CHAPTER 1: INSTALL BUILDING DOORS AND WINDOWS

Unit of learning code: CON/CU/BUT/CR/10/6

Related Unit of Competency in Occupational Standard **Install building doors and windows**

1.1 Introduction to the unit of learning

This Unit describes the competences required to install building windows and doors. It involves preparing window and door schedules, fabricating/ordering building doors and windows, fixing building doors and windows and applying door and window finishes.

1.2 Summary of Learning Outcomes

1. Prepare door and window schedule
2. Fabricate/order doors and windows
3. Fix building doors and windows
4. Apply door and window finishes

1.1.1 Learning Outcome 1: Prepare door and window schedule

1.1.1.1 Introduction to the learning outcome

This learning outcome specifies the competencies required to prepare door and window schedules. It entails identification of windows and doors dimensions as well as preparation of specifications and schedules.

Performance Standard

1.1 Doors and window dimensions and specifications are identified based on the architectural drawings
1.2 Door and window sketches are prepared based on dimensions and specifications
1.3 Window and door schedule is prepared with quantities and quoted prices

1.1.2 Information Sheet

1.1.2.1 Definition of terms

Schedule – This is a list of different door and window sizes and types that are specified on the contract documents to ensure proper installation.

1.1.2.2 Construction dimensions

Location of doors

Doors are provided in a building to provide an excess to the inside of the room. Hence they should be located in places where movement in and out of the room won't be hindered as well as ensuring that the room gets maximum utilisation. Doors therefore are most conveniently placed at the corners of the room facing each other. This provides good ventilation as well as creating least interference with the inside arrangement of the room

Location of Windows

Factors affecting location of windows

i. Distribution and control of daylight
ii. Desired vision of outside
iii. Privacy
iv. Ventilation
v. Control of heat loss

Windows should be located opposite to each other wherever possible for ventilation purposes. An attempt should be made to get the maximum amount of light into the room. Wherever windows have to be located in residential buildings situated just near public places such as shopping centre, the privacy of the room should be considered. In such a case it would be wise to locate windows at a higher level, say about two meters above ground level.

It is desirable to locate windows above the floor level of a room in such a way that the residents can conveniently look outside. A height of 0.75 to 1 meter above floor level is recommended.

1.2.2.3 Sizes of doors and windows

Doors

Internal doors of residential buildings should not as a rule be less than 0.9×2 meter. However, the size of doors leading to bathrooms can be reduced to 0.75×2 meter. It should be aimed that two persons walking shoulder to shoulder should conveniently pass through the door. A size of 1.0×2 meter would be an average recommended standard. Doors in public places should be of larger sizes and height increased accordingly.

Doors of garages should not be less than 2.5×2.25 m.

Windows

The size of windows should be governed by the total area of window space needed.

The following criterion should be considered when designing windows.

i. Breadth of window = 1/3(width of room + height of room)
ii. There should be one square meter of window space for every 30 to 40 cubic meter of inside content of the room.
iii. Glass area in the window should be at least 15% of the floor area of the room. However, it is good practice to provide 20% of the floor area as the total glass area of the windows.

Types of doors and windows

1.2.2.4 Types of doors

1. **Wooden doors**

Advantages of Wooden Doors

Wooden door has lots of appeal and benefits given below:

- Wood is a material that is easy to work.
- Solid wooden panel PVC glass door is eco-friendly, soundproof, waterproof (suitable for coastal areas).
- We can use it as a security door, entry door or a revolving door.
- A wooden door has simple installation, smooth surface, master sculpture, and durability.
-

Disadvantages of Wooden Doors

However, the wooden door has some disadvantages too. These are :

- It needs care and maintenance to keep performing at its peak.
- A wooden door should be sealed before installation, otherwise, it might absorb moisture.
- Because of its heavy material, a wooden door may sag over time. Thus, it needs to update its hardware and frame.

Types of wooden doors

i. Battened and ledged doors

- Battens are vertical bonds which are having grooves are attached together by horizontal supports called ledges as shown in below figure.
- General Dimensions of batten are 100-150mm width and 20-30mm thick.
- General dimension of ledges are 100-200mm width and 25-30mm thick.
- This type of battened and ledged doors suitable for narrow openings.

Figure 1 iBattened and ledged door

REFERENCE

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwis69uI7qPxAhVxzoUKHaDrAnQQFjAAegQIAhAD&url=https%3A%2F%2Ftheconstructor.org%2Fbuilding%2Ftypes-of-doors%2F11898%2F&usg=AOvVaw2It2BJDBN9ZAi3NDYkQhHC

ii. Battened, ledged and braced doors

- To make more rigid, braces are provided diagonally in additional to battens and ledges as shown in figure.
- Braces are having 100-150mm width and 25-30mm thickness are preferable.
- Braces should place upwards from handing side, then they acts as struts and take compression.
- These types of doors can be used for wider openings.

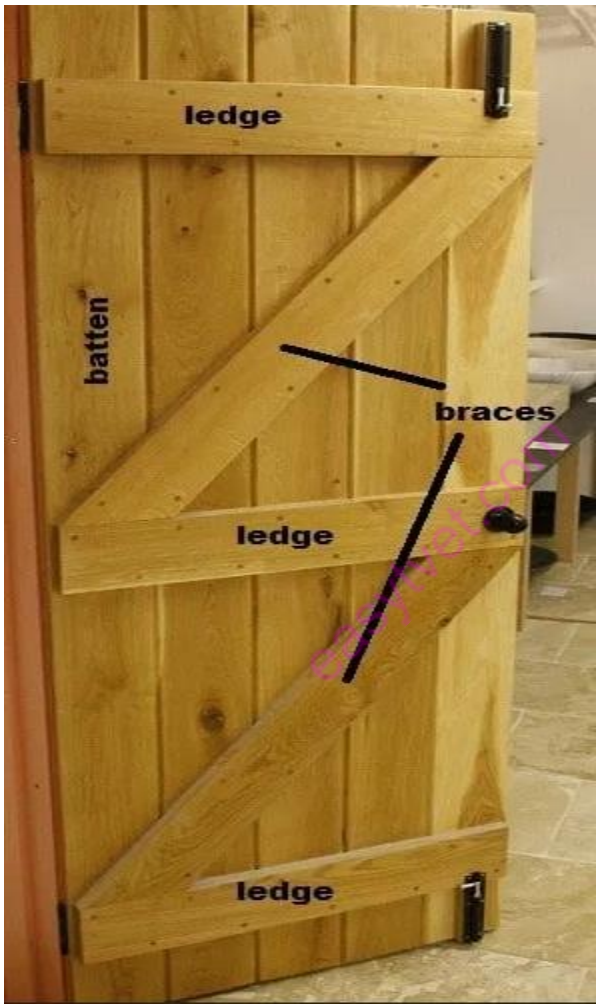

Figure 2 Battened, ledged and braced door

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iii. Battened, ledged and framed doors

- For the simple battened and ledged door, frame work is provided in the form of two verticals, known as stiles.
- Stiles are generally 100mm wide and as far as thickness is concerned, the thickness of stile should be equal to the combined thickness of ledge and batten. Preferably 40 mm.

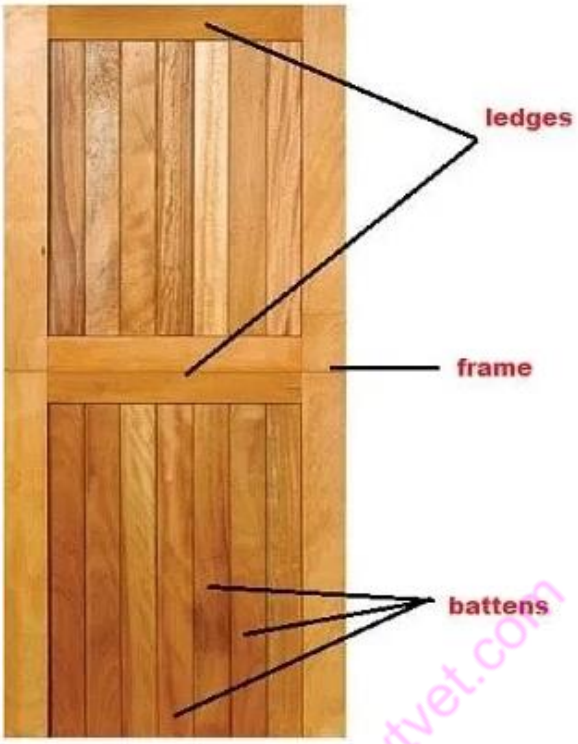

Figure 3 Battened, ledged and framed door

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iv. Battened, ledged, braced and framed doors

- In this type, the door made up of battens, ledges, stiles and braces. So, it is more rigid.
- The braces are connected diagonally between the ledges, at about 40mm from the stiles.

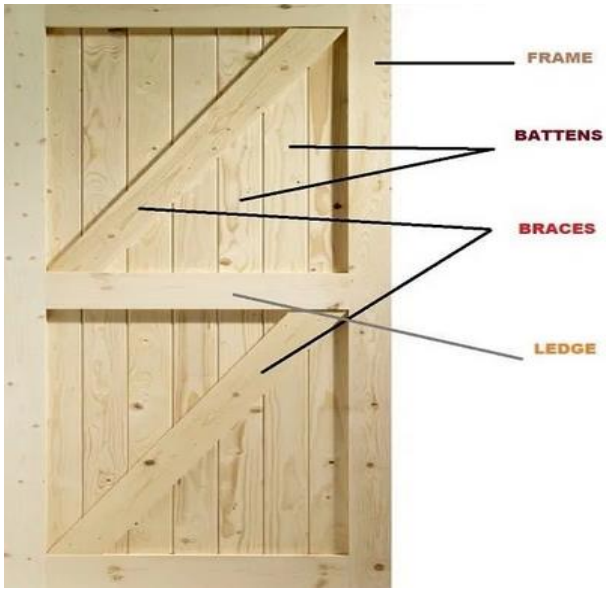

Figure 4 **Battened, ledged, braced and framed door**

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v. Framed and panelled doors

- These are very strong and will give good appearance when compared to battened doors. These are the widely used doors in almost all types of buildings.
- Stiles, vertical members and rails, horizontal members are grooved along the inner edges of frame to receive the panels.
- The panels are made up of timber or plywood or A.C. sheets or glass.
- These doors may be single leaf for narrow openings and double leaf for wider openings.
- Minimum width of stile should be 100mm and minimum width of bottom and locked rail should be 150mm.

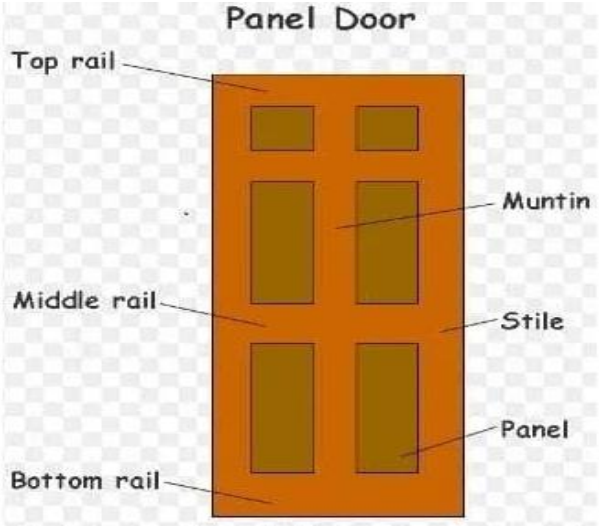

Figure 5 Framed and paneled door

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Figure 6 Framed and paneled door

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https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwis69uI7qPxAhVxzoUKHaDrAnQQFjAAegQIAhAD&url=https%3A%2F%2Ftheconstructor.org%2Fbuilding%2Ftypes-of-doors%2F11898%2F&usg=AOvVaw2It2BJDBN9ZAi3NDYkQhHC

vi. Glazed or sash doors

- Glazed doors are generally provided in interior wall openings or in hospitals, colleges etc.
- The interior of room is visible through glazed doors and light also passes through glazed portion of the door.
- These may be fully glazed or partly glazed and partly panelled. Glass panels are provided for glazed doors.

Figure 7 Glazed or sash door

REFERENCE

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwis69uI7qPxAhVxzoUKHaDrAnQQFjAAegQIAhAD&url=https%3A%2F%2Ftheconstructor.org%2Fbuilding%2Ftypes-of-doors%2F11898%2F&usg=AOvVaw2It2BJDBN9ZAi3NDYkQhHC

vii. Louvered doors

- The louvers permit natural ventilation when the door is closed and also provide privacy in the room.
- These are generally used for toilets of residential and public buildings.
- The door may be fully louvered are partly louvered.

- Louvers are made up of timber or glass or plywood and these may be either fixed or movable.

Figure 8 Louvered door

REFERENCE

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwis69uI7qPxAhVxzoUKHaDrAnQQFjAAegQIAhAD&url=https%3A%2F%2Ftheconstructor.org%2Fbuilding%2Ftypes-of-doors%2F11898%2F&usg=AOvVaw2It2BJDBN9ZAi3NDYkQhHC

viii. Wire gauzed doors

Wire gaged doors permits natural ventilation and restrict the entry of flies, mosquitoes, insects etc.. These doors are commonly used in hotels, restaurants and for cup boards containing eatables.

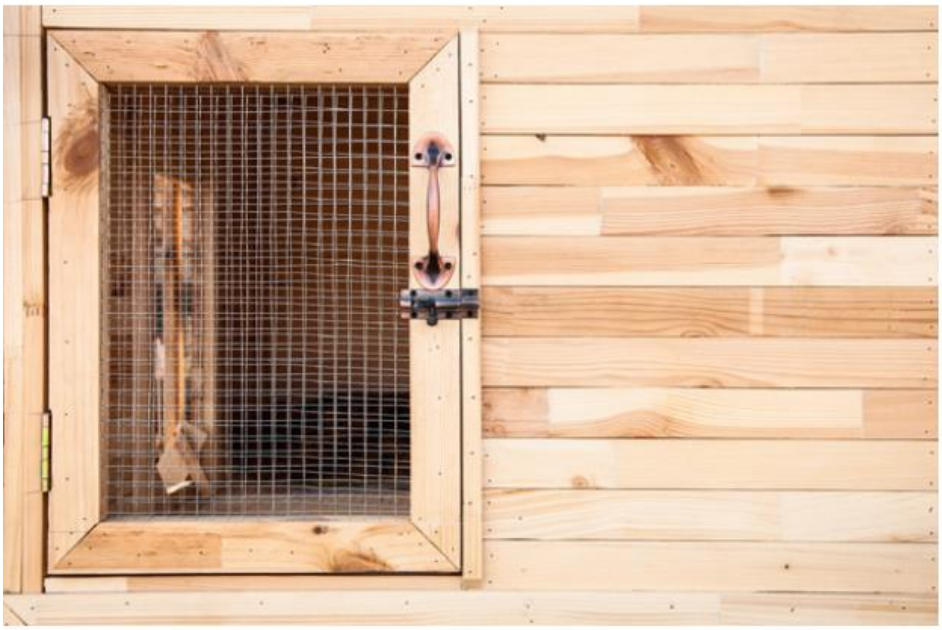

Figure 9 Wire gauzed door

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ix. **Flush doors**

Flush doors are the most common type used in the house as well as public buildings due to its pleasant appearance and simple construction. These doors have a joint less surface on both sides. Because of the plain face, they are easy to clean and decorate. The flush doors also have high strength, durability and are cheaper than the panel door. With varieties of laminates and veneers, which resembles natural wood, they look beautiful and are attractive appealing and available to a wide range of choices.

Figure 10 Flush door

REFERENCE

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwis69uI7qPxAhVxzoUKHaDrAnQQFjAAegQIAhAD&url=https%3A%2F%2Ftheconstructor.org%2Fbuilding%2Ftypes-of-doors%2F11898%2F&usg=AOvVaw2It2BJDBN9ZAi3NDYkQhHC

There are two types of Flushed doors:

Solid Core or Laminated Core Flush Door

- The core part in solid core flush door consists of core strips of timber which are glued under high pressure condition. Similarly in the laminated core, battens of 25mm width are glued under high pressure.
- These doors consist of wooden frame with stiles and rails for holding the core.
- Finally plywood sheets or face veneer and cross-bands are glued under pressure on both sides of doors.

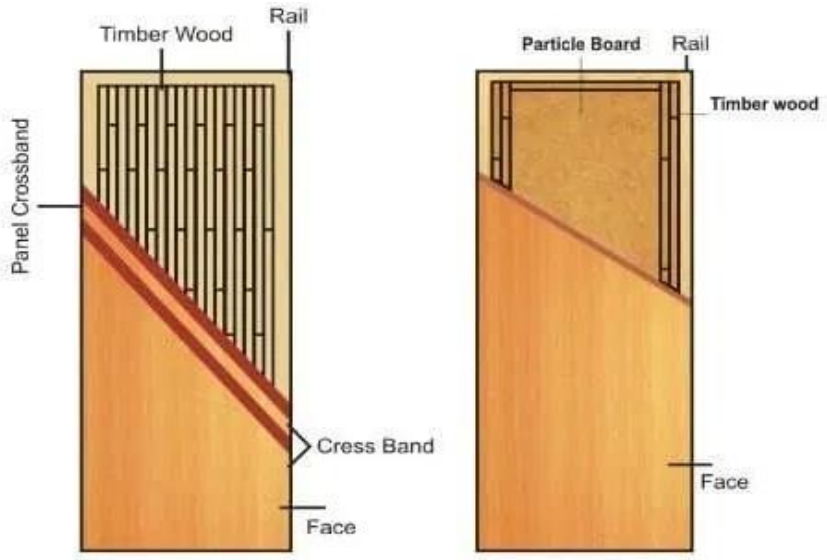

Figure 11Solid Core or Laminated Core Flush Door

REFERENCE

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwis69uI7qPxAhVxzoUKHaDrAnQQFjAAegQIAhAD&url=https%3A%2F%2Ftheconstructor.org%2Fbuilding%2Ftypes-of-doors%2F11898%2F&usg=AOvVaw2It2BJDBN9ZAi3NDYkQhHC

Hollow core and cellular core flush door

- In this case also stiles and rails are provided for frame. But, a minimum of two intermediate rails should be provided.
- The inner space of door consists of equally space battens of width 25mm each. Other space is called void space which does not exceed 40% of the area of door.
- Here also face veneer and cross-bands are glued under high pressure.

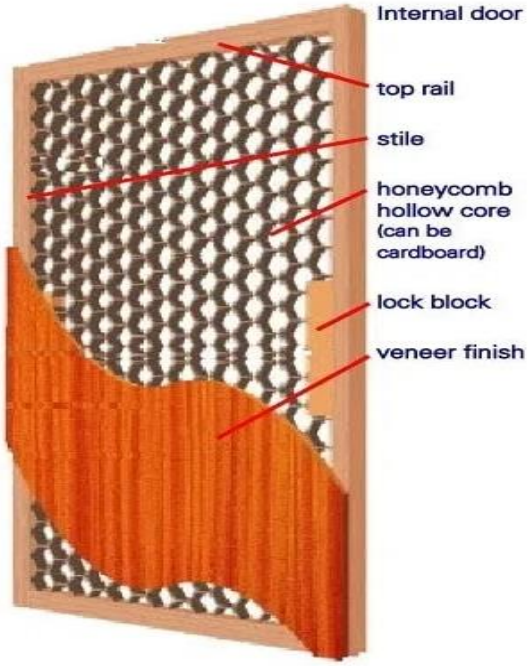

Figure 12 Hollow core and cellular core flush door

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2. Metal doors

Advantages of Metal Doors

Metal door provides the following benefits -

- This door is effortless to handle.
- It can only be placed on a door frame with durability and easy installation.
- Having windstorm resistant component, it can be as aristocratic as a wooden door.
- The metal door comes in various forms. Fire rated metal door is a great way to include extra light in a room, providing additional security.
- Sheet metal door is a hinged door made of metal fragments with a lock and a lock code.
- It is sturdy with various designs and patterns, also chemical resistant.
- Real wood texture effects are the reason behind the success of a metal door.
- Using paints, we can keep it for a long time.
- As the price is not high, all classes of people can afford it.

Disadvantages of Metal Doors

The disadvantages of a metal door are -

- It has a rusting problem.
- It cannot give an architectural view.
- This might be heavy in weight.

Types of metal doors

i. Hollow metal doors

Hollow steel sections are used to make these doors. The rails and stiles etc., are strengthened by welding small T or I sections inside.

Figure 13Hollow metal door

REFERENCE

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwis69uI7qPxAhVxzoUKHaDrAnQQFjAAegQIAhAD&url=https%3A%2F%2Ftheconstructor.org%2Fbuilding%2Ftypes-of-doors%2F11898%2F&usg=AOvVaw2It2BJDBN9ZAi3NDYkQhHC

ii. Steel plate doors

- The door frame is made up of angle or T-sections.
- Shutter is made up of frame of angle of iron, having 2 verticals at least 3 horizontal.
- Mild steel plates are welded to the shutter frame.

Figure 14Steel plate door

REFERENCE

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwis69uI7qPxAhVxzoUKHaDrAnQQFjAAegQIAhAD&url=https%3A%2F%2Ftheconstructor.org%2Fbuilding%2Ftypes-of-doors%2F11898%2F&usg=AOvVaw2It2BJDBN9ZAi3NDYkQhHC

iii. Corrugated steel doors

These are same as mild steel sheet doors, but in place of mild steel sheet corrugated steel sheet is welded.

Figure 15 Corrugated steel door

REFERENCE

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwis69uI7qPxAhVxzoUKHaDrAnQQFjAAegQIAhAD&url=https%3A%2F%2Ftheconstructor.org%2Fbuilding%2Ftypes-of-doors%2F11898%2F&usg=AOvVaw2It2BJDBN9ZAi3NDYkQhHC

iv. Rolling shutters

Rolling steel shutter doors are commonly used for warehouses, garages, shops etc.. These are very strong and offer proper safety to the property. The door consists frame, drum and a shutter of thin steel plate inter locked together. A horizontal shaft is provided in the drum which helps to open or close the shutter.

Figure 16 Rolling shutters

REFERENCE

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwis69uI7qPxAhVxzoUKHaDrAnQQFjAAegQIAhAD&url=https%3A%2F%2Ftheconstructor.org%2Fbuilding%2Ftypes-of-doors%2F11898%2F&usg=AOvVaw2It2BJDBN9ZAi3NDYkQhHC

v. Collapsible doors

Collapsible steel doors are generally used for workshops, sheds, warehouses etc.. It acts like a steel curtain which will be opened or closed by horizontal pull or push. Vertical double channel units of (20x10x2 mm) are spaced at 100 to 120 mm thick and are braced flat iron diagonals 10 to 20mm wide and 5mm thick.

Figure 17 Collapsible doors

REFERENCE

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwis69uI7qPxAhVxzoUKHaDrAnQQFjAAegQIAhAD&url=https%3A%2F%2Ftheconstructor.org%2Fbuilding%2Ftypes-of-doors%2F11898%2F&usg=AOvVaw2It2BJDBN9ZAi3NDYkQhHC

3. **Composite doors**

   A composite door is a new invention which is depicted with the modernistic door technology. Lately, it has become the alternative to wooden, steel or UPVC door. It's not made from a single substance. Instead, it is made using a combination of material like PVC, wood, muffled foam and glass reinforced plastic (GRP). In most cases, it is made from fiberglass

Advantages of Composite Doors

A composite door is prominent for its special features-

- Composite doors are strong and sturdy. As the name might suggest, composite doors are made out of a selection of materials, including rigid polyurethane, uPVC, and GRP. These materials make the door far stronger and sturdier than a traditional PVC door.
- Wide variety of designs
- Highly aesthetic
- Composite doors are more thermally efficient
- Safe and secure. Composite doors come with additional locking options which can give you piece of mind.

Disadvantages of Composite Doors

In spite of having so many advantages, Composite Door has some problems too which regard the following-

- Tend to be more expensive than the other doors.
- Although they mimic wood, they still not boast of the natural wood texture.

Types of composite doors

i. Revolving doors - A revolving door consists of three or four stiff upright sections hanging on a mid-shaft and rotates around a vertical axis. It allows a large number of people to pass in and out only by a gentle push.

Figure 18 Revolving doors

REFERENCE

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwis69uI7qPxAhVxzoUKHaDrAnQQFjAAegQIAhAD&url=https%3A%2F%2Ftheconstructor.org%2Fbuilding%2Ftypes-of-doors%2F11898%2F&usg=AOvVaw2It2BJDBN9ZAi3NDYkQhHC

ii. Sliding doors - A sliding door is an elegant aesthetic to any home or places providing euphony. Sliding door opens crosswise by sliding which is parallel to the wall. It has a horizontal mechanism. Slide door is also known as “Patio Door”. It is commonly used as shower door, glass door, and screen door or in vans. It permits people to both enter and leaves. It is usually considered a single unit which consists two-panel sections. A sliding door is usually made of wood, aluminum, stainless steel but it appears in its best form when it is made from UPVC plastic glass

Figure 19 Sliding doors

REFERENCE

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwis69uI7qPxAhVxzoUKHaDrAnQQFjAAegQIAhAD&url=https%3A%2F%2Ftheconstructor.org%2Fbuilding%2Ftypes-of-doors%2F11898%2F&usg=AOvVaw2It2BJDBN9ZAi3NDYkQhHC

iii. Telescopic doors – this is a door made up of leaves that slide one in front of the other to lodge itself into a reduced retraction space on the side when it opens. They are ideal for small, partitioned areas with liitle space behind the leaves

Figure 20 Telescopic door

REFERENCE

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwis69uI7qPxAhVxzoUKHaDrAnQQFjAAegQIAhAD&url=https%3A%2F%2Ftheconstructor.org%2Fbuilding%2Ftypes-of-doors%2F11898%2F&usg=AOvVaw2It2BJDBN9ZAi3NDYkQhHC

Factors determining the choice of doors:

1. It must satisfy the intended function
2. Ensure privacy, safety and security
3. Easy to make and use
4. Aesthetic look and appearance
5. Future repairs and maintenance
6. Budget
7. Durability
8. Fire resistance,
9. Insulation properties

Types of windows

1. Fixed Windows

Fixed windows are fixed to the wall without any closing or opening operation. In general, they are provided to transmit the light into the room. Fully glazed shutters are fixed to the window frame. The shutters provided are generally weatherproof

Figure 21 Fixed Windows

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2. Sliding Windows

In this case, window shutters are movable in the frame. The movement may be horizontal or vertical based on our requirements. The movement of shutters is done by the provision of roller bearings. Generally, this type of window is provided in buses, bank counters, shops, etc

Figure 22 Sliding Windows

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3. Pivoted Windows

In this type of windows, pivots are provided to window frames. Pivot is a shaft which helps to oscillate the shutter. No rebates are required for the frame. The swinging may either horizontal or vertical based on the position of pivots

Figure 23 Pivoted Windows

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4. Double Hung Windows

Double hung windows consist of pair of shutters attached to one frame. The shutters are arranged one above the other. These two shutters can slide vertically with in the frame. So, we can open the windows on top or at bottom to our required level.

Figure 24 Double Hung Windows

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjX8rLh76PxAhVNxhoKHaSkA7UQFjAGegQIAhAD&url=https%3A%2F%2Ftheconstructor.org%2Fbuilding%2Ftypes-of-windows%2F12776%2F&usg=AOvVaw1DOUBYeM_FkHvfw1o9Yjbl

5. Louvered Windows

Louvered windows are similar to louvered doors which are provided for the ventilation without any outside vision. The louvers may be made of wood, glass or metal. Louvers can also be folded by provision of cord over pulleys. We can maintain the slope of louvers by tilting cord and lifting cord.

Recommended angle of inclination of louvers is about 45^{o}. The sloping of louvers is downward to the outside to run-off the rain water. Generally, they are provided for bathrooms, toilets and privacy places etc

Figure 25 Louvered Windows

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjX8rLh76PxAhVNxhoKHaSkA7UQFjAGegQIAhAD&url=https%3A%2F%2Ftheconstructor.org%2Fbuilding%2Ftypes-of-windows%2F12776%2F&usg=AOvVaw1DOUBYeM_FkHvfw1o9Yjbl

6. Casement Windows

Casement windows are the widely used and common windows nowadays. The shutters are attached to frame and these can be opened and closed like door shutters. Rebates are provided to the frame to receive the shutters. The panels of shutters may be single or multiple. Sometimes wired mesh is provided to stop entering of flies.

Figure 26 Casement Windows

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjX8rLh76PxAhVNxhoKHaSkA7UQFjAGegQIAhAD&url=https%3A%2F%2Ftheconstructor.org%2Fbuilding%2Ftypes-of-windows%2F12776%2F&usg=AOvVaw1DOUBYeM_FkHvfw1o9Yjbl

7. Metal Windows

Generally mild steel is used for making metal windows. These are very cheap and have more strength. So, now days these are widely using especially for public buildings, private building etc. Some other metals like aluminum, bronze, stainless steel etc. also used to make windows. But they are costly compared to mild steel windows. For normal casement windows also, metal shutters are provided to give strong support to the panels.

Figure 27 Metal Windows

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjX8rLh76PxAhVNxhoKHaSkA7UQFjAGegQIAhAD&url=https%3A%2F%2Ftheconstructor.org%2Fbuilding%2Ftypes-of-windows%2F12776%2F&usg=AOvVaw1DOUBYeM_FkHvfw1o9Yjbl

8. Sash Windows

Sash window is type of casement window, but in this case panels are fully glazed. It consists top, bottom and intermediate rails. The space between the rails is divided into small panels by mean of small timber members called sash bars or glazing bars.

Figure 28 Sash Windows

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjX8rLh76PxAhVNxhoKHaSkA7UQFjAGegQIAhAD&url=https%3A%2F%2Ftheconstructor.org%2Fbuilding%2Ftypes-of-windows%2F12776%2F&usg=AOvVaw1DOUBYeM_FkHvfw1o9Yjbl

9. Corner Windows

As in the name itself corner windows are provided at the corners of room. That means corner window has two faces in perpendicular directions. By providing this type of windows, light or air can be entered into room in two different directions.

To provide this type of window special lintel is provided in the wall. Corner windows will give aesthetic appearance to the building

Figure 29 Corner Windows

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjX8rLh76PxAhVNxhoKHaSkA7UQFjAGegQIAhAD&url=https%3A%2F%2Ftheconstructor.org%2Fbuilding%2Ftypes-of-windows%2F12776%2F&usg=AOvVaw1DOUBYeM_FkHvfw1o9Yjbl

10. Bay Windows

Bay windows are projected windows form wall which are provided to increase the area of opening, which enables more ventilation and light form outside. The projection of bay windows are of different shapes. It may be triangular or rectangular or polygonal etc. They give beautiful appearance to the structure

Figure 30 Bay Windows

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjX8rLh76PxAhVNxhoKHaSkA7UQFjAGegQIAhAD&url=https%3A%2F%2Ftheconstructor.org%2Fbuilding%2Ftypes-of-windows%2F12776%2F&usg=AOvVaw1DOUBYeM_FkHvfw1o9Yjbl]

11. Dormer Windows

Dormer windows are provided for sloped roofs. These are projected from the sloping surface as shown in below image. They provide ventilation as well as lighting to the room. They also enhance aesthetic sense of room

Figure 31 Dormer Windows

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjX8rLh76PxAhVNxhoKHaSkA7UQFjAGegQIAhAD&url=https%3A%2F%2Ftheconstructor.org%2Fbuilding%2Ftypes-of-windows%2F12776%2F&usg=AOvVaw1DOUBYeM_FkHvfw1o9Yjbl

12. Clerestory Windows

If the rooms in a building are of different ceiling heights, clerestory windows are provided for the room which has greater ceiling height than the other rooms. The shutters are able to swing with the help of cord over pulleys. This also enhances the beauty of building.

Figure 32 Clerestory Windows

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjX8rLh76PxAhVNxhoKHaSkA7UQFjAGegQIAhAD&url=https%3A%2F%2Ftheconstructor.org%2Fbuilding%2Ftypes-of-windows%2F12776%2F&usg=AOvVaw1DOUBYeM_FkHvfw1o9Yjbl

13. Lantern Windows

Lantern windows are provided for over the flat roofs. The main purpose of this window is to provide the more light and air circulation to the interior rooms. Generally, they are projected from the roof surface so, we can close the roof surface when we required

Figure 33 Lantern Windows

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjX8rLh76PxAhVNxhoKHaSkA7UQFjAGegQIAhAD&url=https%3A%2F%2Ftheconstructor.org%2Fbuilding%2Ftypes-of-windows%2F12776%2F&usg=AOvVaw1DOUBYeM_FkHvfw1o9Yjbl

14. Gable Windows

Gable windows are provided for sloped roof buildings. These windows are provided at the gable end of sloped roof so; they are called as gable windows. They also improve the appearance of building.

Figure 34 Gable Windows

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjX8rLh76PxAhVNxhoKHaSkA7UQFjAGegQIAhAD&url=https%3A%2F%2Ftheconstructor.org%2Fbuilding%2Ftypes-of-windows%2F12776%2F&usg=AOvVaw1DOUBYeM_FkHvfw1o9Yjbl

15. Ventilators

Ventilators are provided for the purpose of ventilation in the room. They are provided at greater height than windows nearer to roof level. It is in very small size. Horizontally pivoted shutters are provided for ventilators. Sometimes shutter is replaced by wired mesh, in this case sunshade is provided to prevent against rain water

Figure 35 Ventilators

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjX8rLh76PxAhVNxhoKHaSkA7UQFjAGegQIAhAD&url=https%3A%2F%2Ftheconstructor.org%2Fbuilding%2Ftypes-of-windows%2F12776%2F&usg=AOvVaw1DOUBYeM_FkHvfw1o9Yjbl

16. Skylights

Skylights or generally provided on the top of sloped roofs. To admit light into the rooms, sky lights are provided. It is provided parallel to the sloping surface. Sky lights can be opened when we required. Lead gutters are arranged to frame to make it as waterproof

Figure 36 Skylights

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjX8rLh76PxAhVNxhoKHaSkA7UQFjAGegQIAhAD&url=https%3A%2F%2Ftheconstructor.org%2Fbuilding%2Ftypes-of-windows%2F12776%2F&usg=AOvVaw1DOUBYeM_FkHvfw1o9Yjbl

Door and window detailing

Window details

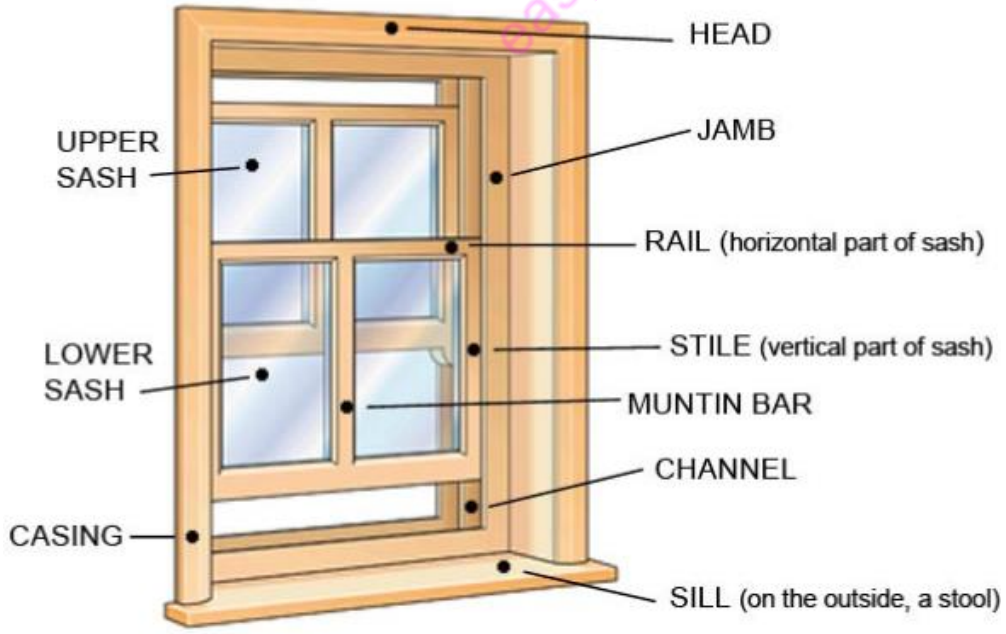


Figure 37 Window details

https://www.google.com/url?sa=i&url=https%3A%2F%2Fkimberlypainting.com%2Fservices%2Fwindow-repair%2F&psig=AOvVaw1pPPs1WLov1zKV_suBzB40&ust=1624198506280000&source=images&cd=vfe&ved=0CAoQjRxqFwoTCNiW0ozxo_ECFQAAAAAdAAAAABAD

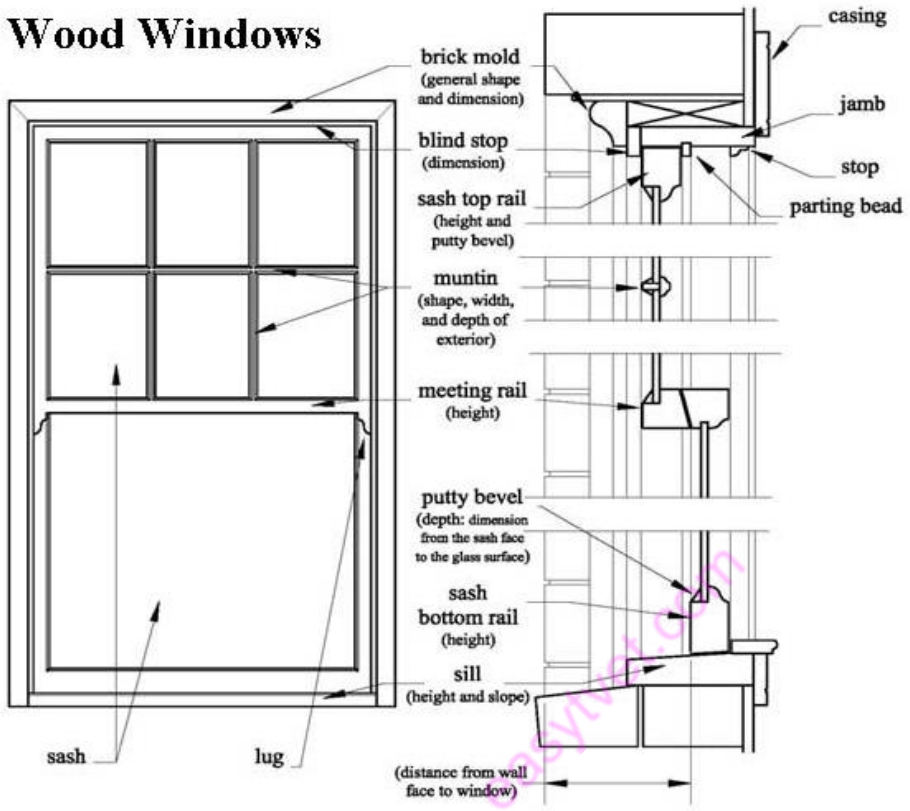


Figure 38 Wood window details

https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.wdma.com%2Fthe-window-glossary&psig=AOvVaw1pPPs1WLov1zKV_suBzB40&ust=1624198506280000&source=images&cd=vfe&ved=0CAoQjRxqFwoTCNiW0ozxo_ECFQAAAAAdAAAAABAJ

Door details

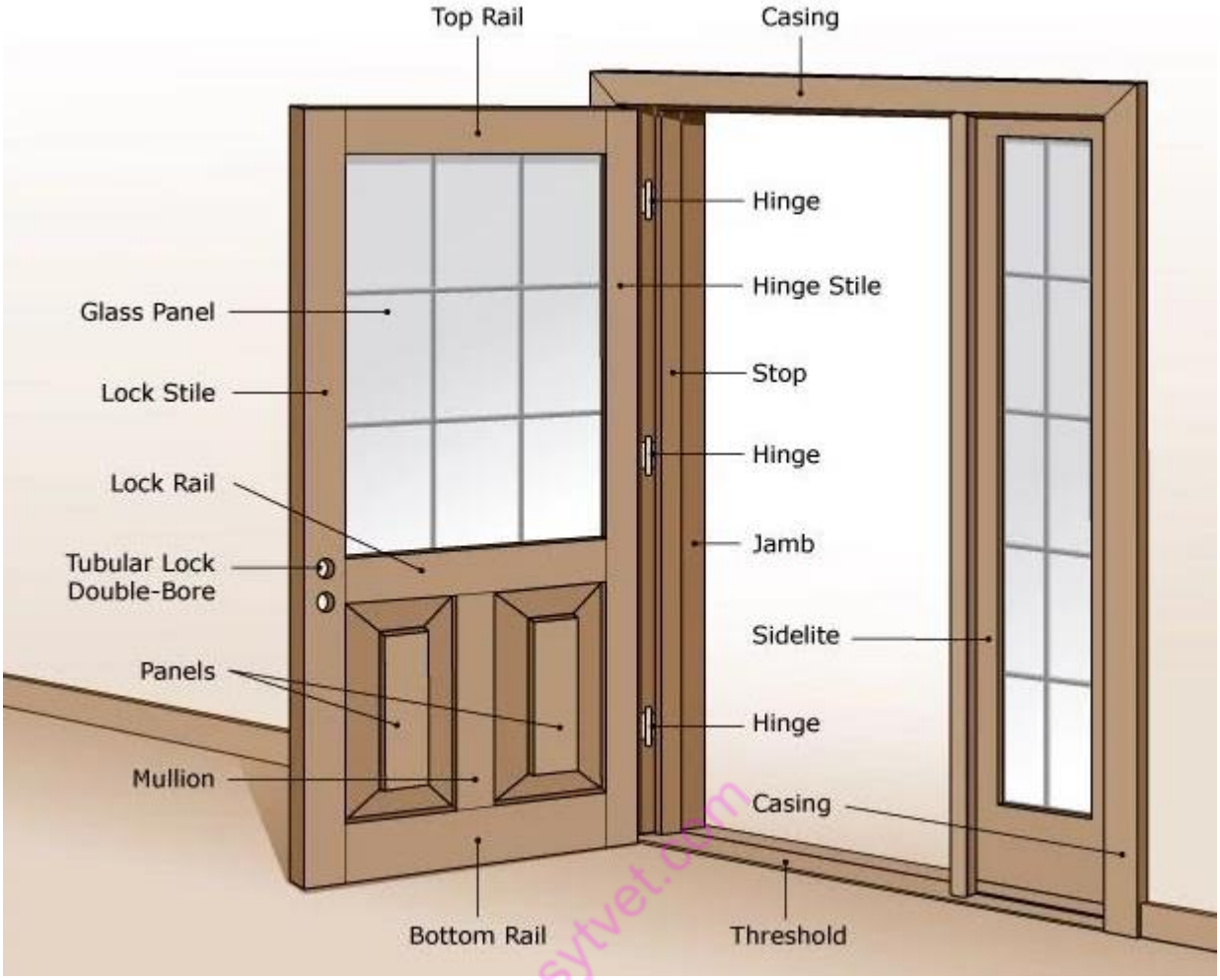


Figure 39 Door details

https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.anatomynote.com%2Fbuilding-houseware-tools%2Fbuilding-parts%2Fdoor-parts-name%2F&psig=AOvVaw3QNDpHehglLRPHC5KONSIl&ust=1624198795507000&source=images&cd=vfe&ved=0CAoQjRxqFwoTCOjes5Tyo_ECFQAAAAAdAAAAABAU

Window and door schedule format

The term 'schedule' simply refers to a list. That can be a list of items, activities, events, information, and so on. Schedules may be appended to other documents, such as contracts. Window and door schedules are a convenient way of presenting complex information about the different door and window sizes and types that are specified on the contract documents to ensure proper installation. Drawings may refer to window and door schedules by use of a code corresponding to a door or window type on the schedule.

A door schedule is a document, which has all the information a joiner will require in selecting the correct door for a designated position, as well as the correct ironmongery that has to be fitted to each door

Typical information contained on a door schedule might include:

- Code number (which corresponds with the drawings).
- Name.
- Style.
- Number required.
- Size (width, height, thickness).
- Material.
- Composition.
- Colour and finish.
- Style of hardware.
- Hinges, locks, handles, push plates, pull handles, kicker plates, vision panels, stops, closers and so on.
- Weight.
- Fire rating.
- Acoustic rating.
- Manufacturer
- Product series.
- Other remarks.

Schedules may also include a simple elevation illustrating the overall composition of the door or window**.**

1.1.3 Learning Activities

1.1.3.1 Practical assessment

You are required to complete the following tasks

1. Prepare a door schedule
2. Prepare a window schedule

1.1.3.2 Resource Requirements

1. A fully functional workshop
2. Trained quality control staff
3. Computers
4. Calculators

1.1.3.3 Self-Assessment questions

1. What is a door?
2. Which are some functional requirements of doors?
3. What criteria would you use to choose the type of door to install in a building?
4. What are some popular types of wooden doors?
5. What is a door/window schedule?
6. Which details would you include in a door/window schedule?
7. Using a well labelled sketch illustrate door details.
8. Which criterion would you use when designing a window?
9. Windows come in a variety of sizes and shapes. Which are some of these types?
10. Which unique advantages do metal doors have over wooden doors?

1.1.3.4 Response to self-assessment questions

1. What is a door?
   A door is a hinged or otherwise movable barrier that allows entry into or exit out of an enclosure
2. Which are some functional requirements of doors?
   a. **Security – prevention of unauthorised entry**
   b. **Privacy**
   c. **Strength and stability**
   d. **Resistance to weather**
   e. **Durability**
   f. **Fire safety**
   g. **Thermal insulation**
   h. **Sound insulation**
   i. **Aesthetics**
3. What criteria would you use to choose the type of door to install in a building?
   a. **Functionality**
   b. **Privacy**
   c. **Safety**

d. **Security**
e. **Ease of use**
f. **Aesthetic look and appearance**
g. **Future repairs and maintenance**
h. **Budget**
i. **Durability**
j. **Fire resistance,**
k. **Insulation properties**

4. What are some popular types of wooden doors?
   a. **Flush doors**
   b. **Battened and ledged doors**
   c. **Battened, braced and framed doors**
   d. **Panelled doors**
   e. **Glazed doors**
5. What is a door/window schedule?
   This is a list of different door and window sizes and types that are specified on the contract documents to ensure proper installation
6. Which details would you include in a door/window schedule?
   - **Code number (which corresponds with the drawings).**
   - **Name.**
   - **Style.**
   - **Number required.**
   - **Size (width, height, thickness).**
   - **Material.**
   - **Composition.**
   - **Colour and finish.**
   - **Style of hardware.**
   - **Hinges, locks, handles, push plates, pull handles, kicker plates, vision panels, stops, closers and so on.**
   - **Weight.**
   - **Fire rating.**
   - **Acoustic rating.**
   - **Manufacturer**
   - **Product series.**

7. Using a well labelled sketch illustrate door details.

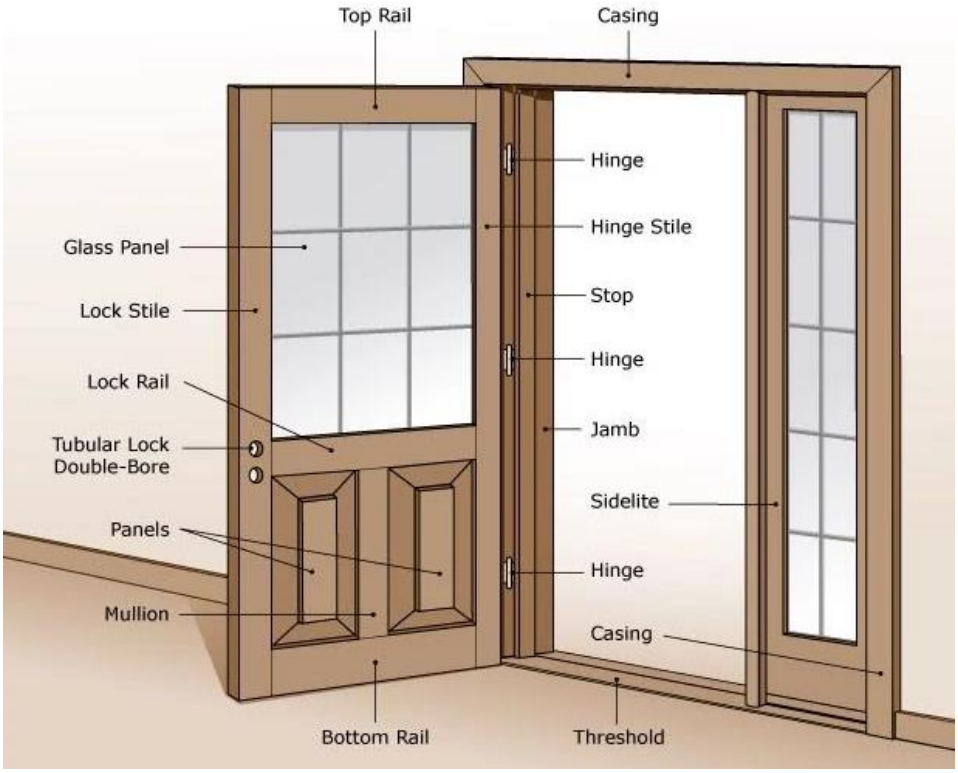


Figure 40 Door details

https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.anatomynote.com%2Fbuilding-houseware-tools%2Fbuilding-parts%2Fdoor-parts-name%2F&psig=AOvVaw3QNDpHehglLRPHC5KONSll&ust=1624198795507000&source=images&cd=vfe&ved=0CAoQjRxqFwoTCOjes5Tyo_ECFQAAAAAdAAAAABAU

8. Which criterion would you use when designing a window?
    - **Breadth of window = 1/3(width of room + height of room)**
    - **There should be one square meter of window space for every 30 to 40 cubic meter of inside content of the room.**
    - **Glass area in the window should be at least 15% of the floor area of the room.**
9. Windows come in a variety of sizes and shapes. Which are some of these types?
    a. **Sash windows**
    b. **Louvered windows**
    c. **Bay windows**
    d. **Dormer windows**
    e. **Casement windows**
10. Which unique advantages do metal doors have over wooden doors?
    a. **Strength – metal doors are stronger**

b. Durability – metal doors last longer

Tools, Equipment, Supplies, and Materials

Tools and equipment

- Computers
- Calculators

Materials and supplies

- Stationery
- Files
- Journals
- Manuals
- Resource persons

1.1.4 References

1. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiYjaDR5_XuAhUPKBoKHZxIBw4QFjANegQIExAD&url=https%3A%2F%2Fwww.designingbuildings.co.uk%2Fwiki%2FWindow_and_door_schedules&usg=AOvVaw3ngWtwrgJkA9vJcXUuHmiV
2. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjAqoKStvbuAhVvDWMBHX4yDGYQFjAQegQIMxAD&url=https%3A%2F%2Ftheconstructor.org%2Fbuilding%2Ftypes-of-doors%2F11898%2F&usg=AOvVaw2It2BJDBN9ZAi3NDYkQhHC

1.2.1 Learning Outcome 2 Fabricate/order doors and windows

1.2.1.1 Introduction to the learning outcome

This learning outcome specifies the competencies required to fabricate doors and windows.

Performance Standard

2.1 Door and window specifications are obtained from door and window schedule and architectural plan
2.2 Doors and windows are fabricated and ordered as per set procedures
2.3 Doors and windows are delivered to the site as per standard operating procedures

1.2.1.2 Information Sheet

1.2.1.2.1 Definition of terms

Specifications – this is a detailed description of the design and materials to make something

1.2.1.2.2 Door specifications

Example 1

PRODUCT SPECIFICATION

1) Door Leaf Construction

Door leaf is constructed with 1.2mm thick Electro-Galvanised Steel. The front and bottom panels are formed into a 'U' shape with steel stiffeners stitch welded on the front panel at 300mm part. The front and bottom panels are interlocked and spots welded on the edges and at the top and bottom channel cover. Hinge plates and reinforce doors closer plates are tack welded in position internally.

2) Door Frame Construction

Door Frames of single or double rebates are formed with 1.5mm thick Electro-Galvanised Steel, welded 90 degree at the top and side jambs. Reinforced steel plates for door closer and selector bar are welded on the top jamb. A temporary bar is tack welded at the bottom for installation purpose.

3) Door sizes (maximum)

Single Leaf : Overall Dimension 1088mm (width) x 2400mm (height) x 45mm (thick)

Double Leaf : Overall Dimension 22600mm (width) x 2400mm (height) x 45mm (thick)

4) Fire Seal

Ceramic fibre tape - - used on vision panels

5) Accessories

Vision Panel - 150mm (width) x 300mm (height) size, 1200mm from floor level, enclosed with steel Architrave.

6) Ironmongeries

Hinges – Stainless Steel 127mm x 89mm x 3mm (thick)

Lockset – ADH Cylindrical Lockset or equivalent. Door closer – TS 83 Dorma or equivalent.

Flush Bolt – Stainless Steel 172mm by 26mm length.

7) Type of Door Finish

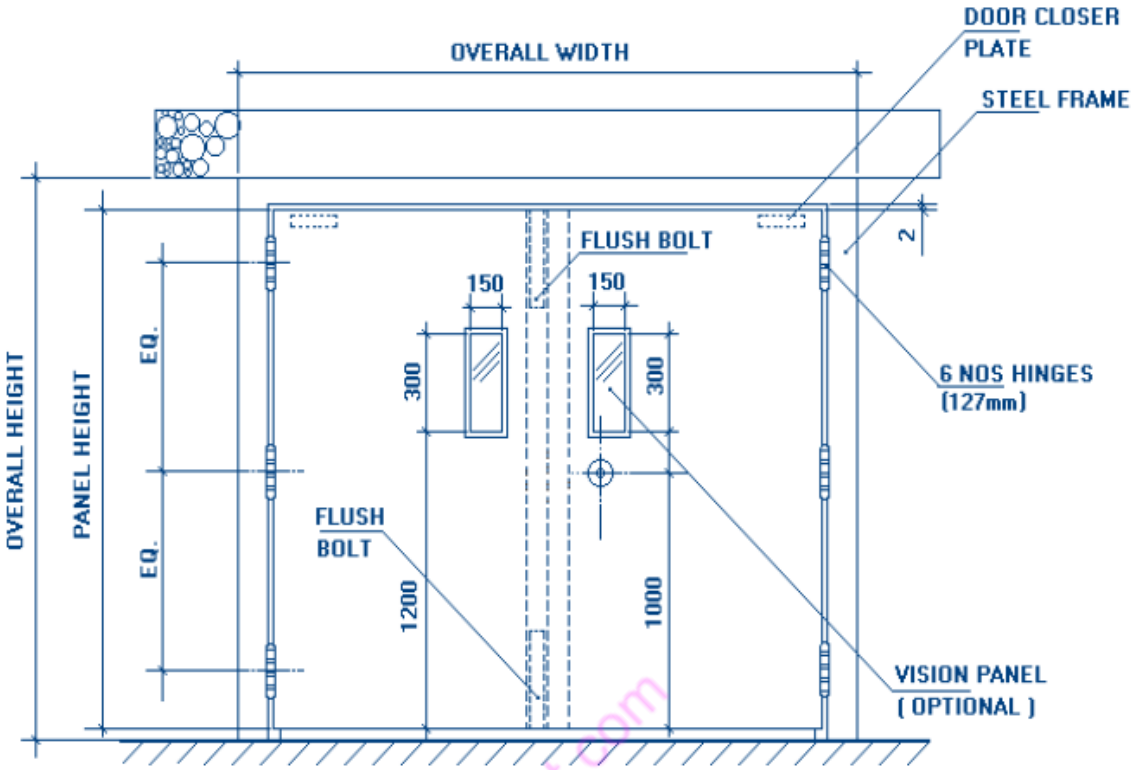
Spray Paint or Powder Coated

Vinyl Laminate

8) Test Report Number

WARRES No. 100357 (4 hour)

Table 1 Door specifications



1.2.1.2.2 Windows specifications

Example 1

Aluminium Casement windows

a. Specs:
   1) AAMA Designation: C-HC100; C-AW100
   2) ASTM F 588 (Forced Entry) Grade 10
   3) U-Value 0.43
   4) Water Resistance: 15 PSF
b. Size Limitations:
   1) With roto operators - Minimum Size 16 inches wide by 24 inches high. Maximum Size 36 inches wide by 60 inches high.
c. Flat Screens: Frame shall be constructed of 6063 T-5 alloy extruded aluminum.
   1) Fiberglass 18x16 Mesh
   2) Aluminum 18x16 Mesh

d. Hardware:
   1) Standard: Cam handles and 4-bar stainless steel balanced arms.
   2) Optional: Concealed 4-bar stainless steel balanced arms or egress hinges, cam handles, custodial locks, friction adjustors, limited opening devices, limit stops or screens as specified.

Example 2

Aluminium fixed window

a. Specs:
   1) AAMA Designation: F-HC100; F-AW100
   2) ASTM F 588 (Forced Entry) Grade 10
   3) U-Value: 0.29
   4) Water Resistance: 15 PSF
b. Size Limitations:
   1) Minimum Size 14 inches wide by 14 inches tall. Maximum Size

1.2.1.2.3 Materials for making doors and windows

Wood

Wooden doors and windows are the most common types. Wood is the cheapest and most locally available material in most places on the planet. There are many benefits of wood when used to construct houses. Wood is a poor conductor of heat, therefore, serves to keep the house warm. It avoids excessive heat loss from the house. Wood also contributes to noise apartment in the house.

There are however different categories of wood. Timber is not standard. It is classified into soft woods like podo, medium, and hardwoods like mahogany. Hardwoods are more secure and durable than soft and medium woods.

Metal

Metal is the most secure material. Metal is more compatible with technology and its dynamicity than wood. Metallic doors and windows have been modified and customized to suit specific needs. There is a wide array of metals that are used as a material for doors and windows. This ranges from iron, which is the most common and preferred, aluminum, and copper. Metals have their unique

characteristics that make them suitable or not for construction materials. Some of the desirable characteristics are malleability, ductility, conductivity for both heat and electricity, hardness, and reactivity to the different climatic conditions as exposed.

UPVC doors and windows

Thanks to the dynamicity in technology, metallic doors and windows have been modifying to suit certain needs perfectly. They have been used to solve many puzzles as far as the environments inside of houses are concerned. This has been significantly shown through the UPVC windows and doors. UPVC windows and doors are fitted with unique materials and accessories to ensure maximum security, ease of use and as well minimize excessive heat loss from the house. The UPVC doors and windows have helped cut down electricity bill due to temperature control measures.

Fiberglass

Fiberglass windows have gained traction in recent years. Their makeup of reinforced glass fibers and resin creates a strong durable material that requires little maintenance. Fiberglass can mimic the look of wood windows giving them a better aesthetic.

Composite

This type of frame is made from a combination of wood, metal, and vinyl. Choosing composite windows gives you the best aspects of different materials combined for a stronger product. When this type of window first came out, the composite material was just used for the windowsills, but now the entire window frame is made from it

1.2.1.2.4 Fabrication methods for doors and windows

Wood door manufacturing process

The manufacturing process has fifteen procedures.

- First it is to get the materials needed.
- Second, it is to check the quality of materials and as it is wood to dry it if needed.
- The third step is to manufacture the door frame. It includes manufacturing the two stiles and rails and then to assemble them.

- The third, fourth and fifth steps take place simultaneously. It is to manufacture the center part of a door which is also called the core of a door and to manufacture a window. Ply-wood cross bands are placed on both sides and hot press glued to the core board.
- The sixth step is to assemble the parts from third and fourth step.
- The following step is cutting and curving.
- Then the door is sanded and cleaned to prepare it for laminating.
- The lamination of face veneer protects the core and to decorate the door.
- After lamination, the edge of the veneer is lipped with edge bandings. It protects the veneer from being ripped off the door.
- The next step, cutting, is implemented for lock holes and hinge holes.
- The curving is done in this step as well.
- Then the door is sent to the painting department to paint with protective and decorative paintings. The door has three layers of paintings normally.
- After the painting has dried, the accessories of the door are installed on the door. The installation depends on requirements of the customer. After the installation, some doors are selected for a series of quality tests.
- The final step is packaging. The door is covered with protective plastic package. After all the steps, it is sent to storage or customer.

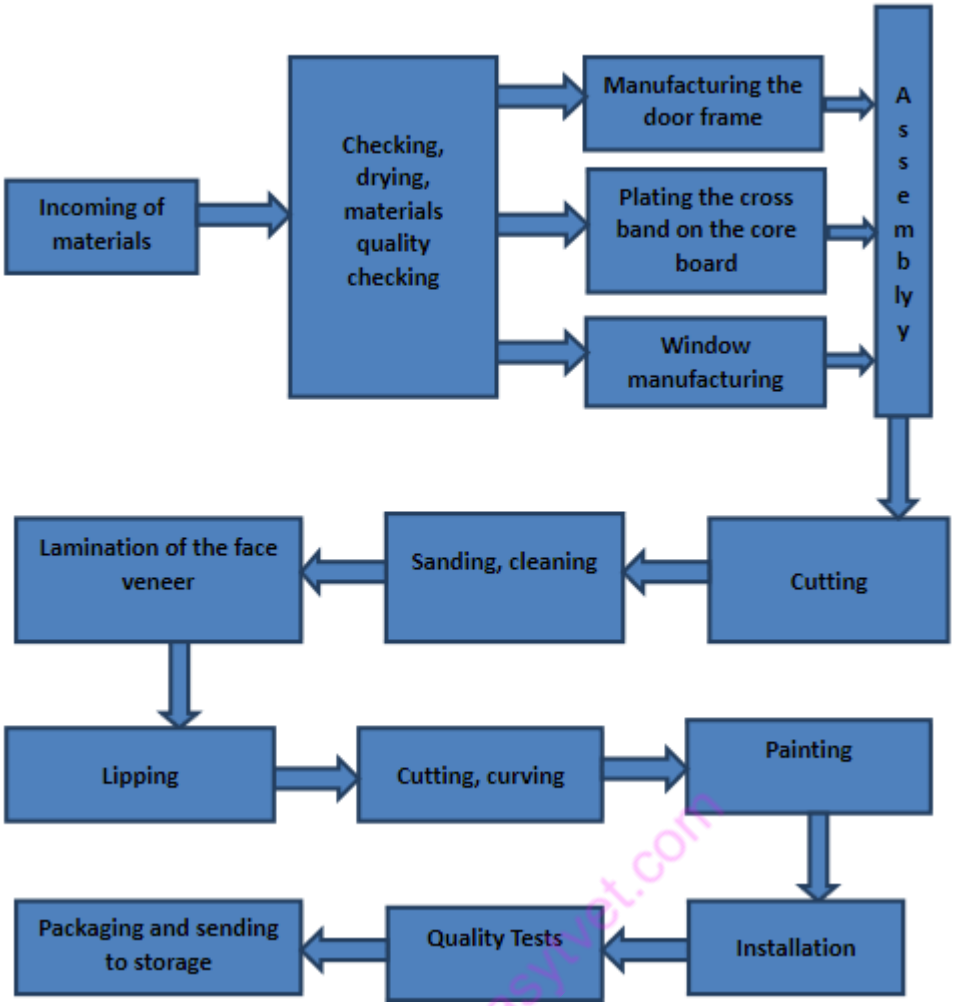


Figure 41 Wood door manufacturing process

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwj-vtL28qPxAhVIExoKHRy7AOAQFjANegQIFRAF&url=https%3A%2F%2Fwww.theseus.fi%2Fbitstream%2F10024%2F29578%2F1%2FYan_Binbin.pdf&usg=AOvVaw3jkkaW0n9uqhdDUyu9Ly9A

Metal door manufacturing process

1) Cutting

In this process, the metal workpiece is split into two or many pieces Metal cutting with the hacksaw is a traditional way to cut metal.

But nowadays Metal cutting is taking place with plasma torches, water jets, lasers machine and other advanced machines.

2) **Folding**

This is the process of folding metal sheets into the desired shape and size. Dies and bending machine are used to fold or bend metal.

3) **Machining**

This process is used to remove the excess material from raw material, this process is done with a lathe machine or three axes machine.

4) **Punching**

Punching process is used to convert metal into required shape using die and punching machine.

5) **Shearing**

The process of making a long cut on a piece of metal. This process is done on sheet metal.

6) **Stamping**

Stamping process similar to that punching process, but here metal is not cut into pieces only the die is shaped to make a raised portion of material rather than penetrating.

7**) Casting**

This is one of the oldest and flexible methods used in fabrication.

In this process, Metal is poured into the mold to get the desired shape of the mold.

8) **Welding**

Welding is a process of joining two pieces together, there are various types of welding process exists.

Some popular welding methods are

- Shielded Metal Arc Welding (SMAW)
- Gas Metal Arc Welding (GMAW/MIG)
- Flux Cored Arc Welding (FCAW)
- Gas Tungsten Arc Gas Welding (GTAW/TIG)

9) **Finishing**

Once all the other processes are completed the metal sheet is finished off by painting or applying a silk coating**.**

Functions of doors and windows

Functions of doors

- The main function of door is to maintain privacy and safety inside the room or house when it is closed. See how to secure your door properly here.
- Doors provide connecting link between the various internal rooms of the house.
- It gives an aesthetic view to the house.
- Open door provides lighting and ventilation to various rooms in the house.
- It controls the physical atmosphere within a space by enclosing it, excluding air drafts so that interiors may be more effectively heated or cooled.
- It also acts as noise barrier when there are chances of too much noise outside of the house.
- It is used to screen areas of a house for aesthetic purposes, keeping formal & utility area separate.
- Open door allows people and animals entering the house.
- The house doors used to manage the physical atmosphere inside a room, so that heating or cooling of interiors may become more effective.
- It also plays a significant role in preventing the spread of fire or smoke.
- It is equipped with locking mechanisms, which allow entrance to only selected people and hence keep out others is also the function of door.

Functions of windows

a. Providing natural sunlight
b. Ventilation
c. Protection against weather elements
d. Thermal insulation
e. Contribute to comfortability of the house

1.2.1.2.5 Tools and equipment

Tools used in fabrication of wooden doors and windows

1. **Auger:** - This tool is used make deep hole or boring in the wooden member. Auger bit, Center Bit, Rose Counter Sunk Bit , Screw Driver Bit:- These bits are used to make holes in the wooden pieces in different shape and size.
2. **Brace:-** This tool is used to make hole, in this tool a bit is attached at the lower end of this tool and a hole is bored by hand press.

3. **Compass saw, Coping saw, Cross cut saw, hand saw:-**There are many type of saw and used to cut the timber / wood.
4. **Gimlet: -** This tool is small and used for making and boring small holes
5. **Bradawl:-** This tool has sharpened end required to use for making punching in the timber.
6. **Firmer chisel, Mortise chisel, paring chisel:-**These various types of chisel are used to make required cut in the wooden piece to fit the other piece in the cut.
7. **Claw hammer:-**This hammer one end is solid used for hammering the nails or wooden piece where as other end is use to extract nails from wooden pieces.
8. **Marking gauge, marking knife:** - This tool is required for marking lines or Nissans on wooden pieces.
9. **Bed plane, Jack plane, Rebate plane**:- There are various types of plane use to make the surface of timber smooth, making rebate in the timber and making or forming molding.
10. **Nail punch:** - This tool make the space for nails or screws to make the carpentry work speedy and easy.
11. **Cramp**: - This tool is required to hold the timber piece to make the carpentry work speedy and easy.
12. **Square**:-This made either wood or iron use to check the right angle of the wooden frame.
13. **Oil Stone:-** This is a piece of stone required to sharpen the carpentry tools, which makes the work speedy and easy.
14. **Pincers, Pliers:** - These tools are used to extract nails from the timber and make the work easy & speedy.
15. **Screw Driver:-** To fix and extract the screws from timber and make the work easy & speedy.
16. **Mallet Hammer, pall hammer, Waller Hammer;-** These are used to forming the joints by hammering one piece to the other piece.

1.2.1.3 Learning Activities

Practical assessment

You are required to complete the following tasks

1. Prepare a window specifications using the architectural plan provided
2. Prepare a doors specifications using the architectural plan provided
3. Fabricate a wooden door
4. Fabricate a metal door

Resource Requirements

1. A fully functional carpentry and joinery workshop
2. Personal protective equipment
3. Trained quality control staff
4. Fabrication tools and equipment

Self-Assessment questions

1. What are the benefits of wood as a door making material?
2. What are the main functions of windows?
3. What is fabrication?
4. Using a flow chart illustrate how a wooden door is fabricated in the factory

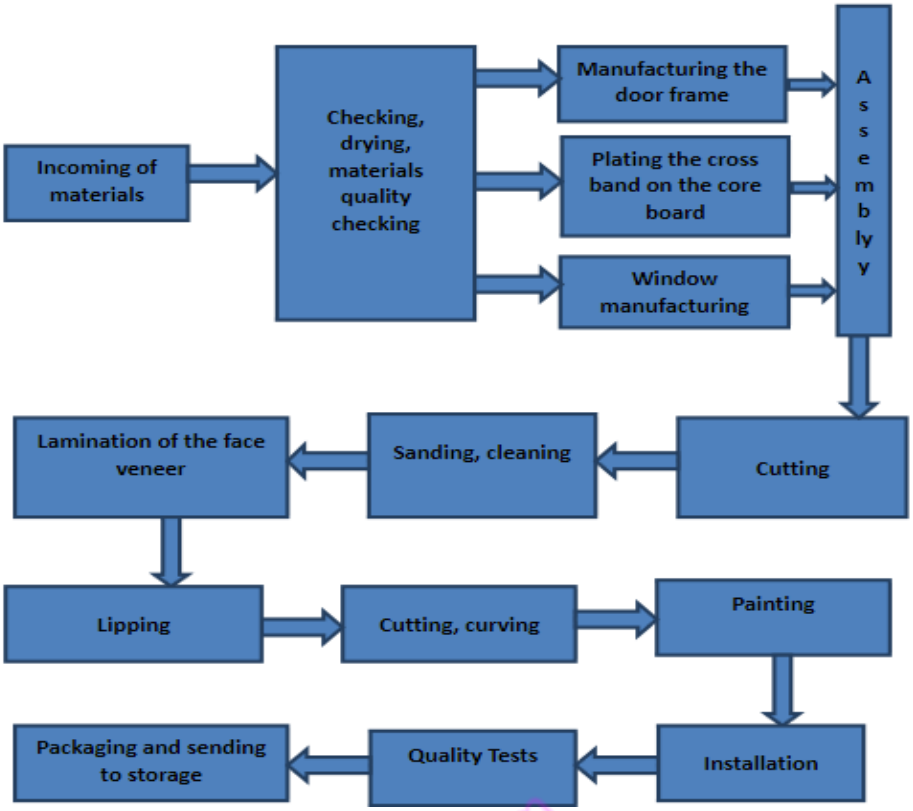
5. What are some challenges which could be encountered during metal door fabrication?
6. What is meant by specifications?
7. Which are some of the tools used in doors and windows fabrication?
8. Using a well labelled sketch illustrate a fully fabricated wooden window
9. What is the importance of specifications?

Response to self-assessment questions

1. What are the benefits of wood as a door making material?
    a. **Easily available in most places**
    b. **Easier to work on than metal**
    c. **Flexibility**
    d. **Gives more aesthetic value**
2. What are the main functions of windows?
    i. **Providing natural sunlight**
    ii. **Ventilation**
    iii. **Protection against weather elements**
    iv. **Thermal insulation**
    v. **Contribute to comfortability of the house**

3. What is fabrication?

    This is the action or process of manufacturing something
4. Using a flow chart illustrate how a wooden door is fabricated in the factory.



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5. How is a metal door fabricated?

a. Cutting-In this process, the metal workpiece is split into two or many

b. Folding-In this process the metal is folded into the desired shape

c. Machining-This process is used to remove the excess material from raw material, this process is done with a lathe machine or three axes machine.

d. Punching-Punching process is used to convert metal into required shape using die and punching machine.

e. Shearing-This is the process of making a long cut on a piece of metal. This process is done on sheet metal.

f. **Stamping-Stamping process similar to that punching process, but here metal is not cut into pieces only the die is shaped to make a raised portion of material rather than penetrating.**
g. **Casting-In this process, Metal is poured into the mold to get the desired shape of the mold.**
h. **Welding-Welding is a process of joining two pieces together**
i. **Finishing-Once the metal is converted into the required form it is painted, silk coated or corrosion proofed.**

6. What are some challenges which could be encountered during metal door fabrication?
    a. **Deformation of metal sheet during welding**
    b. **Cracking of metal sheet**
    c. **Incomplete fusion**
    d. **Spatter**
    e. **Undercut**
7. What is meant by specifications?

    Specifications – this is a detailed description of the design and materials to make something
8. Which are some of the tools used in doors and windows fabrication?
    a. **Auger**
    b. **Auger bit**
    c. **Brace**
    d. **Compass saw**
    e. **Bradawl**
    f. **Chisels**
    g. **Claw hammer**
    h. **Marking gauge**
    i. **Screw drivers**
9. Using a well labelled sketch illustrate a fully fabricated wooden window

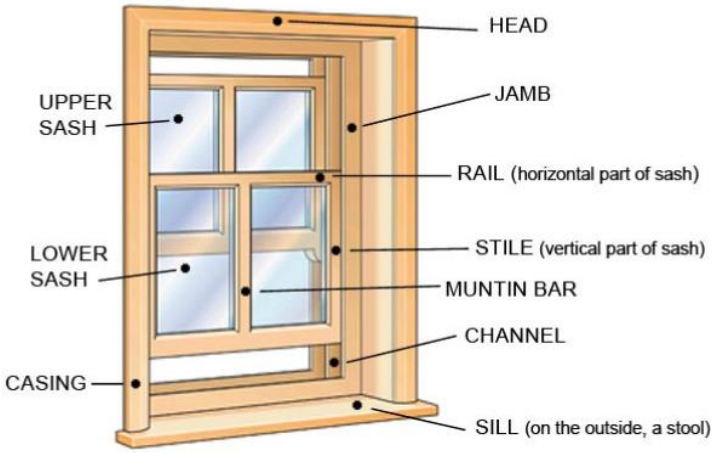

Figure 42 window details

10. What is the importance of specifications?

i. **It provides clear instructions on the intent, performance, and construction of the project.**
ii. **It can reference the quality and standards which should be applied.**
iii. **Materials and manufacturers' products can be clearly defined.**
iv. **The requirements for installation, testing, and handover can be identified.**
v. **Classification in the specification can be used to support handover and running of the asset.**
vi. **The drawing or model does not need to be overloaded with detailed information, which can sometimes be difficult to identify.**
vii. **It can be used to support the costing of a project: not only the materials and products but also the performance and workmanship**
viii. **The specification forms part of the contractual documents, along with the drawings, and therefore can help minimize project risk and provide support should there be any legal disputes.**
ix. **It supports the interpretation of the client brief and gives the client assurance that the asset which they commissioned is being delivered.**
x. **It is not only essential for the construction phase but also used as part of the soft landing process, subsequent asset management and the lifecycle plan.**
xi. **By being clear and concise and containing all the information, it saves the project team, the client and the contractor time and money by providing answers to many of the on-site construction questions.**
xii. **There is the option for the design team to build a suite of office masters, which would improve efficiency, provide quality assurance and project consistency.**
xiii. **Office masters can save the team time and money by being developed over a period of time and then being adapted to suit the project specifics, therefore drawing on specialist knowledge when needed.**

xiv. **The specification should be used by all the project team throughout the construction phase; it should be a living document and not stop being used at the design phase.**

xv. **The specification and any variations or value engineering can also be used for the project audit trail and should form part of the handover documents. It will then form the basis for the running of the asset by the asset management team**

Tools, Equipment, Supplies, and Materials

1.2.1.4 References

1. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwi00emAyPbuAhWBzIUKHTebCxkQFjAQegQIGxAD&url=https%3A%2F%2Fwww.arcat.com%2Fsdspecs%2Fhtm%2F08520des.htm&usg=AOvVaw3mFNy8gQnKWw9bki315jLu
2. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiqxvK-yvbuAhXIURUIHdP0D5QQFjARegQIGxAD&url=https%3A%2F%2Fwww.theseus.fi%2Fbitstream%2F10024%2F29578%2F1%2FYan_Binbin.pdf&usg=AOvVaw3jkkaW0n9uqhdDUyu9Ly9A

1.3.1 Learning Outcome 3: Fix building doors and windows

1.3.1.1 Introduction to the learning outcome

This learning outcome specifies the competencies required to fix building doors and windows. It entails preparing window and door openings, fixing ironmongery and fixing doors and windows as per SOPs.

Performance Standard

3.1 Door and window openings are prepared for fixing as per SOPs
3.2 Connecting ironmongery is fixed on the door and window openings as per SOPs
3.3 Doors and windows are fixed as per SOPs

1.3.1.2 Information Sheet

1.3.1.2.1 Definition of terms

Ironmongery – these are objects made of metal normally used as window and door accessories.

1.3.1.2.2 Ironmongery

1. Butt Hinge

This is the most common type of hinge used for doors and windows. It has two flanges made of cast iron or steel. One flange is screwed to the door or window and other one screwed to frame.

Figure 43 Butt Hinge

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2. Back Flap Hinge

These are similar to butt hinges and used for thin doors. Back flap hinges have wide flanges than butt hinges. They are fixed to the back side of door and frame

Figure 44 Back Flap Hinge

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3. Counter Flap Hinge

This hinge has two centers, and these can be folded back to back.

Figure 45 Counter Flap Hinge

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4. Parliamentary Hinge

When the opening is very small or narrow, then it is better to provide parliamentary hinges to provide more space of opening as well as to avoid obstruction while moving furniture etc.

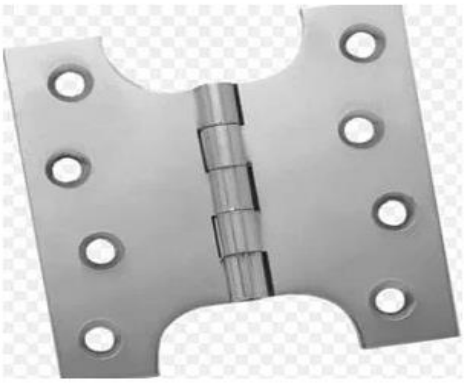

Figure 46 Parliamentary Hinge

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5. Spring Hinge

Spring hinges are used for swinging doors. The door is closed automatically due to spring action in this case. Spring hinges are available as single acting and double acting spring hinges.

Figure 47 Spring Hinge

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6. Rising Butt Hinge

It is similar to normal butt joint, but it has helical nickel joint in between flanges which helps the door to raise vertically upwards when opened. This is useful for the rooms having carpets etc. the raise may be about 10mm.

Figure 48 Rising Butt Hinge

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7. Garnet Hinge

It has Tw different shaped hinges. One is of long arm shaped which is fixed to the door and another is of plate shaped which is fixed to the frame. This type of hinge is used for battened or ledged doors.

Figure 49 Garnet Hinge

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8. Strap Hinge

It is also used for battened and ledged doors and windows. It has two long arm shaped flanges.

Figure 50 Strap Hinge

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9. Pin Hinge

This type of hinge consist two flanges which are joined by pin. If the pin is removed then we can separate the flanges. This is generally used for heavy doors. Two flanges are separately fixed to the door and frame.

Figure 51 Pin Hinge

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10. Nar-Madi Hinge

This is also used for heavy doors, but it consists only one flange which is fixed to the door. Pin is fixed to the frame to which flange is attached whenever is needed.

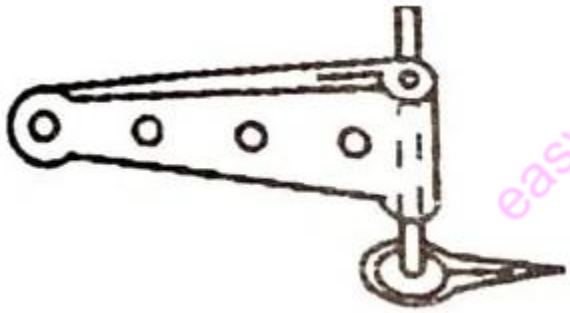

Figure 52 Nar-Madi Hinge

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11. Hook and Eye Type Bolts

This type of bolt is used to keep the windows shutter in required position when it is opened. Hook is fixed to the shutter frame and eye is fixed to the window rail.

Figure 53 Hook and Eye Type Bolts

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12. Flush Bolt

In case of flush bolt the bolt flush is desired to keep with the face of the door.

Figure 54 Flush Bolt

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13. Aldrop Bolt

Aldrop bolt is olden type and most common type bolt. To lock this bolt pad locks are used.

Figure 55 Aldrop Bolt

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14. Barrel Bolt

To fix the back faces of doors barrel bolts are used. It contains socket and plate, socket is fixed to the frame and plate is fixed to the back face of door.

Figure 56 Barrel Bolt

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15. Espagnalette Bolt

This is used for highly secured doors and casement windows which cannot be reached easily.

Figure 57 Espagnalette Bolt

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16. Hasp and Staple Bolt

This is also locked by using pad lock as aldrop bolt. Hasp is fixed to the door or window while staple is fixed to frame.

Figure 58Hasp and Staple Bolt

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17. Handles

Handles are used to open or close the door or windows. There are many types of handles are available. Some of them are Bow type, Lever handle, Door handle, Wardrobe handle Etc.

Figure 59 Handles

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18. Locks

Locks used for doors and windows are many types and some of them are padlock, mortise lock, rim lock, cupboard lock and lever handle lock etc

Figure 60 Locks

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1.3.1.2.3 Types of openings

Jambs of Openings

In solid walls, windows and doors opening jambs can be either rebated or plain.

The latter is employed for small section windows and door frame that is made from steel. It can be used for large sections where entire external face of frames is to be exposed externally.

It is advised to paint window and door frames that are created from soft wood. This is to protect the wood from rain influences, and the wood would swell and decay when it is wet.

Furthermore, it is architecturally desirable to hide all or part of window and door frames. Because not only does rebated openings jambs provide protection against weather but also it is more aesthetically appealing.

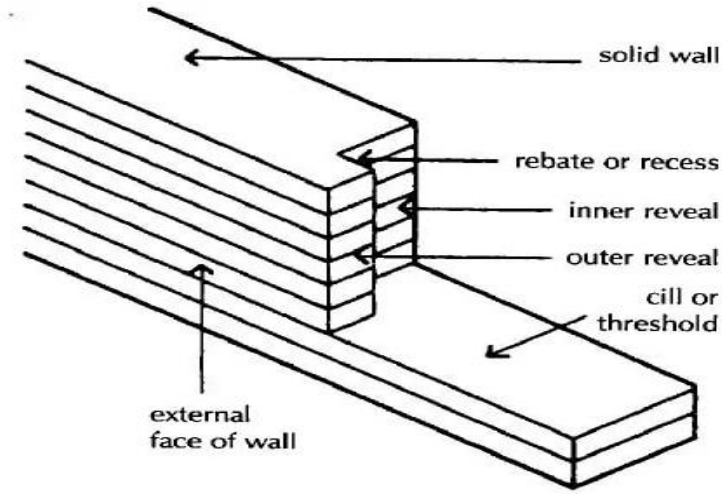

Figure 61 Jambs of Openings

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Head of Openings in Solid Walls

Lintels or arches should be used to support solid brickwork over the head of openings. the solid brickwork over either lintels or arches is an isosceles triangle with 60^{o} degree that is created by the bonding of bricks.

If the solid brickwork inside the triangle in a bonded wall is taken out the arching effect will take place which means the load of the wall above the triangle would be transferred to the bricks of each side of the opening.

Lintel is a term used for any single solid length of stone, timber, steel, or concrete and which is constructed above the opening to support the above brickwork.

Lintels are capable of transferring load to the jambs if the lintel ends are built into the bricks properly. Moreover, the wall area on which the end of a lintel bears is called its bearing at ends.

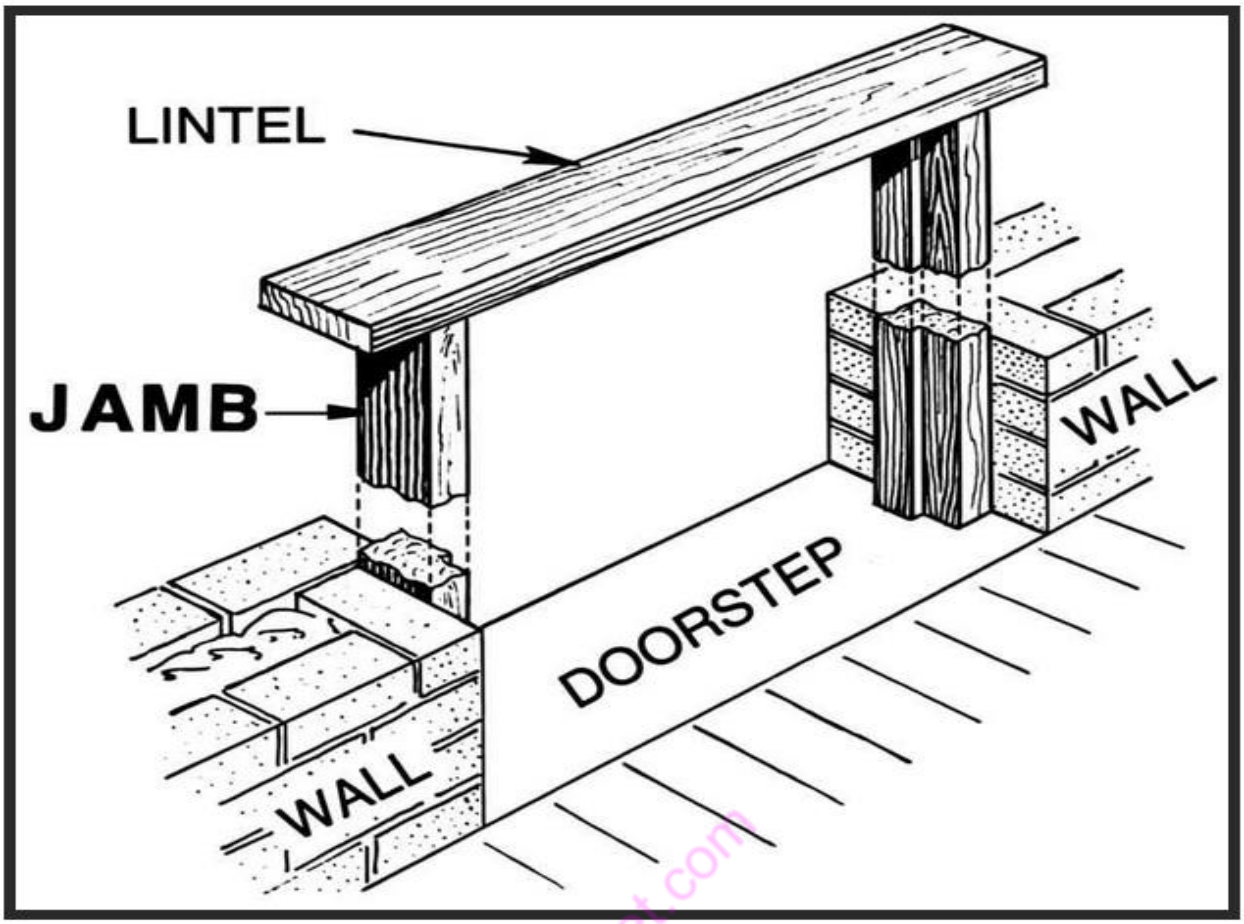

Figure 62 Lintels

https://www.google.com/url?sa=i&url=https%3A%2F%2Fgharpedia.com%2Fblog%2Fwhat-is-lintel-definition-types-purpose%2F&psig=AOvVaw3FVTyTpTWykyg0-2OEdOqL&ust=1624343567482000&source=images&cd=vfe&ved=0CCQQr4kDahcKEwjAv6jFjajxAhUAAAAAHQAAAAAQAg

Types of Lintels and Arches for Openings in Walls

Timber Lintels

This type of lintel was employed to support loads over the opening of solid brickwork and were common up to the beginning of twentieth century. The application of timber lintels was decreased because it has no proper resistance against fire.

Concrete Lintels for Openings in Walls

These are economical and practical lintel types and can be casted in different shapes and forms. Concrete are considerably strong in withstanding crushing and will not deteriorate unless it exposed to weather.

The most outstanding disadvantage of concrete lintel is its low tensile strength for which steel bars are introduced to compensate concrete disadvantage.

The diameter of reinforcing steel for lintels of 1.8 m span is 10mm or 12mm diameters and the end of the bars should be either bent up at ninety degree or hooked as shown below

Pre-stressed Concrete Lintels for Openings in Walls

This type of lintel is employed mostly for internal openings. There are two types of pre-stressed lintel includes composite lintels and non-composite lintels.

The composite lintels are relatively thin precast lintels that are constructed over openings. If width of opening is higher than 1200 mm, the pre-stressed lintels have to be supported until the brickwork over is set in order to prevent excessive deflections.

The non-composite pre-stressed lintels are used when there is large loads and not adequate brickwork over to act compositely with the lintel.

Boot Lintels for Openings in Walls

These lintels are used to decrease the lintel depth which is exposed externally as shown below

Pre-stressed Steel Lintels

It is possible to use this type of lintel instead of concrete lintel to support both non-load bearing and load bearing walls. Generally, hollow box form is used for lintel over door opening in internal load bearing walls.

Pre-stressed steel lintels with different length and section are constructed to be used for standard openings, thickness of walls, height of brickwork course, and sufficient bearing at ends.

The crushing resistance of hollow pre-stressed steel lintels must be improved by filling it with concrete when the width of the opening is large. Thin corrugated pre-stressed steel lintels are produced to suit thin, non-load bearing brickworks over narrow door openings in partition walls.

Brick Lintels

Brick lintels can be constructed as bricks on end, bricks on edge, and coursed bricks laid horizontally over openings as shown below

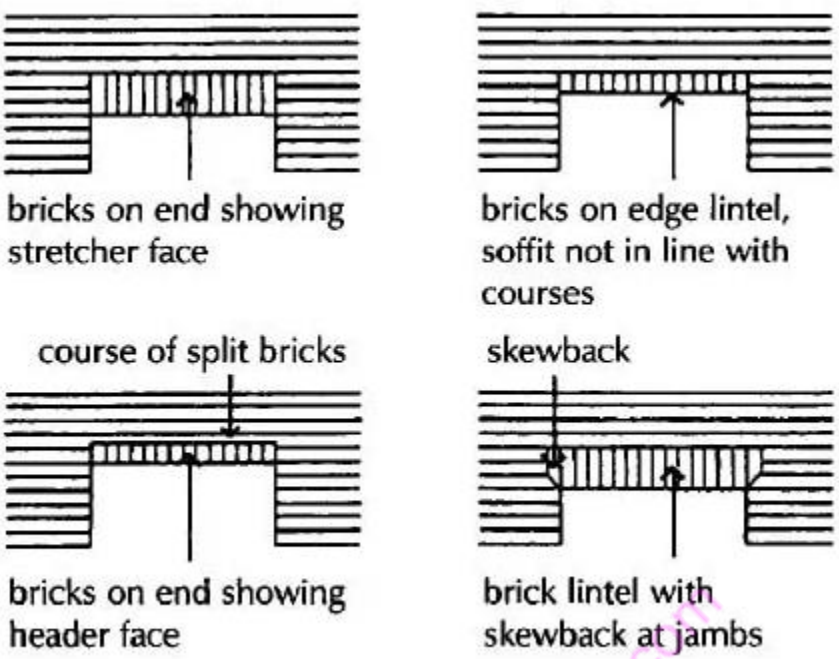

Figure 63 Brick Lintels

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Brick Arches for Openings in Walls

different types of brick arches used over opening in solid walls are provided in the following sections.

Semicircular Arch

This is the most beautiful, elegant, and efficient types of arch which is used above the small openings for windows and doors. The semicircular arch transfers load directly to the brick on each side of the openings.

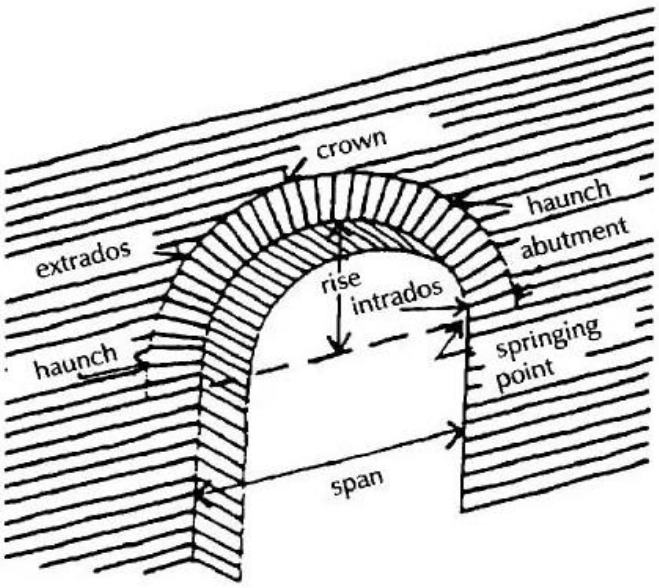

Figure 64 Semicircular Arch

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Rough and Axed Arch for Openings in Walls

There are two methods to construct rough and axed arch namely: brick laid with wedge shaped mortar joints and wedge shaped bricks with uniform mortar thickness. Rough brick arch is built with uncut and wedge shaped mortar joints.

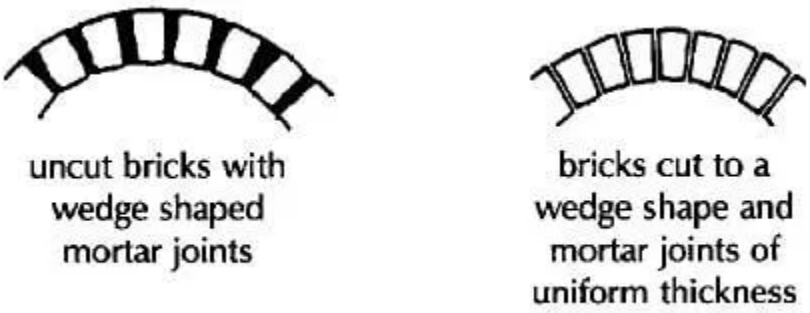

Figure 65 Rough and Axed Arch for Openings in Walls

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Fixing methods

Installing windows in concrete wall is sometimes required when the function of certain spaces is varied or lights are required in garages or basements. It is necessary to conduct the work properly and according to the applicable codes in addition to consulting structural engineer to ensure proper transfer of loads above the window during making opening, construction of lintels, and window installations.

1.3.1.2.4 Procedure for Installing Windows in Brick Masonry Wall

Making Opening

1. Before making opening it is necessary to examine that the wall exclusive of opening is adequate to take the load coming on the structure.
2. Check for obstacles such as buried utilities, shrubbery, indoor wiring and ductwork. The more stuff you have to move or work around, the more complex, time-consuming and expensive the project becomes.
3. All the structural members supported on the walls which have direct bearing over the area in which opening is to be made, shall be properly supported with props to relieve the load from masonry wall till the lintel over the opening is strong enough to take the load.
4. The portion to be dismantled may be clearly marked on both sides of the wall.
5. Dismantling shall be carried out from top to bottom within the marked area.
6. The sides of the opening shall be parallel and perpendicular to the plane of wall.

Construction of Lintel

- The lintel shall be invariably cast first in the opening made for the purpose.
- One side of the shuttering shall be kept open in the beginning till the concrete is laid.

- The shuttering shall then be fixed for half of the opening and concreting completed.
- Curing of lintel casted shall be done for a minimum period of 7 days.
- Sometimes, L-shaped steel beam may be enough to be used as a lintel.

Installing Window

1. Build a wood casing screwed to the concrete opening.
2. Frame the bottom shelf with an angle so that the water striking the window will run away from it.
3. Flash the entire wood casing using the proper primer.
4. Install window in the flashed opening and leave adequate space all around the window for insulation.
5. Fill that space with low expansion polyurethane spray foam.
6. In a concrete wall without wood framing, install the window framework by fastening it into the concrete wall with self-tapping concrete screws.
7. For a block wall installation, fasten with rust-resistant screws using a toe-nail method through the jambs into the head and sill boards at each corner.
8. Lower the window into the framed opening, inserting the bottom window edge first, then tipping in the top.
9. Shim the window from both the interior and exterior sides until it is level, square, and flush with the exterior side of the basement wall. Take care not to damage the window with excessive shim pressure.
10. Apply expanding foam to the window frame gap created by the shims. Allow the foam to cure for at least one hour before trimming the excess.
11. Apply sealant around the window frame joint on both the exterior and interior sides.

1. Fixing Doors and Windows with Lugs

i. The doors, windows, and ventilator units shall not be "built-in" as the work proceeds but openings shall be left out and the frames should be installed afterward so that the minimum specified clearance is left between the opening and unit frame. The size of the opening shall be checked and cleared of obstructions.
ii. The size of the opening shall be checked and cleared of obstruction.
iii. The position of holes shall be marked on the jamb, and the holes shall be made in the masonry.

iv. The size of the lugs shall not be less than 10 cm in length, 15 mm in width, and 3 mm in thickness.
v. The frames of units shall be temporarily fixed in the wall openings with the use of wooden wedges at the jamb, head, and sill.
vi. The door or window frame shall be fixed with the lugs with 20 mm long and 6.3 mm diameter G. I. countersunk machine screws and nuts.
vii. In the case of the flush opening, wedges shall be removed, and the gap between the unit and the jambs shall be filled with cement mortar, as shown in figure 1.
viii. In the case of flush jamb with external "fair-faced" finish, the gap shall be filled with mastic from inside till it oozes out on the external face in the gap between the unit and the jambs.
ix. The oozing mastic shall be cleaned and flush pointed. The gap in the internal side shall be filled with mastic to about 1/3rd depth and the rest with cement mortar, as shown in Figure-1.
x. In case of rebated jambs finished "fair-faced" externally, to ensure a watertight joint, the mastic shall be applied to the inside channel of the jamb, frame, and sill.
xi. After the unit is firmly fixed in position, surplus mastic shall be cleaned and flush pointed, as shown

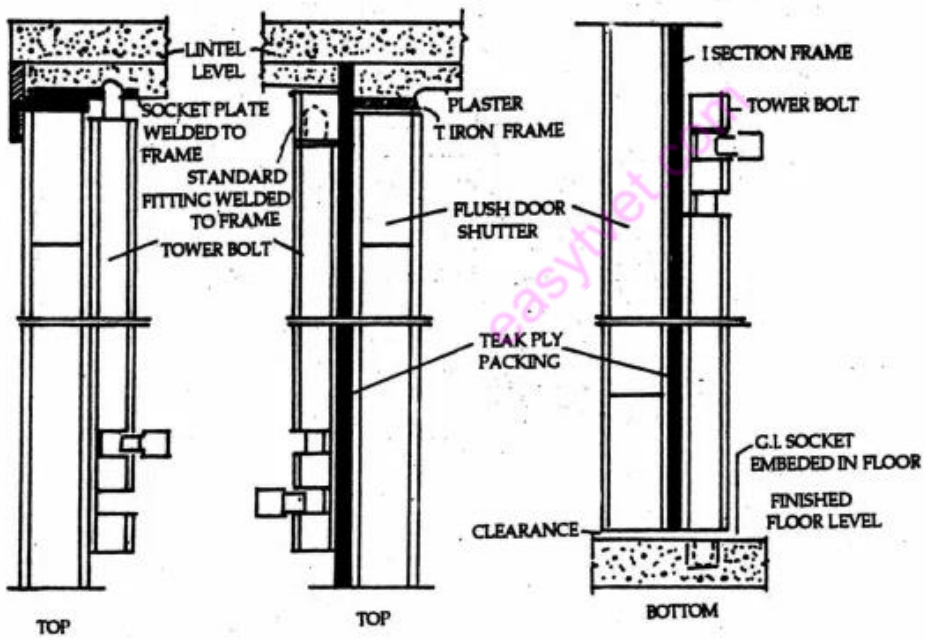

Figure 66 Fixing Doors and Windows with Lugs

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2. Fixing with Screws and Plugs

In R. C. C works, where lugs cannot be embedded due to reinforcement bars, etc. rawl plugs or other approved metallic fasteners may be fixed in proper position and the frame fixed to them with 60 mm galvanized wood screws of designation 10.

3. Fixing in Wood Work Opening

1. Opening in woodwork is generally rebated, and approved rubber linings or mastic shall be applied to the sill, jambs, and channel before fixing in position.
2. The frame shall be set in the opening with wooden wedges and fixed in the masonry openings with 60mm galvanized wood screws of designation 10.
3. To match the adjoining work, extra timber fillets of hardwood shall be provided around the frame to close the extra gap between openings and frames.

4. Fixing in Steel Work Opening

1. Before placing the unit frame in a position, approved mastic shall be applied as specified, and a mild steel or hardwood fillet shall be provided around the frame to close the extra gap between opening and frame.
2. The unit shall then be fixed to the opening with fixing clips or with nuts and bolts, as shown in the drawings or as directed by the engineer.

5. Fixing of Composite Units

1. Where large units shall be formed by coupling individual units together (with coupling sections), the mullions and transom shall be bedded in mastic to ensure water tightness.
2. Mastic shall be applied liberally to the channels of the outside frame sections before assembly and after coupling.
3. Any mastic oozing out shall be cut out neatly.

Precautions for Fixing Doors and Windows

1. Proper care shall be taken that steel doors and windows etc. are not deformed/damaged during subsequent constructions.
2. Special care shall be taken that scaffolding does not rest on the steel door window frames or glazing bars.
3. All fittings and hinges (projecting hinges) shall be protected, preferably with alkaline sheets, to protect from damage during execution of work.

Tools and equipment

- Drill / Driver and Bits.
- Circular Saw.
- Planer
- Router
- Screwdriver.
- Hammer.
- Utility Knife.
- Wood Chisel

1.3.1.3 Learning Activities

Practical assessment

You are required to complete the following tasks

1. Prepare a window opening
2. Fix the window provided in the opening prepared in (1) above
3. Prepare a door opening
4. Fix the door provided in the opening prepared in (3) above

Resource Requirements

1. A fully functional workshop
2. Door/window fixing tools and equipment
3. Trained quality control staff

Self-Assessment questions

1. What is ironmongery as used in windows/doors fixing?
2. Which kind of ironmongery is commonly found in flush wooden doors?
3. How would you prepare an opening ready for window installation?
4. Which types of openings are commonly found in buildings?
5. How would you fix a window in a steelwork opening?
6. How is a lintel constructed?
7. What is a jamb?
8. Which types of locks are used in doors?
9. How are composite units fixed?
10. Which precautions would you observe when fixing a door or a window?

Response to self-assessment questions

1. What is ironmongery as used in windows/doors fixing?
   Ironmongery – these are objects made of metal normally used as window and door accessories.
2. Which kind of ironmongery is commonly found in flush wooden doors?
   i. **Handles**
   ii. **Flush bolt**
   iii. **Butt hinge**
   iv. **Locks**
3. How would you prepare an opening ready for window installation?
   i. **Before making opening examine whether the wall exclusive of opening is adequate to take the load coming on the structure.**
   ii. **Check for obstacles such as buried utilities, shrubbery, indoor wiring and ductwork. The more stuff you have to move or work around, the more complex, time-consuming and expensive the project becomes.**
   iii. **All the structural members supported on the walls which have direct bearing over the area in which opening is to be made, shall be properly supported with props to relieve the load from masonry wall till the lintel over the opening is strong enough to take the load.**
   iv. **The portion to be dismantled may be clearly marked on both sides of the wall.**
   v. **Dismantling shall be carried out from top to bottom within the marked area.**
   vi. **The sides of the opening shall be parallel and perpendicular to the plane of wall.**
4. Which types of openings are commonly found in buildings?

   i. **Jambs**
   ii. **Lintels**
   iii. **Arches**
5. How would you fix a window in a steelwork opening?
   i. **Before placing the unit frame in a position, approved mastic shall be applied as specified, and a mild steel or hardwood fillet shall be provided around the frame to close the extra gap between opening and frame.**
   ii. **The unit shall then be fixed to the opening with fixing clips or with nuts and bolts, as shown in the drawings or as directed by the engineer.**
6. How is a lintel constructed?

i. **A lintel can be cast first in the opening made for the purpose.**

ii. **One side of the shuttering shall be kept open in the beginning till the concrete is laid.**

iii. **The shuttering shall then be fixed for half of the opening and concreting completed.**

iv. **Curing of lintel casted shall be done for a minimum period of 7 days.**

v. **Sometimes, L-shaped steel beam may be enough to be used as a lintel.**

7. What is a jamb?
   A jamb is a vertical component that forms the side of an opening in a wall such as that of a door frame or window frame.
8. Which types of locks are used in doors?
   i. **Padlock,**
   ii. **Mortise lock,**
   iii. **Rim lock,**
   iv. **Cupboard lock**
   v. **Lever handle lock**
9. How are composite units fixed?

   i. **Large units shall be formed by coupling individual units together (with coupling sections), the mullions and transom shall be bedded in mastic to ensure water tightness.**
   ii. **Mastic shall be applied liberally to the channels of the outside frame sections before assembly and after coupling.**
   iii. **Any mastic oozing out shall be cut out neatly.**
10. Which precautions would you observe when fixing a door or a window?
    i. **Proper care shall be taken that steel doors and windows etc. are not deformed/damaged during subsequent constructions.**
    ii. **Special care shall be taken that scaffolding does not rest on the steel door window frames or glazing bars.**
    iii. **All fittings and hinges (projecting hinges) shall be protected, preferably with alkaline sheets, to protect from damage during execution of work.**

Tools, Equipment, Supplies and Materials

- Drill / Driver and Bits.
- Circular Saw.
- Planer
- Router

- Screwdriver.
- Hammer.
- Utility Knife.
- Wood Chisel

1.3.1.4 References

1. Lynch, G., Gauged Brickwork, A Technical Handbook, Gower Publishing Company, Aldershot, Hants, England, 1990, 115 pp.
2. D. Walton, The Motivate Series Building Construction Principles
3. R. Chudley Building Construction Handbook

1.4.1 Learning Outcome 4; Apply doors and window finishes

1.4.1.1 Introduction to the learning outcome

This learning outcome specifies the competencies required

Performance Standard

4.1 Windows and doors (where applicable) glazing is fixed as per SOPs
4.2 Windows and doors plastering are applied as per SOPs
4.3 Ironmongery (other) are fixed as per SOPs
4.4 Windows and doors are painted as per SOPs.

1.4.1.2 Information Sheet

1.4.1.2.1 Definition of terms

Glazing – this is the process of fixing glass on windows or doors

1.4.1.2.2 Glazing methods

Glazing in critical locations

Glazing in doors and windows in areas known as 'critical locations' need to be given special consideration in order to prevent potential injury to people within or around the building

These 'critical locations', are:

- In a door or, in a side panel adjacent to a door; where the glazing is within 300mm of the door and the glazing is situated between floor level and a height of 1500mm.
- In an internal or external wall or partition between floor level and a height of 800mm.

It is important that any glazing within these 'critical locations' should be either:

- Provided with permanent protection
- Small panes
- Robust
- Break safely

If permanent protection is provided, there is no requirement for the glazing itself to be of a special type. Permanent protection may take the form of railing or barriers and should:

- Be designed to be robust.
- Have a maximum opening or gap in any railing of 75mm or less.
- Be a minimum of 800mm high.
- Be non-climbable (especially where floor is acting as a balcony).

Small panes, either an isolated pane within glazing bars or copper or lead lights, should be restricted in size so that any breakage would be strictly limited.

Small panes should be:

- No more than 0.5m2 in area
- No wider than 250mm

Where concealed annealed glass is used, a minimum of 6mm thickness is recommended (4mm for copper or lead lights). Some materials are inherently strong , such as glass blocks or polycarbonates, whereas concealed annealed glass will need to be of an increased thickness as the area of the panel increases to be considered 'safe'. As an alternative to any of the above solutions, it is possible for the material to break 'safely' when tested to BS EN 12600, which would mean that:

- Only a small opening was created with a limited size of detached particles.
- The balance would create only small pieces that are not sharp or pointed.
- The pane disintegrates with only small detached particles.

A glazing material would be suitable for a critical location if it meets the requirements of BS 6262 – 4 when tested in accordance with BS EN 12600. Glass installed in a door or in a side

panel to a door that exceeds 900mm wide must meet the relevant requirements of BS EN 12600 and BS 6262 - 4. (See figure below for the critical locations)

Glazing should be in accordance with BS 6262. Insulated glass units (IGU) should meet requirements of BS EN 1279 – Glass in building – insulating glass units, be CE marked and carry third-party accreditation. This includes windows in possession of a BBA certificate and timber windows.

- They should have continuous dual seals; single seal units are not acceptable.
- Desiccant should be provided to spacer bars.
- Any glazing on-site must have a drained and ventilated bottom bead with a minimum gap of 5mm between the edge seal of the insulated glass unit and the bottom channel of the frames glazing rebate.

Any glazing with an area greater than $1m^2$ must have a drained and ventilated bottom bead with a minimum gap of 5mm between the edge seal of the insulated glass unit and the bottom channel of the frames glazing rebate.

• Glazing with an area less than 1m2 may be solid bedded.

• All spacer bars should be stamped with BS EN 1279.

• PVC-U frames and spacer bars should be stamped with BS 7412, 7413, and 7414.

Linseed oil glazing putty should not be used when the joinery is finished with vapour permeable paint or stain. Glazing putty should also not be used with organic solvent-based stains, the putty should be neatly finished to receive a protective paint coat.

Putty is not suitable for laminated glass and double-glazed units, the workmanship should be in accordance with BS 8000: 7. To ensure the compatibility of the whole glazing system is to a high level of workmanship and control, it is recommended that factory pre-glazed systems be installed in all external openings.

External glazing beads should be pinned at a maximum of 150mm centres (a maximum of 50mm from corners) or screwed at 200mm centres (maximum 50mm from corners).

The preferred method of installation for double-glazed units is either;

- Drained and ventilated frames, as recommended by the Glass and Glazing Federation (GGF), where possible this method should be adopted for external glazing.
- Solid bedding of units in 16mm–18mm deep frame rebates; 18mm rebates are recommended by the GGF to allow for tolerances. In all cases, sealants should not be sensitive to ultraviolet light. External glazing beads should be fixed at a maximum of 150mm centers, and the glazing bedded in non-setting putty. Louvre windows should not be used and double-glazing should be fixed and bedded as recommended by the GGF.

Control of condensation
Minimise the effects of condensation on glazing and frames by;

- Using insulated or thermally broken metal frames.
- Using details that prevent condensation running onto walls or floors.
- Housing window boards into frames to prevent condensation entering the joint.
- Providing thermal insulation to walls at lintels, sills and jambs.
- Using trickle ventilators, or similar, to provide background ventilation where required by the Building Regulations. Further guidance on this subject is provided in BRE report BR 262, Thermal insulation: Avoiding risks 2002.

Nickel sulphide inclusions in glazing
Toughened glass which is installed in windows and patio doors which are externally beaded in buildings that exceed 3 storeys in height must be Heat Soak Tested in accordance with BS EN 14179-1. The glass must be permanently marked in accordance with BS EN 14179-1, or copies of test certificates must be disclosed for all affected panes.

Appearance of glazing
Glass must meet the visual assessment criteria of the Glass and Glazing Federation and CWCT Technical Note 35 (TN 35). The total number of faults permitted in a glass unit shall be the sum total of those permitted by the relevant BS EN Standard for each pane of glass incorporated into the unit concerned.
Faults include;

- Inclusions, bubbles, spots and stains.
- Residues within the insulated glass unit cavity. Fine scratches not more than 25mm long.
- Minute particles
- When assessing the appearance of glass:

The viewing distance used shall be the furthest stated in any of the BS EN Standards for the glass types incorporated in the glazed unit. In the event of doubt the viewing distance shall be three metres.
The viewing shall commence at the viewing distance and shall not be preceded by viewing at a closer distance.
The viewing shall be undertaken in normal daylight conditions without use of magnification.

The above does not apply within 6mm of the edge of the pane, where minor scratching is acceptable. Scratches on doors, windows and frames and factory finished door and window components should not have conspicuous abrasions, or scratches when viewed from a distance of 0.5m.
Surface abrasions caused during the building-in process should be removed in accordance with the manufacturer's instructions, which may include polishing out, re-spraying or painting.
In rooms where there is no daylight, scratches should be viewed in artificial diffused light from fixed wall or ceiling outlets and not from portable equipment.

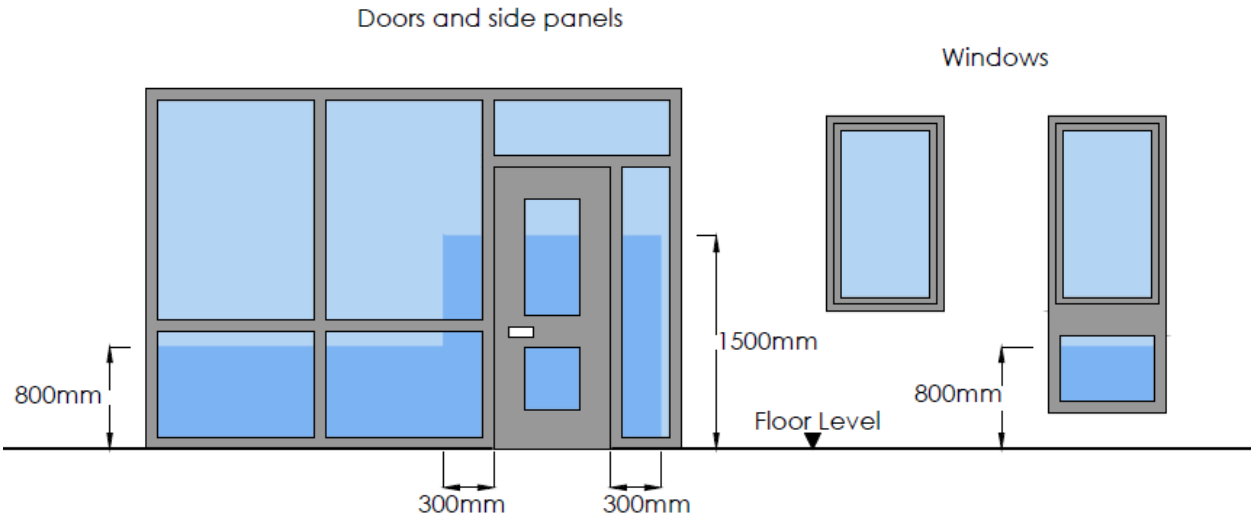

Figure 67 Glazing to critical locations

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1.4.1.2.2 Procedure for glazing a window

1. **Inspect the Window**

Before carrying out the task of how to glaze a window, examine every inch of the exterior. If you notice a few tiny cracks, there's no need to fix it. But if there is no glazing present or you have it have deeper cracks, consider re-glazing the window

2. **Take Out the Sash**

To perform this task, head to the outer part of the window interior and extract the long, slim pieces of wood. Usually, screws hold down the stops of a window. However, painted stops will have screws covered in paint. If you want to remove screws from coated stops, use a blade to gently cut the paint line.

3. **Take out the Damaged Glazing**

Prepare to discard the old glazing. First, find a scraper or razor knife and break the glazing into small pieces. When finished, you should notice a few bits on the glass or wood.

4. **Inspect the Wood Frame –**

Check the wood for any damage. If you find any cracks, you can patch them with two-part epoxy. Then, shape and sand the material until it smoothens out with the wood

5. **Install the Glass**

Measure the distance between both sides of the wood opening. To get the right fit, deduct to a one-eight inch. By taking this step, the area can carry the glass and the metal clips on the glazing.

6. **Apply the Window Putty**

Take a golf ball size of the putty in your hand and work it out for a few minutes. When it becomes pliable, roll it out, and apply the material to the corner of the windowpane. Avoid forcing the rolled-up putty.

Get a putty knife and use it to push the glazing into the frame and glass. Remember to use the blade to smoothen the glazing and get rid of any excesses around the window. The aim is to make the interior edge of the glazing line with the wood mullion on the opposite side of the glass.

1.4.1.2.3 Painting

Steps followed in Painting a door

i. Sand the Door Smooth- start with a light sandpaper or a sanding sponge. This will roughen the surface a little and allow the primer to adhere better. smooth out chipped paint and imperfections from previous paint jobs.
ii. Remove the Sanding Dust Use a vacuum with a brush attachment to remove most of the dust. Wipe off the rest with a damp rag
iii. Sand After Priming Sand out any imperfections in the prime coat; Shine a light across the surface at a low angle to accentuate imperfections; Mark any spots that need an extra dab of filler with masking tape.
iv. Paint for a Smooth Finish Choose a paint designed for a smooth finish;
v. Paint all four edges of the door first.
vi. Brush on a light coat.
vii. Roll on the paint where you can
viii. Brush out rolled paint.

ix. Brush Around the Panels

1.4.1.2.4 Plastering

How to Repair the Plaster around a Window

- Pry off the trim molding around the window with the flat edge of a pry bar.
- Pull the nails from the molding with a nail puller or pliers. If necessary, tap the tip of the nails with a hammer to push the nail heads out from the surface of the molding enough to remove them with a puller or pliers.
- Scrape out damaged plaster around the window with the flat edge of the pry bar or a metal 5-in-1 scraping tool
- Sand the plaster around the area where you removed the trim with coarse-grit sandpaper. This roughens the surface and helps the repair compound hold. Sand approximately 3 inches over onto the plaster.
- Vacuum debris from the spaces around the window where you removed the molding and from the plaster you sanded.
- Mix plaster patching and repair compound with water in a plastic container such as a bucket or large bowl that is not used for food preparation. You can mix a small batch with a wooden paint stir stick; large batches more easily are mixed with a paint mixing paddle fastened to a power drill. Use the dry mix-to-water ratio recommended on the bag, and only mix as much as you need to apply one coat. Mixed plaster compound does not stay wet when stored. The thickness of the first layer is not critical. You need enough to force some through the spaces between the lath strips while leaving approximately 1/2 inch of material on the face of the lath.
- Scoop the compound onto a plaster finishing trowel or drywall finishing knife. Spread a 3/8-inch-thick layer of compound onto the lath, gently pressing to force some of the material between the lath strips; this creates lumps called keys on the back side of the lath, which hold the plaster in place after it dries.
- Wait 10 to 20 minutes until the plaster feels solid, cold and damp, but not hard, then drag a plaster comb across the surface of the plaster to create ridges. If you don't have a plaster comb, you can create the ridges by dragging a thin finishing nail across the plaster in numerous rows approximately 1/16-inch apart
- Let the first application of plaster patching compound dry for as long as the manufacturer recommends. In approximately two hours, the product will harden enough to apply more.
- Mix another batch of compound when the first layer is hardened to the touch. Spread a 3/8-inch-thick layer over the first layer, comb or score it very lightly with the comb or nail, and let the repair dry.
- Mix a final batch of plaster after the last coat you applied feels hard. In some cases, this requires overnight curing, but you may apply the finish coat the same day if the plaster patch compound manufacturer directs you to do so
- Spread a thin layer of plaster onto the repaired area and over onto the sanded portion of the surrounding plaster, making a seamless repair. This layer is a skim coat, and should be approximately 1/8-inch thick. If 1/8 inch is not enough plaster to match the thickness and blend with the surrounding plaster wall, apply a thicker layer

- Mist the fresh plaster on the wall with water from a pump spray bottle, and feather or blend the material with the flat side of the blade to create a smooth finish. Unlike drywall, which is sanded to smooth out imperfections, plaster is smoothed and finished with the metal blade.
- select finishing nails slightly larger in diameter than the original finishing nails used to install the molding.
- Hold one section of trim molding against the edge of the window frame where you removed it. Drive finishing nails through the original nail holes in the molding and into the wall. Install each section of molding the same way.

1.4.1.2.5 Tools and equipment

1. **Pointing Trowel -** A plasterer uses a pointing trowel for trimming small areas that needed extra attention. They are typically between 5-6 inches (12-15cm) in length**.**

Figure 68 Pointing Trowel

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiOsYvd9aPxAhVNzoUKHb5bCXQQFjAAegQIAhAD&url=https%3A%2F%2Fwww.wonkeedonkeetools.co.uk%2Fbest-plasterers-tools&usg=AOvVaw1ngjlsxLadHwotKgRvtaIx

2. **Window Trowel -** Its design of a long thin shank provides plasterers the ability to accurately level plaster over tricky joints and in hard to reach places**.**

Figure 69 Window Trowel

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiOsYvd9aPxAhVNzoUKHb5bCXQQFjAAegQIAhAD&url=https%3A%2F%2Fwww.wonkeedonkeetools.co.uk%2Fbest-plasterers-tools&usg=AOvVaw1ngjlsxLadHwotKgRvtaIx

3. **Corner Trowel (Internal and External)** Corner trowels allow you to finish the internal and external corners of a surface with accuracy and ease. A plasterers quality of work is typically judged on how smooth the finish is in addition to how well the corners of the surface are sealed. A corner trowel is a must have tool for a plasterer to ensure a smooth fill in to each edge of the surface.

Figure 70 Corner Trowel

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiOsYvd9aPxAhVNzoUKHb5bCXQQFjAAegQIAhAD&url=https%3A%2F%2Fwww.wonkeedonkeetools.co.uk%2Fbest-plasterers-tools&usg=AOvVaw1ngjlsxLadHwotKgRvtaIx

4. **Bucket -** A bucket has multiple uses and applications. You'll want at least a 10-litre bucket depending on your needs but this size would be suitable for most general purpose jobs. Ensure your bucket is clean and dry before mixing in it to ensure that your plaster mix it smooth and ready for application.

Figure 71 Bucket

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiOsYvd9aPxAhVNzoUKHb5bCXQQFjAAegQIAhAD&url=https%3A%2F%2Fwww.wonkeedonkeetools.co.uk%2Fbest-plasterers-tools&usg=AOvVaw1ngjlsxLadHwotKgRvtaIx

5. **Finishing Trowel** - A wide, flat, rectangular blade allows you to spread, smooth and level your plaster. You will be using this tool a lot, so invest in a good quality one with a comfortable grip. Top quality trowels are not welded through and are slightly convexed**.**

Figure 72 Finishing Trowel

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiOsYvd9aPxAhVNzoUKHb5bCXQQFjAAegQIAhAD&url=https%3A%2F%2Fwww.wonkeedonkeetools.co.uk%2Fbest-plasterers-tools&usg=AOvVaw1ngjlsxLadHwotKgRvtaIx

6. **Hand-Board (Hawk)** - A hawk is a simple portable surface which provides you with a flat plate on which to store a small amount of plaster material for ease of application to walls and ceilings.

This can help speed up work by allowing for plasterers to complete sections without having to continually return to wherever the mixed plaster is stored. This is especially useful when working in hard to reach areas as it allows for high walls or ceiling corners to be plastered in one go to ensure the quality of finish.

Figure 73 Hand-Board (Hawk)

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiOsYvd9aPxAhVNzoUKHb5bCXQQFjAAegQIAhAD&url=https%3A%2F%2Fwww.wonkeedonkeetools.co.uk%2Fbest-plasterers-tools&usg=AOvVaw1ngjlsxLadHwotKgRvtaIx

7. **Straight Edge -** A straight edge is used to even off rendered floors and can cover a large area in a short time. Typically used to measure distances, a plasterers straight edge is also used to help ensure surfaces are smooth. A plasterers straight edge is typically made from aluminium and is a great tool to use in the final steps of plastering to ensure a perfectly smooth finish.

Figure 74 Straight Edge

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiOsYvd9aPxAhVNzoUKHb5bCXQQFjAAegQIAhAD&url=https%3A%2F%2Fwww.wonkeedonkeetools.co.uk%2Fbest-plasterers-tools&usg=AOvVaw1ngjlsxLadHwotKgRvtaIx

8. **Tin Snips -** Tin snips are a type of shears used for snipping sheet metal. Their long handles provide higher leverage and certain models have a compound-action handle which increases the mechanical advantage. A plasterer will want a decent pair of these for trimming up beading**.**

Figure 75 Tin Snips

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiOsYvd9aPxAhVNzoUKHb5bCXQQFjAAegQIAhAD&url=https%3A%2F%2Fwww.wonkeedonkeetools.co.uk%2Fbest-plasterers-tools&usg=AOvVaw1ngjlsxLadHwotKgRvtaIx

9. **Spirit Level -** A spirit level is absolutely essential if you want to have flat surfaces and even finishes. The reputation of plasterers quality of work is vital for expanding your customer base and repeat work. Spirit levels allow you to ensure that you get perfectly even plaster finishes every time**.**

Figure 76 Spirit Level

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiOsYvd9aPxAhVNzoUKHb5bCXQQFjAAegQIAhAD&url=https%3A%2F%2Fwww.wonkeedonkeetools.co.uk%2Fbest-plasterers-tools&usg=AOvVaw1ngjlsxLadHwotKgRvtaIx

10. **Jointing Knife / Taping Knife -** Jointing knives are designed for the laying of drywall tape. They help to seal the joints between boards and provide a seamless finish. All plasterers need a couple of these at hand, preferably a large taping knife and a smaller jointing knife for those cramped spaces.

Figure 77 Jointing Knife / Taping Knife

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiOsYvd9aPxAhVNzoUKHb5bCXQQFjAAegQIAhAD&url=https%3A%2F%2Fwww.wonkeedonkeetools.co.uk%2Fbest-plasterers-tools&usg=AOvVaw1ngjlsxLadHwotKgRvtaIx

11. **Step Ladder** - Plasterers need to reach high walls as well as ceilings so a good quality step ladder is vital.

Figure 78 Step Ladder

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiOsYvd9aPxAhVNzoUKHb5bCXQQFjAAegQIAhAD&url=https%3A%2F%2F

www.wonkeedonkeetools.co.uk%2Fbest-plasterers-tools&usg=AOvVaw1ngjlsxLadHwotKgRvtaIx

1.4.1.3 Learning activities

Practical assessment

You are required to complete the following tasks

1. Fix ironmongery on the door provided
2. Fix a window and then conduct finishing by plastering around the same window
3. Fix a door and then conduct finishing by painting the same door.

Resource Requirements

1. A fully functional workshop
2. A door and a window to be fixed in place.

Self-Assessment questions

1. What is plastering?
2. How is plastering carried out?
3. Which are some tools used in plastering?
4. Which steps would you follow when painting a door?
5. Which steps would you follow when glazing a window?
6. Which guidelines govern glazing?
7. What is the importance of a pointing trowel?
8. Which are the main reasons of painting surfaces?

9. What are the main characteristics of good paint?
10. Which are the main types of paints?

Response to self-assessment questions

1. What is plastering?

   Plastering is the process of covering rough walls and uneven surfaces in the construction of houses and other structures with a plastic material, called plaster, which is a mixture of lime or cement concrete and sand along with the required quantity of water.

2. How is plastering carried out?

   i. **Preparing the surface**
   ii. **Mixing**
   iii. **Applying the plaster finish**
   iv. **Finishing**

3. Which are some tools used in plastering?

   i. **Trowel**
   ii. **Buckets**
   iii. **Jointing knife**
   iv. **Spirit level**
   v. **Straight edge**

4. Which steps would you follow when painting a door?

   i. **Sand the Door Smooth- start with a light sandpaper or a sanding sponge. This will roughen the surface a little and allow the primer to adhere better. smooth out chipped paint and imperfections from previous paint jobs.**
   ii. **Remove the Sanding Dust Use a vacuum with a brush attachment to remove most of the dust. Wipe off the rest with a damp rag**
   iii. **Sand After Priming Sand out any imperfections in the prime coat; Shine a light across the surface at a low angle to accentuate imperfections; Mark any spots that need an extra dab of filler with masking tape.**

iv. **Paint for a Smooth Finish Choose a paint designed for a smooth finish;**
v. **Paint all four edges of the door first.**
vi. **Brush on a light coat.**
vii. **Roll on the paint where you can**
viii. **Brush out rolled paint.**
ix. **Brush Around the Panels**

5. Which steps would you follow when glazing a window?

i. **Inspect the Window**
ii. **Take Out the Sash**
iii. **Take out the Damaged Glazing**
iv. **Inspect the Wood Frame –**
v. **Install the Glass**
vi. **Apply the Window Putty**

6. Which guidelines govern glazing?

Glazing should be in accordance with BS 6262. Insulated glass units (IGU) should meet requirements of BS EN 1279 – Glass in building – insulating glass units, be CE marked and carry third-party accreditation. This includes windows in possession of a BBA certificate and timber windows.

- **They should have continuous dual seals; single seal units are not acceptable.**
- **Desiccant should be provided to spacer bars.**
- **Any glazing on-site must have a drained and ventilated bottom bead with a minimum gap of 5mm between the edge seal of the insulated glass unit and the bottom channel of the frames glazing rebate.**

Any glazing with an area greater than 1m² must have a drained and ventilated bottom bead with a minimum gap of 5mm between the edge seal of the insulated glass unit and the bottom channel of the frames glazing rebate.

• Glazing with an area less than 1m2 may be solid bedded.

• All spacer bars should be stamped with BS EN 1279.

• PVC-U frames and spacer bars should be stamped with BS 7412, 7413, and 7414.

Linseed oil glazing putty should not be used when the joinery is finished with vapour permeable paint or stain. Glazing putty should also not be used with organic solvent-based stains, the putty should be neatly finished to receive a protective paint coat.

Putty is not suitable for laminated glass and double-glazed units, the workmanship should be in accordance with BS 8000: 7. To ensure the compatibility of the whole glazing system is to a high level of workmanship and control, it is recommended that factory pre-glazed systems be installed in all external openings.

7. What is the importance of a pointing trowel?

   A pointing trowel is a bricklayer's tool used for filling and shaping the mortar in between bricks, a process known as pointing.

8. Which are the main reasons of painting surfaces?
   i. **Simple maintenance – surfaces and areas that are well-painted are much easier to clean**
   ii. **Provides protection to surface against from solar radiation, insects, rain and other external factors**
   iii. **Improving the visual appeal of the surface**
   iv. **Improving surface durability**
   v. **Waterproofing**
9. What are the main characteristics of good paint?
   i. **Should form a durable and hard coating**
   ii. **Should be easy to apply**
   iii. **Should form a thin film without cracking**
   iv. **Reasonable or excellent drying period**
   v. **Should not get affected by weather conditions**
10. Which are the main types of paints?

i. **Enamel Paint**

This particular type of paint is commonly produced by adding zinc or lead straight to varnish. In order to achieve a vast array of colors, pigments are going to be added onto it. Enamel paints are proven to form hard and glossier coatings that are absolutely easy to clean. Additionally, the paint is characterized by being chemically resistant and waterproof, offering excellent color retention and good coverage.

Some of the most common uses of enamel paint:

- **Windows**
- **Interior and exterior walls**
- **Stairs**
- **Wood trims, flooring, doors**

ii. **Oil Paint**

Oil paints usually use white lead as its base and are usually applied in 3 coatings – primer, undercoat, and lastly finish coat. This type of paint can greatly achieve glossy and mat finishes and at the same time while being durable and affordable. The painted surfaces after using oil paint are very easy to clean and it is also characterized by ease of application. Oil paint is typically used indoors, metal structures, walls and windows. It is important to take note that oil paint isn't suitable most particularly for humid conditions and it also take so much time to dry out completely. For its application, linseed oil and pigments should be added beforehand.

iii. Emulsion Paint

Emulsion paints often use polystyrene and polyvinyl acetate as its binding materials, and at the same time, it contains driers such as manganese and cobalt. Furthermore, this paint can either be oil-based or water and its pigments are often used in order to achieve all desired colors. Emulsion paints are typically characterized by its hardening and fast-drying capabilities. For the surfaces, it can be easily cleaned using water. After the application, the paint itself definitely offers good color retention, durability and lastly alkali resistance.

iv. Cement Paint

This type of paint is neither water nor oil-based but usually available in powder form, mixed using water to achieve paint consistency. The very base material for this is either colored cement or white and it might also contain pigments, other additives, and even accelerators. Cement paint is commonly used in both rough external and internal surfaces since its characteristics are proven to be very durable and waterproof. Take into consideration that cement has longer drying time, usually for about 24 hrs. The application for it should be done in two coatings in order to prevent dampness issues.

v. Bituminous Paint

This specific type of paint is usually made from tar or dissolved asphalt that ultimately gives it a common characterized black color. It is also waterproof and at the same time alkali-resistant. However, it is not suitable for any applications wherein it will be fully exposed to the sun because it gradually deteriorates. Bituminous paint is typically used for concrete foundations, underwater ironworks, iron pipes, and wooden surfaces. For metal application, it helps in providing rust resistance.

vi. Plastic Paint

This type of paint often uses water as the thinner, and this is very much available in a wide-ranging set of colors. The way it dries is quick and it certainly offers very high coverage. Below are the common applications of plastic paint:

· Slabs

· Ceilings, walls of display rooms, auditoriums, showrooms, etc.

· Decks

Tools, Equipment, Supplies and Materials

Tools required

- Bucket
- Dust mask
- Orbital sander
- Paint brush
- Paint roller
- Paint scraper
- Putty knife
- Rags
- Roller sleeve
- Roller tray
- Sanding block
- Shop light

- Shop vacuum
- Tweezers
- Utility knife

Supplies and materials

- Foam brushes
- Paint
- Paint drip remover
- Primer
- Sandable filler
- Sanding sponges
- Sandpaper

1.4.1.4 References

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2. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjJp7O8y_3uAhWSo3EKHeNiAn4QwqsBMAB6BAgIEAM&url=https%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3DaUxvl4P5p4Y&usg=AOvVaw1lN64AdHBKjJitcZdh4l8L