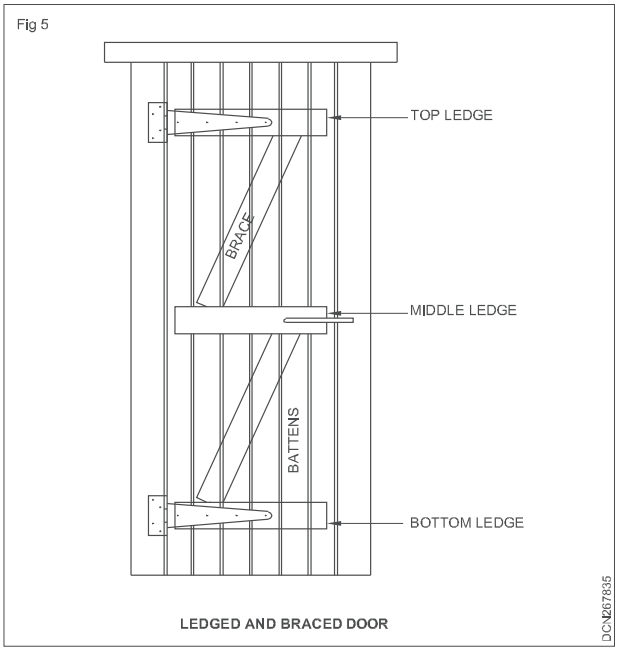
According to arrangement of components	On the basis of method of manner of Construction	On the basis of working operation	Metal doors
Battened and ledged doors	Framed and paralled door	Revovling door	Mild steel door
Battened ledged and braced doors	Glazed or sash door	Sliding door	Corrugated steel door
Battened ledged and framed	Flush door	Swing door	Hollow metal door
Battened ledged, braced and framed doors	Louvered doors	Collapsible door	Metal covered plywood door
	Wire gauged doors	Rolling steel shutter door	

Battened and ledged doors (Fig 4)



This is the simplest type doors, specially suitable for narrow opening when strength and appearance are not important. These doors are formed of vertical boards known as battens which are usually tongued and grooved and are fixed together by horizontal supports known as ledges. Batterns are 10-15cm wide and 20mm-30mm thick. Ledges are generally provided at the top, middle and bottom. The door is hung to the frame by means of T-Hinge of iron.

Battened ledged and braced doors (Fig 5)



These doors are similar to ledged doors except that diagonal members known as braces are provided as shown in figure. The braces are generally 10cm – 15 cm wide and 30 mm thick. The brace give rigidity to the door and hence doors of this types are useful for wide opening. It should be noted that braces must slope upwards from the hanging side as they have to work in compression and not in tension.

Battened ledged and framed doors

In this type of doors a frame work for shutters are provided to make the door stronger and better in appearance as shown in figure. Styles are generally 10cm wide and 40mm thick. The ledges are provided as usual. The total thickness of styles is made equal to the thickness of ledges & thickness of batterns.

Battened ledged framed and braced doors

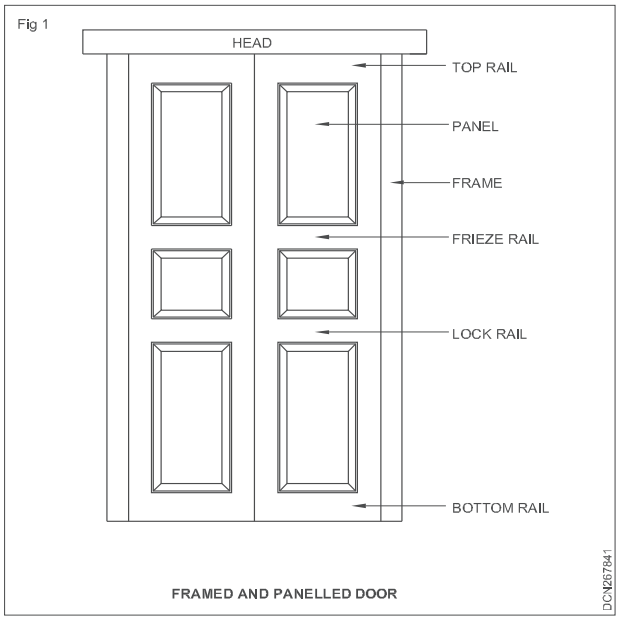
This is just similar to the battened ledged and framed doors, except that brace are introduced. This type of door is durable and stronger and hence it can be used for external use. The brace must stop upward from hanging side.

Types of doors - II

Objectives: At the end of this lesson you shall be able to

- **explain types of door according to manner of construction (framed and panelled door, glazed or sash door)**
- **explain types of door according to manner of construction (flush door, louvered door and wire gauged door)**

Framed and panelled door (Fig 1)



FRAMED AND PANELLED DOOR

These type of doors are widely used in almost all types of buildings since they are strong and give better appearance than battened doors. This door consists, of frame-work in the form of vertical members called styles and horizontal member called rails which are grooved along the inner edge of the frame to receive the panels. The panels are made from timber, plywood, block boards, A.C sheet or even glasses. Panalled doors are of various types such as.

Single panelled doors

Two panelled doors

Three panelled doors

Multiple panelled doors

Panelled doors may contain single leaf for small opening or may contain two leaves for wider openings. In double leaf door each leaf has separate frames each hinged to the corresponding jamb post of the door.

Features of framed and panelled door

The styles are made continuous from top to bottom that is they are in single pieces.

Various rail (in top rail, bottom rail and intermediate rail) are jointed to the styles at both the ends.

The styles and rails are jointed by tenon and mortised joints.

The bottom and lock rail are made wider than top and frieze rails.

The entire frame is grooved on all the inside face to receive panels.

Additional timber beading is provided on one or both the sides to improve the elevation of the door.

The minimum width of the style is kept as 100mm. The minimum width of bottom rail and top rail is kept as 150mm.

If panels are made timbers, its minimum width should be 150mm and minimum thickness should be 20mm.

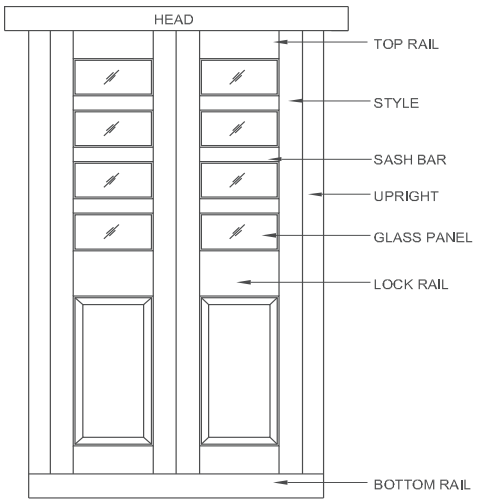
However the maximum area of single panel of timber should not be more than $0.5m^2$. These districtions do not apply to panel of plywood, particles boards on hard board.

Glazed or sash door (Fig 2)

Glazed or sash door are provided where additional light is required to be admitted to the room through the door or where the visibility of the interior of the room is required from the adjacent room. Such doors are commonly used in residential as well as public buildings like hospitals, schools colleges etc. The doors may be within fully glazed or they may be partially glazed and partially paneled. In the letter case the ratio of glazed portion to the paralled portion is kept 2:1 is bottom $1/3^{rd}$ height is paralled and top 2/3 height is glazed. The glass is required into the rebate provided in the wooden sash bars and secured by rails and putty. Partially glazed doors

are sometimes provided with styles which gradually get diminished at lock rail to improve the elevation or to permit more area for the glazed panels. Such style which decrease in width at lock level are called diminishing style or gun stock rail or gun stock style.

Fig 2



GLAZED OR SASH DOOR

Flush Door

Flush doors are becoming popular these days because of their pleasing appearance, simplicity of construction, less cost, and greater durability. They are used both for residential as well as public and commercial buildings. These doors consist of solid or semi-solid skeleton or core covered both sides with plywood, or veneers etc. This door presents a flush and joint less surface which can be neatly polished.

Flush dooors are of two types

a Solid core or laminated core flush door

b Hollow core or celluar core flush door (framed)

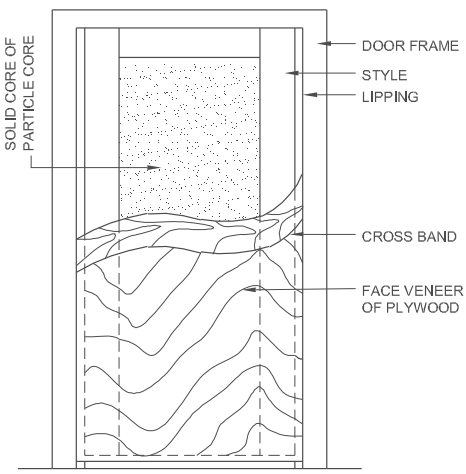
a Solid core or laminated core flush door (Fig 3 & 4)

Solid core flush door consists of framework in the form of styles, top and bottom rails of not less than 75 mm width. The inner space of the frame is provided with block board or particle board.

In the laminated core flush door the wooden strips of maximum width 25mm are glued together and length of each strip is equal to the length of the laminated core. It is housed in the outer frame made of styles, top and bottom rails of not less than 75 mm width.

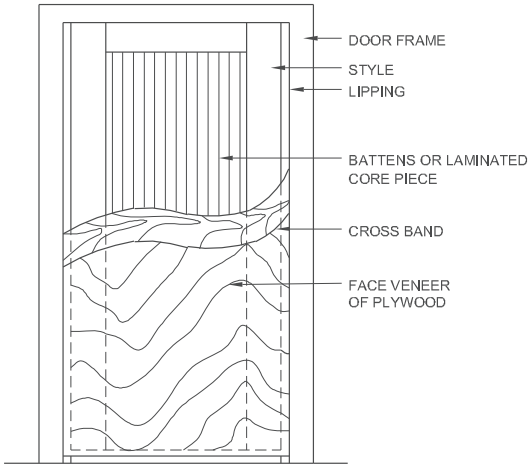
In each type of core, plywood sheets are glued under pressure to the assembly of core housed in the frame on both faces. Alternatively separate cross bands and face veneers can be glued on both the faces, with the grains of core at right angles to that of the cross bands. Such doors are quiet strong but are heavy and require more materials.

Fig 3



SOLID CORE FLUSH DOOR

Fig 4



LAMINATED CORE FLUSH DOOR

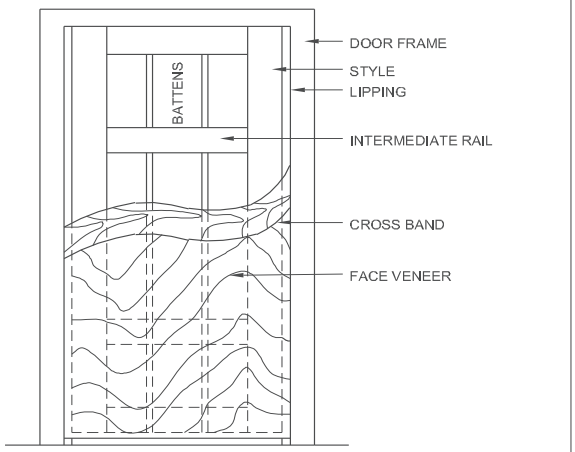
b Hollow or cellular core flush door (Framed flush door) (Fig 5)

A hollow core flush door consists of frame made up of styles, top and bottom rails and a minimum of two intermediate rails, each of minimum 75 mm width. The inner spaces of the frame is provided with equally spaced battens each of minimum 25 mm width, such that the area of voids is limited to 500 $cm^{2.}$

A cellular core flush door consists of frame work made of style, top and bottom rails each of 75 mm width. The

voids space is filled with equally spaced battens of wood or plywood, each of minimum 25mm width. The battens are so arranged that the voids space between the adjacent vertical and horizontal batterns does not exceed 25 cm^2 in area. Total area of voids does not exceed 40% of the area of the shutter.

Fig 5

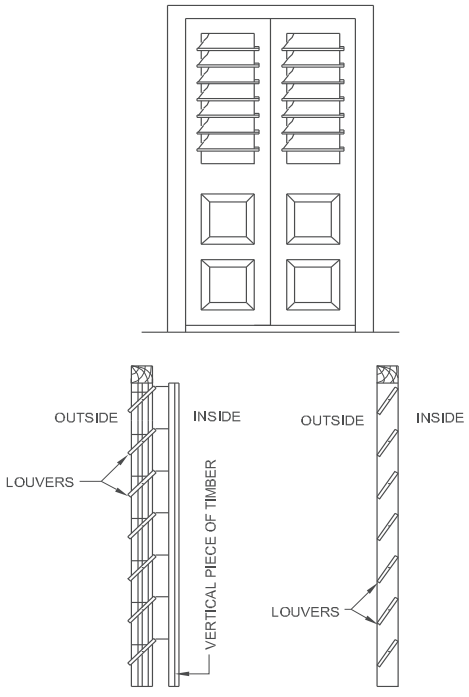


HOLLOW OR CELLULAR CORE FLUSH DOOR

In both types, shutters are formed with, plywood sheets or cross bands and face veneers which are glued under pressure to both the faces of core.

Louvred or Venetian Door (Fig 6)

Fig 6

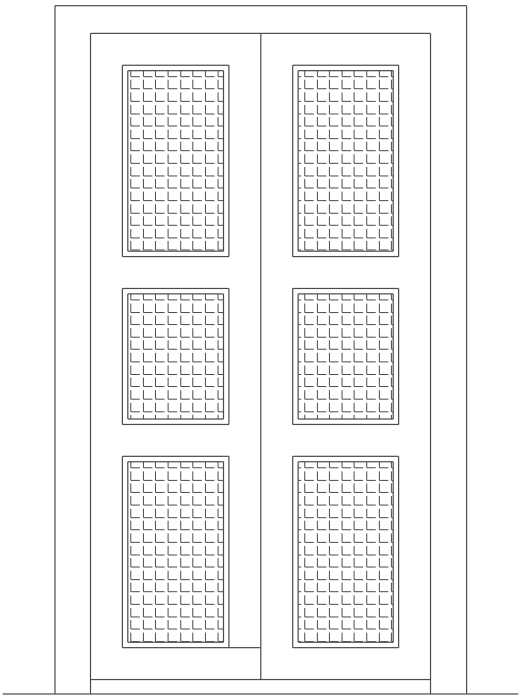


LOUVERED OR VENITIAN DOOR

Louvered doors permit free circulation of air through them and at the same time maintain the privacy of the room. However these doors catch dust which is very difficult to be cleaned. These doors are generally used for latrine and bathrooms of residential and public buildings. The doors may be either louvered to its full height or it may be partially louvered and partially. Panelled. The louverds are arranged and partially paneled. The louvers are arranged at such an inclination that vision is obstructed while they permit free passage of air. This is achieved by fixing the upper back edge of a louver, higher than the lower front edge of the louver just above it. Louvers may be either movable or fixed. In the case of movable louvers, a vertical piece of timber is provided to which louvers are attached through hinges. The movement of louver is activated by the vertical piece of timber. Louvers may be made of either timber or glass or plywood.

Wire gauged doors (Fig 7)

Fig 7



WIRE GAUGED DOOR

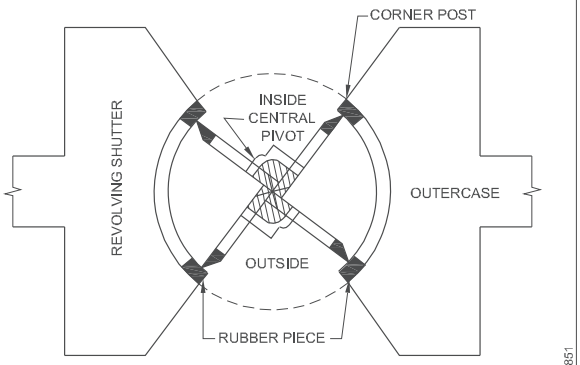
These types of doors are provided to check the entry of flies, mosquitoes, insects etc. Wire mesh is provided in the panels and therefore they permit free passage of air. Such doors are commonly used for refreshment room, hotels, cup-boards containing estables in sweet shops etc. The door is formed of wooden framework consisting of vertical styles and horizontal rails and the panel opening are provided with fine mesh of galvanized wire gauges. The wire gauge is fixed by means of nails and timber beadings. Generally the door has two shutter is fully panelled and the outer shutter has wire gauged panels.

Types of doors - III

Objectives: At the end of this lesson you shall be able to
- **explain types of doors according to working operation.**

1 Revolving Doors (Fig 1)

Fig 1

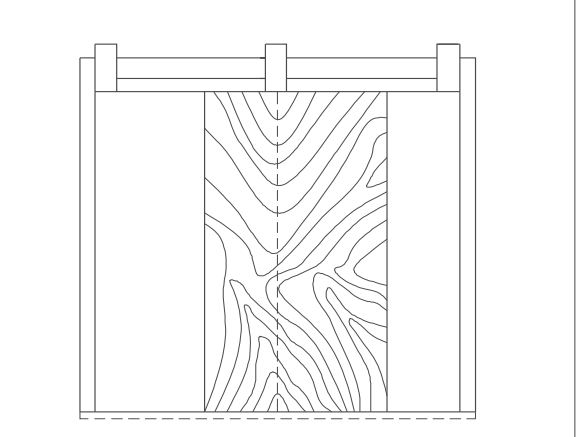


REVOLVING DOOR

Such doors are provided only in public buildings such as libraries, museums, and banks etc. where there are contant visitors. Such doors provide entrance to one person and exit another person simultaneously and close automatically when not in use. This door is also suitable for air conditioned buildings and buildings at places where strong breeze blow throughout the year, since the door is so assembled that it excludes the wind drought. The door many consist of centrally placed mullion to which four radiating shutters are provided. The mullion or vertical timber is supported on ball bearings at the bottom and has bush bearing at the top so that it rotation is without any jerk, friction and noise. The shutters may be fully glazed, fully paneled or partially glazed and partially parelled. The shutters and the mullion are enclosed in a vestibule. Vertical rubber piece are provided at the rubbing ends of shutters to prevent draught of air. The radiating shutter can be folded when traffic is more. The opening can also be closed.

Sliding Door (Fig 2)

Fig 2

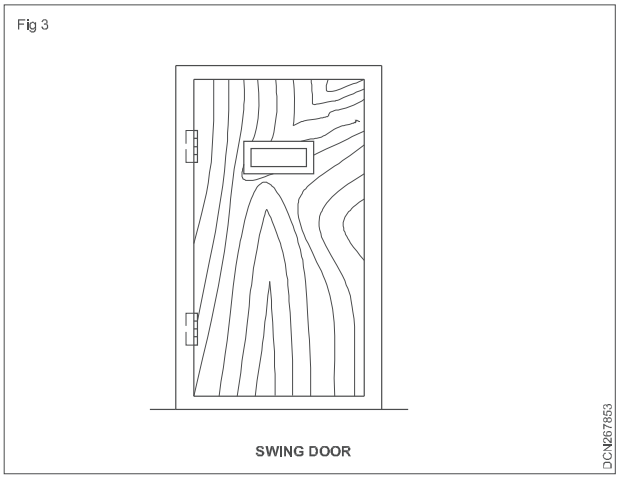


SLIDING DOOR

In this type of door, the shutter slides on the side with help of runner and guide rails. The shutter may be of one or several leaves and can slide either on one side or both the sides. Cavities may be provided in the wall to receive the door in an open position or it may be simply lie touching the wall. As sliding door does not cause any obstruction during movement, it is used for entrance of godowns, sheds, shops, show rooms etc. It is provided with handles, locking arrangement, stopper etc.

Swing Door (Fig 3)

Fig 3

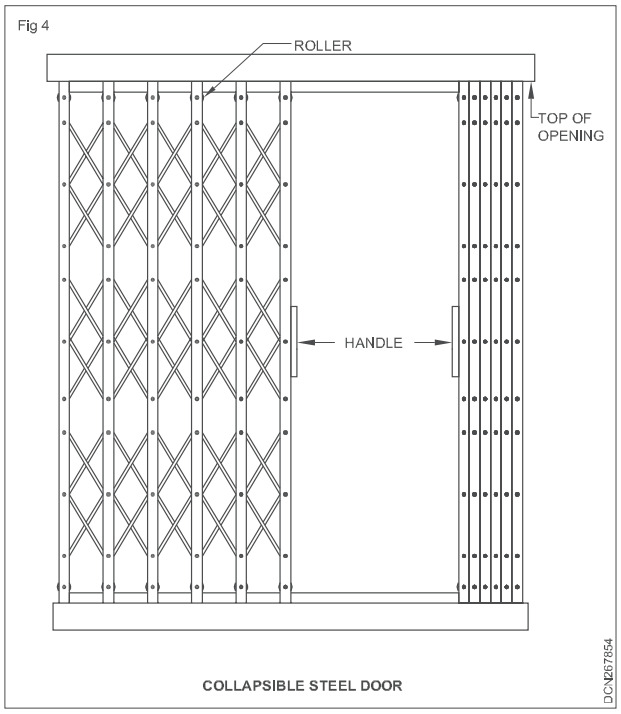


SWING DOOR

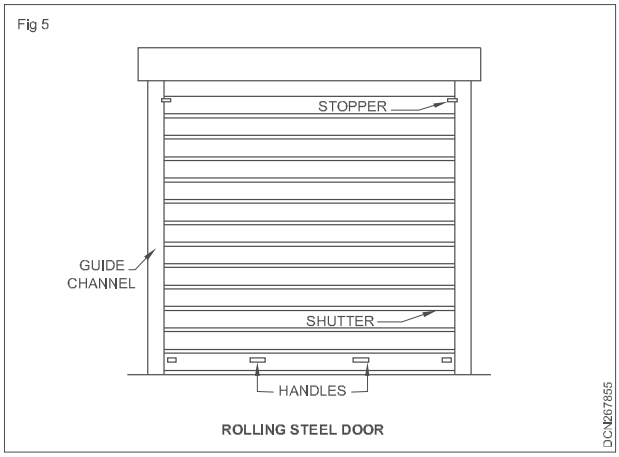
A swing door has its shutter attached to the door frames by means of special double action spring hinges so that the shutter moves both inward and outward as desired. Generally such doors have single leaf, but two leaves can also be provided. Such doors are not rebated at the meeting styles. The closing edge of which should be segmental when the door is to be used, a sight push is made and the action of spring brings the shutter to closed position. The return of the shutter is with force and hence in order to avoid the accident, either the door should be fully glazed or a peep hole should be provided at the eyelevel as shown in figure 3.

Collapsible Steel Door (Fig 4)

A collapsible door may consist of a mild steel frame. Two vertical pieces of mild steel channels about 15 to 20 mm wide are jointed together with the hollow portion of the channel insides; so that a vertical gap is created. Such channel units are spaced at 100-120 mm apart and are braced with flat iron diagonals 10-20mm wide and 5 mm thick. These diagonals allow the shutter to open out or get closed. The door can be opened or closed by a slight push or pull. A collapsible door thus work without hinges. It is used for compound gate, residential building, sheds, godown etc.



Rolling Steel Shutter (Fig 5)



A rolling steel shutter may consist of a frame, a drum and a shutter of thin steel plate or iron sheet of thickness about 1mm. Grooves of about 25 mm thickness are left in the frame. A horizontal shaft and springs are provided in the drum at the top. The diameter of drum is about 20 cm – 30 cm. The shutters are usually rolled in turns. Thus a slight push or pull will open or closed the shutter.

Rolling steel shutter doors are sufficiently strong and they can be easily rolled up or down. They cause no obstruction to the floor as well as openings. Rolled steel shutter door are usually provided for garages, showrooms, shops, godowns etc. They provide security against fire, but the appearance is not good. They cause noise in movement.

Rolling Shutters are two types:

i Pull push type rolling shutters provided for door opening area less than $10m^2$

ii Mechnical gear type rolling shutters provide for door opening are greater than 10 m^2

Windows and ventilators

Objectives: At the end of this lesson you shall be able to
- **enumerate factors for selection of size, location & no. of windows in a room**
- **describe Indian standard recommendations of windows**
- **explain different types of windows and ventilators.**

Introduction

Windows: Windows are necessary for ventilation and lighting. These are usually glazed with clear or opaque glasses. As already stated, not less than 10 t0 15 percent of the floor area of a room is given to windows opening to the outside. The smaller the floor area, the larger will be the percentage.

Ventilators

Ventilators are windows of small heights and they are fixed at the top of door or window. The ventilators are provided with glass panels and steel grill is fixed in ventilator for the purpose of safety.

Windows

The selection of size, shape location and no. of windows in a room depends upon the following factors.

1 Size of the room
2 Location of the room
3 Utility of the room
4 Direction of the wall
5 Direction of the wind
6 Climatic conditions such as humidity, temperature etc.
7 Requirement of exterior view
8 Architectural treatment to the exterior of the building.

Based on these factors the following thumb rules are in use.

1 Breath of window = 1/8 (Width of room + Height of room)
2 The total area of window opening normally varies from 10-12% of the floor areas of the room depending upon the climatic conditions.
3 The area of window opening should be at least 1 sq.m for every 30-40 cubic metre of the room volume.
4 In public buildings, the minimum area of window should be 20% of floor areas.
5 For sufficient natural light, the area of the glazed panels should at least be 8-10% of the floor area.

Indian standard recommends that the size of window frame. Should be derived after allowing a margin of 5 mm all round an opening for convenience of fixing. The width and height of an opening is indicated by a number of modules, where each module is of 100 mm. A designation 6ws 12 indicates a window opening with single shutter having width equal to 6 modules.

It, 6 x 100 = 600 mm

And height equal to 12 modules

It, 12 X 100 = 1200 mm

Indian standard recommendations for size of opening size of frame and size of window shutters are given below:

Sl No	Designation	Size of Opening	Size of Window frame	Size of window shutters
1	6 WS 12	600 x 1200	590 x 1190	560 x 110
2	10 WT 12	1000 x 1200	990 x1190	460 x 1100
3	12 WT 12	1200 x 1200	1190 x 1190	560 x 1100
4	6 WS 13	600 x 1300	590 x 1290	560 x 1200
5	10 WT 13	1000 x 1300	990 x 1290	460 x 1200
6	12 WT 13	1200 x 1300	1190 x 1290	560 x 1200

Types of Windows

The Common Verities of windows used in building construction are as follows:

1 Fixed Window
2 Pivoted window
3 Double hung window
4 Casement window
5 Sliding window
6 Sash window
7 Louvered window
8 Metal window
9 Bay window
10 Clerestorey window
11 Dormer window
12 Corner window
13 Gable window
14 lantern window
15 Sky lights
16 Ventilators
17 Combined windows and Ventilators.

Fixed Window (Fig 1)

These windows are provided for the only purpose of admitting light and providing vision in the room. This window may consist of a window frame to which shutters are fixed. No rebate are provided to the window frame. The shutters are fully glazed.

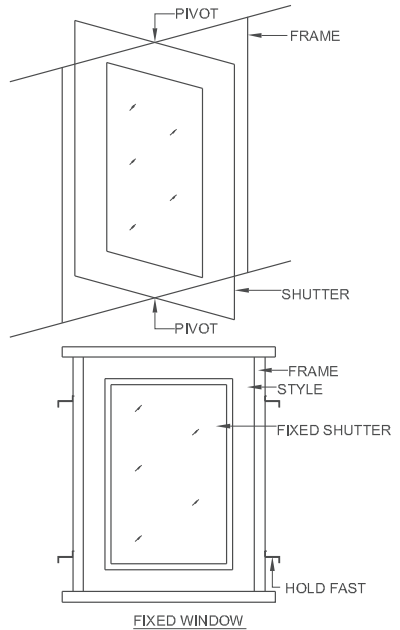
Pivoted window (Fig 1)

In this type of window the shutter is capable of rotating about a pivot fixed to window frame. The window frame has no rebate. The shutter can rotate horizontally or vertically depending upon the position of pivot.

Double – hung window (Fig 2)

This type of window consist of a pair of shutters arranged one above the other which can slide vertically within the grooves provided in the frame. A pair of metal weights connected by chain passing over pulleys, is provided for each shutter. By this arrangement the window can be opened at top or bottom to the desired extent by pulling the metal weight suitably. Thus in this type of window, it is possible to have controlled ventilation. In addition, the shutter can also be cleaned easily.

Fig 1



FIXED WINDOW

PIVOTED WINDOW

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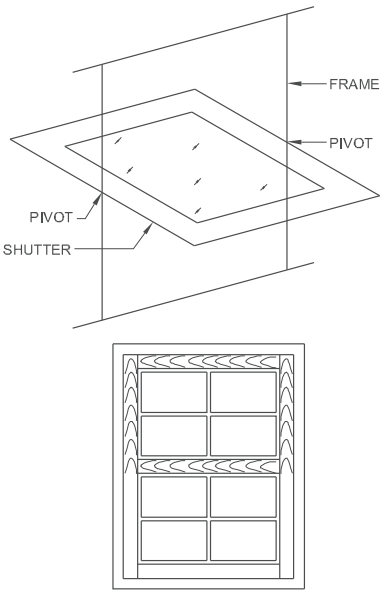
Fig 2



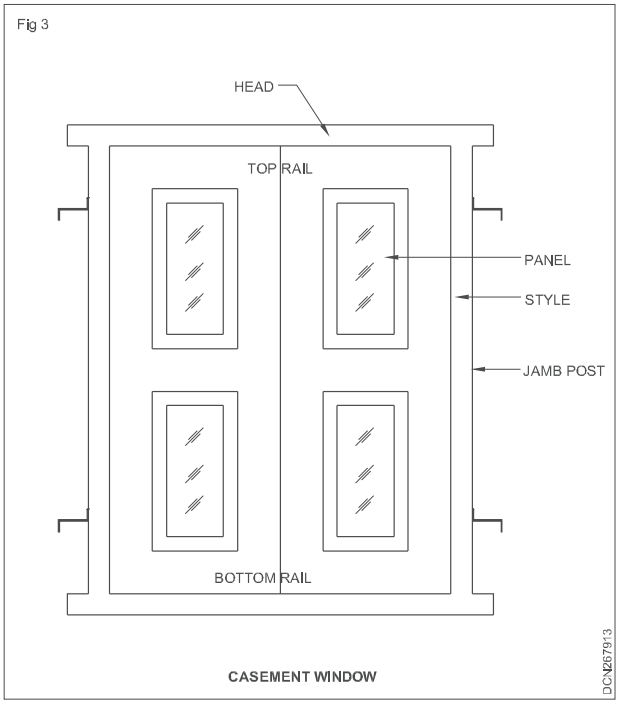
DOUBLE - HUNG WINDOW

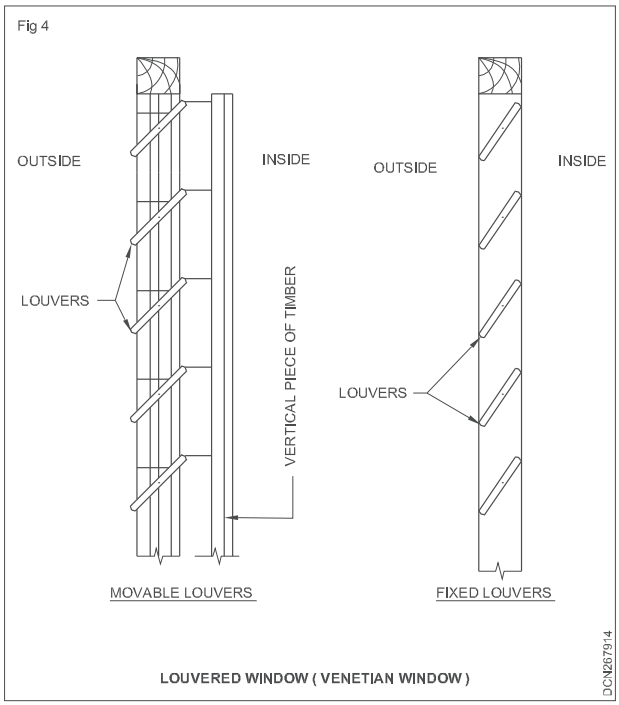
PIVOTED WINDOW

DCN267912

Casement window (Fig 3)

Window where shutters open like door are called casement windows. The window has a frame which is rebated to receiving the shutters. The shutters consist of style, top rail, bottom rail and intermediate rail, thus dividing it into panels. The panel may be glazed or unglazed or partially unglazed. In case of windows with double shutters, the outer shutter may have wire-gauged panels.





Sliding Window

In this type of window the shutters move on roller and can slide horizontally or vertically similar to slding door.

Sash or glazed window

In this case the window shutter consists two vertical styles, top and bottom rails. The panel space of window shutter between the style and rail is fixing divided by sash bars into panels of small size for fixing glass panels. The glass panels are secured in position either by putty or by fillets, known as glazing beads.

Louvered window (Venetian window) (Fig 4)

In this type of windows the lowers are provided as in the case of louvered doors. They allow free passage or air when close and at the same time they maintain sufficient privacy. The shutter consists of top rail, bottom rail and two styles; which are grooved to receive the louvers. The economical angle of inclination of the louvers is 45^0 and they are generally fixed in position.

Metal window

These are now a day's widely used especially in public buildings. Windows are made of metals like mild steel, glavanised mild steel, aluminimum, bronze, stainless steel etc. Bronze, aluminium and stainless steel are considered to be the best as they process high degree of elegance, finishing, durability and are dust-proof as well. Mild steel being cheapest of the above metals, steel window works out to be the most economical. Hence steel windows are extensively used in all types of buildings.

Steel window can be fixed direct in the masonry opening in the wall or it may be fitted in a wooden frame fixed in a window opening in the wall. It should be ensured that no load of the wall etc, is transferred to the window frame. For this it is usual practice to keep the size of the window opening slightly more than that of window frame. Also the frame may be fixed in the opening after the masonry work is complete.

Method of fixing metal windows (Steel windows)

The prepared opening in which steel window frame is to be fixed is cleaned and exact position of the window frame is maked by drawing lines.

The distance of fixing holes on the frame are measured and these positions are marked on the chalk line drawn in the opening.

Holes are cut in brick masonry of size 5 m^2 and 5-10cm deep to accommodate hold fast or legs. In case of stone masonry or R.C.C work where it is difficult to cut holes for legs, wooden plugs are embedded at appropriate places during the construction itself. The window frame is then fixed to these plugs with the help of galvanized iron or wood screws.

The frame is placed in the opening and position is adjusted in correct alignment by striking wooden wedges in correct position. Since there is a little gap between the opening and window frame temporary wooden wedges can be easily driven after adjusting the window in correct alignment the legs are screwed light in the frame.

Legs are grouted into the holes with cement mortar. After grout has set, wooden wedges are removed and space

between the opening and frame is filled with cement mortar.

Following precaution is to be taken in metal windows:

The members of the frame and sash should be properly welded at corners.

Precaution should be taken to prevent the corrosion of metal windows.

Glasses panels should be properly fixed.

The metal frame should be embedded in cement or bituminous mastic to prevent the entry of moisture on rain water.

It is advisable to check and slightly adjust the movement of shutter before erecting the window in the opening.

The handles to the window should be fixed before doing the glazing work.

Scaffolding members or any other support should not be tilt down the metal windows. Otherwise the window will be damaged.

The masonry opening to receive the metal window should be prepared in proper level and plumb.

Following are the advantages of steel windows over wooden windows

The steel windows are factory made products and hence they possess greater precision as compared to the wooden windows.

The steel windows are not subjected to contraction and expansion due to whether effects as sin the case of wooden windows.

The steel windows exhibit elegant appearance.

The members of steel windows are narrow and hence the steel windows admit more light and ventilation for the same area as compared to the wooden windows.

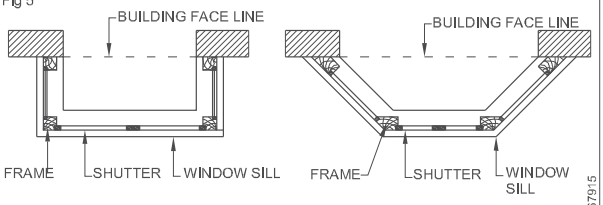
The steel windows are highly termite proof and fire proof.

Steel windows are more durable and stronger as compared to wooden windows.

Bay windows (Fig 5)

Bay windows project outside the external walls of a room. This projection may be triangular, circular, rectangular or polygonal in plan. Such a window is provided to get an increased area of opening for admitting more light and air. They also provide extra space in the room, and improved the overall appearance of the building.

Fig 5

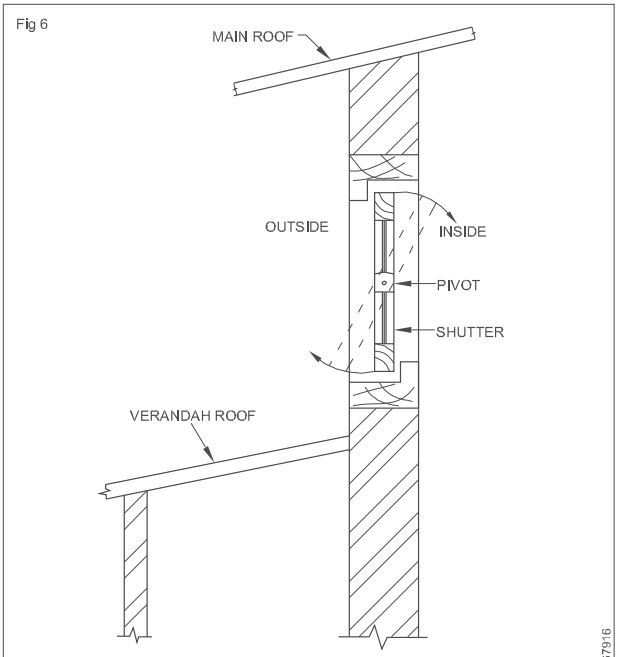


BAY WINDOWS

Clere – storey window (Fig 6)

These windows are provided near the top of main roof. The pivoted windows are used for this purpose. The clere-storey windows provide ventilation to the inside of the room where the front is blocked by veranda and improved the appearance of the building.

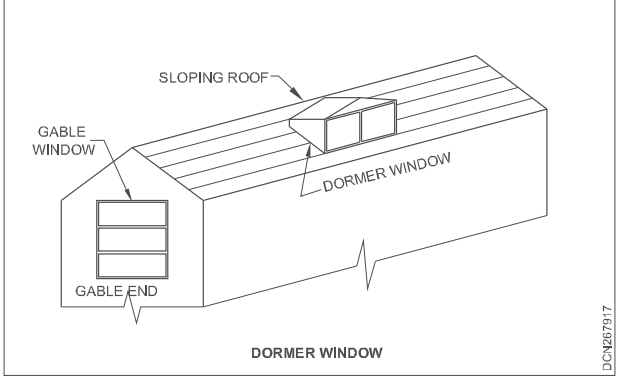
Fig 6



CLERESTOREY WINDOW

Dormer Window (Fig 7)

Fig 7



DORMER WINDOW

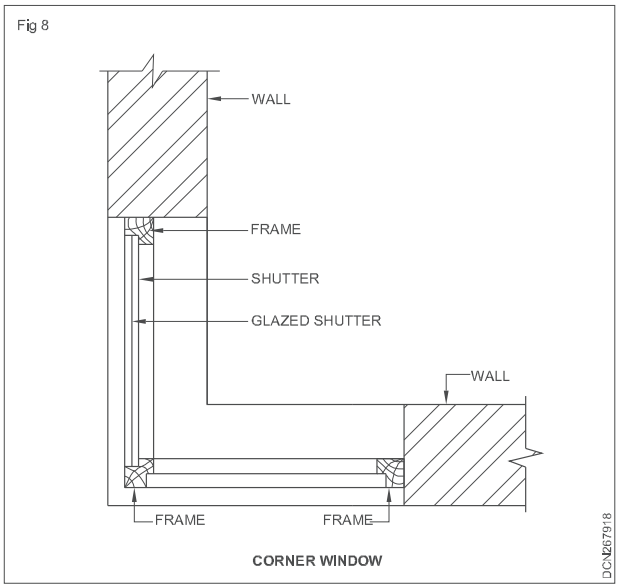
A dormer window is a vertical window built in the sloping side of the pitched roof. This window is provided to achieve proper ventilation and lighting of the enclosed

spaces below the roof. Dormer window also serves as an architectural feature of the building.

Gable Window (Fig 7)

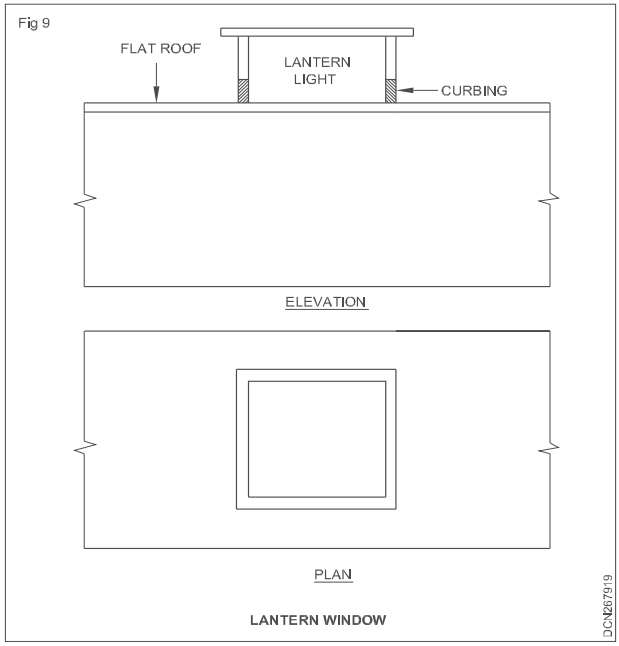
The windows provided a in the gable end of a pitched roof are known as a gable windows.

Corner window (Fig 8)



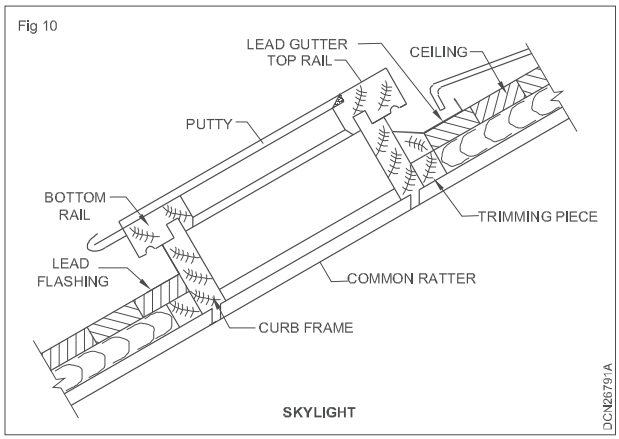
These windows are provided at the corner of the room and thus they have two faces and two directions. Due to this there is entry of light and air from two directions and in many cases the elevation of the building is also improved. However special lintel will have to be casted at the corner and jamb posts of the window at the corner will have to be made of heavy section.

Lantern Window (Fig 9)



These are the windows which are fixed on flat roofs to provide light to the inner portion of the building where light coming from the windows in external wall is in sufficient. They may be square or rectangular or curved. Glass panels are generally fixed; but if ventilation is required in addition to light, then pivot window may be provided.

Sky light (Fig 10)



A sky light is provided on a sloping roof to admit light. The window project above the sloping surface and is parallel to the sloping roof surface. The sky light is provided with a view to permit the room below to be fully lighted with natural light. The opening for sky light is made by cutting the common rafters.

Ventilators

Ventilators are small windows fixed at a greater height than the window, generally about 30-50cm below the roof level. The ventilator has a frame and a shutter generally glazed and horizontally pivoted. The top edge of the shutter open inside the bottom edge open outside so that rain water is excluded.

Ventilators combined with window or door

Ventilators may be provided in continuation of a door or a window at its top. Such a ventilator is known as Fan-light. The construction of a fan light is similar to sash window. Such a ventilator is usually hinged at top and can open out. Alternatively, the ventilator shutter can he hinged at the bottom.

Fixtures and fastenings

Objective: At the end of this lesson you shall be able to
- **explain types of fixtures and fastenings.**

Introduction

Various types of fastenings are employed for connecting and maintaining the joints. The basic objects of different fastening and their important features are given below:

Fixtures and fastenings

The following types of fixtures and fastenings are required for doors, windows and ventilators.

1 Hinges

2 Bolts

3 Handles

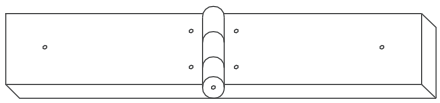
4 Locks.

1 Hinges

Following types of hinges are used for doors, windows and ventilators.

a Black flap hinge: These hinges are used where the shutters are thin. These are fixed on backside of the shutter and frame. (Fig 1)

Fig 1

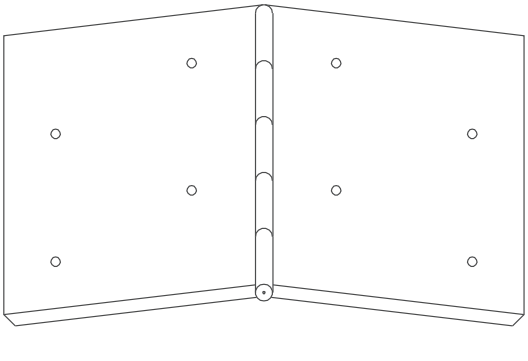


BACK FLAP HINGE

DCN267921

b Butt Hinge: These hinges are commonly used for fixing door and window shutters to the frame. (Fig 2)

Fig 2

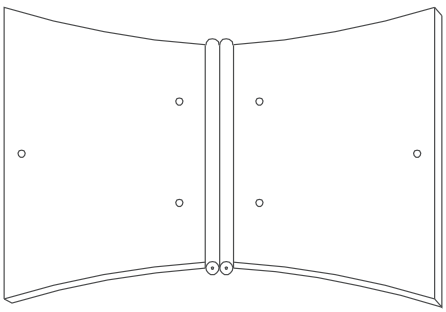


BUTT HINGE

DCN267922

c Counter-Flap hinge: This type of hinge has three parts and two centres. Provision of this type of hinge enable the shutter to be folded back to back (Fig 3)

Fig 3

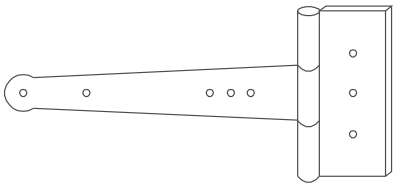


COUNTER - FLAP HINGE

DCN267923

d Garnet hinge: This type of hinge is also known as T-hinge and is commonly used for battened, ledged and braced doors. (Fig 4)

Fig 4

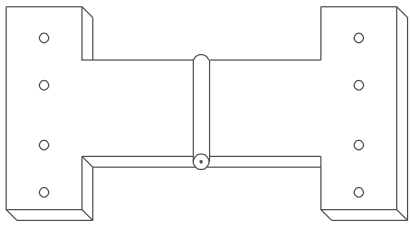


GARNET HINGE

DCN267924

e Parliamentary Hinge: These hinges permit the door shutters, when open, the rest parallel to the wall. Hence these hinges are used where the opening is narrow and when it is required to keep the opening free from obstruction due to door shutters. (Fig 5)

Fig 5



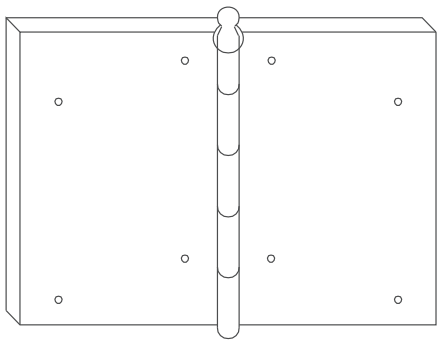
PARLIAMENTARY HINGE

DCN267925

f Pin hinge: This is used for heavy door shutters. The centre pin of the hinge can be removed and the two leaves or straps of the hinge can be fixed separately to the frame and the shutter. (Fig 6)

g Strap hinge: It is used for ledged and braced door and for heavy doors such as for garages, stables gate etc. (Fig 7)

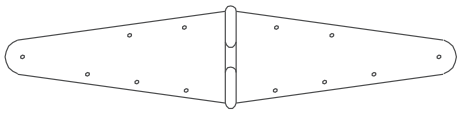
Fig 6



PIN HINGE

DCN267926

Fig 7

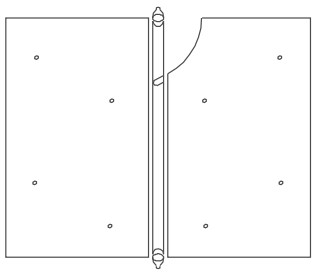


STRAP HINGE

DCN267927

h **Spring hinges:** Single acting or double acting hinges are used for swinging doors, single acting hinge is used when door shutter opens only in one direction while the double acting hinge is used when shutter swings in both the directions. The door closes automatically due to spring action (Fig 8)

Fig 8



SPRING HINGE

DCN267928

i **Rising butt hinge:** Such hinges are used for doors of rooms having carpet etc. They are used in place of ordinary butt hinges. The door is closed automatically, due to which the shutter is raised by 10 mm on being opened (Fig 9)

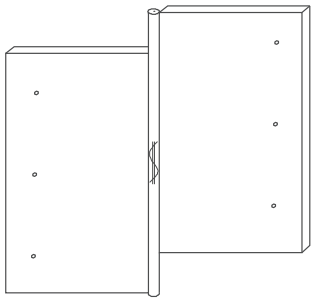
Bolts

Following are the various type of bolts used for doors and windows:

a **Aldrop:** It is fixed on external doors where pad locks are to be used (Fig 10)

b **Barrel bolt**: It is used for fixing back faces of doors. The socket is fixed to the door frame while the plate is succeeded to the inside of the shutter (Fig 11)

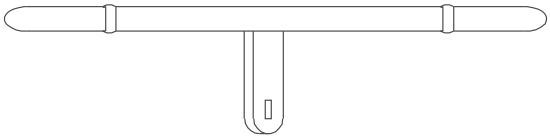
Fig 9



RISING BUTT HINGE

DCN267929

Fig 10



ALDROP

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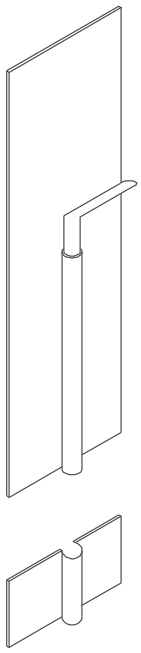
Fig 11



BARREL BOLT

DCN267792B

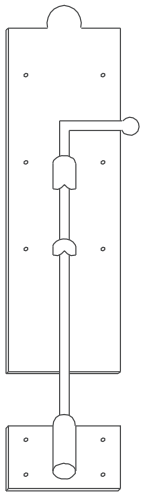
c **Tower bolt:** This is similar to barrel bolt except that instead of barrel bolt are two or three staples (Fig 12)

d **Flush bolt:** This bolt is used when it is desired to keep the bolt flush with the face of the door (Fig 13)

e **Hasp and Staple bolt:** This is used for external doors where padlock is to be used. The staple is fixed to the door frame while hasp is fixed to the shutter (Fig 14)

f **Latch :** This is made of iron, it consists of lever pivoted at one end. The Liver is secured in a hasp and staple. It is fixed to the inside face of the door (Fig 15)

Fig 12



TOWER BOLT

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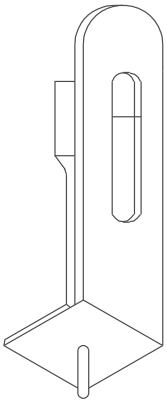
Fig 13



FLUSH BOLT

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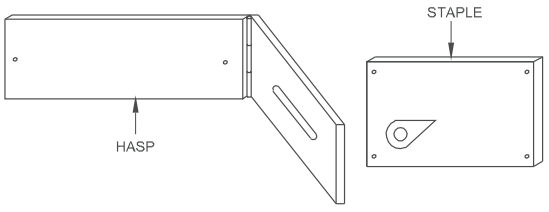
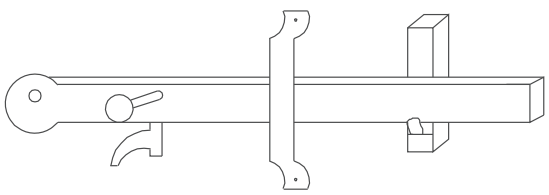
Fig 14



HASP AND STAPLE BOLT

DCN26792E

Fig 15



LATCH

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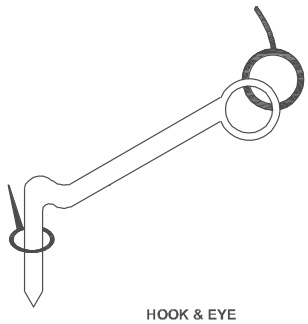
Locks

a Hook and Eye: This is used for keeping the window shutter in position when the window is opened (Fig 16)

Fig 16

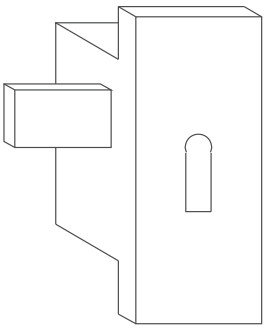


HOOK & EYE

DCN26792G

b Cup-board lock: It is used to secure doors of minor importance (Fig 17)

Fig 17

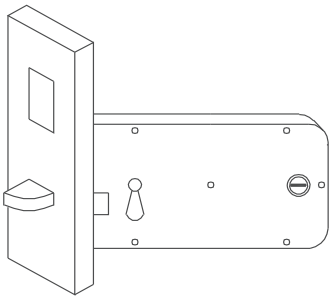


CUP - BOARD LOCK

DCN26792H

c Mortice lock: It is fixed in mortice formed on the edge of a door (fig 18)

Fig 18



MORTICE LOCK

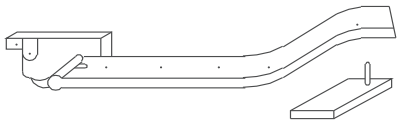
DCN26792I

d Peg Stay: It is used for steel windows. The width of opening can be adjusted by holes which are provided in the peg stay (Fig 19)

e Pad lock: It is used for securing doors when all drop bolts and hasp and staple bolts are employed (Fig 20)

f Rim Lock : It is used for thin doors (Fig 21)

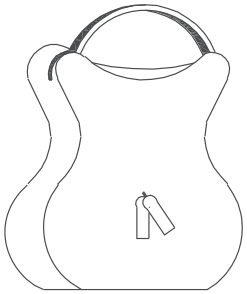
Fig 19



PEG STAY

DCN26792J

Fig 20



PAD LOCK

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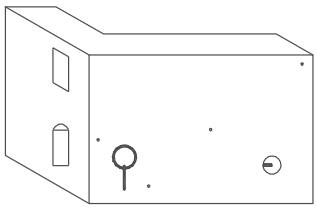
Fig 21



RIM LOCK

DCN26792L

Floor (Ground)

Objectives: At the end of this lesson you shall be able to
- **define the floor**
- **purpose**
- **flooring materials & factors affecting the choice of flooring material**
- **components of a floor**
- **types of floors.**

Introduction

In order to sub-divide the portion between the plinth level or basement level and roof level, solid constructions are carried out. These constructions are known as floors and exposed top surface of floors are termed as floorings. Ground floors or basement floors are termed as flooring. Ground floor or basement floors, which directly kept on the ground, do not require the provision of a floor. But they are provided with suitable type of flooring. In addition to that measures should be taken to prevent the entry at dampers and for giving thermal insulation.

Definition

It is a horizontal element of a building structure, which divide the building into different levels, for the purpose of creating more accommodation within a restricted space, one above the other and provide support for the occupants, furniture and equipment of a building.

Purpose

The purpose of floor is to creating more accommodation within a restricteed space, one above the other and provide support for the occupants, furniture and equipment of a building.

Flooring Materials

For giving pleasing appearance to the upper surface of the floor, various materials are used. The common materials used as flooring are:

1 Mud
2 Muram
3 Bricks
4 Flag Stones
5 Concrete
6 Terrazzo
7 Mosaic
8 Tiles
9 Marble
10 Granolithic Finish
11 Wood or timber
12 Asphalt
13 Rubber
14 Linoleum
15 Cork

Factors affecting the selection of flooring materials

1 Appearance: The material should give pleasing appearance and if should produce the colour effect with the use of building.
2 Cleanliness: It should be such that it can be cleaned easily and effectively and has resistance against oil, grease etc.
3 Comfort: It should possess good thermal insulation to give comfort for the residents.
4 Cost: Cost should be reasonable.
5 Damp resistance: The material should offer sufficient resistance against dampness.
6 Durability: Resistance to wear, tear and chemical action.
7 Fire resistant:
8 Easy to give maintenance
9 Noiseless while Len which using the floor.
10 Non stippery surface but smooth enough to clean easily.

Components of Floor

Floor is composed of two essential components.

1 Sub floor – base course or floor base.
2 Floor covering, or simply flooring.

Sub Floor: It provides proper support to floor covering and the super imposed load are carried by it.

Floor covering: It provides a smooth, clean, impervious and durable surface.

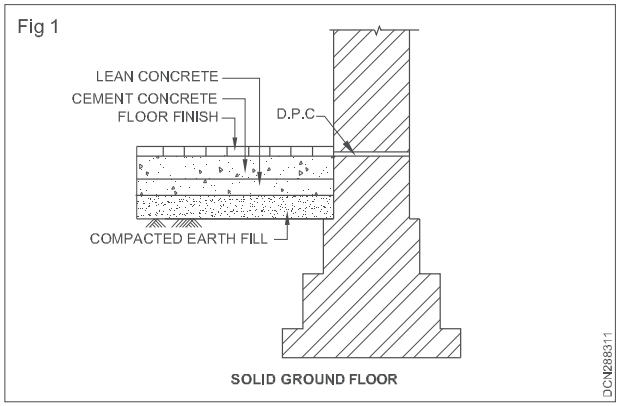
Types of floor

The floor is mainly divided in to two:

1 Ground Floor

2 Upper floor

Ground floor (basement floor) (Fig 1)



The floors resting directly on the ground surface are known as ground floors. They do not require provision of a floor. The major problems of a ground floor are damp exclusion and thermal insulation. For this purpose it is usually provided a bedding concrete of 1:4:8.

Material used for ground floor

Mud floors

1 Such flooring is cheap, hard and fairly impervious.

2 Easy to construct and easy to maintain.

3 It has good thermal insulation property.

4 Over a well-prepared ground, a 25 cm thick selected moist earth (mostly impervious) is spread and is then rammed well to get a compacted thickness of 15 cm.

5 In order to prevent cracks due to drying, small quantity of chopped straw is mixed in the moist earth, before ramming.

6 Sometimes, cow-dung is mixed with earth and a thin layer of this mix is spread over the compacted layer.

7 Sometimes, a thin paint of cement – cow – dung (1:2 to 1:3) is applied.

Muram floors

1 Muram is a form of disintegrated rock with binding material.

2 To construct such a floor, a 15 cm thick layer of muram is laid over prepared sub grade.

3 Over it, a 2.5 cm thick layer of powdered muram (Fine muram) is spread and water is sprinkled over it.

4 The surface is then rammed well.

5 After ramming, the surface is saturated with a 6 mm thin film of water

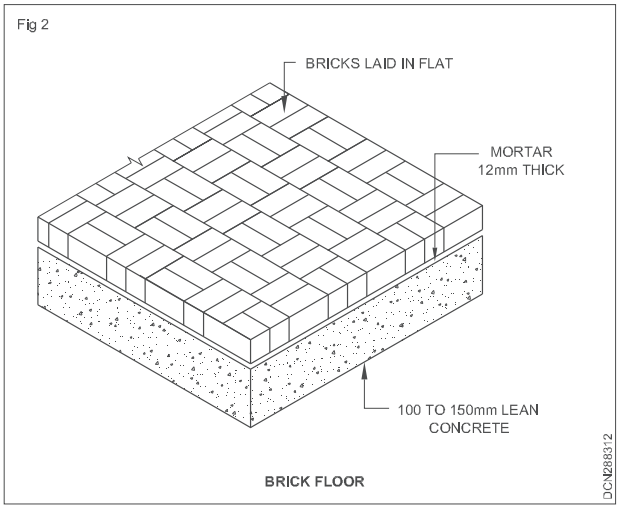
6 The surface well - trampled under the feet of workmen till the cream of muram rises to the top.

7 The surface is levelled and then kept in that state for a day, and then rammed again with wooden rammers.

8 The surface is then smeared or rubbed with thin paste of cow dung and rammed again for two days, during morning hours.

9 Finally, a coating of mud - cow dung mix is applied over the surface.

Brick floors (Fig 2)

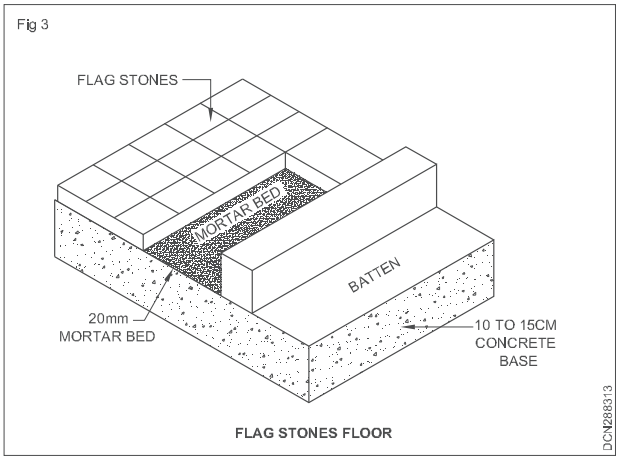


1 These floors are used in cheap type of construction such as stores, godowns, Warehouses etc.

2 The brick to be used should be of uniform shape and colour and good quality.

3 It consists of layer of brick (Flat or on edge) laid over 10 to 15 cm thick P.C.C of 1:8:16

Flag Stone Floor (Fig 3)



1 Flagstone is any laminated sand stone available in 2cm to 4 cm thickness.

2 The stone slabs are laid on concrete base.

3 The sub soil is properly compacted, over which 10 to 15 cm thick lime concrete or lean cement concrete is laid.

4 The Flagstones (Stone slabs) are then laid over 20 to 25 mm thick layer of bed mortar.

5 In laying the slabs, work is started from two diagonally opposite corners and brought up from both sides.

6 A strings is stretched between two corner slabs first to correct level.

1 Other slabs are then so laid that their tops touch the string.

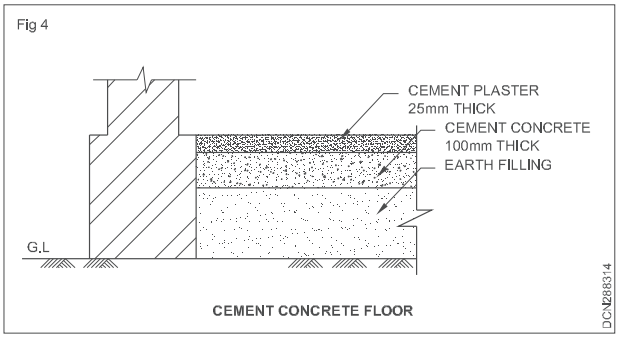
2 If any particular slab falls lower than the string level, it is re-laid by putting fresh layer of stiff mortar.

3 When the stone slabs are properly set, mortar in the joints is raked out to a depth of about 15 to 20 mm and then flush pointed with 1:3 cement mortars.

4 Proper slope is given to the surface for drainage.

5 The work is properly cured.

Cement Concrete floor (Fig 4)



1 This is commonly used for residential, commercial and even industrial buildings.

2 It is moderately cheap, quite durable and easy to construct.

3 The floor consists of two components (1) base concrete, and (2) topping or wearing surface.

4 The base course may be 7.5 to 10 cm thick, either in lean cement concrete (1:3:6 to 1:5:10) or line concrete containing 40% mortar of 1:2 line – sand (or 1 lime: 1Surkhi: 1 sand) and 60% coarse aggregate of 40mm nominal size.

5 The base course is laid over well compacted soil, and leveled to rough surface.

6 It is properly cured.

7 When the base concrete has hardened, its surface is brushed with stiff broom and cleaned thoroughly.

8 It is wetted the previous right of laying topping and excess water is drained.

9 The topping is then laid in square or rectangular panels, by use of either glass or plain asbestos strips or by use of wooden battens set on mortar bed.

10 The topping consists of 1:2:4 cement concrete laid to the desired thickness (usually 4 cm) in one single operation. in the panel.

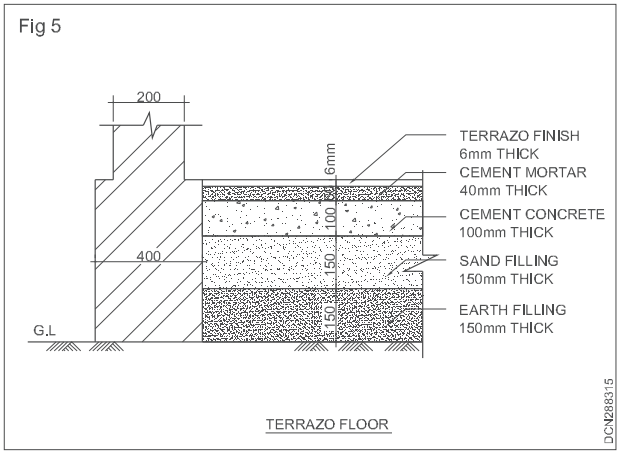
11 Topping concrete is spread evenly with the help of a straight edge, and its surface is thoroughly tamped and floated with wooden floats till the cream of concrete comes at the top.

12 Steel trowel is used for smoothening and finishing the top surface.

13 The prepared surface is protected from sunlight, rain, and other damages for 12 to 20 hours.

14 The surface is then properly cured for a period of 7 to 14 days.

Terazzo floor (Fig 5)



1 In this floor, marble chips of various shades are used as aggregate.

2 The proportion of terrazzo mix is generally 1:2 to 1:3 i.e, one part of cement to two to threee parts of marble chips by volume.

3 Prepare base concrete surface of 75cm thick.

4 Over this cement mortar 1:3 of 34 mm thick is laid, and zigzag line are market on it. Surface is cured for effect

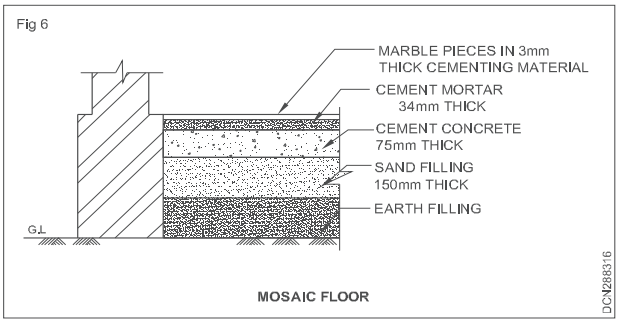
5 The cement and marble chips are thoroughly mixed wet and laid for a thickness 20 mm.

6 The first coat of polishing is done by a coarse carborandom stone, second coat is done by finely grained carborandom stone.

7 Wax is applied as a final coat of polishing to get glossy surface

8 This floor in generally used for residential buildings, bath room, Clock rooms, etc.

Mosaic floor (Fig 6)



1 Mosaic flooring is made of small pieces of broken tiles of china glazed or of cement, or of marble, arranged in different pattern.

2 These pieces are cut to desired shapes and sizes.

3 A concrete base is prepared as in the case of concrete flooring, and over it 5 to 8 cm lime – surkhi mortar is spread and levelled.

4 On this, a 3 mm thick cementing material, in the form of pate comparising two parts of slaked lime, one part of powered marble and one part of puzzolana material, is spread and is left dry for about 4 hours.

5 Small pieces of broken tiles or marble pieces of different colours are arranged in definite patterns and hammered into the cementing layer.

6 The surface is gently rolled by a stone roller.

7 Sprinkle water over the surface.

8 Surface is allowed to dry for 1 day, and is thereafter, rubbed with a pumice stone.

9 The surface is polished smooth.

10 The floor is allowed to dry for two weeks before use.

Tiled floors

1 Firstly, levelled hard bed or 15 cm thick P.C.C is preparedd.

2 Over this bed, a thin layer of cement mortr 1:1 is laid.

3 Then pre cast tiles of cement concrete or pottery are laid over it carefully, filling the joints with mortar, which are generally paper thick.

4 Extra cement is wiped off and joints cleaned with saw dust. Afterr curing the surface is rubbed and polished.

Marble

1 It is a superior type of flooring, used in residential buildings, hospitals, sanatoriums, temples etc. Where extra cleanliness is an essential requirement.

2 Marble slab may be laid in different sizes, usually in rectangular or square shapes.

3 The base concrete is prepared in the same manner as that for concrete flooring.

4 Over the base concrete, 20 mm thick bedding mortar of either 1:4 cement sand mix or (lime putty): 1 (surkhi):1 (coarse sand) mix is spread under the area of each individual slab.

5 The marble slab is then lifted up, and fresh mortar is added to the hollows of the bedding mortar.

6 The mortar is allowed to harden slightly, cement slurry is spread over it, the edges of already laid slabs are smeared with cement slurry paste, and then the marble slab is placed in position.

7 It is gently pushed with wooden mallet so that cement pastes oozes out. This is cleaned with cloth.

8 The paved area is properly cured for about a week.

Granolithic floors

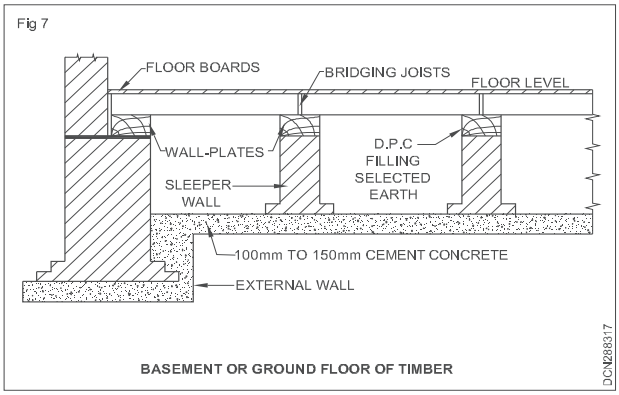
1 It is a finished coat, which is provided over a concrete surface.

2 The concrete mix used is 1:1:2 or 1:1:3. And aggregate used may be basalt, lime stone or quartz silt.

3 The granolithic layer of concrete is laid before the base concrete is set to get a monolithic construction.

4 The minimum thickness of finishing should be 12 mm.

Wooden floors (Fig 7)



1 In hilly areas where the wood is available in a large quantity and on the other hand, the climate is damp, wooden floors are used.

2 These are also used in dancing halls, auditoriums, etc.

3 The timber to be used for flooring should be of the best quality, well – seasoned and free from cracks, knots, flaws and other defects.

Asphalt floor

1 The asphalt flooring can be carried out in a variety of colours and in different forms.

2 The asphalt tiles, which are produced from natural asphalt, bitumen, asbestos fiber and mineral pigments are available in different sizes and in a variety of colours.

3 The asphalt terrazzo is formed by the combination of black or coloured asphalt with marble chips.

4 This terrazzo is laid hot and the surface is made smooth by a trowel.

5 The asphalt flooring is water-proof (no space), vermin proof, dustless and joint less.

6 It is used for surface subjected to heavy wear as incase of dairies, breweries, hospitals, shops, restaurants, loading platforms, swimming pools, terrace etc.

Rubber floor

1 It consists of sheets or tiles of rubber, in a variety of patterns and colours.

2 The sheet or tile is manufactured by mixing pure rubber with fillers such as cotton fibre, granulated cork or asbestos fibre.

3 The sheets or tiles are fixed to concrete base or wood by means of appropriate adhesive.

4 Rubber flooring is resilient and noise proof.

5 However, they are costly.

6 They are used only in office or public building.

Linoleum floor

1 It is a covering which is available in rolls, and which is spread directly on concrete or wooden flooring.

2 Linoleum sheet is manufactured by mixing oxidized linseed oil in gum, resins, pigments, wood flour, cork dust and other filler materials.

3 The sheets are either plain or printed, and are available in 2 to 6 mm thickness, and 2 to 4 m width.

4 Linoleum tiles are also available, which can be fixed (or glued) to concrete base or wood floor, in different patterns.

5 Linoleum sheet is either spread as such, or also may be glued to the base by inserting a layer of saturated felt.

6 Linoleum coverings are attractive, resilient, durable and cheap, and can be cleared very easily.

7 However, it is subjected to rotting when kept wet or moist for some time.

8 It cannot, therefore, be used for bath room, kitchens etc.

Cork floor

1 This type of flooring is perfectly noiseless, and is used in libraries, theatres, art galleries, broadcasting station etc.

2 Cork which is the outer bark of cork oak tree, is available in the form of cork carpet and cork tiles.

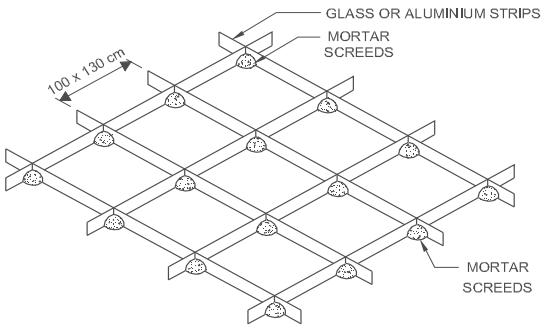
3 It is fixed to concrete base by inserting a layer of saturated felt.

4 Cork Carpet is manufactured by heating granules of cork with linseed oil and compressing it by rolling on canvas.

5 Cork tiles are manufactured from high grade cork or shearing compressed in module to a thickness of 12mm and baked subsequently.

Glass floor (Fig 8)

Fig 8



METHOD OF FIXING GLASS STRIPS FOR CONCRETE FLOOR

1 This is special purpose flooring, used in circumstances where it is desired to transmit light from upper floor to lower floor, and specially to admit light at the basement from the upper floor.

2 Structural glass is available in the form of tiles or slabs, in thickness varying from 12 to 30 mm.

3 These are fixed in closely spaced frames so that glass and the frame can sustain anticipated loads.

4 Glass flooring is very costly, and is not commonly used.

Plastic or PVC floor

1 It is made of plastic material, called Poly Vinyl Chloride (P.V.C), fabricated in the form of tiles of different sizes and different colour shades.

2 These tiles are now widely used in all residential as well as non –residential buildings.

3 The tiles are laid on concrete base.

4 Adhesive of specified make is applied on the base as well as on the back of P.V.C tile with the help of a notched trowel.

5 The tile is laid when the adhesive has set sufficiently (say within 30 minutes of its application); it is gently pressed with the help of a 5 kg weight wooden roller and the oozing out adhesive is wiped off.

6 The floor is washed with warm soap water before use. P.V.C tile flooring is resilient, smooth, good looking and can be easily cleaned.

7 However, it is costly and slippery, and can be damaged very easily when in contract with burning objects.

Upper floors

Objectives: At the end of this lesson you shall be able to
- **define the upper floor**
- **purpose**
- **types of upper floors**
- **choice of floor.**

Introduction

An upper floor is basically a principal structural element, and the general structural design of a building will greatly influence the choice of the type of floor. Upper floors are supported either on the walls or on columns; they have, therefore, the major problems of strength and stability.

The structural design of upper floors has to be such as to support the loads set up by the use of the building, in addition to the self weight and the weight of partitions etc. However, the flooring materials are practically the same as used for ground floor.

Definition

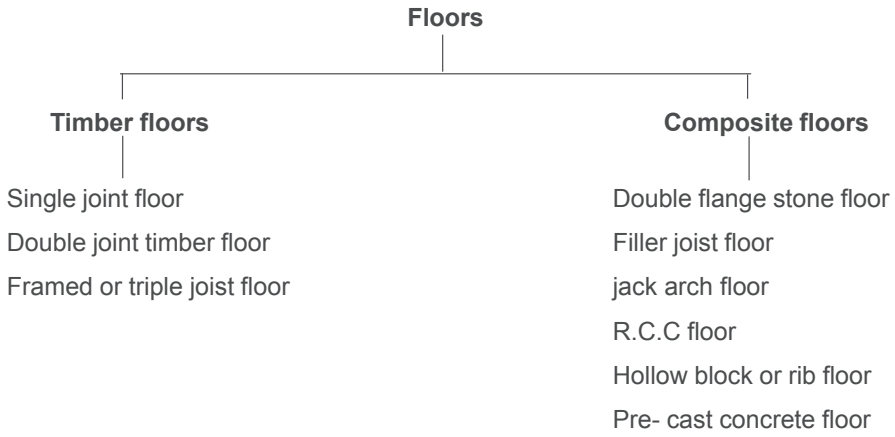
The floors constructed above the ground floor are known as upper floors.

Purpose

To create more accommodation with in a restricted space, one above the other and to provide support for the occupants, furniture and equipment of a building.

Types of floor

Floors are classified based on types of materials and construction as below.



Timber Floor

This type of floor is preferred in hilly areas where timber is easily available, normally it is used in auditoriums where dances or dramas are performed…

A Single joist timber floor (Fig 1)

- It is adopted for maximum span of 3.6 m
- These floors consist of single joists which are place below the floor boards.
- The joists are usually at a centre to centre distance of 300 mm to 450 mm.
- The joists are supported on wall – plates at their ends.
- When the span of joist exceeds about 2.4m, herring bone strutting are provided.
- Ends of this struts are nailed to the joists.
- At the end, the wedges are provided between the wall and the joist.

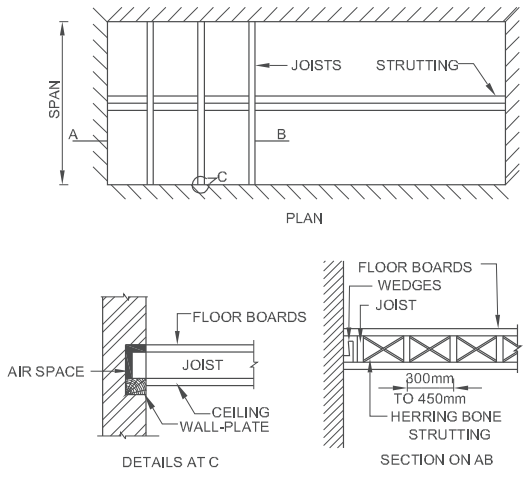
B Double joist timber floor (Fig 2)

1 It is stronger than single joist timber floor. Span is up to 7.5m

2 In this type of floor, the intermediate supports, known as the binders, are provided for the bridging joists.

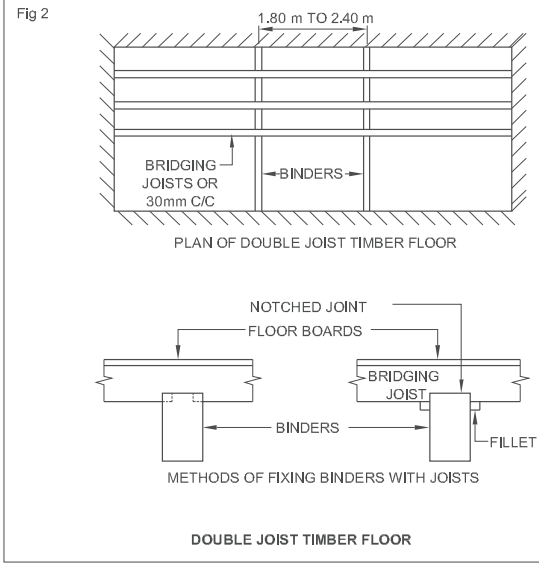
3 The end of binders rest on wooden stone blocks.

Fig 1



DETAILS OF SINGLE JOIST TIMBER FLOORS

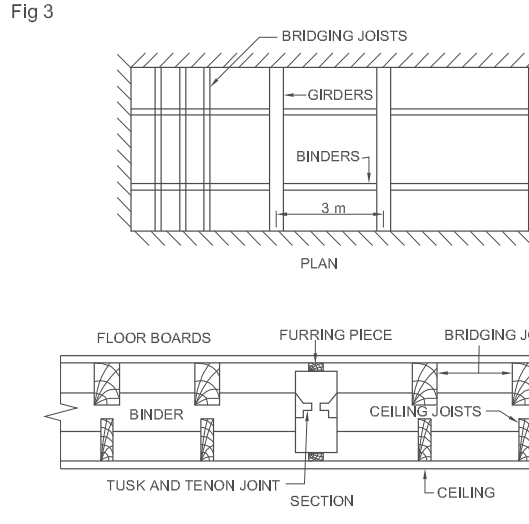
Fig 2



DOUBLE JOIST TIMBER FLOOR

C Framed or triple joist timber floor (Fig 3)

Fig 3



DETAILS OF FRAMED TIMBER FLOORS

1 It is suitable for span greater than 7.5 m

2 In this type of floors, the intermediate support, known as the girders, are provided to support the binders.

3 The girders are placed at a centre to centre distance of 3 m.

4 The ends of binders are supported on iron stirrups which are fixed to the girders.

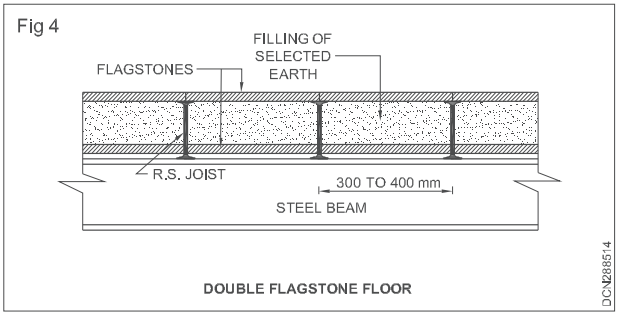
5 The ends of girders rest in walls on stone or concrete templates.

Composite floor

If floors are composed of more than one material, then they are known as composite floors. It is more fire resistant and sound proof than timber floor. It can be easily cleaned and possesses better hygienic property. It can be adopted for long spans.

A – Double flagstone floor (Fig 4)

Fig 4



DOUBLE FLAGSTONE FLOOR

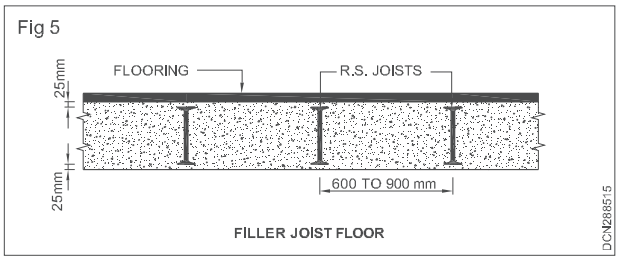
1 Flagstones of two layers are used.

2 If span is about 4 m only steel joists are provided.

3 Top layer of flag stone is finished.

B – Filler joist floor (Fig 5)

Fig 5



FILLER JOIST FLOOR

1 Small sections of R S J are placed in concrete.

2 The joists may either rest on wall or on steel beams.

3 The joists act as reinforcement.

4 The concrete should completely surround the joist.

C – Jack arch floor (Fig 6)

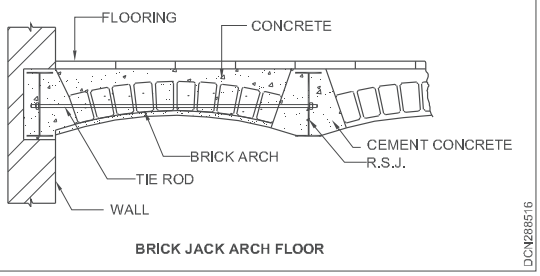
1 Brick or concrete arches are constructed and they rest on the lower flange of mild steel joist.

2 The joists are placed at a distance of about 800 mm to 1200 mm centre to centre.

3 Rise of arch should be 100 mm to 200 mm.

4 The minimum depth of concrete at the crown should be 150mm.

Fig 6



BRICK JACK ARCH FLOOR

D – R.C.C floor

1 Steel bars and concrete are used to form a floor. Beams and slabs are designed as per load on floor.

2 For R.C.C slab, the thickness varies from 80 mm to 150 mm and the main reinforcement is generally in the form of mild steel bars of diameter varying from 9mm to 12 mm.

3 R.C.C beams are to be provided when the span of slab exceeds 4 m or so.

4 The location, spacing and bending of steel bars are to be decided carefully.

5 RCC work may be cast –in-situ or pre-cast, the former being very common.

6 Suitable flooring can be provided on the surface of an R C.C floor.

7 The R.C.C floors are less costly, durable, and easy to construct and fire proof.

8 However, they are likely to transmit sound.

9 In any case, the R.C.C. floors are fast replacing other types of floors.

10 The reinforcement in the flat slab can be arranged either in two-way system or four-way system.

11 For ordinary loading conditions, the two-way system of reinforcement is generally preferred.

Hallow block or rib floor

1 Hollow blocks of clay or concrete are used to reduce self weight of floor.

2 This type of floor is economical, fire-proof, sound-proof and light in weight.

3 Plumbing and electrical installations can be conveniently carried through the hollow blocks without affecting the appearance.

4 These floors are widely used for building like hospitals, hotels, schools, offices, etc.

E-Pre-cast concrete floor

1 With the development of pre-cast concrete construction technique, it is possible to prepare the pre-cast unit for the floor.

2 These pre-cast units are available in suitable size and can be conveniently handled, transported and fixed.

3 They may be supported either on walls or on rolled steel joists.

4 The sides of each unit contain grooves which are used to connect the adjacent units.

5 The members are light in weight and hence the cost proves to be economical.

6 They are fire-proof and sound-proof.

7 They do not require formwork during construction.

8 They have good thermal insulation.

Choice of floor

Choice of floor depends upon,

1 Span

2 Maximum load on the floor

3 Type of construction

4 Material and labour available

5 Purpose or use of building.

Vertical transportation

Objectives: At the end of this lesson you shall be able to
- **enlist the different means of vertical traansportaion**
- **define ramp**
- **explain the features of ramp**
- **state the materials used and purpose of ramp**
- **express the pitcher of ladder, stair & ramp.**

Introduction

Vertical transportation is a phrase used to describe the various means of travelling between floors in a building. All buildings with more than one storey have at least one means of vertical transportation. The provision and position of vertical transportation is a very important consideration while designing buildings in order to ensure all the occupants of the building can escape safely in the event of a fire.

Types of vertical transportation used in different buildings

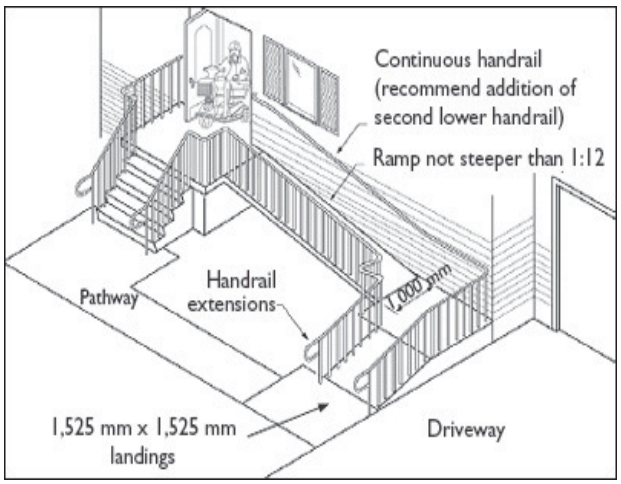
- **Ramps**
- **Ladder**
- **Stair**
- **Lifts (Elevators)**
- **Escalators**

Among these stairs are most commonly used for vertical transportation in residential buildings, lifts in workshops are lifts & escalators in commercial buildings.

Ramps

Definition

A ramp is a sloping surface and it is adopted as a substitute for stair for easy connection between the floors. They are especially useful when large numbers of people or vehicles are to be moved from floor to floor.



The important features of the ramps are as follows

- Minimum slope is 1 in 10, maximum slope is 1 in 15
- Shape need not be straight

- Provided with hand rail on both sides
- Minimum width of ramp for hospital should be 2.25m
- Ramp leads directly from open space on ground level to upper floor levels.
- Used in garages, railway stations, stadium, town hall, hospital etc.

Materials

The materials used for ramp construction are rock or stone, brick, timber, steel, plain concrete, reinforced concrete etc.

Purpose

Communication between different levels of building.

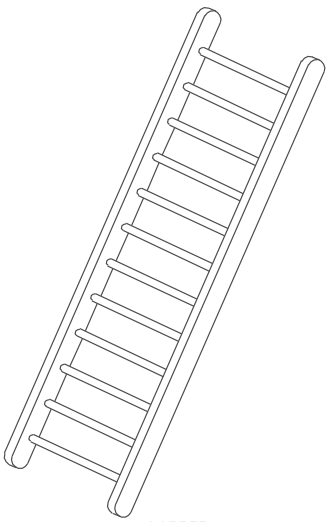
Easy and comfort transportation for vehicles, disable persons etc.

Improves aesthetic views for large buildings.

Ladder (Fig 1)

A structure of wood, metal, or rope, commonly consisting of two sidepieces between which a series of bars or rungs are set as suitable distances, forming a means of climbing up or down.

Fig 1



LADDER

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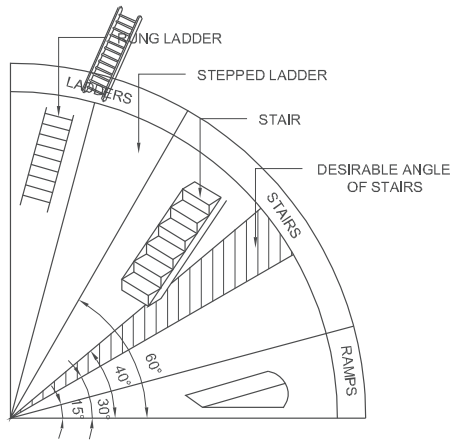
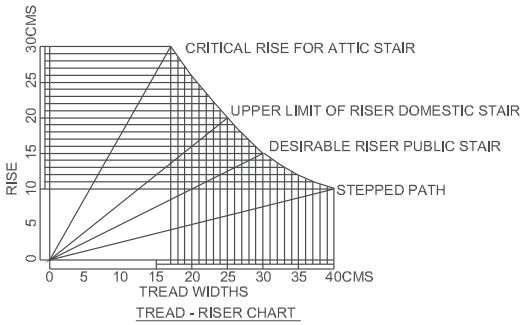
Fig 2



SLOPES OF LADDERS, STAIRS & RAMPS



TREAD - RISER CHART

RAMPS, STAIRS, LADDERS

DCN298522

Stairs

Objectives : At the end of this lesson, you shall be able to,

- **define stair, stair case**
- **enlist the technical terms**
- **define the different types of slip.**

Introduction

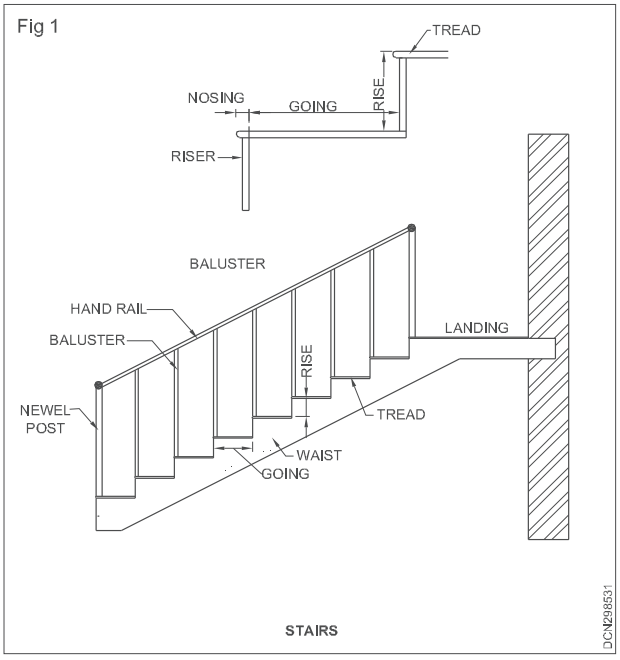
A stair is a convenient means of access between the floors of a building. It is constructed to provide ready, easy, comfortable and safe ascent/descent with series of steps that are neither laborious nor difficult to climb within an enclosure called stairwell (Staircase).

Definition

A stair is defined as a series of steps suitably arranged for the purpose of connecting different floors of a building. It is provided to afford the means of ascending and descending between floors and landing. The room or enclosure of a building in which the stair is located is known as stair case. The opening or space occupied by the stair is known as stair way. It should be suitably located to provide easy access to all the rooms.

The definitions of technical terms used in connection with the stair are:-

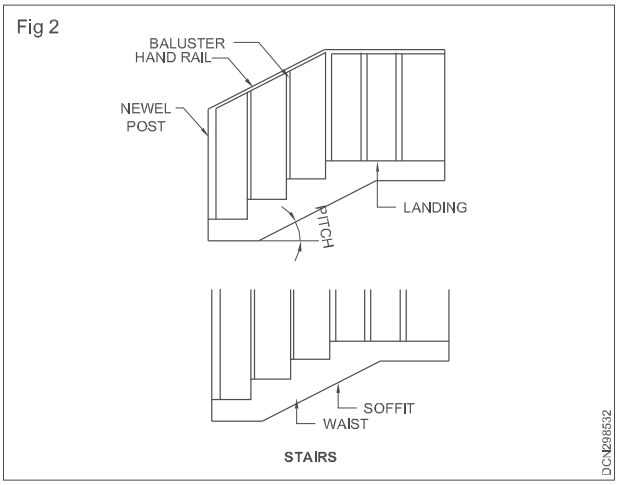
Fig 1



Sl.No	Terms	Definition
1.	Tread	The horizontal upper portion of step
2.	Going	Horizontal distance between faces of two consecutive risers.
3.	Riser	The vertical front member of step
4.	Rise	Vertical distance between two successive treads
5.	Flight	Series of step between landings
6.	Nosing	The projecting part of the tread beyond the face of riser
7.	Scotia	Additional moulding provided under the nosing to improve the elevation of step and to provide extra strength to nosing end
8.	Walking Line	The approximate line of movement of people on a stair. It may be 45 cm from the centre of handrail.
9.	Head room	The vertical distance between the nosing of one flight and the bottom of the flight immediately above.

10.	Run	Total length of stair in a horizontal plane. It includes the lengths of landings also.

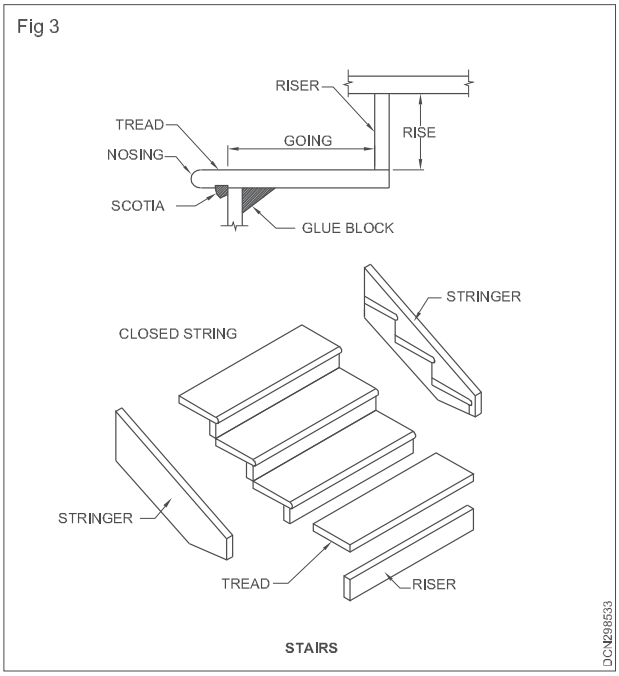
Fig 2



STAIRS

11	Soffit	The under surface of stair
12	Waist	The thickness if structural slab in case of RCC stair
13	Stringers	Inclined member in wooden stairs acting as wooden beams to support the steps.

Fig 3



STAIRS

14	String	The inclined member of a stair which supports the ends of step is known as string.
	a Cut or open string.	In the cut or open string, the upper edge is cut away to receives the ends of steps as shown in fig 3.
	b A closed or housed string.	In the closed or housed string, the ends of steps are housed between straight parallel edges of the string as shown in fig 3.

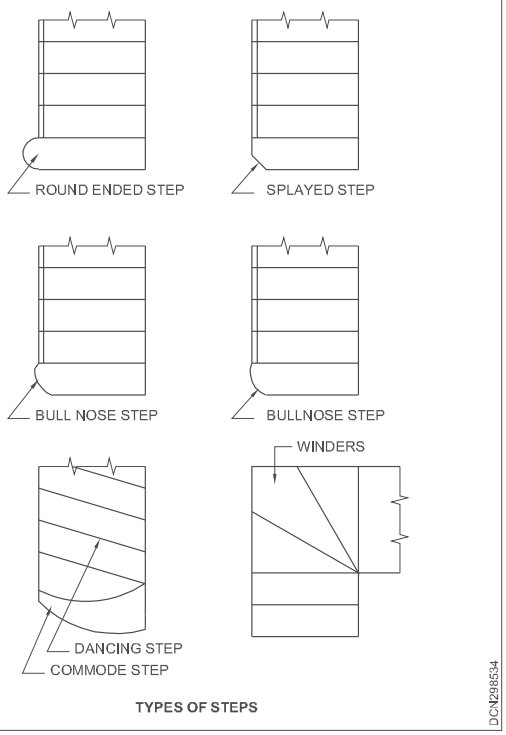
15	Pitch	The angle of inclination of stair with the floor.
16	Landing	Horizontal platform between two flights to change of direction and to take rest for users.
17	Baluster	The vertical member fixed between string and hand rail to give support to hand rail
18	Handrail	The inclined rail over the string
19	Newel post	Vertical member placed at the end of flights to connect the ends of string and handrail.
20	Balustrade or Barrister	The combined frame work of hand rail and baluster.

STEPS: It is a portion of stairs which permits ascent or decent it comprises of a tread and riser. A stair is composed of a set of steps.

Types of steps (Fig 4)

Sl. no	Terms	Definition
1	Flier	Ordinary step of rectangular shape in plan
2	Bull nose step	It forms a circular quadrant in plan and provided at the bottom of flight
3	Commode step	This step has a curved rise and tread
4	Dancing step	Step do not radiate from common centre
5	Round ended step	Similar to bull nose step except that its ends are semicircular in plan
6	Splayed step	One end or both ends splayed in plan.
7	Winder	Tapering step and used to change the direction of flight

Fig 4

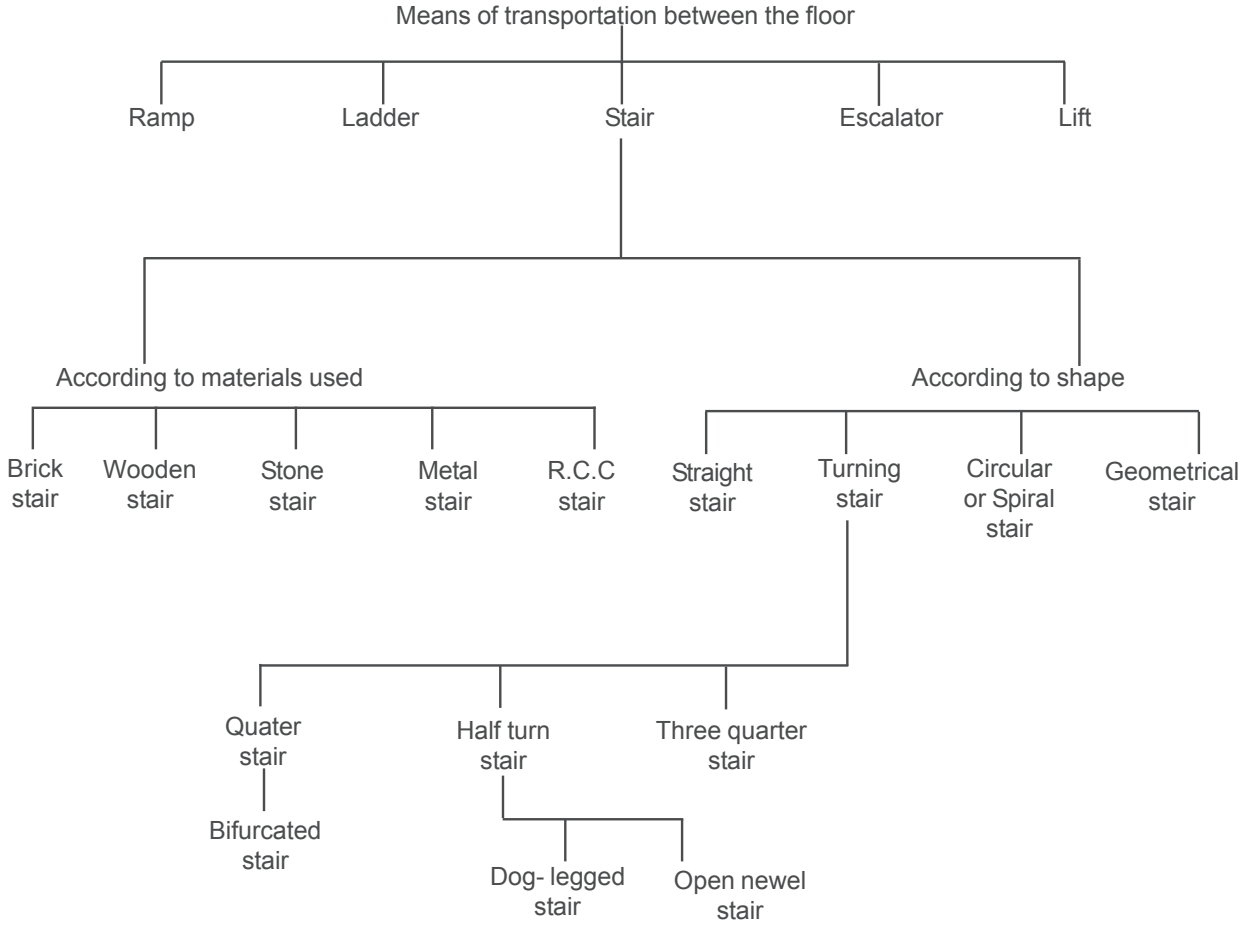


TYPES OF STEPS

Classification of stairs according to shape

Objectives : At the end of this lesson, you shall be able to

- **classify the means of vertical transportation**
- **explain types of stairs according to shape.**



Stair

Types of stairs

Stairs are classified as follows.

A Straight stair

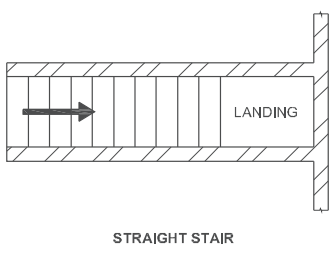
B Turning stair

C Circular or spiral stair

D Geometrical stair

A Straight stair : In case of straight stair all steps leads in one direction only. This type of stair may consist of one or more flights and they are used when space available for staircase is long but narrow in shape. (Fig 1)

Fig 1



B Turning stair : In case of turning stair the flights takes turn.

The usual type of turning stair are described below.

1 Quarter-turn stair

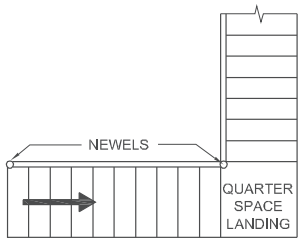
i Biffurcated stair

ii Half-turn stair

iii 3-Quarter-turn stair

i Quarter-turn stair (Fig 2)

Fig 2



QUARTER - TURN STAIR

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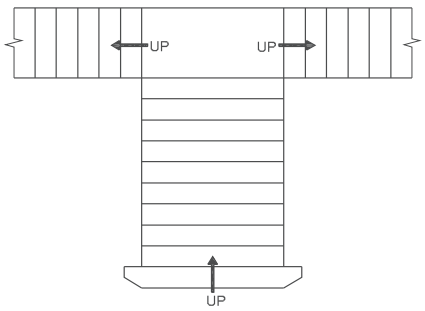
A stair turning through one right angle is known as a quarter-turn stair.

Biffurcated stair (Fig 3)

Fig 3



BIFURCATED STAIR

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If a quarter turn stair is branched into two flights. At a landing as shown in figure is known as buffercated stair.

ii Half-turn stair

A stair turning through two right angle is known is a half-turn stair. A half-turn stair may be dog legged stair, and open newel stair.

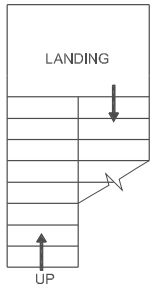
a Dog-legged stair

b Open-newel stair

a Dog-legged stair (Fig 4)

The stair its flights run in opposite directions and there is no space between them in space plan. The stair are useful where total width of space available for stair case is equal to twice the width of step.

Fig 4



DOG LEGGED STAIR

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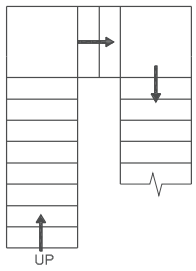
b Open newel stair (Fig 5)

Fig 5



OPEN NEWEL STAIR

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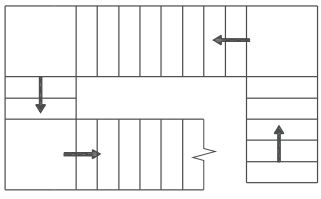
In case of an open newel stair there is a well or opening between the flights in plan. This well may be rectangular or any geometrical shape and it can be used for fixing lift. These stair are useful where the total width of the space available for staircase has width greater than twice the width of the step.

iii Three quarter turn stair (Fig 6)

Fig 6



THREE QUARTER-TURN STAIR

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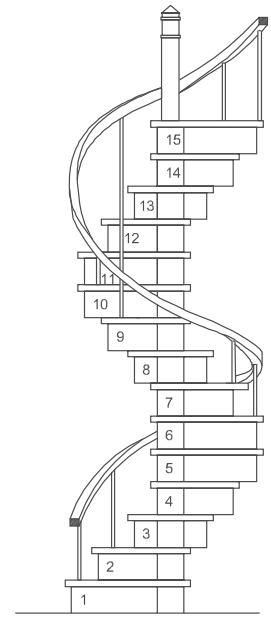
A stair turning through three right angles is known as three quarter-turn stair as shown in figure. In this case an open well is formed.

C Circular helical or spiral stair (Fig 7)

Fig 7

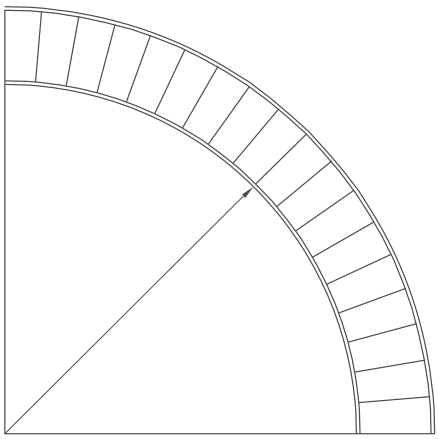


CIRCULAR OR HELICAL OR SPIRAL STAIR

In this type of stair, the steps are radiate from the centre. The flights consist of winders only and they may be continued through any desired number of turns. Spiral stair may be constructed of cast-Iron, Mild steel, concrete. Usually the structural design and construction of spiral stair are complicated in nature. For concrete spiral stair, steel reinforcement is heavy and framework is complicated so it is expensive. Spiral stair is useful where space available is limited and where traffic is less.

D Geometric Stair (Fig 8)

Fig 8



GEOMETRICAL STAIR

These stairs have any geometrical shape and they do not require newel post. The handrail of a geometrical stair continuous without interruption and without any angular turns. Considerable skill is required for the construction of a geometrical stair and it is found that a geometrical stair is weaker than corresponding open-newel stair.

Classifications stair according to material and requirements of good stair

Objectives : At the end of this lesson, you shall be able to,
- **classify the stair according to materials**
- **explain the requirements of a good stairs**
- **design the stair case as per the given data.**

Introduction

Any well planned stair should meet the following criteria for easy, quick and safe ascent/decent.

Classification of stair according to materials used

Following are the materials which are commonly used in the construction of a stair

1 Stone stair

2 Wooden stair

3 Brick stair

4 Metal stair

5 R.C.C stair

Stone Stair

The stone to be used for the construction of stair should be hard, non-absorbent and they should possess enough resistance to the action of fire. These stairs are used for ware houses, work shopes etc.

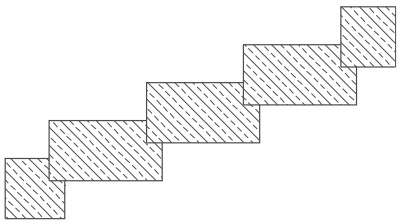
Construction

A stone step may be constructed in any one of the following ways.

a Rectangular step (Fig 1)

In case of a rectangular step the arrangement is made of as shown in figure. The overlap is about 25 mm to 40 mm. This arrangement results in considerable saving in labour of cutting and dressing stone.

Fig 1



RECTANGULAR STEP

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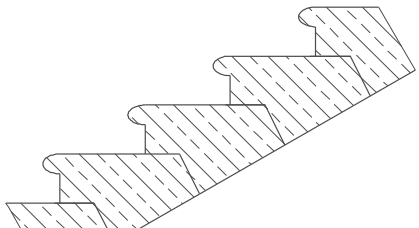
b Spandril step (Fig 2)

Fig 2



SPANDRIL STEP

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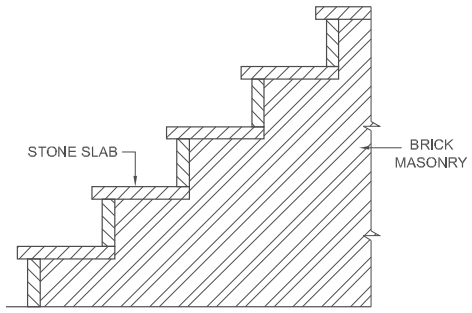
In this arrangement the steps are cut in such a way so as to obtain a Plane soffit as shown in figure. This arrangement is used where head room is desired. The soffit affords a nice appearance and weight of step is also reduced the ends of spandrel step which are built into the wall should be square so as to provides a horizontal seating or bearing. The soffit can also be made broken or moulded.

c Build up step (Fig 3)

Fig 3



BUILT-UP STEP

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These steps used as treads and risers in the form of thin sawn stone or marble stone, placed over brick or concrete step. The thickness of stone slab may vary from 2-5 cm.

Support and fixing

A stone may be supported and fixed in any one of the following four ways.

1 The step may be supported and fixed at the both ends in a wall. The bearing in wall should be at least 10cm for stairs up to 1.2m width and 20 cm for stairs having width greater than 1.2m.

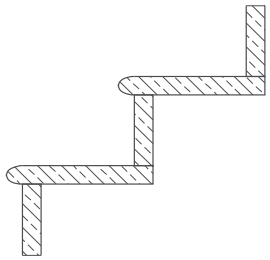
2 The step may be supported at one end in a wall and the other end may be left unsupported, such a cantilever step should not have length more than 1.2m.

3 The step may be supported at one end in a wall and other end, it may be supported by a steel work.

4 The step may be supported both end on a steel work.

d Tread and Riser step (Fig 4)

Fig 4



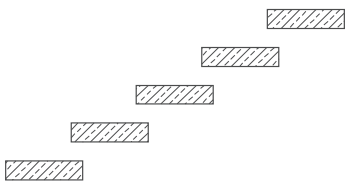
TREAD AND RISER STEP

DCN298624

In this arrangement the treads and risers of stones are provided as in case of timber steps. The stone slab treads and risers are connected by dowels as shown in figure.

e Cantilever tread-slab step (Fig 5)

Fig 5



CANTILEVER TREAD-SLAB STEP

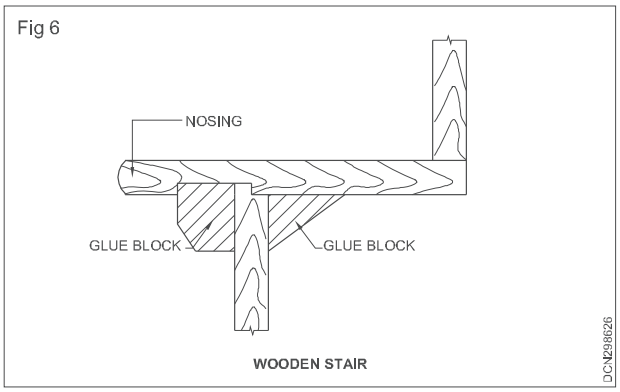
DCN298625

In this arrangement the steps are formed of treads only. For this purpose only this slab stones are used without any riser. The steps may either be rectangular or triangular.

2 Wooden Stair (Timber stair) (Fig 6)

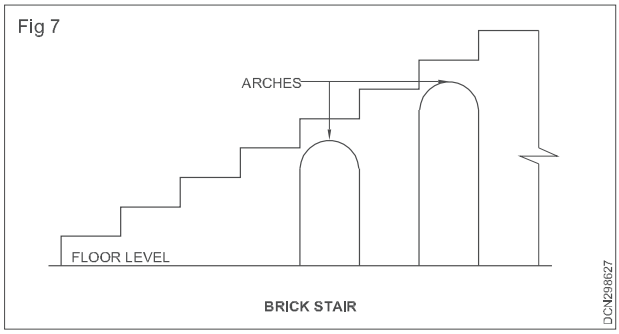
As wooden stairs are light in weight they are mostly used for residential building. But they have very poor fire resistance. They are un suitable for high raise residential building and for public building. Sometimes hard building wood such as (Mahogany, out etc) of paper thickness may be used. The timber used for the construction should be free from fungal decay and insect attack, and should be usual traded before use. In timber stair the strings are the support for the stair and act as inclined beam spanning be-

tween the floor and the landing. For additional support, a bearer or a carriage may be place under the treads.



The thickness of tread of a timber stair should not be less than 32mm (1/1/2 inch) and that of riser 25 mm. The nosing of the step should not project beyond the face of the riser for not more than the thickness of the treads. The thickness of the stinger should be 30-50 mm and 25-40 cm deep. Landing is constructed of tongued and grooved boarding on timber joist which are supported on walls.

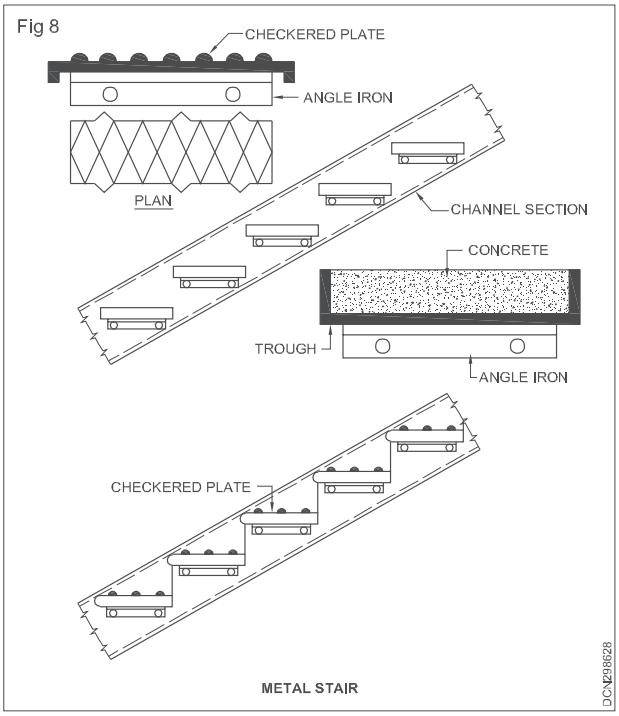
3 Brick Stair (Fig 7)



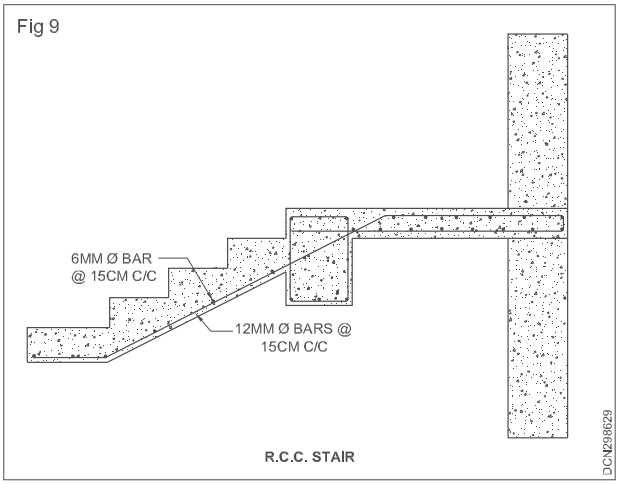
These stair are now not frequently used. A brick stair may be made of solid construction or arches may be provided as shown in figure. This arch reduces the quantity of brickwork and gives additional space which can be used for making cupboards. In case of brick stair the treads and risers are generally made equal to the length of 1 ½ bricks and height of two layer of brick respectively. The treads and risers of brick stair are finished with suitable flooring materials.

4 Metal Stair (Fig 8)

The External fire - escape stairs are generally made of metal. The common metal used for the construction of stairs is cast-Iron, bronze, mild steel. Metal stairs are generally is used in factories, workshop, godowns etc. In metal stairs the stringers are usually of channel sections and treads and risers are supported on angles, which are connected to the stringers. Tread and riser of a step may be of one unit or separate unit. For metal stair metal baluster with handrail of pipe are used.



R.C.C Stair (Fig 9)



These stairs are new commonly used in all types of construction. They are found to resist wear and fire better than any other material and can be moulded to the desired shape. The step can be provided with suitable finishing material such as marbles, tiles etc. These stairs can be easily maintained clean and they are strong, durable and pleasing in appearance. A typical R.C.C stair is shown in figure 9. The details and placing of reinforcement will naturally depend on design of R.C.C stair. The steps may be cast-in-sites or pre - cast.

Requirements of a good stairs

A well designed stair should fullfill the following requirements.

i **Design of layout** : The height of floor is generally known procedure for determining the no. of treads and risers is as follows.

a The position of 1st and last risers are determined with regard to the position of doors, windows, verandas etc.

b A convenient height of riser is assumed.

c No. of risers equal to total height of floor divided by height of risers.

$$\text{i.e. no.of risers} = \frac{\text{Total height of floor}}{\text{Height of riser}}$$

d No. of treads = no. of riser -1

This is due to the fact that the surface of the upper floor forms the tread for the top step.

E.g:- For instance let us assume that height of floor is 3.8 m assume the rise of 14 cm.

$$\text{No. of treads} = \frac{3.50}{0.14} = 25 \text{ nos}$$

No. of treads in single flight = 25-1=24 Nos.

No. of treads in double flight = 25-2=23 Nos

Depending upon the space available for staircase the type of stair is selected.

Tread and Riser

In - order to make the ascend and descend easy the tread and risers of a stair should be proportional following rules of thumb are commonly used for obtaining a satisfactory proportion of the tread and riser of a step.

i Rise in cm X going in cm = 40 to 45

ii Rise in cm X going in cm = 426 (approximately)

iii 2 rise in cm X going in cm = 60 (approximately)

Take rise equal to 14 cm and going would be 30 cm as standard.

Other combination of rise and going would be 15 X 28 cm, 16 X 26 cm, 17 X 24 cm.

5 Materials and workman ship

The stair should be constructed of sound material and good workman ship so as to impart durability and strength to the stair.

6 Width

The width of stair should be sufficient for 2 persons to pass on it simultaneously and for furniture. The minimum width of stair is taken as about 80 cm.

7 Pitch

The inclination of a stair to the horizontal should be limited to 30°- 45°.

8 Head room

It should preferable not less than 2m.

9 Flight

It is not desirable to provide a flight with more than 12 or at most 15 steps and not less than 3 steps. Suitable landing should be provided to give comfort and safety to the users of the stair.

10 Winders

These are to be avoided as far as possible. However if winders are un- avoidable they should be place at the bottom rather than at the top of the flight.

11 Hand rail

When a flight consists of more than 3 steps a hand rail at least on one side is considered to be necessity.

12 Location

The stair should be suitably located in the building and they are well lighted, well ventilated and have convenient approches.

Problem (Fig 10)

1 The inside dimension of a stair case in a residential building are 2m X 4.6m. The height of floor is 3.3 m and the roof consist of R.C.C slab of 12 cm thickness. Design a proper layout of R.C.C slab stair for this building.

Section

Adopt a dog - legged stair

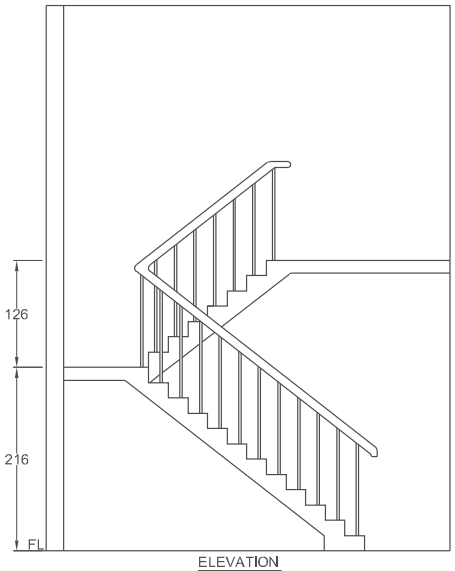
Assume a convenient height of riser say = 18 cm

$$\text{Then the no of raiser} = \frac{\text{Total hight of floor}}{\text{Height of risen}}$$

Total height = 3.30 + 0.12 = 3.42 m

Height of riser = 18 cm

Fig 10



ELEVATION

PROBLEM

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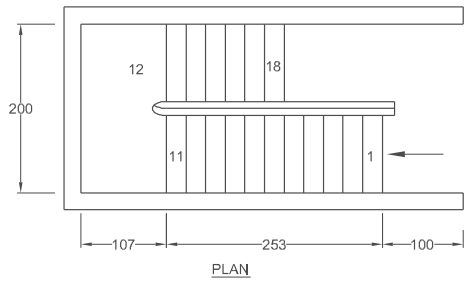
Fig 11



PLAN

PROBLEM

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$$Numberofrisers = \frac{3.42}{0.18}$$

Split the number of risers into two flights conveniently say 12nos in first flight and 7 nos in second flight.

No of steps in 1st flight = 12-1 = 11 nos

No. of steps in 2nd flight = 7-1 = 6 nos

Draw the plan and sectional elevation of the dog legged stair case according the disigned values.

Lift or elevators

Objectives : At the end of this lesson, you shall be able to

- **introduction of Lift or Elevators**
- **materials**
- **purpose**
- **construction**

Introduction of lift or elevators

Lift is typically used for two purposes - passengers and goods. Passenger lifts, as the name suggests, are designed primarily for moving people although they are often used for moving small hand trolleys, persons in wheelchairs and sometimes prams/pushchairs. Passenger lifts in hospitals are often large enough to accommodate a hospital bed.

Passenger lifts usually have sliding automatic doors although in smaller building, they may have a hinged door. In both cases, a safety interlock is fitted that prevents the lift from moving while the doors are open.

In most medium sized office buildings, separate good 5 lifts are not required as most goods are small enough to fit in passenger lifts, however, industrial buildings, shopping malls and large retail stores often have a need for separate goods lifts.

Smallest goods lifts typically utilize automatic sliding doors in the same manner as passenger lifts. However larger lifts often utilize sliding concertina doors that must be opened and closed by the operator but like the passenger lift, there is usually a safety interlock to prevent the lift from moving unless the doors are closed. Similarly, the door is locked while the lift is moving for the safety of the occupants.

Definition of lift or elevator

Lift/elevation is a type of vertical transportation equipment that efficiently moves people or goods between floors of buildings.

They are generally powered by electrical motors that either drive traction cables or counter weight system like a hoist, or pump hydraulic fluid to raise a cylindrical piston like a jack.

The type, size and number of elevators required is determined by:

- The type and tempo of traffic carried
- The total Vertical distance travelled: (The number of floors served and the floor to floor height)
- The average round trip time and elevator speed desired.

Factors to consider in planning for elevators in a building include:

- Size, material and structural equipments for the elevator shaft
- Structural support requirements for the elevator and its hasting equipment
- Space and enclosure requirements for the elevators hosting and control equipment
- Electric power and control equipment required
- Lobby space requirements for banks of elevators.

Moving stairs (escalator)

Objectives : At the end of this lesson, you shall be able to

- **definition of moving stairs (Escalators)**
- **features of the escalators**
- **construction**

Definition of moving stairs (escalators)

These stairs are known as the escalators or ever-moving flights of electrically operated stairs. These escalators are kept in motion by a revolving drum. A few steps at top and bottom are kept level though moving individually. The only thing a person has to do is to occupy a step of the escalator for his upward or downward motion.

Feature of escalators

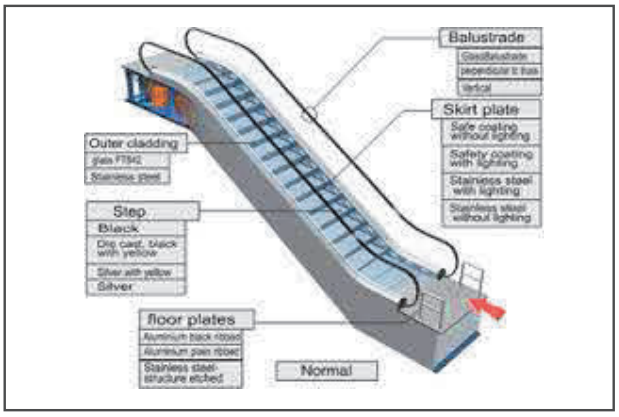
The important features of the escalators are as follows.

Essential parts

An escalator consists essentially of the three parts: steel trussed framework handrails and an endless belt with steps. The accurately prepared tracks are attached to the steel trusses and the steps move on these tracks.

Speed and slope

The used accepted speed of the moving stair is 450 mm per second. A moving stair is in the form of an inclined bridge between two successive floors and its pitch or inclination to the horizontal is kept 30 degree.



Design

The various components of a moving stair should be carefully designed for the loads likely to come over them. The important factor affecting the design is the floor to floor height. The stairway should be kept independent by providing a structural frame around the stair well. This structural frame takes the load of floor handrail, etc.

Location

Before the position of a moving stair in a building is decided, a careful study of flow of traffic should be made or if it is a new structure, the moving stairs should be located at points where the traffic is likely to be the heaviest.

Installation

The various parts of a moving stair are prepared in the workshop and they are then brought on site for installation. The process of installation should be carefully done so as to fit each part of the stair in its proper position. This arrangement will ensure smooth working of the stair. Moreover the escalators are arranged in pairs:

i upward movement and

ii downward movement.

The units may be placed parallel to each other.

Advantages

The moving stairs consume less power, possess large capacity and they have continuous operation without the help of operators. They are used for commercial buildings, railways, airports, etc.

Roofs

Objectives : At the end of this lesson, you shall be able to
- **define Roof**
- **identify the components of roof**
- **classify the roof**
- **forms of pitched roof**
- **explain the pitched roof.**

Introduction

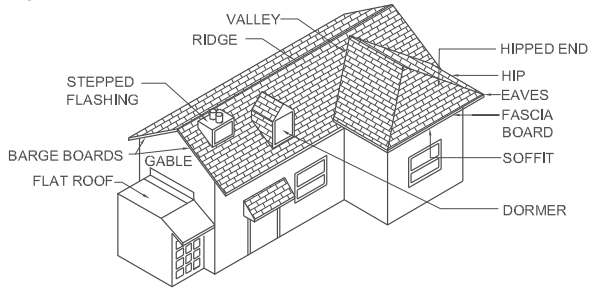
Roof is the uppermost part of the building, which is supported on structural members and covered with a roofing material. Basically roof consists of trusses, portals, beams, slabs, and domes. The roof covering may be AC sheet, G I sheet, Wooden shingles, tiles etc.

Definition

A topmost covered structure provided over a building to protect from rain, snow, sun, and wind is called Roof.

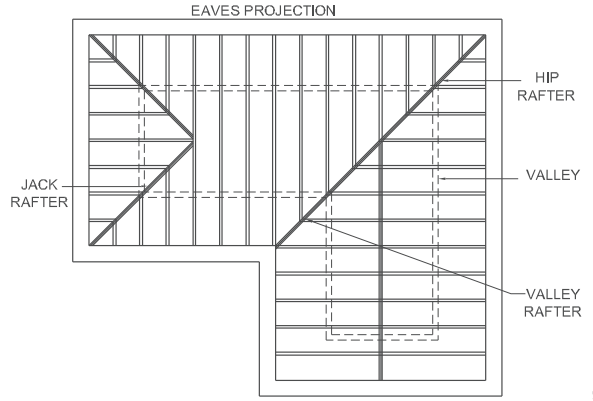
Elements of roof (Figs 1 & 2)

Fig 1



ELEMENTS OF ROOF

Fig 2



ELEMENTS OF ROOF

Span: Horizontal distance between internal faces of wall

Rise: The vertical distance between top of ridge piece and wall plate

Ridge: Wooden member provided in ridge line

Rafters: Members which support extend from eaves to ridge

Common Rafter : Rafter which supports roofs covering and extend from eaves to ridge

Principal rafter: Rafter which supports purlins

Jack rafter: Rafters shorter than common rafter

Hip rafter: Rafter provided on the junction of two slopes

Batten: Wooden plank on which roof covering is fixed

Cleat: Small wooden blocks fixed on principal rafter to prevent purlin from sliding.

Pitch: The inclination of roof

Purlin: The member fixed on principal rafter along the length of roof to carry common rafter or roof covering

Eave Board: Projection of roof beyond the surface of wall is eave and the wooden board which covers the ends of common rafters.

Valley: When two slopes meet together makes an internal angle

Wall plate: A long wooden member embedded on top of wall to receive common rafter

Barge board: The wooden planks or boards which are on the gable end of a roof

Verge: The edge of a roof running between the eaves and ridge

Gable: The triangular upper part of a wall formed at the end of a pitched roof.

Template : This is a square or rectangular block of stone or concrete placed under beam or truss, to spread the load over a large area of the wall.

Cleat : These are shorter section of wood or steel (angle Iron) which are fixed on the principal rafters of trusses to support the purlin.

Classification of Roofs

The roofs are classified into the following three categories.

i Pitched roof

ii Flat roof or terraced roof

iii Curved roof

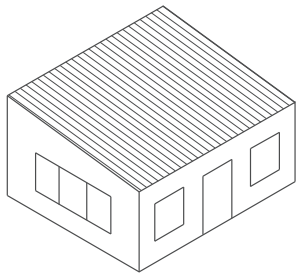
i Pitched roof

A sloping roof is known as pitched roof.

Pitched roofs are basically of following forms:-

1 Lean to roof : This is the simplest type of steps roof provided either for a room of small span or for verandah. It has slope only one side a shown in figure. (Fig 3)

Fig 3



LEAN TO ROOF

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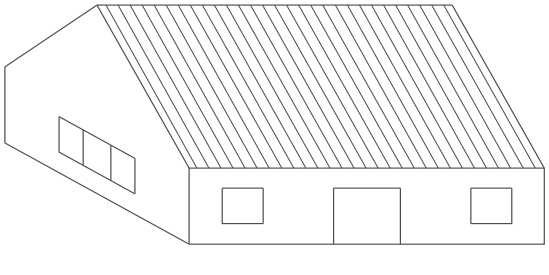
2 Gable roof : This is the common type of sloping roof which slope in two directions. The two slopes meet at the ridge. At the end face a vertical triangle is formed. (Fig 4)

Fig 4



GABLE ROOF

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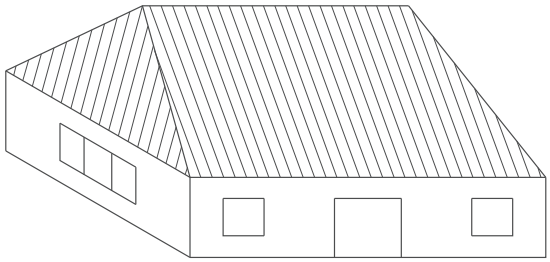
3 Hip roof : This roof is formed by four sloping surface is four directions. At the end faces sloping triangle are formed. (Fig 5)

Fig 5



HIP ROOF

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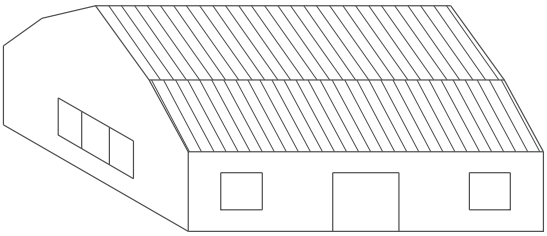
4 Gambrel roof : This roof is like a gable roof, slopes in two directions. But there is a break in each slope shown in figure. (Fig 6)

Fig 6



GAMBREL ROOF

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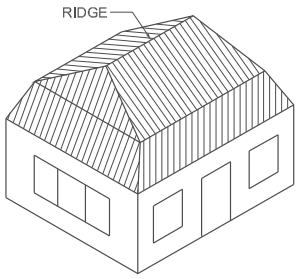
5 Mansard roof or curved roof : Mansard roof like a hip roof slopes in four directions but each slopes have a break thus sloping are formed. (Fig 7)

Fig 7



MASARD ROOF

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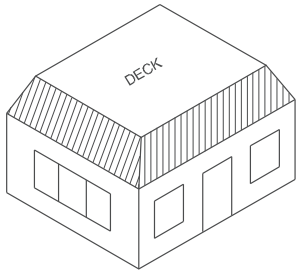
6 Deck roof : A deck roof has slope in all four directions like a hip roof. But deck or plane surface is formed at the top. (Fig 8)

Fig 8



DECK ROOF

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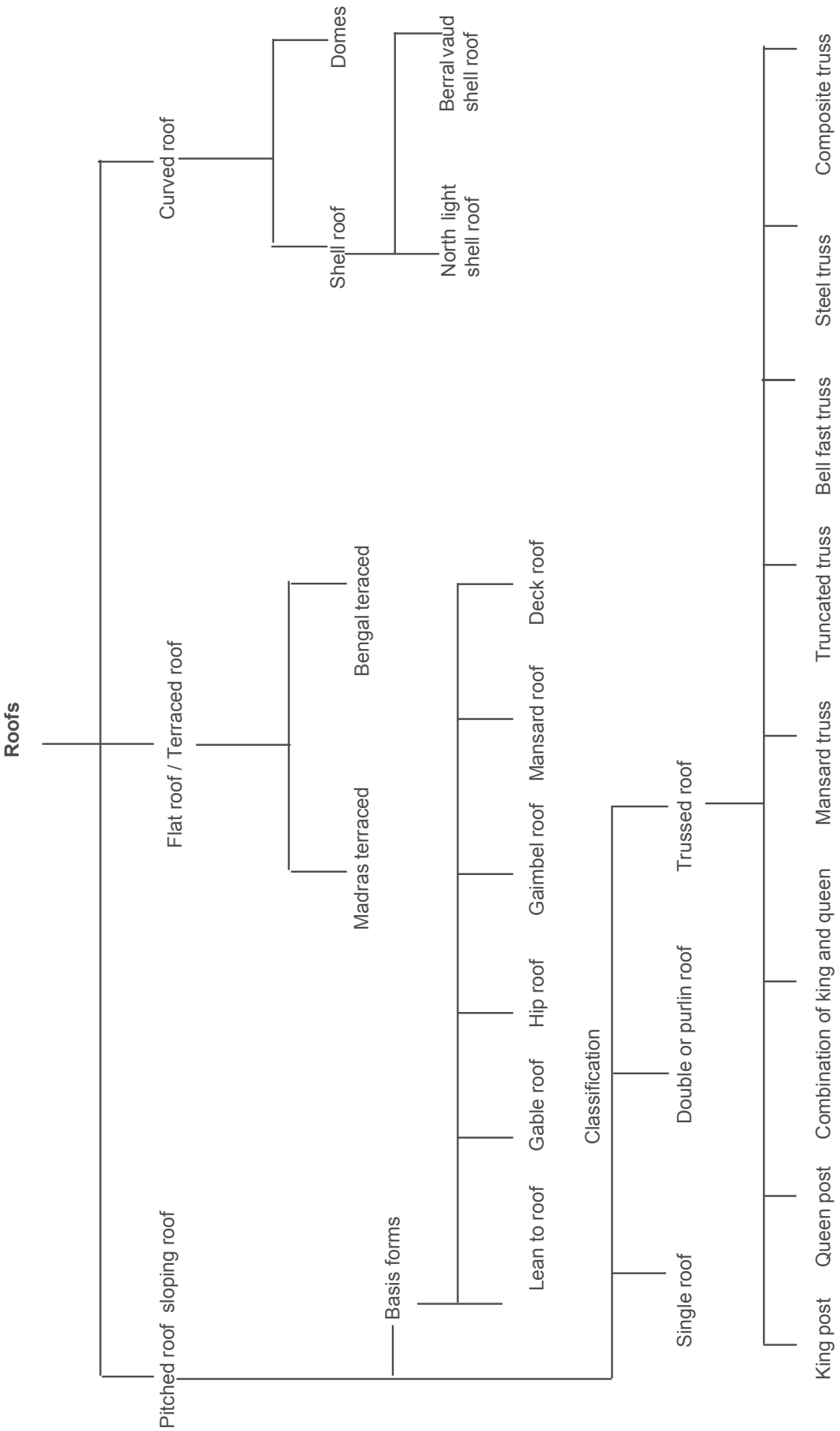


Definition

A pitched roof is one where the slope in any plane exceeds 10° to the horizontal.

Types of pitched roof

Pitched roof may be broadly classified into following

1 Single roof

2 Double roof (Purlin roof)

3 Trussed roof (Frame roof)

1 Single roof

Single roof are those which consist only the rafters which are supported at the ridge and at the cases. And such roofs are used only span is limited to 5m otherwise the size of rafters will be uneconomical the maximum span of the rafter taken as 2.5 m.

Single roofs are of four types.

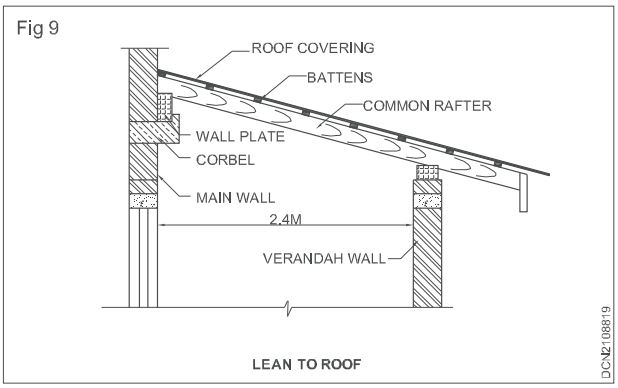
a Lean to roof or verandah roof or shed roof

b Couple roof

c Couple close roof

d Collar beam roof

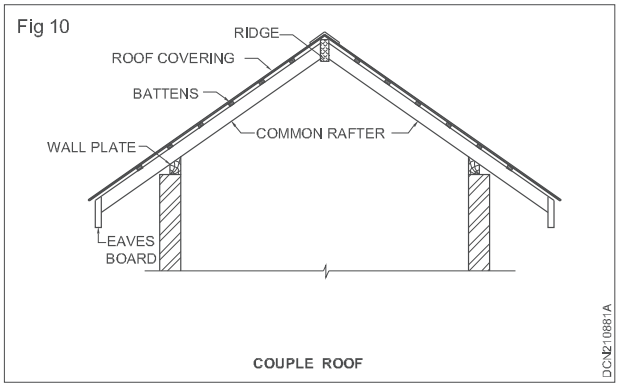
a Lean to roof (Fig 9)



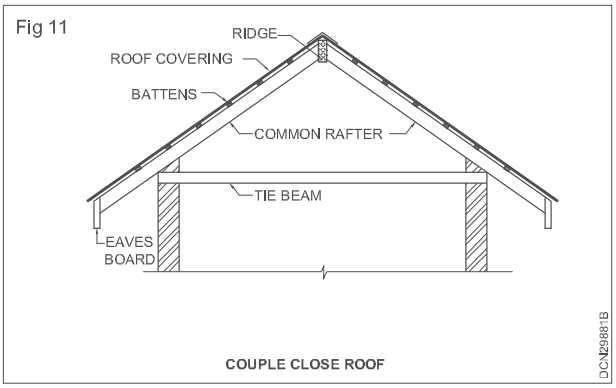
This is the simplest form of sloping roof in which rafters slope to one side only. The wall to one side of the room or veranda is taken higher than wall or pillars to other side. A wooden wall plate is supported either on a steel corbel or stone corbel or a wooden corbel which are provided at 1 m centre to centre. The usual slope of this roof is 30°. The rafters are suitably secured on the wall plate and ever boards, battens and roof covering are provided as shown in figure. A lean to roof is generally used for sheds, out- houses attached to main building, verandas etc. It is suitable for a maximum span of 2.4 m.

b Couple Roof (Fig 10)

In this type of roof the common rulers slope upwards from the opposite walls and they meet on a ridge in the middle as shown in figure. The common rafters are firmly secured in positions at the both ends, the one end being on the ridge piece and other on the wall plate. Such a roof is not very much favoured because it has the tendency to spread out at the feet, it usual plate level and it push out with a force the wall supporting the wall plate. A couple roof is suitable for span up to about 3.6 m.



c Couple close Roof (Fig 11)

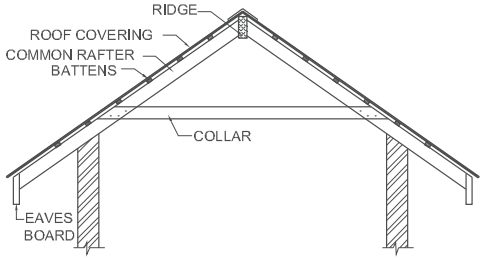


This roof is just III rd to a couple roof except that the legs of the common rafters are concealed by a tie beam as shown in figure. The tie beam by a tie beam as shown in figure. The tie beam position tendency of rafters to spread out and thus the danger of overturning of the walls is avoided. The tie beam can also be used as a ceiling joist when required. A close roof can be adopted economically up to span of 4.2. For increased span for load the rafters may have tendency to say in the middle. This can be checked by providing a central vertical rod, called king rod, or king boll which connect the ridge beam and tie beam is shown in figure.

d Collar beam roof (Fig 12)

When span increase or when the load is more the rafters of the couple close roof have the tendency to bend. This is avoided by rising the tie beam and fixing it 1/3 or 1 ½ of the vertical height from the wall plate to the ridge. This rised beam is known as the collar beam or collar tie. This roof is suitable for span up to 5m. A lower collar position gives stronger roof. A collar beam provides roof greater height of the room. If two collar beam crossing each other are provided to give the appearance of scissors, it is known as collar and scissors roof.

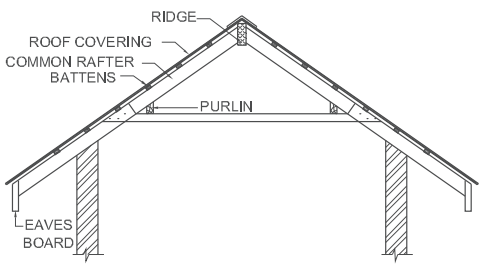
Fig 12



COLLAR BEAM ROOF

(II) Double (Purlin) Roof (Fig 13)

Fig 13



DOUBLE (PURLIN) ROOF

These roof have two basic elements

i Rafter

ii Purlin

The purlins give intermediate support to the rafters and are supported on end walls. The intermediate supports so provided in the form of purlins, reduce the size of the rafters to the economical range. Such a roof is also known as rafter and purlin roof. The rafters are provided fore-close (42-60 cm c-c). Each rafters is thus supported at 3 points.

i At the bottom on wall plate

ii At the lop by the ridge

iii At the centre by a purlin

For large roof 2 or more purlins may be provided to support each rafter.

Trussed roof

Objectives : At the end of this lesson, you shall be able to,

- **define roof trussed**
- **sketch the basic types of trussed roofs**
- **explain the features & uses of basic forms trussed roofs.**

Definition

Trussed roof is used when the span exceeds 4.8m and there are no inside supporting walls or partitions for the purlins then the framed structure which are used to support the root is called truss.

Trussed roof

When span of the roof exceeds 5 m and there are no inside wall to support the purlins, framed structure known as trusses are provided at suitable interval along the length of the room. Spanning is generally limited to 3 m for wooden trusses. The roof may be consist of 3 elements.

a Rafters : Supporting the roofing elements

b Purlins : To provide intermediate support to rafters.

c Truss: To provide support to the end of purlin. The trusses span in the same direction in which the couple of rafters run. The truss also support the ridge piece or ridge beam.

The different type of trusses are as follows:-

1 King post truss

2 Queen post truss

3 Combination of king post and queen post truss

4 Mansard truss

5 Truncated truss

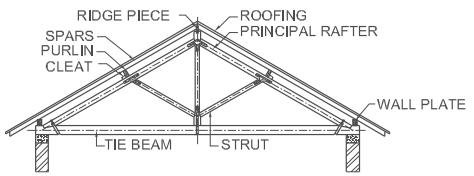
6 Bel - fast truss

7 Steel truss

8 Composite truss

1 King post truss (Fig 1)

Fig 1



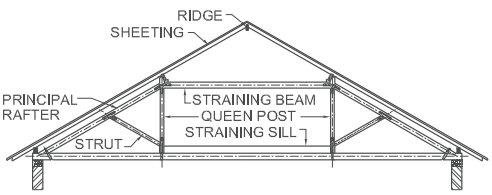
KING POST TRUSS

In this type of truss the central post known as king post forms a support for the tie beam. The inclined member known as struts prevent the principal rafter from bending in the middle. A king post truss is suitable for roof of span varying from 5-8 m.

Suitable joints are provided between the rafter and tie beams, between the principal rafter and king post, between king post and tie beam and at the end of strut. The joints are further strengthened by straps, bots as shown in figure. King post trusses are placed at centre to centre distance of 3m.

2 Queen post truss (Fig 2)

Fig 2



QUEEN POST TRUSS

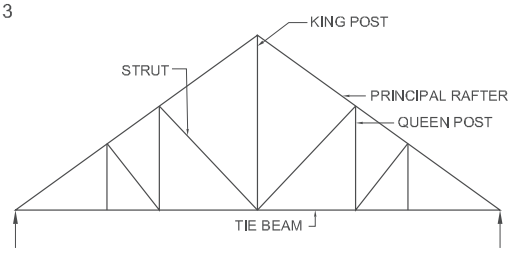
This truss differs from a king post truss in having two vertical posts, known as the queen post. The upper end of a queen post are kept in position by means of horizontal member known as a straining beam. A straining sill is introduced on the tie beam between the queen post to counteract the trust of struts. The additional purline are supported on the queen post as shown in figure.

A queen post truss in suitable for roof of span varying from 8-12m. Suitable joints should be provided at all the connections. The queen post trusses are space at a centre to centre distance of 3m.

3 Combination of king post and queen post

A convenient combination of the king post and queen post truss can be made to increase the suitability of queen post truss up to a span of 18m. For this purpose, the queen post truss is strengthened by one more up right member known as the princess post on either side as shown in figure 3.

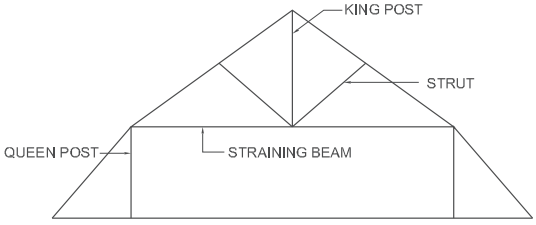
Fig 3



COMBINATION OF KING POST AND QUEEN POST TRUSS

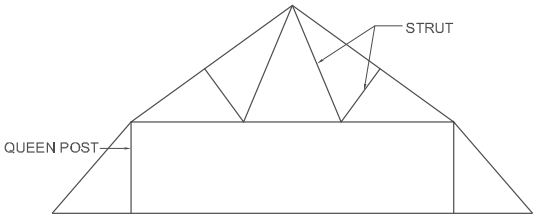
4 Mansard Truss (Fig 4 & 5)

Fig 4



MANSARD TRUSS

Fig 5



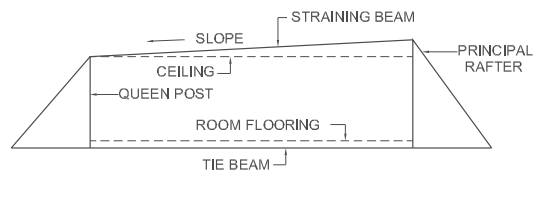
MANSARD TRUSS

Mansard truss a two- storey truss with upper portion consisting of the king post truss a lower portion of queen post truss. It is thus a combination of the king post truss and queen post truss.

The mansand truss has two pitches. The upper pitch (King post truss) varies from 30° - 40° and lower pitch (Queen post truss) Varies from 60°-70°.

5 Truncated truss (Fig 6)

Fig 6

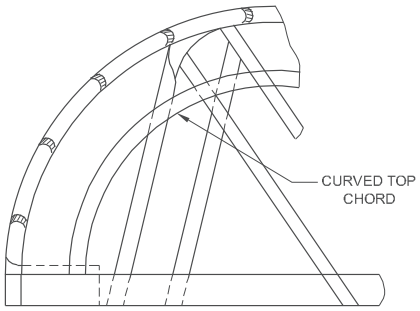


TRUNCATED TRUSS

This truss is just similar to the mansard truss except that the top is finished flat with a gentle slope to one side as shown in figure. It is used when a room is required in the roof.

6 Bel fast truss (Fig 7)

Fig 7

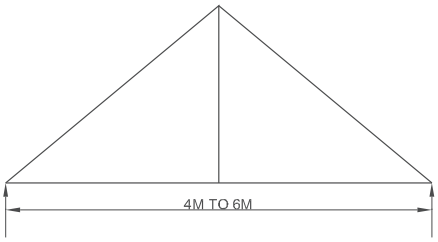


BET - FAST TRUSS

This truss is in the form of a bow. Which consist of thin sections of timber which its top chord curved. If the roof covering is light roof truss can be used up to 30 m span. The roof truss is also known as latticed roof truss.

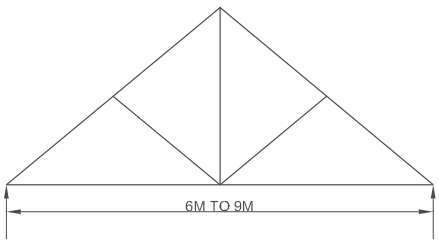
7 Steel roof truss (Figs 8 & 9)

Fig 8



KING POST STEEL TRUSS

Fig 9



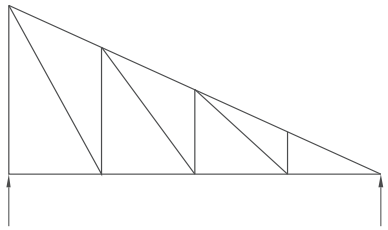
KING POST STEEL TRUSS

When the span exceeds 10m, timber truss becomes heavy and uneconomical. Steel trusser are more economical for large span. The mild steel is easily available in rolled section of standard shape and size such as channels T- sections and plate. Most of the roof trusser are

fabricated from angle sections because they can resist effectively both tensions as well as compression and their jointing is easy. The arrangement and size of various member of a steel truss depend on the span, loading and wind pressure.

The various type of steel truss along with their suitability for different span ranges are shown in figure. (Figs 10 to 18)

Fig 10



NORTH-LIGHT STEEL TRUSS

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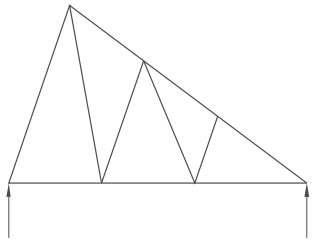
Fig 11



NORTH-LIGHT STEEL TRUSS

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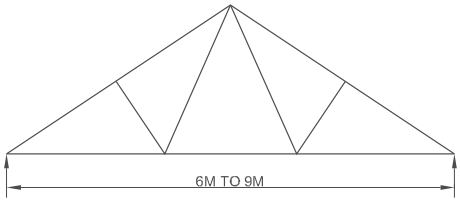
Fig 12



SIMPLE FINK STEEL TRUSS

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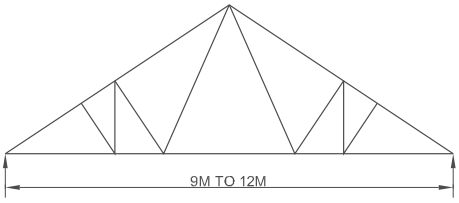
Fig 13



HOUSE STEEL TRUSS

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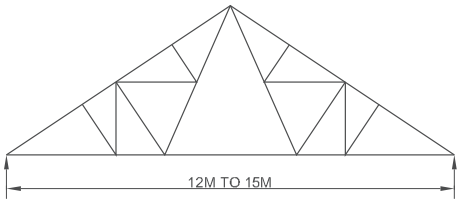
Fig 14



COMPOUND FINK STEEL TRUSS

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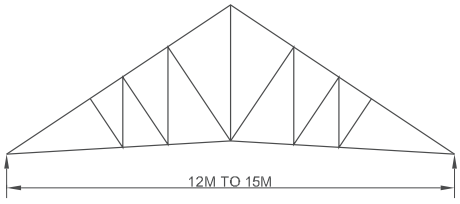
Fig 15



COMPOUND HOUSE STEEL TRUSS WITH KING POST STEEL RAISED CHORD

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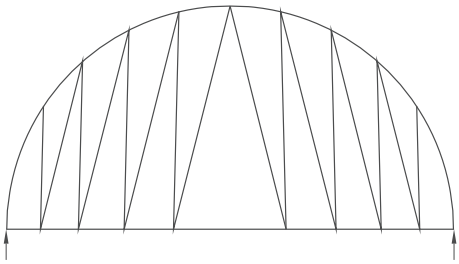
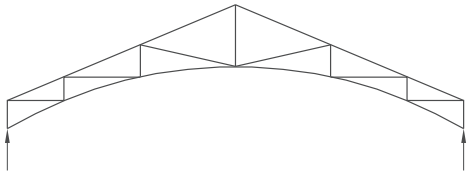
Fig 16



BOW-STRING STEEL TRUSS

DCN210891G

Fig 19



ARCH - STEEL TRUSS

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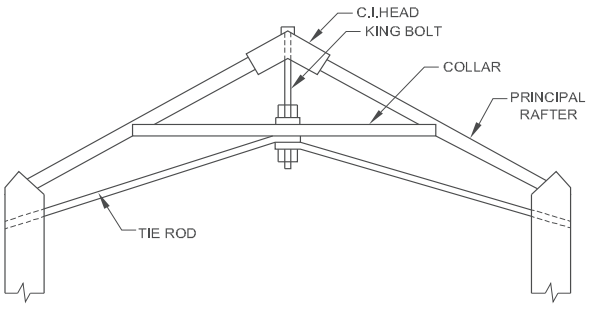
Fig 18



COMPOSITE TRUSS

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8 Composite truss (Fig 18)

These trusses are composed of wooden member and steel or wrought - iron member. The steel is used for member which have to resist tensile stresses. A composite truss is light in weight and economical.

Following are the advantages of steel trusses over timber trusses:-

1 The components of steel trusses can be easily obtained in required dimensions and it result into the minimum wastage of material.

2 They are fire proof and termite proof.

3 They are light in weight and can be fabricated in any shape.

4 They are strong and more durable as compared to the timber truss.

5 They can be easily and speedily installed because of their correction techniques.

Flat roof

Objectives : At the end of this lesson, you shall be able to,

- **define flat Roof**
- **enumerate advantages and disadvantages.**
- **explain types of flat roof construction**
- **state the methods of drainage of flat roof and pitched roof**

Definition

Flat roof or terraced Roof

A roof which is nearly flat is known as the flat roof. It should be noted that no roof can be laid perfectly level. The roof must slope in one direction to drain off rain water rapidly and easily to the upper floor, the flat roof can be constructed on flag stones, RSJ and flag stones, R.C.C reinforced brickwork, Jack arch roof and pre-cast cement concrete unit. A flat roof is one where the slope in any plane does not exceed 10° to the horizontal.

Advantages of Flat roof

1 The roof can be used as terrace for playing, gardening, sleeping and for celebrating functions.

2 Construction and maintenance is easier.

3 They can be easily made fire proof in comparison to pitched roof.

4 They are more stable against high wind.

5 They do not require false ceiling which is essential in pitched roof.

6 The construction of upper floor can be easily done over flat roof, if so require in future.

Disadvantages

1 A flat roof cannot be used for long span without the introduction of intermediate pillars and beams.

2 Packets of water are formed on the surface of the roof it slope is not sufficient.

3 Cracks are developed on the surface of the roof when variation in temperature in ligh.

Type of flat roof construction

Flat roofs are constructed in similar way as the floors except that the roof surface is required to be protected against weather elements such as rain, heat, snow etc. For this purpose, the top surface of roof is given necessary slopes, either two-way or four-way, and also treated with damp-proofing materials to safeguard against the effects of rain and snow. In addition, the flat roofs are either provided with the insulation layer or treated by insulating material to counteract the effects of heat due to temperature variations.

1 Mud Terrace Roof,

2 Brick- Concrete Terrace Roofs (Including Madras Terrace Roof)

3 Jack Arch Flat Roofs,

4 R.C.C or Reinforced Brick Slab Roofs, and

5 Bengal Terrace Roofs.

1 Mud Terrace Roofs

This type of roof, which is the cheaper and fairly water-tight, is extensively used at places of light rainfall. This mud terrace is constructed out of good white earth, containing a large percentage of sodium salts.

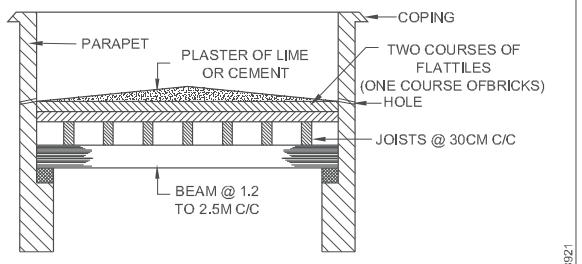
2 Brick - Concrete Terrace Roofs (Fig 1)

In places where the rain fall is heavy and the mud terrace roofs do not provide a satisfactory water-tight surface, one of the following methods of roof construction can be adopted:

In one method, as illustrated in Fig 1 the beams or girders of adequate sizes are placed, spanning across the

room over the wall on girders or plates of wood or stone at regular intervals of 1.2 to 2.5 m.

Fig 1



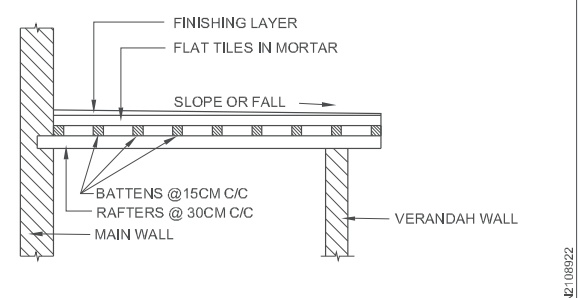
BRICK-CONCRETE TERRACE ROOFS

Above these, the joists are placed at right angles to beams, etc. At spacing of 30cm centre -to -centre. Over the joists, either two courses of flat tiles or one course of bricks are laid and set in lime or cement mortar.

This is finally covered with a 7.5 to 10 cm thick plaster of lime or cement and rubbed to a polished surface.

II Bangal terraced roof (Fig 2)

Fig 2



BANGAL TERRACED ROOF

The procedure of construction is as follows

1 The rafters are placed with slight inclination at 13-15 cm. One end of the rafter is inserted into the main wall to a depth of 20 cm and its other end is supported on a veranda wall or a bressumer. A bressumer is a beam on lintel or which is provided to support a wall over an opening.

2 Battens are provided at right angle to the rafter at a centre distance of about 15 cm.

3 A course of flat tiles are then lard in mortar over the battens.

4 Finally, the surface of the roof is finished in any one of the following methods.

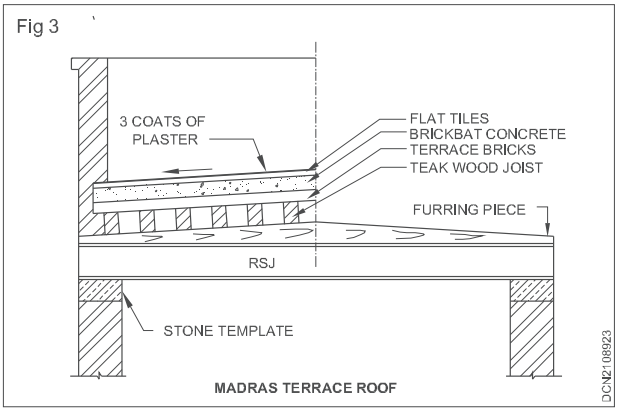
   a Two or more causer of flat tiles may be lard and then the surface of roof is rubbed or polished with 2 or 3 coat of plaster.

   b A layer of fine jelly concrete may be laid over the first courses of flat tiles. The thickness of layer of concrete may be 40 mm.

5 As this type of roof is generally used in Bengal state to cover verandah it is known as Bengal terrace roof.

I Madras terrace roof (Fig 3)

Fig 3



MADRAS TERRACE ROOF

The procedure of construction is as follows

i Teakwood joists are placed on rolled steel joist with a furring piece between the joists and rolled steel Joists. The furring is placed sloping and it gives necessary slope to the flat roof.

ii A course of specially prepared terrace bricks is laid diagonally across joist. The size of brick is generally 15cm X 75cmX 25cm and they are placed on edge in lime mortar.

iii After the brick course has set, a course of brick bat concrete is laid. The thickness of this course is about 75 mm and it consist of 3 part of brickbat, 1 part of gravel and sand and 50% of lime mortar by volume.

iv The concrete is well rammed for 3 days and allowed to set

v Flat tiles are then laid over the layer of concrete. The tiles are laid in two courses of 50 mm thickness.

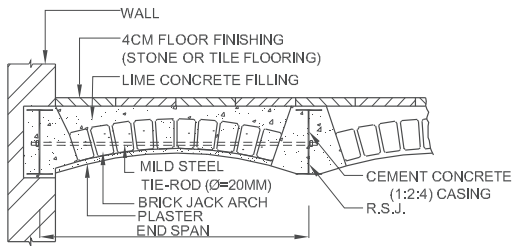
vi Finally the surface of the roof is finished with 3 coat of plaster as shown in figures, with a given slope of 1 is 30

vii As this type of flat roof construction is widely used in madras state (Tamil Nadu). It is known as madras terrace roof.

3 Jack Arch Flat Roofs (Fig 4)

These roofs are constructed in a similar way as the Jack Arch Floors (already described in Under Article 02.01.02) except they are provided with a protective layer at the top to safeguard against weather elements.

Fig 4



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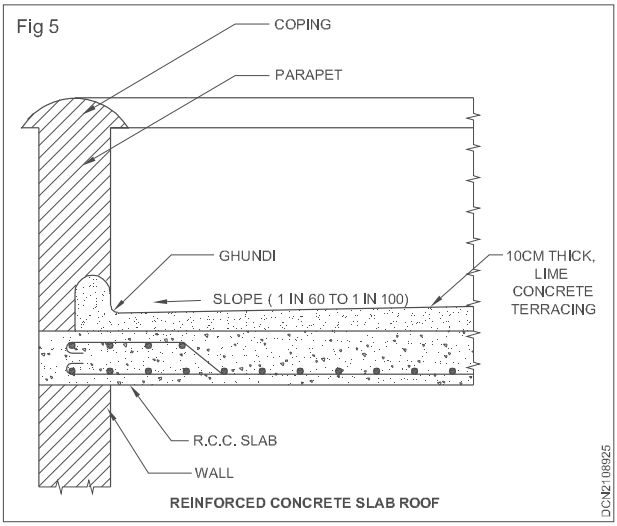
JACK ARCH FLAT ROOF

4 Reinforced Concrete or Reinforced Brick Flat Roofs (Fig 5)

Fig 5



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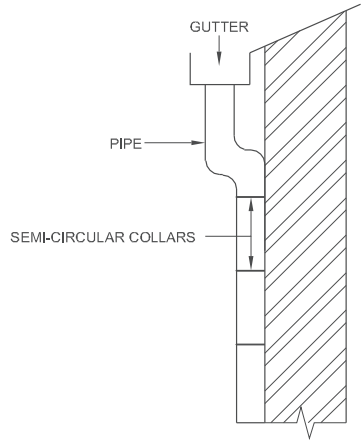
REINFORCED CONCRETE SLAB ROOF

These R.C.C or R.B. flat roofs are constructed in a similar way as R.C.C or R.B. floors (already described under Article 02.01.02) except that they are required to be protected against weather elements, i.e, rain, snow, heat, etc. A protective covering, consisting of 10 cm thick layer of lime concrete terracing with some waterproofing compound, is provided over the R.C.C or R.B. slab. This layer makes the roof leak- proof. The layer of lime concrete is thoroughly beaten by hand beaters to make it hard, impervious and compact. At the junction of wall, the lime concrete terracing is taken inside the wall for a depth of 10-15 cm and the corner is given a round smooth finish. This is done to prevent the accumulation and leakage of water at junctions. The construction details are illustrated in Fig 5.

The lime terracing is provided with a little slope, usually 1 in 60 to 1 in 100, to drain off the rain water rapidly and easily.

Drainage of pitched and flat roofs (Figs 6 & 7)

Fig 6



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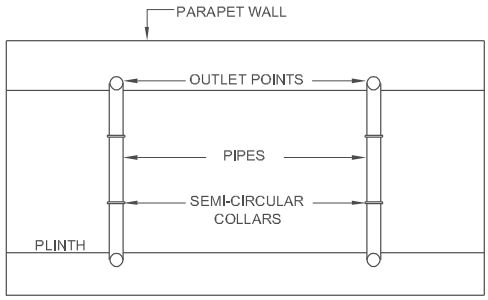
DRAINAGE OF A PITCHED ROOF

Fig 7



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DRAINAGE OF A FLAT ROOF

It is necessary to dispose off the rain water that falls on a pitched roof or a flat roof. In case of a pitched roof, a trough known as a gutter, is provided at the end of slope as shown in fig 6. This gutter extends for the full length of the roof at suitable points along the length of gutter, the outlet points are provided and in these outlet points, the ends of rain water pipes are fitted.

In case of flat roofs, no gutters are provided and the roof is provided with such a slope that the rain water is guided to the outlet points as shown in fig 7. The rain water thus collected is led through the pipes to the ground level.

Curved roof

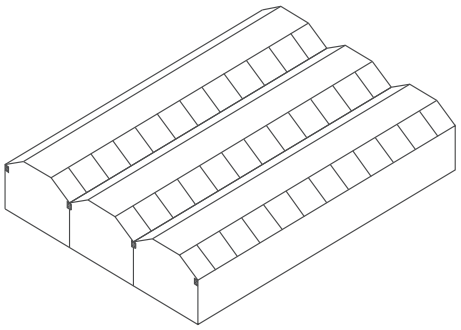
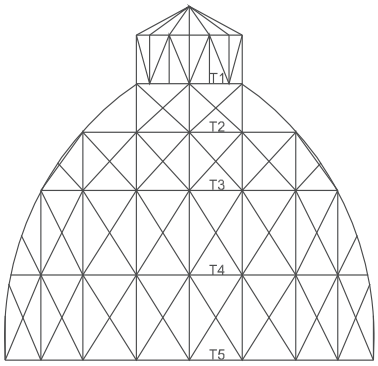
Objectives : At the end of this lesson, you shall be able to,

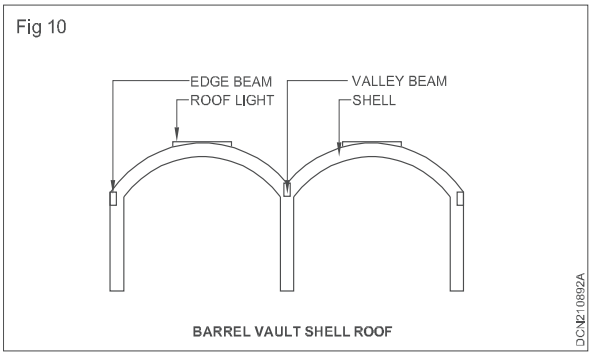
- **define curved roof**
- **explain the features & uses of basic forms curved roofs.**

Definition

These are just the modifications of pitched roofs and are frequently employed in the modern age to cover large areas and to give architectural effects. The shell roofs and domes are the varieties of the curved roofs. They are useful for big structures such as factories, monumental works, libraries, theatres, recreation centres, etc. The curved roofs may be constructed of timber or R.C.C the latter material being very common now - a- days. There are two common forms of a shell roof.

Types of curved roofs

Name	Description	Figure
North light shell roof:	These shell roofs are useful for big structures such as factories these are used in northern area	Fig 8  NORTH LIGHT SHELL ROOF DCN2108928
Dome:	An element of architecture that resembles the hollow upper half of a sphere. Made of various materials. Used for appearance	Fig 9  STEEL FRAME DOME DCN2108929

Name	Description	Figure
Barrel vault : shell roof	It is useful when roof is to be pro vided on circular brick work.	Fig 10 

Roof covering for pitched roofs

Objective : At the end of this lesson, you shall be able to
- **state the types of pitched roof covering materials.**

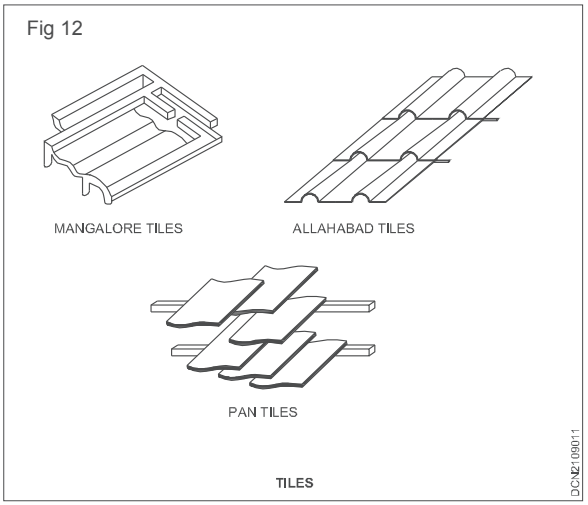
Roof covering for pitched roofs

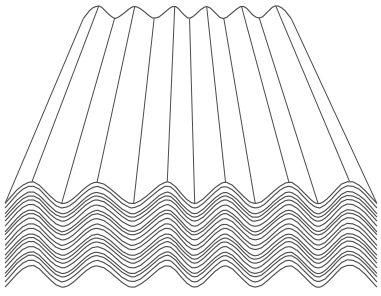
Roof covering is an essential component of pitched roof to be placed over the roof framework to protect it from main rain, snow, sun, wind and atmospheric agencies.

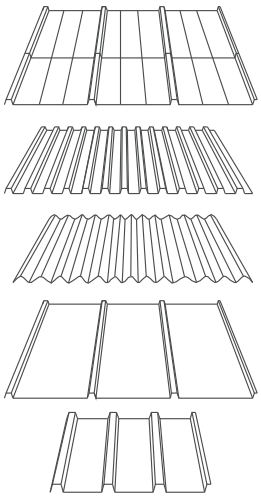
Following points should be considered before selecting the type of roof covering for a pitched roof.

1 Climate of the locality
2 Nature of the building
3 Initial cost and maintenance cost
4 Durability
5 Availability of the material
6 Fabrication facilities
7 Type of roof framework
8 Resistance to fire and heat
9 Special feature of the locality.

Roof covering materials

Name	Description	
Thatch:	Extensively used in sheds & villages Cheapest & lightest material Unstable against wind. Laid on battens.	Fig 11 
Tiles:	These are largely used various kinds of tiles are used. Commonly used for covering sloped roof.	Fig 12 

Poly carbonate sheets	New type material with high strength, heat insulation and good light trans mission. Good weather resistance and UV protection.	Fig 13 
Glass	Structural glass slabs are available at in different gauges. Fibre glass is both strong and Height weight. Provide good light transmission,good appearance, etc.	Fig 14 
Slates	It is stratified rocks. Produced in large number of sizes. Obtained from either quarries or from mines.	Fig 15 
Asbestos cement sheets (AC sheets)	For AC sheets the cement is mixed with about 15% of asbestos fibres and the paste so formed are pressed under roll ers with grooves or teeth with series of corrugations. They are used for facto ries, workshops, garages, big halls etc. Available in different trade such as big six sheet, standard sheet, Trafford sheet etc.	Fig 16  ASBESTOS CEMENT SHEETS DCN210901-2

Shingles:	Wood shingles are the sawn or split thin pieces of wood obtained from well sea soned timber resembling slates or tiles. Generally restricted in hilly areas. Laid in a manner as slates or tiles.	Fig 17 
Corrugated galvanized iron sheet:	Prepared by pressing flat wrought iron plates between rollers with grooves or teeth and then galvanized with coat of zinc. Corrugations are present to in crease strength and rigidity.	Fig 18  CORRUGATED GALVANIZED IRON SHEET DCN2109013
Ruberoid	Light, flexible & waterproof, Not affected by heat or cold & not attacked by fire. Available in rolls.	Fig 19