RQF LEVEL 5

TRADE: INTERIOR DESIGN

MODULE CODE: INDDW501

TEACHER'S GUIDE

Module name: DESIGNING WINDOWS

Table of content

Acronyms

Introduction

✓ **Definition of Window**:

- A window is a vented barrier provided in a wall opening to admit light and air into the structure and also to give outside view.

✓ Purposes of windows

- Windows increases the beauty appearance of building.
- Admission of light and air (ventilation)
- Windows are often arranged also for the purposes of architectural decoration.
- To give outside view

✓ **Selection Criteria for Windows design**

Selection of suitable window in a particular place should be dependent of following factors.

- Location of room
- Size of room
- Direction of wind
- Climatic conditions
- Utility of room
- Architectural point of view

Module Code and Title: INDDW501: DESIGNING WINDOWS

Learning Units:

1. Select type of window to design
2. Select materials
3. Develop Window design
4. Implement the window design

Learning Unit 1: Select type of window to design

STRUCTURE OF LEARNING UNIT 1

Learning outcomes:
1.1. Identify window
1.2. Identify window features
1.3. Assess types of window accessories

Learning outcome 1.1: Identify window

 Duration: 5 hrs

 Learning outcome 1.1 Objectives

By the end of the learning outcome, the trainees will be able to:

1. Define properly window
2. To differentiate correctly types of windows
3. To categorise properly shapes of windows

 Resources

Equipment	Tools	Materials
- Projectors - Computer	- Flash Cards	- Art Glass samples - Flip Chart - Books - Internet - Photos

 Advance preparation:

- ✓ Projectors
- ✓ Computer
- ✓ Pictures of different types of windows

Indicative content 1. Identification of different types of Windows and styles

There are so many types of windows that are available based on their positions, materials and functioning.

1. Fixed windows
2. Sliding windows
3. Pivoted windows
4. Double hung windows
5. Louvered windows
6. Casement windows
7. Metal windows
8. Sash windows
9. Corner windows
10. Bay windows
11. Dormer windows
12. Clerestory windows
13. Lantern windows
14. Gable windows
15. Ventilators
16. Skylights
17. Horizontal sliding sash window
18. Awning window
19. Eyebrow window
20. Single-hung sash window
21. Oriel window
22. Thermal, or Diocletian windows
23. Picture windows
24. Emergency exit windows (Egress)
25. Stained glass windows
26. French windows
27. Panel windows
28. Double - and triple paned windows

❖ Description of Types of Windows and styles used in Buildings

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 weather proof.

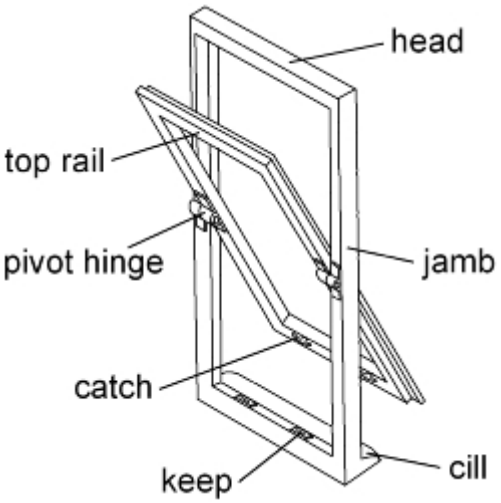
2. Sliding Windows

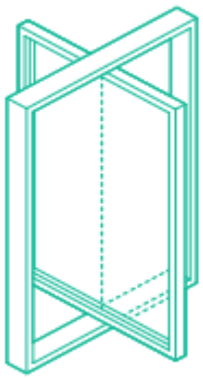
In this case, window shutters are movable in the frame. The movement may be horizontal or vertical based on our requirement. The movement of shutters is done by the provision of roller bearings. Generally, this type of window is provided in buses, bank counters, shops etc.

SLIDING WINDOWS. Are windows constructed in a frame and installed so that they slide open and closed, as opposed to opening, in or out, on a hinge.

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.

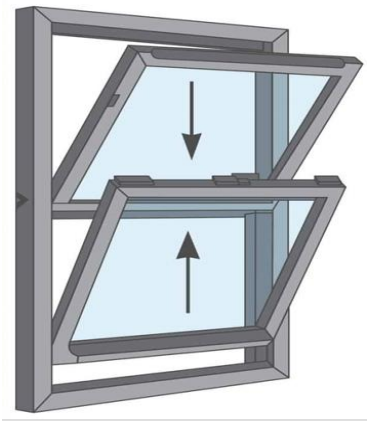




4. Double Hung Windows

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.

To operate the double hung windows, a chain or cord consisting metal weights is metal provided which is connected over pulleys. So, by pulling the weights of cord the shutters can move vertically. Then we can fix the windows at our required position of ventilation or light etc.



5. Jalousie 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°. 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.

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 fly's.

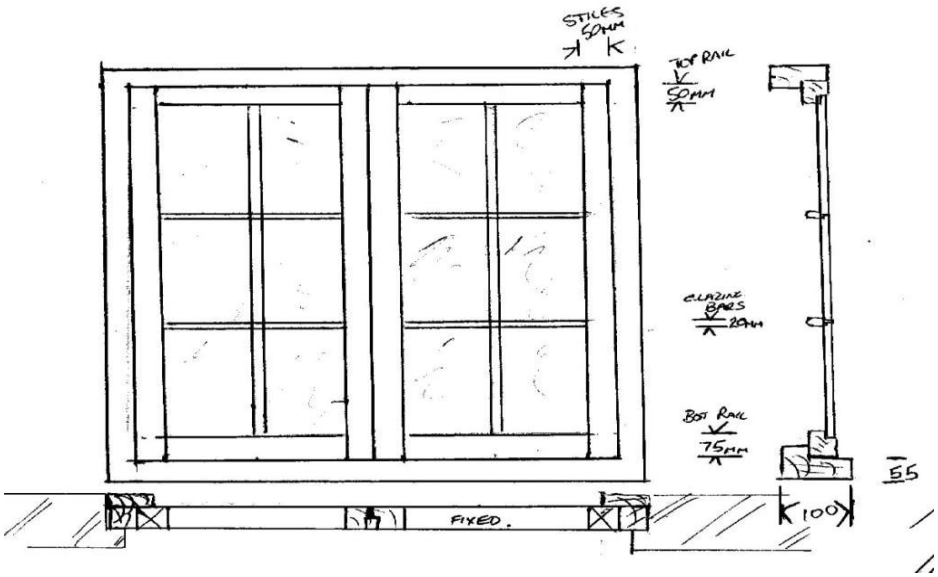
7. Metal Windows

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 aluminium, 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.

8. Sash Windows

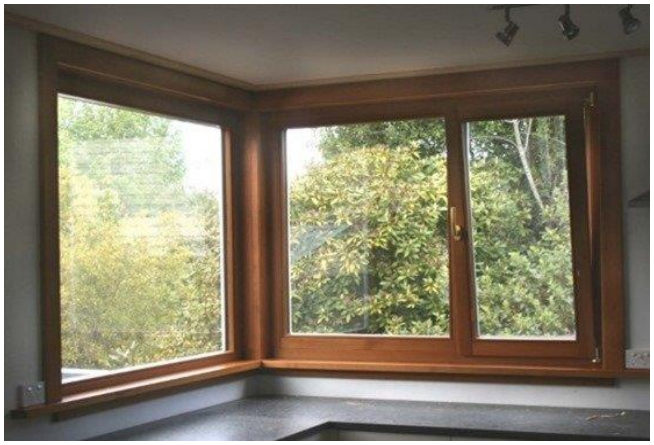
A **sash window** or **hung sash window** is made of one or more movable panels, or "sashes". Sash window is type of casement window, but in this case panels are fully glazed. It consists top, bottom and intermediate rails. The space between the rails is divided into small panels by mean of small timber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



9. Corner Windows

As in the name itself corner windows are provided at the corners of room. That means corner windows 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.



10. Bay Windows

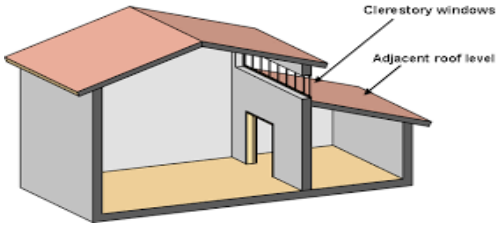
Bay windows are projected windows form wall which are provided to increase the area of opening, which enables more ventilation and light form outside. The projection of bay windows is of different shapes. It may be triangular or rectangular or polygonal etc. They give beautiful appearance to the structure.

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.

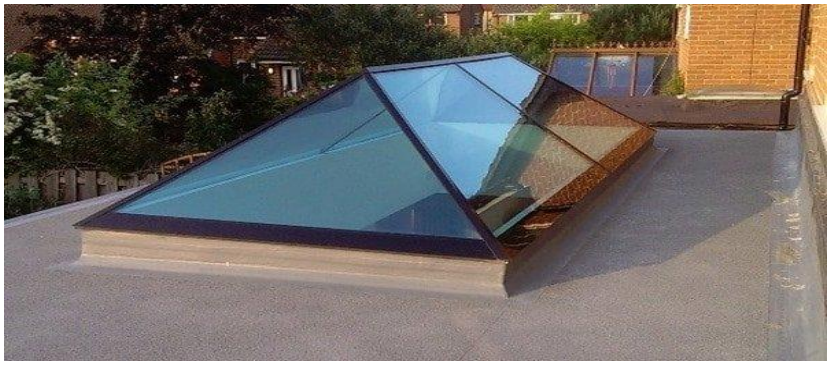
12. Clerestory Windows

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 able to swing with the help of cord over pulleys. These also enhances the beauty of building.



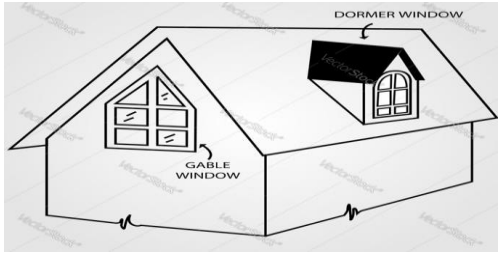
13. Lantern Windows

Lantern windows are provided for over the flat roofs. The main purpose of this window is to provide the lighter 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.



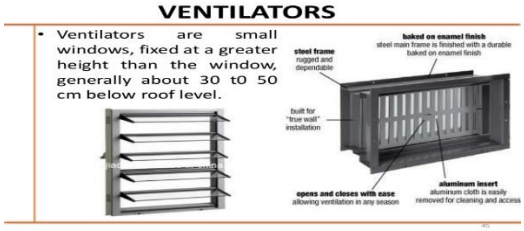
14. Gable Windows

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.



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.



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.

17. Awning windows

Are hinged on the top and open outward from the bottom, allowing for ventilation and protection from the rain. Often placed higher on walls for privacy or in combination with large stationary windows for a better view.

18. Eyebrow window

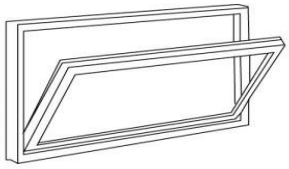
The **eyebrow window**, or **eyebrow dormer** as it is often referred to since it is most commonly found in roofs, is a small arched **window** that projects into the roof to allow light into an upper story.

19. A single hung sash window

Single-Hung windows allow ventilation through a **single** operable lower sash.

20. Hopper window

Hopper windows haves bottom-hinged sashes that swing inward from their frame.



21. Oriel window

An oriel window is a form of bay window which protrudes from the main wall of a building but does not reach to the ground.

22. Thermal, or Diocletian windows

Diocletian window, also called thermal window, semicircular window or opening divided into three compartments by two vertical mullions. Diocletian windows were named for those windows found in the Thermae, or Baths, of Diocletian (now the church of Santa Maria degli Angeli) in Rome.

23. Picture windows

A **picture window** is a large **window** that does not open up. It offers a clear and unobstructed view of the outside environment. It is basically framework for whatever view is on display.

24. Emergency exit windows (Egress)

Egress Window is a safe exit from a property and it' mainly help in times of emergency like Fire etc!

25. Stained glass windows

Stained glass, in the arts, the coloured **glass** used for making decorative **windows** and other objects through which light passes. Strictly speaking, all coloured **glass** is "**stained**," or coloured by the addition of various metallic oxides while it is in a molten state.

26. French windows

Each of a pair of glazed doors in an outside wall, serving as a window and door, typically opening on to a garden or balcony.

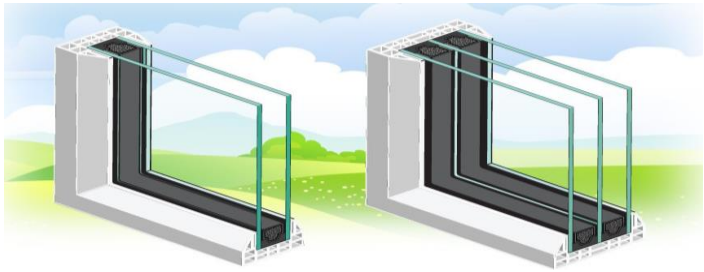
27. Panel windows

Panelled window is a very old type of window and popular, even today, throughout the world. Generally, the panels were made of wood, and nowadays are also made of vinyl, aluminum, etc. The stiles and rails are meeting at outside the frame members. This type of window has single, double, three or six panels.

Panelled Window

28. Double - and triple paned windows

The primary difference between double- and triple-pane windows is that triple-pane windows are fabricated with three panes of glass instead of two. ... The additional insulation makes them the best windows for sound reduction, but consider their cost carefully before you make a final decision.

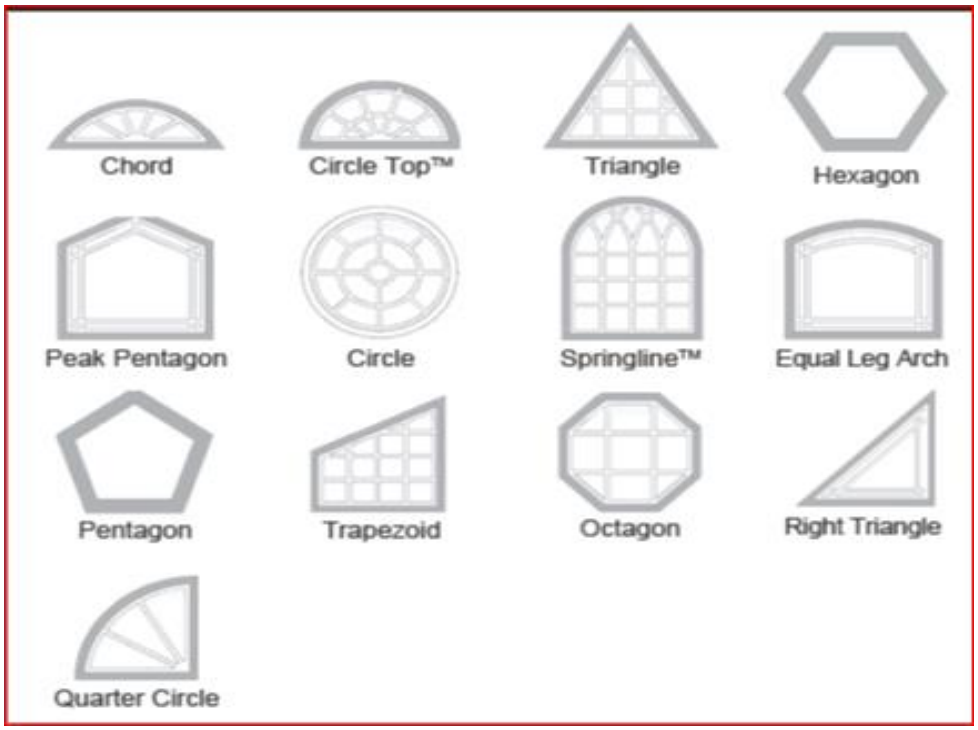


Indicative content 2. Windows Shape

Those are different types of window shapes. It depends on the designer and type of construction to choose one of those shapes.

Window Shapes Are:

- ✓ Oval
- ✓ Circular
- ✓ Hexagonal
- ✓ Square
- ✓ Rectangular
- ✓ Arch
- ✓ Circle Top
- ✓ Eyebrow
- ✓ Triangle
- ✓ Quarter circle



Theoretical learning Activity

- ✓ By means of sketch discuss Window types and styles (example: ask trainees to brainstorm about within groups)

Practical learning Activity

- ✓ With using simple sketches, draw ant ten (10) types of windows.

Points to Remember

- Windows types and styles
- Window Shapes

Learning outcome 1.1 Formative assessment

Written assessment

1. Define “Window” as used in construction. **(5 marks)**

Answer: A window is a vented barrier provided in a wall opening to admit light and air into the structure and also to give an outside view. Windows also increase the beautiful appearance of the building.

2. List any ten (10) types of windows used in construction. **(5 marks)**

Answer:

1. Fixed windows
2. Sliding windows
3. Pivoted windows
4. Double-hung windows
5. Louvered windows
6. Casement windows
7. Metal windows
8. Sash windows
9. Corner windows
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24. Emergency exit windows (Egress)
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26. French windows
27. Panel windows
28. Double - and triple-paned window

Learning Outcome 1.2: Identify window features

 Duration:10 hrs

Learning outcome 1.2 Objectives

By the end of the learning outcome, the trainees will be able to:

1. Identify properly window Components
2. Differentiate correctly types of Window Treatment
3. Select properly types of window frames

Resources

Equipment	Tools	Materials
- Computer - Projector		- Photos - Internet - Books - Flashcards - Frame samples

Advance preparation:

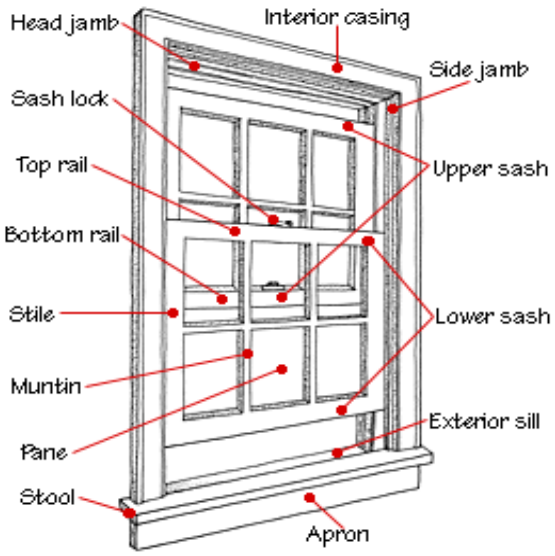
- Computer
- Projector
- Photos
- Frame samples

Indicative Content 1: Identification of Windows components

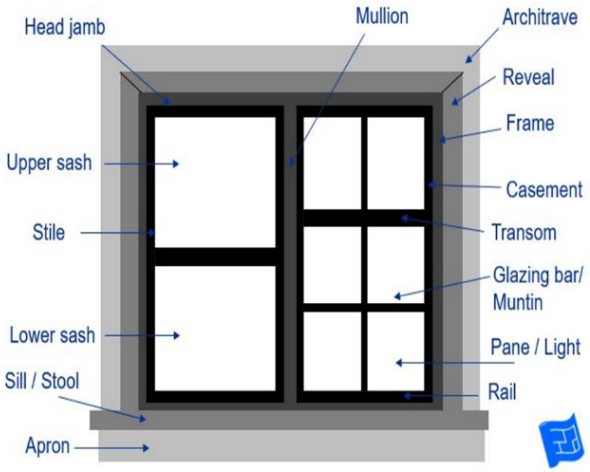
Windows area can include a number of different components

1. **Light**: The area between the outer parts of a window, usually filled with a glass pane.
2. **Frame:** This holds the light in place and supports the window system. Or The framework that makes up the window's perimeter and supports the entire window system.
3. **Lintel:** A beam over the top of a window.
4. **Jamb**: The vertical parts form the sides of the frame.
5. **Sill (or cill):** The bottom piece in a window frame, often projecting beyond the line of the wall.
6. **Mullion:** A vertical element between two window units or lights.
7. **Transom:** A horizontal element between two window units or lights.

8. **Head:** The uppermost member of the frame.
9. **Sash**: The frame holding the glazing. The sash can be divided into two categories:
   - **Upper sash:** The upper part of the fixed or movable framework holding the pane of a window.
   - Lower sash: The lower part of the fixed or movable framework holding the pane of a window.
10. **Casement:** a window (or sash) attached to its frame by one or more hinges.
11. **A muntin:** Is a strip of wood or metal that separates and holds panes of glass in a window.
12. **Reveal** refers very broadly to the inner surface of an opening or recess in a wall, typically in relation to a window or door. The reveal forms a box structure to which a window or door frame is attached.
13. **Grids/Grille:** these are narrow strips of wood, vinyl, or metal used to visually separate the glass of a window into panes or lites.



Parts of window (fig.1)



Parts of window (fig.2)

- Some description
  - ✓ Window Sash

The window sash is one of the most important parts of your window. A window sash is part of the window that contains the glass panel and opens and closes.

  - ✓ Importance of a Window Sash

The sash window frame usually has a locking system, providing extra safety and security for your property. Another reason it is important to ensure your window sashes are working properly is for safety and security reasons. If the locks on your windows are broken, damaged,

or just not functioning anymore, this poses a major security threat. Without functioning locks, anyone could break into your home with ease. What's more, if you have children, window openings that are not controlled can be very unsafe. So, keep your home secure with working sashes.

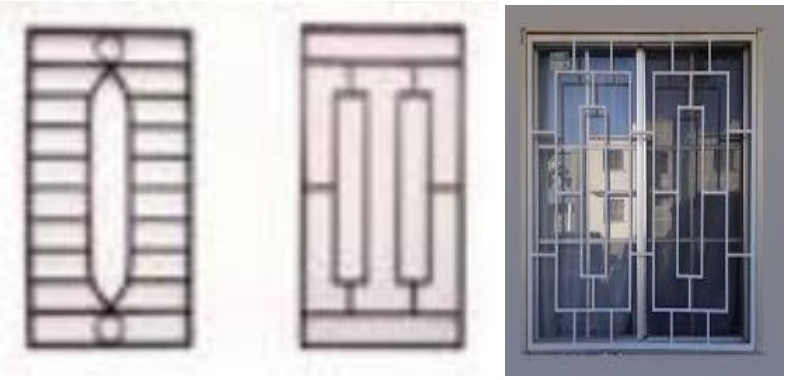
The window sash is the most crucial element of your window. It affects the overall performance and durability of your sash windows and, if it isn't working properly, it could lead to numerous problems – particularly draughts and leaks. So, it is important that your window sashes are kept in good working order.

- Window grids/grille

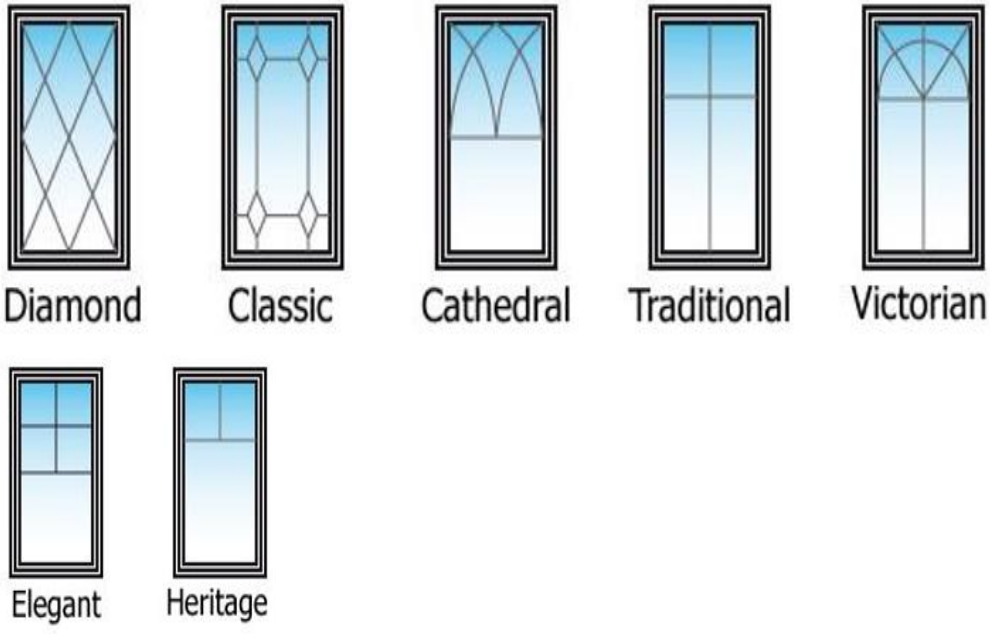
Window "grille" is really a metal or wood lattice-like structure attached outside the plane of the window, sort of like a window guard. Also Grids (or muntins or grilles) are strips of material that simulate smaller panes of glass. Use our quick guide to window grids to help make decisions regarding the style of your windows.

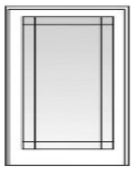
- Grid Style
  - Colonial-style grids are usually divided into equal sections. Commonly in sets of 4, 6 or 9. Colonial grids are a more traditional look.
  - Prairie-style grids are divided into unequal panes. They feature a larger square in the middle and smaller squares in the corners. These are a contemporary or farmhouse style.
  - Diamond grids Diagonal metals create a diamond grid system of small panes of glass, also referred to as lites. With modern technology, many new windows are now made of a single glass pane.
  - Tall fractional grilles are suspended between the panes of glass, allowing you to easily clean both the inside and outside of your windows and doors. Fine light Between-the-Glass with Exterior Grilles grilles-between-the-glass make interior windows and patio door glass easier to clean.
  - Short fractional also known as top row grids or short fractional grids, drop grids are only placed along the top portion of the window or door. Thus, for homeowners deciding whether to choose grids or forgo them in favor of the current "clear" look, drop grids provide a charming compromise

Custom: For a truly unique look, try a custom grid configuration like diagonals. Grid styles add more design possibilities.



- Images of clarification for different types of grilles





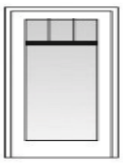
Prairie

Colonial

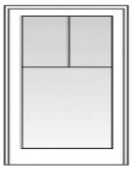
Modified Colonial

Modified Colonial–
Simulated Check Rail

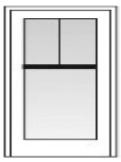
Short Fractional



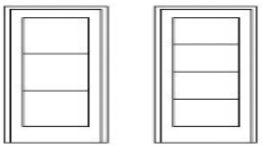
Short Fractional–
Simulated Check Rail



Tall Fractional



Tall Fractional–
Simulated Check Rail



Specified Equal Light

- Grid Types

There are three grid types:

- Grids between Glass (GBG)
- Exterior Grids, and
- Simulated Divided Lites (SDL).

- **Grids between Glass (GBG):** Are color-matched grids installed between the glass panes, making them an attractive, easy-to-clean option.

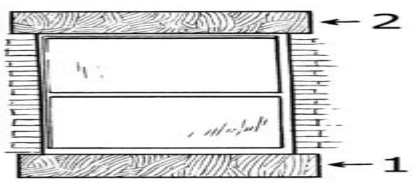
- **Exterior grids:** Are grids installed on the exterior surface of the glass with a grid between the panes of glass. Permanently attached to the window, exterior grids are available in 5/8" or 1" profile.

- **Simulated Divided Lights (SDL):** SDL grids are designed to replicate those beautiful older windows. SDL simulates several single panes of glass set into the grids.

- Window sill

  - **A window sill** is the surface at the bottom of a window. Window sills serve to hold the window or glass in place and also provide a mechanism for the shedding of rain water away from the wall directly below the window.

A window sill can be the horizontal piece below a window unit in masonry construction or in wood framing. The sill of the window frame sits on the window sill of the wall opening.



1) Sill; 2) lintel.

❖ Main Reasons Why Homes Need to Have Window Sills

- **Keeps water out**

As water sprinkles down a dwelling, the upper window sill catches it and directs it away from the structure. The water will either spill on the side of a window sill or over it, keeping it from seeping through and ruining the interior structure of a build.

- **Window sills help hold a window in place.**

Window sills are necessary because they are a part of a building's structure. They serve as the framing of the window to keep it in place. Without a window sill, the opening of that window would sway and shift as the foundation settles.

- **The window sill acts as a brace to reinforce the wall.**
- **Interior Window sills can be decorative.**

As a building contractor, there is no choice of whether or not you should install them. It's absolutely necessary, whether you understand the reasoning behind them or not. Buyers expect it and it's as common.

- Window lintel

The Lintel is a horizontal member placed just over the openings of doors, windows, verandas, etc. to support the load of the masonry work over It.

Lintel beams provide supports to the openings in the building and transfer that load safely to the masonry walls or columns. Their width must be equal to the width of the wall – where they are constructed. They are built on the top of openings, and their ends are built in the wall.

Arches are also constructed on the place of the lintel. However, as compared to arches, lintel beams are very easy to construct. Lintel beams are rectangular in plan and section. They are constructed with different materials

❖ Types of lintel

They have the following major types.

- Wooden Lintel.
- Stone Lintel.
- Concrete Lintel.
- Reinforced Brick Lintel.
- Steel Lintel.

❖ Description of lintels

1. Wooden Lintels.

Wooden or Timber Lintels are the oldest types of lintel. Timber lintels are relatively costlier, structurally weak and vulnerable to fire. They are also liable to decay if not properly ventilated. Sometimes, timber lintels are strengthened by the provision of mild steel plates at their top and bottom; such lintels are called flitched lintels.

2. Stone lintels.

Rectangular pieces of stone can be used as lintel. This type of lintel will be very firm and strong, but it weighs too much. Their thickness is kept approximately 10 cm per meter.

3. Concrete Lintels.

They are made of cement concrete and have the following types.

- Plain Concrete Lintel: This type of lintel is prepared with plain concrete as steel bars are not used in it.
- R.C.C Lintels. (Reinforced concrete): In this type, reinforcement is used to overcome the low tensile problem in concrete.

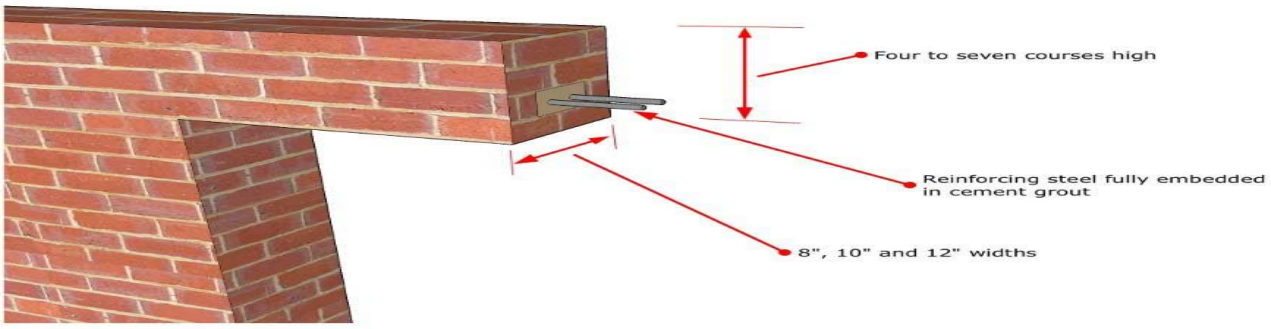
It has two types with respect to their construction.

- ✓ Precast Lintels: They are generally prepared in factories
- ✓ Cast in Situ Lintel: They are constructed directly on the openings monolithically with the masonry walls or columns.

Subsequently, steel bars are tightened together after its design.

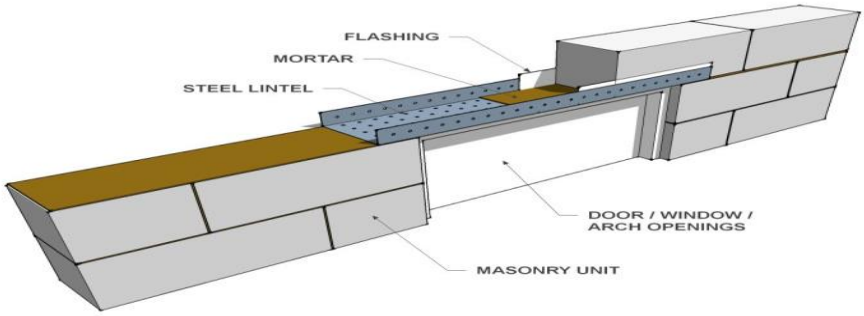
4. Reinforced Brick Lintels:

Where loads are heavy, or span is more, it may be made of reinforced brick work. The depth of such lintel is kept equal to 10 cm or in multiple of 10 cm. Sometimes, a 15 cm thick brick lintel may be obtained by using 5 cm thick lies in conjunction with 10 cm thick bricks.



5. Steel Lintels.

It consists of rolled steel joists or channel sections either used singly or in the combination of two or three units. They are provided where the opening is large and where the super-imposed loads are also heavy.



❖ Advantages of lintel

They have the following advantages.

- They look simpler and are easy to build.
- The Excessive load is not applied over the ending supports of lintels. Hence, they are not required to be constructed so firmly.
- Centering of lintel is easy, and frameworks are also inexpensive.
- They can bear a high amount of load if the load is coming uniformly.
- They are delicate and look simple.

Content 2: Identification of types of window treatment

❖ Types of Windows Treatment

1. **Glazing**: is the action, process, or trade of fitting windows with glass.

Steps of glazing window with putty

Step1: Inspect the window

Step2: take out the sash

Step3: takeout the damaged glazing

Step4: inspect the wood frame

Step 5: Install the glass

Step6: apply the window putty

Step7: cover the glazing in paint

2. **Insect screens**

A window screen (also known as an insect screen, bug screen, fly screen or wire screen) is designed to cover the opening of a window. It is usually a mesh made of metal or plastic wire, or another piece of plastic and stretched in a frame of wood or metal. It serves to keep leaves, debris, spiders, insect, birds, and other animals from entering and without blocking flesh air –flow.


3. **Art Glass**: is an item that is made, generally as an artwork for decoration but often also for utility from glass, sometimes combined with other materials.

Indicative Content 3: Identification of the type of Windows frame

✓ **Frame of window**

A **window frame** supports the weight of the wall around the opening using the studs to transfer the load to the foundation.

The window frame is divided into a head side (the top), sill side (bottom), and jambs (sides).

- **Materials for a window frame design**

It is usually most cost-effective in the long run to install the best window you can afford. Window frames can be made of wood (which may be clad with aluminum or vinyl on the exterior portions), vinyl, fiberglass, or metal

✓ **The major types of window frames**

The four major types of window frames are vinyl, aluminium, fiberglass, and wooden. It's important to consider the benefits of each to determine which type fits your needs.

- Wooden frames
- Vinyl
- Aluminium
- Fiberglass
- PVC
- Steel

1. Vinyl Window Frames

Vinyl windows are windows with frames made out of PVC (polyvinyl chloride). They are also affordable and are known for being good insulators. Vinyl is the go-to material for those looking to play with window frame designs to match their style. However, when it comes to durability wooden and aluminum windows are a better option.

2. Fiberglass Window Frames

Fiberglass window and door frames are essentially composed of glass fibers and resin, materials that expand and contract very little with temperature changes in the weather.

Fiberglass windows' durability is evidenced by their ability to resist weathering and standing up to extreme temperature changes more capably than any other material. Painting tends to being life to the otherwise dull material, although even then people still find it lacking in charm, People also prefer vinyl to fiberglass as the former is a cheaper option and offers more aesthetic value.

3. Aluminium Window Frames

Aluminum is the most abundant metallic element in Earth's crust and the most widely used nonferrous metal. Aluminum windows are known for being rugged and long lasting. They let in plenty of sunlight and are low-maintenance, especially when they aren't painted. They don't wear out in sunlight, rot or suffer from most common wear problems that affect other materials. When compared to other options they fall short in terms of efficiency. They are also quite expensive.

4. Wooden Window Frames

Wooden windows are highly durable, they're attractive, and they are known to last for a very long time when properly maintained. They are not only the most expensive in this list, but also require a lot maintenance. They are also susceptible to rot and weathering in certain climates.

5. PVC frames

PVC, in full polyvinyl chloride, a synthetic resin made from the polymerization of vinyl chloride. Very strong and easy to maintain with an individual appearance.

6. Steel frames

Window frame made in steel. This type of window frame is found in a basement, apartment complex or a school.

Summary for the trainer related to the content (keynotes using bullets such as ticks etc.)

Theoretical learning Activity

- ✓ Presentation on window components
- ✓ Research on window frames
- ✓ Group Discussion on window components **(**example: ask trainees to brainstorm about window frames within groups)

Practical learning Activity

- ✓ Correct identification and selection of the window frame materials.

Points to Remember

- ✓ Window Components
- ✓ Types of window treatment
- ✓ Types of window frames

Learning Outcome 1.2 Formative assessment

Written assessment

1. **Answer by TRUE or FALSE**
   a) Frame holds the light in place and supports the window system.
   b) Jamb is a beam over the top of a window.
   c) Lintel is the vertical parts from the sides of the frame.
   d) Sill (or cill) is the bottom piece in a window frame, often projecting beyond the line of the wall.
2. List any three (3) window treatments.

   Answer:

   - Glazing
   - Insect screens
   - Art Glass
3. Identify any five (5) types of window frames.

Answer:

- Wooden frames
- Vinyl
- Aluminum
- Fiberglass
- PVC Steel

Learning Outcome 1.3 Assess types of window accessories

Duration: 5 hrs

Learning Outcome 1.3 Objectives

By the end of the learning outcome, the trainees will be able to:

1.Identify properly types of window accessories

Resources

Equipment	Tools	Materials
- Computer - Projector		- Photos - Internet - Books - Flash cards - Samples of window accessories

Advance preparation:

Availability of Samples of window accessories

Indicative Content 1: Types of Windows accessories

✓ Meaning of window accessories

Window accessories typically refers to the pieces and parts that are used to lock or open your window. These typically include cam locks, lift rails or lift handles, and crank handles.

1. Window locks

✓ Types of Window Locks

a) Keyed Locks: They're installed on the side of your window and secure it to the frame. Keyed locks, as the name implies, can only be locked and unlocked using a key. It's important that you know where the key is otherwise you won't be able to open your window ever again.

b) Child Safety Latches: Child safety latches allow your window to open to a certain degree. Double hung and sliding windows often have two sets of child safety latches found at 3 and 5 inches. They're known as child safety latches is because they're made more to keep children in your home than trespassers out.

c) Swivel Action Locks: These locks use a self-locking snib (catch) to prevent a closed window from opening. It does not require a key and work well with most double hung

windows. To open a window with a swivel action lock, you turn the snib from left to right to release.

d) Lag Screws: If you're looking for a cheap way to add extra security to your window, lag screw locks are a great option. You'll need to drill a couple of holes on the window and insert the lag screws. Then, by tightening washers on each side, you're able to prevent the window from opening.

e) Sliding Window Locks: It's a long solid lock that's placed in the track on the side that prevents the window/door from opening. These locks can only be used with sliding windows and sliding patio doors.

f) Hinged Wedge Locks: A hinged wedged lock prevent a double hung window from opening. If installed directly above the sash, it can keep a closed window from opening until you push the lock inward to allow the window to open fully.

g) Window Pin Lock: There are two pieces to a window pin lock: the part that's installed on your window and the one on your window frame. When these two parts are attached, they prevent your window from opening.

h) Folding Latches: Folding latches are often used to lock casement and awning windows. They're found on the frame of the window and, once the window is closed, fold down to lock it into place. If you want to open your window, it's as simple as unfolding the latch by pulling it up.

i) Handle Lock: A common window lock that's associated with hopper and awning windows is a handle lock. They're a simple latch that, when horizontal, locks your window. When it's pulled vertically, it unlocks and doubles as a handle to open your window.

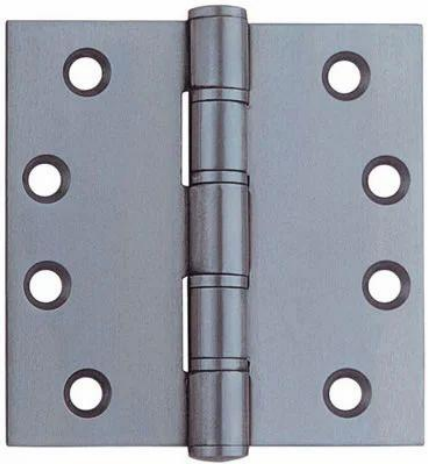
2. Window Latch: Window latches are the most common type of window lock. They're found on most single and double-hung windows when they're installed. Made up of a catch and a lever that sits on the internal frame of the window, not only do they provide security, but it also helps to keep your energy bills down and heat inside the home as the window latch also helps to secure the seal around the window and keep the cold out.

3. Blinds: Blinds lift up and down with a cord or lifting mechanism like shades do, in that blinds are not a solid length of fabric. Rather, they are made of wood, bamboo, aluminium, or vinyl slats, also called louvers, that tilt open to let in light or close for privacy.

4. Louvers: Window louvers are essentially shades for the building. They are a series of slats placed either on the rear window or the quarter window intended to reduce glare and keep the interior of your building cool. They allow the flow of air while blocking rain and debris from entering the building.

5. Window Bars: A wood or metal division between the panes of a window or a bar for fastening a window or a shutter also is ar for preventing passage through a window.


6. Hinges: a jointed device or flexible piece on which a window, door, gate, lid, or other attached part turns, swings, or moves.



7. **Handles**: is defined as the short length of material that attaches to a window in order to aide rotation of the hinge and therefore opening and closing of the window.

Theoretical learning Activity

- ✓ Presentation on types of window accessories
- ✓ Group discussion on the importance of window accessories (example: ask trainees to brainstorm about window accessories within groups)

Practical learning Activity

- ✓ Careful assessment of types of window accessories according to the nature of the project (Example: Trainees in pair perform research on window accessories)

Points to Remember (Take home message)

Types of window accessories

- Window Locks
- Window latches
- Blinds
- Louvers
- Window Bars
- Handles o Hinges

Learning Outcome 1.3 Formative assessment

Written assessment

1. Identify any five (5) types of window accessories.

Answer:

o Window Locks
o Window latches
o Blinds
o Louvers
o Window Bars
o Handles
o Hinges

2. Name the window accessories below:

(a)

(b)

(c)

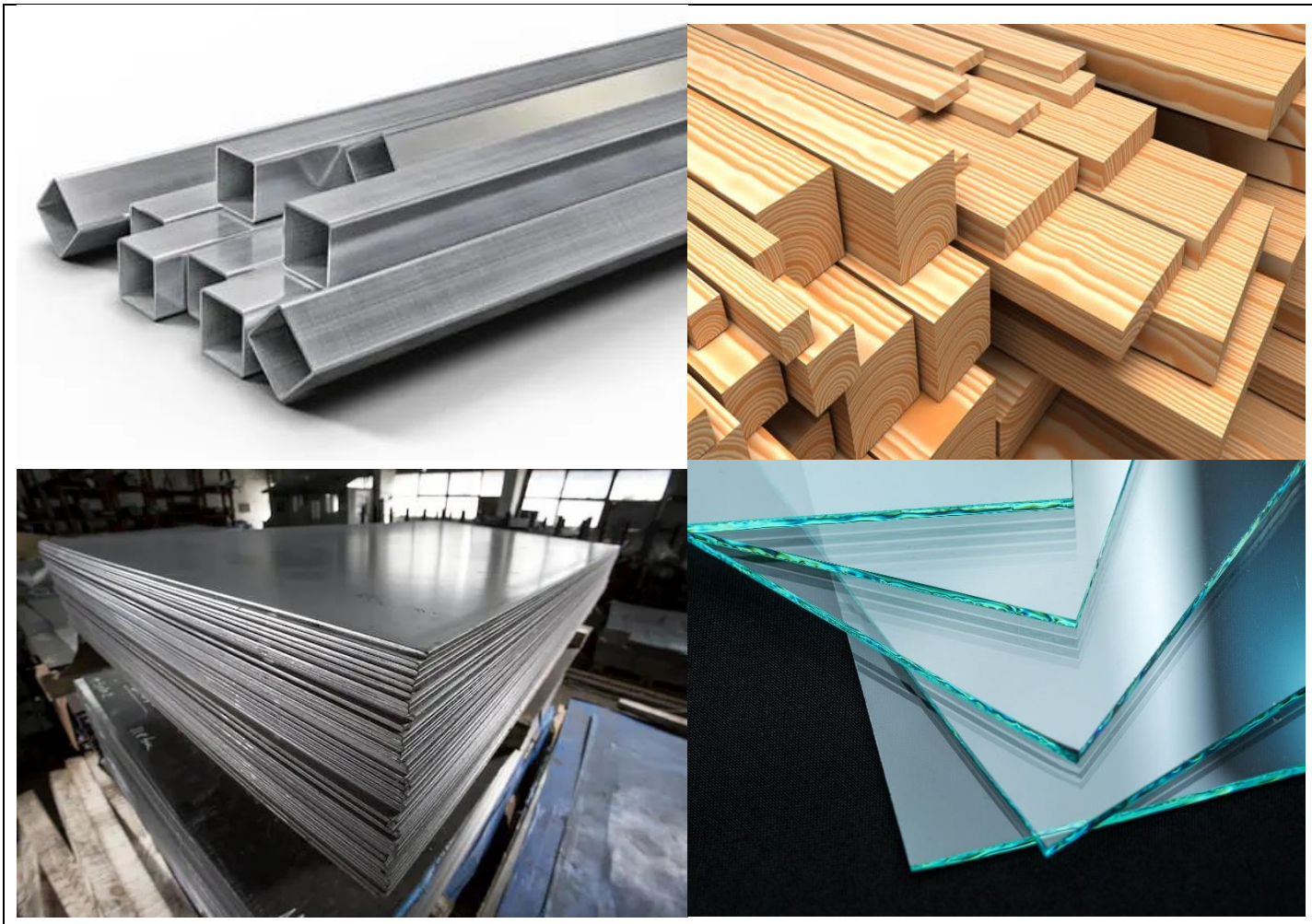
Answer:

(a) Blind

(b) Handle

(c) Window bars

Learning Unit 2: Select materials



STRUCTURE OF LEARNING UNIT 2

Learning outcomes:

2.1: Assess window material specifications
2.2: Select materials to use for window design
2.3. Select window finishes

Learning outcome 2.1: Assess window material specifications

 Duration: 10hrs

 Learning Outcome 2.1 Objectives:

By the end of the learning outcome, the trainees will be able to:

1. Identify correctly types of Window Materials,
2. Identify properly the materials specifications.

 Resources

Equipment	Tools	Materials
- Computer		- Reference books - Internet - Flashcards - Material samples

 Advance preparation:

- Make sure that window materials are available in the workshop for identification.

Indicative Content 1: Identification of type of window materials

There are many materials that should be used in the construction of windows:

1. Wood

The hard fibrous material forms the main substance of the trunk or branches of a tree or shrub, used is for fuel or timber. After extracting wood from trees the wood logs are subjected to Seasoning.

- ✓ **WOOD CLASSIFICATIONS**
- Hardwood
- Softwood.

2. Metal Windows

Metal windows, generally mild steel is used for making metal windows. Some other metals like **aluminium, bronze, stainless steel,** iron, etc. are also used to make windows.

3. Glass

Glass is a hard substance that may be transparent or translucent and brittle in nature.
It is manufactured by the fusion process. In this process, sand is fused with lime, soda, and some other admixtures and then cooled rapidly.

- ➢ **Engineering Properties of Glass**
- Transparency
- Strength
- Workability
- Transmittance
- U value (a measure of heat transfer (loss and gain)

- R-value (measure of heat resistance)
- Recycle property.

❖ **<u>Types of glass used in window construction are the following:</u>**

- Clear glass
- Opaque glass
- Mirror glass
- Art glass
- Stained glass

4. Fiberglass

Is a common type of fiber-reinforced plastic using glass fiber. The fibers may be randomly arranged, flattened into a sheet (called a chopped strand mat), or woven into a fabric.

5. Composite wood

Composite wood is a mixture of several components that may include wood, plastic, and straw (glass). The particles and fibers from different woods are combined, and adhesives keep them bound together. A veneer is often applied to the outside in order to make the composite wood appear more attractive. Composite woods are often used in cabinets, furniture, sheathing, flooring, and siding. They are less expensive than hardwood, and they are also weather-resistant when they have been painted or sealed.

6. P.V.C (Polyvinyl Chloride)

PVC is not used for window frames, although some manufacturers may use “PVC” to refer to their uPVC windows. Instead, uPVC is used for window frames, as it does not decompose and is weather-resistant.
UPVC will not change shape under normal weather conditions, but it can be reshaped at very high temperatures. UPVC windows are more energy-efficient than those with wooden or metal frames. Moreover, uPVC can also be used for door frames and conservatories.

Theoretical learning Activity

- ✓ Group work on Presentations on window material specifications

- ✓ Brainstorming and discussing window materials focusing on PVC and Vinyl. (for example: ask trainees to brainstorm about materials used in window construction within groups)

Practical learning Activity

- ✓ Perform the task of selecting materials for making a metal window according to the design specifications. (All types of materials for making different types of window are available in the workshop).

Points to Remember (Take home message)

- Wood
- Metal
- Glass
- Fiberglass
- PVC
- Composite Wood

Learning Outcome 2.1 Formative assessment

Written assessment

1. Write in full word: PVC

Answer: PVC: Polyvinyl Chloride

2. List any five (5) types of glass used for windows

Answer:

- ✓ Clear glass
- ✓ Opaque glass
- ✓ Mirror glass
- ✓ Art Glass
- ✓ Stained glass

Learning Outcome 2.2: Select materials to use for window design


Duration: 5hrs


Learning outcome 2.2 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Describe effectively factors to consider during selection of materials for window design.


Resources

Equipment	Tools	Materials
- Computer		- Reference books - Internet - Material samples


Advance preparation:

- The window materials samples are available.

Indicative Content 1: Factors to consider during selection of materials for Windows design

Factors to consider during selection of materials for window design are the following:

1) Stiffness

Stiffness is the extent to which an object resists deformation in response to an applied force. The complementary concept is flexibility or pliability: the more flexible an object is, the less stiff it is

A *material's stiffness* indicates its ability to return to its original shape or form after an applied load is removed. When a *material* is subjected to a load — its own unsupported weight, an external applied load, or both

2) Malleability

It is a property of material by which it can be beaten to form its thin sheets. Most of the metals are malleable.
Examples of malleable metals are zinc, iron, aluminium, copper, gold, silver, and lead. silver and gold are highly malleable.

3) Hardness

Hardness is the property of a material that enables it to resist plastic deformation, penetration, indentation, and scratching. Therefore, hardness is important from an engineering standpoint because resistance to wear by either friction or erosion by steam, oil, and water generally increases with hardness.

4) Durability

Durability is defined as the ability of a material to remain serviceable in the surrounding environment during the useful life without damage or unexpected maintenance.

5) Weather resistance

Weather resistance is the ability of a *material* to prevent corrosion, loss of *material* or any sort of deterioration due to prolonged exposure to harsh environmental and *weather* conditions.

6) Aesthetics

The term stems from the Greek word “aesthetics,” meaning “of sense perception,” and is related to the study of sensory values. In design, aesthetics refers to the visual attractiveness of a product. Studies have proven that creating good aesthetics in a product leads to better usability and user experience.

7) Cost

This is the cost of materials used to manufacture a product or provide a service. Excluded from the material cost is all indirect materials, such as cleaning supplies used in the production process

8) Availability

Something with **availability** is easy to get or to access. The noun **availability** indicates that something is easily obtainable and ready for use. *Availability of materials* play a major role in the budget of the project.

9) Environmental friendliness

Environmentally friendly building materials are those that make optimal use of resources, produce minimum waste and are safe for the environment and people.

10) Maintenance

Maintenance is also an important selection criterion for construction material because the good materials are those which are easy and economical to maintain. Maintenance will help to keep the look of building for a long time period and will increase the life of the building.

Theoretical learning Activity

- ✓ Internet research on metal properties
- ✓ Individual presentation on wood properties
- ✓ Observation on different varieties of wood
- ✓ Presentation on material durability
- ✓ Group Discussion on maintenance of wood (example: ask trainees to brainstorm about Factors to consider during selection of materials for window design within groups)

Practical learning Activity

- ✓ Careful selection of materials to use according to window functionality and aesthetics (Example: Trainees in pair perform).

Points to Remember (Take home message)

- Stiffness
- Malleability
- Hardness
- Durability
- Weather Resistance

Learning Outcome 2.2 Formative assessment

Written assessment

1. List any ten (10) factors considered during selecting of window materials.

Answer:

- ✓ Stiffness
- ✓ Malleability
- ✓ Hardness
- ✓ Durability
- ✓ Weather Resistance
- ✓ Aesthetics
- ✓ Maintenance
- ✓ Cost
- ✓ Availability
- ✓ Environmental friendliness

2. Differentiate malleability from durability of window material.

Answer:

- ➢ Malleability: It is a property of material by which it can be beaten to form its thin sheets. Most of the metals are malleable.
- ➢ Durability is defined as the ability of a material to remain serviceable in the surrounding environment during the useful life without damage or unexpected maintenance.

Learning Outcome 2.3: Select window finishes

Duration: 5 hrs

Learning outcome 2.3 objectives :

By the end of the learning outcome, the trainees will be able to:

1. Identify effectively types of window finishes.

Resources

Equipment	Tools	Materials
- Computer		- Reference books - Internet - Wood Finish samples - Paint samples - Metal finish samples - Glass finish samples

Advance preparation:

- Make sure that materials are available before performing any tasks of window material finishes.

Content 1: Description of Types of windows finishes

- ❖ Types of windows finishes

1. Wood Finishes

- ✓ **Varnish:** liquid coating material containing a resin that dries to a hard transparent film. Most varnishes are a blend of resin, drying oil, drier, and volatile solvent. When varnish dries, its solvent portion evaporates, and the remaining constituents oxidize or polymerize to form a durable transparent film.
- ✓ **Paint:**

  Wood Primer is a general purpose oil-based primer for interior and exterior wooden surfaces. Acrylic paint is a great choice for indoor wood paintings. Use acrylic enamel for outdoor wood paintings.
- ✓ **Wood staining:**

  Wood stain is a type of paint that is used to color wood by soaking pigment into wood fibers with a solvent and then having it set and bind to the wood. Stain works by saturating color into the wood itself, rather than applying a layer of color over the surface of wood.
- ✓ **Wood sealant:**

  A sealer coat (sometimes called "wash coat") is often used over the stain or on unstained wood. Its purpose is to "seal" the pores of the wood to give you a smooth, even surface for the top coats of varnish or lacquer. The sealer coat will also prevent the stain from bleeding into successive coats of finish materials

  - ➢ Sealant Types

1. Polyurethane is a synthetic, oil-based varnish that deposits a highly durable and protective coating on painted and bare wood surfaces.
2. Polycrylic is a water-based finish coat that applies with a brush, gives off little odor, and cleans up easily with with water.

2. Metal Finishes

- ✓ **Paint:** You can use either a water-based acrylic paint or an oil-based paint, as long as the container identifies "for metal" somewhere on its labeling. Oil-based paints take much longer to dry, and they need a high-quality paintbrush that doesn't shed during application
- ✓ **Anti-rust** Austenitic stainless have high amounts of nickel and chromium. The chromium combines with the oxygen before the iron is able to which forms a

chromium oxide layer. This layer is very corrosion resistant which prevents rust formation and protects the underlying metal

- ✓ Varnish Metal is a fairly durable material with excellent performance. However, even metal structures are exposed to negative factors and can quickly deteriorate. For the protection of such products produced special means. One of the most reliable protective coatings is varnish

  - ➢ All varnishes for metal surfaces have common qualities:

    - The composition of this material necessarily includes substances that protect the metal from corrosion;
    - The coating created by varnish is distinguished by high strength and wear resistance;
    - Mixtures not only create a durable coating, but also extend the service life of metal structures.

Examples of metal varnishes:

- bituminous varnish;
- coating, based on polyurethane;
- acrylic based varnish;
- alkyd mixtures;
- heat-resistant solutions for stoves and fireplaces;
- lacquer

In addition to shade, paints and varnishes differ in the level of gloss created by the coating:

- Frosted; Semi-gloss; Brilliant glossy finish; Semi glossy; High gloss.

- ✓ Bronze paint Bronze is a metallic brown color which resembles the actual alloy bronze. To make bronze color easily you need to mix color brown, white and red one after one.
- ✓ Gold/silver plating: Gold plating is a method of depositing a thin layer of gold on the surface of glass or metal, most often copper or silver. Gold plating is often used in electronics, to provide a corrosion-resistant electrically conductive layer on copper, typically in electrical connectors and printed circuit boards.
- ✓ Metal plating: Metal plating is a method of plating where metals are deposited on the substrates. This process is used to coat and protect metals and other materials by forming a thin layer of metal over the substrates.
- ✓ Metal sealant: The surface should be well prepared before applying the sealant. Remove peelings from paint, rust, and elements of corrosion, dirt, oil, or grease. It is recommended that you apply the sealant over a primer to enhance its resistance to corrosion and rust.

3. Glass Finishes

- ✓ **Stained glass:** in the arts, the colored glass used for making decorative windows and other objects through which light passes. As a material *stained glass* is *glass* that has been colored by adding metallic salts during its manufacture.
- ✓ **Mirror paint:** mirror paint is Rust-Oleum's specialty mirror spray. While you can achieve a **mirror** effect with other spray paint, Rust-Oleum is the only paint specially formulated to create a perfect mirror finish.
- ✓ **Tinting:** Window tinting refers to the process of applying a thin laminate film to a window glass in order to darken it. The reasons people choose to tint the windows of a house is to increase the privacy, security, or protection.
- ✓ **Decorative glass panes** (also known as ornamental glass): Glass that is used for more than just a functional purpose—particularly if it is designed to be pretty or change the look of the space in which it is used.

  Easily recognizable use of decorative glass might be frosted, colored or textured glass in windows, which can be found in residential as well as corporate buildings. Stained glass is also a type of decorative glass.

Theoretical learning Activity

- ✓ Internet research on metal finishes
- ✓ Individual presentation on metal finishes
- ✓ Observation on types of wood finishes
- ✓ Presentation on glass finishes
- ✓ Group Discussion on wood finishes (example: ask trainees to brainstorm about Types of windows finishes within groups)

Practical learning Activity

- ✓ Careful selection of finishes materials to use according to window functionality and aesthetics (Example: Trainees in pair perform).

Points to Remember (Take home message)

- Varnish
- Paint
- Wood staining
- Wood sealant

Learning Outcome 2.3 Formative assessment

Written assessment

1. List any five (5) metal finishes.

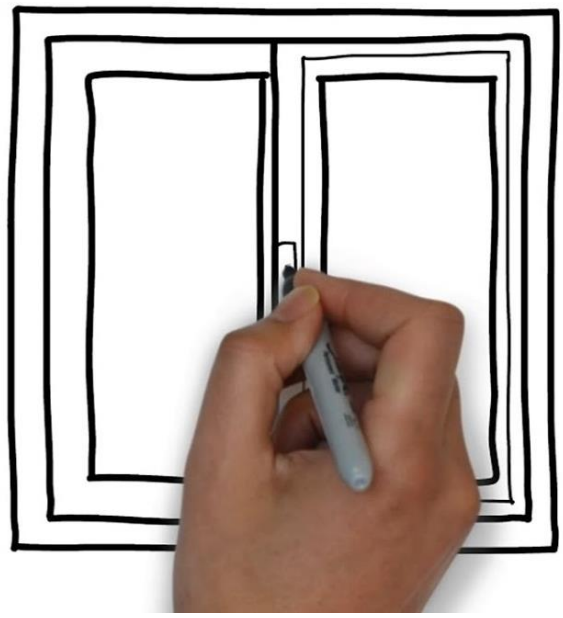
Answer:

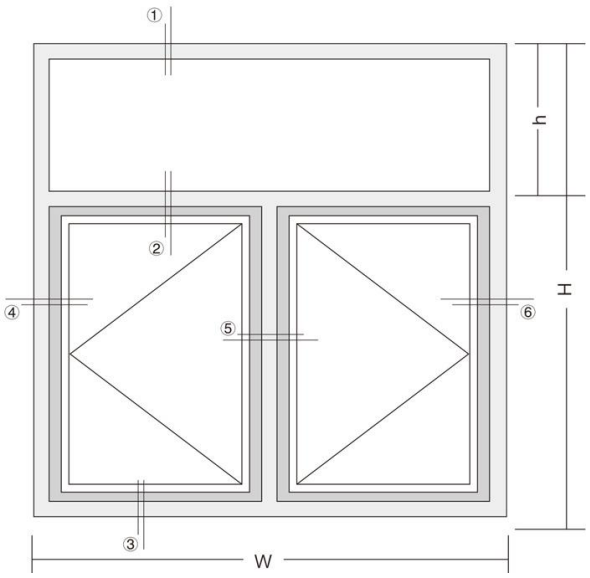
- ✓ Paint
- ✓ Anti-rust
- ✓ Varnish
- ✓ Bronzer
- ✓ Gold/silver plating
- ✓ Metal Plating
- ✓ Metal sealant

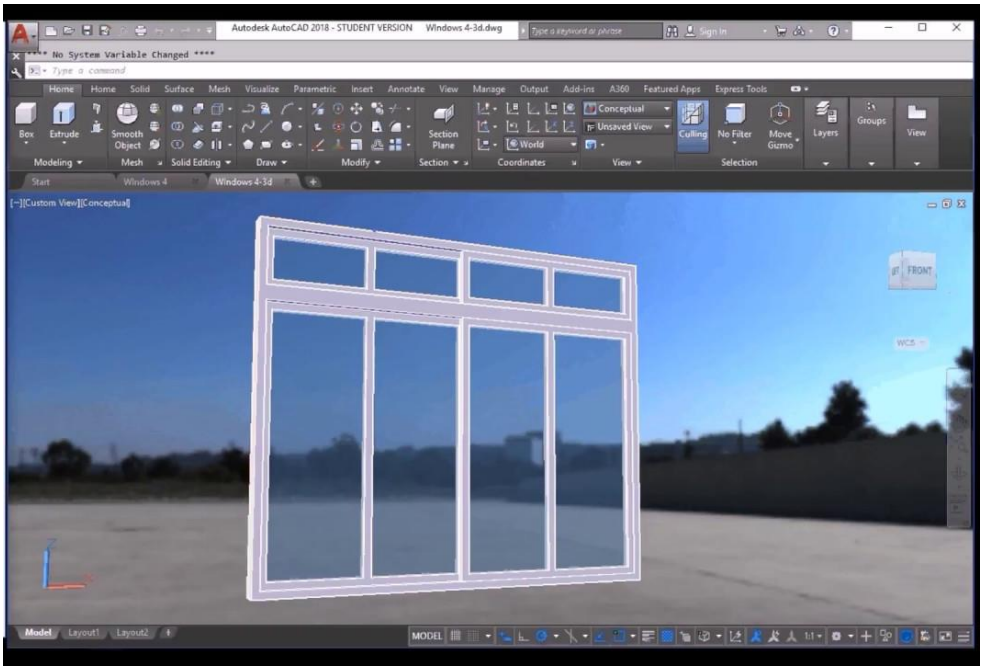
2. Define “Wood sealant “used as finishing material for wood.

Answer: Wood sealant: A sealer coat (sometimes called "wash coat") is often used over the stain or on unstained wood. Its purpose is to "seal" the pores of the wood to give you a smooth, even surface for the top coats of varnish or lacquer. The sealer coat will also prevent the stain from bleeding into successive coats of finish materials.

Learning Unit 3-Develop Window design







STRUCTURE OF LEARNING UNIT 3

Learning outcomes:

3.1: Precise drawing of preliminary sketches 3.2: Develop final drawings and renderings 3.3: Present the final design

Learning outcome 3.1: Precise drawing of preliminary sketches


Duration: 5 hrs


Learning Outcome 3.1 Objectives:

By the end of the learning outcome, the trainees will be able to:

1. Identify correctly the Steps of developing preliminary sketching
2. Develop properly the preliminary sketches of a window


Resources

Equipment	Tools	Materials
- Drawing board		- Internet - Books - Pencils - Eraser - Papers - Ink pens - Sketchbooks

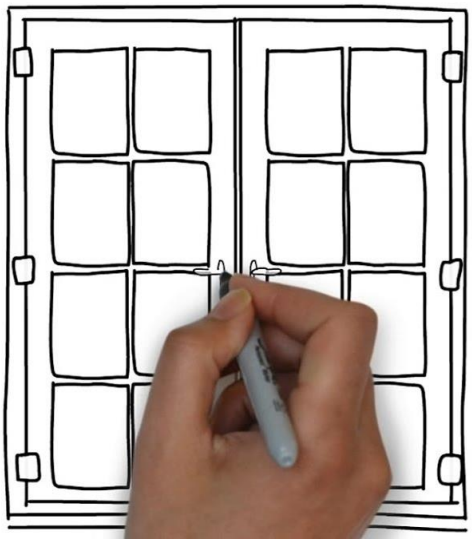

Advance preparation:

- Drawing equipment and materials are available.

Content 1: Steps of developing preliminary sketching

- Preliminary sketches

Preliminary sketches are the initial set of sketches, drawings and plans used to convey concepts, designs, and ideas between clients, design professionals, and project stakeholders.



- The Purpose of Preliminary sketches

Preliminary sketches serve the purpose of communicating and establishing an understanding and direction of a project between the client and the design team. Preliminary sketches help visualize ideas among the different parties involved. The preliminary drawings serve to move projects forward and initiate cost estimates, feasibility studies and other analysis.

Although preliminary drawings help establish a common understanding and vision of a project, they are not intended as specifications for construction or engineering purposes. Instead, preliminary drawings establish the basis for more specific plans that will ensue.

- Steps of developing preliminary sketching

1. Small thumbnail sketches: Thumbnail sketches are drawing quick, abbreviated drawings. Usually, they are done very rapidly and with no corrections - you can use any medium, though pen or pencil is the most common, Thumbnail drawings are small, preliminary sketches, usually done within an outlined frame as a quick snapshot of your painting idea.
2. Large detailed sketches: Detail sketches provide a detailed description of the geometric form of a part of an object They tend to be large-scale drawings that

show in detail parts that may be included in less detail on general arrangement drawings

3. **Final sketches:** A completed sketch from which fabrication of an item can take place.

Theoretical learning Activity

- ✓ Individual presentation of preliminary sketches (example: ask trainees to brainstorm about Steps of developing preliminary sketching within groups)

Practical learning Activity

- ✓ Practical exercises on developing preliminary sketches
- ✓ Precise drawing of preliminary sketches according to the design requirements (Example: Trainees in pair perform)

Points to Remember (Take home message)

- Small thumbnail sketches
- Large detailed sketches
- Final sketches

Learning outcome 3.1. Formative assessment

Practical assessment

Task: Produce preliminary sketches of a sliding window

Checklist

Indicator: Development of Preliminary design sketches	Score	
	Yes	No
Small thumbnail sketches		
Large detailed sketches		
Final sketches		
Observation		

Learning Outcome 3.2: Develop final drawings

 Duration: 25 hrs

Learning Outcome 3.2 Objectives:

By the end of the learning outcome, the trainees will be able to:

1. Develop properly of final drawings using CAD

Resources

Equipment	Tools	Materials
- Computer - Projector	- Flash disk	- Internet - Solid works - Visual aid - Pin-up board - ArchiCAD - SketchUp - Artlantis studio - Twinmotion

Advance preparation:

- Availability of computers with CAD software,
- Projector

Content 1: Description of Steps of developing final drawings for window design

✓ Steps of developing final drawings for window design

➢ Creation of geometric shapes, form, and bodies

Geometric Shapes can be defined as figure or area closed by a boundary which is created by combining the specific amount of curves, points, and lines. Different geometric shapes are Triangle, Circle, Square, etc. ... All of us know about the common shapes in geometry like a square, rectangle, circle, and triangle

➢ Scaling design components

Scaling design can encompass everything from creating uniformity through systems to spreading design thinking practices throughout the organization—and beyond.

➢ Design component manipulation

- Move

To Move Objects Using Two Points

1. Click Home tab Modify panel Move. Find.
2. Select the objects to move and press Enter.
3. Specify a base point for the move.
4. Specify a second point. The objects you selected are moved to a new location determined by the distance and direction between the first and second points.

- Drag

Select an object or several objects if you wish. With your left mouse button, click and hold down the mouse button anywhere on the object (or any one of the objects). You'll see an arrow cursor. Drag (with the mouse button still held down) the object(s) wherever you want.

- Align

To Align two Objects in 2D

1. Click Home tab Modify panel Align. Find.
2. Select the objects that you want to align.
3. Specify a source point and then the corresponding destination point. To rotate the object, specify a second source point followed by a second destination point.
4. Press Enter to end the command.

- Crop

Crop an AutoCAD drawing

1. Zoom out until you see the entire AutoCAD drawing on the screen.
2. Click an empty space on the diagram to deselect anything that may be already selected.
3. Rest your cursor on the outside edge of the AutoCAD drawing until your cursor changes to this icon:
4. Right-click, and then click Crop Tool.
5. Drag the crop handles

Connect

We use the Join command to fill gaps between lines, arcs, elliptical arcs, open splines, 2D and 3D polylines, and helixes.

1. Click Home tab Modify panel Edit Polyline. Find.
2. Select a polyline, spline, line, or arc to edit. ...
3. Enter j (Join).
4. Select one or more polylines, splines, lines, or arcs that are located end to end.
5. Press Enter to end the command.

Mirror/duplicate

How to Use the mirror Command in AutoCAD?

- Press Esc to make sure that no command is active and no objects are selected.
- Click the Mirror button on the Home tab's Modify panel, or enter MI and press Enter.
- Select at least one object, and press Enter to end the object selection. ...
- Specify the start of the mirror line by clicking a point or typing coordinates

Cut/copy and paste

Paste a selection as a block in the target drawing

1. Choose Copy with Base Point in the Edit menu.
2. Type copy base in the command bar, then press Enter.
3. Press and hold the Ctrl and Shift keys, then press C

Animation

To Create a Motion Path Animation

- In the drawing, create a path object for either the camera or the target. ...
- If the Animations panel is not displayed on the Visualize tab, right-click the Visualize tab and click Panels Animations.
- Click Visualize tab Animations panel Animation Motion Path.

Color/paint

1. Select the objects whose color you want to change.
2. Right-click in the drawing area, and choose Properties.
3. In the Properties palette, click Color, and then click the down arrow. From the drop-down list, choose the color that you want to assign to the objects.
4. Press Esc to remove the selection.

Pull and push

Press or Pull Multiple Areas or Objects

- Click Home tab Modeling panel Press pull. Find.
- Do one of the following: Press and hold Shift as you select the object, face, or area. Select the object, face, or area. ...
- Press Enter when the selection set is complete.
- Follow the prompts to complete the activity.

Intersect

With INTERSECT, you can create a 3D solid from the common volume of two or more existing 3D solids, surfaces, or regions. If you select a mesh, you can convert it to a solid or surface before completing the operation. You can extrude 2D profiles and then intersect them to create a complex model efficiently

Chamfer/fillet

Whereas Trim, Extend, and Break alter one object at a time, the Fillet and Chamfer commands modify a pair of objects in AutoCAD 2014. Fillet creates a curved corner between two lines, whereas Chamfer creates a bevelled corner.

Trim

To Trim an Object

1. Click Home tab Modify panel Trim. Find.
2. Select the objects to serve as cutting edges. Press Enter when you finish selecting the cutting edges.
3. Select the objects to trim and press Enter a second time when you finish selecting the objects to trim.

Resize/scale

However, you can change scale in AutoCAD by using the AutoCAD scale factor. Window select the object(s) in AutoCAD, type SCALE, and then specify a number between 0 and 1. Hit Enter. The size of the object(s) will SCALE DOWN by that factor.

Split

Breaking a line into two in AutoCAD

1. Type in BREAK at the command line or select break tool.
2. Select the object you wish to break.
3. Select First Point Option (F) then.
4. Pick the point where you wish divide the object.
5. When prompted to specify second break point, type @ and Enter.

Theoretical learning Activity

- ✓ Practical exercises on producing final project drawings
- ✓ Demonstration on how to produce final drawings in CAD (example: ask trainees to brainstorm about within Steps of developing final drawings for window design groups)

Practical learning Activity

- ✓ Neat development of final drawings using CAD in line with the project specifications (Example: Trainees in pair perform)

Points to Remember (Take home message)

- Creation of geometric shapes, form and bodies
- Scaling design components
- Design component manipulation

Learning outcome 3.2. Formative assessment

Practical assessment

Task: Produce final drawings of a sliding window

Checklist

Indicator: Development of final drawings using CAD	**Score**	
	Yes	**No**
Creation of geometric shapes, form and bodies		
Scaling design components		
Design component manipulation		
Observation		

Learning Outcome 3.3: Develop final design


Duration: 10 hrs

Learning Outcome 3.3 Objectives:

By the end of the learning outcome, the trainees will be able to:

1. Produce properly rendered images of windows,
2. Perform properly the design layouts of the windows

Resources

Equipment	Tools	Materials
- Computer - Colour Printer	- Flash disk	- Internet - books - Adobe InDesign - Papers - Pin-up boards - Colors - Videos

Advance preparation:

- Availability of computers with CAD software,
- Availability of Printer

Content 1: Steps of rendering

Rendering refers to the process of adding physical attributes and details, such as color, shading, texture, and lamination, to a grid frame (or wire frame) that in return creates realistic images on a screen.

Contemporary architects use hand-drawn sketches, pen and ink drawings, and watercolor renderings to represent their design with the vision of an artist.

- ❖ Steps of rendering
  - ✓ **Selection of view to render**
  - ✓ **Editing render settings**
    - Lighting
    - Textures
    - Colour
    - Background
    - Materials
    - Resolution
    - Save and rename
  - ✓ **Run the render**

- ❖ Steps of developing design layout
    - Select drawings
    - Select rendered images
    - Align images to the layout
    - Scale image
    - Print layout

Practical learning Activity

- ✓ Practical exercises on rendering images

- ✓ Practical exercises on producing layouts

Points to Remember (Take home message)

- ✓ Selection of view to render
- ✓ Editing render settings
- ✓ Run the render
- ✓ Select drawings
- ✓ Select rendered images
- ✓ Align images to the layout
- ✓ Scale image
- ✓ Print layout

Learning outcome 3.3. Formative assessment

Practical assessment

Task: Produce rendered images of a sliding window and produce layout for the sliding window.

Checklist

Indicator 1: Development of rendered images	**Score**	
	Yes	**No**
Selection of view to render		
Editing render settings		
Run the render		
Indicator 2: Development of design layout		
Select drawings		
Select rendered images		
Align images to the layout		
Scale image		
Print layout		
Observation		

Learning unit 4: Implement the window design




STRUCTURE OF LEARNING UNIT 4

Learning outcomes:

4.1: Proper wearing of PPE

4.2: Cut and assemble of window components

4.3: Mounting of the window

4.4: Proper finishing of the window

4.5: Cleaning of the workspace and storage of tools and equipment

Learning Outcome 4.1: Proper wearing of PPE

Duration: 2 hrs

Learning outcome 4.1 objectives :

By the end of the learning outcome, the trainees will be able to:

1. Wear properly the PPE during window making.

Resources

Equipment	Tools	Materials
- Samples of PPE		- Reference books - Internet - Tutorial on how to wear PPE

Advance preparation:

- PPE samples are available at the workplace.

Content 1: Identification of Types of PPE and guidelines

✓ **Meaning of PPE:** Personal protective equipment (PPE) is clothing and equipment worn by employees, students, contractors or visitors to protect or shield their bodies from workplace hazards.

✓ **Types of PPE and their uses**

- Respiratory protection –Face masks
- Eye protection –spectacles/goggles, shields, visors
- Hearing protection –Ear muffs and plugs
- Hand protection –Gloves and barrier creams
- Foot protection –Shoes/boots
- Head protection –Helmets, caps and hats
- Skin/Whole body protection –Overall, Aprons, Long sleeved clothes

✓ **PPE guidelines**

- PPE should fit properly, and it should not block movement or communication.
- Select the right PPE for the task.
- Do not wear PPE that could potentially cause injury, such as loose fitting gloves that could be caught in moving parts of equipment or machinery.
- For loose fitting gloves, tape or fold a cuff on the gloves to prevent chemicals from running down the user's arm.
- Do not wear PPE outside of laboratory or shop areas to prevent spreading contamination to other areas.
- Employees must be trained in how to don and doff PPE and the limitations of the PPE for the specific procedure.
- Workers need to handle PPE safely when removing it from the body to avoid contaminating themselves and surfaces nearby.

Theoretical learning Activity

- ✓ Brainstorming and discussing the advantages and disadvantages of using PPE.
- ✓ Brainstorming different types of PPE and their uses
- ✓ Individual research on how to wear PPE

Practical learning Activity

- ✓ Proper wearing of PPE as per their types and functionality.

Points to Remember (Take home message)

- Respiratory protection –Face masks
- Eye protection –spectacles/goggles, shields, visors
- Hearing protection –Ear muffs and plugs
- Hand protection –Gloves and barrier creams
- Foot protection –Shoes/boots
- Head protection –Helmets, caps and hats
- Skin/Whole body protection –Overall, Aprons, Long sleeved clothes

Learning outcome 4.1. Formative assessment

Written assessment

1. Describe any four (4) types of PPE.

Answer:

- ✓ Respirators: Masks
- ✓ Skin Protection: Gloves
- ✓ Eye Protection: Goggles, Face Shields
- ✓ Hearing Protection: Ear Plugs
- ✓ Protective clothing: Helmets, Overalls, Safety shoes

2. Identify any three (3) guidelines for PPE.

Answer:

- PPE should fit properly, and it should not block movement or communication.
- Select the right PPE for the task.
- Do not wear PPE that could potentially cause injury, such as loose fitting gloves that could be caught in moving parts of equipment or machinery.
- For loose fitting gloves, tape or fold a cuff on the gloves to prevent chemicals from running down the user's arm.
- Do not wear PPE outside of laboratory or shop areas to prevent spreading contamination to other areas.

Learning Outcome 4.2: Cut and assemble of window components

 Duration: 20 hrs

 Learning outcome 4.2 objectives :

By the end of the learning outcome, the trainees will be able to:

1. Identify properly all the types of window components,
2. Cut and assemble properly window components.

 Resources

Equipment	Tools	Materials
-PPE -Arm radial saw -Surface planer machine -Thicknesser machine -Circular saw -Angle grinder machine	-Tape measure -Hammer -Drill/driver -Hand Saw	-Reference books - Internet - Scenario - tutorials -Screws -Galvanized casing nails -Cutting disks -Grinding disks

 Advance preparation:

- Equipment, tools, and materials are available at the workplace.

Content 1: Cut and assemble window components

❖ Description of Material cutting techniques

Material cutting techniques can be described as follow:

✓ Cutting Metals

- **Laser cutting**: Laser Cutting is a non-contact process which utilizes a laser to cut materials, resulting in high quality, dimensionally accurate cuts. The process works by directing the laser beam through a nozzle to the workpiece. A combination of heat and pressure creates the cutting action.

- **Turning:** Turning is a machining operation performed on a lathe in which the work piece rotates at high speeds while a fixed cutting tool removes material.

- **Drilling:** Drilling is a cutting process that uses a drill bit to cut a hole with a circular cross-section in solid materials.

- **Welding Flame:** Because each element has an exactly defined line emission spectrum, scientists are able to identify them by the color of flame they produce. For example, copper produces a blue flame, lithium and strontium a red flame, calcium an orange flame, sodium a yellow flame, and barium a green flame.

- **Plasma:** Plasma cutting (plasma arc cutting) is a melting process in which a jet of ionised gas at temperatures above 20,000°C is used to melt and expel material from the cut. During the process, an electric arc is struck between an electrode (cathode) and the workpiece (anode).

- **Grinding metal grinding:** Metal Grinding is used to finish off rough edges, deburr metal parts, smooth welds, create sharp edges and sometimes create unique finished looks on a metal part.

- **Water jet:** A *waterjet* is a tool used in machine shops to cut *metal* parts with a (very) high-pressure stream of *water*. As amazing as it sounds, if you get *water* flowing fast enough it can actually cut *metal*.

- ✓ Cutting Wood:

  - **Saw cutting:** It is used to cut through material, very often wood. The cut is made by placing the toothed edge against the material and moving it forcefully forth and less vigorously back or continuously forward.

  - **Laser cutting:** Laser cutters can cut through material up to 3/4″ (20 mm) thick, although the effective thickness depends on the material and the laser cutter itself. They're usually only used to cut flat sheets of material.

  - **Chamfering using Router and spindle moulder machine:** Is making a small cut, usually at a 45 degree angle, to remove a 90 degree edge.

  - **Cross cutting:** Crosscut is any cut that slices across the grain direction of the wood.
  - **Ripping**: Rip-cut is a type of cut that severs or divides a piece of wood parallel to the grain.
  - **Drilling**

- ✓ Cutting Glass

  - **Carbide steel:** Carbide" is short for Tungsten Carbide; it is a chemical compound which contains equal parts of tungsten and carbon atoms. ... Carbide is much denser than both steel and Titanium.

  - **Glass cutting:** A *glass cutter* is a tool used to make a shallow score in one surface of a piece of *glass*

  - **Oil cutting:** The effective cutting of glass also requires a small amount of oil (kerosene is often used) and some glass cutters contain a reservoir of this oil which both lubricates the wheel and prevents it from becoming too hot.

  - **Diamond cutting:** Diamonds are the hardest known substance having hardness set to 10 mohs hardness scale, while glass which are used on windows have a hardness of 5.5 mohs hardness scale. And diamonds being the hardest substance can precisely and accurately cut glass in any desired shape or form.
  - **Laser cutting**
  - **Water jet Glass cutting**

Content 1: Cut and assemble window components

Theoretical learning Activity

- ✓ Brainstorming and discussion on different cutting techniques for different materials,
- ✓ Individual research on other different cutting techniques.

Practical learning Activity

- ✓ Practical activities on different methods of cutting windows materials.

Points to Remember (Take home message)

- ✓ Cutting Metals
  - ➢ Laser cutting
  - ➢ Turning
  - ➢ Drilling
  - ➢ Welding Flame
  - ➢ Plasma
  - ➢ Grinding metal grinding
  - ➢ Water jet
- ✓ Cutting Wood
  - ➢ Saw cutting
  - ➢ Laser cutting
  - ➢ Chamfering using Router and spindle moulder machine
  - ➢ Cross cutting
  - ➢ Ripping
  - ➢ Drilling
- ✓ Cutting Glass
  - ➢ Carbide steel
  - ➢ Glass cutting
  - ➢ Oil cutting
  - ➢ Diamond cutting
  - ➢ Laser cutting
  - ➢ Water jet Glass cutting

Learning Outcome 4.3: Perform Windows mounting

Duration: 20hrs

Learning outcome 4.3 objectives :

By the end of the learning outcome, the trainees will be able to:

3. Develop properly of final drawings using CAD
4. Develop correctly of design layout

Resources

Equipment	Tools	Materials
✓ Computer ✓ CAD Software ✓ PPE:	✓ Brush ✓ Tape Measure ✓ Ruler ✓ Glass Cutter	✓ Wood ✓ Metal ✓ Glass ✓ Cardboard

Helmet Gloves Goggles Dust mask Overall ✓ Wood working machine Panel saw machine, surface planer machine, moulding or shaper machine, band saw machine…. etc. ✓ Angle grinder machine, gas welding, arc welding machine, air compressor machine,	✓ Cutting blade ✓ Metal cutter ✓ Saw ✓ Pencil/Pen ✓ Glue Applicator ✓ Masking tape	✓ Glue ✓ Paint ✓ Varnish ✓ Wood stain ✓ Plastic ✓ Floor Plans
 Advance preparation: • Make sure that materials are available before performing any tasks		

Content 1: Description of Steps of mounting a window

2. Preparing a rough opening

- ➢ Mark corners of the Window
- ➢ Cut window opening
- ➢ Verify if window fits

5. Install vapor barriers (optional)

6. Mount the window

- ➢ Rest bottom of window in the opening
- ➢ Push top in to the opening
- ➢ Check if window is level.
- ➢ Secure window with nails
- ➢ Apply flashing and sealant (Optional)

Theoretical learning Activity

- ✓ Brainstorming on mounting fixed windows
- ✓ Individual research on mounting bay windows
- ✓ Internet research on mounting double hung windows
- ✓ Practical exercise on mounting windows (example: ask trainees to brainstorm about Steps of mounting a window within groups)

Practical learning Activity

- ✓ Proper cleaning of the workspace and storage of tools and equipment in accordance to the health standards (Example: Trainees in pair perform)

Points to Remember (Take home message)

- **Steps of mounting a window**
  - ✓ Preparing a rough opening
  - ✓ Mark corners of the window
  - ✓ Cut window opening
  - ✓ Verify if window fits
  - ✓ Install vapour barriers
  - ✓ Mount the window
  - ✓ Rest bottom of window in the opening
  - ✓ Push top in to the opening
  - ✓ Check if window is
  - ✓ level Secure window with nails Apply flashing and sealant

Learning Outcome 4.4: Apply window finishes

 Duration: 20hrs

 Learning outcome 4.3 objectives:

By the end of the learning outcome, the trainees will be able to:

7. Develop properly of final drawings using CAD
8. Develop correctly of design layout

 Resources

Equipment	Tools	Materials
✓ Computer ✓ CAD Software ✓ PPE: Helmet Gloves	✓ Brush ✓ Tape Measure ✓ Ruler ✓ Glass Cutter ✓ Cutting blade ✓ Metal cutter	✓ Wood ✓ Metal ✓ Glass ✓ Cardboard ✓ Glue ✓ Paint

Goggles Dust mask Overall ✓ Wood working machine Panel saw machine, surface planer machine, moulding or shaper machine, band saw machine…. etc. ✓ Angle grinder machine, gas welding, arc welding machine, air compressor machine,	✓ Saw ✓ Pencil/Pen ✓ Glue Applicator ✓ Masking tape	✓ Varnish ✓ Wood stain ✓ Plastic ✓ Floor Plans
Advance preparation: • Make sure that materials are available before performing any tasks		

Content 1: Description of material finishing techniques

✓ <u>Step-by-step instructions for finishing wood windows</u>

➢ Step one: Prep the wood surface

- The wood surface may require light sanding to remove rough surfaces or construction residue
- Use 180-grit or finer sandpaper on a sanding block with an edger; sand with the grain; avoid touching the glass with the sandpaper
- Remove all sanding dust with a tack cloth before applying the finish
- Do not use steel wool: the fibers might get caught in the surface of the wood and rust when exposed to moisture

➢ Step two: Clean the glass

- Remove sawdust, grease or caulking on the glass using a small amount of mineral spirits
- Clean the glass with a vinegar-based window

- Avoid ammonia-based cleaning products that can cloud the glass
- Avoid getting cleaning products on unfinished wood, which may discolour it.

➢ Step three: Apply the finish

- Before you begin
    - If your window has a removable interior glass panel, remove it according to the manufacturer's instructions and finish the wood between the panes, in addition to the room-side wood; make sure the finish has fully cured (according to the manufacturer's instructions) before reinstalling the glass panel
    - Avoid getting paint in the breather or weep holes on the window sash or door panels, or any other finishing products on the weather-stripping or any vinyl parts, which may compromise performance
    - If paint, stain or finish gets on the mohair weather-stripping, blot the weather-stripping thoroughly with a rag, allow it to dry, then flake off any residue with your fingernail
    - On double-hung windows, do not paint, stain or finish the vertical sash edges (the wood part that slides up and down against the frame), which may cause the sash to stick

✓ Finishing processes for steel windows

1. Cleaning
2. Pre-treatment
3. Epoxy e-coat primer
4. Epoxy powder primer
5. Ultrathane polyurethane top coat

- Identification of Styles of finishing
    - ❖ Antiques: It can be applied on almost any paintable surface without stripping the old finish off. Applying an antique finish is a three-step process. First a base coat of solid background color, usually a semi-gloss or satin-finish enamel, is painted on. The result is an ''antique white'' finish
    - ❖ Brushed metal: has a dull polish and is made through friction. The metal is polished with a fine bristle brush on a belt or wheel that moves in the same direction the whole time
    - ❖ Hammered Hammer paint (or hammered paint) is a special lacquer with a surface that looks like hammered metal when dried. It is also known as hammertone.

- **Polished:** A polished finish has a highly reflective surface, which will display the vibrancy of the stone's colors as well as the “character” of the stone. The texture is very smooth and is not very porous. The full color, depth, and crystal structure is visible with a polished finish
- **Satin:** Satin finishes have a beautiful luster that is often described as appearing velvety. Satin is slightly less lustrous than semi-gloss, and can appear to be both flat and glossy, depending on the lighting in the room.

Theoretical learning Activity

- ✓ Internet research on metal finishes
- ✓ Individual presentation on metal finishes
- ✓ Observation on types of wood finishes
- ✓ Presentation on techniques of finishing
- ✓ Group Discussion on wood finishes
- ✓ Practical exercises on finishing windows (example: ask trainees to brainstorm about material finishing techniques within groups)

Practical learning Activity

- ✓ Proper finishing of the window according to the design project (Example: Trainees in pair perform)

Points to Remember (Take home message)

- ✓ **Material finishing techniques:**
  - Metals:
    - Stain-and-clear finish,
    - Paint finish,
    - High exposure finishing
    - Cleaning and maintenance
  - Wood:
    - Stain-and-clear finish,
    - Paint finish,

LO 4.5: Clean workspace and store tools and equipment

 Duration: 20hrs

 Learning outcome 4.5 : objectives :

By the end of the learning outcome, the trainees will be able to:

1.Clean workspace and store properly tools and equipment

 Resources

Equipment	Tools	Materials
✓ Computer ✓ CAD Software ✓ PPE: Helmet Gloves Goggles	✓ Brush ✓ Tape Measure ✓ Ruler ✓ Glass Cutter ✓ Cutting blade ✓ Metal cutter ✓ Saw ✓ Pencil/Pen ✓ Glue Applicator	✓ Wood ✓ Metal ✓ Glass ✓ Cardboard ✓ Glue ✓ Paint ✓ Varnish ✓ Wood stain ✓ Plastic

Dust mask Overall ✓ Wood working machine Panel saw machine, surface planer machine, moulding or shaper machine, band saw machine…. etc. ✓ Angle grinder machine, gas welding, arc welding machine, air compressor machine,	✓ Masking tape	✓ Floor Plans

Advance preparation:

- Make sure that materials are available before performing any tasks

Content 1: Discussion about Cleaning tools and equipment

➢ **Cleaning principles:**

- **Dry clean.** Remove visible and gross soils and debris.
- **Pre-rinse.** Rinse all areas and surfaces until they are visibly free of soil.
- **Wash (soap and scrub).** Use the right detergent in the right concentration with the right level of mechanical action in the right water temperature for the right contact time.
- **Post-rinse.** Rinse away all visible detergents and remaining soil.
- **Inspect.** Look again at crevices and other contamination traps to ensure they're free of soils and detergents. Determine whether steps 1-4 should be performed again.
- **Sanitize.** Foam, wipe or spray sanitizing chemicals onto surfaces as per the appropriate instructions.
- **Dry.** Ensure adequate time is allotted for equipment to thoroughly dry.

- Verification. Gather proof that the cleaning performed achieved the expected level by following facility verification protocols.

➢ Description of Cleaning Methods

✓ Cleaning with bases

Good bases for cleaning They react/break down organic chemicals like oil/grease without attacking the metals that they are attached too which is better than acids which do react with metals as well.

✓ Cleaning with acids

Acids are used to remove mineral deposits, rust stains, and hard water deposits. They can remove discoloration from some metals, such as aluminium, brass, bronze, and copper. Some acids are effective both in cleaning and disinfecting surfaces.

✓ Cleaning with solvents

Solvent cleaning is the process of removing soil from a surface with an organic solvent without physically or chemically altering the material being cleaned. This includes methods such as vapor degreasing, spraying, immersion, and mechanical or ultrasonic scrubbing.

✓ Chemical cleaning

Chemical cleaning is a method to derive surfaces of equipment using appropriate chemicals.

➢ Common cleaning agents

- ✓ Water, the most common cleaning agent, which is a very powerful polar solvent.
- ✓ Soap or detergent.
- ✓ Ammonia solution.
- ✓ Calcium hypochlorite (powdered bleach)
- ✓ Citric acid.
- ✓ Sodium hypochlorite (liquid bleach)
- ✓ Sodium hydroxide (lye)
- ✓ Acetic acid (vinegar

➢ Description of Methods of storing tools and equipment

❖ Importance of proper storage of tools and equipment

✓ It is an important factor for safety and health as well as good business.

✓ Improves appearance of general-shop and construction areas.

✓ Reduces overall tool cost through maintenance.

✓ This also ensures that tools are in good repair at hand.

✓ Teaches workers principles of (tool) accountability.

- Points to follow in storing tools and equipment:
  - ✓ Have a designated place for each kind of tools.
  - ✓ Label the storage cabinet or place correctly for immediate finding.
  - ✓ Store them near the point of use.
  - ✓ Wash and dry properly before storing.
  - ✓ Store knives properly when not in use with sharp edge down.
  - ✓ Put frequently used items in conveniently accessible locations.
  - ✓ Gather and secure electrical cords to prevent entanglement or snagging.
  - ✓ Cutting boards should be stored vertically to avoid moisture collection.
  - ✓ Metal equipment can be stacked on one another after drying such as storage dishes and bowls.
  - ✓ Make sure the areas where you are storing the equipment are clean, dry and not overcrowded.
  - ✓ Store clean tools in an empty plastic container
  - ✓ Hang tools up on a rack
  - ✓ Gloves should always be kept in closed container
  - ✓ Have a Designated place for each kind of tools
  - ✓ Wash and dry properly before storing

Theoretical learning Activity

- ✓ Individual research on types of cleaning products
- ✓ Observation on tools used to clean a workspace
- ✓ Practical exercise on cleaning the workspace (example: ask trainees to brainstorm about Clean workspace and store tools and equipment within groups)

Practical learning Activity

- ✓ Proper cleaning of the workspace and storage of tools and equipment in accordance to the health standards. (Example: Trainees in pair perform)

Points to Remember (Take home message)

Clean workspace and store tools and equipment Cleaning tools and equipment:

- Cleaning materials and product
- Cleaning Methods:
  - ✓ Cleaning with bases,
  - ✓ Cleaning with acids,
  - ✓ Cleaning with solvents,
  - ✓ Chemical cleaning
- Methods of storing tools and equipment:
  - ✓ Store clean tools in an empty plastic container,
  - ✓ Hang tools up on a rack,
  - ✓ Have a Designated place for each kind of tools,
  - ✓ Wash and dry properly before storing

Formative assessment

Written assessment

01. **a.** Does a wooden window require maintenance? Why?
    b. Define a window and what are its types.
02. **a.** Why do we need to provide a preliminary sketch before providing final drawing?
    b. What are the purposes of providing a small thumbnail sketch before providing the final sketch of a window?
    a. List three (4) types of glass used for windows?
    b. Name the type of finish suitable for exterior metallic door?
03. List at least six design components found in CAD software that can be used to window design.
04. Define the following rendering tools:
    a. Background
    b. Textures
05. Which term does the designer use, to indicate the way in which the parts of an object are arranged or laid out?
06. **a.** Identify the importance of window blinds in a building?
    b. Explain the functions of the following window accessories;
        i. Louvers
        ii. Handles

07. If rust on metallic windows, are not checked early it has the ability to decay them and make them weak and also cause them to change color.

08. How would you solve this problem by using what you have learned in window finishes?
09. How to develop a preliminary sketch of any window type?
10. Make a distinction between sash and frame as the components of window?

11. AutoCAD is one of the oldest and most used CAD software for 2D/3D drafting and design. It has the ability to create blueprints, equipment layouts, section planes, models documentation, etc. It is popular among interior designers and architects. Justify, why most interior designer and architect prefer to use AutoCAD software rather than other CAD software?

12. List down the steps involved in mounting of window to perform its functions on building.
13. What are most important six (6) design components (modify tools) that can be used to design window in CAD software?
14. Texture has an effect on the appearance of how we see color because of how color absorbs and reflects light from its surface.
15. How would you decide the type of color and texture to be used in window design?

16. What are three (3) the rules and regulation to be taken into account when you are working on wood working machine?
17. Layout design is the process of arranging visual elements—like text, images, and shapes—on a given page. Layout design is important for any project that conveys a message to the observer.
18. Discuss on the steps to be involved in developing a design layout.
19. A stuck window is a common household issue, but it's one that could point to larger problems. A window that won't open or close may also have issues *locking*. Whether it's a minor annoyance or a major cause for concern, no one wants to deal with a stuck window. So, why do windows get stuck, anyway? What possible solution to prevent window stuck?

Practical assessment

Ibiza Holdings wants to build a youth recreational centre in Rubavu district. They need customized windows inspired by nature for the lobby and the activity rooms. You are contracted to design windows that match their theme. The floor plans will be provided by Ibiza holdings. As a FIXTURE AND FITTINGS Designer, you are requested to produce layouts containing both technical and rendered images. You are also requested to make a model of the designed windows on a scale of 1:10. You can either use cardboard, wood, metal or glass for the model. Choose suitable finishing according to the material used. The assignment will be done in 5 days, 1 hour per day under the supervision of the trainer. The project must be presented within 30 minutes.

References:

1) https://www.homecrux.com/different-window-types-styles-and-design
2) https://www.bing.com/search?q=materials+used+in+window+component

3) https://www.bing.com/search?q=window+finishes
4) https://www.bing.com/search?q=windows+feature
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