CHAPTER 1

DOORS AND WINDOWS

A door is a movable barrier secured in an opening, known as the doorway, through a building wall or partition for the purpose of providing access to the inside of a building or rooms of a building. A door is held in position by doorframes, the members of which are located at the sides and top of the opening or doorway. Sills may or may not be provided at the bottom of doorways. A window is defined as an opening in a wall of a building to serve one or more of the functions like natural light, natural ventilation and vision.

The main function of a door in a building is to serve as a connecting link between the internal parts and to allow free movement to the outside of the building. Windows are generally provided for the proper ventilation and lighting of a building and their size and number should be properly determined as per the requirements. To perform their basic functions, the following functional requirements should be satisfied in their design and construction.

a) Weather resistance: They should be strong enough to resist the adverse effects of weather such as wind and rainfall.
b) Sound and thermal insulation: They should be capable of being made airtight to achieve insulation against sound and heat. They should act as vertical barriers like walls for the passage of sound, heat and fire.
c) Damp prevention and termite proofing: They should not be affected by termite and moisture penetration as they reduce their strength and durability.
d) Fire resistance and durability: They should offer fire resistance and should be durable.
e) Privacy and security: They should offer sufficient privacy without inconvenience or trouble and security against burglars.

LOCATION OF DOORS AND WINDOWS

The designer or planner should observe the following rules while deciding the location of doors and windows:

1. The number of doors should be kept minimum for each room because larger numbers cause obstruction and decrease the utility of the accommodation. The location and size of the doors should be based on their functional requirement.
2. From the viewpoint of utility and privacy of the occupants, doors should preferably be located near the corner of a room.
3. For good ventilation and free air circulation inside the room, the doors should be located in opposite walls facing each other.
4. The location, number and size of the windows are decided considering various factors, like desired daylight, vision, privacy, ventilation and heat loss.
5. The sill of a window should be located at a height of 0.75–1 m above the floor level. However, windows when exposed to public places like shopping centres and cinema theatres are located at a higher level say about 2 m. This is essential for achieving privacy in buildings on the ground floor.
6. Doors and windows should be located by keeping in view the interior decoration of the room and views of the building owner.

DOORS

From the operational point of view, the doors are classified as below.

Swinging doors

In these doors, the shutter is hung to the door frame on hinges or butts fixed to one side of the shutter, so that they swing on a vertical axis. The doors may be single swinging, double swinging or double acting type.

In single swinging type doors, if a person is standing on the outside of a door and the hinges are at his left, the door is a left-hand door, but if they are at his right it is a right-hand door.

In double swinging doors, the shutters are hinged at opposite sides of an opening. These doors are extensively used at the entrances of buildings. In double acting doors, the shutters are provided with special hinges, which keep the door closed when it is not held open. Doors of this type can be easily pushed in either direction.

Folding doors

These doors are usually single or as folding partitions so that two rooms may be used together as a single room or separately. They are made of wood or metal and are used for very large openings. Doors are also hinged together.

Sliding doors

Sliding doors that slide sideways were extensively used in the past for residences. The door shutters can also slide either upward or downward. These doors do not cause any obstruction in movements. The vertical sliding doors are pulled up by cables or chains and are used for large openings in industrial and freight elevator doors. The right angle doors are suspended from an overhead track and are used to a very limited extent for garages.

Rolling doors

This is a modification over sliding doors. These doors are generally made of steel or slates of sheet metal and can be easily closed or opened by slightly pulling or pushing the shutter. They do not require much space and are commonly used for garages, show rooms, shops, etc.

Revolving doors

These doors are extensively used where frequent opening and closing of doors are to be avoided due to heavy foot traffic, like markets, public buildings, hotels, stores, theatres and hospitals. The arrangements are made to rotate the door to about one side of the shutter and get it closed automatically whenever pushed and left.

Collapsible doors

These doors consist of a mild steel frame, which is made up of light steel channel sections. They are provided with rollers at the bottom and top to roll on rails when they open or collapse. These

doors work without hinges and can be opened or closed by a slight pull or push. These doors are extensively used for residential buildings, public buildings, schools, etc.

WINDOWS

1. Fixed window

It is fixed in the wall and makes no provision for natural air circulation.

2. Double hung window

In this type, both sashes slide vertically with the weight balanced by the sash weight, spiral springs or tape spring balances.

3. Horizontal sliding window

In this type, either one or both sashes are arranged to slide horizontally. Sashes are sometimes suspended from rollers operating on overhead tracks. Heavy sashes are often provided with nylon rollers at the bottom for ease in operation.

4. Casement window

Any hinged window, which may swing out or in like doors, is termed as casement window. These windows usually swing on extension hinges provided on the sides. There are out-swinging and in-swinging casement windows with two sashes. Extension hinges are used to make the sash swing clear of the inside surface of the wall.

5. Folding window

It is a form of out-swinging casement window with the two sashes hinged together on its meeting stile, rather than each to its outside stile. The projection arms are so arranged that the sashes operate symmetrically.

6. Pivoted window

Horizontally pivoted sash windows are often arranged in a row to form a continuous window in a sawtooth roof or monitor and they operate in harmony from the floor by a mechanical operation.

7. Top- and bottom-hinged window

Sash windows may be top-hinged out-swinging or top-hinged in-swinging or bottom-hinged in-swinging type.

8. Projected window

A window with a ventilation sash that projects outwards or inwards is called a projected window. In this type, the ends of the arms are pivoted to the side of the sash and to the frame.

9. Hopper window

Any inward projecting window when located at or near the bottom of a window is termed as hopper window.

TYPES OF DOORS

The doors commonly used in buildings are classified into various types depending upon several factors or aspects like materials used in the manufacture of doors, arrangement of door components, method of construction and their working operation.

A. Battened and ledged door

This is the simplest form of door, which is frequently used for narrow openings. The use of this type of door is preferred where cost is the main factor rather than the strength and appearance. This door consists of vertical boards known as battens, which are secured by horizontal pieces known as ledges. Usually, there are three ledges, namely top ledge, middle ledge or lock edge and bottom edge. The outer edges of the ledges are generally chamfered. The bottom and middle ledges are sometimes wider than the top ledges. The battens secured by means of tongued and grooved joint are either V-jointed or beaded (Figure 17.1).

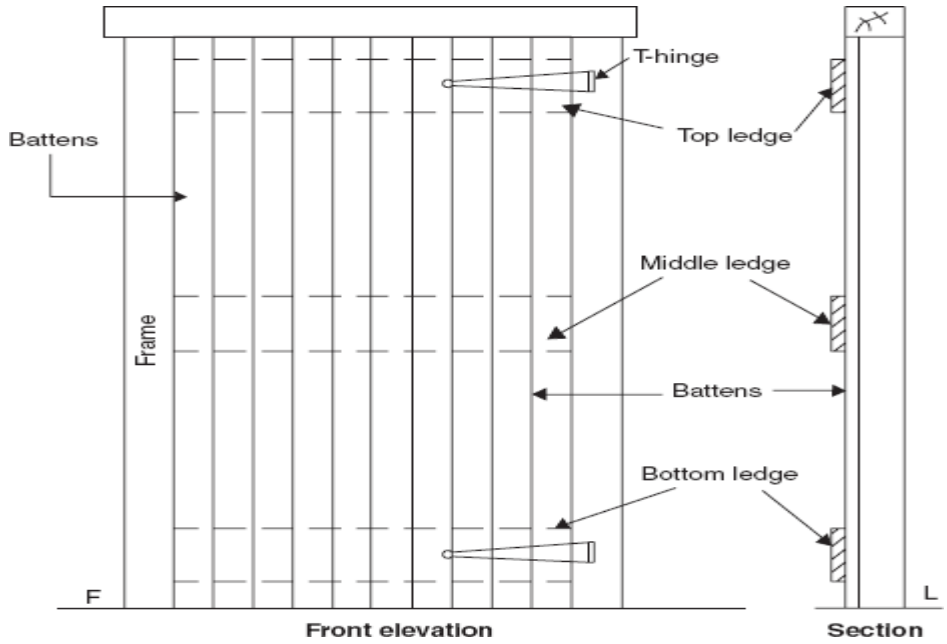

Figure 17.1 Battened and ledged door

The sizes of the door components are as follows:

1. Vertical battens: width is 10–20 cm; thickness is 2–4 cm
2. Top ledge: width is 10 cm; thickness is 3-4 cm
3. Middle and bottom ledge: width is 15–20 cm; thickness is 3-4 cm

B. Battened, ledged and braced door

This door is a modification over battened and ledged doors in which additional diagonal members called braces are provided to increase its rigidity and, hence, the strength. These braces act as struts as they are made to incline upwards from the hanging edge. By doing so, the tendency of dropping at the nose, in the case of wider doors, is prevented. Thus, these types of doors can be used for wider openings.

Braces: width is 10–15 cm; thickness is 3-4 cm. All other members are of the same size as in the above case.

This door is commonly adopted for bathrooms where the appearance is not so important as economy (Figure 17.2).

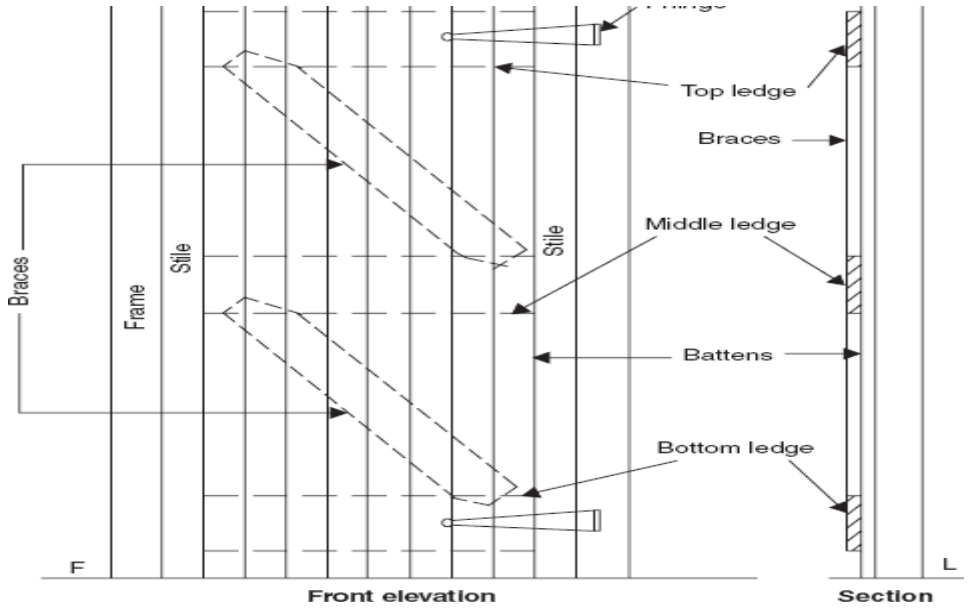

Figure 17.2 Battened, ledged and braced door

C. Battened, ledged and framed door

This door is provided with a framework for shutters to have better strength and appearance than the ordinary battened and ledged doors. This door consists of two vertical styles, three ledges or rails, bottom, top and middle and battened fixed in the framework. Battens and ledges are provided as usual. Stiles are generally 10 cm in width and 4 cm in thickness (Figure 17.3).

D. Battened, ledged, framed and braced door

This door is a modification over the previous type in which additional members known as braces have been introduced to increase its strength, durability and appearance. This type of door is largely used for external work. This door has a framework consisting of two stiles, three ledges on rails, battens and two inclined braces. Generally, the thickness of the top rail and the stiles is same and equal to that of the braces and batten together. The braces are 1.5 × 12 cm (Figure 17.4).

E. Framed and panelled door

This type of door is very commonly used and is constructed in various designs. The object of using such a door is to obtain a framework in which the tendency of shrinkages is reduced and

the appearance enhanced. This type of door consists of a frame in which the panels are fitted. A double-leafed door is with modular dimensions of frame as 120 cm width and 10 cm height.

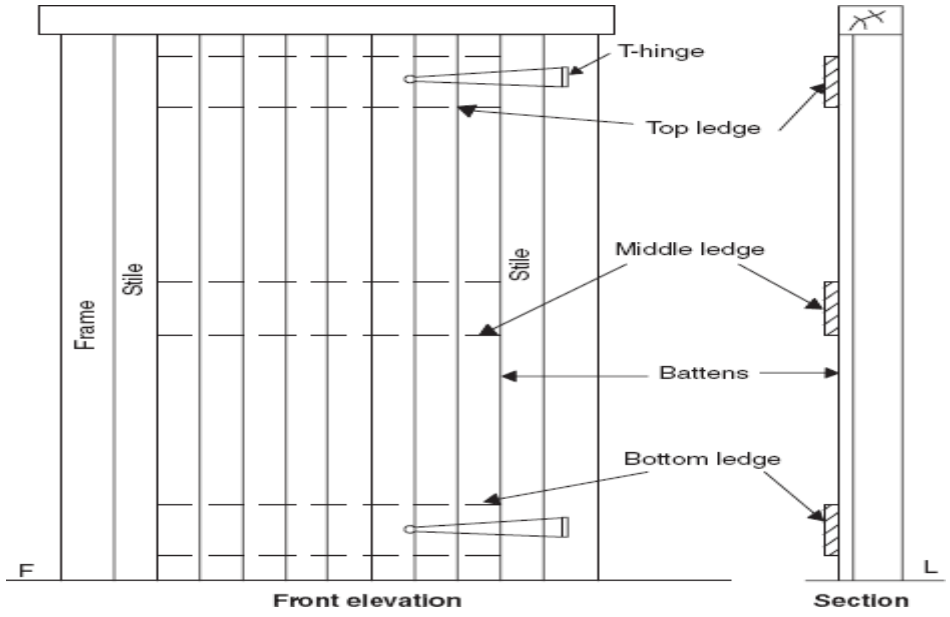

Figure 17.3 Battened, ledged and framed door

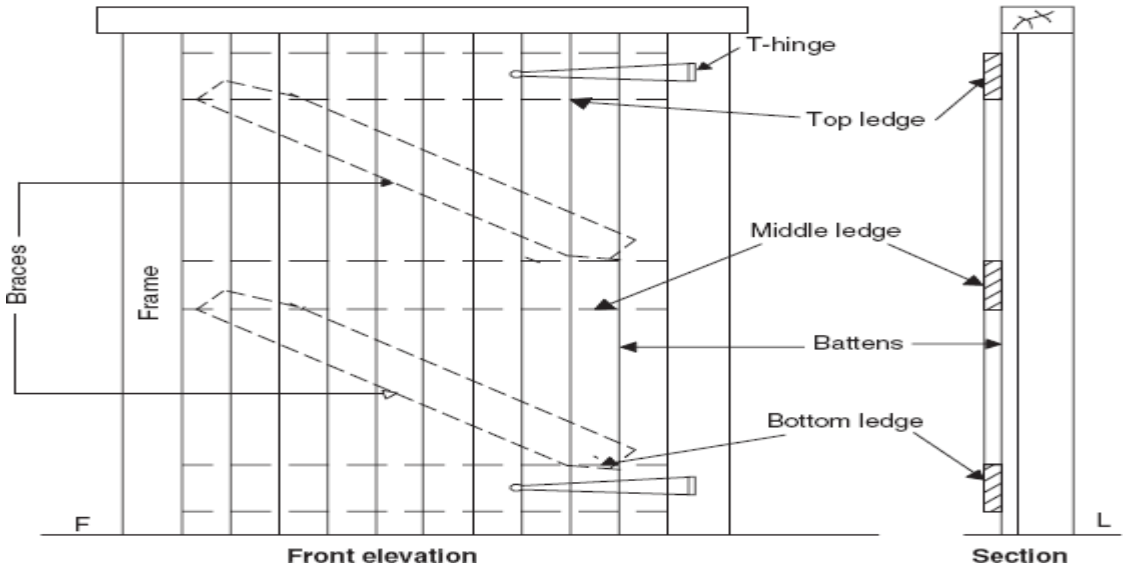

Figure 17.4 Battened, ledged, framed and braced door

1) The stiles are continuous from top to bottom for the full height.
2) The rails, top rail, bottom rail and lock rail, are jointed to the stiles.
3) The frame consists of narrow pieces, mortised and tenoned to each other and grooved on all the inside faces to receive the panels.
4) Bottom and lock rails are made of bigger size and are stronger than top and frieze rails.
5) It is generally recommended that the minimum width of stiles should not be less than 10 cm and for lock and bottom rails not less than 15 cm. The thickness of the shutter frame is usually kept 4-5 cm, but the actual value depends upon several factors like door size, situation of door, type of work, thickness of panels and size of the moulding (Figure 17.5).

F. Glazed or sash door

Sometimes, the doors either fully glazed or partly glazed and partly panelled are used to supplement the natural lighting provided by windows or to make the interior of one room visible from another (Figure 17.6). The glazed or sash door is extensively used these days in residential as well as public buildings. When sufficient light is required to be admitted through doors then fully glazed doors are provided (Figure 17.7). In the case of partly glazed and partly panelled doors, the usual proportion of glazed portion to the panelled portion is kept 2:1.

G. Flush door

Flush doors are becoming more popular these days for residential and public buildings because of several good characteristics like pleasing appearance, simplicity of construction, economy, strength and high durability. A flush door consists of a skeleton or a hollow framework of rails and stiles and it is covered on both the sides with laminated boards or plywood. This door has, therefore, fewer perfectly flush and joint surfaces on both the sides. The nominal thickness of flush door shutters varies from 25 to 40 mm depending upon the type of door (Figure 17.8).

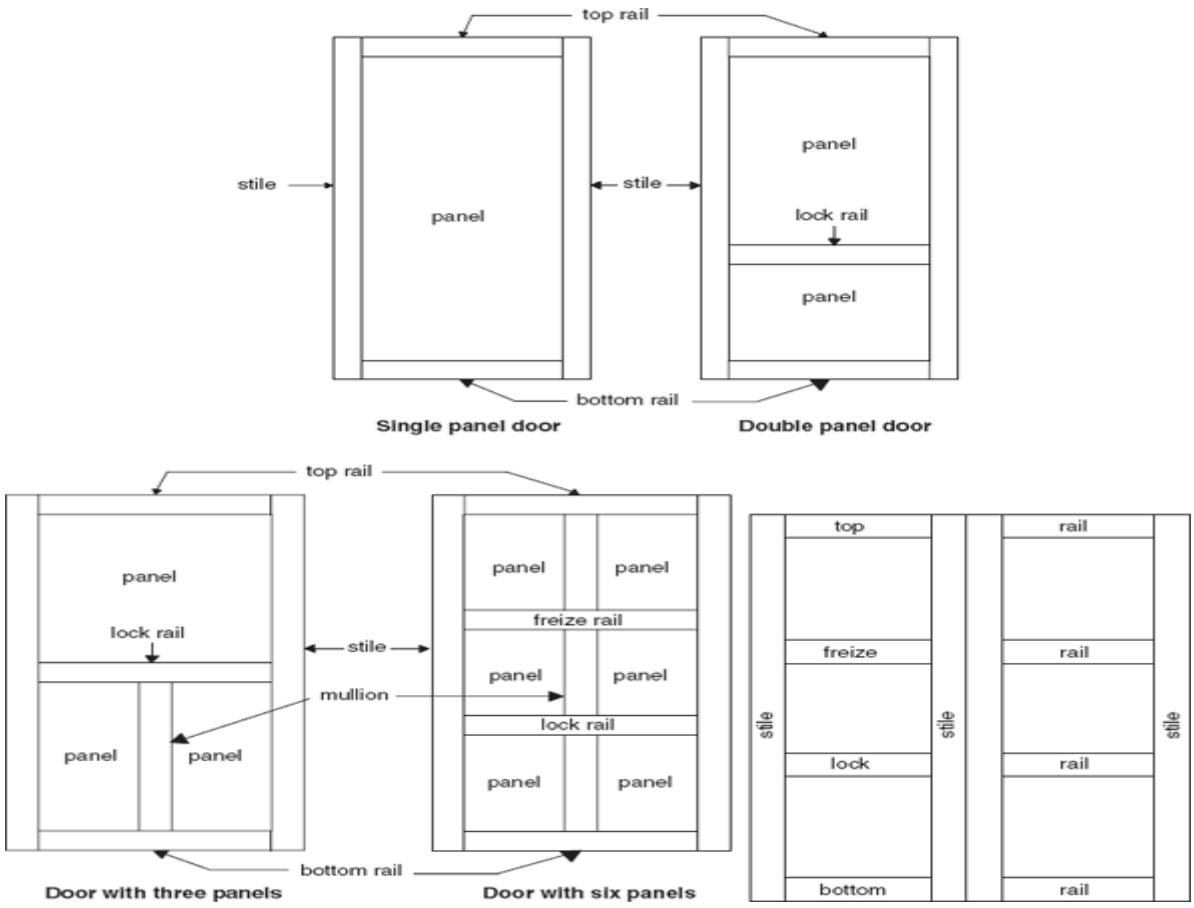

Figure 17.5 Framed and panelled door

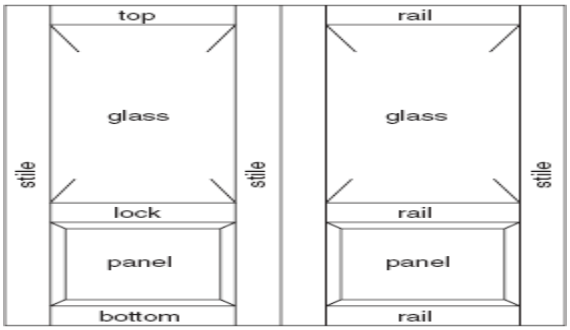

Figure 17.6 Partly panelled and partly glazed door

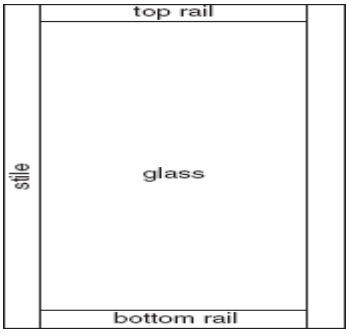

Figure 17.7 Fully glazed door

a) ***Solid Core Flush Door****:* This door consists of a core of strips of a wood glued together under great pressure and faced on each side by plywood sheets. The laminated strips are not less than 20 mm in width and are glued edge to edge. The solid core or limited flush doors are heavy and require more material for their construction.

b) ***Hollow and Cellular Core Flush Door****:* In this type, the frame consists of stiles and top, bottom and intermediate rails, each not less than 7.5 cm wide, and this frame is covered on both the sides by sheets of plywood. Sometimes, the hollow wood frame is filled with granulated cork or any light material instead of being left hollow. To ensure thorough circulation of air within the framing, ventilation holes are provided.

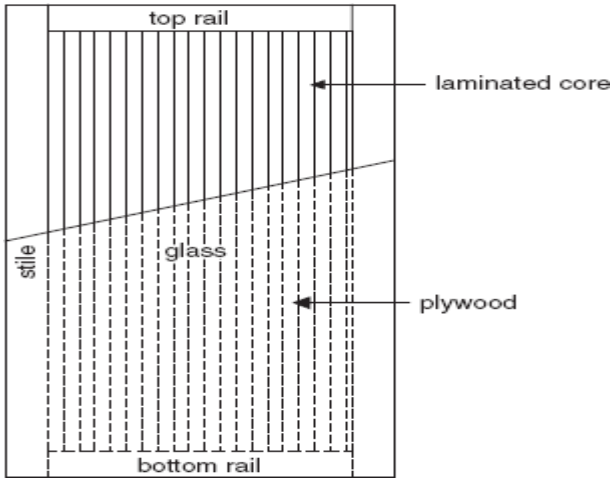

Figure 17.8 Flush door

In the case of hollow core shutters, vertical battens not less than 25 mm wide are so fixed on the rails that they provide void spaces, each not more than 500 cm^2.

Moreover, their void spaces or hollow portions should be equally distributed. In the case of cellular core shutters, vertical battens and horizontal battens or ribs not less than 24 mm wide and made up of strips of wood and plywood or blocks of compressed wood are so fixed that they provide a grid of void spaces, each not more than 25 cm^2 in area.

H. Louvered door or ventilated door

The use of this door is recommended when privacy combined with natural ventilation and quietness for rest is desired, because it allows free passage of air even when closed. These doors are not much favoured since they are difficult to clean. The louvers are made either movable by connecting them to the pivot by means of hinges or fixed into the stile. In the case of movable type, the upward or downward movement of louvers is carried out by lowering and raising the pivot, respectively. Louvers are made of glass or timber.

I. Wire gauzed door

This door is used where it is desired to allow free air into the room and avoid the nuisance of insects, mosquitoes, etc. The wire gauzed door consists of vertical stiles and horizontal rails with fine mesh galvanized gauze fixed to the shutters by a bead braded or nailed to the frame. Generally, the frame is provided with two types of shutters. Shutters of ordinary panelled type are provided on the front side and are made to open to the outside of the room, whereas another type of shutter is provided with a wire gauze and is made to open to the inside of the room.

J. Collapsible steel door

The collapsible steel door neither requires hinges for opening and closing the shutters nor any frame for hanging them. This door is extensively used for the main entrance of residential buildings, shops, garages, etc. where the width of the door is large and the space is sufficient to provide two-leafed hinged shutters. This door being very strong can be used in exposed situations to safeguard against robbers. It may be made of single or double shutters depending upon the size of the opening.

It is fabricated from vertical pieces of rolled steel channels 16–20 mm wide, joined together with the hollows of the channel on the inside, leaving a vertical gap of 12–20 mm between them. Rollers are provided both at their top and bottom or at the top in some case. The doors can be opened or closed by a slight pull or push. The vertical channel pieces are spaced at 10–12 cm centre to centre and are joined to one another by means of hoop iron cross pieces or flats 16–20 mm wide and 5 mm thick, which allow the door to open or fold (Figure 17.9).

K. Rolling steel shutter door

This door is capable of being rolled up at the top easily and causes no obstruction either in the opening or floor space. It is commonly used for the main entrance of shops, garages, godowns, etc. It is sufficiently strong and offers proper safety to the interior when closed. A rolling steel door consists of a frame, a drum and a shutter of thin steel plates or iron sheets of thickness about 1 mm and width varying up to 6 m. Steel guides are provided on the sides for the movement of shutters. The door is counterbalanced by means of helical springs enclosed in the drum.

L. Revolving door

This door provides entrance on one side and exit on the other side simultaneously. It keeps the opening automatically closed when it is not in use. These doors are provided where there is constant foot traffic of people entering and leaving the entrance of public buildings. Revolving doors consist of four upright cross wings, i.e., shutters which are arranged diagonally on the sides of a centrally placed pivot. These shutters revolve about this pivot or vertical axis.

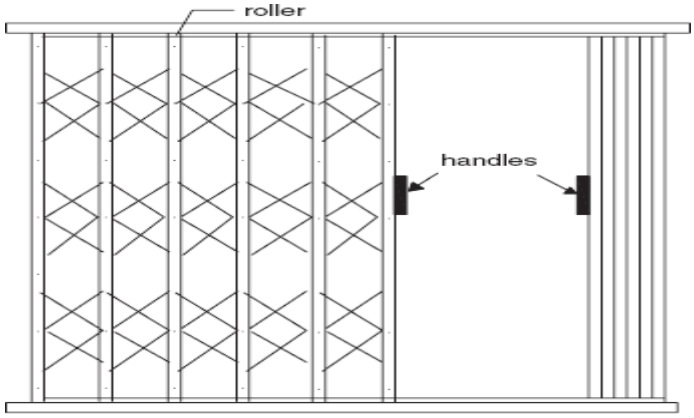

Figure 17.9 Collapsible door

M. Side sliding door

In this type of doors, the need of hinges for fixing shutters to frames of doors is eliminated. It is commonly used for the entrance of godowns, sheds, shops, garages, etc. The shutter of this type of door consists of one or several panels, which can slide either on one side or both the sides. These doors are operated by sliding the doors on the sides with the help of runners at the top and guides at the bottom.

TYPES OF WINDOWS

Windows are provided in the wall openings for admission of light, free circulation of air and sunshine. As a general rule, the minimum area of a window or windows should be one-tenth of the floor area of the room and at least half of this area should be made open for ventilation.

A. Casement window

The simplest type of casement window consists of a square or rectangular window frame of metal or wood, with a casement hinged at one side to the frame to open out. The side-hinged opening part of the window is known as the casement and it consists of glass surrounded and supported by metal or timber strips. The casement is hinged to open out because an outward opening casement can more readily be made to exclude rain and wind than one opening inwards. The usual sizes of the component parts of a casement window are as follows (Figure 17.10):

	Width × thickness
Vertical stiles, top rails and bottom rails	7 × 3.5 cm–9.5 × 3.5 cm
Heads, mullions and transoms	9 × 7 cm–12 × 7 cm
Sash or glazing bars	3.5 × 3.5 cm
Maximum size of the shutter	60 × 120 cm

B. Double hung window

This window has a pair of shutters one above the other which can slide within the grooves in the frame. Two metallic weights are connected to each shutter by a cord or chain passing over pulleys. The following features regarding double hung windows should be noted.

In these windows, the shutters can be made to open to the desired extent and, hence, ventilation can be controlled. Moreover, the sliding of the shutters vertically facilitates in the cleaning of the shutter.

A special frame known as the boxed frame or cased frame is employed for sashes sliding vertically. This frame consists of two vertical members, a head and a sill, and a parting bead. The

function of the parting bead is to separate the two shutters or sashes when they are opposite to each other.

Figure 17.10 Wooden casement window

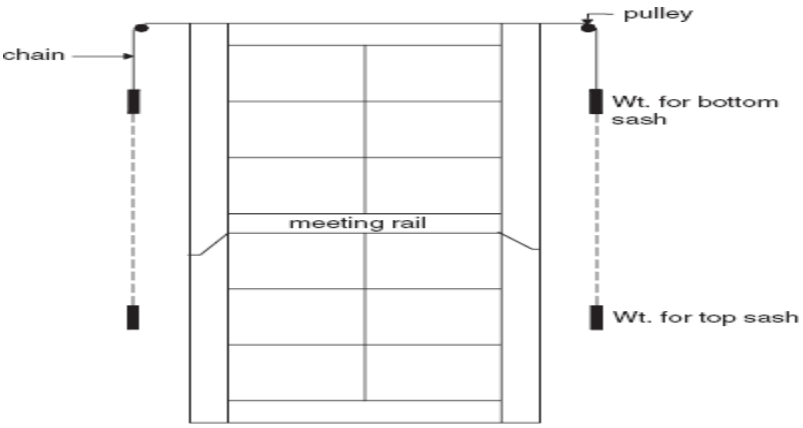

Figure 17.11 Double hung window

The shutters are constructed as usual and consist of two stiles, a top rail, a bottom rail and sash bars. The thickness of the shutters is kept to about 5 cm.

The metallic counter-weights usually of cast iron are made as heavy as the sash or shutter so that little effort is required to slide the sashes up or down (Figure 17.11).

C. Sash or glazed window

A sash consists of stiles, rails, transoms and mullions. The glass panes are cut into smaller size than the size of the panels into which they are to be fitted. It is essential to allow slight movement of the sash due to temperature changes. The sash may be rigidly fixed to the frame, hinged at the stiles or may be slided horizontally or may be pivoted to rotate horizontally or vertically. Generally, the sash is hinged to one stile and opens out to keep it watertight.

Louvered window

This window provides free passage of air and sufficient light even when closed. It affords sufficient privacy and also provides protection against excessive daylight and glare inside buildings. It may be fixed or moving type.

Metal window

In the modern age, this type of window is becoming more popular. It is fabricated from light rolled steel sections which form the window frame. The glass panes are fixed into the frame. The glazed shutter may be hung at the top, bottom, side or pivoted to rotate in any direction. The double hung type window may be fabricated with metal frames. The frame is attached to the masonry wall in grooves with cement grout. Sometimes, the timber frame and sill are used to fox up the steel shutter. Steel windows must be properly painted. The hollow metal window is fabricated by annealed steel, bronze, copper, nickel steel or galvanized steel. It is either casement type or double hung type. It is more fire resistant though more costly (Figure 17.12).

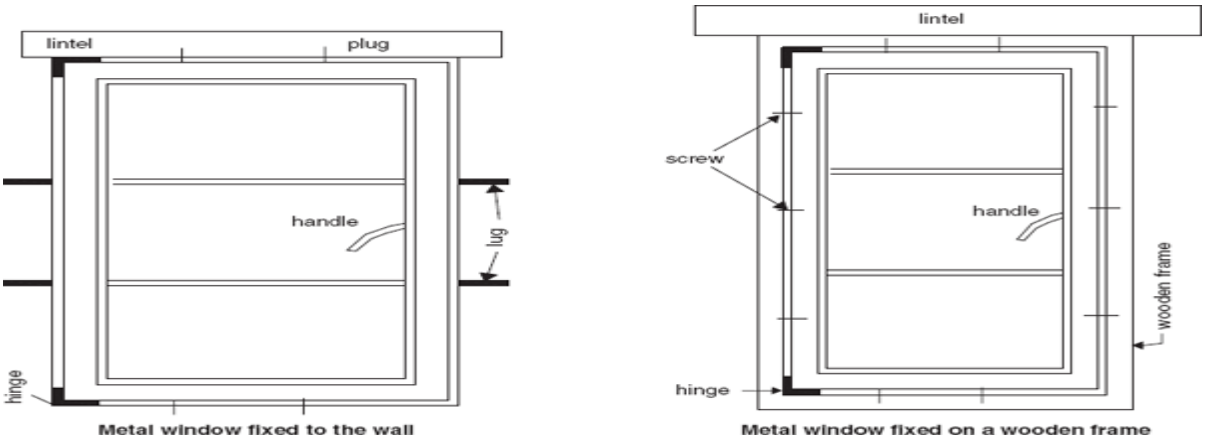

Figure 17.12 Metal window

D. Sliding window

This window works exactly on the same principle as sliding doors. It is made of shutters, which move horizontally or vertically on small roller bearings. Suitable openings or cavities are provided in the frame or walls to receive the shutters when the windows are opened out. The windows of this type are commonly used in trains, buses and counter-windows.

E. Pivoted window

In such type of windows, shutters swing around pivots. It may be horizontally pivoted or vertically pivoted. Such windows are easier to clean and they allow more light to come inside the room. The frame of this type of window is similar to that of a casement window but no rebates are made in the frame (Figure 17.13).

Bay window

It is a window in the building which is projected beyond the walls of the room. It is provided to improve the architectural appearance of the building. Additional space is obtained to allow light and air into the room.

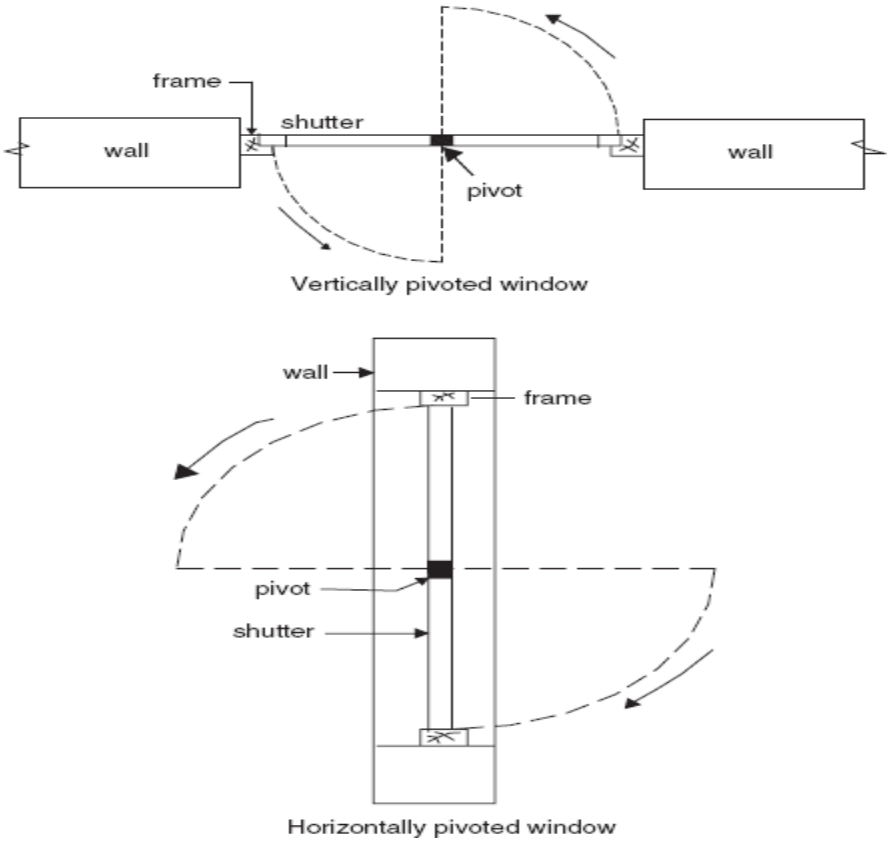

Figure 17.13 Pivoted window

F. Clere-story window

This window is usually provided near the top of the main roof and is made to open to the adjoining verandah or lean to the roof. This window is made to swing on two horizontal pivots provided in the side stiles. The shutter of the window is opened or closed by means of two cords, one from the top rail and the other from the bottom. It should be noted here that the upper part of the shutter opens to the inside of the room and the lower part opens outside. This is essential to exclude the rainwater (Figure 17.14).

G. Corner window

As the name implies, this type of window is placed in the corner of a room in a building. This window provides light and ventilation from two directions at right angles to each other and improves the appearance of the building (Figure 17.15).

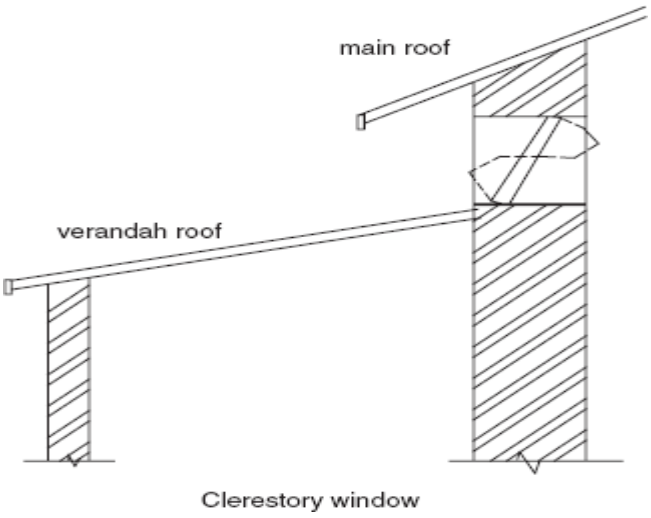

Figure 17.14 Clere-story window

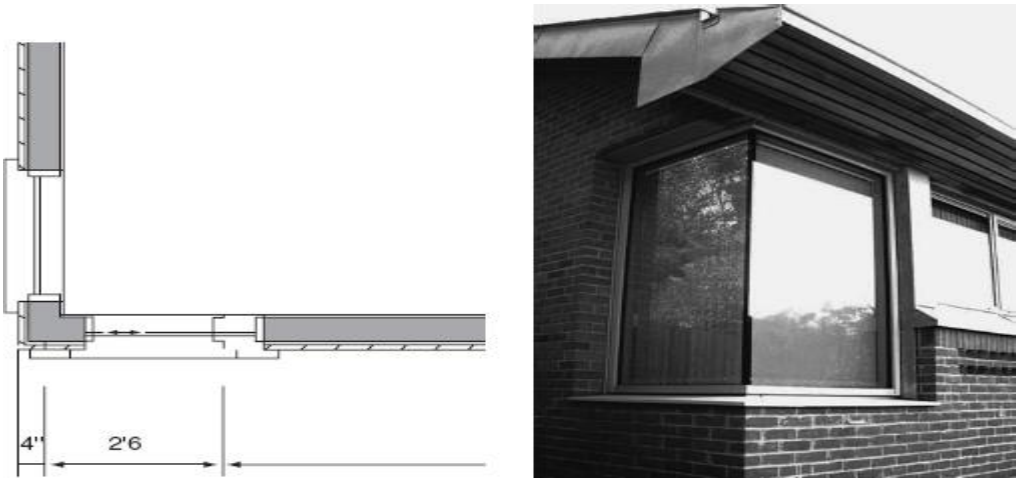

Figure 17.15 Corner window

H. Dormer window

These are the vertical windows built on the sloping sides of a pitched roof. These windows are provided to admit light and air to the rooms or the enclosed space below the roof slopes. These windows add to the appearance of the building (Figure 17.16).

I. Lantern light

Sometimes, the light entering from the windows in the walls is inadequate. In this case, some more windows are provided on the flat roofs to admit more light into the room. This type of window is known as lantern. It may be curved, rectangular or square. Generally, glass panels are used to cover the sides of the lantern. Pivoted shutters may be used when it is desired to admit air and light (Figure 17.17).

Figure 17.16 Dormer window

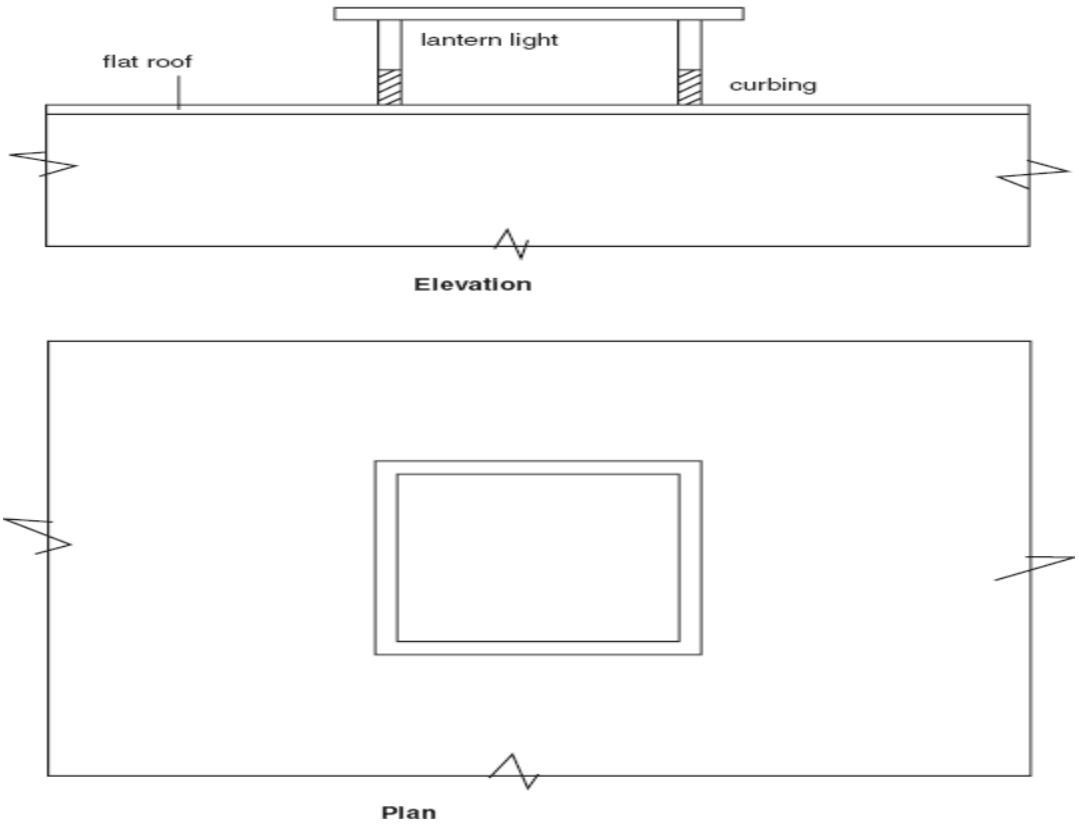

Figure 17.17 Lantern light

J. Sky light

This type of window is fixed on the sloping surface of an inclined roof. It is meant to admit light into the room and generally is fixed with glass panes to cover it. Reinforced or ribbed glass is preferred. A curb frame is provided with the common rafter to support the window (Figure 17.18).

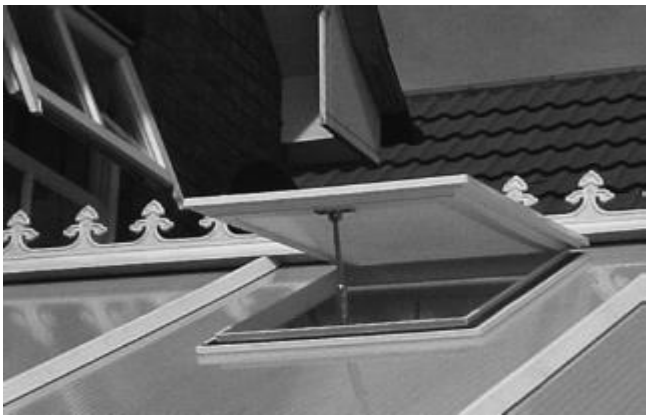

Figure 17.18 Sky light

K. Circular window

It is a window which is circular in shape and pivoted on the central axis. It is opened and closed by means of two cords, like clere-story windows. These windows are commonly used in factories and lofty rooms for admitting light and air (Figure 17.19).

Figure 17.19 Circular window

FIXTURES AND FASTENINGS FOR DOORS AND WINDOWS

The various fixtures used are:

1. Hinges
2. Bolts
3. Locks
4. Handles

The most commonly used type of hinges is the butt hinge whose length varies from 1 to 20 cm. Various other types of hinges like counter flap hinges, spring hinges and parliamentary hinges are also being used.

Barrel bolts and tower bolts are the most commonly used type and their length varies from 10 to 40 cm. Hook and eye is another type which is commonly used for windows. Hasp and staple bolt and Aldrop bolt is used where padlocks are used.

Mortice locks are used for thicker doors and are embedded in the door frame. Otherwise, pad locks are also used.